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BUS-65517II
Hardware Manual
IDEA CARD IBM® PC Compatible
MIL-STD-1553 Simulator and Tester

MN-65517-001

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DECLARATION OF CONFORMITY

We Data Device Corporation
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declare under our sole responsibility that the product(s)

BUS-65517II

to which this declaration relates is in conformity with the following standard(s) or other normative document(s):

EN 55022-1: 1998 CLASS B; Conducted Emissions (150kHz to 30MHz)
CLASS B; Radiated Emissions (30MHz to 1GHz)

EN 50082-1: 1997 EN 61000-4-2:1995; Electrostatic Discharge
EN 61000-4-3:1997; Radiation Immunity
ENV 50204:1994; Radiated Immunity, Pulsed
EN 61000-4-4:1995; EFT/Burst, Power and I/O Leads
EN 61000-4-5:1995; Surge Immunity, Power Leads
EN 61000-4-6:1996; Conducted Immunity, Power and I/O Leads
EN 61000-4-11:1994; Voltage Dips and Interrupts

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Date May 2, 2000

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RECORD OF CHANGE

Revision	Date	Pages	Description
E	February, 2006	11	Simulated Bus Lab Bench interconnections diagram modified

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INTRODUCTION

FEATURES AND OVERVIEW

The 1553-IDEA is a versatile workstation for the Integrated Development, Emulation, and Analysis of MIL-STD-1553B systems. The workstation consists of a standard full-size IBM-PC card, software diskettes, and any IBM-PC compatible. The IDEA-1553 card supports 2 concurrent and independent functions:

- Emulation of a bus controller (BC), and up to 31 remote terminals (RTs).

- Bus monitor (Monitor).

The BC supports 250 independent messages and all communication formats defined by MIL-STD-1553B. Messages are organized in a communication frame of up to 1000 entries with inter-message timing accurate to 5 microseconds.

All RTs provide powerful real-time emulation of MIL-STD-1553B bus activity, including such options as legality, broadcast and dynamic bus control.

The workstation stores monitored bus traffic on a stack residing in IBM RAM. The stack can accommodate 32K messages and has a capacity of up to 256KB.

The card contains a sophisticated error injection circuit capable of generating all error-types required for validation and production testing.

The 1553-IDEA board has a dual architecture: one half implements the BC and multiple RTs while the other half implements the Monitor (See FIGURE 1). Each half contains its own Z8002B (10 MHZ) microprocessor, memories, and peripheral circuits. The card appears to the IBM-PC as 32KB of shared memory; the memory is used for control/data and may be mapped to any 32KB block between addresses 512K and 1024K.

The 1553-IDEA software runs under DOS 3.1 (or later) and requires a minimum of 512KB of IBM RAM. Software supports color displays.

The BC/RTs and Monitor interface with a dual redundant 1553 bus. Each 1553 bus interface is based on two identical proprietary gate arrays.

The card's rear bracket has one D-type and two triax connectors. The triax connectors provide transformer coupled stubs, while the D-type connect supplies two direct coupled stubs as well as a byte of input and a byte of output for triggering and gating.

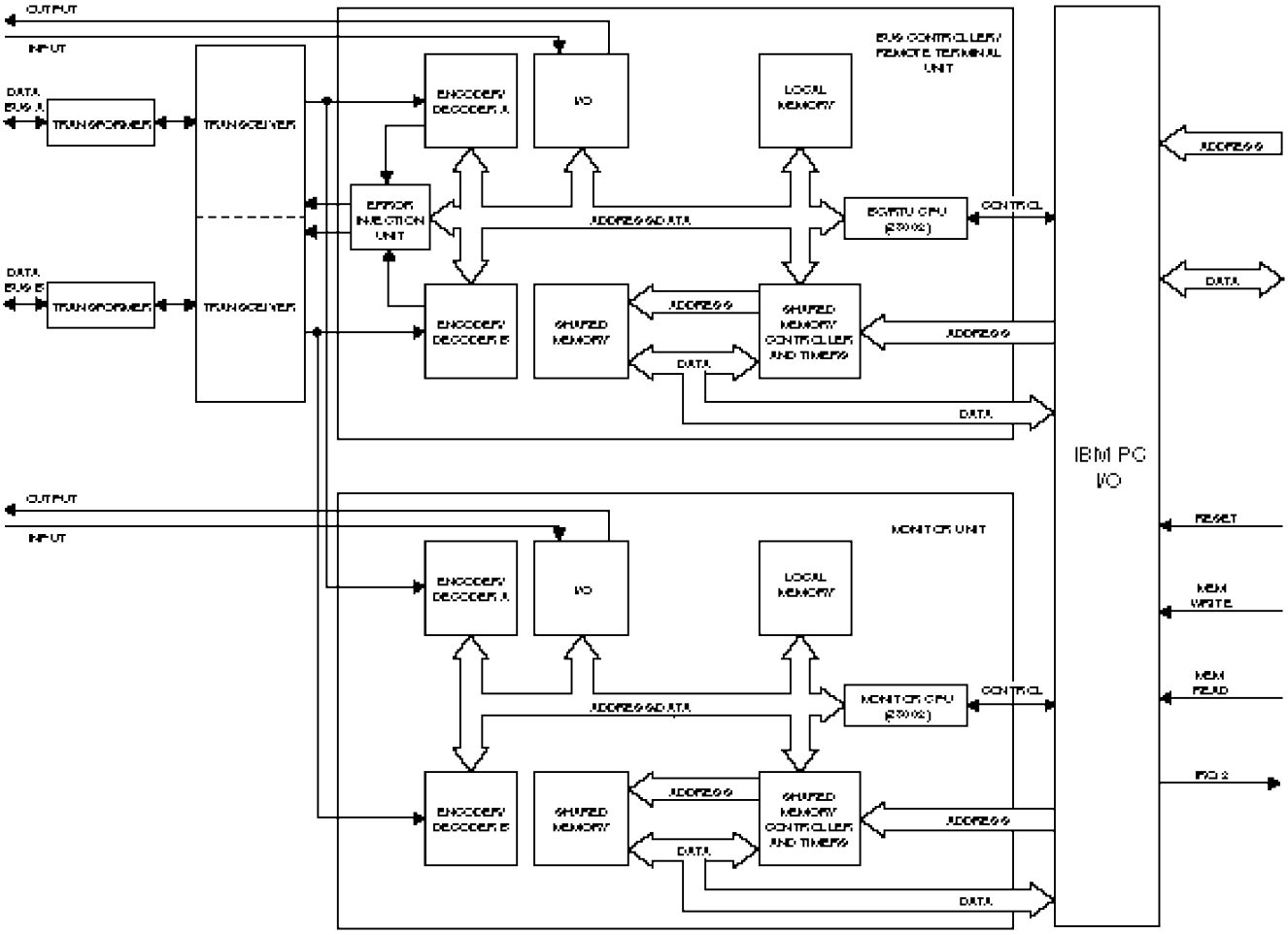


FIGURE 1. 1553-IDEA BLOCK DIAGRAM

HARDWARE INSTALLATION

The 1553-IDEA card may be inserted into any full size IBM compatible 8-bit slot. When installing the card, the following should be observed:

1. **NEVER** insert or remove the card with the power turned-on.

2. Insert the card at a slight angle so that the 2 triax connectors first protrude from the rear opening and then gently press the card into the mother-board connector.

3. Make sure that adjacent cabling and wiring do not hinder the airflow around the card.

Note: The following installation information pertains to the BUS-65517II (Mark 2) card. For installation information on the BUS-65517 (Mark 1) card skip to page 7.

HARDWARE CONFIGURATION (65517II)

There are three jumper blocks on the card that must be configured before it can be installed into a PC. They are the memory base address, the interrupt level, and the bus coupling mode (See FIGURE 2).

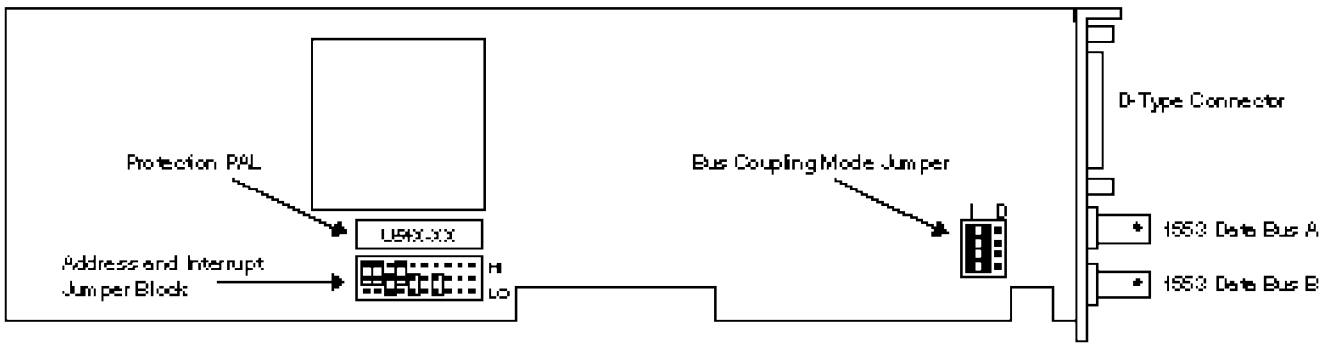


FIGURE 2. BUS-65517II JUMPER BLOCKS

Memory Base Address

The base address jumper block is used to memory map the card to any half segment between 512K and 1024K in the PC's first megabyte of RAM. Address pins 19, 18, 17, 16, and 15 (located at the bottom of the card, near the card's edge connector) can be placed in a high or low position to configure the card for the correct base address. Table 1 shows the positions of the address pins for each of the allowed half segments. D000 is the default base address for the 65517II card and is usually free. Table 2 gives a typical memory map to help in choosing a half segment that is not in use.

TABLE 1. MEMORY MAPPING					
HALF SEGMENT	ADDRESS PINS				
	19	18	17	16	15
A000	1	0	1	0	0
A800	1	0	1	0	1
B000	1	0	1	1	0
B800	1	0	1	1	1
C000	1	1	0	0	0
C800	1	1	0	0	1
D000	1	1	0	1	0
D800	1	1	0	1	1
E000	1	1	1	0	0
E800	1	1	1	0	1

0 = jumper connected in low position
1 = jumper connected in high position

TABLE 2. TYPICAL MEMORY MAP	
MEMORY BASE HEX ADDRESS	DESCRIPTION
0000-9FFF	64K Base Memory
A000-A7FF	32K
A800-AFFF	32K
B000-B7FF	32K May be used for Video Ram
B800-BFFF	32K May be used for Video Ram
C000-C7FF	32K Reserved for CMOS
C000-CFFF	32K May be reserved for CMOS
D000-D7FF	32K
D800-DFFF	32K
E000-E7FF	32K
E800-EFFF	32K
F000-FFFF	64K Reserved for BIOS

NOTE: The IDEA card needs 32K in upper memory to perform. If your upper memory is loaded with memory resident programs, it may be wise to remove some that are not needed to run the card. Also, when

conflicts occur, it is wise to append an exclude command to your memory manager in your CONFIG.SYS file.

Example: `DEVICE=C:\DOS\EMM386.EXE X=D000-D7FF`
(This example assumes the use of EMM386.EXE as the memory manager and D000 as the base address being excluded.)

Interrupt Level Selection

The BUS-65517II allows for the selection of an interrupt request level (IRQ). The user can select 2, 3, 4, 5, or 7 using one jumper, positioned low, for the selected interrupt. Table 3 shows a typical interrupt map to help guide the user's selection of an interrupt.

TABLE 3. TYPICAL INTERRUPT MAP

INTERRUPT LEVEL	ISA DEFAULT
IRQ 2	Cascade, IRQ 8-15 Mapped here also.
IRQ 3	COM 2
IRQ 4	COM 1
IRQ 5	LPT 2
IRQ 7	LPT 1

FIGURE 3 gives an example of the jumper settings for memory base address D000 and interrupt request level 3.

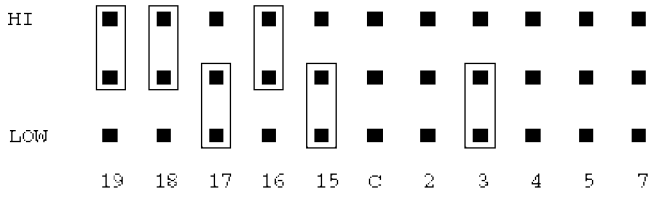


FIGURE 3. EXAMPLE ADDRESS AND INTERRUPT JUMPERS

Note: The C connection is a no connect jumper and is no longer present on the latest IDEA cards.

Bus Coupling Mode

The BUS-65517II can be interfaced to a MIL-STD-1553 bus in either Direct or Transformer coupled mode. A jumper block (shown in FIGURE 2) allows the user to determine which mode is to be used. FIGURE 4 shows how the jumper block must be configured for both modes.

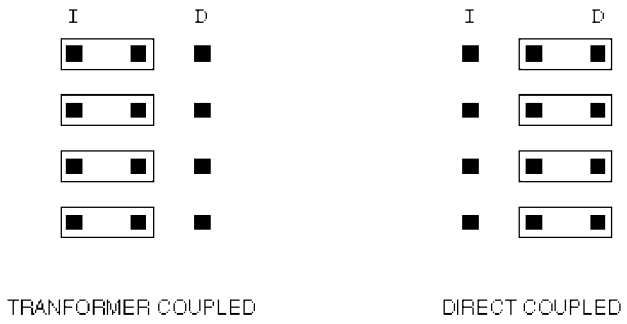


FIGURE 4. THE BUS COUPLING MODE JUMPER BLOCK

Skip to page 8 (Triax Connectors).

HARDWARE CONFIGURATION (65517)

There is only one jumper block on the Mark 1 card that must be configured before installation into the PC. It is the memory base address.

Memory Base Address

The base address jumper block is used to memory map the card to any segment between 512K and 1024K in the PC's first megabyte of RAM. Address pins 18, 17, and 16 (located at the bottom of the card, near the card's edge connector) can be jumpered to map the correct base address. Table 4 shows the jumper positions of the address pins for each of the allowed segments. Table 2 (page 4) gives a typical memory map to help in choosing a segment that is not in use.

TABLE 4. MEMORY MAPPING (Mark 1)

SEGMENT	ADDRESS PINS		
	18	17	16
8	X	X	X
9	X	X	-
A	X	-	X
B	X	-	-
C	-	X	X
D	-	X	-
E	-	-	X
F	-	-	-

X - jumper connected

Note: The Mark 1 IDEA card needs 64K in upper memory to perform. If your upper memory is loaded with memory resident programs, it may be wise to remove some that are not needed to run the card.

TRIAX CONNECTORS

The triax connectors are standard BJ77 types manufactured by Trompeter Electronics Inc. Two mating connectors (Trompeter PL-75) are supplied with the card. The connectors may be configured for either direct or transformer coupling (**Note: Mark I cards are hardwired for transformer coupling only!**). The IDEA card should be connected to a bus as specified by MIL-STD-1553B, refer to page 10 for further information on interfacing to a 1553 data bus.

Due to heat dissipation limitations, the triax connectors should never be shorted for more than a few seconds while transmitting. The connector's center pin is positive during the first half of a command sync. The upper connector corresponds to bus A.

D-TYPE CONNECTOR

The D-type connector pinout is as follows:

Pin	Function	
1	Direct-coupled TX Bus A	
2	BC discrete input 3	
3	BC discrete input 2	
4	BC discrete input 1	
5	BC discrete input 0	
6	Monitor discrete input 0	(capture event input)
7	Monitor discrete input 1	
8	Monitor discrete input 2	
9	Monitor discrete input 3	
10	Monitor discrete output 3	(invalid output)
11	Monitor discrete output 2	
12	Monitor discrete output 1	(capture event output)
13	Monitor discrete output 0	
14	GND	
15	BC discrete output 3	
16	BC discrete output 2	
17	BC discrete output 1	
18	BC discrete output 0	(start of FRAME)
19	5 Volts	
20	N/C	
21	TX Active Bus B	(logic "1" indicates transmission)
22	TX Active Bus A	(logic "1" indicates transmission)
23	Direct-coupled TXN Bus B	(same polarity as triax center pin)
24	Direct-coupled TX Bus B	
25	Direct-coupled TXN Bus A	(same polarity as triax center pin)

The CAPTURE EVENT and INVALID outputs are active high, TTL compatible signals. The delay from the occurence of the capture event or invalid word until the rising edge of these outputs depends on the type of messages and the inter-message gaps. Assuming an intermessage gap of 20 microseconds, an upper bound for the delay is the length of the message plus 20 microseconds. The logic “1” level will remain until the Monitor is halted.

START OF FRAME is a logic “1” output pulse of width 2.7 - 5.5 microseconds. The rising edge of the signal occurs approximately 15 microseconds before the start of transmission in the case of the MENU software. In the case of the RTL software, the time is about 23 microseconds.

The output electrical characteristics are:

3.2 milliamps (max) for the output of 2.4 volts (min)
24 milliamps (max) for the output of 0.5 volts (max)

The CAPTURE EVENT input is used to trigger the transfer of messages from the COMMUNICATION STACK to the PC. The trigger is activated by a logic “1” TTL compatible level and must have a minimum width of the longest message plus 20 microseconds.

INTERFACE TO MIL-STD-1553 BUS

FIGURE 5 illustrates the interface from the IDEA Card to a 1553 bus. Connections for both transformer (long stub) and direct (short stub) coupling are indicated. Direct coupling can be implemented by using either the Triax connectors or the D-type connector. Transformer coupling can only be implemented using the Triax connectors.

For both coupling configurations, the transformer on the IDEA Card is called the isolation transformer. For the transformer coupling configuration, the transformer that interfaces the stub to the bus is called the coupling transformer.

In accordance with MIL-STD-1553B, the turns ratio of the coupling transformer is defined to be 1.0 to 1.4. For both coupling configurations, an isolation resister is required to be in series with each leg connecting the 1553 bus. This protects the bus against short circuit conditions in the transformers, stubs, or terminal components.

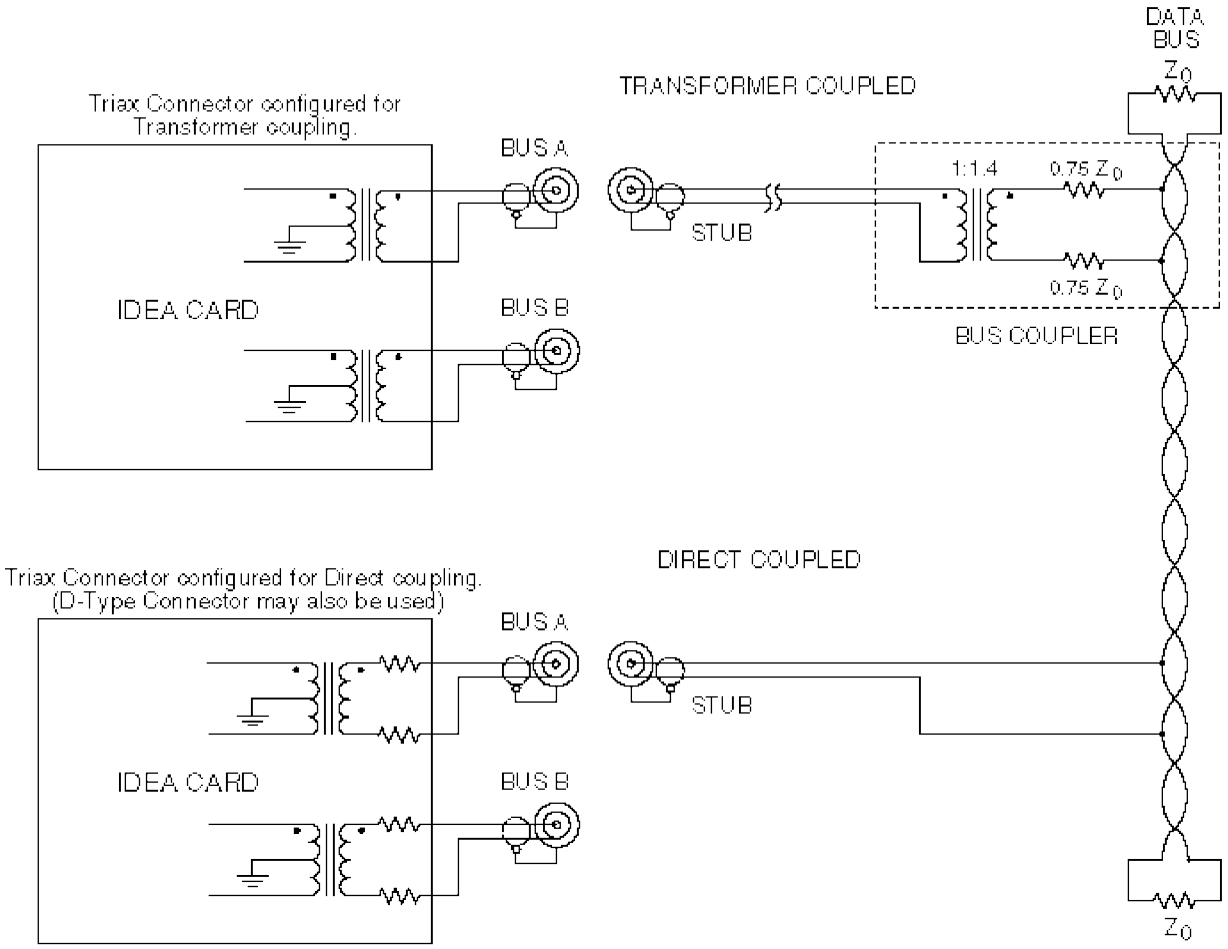
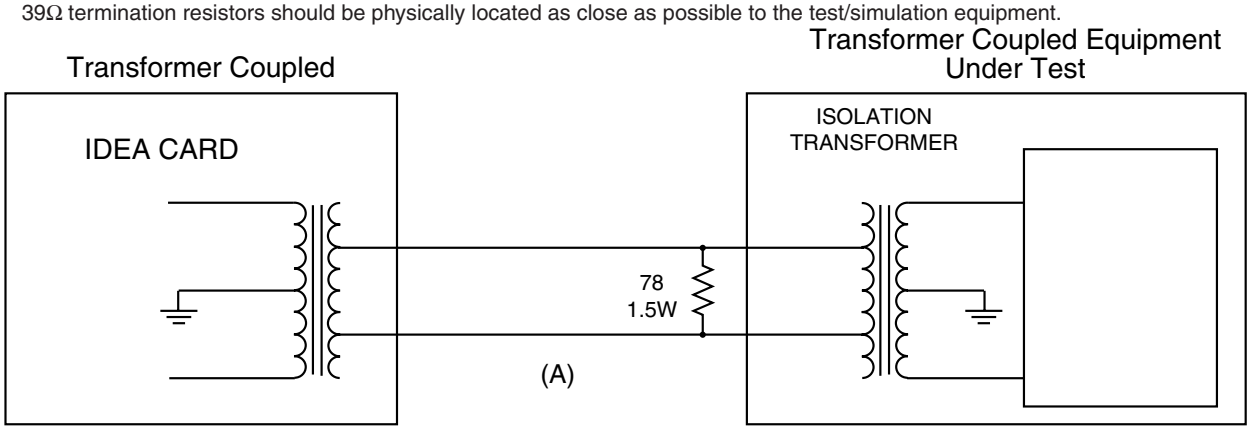


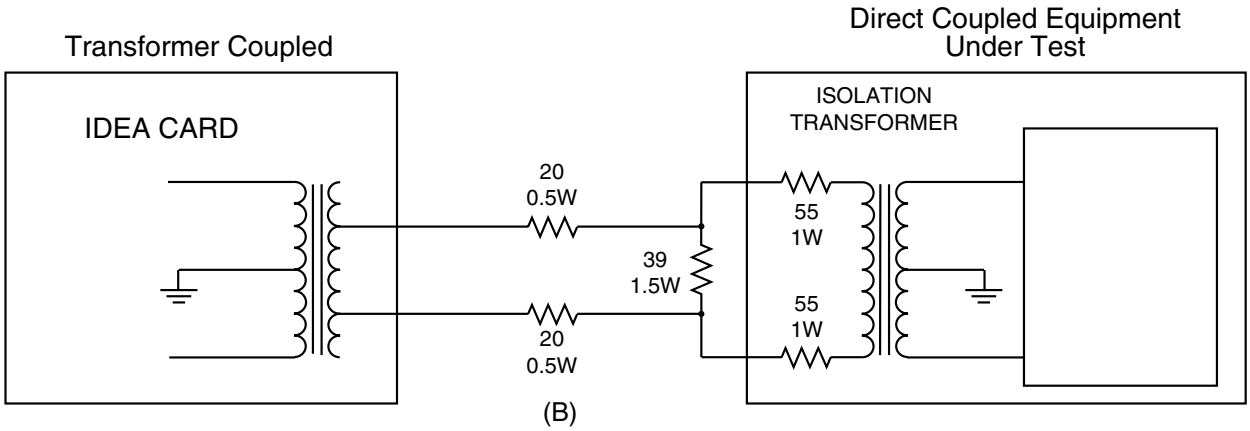
FIGURE 5. INTERFACE TO A MIL-STD-1553 BUS

"SIMULATED BUS" (LAB BENCH) INTERCONNECTIONS

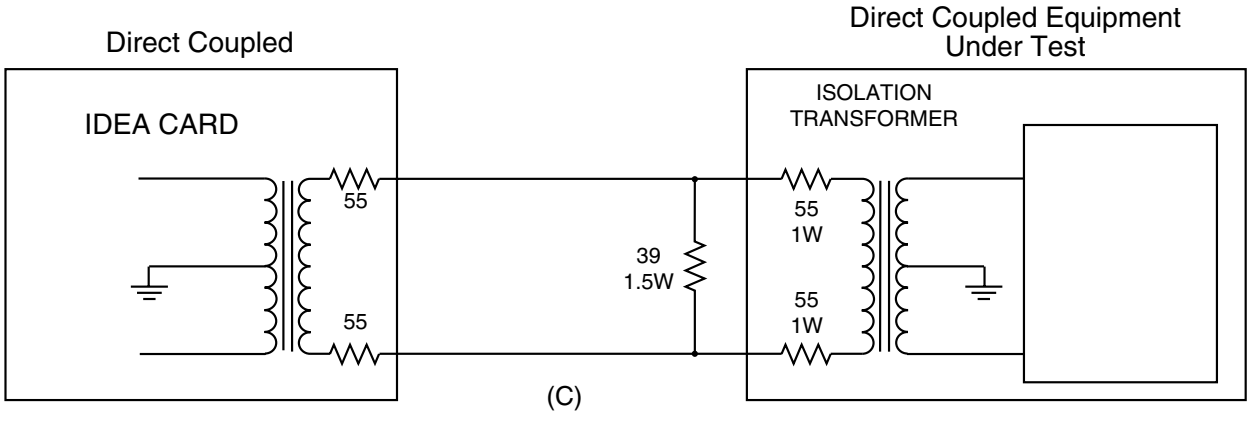
For purposes of software development and system integration, it is generally not necessary to integrate the required couplers, terminators, etc., that comprise a complete MIL-STD-1553B bus. In most instances, a simplified electrical configuration will suffice. The interconnection methods illustrated in FIGURE 6 allows the IDEA Card to be interfaced over a "simulated bus" to simulation and test equipment. The length of this "simulated bus" should not exceed 5 feet. It is important to note that the **termination resistors indicated are necessary** (if not already present within the test/simulation equipment) in order to ensure reliable communications between the IDEA Card and the simulation/test equipment. As illustrated in FIGURE 6 the 78Ω and 39Ω termination resistors should be physically located as close as possible to the test/simulation equipment.



Transformer Coupled-to-Transformer Coupled;



Transformer Coupled-to-Direct Coupled;



Direct Coupled-to-Direct Coupled;

Figure 6. Simulated BUS Interconnections

INSTALLING SOFTWARE PROTECTION PAL

Several optional software packages are available in support of the BUS-65517II. Licensing for these software packages is controlled by a “protection PAL” installed on the card. The protection PAL is located on the board just above the memory base address jumpers and is labeled “U54" (refer to FIGURE 2 for the location of the protection PAL). The default PAL shipped with the card is U54C (U54B for older cards). This PAL provides access to the DOS menu. The optional replacement PALs will be labeled “U54C-xx”, where xx represents a 2 digit number indicating the software option. For example the BUS-69025 software package contains a U54C-25 protection PAL which provides a license to use the C and Pascal runtime libraries for DOS and Windows. The protection PAL is socketed to allow for easy removal and installation of new PALs.

The distribution disks for the BUS-65517II IDEA Card contain all of the optional software packages available for the card. Running a software program without the appropriate license (ie. protection PAL) will result in a runtime error with the card.

Installing a new software option requires that the U54 chip be replaced with the new PAL. Care should be taken to ensure that none of the components on the card are damaged due to electro-static discharge (ESD).

1. First take note of the orientation of the chip in the socket (ie the location of pin 1). Pin 1 is indicated on the PAL by a U shaped indentation on one edge of the chip. The outline of the chip screened on the board has a similar indentation indicating the proper way in which the chip must be inserted.
2. Remove the existing U54 chip using an IC puller or a suitable chip extraction device.
3. Install the new U54 chip into the socket paying close attention to the location of pin 1 on both the IC and the socket (see FIGURE 7).
4. Visually inspect the chip to ensure that the orientation of the chip is proper, the chip is properly seated in the socket and that no pins are bent over.

After installing the new PAL it is recommended that the IDEASOFT program be run to check that the protection PAL indicates the proper software options. It is also recommended that the IDEA menu be run to ensure that the card is operating properly.

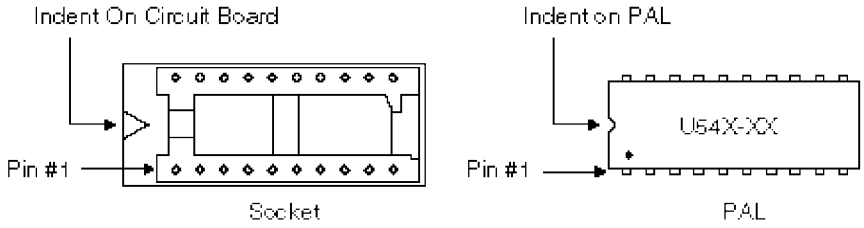


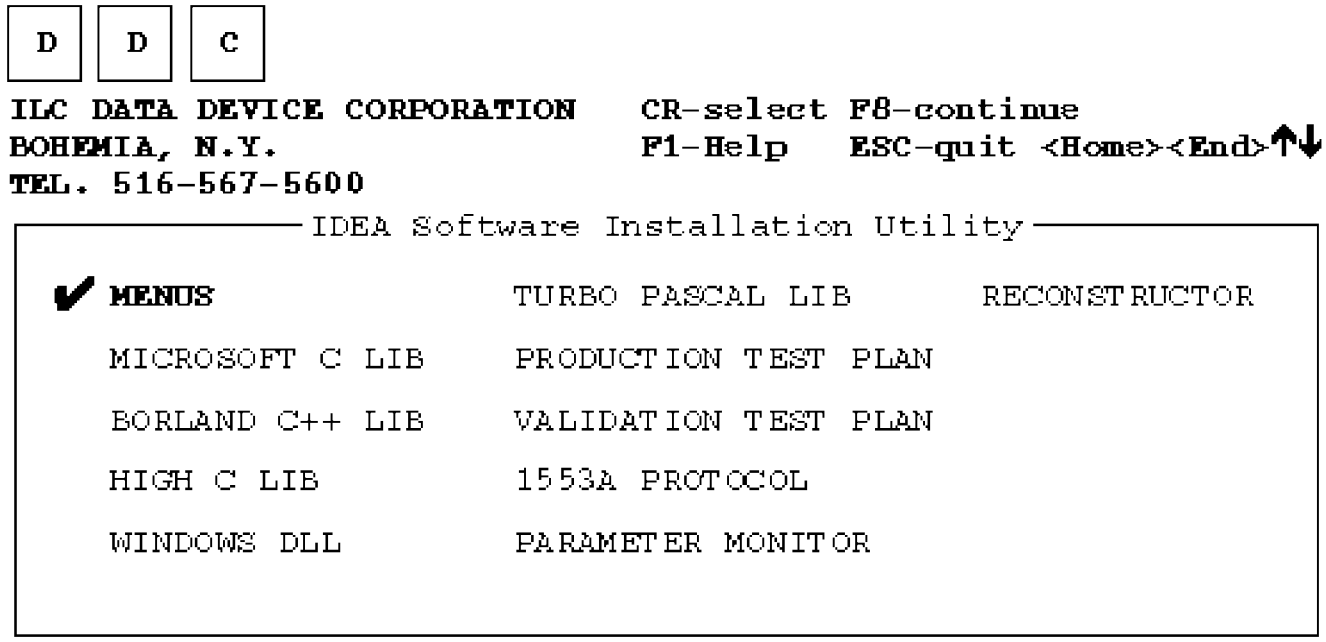
FIGURE 7. PROTECTION PAL AND SOCKET

SOFTWARE INSTALLATION

Place disk #1 in drive A: and type the following:

`A:`	(change to drive containing IDEA disks)
`INSTALL`	(execute installation program)

You will see a screen like the one below:



To select the item you want to install, simply highlight the option, using the arrow keys, and depress the RETURN (CR) key. Once an item has been selected there will be a **%** next to that item (As shown above). To Deselect that item simply highlight and press the RETURN (CR) key again. You may install all of the software packages but the protection PAL (labeled U54... on the IDEA card) will ONLY allow you to use the ones you paid for.

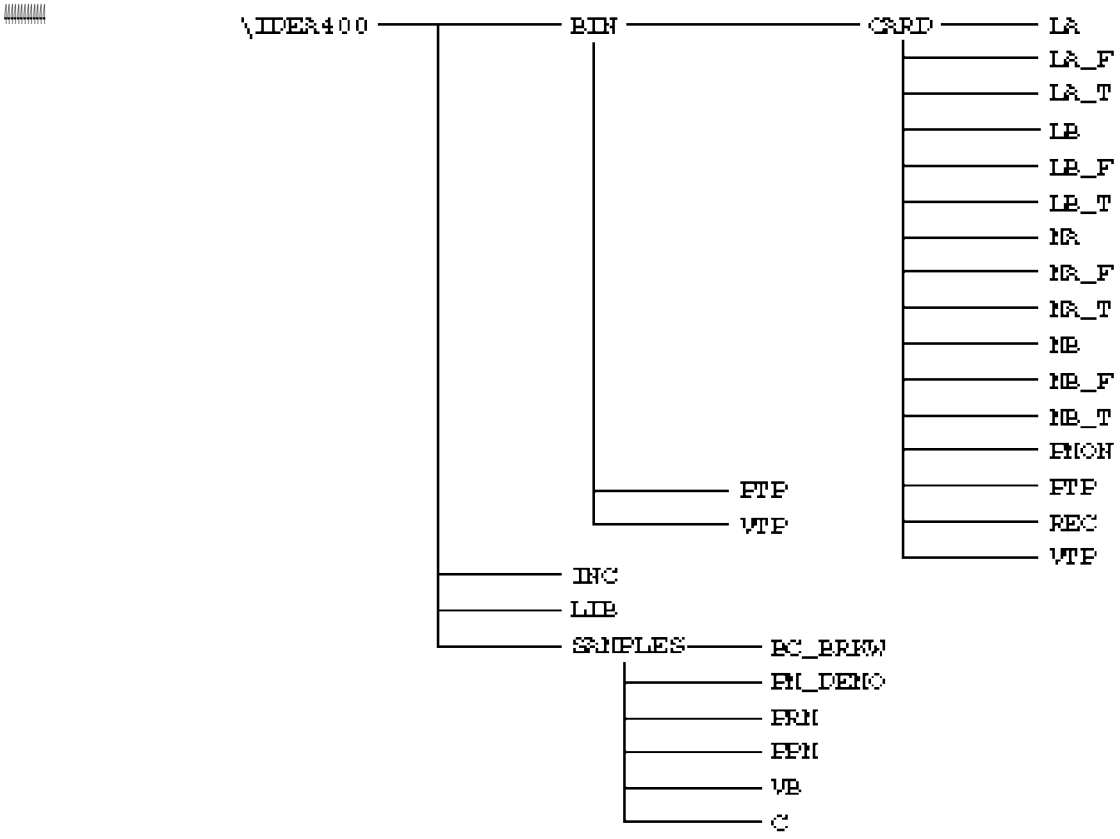
Once all selections have been made, depress the F8 Key to continue with the installation process. If you wish to quit the installation program at any time, depress the ESC key.

At this point in the installation process the user will be prompted for the interrupt request and the base address. Enter the values that were configured during the hardware installation. Once the interrupt and address are entered the user will then be prompted for the drive which the software will be installed to. Next a directory can be chosen for the software. The default drive is C and the default directory is IDEA400.

Once the user confirms his choices the actual installation will begin. The IDEA software is organized on your HARD DISK in the form of a tree as illustrated below.

NOTE: The tree depends on the software that has been installed, thus your tree may not have every branch.

IDEA TREE:



Your diskettes can be copied as often as you wish. However, the software products are protected and require the correct version of the PAL in order to run. The protection PAL is a device on the board which is labeled U54.... This device is mounted on a socket to be replaced by the customer.

The directory `\IDEA400` (which is the root of the IDEA tree) contains 5 sub-directories (maybe less) and the following files:

- readme.txt (a text file with the latest revisions)
- release.txt (release notice for the IDEA software)
- ideasoft.exe (a program to read the PAL and tell the user what software he may access) (See IDEASOFT Section on page 18)
- rest_scn.exe (an auxiliary program used by ideasoft.exe)
- ideasoft.hlp (an auxiliary program used by ideasoft.exe)
- bimgr.sys (an auxiliary program used by ideasoft.exe)

The **BIN** sub-directory contains the sub-directory `CARD` and the following executable files and dynamic link libraries:

- setidea.bat - a batch file to help you define the environment variable IDEA
- idea.exe - DOS IDEA Menus
- pmon.exe - Parameter Monitor
- rec.exe - Communication Reconstructor
- idwbc40.dll - DLL for C applications under MS Windows 3.1/3.11
- iddp.dll - DLL for Pascal Protected Mode applications
- idvb.dll - DLL for MS Visual Basic applications under MS Windows 3.1/3.11

The **PTP** and **VTP** sub-directories contain the executable files for the corresponding applications:

- product.bat - Production Test Plan
- validate.bat - Validation Test Plan

The **CARD** sub-directory contains 16 subdirectories with the binary files `(*.BIN)`. The following name convention is used:

1. Sub-directories PMON, PTP, REC and VTP contain the binary files used by the IDEA card to run the corresponding applications.
2. Other sub-directories have a name of the form: XY_Z,

where X specifies the IDEA application type. The available options are:

X = M (Menu applications) - This option provides the shortest Intermessage Gap. Intermessage routines are not executed.

X = L(Library applications) - This option allows the execution of up to 2 Intermessage Routines by the BC or RTs during the Intermessage Gap.

Y specifies the 1553 protocol. The available options are:

Y = A (MIL-STD-1553A)
Y = B (MIL-STD-1553B)

Z specifies the IDEA Monitor type. The available options are:

Z = [blank] (Regular Monitor) - This option provides the selective, triggerable Bus Monitor with extensive capabilities for communication error detection. The shortest monitored intermessage gap is 14 usec.

Z = F (Fast Monitor) - Non-selective and non-triggerable Bus Monitor. The shortest monitored intermessage gap is 4 usec.

Z = T (Turbo Monitor) - Selective, triggerable Bus Monitor with limited capability for triggering. The shortest monitored intermessage gap is 7 usec.

The following table summarizes the distinguishing features of the Regular, Fast, and Turbo Monitor.

Features	RM	FM	TM
Message Selection	Yes	No	Yes
Support RTC (bits)	32	16	32
Output Trigger	Yes	No	No
Capture on commnd	Yes	No	Yes
Capture on flagged bit in status	Yes	No	TX only
Capture on other exception	Yes	No	Yes
Extra Word Check	Yes	No	RX only
Set exception “Flagged Bit in Status”	Yes	Yes	TX only

Each of the above (XY_Z) sub-directories include the appropriate versions of the following files:

mon.bin
bcrt.bin
imrlib.bin
bootmk2.bin
idea.sym

NOTE: These files are copied automatically and must not be modified by the user.

There is also an IDEA.CFG file in each of the subdirectories that have binary files. These configuration files allow the user to modify software configurations. (See CONFIGURATION FILE on page 22).

The **LIB** sub-directory contains the following static link libraries:

- id_drvl.lib - Microsoft C 5.1 Large Memory Model
- id_drvl7.lib - Microsoft C 7.0 Large Memory Model
- iddp.lib - Borland Pascal 7.0 Protected Mode Import Library
- iddrvhcf.lib - MetaWare High C 3.3 Flat Model
- idrvbc31.lib - Borland C 3.1 Large Memory Model
- idrvbc40.lib - Borland C/C++ 4.5 Large Memory Model
- idvb.lib - Microsoft Visual Basic 3.0 Import Library
- idwbc40.lib - Microsoft Windows 3.1/3.11 Import Library for Borland C/C++ 4.5 or

Microsoft Visual C/C++ 1.5 applications.

The **INC** sub-directory contains the include files for C/C++, Pascal (Real and Protected Mode) and Visual Basic applications:

- drv.in - include file for C/C++ applications
- const.bas, func.bas - include files for Visual Basic applications
- idea_pm.pas - include file for Pascal Protected Mode applications
- ideadrv.pas - include file for Pascal Real Mode applications.

NOTE: The other files contained in the INC directory are included automatically and must not be modified by the user.

The **SAMPLES** sub-directory contains the following examples of IDEA applications:

- BC_BRKW- this sub-directory contains a "C" application under MS Windows. The application may be compiled with either MS Visual C (Quick Win) or Borland C (EasyWin) compilers. The import library IDWBC40.LIB must be added to the project.
- C - this sub-directory contains 2 "C" applications under MS DOS. The applications may be compiled with any of the above mentioned C compilers. The corresponding IDEA static library must be added to the project.
- PPM - this sub-directory contains 3 "Pascal" applications under MS DOS. The applications may be compiled with Borland Pascal 7.0 for Protected Mode.
- PRM - this sub-directory contains 3 "Pascal" applications under MS DOS. The applications may be compiled with Borland Pascal 7.0 for Real Mode.
- VB - this sub-directory contains a "Basic" application under MS Windows. The application contains 2 files (*.bas and *.frm). It may be compiled with MS Visual Basic 3.0. Include files CONST.BAS and FUNC.BAS must be added to the VB project.
- PM_DEMO- DEMO project for Parameter Monitor (see PMON USER GUIDE for details).

NOTE:
1. IDEA FOR WINDOWS must be installed before running any other application ("C" or "Basic") under MS Windows.
2. Beginning from Software Release 4.0 you must not modify the IDEA.CFG file and the `*.BIN, *.SYM` files in the case of Windows applications. Instead, the card(s) configuration and the desired application type should be defined interactively from the Control Panel. These limitations are required to allow separate IDEA applications to be run as separate tasks and as a result fast switching between the different types of card applications is facilitated. For example, you can run the Menu/1553B Bus Controller with the Turbo Monitor and then run the Driver/1553A Bus Controller with the Regular Monitor without exiting Windows and redefining of the IDEA environment variable.

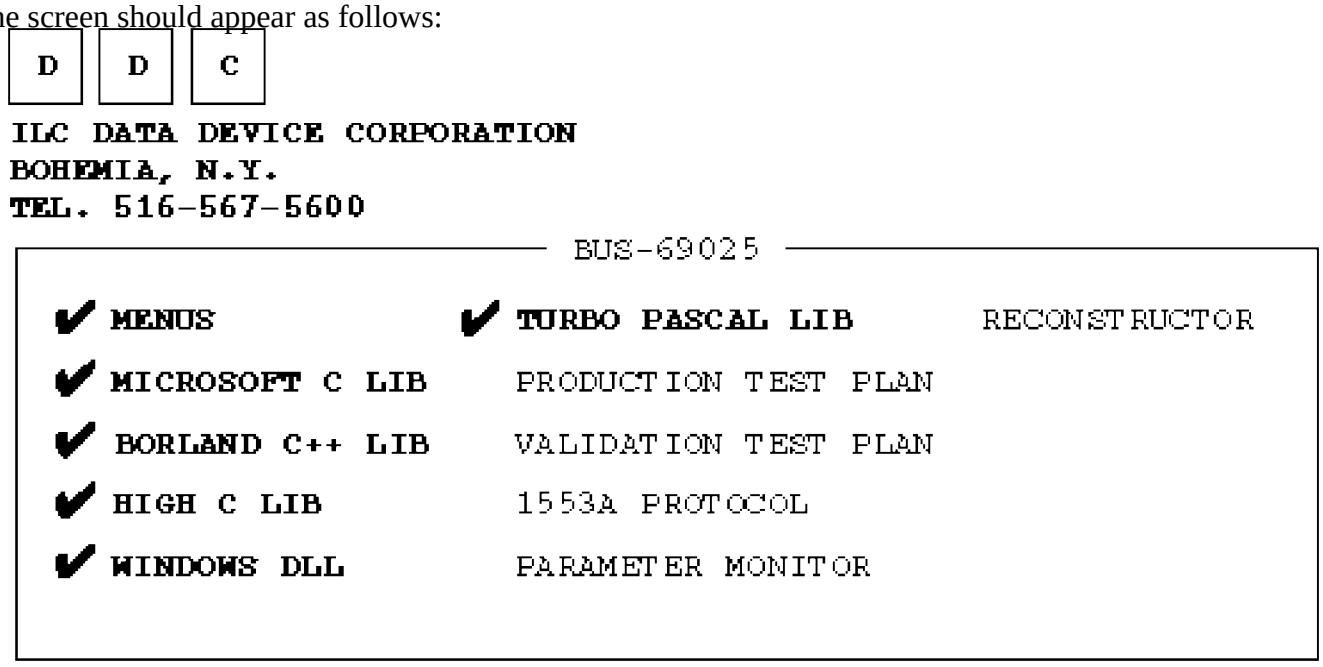
Note: If you are only installing the Windows Menus, skip to page 55.

USING THE IDEASOFT PROGRAM: Checking to see what software you can use.

After you have installed the software, you can use the IDEASOFT.EXE program in the root of the IDEA tree to determine the software that can be used. To use this program type the following at the DOS prompt:

`C:`	(change to drive with IDEA software)
`CD IDEA400\BIN`	(move to the bin directory of the IDEA tree)
`SETIDEA M B`	(setup path for binary and symbol files)
`CD ..`	(move to the root of the IDEA tree)
`IDEASOFT`	(execute the Ideasoft program)

The screen should appear as follows:



The screen above is displayed if you have the BUS-69025 PAL (U54C-25) installed. The checked values are also displayed in green if you have a color monitor. These check marks tell you which Software Packages the protection PAL allows you to access.

If the screen comes up with nothing checked (ALL options in RED), it could be one of the following:

A) The card is not installed in the computer.
B) You did not type `SETIDEA M B` before running the IDEASOFT program.
C) The base address or interrupt request value in the `IDEA.CFG` file does not match what is

jumpered on the card. (See CONFIGURATION FILE, page 22).

RUNNING THE MENU DRIVEN SOFTWARE FOR THE FIRST TIME

The BUS-65517II comes with, at a minimum, a U54C PAL (U54B on older IDEA Cards) which is capable of running DOS/Windows menus to control the card.

Before preceding any further it is wise to run the menu software to insure that the card, PAL and software are installed properly.

To run the menu software, type the following:

`C:`	(change to drive with IDEA software)
`CD IDEA400\BIN`	(move to the bin directory of the IDEA tree)
`SETIDEA M B`	(setup path for binary and symbol files)
`IDEA`	(execute the MENU software)

If the card is running and configured correctly the initial menu screen should appear with I D E A displayed in big block letters. At the bottom of the screen a message should appear indicating -> "Self_Test Passed". If this message does not appear one of the following problems may have occurred.

A) The card is not installed in the computer.

B) SETIDEA was not run or was run incorrectly, so initialization of the environmental variable did not proceed correctly. At the DOS prompt and while in bin directory of the IDEA tree, type `SETIDEA M B` and then type `SET`, there should be a line:

```
IDEA=C:\IDEA400\BIN\CARD\MB.
```

C) The jumpers on the card which indicate the base address and interrupt request do not agree with the values that were given during installation of the software. In this case, the user must determine the base address and interrupt request on the card and modify the `IDEA.CFG` file (see CONFIGURATION FILE on page 22).

If you are able to determine that none of the above problems has occurred and the card in still not passing the self test, the problem is most likely a conflict between your base address and another program using the same half segment or an interrupt conflict. At this point, turn off the computer and remove the card and determine another half segment that is free in your computer. Change the jumpers on the card and then reinsert the card into the 8-bit slot. Now the `IDEA.CFG` file must be modified to so it can access the new half segment in memory (see CONFIGURATION FILE on page 22). Try to run the software, if it still does not pass repeat the process with a different base address or interrupt request.

THE IDEA ENVIRONMENT

The software downloaded to the card (binary and symbol files) reside in a directory which is specified by the environment variable called **IDEA**.

This variable must set before running the program.

Suppose, for example, that you want to run `IDEA.EXE` with the Fast Monitor and the 1553A option. The IDEA variable should be assigned as follows:

```
SET IDEA=C:\IDEA400\BIN\CARD\MA_F
```

If you run your program or `IDEA.EXE` from a directory which contains the files downloaded to the card, you do not have to define the variable IDEA.

To cancel the variable, simply type:

```
SET IDEA=
```

We recommend that the user append the `PATH` statement in their `AUTOEXEC.BAT` to include the path to the subdirectory `C:\IDEA400\BIN\` so that the `IDEA.EXE` menu program can be run from any subdirectory.

Note: There are no spaces on either side of the "=" sign in the `SET` statement.

> **WARNING:**
>
> 1) Make sure that the IDEA variable specifies the correct sub-directory of the type of program you would like to run. Use the `SET` command to check its value.
>
> 2) Don't mix `*.BIN` and `*.SYM` files from different subdirectories. Although they may have the same name and size, they have different contents.

Using Setidea

SETIDEA.BAT is a batch file located in the bin directory of the IDEA tree.

Its purpose is to quickly set the path for the environmental variable IDEA so that the correct software is downloaded to the card. Since there are many different ways the software can be run, the parameters for SETIDEA allow the user to change the IDEA variable and run the card as specified.

The syntax of SETIDEA are as follows: ("|" can read as an "or")

```
SETIDEA M|L A|B [F|T] or
SETIDEA P|R|V|O
```

M - stands for MENU L - stands for LIB
A - stands for 1553A B - stands for 1553B
F - stands for FAST MONITOR T - stands for TURBO MONITOR
P - stands for PARAMETER MONITOR
R - stands for RECONSTRUCTOR
V - stands for VTP
O - stands for PTP

`SETIDEA M B F, SETIDEA P, SETIDEA L A` are all legal commands using SETIDEA. They will set the environmental variable IDEA as follows:

`SETIDEA M B F`	=> MENU software using 1553B protocol and FAST MONITOR
`SETIDEA P`	=> PMON software
`SETIDEA L A`	=> LIB software using 1553A protocol

If the user were to type `SET` at the command prompt after each SETIDEA command the IDEA variable path will change as follows:

```
IDEA=C:\IDEA400\BIN\CARD\MB_F
IDEA=C:\IDEA400\BIN\CARD\PMON
IDEA=C:\IDEA400\BIN\CARD\LA
```

Only one software package can be used at any one time. Thus, if you are using MENU (DOS Menus) with 1553B protocol and now wish to use 1553A protocol, you must exit out of MENU and type `SETIDEA M A` to switch IDEA to the correct directory.

CONFIGURATION FILE

The CONFIGURATION FILE consists of assignment instructions used to initialize certain program parameters. The file is named `IDEA.CFG` and each line has the following syntax:

```
<keyword>=<value>
```

There are `IDEA.CFG` files in each subdirectory that contain binary and symbol files (every subdirectory of CARD). The configuration file located in the `C:\IDEA400\BIN\CARD\MB` directory should be modified when using the MENU 1553B software. The configuration file located in the `C:\IDEA400\BIN\CARD\MA` should be modified when using the MENU 1553A software. You must be careful to modify the correct configuration file for the software that you will be using and that MEMORY and INTERRUPT have the same values as the jumpered IDEA card. At a minimum, the file should contain the lines:

```
MEMORY=D000
TYPE=3
INTERRUPT=3
```

The keywords are:

MEMORY - This instruction defines the memory location (base address) occupied by the IDEA board. The values specify half segment boundaries; the legal values are A000, A800,..., F000, F800. All 4 characters should be specified. This half segment must have the same value as the base address jumpered on the board. If you change the base address jumpered on the board and do not want to reinstall the software, simply change the MEMORY value to the new address.

Usually, at least one of the half segments A000, A800, D000, or D800 are free.

Example: `MEMORY=D000`

INTERRUPT - This instruction specifies an integer which determines the interrupt request line used by the IDEA card. The value of this keyword must be the same as the value jumpered on the card. If you change the jumpered value you must edit this line to match the jumpered value or else you will not be able to run the software.

Example: `INTERRUPT=3`

TYPE - This instruction defines the card's hardware version.

Example:	`TYPE=3`	(defines MK II hardware)
	`TYPE=1`	(defines MK I hardware)
	`TYPE=4`	(defines VME/VXI hardware)

1553 - This instruction specifies whether 1553A or 1553B should be emulated.

Example:
```
1553=A
1553=B
```

DEBUG(optional) - This instruction allows you to exit the IDEA.EXE program to a DOS shell by pressing F9.

Example: `DEBUG=yes`

EXPANDED (optional) - This instruction allows you to use expanded memory for the Monitor stack. Only non-cyclic stacks are supported when this option is invoked. Both EMM 4.0 and COMPAQ EMM 3.2 standards are supported.

Example: `EXPANDED=yes`

COLORS (optional) - This instruction assigns the colors used be the program. The colors are numbered as follows:

0 - BLACK	2 - GREEN	4 - RED	6 - BROWN
1 - BLUE	3 - CYAN	5 - MAGENTA	7 - WHITE

The color mapping is specified by a vector with 8 entries, numbered 0 to 7 from left to right. The value in the J'th position defines which color shall be used instead of color J. The default mapping is:

COLORS=0 1 2 3 4 5 6 7

Example: `COLORS=0 1 2 3 7 5 6 7` (replaces red by white)

Note: COLORS=0 0 7 7 2 0 0 7 (best color selection for B&W display)

SETUP(optional) - This instruction specifies a user setup file which is used to overwrite the IDEA program default values. The instruction has the form:

`SETUP=my_set.sup` (the sup extension stands for SetUP)

KEYSTROKE(optional) - This instruction causes the IDEA program to automatically execute the specified keystroke file. The execution begins immediately after entering the root menu for he first time. The keystroke file is executed after loading the setup file. The instruction has the form:

`KEYSTROKE=my_key.plb` (the plb extension stands for PLayBack)

DELAY (optional) - This instruction specifies an integer which defines the delay before reading the next keystroke from the playback file. This option is useful for demonstration or debugging purposes. An instruction that sets DELAY equal to 1 will cause the IDEA program to enter the main menu without the need for intervention from the keyboard. This is useful when running the IDEA from a batch file. The default assignment is:

```
DELAY=0
```

PRN_SCREEN (optional) - By default F7 outputs the current screen to the printer. This instruction can be used to redirect the output to a file. The instruction has the form:

```
PRN_SCREEN=filename.prn
```

The remaining sections describe in detail the operation of the DOS/Windows Menus which come with the BUS-65517II card. For operation information on the other software packages that your PAL can support, refer to that specific software manual.

OPERATION OF DOS MENU

The 1553 IDEA provides a menu-driven interface for defining all options, parameters and data. The menus are organized in a tree structure as illustrated in FIGURE 8. The root menu is shown in FIGURE 9.

While in a menu page the cursor is controlled by the standard positioning keys: right/left arrows, up/down arrows, End, Home and Tab.

Menu pages can be printed at any time by pressing Shift-PrtSc.

Each menu contains the menu path-name located at the top-left corner of the screen, a list of sub-menus displayed across the top of the screen in the form of a bar (where applicable), menu variables and a list of function keys located at the bottom of the screen.

Sub-menus are chosen in one of two ways: by typing the bold character in the sub-menu name or by positioning the cursor on the name and striking Enter.

The menu variables specify all user definable parameters. The value of a variable is changed by simply positioning the cursor on the appropriate field and overwriting its contents. When relevant, the user is assisted by windows explaining the options and is warned if he attempts to enter an illegal value.

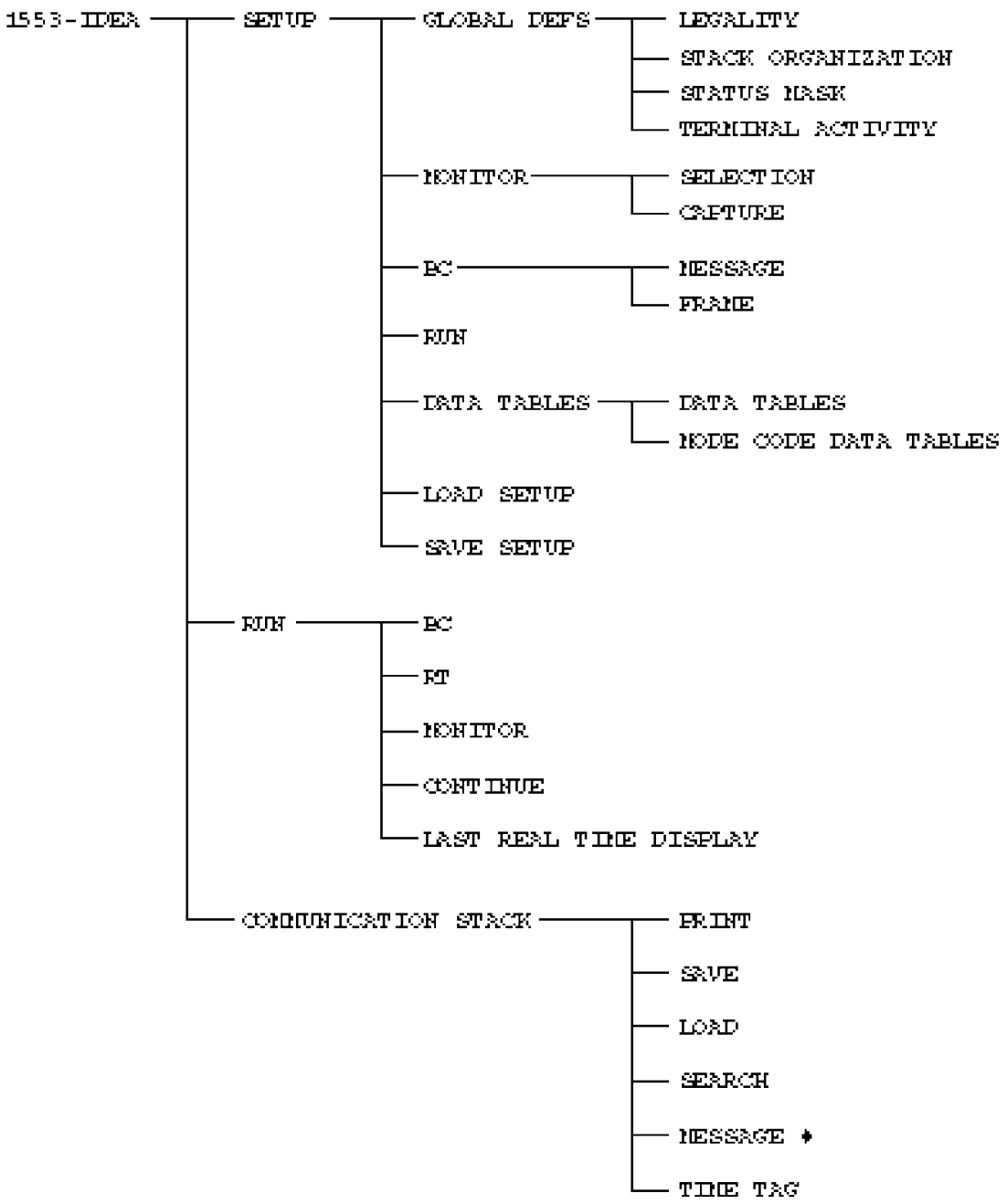


FIGURE 8. MENU TREE

As mentioned earlier, the bottom line of each menu page contains a list of function and control keys. Their definitions are as follows:

F2 - ABORT
The ABORT option returns the user to the parent menu without updating internal variables.

F3 - RESET
The RESET option resets the card and returns control to the root of the menu tree without modifying the setup. This option is always available - even when keystrokes are read from a file instead of the keyboard.

F4 - TO ROOT
The ROOT option returns the user to the root of the menu tree after updating internal variables.

F5 - KEYSTROKE
The KEYSTROKE option provides the following functions:

* SAVE
  SAVE causes all subsequent keystrokes to be recorded in a disk file. This operation is terminated by pressing F5 once again. The file name is specified by the user and the extension ".plb" (playback) is automatically appended.

* READ
  READ causes previously saved keystrokes to be read from a file instead of the keyboard. The file name should be given without the extension ".plb".

* LIST
  LIST displays all file names ending in ".plb" in the default directory. A file is READ by positioning the cursor on the appropriate name and striking ENTER. The LIST option is exited by striking Esc.

F6 - NO DISPLAY
The NO DISPLAY option suppresses the display of the menu's bottom line.

F7 - PRINT SCREEN
The PRINT SCREEN option sends the current screen to the line printer or to a file (see CONFIGURATION FILE on page 22).

F10 - NEXT
The NEXT option toggles the contents of the screen's bottom line (since more than one line is required to display all the function key options).

Esc - RETURN
Esc returns the user to the previous menu.

MODES OF OPERATION

The 1553-IDEA WORKSTATION has 3 modes of operation (FIGURE 9):

1. SETUP
2. RUN
3. DISPLAY COMMUNICATION STACK

The SETUP mode allows the user to define parameters, and data with the assistance of a menu-driven interface. All set-ups and keystrokes can be saved for future use. No real-time activity is performed while in this mode.

In RUN mode the previously defined setup is executed. The BC/RTs transmit and receive 1553 traffic and the Monitor stores the messages in a cyclic buffer. The IBM, in real-time, copies the Monitor's buffer to a much larger stack in its own memory space and updates a screen of counters (number of messages and error types per RT). No modification of parameters or data is supported during RUN mode.

The DISPLAY COMMUNICATION STACK mode allows the user to examine monitored traffic. Since the stack can be of considerable size (> 100KB), tools are provided for searching, scrolling, saving, and printing the stack.

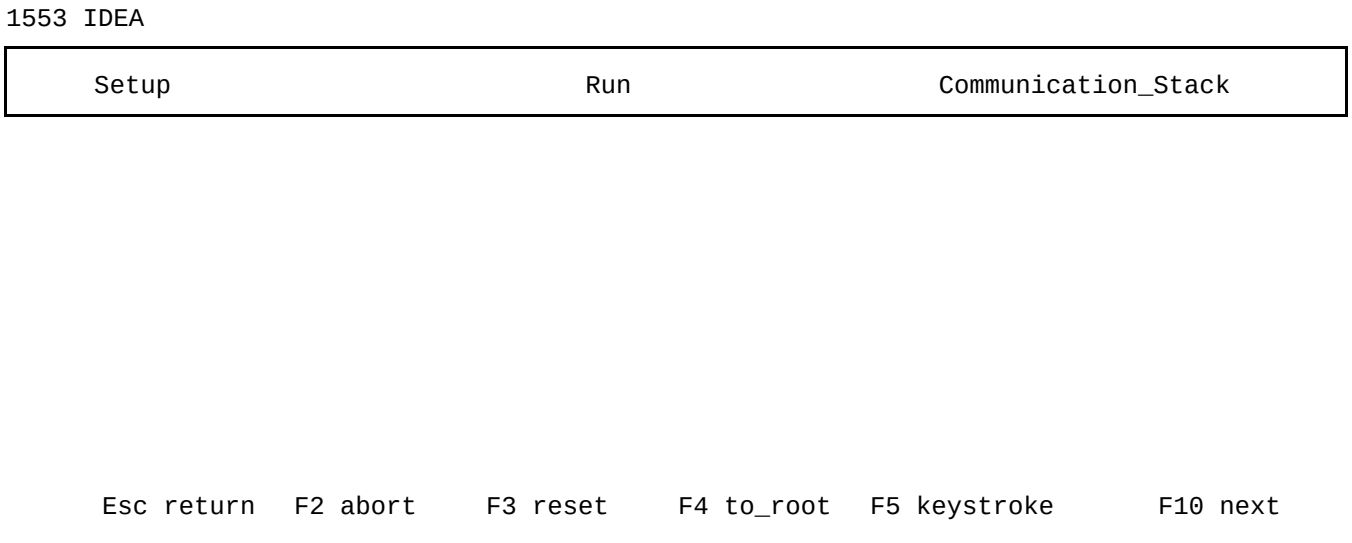


FIGURE 9. ROOT MENU

SETUP MENU

All parameters and data are entered via the SETUP menu (FIGURE 10).

```
/setup
```

```
Global_defs      Monitor      BC      RT      Data_tables      Load\Save_setup
```

FIGURE 10. SETUP MENU

GLOBAL DEFINITIONS

The GLOBAL DEFINITIONS, illustrated in FIGURE 11, are common to the BC, RTs and Monitor. In addition to choosing from 4 sub-menus, the user can modify a table consisting of the following variables:

1. **Transmit Amplitude**
   The transmit amplitude of the BC and RT can be varied from 0.10 to over 18 volts P-P as measured across a 77 ohm load attached to the card's triax connector. The amplitude is specified by entering a number between 0 (minimum) and 255 (maximum).
2. **Response Timeout**
   The response timeout counter of the BC, RT, and Monitor can be programmed with the following values: 14, 16, 18 and 20 microseconds. If a status word is received after the allowed time, the Monitor and BC will detect a "No Response" error but the word will not be stored. This definition also affects an internal RT when participating in an RT-RT transfer with an external RT serving as transmitter.

```
/setup/global_defs
```

```
Legality      Stack_organization      status_Mask      Terminal_activity
```

```
Transmit Amplitude:    200
```

```
Response Timeout:       14  usec
```

FIGURE 11. GLOBAL DEFINITIONS MENU

Legality

The LEGALITY menu is shown in FIGURE 12. The legality detection option determines whether or not message legality should be checked by the RTs. If the option is chosen, the RT will respond to illegal commands with ME=1 in the status.

The user can choose whether or not to implement the broadcast option. If broadcast is not implemented, the RTs will ignore such messages and the Monitor will flag them as illegal.

Each mode code, including all reserved codes, can be defined as legal or illegal. However, if MIL-STD-1553B associates a unique T/R bit value with a mode code, then the same mode code with the opposite T/R bit value is always illegal. If a reserved code with data is legalized, it will be legal for both values of T/R.

The legality detection option, broadcast implementation option, and mode command legality are defined by entering Y/N in the relevant field. These definitions effect all RTs. By default, all options and all non-reserved mode commands are legal.

/setup/global_defs/legality

Broadcast:		Yes	Legality		Yes
Mode Commands Without Data			Mode Commands With Data		
00000	Dynamic Bus Control	Yes	10000	Transmit Vector Word	Yes
00001	Synchronize	Yes	10001	Synchronize	Yes
00010	Transmit Status Word	Yes	10010	Transmit Last Command	Yes
00011	Initiate Self Test	Yes	10011	Transmit BIT Word	Yes
00100	Tx Shutdown	Yes	10100	Selected Tx Shutdown	Yes
00101	Override Tx Shutdown	Yes	10101	Override Sel. Shutdown	Yes
00110	Inhibit TF Bit	Yes	10110	Reserved	No
00111	Override Inhibit TF	Yes	10111	Reserved	No
01000	Reset Remote Terminal	Yes	11000	Reserved	No
01001	Reserved	No	11001	Reserved	No
01010	Reserved	No	11010	Reserved	No
01011	Reserved	No	11011	Reserved	No
01100	Reserved	No	11100	Reserved	No
01101	Reserved	No	11101	Reserved	No
01110	Reserved	No	11110	Reserved	No
01111	Reserved	No	11111	Reserved	No

FIGURE 12. LEGALITY MENU

Stack Organization

The STACK ORGANIZATION menu is shown in FIGURE 13.

The stack size can be varied in 2KB increments from 64KB to the maximum available RAM space under DOS. In order to assist the user, the maximum available space appears on the screen.

The stack may be defined as cyclic (i.e., overwritten after it is filled) or non-cyclic.

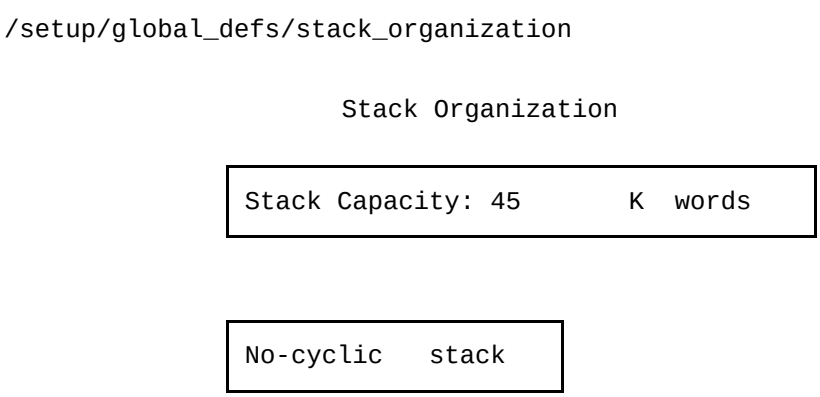


FIGURE 13. STACK ORGANIZATION MENU

Status Mask

The Monitor masks all received status words. The most significant 5 bits in the STATUS MASK are always "0"'s; the remaining bits are defined by the user. If a bit in the mask word is set to 1 and the corresponding bit in the status is also set to 1, the Monitor detects an exceptional condition. Exceptional conditions are counted in real-time and denoted in the stack. The menu is shown in FIGURE 14. By default, all mask bits are set.

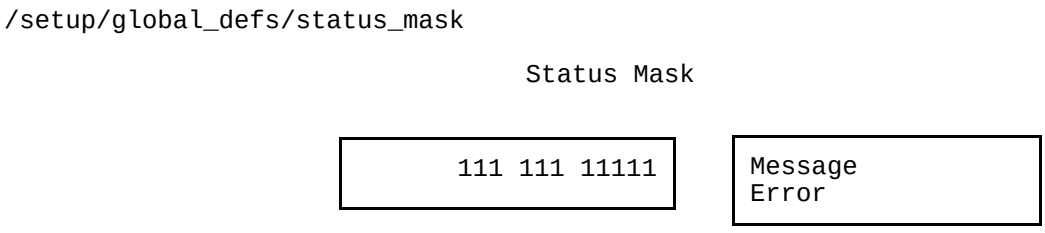


FIGURE 14. STATUS MASK MENU

Terminal Activity

The TERMINAL ACTIVITY menu (FIGURE 15) defines the set of emulated terminals (RTs and BC). If the BC is emulated, it must be assigned a terminal address (since after passing control it may become an RT).

By default, the BC and 4 RTs are emulated; they are assigned terminal addresses 0 and 1-4 respectively.

The activity of terminal 31 (broadcast), as determined by the LEGALITY menu, is also indicated.

```
/setup/global_defs/terminal_activity

      Emulated RTs and BC
```

Bus Controller	
Emulated: Yes	By terminal: 00

Tadr		Tadr		Tadr		Tadr	
00	Yes BC	08	No	16	No	24	No
01	Yes	09	No	17	No	25	No
02	Yes	10	No	18	No	26	No
03	Yes	11	No	19	No	27	No
04	Yes	12	No	20	No	28	No
05	No	13	No	21	No	29	No
06	No	14	No	22	No	30	No
07	No	15	No	23	No	Bcst	Yes

FIGURE 15. TERMINAL ACTIVITY MENU

MONITOR

The Monitor operation is organized as a pipeline with 3 stages: the first stage monitors all messages received from the bus, the second stage stores selected messages in a circular buffer, and the third stage transfers the contents of the circular buffer to the IBM stack. The second and third stages are programmed by the SELECTION and CAPTURE menus respectively (FIGURE 16).

The first stage of the Monitor's pipeline listens on both buses until it detects a command and then receives exclusively from the active bus until the message is completed or invalidated. All errors recognized by the Monitor, except "Incorrect RT address in status" and "Flagged bit in status", invalidate the message.

```
/setup/monitor
```



FIGURE 16. MONITOR MENU

Selection

The SELECTION option (FIGURE 17) specifies which messages should be stored in the circular buffer. The selection is based on the values of the 11 bits: terminal address, T/R, sub-address. After choosing this option, a 32 X 32 matrix with rows corresponding to terminal addresses and columns corresponding to sub-addresses is displayed. The user can modify the contents of the matrix with the following values:

1. "R" - receive only
2. "T" - transmit only
3. "X" - both receive and transmit
4. "." - not selected (The user can also enter a "space"; however, for readability, a period is echoed to the screen).

To facilitate the rapid modification of the matrix, the user can choose the "Fill to end of line" mode. While in this mode, all entries from the cursor position to the end of the line will be defined by a single keystroke of the desired character. The "Fill to end of line" mode is toggled by pressing "F".

The matrix is split between two screens toggled by PgUp/PgDn.

/setup/monitor/selection

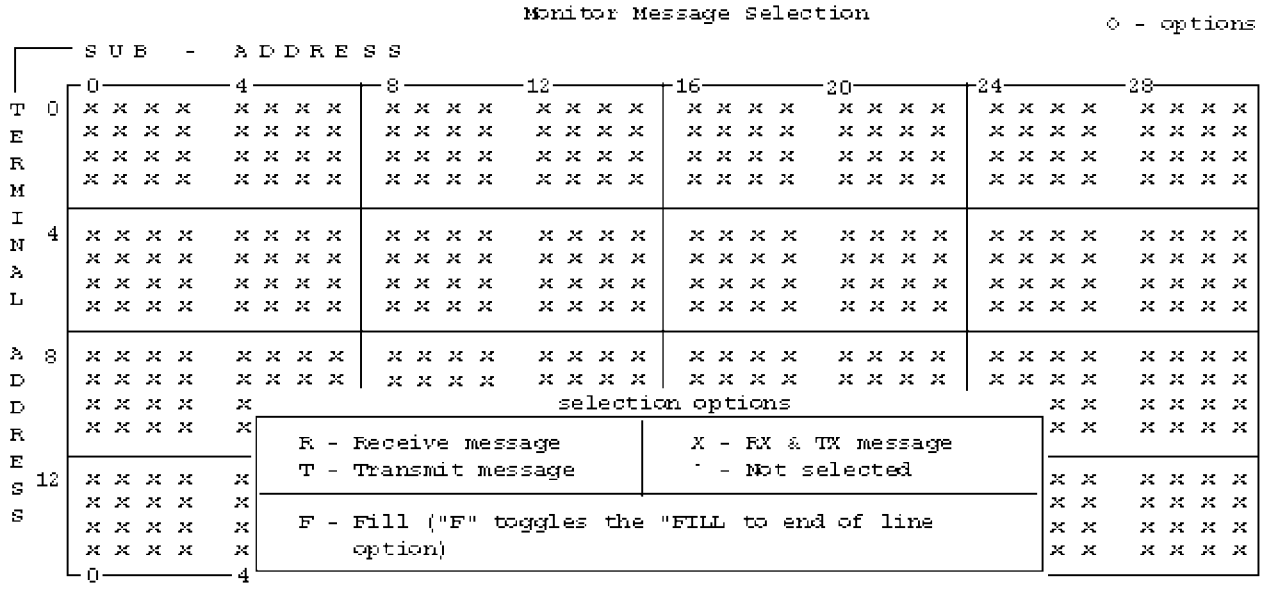


FIGURE 17. SELECTION MENU

Capture

The CAPTURE option (FIGURE 18) specifies an event which determines when to start the transfer of 1553 messages to the IBM stack. Since the card stores all selected messages in a circular buffer, the information immediately preceding the capture event is also available. If fewer than 2K words preceded the capture event, all the words will appear on the stack. If more than 2K words preceded the capture event, then between 2K and 4K words will appear on the stack.

The capture event is marked in the Communication Stack by the word "CAPTURE" in inverse video. In addition, a TTL trigger of width at least 3 microseconds is outputted to the card's D-type connector.

/setup/monitor/capture

```
Capture starts at: Immediate
```

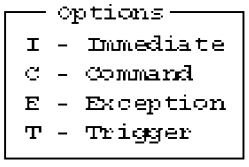


FIGURE 18. CAPTURE MENU

1. **Immediate**

Stack storage starts immediately.

2. **Command template**
   Capture starts after detecting a match between a command and a template of 1's, 0's and X's (don't cares). After choosing this option, the default template appears on the screen and may be modified. The user returns to the MONITOR menu by pressing Esc.

3. **Exception**
   Capture starts after detecting any one of the following events:

   - any exception
   - invalid command
   - invalid data
   - invalid status
   - incorrect RT address in status
   - flagged bit in status (as determined by the status mask)
   - no response
   - early response
   - gap preceding data word
   - illegal mode or broadcast command

After choosing the exception option, the above list of possibilities appears on the screen. The exception is selected by placing the cursor (with the up/down arrows) on the appropriate row and pressing Esc.

4. **External trigger**
   Capture starts after detecting a logic "1" level on the external trigger input located on the card's D-type connector.

The CAPTURE and SELECTION options are independent; as a result, the capture event can be determined by any message, even when not selected.

BC

The BC activity is defined by a set of MESSAGEs organized in a FRAME (FIGURE 19).

/setup/bc

Message	Frame

FIGURE 19. BC MENU

Message

The BC supports 250 independent messages and all communication formats. Each message is defined by a page as illustrated in FIGURE 20.

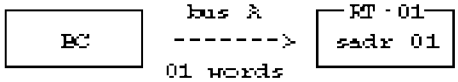
Messages are identified by a number (1 - 250) located at the top of the page. The user can access other pages by pressing PgUp/PgDn or by overwriting the page identification number.

/setup/bc/message

Message - 1

Communication type: Receive

tadr	t/r	sadr	wcnt
01	R	01	01



time to next message: Default	data table number:	bus	error: None
95 usec.	1	A	

FIGURE 20. MESSAGE PAGE

The communication type is defined by 4 values:

1. "R" - Receive (including broadcast)
2. "T" - Transmit
3. "X" - RT-RT
4. "M" - Mode

When the cursor is positioned on the communication type field, a window reminding the user of the above

options appears.

The user modifies the command's fields by overwriting their default values (using radix 10). The T/R field can only be modified in the case of mode commands. A pictorial description of the message appears on the right-hand side of the screen.

The "time to next message" defines the time from the start of the current message to the start of the following one. The time has an accuracy of 5 microseconds and a maximum value of 130,000 microseconds. The default value is based on the message length (including a response time of 10 microseconds) and an intermessage gap of approximately 25 microseconds. This calculation does not take into account word/bit count errors. A different value can be defined by pressing "U" and entering the desired time.

If the user defines a time resulting in an intermessage gap less than 25 microseconds, the present message will always be completed but the following intermessage gap may approach 25 microseconds. For example, if the user defines a receive message with 5 data words and a word count error "missing 2 words", then the BC can implement a time to next message of 4*20 + 10 + 25 = 115 microseconds.

The next variable in the MESSAGE menu is the data table ID number (1-250). This number identifies the data table used for transmit/receive messages.
The bus can be defined as A or B.

The BC can inject a wide variety of errors in the words which it transmits. When the cursor is placed on the error field, a window (FIGURE 21) appears with the following contents:

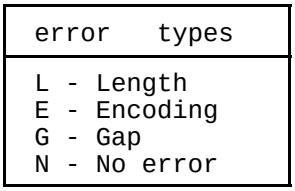


FIGURE 21. ERROR OPTIONS WINDOW

After choosing one of the error options, an additional window appears for further error specification.

1. **Length**
   Length errors are of two types: word count and bit count. The window for defining word count errors is illustrated in FIGURE 22.

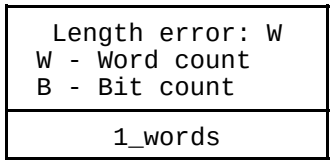


FIGURE 22. WORD COUNT ERROR WINDOW

The number entered defines the change in the number of data words to be transmitted. If the message defines N data words, the actual number of words sent can vary from 0 to N + 1. For example, if a receive message has a word count of 7 and the user defines a change of -3, only 4 data words will be sent.

Bit count errors (FIGURE 23) are defined by two values: the number (+2, +1, -1, -2) of extra/missing bits and the word position in the message. The first word in the message is numbered 0. For example, in a receive message the command is numbered 0 and the first data word is numbered 1.

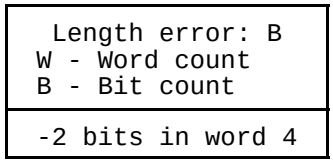


FIGURE 23. BIT COUNT ERROR WINDOW

2. **Encoding**
   Two types of encoding errors can be injected: signal inversion and glitches.

Signal inversion is implemented by exchanging the outputs of the Manchester encoder while glitches are achieved by forcing the encoder outputs to equality (i.e., no transmitter output).

The encoding error timing is controlled by two parameters: error width and error location. The error width has a resolution of 50 nanoseconds and a maximum value of 3.00 microseconds. Errors begin on half bit boundaries. The window for defining encoding errors is illustrated in FIGURE 24 (the window shows the definition for a parity error in data word number 2).

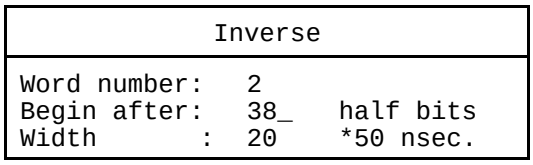


FIGURE 24. ENCODING ERROR WINDOW FOR PARITY ERROR

3. **Gap**

The BC can inject a gap of 3 or 4 microseconds (from zero-cross of parity bit to zero-cross of following sync) between contiguous words.

The window for defining gap errors is illustrated in FIGURE 25.

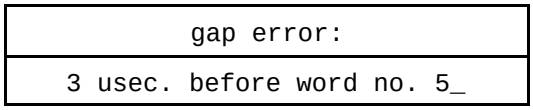


FIGURE 25. GAP ERROR WINDOW

Frame

The FRAME, illustrated in FIGURE 26, defines the contents and timing for a complete communication period. The FRAME contains up to 1000 messages divided into minor frames of equal duration. The minor frame time has an accuracy of 5 microseconds and a maximum value of 2**32 microseconds (about 1 hour). The FRAME can be repeated periodically; its duration is the sum of minor frame times. Each entry in the FRAME is either a message number (1-250) or one of the following symbols:

- M (end of minor frame symbol)

- F (end of FRAME symbol)

Empty minor frames can be specified by entering successive M's.

The next message to be sent is pointed to by "<".

```
/setup/bc/frame                                   FRAME-TABLE
      Minor frame time:                 500 usec
```

	0	1	2	3	4	5	6	7	8	9
000	1<	2	3	M	5	6	F	8	9	10
010	11	12	13	14	15	16	17	18	19	20
020	21	22	23	24	25	26	27	28	29	30
030	31	32	33	34	35	36	37	38	39	40
040	41	42	43	44	45	46	47	48	49	50
050	51	52	53	54	55	56	57	58	59	60
060	61	62	63	64	65	66	67	68	69	70
070	71	72	73	74	75	76	77	78	79	80
080	81	82	83	84	85	86	87	88	89	90
090	91	92	93	94	95	96	97	98	99	100
100	101	102	103	104	105	106	107	108	109	110
110	111	112	113	114	115	116	117	118	119	120
120	121	122	123	124	125	126	127	128	129	130
130	131	132	133	134	135	136	137	138	139	140
140	141	142	143	144	145	146	147	148	149	150

```
BC ------> RT-01 sadr 01
     bus A
     06 words

data table no:   1

Gap error:
  Gap of 3 usec
  Before data word  05

O - Options
```

FIGURE 26. FRAME

In addition to moving with the arrow, Home and End keys, the user can jump 100 entries in the FRAME by pressing PgUp/PgDn.

When the cursor is placed on a message number, a pictorial description of its format appears on the right-hand side of the screen. In addition, the relevant data table number and error definition are also shown.

The message can be displayed and edited by pressing "E" (Edit); the user returns to the FRAME by striking Esc.

Items may be deleted or inserted by pressing the "Del" or "Ins" keys. "Del" deletes the item under the cursor and shifts all following entries to the left. "Ins" inserts an "M" and shifts all following entries to the right (the "M" can then be overwritten).

The minor frame time is changed by pressing "T" and entering the desired value.

A window reminding the user of the available options (FIGURE 27) is obtained by pressing the letter "O".

```
┌──────────────────────────┐
│         options          │
├──────────────────────────┤
│ E - Edit message         │
│ T - Time of minor frame  │
│ Del - Delete an item     │
│ Ins - Insert an item     │
└──────────────────────────┘
```

FIGURE 27. FRAME OPTIONS WINDOW

RT

The 1553-IDEA concurrently emulates up to 31 RTs. Each RT complies with MIL-STD-1553B requirements and options, except for the following limitations:

- the intermessage gap following a broadcast command should exceed 15 microseconds

- while an RT is actively transmitting or receiving it will not respond to commands on the alternate bus

The RT's responses to commands is summarized in Appendix C.

Each emulated RT has its own last status and last command words. The status bits MESSAGE ERROR, BROADCAST COMMAND RECEIVED, and DYNAMIC BUS CONTROL ACCEPTANCE are determined dynamically. The emulated RTs share 252 data tables together with the BC.

If an RT receives a command such that the given value of terminal address, T/R, and sub-address is not associated with any data table in the range 1 - 250, the command is considered illegal. Illegal receive (transmit) commands are mapped automatically to data tables 0 (251). The association is defined by the DATA TABLE menu. If the illegality detection option was chosen in the GLOBAL DEFINITIONS menu, the RT responds with ME=1 in the status but does not transmit data. The RT behaves similarly regarding illegal mode codes.

Each RT can become a BC after receiving the mode command DYNAMIC BUS CONTROL. Upon receiving control, the new BC issues the next message in the FRAME after a programmable delay.

Errors are defined individually for each RT (and not on a message basis). All error types can be injected when the BC is external to the 1553-IDEA. However, if a message is internal (i.e., both the BC and the RT are emulated), the only RT error type executed is late response; other RT error types will be ignored. Late responses to internal messages are provided so that external RTs participating in RT-RT transfers can be tested.

If no errors are injected by the RT, its response time is 10 microseconds. The RT does not detect legality when injecting the following errors: word length, gap, and encoding.

Each RT is defined by a page as shown in FIGURE 28.

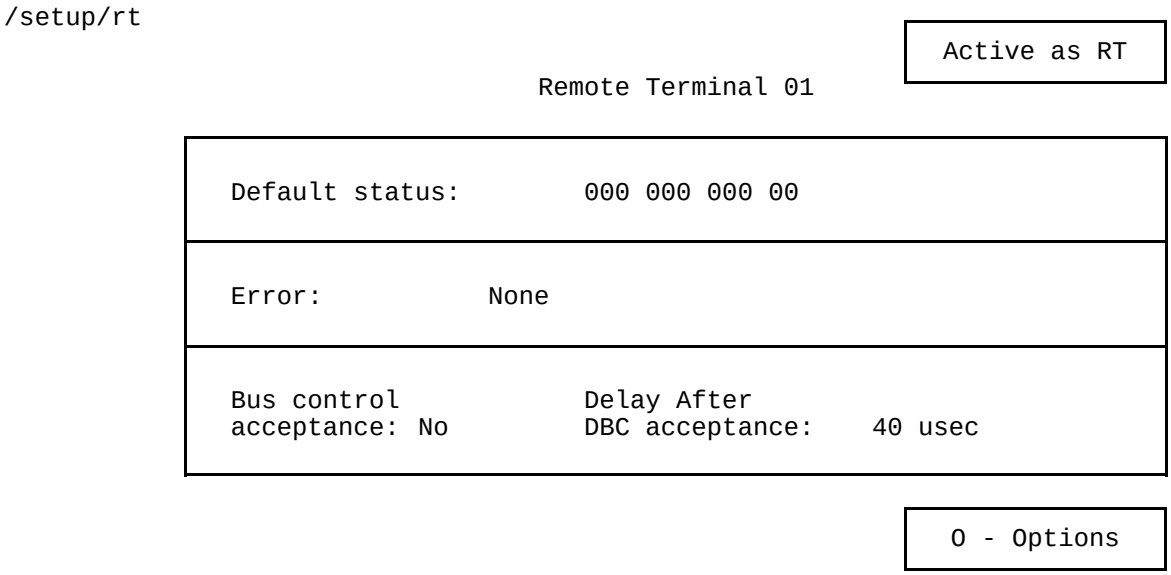


FIGURE 28. RT PAGE

Each RT page is identified by its terminal address (0 - 30) located at the top of the page. The user can access other pages by placing the cursor on the page number and entering the desired value. The PgUp/PgDn keys are available, irrespective of the cursor position.

The RT page contains the following parameters:

- **Default Status**
  The user can define any status bit, except the terminal address, to have a specified value.

- **Error**
  In addition to all the errors defined on the BC Message Page, the user may define terminal address and response errors (FIGURE 29).

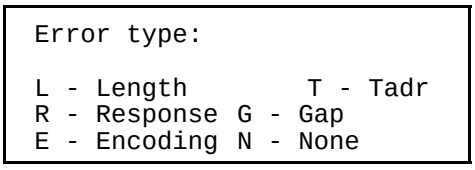


FIGURE 29. RT ERROR OPTION WINDOW

The user can replace the terminal address in the status with any value.

The response errors (FIGURE 30) are as follows:

* "N" - no response on bus A, B or both
* "L" - late response (12 - 30 microseconds, with 1 microsecond resolution)
* "A" - response on alternate bus

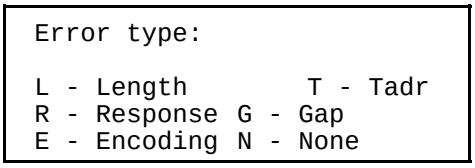


FIGURE 30. RT RESPONSE ERROR WINDOW

- Bus Control Acceptance
  The user can determine whether or not the RT will accept bus control after receiving the mode command "Dynamic Bus Control". The RT will accept control only if "Dynamic Bus Control" is legal. The first message issued by the new BC can be delayed from 40 to 130,000 microseconds (accuracy +/-5 microseconds).

DATA TABLES

The 1553-IDEA supports 252 independent data tables for transmit/receive messages.

Each transmit/receive data table is defined by a page as shown in FIGURE 31.

/setup/data/RX_TX

Data table - 1
Size: 16

O - Options

Word #	Data [hex]	Word #	Data [hex]
1:	0110	17:	
2:	0101	18:	
3:	0102	19:	
4:	0103	20:	
5:	0104	21:	
6:	0105	22:	
7:	0106	23:	
8:	0107	24:	
9:	0108	25:	
10:	0109	26:	
11:	010A	27:	
12:	010B	28:	
13:	010C	29:	
14:	010D	30:	
15:	010E	31:	
16:	010F	32:	

FIGURE 31. TRANSMIT/RECEIVE DATA TABLE PAGE

Each data table is identified by a number (0 - 251) located at the top of the page. The user can access other pages by pressing PgUp/PgDn or by overwriting the page identification number.

The data table size (1 - 32) is specified by the user. The memory space reserved for the tables consists of 4K words. If the user attempts to define more data, a warning is issued.

The data is displayed in hexadecimal. The default data of table T, word N is 256*T + N. The contents are modified by overwriting the default values. The user can move between the 2 columns of data by pressing either TAB or Shift+TAB.

There are 2 independent mappings which refer to data tables: one for internal BC messages and the other for internal RTs.

The internal BC message mapping determines which data table should be used by the BC for each transmit/receive message. This mapping is defined by the data table field in the message pages.

The mapping for the internal RTs determines which data table an RT should use when responding to a command. Each value of terminal address, T/R bit, and subaddress is associated to a unique table. If the data table number is in the range 1 - 250, the command is considered legal. Data tables 0 (251) are used for illegal receive (transmit) commands. If a command is not defined as legal (by the user), it is automatically considered illegal and mapped accordingly. The tables used for illegal commands have a fixed size of 32 words.

The list of commands for internal RTs which refer to a data table can be viewed and edited as described below.

The DATA TABLE menu has the following options (FIGURE 32):



FIGURE 32. TRANSMIT/RECEIVE DATA TABLE OPTION WINDOW

* "N" - The next unassigned table (i.e., a table not referred to by any internal RT or BC) is displayed.

* "S" - The amount of memory space available for additional data tables is displayed.

* "R" - The list of commands (for internal RTs) which refer to the data table is displayed. Note that the list is sorted.

* "M" - The list of messages (defined by the internal BC) which refer to the data table is displayed.

The data table can be modified with the following keys:

* "Ins" - The word under the cursor is duplicated and all subsequent words are shifted downwards. The duplicated word can then be overwritten if desired.

* "Del" - The word under the cursor is deleted and all subsequent words are shifted upwards.

* "U" - The word previously deleted is inserted at the cursor's position.

The options Ins, Del, and U update the table size displayed at the top of the page.

The list of commands (for internal RTs) which refer to the data table is modified with the following options:

* "Ins" - A window for defining a new command is displayed. After entering its contents, the command is inserted into the appropriate place in the (sorted) list.

* "Del" - The command word under the cursor is deleted and all subsequent command words are shifted upwards.

* "U" - The command word previously deleted is reinserted.

* "S" - A window for defining a command is displayed. After entering its contents, a search is performed for the specified command. If the command is mapped to the current data table, the cursor is placed on the command's position in the list; otherwise, the appropriate data table number is displayed.

In addition to the tables for transmit/receive messages, mode commands requiring data have separate tables with entries for each terminal address (FIGURE 33).

/setup/data/mode

Mode code - 16 Transmit Vector Word

TADR		Data	TADR		Data
00	BC	0000	16		8000
01	RT	0800	17		8800
02	RT	1000	18		9000
03	RT	1800	19		9800
04	RT	2000	20		A000
05		2800	21		A800
06		3000	22		B000
07		3800	23		B800
08		4000	24		C000
09		4800	25		C800
10		5000	26		D000
11		5800	27		D800
12		6000	28		E000
13		6800	29		E800
14		7000	30		F000
15		7800	31	Y	F800

FIGURE 33. MODE COMMAND DATA TABLE PAGE

As in the case of transmit/receive data tables, the user can access other pages by pressing PgUp/PgDn or by overwriting the page identification number.

SAVE SETUP

This option saves all user defined parameters to disk. The user is prompted for the file name; the extension ".SUP" is appended automatically to the name.

LOAD SETUP

This option loads parameters previously saved by the user.

The user can change the default setup by performing a SAVE SETUP and assigning the resulting file to the keyword "SETUP" in the file IDEA.CFG (for details, see CONFIGURATION FILE page 22).

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RUN MENU

The RUN commands activate the real-time functions of the card and the REAL-TIME DISPLAY. There are 4 types of RUN commands (FIGURE 34):

```
/run
```

```
BC        RT        Monitor        Continue        Last_run_display
```

FIGURE 34. RUN MENU

- **RUN BC**
  The BC executes the FRAME N times or forever. FOREVER is chosen by entering "F"; N times is selected by entering a number between 1 and 100,000,000. The Monitor stores the bus traffic on the stack and the internal RTs are active.

- **RUN RT**
  The emulated RTs and the Monitor are activated.

- **RUN Monitor**
  The Monitor is activated.

- **CONTINUE**
  The CONTINUE instruction causes the real-time activity, as defined by the previous RUN, to be reactivated. After reactivation, the BC issues the next message (marked by "<") in the FRAME and the Monitor appends subsequent traffic to the stack.

The RUN (BC, RT or Monitor) instruction zeroes all the REAL-TIME DISPLAY counters; after a CONTINUE the counters continue from their last values.

RUN commands are terminated by pressing "H" (HALT) or Esc (these options appear on the REAL-TIME DISPLAY). HALT terminates the card's real-time activity without deleting the REAL-TIME DISPLAY.

If the BC finishes execution (i.e., after completing a RUN BC N times), both the BC and the RTs are halted automatically. Since all other variations of the RUN command execute for an indefinite period, the user must terminate the instruction - even when the RUN is issued from a keystroke file.

In this case, CONTINUE will reactivate only the Monitor. When a RUN (other than RUN BC N times is issued from a keystroke file Esc terminates the card's real-time activity and replaces the REAL-TIME DISPLAY with the RUN menu.

The REAL-TIME DISPLAY's header indicates the RUN command type and its status (running or halted).

The RUN menu also includes an instruction for viewing the last REAL-TIME DISPLAY.

In addition to the RUN commands, the user can specify whether the next RUN should initialize the communication stack or append to it.

Real-Time Display

While in RUN mode the 1553-IDEA displays statistics of the monitored bus traffic. The information displayed (FIGURE 35) consists of individual counters for each terminal address as well as a global counter defining the total number of invalid commands.

For reference, the RUN status is shown at the top of the screen by highlighting the relevant words in inverse video.

Note that the response timing counter includes both no response and early response errors. If messages from more than 16 RTs are received, the display is split between two screens. The user may toggle between the screens by using PgDn/PgUp.

```
/run/bc                                                    BC RT MON     running halted
                              REAL TIME DISPLAY
  invalid commands = 00000                          total commands = 0,000,000,014
```

tadr	invalid data	invalid status	delayed data	resp. timing	wrong tadr	bit in status	illegal mde/cmd	total messages
01	00000	00000	00000	00000	00000	00000	00000	0,000,000,002
02	00000	00000	00000	00000	00000	00000	00000	0,000,000,002
04	00000	00000	00000	00000	00000	00000	00000	0,000,000,002
05	00000	00000	00000	00000	00000	00000	00000	0,000,000,004
07	00000	00000	00000	00000	00000	00000	00000	0,000,000,002
08	00000	00000	00000	00000	00000	00000	00000	0,000,000,002
					H-halt	PgUp	PgDn	

FIGURE 35. REAL-TIME DISPLAY

DISPLAY COMMUNICATION STACK

The DISPLAY COMMUNICATION STACK instruction displays the information stored by the Monitor. The DISPLAY COMMUNICATION STACK menu and a typical page of messages is illustrated in FIGURE 36.

```
/stack
```

```
     Print       saVe       Load       Search       Message_#       Time_tag
```

```
    1.    TIME =        0 usec  BUS A
          Cmd   0845   01-R-02-00

          Data  0100 0101 0102 0103 0104
                0105 0106 0107 0108 0109
                010A 010B 010C 010D 010E
                010F 0110 0111 0112 0113
                0114 0115 0116 0117 0118
                0119 011A 011B 011C 011D
                011E 011F

          Stat  0900
                  Serv_req
    Exception   Bit in status

    2.    TIME =        180    usec  BUS A
  Capture  Mode  17E2     02-T-31-02

          Stat  1000

    3.    TIME =         74    usec  BUS A
          Cmd   2865     05-R-03-05
          Cmd   24A5     04-T-05-05

          Stat  2000

          Data  1D00 1D01 1D02 1D03 1D04

          Stat  2800

End of tables
```

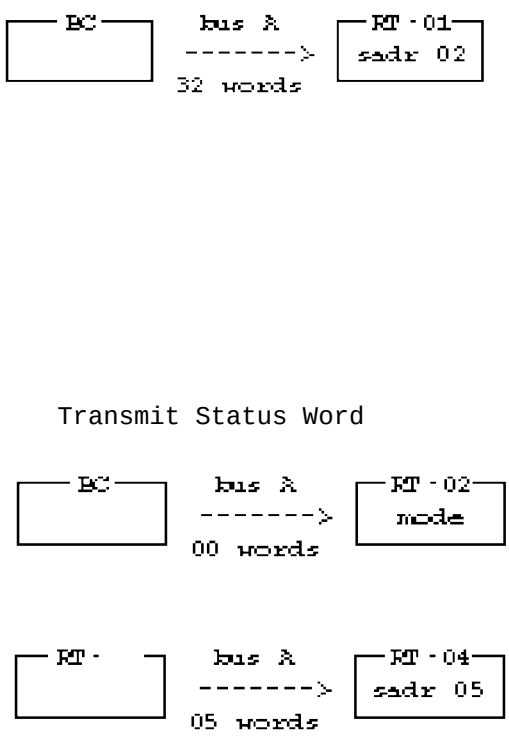


FIGURE 36. COMMUNICATION STACK MENU

The stack contains:

- message number
- time-tag
- command(s)
- status(es)
- data
- active bus ID
- error type
- capture symbol
- pictorial message display

The message number is assigned sequentially to facilitate random access to the stack.

Each message is time-tagged at the beginning of the message. The value is either the time elapsed from the first message on the stack or from the previous message.

The commands are displayed in hexadecimal and the fields are displayed individually in decimal.

The statuses are displayed in hexadecimal; set bits are listed by name.

The data words are displayed in hexadecimal.

The active bus ID is denoted A or B.

The exceptions recognized by the Monitor are:

- invalid command
- invalid data
- invalid status
- incorrect RT address in status
- flagged bit in status (as determined by the status mask)
- no response
- early response
- gap between "contiguous" words
- illegal mode command
- illegal broadcast command

Invalidity errors are further classified as:

- parity
- short word
- long word
- Manchester encoding

After detecting an invalidity or timing error, subsequent errors and data in the same message are ignored.

The word "CAPTURE" in inverse video is appended to the message following the capture event.

A pictorial message display appears on the right side of the screen.

The user moves through the stack with the standard IBM keys: arrows, PgDn, PgUp, Home and End.

The DISPLAY COMMUNICATION STACK menu has the following instructions:

- **PRINT**
  The PRINT instruction sends a specified portion of the stack (in ASCII format) to a printer or disk. In case of disk, the user is prompted for the file name; the extension ".PRN" is appended automatically to the name.

- **SAVE**
  The SAVE instruction saves a specified portion of the stack to a disk file (in compressed binary form). The user is prompted for the file name; the extension ".STK" is appended automatically to the name.

- **LOAD**
  The LOAD instruction loads a previously saved stack.

- **SEARCH**
  The SEARCH instruction finds the first occurrence of one of the following:

  * command/status/data template match
  * exception
  * capture symbol

- **MESSAGE NUMBER**
  The MESSAGE NUMBER instruction places message number N at the top of the screen.

- **TIME-TAG DEFINITION**
  The TIME-TAG DEFINITION instruction specifies the displayed time as either the time elapsed from the first message on the stack or the time from the previous message.

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OPERATION OF WINDOWS MENUS

The 1553 **IDEA for Windows** software provides a user friendly GUI (Graphical-User-Interface) for defining all options, parameters and data on the 1553-bus.

The new features provided by the **IDEA for Windows** software include:

- Real-time disk storage of 1553 traffic.
- Filter functions for the communication stack file.
- Remote Terminals, Data Tables, Messages, and Mode Commands can be referred to by name.
- Up to 2 Intermessage Routines may be executed by the card during Intermessage Gaps.
- Conversion of binary setup file to ASCII format and vice versa.
- On line help.

Note: Before running IDEA for Windows make sure you are familiar with the Windows environment and common Windows commands, such as “double click”.

IDEA FOR WINDOWS INSTALLATION

To install the **IDEA for Windows** program, insert the program disk into the appropriate disk drive. From Program Manager's **File** menu select **Run** and type `install.exe` with the correct pathname to the disk drive.

Example:

```
A:\install.exe
```

Click **"OK"** and the install window will appear. This window allows the user to change the drive and directory where the program will be stored. The default drive is `C` and the default directory is `\IDEA400`. When you are satisfied with the location, click on **"START"** and the copying of files to the hard disk will begin.

Once copying of the files is completed a group named **IDEA For Windows 4.0** will be created with the following icons:

- Setup Editor
- Run
- Stack View
- Conversion
- BUS 65517 RTL Reference
- IDEA for Windows Reference

The **BUS 65517 RTL Reference** icon contains an online reference for the IDEA Run Time Library, along with detailed information about important functions. The **IDEA for Windows Reference** icon contains online help for IDEA For Windows 4.0. The remaining icons will be described in detail.

Besides the icons and program group described above, a **IDEA 1553** icon will be created in the Control Panel (The Control Panel is located in the Main program group). The IDEA 1553 icon allows for the modification of card parameters, such as base memory address and interrupt request level.

CONFIGURING IDEA FOR WINDOWS

To configure your card for the IDEA for Windows program double click on the **IDEA 1553** icon in the Windows Control Panel. The "IDEA 1553 Card Install" window will appear as shown below.

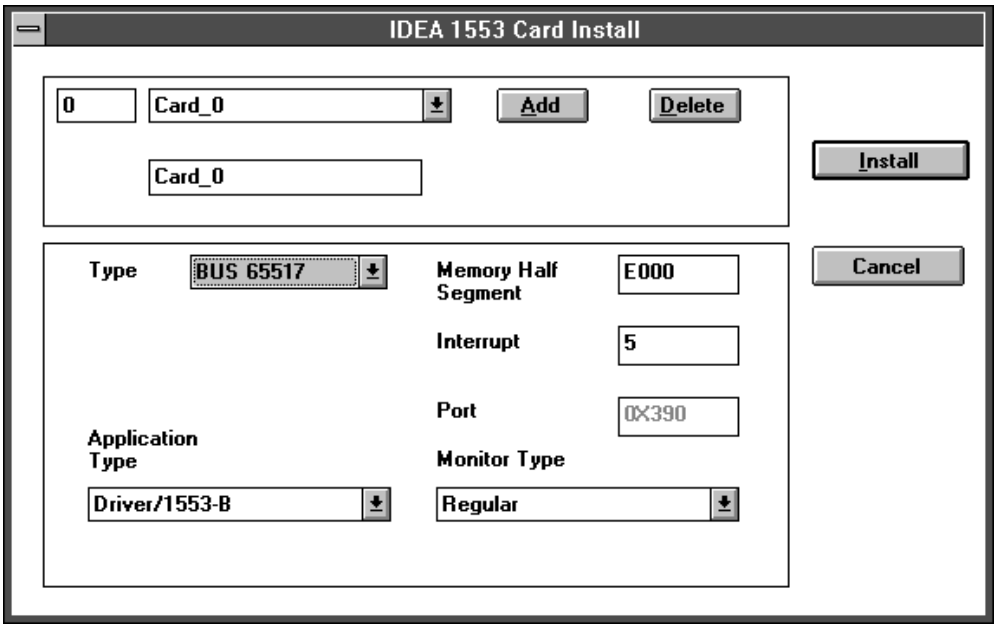


FIGURE 37. "IDEA 1553 CARD INSTALL" WINDOW

The Window is broken up into two parts:

Top rectangle => Card Slot # and Name
Bottom rectangle => Card Parameters

Card Slot # and Name: From left to right we have the Card Slot, the Card Name, the ADD button and the DELETE button. The lower Card Name box allows you to edit the name of the card in the specified slot. The default name is CARD_X, where X is the Card Slot number. The ADD button allows you to configure another IDEA Card to run on your system, you can have as many as 8 IDEA Cards running concurrently. The DELETE button removes Card Slot information when a Card is uninstalled from your system.

Card Parameters: Clockwise we have the Card Type, the Memory Half Segment, the Interrupt, the Port Address (used only with the BUS-65518 card), the Monitor Type and the Application Type.

Card Type - This field can be either BUS-65517 or BUS-65518.

Memory Half Segment - This field defines the memory location (base address) occupied by the IDEA card. The values specify half segment boundaries in hex; the legal values are 0xA000,

0xA800, ..., 0xF000, F800. All 6 characters should be specified. The value must have the same value as the base address jumpered on the card. If you change the base address jumpered on the board simply change this value to the new address.

Interrupt - This field specifies an integer which determines the interrupt level used be the IDEA card. The value of this keyword must be the same as the value jumpered on the card. If you change the jumpered value you must edit this field to match the jumpered value or else the software will not run correctly.

Monitor Type - This field specifies one of three ways to run the IDEA Card Monitor.

"Regular" - refers to the option which provides the selective, triggerable Bus Monitor with extensive capabilities for communication error detection. The shortest monitored intermessage gap time is 14 μsec.

"Fast" - refers to the option which provides a non-selective and non-triggerable Bus Monitor with a shortest monitored intermessage gap time of 4 μsec.

"Turbo" - refers to the option which provides a selective, triggerable Bus Monitor with limited capability for triggering. The shortest monitored intermessage gap time is 7 μsec.

Application Type - This field allows the user to specify what type of application software is to be downloaded to the Card. There are four options:

"Menu/1553-B" - (default option) allows 1553B protocol to be used without support for intermessage gap routines such as interrupts.

"Menu/1553-A" - allows 1553A protocol to be used without support for intermessage gap routines.

"Driver/1553-B" - allows 1553B protocol to be used with support for intermessage gap routines.

"Driver/1553-A" - allows 1553A protocol to be used with support for intermessage gap routines.

NOTE: Since the Menu options above do not support intermessage gap routines they require less overhead and thus produce shorter intermessage gap times.

At any time, you can click on the **"CANCEL"** button to exit without saving or click **"INSTALL"** to save the changes to the `IDEA.INI` file in your Windows directory.

WORKING WITH THE IDEA FOR WINDOWS PROGRAM

As in the DOS Menus, the three major functions of the Windows Menus are **Setup, Run, and Display Stack**. The Windows Menus also provide a file conversion icon, which will be described later.

USING THE SETUP EDITOR

The SETUP EDITOR, shown in FIGURE 38, allows the user to define parameters and data, and gives the user full control over the capabilities of the IDEA Card. This includes operating the IDEA as a BC, one or more RTs and a selectable triggerable Monitor. No real-time activity is performed while in this Window.

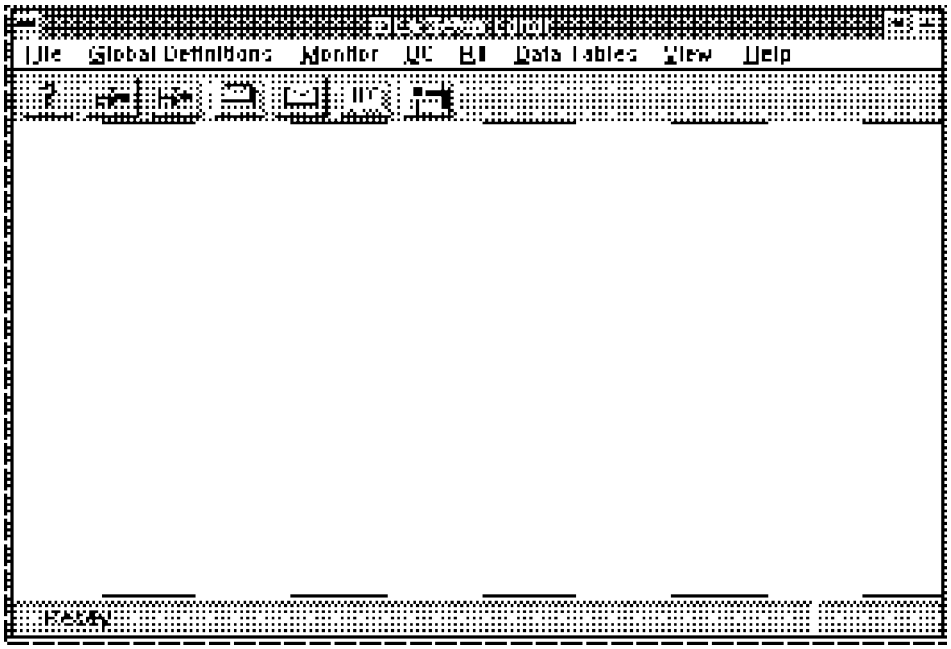


FIGURE 38. IDEA FOR WINDOW'S SETUP EDITOR

The Setup Editor Window contains 8 pull-down menus: `FILE`, `GLOBAL DEFINITIONS`, `MONITOR`, `BC`, `RT`, `DATA TABLES`, `VIEW`, and `HELP`.

A toolbar, underneath the pull-down menus, displays commonly used commands: (From left to right)

- `HELP`
- `LOAD SETUP`
- `SAVE SETUP`
- `FRAME`
- `MESSAGE DEFINITION`
- `REMOTE TERMINAL DEFINITION`
- `DATA TABLE DEFINITION`

The bottom of the IDEA window contains a status line which displays information on the menu command being selected. Each command will be described in detail under the appropriate pull-down menu description.

FILE MENU

Load Setup

This option loads setup parameters which were previously saved.

Save Setup

All the parameters defined during the current session can be saved to a file.

Load/Save Setup Dialog Box

This dialog box is used to define the Setup file name. The name may be typed explicitly or chosen from a list of previously defined file names.

To choose a file name from the list, double click the name or select it with an arrow key and press Enter. To change the current directory, select a directory name in the directory list, then double click it or press Enter.

To specify a file name explicitly, set the cursor on the Edit box and type the file name without extension. The only permitted extension, .stp, is added automatically.

Conversion

The Conversion Window allows the user to convert a binary setup file (*.stp) to ASCII text (*.txt) for easy editing and then to convert back to binary for loading into the Setup Editor. The Conversion Window can also be opened using its own icon in the IDEA For Windows program group.

Setup File Conversion Dialog Box

Select or type the desired file name, and then click the **TXT to BIN** or **BIN to TXT** button to perform the conversion.

Description

The Description option allows the user to append a short description to the setup file.

Description Dialog Box

Type in a brief description for the setup file and click **OK** or click **CANCEL** to quit without saving.

Exit Setup Editor

After confirmation, the present instance of IDEA Setup will be closed.

GLOBAL DEFINITION

The GLOBAL DEFINITIONS are common to the BC, RTs, and Monitor. There are five submenus associated with GLOBAL DEFINITIONS, each produce a dialogue box which can be modified by the user.

Legality

This option allows the user to determine whether or not message legality should be checked by RTs. If the option is chosen, the RT will respond to illegal commands with ME=1 in the status.

The user has the option to choose whether or not to implement the broadcast option. If broadcast is not implemented, the RTs will ignore such messages and the Monitor will flag them as illegal.

Each mode code, including all reserved codes, can be defined as legal or illegal. However, if **MIL-STD-1553B** associates a unique T/R bit value with a mode code, then the same mode code with the opposite T/R bit value is always illegal. If a reserved code with data is legalized, it will be legal for both values of T/R.

Mode commands can be assigned arbitrary names defined by the user. You can associate 2 intermessage routines with each mode code. These routines are executed by an emulated RT immediately after the mode command is executed - provided that the BC is not emulated (i.e., the BC is external to the IDEA).

Legality Dialog Box

The legality detection option and broadcast implementation option are defined by clicking the **YES** button in the relevant field. To define the mode code as legal/illegal, check/uncheck the button on the left side of the corresponding field. You can change the name of any mode command by typing a new name instead of the one in the edit box.

To associate intermessage routines with a mode command, first choose the desired mode command name by clicking on the corresponding dialog box and then use the 2 combo boxes on the bottom of the screen to specify the intermessage routines.

Status Mask

The Monitor masks all received status words. The most significant 5 bits in the Status Mask are always 0's; the remaining bits are defined by the user. If a bit in the mask word is set to 1 and the corresponding bit in the status is also set to 1, the Monitor detects an exceptional condition. Exceptional conditions are counted in real-time and denoted in the stack. By default, all mask bits are set.

Status Mask Dialog Box

To set/reset any bit in the Status Mask, check/uncheck the relevant box.

Terminal Activity

The Terminal Activity Dialog Box defines the set of emulated terminals (RTs and BC) and logical names for all terminals.

Terminal Activity Dialog Box

To define a terminal as active, check the corresponding box. The activity of terminal 31 (broadcast), as determined by the "Legality" dialog box, may also be changed.

All terminals have default names **“RT_XX”**, where X is the terminal address (from 0 to 30). You can edit the name in the edit box next to the terminal address; all the names must be unique.

You can edit the RT by clicking the desired terminal address and then clicking the **Edit RT** button.

Response Timeout

The response timeout counter for the BC, RT, and Monitor can be programmed with the following values: 14, 16, 18 and 20 microseconds. If a status word is received after the allowed time, the Monitor and BC will detect a **"No Response"** error and the status will not be stored. This definition also affects an internal RT when participating in an RT-RT transfer with an external RT serving as the transmitter.

Response Timeout Dialog Box

Choose the desired timeout value by checking the corresponding box.

Transmit Amplitude

The transmit amplitude of the BC and RT can be varied between 0.10 to at least 28 volts P-P as measured across a 77 ohm load attached to the card's triax connector. The amplitude is specified by entering a number between 0 (minimum) and 255 (maximum).

Transmit Amplitude Dialog Box

Type the desired value (from 0 to 255) in the edit box. Use Up/Down arrows to increase/decrease the setting.

MONITOR

The Monitor operation is organized as a pipeline with 3 stages: the first stage monitors all messages received from the bus, the second stage stores selected messages in a circular buffer, and the third stage transfers the contents of the circular buffer to the IBM stack. The second and third stages are programmed be the SELECTION and CAPTURE menus respectively.

The first stage of the Monitor's pipeline listens on both buses until it detects a command and then receives exclusively from the active bus until the message is completed or invalidated. All errors recognized by the Monitor, except "Incorrect RT address in status" and "Flagged bit in status", invalidate the message.

Selection

The "Selection" option specifies which messages should be stored by the Monitor. The selection is based on the following:

1. value of the 11 bits: terminal address, T/R, and subaddress.
2. 1553 bus (bus A, bus B, or both)

After choosing this option, part of a 32 X 32 matrix with rows corresponding to terminal addresses and columns corresponding to subaddresses is displayed.

Selection Dialog Box

The selection of monitored messages is specified by the following values:

- "R" - receive only
- "T" - transmit only
- "X" - both receive and transmit
- " " - not selected

By default all messages on 2 buses are selected. To change a selection, click the desired terminal address/subaddress combination and type R, T, X or "space". You can also use the selection buttons at the bottom of the dialog box.

To toggle the 1553 bus selection, click the "Bus" button on the bottom of the screen. To facilitate the rapid modification of the matrix, entire rows or columns may be changed by checking the corresponding button on the left or top sides and then clicking one of the selection buttons. To change the selection for the entire matrix use the button at it's left top corner.

Capture

The "Capture" option specifies an event which determines when to start the transfer of 1553

messages to the PC stack. Since the card stores all selected messages in a circular buffer, the information immediately preceding the capture event is also available. The capture event is marked in the Communication Stack by the word "CAPTURE". In addition, a TTL trigger of width at least 3 microseconds is outputted to pin 12 on the card's D-type connector.

Capture Dialog Box

The following capture events may be chosen:

- Immediate
- Command template
- Exception
- External trigger

Immediate - Stack storage starts immediately.

Command template - Capture starts after detecting a match between a command and a template of 1's, 0's and X's (don't cares). After choosing this option, the default template appears on the screen and may be modified.

Exception - Capture starts after detecting any one of the following events:

- any exception
- invalid command
- invalid data
- invalid status
- incorrect RT address in status
- flagged bit in status (as determined by the status mask)
- no response
- early response
- gap preceding data word
- illegal mode or broadcast command

External trigger - Capture starts after detecting a logic “1” level on the external trigger input located on pin 6 of the card's D-type connector.

The “Capture” and “Selection” options are independent; as a result, the capture event can be determined by any message - even when not selected.

BC

The BC activity is defined by a set of MESSAGEs organized in a FRAME.

Message

The BC supports 250 independent messages, 5 special frame symbols and all communication formats. The Message Dialog Box defines the desired set of messages.

Message Dialog Box

Messages are identified by a name, which can be edited, located at the top of the dialog box.

There are 4 communication types:

- Receive (including broadcast)
- Transmit
- RT-RT
- Mode Command (receive and transmit)

The communication type is changed by clicking the "Type" button at the top of the screen. Default values defining RT addresses, subaddresses, word counts and data tables are then displayed. The defaults can be changed by clicking the desired rectangle and editing its contents. The 1553 bus (A or B) is selected by clicking the bus icon.

The **"time to next message"** defines the time from the start of the current message to the start of the following one. The time has an accuracy of 5 microseconds and a maximum value of 130,000 microseconds. The default value is based on the message length (including a response time of 10 microseconds) and an intermessage gap of approximately 25 microseconds. This calculation does not take into account word/bit count errors.

If you define a time resulting in an intermessage gap of less than 25 microseconds, the present message will always be completed but the following intermessage gap may still approach 25 microseconds. For example, if a receive message has 2 data words and a word count error "missing 2 words", then the BC will implement a time to next message of approximately 4*20 + 10 + 25 = 115 microseconds.

You can associate 2 intermessage routines with each message. These routines are executed by the Bus Controller immediately after the message is executed. The default intermessage routines are "**NO OPERATION**". To change the default, click the IMR rectangle and a dialog box will appear.

The BC can inject a wide variety of errors in the words which it transmits. When the cursor is placed on the error field, a corresponding window appears.

Command Definition Dialog Box

To assign a data table to a message click on the blue message box (in the Message Definition Dialog box) and a COMMAND DEFINITION Dialog Box will be displayed. Depending on the type of message you are assigning you may obtain one of three dialog boxes:

- BC
- RT
- Mode Command

BC - When editing a BC message you can select the data table name from the list of names in the combo box. To change the contents of the data table, click the "Data Table" button above the combo box.

RT - The RT definition dialog box allows you to modify the following command fields:

- Terminal address / Terminal Name
- Subaddress
- Word count

RTs may be referenced by name as well as by terminal address. To change the Terminal Name, click the **Edit Tadr** button.

Mode Command - The Mode Command definition dialog box allows you to modify the following command fields:

- Terminal address / Terminal Name;
- Mode code / Mode Command Name.

Mode codes and RTs may be referenced by name as well as by terminal address. To change the Terminal Name, click the Terminal Name combo box and then click the **Edit Tadr** button. To change the Mode Command Name click the Mode Code combo box and then click the **Edit Mode** button.

Intermessage Routines Dialog Box

This dialog box is displayed when you click anywhere inside the Intermessage Routines box in the BC/MESSAGE DEFINITION dialog box. It allows you to select 2 intermessage routines from the list of IMRs.

Message Error Injection Dialog Box

The Error Injection dialog box is displayed when you click on the word **Errors** in the BC/MESSAGE DEFINITION dialog box. There are 4 options which can be modified:

- Length
- Encoding
- Gap
- No error

Length - “Length” errors are of two types: word count and bit count.

Word count errors are defined by specifying the change in the number of data words to be transmitted. If the message defines N data words, the actual number of words sent can be varied from 0 to N + 1. For example, if a receive message has a word count of 7 and you define a change of -3, only 4 data words will be sent.

Bit count errors are defined by two values: the number (+2, +1, -1, -2) of extra/missing bits and the word position in the message. The first word in the message is numbered 0. For example, in a receive message, the command is numbered 0 and the first data word is numbered 1.

Encoding - Two types of encoding errors can be injected: signal inversion and glitches.

Signal inversion is implemented by exchanging the outputs of the Manchester encoder, while glitches are injected by forcing the encoder outputs to equality (i.e., no transmitter output).

The encoding error timing is controlled by two parameters: error width and error location.

The error width has a resolution of 50 nanoseconds and a maximum value of 3.00 microseconds. Errors locations begin on half-bit boundaries.

Gap - The BC can inject a gap of 3 or 4 microseconds (from the zero-cross of the parity bit to the zero-cross of the following sync) between contiguous words.

Frame

The Frame defines the contents and timing for a complete communication period.

Frame Dialog Box

The frame contains up to 1000 messages divided into minor frames of equal duration. The minor frame time has an accuracy of 5 microseconds and a maximum value of 2**32 microseconds (about 1 hour). The frame can be repeated periodically; its duration is the sum of minor frame times. Each entry in the frame is either a message name or one of the following symbols: M (end of minor frame symbol), F (end of frame symbol).

You can define the frame entry by clicking the combo box and choosing the desired message or frame symbol from the list; or you can type the entry explicitly.

The message can be displayed and edited by pressing the "Edit" button. Items may be deleted or inserted by pressing the "Delete" or "Insert" buttons. "Delete" deletes the item under the cursor and shifts all the following entries to the left. "Insert" inserts a message with the same name and shifts all the following entries to the right. To move through frame, use the scroll bar on the left side of dialog box.

RT

The 1553-IDEA concurrently emulates up to 31 RTs. Each RT complies with MIL-STD-1553B requirements and options, except for the following limitations:

- the intermessage gap following a broadcast command should exceed 15 microseconds
- while an RT is actively transmitting or receiving it will not respond to commands on the alternate bus

Each emulated RT has its own last status and last command words. The status bits **Message Error**, **Broadcast Command Received**, and **Dynamic Bus Control Acceptance** are determined dynamically. The emulated RTs share 252 data tables together with the BC.

If an RT receives a command such that the given value of terminal address, T/R, and subaddress is not associated with any data table number in the range 1 - 250, the command is considered illegal. Illegal receive (transmit) commands are mapped automatically to data tables 0 (251). If the illegality detection option was chosen in the "Legality" window, the RT responds with ME=1 in the status but does not transmit data. The RT behaves similarly regarding illegal mode codes.

Each RT can become a BC after receiving the mode command "Dynamic Bus Control". Upon receiving control, the new BC issues the next message in the **Frame** after a programmable delay.

Errors are defined individually for each RT (and not on a message basis). All error types can be injected when the BC is external to the 1553-IDEA. However, if a message is internal (i.e., both the BC and the RT are emulated), the only RT error type executed is late response; other RT error types will be ignored. Late responses to internal messages are provided so that external RTs participating in RT-RT transfers can be tested.

The RT response time is approximately 10 microseconds.

Remote Terminal Definition Dialog Box

Each RT dialog box is identified by its terminal address (0 - 30) or name located at the top of the page (RT names may be changed in the GLOBAL DEFINITIONS/TERMINAL ACTIVITY dialog box). The RT dialog box allows you to define the following:

- **Association of Tx and Rx subaddresses to data tables**. Use the scroll bars to see the list of subaddresses and their corresponding data tables. To change the default association, press the **Data Tables Assignment** button. You can also change the name or contents of each data table by double clicking on the corresponding row of the list box.

- **Default Status.** You can define any bit in the RT's status, except the terminal address (5 most significant bits). A bit is set to 1 when the corresponding row is checked.

- **Error.** In addition to the error types defined in the BC Message dialog box, you can define terminal address and response errors. To receive the **Error Definition Dialog Box,** check the **Error** button.

- **Bus Control Acceptance.** You can determine whether or not the RT will accept bus control after receiving the mode command "Dynamic Bus Control". The RT will accept control only if "Dynamic Bus Control" is legal. The first message issued by the new BC can be delayed from 40 to 130,000 microseconds.

RT Error Definition Dialog Box

Illegal Terminal Address Errors are defined by replacing the terminal address in the status with a different value.

The **Response Errors** are as follows:

- no response on bus **A**, **B** or both
- late response (12 - 30 microseconds, with 1 microsecond resolution)
- response on alternate bus

DATA TABLES

The 1553-IDEA supports 252 independent data tables for transmit/receive messages. The data tables are defined by the Data Table Dialog Box.

BC/RT Data Tables

This option allows you to modify the BC/RT data tables

Data Table Definition Dialog Box for BC/RT

Each data table is identified by a name located in the combo box at the top of the screen. You can access other tables by selecting their name from the list or by typing the name explicitly. Each data table has a default name **"DT_XX"** where XX is the data table serial number (from 0 to 251). You can overwrite the default name by typing a new name.

The data table size (1 - 32 words) is specified by the user. The memory space reserved for the tables consists of 4K words and the amount of memory already used can be obtained from the **System Info Dialog Box**.

The data is displayed in hexadecimal, octal, decimal or binary. When decimal is chosen, the number is displayed as a signed integer. The default value for word N in table XX is 256*XX + N. The

contents are modified by overwriting the default values.

If the data table size is increased, the new words are filled with default values. You can also type new data words at the end of the table. This automatically increases the table size.

To insert new words, position the cursor on the desired location and click the **INSERT** button. The data table size will be increased by 1 and space will be inserted. You can overwrite it by your data word, otherwise it will be replaced by zero when the **OK** button is pressed. Similarly, to delete a word, select it and click the **DELETE** button.

You can assign 2 intermessage routines to each data table. These routines are executed at the end of the message which accessed the table - provided the BC is not emulated (i.e., the BC is external to the IDEA). If the BC is emulated, then the intermessage routines assigned to the message (as opposed to the data table) are executed instead.

Mode Code Data Tables

This option allows you to define data for mode commands.

Mode Code Data Tables Dialog Box

Each mode command requiring data (mode codes 16 to 31) has a separate data table with entries for each terminal address. To obtain the table corresponding to the specified mode command, select the desired name (or mode code) in the box at the top of the screen.

USING THE RUN WINDOW

The icon labeled RUN opens the IDEA Run section which is used for real-time activity.

FILE MENU

Menu options from the FILE pull-down menu:

Load Setup

This option loads setup parameters which were previously saved.

Card Activity

This option defines an active IDEA card. Your computer can host up to 8 IDEA boards; the actual number of cards and their memory locations are specified when you install IDEA for Windows. To change these definitions, use the **IDEA 1553** icon in your Windows Control Panel.

Define Stack File

This option assigns a file which will be used by Monitor to store real-time communication.

Define Stack File Size

This option defines the amount of hard disk space that may be used for storing the Communication Stack file. By default, the amount equals the total unused space on the disk (up to 2 GB).

Exit Run

Closes the Run section.

RUN BC

This option defines the number of times the BC should execute the frame. **"Forever"** is chosen by checking the "Forever" box; N times is selected by unchecking the "Forever" box and entering a number between 1 and 100,000,000.

After **Run BC** is issued, the Monitor stores the bus traffic on the stack and the internal RTs are activated.

RUN RT

The emulated RTs are activated. and the Monitor stores the bus traffic on the stack.

RUN MONITOR

The Monitor is activated and stores messages into the Communication Stack file.

USING THE COMMUNICATION STACK VIEW WINDOW

The STACK VIEW icon is used to display and analyze the information stored by the Monitor.

FILE MENU

The following are found in the file pull-down menu:

Load

This option opens the communication stack file.

Filter To File

This option selects a subset of the information in the input Communication Stack file and copies it to a destination file.

Filter Options Dialog Box

This dialog box defines the selection criteria for filtering the Communication Stack file.

You can select the set of messages based on the values of command, status, or data as well as exception or capture events. You can limit the selection to a specified range determined by message numbers and/or the Real Time Clock.

Once you click **OK** a dialog box will be displayed which will allow you to define the destination file.

Save As Text - Saves the Communication Stack file in ASCII format.

Print File - This option prints a portion of the Communication Stack file.

Message Range Dialog Box

By default, all messages are printed. You can modify the range by overwriting the first and/or last message numbers.

Exit Stack View - Exit Stack View.

SEARCH

This option allows you to search the communication stack for specific instances. The instances are described below.

Search For Command

This option specifies the command template for the search.

Command Template Dialog Box

To define the command template, select the Terminal Address(es), direction(s), Subaddress(es), Word Count(s) by checking the corresponding boxes. Use the **"Fill"**, **"Invert"** and **"Clear"** buttons at the left and bottom sides of the dialog box to facilitate modification of the template.

Search for Status

This option specifies the status template for the search.

Status Template Dialog Box

The most significant 5 bits of the status word (i.e., the terminal address) are selected by checking the corresponding boxes at the top of the dialog box. The remaining bits are defined explicitly by toggling the **Status Bit** boxes at the bottom of the screen. Use the **"Fill"**, **"Invert"** and **"Clear"** buttons at the right and bottom sides of the dialog box to facilitate modification of the template.

Search for Data

This option specifies the data word value as well as the data locations within the message for the search.

Data Selection Dialog Box

To specify the data word locations, check the corresponding boxes at the top of the dialog box. The value can be given in hex, binary or decimal. Use the **"Fill"**, **"Invert"** and **"Clear"** buttons at the right and bottom sides of the dialog box to facilitate modification of the template.

Search for Exception

This option specifies the exception condition for the search.

The possibilities are:

- Any exception
- Invalid Command
- Invalid Data
- Invalid Status
- Gap preceding Data Word
- Response Time
- Wrong RT Address in Status
- Flagged Bit in Status
- Illegal Command

Search for Time

This option specifies the message time tag value (i.e., chronological time as determined by the Real Time Clock), where the search should be started.

Search for Time Dialog Box

Type the message chronological time (in seconds) and click the **"OK"** button.

Search for Capture

This option searches for the message marked as the **CAPTURE** event in the Communication Stack.

Search Again

This option finds the next occurrence of the message meeting the search criteria.

VIEW

This pull-down menu gives you control over the displaying of the Communication Stack. The following are explanations of how this can be done.

Radix

Click the corresponding menu item to change the radix of the displayed data.

Set Time Tag Type

This option specifies whether the Time Tag was written by the Regular or Fast Monitor. The Fast Monitor stores a 16-bit Time Tag, while the Regular Monitor stores all 32 bits.

Details

This option allows you to change the format of the displayed information. The default, **Full**, specifies that all available information shall be displayed; **Brief** specifies that only Commands and Time be displayed.

Adjust Time

Allows the adjustment of the time tag to two options:

- **Set Time Tag to Zero** - This option zeroes the chronological time of the message that is currently displayed at the top of the screen; all other message times will be adjusted accordingly. This option is useful when a given message time serves as a reference point. The RTC itself is not affected.
- **Set Time Tag to RTC** - This option specifies that messages shall be time-tagged with the actual value of the IDEA Real Time Clock. The RTC is zeroed when the IDEA Monitor is reset.

MESSAGE

This option provides random access to messages.

Message Number Dialog Box

Type the message number and click the **"OK"** button.

APPENDIX A

PROGRAMMED MODIFICATION OF DATA TABLES

All data structures and parameters are defined interactively by the user in SETUP mode; these values may than be saved to disk and reloaded as desired. Since these files have a standard structure, they can be easily modified by user programs under DOS. In this appendix we illustrate how to modify the data table setup.

All saved setup files have a fixed extension, ".sup", which is appended to the file name specified by the user. A setup file consists of 19 contiguous blocks. Each block corresponds to specific variables or structures and consists of a header and body. The header has 3 fields:

1. **NAME**
   The NAME is an ASCII string of 10 characters (10 bytes long).

2. **SIZE**
   The SIZE field is 2 bytes long and specifies the number of bytes in the body.

3. **INDEX**
   The INDEX is a positive integer, which identifies the current block. The length of the INDEX field is 2 bytes.

The body contains the data structure or variable in SIZE bytes. In particular, the data table block header is defined by:

1. NAME = "rt_datatbl"

2. SIZE = 3F00 (hex)

3. INDEX = 3

The body of the data table block consists of 252 contiguous tables, each containing 32 words.

When loading a setup file, the loader identifies the variable in the first block with the aid of the INDEX and then reads SIZE bytes from the body of the block into the variable. The loader then proceeds to the second block, which resides in the input file 10 + 2 + 2 + SIZE bytes after the beginning of the first block. Subsequent blocks are dealt with similarly.

A user program can display the data tables specified by a setup file as follows:
1A

1. Enter the IDEA program.

2. Enter the SETUP menu and define the desired variables.

3. Issue a RUN command.

4. Return to the SETUP menu and save the setup in a file named "MYPARAMS".

5. Return to the root menu and exit to DOS.

6. Run the program "get_data" by typing the following:

```
get_data params
```

Since the setup file contains binary values which when read by BASIC programs may be interpreted as "end-of-file" (i.e., ASCII character 26), it cannot be read directly by BASIC. This difficulty can be avoided by loading the file with the DOS debugger.

The program get_data consists of 3 files:

1. **get_data.bat**
   This batch file activates the debug utility and then calls a BASIC program which displays the data. The contents of the file are:

```
debug %1.SUP < get_data.deb
basic get_data
```

2. **get_data.deb**
   This file provides input for the debug utility. The file contains 2 instructions for the debugger: load the named file into the IBM memory at address 4000 (hex) and quit. The contents are:

```
L4000:0
Q
```

3. **get_data.bas**

This BASIC program displays a data word from a specified data table:

```
10  DEF SEG = &H4000
20  J = 0
30  SIZE = 0
40  IDEX = -1
50  WHILE INDEX-3
60     J = J + 10 + SIZE
70     SIZE = PEEK(J) + 256*PEEK(J+1)
90     INDEX = PEEK(J+2)
100    J = J + 4
120 WEND
130 INPUT "ENTER TABLE NUMBER (0-251): "; TABLE
140 IF (TABLE < 0) OR (TABLE > 251) THEN GOTO 130
150 INPUT "ENTER WORD NUMBER: "; WORD
160 IF (TABLE = 0) AND (WORD = 0) THEN GOTO 220
170 IF (WORD < 1) OR (WORD > 32) THEN GOTO 150
180 K = J + TABLE*64 + 2*WORD
190 DAT = PEEK(K-2)+ 256*PEEK(K-1)
200 PRINT HEX$(DAT)
210 PRINT : GOTO 130
220 SYSTEM
```

In a similar manner, the user can define his own data by creating a setup file containing a single block named "rt_datatbl". The following example builds a file named "my_data.sup" which defines 252 data tables such that word number W in table number T equals 256*W + T.

```
10  OPEN "my_data.sup"  FOR OUTPUT AS  1
20  rem    Write the Block Header:
30  rem    - NAME  is  rt_datatbl
40  rem    - SIZE  is  3F00 (hex)
50  rem    - INDEX is  3
60  PRINT #1,"rt_datatbl";
70  PRINT #1,CHR$(00);CHR$(63);
80  PRINT #1,CHR$(3);CHR$(0);
90  FOR TABLE = 0 TO 251
100   FOR WORD = 0 TO 31
110     PRINT #1,CHR$(TABLE);CHR$(WORD);
120   NEXT WORD
130 NEXT TABLE
140 CLOSE #1
150 SYSTEM
```

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APPENDIX B

STRUCTURE OF THE COMMUNICATION STACK

Each monitored message is stored on the COMMUNICATION STACK in the form of a MESSAGE HEADER, followed by data words. The MESSAGE HEADER has the following structure:

	MSB 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	LSB 0
1	DON'T CARE			WORD COUNT					CMODE		ILL CMD	DON'T CARE		1	CAP	BUS
2	RECEIVE/MODE COMMAND															
3	TRANSMIT/INVALID COMMAND															
4	TRANSMIT STATUS															
5	RECEIVE STATUS															
6	RTC HIGH															
7	RTC LOW															
8	0	0	0	SW	P	V	W	1	1	ERROR CODE						0

1. **BUS**
   BUS = 0(1) defines A(B) as the active bus.

2. **CAP**
   CAP = 1 signifies that the capture event was detected before the end of the message. The bit remains set for all subsequent messages.

3. **ILL CMD**
ILL CMD = 1 denotes an illegal command. The possibilities are:

- Transmit broadcast (non-mode) command
- Mode command with broadcast forbidden by MIL-STD-1553B
- Mode command with incorrect T/R bit, as defined by MIL-STD-1553B
- Unimplemented mode commands, as defined by the LEGALITY menu

4. **CMODE**
CMODE defines the message type. The possibilities for valid command(s) are:

00 - Mode command
01 - Receive
10 - Transmit
11 - RT to RT

5. **WORD COUNT**
WORD COUNT defines the actual number of data words stored on the stack. The field contains 6 bits; values 0 and 32 appear as 000000 and 100000 respectively.

6. **RECEIVE/MODE COMMAND**
This word contains valid RECEIVE or MODE commands.

7. **TRANSMIT/INVALID COMMAND**
This word contains TRANSMIT or INVALID commands.

8. **TRANSMIT STATUS**
This word contains the STATUS word belonging to a command with T/R=1.

9. **RECEIVE STATUS**
This word contains the STATUS word belonging to a command with T/R=0.

10. **RTC HIGH**
This word contains the most significant 16 bits of the time-tag.

11. **RTC LOW**
This word contains the least significant 16 bits of the time-tag.

12. **ERROR CODE**
The ERROR CODE is a 6 bit field with the values given in TABLE B-1.

13. **LW**
    LW = 1 denotes that there was a long word error (time between successive syncs greater than 21 microseconds) in the second to last monitored data word.

14. **V**
    V = 0 signifies a Manchester encoding error in the last monitored word.

15. **P**
    P = 0 signifies a parity error in the last monitored word.

16. **SW**
    SW = 0 signifies a short word error in the last monitored word.

The bits LW, V, P, and SW have meaningful values only if the ERROR CODE indicates an INVALID WORD.
Erroneous messages always result in an ERROR CODE with
a non-zero value in the 4 least significant bits.

TABLE B-1. ERROR CODES

BINARY	ERROR
00 0000	NO ERROR
00 0001	Wrong RT address and invalid data
00 0010	Flagged bit in status and invalid data
00 0011	Invalid data
00 0100	Invalid command
00 0101	Wrong RT address and invalid data
00 0110	Flagged bit in status and invalid data
00 0111	Invalid data
00 1000	Invalid command
00 1001 - 00 1011	UNDEFINED
00 1100	Extra word
00 1101	Flagged bit in status and extra word
00 1110	Wrong RT address and extra word
00 1111	Invalid command
01 0000	NO ERROR
01 0001	Flagged bit in status
01 0010	Wrong RT address
01 0011	UNDEFINED
01 0100	Gap
01 0101	Flagged bit in status and gap
01 0110	Wrong RT address and gap
01 0111	Wrong RT address and invalid data

TABLE B-1. ERROR CODES (continued)

01 1000	Invalid data
01 1001	Flagged in status and invalid data
01 1010	Wrong RT address and invalid data
01 1011	Invalid data
01 1100	Inverse sync
01 1101	Flagged bit in status and inverse sync
01 1110	Wrong RT address and inverse sync
01 1111	Flagged bit in status and invalid data
10 0000	NO ERROR
10 0001	Flagged bit in status
10 0010	Wrong RT address
10 0011	UNDEFINED
10 0100	No response
10 0101	Invalid status
10 0110	Invalid status
10 0111	Invalid status
10 1000	Invalid status
10 1001 - 10 1011	UNDEFINED
10 1100	Early response
10 1101	Invalid status
10 1110	Invalid status
10 1111	Invalid status
11 0000	NO ERROR
11 0001	Flagged bit in status
11 0010	Wrong RT address
11 0011	UNDEFINED
11 0100	No response
11 0101	Flagged bit in status and no response
11 0110	Wrong RT address and no response
11 0111	UNDEFINED
11 1000	Invalid status
11 1001	Flagged bit in status and invalid status
11 1010	Wrong RT address and invalid status
11 1011	UNDEFINED
11 1100	Early response
11 1101	Flagged bit in status and early response
11 1110	Wrong RT address and early response
11 1111	UNDEFINED

APPENDIX C

RT RESPONSE TO COMMANDS

The following tables summarize the RT's responses to commands.

Legality Detection	Broadcast Command	Receive/ Transmit	Legal T/R-SADR	RT Response
YES	NO	X	YES	<1>
YES	NO	X	NO	<2>
YES	YES	RX	X	<4>
YES	YES	TX	X	<5>
NO	NO	X	YES	<1>
NO	NO	X	NO	<1>
NO	YES	RX	X	<4>
NO	YES	TX	X	<3>

TABLE C.1. RT RESPONSE TO TRANSMIT/RECEIVE COMMANDS

The above table assumes that broadcast commands are legal; if they are illegal, the broadcast command is simply ignored (i.e. response <3>).

Legality Detection	Legal Mode Code	Legal T/R	RT Response
YES	YES	YES	<1>
YES	YES	NO	<2>
YES	NO	X	<2>
NO	YES	YES	<1>
NO	YES	NO	<3>
NO	NO	X	<3>

TABLE C.2. RT RESPONSE TO NON-BROADCAST MODE COMMANDS

Legality Detection	Legal Mode Code	Legal T/R	Broadcast Legality	RT Response
YES	YES	YES	YES	<4>
YES	YES	YES	NO	<5>
YES	YES	NO	YES	<5>
YES	YES	NO	NO	<5>
YES	NO	X	X	<5>
NO	YES	X	NO	<3>
NO	NO	X	X	<3>
NO	YES	YES	YES	<4>
NO	YES	NO	YES	<3>

TABLE C.3. RT RESPONSE TO BROADCAST MODE COMMANDS

RT Response Definitions

<1> - Send cleared status word.
<2> - Send status with Message Error (ME) set.
<3> - No response and no update of last status and last command (i.e., ignore the command).
<4> - No response, set Broadcast Command Received (BCR) bit in last status.
<5> - No response, set BCR and ME bits in last status.
X - Don't care.

1. If a mode command with code between 10110-11111 is defined as legal (implemented), then it is considered legal for both transmit and receive.

2. The user can choose whether or not to implement the broadcast option. If broadcast is not implemented, the RTs will ignore such messages.

3. The RT does not detect legality when injecting the following errors: word length, gap, and encoding.

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