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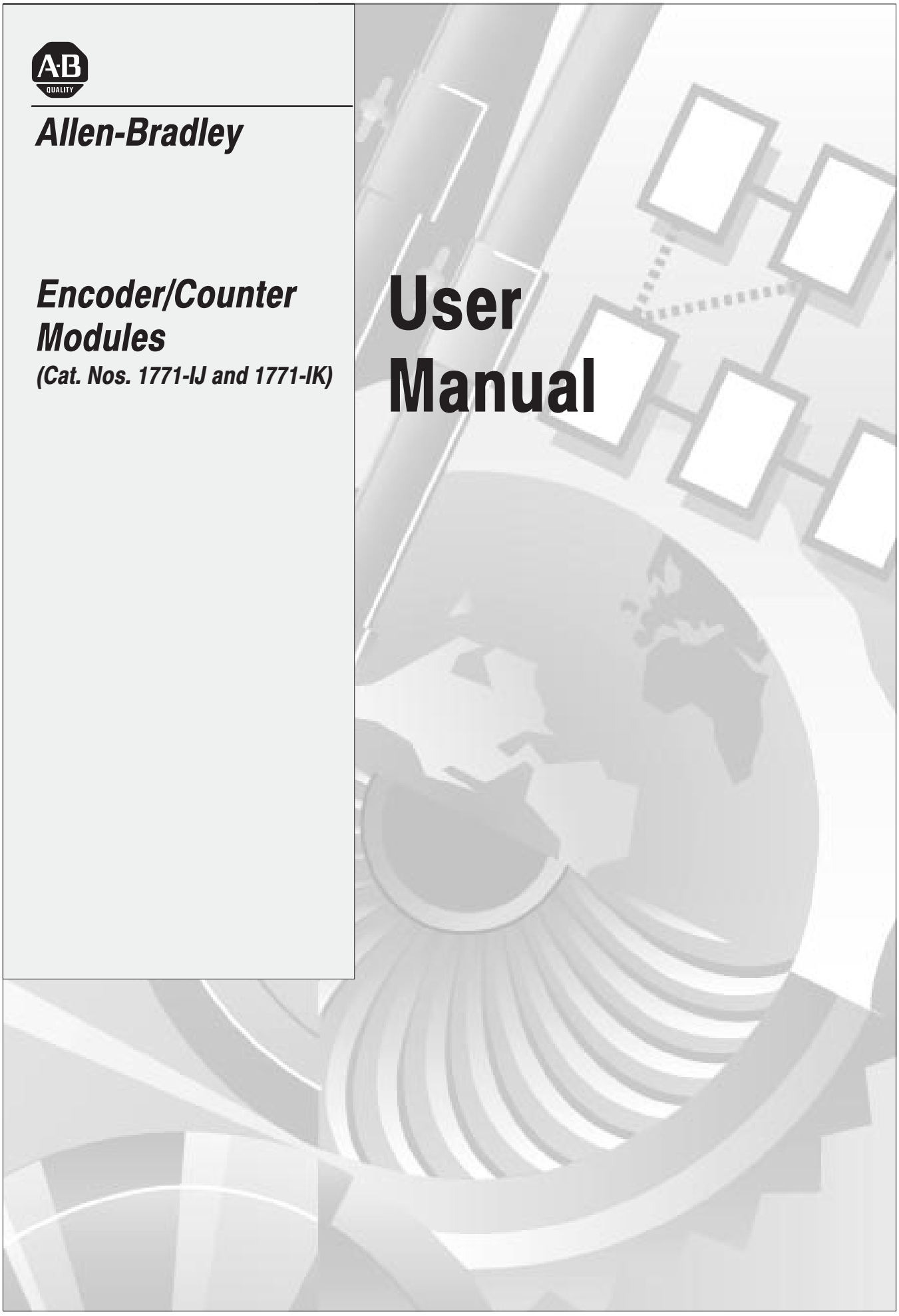
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Allen-Bradley

Encoder/Counter Modules

(Cat. Nos. 1771-IJ and 1771-IK)

User Manual

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Using This Manual

Preface Objectives

Read this preface to familiarize yourself with this manual and to learn how to use it properly and efficiently.

Audience

We assume that you have previously used an Allen-Bradley programmable controller, that you are familiar with its features, and that you are familiar with the terminology we use. If not, read the user manual for your processor before reading this manual.

Vocabulary

In this manual, we refer to:

- the individual encoder counter module as the "module."
- the programmable controller as the "controller" or the "processor."

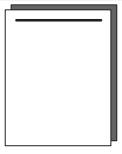
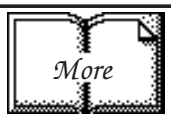
What This Manual Contains

The contents of this manual are as follows:

Chapter	Title	What's Covered
1	Introduction	General overview of the modules
2	Preliminary Adjustments	Setting the switches and understanding the operation
3	Installation	How to install the modules
4	Module/Processor Communication	How the module communicates with the processor
5	Single Transfer Programming	How to transfer information with single transfer programming
6	Block Transfer Programming	How to transfer information with block transfer programming
7	Special Programming	Special programs to extend the count beyond 999
Appendix		
A	Specifications	Module specifications

Conventions

We use these conventions in this manual:

In this manual, we show:	Like this:
that there is more information about a topic in another chapter in this manual	
that there is more information about the topic in another manual	

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Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of these products must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards. In no event will Rockwell Automation be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

Any illustrations, charts, sample programs, and layout examples shown in this publication are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen–Bradley publication SGI–1.1, Safety Guidelines for Application, Installation, and Maintenance of Solid–State Control (available from your local Rockwell Automation office), describes some important differences between solid–state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication. Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of Rockwell Automation, is prohibited.

Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard. avoid a potential hazard, and recognize the consequences of a potential hazard.

WARNING



Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION



Identifies information about practices or circumstances that may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

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Summary

This preface gave you information on how to use this manual efficiently.

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Introduction

General

This publication describes installation, adjustments and the programming necessary for communication between the Encoder/Counter Module (cat. no. 1771-IJ,-IK) and a programmable controller processor. The programming techniques given here enable the processor to direct the operation of the encoder/counter module and to monitor its status.

The encoder/counter module can be used with any Allen-Bradley processor that uses the 1771 I/O structure.

Depending on the intended use of the encoder/counter module, two different programming methods can be used. These methods are:

- Single transfer programming

  Use single transfer only if the module is in a local I/O chassis and generally when not using preset words. (If using preset words with single transfer, you must use multiplexing as described in section titled Multiplexing in Chapter 5). If using single transfer, disregard chapter 6 on block transfer.
- Block transfer programming

  Use block transfer any time. If using block transfer, disregard chapter 5 on single transfer.

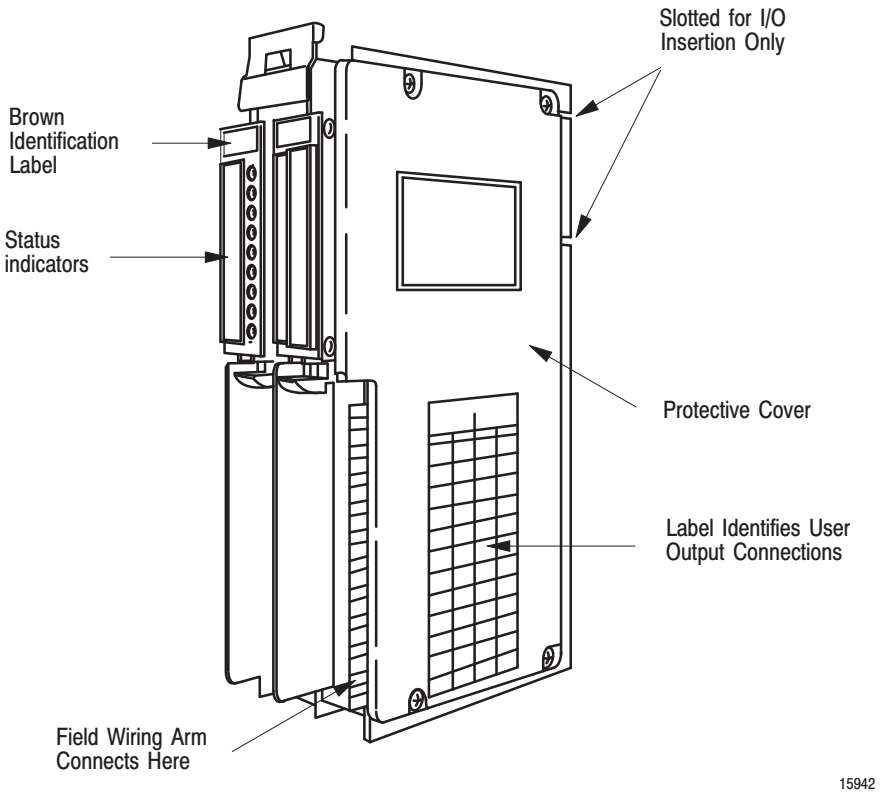
General Description

The encoder/counter module maintains a count, independent of the processor, of input pulses that typically originate from such devices as quadrature type encoders, high speed optical beam counters, and certain types of switches. The module (Figure 1.1) is capable of making decisions based on the count total by comparing it to previously programmed values and activating either one or both of its outputs based on the results of the comparison. The module can also return the accumulated count to the processor for arithmetic computations or display.

The module also provides inputs for a marker signal from an encoder and a voltage level signal from a limit switch to allow for home positioning. In the count mode, the direction of the count can be changed either from the processor or, for speed critical application, at the module itself through an external switch. The maximum detectable input pulse frequency of the module is 50kHz.

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Figure 1.1
Encoder Counter Module (cat. no. 1771-IJ/IK)



The module will count in either BCD or binary numbers. In the BCD mode, the range is 000 to 999 with carry and borrow bits provided to cascade counters in the program. The binary mode allows a higher count total, with a range of 0000 to 4095_{10}, but the number appears at the processor in binary. Additionally, the module can improve the accuracy of certain quadrature type of encoders by adding the count at both channel A and channel B (times 2 mode), or by counting the rising and falling of both channel inputs to give a fourfold increase in the count (times 4 mode).

The encoder/counter module is available in two versions:

- cat. no. 1771-IJ - uses a 5V dc external power supply that allows inputs to be TTL compatible. Outputs can either be driven from the 5V dc supply through the module or from a separate load supply of a different voltage.
- cat. no. 1771-IK - uses a 12-24V dc external power supply. Input devices should be compatible with the voltage of the external power supply. Outputs can be driven either from the external supply through the module or from a separate load supply.

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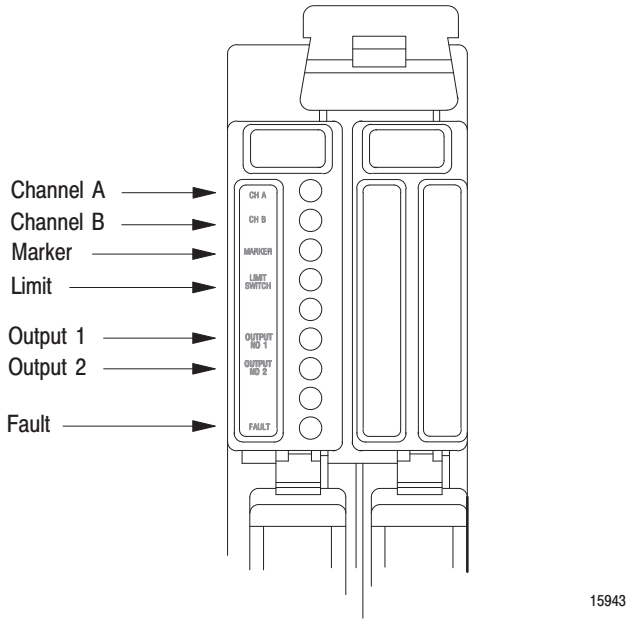
The encoder/counter module is shipped with two 12 terminal gold-plated Field Wiring Arms (cat. no. 1771-WB).

Unless otherwise noted, this manual refers to both versions of the module.

Status Indicators

There are seven status indicators (Figure 1.2) on the front of the left half of the module. The four indicators, corresponding to channel A, channel B, marker, and switch inputs, illuminate when their respective input signals are high. The next two indicators show the state of the outputs. An output indicator is on when the output circuit is activated. The bottom indicator illuminates when the module detects a fault.

Figure 1.2
Red LED Status Indicators



When system power is turned on, the module runs a self-test. During power-up, it is normal for the fault indicator to flash on momentarily. If the FAULT LED does not turn off, the module has detected a fault. The self-test includes checks to make sure that all counters and registers have been reset to zero and memory is cleared. If a breakdown of communication occurs during block transfer, the FAULT LED will also light. Bit 14, the diagnostic bit in the input status word, is also set anytime the FAULT LED is on.

After power-up, the module will stay in its reset state (outputs disabled and counter held reset) until the necessary control bits are set in the program.

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System Power

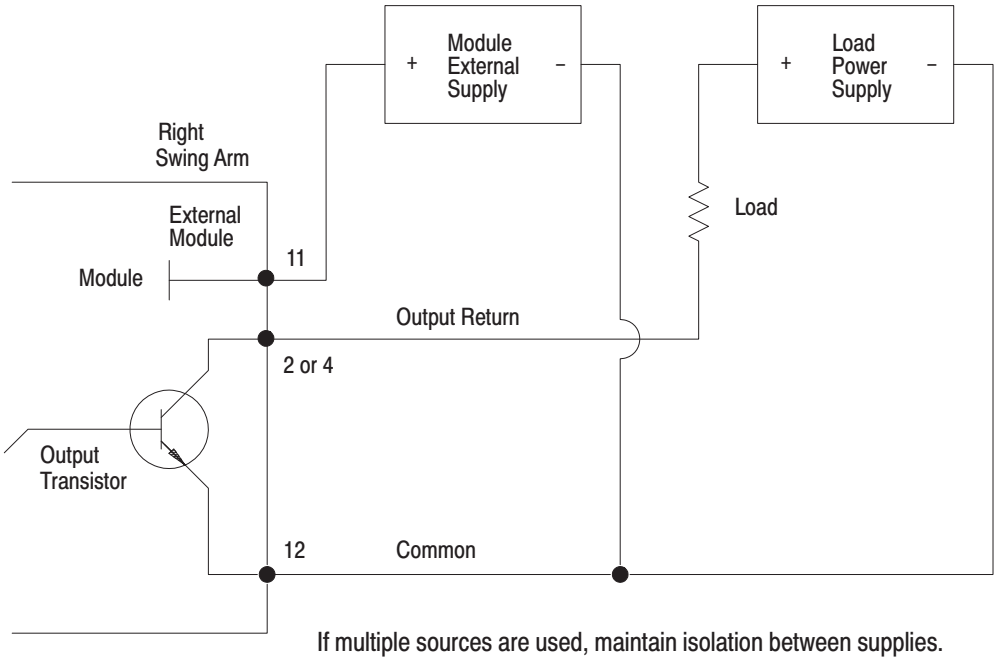
System power is supplied through the I/O chassis backplane from the 5V dc chassis power supply. The module requires a current of 1.4A. The sum of the current requirements of all modules in the chassis must not exceed the power supply or backplane rating.

External Power

The module requires an external power supply connected to the field wiring arm. For the 1771-IJ, the supply must be able to deliver 140mA at 5V dc ±0.25V with less than 50mV ripple, peak-to-peak. The 1771-IK requires 110mA at 12V dc or 200mA at 24V dc, with less than 50mV ripple, peak-to-peak. These requirements are for the module only. The current requirements of all output devices, if they are to be driven directly from the module, must be added to the requirements of the module.

It is also possible to drive output devices from a separate load supply, using the output on the module only as a switch. When the output is on and conducting, a maximum of 0.5V dc is dropped across it. The load supply voltage should not exceed 30V dc. Refer to Figure 1.3 for the necessary modifications to the wiring diagram.

Figure 1.3
Modification of Output Circuit for Application of Separate Load Power Supply



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The power for the input device can be provided by the module's external power supply, but, unlike the power for the output device, this is not available through the module. If a high degree of isolation is needed, use a separate input power supply. If a limit switch is used, the limit switch input is configured to accept an "on" voltage of 12 to 48V dc, requiring a maximum of 10mA at 48V dc.

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Preliminary Adjustments

General

The module has programming options (Table 2.A) that are selected by setting the five switches on the programming option switch assembly (SW-1). These options include the choices between encoder and counter operation, block transfer or single transfer, BCD or binary data formats and count resolution in the encoder mode.

Table 2.A
Programming Option Switch Assembly SW-1

	1	2, 3	4	5
On	Single Transfer	See Table 2.B Multiplier for Count Resolution	Encoder Mode	Binary
Off	Block Transfer		Counter Mode	BCD

Block Transfer/Single Transfer

Block transfer/single transfer (switch 1) - Use single transfer programming only when the module is in a local I/O chassis. This type of programming shifts a single word of data each program scan from the processor's data table to the module. It therefore takes three program scans to send a new control word and the two preset values to the module. However, once new data has been sent to the module, it will remain active until another transfer updates it.

The input status word will always appear at the proper address location in the input image table. To use single transfer programming, switch 1 must be set to single transfer (on).

Block transfer moves all three data words from the processor to the module in a single scan. Since the module has bidirectional block transfer, the processor must also be programmed to read for block transfer, or the data table will not display the status word. To use block transfer, switch 1 must be set for block transfer (off).

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Count Resolution

Count resolution (switches 2 and 3) - In the encoder mode, the accuracy of a quadrature type encoder can be improved by allowing the module to count the pulse trains at both channel inputs. This doubles the number of pulses counted for the same degree of rotation at the encoder. A further improvement can be made by letting the module count the leading and trailing edges of both pulse trains, thereby counting four times (times 4) for the same degree of rotation. Certain applications may need the actual count and module should be set for times 1 (the pulse is counted on its rising edge as high true). The count resolution setting affects the total count kept at the module and as it is sent back in the status word. Programming manipulations of the status word and the preset values must account for the multipliers. The count resolution setting may also be limited by the program scan time if the carry or borrow bits are used to cascade counters.

Note: In the counter mode, the count resolution setting (Table 2.B) has no effect on the count.

Table 2.B
Count Resolution Settings

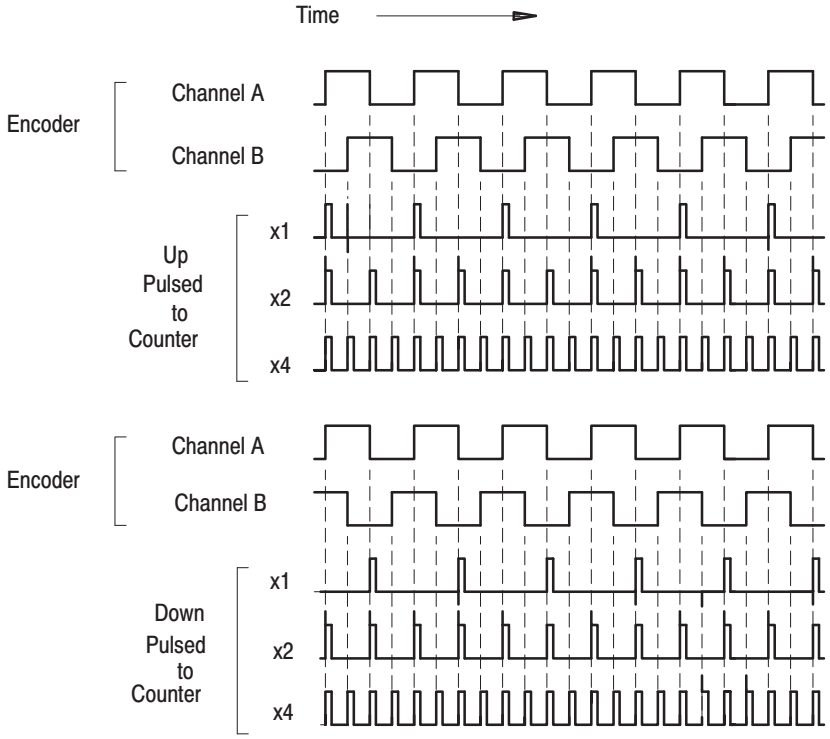
Multiplier	Switch 2	Switch 3
Times 1	On	On
Times 2	On	Off
Times 4	Off	Off

Encoder Counter Selection

Encoder/counter selection (switch 4) - In the encoder mode, the module counts the number of input pulses entering on channel A from a quadrature type encoder. By comparing the phase relationship between input pulses on channel A and pulses appearing at channel B, it knows whether to add or subtract the incoming count from the total (that is, whether to count up or down). The phasing (Figure 2.1) between the channels is determined by the direction in which the encoder is turned. To use the module in the encoder mode, switch 4 must be set to encoder (on).

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Figure 2.1
Input Pulses



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In the counter mode, the module adds the incoming pulses on channel A. The count is incremented on the rising edge of the pulse (high true). The direction of the count can be controlled with either the control word or an external switch wired to channel B. Channel B must be left unconnected if the count direction is to be software controlled. Typical input device counting might be high speed static switches and incremental encoders. Mechanical switches are not recommended as input counting devices used with the 1771-IJ because the contact bounces might be counted as pulses. However, the 1771-IK can be used with a mechanical switch, provided the module is configured for mechanical counting (filter has been put in) and the counting frequency does not exceed 50Hz. To use the module in the counter mode, switch 4 must be set to counter (off).

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Binary/BCD Data Format

Binary/BCD data format (switch 5) - The preset values and the accumulated total in the status word have the option of appearing in either BCD or binary formats. If the BCD format is selected, the processor can directly manipulate these values in comparisons or arithmetic functions but the accumulated value is limited to a count between 000 and 999. The binary option allows an increased range of 0000 to 4095_{10}. With some processors, the programming must reconstruct a BCD number from the binary value. To select binary mode, set switch 5 on. To select BCD mode, set switch 5 off.

Because different types of input devices are compatible with different voltage ranges, the 1771-IJ (5V dc) and 1771-IK (12-24V dc) input channels are configured differently.

1771-IJ

Because the 1771-IJ module is designed to work with 5V TTL type devices, each input channel and the marker input can be set for single ended or differential line inputs (Table 2.C). The input device should be capable of providing 16mA of sink current. The module detects a voltage of 2.4V dc or above at either channel as logic “1” or true. A voltage below 0.6V dc is considered as logic “0” or false.

Table 2.C
Input Configuration Switch Assembly 1771-IJ SW-2

	1	2	3
	Marker	**Chan. B**	**Chan. A**
On	Single ended	Single ended	Single ended
Off	Differential	Differential	Differential

The marker input registers as true when the input pulse from the encoder is high.

The limit switch input senses a voltage of greater than 10 volts dc as logic “1” (on), and less than 5 volts dc as logic “0” (off). The input voltage that appears through the switch should be from a 12 to 48V dc external supply capable of supplying 10mA of source current at 48V dc. The limit switch input has a signal delay of 16ms ($\pm$7ms) because of the filtering needed to protect against contact bounce.

The channel B input can be used in the counter mode to select count direction. If the channel B input terminal is not connected, the control word in the output program selects the direction of the count. For external hardware control, the count direction bit in the control word must be set to count up.

Then if channel B is allowed to float high or is driven high, the module counts up; if it is pulled low, either through a gate or a transistor switch, it will count down.

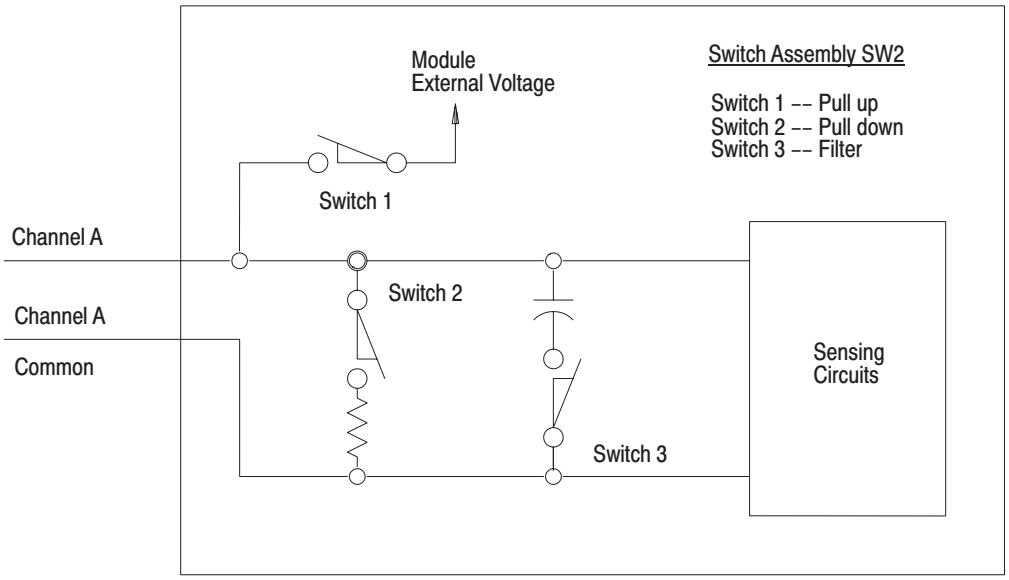
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No special filtering is provided on channel B, since the filtering necessary for a mechanical switch would defeat the purpose of a very fast count direction change that is not dependent on the processor scan time. Therefore, a transistor switch or gate should be used to pull the channel B input low. The gate or switch must sink 14ma of current to pull the channel B input low. The count changes direction in less than 0.01ms from the time channel B input changes state.

1771-IK

The 1771-IK module is designed to accept several types of devices that will operate in the 12 to 24V dc range (Figure 2.2). Since most high voltage quadrature encoder outputs produce signals through an open collector output, the module is configured for a pull-up on channel B. Channel A must be set for a pull-up by setting switch 1 on and switch 2 off. Some counting devices may also use a pull-up arrangement.

Figure 2.2
Input Configuration for Channel A of the 1771-IK Showing Functions of Switch Assembly SW-2



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The settings on the input configuration switch assembly SW-2 are not the same on the 1771-IJ as they are for 1771-IK. Refer to Table 2.D for switch settings.

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Table 2.D
Input Configuration Switch Assembly (1771-IK) SW-2

	Switch 1	Switch 2	Switch 3
On	Pull-up	Pull-down	Filter in (50 Hz)
Off	Float	Float	Filter out (50K Hz)

Certain counting devices may need an input designed to pull current down through the device. Switch 2 should be set on for pull-down and switch 1 left off. The module detects a minimum of 7.2V dc at its input channels as true for a 12V dc external supply and 14.4V dc at 24V dc external supply. A signal with a maximum voltage of 4.8V dc is considered false for a 12V dc supply and 9.6V dc is false for a 24V dc supply. Each input channel sinks 10mA at 12V dc and 20mA at 24V dc.

If it is necessary to debounce a contact type of device, such as a switch, the filter can be added across the inputs by setting switch 3 on. By adding the filter to the circuit, the maximum counting frequency the module will detect is 50Hz.

Channel B input and the marker input are for open collector encoder drivers (the channel B input has an internal pull-up) and are not switch selectable. The marker input reads a signal as high true.

The limit switch input senses a voltage of greater than 10 volts dc as a logic “1” (on), and less than 5 volts dc as a logic “0” (off). The input voltage that appears through the switch should be from a 12 to 48V dc external supply that is capable of supplying 10mA of source current at 48V dc. The limit switch input has a signal delay of 16 ms ($\pm$7ms) because of the filtering needed to protect against contact bounce.

The channel B input can be used in the counter mode to select count direction. If the channel B input terminal is not connected, the control word in the output program selects the direction of the count. For external hardware control, the count direction bit in the control word must be set to count up.

Then if channel B is allowed to float high or is driven high, the module counts up; if it is pulled low, either through a gate or a transistor switch, it will count down. Any gate or switch should be compatible with the external voltage supply (12 to 24V dc).

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No special filtering is provided on channel B, since the filtering necessary for a mechanical switch would defeat the purpose of a very fast count direction change that is not dependent on the processor scan time. Therefore, a transistor switch or gate should be used to pull the channel B input low, sinking 10mA at 12V dc or 20mA at 24V dc. The count changes direction in less than 10 microseconds from the time channel B input changes state.

Refer to the connection diagrams (Figures 3.1 and 3.2) for interfacing different devices.

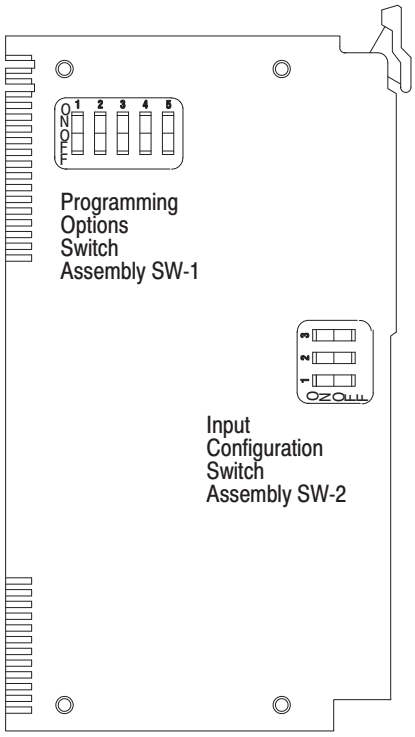
Setting Switch Assemblies

Switch assembly settings-these features are selected on two switch assemblies that are located on the circuit board underneath the component cover.

To select these options, proceed as follows:

1. Take off the left-side cover by removing the four slotted screws.
2. Refer to Figure 2.3. Identify the programming option switch assembly (SW-1) and the input configuration switch assembly (SW-2).

Figure 2.4
Location of Switch Assemblies



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3. Set the switches of SW-1 (Table 2.E) according to the desired programming options. The settings for the count resolution switches (times 1, 2, or 4) do not matter if the counter mode has been selected. The tip of a ball point pen can be used to set the rocker arm of a switch. Do not use a pencil because the point can break off and jam the switch.
4. Set the three switches of SW-2 (Table 2.E) according to the input configurations that have been chosen.
5. Replace the component cover and tighten the screws.

Table 2.E
Programming Option Switch Assembly SW-1

	1	2, 3	4	5
On	Single Transfer	See Table 2.B Multiplier for Count Resolution	Encoder Mode	Binary
Off	Block Transfer		Counter Mode	BCD

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Installation

Environment and Enclosure

ATTENTION



Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664–1), at altitudes up to 2000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as “open type” equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present, and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosures. Also, see the appropriate sections in this publication, as well as the Allen–Bradley publication 1770–4.1, (“Industrial Automation Wiring and Grounding Guidelines”), for additional installation requirements pertaining to this equipment.

The 1771-IJ and 1771-IK are modular components of the 1771 I/O system and require a properly installed system chassis. Refer to publication 1771–IN075 for detailed information on acceptable chassis and proper installation and grounding requirements.

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ATTENTION



Preventing Electrostatic Discharge
This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- If available, use a static–safe workstation.
- When not in use, keep modules in appropriate static–safe packaging.

Module Placement

The module may be placed in any 1771 I/O chassis. However, the module must only be inserted in a single module group; it cannot straddle two groups. To minimize noise, group low voltage input modules together within a single I/O chassis whenever possible.

WARNING



Remove power from the I/O chassis backplane and wiring arm before removing or installing a module.

- Failure to remove power from the backplane could cause unexpected machine operation with possible damage to equipment or injury to personnel. It could also damage the module or degrade performance.
- Failure to remove power from the wiring arm could damage the module or degrade performance.

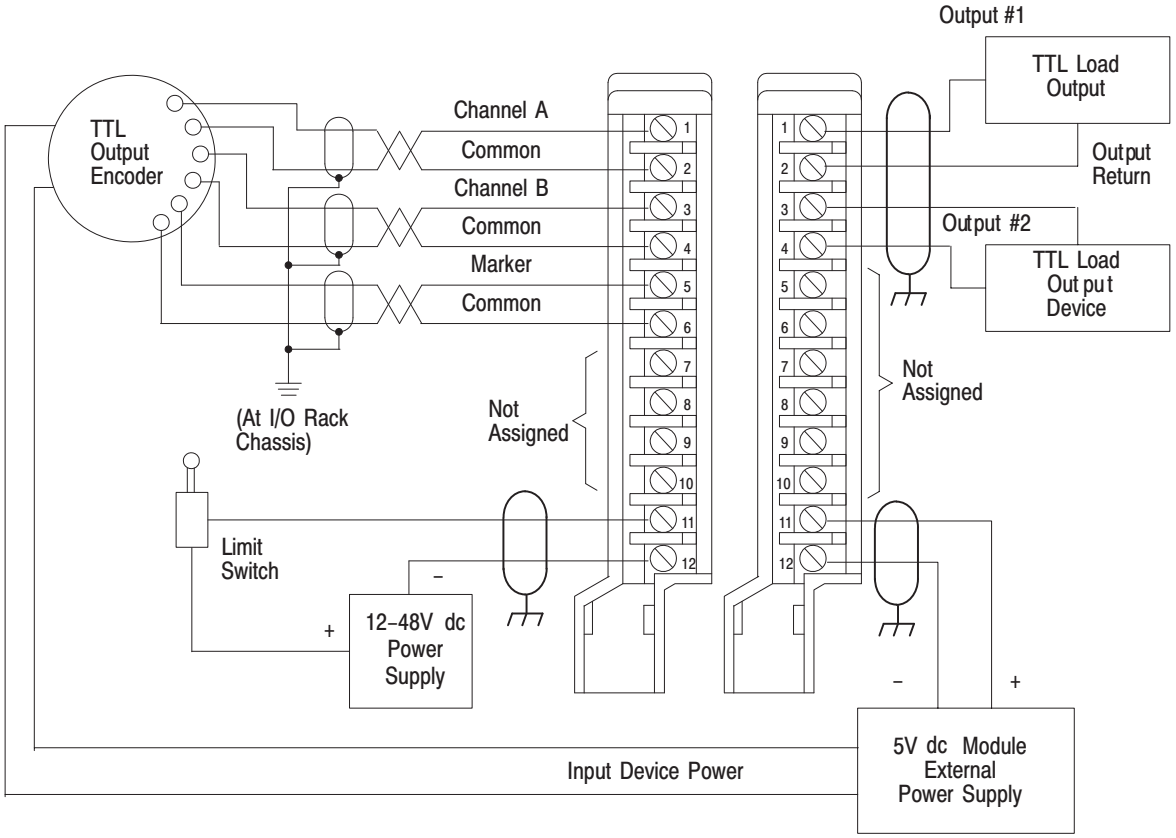
Recommended Cable

Use the proper cable to connect the input devices to the module field wiring arm. Follow the appropriate connection diagram (Figure 3.1 and Figure 3.2). Input devices cannot be more than 40 cable feet from the module.

Use Belden 8761 cable for pulse counter applications with a signal below 20K Hz; use Belden 9182 cable for frequencies up to 50k Hz. Use Belden 8725 cabe (4-twisted pair cable) for encoder applications below 20k Hz.

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Figure 3.1
Connection Diagram Showing Typical 1771-IJ Encoder Application



Note: Use a single external supply as shown here, or use an additional isolated supply as shown on figure 3.2.

Note: The module must be placed in a single module group (0–1).

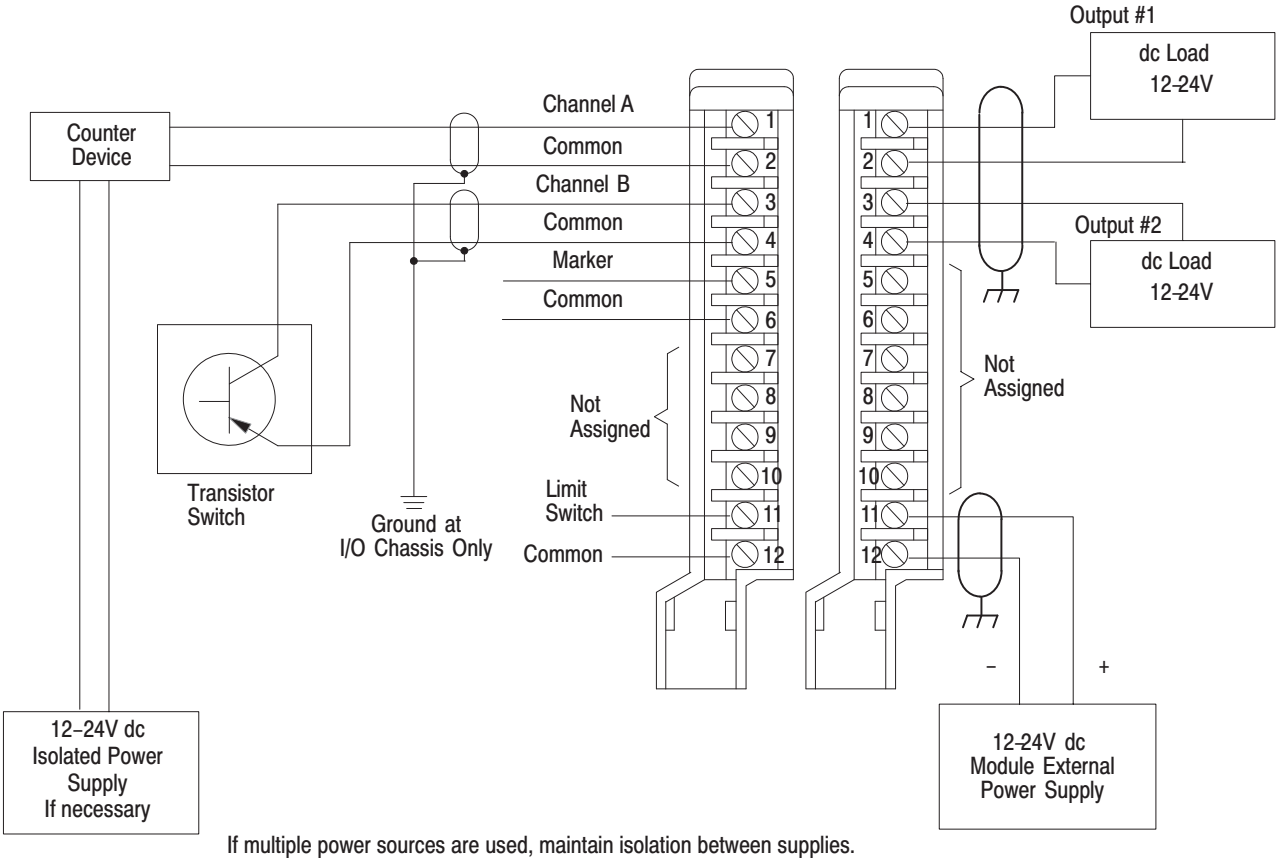
If multiple power sources are used, maintain isolation between supplies.

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If you use the limit switch, you must use shielded cable such as Belden 8761 or 9182 for cabling.

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Figure 3.2
Connection Diagram Showing Typical 1771-IK Counter Applications with External Count Direction



If multiple power sources are used, maintain isolation between supplies.

Note: The module must be placed in a single module group (0–1).

Note: Use isolated external supplies as shown here, or use a single supply as shown on figure 3.1. 15949

Shielded Cable

The cable has a foil shield with a bare drain wire. The drain wire should be connected to the enclosure ground at an I/O chassis mounting bolt or stud. Connect the drain wire at only one end. The foil and drain at the other end of the cable, which connects to the device, should be cut short and taped back to insulate it from any electrical contact.

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Keying

Plastic keying bands provide an easy method for keying an I/O slot to accept only one type of module. Use of keying bands is strongly recommended to prevent accidental insertion of the wrong type of module.

The module is slotted in two places on its rear edge. The position of the keying bands on the backplane connector must correspond to these slots to allow insertion of the module. Because the module uses two slots, both slots have to be keyed. Snap the keying bands on the upper backplane connectors between these numbers printed on the backplane (Table 3.A). Keying is different for the 1771-IJ and the 1771-IK.

Table 3.A
Module Keying

Module	Left Connector	Right Connector
1771-IJ	6 and 8 18 and 20	4 and 6 32 and 34
1771-IK	6 and 8 20 and 22	4 and 6 32 and 34

IMPORTANT Insert the module in a single module group (slots 0 and 1). It must not straddle two module groups.

The position of the these keying bands may be changed if subsequent system design and rewiring makes insertion of a different type of module necessary.

Specifications

Complete specifications for the 1771-IJ and -IK modules are contained in Appendix A.

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Module/Processor Communication

General

Communication between the processor and the encoder/counter module is bidirectional. This means that information is transferred to and from the module: the processor instructs the module to perform specific functions and may provide values to be compared on the module and used for output control; the module transmits its accumulated count and other status information to the processor. Because both input and output data are transmitted between this module and the processor, special programming techniques are used to coordinate and control this bidirectional data transfer.

Complete 16–bit words are transferred between the module and the processor. The processor sends up to 3 words of data to the encoder/counter module:

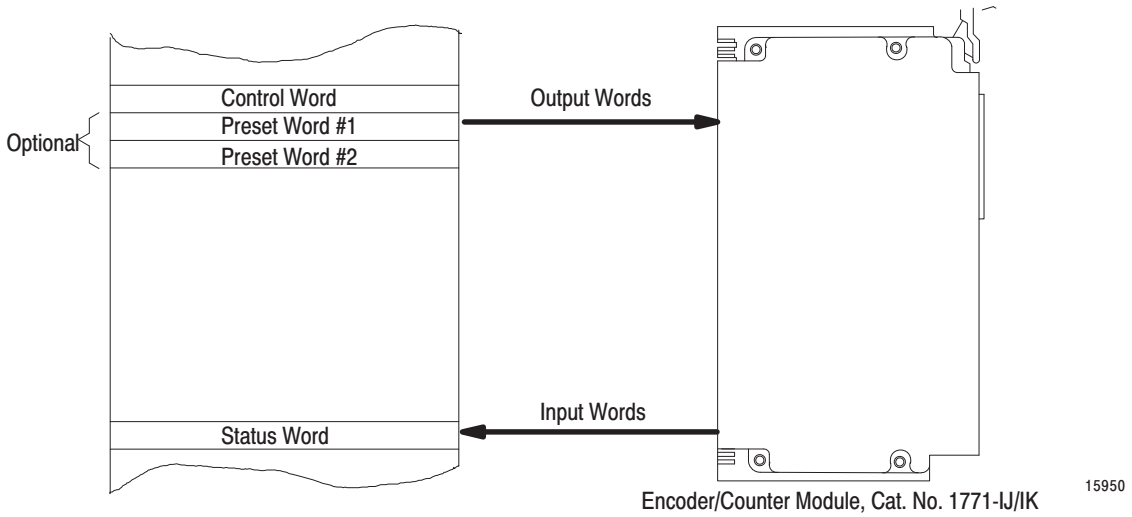
Control word
Preset word #1
Preset word #2

These are termed the output words since they are output with respect to the program.

The encoder/counter module sends a status word to the processor.

Figure 4.1 shows the transfer of output and input words in bidirectional module/processor communication, described in the following paragraphs.

Figure 4.1
Bidirectional Module/Processor Communication



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Outputs Words

The program controls encoder/counter module operation through the output words. These words function as follows:

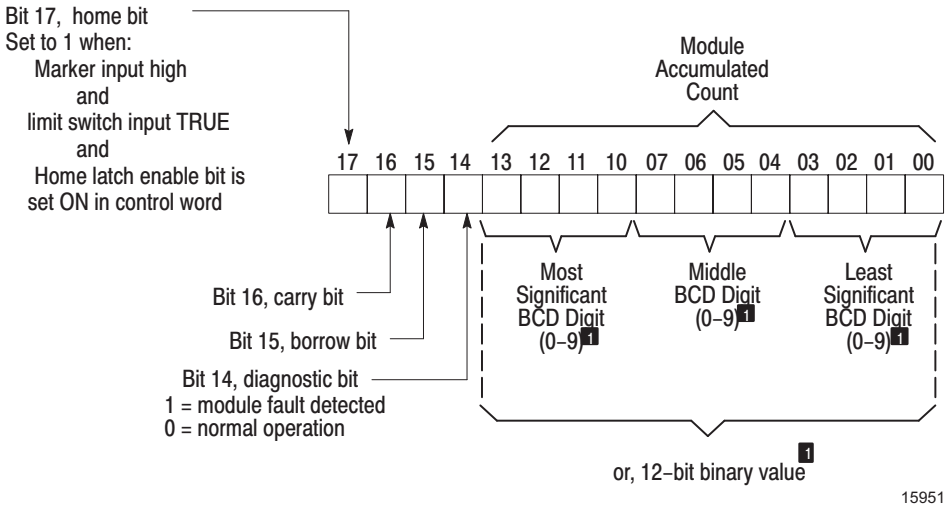
- Control word – the control word, as its name implies, instructs the module on its operation and on control of its own outputs. By setting specific control word bits, you set up the module's initial mode of operation and can subsequently alter module operation as the application requires.
- Preset words #1 and #2 – the optional preset words are values that can be used for comparison by the module. When these words are used, the module controls its own output based on comparison between its accumulated count preset values. You can use these words to direct module control of its own output terminals, independent of the timing of the processor I/O and program scans.

Stored in the data table, these output words are sent to the module as controlled by the program. The storage and transmission of these words to the module differ depending on whether single transfer or block transfer programming is used. In addition, the bit–by–bit significance of these words is dependent on the data transfer method used. For this reason, specific information on the storage and composition of these words is given separately in the following chapters which describe each programming method.

Input Status Word

The input status word is the single input word received from the encoder/counter module. This word has the same format for both block and single transfer programming. The input status word has the format of Figure 4.2.

Figure 4.2
Input Status Word – Single Transfer and Block Transfer



1 Module switch selection dtermines whether bits 00-13 are of binary or BCD format

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Bits 00–13 of this word show the accumulated count kept by the module. This count may be stored either in BCD form, as 000–999 (decimal) or in 12–bit binary form, as a binary value from 0000 0000 0000 to 1111 1111 1111. A switch selection, set during module installation, determines the numerical form in which the accumulated count is stored.

Bits 14–17 of this input word serve as status bits. Bit 14, the diagnostic bit, is set to 1 if the module has detected a fault in its own operation; normally, this bit is 0. Bits 15 and 16 are the carry and borrow bits, respectively. These bits indicate whether the count has overflowed or underflowed.

Bit 17 of the input status word is the home bit. Three conditions are required to set this bit to 1:

- Marker input is high
- Limit switch input is true (high).
- Home latch enable bit is on (1).

The marker and limit switch input devices connect to module input terminals. The home latch enable bit is in the control word, one of the three output words. Note that the home bit, once set to 1, remains 1 until the home latch enable bit is reset to 0.

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Single Transfer Programming

General

Single transfer programming is one method for coordinating and controlling bidirectional module/processor communication. This method can only be used when the module is in a local I/O chassis.

Single transfer may be the recommended method even where block transfer capability is available. Specifically, single transfer programming is suggested whenever preset #1 words and #2 are not used. When one or both preset words are used, block transfer methods may be more efficient, depending on the application.

The material for single transfer programming is organized as follows:

- Section titled **Output Words - Single Transfer** describes the configuration of output words when using single transfer methods.
- Section titled **Single Transfer Description** gives a general description of how single transfer programming works and an example for applications where no preset words are required.
- Section titled **Multiplexing** shows how multiple words of output data are multiplexed in single transfer.
- Section titled **Example Program - Single Transfer** gives a sample program for single transfer programming.

Output Words - Single Transfer

The output control and preset words have a unique configuration when single transfer programming has been selected. Initially, the program must set the bits in these words to the desired combination for the application. Then, using single transfer techniques, the program sends these output words to the module.

Output Control Word

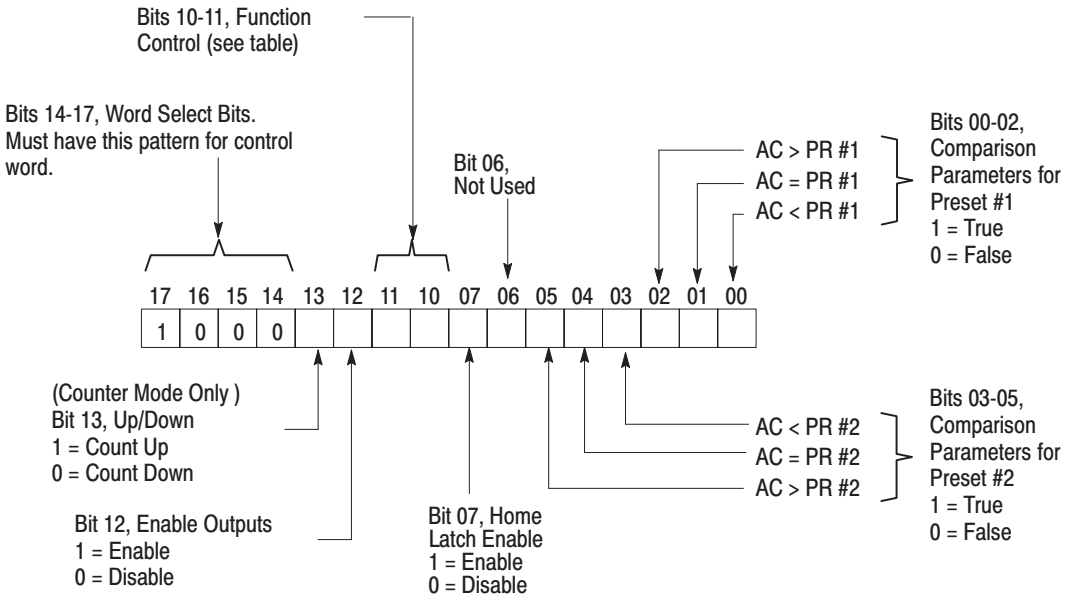
Figure 5.1 shows the configuration of the output control word for single transfer. By setting bits in this word, you set up the initial mode of module operation and change it as required during operation.

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Figure 5.1
Control Word - Single Transfer

Function Control Bits

BIT 11	BIT 10	FUNCTION
0	0	Count
0	1	Reset, and hold the accumulated count at 000.
1	0	Return the accumulated count to 000 and begin counting immediately.
1	1	Invalid, module executes previously programmed function.



Bits 14-17 of this word are word select bits. These bits must have the setting shown in Figure 5.1 to identify the word as the output control word.

Bit 13 of this word is the up/down bit. This bit is significant only when the module is used in the counter mode. The state of this bit controls module function as follows:

1 -The module increments its accumulated count with each count received on channel A.

0 -The module decrements its accumulated count with each received on channel A.

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Note that if a device is wired to channel B for external control of count direction, the up/down bit must be set to 1. Count direction can be externally controlled by using a transistor switch, as described in chapters 2 and 3.

Bit 12 is the enable outputs bit. The state of this bit controls module outputs as follows:

1 -Outputs enabled. This means that the output module can be energized based on logical operations performed by the module.

0 -Outputs disabled. This means that the outputs of the module cannot be energized.

With bit 12 set to 1, the module can energize its output terminals based on a comparison of its accumulated count and preset values set by the program.

Bits 10 and 11 are termed function control bits. These bits control module function in both encoder and counter modes. They permit the counting operation of the module to be enabled or reset by the program. The table in Figure 5.1 shows the bit settings for each function.

Bit 07 is the home latch enable bit.

The module resets the count to zero only when all three of these conditions are true:

- Home latch enable bit (bit 07) is set to 1.
- Marker input is high.
- Home limit switch is closed (limit switch LED is on).

The count remains at zero until one or more of these conditions go false. Then module operation follows the function control bits described in Figure 5.1.

The module indicates it has reset its count to zero by setting the home bit (bit 17 in the input status word). It resets this bit when the home latch enable bit (bit 07) is reset. (Refer to Figure 4.2, Input Status Word).

The system can bring the machine back to a repeatable starting position, and the module count can be reset to zero by toggling either the marker input or home limit switch rather than changing bits 11 and 10 in the control word as long as the three conditions are met.

Carry and borrow bits are not affected by resetting the module count. The home limit switch LED turns on whenever the home limit switch is closed.

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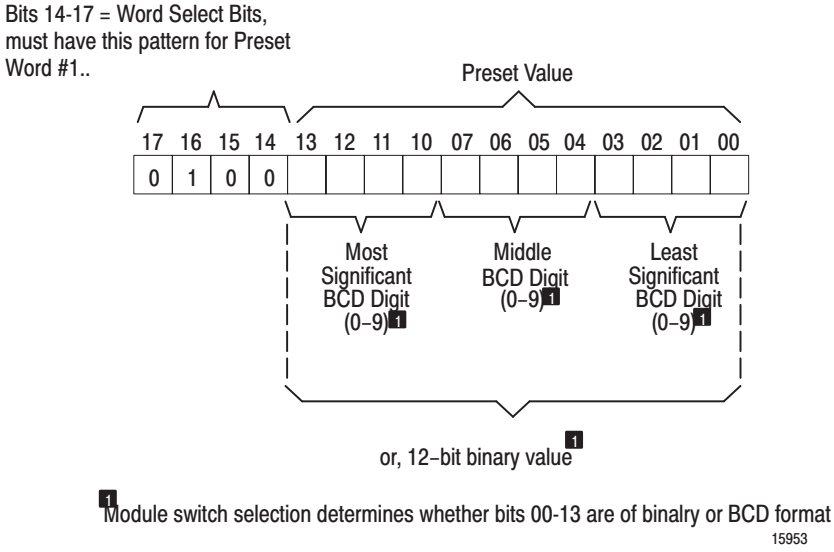
Bits 00-05 are significant only when one or both preset words are used. These bits establish the comparison conditions for module control of its outputs. As Figure 5.1 shows, bits 00-02 set up parameters for comparison with preset word #1; bits 03-05 set up parameters for comparison with preset word #2. The module then controls its output #1 or #2 based on the true or false comparison of its accumulated count with these presets.

When any of these bits is set to 1, the indicated condition is considered by the module as true (that is, as a true condition enabling the module to turn on its output). As Figure 5.1 shows, one bit is used for each comparison parameter: less than, equal to, or greater than. Note that more than one of these bits can be set to 1 for each preset, allowing such combinations as less than or equal to, greater than or equal to, or not equal to.

Preset Words

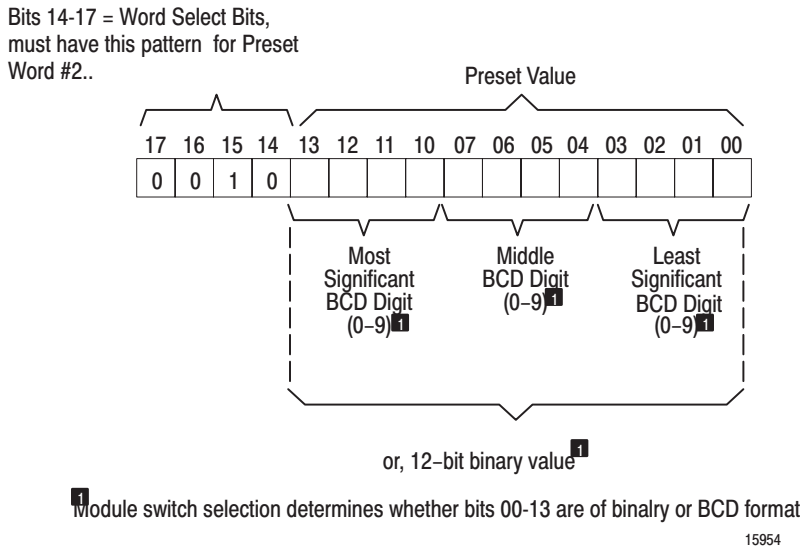
In single transfer communication, the preset words have the format of Figure 5.2 and Figure 5.3. In this format, bits 00-13 store the preset value. When BCD operation has been selected, these bits may represent a 3-digit value from 000-999. When 12-bit binary operation has been selected, the value may range from 0 to 1111 1111 1111 binary (4095 decimal). A module switch selection, made during installation, selects either BCD or binary mode.

Figure 5.2
Preset Word #1 - Single Transfer



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Figure 5.3
Preset Word #2 - Single Transfer



Note that bits 14-17 have a unique coding to identify each preset word.

Note: If BCD operation has been switch selected, only BCD digits should be entered in the data table word output to the module. If non-BCD digits are entered in a preset value, the module sets its default preset value to 000 for the word.

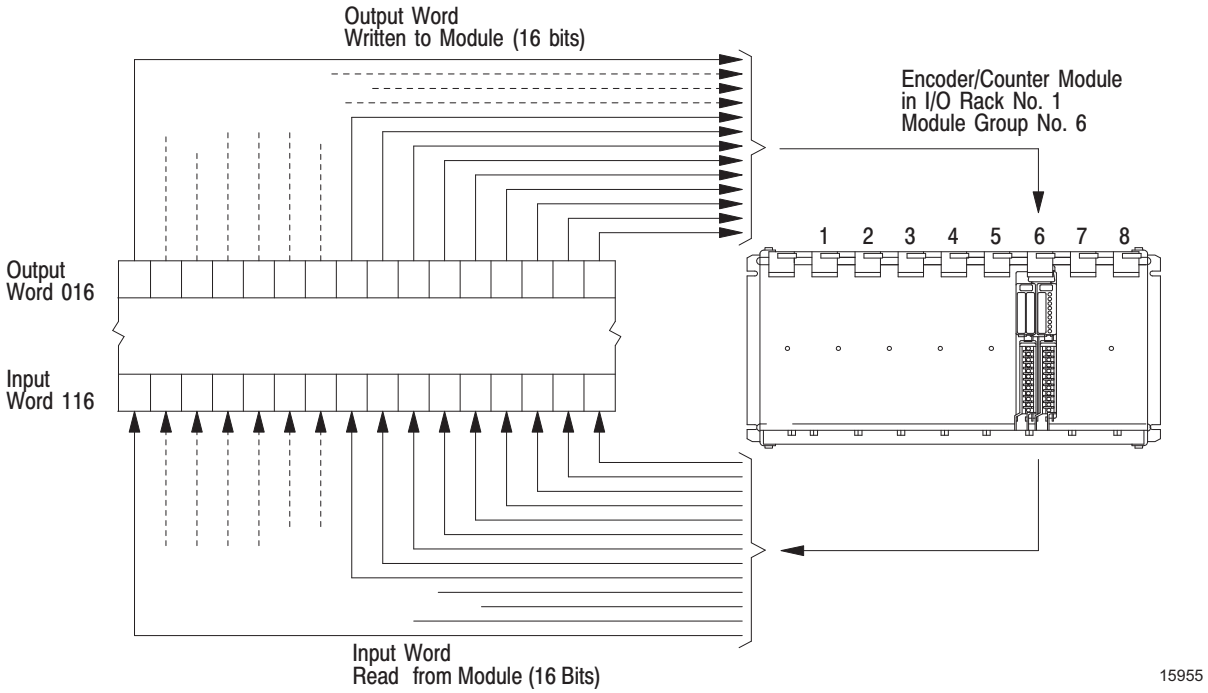
Single Transfer Description

Single transfer programming uses the I/O scan for bidirectional module/processor communication. The I/O scan is an automatic function of the processor during which it performs two operations: it writes output image table data to I/O modules and reads I/O module data into the input image table. The write cycle of the I/O scan must be manipulated by the program for communication with the encoder/counter module. By this manipulation, up to three 16-bit words are sent to the module by using one output image table word. The read cycle of the I/O scan is also used, but is not manipulated by the program since only a single input status word is read from the module.

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Bidirectional single transfer programming, then, requires both an input image table and an output image table word. The addresses of these image table words depend on the location of the I/O module in the chassis. For example, for modules in I/O rack 1, module group 6, the corresponding output image table word is 016; the input image table word is 116. Because the encoder/counter module occupies one module group in the I/O chassis, the processor writes one complete 16-bit output image table word to the module and reads one complete 16-bit input image table word from the module during each I/O scan. Figure 5.4 shows the relationship of module slot placement to image table location in memory.

Figure 5.4
Example Module Position/Image Table Word Relationship



The input image table word, the means for reading data from the module, is updated automatically by the processor each I/O scan. To examine the input status word from the module, the program only needs to examine the word stored at the input image table location corresponding to the placement of the encoder/counter module.

The output image table word, the means for writing data to the module, is sent by the processor automatically, each I/O scan. In applications where only the output control word is used, this word can be stored directly in the output image table location corresponding to the placement of the encoder/count module. Section titled **Example Rungs-No Preset Words Used** shows the type of program needed for this type of communication.

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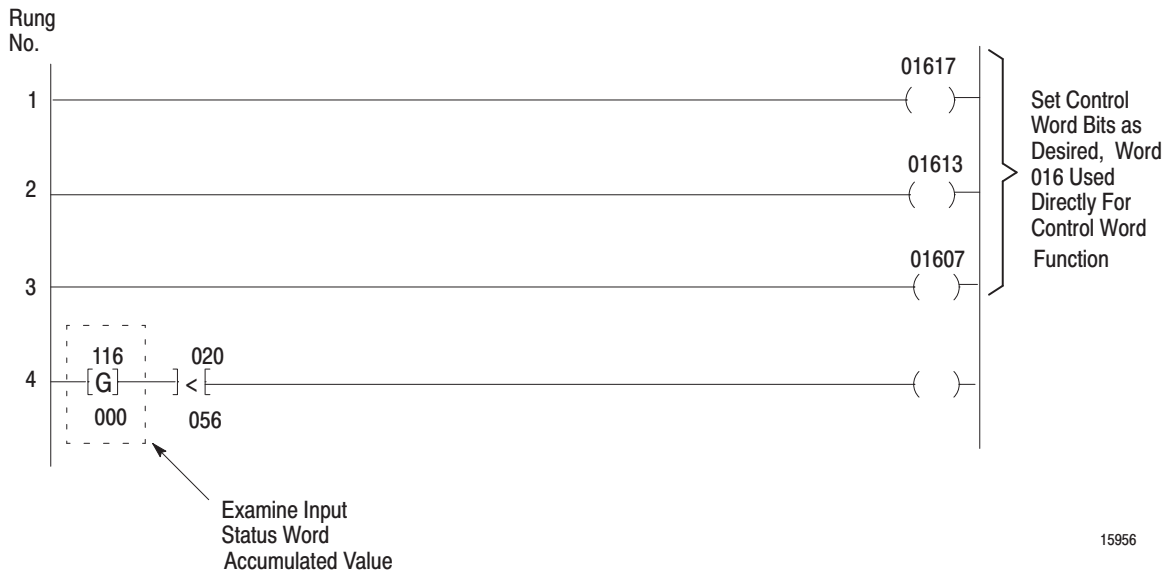
However, in some applications, one or both preset words must be used. Here, the complication involving the output image table word is readily apparent: it must be used to serve multiple purposes; not only will this word send the output control word, it is also needed to send one or both preset words to the module. The use of this word for more than one purpose is termed multiplexing. For multiplexing, program manipulation and coordination of the control of the output image table word are necessary. Sections titled **Multiplexing** and **Example Program - Single Transfer** describe multiplexing for single transfer communication.

Example Rungs - No Preset Words Used

Figure 5.5 illustrates a typical example in which bidirectional single transfer occurs, assuming that no preset words are used. This example assumes the module placement shown in Figure 5.4.

There is no manipulation of intermediate storage words when only the output control word is needed. Thus, in this instance, the bits in the output image table word corresponding to the module are set directly to determine the module's control function. In the example of Figure 5.5, rungs 1-3 turn on various bits in the output word. Bits are 0 unless set to 1 by a program instruction. Here, it is assumed that no other use is made of word 016.

Figure 5.5
Example Rungs - Single Transfer (No Preset Words used)



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Rung 4 shows the input status word examined in the user program. Note that this word is automatically in the input image table when single transfer is selected. The processor automatically updates this word each I/O scan.

In summary, when you are not using preset words, you need only set bits of the output image table word which corresponds to the module. This word then serves as the output control word. However, when using one or both preset words, the output image table word is used for multiple purposes and intermediate storage word addresses must be used for output control and preset word storage. The following sections outline methods for multiplexing the output words in such applications.

Multiplexing

The processor writes a single word - the output image table word - to the encoder/counter module each I/O scan. Multiplexing is a programming technique by which the processor can share this single output image table word and use it to send multiple words to the module, one word at a time. Multiplexing, therefore, is useful when one or more preset words are needed.

Multiplexing requires an orderly sequencing of events in the program. The program must coordinate control of the output image table word such Multiplexing requires an orderly sequencing of events in the program. The program must coordinate control of the output image table work such that it sends the intended output word, whether control or preset, to the module. In this publication, a scan counter is used for this coordination. While it is not the only method of control for multiplexing, the scan counter is a direct and easily understood method and can be used with any PLC or PLC-2 family processor.

To understand the scan counter's function, consider how information must be transferred to the module. In one program scan, the processor stores the word that is to be sent to the module in the output image table word for the module. During the very next I/O scan, the processor automatically outputs the image table word to the module.

Table 5.A lists a sequence of operation for single transfer in a typical application, showing what must happen at each value of the scan counter. This example assumes that both preset words are used. If only one of the preset words is needed, only counts 1 and 2 of the scan counter are necessary.

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Table 5.A
Scan Count Sequencing

At Count: [1]	Program Executes Command To:	I/O Scan:
1	PUT Control word into output word	Sends output word
2	PUT Preset word #1 into output word	Sends output word
3	PUT Preset word #2 into output word	Sends output word

[1] This count is the scan counter Accumulated value for PLC-2, PLC-2/15, PLC-2/20, and Mini-PLC-2 Controllers. For the PLC Controller, these values would be doubled: 2, 4, and 6 respectively.

The scan counter must indicate that both an I/O scan and a program scan have occurred. For PLC-2, PLC-2/15, PLC-2/20 and PLC-2/30 Processors and the Mini-Processor Module, the I/O scan and program scan, because they are sequential, are synchronous: one program scan occurs for each I/O scan. This means the scan counter can simply be incremented each program scan. Section titled **Scan Counter - PLC-2 Family Processors** describes a suitable scan counter for these processors.

With the PLC processor, however, the I/O scan and program scan are asynchronous; this means that the scan counter must be programmed to increment based on the longer of the two scans. Section titled **Scan Counter - PLC Processor** describes a suitable scan counter for these processors.

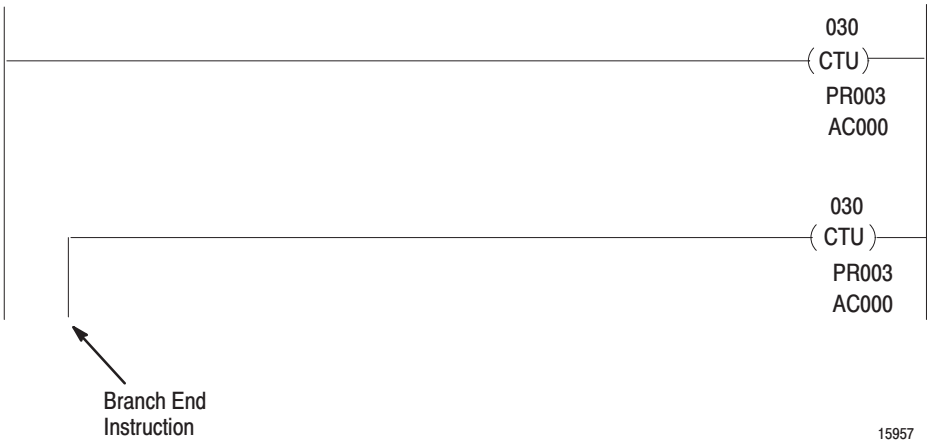
With the sample program following, note that the scan counter is programmed to run continuously; it resets itself when the accumulated value equals the preset value, and begins to count again. This arrangement is normally preferred because it allows subsequent programmed changes in bits of the output control word to be sent to the module as soon as possible after the change is made.

Scan Counter - PLC-2 Family Processors

Figure 5.6 shows an example scan counter that can be used for any PLC-2 family processor. This type of scan counter increments with each program scan. Because the I/O and program scans of these processors are synchronous, each increment of this scan counter indicates that both an I/O scan and a program scan have occurred.

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Figure 5.6
Scan Counter - PLC-2 Processors



The output instruction of both rungs in Figure 5.6 is an up-counter (CTU) instruction. The first rung, since it is unconditional, is always true. The second rung, since a branch end instruction by itself is always false, sets the conditions for the counter as false. Because an up-counter (CTU) increments for each false to true transition, CTU 030 registers one count each time the program scan occurs.

Scan Counter - PLC Processor

Figure 5.7 shows an example scan counter that can be used for a PLC processor. Because the I/O and program scans of this processor are asynchronous, this scan counter differs in form and operation from the scan counter for PLC-2 processors.

Figure 5.7
Scan Counter - PLC Processor



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In order to keep track of both I/O and program scans, the PLC scan counter rungs manipulate a particular type of memory bit. This must be a bit in the input image table which is not wired to a corresponding input device, so that the bit is turned off each I/O scan. Choose a bit which satisfies all of the following conditions:

- is in a module group that is scanned immediately after the encoder/counter module is scanned
- is an actual terminal address on an installed input module
- is off at all times

The first condition requires a brief knowledge of I/O scan sequencing. The remote I/O PLC processor scans I/O modules in order of module group no. It first scans module group 0 in all I/O racks, then module group 1, then 2 and so on. Therefore, when selecting an input image table bit for scan counter control, choose a bit with a greater module group no. than the module group no. of the encoder/counter module. If the encoder/counter module is placed in module group 7, and unused input in module group 0 would be appropriate for this purpose. Note that the I/O rack number is of no consequence in selecting this bit.

The second condition requires that this input address correspond to an actual input module terminal of the controller.

For the third condition, it is suggested that the input terminal at the address be connected to the L2 (AC low) or DC COMMON terminal on the input module wiring arm. This helps prevent the terminal from being connected to an input device at some later time.

In Figure 5.7, it is assumed that bit 11111 satisfies all three of these conditions.

The I/O scan and program scan both manipulate bit 11111. In rung 1, this bit is examined as an input condition for the scan counter. When this bit is OFF, CTU 200 increments. When CTU 200 increments, bit 20017 is set on. In rung 2, bit 20017 latches bit 11111 on. Then, in rung 3, bit 20017 is turned off. Bit 11111 remains on until the next I/O scan. With this arrangement, CTU 0 cannot increment until both an I/O scan and program scan occur.

Note that, for the PLC processor, two scan counts are used between each step in single transfer, as indicated in NO TAG.

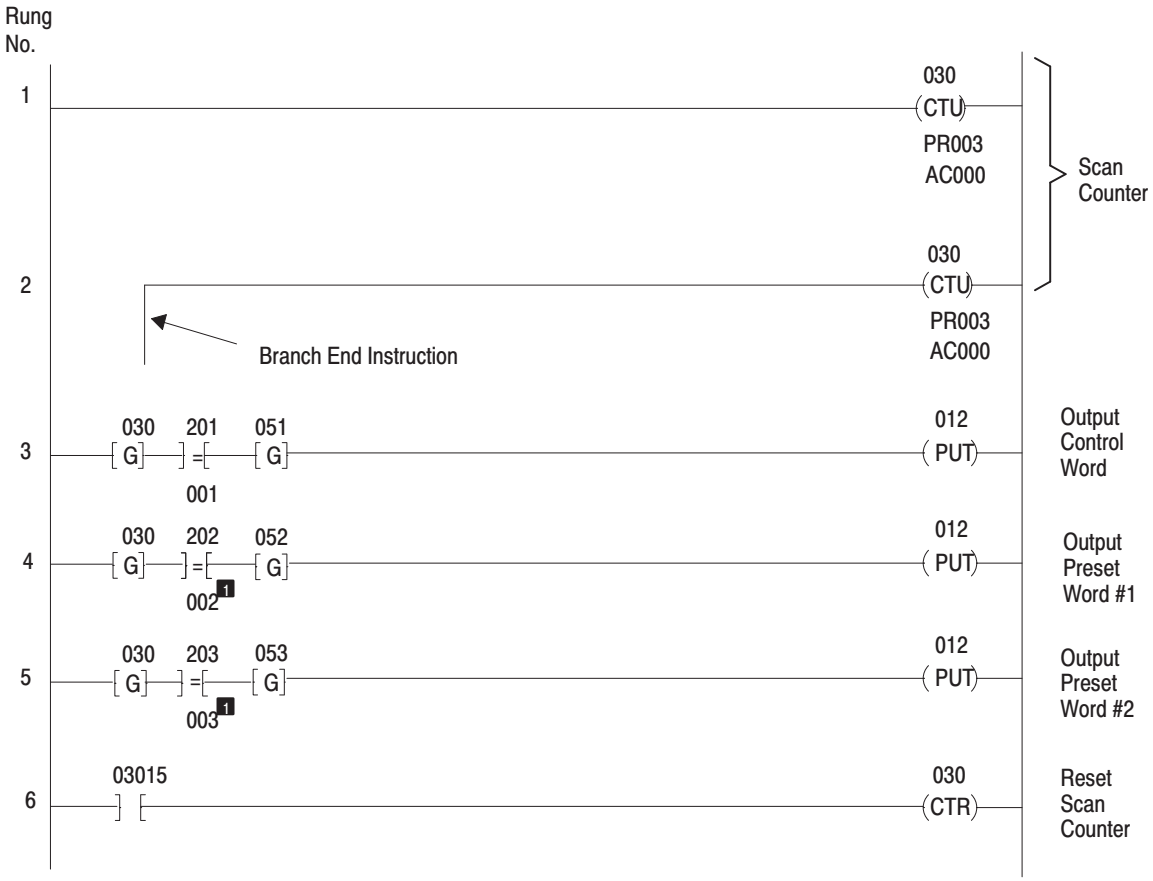
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Note: In some applications, it may be feasible to designate an input location for the purpose of scan counter control. In this instance, an on-delay timer (TON) instruction can be used to multiplex output data to the encoder/counter module. A timer with 0.1-second resolution is acceptable for this purpose. Each step of Table 5.A can be programmed to be executed at a 0.1-second interval from the previous step.

Example Program - Single Transfer

Figure 5.8 is an example program for single-transfer multiplexing of output words to the encoder/counter module. This example uses the type of scan counter recommended for PLC-2 processors. However, the general format of these rungs would be the same for a PLC processor, with addressing differences, substitution of the type of scan counter shown in Figure 5.7, and other minor changes.

Figure 5.8
Example Program - Single Transfer



1 For the PLC processor, values of constants would be 003 in rung 4, 005 in rung 5.

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The following assumptions are made for this sample program:

- Encoder/counter module is in I/O rack 1, module group 2.
- Output control word is stored in word 051.
- Preset words #1 and #2 are stored in words 052 and 053, respectively.
- The scan counter is recycled, as shown in rung 6. This allows continuous update of the module should output values be changed by the program.

For this example, it is assumed that the bit patterns of the output words are set up elsewhere in the program.

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Block Transfer Programming

General

Block transfer programming is available with all Allen-Bradley processors that use the 1771 I/O structure.

Block transfer is specifically intended for use with I/O modules such as the encoder/counter module, that perform more complex operations than simple on/off input sensing or output switching. For the operation of such modules, multiple words of data must be transferred to or from the processor.

Block transfer can be particularly useful with the encoder/counter module when more than one word must be output to the module, that is, when one or both preset words are used. By using block transfer in these applications, you can avoid any involvement with multiplexing techniques for module/processor communication. Multiplexing techniques are used in single transfer programming, as described in chapter 5. Note, however, that single transfer techniques can be the easiest to use in any application where only a single output control word must be sent to the module. For this reason, when not using any of the preset words, use single transfer programming for module/processor communication.

The material for block transfer is organized as follows:

- Section titled **Output Words - Block Transfer** describes the configuration of output words when using block transfer.
- Section titled **Example Block Transfer Programs** describes block transfer ladder logic for PLC -2, PLC-3, and PLC-5 family processors.

Output Words – Block Transfer

The output control and preset words have a unique configuration when block transfer programming has been selected. Initially, the program must set the bit combinations of these words to the proper arrangement for the application. Then, through block transfer, these words are transmitted to the encoder/counter module.

Output Control Word

Figure 6.1 shows the configuration of the output control word for block transfer. By setting bits in this word, you set up the initial mode of module operation and change it as required during operation.

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Figure 6.1
Control Word - Block Transfer Mode

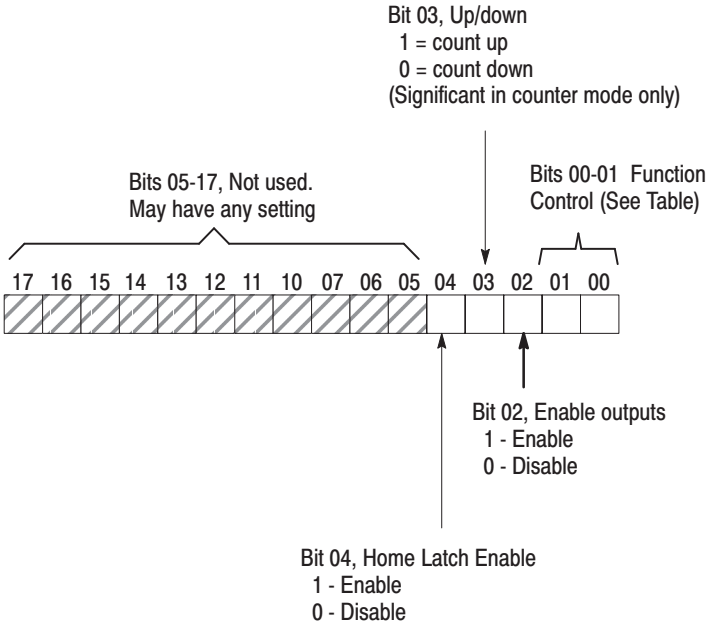


Table Function Control Bits

BIT 01	BIT 00	FUNCTION
0	0	Count.
0	1	Reset and hold the accumulated count at 000.
1	0	Return the accumulated count to 000 and begin counting immediately.
1	1	Invalid, module executes previously programmed function.

15960

Bit 04 is the home latch enable bit.

The module resets the count to zero when all three of the following conditions are true:

- Home latch enable bit (bit 04) is set to 1.
- Marker input is high.
- Home limit switch is closed (limit switch LED is on).

The count remains at zero until one or more of these conditions go false. Then module operation follows the function control bits described in Figure 6.1.

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The module indicates it has reset its count to zero by setting the home bit (bit 17 in the input status word). It resets this bit when the home latch enable bit (bit 04) is reset. (Refer to Figure 4.2, Input Status Word).

The system can bring the machine back to a repeatable starting position, and the module count can be reset to zero by toggling either the market input or home limit switch rather than changing bits 01 and 00 in the control word as long as the three conditions are met.

Carry and borrow bits are not affected by resetting the module count. The home limit switch LED turns on whenever the home limit switch is closed.

Bit 03 of this word is the up/down bit. This bit is significant only when the module is used in the counter mode. The state of this bit control module function as follows:

1 -The module increments its accumulated count with each pulse received on Channel A.

0 -The module decrements its accumulated count with each pulse received on channel A.

Note that if a device is wired to the Channel B input of the module for external count direction, the up/down bit must be set to 1.

Bit 02 is the enable outputs bit. The status of this bit controls module outputs as follows:

1 -Outputs enabled. This means that the outputs of the module can be energized based on logical operations performed by the module.

0 -Outputs disabled. This means that the outputs of the module cannot be energized.

With bit 02 set to 1, the module can energize its output terminals based on a comparison of its accumulated count and preset values entered by the program.

Bits 00 and 01 are termed function control bits. These bits control module function in both encoder and counter modes. They permit the counting function of the module to be enabled or reset by the program. The table in Figure 6.1 shows the bit settings for each function.

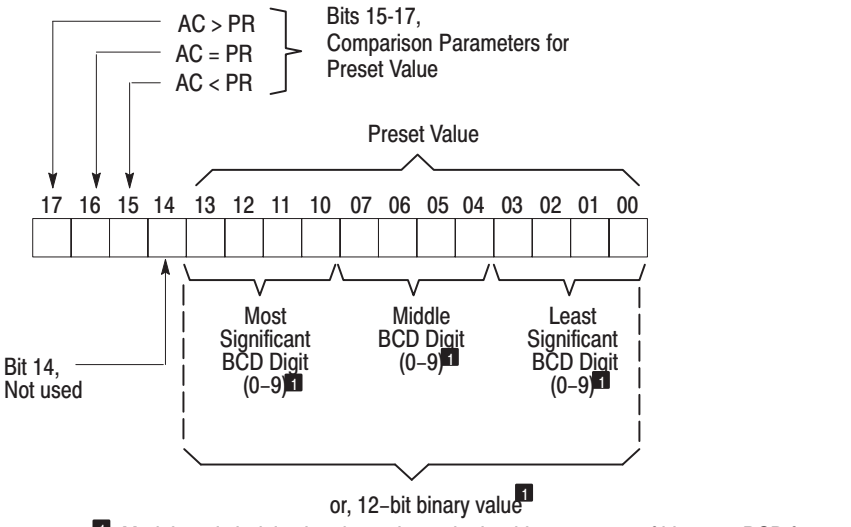
Bits 05-17 of this word are not used by the module and may have any setting.

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Preset Words

In block transfer communication, preset words #1 and #2 have the format of Figure 6.2. Here bits 00-13 store the preset value. When BCD operation has been selected, these bits may represent a value from 000-999. When 12-bit binary operation has been selected, the value may range from 0 to 1111 1111 1111 binary (4095 decimal). A module switch selection is made during installation to select either BCD or binary mode.

Figure 6.2
Preset Words - Block Transfer Mode



Note: If BCD operation has been selected, only BCD digits should be entered in the data table word output to the module. If non-BCD digits are entered in a preset value, the module sets its default preset value to 000 for that word.

Bits 15-17 establish the comparison to be made by the module between its accumulated count and each preset value. When any of these bits are set to 1, the module makes the indicated comparison between its accumulated count and the appropriate preset word value. When the comparison is true, the corresponding output of the module may be energized. Of course, the enable outputs bit in the control word must also be set to 1 for outputs to be energized.

As Figure 6.2 shows, one bit is used for each comparison parameter: less than, equal to, or greater than. Note that more than one of these bits can be set to 1 for each preset, allowing such combinations as less than or equal to, greater than or equal to, or not equal to.

Bit 14 of each preset word is not used. It may be 1 or 0.

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Note that there is no identifying bit pattern to distinguish preset words #1 and #2 from each other. The encoder/counter module identifies these words by their order of transmission in block transfer. As these words are stored in memory, preset word #1 is stored in the word immediately following the output control word. Preset word #2 is then stored in the word immediately following preset word #1.

Example Block Transfer Programs

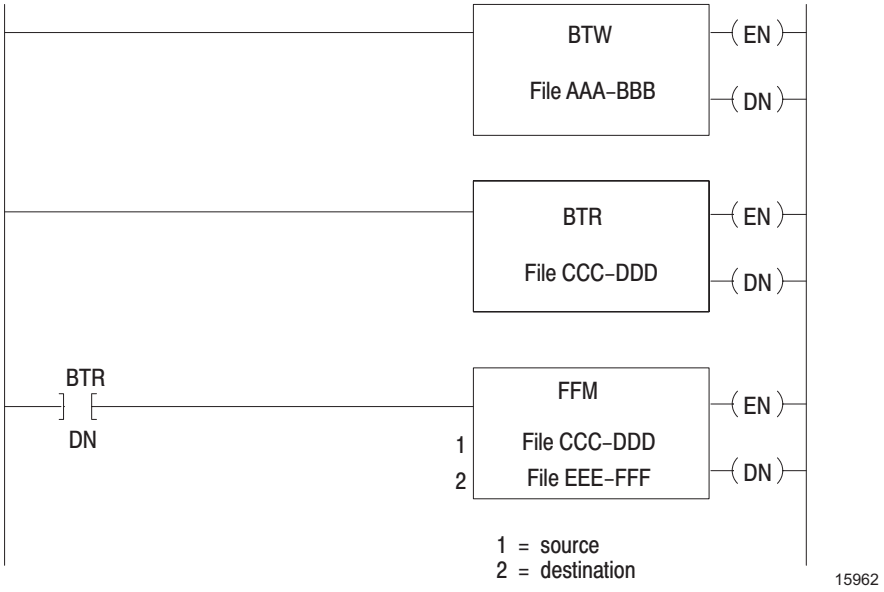
The module communicates with any Allen-Bradley processor that has block transfer capability. The module is a bidirectional block transfer module. Bidirectional means that the module performs both read and write block transfer operations. You transfer data from your module to the processor's data table with a block transfer read (BTR) instruction. You transfer data to your module from the processor's data table with a block transfer write (BTW) instruction.

PLC-2 Family Processors

The following examples use block transfer instructions to perform block transfers. However, the Mini-PLC-2 (cat. no. 1772-LN3) and PLC-2/20 (cat. no. 1772-LP1,-LP2) processors use multiple GET instructions to perform block transfers. Refer to the processor user's manual for an explanation of multiple GET block transfer.

The generalized and example programs (Figure 6.3 and Figure 6.4) demonstrate the use of a single block transfer read (BTR) and a single block transfer write (BTW) to pass data between the processor and the module.

Figure 6.3
Generalized Ladder Logic for PLC-2 Block Transfer



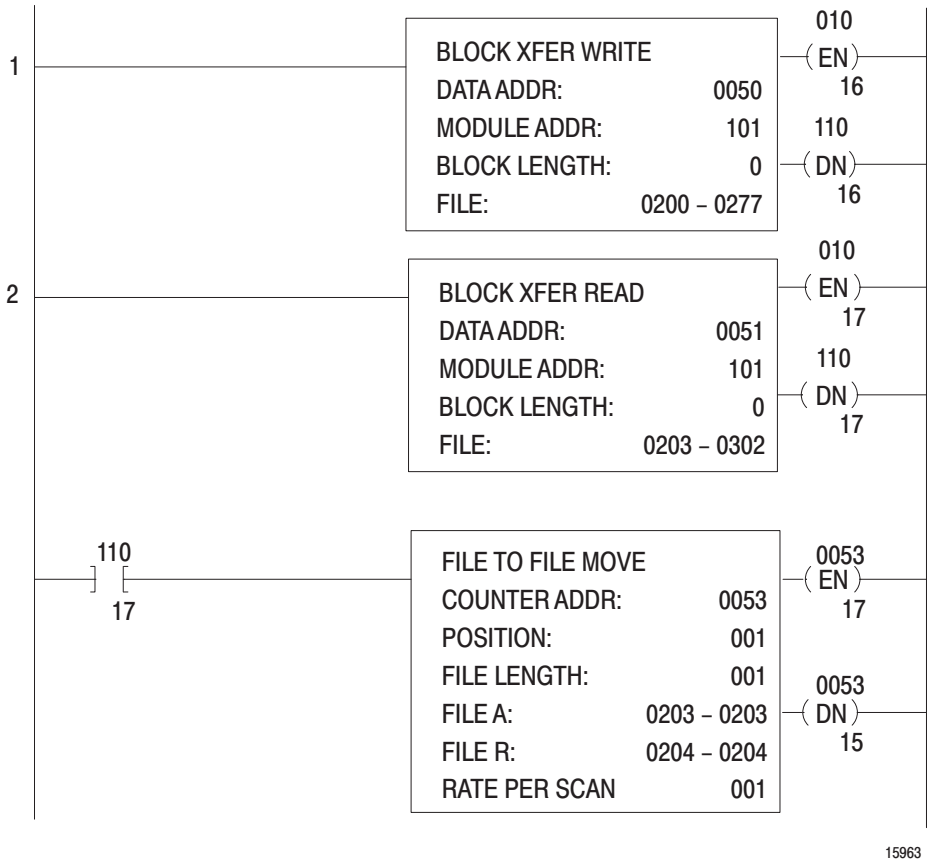
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Rung Descriptions

Rungs 1 and 2 - These rungs request the block transfer write (BTW) and block transfer read (BTR) operations.

Rung 3 - When the processor successfully completes a BTR operation, it sets the done (DN) bit and enables the file-to-file move (FFM) instruction. The FFM instruction moves the BTR data file (CCC-DDD) into a storage data file (EEE-FFF). This prevents the processor from using invalid data if a block transfer communications fault should occur.

Figure 6.4
Example Ladder Logic for PLC-2 Block Transfer



For PLC-2 family processors, we recommend that you set the block length to zero. Then the module determines the number of transfer words. The 1771-IJ/IK defaults to 3 words in a BTW and 1 word in a BTR if you program a block length of zero.

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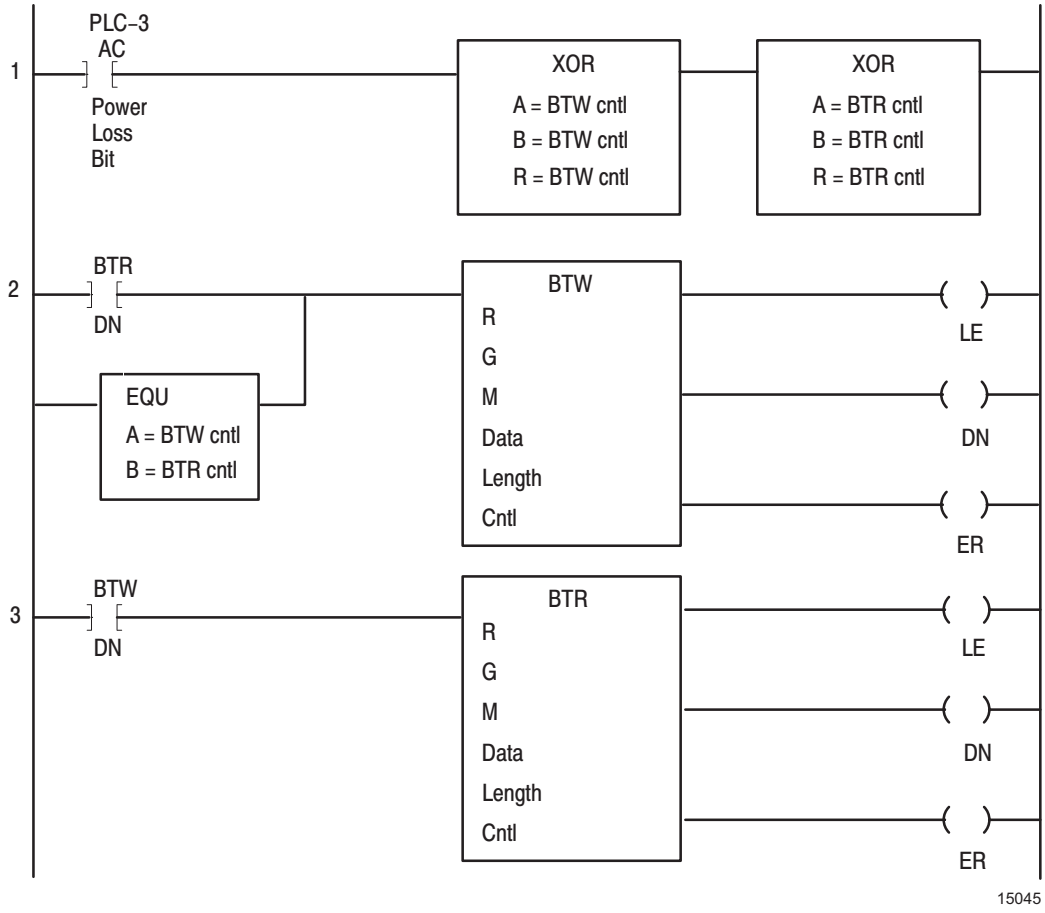
PLC-3 Family Processors

Use the following ladder logic with PLC-3 or PLC-3/10 processors. This program assumes that your application requires a single BTR and BTW instruction to pass data between the processor and the module.

Ladder logic alternates the execution of BTR and BTW instructions. The processor checks data validity before accepting read data, and sets one enable bit at a time.

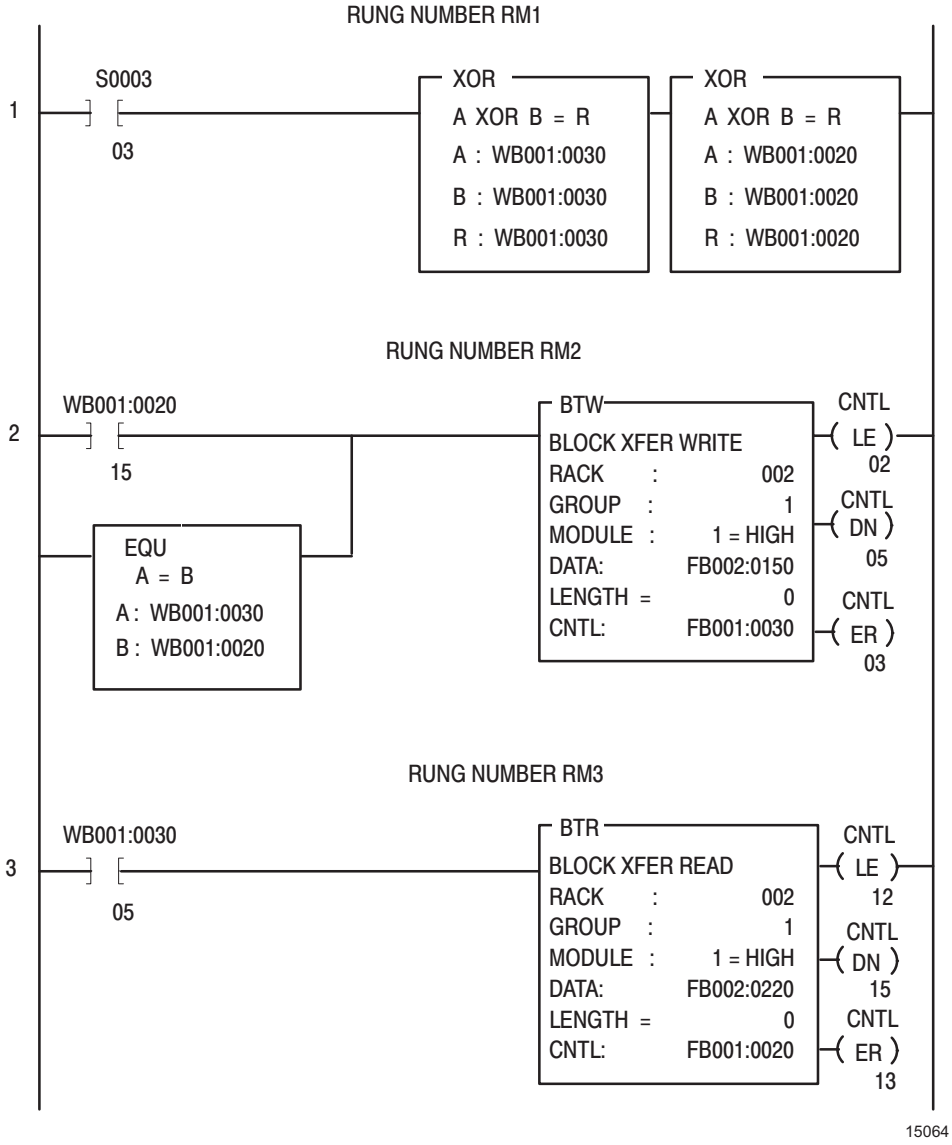
Refer to Figure 6.5 for generalized ladder logic, and to Figure 6.6 for example ladder logic with entered values.

Figure 6.5
Generalized Ladder Logic for PLC-3 Block Transfer



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Figure 6.6
Sample Ladder Logic for PLC-3 Block Transfer



Rung Descriptions

Rung 1 - Rung one is true only at power up. It uses status word 3, bit 03 (the PLC-3's AC power loss bit) to zero the control file of both the BTR and BTW instructions.

Rung 2 - The equal instruction is used at power up. At power up, the BTR and BTW control files both equal zero, so the BTW instruction is enabled.

Rung 2 and 3 - During normal program execution, the BTW and BTR instructions are alternately executed. The done bit of either instruction enables the next block transfer instruction. After power up, the BTR and BTW done bits are used to alternate reads and writes.

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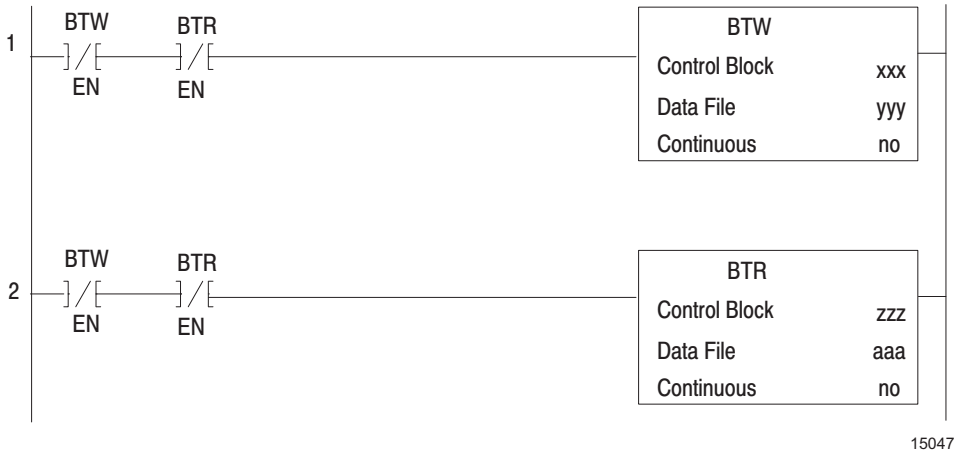
PLC-5 Family Processors

You can use the following ladder logic with PLC-5 processors. This program assumes that your application requires a single BTR and BTW to pass data between the processor and the module.

Ladder logic alternates the execution of BTR and BTW instructions. The processor checks data validity before accepting read data, and sets one enable bit at a time.

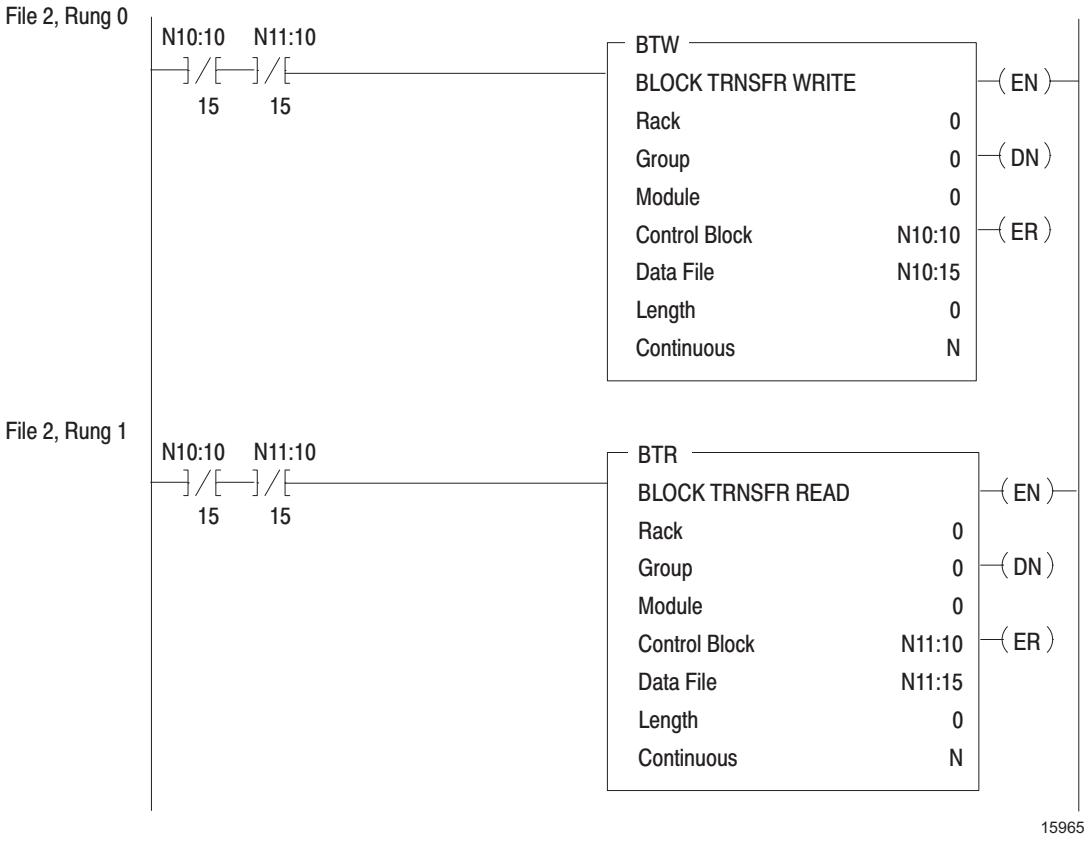
Refer to Figure 6.7 for generalized ladder logic, and to Figure 6.8 for example ladder logic with entered values.

Figure 6.7
Generalized Ladder Logic for PLC-5 Block Transfer



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Figure 6.8
Example Ladder Logic for PLC-5 Block Transfer



Rung Descriptions

Rungs 0 and 1 - Rungs 0 and 1 execute BTW and BTR instructions alternately. When the processor completes the BTW instruction, it enables the BTR instruction immediately in the same scan. Enabling a block transfer instruction places the block transfer request in queue. There is one queue for each I/O chassis. Waiting time depends on the number of queued requests ahead of it.

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Special Programming

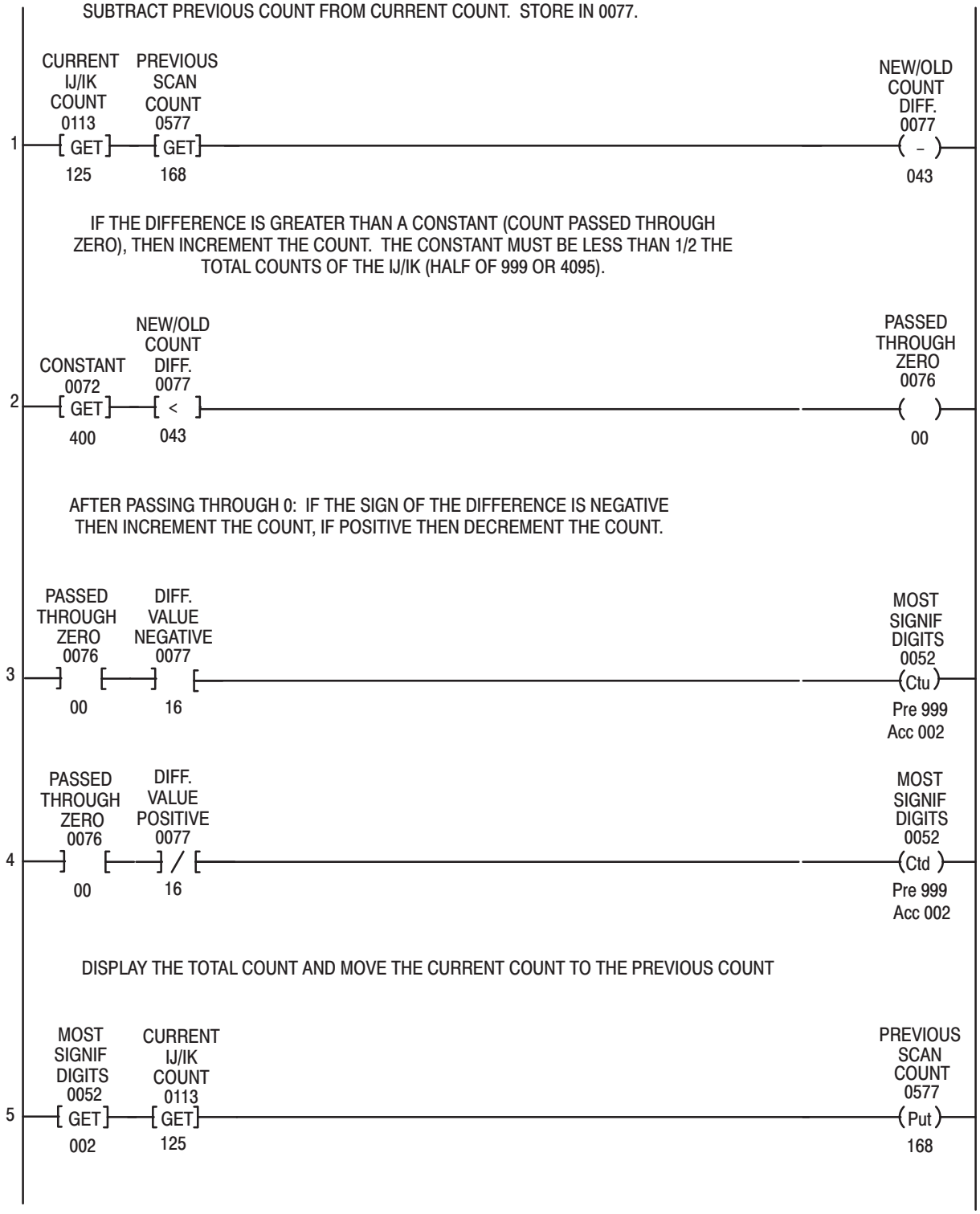
Extending the Count Beyond 999

The input Status word stores a maximum count of 999 (BCD). If using binary resolution, the maximum count is 1111 1111 1111 (4095 binary). To count beyond these full scale values, you may want to use either of the following ladder programs for PLC–2 or PLC–3 family processors.

Both programs (Figure 7.1 and Figure 7.2) extend the count beyond 999 (4095 binary) in the same manner. Either program compares the new count value with the value in the previous scan (old value). If the difference of the new value less the old value is greater than a constant (a constant less than 999/2 or 4095/2), the count passed through zero. If the sign of the difference is negative, the up counter is incremented by one; if positive the down counter is decremented by one.

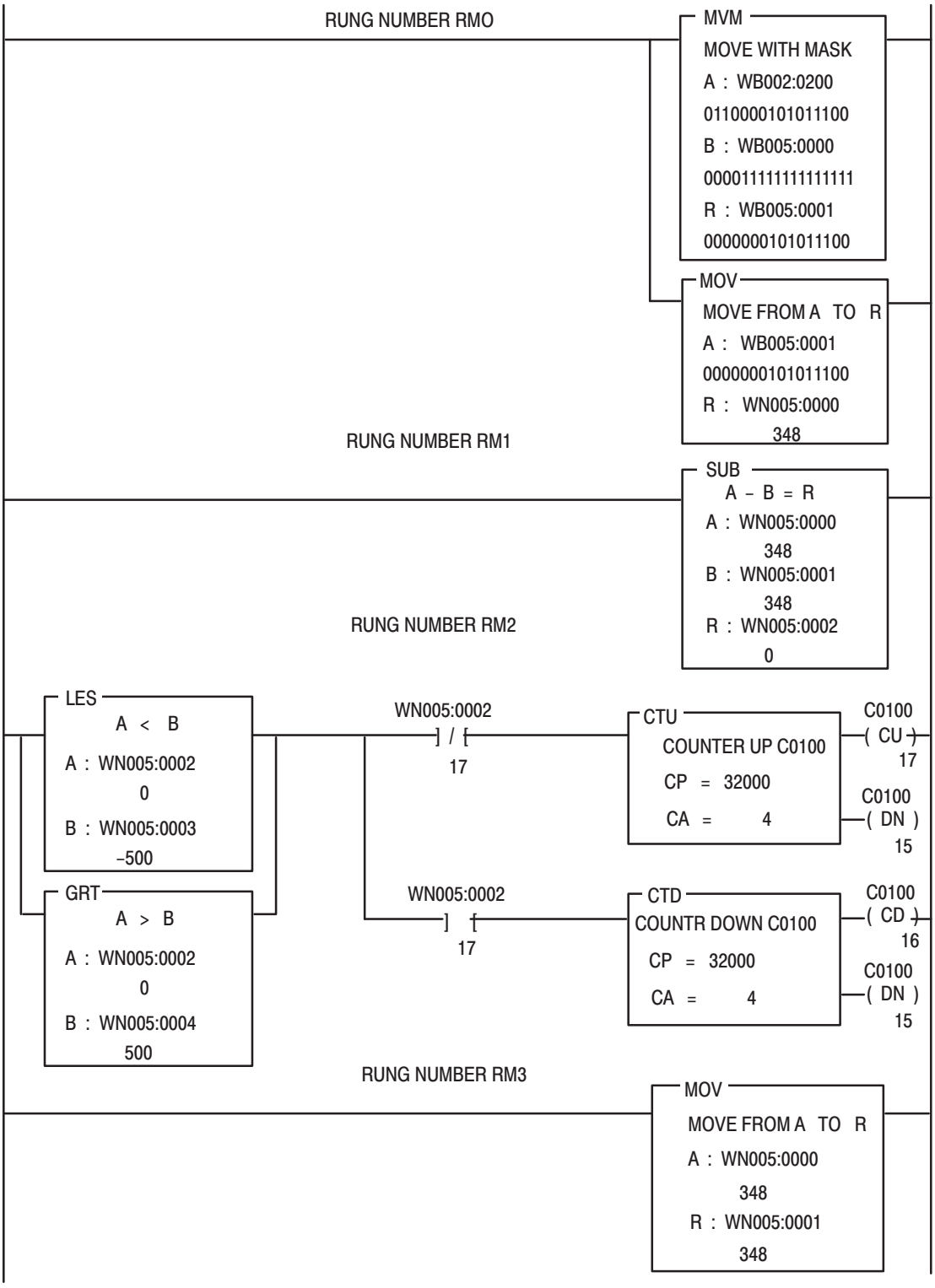
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Figure 7.1
Ladder Logic for Extending the Count Beyond 999 (PLC–2 Program)



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Figure 7.2
Ladder Logic for Extending the Count Beyond 999 (PLC–3 Program)



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Rung Descriptions (Figure 7.2)

Rung 0 – This rung strips the upper byte of the count value and stores the value.

A = BTR status
B = Mask
R = Temporary count storage with upper byte removed

A = Temporary count storage with upper byte removed
R = New count value

Rung 1 – This rung subtracts the old count value from the new value and stores the difference with its sign.

A = New count value
B = Old count value
R = Difference of new count value less old value

Rung 2 – This rung looks at the sign and magnitude of the difference from rung 1 and compares it with a constant (a constant less than 999/2 or 4095/2). If positive, the up counter is incremented by one; if negative, the down counter is decremented by one.

Rung 3 – This rung moves the new count value (A) to the old count storage location (R).

A = New count value
R – Old value storage location

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Specifications

Specifications – 1771-IJ and -IK Encoder Counter Modules	
General Input Specifications	
Number of Counters	1
Counter Input (switch selectable)	Single channel (counter) Dual channel (encoder)
Input Pulse Rate	50KHz maximum
Data Transfer Modes (switch selectable)	Single transfer mode Block transfer mode
1771–IJ	
External supply	5V dc, ±0.25V
Input Ratings	Vin = 0–5V dc Vih (min) = 2.4V dc Vil (max) = 0.6V dc Device driving input terminal must be able to sink 16A minimum.
Output Ratings	2 open–collector outputs without internal pull–up resistors Iout = 500mA maximum per output Vout = 5V dc maximum
Power Dissipation	1771-IJ – 6.7 Watts maximum
Thermal Dissipation	1771-IJ – 22.9 BTU/hr
1771–IK	
External Supply (Vext)	12–24V dc Input circuits require 170mA maximum Output circuits require 1.08A maximum
Input Ratings	0 < Vin < Vext For Vext = 12V dc: Vih = 7.2V dc max; Vil = 4.8V dc max Device driving input terminal must sink (or source if selected on Channel A) 10mA For Vext = 24V dc: Vih = 14.4V dc max; Vil = 9.6V dc max Device driving input terminal must sink (or source if selected on Channel A) 20mA
Output Ratings	2 open collector outputs without internal pull–up resistors. Iout = 500mA max per output Vout = Vext
Power Dissipation	1771-IK – 12.1 Watts maximum
Thermal Dissipation	1771-IK – 41.3 BTU/hr
General Specifications	
Module Location	Cat. No. 1771 I/O chassis
I/O Isolation	Tested to 1500V ac for 1s
Limit Switch Input	12–48V dc
Backplane Power Supply 5V Current Requirements	1.2A typical 1.4A maximum
Current consumption from external power supply	150mA @ 12V dc 75mA @ 24V dc

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Specifications – 1771-IJ and -IK Encoder Counter Modules		
Indicators		2 Channel A and B status 1 Marker 1 Limit 2 Output 1 and 2 1 Red Fault
Keying	1771–IJ	Left connector: Between 6 and 8; 18 and 20 Right connector: Between 4 and 6; 32 and 34
	1771–IK	Left connector: Between 6 and 8; 20 and 22 Right connector: Between 4 and 6; 32 and 34 **Note:** Modules must be in a single module group (slots 0 and 1). Do not straddle 2 module groups.,
Environmental Conditions		
Operational Temperature		IEC 60068–2–1 (Test Ad, Operating Cold) IEC 60068–2–2 (Test Bd, Operating Dry Heat) IEC 60068–2–14 (Test Nb, Operating Thermal Shock) 32 to 140°F (0 to 60°C)
Storage Temperature		IEC 60068–2–1 (Test Ab, Unpackaged, Nonoperating Cold) IEC 60068–2–2 (Test Bb, Unpackaged, Nonoperating Dry Heat) IEC 60068–2–14 (Test Na, Unpackaged, Nonoperating Thermal Shock) –40 to 185°F (–40 to 85°C)
Relative Humidity		IEC 60068–2–30 (Test Db, Unpackaged, Nonoperating Damp Heat) 5 to 95% noncondensing
Shock Operating Nonoperating		IEC 60068–2–27 (Test Ea, Unpackaged Shock) 30g 50g
Vibration		IEC 60068–2–6 (Test Fc, Operating) 2g @ 10–500Hz
ESD Immunity		IEC 61000–4–2 4kV contact discharges
Radiated RF Immunity		IEC 61000–4–3 10V/m with 1kHz sine–wave 80% AM from 30MHz to 1000MHz 10V/m with 200Hz 50% Pulse 100% AM at 900MHz
EFT/B Immunity		IEC 61000–4–4 ±1kV @ 5kHz on signal ports
Surge Transient Immunity		IEC 61000–4–5 ±2kV line–earth (CM) on shielded ports
Conducted RF Immunity		IEC 61000–4–6 10V rms with 1kHz sine wave 80% AM from 150kHz to 30MHz
Emissions		CISPR 11 Group 1, Class A (with appropriate enclosure)
Enclosure Type		None (open style
Input Conductors Wire Category Length (max)		 Belden 8761 (for pulse counter applications below 20KHz); Belden 9182 (for frequencies up to 50KHz) Belden 8725 (for twisted pair encoder applications below 20KHz) 2[1] Sensor must be within 40ft of the module
Field Wiring Arm		Cat. No. 1771–WB
Field Wiring Arm Screw Torque		7–9 pound–inches (0.6–0.7Nm)

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Specifications – 1771-IJ and -IK Encoder Counter Modules		
Field Wiring Arm Wiring Size Insulation Category		14–22AWG (2.5–0.25mm^2) solid or stranded copper wire rated at 60°C or greater 3/64 inch (1.2mm) maximum 2[1]
Certifications (when product is marked)	UL CSA CE[2] C–Tick[2]	UL Listed Industrial Control Equipment CSA Certified Process Control Equipment European Union 89/336/EEC EMC Directive, compliant with: EN 61000–6–4, Industrial Emissions EN 50082–2, Industrial Immunity EN 61000–6–2, Industrial Immunity EN 61326, Meas./Control/Lab., Industrial Requirements Australian Radiocommunications Act,compliant with AS/NZS 2064, Industrial Emissions

1 Use this conductor category information for planning conductor routing . Refer to publication 1770-4.1, "Industrial Automation Wiring and Grounding Guidelines."
2 See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

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