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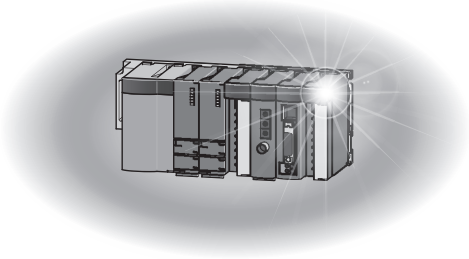
MITSUBISHI ELECTRIC

Mitsubishi Programmable Controller

MELSEC Q series

AD51H-BASIC Programming Manual (Command)

-QD51
-QD51-R24
-A1SD51S
-AD51H-S3



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• SAFETY PRECAUTIONS •

(Always read these instructions before using this equipment.)

Before using this product, please read this manual and the relevant manuals introduced in this manual carefully and pay full attention to safety to handle the product correctly.
The instructions given in this manual are concerned with this product. For the safety instructions of the programmable controller system, please read the CPU module user's manual.
In this manual, the safety instructions are ranked as "DANGER" and "CAUTION".

⚠ DANGER	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight personal injury or physical damage.

Note that the ⚠CAUTION level may lead to a serious consequence according to the circumstances. Always follow the instructions of both levels because they are important to personal safety.

Please save this manual to make it accessible when required and always forward it to the end user.

[Design Precautions]

⚠ DANGER

- Make sure to configure the interlock line outside the PLC system so that the system always operates normally when changing the data and control status of the PLC being operated from a peripheral device.
  Moreover, determine in advance how the system handles with communication errors by poor cable connection, etc. that may occur when performing online operations on the PLC CPU from a peripheral device.

⚠ CAUTION

- Please read this manual thoroughly and confirm the safety before starting online operations (especially forced outputs and operating status modifications) performed by connecting a peripheral device to the operating CPU module.
  Incorrect online operations may cause damage to the machinery or result in accidents.

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REVISIONS

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Japanese Manual Version SH-080094-D

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INTRODUCTION

Thank you for purchasing the MELSEC-Q, A series PLC.
Please read this manual carefully so that equipment is used to its optimum.

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How to use this manual

- Please read Chapter 1 through Chapter 11 and the Appendix if the manual should be used with Interpreter BASIC.
- Please read the AD51H-BASIC Programming Manual (Debug and Compile) and understand the restrictions of the compiler if the manual should be used with Compiler BASIC. Then proceed to read Chapter 1 through Chapter 11 and the Appendix.

Regarding Compiler BASIC

- Please be aware that there are many detailed restrictions for each instruction when using Compiler BASIC. See the AD51H-BASIC Programming Manual (Debug and Compile) for details on these restrictions.
- An assembler and a linker is required to compile programs. These are not included in the SW1IVD-AD51HP-E software package and must be purchased separately.

  Recommended Products
  - IBM/AT Compatible Personal Computer

    Turbo Assembler Ver 5.0

    For Turbo Assembler, contact Borland Software Corporation.

- MS-DOS is used for the Compiler BASIC. The user must have adequate knowledge about MS-DOS to use it.

About Module Names

The module model names are abbreviated as follows in this manual.

AD51H-S3	• • • • •	Refers to operations only for the AD51H-S3.
A1SD51S	• • • • •	Refers to operations only for the A1SD51S.
QD51	• • • • •	Refers to operations only for the QD51.
QD51-R24	• • • • •	Refers to operations only for the QD51-R24.
QD51 (-R24)	• • • • •	Refers to common items for both the QD51 and the QD51-R24.
Communication Module	• • • • •	Refers to common items for all modules.

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About differences between modules

Descriptions in this manual uses AD51H-S3, A1SD51S and QD51(-R24) as module examples.

The differences are shown below since the settings differ for each module.

		QD51	QD51-R24	A1SD51S	AD51H-S3
The number of tasks		2	2	2	8
General-purpose input/output		Input : 26 points Output : 23 points	Input : 26 points Output : 23 points	Input : 27 points Output : 23 points	Input : 27 points Output : 17 points
The number of I/O points occupied		32 points	32 points	32 points	48 points (first 16 points as vacant, second 32 points as special)
Interface	CH1(RS-232)	○	○	○	○
	CH2(RS-232)	○	—	○	○
	CH3(RS-422/485)	—	○	○	○
	CH4(parallel)	—	—	—	○
	Memory card	—	—	—	○ (Number of loadable cards: 2)
Transmission rate		300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400 bps		300, 600, 1200, 2400, 4800, 9600, 19200 bps	
Character length		7, 8		5, 6, 7, 8	
Console setting		Set in the "Switch setting for I/O and intelligent function module" screen of GX Developer.		Set at the mode switch2 of the DIP switch on the communication module.	
Mode switching		Set in the "Switch setting for I/O and intelligent function module" screen of GX Developer.		Set at the mode switch1 of the rotary switch on the communication module.	
Execution time switching		Unsupported	Unsupported	Unsupported	Supported (Set at the mode switch3 of the DIP switch on the AD51H-S3 communication module.)

Refer to the user's manual for each communication module for details.

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1 OVERVIEW

This programming manual describes how to use instructions and functions of the programming language "AD51H-BASIC" used with the communication module.

Please refer to the following manuals as necessary when using AD51H-BASIC.

- Intelligent communication module type AD51H-S3 User's Manual : (IB(NA) - 66401)
- Type A1SD51S Intelligent communication module User's Manual : (IB(NA) - 66551)
- Q Corresponding Intelligent Communication Module User's Manual : (SH(NA) - 080089)
- AD51H-BASIC Programming Manual (Debug and Compile) : (SH(NA) - 080091)
- AD51H-BASIC Package type SW1IVD-AD51HP-E Operating Manual : (IB(NA) - 66698)

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1.1 Features

The following are features of AD51H-BASIC.

(1) Both interpreter-type BASIC and compiler-type BASIC languages can be employed.

This allows easy creation of system control programs and programs that perform data linking with a computer without being aware of the complicated internal structure of the module; it is easy to use even for beginners.
The execution speed can be made faster by compiling already created programs.

(2) Multiple programs can be executed simultaneously by means of multitask processing.

The communication module supports multitask processing. Because of this, up to 8 BASIC programs can be executed simultaneously on the AD51H-S3, and up to 2 BASIC programs can be executed simultaneously on the A1SD51S/QD51 (-R24). In such cases, the communication module sequentially switches the execution of each program, so it appears to the user as if the multiple programs are running simultaneously.

(3) Data can be communicated between programs via message ports and communication module internal devices.

When multiple programs are executed simultaneously using the multitask processing function, data can be communicated using the following means.

1) Message ports • 1 to n data communication
2) Communication module internal devices • • • • • 1 to n data communication
3) Shared memory • 1 to n data communication

(4) Execution can be synchronized between programs via events.

When multiple programs are executed simultaneously using the multitask processing function, it is possible to synchronize their executions. This is achieved by making programs wait for an event using the ZWAIT EVENT instruction and generating an event by the ZSIGNAL instruction.

(5) Instructions for data link with external devices have been unified.

Data link with the PLC CPU of the same station as the communication module or other PLC CPUs via MELSECNET can be performed using the PCRD/PCWT instructions. The data link between the various interfaces of the communication module and external devices is performed using the ZRECEIVE/ZSEND instructions.
In this way, by creating a single subroutine that performs data link, it is possible to share the arguments of each instruction by passing them to variables in that subroutine.

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1.2 Symbols Used in This Manual

This manual uses the following symbols (used especially within Format) for descriptive purposes.
The symbols and their meanings are described in the following. Be sure to understand them fully before starting to create programs. Note that the symbols shown below should not be entered when actually entering the instructions and arguments related to the description sections that use these symbols. Doing so will result in a syntax error. Other symbols and characters have special meanings. Use them according to their descriptions.

[ ] (Square brackets)	: [ ] indicates that the arguments inside them are optional.
{ } (brackets)	: { } indicates that the arguments inside them are optional or can be repeated.
< >	: < > indicates that the single item inside should be entered (specified) by the user.
| (vertical line)	: Indicates that one of the two or more items separated by pipe symbols must be chosen and entered. When the range of options is hard to see, it is underlined.
△	: Indicates a place where at least one space must be entered, or a single space.
H	: Indicates that the alphanumeric string immediately before it is an integer value expressed in hexadecimal format.
Ctrl + ⬚	: Indicates a key operation where the ⬚ key is pressed while at the same time holding the control key pressed.
Enter	: Indicates that the enter key should be pressed.

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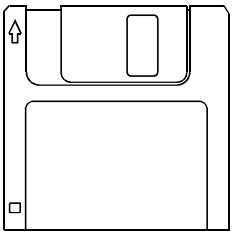
2 THE BASICS OF AD51H-BASIC

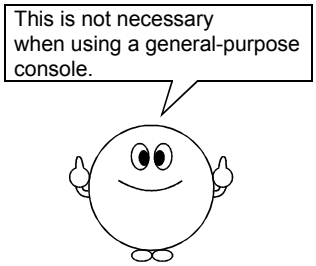
2.1 Preparation to Use AD51H-BASIC

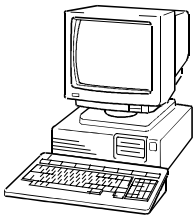
In order to edit or execute a program using AD51H-BASIC (hereinafter referred to as BASIC), it is necessary to change the mode of the communication module to programming mode, then connect the console, and start up BASIC. The procedures and the relevant reference manuals are shown below.

(1) Setting the communication module and connecting the console.
Perform settings and connections for each communication module.

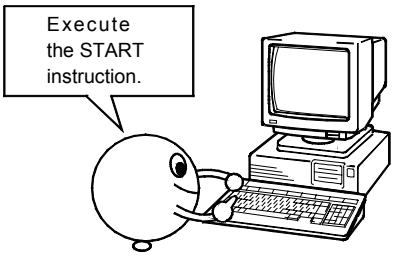
(2) Console preparation
Carry out the online programming items according to the Type SW□IVD-AD51HP/SW□NX-AD51HP Software Package Operation Manual.

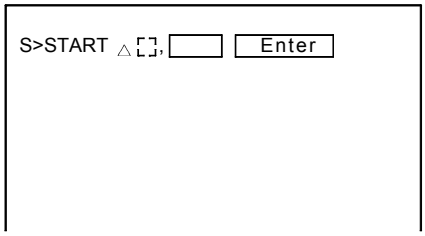

SW1IVD-AD51HP-E





(3) Editing and running BASIC programs can be started by using the START instruction in the system mode of the communication module, according to the user's manual for each communication module.

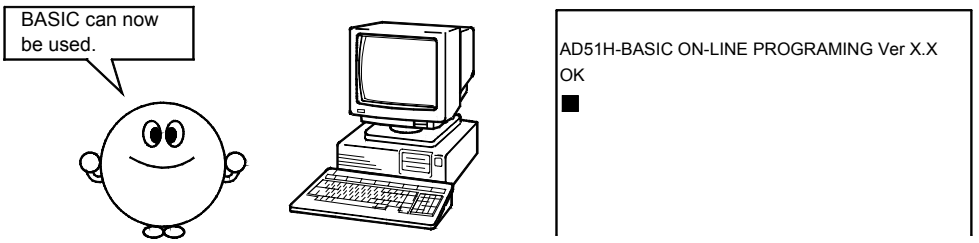


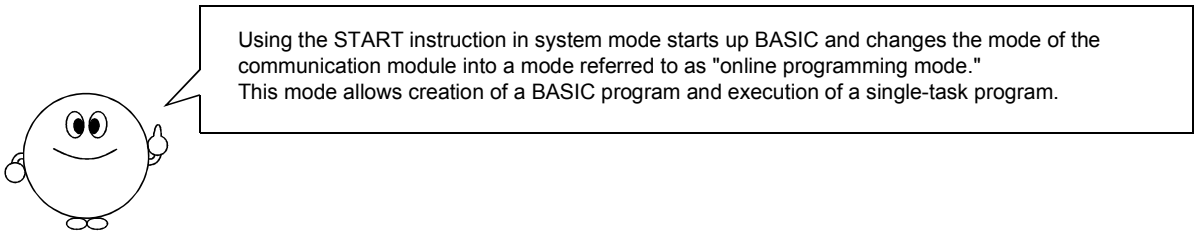


2 - 1

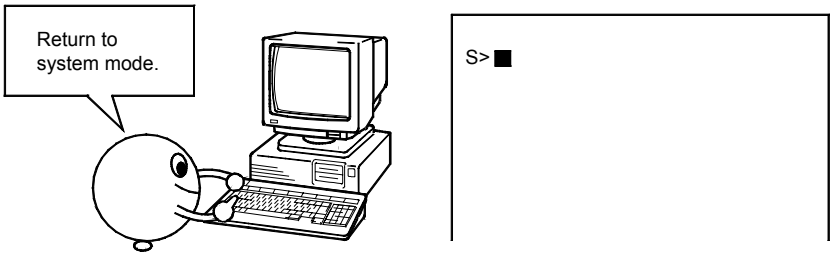
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(4) This allows editing and execution of BASIC programs and an 'OK' is displayed on the console screen.





(5) Execute the SYSTEM instruction or press the Ctrl + D keys to change the mode of the communication module back to system mode after finishing editing and execution with BASIC.



REMARK

- In order to perform multitask operation of programs, it is necessary to perform multitask settings and specify the execution in system mode of the communication module. See the AD51H-BASIC Programming Manual (Debug and Compile) for details.

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Note

There are two modes for executing BASIC programs in the communication module.

- Programming mode (online programming mode)
  In this mode, BASIC programs can be executed online, and only the BASIC program being edited can be executed.

  It is not possible to perform multitask execution of BASIC programs while in programming mode.

  This manual describes examples of programming and execution in programming mode, with the exception of multitask instructions.

- Run mode
  This mode allows multitask execution of BASIC programs that use multitask instructions.
  It is not possible to create or edit BASIC programs in run mode.

Changing between programming mode and run mode of the communication module is performed by the methods shown below.

• AD51H-S3, A1SD51S	• • • • •	Use the rotary switch of the main module (Mode setting switch)
• QD51 (-R24)	• • • • •	"Switch setting for I/O and intelligent function module" screen of GX Developer

See the user's manual for each communication module for detailed descriptions of each mode and changing between them.

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2.2 Direct Mode and Program Mode

- Direct mode

  When a BASIC instruction is entered and the Enter key is pressed while “OK” is displayed on the console screen, BASIC will execute the instruction immediately. This is referred to as execution in direct mode.
  The results of the operation executed in direct mode will remain in memory, but the instruction line will be cleared.
  All BASIC instructions with the exception of DEF FN can be executed in direct mode.

- Program mode

  Entering a BASIC instruction preceded by a line number and pressing Enter will store the instruction in the memory of the communication module. Lines are comprised of line numbers and BASIC instructions, and a group of more than one line is referred to as a BASIC program (or simply, a program).
  A program is comprised of statements that specify a series of operations that the computer performs. Designing and testing a program is referred to as programming. Programs stored in memory can be executed by entering the RUN instruction of BASIC.
  This execution is referred to as program mode execution, as opposed to direct mode execution.

2.3 Line Format

Lines are the smallest components of a program and are comprised of one <line number>, a sentence, and a Return symbol that indicates the end of the line.

A sentence is a collection of <statements> that make sense as an instruction. (Return is entered by pressing the Enter key while editing the program.)

The line format is as follows:

Sentence

<Line Number> △ [<Label:>] <Statement> {:<Statement> } Return

(1) Line Number

<Line Numbers> are written from the 1st column of the line and are represented by whole numbers between 1 and 65529 (decimal constant).
The line numbers are placed in ascending order within the program.
Line numbers act as indices for controlling program execution, and at the same time, as line search indices when editing the program.

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(2) Labels

<Labels> are terms in lines that are specified as branch destinations for instructions such as GOTO, GOSUB, and RESTORE, or lines that are specified as the next data to be read. They are placed next to line numbers. When specifying a line that includes <Label> in instructions such as the ones listed above, it is possible to specify the line by the label instead of the line number.

- Labels are character strings that begin with an asterisk (*). A label is expressed as a maximum of 15 alphanumeric characters and periods, excluding the asterisk, starting with an alphabetic character. All labels must be distinguishable.
- Reserved words cannot be used as labels.
- The label name referred to (label name called) must be placed at the beginning of the line.
- When a label is followed by an instruction within one line, they must be separated using a colon (:).
- If the same label name is defined in several places, the label with the smallest line number will always be referenced and an error will not be generated.

(3) Statements

<Statements> are instructions that are written following the BASIC syntax and form the smallest element of a sentence.

(4) Colons (:)

Colons are symbols used to separate statements when one sentence contains multiple statements. Sentences comprised of one statement are referred to as simple sentences. Sentences comprised of multiple statements separated by colons (:) are referred to as complex sentences (multi-statements).

(5) Length of one line

The length of one line must be less than 254 characters, including line number and spaces. One program line is considered to end at the location where the Enter key is pressed.

2.4 Spaces and Keywords

The names of the BASIC instructions and functions are keywords that have special meanings in BASIC. A space (Character 20h shown in Appendix 4.1) should not be entered within these keywords. Moreover, keywords, variables, arrays, constants, and logical operators must be separated using spaces, parentheses, numerical operators, or other symbols allowed by the syntax rules. Spaces can be used freely in all other places, and will be ignored no matter where in the sentence they appear.

Example		
	P△R△I△N△T	Error
	A△=△B△+△C	OK
	A=B△AND△C	The logical product of B and C will be entered in A
	A=BANDC	The contents of variable BANDC will be entered in A

REMARK

The Enter key (Enter key) will be referred to differently depending on the console used.

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2.5 Characters Used in BASIC

The following characters are used in BASIC.

- Uppercase alphabet ABCDEFGHIJKLMNOPQRSTUVWXYZ
- Lowercase alphabet abcdefghijklmnopqrstuvwxyz
- Numbers 0123456789
- Special characters (Space) ! ” # $ % & ‘ ( ) * + - , . / : ; < > = ? @ [ ] ¥ ^ { } | –

See Appendix 4.1, Character Code Table for the codes for alphabets, numbers and special character.
The program instructions are entered using uppercase or lowercase alphabet characters and symbols that are specified in the syntax. Other characters cannot be used as character data.
The instructions are treated in the exact same manner whether entered in uppercase or lowercase alphabet characters, and all instructions entered in lowercase will be converted to uppercase and stored in a memory.
However, the character data (notation characters or file names enclosed in “ ”) will be stored exactly the way it is coded.

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The special characters have the following meanings in BASIC statements.

Special Character	Name	Meaning
△	Space	Used to separate instructions and parameters.
!	Exclamation	Indicates single-precision type.
“	Double quotation mark	Symbols for enclosing a character string.
#	Number sign	File number symbol, indicates double-precision type.
$	Dollar sign	Indicates character type.
%	Percent sign	Indicates integer type.
&	Ampersand	Specifies character format.
‘	Apostrophe	Comment delimiter
(	Left parenthesis	
)	Right parenthesis	
*	Asterisk	Multiplication symbol
+	Plus sign	Positive symbol, addition symbol, character string addition symbol
,	Comma	Delimiter Example INPUT A, B PRINT X, Y, Z DATA 10, 13, 91, 4
-	Negative sign, minus, hyphen	Negative sign, subtraction symbol. Used to specify a range of lines in instructions such as LIST and DELETE. Example LIST 100-300 DELETE 1000-3000 DEFDBL A-H
.	Period	Used as a decimal point as well as internally by BASIC as a line number control pointer. Line number values that change constantly are stored in this way, for example, line numbers in which errors were generated during program execution, line numbers at which the program was halted by STOP or END instructions, or line numbers when a new line number is inserted.
		Example LIST. AUTO.
/	Slash	Division symbol.
:	Colon	Multi-statement delimiter
;	Semicolon	Delimiter Example PRINT “Answer=” ; A A PRINT X ; Y ; Z INPUT “A=” ; A
<	Less-than sign	

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=	Equal sign	
>	Greater-than sign	
?	Question mark	Substitution for the PRINT instruction Example ? A, B ?FRE(0) ?TIME$
@	Commercial at	
[	Left bracket	
¥	Yen sign	Integer division symbol
]	Right bracket	
^	Accent circonflexe (upward arrow head)	Power symbol
_	Underscore	
`	Accent grave	
[	Left square bracket	
|	Vertical line	
]	Right square bracket	
‾	High bar	

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2.6 What are Instructions and Functions?

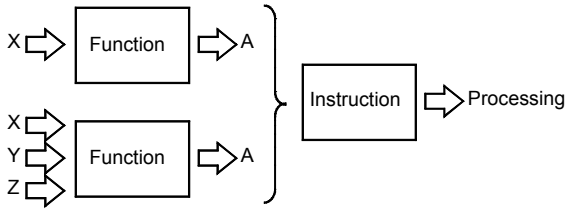
Only instructions or functions that follow the BASIC syntax can be written in BASIC statements. The section describes what instructions and functions are.

- Instructions

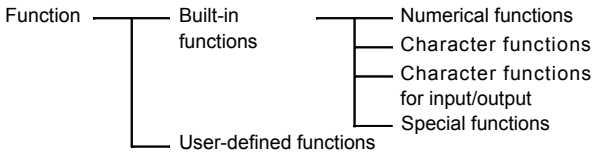
  Each BASIC instruction instructs a certain processing to take place. For example, when the PRINT instruction is used, characters will be displayed on the screen.
- Functions

  Functions in BASIC return a single value in response to 1 or multiple arbitrary input values.

  Functions can only return values. Therefore, in order to use the results, they are used in conjunction with instructions.



There are the following types of functions.



Built-in functions are functions already provided with BASIC. User-defined functions are functions defined by the user using the DEFFN instruction.

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2.7 Constants

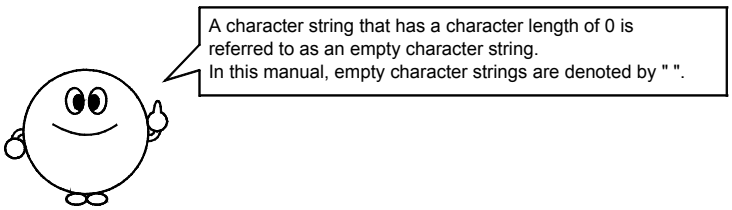
Constants are fixed values used when a BASIC program is executed. There are two types of constants: character constants and numeric constants.

2.7.1 Character string constants

Character string constants are any character strings that can be contained in a character set up to a maximum of 255 characters enclosed by quotation marks (“).

Example

“HELLO”
“$25,000.00”



2.7.2 Numeric constants

Numeric constants are positive or negative numbers. Numeric constants cannot contain any commas. There are the following 5 types of numeric constants.

(1) Integer constants

All integers between –32768 to +32767, with or without a % symbol. Decimal points cannot be added.

Example

100
+123
-32768
32767%

(2) Fixed decimal point constants

Positive or negative real numbers (numbers that include decimal points), including all integers that are not included in (1) above.

Example

100.0
-123.21

(3) Floating-point constants

Positive or negative numbers expressed in exponential format.
Floating-point constants are comprised of an integer or fixed decimal point number (base number), followed by the letter E, and then an integer (exponent).
Floating-point constants can express values between 10^{-38} to 10^{+38}.

Example

235.988E-7	• • • • •	0.0000235988
2359E6	• • • • •	2359000000

(Double-precision floating-point constants use D instead of E.)

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(4) Hexadecimal Constants

A hexadecimal number (0 through 9, A through F) is preceded by &H.

Example

&H76	• • • • •	118
&H32F	• • • • •	815

(5) Octadecimal Constants

An octadecimal number (0 through 7) is preceded by &0 or &.

Example

&0347	• • • • •	231
&1234	• • • • •	668

2.7.3 Single-precision and double-precision numeric constants

Fixed decimal point constants and floating-point constants can be either single precision or double precision. Single-precision constants are stored in a memory with an accuracy of 7 significant digits. Double-precision constants are stored in a memory with an accuracy of 16 significant digits.

(1) Single-precision constants are numeric constants that can be categorized into one of the following:
  (a) Constants with 7 or less significant digits
  (b) Constants expressed in exponential format using E
  (c) Constants that are followed by an exclamation mark (!)

(2) Double-precision constants are numeric constants that can be categorized into one of the following:
  (a) Constants with 8 or more significant digits
  (b) Constants expressed in exponential format using D
  (c) Constants that are followed by a number sign (#)

Example

Single-precision constants	Double-precision constants
46.8	345692811
-7.09E-06	-1.09432D-06
3489.0	3489.0#
22.5!	7654321.1234

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2.8 Variables

Variables are names that are used to represent values used within BASIC programs. Values of variables can be defined by the programmer or assigned as calculation results. The values of numeric variables are 0 and values of character string variables are empty character strings until their proper values are defined.

2.8.1 Variable names and type declaration characters

Variable names are subject to the following restrictions:

- The length of variable names within BASIC is restricted to a maximum of 15 characters.
- Variable names must be comprised of alphanumeric characters. Periods are also valid.
- The first character of a variable name must be an alphabet character.
- Special characters (%, !, #, $) may be used as a type declaration character.
- Reserved words cannot be used for variable names, but reserved words may be used as a portion of a variable name.
  Reserved words include all instruction, function, and operator names.
- If a variable name begins with FN, it is considered to be a call to a user-defined function.
- Variables represent either numeric values or character strings.
- The last character of a character string variable name must be a dollar sign ($).
  For example, in A$=”SALESREPORT”, the dollar sign is a variable declaration character, and “declares” that the variable represents a character string.
- Numeric variable names can be declared as single-precision, double-precision, or as integers.
- There are the following types of declaration characters for variable names.

%	Integer variables
!	Single-precision variables
#	Double-precision variables
$	Character string variables

If a declaration character is omitted in a numeric variable name, it is assumed that the variable represents a single-precision numeric value.
The following are some examples of variable names.

Example

PI#	• • • • •	Declares a double-precision variable.
MINIMUM!	• • • • •	Declares a single-precision variable.
LIMIT%	• • • • •	Declares an integer variable.
N$	• • • • •	Declares a character string variable.
ABC	• • • • •	Declares a single-precision variable.

The variable type can also be declared using DEFINT, DEFSTR, DEFSNG, and DEFDBL within programs.

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2.8.2 Array variables

- Arrays are groups of values that can be referenced using the same variable name.
- Each element within an array is referred to via the array variable name. Array variable names can be used within BASIC instructions and functions in the same manner as variables.
- An array has a number of elements, a number of dimensions, and a value type. The specification of the value type is the same as for variable names, but the number of dimensions and number of elements usually require declaration.
- An array is declared using the DIM instruction. For example,

10 DIM A$(3) • • • • • • Declares a one-dimensional array with the name A$ that uses character strings as values.

20 DIM B(3,2) • • • • • • Declares a two-dimensional array B that uses numeric values as values.

- An array variable name has the same number of subscripts as the number of dimensions in the array. Subscripts indicate the location of each element within an array. The range of values that subscripts can have is from 0 to 32767.
  For example, each element of arrays A$ and B above can be referenced using the following array variable names.

Array A$

A$(0)
A$(1)
A$(2)
A$(3)

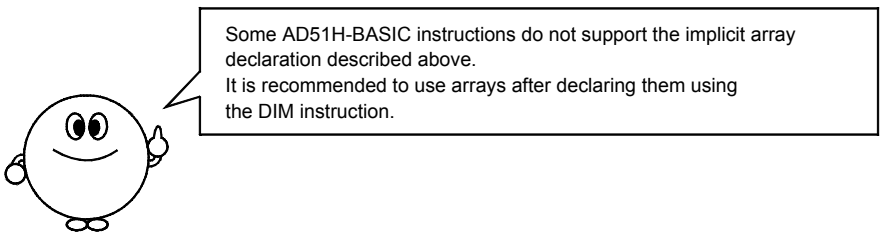
Array B

B(0,0)	B(0,1)	B(0,2)
B(1,0)	B(1,1)	B(1,2)
B(2,0)	B(2,1)	B(2,2)
B(3,0)	B(3,1)	B(3,2)

- A maximum of 255 dimensions can be used in one array.
- If an array variable name is referenced before the array is declared using the DIM instruction, it is assumed that the array has a maximum value of 10 for the subscripts.
  For example, consider the following instruction:

  30 C(3)=200

  If an array declaration for C is not present before executing the instruction, it is assumed that the array is one-dimensional and has elements ranging from C(0) through C(10).
  This implicit array declaration is possible only with arrays of two dimensions or less.



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2.8.3 Special variables (How to use B@ and W@)

- These variables are used to read/write from/to each device of the communication module from within BASIC programs.
- There are the following 4 types of special variables.

B@ (EM, expression)	• • • • •	Read/write from/to the extension relays EM.
W@ (ED, expression)	• • • • •	Read/write from/to the registers ED.
B@ (X, expression)	• • • • •	Write to general-purpose inputs X.
W@ (Y, expression)	• • • • •	Read from general-purpose outputs Y.

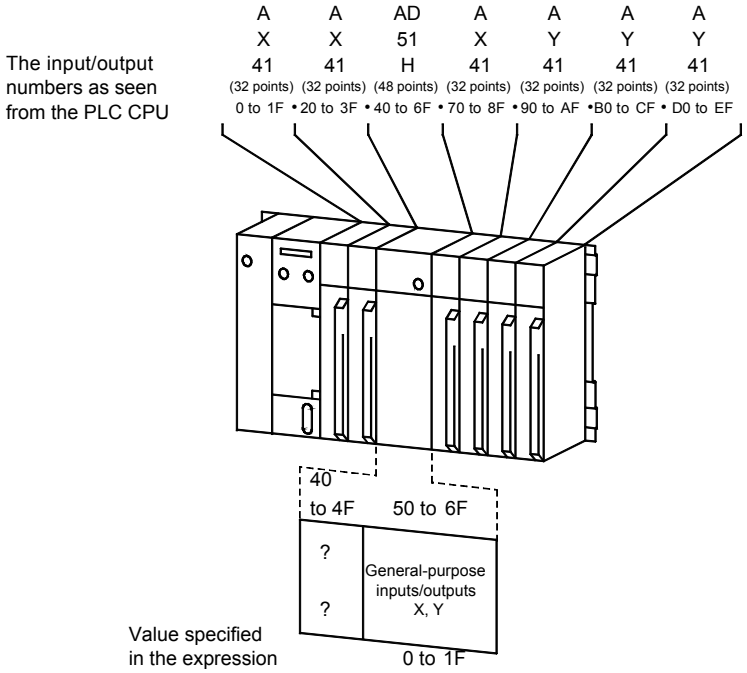
Refer to the user's manual for each communication module for details on the extension relays EM, extension registers ED, general-purpose inputs X, and general-purpose outputs Y.
Note that it is possible to read and write to/from the special EM and special ED extension devices.

(1) Reading from and writing to bit devices

B@(EM, expression) • • • • • Specify a value between 0 and 1023 for the expression.

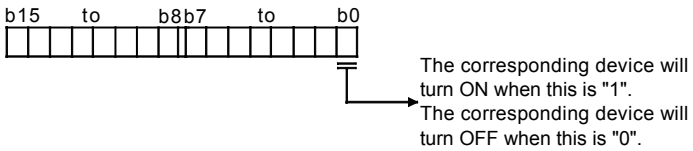
B@(X, expression)
B@(Y, expression) • • • • • Specify a value between 0 and 1F$_H$ for the expression. Since this must be specified in hexadecimal, place '&H' in front of the numeric value.

- Specify a device number in the expression.
  When general-purpose inputs X or outputs Y are specified, values between 0 and1F$_H$ are used regardless of the input/output numbers of the entire system.



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- Data, when being read, is represented by the value 1 when ON and 0 when OFF.
- Only bit 0 of the value stored in the specified value or specified variable is valid for data being written.



Therefore, data must be stored as integer constants or integer variables during write operations.

- It is only possible to write when general-purpose inputs X are specified. Also, it is possible only to read when general-purpose outputs Y are specified.

Example

```
A=B@(EM, 100)
A%=B@(Y, &H1B)
B@(EM, 200) = A%
B@ (X, &HA) = A%
```

(2) Reading and writing from/to word devices

W@(ED, expression) ••••• Specify a value between 0 and 1023 for the expression.

- Specify a device number in the expression.
- If the data is not an integer constant or an integer variable when the write operation is performed, the value is changed to an integer type and written.

Example

```
A=W@(ED,50)      ••••• The data stored in ED50 will be read and
                       assigned to single-precision variable A.
A%=W@(ED,50)     ••••• The data stored in ED50 will be read and
                       assigned to integer variable A%.
W@(ED,80)=1234   ••••• 1234 is written to ED80.
W@(ED,80)=A      ••••• The contents of a single-precision real
                       number A will be written to ED80.
```

- When reading a 32-bit data value, it should be read into an array variable of integer type, converted to 32-bit data using CIDB and CISN instructions, and then used.

Example

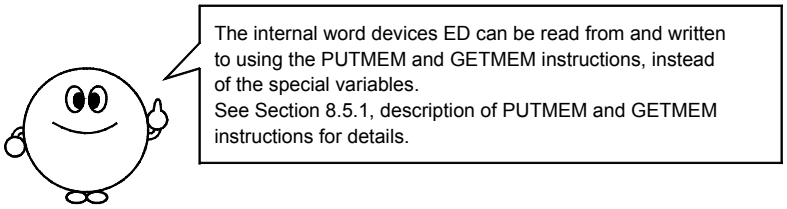
```
100 DIM A% (1)
110 A%(0)=W@(ED,100)  }
                      } ••••• Read the 32-bit data stored in
120 A%(1)=W@(ED,101)  }       ED100 and ED101 to A%(0) and
                              A%(1) as 16-bit data respectively.
130 B#=CIDB(A%(0))    ••••• The data in A%(0) and A%(1) are
                              converted to 32-bit data, and then
                              assigned to B#.
```


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• When writing 32-bit data, the data is first set in array variables of integer format using CDBI and CSNI instructions, then written to each device.

Example

```
100 DIM A%(1)
110 CDBI 123456!,A%(0)          ••••• "123456" is handled as 32-bit data and the lower 16-bits of data are stored in A%(0) and the upper 16-bits of data are stored in A%(1).
120 W@(ED,102)=A%(0)            ••••• The lower 16-bits of data stored in A%(0) is written to ED102, and the upper 16-bits of data stored in A%(1) is written to ED103.
130 W@(ED,103)=A%(1)
```



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2.9 Type Conversion

BASIC changes the type of numeric constants to another type as needed. In this case, it follows the following rules.

(1) When a numeric constant of a certain type is assigned to a numeric variable of a different type, the value of the constant will be changed to the type declared in the variable name and stored. (If a numeric value is assigned to a character string variable, or vice versa, a “Type mismatch” error will occur.)

Example

```
10 A% =23.42
20 PRINT A%
RUN
 23
OK
■
```

(2) If an expression contains different types of numeric constants or numeric variables, the operation result will be as follows.

• When two values are used for an operation:

Value 1	Value 2		Operation Result
Integer	Integer	→	Integer
Integer	Single-precision real number	→	Single-precision real number
Integer	Double-precision real number	→	Double-precision real number
Single-precision real number	Single-precision real number	→	Single-precision real number
Single-precision real number	Double-precision real number	→	Double-precision real number
Double-precision real number	Double-precision real number	→	Double-precision real number

(The result is the same when Value 1 and Value 2 are reversed.)

Example

```
10 D#=6#/7  ·····
20 PRINT D#
RUN
 .8571428571428571
OK
■
```

Since double-precision is divided by single-precision here, the arithmetic operation is performed in double-precision. The result will be assigned to D# as a double-precision value.

(3) When a logical operation is performed, numeric constants and numeric variables within the expression are converted to integers before carrying out the operation. The value must be within the range from –32768 to 32767. An “Overflow” error will occur if this range is exceeded.

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(4) When a numeric value of fixed decimal point format is converted to an integer, the decimal fraction is disregarded.

Example

```
10 C%=55.88
20 PRINT C%
RUN
 55
OK
■
```

(5) If a single-precision value is assigned to a double-precision variable, only the rounded first seven digits of the converted numeric value will be valid. This is because single-precision numeric values can hold an accuracy of up to seven digits.

Example

```
10 A=2.04
20 B#=A
30 PRINT A;B#
RUN
 2.04 2.039999961853027
OK
■
```

2.10 Expressions and Operators

Expressions are simply constants or variables combined in order to obtain a character string constant, numeric constant, variable, function, or a certain value. Numeric expressions deal with numeric values and character string expressions deal with character strings.
Operators perform arithmetic or logical operations on each value.
Operators can be classified into the following three types.

(1) Arithmetic operator

(2) Relational operator

(3) Logical operator

2.10.1 Arithmetic operators

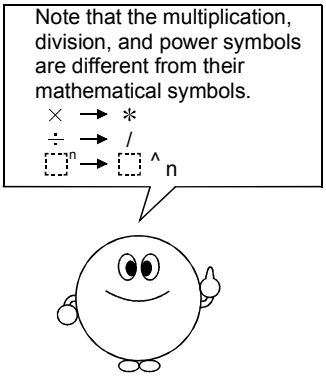
When one expression contains multiple arithmetic operators, the operation will be performed in the following priority order.

Operator	Meaning		Example
^	Power	• • • • •	X^Y
–	Change sign	• • • • •	–Y
*, /	Multiplication, floating point division	• • • • •	X*Y, X/Y
+, -	Addition, subtraction	• • • • •	X+Y

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In order to change the order of operations, parentheses are used. When a portion of an expression is surrounded by parentheses, the operation within the parentheses are performed first. When an operator is followed by another operator, parentheses must be used.
Operations on double-precision real numbers may be performed in arithmetic operations, but numbers lifted to higher powers are all converted to single-precision.
Some algebraic numeric expressions and their corresponding BASIC expressions are shown below.

Algebraic expression		BASIC expression
X+2Y	•••••••	X+Y＊2
$X-\frac{Y}{Z}$	•••••••	X-Y/Z
$\frac{XY}{Z}$	•••••••	X＊Y/Z
$\frac{X+Y}{Z}$	•••••••	(X+Y)/Z
$(X^2)^y$	•••••••	(X^2)^Y
X^{Y^Z}	•••••••	X^(Y^Z)
X(-Y)	•••••••	X＊ (-Y)



- Integer division and remainder operations
  Integer division operations are expressed using \. Fractional portion of divisor, dividend, and the quotient are dropped before the operation and rounded to integers.

  Example

```
PRINT 10\ 4
 2
OK
PRINT 25.6\ 6.99 ..... The dividend is rounded down to 25,
                       the divisor to 6, and the quotient to 4.
 4
OK
■
```

  Remainder operations are expressed using the operator MOD and gives the remainder in integer division integer format.

  Example

```
PRINT 15.4 MOD 4 ..... The remainder left after
 3                     dividing 15 by 4 is 3.
OK
PRINT 25.68 MOD 6.9 ..... The remainder left after
 1                        dividing 25 by 6 is 1.
OK
■
```


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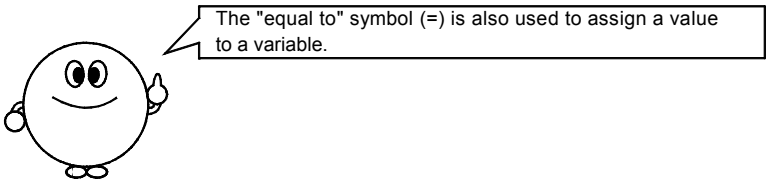
- Division when overflow occurs or when the divisor is 0.
  If a divisor becomes 0 in a division while executing an expression, a “Division by zero” error will occur. Also, if 0 is lifted to a negative power, a “Division by zero” error will occur.
  When an overflow occurs, an “Overflow” error will be generated.

- Mixing with other types of operators
  An expression can contain logical operators, other than arithmetic operators. When an expression contains a relational operator, the arithmetic operation is performed by returning the value –1 if the result of the logical operation is True, and value 0 if the result of the logical operation is False.
  Example
  (A=B) * (A>C)
  (A AND MASK)/2

2.10.2 Relational operators

Relational operators are used to compare two values. The results of comparisons are expressed as either “True” (-1) or “False” (0). Results such as these are used to determine the program flow.

Operator	Meaning	Example
=	Equal to	X=Y
<>, ><	Not equal to	X<>Y, X><Y
<	Less than	X<Y
>	Greater than	X>Y
<=, =<	Less than or equal to	X<=Y, X=<Y
>=, =>	Greater than or equal to	X>=Y, X=>Y



When a relational operator and an arithmetic operator both exist in the same equation, the arithmetic operator will always take priority. The result is then used for the relational operation.

Example

X+Y<(T-1)/Z ••••• The result is True if the value X + Y is less than $\frac{T-1}{Z}$

SIN(X)<0 ••••• The result is True if the value SIN(X) is less than 0.

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2.10.3 Logical operators

Logical operators perform bitwise operations or Boolean operations.
Logical operators provide the value “True” (other than 0) or “False” (0).
In an expression, logical operations will be performed after arithmetic calculations and relational calculations.
The results of logical calculations are as follows. Each operator is listed in the order of highest priority to lowest priority, 1) to 6).

1) NOT; Negation

X	NOT X
1	0
0	1

2) AND; Conjunction

X	Y	X AND Y
1	1	1
1	0	0
0	1	0
0	0	0

3) OR; Disjunction

X	Y	X OR Y
1	1	1
1	0	1
0	1	1
0	0	0

4) XOR; Inequivalence (exclusive OR)

X	Y	X XOR Y
1	1	0
1	0	1
0	1	1
0	0	0

5) IMP; Implication

X	Y	X IMP Y
1	1	1
1	0	0
0	1	1
0	0	1

6) EQV; Equivalence

X	Y	X EQV Y
1	1	1
1	0	0
0	1	0
0	0	1

Like relational operators, two or more relations can be tied together by logical operators to determine the flow of the program, providing a conclusion of True or False.

Example

D<200 AND F<4	• • • • •	True when D is less than 200 and F is less than 4.
1>10 OR K<0	• • • • •	True when I is greater than 10 or K is less than 0.
NOT P	• • • • •	True when P is equal to 0.

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Note

- Operations involving logical operators are performed after converting the numeric constant or numeric variable to an integer within the range from –32768 to +32767 (expressed as two's-compliment number if negative).
  If the value exceeds the range from –32768 to +32767, an Overflow error will occur.
- Logical operations are performed bitwise between two integers. The corresponding bits in the two integers determine each resulting bit.
  For example, an AND operator can be used to "mask" all bits except a certain bit. Then an OR operator can be used to combine the contents of the two bytes. This allows the creation of a specific binary number.
  The following describes how this is done using logic operators.

Example

63 AND 16 • • • • • • • • • • 16

63 is 111111 in binary code. 16 is 10000 in binary code.
Therefore, 63 AND 16 = 16.

63 • • • 0000 0000 0011 1111
AND 16 • • • 0000 0000 0001 0000
0000 0000 0001 0000 • • • 16

15 AND 14 • • • • • • • • • • 14

15 is 1111 in binary code. 14 is 1110 in binary code.
Therefore, 15 AND 14 = 14.

-1 AND 8 • • • • • • • • • • 8

-1 is 1111111111111111 in binary. 8 is 1000 in binary.
Therefore, –1 AND 8 = 8.

4 OR 0 • • • • • • • • • • 6

4 is 100 in binary. 2 is 10 in binary.
Therefore, 4 OR 2 = 6.

4 • • • 0000 0000 0000 0100
OR 2 • • • 0000 0000 0000 0010
0000 0000 0000 0110 • • • 6

10 OR 10 • • • • • • • • • • 10

10 is 1010 in binary code. Therefore, 1010 OR 1010 = 1010 (in other words, 10.)

-1 OR -2 • • • • • • • • • • -1

-1 is 1111111111111111 in binary code. –2 is 1111111111111110 in binary code. Therefore, -1 OR -2 = -1.

NOT X • • • • • • • • • • -(X+1)

Two's-compliment of an arbitrary integer is the value obtained by reversing all the bits of the integer and adding 1.

3 • • • 0000 0000 0000 0011
Bit reversal • • • 1111 1111 1111 1100
Add 1 • • • 1
–3 • • • 1111 1111 1111 1101 • • • two's-compliment numbers

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2.11 Character String Operations

Character strings can be connected using the operator +.

Example

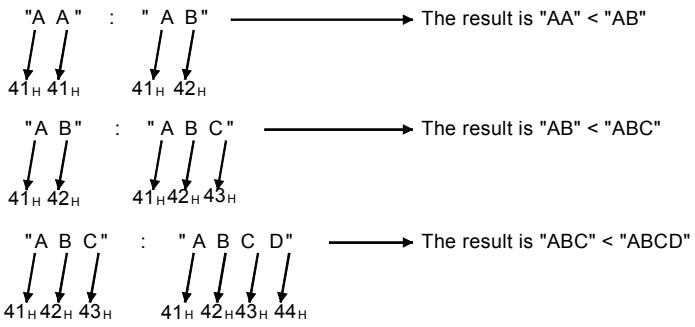
```
10 A$=" FILE":B$=" NAME"
20 PRINT A$+B$
30 PRINT" NEW"+A$+B$
RUN
FILENAME
NEWFILENAME
OK
■
```

Also, relational operations can be performed on character strings using the relational operators shown below.

= < > < > <= >=

In character string comparisons, the characters in two character strings are compared one by one (1 byte) in sequence from the beginning, by assuming the character code (Appendix 4.1) as a value.
If the character codes for both character strings are completely identical, the character strings are considered equal. However, if there is even one different byte, the character string with the lesser character code is considered to be the lesser of the two.
Also, if one of the character strings ends during a comparison, the shorter of the two will be considered to be the lesser of the two.
The spaces in the beginning or end of the character string are also subject to comparison.

Example



As shown above, character string comparison can be used to sort character strings in alphabetical order. All character string constants in expressions to be compared must be enclosed in parentheses.

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2.12 Priority Order of Operations

Operations are performed in the following order. Operators on the same level take priority from left to right.

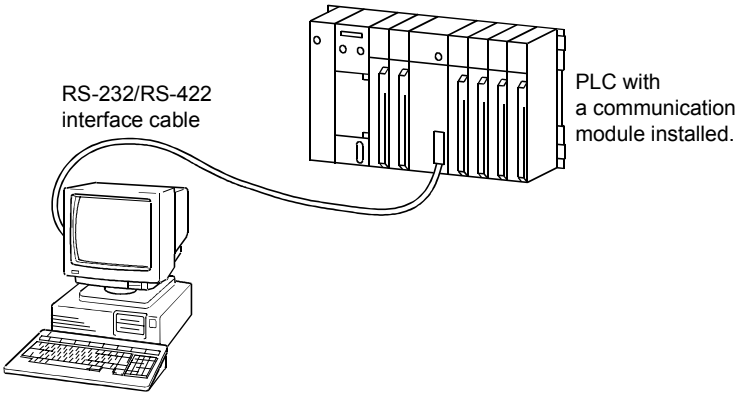
Expressions enclosed in parentheses
Functions
Exponent (power)^
Negative sign (-)
*, /
\
MOD
+, -
Relational operators (<, >, =, etc.)
NOT
AND
OR
XOR
IMP
EQV

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3 LET'S CREATE AND EXECUTE A PROGRAM

This chapter describes how to create and execute a program, as well as how to use basic instructions in AD51H-BASIC.
Please try to actually create a program and test it to see if it yields the proper results.
The procedures described below assume that the following system configuration is used.



Console comprised of an IBM/AT compatible personal computer booted with SW1IVD-AD51HP-E

Please make the following settings on the IBM/AT compatible personal computer and the communication module.

Communication module • • • • • • • • • • Set the module so that it is in programming mode and the IBM/AT compatible personal computer is used as the console.

Reference Manual

- The user's manual for each of the communication modules.

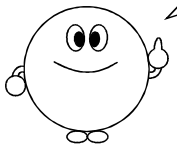
IBM/AT Compatible Personal Computer • • • • • • • • • • • • • Start up the SW1IVD-AD51HP-E software package and select the online programming category so that BASIC can be used in the communication module's system mode .

Reference Manuals

- Type SW1IVD-AD51HP-E Software Package Operation Manual (Regarding the startup of the IBM/AT compatible personal computer)
- AD51H-BASIC Programming Manual (Debug and Compile) (Regarding AD51H-S3 system mode)

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• If equipment other than an IBM/AT compatible personal computer is used as a console, the keys in the manual should be substituted with the appropriate keys as follows.

Enter	→ Carriage Return Key (Typically, corresponds to the CR key)
Ctrl	→ Control Key (Typically, corresponds to the CTRL and CNTL keys)
Insert	→ Insert Key (Typically, corresponds to the INS key)
Delete	→ Delete Key (Typically, corresponds to the DEL key)
Back Space	→ Backspace Key (Typically, corresponds to the BS key)

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3.1 Creating a Program

In order to create a program, it is necessary to make the console usable first.
Start up the system so that AD51H-BASIC can be used on the console.
The outline of the system startup procedures are described in Section 2.1. See the user's manual for each communications module for details.

Verify that the console screen displays the following :

```
OK
■          The flashing mark is called the cursor.
```

"OK" denotes that AD51H-BASIC is waiting for an instruction from you, the user. Now, enter the following :

NEW [Enter]

NEW is an instruction that clears all programs from the memory. If a previous program is still left when a new program is being written, they will get mixed with one another. Therefore, it is always necessary to execute the NEW instruction.

Now, the console is ready for program creation. Enter the following program.

```
10 REM  Calculation of compound interest
20 INPUT  "Principal=";M
30 INPUT  "Interest rate=";R
40 INPUT  "Period=";K
50 RR=R/100
60 G=M(1＊+RR) ^ K
70 PRINT  "Interest included=";INT(G); "YEN"
80 END
```

It is necessary to place line numbers when entering instructions in a program. The AUTO instruction is a convenience as it displays line numbers automatically. Enter the following instruction.

AUTO [Enter]

The screen changes as shown below.

```
10␣■
```

REMARK

If the screen displays "Syntax error" when you press the [Enter] key, it means that there was an syntax error in the instruction you have just entered. Try entering it again.
Also, if you have pressed a wrong key, press the [Back Space] key. If it was before pressing the [Enter] key, the cursor will move back for one character and you can correct your error.

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Enter line 10 as shown in the program example and press the Enter key.

REM Calculation of compound interest Enter

The line number 20 will be displayed on the screen. Enter the instructions until you reach line 70 in the same way.

When you finish entering line 70, the screen should look as follow :

70 END
80 ■

This is the end of the program, so let's end the line number display of the AUTO instruction.
Press the following keys.

Ctrl + C • • • • • • Press the C key while holding down the Ctrl key.

OK is displayed on the screen again.

Now let's verify that you have entered the program properly. Use the LIST instruction to display the program you have entered. Please enter the following.

LIST Enter

If the program looks just like the one written on the previous page, it is a success.

```
LIST
10 REM Calculation of compound interest
20 INPUT "Principal=";M
30 INPUT "Interest Rate=";R
40 INPUT "Period=";K
50 RR=R/100
60 G=M *(1+RR)^K
70 PRINT "Interest included=";INT(G); "YEN"
80 END
OK
■
```

REMARK

- If the display does not match the program on the previous page, re-enter the contents of the wrong line starting with the line number while OK is displayed. Then press the Enter key. Issuing the LIST instruction again will display the revised contents.
  An easier way of editing is described in Section 3.2.3.

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3.2 Executing and Editing a Program

3.2.1 Executing a program

Let's execute the program that you entered in Section 3.1. Enter the following while "OK" is displayed on the console.

RUN Enter

The RUN instruction is used to execute the program stored in the memory. The screen should display the following.

```
OK
RUN
Principal=?
```

The program shown in Section 3.1 calculates a compound interest. The text 'Principal=?' is caused by the INPUT instruction in line 20, which lets BASIC ask 'How much is the principal?' Now enter the following.

10000 Enter

This means that you have told the program "the principal is 10,000 yen." Now the console will display 'Interest Rate=?' and 'Period=?.' Enter 5 Enter and 3 Enter in the same way. This means 'the interest rate is 5%' and 'the period is 3 years.' After the entry to 'Period=?' is finished, the screen will display the following message and the execution of the program is ended.

```
Interest included=11576 yen
OK
```

(This means that if 10,000 yen is invested at an annual compound rate of 5% for 3 years, the interest included is 11,576 yen.)

3.2.2 If an error occurs

There are cases, after a program is executed using the RUN instruction, a message like the one shown below is displayed and the execution is stopped.

```
×××××× in NNNN
OK
```

This means that BASIC is telling you that an error is present in the program and it cannot be properly executed.
The ×××××× part of the message is called an error message. It indicates the kind of error present. The NNNN part tells you the line that contains the error.
See Appendix 4.4 for details on what each error message means.

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3.2.3 Editing a program

If there is an error in a created program or if a program requires improvement, the program must be edited. There are two ways of editing a program.

(1) Line-by-line edition

This is a way of re-entering one line of a program at a time.
This is also used to add new lines and delete single lines.

- In order to edit a line, re-enter the entire line, starting with the line number and finishing at the end of the instruction; then press Enter.
- If an already existing line number is entered, the new contents will overwrite the old without any confirmation.
- In order to add a new line, enter a line number that is greater than the very last line of the program as the line number, enter the instruction, and press Enter.

```
to
120 PRINT "END"
```

⇨ To add a line, choose a line number greater than 120.
Example 130 PRINT “BYE!!” Enter

- In order to insert a line, enter a line number that lies between line numbers of the current program, enter the instruction, and press Enter.

```
to
10 INPUT "Production Target" ; A
20 IF A=0 GOTO 120
to
```

⇨ To insert a line between lines 10 and 20, choose a line number between 10 and 20.
Example 15 IF A<0 GOTO 10 Enter

- In order to delete a line, simply enter the line number and press Enter.

```
to
30 PRINT "Time" ; TIME$
to
```

⇨ Inputting 30 Enter will delete line 30.

- To delete all lines within a certain range at one go, use the DELETE instruction.

Example

DELETE 600 • • • • • • • • • Deletes only line 600.
DELETE 300-400 • • • • • • Deletes the lines in between lines 300 and 400.
DELETE -500 • • • • • • • • • Deletes all the lines from the first line to line 500.

The changes made to the program as shown above can be verified by using the LIST instruction. The program displayed using the LIST instruction will be sorted by line number.

- To pause the list display, press the Ctrl + S keys.
- To continue the list display, press any key other than the Ctrl + C keys.
- To stop the list display, press the Ctrl + C keys.

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(2) Editing using the screen editor

This is a way of editing the program by displaying the program to be edited on the screen and moving around the cursor.
It is possible to edit only the necessary areas, so this is easier than line-by-line edition.
The following shows the procedures for editing a program using the screen editor.

1) Display the program to be edited using the LIST instruction.
The following range specifications are possible using the LIST instruction.

LIST ••••••••• Lists all the lines of the program.
LIST 300-400 ••• Lists all the lines between 300 and 400.
LIST -500 •••••• Lists all the lines from the beginning to line 500.
LIST 600- •••••• Lists all the lines from line 600 to the end.

It is also possible to edit the program upon stopping the list display.
Press the [Ctrl] + [C] keys to stop the list display of the program in the middle.

2) Next, move the cursor to the area you want to edit by using the following keys.

[↑] •••••• Moves the cursor one line up.

[↓] •••••• Moves the cursor one line down.

[→] •••••• Moves the cursor one character right.

[←] •••••• Moves the cursor one character left.

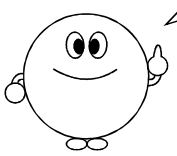
3) Edit the program by making modifications or pressing the following keys.

[Insert] •••••••••• The text to the right of the cursor location moves one space to the right and a space is inserted in the empty space.

[Delete] / [Back Space] ••••• Erases the character immediately before the cursor and moves the text to the right of the cursor one space to the left.

[Ctrl] + [E] •••••••• Erases the text from the cursor location to the end of the line.

4) Press the [Enter] key after editing is complete.

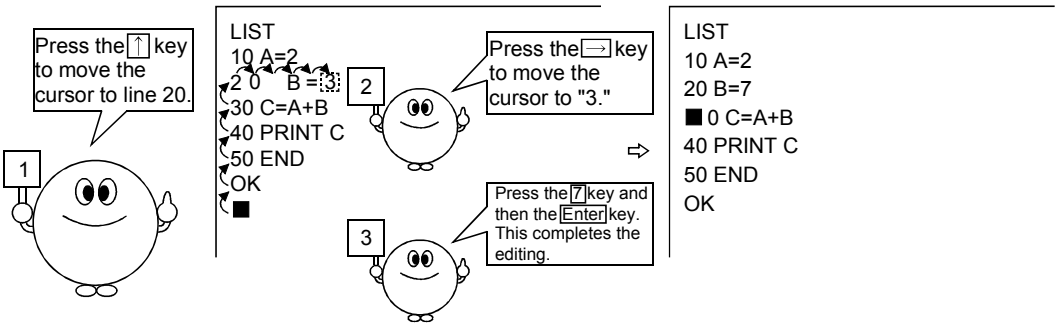


- If the [Enter] key is not pressed, the changes made to the program only appear on the screen. Always press the [Enter] key to commit the edited program line to the memory.
- There are many other keys that are handy for editing. For details, see Appendix 4.2.

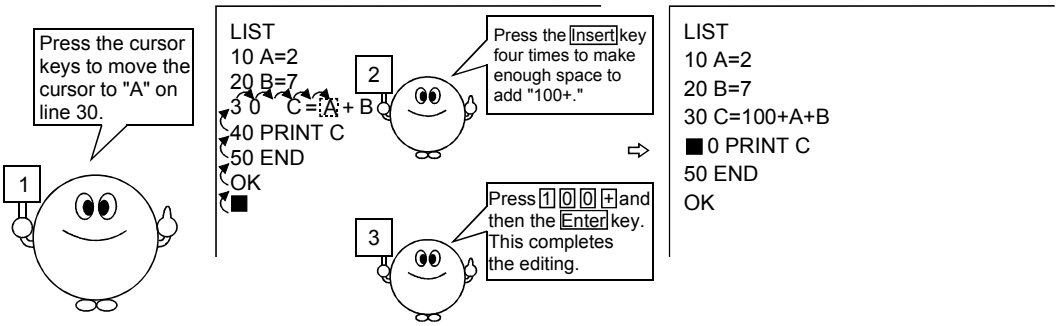
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(3) Examples of editing using the screen editor.

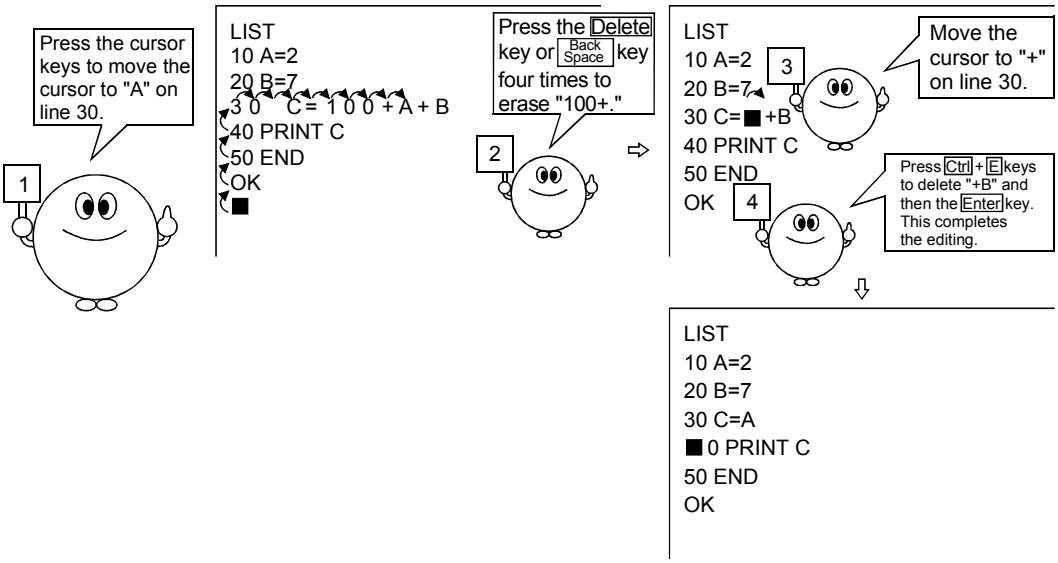
1) Overwriting • • • • • • • • • • • • • Change line 20 to B=7.



2) Adding (inserting) • • • • • • • • Change line 30 to C=100+A+B



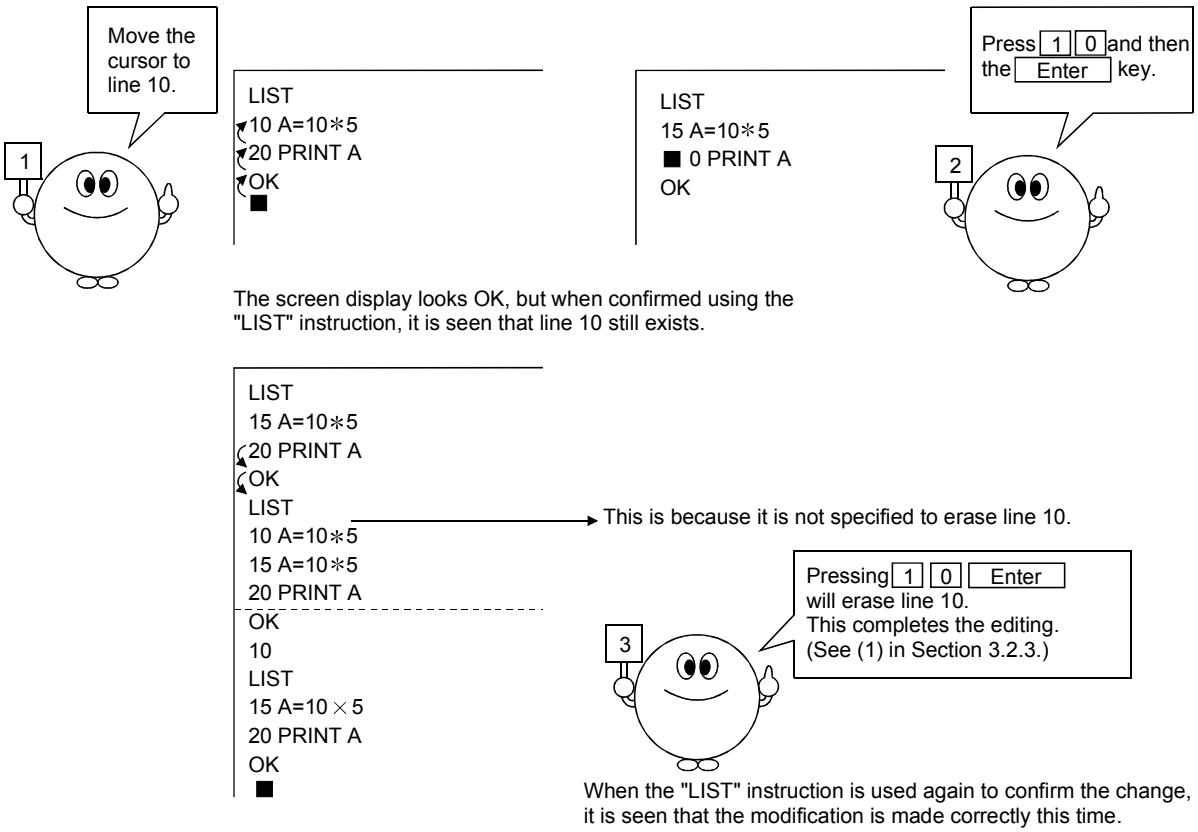
3) Deleting • • • • • • • • • • • • • • • Change line 30 to C=A.



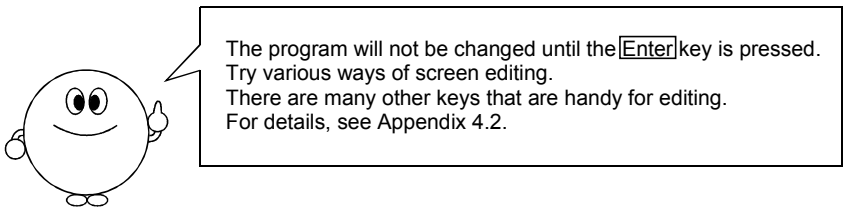
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4) Changing a line number • • • • Caution is needed when changing line numbers. Line 10 should be changed to line 15.



Even if the line number is changed, the original line will still be there. This method can be used to make copies of lines with the same contents repeatedly.



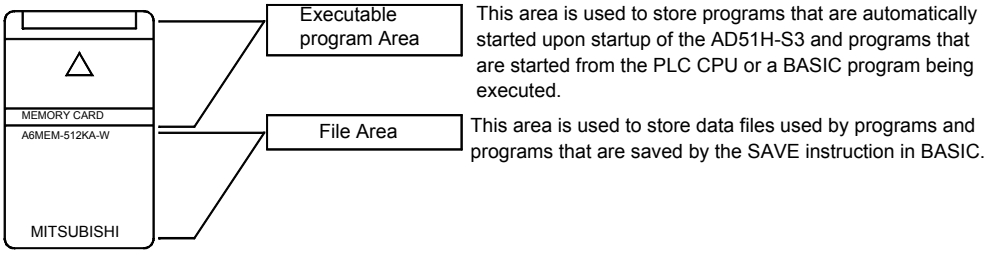
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3.3 Saving and Loading a Program

The program in the memory of the communication module disappears entirely once the power is turned OFF or the NEW instruction is invoked. Once a program is created, it should be saved and managed on a memory card, floppy disk, or hard disk.

3.3.1 Memory cards used for AD51H-BASIC (AD51H-S3 only)

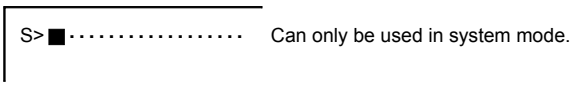
Memory cards used with the AD51H-S3 must be formatted using the CFORMAT instruction in system mode. This CFORMAT instruction will separate the memory card into two areas.



Input and output to these areas can only be performed under the following conditions.

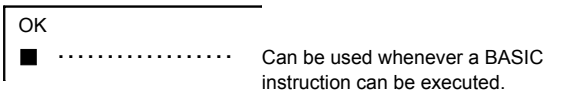
Executable program area

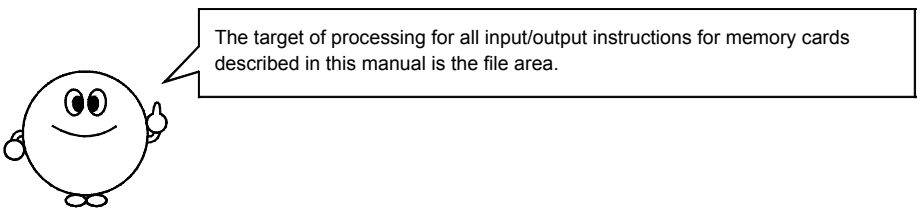
Programs may be registered in system mode.



File area

Data and programs may be registered using various BASIC instructions.





REMARK

- See the AD51H-BASIC Programming Manual (Debug and Compile) for information on the CFORMAT instruction and system mode.
- See Chapter 6 for information on data files.

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3.3.2 Saving a program

Use the SAVE instruction to save the program to the file area of a memory card, floppy disk (FD), or hard disk (HD).
The SAVE instruction is entered in the following format.

SAVE△"[Drive Number] : [System Name\][File Name]"

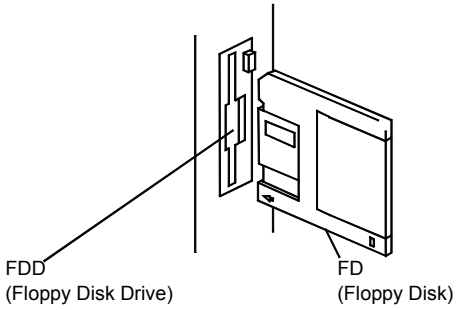
(1) [Drive Number] specifies the memory card or FD in which the program will be saved.

Memory card mounted in MEMORY CARD 1 ••••••0
Memory card mounted in MEMORY CARD 2 ••••••1
} AD51H-S3 only

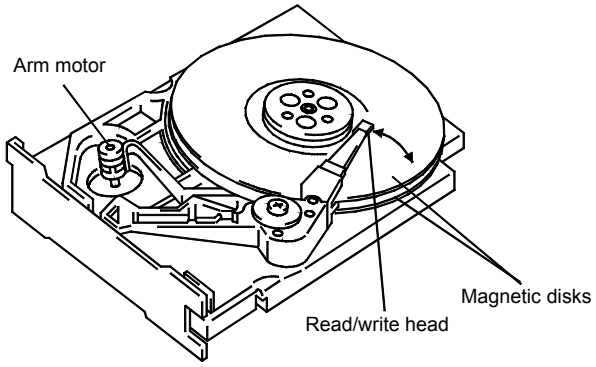
Drive A of the console ••••••••••••••••••••••••••2
Drive C of the console ••••••••••••••••••••••••••3
Drive D of the console ••••••••••••••••••••••••••4

REMARK

- FD ••••••••• Abbreviation of Floppy Disk.
- FDD ••••••••• Abbreviation of Floppy Disk Drive. This is the part of the console used to read and write from/to a FD.

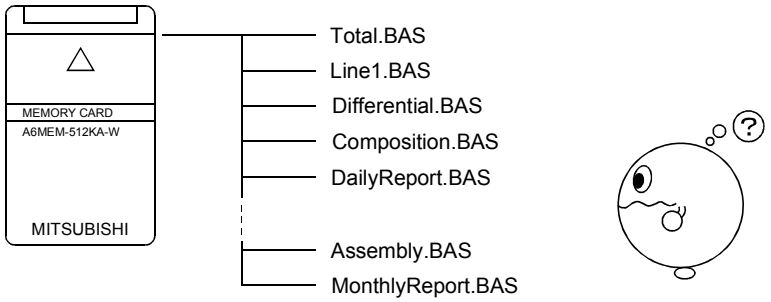


- HD ••••••••• Abbreviation of Hard Disk.
- HDD ••••••••• Abbreviation of Hard Disk Drive.
  This is built into the console. The inside looks like shown below.

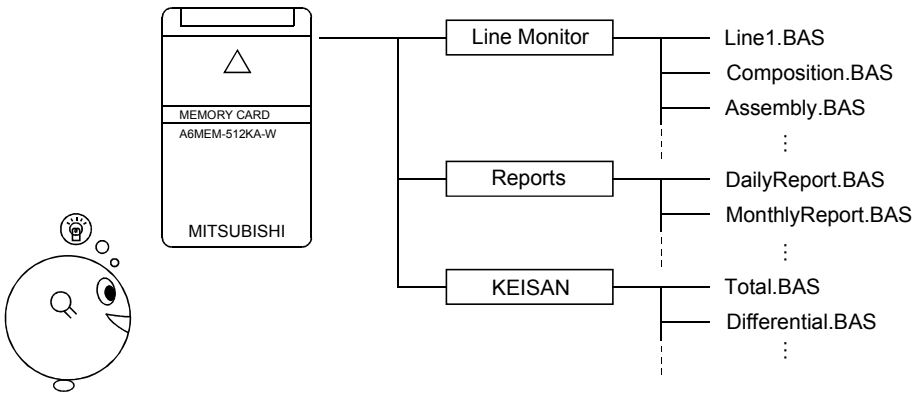


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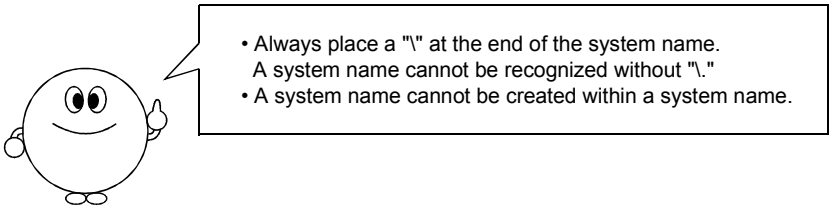
(2) [System Name\] is used to classify programs into several groups for easier management. When many programs are stored on a memory card or FD, it gets harder to manage.



The files become easier to manage by defining program groups and saving a program to either one of the groups as follows.



[System Name\] is used to specify the group name. If a specified [System Name\] does not exist, a new [System Name\] is registered and the program will be saved in it. If it already exists, the program will be saved in the [System Name\] group.
System names can be omitted. In this case, the program will be stored as a group that doesn't have a system name.



[System Name\] should follow the rules described below.
• Permitted special characters are alphabet characters, numeric characters and the following symbols.
!, #, $, %, &, ', (,), -, @, ^, _, {, }, ~

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• A system name can contain up to 8 characters.
• The following character strings cannot be used as system names. If used, the operation may not be performed normally. However, it is allowed to use these character strings as a portion of a system name.
AUX, CLOCK, CON, NUL, PRN

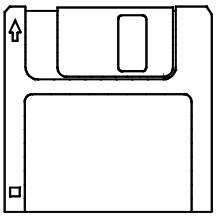
(3) [File Name] is a unique name used to save individual programs. Choose a name that is easy to recognize.
[File Name] should follow the rules described below.
• Permitted special characters are alphabet characters, numeric characters and the following symbols.
!, #, $, %, &, ', (,), -, @, ^, _, {, }, ~
• A file name is comprised of a "file name" and an "extension" delimited by a period.
A maximum of 8 characters can be specified for a file name, and a maximum of 3 characters for extension.
• The following character strings cannot be used as a file name or extension. If used, the operation many not be performed normally. However, it is allowed to use these character strings as a portion of a file name and extension.
AUX, CLOCK, CON, NUL, PRN, BAT, COM, EXE

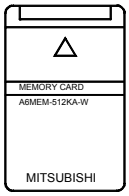
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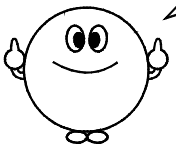
Usage examples

SAVE "0 : 51H/TEST1" ••••••••••• Save a program with the system name '51H' and file name 'TEST1.BAS' in the file area of a memory card mounted in MEMORY CARD 1.

SAVE "2 : KEISAN.BAS" ••••••••••• Save a program with no system name and file name 'KEISAN. No1' in the A drive of the console.







Store necessary programs with caution.
Also, make sure to periodically back up programs stored on memory cards or FD.
See the AD51H-BASIC software package operating manual for how to take backups.

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3.3.3 Loading programs

Programs stored in the file area of a memory card, FD, or HD can be read into the communication module's memory using the LOAD instruction.
The LOAD instruction is entered in the following format.

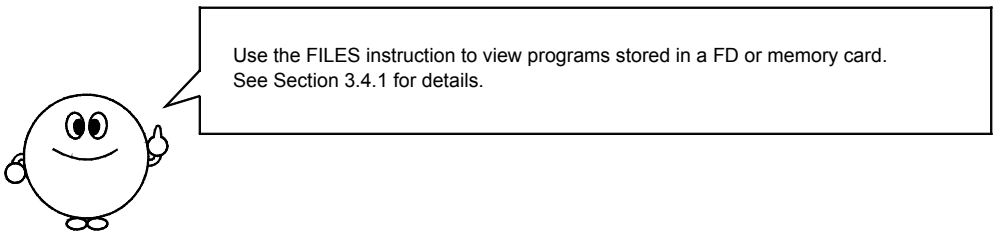
LOAD△"[Drive Name] : [System Name\][File Name]"

(1) [Drive Name], [System Name\], and [File Name] are specified in the same manner as for the SAVE instruction.
See (1) through (3) of Section 3.3.2.

(2) If a non-existent [System Name\] or [File Name] is specified, an error (File not found) will occur.

Usage examples

LOAD "1 : Nagata\SAMPLE"	• • • • • • • • •	Read a program with the file name 'SAMPLE.BAS' and the system name 'Nagata' from the file area of the memory card mounted in MEMORY CARD 2.
LOAD "2 : LINE. P01"	• • • • • • • • •	Read a program with the file name 'LINE1.P01' without a system name from the A drive of the console.



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3.4 Organizing Memory Cards and FDs

Besides BASIC programs, data can also be saved onto memory cards, FDs, and HD. (See Chapter 6 for how to store data.) Programs and data stored on a memory card or FD are collectively referred to as "files." This section describes how to organize files, such as listing files and renaming files.

3.4.1 Displaying file names

It is possible to display a list of files saved in the file area of a memory card or FD and HD. To display the list, use the FILES instruction in the format shown below.

FILE△"[Drive Name] : [System Name\][File Name]"[,S]

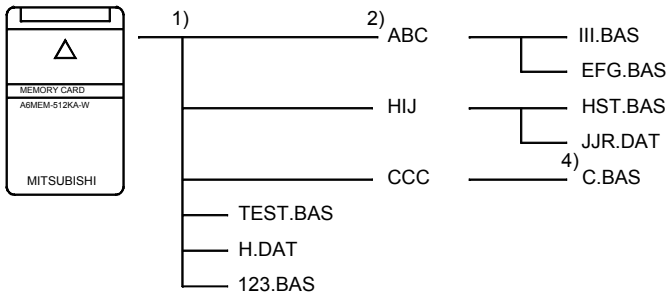
(1) See Section 3.3.2 (1) through (3) for how to specify [Drive Name], [System Name\], and [File Name].

(2) [System Name] and [File Name] can be omitted.
Wildcards (fuzzy specification) can also be used for the [File Name]. See Appendix 1.4 for how to use wildcards.

(3) Specifying [, S] will also display the size and data along with the file name.

Usage examples

Let's assume that the files are stored in the following manner in the file area of the memory card in MEMORY CARD 2



1) FILES"1:" .....

This displays names of files without a system name in the file area of the memory card.

```
\ABC     :\HIJ     :\CCC     :TEST BAS:
H DAT :123 BAS:
OK
■
```

□\denotes a system name. This means that on this memory card, system names ABC, HIJ, and CCC are registered.

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2) FILES"1:ABC\" ····· This displays the names of the files stored under system name ABC in the file area of the memory card.

```
III BAS:EFG BAS:
OK
■
```

3) FILES" 1:HIJ\JR.DAT" ····· This displays the name of the file JR.DAT stored under system name HIJ in the file area of the memory card.

```
File not found
OK
■
```

Since there is no file by the name JR.DAT under system name HIJ on the memory card, a "File not found" error is generated.

4) FILES"1:CCC\C.BAS", S ····· This displays details of file C.BAS stored under system name CCC in the file area of the memory card.

```
C  BAS  ××××   ××-××-××   ××:××
OK
■
```

- ×××× : Displays the file size in bytes.
- ××-××-×× : Displays the file creation date in the year-month-date format.
- ××:×× : Displays the file creation time.

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3.4.2 Renaming files

It is sometimes necessary to change the name of a file stored in the file area of a memory card, or on a FD or HD. The NAME instruction is used to perform this task. The NAME format is as shown below.

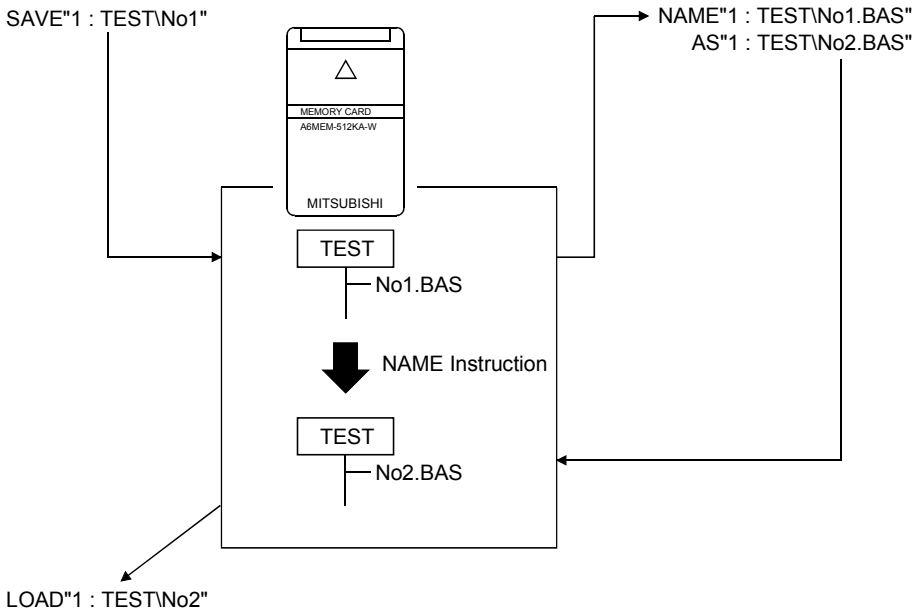
NAME△"[Drive Number] : [System Name\][File name to be Changed]"AS "[Drive Number] : [System Name\][New File Name]"

(1) See Section 3.3.2 (1) and (2) for the contents and specification method of [Drive Name] and [System Name\].

(2) [File name to be Changed] and [New File Name] are specified exactly in the same manner as [File Name] described in Section 3.3.2 (3).

Usage examples

Rename file 'No1.BAS' under system name 'TEST' in the memory card mounted in MEMORY CARD 2 to 'No2.BAS.'



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3.4.3 Deleting files

The number of files that can be saved on a memory card or FD is limited. If all the files saved are needed, a new memory card or FD must be prepared. If there are files that are no longer needed, deleting them will free some space to save new programs or data.

Use the KILL instruction to delete files on a memory card or FD. The KILL instruction is entered in a format shown below.

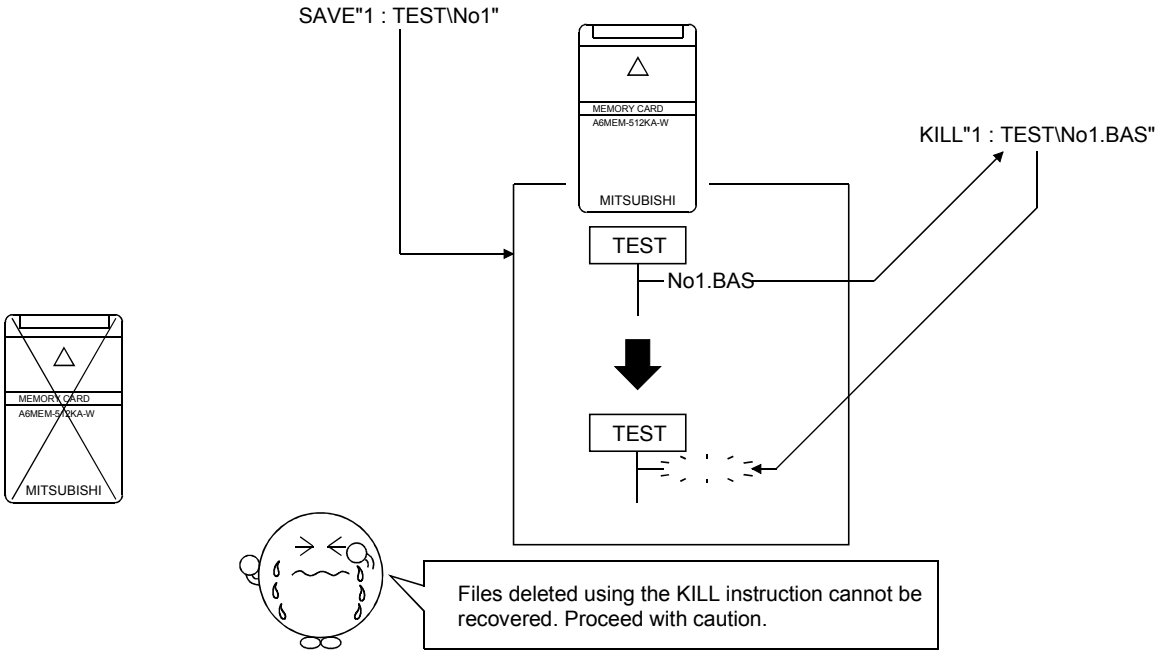
KILL△"[Drive Name] : [System Name\][File Name]"

(1) See Section 3.3.2 (1) and (2) for the contents and specification method of [Drive Name], and [System Name\].

(2) [File Name] is specified exactly in the same manner as [File Name] described in Section 3.3.2 (3).

Usage examples

Delete file 'NO1.BAS' under system name 'TEST' in the memory card mounted in MEMORY CARD 2 .



REMARK

System names that are no longer needed can be deleted using the KILL instruction as well. See the description of the KILL instruction for details.

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3.5 Specifying Data

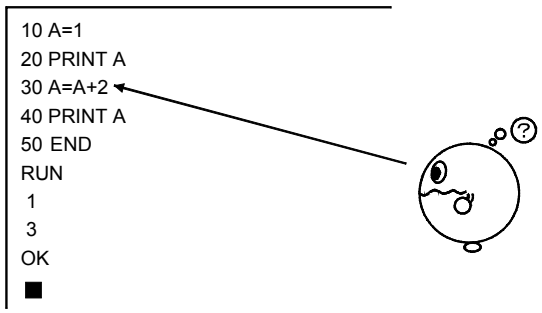
There are three ways of assigning a value to a BASIC variable.

1) Use an assignment statement. (e.g., A=1, B=120)
2) Input from the keyboard or other device.
3) Use the READ - DATA instructions.

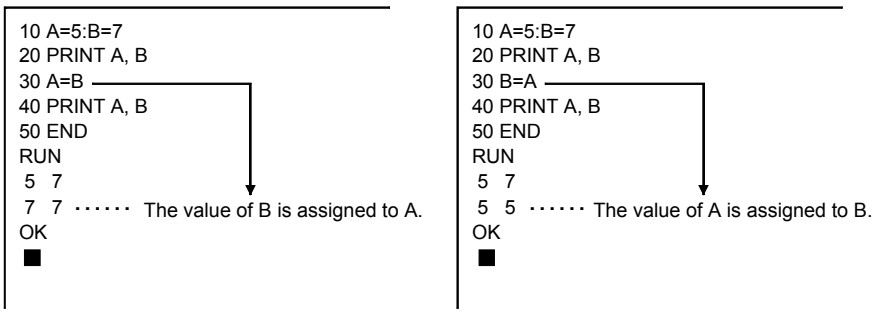
Method 2) is described in Section 3.11, and Chapter 4, 6, and 7. In this section, methods 1) and 3) are described.

3.5.1 Assignment statements

The character "=" is used frequently in programs, but the meaning is somewhat different from the mathematical "=."
To begin with, try executing the following program.



Line 30 states that A=A+2. If this were an equation, the expression 0=2 would be obtained by subtracting A from the both sides, which would be invalid. However, the program runs properly.
The "=" character in BASIC means to assign the result of the expression, etc. on the right side to the variable prepared in the left side. Line 30 thus means to add 2 to the current value of A and to assign the result to the new A.
In other words, A=C+E is valid, but D+E=A will be invalid. Executing the following two blocks will clarify the meaning of "=."



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3.5.2 Preparing groups of data

Use the READ and DATA instructions in order to prepare a group of data to be assigned. These instructions use the READ instruction to obtain the data specified by the DATA instruction. Try executing the following example.

```
10 READ A, B, C, D
20 PRINT A, B, C, D
30 DATA 35, 6, -8, 12
RUN
35  6  -8  12
OK
■
```

The variables following the READ instruction correspond to the values following the DATA instruction as shown below.

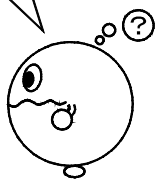
A	B	C	D
35	6	-8	12

The DATA instruction will be read properly by the READ instruction no matter where they are placed and no matter how scattered they are. In addition, any character strings can be used.

```
10 DATA 51H
20 READ A$, B$, C$
30 DATA MEE
   ⋮
70 DATA TD
80 READ D$
90 DATA PC
   ⋮
```

A$	B$	C$	D$
"51H"	"MEE"	"TD"	"PC"

There isn't anything that corresponds to CM$.



However, the following program has a problem.

```
10 DATA MTC
20 READ BM$, CM$
   ⋮
```

BM$	CM$
"MTC"	

As shown above, an error will be generated if the DATA instruction does not include a value that corresponds to a READ instruction.

If a numeric value is specified by the DATA instruction, the following will occur depending on the variable specified by the READ instruction that reads that data.

```
10 READ A$, B%
20 DATA "7", 7
```

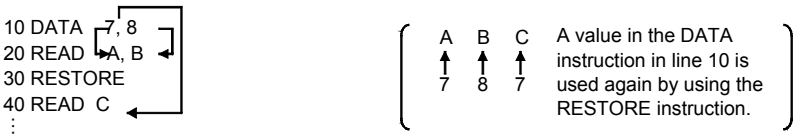
A$	B%
"7"	7

If a character variable is specified by the READ instruction, it is treated as a character string.

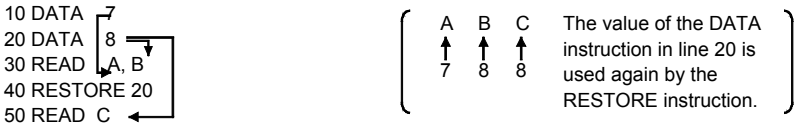
If a numeric variable is specified by the READ instruction, it is treated as a numeric value.

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Use the RESTORE instruction in order to use values of the same DATA instruction again. The following illustrates what happens when the RESTORE instruction is used.



Line numbers can be specified when using the RESTORE instruction. The following illustrates what happens when a line number is specified.



REMARK

The READ instruction can use arrays instead of variables that read data. The following program is an example where data is assigned to A$(0) through A$(2). Try executing this block.

```
10 DIM   A$(2)
20 READ  A$(0), A$(1), A$(2)
30 PRINT A$(0), A$(1), A$(2)
40 DATA 51H, PC, A
RUN
51H   PC   A
OK
■
```



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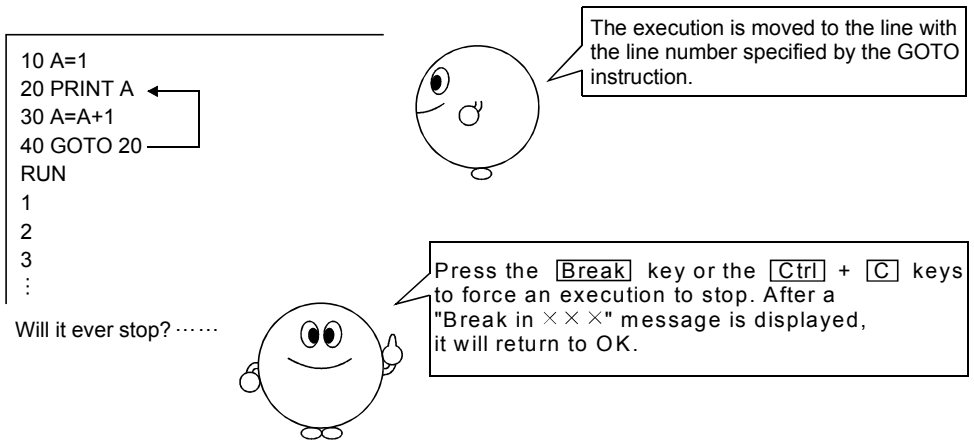
3.6 Jumps and Loops

BASIC programs are typically executed in increasing order of line numbers. However, there are instances when it is better that the order of execution is changed. AD51H-BASIC has the following instructions to change the order in which execution is carried out in a program.

GOTO_____	Jump unconditionally
ON GOTO_____	Jump depending on a value
FOR-NEXT_____	Loop for the number of times specified
WHILE-WEND_____	Loop while a certain condition is met

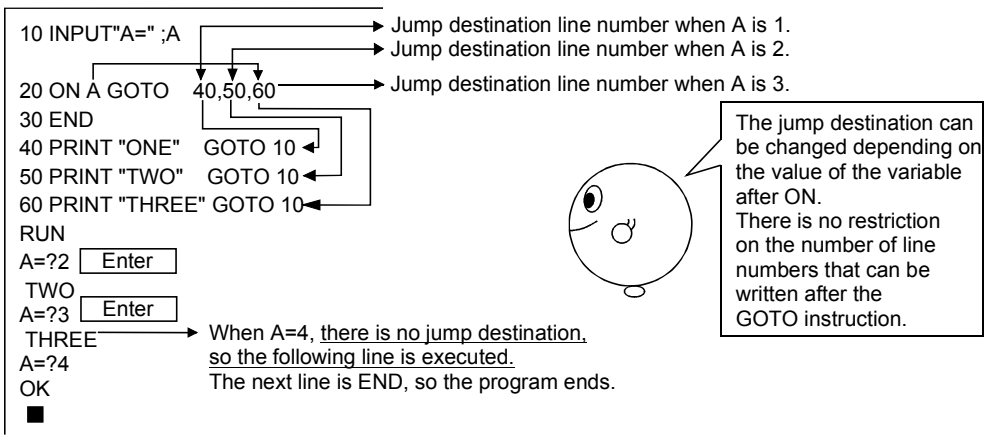
3.6.1 Jump unconditionally

Use the GOTO instruction to jump to the specified location unconditionally.



3.6.2 Jump depending on a value

The ON-GOTO instruction expands the functionality of the GOTO instruction; it is possible to jump to a different line depending on the value of a variable. This allows multiple destinations to be specified for the jump.

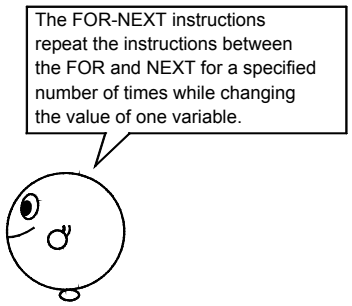


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3.6.3 Loop for the number of times specified

Use the FOR-NEXT instructions to execute certain instructions for a certain number of times. Consider the following program.

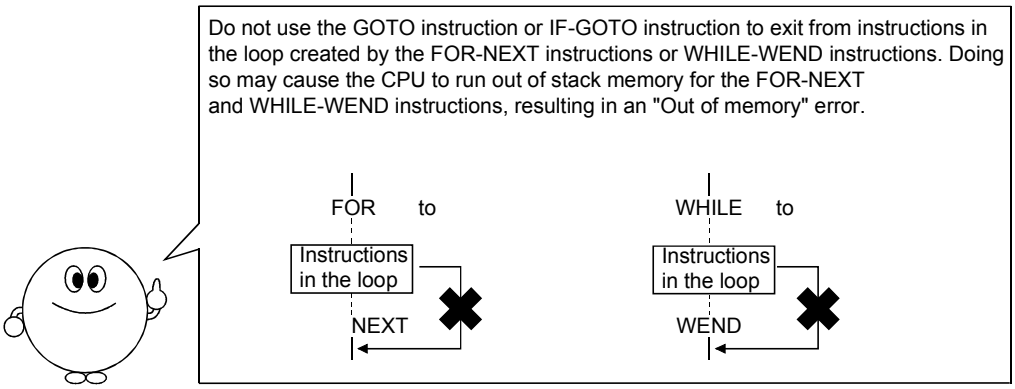
```
10 FOR N=1 TO 5
20 PRINT N;
30 NEXT N
40 END      (Repeats 5 times)
RUN
 1 2 3 4 5
OK
■
```



Variable N doesn't necessarily have to increase by 1. It is also possible, for example, to increase the value of variable N by 0.5 or to decrease it by 2. The rate of change can be specified by the STEP instruction.

```
10 FOR N=2 TO 4 STEP 0.5
20 PRINT N;
30 NEXT N
RUN
 2 2.5 3 3.5 4
   0.5 0.5 0.5 0.5
OK
■
```

```
10 FOR N=5 TO 1 STEP -2
20 PRINT N;
30 NEXT N
RUN
 5  3  1
   -2  -2
OK
■
```



REMARK

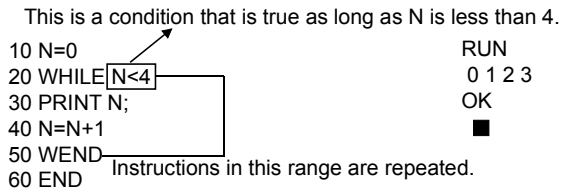
The NEXT instruction determines whether or not the loop will continue in the FOR-NEXT instructions. Therefore, instructions between the FOR-NEXT instructions are executed at least once, even in the FOR-NEXT instructions shown below.

```
10 FOR J=10 TO 1 STEP 2
20 PRINT "  A"
30 NEXT J
RUN
A  <-- It is not possible to increase the value of J from 10 to 1
OK     in step of 2, but the instruction of line 20 has already
■      been executed.
```


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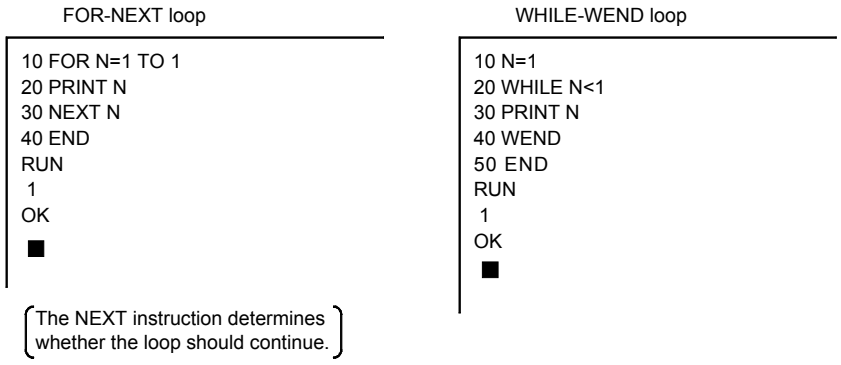
3.6.4 Loop while a certain condition is met

Use the WHILE-WEND instructions to repeat execution of instructions only while a certain condition is met.



The instructions in the loop are repeated while the condition stated immediately after WHILE is met.
For details on how to specify conditional expressions, see Section 3.7.1.

The WHILE-WEND instructions are loop instructions very similar to the FOR-NEXT instructions, but it is the WHILE instruction that determines whether or not the loop should continue. Therefore, if a condition is not met from the beginning, the instructions between the WHILE and the WEND will not be executed even once.



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3.7 Letting BASIC Make Decisions

In BASIC, a program can be branched into different instructions based on whether or not a specified condition is met.

3.7.1 Condition specification

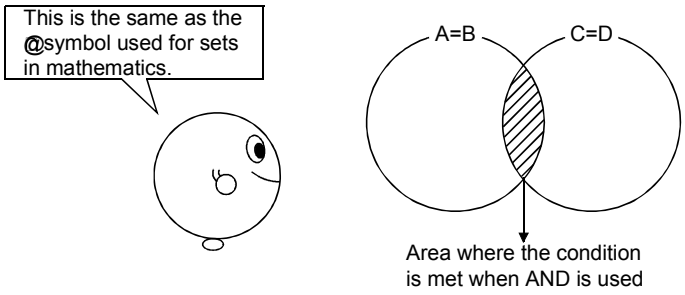
The following symbols are used to specify conditions.

Symbol	Meaning	Example	
=	Equal to	A=B	• • • • • • The condition is met when A and B are equal.
<	Less than	A<B	• • • • • • The condition is met when A is less than B.
>	Greater than	A>B	• • • • • • The condition is met when A is greater than B.
<=	Equal to or less than (Including and up to)	A<=B	• • • • • • The condition is met when A is less than or equal to B.
=>	Equal to or greater than (Including and more than)	A>=B	• • • • • • The condition is met when A is greater than or equal to B.
<>	Not equal to	A<>B	• • • • • • The condition is met when A is not equal to B.

More conditions can be created by combining these symbols with the logical operators 'AND' and 'OR.' When a condition is combined with another condition, they are referred to as "logical expressions."

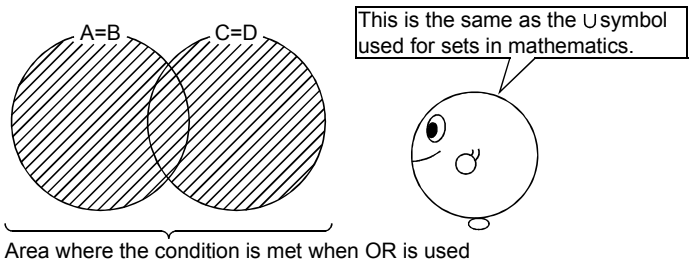
• When using 'AND' • • • Conditions are connected using the logical operator 'AND.' There is no restriction on the number of conditions that can be connected using the logical operator.

Example A=B AND C=D • • • The condition is met when A and B are equal and C and D are equal.



• When using 'OR' • • • Conditions are connected using the logical operator 'OR.' There is no restriction on the number of conditions that can be connected using the logical operator.

Example A=B OR C=D • • • The condition is met when A and B are equal or C and D are equal.



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3.7.2 Judgment instructions

Use the IF instruction to make a judgment. The IF instruction is entered in the format shown below.

IF (Condition or logical expression) THEN (Instruction executed when the condition or logical expression is met) ELSE (Instruction executed when the condition or logical expression is not met)

(1) Specify the condition or logical expression in [Condition or logical expression] according to the method shown in Section 3.7.1.

(2) Enter the instruction to be executed when [Condition or logical expression] is met after the THEN instruction. Any instructions can be entered, and it is possible to use multi-statements (→Section 2.3).

(3) Enter the instruction to be executed when [Condition or logical expression] is not met after the ELSE instruction. As with (2), any instructions can be entered, and multi-statements (→Section 2.3) are allowed.

Example

It is not necessary to split line 20 as shown here. You can enter it in one line.

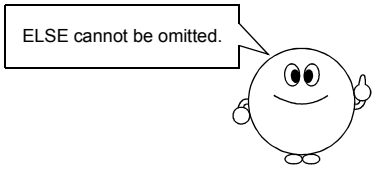
```
10 FOR I=1 TO 10
20 IF  I<=5 THEN PRINT I;   "Less than or equal to"   ····· Executed when I is less than 5
           ELSE PRINT I;   "Greater than"·····  ····· Executed when I is greater tha
30 NEXT I
40 END
RUN
1 Less than or equal to.
2 Less than or equal to.
   :
5 Less than or equal to.
6 Greater than
   :
10 Greater than
OK
■
```

REMARK

When the GOTO instruction is placed after the THEN or ELSE instruction, the GOTO or THEN instruction can be omitted as shown below.

Example

```
IF A=1 THEN GOTO 100 ELSE GOTO 200
           ⇩
IF A=1 THEN 100     ELSE 200
IF A=1 THEN GOTO  70 ELSE GOTO  10
           ⇩
IF A=1     GOTO  70 ELSE  10
```



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REMARK

When single-precision or double-precision values are compared using the equal sign, there are cases where the result is incorrect.

Example

```
10 A=0
20 FOR I=1 TO 1000
30 A=A+0.0001                    Since 0.0001 is added 1000
40 NEXT I                        times, A should equal 0.1.
50 IFA=0.1 THEN PRINT            If A is 0.1, EQ! is displayed.
60 END
RUN
OK                               EQ! was never displayed.
PRINT A
0.100001                         The value of A is not 0.1.
OK
■
```

The reason for this is that single-precision or double-precision values are stored in the memory in floating point format; thus it is sometimes not possible to hold the exact values.
(Example is one such case.)

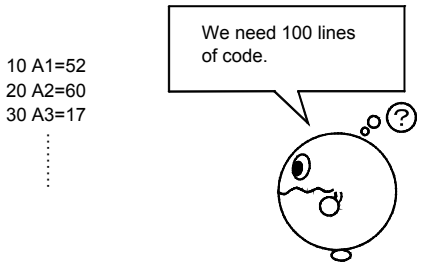
In order to compare whether such values are equal, it should instead be checked if the absolute value of the difference is smaller than some appropriate tolerance.

```
10 A=0
20 FOR I=1 TO 10
30 A=A+0.01
40 NEXT I
50 IF ABS(0.1-A)<1E-5 THEN PRINT"EQ!"   When the difference between
60 END                                  0.1 and A is less than 10^-5,
RUN                                     A is considered equal to 0.1.
EQ!                                     EQ! is displayed.
OK
■
```


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3.8 How to Use Arrays

Let's assume that a quantity of 100 data must be assigned to variables. Using A1, A2 ... as variables, for example.



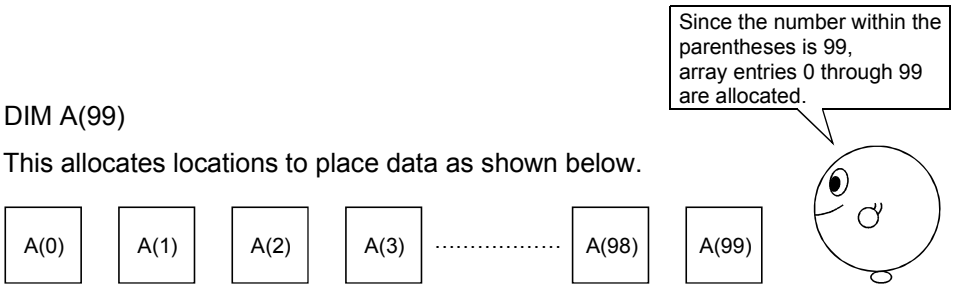
100 variables will be required, and that's a lot of trouble. It is much more convenient to use arrays in such instances.
It is necessary to tell BASIC that arrays will now be used. This is done by using the DIM instruction.

DIM A(99)

This allocates locations to place data as shown below.

DIM A(99)

This allocates locations to place data as shown below.



If 70 is to be assigned to A(50), enter the following.

A(50)=70

Now, the value within the parentheses can be specified by a variable, instead of a number.

S=50 : A(S)=70

Since the value of S is 50, 70 will be assigned to A(50).
Now, let's consider assigning 100 data to variables again. When READ, DATA, and FOR-NEXT from Section 3.5 and 3.6 are used.

```
10  DIM    A(99)
20  FOR    I=0  TO  99
30  READ   A(I)
40  NEXT
50  DATA   52, 60, 70, • • •
```

How about this? The program is now amazingly short. Array variables become a useful tool when repeating similar processes by specifying a variable for a value within parentheses.

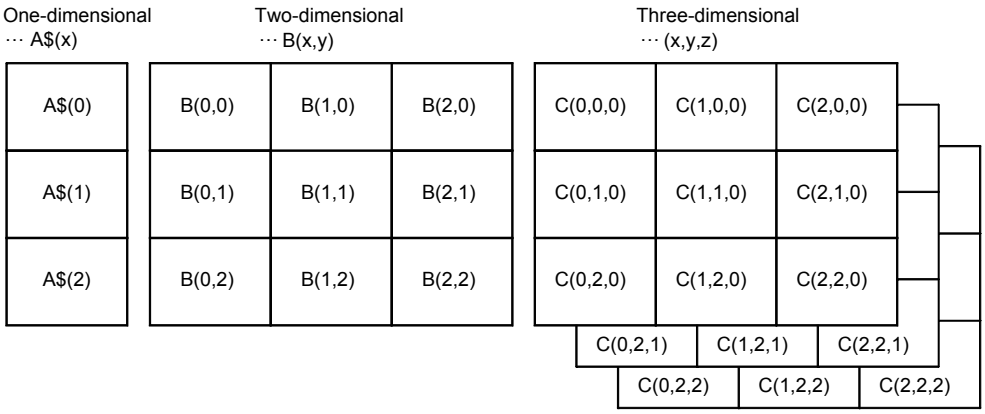
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Arrays are not limited to just numeric values. There are types of array that handle characters as well. In addition, when using numeric type arrays, different types of numbers can be defined, such as integers, single-precision, and double-precision. (For details on defining variable types, see the sections for the DEFINT, DEFSNG, and DEFDBL instructions.)

A$(n) ••••••••• Indicates character array A$.
A%(n) ••••••••• Indicates integer array A%.
A!(n) ••••••••• Indicates single-precision array A!.
A#(n) ••••••••• Indicates double-precision array A#.

3.8.1 Number of dimensions in an array

The dimension of an array refers to the number of indices within the parentheses. The following example shows one to three dimensional arrays.



For arrays with two dimensions or more, data can be extracted quickly by combining meanings.
For example, before specifying the array A(x,y), the following is defined.

X=1	••••	PLC	y=1	••••	Production schedule	
X=2	••••	Factory automation controller	y=2	••••	Produced quantity	
X=3	••••	Robot	y=3	••••	Achievement %	Then assign the data as shown:

The number of PLCs produced to A(1,2)
The target production of robots to A(3,1)
•
•
•
•
This way, data can be extracted only by matching the values in the parentheses to the target elements to reference the target data .

It is possible to define a maximum of 255 dimensions.

REMARK

It is possible to define a maximum of 255 dimensions, but in actuality, the amount of memory may not be enough when too many dimensions are reserved.

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3.9 Using Subroutines

There are cases when a certain process is repeatedly performed within a program. For example, if making a bar graph using the character "*,"

```
10 READ A
20 FOR I=1 TO A
30 PRINT "  *"  ;
40 NEXT I
50 PRINT
60 READ A
70 FOR I=1 TO A
80 PRINT "  *"  ;
90 NEXT I
100 PRINT
110 DATA 5,9
120 END
```

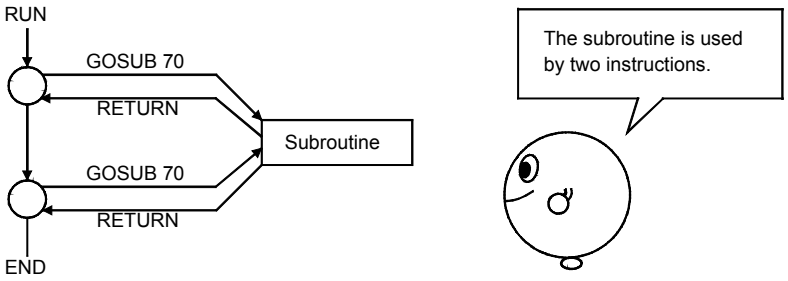
```
RUN
*****
*********
OK
■
```

The areas marked with ⬚ are identically the same. If more graphs are to be created, a long program may be required.
Subroutines are used to call the same process from various locations, treating them as one "group." Namely, the GOSUB instruction and RETURN instruction are used.
Modify the program above so that it looks like as shown below.

```
10 READ A
20 GOSUB 70
30 READ A
40 GOSUB 70
50 DATA 5,9
60 END
70 FOR I=1 TO A
80 PRINT "  *"  ;
90 NEXT I
100 PRINT
110 RETURN
```

```
RUN
*****
*********
OK
■
```

The execution result is the same, but the area marked with ⬚ is now only one.
'GOSUB 70' in lines 20 and 40 calls the ⬚ area that starts at line 70 (→ Subroutine).
After the ⬚ area (→ Subroutine) is completed, the execution returns to where it left off by the RETURN instruction in line 110.



REMARK

Always use the GOSUB instruction to call subroutines. If the GOTO instruction is used, an error will be generated at the RETURN instruction.

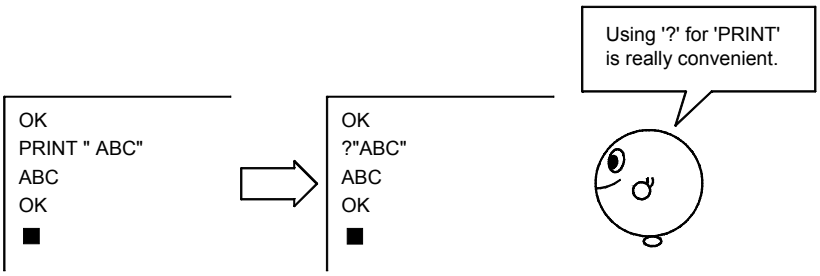
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3.10 Displaying Characters on the Screen

The PRINT instruction is used to display text on the screen. Since this instruction is mostly used, '?' is read as PRINT in BASIC.

Example



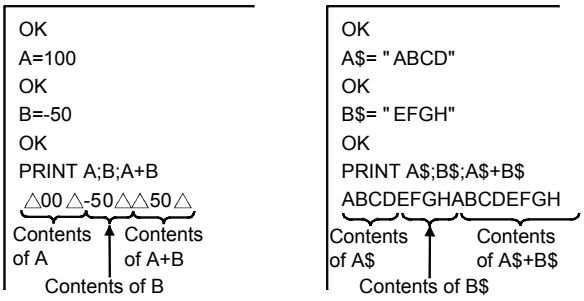
The text to be printed on the screen is specified after the PRINT instruction.
Items that can be displayed are constants, contents of variables, contents of arrays, values of functions, and all these items combined with the operands.

Example

PRINT "ABC" → The character constant "ABC" will be displayed.
PRINT A% → The contents of the integer variable A% will be displayed.
PRINT A$+C$ → The contents of character variable A$ plus the contents of character variable C$ will be displayed.

Also, the texts can be displayed continuously by separating them by "," (comma) and ";" (semicolon) with the PRINT instruction.
Examples of using ";" (semicolon) are shown below.

Example



As shown above, when a ";" (semicolon) is used, one data is displayed, then the next data is displayed immediately after it. The only thing to be careful is that the display method for numeric values and characters are different.

- When numeric values are being displayed, a sign is always shown in front.
  When the value is negative, "-"
  When the value is positive, "△" (A space is displayed.)
- When a numeric value is displayed, a space is automatically inserted after the value. (Example above may be easier to understand after this is said.)

  Because of this, a space is inserted even if ";" is used to display data continuously. Text display doesn't have the same characteristics, so they are displayed continuously without spaces.

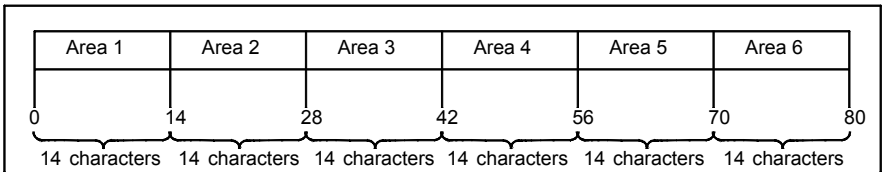
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The following illustrates cases where "," (comma) is used.

Example



BASIC manages one line on the screen by separating them into areas of 14 characters.



When commas are used as separators, the location where the next data will be displayed in the beginning of the next area.
The BASIC operation (automatic display of spaces) when displaying numerical numbers is the same as separating with ";" (semicolon).

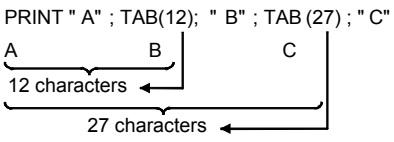
3.10.1 Functions for displaying characters

There are two dedicated functions for the PRINT instruction.

(1) TAB Function

You can directly specify the number of characters from the left edge of the screen of the current line with the TAB function. Use ";" (semicolon) to delimit the TAB function.

Example



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```
10 INPUT A$
20 INPUT B$
30 PRINT A$,B$
40 PRINT A$;TAB(20);B$
RUN
? 1234567
? 3478
1234567 3478
1234567             3478
OK
RUN
? 123456789012345
? 1000
123456789012345             1000
123456789012345     1000
OK
■
```

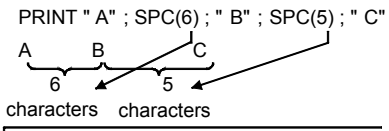
The spacing is always constant if the TAB function is used.

When the TAB function is used, the display positions will not vary depending on the display contents as with when ";" or "," is used.

(2) SPC Function

When the SPC function is used, a number of blank spaces can be displayed from the last displayed character position. Use ";" (semicolon) as a separator for the SPC function. When the SPC function is used, the number of spaces will not vary depending on the display contents as with when ";" or "," is used.

Example




```
10 INPUT A$
20 INPUT B$
30 PRINT A$,B$
40 PRINT A$;SPC(5);B$
RUN
? 1234567
? 3478
1234567     3478
1234567     3478
OK
RUN
? 123456789012345
? 1000
123456789012345          1000
123456789012345     1000
OK
■
```

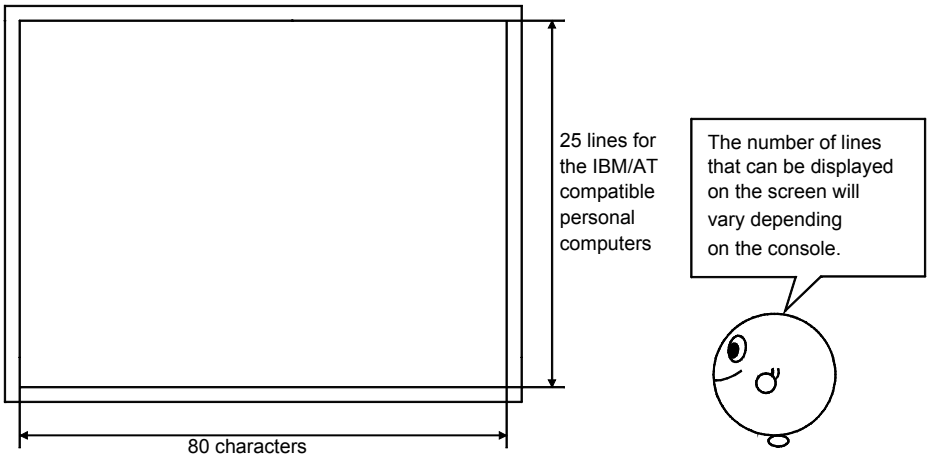
Constant if the SPC function is used.

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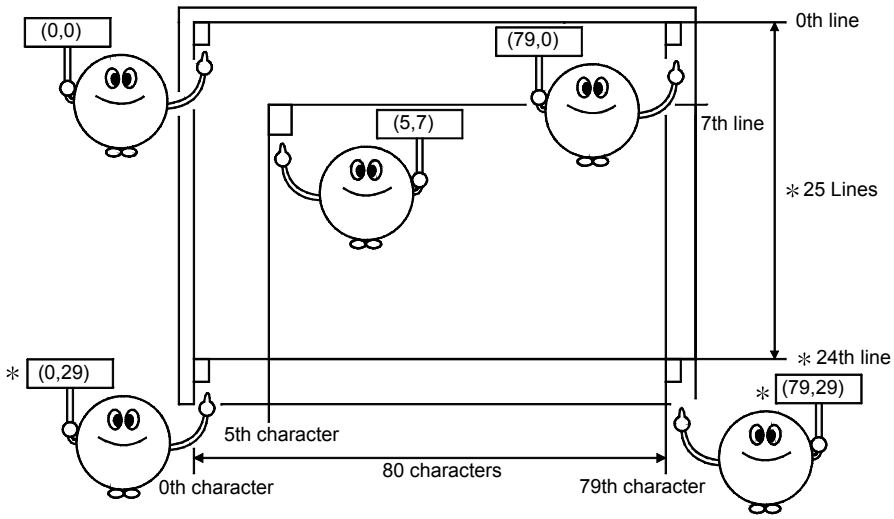
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3.10.2 Displaying characters to an arbitrary position

Characters can only be controlled in lateral direction on the screen with separating with delimiters ";" and "," as well as the TAB and SPC functions. However, there may be a case where you desire a text to be at any position in vertical direction as well. In such case, the LOCATE instruction is used. The following shows the console screen structure:



The LOCATE instruction directly specifies the display position using coordinates with the upper left corner of the screen as (0,0). The display position is displayed first for the coordinate in horizontal direction, and then the coordinate in the vertical direction.



∗ This example is illustrated using an IBM/AT compatible personal computer as the console. The maximum coordinate value in the vertical direction may vary if other consoles are used.

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The following shows how to use the LOCATE instruction:

LOCATE△ position in horizontal direction, position in vertical direction

This allows the specification of the screen display position, and then the PRINT instruction can be used to display characters.

Example

```
10 CLS ⟶ This instruction clears the screen
20 LOCATE 10,5
30 PRINT " MELSEC AD51H-BASIC"
40 LOCATE 65,20
50 PRINT  "Pleased to meet you!!"
60 END
RUN
```

```
 MELSEC AD51H-BASIC




          Pleased to meet you!!
OK
■
```


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3.11 Entering Data Using the Keyboard

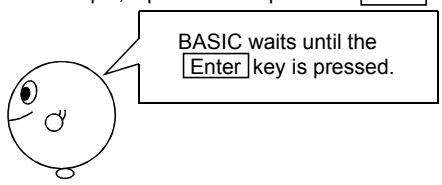
There are two methods to notify data entered via keyboard to BASIC. One method is using the INPUT instruction, which BASIC pauses the program and waits for an input. The other is the function INKEY$ that simply checks for keyboard status and doesn't stop the program.
The INPUT instruction is used when you wish to pause the execution by BASIC while data is being entered.
The INPUT instruction is used as follows.

INPUT△ Variable name in which to place data

Example

```
10 INPUT A
20 INPUT B
30 PRINT A+B
40 END
RUN
? 6
? 10
 16
OK
■
```

BASIC is asking for the value of A. For example, if "6" is the value for A, input "6" and press the Enter key.
Similarly, BASIC is asking for the value of B.
For example, input "10" and press the Enter key.



Sometimes it is difficult to understand what BASIC is asking for, if only '?' is displayed on the screen. Therefore, there is a function to specify a character constant. See the program below.

Example

```
10 INPUT " A=" ;A
20 INPUT " B=" ;B
30 PRINT A+B
40 END
RUN
A=?6
A=?10
 16
OK
 ■
```

As shown above, it's now clear as to what the program is asking for when a character constant is placed in front of the variable name separated by a semicolon.

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The INPUT instruction pauses the program until data is entered and the Enter key is pressed. When you don not wish to pause the program, the INKEY$ function is used. the following shows an example program:

Example

```
10 A$=INKEY$
20 PRINT A$
30 GOTO 10
RUN
 ⋮
```

No output is displayed on the screen even after execution.
Now press the A key.

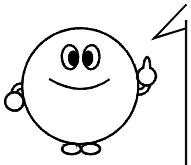
```
 ⋮
 △
 A ←— "A" is displayed on the screen when the A key is pressed.
 A ←— When the A key is released, the screen will be blank again.
 ⋮
```

As you can see, the INKEY$ function checks for the keyboard status and the program is not be paused. The INKEY$ function uses an empty as the value, and uses the text as the value when a key is pressed. However, since this value is a character string, the substituted variable must be a character variable or a character array.
Furthermore, unlike the INPUT function, multiple characters cannot be input once.

Example

```
10 N=0
20 PRINT "Count in progress"
30 N=N+1
40 K$=INKEY$
50 IF INKEY$= "Y" THEN GOSUB 70
60 GOTO 30
70 PRINT "N= ";N;"
80 RETURN
```

```
RUN
Count in progress.
N = 30.   ←—— Press the Y key.
N= 530.   ←—— Press the Y key.
```



If the INKEY$ function is used to wait for an input as shown below, the efficiency of multitask execution may be degraded.

```
10 PRINT  "Press the Y key."
20 K$=INKEY$
30 IF K$= " Y" GOTO 50
40 GOTO 20
50 END
```

Use the INPUT$ function in the following case

```
10 PRINT  "Press the Y key."
20 K$=INPUT$(1)
30 IF K$<> " Y" GOTO 20
40 END
```


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3.12 Printing to the Printer

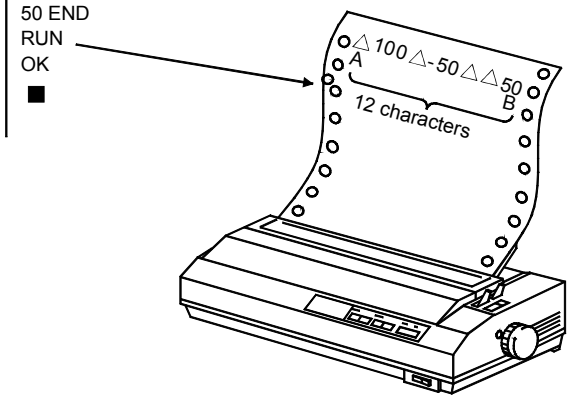
The values of constants, variables, and arrays can all be printed to the printer, just as they can be displayed on the screen. When sending data to a printer, the ZLDV instruction checks to see where the printer is connected. The setting is as follows.

- To use a printer connected to the console ••••••••• ZLDV 0
- To use a printer connected to CH1 (RS232) interface ••••••••• ZLDV 1
- To use a printer connected to CH2 (RS232) interface ••••••••• ZLDV 2
- To use a printer connected to CH3 (RS422) interface ••••••••• ZLDV 3
- To use a printer connected to CH4 (PARALLEL) interface ••••••••• ZLDV 4

Data to be sent to the printer is specified using the LPRINT instruction. The contents that are written after the LPRINT instruction are exactly the same as when using the PRINT instruction in Section 3.10. SPC and TAB functions can also be used. However, the LOCATE instruction will produce no result to the printer.

Example

```
10 ZLDV 0
20 A=100:B=-50
30 LPRINT A;B;A+B
40 LPRINT " A" ;TAB(12); " B"
50 END
RUN
OK
■
```



REMARK

- Other than just printing character, a printer can be used to perform various operations by sending data referred to as control codes. For details, refer to the manual for the printer used.
- The ZCNTL instruction can be used to read the printer status or to send a reset signal to the printer.

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3.13 Character Processing

3.13.1 Types of characters

There are three basic categories of characters used in BASIC.

- Half-byte characters (1-byte characters) ••••• These are characters that can be input from the keyboard and include numbers, alphabet characters, special characters, etc.
- Control characters ••••• Control characters refer to character codes 00h through 1Fh. These are not normally used, and produce the same result as when pressing the ↑ key, ↓ key, ← key, → key, or Ctrl + ⬚ keys on the keyboard. To specify these characters, the CHR$ function is used.

3.13.2 Half-byte character unit processing

(1) To extract a portion of a character string

There are three functions that can be used to extract a certain portion of a character string and create a new character string. The following shows an example:

Example

```
10 A$= "ABCDEFGHIJ"
20 B$=LEFT$ (A$, 4)
30 PRINT B $
RUN
ABCD
OK
■
```

LEFT$(A$, n) creates a new character string by extracting up to the nth character counting from the left within the character string A$.

Example

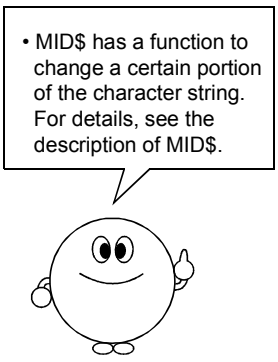
```
10 A$= "ABCDEFGHIJ"
20 B$=RIGHT $(A$, 4)
30 PRINT B $
RUN
GHIJ
OK
■
```

RIGHT$(A$, n) creates a new character string by extracting up to the nth character counting from the right within the character string A$.

Example

```
10 A$= "ABCDEFGHIJ"
20 B$=MID $(A$, 4, 3)
30 PRINT B $
RUN
DEF
OK
■
```

MID$(A$, n, m) creates a new character string by extracting m characters from the nth character counting from the left within the character string A$.



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(2) Finding the length of a character string

The LEN function is used to find the length of a character string.

```
10 A$= "ABCDE"
20 A= LEN (A$)
30 PRINT A
40 END
RUN
 5
OK
■
```

(3) Converting characters to ASCII code equivalents

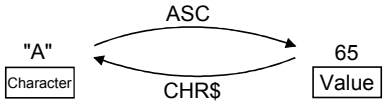
Each character used in BASIC has a corresponding ASCII code number.
(See Appendix 4.1)
For example, for alphabet characters, the codes correspond as follows:

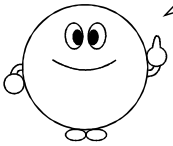
[Character]	[Code]
A	65
B	66
:	:

The ASC function and CHR$ function are used for conversion between ASCII codes and characters.

Example

```
OK
PRINT ASC( " A" )
 65
OK
PRINT CHR$(65)
A
OK
■
```





- Only character constants, character arrays, or character conversion can be specified inside the parentheses of an ASC function.
  Only numeric constants, numeric arrays, or variables can be specified inside the parentheses of a CHR$ function.
- Specifying number 31 or less in the parentheses in a CHR$ function will produce control characters described in Section 3.13.1.

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(4) Conversion of numbers and characters

The following calculation cannot be performed even if the character string is fully comprised of numbers.

Example

```
OK
A$= " 12345"
OK
B=1156
OK
PRINT A$+B
Type mismatch
OK
■
```

The VAL function is used when treating a character string comprised of only numbers as a numeric value. The VAL function converts character strings to numeric values.

Example

Continued from Example above

```
A=VAL(A$)
OK
PRINT A+B
 13501
OK
■
```

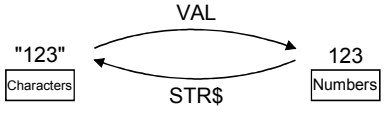
Conversely, when handling numeric values as character strings, the STR$ function is used. The STR$ function converts numeric values to character strings.

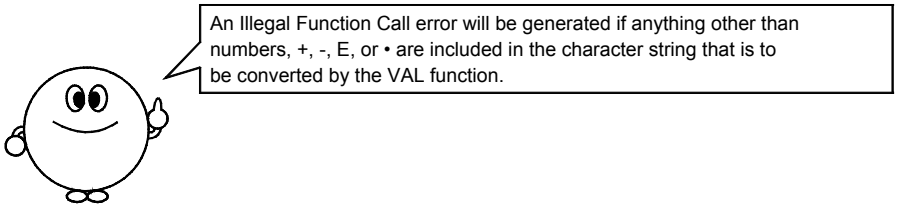
Example

Continued from Example above

```
C$=STR$(A+B)
OK
PRINT RIGHT$(C$, 3)
501
OK
■
```

Here is a summary of the above points.





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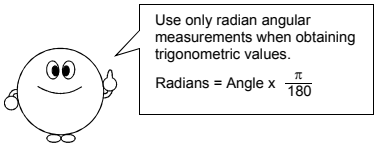
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3.14 About Types of Numeric Relationships

There are functions in BASIC that allow trigonometric functions to be used. The following describes how to express the trigonometric functions that can be used in BASIC.

(1) Trigonometric Functions

- sin x → SIN(X)
- cos x → COS(X)
- tan x → TAN(X)
- arc $\tan^{-1}$ → ATN(A)



(2) Exponential functions and logarithmic functions

- e^x → EXP(X)
- logeX → LOG(X) This is a natural log

There is no function that can directly obtain a value for log10X (standard log). Please use $\log_{10}X=\frac{\log eX}{\log e10}$.

(3) Square roots

- $\sqrt{x}$ → SQR(X)

(4) Numeric Conversions

- Integer conversion → INT(X)
- Absolute values → ABS(X)
- Sign → SGN(X)
- Round off decimal point → FIX(X)

(5) Random numbers

- Random numbers between 0 and 1 → RMD(X)

For details on function arguments, see the detailed descriptions.

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3.15 Executing a Large Program by Dividing it up

A large program that doesn't fit into memory cannot be executed. However, if a large program can be divided and saved into smaller programs and then executed one by one, it is possible to yield the same result of running one large program.
It is possible in AD51H-BASIC to execute a program that has been divided up by using the following procedure.

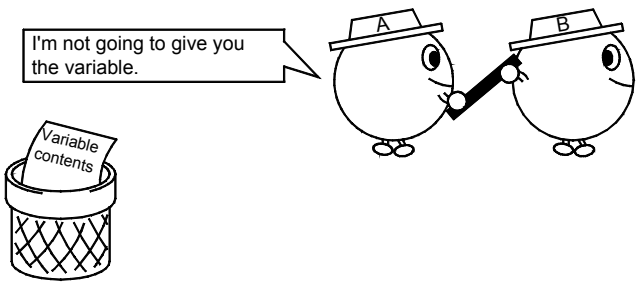
1. When the variable contents do not have to be transferred ••••••••• The LOAD and RUN instructions are used.
2. When the contents have to be transferred ••••••••• The CHAIN instruction is used.
3. When a portion of the program is shared ••••••••• The CHAIN instruction is used.

(1) When the variable contents do not have to be transferred

When there is no need to transfer the contents of variables that are used in the current program to the next program, use the RUN "Program Name" instruction or the R option in the LOAD instruction to execute the new program.

```
10 PRINT  "Program B executed!!"
20 PRINT " A=" ;A
30 END
SAVE " PRO-B"
OK
NEW
OK
10 PRINT  "Program A executed!!"
20 A=100
30 PRINT " A=" ;A
40 RUN " 0:PRO-B"  ····· LOAD " 0:PRO- B" Same as LOAD "0:PRO-B",R.
SAVE " PRO-A"
OK
■
```

```
RUN
Program A executed!!
A= 100
Program B executed!!
A= 0  ····· The content of the variable is not transferred.
OK
■
```



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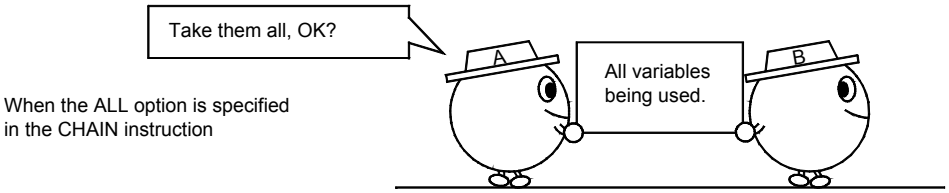
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(2) When the contents have to be transferred

The CHAIN instruction is used when the variable used in the program currently being executed must be transferred to the next program. When all of the used variables are to be transferred, the ALL option of the CHAIN instruction is used. The COMMON instruction is used when certain variable contents are to be transferred.

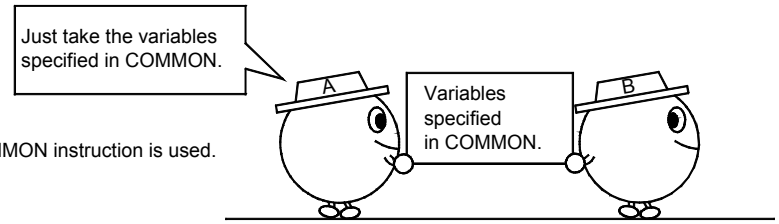
```
10 PRINT  "Program B executed!!"
20 PRINT " A=" ;A
30 END
SAVE " PRO-B"
OK
NEW
OK
10 PRINT  "Program A executed!!"
20 A=100
30 PRINT " A=" ;A
40 CHAIN " 0:PRO-B"  , 10, ALL ····· This is an example of all variables being transferred.
SAVE " PRO-A"
OK
```

```
RUN
Program A executed!!
A=100
Program B executed!!
A=100 ····· The contents of the
OK          variable have been
            transferred.
```



When the ALL option is specified in the CHAIN instruction

```
COMMON
A, B$, C%(1)
```



When the COMMON instruction is used.



Variables not specified in COMMON.

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(3) When a portion of the program is shared

The MERGE and DELETE options of the CHAIN instruction are used when a certain portion of the current program is to be switched with another program.

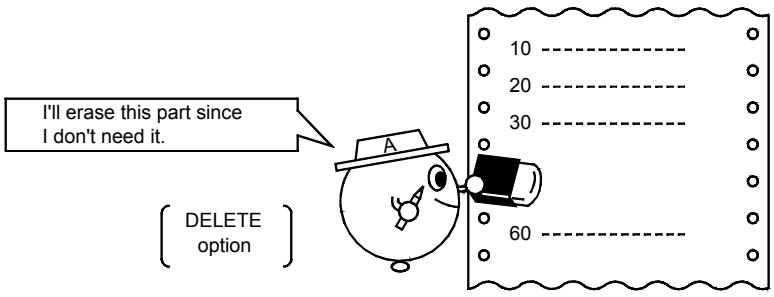
```
70 PRINT  "Program B executed!!"
80 A=4:GOSUB 1000
90 END
SAVE " PRO-B"
OK
NEW
OK
10 PRINT  "Program A executed!!"
20 A=7:B=3:GOSUB 1000
30 CHAIN MERGE "  0:PRO-B"  , 70, ALL, DELETE 10-30
1000 PRINT "  A=" ;A
1010 PRINT "  B=" ;B
1020 RETURN
SAVE " PRO-A"
OK
■
```

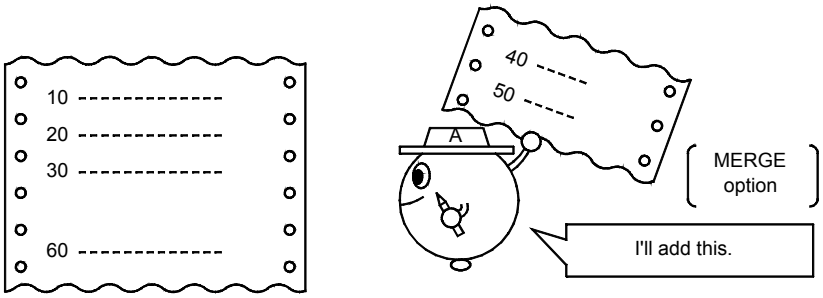
Lines 90 through 30 of the current program will be deleted and the "PRO-B.BAS" program will be added.

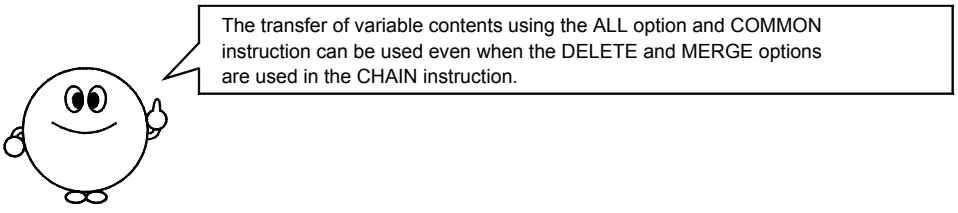
```
RUN
Program A executed!!
A= 7
B= 3
Program B executed!!
A= 4
B= 3
OK
LIST
70 PRINT  "Program B executed!!"
80 A=4:GOSUB 1000
90 END
1000 PRINT "  A=" ;A
1010 PRINT "  B=" ;B
1020 RETURN
OK
■
```

Contents of "PRO-B.BAS"

The original program contents







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4 THE EXCHANGE BETWEEN THE PLC AND BUFFER MEMORY

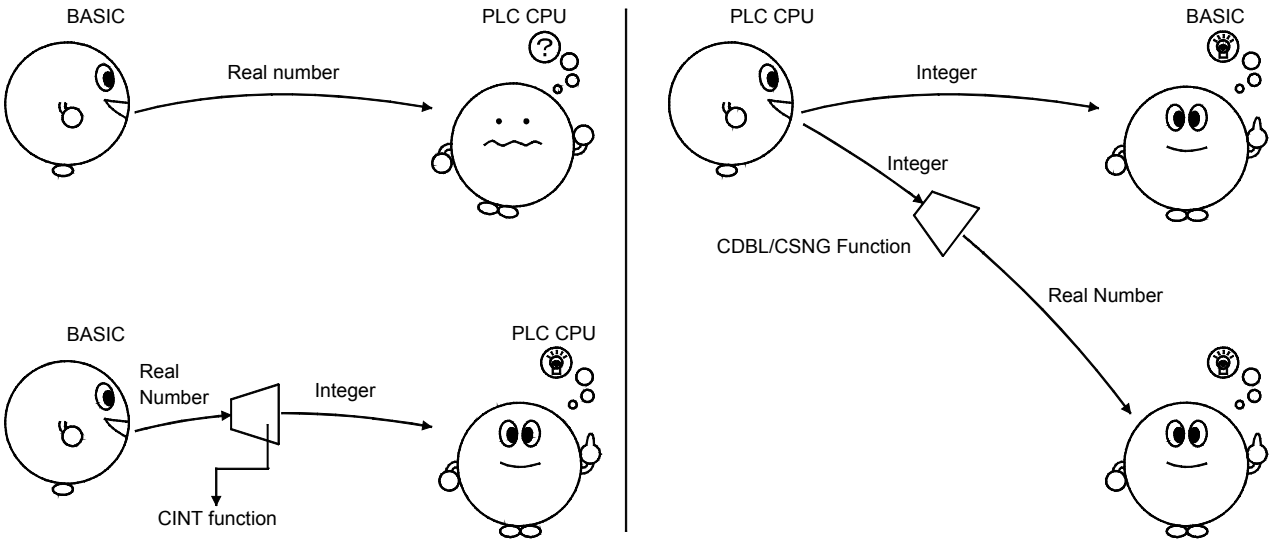
4.1 PLC Numeric Data and BASIC Numeric Data

Data handled within the PLC are generally integers. It handles integers (not including decimals) between –32768 and 32767 for one word (16 bits) and –2147483648 through 2149483647 for two words (32 bits).

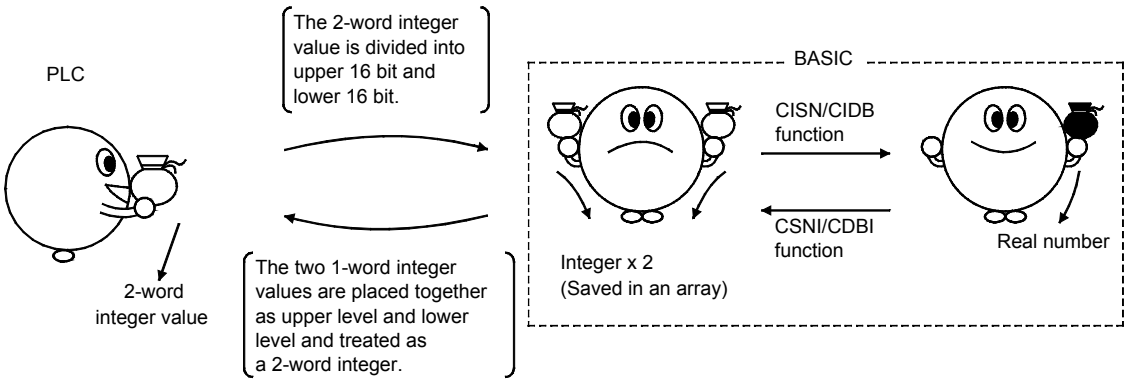
However, data handled within BASIC are generally real numbers and integers. It handles real numbers from (10^{-38} through 10^{38}) integers from –32768 through 32767 (not including decimals).

As shown above, data is handled differently between the PLC and BASIC. Therefore, it is necessary to perform data conversion between real numbers and integers to communicate with the PLC.

• 1-word processing



• 2-word processing



4 - 1

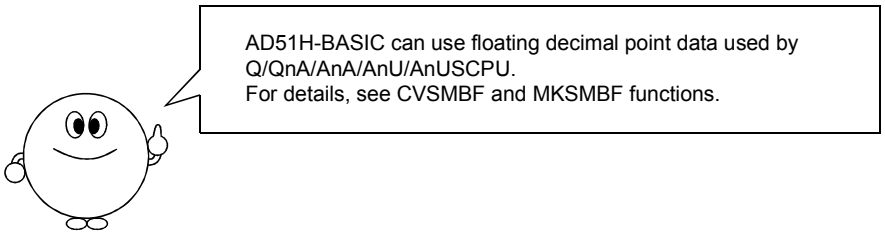
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4.2 The Exchange with the PLC

The following data exchange is performed between the PLC CPU and BASIC.

- Read and write of devices within the PLC CPU
- Read and write of the buffer memory within the intelligent function module/special function module
- Read and write of the control of the PLC CPU
- Read and write of the sequence programs and parameters, etc.

The PCRD and PCWT instructions are used to perform these processes.

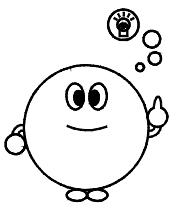


4.2.1 Control tables

The idea of “Control Tables” is used since many parameters are required to execute the PCRD and PCWT instructions. The control tables are a type of memory used to hand over parameters that are used to notify the process contents to the system when the above processes are performed by the BASIC program.
The BASIC program stores the necessary parameters in one array, and the parameters are handed to the system by specifying only the array name during execution.
For example, to read the device descriptions of the PLC CPU, the PLC station number, device read designation, bit/word designation, read head device, number of points read, and the parameter settings of the data storage variable must be set. If many parameters are arranged following the instruction, the program becomes hard to read. When the control tables are used, the actual instruction become easier to see, and the parameters can be written so that they are understood easily.

Using Control Tables

```
100 RD%(0)=1              :'  Station Number
110 RD%(1)=1              :'  Read Designation
120 RD%(2)=2              :'  Word Unit
130 RD%(3)=1              :'  Device Code
140 RD%(4)=&H10           :'  Head Device No,
150 RD%(5)=1              :'  Reads 1 word
200 PCRD RD%( ), A%( )
```



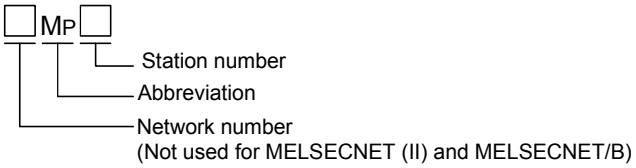
4 - 2

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4.2.2 PLC station number

In AD51H-BASIC, not only can the PLC attached to the communication module be accessed, but PLCs of other stations that are data-linked via the MELSECNET can be accessed as well. However, the following restrictions apply depending on whether the PLC with the communication module attached is a master station (control station) or local station (standard station).

In this section, the following abbreviations are used to describe each station type.



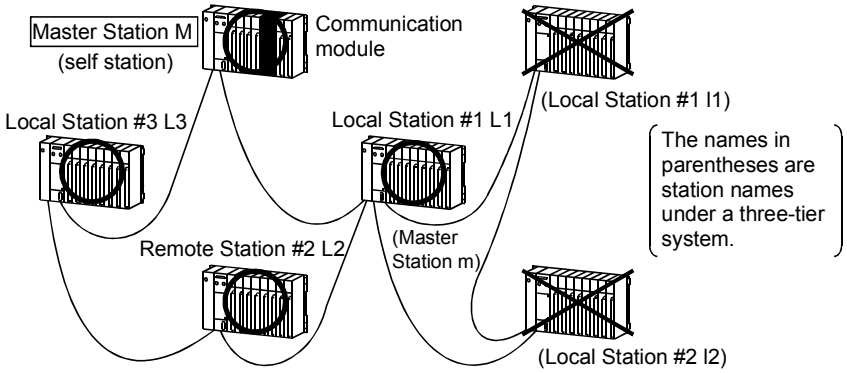
Abbreviation	Station type	Mounted CPU ＊1
M	MELSECNET (II) and MELSECNET/B two-tier master station	A0J2HCPUP21, A0J2HCPUR21, A2CCPUP21, A2CCPUR21, AnNCPU, AnACPU, AnUCPU, AnUSCPU, AnSCPU, QnACPU, QnASCPU
L	MELSECNET (II) and MELSECNET/B two-tier local station	A0J2HCPUP21, A0J2HCPUR21, A2CCPUP21, A2CCPUR21, AnNCPU, AnACPU, AnUCPU, AnUSCPU, AnSCPU, QnACPU, QnASCPU
R	MELSECNET (II) and MELSECNET/B two-tier remote I/O station	—
L/m	MELSECNET (II) and MELSECNET/B two-tier local station/ three-tier master station	AnNCPUP21, AnNCPUR21, AnACPUP21, AnACPUR21, AnUCPU, AnUSCPU, QnACPU, QnASCPU
l	MELSECNET (II) and MELSECNET/B three-tier local station	A0J2HCPUP21, A0J2HCPUR21, A2CCPUP21, A2CCPUR21, AnNCPU, AnACPU, AnUCPU, AnUSCPU, AnSCPU, QnACPU, QnASCPU
r	MELSECNET (II) and MELSECNET/B three-tier remote I/O station	—
Mp	MELSECNET/10 control station	QCPU, QnA(R)CPU, QnASCPU, AnUCPU, AnUSCPU
Ns	MELSECNET/10 standard station (Operable as a sub-control station)	QCPU, QnA(R)CPU, QnASCPU, AnUCPU, AnUSCPU
N	MELSECNET/10 standard station (Not operable as a sub-control station)	AnACPU, AnNCPU, AnSCPU
MR	MELSECNET/10 remote master station	QCPU, QnA(R)CPU, QnASCPU, AnUCPU, AnUSCPU
R	MELSECNET/10 remote I/O station	—

＊1: Refer to the user's manual for each communication module for details on the mounted CPU.

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(1) MELSECNET (II), MELSECNET/B

(a) When the CPU with the communication module attached (self station) is a MELSEC two-tier master station, data from all local stations and remote I/O stations within the self station and two-tier loop can be accessed.
Only the buffer memory of the special function module can be accessed for remote I/O stations.

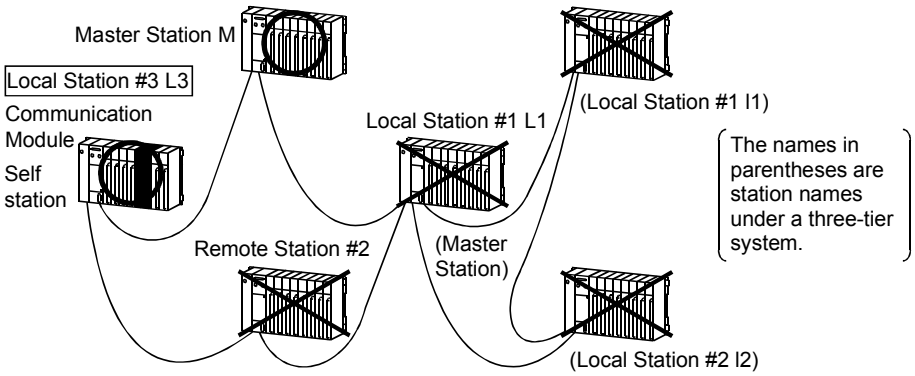


Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
M (self station)	255	0	255	×	
L1/m	1	0	1	×	
L2	2	0	2	×	
L3	3	0	3	×	
I1	×	×		×	
I2	×	×		×	

× : Not accessible

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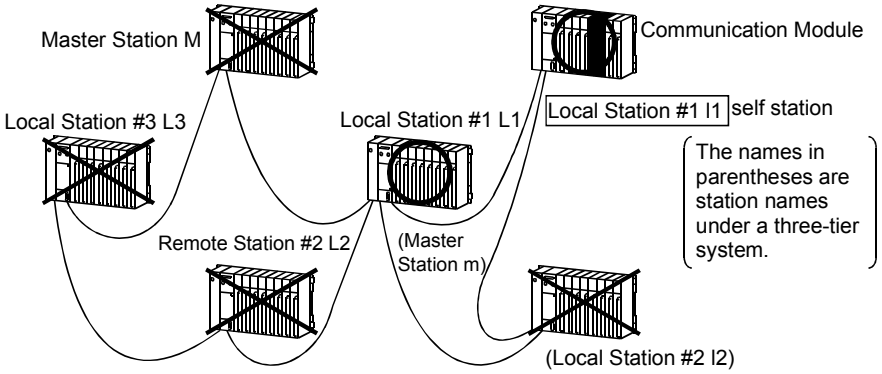
(b) When the CPU with the communication module attached (self station) is a MELSEC two-tier or three-tier local station, only the data from the self station and master stations within the same loop can be accessed.



Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
M	0	0	0	×	
L1/m	×	×		×	
L2	×	×		×	
L3 (self station)	255	0	255	×	
l1	×	×		×	
l2	×	×		×	

× : Not accessible

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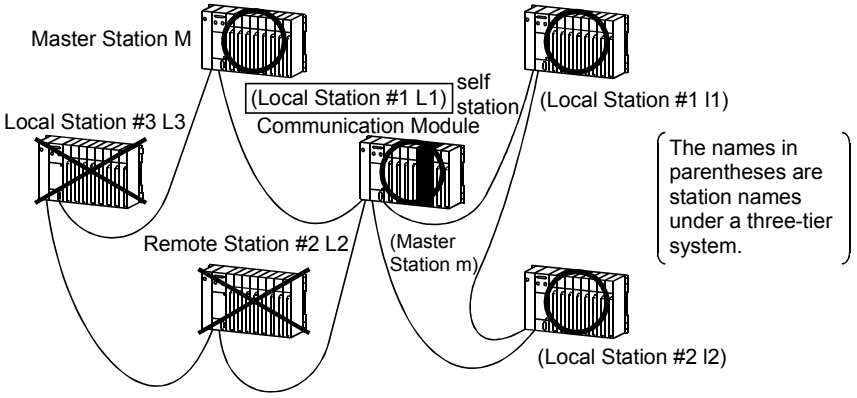
Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
M	×	×		×	
L1/m	0	0	0	×	
L2	×	×		×	
L3	×	×		×	
l1 (self station)	255	0	255	×	
l2	×	×		×	

× : Not accessible

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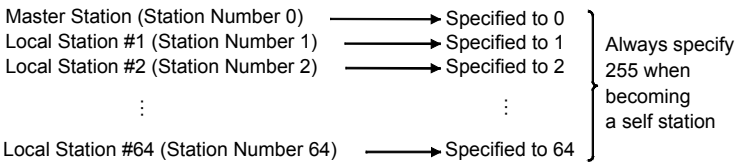
(c) When the CPU (self station) with the communication module attached is a MELSEC three-tier master station, data from the self station and master station of the two-tier loop and all local stations and remote I/O stations within the three-tier loop can be accessed.
Only the buffer memory of the special function module can be accessed for remote I/O stations.



Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
M	0	0	0	×	
L1/m (self station)	255	0	255	×	
L2	×	×		×	
L3	×	×		×	
I1	1	0	1	×	
I2	2	0	2	×	

× : Not accessible

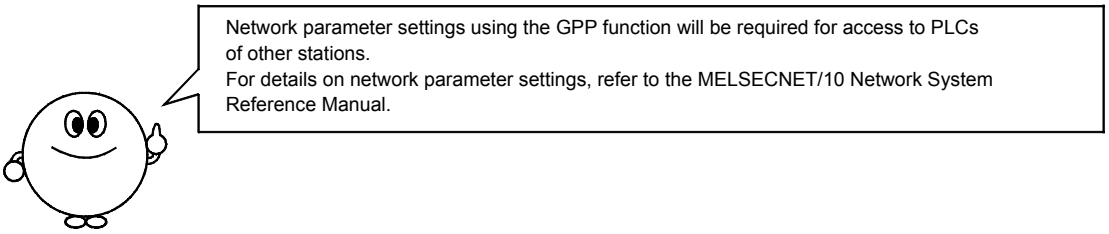
The setting to determine to which PLC communication is to be made is performed by specifying the station number within the same loop of self station. However, when performing access to the self station, the station number is specified as 255.



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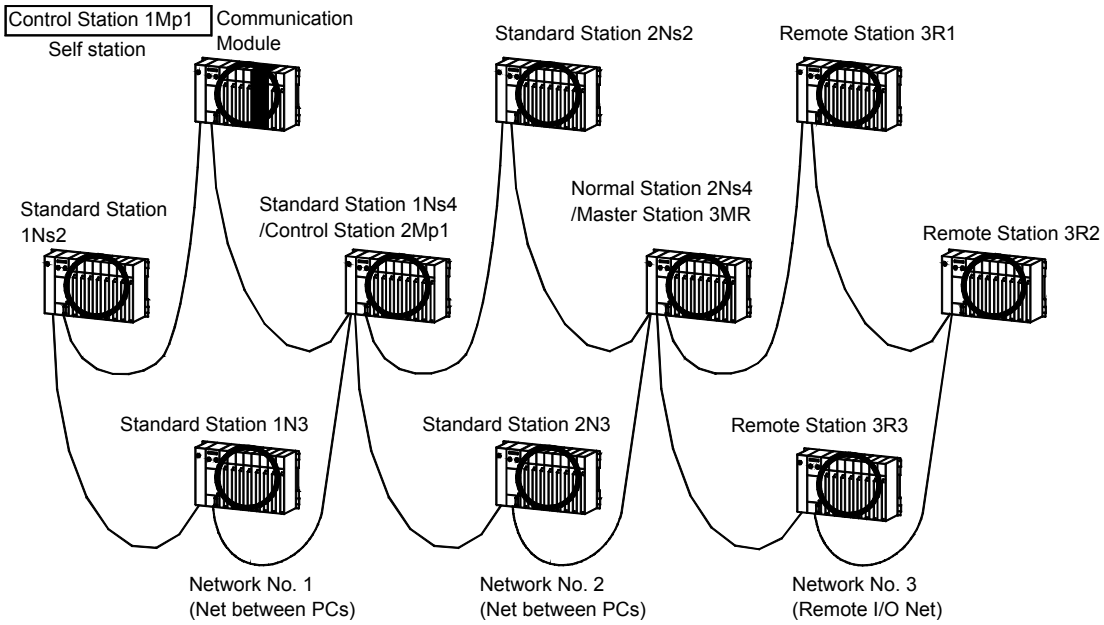
(2) MELSECNET/10



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(a) MELSECNET/10 Multi-Tiered System

1) When the CPU (self station) with the communication module attached is a MELSECNET/10 control station (Mp) or standard station (Ns), data from the self station and all stations can be accessed.



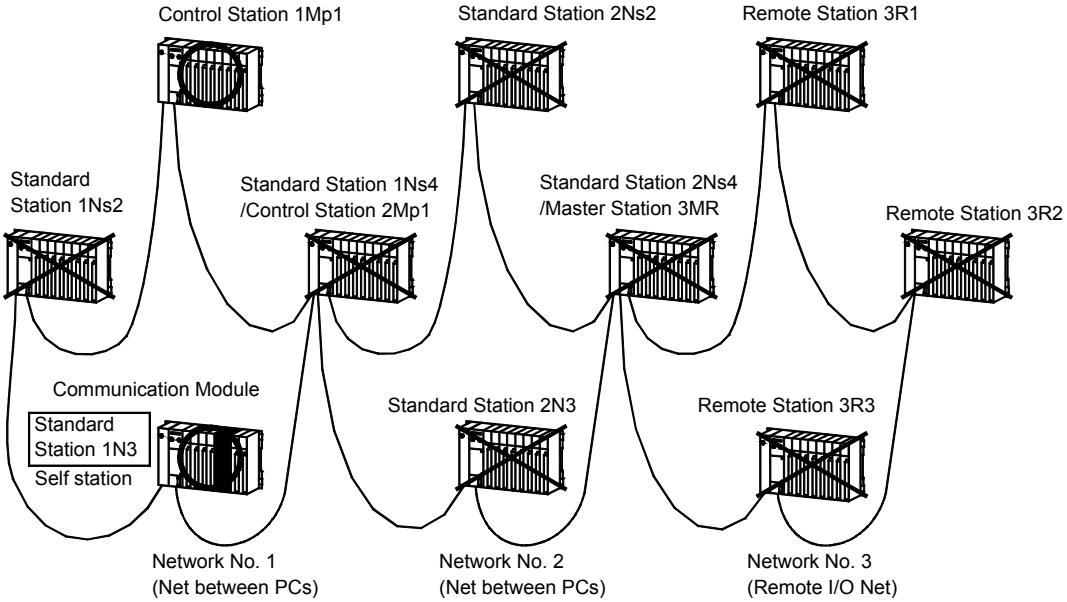
Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1 ＊1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
1Mp1 (self station)	255	0	255	0	255
1Ns2	2	1	2	1	2
1N3	3	1	3	1	3
1Ns4/2Mp1	4	1	4	1	4
2Ns2	×	2	2	2	2
2N3	×	2	3	2	3
2Ns4/3MR	×	2	4	2	4
3R1	×	3	1	3	1
3R2	×	3	2	3	2
3R3	×	3	3	3	3

× : Not accessible

＊1: When accessing the other station in format 1, a “Valid module during other station access” setting is required for the communication module mounted stations (excluding remote stations).
Set the “Valid module during other station access” on the module corresponding to the access destination network number.

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2) When the CPU (self station) with the communication module attached is a MELSEC/10 standard station (N), data from the self station and the control stations (Mp) within the same network can be accessed.

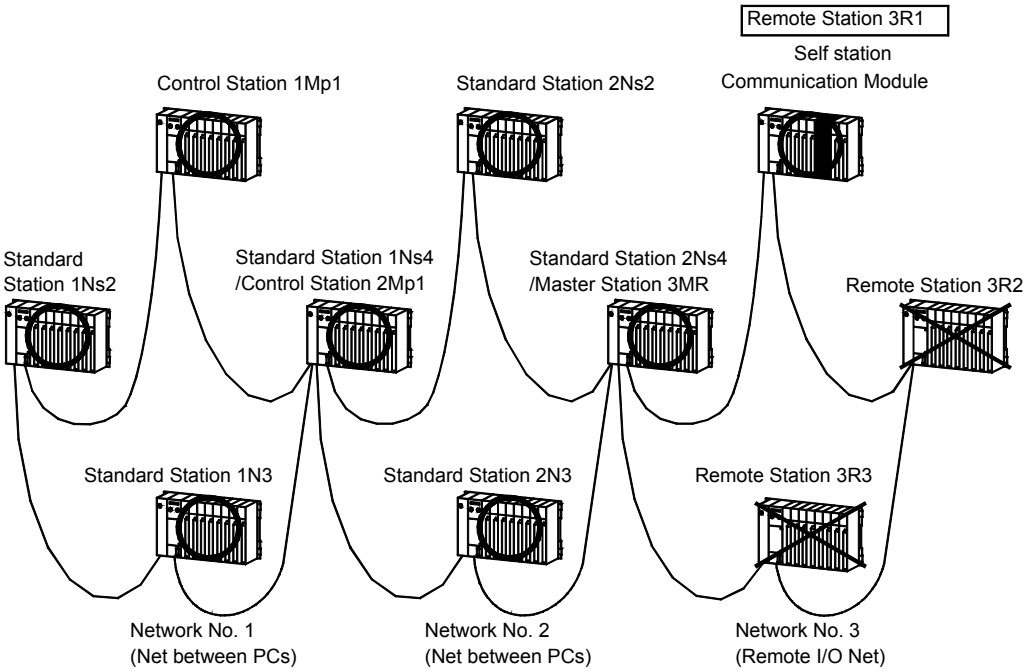


Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
1Mp1	0	0	0	×	
1Ns2	×	×		×	
1N3 (self station)	255	0	255	×	
1Ns4/2Mp1	×	×		×	
2Ns2	×	×		×	
2N3	×	×		×	
2Ns4/3MR	×	×		×	
3R1	×	×		×	
3R2	×	×		×	
3R3	×	×		×	

× : Not accessible

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3) When the CPU (self station) with the communication module attached is a MELSEC/10 remote station (R), data from the self station and the master stations (MR) within the same network, control stations (Mp) and standard stations (Ns, N) from other networks can be accessed.



Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1 ＊1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
1Mp1	×	1	1	1	1
1Ns2	×	1	2	1	2
1N3	×	1	3	1	3
1Ns4/2Mp1	×	2	1	2	1
2Ns2	×	2	2	2	2
2N3	×	2	3	2	3
2Ns4/3MR	0	3	125	3	125
3R1 (self station)	255	0	255	0	255
3R2	×	×		×	
3R3	×	×		×	

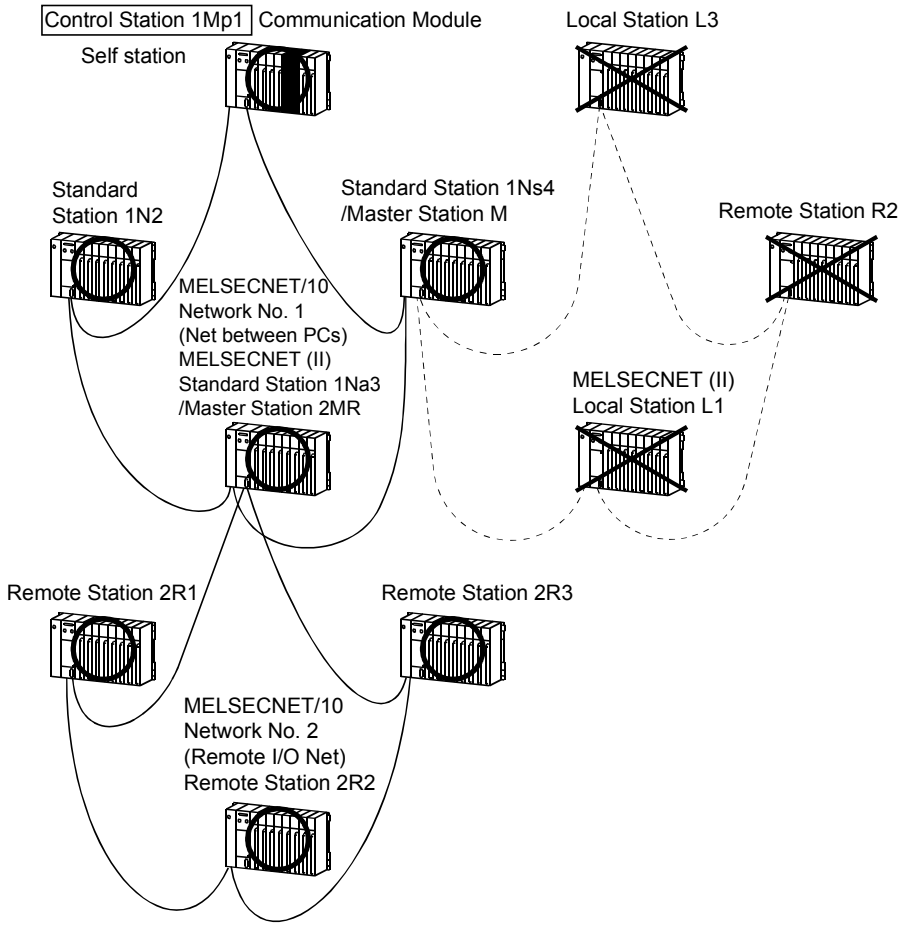
× : Not accessible

＊1: When accessing the other station in format 1, a “Valid module during other station access” setting is required for the communication module mounted stations (excluding remote stations).
Set the “Valid module during other station access” on the module corresponding to the access destination network number.

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(3) Mixed System with MELSECNET/10 and MELSECNET (II)

1) When the CPU (self station) with the communication module attached is a MELSECNET/10 control station (Mp) or a standard station (Ns), data from the self station and all MELSECNET/10 stations can be accessed.



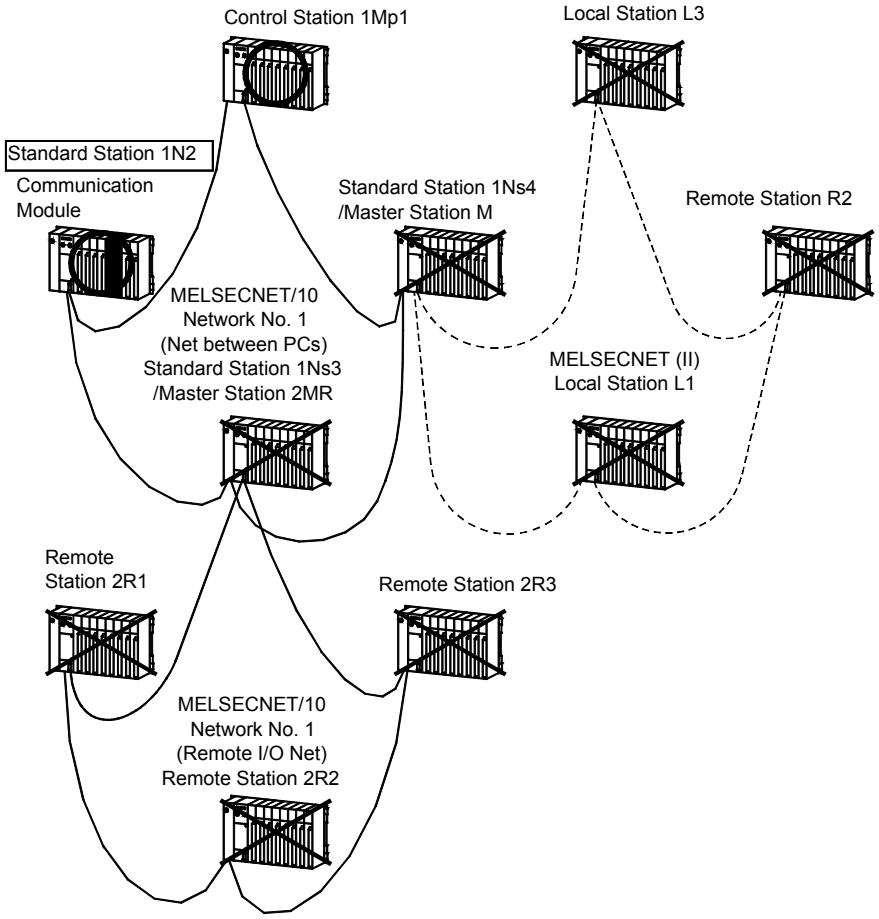
Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1 ＊1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
1Mp1 (self station)	255	0	255	0	255
1N2	2	1	2	1	2
1Ns3/2MR	3	1	3	1	3
1Ns4/M	4	1	4	1	4
2R1	×	2	1	2	1
2R2	×	2	2	2	2
2R3	×	2	3	2	3
L1	×	×		×	
R2	×	×		×	
L3	×	×		×	

× : Not accessible

＊1: When accessing the other station in format 1, a “Valid module during other station access” setting is required for the communication module mounted stations (excluding remote stations).
Set the “Valid module during other station access” on the module corresponding to the access destination network number.

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2) When the CPU (self station) with the communication module attached is a MELSECNET/10 standard station (N), data from the self station and control stations (Mp) of the same network can be accessed.

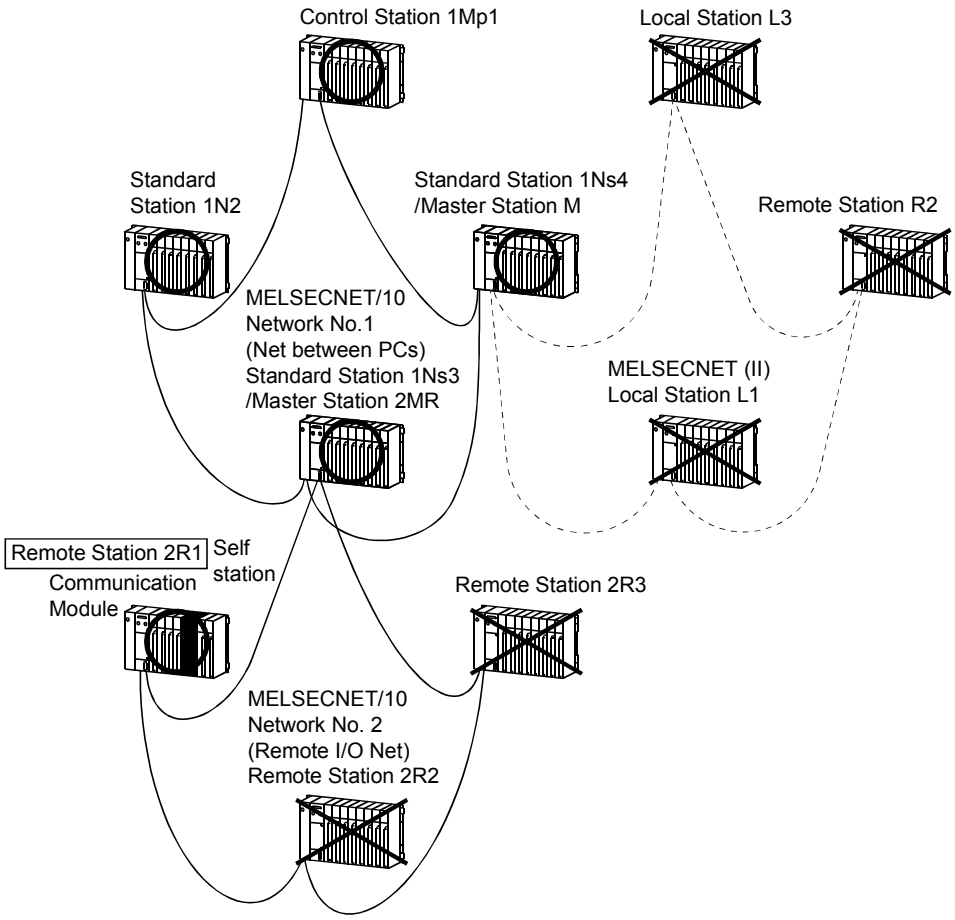


Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
1Mp1	0	0	0	×	
1N2 (self station)	255	0	255	×	
1Ns3/2MR	×	×		×	
1Ns4/M	×	×		×	
2R1	×	×		×	
2R2	×	×		×	
2R3	×	×		×	
L1	×	×		×	
L2	×	×		×	
L3	×	×		×	

× : Not accessible

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3) When the CPU (self station) with the communication module attached is a MELSECNET/10 remote station (R), data from the self station and master station (MR) of the same network and control stations (Mp) and standard stations (Ns, N) of other networks can be accessed.

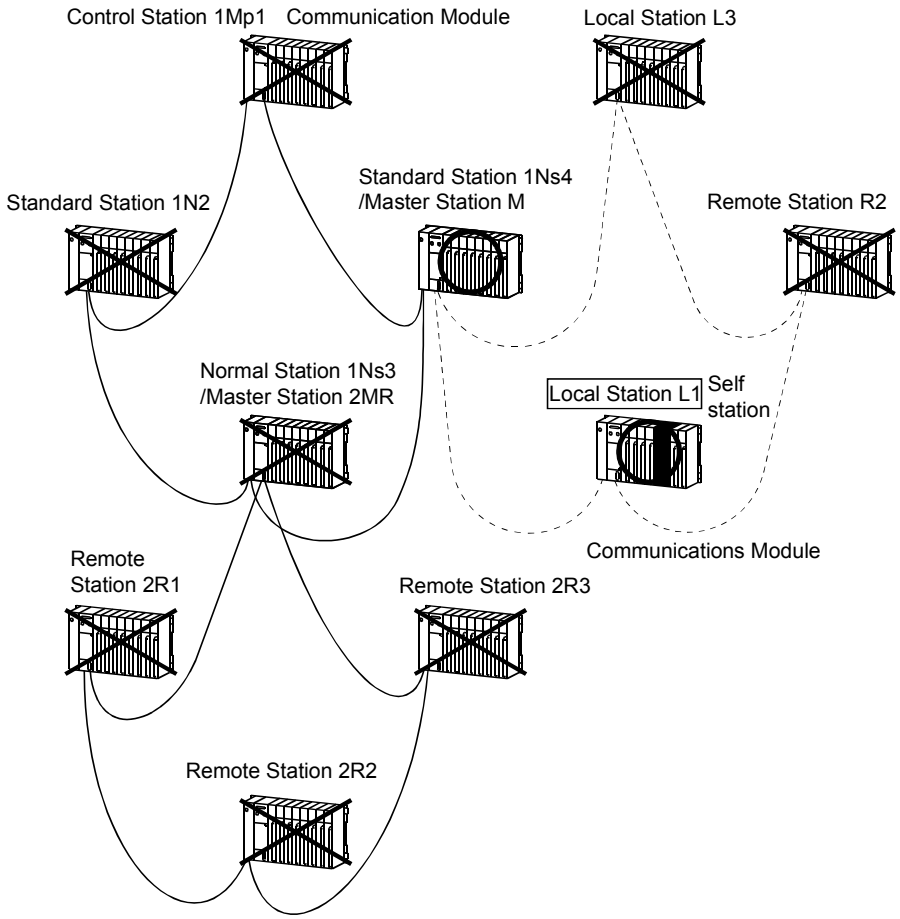


Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
1Mp1	×	1	1	1	1
1N2	×	1	2	1	2
1Ns3/2MR	0	2	125	2	125
1Ns4/M	×	1	4	1	4
2R1 (self station)	255	0	225	0	225
2R2	×	×		×	
2R3	×	×		×	
L1	×	×		×	
R2	×	×		×	
L3	×	×		×	

× : Not accessible

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4) When the CPU (self station) with the communication module attached is a MELSECNET (II) local station (L), data from the self station and MELSECNET (II) master stations (M) can be accessed.



Access destination	Network number and station number specified by the PCRD instruction/PCWT instruction				
	Format 1	Format 2		Format 3	
	Station number	Network number	Station number	Network number	Station number
1Mp1	×	×		×	
1N2	×	×		×	
1Ns3/2MR	×	×		×	
1Ns4/M	0	0	0	×	
2R1	×	×		×	
2R2	×	×		×	
2R3	×	×		×	
L1 (self station)	255	0	255	×	
R2	×	×		×	
L3	×	×		×	

× : Not accessible

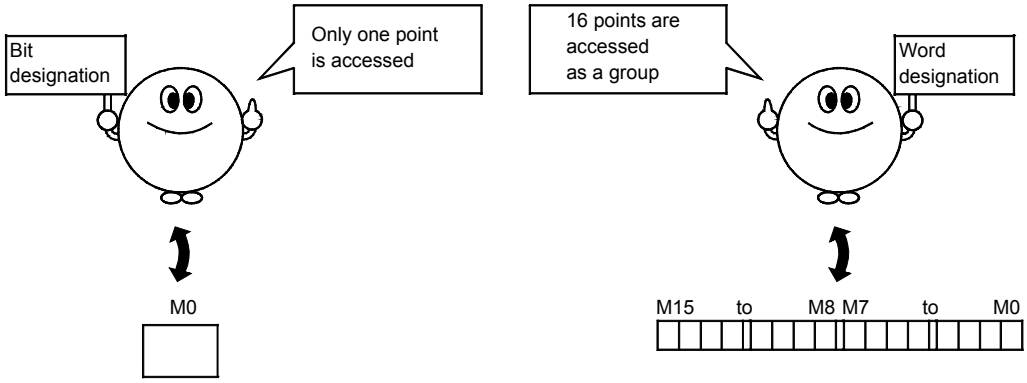
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4.2.3 Choosing a process

Process requests of PCRD and PCWT instructions are specified using values referred to as process codes. For details, see the descriptions of the PCRD and PCWT instructions.

4.2.4 Bit/Word designation

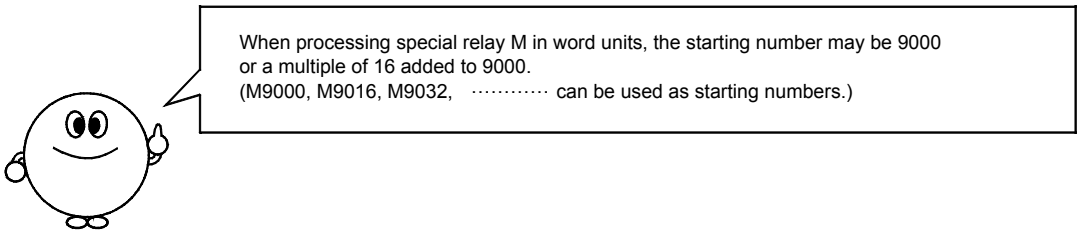
Bit/Word designation refers to the designation of processing in 1-bit units or 1-word (16-bit) units when the PLC accesses the bit device.



When word-unit process is specified, 16 bits of process points will be specified. Also, when word-unit is specified, the starting number of the respective device must be specified as 0 or a multiple of 16.

Example

For M, M0, M16, M32, • • • • are used as starting numbers.
For B, B0, B10, B20, • • • • are used as starting numbers.



When accessing word devices, use word unit processing.

REMARK

Access • • • I/O processing such as data read and write.

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4.2.5 Device number designation

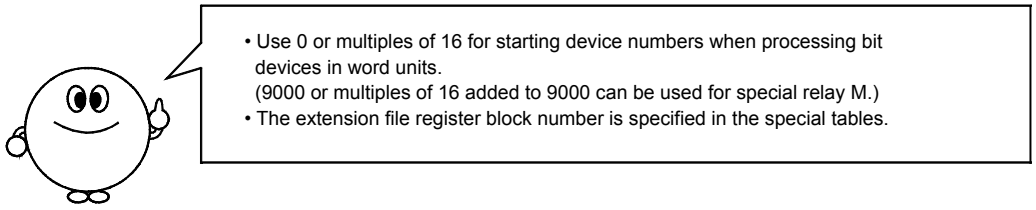
The PLC devices are specified using "device codes" and "device numbers."

(1) For A series

The device codes and usable device numbers are as follows.

Device Code	Device	Usable Device Number
1 (&H1)	X (Input)	0H to 7FF H (0 H to 1FFF H)
2 (&H2)	Y (Output)	0H to 7FF H (0 H to 1FFF H)
3 (&H3)	M (Internal relay)	0 to 2047 (0 to 8191)
	L (Latch relay)	0 to 2047 (0 to 8191)
	S (Step relay)	0 to 2047 (0 to 8191)
	M (Special relay)	9000 to 9255
4 (&H4)	B (Link relay)	0H to 7FF H (0 H to 1FFF H)
5 (&H5)	F (Annunciator)	0 to 255 (0 to 2047)
6 (&H6)	T (Timer [contact])	0 to 255 (0 to 2047)
7 (&H7)	T (Timer [coil])	0 to 255 (0 to 2047)
8 (&H8)	C (Counter [contact])	0 to 255 (0 to 1023)
9 (&H9)	C (Counter [coil])	0 to 255 (0 to 1023)
16 (&H10)	T (Timer [current value])	0 to 255 (0 to 2047)
17 (&H11)	C (Counter [current value])	0 to 255 (0 to 1023)
18 (&H12)	D (Data register)	0 to 1023 (0 to 8191)
	D (Special register)	9000 to 9255
19 (&H13)	W (Link register)	0H to 3FF H (0 H to 1FFF H)
20 (&H14)	R (File register)	0 to 8191

The numbers within parentheses for the usable device numbers are device numbers that can be handled by AnA/AnU/AnUSCPU.





(1) The range of device numbers and file register capacity depends on the CPU specification and parameter set values. For details, refer to the User's Manual for the CPU used.

(2) The special relays (M9000 through M9255) and special registers (D9000 through D9255) are separated into read only, write only, and system use. A PLC CPU error may occur when write is performed to an area outside of the write only area. For details on special relays and special registers, refer to the ACPU/QCPU-A (A Mode) Programming Manual (Common Commands Edition).

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(2) Q/QnA series

The device codes and usable device numbers are as follows.

Device Code	Device	Usable Device Number
156 (&H9C)	X (Input)	0 to 1FFF
157 (&H9D)	Y (Output)	0 to 1FFF
144 (&H90)	M (Internal relay)	0 to 8191
146 (&H92)	L (Latch relay)	0 to 8191
147 (&H93)	F (Annunciator)	0 to 2047
148 (&H94)	V (Edge relay)	0 to 2047
160 (&HA0)	B (Link relay)	0 to 1FFF
168 (&HA8)	D (Data register)	0 to 12287
180 (&HB4)	W (Link register)	0 to 1FFF
193 (&HC1)	TS (Timer [contact])	0 to 2047
192 (&HC0)	TC (Timer [coil])	0 to 2047
194 (&HC2)	TN (Timer [current value])	0 to 2047
199 (&HC7)	SS (Accumulated timer [contact])	0 to 2047
198 (&HC6)	SC (Accumulated timer [coil])	0 to 2047
200 (&HC8)	SN (Accumulated timer [current value]	0 to 2047
196 (&HC4)	CS (Counter [contact])	0 to 1023
195 (&HC3)	CC (Counter [coil])	0 to 1023
197 (&HC5)	CN (Counter [current value])	0 to 1023
161 (&HA1)	SB (Link special relay)	0 to 7FF
181 (&HB5)	SW (Link special register)	0 to 7FF
152 (&H98)	S (Step relay)	0 to 8191
162 (&HA2)	DX (Direct input)	0 to 1FFF
163 (&HA3)	DY (Direct output)	0 to 1FFF
204 (&HCC)	Z (Index register)	0 to 15
175 (&HAF)	R (File register [for normal access])	0 to 32767
45232 (&HB0B0)	ZR (File register [for continuous access])	0 to FE7FF



(1) Accesses the device memory within the A/QnACPU.

(2) For Q/QnACPU, the internal relays (M), latch relays (L), step relays (S) of the internal user are all separate devices.

(3) The usable device numbers in the chart are all usable ranges during default assignment. If the device ranges are changed using parameter settings, the device range can be accessed after the change is made.

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4.2.6 Storage area for reading and writing data

The method in which data is read and written from the PLC device must be specified. Integer type variables, array/character type variables, and arrays can be used as data storage areas. If arrays are to be used, the arrays must be defined with the DIM instruction.

(1) When using integer type variables and integer type arrays as a data storage area

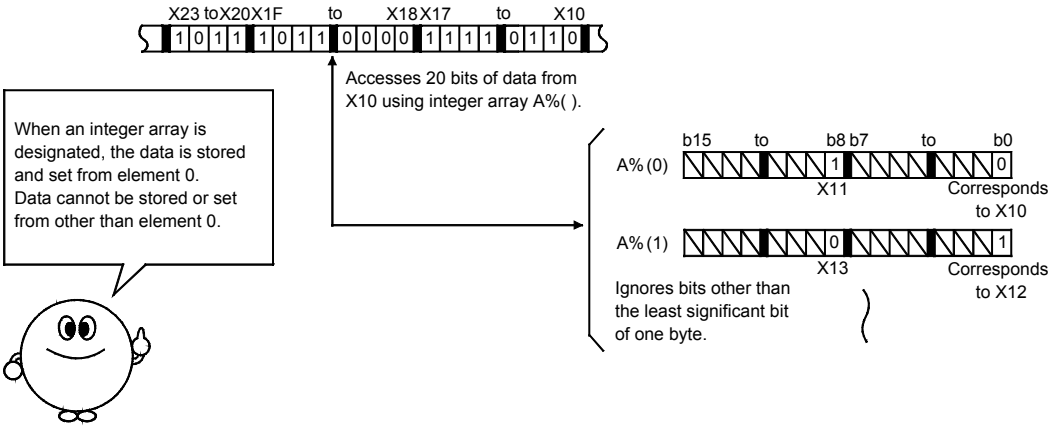
(a) Bit devices

Bit devices are handled in bit units or word units. The following describes each of them.

- Bit units

  When bit units are designated, one point of ON/OFF data of the device number for each variable will be stored and set in the least significant bit of the variable for the specified number of points.

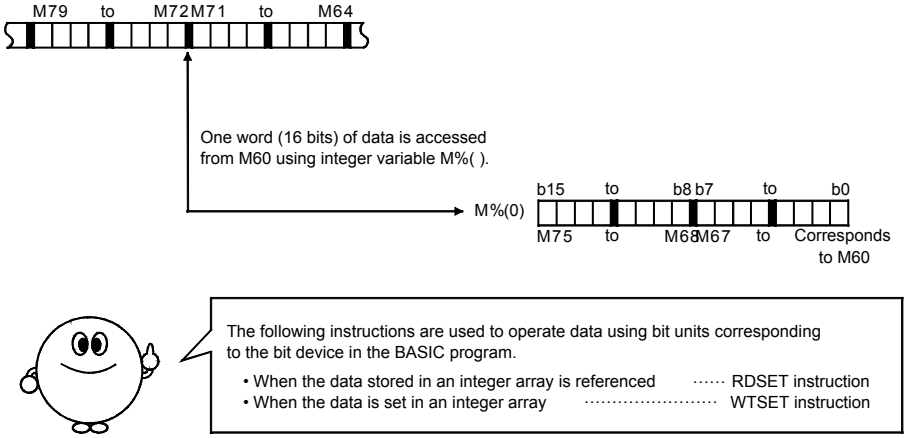
  The status of the least significant bit is “0” when the corresponding device is OFF and “1” when it is ON.



- Word Units

  When bit devices are designated using word units, the 16 points of ON/OFF data for each variable will be paired with each bit and stored and set from the lower bit in the variable.

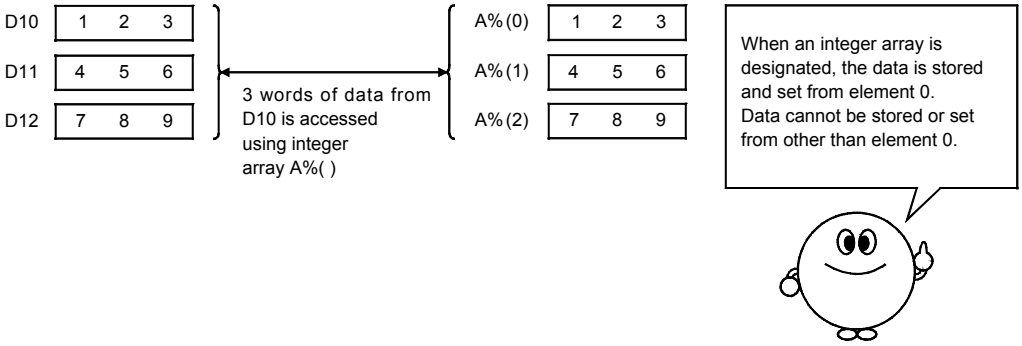
  The status of the each bit is “0” when the corresponding device is OFF and “1” when it is ON.



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(b) Word Devices

When a word device is designated in word units, one point of device number data is stored per variable.



(2) When character variables and character array variables are used as data storage area

(a) Bit Device

Bit units are handled in the same manner as (1), and they are handled in bit units and word units.

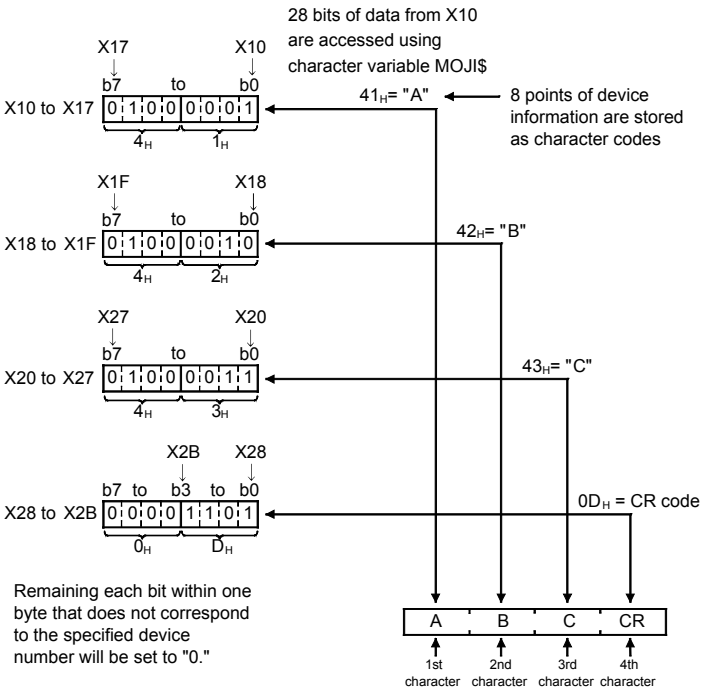
- Bit units

  The data read during bit unit designation considers eight points of ON/OFF data for the device number as a single JIS8 code. The data for the number of devices designated is stored using characters compatible with the JIS8 code.

  Therefore, the amount of data required for storing and setting the amount of data designated in the number of process points to the elements are as follows.

  The number of character data = Number of Process Points/8 (Decimals are rounded up)

  The status of the each bit is “0” when the corresponding device is OFF and “1” when it is ON.

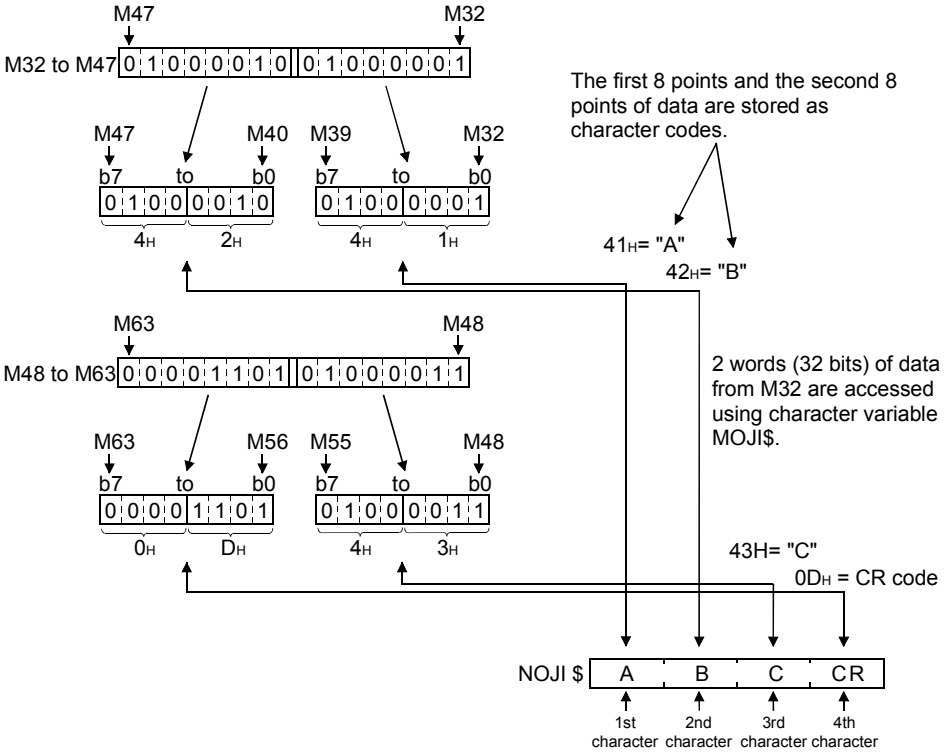


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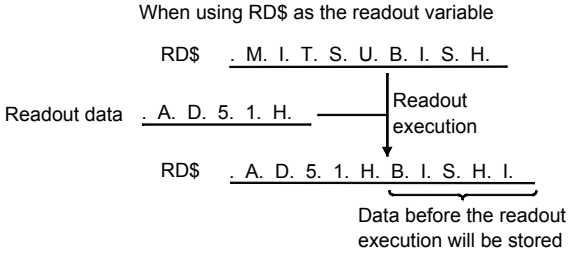
- Word Units

  Continuous device numbers are read in blocks of 16 points when the bit device is designated in word units.
  The 16 points of data that has been read are separated into 8 points in the first half and 8 points in the second half. Then the 8 points of ON/OFF data for the device numbers are treated as a single JIS8 code and it is stored using the corresponding characters.
  Therefore, the amount of data required for storing and setting the amount of data designated in the number of process points to the elements are as follows.

  Number of character data = Process points x 2 bytes
  The status of the each bit is “0” when the corresponding device is OFF and “1” when it is ON.



When reading data with the PCRD instruction, the following illustrates if a character data greater than the character variable specified as readout variables or number of bytes to be read in the character array variables (one byte = one character) is stored.



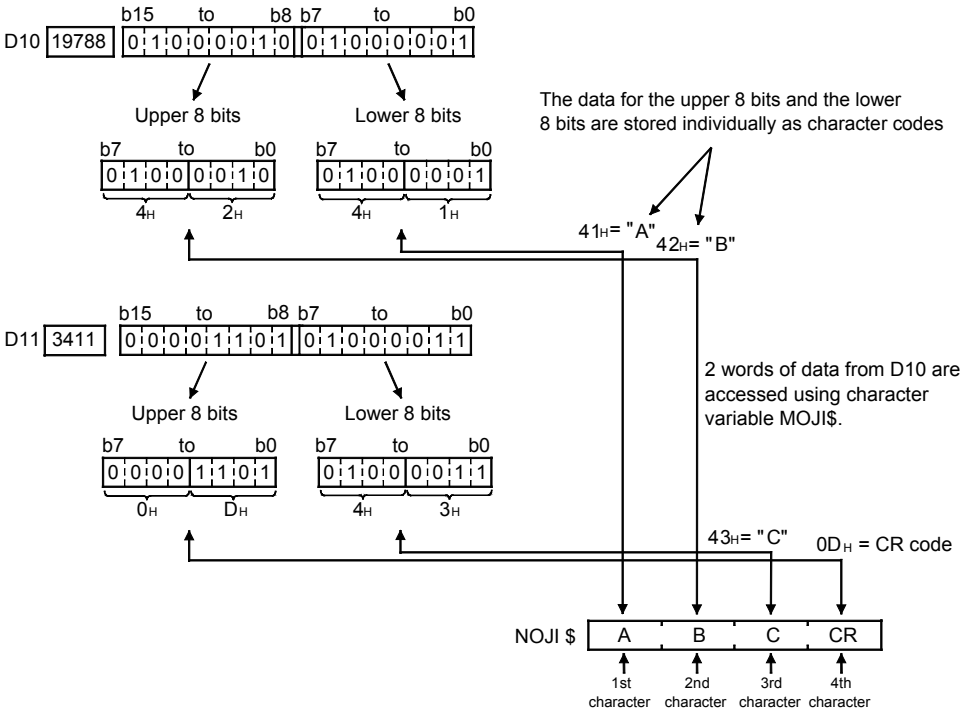
4 - 21

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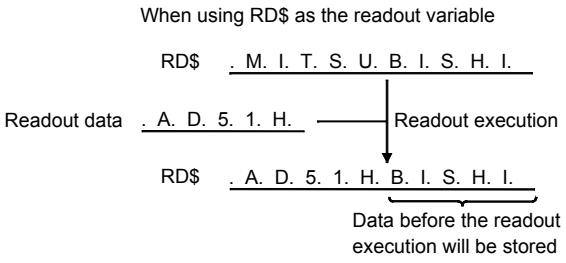
(b) Word Devices

The data that has been read from the designated word device in word units is separated into 8 points in the first half and 8 points in the second half. Then the 8 points of ON/OFF data for the device numbers are treated as a single JIS8 code and it is stored using the corresponding characters. Therefore, the amount of data required for storing and setting the amount of data designated in the number of process points to the elements are as follows.

Number of character data = Process points x 2 bytes



When reading data with the PCRD instruction, the following illustrates if a character data greater than the character variable specified as readout variables or number of bytes to be read in the character array variables (one byte = one character) is stored.



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(3) When using an internal device as a data storage area (when using ED and EM)

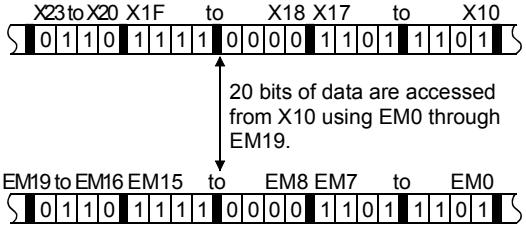
(a) Bit device

Bit devices are handled in bit units or word units. The following describes each of them.

• Bit units

When bit unit designation is used, the internal bit device EM is used and the specified device and EM are matched one-to-one correspondence. Only the designated points are stored and set.

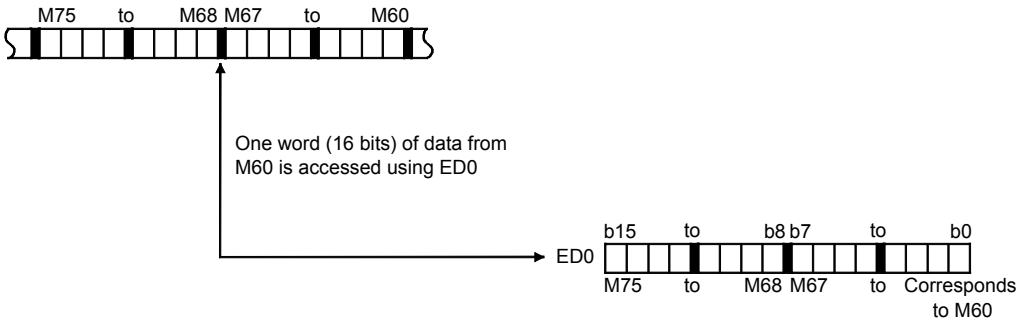
The status of each bit is “0” when the corresponding device is OFF and “1” when it is ON.



• Word Units

When bit devices are designated using word units, the 16 points of ON/OFF data for each ED will be paired with each bit using word device ED, then stored and set from the lowest bit of ED.

The status of the each bit is “0” when the corresponding device is OFF and “1” when it is ON.

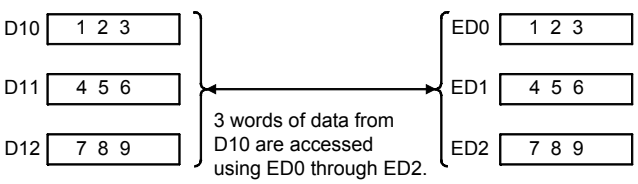


REMARK

Access • • • I/O processing such as data read and write.

(b) Word devices

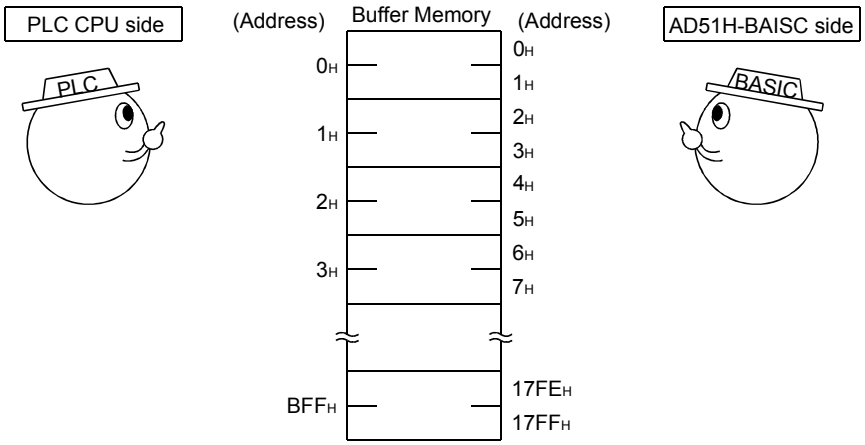
When word devices are designated in word units, the internal word device ED is used to store and set one point of word device data for one ED.



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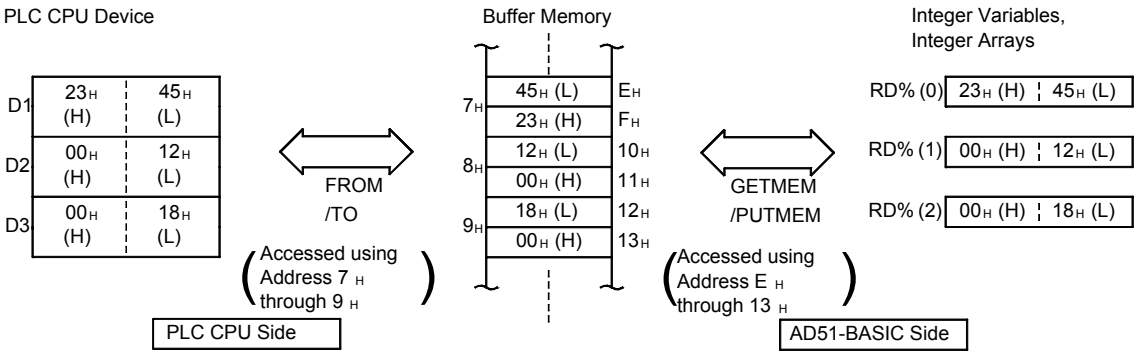
4.3 Communication with the Buffer Memory

There are 6 Kbytes of buffer memory in the communications module that can be read and written by the FROM and TO instructions from the PLC. Vast amounts of data can be communicated with the PLC CPU using this area. The PUTMEM and GETMEM instructions are used to access the buffer memory from BASIC.
The buffer memory addresses differ from when designation is performed from the PLC CPU and from the AD51H-BASIC. The differences are shown below.



The addresses from the PLC CPU side are in lead units, but the BASIC side addresses are in byte unites. Therefore, BASIC uses 2 addresses when 1-word data are being handled and 4 addresses when 2-word data are being handled. Note the following when specifying addresses in BASIC.
Actual data flow shows as follows.

- For numeric value data

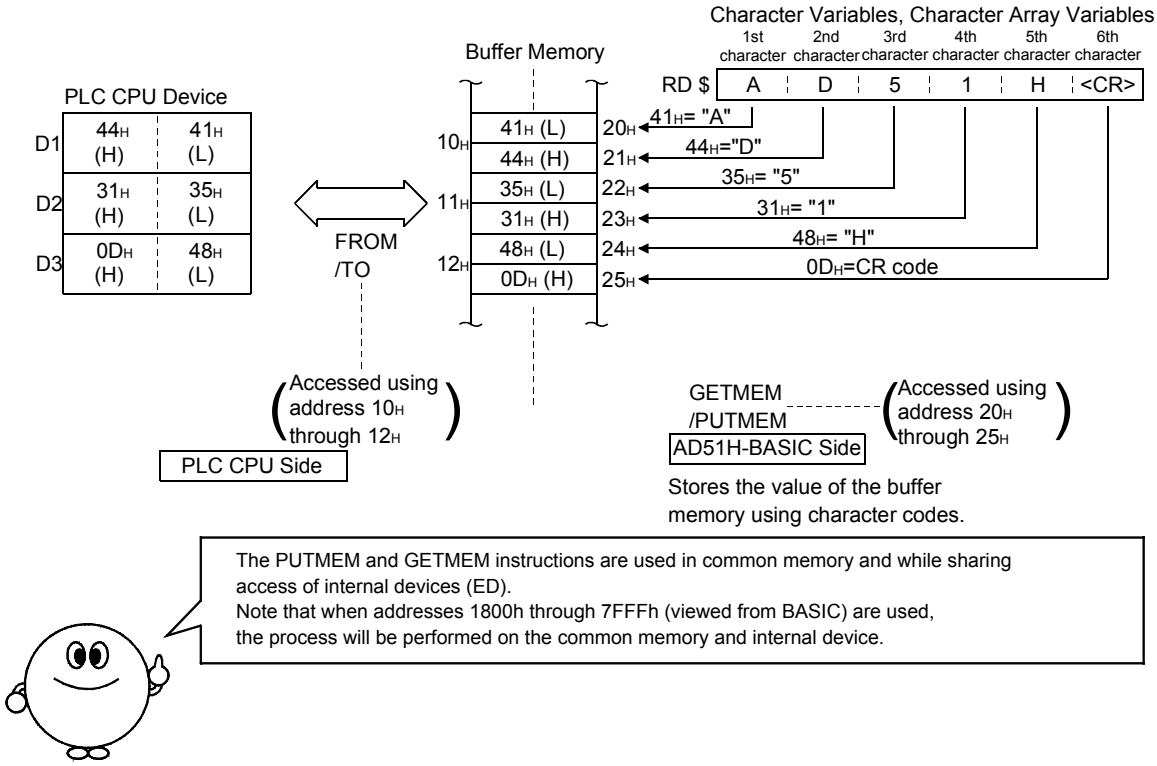


REMARK

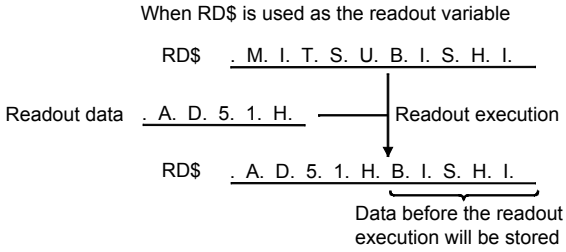
For details on FROM/TO instructions, refer to the ACPU/QCPU-A (A Mode) Programming Manual (Common Commands Edition).

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• For character data



• When reading data with the GETMEM instruction, the following illustrates if a character data greater than the character variable specified as readout variables or number of bytes to be read in the character array variables (one byte = one character) is stored.



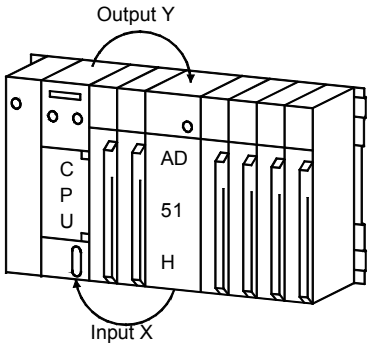
REMARK

Access • • • A collective term for I/O processing such as reading and writing data.

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5 COMMUNICATION USING GENERAL-PURPOSE INPUT/OUTPUT

The communication module can communicate with PLC CPU using I/O devices (Input X, Output Y).



note

(1) The number of I/O devices and their numbers will vary depending on communications module used. Refer to the User's Manual for the communications module used.

(2) The AD51H-S3 is used in this chapter.

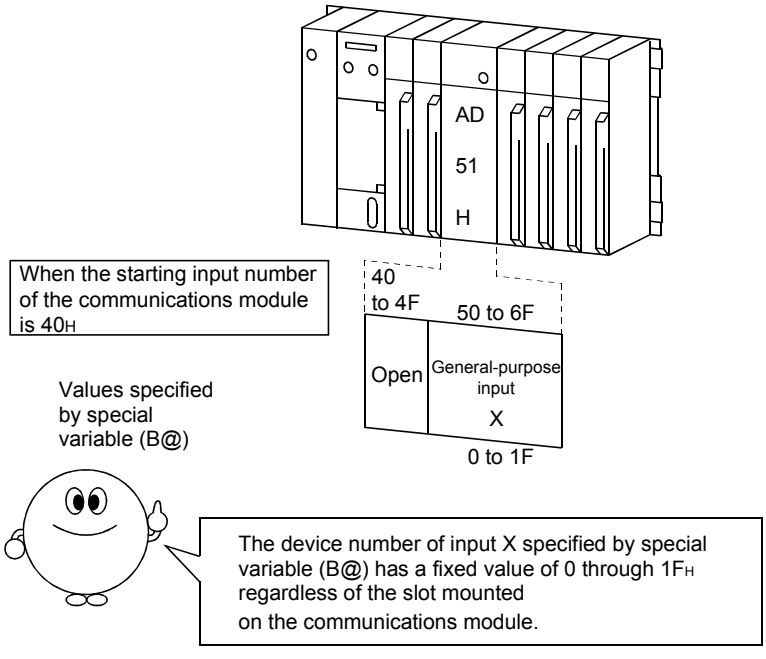
5.1 Communications Module → PLC CPU (About Input Device X)

Turns ON/OFF the input X in the sequence program by Special variable (B@).

When the input device X is turned ON/OFF using special variable (B@), the next corresponding input device X is turned ON/OFF in the sequence program.

Example

For AD51H-S3



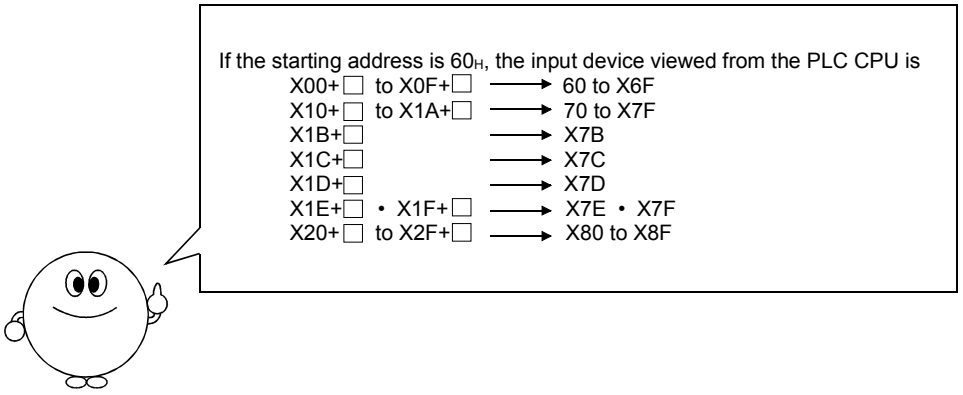
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The following describes the input device X viewed from the PLC CPU when the starting address is □.

	Input Device X of Sequence Program	Signal Name	Values specified by Special Variable B@
	X00 + □ to X0F + □	Not used	—
	X10 + □ to X1A + □	Can be used as a general-purpose input	&H00 to &H0A
*	X1B + □	Multitask Execution Start	&H0B
*	X1C + □	Multitask Execution Stop	&H0C
*	X1D + □	Communications Module System Down	&H0D
	X1E + □ to X1F + □	Cannot be used, since it is used by the system	—
	X20 + □ to X2F + □	Can be used as a general-purpose input	&H10 to &H1F

* X1B+□, X1C+□, and X1D+□ should not be turned ON or OFF by the user since the system turns them ON or OFF.

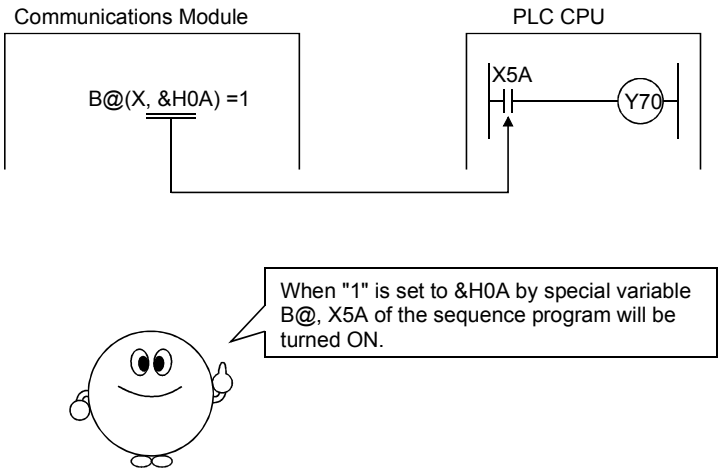
X1E+□ and X1F+□ cannot be used by the user since it is used by the system. If it used (ON/OFF) by the sequence program, its functions may not be guaranteed as a communications module.



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• X10+□ through X1A+□, X20+□ through X2F+□ • • • General-purpose input
Controls input X of the sequence program by special variable B@.

Example for starting address 40H

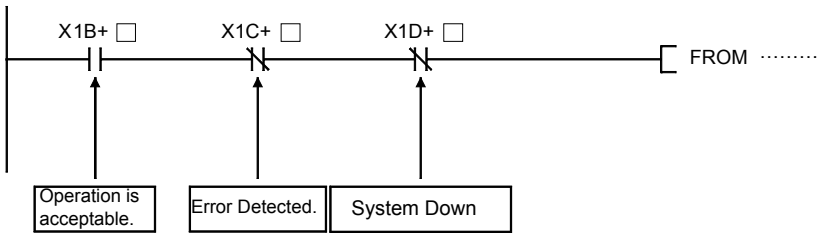


• X1B+□ • • • Multitask Execution Start
Turns on when the initialization settings are complete and the BASIC multitask operations are enabled. Multitask Execution Start (X1B+□) will be turned OFF when Multitask Execution Stop (X1C+□) or Communications Module System Down (X1D+□) are turned ON.

X1C+□ • • • Multitask Execution Stop
Turns ON when an error is generated or when the error handling not performed and processing does not recover from an error.

X1D+□ • • • Communications Module System Down
Turns ON when an error such as shutdown of the communications module system occurs.

Using the above three inputs, interlocks are placed so that the FROM and TO instructions or the output device operations shown in Section 5.2 are stopped when the communications module is not operating normally.



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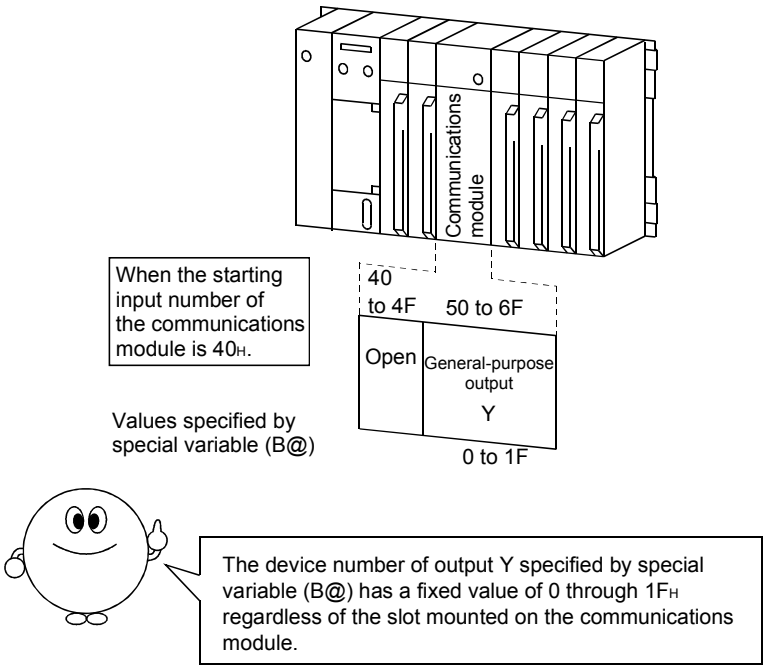
5.2 PLC CPU → Communications Module (About Output Device Y)

Controls the value of Special Variable (B@) using the output Y in the sequence program.

When the output device Y is turned ON/OFF using the sequence program, the next corresponding output device is turned ON/OFF in the communication module.

Example

For AD51H-S3

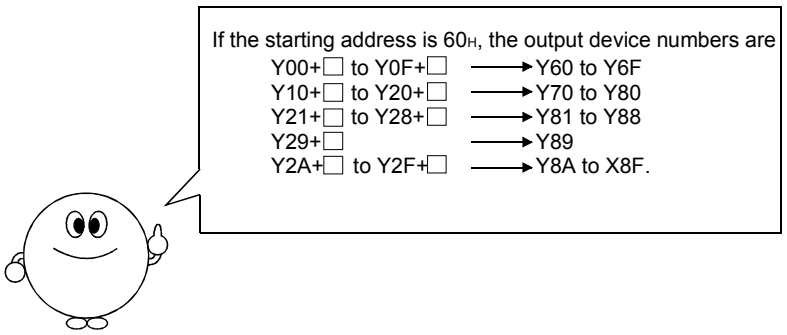


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The following describes the output device Y viewed from the PLC CPU when the starting address is □.

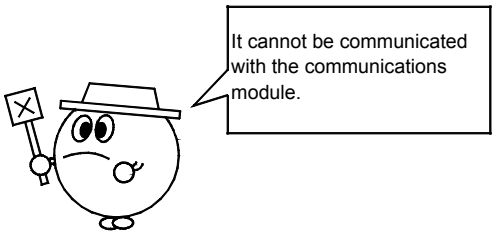
Output Device Y in the Sequence Program	Signal Name	Value designated by Special Variable B@
Y00 + □ to Y0F + □	Not used (However, it can be used as a substitute for internal relay (M) in the sequence program)	――
Y10 + □ to Y20 + □	Can be used as a general-purpose output	&H00 to &H10
Y21 + □ to Y28 + □	Startup Program Designation (BASIC Task No. 1 through BASIC Task No. 8)	&H11 to &H18
Y29 + □	Program Startup	&H19
Y2A + □ to Y2F + □	Cannot be used since it is used by the system.	&H1A to &H1F

Y2A+□ through Y2F+□ cannot be used by the user since it is used by the system. If it used (ON/OFF) by the sequence program, its functions may not be guaranteed as an AD51H unit.



• Y00+□ through Y0F+□ • • • Not used.
(However, it can be used as a substitute for internal relay <M>)

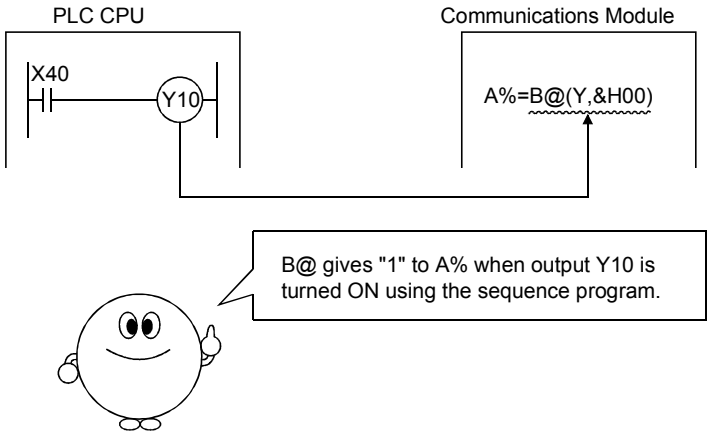
It can be used as a substitute for internal relay (M) in the sequence program.



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• Y10+□ through Y20+□ • • • General-Purpose Output

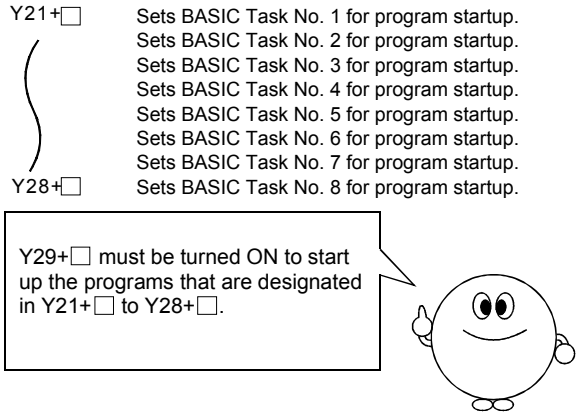
Controls the value of Special Variable (B@) using output Y in the sequence program.
Example when the starting address is 00H



• Y21+□ through Y28+□ • • • Startup Program Designation
(BASIC Task No. 1 through BASIC Task No. 8)

Sets the programs that correspond to output Y that has been turned ON between Y21+□ through Y28+□ for startup.

The programs that correspond to output Y are as follows.

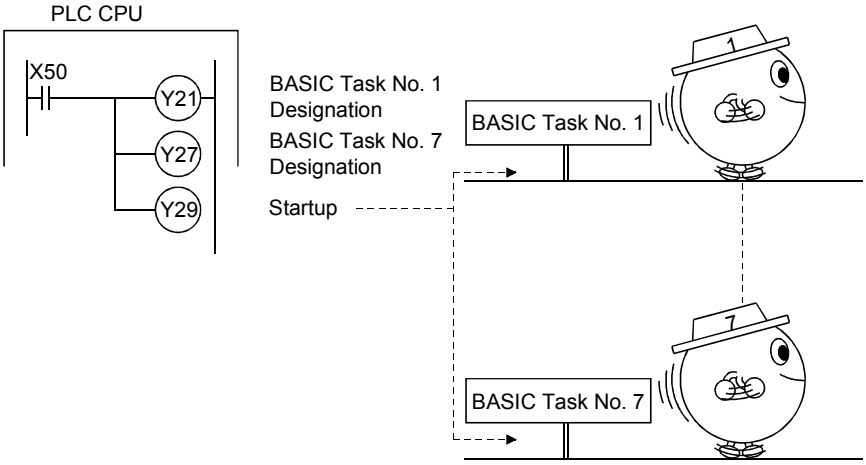


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• Y29+□ • • • Program Startup (cannot be used as a general-purpose output)

Starts up the program that has been designated as startup programs by output Y in Y21+□ through Y28+□.

Example : Starts up the programs BASIC Task No. 1 and BASIC Task No. 7.



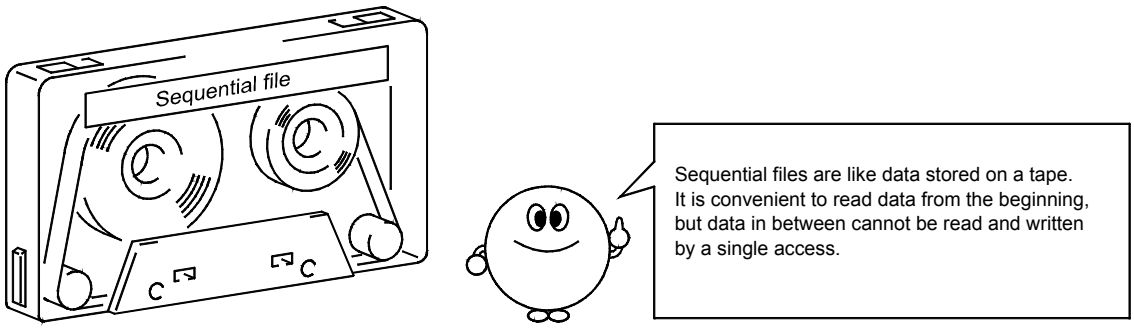
5 - 7

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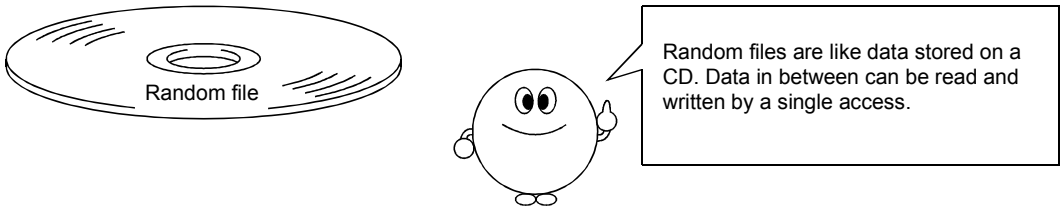
6 I/O PROCESSING OF DATA FILES

The following two types of data files can be creating by BASIC. These files have the following characteristics.

• Sequential Files
Data are written in a file continuously. This allows data to be saved on memory cards and FD without wasting space, but portions that are only required cannot be read and written.



• Random Files
Data is written on separate blocks. This allows a required portion of the data to be read and written. However, wasted space will be created if data that is smaller than a block is saved.



REMARK

Data in sequential files and random files can be used with one another, but note the following.

- When data from a sequential file is used as a random file, be sure that the data from the sequential file is correctly corresponding to the field of the random file.
- When data from a random file is used as a sequential file, carefully evaluate the handling of characters in the random file data that are used as separator symbols for sequential files.
  For details on separator symbols for sequential files, see Section 6.2.

6 - 1

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6.1 File Numbers

BASIC can use up to 8 strings of data files per program simultaneously.
In BASIC data file I/O instructions, file numbers are used to specify which of these 8 data files will be input and output.

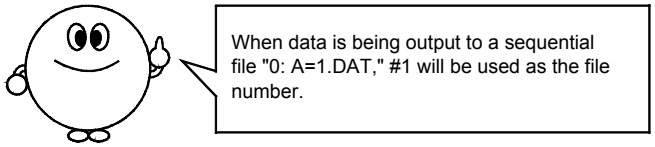
(1) The correspondence between data files and file numbers

Data files and file numbers of which I/O is performed are assigned correspondence by the file numbers that are designated when the data files are opened with the OPEN instruction.

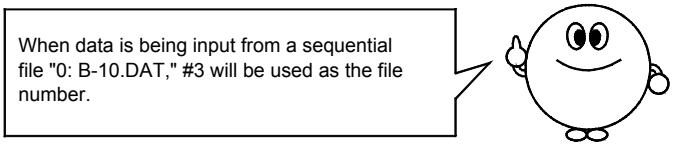
Example

For sequential files

1) OPEN " 0:A-1. DAT" FOR OUTPUT AS # 1

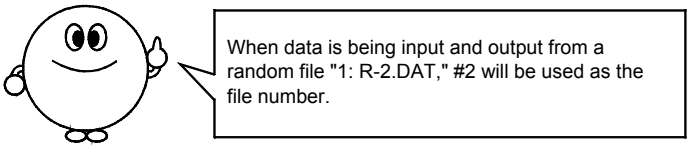


2) OPEN " 0:B-10. DAT" FOR INPUT AS # 3



For random files

3) OPEN " 1:R-2. DAT" AS # 2



(2) File numbers in I/O instructions

In I/O instructions to be used with data files, the data files to which the I/O is being performed is directly not specified. File numbers are used instead.
I/O will be performed on data files that are corresponded using the OPEN instruction by designating a file number.

Example

Assuming that 1), 2), and 3) of (1) are already running:

1)' PRINT # 1. "MITSUBISHI"
→ "MITSUBISHI" is output to sequential file "0:A-1.DAT"

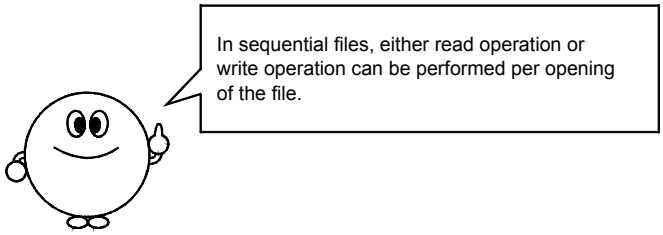
2)' INPUT # 3. A$
→ Data is input to variable A$ from the sequential file "0:B-10.DAT."

3)' FIELD # 2. R$ AS 100
→ The file buffer of random file "1:R-2.DAT" is defined.

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6.2 Sequential File I/O Procedures

The following shows an overview of I/O procedures for sequential files.

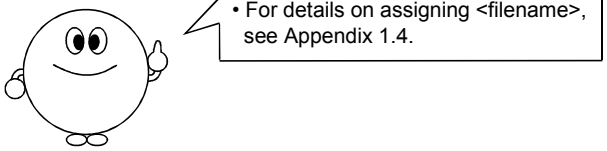


(1) Writing data to a file

1) Open a file in output mode.

OPEN "<filename>" FOR OUTPUT AS #n

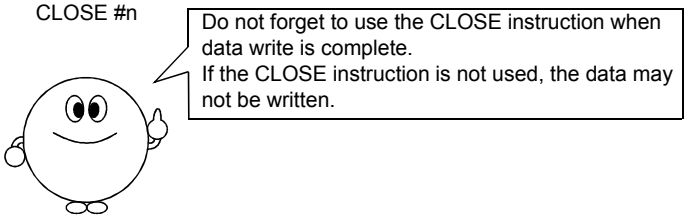
2) Write the data in the file



PRINT #n, <write data>, ·····
PRINT #n, USING " ·····", <write data>, ·····

3) Close the file

CLOSE #n



When appending (writing) data to a sequential file that already contains data, and if "OPEN "<filename>" FOR APPEND AS #n" is used to open the file, a new data is written following the existing data. If "OPEN "<filename>" FOR OUTPUT AS #n" is used to open the file, all existing data is deleted and the data will be written from the beginning.

(2) Reading data from a file

1) Open the file in Input mode.

OPEN " <filename> " FOR INPUT AS #n

2) Read the data from the file.

INPUT #n, <variable to store the data read>, ·····
LINE INPUT #n, <variable to store the data read>, ·····

3) Close the file.

CLOSE # n

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The following shows the data when performing read or write operation into the sequential file.

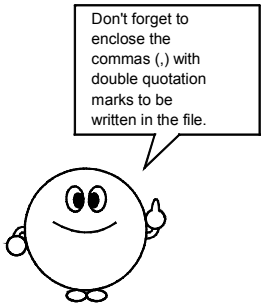
When handling character data

Example

A$ = "ABC"
B$ = "123"
C$= "abc"

• PRINT #n, A$; B$; C$ → ABC,1,2,3,a ,b ,c ,[CR],[LF]

Contents of data file



In this case, ABC, 123, and abc have no separators, to the contents of the data file will consider these to be one data.
In order to handle these as three separate data, commas (,) must be used as separators.

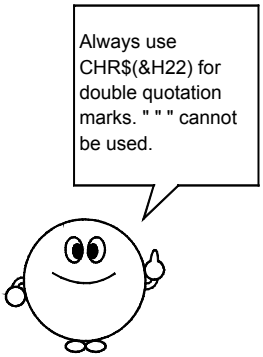
• PRINT #n, A$; " , " ; B$; " , " ; C$ → ABC , ,1,2,3, , ,a ,b ,c ,[CR],[LF]

Contents of data file

BASIC treats the commas as separators, so these are treated as three separate data.

Example

D$ = "Mitsubishi"
E$ = "Electric,Co."



• PRINT #n, D$; E$ → M,i ,t ,s ,u ,b ,i ,s ,h ,i ,E ,l ,e ,c ,t ,r ,i ,c , ,C ,o , .,[CR],[LF]

In this case, the comma (,) in D$ will be treated as a separator, so the readout will be treated as two separate data as shown below.
" Mitsubishi "
" Electric,Co."
To separate the data as the same as the original data, double quotation marks (") will be used as follows. Always use the CHR$ function when using double quotation marks (").

• PRINT #n, D$; " , " ; CHR$(&H22) ; E$; CHR$(&H22)

↓

M ,i ,t ,s ,u ,b ,i ,s ,h ,i ," E ,l ,e ,c ,t ,r ,i ,c , ,C ,o , . ," ,[CR],[LF]

BASIC will treat data surrounded in double quotation marks to be one data.
Therefore, it will be using the same separating method as D$ and E$.

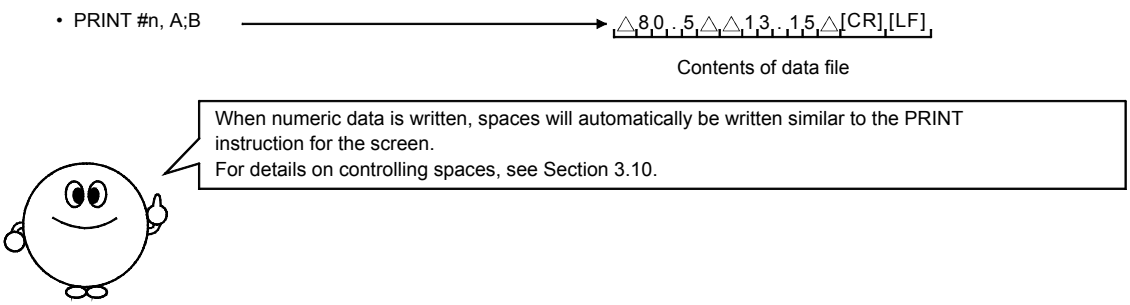
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When handling numeric data

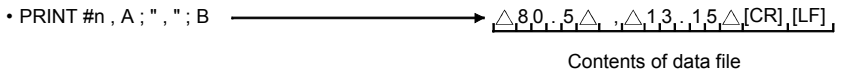
When writing numeric data into a sequential file, the numeric value is written after automatically converting into the character data. Also, when reading data from a sequential file as numeric data, the written character data will be automatically converted into the numeric values. Therefore, data from a sequential file that is comprised only with numbers can be treated as character data or numeric data.

Example

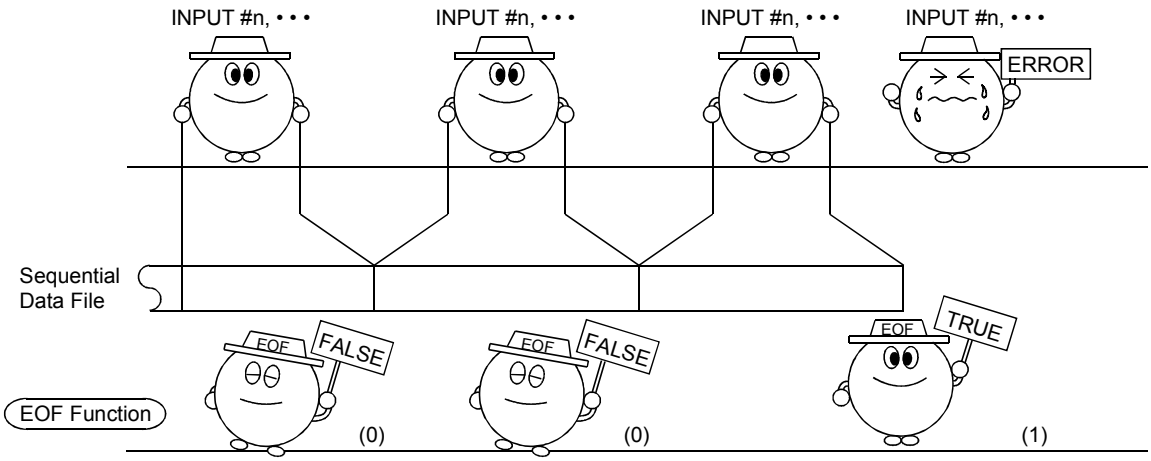
Assume
A = 80.5
B = 13.15



In this case, there is no separator between 80.5 and 13.15, so the contents of the data file will be treated as one data.
Also, spaces are ignored when using numeric data in BASIC, but since data such as 80.513.15 is not valid as a single number, and an error will be generated.
To treat these as two separate data, a comma is used as follows.



Because BASIC treats commas (,) as separators, the data will be treated as two separate data.
When reading data from a sequential file, the data will always be read in order starting from the beginning. When there is no more data to be read, an "INPUT past end" error will be generated.
The EOF function is used to avoid this error. The EOF function will be "TRUE" when there is no more data to be read, and this function can be judged by the IF instruction.



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Example

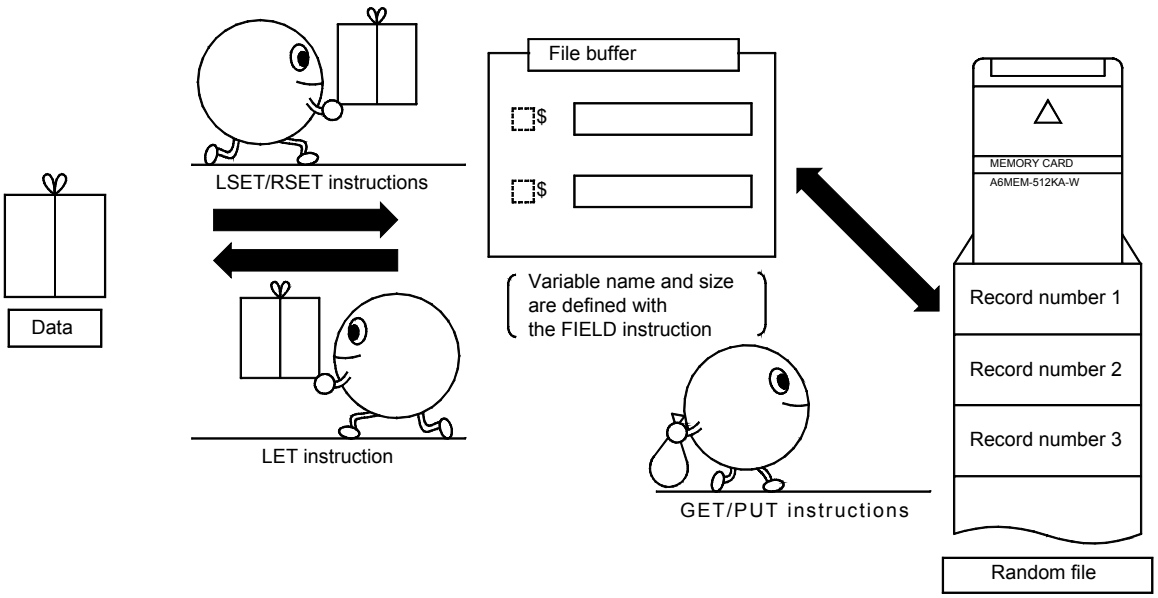
```
1 ' Register data to a sequential file
2 '
10 OPEN "0:TEST.DAT" FOR OUTPUT AS #1          : 'Generates TEST.DAT file and names it as file
                                                   number 1
20 INPUT "Date:";D$
30 LINE INPUT "Item Name:";H$
40 INPUT "Quantity:";K
50 INPUT "Rate (%):";W
60 PRINT #1,D$;",";                            :  'Data entered in line 20 is written into the file
70 PRINT #1,CHR$(&H22);H$;CHR$(&H22);",";      :  'Data entered in line 30 is written into the file
80 PRINT #1,K;",";                             :  'Data entered in line 40 is written into the file
90 PRINT #1 USING "###.#";W                    :  'Data entered in line 50 is written into the file
100 INPUT "Continue? (Y/N)";Y$
110 IF Y$="Y" OR Y$="y" GOTO 20                :  'Repeats data input
120 CLOSE #1                                   :  'Closes the file
130 END
```

```
1 ' Read data from the sequential file written above
2 '
10 OPEN "0:TEST.DAT" FOR INPUT AS #1           :  'Opens the TEST.DAT file using input mode
                                                   and names it as file number 1
20 IF EOF(1) GOTO 100                          :  'Ends program when the end of file is
                                                   detected
30 INPUT #1, D$                                :  'Reads date written in the file
40 INPUT #1, H$                                :  'Reads item name written in the file
50 INPUT #1, K                                 :  'Reads quantity written in the file
60 INPUT #1, W                                 :  'Reads rate written in the file
70 PRINT D$,H$,K:"quantity",W:"%"              :  'Displays data that has been read
80 PRINT
90 GOTO 20
100 CLOSE #1                                   :  'Closes the file
110 END
```


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6.3 Random File I/O Procedures

Random files can be used to perform input and output once they are opened. The following explains how to input and output the random file data:



- A random file manages data by separating each record. Numbers are assigned to each of the records. When data is read or written, the record number is designated and the data input/output are performed with the file buffer. The numbers placed on the blocks are referred to as "Record numbers."

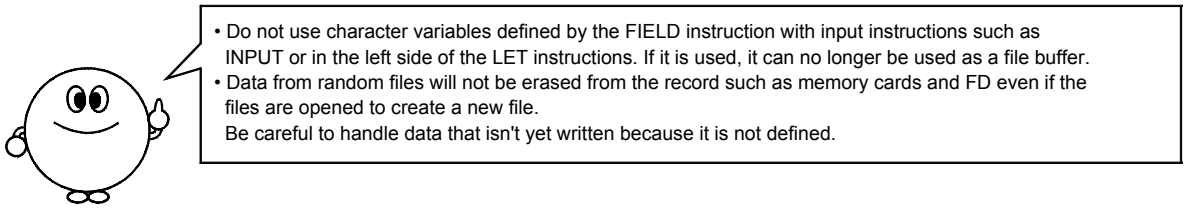
- "File buffer" acts as a window when performing I/O with random files. The character variables defined by the FIELD instruction are used during I/O for the "file buffer." Therefore, data written into the file buffer must all be character data.
  For example, when numeric data is being written, the STR$ function is used to convert them into character data or they are converted using the following functions below. Then, they are placed in the file buffer by the LSET or RSET instruction and written into the file by the PUT instruction.

Integer Data → MKI$(I)	(Becomes 2 bytes of character data)
Single-precision Data → MKS$(R)	(Becomes 4 bytes of character data)
Double-precision Data → MKD$(D)	(Becomes 8 bytes of character data)

- When writing data into a random file, the data that is to be written is stored in the "file buffer" using the LSET and RSET instructions. Then, it is written in an arbitrary record <record number> by the PUT instruction.

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• When reading data from a random file, the data block from a desired <record number> is placed in the "file buffer" by the GET instruction. The data stored in the "file buffer" is read into general variables using instructions such as the LET instruction.

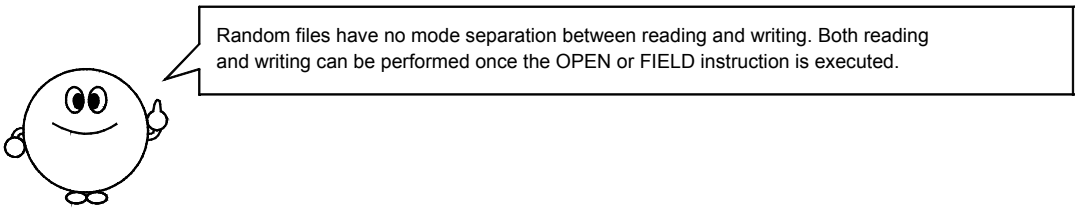


• Once numeric data are converted to character data and written into a file, use functions such as VAL function to read the data and convert them into numeric data. However, character data converted using MKI$, MKS$, or MKD$ function must be converted into numeric data using the CVI, CVS, or CVD functions.
Character data is placed directly into the file buffer using the LSET or RSET instruction, and then written into a file using the PUT instruction.

• The following useful functions can be used when using random files.

• LOC (File number)	• • • • • • • • •	Provides the record number that has been accessed (read or written) by GET or PUT instruction immediately before the specified random file is used.
• LOF (File number)	• • • • • • • • •	Provides the last record number for the specified random file.

See an Example for practical use.



REMARK

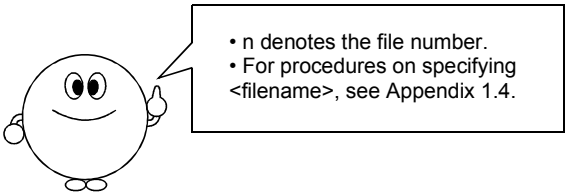
• A maximum of 32767 records can be used for one random file.
• If data is written to a record that already contains data, the previous contents will be overwritten by the new data.

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The following is an overview of I/O procedures for random files

1) Open the file.

OPEN "<filename>" AS #n

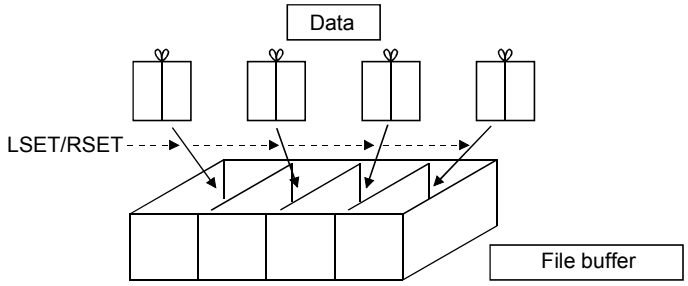


2) Define a file buffer.

FIELD #n, 8 AS A$, 32 AS B$

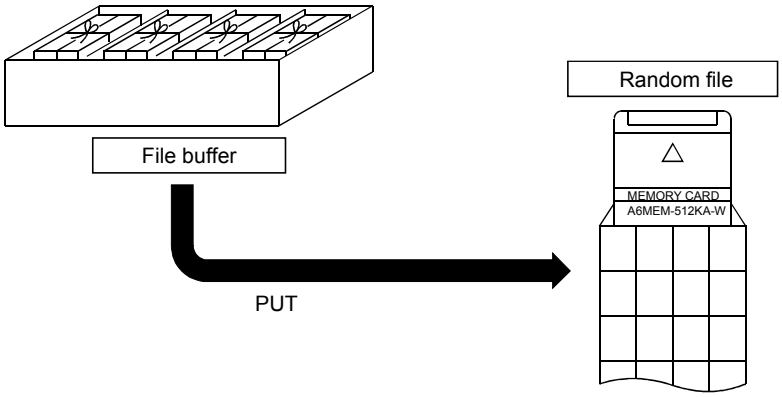
3)' Place the data in the file buffer if data is to be written.

LSET A$=MKD$ (D#) • • • • • • • • • Numeric data (D#) is converted to character
LSET B$=X$ data using MKI, MKS, or MKD function.



The data in the file buffer is written into a record by the PUT instruction

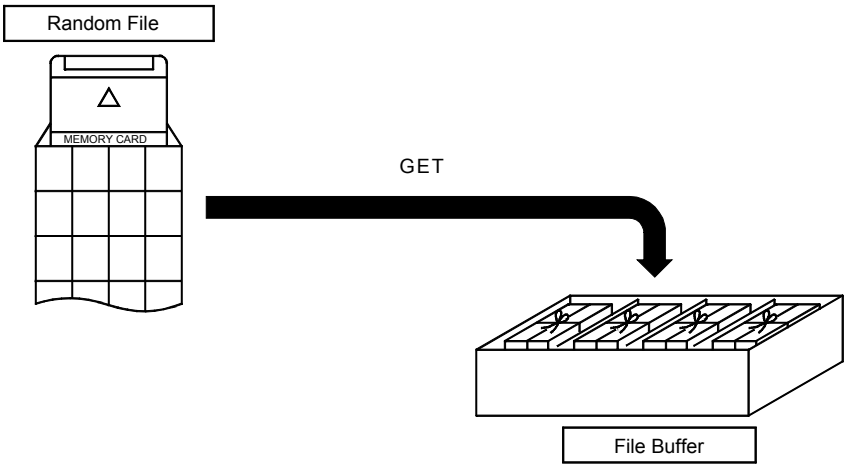
PUT #n, <record number>



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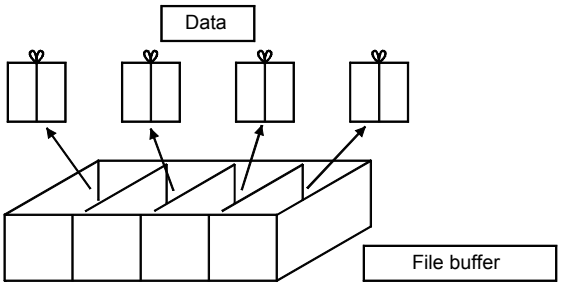
3)" Read the data into the file buffer using the GET instruction if data is to be read.

GET #n, <record number>



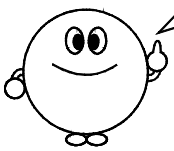
Read the data in the file buffer to variables.

D1#=CVD (A$) • • • • • • • • • The numeric data is converted back to numeric
X1$=B$ data using CVI, CVS, or CVD function.



4) Close the file.

CLOSE #n



• Always execute the CLOSE instruction after data input/output is complete.
• After the CLOSE instruction is executed,
input/output operation can no longer be performed in the file.
Furthermore, input/output operation cannot be performed in the file buffer.

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Example

```
1 ' Register data in a random file
2 '
10 OPEN "R-TEST.DAT" AS #1                    : 'Generates R-TEST.DAT file and names it as
                                                  file number 1
20 FIELD #1,8 AS D$,30 AS H$,2 AS K$,4 AS W$  : 'Assigns the file buffer
30 R = 0
40 R = R+1                                    : 'Specifies the record number
50 INPUT "Date:";D1$
60 LINE INPUT "Item Name:";H1$
70 INPUT "Quantity:";K1
80 INPUT "Rate(%):";W1
90 LSET D$=D1$                                : 'Writes data entered in line 50 into file buffer
100 LSET H$=H1$                               : 'Writes data entered in line 60 into file buffer
110 LSET K$=MKI$(K1)                          : 'Writes data entered in line 70 into file buffer
120 LSET W$=MKS$(W1)                          : 'Writes data entered in line 80 into file buffer
130 PUT #1,R
140 INPUT "Continue? (Y/N)";Y$
150 IF Y$="Y" OR Y$="y" GOTO 40               : 'Repeats data input
160 CLOSE #1                                  : 'Closes the file
170 END
```

```
1 ' Read data from the random file written above
2 '
10 OPEN "R-TEST.DAT" AS #1                    : 'Opens R-TEST.DAT file and names it as file
                                                  number 1
20 FIELD #1,8 AS D$, 30 AS H$, 2 AS K$, 4 AS W$ : 'Assigns the file buffer
30 FOR R=1 TO LOF(1)                          : 'Repeats at the last of random file (value
                                                  shown by the LOF function)
40 GET #1,R                                   : 'Reads data from the random file
50 D1$=D$:H1$=H$                              : 'Reads data from the file buffer
60 K=CVI(K$)
70 W=CVS(W$)
80 PRINT D$,H$;K;"quantity",W;"%"             : 'Displays the read data
90 PRINT
100 NEXT R
110 CLOSE #1                                  : 'Closes file

120 END
```


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6.4 Caution on Handling Data Files

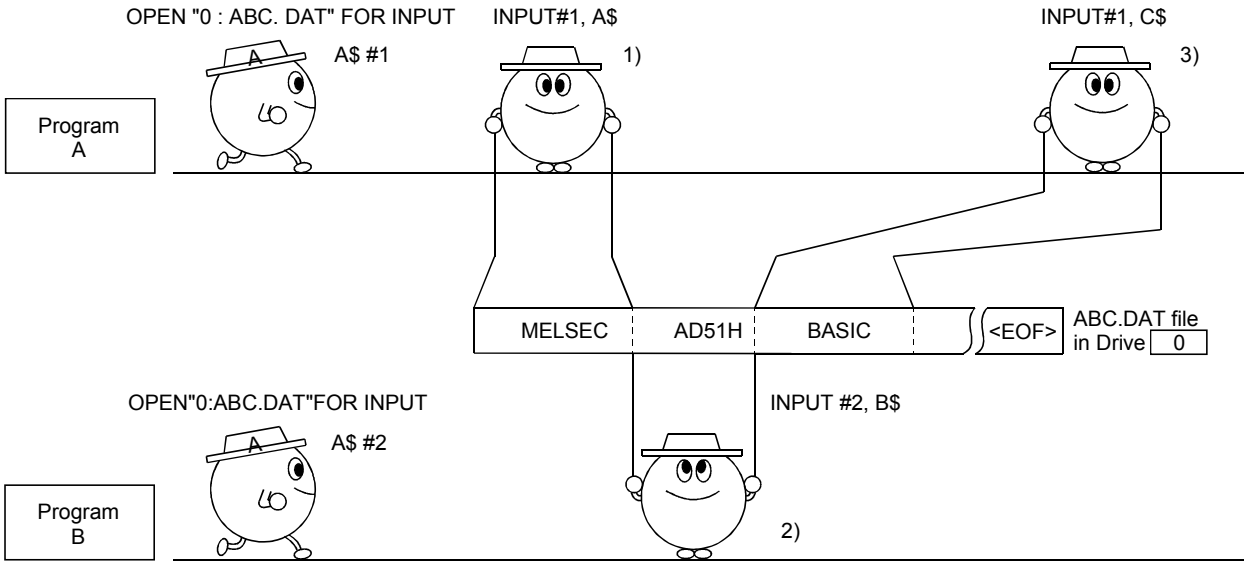
6.4.1 Handling data files during multitask processing

When data is input or output to the same data file simultaneously by multiple programs during multitask processing, it is processed as follows.

- Random files can be opened by multiple programs simultaneously.
  In such cases, the OS of the communication module will perform exclusive control for each data I/O instruction, so the user does not have to perform any exclusive control.
- Sequential files can be opened by multiple programs simultaneously only during input processing (INPUT mode) or during append processing (APPEND mode). In such cases, the OS of the communication module will perform exclusive control for each data I/O instruction, so the user does not have to perform any exclusive control.

  Example

  When two programs are concurrently running and sequential file ABC.DAT in drive 0 is to be read.

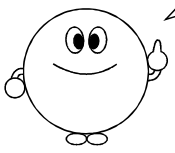


When data is read in order of 1), 2) and 3):

"MELSEC" is stored in A$ of Program A "AD51H" is stored in B$ of Program B

"BASIC" is stored in C$ of Program A

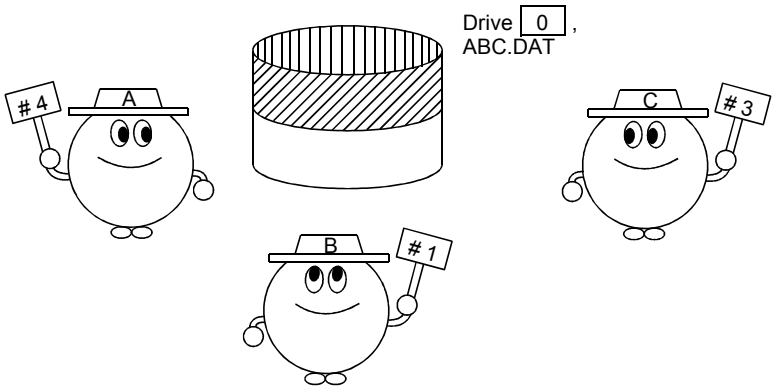
Perform exclusive control using the ZRESERVE/ZRELEASE functions when all the data is to be read by program A or program B. For details on exclusive control, see Section 8.3.



- Always perform exclusive control using ZRESERVE/ZRELEASE functions when output processing (OUTPUT mode) is to be used by one of the programs.
  If the exclusive control is not used, an error may be generated in the program that opened the file simultaneously. For details on exclusive control, see Section 8.3.

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• File numbers specified by the OPEN instruction are managed by each program. Therefore, no problem occurs even if the file number for the data file opened simultaneously has a different number for each program.



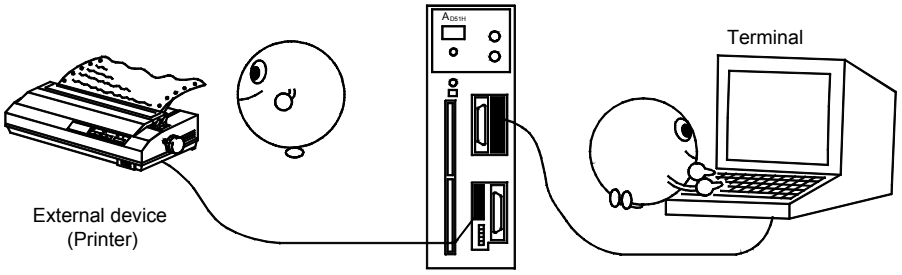
6.4.2 Number of data files that can be handled by each program

A maximum of eight data files can be opened simultaneously for each program. Also, each program can open 8 data files under multitasking conditions. Thus, a maximum of 64 data files can be opened simultaneously for the entire communication module.

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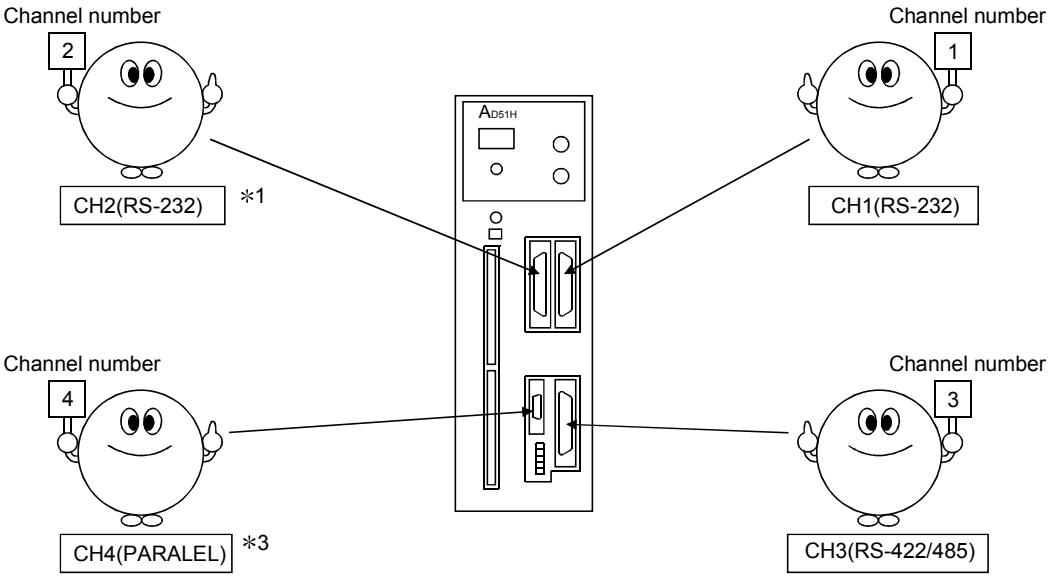
7 COMMUNICATION WITH EXTERNAL DEVICES

The communication module is equipped with several communication interfaces and the communication with external devices and terminals can thus be achieved through various interfaces.



7.1 Correspondence between the Interface and Channel Number

A unique number, called “channel number,” is assigned to each interface.
In order to communicate with an external device or terminal, specify which of the communication module interfaces is to be used using the channel number in question.



*1 QD51-R24 does not have CH2 (RS-232).
*2 QD51 does not have CH3 (RS-422/485).
*3 QD51(-R24), A1SD51S does not have CH4 (PARALLEL).

REMARK

The communication module uses the non-procedure protocol for all communication with external devices and terminals.
To perform protocol communication, the user needs to write a protocol control program.

7 - 1

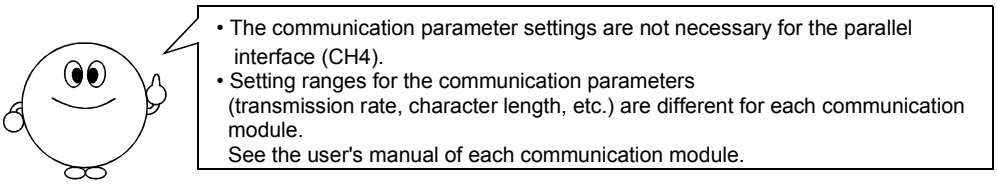
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7.2 Preparation for the Communication

Various settings are necessary in order to communicate with external devices and terminals. The preparations required to perform the communication are described below.

7.2.1 Communication parameter setting

In order to communicate through the RS-232 (CH1, CH2) or RS-422 (CH3) interface, the following parameters have to be set using the ZOPEN and ZCNIL instructions prior to the actual communication. These parameters on the communication module side and the target device side must correspond correctly.
If they do not correspond correctly, the communication may not be possible or communication errors may occur.



- Transmission rate • • • Specify this parameter when using the ZOPEN instruction. Specify the speed of the data communication. The following values can be set in BASIC: 300 bps, 600 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps.
- Character length • • • Specify this parameter when using the ZOPEN instruction. Specify the number of bits in the codes that represent each character used in the communication. The following values can be set in BASIC:
  - 5 bits • • • 32 characters from 0 through $1F_H$ can be represented.
  - 6 bits • • • 64 characters from 0 through $3F_H$ can be represented.
  - 7 bits • • • 128 characters from 0 through $7F_H$ can be represented.
  - 8 bits • • • 256 characters from 0 through FF_H can be represented.
- Parity bit • • • Specify this parameter when using the ZOPEN instruction. Specify how the data is during the communication checked (parity check). The following can be specified in BASIC:
  - No parity check is performed.
  - Parity check is performed and even parity bit is used.
  - Parity check is performed and odd parity bit is used.

REMARK

Parameter • • • Parameters refer to data that must be specified for the communication.

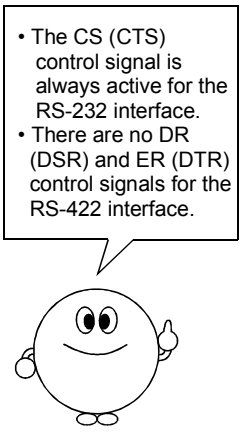
7 - 2

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- Stop bit • • • Specify this parameter when using the ZOPEN instruction.
  Specify the data delimiter. The following values can be set in BASIC:
  - 1 bit • • • The data delimiter is represented by 1 bit.
  - 2 bits • • • The data delimiter is represented by 2 bit.
  - 1.5 bits • • • The data delimiter is represented by 1.5 bit.

Specify the following items as necessary.
Details of the DC1/DC3 control and signal control are explained in Appendix 7.

- Size of the receive buffer • • • Specify this parameter when using the ZCNTL instruction.
  The receive buffer is a memory area where the received data is automatically stored even if the data receive instruction is not executed when the data is received from the external device.
  All the data received while the data receive instruction is not executed will be ignored if 0 is specified as the receive buffer size.
- DC1/DC3 control • • • Specify this parameter when using the ZCNTL instruction.
  If the DC1/DC3 control is activated on the communication module, a DC3 code is sent when the receive buffer becomes full and a DC1 code is sent when the buffer space becomes available while receiving data.
  During the data transmission, the transmission is stopped when a DC3 code is received, and it is resumed when a DC1 code is received.
  The settings of the DC1/DC3 control on the communication module side and on the external device side have to be the same.
- Signal control specification • • • Specify this parameter when using the ZCNTL instruction.
  Transmission and reception of data are controlled by the CS (CTS), RS (RTS) (RS-232/RS-422), ER (DTR), and DR (DSR) (RS-232 only) signals of the interface. The following table shows what occurs when each control signal is activated or deactivated.



Signal	Control activated	Control deactivated
CS (CTS)	Input signal. The data is sent when this signal is ON.	This control cannot be deactivated for the RS-232 interface.
RS (RTS)	Output signal. This signal is turned ON when the data can be received normally.	The data is received regardless of the signal.
DR (DSR)	Input signal. The data is sent when this signal is ON.	The data is sent regardless of the signal.
ER (DTR)	Output signal. This signal is turned ON when the data can be received normally.	The data is received regardless of the signal.

The settings of the control signal specifications do not need to be the same on the communication module side and on the external device side. They change depending on the signal connections of the cable, however, so care must be taken.

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- Break character • • • Specify this parameter when using the ZCNTL instruction.
  It is possible to terminate data reception when receiving data designated as a break character while receiving data from an external device.
  The break character is meaningless unless the character sent by the transmission side and the character recognized by the communication module match.

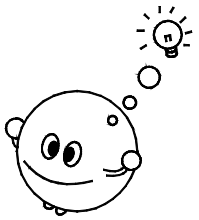
7.2.2 Control table

Since many parameters are specified in the ZOPEN and ZCNTL instructions, the 'control table' concept is used. A control table is a table in memory for storing the parameters used to notify the necessary information of the processing to the communication module's system when carrying out the above-mentioned processing in the BASIC program. The BASIC program stores the necessary parameters in an array, and passes the parameters to the communication module's system by specifying only the name of the array in the instruction.

For example, in order to execute the ZOPEN instruction, it is necessary to set the transmission rate, character length, parity, and stop bit parameters. If too many parameters are listed after the instruction, however, the program will be hard to read. If a control table is used here, the actual instruction becomes concise and the parameters can be written simply as well.

Using a control table

```
100P%(0)=9600          :'   Transmission rate
110P%(1)=&H108         :'   Parity & character length
120P%(2)=1             :'   Stop bit
130ZOPEN #1, P%( )
```



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7.3 Communication Procedure with External Devices

This section explains how to communicate with a console, terminal, printer, other external devices.

7.3.1 Communication with a console

The following explains how to communicate with a console connected to either the RS-232 or the RS-422/RS-485 interface of the communication module, as well as precautions when carrying out the communication.

> Refer to the user's manual for each communication module for details on the console setting of the communication module.

(1) To display data on the console screen

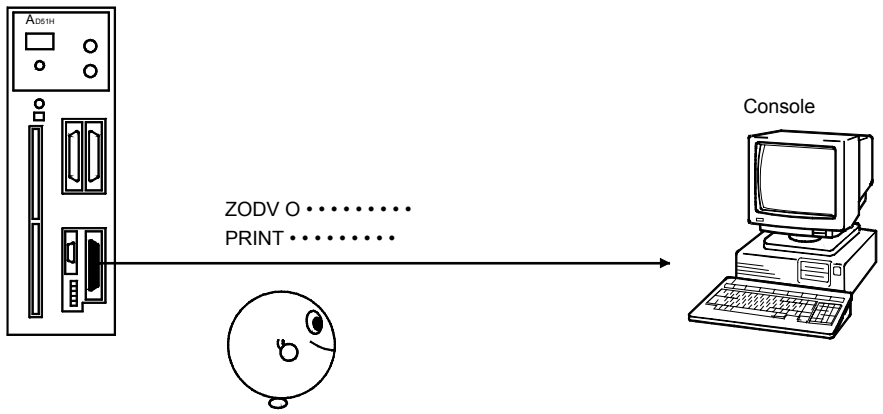
1) Switch the output destination to the console using the ZODV instruction.

ZODV 0 ← Always 0 when the console is specified.

2) Use the following instructions to output to the console screen or to control the screen:

PRINT	Displays data on the screen of the specified console.
PRINT USING	Displays data on the screen of the specified console. (Format can be specified.)
LOCATE	Specifies the data display location at the specified console screen.
CLS	Clears the screen of the specified console.

Note that the TAB and SPC functions can also be used with the PRINT instruction.



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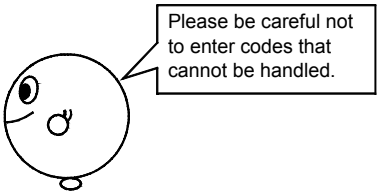
(2) To enter data from the keyboard of the console

1) Switch the input source to the console using the ZIDV instruction.

ZIDV 0
→ Always 0 when the console is specified.

2) Use the following instructions to enter data from the console's keyboard. Note, however, that some instructions (functions) cannot handle certain character codes.

- INPUT — Character codes 0 through 1F$_H$ (control codes), 2C$_H$ (comma), 7F$_H$ (Delete), 80$_H$, and FD$_H$ through FF$_H$ cannot be handled as data.
- LINE INPUT — Character codes 0 through 1F$_H$ (control codes), 7F$_H$ (Delete), 80$_H$, and FD$_H$ through FF$_H$ cannot be handled as data.
- INKEY$, INPUT$, (numerical expression) — Character codes 0$_H$, 03$_H$, 13$_H$, 80$_H$, and FD$_H$ through FF$_H$ (control codes) cannot be handled as data.



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7.3.2 Communication with a terminal

The following explains how to communicate with a terminal connected to either the RS-232 or the RS-422/RS-485 interface of the communication module, as well as precautions when carrying out the communication.

> Items described in this section do not apply to a terminal connected to an interface specified as a console in the communication module.

(1) To display data on the terminal screen

1) Open the interface and specify communication parameters according to the terminal to be used.

ZOPEN # <channel number>, <control table>
ZCNTL # <channel number>, 0, <control table>

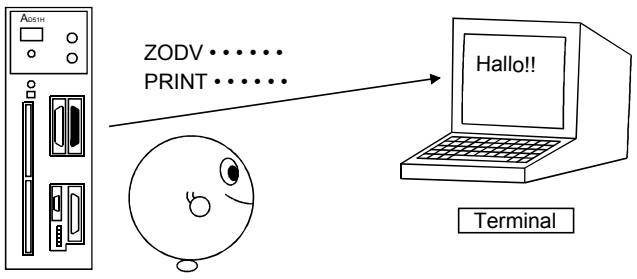
2) Specify the channel number of the interface to which the terminal used for screen output is connected using the ZODV instruction.

ZODV <channel number>

3) Use the following instructions to output to the terminal screen or to control the screen:

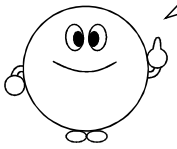
PRINT ——— Displays data on the screen of the specified terminal.
PRINT USING ——— Displays data on the screen of the specified terminal. (Format can be specified.)
LOCATE ——— Specifies the data display location at the specified terminal screen.
CLS ——— Clears the screen of the specified terminal.

Note that the TAB and SPC functions can also be used with the PRINT instruction.



4) Close the interface and switch the output destination back to the console to finish the screen display.

ZCLOSE # <channel number>
ZODV 0



When the ZODV or ZIDV instruction is used to switch screen display to the terminal, the key codes for the cursor control keys and the function keys of the terminal are automatically converted to the codes that correspond to the communication module. Therefore, it is more convenient to use these instructions than to use the ZSEND and ZRECEIVE instructions described in Section 7.3.4.

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(2) To enter data from the keyboard of a terminal

1) Open the interface and set the communication parameters according to the terminal to be used.

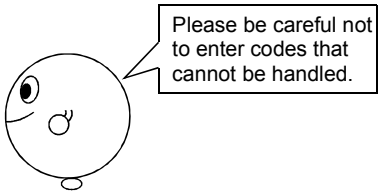
ZOPEN # <channel number>, <control table>
ZCNTL # <channel number>, 0, <control table>

2) Specify the channel number of the interface to which the terminal used for keyboard input is connected using the ZIDV instruction.

ZIDV <channel number>

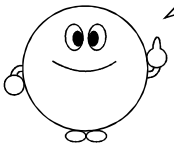
3) Use the following instructions (functions) to enter data from the keyboard of the terminal.
Note, however, that some instructions (functions) cannot handle certain character codes.

INPUT ——— Character codes 0 through 1Fh (control codes), 2Ch (comma), and 7Fh ([Delete]) cannot be handled as data.
LINE INPUT ——— Character codes 0 through 1Fh (control codes) and 7Fh ([Delete]) cannot be handled as data.
INKEY$
INPUT$
(numerical expression) ——— Character code 0h cannot be handled as data.



4) Close the interface and switch the input source back to the console to finish entering data.

ZCLOSE # <channel number>
ZIDV 0



Be careful about the following points when entering data from the keyboard of a terminal.
- The program cannot be stopped by pressing the [Break] / [Ctrl] + [C] keys when entering data from an external device other than the console via the ZIDV instruction. The code 03H is entered when the INKEY$ or INPUT$ function is used.
- If the DC1/DC3 control is activated for the interface to which the terminal is connected and a code corresponding to DC1 or DC3 is entered, the DC1/DC3 control is carried out and data cannot be entered.
- Do not use keys which are equivalent to the [Esc] key or the FDH code on the terminal. Data may not be input correctly.

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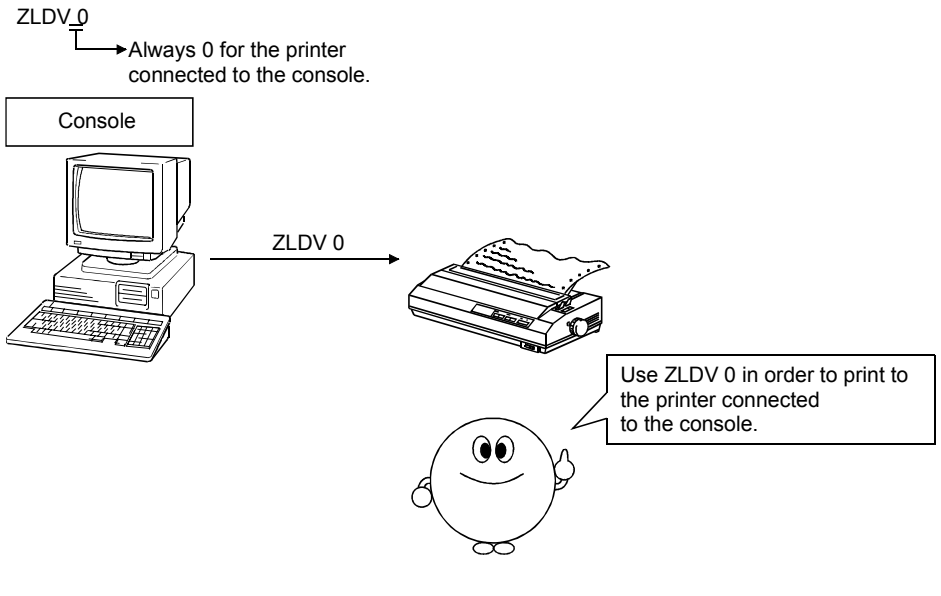
7.3.3 Communicating with a printer

The following explains how to send data to a printer connected to the RS-232or RS-422/RS-485 parallel interface of the communication module, as well as precautions when carrying out the transmissions.

Items described in this section do not apply to a printer connected to an interface specified as a console in the communication module.

(1) Output to the printer connected to the console

1) Switch the output destination to the printer connected to the console using the ZLDV instruction.



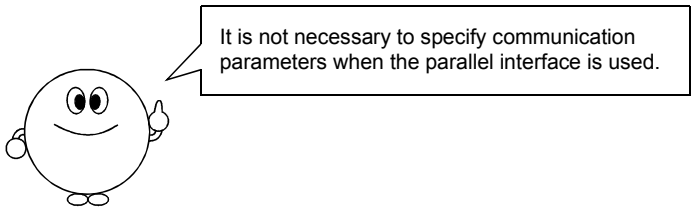
2) Use the following instructions to print on the printer:

LPRINT ——— Prints data on the specified printer.
LPRINT USING ——— Prints data on the specified printer. (Format can be specified.)
LLIST ——— Prints a program list on the specified printer.

Note that the TAB and SPC functions can also be used with the LPRINT instruction.

(2) Output to the printer connected to an interface of the communication module

1) Open the interface and specify communication parameters according to the printer to be used.



ZOPEN # <channel number>, <control table>
ZCNTL # <channel number>, 0, <control table>

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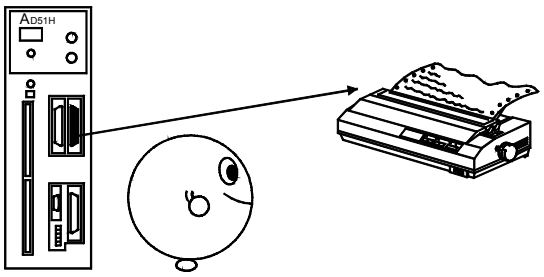
2) Specify the channel number of the interface to which the printer for printing data is connected using the ZLDV instruction.

ZLDV <channel number>

3) Use the following instructions to print on the printer:

LPRINT ——— Prints data on the specified printer.
LPRINT USING ——— Prints data on the specified printer (Format can be specified.)
LLIST ——— Prints a program list on the specified printer.

Note that the TAB and SPC functions can also be used with the LPRINT instruction.



4) Close the interface to finish printing.

ZCLOSE # <channel number>

REMARK

- The ZCNTL instruction has functions with which to read the printer status and send a reset signal to the printer as well.
  See the description of the ZCNTL instruction for the details.

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7.3.4 Communication with other external devices

The following explains how to communicate with external devices, other than terminals and printers, which are connected either to the RS-232 or the RS-422/RS-485 interface of the communication module, as well as precautions when carrying out the communication.

(1) To transmit data • • • Use the ZSEND instruction.

1) Open the interface and specify the communication parameters according to the external device to be used.

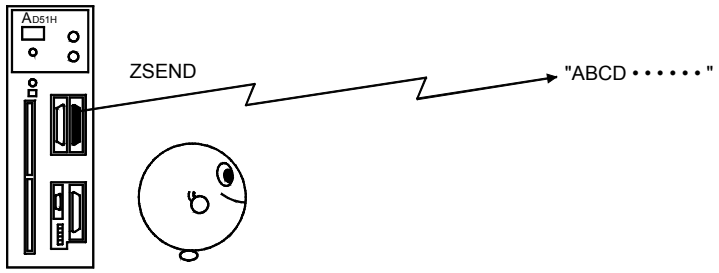
ZOPEN # <channel number>, <control table>
ZCNTL # <channel number>, 0, <control table>

2) Prepare the data to transmit, then specify the number of bytes of transmission data and the timeout in the control table used for the ZSEND instruction.

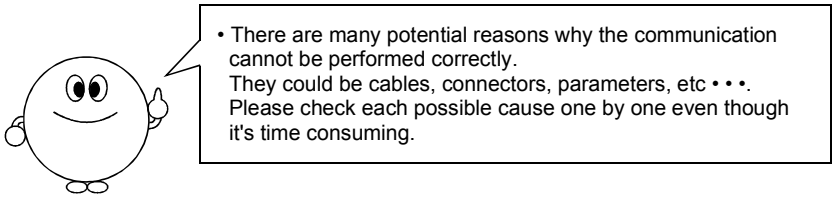
3) Execute the ZSEND instruction.

ZSEND # <channel number>, <control table>, <output element>

When the execution of the ZSEND instruction is completed, the number of bytes of transmitted data is stored in the control table used for the ZSEND instruction.



4) An error occurs if the data was not sent normally. In this case, check the condition of the communication line, the communication parameters of the interface, the contents of the control table, etc.



REMARK

- Timeout • • • Specifies the time (in seconds) that is allowed to pass from the start of the communication before a timeout error occurs if the communication for some reason did not finish.

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(2) To receive data • • • Use the ZRECEIVE instruction or INPUT$ function.

1) Open the interface and specify the communication parameters according to the external device to be used.

ZOPEN # <channel number>, <control table>
ZCNTL # <channel number>, 0, <control table>

2) Follow the steps below to use the ZRECEIVE instruction:

(a) Specify the number of bytes of transmission data and the timeout in the control table used for the ZRECEIVE instruction.

(b) Define the variables and arrays for storing the received data as follows:

To store the received data in a character variabl : $=SPACE$(255)
To store the received data in an integer : %=0
To store the received data in an array : DIM (n)

n is the maximum number of elements used.

(c) Execute the ZRECEIVE instruction.

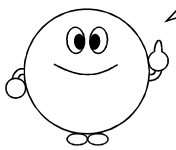
ZRECEIVE # <channel number>, 0, <control table>, <input element>

- When the execution of the ZRECEIVE instruction is completed, the number of bytes of received data is stored in the control table used for the ZRECEIVE instruction.
- The reception process is terminated if the data specified as a break character is detected while receiving data.

2) INPUT$ function is used in the following format:

<variable where the received data is stored> = INPUT$ (<number of input characters>, %<board number>, <timeout>)

3) An error occurs if the data was not received normally. In this case, check the condition of the communication line, the communication parameters of the interface, the contents of the control table, etc.

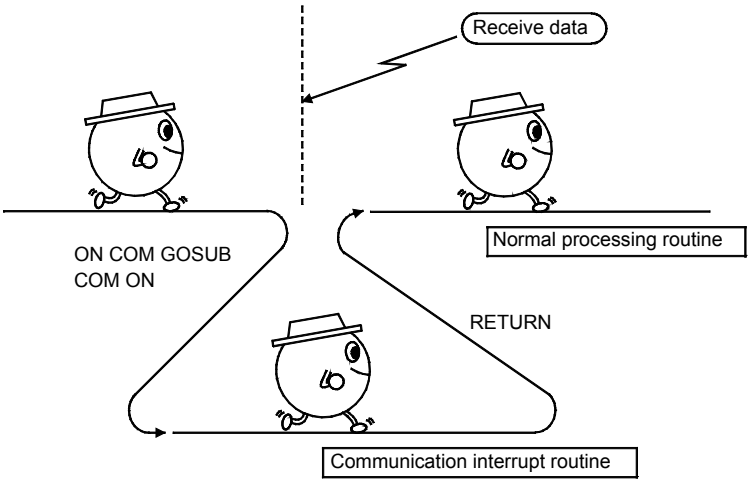


- The RS (RTS)/ER (DTR) signal can be turned ON or OFF using the ZCNTL instruction during the data communication with the external device.
  See the description of the ZCNTL instruction for the details.

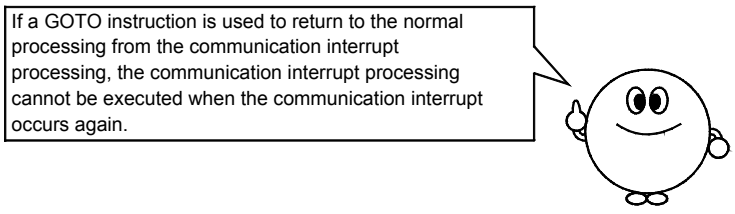
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7.4 Interrupt Processing from External Devices

It is possible to define "communication interrupt routines" whose execution can be started when data from the external device is received by the AD51H-BASIC program. The "communication interrupt routine" should be defined beforehand using the ON COM GOSUB instruction. The ON COM GOSUB instruction specifies a line number or a label. When data is received from the external device, the execution is started from the line with the specified line number or label.
In addition, communication interrupts need to be enabled using the COM instruction in advance in order to execute the "communication interrupt routine".



Any processing can be executed within the "communication interrupt routine" using the BASIC instructions. It is possible to return to the point where the processing was interrupted due to the execution of the "communication interrupt routine" by using the RETURN instruction when the interrupt processing is completed.
In order to return to a line with a specified line number or label, specify the line number or label after the RETURN instruction.



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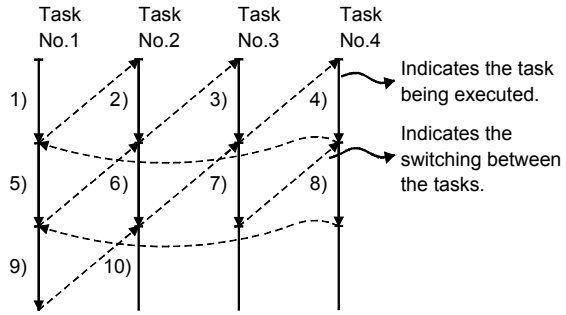
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8 MULTITASK PROCESSING

8.1 Multitask Processing

Multitask processing refers to executing multiple programs simultaneously on a single device. In AD51H-BASIC, it is possible to perform multitask processing of a maximum of eight BASIC programs on the AD51H-S3, a maximum of two on the A1SD51S, and a maximum of two on the QD51(-R24).
Multitasking means executing multiple (multi) programs (tasks).
There is only one main CPU (central processing unit) in the communication module. Multitasking accomplishes parallel operations by successively switching between the execution of multiple programs. The processing speed of the main CPU is very fast, so to the human eye it appears as if it is processing multiple programs simultaneously.

When there are four tasks
(The numbers in the circles indicate the order of processing by the CPU.)



Simultaneously executed BASIC programs operate for the execution time allocated by the OS (50ms or 100ms) and are then switched by the OS.
The switching of the execution of each program by the OS (scheduling by the OS) during the parallel processing occurs according to the priority of each program (refer to Section 8.1(2), Execution Priority) and when any of the following situations occurs.

- When a data input/output (communication) instruction is executed to the screen, keyboard, disk, peripheral device, or external device.
- When an instruction for controlling the program execution (interrupt, stop, or terminate), or an instruction for controlling multitasking (synchronizing the execution, starting, changing priorities) is executed
- When the interrupt status of the program execution is released (when input/output is finished, specified time has elapsed, etc.)
- When the program has been executed continuously for a specified time (50ms or 100ms) (execution of multi-statements, etc.)

See Appendix 3 for the instructions for switching the program execution.

REMARK

- Changing the execution time is supported by the AD51H-S3 only. The execution time is fixed to 50ms for the A1SD51S and QD51 (-R24).
- Use the mode setting switch 2 of the AD51H-S3 module to switch the execution time (to 50ms or 100ms). For details, see the Intelligent communication module type AD51H-S3 User's Manual.
- The switching between tasks according to the above-mentioned execution time may occur in the middle of executing an instruction, but the processing is carried out normally.

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(1) Status transition of a BASIC program

The following describes how the status of one BASIC program changes (status transition) after the start of its execution.

The program operation status can be roughly divided into four. Once the execution is started, the program operates in parallel with other programs while changing its status among 1) through 3) described below. The status changes to 4) when the END instruction is executed and 5) when the SYSTEM instruction is executed.

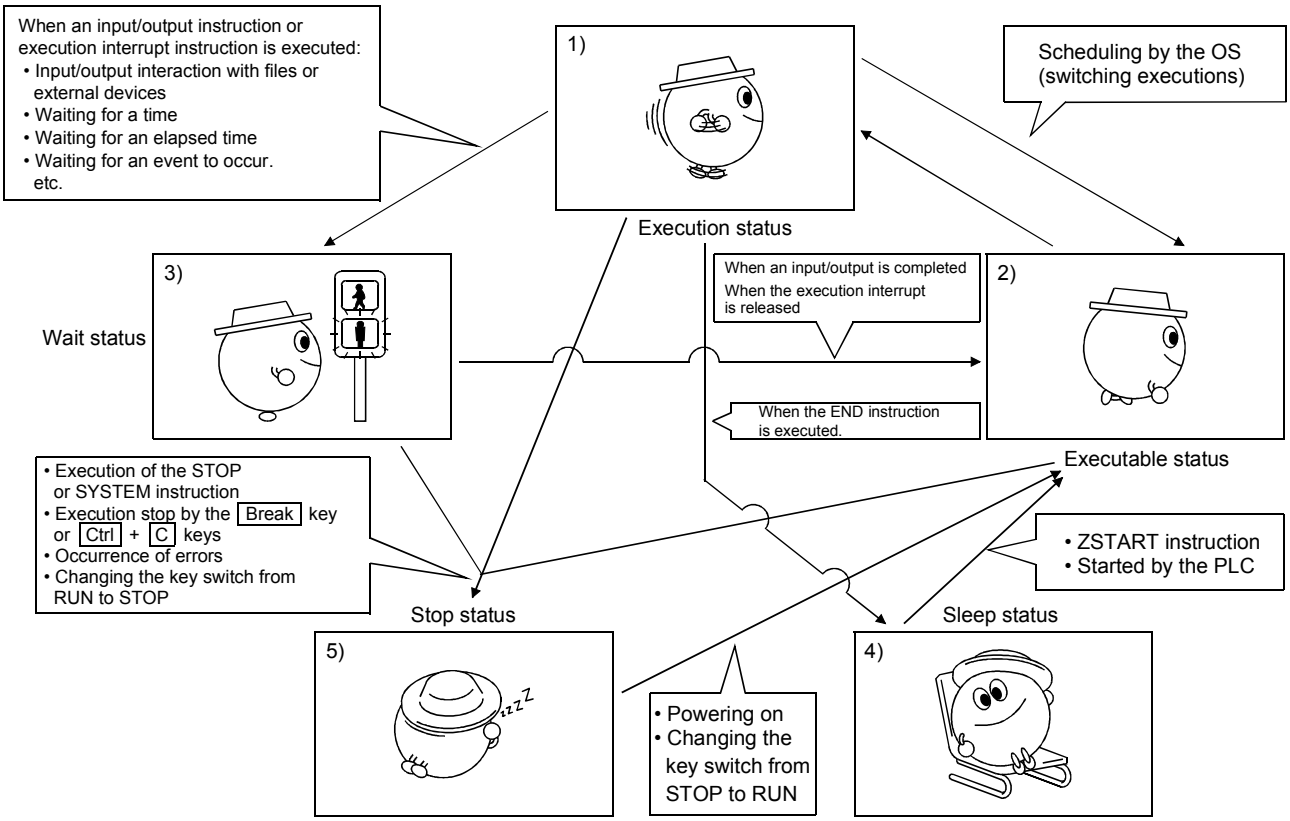
1) Execution status _____ A status where the program is currently being executed.

2) Executable status _____ A status where the program can immediately make a transition to the execution status if the execution privilege is given to it from the OS when the switching of executions occurs.

3) Wait status _____ A status where the program waits for the completion of input/output or the release of an execution interrupt while an input/output instruction is being executed to the screen, keyboard, disk, peripheral device, or external device, or an execution interrupt instruction is being executed.

4) Sleep status _____ A status where the program is not currently executed (other than 1) through 3)). While in the sleep status, the program can be restarted by using the ZSTART instruction.

5) Stop status _____ A status where no program is being executed by the AD51H.

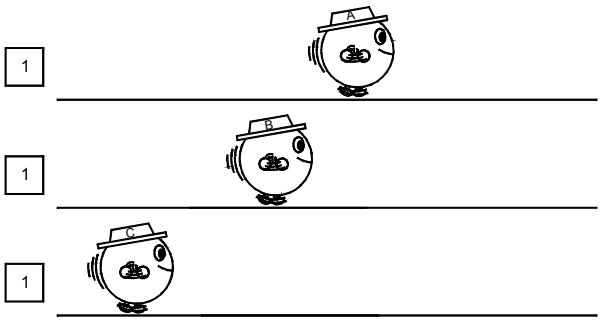


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(2) Priority of the programs (Task priority)

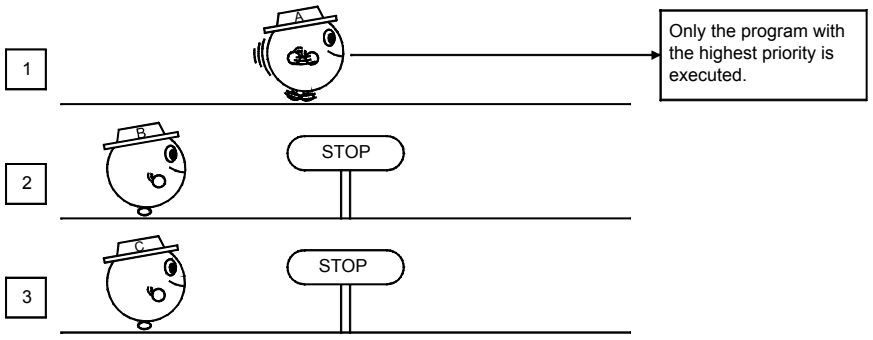
An execution priority can be assigned to each program executed in multitask processing. All programs are set to have the same priority when BASIC is started up, which means that the main CPU executes all programs equally through the scheduling by the OS.

[Priority]



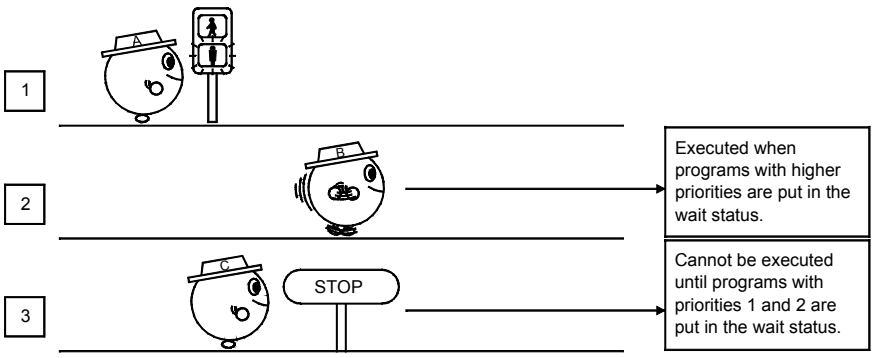
When the priority of the program is changed by the ZURGENCY instruction, the OS performs no scheduling and only the program with the highest priority is executed, unless the program execution switching instruction shown in Appendix 3 is executed.

[Priority]



Programs with low priorities are not executed until all programs with higher priorities are put in the wait status or until the program execution switching instruction shown in Appendix 3 is executed.

[Priority]

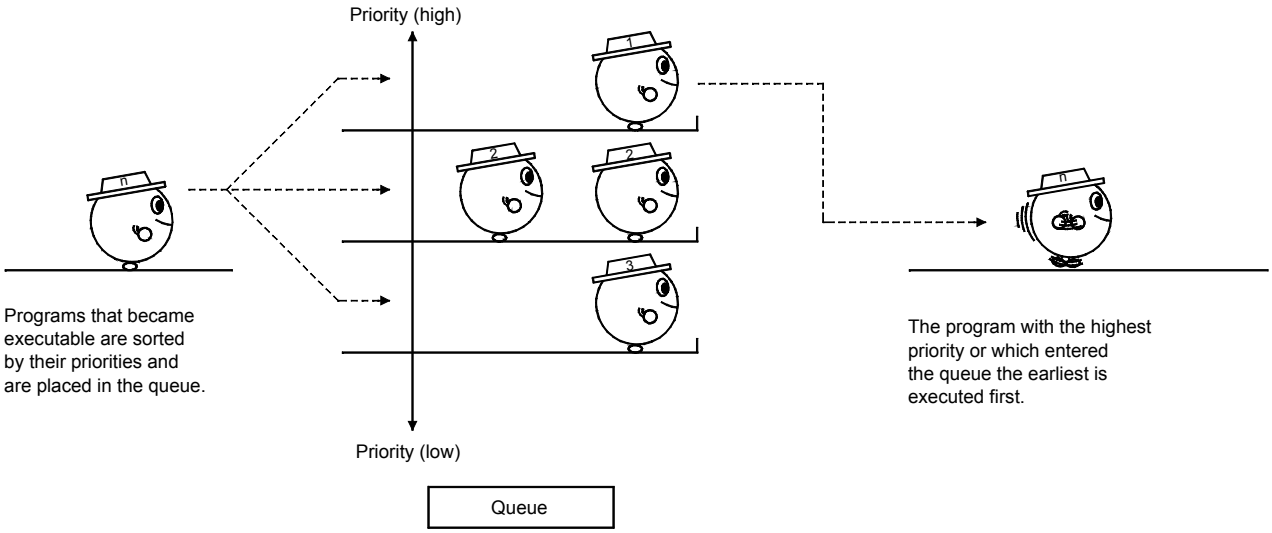


It is recommended that the priority shall be raised only when a certain emergency processing is required, and that the same priority is assigned to all programs otherwise.

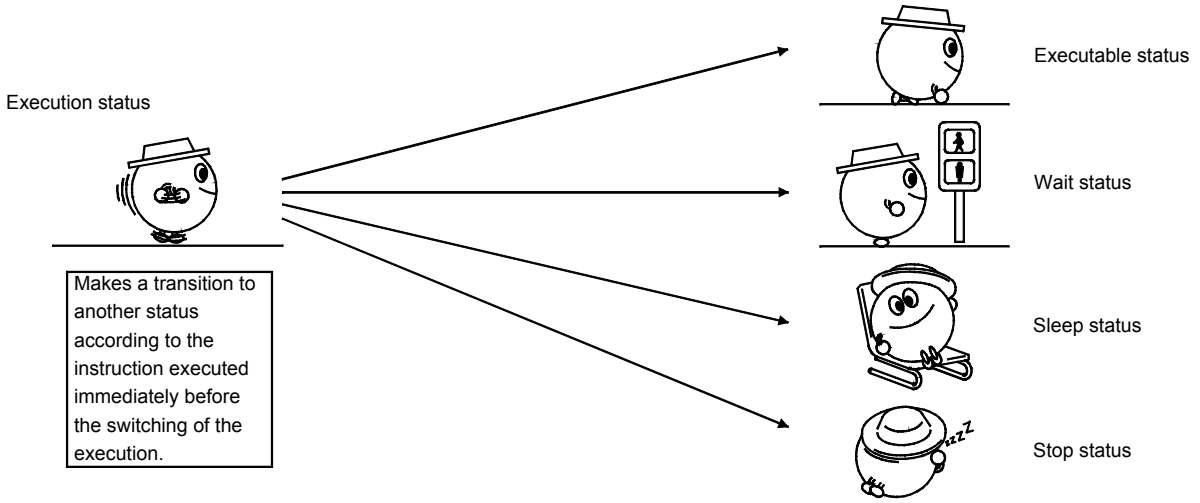
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(3) Execution order when BASIC programs are executed simultaneously

The following explains the execution order of each program when multiple BASIC programs are executed at start-up.
In reality, the BASIC programs do not operate (execute) by themselves. Each BASIC program operates together with the system program according to the scheduling by the system of the communication module.
When multiple BASIC programs run in parallel, the communication module selects (gives execution privilege to) the program with the highest priority among the executable programs (see the previous page) in the queue at the time of switching execution of each program. Then it lets the program execute until the next execution switching occurs. By repeating this operation, the communication module allows multiple programs to run in parallel.



The program given the execution privilege by the OS goes into the execution status and executes the specified instructions as shown in the figure above. It makes a transition to the next status when the switching of the execution occurs.

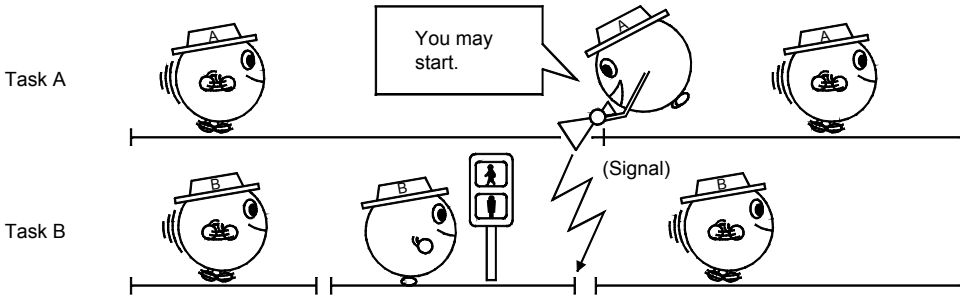


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8.2 How to Synchronize the Execution (Event Control)

In the multitask processing, the processing of each program proceeds independently. Therefore, correct data may not be received, depending on the timing, when the data needs to be exchanged between programs.
Event control is a method for synchronizing the executions. A program is kept waiting for a signal (WAIT status), and is allowed to continue its execution when the appropriate signal (event) is given.



In addition to the BASIC programs, a predefined extension relay (EM) in the communication module can also generate signals for releasing the wait status.

It is possible to perform event control that synchronizes the executions of the BASIC programs in AD51H-BASIC. In order to achieve this, define events according to the specific procedures and specify the settings so that event generation is enabled.

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(1) To perform event control

In order to perform event control, the following should first be understood:

(a) The event control is enabled by defining the events in one of the BASIC programs in advance and specifying the settings so that event generation is enabled in that program. These definitions and settings may occur in any program. Note also that the programs for which the definitions and settings were specified do not have to reside in memory at the time of the event control.

(b) If the event is only defined, the status of the event is the same as if the setting to disable event generation (ZEVENT DISABLE) is specified.
To perform event control, it is necessary to specify the setting to enable the event generation (ZEVENT ENABLE) in the program in which the event was defined.

(c) To synchronize the execution with other BASIC programs using the event control, the BASIC program which is made to wait for the event generation has to be placed in the status where it waits for the event generation before the event occurs.
If an event occurs but no BASIC program is waiting for the generation of the event, the occurrence of the event becomes invalid (ignored).

(d) When performing event control, it is necessary to disable the occurrence of the events at the system start-up and shutdown of the communication module. (Initialization of the event information managed by the system)
Carry out one of the following:
1) Restart the power or push the RESET switch.
2) Redefine the events in the BASIC program that is executed first at the system start-up of the communication module, or in the BASIC program that finishes the execution lastly. (Redefine the event handling using the DEF ZEVENT instruction.)

Example

```
FOR I%=0 TO 16
DEF ZEVENT I%
NEXT I%
```

REMARK

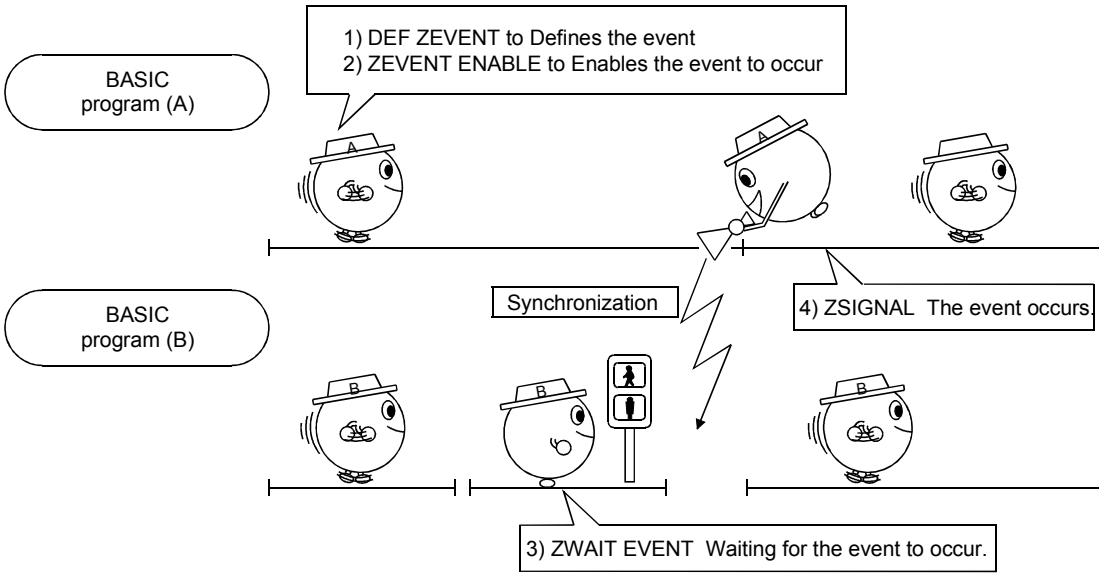
In the communication module, it is not possible to perform event control using the bit devices of the PLC CPU.
However, stopped BASIC programs can be started by a command from the PLC CPU. See Section 5.2 for the details.

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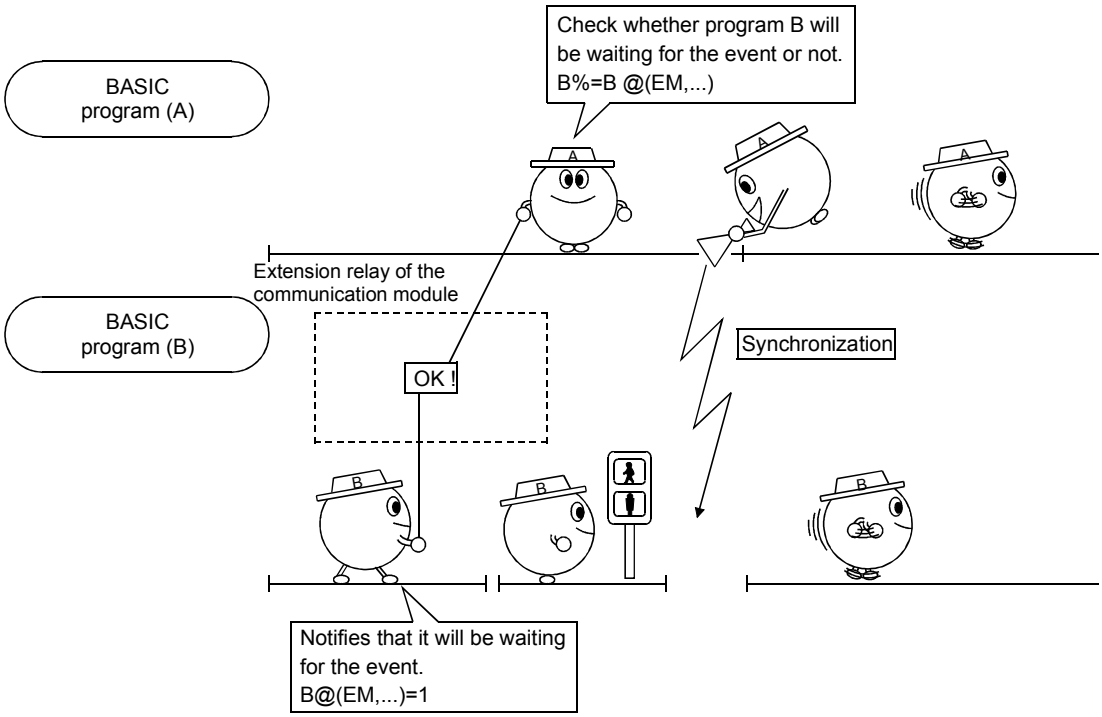
(2) Execution order of the instructions when the event control is performed

The following shows the execution order of the instructions when the execution of the BASIC program is being controlled by the events (execution start, execution resume). Execute in the order starting from (1).

(a) When synchronizing the execution between BASIC programs



As shown above, execute steps 1) and 2) in one program and then generate the event while one of the programs is waiting for the event to occur. If 4) is executed before 3), the execution cannot be synchronized. To prevent the generated event from becoming invalid, apply interlock between programs whose executions are to be synchronized by using an extension relay of the communication module, etc.

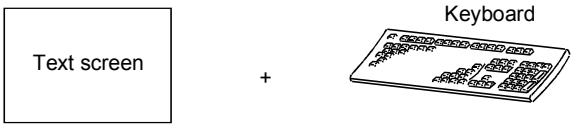


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8.3 To Use Devices (Resources) in Multitasking (Mutual Exclusive Control of Resources)

Resources refer to all of the hardware and software that can be used by the programs. For example, they could be screens, printers, files, disks, optional boards, memory, etc. When these devices are used in multiple programs being executed, some of them can be grouped into one resource, or split into pieces to treat each of the pieces as a single resource.

Example

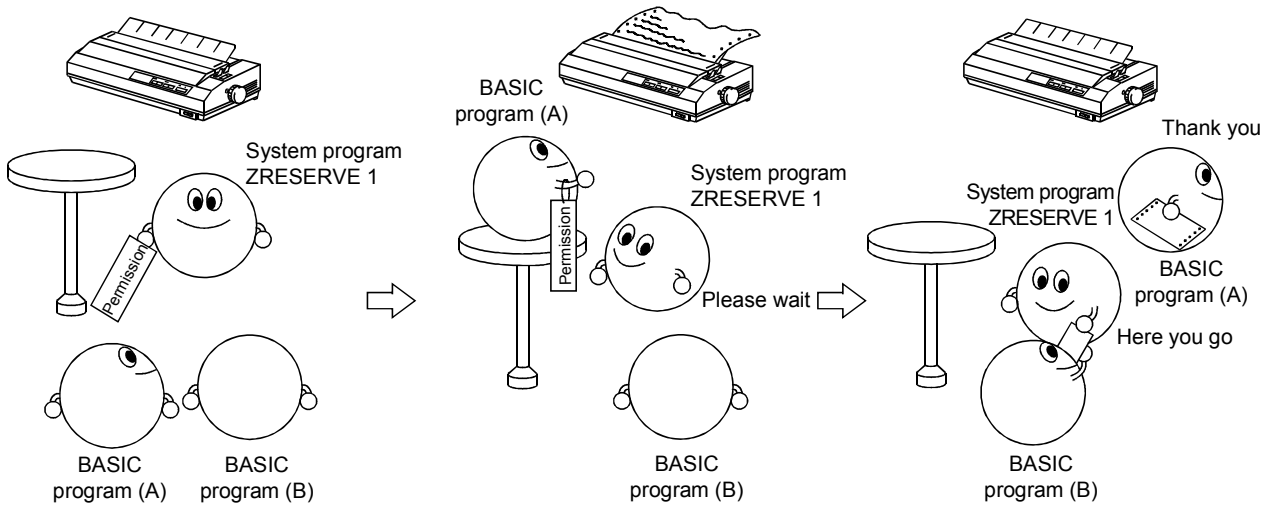


To split one resource into pieces and treat each of the pieces as a single resource
(Extension relays of the communication module EM0 through EM1023)



Mutual exclusive control of a resource means limiting access to that certain resource. While one program is using a certain resource, other programs are prevented from using the resource when multiple programs are executed simultaneously. This section explains how to limit access to the specified resource to one program at a time while multiple programs are being executed.

• Example of exclusive control of a printer



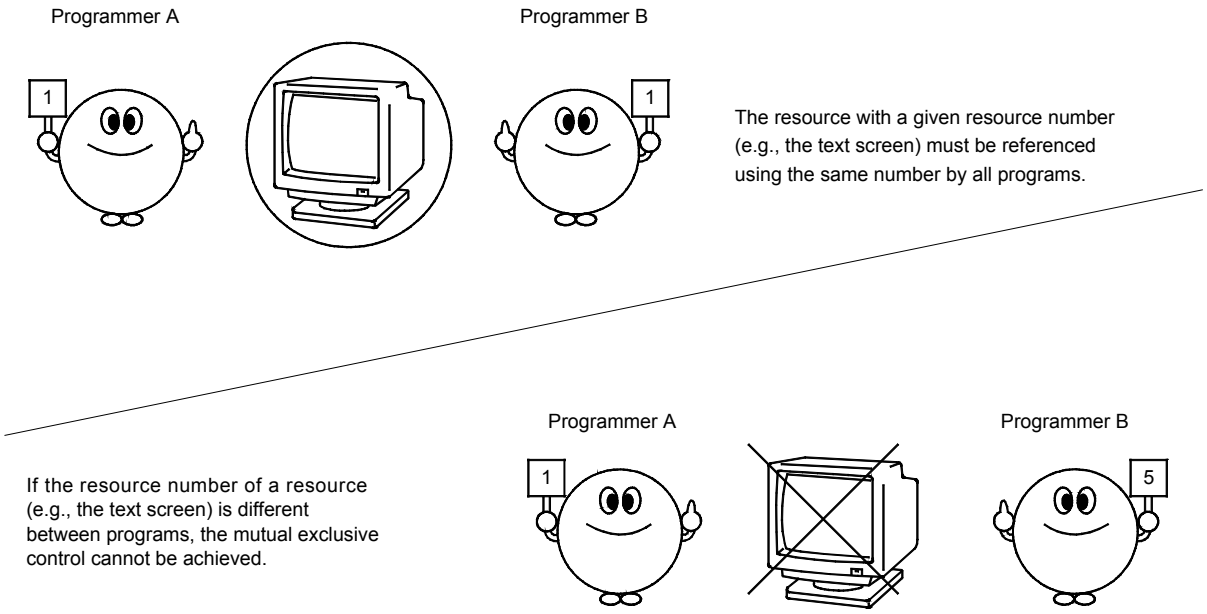
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(1) To limit the access to the resource

In order to limit the access to resources, the following should first be understood:

(a) Mutual exclusive control of the resource is performed strictly under the agreement between the programmers. The mutual exclusive control of the resource is meaningless if such agreement is not followed.



(b) A program that uses a resource (see (2)) with an assigned resource number must always execute the ZRESERVE instruction before it uses the resource. After finishing using the resource, it must execute the ZRELEASE instruction immediately so that another program can use the resource.
If the resource with the assigned resource number is already being used by another program when the ZRESERVE instruction is executed, the execution is halted until that program finishes using the resource and executes the ZRELEASE instruction.
In order to prevent the execution of a program from being stopped for a long period of time, specify a "timeout" when executing the ZRESERVE instruction.
An error occurs if the resource is not available within the specified period of time, which makes it possible to perform another processing by the error handling.

(c) Try to limit the access to one resource at a time if possible when using resources to which resource numbers are assigned.

(d) When using multiple resources with assigned resource numbers simultaneously, decide the order of the specified resource numbers in each ZRESERVE instruction. (To prevent deadlock of the program.)
For example, use the resources in sequence from the smaller or largest resource number. (See (3).)

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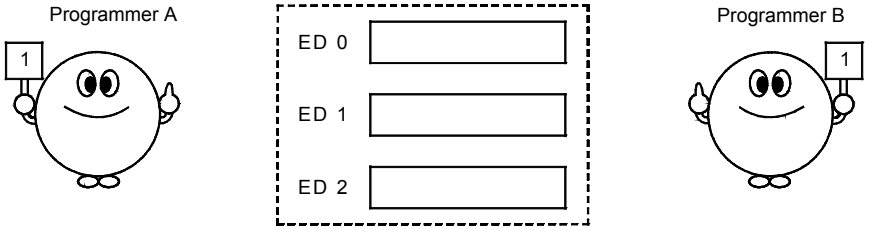
(2) Assigning resource numbers to resources

The following explains how to assign resource numbers specified in the ZRESERVE and ZRELEASE instruction to resources, such as screen or printer, in order to limit the access to resources.

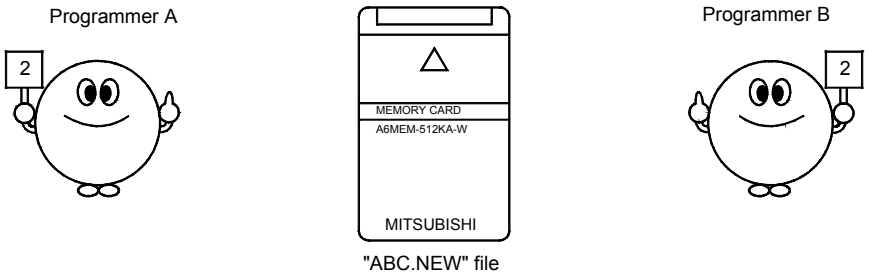
Assignment of resource numbers to resources is an agreement made between the programmers before writing programs; there are no instructions for assigning resources.

For example, make arrangement as follows:

• Before reading and writing data ED0 through ED2, assign 1 as the resource number for ED0 through ED2, then execute the ZRESERVE instruction.



• Before reading/writing data to/from the "ABC.NEW" file in drive 0, assign 2 as the file's resource number, then execute the ZRESERVE instruction.



An example of the steps for assigning resource numbers to resources is shown below:

(a) List all the resources that will be used in the programs to be executed simultaneously.

(b) From the resources listed in (a), identify which resources might be used simultaneously by multiple programs.

(c) From the resources identified in (b), select which resources will have problems if used simultaneously.

(d) For the resources selected in (c), clarify the breakdown of the resources to which the resource numbers are assigned, by combining multiple resources to one resource or by splitting one resource to multiple resources and treating each of them as one resource.

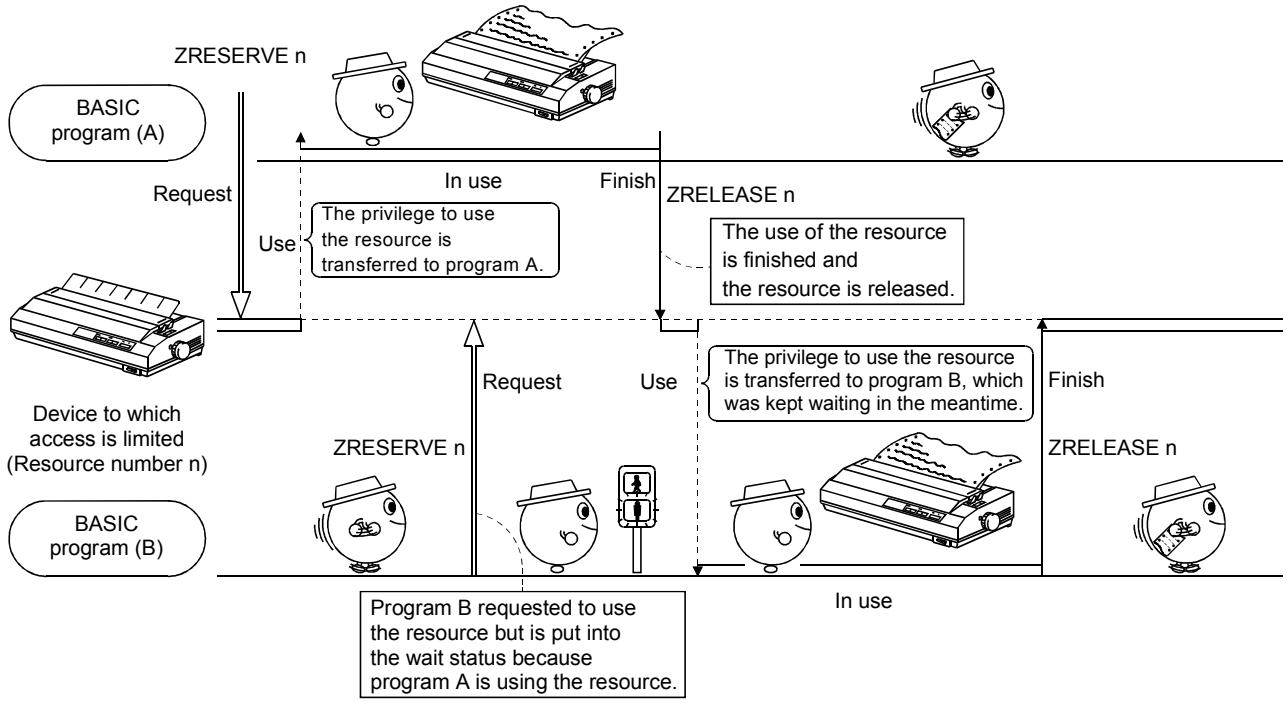
(e) Assign one of the resource numbers 0 through 63 to each of the resources clarified in (d). (By arrangement)

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(3) Execution order of instructions when limiting access to the resources

The following describes the execution order of instructions when limiting access to the resources in the BASIC program.

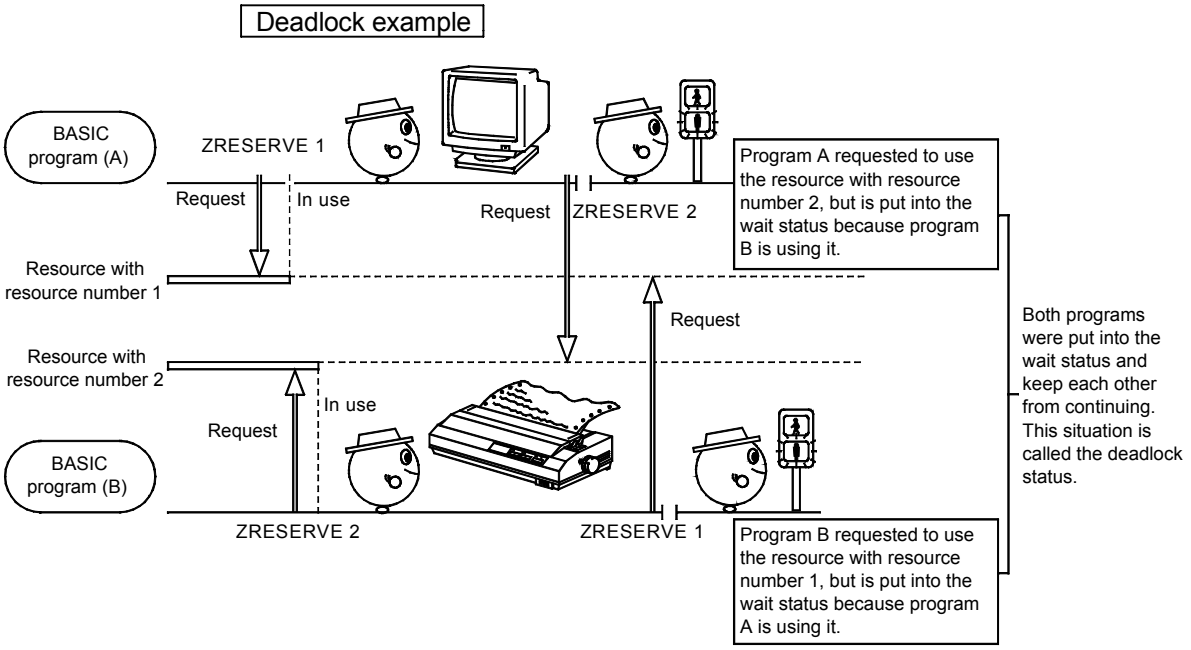
ZRESERVE:
Requests mutual exclusive control of the resource.
ZRELEASE:
Finishes mutual exclusive control of the resource.



As shown above, use the resource after executing the ZRESERVE instruction in order to use the resource assigned to resource number n. Execute the ZRELEASE instruction in order to finish using the resource.
Care must be taken when each of the programs executed simultaneously uses multiple resources. If the order of the resource numbers specified by each ZRESERVE instruction is not handled as arranged, both programs may keep each other from being able to continue. (Deadlock prevention)

An example of a deadlock is shown next.

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In this case, if the "timeout" parameter is specified by each ZRESERVE instruction, a timeout error occurs after the specified period of time and the execution interrupted status can be released.
However, it is not preferable to release the execution interrupted status by generating an error; it is recommended to modify the program appropriately.

(5) Types of resources which are managed by the OS program of the communication module

Resources that do not require mutual exclusive control are as follows.

(a) Resources managed by the OS of the communication module

- Channel numbers for data communication with external devices.
- File numbers specified for input/output interaction with files and devices.
- Priorities that define the program's execution order.
  High priority numbers may be used in mutual exclusion, however.
  For example, if an emergency processing at an error occurrence needs to be executed preceding other programs.
- Character strings assigned to function keys

(b) Resources managed by each program

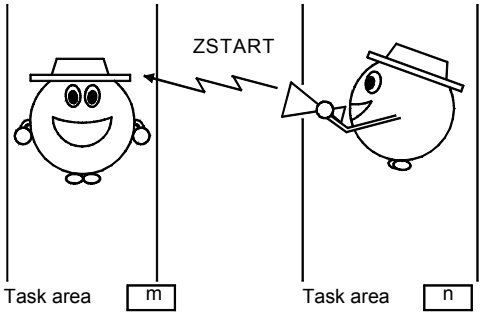
- Variables and Arrays handled by the program.

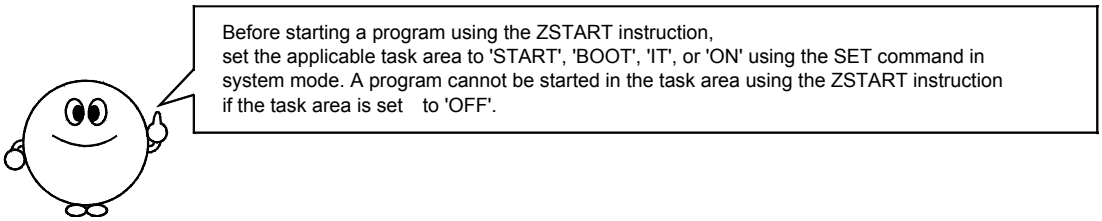
Resources other than the ones listed above can be accessed by all programs.
For example:
Text screen
Keyboard
Files and disks
Extension devices of the communication module
Event numbers
Resource numbers etc.

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8.4 Start Another Program from within a Program

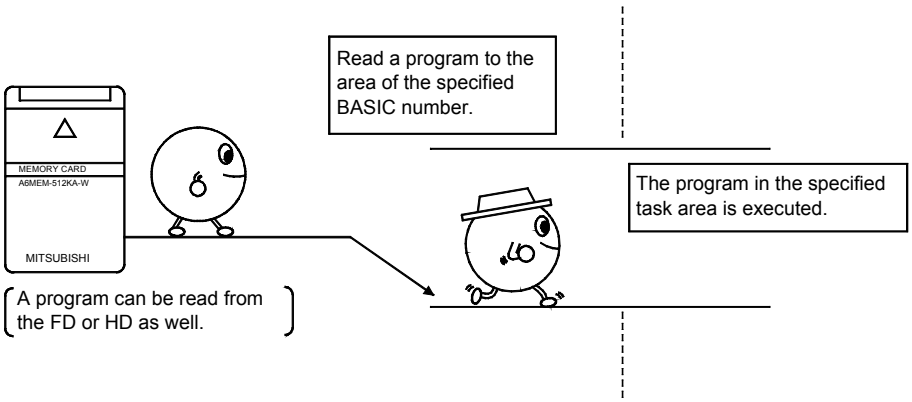
It is possible to start a new program using the ZSTART instruction to specify any task area while executing multitask processing.



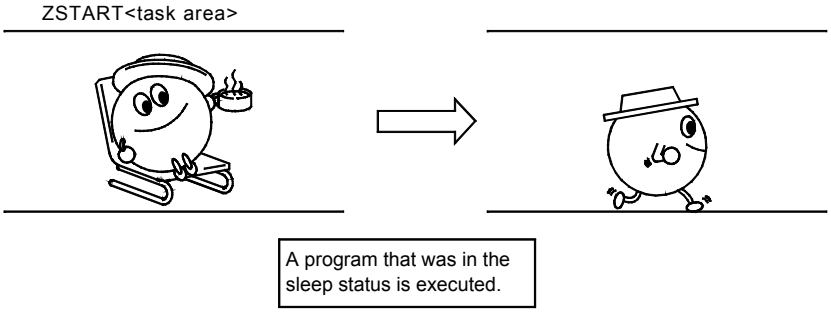


There are two ways to start a program using the ZSTART instruction.

1) Read a program from a memory card to the specified task area and start it.
   ZSTART<task area>, <program to be read>



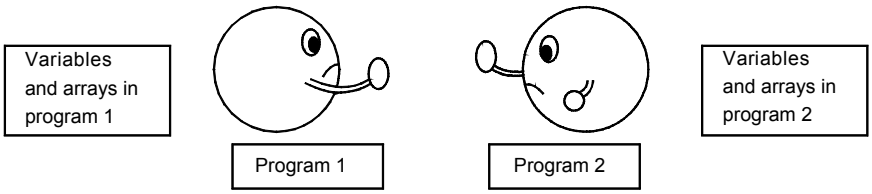
2) Start a program already residing in the task area, which has currently been put in the stop status by the END instruction.



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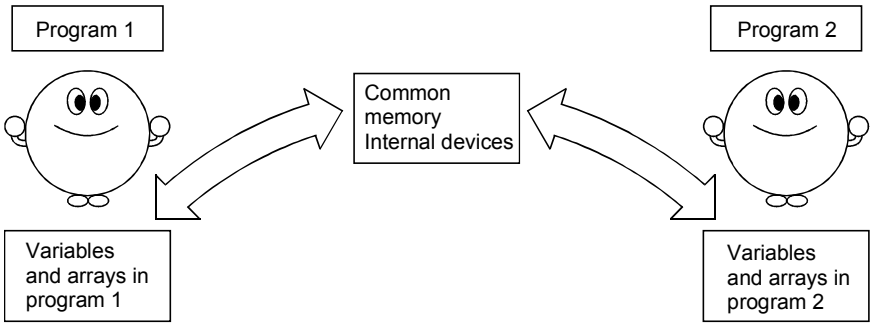
8.5 Exchanging Data between Tasks

The contents of variables and arrays in each task can be referenced only within each program during multitask processing. It is necessary to use a special method to exchange data between programs.

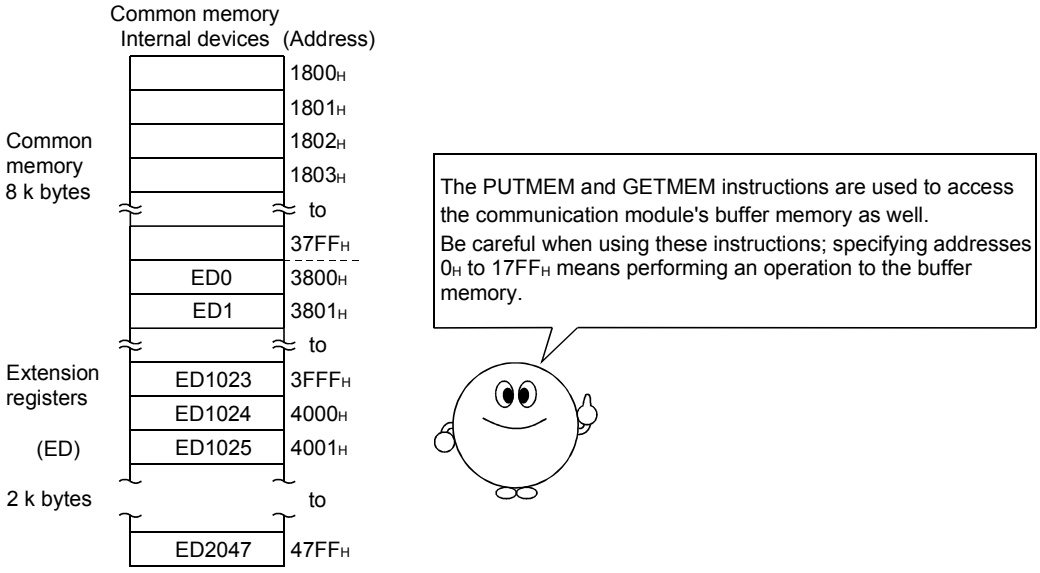


8.5.1 Common memory and internal devices

Common memory and extension registers (ED) can be used equally from all tasks in AD51H-BASIC. Data can be exchanged between tasks by using this area.



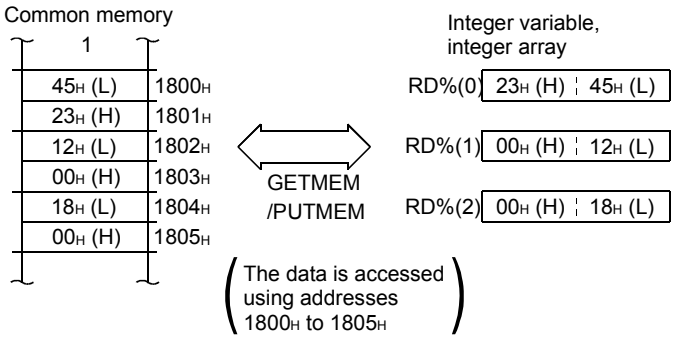
The PUTMEM and GETMEM instructions are used in order to access common memory and extension registers. The memory configuration is as follows.



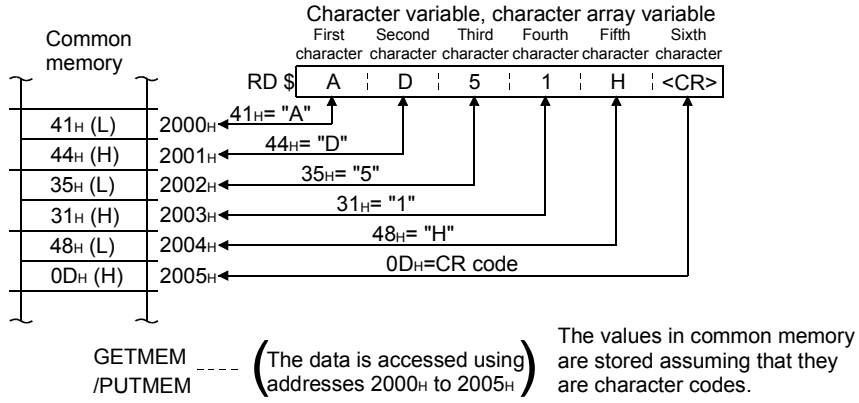
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Data is stored in the following manner.

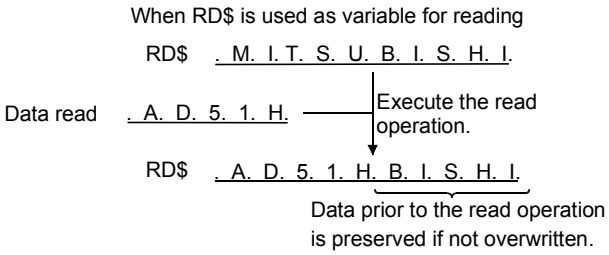
• For numeric data



• For character data



• If, when reading data using the GETMEM instruction, a character variable or character array variable specified as the variable for reading stores more character data than the number of bytes read (1 byte equals one character), the result becomes as follows.



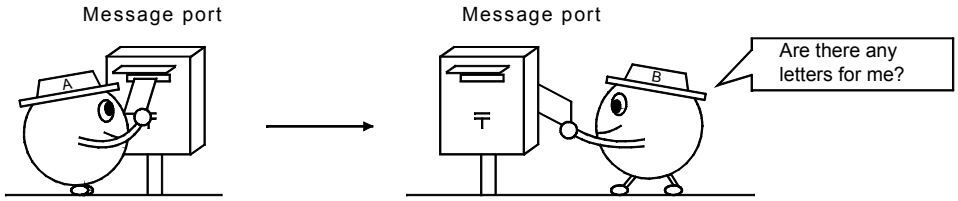
REMARK

Data can also be read/written to/from the extension registers ED using the special variable W@(ED, n). See Section 2.8.3 for the details.

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8.5.2 Message ports

It is possible to exchange messages, as if sending letters, between the programs, and synchronize the executions by making (defining) a message transfer location (message port) in memory in AD51H-BASIC.
To synchronize the executions via a message port, it is not necessary to consider the interlocking of the wait status as required by the event control. The wait status is created automatically.

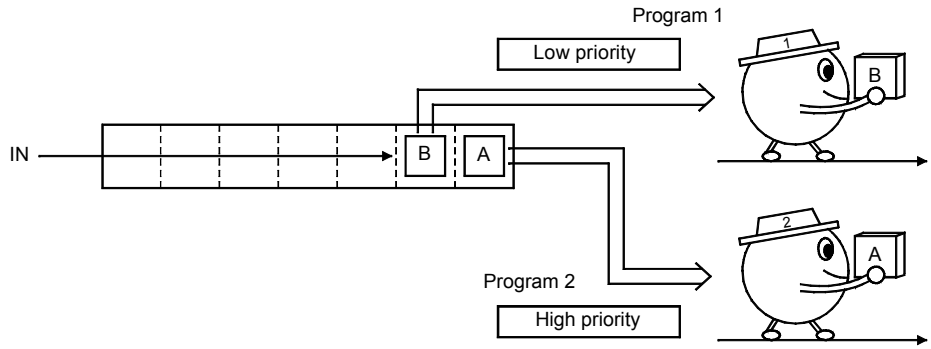


(1) To use message ports

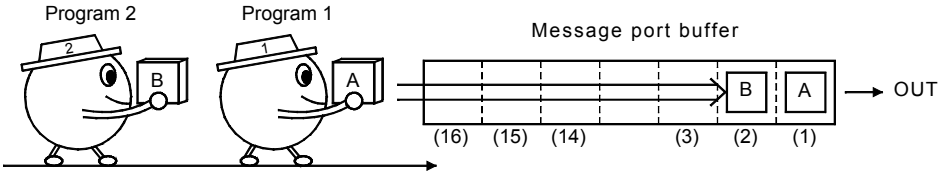
In order to use message ports, the following should first be understood:

- In order to use a message port, it is necessary to open the message port in one of the BASIC programs in advance. A message port can be opened in any program. Moreover, the program that opened the message port does not have to reside in memory.
- The maximum length of a message is 256 bytes.
- Up to a maximum of 32 message ports can be opened in the communication module. To distinguish each message port, a number from 0 to 31 is assigned to each message port.
- Each message port can store up to 16 messages asynchronously. Message data in a message port can be retrieved in the order of transmission (FIFO method) or in the order of the program priority (priority method). Whether a message port uses the FIFO method or priority is predefined by the message port number.

Priority method • • • Message port numbers from 0 to 15



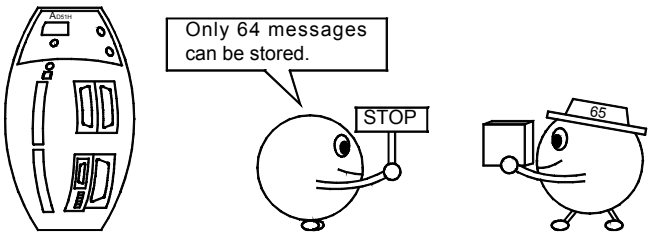
FIFO method • • • Message port numbers from 16 to 31



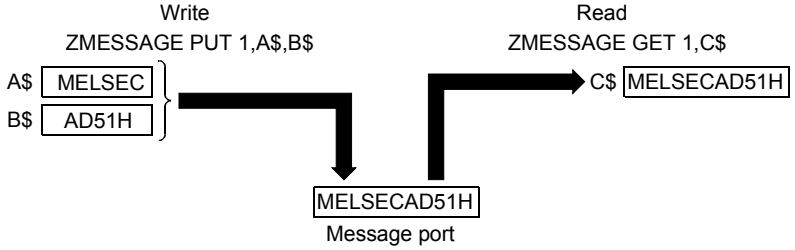
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• An error occurs if the total number of messages in all message ports exceeds 64. Fortunately, the total number decreases by one each time a message is read.



• If there are no messages in the specified message port when a program is trying to read a message from the message port, the operation will wait until a message is sent to the message port.
• Make an agreement on the following in advance before using a message port.
1) The length of the message input to and output from the message port (number of bytes)
2) The message port type (FIFO method, priority method)
• When multiple data is combined into one message, it is treated as one data item on the reading side even if it is written as follows.



This is because message ports do not support delimiters within a message. The user needs to manage delimiters within a message.

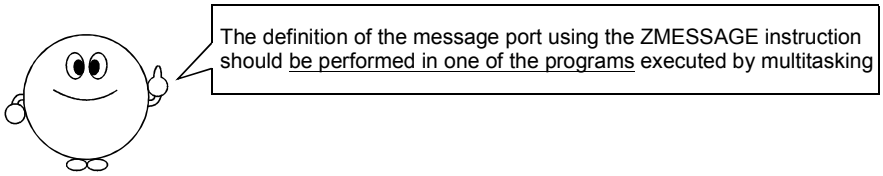
(2) How to use message ports

The following explains message port data, how to input or output messages, and precautions on inputting/outputting messages.

1) Define a message port.

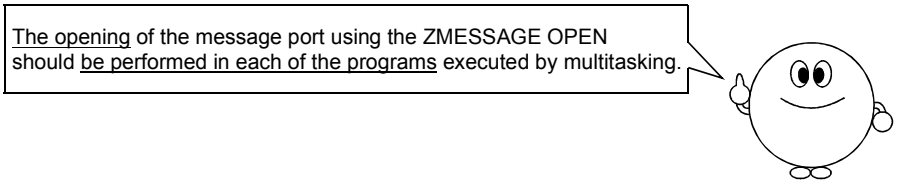
ZMESSAGE <message port number> LEN=<message length>

BASIC creates a message port in the main memory according to the definition of the message port.



2) Open the message port.

ZMESSAGE OPEN <message port number>



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3) To write a message to the message port:

ZMESSAGE PUT <message port number>, <transmission data>, • • •

3)' To read a message from the message port:

ZMESSAGE GET <message port number>, <variable where the data read is stored>, • • • • • • △ <timeout>

See 2) in (3) for the specification of <timeout>.

4) Close the message port to finish inputting/outputting the message.

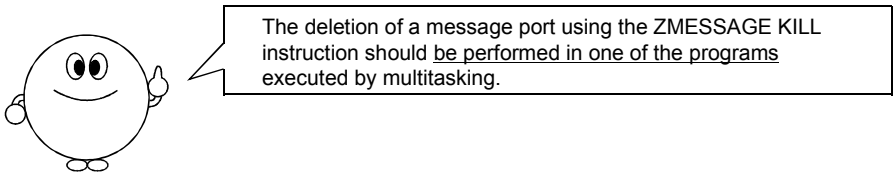
ZMESSAGE CLOSE <message port number>

The closed message port can be opened again by the ZMESSAGE OPEN instruction.

5) Delete the message port when finishing using the message port.

ZMESSAGE KILL, <message port number>

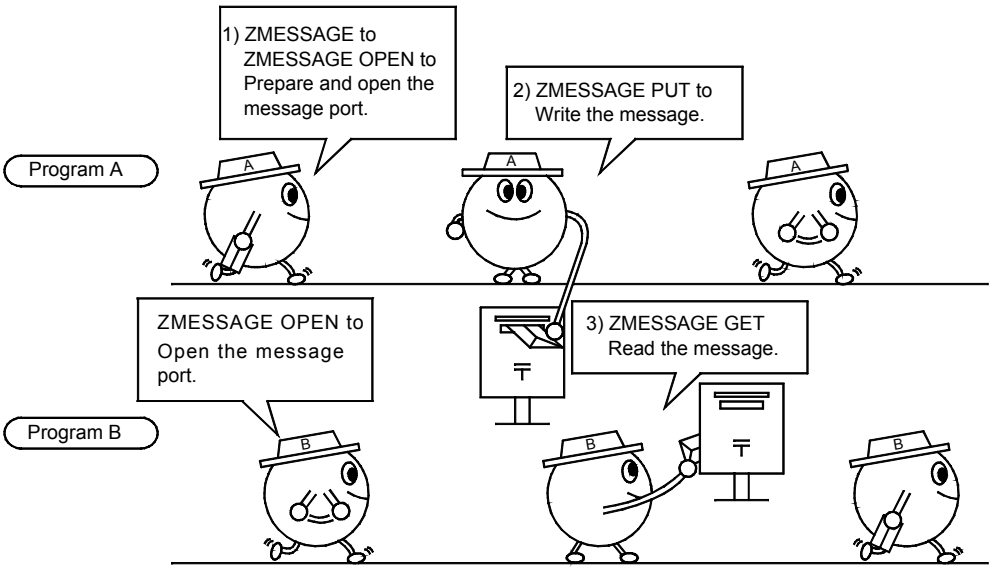
Once the message port is deleted, the message port in the main memory is also deleted. Therefore, it is necessary to define the message port in order to use the message port specified by <message port number> again.



(3) Execution order of instructions when using a message port

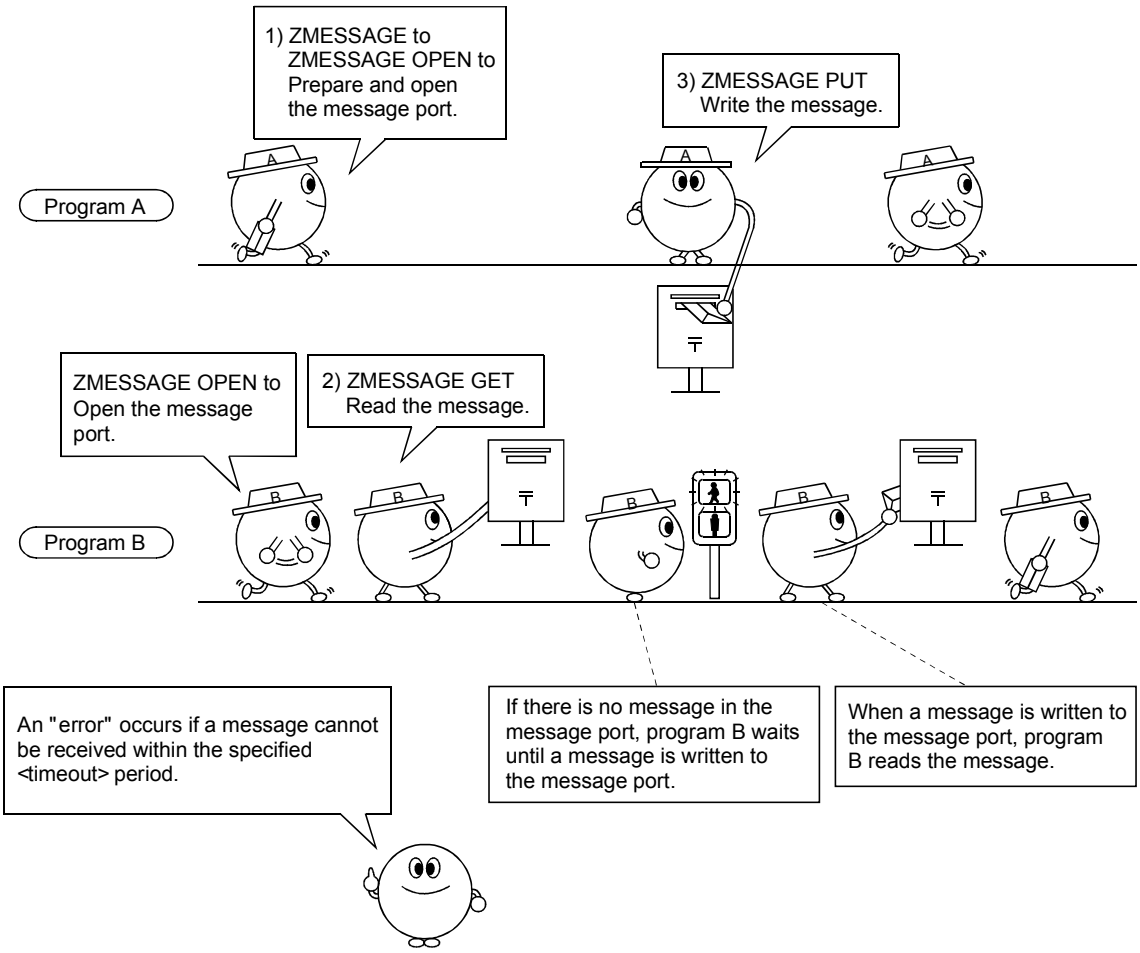
The following shows the execution order of instructions when programs are exchanging messages and synchronizing their executions through message ports:

1) The following occurs when program B reads a message after program A writes the message.



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2) If program B reads a message before program A writes it, the execution is synchronized as follows:



Unlike the event control, it is not necessary to interlock the programs when using a message port because the program goes into the wait status automatically.

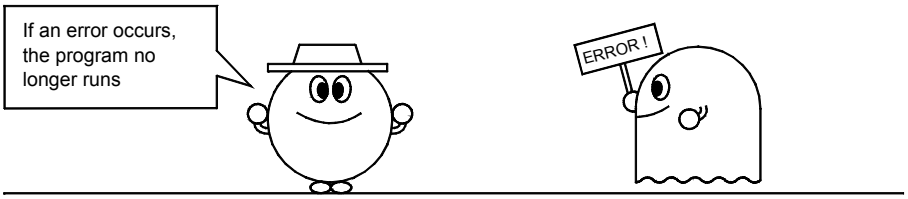
REMARK

In message exchange using message ports, the OS does not keep track of which program writes which message.
If it is desired to keep track of which program writes a given massage, add the program name or similar identifier to the message so that it can be identified on the reading side.

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9 THE CONCEPT OF ERROR HANDLING

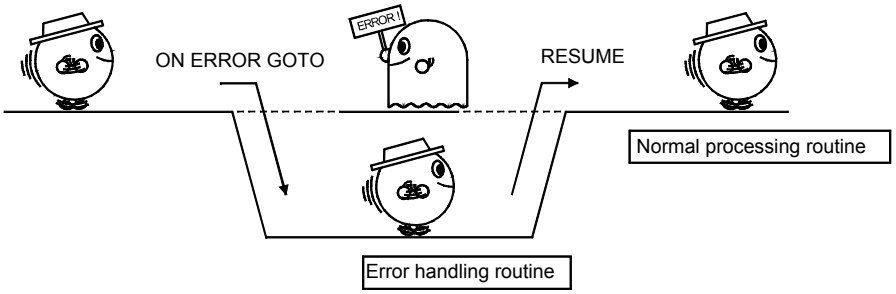
If an error occurs while running the BASIC program, an error message is displayed and the program stops running.



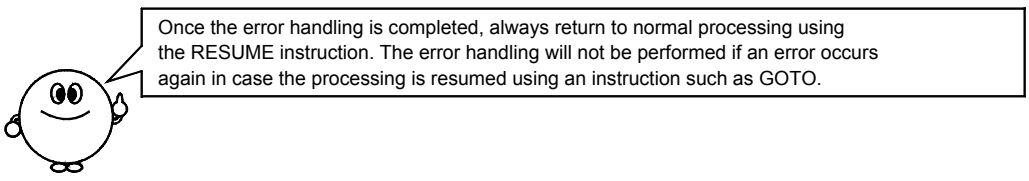
Although the program is usually created to generate a minimal amount of errors taking as many potential causes into consideration as possible, errors may occur due to causes that are normally difficult to foresee.
Creating an “error handling routine” in BASIC to deal with these kinds of errors will allow the program to continue running without stopping and displaying an error message.

9.1 Definition of Error Handling

Error handling routine is a routine performed when an error occurs. It is defined using the ON ERROR GOTO instruction. By specifying a line number or label after the ON ERROR GOTO instruction, the routine begins executing from the line specified by this line number or label once an error occurs.



In the error handling routine, appropriate corrective action for the error can be taken using BASIC instructions.
Once the error handling is completed, normal processing can be resumed using the RESUME instruction.



REMARK

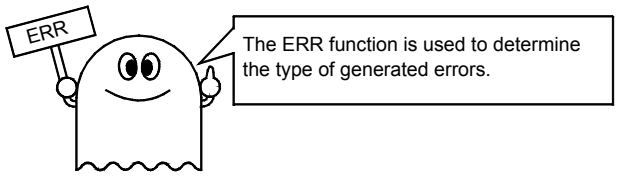
- To disable an error handling routine that has been defined, set ON ERROR GOTO to 0. After this, an error message is displayed and the program stops if an error occurs.

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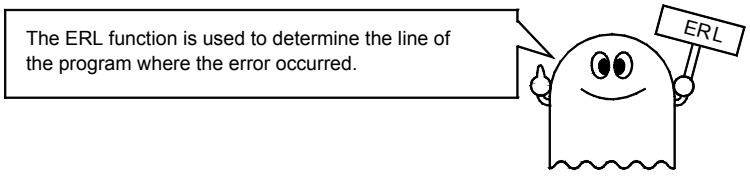
9.2 How to Determine the Type of Error and the Location where the Error Occurred

The type of error and the line number where it has occurred can be determined by using the following two functions in the error handling routine.

- ERR function Gives the error code for the generated error.



- ERL function Gives the line number where the error occurred



The ERR function gives the type of error as an error code. See the error code table in Appendix 4.4 for the correspondence between the error type and error code.
The generated error can be determined in detail by combining the ERR and ERL functions.
The error handling routine is branched according to these functions, in order to perform the correct processing for the generated error.

Example

```
 5  ON ERROR GOTO 100
10  INPUT "X=" ;X
20  INPUT "Y=" ;Y
30  A=EXP (X) :PRINT "EXP (X)=" ;A
40  B=10^Y :PRINT "10^Y=" ; B
50  END
100  IF ERR=6 AND ERL=30 THEN ———— This is the judgment when an
PRINT "Choose a smaller X"          Overflow error occurs at line 30.
110  IF ERR=6 AND ERL=40 THEN ———— This is the judgment when an
PRINT "Choose a smaller Y"          Overflow error occurs at line 40.
120  RESUME 10
RUN
X=?100
Y=?2
"Choose a smaller X"
X=?2
Y=?2
EXP (X)=7.38906
10^Y=100
OK
■
```


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9.3 Precautions Regarding Error Handling

Some precautions when creating an error handling routine are given below.

(1) Example of error prevention in a program

The error handling routine is the last defense against the program stopping. It is better to create the program so that errors can be prevented in the program itself, if possible, without using an error handling routine.

Example

```
10 INPUT " A=" ;A
20 INPUT "B=" ;B
30 C=A/B
40 PRINT " A/B =" ;C
```

If B is set to 0 in this program, a Division by 0 error will occur at line 30.



```
10 INPUT " A=" ;A
20 INPUT "B=" ;B
25 IF B=0 GOTO 20
30 C=A/B
40 PRINT " A=" ;C
```

Add line 25 so that line 30 will not be executed if B = 0.

(2) Corrective action when an error that cannot be handled occurs

In the error handling routine, combine the ERR function and ERL function in an appropriate manner and always make sure that generated error can be properly handled in the error handling routine. If this is not checked, the error may not be properly handled in the error handling routine and an error may occur in system operation.

It is recommend to interrupt the error handling using “ON ERROR GOTO 0” and stop the program operation if an error that cannot be handled occurs.

Example

Perform the error handling for preventing a wrong memory card from being inserted. The program is stopped if any other errors occur.

```
  10 ON ERROR GOTO 1000
     :
 100 OPEN "  0:DATA\110.DA   T" FOR INPUT AS #1
     :
 200 OPEN "  0:DATA\120.DAT"    FOR INPUT AS #2
     :
 900 END
11000  IF ERR<>53 THEN ON ERROR GOTO 0 • • •     Check if the error is File not Found.
                                                 It the error is not File not Found, stop the program.
 1010  IF ERL=100 THEN PRINT "Insert the memory card that contains 110.DAT" :GOTO 1040 • • • •
                                                                  :
 1020  IF ERL=200 THEN PRINT "Insert the memory card that contains 120.DAT" :GOTO 1040 • • • •
                                                                  :
 1030  ON ERROR GOTO 0 • • • • • •    If the error did not occur at line 100 or line 200, stop the program.
 1040  PRINT "Press any key when the card is inserted"
 1050  K$=INPUT$(1)
 1060  RESUME • • • • • •    Start the execution again from the instruction that generated the error.
```

Check whether the error occurred at line 100 or line 200.

If the error occurred at line 100 or line 200, an error handling appropriate to each case is performed.

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10 PROGRAM DEBUGGING

Program debugging refers to the operation of checking whether an edited program will run correctly and revise the program so that it runs correctly. (Debug = removing the bugs)
This section shows the sequence of program debugging and the instructions used in debugging.

10.1 Sequence of Debugging Programs Executed Simultaneously in Multitasking

When executing multiple programs simultaneously (parallel operation in multitasking), program debugging is generally performed in the following sequence.

1) Single debugging •••• Execute the programs one at a time, and check each program to see if it runs properly while specifying various conditions that change the flow of execution.
2) Combination debugging •••• Group the programs together in several groups, each consisting of multiple programs related to the execution of one process.
Next, execute multiple programs in one group at a time according to the specifications and check to see if each program runs properly.
3) Overall debugging •••• Execute all the programs according to the specifications and check to see if each program runs properly.
If each program runs according to the specifications in an overall debugging, then the debugging is complete.

10.2 Instructions Used when Debugging Programs

The following are typical instructions used when debugging BASIC programs.
See Chapter 11 for details on each instruction.

(1) TRON and TROFF instructions

The TRON instruction is used to follow the program flow. When the TRON instruction is executed, the line numbers of lines that have been executed are shown enclosed in square brackets. This makes it easy to see how the flow branches due to the IF~GOTO instruction and how the instructions are repeated due to the FOR~NEXT instruction.
Execute the TROFF instruction to stop the line number display.

```
10 C=10
20 FOR I=1 TO 3
30  C=C+1
40 NEXT I
50 TRON
60 FOR I=1 TO 3
70  C=C+1
80 PRINT I;C
90 NEXT I
100 TROFF
110 C=C+1
120 PRINT C
130 END
```

```
RUN
[60][70][80] 1  14
[90][70][80] 2  15
[90][70][80] 3  16
[90][100]  17
OK
```

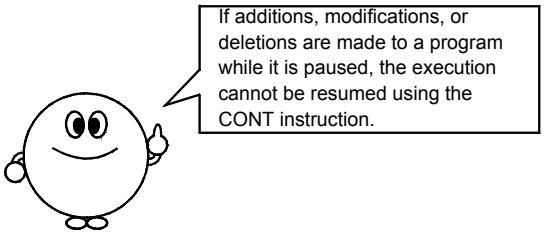

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(2) STOP and CONT instructions and operation of the Break (Ctrl + C) key

The program pauses (interrupts) when a STOP instruction is executed.
Also, if the Break (Ctrl + C) key is pressed while the program is being executed, the program pauses (interrupts) in the same way as in the case of the STOP instruction.
Execute the CONT instruction to resume the execution of a program that has been paused (from the next instruction).

```
10 C=1                          RUN
20 FOR I%=0 TO 3                0
30  PRINT I%                    1
40 NEXT I%                      2
50  PRINT "Count = ";C          3
60 STOP                         Count = 1
70 C=C+1                        Break in 60
80 GOTO 20                      OK
                                CONT
                                0
                                1
                                2
                                3
                                Count = 2
                                Break in 60
                                OK
```



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(3) PRINT instruction and LET instruction

The targets of these instructions are the values of variables and arrays used in a program at the time it was paused by the above-mentioned STOP instruction.
Execute the PRINT instruction to display the values of variables etc. on the screen while the program is paused.
Execute the LET instruction to forcefully change the values of variables etc. while the program is paused.

```
10 DIM IN$(2)
20 FOR I%=0 TO 2
30  INPUT IN$(I%)
40 NEXT I%
50 STOP
60 FOR I%=0 TO 2
70  PRINT IN$(I%)
80 NEXT I%
90 END
```

```
RUN
? MITUBISHI
? MELSEC
? AD51H
Break in 50
OK
PRINT IN$(0)
MITUBISHI
OK
IN$(0) = "Mitsubishi"
OK
PRINT IN$(2)
AD51H
OK
IN$(2)="BASIC"
OK
CONT
Mitsubishi
MELSEC
BASIC
OK
```

Use the following instructions in a BASIC program to make debugging easier.

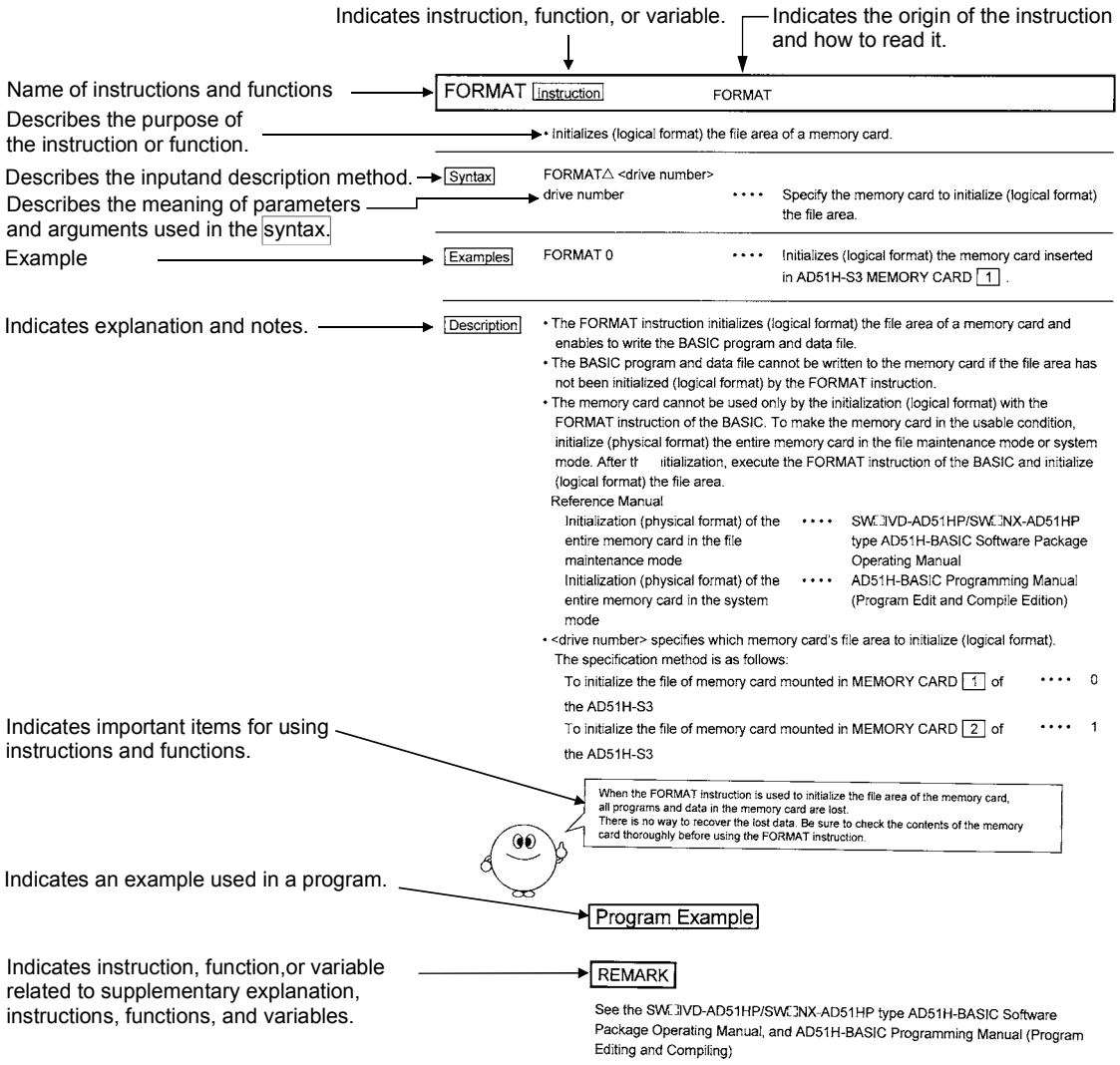
- ON ERROR GOTO and RESUME instructions
  Use these instructions to prevent the program from being stopped due to error occurrence.
- ERROR instruction
  Use this instruction to generate an error to check whether or not the flow of the program execution is correct.
- ERR and ERL functions
  Use these instructions to check the error code of an error that just occurred and the line number where the error occurred, respectively.

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11 INSTRUCTIONS AND FUNCTIONS

This chapter explains general instructions and functions used by AD51H-BASIC.

Each item is described in the following format.



Symbols used in the syntax have the following meanings:

1) The part written in alphabetical characters must be entered as is.
2) Items enclosed with brackets [ ] may be omitted.
3) Items enclosed with parentheses ( ) or double quotations (“ “) need to be enclosed by them.
4) Items with omissible symbol (• • • • •) can be repeatedly listed as long as they fit in one line.
5) △ indicates that at least one space is necessary.
6) Items enclosed with < > are specified by the user. Specify an appropriate parameter for the intended operation.

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11

ABS Function ABSolute

• Returns the absolute value of an arithmetic expression.

Syntax

ABS (<arithmetic expression>)

arithmetic expression	• • • •	Specify the value to calculate the absolute value.

Examples

A=ABS(−3.14)	• • • •	Assigns 3.14 (absolute value of −3.14) to A.
B=ABS(0)	• • • •	Assigns 0 (absolute value of 0) to B.
C=ABS(3.14)	• • • •	Assigns 3.14 (absolute value of 3.14) to C.

Description

• The ABS function returns the absolute value of <arithmetic expression>.
• Returned values are always positive or 0.
• Returns a double precision number if a double precision real number is included in the <arithmetic expression>, otherwise returns a single precision number.

Program Example

```
10 ' Calculates absolute value
20 A=-2.56
30 B=0                                  :  'Defines the value
40 C=2.56
50 PRINT "ABS(A)=";ABS(A)
60 PRINT "ABS(B)=";ABS(B)               :  'Displays the absolute value
70 PRINT "ABS(C)=";ABS(C)
80 END


RUN
ABS(A)= 2.56
ABS(B)= 0
ABS(C)= 2.56
OK
```


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ASC Function ASCii

• Returns the character code corresponding to the starting character of the character string expression.

Syntax

ASC (<character string expression>)

character string expression • • • • Specify the character string to return a character code.

Examples

A=ASC(“BASIC”) • • • • Stores the character code (42_H) of the starting character B of the character string to A.

C=ASC(“D”) • • • • Stores the character code (44_H) of character “D” to C.

Description

• The ASC function returns the character code that corresponds to the starting character of <character string expression>.

• If an empty character string is specified in < character string expression>, an “Illegal function call” error occurs.

Program Example

```
10 ' Displays the character code of the starting character of a character string
20 A$="AD51H-BASIC"                          :  ' Defines the character string
30 CODE=ASC(A$)                              :  ' Returns the character code
40 PRINT "Character =";CHR$(CODE)            :  ' Displays the character
50 PRINT "Decimal =";CODE                    :  ' Character code (decimal)
60 PRINT "Hexadecimal =";HEX$(CODE)          :  '                (hexadecimal)
70 END
```

```
RUN
Character =A
Decimal= 65
Hexadecimal=41
OK
```

REMARK

• See the CHR$ and HEX$ functions.

• For converting from a character code numeric value to a character string, see the CHR$ function.

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ATN Function — TaNgent

• Returns arc tangent ($\tan^{-1}$) of the arithmetic expression.

Syntax

ATN (<arithmetic expression>)

arithmetic expression • • • • Specify an arithmetic expression to calculate the arc tangent.

Examples

```
A=(180/3.141592) *
ATN(1)
```

• • • • Calculates the arc tangent of 1, then converts to degrees and assigns it to A.

Description

• The ATN function returns the arc tangent ($\tan^{-1}$) of the value from the <arithmetic expression>.
• While <arithmetic expression> can be any value type, the ATN function always calculates in single precision.
• Unit of the returned value is in radian.

Program Example

```
10 ' Calculates angle by the ATN function
20 HI=1732/1000                    :  ' Defines the value
30 RAD=ATN(HI)                     :  ' Calculates the angle
40 DEG=(RAD*180)/3.141592653#      :  ' Converts the value in radian to degrees
50 PRINT "RAD.=";RAD               :  ' Display
60 PRINT "DEG.=";DEG
70 END


RUN
RAD.= 1.04719
DEG.= 59.9993
OK
```

REMARK

See the COS, SIN and TAN functions.

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AUTO Instruction — AUTOmatic

• Automatically displays the line number at the beginning of a line.

Syntax

AUTO△ <line number>, <increment>

line number	• • • •	Specify the line number to start the display.
increment	• • • •	Specify the increment of the line number.

Examples

AUTO	• • • •	Generates the line number starting from line number 10 in increments of 10. (Line number 10, 20, 30, …)
AUTO 100	• • • •	Generates the line number starting from line number 100 in increments of 10. (Line number 100, 110, 120, …)
AUTO 100, 20	• • • •	Generates the line number starting from line number 100 in increments of 20. (Line number 100, 120, 140, …)
AUTO , 20	• • • •	Generates the line number starting from line number 0 in increments of 20. (Line number 0, 20, 40, …)
AUTO 100	• • • •	Generates the line number starting from line number 100 in the increment that was previously specified by the AUTO instruction.

Description

- The AUTO instruction automatically displays the line number as specified.
- The value specified by <line number> becomes the first line number. For the successive lines, the value specified by <increment> is added to the value of the line number.
- If <line number> and <increment> are both omitted, 10 is assumed for both values.
- If only <line number> is omitted, 0 is assumed for the line number.
- If a comma is added after the <line number>, and <increment> is omitted, <increment> in the previous AUTO instruction is applied.
- If a line number that has been already used is specified in the AUTO instruction, ＊ (asterisk) is displayed after the line number. If no character is entered from the keys after ＊, the contents of the line are not changed even if the Enter key is pressed.
- To finish the execution of the AUTO instruction, press the Ctrl + C keys or Break key.
- While the AUTO instruction is being executed, the line that is already displayed can't be changed by moving the cursor.

REMARK

See Section 3.1.

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B@ Variable

Bit@

• Reads or writes bit information in the expansion relay (EM), special relay (EM) general-purpose input (X), and general-purpose output (Y).

Syntax

B@ (<device> , <device number>)

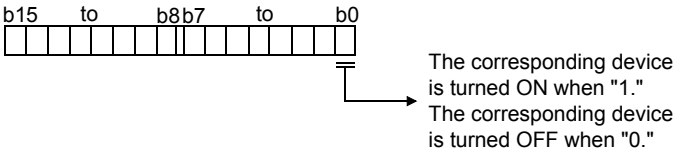
device	• • • •	Specify the device to read and write.
device number	• • • •	Specify the device number to read and write.

Examples

A%=B@ (EM, 100)	• • • •	Reads the bit information of the expansion relay EM100 to A%.
A%=B@ (Y, &H1B)	• • • •	Reads the bit information of the general-purpose output Y001B to A%.
B@ (EM, 200) =A%	• • • •	Write the bit information to the expansion relay EM200.
B@ (X, &HA) = A%	• • • •	Write the bit information to the general-purpose input X000A.

Description

• The B@ variable reads and writes the bit information of the device.
• Specify one of the following devices for <device>:
  Expansion relay • • • • EM
  General-purpose input • • • • X
  General-purpose output • • • • Y
• Specify the following device number for <device number>:
  EM • • • • 0 to 1023
  X, Y • • • • &H0 to &H1F
• The read data is 1 when ON and 0 when OFF.
• For the write data, bit 0 of the specified value or of the value that is stored in the specified variable is valid.



• Set the data by an integer constant or an integer variable when writing.
• Only write operation can be used when general-purpose input X is specified.
• Only read operation can be used when general-purpose output Y is specified.

REMARK

See the W@ function.

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BEEP Instruction

BEEP

• The buzzer sounds from the console's built-in speaker.

Syntax

BEEP

Examples

BEEP

Description

• The BEEP instruction rings the buzzer for a certain duration as executing PRINT CHR$(7).
• The BEEP instruction can be executed only at the port specified as a console in the communication module. It is not for the output destination switching by the ZODV instruction.

Program Example

```
10 ' Rings the buzzer 10 times
20 FOR I=1 TO 10                :  ' Repeats 10 times
30  BEEP                        :  ' Rings the buzzer
40  PRINT I;"times"             :  ' Displays the count
50  FOR J=0 TO 200              :  ' Pauses by looping
60   NEXT J
70 NEXT I
80 END
```


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BIN$ Function

BINary $

• Converts a decimal number to a binary string.

Syntax

BIN$ (<arithmetic expression>)

arithmetic expression • • • • Specify an integer to return a character string.

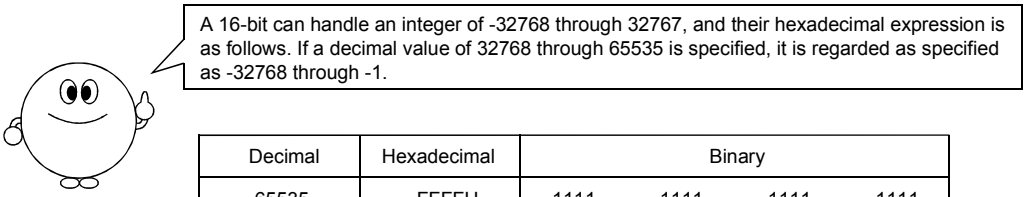
Examples

A$=BIN$(10) • • • • Stores the character string of binary expression of integer 10 to A$.

Decimal		Binary
10	→	1010

Description

• The BIN$ function returns a character string for the binary expression of an integer.
• If the value of <arithmetic expression> contains a fractional part, the fractional part is rounded down to an integer, then converted.



Decimal	Hexadecimal	Binary				
65535 to 32768	FFFFH to 8000H	1111 to 1000	1111	1111 to 0000	1111	Same result
32767 to 0	7FFFH to 0000H	0111 to 0000	1111	1111 to 0000	1111	
-1 to -32768	FFFFH to 8000H	1111 to 1000	1111	1111 to 0000	1111	

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Program Example

```
10 ' Converts a decimal number to a binary number
20 A=1234                                  :  ' Defines the numeric value
30 A$=BIN$(A)                              :  ' Converts to a binary number
40 PRINT "Decimal=";A
50 PRINT "Binary=";A$
60 END


RUN
Decimal= 1234
 Binary=10011010010
OK
```


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BSWAP Instruction — Byte SWAP

• Swaps two values in byte units.

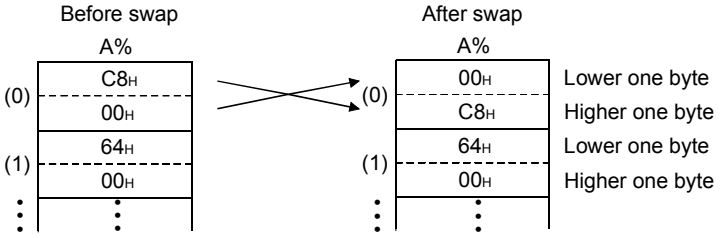
Syntax

BSWAP△ <variable 1> , <swap starting address of variable 1> ,
<variable 2> , <swap starting address of variable 2> , <swap count>

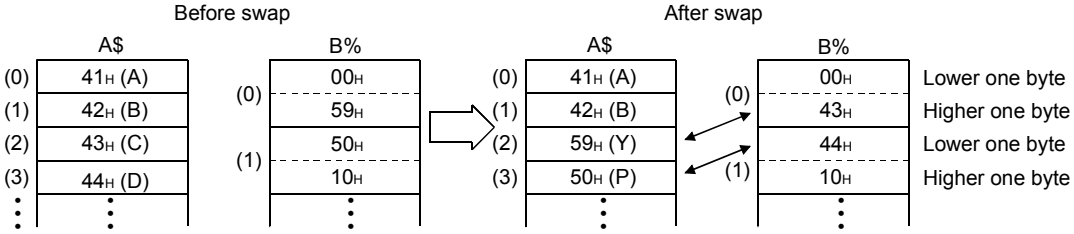
variable 1, variable 2	• • • •	Specify the variables to be swapped.
swap start address of variable 1, variable 2	• • • •	Specify the swap start address of variable1 and variable2.
swap count	• • • •	Specify the number of items to swap in byte units.

Examples

BSWAP A%( ), 0, A%( ), 1, 1 • • • • Swaps the upper one byte and lower one byte of A%(0).



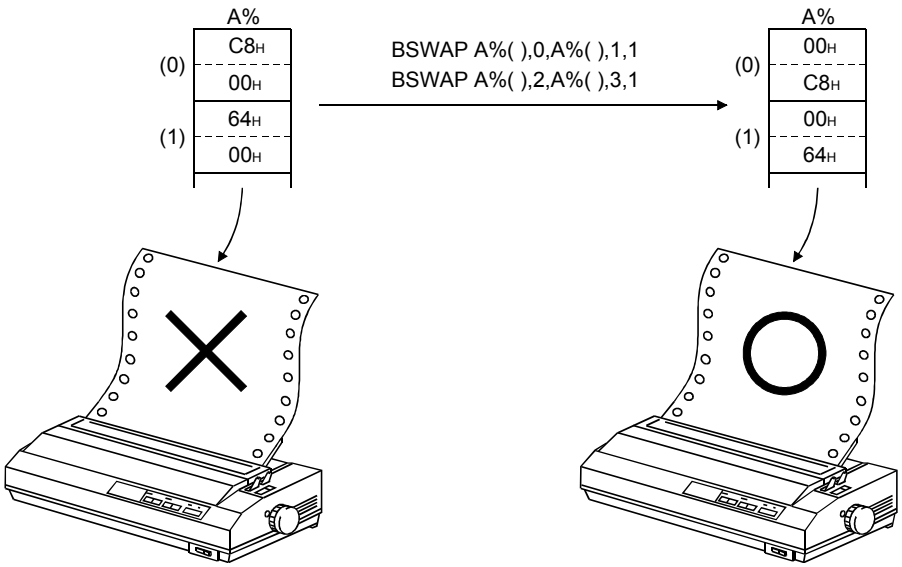
BSWAP A$, 2, B%( ), 1, 2 • • • • Swaps two bytes of character array A$(2), A$(3) and other two bytes that are the upper one byte of the integer array B%(0) and the lower one byte of B%(1).



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Description

• The BSWAP instruction swaps two values in byte units starting from the address specified by the variable.
Especially, this instruction is used in order to rearrange the I/O data that is communicated with the external device so that it conforms to the data format of the device used.



• An error occurs if the swap starting address in the variable is larger than the array size specified by the DIM instruction.
• The same variable can be specified to <variable1> and <variable2>.
• Specify the number of swap counts in bytes to <swap count>.

Program Example

```
10 ' Swaps the contents of array A%(0) and A%(1)
20 DIM A%(1)                          :  ' Defines the array
30 A%(0)=&H924                        :  ' Defines a numeric value to the array
40 A%(1)=&H1159
50 PRINT "Before swap"                :  ' Displays the value before swapping
60 PRINT "A%(0)=&H";HEX$(A%(0))
70 PRINT "A%(1)=&H";HEX$(A%(1))
80 BSWAP A%( ),0,A%( ),2,2            :  ' Swaps
90 PRINT "After swap"                 :  ' Displays the value after swapping
100 PRINT " A%(0)=&H";HEX$(A%(0))
110 PRINT " A%(1)=&H";HEX$(A%(1))
120 END
```


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```
RUN
Before swap
 A%(0)=&H924
 A%(1)=&H1159
After swap
 A%(0)=&H1159
 A%(1)=&H924
OK
```


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CDBI Instruction — Convert DouBle to Integer

• Converts a double precision real number to a 2-word (32-bit) integer used by the PLC CPU.

Syntax

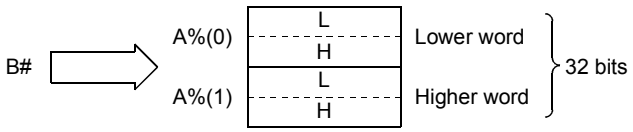
CDBI△<double precision variable> , <array variable>

double precision variable • • • • Specify the double precision variable where the data to be converted is stored.

array variable • • • • Specify the one dimensional integer array variable where the converted data is stored.

Examples

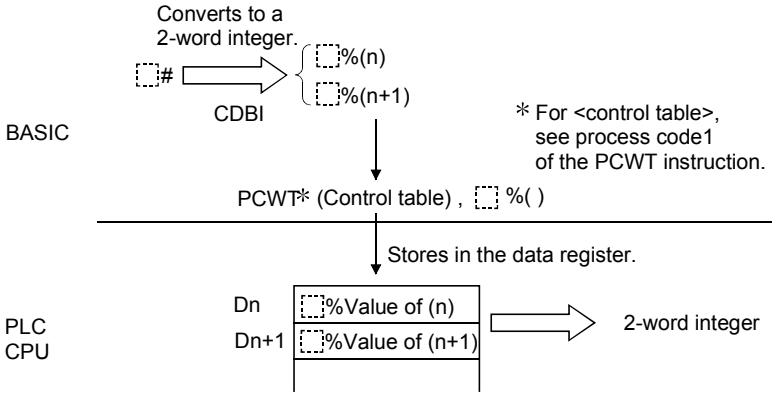
CDBI B#, A%(0) • • • • Converts the value of B# to an integer and stores in A%(0) and A%(1).



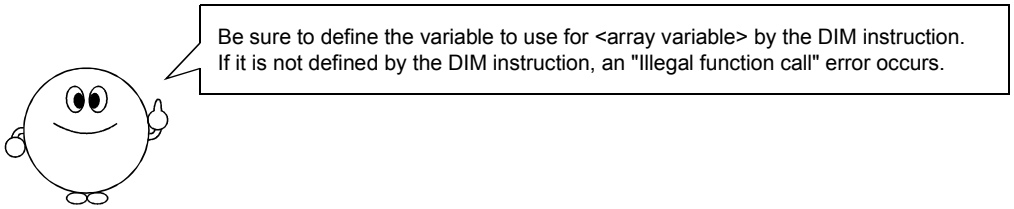
Description

• The CDBI instruction converts a double precision real number to a 2-word (32-bit) integer used by the PLC CPU.
• BASIC can handle a double precision real number of −2147483648 through 2147483647. An "Over flow" error occurs if the value exceeds this range.
If the converting double precision real number contains a fractional part, the fractional part is rounded down, then converted.
• The following illustrates handling of BASIC's double precision real number by the PLC:

Example



• <array variable> uses a one dimensional integer array variable.
An "Illegal function call" error occurs if anything other than the one dimensional integer array variable is specified.



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Program Example

```
10 ' Converts the double precision real number to a 2-word integer and writes it into D0 and D1
20 DIM B%(1),TBL%(5)                 :  ' Defines the array
30 A#=1234567890#                    :  ' Defines the double precision real number
40 CDBI A#,B%(0)                     :  ' Converts to a 32-bit integer
50 TBL%(0)=255                       :  ' Sets the communication station number to
                                        the local station
60 TBL%(1)=1                         :  ' Specifies writing to the device memory
70 TBL%(2)=2                         :  ' Specifies word as the unit
80 TBL%(3)=18                        :  ' Specifies the data register
90 TBL%(4)=0                         :  ' Specifies the device number
100 TBL%(5)=2                        :  ' Specifies the number of processing items
110 PCRD TBL%(),B%()                 :  ' Executes the write operation
120 END
```

REMARK

See the CDBI, CIDB, CISN, PCRD and PCWT instructions, and Chapter 4.

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CDBL Function — Convert to DouBLe

• Converts an integer or a single precision real number to a double precision real number.

Syntax

CDBL (<arithmetic expression>)

arithmetic expression	• • • •	Specify an integer or a single precision real number to be converted to a double precision real number.

Examples

A#=CDBL(B!)	• • • •	Converts the value of the single precision real number B! into a double precision real number and assigns it to A#.
C#=CDBL(D%)	• • • •	Converts the value of integer D% and assigns it to C#.

Description

• The CDBL function converts the value of <arithmetic expression> into a double precision real value.
• Although the type is converted, the number of effective digits is unchanged.
• The accuracy of the result value is the same as the one of the type before the conversion. (Integer part only for the integer type and the number of effective digits is six for a single precision real number.)
• When a single precision real number is converted by the CDBL function, the converted double precision real number and the original single precision real number may not match. This is because internally some values may not be represented correctly.

Example

```
PRINT CDBL (0.1!)
.1000000014901161
OK
■
```


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Program Example

```
10 ' Converts an integer or a single precision real number into a double precision real number
20 A%=256                          :  ' Defines an integer
30 B!=5.78                         :  ' Defines a single precision real number
40 A#=CDBL(A%)                     :  ' Converts an integer to a double precision
                                      real number
50 B#=CDBL(B!)                     :  ' Converts a single precision real number to
                                      a double precision real number
60 PRINT "A%=";A%,"B!=";B!         :  ' Value before conversion
70 PRINT "A#=";A#,"B#=";B#         :  ' Value after conversion
80 END


RUN
A%= 256       B!= 5.78
A#= 256       B#= 5.779999732971191
OK
```

REMARK

- The value is automatically converted to a double precision real number when a value is assigned to a double precision variable, or when a double precision real value is used as part of an arithmetic calculation. Therefore, A#=CDBL(3042.12!) and A#=3042.12! have the same result.

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CHAIN Instruction — CHAIN

• Erases or partly deletes the program that is currently being executed, and reads and executes the specified program.

Syntax

CHAIN△"[<drive number>:] [<system name> \] <file name>"
[, <line number1> :] [, ALL]
CHAIN△MERGE△" [<drive number>:] [<system name> \] <file name>" [, <line number 1> :]
[, ALL] [, DELETE△<line number 2> - <line number 3>]

drive number	• • • •	Specify the memory card or FD where the program to be read is stored.
system name	• • • •	Specify the system name where the program to be read is stored.
file name	• • • •	Specify the file name of a program to be read.
line number 1	• • • •	Specify the execution starting line of the program.
line number 2	• • • •	Specify the area to be deleted by the DELETE option.
line number 3	• • • •	Specify the area to be deleted by the DELETE option.

Examples

CHAIN "0:PRGM-A"	• • • •	Erases the current program and reads the program stored in the "PRGM-A.BAS" file from the memory card inserted in the M-CARD0. Then, executes the program after handing over the variables specified by the COMMON instruction.
CHAIN "1:PRGM-A", 200, ALL	• • • •	Erases the current program and reads the program written in the "PRGM-A.BAS" file of "1". Then, hands over all variables, etc., and starts executing from line number 200 of the program just read.
CHAIN MERGE "A:SUB-A", DELETE 1000-2000	• • • •	Erases line number 1000 through 2000 of the current program and reads the program written in the "SAB-A.BAS" file of "0." Then, merges them into one program and starts executing from line number 1000.
CHAIN MERGE, "0:TEST", 1000, DELETE 1000-1500	• • • •	Erases line number 1000 through 1500 of the current program and reads the program written in the "TEST.BAS" file of "0." Then, merge them into one program and starts executing from line number 1000.

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Description

• The CHAIN instruction reads a different program (subsequent program), which is separate from the program currently residing on the memory (current program), to the area of the same BASIC number, and hands the variables and their contents of the current program over to the subsequent program, then have the newly read program start its execution. In this way, a large program can be split and executed continuously.
• For details of specifying <drive number>; <system name> \ <file name> to read a new program, see Section 3.3.3.
• <line number 1> is the execution starting line of the newly read program and the program is started from the specified line number by specifying this line number. The program starts from the first line if <line number 1> is omitted.
<line number 1> may not be specified by a label. In addition, it is not a subject of line number change by the RENUM instruction.
• Hand over the variables of the current program (current program) to the newly read program (subsequent program) as follows:
1) To hand over all variables from the current program to the subsequent program, specify the ALL option in the CHAIN instruction.
2) To hand over only a part of variables from the current program to the subsequent program, omit the ALL option in the CHAIN instruction and specify the variables to hand over separately by using a COMMON instruction.
For details of the COMMON instruction, see the COMMON item.
• The following restrictions apply for handing over the variables:
1) The user-defined functions that were defined by the DEF FN function cannot be handed over.
2) The constant types defined by the DEFDBL, DEFSNG, DEFINT, and DEFSTR instructions can be handed over only when the MERGE option is specified.

To specify the MERGE option

• If the MERGE option is specified, the subsequent program is merged into the current program and executed. This option enables to replace the internal subroutine. In order to replace, it is necessary to specify which part of the current program to erase and the subsequent program to merge. Specify this with the DELETE option. In other words, <line number 2> - <line number 3> of the current program is deleted and the subsequent program is inserted into that part.
If both MERGE and DELETE options are specified, the program lines are reordered depending on the line numbers of the merging program and merged program.
• Be sure to specify the MERGE option when the DELETE option is specified.

REMARK

See Section 3.15.

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CHR$ Function CHaRacter $

• Returns a character whose character code is the value of the arithmetic expression.

Syntax

CHR$ (<arithmetic expression>)

arithmetic expression • • • • Specify the character code to get a character.

Examples

PRINT CHR$ (&H41) • • • • Displays A whose character code is 41.

Description

• CHR$ function returns a character whose character code is the numeric value specified by <arithmetic expression>.
Specify the arithmetic expression by 0 through 255 (&H00 through &HFF).
• Normally, the CHR$ function is used in order to display a special character.
• For converting from a character to a value, see the ASC function.

Program Example

```
10 ' Displays characters of character code from &H41 to &H5A.
20 FOR I=&H41 TO &H5A                    :   ' Repeats from &H41 to &H5A
30  PRINT CHR$(I);" ";                   :   ' Displays a character
40 NEXT I
50 END


RUN
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
OK
```

REMARK

See the ASC function.

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CIDB Function — Convert Integer to DouBle

• Converts a 2-word (32-bit) integer to be used by the PLC CPU into a double precision real number.

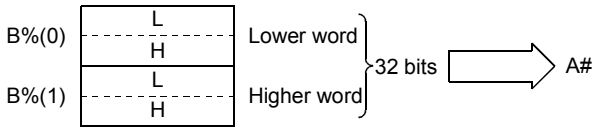
Syntax

CIDB (<array variable>)

array variable • • • • Specify a one-dimensional integer array variable where the data to be converted is stored.

Examples

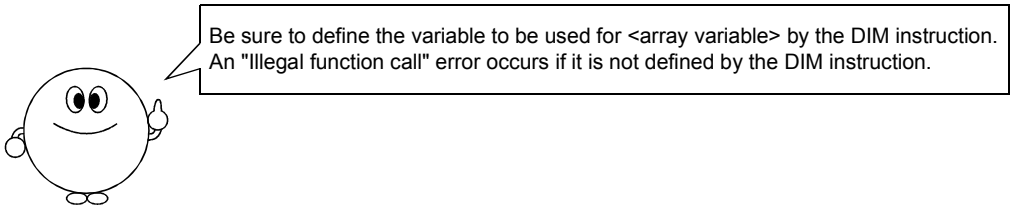
A#=CIDB(B%(0)) • • • • Converts an integer value in B%(0) and B%(1) into a double precision and stores in A#.



Description

• The CIDB function converts a 2-word (32-bit) integer to be used by the PLC CPU into a double precision real number.

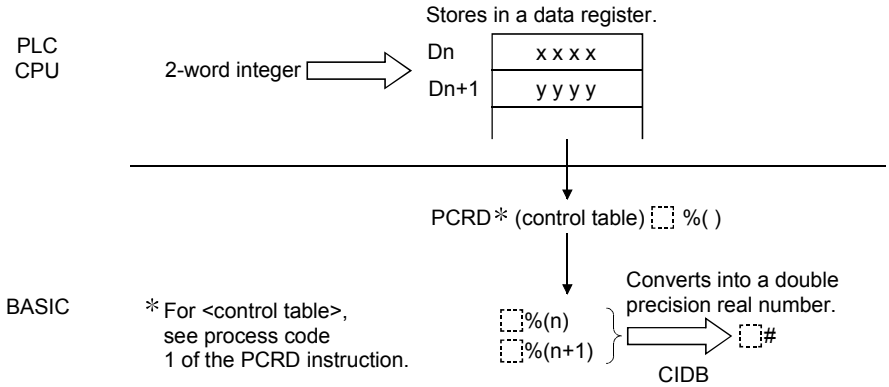
• <array variable> uses a one dimensional integer array.
An "Illegal function call" error occurs if anything other than one dimensional integer array is specified.



• Accuracy of the double precision real number, which was converted from a 2-word (32-bit) integer, is the same as the accuracy before the CIDB function was executed.

• The following shows how to handle 2-word (32-bit) integer to be used by the PLC CPU in BASIC:

Example



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Program Example

```
10 ' Converts 2-word integer in D0, D1 to a double precision real number
20 DIM TBL%(5),A%(1)                    :  ' Defines arrays
30 TBL%(0)=255                          :  ' Sets the communication station number to
                                           the local station
40 TBL%(1)=1                            :  ' Specifies readout of the device memory
50 TBL%(2)=2                            :  ' Specifies word as the unit
60 TBL%(3)=18                           :  ' Specifies the data register
70 TBL%(4)=0                            :  ' Specifies the starting device number to be
                                           read
80 TBL%(5)=2                            :  ' Specifies the readout count
90 PCRD TBL%(),A%()                     :  ' Executes the read operation
100 A#=CIDB(A%(0))                      :  ' Converts into a double precision real
                                           number
110 PRINT "D0,D1value-->";A#
120 END
```

REMARK

See the CSNI instruction, CIDB function, CISN function, PCRD instruction, PCWT function, and Chapter 4.

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CINT Function — Convert INTeger

• Converts a single precision real number or a double precision real number into an integer.

Syntax

CINT (<arithmetic expression>)

arithmetic expression • • • • Specify a single precision real number or a double precision real number to convert into an integer.

Examples

A%=CINT(B!) • • • • Converts a single precision real number B! into an integer and assigns it to A%.

C%=CINT(D#) • • • • Converts a double precision real number D# into an integer and assigns it to C%.

Description

• The CINT function converts the value of <arithmetic expression> into an integer value and returns the maximum integer that does not exceed the value of <arithmetic expression>.

• The fraction part is rounded down if a positive value is specified, and the fraction part is rounded up if a negative number is specified.

Example

5.689 → 5
1.031 → 1
2.999 → 2

-3.84 → -4
-1.2639 → -2
-1.9999 → -2

• An “Over flow” error occurs if the result value is out of the range of −32768 to 32767. Use the INT function to convert a value over 32768 into an integer value.

Program Example

```
10 ' Converts a single precision or a double precision real number into an integer
20 A!=7.15                    :  ' Defines a single precision real number
30 B#=1.598421#               :  ' Defines a double precision real number
40 A%=CINT(A!)                :  ' Converts a single precision real number to
                                 an integer
50 B%=CINT(B#)                :  ' Converts a double precision real number
                                 to an integer
60 PRINT "A!=";A!,"B#=";B#    :  ' Value before conversion
70 PRINT "A%=";A%,"B%=";B%    :  ' Value after conversion
80 END


RUN
A!= 7.15          B#= 1.598421
A%= 7             B%= 1
OK
```


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REMARK

- When assigning a value to an integer variable, the value type is automatically converted into an integer if the instruction or function requires an integer type as its parameter (argument). A%=3042.12! and A%=CINT(3042.12!) will have the same result.

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CISN Function — Convert Integer to SiNgle

• Converts a 2-word (32-bit) integer to be used by the PLC CPU into a single precision real number.

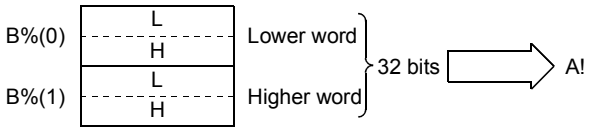
Syntax

CISN (<array variable>)

array variable •••• Specify a one-dimensional integer array variable where the converting data is stored.

Examples

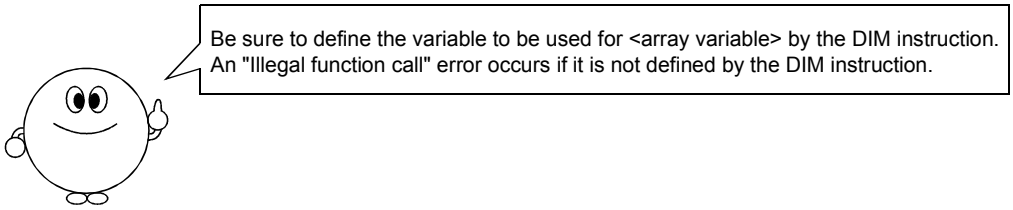
A!=CISN(B%(0)) •••• Converts an integer value in B%(0) and B%(1) into a single precision and stores in A!.



Description

• The CISN function converts a 2-word (32-bit) integer to be used by the PLC CPU into a single precision real number.

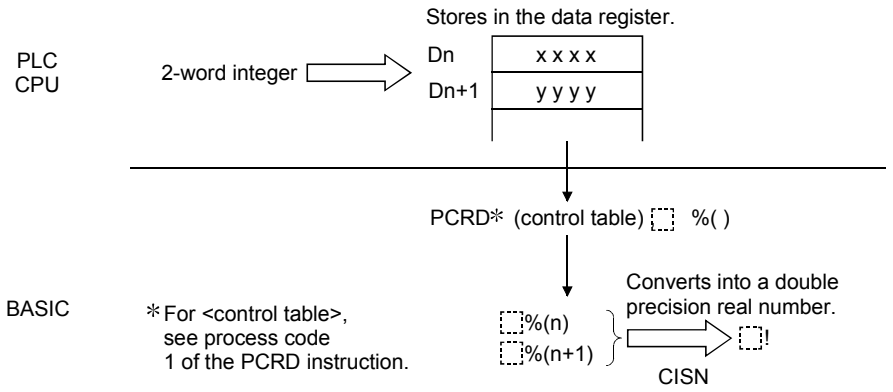
• <array variable> uses a one dimensional integer array variable.
An "Illegal function call" error occurs if anything other than one dimensional integer array is specified.



• Accuracy of the single precision real number, which was converted from a 2-word (32-bit) integer, is the same as the accuracy before the CISN function was executed. (The number of effective digits is six.)

• The following shows how to handle 2-word (32-bit) integer to be used by the PLC CPU in BASIC:

Example



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Program Example

```
10 ' Converts 2-word integer in D0, D1 to a double precision real number
20 DIM TBL%(5),A%(1)                    :  ' Defines arrays
30 TBL%(0)=255                          :  ' Sets the communication station number to
                                           the local station
40 TBL%(1)=1                            :  ' Specifies readout of the device memory
50 TBL%(2)=2                            :  ' Specifies word as the unit
60 TBL%(3)=18                           :  ' Specifies the data register
70 TBL%(4)=0                            :  ' Specifies the device number
80 TBL%(5)=2                            :  ' Specifies the processing count
90 PCRD TBL%(),A%()                     :  ' Executes the read operation
120 A!=CISN(A%(0))                      :  ' Converts into a single precision real
                                           number
140 PRINT "D0, D1 value -->";A!
150 END
```

REMARK

See the CIDB, CDBI, CSNI, PCRD and PCWT instructions, and Chapter 4.

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CLEAR Instruction — CLEAR

• Initializes all variables and sets up the memory area.

Syntax

CLEAR△ [<arithmetic expression>]

arithmetic expression • • • • Specify the size of the memory area used for storing the character string by BASIC in number of bytes. It is set to 300 if the arithmetic expression is omitted, however.

Examples

CLEAR 1000 • • • • Initializes variables and sets up a memory area of 1000 bytes.

Description

• The CLEAR instruction initializes all variables and sets up a memory area.
• After the CLEAR instruction is executed, contents of variables, declarations, and definitions become as follows:

Numeric variable	• • • •	0
Character variable	• • • •	Empty character string
Array definition (DIM statement)	• • • •	Invalid
Type declaration of variable	• • • •	Invalid
User-defined function	• • • •	Invalid

• A large memory area is required in order to process many characters. An “Out of string space” error occurs if the memory area is insufficient. In this case, increase the memory area by specifying <arithmetic expression> in the CLEAR instruction.
• The default value is set to 300 when the interpreter is started up.

REMARK

• Use the ERASE instruction in order to initialize only the array variables.
• See the DIM instruction and FRE function.

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CLOSE Instruction CLOSE

• Terminates the I/O processing of a file.

Syntax

CLOSE△ # <file number> [, # <file number> …]

file number • • • • Specify the file number that was opened by the OPEN instruction.

Examples

CLOSE • • • • Closes all files and terminates the I/O processing for the file.

CLOSE #1 • • • • Closes the #1 file and terminates the I/O processing for the file of file number 1.

Description

• The CLOSE instruction closes (terminates processing) a file that is completed for data I/O processing.
• Specify the file number opened by the OPEN instruction for <file number>.
• If <file number> is omitted, all files currently open are closed.
• Specify 1 through 8 for <file number>.
• All files are automatically closed if RUN, CLEAER, END, NEW, LOAD, CLOSE, or SYSTEM instruction is executed, or if the program is edited.
Files are not closed, however, by the STOP instruction.

REMARK

See the OPEN, END, STOP, NEW, LOAD and CHAIN instructions, and Chapter 6.

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CLS Instruction — CLear Screen/CLS

• Clears the screen display.

Syntax

CLS [<function>]

function •••• Specify '1'.

Examples

CLS
CLS 1 } •••• Clears the text screen.

Description

• The CLS instruction clears the console screen specified by the ZODV instruction and moves the cursor to the upper left corner of the screen.
• Specify "1" to <function>. If omitted, "1" is assumed.

REMARK

• See Section 3.10.2.

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COM ON/OFF/STOP Instruction COMmunication ON/OFF/STOP

• Controls to enable, prohibit, and stop the interrupt from the communication line.

Syntax

COM (<channel number>) ON
COM (<channel number>) OFF
COM (<channel number>) STOP

channel number • • • • Specify the communication port to be controlled for the interrupt from the communication line.

Examples

COM (1) ON • • • • Enables interrupt from CH1(RS-232).

Description

• The COM ON/OFF/STOP instruction declares whether the interrupt, which occurs by the communication input from the outside to the communication port (RS-232/422), is enabled (ON), prohibited (OFF), or stopped (STOP).
• <channel number> specifies the communication port to be interrupted from the communication port.
Correspondence of <channel number> and the communication port is as follows:
1 • • • • CH1 (RS-232)
2 • • • • CH2 (RS-232)
3 • • • • CH3 (RS-422)
• <channel number> may be omitted. If omitted, it is assumed both RS-232 and 422 ports are specified.
• An interrupt is enabled immediately after the COM ON instruction is executed. After this instruction is executed, the interrupt is executed every time there is an input to the communication port specified by <channel number>, and the execution branches to the processing routine of the line number specified by the ON COM GOSUB instruction.
• The COM OFF instruction prohibits the interrupt. After this instruction is executed, a branch to the processing routine does not occur even if there is an input to the communication port.
• The COM STOP instruction stops the interrupt. After this instruction is executed, the input to the communication port is recorded but no branching to the processing routine occurs. When COM ON enables the interrupt later, however, a branching to the processing routine occurs.
• Set the communication port to the COM OFF state when the program is completed.
• While multitask processing is being performed, access from only one program is valid to a port.

REMARK

See the ON COM GOSUB and ZOPEN instructions, Section 7.4, and Appendix 2.

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COMMON Instruction — COMMON

• Sets variable and others to be passed to the program to be executed by the CHAIN instruction.

Syntax

COMMON△ <data to be passed> [, <<data to be passed >, …]

data to be passed • • • • Specify a variable or array that is passed to the program to be executed by the CHAIN instruction.

Examples

COMMON A$, B%( ) • • • • Passes A$ and all elements of array B% to the program to be executed by the CHAIN instruction.

Description

• The COMMON instruction specifies variables or arrays to be passed to the program that will be executed by the CHAIN instruction.
• In <data to be passed>, specify variables and others to be passed to the program that is read by the CHAIN instruction.
• To specify an array, write only parentheses after the array name.
A%( ), B#( ), C$( )
• If there is an error in the COMMON instruction, an error occurs when the CHAIN instruction is executed.
• To pass all variables and arrays, specify the ALL option in the CHAIN instruction.
• When <data to be passed> is specified in the COMMON instruction and the ALL option is specified in the CHAIN instruction, everything is passed regardless of the <data to be passed> specification in the COMMON instruction.

REMARK

- The COMMON instruction is valid even if it is described in a part of a program.
- Write the COMMON instruction in the program that executes the CHAIN instruction.
- See the CHAIN instruction.

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CONSOLE Instruction CONSOLE

• Sets the number of display lines of the console screen.

Syntax

CONSOLE <number of lines>

number of lines • • • • Specify the number of display lines as 20 through 32 depending on the console used.

Examples

CONSOLE 25 • • • • Displays 25 lines.

Description

• The CONSOLE instruction sets the number of display lines of the console according to the console screen.
• The initial condition of the CONSOLE instruction is set according to the console set by MODE SW2.
• The following values are used when VG-620, VT-382, and A7PHP are used:

VG-620	• • • •	24 lines
VT-382	• • • •	24 lines
IBM/AT compatible, A7PHP, A7LMS	• • • •	25 lines

• Normal screen scroll operation is not performed if the specified number of lines differs from the number of display lines of the console.

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CONT Instruction — CONTinue

• Resumes the program that was stopped by the Ctrl + C or Break key in programming mode, or by executing the STOP or END instruction.

Syntax

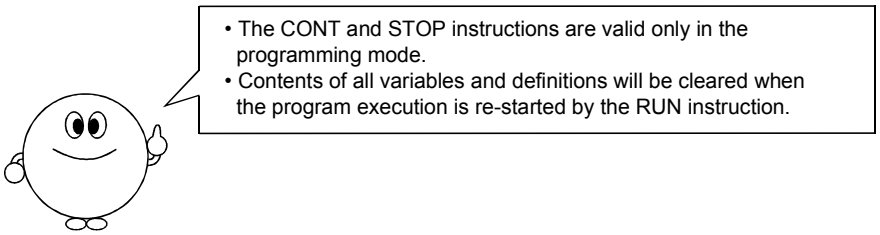
CONT

Examples

CONT • • • • Resumes execution of the program from the point where the program execution was stopped.

Description

• The CONT instruction resumes the program that is being stopped.
• The program execution resumes from the next line after it stopped.
• If it was stopped in the wait state of the input by the INPUT instruction, the execution resumes after displaying a question mark (?) again.
• Normally, CONT is used with the STOP instruction for debugging. When the program execution stops, the intermediate results can be checked and modified in the direct mode. The program execution can resume by the CONT or GOTO instruction.
• A “Can’t continue” error occurs if the CONT instruction is executed after the program is modified.
For details on debugging, see Chapter 10.



When the CONT instruction is used to restart a program that terminated by the END instruction at the middle of the program, the execution starts from the instruction of the next line number.

REMARK

See the END, RUN and STOP instructions, and Chapter 10.

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COS Function COS

• Returns a cosine value of the trigonometric function

Syntax

COS (<arithmetic expression>)

arithmetic expression • • • • Specify a numeric value in radian.

Examples

A=COS(3.14159/180*60) • • • • Converts 60° angle to radian, calculates its cosine value, and stores in A.

Description

• The COS function returns a cosine when the <arithmetic expression> value is given in radian ((π/180) x angle).
• <arithmetic expression> can be any numeric value type, but the COS function always calculates in single precision.

Program Example

```
10 ' Calculates cos 60°C
20 A=(3.141592653#*60)/180          :  ' Converts 60° to radian
30 B=COS(A)                         :  ' Calculates cos
40 PRINT "60°C       =";A;"radian"
50 PRINT "cos 60°C  =";B


RUN
60°          = 1.0472 radian
cos 60°      = .5
OK
```

REMARK

See the ATN, SIN and TAN functions.

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CSNG Function — Convert SiNGle

• Converts an integer or a double precision real number into a single precision real number.

Syntax

CSNG (<arithmetic expression>)

arithmetic expression • • • • Specify an integer or a double precision real number to be converted into a single precision real number.

Examples

A!=CSNG(B%) • • • • Converts integer value B% into a single precision real number and assigns it to A.

C!=CSNG(D#) • • • • Converts double precision real number D# into a single precision real number and assigns it to C.

Description

• The CSNG function converts the <arithmetic expression> value to a single precision real number with six digits of effective figures.
• An “Over flow” error occurs if the converted value is out of range of −1.70141E+38 to 1.7014E+38.

Program Example

```
10 ' Converts an integer or double precision real number into a single precision real number
20 A%=2                                  :  ' Defines the integer
30 B#=1.37825432#                        :  ' Defines the double precision real number
40 A!=CSNG(A%)                           :  ' Converts the integer into a double
                                            precision real number
50 B!=CSNG(B#)                           :  ' Converts the double precision real number
                                            into a single precision real number
60 PRINT "A%=";A%,"B#=";B#               :  ' Value before conversion
70 PRINT "A!=";A!,"B!-":B!               :  ' Value after conversion
80 END


RUN
A%= 2          B#= 1.37825432
A!= 2          B!= 1.37825
OK
```

REMARK

• When assigning a value to the single precision variable, the type is automatically converted into single precision if the instruction or function requires a single precision real number as its parameter (argument).
The result of A!=3042.1545452# and A!=CSNG(3042.1545452#) will be the same.

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CSNI Instruction — Convert SiNgle to Integer

• Converts a single precision real number into a 2-word (32-bit) integer to be used by the PLC CPU.

Syntax

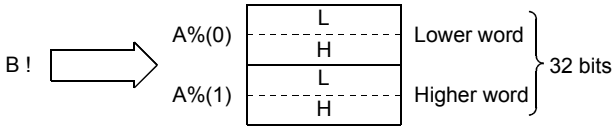
CSNI△ (single precision variable> , <array variable>

single precision variable • • • • Specify the single precision variable where the data for conversion is stored.

array variable • • • • Specify the one dimensional integer array variable where the converted data is stored.

Examples

CSNI B!, A%(0) • • • • Converts the value of B! into an integer and stores in A%(0) and A%(1).



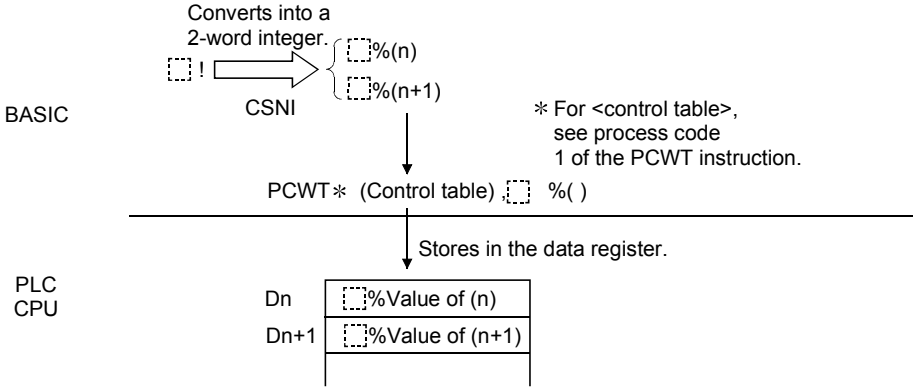
Description

• The CSNI instruction converts a single precision real number into a 2-word (32-bit) integer that is used by the PLC CPU.

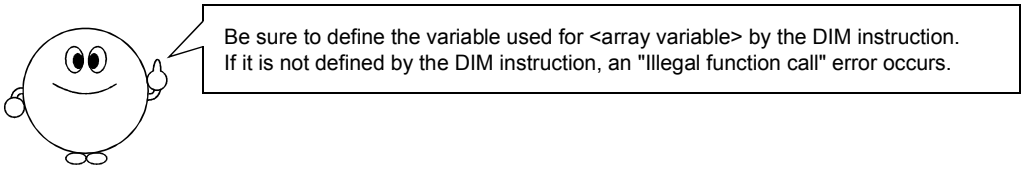
• BASIC can handle a single precision real number −2.14748E+09 through 2.14748E+09. An "Over flow" error occurs if the value exceeds this range. If the converting single precision real number contains a fractional part, the fractional part is rounded down, then converted.

• The following shows handling of BASIC's single precision real number by the PLC CPU:

Example



• <array variable> uses a one dimensional integer array variable. An "Illegal function call" error occurs if anything other than the one dimensional integer array variable is specified.



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Program Example

```
10 ' Converts the single precision real number to a 2-word integer and writes it into D0 and D1
20 DIM B%(1)                    :  ' Defines the array
30 A!=999999!                   :  ' Defines the single precision real number
40 CSNI A!,B%(0)                :  ' Converts to a 32-bit integer
70 TBL%(0)=255                  :  ' Sets the communication station number to
                                   the local station
80 TBL%(1)=1                    :  ' Specifies writing to the device memory
90 TBL%(2)=2                    :  ' Specifies word as the unit
100 TBL%(3)=18                  :  ' Specifies the data register (D)
110 TBL%(4)=0                   :  ' Specifies the device number (0)
120 TBL%(5)=2                   :  ' Specifies the number of processing items
130 PCRD TBL%(),B%()            :  ' Executes the write operation
140 END
```

REMARK

See the CISN, CDBI, CSNI, PCRD and PCWT instructions, and Chapter 4.

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CVD Function — ConVert to Double

• Converts a character string, which was converted by the MKD$ function, back to a double precision real number.

Syntax

CVD (<character string expression>) [, S])

character string expression • • • • Specify the character string that was converted by the MKD$ function.

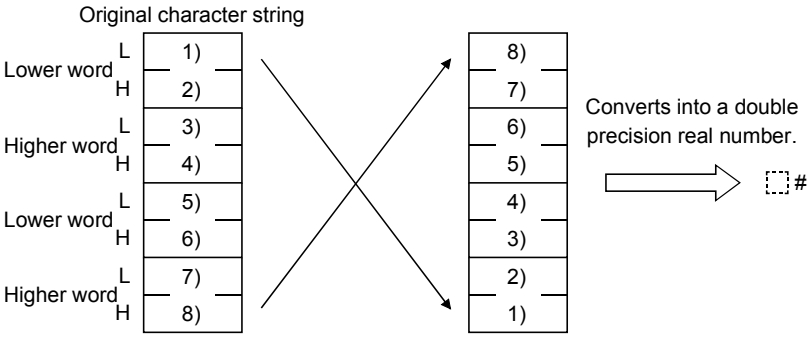
Examples

A#=CVD(MD$) • • • • Converts the character string (MD$), which was converted by the MKD$ function, back to the original double precision real number and assigns it to A#.

B#=CVD(MD$, S) • • • • After replacing the contents of the character string MD$, converts it back to the original double precision real number and assigns it to B#.

Description

• The CVD function converts the character string, which was converted by the MKD$ function, back to the original numeric value.
• Since all the data, which is written into the random access file, has to be a character string, a double precision real number is converted into an 8-byte character string by the MKD$ function before written into a file. Conversely, the 8-byte character string has to be converted back to the original double precision real number when this data is read from the file and to treat as a real number. The CVD function is used for this purpose.
• The CVD function can convert only the character string, which was converted by the MKD$ function, into a double precision real number. If other character stings are specified in <character string expression>, normal data will not be returned or an "Illegal function call" error occurs.
• The data, which was converted to a character string by the MKD$ function, can be used for the data communication in addition to writing to a random access file.
• When the [, S] option is specified, the character string subject to the conversion is rearranged as follows, then converted it into a double precision real number.



REMARK

See the MKD$ function.

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CVDMBF Function — ConVert Double Microsoft Binary Format

• Converts a double precision real number of AD51H-BASIC, which was converted by the MKD$ function, into the IEEE format double precision internal expression.

Syntax

CVDMBF (<character string expression>)

character string expression • • • • Specify the character string that was converted from a double precision real number by the MKD$ function.

Examples

A#=CVDMBF (MKD$(B#)) • • • • Converts the double precision real number stored in B# into an IEEE format double precision internal expression and assigns it to A#.

Description

• The CVDMBF function converts a character string, which was converted from a double precision real number on AD51H-BASIC by the MKD$ function, into the IEEE format double precision internal expression.
• The internal representation of the AD51H-BASIC real number and that of the IEEE format floating point real number are different. The CVDMBF function is used for conversion between these two.
• Always specify a character string, which was converted from a double precision real number by the MKD$ function, into <character string expression>.
Character string expressions that were converted by the MKI$, MKS$ or other function cannot be converted correctly.
• Use double precision type (□#) for the variable to assign to, since the CVDMBF function returns a double precision value.
• The values converted by the CVDMBF function are used for the data communication with a system that uses the internal expression of the IEEE format double precision values.

REMARK

- The values obtained from the CVDMBF function have no meaning on AD51H-BASIC.
- See the CVSMBF, MKDMBF$, and MKSMBF$ functions.

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CVI Function — ConVert to Integer

• Converts a character string, which was converted by the MKI$ function, back to an integer.

Syntax

CVI (<character string expression>) [, S])

character string expression • • • • Specify the character string that was converted by the MKI$ function.

Examples

A%=CVI(MI$) • • • • Converts the character string (MI$), which was converted by the MKI$ function, back to the original integer and assigns it to A%.

B%=CVI(MI$, S) • • • • After replacing the contents of the character string MI$, converts it back to the original integer and assigns it to B%.

Description

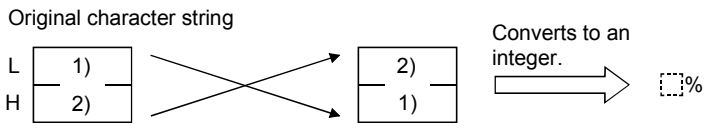
• The CVI function converts the character string, which was converted by the MKI$ function, back to the original numeric value.

• Since all the data, which is written into the random access file, has to be a character string, an integer is converted into a 2-byte character string by the MKI$ function before written into a file. Conversely, the 2-byte character string has to be converted back to the original integer when this data is read from the file and to treat as an integer. The CVI function is used for this purpose.

• The CVI function can convert only the character string, which was converted by the MKI$ function, into an integer. If other character stings are specified in <character string expression>, normal data will not be returned or an "Illegal function call" error occurs.

• The data, which was converted to a character string by the MKI$ function, can be used for the data communication in addition to writing to a random access file.

• When the [, S] option is specified, the character string subject to the conversion is rearranged as follows, then converted it into an integer.



REMARK

See the MKI$ function.

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CVS Function — ConVert to Single

• Converts a character string, which was converted by the MKS$ function, back to a single precision real number.

Syntax

CVS (<character string expression>) [, S])

character string expression • • • • Specify the character string that was converted by the MKS$ function.

Examples

A!=CVS(MS$) • • • • Converts the character string (MS$), which was converted by the MKS$ function, back to the original single precision real number and assigns it to A!.

B!=CVS(MS$, S) • • • • After replacing the contents of the character string MS$, converts it back to the original single precision real number and assigns it to B!.

Description

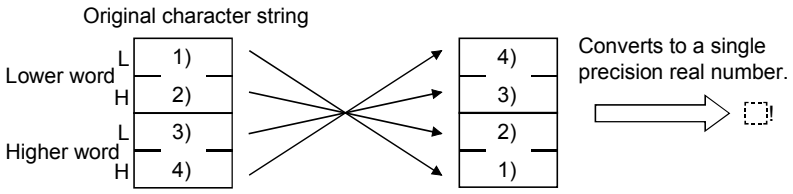
• The CVS function converts the character string, which was converted by the MKS$ function, back to the original numeric value.

• Since all the data, which is written into the random access file, has to be a character string, a single precision real number is converted into a 4-byte character string by the MKS$ function before written into a file. Conversely, the 4-byte character string has to be converted back to the original single precision real number when this data is read from the file and to treat as a real number. The CVS function is used for this purpose.

• The CVS function can convert only the character string, which was converted by the MKS$ function, into a single precision real number. If other character stings are specified in <character string expression>, normal data will not be returned or an "Illegal function call" error occurs.

• The data, which was converted to a character string by the MKS$ function, can be used for the data communication in addition to writing to a random access file.

• When the [, S] option is specified, the character string subject to the conversion is rearranged as follows, then converted it into a single precision real number.



REMARK

See the MKS$ function.

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CVSMBF Function — ConVert Single Microsoft Binary Format

• Converts a single precision real number of AD51H-BASIC, which was converted to the character string by the MKS$ function, to the internal expression of a floating point real number (IEEE format single precision internal expression) that is used by Q/QnA/AnA/AnU/AnUSCPU.

Syntax

CVSMBF (<character string expression>)

character string expression •••• Specify the character string that was converted from a single precision real number by the MKS$ function.

Examples

A!=CVSMBF(MKS$(123.45)) •••• Converts a single precision real number 123.45 to the internal expression of the floating point real number (IEEE format single precision internal expression) that is used by Q/QnA/AnA/AnU/AnUSCPU, and assigns it to A!.

Description

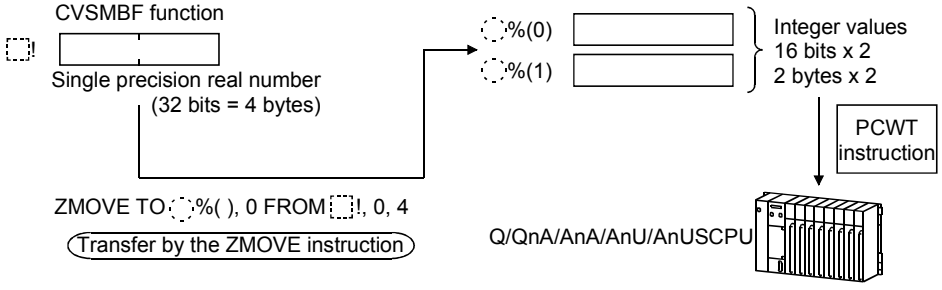
• The CVSMBF function converts a character string, which was converted from a single precision real number on AD51H-BASIC by the MKS$ function, into the internal expression of the floating point real number (IEEE format single precision internal expression) that is used by Q/QnA/AnA/AnU/AnUSCPU.

• The internal representation of the AD51H-BASIC real number and that of the floating point real number (IEEE format) are different. The CVSMBF function is used for conversion between these two.

• Always specify a character string, which was converted from a single precision real number by the MKS$ function, into <character string expression>.
Character string expressions that were converted by the MKI$, MKD$ or other function cannot be converted correctly.

• Use single precision type (□!) for the variable to assign to, since the CVSMBF function returns a single precision value.

• To write a value that was converted by the CVSMBF function to Q/QnA/AnA/AnU/AnUSCPU by the PCWT instruction, it is necessary to assign the value from the CVSMBF function to two integer array variables by the ZMOVE instruction.



• In addition for the Q/QnA/AnA/AnU/AnUSCPU, the values converted by the CVSMBF function can be used for the data communication with the system that uses the internal expression of the IEEE format single precision numeric value.

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Program Example

```
10 ' Converts a single precision real number to a floating decimal point real number for AnACPU, and
   writes to D0, D1.
20 DIM TBL%(5),A%(1)                    :  ' Defines arrays
30 A!=5.6767                            :  ' Defines a single precision real number
50 A$=MKS$(A!)                          :  ' Converts into a character string
70 B!=CVSMBF(A$)                        :  ' Converts into the IEEE (AnACPU) format
90 ZMOVE TO A%(),0 FROM B!,0.4          :  ' Stores in array A%
100 TBL%(0)=255                         :  ' Sets the communication station number to
                                           the local station
110 TBL%(1)=1                           :  ' Specifies writing to the device memory
120 TBL%(2)=2                           :  ' Specifies word as the unit
130 TBL%(3)=18                          :  ' Specifies the data register
140 TBL%(4)=0                           :  ' Specifies the device number
150 TBL%(5)=2                           :  ' Specifies the number of processing items
160 PCWT TBL%(),A%()                    :  ' Executes the write operation
170 END
```

REMARK

- The values from the CVSMBF function has no meaning on AD51H-BASIC.
- See the CVDMBF, MKDMBF$ and MKSMBF$ functions.

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DATA Instruction

DATA

• Specifies values and character strings to be read by READ.

Syntax

DATA△ <constant> [<, constant> …]

constant	• • • •	Specify any numeric value constant (fixed point constant, floating point constant, integer constant), or a character string constant.

Examples

DATA 1, 2, 3	• • • •	Defines the data (1, 2, 3) that is read by the READ instruction.

Description

• The DATA instruction specifies the data to be read by the READ instruction.
• The DATA instruction is a non-executable instruction and can be written in any place of the program.
• One DATA instruction can specify as many constants as they fit in one line (255 characters) separated by comma (,).
If the character string constant contains comma (,), colon (:), semicolon (;), or a space before or after, the constant needs to be enclosed with the double quotation marks (“). Otherwise, no quotation marks are necessary.
• One program can contain multiple DATA instructions.
• The READ instruction reads data in the ascending order of the line number that contains a DATA instruction.
• The type of the constant in a DATA instruction and the type of the variable that corresponds to the READ instruction must match.
The constant of the DATA instruction can be read again from any location by executing a RESTORE instruction.
• The DATA instruction is normally used in a pair with the READ instruction. See the READ instruction for details.
• An “Out of DATA” error occurs if there are fewer number of data than the count to be read by the READ instruction.

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Program Example

```
10 ' Reads the data specified in the DATA instruction by the READ instruction and displays it
20 DATA 1,2,"ABC"
30 READ A,B,C$,D$,E                          :' Reads data
40 DATA "AD51H",90
50 PRINT "A=";A,"B=";B,"C$=;C$               :' Displays data
60 PRINT "D$=";D$,"E=";E
70 END

RUN
A= 1         B= 2         C$=ABC
D$=AD51H     E= 90
OK
```

REMARK

See the READ and RESTORE instructions, and Section 3.5.2.

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DATE$ Function

DATE $

• Sets year, month, and day to the PLC CPU.
• Reads year, month, and day from the PLC CPU.

Syntax

DATE$=" <year> / <month> / <day> [/ <day of the week>]"
DATE$

year	• • • •	Specify a character string that represents the year "1990" to "2089."
month	• • • •	Specify a character string that represents the month "01" to "12."
day	• • • •	Specify a character string that represents the day "01" to "31."
day of the week	• • • •	Specify a character string that represents the day of the week.

Examples

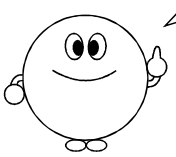
DATE$="1990/07/30/MON"	• • • •	Sets Monday July 30, 1990.
A$=DATE$	• • • •	Reads year, month, and day, then assigns them to A$.

Description

• The DATE$ function sets or reads the date of the PLC CPU in which the communication module is installed.
• Be sure to set the correct time by the TIME$ function before setting the year, month, and day. The year, month, and day may not be set correctly depending on the time.
• Set the date using the following format:
DATE$="year/month/date[/ the day of the week]"
1) Use '/' (slash) to separate the year and month, month and day.
2) Specify the year by a four-digit Christian Era.
3) Attach 0 front of the numbers 1 through 9 (01 through 09) for the month and day specifications.
4) Specify the day of the week as follows:

Monday: MON	Friday: FRI
Tuesday: TUE	Saturday: SAT
Wednesday: WED	Sunday: SUN
Thursday: THU	

The day of the week may be omitted.
5) Year, month, and day cannot be set partially.
• When the date is read out, it is provided in the same format as that for setting the year, month, and day.



• The DATE$ function is valid only when the PLC CPU has the clock function. The PLC CPU without the clock function (A□, A3H, A0J2(H)CPU) cannot execute the DATE$ function.
• If the year's character string is not within the range of 1990 to 2089, the normal processing is not performed.

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Program Example

```
10 ' Sets the calendar and reads out
30 A$="1991/04/01/MON"                    :  ' Sets the year, month, and day
40 DATE$=A$                               :  ' Writes the year, month, and day
60 B$=SPACE$(14)                          :  ' Stores dummy
70 B$=DATE$                               :  ' Reads year, month, and day
80 PRINT "Contents of the calendar-->";B$ :  ' Checks the contents after writing
90 END


RUN
Contents of the calendar-->1991/04/01/MON
OK
```


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DEFDBL Instruction

DEFine DouBle

• Defines variables that start with a character of the specified range as the double precision real number type.

Syntax

DEFDBL△ <alphabetical character> [- <alphabetical character>] [, <alphabetical character> [- <alphabetical character>], …

Examples

DEFDBL A,C-E • • • • Defines variables starting with A and variables starting with C, D, E as double precision real number variables.

Description

• The DEFDBL instruction defines variables that start with a character of the specified range as the double precision real number type. It defines the type of all variables starting with a character specified by <alphabetical character> or with a character within the range specified by <alphabetical character-alphabetical character> as double precision real number type.
• Specification by the type declaration statement has priority for specifying the variable type, and the result will be as follows:

Example

```
10 DEFDBLA
20 A=10/3        (Double precision)
30 A%=10/3       (Integer)
40 A!=10/3       (Single precision)
50 PRINT A, A%, A!
60 END
```

```
RUN
 3.333333333333333   3   3.3333
OK
■
```

• Variables that were defined as double precision real number type by the DEFDBL instruction and variables with the double precision type declaration character '#' are regarded as the same.

Example

```
10 DEFDBLA

20 A=10/3 • • • Assigns
                10/3=3.333 • • •
30 A#=5/3 • • • Assigns
                5/3=1.666 • • •
40 PRINT A

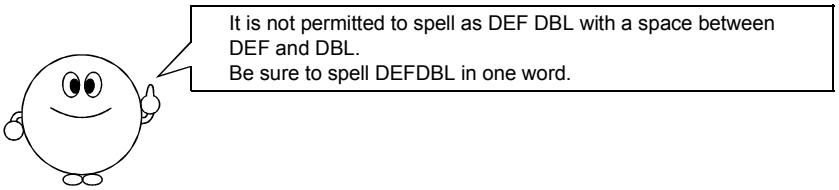
50 END
```

```
RUN

 1.666666666666667 • • •   Attempted to display A, but the value of A# at line 30 is displayed, i.e., A=A#.
OK

■
```

• If the type is not declared by the DEFDBL instruction, a variable that has a variable name without type declaration character is regarded as a single precision variable.



REMARK

See the DEFINT, DEFSNG and DEFSTR instructions, and Section 2.9.

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DEF FN Instruction — DEFine FuNction

• Defines a user function and names it.

Syntax

DEF△FN <name> [(<dummy argument> [, <dummy argument>], …)] = <function definition expression>

name	• • • •	Specify a name of the defined function.
dummy argument	• • • •	Specify a variable that is used in the function definition expression.
function definition expression	• • • •	Specify an expression to calculate the value of the function.

Examples

DEF FNCOT(X)=1/TAN(X) • • • • Defines cot χ $\left(=\frac{1}{\tan\chi}\right)$ as a function called FNCOT(X).

Description

• The DEFFN function defines a user function and names it.
• When using a function that is not provided by BASIC, the user has to write the function. The user can freely define the function using the DEF FN instruction.
• <name> is used to call the function defined by the DEF FN instruction from the FN instruction, and name it by the same rule for a variable name. If a type specification character (%, !, #, $) is attached to <name>, the defined function returns a value of that type. If a type specification character is not attached, a single precision value is returned.

Example

```
DEF FNA%(X, Y)=X+Y        →FNA%(X, Y) returns an integer.
DEF FNB#(X, Y)=X/Y        →FNB#(X, Y) returns a double precision value.
DEF FNC$(X$)="OK"+X$      →FNC$(X$) returns a character.
```

• <dummy argument> is a variable used by the function's definition expression, and is replaced by <real argument> and calculated according to the constant expression of the function. <dummy argument> may be omitted.
(You can define a function without arguments.)
• The definition expression of the function defines the calculation method of the function, and is described within one line (255 characters for the entire DEF FN statement.)
• The variables listed in the definition expression of the function is just for defining the calculation format, and the values are not changed nor referred to even if the same variable is used in the program. In addition, it is not necessary to use all variables as <dummy argument>. If is not used as <dummy argument>, the variable value at that moment is used for calculation.

```
DEF FNA(X,Y)=A*X+B*Y   Values at the time of calculating
                       FNA(X, Y) are used for A and B.
```

• Writing the FN instruction in the expression makes a call.
• The direct mode cannot be used with the DEF FN instruction.

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Program Example

```
10 ' Defines a formula to calculate the area of a triangle as function name FNA
20 DEF FNA(A,B)=(A*B)/2                    :   ' (base*height)/2
30 INPUT "Base=";C                         :   ' Input of the base
40 INPUT "Height =";D                      :   ' Input of the height
50 E=FNA(C, D)                             :   ' Calculation
60 PRINT "Area of the triangle =";E        :   ' Displays the calculation result
70 END


RUN
Base =? 10
Height =? 2
Area of the triangle = 10
OK
```


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DEFINT Instruction — DEFine INTeger

• Defines variables that start with a character of the specified range as the integer type.

Syntax

DEFINT△ <alphabetical character> [- <alphabetical character>] [, <alphabetical character> [- <alphabetical character>], …

Examples

DEFINT B, F-H • • • • Defines variables starting with B and variables starting with F, G, H as integer variables.

Description

• The DEFINT instruction defines variables that start with a character of the specified range as the integer type. It defines the type of all variables starting with a character specified by <alphabetical character> or with a character within the range specified by <alphabetical character-alphabetical character> as the integer type.
• Specification by the type declaration statement has priority for specifying the variable type, and the result will be as follows:

Example

```
10 DEFINT A
20 A=10/3
30 A#=10/3
40 A!=10/3
50 PRINT A, A#, A!
60 END
```

(Integer) (Double precision) (Single precision)

```
RUN
 3          3.333333333333333          3.3333
OK
■
```

• Variables defined as integer type by the DEFINT instruction and variables with the integer type declaration character '%' are regarded as the same.

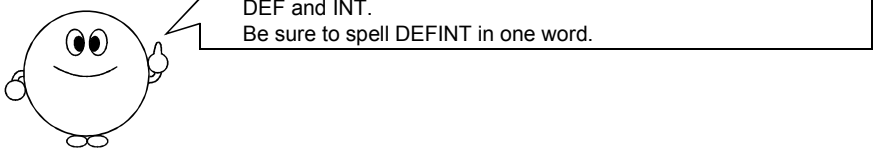
Example

```
10 DEFINT A
20 A=100
30 A%=777
40 PRINT A
50 END
```

```
RUN
 777
OK
■
```

• • • Attempted to display A, but the value of A% in line 30 is displayed, i.e., A=A%.

• If the type is not declared by the DEFINT instruction, a variable that has a variable name without type declaration character is regarded as a single precision variable.



REMARK

See the DEFDBL, DEFSNG and DEFSTR instructions, and Section 2.9.

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DEFSNG Instruction

DEFine SiNGle

• Defines variables that start with a character of the specified range as the single precision real number type.

Syntax

DEFSNG△ <alphabetical character> [- <alphabetical character>] [, <alphabetical character> [- <alphabetical character>], …

Examples

DEFSNG C, X-Z • • • • Defines variables starting with C and variables starting with X, Y, Z as single precision real number type variables.

Description

• The DEFSNG instruction defines variables that start with a character of the specified range as the single precision real number type. It defines the type of all variables starting with a character specified by <alphabetical character> or with a character within the range specified by <alphabetical character-alphabetical character> as the single precision real number type.
• Specification by the type declaration statement has priority for specifying the variable type, and the result will be as follows:

Example

```
10 DEFSNG A
20 A=10/3        (Single precision)
30 A%=10/3       (Integer)
40 A#=10/3       (Double precision)
50 PRINT A, A%, A#
60 END
```

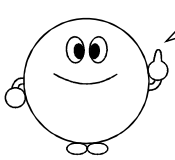
```
RUN
 3.3333    3    3.333333333333333
OK
■
```

• Variables defined as single precision real number type by the DEFSNG instruction and variables with the single precision real number type declaration character '!' are regarded as the same.

Example

```
10 DEFSNG A
20 A=10/3 • • • Assigns
                10/3=3.333 • • •
30 A!=5/3 • • • Assigns
                5/3=1.666 • • •
40 PRINT A
50 END
```

```
RUN
 1.6666          • • • Attempted to display A,
                       but the value of A! in line 30
                       is displayed, i.e., A=A!.
OK
■
```



It is not permitted to spell as DEF SNG with a space between DEF and SNG.
Be sure to spell DEFSNG in one word.

REMARK

See the DEFDBL, DEFINT and DEFSTR instructions, and Section 2.9.

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DEFSTR Instruction

DEFine STRing

• Defines variables that start with a character of the specified range as the character type.

Syntax

DEFSTR△ <alphabetical character> [- <alphabetical character>] [, <alphabetical character> [- <alphabetical character>], …

Examples

DEFSTR M, P-R • • • • Defines variables starting with M and variables starting with P, Q, R as character variables.

Description

• The DEFSTR instruction defines variables that start with a character of the specified range, as the character type. It defines the type of all variables starting with a character specified by <alphabetical character> or with a character within the range specified by <alphabetical character-alphabetical character> as the character type.
• Specification by the type declaration statement has priority for specifying the variable type, and the result will be as follows:

Example

```
10 DEFSTR A
20 A= "10/3"        (Character)
30 A%=10/3          (Integer)
40 A!=10/3          (Single precision)
50 PRINT A, A%, A!
60 END
```

```
RUN
10/3          3          3.3333
OK
■
```

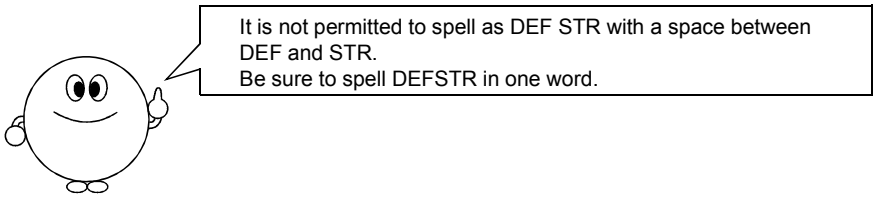
• Variables defined as character type by the DEFSTR instruction and variables with the character type declaration character '$' are regarded as the same.

Example

```
10 DEFSTR A
20 A= "TOKYO"
30 A$= "NAGOYA"
40 PRINT A
50 END
```

```
RUN
NAGOYA        • • • Attempted to display A,
                    but the value of A$ in line
                    30 is displayed, i.e., A=A$.
OK
■
```

• If the type is not declared by the DEFSTR instruction, a variable that has a variable name without type declaration character is regarded as a single precision variable.



REMARK

See the DEFDBL, DEFINT and DEFSNG instructions, and Section 2.9.

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DEF ZEVENT Instruction DEFine Z EVENT

• Defines an event for synchronizing execution between the programs.
• Defines an event by the expansion relay (EM) of the communication module.

Syntax

DEF ZEVENT△ (event number)
DEF ZEVENT△ (event number), <device>

event number	• • • •	Specify a number that represents the event defined by this instruction.
device	• • • •	Specify a communication module's expansion relay (EM) that generates an event by turning ON.

Examples

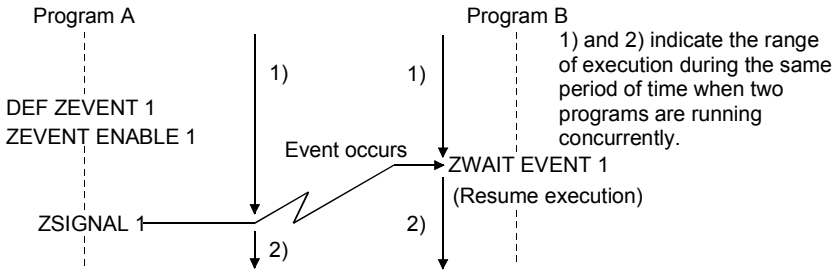
DEF ZEVENT 1	• • • •	Defines an event as event number 1 that is generated by the ZSIGNAL instruction in order to synchronize between the programs.
DEF ZEVENT 3, "EM0001"	• • • •	Defines an event, which is generated when the communication module's expansion relay EM0001 is turned ON, as event number 3.

Description

• Defines various events that are used for multitask operations.
• An event is a signal for controlling another BASIC program from a BASIC program.

Definition of an event generated by the ZSIGNAL instruction

• Defines an event for synchronizing execution with another BASIC program. In this case, specify only <event number> and do not specify <device>.



• Events generated by the ZSIGNAL instruction are generated only by the ZSIGNAL instruction. After defined by the DEF ZEVENT instruction, this event is used for resuming execution of a BASIC program that is waiting for the event, after enabling this event by the ZEVENT instruction and executing the ZSIGNAL instruction.

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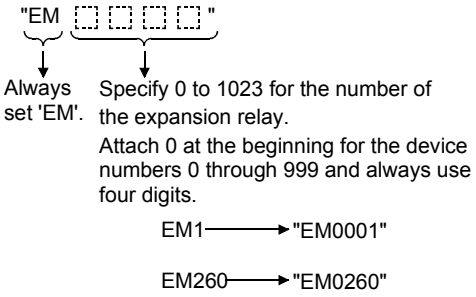
• <event number> is used as a number for specifying whether enabling or disabling the defined event to occur, for creating an event, and for waiting for an event to occur. Treat <event number> as the common number between the BASIC programs.
A value ranging 0 to 63 can be specified to <event number>, and <event number> is shared with the event by the communication module's expansion relay (EM).
• If an event number that has been already defined is specified, the contents of the previous definition become invalid and the newly defined contents become valid.

Defining an event by the communication module's expansion relay (EM)

• Defines an event that is generated when the communication module's expansion relay (EM) changes from OFF → ON. In this case, be sure to specify <device> and <event number>.
• The event defined by this method is generated by the ZSIGNAL instruction and by the change of the target bit device (OFF → ON). This event is used for resuming execution of a program is waiting for the event to occur by the ZSIGNAL instruction or by a change of the target bit device, after enabling the event to occur by the ZEVENT instruction.
• <event number> is used as a number for specifying whether enabling or disabling the defined event to occur, for creating an event, and for waiting for an event to occur. Treat <event number> as the common number between the BASIC programs.
A value ranging 0 to 15 can be specified to <event number>, and <event number> is shared with the event for synchronization between the programs.



Only 0 to 15 can be specified for the event number of an event from the communication module's expansion relay (EM). An error occurs if 16 to 63 is specified.
• Specify the communication module's expansion relay (EM), which generates the defined event at the transition of OFF to ON, to <device>. The following shows how to specify the EM:

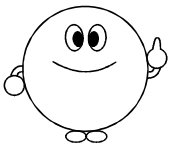


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To perform the event control, it is necessary to process to disable the generation of events which are handled at the startup and shutdown of BASIC, in order to initialize the event information that is managed by the system.
Execute one of the following:
1) Power on again or operate the RESET switch of the communication module when starting up BASIC.
2) Redefine the event to be handled by the program that is executed first at the BASIC startup, or by the program that is executed last for finishing the BASIC's operation.
Use the following to redefine the event:

```
FOR I%=0 TO 63
DEF ZEVENT I%
NEXT I%
```



REMARK

- See Section 8.2 for event control.
- See the ZEVENT, ZSIGNAL and ZWAIT EVENT instructions.

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DELETE Instruction DELETE

• Deletes the specified range of the program.

Syntax

DELETE△ [[<line number 1>] -] [<line number 2>]

line number 1	• • • •	Specify the first line to delete.
line number 2	• • • •	Specify the last line to delete.

Examples

DELETE 100 – 150	• • • •	Deletes from line 100 to line 150 of the program.
DELETE 50 -	• • • •	Deletes from line 50 to the end of the program.
DELETE - 200	• • • •	Deletes from the beginning to line 200 of the program.
DELETE 70	• • • •	Deletes line 70 of the program.

Description

• The DELETE instruction deletes the range of the program specified by <line number 1> and <line number 2>.
• When both <line number 1> and <line number 2> are specified, all the lines included in this range are deleted.
• When <line number 1> and a hyphen (“-“) are specified, lines starting from the specified line through the end of the program are deleted.
• When only a hyphen (“-“) and <line number 2> are specified, lines starting at the beginning of the program through the specified line are deleted.
• When only <line number 1> is specified, only this line is deleted.
• The following occurs when the DELETE instruction is executed in the program.

In programming mode

The program waits for the next instruction.

In run mode

The program becomes in the idling state.

• An “Illegal function call” error occurs if the line number specified by <line number> does not exit.

REMARK

See the CHAIN instruction and Section 3.2.3.

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DIM Instruction — DIMension

• Specifies the size of a dimension and assigns a memory area necessary for the array.

Syntax

DIM△ array variable name (numeric expression [, numeric expression] …) [, array variable name (numeric expression [, numeric expression] …)]

array variable name • • • • Specify the name of a variable used as an array.

numeric expression • • • • Specify the size of the array specified by the array variable name.

Examples

DIM A(2, 2) • • • • Indicates a two dimensional numeric value array.

A(0, 0)	A(1, 0)	A(2, 0)
A(0, 1)	A(1, 1)	A(2, 1)
A(0, 2)	A(1, 2)	A(2, 2)

Description

• The DIM instruction specifies the size of an array variable and assigns a memory area necessary for the array.

• The following arrays can be defined:

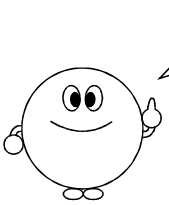
A(n) • • • • Numeric value array
A%(n) • • • • Integer array
A!(n) • • • • Single precision array
A#(n) • • • • Double precision array
A$(n) • • • • Character array

• <numeric expression> may be specified up to 32767. An insufficient memory occurs if too large memory area is assigned.

• When using an array, a “Subscript out of range” error occurs if the index of the array variable name is larger than the value of <numeric expression> specified by the DIM instruction.

• The minimum value of <numeric expression> is 0.

• If an array variable name, which is not specified by the DIM instruction, is used, 10 is assumed for the minimum value of its index.



In some instructions of AD51H-BASIC, there are some that do not correspond to the implicit array declarations as shown above.
It is recommended that arrays be used after declaring variables by the DIM instruction.

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• The DIM instruction initializes all element values of the specified numeric value array to 0, and all element values of a character string array to an empty character string.
• A “Redimensioned array” error occurs if the DIM instruction defines an array variable specified by the DIM instruction again.
In order to redefine, delete the definition by the ERASE instruction, then use the DIM instruction to define it again.

REMARK

• See the ERASE instruction and Section 3.8.
• For defining variable types, see DEFINT/DEFSNG/DEFDBL instructions.

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END Instruction

END

• Terminates the execution of the program and brings to the input wait state for an instruction in programming mode.
• Terminates the execution of the program and brings to the idling state in run mode.

Syntax

END

Examples

END	• • • •	Terminates the execution of the program and brings to the input wait state for an instruction after closing all open files (Programming mode). Terminates the program execution and brings to the idling mode after closing all open files (Run mode).

Description

• After terminating the program execution, the following occurs:

In programming mode

• Closes all open files and brings to the input wait state for an instruction.
• This instruction is different from the STOP instruction, and the "Break in ____" message is not displayed.
• The END instruction at the end of the program may be omitted.
The file is not closed, however, if the END instruction is omitted.

In run mode

• Terminates the program execution and brings to the idling state. The program in the idling state can be executed again by the ZSTART instruction.

REMARK

See the CLOSE, RUN, and STOP instructions.

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EOF Function — End Of File

• Returns -1 (True) if the end of a sequential file is detected.

Syntax

EOF (<file number>)

file number • • • • Specify the file number specified by the OPEN instruction.

Examples

IF EOF (1) THEN CLOSE #1 • • • • Closes the file when the end of a sequential file, which has file number 1, is detected.

Description

• The EOF function detects the end of a file specified by <file number> in the sequential file.
• Returns True (-1) at the end of the file, otherwise returns False (0).

REMARK

See the LOC, LOF and OPEN instructions, and Chapter 6.

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ERASE Instruction

ERASE

• Deletes the array defined by the DIM instruction from memory.

Syntax

ERASE△ <array variable> [<, array variable> …]

array variable • • • • Enter the array variable specified by the DIM instruction.

Examples

ERASE A, B$ • • • • Deletes array variables A and B$.

Description

• The ERASE instruction deletes the array that was defined by the DIM instruction from memory.
• The array, which was deleted by the ERASE instruction, can be declared again by the DIM instruction.
• All data, which was stored in the array deleted by the ERASE instruction, is lost.
• A “Redimensioned array” error occurs if the array is declared again by the DIM instruction without being deleted by the ERASE instruction.

Program Example

```
1 ' Deletes by the ERASE instruction and redefines by the same variable name
10 DIM A(99)
20 DIM A(199)


RUN
Redimensioned array in 20
OK
15 ERASE A
LIST
1 ' Deletes by the ERASE instruction and redefines by the same variable name10 DIM A(99)
10 DIM A(99)
15 ERASE A
20 DIM A(199)
OK
RUN
OK
```

REMARK

See the DIM and CLEAR instructions.

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ERL Function — ERror Line

• Returns the line number where an error was detected.

Syntax

ERL

Examples

E=ERL • • • • Stores the line number where the error was detected to E.

Description

• The ERL function returns the line number where the error was detected when an error has occurred.
• The ERL function is used in the error processing routine so that the processing branches depending on the line where the error occurred.
• If the instruction that caused the error was being executed in the direct mode, the ERL function returns 65535.
• The ERL function has a limited purpose and it cannot be specified on the left side of the equal sign in the LET instruction and some other places.

Program Example

```
10 ' Displays the line number where the error occurred
20 ON ERROR GOTO 100                 :  ' Branches to line 100 when an error occurs
50 ERROR 10                          :  ' <-- Error occurs at this line
60 END
100 PRINT "ERROR LINE =";ERL         :  ' Displays the line number where the error
                                        occurred
110 RESUME 60


RUN
ERROR LINE = 50
OK
```

REMARK

See the ON ERROR GOTO and RESUME instructions, ERR function, and Chapter 9.

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ERR Function — ERRor code

• Returns a detected error code.

Syntax

ERR

Examples

E=ERR • • • • Stores the code of the detected error in E.

Description

• The ERR function returns the code of the detected error when an error occurs.
• The ERR function is used in the error processing routine so that the processing branches depending on the error content.
• The ERR function has a limited purpose and it cannot be specified on the left side of the equal sign in the LET instruction and some other places.
• For the error codes, see Appendix 4.4.

Program Example

```
10 ' Displays the error code
20 ON ERROR GOTO 100                    :  ' Branches to line 100 when an error occurs
50 ERROR 10                             :  ' <-- An error of error code 10 occurs
60 END
100 PRINT "ERROR CODE =";ERR            :  ' Displays the error code
110 RESUME 60

RUN
ERROR CODE = 10
OK
```

REMARK

See the ON ERROR GOTO and RESUME instruction, ERL function, and Chapter 9.

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ERROR Instruction — ERROR

• Generates the error of the specified error code.

Syntax

ERROR△ <integer expression>

integer expression • • • • Specify the error code of the error to be generated.

Examples

E=ERROR 2 • • • • Generates a “Syntax error” whose error code is 2.

Description

• The ERROR instruction generates an error of the specified error code.
• If the value of <integer expression> is the value registered as an error code in BASIC (see Appendix 4.4), the ERROR instruction generates an error of the corresponding error code.
• The BASIC causes an “Unprintable error” if an error number, whose error message is not defined by the ERROR instruction, is specified.
• The ERROR instruction is used in order to check the operation when an error processing is defined.

REMARK

See the ON ERROR GOTO and ERR instructions, ERL function, and Chapter 9.

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EXP Function — EXPonential

• Returns the exponential function value of base e (e=2.718281).

Syntax

EXP (<numeric expression>)

numeric expression •••• Specify the multiplicator n of e^n.

Examples

E=EXP(10) •••• Calculates EXP(10) and stores it in E.

Description

• The EXP function returns the exponential function value of base e.
• Specify 87.33655 or smaller to <numeric expression>. An “Overflow” error occurs if it exceeds this value.
• The EXP function calculates in single precision.

Program Example

```
10 ' Calculates the value of e^5.2
20 A=5.2
30 B=EXP(A)                                   :  'Calculates e^5.2
50 PRINT "e^5.2=";B
60 END


RUN
e^5.2= 181.272
OK
```

REMARK

See the LOG function.

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FIELD Instruction — FIELD

• Assigns the area for the specified variable to the random file buffer.

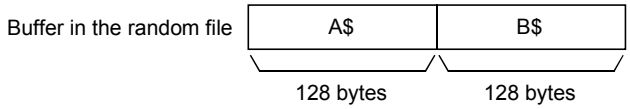
Syntax

FIELD△ <#> <file number> , <field length> AS <character string variable> [, <field length> AS <character string value>] …

file number	• • • •	Specify the file number of the random file specified by the OPEN instruction.
field length	• • • •	Specify the number of characters to assign to the buffer.
character string variable	• • • •	Specify the character string variable that corresponds to the part specified by the field length.

Examples

FIELD #1, 128 AS A$, 128 AS B$ • • • • Defines variables A$ and B$, which are used in the program, in the random file buffer of file number 1, and specifies 128 bytes as the assigned number of bytes for each.



Description

• The FIELD instruction assigns an area of the specified variable in the random file buffer that is specified by <file number>. The program writes and reads data with the random file buffer through these variables.
• The FIELD instruction has to be executed before reading data by the GET instruction or writing data by the PUT instruction.
• Use the LSET instruction and RSET instruction to write data to the random file buffer.
• The total number of bytes (total of <field length>) retained by one FIELD instruction should not exceed the buffer size (256 bytes). A “Field overflow” error occurs if the total number of retained bytes exceeds 256.

REMARK

• Multiple FIELD instructions can be executed in the random file buffer of the same file number. Each FIELD instruction assigns the variable from the beginning of the random file buffer, so all assignments become valid simultaneously.
• See the OPEN instruction and Chapter 6.

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FILES Instruction FILES

• Displays the file name of a file in a memory card, FD, HD, etc.

Syntax

FILES [“ <drive number> :] [<system name>\] [< file name>] “] [, S]

drive number	• • • •	Specify a memory card or FD to display the file name.
system name	• • • •	Specify the system name to display the file name.
file name	• • • •	Specify the file name to be displayed.

Examples

FILES “0:”, S	• • • •	The FILES instruction displays the file name, size, as well as the created date and time of a file without the system name in the memory card inserted in AD51H-S3 MEMORY CARD 1 .
FILES “2:TEST\”	• • • •	Displays the file name of a file in system name TEST of console’s A drive.

Description

• The FILES instruction displays the file name of the file in the system name specified by <system name> in a memory card, FD, HD, etc. specified by <drive number>.
• The FILES instruction displays only the file name if <file name> is specified.
In <drive number>, specify the memory card, FD, or HD to display the file name using the following numbers:

During online programming

To specify the memory card mounted in AD51H MEMORY CARD 1	• • • •	0
To specify the memory card mounted in AD51H MEMORY CARD 2	• • • •	1
To specify the A drive of the console	• •	2
To specify the C drive of the console	• •	3
To specify the D drive of the console	• •	4

During offline programming

To specify the A drive of the console	• •	1
To specify the C drive of the console	• •	3
To specify the D drive of the console	• •	4

• The file name, file size, as well as the creation date and time are displayed if the [, S] option is specified. If the [, S] option is not specified, only the file name is displayed.
• If <system name> is omitted, the name of file without a system name will be displayed.
• Wildcards (ambiguous specification) may be used for <file name>.
For the use of wildcard, see Appendix 1.4.
• SW1IVD-AD51HP-E cannot perform offline programming.

REMARK

See the LFILES instruction and Section 3.4.1.

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FIX Function

FIX

• Returns only the integer part after truncating the fractional part of the numeric value.

Syntax

FIX (<numeric expression>)

numeric expression • • • • Specify a numeric value to truncating the fractional part.

Examples

FIX(1.28)→1 • • • • Returns 1 after truncating the fractional part of 1.28.

FIX(-1.28) →-1 • • • • Returns -1 after truncating the fractional part of -1.28.

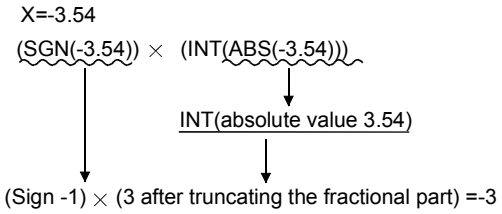
Description

• The FIX function returns only the integer part after truncating the fractional part of an integer.

• The FIX function is different from the INT function, and the fractional part is truncated by the FIX function even if the argument (X) is negative.

• FIX(X) is equivalent to (SGN(X)) X (INT(ABS(X))).

Example



Program Example

```
10 ' The fractional part of the numeric value is truncated
20 A=3.95                                   :  ' Defines the numeric value
30 B=-3.95
40 C=FIX(A!)                                :  ' The fractional part of A is truncated and
                                               stored in C
50 D=FIX(B!)                                :  ' The fractional part of B is truncated and
                                               stored in D
60 PRINT "      A=";A,"     B=";B
70 PRINT "FIX(A)=";C,"FIX(B)=";D            :  ' Numeric value after the fractional part is
                                               truncated
80 END


RUN
    A= 3.95       B=-3.95
FIX(A)= 3     FIX(B)=-3
OK
```

REMARK

See the CINT and INT functions.

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FOR to NEXT Instruction — FOR to NEXT

• Executes a series of instructions for the specified number of times.

Syntax

FOR△ <variable name> = <initial value> △ TO <final value> △ [STEP <increment>]
NEXT [<variable name>] [, <variable name>]

variable name	• • • •	Specify a variable that controls the repeat.
initial value	• • • •	Specify the initial value of the variable that controls the repeat.
final value	• • • •	Specify the final value of the variable that controls the repeat.
increment	• • • •	Specify the increment of the variable that controls the repeat.

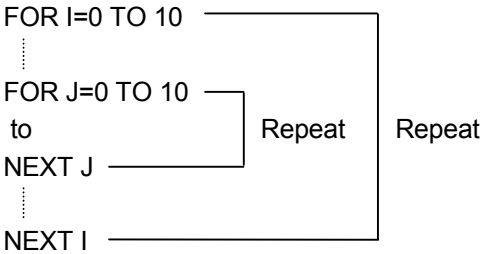
Examples

```
FOR I=0 TO 100 STEP 2
 to
NEXT I
```

• • • • Repeatedly executes through NEXT I by changing variable I from 0 to 100 with increment 2.

Description

• The FOR to NEXT instruction repeatedly executes the instructions between FOR and NEXT for the specified number of times.
• Only an integer variable and single precision variable can be used for the variable specified by <variable name>. Character variable and double precision variable cannot be used.
• When instructions between the FOR instruction and the NEXT instruction are executed, an increment specified by STEP is added to the variable and compared to the final value. If the value of the variable is equal to or less than the final value, the same processing is repeated after returning to the instruction following the FOR instruction. If the value of the variable is larger than the final value, the instruction after the NEXT instruction will be executed.
• The increment of the variable is considered 1 if STEP is omitted.
If the value specified by STEP is negative, the final value must be smaller than the initial value. In this case, the variable decrements after every repeat and it continues until the value of the variable is less than the final value.
If the STEP value is positive and the initial value is larger than the final value, or if the STEP value is negative and the initial value is smaller than the final value, the instructions between the FOR instruction and the NEXT instruction is executed only once.
• The FOR to NEXT loop can be nested. A FOR to NEXT loop can be inside of another FOR to NEXT loop.
If the loop is nested, the variable used in each loop has to be distinct. A FOR to NEXT instruction loop has to be within another FOR to NEXT instruction.



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If the nested loops have the same end point, multiple variable names can be described following one NEXT instruction.
However, list variable names in the order starting from the one that corresponds to the closest FOR instruction.

```
FOR I=0 TO 10
  :
FOR J=0 TO 10
 to
NEXT J, I
```

• A “NEXT without FOR” error occurs if the NEXT instruction without the corresponding FOR instruction is detected.

Program Example

```
10 ' Makes a multiplication table
30 FOR I=1 TO 9                              :   ' Repeats with I=1 to 9
40  FOR J=1 TO 9                             :   ' Repeats with I=1 to 9
50   PRINT USING "####";I*J;                 :   ' Displays the value of I*J
60  NEXT J
70  PRINT                                    :   ' New line
80 NEXT I
90 END


RUN
        1    2    3    4    5    6    7    8    9
        2    4    6    8   10   12   14   16   18
        3    6    9   12   15   18   21   24   27
        4    8   12   16   20   24   28   32   36
        5   10   15   20   25   30   35   40   45
        6   12   18   24   30   36   42   48   54
        7   14   21   28   35   42   49   56   63
        8   16   24   32   40   48   56   64   72
        9   18   27   36   45   54   63   72   81
OK
```

REMARK

See the ERASE and WHILE to WEND instructions, and Section 3.6.3.

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FORMAT Instruction FORMAT

• Initializes (logical format) the file area of a memory card.

Syntax

FORMAT△ <drive number>

drive number •••• Specify the memory card to initialize (logical format) the file area.

Examples

FORMAT 0 •••• Initializes (logical format) the memory card inserted in AD51H-S3 MEMORY CARD 1 .

Description

• The FORMAT instruction initializes (logical format) the file area of a memory card and enables to write the BASIC program and data file.
• The BASIC program and data file cannot be written to the memory card if the file area has not been initialized (logical format) by the FORMAT instruction.
• The memory card cannot be used only by the initialization (logical format) with the FORMAT instruction of the BASIC. To make the memory card in the usable condition, initialize (physical format) the entire memory card in the file maintenance mode or system mode. After the initialization, execute the FORMAT instruction of the BASIC and initialize (logical format) the file area.

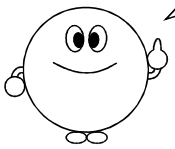
Reference Manual

Initialization (physical format) of the entire memory card in the file maintenance mode	••••	AD51H-BASIC type Package SW1IVD-AD51HP-E Operating Manual
Initialization (physical format) of the entire memory card in the system mode	••••	AD51H-BASIC Programming Manual (Debug and Compile)

• <drive number> specifies which memory card's file area to initialize (logical format).
The specification method is as follows:

To initialize the file of memory card mounted in MEMORY CARD 1 of the AD51H-S3	••••	0
To initialize the file of memory card mounted in MEMORY CARD 2 of the AD51H-S3	••••	1

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When the FORMAT instruction is used to initialize the file area of the memory card, all programs and data in the memory card are lost.
There is no way to recover the lost data. Be sure to check the contents of the memory card thoroughly before using the FORMAT instruction.

REMARK

See the AD51H-BASIC type Package SW1IVD-AD51HP-E Operating Manual, and AD51H-BASIC Programming Manual (Debug and Compile)

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FRE Function FREe

• Returns the size of the unused area of memory in bytes.

Syntax

FRE (<numeric expression>)
FRE (<character string expression>)

numeric expression	• • • •	Specify an numeric constant or numeric value variable as a dummy.
character string expression	• • • •	Specify a character constant or character variable as a dummy.

Examples

PRINT FRE(A)	• • • •	Displays the number of bytes that can be used by the BASIC program.
PRINT FRE(“TEST”)	• • • •	Displays the number of bytes of the unused character string processing area.

Description

• The FRE function returns the number of bytes of the unused area in the BASIC program area when <numeric expression> is specified.
The unused area is the area that is not used as the program, area for processing the character string, or as the variable area.
The value of <numeric expression> is a dummy and has no meaning.
• The size of the unused character string processing area is returned in bytes when <character string expression> is specified.
The value of <character string expression> is a dummy and has no meaning.
• The value returned from the FRE function is not the unused area of the entire memory that is used by multitask processing, but the unused area of the task number area where the FRE function is executed.
• For the memory map, see the User’s Manual of each communication module used.

Program Example

```
10 ' Displays the size of the unused memory area
20 PRINT "Task No. area-->";ZBAS          :  ' Displays the task No. area
30 PRINT "Unused area=";FRE(0);"byte"     :  ' Displays the size of the unused area
50 END


RUN
Task No. area--> 1
Unused area= 4601 bytes
OK
```

REMARK

See the CLEAR and ERASE instructions.

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GET Instruction

GET

• Reads one record from a random file to the random file buffer.

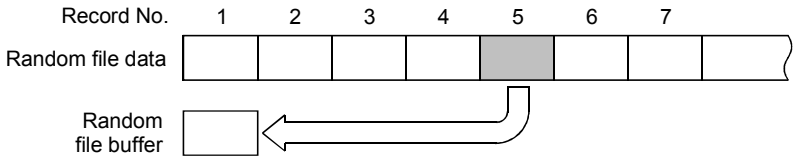
Syntax

GET△ [#] <file number> [, <record number>]

file number	• • • •	Specify the file number opened by the OPEN instruction.
record number	• • • •	Specify which record of the random file to be read.

Examples

GET #1, 5 • • • • Reads from the fifth record of file number 1 to the random file buffer.



Description

• The GET instruction reads one record of data from the random file to the random file buffer.
• <file number> is the number specified when the random file to read the file from was opened by the OPEN instruction.
• <record number> indicates which order of the record to read from the random file.
• If <record number> is omitted, the next record number of the record, which was specified by the GET or PUT instruction executed immediately before, is assigned.
If <record number> of the GET instruction executed immediately after the OPEN instruction is omitted, “1” is assigned to the record number and executed.

REMARK

See the OPEN, FIELD, PUT and CLOSE instructions, and Chapter 6.

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GETMEM Instruction GET MEMory

• Reads data from the buffer memory, common memory, and expansion register (ED) of the communication module.

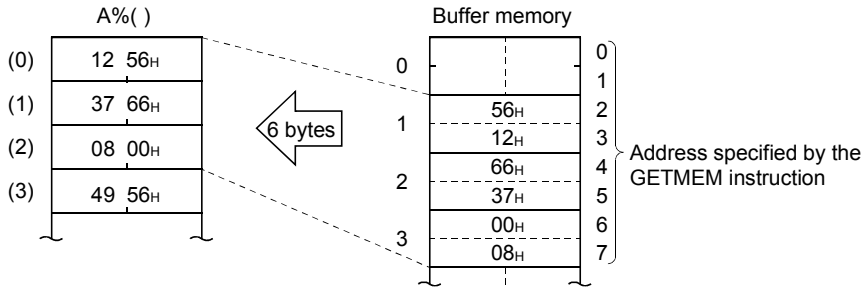
Syntax

GETMEM △ TO △ <read data store area> , <offset 1>
△ FROM △ <read source> , <offset 2>, <number of bytes>

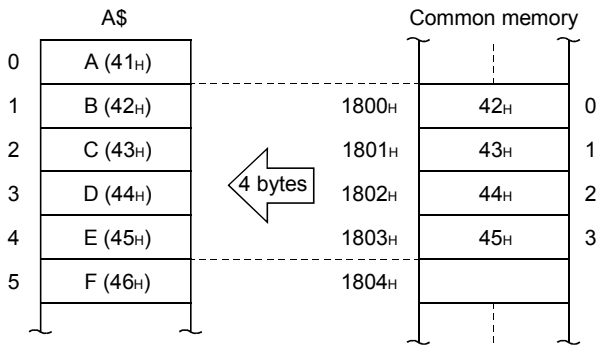
read source	• • • •	Specify the starting address of the buffer memory or common memory, or the starting device of the expansion register (ED).
read data store area	• • • •	Specify the integer variable, integer array name, character variable, or character array variable to store the read data.
offset 1	• • • •	Specify the offset value (in bytes) from the start of the read data store area.
offset 2	• • • •	Specify the offset value (in bytes) from the start of the read source.
number of bytes	• • • •	Specify the length of read data in bytes.

Examples

GETMEM TO A%( ),
0 FROM 0, 2, 6 • • • • Reads data of the buffer memory 1 through 3 (six bytes) to A%(0) through A%(2).

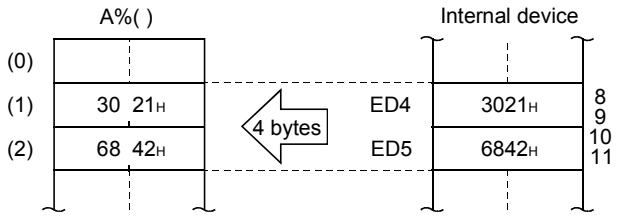


GETMEM TO A$, 1 FROM
&H1800, 0, 4 • • • • Reads data from the address &H1800 through &H1803 (four bytes) of the common memory in the communication module to second through fifth characters of A$.



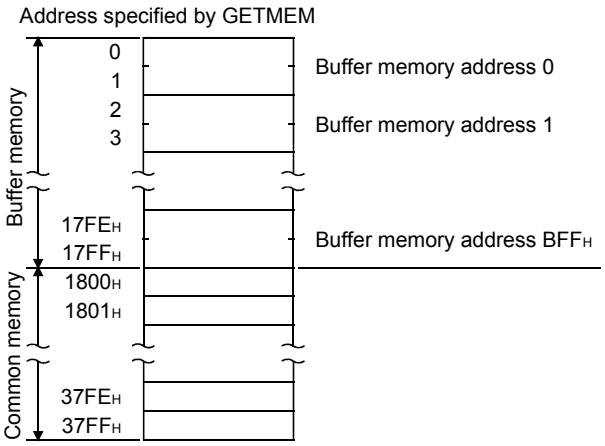
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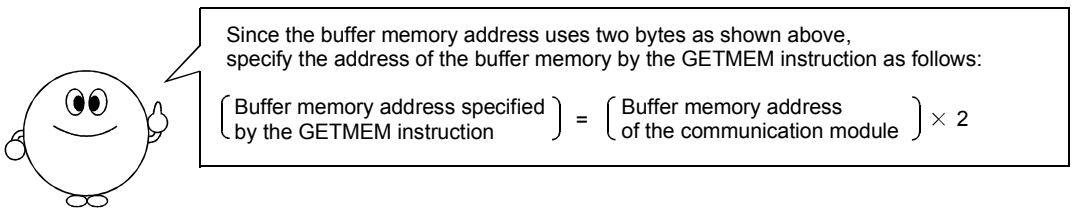
GETMEM TO A%( ),
2 FROM W@(ED, 2), 4, 4 • • • • Reads data of ED4 and ED5 (four bytes) to A%(1) and A%(2).



Description

- The GETMEM instruction reads data of <number of bytes> from the buffer memory, common memory or expansion register specified by <read source> and <offset 2>, to the variable specified by <read data store area> and <offset 1>.
- The address of the buffer memory or common memory, or an expansion register is specified for <read source>.
  The addresses of the buffer memory and common memory are as follows. Specify the starting address of readout in <read source>.





To read to the expansion register, specify the starting device of the read source by using special variable W@(ED, n).

To start from ED 100 → W@(ED, 100)
To start from ED 20 → W@(ED, 20)

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• Specify the variable, etc. where the data read from the buffer memory is stored in <read data store area>.
Store dummy data of <number of bytes> or more to the variable specified as <read data store area> before executing the GETMEM instruction. An error occurs during the execution of the GETMEM instruction if the dummy data is not stored.

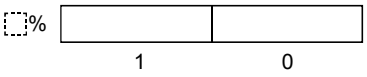
Integer variable □%=0
character variable □$=SPACE$(255)

• Always use the DIM instruction to define the area used as <read data store area> even if the number of used elements is 10 or less. If it is not defined by the DIM instruction, data can be stored only in the area that was defined by the DIM instruction when the GETMEM instruction is executed.
In addition, store the dummy data for <number of bytes> or more as follows, when a character array variable is used:

□$(n)=SPACE$(255)

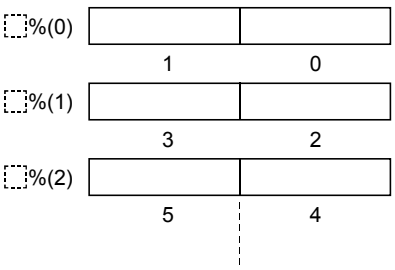
• In <offset 1>, specify in bytes which part of data of variables specified by <read data store area> will be stored at the beginning.
In <offset 2>, specify in bytes which part of data of variables specified by <read source> to be read at the beginning.

When an integer variable is specified:



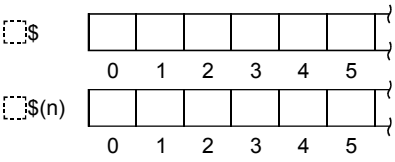
Specify 0 to specify the lower byte, or 1 to specify the higher byte, since the integer variable consists of two bytes (=16 bits) per variable.

When an integer array variable name is specified:



The offset values are as follows, since an integer array consists of two bytes (=16 bits) per element:
• To specify the lower byte of element number n
<offset> = n×2
• To specify the higher byte of element number n
<offset> = n×2+1

When a character variable or a character array variable is specified:



For the character variable and character array variable, specify
<offset> = n-1
to specify the nth character in the variable as the starting data, since a half-byte character in the variable is one byte.

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• Specify the length of data to be read from the starting location specified by <offset 2> to <number of bytes> in bytes.
If <read data store area> is an integer variable or integer array, use the following to store the read data to n elements:

<number of bytes> = n×2

since one element (variable) consists of two bytes.

• If <read data store area> is a character variable or character array variable, use the following to store the read data to half-byte characters:

<number of bytes> = n

since one to half-byte character consists of one byte.

• The user should manage the placement position, size, and data type of each data in the buffer memory, etc.
Data is not converted when reading and writing data to the buffer memory, etc.

• While the program is executed by multitask processing, perform the exclusive control by the ZRESERVE and ZRELEASE instructions in order to read and write data to the buffer memory, etc. of the same area.
No error occurs when another program requests reading or writing to the common memory area where data is being read and written. Reading and writing are allowed concurrently.

REMARK

See the PUTMEM instruction, and Sections 4.3 and 8.5.1.

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GOSUB RETURN Instruction GO to SUBroutine/RETURN

• Branches to a subroutine and returns to the specified line number.

Syntax

GOSUB△ <line number 1>
RETURN△ [<line number 2>]

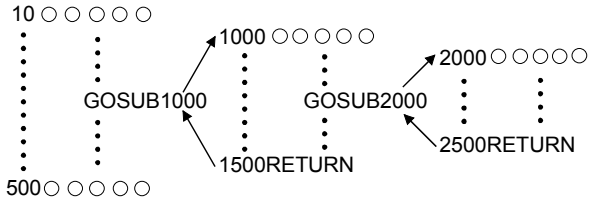
line number 1	• • • •	Specify the starting line number of the subroutine to be branched.
line number 2	• • • •	Specify the line number to return.

Examples

GOSUB 100	• • • •	Branches to the subroutine of line number 100.

Description

• The GOSUB to RETURN instruction branches to the subroutine by GOSUB, then returns to the instruction after the GOSUB instruction, specified line number, or label by the RETURN instruction.
• <line number> can also be specified by a label.
• The same subroutine can be called many times in a program.
• Subroutines can be nested as long as the memory capacity allows.
An “Out of Memory” error occurs when the memory runs out.



• The RETURN instruction returns the control to the following instruction of the GOSUB instruction that branched to the subroutine.
• While multiple RETURN instructions can be specified within one subroutine, they have to correspond to GOSUB instructions correctly.
• A subroutine must be used by a GOSUB instruction. If it is executed by itself, a “RETURN without GOSUB” error occurs when the RETURN instruction is executed.

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Program Example

```
10 ' Example using a subroutine
20 PRINT "At line 10 of the main routine"
30 GOSUB 100                          :  ' Branches to a subroutine
40 PRINT
50 PRINT "At line 50 of the main routine"
60 END                                :  ' End of execution
100 PRINT
110 PRINT "Entered the subroutine"
120 RETURN                            :  ' Returns to the main routine


RUN
At line 10 of the main routine

Entered the subroutine

At line 50 of the main routine
OK
```

REMARK

See Section 3.9.

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GOTO Instruction — GOTO

• Moves the program flow to the specified line number unconditionally.

Syntax

GOTO△ <line number>

line number •••• Specify the jump destination line number.

Examples

GOTO 100 •••• Moves the execution to line number 100.

Description

• The GOTO instruction moves the program flow to the specified line number unconditionally.
• The execution moves to the line specified by <line number>.
• <line number> can also be specified by a label.
• An “Undefined line number” error occurs if a line that does not exist is specified for <line number>.

Program Example

```
10 ' Repeats calculation until X reaches 4096
20 X=1                          :  ' Defines 1 to variable X
30 PRINT "X=";X                 :  ' Displays
40 X=2*X                        :  ' Doubles the value of X
50 IF X=4096 THEN END           :  ' Ends if X=4096
60 GOTO 30                      :  ' Returns to line 30
RUN
X= 1
X= 2
X= 4
X= 8
X= 16
X= 32
X= 64
X= 128
X= 256
X= 512
X= 1024
X= 2048
OK
```

REMARK

See the FOR to NEXT, IF to THEN and IF to GOTO instructions, and Section 3.6.

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HEX$ Function HEXadecimal $

• Converts a decimal number to a hexadecimal character string.

Syntax

HEX$ (<numeric expression>)

numeric expression •••• Specify within a range from -32768 to 65535.
＊ Values from 32768 to 65535 are the same as values from -32768 to -1 (8000_H to $FFFF_H$), however.

Examples

PRINT HEX$(200) •••• Converts 200 to C8 in hexadecimal and displays it.

Description

• The HEX$ function converts a decimal umber to a hexadecimal character string.
• The fractional part of the numeric expression is truncated, then converted into an integer.
• The hexadecimal numbers and decimal numbers correspond as follows:

Hexadecimal number	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
Decimal number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Program Example

```
10 ' Converts a decimal number to a hexadecimal number
20 A=200                                  :  ' Defines a numeric value
30 PRINT "Decimal number=";A
40 A$=HEX$(A)                             :  ' Converts into a hexadecimal number
50 PRINT "Hexadecimal number=";A$
60 END

RUN
Decimal number = 200
Hexadecimal number=C8
```

REMARK

See the VAL, BIN$ and OCT$ functions, and Section 2.7.2.
Add "&H" before a numeric number to express a hexadecimal numeric number.

Example

Decimal 200 → Hexadecimal &HC8

Use the VAL function to convert a hexadecimal number of a character string into a decimal number.

Example

VAL("&HC8") → Decimal 200

Always add "&H".

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IF GOTO ELSE Instruction

IF to GOTO to ELSE

• Selects a branch destination according to the result of an expression.

Syntax

IF△ <conditional expression> △GOTO <line number> [△ELSE <instruction> / <line number>]

conditional expression	• • • •	Specify with a relational operation expression (<, >, =).
line number	• • • •	Specify a line number of execution destination that is executed when the conditional expression is true.
instruction/line number	• • • •	Specify the instruction that is executed when the conditional expression is false, or a line number of execution destination.

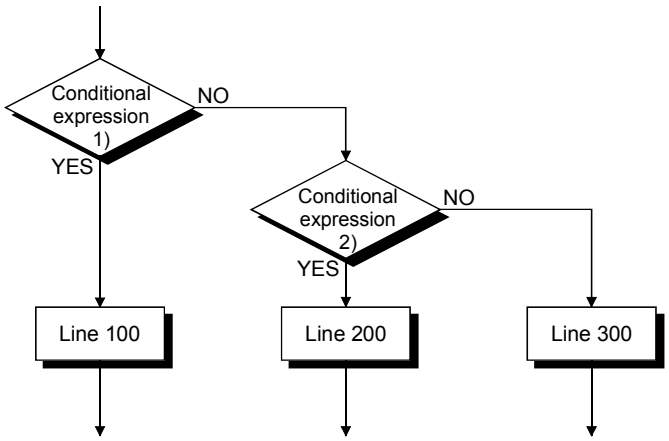
Examples

IF X> Y GOTO 100 ELSE END	• • • •	Branches to line 100 when X is greater than Y. Otherwise, terminates the program execution.
IF X=0 GOTO 100 ELSE 200	• • • •	Branches to line 100 if X is 0. If X is not 0, branches to line 200.

Description

• The IF to GOTO to ELSE instruction selects the execution according to the result of the expression.
• If the condition of <conditional expression> is true, the instruction after GOTO is executed and the instruction after ELSE is ignored.
• If the condition of <conditional expression> is false, the instruction after GOTO is ignored and the instruction after ELSE is executed.
The execution moves to the instruction of the next line if ELSE is not specified.
• <line number> can also be specified by a label.
• The IF instruction can be nested by writing a separate IF instruction after ELSE.

Example IF <conditional expression 1)> GOTO 100 100 ELSE IF <conditional expression 2)> GOTO 200 ELSE 300



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Program Example

```
10 ' Branches according to the condition
20 INPUT "X=";X                              :  ' Enter a value
30 IF X>=0 AND X<=10 GOTO 50 ELSE 60         :  ' Branch to line 50 if X is 0 to 10,
50 PRINT "Within range from 0 to 10!": END   :  '   otherwise branch to line 60
60 PRINT "Out of range!":END


RUN
X=? 1
Within range from 0 to 10!
OK
RUN
X=? 20
Out of range!
OK
```

REMARK

The correct result may not be obtained if single precision or double precision values are compared by an equal sign in <conditional expression>.
For details, see remarks in Section 3.7.2.

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IF THEN ELSE [Instruction] IF to THEN toELSE

• Selects an instruction to execute according to the result of the expression.

[Syntax]

IF △ <conditional expression> △ THEN <instruction> / <line number> [: <instruction> / <line number>] [△ ELSE <instruction> / <line number>]

conditional expression	• • • •	Specify by a relational operation expression (<, >, =).
instruction or line number	• • • •	Specify an instruction to execute or a line number to branch after THEN or ELSE.

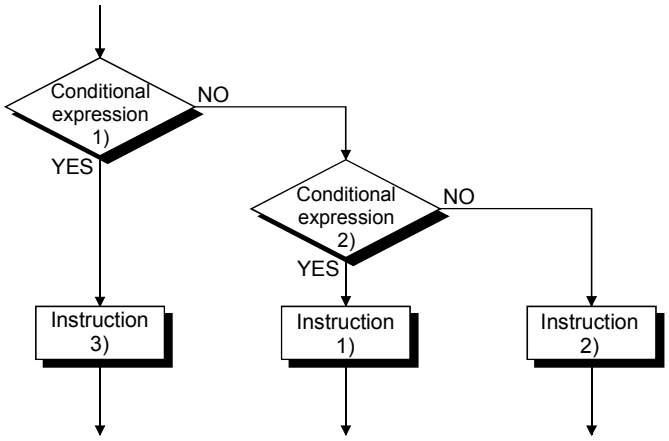
[Examples]

IF X=Y THEN PRINT “Hit!” ELSE PRINT “Miss!”	• • • •	Displays “Hit!” if X and Y are the same, or displays “Miss!” otherwise.
IF X=0 THEN 100 ELSE 200	• • • •	Executes line 100 if X is 0 or executes line 200 otherwise.

[Description]

• The IF to THEN to ELSE instruction selects an instruction to execute or a line number to branch according to on the result of the expression.
• If the condition of <conditional expression> is true, the instructions after THEN are executed. Instructions after ELSE are ignored.
• If the condition of <conditional expression> is false, the instructions after THEN are ignored and instructions after ELSE are executed.
The execution moves to the instruction of the next line if ELSE is not specified.
• <line number> can also be specified by a label.
• The IF instruction can be nested by writing another IF instruction after THEN or ELSE.

[Example] IF <conditional expression 1)> THEN IF <conditional expression 2)> THEN [Instruction 1)] ELSE [Instruction 2)] ELSE ELSE [Instruction 3)]



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Program Example

```
0 ' Selects an instruction to execute according to the condition
20 INPUT "X=";X                                          :   ' X input
30 INPUT "Y=";Y                                          :   ' Y input
40 IF X=Y THEN PRINT "Same" ELSE PRINT "Different"
                                                         :   ' Displays 'Same' if X=Y
50 END                                                   :   ' Different' if X<>Y


RUN
RUN
X=? 5
Y=? 5
Same
OK
RUN
X=? 3
Y=? 9
Different
OK
```

REMARK

The correct result may not be obtained if single precision or double precision values are compared by an equal sign in <conditional expression>.
For details, see remarks in Section 3.7.2.

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INKEY$ Function

INput KEY $

• Returns the character if there is an input from the keyboard, or returns an empty character string (“ “) if there is no input.

Syntax

INKEY$

Examples

A$=INKEY$ • • • • Assigns the character to A$ if there is a keyboard input, or assigns an empty character string (“ “) to A$ if there is no input.

Description

• The INKEY$ function returns the character if there is a key input from the keyboard specified by ZIDV instruction, or returns an empty character string if there is no input. It is not displayed on the screen, however.

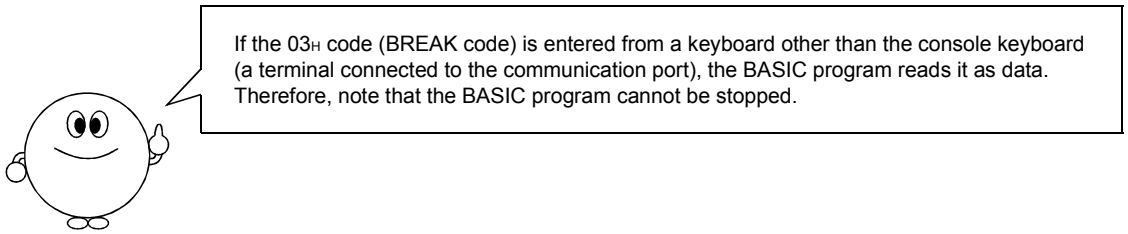
• All the keys except for the following keys can be entered from the keyboard that is specified as a console.

Ctrl + C , Ctrl + S , Break key (Processes exactly as key operation.)

Keys that correspond to 00_H, 80_H, and FD_H to FF_H

• All the keys can be entered from the keyboard other than the console (a console connected to the communication port), except for the keys that correspond to the 00h code and keys that correspond to the DC1/DC3 codes that were specified by the ZCNTL instruction.

• The new line character and others, which cannot be entered by the INPUT instruction and LINE INPUT instruction, can also be entered by the INKEY$ instruction.



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Program Example

```
10 ' Pressing any key terminates the program
20 PRINT "*";
30 A$=INKEY$                          :  ' Checks the key status
40 IF A$="" GOTO 20                   :  ' Returns to line 20 if no key is pressed
50 END


RUN
**************
OK
```

REMARK

See the INPUT$ function, CONT and INPUT instructions, and Section 3.11.

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INPUT Instruction

INPUT

• Data entry from the keyboard.

Syntax

INPUT△ [“ <character string to be displayed> “;] <variable name> [, <variable name>, …]

character string to be displayed	• • • •	Specify a character constant to display when requesting an input.
variable name	• • • •	Specify a variable where the entered data is stored

Examples

INPUT “Target number=”;M	• • • •	Displays “Target number=” on the console screen and waits for the next input. When data is entered, stores the entered data in M.

Description

• The INPUT instruction temporarily stops the program execution and displays a question mark (?) on the screen specified by the ZODV instruction. Once the question mark is displayed, you can enter data from the keyboard specified by the ZIDV instruction.

• If <character string to be displayed> is specified, the character string is displayed before the question mark on the screen specified by the ZODV instruction.

•. The entered data is assigned to the variable specified by <variable name>.

• The number of data items to be entered must match the specified <variable name> counts. The variable specified by <variable name> is a numeric variable or a character string variable (including an array variable).
The type of each data item to be entered must match the type of <variable name>.
(Entry of a character string to the INPUT instruction does not have to be enclosed by the double quotation marks.)
If the number of items or type of the data to be entered to the INPUT instruction does not match, a message “?Redo from start” is displayed and waits for an input again. If there are more data items than the number of <variable> items, “Extra ignored” is displayed and the next instruction is executed.

• Delimit data items by a comma (,).

• The INPUT instruction continues waiting for the data entry until the Enter key (enter code) is entered.

• You cannot enter a comma (,) and a double quotation mark (“) by the INPUT instruction. Use the LINT INPUT instruction to enter these characters.

• When input is made from a terminal other than the one specified as a console in the communication module with the ZIDV instruction, the following key inputs are assigned to the variables specified by <variable name> without conversion.
Ctrl + C , Ctrl + S , Break
Keys that correspond to DC1/DC3 specified by the ZCNTL instruction
Therefore, note that the program execution cannot be stopped (Ctrl + C , Break).

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Program Example

```
10 ' Data input
20 INPUT "X=";X                                    :    ' Input
30 PRINT "X^2=";X^2
40 END


RUN
X=? 2
X^2= 4
OK
```

REMARK

See the INPUT$ function, LINE INPUT instruction, and Section 3.11.

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IPUT$ Function — INPUT $

• Returns a character string of the specified length after reading from the keyboard of the console.
• Returns a character string of the specified length after reading from a sequential file.
• Returns a character string of the specified length after reading from the communication port of the communication module.

Syntax

INPUT$ (<numeric expression>)
INPUT$ (<numeric expression> , # <file number>)
INPUT$ (<numeric expression> , % <port number> [, <wait time>])

numeric expression	• • • •	Specify the length of a character string to be read.
file number	• • • •	Specify the file number of the sequential file that was opened by the OPEN instruction
port number	• • • •	Specify the port number of port opened by the ZOPEN instruction.
wait time	• • • •	Specify the wait time for the data entry from the communication port in seconds.

Examples

A$=INPUT$(3)	• • • •	Reads three characters from the keyboard at the console and assigns them to A$.
B$=INPUT$(10, #1)	• • • •	Reads ten characters from the sequential file opened by the file number 1, then assigns them to B$.
C$=INPUT$(7, %1, 20)	• • • •	Reads seven characters from CH1(RS-232) of the communication module and assigns them to C$. "Time out error" occurs if twenty seconds elapses before reading seven characters.

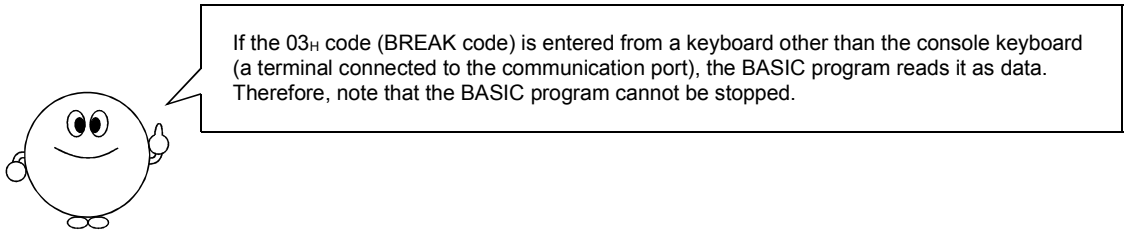
Description

• The INPUT$ function reads and returns number of characters specified by <numeric expression> from the keyboard, sequential file, or a communication port.
• <numeric expression> specifies the length of character string to be read.
Specify the length from 1 to 255 range.

Reading from the keyboard

• If nothing is specified after <numeric expression>, input from the keyboard specified by the ZIDV instruction is accepted.
• All of the keys except for the following keys or codes can be read from the keyboard that is specified as the console.
Ctrl + C , Ctrl + S , Break key (Processes exactly as key operation.)
Codes that correspond to 00_H, 80_H, and FD_H to FF_H
• All the keys can be entered from the keyboard other than the console's keyboard (a console connected to the communication port), except for the keys that correspond to the 00_H code and keys that correspond to the DC1/DC3 codes that were specified by the ZCNTL instruction.

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Description

• For the input from the keyboard, the program continues waiting for the input of number of characters specified by <numeric expression>. If the buffer contains the data that has already been entered, the characters are read from the beginning of the buffer.
The entered characters are not displayed on the screen.

Reading from a sequential file

• When <file number> is specified after <numeric expression>, a character string of <numeric expression> characters are read from the sequential file.
• <file number> specifies the file number set by the OPEN instruction to the corresponding sequential file.
• When reading from a file, all of the delimiters are read as data.
• An “Input past end” error occurs if there is no data to read when trying to read from a file.

Reading from a communication port of the communication module

• If <port number> is specified after <numeric expression>, input is accepted from CH1(RS-232), CH2(RS-232), and CH3(RS-422) of the communication module.
• Specify <port number> as follows:

CH1(RS-232)	• • • •	1
CH2(RS-232)	• • • •	2
CH3(RS-422)	• • • •	3

• All the codes including 00H code as well as characters can be read as data by the input from a port.
Therefore, the BASIC program reads the 03H code (BREAK code) as data, and note that the BASIC program is not stopped.
• <wait time> sets the duration to wait for the data input.
The value can be set from 0 to 255 seconds.
A “Time out error” occurs if the input of the number of bytes specified by <numeric expression> has not occurred within the specified duration.
When 0 is specified to <wait time> or when <wait time> is omitted, the program continues waiting until the input of the number of characters specified by <numeric expression> occurs.
• If the buffer contains the data that has been already entered when reading from a port, the characters are read from the beginning of the buffer.

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Program Example

```
10 ' Waits for the input from the keyboard
20 PRINT "Yes or No ?";
30 A$=INPUT$(1)                                    :    ' Enters one character from the keyboard
40 IF A$="Y" OR A$="y" THEN PRINT:PRINT "OK!!":GOTO 60
50 PRINT:PRINT "???"
60 END


RUN
Yes or No ?
OK!!
OK
RUN
Yes or No ?
???
OK
```

REMARK

See the INPUT and LINE INPUT instructions, and Section 3.11

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INPUT# Instruction

INPUT #

• Reads data from a sequential file.

Syntax

INPUT△# <file number>, <variable name> [, <variable name> , …]

file number	• • • •	Specify the file number of the sequential file that was opened by the OPEN instruction.
variable name	• • • •	Specify the variable where the read data is stored.

Examples

INPUT#2, A	• • • •	Reads numeric data from the sequential file that was opened by file number 2, then assigns it to A.

Description

• The INPUT# instruction reads data from a sequential file and stores it in a variable.
• <file number> is the number used for opening the sequential file for input by the OPEN instruction.
• <variable name> indicates a variable where the data item in the file is assigned to. The type of the data item in the file must match that of the variable name.
• If the data item is a numeric value, the first character other than space, enter, and line feed is considered as the beginning of the numeric value and the end of the numeric value is indicated by a space, enter, line feed, or comma.
• When reading a data item of a character string, the first character other than space, enter, or line feed is considered as the beginning of the character string data item.
If this first character is a double quotation mark (“), the character string includes all characters between the first double quotation mark and the second double quotation mark.
A double quotation mark cannot be included as a character in a character string that is enclosed by double quotation marks.
If the first character of a character string is not a double quotation mark, the end of the character string is indicated by either a comma or Enter.
The maximum number of characters that can be read is 255.
If there is no delimiter (Enter, comma) within 255 characters, the entire 255 characters are read as one character string.
• If the program reaches the end of file while reading numeric data or character string data, the data item ends at that point.

REMARK

See the INPUT$ and LINE INPUT# functions, LOF and OPEN instructions, and Chapter 6.

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INSTR Function

IN STRing

• Searches a specified character string in the character string and returns the position of the first match.

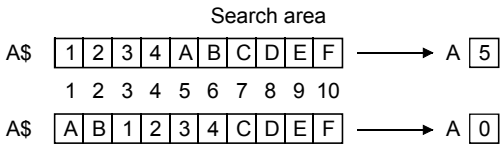
Syntax

INSTR ([<numeric expression > ,] <character string expression 1>, < character string expression 2>)

numeric expression	• • • •	Specify the position to start searching the character string.
character string expression 1	• • • •	Specify the target character string.
character string expression 2	• • • •	Specify the character string to be searched.

Examples

A=INSTR(2, A$, “ABC”) • • • • Searches the character string “ABC” from the second character of A$, and assigns the position if found or assigns 0 if not found to A.



Description

• The INSTR function searches <character string expression 2> in <character string expression 1>, then returns the position of the first match if found or returns 0 if not found.
• Specify the position to start the search to <numeric expression>. If omitted, the search starts from the beginning of <character string expression 1>, and the INSTR function returns 0 if a value larger than the number of characters in <character string expression 1> is specified.
• 0 is returns if <character string expression 1> is an empty character string.
• The same value as <numeric expression> is returned if <character string expression 2> is an empty character string.

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Program Example

```
10 ' Searches for the specified characters
20 A$="AD51HMitsubishiPLC"
30 A=INSTR(2,A$,"PLC")          :  ' Searches for PLC from a character string
40 PRINT "A$=";A$               :  ' Displays the character string
50 PRINT "PLC is the ";A;"th character"  :  ' Displays the position where 'PLC' was
                                           detected
60 END


RUN
A$=AD51HMitsubishiPLC
PLC is the 16th character
OK
```

REMARK

See the KINSTR, KLEN, and LEN functions.

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INT Function

INTeger

• Returns the integer value of the numeric expression

Syntax

INT (<numeric expression>)

numeric expression • • • • Specify the value to be processed.

Examples

A=INT(B) • • • • Converts the value of B into an integer value and assigns it to A.

Description

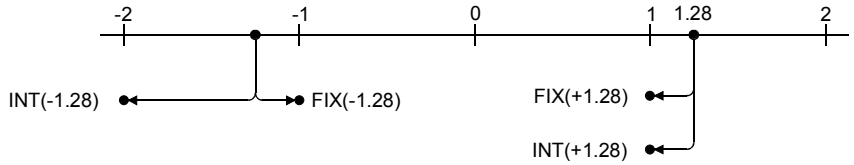
• The INT function returns the maximum integer value that does not exceed the value of <numeric expression>.

• The INT function calculates the maximum integer which does not exceed <numeric expression> when truncating the fractional part. Thus, the result is different when the numeric value is negative from the result by the FIX function that simply truncates the fractional part.

Example

FIX(1.28) —— 1 INT(1.28) —— 1

FIX(-1.28) —— -1 INT(-1.28) —— -2



• Unlike the CINT function, the type is not converted.

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Program Example

```
10 ' Differences of calculation results among INT, FIX and CINT functions
20 DIM A(3)                                  :  ' Defines an array
30 A(0)=12.34                                :  ' Stores the value
40 A(1)=12.56
50 A(2)=-12.34
60 A(3)=-12.56
70 FOR I=0 TO 3                              :  ' Repeats with I=0 to 3
80  PRINT "A(";I;")=";A(I)                   :  ' Displays the original value
90  PRINT "INT =";INT(A(I))                  :  ' Displays the result of conversion by the
                                                   INT function
100  PRINT "FIX =";FIX(A(I))                 :  ' Displays the result of conversion by the
                                                   FIX function
110  PRINT "CINT=";CINT(A(I))                :  ' Displays the result of conversion by the
                                                   CINT function
120  PRINT
130 NEXT I
140 END


RUN
A( 0 )= 12.34
INT = 12
FIX = 12
CINT= 12

A( 1 )= 12.56
INT = 12
FIX = 12
CINT= 12

A( 2 )=-12.34
INT =-13
FIX =-12
CINT=-13

A( 3 )=-12.56
INT =-13
FIX =-12
CINT=-13

OK
```

REMARK

See the CINT and FIX functions.

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KEY Instruction KEY

• Defines a character string to a function key of the console.

Syntax

KEY△ <key number> , <character string>

key number	• • • •	Specify a function key to define the character string.
character string	• • • •	Specify the character string to be defined.

Examples

KEY 1, “MITSUBISHI” • • • • Defines the character string “MITSUBISHI” to the function key (F1) of function key number 1 of the console.

Description

• The KEY instruction defines a character string or a control character to a function key of the console.
• Specify <key number> which corresponds to the function key number on the keyboard.
• The range of the function key number is from 1 to 10.
• In <character string>, specify a character string of up to 15 characters to assign to the specified function key. (A control character is also counted as one character.)
The first 15 characters are valid if 16 or more characters are specified.
Specify control characters using the CHR$ function.
• After the assignment is finished, pressing the function key is equivalent to entering the character string assigned to the key from the keyboard.
• The defined character string can be displayed on the screen by the KEY LIST instruction.
• The following character string is defined to each function key:

F1	• • • •	load”	F6	• • • •	save”
F2	• • • •	auto	F7	• • • •	key
F3	• • • •	goto	F8	• • • •	print
F4	• • • •	list	F9	• • • •	list.+$0D_H$+$1E_H$+$1E_H$
F5	• • • •	run+$0D_H$	F10	• • • •	cont+$0D_H$

REMARK

See the KEYLIST instruction.

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KEYLIST Instruction — KEY LIST

• Displays the character string defined to the function key of the console.

Syntax

KEY LIST

Examples

KEY LIST	• • • •	Displays the character string defined to the function key of the console.

Description

• The KEY LIST instruction displays the character string defined to the function keys F1 to F10 of the console.

• The following character string is assigned to each function key:

F1	• • • •	load”	F6	• • • •	save”
F2	• • • •	auto	F7	• • • •	key
F3	• • • •	goto	F8	• • • •	print
F4	• • • •	list	F9	• • • •	list.+0D$_H$+1E$_H$+1E$_H$
F5	• • • •	run+0D$_H$	F10	• • • •	cont+0D$_H$

• The character string definition to the function keys of the console can be changed by the KEY instruction.

REMARK

See the KEY instruction.

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KILL Instruction KILL

• Deletes a file in the memory card, FD, or HD.
• Deletes the system name in the memory card, FD, or HD.

Syntax

KILL" [<drive number> :] [<system name>\] [<file name>]"

drive number	• • • •	Specify the memory card, FD or HD where the file to be deleted is stored.
system name	• • • •	Specify the name of the system where the file to be deleted is stored.
file name	• • • •	Specify the name of the file to be deleted.

Examples

KILL"1:TEST\No0.BAS"	• • • •	Deletes a file with file name No1.BAS and system name TEST from the memory card inserted in AD51H-S3 MEMORY CARD 2 .
KILL"0:BASIC\"	• • • •	Deletes system name BASIC from the memory card inserted in AD51H-S3 MEMORY CARD 1 .

Description

• The KILL instruction deletes a file in the FD or HD of the console, or in the memory card inserted in the AD51H-S3 memory card interface.
• For <drive number>, specify the memory card, FD, or HD where the file to be deleted is stored using the following number:

During online programming

To specify the memory card mounted in AD51H-S3 MEMORY CARD 1	• • • • •	0
To specify the memory card mounted in AD51H-S3 MEMORY CARD 2	• • • • •	1
To specify the A drive of the console	• •	2
To specify the C drive of the console	• •	3
To specify the D drive of the console	• •	4

During offline programming

To specify the A drive of the console	• •	1
To specify the C drive of the console	• •	3
To specify the D drive of the console	• •	4

• Specify the system name where the file to be deleted exists in <system name>. If <system name>\is not specified, files without a system name will be deleted.

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- Specify the file name and identifier of the file to be deleted in <file name>. The identifier cannot be omitted in the KILL instruction.
- The KILL instruction cannot be executed when at least one data file is open. A “File already open” error occurs when the KILL instruction is executed while a file is open.
- SW1IVD-AD51HP-E cannot perform offline programming.

REMARK

See Section 3.4.3.

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LEFT$ Function

LEFT $

• Extracts a character string of the number of characters specified from the left of the character string.

Syntax

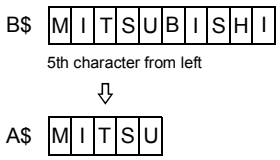
LEFT$ (<character string expression> , <numeric expression>)

character string expression • • • • Return a character string of the number of characters to be processed.

numeric expression • • • • Specify the length of the character string to be extracted.

Examples

A$=LEFT$(B$, 5) • • • • Stores the first five characters of B$ counting from the left into A$.

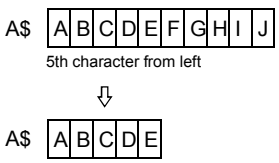


Description

• The LEFT$ function extracts and returns the character string of the number of characters specified from the left of the character string.
• When the value of <numeric expression> is greater than the number of bytes in <character string expression>, the entire character string will be returned.
• The valid range for <numeric expression> is 0 to 255. If the value exceeds 255, an “Illegal function call” error will be generated. Also, when 0 is specified, an “ “ (empty string) will be returned.
• If the extracted character string is stored into the original character string, the original character string will be changed.

Example

A$=LEFT$(A$, 5)



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Program Example

```
10 ' Extracts 5 characters from the left of the character string
20 A$="AD51H-BASIC"                                  :  ' Defines the character string
30 B$=LEFT$(A$,5)                                    :  ' Extracts 5 characters from the left
50 PRINT "5 characters counting from the left --->";B$  :  ' Displays extracted character string
60 END


RUN
5 characters counting from the left ---> AD51H
OK
```

REMARK

See the RIGHT$ and MID$ (Part 2) functions.

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LEN Function LENgth

• Returns the number of characters composing a character string.

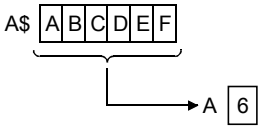
Syntax

LEN (<character string expression>)

character string expression • • • • Specify the character string for which the number of characters will be counted.

Examples

A=LEN(A$) • • • • Stores the number of characters in character variable A$ in A.



Description

• The LEN function counts and returns the number of characters of the character string specified by the character string expression.
• The control characters 00h through 1Fh in the character code and spaces are counted.

Program Example

```
10 ' Checks the number of characters in the character string
20 A$="AD51H-BASIC"                    :   ' Defines the character string
40 PRINT "Number of characters-->";LEN(A$)
50 END


RUN
Number of characters--> 11
OK
```

REMARK

See the Section 3.13.2.

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LET Instruction

LET

• Assigns the value of the expression to a variable.

Syntax

[LET△] <variable name> = <expression>

variable name • • • • Specify numeric variable, character variable, or array variable.

expression • • • • Specify numeric expression, character string, array, or function.

Examples

LET A=1 • • • • Assigns "1" to numeric variable A.

LET A$=”MITSUBISHI” • • • • Assigns character string “MITSUBISHI” to character string variable A$

Description

• The LET instruction assigns the value of an expression to a variable.

• The LET command may be entirely omitted.

Example

LET A=10 ⟶ A=10

LET A$=”NAGOYA” ⟶ A$=”NAGOYA”

• If the <expression> is a numeric expression, <variable name> must be a numeric variable. If the <expression> is a character string, the <variable name> must be a character string variable. If the <expression> and <variable name> do not match, a “Type mismatch error” will be generated.

• If the <expression> and <variable name> types do not match, the <expression> should be changed to match with the <variable name> type and then assigned.

Example

Integer type variable: A%=55.88

PRINT A% ⟶ 55

Single-precision type variable: B=.8571428571428571

PRINT B ⟶ .857143

Double-precision type variable: C#=2.04

PRINT C# ⟶ 2.039999961853027

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Program Example

```
10 ' Assigns 1 to Variable A and assigns A + 1 to Variable B
20 A=1                                          :  ' Stores 1 in A
30 B=A+1                                        :  ' Stores A+1 in B
40 PRINT "A=";A, "B=";B                         :  ' Displays A and B
50 END


RUN
A= 1            B= 2
OK
```

REMARK

See Section 3.5.1.

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LFILES Instruction — LFILES

• Outputs the names of the files on an FD or HD to a printer.

Syntax

LFILES△[“ [<drive number> :] [<system name>\] “] [, S]

drive number •••• Specify the memory card, FD, or HD used to display files.

system name •••• Specify the system name used to display the filename.

Examples

LFILES”0 : ”, S •••• Prints the filename, size, and creation data of the file with no system name in the memory card attached to AD51H-S3 MEMORY CARD 1 to the printer.

LFILES”2 : TEST\” •••• Prints the filenames in system name TEST in drive A of the console to the printer.

Description

• The LFILES instruction prints the filenames of files in the specified <system name> in the specified <drive number> in a memory card, FD, or HD to a printer specified by the ZLDV instruction.

• <drive number> is used to specify the memory card, FD, or HD from which the filename is displayed as follows.

During online programming

To specify the memory card inserted in AD51H-S3 MEMORY CARD 1	••••	0
To specify the memory card inserted in AD51H-S3 MEMORY CARD 2	••••	1
To specify the A drive of the console	••••	2
To specify the C drive of the console	••••	3
To specify the D drive of the console	••••	4

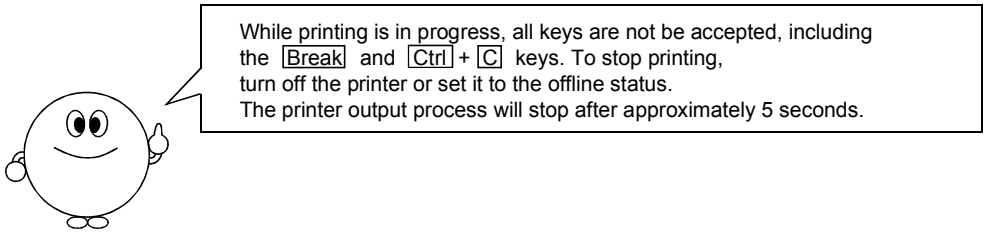
During offline programming

To specify the A drive of the console	••••	1
To specify the C drive of the console	••••	3
To specify the D drive of the console	••••	4

• The [, S] option is used to display the filename, file size, and creation data. If the [, S] option is not specified, only the filename will be printed.

• If <system name> is omitted, the files with no system name will be displayed.

• SW1IVD-AD51HP-E cannot perform offline programming.



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LINE INPUT Instruction

LINE INPUT

• Stores the entire line (255 characters or less) of the key input into a character string variable without any delimiters.

Syntax

LINE INPUT△ [" <display character string> ";] <character string variable>

display character string	• • • •	Specify the characters to display in front of the character string variable.
character string variable	• • • •	Specify the character string variable for storage.

Examples

LINE INPUT"DATA-";A$	• • • •	The data entered via the keyboard is stored in A$ after the Enter key is pressed.

Description

• The LINE INPUT instruction stops the program temporarily and performs key input from the keyboard specified by the ZIDV instruction.
• A question mark (?) as with the INPUT instruction is not be displayed when the LINE INPUT instruction is used.
• All characters entered until the Enter key is pressed is assigned to the <character string variable> when the LINE INPUT instruction is used.
• The following keyboards can be used for key input.
The console keyboard
Keyboard from the terminal connected to the communications port
• When the <display character string> is specified, the character string specified will be displayed on the screen specified by the ZODV instruction prior to the key input.
• When only the Return key is pressed without entering character string data, <character string variable> will assume that an empty character string has been entered.
• When performing data entry using a terminal connected to the communications port, the port must be open via the ZOPEN instruction and the input destination must be specified with the ZIDV instruction.
• When input console is made from a console other that the one specified as a console in the communication module with the ZODV instruction, the following key inputs are assigned to the variables specified by <variable name> without conversion.
• Ctrl + C , Ctrl + S , Ctrl + Q , and Break
Therefore, note that programs cannot be stopped (Ctrl + C or Break).

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Program Example

```
10 ' Enters the character string until the Enter key is pressed
20 LINE INPUT "Address: ";A$
30 LINE INPUT "Name: ";B$ : ' Enters the character string
40 PRINT
50 PRINT A$;" : ";B$                                    :    ' Displays entered character string
60 END


RUN
Address : NAGOYA
Name : MITUBISHI

NAGOYA : MITUBISHI
OK
```

REMARK

See the CLOSE and INPUT instructions, and INPUT$ function.

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LINE INPUT# Instruction

LINE INPUT #

• Stores the entire line (255 characters or less) from a sequential file into a character string variable without any delimiters.

Syntax

LINE INPUT△# <file number> , <character string variable>

file number • • • • Specify the file number from which the data will be read.

character string variable • • • • Specify the variable to which the read character string will be stored.

Examples

LINE INPUT# 1, A$ • • • • Reads one line from the sequential file number 1 and stores it in A$.

Sequential File #1

ABCDEFG • • • • • • • • • • • • ⇨ A$= "ABCD "

255 characters

Description

• The LINE INPUT# instruction reads an entire line from the sequential file specified in <file number> and stores it in a character string variable.

• The sequential file must be open with the OPEN instruction prior to executing this instruction.

• The LINE INPUT# instruction reads all characters (including commas (,), colons (:), semicolons (;), and double quotation marks (“)) without separating the characters until the Enter key (&H0D) is pressed.

" ABCD" ," EFGH" ," IJ;KL" ⇨ A$

22 characters

• A maximum of 255 characters can be read. If the Enter key is not detected within 255 characters, all 255 characters will be read as one character string.

ABCDEFGH Enter — Reads 8 characters up to the Enter key.

ABCDEF • • • • • • • • ; "XY" — Reads all 255 characters.

REMARK

See the INPUT# instruction and INPUT$ function, and Chapter 6.

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LIST Instruction

LIST

• Displays the entire program or a portion of it within the program area.

Syntax

LIST△ [<line number 1> [- [<line number 2>]]]

line number 1	• • • •	Specify the line number to start the program list.
line number 2	• • • •	Specify the line number to end the program list.

Examples

LIST	• • • •	Displays all lines.
LIST 500	• • • •	Lists line number 500.
LIST 150-	• • • •	Lists the lines from line 150 to the end.
LIST –1000	• • • •	Lists the lines from the beginning to line 1000.
LIST 150-1000	• • • •	Lists the lines from line 150 to line 1000.
LIST.	• • • •	Lists the line in which execution was suspended by the STOP instruction or error occurrence.

Description

• The LIST instruction displays the program within the program area.
• If only <line number 1> is specified, only that line is displayed.
• If <line number 1> and a hyphen (-) are specified, the program starting with that line to the end is displayed.
• If a hyphen (-) and <line number 2> are specified, the program starting from the beginning to the <line number 2> specified will be displayed.
• If <line number 1> and <line number 2> are specified, the program from <line number 1> to <line number 2> will be displayed.
• If both line numbers are omitted, the entire program will be displayed.
• If a line number pointer (.) is specified instead of line numbers, the line number in which the program suspended due to the STOP instruction or error occurrence will be displayed.
• To pause the execution of the LIST instruction, press the Ctrl + S keys. To continue the execution, press any key. To end the execution while it is in progress, press the Ctrl + C keys or Break key.
• When the LIST instruction is executed in programming mode, BASIC will wait for an instruction after displaying the program.

REMARK

See the LLIST instruction and Section 3.2.3.

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LLIST Instruction

LLIST

• The entire program area or a portion of the program within the specified range will be printed to the printer.

Syntax

LLIST△ [<line number 1> [- [<line number 2>]]]

line number 1	• • • •	Specify the line number to start printing to the printer.
line number 2	• • • •	Specify the line number to stop printing to the printer.

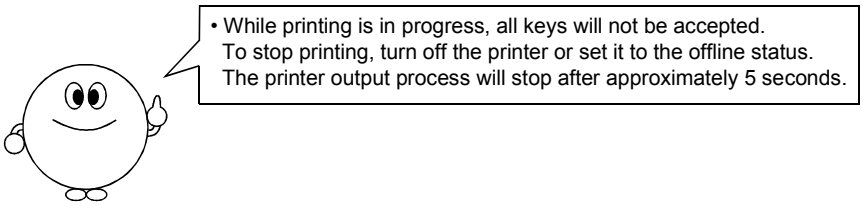
Examples

LLIST	• • • •	Prints all lines to the printer.
LLIST 100	• • • •	Prints only line number 100 to the printer.
LLIST 200-	• • • •	Prints from line number 200 to the end of the program to the printer.
LLIST –150	• • • •	Prints from the beginning to line 150 to the printer.
LLIST 300-1000	• • • •	Prints from line 300 to line 1000 to the printer.

Description

• The LLIST instruction prints the entire program or a portion of the program within the specified range to a printer.

• When the LLIST instruction is complete, BASIC will wait for an instruction.



• The output printer must be specified with the ZLDV instruction.

REMARK

See the ZLDV and LIST instructions, and Section 3.2.3.

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LOAD Instruction LOAD

• Reads programs from a memory card, FD, or HD.

Syntax

LOAD△" [<drive number> :] [<system name>\] <file name> "

drive number	• • • •	Specify the memory card, FD or HD where the file to be loaded is stored.
system name	• • • •	Specify the name of the system where the file to be loaded is stored.
file name	• • • •	Specify the name of the file to be loaded.

Examples

LOAD "0:TEST\No1.BAS"	• • • •	Reads the program No1.BAS within system name TEST in the memory card of AD51H-S3 MEMORY CARD 1 .

Description

• The LOAD instruction reads a program stored in a memory card, FD, or HD to the memory of the communication module.

• <drive number> is used to specify the memory card, FD, or HD that contains the program to be read.

During online programming

To specify the memory card inserted in AD51H-S3 MEMORY CARD 1	• • • •	0
To specify the memory card inserted in AD51H-S3 MEMORY CARD 2	• • • •	1
To specify the A drive of the console	• • • •	2
To specify the C drive of the console	• • • •	3
To specify the D drive of the console	• • • •	4

During offline programming

To specify the A drive of the console	• • • •	1
To specify the C drive of the console	• • • •	3
To specify the D drive of the console	• • • •	4

• <system name> is used to specify the system name to which the program is stored. If the specified system name does not exist, a "File not found" error will be generated.

• <filename> is used to specify the filename and extension of the saved program. To specify a filename with no extension, specify only the filename.

• SW1IVD-AD51HP-E cannot perform offline programming.

REMARK

See the CHAIN, MERGE, RUN and SAVE instructions, and Section 3.3.3.

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LOC Function LOCation

• Returns the current logical location within a file.

Syntax

LOC (<file number>)

file number •••• Specify the file number of the file in order to detect its current location.

Examples

PRINT LOC(1) •••• If file number 1 is a sequential file, the location will be displayed in increments of 256 bytes. If file number 1 is a random file, the record number last accessed will be displayed.

Description

• The LOC function returns the current logical location within a file.
• The value returned by the LOC function will differ depending on the type of the specified file in <file number>.

For sequential files

The number of records that have been read/written (one record = 256 bytes) since the file was opened will be returned as the function value.

For random files

The record number accessed last by the GET or PUT instruction will be returned as the function value.

Program Example

```
10 ' Finds the record number in which data is written to a random file
20 OPEN "LOC.DAT" AS #1                          :  ' Opens the file
30 FIELD #1,8 AS CS$, 10 AS AR$, 4 AS CL$, 10 AS NA$
                                                 :  ' Assigns a variable region in the random
                                                    file buffer
40 INPUT "CALLSIGN";C$:LSET CS$=C$               :  ' Enters data
50 INPUT "AREA ";A$:LSET AR$=A$
60 INPUT "CLASS ";B$:LSET CL$=B$
70 INPUT "NAME ";N$:LSET NA$=N$
80 PUT #1                                        :  ' Writes to file
90 PRINT LOC(1); "Station number"                :  ' Displays record number written by the
                                                    PUT instruction
100 INPUT "Continue registration? (Y/N)";Y$      :  ' Y or N is input
110 IF Y$="Y" OR Y$="y" THEN 40                  :  ' Continues registration if Y
120 CLOSE #1                                     :  ' Closes the file
```

REMARK

See the EOFand LOF functions.

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LOCATE Instruction LOCATE

• Specifies the display position on the console screen.

Syntax

LOCATE△ <horizontal position> , <vertical position> [, <cursor switch>]

horizontal position	• • • •	Specify the screen display position in the horizontal direction (X-axis).
vertical position	• • • •	Specify the screen display position in the vertical direction (Y-axis).
cursor switch	• • • •	Specify the enabling or disabling of the cursor display.

Examples

LOCATE 5,1	• • • •	Specifies the screen display position to 5 horizontal and 1 vertical.
LOCATE 10, 20, 0	• • • •	Specifies the screen display location to 10 horizontal, 20 vertical, and without cursor display.

Description

• The LOCATE instruction moves the cursor on the console screen specified by the ZODV instruction.
• <horizontal position> and <vertical position> specify the position to move the cursor.
• <vertical position> is specified within the range of 0 through 31.
However, note that the line range in which display can be performed differs depending on the display used.
• <horizontal position> is specified within a range between 0 and 79.
• Once the LOCATE instruction is executed, the next display output onto the screen or the character display input from the keyboard will be displayed in the position specified by the LOCATE instruction.
• An error will not be generated if the values are out of range of <horizontal position> and <vertical position> specifications, but the display will be at an undefined location.
• The cursor is displayed when <cursor switch> is set to 1. The cursor is not displayed when <cursor switch> is set to 0. To display the cursor again, execute the LOCATE instruction.

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Program Example

```
10 ' Displays the character string at the specified location on the screen
11 CLS                                    :  ' Clears the screen
12 Y=1
20 A$="AD51H-BASIC"                       :  ' Defines the character string
30 FOR X=1 TO 10
40 Y=Y+1
50 LOCATE X,Y                             :  ' Specifies display location
60 PRINT A$                               :  ' Displays the character string
80 NEXT X
90 END
```

```
 AD51H-BASIC
  AD51H-BASIC
   AD51H-BASIC
    AD51H-BASIC
     AD51H-BASIC
      AD51H-BASIC
       AD51H-BASIC
        AD51H-BASIC
         AD51H-BASIC
          AD51H-BASIC
           AD51H-BASIC
OK
```

REMARK

See the TAB instruction and Section 3.10.2.

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LOF Function — Length Of File

• Returns the size of a file in record units (number of sectors).

Syntax

LOF (<file number>)

file number •••• Specify the file number specified by the OPEN instruction.

Examples

PRINT LOF=(1) •••• Displays the record number (number of sectors) of file number 1.

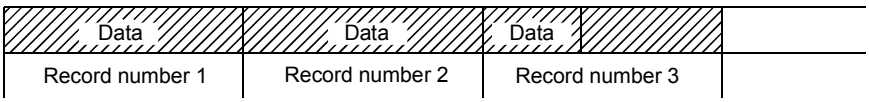
Description

• The LOF function returns the file size in record units (number of sectors).
• Records are the smallest unit that can be maintained on FD, HD, or memory card. One record can hold 256 bytes of data.
• The value returned by the LOF function will differ depending on the file type specified by the <file number>.

For sequential files

•••• When data is written in byte units, the file size will be returned in record number (number of sectors).

Example

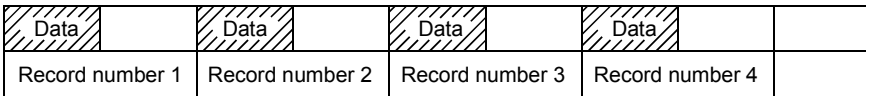


The LOF function returns 3.

For random files

•••• Writes data in record units and returns the file size in the maximum record number (number of sectors).

Example



The LOF function returns 4

• If the record number (number of sectors) specified by the GET instruction is greater than the value obtained by the LOF function, an “Input past end” error occurs.

REMARK

See the EOF and LOC functions, and Chapter 6.

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LOG Function — LOGarithm

• Returns a natural logarithm value.

Syntax

LOG (<numeric expression>)

numeric expression • • • • Specify the value of which natural logarithm is obtained.

Examples

A=LOG(10) • • • • Stores the natural logarithm of 10 to A.

Description

• The LOG function obtains the natural logarithm of the value specified by a numeric expression.
• The computation is performed in single-precision.
• To determine a common logarithm log10X with 10 as the base, define by using log10X = logeX/loge10.

Program Example

```
10 ' Obtains LOGe 100
20 A=100
30 B=LOG(A)                                   :   ' Obtains LOGe 100
40 PRINT "LOGe 100 =";B
50 END


RUN
LOGe 100 = 4.60517
OK
```

REMARK

See the EXP function.

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LPRINT Instruction

LPRINT

• Outputs data to the printer.

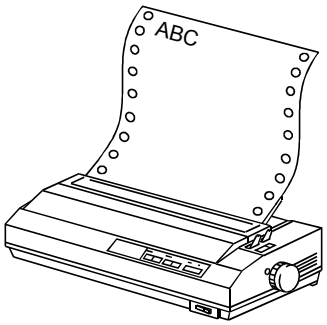
Syntax

LPRINT△ [<equation> [, <equation>] ...] [;]

equation • • • • Specify the data to be output to the printer.

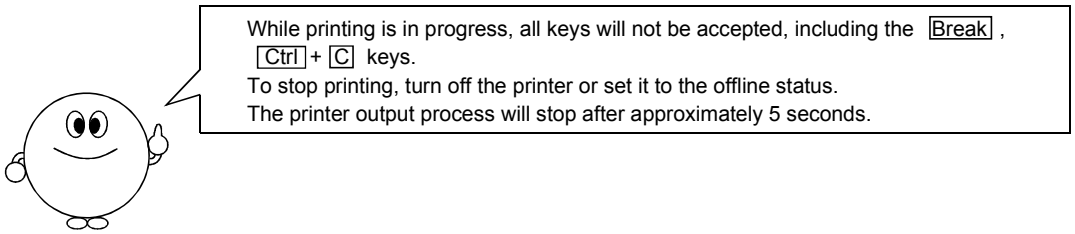
Examples

LPRINT “ABC” • • • • Outputs ABC to the printer.



Description

• The LPRINT instruction outputs data to the printer.
• This instruction is the same as the PRINT instruction except for the fact that it outputs data to the printer (See PRINT Instruction.)
• The output printer is specified with the ZLDV instruction.



REMARK

See the PRINT, SPC and TAB instructions, and Section 7.3.3.

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LPRINT USING Instruction LPRINT USING

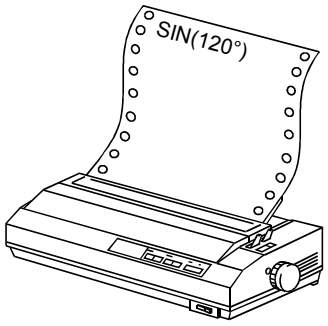
• Outputs data in the specified format to the printer.

Syntax

LPRINT△USING△" <display format> "; <expression> [, <expression>] ... [;]

display format • • • • Specify the format for the character string or numeric values to be displayed.

expression • • • • Specify the character string or numeric values to be displayed.

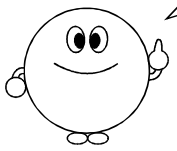


Examples

LPRINT USING "SIN(###°)";120 • • • • Displays SIN(120°) on the printer.

Description

• The LPRINT USING instruction outputs data in the specified format to the printer.
• This instruction is the same as the PRINT USING instruction except for the fact that it outputs data to the printer.
• The output printer is specified with the ZLDV instruction.



• While printing is in progress, all keys will not be accepted, including the Break , Ctrl + C keys. To stop printing, turn off the printer or set it to the offline status. The printer output process will stop after approximately 5 seconds.
• For <display format> setting using the LPRINT USING instruction, see the format specification of the PRINT USING instruction.

REMARK

See the PRINT USING instruction and Section 7.3.3.

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LSET Instruction — Left SET

• Left-aligns and moves data to the random file buffer for execution of the PUT instruction.

Syntax

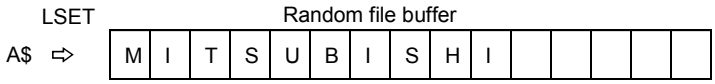
LSET△ <character string variable> = <character string expression>

character string variable • • • • Specify the character string variable defined by the FIELD instruction.

character string expression • • • • Specify the character string data to be written.

Examples

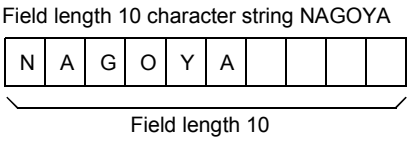
LSET A$="MITSUBISHI" • • • • Reserves “MITSUBISHI” in A$ justified to the left.



Description

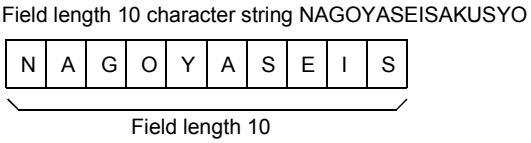
• The LSET instruction moves the data from the memory to the random file buffer to prepare it for the PUT instruction.
• The file must be open as a random file to execute this instruction.
• The character string variable must be defined with the FIELD instruction prior to executing the LSET instruction.
• If the character string length is shorter than the field length assigned to the character string variable, the LSET instruction stores the character string justified to the left.
The spare area in the field will be filled with spaces.

Example



• If the length of the character string expression is longer than the field length assigned by the FIELD command, the characters on the right side will be truncated.

Example



• Numeric values must be converted to character strings using MKI$, MKS$ or MKD$ function before they are sent to the random file buffer.

REMARK

See the FIELD, PUT, GET and RSET instructions, and Chapter 6.

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MERGE Instruction MERGE

• Merges programs in the memory and a program stored in a memory card, FD, or HD.

Syntax

MERGE△" <drive number> : <system name>\<file name> "

drive number	• • • •	Specify the memory card, FD or HD where the file to be merged is stored.
system name	• • • •	Specify the name of the system where the file to be merged is stored.
file name	• • • •	Specify the name of the file to be merged.

Examples

LOAD"0:TEST\No1.BAS"	• • • •	Merges the program in the memory and the program No1.BAS stored in system TEST in the memory card inserted in AD51H-S3 MEMORY CARD 1 .

Description

• The MERGE instruction merges the program currently in memory with a program stored on a memory card, FD, or HD. The merged program is treated as a new program and stored in the memory.

• <drive number> is used to specify the program to be merged placed on a memory card, FD, or HD using the following numbers.

During online programming

To specify the memory card inserted in AD51H-S3 MEMORY CARD 1	• • • •	0
To specify the memory card inserted in AD51H-S3 MEMORY CARD 2	• • • •	1
To specify the A drive of the console	• • • •	2
To specify the C drive of the console	• • • •	3
To specify the D drive of the console	• • • •	4

During offline programming

To specify the A drive of the console	• • • •	1
To specify the C drive of the console	• • • •	3
To specify the D drive of the console	• • • •	4

• <system name> is used to specify the system name in which the saved program is stored. If the specified file does not exist, a "File not found" error will be generated.

• <filename> is used to specify the program file name and extension that will be merged. To specify a filename with no extension, specify only the filename.

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- If there is a line with the same number in both the program in the memory and the program to be merged, the line in the program to be merged will take priority.
- After the MERGE instruction is complete, BASIC will wait for the next instruction. To use the MERGE instruction in a program, use the CHAIN instruction to specify it.
- SW1IVD-AD51HP-E cannot perform offline programming.

REMARK

See the CHAIN, COMMON, DELETE, LOAD and SAVE instructions, and Section 3.15.

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MID$ (Part 1) Function MIDdle $

• Replaces a section of a character string with another character string.

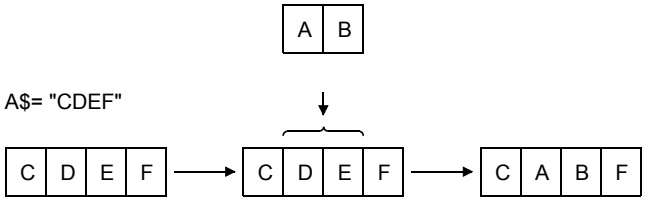
Syntax

MID$(<character string expression 1> , <integer expression 1> [, <integer expression 2>])
= <character string expression 2>

character string expression 1	• • • •	Specify the character string or character string variable to be replaced.
character string expression 2	• • • •	Specify the character string or character string variable that will do the replacing.
integer expression 1	• • • •	Specify the starting position of the character string to be replaced.
integer expression 2	• • • •	Specify the number of characters that will do the replacing.

Examples

MID$(A$,2)=”AB” • • • • Characters in A$ starting with the second character are replaced with “AB.”



Description

• The MID$ (Part 1) function replaces a section of a character string with another character string.
• If <integer expression 2> is omitted, the entire string will be replaced. The character string cannot exceed the size of <character string expression 1> even if <integer expression 2> is not specified.
• The value of <integer expression 1> cannot exceed the number of characters of <character string expression 1>. Also, a value that is 0 or less cannot be specified.
• An empty character string cannot be specified for <character string 1>.

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Program Example

```
10 ' Replaces character string
20 A$="ABCDEFGHI"                                   :  ' Defines character string
30 B$="XYZ"                                         :  ' Defines character string to replace with
40 PRINT "Original Character String-------->";A$
50 MID$(A$,3,3)=B$                                  :  ' Replaces
60 PRINT "Character string after replacement-->";A$
70 END


RUN
Original character string -------->ABCDEFGHI
Character string after replacement-->ABXYZFGHI
OK
```

REMARK

See the MID$ (Part 2) function and Section 3.13.

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MID$ (Part 2) Function MIDdle $

• Returns the partial character expression that begins with the specified position in a character string.

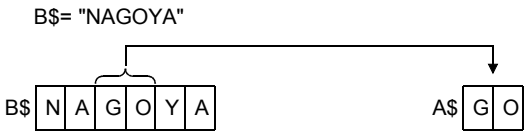
Syntax

MID$(<character string expression> , <integer expression 1> [, <integer expression 2>])

character string expression 1	• • • •	Specify the source character string or character string variable.
integer expression 1	• • • •	Specify the starting position of the character string that will be extracted.
integer expression 2	• • • •	Specify the number of characters of the character string that will be extracted.

Examples

A$=MID$(B$,3,2) • • • • Extracts the third and fourth character from the left of character string B$ and stores it in A$.



Description

• The MID$ (part 2) function extracts a character string from the specified position in a character string.
• If <integer expression 2> is omitted, or if the remaining number of characters of the position specified by <integer expression 1> is less than the number of characters specified by <integer expression 2>, the remainder of the character string from the position specified by <integer expression 1> will be returned.
• If the value of <integer expression 1> is greater than the length of <character string expression>, an empty character string will be returned.

Program Example

```
10 ' Extracts character string
20 A$="AD51H-BASIC"                 :  ' Defines character string
40 B$=MID$(A$,7,5)                  :  ' Extracts 5 characters from the 7th
                                       character in the character string

50 PRINT "Extracted characters-->";B$
60 END


RUN
Extracted characters-->BASIC
OK
```

REMARK

See the RIGHT$, LEFT$ and MID$ (Part 1) functions, and Section 3.13.

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MKD$ Function — MaKe Double $

• Converts a double-precision type numeric value into a character string.

Syntax

MKD$ (<double precision expression> [, S])

double precision expression • • • • Specify the double precision expression to be converted into a character string.

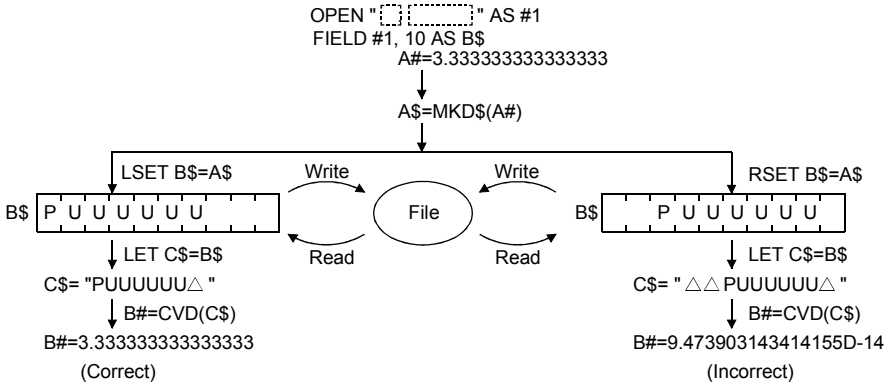
Examples

C$=MKD$(3. 14159265389) • • • • Converts into an 8-byte character string and stores in C$.

Description

• The MKD$ function converts a double-precision numeric value to an 8-byte character string.
• Double-precision numeric values that will be written to the random file buffer using the LSET or RSET instruction must be converted to a character string with the MKD$ function.
• The data converted into a character string by the MKD$ function can be restored to the original numeric value only by the CVD function.
• It is recommended to use the LSET instruction when writing data that was converted to a character string using the MKD$ function to the random file buffer.
If the field length (number of bytes) of each variable specified by the FIELD instruction is greater than the used field length (number of bytes) of the MKD$ function, the data will not be correctly converted by the CVD function.

Example

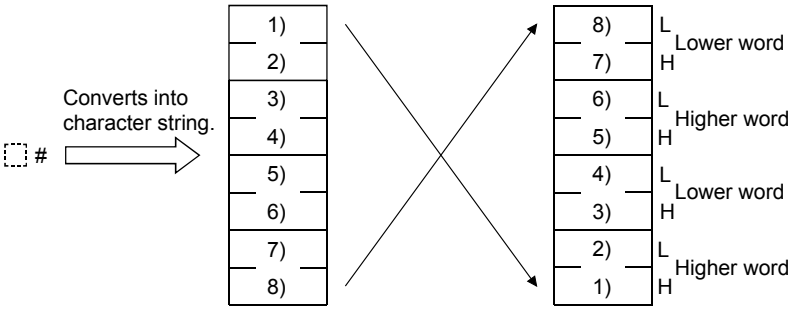


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The CVD function converts the required number of bytes from the left side of each variable area specified by the FIELD instruction.

- The data converted to character strings using the MKD$ function may be used for data communication as well as for writing to the random file buffer.
- When the [,S] option is specified, the double-precision real number will be converted to a character string and rearranged as follows.



REMARK

See the MKI$, MKS$, CVD, CVI, and CVS functions.

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MKDMBF$ Function — MaKe Double Microsoft Binary Format $

• Converts data of IEEE format double-precision internal expression to a character string that can be converted to a numeric value using the CVD function.

Syntax

MKDMBF$ (<numeric expression>)

numeric expression	• • • •	Specify a numeric value of double-precision internal expression of IEEE format.

Examples

A#=CVD(MKDMBF$(B#))	• • • •	Converts an IEEE format double-precision internal expression data B# into an internal expression of an AD51H-BASIC double-precision real number and stores it in A#.

Description

• The MKDMBF$ function converts data of IEEE format double-precision internal expression to a character string that can be converted to a numeric value using the CVD function in AD51H-BASIC.
• The IEEE format double-precision internal expression and the AD51H-BASIC internal expression for real numbers are different. The MKDMBF$ function converts between the two.
• Always specify a numeric value of IEEE format double precision internal expression for the <numeric expression>. Conversion will not be performed correctly with other numeric values.
• The MKDMBF$ function only performs data conversion for double-precision real numbers.
• The MKDMBF$ function is used, for example, to convert system data that performs internal expression of IEEE format double-precision numeric values.

REMARK

See the CVDMBF, CVSMBF, and MKSMBF$ functions.

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MKI$ Function — MaKe Integer $

• Converts an integer type numeric value into a character string.

Syntax

MKI$ (<integer expression> [, S])

integer expression • • • • Specify the integer to be converted into a character string.

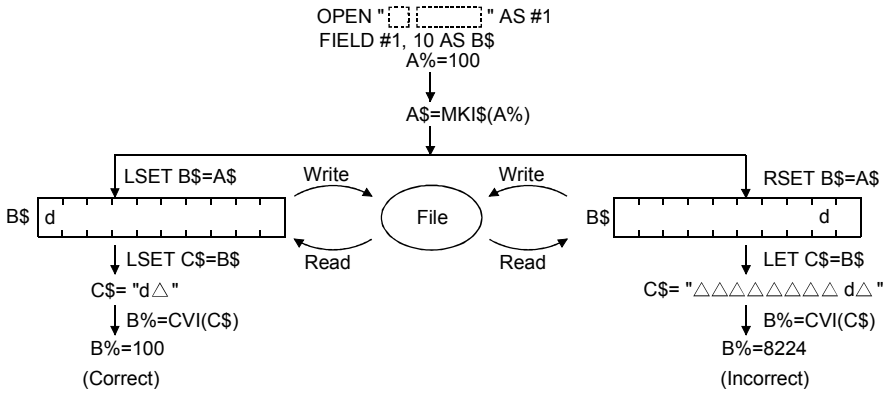
Examples

A$=MKI$(314) • • • • Converts into a 2-byte character string and stores in A$.

Description

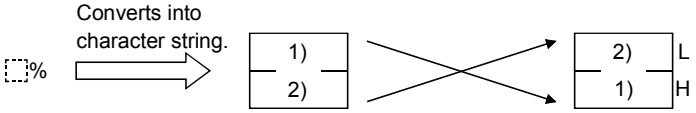
• The MKI$ function converts an integer type numeric value to a 2-byte character string.
• Integer type numeric values that will be written to the random file buffer using the LSET or RSET instruction must be converted to a character string with the MKI$ function.
• The data converted into a character string by the MKI$ function can be restored to the original numeric value only by the CVI function.
• It is recommended to use the LSET instruction when writing data that was converted to a character string using the MKI$ function to the random file buffer.
If the field length (number of bytes) of each variable specified by the FIELD instruction is greater than the used field length (number of bytes) of the MKI$ function, the data will not be correctly converted by the CVI function.

Example



The CVI function converts the required number of bytes from the left side of each variable area specified by the FIELD instruction.

• The data converted to character strings using the MKI$ function may be used for data communication as well as for writing to the random file buffer.
• When the [,S] option is specified, the integer will be converted to a character string and rearranged as follows.



REMARK

See the MKD$, MKS$, CVD, CVI, and CVS functions.

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MKS$ Function — MaKe Single $

• Converts a single-precision type numeric value into a character string.

Syntax

MKS$ (<single precision expression> [, S])

single precision expression • • • • Specify the single precision expression to be converted into a character string.

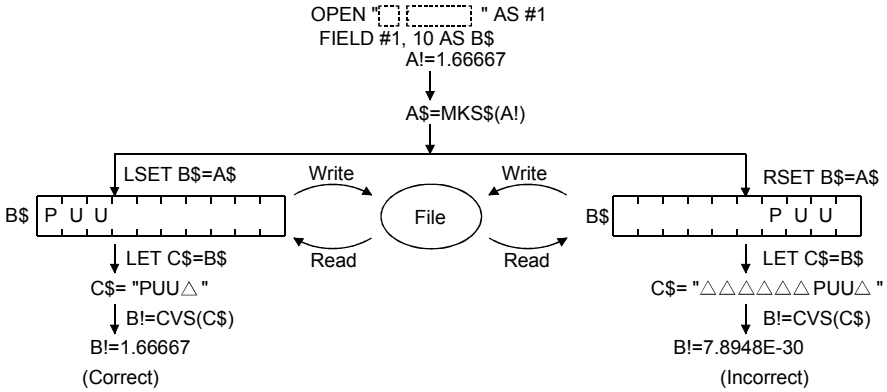
Examples

B$=MKS$(3. 14159) • • • • Converts into a 4-byte character string and stores in B$.

Description

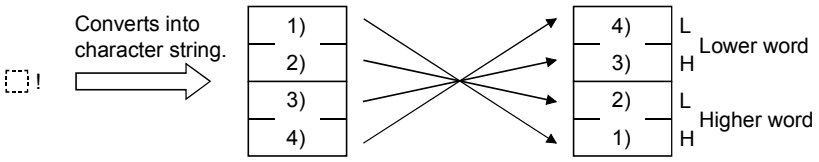
• The MKS$ function converts a single-precision numeric value to a 4-byte character string.
• Single-precision numeric values that will be written to the random file buffer using the LSET or RSET instruction must be converted to a character string with the MKS$ function.
• The data converted into a character string by the MKS$ function can be restored to the original numeric value only by the CVS function.
• It is recommended to use the LSET instruction when writing data that was converted to a character string using the MKS$ function to the random file buffer.
If the field length (number of bytes) of each variable specified by the FIELD instruction is greater than the used field length (number of bytes) of the MKS$ function, the data will not be correctly converted by the CVS function.

Example



The CVS function converts the required number of bytes from the left side of each variable area specified by the FIELD instruction.

• The data converted to character strings using the MKS$ function may be used for data communication as well as for writing to the random file buffer.
• When the [,S] option is specified, the single-precision real number will be converted to a character string and rearranged as follows.



REMARK

See the MKD$, MKI$, CVD, CVI, and CVS functions.

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MKSMBF$ Function — MaKe Single Microsoft Binary Format $

• Converts data of floating point real numbers used by the Q/QnA/AnA/AnU/AnUSCPU (IEEE format single-precision internal expression) into a character string that can be converted to a numeric value using the CVS function.

Syntax

MKSMBF$ (<numeric expression>)

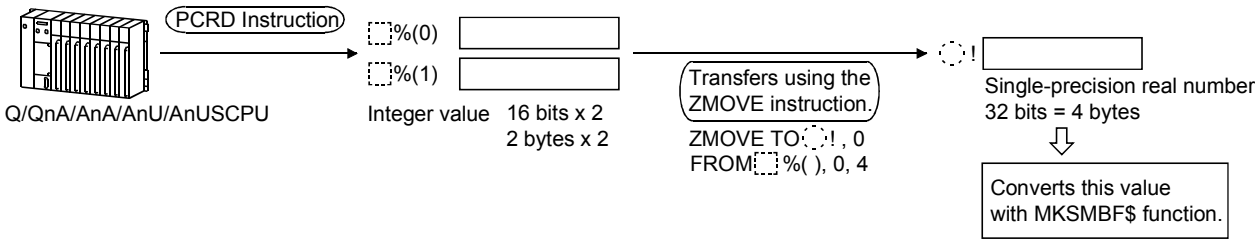
numeric expression • • • • Specify a numeric value of floating point real numbers used by the AnA/AnU/AnUSCPU (IEEE format single-precision internal expression).

Examples

A!=CVS(MKSMBF$(B!)) • • • • Converts value B!, which is a floating point real number used by the Q/QnA/AnA/AnU/AnUSCPU (IEEE format single-precision internal expression) into an internal expression of an AD51H-BASIC single-precision real number and stores it in A!.

Description

• The MKSMBF$ function converts data of floating point real numbers used by the Q/QnA/AnA/AnU/AnUSCPU (IEEE format single-precision internal expression) into a character string that can be converted to a numeric value using the CVS function in AD51H-BASIC.
• The Q/QnA/AnA/AnU/AnUSCPU internal expression (IEEE format single-precision internal expression) and the AD51H-BASIC internal expression for real numbers are different. The MKSMBF$ function converts between the two.
• Be sure to specify a numeric value of Q/QnA/AnA/AnU/AnUSCPU internal expression (IEEE format single-precision internal expression) for the <numeric expression>. Conversion will not be performed correctly with other numeric values.
• The MKSMBF$ function only performs data conversion for single-precision real numbers.
• When reading an Q/QnA/AnA/AnU/AnUSCPU floating point real number with the PCRD instruction, store the data in integer arrays. Then assign the data to a single-precision real number variable, and then convert with the MKSMBF$ function.



• Other than converting Q/QnA/AnA/AnU/AnUSCPU floating point data, the MKSMBF$ function is used, for example, to convert system data that performs internal expression of IEEE format single-precision numeric values.

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Program Example

```
10 ' Reads AnACPU floating point real numbers from D0 and D1 and convert them into single-
   precision real numbers
30 DIM TBL%(5),A%(3)                          :  ' Defines array
40 TBL%(0)=255                                :  ' Sets communication station number to
                                                    local station
50 TBL%(1)=1                                  :  ' Specifies to read the device memory data
60 TBL%(2)=2                                  :  ' Specifies the word unit
70 TBL%(3)=18                                 :  ' Specifies the data register
80 TBL%(4)=0                                  :  ' Specifies the starting device number to be
                                                    read
90 TBL%(5)=2                                  :  ' Specifies the number of points to be read
100 PCRD TBL%( ),A%( )                        :  ' Starts reading
105 A!=0                                      :  ' Stores dummy in A!
110 ZMOVE TO A!,0 FROM A%( ),0,4              :  ' Stores data read from A!
120 B!=CVS(MKSMBF$(A!))                       :  ' Executes conversion
130 PRINT "Floating point real number from D0, D1-->";B!
140 END
```

REMARK

See the CVDMBF, CVSMBF, and MKDMBF$ functions.

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NAME Instruction NAME

• Changes file names of program and data files stored in a memory card, FD, and HD.

Syntax

NAME△"<drive number>:<system name\> <old file name>"
△AS△"<drive number>:<system name\> <new file name>"

drive number	• • • •	Specify the memory card, FD, or HD that contains the file whose file name is to be changed.
system name	• • • •	Specify the system name that contains the file whose file name is to be changed.
old file name	• • • •	Specify the file name of the file whose file name is to be changed.
new file name	• • • •	Specify the new file name to be assigned.

Examples

NAME "0:TEST\No1.BAS" • • • • Changes the file name of the file No1.BAS stored under system name TEST in the memory card mounted in the AD51H-S3 MEMORY CARD 1 to No2.BAS.
AS "0:TEST\No2.BAS"

Description

• The NAME instruction changes file names of files stored in a memory card, FD, or HD.
• <drive number> and <system name> must be the same for <old file name> and <new file name>.
• Specify the memory card, FD, or HD that contains the file whose name is to be changed using one of the following numbers for <drive number>.

During online programming

To specify the memory card inserted in AD51H-S3 MEMORY CARD 1	• • • • •	0
To specify the memory card inserted in AD51H-S3 MEMORY CARD 2	• • • • •	1
To specify the A drive of the console	• •	2
To specify the C drive of the console	• •	3
To specify the D drive of the console	• •	4

During offline programming

To specify the A drive of the console	• •	1
To specify the C drive of the console	• •	3
To specify the D drive of the console	• •	4

• Specify the name of the system where the file to be deleted is stored for <system name>. If <system name>\ is not specified, files without a system name will be deleted.

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- Specify the name and extension of the file whose name is to be changed for <old file name>. Specify only the name of the file when specifying a file name without extension.
- Specify the new name and extension given to the file for <new file name>. If the extension is omitted, the file name will not contain an extension.
- The NAME instruction cannot be executed if even one data file is open. If the NAME instruction is executed when a file is open, a “File already Open” error is generated.
- SW1IVD-AD51HP-E cannot perform offline programming.

REMARK

See Section 3.4.2.

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NEW Instruction

NEW

• Erases all programs in memory and initializes all variables.

Syntax

NEW

Examples

NEW • • • • Erases all programs in memory and initializes all variables.

Description

• The NEW instruction erases all programs currently resident in memory and initializes memory before entering a new program. The size of the memory area defined by the CLEAR instruction does not change, however.
• When the NEW instruction is executed, BASIC will wait for a next instruction.
• The NEW instruction automatically closes all files, if any files were open.

REMARK

See the CLOSE, END, LOAD and SAVE instructions, and Section 3.1.

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OCT$ Function

OCTal $

• Converts a decimal number to an octal string.

Syntax

OCT$ (<numeric expression>)

numerical expression • • • • Specify a value within the range between -32768 and 65535.

＊ Note that numbers from 32768 to 65535 are the same as the values from -32768 to -1 (8000_H to $FFFF_H$).

Examples

PRINT OCT$(10) • • • • Converts decimal number 10 into octal and displays the result.

Description

• The OCT$ function converts a numeric value to a character string variable in octal notation.
• Digits after the decimal point are truncated if a decimal point is included in the value in <numeric expression>.
• Octal and decimal correspond as follows.

Octal	0	1	2	3	4	5	6	7	10	11	12
Decimal	0	1	2	3	4	5	6	7	8	9	10

Program Example

```
10 ' Converts a decimal number to an octal number
20 A=100                                  :  'Defines a value
30 A$=OCT$(A)                             :  'Converts into an octal number
40 PRINT "Decimal number=";A
50 PRINT "Octal number=";A$
60 END

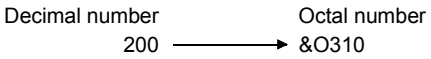

RUN
Decimal number=100
 Octal number=144
OK
```


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REMARK

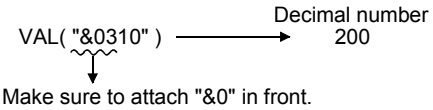
See the BIN$, HEX$, and VAL functions.
Octal numbers are expressed by placing "&0" in front of the numeric value.

Example



Use the VAL function to convert a character string variable in octal notation into a decimal number.

Example



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ON COM GOSUB Instruction

ON COMmunication GO to SUBroutine

• Defines the starting line of the processing routine to be branched to when an interrupt occurs from a communication line.

Syntax

ON△COM(<channel number>) GOSUB <line number>

channel number	• • • •	Specify the communication line to generate the interrupt.
line number	• • • •	Specify the line number to be processed after the interrupt.

Examples

ON COM (1) GOSUB 1000	• • • •	Branches to line 1000 if an input interrupt is generated from the communication line CH1 (RS-232).

Description

• The ON COM GOSUB instruction defines the starting line of the processing routine to be branched to when an interrupt is generated from a communication line.

• The following values can be specified as <channel number>.

1 • • • • CH1 (RS-232)
2 • • • • CH2 (RS-232)
3 • • • • CH3 (RS-422/485)

• If the command currently being executed involves waiting for external input, such as the INPUT instruction, the branch processing will not be executed until the current command is finished, even if an input interrupt occurs from a communication line.

• In the same way as usual subroutines, the returning from the processing routine is carried out by using the RETURN instruction. When RETURN is simply entered, execution starts from the instruction next to the one where an interrupt occurred. When a line number is specified after RETURN, execution starts from that specified line.

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Program Example

(Executed in BASIC on the AD51H)

```
10 ' This program receives data continually and ends only when an interrupt occurs from CH2
20 ON ERROR GOTO 500                    :  ' Branches to line 500 if an error occurs
30 CLS
40 ON COM(2) GOSUB 340                  :  ' Branches to line 340 when there is an
                                           interrupt from CH2
50 COM(2) ON                            :  ' Allows an interrupt
60 DIM TBL1%(2),CNT%(10),TBL2%(2)
70 '***** RS-232C CH.OPEN *****
80 CH%=2                                :  ' Defines a communication channel
90 TBL1%(0)=4800                        :  ' Sets the baud rate
100 TBL1%(1)=&H8                        :  ' Sets character length, parity bit,
110 TBL1%(2)=&H1                        :  ' and stop bit
120 ZOPEN #CH%,TBL1%( )                 :  ' Opens the communication channel
130 '
140 '***** PORT CNTL *****
150 CNT%(0)=32                          :  ' Specifies control by the RS and ER
                                           signals
160 CNT%(1)=&H1                         :  ' Turns the RS control signal on
170 ZCNTL #CH%,0,CNT%( )                :  ' Executes
180 '
190 '***** MAIN PROGRAM *****
200 J=0                                 :  ' Displays on the screen
210 LOCATE 0,J
220 PRINT "MAIN PROGRAM"
230 J=J+1
240 IF J=10 THEN J=0
250 FOR I=0 TO 100
260 NEXT I
270 CLS
280 GOTO 210
290 '
300 '***** RS-232C CH.CLOSE *****
310 ZCLOSE #CH%
320 END
330 '
340 '***** DATA RECEIVE *****
350 TBL2%(0)=12                         :  ' Specifies the number of transmission
                                           request bytes
360 TBL2%(1)=0                          :  ' Stores the number of bytes transmitted
370 TBL2%(2)=300                        :  ' Specifies the timeout value
380 WOR%=TBL2%(0)/2
390 DIM CTBL%(WOR%-1)
```


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```
400 ZRECEIVE #CH%,0,TBL2%( ),CTBL%( )          :  ' Executes the reception operation
410 LOCATE 0,15
420 PRINT "RECEIVE CHARACTER =";TBL2%(1)       :  ' Displays the number of received
                                                    characters
430 FOR I%=0 TO WOR%-1
440 LOCATE 0,16+I%
450 PRINT "RECEIVE DATA =&H";HEX$(CTBL%(I%))   :  ' Displays the data received
460 NEXT I%
470 RETURN 310
480 '
490 '***** ERROR ROUTINE *****
500 ERTYPE%=ERR:ERLINE%=ERL                    :  ' Stores the error occurred, and the line
510 IF ERTYPE%=17 THEN PRINT "ZOPEN ERROR!!"
                                               :  ' Notifies if it is a Z-related error
520 PRINT "ERROR CODE =";ERTYPE%               :  ' Displays the error code
530 PRINT "ERROR LINE =";ERLINE%               :  ' Displays the line where the error occurred
540 RESUME 310                                 :  ' Returns the operation to line 310
```


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(Executed in BASIC on the LM7000)

```
10 ' This program sends data to the console (transmission from the LM7000)
20 ON ERROR GOTO 380                          :  'Branches to line 360 if an error occurs
30 '
40 '***** RS-232C CH.OPEN *****
50 DIM T%(8)                                  :  ' Defines the array
60 CH%=18                                     :  ' Defines the channel number
70 T%(0)=4800                                 :  ' Specifies the baud rate
80 T%(1)=&H8                                  :  ' Specifies the character length, parity bit,
90 T%(2)=&H1                                  :  ' Stop bit, and DC control
100 T%(3)=0                                   :  ' Specifies control by the DC signal
110 T%(5)=0                                   :  ' Specifies the DC1 and DC codes
120 T%(4)=0                                   :  ' Specifies the receive buffer
130 T%(6)=0                                   :  ' Specifies the DC2 and DC3 codes
140 T%(7)=0                                   :  ' Specifies the DC4 code
150 ZOPEN #CH%,T%( )                          :  ' Opens the communication channel
160 '
170 '***** RS CNTL *****
180 DIM CNTL%(1)                              :  ' Defines the array
190 CNTL%(0)=32                               :  ' Specifies control by the RS and ER
                                                 signals
200 CNTL%(1)=&H1                              :  ' Turns the RS control signal on
210 ZCNTL #CH%,0,CNTL%( )                     :  ' Executes control by the signals
220 '
230 '***** DATA SEND *****
240 DIM TBL%(2)                               :  ' Defines the array
250 TBL%(0)=12                                :  ' Specifies the request characters
260 TBL%(1)=0                                 :  ' Stores the characters to be transmitted
270 TBL%(2)=100                               :  ' Specifies the timeout value
280 SD$="AD51H-BASIC "                        :  ' Defines the transmission data
290 ZSEND #CH%,0,TBL%( ),SD$                  :  ' Executes the transmission
300 PRINT "SEND CHARACTER =";TBL%(1)          :  ' Displays the number of transmitted
                                                 characters
310 PRINT "SEND DATA =";SD$                   :  ' Displays the transmitted data
320 '
330 '***** RS-232C CH.CLOSE *****
340 ZCLOSE #CH%                               :  ' Closes the communication channel
350 END                                       :  ' Ends the execution
360 '
370 '***** ERROR ROUTINE *****
380 ERTYPE%=ERR:ERLINE%=ERL                   :  ' Stores the error occurred, and the line
390 IF ERTYPE%=94 THEN ERTYPE%=ZERROR(1)      :  ' Notifies if it is a Z-related error
400 PRINT "ERROR CODE =";ERTYPE%              :  ' Displays the error code
410 PRINT "ERROR LINE =";ERLINE%              :  ' Displays the line where the error occurred
420 RESUME 340                                :  ' Returns the operation to line 320
```


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REMARK

See the CON ON/OFF/STOP and ZOPEN functions, and Section 7.4.

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ON ERROR GOTO Instruction ON ERROR GOTO

• Enables interrupt processing if an error occurs and moves the execution to the starting line of an error handling routine.

Syntax

ON△ERROR△GOTO△<line number>

line number • • • • Specify the starting line number or label of the error handling routine of the program that will be executed if an error occurs.

Examples

ON ERROR GOTO 100 • • • • Moves the execution to line 100 if an error occurs.

Description

• The ON ERROR GOTO instruction enables interrupt processing if an error occurs and moves the execution to the start line of an error handling routine.
• A label name can be specified instead of a line number for <line number>.
• If the specified <line number> does not exist, an “Undefined line number” error occurs.
• Do not display characters or switch ports via the ZIDV or ZODV instruction in the error handling routine.
Character display and input/output processing may not be performed correctly upon returning to the main program, depending on the execution timing of the error handling routine.
• Specify 0 for the value in <line number> before executing the program in order to disable a previously enabled interrupt at error generation.
Then, if the program detects an error, it displays the error message and stops the execution of the program.
• If "ON ERROR GOTO 0" is present in an error handling routine, the errors that have occurred are displayed and the execution of the program stops.
• It is recommended to specify "ON ERROR GOTO 0" if an error that is not handled explicitly in the error handling routine is detected.
• Use the RESUME instruction to return from the error handling routine.
• If an error occurs during the execution of an error handling routine, BASIC displays the corresponding error message and the execution of the program stops.

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Program Example

```
10 ' This program displays "ERROR" if an error occurs
20 ON ERROR GOTO 50          :  ' Defines the branch destination at error
                                   generation
30 ERROR 10                  :  ' An error occurs
40 END
50 PRINT "ERROR"
60 RESUME 40                 :  ' Ends error processing


RUN
ERROR
OK
```

REMARK

See the ERROR and RESUME instructions, ERL and ERR functions, and Chapter 9.

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ON GOSUB Instruction — ON to GOSUB

• Branches to one of the lines specified with the line numbers according to the value.

Syntax

ON△<expression>△GOSUB△<line number>[,<line number>…]

expression	• • • •	Branches to the specified line number depending on the value of the expression.
line number	• • • •	Specify the line number to which the execution is branched.

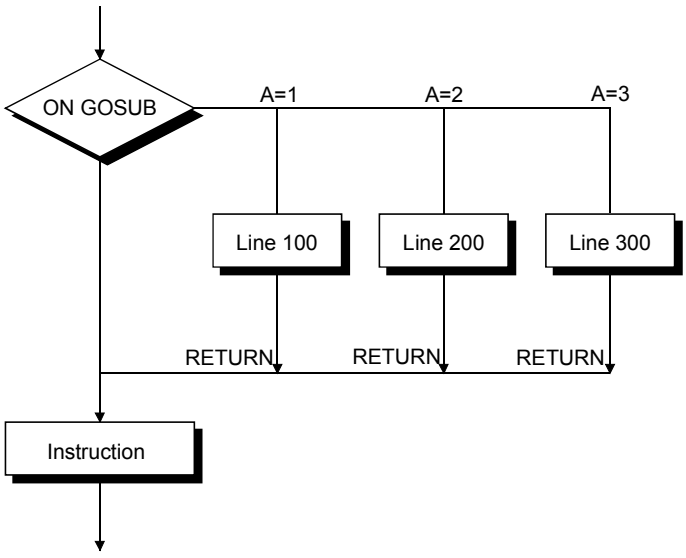
Examples

ON A GOSUB 200, 300, 400	• • • •	Executes the subroutine at line 200 if the value of A is 1, the subroutine at line 300 if A is 2, and the subroutine at line 400 if A is 3.

Description

• The ON to GOSUB instruction branches the program execution to one of several specified line numbers depending on the value of the specified expression.
• Digits after the decimal points are truncated if the value of <expression> is not an integer.
• The execution moves to the next instruction if the value of <expression> is 0 or greater than the number of specified line numbers, which should be 255 or less.
• An “Illegal function call” error occurs if the value of <expression> is negative or greater than 255.
• A label name can be used instead of an actual line number for <line number>.
• Each of the line numbers specified in the ON to GOSUB instruction must be specified as the corresponding starting line numbers of the processing routines.
• If an instruction is written following the ON to GOSUB instruction, the ON to GOSUB instruction is executed when it is returned by the RETURN instruction after the execution of the processing routine.

ON [A] GOSUB [100] , [200] , [300] : [instruction]



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Program Example

```
10 ' This program branches to a subroutine depending on the value of variable A
20 INPUT A                                  :  ' Enters a value
30 ON A GOSUB 100, 200, 300                 :  ' Branches to a subroutine depending on
                                                 the value
40 END
100 PRINT "This is the subroutine when 1 is entered":RETURN
200 PRINT "This is the subroutine when 2 is entered":RETURN
300 PRINT "This is the subroutine when 3 is entered":RETURN


RUN
? 1
This is the subroutine when 1 is entered
OK
RUN
? 2
This is the subroutine when 2 is entered
OK
RUN
? 3
This is the subroutine when 3 is entered
OK
RUN
? 4
OK
```

REMARK

See the GOSUB instruction.

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ON GOTO Instruction — ON to GOTO

• Branches to one of the lines specified with the line numbers according to the value.

Syntax

ON△<expression>△GOTO△<line number>[,<line number>…]

expression	• • • •	Branches to the specified line number depending on the value of the expression.
line number	• • • •	Specify the line number to which the execution is branched.

Examples

ON A GOTO 200, 300, 400	• • • •	Branches to line 200 if the value of A is 1, to line 300 if A is 2, and to line 400 if A is 3.

Description

• The ON to GOTO instruction branches the program execution to one of several specified line numbers depending on the value of the specified expression.
• Digits after the decimal points are truncated if the value of <expression> is not an integer.
• The execution moves to the next instruction if the value of <expression> is 0 or greater than the number of specified line numbers, which should be 255 or less.
• An “Illegal function call” error occurs if the value of <expression> is negative or greater than 255.
• A label name can be used instead of an actual line number for <line number>.

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Program Example

```
10 ' This program branches depending on the value of variable A
20 INPUT A                                    :  ' Enters a value
30 ON A GOTO 100, 200, 300                    :  ' Branches depending on the value
40 END
100 PRINT "This is the processing when 1 is entered": END
200 PRINT "This is the processing when 2 is entered": END
300 PRINT "This is the processing when 3 is entered": END


RUN
? 1
This is the processing when 1 is entered
OK
RUN
? 2
This is the processing when 2 is entered
OK
RUN
? 3
This is the processing when 3 is entered
OK
RUN
? 4
OK
```

REMARK

See the GOTO instruction and Section 3.6.

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OPEN Instruction — OPEN

• Opens a file and enables it for input/output processing.

Syntax

OPEN△"[<drive number>:][<system name>\]<file name>"
[△FOR△<mode>]△AS△ [#]<file number>

drive name	• • • •	Specify the memory card or FD drive containing the file to be opened.
system name	• • • •	Specify the system name under which the file to be opened is stored.
file name	• • • •	Specify the file name to be opened.
mode	• • • •	Specify to enable the sequential file for either input, output, or append processing.
file number	• • • •	Specify the file number of the file to be created in the range from 1 to 8.

Examples

OPEN "2:ABCD" FOR OUTPUT AS #1	• • • •	Opens the sequential file with the file name "ABCD" on drive A of the console for output as file number 1.

Description

• The OPEN instruction opens a file and enables it for input/output processing.
• It assigns a <file number> and input/output buffer to the file specified by <system name> and <file name> and defines the mode of the file. Afterward, data input/output operations to this file are performed by referring to this file number.
• In order to input or output data to/from a file, it is always necessary to execute the OPEN instruction first to open the file.
• <drive number> is specified using the following numbers:

• When specifying a file in MEMORY CARD 1 drive of AD51H-S3	• • • • •	0
• When specifying a file in MEMORY CARD 2 drive of AD51H-S3	• • • • •	1
• When specifying drive A of the console	• •	2
• When specifying drive C of the console	• •	3
• When specifying drive D of the console	• •	4

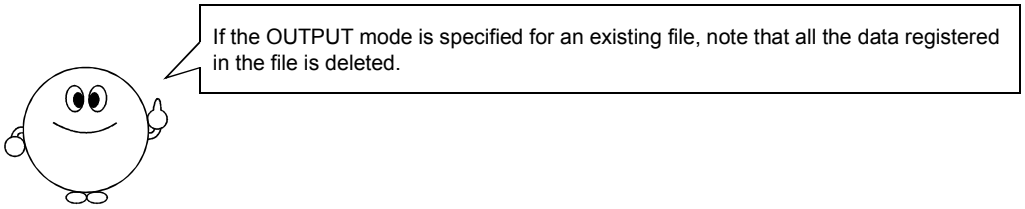
If a drive number other than the ones listed above is specified, a "Bad drive number" error occurs.

• <mode> specifies whether input or output processing can be performed to the file. Specify one of the following options:
INPUT: Inputs data to the sequential file.
OUTPUT: Outputs data from the sequential file.
APPEND: Adds data to the end of the existing sequential file.

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- If the FOR <mode> part of the instruction is omitted, it is specified that the processing can be performed on a random file.
- In INPUT and APPEND modes, if the specified file does not exist, a “File not found” error occurs.
- Open files are automatically closed by executing the following instructions or modifying the program.

  RUN, CLEAR, END, NEW, LOAD, CLOSE



REMARK

See Chapter 6.

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PCRD Instruction PC ReaD

• Reads various data from the PLC CPU.

Syntax

PCRD△<control table> , <storage area for data read>

control table •••• Specify the type of data to be read from the PLC CPU.

storage area for data read •••• Specify the variable in which data read from the PLC CPU is stored.

Examples

PCRD A%( ), B%( ) •••• Reads the type of data specified by the integer array A% from the PLC CPU and stores it in the integer variable B%.

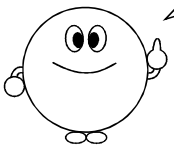
Description

• The PCRD instruction reads various data from the PLC CPU.
• The processing to be performed is specified by the processing code in the control table. The following processing can be performed.

Processing code	Description of the processing	A series	QnA series	Q series
1 (&H1)	Reading device memory data	○	△＊1	△＊1
2 (&H2)	Reading device memory registered to be monitored by the PCWT instruction	○	×	×
4 (&H4)	Reading extension file register	○	×	×
5 (&H5)	Reading extension file registers registered to be monitored by the PCWT instruction	○	×	×
7 (&H7)	Reading extension file register data by specifying sequential addresses	○＊2	×	×
8 (&H8)	Loading a sequence program	○	×	×
9 (&H9)	Loading a microcomputer program	○	×	×
10 (&HA)	Reading comment data	○	×	×
11 (&HB)	Reading extension comment data	○	×	×
12 (&HC)	Reading a special function module's buffer memory	○	×	×
13 (&HD)	Reading the type of the PLC CPU	○	×	×
14 (&HE)	Reading parameter data (reading MELSECNET/10 parameters)	○	×	×
21 (&H15)	Reading network information	○	×	×
22 (&H16)	Reading routing parameters	○	×	×
513 (&H201)	Reading the type name of the Q/QnA series PLC CPU	×	○	○
515 (&H203)	Reading device memory of the Q/QnA series PLC CPU	×	○	○
516 (&H204)	Random read of device memory of the Q/QnA series PLC CPU	×	○	○
533 (&H215)	Reading buffer memory of the intelligent function module/special function module of a Q/QnA series PLC CPU	×	○	○

＊1 : Possible only within the device range of AnA/AnU/AnUSCPU. (File register R cannot be read.)
＊2 : Available only for AnA/AnU/AnUSCPU.

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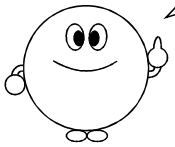


The number of elements is 10 or less for all the arrays used for <control table>.
However, the arrays should always be defined using the DIM instruction.
If an array is not defined using the DIM instruction, an error occurs at the execution of the PCRD instruction (usually, an array with 10 or fewer elements can be used without defining it).

• <storage area for data read > is a variable or device range for storing the data read from the PLC CPU. Specify an integer variable, an integer array name, a character variable, a character array variable, extension registers ED, or extension relays EM. Each of them is specified in the following manner.

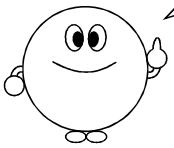
Integer variable	□%
Character variable	□$
Integer array name	□% ( )
Character array variable	□$ (n)
ED	W@ (ED,n)
EM	B@ (EM,n)

} Indicates using the special variables.



Store dummy data in the variable used as <storage area for data read> before executing the PCRD instruction. If the PCRD instruction is executed without storing this dummy data, an error occurs.
Integer variables □%=0
Character variables □$=SPACE$ (255)
The dummy data is not necessary for ED and EM.
An array used as <storage area for data read> must always be defined using the DIM instruction, even if the number of elements used is 10 or less. If the PCRD instruction is executed without defining the array, an error occurs.

• See Section 4.2.6 for how to store data read.
• All the processing performed using the PCRD instruction can be executed even while the applicable PLC CPU is running.



Be sure to reset the communication module once if the type of the PLC CPU in the data link system that is being accessed from the communication module is changed.
If it is attempted to access the PLC CPU without resetting, incorrect data may be read.

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Processing Code 1

Reading device memory data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	• • • • • • •	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Processing unit	Specify the device processing unit.
□%(3)	□%(6)	Device code	Specify the device code.
□%(4)	□%(7)	Device number	Specify the device number.
□%(5)	□%(8)	Number of points	Specify the number of points to be read.

• It is possible to read data of device memory other than extension file registers of the PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) • • • • • • Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) • • • • • • Processing code
• Specify 1.

□%(2) • • • • • • Specify the device processing unit.
• When reading in bit units • • • • • 1
• When reading in word units • • • 2
Always specify "2" when reading from word devices.

□%(3) • • • • • • Specify the device using the defined code.
See Section 4.2.5 for the code numbers.

□%(4) • • • • • • Specify the device number of the device specified in □%(3).
See Section 4.2.5 for the allowable specification range.
Note, however, that values other than 0 or multiples of 16 cannot be specified for the device number when reading from bit devices in word units.

□%(5) • • • • • • Specify the number of points of device memory to be read, including the device specified in □%(3) and □%(4).
The allowable specification range is as follows:

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• When bit units are specified
  • Bit devices 1 to 256 points
• When word units are specified
  • Bit devices 1 to 32 words
  • Word devices 1 to 64 points

Format 2 control table

□%(0) • • • • • • Format 2 control table
  • Specify 256.

□%(1) • • • • • • Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) • • • • • • Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) • • • • • • Detailed error codes are stored here.
See Appendix 4.4.2 for the details of the error codes.

□%(4) • • • • • • Processing code
  • Specify 1.

□%(5) • • • • • • Specify the device processing unit.
  • When reading in bit units • • • • • 1
  • When reading in word units • • • 2

□%(6) • • • • • • Specify the device using the defined code.
See Section 4.2.5 for the code numbers.

□%(7) • • • • • • Specify the device number of the device specified in □%(3).
See Section 4.2.5 for the allowable specification range.
Note, however, that values other than 0 or multiples of 16 cannot be specified for the device number when reading from bit devices in word units.

□%(8) • • • • • • Specify the number of points of device memory to be read, including the device specified in □%(3) and □%(4).
The allowable specification range is as follows:
  • When bit units are specified
    • Bit devices 1 to 256 points
  • When word units are specified
    • Bit devices 1 to 32 words
    • Word devices 1 to 64 points

• The following processing is performed if file registers (R) are specified as the device memory to be read:
  (1) If the block number of the file registers has never been changed in the PLC CPU, the data in the file registers of block No. 0 is read.
  (2) If the block number of the file registers has been changed in the PLC CPU, the data in the file registers of the new block number is read.
    1) When the block number has been changed using the RSET instruction for extending the file registers of type SW□GHP-UTLPC-FN1 utility software package or type SW□SRX-FNUP software package.
    2) When the block number has been changed using the RSET instruction.

The processing cannot be performed normally by processing code 1 if the block number of the file registers has been changed to 29 or greater using the RSET instruction. In this case, use processing code 4 (reading extension file register data) instead.

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Program Example

(1) Program example for format 1 control table

```
100 ' A program example that reads device memory data of the PLC CPU
110 DIM TBL%(10),A%(20)                    :  'Defines arrays
120 TBL%(0)=255                            :  'Specifies the station number to
                                              communicate with to the local station
130 TBL%(1)=1                              :  'Specifies to read device memory data
140 TBL%(2)=1                              :  'Specifies bit units
150 TBL%(3)=3                              :  'Specifies internal relays M
160 TBL%(4)=&H0                            :  'Specifies the starting device number of the
                                              device memory to be read
170 TBL%(5)=10                             :  'Specifies the number of points to be read
180 PCRD TBL%( ),A%( )                     :  'Executes the read operation
190 J=0
200 FOR I=0 TO 72 STEP8
210  A=RDSET(I,A%(0))                      :  'Reads the status of M
220  IF A=1 THEN PRINT"M";J;"=ON"ELSE PRINT"M";J;"=OFF"
230  J=J+1                                 :  'Adds 1 to J
240 NEXT I
250 END
```

(2) Program example for format 2 control table

```
100 ' A program example that reads device memory data of the PLC CPU
110 DIM TBL%(10),A%(20)                    :  'Defines arrays
120 TBL%(0)=256                            :  'Specifies a format 2 control table
130 TBL%(1)=1                              :  'Specifies network number 1
140 TBL%(2)=1                              :  'Specifies station number 1
150 TBL%(4)=1                              :  'Specifies to read device memory data
160 TBL%(5)=1                              :  'Specifies bit units
170 TBL%(6)=3                              :  'Specifies internal relays M
180 TBL%(7)=&H0                            :  'Specifies the starting device number of the
                                              device memory to be read
190 TBL%(8)=10                             :  'Specifies the number of points to be read
200 PCRD TBL%( ),A%( )                     :  'Executes the read operation
210 J=0
220 FOR I=0 TO 72 STEP8
230  A=RDSET(I,A%(0))                      :  'Reads the status of M
240  IF A=1 THEN PRINT"M";J;"=ON"ELSE PRINT"M";J;"=OFF"
250  J=J+1                                 :  'Adds 1 to J
260 NEXT I
270 END
```


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Processing Code 2

Reading device memory registered to be monitored by the PCWT instruction

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify a control table of format 2.
	□%(0)	Control table	Specify the network number.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• It is possible to read data of device memory that was used for monitor registration by the PCWT instruction with this code.
• An error occurs if device memory is read without performing monitor registration.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 2.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details of the error codes.

□%(4) •••••• Processing code
• Specify 2.

• The following processing is performed if file registers (R) are specified as the device to be read:
(1) If the block number of the file registers has never been changed in the PLC CPU, the data in the file registers of block No. 0 is read.

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(2) If the block number of the file registers has been changed in the PLC CPU, the data in the file registers of the new block number is read.
1) When the block number has been changed using the RSET instruction for extending the file registers of type SW□GHP-UTLPC-FN1 utility software package or type SW□SRX-FNUP software package.
2) When the block number has been changed using the RSET instruction.

The processing cannot be performed normally by processing code 2 if the block number of the file registers has been changed to 29 or greater using the RSET instruction. In this case, use processing code 5 (reading extension file registers registered to be monitored by the PCWT instruction) instead.

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Program Example

(1) Program example for format 1 control table

```
100 ' A program example that reads data of device memory registered to be monitored by the PCWT
      instruction
110 DIM TBL%(10), A%(20), TBL2%(10), B%(20)      :  'Defines arrays
120 A%(0)=1:A%(1)=0                              :  'Registers X000 to X015 to be monitored
130 A%(2)=2:A%(3)=16                             :  'Registers Y016 to Y031 to be monitored
140 A%(4)=3:A%(5)=96                             :  'Registers M096 to M113 to be monitored
150 A%(6)=7:A%(7)=0                              :  'Registers T000 (contact) to be monitored
160 A%(8)=18:A%(9)=48                            :  'Registers D048 to be monitored
170 TBL1%(0)=255                                 :  'Specifies the station number to
                                                    communicate with to the local station
180 TBL1%(1)=2                                   :  'Specifies to monitor registered device
                                                    memory
190 TBL1%(2)=2                                   :  'Specifies word units
200 TBL1%(3)=5                                   :  'Specifies the number of device points to be
                                                    monitored
210 PCWT TBL1%( ),A%( )                          :  'Executes the monitor registration
220 TBL2%(0)=255                                 :  'Specifies the station number to
                                                    communicate with to the local station
230 TBL2%(1)=2                                   :  'Specifies to read devices registered to be
                                                    monitored by the PCWT instruction
240 PCRD TBL2%( ),B%( )                          :  'Executes the read operation
250 PRINT "Status of X000 to X015=&H";HEX$(B%(0)):  'Displays the result
260 PRINT "Status of X016 to X031=&H";HEX$(B%(1))
270 PRINT "Status of M096 to M113=&H";HEX$(B%(2))
280 PRINT "Status of T000 (contact)=&H";HEX$(B%(3))
290 PRINT "Data in D048=";B%(4)
300 END
```


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(2) Program example for format 2 control table

```
100 'A program example that reads device memory registered to be monitored by the PCWT
    instruction
110 DIM TBL1%(10), A%(20), TBL2%(10), B%(20)      :  'Defines arrays
120 A%(0)=1:A%(1)=0                               :  'Registers X000 to X015 to be monitored
130 A%(2)=2:A%(3)=16                              :  'Registers Y016 to Y031 to be monitored
140 A%(4)=3:A%(5)=96                              :  'Registers M096 to M113 to be monitored
150 A%(6)=7:A%(7)=0                               :  'Registers T000 (contact) to be monitored
160 A%(8)=18:A%(9)=48                             :  'Registers D048 to be monitored
170 TBL1%(0)=256                                  :  'Specifies a format 2 control table
180 TBL1%(1)=1                                    :  'Specifies network number 1
190 TBL1%(2)=1                                    :  'Specifies station number 1
200 TBL1%(4)=2                                    :  'Specifies to monitor registered device
                                                     memory
210 TBL1%(5)=2                                    :  'Specifies word units
220 TBL1%(6)=5                                    :  'Specifies the number of device points to be
                                                     monitored
230 PCWT TBL1%( ),A%( )                           :  'Executes the monitor registration
240 TBL2%(0)=256                                  :  'Specifies a format 2 control table
250 TBL2%(1)=1                                    :  'Specifies network number 1
260 TBL2%(2)=1                                    :  'Specifies station number 1
270 TBL2%(4)=2                                    :  'Specifies to read devices registered to be
                                                     monitored by the PCWT instruction
280 PCRD TBL2%( ),B%( )                           :  'Executes the read operation
290 PRINT "Status of X000 to X015=&H";HEX$(B%(0)) :  'Displays the result
300 PRINT "Status of Y016 to Y031=&H";HEX$(B%(1))
310 PRINT "Status of M096 to M113=&H";HEX$(B%(2))
320 PRINT "Status of T000 (contact)=&H";HEX$(B%(3))
330 PRINT "Data in D048=";B%(4)
340 END
```


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Processing Code 4

Reading extension file register

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Block No.	Specify the block number of the extension file registers.
□%(3)	□%(6)	Device number	Specify the device number of the extension file registers.
□%(4)	□%(7)	Number of points	Specify the number of points to be read.

• It is possible to read data of extension file registers (file registers with block number 1 or more) using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
- Specify 4.

□%(2) •••••• Specify the block number of the extension file registers.
- If 0 is specified for the block No., the data in the file registers of the PLC CPU is read.
  (The same processing as reading R□ using the processing code for reading device memory data will be performed.)
- If a block number greater than 0 is specified, the data in the extension file registers is read.
- The maximum value that can be specified for the block No. varies depending on the memory cassette mounted on the PLC CPU.

□%(3) •••••• Specify the device number of the extension file registers.
The maximum value that can be specified for the device number is the value set in the parameters of the PLC CPU.
The allowable specification range is from 0 to 8191.

□%(4) •••••• Specify the number of device points to be read, including the device specified in □%(3).
The range that can be specified is from 1 to 64 points.

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Format 2 control table

□%(0) • • • • • • Format 2 control table
• Specify 256.

□%(1) • • • • • • Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) • • • • • • Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) • • • • • • Detailed error codes are stored here.
See Appendix 4.4.2 for the details of the error codes.

□%(4) • • • • • • Processing code
• Specify 4.

□%(5) • • • • • • Specify the block number of the extension file registers.
• If 0 is specified for the block No., the data in the file registers of the PLC CPU is read.
(The same processing as reading R□ using the processing code for reading device memory data will be performed.)
• If a block number greater than 0 is specified, the data in the extension file registers is read.
• The maximum value that can be specified for the block No. varies depending on the memory cassette mounted on the PLC CPU.

□%(6) • • • • • • Specify the device number of the extension file registers.
The maximum value that can be specified for the device number is the value set in the parameters of the PLC CPU.
The allowable specification range is from 0 to 8191.

□%(7) • • • • • • Specify the number of device points to be read, including the device specified in □%(6).
The range that can be specified is from 1 to 64 points.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that reads extension file register data
110 DIM TBL%(10),A%(20)                 :  'Defines arrays
120 TBL%(0)=255                         :  'Specifies the station number to
                                           communicate with to the local station
130 TBL%(1)=4                           :  'Specifies to read extension file register
                                           data
140 TBL%(2)=1                           :  'Specifies the block number of the
                                           extension file registers to be read
150 TBL%(3)=0                           :  'Specifies the device number of the
                                           extension file registers to be read
160 TBL%(4)=10                          :  'Specifies the number of points to be read
170 PCRD TBL%( ),A%( )                  :  'Executes the read operation
180 FOR I=0 TO 9                        :  'Displays the data read
190  PRINT"A%(";I;" )=1";A%(I)
200 NEXT I
210 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that reads extension file register data
110 DIM TBL%(10),A%(20)                 :  'Defines arrays
120 TBL%(0)=256                         :  'Specifies a format 2 control table
130 TBL%(1)=1                           :  'Specifies network number 1
140 TBL%(2)=1                           :  'Specifies station number 1
150 TBL%(4)=4                           :  'Specifies to read extension file register
                                           data
160 TBL%(5)=1                           :  'Specifies the block number of the
                                           extension file registers to be read
170 TBL%(6)=0                           :  'Specifies the number of points to be read
180 TBL%(7)=10                          :  'Specifies the number of points to be read
190 PCRD TBL%( ),A%( )                  :  'Executes the read operation
200 FOR I=0 TO 9                        :  'Displays the data read
210  PRINT"A%(";I;" )=";A%(I)
220 NEXT I
230 END
```


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Processing Code 5

Reading extension file registers registered to be monitored by the PCWT instruction

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

- It is possible to read data of extension file registers that was used for monitor registration by the PCWT instruction using this code.
- An error occurs if extension file registers are read without performing monitor registration.
- Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code.
• Specify 5.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details of the error codes.

□%(4) •••••• Processing code
• Specify 5.

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Program Example

(1) Program example for a format 1 control table

```
100 'A program example that reads extension file registers registered to be monitored by the PCWT
    instruction
110 DIM TBL1%(10), A%(20), TBL2%(10), B%(20)    :  'Defines arrays
120 TBL1%(0)=255                                :  'Specifies the station number to
                                                   communicate with to the local station
130 TBL1%(1)=5                                  :  'Specifies to register extension file registers
                                                   to be monitored
140 TBL1%(2)=2                                  :  'Specifies the number of points to be
                                                   monitored
150 A%(0)=1:A%(1)=0                             :  'Specifies block number 1 and device
                                                   number 0
160 A%(2)=1:A%(3)=1                             :  'Specifies block number 1 and device
                                                   number 1
170 PCWT TBL1%( ),A%( )                         :  'Executes the monitor registration
180 TBL2%(0)=255                                :  'Specifies the station number to
                                                   communicate with to the local station
190 TBL2%(1)=5                                  :  'Specifies to read the extension file
                                                   registers registered to be monitored by the
                                                   PCWT instruction
200 PCRD TBL2%( ),B%( )                         :  'Executes the read operation
210 PRINT"B%(0)=";B%(0)                         :  'Displays the result
220 PRINT"B%(1)=";B%(1)
230 END
```


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(2) Program example for a format 2 control table

```
100 'A program example that reads extension file registers registered to be monitored by the PCWT
    instruction
110 DIM TBL1%(10), A%(20), TBL2%(10), B%(20)     :  'Defines arrays
120 TBL1%(0)=256                                 :  'Specifies a format 2 control table
130 TBL1%(1)=1                                   :  'Specifies network number 1
140 TBL1%(2)=1                                   :  'Specifies station number 1
150 TBL1%(4)=5                                   :  'Specifies to register extension file registers
                                                    to be monitore
160 TBL1%(5)=2                                   :  'Specifies the number of points to be
                                                    monitored
170 A%(0)=1:A%(1)=0                              :  'Specifies block number 1 and device
                                                    number 0
180 A%(2)=1:A%(3)=1                              :  'Specifies block number 1 and device
                                                    number 1
190 PCWT TBL1%( ),A%( )                          :  'Executes the monitor registration
200 TBL2%(0)=256                                 :  'Specifies a format 2 control table
210 TBL2%(1)=1                                   :  'Specifies network number 1
220 TBL2%(2)=1                                   :  'Specifies station number 1
230 TBL2%(4)=5                                   :  'Specifies to read the extension file
                                                    registers registered to be monitored by the
                                                    PCWT instruction
240 PCRD TBL2%( ),B%( )                          :  'Executes the read operation
250 PRINT"B%(0)=";B%(0)                          :  'Displays the result
260 PRINT"B%(1)=";B%(1)
270 END
```


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Processing Code 7

Reading extension file register data by specifying sequential addresses (direct reading)

Only applicable to AnA/AnU/AnUS CPU

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Device number	Specify the device number of the extension file registers expressed in sequential addresses.
□%(3)	□%(6)		
□%(4)	□%(7)	Number of points	Specify the number of points to be read.

• It is possible to read data from extension file registers by specifying their sequential addresses, rather than dividing them by block numbers, using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 7.

□%(2) ••••••
⋮
□%(3) •••• Specify the device number of the extension file registers expressed in sequential addresses.
The allowable specification range is from 0 to (number of usable blocks × 8192) − 1.
The starting device is calculated from the following formula:
(When specifying device number m (0 to 8191) at nth (1 or more) block from the beginning)
Starting device number = (n − 1) × 8192 + m

□%(4) •••••• Specify the number of device points to be read, including the device specified in □%(2) and □%(3).
The allowable specification range is from 1 to 64 points.

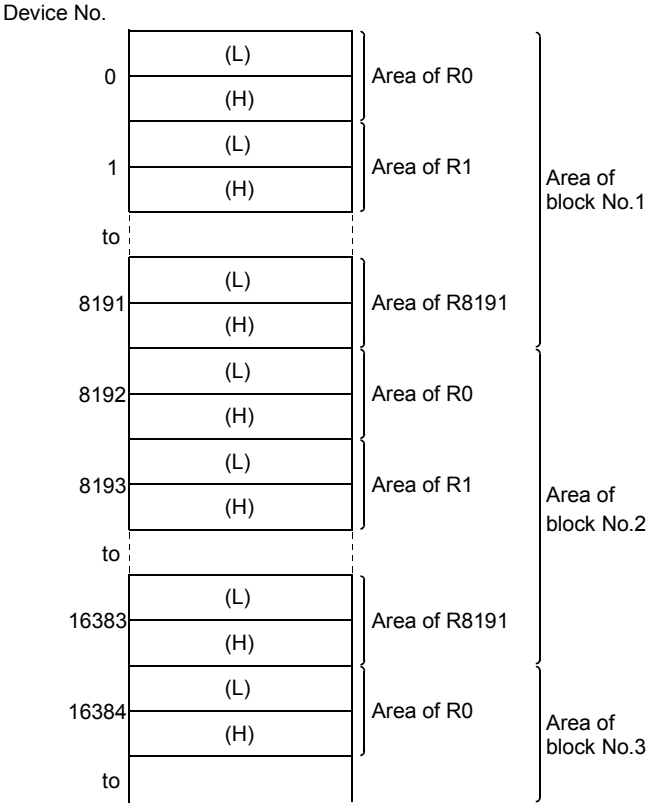
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Format 2 control table

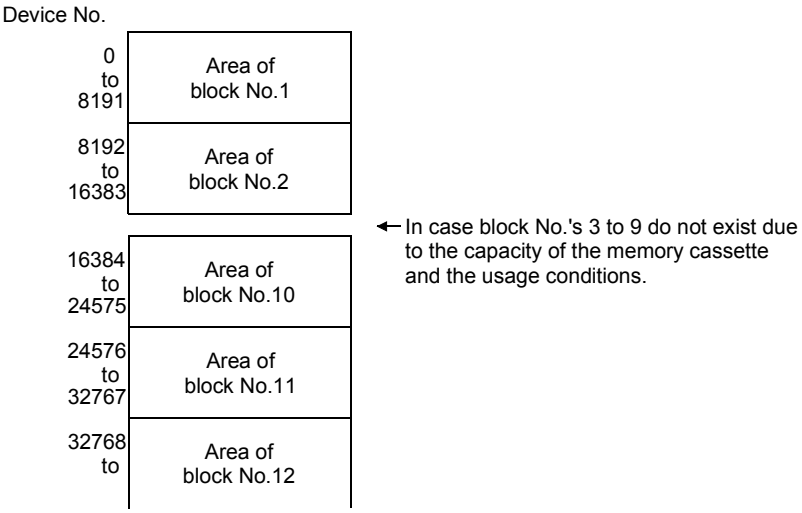
□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU from which data is to be read. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details of the error codes.
□%(4)	• • • • • •	Processing code • Specify 7.
□%(5)	• • • • • •	Specify the device number of the extension file registers expressed in sequential addresses.
□%(6)	• • •	The allowable specification range is from 0 to (number of usable blocks × 8192) − 1. The starting device is calculated from the following formula: (When specifying device number m (0 to 8191) at nth (1 or more) block from the beginning) Starting device number = (n −1) × 8192 + m
□%(7)	• • • • • •	Specify the number of device points to be read, including the device specified in □%(5) and □%(6). The allowable specification range is from 1 to 64 points.

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• The device numbers expressed in sequential addresses are automatically assigned in ascending order, starting with the device number with the smallest block number (number 1).



• Device numbers are not assigned to block numbers that do not exist in the memory cassette.
When the device numbers are assigned, block numbers not found in the memory cassette are skipped.



Refer to the ACPU/QCPU-A (A Mode) Programming Manual (Basics), the User's Manual of the AnA/AnUCPU, the SW□GHP-UTLP-FN1 Operating Manual, and the SW□SRX-FNUP Operating Manual for an explanation about the relationship between the memory cassette and block numbers.

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• Assign values to □%(2) and □%(3) (□%(5) and □%(6) in case of a control table of format 2) in the following manner.

D! •••••• Device number expressed in sequential address

H!
L!
H$
L$ } •••• Used as a work area.

to

```
100 H!=INT(D!/65536!)
110 L!=D!-H1*65536!
120 H$=RIGHT$("0000"+HEX$(H!))
130 L$=RIGHT$("0000"+HEX$(L!))          In case of a control table of format 2
140 □%(2)=VAL ("&H"+L$)      ••••••     □%(5)=VAL ("&H"+L$)
150 □%(3)=VAL ("&H"+H$)      ••••••     □%(6)=VAL ("&H"+H$)
to
```

Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that reads extension file registers by specifying sequential addresses
110 DIM TBL%(4),A%(9)                    :  'Defines arrays
120 TBL%(0)=255                          :  'Specifies the station number to
                                            communicate with to the local station
130 TBL%(1)=7                            :  'Specifies to read extension file register by
                                            specifying sequential addresses
140 D!=0
150 H!=INT(D!/65536!)
160 L!=D!-H!*65536!
170 H$=RIGHT$("0000"+HEX$(H!),4)         :  'The upper byte of the sequential address
180 H$=RIGHT$("0000"+HEX$(L!),4)         :  'The lower byte of the sequential address
190 TBL%(2)=VAL("&H"+L$)                 :  'Stores the lower byte in the control table
200 TBL%(3)=VAL("&H"+H$)                 :  'Stores the upper byte in the control table
210 TBL(4)=10                            :  'Specifies to read for 10 points
220 PCRD TBL%( ),A%( )                   :  'Executes the read operation
230 FOR I=0 TO 9                         :  'Displays the data read
240  PRINT A%(I)
250 NEXT I
260 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that reads extension file register data by specifying sequential addresses
110 DIM TBL%(7),A%(9)                    :  'Defines arrays
120 TBL%(0)=256                          :  'Specifies a format 2 control table
130 TBL%(1)=1                            :  'Specifies network number 1
140 TBL%(2)=1                            :  'Specifies station number 1
130 TBL%(4)=7                            :  'Specifies to read extension file register
                                            data by specifying sequential addresses

140 D!=0
150 H!=INT(D!/65536!)
160 L!=D!-H!*65536!
170 H$=RIGHT$("0000"+HEX$(H!),4)         :  'The upper byte of the sequential address
180 H$=RIGHT$("0000"+HEX$(L!),4)         :  'The lower byte of the sequential address
190 TBL%(5)=VAL("&H"+L$)                 :  'Stores the lower byte in the control table
200 TBL%(6)=VAL("&H"+H$)                 :  'Stores the upper byte in the control table
210 TBL%(7)=10                           :  'Specifies to read for 10 points
220 PCRD TBL%( ),A%( )                   :  'Executes the read operation
230 FOR I=0 TO 9                         :  'Displays the data read
240  PRINT A%(1)
250 NEXT I
260 END
```


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Processing Code 8

Loading a sequence program

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Main/sub specification	Specify either the main program or a subprogram.
□%(3)	□%(6)	Starting step	Specify the starting step of the program to be read.
□%(4)	□%(7)	Number of steps	Specify the number of steps to be read.

• It is possible to read the sequence program in the PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 8.

□%(2) •••••• Specify the program to be read.
• To read the main program ••••• Specify 1.
• To read subprogram (subprogram 1) ••••• Specify 2.
• To read subprogram 2 ••••• Specify 3.
• To read subprogram 3 ••••• Specify 4.
Always specify 1 for PLC CPUs in which subprograms cannot be used.

□%(3) •••••• Specify the starting step count of the program to be read.
The maximum number of steps in the sequence program is the capacity set by the parameter.

□%(4) •••••• Specify the number of steps to be read.
The allowable specification range is from 1 to 64 steps.

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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU from which data is to be read. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 8.
□%(5)	• • • • • •	Specify the program to be read. • To read the main program • • • • • Specify 1. • To read subprogram (subprogram 1) • • • • • Specify 2. • To read subprogram 2 • • • • • Specify 3. • To read subprogram 3 • • • • • Specify 4. Always specify 1 for PLC CPUs in which subprograms cannot be used.
□%(6)	• • • • • •	Specify the starting step count of the program to be read. The maximum number of steps in the sequence program is the capacity set by the parameter.
□%(7)	• • • • • •	Specify the number of steps to be read. The allowable specification range is from 1 to 64 steps.

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• The maximum number of steps in the sequence program is determined by the capacity set by the parameter. The allowable specification range for the starting step count is as follows.

Sequence program	Specified step
Setting value of T0 Setting value of T1 to Setting value of T255	&HFE00 &HFE01 to &HFEFF
Setting value of C0 Setting value of C1 to Setting value of C255	&HFF00 &HFF01 to &HFFFF
Step 0 Step 1 to Step 30718	&H0000 &H0001 to &H77FE

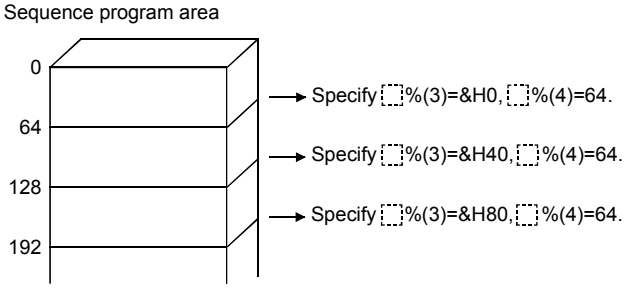
How to calculate the specified step:

(1) Starting step count when a timer setting value is specified
FE00H + the device number of the timer (expressed in hexadecimal)

(2) Starting step count when the counter setting value is specified
FF00H + the device number of the counter (expressed in hexadecimal)

(3) Starting step count when the sequence program itself is specified
0000H + sequence program step count (expressed in hexadecimal)

• The maximum number of sequence program steps that can be read at one time is 64 steps.
The entire program can be read by specifying the starting step count and the number of steps to be read in units of 64 steps as follows.



• The timer and counter setting values are stored using the values (hexadecimal) shown in the table below.

Example of ladder steps in a program	Settings in a program	Settings in BASIC
K□□□□□ T□□□ K□□□□□ C□□□	K0 K1 to K9 K10 to K32767	& H0000 & H0001 to & H0009 & H000A to & H7FFF
D□□□□□ T□□□ D□□□□□ C□□□	D0 D1 D2 to D1023	& H8000 & H8002 & H8004 to & H87FE

How to calculate the setting values in BASIC How to calculate the setting values in BASIC

(1) When set by a constant (K□□□□□)

• • • • • • &H0000 + constant (hexadecimal)

(2) When set by data register (D□□□□□)

• • • • • • &H8000 + device number of data register x 2 (hexadecimal)

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that reads the sequence program in the PLC CPU and saves it on a memory
      card
110 ' (Capacity of the main sequence program: 8 k steps)
120 DIM TBL%(10),A%(100)                    :  'Defines arrays
130 OPEN"0:PROG8.DAT"FOR OUTPUT AS #1       :  'Opens the sequential file
140 TBL%(0)=255                             :  'Specifies the station number to
                                               communicate with to the local station
150 TBL%(1)=8                               :  'Specifies to read the sequence program
160 TBL%(2)=1                               :  'Specifies to read the main program
170 TBL%(4)=64                              :  'Specifies the number of steps to read
180 FOR J=&HO TO &H1F80 STEP 64
190  TBL%(3)=J                              :  'Specifies the starting step of the program
200  PCRD TBL%( ),A%( )                     :  'Executes the read operation
210  FOR I=0 TO 63
220   PRINT #1,A%(I)                        :  'Writes to the sequential file
230  NEXT I
240 NEXT J
250 CLOSE #1                                :  'Closes the file
260 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that reads the sequence program in the PLC CPU and saves it on a memory
      card
110 ' (Capacity of the main sequence program: 8 k steps)
120 DIM TBL%(10),A%(100)                    :  'Defines arrays
130 OPEN"0:PROG8.DAT"FOR OUTPUT AS #1       :  'Opens the sequential file
140 TBL%(0)=256                             :  'Specifies a format 2 control table
150 TBL%(1)=1                               :  'Specifies network number 1
160 TBL%(2)=1                               :  'Specifies station number 1
150 TBL%(4)=8                               :  'Specifies to read the sequence program
160 TBL%(5)=1                               :  'Specifies to read the main program
170 TBL%(7)=64                              :  'Specifies the number of steps to read
180 FOR J=&HO TO &H1F80 STEP 64
190  TBL%(6)=J                              :  'Specifies the starting step of the program
200  PCRD TBL%( ),A%( )                     :  'Executes the read operation
210  FOR I=0 TO 63
220   PRINT #1,A%(I)                        :  'Writes to the sequential file
230  NEXT I
240 NEXT J
250 CLOSE                                   :  'Closes the file
260 END
```


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Processing Code 9

Loading a microcomputer program

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Main/sub specification	Specify either the main program or a sub-microcomputer program.
□%(3)	□%(6)	Starting address	Specify the starting address of the program to be loaded.
□%(4)	□%(7)	Number of bytes	Specify the number of bytes to be read.

• It is possible to load the microcomputer program to the PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 9.

□%(2) •••••• Specify the microcomputer program to be loaded.
• To load the main microcomputer program
••••• Specify 1.
• To load a sub-microcomputer program
••••• Specify 2.
Always specify 1 for PLC CPUs in which sub-microcomputer programs cannot be used.

□%(3) •••••• Specify the starting step count of the microcomputer program to be loaded.
The maximum number of bytes in the microcomputer program that can be specified is the capacity set by the parameter.

□%(4) •••••• Specify the number of bytes to be read.
The allowable specification range is from 1 to 128 bytes.

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Format 2 control table

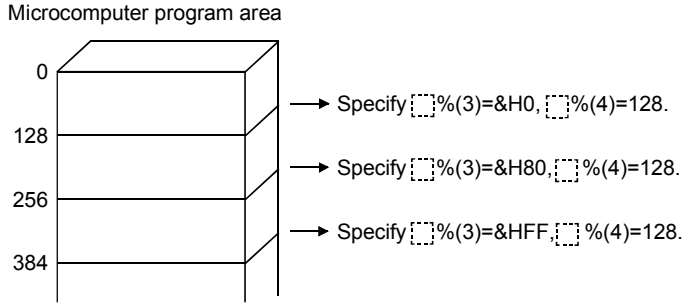
□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU from which data is to be read. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 9.
□%(5)	• • • • • •	Specify the microcomputer program to be loaded. • To load the main microcomputer program • • • • • Specify 1. • To load a sub-microcomputer program • • • • • Specify 2. Always specify 1 for PLC CPUs in which sub-microcomputer programs cannot be used.
□%(6)	• • • • • •	Specify the starting addresses of the microcomputer program to be loaded. The maximum number of bytes in the microcomputer program that can be specified is the capacity set by the parameter.
□%(7)	• • • • • •	Specify the number of bytes to be read. The allowable specification range is from 1 to 128 bytes.

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• The maximum number of bytes in the microcomputer program is determined by the capacity set by the parameter. The starting addresses that can be specified must be in the appropriate ranges as follows.

CPU type	Capacity of the microcomputer program	Microcomputer program address
A0J2HCPU A1SCPU A1SJCPU A2CCPU A52GCPU	Maximum 14 k bytes	&H0000 to &H37FE
A1CPU A1NCPU	Maximum 10 k bytes	&H0000 to &H27FE
A2CPU(S1) A2ACPU(S1) A2NCPU(S1) A2SCPU A2UCPS(S1) A2USCPU(S1)	Maximum 26 k bytes	&H0000 to &H67FE
A3CPU A3ACPU A3HCPU A3MCPU A3NCPU A3UCPU A4UCPU A73CPU A7LMS-F	Maximum 58 k bytes for both main and sub microcomputer programs	&H0000 to &HE7FE

• The maximum number of bytes of the microcomputer program that can be read at one time is 128 bytes.
The entire microcomputer program can be loaded by specifying the starting address number and the number of bytes to be read in units of 128 bytes as follows:



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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that loads the microcomputer program and saves it on a memory card
110 ' (Capacity of the microcomputer program: 8 k bytes)
120 OPEN"0:PROG9.DAT"FOR OUTPUT AS #1        :  'Opens the sequential file
130 DIM TBL%(4),A%(127)                      :  'Defines arrays
140 TBL%(0)=255                              :  'Specifies the station number to
                                                communicate with to the local station
150 TBL%(1)=9                                :  'Specifies to load the microcomputer
                                                program
160 TBL%(2)=1                                :  'Specifies to load the main microcomputer
                                                program
170 TBL%(4)=128                              :  'Specifies the number of bytes to be read
180 FOR J=&HO TO &H1F80 STEP 128
190  TBL%(3)=J                               :  'Specifies the starting address of the
                                                program
200  PCRD TBL%( ),A%( )                      :  'Executes the load operation
210  FOR I=0 TO 127
220   PRINT #1,A%(I)                         :  'Writes to the sequential file
230  NEXT I
240 NEXT J
250 CLOSE #1                                 :  'Closes the file
260 END
```


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(2) Program example of a format 2 control table

```
100 ' A program example that loads the microcomputer program and saves it on a memory card
110 ' (Capacity of the microcomputer program: 8 k bytes)
120 OPEN"0:PROG9.DAT"FOR OUTPUT AS #1        :  'Opens the sequential file
130 DIM TBL%(7),A%(127)                      :  'Defines arrays
140 TBL%(0)=256                              :  'Specifies a format 2 control table
150 TBL%(1)=1                                :  'Specify network number 1
160 TBL%(2)=1                                :  'Specify station number 1
170 TBL%(4)=9                                :  'Specifies to load the microcomputer
                                                program
180 TBL%(5)=1                                :  'Specifies to load the main microcomputer
                                                program
190 TBL%(7)=128                              :  'Specifies the number of bytes to be read
200 FOR J=&HO TO &H1F80 STEP 128
210  TBL%(6)=J                               :  'Specifies the starting address of the
                                                program
220  PCRD TBL%( ),A%( )                      :  'Executes the load operation
230  FOR I=0 TO 127
240   PRINT #1,A%(I)                         :  'Writes to the sequential file
250  NEXT I
260 NEXT J
270 CLOSE #1                                 :  'Closes the file
280 END
```


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Processing Code 10

Reading comment data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Starting address	Specify the starting address of the comment data to be read.
□%(3)	□%(6)	Number of bytes	Specify the number of bytes to be read.

• It is possible to read comment data from the PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 10.

□%(2) •••••• Specify the starting address of the comment to be read.
The maximum number of bytes of comment data is the capacity set by the parameter.

□%(3) •••••• Specify the number of bytes to be read.
The allowable specification range is from 1 to 128 bytes.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 10.

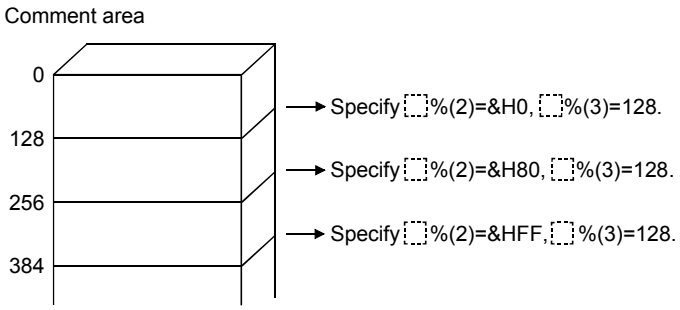
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□%(5) • • • • • • Specify the starting address of the comment to be read.
The maximum number of bytes of comment data is the capacity set by the parameter.

□%(6) • • • • • • Specify the number of bytes to be read.
The allowable specification range is from 1 to 128 bytes.

• The maximum number of bytes in comment data is determined by the capacity set by the parameter. The allowable specification range for the starting step count is as follows:
0 to (1024 x (comment capacity specified by the parameter))

• The maximum number of bytes of comment data that can be read at one time is 128 bytes.
The entire comment data can be read by specifying the starting address number and the number of bytes to be read in units of 128 bytes as follows:



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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that reads the comment data from the PLC CPU and saves it on a memory
      card
110 ' (Comment capacity: 3 k bytes)
120 OPEN"0:PROG10.DAT"FOR OUTPUT AS #1      :  'Opens the sequential file
130 DIM TBL%(10),A%(150)                    :  'Defines arrays
140 TBL%(0)=255                             :  'Specifies the station number to
                                               communicate with to the local station
150 TBL%(1)=10                              :  'Specifies to read comment data
160 TBL%(3)=128                             :  'Specifies the number of bytes to be read
170 FOR J=&HO TO &HB80 STEP 128
180  TBL%(2)=J                              :  'Specifies the starting address of the
                                               comment data
190  PCRD TBL%( ),A%( )                     :  'Executes the read operation
200  FOR I=0 TO 127
210   PRINT #1,A%(I)                        :  'Writes to the sequential file
220  NEXT I
230 NEXT J
240 CLOSE #1 :'Closes the file
250 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that reads the comment data from the PLC CPU and saves it on a memory
      card
110 ' (Comment capacity: 3 k bytes)
110 OPEN"0:PROG10.DAT"FOR OUTPUT AS #1      :  'Opens the sequential file
120 DIM TBL%(10),A%(150)                    :  'Defines arrays
130 TBL%(0)=256                             :  'Specifies a format 2 control table
140 TBL%(1)=1                               :  'Specifies network number 1
150 TBL%(2)=1                               :  'Specifies station number 1
160 TBL%(4)=10                              :  'Specifies to read comment data
170 TBL%(6)=128                             :  'Specifies the number of bytes to be read
180 FOR J=&HO TO &HB80 STEP 128
190  TBL%(5)=J                              :  'Specifies the starting address of the
                                               comment data
200  PCRD TBL%( ),A%( )                     :  'Executes the read operation
210  FOR I=0 TO 127
220   PRINT #1,A%(I)                        :  'Writes to the sequential file
230  NEXT I
240 NEXT J
250 CLOSE #1                                :  'Closes the file
260 END
```


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Processing Code 11

Reading extension comment data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Starting address	Specify the starting address of the extension comment data to be read.
□%(3)	□%(6)	Number of bytes	Specify the number of bytes to be read.

• It is possible to read comment data from the PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 11.

□%(2) •••••• Specify the starting address of the extension comment to be read.
The maximum number of bytes of extension comment data is the capacity set by the parameter.

□%(3) •••••• Specify the number of bytes to be read.
The allowable specification range is from 1 to 128 bytes.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 11.

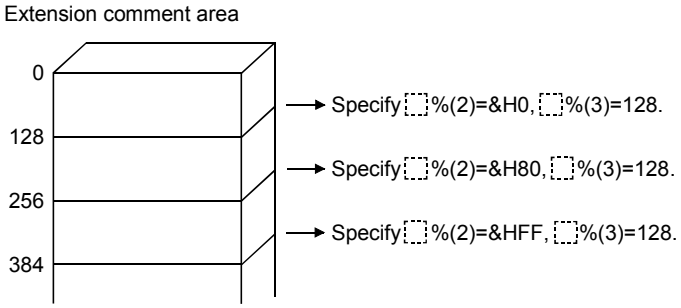
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□%(5) •••••• Specify the starting address of the extension comment to be read.
The maximum number of bytes of extension comment data is the capacity set by the parameter.

□%(6) •••••• Specify the number of bytes to be read.
The allowable specification range is from 1 to 128 bytes.

• The maximum number of bytes in extension comment data is determined by the capacity set by the parameter. The allowable specification range for the starting step count is as follows:
0 to (1024 × (extension comment capacity specified by the parameter))

• The maximum number of bytes of extension comment data that can be read at one time is 128 bytes.
The entire extension comment data can be read by specifying the starting address number and the number of bytes to be read in units of 128 bytes as follows:



Extension comments can only be created by SW□IVD-GPPA.
In addition, extension comment data can be used with the LEDC instruction or others in sequence programs.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that reads the extension comment data from the PLC CPU and saves it on a
      memory card
110 ' (Extension comment capacity: 3 k bytes)
120 OPEN"0:PROG11.DAT"FOR OUTPUT AS #1      :  'Opens the sequential file
130 DIM TBL%(10),A%(150)                    :  'Defines arrays
140 TBL%(0)=255                             :  'Specifies the station number to
                                               communicate with to the local station
150 TBL%(1)=11                              :  'Specifies to read extension comment data
160 TBL%(3)=128                             :  'Specifies the number of bytes to be read
170 FOR J=&HO TO &HB80 STEP 128
180  TBL%(2)=J                              :  'Specifies the starting address of the
                                               extension comment data to be read
190  PCRD TBL%( ),A%( )                     :  'Executes the read operation
200  FOR I=0 TO 127
210   PRINT #1,A%(I)                        :  'Writes to the file
220  NEXT I
230 NEXT J
240 CLOSE #1                                :  'Closes the file
250 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that reads the extension comment data from the PLC CPU and saves it on a
      memory card
110 ' (Extension comment capacity: 3 k bytes)
120 OPEN"0:PROG11.DAT"FOR OUTPUT AS #1      :  'Opens the sequential file
130 DIM TBL%(10),A%(150)                    :  'Defines arrays
140 TBL%(0)=256                             :  'Specifies a format 2 control table
150 TBL%(1)=1                               :  'Specifies network number 1
160 TBL%(2)=1                               :  'Specifies station number 1
170 TBL%(4)=11                              :  'Specifies to read extension comment data
180 TBL%(6)=128                             :  'Specifies the number of bytes to be read
190 FOR J=&HO TO &HB80 STEP 128
200  TBL%(5)=J                              :  'Specifies the starting address of the
                                               extension comment data to be read
210  PCRD TBL%( ),A%( )                     :  'Executes the read operation
220  FOR I=0 TO 127
230   PRINT #1,A%(I)                        :  'Writes to the file
240  NEXT I
250 NEXT J
260 CLOSE #1                                :  'Closes the file
270 END
```


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Processing Code 12

Reading a special function module's buffer memory

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Module number	Specify the module number of the special function module.
□%(3)	□%(6)	Buffer memory address	Specify the buffer memory address.
□%(4)	□%(7)		
□%(5)	□%(8)	Number of bytes	Specify the number of bytes to be read.

• It is possible to read the data of the special function module's buffer memory using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 12.

□%(2) •••••• Specify the module number of the special function module whose buffer memory data is to be read.

□%(3) •••••• Specify the address of buffer memory whose data is to be read.
□%(4) ••••

□%(5) •••••• Specify how many bytes of data should be read, including the specified buffer memory address of the special function module.
The allowable specification range is from 1 to 128.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

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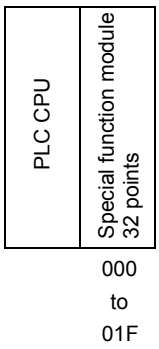
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 12.
□%(5)	• • • • • •	Specify the module number of the special function module whose buffer memory data is to be read.
□%(6)	• • • • • •	Specify the address of buffer memory whose data is to be read.
□%(7)	• • • •	
□%(8)	• • • • • •	Specify how many bytes of data should be read, including the specified buffer memory address of the special function module. The allowable specification range is from 1 to 128.

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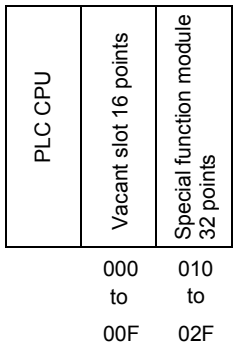
• The module number (hexadecimal) of the special function module is the two most significant digits of the 3-digit expression of the last address of the special function module's I/O addresses seen from the PLC CPU.

(a) In case of a single-slot module (e.g., AD61, A68AD)



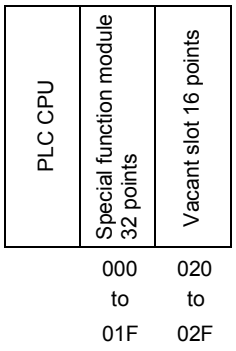
• • • • • • Since the last address is $01F_H$, the special function module number is "01_H."

(b) In case of a module where the first half slot is allocated as a vacant slot (e.g., AD72, A68AD)



• • • • • • Since the last address is $02F_H$, the special function module number is "02_H."

(c) In case of a module where the second half slot is allocated as a vacant slot (e.g., A61LS)

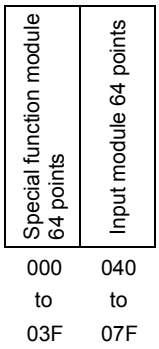


• • • • • • Since the last address is $01F_H$, the special function module number is "01_H."

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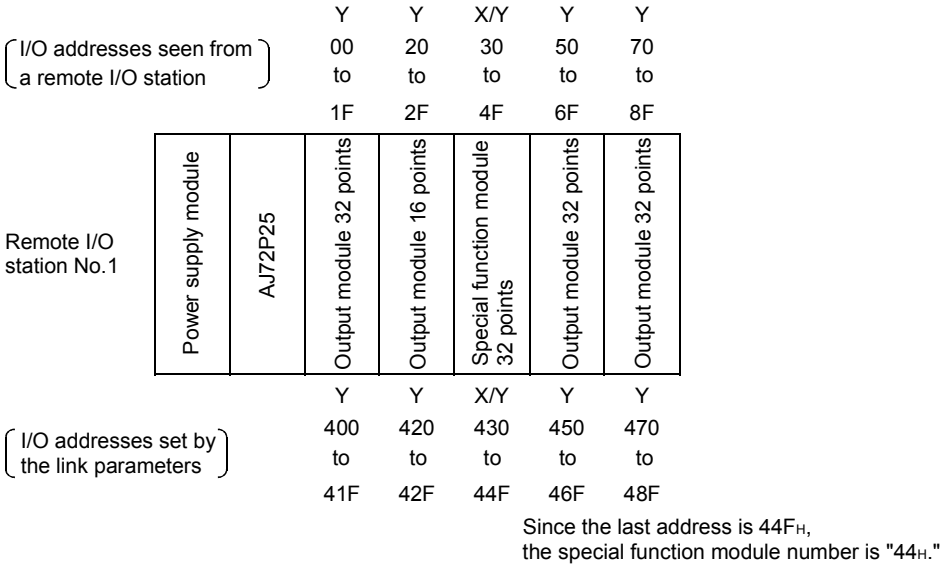
(d) In case of a module where both the special function module and an input/output module are allocated (e.g., A81CPU)
(In case of A81CPU)



• • • • • • Since the last address is 03F$_H$, the special function module number is "03$_H$."

(e) Module number of the special function module of a MELSECNET remote I/O station
The module number of the special function module of a MELSECNET remote I/O station is determined by the settings of the link parameters set at the MELSECNET master station.

L/R No.	M ← L		M → R	M ← R	M → L/R		M ← L/R	
	B	W	W	W	Y	X/Y	X	Y/X
R1	• • • • •	• • • • •	29C-309	0F9-15E	400-48F	000-08F	430-44F	030-04F
R2	• • • • •	• • • • •	215-24F	080-0A3	510-67F	010-17F	500-65F	000-15F
R3	• • • • •	• • • • •	1B6-214	15F-1B5	270-32F	050-10F	220-28F	000-06F
	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—



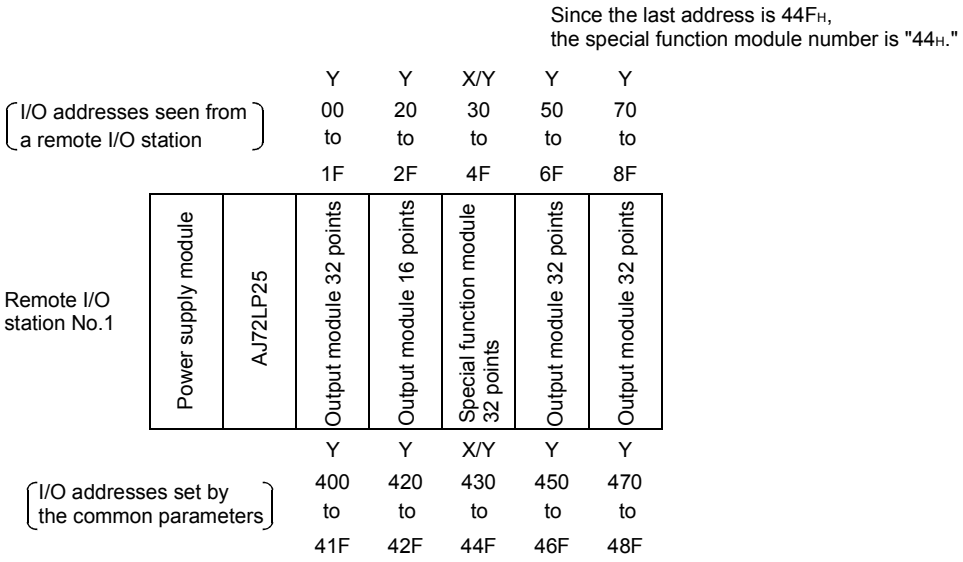
Since the last address is 44F$_H$,
the special function module number is "44$_H$."

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(f) Module number of the special function module of a MELSECNET/10 remote I/O station

The module number of the special function module of a MELSECNET/10 remote I/O station is always the two most significant digits of the 3-digit expression of the last “I/O address seen from a remote I/O station.”
Specify the module number using the last “I/O address seen from a remote I/O station” regardless of the settings of the common parameters set at the master station of the MELSECNET/10 remote I/O net.



• The special function module’s buffer memory contains 16 bits (one word) per one address and reading/writing operations between the PLC CPU and special function module are performed with the FROM/TO instruction.
When reading/writing from the special function module’s buffer memory to the communication module or vice versa, the operation is carried out in units of 8 bits (one byte) per one address.

The addresses to specify in the communication module (hexadecimal) are obtained by the following conversion from addresses for the FROM/TO instruction.

Specified address (hexadecimal) = convert {(address for the FROM/TO instruction x 2)} into a hexadecimal number + [the starting address of each module]

Example: When specifying address 1 of the FROM/TO instructions (the preset value of CH.1) of the type AD61 high-speed counter module.

(Specified address 82H) = (FROM/TO instruction address 0 x 2, 1H x 2) + (starting address 80H)

See the Appendix 8 for the starting address of each intelligent function module/special function module.

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• Assign values to □%(3) and □%(4) (□%(6) and □%(7) in case of a format 2 control table) in the following manner.

D! ••••••• Address viewed from the communication module

H!
L!
H$
L$ } ••••••• Used as a work area.

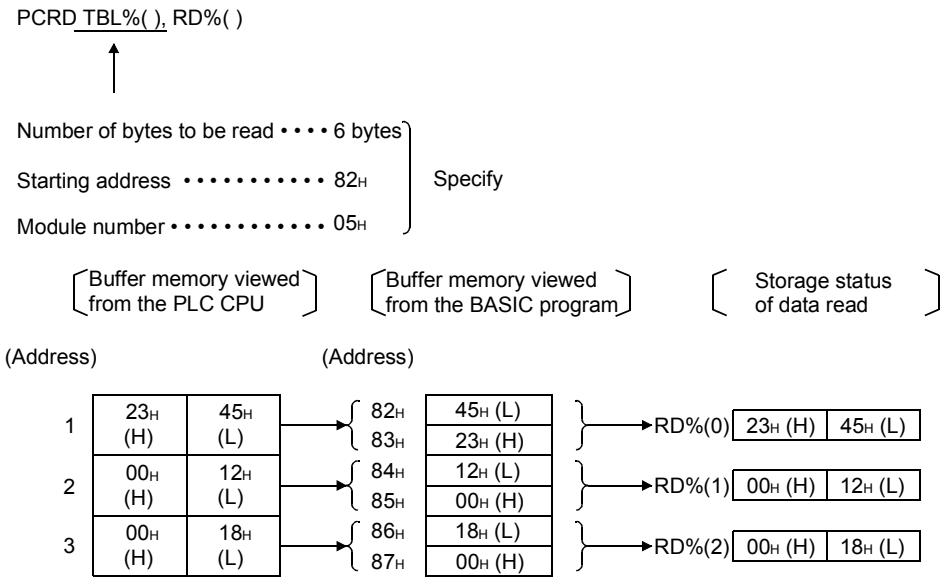
to
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$ (H!))
130 L$=RIGHT$("0000"+HEX$ (L!))
140 □%(3)=VAL("&H+L$)
150 □%(4)=VAL("&H+H$)
to

In case of a format 2 control table
••••••• □%(6)=VAL("&H+L$)
••••••• □%(7)=VAL("&H+H$)

• Data is stored in <storage area for data read> in the following manner.

Example: When reading data in buffer memory addresses 1 to 3 from an AD61 module whose I/O addresses are from X/Y40 to X/Y5F.

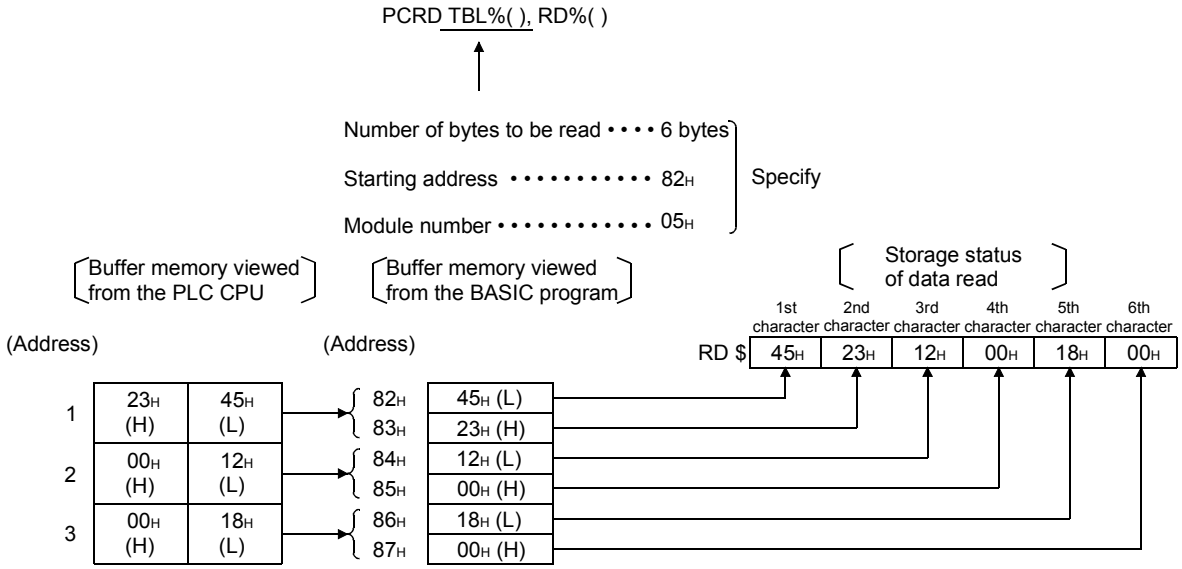
1) If an input element is specified as a positive variable/array, the data is stored as follows:



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2) If an input element is specified as a character variable or character array variable name:



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Program Example

(1) Program example for a format 1 control table

```
100 'A program example that reads buffer memory 1 of the special function module (A68AD)
110 '(Starting address of A68AD: &H80)
120 DIM TBL%(5),A%(0)                          :  'Defines arrays
130 TBL%(0)=255                                :  'Specifies the station number to
                                                  communicate with to the local station
140 TBL%(1)=12                                 :  'Specifies to read buffer memory
150 TBL%(2)=&H9                                :  'Specifies the module number
160 D!=&H94                                    :  'Specifies the buffer memory address
170 H!=INT(D!/65536!)
180 L!=D!-H!*65536!
190 H$=RIGHT$("0000"+HEX$(H!),4)               :  'Upper byte of the buffer memory address
200 L$=RIGHT$("0000"+HEX$(L!),4)               :  'Lower byte of the buffer memory address
210 TBL%(3)=VAL("&H"+L$)                       :  'Stores the lower byte in the control table
220 TBL%(4)=VAL("&H"+H$)                       :  'Stores the higher byte in the control table
230 TBL%(5)=2                                  :  'Specifies the number of bytes to be read
240 PCRD TBL%( ),A%( )                         :  'Executes the read operation
250 PRINT "Digital output of CH1=";A%(0)       :  'Displays the result
260 END
```

(2) Program example for a format 2 control table

```
100 'A program example that reads buffer memory 1 of the special function module (A68AD)
110 '(Starting address of A68AD: &H80)
120 DIM TBL%(8),A%(0)                          :  'Defines arrays
130 TBL%(0)=256                                :  'Specifies a format 2 control table
140 TBL%(1)=1                                  :  'Specifies network number 1
150 TBL%(2)=1                                  :  'Specifies station number 1
140 TBL%(4)=12                                 :  'Specifies to read buffer memory
150 TBL%(5)=&H9                                :  'Specifies the module number
160 D!=&H94                                    :  'Specifies the buffer memory addresses
170 H!=INT(D!/65536!)
180 L!=D!-H!*65536!
190 H$=RIGHT$("0000"+HEX$(H!),4)               :  'Upper byte of the buffer memory address
200 L$=RIGHT$("0000"+HEX$(L!),4)               :  'Lower byte of the buffer memory address
210 TBL%(6)=VAL("&H"+L$)                       :  'Stores the lower byte in the control table
220 TBL%(7)=VAL("&H"+L$)                       :  'Stores the higher byte in the control table
230 TBL%(8)=2                                  :  'Specifies the number of bytes to be read
240 PCRD TBL%( ),A%( )                         :  'Executes the read operation
250 PRINT "Digital output of CH1=" ;A%(0)      :  'Displays the result
260 END
```


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Processing Code 13

Reading the type name of the PLC CPU

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• It is possible to read the type names of PLC CPUs on MELSECNET (II), MELSECNET/B, and MELSECNET/10 networks using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 13.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 13.

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• The type name of the PLC CPU is stored using the following codes in <storage area for data read>.

PLC CPU type name	Code read (hexadecimal)
A2UCPU A2USCPU	82H
A2UCPU-S1 A2USCPU-S1	83H
A3UCPU	84H
A4USCPU	85H
AJ72LP25/BR25	8BH
A2ACPU A2ASCPU-S1	93H
A3ACPU	94H
A0J2HCPU A1SCPU A1SJCPU	98H
A2CCPU A52GCPU	9AH
A0J2CPU	A0H
A1CPU A1NCPU	A1H
A2CPU(-S1) A2NCPU(-S) A2SCPU	A2H
A3CPU A3NCPU A73CPU A7LMS-F	A3H
A3HCPU A3MCPU	A4H
AJ72P25/R25	ABH

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Program Example

(1) Program example for a format 1 control table

```
100 'A program example that reads the PLC CPU's type name
110 DIM TBL%(1),A%(0)                                  :  'Defines arrays
120 TBL%(0)=255                                        :  'Specifies the station number to
                                                          communicate with to the local station
130 TBL%(1)=13                                         :  'Specifies to read PLC CPU's type name
140 PCRD TBL%( ),A%( )                                 :  'Executes the read operation
150 PRINT "Type name code of PLC CPU=&H";HEX$(A%(0))
                                                       :  'Displays the result
160 END
```

(2) Program example for a format 2 control table

```
100 'A program example that reads the PLC CPU's type name
110 DIM TBL%(1),A%(0)                                  :  'Defines arrays
120 TBL%(0)=256                                        :  'Specifies a format 2 control table
130 TBL%(1)=1                                          :  'Specifies network number 1
140 TBL%(2)=1                                          :  'Specifies station number 1
150 TBL%(4)=13                                         :  'Specifies to read PLC CPU's type name
160 PCRD TBL%( ),A%( )                                 :  'Executes the read operation
170 PRINT "Type name code of PLC CPU=&H";HEX$(A%(0))
                                                       :  'Displays the result
180 END
```


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Processing Code 14

Reading parameter data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Starting address	Specify the starting address of the parameter area to be read.
□%(3)	□%(6)		
□%(4)	□%(7)	Number of bytes	Specify the number of bytes to be read.

• This code reads the parameters from the PLC CPU.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 14.

□%(2) ••••••• Specify the starting address of the parameter area to be read.

□%(3) •••

□%(4) •••••• Specify the number of bytes to be read.

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Format 2 control table

□%(0)	•••••••	Format 2 control table • Specify 256.
□%(1)	•••••••	Specify the number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	•••••••	Specify the station number of the PLC CPU from which data is to be read. See Section 4.2.2 for the allowable specification range.
□%(3)	•••••••	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	•••••••	Processing code • Specify 14.
□%(5)	•••••••	Specify the starting address of the parameter area to be read.
□%(6)	•••	
□%(7)	•••••••	Specify the number of bytes to be read.

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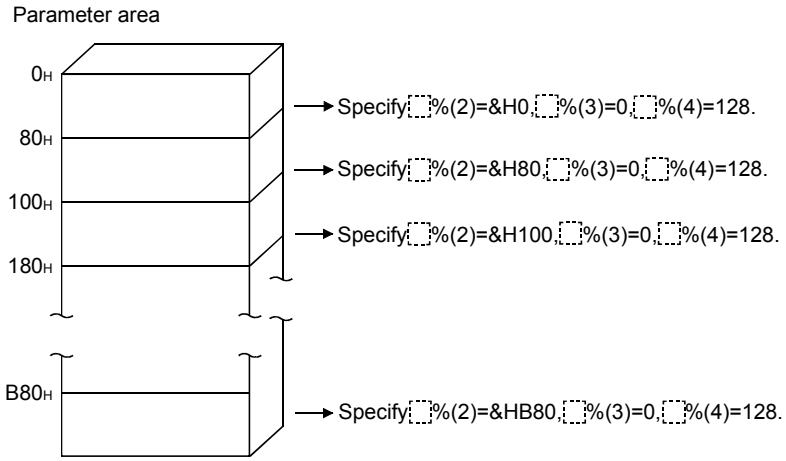
• Assign values to □%(2) and □%(3) (□%(5) and □%(6) in case of a format 2 control table) in the following manner.

```
D!   ••••  Starting address of the parameter area
H!
L!   ••••  Used as work area.
H$
L$
 to
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$(H!))
130 L$=RIGHT$("0000"+HEX$(L!))          Format 2 control table
140 □%(2)=VAL("&H"+L$)      ••••  □%(5)=VAL("&H"+L$)
150 □%(3)=VAL("&H"+H$)      ••••  □%(6)=VAL("&H"+H$)
 to
```

• The capacity of parameter data is set as follows:

A0J2	••••	16 k bytes (addresses 0000 to 000F$_H$)
Other CPUs	••••	3 k bytes (addresses 0000 to 0BFF$_H$)

The maximum number of bytes of parameter data that can be read at one time is 128 bytes. In CPUs other than A0J2CPU, read all data by specifying the starting address and the number of bytes to be read in units of 128 bytes as follows:



• The parameters set in the memory capacity settings of the GPP function and the MELSECNET/10 network parameters are read using processing code 14.
The network parameters are read/written together with the parameters if the PLC CPU that performs the parameter read/write operation is an AnUCPU. If the network parameters are also read/written, read or write the entire amount of data corresponding to parameter capacity (3 k bytes) plus network parameter capacity.
The capacity of the network parameters is displayed on the screen for setting network parameters in the GPP function.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that reads parameters from the PLC CPU and saves them on a memory
      card
110 ' (Four network modules are connected. All the modules are control stations. Network parameter
      capacity: 16 k bytes)
120 OPEN "0:PROG14.DAT" FOR OUTPUT  AS #1     :  ' Opens the sequential file
130 DIM TBL%(10),A%(150)                      :  ' Defines arrays
140 TBL%(0)=255                               :  ' Specifies the station number to
                                                    communicate with to the local station
150 TBL%(1)=14                                :  ' Specifies to read parameters
160 TBL%(4)=128                               :  ' Specifies the number of bytes to be read
170 FOR J=&H0 TO &H3F80 STEP 128
180  D!=J                                     :  ' Specifies the starting address
190  H!=INT (D!/65536!)
200  L!=D!-H!*65536!
210  H$=RIGHT$("0000"+HEX$(H!), 4)            :  ' Upper byte of the starting address
220  L$=RIGHT$("0000" +HEX$(H!), 4)           :  ' Lower byte of the starting address
230  TBL%(2)=VAL("&H"+L$)                     :  ' Stores the lower byte in the control table
240  TBL%(3)=VAL("&H"+L$)                     :  ' Stores the upper byte in the control table
250  PRINT  H$,L$
260  PCRD TBL%( ),A%( )                       :  ' Executes the read operation
270  FOR I=0 TO 127
280   PRINT #1,A%(I)                          :  ' Writes to the file
290  NEXT I
300 NEXT J
310 CLOSE #1                                  :  ' Closes the file
320 END
```


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(2) Program example for a format 2 control table

```
100 'A program example that reads parameters from the PLC CPU and saves them on a memory card
110 '(Four network modules are connected. All the modules are control stations. Network parameter
      capacity: 16 k bytes)
120 OPEN "0:PROG14.DAT" FOR OUTPUT AS #1     :  'Opens the sequential file
130 DIM TBL%(10),A%(150)                     :  'Defines arrays
140 TBL%(0)=256                              :  'Specifies a format 2 control table
150 TBL%(1)=1                                :  'Specifies network number 1
160 TBL%(2)=1                                :  'Specifies station number 1
170 TBL%(4)=14                               :  'Specifies to read parameters
180 TBL%(7)128                               :  'Specifies the number of bytes to be read
190 FOR J=&H0 TO &H3F80 STEP 128
200  D!=J                                    :  'Specifies the starting address
210  H!=INT (D!/65536!)
220  L!=D!-H!*65536!
230  H$=RIGHT$("0000"+HEX$(H!), 4)           :  'Upper byte of the starting address
240  L$=RIGHT$("0000"+HEX$(L!), 4)           :  'Lower byte of the starting address
250  TBL%(5)=VAL("&H"+L$)                    :  'Stores the lower byte in the control table
260  TBL%(6)=VAL("&H"+L$)                    :  'Stores the upper byte in the control table
270  PRINT H$,L$
280  PCRD TBL%( ),A%( )                      :  'Executes the read operation
290  FOR I=0 TO 127
300   PRINT #1,A%(I)                         :  'Writes to the file
300  NEXT I
310 NEXT J
320 CLOSE #1                                 :  'Closes the file
330 END
```


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Processing Code 21

Reading network information

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• This code reads the network information of an accessed station.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 21.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 21.

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• The following information is read to <storage area for data read>.
(1) Number of link/network modules mounted.
(2) System code
1 : MELSECNET/10
2 : MELSECNET (II), MELSECNET/B
(3) Network number
0 : MELSECNET (II), MELSECNET/B
Other than 0 : Network number set
(4) Link/network station number
0 to 64 : Station number of the corresponding data link/network module
(5) Group number
0 : No group setting. MELSECNET (II), MELSECNET/B
Other than 0 : Group number set

Information for items (2) to (5) is read for the number of link/network modules mounted.

• Even if the capacity of <storage area for data read> is smaller than the number of data, this code ends normally without generating an error.
Define arrays larger than the necessary amount of data.

Program Example

(1) Program example for a format 1 control table

```
100 DIM TBL%(10),A%(20)          :  ' Defines arrays
110 TBL%(0)=255                  :  ' Specifies the station number to
                                    communicate with to the local station
120 TBL%(1)=21                   :  ' Specifies to read network information
130 PCRD TBL%( ),A%( )           :  ' Executes the read operation
140 END
```

(2) Program example for a format 2 control table

```
100 DIM TBL%(10),A%(20)          :  'Defines arrays
110 TBL%(0)=256                  :  'Specifies a format 2 control table
120 TBL%(1)=1                    :  'Specifies network number 1
130 TBL%(2)=1                    :  'Specifies station number 1
140 TBL%(4)=21                   :  'Specifies to read network information
150 PCRD TBL%( ),A%( )           :  'Executes the read operation
160 END
```


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Processing Code 22

Reading routing parameters

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• This code reads the routing parameters of an accessed station.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 22.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 22.

• The following information is read to <storage area for data read>.
(1) Number of routing parameter settings
(2) Destination network number
(3) Relay network number
(4) Relay network station number

Information for items (2) to (4) is read for the number of routing parameter settings.

• Even if the capacity of <storage area for data read> is smaller than the number of data, this code ends normally without generating an error.
Define arrays larger than the necessary amount of data.

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Program Example

(1) Program example for a format 1 control table

```
100 DIM TBL%(10),A%(100)          :  ' Defines arrays
110 TBL%(0)=255                   :  ' Specifies the station number to
                                     communicate with to the local station
120 TBL%(1)=22                    :  ' Specifies to read routing parameters
130 RCRD TBL%(),A%()              :  ' Executes the read operation
140 END
```

(2) Program example for a format 2 control table

```
100 DIM TBL%(10),A%(100)          :  'Defines arrays
110 TBL%(0)=256                   :  'Specifies a format 2 control table
120 TBL%(1)=1                     :  'Specifies network number 1
130 TBL%(2)=1                     :  'Specifies station number 1
140 TBL%(4)=22                    :  'Specifies to read routing parameters
150 PCRD TBL%( ),A%( )            :  'Executes the read operation
160 END
```


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Processing Code 513 Reading the type name of the Q/QnA series PLC CPU

Control table format definition

Only applicable to QD51 (-R24)

Element position			Item	Description
Format 1	Format 2	Format 3		
□%(0)	—	—	Station number	Specify the station number of the PLC.
	□%(0)	□%(0)	Control table	Specify a control table of format 2 or.3.
	□%(1)	□%(1)	Network number	Specify the network number.
	□%(2)	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	□%(3)	Detailed error code	Detailed error codes are stored here.
		□%(4)	Requested CPU	Specify the requested CPU.
□%(1)	□%(4)	□%(5)	Processing code	Specify the processing code.
□%(2)	□%(5)	□%(6)	Fixed value	Specify 0.

• It is possible to read the type name of the Q/QnA series PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU whose type name is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 513 (&H201).

□%(2) •••••• Fixed value
• Specify 0 (&H0).

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256 (&H100).

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU whose type name is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 513 (&H201).

□%(5) •••••• Fixed value
• Specify 0 (&H0).

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Format 3 control table

□%(0) •••••• Format 3 control table
  • Specify 257 (&H101).

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU whose type name is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Specify the requested CPU.
  • PLC No.1 •••••• 992 (&H3E0)
  • PLC No.2 •••••• 993 (&H3E1)
  • PLC No.3 •••••• 994 (&H3E2)
  • PLC No.4 •••••• 995 (&H3E3)
  • Control PLC •••••• 1023 (&H3FF)

□%(5) •••••• Processing code
  • Specify 513 (&H201).

□%(6) •••••• Fixed value
  • Specify 0 (&H0).

• The type name of the Q series CPU is stored using the following codes in <storage area for data read>.

CPU type name	Type name string	Type name code
Q2ACPU	Q2ACPU	&H0021
Q2ACPU-S1	Q2ACPU-S1	&H0022
Q3ACPU	Q3ACPU	&H0023
Q4ACPU	Q4ACPU	&H0024
Q02CPU	Q02CPU	&H0041
Q02HCPU	Q02HCPU	&H0041
Q06HCPU	Q06HCPU	&H0042
Q12HCPU	Q12HCPU	&H0043
Q25HCPU	Q25HCPU	&H0044

□% (0) to □% (7)	Type name string	The type name string is stored here.
□% (8)	Type name code	The type name code is stored here.
□% (9) to □% (31)	Dummy	Dummy bytes (0) are stored here.

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Program Example

(1) Program example for a format 1 control table

```
100 'A program example that reads the type name of the Q/QnA series CPU
110 DIM TBL%(10),A%(31)                    :  'Defines the arrays
120 TBL%(0)=255                            :  'Specifies the station number to
                                              communicate with to the local station
130 TBL%(1)=513                            :  'Specifies to read Q/QnA series CPU's type
                                              name
140 TBL%(2)=0                              :  'Specifies the fixed value (dummy)
150 PCRD TBL%(),A%()                       :  'Executes the read operation
160 KATAMEI$=""
170 FOR I=0 TO 8
180 MOJI$=HEX$ (A%(I))                     :  'Reads the type name
190 KATAMEI$=KATAMEI$+MOJI$
200 NEXT I
210 PRINT "Type name string of Q series CPU=";KATAMEI$
                                           :  'Displays the result
220 PRINT "Type name code   =&H";HEX$(A%(9))
230 END
```

(2) Program example for a format 2 control table

```
100 'A program example that reads the type name of the Q/QnA series CPU
110 DIM TBL%(10), A%(31)                   :  'Defines the arrays
120 TBL%(0)=256                            :  'Specifies a format 2 control table
130 TBL%(1)=1                              :  'Specifies network number 1
140 TBL%(2)=1                              :  'Specifies station number 1
150 TBL%(4)=513                            :  'Specifies to read Q/QnA series CPU's type
                                              name
160 TBL%(5)=0                              :  'Specifies the fixed value (dummy)
170 PCRD TBL%(),A%()                       :  'Executes the read operation
180 KATAMEI$=""
190 FOR I=0 TO 8
200 MOJI$=HEX$(A%(I))                      :  'Reads the type name
210 KATAMEI$=KATAMEI$+MOJI$
220 NEXT I
230 PRINT "Type name string of Q series CPU=";   :  'Displays the result
240 PRINT "Type name code =&H"; HEX$(A%(9))
250 END
```


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(3) Program example for a format 3 control table

```
100 'A program example that reads the type name of the Q/QnA series CPU
110 DIM TBL%(10),A%(31)                    :  'Defines the arrays
120 TBL%(0)=257                            :  'Specifies a format 3 control table
130 TBL%(1)=1                              :  'Specifies network number 1
140 TBL%(2)=1                              :  'Specifies station number 1
150 TBL%(4)=&H03E3                         :  'Specifies the requested CPU (PLC No.4)
160 TBL%(5)=513                            :  'Specifies to read Q/QnA series CPU's type
                                              name
170 TBL%(6)=0                              :  'Specifies the fixed value (dummy)
180 PCRD TBL%(),A%()                       :  'Executes the read operation
190 KATAMEI$=""
200 FOR I=0 TO 8
210 MOJI$=HEX$(A%(I))                      :  'Reads the type name
220 KATAMEI$=KATAMEI$+MOJI$
230 NEXT I
240 PRINT "Type name string of Q series CPU=";  :  'Displays the result
250 PRINT "Type name code  =&H";HEX$(A%(9))
260 END
```


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Processing Code 515 Reading device memory of the Q/QnA series PLC CPU

Only applicable to QD51 (-R24)

Control table format definition

Element position			Item		Description
Format 1	Format 2	Format 3			
□%(0)			Station number		Specify the station number of the PLC.
	□%(0)	□%(0)	Control table		Specify a control table of format 2.
	□%(1)	□%(1)	Network number		Specify the network number.
	□%(2)	□%(2)	Station number		Specify the station number of the PLC.
	□%(3)	□%(3)	Detailed error code		Detailed error codes are stored here.
		□%(4)	Requested CPU		Specify the requested CPU.
□%(1)	□%(4)	□%(5)	Processing code		Specify the processing code.
□%(2)	□%(5)	□%(6)	Device code		Specify the device code.
□%(3)	□%(6)	□%(7)	Device number	lower	Specify the device number.
□%(4)	□%(7)	□%(8)		higher	
□%(5)	□%(8)	□%(9)	Number of points		Specify the number of device points to be read.

• It is possible to read the device memory of the Q/QnA series PLC using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is to be read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 515 (&H203).

□%(2) •••••• Specify the device using the defined code.
• See Section 4.2.5 for the code numbers.

□%(3) •••••• Specify the device number (lower digit) of the device specified in □%(2). See Section 4.2.5 for the allowable specification range.

□%(4) •••••• Specify the device number (higher digit) of the device specified in □%(2). See Section 4.2.5 for the allowable specification range.

□%(5) •••••• Specify the number of device points to be read, including the devices specified in □%(2), □%(3), and □%(4).
The allowable specification ranges are as follows:
(a) Bit devices
• Q series CPU 1 to 15360 points
• QnA series CPU 1 to 7680 points
(b) Word devices
• Q series CPU 1 to 960 points
• QnA series CPU 1 to 480 points

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Format 2 control table

□%(0) • • • • • • Format 2 control table
• Specify 256 (&H100).

□%(1) • • • • • • Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) • • • • • • Specify the station number of the PLC CPU whose type name is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) • • • • • • Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) • • • • • • Processing code
• Specify 515 (&H203).

□%(5) • • • • • • Specify the device using the defined code.
• See Section 4.2.5 for the code numbers.

□%(6) • • • • • • Specify the device number (lower digit) of the device specified in □%(5). See Section 4.2.5 for the allowable specification range.

□%(7) • • • • • • Specify the device number (higher digit) of the device specified in □%(5). See Section 4.2.5 for the allowable specification range.

□%(8) • • • • • • Specify the number of device points to be read, including the devices specified in □%(5), □%(6), and □%(7).
The allowable specification ranges are as follows:
(a) Bit devices
• Q series CPU 1 to 15360 points
• QnA series CPU 1 to 7680 points
(b) Word devices
• Q series CPU 1 to 960 points
• QnA series CPU 1 to 480 points

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Format 3 control table

□%(0) ••••••
Format 3 control table
• Specify 257 (&H101).

□%(1) ••••••
Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) ••••••
Specify the station number of the PLC CPU whose type name is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) ••••••
Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) ••••••
Processing code
• Specify 515 (&H203).

□%(5) ••••••
Specify the requested CPU.
• PLC No.1 •••••• 992 (&H3E0)
• PLC No.2 •••••• 993 (&H3E1)
• PLC No.3 •••••• 994 (&H3E2)
• PLC No.4 •••••• 995 (&H3E3)
• Control PLC •••••• 1023 (&H3FF)

□%(6) ••••••
Specify the device using the defined code.
• See Section 4.2.5 for the code numbers.

□%(7) ••••••
Specify the device number (lower digit) of the device specified in □%(6). See Section 4.2.5 for the allowable specification range.

□%(8) ••••••
Specify the device number (higher digit) of the device specified in □%(6). See Section 4.2.5 for the allowable specification range.

□%(9) ••••••
Specify the number of device points to be read, including the devices specified in □%(6), □%(7), and □%(8).
(a) Bit devices
• Q series CPU 1 to 15360 points
• QnA series CPU 1 to 7680 points
(b) Word devices
• Q series CPU 1 to 960 points
• QnA series CPU 1 to 480 points

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• Assign values to □%(3) and □%(4) (□%(6) and □%(7) in case of a format 2 control table, □%(7) and □%(8) in case of a format 3 control table) in the following manner.

```
D!    ••••  Device number of the device to be read
H!
L!    ••••  Used as work area.
H$
L$
 to
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$(H!),4)
130 L$=RIGHT$("0000"+HEX$(L!),4)          In case of a format 2 control table
140 □%(3)=VAL("&H"+L$)      ••••  □%(6)=VAL("&H"+L$)
150 □%(4)=VAL("&H"+H$)      ••••  □%(7)=VAL("&H"+H$)
 to
```

Program Example

(1) Program example for a format 1 control table

```
100 'A program example that reads the device memory of the Q/QnA series CPU
110 DIM TBL%(10),A%(100)                 :  'Defines the arrays
120 TBL%(0)=255                          :  'Specifies the station number to
                                            communicate with to the local station
130 TBL%(1)=515                          :  'Specifies to read device memory of the
                                            Q/QnA series CP
140 TBL%(2)=144                          :  'Specifies internal relays M
150 D!=0                                 :  'Specifies device number 0
160 H!=INT(D!/65536!)                    :  'Splits into lower and higher digits
170 L!=D!-H!*65536!
180 H$=RIGHT$("0000"+HEX$(H!),4)
190 L$=RIGHT$("0000"+HEX$(L!),4)
200 TBL%(3)=VAL("&H"+L$)                 :  'Stores the lower digit of the device number
210 TBL%(4)=VAL("&H"+H$)                 :  'Stores the higher digit of the device
                                            number
220 TBL%(5)=10                           :  'Specifies the number of points to be read
230 PCRD TBL%(),A%()                     :  'Executes the read operation
240 I=0
250 FOR I=0 TO 100
260 PRINT HEX$(A%(I))
270 NEXT I
280 END
```


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(2) Program example for a format 2 control table

```
100 'A program example that reads the device memory of the Q/QnA series CPU
110 DIM TBL%(10),A%(100)                    :  'Defines the arrays
120 TBL%(0)=256                             :  'Specifies a format 2 control table
130 TBL%(1)=1                               :  'Specifies network number 1
140 TBL%(2)=1                               :  'Specifies station number 1
150 TBL%(4)=515                             :  'Specifies to read device memory of the
                                               Q/QnA series CP
160 TBL%(5)=144                             :  'Specifies internal relays M
170 D!=0                                    :  'Specifies device number 0
180 H!=INT(D!/65536!)                       :  'Splits into lower and higher digits
190 L!=D!-H!*65536!
200 H$=RIGHT$("0000"+HEX$(H!),4)
210 L$=RIGHT$("0000"+HEX$(L!),4)
220 TBL%(6)=VAL("&H"+L$)                    :  'Stores the lower digit of the device number
230 TBL%(7)=VAL("&H"+H$)                    :  'Stores the higher digit of the device
                                               number
240 TBL%(8)=10                              :  'Specifies the number of points to be read
250 PCRD TBL%(),A%()                        :  'Executes the read operation
260 I=0
270 FOR I=0 TO 100
280 PRINT HEX$(A%(I))
290 NEXT I
300 END
```


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(3) Program example a for format 3 control table

```
100 'A program example that reads the device memory of the Q/QnA series CPU
110 DIM TBL%(10),A%(100)                    :  'Defines the arrays
120 TBL%(0)=257                             :  'Specifies a format 3 control table
130 TBL%(1)=1                               :  'Specifies network number 1
140 TBL%(2)=1                               :  'Specifies station number 1
150 TBL%(4)=515                             :  'Specifies to read device memory of the
                                               Q/QnA series CPU
160 TBL%(5)=&H03E3                          :  'Specifies the requested CPU (PLC No.4)
170 TBL%(5)=144                             :  'Specifies internal relays M
180 D!=0                                    :  'Specifies device number 0
190 H!=INT(D!/65536!)                       :  'Splits into lower and higher digits
200 L!=D!-H!*65536!
210 H$=RIGHT$("0000"+HEX$(H!),4)
220 L$=RIGHT$("0000"+HEX$(L!),4)
230 TBL%(6)=VAL("&H"+L$)                    :  'Stores the lower digit of the device number
240 TBL%(7)=VAL("&H"+H$)                    :  'Stores the higher digit of the device
                                               number
250 TBL%(8)=10                              :  'Specifies the number of points to be read
260 PCRD TBL%(),A%()                        :  'Executes the read operation
270 I=0
280 FOR I=0 TO 100
290 PRINT HEX$(A%(I))
300 NEXT I
310 END
```


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Processing Code 516 Random read of device memory of the Q/QnA series PLC CPU

Control table format definition

	Element position			Item		Description
	Format 1	Format 2	Format 3			
Only applicable to QD51 (-R24)	□%(0)			Station number		Specify the station number of the PLC.
		□%(0)	□%(0)	Control table		Specify a control table of format 2.
		□%(1)	□%(1)	Network number		Specify the network number.
		□%(2)	□%(2)	Station number		Specify the station number of the PLC.
		□%(3)	□%(3)	Detailed error code		Detailed error codes are stored here.
		|	□%(4)	Requested CPU		Specify the requested CPU.
	□%(1)	□%(4)	□%(5)	Processing code		Specify the processing code.
	□%(2)	□%(5)	□%(6)	Lower	Number of word device points	Specify the number of word device points.
				Higher	Number of bit device points	Specify the number of bit device points.
	□%(3)	□%(6)	□%(7)	Number of double-word device points		Specify the number of double-word device points.
	□%(4)	□%(7)	□%(8)	Fixed value		Specify 0.
Repeat for the number of points to be read.	□%(5)	□%(8)	□%(9)	Device code		Specify the device code.
	□%(6)	□%(9)	□%(10)	Device number	lower	Specify the device number.
	□%(7)	□%(10)	□%(11)		higher	
	□%(8)	□%(11)	□%(12)	Processing unit		Specify the device processing unit.
	□%(9)	□%(12)	□%(13)	Fixed value		Specify 0.
	⋮	⋮	⋮	⋮		⋮

- It is possible to read individual devices in the device memory of the Q/QnA series PLC CPU using this code.
- Specify the following data for <control table>.

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Format 1 control table

□%(0)	• • • • • •	Specify the station number of the PLC CPU from which data is to be read. See Section 4.2.2 for the allowable specification range.
□%(1)	• • • • • •	Processing code • Specify 516 (&H204).
□%(2)	• • • • • •	Specify the number of points for the word device (lower digit) or bit device (higher digit) to be read. ＊1
□%(3)	• • • • • •	Specify the number of double-word device points to be read. ＊1
□%(4)	• • • • • •	Fixed value • Specify 0 (&H0).
□%(5)	• • • • • •	Specify the device using the defined code. • See Section 4.2.5 for the code numbers.
□%(6)	• • • • • •	Specify the device number (lower digit) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(7)	• • • • • •	Specify the device number (higher digit) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(8)	• • • • • •	Specify the device processing unit. • When reading in bit units • • • • 0 (&H0) • When reading word devices in word/double - word units • • • • 0 (&H0) • When reading bit devices in word units • • • • 8960 (&H2300) • When reading bit devices in double - word units • • • • 9984 (&H2700)
□%(9)	• • • • • •	Fixed value • Specify 0 (&H0).

＊1 : The number of points to be read should be within the appropriate range:

• In case of a Q series CPU

1 ≦ (number of bit device points + number of word device points + number of double - word device points) ≦ 192 points

• In case of a QnA series CPU

1 ≦ (number of bit device points + number of word device points + number of double - word device points) ≦ 96 points

Note that for ZR devices the number of points that can be read should be multiplied by 2.

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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256 (&H100).
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU whose device memory data is to be read. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 516 (&H204).
□%(5)	• • • • • •	Specify the number of points for the word device (lower digit) or bit device (higher digit) to be read. ＊1
□%(6)	• • • • • •	Specify the number of double-word device points to be read. ＊1
□%(7)	• • • • • •	Fixed value • Specify 0 (&H0).
□%(8)	• • • • • •	Specify the device using the defined code. • See Section 4.2.5 for the code numbers.
□%(9)	• • • • • •	Specify the device number (lower digit) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(10)	• • • • • •	Specify the device number (higher digit) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(11)	• • • • • •	Specify the device processing unit. • When reading in bit units • • • • 0 (&H0) • When reading word devices in word/double - word units • • • • 0 (&H0) • When reading bit devices in word units • • • • 8960 (&H2300) • When reading bit devices in double - word units • • • • 9984 (&H2700)
□%(12)	• • • • • •	Fixed value • Specify 0 (&H0).

＊1 : The number of points to be read should be within the appropriate range:

• In case of a Q series CPU

1 ≦ (number of bit device points + number of word device points + number of double - word device points) ≦192 points

• In case of a QnA series CPU

1 ≦ (number of bit device points + number of word device points + number of double - word device points) ≦ 96 points

Note that for ZR devices the number of points that can be read should be multiplied by 2.

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Format 3 control table

□%(0)	• • • • • •	Format 3 control table • Specify 257 (&H101).
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU whose device memory data is to be read. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 516 (&H204).
□%(5)	• • • • • •	Specify the requested CPU. • PLC No.1 • • • • • • 992 (&H3E0) • PLC No.2 • • • • • • 993 (&H3E1) • PLC No.3 • • • • • • 994 (&H3E2) • PLC No.4 • • • • • • 995 (&H3E3) • Control PLC • • • • • • 1023 (&H3FF)
□%(6)	• • • • • •	Specify the number of points for the word device (lower digit) or bit device (higher digit) to be read. ＊1
□%(7)	• • • • • •	Specify the number of double-word device points to be read. ＊1
□%(8)	• • • • • •	Fixed value • Specify 0 (&H0).
□%(9)	• • • • • •	Specify the device using the defined code. • See Section 4.2.5 for the code numbers.
□%(10)	• • • • • •	Specify the device number (lower digit) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(11)	• • • • • •	Specify the device number (higher digit) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(12)	• • • • • •	Specify the device processing unit. • When reading in bit units • • • • 0 (&H0) • When reading word devices in word/double - word units • • • • 0 (&H0) • When reading bit devices in word units • • • • 8960 (&H2300) • When reading bit devices in double - word units • • • • 9984 (&H2700)
□%(13)	• • • • • •	Fixed value • Specify 0 (&H0).

＊1 : The number of points to be read should be within the appropriate range:

• In case of a Q series CPU

1 ≦ (number of bit device points + number of word device points + number of double - word device points) ≦ 192 points

• In case of a QnA series CPU

1 ≦ (number of bit device points + number of word device points + number of double - word device points) ≦ 96 points

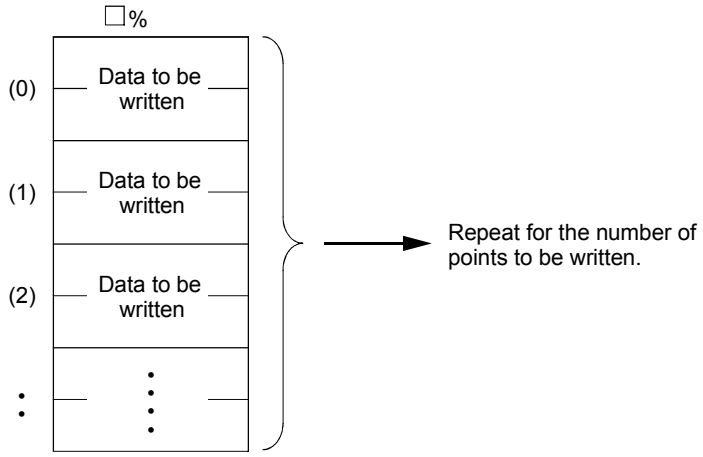
Note that for ZR devices the number of points that can be read should be multiplied by 2.

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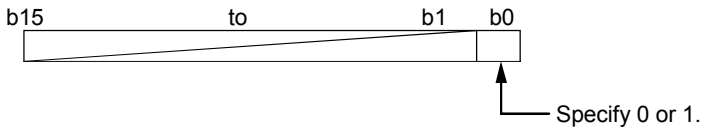
• Assign values to □%(6) and □%(7) (□%(9) and □%(10) in case of a format 2 control table, □%(10) and □%(11) in case of a format 3 control table) in the following manner.

```
D!    ••••  Device number of the device to be read
H!
L!    ••••  Used as work area.
H$
L$
 to
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$(H!),4)
130 L$=RIGHT$("0000"+HEX$(L!),4)          In case of a format 2 control table
140 □%(6)=VAL("&H"+L$)    ••••••••••  □%(9)=VAL("&H"+L$)
150 □%(7)=VAL("&H"+H$)    •••• ••▪•••  □%(10)=VAL("&H"+H$)
 to
```

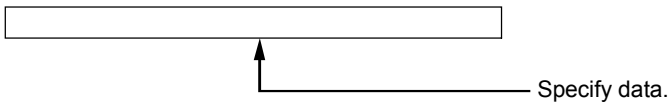
• Data is stored for the number of points read in <storage area for data read> as follows:



• In case of bit devices



• In case of word or double-word devices



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Program Example

(1) Program example for a format 1 control table

```
100 'A program example that reads the device memory of the Q/QnA series PLC CPU
110 DIM TBL%(20),A%(10)                 : 'Defines the arrays
120 TBL%(0)=255                         : 'Specifies the station number to
                                          communicate with to the local station
130 TBL%(1)=516                         : 'Specifies to read random devices of the
                                          Q/QnA series PLC CPU
140 TBL%(2)=&H101                       : 'Reads one bit device point or one word
                                          device point
150 TBL%(3)=&H1                         : 'Reads one double-word device point
160 TBL%(4)=0                           : 'Fixed value
170 TBL%(5)=168                         : 'Specifies data registers (D)
180 D!=0                                : 'Specifies device number 0
190 GOSUB 400
200 TBL%(6)=L%                          : 'Stores the lower digit of the device number
210 TBL%(7)=H%                          : 'Stores the higher digit of the device
                                          number
220 TBL%(8)=0                           : 'Specifies word units as processing unit
230 TBL%(9)=0                           : 'Fixed value
240 TBL%(10)=144                        : 'Specifies internal relays (M)
250 D!=0                                : 'Specifies device number 0
260 GOSUB 400
270 TBL%(11)=L%                         : 'Stores the lower digit of the device number
280 TBL%(12)=H%                         : 'Stores the higher digit of the device
                                          number
290 TBL%(13)=0                          : 'Specifies bit units as processing unit
300 TBL%(14)=0                          : 'Fixed value
310 TBL%(15)=168                        : 'Specifies data registers (D)
320 D!=8000                             : "Specifies device number 8000
330 GOSUB 400
340 TBL%(16)=L%                         : 'Stores the lower digit of the device number
350 TBL%(17)=H%                         : 'Stores the higher digit of the device
                                          number
360 TBL%(18)=0                          : 'Specifies double-word units as processing
                                          unit
370 TBL%(19)=0                          : 'Fixed value
380 PCRD TBL%(),A%()                    : 'Executes the read operation
390 END
```


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```
400 H!=INT(D!/65536!)                    :  'Splits into lower and higher digits
410 L!=D!-H!*65536!
420 H$=RIGHT$("0000"+HEX$(H!),4)
430 L$=RIGHT$("0000"+HEX$(L!),4)
440 L%=VAL("&H"+L$)
450 H%=VAL("&H"+H$)
460 RETURN
```


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(2) Program example for a format 2 control table

```
100 'A program example that reads the device memory of the Q/QnA series PLC CPU
110 DIM TBL%(20),A%(10)                 : 'Defines the arrays
120 TBL%(0)=256                         : 'Specifies a format 2 control table
130 TBL%(1)=1                           : 'Specifies network number 1
140 TBL%(2)=1                           : 'Specifies station number 1
150 TBL%(4)=516                         : 'Specifies to read random devices of the
                                          Q/QnA series PLC CPU
160 TBL%(5)=&H101                       : 'Reads one bit device point or one word
                                          device point
170 TBL%(6)=&H1                         : 'Reads one double-word device point
180 TBL%(7)=0                           : 'Fixed value
190 TBL%(8)=168                         : 'Specifies data registers (D)
200 D!=0                                : 'Specifies device number 0
210 GOSUB 420
220 TBL%(9)=L%                          : 'Stores the lower digit of the device number
230 TBL%(10)=H%                         : 'Stores the higher digit of the device
                                          number
240 TBL%(11)=0                          : 'Specifies word units as processing unit
250 TBL%(12)=0                          : 'Fixed value
260 TBL%(13)=144                        : 'Specifies internal relays (M)
270 D!=0                                : 'Specifies device number 0
280 GOSUB 420
290 TBL%(14)=L%                         : 'Stores the lower digit of the device number
300 TBL%(15)=H%                         : 'Stores the higher digit of the device
                                          number
310 TBL%(16)=0                          : 'Specifies bit units as processing unit
320 TBL%(17)=0                          : 'Fixed value
330 TBL%(18)=168                        : 'Specifies data registers (D)
340 D!=8000                             : "Specifies device number 8000
350 GOSUB 420
360 TBL%(19)=L%                         : 'Stores the lower digit of the device number
370 TBL%(20)=H%                         : 'Stores the higher digit of the device
                                          number
380 TBL%(21)=0                          : 'Specifies double-word units as processing
                                          unit
390 TBL%(22)=0                          : 'Fixed value
```


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```
400 PCRD TBL%(),A%()                    :  'Executes the read operation
410 END
420 H!=INT(D!/65536!)                   :  'Splits into lower and higher digits
430 L!=D!-H!*65536!
440 H$=RIGHT$("0000"+HEX$(H!),4)
450 L$=RIGHT$("0000"+HEX$(L!),4)
460 L%=VAL("&H"+L$)
470 H%=VAL("&H"+H$)
480 RETURN
```


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(3) Program example for a format 3 control table

```
100 'A program example that reads the device memory of the Q/QnA series PLC CPU
110 DIM TBL%(20),A%(10)                 : 'Defines the arrays
120 TBL%(0)=256                         : 'Specifies a format 2 control table
130 TBL%(1)=1                           : 'Specifies network number 1
140 TBL%(2)=1                           : 'Specifies station number 1
150 TBL%(4)=516                         : 'Specifies to read random devices of a
                                          Q/QnA series PLC CPU
160 TBL%(5)=&H3E3                       : 'Specifies the requested CPU (PLC No.4)
170 TBL%(6)=&H101                       : 'Reads one bit device point or one word
                                          device point
180 TBL%(7)=&H1                         : 'Reads one double-word device point
190 TBL%(8)=0                           : 'Fixed value
200 TBL%(9)=168                         : 'Specifies data registers (D)
210 D!=0                                : 'Specifies device number 0
220 GOSUB 430
230 TBL%(10)=L%                         : 'Stores the lower digit of the device number
240 TBL%(11)=H%                         : 'Stores the higher digit of the device
                                          number
250 TBL%(12)=0                          : 'Specifies word units as processing unit
260 TBL%(13)=0                          : 'Fixed value
270 TBL%(14)=144                        : 'Specifies internal relays (M)
280 D!=0                                : 'Specifies device number 0
290 GOSUB 430
300 TBL%(15)=L%                         : 'Stores the lower digit of the device number
310 TBL%(16)=H%                         : 'Stores the higher digit of the device
                                          number
320 TBL%(17)=0                          : 'Specifies bit units as processing unit
330 TBL%(18)=0                          : 'Fixed value
340 TBL%(19)=168                        : 'Specifies data registers (D)
350 D!=8000                             : "Specifies device number 8000
360 GOSUB 430
370 TBL%(20)=L%                         : 'Stores the lower digit of the device number
380 TBL%(21)=H%                         : 'Stores the higher digit of the device
                                          number
390 TBL%(22)=0                          : 'Specifies double-word units as processing
                                          unit
```


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```
400 TBL%(23)=0                          :  'Fixed value
410 PCRD TBL%(),A%()                    :  'Executes the read operation
420 END
430 H!=INT(D!/65536!)                   :  'Splits into lower and higher digits
440 L!=D!-H!*65536!
450 H$=RIGHT$("0000"+HEX$(H!),4)
460 L$=RIGHT$("0000"+HEX$(L!),4)
470 L%=VAL("&H"+L$)
480 H%=VAL("&H"+H$)
490 RETURN
```


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Processing Code 533

Reading the buffer memory of the intelligent function module/special function module of the Q/QnA series PLC CPU

Only applicable to QD51 (-R24)

Control table format definition

Element position			Item		Description
Format 1	Format 2	Format 3			
□%(0)			Station number		Specify the station number of the PLC.
	□%(0)	□%(0)	Control table		Specify a control table of format 2.
	□%(1)	□%(1)	Network number		Specify the network number.
	□%(2)	□%(2)	Station number		Specify the station number of the PLC.
	□%(3)	□%(3)	Detailed error code		Detailed error codes are stored here.
		□%(4)	Requested CPU		Specify the requested CPU.
□%(1)	□%(4)	□%(5)	Processing code		Specify the processing code.
□%(2)	□%(5)	□%(6)	Starting I/O number		Specify the starting I/O number of the intelligent function module/special function module.
□%(3)	□%(6)	□%(7)	Buffer memory starting address	Lower	Specify the starting I/O address of the intelligent function module's/special function module's buffer memory.
□%(4)	□%(7)	□%(8)		Higher	
□%(5)	□%(8)	□%(9)	Number of points		Specify the number of points to be read.

- It is possible to read the buffer memory data of the intelligent function module/special function module from the Q/QnA series PLC CPU using this code.
- Specify the following data for <control table>.

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Format 1 control table

□%(0)	• • • • • •	Specify the station number of the PLC CPU from which data is to be read. See Section 4.2.2 for the allowable specification range.
□%(1)	• • • • • •	Processing code • Specify 533 (&H215).
□%(2)	• • • • • •	Specify the starting I/O number of the intelligent function module/special function module whose buffer memory data is to be read.
□%(3)	• • • • • •	Specify the buffer memory address (lower digit) whose data is to be read.
□%(4)	• • • • • •	Specify the buffer memory address (higher digit) whose data is to be read.
□%(5)	• • • • • •	Specify the number of bytes of data to be read, including the specified intelligent function module's/special function module's buffer memory addresses. The allowable specification range is as follows: • Q series CPU 1 to 1920 bytes • QnA series CPU 1 to 960 bytes

Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256 (&H100).
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU from which buffer memory is to be read. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 533 (&H215).
□%(5)	• • • • • •	Specify the starting I/O number of the intelligent function module/special function module whose buffer memory data is to be read.
□%(6)	• • • • • •	Specify the buffer memory address (lower digit) whose data is to be read.
□%(7)	• • • • • •	Specify the buffer memory address (higher digit) whose data is to be read.
□%(8)	• • • • • •	Specify the number of bytes of data to be read, including the specified intelligent function module's/special function module's buffer memory addresses. The allowable specification range is as follows: • Q series CPU 1 to 1920 bytes • QnA series CPU 1 to 960 bytes

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Format 3 control table

□%(0) •••••• Format 3 control table
  • Specify 257 (&H101).

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which buffer memory is to be read.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
  • Specify 533 (&H215).

□%(5) •••••• Specify the requested CPU.
  • PLC No.1 •••••• 992 (&H3E0)
  • PLC No.2 •••••• 993 (&H3E1)
  • PLC No.3 •••••• 994 (&H3E2)
  • PLC No.4 •••••• 995 (&H3E3)
  • Control PLC •••••• 1023 (&H3FF)

□%(6) •••••• Specify the starting I/O number of the intelligent function module/special function module whose buffer memory data is to be read.

□%(7) •••••• Specify the buffer memory address (lower digit) whose data is to be read.

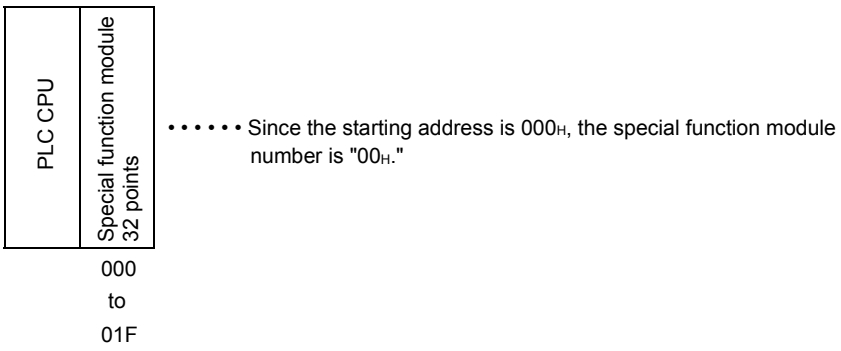
□%(8) •••••• Specify the buffer memory address (higher digit) whose data is to be read.

□%(9) •••••• Specify the number of bytes of data to be read, including the specified intelligent function module's/special function module's buffer memory addresses.
The allowable specification range is as follows:
  • Q series CPU 1 to 1920 bytes
  • QnA series CPU 1 to 960 bytes

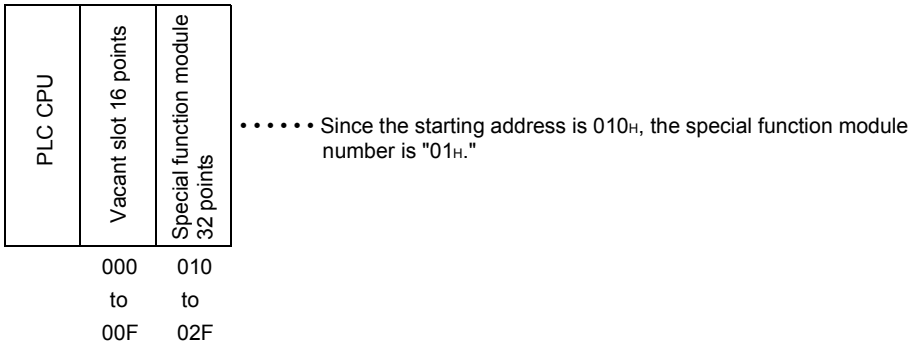
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• The starting I/O number (hexadecimal) of the intelligent function module/special function module is the two higher digits of the 3-digit expression of the starting address of the intelligent function module's/special function module's I/O addresses seen from the Q/QnA PLC CPU.

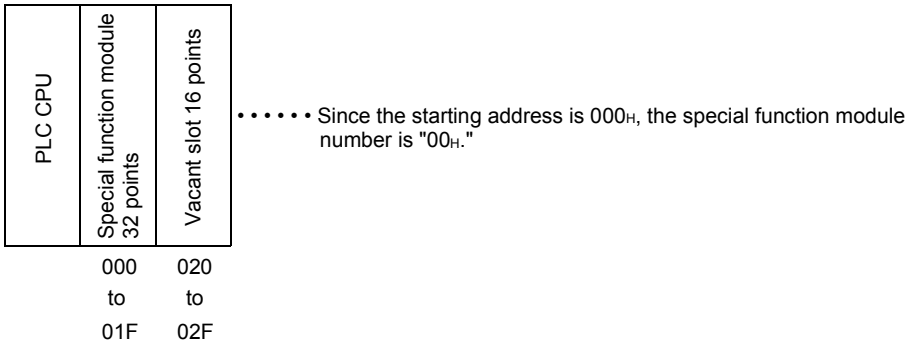
(a) In case of a single-slot module



(b) In case of a module where the first half slot is allocated as a vacant slot (e.g., AD72, A84AD)



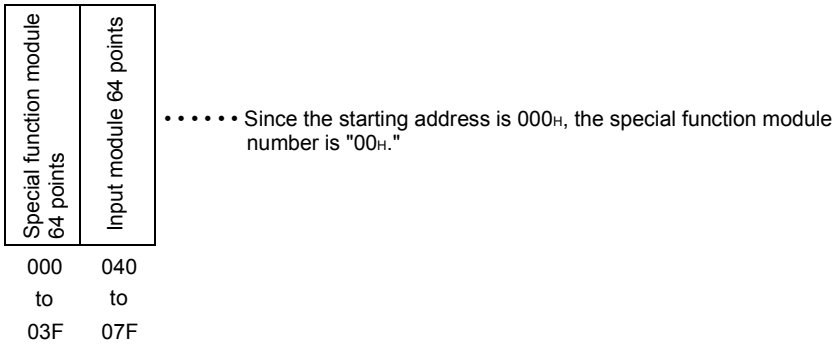
(c) In case of a module where the second half slot is allocated as a vacant slot (e.g., A61LS)



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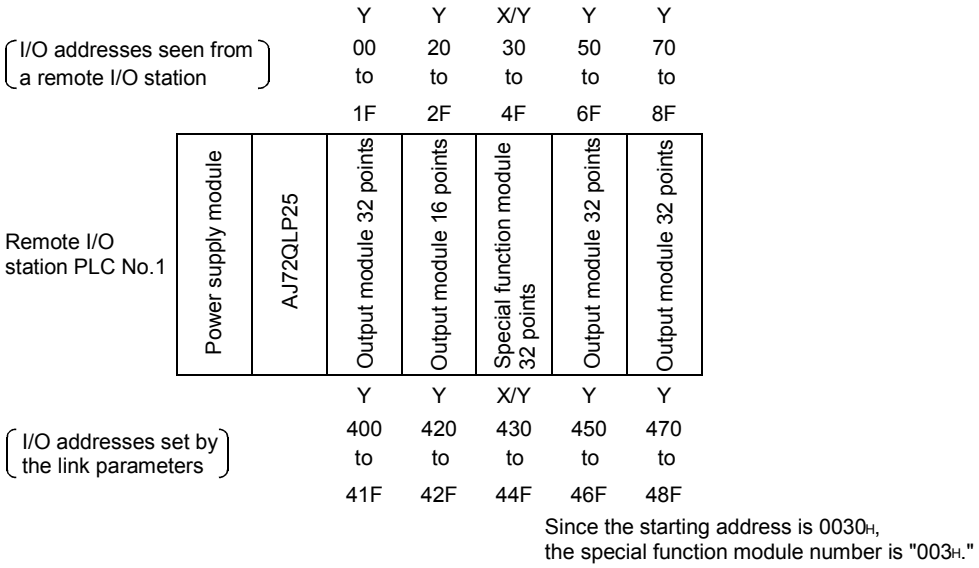
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(d) In case of a module where both an intelligent function module and an input/output module are allocated (e.g., A81CPU)



(e) Module number of the intelligent function module/special function module of a MELSECNET/10 remote I/O station

The starting I/O module number of the intelligent function module/special function module of a MELSECNET/10 remote I/O station is always the three higher digits of the
4-digit expression of the head number of "the I/O signals seen from a remote I/O station."
Specify the module number using the head "I/O signal seen from a remote I/O station" regardless of the settings of the common parameters set in the master station of the MELSECNET/10 remote I/O net.



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• The intelligent function module's/special function module's buffer memory contains 16 bits (one word) per one address and reading/writing operations between the PLC CPU and intelligent function module/special function module are performed with the FROM/TO instructions.
When reading/writing from the intelligent function module's/special function module's buffer memory to the QD51 (-R24) or vice versa, the operation is performed in units of 8 bits (one byte) per one address.

The addresses (hexadecimal) to specify in the QD51 (-R24) are obtained by the following conversion from addresses for the FROM/TO instructions.

Specified address (hexadecimal) = convert {(address for the FROM/TO instruction × 2)} into a hexadecimal number and add (the starting address of each module)

Example : When specifying address 1 of the FROM/TO instructions (the preset value of CH.1) of the type AD61 high-speed counter module.

$$\left(\begin{array}{c}\text{Specified}\\ \text{address } 82_H\end{array}\right) = \left(\begin{array}{c}\text{FROM/TO instruction}\\ \text{address } 0 \times 2,\ 1_H \times 2\end{array}\right) + \left(\begin{array}{c}\text{starting}\\ \text{address } 80_H\end{array}\right)$$

See Appendix 8 for the starting address of each intelligent function module/special function module.

• Assign values to □%(3) and □%(4) (□%(6) and □%(7) in case of a format 2 control table, □%(7) and □%(8) in case of a format 3 control table) in the following manner.

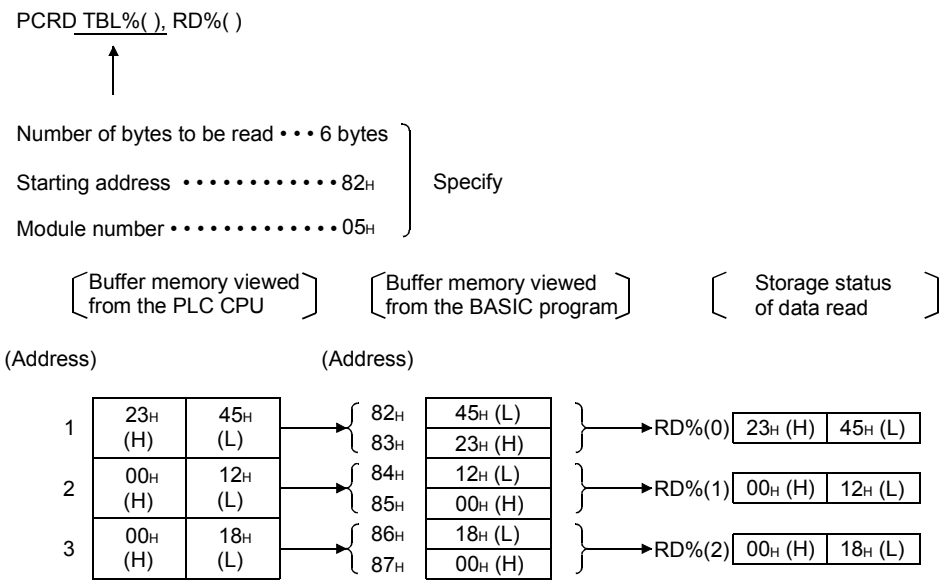
```
D!    ••••  The specified address calculated using the formula above
H!
L!    ••••  Used as work area.
H$
L$
 to
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$(H!),4)
130 L$=RIGHT$("0000"+HEX$(L!),4)          In case of a format 2 control table
140 □%(3)=VAL("&H"+L$)     ••••           □%(6)=VAL("&H"+L$)
150 □%(4)=VAL("&H"+H$)     ••••           □%(7)=VAL("&H"+H$)
 to
```


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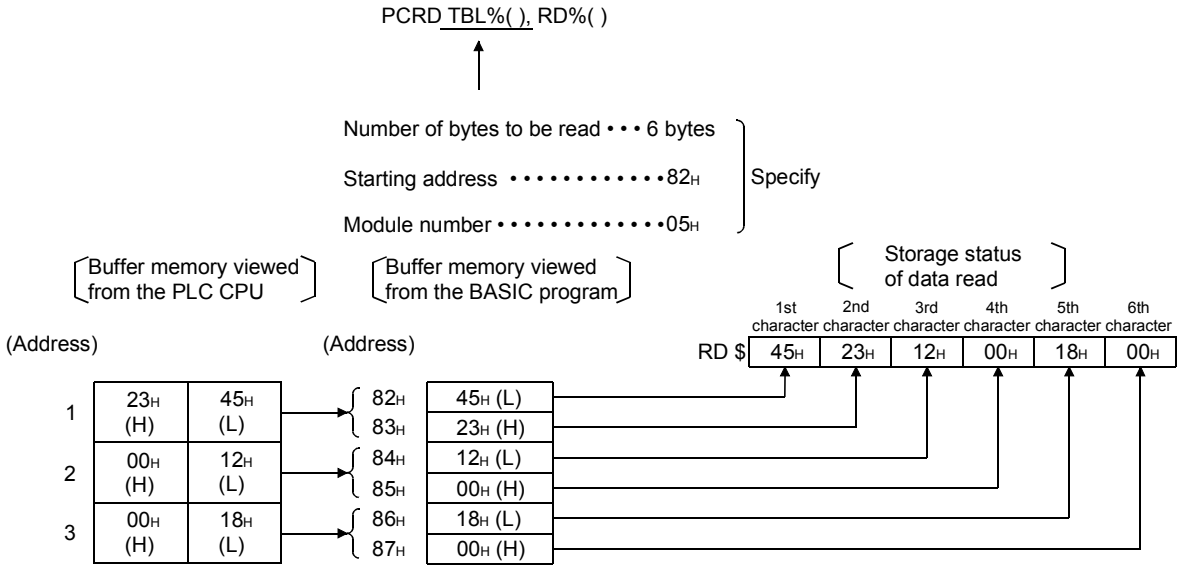
• Data is stored in <storage area for data read> as follows:

Example : When reading data in buffer memory addresses 1 to 3 from an AD61 module whose I/O addresses are X/Y40 to X/Y5F.

1) If an integer variable or array variable is specified for an input element, data is stored as follows:



2) If a character variable name or character array variable name is specified for an input element:



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Program Example

(1) Program example for a format 1 control table

```
100 'A program example that reads buffer memory 1 of the intelligent function module (Q68AD)
110 '(Starting address of Q68AD: &H80)
120 DIM TBL%(10),A%(20)                    : 'Defines the arrays
130 TBL%(0)=255                            : 'Specifies the station number to
                                             communicate with to the local station
140 TBL%(1)=533                            : 'Specifies to read buffer memory
150 TBL%(2)=&H9                            : 'Specifies the starting I/O number
160 D!=&H94                                : 'Specifies the buffer memory address
170 H!=INT(D!/65536!)                      : 'Splits into lower and higher digits
180 L!=D!-H!*65536!
190 H$=RIGHT$("0000"+HEX$(H!),4)
200 L$=RIGHT$("0000"+HEX$(L!),4)
210 TBL%(3)=VAL("&H"+L$)                   : 'Stores the lower digit of the buffer memory
                                             address
220 TBL%(4)=VAL("&H"+H$)                   : 'Stores the higher digit of the buffer
                                             memory address
230 TBL%(5)=2                              : 'Specifies the number of points to be read
240 PCRD TBL%(),A%()                       : 'Executes the read operation
250 PRINT "Digital output of CH1=";A%(0)   : 'Displays the result
260 END
```


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(2) Program example for a format 2 control table

```
100 'A program example that reads buffer memory 1 of the intelligent function module (Q68AD)
110 '(Starting address of Q68AD: &H80)
120 DIM TBL%(20),A%(10)                    :  'Define arrays
130 TBL%(0)=256                            :  'Specifies a format 2 control table
140 TBL%(1)=1                              :  'Specifies network number 1
150 TBL%(2)=1                              :  'Specifies station number 1
160 TBL%(4)=533                            :  'Specifies to read buffer memory
170 TBL%(5)=&H9                            :  'Specifies the starting I/O number
180 D!=&H94                                :  'Specifies the buffer memory address
190 H!=INT(D!/65536!)                      :  'Splits into lower and higher digits
200 L!=D!-H!*65536!
210 H$=RIGHT$("0000"+HEX$(H!),4)
220 L$=RIGHT$("0000"+HEX$(L!),4)
230 TBL%(6)=VAL("&H"+L$)                   :  'Stores the lower digit of the buffer memory
                                              address
240 TBL%(7)=VAL("&H"+H$)                   :  'Stores the higher digit of the buffer
                                              memory address
250 TBL%(8)=2                              :  'Specifies the number of points to be read
260 PCRD TBL%(),A%()                       :  'Executes the read operation
270 PRINT "Digital output of CH1=";A%(0)   :  'Displays the result
280 END
```


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(3) Program example for a format 3 control table

```
100 'A program example that reads buffer memory 1 of the intelligent function module (Q68AD)
110 '(Starting address of Q68AD: &H80)
120 DIM TBL%(20),A%(10)                    :  'Defines the arrays
130 TBL%(0)=256                            :  'Specifies a format 2 control table
140 TBL%(1)=1                              :  'Specifies network number 1
150 TBL%(2)=1                              :  'Specifies station number 1
160 TBL%(4)=533                            :  'Specifies to read buffer memory
170 TBL%(5)=&H3E3                          :  'Specifies the requested CPU
180 TBL%(6)=&H9                            :  'Specifies the starting I/O number
190 D!=&H94                                :  'Specifies the buffer memory address
200 H!=INT(D!/65536!)                      :  'Splits into lower and higher digits
210 L!=D!-H!*65536!
220 H$=RIGHT$("0000"+HEX$(H!),4)
230 L$=RIGHT$("0000"+HEX$(L!),4)
240 TBL%(7)=VAL("&H"+L$)                   :  'Stores the lower digit of the buffer memory
                                              address
250 TBL%(8)=VAL("&H"+H$)                   :  'Stores the higher digit of the buffer
                                              memory address
260 TBL%(9)=2                              :  'Specifies the number of points to be read
270 PCRD TBL%(),A%()                       :  'Executes the read operation
280 PRINT "Digital output of CH1=";A%(0)   :  'Displays the result
290 END
```


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PCWT Instruction — PC WriTe

- This instruction is used to write various data to the PLC CPU.
- This instruction is used to operate the PLC CPU.

Syntax

PCWT△<control table>, <storage area for data to be written>

Control table	••••	Specify the type of data written to the PLC CPU.
Storage area for data to be written	••••	Specify the variable in which data to be written to the PLC CPU is stored.

Examples

PCWT A%( ), B%( )	••••	Writes data stored in the integer array B% to the PLC CPU with the type of data specified by the integer array A%.

Description

- The PCWT instruction reads various data to the PLC CPU and operates the PLC CPU.
- The processing to be performed is specified by the processing code in the control table. The following processing can be performed.

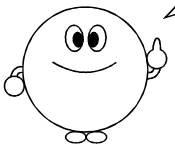
Processing code	Description of the processing	A series	QnA series	Q series
1 (&H1)	Writing to device memory	○	△＊1	△＊1
2 (&H2)	Monitor registration of device memory	○	×	×
3 (&H3)	Random writing to device memory	○	×	×
5 (&H5)	Monitor registration of extension file registers	○	×	×
6 (&H6)	Random writing to extension file registers	○	×	×
7 (&H7)	Writing data to extension file registers by specifying sequential addresses	○＊2	×	×
8 (&H8)	Writing a sequence program	○＊3	×	×
9 (&H9)	Writing a microcomputer program	○＊3	×	×
10 (&HA)	Writing comment data	○	×	×
11 (&HB)	Writing extension comment data	○	×	×
12 (&HC)	Writing to the special function module's buffer memory	○	×	×
14 (&HE)	Writing parameter data	○＊3	×	×
15 (&HF)	Analyzing parameter data	○＊3	×	×
16 (&H10)	Remote STOP of the PLC CPU	○	○	○
17 (&H11)	Remote RUN of the PLC CPU	○	○	○
20 (&H14)	Interrupting the PLC CPU	×	×	○＊4
515 (&H203)	Writing data to the device memory of the Q/QnA series PLC CPU	×	○	○
516 (&H204)	Random data writing to the device memory of the Q/QnA series PLC CPU	×	○	○
533 (&H215)	Writing to the buffer memory of the intelligent function module/special function module of the Q/QnA series PLC CPU	×	○	○

＊1 Possible only within the device range of AnA/AnU/AnUSCPU. (File register R cannot be read.)
＊2 Available only for AnA/AnU/AnUSCPU.
＊3 Cannot be executed while the PLC CPU is running.
＊4 Available only for the local station.

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• <Storage area for data to be written> is a variable or device range that stores the data to be written to the PLC CPU. Specify an integer variable, integer array name, character variable, character array variable, extension registers ED, or extension relays EM.
Each of them is specified in the following manner.

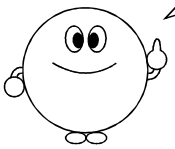
Integer variable	□%	
Character variable	□$	
Integer array name	□% ( )	
Character array variable	□$ (n)	
ED	W@ (ED,n)	Expressed by special variables.
EM	B@ (EM,n)	



An array used as <storage area for data to be written> must always be defined using the DIM instruction, even if the number of elements used is 10 or less.
An error occurs if the PCWT instruction is executed without defining the array.
(Usually, an array with 10 or fewer elements can be used without defining it with the DIM instruction.)

• See Section 4.2.6 for how to store data written.
• Some of the processing that can be performed by the PCWT instruction is not possible to execute if the relevant PLC CPU is running. The following message is shown in the descriptions below if the processing cannot be executed while the PLC CPU is running:

Processing Disabled while Running



Be sure to reset the AD51H once if the type of the PLC CPU in the data link system that is being accessed from the AD51H is changed.
Incorrect data may be written if it is attempted to access the PLC CPU without resetting it.

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Processing Code 1

Writing to device memory

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	• • • • • • •	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Processing unit	Specify the processing unit of the device.
□%(3)	□%(6)	Device code	Specify the device code.
□%(4)	□%(7)	Device number	Specify the device number.
□%(5)	□%(8)	Number of points	Specify the number of points to be written.

• It is possible to write data to device memory other than extension file registers of the PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) • • • • • • Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) • • • • • • Processing code
• Specify 1.

□%(2) • • • • • • Specify the device processing unit.
• When reading in bit units • • • • • 1
• When reading in word units • • • 2

□%(3) • • • • • • Specify the device using the defined code.
See Section 4.2.5 for the code numbers.

□%(4) • • • • • • Specify the device number of the device specified in □%(3).
See Section 4.2.5 for the allowable specification range.
Note, however, that values other than 0 or multiples of 16 cannot be specified for device numbers when writing to bit devices in word units.

□%(5) • • • • • • Specify the number of device points to be written, including the device specified in □%(3) and □%(4).
The allowable specification range is as follows:
• When bit units are specified
• Bit devices 1 to 256 points

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• When word units are specified
  • Bit devices 1 to 32 words
  • Word devices 1 to 64 points

Format 2 control table

□%(0) • • • • • • Format 2 control table
  • Specify 256.

□%(1) • • • • • • Specify the number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) • • • • • • Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(3) • • • • • • Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) • • • • • • Processing code
  • Specify 1.

□%(5) • • • • • • Specify the device processing unit.
  • When reading in bit units • • • • • 1
  • When reading in word units • • • 2

□%(6) • • • • • • Specify the device using the defined code.
See Section 4.2.5 for the code numbers.

□%(7) • • • • • • Specify the device number of the device specified in □%(4).
See Section 4.2.5 for the allowable specification range.
Note, however, that values other than 0 or multiples of 16 cannot be specified for device numbers when writing to bit devices in word units.

□%(8) • • • • • • Specify the number of device points to be written, including the device specified in □%(6) and □%(7).
The allowable specification range is as follows:
  • When bit units are specified
    • Bit devices 1 to 256 points
  • When word units are specified
    • Bit devices 1 to 32 words
    • Word devices 1 to 64 points

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• The following processing is performed if file registers are specified as the device memory to be written to:
(1) If the file registers have never been changed in the PLC CPU, data is written to the file registers of block number 0.
(2) If the block number of the file registers has been changed in the PLC CPU, data is written to the file registers of the new block number.
1) When the block number has been changed using the RSET instruction of the microcomputer program package of the type SW□GHP-UTLPC-FN1 utility software package or the type SW□SRX-FNUP software package.
2) When the block number has been changed using the RSET instruction.

Processing cannot be performed normally with processing code 1 if the block number of the file registers has been changed to 29 or greater using the RSET instruction. In this case, use processing code 4 (writing to extension file registers) instead.

Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes data to device memory of the PLC CPU
110 DIM TBL%(10),A%(20)                 :  'Defines arrays
120 TBL%(0)=255                         :  'Specifies the station number to
                                           communicate with to the local station
130 TBL%(1)=1                           :  'Specifies to write to device memory
140 TBL%(2)=2                           :  'Specifies word units
150 TBL%(3)=3                           :  'Specifies internal relays M
160 TBL%(4)=0                           :  'Specifies the device number
170 TBL%(5)=1                           :  'Specifies the number of words to be
                                           written
180 A%(0)=&H5                           :  'Turns M1 and M3 ON and all others OFF
190 PCWT TBL%( ),A%( )                  :  'Executes the write operation
200 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that writes data to device memory of the PLC CPU
110 DIM TBL%(10),A%(20)                 :  'Defines arrays
120 TBL%(0)=256                         :  'Specifies a format 2 control table
130 TBL%(1)=1                           :  'Specifies network number 1
140 TBL%(2)=1                           :  'Specifies station number 1
130 TBL%(4)=1                           :  'Specifies to write to device memory
140 TBL%(5)=2                           :  'Specifies word units
150 TBL%(6)=3                           :  'Specifies internal relays M
160 TBL%(7)=0                           :  'Specifies the device number
170 TBL%(8)=1                           :  'Specifies the number of words points to be
                                           written
180 A%(0)=&H5                           :  'Turns M1 and M3 ON and all others OFF
190 PCWT TBL%( ),A%( )                  :  'Executes the write operation
200 END
```


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Processing Code 2

Monitor registration of device memory

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Processing unit	Specify the processing unit of the device.
□%(3)	□%(6)	Number of points	Specify the number of points to be monitored.

• This code is used to perform monitor registration of device memory of the PLC CPU, except extension file registers.
• By performing monitor registration, it becomes easy to monitor devices nonsequentially using the PCRD instruction.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU whose device memory will be registered to be monitored.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 2.

□%(2) •••••• Specify whether the monitoring of the device is to be performed in word or bit units.
• When reading in bit units ••••• 1
• When reading in word units ••• 2

□%(3) •••••• Specify the number of device points to be monitored. The allowable specification ranges for the number of points are as follows:
• When bit units are specified
• Bit devices 1 to 40 points
• When word units are specified
• Bit devices 1 to 20 words (16 to 320 points, in units of 16 points)
• Word devices 1 to 20 words

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Format 2 control table

□%(0) • • • • • • Format 2 control table
• Specify 256.

□%(1) • • • • • • Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) • • • • • • Specify the station number of the PLC CPU from which data is read.
See Section 4.2.2 for the allowable specification range.

□%(3) • • • • • • Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) • • • • • • Processing code
• Specify 2.

□%(5) • • • • • • Specify whether the monitoring of the device is to be performed in word or bit units.
• When reading in bit units • • • • • 1
• When reading in word units • • • 2

□%(6) • • • • • • Specify the number of device points to be monitored. The allowable specification ranges for the number of points are as follows:
• When bit units are specified
• Bit devices 1 to 40 points
• When word units are specified
• Bit devices 1 to 20 words (16 to 320 points, in units of 16 points)
• Word devices 1 to 20 words

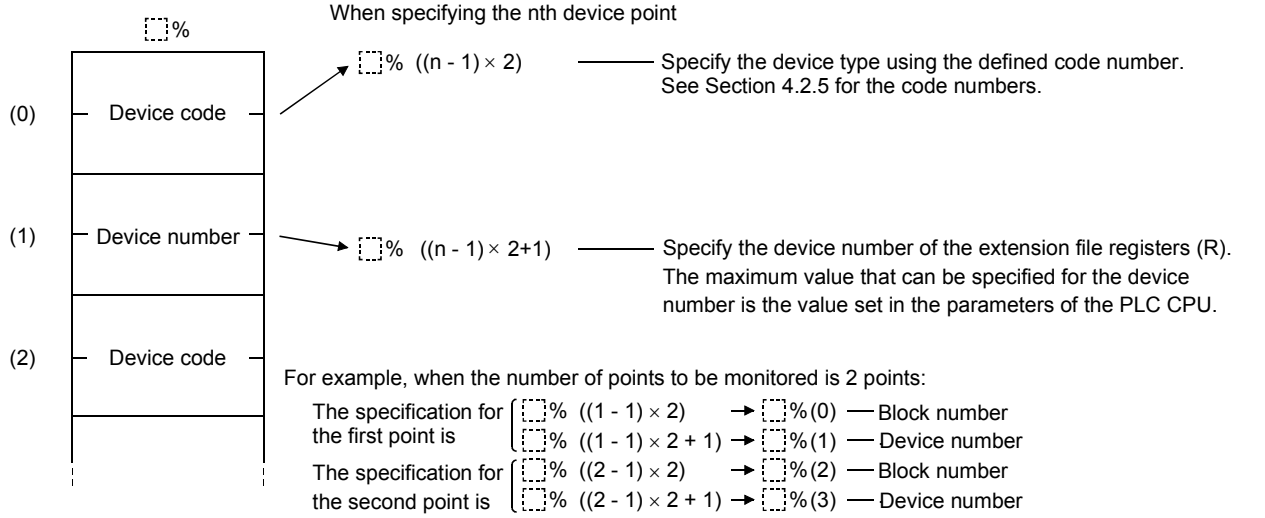
In case of PLC CPUs other than A3HCPU, AnACPU, AnUCPU, and AnSUCPU, one point of device X (input) is processed as 2 points.
When X is included among the specified devices, specify the number of points as follows:

$$\left[\text{Specified number of points for X} \times 2 + \text{specified number of points for other devices}\right] \leqq 40 \text{ points}$$

If only X is specified, the number of processing points that can be communicated at one time is half of the values given above.

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• Specify extension devices to be monitored using integer arrays for the number of points monitored in <storage area for data to be written>.



• The following processing is performed if file registers are specified as the device memory to be monitored:

(1) If the file registers have never been changed in the PLC CPU, data is written to the file registers of block number 0.

(2) If the block number of the file registers has been changed in the PLC CPU, data is written to the file registers of the new block number.

1) When the block number has been changed using the RSET instruction of the microcomputer program package of the type SW□GHP-UTLPC-FN1 utility software package or the type SW□SRX-FNUP software package

2) When the block number has been changed with the RSET instruction

Processing cannot be performed normally with processing code 2 if the block number of the file registers has been changed to 29 or greater using the RSET instruction. In this case, use processing code 5 (monitor registration of extension file registers) instead.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that reads device memory registered to be monitored by the PCWT
      instruction
110 DIM TBL1%(10),A%(20),TBL2%(10),B%(20)      :  'Defines arrays
120 A%(0)=1:A%(1)=0                            :  'Registers X000 to X015 to be monitored
130 A%(2)=2:A%(3)=16                           :  'Registers Y016 to Y031 to be monitored
140 A%(4)=3:A%(5)=96                           :  'Registers M096 to M113 to be monitored
150 A%(6)=7:A%(7)=0                            :  'Registers T000 (contact) to be monitored
160 A%(8)=18:A%(9)=48                          :  'Registers D048 to be monitored
170 TBL1%(0)=255                               :  'Specifies the station number to
                                                  communicate with to the lacal station
180 TBL1%(1)=2                                 :  'Specifies to monitor registered device
                                                  memory
190 TBL1%(2)=2                                 :  'Specifies word units
200 TBL1%(3)=5                                 :  'Specifies the number of device points to be
                                                  monitored
210 PCWT TBL1%( ),A%( )                        :  'Executes the monitor registration
220 TBL2%(0)=255                               :  'Specifies the station number to
                                                  communicate with to the local station
230 TBL2%(1)=2                                 :  'Specifies to read devices registered to be
                                                  monitored using the PCWT instruction
240 PCRD TBL2%( ),B%( )                        :  'Executes the read operation
250 PRINT "Status of X000 to X015=&H";HEX$(B%(0)):  'Displays the result
260 PRINT "Status of Y016 to Y031=&H";HEX$(B%(1))
270 PRINT "Status of M096 to M113=&H";HEX$(B%(2))
280 PRINT "Status of T000 (contact)=&H";HEX$(B%(3))
290 PRINT "Data in D048=&H";B%(4)
300 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that reads device memory registered to be monitored by the PCWT
    instruction
110 DIM TBL%(10),A%(20),TBL2%(10),B%(20)          :  'Defines arrays
120 A%(0)=1:A% (1)=0                              :  'Registers X000 to X015 to be monitored
130 A%(2)=1:A% (3)=16                             :  'Registers Y016 to Y031 to be monitored
140 A%(4)=3:A% (5)=96                             :  'Registers M096 to M113 to be monitored
150 A%(6)=7:A% (7)=0                              :  'Registers T000 (contact) to be monitored
160 A%(8)=18:A% (9)=48                            :  'Registers D048 to be monitored
170 TBL1%(0)=256                                  :  'Specifies a format 2 control table
180 TBL1%(1)=1                                    :  'Specifies network number 1
190 TBL1%(2)=1                                    :  'Specifies station number 1
200 TBL1%(4)=2                                    :  'Specifies to monitor registered device
                                                     memory
210 TBL1%(5)=2                                    :  'Specifies word units
220 TBL1%(6)=5                                    :  'Specifies the number of device points to be
                                                     monitored
230 PCWT TBL1%( ),A%( )                           :  'Executes the monitor registration
240 TBL2%(0)=256                                  :  'Specifies a format 2 control table
250 TBL2%(1)=1                                    :  'Specifies network number 1
260 TBL2%(2)=1                                    :  'Specifies station number
270 TBL2%(4)=2                                    :  'Specifies to read devices registered to be
                                                     monitored by the PCWT instruction
280 PCRD TBL2%( ),B%( )                           :  'Executes the read operation
290 PRINT "Status of X000 to X015=&H";HEX$(B%(0)) :'Displays the result
300 PRINT "Status of Y016 to Y031=&H";HEX$(B%(1))
310 PRINT "Status of M096 to M113=&H";HEX$(B%(2))
320 PRINT "Status of T000 (contact)=&H";HEX$(B%(3))
330 PRINT "Data in D048=";B%(4)
340 END
```


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Processing Code 3

Random writing to device memory

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Processing unit	Specify the processing unit of the device.
□%(3)	□%(6)	Number of points	Specify the number of points to be written.

• It is possible to write data nonsequentially to the PLC CPU's device memory, except extension file registers, using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 3.

□%(2) •••••• Specify the device processing unit.
• When writing in bit units ••••• 1
• When writing in word units ••• 2

□%(3) •••••• Specify the number of device points to be written. The allowable specification ranges for the number of points are as follows:
• When bit units are specified
• Bit devices 1 to 20 points
• When word units are specified
• Bit devices 1 to 10 words (16 to 160 points, in units of 16 points)
• Word devices 1 to 10 points

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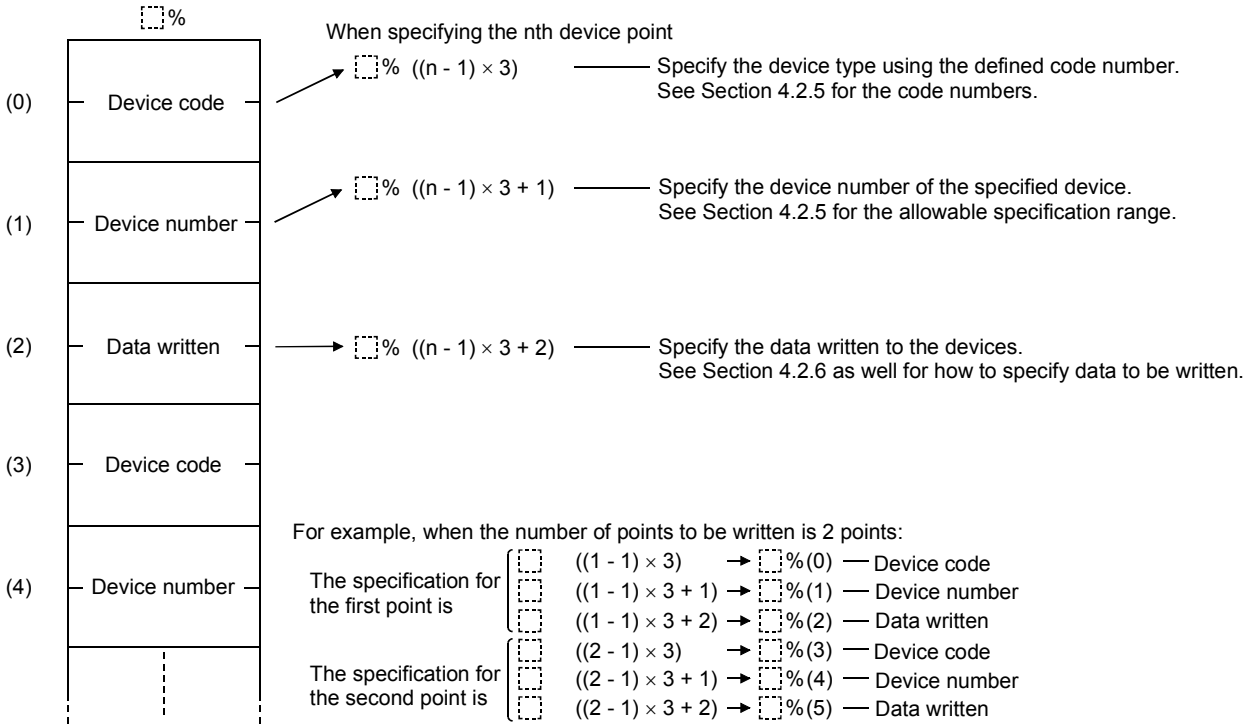
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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 3.
□%(5)	• • • • • •	Specify the device processing unit. • When writing in bit units • • • • • 1 • When writing in word units • • • 2
□%(6)	• • • • • •	Specify the number of device points to be written. The allowable specification ranges for the number of points are as follows: • When bit units are specified • Bit devices 1 to 20 points • When word units are specified • Bit devices 1 to 10 words (16 to 160 points, in units of 16 points) • Word devices 1 to 10 points

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• Specify the devices to which data is to be written along with the data itself using integer arrays for the number of points to be written in <storage area for data to be written>.



• The following processing is performed if file registers are specified as the device memory to which data is to be written:

(1) If the file registers have never been changed in the PLC CPU, data is written to the file registers of block number 0.

(2) If the block number of the file registers has been changed in the PLC CPU, data is written to the file registers of the new block number.

1) When the block number has been changed using the RSET instruction of the microcomputer program package of the type SW□GHP-UTLPC-FN1 utility software package or the type SW□SRX-FNUP software package

2) When the block number has been changed using the RSET instruction

Processing cannot be performed normally with processing code 3 if the block number of the file registers has been changed to 29 or greater using the RSET instruction. In this case, use processing code 6 (random writing to extension file registers) instead.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes data nonsequentially to device memory
110 DIM TBL%(10),A%(20)                 : 'Defines arrays
120 TBL%(0)=255                         : 'Specifies the station number to
                                          communicate with to the local station
130 TBL%(1)=3                           : 'Specifies to write data nonsequentially to
                                          device memory
140 TBL%(2)=1                           : 'Specifies bit units
150 TBL%(3)=5                           : 'Specifies the number of points to be
                                          written
160 A%(0)=3:A%(1)=0:A%(2)=1             : 'Turns M00 ON
170 A%(3)=3:A%(4)=5:A%(5)=1             : 'Turns M05 ON
180 A%(6)=3:A%(7)=10:A%(8)=1            : 'Turns M10 ON
190 A%(9)=2:A%(10)=0:A%(11)=1           : 'Turns Y00 ON
200 A%(12)=2:A%(13)=5:A%(14)=1          : 'Turns Y05 ON
210 PCWT TBL%( ),A%( )                  : 'Executes the write operation
220 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that writes data nonsequentially to device memory
110 DIM TBL%(10),A%(20)                 : 'Defines arrays
120 TBL%(0)=256                         : 'Specifies a format 2 control table
130 TBL%(1)=1                           : 'Specifies network number 1
140 TBL%(2)=1                           : 'Specifies station number 1
150 TBL%(4)=3                           : 'Specifies to write data nonsequentially to
                                          device memory
160 TBL%(5)=1                           : 'Specifies bit units
170 TBL%(6)=5                           : 'Specifies the number of points to be
                                          written
180 A%(0)=3:A%(1)=0:A%(2)=1             : 'Turns M00 ON
190 A%(3)=3:A%(4)=5:A%(5)=1             : 'Turns M05 ON
200 A%(6)=3:A%(7)=10:A%(8)=1            : 'Turns M10 ON
210 A%(9)=2:A%(10)=0:A%(11)=1           : 'Turns Y00 ON
220 A%(12)=2:A%(13)=5:A%(14)=1          : 'Turns Y05 ON
230 PCWT TBL%( ),A%( )                  : 'Executes the write operation
240 END
```


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Processing Code 4

Writing to extension file registers

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Block number	Specify the block number of the extension file registers.
□%(3)	□%(6)	Device number	Specify the device number of the extension file registers.
□%(4)	□%(7)	Number of points	Specify the number of points to be written.

• It is possible to write data to extension file registers (file registers with block number 1 or greater) using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
- Specify 4.

□%(2) •••••• Specify the block number of the extension file registers.
- If 0 is specified for the block number, data is written to the file registers of the PLC CPU.
  (This is the same processing as writing to R□ by writing device memory.)
- If a number greater than 0 is specified for the block number, data is written to the extension file registers.
- The maximum value that can be specified for the block number varies depending on the memory cassette mounted on the PLC CPU.

□%(3) •••••• Specify the device number of the extension file registers.
The maximum value that can be specified for the device number is the value set in the parameters of the PLC CPU.

□%(4) •••••• Specify the number of device points to be written, including the device specified in □%(3).
The allowable specification range is from 1 to 64 points.

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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 4.
□%(5)	• • • • • •	Specify the block number of the extension file registers. • If 0 is specified for the block number, data is written to the file registers of the PLC CPU. (This is the same processing as writing to R□ by writing device memory.) • If a number greater than 0 is specified for the block number, data is written to the extension file registers. • The maximum value that can be specified for the block number varies depending on the memory cassette mounted on the PLC CPU.
□%(6)	• • • • • •	Specify the device number of the extension file registers. The maximum value that can be specified for the device number is the value set in the parameters of the PLC CPU.
□%(7)	• • • • • •	Specify the number of device points to be written, including the device specified in □%(6). The allowable specification range is from 1 to 64 points.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes data to extension file registers
110 DIM TBL%(10),A%(20)              :  'Defines arrays
120 TBL%(0)=255                      :  'Specifies the station number to
                                        communicate with to the local station
130 TBL%(1)=4                        :  'Specifies to write data to extension file
                                        registers
140 TBL%(2)=1                        :  'Specifies the block number of the
                                        extension file registers
150 TBL%(3)=0                        :  'Specifies the device number of the
                                        extension file registers
160 TBL%(4)=1                        :  'Specifies the number of points to be
                                        written
170 A%(0)=1234                       :  'Specifies the data to be written
180 PCWT TBL%( ),A%( )               :  'Executes the write operation
190 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that writes data to extension file registers
110 DIM TBL%(10),A%(20)              :  'Defines arrays
120 TBL%(0)=256                      :  'Specifies a format 2 control table
130 TBL%(1)=1                        :  'Specifies network number 1
140 TBL%(2)=1                        :  'Specifies station number 1
150 TBL%(4)=4                        :  'Specifies to write data to extension file
                                        registers
160 TBL%(5)=1                        :  'Specifies the block number of the
                                        extension file registers
170 TBL%(6)=0                        :  'Specifies the device number of the
                                        extension file registers
180 TBL%(7)=1                        :  'Specifies the number of points to be
                                        written
190 A%(0)=1234                       :  'Specifies the data to be written
200 PCWT TBL%( ),A%( )               :  'Executes the write operation
210 END
```


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Processing Code 5

Monitor registration of extension file registers

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Number of points	Specify the number of points to be monitored.

• This code is used to perform monitor registration of extension file registers of the PLC CPU.
• By performing monitor registration, it becomes easy to monitor extension file registers nonsequentially using the PCRD instruction.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU from which data is read.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 5.

□%(0) •••••• Specify the number of points for the extension file registers to be monitored. The allowable specification for the number of points is from 1 to 20 points.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU from which data is read.
See Section 4.2.2 for the allowable specification range.

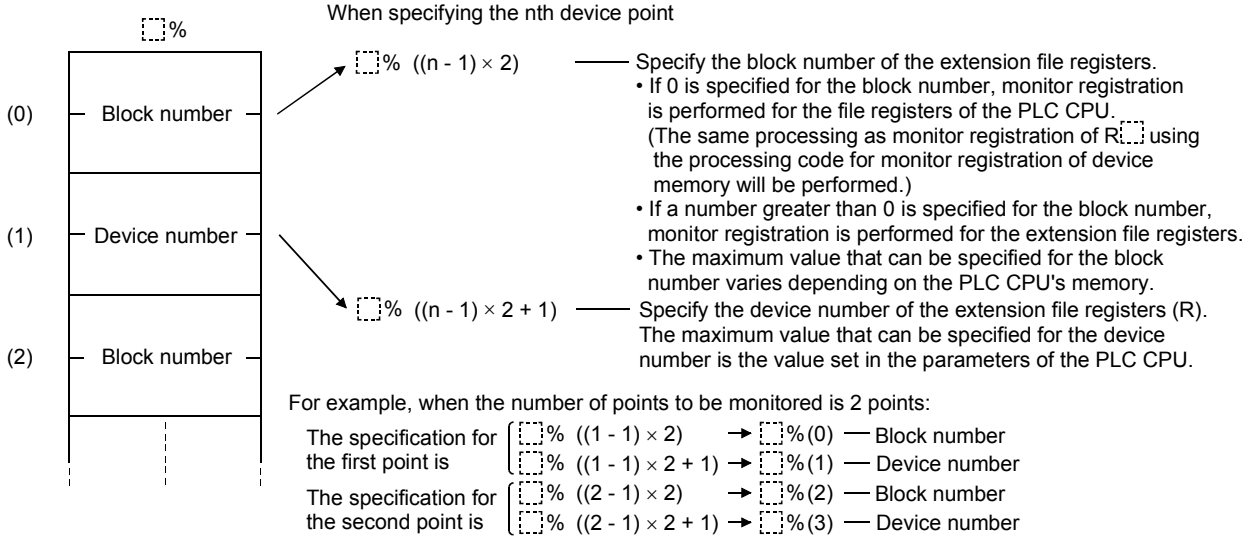
□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 5.

□%(5) •••••• Specify the number of points for the extension file registers to be monitored. The allowable specification range for the number of points is from 1 to 20 points.

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• Specify the extension file registers to be monitored using integer arrays for the number of points to be monitored in <storage area for data to be written>.



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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that monitors extension file registers registered to be monitored by the
      PCWT instruction
110 DINM TBL1%(10),A%(20),TBL2%(10),B%(20)    :  'Defines arrays
120 TBL1%(0)=255                              :  'Specifies the station number to
                                                 communicate with to the local station
130 TBL1%(1)=5                                :  'Specifies to register extension file registers
                                                 to be monitored
140 TBL1%(2)=2                                :  'Specifies the number of points to be
                                                 monitored
150 A%(0)=1:A%(1)=0                           :  'Specifies block number 1 and device
                                                 number 0
160 A%(2)=1:A%(3)=1                           :  'Specifies block number 1 and device
                                                 number 1
170 PCWT TBL1%( ),A%( )                       :  'Executes the monitor registration
180 TBL2%(0)=255                              :  'Specifies the station number to
                                                 communicate with to the local station
190 TBL2%(1)=5                                :  'Specifies to monitor extension file registers
200 PCRD TBL2%( ),B%( )                       :  'Executes the monitoring
210 PRINT"B%(0)=" :B%(0)                      :  Displays the result
220 PRINT"B%(1)=" :B%(1)
230 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that monitors extension file registers registered to be monitored by the
    PCWT instruction
110 DIM TBL1%(10),A%(20),TBL2%(10),B%(20)      :  'Defines arrays
120 TBL1%(0)=256                               :  'Specifies a format 2 control table
130 TBL1%(1)=1                                 :  'Specifies network number 1
140 TBL1%(2)=1                                 :  'Specifies station number 1
150 TBL1%(4)=5                                 :  'Specifies to register extension file registers
                                                  to be monitored
160 TBL1%(5)=2                                 :  'Specifies the number of points to be
                                                  monitored
170 A%(0)=1:A%(1)=0                            :  'Specifies block number 1 and device
                                                  number 0
180 A%(2)=1:A%(3)=1                            :  'Specifies block number 1 and device
                                                  number 1
190 PCWT TBL1%( ),A%( )                        :  'Executes the monitor registration
200 TBL2%(0)=256                               :  'Specifies a format 2 control table
210 TBL2%(1)=1                                 :  'Specifies network number 1
220 TBL2%(2)=1                                 :  'Specifies station number 1
230 TBL2%(4)=5                                 :  'Specifies to register extension file registers
                                                  to be monitored
240 PCRD TBL2%( ),B%( )                        :  'Executes the monitoring
250 PRINT"B%(0)=" :B%(0)                       :  'Displays the result
260 PRINT"B%(1)=" :B%(1)
270 END
```


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Processing Code 6

Random writing to extension file registers

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Number of points	Specify the number of points to be written.

• It is possible to write data nonsequentially to the extension file registers of the PLC CPU using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 6.

□%(2) •••••• Specify the number of points for the extension file registers to which data is written. The allowable specification range for the number of points is 1 to 10 points.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

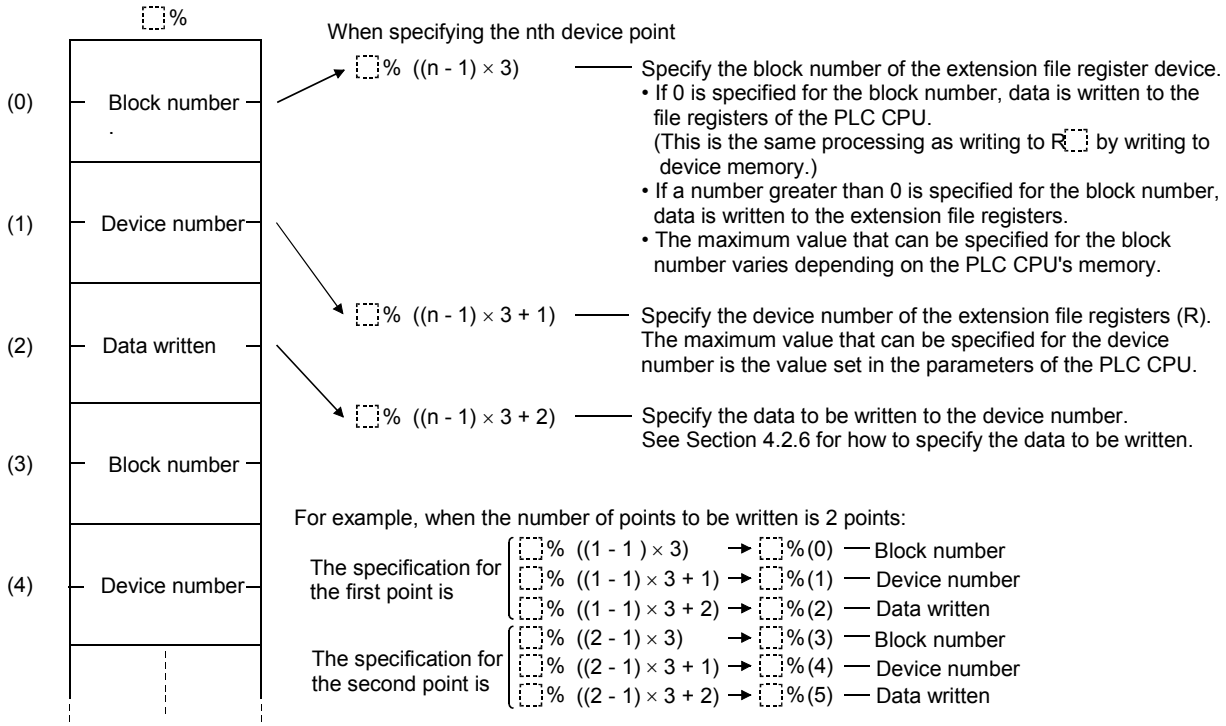
□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 6.

□%(5) •••••• Specify the number of points for the extension file registers to which data is written.
The specification range for the number of points is 1 to 10.

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• Specify the extension file registers to which data is to be written along with the data itself using integer arrays for the number of points to be written in <storage area for data to be written>.



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Program Example

(1) Program example for a format 1 control table

```
100 'A program example that writes data nonsequentially to extension file registers
110 DIM TBL%(10),A%(20)                    :  'Defines arrays
120 TBL%(0)=255                            :  'Specifies the station number to
                                              communicate with to the local station
130 TBL%(1)=6                              :  'Specifies to write data nonsequentially to
                                              extension file registers
140 TBL%(2)=2                              :  'Specifies the number of points to be
                                              written
150 A%(0)=1:A%(1)=0:A%(2)=1234             :  'Specifies the block number and device
                                              number to which data is written, and data
                                              to be written
160 A%(3)=1:A%(4)=1:A%(5)=5678
170 PCWT TBL%( ),A%( )                     :  'Executes the write operation
180 END
```

(2) Program example for a format 2 control table

```
100 'A program example that writes data nonsequentially to extension file registers
110 DIM TBL%(10),A%(20)                    :  'Defines arrays
120 TBL%(0)=256                            :  'Specifies a format 2 control table
130 TBL%(1)=1                              :  'Specifies network number 1
140 TBL%(2)=1                              :  'Specifies station number 1
150 TBL%(4)=6                              :  'Specifies to write data nonsequentially to
                                              extension file registers
160 TBL%(5)=2                              :  'Specifies the number of points to be
                                              written
150 A%(0)=1:A%(1)=0:A%(2)=1234
160 A%(3)=1:A%(4)=1:A%(5)=5678
170 PCWT TBL%( ),A%( )                     :  'Executes the write operation
180 END
```


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Processing Code 7

Writing data to extension file registers by specifying sequential addresses (direct writing)

Only applicable to AnA/AnU/AnUSCPU

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Device number	Specify the device number of the extension file registers expressed in sequential addresses.
□%(3)	□%(6)		
□%(4)	□%(7)	Number of points	Specify the number of points to be written.

- It is possible to write data to extension file registers by specifying their sequential addresses, rather than dividing them by block numbers, using this code.
- Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
- Specify 7.

□%(2) ••••••
⋮ Specify the device number of the extension file registers expressed in sequential addresses.
□%(3) •••

□%(4) •••••• Specify the number of device points to be written, including the device specified in □%(2) and □%(3).
The allowable specification range is from 1 to 64 points.

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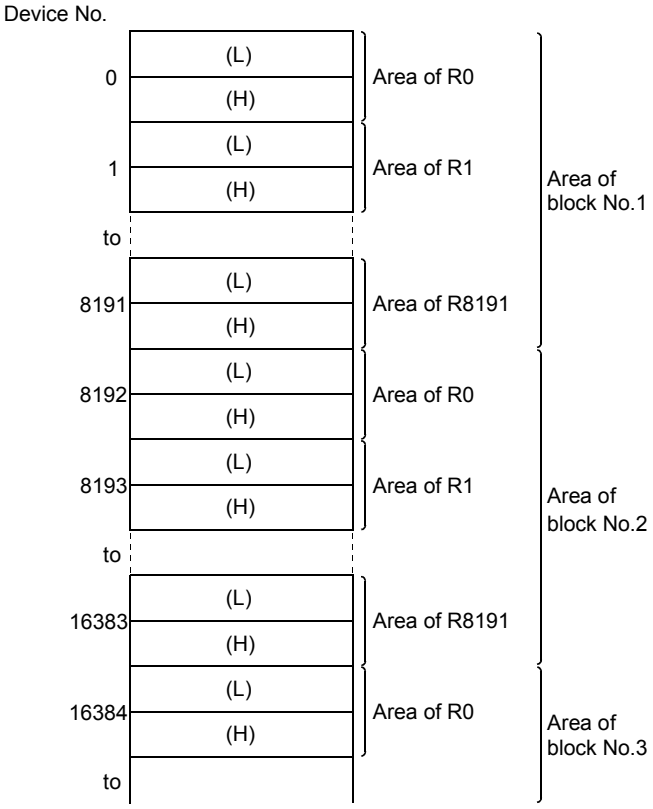
Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 7.
□%(5)	• • • • • •	Specify the device number of the extension file registers expressed in sequential addresses.
□%(6)	• • •	
□%(7)	• • • • • •	Specify the number of device points to be written, including the device specified in □%(5) and □%(6). The allowable specification range is from 1 to 64 points.

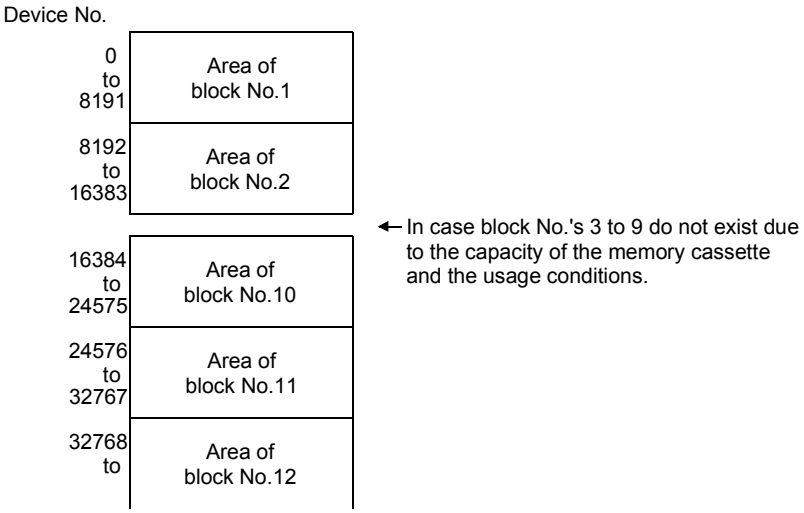
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• Device numbers expressed in sequential addresses are automatically assigned in ascending order, starting with the device number with the smallest block number (number 1).



• Device numbers are not assigned to block numbers that do not exist in the memory cassette.
When the device numbers are assigned, block numbers not found in the memory cassette are skipped.



See the ACPU/QCPU-A (A Mode) Programming Manual (Basics), AnA/AnUCPU User's Manual, SW□GHP-UTLP-FN1 Operating Manual, or SW□SRX-FNUP Operating Manual for an explanation about the relationships between the memory cassette and block numbers.

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• Assign values to □%(2) and □%(3) (□%(5) and □%(6) in case of a format 2 control table) in the following manner.

D! •••• Device number expressed in sequential address
H!
L! •••• Used as work areas.
H$
L$
to

```
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$(H!))
130 L$=RIGHT$("0000"+HEX$(L!))          In case of a format 2control table
140 □%(2)=VAL("&H"+L$)      •••• □%(5)=VAL("&H"+L$)
150 □%(3)=VAL("&H"+H$)      •••• □%(6)=VAL("&H"+H$)
```

to

Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes data to extension file registers by specifying sequential addresses
110 DIM TBL%(10),A%(20)                    :  'Defines arrays
120 TBL%(0)=255                            :  Specifies the station number to
                                              communicate with to the local station
130 TBL%(1)=7                              :  'Specifies to write data to extension file
                                              registers by specifying sequential
                                              addresses
140 D!=10                                  :  'Specifies the sequential addresses for
                                              writing
150 H!=INT(D!/65536!)
160 L!=D!-H!*65536!
170 H$=RIGHT$("0000"+HEX$(H!),4)           :  'Higher byte of the sequential address
180 L$=RIGHT$("0000"+HEX$(L!),4)           :  'Lower byte of the sequential address
190 TBL%(2)=VAL("&H"+L$)                   :  'Stores the lower byte in the control table
200 TBL%(3)=VAL("&H"+H$)                   :  'Stores the higher byte in the control table
210 TBL%(4)=3                              :  'Specifies the number of points to be
                                              written
220 A%(0)=0123                             :  'Specifies the data to be written
230 A%(1)=4567
240 A%(2)=8901
250 PCWT TBL%( ),A%( )                     :  'Executes the write operation
260 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that writes data to extension file registers by specifying sequential addresses
110 DIM TBL%(10),A%(20)                    :  'Defines arrays
120 TBL%(0)=255                            :  'Specifies a format 2 control table
130 TBL%(1)=1                              :  'Specifies network number 1
140 TBL%(2)=1                              :  'Specifies station number 1
130 TBL%(4)=7                              :  'Specifies to write data to extension file
                                              registers by specifying sequential
                                              addresses
140 D!=10                                  :  'Specifies the sequential addresses for
                                              writing
150 H!=INT(D!/65536!)
160 L!=D!-H!*65536!
170 H$=RIGHT$("0000"+HEX$(H!),4)           :  'Higher byte of the sequential address
180 L$=RIGHT$("0000"+HEX$(L!),4)           :  'Lower byte of the sequential address
190 TBL%(5)=VAL ("&H"+L$)                  :  'Stores the lower byte in the control table
200 TBL%(6)=VAL ("&H"+H$)                  :  'Stores the higher byte in the control table
210 TBL%(7)=3                              :  'Specifies the number of points to be
                                              written
220 A%(0)=0123                             :  'Specifies the data to be written
230 A%(1)=4567
240 A%(2)=8901
250 PCWT TBL%( ),A%( )                     :  'Executes the write operation
260 END
```


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Processing Code 8 Writing a sequence program Processing Disabled while Running

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Main/sub specification	Specify either the main program or a subprogram.
□%(3)	□%(6)	Starting step	Specify the starting step of the program to be written.
□%(4)	□%(7)	Number of steps	Specify the number of steps to be written.

• This code is used to write a sequence program to the PLC CPU.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 8.

□%(2) •••••• Specify the program to be written.
• To write the main program •••••• Specify 1.
• To write a subprogram (subprogram 1) •••••• Specify 2.
• To write subprogram 2 •••••• Specify 3.
• To write subprogram 3 •••••• Specify 4.
Always specify 1 for PLC CPUs in which subprograms cannot be used.

□%(3) •••••• Specify the head step number of the program to be written.
The maximum number of steps in the sequence program is the capacity set by the parameter.

□%(4) •••••• Specify the number of steps to be written.
The allowable specification range is from 1 to 64 steps.

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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 8.
□%(5)	• • • • • •	Specify the program to be written. • To write the main program • • • • • • Specify 1. • To write a subprogram (subprogram 1) • • • • • • Specify 2. • To write subprogram 2 • • • • • • Specify 3. • To write subprogram 3 • • • • • • Specify 4. Always specify 1 for PLC CPUs in which subprograms cannot be used.
□%(6)	• • • • • •	Specify the head step number of the program to be written. The maximum number of steps in the sequence program is the capacity set by the parameter.
□%(7)	• • • • • •	Specify the number of steps to be written. The allowable specification range is from 1 to 64 steps.

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• The maximum number of steps in the sequence program is determined by the capacity set by the parameter. The allowable specification range for the starting step number is as follows:

Sequence program	Specified step
Setting value of T0 Setting value of T1 to Setting value of T255	&HFE00 &HFE01 to &HFEFF
Setting value of C0 Setting value of C1 to Setting value of C255	&HFF00 &HFF01 to &HFFFF
Step 0 Step 1 to Step 30718	&H0000 &H0001 to &H77FE

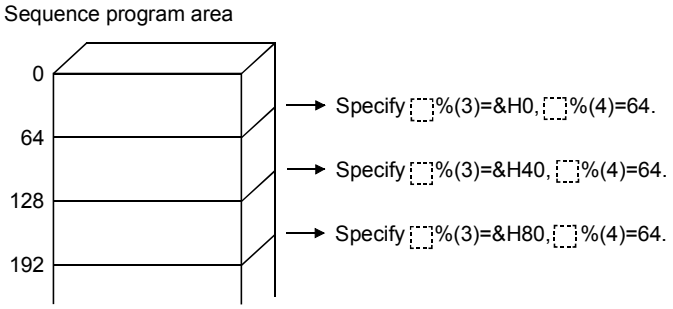
How to calculate the specified step

(1) Starting step number when a timer setting value is specified
FE00H + the device number of the timer (expressed in hexadecimal)

(2) Starting step number when the counter setting value is specified
FF00H + the device number of the counter (expressed in hexadecimal)

(3) Starting step number when the sequence program itself is specified
0000H + sequence program step number (expressed in hexadecimal)

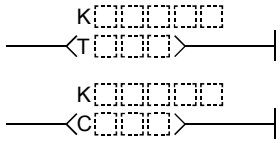
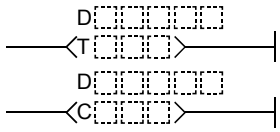
• The maximum number of sequence program steps that can be read at one time is 64 steps. The entire program can be read by specifying the starting step number and the number of steps to be read in units of 64 steps as follows:



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• The timer and counter setting values are stored using the values (hexadecimal) shown in the table below.

Example of ladder steps in a program	Settings in a program	Settings in BASIC
	K0 K1 to K9 K10 to K32767	& H0000 & H0001 to & H0009 & H000A to & H7FFF
	D0 D1 D2 to D1023	& H8000 & H8002 & H8004 to & H87FE

How to calculate the setting values in BASIC

(1) When set by a constant (K□□□□□)

• • • • &H0000 + constant (hexadecimal)

(2) When set by data register (D□□□□□)

• • • • &H8000 + device number of data register × 2

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Use the data read from the PLC CPU by using the PCRD instruction for the sequence program to be written. If other data is written, the PLC CPU cannot operate normally.

Program Example

(1) Program example for a format 1 control table

```
100 'A program example that writes the sequence program stored in a memory card to the PLC CPU
110 '(Capacity of the main sequence program: 8 k steps)
120 DIM TBL%(10),A%(100)                    :  'Defines arrays
130 OPEN "0:PROG8.DAT" FOR INPUT AS #1      :  'Opens the file
140 FOR J=&H0 TO, &H1FC0 STEP 64
150  FOR I=0 TO 63
160   INPUT #1,A%(I)                        :  'Reads from the file
170  NEXT I
180  TBL%(0)=255                            :  'Specifies the station number to
                                                communicate with to the local station
190  TBL%(1)=8                              :  'Specifies to write the sequence program
200  TBL%(2)=1                              :  'Specifies to write to the main sequence
                                                program area
210  TBL%(3)=J                              :  'Specifies the head step number to be
                                                written
220  TBL%(4)=64                             :  'Specifies the number of steps to be written
230  PCWT TBL%( ),A%( )                     :  'Executes the write operation
240 NEXT J
250 CLOSE                                   :  'Closes the file
260 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that writes the sequence program stored in a memory card to the PLC CPU
110 (Capacity of the main sequence program: 8 k steps)
120 DIM TBL%(10),A%(100)                    :  'Defines arrays
130 OPEN "0:PROG8.DAT" FOR INPUT AS #1      :  'Opens the file
140 FOR J=&H0 TO, &H1FC0 STEP 64
150  FOR I=0 TO 63
160   INPUT #1,A%(I)                        :  'Reads from the file
170  NEXT I
180  TBL%(0)=256                            :  'Specifies a format 2 control table
190  TBL%(1)=1                              :  'Specifies network number 1
200  TBL%(2)=1                              :  'Specifies station number 1
210  TBL%(4)=8                              :  'Specifies to write the sequence program
220  TBL%(5)=1                              :  'Specifies to write to the main sequence
                                                program area
230  TBL%(6)=J                              :  'Specifies the head step number to be
                                                written
240  TBL%(7)=64                             :  'Specifies the number of steps to be written
250  PCWT TBL%( ),A%( )                     :  'Executes the write operation
260 NEXT J
270 CLOSE                                   :  'Closes the file
280 END
```


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Processing Code 9 Writing a microcomputer program Processing Disabled while Running

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Main/sub specification	Specify either the main program or a sub-microcomputer program.
□%(3)	□%(6)	Starting address	Specify the starting address of the program to be written.
□%(4)	□%(7)	Number of bytes	Specify the number of bytes to be written.

• This code is used to write a microcomputer program to the PLC CPU.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 9.

□%(2) •••••• Specify the microcomputer program to be written.
• To write the main microcomputer program •••••• Specify 1.
• To write a sub-microcomputer program •••••• Specify 2.
Always specify 1 for PLC CPUs in which sub-microcomputer programs cannot be used.

□%(3) •••••• Specify the starting address of the microcomputer program to be written.
The maximum number of bytes in the microcomputer program that can be specified is the capacity set by the parameter.

□%(4) •••••• Specify the number of bytes to be written.
The allowable specification range is from 1 to 128 bytes.

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Format 2 control table

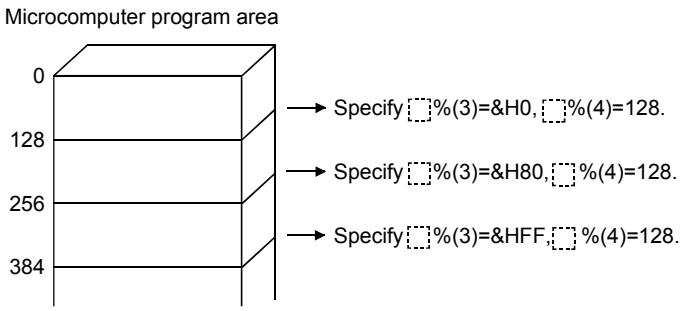
□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 9.
□%(5)	• • • • • •	Specify the microcomputer program to be written. • To write the main microcomputer program • • • • • • Specify 1. • To write a sub-microcomputer program • • • • • • Specify 2. Always specify 1 for PLC CPUs in which sub-microcomputer programs cannot be used.
□%(6)	• • • • • •	Specify the starting address of the microcomputer program to be written. The maximum number of bytes in the microcomputer program that can be specified is the capacity set by the parameter.
□%(7)	• • • • • •	Specify the number of bytes to be written. The allowable specification range is from 1 to 128 bytes.

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• The maximum number of bytes in the microcomputer program is determined by the capacity set by the parameter. The starting addresses that can be specified are as follows:

CPU type name	Capacity of the microcomputer program	Microcomputer program address
A0J2HCPU A1SCPU A1SJCPU A2CCPU A52GCPU	Maximum 14 k bytes	&H0000 to &H37FE
A1CPU A1NCPU	Maximum 10 k bytes	&H0000 to &H27FE
A2CPU (S1) A2ACPU (S1) A2NCPU (S1) A2SCPU A2UCPU (S1) A2USCPU (S1)	Maximum 26 k bytes	&H0000 to &H67FE
A3CPU A3ACPU A3HCPU A3MCPU A3NCPU A3UCPU A4UCPU A73CPU A7LMS-F	Maximum 58 k bytes for both main and sub microcomputer programs	&H0000 to &H7FE

• The maximum number of bytes of the microcomputer program that can be written at one time is 128 bytes.
The entire microcomputer program can be written by specifying the starting address number and the number of bytes to be written in units of 128 bytes as follows:



Use the data read from the PLC CPU by using the PCRD instruction for the microcomputer program to be written. If other data is written, the PLC CPU cannot operate normally.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes the microcomputer program stored in a memory card to the PLC
    CPU
110 ' (Capacity of the microcomputer program: 8 k bytes)
120 DIM TBL%(10),A%(150)                    :  'Defines arrays
130 OPEN "0:PROG9.DAT" FOR INPUT AS #1      :  'Opens the file
140 FOR J=&H0 TO &H1F80 STEP 128
150  FOR I=0 TO 127
160   INPUT #1,A%(I)                        :  'Reads from the file
170  NEXT I
190  TBL%(0)=255                            :  'Specifies the station number to
                                                communicate with to the local station
200  TBL%(1)=9                              :  'Specifies to write the microcomputer
                                                program
210  TBL%(2)=1                              :  'Specifies to write to the main
                                                microcomputer program area
220  TBL%(3)=J                              :  'Specifies the starting address to be written
230  TBL%(4)=64                             :  'Specifies the number of bytes to be written
240  PCWT TBL%( ),A%( )                     :  'Executes the write operation
250 NEXT J
260 CLOSE                                   :  'Closes the file
270 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that writes the microcomputer program stored in a memory card to the PLC
    CPU
110 ' (Capacity of the microcomputer program: 8 k bytes)
120 DIM TBL%(10),A%(150)                    :  'Defines arrays
130 OPEN " 0:PROG9.DAT" FOR INPUT AS #1     :  'Opens the file
140 FOR J=&H0 TO &H1F80 STEP 128
150  FOR I=0 TO 127
160   INPUT #-,A%(I)                        :  'Reads from the file
170  NEXT I
190  TBL%(0)=256                            :  'Specifies a format 2 control table
200  TBL%(1)=1                              :  'Specifies network number 1
210  TBL%(2)=1                              :  'Specifies station number 1
220  TBL%(4)=9                              :  'Specifies to write the microcomputer
                                               program
230  TBL%(5)=1                              :  'Specifies to write to the main
                                               microcomputer program area
240  TBL%(6)=J                              :  'Specifies the starting address to be written
250  TBL%(7)=64                             :  'Specifies the number of bytes to be written
260  PCWT TBL%( ),A%( )                     :  'Executes the write operation
270 NEXT J
280 CLOSE                                   :  'Closes the file
290 END
```


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Processing Code 10

Writing comment data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Starting address	Specify the starting address of the comment data to be written.
□%(3)	□%(6)	Number of bytes	Specify the number of bytes to be written.

• This code is used to write comment data to the PLC CPU.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 10.

□%(2) •••••• Specify the starting address of the comment data to be written.
The maximum number of bytes in comment data is the capacity set by the parameter.

□%(3) •••••• Specify the number of bytes to be written.
The allowable specification range is from 1 to 128 bytes.

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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU from which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 10.
□%(5)	• • • • • •	Specify the starting address of the comment data to be written. The maximum number of bytes in comment data is the capacity set by the parameter.
□%(6)	• • • • • •	Specify the number of bytes to be written. The allowable specification range is from 1 to 128 bytes.

• The maximum number of bytes in comment data is determined by the capacity set by the parameter. The allowable specification range for the starting address is as follows:

0 to (1024 × (comment capacity specified by the parameter))

• The maximum number of bytes of the comment that can be written at one time is 128 bytes.
The comment can be written by specifying the starting address number and the number of bytes to be written in units of 128 bytes.

Use the data read from the PLC CPU by using the PCRD instruction for the comment to be written. If other data is written, the PLC CPU cannot operate normally.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes the comment data stored in a memory card to the PLC CPU
110 ' (Comment capacity: 3 k steps)
120 DIM TBL%(10),A%(150)                 :  'Defines arrays
130 OPEN "0:PROG9.DAT" FOR INPUT AS #1   :  'Opens the file
140 FOR J=&H0 TO &HB80 STEP 128
150  FOR I=0 TO 127
160   INPUT #1,A%(I)                     :  'Reads from the file
170  NEXT I
180  TBL%(0)=255                         :  'Specifies the station number to
                                             communicate with to the local station
190  TBL%(1)=10                          :  'Specifies to write comment data
200  TBL%(2)=J                           :  'Specifies the starting address of the
                                             comment data to be written
210  TBL%(3)=128                         :  'Specifies the number of bytes to be written
220  PCWT TBL%( ),A%( )                  :  'Executes the write operation
230 NEXT J
240 CLOSE                                :  'Closes the file
250 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that writes the comment data stored in a memory card to the PLC CPU
110 ' (Comment capacity: 3 k steps)
120 DIM TBL%(10),A%(150)                 :  'Defines arrays
130 OPEN "0:PROG9.DAT" FOR INPUT AS #1   :  'Opens the file
140 FOR J=&H0 TO &HB80 STEP 128
150  FOR I=0 TO 127
160   INPUT #1,A%(I)                     :  'Reads from the file
170  NEXT I
180  TBL%(0)=256                         :  'Specifies a format 2 control table
190  TBL%(1)=1                           :  'Specifies network number 1
200  TBL%(2)=1                           :  'Specifies station number 1
210  TBL%(4)=10                          :  'Specifies to write comment data
220  TBL%(5)=J                           :  'Specifies the starting address of the
                                             comment data to be written
230  TBL%(6)=128                         :  'Specifies the number of bytes to be written
240  PCWT TBL%( ),A%( )                  :  'Executes the write operation
250 NEXT J
260 CLOSE                                :  'Closes the file
270 END
```


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Processing Code 11

Writing extension comment data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Starting address	Specify the starting address of the extension comment data to be written.
□%(3)	□%(6)	Number of bytes	Specify the number of bytes to be written.

• This code is used to write extension comment data to the PLC CPU.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 11.

□%(2) •••••• Specify the starting address of the extension comment to be written.
The maximum number of bytes of extension comment data is the capacity set by the parameter.

□%(3) •••••• Specify the number of bytes to be written.
The allowable specification range is from 1 to 128 bytes.

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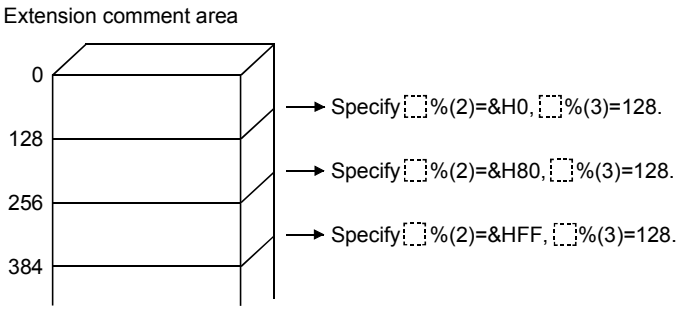
Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 11.
□%(5)	• • • • • •	Specify the starting address of the extension comment to be written. The maximum number of bytes of extension comment data is the capacity set by the parameter.
□%(6)	• • • • • •	Specify the number of bytes to be written. The allowable specification range is from 1 to 128 bytes.

• The maximum number of bytes of extension comment data is determined by the capacity set by the parameter. The allowable specification range for the starting address is as follows:

0 to (1024 × (extension comment capacity specified by the parameter))

• The number of bytes of the extension comment that can be written at one time is 128 bytes.
The extension comment can be written by specifying the starting address number and the number of bytes to be written in units of 128 bytes as follows:



Extension comments can only be created by SW□IVD-GPPA.
In addition, extension comment data can be used by the LEDC instruction, etc. in sequence programs.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes the extension comment data stored in a memory card to the PLC
      CPU
110 ' (Extension comment capacity: 3 k bytes)
120 DIM TBL%(10),A%(150)                    :  'Defines arrays
130 OPEN "0:PROG9.DAT" FOR INPUT AS #1      :  'Opens the file
140 FOR J=&H0 TO &HB80 STEP 128
150  FOR I=0 TO 127
160   INPUT #1,A%(1)                        :  'Reads from the file
170  NEXT I
180  TBL%(0)=255                            :  'Specifies the station number to
                                                communicate with to the local station
190  TBL%(1)=11                             :  'Specifies to write extension comment data
200  TBL%(2)=J                              :  'Specifies the starting address of the
                                                extension comment data to be written
210  TBL%(3)=128                            :  'Specifies the number of bytes to be written
220  PCWT TBL%( ),A%( )                     :  'Executes the write operation
230 NEXT J
240 CLOSE                                   :  'Closes the file
250 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that writes the extension comment data stored in a memory card to the PLC
      CPU
110 ' (Extension comment capacity: 3 k bytes)
120 DIM TBL%(10),A%(150)                    :  'Defines arrays
130 OPEN "0:PROG9.DAT" FOR INPUT AS #1      :  'Opens the file
140 FOR J=&H0 TO &H1F80 STEP 128
150  FOR I=0 TO 127
160   INPUT #1,A%(I)                        :  'Reads from the file
170  NEXT I
180  TBL%(0)=256                            :  'Specifies a format 2 control table
190  TBL%(1)=1                              :  'Specifies network number 1
200  TBL%(2)=1                              :  'Specifies station number 1
210  TBL%(4)=11                             :  'Specifies to write extension comment data
220  TBL%(5)=J                              :  'Specifies the starting address of the
                                                extension comment data to be written
230  TBL%(6)=128                            :  'Specifies the number of bytes to be written
240  PCWT TBL%( ),A%( )                     :  'Executes the write operation
250 NEXT J
260 CLOSE                                   :  'Closes the file
270 END
```


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Processing Code 12

Writing to the special function module's buffer memory

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Module number	Specify the module number of the special function module.
□%(3)	□%(6)	Buffer memory address	Specify the buffer memory address.
□%(4)	□%(7)		
□%(5)	□%(8)	Number of bytes	Specify the number of bytes to be written.

• It is possible to write data to the special function module's buffer memory using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 12.

□%(2) •••••• Specify the module number of the special function module to whose buffer memory the data is to be written.

□%(3) ••••••
⋮ Specify the buffer memory address to which the data is to be written.
□%(4) •••

□%(5) •••••• Specify how many bytes of data should be written, including the specified buffer memory address of the special function module.
The allowable specification range is from 1 to 128 bytes.

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Format 2 control table

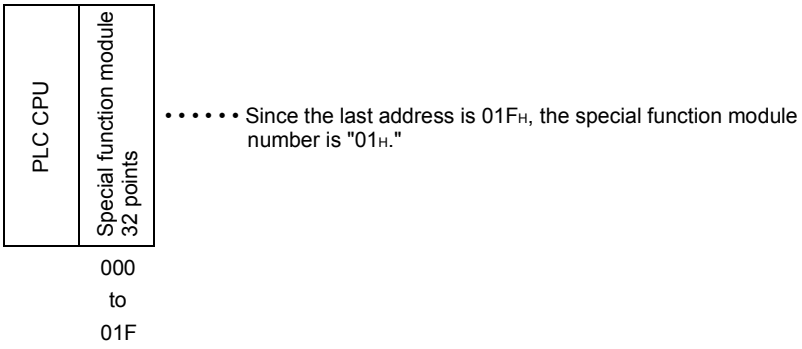
□%(0)	• • • • • •	Format 2 control table • Specify 256.
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 12.
□%(5)	• • • • • •	Specify the module number of the special function module to whose buffer memory the data is to be written.
□%(6)	• • • • • •	Specify the buffer memory address to which the data is to be written.
□%(7)	• • •	
□%(8)	• • • • • •	Specify how many bytes of data should be written, including the specified buffer memory address of the special function module. The allowable specification range is from 1 to 128 bytes.

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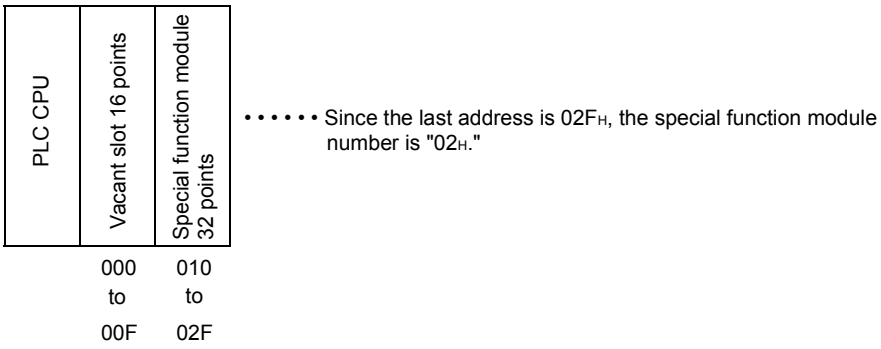
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• The module number (hexadecimal) of the special function module is the two higher digits of the 3-digit expression of the last address of the special function module's I/O addresses seen from the PLC CPU.

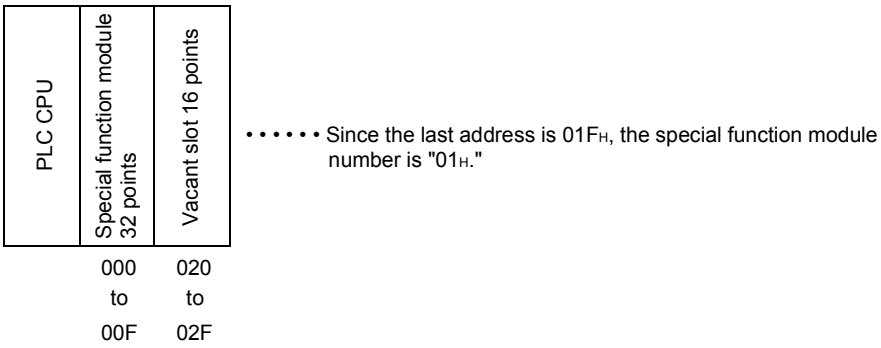
(a) In case of a single-slot module (e.g., AD61, A68AD)



(b) In case of a module where the first half slot is allocated as a vacant slot (e.g., AD72, A68AD)



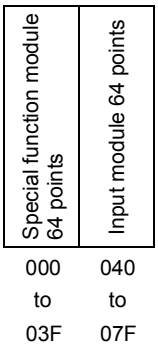
(c) In case of a module where the second half slot is allocated as a vacant slot (e.g., A61LS)



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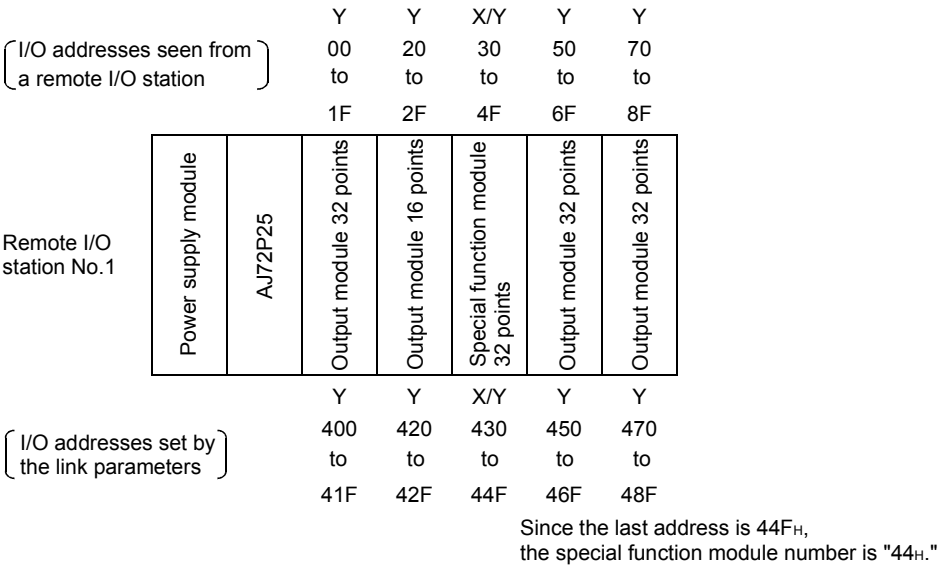
(d) In case of a module where both the special function module and an input/output module are allocated (e.g., A81CPU)
(In case of A81CPU)



• • • • • • Since the last address is 03F$_H$, the special function module number is "03$_H$."

(e) Module number of the special function module of a MELSECNET remote I/O station
The module number of the special function module of a MELSECNET remote I/O station is determined by the settings of the link parameters set at the MELSECNET master station.

L/R	M←L		M←R	M←R	M←L/R		M←L/R	
No.	B	W	W	W	Y	X/Y	X	Y/X
R1	—	—	29C-309	0F9*15E	400-48F	000-08F	430-44F	030-04F
R2	—	—	215-24F	080-0A3	510-64F	010-17F	500-65F	000-15F
R3	—	—	1B6-214	15F-1B5	270-32F	050-10F	220-28F	000-06F
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–



Since the last address is 44F$_H$,
the special function module number is "44$_H$."

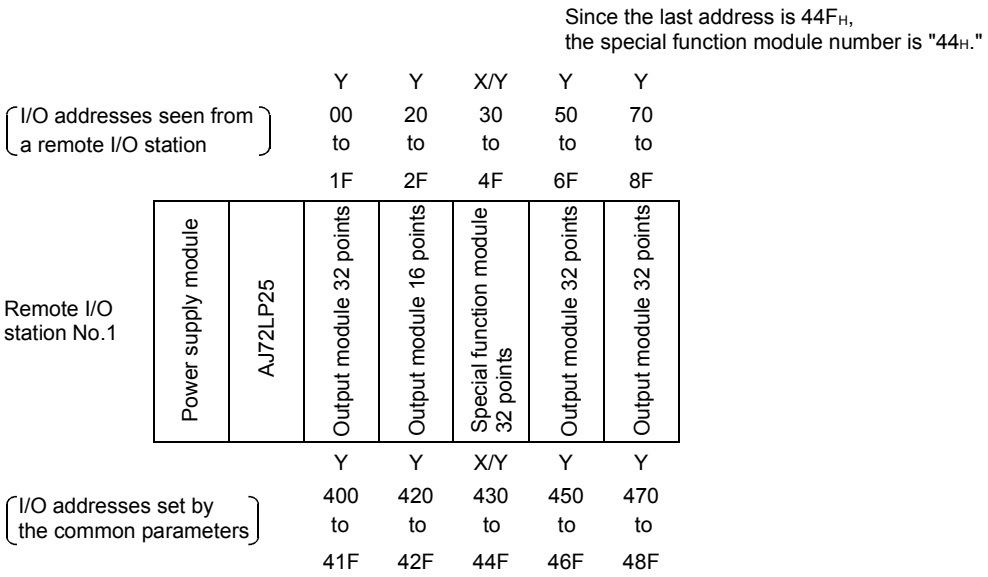
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(f) Module number of the special function module of a MELSECNET/10 remote I/O station

The module number of the special function module of a MELSECNET/10 remote I/O station is always the two higher digits of the 3-digit expression of the last "I/O address seen from a remote I/O station."

Specify the module number using the last "I/O address seen from a remote I/O station" regardless of the settings of the common parameters set at the master station of the MELSECNET/10 remote I/O net.



• The special function module's buffer memory contains 16 bits (one word) per address and reading/writing operations between the PLC CPU and special function module are performed using the FROM/TO instructions. When reading/writing from the special function module's buffer memory to the communication module or vice versa, the operation is performed in units of 8 bits (1 byte) per address.

The addresses to specify in the communication module (hexadecimal) are obtained by the following conversion from addresses for the FROM/TO instructions.

Specified address (hexadecimal) = convert { (address for the FROM/TO instruction x 2) } into a hexadecimal number + [the starting address of each module]

Example : When specifying address 1 of the FROM/TO instruction (the preset value of CH.1) of the type AD61 high-speed counter module.

(Specified address 82_H) = (FROM/TO instruction address 0×2, $1_H \times 2$) + (starting address 80_H)

See Appendix 8 for the starting address of each intelligent function module/special function module

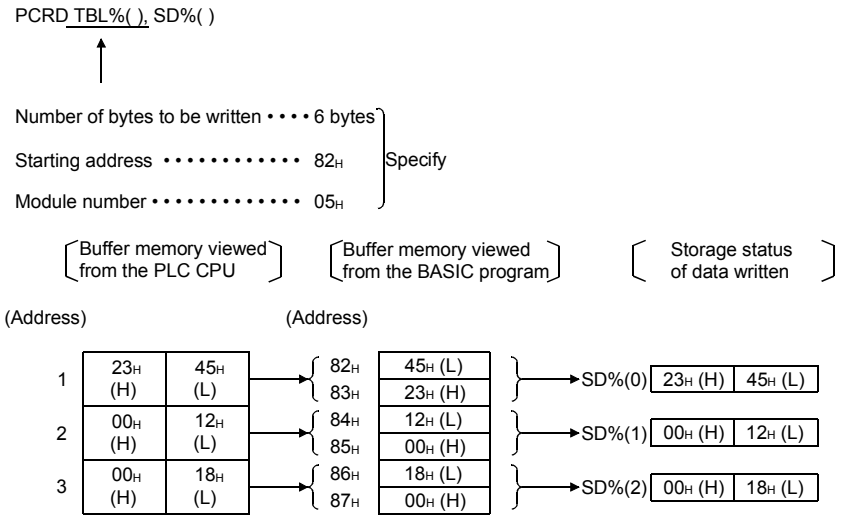
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• Assign values to □%(3) and □%(4) (□%(6) and □%(7) in case of a format 2 control table) in the following manner.

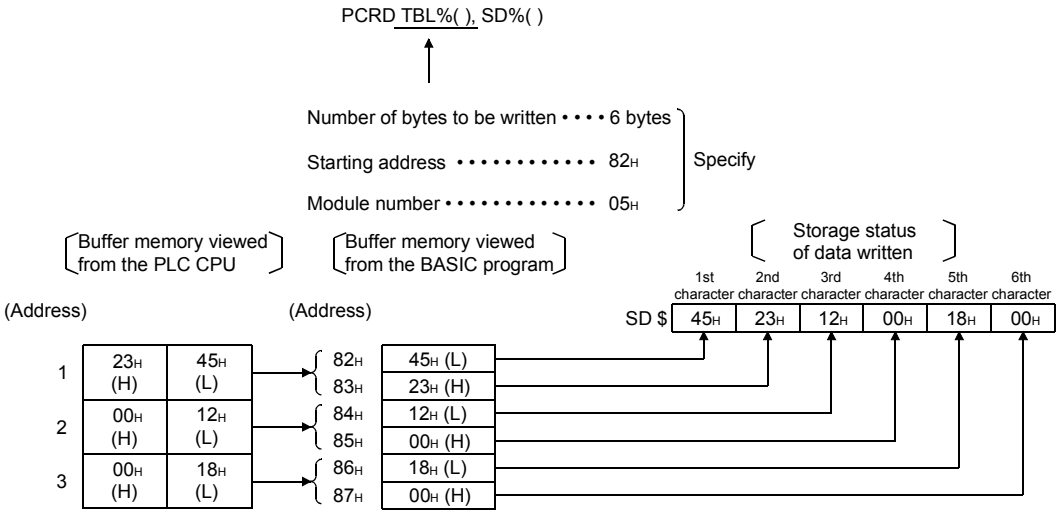
```
D!      • • •    Address seen from the communication module
H!
L!      • • • •  Used as work areas.
H$
L$
 to
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$(H!))
130 L$=RIGHT$("0000"+HEX$(L!))          In case of a format 2 control table
140 □%(3)=VAL("&H"+L$)      • • • •  □%(6)=VAL("&H"+L$)
150 □%(4)=VAL("&H"+H$)      • • • •  □%(7)=VAL("&H"+H$)
 to
```

• Data is stored in <storage area for data to be written> in the following manner.
Example : When writing data to buffer memory addresses 1 to 3 of an AD61 module whose I/O addresses are from X/Y40 to X/Y5F.

1) If an input element is specified as an integer variable/array, the data is stored as follows:



2) If an input element is specified as a character variable or character array variable name:



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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes data to buffer memory 0 of the special function module (A62DA)
110 ' (Starting address of A62DA: &H0A)
120 DIM TBL%(5),A%(0)                    :  'Defines arrays
130 TBL%(0)=255                          :  'Specifies the station number to
                                            communicate with to the local station
140 TBL%(1)=12                           :  'Specifies to write data to buffer memory
150 TBL%(2)=&HA                          :  'Specifies the module number
160 D!=&HA0                              :  'Specifies the buffer memory address
170 H!=INT(D!/65536!)
180 H$=RIGHT$("0000"+HEX$(H!),4)         :  'Higher byte of the buffer memory address
190 L$=RIGHT$("0000+HEX$(L!),4)          :  'Lower byte of the buffer memory address
200 TBL%(3)=VAL("&H"+L$)                 :  'Stores the lower byte in the control table
210 TBL%(4)=VAL("&H"+H$)                 :  'Stores the higher byte in the control table
220 TBL%(5)=2                            :  'Specifies the number of bytes to be written
230 A%(0)=&H3E8                          :  'Specifies the values to be written
240 PCWT TBL%( ),A%( ) :                 :  'Executes the write operation
250 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that writes data to buffer memory 0 of the special function module (A62DA)
110 ' (Starting address of A62DA: &H0A)
120 DIM TBL%(8),A%(0)                    :  'Defines arrays
130 TBL%(0)=256                          :  'Specifies a format 2 control table
140 TBL%(1)=1                            :  'Specifies network number 1
150 TBL%(2)=1                            :  'Specifies station number 1
160 TBL%(4)=12                           :  'Specifies to write data to buffer memory
170 TBL%(5)=&HA                          :  'Specifies the module number
180 D!=&HA0                              :  'Specifies the buffer memory address
190 H!=INT(D!/65536!)
200 H$=RIGHT$("0000"+HEX$(H!),4)         :  'Higher byte of the buffer memory address
210 L$=RIGHT$("0000+HEX$(L!),4):         :  'Lower byte of the buffer memory address
220 TBL%(6)=VAL("&H"+L$)                 :  'Stores the lower byte in the control table
230 TBL%(7)=VAL("&H"+H$)                 :  'Stores the higher byte in the control table
240 TBL%(8)=2                            :  'Specifies the number of bytes to be written
250 A%(0)=&H3E8                          :  'Specifies the values to be written
260 PCWT TBL%( ),A%( ) :                 :  'Executes the write operation
270 END
```


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Processing Code 14

Writing parameter data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.
□%(2)	□%(5)	Starting address	Specify the starting address of the parameter area to be written.
□%(3)	□%(6)		
□%(4)	□%(7)	Number of bytes	Specify the number of bytes to be written.

• This code is used to write the parameters to the PLC CPU.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 14.

□%(2) •••••• Specify the starting address of the parameter area to be written.

□%(3) •••⋮

□%(4) •••••• Specify the number of bytes to be written.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 14.

□%(5) •••••• Specify the starting address of the parameter area to be written.

□%(6) •••⋮

□%(7) •••••• Specify the number of bytes to be written.

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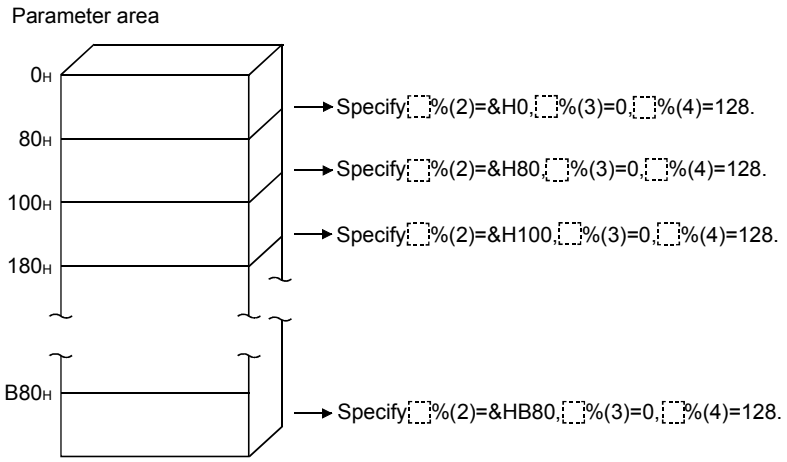
• Assign values to □%(2) and □%(3) (□%(5) and □%(6) in case of a format 2 control table) in the following manner.

```
D!      ••••   Starting address of the parameter area
H!
L!      ••••   Used as work areas.
H$
L$
 to
100 H!=INT(D!/65536!)
110 L!=D!-H!*65536!
120 H$=RIGHT$("0000"+HEX$(H!))
130 L$=RIGHT$("0000"+HEX$(L!))          In case of a format 2 control table
140 □%(2)=VAL("&H"+L$)      ••••  □%(5)=VAL("&H"+L$)
150 □%(3)=VAL("&H"+H$)      ••••  □%(6)=VAL("&H"+H$)
 to
```

• The capacity of the parameter data is set as follows:

A0J2 •••• 16 k bytes (addresses 0000 to $000F_H$)
Other CPUs •••• 3 k bytes (addresses 0000 to $0BFF_H$)

The maximum number of bytes of parameter data that can be written at one time is 128 bytes. In PLC CPUs other than A0J2CPU, write entire data by specifying the starting address and the number of bytes to be written in units of 128 bytes as follows:



• The parameters set in the memory capacity settings of the GPP function, etc. and the MELSECNET/10 network parameters are written using processing code 14.
The network parameters are written together with the parameters if the PLC CPU that performs the parameter write operation is an AnUCPU.
If the network parameters are also written, write the entire amount of data corresponding to parameter capacity (3 k bytes) plus network parameter capacity.

The capacity of the network parameters is displayed on the screen for setting network parameters in the GPP function.

Make sure always to perform the parameter analysis using Processing Code 15 after writing parameter data.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that writes the parameters stored in a memory card to the PLC CPU
110 ' (Four network modules are connected. All the modules are control stations. Network parameter
capacity: 16 k bytes)
120 DIM TBL1%(10),A%(150),TBL2%(10),B%(10)      :  'Defines arrays
130 OPEN "0:PROG14.DAT" FOR INPUT AS #1         :  'Opens the file
140 FOR J=&H0 TO &H3F80 STEP 128
150  FOR I=0 TO 127
160   INPUT #1,A%(1)
170  NEXT I
180  TBL%(0)=255                                :  'Specifies the station number to
                                                    communicate with to the local station
190  TBL%(1)=14                                 :  'Specifies to write parameters
200  D!=J                                       :  'Specifies the starting address of the
                                                    parameter data to be written
210  H!=INT(D!/65536!)
220  L!=D!-H!*65536!
230  H$=RIGHT$("0000"+HEX$(H!),4)               :  'Higher byte of the starting address of the
                                                    parameter data
240  L$=RIGHT$("0000"+HEX$(L!),4)               :  'Lower byte of the starting address of the
                                                    parameter data
250  TBL1%(2)=VAL("&H"+L$)                      :  'Stores the lower byte in the control table
260  TBL1%(3)=VAL("&H"+H$)                      :  'Stores the higher byte in the control table
270  TBL1%(4)=128                               :  'Specifies the number of bytes to be written
280  PCWT TBL1%( ),A%( )                        :  'Executes the write operation
290 NEXT J
300 CLOSE                                       :  'Closes the file
310 TBL2%(0)=255                                :  'Specifies the station number to
                                                    communicate with to the local station
320 TBL2%(1)=15                                 :  'Specifies to analyze the parameter data
330 PCWT TBL2%( ),B%( )                         :  'Executes the analysis
340 END
```


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(2) Program example for a format 2 control table

```
100 ' A program example that writes the parameters stored in a memory card to the PLC CPU
110 ' (Four network modules are connected. All the modules are control stations. Network parameter
capacity: 16 k bytes)
120 DIM TBL1%(10),A%(150),TBL2%(10),B%(10)      :  'Defines arrays
130 OPEN "0:PROG14.DAT" FOR INPUT AS #1         :  'Opens the file
140 FOR J=&H0 TO &H3F80 STEP 128
150  FOR I=0 TO 127
160   INPUT #1,A%(I)
170  NEXT I
180  TBL1%(0)=256                               :  'Specifies a format 2 control table
190  TBL1%(1)=1                                 :  'Specifies network number 1
200  TBL1%(2)=1                                 :  'Specifies station number 1
210  TBL1%(4)=14                                :  'Specifies to write parameters
220  D!=J                                       :  'Specifies the starting address of the
                                                   parameter data to be written
230  H!=INT(D!/65536!)
240  L!=D!-H!*65536!
250  H$=RIGHT$("0000"+HEX$(H!),4)               :  'Higher byte of the starting address of the
                                                   parameter data
260  L$=RIGHT$("0000"+HEX$(L!),4)               :  'Lower byte of the starting address of the
                                                   parameter data
270  TBL1%(5)=VAL("&H"+L$)                      :  Stores the lower byte in the control table
280  TBL1%(6)=VAL("&H"+H$)                      :  'Stores the higher byte in the control table
290  TBL1%(7)=128                               :  'Specifies the number of bytes to be written
300  PCWT TBL1%( ),A%( )                        :  'Executes the write operation
310 NEXT J
320 CLOSE                                       :  'Closes the file
330 TBL2%(0)=256                                :  'Specifies a format 2 control table
340 TBL2%(1)=1                                  :  'Specifies network number 1
350 TBL2%(2)=1                                  :  'Specifies station number 1
360 TBL2%(4)=15                                 :  'Specifies to analyze the parameter data
370 PCWT TBL2%( ),B%( )                         :  'Executes the analysis
380 END
```


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Processing Code 15

Analyzing parameter data

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• This code is used to analyze the parameter data of the PLC CPU.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU whose parameter data is to be analyzed.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 15.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU whose parameter data is to be analyzed.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 15.

• Specify a dummy variable or array for <storage area for data to be written>. The analysis is carried out irrespective of the kind of variable or array used. The variable or array specified for <storage area for data to be written> is not changed by the execution of the operation.

If parameter data is not analyzed via Processing Code 15 , the PLC CPU will continue to operate using the parameters before the change.

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Program Example

(1) Program example for a format 1 control table

```
00 ' A program example that analyzes the parameters of the PLC CPU
110 DIM TBL%(10), A%(10)          :  'Defines arrays
120 TBL%(0) = 255                 :  'Specifies the station number to
                                     communicate with to the local station
130 TBL%(1) = 15                  :  'Specifies to analyze parameter data
140 PCWT TBL%( ), A%( )           :  'Executes the analysis
150 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that analyzes the parameters of the PLC CPU
110 DIM TBL%(10), A%(10)          :  'Defines arrays
120 TBL%(0) = 256                 :  'Specifies a format 2 control table
130 TBL%(1) = 1                   :  'Specifies network number 1
140 TBL%(2) = 1                   :  'Specifies station number 1
150 TBL%(4) = 15                  :  'Specifies to analyze parameter data
160 PCWT TBL%( ), A%( )           :  'Executes the analysis
170 END
```


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Processing Code 16

Remote STOP of the PLC CPU

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• This code is used to stop a PLC CPU on a remote station.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which the remote STOP is to be performed.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 16.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU to which the remote STOP is to be performed.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 16.

• Specify a dummy variable or array for <storage area for data to be written>. The analysis is performed irrespective of the kind of variable or array used. The variable or array specified for <storage area for data to be written> is not changed by the execution of the operation.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that stops a PLC CPU on a remote station
110 DIM TBL%(10), A%(10)                 :  ' Defines arrays
120 TBL%(0) = 255                        :  ' Specifies the station number to
                                            communicate with to the local station
130 TBL%(1) = 16                         :  ' Specifies to perform remote STOP to a
                                            PLC CPU
140 PCWT TBL%( ), A%( )                  :  ' Executes the remote STOP
150 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that stops a PLC CPU on a remote station
110 DIM TBL%(10), A%(10)                 :  ' Defines arrays
120 TBL%(0) = 256                        :  ' Specifies a format 2 control table
130 TBL%(1) = 1                          :  ' Specifies network number 1
140 TBL%(2) = 1                          :  ' Specifies station number 1
130 TBL%(3) = 16                         :  ' Specifies to perform remote STOP to a
                                            PLC CPU
140 PCWT TBL%( ), A%( )                  :  ' Executes the remote STOP
15 END
```


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Processing Code 17

Remote RUN of the PLC CPU

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• This code is used to run a PLC CPU on a remote station.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which the remote RUN is to be performed.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 17.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU to which the remote RUN is to be performed.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 17.

• Specify a dummy variable or array for <storage area for data to be written>. The analysis is carried out irrespective of the kind of variable or array used. The variable or array specified for <storage area for data to be written> is not changed by the execution of the operation.

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Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that runs a PLC CPU on a remote station
110 DIM TBL%(10), A%(10)          :  'Defines arrays
120 TBL%(0) = 255                 :  'Specifies the station number to
                                     communicate with to the local station
130 TBL%(1) = 17                  :  'Specifies to perform remote RUN to a PLC
                                     CPU
140 PCWT TBL%( ), A%( )           :  'Executes the remote RUN
150 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that runs a PLC CPU on a remote station
110 DIM TBL%(10), A%(10)          :  'Defines arrays
120 TBL%(0) = 256                 :  'Specifies a format 2 control table
130 TBL%(1) = 1                   :  'Specifies network number 1
140 TBL%(2) = 1                   :  'Specifies station number 1
150 TBL%(4) = 17                  :  Specifies to perform remote RUN to a PLC
                                     CPU
140 PCWT TBL%( ), A%( )           :  'Executes the remote RUN
150 END
```


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Processing Code 20

Interrupting the PLC CPU

Control table format definition

Element position		Item	Description
Format 1	Format 2		
□%(0)	•••••••	Station number	Specify the station number of the PLC.
	□%(0)	Control table	Specify a control table of format 2.
	□%(1)	Network number	Specify the network number.
	□%(2)	Station number	Specify the station number of the PLC.
	□%(3)	Detailed error code	Detailed error codes are stored here.
□%(1)	□%(4)	Processing code	Specify the processing code.

• It is possible to interrupt the PLC CPU of the station on which the communication module is mounted using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) •••••• Always specify the self station (255).
□%(1) •••••• Processing code
• Specify 20.

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256.
□%(1) •••••• Always specify network number 1 (1).
□%(2) •••••• Always specify the self station (255).
□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.
□%(4) •••••• Processing code
• Specify 20.

• Specify a dummy variable or array for <storage area for data to be written>. The analysis is carried out irrespective of the kind of variable or array used. The variable or array specified for <storage area for data to be written> is not changed by the execution of the operation.

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• The PLC CPU executes the following interrupt programs when interrupted from the communication module.

AnA/AnU/AnUSCPU	• • • •	One of the interrupt programs from I16 to I23
QnA/Q2AS(H)CPU	• • • •	One of the interrupt programs from I16 to I27
AnN/AnS/AnSHCPU	• • • •	Either interrupt program I16 or interrupt program I17
QCPU	• • • •	One of the interrupt programs from I50 to I255 (set in the intelligent function module interrupt point setting of the parameter).

Which interrupt program is executed is determined by the position of the communication module mounted on the PLC CPU.

Example It is possible to mount two communication modules on a station with an A3NCPU. Interrupt program I16 is executed if the communication module closer to the PLC CPU interrupts the PLC CPU. Interrupt program I17 is executed if the communication module farther away from the PLC CPU interrupts the PLC CPU.

If only one communication module is mounted, interrupt program I16 is always executed.

If a communication module is mounted on a station where one or more special function modules that can interrupt the PLC CPU are also mounted, the module closest to the PLC CPU executes interrupt program I16.

See the ACPU/QCPU-A (A Mode) Programming Manual (Basics) for how to create an interrupt program.

Program Example

(1) Program example for a format 1 control table

```
100 ' A program example that interrupts the PLC CPU
110 DIM TBL%(10), A%(10)              :  'Defines arrays
120 TBL%(0) = 255                     :  'Specifies the station number to
                                         communicate with to the local station
130 TBL%(1) = 20                      :  'Specifies to interrupt the PLC CPU
140 PCWT TBL%( ), A%( )               :  'Executes the interrupt
150 END
```

(2) Program example for a format 2 control table

```
100 ' A program example that interrupts the PLC CPU
110 DIM TBL%(10), A%(10)              :' Defines arrays
120 TBL%(0) = 256                     :  'Specifies a format 2 control table
130 TBL%(1) = 1                       :  'Specifies network number 1
140 TBL%(2) = 255                     :  'Specifies station number 255 (local station)
130 TBL%(4) = 20                      :  'Specifies to interrupt the PLC CPU
140 PCWT TBL%( ), A%( )               :  'Executes the interrupt
150 END
```


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Processing Code 515 Writing data to the device memory of a Q/QnA series PLC CPU

Control table format definition

Only applicable to QD51 (-R24)

Element position			Item		Description
Format 1	Format 2	Format 3			
□%(0)	• • • • • • • • • • • • •		Station number		Specify the station number of the PLC.
	□%(0)	□%(0)	Control table		Specify a control table of format 2.
	□%(1)	□%(1)	Network number		Specify the network number.
	□%(2)	□%(2)	Station number		Specify the station number of the PLC.
	□%(3)	□%(3)	Detailed error code		Detailed error codes are stored here.
		□%(4)	Requested CPU		Specify the requested CPU.
□%(1)	□%(4)	□%(5)	Processing code		Specify the processing code.
□%(2)	□%(5)	□%(6)	Device code		Specify the device code.
□%(3)	□%(6)	□%(7)	Device number	Lower	Specify the device number.
□%(4)	□%(7)	□%(8)		Higher	
□%(5)	□%(8)	□%(9)	Number of points		Specify the number of device points.

• It is possible to write data to a Q/QnA series PLC CPU's device memory using this code.
• Specify the following data for <control table>.

Format 1 control table

□%(0) • • • • • • Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) • • • • • • Processing code
• Specify 515 (&H203).

□%(2) • • • • • • Specify the device using the defined code.
• See Section 4.2.5 for the code numbers.

□%(3) • • • • • • Specify the device number (lower) of the device specified in □%(2). See Section 4.2.5 for the allowable specification range.

□%(4) • • • • • • Specify the device number (higher) of the device specified in □%(2). See Section 4.2.5 for the allowable specification range.

□%(5) • • • • • • Specify the number of device points to be written, including the devices specified in □%(2), □%(3), and □%(4).
The allowable specification ranges are as follows:
(a) Bit devices
• Q series CPU 1 to 15360 points
• QnA series CPU 1 to 7680 points

(b) Word devices
• Q series CPU 1 to 960 points
• QnA series CPU 1 to 480 points

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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256 (&H100).
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 515 (&H203).
□%(5)	• • • • • •	Specify the device using the defined code. • See Section 4.2.5 for the code numbers.
□%(6)	• • • • • •	Specify the device number (lower) of the device specified in □%(5). See Section 4.2.5 for the allowable specification range.
□%(7)	• • • • • •	Specify the device number (higher) of the device specified in □%(5). See Section 4.2.5 for the allowable specification range.
□%(8)	• • • • • •	Specify the number of device points to be written, including the devices specified in □%(5), □%(6), and □%(7). The allowable specification ranges are as follows: (a) Bit devices • Q series CPU 1 to 15360 points • QnA series CPU 1 to 7680 points (b) Word devices • Q series CPU 1 to 960 points • QnA series CPU 1 to 480 points

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Format 3 control table

□%(0) •••••• Format 3 control table
  • Specify 257 (&H101).

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
  • Specify 515 (&H203).

□%(5) •••••• Specify the requested CPU.
  • PLC No.1 •••••992 (&H3E0)
  • PLC No.2 •••••993 (&H3E1)
  • PLC No.3 •••••994 (&H3E2)
  • PLC No.4 •••••995 (&H3E3)
  • Control PLC ••••••1023 (&H3FF)

□%(6) •••••• Specify the device using the defined code.
  • See Section 4.2.5 for the code numbers.

□%(7) •••••• Specify the device number (lower) of the device specified in □%(6). See Section 4.2.5 for the allowable specification range.

□%(8) •••••• Specify the device number (higher) of the device specified in □%(7). See Section 4.2.5 for the allowable specification range.

□%(9) •••••• Specify the number of device points to be written, including the devices specified in □%(6), □%(7), and □%(8).
The allowable specification ranges are as follows:
(a) Bit devices
  • Q series CPU 1 to 15360 points
  • QnA series CPU 1 to 7680 points

(b) Word devices
  • Q series CPU 1 to 960 points
  • QnA series CPU 1 to 480 points

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• Assign values to □%(3) and □%(4) (□%(6) and □%(7) in case of a format 2 control table, □%(7) and □%(8) in case of a format 3 control table) in the following manner.

```
D!      ••••••   Device number of the device to be written
H!
L!      ••••••   Used as work areas.
H$
L$
 to
100   H!=INT(D!/65536!)
110   L!=D!-H!*65536!
120   H$=RIGHT$("0000"+HEX$(H!),4)
130   L$=RIGHT$("0000"+HEX$(L!),4)          In case of a format 2 control table
140   □%(3)=VAL("&H"+L$) ••••••••••   □%(6)=VAL("&H"+L$)
150   □%(4)=VAL("&H"+H$) ••••••••••   □%(7)=VAL("&H"+H$)
 to
```

Program Example

(1) Program example for a format 1 control table

```
100 'A program example that writes data to a Q/QnA series PLC CPU's device memory
110 DIM TBL%(10),A%(20)                 : 'Defines arrays
120 TBL%(0)=255                         : 'Specifies the station number to
                                          communicate with to the local station
130 TBL%(1)=515                         : 'Specifies to write data to device memory of
                                          the Q/QnA series CPU
140 TBL%(2)=144                         : 'Specifies internal relays M
150 D!=0
160 H!=INT(D!/65536!)                   : 'Splits into lower and higher digits
170 L!-D!-H!*65536!
180 H$=RIGHT$("0000"+HEX$(H!),4)
190 L$=RIGHT$("0000"+HEX$(L!),4)
200 TBL%(3)=VAL("&H"+L$)                : 'Specifies the starting number (lower) of the
                                          device to be written
210 TBL%(4)=VAL("&H"+H$)                : 'Specifies the starting number (higher) of
                                          the device to be written
220 TBL%(5)=16                          : 'Specifies the number of points to be
                                          written
230 A%(0)=&HF
240 PCWT TBL%( ),A%( )                  : 'Executes the write operation
250 END
```


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(2) Program example for a format 2 control table

```
100 'A program example that writes data to a Q/QnA series PLC CPU's device memory
110 DIM TBL%(10),A%(20)                 : 'Defines arrays
120 TBL%(0)=256                         : 'Specifies a format 2 control table
130 TBL%(1)=1                           : 'Specifies network number 1
140 TBL%(2)=1                           : 'Specifies station number 1
150 TBL%(4)=515                         : 'Specifies to write data to device memory of
                                          the Q/QnA series CPU
160 TBL%(5)=144                         : 'Specifies internal relays M
170 D!=0
180 H!=INT(D!/65536!)                   : 'Splits into lower and higher digits
190 L!=D!-H!*65536!
200 H$=RIGHT$("0000"+HEX$(H!),4)
210 L$=RIGHT$("0000"+HEX$(L!),4)
220 TBL%(6)=VAL("&H"+L$)                : 'Specifies the starting number (lower) of the
                                          device to be written
230 TBL%(7)=VAL("&H"+H$)                : 'Specifies the starting number (higher) of
                                          the device to be written
240 TBL%(8)=16                          : 'Specifies the number of points to be
                                          written
250 A%(0)=&HF
260 PCWT TBL%( ),A%( )                  : 'Executes the write operation
270 END
```

(3) Program example a for format 3 control table

```
100 'A program example that writes data to a Q/QnA series PLC CPU's device memory
110 DIM TBL%(10),A%(20)                 : 'Defines arrays
120 TBL%(0)=256                         : 'Specifies a format 3 control table
130 TBL%(1)=1                           : 'Specifies network number 1
140 TBL%(2)=1                           : 'Specifies station number 1
150 TBL%(4)=515                         : 'Specifies to write data to device memory of
                                          the Q/QnA series CPU
160 TBL%(5)=&H3E3                       : 'Specifies the requested CPU (PLC No.4)
170 TBL%(6)=144                         : 'Specifies internal relays M
180 D!=0
190 H!=INT(D!/65536!)                   : 'Splits into lower and higher digits
200 L!=D!-H!*65536!
210 H$=RIGHT$("0000"+HEX$(H!),4)
220 L$=RIGHT$("0000"+HEX$(L!),4)
230 TBL%(7)=VAL("&H"+L$)                : 'Specifies the starting number (lower) of the
                                          device to be written
240 TBL%(8)=VAL("&H"+H$)                : 'Specifies the starting number (higher) of
                                          the device to be written
250 TBL%(9)=16                          : 'Specifies the number of points to be
                                          written
260 A%(0)=&HF
270 PCWT TBL%( ),A%( )                  : 'Executes the write operation
280 END
```


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Processing Code 516 Random data writing to the device memory of a Q/QnA series PLC CPU

Control table format definition

Only applicable to QD51 (-R24)

Element position			Item		Description
Format 1	Format 2	Format 3			
□%(0)	—••••••••••••••		Station number		Specify the station number of the PLC.
	□%(0)	□%(0)	Control table		Specify a format 2 or format 3 control table.
	□%(1)	□%(1)	Network number		Specify the network number.
	□%(2)	□%(2)	Station number		Specify the station number of the PLC.
	□%(3)	□%(3)	Detailed error code		Detailed error codes are stored here.
	|	□%(4)	Requested CPU		Specify the requested CPU.
□%(1)	□%(4)	□%(5)	Processing code		Specify the processing code.
□%(2)	□%(5)	□%(6)	Lower	Number of word device points	Specify the number of word device points to be read.
			Higher	Number of bit device points	Specify the number of bit device points to be read.
□%(3)	□%(6)	□%(7)	Number of double-word device points		Specify the number of double-word device points to be read.
□%(4)	□%(7)	□%(8)	Device code		Specify the device code.
□%(5)	□%(8)	□%(9)	Device number	Lower	Specify the device number.
□%(6)	□%(9)	□%(10)		Higher	
□%(7)	□%(10)	□%(11)	Processing unit		Specify the device processing unit.
□%(8)	□%(11)	□%(12)	Fixed value		Specify 0.
•	•	•	•		•
•	•	•	•		•
•	•	•	•		•
•	•	•	•		•

Repeat for the number of points to be read.

- It is possible to write data nonsequentially to a Q/QnA series PLC CPU's device memory using this code.
- Specify the following data for <control table>.

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Format 1 control table

□%(0)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(1)	• • • • • •	Processing code • Specify 516 (&H204).
□%(2)	• • • • • •	Specify the number of points for word devices (lower) and bit devices (higher) to be written. ∗1
□%(3)	• • • • • •	Specify the number of double-word device points to be written. ∗1
□%(4)	• • • • • •	Specify the device type using the defined code. • See Section 4.2.5 for the code numbers.
□%(5)	• • • • • •	Specify the device number (lower) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(6)	• • • • • •	Specify the device number (higher) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(7)	• • • • • •	Specify the device processing unit. • When writing in bit units • • • 0 (&H0) • When writing to word devices in word/double-word units • • • 0 (&H0) • When writing to bit devices in word units • • • 8960 (&H2300) • When writing to bit devices in double-word units • • • 9984 (&H2700)
□%(8)	• • • • • •	Fixed value • Specify 0 (&H0).

∗1: The number of points to be written should be within the following ranges:

• In case of a Q series CPU

1 ≤ (number of bit device points × 12 + number of word device points × 12 + number of double-word device points × 14) ≤ 1920 points

• In case of a QnA series CPU

1 ≤ (number of bit device points × 12+ number of word device points × 12 + number of double-word device points × 14) ≤ 960 points

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Format 2 control table

□%(0)	• • • • • •	Format 2 control table • Specify 256 (&H100).
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU from which data is read. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 516 (&H204).
□%(5)	• • • • • •	Specify the number of points for word devices (lower) and bit devices (higher) to be written. ∗1
□%(6)	• • • • • •	Specify the number of double-word device points to be written. ∗1
□%(7)	• • • • • •	Specify the device type using the defined code. • See Section 4.2.5 for the code numbers.
□%(8)	• • • • • •	Specify the device number (lower) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(9)	• • • • • •	Specify the device number (higher) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(10)	• • • • • •	Specify the device processing unit. • When writing in bit units • • • 0 (&H0) • When writing to word devices in word/double-word units • • • 0 (&H0) • When writing to bit devices in word units • • • 8960 (&H2300) • When writing to bit devices in double-word units • • • 9984 (&H2700)
□%(11)	• • • • • •	Fixed value • Specify 0 (&H0).

∗1: The number of points to be written should be within the following ranges:

• In case of a Q series CPU

1 ≤ (number of bit device points × 12 + number of word device points × 12 + number of double-word device points × 14) ≤ 1920 points

• In case of a QnA series CPU

1 ≤ (number of bit device points × 12+ number of word device points × 12 + number of double-word device points × 14) ≤ 960 points

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Format 3 control table

□%(0)	• • • • • •	Format 3 control table • Specify 257 (&H101).
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 516 (&H204).
□%(5)	• • • • • •	Specify the requested CPU. • PLC No.1 • • • • • • 992 (&H3E0) • PLC No.2 • • • • • • 993 (&H3E1) • PLC No.3 • • • • • • 994 (&H3E2) • PLC No.4 • • • • • • 995 (&H3E3) • Control PLC • • • • • • 1023 (&H3FF)
□%(6)	• • • • • •	Specify the number of points for word devices (lower) and bit devices (higher) to be written. ∗1
□%(7)	• • • • • •	Specify the number of double-word device points to be written. ∗1
□%(8)	• • • • • •	Specify the device type using the defined code. • See Section 4.2.5 for the code numbers.
□%(9)	• • • • • •	Specify the device number (lower) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(10)	• • • • • •	Specify the device number (higher) of the specified device. See Section 4.2.5 for the allowable specification range.
□%(11)	• • • • • •	Specify the device processing unit. • When writing in bit units • • • 0 (&H0) • When writing to word devices in word/double-word units • • • 0 (&H0) • When writing to bit devices in word units • • • 8960 (&H2300) • When writing to bit devices in double-word units • • • 9984 (&H2700)
□%(12)	• • • • • •	Fixed value • Specify 0 (&H0).

∗1: The number of points to be written should be within the following ranges:

• In case of a Q series CPU

1 ≤ (number of bit device points × 12 + number of word device points × 12 + number of double-word device points × 14) ≤ 192 points

• In case of a QnA series CPU

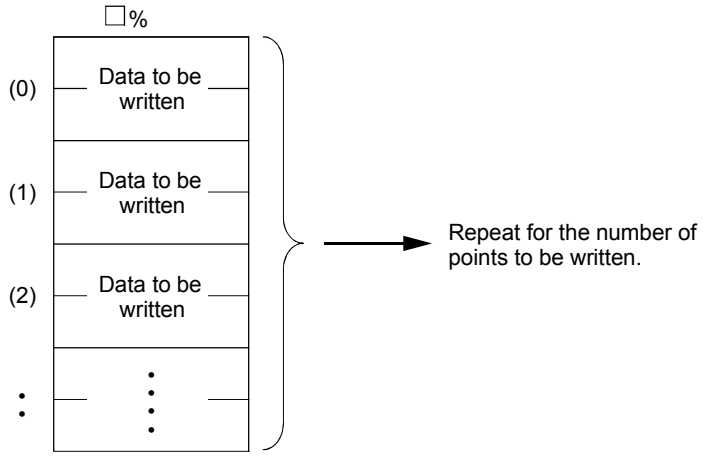
1 ≤ (number of bit device points × 12+ number of word device points × 12 + number of double-word device points × 14) ≤ 96 points

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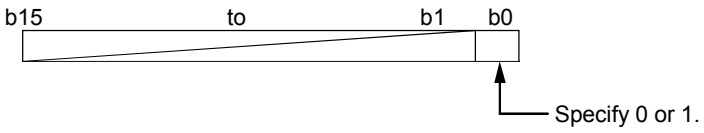
• Assign values to □%(6) and □%(7) (□%(9) and □%(10) in case of a format 2 control table, □%(10) and □%(11) in case of a format 3 control table) in the following manner.

```
D!      ••••••   Device number of the device to which data is to be written
H!
L!      ••••••   Used as work areas.
H$
L$
 to
100   H!=INT(D!/65536!)
110   L!=D!-H!*65536!
120   H$=RIGHT$("0000"+HEX$(H!),4)
130   L$=RIGHT$("0000"+HEX$(L!),4)          In case of a format 2 control table
140   □%(6)=VAL("&H"+L$) ••••••••••   □%(9)=VAL("&H"+L$)
150   □%(7)=VAL("&H"+H$) ••••••••••   □%(10)=VAL("&H"+H$)
 to
```

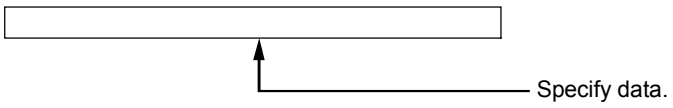
• In <storage area for data to be written>, specify the data to be written to the devices using integer arrays for the number of points to be written as follows:



• In case of bit devices



• In case of word or double-word devices



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Program Example

(1) Program example for a format 1 control table

```
100  'A program example that writes data nonsequentially to devices in a Q/QnA series PLC CPU's
                                                    device memory
110  DIM TBL%(20),A%(10)                        :  'Defines arrays
120  TBL%(0)=255                                :  'Specifies the station number to
                                                    communicate with to the local station
130  TBL%(1)=516                                :  'Specifies to write data nonsequentially to
                                                    the devices of the Q/QnA series PLC CPU
140  TBL%(2)=&H101                              :  'Writes to one bit device point and one
                                                    word device point
150  TBL%(3)=&H1                                :  'Writes to one double-word device point
160  TBL%(4)=168                                :  'Specifies data registers (D)
170  D!=0                                       :  'Specifies device number 0
GOSUB 400
190  TBL%(5)=L%                                 :  'Stores the lower digit of the device number
200  TBL%(6)=H%                                 :  'Stores the higher digit of the device
                                                    number
210  TBL%(7)=0                                  :  'Specifies word units as processing unit
220  TBL%(8)=0                                  :  'Fixed value
230  TBL%(9)=144                                :  'Specifies internal relays (M)
240  D!=0                                       :  'Specifies device number 0
250  GOSUB 400
260  TBL%(10)=L%                                :  'Stores the lower digit of the device number
270  TBL%(11)=H%                                :  'Stores the higher digit of the device
                                                    number
280  TBL%(12)=0                                 :  'Specifies bit units as processing unit
290  TBL%(13)=0                                 :  'Fixed value
300  TBL%(14)=168                               :  'Specifies data registers (D)
310  D!=8000                                    :  'Specifies device number 8000
320  GOSUB 400
330  TBL%(15)=L%                                :  Stores the lower digit of the device number
340  TBL%(16)=H%                                :  'Stores the higher digit of the device
                                                    number
350  TBL%(17)=0                                 :  'Specifies double-word units as processing
                                                    unit
360  TBL%(18)=0                                 :  'Fixed value
370  A%(0)=100:A%(1)=200:A%(2)=300              :  'Specifies the values to write
380  PCRD TBL%( ),A%( )                         :  'Executes the write operation
390  END
400  H!-INT(D!/65536!)                          :  'Splits into lower and higher digits
410  L!=D!-H!*65536!
420  H$=RIGHT$("0000"+HEX$(H!),4)
430  L$=RIGHT$("0000"+HEX$(L!),4)
440  L%=VAL("&H+L$)
450  H%=VAL("&H"+H$)
460  RETURN
```


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(2) Program example for a format 2 control table

```
100  'A program example that writes data nonsequentially to devices in a Q/QnA series PLC CPU's
                                                    device memory
110  DIM TBL%(20),A%(10)                       :  'Defines arrays
120  TBL%(0)=256                               :  'Specifies a format 2 control table
130  TBL%(1)=1                                 :  'Specifies network number 1
140  TBL%(2)=1                                 :  'Specifies station number 1
150  TBL%(4)=516                               :  'Specifies to write data nonsequentially to
                                                    the devices of the Q/QnA series PLC CPU
160  TBL%(5)=&H101                             :  'vWrites to one bit device point and one
                                                    word device point
170  TBL%(6)=&H1                               :  'Writes to one double-word device point
180  TBL%(7)=168                               :  'Specifies data registers (D)
190  D!=0                                      :  'Specifies device number 0
200  GOSUB 400
210  TBL%(8)=L%                                :  'Stores the lower digit of the device number
220  TBL%(9)=H%                                :  'Stores the higher digit of the device
                                                    number
230  TBL%(10)=0                                :  'Specifies word units as processing unit
240  TBL%(11)=0                                :  'Fixed value
250  TBL%(12)=144                              :  'Specifies internal relays (M)
260  D!=0                                      :  'Specifies device number 0
270  GOSUB 420
280  TBL%(13)=L%                               :  'Stores the lower digit of the device number
290  TBL%(14)=H%                               :  'Stores the higher digit of the device
                                                    number
300  TBL%(15)=0                                :  'Specifies bit units as processing unit
310  TBL%(16)=0                                :  'Fixed value
320  TBL%(17)=168                              :  'Specifies data registers (D)
330  D!=8000                                   :  'Specifies device number 8000
340  GOSUB 420
350  TBL%(18)=L%                               :  'Stores the lower digit of the device number
360  TBL%(19)=H%                               :  'Stores the higher digit of the device
                                                    number
370  TBL%(20)=0                                :  'Specifies double-word units as processing
                                                    unit
380  TBL%(21)=0                                :  'Fixed value
390  A%(0)=100:A%(1)=200:A%(2)=300             :  'Specifies the values to write
400  PCRD TBL%( ),A%( )                        :  'Executes the write operation
410  END
420  H!=INT(D!/65536!)                         :  'Splits into lower and higher digits
430  L!=D!-H!*65536!
440  H$=RIGHT$("0000"+HEX$(H!),4)
450  L$=RIGHT$("0000"+HEX$(L!),4)
460  L%=VAL("&H"+L$)
470  H%=VAL("&H"+H$)
480  RETURN
```


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(3) Program example for a format 3 control table

```
100  'A program example that writes data nonsequentially to devices in a Q/QnA series PLC CPU's
                                                    device memory
110  DIM TBL%(20),A%(10)                       :  'Defines arrays
120  TBL%(0)=257                               :  'Specifies a format 3 control table
130  TBL%(1)=1                                 :  'Specifies network number 1
140  TBL%(2)=1                                 :  'Specifies station number 1
150  TBL%(4)=516                               :  'Specifies to write data to individual devices
                                                    of the Q/QnA series PLC CPU
160  TBL%(5)=&H3E3                             :  'Specifies the requested CPU (fourth CPU)
170  TBL%(6)=&H101                             :  'Writes to one bit device point and one
                                                    word device point
180  TBL%(7)=&H1                               :  'Writes to one double-word device point
190  TBL%(8)=168                               :  'Specifies data registers (D)
200  D!=0                                      :  'Specifies device number 0
210  GOSUB 430
220  TBL%(9)=I%                                :  'Stores the lower digit of the device number
230  TBL%(10)=H%                               :  'Stores the higher digit of the device
                                                    number
240  TBL%(11)=0                                :  'Specifies word units as processing unit
250  TBL%(12)=0                                :  'Fixed value
260  TBL%(13)=144                              :  'Specifies internal relays (M)
270  D!=0                                      :  'Specifies device number 0
280  GOSUB 430
290  TBL%(14)=L%                               :  'Stores the lower digit of the device number
300  TBL%(15)=H%                               :  'Stores the higher digit of the device
                                                    number
310  TBL%(16)=0                                :  'Specifies bit units as processing unit
320  TBL%(17)=0                                :  'Fixed value
330  TBL%(18)=168                              :  'Specifies data registers (D)
340  D!=8000                                   :  'Specifies device number 8000
GOSUB 430
360  TBL%(19)=L%                               :  'Stores the lower digit of the device number
370  TBL%(20)=H%                               :  'Stores the higher digit of the device
                                                    number
380  TBL%(21)=0                                :  'Specifies double-word units as processing
                                                    unit
390  TBL%(22)=0                                :  'Fixed value
400  A%(0)=100:A%(1)=200:A%(2)=300             :  'Specifies the values to write
410  PCRD TBL%( ),A%( )                        :  'Executes the write operation
420  END
430  H!=INT(D!/65536!)                         :  'Splits into lower and higher digits
440  L!=D!-H!*65536!
450  H$=RIGHT$("0000"+HEX$(H!),4)
460  L$=RIGHT$("0000"+HEX$(L!),4)
470  L%=VAL("&H"+L$)
480  H%=VAL("&H"+H$)
490  RETURN
```


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Processing Code 533

Writing data to the buffer memory of the intelligent function module/special function module of the Q/QnA series PLC CPU

Control table format definition

Only applicable to QD51 (-R24)

Element position			Item		Description
Format 1	Format 2	Format 3			
□%(0)	• • • • • • • • • • • • •		Station number		Specify the station number of the PLC.
	□%(0)	□%(0)	Control table		Specify a format 2 control table.
	□%(1)	□%(1)	Network number		Specify the network number.
	□%(2)	□%(2)	Station number		Specify the station number of the PLC.
	□%(3)	□%(3)	Detailed error code		Detailed error codes are stored here.
	|	□%(4)	Requested CPU		Specify the requested CPU.
□%(1)	□%(4)	□%(5)	Processing code		Specify the processing code.
□%(2)	□%(5)	□%(6)	Starting I/O number		Specify the starting I/O number of the intelligent function module/special function module.
□%(3)	□%(6)	□%(7)	Buffer memory starting address	Lower	Specify the starting I/O address of the intelligent function module's/special function module's buffer memory.
□%(4)	□%(7)	□%(8)		Higher	
□%(5)	□%(8)	□%(9)	Number of points		Specify the number of points to be written.

- It is possible to write data to buffer memory of the intelligent function module/special function module of the Q/QnA series PLC CPU using this code.
- Specify the following data for <control table>.

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Format 1 control table

□%(0) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(1) •••••• Processing code
• Specify 533 (&H215).

□%(2) •••••• Specify the starting I/O number of the intelligent function module/special function module to whose buffer memory data is to be written.

□%(3) •••••• Specify the address (lower) of buffer memory to which data is to be written.

□%(4) •••••• Specify the address (higher) of buffer memory to which data is to be written.

□%(5) •••••• Specify the number of bytes of data to be written, including the specified intelligent function module's/special function module's buffer memory address.
The allowable specification range is as follows:
• Q series CPU 1 to 1920 bytes
• QnA series CPU 1 to 960 bytes

Format 2 control table

□%(0) •••••• Format 2 control table
• Specify 256 (&H100).

□%(1) •••••• Specify the network number of the network to be accessed.
See Section 4.2.2 for the allowable specification range.

□%(2) •••••• Specify the station number of the PLC CPU to which data is written.
See Section 4.2.2 for the allowable specification range.

□%(3) •••••• Detailed error codes are stored here.
See Appendix 4.4.2 for the details about the error codes.

□%(4) •••••• Processing code
• Specify 533 (&H215).

□%(5) •••••• Specify the starting I/O number of the intelligent function module/special function module to whose buffer memory data is to be written.

□%(6) •••••• Specify the address (lower) of buffer memory to which data is to be written.

□%(7) •••••• Specify the address (higher) of buffer memory to which data is to be written.

□%(8) •••••• Specify the number of bytes of data to be written, including the specified intelligent function module's/special function module's buffer memory address.
The allowable specification range is as follows:
• Q series CPU 1 to 1920 bytes
• QnA series CPU 1 to 960 bytes

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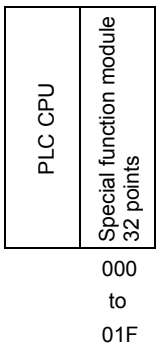
Format 3 control table

□%(0)	• • • • • •	Format 3 control table • Specify 257 (&H101).
□%(1)	• • • • • •	Specify the network number of the network to be accessed. See Section 4.2.2 for the allowable specification range.
□%(2)	• • • • • •	Specify the station number of the PLC CPU to which data is to be written. See Section 4.2.2 for the allowable specification range.
□%(3)	• • • • • •	Detailed error codes are stored here. See Appendix 4.4.2 for the details about the error codes.
□%(4)	• • • • • •	Processing code • Specify 533 (&H215).
□%(5)	• • • • • •	Specify the requested CPU. • PLC No.1 • • • • • • 992 (&H3E0) • PLC No.2 • • • • • • 993 (&H3E1) • PLC No.3 • • • • • • 994 (&H3E2) • PLC No.4 • • • • • • 995 (&H3E3) • Control PLC • • • • • • 1023 (&H3FF)
□%(6)	• • • • • •	Specify the starting I/O number of the intelligent function module/special function module to whose buffer memory data is to be written.
□%(7)	• • • • • •	Specify the address (lower) of buffer memory to which data is to be written.
□%(8)	• • • • • •	Specify the address (higher) of buffer memory to which data is to be written.
□%(9)	• • • • • •	Specify the number of bytes of data to be written, including the specified intelligent function module's/special function module's buffer memory address. The allowable specification range is as follows: • Q series CPU 1 to 1920 bytes • QnA series CPU 1 to 960 bytes

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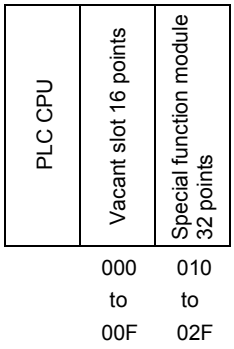
• The starting I/O number (hexadecimal) of the intelligent function module/special function module is the two higher digits of the 3-digit expression of the starting address of the intelligent function module's/special function module's I/O addresses viewed from the Q/QnA PLC CPU.

(a) In case of a single-slot module



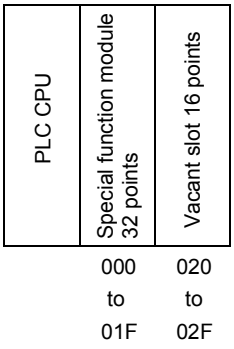
• • • • • • Since the starting address is 000_H, the special function module number is "00_H."

(b) In case of a module where the first half slot is allocated as a vacant slot (e.g., AD72, A84AD)



• • • • • • Since the starting address is 010_H, the special function module number is "01_H."

(c) In case of a module where the second half slot is allocated as a vacant slot (e.g., A61LS)

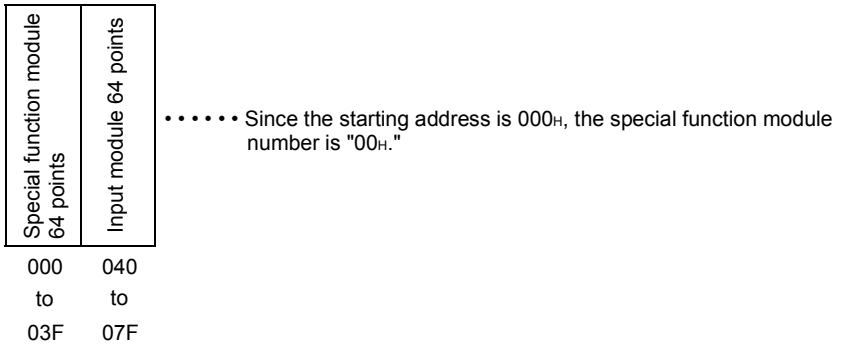


• • • • • • Since the starting address is 000_H, the special function module number is "00_H."

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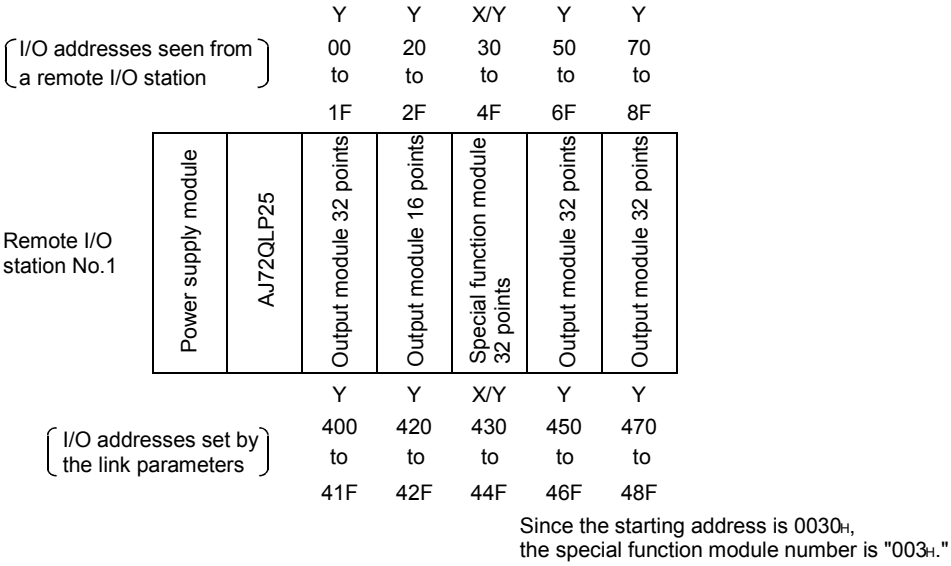
(d) In case of a module where both an intelligent function module and an input/output module are allocated (e.g., A81CPU)



(e) Module number of the intelligent function module/special function module of a MELSECNET/10 remote I/O station

The starting I/O module number of the intelligent function module/special function module of a MELSECNET/10 remote I/O station is always the three higher digits of the 4-digit expression of the starting number of the “I/O signals viewed from a remote I/O station.”

Specify the module number using the starting “I/O signal viewed from a remote I/O station” regardless of the settings of the common parameters set in the master station of the MELSECNET/10 remote I/O net.



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• The intelligent function module's/special function module's buffer memory contains 16 bits (one word) per one address and reading/writing operations between the PLC CPU and intelligent function module/special function module are performed with the FROM/TO instructions.
When reading/writing from the intelligent function module's/special function module's buffer memory to the QD51 (-R24) or vice versa, the operation is performed in units of 8 bits (one byte) per one address.

The addresses (hexadecimal) to specify in the QD51 (-R24) are obtained by the following conversion from addresses for the FROM/TO instructions.

Specified address (hexadecimal) = convert {(address for the FROM/TO instruction x 2)} into a hexadecimal number, then add (the starting address of each module)

Example: When specifying address 1 of the FROM/TO instructions (the preset value of CH.1) of the type AD61 high-speed counter module.

$$\left(\begin{array}{c}\text{Specified}\\ \text{address } 82_H\end{array}\right) = \left(\begin{array}{c}\text{FROM/TO instruction}\\ \text{address } 0 \times 2,\ 1_H \times 2\end{array}\right) + \left(\begin{array}{c}\text{starting}\\ \text{address } 80_H\end{array}\right)$$

See Appendix 8 for the starting address of each intelligent function module/special function module.

• Assign values to □%(3) and □%(4) (□%(6) and □%(7) in case of a format 2 control table, □%(7) and □%(8) in case of a format 3 control table) in the following manner.

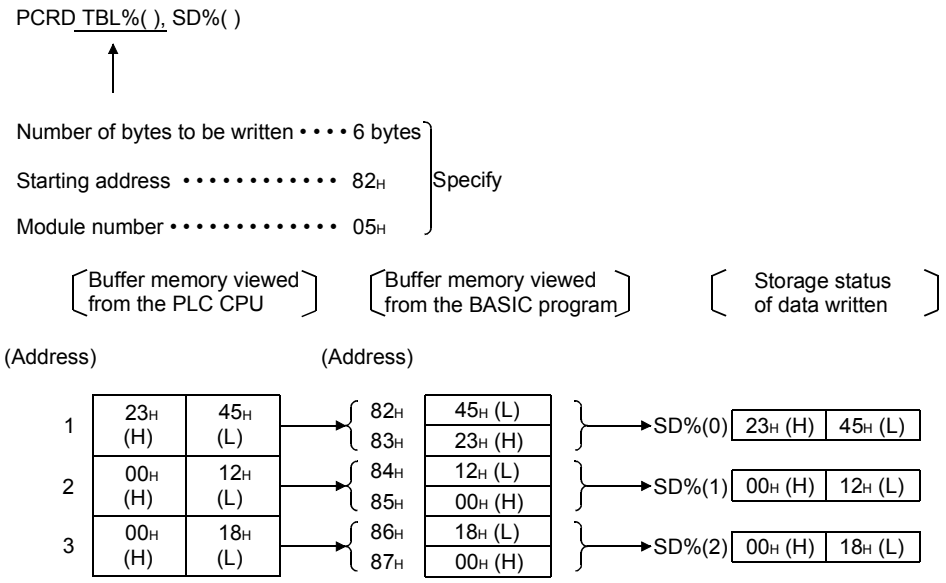
```
D!     • • • • • • The specified address calculated using the formula above
H!
L!     • • • • • • Used as work areas.
H&
L$
 to
100    H!=INT(D!/65536!)
110    L!=D!-H!*65536!
120    H$=RIGHT$("0000"+HEX$(H!))
130    L$=RIGHT$("0000"+HEX$(L!))          In case of a format 2 control table
140    □%(3)=VAL("&H"+L$) • • • • • • • • • •   □%(6)=VAL("&H"+L$)
150    □%(4)=VAL("&H"+H$) • • • • • • • • • •   □%(7)=VAL("&H"+H$)

 to
```

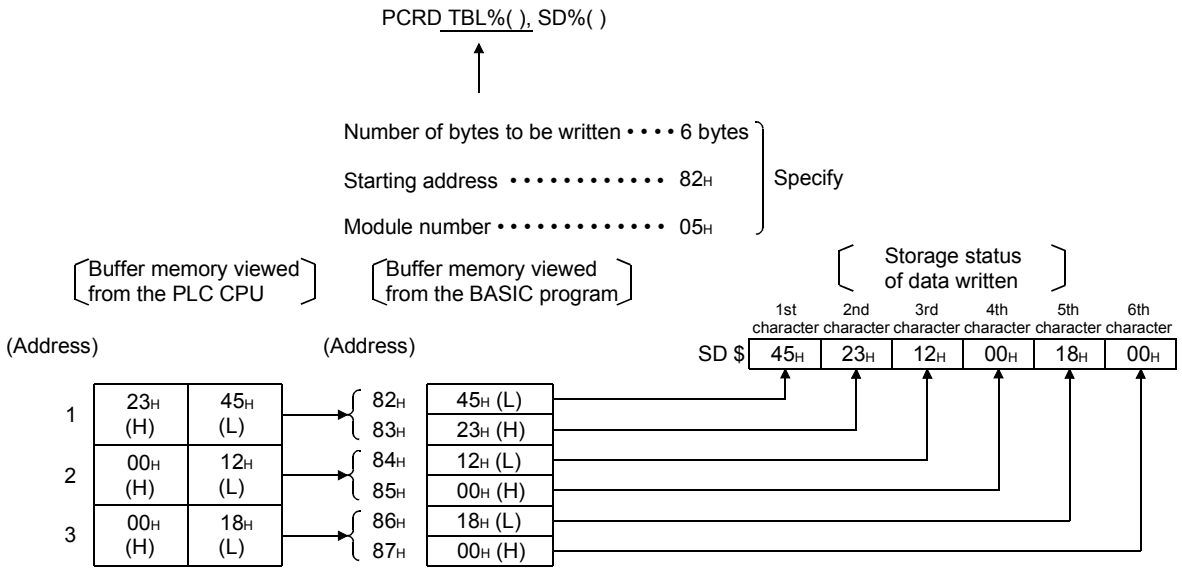

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• Data is stored in <storage area for data to be written> as follows:
Example: When writing data to buffer memory addresses 1 to 3 of an AD61 module whose I/O addresses are X/Y40 to X/Y5F.

1) If an input element is specified as an integer variable/array, the data is stored as follows:



2) If an input element is specified as a character variable or character array variable name:



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Program Example

(1) Program example of a format 1 control table

```
100  'A program example that writes data to buffer memory 1 of the intelligent function module
(Q62DA)
110  ' (Starting address of Q62DA: &H00)
120  DIM TBL%(10),A%(20)                    :  'Defines arrays
130  TBL%(0)=255                            :  'Specifies the station number to
                                                communicate with to the local station
140  TBL%(1)=533                            :  'Specifies to read buffer memory
150  TBL%(2)=&H0                            :  'Specifies the starting I/O number
160  D!=&H1                                 :  'Specifies the buffer memory address
170  H!=INT(D!/65536!)                      :  'Splits into lower and higher digits
180  L!=D!-H!*65536!
190  H$=RIGHT$("0000"+HEX$(H!),4)
200  L$=RIGHT$("0000"+HEX$(L!),4)
210  TBL%(3)=VAL("&H"+L$)                   :  'Stores the lower digit of the buffer memory
                                                address
220  TBL%(4)=VAL("&H"+H$)                   :  'Stores the higher digit of the buffer
                                                memory address
230  TBL%(5)=1                              :  'Specifies the number of points to be read
240  A%(0)=1000                             :  'Specifies the values to be written
250  PCRD TBL%( ),A%( )                     :  'Executes the write operation
260  END
```

(2) Program example of a format 2 control table

```
100  'A program example that writes data to buffer memory 1 of the intelligent function module
(Q62DA)
110  ' (Starting address of Q62DA: &H00)
120  DIM TBL%(10),A%(20)                    :  'Define arrays
130  TBL%(0)=256                            :  'Specifies a format 2 control table
140  TBL%(1)=1                              :  'Specifies network number 1
150  TBL%(2)=1                              :  'Specifies station number 1
160  TBL%(4)=533                            :  'Specifies to read buffer memory
170  TBL%(5)=&H0                            :  'Specifies the starting I/O number
180  D!=&H1                                 :  'Specifies the buffer memory address
190  H!=INT(D!/65536!)                      :  'Splits into lower and higher digits
200  L!=D!-H!*65536!
210  H$=RIGHT$("0000"+HEX$(H!),4)
220  L$=RIGHT$("0000"+HEX$(L!),4)
230  TBL%(6)=VAL("&H"+L$)                   :  'Stores the lower digit of the buffer memory
                                                address
240  TBL%(7)=VAL("&H"+H$)                   :  'Stores the higher digit of the buffer
                                                memory address
250  TBL%(8)=1                              :  'Specifies the number of points to be read
```


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```
260  A%(0)=1000                          :  'Specifies the values to be written
270  PCRD TBL%( ),A%( )                  :  'Executes the write operation
280  END
```

(3) Program example of a format 3 control table

```
100  'A program example that writes data to buffer memory 1 of the intelligent function module
                                            (Q62DA)
110  ' (Starting address of Q62DA: &H00)
120  DIM TBL%(10),A%(20)                 :  'Define arrays
130  TBL%(0)=256                         :  'Specifies a format 3 control table
140  TBL%(1)=1                           :  'Specifies network number 1
150  TBL%(2)=1                           :  'Specifies station number 1
160  TBL%(4)=533                         :  'Specifies to read buffer memory
170  TBL%(5)=&H3E3                       :  'Specifies the requested CPU (PLC No.4)
180  TBL(6)=&H0                          :  'Specifies the starting I/O number
190  D!=&H1                              :  'Specifies the buffer memory address
200  H!=INT(D!/65536!)                   :  'Splits into lower and higher digits
210  L!=D!-H!*65536!
220  H$=RIGHT$("0000"+HEX$(H!),4)
230  L$=RIGHT$("0000"+HEX$(L!),4)
240  TBL%(7)=VAL("&H"+L$)                :  'Stores the lower digit of the buffer memory
                                            address
250  TBL%(7)=VAL("&H"+L$)                :  'Stores the higher digit of the buffer
                                            memory address
260  TBL%(9)=1                           :  'Specifies the number of points to be read
270  A%(0)=1000                          :  'Specifies the values to be written
280  PCRD TBL%( ),A%( )                  :  'Executes the write operation
290  END
```


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PRINT Instruction PRINT

• Displays data on the screen.

Syntax

PRINT△[<data to be displayed>][;]

data to be displayed • • • • Specify the numeric values, numeric variables, character strings, or character string variables to be displayed.

Examples

PRINT “ABC” • • • • Displays ABC.

PRINT “ABC”,”DEF” • • • • Displays 14 characters starting with ABC, and then 14 characters starting with DEF.

PRINT “ABC”;”DEF” • • • • Displays ABCDEF.

Description

• The PRINT instruction displays data on the screen.
• Data is displayed on a console or terminal specified by the ZODV instruction.
• If <data to be displayed> is omitted, one line of blank space is displayed.
• A character string must be enclosed with double quotation marks (“).
• The position where the value of <data to be displayed> is displayed is determined by the symbol used to separate two items of <data to be displayed>.
In BASIC, one line is divided into areas, each of which contains 14 characters.
If two items of <data to be displayed> are separated by a comma (,), the second item of <data to be displayed> is displayed starting from the beginning of the next area.
If two items of <data to be displayed> are separated by semicolon (;), the second item of <data to be displayed> is displayed following the first character string in immediate succession.
Note, however, that a comma (,) cannot be used to separate items of <data to be displayed> unless the data is to be displayed on the console screen. An error occurs if a comma is used.
Furthermore, if a space is used to separate items of <data to be displayed>, the same result as when a semicolon is used will be obtained.
• If only a comma (,) is placed following the <data to be displayed> of the PRINT instruction, the data of the next PRINT instruction is displayed starting from the next area. If only a semicolon (;) is placed following the <data to be displayed>, the data of the next PRINT instruction is displayed following the data of the previous PRINT instruction in succession.

```
PRINT "ABC" ,
PRINT "DEF" ,
```

```
ABC     DEF
 14      14
characters characters
```

```
PRINT "ABC" ;
PRINT "DEF" ;
```

```
ABCDEF
```

• If no comma or semicolon is specified, a new line starts after the corresponding line is displayed.
• If the line to be displayed exceeds the line width of the screen, the remaining data is displayed in the next line.
• When a value is displayed, a blank space is always appended to it. In addition, a blank space is placed immediately before a positive numeric value, and a negative sign (-) is placed immediately before a negative numeric value.

REMARK

See the LOCATE, PRINT USING, SPC and TAB instructions, and Section 3.10.

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PRINT USING Instruction

PRINT USING

• Displays a character string or numeric value in the specified format.

Syntax

PRINT△USING△"<display format>"; <data to be displayed>

display format	• • • •	Specify the format of the character string or numeric value to be displayed.
data to be displayed	• • • •	Specify the character string or numeric value to be displayed.

Examples

```
PRINT USING "###.##" ;123.56 ———— Displays 123.56.
123.56

PRINT USING "&    &" , "ABCD"  ——— Displays four letters, ABCD.
ABCD
```

Description

• The PRINT USING instruction displays data in the specified format.
• Specify the type of format for displaying a character string or numeric value in <display format> (see the next page).
• It is possible to output the data to the console screen as well as to a general-purpose port.

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[Format specification for a character string]
In order to display a character string using the PRINT USING instruction, it is necessary to employ one of the following format characters to determine the format of the character string.

Format character	Function	Example
"!"	Displays the starting character of a given character string.	PRINT USING "!" ;" ABC" A OK
"& n spaces &"	• Displays 2 + n characters from the beginning of a given character string. • Displays 2 characters if no space is specified between the two & characters. • If a given character string is longer than the length specified in the format, the extra characters are not displayed. • A given character string is displayed left-justified and blank spaces are placed for any remaining character spaces of the format.	PRINT USING "& &" ;" ABCD" ABCD OD PRINT USING "& &" ;" ABCD" ;" EFGH" ABCDEFGH OK PRINT USING "& &" ;" AB" ;" CD" AB CD OK

[Format specification for a numeric value]
In order to display a numeric value using the PRINT USING instruction, it is necessary to employ one of the following special characters to determine the format of the numeric value.

Format character	Function	Example
"#"	• Indicates the place of each digit of a numeric value. • A number or a space must be placed at the place of the digit where this character is specified. • If the number of digits of a value to be displayed is less than the specified number of digits, the numeric value is displayed right-justified according to the format and blank spaces are placed for any remaining digit spaces to the left. • If a numeric value has more digits than the number of # characters, a "%" character is displayed at the beginning.	PRINT USING " ####" ;123 123 OK PRINT USING " ##" ;123 %123 OK

(Continued on the next page)

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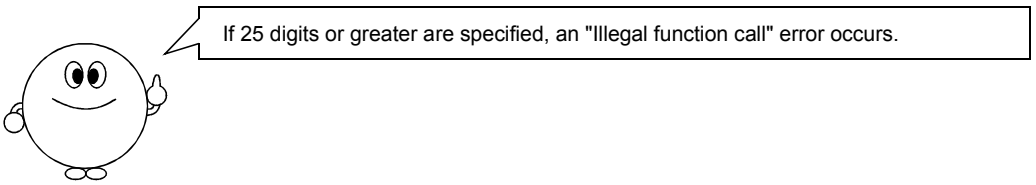
Format character	Function	Example
"."	• A decimal point is inserted. A decimal point can be inserted at any place in the format. • If a format string is placed following a decimal point, the corresponding digits are always displayed. • 0 is displayed for redundant digits in the decimal part. • If the number of decimal places in the format string is smaller than the number of digits in the decimal part of a numeric value, the numeric value is rounded to the specified digit and displayed. • If the number of digits of a numeric value exceeds the number of digits in the format as a result of rounding up the numeric value, % is displayed before the rounded numeric value.	PRINT USING " ##.##" ;.78 0.78 OK PRINT USING " ##.##" ;78 78.00 OK PRINT USING " ##.##" ;78.125 78.13 OK PRINT USING " .##" ;.999 %1.00 OK
"+"	If this character is specified at the beginning or end of the format string, the sign (+ or -) of the value is displayed before or after a numeric value, respectively.	PRINT USING " +##.#" ;–68.9 –68.9 OK PRINTUSING " +##.#" ;24 +24.0 OK PRINT USING " ##.#+ ;–55 55.0– OK
"-"	If this character is specified at the end of the format string, a negative sign (-) is displayed after a negative numeric value.	PRINT USING " ##.#-" ;–70.1 70.1– OK
"**"	If these characters are specified at the beginning of the format string, * is displayed at leading spaces of a numeric value. ** reserves an area for two digits, in the same way as "##."	PRINT USING " **#.#" ;12.39 *12.4 OK PRINT USING " **#.#" ;765.1 765.1 OK
"\\"	• If this character is specified at the beginning of the format string, \ is displayed immediately to the left of a formatted numeric value. \\ reserves an area for two digits, but only the space for one digit among them is used for \. • It is not allowed to specify \\ for a numeric value in exponential format.	PRINT USING " \\###.#" ;456.7 \456.7 OK
"**\"	• If these characters are specified at the beginning of the format string, * is displayed at the leading part and \ is displayed immediately before the number. • **\ reserves an area for three digits, but only one digit among them is used for \.	PRINT USING " **\##.##" ;2.34 ***\2.34 OK

(Continued on the next page)

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Format character	Function	Example
","	• If a comma is specified to the left of a decimal point in the format string, digits in the integer part is divided in three-digit units by commas and then displayed. • A comma reserves an area for one digit. • A comma is invalid if used together with the exponential format (^^^^).	PRINT USING " ###,.##" ;1234.5 1,234.50 OK PRINT USING " ####.##," ;1234.5 1234.50, OK
"^^^^"	• If these characters are placed at the end of a string that specifies a number of digits, a numeric value is displayed in the exponential format. • ^^^^ reserves an area for the displayed characteristic E+XX. • The valid digits are displayed left-justified together with the characteristic. • If a + sign or a +/— sign is not specified at the beginning or end of the format string, respectively, a blank space or a – sign is displayed for the integer part.	PRINT USING " ##.##^^^^" ;234.56 2.35e+02 OK PRINT USING " .####&&&&" ;888888 .0889e+07 OK PRINT USING " +.##&&&&" ;123 +.12E+03 OK



[Multi-field]

It is possible to specify multiple format strings in one PRINT USING instruction. In addition, each of the format strings can be separated by characters other than the format characters. Each of the format strings corresponds to a character string or value to be output, and their order. If the number of format strings is smaller than the number of input data, the correspondence returns to the first format string and is repeated.

Example

PRINT USING "No. ##### AD51H & &";12345;" BASIC Instruction Manual"
No. 12345 AD51H BASIC Instruction Manual
OK

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PRINT# Instruction

PRINT#

• Writes data to a sequential file.

Syntax

PRINT△#<file number>, <data to be written>

file number	• • • •	Specify the file number of a file opened as a sequential file using the OPEN instruction.
data to be written	• • • •	Specify the numeric values or character string expressions to be written to the file.

Examples

PRINT #1,A	• • • •	Writes the value of A to the file opened as file number 1.
PRINT #2,A$	• • • •	Whites the character string A$ to the file opened as file number 2.

Description

• The PRINT# instruction writes data to a sequential file.
• In order to use the PRINT# instruction, it is necessary to open a sequential file using the OPEN instruction in advance.
• The PRINT# instruction writes data to a sequential file in the same manner as data is displayed on the display screen using the PRINT instruction. Therefore, it is necessary to use semicolons (;) to separate numeric expressions and character string expressions in <data to be written>.
If a comma (,) is used instead of a semicolon (;) to separate expressions, any extra spaces that would be inserted when displaying numeric values and characters, are also written to a file.
• The PRINT# instruction does not display data on the screen.

REMARK

See the OPEN, INPUT#, LINE INPUT#, CLOSE PRINT, PRINT USING and PRINT# USING instructions, and Chapter 6.

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PRINT# USING Instruction

PRINT# USING

• Writes data to a sequential file in the specified format.

Syntax

PRINT△#<file number>,USING△"<display format>";<data to be written>

file number	• • • •	Specify the file number of a file opened as a sequential file using the OPEN instruction.
display format	• • • •	Specify the format for characters/numeric values.
data to be written	• • • •	Specify the numeric values or character string expressions to be written to the file.

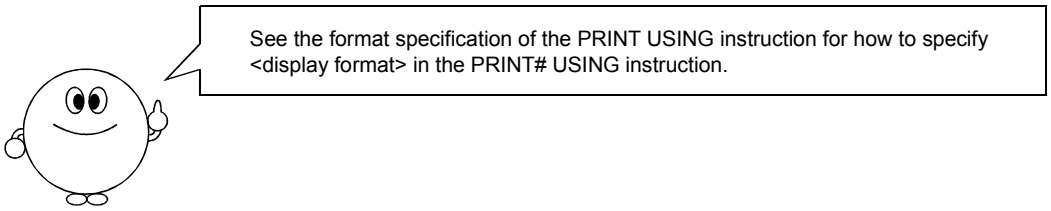
Examples

PRINT #1,
USING "####& &";A;B$ • • • • Places the numeric value A according to the # format and the character string B$ according to the & format, and writes them to the file opened as file number 1.
A=1234 B$="ABCD"
Sequential file #1 1234ABCD

PRINT #2,
USING "\\###.#";C • • • • Adds \ to the numeric value C and writes it to the file opened as file number 2. C=456.7
Sequential file #2 △\456.7

Description

• The PRINT# USING instruction writes data with the specified format to a sequential file.
• In order to use the PRINT# USING instruction, it is necessary to open a sequential file using the OPEN instruction in advance.
• When the PRINT# USING instruction is executed, the content in <data to be written> is written to the file according to the format specified by the character string expression. The data is not displayed on the screen.



REMARK

See the PRINT, PRINT USING and PRINT# instructions, and Chapter 6.

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PUT Instruction

PUT

• Writes one record from a random file buffer to a random file.

Syntax

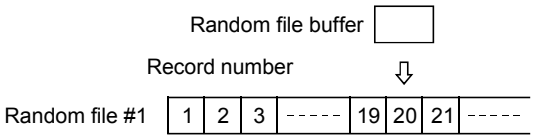
PUT△#<file number>[,<record number>]

file number • • • • Specify the file number of the file to which data is written.

record number • • • • Specify the record number to which data is written.

Examples

PUT #1,20 • • • • Writes a record to the 20th record in the random file opened as file number 1.



Description

• The PUT instruction writes data in a random file buffer to a random file.
• If <file number> is omitted, data will be written to the record number next to the one specified by the GET or PUT instruction executed immediately before.
If <record number> is not specified in the PUT instruction executed immediately after the OPEN instruction, “1” is assigned to <record number> and the data will be written to record number 1.
• When the PUT instruction is executed, 256 bytes of data in the random file buffer are written to the specified record.

REMARK

See the OPEN, FIELD, GET, LSET and RSET instructions, and Chapter 6.

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PUTMEM Instruction — PUT MEMory

• Writes data to the communication module's buffer memory, common memory, or extension registers (ED).

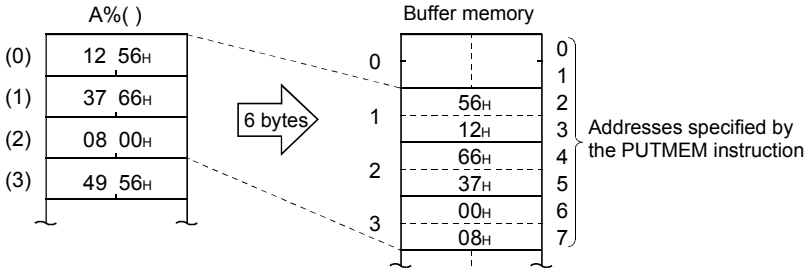
Syntax

PUTMEM△TO△<write destination>,<offset 1>,<FROM>△<storage area for data to be written>,<offset 2>,<number of bytes>

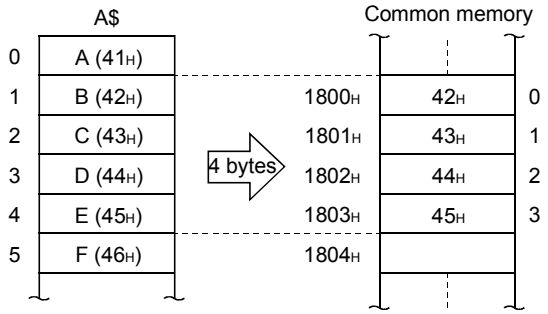
write destination	• • • •	Specify the starting address of buffer memory or common memory, or the starting device number of extension registers (ED).
storage area for data to be written	• • • •	Specify an integer variable, integer array name, character string variable, or character string array variable where the data to be written is stored.
offset 1	• • • •	Specify the offset value (in byte units) from the beginning of the write destination.
offset 2	• • • •	Specify the offset value (in byte units) from the beginning of the storage area for data to be written.
number of bytes	• • • •	Specify the length of data to be written in byte units.

Examples

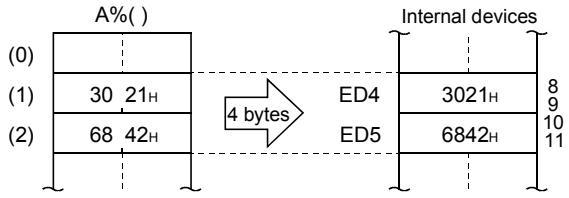
PUTMEM TO 0,2 FROM A%( ),0,6 • • • • Writes data in A%(0) to A%(2) (6 bytes) to communication module's buffer memory 1 to 3.



PUTMEM TO &H1800,0 FROM $,1,4 • • • • Writes data of the 1st to 4th character elements in A$ (4 bytes) to communication module's common memory addresses &H1800 to &H1803.



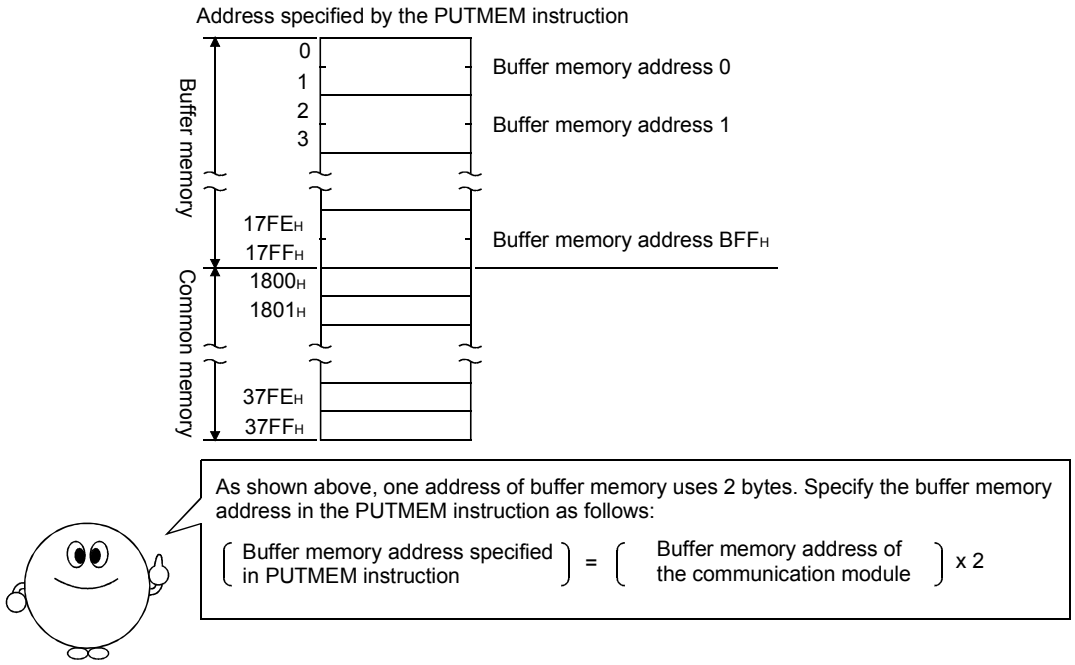
PUTMEM TO W@ (ED,2),4 FROM A%( ),2,4 • • • • Writes data in A%(1) and A%(2) (4 bytes) to ED4 and ED5.



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Description

- The data specified by <storage area for data to be written>, <offset 2> and <number of bytes> is written to buffer memory, common memory, or extension registers (ED) specified by <write destination> and <offset 1>.
- Specify either the address of buffer memory/common memory, or the device of extension registers for <write destination>.
  Buffer memory and common memory addresses are provided in the following manner.
  Specify the starting address to which data is to be written for <write destination>.



In order to write to extension registers, use the special variable W@ (ED,n) and specify the starting device of the write destination.

When ED 100 is the starting device → W@ (ED, 100)
When ED 20 is the starting device → W@ (ED, 20)

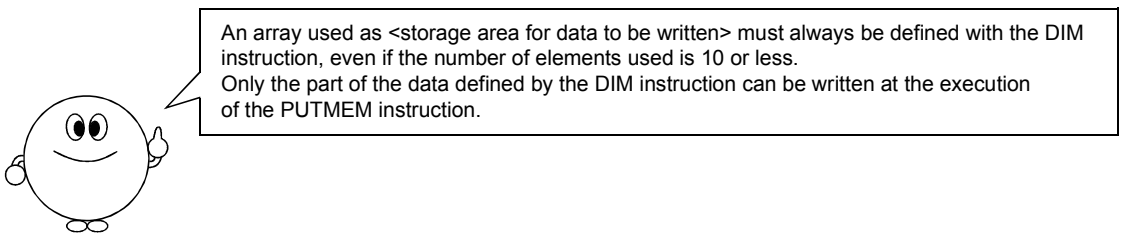
REMARK

See Section 4.3 (buffer memory) and Section 8.5.1 (common memory and extension registers) for how to store data to be written.

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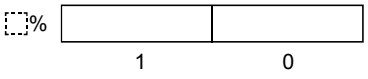
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• Specify a variable or similar that stores the data to be written to buffer memory, etc. for <storage area for data to be written>. In addition, it is necessary that the specified variable stores more data than the amount specified by <offset> and <number of bytes>.



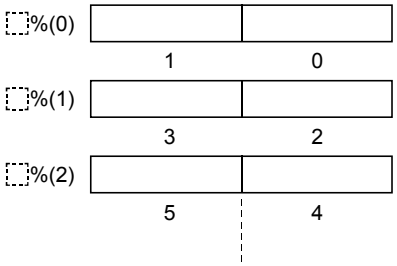
• If a character variable or character array variable is specified for <storage area for data to be written>, the character codes corresponding to the characters to be written are stored in the write destination.
Specify the offset value with respect to the address/device specified in <write destination> in <offset 1> in byte units.
• Specify which part of the data in variables, etc. specified in <storage area for data to be written> in <offset 2> should be written first, in byte units.

When an integer variable is specified



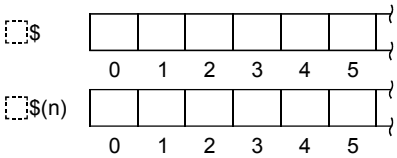
An integer variable contains 2 bytes (= 16 bits) per one variable. Specify 0 to specify the lower byte and 1 to specify the higher byte.

When an integer array variable name is specified



An integer array contains 2 bytes (= 16 bytes) per one element, thus the offset value should be specified as follows:
• When specifying the lower byte of element number n
<offset> = n × 2
• When specifying the higher byte of element number n
<offset> = n × 2 + 1

When a character variable or character array variable is specified



One half-byte character in a variable is 1 byte for a character variable and character array variable. Specify as follows when the nth character in a variable is specified as the starting data:
<offset> = n − 1

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• Specify the length of the data to be written from the starting position specified in <offset 2> for <number of bytes> in byte units.

  If an integer variable or integer array is specified in <storage area for data to be written>, the number of bytes specified when writing n elements is as follows, since one element (variable) contains 2 bytes:

  <number of bytes> = n × 2

  If a character variable or character array variable is specified in <storage area for data to be written>, the number of bytes specified when writing n characters is as follows, since one en character contains 2 bytes:

  <number of bytes> = n

• The allocation, size and type of each data item in buffer memory should be managed by the user.
  Data is not converted during reading or writing data from/to buffer memory, etc.
• If multiple programs read or write from/to the same area of buffer memory, etc. at one time, use exclusive control to the area to one program at a time using the ZRESERVE and ZRELEASE instructions.
  Common memory can be read/written by multiple programs concurrently. An error does not occur even if a program makes a write request to the area of common memory where another program is reading/writing data.

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Program Example

```
10 ' This program writes data to extension registers (TASK 1)
20 ZODV O                                    :  'Displays on the console
30 DIM A%(9)                                 :  'Defines an array
40 DEF ZEVENT 1                              :  'Defines an event
50 ZEVENT ENABLE 1                           :  'Enables event generation
60 A$="TASK 1 writing data"                  :  'Defines an message
70 B$="TASK 1 writing data completed"
80 FOR I=1 TO 10                             :  'Writes the data
90  A%(I-1)=I
100 NEXT I
110 ZRESERVE 1                               :  'Reserves resource number 1
120 LOCATE 0,2                               :  'Specifies the display position
130 PRINT A$                                 :  'Displays the message
140 PUTMEM TO W@(ED,0),0 FROM A%( ),0,20     :  'Executes the write operation
150 PRINT B$                                 :  'Displays the message
160 ZSIGNAL 1                                :  'Event generation
170 PRINT "Data written"                     :  'Displays the data written
180 FOR I=1 TO 10
190  PRINT A%(I-1),
200 NEXT I
210 ZRELEASE 1                               :  'Releases resource number 1
220 END                                      :  'Ends the execution

10 ' This program reads data from extension registers (TASK 2)
20 ZODV O                                    :  'Displays on the console
30 DIM B%(9)                                 :  'Defines an array
40 C$="TASK 2 reading data"                  :  'Defines a message
50 D$="TASK 2 reading data completed"
60 FOR I=0 TO 9                              :  'Stores dummy values
70  B%(I)=0
80 NEXT I
90 ZWAIT EVENT 1                             :  'Waits for event generation
100 ZRESERVE 1                               :  'Reserves resource number 1
110 LOCATE 0,15                              :  'Specifies the display position
120 PRINT C$                                 :  'Displays the message
130 GETMEM TO B%( ),0 FROM W@(ED,0),0,20     :  'Executes the read operation
140 PRINT D$                                 :  'Displays the message
150 PRINT "Data read"                        :  'Displays the data read
160 FOR I=1 TO 10
170  PRINT B%(I-1),
180 NEXT I
190 ZRELEASE 1                               :  'Releases resource number 1
200 END                                      :  'Ends the execution
```

REMARK

See the GETMEM instruction and Section 8.5.1.

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RDSET Function — ReaD SET

• Reads one bit data from the specified bit of an integer array variable.

Syntax

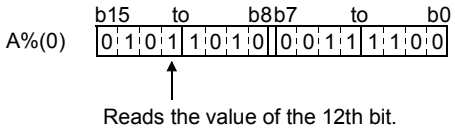
RDSET(<integer expression>,<array element>)

integer expression • • • • Specify which bit to read from the specified integer array, using an integer from -32768 to 65535.

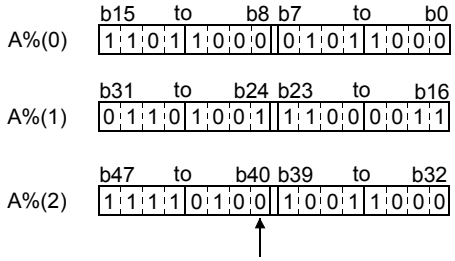
array element • • • • Specify an element of a one-dimensional integer array from which data is read.

Examples

B=RDSET(12,A%(0)) • • • • Reads the value of the 12th bit counting from the 0th bit of A%(0) to B.



B=RDSET(40,A%(0)) • • • • Reads the value of the 40th bit counting from the 0th bit of A%(0) to B.



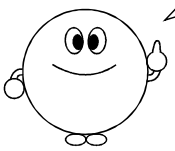
Description

• The RDSET function reads the bit data at a position specified in <integer expression> in the one-dimensional integer array variable specified in <array element>.

• In the bit specification by <integer expression>, it is possible to specify any bit in the array elements relative to the 0th bit of the specified array element.
For example, if values from 0 to 15 are specified, they correspond to each bit of the specified array element. If values from 16 to 31 are specified, they correspond to each bit in the element next to the specified array element (see Example above).
An “Illegal function call” error occurs if the specified value indicates a bit position that exceeds the total number of bits contained in an array variable defined by the DIM instruction.

• Only a one-dimensional integer array variable can be specified in <array variable>.
If a variable other than a one-dimensional integer array variable is specified, an “Illegal function call” error occurs.

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The range of integers that can be expressed by 16 bits is from -32768 to 32767, which are expressed in hexadecimal as follows. If values from -32768 to -1 are specified in decimal, it is assumed that values from 32768 to 65535 are specified.

Decimal	Hexadecimal	Binary
65535 to 32768	$FFFF_H$ to 8000_H	1111 1111 1111 1111 to 1000 0000 0000 0000
32767 to 0	$7FFF_H$ to 0000_H	0111 1111 1111 1111 to 0000 0000 0000 0000
-1 to -32768	$FFFF_H$ to 8000_H	1111 1111 1111 1111 to 1000 0000 0000 0000

These are the same.

Program Example

```
10 ' This program reads one bit data from the specified array
20 DIM A%(0)                          :  'Defines an array
30 A%(0)=&H5F5F
40 FOR I=0 TO 15                      :  'Repeats from I = 0 to 15
50 A=RDSET(I,A%(0))                   :  'Reads the data
60 PRINT A;                           :  'Displays the result
70 NEXT I

RUN
 1 1 1 1 1 0 1 0 1 1 1 1 1 0 1 0
OK
```

REMARK

See the WTSET instruction.

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READ Instruction — READ

• Reads a value defined by the DATA instruction and assigns it to a variable.

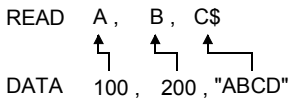
Syntax

READ△<variable name>[,<variable name>]…

variable name •••• Specify the variable to which the data defined by the DATA instruction is to be assigned.

Examples

READ A,B,C$ •••• From the DATA sentence, the numeric values are assigned to A and B and the character string is assigned to C$.



Description

• The READ instruction reads a value defined by the DATA instruction and assigns it to a variable.
• The READ instruction must always be used together with the DATA instruction.
• Each variable in the READ instruction must be one-to-one correspondence to the value of the DATA instruction.
• The variable type specified in the READ instruction can be either a numeric value or character string. However, the types of the value to be read and the variable must match. If the types do not match, a “Syntax error” occurs on the DATA instruction side and the execution stops.
• One READ instruction can reference one or more DATA instructions in sequence.
• If the number of variables in the READ instruction exceeds the number of data specified in the DATA instruction, the error message “Out of data” is displayed.
• If the number of variables is smaller than the number of data specified in the DATA instruction, the READ instruction executed later will read the remaining values sequentially.
If not enough READ instructions are executed, the remaining data are ignored.
Use the RESTORE instruction in order to read values in the DATA instruction from the start again or from the specified position.

REMARK

See the DATA and RESTORE instructions, and Section 3.5.2.

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REM Instruction — REMark

• Provides comments (remarks) in a program.

Syntax

REM△ [<comment>]

Comment • • • • Write the appropriate comment.

Examples

REM**AD51H** or • • • • Indicates that the program is related to the AD51H.

'**AD51H**

Description

• The REM instruction is used to provide comments in a program. It does not affect the execution of a program. The content entered is displayed as it is in the program list.

• It is possible to branch to a REM instruction from a GOTO or GOSUB instruction, but in this case the execution is simply started from the first executable instruction after the REM instruction.

• An apostrophe (') can also be used in place of REM.
A comment starting with an apostrophe (') can be written in the same line as other instructions.
However, it is not allowed to write other instructions after the comment in a successive manner. All text and symbols from an apostrophe (') to the end of line is regarded as a comment.

REMARK

See Section 2.5.

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RENUM Instruction RENUMber

• Reassigns line numbers of a program.

Syntax

RENUM△ [<new start line number>][,[<old start line number>][,<increment>]]

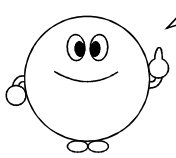
new start line number	• • • •	Specify the starting number for the line numbers to be assigned anew.
old start line number	• • • •	Specify the line number of the current program where the new line numbering starts.
increment	• • • •	Specify the increment per one line in the new line numbering.

Examples

RENUM 500,100, 5	• • • •	Reassigns line numbers anew from the current line 100, starting from line 500 in increments of 5.

Description

• The RENUM instruction reassigns the line numbers of a program.
• Specify values from 1 to 65529 for <new start line number> and <old start line number>.
• If <new start line number> is omitted, it is assumed that 10 is specified.
• If <old start line number> is omitted, line numbers are reassigned from the start line of the current program.
• <increment> is the value increased per one line in the new line numbering. If it is omitted, it is assumed that 10 is specified.
• The RENUM instruction changes the line numbers used in each of instructions such as GOTO, GOSUB, IF-THEN, IF-GOTO, ON-GOTO and ON-GOSUB, as well as instructions for evaluating conditions using the ERL function and the RESTORE and RESUME instructions. They are changed in accordance with the new line numbering.
However, line numbers specified by the CHAIN instruction are not changed.
The error message “Undefined line xxxxx in yyyyy” is displayed if line numbers do not exist in these instructions.
In the error message, xxxxx indicates the line number that did not exist and yyyyy indicates the new line number.
In this case, the non-existent line numbers remain as they are.



It is not possible to change the order of program lines using the RENUM instruction (for example, if 10, 20 and 30 are assigned to a program as line numbers, RENUM 15,30 cannot be specified).

(Incorrect) Program
10
20
30
RENUM 15,30 → ×

(Correct) Program
10
20
30
RENUM 30,10 →

Program
30
40
50

Moreover, line numbers greater than 65529 cannot be generated. If such a specification is made, an "Illegal function call" error occurs.

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RESTORE Instruction

RESTORE

• Specifies the first line number of the DATA instruction data that are to be read by READ.

Syntax

RESTORE△ [<line number>]

line number • • • • Specify the line number of the next DATA instruction to be read.

Examples

RESTORE 60 • • • • Starts reading data in the DATA instruction in line 60.

Description

- The RESTORE instruction specifies a line number in such a way that a subsequent READ instruction reads values of the DATA instruction, starting from the first data in the DATA instruction in the specified line number.
- If <line number> is omitted, the READ instruction after the execution of the RESTORE instruction reads values from the first DATA instruction in the program.
- If <line number> is specified, the READ instruction after the execution of the RESTORE instruction starts reading from the first value of the DATA instruction in the specified line number.
- <line number> can also be specified using a label name.

Program Example

```
10 ' This program specifies the position of data read by the READ instruction, using the RESTORE
instruction
20 RESTORE 200                          :  ' Reads data in line 200
40 READ A$,B$,C$:PRINT A$,B$,C$         :  ' Reads and display the data
60 RESTORE 100                          :  ' Reads data in line 100
80 READ A$,B$,C$:PRINT A$,B$,C$         :  ' Reads and displays the data
90 END
100 DATA Tokyo, Osaka, Nagoya
200 DATA Sapporo, Sendai, Kanazawa

RUN
Sapporo       Sendai        Kanazawa
Tokyo         Osaka         Nagoya
OK
```

REMARK

See the READ and DATA instructions, and Section 3.5.2.

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RESUME Instruction RESUME

• Resumes the program execution after the error handling is completed by the ON ERROR GOTO instruction.

Syntax

RESUME△[<position to resume the execution>]

position to resume the execution • • • • Specify the position where the program execution is to be resumed after the error handling.

- No specification • • • The execution is resumed from the instruction that caused the error.
- Specification of NEXT • • • The execution is resumed from the instruction immediately after the instruction that caused the error.
- Specification of a line number • • • The execution is resumed from the specified line number.

Examples

RESUME	• • • •	Ends the error handling and resumes the program execution from the instruction that caused an error.
RESUME NEXT	• • • •	Ends the error handling and resumes the program execution from the instruction immediately after the instruction that caused an error.
RESUME 150	• • • •	Ends the error handling and resumes the program execution from line 150.

Description

• The RESUME instruction ends the error handling specified by the ON ERROR GOTO instruction and resumes the program execution.
• Use one of the types shown below, depending on where the program execution should be resumed:

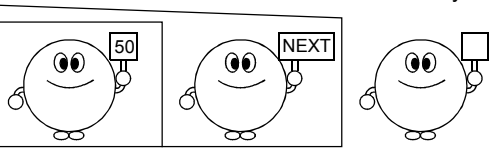
(1) RESUME
Resumes the program execution from the instruction that caused the error.

(2) RESUME NEXT
Resumes the program execution from the instruction immediately after the instruction that caused the error.

(3) RESUME <line number>
Resumes the program execution from the line specified in <line number>.

Program Example

```
10 ON ERROR GOTO 100
20 A=0
30 PRINT 100/A ••••••••••• An error occurs because 100 is devided by 0.
40 PRINT "End"
50 END
100 REM Error handling
110 A=1
120 RESUME
```



Specification of a line number	Specification of NEXT	No specification
⇩	⇩	⇩
The program is executed from the specified line number.	The program is executed from the instruction immediately after the instruction where the error occurred.	The program is executed from the instruction where the error occurred.

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RIGHT$ Function

RIGHT$

• Extracts a character string consisting of the specified number of characters from the right end of a character string and assigns it to a variable.

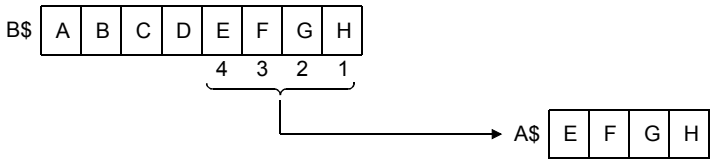
Syntax

RIGHT$(<character string expression>, <numeric expression>)

character string expression • • • • Specify the character string that is to be processed.
numeric expression • • • • Specify the number of characters to be extracted.

Examples

A$=RIGHT$(B$, 4) • • • • Extracts four characters from the right end of B$ and assign them to A$.



Description

• The RIGHT$ function extracts a character string consisting of the specified number of characters from the right end of the string and assigns it to a variable.
• <numeric expression> indicates the length of the character string to be extracted.
• If the value of <numeric expression> is 0, a null character string (" ") is returned. If a value greater than 255 is specified, an "Illegal function call" error occurs.
• If the value of <numeric expression> is equal to or greater than the length in <character string expression>, the entire <character string expression> is returned.

Program Example

```
10 ' This program extracts seven characters from the right end of a character string
20 A$="Sequence program"                    :  'Defines a character string
30 B$=RIGHT$(A$,7)                          :  'Specifies to extract seven characters from
                                                the right
50 PRINT "Seven characters from the right--->";B$   :  'Displays the extracted character string
60 END


RUN
Seven characters from the right--->program
OK
```

REMARK

See the LEFT$, MID$ (1) and MID$ (2) functions, and Section 3.13.2.

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RND Function RaNDom

• Generates random numbers.

Syntax

RND(<numeric expression>)

numeric expression • • • • The generated random number varies depending on whether a positive, 0, or negative number is specified.

Examples

A=RND(1) • • • • Assigns the value generated by RND(1) to the variable A.

B=RND(0) • • • • Generates a random number of the sequence generated previously and assign it to the variable B.

C=RND(-1) • • • • Generates a random number of a new random number sequence and assign it to the variable C.

Description

• The RND function generates a random number in the interval from 0 and up to, but not including, 1.

• The generated random number varies depending on the value specified in <numeric expression>.

If <numeric expression> is positive • • • • A new random number is generated.

If <numeric expression> is 0 • • • • A random number of the sequence generated previously is generated.

If <numeric expression> is negative • • • • A random number of a new random number sequence is generated.

Program Example

```
10 ' This program generates random numbers
20 DIM A(10)                          :  'Defines an array
30 PRINT "RND(1)"
40 FOR I=1 TO 10                      :  'Repeats from I = 1 to 10
50  A(I)=RND(1)                       :  'Generates random numbers by RND(1)
60  PRINT A(I)                        :  'Displays the result
70 NEXT I

RUN
RND(1)
 .286546
 .784621
 .137119
 .226544
 .215274
 .876763
 .8574
 .567958
 .364675
 .0333645
OK
```


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ROT Function — ROTation

• Rotates the memory contents of the specified value and returns the bit-rotated value.

Syntax

ROT△(<numeric expression 1>,<numeric expression 2>)

numeric expression 1	• • • •	Specify the value whose bits are rotated, as an integer value.
numeric expression 2	• • • •	Specify the shift direction and the number of bits, as an integer value.

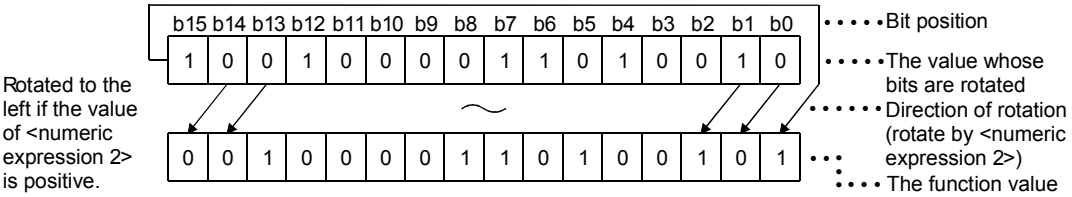
Examples

A%=ROT(B%,C%)	• • • •	Bit-rotates the value of B% by the value of C% and assigns it to A%.
D%=ROT(E%,12)	• • • •	Rotates the value of E% to the left by 12 bits and assigns it to D%.
F%=ROT(G%,-4)	• • • •	Rotates the value of G% to the right by 4 bits and assigns it to F%.

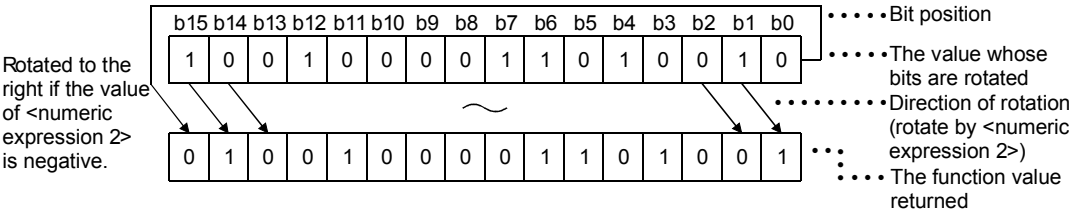
Description

• The ROT function rotates the memory representation of the value specified in <numeric expression 1> by the number of bits specified in <numeric expression 2> and returns the rotated value.

• Specify by how many bits the value specified in <numeric expression 1> should be rotated in <numeric expression 2>.
If the value of <numeric expression 2> is positive, the bits are rotated to the left; the value of the most significant bit (sign bit) is shifted to the least significant bit.



If the value of <numeric expression 2> is negative, the bits are rotated to the right; the value of the least significant bit is shifted to the most significant bit.



• If either <numeric expression 1> or <numeric expression 2> is specified as a value other than an integer, the type of the value is converted to integer data and then processed.

• An error occurs if <numeric expression 1> is not within the range from -32768 to 32767.

• An error occurs if <numeric expression 2> is not within the range from -16 to 16.

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Program Example

```
10 ' This program rotates the bits of the value A%
20 A%=&H55FF
30 B%=1                                          :  'Specifies the number of bits to be rotated
40 C%=-1
50 D%=ROT(A%,B%)                                 :  'Rotates the bits
60 E%=ROT(A%,C%)
70 PRINT "Rotate A%=";A%;" to the left by one bit---> D%=";D%     :     'Displays the result
80 PRINT "Rotate A%=";A%;" to the right by one bit---> E%=";      E%

RUN
Rotate A%=22015 to the left by one bit--->D%=-21506
Rotate A%=22015 to the right by one bit--->E%=-21761
OK
```

REMARK

See the SHA and SHT functions.

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RSET Instruction — Right SET

• Right-aligns and moves data to the random file buffer for execution of the PUT instruction.

Syntax

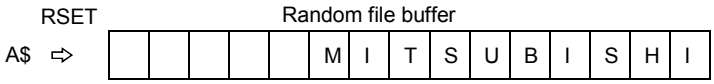
RSET△<character string variable>=<character string expression>

character string variable • • • • Specify a character string variable defined by the FIELD instruction.

character string expression • • • • Specify the character string data to be written.

Examples

RSET A$=" MITSUBISHI" • • • • Stores " MITSUBISHI" in A$ right-justified.



Description

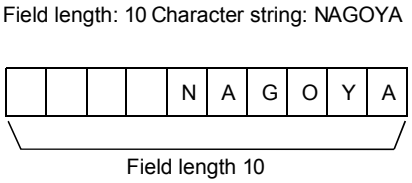
• The RSET instruction moves data from memory to a random file buffer, in preparation for the PUT instruction.

• In order to execute the RSET instruction, it is necessary to open a file as a random file in advance.

• It is necessary to use the FIELD instruction to define a character string variable before executing the RSET instruction.

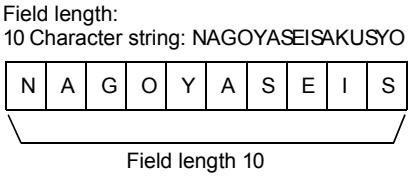
• If the character string expression is shorter than the field length assigned to the character string variable by the FIELD instruction, the RSET instruction stores the character string right-justified in the field.
The extra part of the field is filled by blank spaces.

Example



• If the character string expression is longer than the field length assigned by the FIELD instruction, the excess part of the character string is truncated from the right.

Example



• It is required to convert a numeric value into a character string using one of functions MKI$, MKS$, and MKD$, before using the RSET to transfer it to the random file buffer.

REMARK

See the FIELD, PUT, GET and LSET instructions, and Chapter 6.

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RUN (1) Instruction RUN

• Starts the execution of the program currently resident in the program area.

Syntax

RUN△ [<line number>]

line number • • • • Specify the line number where the execution is started.

Examples

RUN • • • • Starts the execution from the line with the least line number.

Description

• The RUN (1) instruction starts the execution of the program currently exists in the program area.
• If <line number> is specified, the execution starts from the specified line.
• If <line number> is omitted, the execution starts from the line with the least line number. When the execution ends, BASIC goes into the status where it waits for further instructions to be entered.
• The RUN instruction closes all open files and erases all data in memory.

REMARK

See the CONT and STOP instructions, and Chapter 3.

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RUN (2) Instruction RUN

• Executes after loading a program into memory from a memory card, FD, or HD.

Syntax

RUN "[<drive number>:][<system name>\]<file name>"

drive number	• • • •	Specify the memory card, FD, or HD where the program is saved.
system name	• • • •	Specify the system name under which the program is saved.
file name	• • • •	Specify the file name of the saved program.

Examples

RUN"0:TEST\NO1.BAS"	• • • •	Reads the file NO1.BAS stored under system name TEST in the memory card inserted in the AD51H-S3 MEMORY CARD 1 drive and executes it.

Description

• The RUN (2) instruction loads a program into memory from a memory card, FD, or HD, and executes it.

• Specify the memory card, FD, or HD from which the program is read in <drive number>, using the following numbers:

To specify the memory card inserted in AD51H-S3 MEMORY CARD 1	• • • •	0
To specify the memory card inserted in AD51H-S3 MEMORY CARD 2	• • • •	1
To specify the A drive of the console	• • • •	2
To specify the C drive of the console	• • • •	3
To specify the D drive of the console	• • • •	4

• Specify the name given to the program when it was stored in the memory card or FD using the SAVE instruction for <system name> and <file name>.

• The RUN instruction closes all open files and erases all data in memory before loading a program.

REMARK

See Section 3.3.

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SAVE Instruction — SAVE program

• Saves a program to a memory card, FD, or HD.

Syntax

SAVE△"[<drive number>:][<system name>\]<file name>"

drive number	• • • •	Specify the memory card, FD, or HD to which the program is saved.
system name	• • • •	Specify the system name under which the program is saved.
file name	• • • •	Specify the file name of the program to be saved.

Examples

SAVE "0:TEST\No1.BAS" • • • • Saves the program currently exists in memory to the memory card inserted in the AD51H-S3 MEMORY CARD 1 drive, under system name TEST and with the file name No1.BAS.

Description

• The SAVE instruction saves the program currently exists in memory to a memory card, FD, or HD.
• Specify the memory card, FD, or HD to which the program is to be saved in <drive number>, using the following numbers:

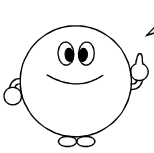
During online programming

To specify the memory card inserted in AD51H-S3 MEMORY CARD 1	• • • •	0
To specify the memory card inserted in AD51H-S3 MEMORY CARD 2	• • • •	1
To specify the A drive of the console	• • • •	2
To specify the C drive of the console	• • • •	3
To specify the D drive of the console	• • • •	4

During offline programming

To specify the A drive of the console	• • • •	1
To specify the C drive of the console	• • • •	3
To specify the D drive of the console	• • • •	4

• Specify the system name under which the program is to be saved in <system name>. If the specified system name does not exist, a new system name is registered.
• If <system name> is omitted, the program is saved as a file without system name. Note that a system name cannot be registered under another system name.
• Specify the name and extension of the file name that will be assigned to the program to be saved in <file name>. If an extension is not specified, the file name will not have an extension.
• SW1IVD-AD51HP-E cannot perform offline programming.



If a file with the same "<drive number>:<system name> \ <file name>" already exists, please note that it is overwritten without confirmation.

REMARK

See the LOAD instruction and Section 3.3.

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SEARCH Function SEARCH

• Searches for the specified value among the elements of the selected array variable and returns the position of the element.

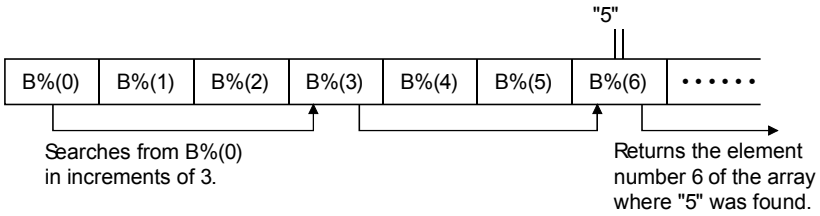
Syntax

SEARCH△(<array variable name>,<value to be searched for>[,<start element position>][,<step value>])

array variable name	• • • •	Specify the array variable to be searched through (one-dimensional integer array variables only).
value to be searched for	• • • •	Specify the integer value to be searched for in the array.
start element position	• • • •	Specify from which element to start the search.
step value	• • • •	Specify the increment of the elements to be searched through.

Examples

A=SEARCH(B%,5,0,3) • • • • Finds the number 5 in the array B%, start searching from B%(0) in increments of 3.



Description

• The SEARCH function searches for the value specified in <value to be searched for> in the array variable specified in <array variable name> and returns the number of the array element where the value is found for the first time.
The target of the search is from the element specified in <start element position> to the last element of the applicable array variable.
If the specified value is not found in the array variable, -1 is returned.
• If the specified array variable is not a one-dimensional integer array variable, an "Illegal function call" error occurs.
• The array variable specified in <array variable name> must be defined using the DIM instruction before executing the SEARCH function.
• If <value to be searched for> is specified as a real number, it is first converted to an integer and then the function is executed.
• If <start element position> is omitted, the search is started from the first element.
• If <step value> is omitted, it is assumed that "1" is specified and all the elements are searched through.

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Program Example

```
10 ' This program searches for a value in an array
20 DIM A%(10)                                  :  'Defines an array
30 FOR I=0 TO 10                               :  'Repeats from I = 1 to 10
40  A%(I)=I+3                                  :  'Stores values in the array variable
50  PRINT "A%(";I;")=";A%(I)
60 NEXT I
70 B=SEARCH(A%,6,0,3)                          :  'Searches for 6
80 PRINT "6 is found in A%(";B;")"             :  'Displays the result
90 END


RUN
A%(0)= 3
A%(1)= 4
A%(2)= 5
A%(3)= 6
A%(4)= 7
A%(5)= 8
A%(6)= 9
A%(7)= 10
A%(8)= 11
A%(9)= 12
A%(10)= 13
6 is found in A%(3)
OK
```


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SGN Function SiGN

• Returns the sign of a value.

Syntax

SGN(<numeric expression>)

numeric expression • • • • Specify the value whose sign is to be returned.

Examples

A=SGN(B%) • • • • Assigns 1 to A if the value of B% is positive, 0 to A if the value of B% is 0, and -1 to A if the value of B% is negative.

Description

• The SGN function returns the sign of a value.
• It returns 1 if the value of <numeric expression> is positive, 0 if it is 0, and -1 if it is negative.

Program Example

```
10 ' This program returns the sign of a value
20 A=-123                              :  'Defines a numeric value
30 B=0
40 C=123
50 PRINT "SGN(A)=";SGN(A)              :  'Displays the result
60 PRINT "SGN(B)=";SGN(B)
70 PRINT "SGN(C)=";SGN(C)

RUN
SGN(A)=1
SGN(B)=0
SGN(C)=-1
OK
```


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SHA Function — SHift Arithmetic

• Arithmetically shifts the memory contents of the specified value and returns the shifted value.

Syntax

SHA(<numeric expression 1>,<numeric expression 2>)

numeric expression 1	• • • •	Specify the target value of the arithmetic shift as an integer value.
numeric expression 2	• • • •	Specify the shift direction and the number of bits as an integer value.

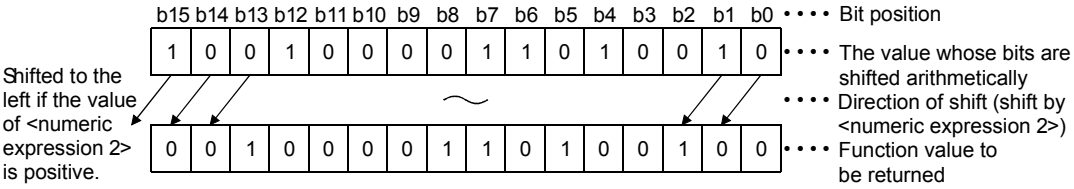
Examples

A%=SHA(B%,C%)	• • • •	Shifts the value of B% arithmetically by the amount of the value C%, and assigns it to A%.
D%=SHA(E%,12)	• • • •	Shifts the value of E% arithmetically to the left by 12 bits and assigns it to D%.
F%=SHA(G%,-4)	• • • •	Shifts the value of G% arithmetically to the right by 4 bits and assigns it to F%.

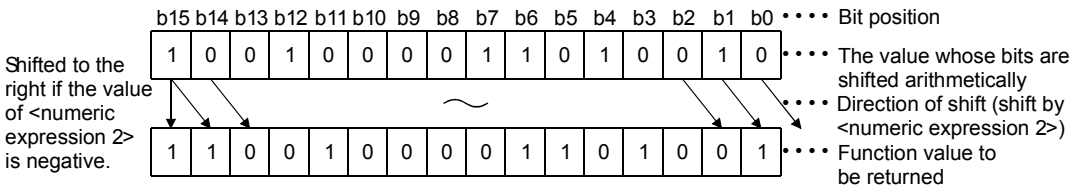
Description

• The SHA function shifts the memory content of the value specified in <numeric expression 1> arithmetically by the amount of bits specified in <numeric expression 2> and returns the shifted value.

• Specify by how many bits the value specified in <numeric expression 1> should be arithmetically shifted in <numeric expression 2>.
If the value of <numeric expression 2> is positive, the bits are shifted to the left and the least significant bit is put into OFF status (0) sequentially. Thus, if 16 is specified in <numeric expression 2>, the function value will always be 0.



If the value of <numeric expression 2> is negative, the bits are shifted to the right and the value of the most significant bit remains as is. Thus, if -16 is specified in <numeric expression 2>, the function value will always be either -1 or 0, depending on the value of the most significant bit.



• If either <numeric expression 1> or <numeric expression 2> is specified as a value other than an integer, the type of the value is converted into integer data and then processed.

• An error occurs if <numeric expression 1> is not within the range from -32768 to 32767.

• An error occurs if <numeric expression 2> is not within the range from -16 to 16.

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Program Example

```
10 ' This program shifts A% arithmetically
20 A%=&H5555
30 B%=1                                   :  'Specifies by how many bits the value
                                             should be shifte
40 C%=-1
50 D%=SHA(A%,B%)                          :  'Arithmetic shift
60 E%=SHA(A%,C%)
70 PRINT "Shift A%=";A%;" to the left by one bit arithmetically--->D%=";   D% Displays the result
80 PRINT "Shift A%=";A%;" to the right by one bit arithmetically--->E%=";  E%

RUN
Shift A%=21845 to the left by one bit arithmetically--->D%=-21846
Shift A%=21845 to the right by one bit arithmetically--->E%= 10922
OK
```

REMARK

See the ROT and SHT functions.

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SHT Function — SHifT logical

• Logically shifts the memory contents of the specified value and returns the shifted value.

Syntax

SHT(<numeric expression 1>,<numeric expression 2>)

numeric expression 1	• • • •	Specify the target value of the logical shift as an integer value.
numeric expression 2	• • • •	Specify the shift direction and the number of bits as an integer value.

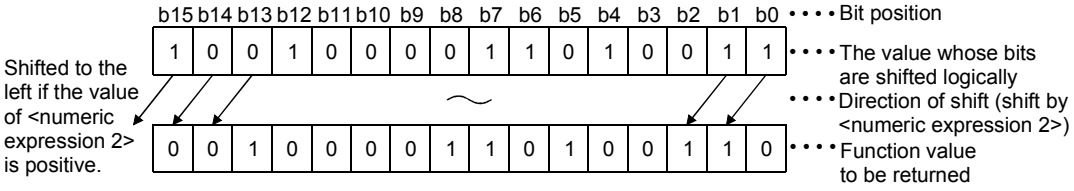
Examples

A%=SHT(B%,C%)	• • • •	Shifts the value of B% logically by the amount of the value C%, and assigns it to A%.
D%=SHT(E%,12)	• • • •	Shifts the value of E% logically to the left by 12 bits and assigns it to D%.
F%=SHT(G%,-4)	• • • •	Shifts the value of G% logically to the right by 4 bits and assigns it to F%.

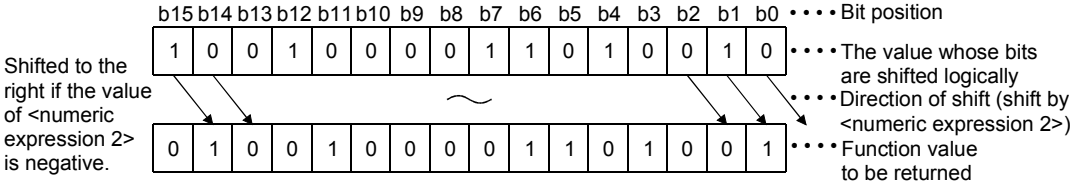
Description

• The SHT function shifts the memory content of the value specified in <numeric expression 1> logically by the amount of bits specified in <numeric expression 2> and returns the shifted value.

• Specify by how many bits the value specified in <numeric expression 1> should be logically shifted in <numeric expression 2>.
If the value of <numeric expression 2> is positive, the bits are shifted to the left and the least significant bit is put into OFF status (0) sequentially. Thus, if 16 is specified in <numeric expression 2>, the function value will always be 0.



If the value of <numeric expression 2> is negative, the bits are shifted to the right and the value of the most significant bit remains as is. Thus, if -16 is specified in <numeric expression 2>, the function value will always be either -1 or 0, depending on the value of the most significant bit.



• If either <numeric expression 1> or <numeric expression 2> is specified as a value other than an integer, the type of the value is converted into integer data and then processed.

• An error occurs if <numeric expression 1> is not within the range from -32768 to 32767.

• An error occurs if <numeric expression 2> is not within the range from -16 to 16.

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Program Example

```
10 ' This program shifts A% logically
20 A%=&H5555
30 B%=1                                          :  ' Specifies by how many bits the value
                                                    should be shifted
40 C%=-1
50 D%=SHT(A%,B%)                                 :  ' Logical shift
60 E%=SHT(A%,C%)
70 PRINT "Shift A%=";A%;" to the left by one bit logically --->D%=";D%     :  ' Displays the result
80 PRINT "Shift A%=";A%;" to the right by one bit logically --->E%=";E%

RUN
Shift A%=21845 to the left by one bit logically --->D%=-21846
Shift A%=21845 to the right by one bit logically --->E%=10922
OK
```

REMARK

See the ROT and SHA functions.

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SIN Function SINe

• Returns the trigonometric sine function of a value.

Syntax

SIN(<numeric expression>)

numeric expression • • • • Specify a value or numeric variable in radians.

Examples

A=SIN(3.14159/180*60) • • • • Converts the angle of 60° (into radians, calculates the sine value, and assigns it to A.

Description

• The SIN function returns the sine function value of <numeric expression>, which must be given in radians (π/180 x angle).
• <numeric expression> can be any type of value, but the SIN function always calculates the result in single-precision.

Program Example

```
10 ' This program returns sin 45°
20 A=(3.141592653#*45)/180          :  ' Converts 45° to radian
30 B=SIN(A)                         :  ' Obtains sin 45°
40 PRINT "45°=";A;"radians"
50 PRINT "sin 45°=";B
60 END

RUN
45°=.785398 radians
sin 45°= .707107
OK
```

REMARK

See the COS and TAN functions.

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SPACE$ Function SPACE$

• Returns a null string of a specified length.

Syntax

SPACE$(<numeric expression>)

numeric expression • • • • Specify the length of the null string.

Examples

A$=SPACE$(10) • • • • Assigns 10 space characters to A$.

Description

• The SPACE$ function creates space characters for the specified length.
• Specify the length of the null string in <numeric expression>.
• The allowable specification value range for <numeric expression> is from 0 to 255. If a value greater than 255 is specified, an "Illegal function call" error occurs.
• The space character returned by the SPACE$ function is the half-byte null character.
• If the value of <numeric expression> is 0, a single null character (" ") is returned.

Program Example

```
10 ' This program displays each line while changing the start of the display position
20 FOR I=1 TO 5                          :  ' Repeats from I = 1 to 5
30  A$="AD51H"                           :  ' Defines a character string
40  A$=SPACE$(I*5)+A$                    :  ' Adds I * 5 spaces to A$
50  PRINT A$                             :  ' Displays the result
60 NEXT I
70 END


RUN
    AD51H
       AD51H
          AD51H
             AD51H
                AD51H
OK
```

REMARK

See the SPC and STRING$ functions.

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SPC Function SPaCe

• Returns a specified number of blank spaces.

Syntax

SPC(<numeric expression>)

numeric expression • • • • Specify the number of blank spaces to be returned.

Examples

PRINT SPC(1);A$ • • • • Displays the contents of A$ after one space.

Description

• The SPC function returns a number of blank spaces equal to the specified number.
• The SPC function can only be used with the PRINT and LPRINT instructions; it cannot be used on its own.
• It is possible to display the output on a console or terminal connected to the communication port specified by the ZODV instruction or write it to a printer connected to the communication port specified by the ZLDV instruction. See the ZODV instruction for information about the output communication ports.
• The allowable value range of <numeric expression> is from 0 to 255. If a value greater than 255 is specified, an "Illegal function call" error occurs.

Program Example

```
10 ' This program displays each line while changing the start of the display position
20 FOR I=1 TO 5                    :  ' Repeats from I = 1 to 5
30  A$="BASIC"                     :  ' Defines a character string
50  PRINT SPC(I*5);A$              :  ' Displays I * 5 spaces and the character
                                      string
60 NEXT I
70 END

RUN
    BASIC
       BASIC
          BASIC
             BASIC
                BASIC
OK
```

REMARK

See the ZODV and ZLDV instructions, and SPACE$ and TAB functions.

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SQR Function — SQuare Root

• Returns the square root of the specified value.

Syntax

SQR(<numeric expression>)

numeric expression • • • • Specify the value for which the square root should be obtained.

Examples

A=SQR(50) • • • • Assigns $\sqrt{50}$ (= 7.071067...) to A.

Description

• The SQR function returns the square root of the specified value.
• The value of <numeric expression> must be 0 or positive.
• The calculation of the SQR function is performed in single-precision.

Program Example

```
10 ' This program returns square root values
20 DIM A(10)                                   :  ' Defines an array
30 PRINT "A(I)=","SQR(A(I))="
40 FOR I=1 TO 10                               :  ' Obtains the square root and displays it
50  A(I)=SQR(I)
60 PRINT I,
70 PRINT A(I)
80 NEXT I

RUN
A(I)=        SQR(A(I))=
 1           1
 2           1.41421
 3           1.73205
 4           2
 5           2.23607
 6           2.44949
 7           2.64575
 8           2.82843
 9           3
 10          3.16228
OK
```


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STOP Instruction

STOP

• Pauses the program execution in programming mode.
• Stops the execution of a program, and puts it in the stop status.

Syntax

STOP

Examples

STOP • • • • Pauses the program execution and forces it into the status where it waits for further instructions to be entered.

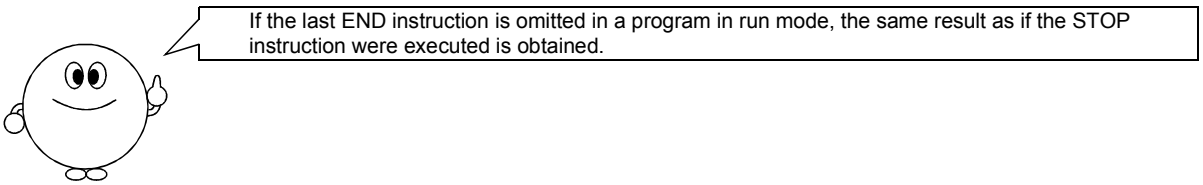
Description

In programming mode

• The STOP instruction pauses the execution of the program and forces it into the status where it waits for further instructions to be entered.
• The STOP instruction can be used at any place in a program.
• When the STOP instruction is executed, the following message is displayed:
Break in nnnnn nnnnn indicates a line number.
• Unlike the END instruction, the STOP instruction does not close open files.
• After a program is forced into the status where it waits for instruction entry by the execution of the STOP instruction, the execution can be resumed by using the CONT instruction. However, if the program is modified during the pause, the execution cannot be resumed by the CONT instruction.

In run mode

• The STOP instruction stops the program execution.
• The program execution can be resumed using the TRUN and TCONTINUE commands of the debugger if the debugger is used.
• The STOP instruction can be used at any place in a program.



REMARK

See the CONT and RUN instructions, and Chapter 10.

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STR$ Function STRing$

• Converts a value to a character string, assuming the value is given as a decimal number.

Syntax

STR$(<numeric expression>)

numeric expression • • • • Specify the value to be converted into a character string.

Examples

A$=STR$(-1.602) • • • • Converts the value -1.602 to the string "-1.602."

B$=STR$(3.12E08) • • • • Converts the value 3.12E08 to the string "△3.12E08."

Description

• The STR$ function returns the value in <numeric expression> as a character string expression of a decimal number. Note that it is not allowed to specify data other than numeric values and variables. All types of numeric values are valid for specification as the value of <numeric expression>, such as real numbers (double-precision and single-precision) and floating points.

• The length of the character string returned is equal to the number of digits of the value plus one character representing the sign. If the value is positive, the sign character becomes blank.

• If the number of digits of the specified value exceeds 16 digits when a double-precision real number is specified, or 6 digits when a single-precision real number is specified, the value is treated in exponential format.

• The VAL function has the opposite functionality of the STR$ function.
In addition, the OCT$ and HEX$ functions convert integer data to octal or hexadecimal strings, respectively, and return them.

Program Example

```
10 ' This program converts numeric values to character strings
20 A=123                                  :  ' Defines numeric values
30 B=456
40 C=1.23456E+07
50 A$=STR$(A)                             :  ' Converts into character strings
60 B$=STR$(B)
70 C$=STR$(C)
80 PRINT "A    =";A                       :  ' Displays the results
90 PRINT "B    =";B
100 PRINT "C    =";C
110 PRINT "A+B  =";A+B
120 PRINT "A$+B$=";A$+B$
130 PRINT "C$   =";C$
140 END
```


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```
RUN
A       = 123
B       = 456
C       = 1.23456E+07
A+B     = 579
A$+B$ = 123 456
C$      = 1.23456E+07
O
```

REMARK

See the HEX$, OCT$, and VAL functions.

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STRING$ Function STRING$

• Returns the specified character for the specified number of times.

Syntax

STRING$(<numeric expression 1>,<character string expression>)
STRING$(<numeric expression 1>,<numeric expression 2>)

numeric expression 1	• • • •	Specify the number of characters to be returned.
character string expression	• • • •	Specify the character to be returned.
numeric expression 2	• • • •	Specify the character code of the character to be returned.

Examples

A$=STRING$(5,"M") • • • • Assigns five "M" characters to A$.

A$	M	M	M	M	M

B$=STRING$(3,&H41) • • • • Assigns three characters of the character code $H41 (=A) to B$.

B$	A	A	A

Description

• The STRING$ function returns the specified character for the specified number of times.
• Specify the number of characters in the string obtained in <numeric expression 1>.
• If <character string expression> is used to specify the character, only the first character in the string is valid. If <numeric expression 2> is used to specify the character, it indicates that the character code is to be repeated. The allowable specification range of the value is from 0 to 255. If a value greater than 255 is specified, an "Illegal function call" error occurs.

Program Example

```
10 ' Display a number of "*" according to the value of the variable A
20 FOR I=0 TO 5                    :  ' Repeats from I=0 to 5
30  A=2^I                          :  ' Calculates the value of A
50  A$=STRING$(A,"*")              :  ' Assigns the number of "*" obtained in the
                                      calculation
60  PRINT A$                       :  ' Displays the result
70 NEXT I
80 END

RUN
*
**
****
********
***************
*******************************
OK
```


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REMARK

See the CHR$, SPACE$, and SPC functions.

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SYSTEM Instruction SYSTEM

• Stops the control of the BASIC interpreter and returns to the communication module's system mode.
• Stops online programming and returns to the main menu screen.

Syntax

SYSTEM

Examples

SYSTEM •••• Stops BASIC control.

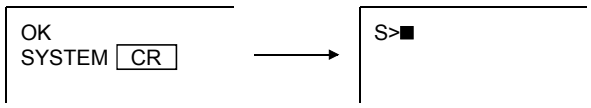
Description

• This instruction stops BASIC control (the system that manages editing and execution of BASIC programs) and returns the mode of the communication module to the following mode.

During online programming

[In programming mode]

The SYSTEM instruction returns to the communication module's system mode.



[In run mode]
The SYSTEM instruction stops the programs in all tasks and returns to the communication module's system mode.
In addition, an "Illegal function call" error occurs.
If the BASIC control is stopped by the SYSTEM instruction, all open files are closed.
Moreover, programs in memory are still saved, but data such as variables is deleted.
See the AD51H-BASIC Programming Manual (Debug and Compile) for information about the communication module's system mode.

During offline programming

The SYSTEM instruction returns to the main menu screen of the system.
See the Operating Manual for information about the SW□SRX-AD51HP/SW□RX-AD51HP system.
SW1IVD-AD51HP-E cannot perform offline programming.

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SWAP Instruction

SWAP

• Swaps the values of two variables.

Syntax

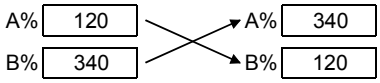
SWAP△<variable 1>,<variable 2>

Variable 1 • • • • Specify the variables whose values are exchanged.

Variable 2 • • • •

Examples

SWAP A%,B% • • • • Swaps the values of A% and B%.



Description

• The SWAP instruction exchanges the value of the variable specified in <variable 1> and the value of the variable specified in <variable 2>.

• Any types of variables can be specified in <variable> (integer, single-precision, double-precision, or character string). However, a "Type mismatch" error occurs if the types of two variables do not match.

Program Example

```
10 ' This program swaps the data in the variables A and B
20 INPUT "A=";A                    :  ' Inputs A
30 INPUT "B=";B                    :  ' Inputs B
40 PRINT "A=";A,"B=";B             :  ' Displays the values before the swapping
50 SWAP A,B                        :  ' Swaps the values
60 PRINT "The values were swapped"
70 PRINT "A=";A,"B=";B             :  ' Displays the values after the swapping
80 END

RUN
A=? 1
B=? 2
A= 1         B= 2
The values were swapped
A= 2         B= 1
OK
```

REMARK

See the BSWAP instruction.

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TAB Function — TABulate

• Moves the current character display position to the specified position.

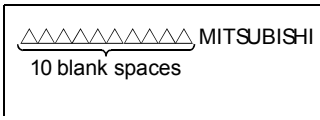
Syntax

TAB(<numeric expression>)

numeric expression •••• Specify the display position relative to the left side of the screen.

Examples

PRINT TAB(10); "MITSUBISHI" •••• Displays "MITSUBISHI" from the 11th character.



Description

• The TAB function displays space characters from the current character display position on the screen to the character position indicated by <numeric expression>. If the current character display position already exceeds the value in <numeric expression>, a new line is started and the same operation is performed.
• The TAB function can be executed only to the screen on a console.
• The TAB function can only be used together with the PRINT and LPRINT instructions.

Program Example

```
10 ' This program displays character strings from the positions specified by the TAB function
20 A$="AD51H"                                  :  ' Defines character strings
30 B$="BASIC"
40 PRINT TAB(5);A$;TAB(15);B$                  :  ' Displays the character strings from the 5th
                                                     and 15th position, respectively
50 END

RUN
    AD51H     BASIC
OK
```

REMARK

See the SPC and LOCATE functions, and Section 3.10.1.

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TAN Function — TANgent

• Returns the trigonometric tangent function of a value.

Syntax

TAN(<numeric expression>)

numeric expression • • • • Specify the value or the numeric variable in radians.

Examples

A=TAN(3.14159/180*45) • • • • Converts the angle of 45(to radians, calculates the tangent value, and assigns it to A.

Description

• The TAN function returns the tangent function value of <numeric expression>, which must be given in radians (π/180 x angle).
• Numeric expression can be any type of value, but the TAN function always calculates the result in single-precision.
• If the following values are specified in <numeric expression>, a "Division by zero" error occurs.
((2n + 1) × π)/2 n=0, 1, 2, 3 • • •
π =3.1415926

Program Example

```
10 ' This program returns tan 45°
20 A=(3.141592653#*45)/180          :  ' Converts 45° to radian
30 B=TAN(A)                         :  'Obtains tan 45°
40 PRINT "45°=";A;"radians"
50 PRINT "tan 45°=";B
60 END

RUN
45°=.785398 radians
tan 45° = 1
OK
```

REMARK

See the SIN and COS functions.

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TIME$ Function

TIME$

• Sets the time of the PLC CPU's clock.
• Reads the time of the PLC CPU's clock.

Syntax

TIME$="<hour>:<minute>:<second>"
TIME$

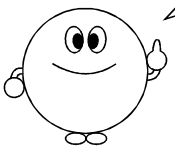
Hour	• • • •	Specify the character string that indicates the hour in the range from "00" to "23."
Minute	• • • •	Specify the character string that indicates the minute in the range from "00" to "59."
Second	• • • •	Specify the character string that indicates the second in the range from "00" to "59."

Examples

TIME$="11:57:30"	• • • •	Sets the PLC CPU's clock to 11 o'clock, 57 minutes, 30 seconds.
A$=TIME$	• • • •	Reads the time from the PLC CPU's clock and assigns it to A$.

Description

• The TIME$ function is used to set the time of the PLC CPU's clock and read the time of the clock.
• Set the time using the following format:
TIME$="hour:minute:second"
1) Use colons (" : ") to separate hours, minutes, and seconds.
2) The hours are specified in 24-hour format, from 0 to 23.
3) If either of the specifications is 0 to 9, add a leading 0 to make it 00 to 09.
4) All three values for the hours, minutes, and seconds must be specified, without omission.
• The time value is read in the same format as when the time is set.



• The TIME$ function is valid only for PLC CPUs with the clock function. The TIME$ function cannot be executed for PLC CPUs without the clock function (i.e., A□, A3H, A0J2(H)CPU).
• Store dummy data in a value used to read the date (year, month, date) as shown below before using the DATE$ function.
If dummy data is not stored, an error occurs.
□$=SPACE$(14)
□$(n)=SPACE$(14)

Program Example

```
10 ' This program sets and reads the time
30 A$="13:23:01"                          :  ' Sets the time
40 TIME$=A$                               :  ' Writes the time
60 B$=SPACE$(8)                           :  ' Stores dummy data
70 B$=TIME$                               :  ' Reads the time
80 PRINT "The time on the clock --->";B$  :  ' Checks the time that was read
90 END

RUN
The time on the clock ---> 13:23:01
OK
```


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REMARK

•See the User's Manual of the applicable CPU for information about the accuracy of the PLC CPU's clock.
• See the DATE$ function.

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TROFF Instruction — TRace OFF

• Resets the trace (tracking) in a program set by the TRON instruction.

Syntax

TROFF

Examples

TROFF • • • • Resets the execution of the trace (tracking).

Description

• The TROFF instruction is used to debug programs together with the TRON instruction.
• When the TROFF instruction is executed, the trace (tracking) is ended.
• The TROFF instruction can be executed in both direct and programming modes.
• When the following instructions are executed, the trace (tracking) is ended in the same way as if the TROFF instruction were executed.

NEW
RUN "file name"
LOAD
CHAIN
MERGE

REMARK

See the TRON instruction and Chapter 10.

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TRON Instruction — TRace ON

• Starts a trace (tracking) in a program.

Syntax

TRON

Examples

TRON • • • • Executes the trace (tracking).

Description

• The TRON instruction is used to debug programs together with the TROFF instruction.
• When the TRON instruction is executed, the line numbers of the executed instructions are displayed enclosed in square brackets ([ ]) while the program is executed.
The display can be shown only on the console screen (the display target specification by the ZODV instruction is ignored).
• The TRON instruction can be executed in both direct and programming modes.
When the following instructions are executed, the trace (tracking) started by the TRON instruction ends.

TROFF
NEW
RUN "file name"
LOAD
CHAIN
MERGE

• Press the Ctrl + S keys to stop the screen display. Press any key to resume the display.

REMARK

See the TROFF instruction and Chapter 10.

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VAL Function VALue

• Returns the value represented by a character string.

Syntax

VAL(<character string expression>)

character string expression • • • • Specify the character string to be converted into a numeric expression.

Examples

A=VAL("123") • • • • Assigns the value represented by the string "123" to A.

Description

• The VAL function returns the value represented by a character string.

When a decimal string is specified

The first character in the string must be either space, +, −, or a digit.
Specify digits only from the second character and onward.
Space, line feed, and tab characters exist in the string are ignored. In addition, if a character that does not represent a numeric value is included, all characters from that place to the end of the string are ignored.

Example

PRINT VAL(" -△1△2△3") ⟶ -123

PRINT VAL(" △12A3") ⟶ △ 12

When an octal string is specified

The first and second characters in the string must be the "&0" characters, which indicate an octal value.
Specify digits only from the third character and onward.
Space, line feed, and tab characters exist in the string are ignored. In addition, if a character that does not represent a numeric value is included, all characters from that place to the end of the string are ignored.

Example

		Octal
PRINT VAL(" &01△2△3") ⟶	△83	(123)
PRINT VAL(" &012A3") ⟶	△10	(12)

When a hexadecimal string is specified

The first and second characters in the string must be the "&H" characters, which indicate a hexadecimal value.
Specify digits and characters from A to F only from the third character and onward.
If characters other than digits and A to F are included in the string after the third character, all characters from that place to the end of the string are ignored.

Example

		Hexadecimal
PRINT VAL(" &H1A△2C") ⟶	△26	(1A)
PRINT VAL(" &H1A2!C") ⟶	△418	(1A2)

• 0 is returned if the first and second characters are not the prescribed characters.
• The VAL function is used to perform the calculation in double-precision.

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Program Example

```
10 ' This program converts character strings to numeric values using the VAL function
20 A$="1234"                          :  ' Defines character strings
30 B$="12.34"
40 C$=" 1234"
50 D$="ABC"
60 E$="&H4F
70 F$="&H4F 56"
80 G$=E$+"12"
90 PRINT VAL(A$)                      :  ' Converts the character string "1234" to the
                                         numeric value 1234
100 PRINT VAL(B$)                     :  ' Converts the character string "12.34" to
                                         the numeric value 12.34
110 PRINT VAL(C$)                     :  ' Converts the character string " 1234" to
                                         the numeric value 1234 ignoring the
                                         leading space
120 PRINT VAL(D$)                     :  ' Returns 0 because the character string
                                         does not represent a numeric value
130 PRINT VAL(E$)                     :  ' Treats the character string as the
                                         hexadecimal number 4F and converts it to
                                         the numeric value 79
140 PRINT VAL(F$)                     :  ' Treats only 4F as a hexadecimal number
                                         and converts it to the numeric value 79,
                                         because there is a space after 4F
150 PRINT VAL(G$)                     :  ' Treats the character string as the
                                         hexadecimal number 4F12 and converts it
                                         to the numeric value 20242
```

```
RUN
 1234
 12.34
 1234
 0
 79
 79
 20242
OK
```

REMARK

See the STR$, HEX$, and OCT$ functions.

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W@ Variable — Word@

• Reads or writes word information in extension registers (ED) or special registers (ED).

Syntax

W@(<device>,<device number>)

device	• • • •	Specify the device to be read or written.
device number	• • • •	Specify the number of the device to be read or written.

Examples

A=W@(ED,50)	• • • •	Reads the data in the extension register ED50 and assigns it to the single-precision variable A.
A%=W@(ED,50)	• • • •	Reads the data in the extension register ED50 and assigns it to the integer variable A%.
W@=(ED,80)=1234	• • • •	Writes 1234 to the extension register ED80.
W@=(ED,80)=A	• • • •	Writes the data of the single-precision variable A to the extension register ED80.

Description

• The W@ variable reads or writes word information of devices.
• Specify the following device type for <device>.
  Extension registers • • • ED
• Specify a device number in the following range for <device number>.
  ED • • • from 0 to 1023
• If the data to be written is not an integer constant or integer variable, the type is converted into integer and the resulting value is written.
• In order to read in units of 32 bits, assign data to an integer array variable, convert it into 32-bit data using the CIDB and CISN instructions, and then read the resulting value.

Example

```
100 DIM A%(1)
100 A%(0)=W@(ED,100)     • • • •  Reads the 32 bits of data stored into
120 A%(1)=W@(ED,101)     • • • •  ED100 and ED101 to A%(0) and
                                  A%(1), respectively, as two 16-bit
                                  data values.
130 B#=CIDB(A%(0))       • • • •  Converts the data in A%(0) and
                                  A%(1) to 32-bit data and assigns it
                                  to B#.
```


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• In order to write in units of 32 bits, assign data to an integer array variable as 32-bit data using the CIDB and CSNI instructions, and then write to each device.

Example

```
100 DIM A%(1)
110 CDBI 123456!,A%(0)      • • • •  Converts "123456" to 32-bit data,
                                     and then assigns the lower 16 bits to
                                     A%(0) and the higher 16 bits to
                                     A%(1).
120 W@(ED,102)=A%(0)
130 W@(ED,103)=A%(1)        • • • •  Writes the lower 16 bits and the
                                     higher 16 bits stored in A%(0) and
                                     A%(1), respectively, to ED102 and
                                     ED103.
```

REMARK

See the B@, PUTMEM, and GETMEM functions.

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WHILE WEND Instruction

WHILE to While END

• These instructions are used to execute the group of instructions between WHILE and WEND repeatedly, while the specified condition holds.

Syntax

WHILE△<expression>
WEND

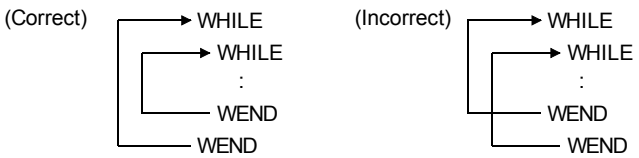
expression	• • • •	Specify the condition under which the instructions enclosed by the WHILE to WEND instructions are executed repeatedly.

Examples

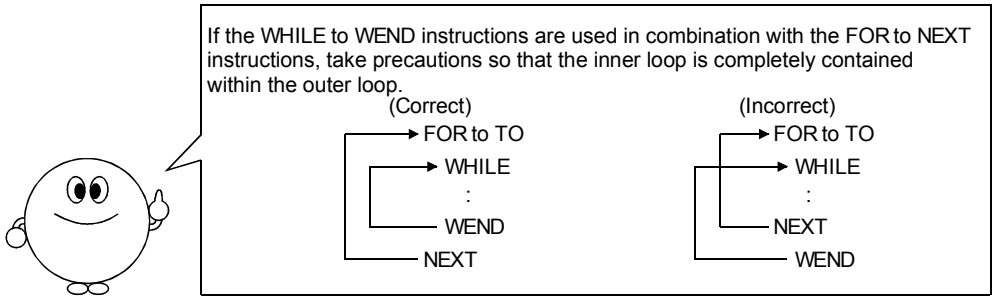
WHILE K>5 to WEND	• • • •	Repeats the instructions between the WHILE to WEND instructions as long as the value of K is greater than 5.

Description

• The WHILE to WEND instructions are used to execute a selected processing under a given condition. The group of instructions from the WHILE instruction to the WEND instruction are executed repeatedly while the condition specified in <expression> holds.
• A pair of WHILE and WEND instructions constitute one loop together.
The difference from the FOR to NEXT instructions is instead of specifying the number of repetitions of the execution, a condition for repeated execution is specified.
• If the value of <expression> is True (any other value than 0), the instructions from the one immediately after the WHILE until the WEND instruction are executed and then the execution returns to the WHILE instruction to evaluate <expression> again. This routine is repeated while the value of <expression> is True. If the value of <expression> is False (0), the instruction immediately after the WEND instruction is executed.
• The repeated processing between the WHILE to WEND instructions is stopped if a GOTO or RESUME instruction is executed inside the WHILE to WEND loop in an error handling routine.
• Lines where WHILE or WEND instructions are written can be specified as the branch destination of a GOTO instruction, etc.
• It is possible to write the WHILE to WEND instructions within a loop created by another pair of WHILE-WEND instructions.
• When using more than one pair of WHILE to WEND instructions, take precautions so that the inner WHILE to WEND loop is completely contained within the outer loop.



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Program Example

```
10 ' This program repeats a calculation while the specified condition holds
20 I=1                                  :  ' Sets the initial value
30 WHILE I<10                           :  ' Repeats until I exceeds 10
40  PRINT "I=":I                        :  ' Displays the values of I
50  I=I+1                               :  ' Adds 1 to I
60 WEND
70 PRINT "I exceeded 10"                :  ' Displays the result
80 END

RUN
I=1
I=2
I=3
I=4
I=5
I=6
I=7
I=8
I=9
I exceeded 10
OK
```

REMARK

See the FOR to NEXT instructions and Section 3.6.4.

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WIDTH Instruction

WIDTH

• Sets the width of data to be output to the printer.

Syntax

WIDTH△LPRINT△<output width>

output width • • • • Specify the output width of one line using a value from 30 to 255.

Examples

WIDTH LPRINT 100 • • • • Sets the width of data to be output to the printer to 100 characters per line.

Description

- The WIDTH instruction sets the output width (the maximum number of characters per line) when printing data output to the printer specified by the ZLDV instruction.
- If a character string longer than <output width> is specified to be printed in one line after executing the WIDTH instruction, the number of characters specified by <output width> is printed and then the remaining characters in the string is printed in the new line.
- If the value specified in <output value> is 255, it is interpreted as if the output width is infinite; the CR (carriage return) code is not sent to the printer.
- The output width is set to 80 characters as default when BASIC is started up.

Program Example

```
10 ' This program specifies the output width of data output to the printer and prints a character string
20 A$="MitsubishiPLCAD51H.ABCDEFGHIJKLMNOPQRSTUVWXYZ,1234567890,abcdefghijklmno
   pqrstuvwxyz"
                                          :  ' Defines a character string
30 WIDTH LPRINT 50                        :  ' Sets the output width to 50 characters
40 LPRINT A$                              :  ' Outputs the character string to the printer
50 WIDTH LPRINT 80                        :  ' Sets the output width to 80 characters
60 LPRINT A$                              :  ' Outputs the character string to the printer
70 END

MitsubishiPLCAD51H.ABCDEFGHIJKLMNOPQRSTUVWXYZ,1234
567890, abcdefghijklmnopqrstuvwxyz
MitsubishiPLCAD51H.ABCDEFGHIJKLMNOPQRSTUVWXYZ,1234567890,abcdefghijklmnopqrstuvw
xyz
```

REMARK

See the LFILES, LLIST, LPRINT, LPRINT USING, PRINT#, PRINT# USING, and ZLDV instructions.

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WTSET Instruction — WriTe SET

• Writes 0 or 1 to the specified bit of an integer array variable.

Syntax

WTSET△<integer expression 1>,<integer expression 2>,<array variable>

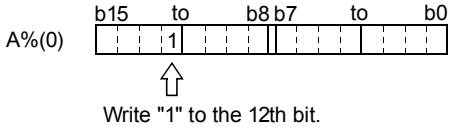
integer expression 1 • • • • Specify which bit of the specified integer array is to be written to, using an integer from 0 to 65535.

integer expression 2 • • • • Specify the data to be written (0 or 1).

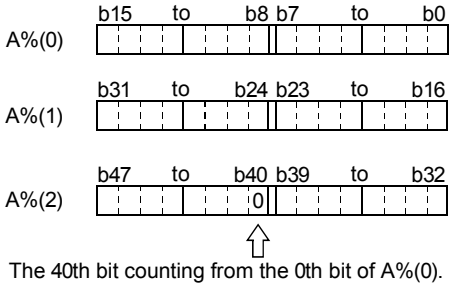
array variable • • • • Specify a one-dimensional integer array variable to which data is written.

Examples

WTSET 12,1, A%(0) • • • • Writes "1" to the 12th bit counting from the 0th bit of A%(0).



WTSET 40,0,A%(0) • • • • Writes "0" to the 40th bit counting from the 0th bit of A%(0).



Description

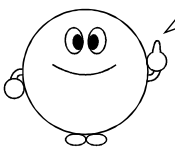
• The WTSET function writes data (1 or 0) specified in <integer expression 2> to the bit specified in <integer expression 1> in the one-dimensional integer array variable specified by <array variable>.

• In the bit specification by <integer expression 1>, it is possible to specify any bit in any array variables relative to the 0th bit of the specified array variable.
An "Illegal function call" error occurs if the specified value indicates a bit position that exceeds the total number of bits contained in an array variable defined by the DIM instruction.

• Specify the data to be written in <integer expression 2>.
The only data that can be specified is "0" or "1."
An "Illegal function call" error occurs if data other than 0 or 1 is specified.

• Only a one-dimensional integer array variable can be specified in <array variable>.
If a variable other than an element of a one-dimensional integer array variable is specified, an "Illegal function call" error occurs.

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The range of integers that can be expressed by 16 bits is from -32768 to 32767, which are expressed in hexadecimal as follows.
If decimal values from -32768 to -1 are specified, it is assumed that values from 32768 to 65535 are specified.

Decimal	Hexadecimal	Binary
65535 to 32768	$FFFF_H$ to 8000_H	1111 1111 1111 1111 to 1000 0000 0000 0000
32767 to 0	$7FFF_H$ to 0000_H	0111 1111 1111 1111 to 0000 0000 0000 0000
-1 to -32768	$FFFF_H$ to 8000_H	1111 1111 1111 1111 to 1000 0000 0000 0000

These are the same.

Program Example

```
10 ' This program writes data to the specified bit
20 DIM A%(0)                          :  ' Defines an array
30 FOR I=1 TO 15 STEP 2               :  ' Writes 1 in every second bit
40 WTSET I,0,A%(0)
50 NEXT I
60 FOR I=1 TO 15 STEP 2               :  ' Writes 0 in every second bit
70 WTSET I,0,A%(0)
80 NEXT I
90 FOR I=0 TO 15                      :  ' Reads the data
100 A=RDSET(I,A%(0))
110 PRINT A;                          :  ' Displays the result
120 NEXT I

RUN
 1  0  1  0  1  0  1  0  1  0  1  0  1  0  1  0
OK
```

REMARK

See the RDSET instruction.

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ZBAS Function

Z • BASic

• Returns the number of the BASIC task area in which the program currently being created or executed resides.

Syntax

ZBAS

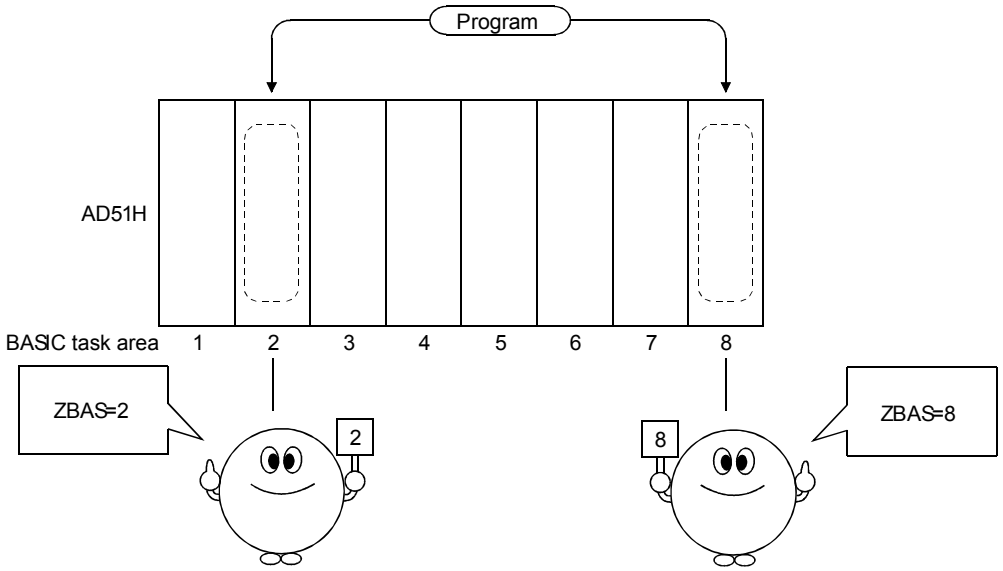
Examples

A=ZBAS • • • • Assigns the BASIC task number of the program currently being created or executed to A.

Description

• The ZBAS shows in which of the communication module's BASIC task areas the program currently being created or executed resides.

• It is possible to create a maximum of two communication modules or eight programs. Each program is assigned a number corresponding to the BASIC task area where it resides. The ZBAS function returns this BASIC task area number.



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ZCLOSE Instruction Z • CLOSE

• Closes a communication channel of a communication port used to communicate with an external device.

Syntax

ZCLOSE△[#<channel number>], [#<channel number>, • • •]

channel number	• • • •	Specify the communication port to be closed.

Examples

ZCLOSE #1,#2	• • • •	Closes CH1 (RS-232) and CH2 (RS-232).
ZCLOSE	• • • •	Closes all communication ports opened in the program.

Description

• The ZCLOSE instruction closes communication channels opened by the ZOPEN instruction and terminates the communication through them.
• If <channel number> is not specified, all communication channels opened in the program are closed.
• It is possible to specify multiple <channel number>, separating them by commas.
• Even if the ZCLOSE instruction is executed on a communication channel that is not open, an error will not occur.

REMARK

See the ZOPEN instruction and Chapter 7.

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ZCNTL Instruction

Z • CoNTroL

• Set communication parameter data for an open communication port and read the status of a communication port.

Syntax

ZCNTL△#<channel number>,0,<control table>

channel number • • • • Specify the communication port that is to be set or whose status is to be read.

control table • • • • Specify the data to be set or the information to be read.

Examples

ZCNTL #1,0,A%( ) • • • • Sets the parameter data specified by the integer array A% for CH1 (RS-232) and reads the status of the information specified by the array from CH1.

Description

• The ZCNTL instruction is used to perform the following settings and status reading for an open communication channel.

• The content of the processing is specified by the processing code in the control table as follows.

Processing code	Description	RS-232	RS-422	PARALLEL
16	Setting communication parameters	○	○	×
17	Reading communication parameters	○	○	×
18	Setting communication control parameters	○	○	×
19	Reading communication control parameters	○	○	×
22	Setting break characters	○	○	×
23	Reading break characters	○	○	×
24	Setting continuous break characters	○	○	×
25	Reading continuous break characters	○	○	×
32	Turning the RS (RTS) and DTR (ER) control signals ON/OFF	○	○	×
33	Reading the ON/OFF status of the CS (CTR), DSR (DR), RS (RTS), DTR (ER), and CD control signals	○	○	×
48	Setting high impedance control	×	○	×
64	Reading causes of reception errors	○	○	×
80	Reading the receive buffer size and the number of characters	○	○	×
128	Reading the printer status	×	×	○
136	Outputting an initialization signal to a printer	×	×	○

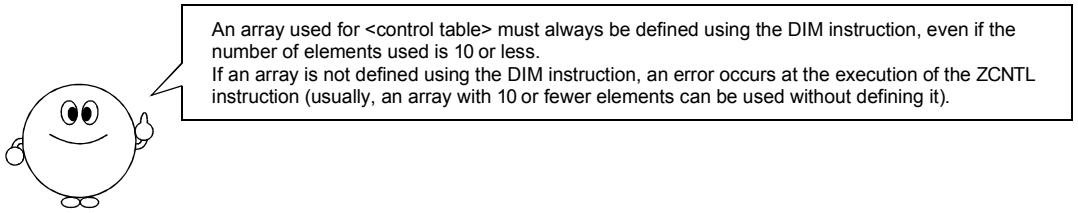
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• Specify which of the communication ports of the communication module is to be used in <channel number>. The channel numbers correspond to the communication ports as follows:

Channel number		Communication port
1	• • • •	CH1 (RS-232)
2	• • • •	CH2 (RS-232)
3	• • • •	CH3 (RS-422)
4	• • • •	CH4 (PARALLEL)

Note that a communication port that is to be set or whose status is to be read using the ZCNTL instruction must be opened by the ZOPEN instruction in advance. If it is not opened, an error occurs.

• Specify the processing code that corresponds to the processing to be performed and the parameters required in the processing in <control table>, which must be an integer array variable. Different <control table> configurations are used depending on the processing; specify the elements according to the specifications of the individual processing code.



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Processing Code 16 Setting communication parameters

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Transmission rate	Specify the transmission rate.
□%(2)	Character length, parity bit	Specify the character length and parity bit in the lower and higher bytes, respectively.
□%(3)	Stop bit	Specify the stop bit in the lower byte. The higher byte is ignored.

Processing Code 17 Reading communication parameters

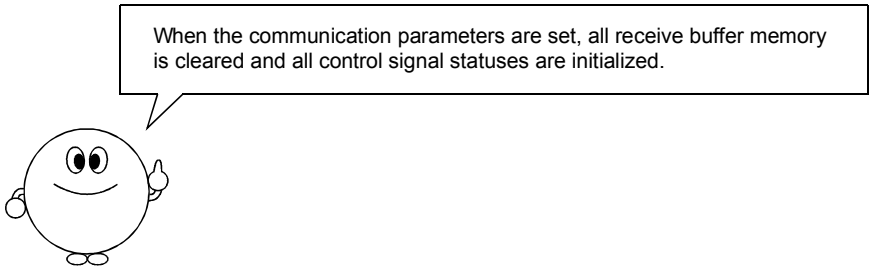
Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Transmission rate	Read the status of the transmission rate.
□%(2)	Character length, parity bit	Read the statuses of the character length and the parity bit into the lower and higher bytes, respectively.
□%(3)	Stop bit	Read the status of the stop bit into the lower byte.

• It is possible to set or read communication parameters of an open communication channel using these codes.
• Specify 16 for the processing code in order to set communication parameters.
Specify 17 for the processing code in order to read communication parameters.
Specify other items as follows:

When changing setting values • • • Sets all the items including values to be changed, in the same way as when specifying parameters in the control table for the ZOPEN instruction. See the ZOPEN instruction for details (it is not possible to set only a part of the items).

When reading set data • • • The currently set parameter data is stored in element positions (1) to (3) of the control table. See the ZOPEN instruction for the meaning of each data item.



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Program Example

```
10 ' This program sets parameters for a communication channel
20 DIM TBL1%(2),TBL2%(3),TBL3%(3),B%(1)          :  ' Defines an arrays
30 A%=1                                          :  ' Communication channel CH1 (RS-232)
40 TBL1%(0)=4800                                 :  ' Sets the baud rate
50 TBL1%(1)=&H107                                :  ' Sets the character length and parity bit
60 TBL1%(2)=&H1                                  :  ' Sets the stop bit
70 ZOPEN #A%,TBL1%( )                            :  ' Opens the communication channel
80 TBL2%(0)=16                                   :  ' Specifies to set the communication
                                                    parameters
90 TBL2%(1)=9600                                 :  ' Sets the baud rate
100 TBL2%(2)=&H208                               :  ' Sets the character length and parity bit
110 TBL2%(3)=&H1                                 :  ' Sets the stop bit
120 ZCNTL #A%,0,TBL2%( )                         :  ' Executes the setting of the communication
                                                    parameters
130 TBL3%(0)=17                                  :  ' Specifies to read the communication
                                                    parameters
140 ZCNTL #A%,0,TBL3%( )                         :  ' Executes reading the communication
                                                    parameters
150 PRINT "Baudrate      =";TBL3%(1)             :  ' Displays the baud rate
160 A$=RIGHT$("0000"+HEX$(TBL3%(2)),4)           :  ' Converts TBL3%(2) to a character string
170 L$=RIGHT$(A$,2)                              :  ' Reads the lower byte
180 H$=LEFT$(A$,2)                               :  ' Reads the higher byte
190 B%(0)=VAL("&H"+L$)                           :  ' Converts the lower byte to a numeric
                                                    value
200 B%(1)=VAL("&H"+L$)                           :  ' Converts the higher byte to a numeric
                                                    value
210 PRINT "Character length=";B%(0)              :  ' Displays the character length
220 PRINT "Parity bit=";B%(1)                    :  ' Displays the parity bit
230 PRINT "Stop bit=";TBL3%(3)                   :  ' Displays the stop bit
240 ZCLOSE #A%                                   :  ' Closes the communication channel
250 END
```


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Processing Code 18 Setting communication control parameters

Control table format definition

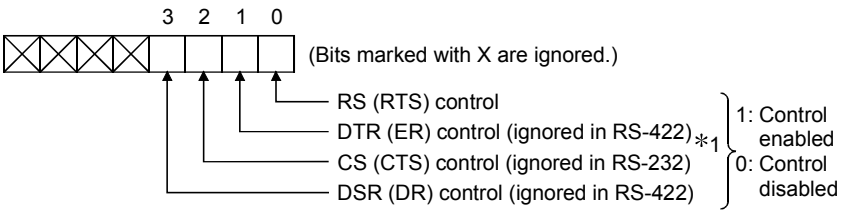
Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	DC control, control by signals	Specify the DC control method in the lower byte and the signal control method in the higher byte.
□%(2)	Dummy data	The specification is not necessary (work area used by the system).
□%(3)	Receive buffer	Specify the size of the receive buffer.

Processing Code 19 Reading communication control parameters

Control table format definition

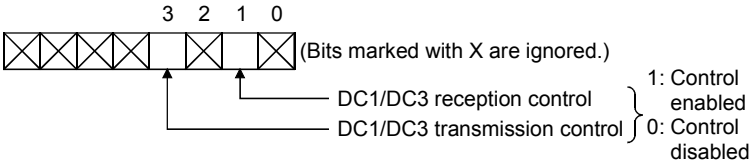
Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	DC control, control by signals	Read the status of DC control into the lower byte and the status of the control by signals into the higher byte.
□%(2)	Dummy data	This data has no meaning (work area used by the system).
□%(3)	Receive buffer	Read the size of the receive buffer.

- It is possible to set or read communication control parameters of an open communication channel using these codes.
- Specify 18 for the processing code in order to set communication control parameters.
  Specify 19 for the processing code in order to read communication control parameters.
- Specify the control by signals in the following manner, using the higher 8 bits of □%(1).



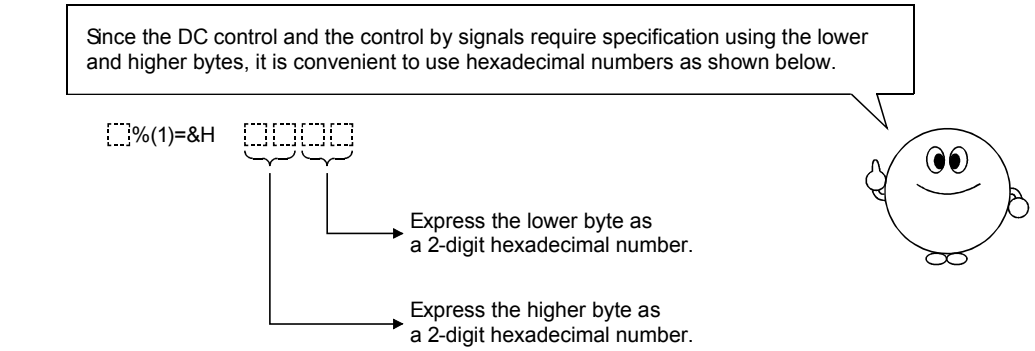
*1: The CS control is enabled in case of RS-232 regardless of the specified data.

- Specify the DC control in the following manner, using the 1st and 3rd bits in the lower 8 bits of □%(1).



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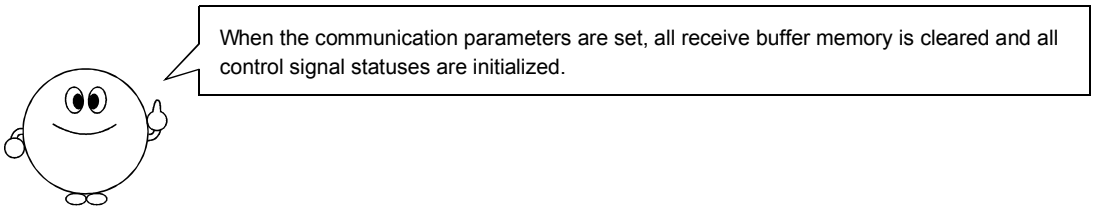
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• Specify the number of bytes for the receive buffer size in the following manner:

0	:	No receive buffer (data received before the execution of a receive request is ignored.)
1 to 1024 bytes	:	Use receive buffer (1024 bytes are recommended).

• %(2) contains meaningless data as it is used by the system of BASIC.



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Program Example

```
1 ' This program sets and reads the communication control parameters
10 DIM TBL1%(2),TBL2%(3),TBL3%(3),B%(1)          :  ' Defines arrays
20 CH%=1                                         :  ' Defines a channel number
30 TBL1%(0)=4800                                 :  ' Sets the baud rate
40 TBL1%(1)=&H8                                  :  ' Sets the character length and parity bit
50 TBL1%(2)=&H2                                  :  ' Sets the stop bit
60 ZOPEN #CH%,TBL1%( )                           :  ' Opens the communication channel
70 TBL1%(0)=18                                   :  ' Specifies to set the communication control
                                                    parameters
80 TBL2%(1)=&HA03                                :  ' Specifies to enable DC1/DC3
                                                    transmission/reception control
90 TBL2%(3)=1024                                 :  ' Sets the receive buffer size to 1024 bytes
100 ZCNTL #CH%,0,TBL2%( )                        :  ' Executes the setting operation
110 TBL3%(0)=19                                  :  ' Specifies to read the communication
                                                    control parameters
120 ZCNTL #CH%,0,TBL3%( )                        :  ' Executes the reading operation
130 PRINT "Setting status of the communication control parameters" :'Displays the result of reading
140 A$=RIGHT$("0000"+HEX$(TBL3%(1)),4)
150 L$=RIGTH$(A$,2)
160 H$=LEFT$(A$,2)
170 B%(0)=VAL("&H"+L$)                           :  ' The value of the lower byte of TBL%(3)
180 B%(1)=VAL("&H"+H$)                           :  ' The value of the higher byte of TBL%(3)
190 B=RDSET(1,B%(0))                             :  ' Checks the first bit of the lower byte
200 IF B=1 THEN PRINT "DC1/DC3 reception control enabled"
210 IF B<>1 THEN PRINT "DC1/DC3 reception control disabled"
220 C=RDSET(3,B%(0))                             :  ' Checks the 3rd bit of the lower byte
230 IF C=1 THEN PRINT "DC1/DC3 transmission control enabled"
240 IF C<>1 THEN PRINT "DC1/DC3 transmission control disabled"
250 FOR I=1 TO 4
260  D=RDSET(I-1,B%(1))                          :  ' Checks the 0th to 3rd bits of the higher
                                                    byte
270  ON I GOSUB 320,350,380,410
280  D=0
290 NEXT I
300 ZCLOSE
310 END
320 IF D=1 THEN PRINT "RS control enabled"
330 IF D<>1 THEN PRINT "RS control disabled"
340 RETURN
350 IF D=1 THEN PRINT "ER control enabled"
360 IF D<>1 THEN PRINT "ER control disabled"
370 RETURN
380 IF D=1 THEN PRINT "CS control enabled"
390 IF D<>1 THEN PRINT "CS control disabled"
400 RETURN
410 IF D=1 THEN PRINT "DR control enabled"
420 IF D<>1 THEN PRINT "DR control disabled"
430 RETURN
```


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Processing Code 22

Setting break characters

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Number of characters	Specify the number of break characters.
□%(2)	Break characters 1 and 2	Specify the code for break character 1 in the lower byte and the code for break character 2 in the higher byte.
□%(3)	Break characters 3 and 4	Specify the code for break character 3 in the lower byte and the code for break character 4 in the higher byte.
□%(4)	Break character 5	Specify break character 5 in the lower byte. The higher byte is ignored.

Processing Code 23

Reading break characters

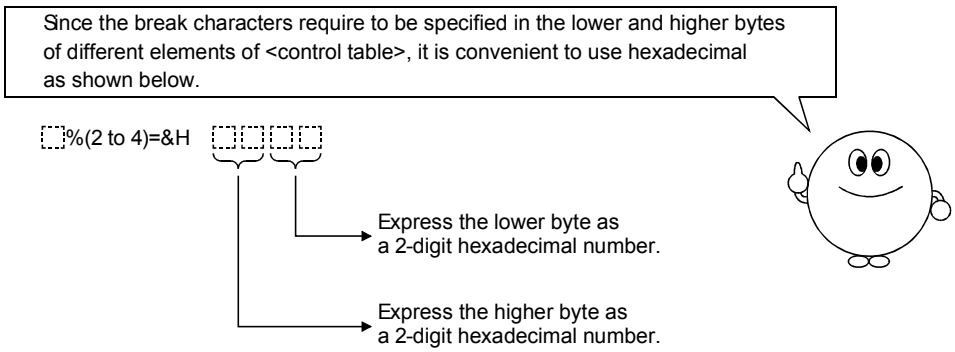
Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Number of characters	Read the number of break characters.
□%(2)	Break characters 1 and 2	Read the code for break character 1 into the lower byte and the code for break character 2 into the higher byte.
□%(3)	Break characters 3 and 4	Read the code for break character 3 into the lower byte and the code for break character 4 into the higher byte.
□%(4)	Break character 5	Read break character 5 into the lower byte. The higher byte is ignored.

- It is possible to set or read break characters of an open communication channel using these codes.
- Specify 22 for the processing code in order to set break characters.
  Specify 23 for the processing code in order to read break characters.
- Specify the number of break characters that ends the execution of a receive request in the <number of characters>.
  0 • • • • • • No break character
  1 to 5 • • • Use the specified number of break characters
- Specify a number of break characters equal to the number set in <number of characters> in <break characters 1 and 2> to <break characters 5>. Break characters exceeding the number set are invalid. Any code from 00_H to FF_H can be set as break characters.

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If a character equal to one of the set break characters is detected during the execution of the ZRECEIVE instruction, the reception data until the break character is stored in the input element of the receive request, after which the execution of the receive request is ended.



Program Example

```
10 ' This program sets and reads break characters
20 DIM TBL1&(2),TBL2%(4),TBL3%(4)          :  ' Defines arrays
30 A%=1                                    :  ' Communication channel CH1 (RS-232)
40 TBL1%(0)=9600                           :  ' Sets the baud rate
50 TBL1%(1)=&H107                          :  ' Sets the character length and parity bit
60 TBL1%(2)=&H1                            :  ' Sets the stop bit
70 ZOPEN #A%,TBL1%( )                      :  ' Opens the communication channel
80 TBL2%(0)=22                             :  ' Specifies to set break characters
90 TBL2%(1)=2                              :  ' Specifies the number of break characters
100 TBL2%(2)=&H30D                         :  ' Defines break characters
110 ZCNTL #A%,0,TBL2%( )                   :  ' Executes the setting of the break
                                                characters
120 TBL3%(0)=23                            :  ' Specifies to read the break characters
130 ZCNTL #A%,0,TBL3%( )                   :  ' Executes the reading of the break
                                                characters
140 PRINT "Number of break characters=";TBL3%(1)  :  ' Displays the result
150 PRINT "Break character=&H";HEX$(TBL3%(2))
160 ZCLOSE #A%                             :  ' Closes the communication channel
170 END
```


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Processing Code 24

Setting continuous break characters

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Setting	Specify whether or not the setting is to be enabled.
□%(2)	Number of characters	Specify the number of break characters.
□%(3)	Break characters 1 and 2	Specify the code for break character 1 in the lower byte and the code for break character 2 in the higher byte.

Processing Code 25

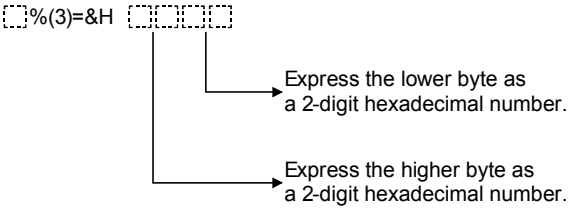
Reading continuous break characters

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Setting	Read whether or not the setting is enabled.
□%(2)	Number of characters	Read the number of break characters.
□%(3)	Break characters 1 and 2	Read the code for break character 1 into the lower byte and the code for break character 2 into the higher byte.

- It is possible to set or read continuous break characters of an open communication channel using these codes.
- Specify 24 for the processing code in order to set the continuous break characters.
  Specify 25 for the processing code in order to read the continuous break characters.
- Specify whether or not continuous break characters should be enabled in <setting>.
  0 • • • Disabled
  1 • • • Enabled
- Specify the number of break characters that ends the execution of a receive request in <number of characters>.
  Always specify 2 for this setting.
- Set the break characters in <break characters 1 and 2>.
  Any code from 00_H to FF_H can be set as break characters.
  If two characters in sequence equal to the set pair of break characters are detected during the execution of the ZRECEIVE instruction, the reception data until the continuous break characters is stored in the input element of the receive request, after which the execution of the receive request is ended.
  If only the first character in a given pair of data values matches the first break character and the second character does not match the second break character, the data pair is not regarded as a break character and treated as usual data.

Since the break characters 1 add 2 must be specified with the lower and higher bytes in <control table>, it is convenient to use hexadecimal numbers as shown below.



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Program Example

```
100 ' This program specifies and reads continuous break characters
110 DIM TBL1%(2),TBL2%(4),TBL3%(4)          :  ' Defines arrays
120 A%=1                                    :  ' Communication channel CH1 (RS-232)
130 TBL1%(0)=9600                           :  ' Sets the baud rate
140 TBL1%(1)=&H107                          :  ' Sets the character length and parity bit
150 TBL1%(2)=&H1                            :  ' Sets the stop bit
160 ZOPEN #A%,TBL1%( )                      :  ' Opens the communication channel
170 TBL2%(0)=24                             :  ' Specifies to set continuous break
                                                 characters
180 TBL2%(1)=1                              :  ' Sets the number of break characters
190 TBL2%(2)=2
200 TBL2%(3)=&H30D
210 ZCNTL #A%,0,TBL2%( )
220 TBL3%(0)=25
230 ZCNTL #A%,0,TBL3%( )
240 PRINT"Number of break characters=";TBL3%(1)
250 PRINT"Break character=&H";HEX$(TBL3%(2))
260 ZCLOSE #A%
270 END
```


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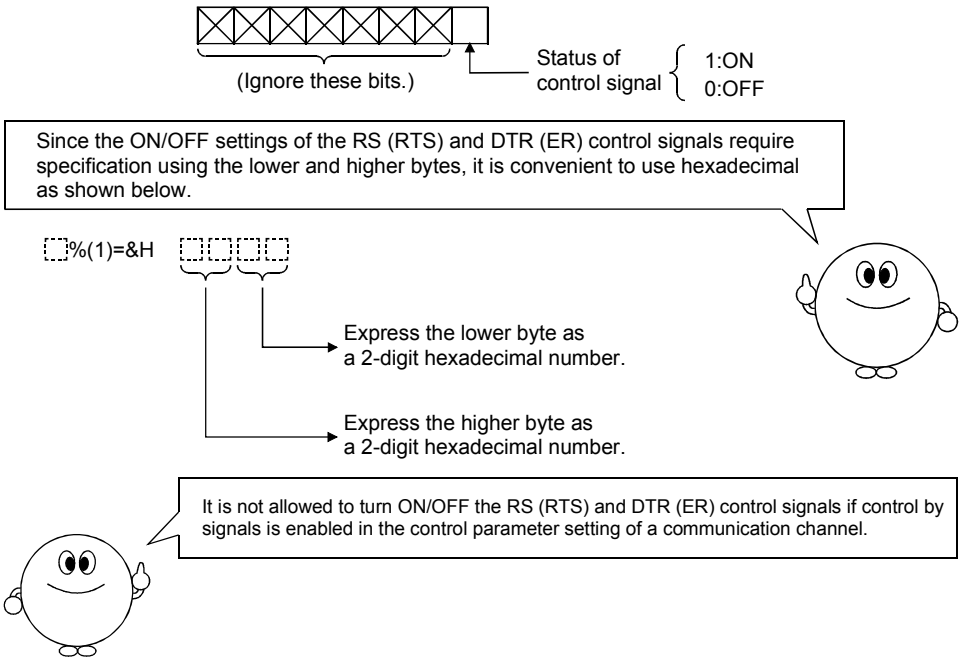
Processing Code 32

Turning ON/OFF the RS (RTS) and DTR (ER) control signals

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	RS (RTS) and DTR (ER) control signals	Specify ON/OFF of the RS (RTS) and DTR (ER) control signals to the lower and higher bytes, respectively.

- This processing code is used to forcefully turn ON/OFF the RS (RTS) and DTR (ER) control signals of the open communication channel.
  Note that the RS-422 interface cannot be controlled by the DTR (ER) control signal.
- Specify 32 for the processing code.
- The ON/OFF status of each control signal is specified in the following manner, using the higher and lower 8 bits of □%(1).



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Program Example

```
10 ' This program specifies the status of the RS/ER control signals to ON or OFF
20 DIM TBL1%(2),TBL2%(3),TBL3%(1)          :  ' Defines arrays
30 A%=1                                    :  ' Defines a channel number
40 TBL1%(0)=9600                           :  ' Sets the baud rate
50 TBL1%(1)=&H108                          :  ' Sets the character length and the parity bit
60 TBL1%(2)=&H1                            :  ' Sets the stop bit
70 ZOPEN #A%,TBL1%( )                      :  ' Opens the communication channel
80 TBL2%(0)=18                             :  ' Specifies to set the communication control
                                              parameters
90 TBL2%(1)=&H0                            :  ' Control by the RS/ER control signals
                                              disabled
100 TBL2%(3)=1024                          :  ' Sets the receive buffer size to 1024 bytes
110 ZCNTL #A%,0,TBL2%( )                   :  ' Executes
120 TBL3%(0)=32                            :  ' Specifies to turn ON/OFF the RS/ER
                                              control signals
130 TBL3%(1)=&H101                         :  ' Turns ON the RS and ER control signals
140 ZCNTL #A%,0,TBL3%( )                   :  ' Executes
150 ZCLOSE #A%
160 END
```


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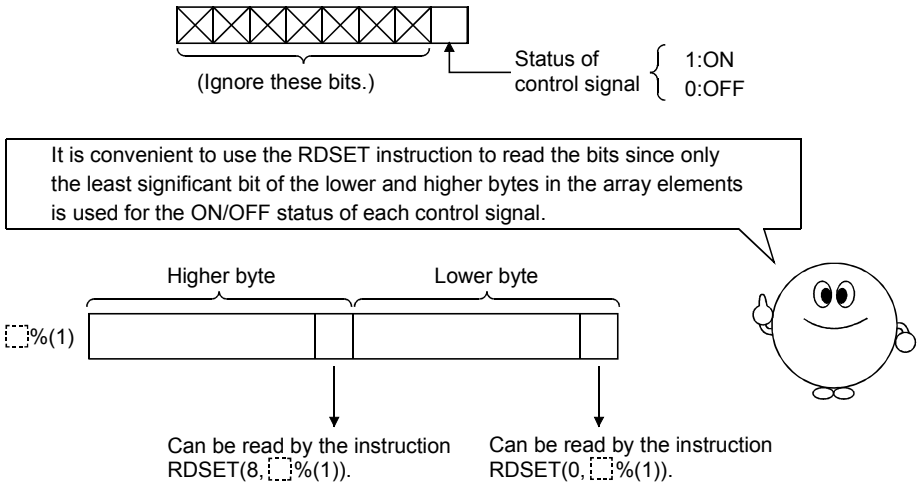
Processing Code 33

Reading the ON/OFF status of the CS (CTR), DSR (DR), RS (RTS), DTR (ER) and CD control signals

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	CS (CTS) and DSR (DR) control signals	Read the status of the CS (CTS) and DSR (DR) control signals into the lower and higher bytes, respectively.
□%(2)	RS (RTS) and DTR (ER) control signals	Read the status of the RS (RTS) and DTR (ER) control signals into the lower and higher bytes, respectively.
□%(3)	CD control signal	Read the status of the CD control signal into the lower byte.

- This processing code is used to read the ON/OFF status of the CS (CTR), DSR (DR), RS (RTS), DTR (ER) and CD control signals of an open communication channel.
- Specify 33 for the processing code.
- The CS (CTR) control signal cannot be read for the RS-232 interface (CH1/CH2). Because the DSR (DR), DTR (ER) and CD control signals are not included in RS-422/485(CH3), they cannot be read for the interface.
- The ON/OFF status of each control signal is expressed in the following manner using the higher and lower 8 bits:



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Program Example

```
10 ' This program reads the ON/OFF status of the CS, DR, RS, ER, and CD control signals
20 DIM TBL1%(2),TBL2%(3)                    :  ' Defines arrays
30 CH%=1                                    :  ' Specifies the communication channel
40 TBL1%(0)=9600
50 TBL1%(1)=&H108
60 TBL1%(2)=&H1
70 ZOPEN #CH%,TBL1%( )                      :  ' Opens the communication channel
80 TBL2%(0)=33                              :  ' Specifies to read the status
90 ZCNTL #CH%,0,TBL2%( )                    :  ' Executes the read operation
100 A=RDSET(0,TBL2%(1))                     :  ' Reads the bit
110 B=RDSET(8,TBL2%(1))
120 C=RDSET(0,TBL2%(2))
130 D=RDSET(8,TBL2%(2))
140 E=RDSET(0,TBL2%(3))
150 PRINT "CS control signal: ";            :  ' Displays the status
160 IF A=1 THEN PRINT "ON" ELSE PRINT "OFF"
170 PRINT "DR control signal: ";
180 IF B=1 THEN PRINT "ON" ELSE PRINT "OFF"
190 PRINT "RS control signal: ";
200 IF C=1 THEN PRINT "ON" ELSE PRINT "OFF"
210 PRINT "ER control signal: ";
220 IF D=1 THEN PRINT "ON" ELSE PRINT "OFF"
230 PRINT "CD control signal: ";
240 IF E=1 THEN PRINT "ON" ELSE PRINT "OFF"
250 ZCLOSE #CH%                             :  ' Closes the communication channel
260 END
```


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Processing Code 48

Specifying high impedance control

Control table format definition

Element position	Item	Description
%(0)	Processing code	Specify the processing code.
%(1)	Setting	Specify whether or not to set the high impedance control.

- This processing code is used to set whether or not the high impedance control is used when the RS-422/485(CH3) and other stations are connected in a 1 : n configuration.
- Specify 48 for the processing code.
- Specify whether or not the high impedance control is used in the setting.
  0 • • • High impedance control disabled
  1 • • • High impedance control enabled
- The default value of the setting is 0 (high impedance control disabled).
- For a transmission station to send data when the communication module and other stations are connected in a 1 : n configuration and the high impedance control is enabled for the communication channel, the transmission station should cancel the high impedance before sending the data. The impedance should then be set high again after sending the data. Stations other than the station sending data should be in the high impedance status.
  At this point, the communication module sends up to 2 bytes of data between the canceling of the high impedance control and the start of transmission, as well as between the end of data transmission and setting the impedance high again. If another station wants to send data thereafter, it must not start its transmission until after the station that was previously sending data finishes transmission of these 2 bytes of data.



Program Example

```
100 ' This program sets the high impedance control
110 DIM TBL1%(10),TBL2%(10)          :  ' Defines arrays
120 CH%=4                            :  ' Selects channel 4
130 TBL1%(0)=4800
140 TBL1%(1)=&H107
150 TBL1%(2)=&H1
160 ZOPEN #CH%,TBL1%( )              :  ' Opens the communication channel
170 TBL2%(0)=48                      :  ' Specifies to set the high impedance
                                        control
180 TBL2%(1)=1                       :  ' Enables the high impedance control
190 ZCNTL #CH%,0,TBL2%( )            :  ' Executes
200 ZCLOSE #CH%                      :  ' Closes the communication channel
210 END
```


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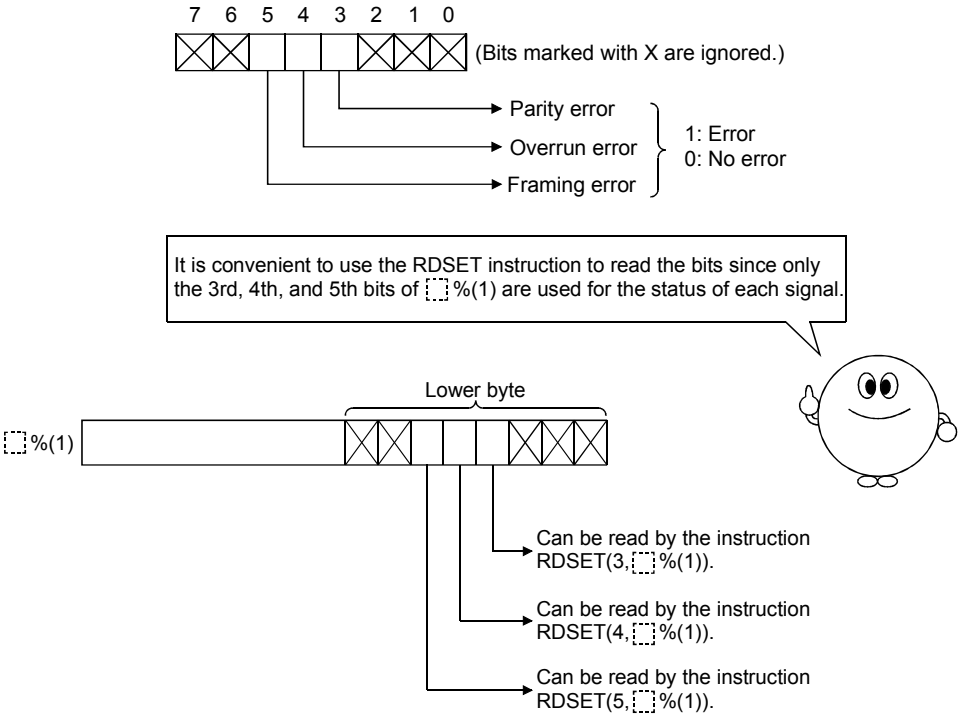
Processing Code 64

Reading causes of reception errors

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Error causes	Read the causes of reception errors into the lower byte.

- It is possible to read the causes of errors (parity, overrun, or framing errors) that have occurred in an open communication channel using this code.
- Specify 64 for the processing code.
- The reception error causes are expressed in the following manner using the lower 8 bits of □%(1).



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Program Example

```
5 ' This program reads the causes of reception errors
10 DIM TBL1%(2),TBL2%(1)                    :  ' Defines arrays
20 CH%=1                                    :  ' Specifies the communication channel
30 TBL1%(0)=9600
40 TBL1%(1)=&H108
50 TBL1%(2)=&H1
60 ZOPEN #CH%,TBL1%( )                      :  ' Opens the communication channel
70 TBL2%(0)=64                              :  ' Specifies to read the causes of reception
                                                 errors
80 ZCNTL #CH%,0,TBL2%( )                    :  ' Executes the read operation
90 A=RDSET(3,TBL2%(1))                      :  ' Reads the bits
100 B=RDSET(4,TBL2%(1))
110 C=RDSET(5,TBL2%(1))
120 IF A=1 THEN PRINT "There is a parity error!"     :  ' Displays the results
130 IF B=1 THEN PRINT "There is an overrun error!"
140 IF C=1 THEN PRINT "There is a framing error!"
150 IF A<>1 AND B<>1 AND C<>1 THEN PRINT "No error"
160 ZCLOSE #CH%                             :  ' Closes the communication channel
170 END
```


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Processing Code 80

Reading the receive buffer size and the number of characters

Control table format definition

Element position	Item	Description
□%(0)	Processing code	Specify the processing code.
□%(1)	Receive buffer	Read the size of the receive buffer.
□%(2)	Number of characters	Read the number of characters stored in the receive buffer.

- It is possible to read the size of the receive buffer and the number of characters stored in the receive buffer using this code.
- Specify 80 for the processing code.
- The reading operation can be performed on CH1 (RS-232), CH2 (RS-232), and CH3 (RS-422/485).

Program Example

```
5 ' This program reads the receive buffer size and the number of characters stored in it
10 DIM TBL1%(10),TBL2%(10)                    :  ' Defines arrays
20 CH%=1                                      :  ' Specifies the communication channel
30 TBL1%(0)=9600
40 TBL1%(1)=&H108
50 TBL1%(2)=&H1
60 ZOPEN #CH%,TBL1%( )                        :  ' Opens the communication channel
70 TBL2%(0)=80                                :  ' Specifies to read the size and the number
                                                    of characters
80 ZCNTL #CH%,0,TBL2%( )                      :  ' Executes the read operation
90 PRINT "The size of receive buffer=";TBL2%(1)  :  ' Displays the result
100 PRINT "The number of characters=";TBL2%(2)
110 ZCLOSE #CH%                               :  ' Closes the communication channel
120 END
```

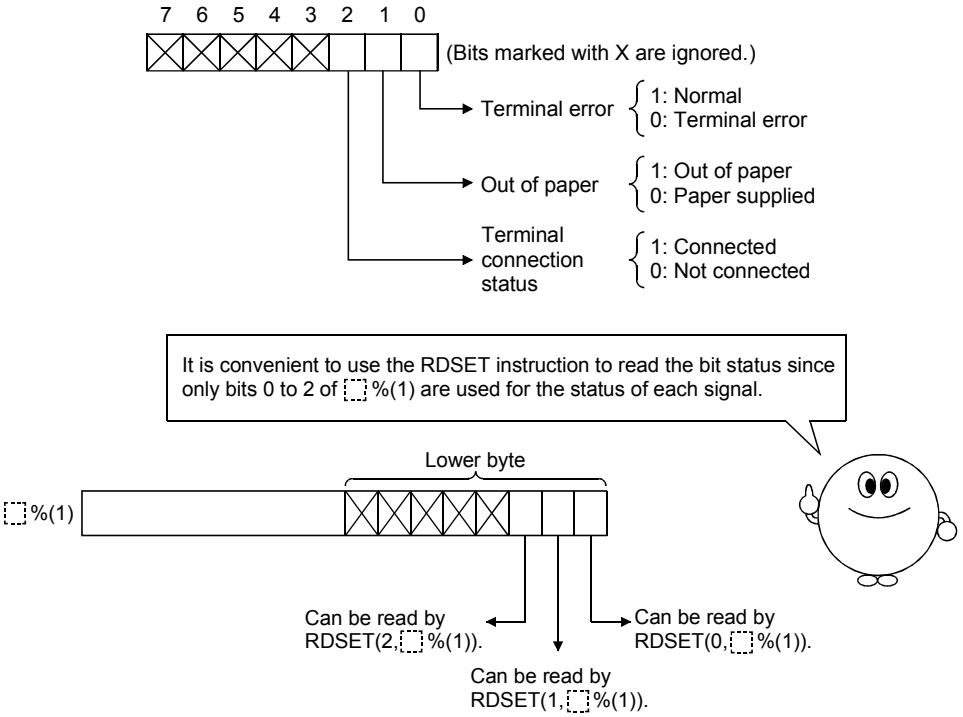

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Processing Code 128 Reading the printer status

Control table format definition

Element position	Item	Description
[ ]%(0)	Processing code	Specify the processing code.
[ ]%(1)	Printer status	Read the printer status into the lower byte.

- It is possible to read the status (terminal error, out of paper, and terminal connection status) of a printer connected to an open parallel interface using this code.
- Specify 128 for the processing code.
- The printer status is expressed in the following manner using the lower 8 bits of [ ]%(1).



The statuses of the following signals of the parallel interface are read into printer status.

Terminal error	• • • •	$\overline{\text{ERROR}}$
Out of paper	• • • •	PE
Terminal connection	• • • •	SLCT

How the ON/OFF status of each signal is controlled depends on the printer; see the manual of the printer used.

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Program Example

```
10 ' This program reads the printer status
20 DIM TBL%(1)                                  :  ' Defines an array
30 ZOPEN #4                                     :  ' Opens the communication channel
40 TBL%(0)=128                                  :  ' Specifies to read the printer status
50 ZCNTL #4,0,TBL%( )                           :  ' Executes the read operation
60 A=RDSET(0,TBL%(1))                           :  ' Reads the bits
70 B=RDSET(1,TBL%(1))
80 C=RDSET(2,TBL%(1))
90 PRINT "The printer status"                   :  ' Displays the result
100 IF A=1 THEN PRINT "Terminal is normal" ELSE PRINT "Terminal error!"
110 IF B=1 THEN PRINT "Out of paper!" ELSE PRINT "Paper supplied"
120 IF C=1 THEN PRINT "The terminal is connected" ELSE PRINT "The terminal is not connected!"
130 ZCLOSE #4
```


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Processing Code 136 Outputting the initialization signal to the printer

Control table format definition

Element position	Item	Description
%(0)	Processing code	Specify the processing code.

- This processing code is used to send an initialization signal for a duration of 100 ms to a printer connected to the open parallel interface.
- Specify 136 for the processing code.
- The initialization signal is sent to the printer via the $\overline{\text{INIT}}$ signal of the parallel interface.
  The data set at the initialization caused by the $\overline{\text{INIT}}$ signal depends on the printer; see the manual of the printer used.

Program Example

```
10 ' This program outputs an initialization signal to a printer
20 DIM TBL%(0)                                  :  ' Defines an array
30 ZOPEN #4                                     :  ' Opens the communication channel
40 TBL%(0)=136                                  :  ' Specifies to output the initialization signal
                                                   to the printer
50 ZCNTL #4,0,TBL%( )                           :  ' Executes the output operation
60 PRINT "Printer initialization completed"     :  ' Displays the completion
70 ZCLOSE #4                                    :  ' Closes the communication channel
80 END
```


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Available only in run mode

ZEVENT Instruction — Z EVENT

• Enables or disables event generation.

Syntax

ZEVENT△ENABLE△<event number>

ZEVENT△ DISABLE △<event number>

ENABLE (enable)	• • • •	Enable the event generation.
DISABLE (disable)	• • • •	Disable the event generation.
event number	• • • •	Specify the event number from 0 to 63 to be enabled/disabled.

Examples

ZEVENT ENABLE 1	• • • •	Enables the event generation of event number 1.
ZEVENT DISABLE 0	• • • •	Disables the event generation of event number 0.

Description

• The ZEVENT instruction is used to enable or disable the event generation.
• If the event generation is enabled, the following occurs:
The event corresponding to <event number> is generated if the status of the target device of the defined event changes from OFF (0) to ON (1) or the ZSIGNAL instruction that specifies the same event number is executed. A program waiting for the generation of the event, if any, can then resume execution.
• If the event generation is disabled, the following occurs:
The event corresponding to <event number> is not generated if the target device of the defined event changes from OFF (0) to ON (1). The event is not generated either if a ZSIGNAL instruction that specifies the same event number is executed.
Therefore, the OS does not resume the execution of waiting programs even if the above-mentioned device changes or the ZSIGNAL instruction is executed.
• <event number> must be defined using the DEF ZEVENT instruction in advance.
• It is allowed to enable or disable the generation of the target event several times within a program.
Whether or not the event is generated is determined by the most recent enabled/disabled specification.
• When the event is defined, the generation of that event is set to be disabled by default.

REMARK

• See Section 8.2 for the details about the event control.
• See the DEF ZEVENT, ZSIGNAL, and ZWAIT EVENT instructions.

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ZIDV Instruction — Z Input DeVice

• Specifies the data input device for the INPUT instruction, etc.

Syntax

ZIDV△<channel number>

channel number •••• Specify the channel number of the communication port to which a console or terminal is connected.

Examples

ZIDV 1 •••• Performs data input using the INPUT instruction, etc. from the terminal connected to CH1 (RS-232).

Description

• The ZIDV instruction is used to specify the device from which data for the INPUT instruction, etc. is input.

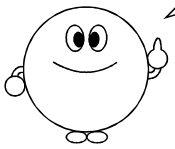
• The input device specified by the ZIDV instruction is valid only for the following instructions and functions.

INPUT INKEY$

INPUT$ LINE INPUT

• Specify the communication port to which the device used for data input is connected in <channel number>.

Channel number		Communication port
0	••••	The console specified in the communication module
1	••••	CH1 (RS-232)
2	••••	CH2 (RS-232)
3	••••	CH3 (RS-422/485)



The communication channel specified by the ZIDV instruction must be opened by the ZOPEN instruction in advance.
This is not required if 0 is specified for <channel number>, however.
Note that if an output destination channel specified by the ZIDV instruction is closed with the ZCLOSE instruction, the output destination for the INPUT instruction, etc. will automatically change to the console specified in the communication module (channel number 0).

REMARK

See the ZLDV, ZODV and ZOPEN instructions, and Section 7.3.

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ZLDV Instruction — Z Line printer DeVice

• Selects a communication port for a printer.

Syntax

ZLDV△<channel number>

channel number • • • • Specify the communication port to which the printer is connected.

Examples

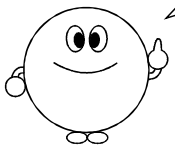
ZLDV 4 • • • • Selects the printer connected to the parallel interface to be the target printer with the printer output instructions.

Description

• The ZLDV instruction specifies to which communication port the printer is connected when the LLIST, LPRINT, and LFILES instructions are executed.

• Specify the communication port to which the printer is connected in <channel number> in the following manner.

Channel number		Communication port
0	• • • •	A printer connected to a peripheral device (the printer set by the basic utility of the peripheral device is selected.)
1	• • • •	CH1 (RS-232)
2	• • • •	CH2 (RS-232)
3	• • • •	CH3 (RS-422/485)
4	• • • •	CH4 (PARALLEL)



The communication channel specified by the ZLDV instruction must be opened by the ZOPEN instruction in advance.
This is not required when 0 is specified for <channel number>, however.
Note that if an output destination channel specified by the ZLDV is closed via the ZCLOSE instruction, the output destination for the print output instructions will automatically change to the printer set by the basic utility of the peripheral device.

REMARK

See the ZIDV, ZODV and ZOPEN instructions, and Section 7.3.

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Available only in run mode

ZMESSAGE Instruction Z MESSAGE

• Defines a message port.

Syntax

ZMESSAGE△<message port number>△LEN=<message length>

<message port number> • • • • Specify the number of the message port to be defined.

<message length> • • • • Specify the length of the message used in the message port in byte units (1 to 256).

Examples

ZMESSAGE 1 LEN=128 • • • • Defines the message port of message port number 1 with the message length of 128 bytes.

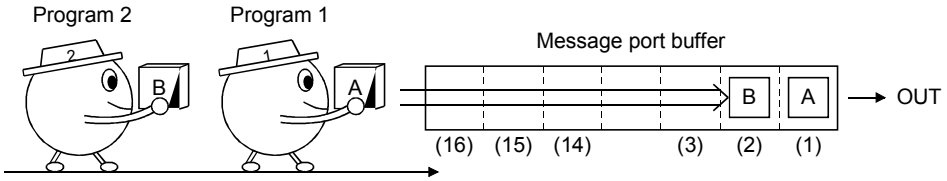
Description

• The ZMESSAGE instruction is used to define message ports in the main memory. Message ports are used to perform communication between programs that operate in multitask operations.

• It is possible to define up to 32 message ports. <message port number> is used to specify which of the message ports to be defined.
<message port number> is determined by the types of message port as follows. Select the type according to the purpose used.

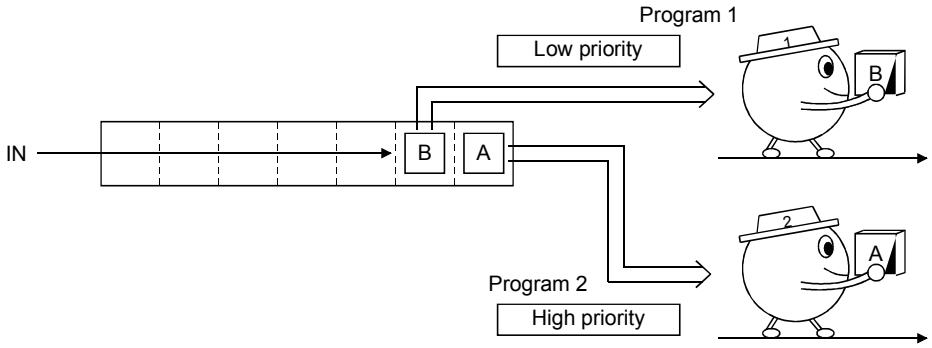
FIFO method • • • Message port numbers 16 to 31

The messages are stored in the message port buffer in the order they are sent to the message ports.



Priority method • • • Message port numbers 0 to 15

This method retrieves the message sent by the program with the highest priority first, regardless of the order of data transmission to the message ports.

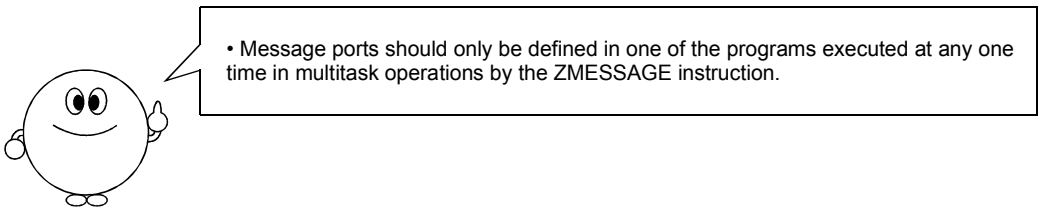


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• Specify the maximum message length that can be transmitted to the message port in <message length>. The specification range is from 1 to 256 bytes.
The necessary number of bytes can be found from the following. Note that if several <output element> are specified in the ZMESSAGE PUT instruction, the necessary number of bytes is the total value of all of <output element>.

Integer data	• • • •	2 bytes per data
Single-precision floating point data	• • • •	4 bytes per data
Double-precision floating point data	• • • •	8 bytes per data
Character data	• • • •	1 byte per character

Normally it is recommended to specify 256 bytes.



• In order to use the message ports, it is necessary to open the message ports by the ZMESSAGE OPEN instruction after defining them by the ZMESSAGE instruction.

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Program Example

```
10 ' This program exchanges data between tasks via the message ports (TASK 1)
20 DEF ZEVENT 1                          :  ' Defines event 1
30 ZEVENT ENABLE 1                       :  ' Enables the generation of event 1
40 A$=SPACE$(80)                         :  ' Stores dummy data in the character
                                            variable
50 ZMESSAGE 1 LEN=80                     :  ' Defines message port 1
60 ZMESSAGE OPEN 1                       :  ' Opens message port 1
70 ZSIGNAL 1                             :  ' Generates event 1
80 ZMESSAGE PUT 1,"MESSAGE FOR TASK2"    :  ' Writes the message
90 ZMESSAGE CLOSE 1                      :  ' Closes message port 1
100 ZMESSAGE 2 LEN=80                    :  ' Defines message port 2
110 ZMESSAGE OPEN=2                      :  ' Opens message port 2
120 ZMESSAGE GET 2,A$                    :  ' Reads the message
130 ZMESSAGE CLOSE 2                     :  ' Closes message port 2
140 PRINT A$                             :  ' Displays the result
150 ZMESSAGE KILL 1                      :  ' Erases message port 1
160 ZMESSAGE KILL 2                      :  ' Erases message port 2
170 END
```

```
10 ' This program exchanges data between tasks via the message ports (TASK 2)
20 ZWAIT EVENT 1                         :  ' Waits for the generation of event 1
30 B$=SPACE$(80)                         :  ' Stores dummy data in the character
                                            variable
40 ZMESSAGE OPEN 1                       :  ' Opens message port 1
50 ZMESSAGE GET 1,B$                     :  ' Reads the message
60 ZMESSAGE CLOSE 1                      :  ' Closes message port 1
70 ZMESSAGE OPEN=2                       :  ' Opens message port 2
80 ZMESSAGE PUT 2,"MESSAGE FOR TASK1"    :  ' Writes the message
90 ZMESSAGE CLOSE 2                      :  ' Closes message port 2
100 LOCATE 0,1                           :  ' Changes the display position
110 PRINT B$                             :  ' Displays the result
120 END
```

REMARK

- See Sections 8.1 and 8.5.2, as well as the ZURGENCY instruction for details about the program priority.
- See the ZMESSAGE CLOSE, ZMESSAGE GET, ZMESSAGE KILL, ZMESSAGE OPEN and ZMESSAGE PUT instructions, and Section 8.5.2.

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Available only in run mode

ZMESSAGE CLOSE Instruction ZMESSAGE CLOSE

• Closes message ports.

Syntax

ZMESSAGE△CLOSE△ [<message port number>]

<message port number> • • • • Specify the number of the message port to be closed.

Examples

ZMESSAGE CLOSE 1	• • • •	Closes the message port of message port number 1.
ZMESSAGE CLOSE	• • • •	Closes all open message ports.

Description

• The ZMESSAGE CLOSE instruction is used to close open message ports.
• Specify the message port number of the message port to be closed in <message port number>.
If it is omitted, all open message ports will be closed.
• Message ports specified in <message port number> cannot be used in a program any longer once the ZMESSAGE CLOSE instruction has been executed.
• Message ports closed by the ZMESSAGE CLOSE instruction can, however, be opened and used again by using the ZMESSAGE OPEN instruction.
• In order to delete message ports, first close the message ports in all the programs being executed in multitask operations, and then execute the ZMESSAGE KILL instruction.

REMARK

See the ZMESSAGE, ZMESSAGE GET, ZMESSAGE KILL, ZMESSAGE OPEN and ZMESSAGE PUT instructions, and Section 8.5.2.

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Available only in run mode

ZMESSAGE GET Instruction ZMESSAGE GET

• Reads messages from message ports.

Syntax

ZMESSAGE△GET△<message port number>, <variable name> • • • [△<timeout value>]

<message port number> • • • • Specify the number of the message port from which the message is to be read.

<variable name> • • • • Specify the variable to which the message read is to be assigned.

<timeout value> • • • • Specify the maximum time to wait for a message to be written in the format "HH:MM:SS:R."

HH: Hours (0 to 23)
MM: Minutes (0 to 59)
SS: Seconds (0 to 59)
R: 100 ms (express 0 to 900 ms using the numbers from 0 to 9)

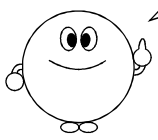
Examples

ZMESSAGE GET 1, AS • • • • Reads character data from the message port with message port number 1 and assigns it to AS.

ZMESSAGE GET 16, A%, "00:01:00:0" • • • • Reads numeric data from the message port with message port number 16 and assigns it to A%. If the message is not written in one minute, a timeout error occurs.

Description

• The ZMESSAGE GET instruction is used to read messages written in a message port. If no messages have been written in the message port, the program execution is halted and the program waits for a message to be written.
• Specify the number of the message port from which the message is to be read in <message port number>.
• Specify the variable to which messages read from message ports are to be assigned in <variable name>.
The type of the messages in the message ports and the type of the variable specified in <variable name> must match.

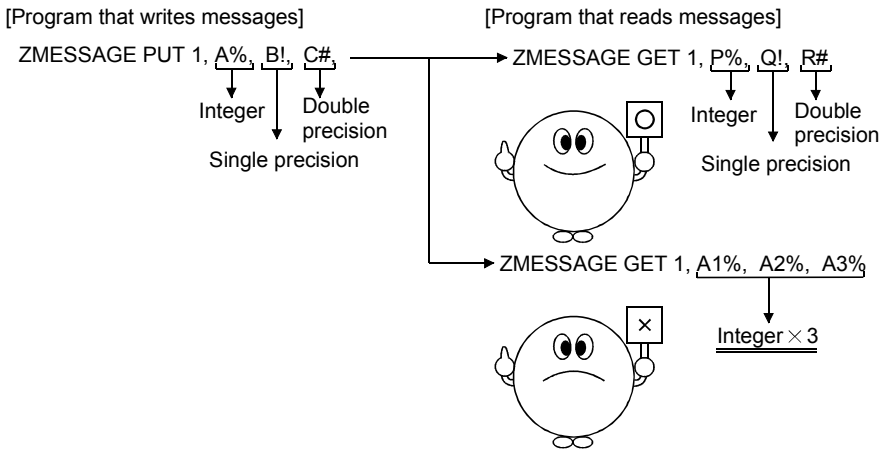


• Store dummy data for a greater number of bytes than the message length in the variable specified in <variable name>, before executing the ZMESSAGE GET instruction as shown below.
If such dummy data has not been stored in advance, an error occurs when the ZMESSAGE GET instruction is executed.
Numeric variable %=0, !=0, #=0
Character variable S=SPACE$(255)
• Always define an array variable specified as <variable name> using the DIM instruction, even if the number of elements used is less than 10. If it is not defined using the DIM instruction, an error occurs at the execution of the ZMESSAGE GET instruction (usually, an array with 10 or fewer elements can be used without defining it using the DIM instruction).

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• If <variable name> is a numeric variable, it is possible to specify multiple <variable name> by separating by commas. In this case, the type of each variable read must correspond correctly to the type of each message written to the message port by the ZMESSAGE PUT instruction. Otherwise, improper messages will be read.

Example



• In <timeout value>, specify the maximum time the program waits for a message to be written in case a message port is empty, using the format shown below (the program execution is stopped while waiting).
"HH:MM:SS:R"

HH	• • • •	Hours ("0" to "23")	MM	• • • •	Minutes ("0" to "59")
SS	• • • •	Seconds ("0" to "59")	R	• • • •	ms (express 0 to 900 ms using numbers from "0" to "9")

If the specification of <timeout value> is omitted or "00:00:00:0" is specified, the program waits for an infinite time.

REMARK

See the ZMESSAGE, ZMESSAGE CLOSE, ZMESSAGE KILL, ZMESSAGE OPEN and ZMESSAGE PUT instructions, and Section 8.5.2.

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Available only in run mode

ZMESSAGE KILL Instruction

ZMESSAGE KILL

• Deletes the defined message ports.

Syntax

ZMESSAGE△KILL△<message port number>

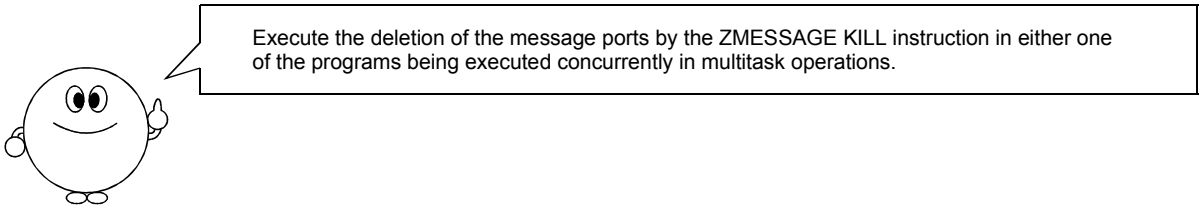
message port number • • • • Specify the number of the message port to be deleted.

Examples

ZMESSAGE KILL 1 • • • • Deletes the message port of message port number 1.

Description

• The ZMESSAGE KILL instruction is used to delete message ports defined in the main memory.
• Specify the message port number of the message port to be deleted in <message port number>.
• In order to delete message ports, it is necessary to close all open message ports in all programs being executed concurrently in multitask operations.
An error occurs if the ZMESSAGE KILL instruction is executed while there is still one or more programs that have not closed all message ports.



REMARK

See the ZMESSAGE, ZMESSAGE CLOSE, ZMESSAGE GET, ZMESSAGE OPEN and ZMESSAGE PUT instructions, and Section 8.5.2.

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Available only in run mode

ZMESSAGE OPEN Instruction ZMESSAGE OPEN

• Opens a previously defined message port.

Syntax

ZMESSAGE△OPEN△<message port number>

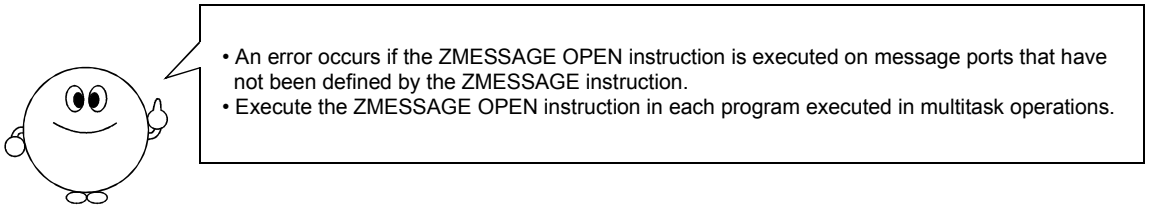
<message port number> • • • • Specify the number of the message port to be opened.

Examples

ZMESSAGE OPEN 1 • • • • Opens the message port of message port number 1.

Description

• The ZMESSAGE OPEN instruction is used to open message ports previously defined by the ZMESSAGE instruction.
• Specify the message port number of the message port to be opened in <message port number>.
• The ZMESSAGE instruction only defines the message ports; the message ports may be used by the ZMESSAGE OPEN instruction.



REMARK

See the ZMESSAGE, ZMESSAGE CLOSE, ZMESSAGE GET, ZMESSAGE KILL and ZMESSAGE PUT instructions, and Section 8.5.2.

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Available only in run mode

ZMESSAGE PUT Instruction ZMESSAGE PUT

• Writes messages to a message port.

Syntax

ZMESSAGE△PUT△<message port number>,<message>, • • •

<message port number>	• • • •	Specify the number of the message port to which a message is to be written.
<message>	• • • •	Specify the message to be written to the message port.

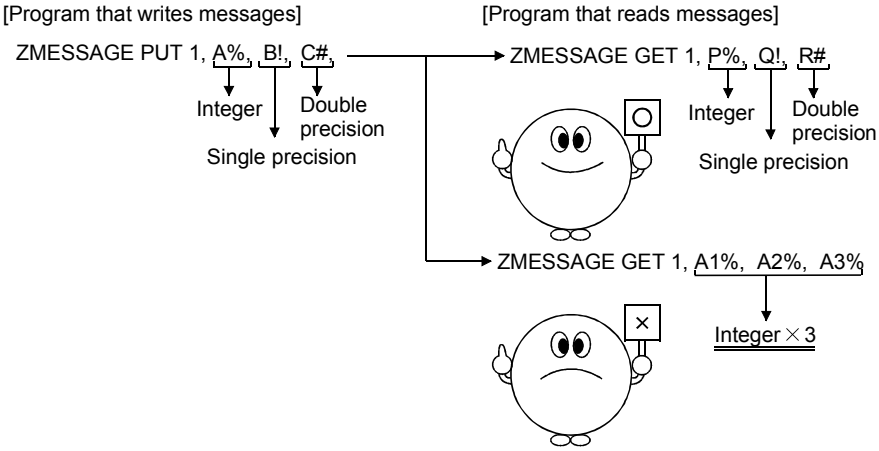
Examples

ZMESSAGE PUT 1,"Hello"	• • • •	Writes a message containing the character string "Hello" to the message port of message port number 1.
ZMESSAGE PUT 16, A%	• • • •	Writes a message containing the data in A% to the message port of message port number 16.

Description

• The ZMESSAGE PUT instruction is used to write messages to message ports.
• Specify the message port number of the message port to which messages are to be written in <message port number>.
• A numeric constant, character string constant, numeric variable, character variable, or an array variable can be specified for <message>. A character string must be enclosed by double quotation marks (").
• If <message> is a numeric value or numeric variable, it is possible to specify multiple <message> by separating each <message> by commas.
In this case, the types of the messages written and the types of the messages read by the ZMESSAGE GET instruction must match correctly. Otherwise, improper messages will be read.

Examples



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REMARK

See the ZMESSAGE, ZMESSAGE CLOSE, ZMESSAGE GET, ZMESSAGE KILL and ZMESSAGE OPEN instructions, and Section 8.5.2.

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ZMOVE Instruction ZMOVE

• Transfers data between variables.

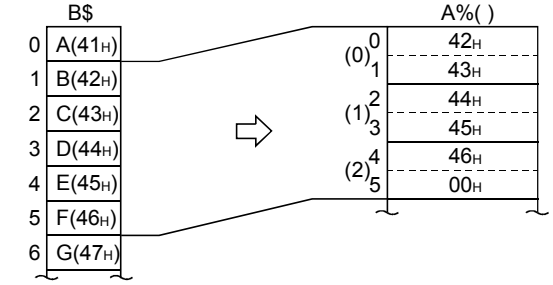
Syntax

ZMOVE△TO△<transfer destination>,<offset 1>△FROM△<transfer source>,<offset 2>,<number of transferred bytes>

transfer destination	• • • •	Specify the variable, one-dimensional array variable, or one-dimensional numeric array name to which data is to be transferred.
offset 1	• • • •	Specify the data storage location within the transfer destination variable or array, using a number from 0 to 65534 in byte units.
transfer source	• • • •	Specify the transfer source, i.e. one-dimensional array variable, one-dimensional numeric array, or character variable in which data is stored before the transfer.
offset 2	• • • •	Specify the data storage location within the transfer source variable, array, or character variable using a number from 0 to 65534 in byte units.
number of transferred bytes	• • • •	Specify the number of bytes of data to be transferred.

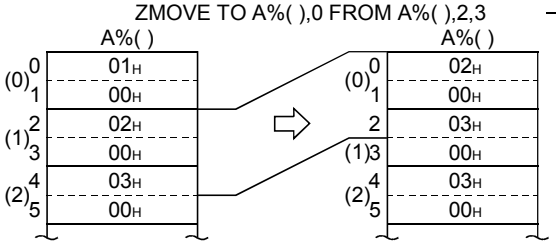
Examples

ZMOVE TO A%( ),0 FROM B$,1,6



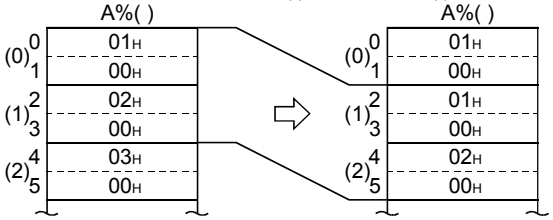
Transfers byte data (for 6 characters) from the first byte (second character) of B$ to A%(0) through A%(2).

ZMOVE TO A%( ),0 FROM A%( ),2,3



Transfers the lower byte data of A%(1) and A%(2) to the lower byte of A%(0) and A%(1).

ZMOVE TO A%( ),2 FROM A%( ),0,4



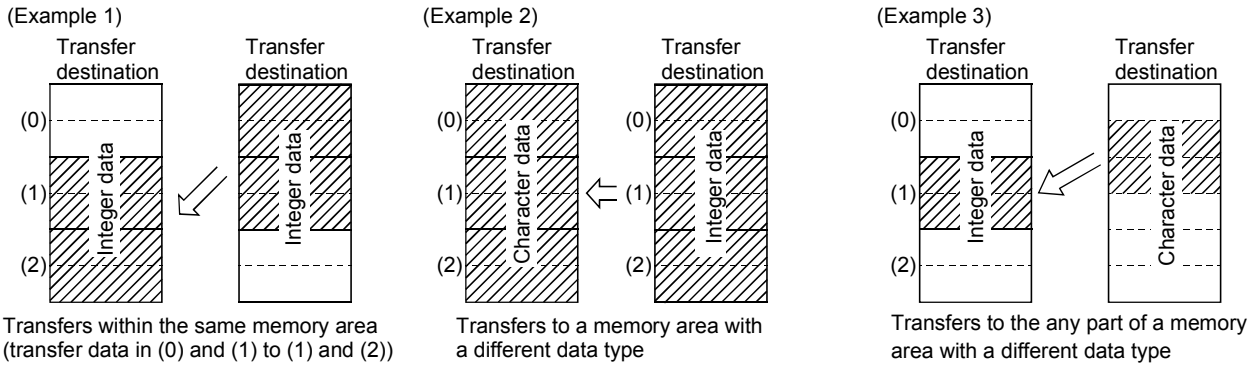
Transfers the data of A%(0) and A%(1) to A%(1) and A%(2).

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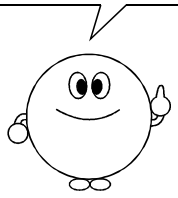
Description

• The ZMOVE instruction is used to transfer data from the area in memory specified in <transfer source> in a BASIC program to the area specified in <transfer destination> as is. The transfer is carried out transparently in units of one byte for the amount specified in <number of transferred bytes>.
Specify the location from which the data transfer should be started, by the offset value in byte units relative to the starting address of the memory area that the <transfer source> occupies. Similarly, specify the location from which the transferred data should be stored, by the offset value in byte units relative to the starting address of the memory area that the <transfer destination> occupies.
• The ZMOVE instruction allows data transfer between two variables that cannot normally be assigned by the LET instruction (numeric value ↔ character).



• For <transfer destination>, specify the variable, etc. to which the data transferred from <transfer source> will be assigned.

• Store dummy data in the variable used as <transfer destination>, before executing the ZMOVE instruction as shown below.
If such dummy data has not been stored, an error occurs when the ZMOVE instruction is executed.
Integer variable □%=0
Floating point variable □!=0,□#=0
Character variable □$=SPACE$(255)
• Always define an array used as <transfer destination> using the DIM instruction, even if the number of elements used is 10 or less.
Furthermore, in cases where a character array variable name is to be used, store dummy data as shown below in the specified elements.
□$(n) = SPACE$(255)
When the ZMOVE instruction is executed, only the data in the specified elements in the array variable name become the target range for the transfer.
• A two dimensional array cannot be used in the ZMOVE instruction.

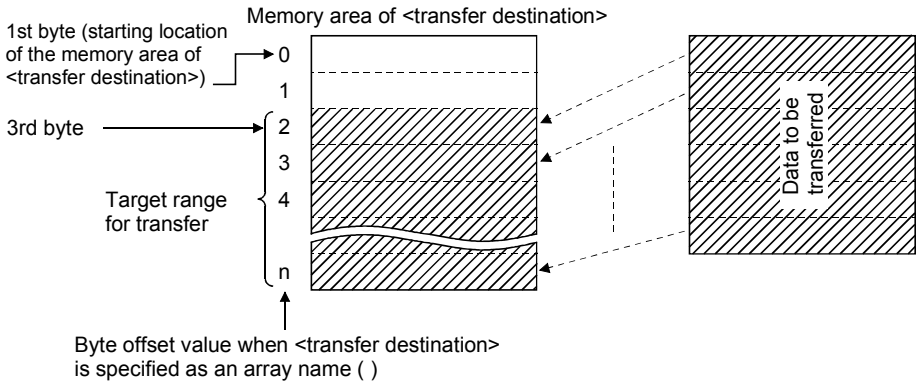


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• Specify the starting location of the data transfer in the memory area of <transfer destination> in <offset 1>. This should be specified as an offset value relative to the starting address of the memory area of <transfer destination>, in byte units.

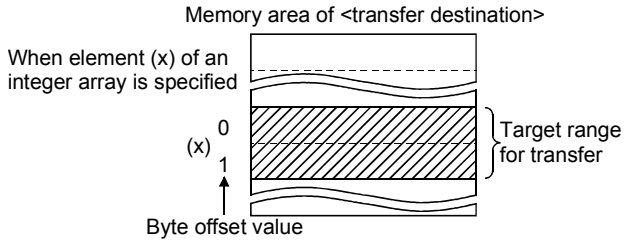
Example

Specify 2 for <offset 1> when data is transferred to the 3rd and subsequent bytes.



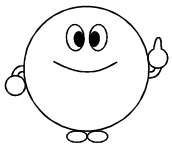
If <transfer destination> is specified as an array variable name, specify the byte offset value relative to the starting address of the memory area of the specified element only.

Example



• For <transfer source>, specify the variable, etc. in which the data to be transferred to <transfer destination> is stored.

Always define an array used as <transfer source> with the DIM instruction, even if the number of elements used is 10 or less.
When the ZMOVE instruction is executed, only data in the portion defined by the DIM instruction becomes the target for transfer.
(Usually, an array with 10 or fewer elements can be used without defining it using the DIM instruction).

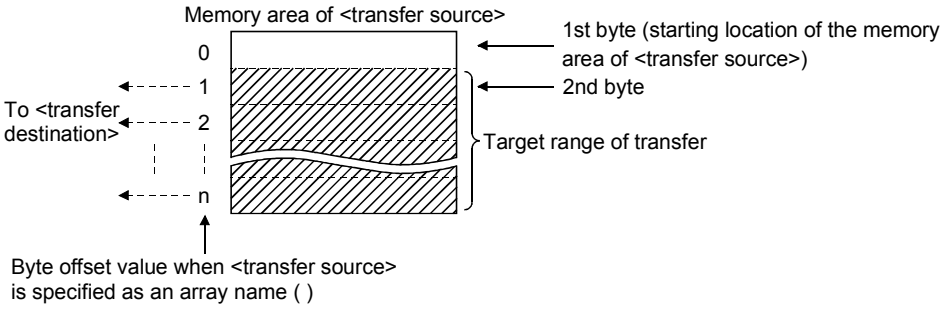


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• Specify the starting location of the data transfer in the memory area of <transfer source> in <offset 2>. This should be specified as an offset value relative to the starting address of the memory area of <transfer source>, in byte units.

Example

Specify 1 for <offset 2> when data in 2nd and subsequent bytes is transferred.



If <transfer source> is specified as an array variable name, specify the byte offset value relative to the starting address of the memory area of the specified element only.
This is done in the same way as specifying the byte offset value for the <transfer destination> in case of an array variable name; see the previous page.

• For <number of transferred bytes>, specify the number of bytes of target memory, which is transferred from the location of <offset 2> in <transfer source> and onward to the location of <offset 1> in <transfer destination> and onward.
Specify the smaller number of bytes if the numbers of bytes to be transferred differ between <transfer destination> and <transfer source>.

• The value ranges that can be specified for <offset 1>, <offset 2>, and <number of transferred bytes> can be summarized as follows. Both conditions must be met.
0 ((offset 1 + number of transferred bytes) (number of bytes of the target memory area in the transfer destination
0 ((offset 2 + number of transferred bytes) (number of bytes of the target memory area in the transfer source

• If the number of bytes in the transfer target ranges in <transfer destination> and <transfer source> and <number of transferred bytes> are different, the least number of bytes among them is the number of bytes that are actually transferred. The execution ends normally after the data in the memory area is transferred.
Any excess memory area in <transfer destination> to which data was not transferred keeps the data before the execution of the ZMOVE instruction (it does not change).

• <offset 1>, <offset 2>, and <number of transferred bytes> can be specified as decimal values. However, if a value greater than 32768 is to be specified, the constant should be expressed in hexadecimal. Values from 32768 to 65535 are expressed by hexadecimal values from &H8000 to &HFFFF. Note that if values from −1 to −32768 in decimal are specified, they are treated and processed as the corresponding values from 65535 to 32768.

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Program Example

```
10 ' This program transfers data in the numeric array variable A%( ) to the character string variable B$
20 DIM A%(9)                                  :  ' Defines an array
30 A%(0)=&H4241                               :  ' Stores the data
40 A%(1)=&H4443
50 PRINT "A%(0)=";HEX$(A%(0))                 :  ' Displays the data before being transferred
60 PRINT "A%(1)=";HEX$(A%(1))
70 PRINT
80 B$=SPACE$(255)                             :  ' Stores dummy data in the character string
                                                    variable
90 ZMOVE TO B$,0,FROM A%( ),0,4               :  ' Executes the data transfer
100 PRINT "B$=";B$                            :  ' Displays the data after being transferred
110 END
```


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ZODV Instruction — Z Output DeVice

• Specifies the data output destination for the PRINT instruction, etc.

Syntax

ZODV△<channel number>

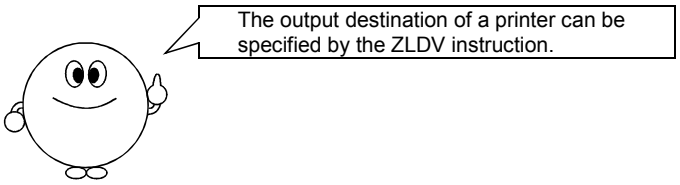
channel number • • • • Specify the channel number of the communication port to which a console or terminal is connected.

Examples

ZODV 1 • • • • Outputs data of the PRINT instruction, etc. to the terminal connected to CH1 (RS-232).

Description

• The ZODV instruction specifies the data output destination for the PRINT instruction, etc.

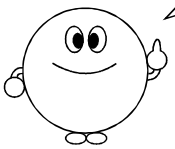


• The output destination specified by the ZODV instruction is valid only for the following instructions/functions:

CLS	PRINT USING
LOCATE	SPC
PRINT	TAB

• Specify the communication port to which the device used for data output is connected in <channel number> using the values below:

Channel number		Communication port
0	• • • •	The console specified in the communication module
1	• • • •	CH1 (RS-232)
2	• • • •	CH2 (RS-232)
3	• • • •	CH3 (RS-422/485)
4	• • • •	CH4 (PARALLEL)



The communication channel specified by the ZODV instruction must be opened by the ZOPEN instruction in advance.
This is not required if 0 is specified for <channel number>, however.
Note that if an output destination channel specified by the ZODV instruction is closed with the ZCLOSE instruction, the output destination for the PRINT instruction, etc. will automatically change to the console specified in the communication module (channel number 0).

REMARK

See the ZIDV, ZLDV and ZOPEN instructions, and Section 7.3.

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ZOPEN Instruction — Z OPEN

• Opens a communication channel of a communication port in preparation for performing communication with an external device.

Syntax

ZOPEN△ [#]<channel number>[<,control table>]

channel number	• • • •	Specify the communication port that communicates with the external device.
control table	• • • •	Specify various parameters for the communication with the external device.

Examples

ZOPEN #1,A%( )	• • • •	Opens CH1 (RS-232) of the communication module with the parameters specified by the integer array A%( ).
ZOPEN #4	• • • •	Opens the parallel interface port of the communication module.

Description

• The ZOPEN instruction is used to open a communication port to enable communication with an external device.

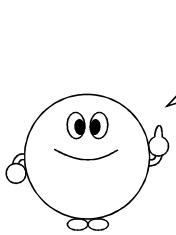
• Specify which communication port of the communication module should be used in <channel number>. The correspondence between channel numbers and communication ports are as follows.

Channel number		Communication port
1	• • • •	CH1 (RS-232)
2	• • • •	CH2 (RS-232)
3	• • • •	CH3 (RS-422/485)
4	• • • •	CH4 (PARALLEL)

• Specify various parameters for communication in <control table>. Note that it is not necessary to specify <control table> for channel number 4 (parallel); in this case, <control table> should be omitted.

• Specify the data using an integer array variable in <control table> as follows.

□%(0)	• • • •	Specify the transmission rate.
□%(1)	• • • •	Specify the parity bit in the higher byte and the character length in the lower byte.
□%(2)	• • • •	Specify the stop bit.



Always define an array used in <control table> by the DIM instruction, even though only three array elements are used.
If the array is not defined using the DIM instruction, an error occurs at the execution of the ZOPEN instruction (usually, an array with 10 or fewer elements can be used without defining it using the DIM instruction).

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Transmission rate

• In case of A1SD51S and AD51H-S3
  Select and set one of the following:
  300, 600, 1200, 2400, 4800, 9600, or 19200 bps
• In case of QD51 (-R24)
  Select and set one of the following:
  300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, or 38400 (setting value: -384) bps

Character length

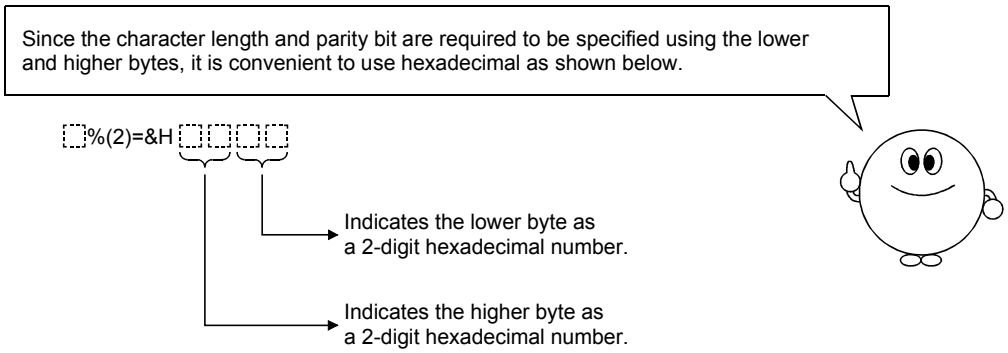
• In case of A1SD51S and AD51H-S3
  Select and set one of the following : 5, 6, 7, or 8
• In case of QD51 (-R24)
  Select and set either 7 or 8.

Parity bit

Select and set one of the following:
No parity (setting value : 0), even parity (setting value : 1), or odd parity (setting value : 2)

Stop bit

Select and set one of the following:
1 bit (setting value: 1), 2 bits (setting value: 2), or 1.5 bits (setting value: 3)



• It is always necessary to open the communication port with the ZOPEN instruction when switching between input/output ports by the ZODV, ZIDV, and ZLDV instructions.
• An error occurs if the ZOPEN instruction is executed on the communication port specified as a console or debug port in the communication module.
• If a value from 1 to 3 is specified for <channel number>, secure 1024 bytes of memory for the communication buffer and clear any data in the buffer area.
  Use the ZCNTL instruction to specify the communication control method and the communication buffer size.

REMARK

See the ZCLOSE instruction and Chapter 7.

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ZRECEIVE Instruction Z RECEIVE

• Receives data from a communication port.

Syntax

ZRECEIVE△#<channel number>,0,<control table>,<input element>

channel number	• • • •	Specify the communication port that receives data.
control table	• • • •	Specify various parameters for receiving data.
input element	• • • •	Stores the variable or array in which received data is stored.

Examples

ZRECEIVE #1,0,A%( ),DA$	• • • •	Receives data from CH1 (RS-232) under the conditions specified by integer arrays A%(0) and A%(2), stores it in DA$, and then stores the number of received bytes in A%(1).

Description

• The ZRECEIVE instruction receives data from the communication port specified in <channel number> according to the parameters specified in <control table> and stores it in <input element>.

• Specify which communication port of the communication module should be used in <channel number>. The correspondence between channel numbers and communication ports are as follows.

Channel number		Communication port
1	• • • •	CH1 (RS-232)
2	• • • •	CH2 (RS-232)
3	• • • •	CH3 (RS-422/485)

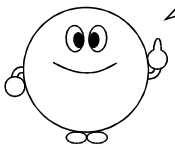
Note that it is always necessary to open the communication port that receives data by the ZRECEIVE instruction in advance using the ZOPEN instruction. An error occurs if it is not opened.

• <control table> specifies the number of bytes of data to be received and a timeout value. In addition, the number of bytes of data actually received is stored at the completion of the reception.

<control table> uses the following integer array variables:

□%(0)	• • • •	Specifies the number of bytes requested to be received.
□%(1)	• • • •	Stores the number of bytes received after the completion of the reception.
□%(2)	• • • •	Specifies the timeout value.

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Always define an array used in <control table> by the DIM instruction, even though only three array elements are used.
If the array is not defined using the DIM instruction, an error occurs at the execution of the ZRECEIVE instruction (usually, an array with 10 or fewer elements can be used without defining it using the DIM instruction).

(1) Specification of the number of bytes requested to be received • • • □%(0)

Specify the number of bytes of data to be received. How to count the number of bytes differs depending on what is specified in <input variable>; see the description of the <input variable> item.
Specify 2 bytes if an integer variable is specified as the input element.
Specify a value in the range from 1 to 1024 bytes if an integer array is specified as the input element.
Specify a value in the range from 1 to 256 bytes if a character string expression is specified as the input element.

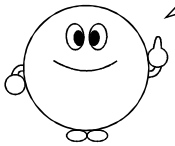
(2) Specification of the timeout value • • • □%(2)

Specify the monitoring time at reception. An error may be generated if a reception is not completed within the time period specified by the timeout value after the execution of the ZRECEIVE instruction. The timeout value is specified in units of 100 ms.
If a timeout error occurs, the number of bytes of data received before the timeout error occurrence is stored in control table □%(1) and the data received before the timeout error occurrence is stored in <input element>.
The allowable specification range is from 0 to 65535. However, if a value from 32768 to 65535 is to be specified, it should be expressed in hexadecimal (a decimal value cannot be assigned and an error occurs). Note that if 0 is specified, it is assumed that there is no timeout.

(3) The number of bytes received • • • □%(1)

The number of bytes of received data is automatically stored after the data reception is complete. If data is normally received, this value becomes the same as the number of bytes requested to be received; it may be used for checking the reception status.

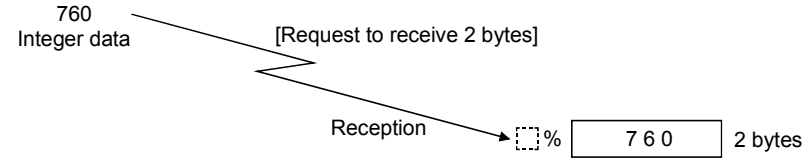
• The data received is stored in <input element>. Specify an integer variable, integer array name, character variable, or character array variable.



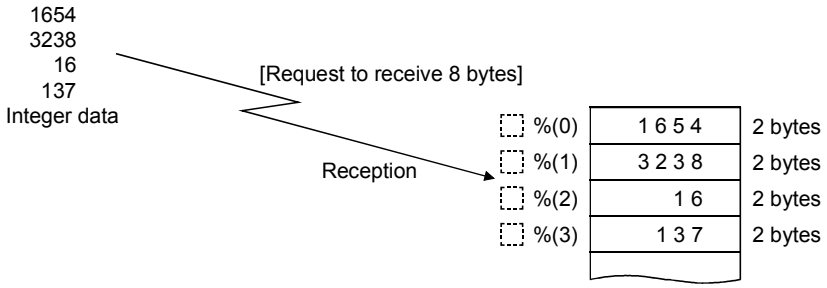
• Store dummy data for the number of bytes requested to be received in the variable used as input variable, before executing the ZRECEIVE instruction as shown below.
If such dummy data has not been stored, an error occurs when the ZRECEIVE instruction is executed.
Integer variable □%=0
Character variable □$=SPACE$(255)
• Always define an array specified as input variable using the DIM instruction, even if the number of elements used is 10 or less. If the array is not defined with the DIM instruction, an error occurs at the execution of the ZRECEIVE instruction.

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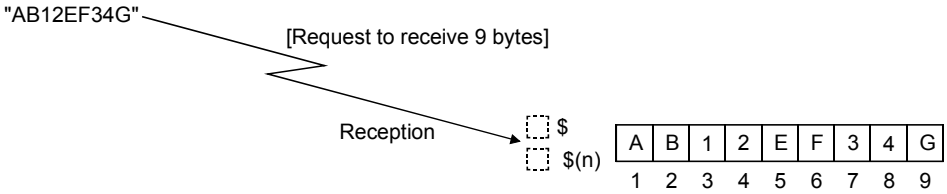
(1) When an integer variable is specified, it is possible to receive one integer data value. One integer data value is treated as 2 bytes; therefore, specify 2 bytes for the number of bytes requested to be received.



(2) When an integer array name is specified, it is possible to receive as many integer data values as the number specified by the number of bytes requested to be received. One integer data value is treated as 2 bytes; therefore, specify (number of integer data to be received x 2) for the number of bytes requested to be received.



(3) When a character variable or character array variable is specified, it is possible to receive as many characters of data as specified by the number of bytes requested to be received. One data character is treated as 1 byte; therefore, specify the same number for the number of bytes requested to be received as the number of characters of data to be received.



- The channel numbers that have not been opened by the ZOPEN instruction cannot be specified. An error occurs if such a channel is specified.
- If the amount of data specified by the number of bytes requested to be received cannot be stored in the variable or array specified as <input element>, an error occurs and the instruction is not executed.
- If a break character specified by the ZCNTL instruction is detected while receiving data, the data reception is stopped. At this point, the number of bytes of data received before the reception of the break character is stored in %(1) of control table and the data received before the reception of the break character is stored in <input element>.

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Program Example (Executed in BASIC on the AD51H)

```
10 ' This program receives data from the LM7000 (AD51H is the reception side)
20 ON ERROR GOTO 360                              :  ' Branches to line 360 if an error occurs
30 '
40 '***** RS-232C CH.OPEN *****
50 DIM TBL1%(2)                                   :  ' Defines an array
60 CH%=1                                          :  ' Defines a communication channel
70 TBL1%(0)=4800                                  :  ' Sets the baud rate
80 TBL1%(1)=&H8                                   :  ' Sets the character length, parity bit,
90 TBL1%(2)=&H1                                   :  ' and stop bit
100 ZOPEN #CH%,TBL1%( )                           :  ' Opens the communication channel
110 '
120 '***** PORT CNTL *****
130 DIM CNT%(10)                                  :  ' Defines an array
140 CNT%(0)=32                                    :  ' Control by the RS/ER signals W
150 CNT%(1)=&H1                                   :  ' Control by the RS control signal NM
160 ZCNTL #CH%,CNT%( )                            :  ' Control by signals S
170 '
180 '***** DATA RECEIVE *****
190 DIM TBL2%(2)                                  :  ' Defines an array
200 TBL2%(0)=12                                   :  ' Sets the number of bytes requested to be
                                                     received
210 TBL2%(1)=0                                    :  ' Stores the number of bytes received
220 TBL2%(2)=300                                  :  ' Sets the timeout value
230 WOR%=TBL2%(0)/2                               :  ' Reads 2 bytes
240 DIM CTBL%(WOR%-1)                             :  ' Defines an array
250 ZRECEIVE #CH%,0,TBL2%( ),CTBL%( )             :  ' Executes the reception
260 PRINT "RECEIVE CHARACTER =";TBL2%(1)          :  ' Displays the number of characters
                                                     received
270 FOR I%=0 TO WOR%-1
280 PRINT "RECEIVE DATA =&H";HEX$(CTBL%(I%))      :  ' Displays the data received
290 NEXT I%
300 '
310 '***** RS-232C CH.CLOSE *****
320 ZCLOSE #CH%                                   :  ' Closes the communication channel
330 END                                           :  ' Ends the execution
340 '
350 '***** ERROR ROUTINE *****
360 ERTYPE%=ERR:ERLINE%=ERL                       :  ' Stores the error that occurred and the line
                                                     in which it occurred
370 IF ERTYPE%=17 THEN PRINT "ZOPEN ERROR!!"      :  ' Displays the error if it is Z related
380 PRINT "ERROR CODE =";ERTYPE%                  :  ' Displays the error code
390 PRINT "ERROR LINE =";ERTYPE%                  :  ' Displays the line where the error occurred
400 RESUME 320                                    :  ' Returns the processing to line 310
```


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(Executed in BASIC on the LM7000)

```
10 ' This program sends data to a console (LM7000 is the transmission side)
20 ON ERROR GOTO 380                              :  ' Branches to line 360 when an error occurs
30 '
40 '***** RS-232C CH.OPEN *****
50 DIM T%(8)                                      :  ' Defines an array
60 CH%=18                                         :  ' Defines a channel number
70 T%(0)=4800                                     :  ' Sets the baud rate
80 T%(1)=&H8                                      :  ' Sets the character length, parity bit,
90 T%(2)=&H1                                      :  ' stop bit, and DC control
100 T%(3)=0                                       :  ' Sets control by signals
110 T%(5)=0                                       :  ' Sets DC1 code and DC code
120 T%(4)=0                                       :  ' Sets the receive buffer
130 T%(6)=0                                       :  ' Sets DC3 code and DC2 code
140 T%(7)=0                                       :  ' Sets DC4 code
150 ZOPEN #CH%,T%( )                              :  ' Opens the communication channel
160 '
170 '***** RS CNTL *****
180 DIM CNTL%(1)                                  :  ' Defines an array
190 CNTL%(0)=32                                   :  ' Specifies control by the RS/ER control
                                                     signals
200 CNTL%(1)=&H1                                  :  ' Turns ON the RS control
210 ZCNTL #CH%,0,CNTL%( )                         :  ' Executes the control by signals
220 '
230 '***** DATA SEND *****
240 DIM TBL%(2)                                   :  ' Defines an array
250 TBL%(0)=12                                    :  ' Sets the requested characters
260 TBL%(1)=0                                     :  ' Stores the number of bytes transmitted to
                                                     TBL%(1)
270 TBL%(2)=100                                   :  ' Sets the timeout value
280 SD$="AD51H-BASIC "                            :  ' Defines transmission data
290 ZSEND #CH%,0,TBL%( ).SD$                      :  ' Executes the transmission
300 PRINT "SEND CHARACTER =":TBL%(1)              :  ' Displays the number of characters
                                                     transmitted
310 PRINT "SEND DATA =";SD$                       :  ' Displays the data transmitted
320 '
330 '***** RS-232C CH.CLOSE *****
340 ZCLOSE #CH%                                   :  ' Closes the communication channel
350 END                                           :  ' Ends the execution
360 '
370 '***** ERROR ROUTINE *****
380 ERTYPE%=ERR:ERLINE%=ERL                       :  ' Stores the error that occurred and the line
                                                     in which it occurred
390 IF ERTYPE%=94 THEN ERTYPE%=ZERROR(1)          :  ' Displays the error if it is Z related
400 PRINT "ERROR CODE =";ERTYPE%                  :  ' Displays the error code
410 PRINT "ERROR LINE =";ERTYPE%                  :  ' Displays the line where the error occurred
420 RESUME 340                                    :  ' Returns the processing to line 320
```


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REMARK

See the ZOPEN, ZSEND and ZCNTL instructions, and Section 7.3.4.

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Available only in run mode

ZRELEASE Instruction

ZRELEASE

• Allows other programs to use a resource to which a resource number is assigned.

Syntax

ZRELEASE△[<resource number>]

resource number	• • • •	Specify the number (0 to 31) allocated among the programmers and assigned to a resource used in a program.

Examples

ZRELEASE 1	• • • •	Allows other programs to use the resource to which resource number 1 is assigned.

Description

• The ZRELEASE instruction allows the program that executes the ZRELEASE instruction to release the exclusive use of a resource obtained in advance by the execution of the ZRESERVE instruction, so that it can be used by other programs.
• If a program (whose execution is being paused) executes the ZRESERVE instruction and specifies the same resource number as the resource that was released, it can take over the exclusive use of the resource.
• Specify the resource number assigned to a resource whose use should be permitted to other programs in <resource number>.
• If the specification of <resource number> is omitted in the ZRELEASE instruction, all resources for which the program that executes the ZRELEASE instruction had obtained the exclusive use of by the ZRESERVE instruction, are released.
• All the resources for which the program had obtained the exclusive use by the ZRESERVE instruction are released by executing the BASIC general instructions, SYSTEM, END and RUN, or changing the program while its execution is being paused.

REMARK

• See the ZRESERVE instruction in Section 8.3 for the details about exclusive control of resources.
• See the ZRESERVE instruction.

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Available only in run mode

ZRESERVE Instruction — Z RESERVE

• Prohibits other programs from using a resource to which a resource number is assigned.

Syntax

ZRESERVE△<resource number>[,<timeout value>]

resource number	• • • •	Specify the number (0 to 31) allocated among the programmers and assigned to a resource used in a program.
timeout value	• • • •	Specify the maximum time that is allowed to wait before prohibiting other programs to use a resource, in the format "HH:MM:SS:R." HH: Hours (0 to 23) MM: Minutes (0 to 59) SS: Seconds (0 to 59) R: 100 ms (express 0 to 900 ms using the numbers from 0 to 9)

Examples

ZRESERVE 1, "00:00:05:0"	• • • •	Prohibit other programs from using the resource to which resource number 1 is assigned. A timeout error is generated if it cannot be prohibited within 5 seconds.

Description

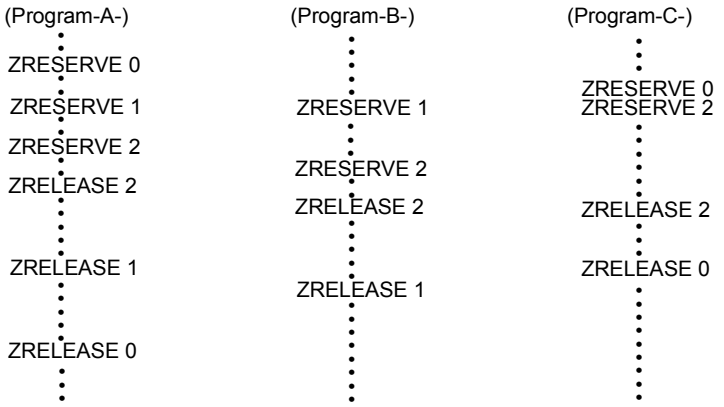
• The ZRESERVE instruction prohibits other programs from using a resource to which a resource number allocated among the programmers is assigned when the resource is shared by multiple programs executed at once. A program that executes the ZRESERVE instruction can obtain the exclusive use of the resource.
• In order to terminate the exclusive use, specify the same resource number as in the ZRESERVE instruction that prohibited the use, and execute the ZRELEASE instruction.
• The ZRESERVE and ZRELEASE instructions are used as a pair so that other programs cannot use the resource for a specified time or while the processing involving the resource is performed.
• The programmers should reach an arrangement in advance for the resources to which resource numbers are to be assigned. Then they should create programs in such a way that the ZRESERVE instruction is executed immediately before using the resources and the ZRELEASE instruction is executed immediately after using it.
• Specify the number assigned to the resource whose use should be prohibited for other programs in <resource number>.
• If another program has executed the ZRESERVE instruction specifying the same resource number before a program executes the ZRESERVE instruction, it must wait before prohibiting the use of the resource from other programs. Specify the maximum time that the program waits in this case in <timeout value>. The specification should be made in the following format. (The program execution is stopped while waiting.)
"HH:MM:SS:R"

HH	• • • •	Hours ("0" to "23")	MM	• • • •	Minutes ("0" to "59")
SS	• • • •	Seconds ("0" to "59")	R	• • • •	ms (express 0 to 900 ms using numbers from "0" to "9")

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If the specification of <timeout value> is omitted or "00:00:00:0" is specified in <timeout value>, the program waits for an infinite time.

- It is possible to prohibit the use of multiple resources at any one time by specifying multiple resource numbers in one program.
- When multiple programs use resources to which different resource numbers are assigned, determine the order of the resource numbers specified in the ZRESERVE instruction as follows in order to prevent programs from going into deadlock status (in which case the execution cannot be made).
  (The following shows a case where the resource numbers are specified from the least order and the ZRESERVE instruction is executed.)

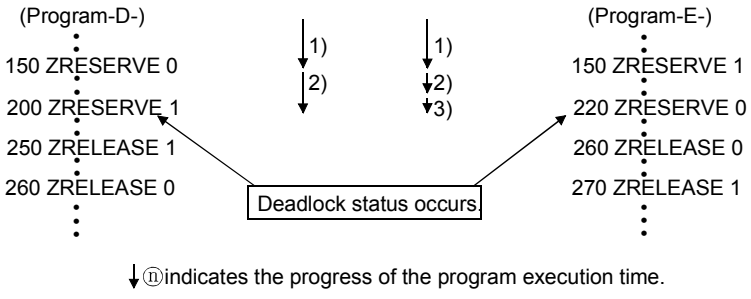


(Example of deadlock occurrence)

When programs -D- and -E- are being executed concurrently, if E executes line number 150 before D executes line number 200, D stops executing at line number 200.

Then, if E tries to execute line number 220, the execution stops in line number 220 because D has already executed the ZRESERVE instruction and specified resource number 0.

D waits for the execution of the ZRELEASE instruction for resource number 1 and E waits for the ZRELEASE instruction for resource number 0, which means that the two programs keep each other from being executed.



REMARK

- See Section 8.3 for the details about exclusive control of resources.
- See the ZRELEASE instruction.

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ZSEND Instruction — Z SEND

• Sends data from a communication port.

Syntax

ZSEND△#<channel number>,0,<control table>,<output element>

channel number	• • • •	Specify the communication port that is used to send the data.
control table	• • • •	Specify various parameters for sending the data.
output element	• • • •	Specify the data to be sent.

Examples

ZSEND #1,0,A%( ),"TEST DATA"	• • • •	Sends "TEST DATA" under the conditions specified by integer array elements A%(0) and A%(2) via CH1 (RS-232) and assigns the number of bytes transmitted to A%(1).

Description

• The ZRECEIVE instruction receives data from the communication port specified in <channel number> according to the parameters specified in <control table> and stores it in <input element>.

• Specify which communication port of the communication module should be used in <channel number>. The correspondence between channel numbers and communication ports are as follows.

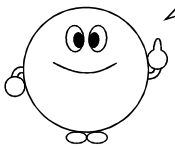
Channel number		Communication port
1	• • • •	CH1 (RS-232)
2	• • • •	CH2 (RS-232)
3	• • • •	CH3 (RS-422/485)
4	• • • •	CH4 (PARALLEL)

Note that a communication port that sends data via the ZSEND instruction must be opened using the ZOPEN instruction in advance. An error occurs if it is not opened.

• <control table> specifies the number of bytes of data to be transmitted and a timeout value. In addition, the number of bytes of data actually transmitted is stored at the completion of the transmission.
<control table> uses the following integer array variables:

□%(0)	• • • •	Specifies the number of bytes requested to be sent.
□%(1)	• • • •	Stores the number of bytes transmitted after the completion of the transmission.
□%(2)	• • • •	Specifies the timeout value.

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Always define an array used in <control table> by the DIM instruction, even though only three array elements are used.
If the array is not defined using the DIM instruction, an error occurs at the execution of the ZRECEIVE instruction (usually, an array with 10 or fewer elements can be used without defining it using the DIM instruction).

(1) Specification of the number of bytes requested to be sent • • • □%(0)

Specify the number of bytes of data to be sent. How to count the number of bytes differs depending on what is specified in <output element>; see the description of the <output element> item.
Specify 2 bytes if an integer variable is specified as the output element.
Specify a value in the range from 1 to 1024 bytes if an integer array is specified as the output element.
Specify a value in the range from 1 to 256 bytes if a character string expression is specified as the output element.

(2) Specification of the timeout value • • • □%(2)

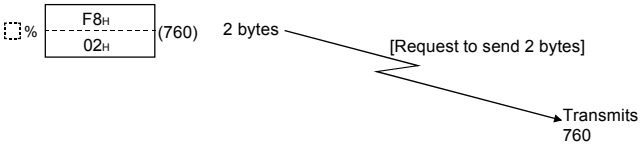
Specify the monitoring time at transmission. It is possible to generate an error if a transmission is not completed within the time specified by the timeout value after the execution of the ZSEND instruction. The timeout value is specified in units of 100 ms.
If a timeout error occurs, the number of bytes of data sent before the timeout error occurrence is assigned to control table □%(1).
The allowable specification range is from 0 to 65535. However, if a value from 32768 to 65535 is to be specified, it should be expressed in hexadecimal (a decimal value cannot be assigned and an error occurs). Note that if 0 is specified, it is assumed that there is no timeout.

(3) The actual number of bytes transmitted • • • □%(1)

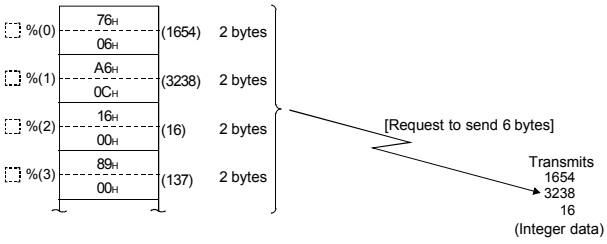
The number of bytes of transmitted data is automatically stored after the data transmission is complete. If data is normally received, this value becomes the same as the number of bytes requested to be sent; it can thus be used for checking the transmission status.

• Specify the data to be output as an integer variable, integer array name, or character string expression in <output element>.

(1) When an integer variable is specified, one integer data value is treated as 2 bytes; therefore specify 2 bytes for the number of bytes requested to be sent.



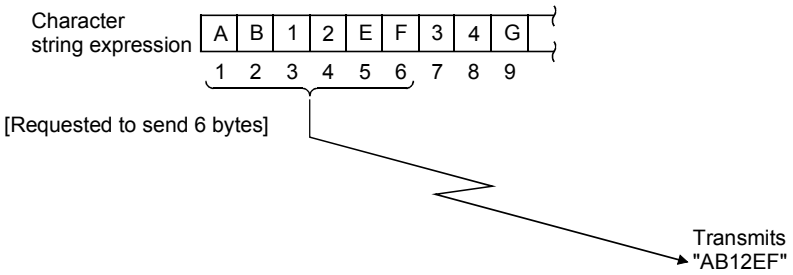
(2) When an integer array name is specified, one element of the array is treated as 2 bytes and the elements corresponding to the number of bytes requested to be sent are transmitted. Make sure to store transmitted data from element number 0 because individual element numbers cannot be specified by the integer array name.



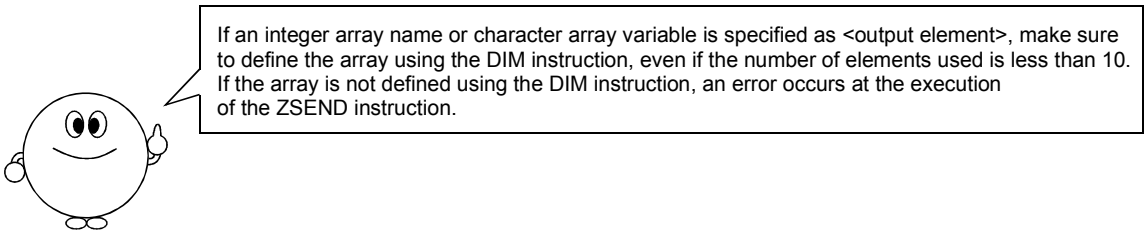
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(3) When a character array expression is specified, one character in the variable is treated as 1 byte and data characters for the number of bytes requested to be sent are transmitted.



• If a variable or array is specified as <output element>, define the variable or array using the DIM instruction and assign data to it before executing the ZSEND instruction.



• A channel number that has not been opened using the ZOPEN instruction cannot be specified. An error occurs if it is specified.
• If there are fewer bytes of data specified in <output element> than the number of bytes requested to be sent, an error occurs and the instruction is not executed.
• If there are more bytes of data specified in <output element> than the number of bytes requested to be sent, only the data corresponding to the number of bytes requested to be sent are transmitted and the remaining data is ignored.

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Program Example (Executed in BASIC on the AD51H)

```
10 ' This program sends data to the LM7000 (AD51H is the transmission side)
20 ON ERROR GOTO 330                                  :  ' Branches to line 330 if an error occurs
30 '
40 '***** RS-232C CH.OPEN *****
50 DIM T%(10)                                         :  ' Defines an array
60 CH%=1                                              :  ' Defines a channel number
70 T%(0)=4800                                         :  ' Sets the baud rate
80 T%(1)=&H8                                          :  ' Sets the character length, parity bit,
90 T%(2)=&H1                                          :  ' and stop bit
100 ZOPEN #A%,T%( )                                   :  ' Opens the communication channel
110 '
120 '***** PORT CNTL *****
130 DIM CNTL%(10)                                     :  ' Defines an array
140 CNTL%(0)=32                                       :  ' Controls by the RS/ER signals
150 CNTL%(1)=&H1                                      :  ' Controls by the RS signal
160 ZCNTL #CH%,0,CNTL%( )                             :  ' Controls by signals
170 '
180 '***** DATA SENO *****
190 DIM TBL%(10)                                      :  ' Defines an array
200 TBL%(0)=30                                        :  ' Sets the number of bytes requested to be
                                                         sent
210 TBL%(1)=0                                         :  ' Assigns the number of bytes transmitted
                                                         to TBL%(1)
220 TBL%(2)=100                                       :  ' Sets the timeout value
230 SD$="SOUSIN DATA :ABCDEFGH 12345678"              :  ' Defines the data to be transmitted
240 ZSEND #CH%,0,TBL%( ),SD$                          :  ' Executes the transmission
250 PRINT "SEND CHARACTER =";TBL%(1)                  :  ' Displays the number of characters
                                                         transmitted
260 PRINT "SEND DATA =";SD$                           :  ' Displays the data transmitted
270 '
280 '***** RS-232C CH.CLOSE *****
290 ZCLOSE #CH%                                       :  ' Closes the communication channel
300 END                                               :  ' Ends the execution
310 '
320 '***** ERROR ROUTINE *****
330 ERTYPE%=ERR:ERLINE%=ERL                           :  ' Stores the error occurred and the line in
                                                         which it occurred
340 IF ERTYPE%=17 THEN PRINT "ZOPEN ERROR!!"          :  ' Displays the error if it is Z related
350 PRINT "ERROR CODE =";ERTYPE%                      :  ' Displays the error code
360 PRINT "ERROR LINE =";ERTYPE%                      :  ' Displays the line where the error occurred
370 RESUME 290                                        :  ' Returns the processing to line 290
```


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(Executed in BASIC on the LM7000)

```
10 ' This program sends data from a console (LM7000 is the reception side)
20 ON ERROR GOTO 390                              :  'Branches to line 360 if an error occurs
30 '
40 '***** RS-232C CH.OPEN *****
50 DIM T%(8)                                      :  ' Defines an array
60 CH%=18                                         :  ' Defines a channel number
70 T%(0)=4800                                     :  ' Sets the baud rate
80 T%(1)=&H8                                      :  ' Sets the character length, parity bit,
90 T%(2)=&H1                                      :  ' stop bit, and DC control
100 T%(3)=0                                       :  ' Sets control by signals
110 T%(4)=0                                       :  ' Sets the receive buffer
120 T%(5)=0                                       :  ' Sets DC1 code and DC code
130 T%(6)=0                                       :  ' Sets DC3 code and DC2 code
140 T%(7)=0                                       :  ' Sets DC4 code
150 ZOPEN #CH%,T%( )                              :  ' Opens the communication channel
160 '
170 '***** DATA RECEIVE *****
180 DIM TBL%(6)                                   :  ' Defines an array
190 TBL%(0)=30                                    :  ' Sets the number of characters requested
                                                     to be received
200 TBL%(1)=0                                     :  ' Stores the number of characters received
210 TBL%(2)=300                                   :  ' Sets the timeout value
220 TBL%(3)=0                                     :  ' Sets the number of break characters
230 TBL%(4)=0                                     :  ' Sets break characters 1 and 2
240 TBL%(5)=0                                     :  ' Sets break characters 3 and 4
250 TBL%(6)=0                                     :  ' Sets break character 5
260 WOR%=TBL%(0)/2                                :  ' Reads 2 bytes
270 DIM CT%(WOR%-1)                               :  ' Defines an array
280 ZRECEIVE #CH%,0,TBL%( ),CT%( )                :  ' Executes the reception
290 PRINT "RECEIVE CHARACTER =";TBL%(1)           :  ' Displays the number of characters
                                                     received
300 FOR I%=0 TO WOR%-1
310 PRINT "RECEIVE DATA =&H";HEX$(CT%(I%))        :  ' Displays the data received
320 NEXT I%
330 '
340 '***** RS-232C CH.CLOSE *****
350 ZCLOSE #CH%                                   :  ' Closes the communication channel
360 END                                           :  ' Ends the execution
370 '
380 '***** ERROR ROUTIME *****
390 ERTYPE%=ERR:ERLINE%=ERL                       :  ' Stores the error occurred and the line
                                                     where it occurred
400 IF ERTYPE%=94 THEN ERTYPE%=ZERROR(1)          :  ' Displays the error if it is Z related
410 PRINT "ERROR CODE =";ERTYPE%                  :  ' Displays the error code
420 PRINT "ERROR LINE =";ERTYPE%                  :  ' Displays the line where the error occurred
430 RESUME 350                                    :  ' Returns the processing to line 350
```


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REMARK

See the ZOPEN, ZRECEIVE and ZCNTL instructions, and Section 7.3.4.

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Available only in run mode

ZSIGNAL Instruction — Z SIGNAL

• Generates the specified event from within a program.

Syntax

ZSIGNAL△<event number>

event number	• • • •	Specify the event to be generated using the event number from 0 to 63 defined by the DEF ZEVENT instruction.

Examples

ZSIGNAL 10	• • • •	Generates the event defined as event number 10.

Description

• The ZSIGNAL instruction generates the specified event from a program.
If one program enables the generation of the target event using the ZEVENT instruction in advance, all programs waiting for the generation of a particular event can resume their execution when the ZSIGNAL instruction is executed for that event.
• The program that has generated the event executes the next statement regardless of whether or not there is another program that waits for the event generation.
• The event should be defined using the DEF ZEVENT instruction and the event generation should be enabled/disabled using the ZEVENT instruction. In addition, the ZWAIT EVENT instruction is used to make a program wait for the generation of a particular event (to synchronize the execution with other programs).
• Make sure to enable the event generation using the ZEVENT instruction in advance. Once this is achieved, the event can be generated in order to start (or resume) the execution of other programs that are being paused, or the same event number can be specified in other programs. If the event generation is not enabled, the event control cannot be performed even if the ZSIGNAL instruction is executed.

REMARK

• See Section 8.2 for the details about the event control.
• See the DEF ZEVENT, ZEVENT, and ZWAIT EVENT instructions.

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Available only in run mode

ZSTART Instruction — Z START

• Starts up the specified program.

Syntax

ZSTART△<number>
ZSTART△<number>,"[<drive number>:][<system name>\]<file name>"

number	• • • •	Specify the number of the task area where the program is started up.
drive number	• • • •	Specify the memory card, FD, or HD that stores the program to be started up.
system name	• • • •	Specify the system name under which the program to be started up is stored.
file name	• • • •	Specify the file name of the program to be started up.

Examples

ZSTART 5	• • • •	Starts up the program stored in the task area No. 5.
ZSTART 2, "0:PRO\TEST.BAS"	• • • •	Starts up after reading the program stored with file name TEST.BAS under system name PRO in the memory card mounted in the AD51H-S3 MEMORY CARD 1 drive into BASIC task area No. 2.

Description

• The ZSTART instruction starts up a program in the specified task area.

When starting a program already resident in memory of the communication module

• Specify only <number>, then the program stored in the task area specified by the <number> is started up.
• In order to start up a program using this method, it is necessary that the task area specified by <number> is in one of the following conditions:
(1) When the task area is set to "BOOT" by the SET command in system mode of the communication module.
(2) When the task area is set to "START" by the SET command in system mode of the communication module and the started program has been stopped by the END instruction.
(3) When the program has been started by the ZSTART instruction or by an interrupt from the PLC CPU and subsequently stopped by the END instruction.
• An error occurs if a program is not stored in the task area specified by <number>.

REMARK

See the AD51H-BASIC Programming Manual (Debug and Compile) for the details about the multitask operations and system mode of the communication module.

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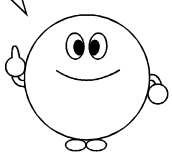
When reading a program from a memory card, FD or HD, and starting it

- If "<drive number>:<system name>\<file name>" is specified after <number>, then the program is read into the task area specified by <number> from the specified memory card, FD, or HD, and started up.
- Only the programs stored in the file area can be read from a memory card. Programs residing in the executable program area cannot be read.
- Specify the memory card, FD, or HD that contains the program to be read in <drive number>, using the following numbers.

To specify the memory card mounted in the AD51H-S3 MEMORY CARD [1]	• • • • 0
To specify the memory card mounted in the AD51H-S3 MEMORY CARD [2]	• • • • 1
To specify the [A] drive of the console	• • • • 2
To specify the [C] drive of the console	• • • • 3
To specify the [D] drive of the console	• • • • 4

- Specify the system name under which the program is saved in <system name>. If the specified system name does not exist, a "File not found" error occurs.
- Specify the name and extension of the file for the saved program in <file name>.
- In order to start up a program using this method, it is necessary that the task area specified by <number> should be in one of the following conditions:
  (1) When the task area is set to "ON" or "BOOT" by the SET command in system mode of the communication module.
  (2) When the task area is set to "START" by the SET command in system mode of the communication module and the started program has been stopped by the END instruction.
  (3) When the program has been started by the ZSTART instruction or by an interrupt from the PLC CPU and is subsequently stopped by the END instruction.
- An error occurs if a program is currently being executed in the task area specified by <number> or if the task area is set to "OFF" by the SET command in system mode of the communication module.

When reading and starting a program in a task area in a stop status, be aware that a program that was stored will be deleted.



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Available only in run mode

ZURGENCY Instruction — Z URGENCY

• Changes the priority of a program.

Syntax

ZURGENCY△<priority>

priority	• • • •	Specify an execution priority order from 0 to 10 when operating programs in multitask operations. The smaller the number is, the higher the priority is.

Examples

ZURGENCY 3	• • • •	Sets the program's priority to 3.

Description

• The ZURGENCY instruction is used to change the execution priority of the program. The priority of a program that executes the ZURGENCY instruction is changed when operating BASIC programs in multitask operations in the communication module.
• The communication module can concurrently execute up to eight BASIC programs. The OS of the communication module executes these programs in parallel while switching between the execution in sequence according to each program's priority.
• When each program is started up, the priority is set to 1.
• The ZURGENCY instruction has the functionality to change the priority of the program that executes this instruction.
• In <priority>, specify the number that the communication module's OS can use as a guide to determine the program to execute when multiple programs are executable.
Note that if -1 is specified, it is assumed that 0 is specified.
• The smaller the number specified in <priority> is, the higher the priority of the program is (a program with higher priority will more often be given the execution right by the OS).
• It is possible to execute multiple programs with the same priority. However, an error occurs if a number -2 or less or from 11 to 99 is specified in <priority>.
• Do not specify a value of 100 or greater in <priority>; the communication module cannot guarantee the operation of the program and the execution result. An error will not occur although a value of 100 or greater is specified.

REMARK

See Sections 8.1 and 8.5.2 for the details about the priority of tasks.

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Available only in run mode

ZWAIT DELAY Instruction

Z WAIT DELAY

• Pauses the program execution until the specified time has elapsed.

Syntax

ZWAIT△DELAY△<time>

time • • • • Specify the time in which the execution is to be paused in the format "HH:MM:SS:R."
HH: Hours (0 to 23)
MM: Minutes (0 to 59)
SS: Seconds (0 to 59)
R: ms (expressing 0 to 900 ms with numbers from 0 to 9)

Examples

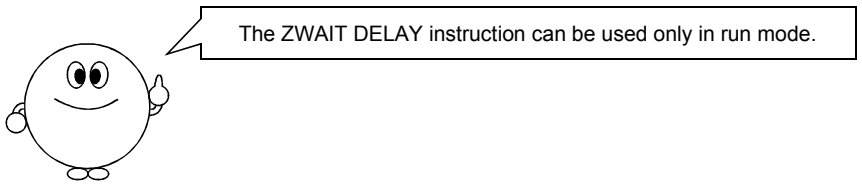
ZWAIT DELAY "00:01:00:0" • • • • Pauses the program execution for one minute.

Description

• The ZWAIT DELAY instruction pauses the program execution until the time specified in <time> has elapsed (the program is put into the wait status).
• Specify the time in which the program execution is to be paused in <time> using the format shown below.
"HH:MM:SS:R"

HH	• • • •	Hours ("0" to "23")	MM	• • • •	Minutes ("0" to "59")
SS	• • • •	Seconds ("0" to "59")	R	• • • •	ms (expressing 0 to 900 ms with numbers from "0" to "9")

• The program execution cannot be resumed until the specified time has elapsed.



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Available only in run mode

ZWAIT EVENT Instruction

Z WAIT EVENT

• Pauses the program execution until the specified event is generated.

Syntax

ZWAIT△EVENT△<event number>[,<timeout value>]

event number • • • • Specify the event number of the event whose generation is to be waited for.

timeout value — Specify the maximum time that the program can wait for the event to be generated in the format "HH:MM:SS:R."

HH: Hours	(0 to 23)
MM: Minutes	(0 to 59)
SS: Seconds	(0 to 59)
R: 100 ms	(expressing 0 to 900 ms with numbers from 0 to 9)

Examples

ZWAIT EVENT 1 • • • • Pauses the program execution until the event corresponding to event number 1 is generated.

ZWAIT EVENT 3, "00:01:00:0" — Pauses the program execution until the event corresponding to event number 3 is generated. If the event is not generated when one minute has elapsed after the program is paused, a timeout error is generated.

Description

• The ZWAIT EVENT instruction pauses the program execution until the event specified in <event number> is generated (the program is put into the wait status).
• Specify the event number of the event whose generation is to be waited for in <event number>. The event number should be the one given to the event at the definition.
• Specify the maximum time that the program can wait for the event to be generated using the format shown below (the program stops the execution while waiting).
"HH:MM:SS:R"

HH	• • • •	Hours ("0" to "23")	MM	• • • •	Minutes ("0" to "59")
SS	• • • •	Seconds ("0" to "59")	R	• • • •	ms (expressing 0 to 900 ms with numbers from 0 to 9)

If the specification of <timeout value> is omitted or "00:00:00:0" is specified, the program waits for an infinite time.
• The ZWAIT EVENT instruction is used when it is desired to synchronize the executions of two or more programs by making a program that executes this instruction wait for an event to be generated from another program.
• In order to resume the execution of the program that executes the ZWAIT EVENT instruction, it is necessary to enable the generation of the target event using the ZEVENT instruction in one of the programs before generating the event.
• Define the event whose generation should be waited using the DEF ZEVENT instruction in advance.
• It is possible to make multiple programs wait for the same event at the same time.

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REMARK

See the ZEVENT, ZSIGNAL, and DEF ZEVENT instructions.

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APPENDIX

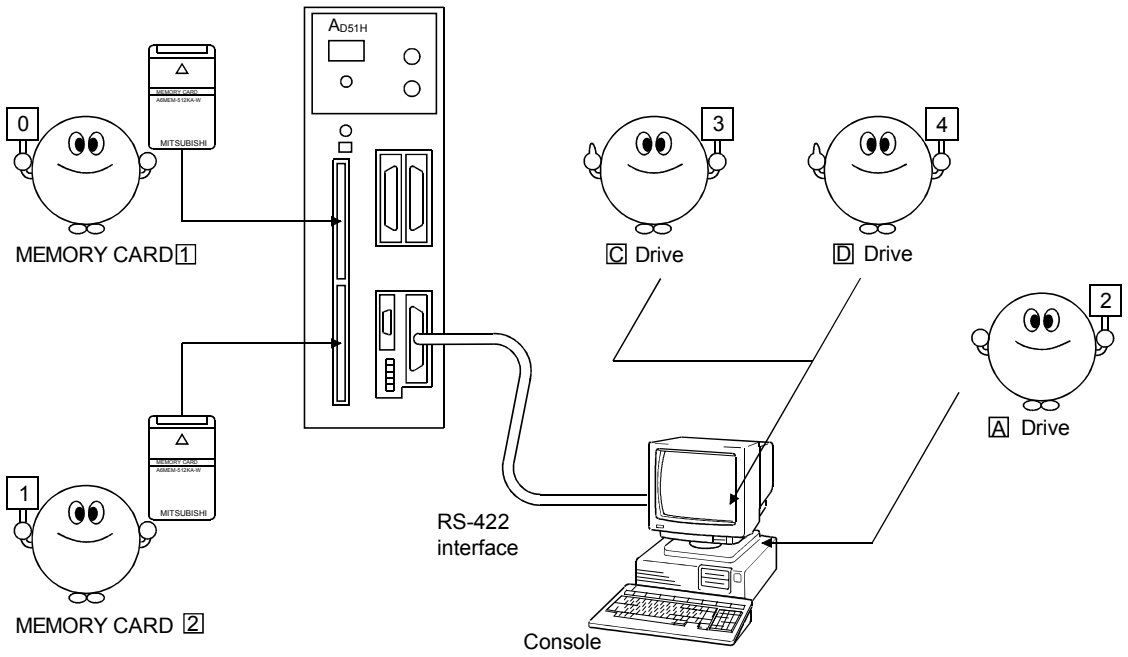
Appendix 1 File Name

Use the following format to specify a file name when saving a BASIC program or data file to a memory card or FD.

"[Drive number]:[System name]\[File name]"

Appendix 1.1 Drive Number

Specify a memory card interface, FD or HD used for saving or reading a program or data for a drive number. A unique number is assigned to each memory card interface, FDD, and HDD; specify these numbers as the drive number.



• When specifying only a drive number in an instruction such as the FILES instruction, always place a colon (:) after the drive number.

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Appendix 1.2 System Name

A system name is used to group and organize programs or data in a memory card, FD or HD.
Any name can be used for a system name as long as it conforms to the following conventions.

[redacted] Characters that can be used [redacted]

Alphabet (A to Z, a to z)
Numbers (0 to 9)
Special characters (!, #, $, %, &, ‘, (,), -, @, ^, _, {, }, ~)

[redacted] Number of characters that can be used [redacted]

8 characters or less.

[redacted] System names that cannot be used [redacted]

The following words have special meanings and therefore cannot be used.
AUX, CLOCK, CON, NUL, PRN, BAT, COM, EXE
However, these words can be used as a part of a system name.

Example

AUX → X	AUXNO	→ ○
	TOAUX	→ ○
	TOAUXNO	→ ○

note

- When specifying only a drive number and system name in an instruction such as the FILES instruction, always place a \ character after the system name.
- A system name must be unique within the same memory card, FD, or HD.

REMARK

System names in AD51H-BASIC are equivalent to sub-directories used in MS-DOS. However, unlike a sub-directory in MS-DOS, a system name cannot be created under another system name.

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Appendix 1.3 File Name

A file name is a name given to individual programs or data files in a memory card, FD, or HD.
A file name is further divided into a file name and an extension. Any name can be used as long as it conforms to the following conventions.

[redacted] Distinction between a name and extension of a file [redacted]

Separate a name and extension of a file using a period as follows:

File name | Extension

[redacted] Characters that can be used [redacted]

Alphabet (A to Z, a to z)
Numbers (0 to 9)
Special characters (!, #, $, %, &, ‘, (,), -, @, ^, _, {, }, ~)

[redacted] Number of characters that can be used [redacted]

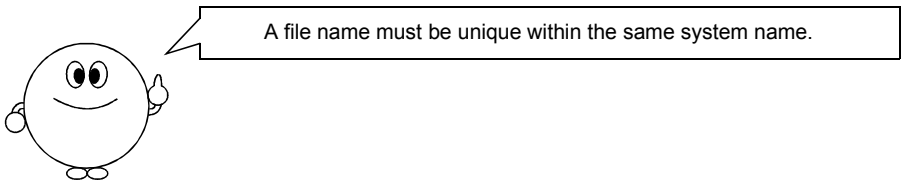
Name	8 characters or less.
Extension	3 characters or less.

[redacted] File names and extensions that cannot be used [redacted]

The following words have special meanings and therefore cannot be used.
AUX, CLOCK, CON, NUL, PRN, BAT, COM, EXE
However, these words can be used as a part of a file name.

Example

AUX → X	AUXNO	→ ○
	TOAUX	→ ○
	TOAUXNO	→ ○



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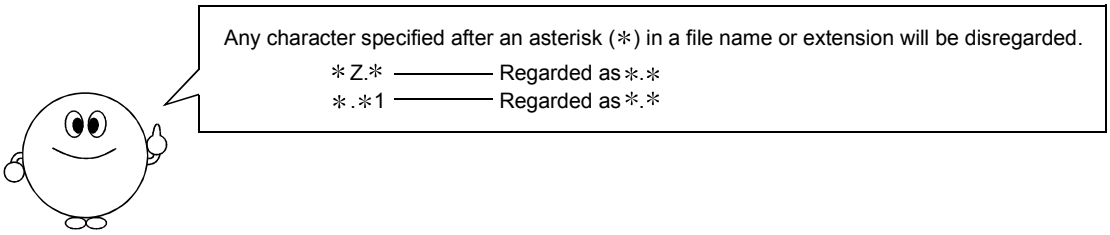
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Appendix 1.4 Wild Cards

Use wild cards in order to select multiple files at the same time when displaying or deleting file names in a memory card, FD, or HD. Wild cards are only valid for file names.
A wild card indicates that any character is acceptable at the place it is specified. There are two types of wild card, asterisk (*) and question mark (?).

• Asterisk (*)
An asterisk indicates that any character can occupy the place where it is specified.

Specification example	Description
A*.*	Represent all files whose file name begins from A.
*.BAS	Represent all files whose file extension is BAS.
.	Represent all files within the specified system name.



• Question mark (?)
A question mark indicates that any file name is acceptable as long as there is one character where it is specified.

Specification example	Description
???123.BAS	Represent all files whose file name's 4th through 6th characters are 123 and extension is BAS.
TEXT?. *	Represent all files whose file name starts with TEXT, followed by any one character.

REMARK

The name wild card is said to come from the fact that * and ? have the same effect as the joker in a deck of cards.

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Appendix 1.5 Precautions when Using Wild Cards

It would appear that the wild cards can be used in any way but the following restrictions do apply.

1) Wild cards can only be used in the following instructions.
   FILES, LFILES, KILL

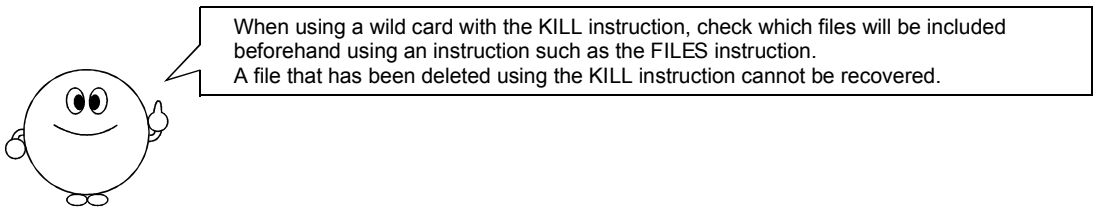
2) A question mark (?) represents one en character. One Kanji is the equivalent of two en characters; it is thus necessary to use two question marks (??) to represent a Kanji.

3) If question marks (?) are specified at the end of a file name or extension, all files that do not have characters for the specified number of question marks will also be included.

   Example

   AD51H??.BAS → AD51HAB.BAS, AD51HG .BAS, AD51H .BAS } All of these will be included.

4) Characters after an asterisk (*) will be disregarded.



Appendix 1.6 The Efficient Way to Assign a File Name

In order to manage files efficiently, use the following methods to assign file names in such a way that wild cards are easy to use.

1) Use the same extension to all data that are used in the same program, etc.

2) Use the extension 'BAS' for all program files.

3) Start the file names with the same characters for programs or data that are related. (It is not a good idea to end the file names with the same character because an asterisk cannot be used.)

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Appendix 2 Precautions on Interrupt Processing

It is possible to activate an interrupt processing routine by the following causes in AD51H-BASIC.

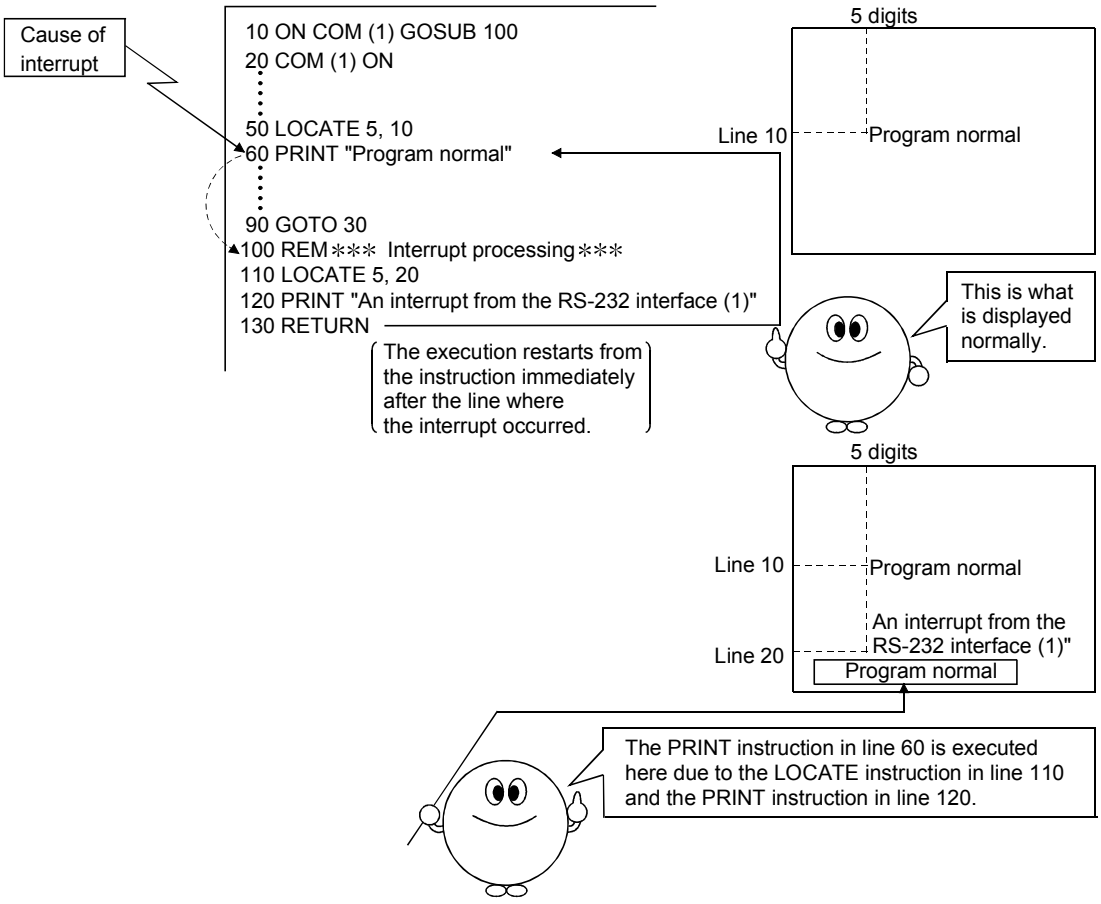
1) Starting up a subroutine due to an interrupt from one of the communication devices connected to the various interfaces of the communication module (ON COM GOSUB instruction)

2) Executing an error handling routine when an error occurs (ON ERROR GOTO instruction)

Since the two types of interrupt processing routines above perform the processing when an interrupt occurs due to the occurrence of their respective cause, it is impossible to tell at which position in the program the interrupt processing routine is executed.
Therefore, if an interrupt processing routine contains instructions to display characters or the ZIDV and ZODV instructions that switch the console, the settings of the character display position and the console switching may become disrupted as shown in the example below.
Create the program in such a way that characters are not displayed or the console switched during the interrupt processing routine.

Example

This example shows a case where characters are displayed during an interrupt processing.



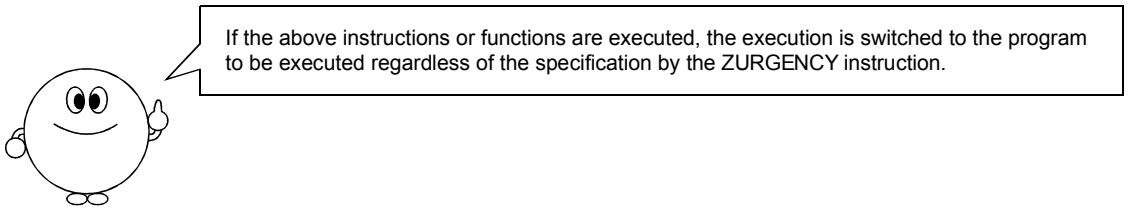
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Appendix 3 Instructions and Functions that Switch Between Programs to be Executed in Multitasking

The following table lists instructions and functions that switch between the programs to be executed in multitask processing.

Instruction	Instruction	Instruction	Instruction	Built-in function
AUTO		PRINT#		
	KILL	PRINT# USING		
CHAIN				
		PUT	ZEVENT	
CLS	LFILES	PUTMEN		FRE
	LINE			
CONT	LINE INPUT	RUN		EOF
	LINE INPUT#		ZEVENT DEF	
	LIST	SAVE	ZRECEIVE	
	LLIST		ZRELEASE	INKEY$
END	LOAD	SET	ZRESERVE	INPUT$
	LOCATE		ZSEND	
FILES	LPRINT	STOP	ZSIGNAL	
	LPRINT USING		ZSTART	
GET		SYSTEM	ZURGENCY	
GETMEN			ZWAIT DELAY	
	MERGE	TIME$	ZWAIT EVENT	
		TRON	ZSEND	
INPUT	NAME	TROFF	ZRECEIVE	PCRD
INPUT#	NEW			PCWT
KEY				
KEYLIST				
	PRINT			
	PRINT USING			



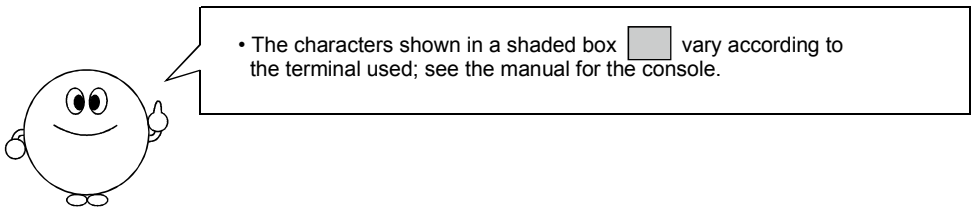
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Appendix 4 Code Table

Appendix 4.1 Character Code Table

Code for the lower 4 bits (hexadecimal)	Code for the higher 4 bits (hexadecimal)							
	0	1	2	3	4	5	6	7
0		D_E	(SP)	0	@	P		p
1	S_H	D_1	!	1	A	Q	a	q
2	S_X	D_2	"	2	B	R	b	r
3	E_X	D_3	#	3	C	S	c	s
4	E_T	D_4	$	4	D	T	d	t
5	E_Q	N_K	%	5	E	U	e	u
6	A_K	S_N	&	6	F	V	f	v
7	B_L	E_B	'	7	G	W	g	w
8	B_S	C_N	(	8	H	X	h	x
9	H_T	E_M	)	9	I	Y	i	y
A	L_F	S_B	*	:	J	Z	j	z
B	H_M	E_C	+	;	K	[	k	{
C	C_L	F_S	,	<	L	\	l	¦
D	C_R	G_S	-	=	M	]	m	}
E	S_O	R_S	.	>	N	^	n	~
F	S_I	U_S	/	?	O	_	o	(DEL)



REMARK

- The following explains how to read the code table.
  When checking any character code, take the value in the column and row corresponding to the position of a character code and place the code for the higher bits to the left and the code for the lower to the right.
  (Example)
  "A" is 41 (hexadecimal)
  This is the value expressed in hexadecimal. It is expressed in decimal as follows:
  $4 \times 16^1+1\times16^0 = 65$
  Thus, the character code for "A" is 65 (&H41).

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Appendix 4.2 List of Control Keys

Key input	Action
[Enter] (return)	Completes the entry for one line.
[→] , [←] , [↑] , [↓]	Moves the cursor in the direction the arrow is pointing.
[Insert]	Moves all characters to the right of the character at the cursor position to the right by one character.
[Delete]	Deletes the character immediately before the cursor and moves the following characters to the left by one character.
[Break]	Interrupts the program execution and returns to the status where BASIC commands can be accepted.
[Esc]	Enters an Esc code (CHR$ (&H1B)).
[F1] to [F10]	Enters the character string defined for each of the function keys.
[Print Screen]	Copies the contents of the screen to a printer.
[Back Space]	Acts identically to the [Delete] key.
[Home]	Moves the cursor to the upper left corner.
[Ctrl] + [B]	Moves the cursor to the left item by item.
[Ctrl] + [C]	Acts identically to the [Break] key.
[Ctrl] + [E]	Deletes all characters from the position at which the cursor is currently blinking to the end of the line.
[Ctrl] + [G]	Sounds the buzzer (beep).
[Ctrl] + [H]	Deletes one character before the cursor. It has the same function as the [Delete] and [Back Space] keys.
[Ctrl] + [I]	Moves the cursor to the tab position. Tab positions are set at 8 character intervals. It has the same function as the [Tab] key.
[Ctrl] + [J]	Inserts a line feed (LF code).
[Ctrl] + [K]	Moves the cursor to the home position (upper left corner). It has the same function as the [Home] key.
[Ctrl] + [L]	Clears the text screen.
[Ctrl] + [M]	This has the same function as the return key ([Enter]).
[Ctrl] + [N]	Moves the cursor to the right item by item.
[Ctrl] + [R]	Moves all characters to the right of the character at the cursor position to the right by one character. It acts identically to the [Insert] key.
[Ctrl] + [S]	Temporarily stops the screen display.

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Appendix 4.3 Control Codes for Screen Display when Using the General-Purpose Console

List of control codes for display

Function	Description	Code used (ASCII)		BASIC instruction
		When the VG-620 is set	When the VT-382 is set	
Line feed	New line operation	CR, LF code ($0D_H$, $0A_H$)	CR, LF code ($0D_H$, $0A_H$)	—
Screen clear	Clears the entire screen.	ESC + E (45_H)	ESC + [($5B_H$) + 2 (32_H) + J ($9A_H$)]	CLS
XON	Specifies to enable transfer from an external device.	DC1 code (11_H)	DC1 code (11_H)	—
XOFF	Specifies to disable transfer from an external device.	DC3 code (13_H)	DC3 code (13_H)	—
Escape	Escape, sequence, introducer	ESC code ($1B_H$)	ESC code ($1B_H$)	—
Cursor control	Cursor, backward	BS code (08_H)	BS code (08_H)	—
	Cursor up	ESC + A (41_H)	ESC + [($5B_H$) + 1 (31_H) + A (41_H)]	—
	Cursor down	ESC + B (42_H)	ESC + [($5B_H$) + 1 (31_H) + B (42_H)]	—
	Cursor right	ESC + C (43_H)	ESC + [($5B_H$) + 1 (31_H) + C (43_H)]	—
	Cursor left	ESC + D (44_H)	ESC + [($5B_H$) + 1 (31_H) + D (44_H)]	—
Cursor addressing	Specifies an absolute cursor position.	ESC + Y(59_H) + line specification code (20_H to $9F_H$) + column specification code (20_H to $9F_H$)	ESC + [($5B_H$) + line position specification +, ($3B_H$) + column position specification + H(48_H)	LOCATE
Audible alarm	Sounds the bell.	BEL code (07_H)	BEL code (07_H)	—

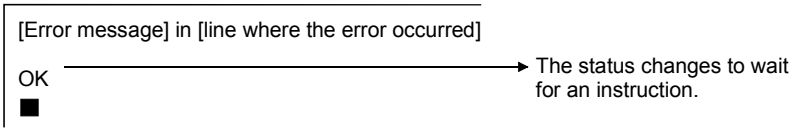
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Appendix 4.4 List of Error Messages and Error Codes

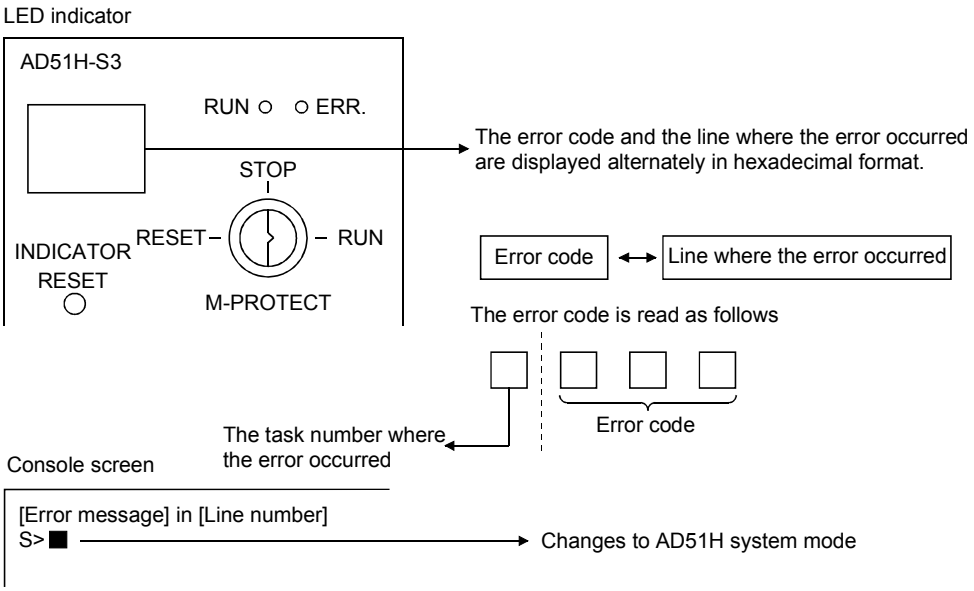
The illustration below shows what happens if an error occurs while an AD51H-BASIC instruction is being executed.

During online programming

Programming mode • • • An error is displayed on the console screen.



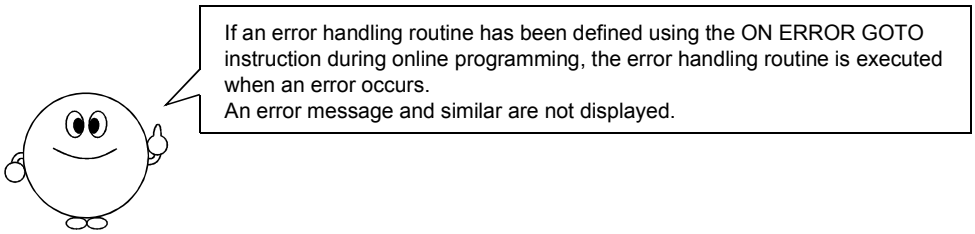
Run mode • • • An error is indicated by the LED indicator on the front of the AD51H-S3 and the console screen.



Special registers

ED9001 to ED9008: Error codes are stored here.

ED9009 to ED9016: Error line numbers are stored here.



REMARK

See the ON ERROR GOTO instruction in Chapter 9 for the error handling routine.

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Appendix 4.4.1 Error message list

The following table lists error messages. If the following messages are displayed, refer to Appendix 4.4.2.
System error (nnnn) in xxxx → See Appendix 4.4.2
The error codes in the "code" column are passed to the ERR function or displayed in the LED indicator.

Error message	Code (hexadecimal)	Meaning	Corrective action
Bad drive number	65 (41_H)	The drive specification is incorrect. A drive that does not exist in the system was specified.	Specify the correct drive name.
Bad File Data	25 (19_H)	Data format in the file is incorrect.	Check the data file attributes. Check whether or not it is a program file.
Bad file mode	54 (36_H)	The file mode is incorrect.	Check the file mode for sequential file access.
Bad file name	62 ($3E_H$)	The file name specification is incorrect.	Specify the correct file name.
Bad file number	52 (34_H)	A file number other than 1 to 8 is specified.	Specify a file number within the range.
Can't continue	17 (11_H)	The execution cannot be restarted using the CONT instruction (the pointer value is corrupted).	Execute from the beginning.
Device already open	75 ($4B_H$)	The ZOPEN instruction has been executed again for a port already opened by the ZOPEN instruction.	Modify the program so that the ZOPEN instruction is not executed twice.
Device I/O error	74 ($4A_H$)	There is an error in the specification of the ZOPEN instruction. (See the description of the ZOPEN for the details.)	Specify the instruction correctly according to the format.
Device not open	76 ($4C_H$)	The device is not open.	Execute the ZOPEN instruction.
Direct Statement in file	63 ($3F_H$)	A direct statement was found when an ASCII format file was read.	A program without line numbers is being read. Check the file.
Disk full	60 ($3C_H$)	• A write operation is attempted when there is not enough space on the disk. • It is attempted to write more than 128 files.	• Delete unnecessary files.

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Error message	Code (hexadecimal)	Meaning	Corrective action
Disk I/O Error	57 (39_H)	• The file area of the specified memory card is write protected. • There is no file area in the specified memory card. • An error occurred during input/output operation to the disk.	• Cancel the write protection for the memory card. • Format the memory card's file area. • This is a fatal error and recovery is impossible.
Division by zero	11 (B_H)	A division by 0 was executed and the value of the result overflowed.	Modify the program so that division by 0 is not performed.
Feature not implemented	26 ($1A_H$)	The program does not exist.	Execute the program after performing the MSAVE operation.
FIELD overflow	50 (32_H)	An area larger than 256 bytes was specified in the FIELD instruction.	Specify an area that can fit in 256 bytes or less.
File already exists	58 ($3A_H$)	It is attempted to change a file name to an already existing name using the NAME instruction.	Change the already existing file name or change the file name to be changed to a different one.
File already open	55 (37_H)	An instruction such as OPEN or KILL was executed to an already open file.	Modify the program so that it does not execute the OPEN instruction, etc., or execute the instruction after closing the file.
File not found	53 (35_H)	A file that does not exist in a memory card, FD, or HD was specified.	Specify the correct file name.
File not OPEN	71 (47_H)	It is attempted to reference a file that is not open.	Modify the program to reference the file after it is opened.
Illegal direct	12 (C_H)	It is attempted to execute a command that cannot be used in direct mode.	Use a command that can be used in direct mode.
Illegal function call	5 (5_H)	The function call method in a statement or function is incorrect.	Specify using the correct format.
Input past end	61 ($3D_H$)	Another input instruction is executed after all the data in the file was read.	Do not execute the extra input instruction.
Line buffer Overflow	23 (17_H)	Characters exceeding the range of the number of characters allowed in one line are entered.	Limit the number of characters in one line to 255 characters or less.

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Error message	Code (hexadecimal)	Meaning	Corrective action
Missing operand	22 (16_H)	A parameter required in the statement is not specified.	Specify the necessary parameter.
Next without FOR	1 (1_H)	There must be a FOR instruction for each NEXT instruction (there are too many NEXT).	Modify the program so that FOR and NEXT match correctly.
No RESUME	19 (13_H)	There is no RESUME instruction in the error handling routine and the program execution cannot continue.	Execute the RESUME instruction.
Out of data	4 (4_H)	The READ instruction is executed when there is no data to read.	Specify the data using the DATA instruction.
Out of memory	7 (7_H)	There is not enough memory (the program is too large or the stacks have been used up).	Reduce the number of variables or subroutines such as the GOSUB instruction.
Out of string space	14 (E_H)	There is no more space in the memory area for storing character strings.	Increase the memory area using the CLEAR instruction.
Overflow	6 (6_H)	Calculation results or input numerical values have exceeded the allowable range.	Modify the program so that the calculation results do not exceed the range.
Position not on Screen	24 (18_H)	The specified cursor position is outside the screen range.	Specify the position within the allowable range in the LOCATE instruction.
Redimensioned array	10 (A_H)	It is attempted to redefine an array or user function.	Do not define arrays or user functions twice.
Rename across disks	68 (44_H)	It is attempted to rename a file across different drives using the NAME instruction.	Rename the file name within the same drive.
RESUME without error	20 (14_H)	The RESUME instruction is specified even though control was not transferred to the error handling routine.	Remove the RESUME instruction or create an error handling routine.
RETURN without GOSUB	3 (3_H)	There must be a GOSUB instruction for each RETURN instruction (there are too many RETURN).	Make sure that the instructions match.
Sequential after PUT	69 (45_H)	It is attempted to access a sequential file after executing the PUT instruction.	Do not try to access the random file as if it were a sequential file.

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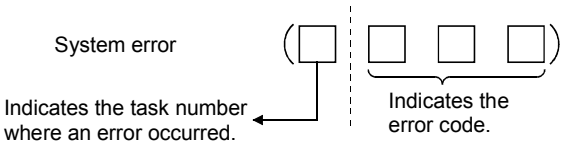
Error message	Code (hexadecimal)	Meaning	Corrective action
Sequential I/O Only	70 (46_H)	Only a sequential input/output can be executed.	Perform only sequential input/output when accessing the sequential file.
String formula too complex	16 (10_H)	Character expression is too complex.	Reduce the complexity of the character expression.
String too long	15 (F_H)	The number of characters in a character variable exceeds 255 characters.	Decrease the number of characters in one variable to 255 or less.
Subscript out of range	9 (9_H)	The value of a subscript for an array variable is out of the specified range.	Modify the program so that the subscript remains within the range specified by the DIM instruction.
Syntax error	2 (2_H)	The command description does not follow the syntax.	Describe according to the syntax.
System error (nnnn)	– (–)	See Appendix 4.4.2.	—
Time out error	31 (F_H)	Characters for the specified number of bytes are not entered within the time specified by the INPUT$ instruction.	Check whether or not there was an input.
Type mismatch	13 (D_H)	The types of variables do not match on the left and right sides of an expression or in the argument of a function, etc.	Modify the program so that the variable types match.
Undefined line number	8 (8_H)	The line number required as a jump destination (jump destination for GOTO, GOSUB, etc.) does not exist.	Check the line number of the jump destination.
Undefined user function	18 (12_H)	It is attempted to call a user function that is not defined by the DEFFN function.	Define the function with the DEFFN function before using.
WEND without WHILE	78 ($4E_H$)	There must be a WHILE instruction for each WEND instruction (there are too many WEND).	Make sure that the instructions match.
WHILE without WEND	77 ($4D_H$)	There must be a WEND instruction for each WHILE instruction (there are too many WHILE).	Make sure that the instructions match.
Unprintable error	Undefined (–)	An error whose error message is undefined.	—

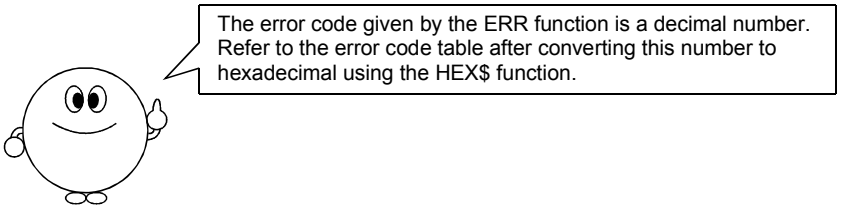
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Appendix 4.4.2 System error code table

An error code at a system error occurrence is expressed as a 4-digit hexadecimal number. The code is read as follows:





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Numbers in the 800H range • • •General errors

Error code	Meaning	Corrective action
803H	The ON COM GOSUB instruction is registered twice.	Use only one ON COM GOSUB instruction.
804H	Specified date and time are incorrect.	Set the correct time, date, and week.
805H	There is no clock function in the CPU.	Execute using a CPU with a clock function.
807H	A ZSTART instruction cannot be executed on the specified task.	Execute the instruction on a task that is stopped.
809H	Memory cannot be reserved for the specified task. The size has not been specified.	Make each task size smaller or reformat the memory card to increase the executable program area. Specify the size with the SET command.
80AH	Cannot be executed in programming mode.	Do not execute the instruction in question on a task whose start condition is OFF in multitask debug mode.
80BH	The control table of the ZCNT instruction is incorrect.	Revise the control table.
80CH	A CPU side error is detected with the date and time specification.	Check the CPU.
824H	There is no free space of the required size in the program area. There is no free space of the required size in the program area and sufficient work area is not obtained when the MSAVE command is executed.	Specify the size for each task correctly.
828H	It is attempted to use a future expansion function.	This function cannot be used.
830H	The message port number is incorrect.	Specify the correct message number.
831H	The specified message port is already defined.	Since it is already defined, it is not necessary to define the message port anew.
832H	The specified message port is not defined.	Use the port after defining it.
833H	The message length exceeded 256 bytes.	Decrease the message length to 256 bytes or less.
834H	The message length specification is incorrect.	Specify the length correctly.
835H	The specified message port is not closed.	Close the message port.
836H	The specified message port is not open.	Open the message port.
841H	The specified address is out of range. An incorrect head device number is specified when accessing ED.	Specify an address within the range. Specify the correct head device number.
842H	The specification of the number of bytes to transfer is incorrect. An incorrect number of points to be processed is specified when accessing ED.	Specify the correct number of bytes to transfer. Specify the correct number of points to be processed.
881H	A task that was forced to end (pressing [Ctrl]+[C]) was aborted due to an error cause during the processing.	Check whether or not there are places where the program might be forcibly stopped in the program. Modify the program so that the [Ctrl]+[C] keys cannot be pressed.
8AEH	Cannot be used in the specified interface.	Change the interface.
8C3H	There is no area where the message can be written.	Increase the message area or delete excess messages.
8CAH	Time out error This error is generated in the following instructions: ZMESSAGE GET, ZRESERVE, ZWAIT EVENT A message, resource number, or event was not generated within the specified time.	Check the status of the message port, resource number, or event that might cause this error.
8CDH	It is attempted to write more than 16 data to a single message port.	Decrease the number of messages to be written.

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Numbers in the 900H range • • • Errors related to file processing

Error code	Meaning	Corrective action
902H	The specified file cannot be found.	Specify the correct file name.
903H	The specified system name cannot be found.	Specify the correct system name.
905H	An illegal operation is performed on a memory card or FD.	Cancel the write protection.
908H	There is not enough memory.	Increase the executable program area of the memory card. Carry out the MSAVE operation from the beginning and secure sufficient memory.
90BH	It is attempted to save a file other than an executable file created by the BASIC compiler with the MSAVE command.	Specify a file compiled using the Microsoft Macro Assembler.
910H	A debug command is executed on a task of compiler BASIC.	Do not execute a debug command on a task of compiler BASIC.
983H	The FILES or LFILES instruction was executed from multiple tasks.	Modify the program so that the instruction is not executed from multiple tasks.
984H	A fatal error occurred in the memory card.	Replace the memory card.
985H	The format of the file area in a memory card is incorrect.	Reformat the memory card's file area.
9C1H	A memory card is not mounted. A memory card is faulty. The memory card mount/dismount request switch is turned OFF. In the case of the A1SD51S or QD51(-R24), it failed in write to the EEP-ROM or flash ROM.	Mount a memory card. Replace the memory card. Turn the memory card mount/dismount request switch ON. If re-execution results in error again, replace the module as the number of times data that can be written to the EEP-ROM or flash ROM may be exceeded.
9C2H	A memory card is write protected.	Cancel the write protection.
9C3H	A memory card's format is incorrect.	Reformat the entire memory card.
9E4H	The header information of a memory card is incorrect.	Reformat the entire memory card.
9E5H	The memory card size specified in the memory card format and the actual memory card size are different.	Match the size specified by the memory card format to the actual memory card size.
9E6H	It is attempted to write data to ROM or a ROM memory card.	Writing is not permitted.
9E8H, 9E9H	The specified area does not exist in a memory card.	Check the memory card.

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Numbers in the A00H range • • • Errors related to communication processing

Error code	Meaning	Corrective action
A2AH, A2BH, A61H, A62H, A73H	Error in communication with the console	Reset the communication module.
A75H	Memory card verification error	Check the memory card size, etc.
A82H	Cannot be used with the specified interface.	Change the interface.
A83H	Time out error	Check devices on the transmission side.
A84H	Reception error	Read the reception error cause using processing code 64 of the ZCNTL instruction and check the error contents.
A85H	Communication buffer overflow	Do not send large amounts of data.
A91H	The specification of the number of requested characters is incorrect.	Specify the number of requested characters correctly.
A92H	The specification of the receive buffer size is incorrect.	Specify the size within the range of 1024 bytes or less.
A93H	Transmission rate specification is incorrect.	Specify the transmission rate correctly.
A94H	Character length specification is incorrect.	Specify the character length correctly.
A95H	Parity bit specification is incorrect.	Specify the parity bit correctly.
A96H	Stop bit specification is incorrect.	Specify the stop bit correctly.
A97H	The specification of the number of break characters is incorrect.	Specify the number of break characters correctly.
AA1H	A printer connected to the parallel interface is faulty.	Check the printer.
AC1H	The size of an array used for a control table is insufficient.	Increase the size of the array.
AC2H	It is attempted to receive more data than the number of input elements. It is attempted to send more data than the number of output elements.	Receive the same amount of data as the number of input elements. Send the same amount of data as the number of output elements.
AC4H	The number of requested bytes during communication is too large.	Specify an appropriate number of requested bytes.
AC7H	A processing code for the ZCNTL instruction is incorrect.	Check the processing code.

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Numbers in the B00H range • • • Errors related to communication with the PLC CPU

Error code	Meaning	Corrective action
B10H	A station with the specified PC number does not exist.	Check the specified station.
B11H	Communication error between the communication module and PLC CPU.	Check the communication module or CPU.
B12H	A special function module cannot be found at the specified I/O address.	Check the special function module at the specified address.
B13H	A step number (address) exceeding the parameter range is specified.	Specify a step number (address) within the parameter range.
B18H	A remote RUN/STOP was executed from another module.	Cancel the remote RUN/STOP from the other module.
B20H	The MELSECNET (II) is not operating correctly.	Check the MELSECNET (II).
B21H	Cannot access the specified special function module.	Check to see if the special function module has failed.
B40H	Time out error	Check the CPU.
B41H	Data communication error with the CPU	Check to see if there is a CPU error.
B46H	The specified CPU is faulty.	Check to see if there is a CPU error.
B80H	The contents of the control table for the PCRD and PCWT instructions are incorrect. The data storage area is too small.	Check the contents of the control table. Increase the data storage area.
B81H	It is attempted to execute processing that the specified CPU cannot perform.	The specified processing cannot be performed in the applicable CPU.
B82H	Device name (device code) is incorrect.	Specify the correct device code.
B83H	Device number is incorrect.	Specify a device number in the allowable range.
B84H	It is attempted to monitor before performing monitor registration.	Monitor after performing monitor registration.
B85H	The PC number is different from at the time of monitor registration.	Use the same PC number as at the time of monitor registration.
B86H	The system configuration is different from at the time of monitor registration.	Use the same system configuration as at the time of monitor registration.
B87H	There are too many points to be monitored.	Decrease the number of monitoring points.
B88H	Cannot be executed in the specified block number of the extension file registers.	Change to extension file registers where the execution is possible.
B89H	It is attempted to change a program or parameters while the ROM is operating.	Do not change programs or parameters while the ROM is operating.
B8AH	It is attempted to perform a processing that cannot be performed while the CPU is running.	Perform the processing after stopping the CPU.
B8DH	A processing code for the PCRD and PCWT instructions is incorrect.	Specify the processing code correctly.
BA4H	An error that occurred in the CPU was returned to the PCRD/PCWT instruction.	Check the detailed error code using the format 2 control table of the PCRD/PCWT instruction. See the manual for the CPU that was accessed or the CPU that was routed through prior to the accessed CPU for the meaning and corrective action for the detailed error code.
BA7H	An error that occurred in the intelligent communication module was returned to the PCRD/PCWT instruction.	Check the detailed error code using the format 2 control table of the PCRD/PCWT instruction. See the error code table in Appendix for the meaning and corrective action for the detailed error code.
BACH	An error that occurred in Ethernet was returned to the PCRD/PCWT instruction.	Check the detailed error code using the format 2 control table of the PCRD/PCWT instruction. See the manual for the Ethernet module that was routed through prior to the access target for the meaning and corrective action for the detailed error code.
BAFH	An error that occurred in the network module was returned to the PCRD/PCWT instruction.	Check the detailed error code using the format 2 control table of the PCRD/PCWT instruction. See the manual for the network module that was routed through prior to the access target for the meaning and corrective action for the detailed error code.

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Numbers in the F00H range • • •Warning errors

Error code	Meaning	Corrective action
F20H	INIE error • The memory card/user ROM is not mounted. • The memory card/user ROM is not formatted. • The BASIC program is not registered to the memory card/user ROM/EEP-ROM/flash ROM. • The memory card/user ROM/EEP-ROM/flash ROM is faulty.	• Reexamine the mounting status of the memory card/user ROM. • Re-set the contents of the BASIC program to the memory card/user ROM/EEP-ROM/flash ROM. • Replace the memory card/user ROM. • Replace the communication module.
F21H	MTSE error • Multitask setting is in error. The size of the BASIC task is 0. The starting conditions of the BASIC task are all OFF. • The memory card/user ROM/EEP-ROM/flash ROM is faulty.	• Reexamine the multitask setting. • Re-set the contents of the memory card/user ROM/EEP-ROM/flash ROM. • Replace the memory card/user ROM. • Replace the communication module.
F80H	Memory card 1 battery low	Replace the battery with the memory card connected while the power to the AD51H-S3 is on.
F81H	Memory card 2 battery low	Replace the battery with the memory card connected while the power to the AD51H-S3 is on.

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Numbers in the 7000H range • • • Detailed errors generated by the intelligent communication module

Error code	Meaning	Corrective action
7008H	[Processing code error] • The corresponding processing code cannot be used. • A processing code that cannot be used in the applicable CPU is specified.	• Revise the processing code.
7140H	[Control table data error] • The control table data is incorrect.	• Change the control table data appropriately.
7141H	[Target CPU error] • The corresponding request cannot be made to the applicable CPU.	• Change the CPU type of the applicable station and the requested type appropriately.
7142H	[Device code error] • The device code is incorrect.	• Change the device code appropriately.
7143H	[Device number error] • The device number is incorrect.	• Change the device number appropriately.
7144H	[No monitor registration error] • A monitoring request is made while a monitor registration has not been performed.	• Perform a monitor registration.
7145H	[Station number mismatch error at registration] • The station numbers specified at the monitor registration and monitoring request are different.	• Use the same station number as the one at the monitor registration. • Perform the monitor registration again using the correct station number.
7146H	[CPU type mismatch error at registration] • The CPU types specified at the monitor registration and monitoring request are different.	• Change the type of the applicable CPU appropriately. • Perform the monitor registration again.
7147H	[Number of points monitored over error] • There are too many points to be monitored.	• Reduce the number of points to be monitored.
7148H	[No extension R register block error] • The specified extension R register block does not exist.	• Check to see if there is a corresponding extension R register block in the specified extension R register block number or the CPU.
7149H	[ROM operating error] • The CPU is currently accessing the ROM.	• Change the status of the CPU appropriately.
714AH	[During RUN error] • The CPU is running.	• Change the status of the CPU appropriately.
714DH	[Processing code error] • A processing code for the control table is incorrect.	• Modify the processing code for the control table appropriately.
714EH	[Network number mismatch error at registration] • The network numbers specified at the monitor registration and monitoring request are different.	• Use the same network number as the one at the time of monitor registration. • Perform the monitor registration again using the correct network number.
7150H	[DNA specification CPU error] • The local station CPU cannot specify a network number. • A network number other than 0 was specified although an AnACPU or similar is the local station.	• Change the network number specification and the CPU type for the local station appropriately.
7151H	[Station number error] • A faulty station number was specified.	• Change the station number appropriately.
7164H	[Data specification error] • The specified data in the control table or storage area for data to be written is incorrect.	• Change the contents of the control table and the storage area for data to be written appropriately.
7174H	[Time out error] • There is no response from the CPU.	• Check the status of the CPU. • Check whether or not the CPU is operating correctly. • Reset the CPU and the intelligent communication module.
7175H	[General data processing in progress error] • There was an error in the data communication with the CPU.	
7177H	[CPU NOT READY error] • The CPU is faulty.	
717AH	[Abort error] • A request was forcibly stopped (Ctrl + C entered) during processing.	• Execute again if necessary.

See the MELSECNET/10 Network System Reference Manual for other detailed error codes.

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Appendix 5 How to Obtain Trigonometric Functions not Available in AD51H-BASIC

A trigonometric function not available in AD51H-BASIC can be derived by combining existing trigonometric functions.
The table below shows formulas for the derived trigonometric functions.

Derived function	Expression
Arc sine	ARCSIN(X)=ATN(X/SQR(–X＊X+1))
Arc cosine	ARCCOS(X)=–ATN(X/SQR(–X＊X+1))+1.5708
Arc secant	ARCSEC(X)=ATN(SQR(X＊X–1))+(SGN(X)–1)＊1.5708
Arc cosecant	ARCCSC(X)=ATN(1/SQR(X＊X–1))+(SGN(X)–1) ＊1.5708
Arc cotangent	ARCCOT(X)=–ATN(X)+1.5708
Cosecant	SCS(X)=1/SIN(X)
Cotangent	COT(X)=1/TAN(X)
Secant	SEC(X)=1/COS(X)
Hyperbolic sine	SINH(X)=(EXP(X)–EXP(–X))/2
Hyperbolic cosine	COSH(X)=(EXP(X)+EXP(–X))/2
Hyperbolic tangent	TANH(X)=–EXP(–X)/(EXP(X)+EXP(–X)) ＊2+1
Hyperbolic secant	SECH(H)=2/(EXP(X)+EXP(–X))
Hyperbolic cosecant	CSCH(H)=2/(EXP(X)-EXP(–X))
Hyperbolic cotangent	COTH(X)=EXP(–X)/(EXP(X)–EXP(–X))＊2+1
Hyperbolic arc sine	ARCSINH(X)=LOG(X+SCR(X＊X+1))
Hyperbolic arc cosine	ARCCOSH(X)=LOG(X+SQR(X＊X–1))
Hyperbolic arc tangent	ARCTANH(X)=LOG((1+X)/(1–X))/2
Hyperbolic arc secant	ARCSECH(X)=LOG((SQR(–X＊X+1)+1)/X)
Hyperbolic arc cosecant	ARCCSCH(X)=LOG((SGN(X) ＊SQR(X＊X+1)+1)/X)
Hyperbolic arc cotangent	ARCCOTH(X)=LOG((X+1)/)X–1))/2

Note that a certain degree of inaccuracy may occur.

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Appendix 6 Reserved Words

The following reserved words have special meanings so they must not be used in variable names and others.

A :
ABS
ACS
AND
ASC
ASN
ATN
AUTO

B :
BEEP
BIN$
BLOAD
BSAVE

C :
CALL
CDBI
CDBL
CHAIN
CHR$
CIDB
CINT
CISN
CLEAR
CLOSE
CLS
COLOR
COM
CONT
CONSOLE
COS
CSNG
CSNI
CSRLIN
CVB
CVD
CVDMBF
CVI
CVDMBF
CVS

D :
DATA
DEF
DEFBYT
DEFDBL
DEFINT
DEFSNG
DEFSTR
DEF ZEVENT
DELETE
DIM
DRAW
DRD
DWT

E :
ED
EDIT
ELSE
EM
END
EOF
EQV
ERASE
ERL
ERR
ERROR
EXP

F :
FIELD
FILES
FIX
FN
FOR
FORMAT
FRE

G :
GET
GETMEN
GOSUB
GOTO
GO TO

H :
HEX$

I :
IF
IMP
INIT
INIT%
INKEY$
INP
INPUT
INPUT#
INPUT$
INPUT%
INSTR
INT

K :
KEY
KILL

L :
LEFT$
LEN
LET
LFILES
LINE
LIST
LLIST
LOAD
LOC
LOCATE
LOF
LOG
LPOS
LPRINT
LSET

M :
MERGE
MID$
MKB$
MKD$
MKDMBF$
MKI$
MKS$
MKSMBF$
MOD
MON1
MON2

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N :
NAME
NEW
NEXT
NOT

O :
OCT$
OFF
ON
OPEN
OR
OUT

P :
PC
PEEK
PEEK2
POKE
POKE2
PORT
POS
PRCHE
PRD
PRESET
PRINT
PRINT#
PRINT%
PRRD
PRUN
PRWT
PSET
PUT
PUTMEM
PWT

R :
RDSET
READ
REM
RENUM
RESTORE
RESUME
RETURN
RIGHT$
RND
RSET
RUN

S :
SAVE
SEARCH
SGN
SIN
SPACE$
SPC
SPU$
SOR
STEP
STOP
STRING$
STR$
SWAP
SYSTEM

T :
TAB
TAN
TC1
TC2
THEN
TIMER
TO
TROFF
TRON

U :
USING
USR

V :
VAL
VARPTR

W :
WAIT
WTSET

X :
XOR

Z :
ZCLOSE
ZIDV
ZLDV
ZODV
ZOPEN
ZEVENT
ZMESSAGE
ZMESSAGE CLOSE
ZMESSAGE GET
ZMESSAGE KILL
ZMESSAGE OPEN
ZMESSAGE PUT
ZRELEASE
ZRESERVE
ZSIGNAL
ZSTART
ZURGENCY
ZWAIT DELAY
ZWAIT EVENT

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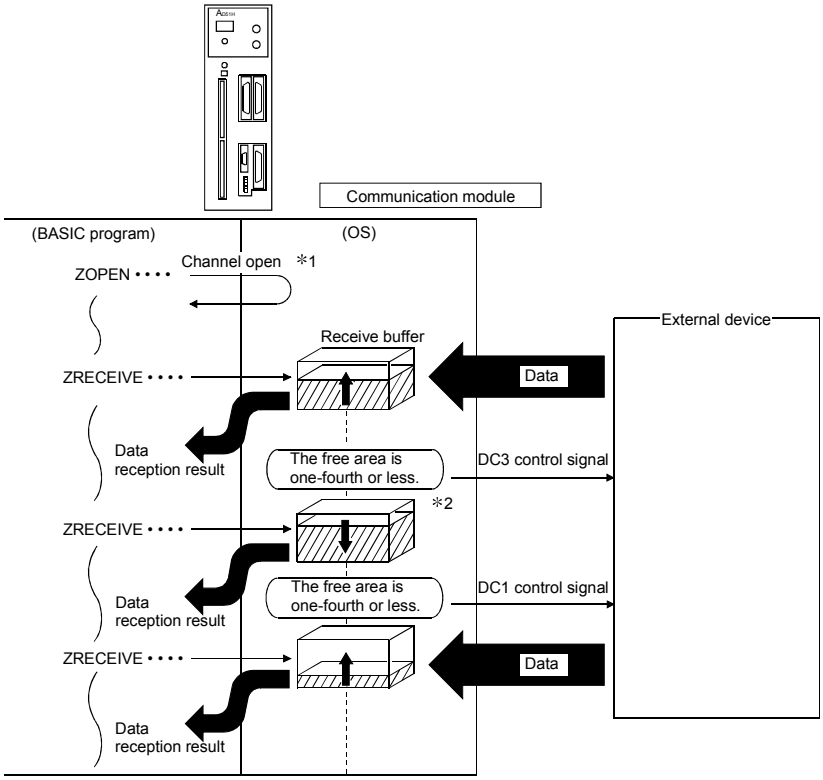
Appendix 7 Details of Communication Control

Appendix 7.1 DC1/DC3 Control

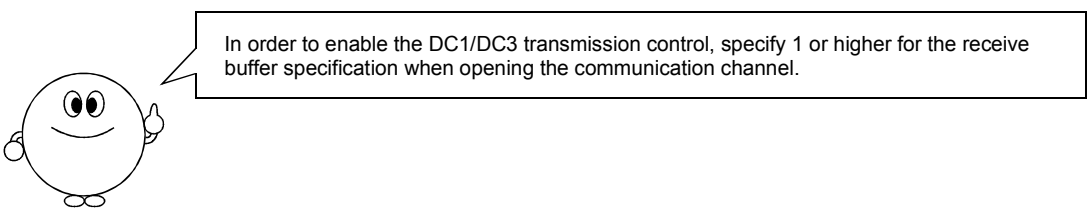
The following diagram shows the data flow when the DC1/DC3 control is enabled in the communication channel.

Appendix 7.1.1 DC1/DC3 transmission control enabled

When the DC1/DC3 control is enabled, DC1/DC3 control signals are sent to an external device based on the size of the free area in the receive buffer specified by the user, allowing the data transmission from the external device to the communication module to be controlled and requested.
A DC3 control signal is sent to the external device when the free area in the receive buffer becomes one-fourth or less of the total space as data received from the external device is stored.
A DC1 control signal is sent to the external device when the free area in the receive buffer becomes three-fourths or more of the total space because of receive requests from the BASIC program in the communication module.



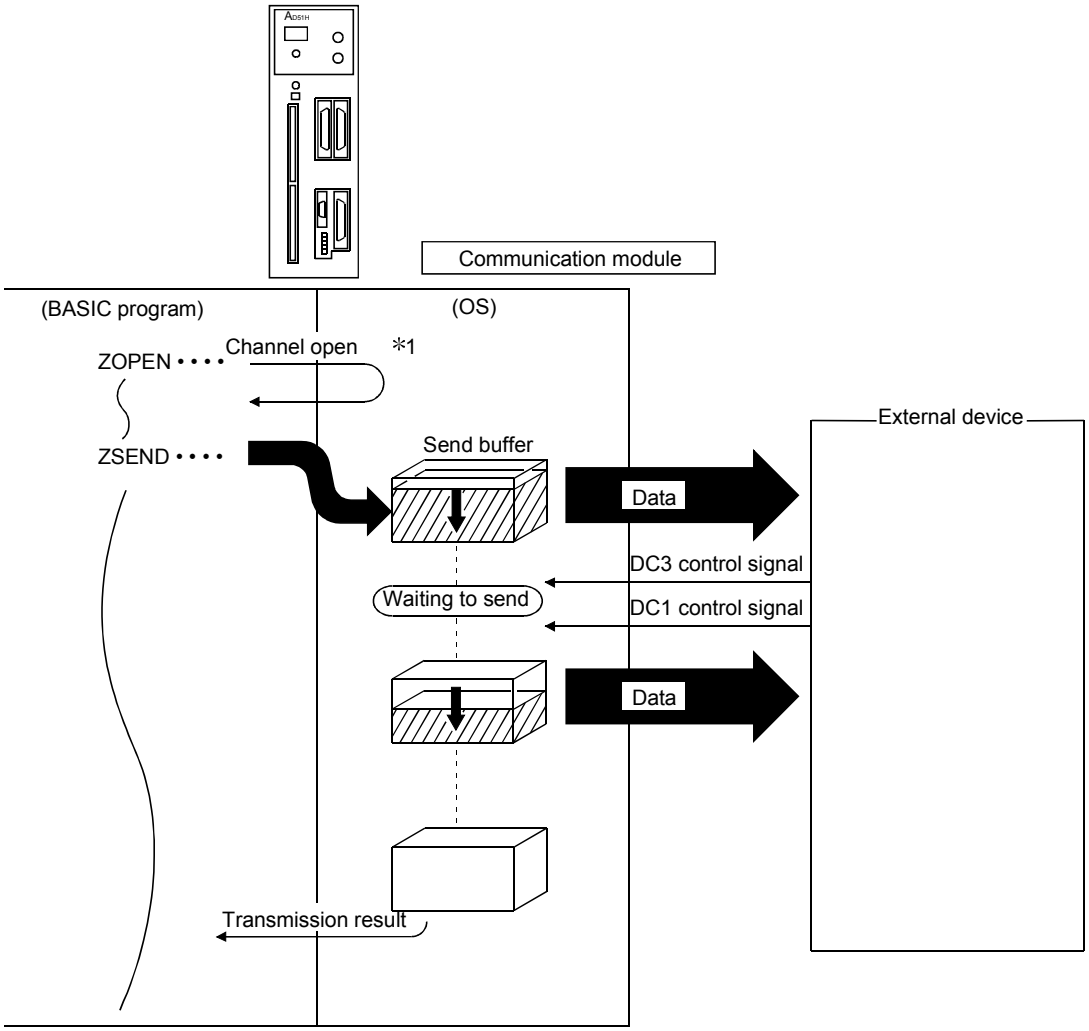
*1 A DC1 control signal is not sent to the external device when the communication channel is opened. The status of the receive buffer is the same as when the DC1 control signal is sent, however.
*2 After a DC3 control signal is sent, the received data is stored in the receive buffer until the free area in the receive buffer runs out.



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Appendix 7.1.2 DC1/DC3 reception control enabled

Transmission of data from a BASIC program is controlled by DC1/DC3 control signals received from an external device.
If a DC1 control signal is received, data transmission starts or continues.
If a DC3 control signal is received, data transmission is stopped. When a data transmission is stopped due to the reception of the DC3 control signal, the remaining data will be sent when a DC1 control signal is received again later.



*1 When the communication channel is opened, the status of the send buffer is the same as when a DC1 control signal is received even if the DC1 control signal is not received from the external device.

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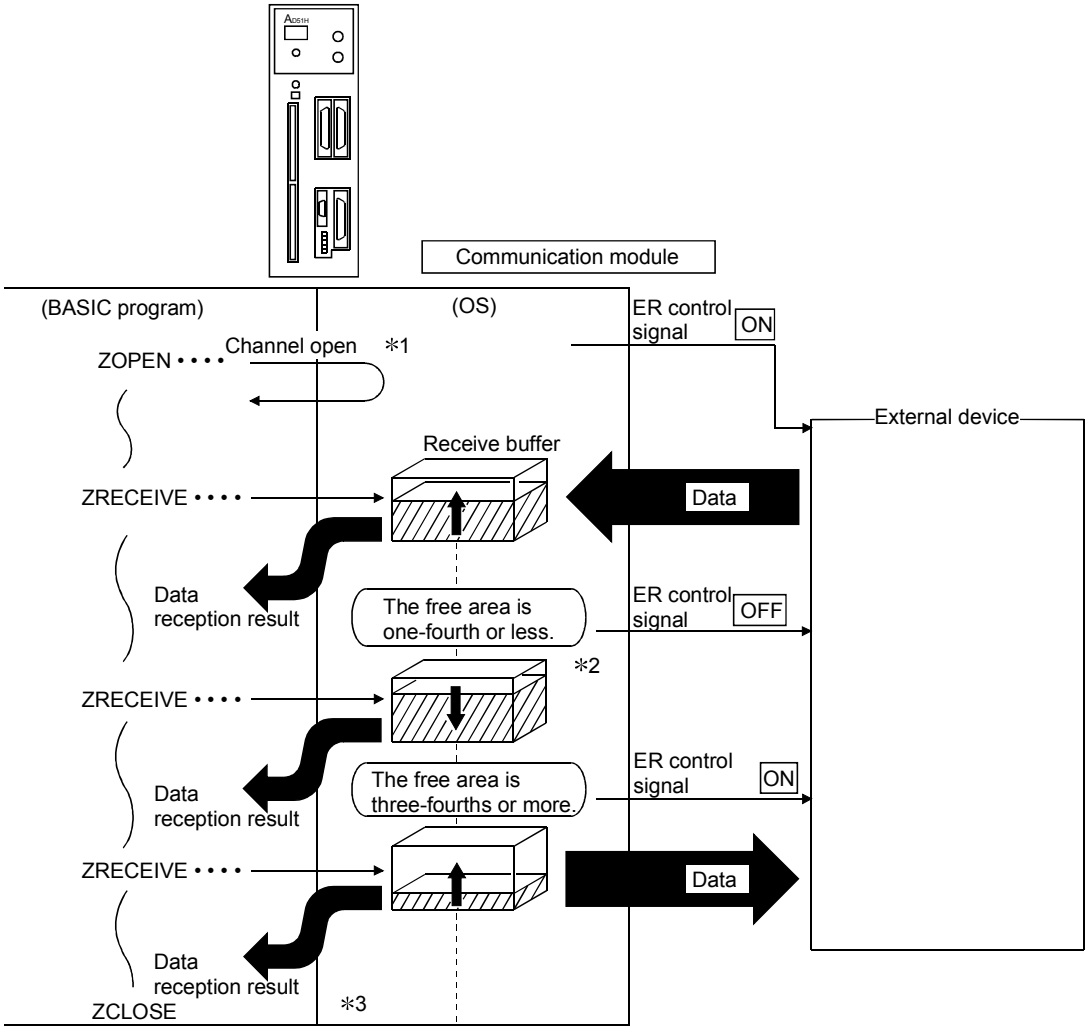
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Appendix 7.2 Control by Signals

The following diagram shows the data flow when control by signals is enabled in the communication channel.

Appendix 7.2.1 ER (DTR) control enabled

When the ER (DTR) control is enabled, ER (DTR) control signals of the RS-232 interface are turned ON/OFF based on the size of the free area in the receive buffer specified by the user, allowing the data transmission from the external device to the communication module to be controlled and requested.
An ER control signal is turned OFF when the free area in the receive buffer becomes one-fourth or less of the total space as data received from the external device is stored.
An ER control signal is turned ON when the free area in the receive buffer becomes three-fourths or more of the total space because of receive requests from the BASIC program in the communication module.



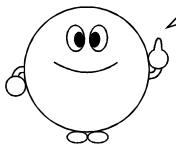
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∗1 When the communication module is started up, the ER (DTR) control signal is turned OFF.
The ER (DTR) control signal turns ON when the communication channel is opened. After that, the ER (DTR) control signal turns ON and OFF when data is received depending on the size of the free area in the receive buffer.

∗2 Even if the ER (DTR) control signal is turned OFF, the received data is stored in the receive buffer until there is no more free area in the receive buffer.

∗3 The ER (DTR) control signal does not turn OFF even if the communication channel is closed.
Even after the channel is closed, the ER (DTR) control continues and data received from the external device is stored until there is no more free area in the receive buffer. However, the received data remaining in the receive buffer when the communication channel is closed and the received data stored in the receive buffer after the communication channel is closed cannot be read by the BASIC program. When the communication channel is reopened, the received data in the receive buffer is cleared.



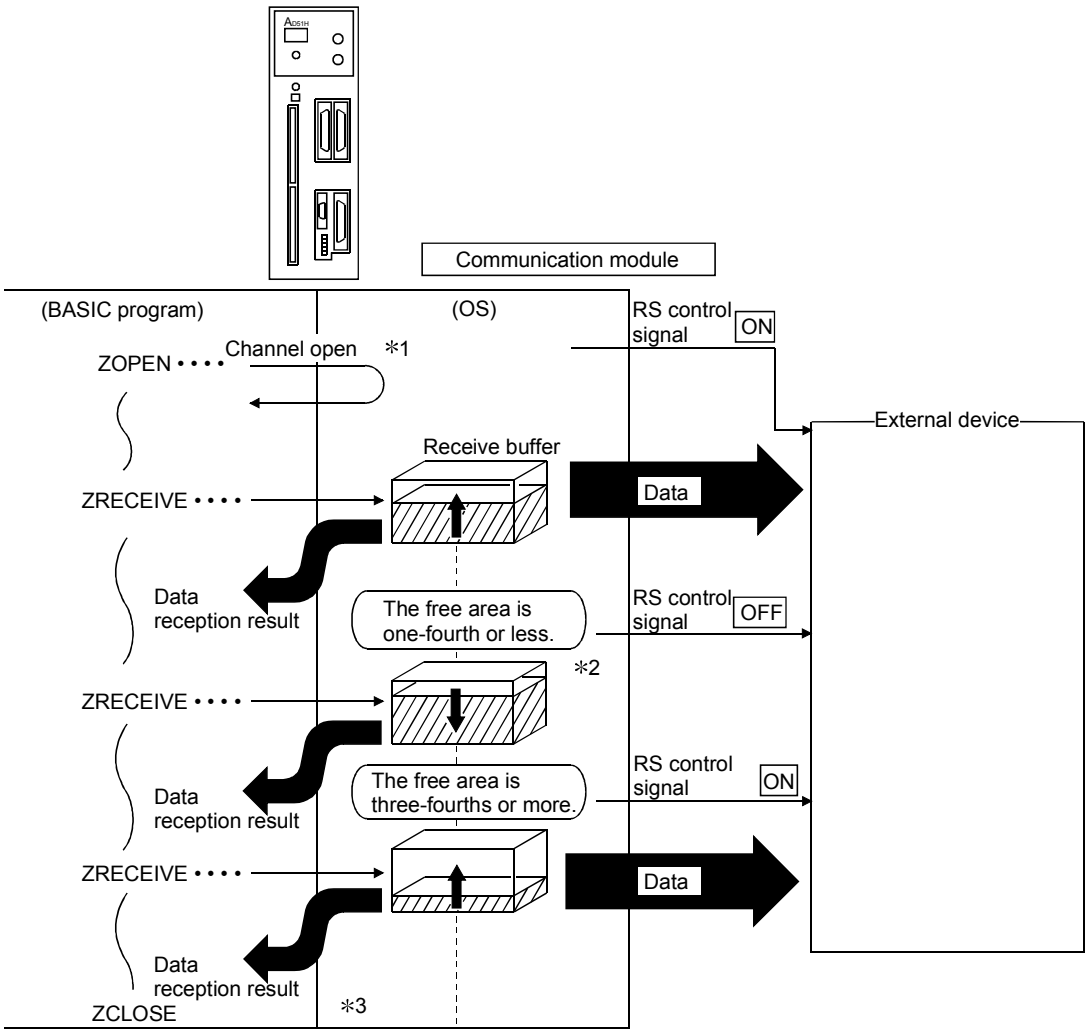
- In order to enable the ER (DTR) control, specify 1 or greater in the receive buffer specification when opening the communication channel.
- The ER (DTR) control signal is turned OFF if the communication channel is opened without enabling the ER (DTR) control.
- The RS (RTS) control has the same control function as the ER (DTR) control.
  Determine which of the control functions of the communication module to use depending on the external device's specifications.

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Appendix 7.2.2 RS (RTS) control enabled

When the RS (RTS) control is enabled, RS (RTS) control signals of the target interface are turned ON/OFF based on the size of the free area in the receive buffer specified by the user, allowing the data transmission from the external device to the communication module to be controlled and requested.
An RS (RTS) control signal is turned OFF when the free area in the receive buffer becomes one-fourth or less of the total space as data received from the external device is stored.
An RS (RTS) control signal is turned ON when the free area in the receive buffer becomes three-fourths or more of the total space because of receive requests from the BASIC program in the communication module.



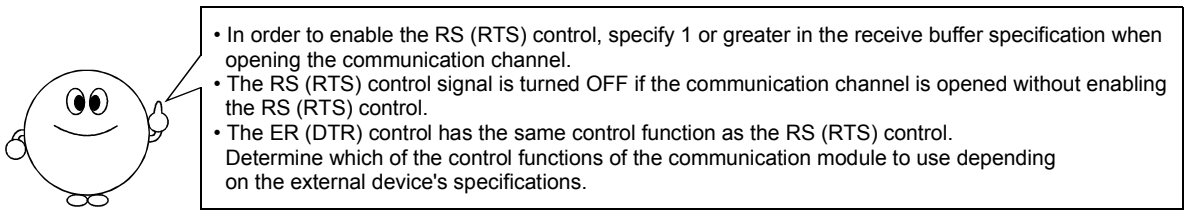
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*1 When the communication module is started up, the RS (RTS) control signal is turned OFF.
The RS (RTS) control signal turns ON when the communication channel is opened. After that, the RS (RTS) control signal turns ON and OFF when data is received depending on the size of the free area in the receive buffer.

*2 Even if the RS (RTS) control signal is turned OFF, the received data is stored in the receive buffer until there is no more free area in the receive buffer.

*3 The RS (RTS) control signal does not turn OFF even if the communication channel is closed.
Even after the channel is closed, the RS (RTS) control continues and data received from the external device is stored until there is no more free area in the receive buffer. However, the received data remaining in the receive buffer when the communication channel is closed and the received data stored in the receive buffer after the communication channel is closed cannot be read by the BASIC program. When the communication channel is reopened, the received data in the receive buffer is cleared.

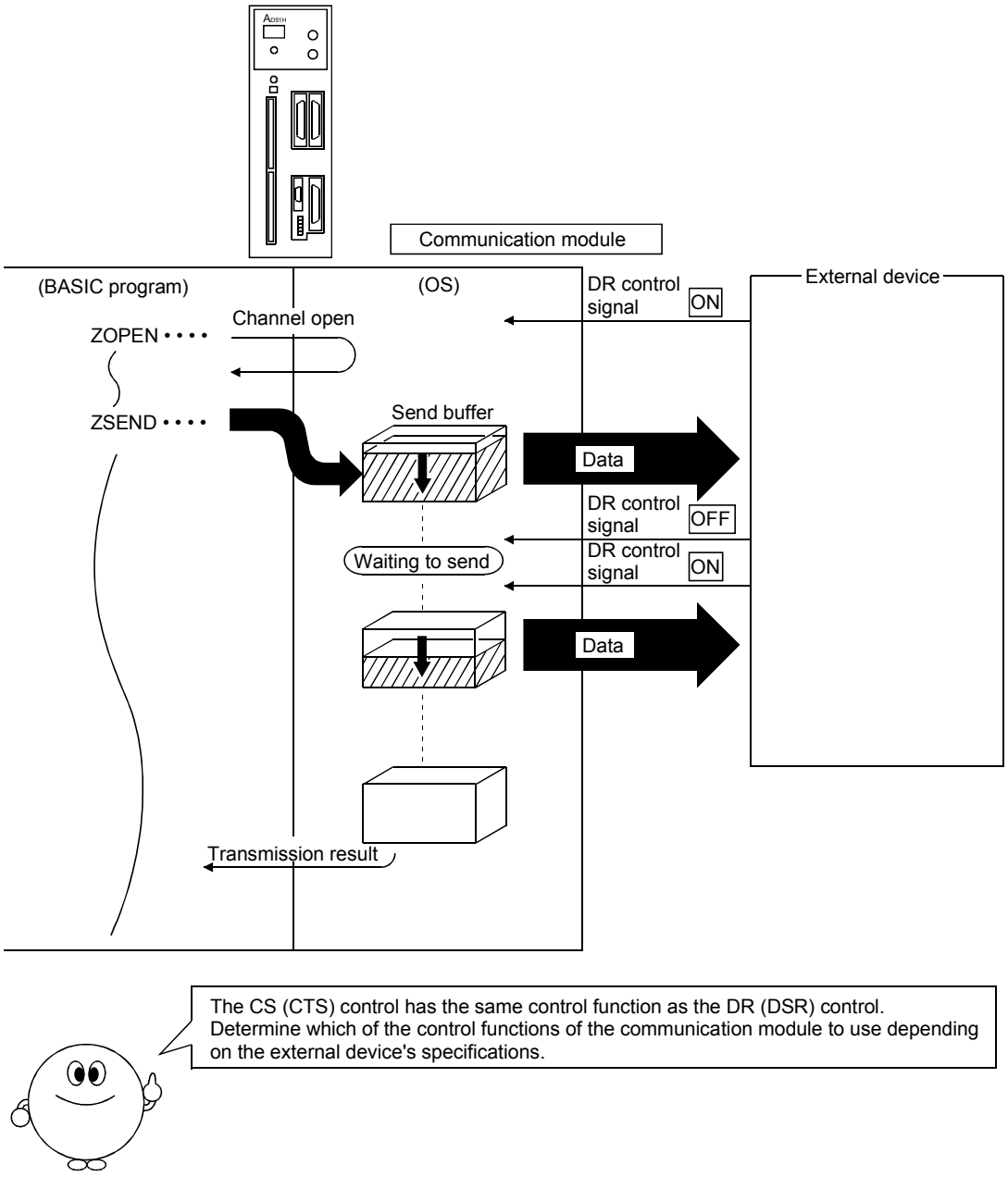


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Appendix 7.2.3 DR (DSR) control enabled

The data transmission from the BASIC program is controlled depending on whether the DR (DSR) control signal is ON or OFF at the RS-232 interface on the communication side.
When the DR (DSR) control signal is ON, the data transmission starts or continues. When the DR (DSR) control signal turns OFF, the data transmission stops. When the data transmission stops due to the DR (DSR) control signal being turned off, the remaining data will continue to be sent when the DR (DSR) control signal turns ON again later.

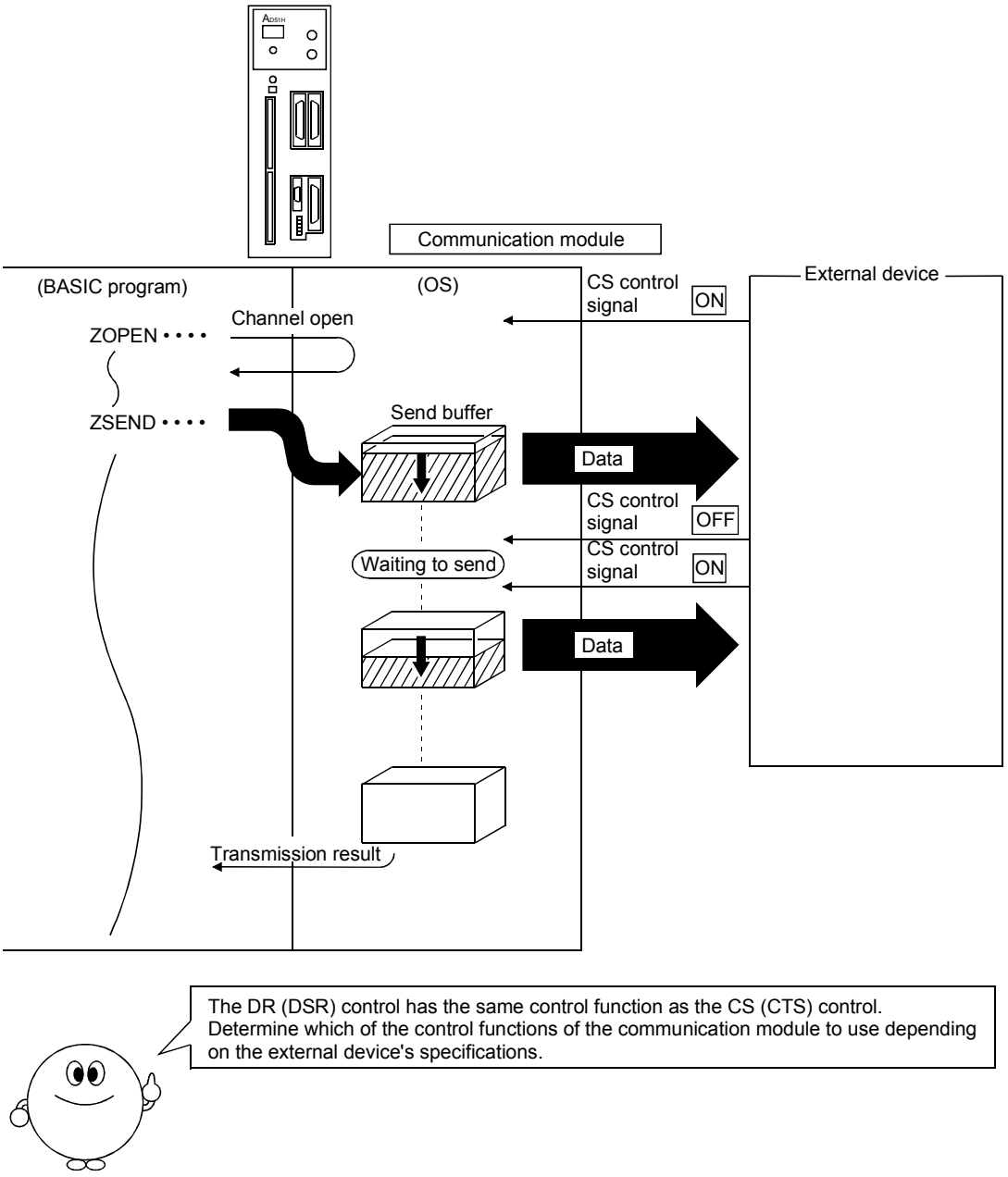


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Appendix 7.2.4 CS (CTS) control enabled

The data transmission from the BASIC program is controlled depending on whether the CS (CTS) control signal is ON or OFF at the target interface on the communication side.
When the CS (CTS) control signal is ON, the data transmission starts or continues. When the CS (CTS) control signal turns OFF, the data transmission stops. When the data transmission stops due to the CS (CTS) control signal being turned off, the remaining data will continue to be sent when the CS (CTS) control signal turns ON again later.



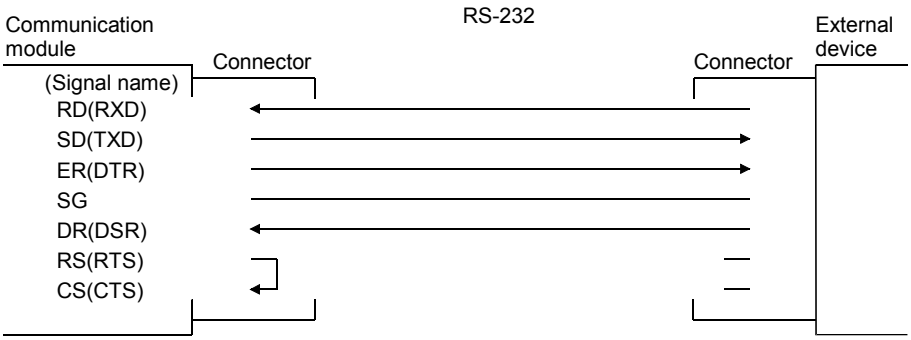
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Appendix 7.2.5 How to connect the communication module to an external device and precautions on specifying control by signals

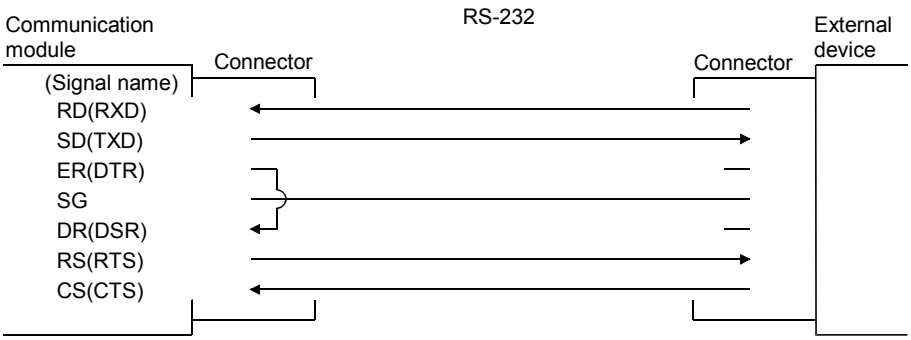
In the following, some precautions on specifying the control by signals using an interface connection between the communication module and an external device are given using the RS-232 interface as an example.

(1) When only the RS (RTS) and CS (CTS) control signal lines are looped back on the communication module side



If the RS (RTS) control is disabled, data can be received from the external device but data cannot be sent to the external device.
In order to send data, turn the RS (RTS) control signal ON using processing code 32 of the ZCNTL instruction.

(2) When only the ER (DTR) and DR (DSR) control signal lines are looped back on the communication module side

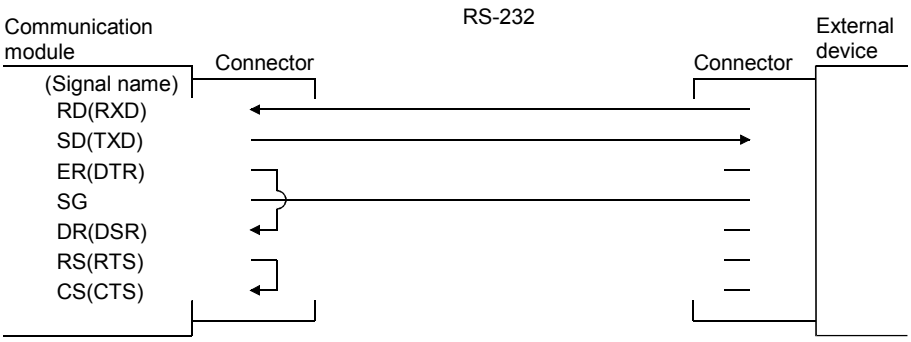


If the ER (DTR) control is disabled and DR (DSR) control is enabled, data can be received from the external device but data cannot be sent to the external device.
In order to send data, disable the DR (DSR) control.

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(3) When the RS (RTS) and CS (CTS) control signal lines as well as the ER (DTR) and DR (DSR) control signal lines are looped back on the communication module side



If either the RS (RTS) or the ER (DTR) control is disabled, data can be received from the external device but data cannot be sent to the external device. In this case, turn the RS (RTS) control signal ON using processing code 32 of the ZCNTL instruction and disable the DR (DSR) control to send data to the external device.

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Appendix 7.3 Break Control

If a BASIC program in the communication module receives data from an external device, only data up to the break character specified by the control interface is stored in the variable.
If the break character is not detected within the number of characters requested at a receive request, reception data for the number of requested characters is stored in the variable.
The break character can be specified in the ZRECEIVE instruction used to request data reception.
(Depending on the character length at the time of transmission, any data corresponding to the codes from 00h to FFh can be specified as the break character.)

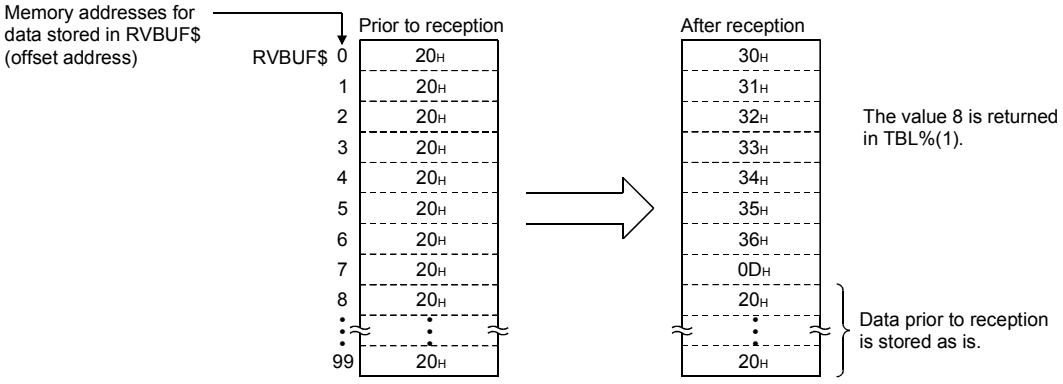
Appendix 7.3.1 Break character specifying side

The following is an example where character data corresponding to codes 03h and 0Dh is specified as the break character in the ZRECEIVE instruction and the received data is entered. It is assumed that the communication channel is already open.

```
10  DIM TBL1%(2),TBL2%(4),TBL3%(2)
20  TBL1%(0)=9600
30  TBL1%(1)=&H108
40  TBL1%(2)=&H1
50  ZOPEN #2,TBL1%( )              : ‘ Opens the channel
60  TBL2%(0)=22                    : ‘ Specifies to set the break character
70  TBL2%(1)=2                     : ‘ Specifies the number of break characters (2 types)
80  TBL2%(2)=&H30D                 : ‘ Specifies the break characters (&H03 and &H0D data)
90  ZCNTL #2,0,TBL2%( )            : ‘ Executes the break character setting
100  RD$=SPACE$(100)               : ‘ Stores a dummy
110  TBL3%(0)=100                  : ‘ Number of requested bytes (100 byte)
120  TBL3%(2)=200                  : ‘ Timeout value (20 seconds)
130  ZRECEIVE #2,0,TBL3%( ),RD$    : ‘ Executes the reception operation
```

In this case, the amount of received data (number of bytes) returned to the BASIC program is returned to TBL%(1). Also, when the break character is detected by the system program, the detected break character is included in the last data received within RVBUF$.
(Example)
△ indicates a space (20_H) and ^C_R the carriage return ($0D_H$) code.
When the reception data “0123456^C_R” is returned:

The content of RVBUF$ prior to the execution of the ZRECEIVE instruction • • • “△△△△ • • • • △△” (for 100 bytes)
The content of RVBUF$ after the execution of the ZRECEIVE instruction • • • “0123456^C_R△△ • • △△” (for 100 bytes)



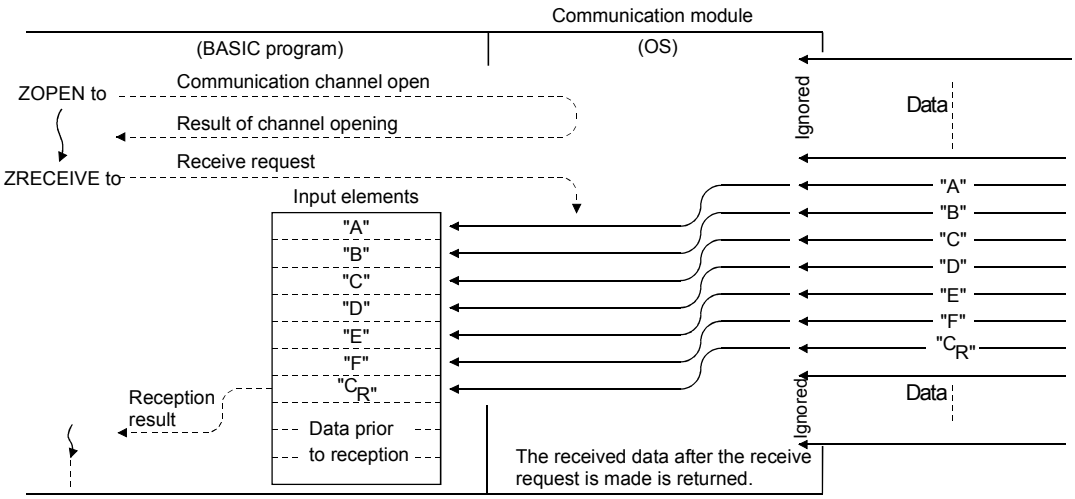
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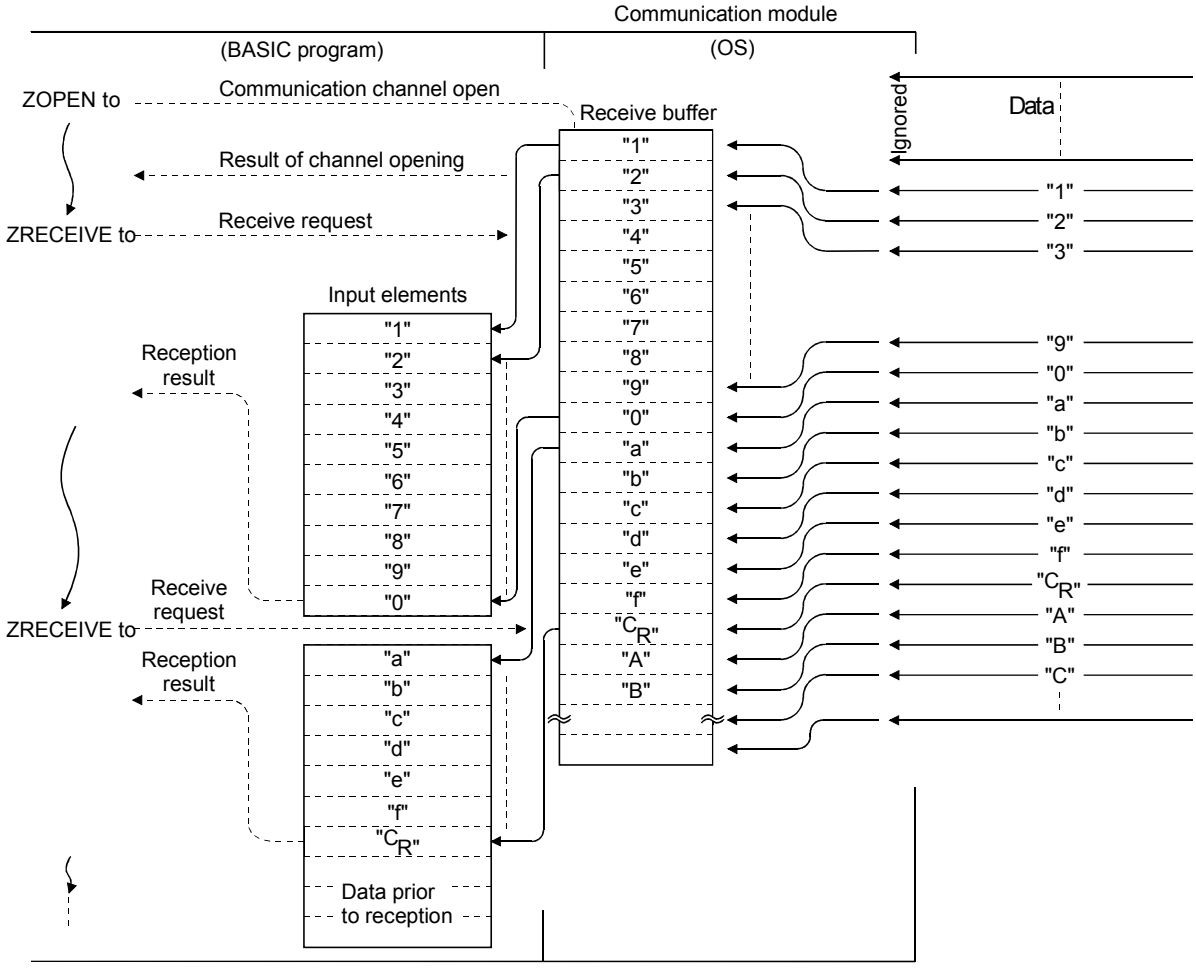
Appendix 7.3.2 Flow of received data when a break character is specified

The examples in the following figures illustrate the flow of received data when 0 is specified in the receive buffer specification (no receive buffer) and when 1 to 1024 is specified (receive buffer available) when the communication channel is opened. The $0D_H$ ($^{C}_{R}$) data is specified as the single break character and a maximum of 10 bytes is requested to be received.

(1) When there is no receive buffer



(2) When a receive buffer is available



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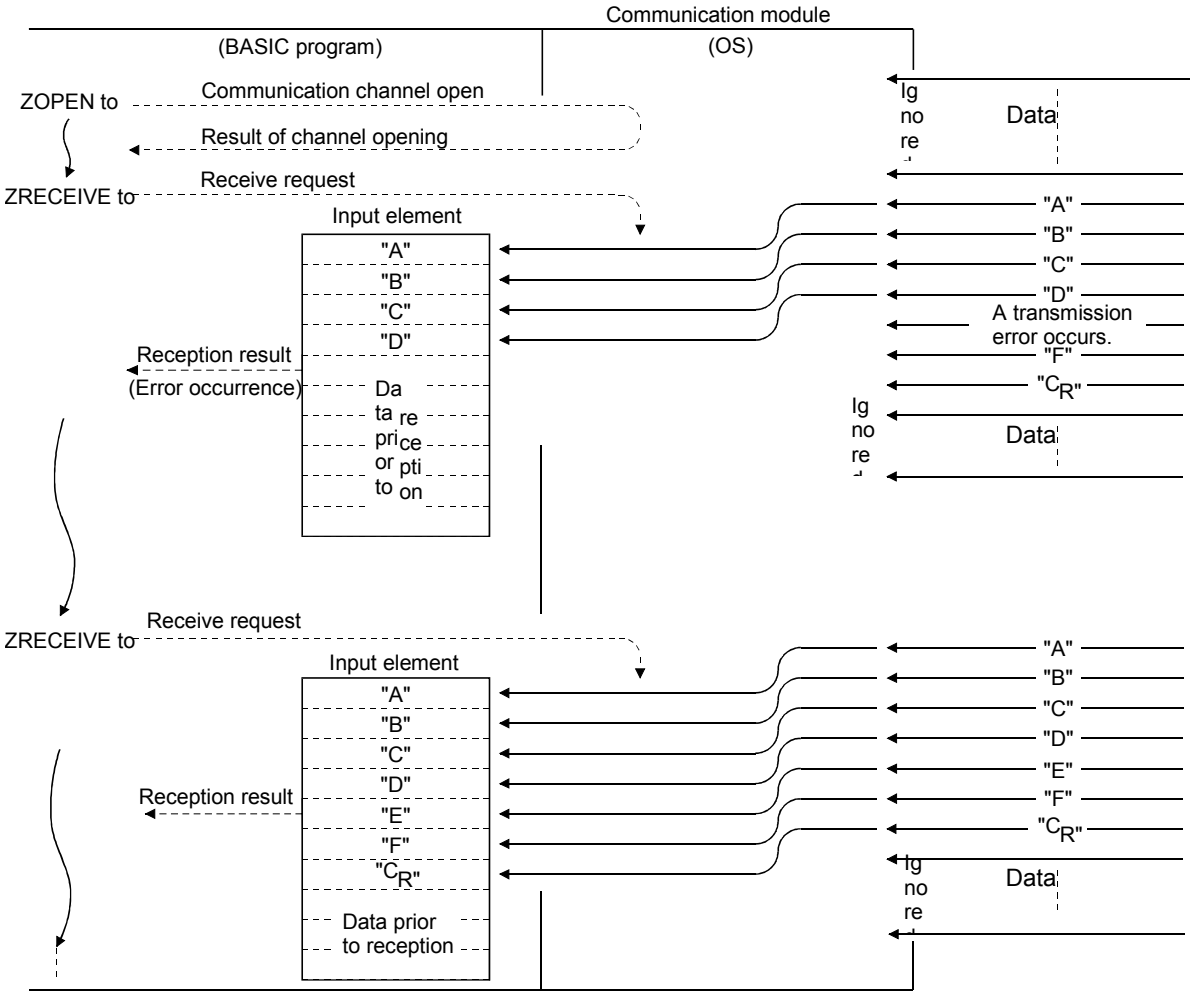
Appendix 7.4 Data Flow When an Error Occurs During Data Reception

Appendix 7.4.1 Data flow when a transmission error occurs

The examples in the following figures illustrate the flow of data when a transmission error (frame error, parity error, overrun error) occurs while receiving data from an external device.
The $0D_H$ ($^{C}_{R}$) data is specified as the single break character and a maximum of 10 bytes is requested to be received.

(1) When there is no receive buffer

If a transmission error occurs while a BASIC program is receiving data from the host after requesting to receive data, the data received up to the time when the transmission error occurred is returned.



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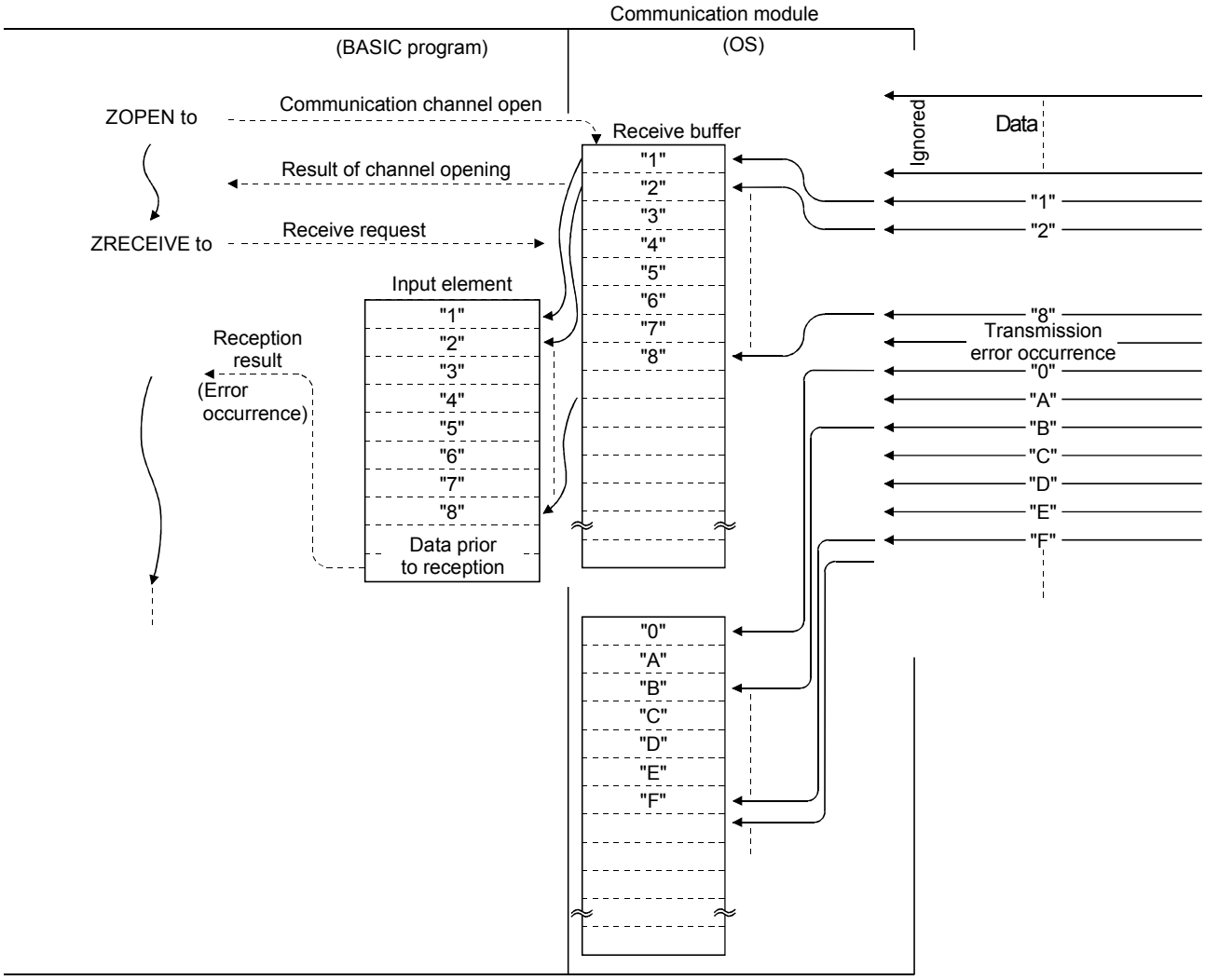
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(2) When a receive buffer is available

1) When data for the number of characters requested to be received is not stored in the receive buffer

The reception data stored in the receive buffer up to the time the transmission error occurred is returned to the BASIC program.

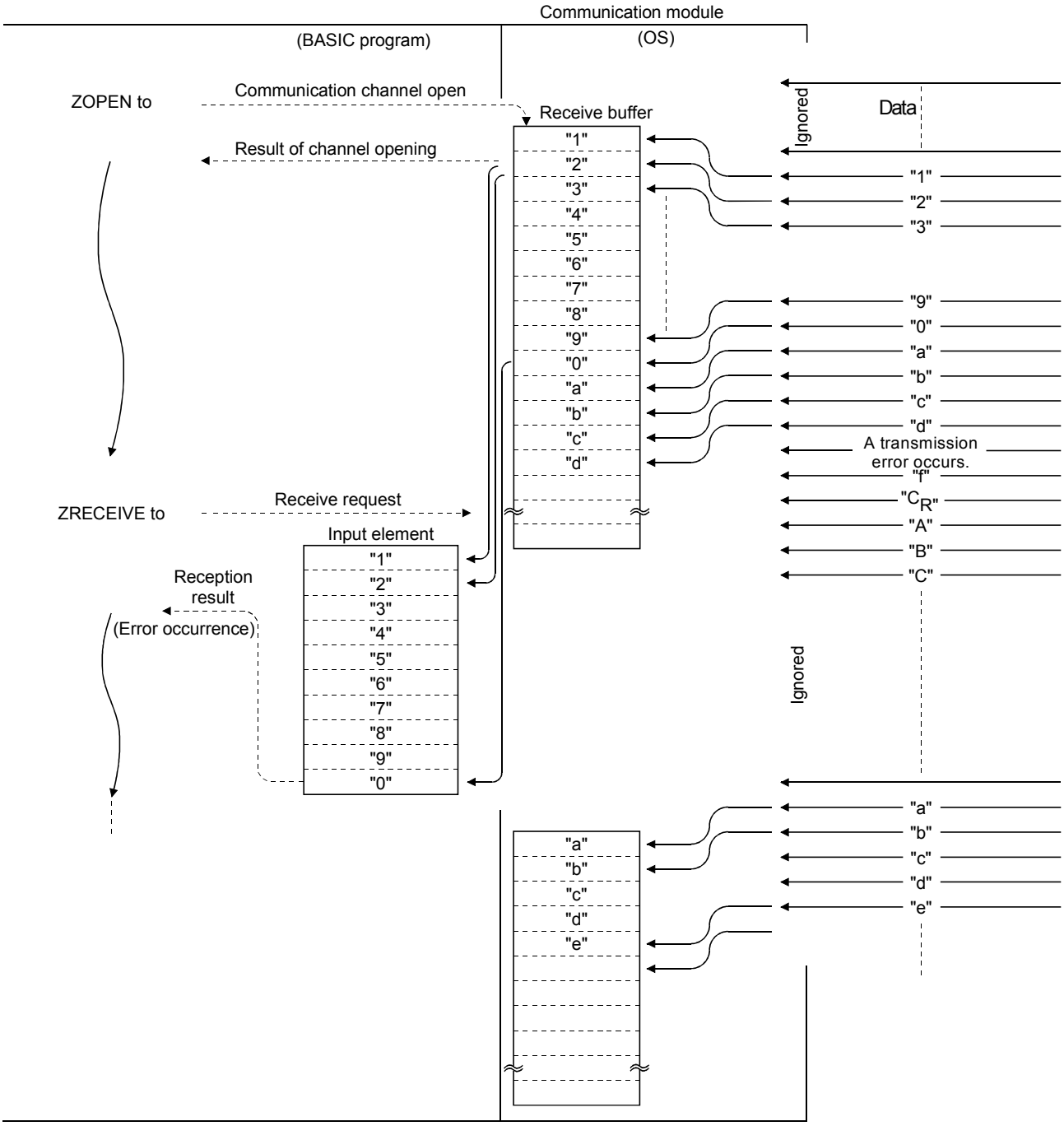
Data received normally after the transmission error is stored in the receive buffer again, so it can be accessed by the BASIC program.



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2) When data greater than the number of characters requested to be received is stored in the receive buffer
Data received after the transmission error is not stored in the receive buffer. (Ignored)
Reception data stored in the reception buffer for the amount of characters requested to be received from the BASIC program, is returned to the BASIC program.
When the processing of the reception request from the BASIC program has been completed, the following processing is performed.
1) All of the remaining data in the receive buffer is deleted.
2) After processing 1) is completed, data received afterward is again stored in the receive buffer.(This reception data can be accessed by the BASIC program.)

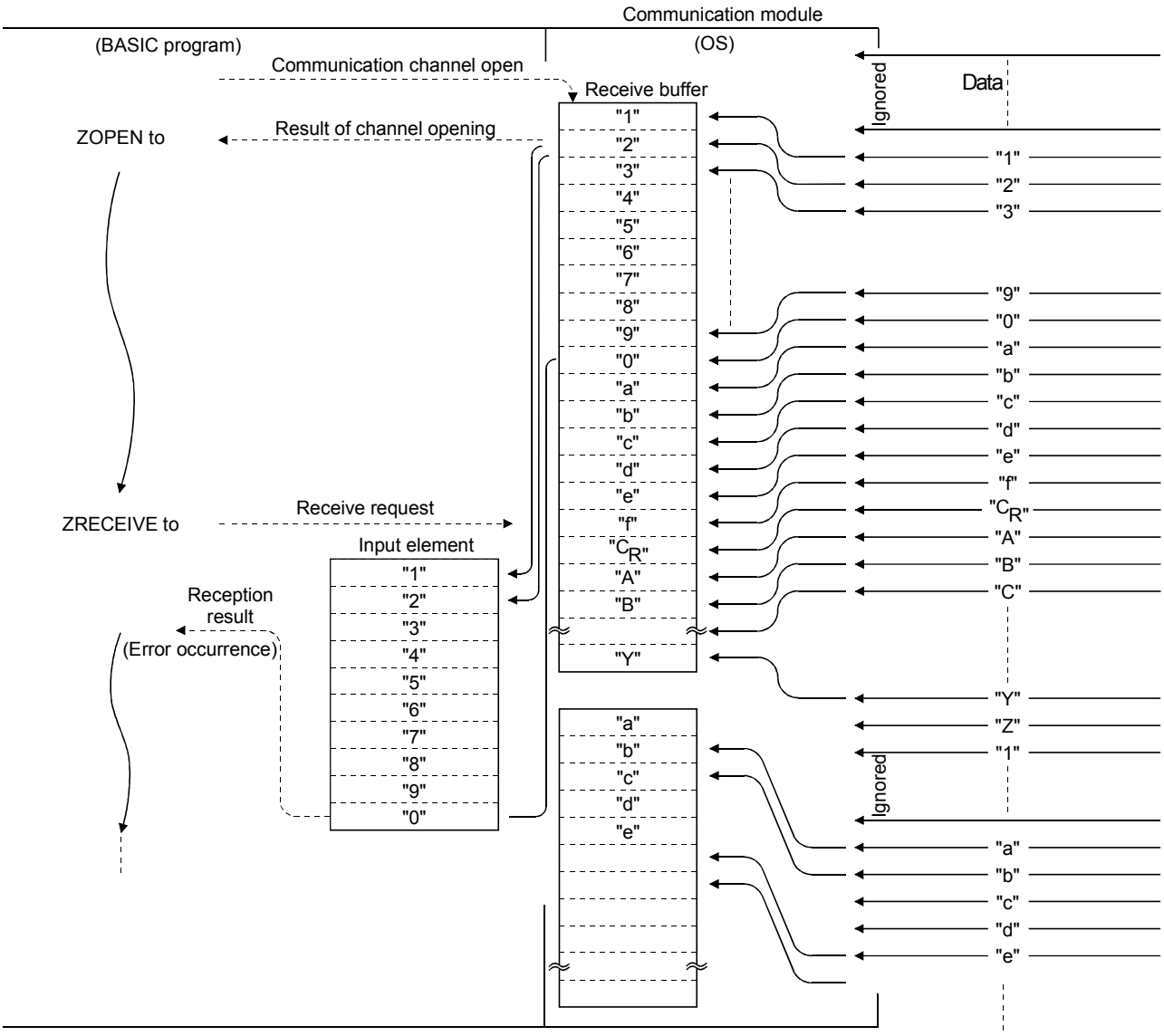


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Appendix 7.4.2 Data flow when a receive buffer full error occurs

The following diagram illustrates the flow of data when 1 to 1024 is specified (receive buffer available) in the receive buffer specification when the communication channel is opened and a receive buffer full error occurs due to the data received from an external device.
The $0D_H$ ($^{C}_{R}$) data is specified as the single break character and a maximum of 10 bytes is requested to be received.
Data received after a receive buffer full error is ignored.
Reception data stored in the reception buffer for the amount of characters requested to be received from the BASIC program, is returned to the BASIC program.
When the processing of the reception request from the BASIC program has been completed, the following processing is performed.

1) All of the remaining data in the receive buffer is deleted.
2) After processing 1) is completed, data received afterward is again stored in the receive buffer.(This reception data can be accessed by the BASIC program.)



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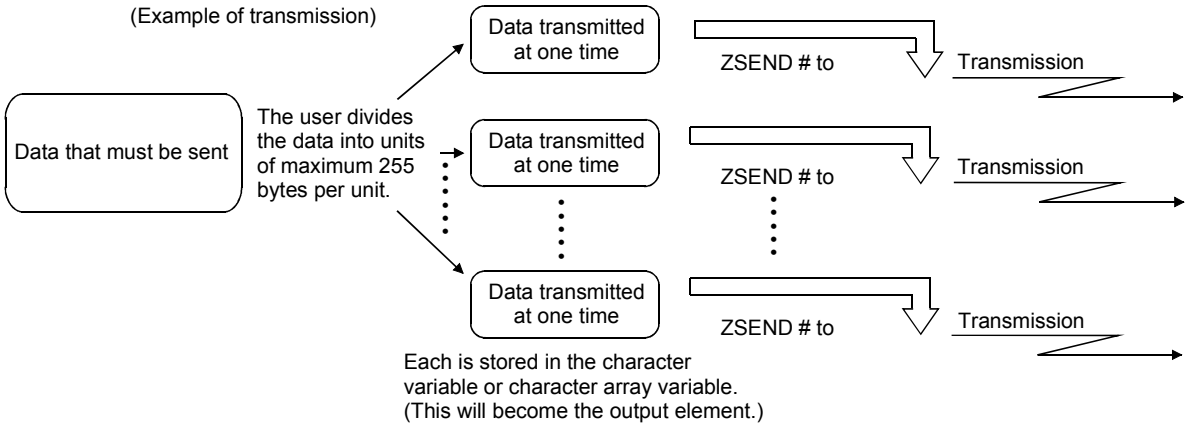
Appendix 7.5 How to Clear Reception Data Stored in the Receive Buffer

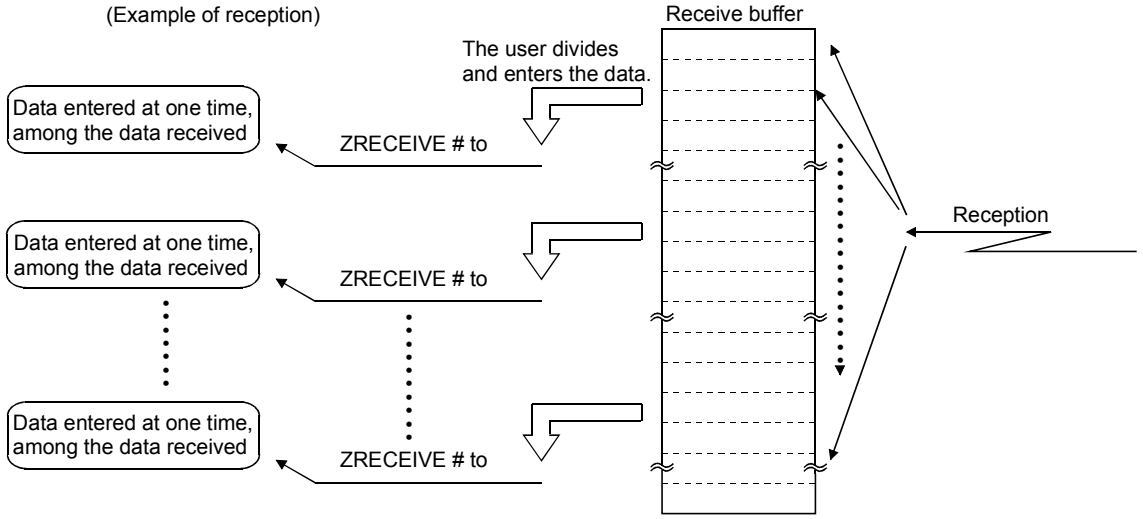
If 1 or greater is specified in the receive buffer specification when the communication channel is opened, the data received from the external device is stored in the receive buffer of the specified size.
Use one of the methods indicated below to clear the reception data stored in the receive buffer and then store data received later in the receive buffer anew.

1) Close the currently open target communication channel, then reopen it.
2) Specify the number of requested characters for the size of the receive buffer and the timeout value as 1 using the ZRECEIVE instruction, then request to receive data.
   All of the data returned by this reception request will be ignored.
3) Change the setting value using the ZCNTL instruction.

Appendix 7.6 Sending or Receiving Character Data of 256 Bytes or More

When sending or receiving character data of 256 bytes or more to/from an external device in non procedure mode via the RS-422 interface or RS-232 interface, divide the data into units of a maximum 255 bytes.
This must be done because a BASIC program cannot handle character data of 256 bytes or more per transmission or reception request.





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Appendix 8 Starting Address of Each Intelligent Function Module/ Special Function Module

The following table shows the intelligent function modules/ special function modules which can read the data from/write the data to the buffer memory with the PCRD instruction or PCWT instruction, along with their "starting address" and "module number" specified in the control table.

REMARK

The "buffer memory starting address" and "module number when loaded in slot 0" shown in the table shall be used for the "starting address" and "module number" specified in the control table.

Model names of each intelligent function module/ special function module

Module model name	Buffer memory starting address (Hexadecimal)	Module number when loaded in slot 0
Model Q62AD-DGH, Q64AD (-GH), Q68ADV/ADI Analog-Digital Conversion Module	1008H	0000H
Model Q62DA (-FG), Q64DA, Q68DAV/Q68DAI Digital-Analogue Conversion Module	1008H	
Model Q64TCTT/Q64TCRT Temperature Control module	1000H	
Model Q64TCTTBW/Q64TCRTBW Temperature Control module	1000H	0010H
Model Q64TD, Q64RD Thermocouple Input Module (Function version B)	2000H	0000H
Model Q64TD, Q64TDV-GH, Q64RD(-G) Thermocouple Input Module (Function version C)	8000H	
Model QD51 (-R24) Intelligent Communication module	10000H	
Model QD60P8-G Channel Isolated Pulse Input Module	2000H	
Model QD62, QD62E, QD62D High speed counter module	3CH	
Model QD70P4/P8, QD70D4/D8 Positioning module	5000H	
Model QD75P1/P2/P4, QD75D1/D2/D4, QD75M1/M2/M4 Positioning module	10000H	
Model QJ61BT11(N)CC-Link System Master/Local Module	10000H	
Model QJ71C24N (-R2/R4), QJ71C24 (-R2) Serial Communication Module	10000H	
Model QJ71DN91 DeviceNet Master-Slave Module	10000H	
Model QJ71E71-100/-B5/-B2 Ethernet interface module	10000H	
Model QJ71FL71-T/-B5/-B2 -F01 FL-net (OPCN-2) Interface Module	10000H	
Model QJ71PB92D PROFIBUS-DP Interface module	10000H	
Model AD61 (S1) High-speed Counter Module	80H	
Model A616AD Analog-Digital Conversion Module	10H	
Model A616DAI/DAV Digital-Analogue Conversion Module	10H	
Model A616TD Temperature-Digital Conversion Module	10H	
Model A62DA(S1) Digital-Analogue Conversion Module	10H	
Model A68AD(S2) Analog-Digital Conversion Module	80H	
Model A68ADN Analog-Digital Conversion Module	80H	
Model A68DAV/DAI Digital-Analogue Conversion Module	10H	
Model A68RD3/4 Temperature-Digital Conversion Module	10H	
Model A84AD Analog-Digital Conversion Module	10H	0001H
Model A81CPU PID Control Module	200H	0000H
Model A61LS Position Detection Module	80H	
Model A62LS (S5) Position Detection Module	80H	0001H
Model AJ71PT32 (S3) /AJ71T32-S3 MELSECNET/MINI (-S3) Master Module	20H	0000H
Model AJ61BT11 CC-Link System Master/Local Module	2000H	
Model AJ71C22 (S1) Multidrop Link Module	1000H	
Model AJ71C24 (S3/S6/S8) Computer Link Module	1000H	
Model AJ71UC24 Computer Link Module	400H	
Model AD51 (S3) Intelligent Communication Module	800H	0001H
Model AD51H (S3) Intelligent Communication Module	800H	

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Module model name	Buffer memory starting address (Hexadecimal)	Module number when loaded in slot 0
Model AJ71C21 (S1) Terminal Interface Module	400H	0000H
Model AJ71B62 B/NET Interface Module	20H	
Model AJ71P41 SUMINET Interface Module	400H	
Model AJ71E71 (S3) Ethernet Interface Module	400H	
Model AD51FD (S3) External Problem Diagnostic Module	280H	0001H
Model AD57G (S3) Graphic Controller Module	280H	
Model AS25VS Vision Sensor Module	100H	
Model AS50VS Vision Sensor Module	100H	
Model AS50VS - GN Vision Sensor Module	80H	
Model AD59 (S1) Memory Card Interface Module	1800H (*1)	0000H
Model AD70 (D) (S2) Positioning Module	80H	
Model AD71 (S1/S2/S7) Positioning Module	200H	
Model AD72 Positioning Module	200H	0001H
Model AD75P1/P2/P3 (S3)/AD75M1/M2/M3 Positioning Module	800H	0000H
Model AJ61QBT11 CC-Link System Master/Local Module	2000H	
Model AJ71QC24(N) (R2, R4) Serial Communication Module	4000H	
Model AJ71QE71 (B5) Ethernet Interface Module	4000H	
Model A1SD61/A1SD62 (E/D) High-Speed Counter Module	10H	
Model A1S62DA Digital-Analog Conversion Module	10H	
Model A1S62RD3/4 Temperature-Digital Conversion Module	10H	
Model A1S64AD Analog-Digital Conversion Module	10H	
Model A1SJ71 (U) C24-R2 Computer Link Module	400H	
Model A1SJ71 (U) C24-PRF Computer Link Module	400H	
Model A1SJ71 (U) C24-R4 Computer Link Module	400H	
Model A1SJ71E71 (S3) Ethernet Interface Module	400H	
Model A1SD70 Single Axis Positioning Module	80H	
Model A1SD71-S2/S7 Positioning Module	200H	0001H
Model A1SD75P1/P2/P3 (S3)/A1SD75M1/M2/M3 Positioning Module	800H	0000H
Model A1S63ADA Analog I/O module	10H	
Model A1S64TCTT (BW)-S1 Temperature Controller Module	20H	
Model A1S64TCRT (BW)-S1 Temperature Controller Module	20H	
Model A1S62TCTT (BW)-S2 Temperature Controller Module	20H	
Model A1S62TCRT (BW)-S2 Temperature Controller Module	20H	
Model A1SJ71PT32-S3 MELSECNET/MINI-S3 Master Module	20H	
Model A1SJ61BT11 CC-Link System Master/Local Module	2000H	
Model A1SJ71QC24(N) (R2) Serial Communication Module	4000H	
Model A1SJ71QE71-B2/B5 Ethernet Interface Module	4000H	
Model A1SJ61QBT11 CC-Link System Master/Local Module	2000H	

*1 Changing the memory card bank using the I/O signals Y10 and Y11 between the PLC CPU and the AD59 (S1) makes it possible to read/write from the memory card access memory area only.

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WARRANTY

Please confirm the following product warranty details before starting use.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.
However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place.
Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

(2) Even within the gratis warranty term, repairs shall be charged for in the following cases.

1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
2. Failure caused by unapproved modifications, etc., to the product by the user.
3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. Onerous repair term after discontinuation of production

(1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.

(2) Product supply (including repair parts) is not available after production is discontinued.

3. Overseas service

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

4. Exclusion of chance loss and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation of damages caused by any cause found not to be the responsibility of Mitsubishi, loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products, special damages and secondary damages whether foreseeable or not , compensation for accidents, and compensation for damages to products other than Mitsubishi products, replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Changes in product specifications

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

6. Product application

(1) In using the Mitsubishi MELSEC programmable logic controller, the usage conditions shall be that the application will not lead to a major accident even if any problem or fault should occur in the programmable logic controller device, and that backup and fail-safe functions are systematically provided outside of the device for any problem or fault.

(2) The Mitsubishi programmable logic controller has been designed and manufactured for applications in general industries, etc. Thus, applications in which the public could be affected such as in nuclear power plants and other power plants operated by respective power companies, and applications in which a special quality assurance system is required, such as for Railway companies or Public service purposes shall be excluded from the programmable logic controller applications.
In addition, applications in which human life or property that could be greatly affected, such as in aircraft, medical applications, incineration and fuel devices, manned transportation, equipment for recreation and amusement, and safety devices, shall also be excluded from the programmable logic controller range of applications.
However, in certain cases, some applications may be possible, providing the user consults their local Mitsubishi representative outlining the special requirements of the project, and providing that all parties concerned agree to the special circumstances, solely at the users discretion.

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