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FIREBIRD 4000

OPERATING MANUAL

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SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The FIREBERD 4000 Operating Manual provides descriptions and operating instructions for Telecommunications Techniques Corporation's (TTC's) FIREBERD 4000 Communications Analyzer. Included are component descriptions, functional descriptions, operating instructions, and instrument specifications. Also described are the data interfaces used with the FIREBERD 4000.

This section offers an overview of FIREBERD 4000 Communications Analyzer features and options.

1.2 INSTRUMENT OVERVIEW

The FIREBERD 4000 (Figure 1-1) is an instrument that uses internal and modular interfaces to test the quality of digital communications networks and equipment. It provides the analysis capabilities to isolate circuit malfunctions and report the results on the front panel or on a printout. Highly versatile, the FIREBERD 4000 is used in locations such as central offices, technical control centers, end-user sites, engineering laboratories, and earth stations.

1.2.1 Features

The FIREBERD 4000 offers these key features and characteristics:

- Operates on circuits transmitting and receiving data from 50 b/s to 15 Mb/s.
- Complete error analysis with bit, block, BPV, code, character, and frame or CRC errors measured simultaneously.
- Set-up panel and display that permits configuration of the unit for any test from the front-panel.
- Synchronous and asynchronous testing via internal EIA RS-232-C and MIL-STD-188C interfaces.
- CCITT V.35, EIA RS-449, DDS, T1, G.704, and G.703 testing via modular interfaces installed in the FIREBERD 4000's rear panel.
- Thirteen fixed clock frequencies ranging from 300 Hz to 2048 kHz.
- Generates six fixed data patterns: MARK only, SPACE only, 1:1, 1:7, and 3IN24, 1004Hz.
- Generates seven pseudorandom data patterns: 63, 511, 2047, 2^{15}-1, 2^{20}-1, 2^{23}-1, and QRSS.
- Generates user-programmable patterns that include: a synchronous 3- to 24-bit binary test pattern and three asynchronous (three synchronous with Option 4006) 1- to 2000-character hexadecimal test patterns for acceptance testing, stress testing, or simulating live data.
- Generates standard FOX message in four asynchronous (one synchronous with Option 4006) character formats: Baudot, BCDIC, ASCII, and EBCDIC.
- RS-232 printer/remote controller interface provides access for an external printer for printing test results and unit configurations, or computer-controlled operation for unattended testing from a remote site.
- Dual results displays which show any two test measurements at the same time.
- Summary test results category that displays key non-zero and "out-of-spec" measurements, eliminating the need to search through long lists of test results.
- Histogram analysis displayed in either a graph or list provides a perspective as to how selected results change with time.

1.2.2 Optional Capabilities

In addition to the standard features, the FIREBERD 4000 also offers these optional capabilities. Additional options and accessories are described in Section 9, Options and Accessories.

- *Second Interface Slot (Option 4001)* allows a second modular data interface to be installed and operated in the FIREBERD 4000.

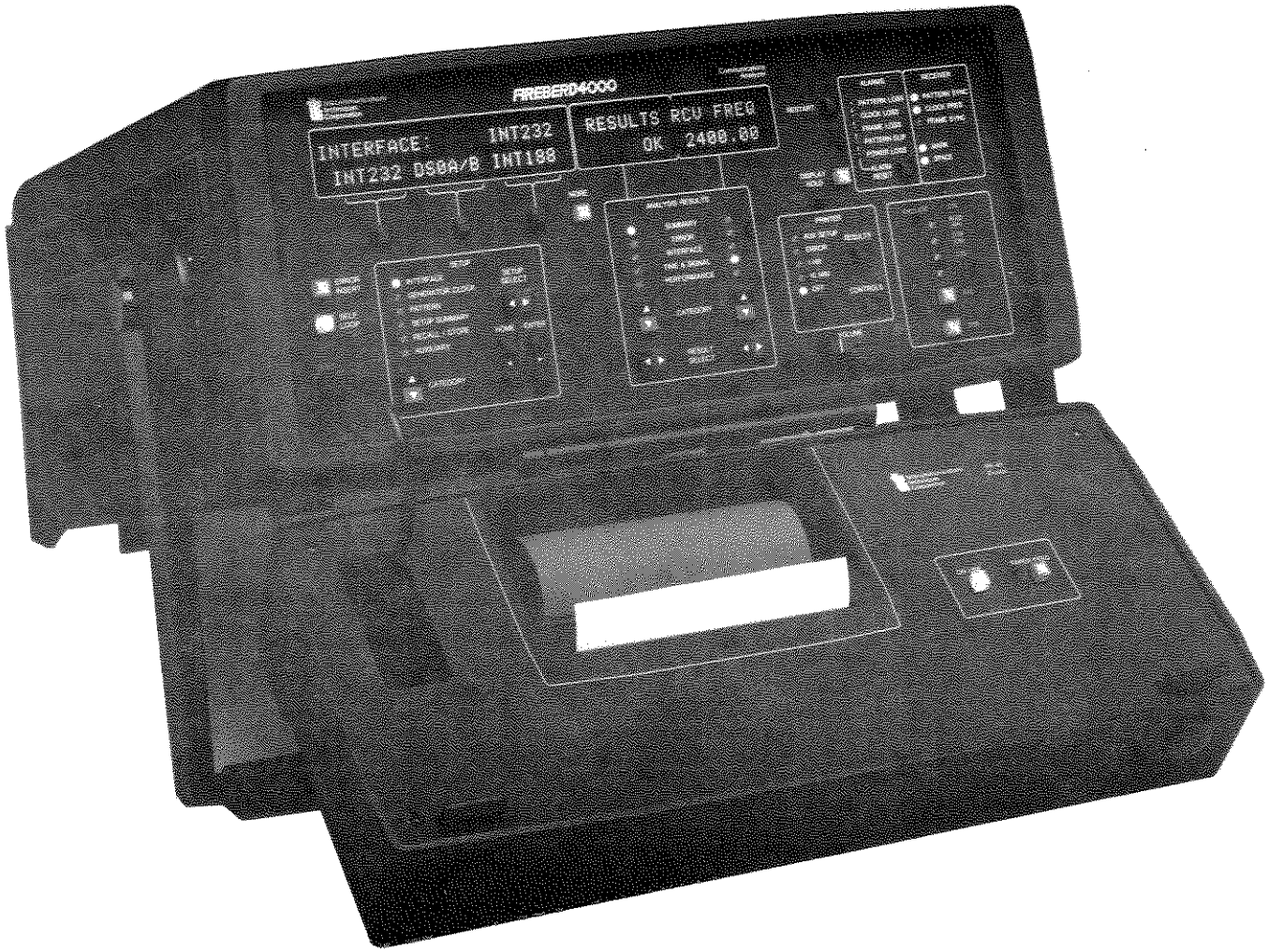


Figure 1-1
The FIREBERD 4000 Communications Analyzer

- *IEEE-488 Remote Control/Printer Interface (Option 4002)* allows unit to be connected to IEEE-488 Standard Digital Interface for Programmable Instrumentation (Std 1987) compatible remote control devices and printers.

- *Precision Time Base (±1ppm) clock (Option 4003)* provides a more accurate clock source for improved signal analysis.

- *CCITT G.821 Performance Analysis (Option 4004)* provides statistical information about the performance of the equipment or system under test in accordance with CCITT Recommendation G.821.

- *Frequency Synthesizer (Option 4005)* permits testing at non-standard clock frequencies from 50 Hz to 15 MHz.

- *Synchronous User Pattern (Option 4006)* allows three user-programmable 1- to 2000-character patterns to be generated for testing synchronous circuits.

- PR-45 Thermal Dot-Matrix Printer built into the FIREBERD 4000 cover provides hard copy test results and mainframe configurations in a 40-column format. (For plastic case mainframes only.)

1.3 OPERATING MODES

The FIREBERD 4000 can be used in these modes of operation:

- Emulate data terminal equipment (DTE), data communications equipment (DCE), or digital transmission test sets.

- Synchronous and recovered (interface dependent) timing modes.

- Asynchronous timing mode from the internal EIA RS-232-C or MIL-STD-188C data interfaces.

- In-service monitoring of live data or out-of-service testing.

- Loopback or end-to-end circuit testing.

- Remote control operation through a computer or dumb terminal.

SECTION 2
PREPARATION FOR USE

2.1 INTRODUCTION

This section provides information related to unpacking, initial inspection, safety procedures, power requirements, and instrument checkout.

2.2 UNPACKING AND INITIAL INSPECTION

The shipping container should be inspected for damage when it is received. If the shipping container or shipping material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the unit has been checked mechanically and electrically. Procedures for checking the electrical performance are provided in Section 2.7, Instrument Checkout. The customer should notify TTC if the contents are incomplete, if there is mechanical damage or defect, or if the FIREBERD does not pass the instrument checkout procedures in Section 2.7. If the shipping container is damaged, notify the carrier and TTC, and keep the shipping container and materials for the carrier's inspection. Should repairs be necessary, follow the instructions in Section 10, Maintenance and Service, for returning the unit to TTC.

2.3 INSTRUMENT IDENTIFICATION

An identification sticker is attached to the rear panel of each FIREBERD 4000. This sticker bears the serial number assigned to the unit. Any factory installed options are also listed by option number on the rear panel. Quote the serial number and options on any correspondence with TTC concerning the unit.

2.4 EQUIPMENT INCLUDED

The following equipment is supplied with the FIREBERD 4000:

Power cord
Operating manuals
Front cover
Snap-on top pouch

Additional options and accessories are identified in Section 9, Options and Accessories.

2.5 WARNINGS

The following precautions must be observed before and during all phases of unit operation. Failure to comply with these precautions or specific warnings found elsewhere in the manual can cause physical harm to the operator or damage to the unit. TTC assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT

To minimize shock hazard, the chassis must be connected to an approved electrical ground through the three-conductor AC power cord and/or the grounding lug on the rear panel. The power cord must either be plugged into an approved three-conductor electrical outlet with safety ground or used with a three-prong to two-prong adaptor with the grounding wire (green) securely connected to an electrical ground (safety ground) at the power outlet.

USE PROPER LINE VOLTAGE SETTING AND FUSE RATING

Before connecting the AC power cord, verify that the line voltage selector module is positioned for the correct operating voltage. Never operate the unit with an incorrectly rated fuse. Refer to Section 2.6, Power Requirements, for information on voltage settings and fuse ratings.

KEEP AWAY FROM LIVE CIRCUITS

Do not remove covers or insert fingers or other objects through the ventilation holes while power is applied to the unit.

TURN OFF POWER BEFORE INSERTING OR REMOVING INTERFACE MODULES

Damage can result to the FIREBERD 4000 and the data interface when the interface is inserted or removed with the unit power turned on.

DO NOT OPERATE IN AN AMBIENT TEMPERATURE ABOVE 50°C.

2.6 POWER REQUIREMENTS

This section contains information on the unit's input power requirements. The power switch, power receptacle, line voltage selector, and fuseholder are all located on the rear panel. Figure 2-1 shows the power input module.

2.6.1 Power Switch

The power switch is located on the left side of the rear panel. The rocker switch is labeled "0" for OFF and "1" for ON. Press the appropriate label to set the power ON or OFF.

2.6.2 Power Receptacle

The FIREBERD 4000 is equipped with a recessed three-prong, male, power receptacle. The receptacle provides hot, neutral, and safety ground to the unit. Power must be supplied through an approved three-prong electrical outlet or used with a three-prong to two-prong adaptor with the grounding wire (green) securely connected to an electrical ground (safety ground) at the power outlet.

2.6.3 Line Voltage Selector and Fuseholder

The FIREBERD 4000 requires a power source of 120 or 240 VAC, single phase, 50 or 60 Hz, that can deliver 110 volt-amperes (maximum). The line voltage selector and fuseholder module, located to the right of the power receptacle, sets the input voltage and contains two fuses (2A, 250V slow blow) for normal operation and protection. Removing and rotating the module allows the input voltage requirement for the unit to be changed to match the source voltage.

Before connecting the AC power cord, verify that the proper line voltage is selected for the source voltage. The

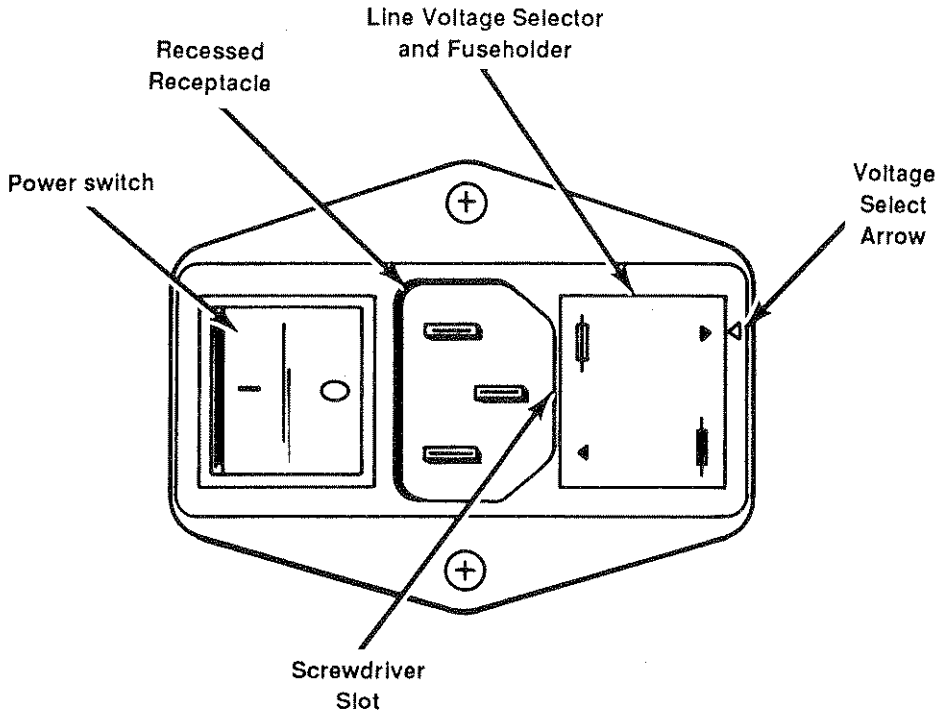


Figure 2-1
Power Input Module

selected input voltage is determined by the markings on the module as shown in Figure 2-1. The voltage is marked next to the arrow located on the upper right side of the module.

NOTE: The power cord supplied with the unit may have to be replaced to match the particular power-source output plug.

2.6.4 Changing the Input Line Voltage

To change the input line voltage, perform the following procedure. A small flat-head screwdriver is required to remove the module.

(1) Remove the power cord from the rear panel.

(2) Locate the line voltage and fuseholder module on the right side of the power cord receptacle on the rear panel (see Figure 2-1).

(3) Insert a small flat-head screwdriver into the small notch on the left side of the module (see Figure 2-1) and gently pry the module from the power input module.

(4) Pull the voltage selector module straight out.

(5) Rotate the module and re-insert it so that the appropriate operating voltage is next to the arrow located on the upper right side of the power input module (see Figure 2-1).

(6) Press the line voltage and fuseholder module securely back into place.

2.6.5 Replacing the Line Fuse

Two fuses (2A, 250V slow blow) are supplied in the module, one for circuit protection and one used as a spare. The same fuse size is used for both input voltage selections. Figure 2-2 shows the module and the fuse locations for the input voltages. Only the fuse indicated for the specific operating voltage is required to operate the FIREBERD 4000.

WARNING: Never operate the unit with an improperly rated fuse.

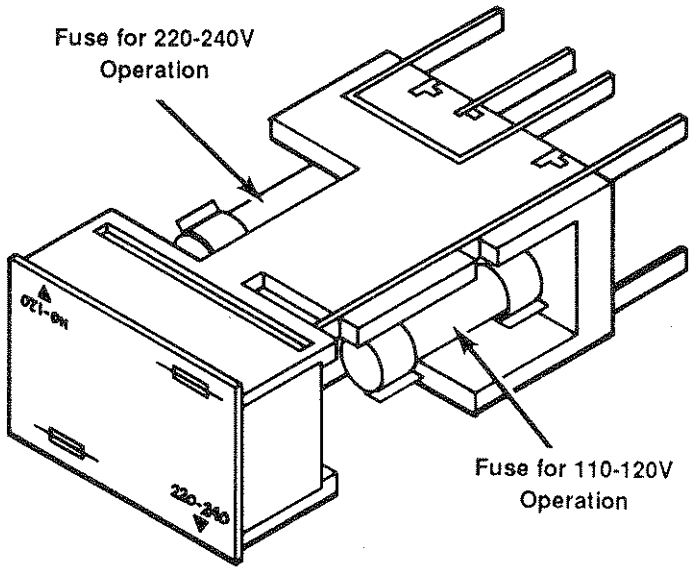


Figure 2-2
Fuse Locations

To replace the line fuse perform the following procedure. A small flat-head screwdriver is required to remove the module.

(1) Remove the power cord from the rear panel.

(2) Locate the line voltage and fuseholder module on the right side of the power cord receptacle on the rear panel (see Figure 2-1). Note the orientation of the line voltage and fuseholder module before removing it.

(3) Insert a small flat-head screwdriver into the small notch on the left side of the module (see Figure 2-1) and gently pry the module from the power input module.

(4) Pull the line voltage and fuseholder module straight out.

(5) Identify and remove the blown fuse and install a new fuse of the correct size.

(6) Verify the orientation of the line voltage and fuseholder module and re-insert it so the appropriate operating voltage (labeled on module) is next to the arrow located on the upper right side of the power input module.

(7) Press the line voltage and fuseholder module securely back into place.

2.7 INSTRUMENT CHECKOUT

This section describes the automatic self-test that the FIREBERD 4000 performs at power-up. Also included is a manual self-test which can be used to verify proper operation of the FIREBERD. The following procedures assume that the user is familiar with the operation of the FIREBERD 4000; unfamiliar users should refer to Section 4, Operating Instructions.

2.7.1 Automatic Self-Test

The automatic self-test is a series of diagnostic tests performed by the FIREBERD at power-up. These tests ensure that the FIREBERD is functioning correctly. If any of these tests fail, the FIREBERD 4000 displays an error message specifying what part of the unit failed. During the automatic self-test:

- All discrete LEDs, switches containing LEDs, and backlighted panel labels illuminate and the software revision and date appear in the display for approximately 4 seconds.
- All memory is tested. If an error is found, a message is displayed. If an EPROM error message appears, the unit may not be able to operate. Call TTC for service.
- Switch positions are checked. If a switch is pressed or stuck during power-up, an error message is displayed specifying the stuck key. Refer to Appendix D for a list of the error messages.
- Non-volatile RAM (NOVRAM) is checked at power-up. The FIREBERD 4000 restores the unit to the settings that were selected before the last power-down. The unit defaults to the SETUP SUMMARY display showing the current unit setting selected at the time of the last power-down. If any changes are found, a message is displayed specifying what general portion of NOVRAM failed, and the original factory settings are automatically restored for the affected portion of NOVRAM. The FIREBERD 4000 may still function even though switch settings may not be saved during a power cycle.

2.7.2 Manual Self-Test

The manual self-tests are performed in the Self-Loop mode. The FIREBERD's operation in this mode is directly related to the interface selected. The internal EIA RS-232-C/ CCITT V.24 data interface is used for this test. If the internal RS-232-C is suspected of malfunctioning, an installed interface may be substituted for this test. Remember that power to the FIREBERD must be turned OFF before inserting or removing an interface. If the interface used has clock invert switches, they should be placed in the NORMAL position for this test. Other interface switches should be set appropriately. Refer to Section 5, Data Interfaces, for information on interface set-up procedures.

If the self-test procedure leads to a determination that servicing of the FIREBERD is required, it is helpful to note the areas of the test in which the FIREBERD failed before contacting TTC for assistance. Before beginning the manual self-test procedure, verify that:

- The AC line voltage is set properly.
- If present, the interface is installed properly.
- Power is turned ON.
- The automatic self-test is successful.

The following test procedures can be performed sequentially, or individually, as required. The tests include:

- Generator clock and frequency counter test.
- Synchronous transmit and receive test.

- Error counter and error insert test.
- Data pattern generator test.
- Time and date test.

2.7.2.1 Generator Clock and Frequency Counter Test

This test verifies the operation of the generator clock and the frequency counter.

Test Set-Up

Step	Switch	Selection
(1)	SELF LOOP	ON
(2)	SETUP CATEGORY	INTERFACE
	HOME key	Press
	Softkey	INT232
	SETUP SELECT	Press right arrow (EMULATE)
	Softkey	DTE
	SETUP SELECT	Press right arrow (TIMING)
	Softkey	SYNC
(3)	SETUP CATEGORY	GENERATOR CLOCK
	HOME key	Press
	Softkey	INTRNL
	SETUP SELECT	Press right arrow (INTERNAL)
	MORE key	Locate 64.0k softkey label
	Softkey	64.0k
(4)	SETUP CATEGORY	PATTERN
	HOME key	Press
	MORE key	Locate 2^15-1 softkey label
	Softkey	2^{15}-1
(5)	Left RESULTS CATEGORY	TIME & SIGNAL
(6)	Left RESULT SELECT	GEN FREQ
(7)	Right RESULTS CATEGORY	TIME & SIGNAL
(8)	Right RESULT SELECT	RCV FREQ

Test Procedure

(1) Verify that the results show:

GEN FREQ
64000.0
RCV FREQ
64000.0

2) Repeat procedure by changing the frequency as required.

2.7.2.2 Synchronous Transmit and Receive Test

This test verifies the operation of the transmit and receive circuitry.

Test Set-Up

Step	Switch	Selection
(1)	SELF LOOP	ON
(2)	SETUP CATEGORY	INTERFACE
	HOME key	Press
	Softkey	INT232
	SETUP SELECT	Press right arrow (EMULATE)
	Softkey	DTE
	SETUP SELECT	Press right arrow (TIMING)
	Softkey	SYNC
(3)	SETUP CATEGORY	GENERATOR CLOCK
	HOME key	Press
	Softkey	INTRNL
	SETUP SELECT	Press right arrow (INTERNAL)
	MORE key	Locate 64.0k softkey label
	Softkey	64.0k
(4)	SETUP CATEGORY	PATTERN
	HOME key	Press
	MORE key	Locate 2^15-1 softkey label
	Softkey	2^{15}-1
(5)	ERROR INSERT	OFF
(6)	Left RESULTS CATEGORY	ERROR
(7)	Left RESULT SELECT	BIT ERRS

Test Procedure

(1) Press RESTART switch.

(2) Verify that the PATTERN SYNC LED illuminates and that zero appears in the BIT ERRS result.

2.7.2.3 Error Counter and Error Insert Test

This test verifies the operation of the error counter and the error insert function.

Test Set-Up

Step	Switch	Selection
(1)	SELF LOOP	ON
(2)	SETUP CATEGORY	INTERFACE
	HOME key	Press
	Softkey	INT232
	SETUP SELECT	Press right arrow (EMULATE)
	Softkey	DTE
	SETUP SELECT	Press right arrow (TIMING)
	Softkey	SYNC
(3)	SETUP CATEGORY	GENERATOR CLOCK
	HOME key	Press
	Softkey	INTRNL
	SETUP SELECT	Press right arrow (INTERNAL)
	MORE	Locate 64.0k softkey label
	Softkey	64.0k
(4)	SETUP CATEGORY	PATTERN
	HOME key	Press
	MORE key	Locate 2^15-1 softkey label
	Softkey	2^{15}-1
(5)	ERROR INSERT	OFF
(6)	Left RESULTS CATEGORY	ERROR
(7)	Left RESULT SELECT	BIT ERRS
(8)	VOLUME	Middle position

Test Procedures

(1) Press RESTART switch.

(2) Press ERROR INSERT switch once.

(3) Verify that the left BIT ERRS result increments by one count and that a beep is heard every time the ERROR INSERT switch is pressed.

(4) Press ERROR INSERT switch until the switch LED illuminates.

(5) A beep should occur for every second that an error is detected.

(6) Press right RESULTS CATEGORY switch and select ERROR.

(7) Press right RESULT SELECT switch and select BER result.

(8) Press RESTART once.

(9) Verify that the right BER result displays 1.00 E-03 after approximately 15 seconds.

2.7.2.4 Data Pattern Generator Test

This test verifies the operation of the data pattern generator.

Test Set-Up

Step	Switch	Selection
(1)	SELF LOOP	ON
(2)	SETUP CATEGORY	INTERFACE
	HOME key	Press
	Softkey	INT232
	SETUP SELECT	Press right arrow (EMULATE)
	Softkey	DTE
	SETUP SELECT	Press right arrow (TIMING)
	Softkey	SYNC
(3)	SETUP CATEGORY	GENERATOR CLOCK
	HOME key	Press
	Softkey	INTRNL
	SETUP SELECT	Press right arrow (INTERNAL)
	MORE key	Locate 0.3k softkey label
	Softkey	0.3k
(4)	SETUP CATEGORY	PATTERN
	HOME key	Press
	Softkey	MARK

Test Procedures

(1) Verify that the RECEIVER MARK LED illuminates.

(2) Press ERROR INSERT switch a few times.

(3) Verify that the RECEIVER SPACE LED briefly illuminates.

(4) Press SETUP CATEGORY switch and select PATTERN category.

(5) Locate and press the 3IN24 softkey.

(6) Verify that the MARK and SPACE indicators are both flashing.

(7) Sequence through all the pattern positions and verify that the RECEIVER PATTERN SYNC LED is illuminated for each pattern, except FOX and USER.

2.7.2.5 Time and Date Test

This test verifies that the FIREBERD is recording the correct time and date.

Test Set-Up

Step	Switch	Selection
(1)	Left RESULTS CATEGORY	TIME & SIGNAL
(2)	Left RESULT SELECT	TIME
(3)	Right RESULTS CATEGORY	TIME & SIGNAL
(4)	Right RESULT SELECT	DATE

Test Procedures

(1) Verify that the correct time and date are shown.

(2) If the time and date are not correct, reset them using the AUXILIARY SETUP TIME and DATE menus. Locate the the AUXILIARY TIME and DATE selections using the SETUP SELECT switch.

SECTION 3
INSTRUMENT DESCRIPTION

3.1 INTRODUCTION

This section describes the FIREBERD 4000 Communications Analyzer physical characteristics, front panel switches and indicators, and rear panel switches and indicators.

3.2 PHYSICAL DESCRIPTION

The FIREBERD 4000, shown in Figure 1-1, is transportable, easy to set up, and easy to use. The FIREBERD 4000 front panel controls and indicators are clearly marked and conveniently located for quick recognition and access during set-up and testing. The vacuum fluorescent display provides easy-to-read menus and analysis results. The menus and analysis results lists are categorized to make retrieval and access simple.

The adjustable handle rotates 285° for easy handling, storage, and front panel viewing. The front panel is designed to allow the FIREBERD to be placed facedown for installing interface modules and other options in the rear panel slot(s). The hinged cover provides protection of the front panel, additional storage space for cables, or houses the optional thermal printer.

The unit weighs less than 19 pounds, when fully configured, and measures approximately 6" high, 14" wide, and 12" deep. The case is available in either a high-impact plastic or heavy-gauge metal.

The rear panel provides connections for: (1) an external printer for collecting mainframe configurations and analysis results printouts; (2) a remote terminal or computer for remote control operation; and (3) testing EIA RS-232-C/CCITT V.24 and MIL-STD-188C compatible systems. A standard interface slot accommodates modular interfaces, allowing the FIREBERD access to a variety of interface circuits. An optional second interface slot can be added, so that two interfaces can be installed and either interface selected. The rear panel also has retractable standoffs which safeguard the rear panel and allow the FIREBERD to be placed on end during testing. Power is supplied to the unit through the rear panel and can be selected for 120 or 240 VAC operation. The fuse and power switch are also located on the rear panel.

With the appropriate equipment rack mounts, the FIREBERD 4000 can be mounted in a test bay for permanent installations. The FIREBERD is also capable of individually selecting and configuring up to 16 data interfaces when the interfaces are installed in up to four ISU-6000 Interface Switching Units. This configuration provides the ability to test a wide variety of circuits from different interface connections and mainframe configurations.

3.3 FRONT PANEL CONTROLS AND INDICATORS

Figure 3-1 identifies the key sections and switches of the FIREBERD 4000 front panel. The following information describes the functions of the front panel displays, controls, indicators, and the printer connector. The FIREBERD 4000 front panel design allows easy set-up and operation in many circuit configurations.

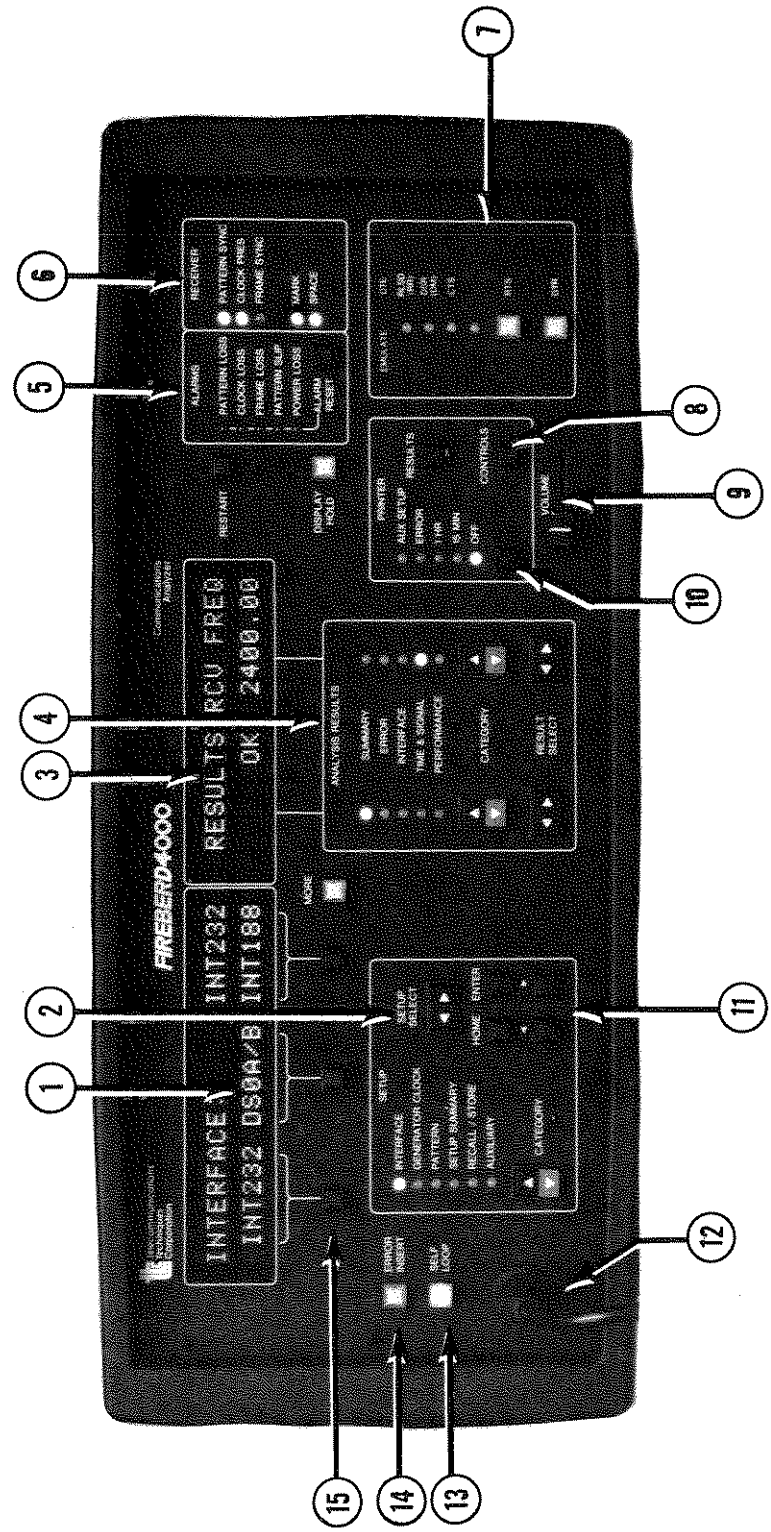
3.3.1 SETUP Panel and Display Sections

The SETUP panel and display sections are used to:

- Select and configure built-in and installed interfaces for circuit testing.
- Select the mainframe generator clock source and frequency.
- Select the test pattern.
- Store and recall front panel test configurations.
- Configure the remote control/printer interfaces.

The following information explains the function of the SETUP panel display and switches.

SETUP Display - The SETUP display is a 40-character, 2-line vacuum fluorescent display capable of displaying upper and lowercase alphanumeric characters and a cursor. Mainframe and interface configuration menus are displayed here. The top line indicates the menu name and selected function and/or option. The bottom line indicates menu choices for the three softkeys below the display.



Legend:

1 SETUP Display
2 SETUP Panel
3 Analysis RESULTS Display
4 Analysis RESULTS Panel
5 ALARMS Status Panel
6 RECEIVER Status Panel
7 Interface Status and Control Panel
8 PRINTER Control Panel
9 VOLUME Switch
10 PRINT EVENT Switch
11 Keypad
12 PR-45 Printer Connector
13 SELF LOOP Switch
14 ERROR INSERT Switch
15 Softkey (x3)

Figure 3-1
The FIREBERD 4000 Front Panel

Softkeys - These three momentary pushbutton switches below the display are used to select a function, option, or operation depending on the requirements of the menu displayed. A softkey is only functional when a label is displayed above it. When a softkey is pressed, the selected function is displayed on the upper right of the display. The softkeys are not functional when the SETUP SUMMARY menu is displayed.

MORE Key - This momentary pushbutton switch illuminates when a displayed menu has more than three selections. When pressed, the MORE key displays the next set of softkey labels. Continually pressing this key cycles through the menu selections.

SETUP CATEGORY Switch - This rocker switch allows scrolling up or down through the SETUP menu categories listed above the switch. Repeatedly pressing the CATEGORY switch sequentially illuminates the labeled SETUP category LEDs and displays the previously displayed category menu. The FIREBERD SETUP menus are described in Section 4, Operating Instructions.

SETUP CATEGORY LEDs - These six LEDs indicate which SETUP category is currently displayed. The LEDs illuminate sequentially as the SETUP CATEGORY switch is pressed.

INTERFACE - Indicates the Interface category is displayed. This category contains menus to control interface selection and operation of menu controlled interfaces.

GENERATOR CLOCK - Indicates the Generator Clock category is displayed. This category contains menus to control the mainframe clock source and frequency.

PATTERN - Indicates the Data Pattern category is displayed. This category contains menus that provide mainframe test pattern selections.

SETUP SUMMARY - Indicates the SETUP Summary is displayed. This display summarizes the mainframe configuration.

RECALL/STORE - Indicates the Recall and Store category is displayed. This category contains menus that allow front panel configurations to be saved and recalled at any time.

AUXILIARY - Indicates the Auxiliary Function category is displayed. This category contains menus that control the remote control/printer interfaces, printout formats, and signal processing thresholds.

SETUP SELECT Switch - This rocker switch allows scrolling through available menus for the selected SETUP category.

SETUP Panel Keypad - These four momentary pushbutton switches are used to save selected data, return to the home menu of the selected category, and control the display cursor.

HOME Key - Pressing the HOME key returns the selected SETUP category to its home menu.

ENTER Key - Pressing the ENTER key saves parameter changes keyed in through the front panel.

Cursor Keys - Pressing the arrow keys move the cursor left or right across the displayed field. These keys are only active when the cursor is displayed.

3.3.2 ANALYSIS RESULTS Panel and Display Section

The ANALYSIS RESULTS panel and display section presents the results of an established test. Two results are displayed at one time from the categories listed in the ANALYSIS RESULTS panel. Refer to Section 4 for descriptions of each category and result available.

ANALYSIS RESULTS DISPLAY - The display is a 34-character, 2-line vacuum fluorescent display capable of displaying upper and lowercase alphanumeric characters. Two test results are displayed at the same time. The top line identifies the selected result and the bottom line indicates the results value gathered during the test.

ANALYSIS RESULTS CATEGORY Switches - The two ANALYSIS RESULTS rocker switches select the category of results being displayed. The switches allow two categories to be displayed at the same time. Pressing either CATEGORY switch, up or down, sequentially illuminates the labeled category LEDs and displays the selected category above the appropriate switch. The results displayed in each category are selected with either corresponding RESULT SELECT switch.

ANALYSIS RESULTS CATEGORY LEDs - The five LEDs indicate which results category is selected. These LEDs illuminate sequentially as the RESULTS CATEGORY switch is pressed.

SUMMARY - Indicates the Results Summary category is displayed. This category provides a summary of results that indicate "non-zero" or "out-of-spec" measurements errors have been detected.

ERROR - Indicates the Error Results category is displayed. This category presents commonly used error results.

INTERFACE - Indicates the Interface Results category is displayed. This category presents interface-specific error results.

TIME & SIGNAL - Indicates the Time and Signal Results category is displayed. This category presents time related results and signal frequencies.

PERFORMANCE - Indicates the Performance Results category is displayed. This category presents CCITT G.821 performance results (Option 4004 is required).

RESULT SELECT Switches - These two rocker switches allow two results selections to be displayed at the same time, one from each selected category. Pressing the left or right switches steps the available results across the corresponding display. The categories displayed are selected using the CATEGORY switches.

RESTART Switch - Pressing this momentary pushbutton switch clears all accumulated measurements and indicated alarms, restarts the test, and resynchronizes the receiver. The mainframe generator is not affected.

DISPLAY HOLD Switch - This momentary pushbutton switch allows the displayed ANALYSIS RESULTS information to be halted and examined at any given instance. Normally, the displayed results are continuously updated (whether displayed or not). Pressing DISPLAY HOLD halts the display and illuminates the LED within the switch. Pressing DISPLAY HOLD again allows the display to resume normal operation. It should be noted that, while the display is on hold, the mainframe continues to accumulate analysis results. Releasing the display hold updates the display with the current results values.

3.3.3 RECEIVER Status Panel

The RECEIVER status panel monitors five conditions related to proper received signal processing: pattern synchronization, clock presence, frame synchronization, and Mark and Space signals. Each LED illuminates when the corresponding condition is established or detected. The LEDs remain illuminated until the test is restarted (press RESTART or power up) or the condition is no longer detected.

PATTERN SYNC - Illuminates (green LED) when pattern synchronization is established between the received data and the FIREBERD receiver.

CLOCK PRES - Illuminates (green LED) when the clock signal is detected and the receiver has synchronized to it.

FRAME SYNC - Illuminates (green LED) when frame synchronization is achieved.

MARK - Illuminates (yellow LED) when the mainframe identifies a received pulse as a Mark.

SPACE - Illuminates (yellow LED) when the mainframe identifies a received pulse as a Space.

3.3.4 ALARMS Status Panel

The ALARMS status panel monitors five conditions related to signal processing and interface operation: pattern loss, clock loss, frame loss, pattern slip, and power loss. Each red LED illuminates when the corresponding condition occurs. The LEDs remain illuminated until either the ALARM RESET switch is pressed or the test is restarted (press RESTART or power up). The action of the ALARMS panel is dependent on the interface being used. Not all alarm conditions are applicable to all interfaces. Refer to the appropriate interface manual for details.

PATTERN LOSS LED - Illuminates when pattern synchronization is lost.

CLOCK LOSS LED - Illuminates when clock or signal presence is lost.

FRAME LOSS LED - Illuminates when frame synchronization is lost.

PATTERN SLIP LED - Illuminates when a pattern slip is detected.

POWER LOSS LED - Illuminates to indicate that a power loss occurred during a test, whether the power loss was intentional or not. This alarm is helpful during unattended testing.

ALARM RESET Switch - Pressing this momentary pushbutton switch clears and resets the illuminated alarms.

3.3.5 Interface Status and Control Panel

The interface status and control panel contains four yellow LEDs, two momentary pushbutton switches, and three columns of panel labels. Figure 3-2 shows all of the indicators and switches illuminated during the power-up, self-test sequence. The panel operation and significance of the LEDs are

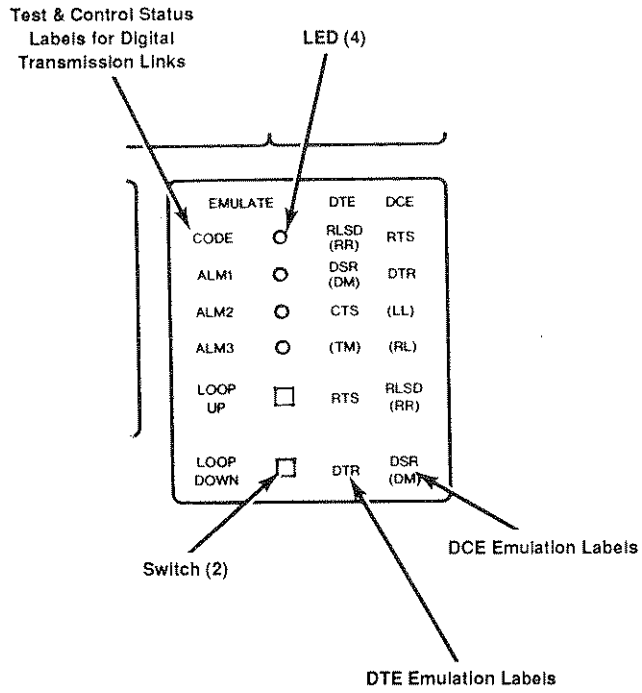


Figure 3-2
Interface Status and Control Panel

dependent on the data interface being used in the mainframe. Therefore, refer to the appropriate interface operating manual for specific details regarding the function of the LEDs, panel labels, and switches.

Interface Status LEDs

The LEDs indicate the status of specific signaling leads that control DTE and DCE operation on interfaces, such as EIA RS-232-C/V.24, EIA RS-449/CCITT V.10/V.11, or CCITT V.35 compatible data interfaces. The LEDs can also indicate the status of the test and control status codes generated over digital transmission links like 2048 kb/s G.704, 64 kb/s G.703, DDS DS0A/B, and DS1/T1 networks.

Interface Control Switches

The two switches provide control over two signaling leads that control DTE and DCE operation on interfaces, such as the EIA RS-232-C/V.24, EIA RS-449/CCITT V.10/V.11, or CCITT V.35 data interfaces. Each switch toggles between ON and OFF each time it is pressed; a yellow LED within the switch illuminates in the ON position. The switches are also used to send mainframe generated control signals used over digital transmission links like the DDS DS0A/B and DS1/T1 networks to establish remote loopbacks. When a switch is pressed, the switch illuminates and the corresponding code is transmitted.

Depending on the data interface being used and how it is configured, the LEDs and switches are identified by one of three columns of illuminated panel labels. Because the FIREBERD can emulate DTE or DCE, or function in digital transmission networks, the panel labels define the function of the LEDs and switches for a particular application. It should also be noted that not all the LEDs and switches are used and only those needed for a particular application are identified by illuminating the appropriate panel label. Again, refer to the appropriate interface operating manual for specific information on the panel labels.

The EMULATE DTE label and the panel labels below it illuminate when the FIREBERD is emulating DTE (Data Terminal Equipment). The EMULATE DCE and the panel labels below it illuminate when the FIREBERD is emulating DCE (Data Communication Equipment). The DTE and DCE emulation labels not in parentheses indicate EIA RS-232-C/V.24 lead notation and the labels in parentheses indicate EIA RS-449 lead notation. When neither emulation label is illuminated, the test and control labels are illuminated. Because of the different codes and alarms generated over digital transmission links, generic labels are used to identify the LEDs. The label definitions are provided in the data interface manuals.

3.3.6 PRINTER Control Panel

The PRINTER control panel contains three momentary pushbutton switches and five LEDs that are used to turn a printer on and off and initiate specific printouts at set periods or as desired. Refer to Section 6, Printer Operation, for setting up and operating a printer with the FIREBERD.

Print Event Switch - This momentary pushbutton switch controls the operation and set-up of the printer attached to the FIREBERD. Repeatedly pressing the switch sequentially illuminates the labeled LEDs listed above the switch from bottom to top.

AUX SETUP - Indicates that the Auxiliary Print Event menu **(AUX PRINT EVENT: ERROR/TIMED/HST-GRM)**, in the SETUP AUXILIARY menu, determines the printout generated.

ERROR - Indicates that printouts are generated each time an error is detected and displayed on the ANALYSIS RESULTS display. The reported errors include: bit errors, frame errors, CRC errors, BPV errors, clock slips, and block errors.

1 HR - Indicates that results printouts occur every 60 minutes after a test is started.

15 MIN - Indicates that results printouts occur every 15 minutes after a test is started.

OFF - Indicates that no results or status printout is generated.

PRINTER RESULTS Switch - This momentary pushbutton switch causes a snapshot of the current results to be printed. Every time RESULTS is pressed, the current results are printed, regardless of the printer event selection or the DISPLAY HOLD function.

PRINTER CONTROLS Switch - This momentary pushbutton switch causes a printout of the current front panel switch and set-up menu settings to be printed.

3.3.7 VOLUME Control

The Volume control slide switch controls the volume of the audible tones generated by the FIREBERD. The audible tones identify specific conditions that may occur during testing.

A short single tone beep indicates:

- an invalid keypad entry.
- the cursor has reached the limits of a field.
- a bit error has occurred when the bit error count or errored seconds result is displayed.

A two tone beep indicates a loss of pattern synchronization.

3.3.8 PR-45 Printer Connector

The 8-pin DIN connector provides power, data, and control leads for the optional PR-45 thermal printer (see Section 6).

3.3.9 SELF LOOP Switch

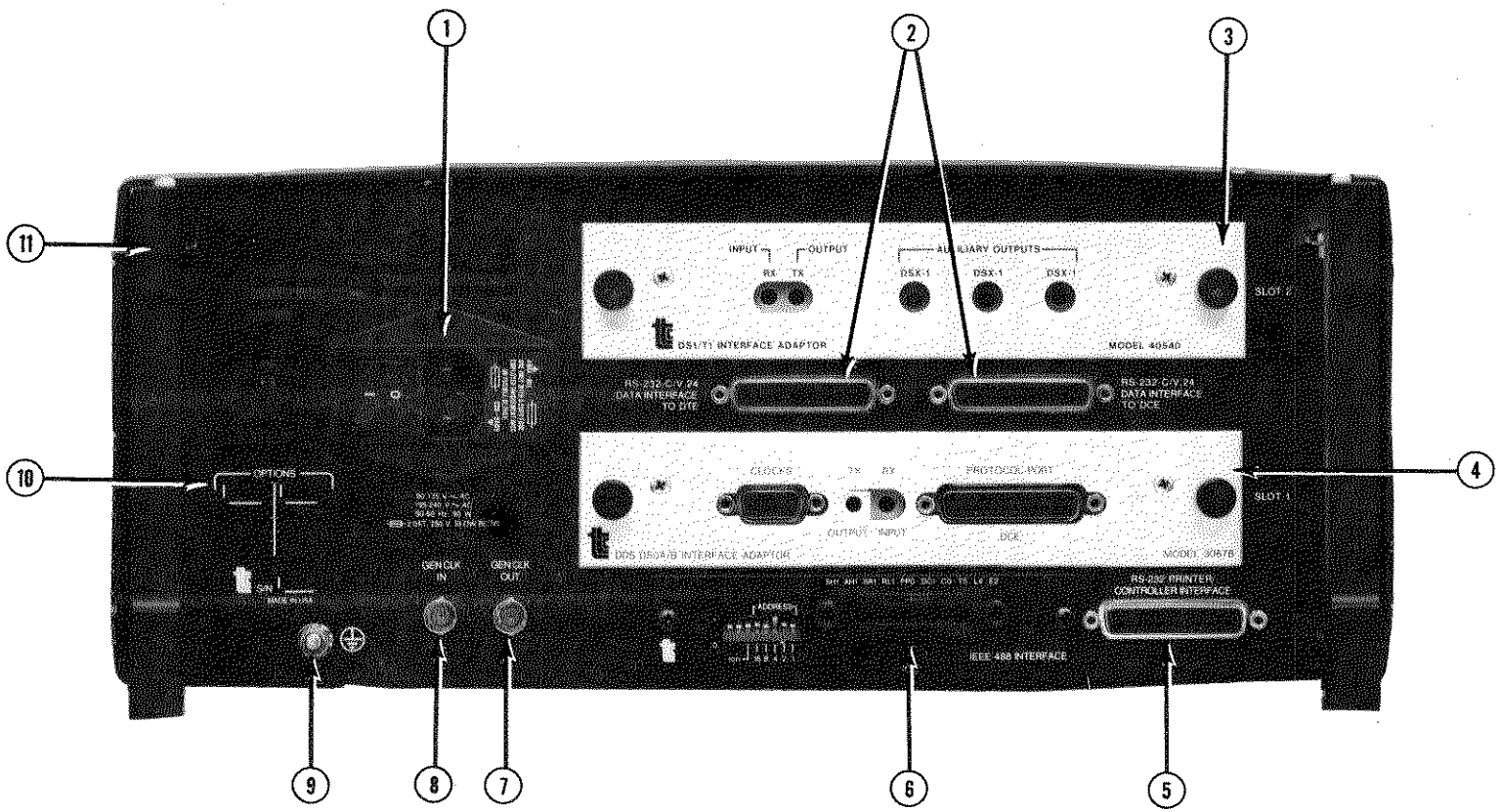
The SELF LOOP momentary pushbutton switch changes the FIREBERD operation from a normal full-duplex test mode to a self-loop test mode and vice versa. When in self-loop, the SELF LOOP switch illuminates (red LED), indicating the data interface transmit data and clock leads are connected to the receive data and clock leads, establishing an internal loop to test the mainframe and selected data interface. The internal interface loop disconnects the FIREBERD from the circuit under test without the need for disconnecting the cables from the interface. Pressing the SELF LOOP switch again, while illuminated, releases the self-loop mode and the switch LED turns off.

3.3.10 ERROR INSERT Switch

The ERROR INSERT momentary pushbutton switch allows bit errors to be inserted in the test pattern data stream either singly or continuously at a bit error rate of 10^{-3}. Each time the switch is momentarily pressed and released, a single error is inserted. When the switch is held down for longer than 1 second, the continuous 10^{-3} error rate is applied to the test pattern and the switch LED illuminates. Momentarily pressing the switch, while illuminated, returns the test pattern back to the error-free state and the switch LED is extinguished.

3.4 FIREBERD 4000 REAR PANEL

The FIREBERD 4000 rear panel, shown in Figure 3-3, provides the connections for an external printer or for remote control devices operating from an RS-232-C or IEEE-488 interface. External clock sources can be connected to or brought out from the mainframe. A standard interface slot allows different interface modules to be installed, allowing the FIREBERD the capability to access a variety of interface circuits. An optional second interface slot can be added so that



Legend:

1 Power Input Module

2 Internal DTE/DCE EIA RS-232-C/CCITT V.24 and MIL-STD-188C Compatible Data Interface Connectors

3 SLOT 2 - Optional Data Interface Slot (Options 4001) with DS1/T1 Data Interface Installed

4 SLOT 1 - Standard Data Interface Slot with DDS DS0A/B Data Interface Installed

5 RS-232-C/V.24 DCE Printer/Remote Control Interface Connector

6 Optional IEEE-488 Interface Slot (Option 4002) with Interface Installed

7 BNC Generator Clock Output Connector

8 BNC Generator Clock Input connector

9 Ground Lug

10 Installed Option List

11 Folding Rear Panel Standoff

Figure 3-3
The FIREBERD 4000 Rear Panel

two interfaces can be installed and operated from the front panel, one at a time. The rear panel has folding standoffs which safeguard the rear panel and allow the FIREBERD to be placed on end during testing. Power is also supplied through the rear panel.

Power Input Module - This module provides power control, connection, electrical protection, and input voltage selection for the mainframe. The rocker switch provides power control and is labeled 1 (ON) and 0 (OFF). The power receptacle and cord are standard three-prong connections with hot, neutral, and ground leads. The voltage selector and fuse holder module provides the option to change the input voltage from 120 VAC to 240 VAC. The fuses, one live and one spare, are also built into the module. Refer to Section 2, Preparation for Use, for the FIREBERD 4000 voltage and fuse requirements.

Data Interface Module Slots - Slot 1 is the standard interface slot where the interface module is plugged into the mainframe. Slot 2 is the optional interface slot for a second interface to be installed in the mainframe. Option 4001 is required to use Slot 2. A blank plate covers the slot when the option is not installed. The slot(s) are also used to connect the FIREBERD to up to four ISU-6000 Interface Switching Units. Refer to Section 5, Data Interfaces, for information on configuring and operating the installable interfaces.

Internal RS-232-C/V.24 DATA INTERFACE TO DTE/DCE Connectors - The internal EIA RS-232-C/V.24 interface has two female, 25-pin, D-type connectors for separate DTE and DCE operation. The left connector is configured as a DCE connection to test DTE. The right connector is configured as a DTE connection to test DCE. The connections are used to test EIA RS-232-C/V.24 and MIL-STD-188C compatible devices. Refer to Section 5, Data Interfaces, for information on configuring and operating the internal interface.

RS-232 PRINTER/CONTROLLER INTERFACE Connector - This connector is a female, 25-pin, D-type connector configured for asynchronous DCE operation. The connector can be configured to send information to a compatible printer to generate printouts of status messages, test results, and mainframe configurations. The connector is also used to connect a device to the FIREBERD 4000 for remote control operation. The FIREBERD can be controlled using a dumb terminal or computer with a communications package. Refer to Section 6, Printer Operation, and Section 7, Remote Control, for printer and remote control operation.

Optional IEEE-488 Interface Slot - This slot allows the optional IEEE-488 Interface (Option 4002) to be installed in the FIREBERD 4000. When the option is not provided, the slot is covered with a blank plate.

GEN CLK IN Connector - An external clock source can be connected to the FIREBERD through the BNC connector. The input signal is selected through the GENERATOR CLOCK menu, BNC selection. The FIREBERD accepts a sine- or square-wave signal with a level from 1.5 volts peak-to-peak to a maximum of 25 volts peak-to-peak. The acceptable frequency range is from 50 Hz to 15 MHz. The BNC input has a built-in, 50-ohm termination.

GEN CLK OUT Connector - This BNC connector provides a buffered generator clock source output. The output level is TTL (0 to +5V) and drives a 50-ohm load.

Installed OPTIONS List - This panel lists the installed options in the unit. Refer to Section 9, Options and Accessories, for information on options and accessories.

SECTION 4
OPERATING INSTRUCTIONS

4.1 INTRODUCTION

This section describes the process for configuring the FIREBERD 4000, explains how to manipulate the menus with the SETUP panel switches, discusses the structure of the mainframe set-up menus, and provides descriptions for each SETUP category. The ANALYSIS RESULTS, ALARMS, and RECEIVER panels are also described in this section. The Interface Status and Control and PRINTER Control panels are discussed in Sections 5 and 6, respectively.

4.2 CONFIGURING THE FIREBERD 4000

The FIREBERD 4000 and an interface can be configured in three easy steps:

(1) Configure the interface through the interface set-up menu when one is available or through the interface panel switches.

(2) Select the generator clock source and frequency.

(3) Select the test pattern.

Once the interface, clock frequency, and test pattern are configured, the FIREBERD 4000 can be connected to the circuit being tested.

4.3 STEPPING THROUGH THE SETUP MENUS

The following information explains how to operate the SETUP panel when configuring the interface and mainframe. The SETUP panel switches provide access and control over the categories and menus used to configure the FIREBERD 4000. The display provides easy-to-read menus.

By selecting a category with the SETUP CATEGORY switch, selecting functions or parameters with the softkeys, and stepping through the category menus with the SETUP SELECT switch, the interface, generator clock, and test pattern can be selected and configured. The other keys (MORE, HOME, ENTER, and cursor) simplify the process of selecting and entering menu selections and parameters.

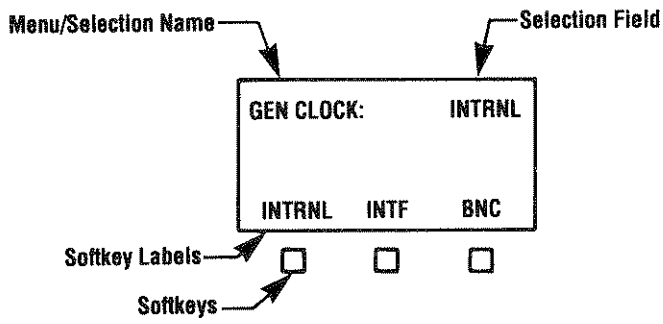


Figure 4-1
The SETUP Menu Display

4.3.1 SETUP Panel Display

The SETUP panel display provides the user with a menu name, a selection field, and softkey labels, as shown in Figure 4-1. The menu name (e.g., GEN CLOCK) identifies the displayed menu. The selection field identifies the currently selected menu function, option, or parameter. The softkey labels identify the menu selections or control functions available for the selected menu. The display changes when a new menu or category is selected by the SETUP CATEGORY switch, SETUP SELECT switch, or HOME key.

4.3.2 SETUP CATEGORY Switch

The SETUP CATEGORY switch provides access to the six categories listed above the switch, as shown in Figure 4-2. Pressing the switch selects the category above or below the currently displayed category. The displayed menus shown in Figure 4-2 are the default menus for each category. These menus are also called the home menus. The home menus can be accessed by pressing the HOME key. However, as each category is displayed, different menus may appear because the front panel remembers which menu was last displayed when the category was last used. The last menu displayed when leaving a category is the first menu displayed when returning to that category. This allows a specific menu to be displayed in a category each time the category is selected.

4.3.3 Softkeys

The softkeys are software-controlled switches which change functionality and definition according to the menu selected (see Figure 4-1). The softkeys have three basic functions:

(1) Selecting a function or item from a list (the selected item is displayed in the selection field). In most cases, pressing a softkey selects a parameter such as a fixed clock frequency, test pattern, or interface configuration parameter. In other situations, pressing the softkey directs the flow of the menus selected in a category, like changing the internal RS-232-C/V.24 Interface from synchronous to asynchronous operation.

(2) Scrolling through lists of options or digits. Another function of the softkey is to provide directional control when viewing lists of options like those shown in Figure 4-3(A) or changing numerical values in the selection field. The softkeys can be labeled **FWD** (forward), **RVRS** (reverse), **UP**, **DOWN** (see Figure 4-3(B)), or by a parameter, such as **BAUD**, or **DATA** as in the AUXILIARY RS232Iinterface menu.

(3) Answering a question or asking for help. When entering a parameter, such as a synthesizer frequency, and pressing the SETUP SELECT switch instead of the ENTER key, a question is asked to save the newly entered information. When a softkey is labeled HELP, pressing it displays a help message that indicates a range for the selected menu.

Keep in mind that the display does not advance to a new menu or function when pressing a softkey; only the selection field changes to indicate that the selection has been made.

4.3.4 MORE Key

The MORE key illuminates when more than three softkey selections are available in the selected menu, as illustrated with the INTERNAL FREQ menu in Figure 4-4. Pressing the MORE key when it is illuminated changes the softkey labels to the next set of labels.

4.3.5 SETUP SELECT Switch

The SETUP SELECT switch allows left or right lateral movement through the selected category when the category has more than one menu, as shown in Figure 4-5. Figure 4-5 shows the GEN CLOCK menu when the INTERNAL FREQ menu has been selected and the SETUP SELECT switch is pressed to scan the GENERATOR CLOCK category. If the selection in the selection field does not have a menu associated with it, pressing the SETUP SELECT switch does not step the category to another menu. This becomes apparent when the display does not change.

4.3.6 SETUP Panel Keypad

The SETUP panel keypad contains the HOME, ENTER, and left and right cursor keys. They are used to save selected data, return to the selected category home menu, and control the display cursor. Pressing the HOME key returns the selected category back to the home menu of the category, as illustrated in Figure 4-6. Each of the category home menus are shown in Figure 4-2.

The cursor keys are only used to position the cursor in the selection field (see Figure 4-3(A)). The character above the cursor can be changed using the scrolling softkeys of the selected menu. These keys are only used when the cursor is displayed in the selection field.

The ENTER key is used to store keyed-in parameters in memory. Whenever the cursor appears in the selection field,

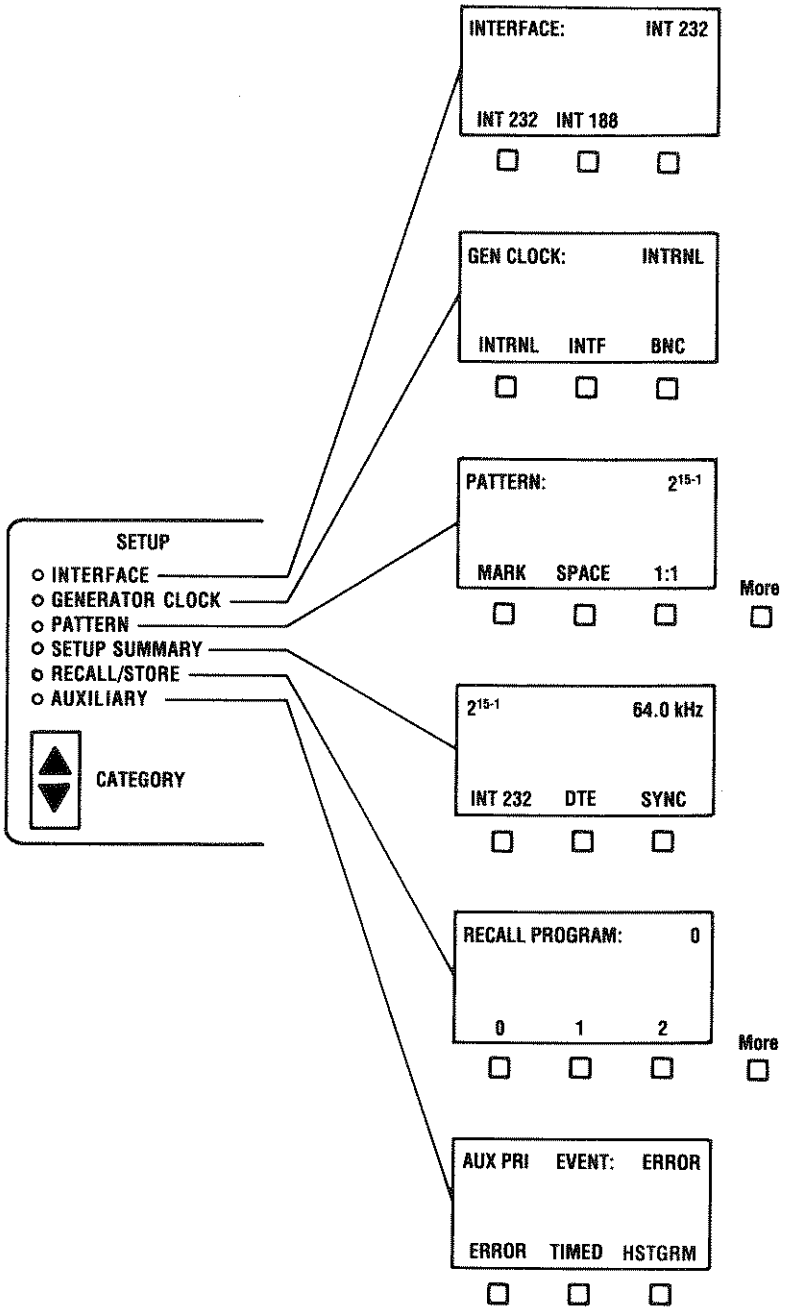


Figure 4-2
The SETUP CATEGORY Switch and Home Menus

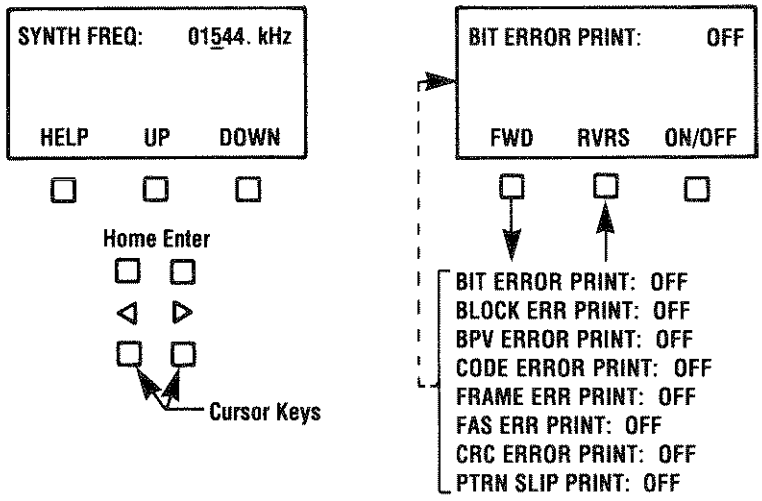


Figure 4-3
Softkey Scrolling and Cursor Keys

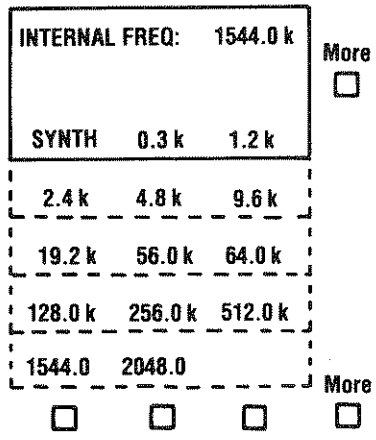


Figure 4-4
The MORE Key

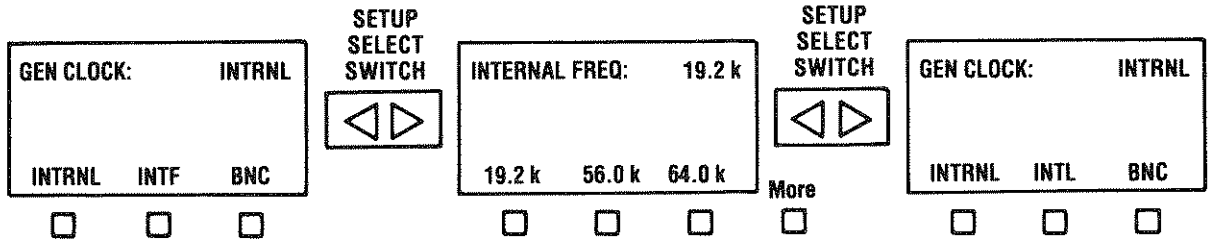


Figure 4-5
The SETUP SELECT Switch

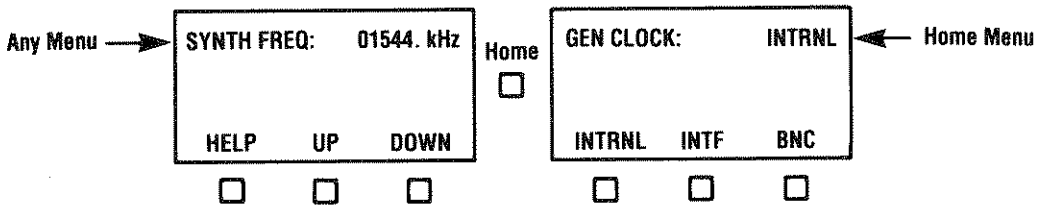


Figure 4-6
The HOME Key

the ENTER key must be used to save the changed entry. If the parameter is not changed, there is no need to press the ENTER key. When the AUXILIARY DATE and TIME menus are reset, the new values must be saved by pressing the ENTER key (date and time cannot be saved by pressing SETUP SELECT).

Figure 4-7 illustrates two ways of saving a keyed-in entry using the ENTER key, SETUP SELECT, or SETUP CATEGORY switch. Once the changes have been keyed in, pressing the ENTER key saves the new entry. If the keyed-in entry is not within the valid limits of the menu (check the HELP message), pressing the ENTER key displays the menu help message for about 10 seconds, then returns to the displayed menu without affecting the invalid entry. Pressing any key while the help message is displayed bypasses the message. Correct the invalid entry and press the ENTER key again. The alternative to pressing the ENTER key is using the SETUP SELECT or SETUP CATEGORY switch.

With the entry keyed in, pressing the SETUP SELECT or SETUP CATEGORY switch displays **<ENTER> CHANGES? YES/NO**. Pressing the **YES** softkey stores the selected entry and returns the display to the current menu. Pressing the **NO** softkey does not retain the current entry, but the previous entry is retained and displayed. If an invalid entry is keyed in and **YES** is pressed, the HELP message momentarily appears. The displayed menu reappears with the invalid entry displayed. Verify that the keyed-in entry is within the limits of the menu before pressing the SETUP SELECT or SETUP CATEGORY switch.

After the entry has been saved, pressing the SETUP SELECT or SETUP CATEGORY switch displays the next menu or category to be selected. Pressing the ENTER key to save an entry before pressing the SETUP SELECT or SETUP CATEGORY switch bypasses the need to answer the "enter changes?" query.

4.4 INTERFACE SETUP CATEGORY

The INTERFACE SETUP category is used to select an interface and sometimes to configure it. The category provides access to the internal RS-232-C/V.24 and MIL-STD-188C Interfaces, the installed interface module (two interfaces if the optional SLOT 2 is installed), and, if connected to the mainframe, the ISU-6000.

To select an interface, select the INTERFACE SETUP category with the SETUP CATEGORY switch (INTERFACE LED illuminates), then press the corresponding softkey, as shown in Figure 4-8. The selected interface label appears in the display selection field. Press the SETUP SELECT switch to determine where to configure the interface: interface panel switches or INTERFACE menu. If the INTERFACE menu does not change, configure the interface using the interface panel switches. However, if the INTERFACE menu does change to a new display, then the interface can be configured from the front panel. Figure 4-8(A) shows how the INTERFACE menu appears when only the internal RS-232-C/V.24 and MIL-STD-188C Interfaces (labeled INT232 and INT188) are available. Figure 4-8(B) shows the INTERFACE menu when two installed interfaces are available. Figure 4-8(B) also shows how an installed interface is treated without a set-up menu. Specific interface configuration and operation information is discussed in Section 5, Data Interfaces.

The INT232 and INT188 Interfaces are always available from the INTERFACE menu. The INT232 Interface is listed first and the INT188 Interface is always listed last in the list of interfaces (see Figure 4-8(A)). When an interface module is installed in SLOT 1, the interface label is added to the menu selections (softkey labels) and the INT188 label moves to the right of the list. When a second interface module is installed in the optional interface slot, SLOT 2, the MORE key illuminates indicating that more than three interfaces are available (see Figure 4-8(B)). The interface listed after INT232 in the INTERFACE menu is installed in the standard interface slot, SLOT 1, and the third interface listed is installed in the optional interface slot, SLOT 2.

Another interface configuration available to the FIREBERD 4000 is having up to two dual-unit ISU-6000s connected to the FIREBERD 4000 through the two interface slots. The ISU softkey labels, **ISU1** through **ISU4**, appear in the INTERFACE SETUP menu. Pressing one of the ISU softkeys accesses the ISU and up to four interfaces at one time. With two dual-unit ISU-6000s connected to one FIREBERD 4000, up to 16 interfaces can be accessed one at a time. Additional information on the ISU-6000 is found in Section 5 of this manual and in the ISU-6000 Operating Manual.

4.5 GENERATOR CLOCK SETUP CATEGORY

The GENERATOR CLOCK SETUP category, shown in Figure 4-9, controls the timing source and frequency of the mainframe generator clock. The generator clock is used as the timing source for transmitting test patterns at the required network data rate.

There are three standard clock sources available for the operation of the FIREBERD 4000: the internal clock generator (**INTRNL** softkey), the selected interface clock generator

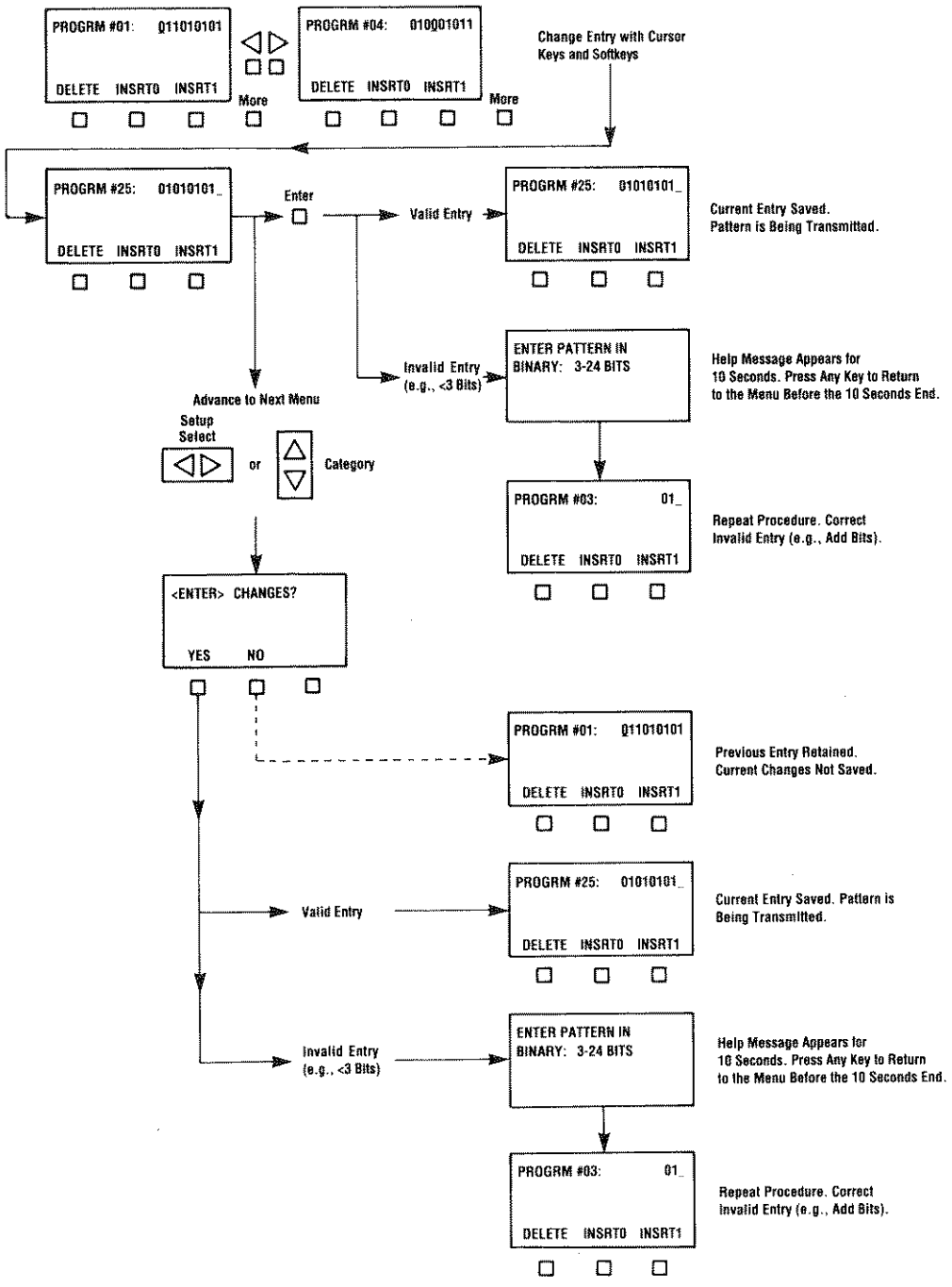
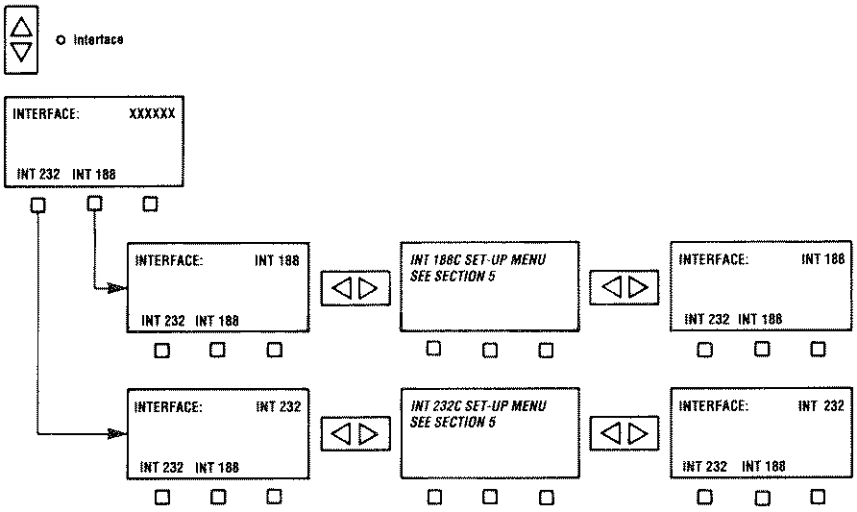


Figure 4-7
Entering Data in the SETUP Menus

A. Basic Interface Setup Menu



B. Interface Setup Menu with Two Interfaces Installed

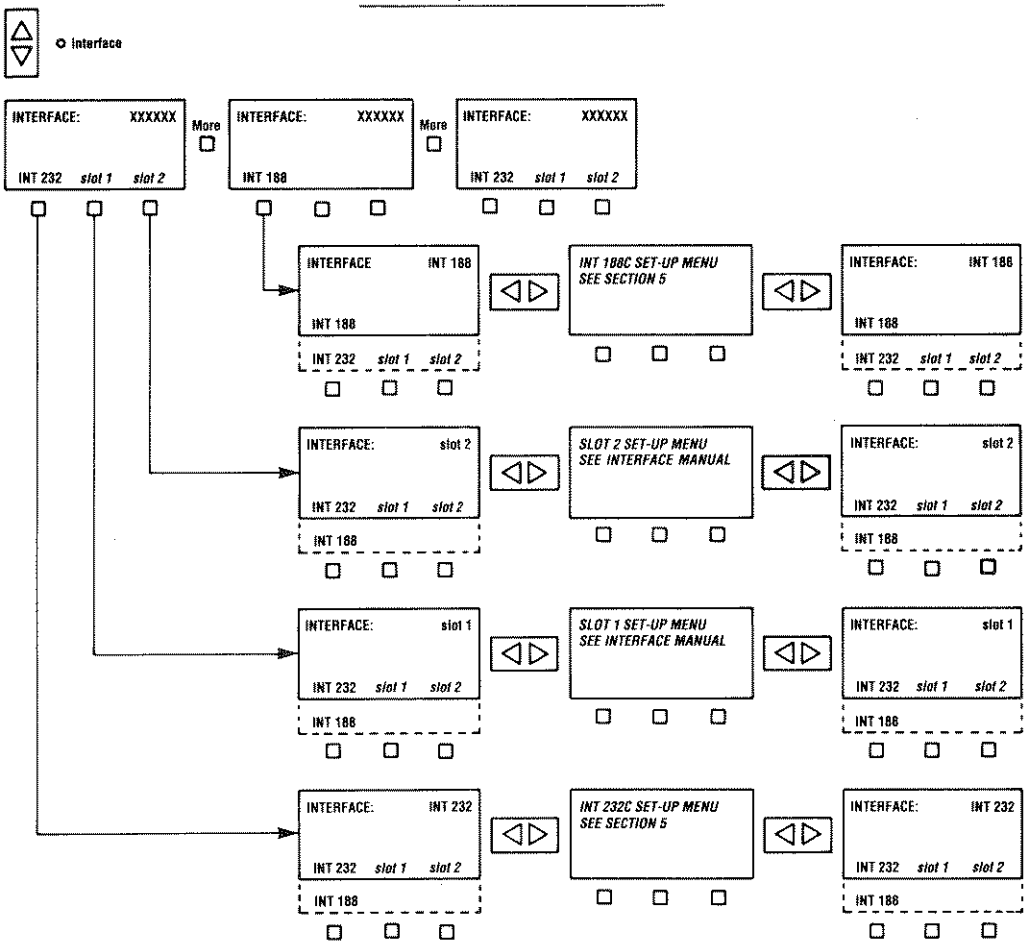


Figure 4-8
INTERFACE SETUP Menu

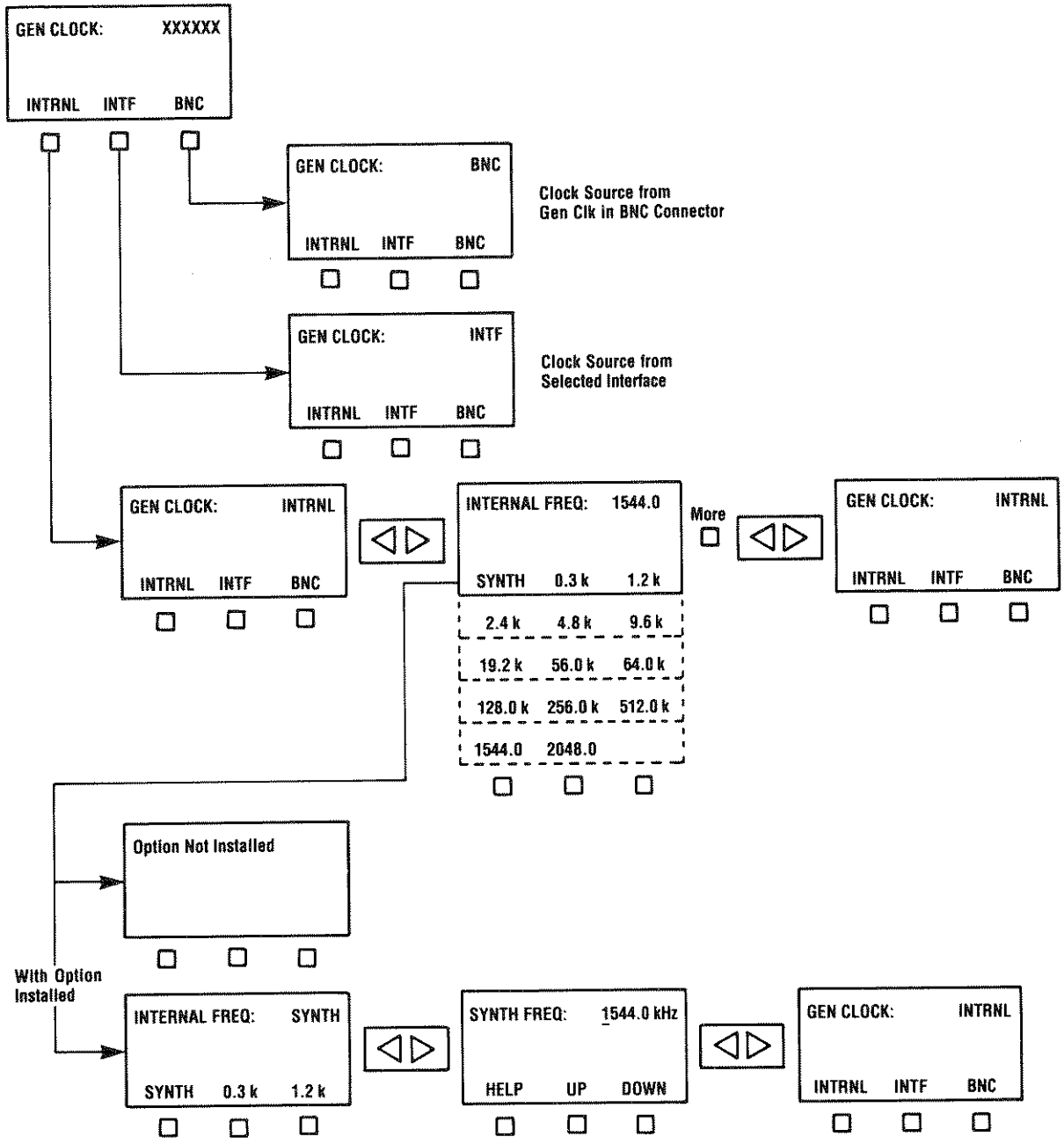


Figure 4-9
Generator Clock Menu

(**INTF** softkey), and the GEN CLK IN BNC connector on the rear panel (**BNC** softkey). An optional frequency synthesizer (Option 4005) clock generator (**INTRNL**, **SYNTH** softkey) is also available for the FIREBERD 4000.

To select a timing source, select the GENERATOR CLOCK category with the SETUP CATEGORY switch (GENERATOR CLOCK LED illuminates), then press the appropriate softkey (see Figure 4-9). The selected timing source label appears in the display selection field.

When the FIREBERD 4000 is configured to test asynchronous circuits (i.e., internal RS-232-C/V.24 Interface), selecting a clock frequency greater than 20 kHz causes the **ASYNC FREQUENCY CONTENTION** message to flash in the ANALYSIS RESULTS display and defaults the frequency to 20 kHz. Set the clock frequency to less than 20 kHz to eliminate the contention message.

4.5.1 Internal Generator Clock Menu

The standard internal generator clock provides a set of fixed frequencies that are selectable through the INTERNAL FREQ menu (see Figure 4-9). The fixed frequencies, displayed in kHz, include: 300, 1200, 2400, 4800, and 9600 Hz; 19.2, 56.0, 64.0, 128.0, 256.0, and 512.0 kHz; and 1.544 and 2.048 MHz. To select a frequency:

(1) Press the **INTRNL** softkey and SETUP SELECT switch to access the INTERNAL FREQ menu (see Figure 4-9).

(2) Press the MORE key, if necessary, until the desired frequency appears.

(3) Press the corresponding softkey to select the frequency. When the frequency softkey is pressed, the generator is automatically programmed with the selected frequency.

If the desired frequency is not listed, use the optional frequency synthesizer (Option 4005 if installed) to set the frequency.

4.5.2 Optional Frequency Synthesizer Menu

The Synthesizer menu (**SYNTH** softkey) allows access to the optional frequency synthesizer (Option 4005) generator clock when it is installed. When the synthesizer is not installed and the **SYNTH** softkey is pressed, OPTION NOT INSTALLED momentarily appears in the display. The Synthesizer Frequency menu (SYNTH FREQ) allows any frequency from 50 Hz to 15 MHz to be entered when the fixed frequencies do not provide the required value. Additionally, the optional frequency synthesizer also allows the fixed internal frequencies to be customized through the Auxiliary Frequency menu.

Entering the Synthesizer Frequency

Enter the synthesizer frequency as follows:

(1) Select the GENERATOR CLOCK category, INTERNAL FREQ, SYNTH FREQ menu, as shown in Figure 4-10.

(2) Use the cursor keys to move the cursor and the **UP** and **DOWN** softkeys to key in the digits for the required frequency. Each position can be changed from 0 - 9 and "." (decimal). The frequencies must be entered in kHz and the decimal point can be added as appropriate.

(3) Once the frequency is keyed in, press the ENTER key to save the frequency.

Changing the Fixed Internal Frequencies

All 13 fixed frequencies listed under the Generator Clock INTERNAL FREQ menu can be changed from the Optional Auxiliary Fixed Frequency Editor menu (FREQ). The menu is only available when the optional frequency synthesizer is installed. It is used to re-order the fixed internal frequencies or change them to application-specific frequencies. Figure 4-11 shows how to access the FREQ menu.

To change the INTERNAL FREQ menu frequencies, proceed as follows:

(1) Select the AUXILIARY category. If necessary, press the HOME key, then press the left SETUP SELECT arrow switch until the Auxiliary Frequency menu appears (see Figure 4-11).

(2) Press the **FREQ#** softkey to select the frequency to be changed. Note that the FREQ number and displayed frequency change as the **FREQ#** softkey is pressed.

(3) Use the cursor keys and the **UP** and **DOWN** softkeys to change the displayed frequency.

(4) When the appropriate frequency is keyed in, press the ENTER key to save the frequency.

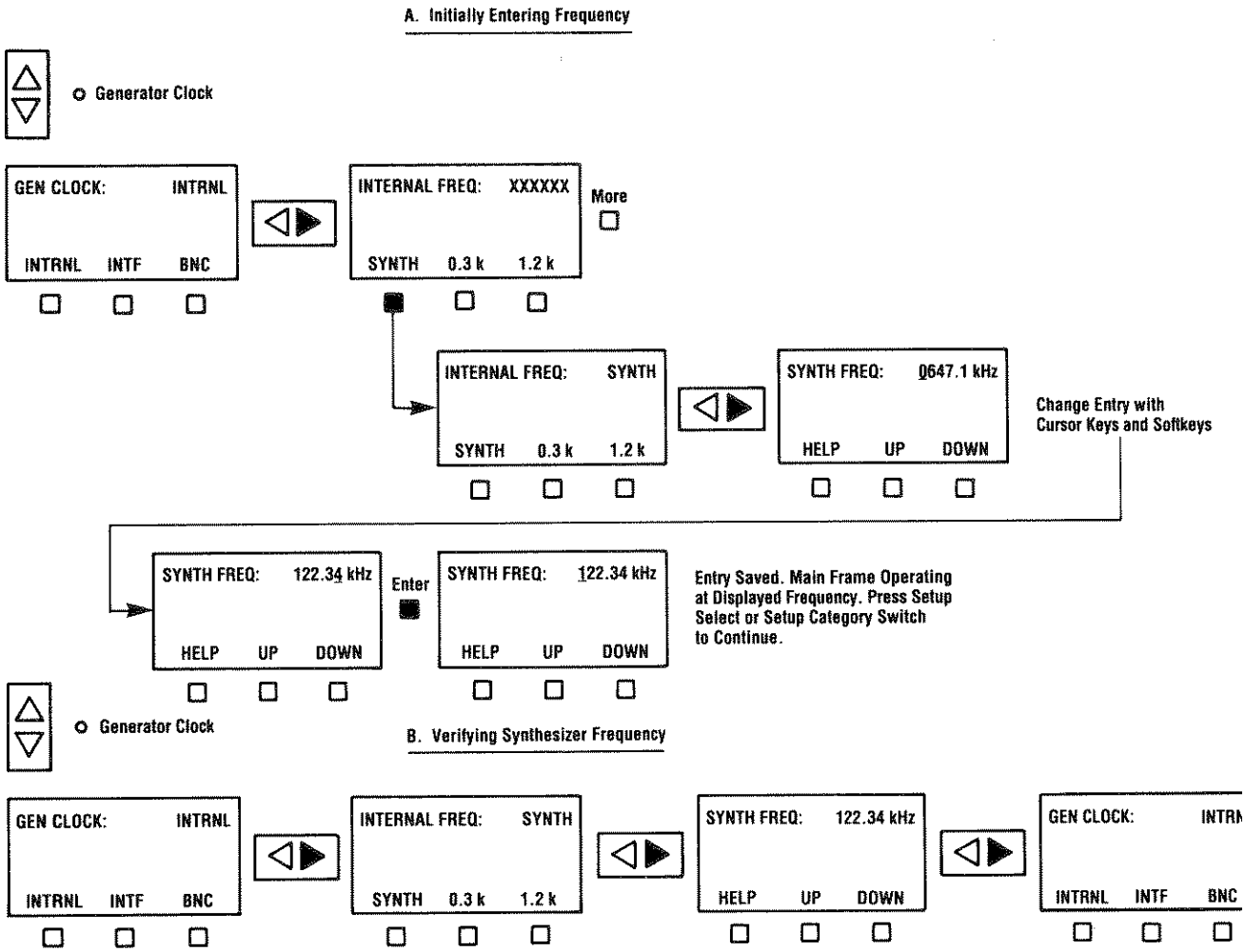


Figure 4-10
Generator Clock Synthesizer Menu

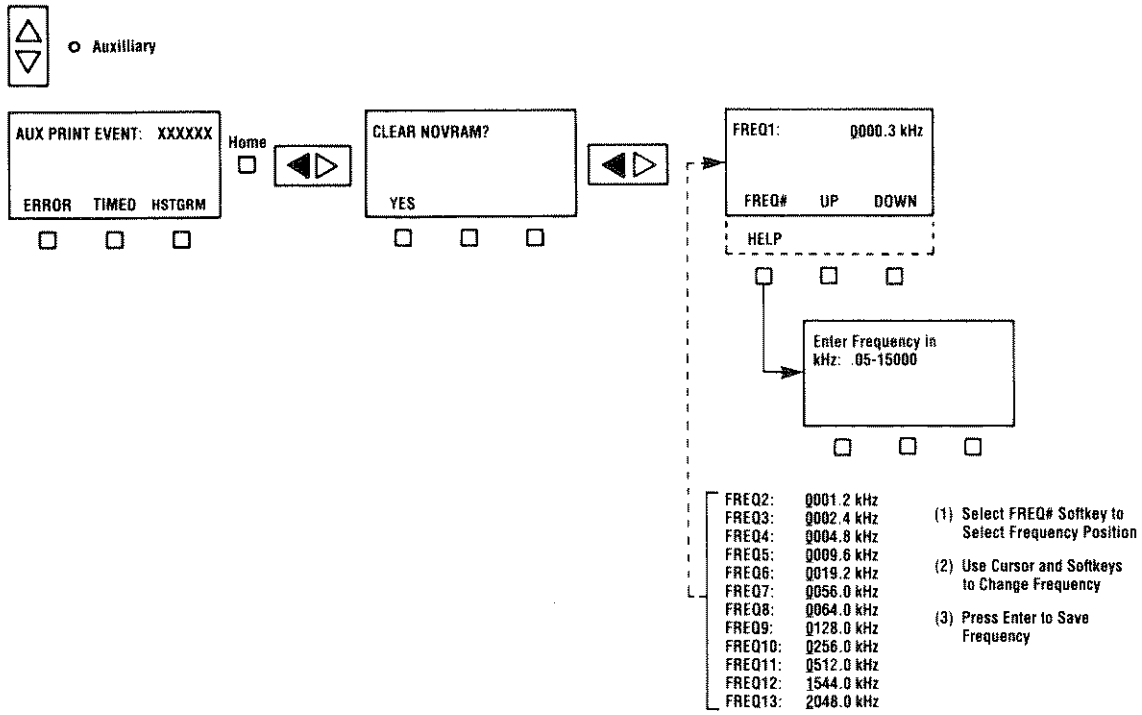


Figure 4-11
Changing the Fixed Generator Clock Frequencies

4.5.3 Interface Generator Clock Menu

The Interface menu (**INTF** softkey) selection causes the installed interface to provide the clock source for pattern generation. In some cases the interface requires this selection to be made manually, whereas other interfaces automatically make this selection (e.g., the DDS DS0A/B Data Interface). Refer to the corresponding interface operating manual for specific clock source requirements.

4.5.4 External Generator Clock Input Menu

The BNC menu (**BNC** softkey) selection allows an external clock source to be supplied to the FIREBERD through the GEN CLK IN connection on the rear panel. The connection can accept an input frequency from 50 Hz to 15 MHz.

NOTE: The GEN CLK IN connection should only be used as a clock source when testing synchronous circuits.

It should be noted that the GEN CLK OUT connection output can get its source from the GEN CLK IN connection, the internal mainframe clock, or the installed interface clock depending on the GENERATOR CLOCK menu selection. When testing circuits which have framed data formats (e.g., G.704 2048 kb/s, T1, or DDS DS0A/B Interfaces), the GEN CLK OUT signal is momentarily interrupted to allow the insertion of the framing bits in the data stream. The clock output frequency is the difference between the base clock frequency and the framing clock frequency.

4.6 PATTERN SETUP CATEGORY

The PATTERN SETUP category provides a list of fixed, pseudorandom, and programmable test patterns, as shown in Figure 4-12. Pressing the MORE key allows the user to view the list of available test patterns. The fixed, pseudorandom, and FOX message test patterns are selected by pressing the corresponding softkey. The programmable test patterns are also selected by pressing the corresponding softkey. An additional menu allows the creation of customized patterns that are not otherwise provided through the PATTERN category. Table 4-1 describes the test patterns that are generated by the FIREBERD 4000.

NOTE: Additional patterns maybe available depending on the selected interface. Refer to the selected interface operating manual for specific patterns.

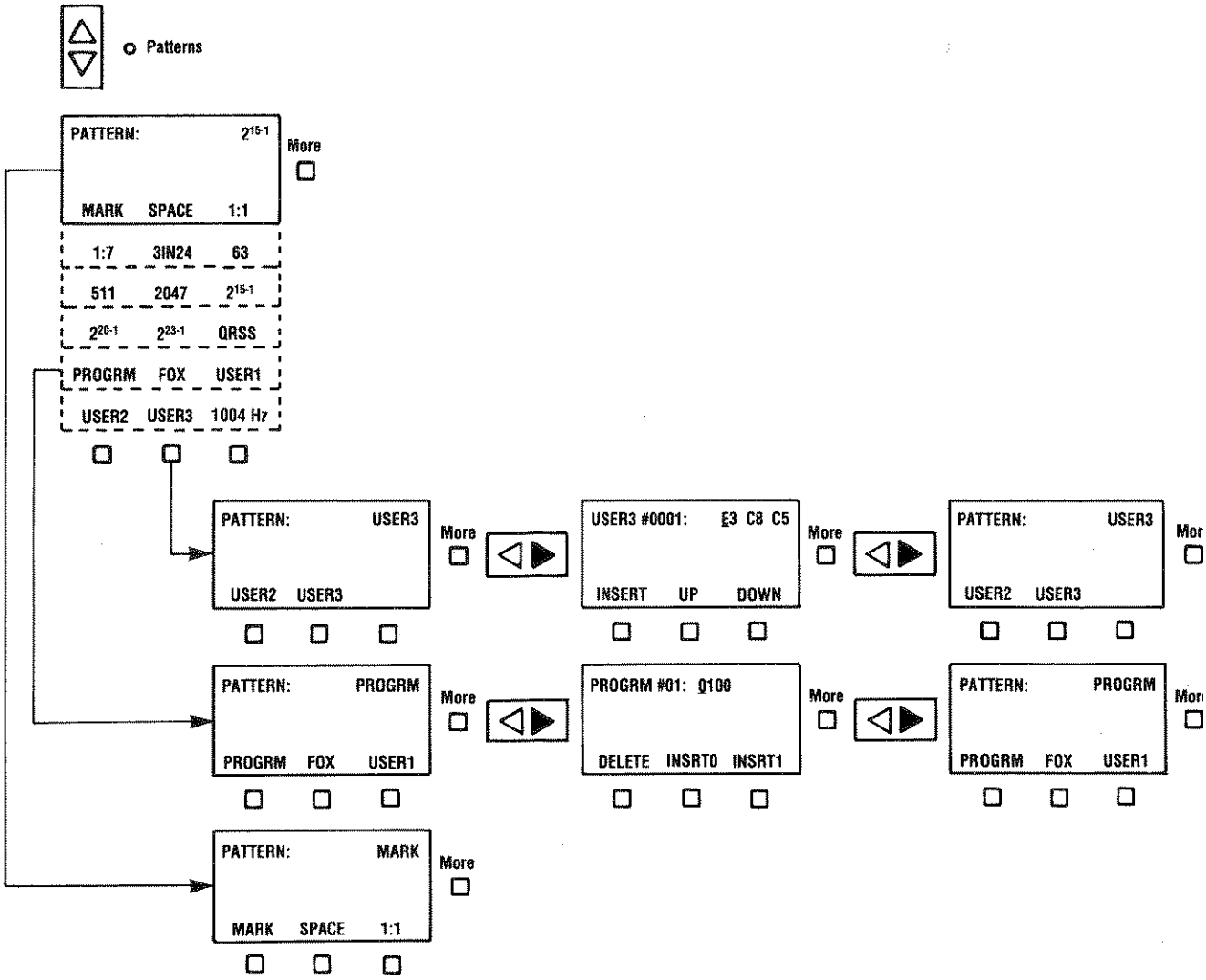


Figure 4-12
PATTERN Set-up Menu

4.6.1 Test Patterns and Testing Asynchronous Circuits

The following patterns are valid when testing asynchronous circuits: MARK, SPACE, 1:1, 63, 511, 2047, 2^{15}-1, FOX, and USER(1-3). The following patterns are not valid when testing asynchronous circuits: 1:7, 3IN24, 2^{20}-1, 2^{23}-1, QRSS, PROGRM and 1004Hz. When an invalid pattern is selected, the message **ASYNC PATTERN CONTENTION** flashes in the ANALYSIS RESULTS display and a 1:1 pattern is generated. To clear the contention message, select a valid pattern.

Asynchronous data generation and reception is restricted to data rates up to 20 kb/s. The data is formatted and transmitted in the following order: one start bit; 5, 6, 7, or 8 data bits; odd, even, or no parity bit; and 1, 1.5, or 2 stop bits. The MARK, SPACE, 1:1, 63, 511, 2047, and 2^{15}-1 patterns are interleaved with the appropriate character format before being transmitted. The start, stop, and parity bits are transparent to analysis, and are controlled through the INT232 Interface ASYNC TIMING set-up menu.

Table 4-1
FIREBERD 4000 Test Patterns

Pattern	Description
MARK	This selection provides a fixed Mark only (all ones) test pattern. The pattern is used as a keep alive, idle, or Red alarm pattern in some circuits.
SPACE	This selection provides a fixed Space only (all zeros) test pattern. The pattern is used in place of the Mark pattern when an inverted data pattern is required.
1:1	This selection provides a fixed alternating Mark and Space test pattern. The pattern is used to perform a minimum level stress test on clock recovery circuits.
1:7	This selection provides a fixed pattern that generates 1 Mark for every 7 Spaces. The pattern is used to stress the 12.5% ones density requirement for T1-type circuits. Pattern cannot be used to test asynchronous circuits.
3IN24	This selection provides a fixed pattern that generates 3 Marks separated by 3 Spaces and 15 consecutive Spaces in every 24 bits transmitted. The pattern generated appears as: "1000 1000 1000 0000 0000 0000". The pattern is used to test the excess zeros requirement for T1-type circuits. Pattern cannot be used to test asynchronous circuits.
63	This selection provides a 63-bit (2^6-1) pseudorandom pattern that generates a maximum of 5 sequential zeros and 6 sequential ones.
511	This selection provides a 511-bit (2^9-1) pseudorandom pattern that generates a maximum of 8 sequential zeros and 9 sequential ones. Used to test DDS circuits and other circuits operating below 56 kb/s.
2047	This selection provides a 2047-bit (2^{11}-1) pseudorandom pattern that generates a maximum of 10 sequential zeros and 11 sequential ones. Used to test DDS circuits and other circuits operating at 56 kb/s.
2^{15}-1	This selection provides a 32,767-bit pseudorandom pattern that generates a maximum of 14 sequential zeros and 15 sequential ones. Compatible with CCITT Recommendations O.151 (at 64, 1544, 2048, 3152, and 6312 kb/s) and G.703. Provides a maximum number of zeros allowed for framed, non-B8ZS testing.

Table 4-1
FIREBERD 4000 Test Patterns (Continued)

Pattern	Description
2^{20}-1	This selection provides a 1,048,575-bit pseudorandom pattern that generates a maximum of 19 sequential zeros and 20 sequential ones. Used on T1 applications to stress circuits with excess zeros. Pattern cannot be used to test asynchronous circuits.
2^{23}-1	This selection provides a 8,388,607-bit pseudorandom pattern that generates a maximum of 22 sequential zeros and 23 sequential ones. Pattern cannot be used to test asynchronous circuits.
QRSS	This selection provides the Quasi-Random Signal Source (QRSS) pattern that is a modified 2^{20}-1 pseudorandom pattern. It generates a maximum of 14 sequential zeros and 20 sequential ones, and simulates live data on T1-type circuits. Pattern cannot be used to test asynchronous circuits.
PROGRM	This selection provides access to the Programmable Bit Pattern menu (PROGRM), that provides the ability to create a 3-bit to 24-bit test pattern, which is not necessarily available through the fixed and pseudorandom patterns provided by the FIREBERD. Refer to Section 4.6.3 for instructions on entering a bit pattern.
FOX	This selection generates the "THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 1234567890 <CR><LF>" test message. It can only be used to test asynchronous circuits unless Option 4006 is installed. Depending on the character length used, the FOX message is generated in four different asynchronous formats. The mainframe automatically formats the FOX message to the appropriate character length selected. The character length is set through the ASYNC DATA selection in the INT232 interface menu as follows: **# of Data Bits** — **Code** 5 — Baudot 6 — BCDIC 7 — ASCII 8 — EBCDIC
USER 1-3	This selection provides access to the User Programmable Character pattern menu (USER1 to USER3), that enables the creation and transmission of three test patterns from 1 to 2048 hexadecimal characters in length. It can only be used to test asynchronous circuits unless Option 4006 is installed. Refer to Section 4.6.4 for instructions on entering a hexadecimal pattern.
1004Hz	This selection provides a 1004 Hertz tone in a 247 byte pattern that is μ-law sampled. The pattern generated is used to test within a single DS0 (64k) timeslot of a T1 circuit.

4.6.2 Test Patterns and Testing Synchronous Circuits

The following patterns are valid when testing synchronous circuits: MARK, SPACE, 1:1, 1:7, 3IN24, 63, 511, 2047, 2^{15}-1, 2^{20}-1, 2^{23}-1, QRSS, PROGRM. The following patterns are not valid when testing synchronous circuits without the Synchronous User Pattern module installed (Option 4006): FOX and USER(1-3) 1004 Hz. When an invalid pattern is selected, the message **SYNC PATTERN CONTENTION** flashes in the ANALYSIS RESULTS display and a 1:1 pattern is generated. To clear the contention message, select a valid pattern.

In synchronous operation, the maximum data rate is restricted by the data interface used. When testing data streams using framed data patterns (e.g., DS1/T1, DS1/Fe, DDS DS0A 19.2 kb/s, or DDS DS0B framing), the test patterns are synchronized with framing bits. With the Synchronous User Pattern module installed, the FOX and USER(1-3) patterns are generated in an 8-bit format that is synchronized with the appropriate signal framing requirements.

4.6.3 Programmable Bit Pattern Menu

Figure 4-13 shows how to enter a bit pattern through the PROGRM menu. The displayed bit pattern reads from left to right with Bit 1 on the left and Bit 24 on the right (see Figure 4-13). Each bit is entered or edited in binary form using the appropriately labeled softkeys:

DELETE - Deletes the bit over the cursor.

INSRT0 - Inserts a zero at the position of the cursor. When the **INSRT0** softkey is pressed, the bit at the cursor moves to the right.

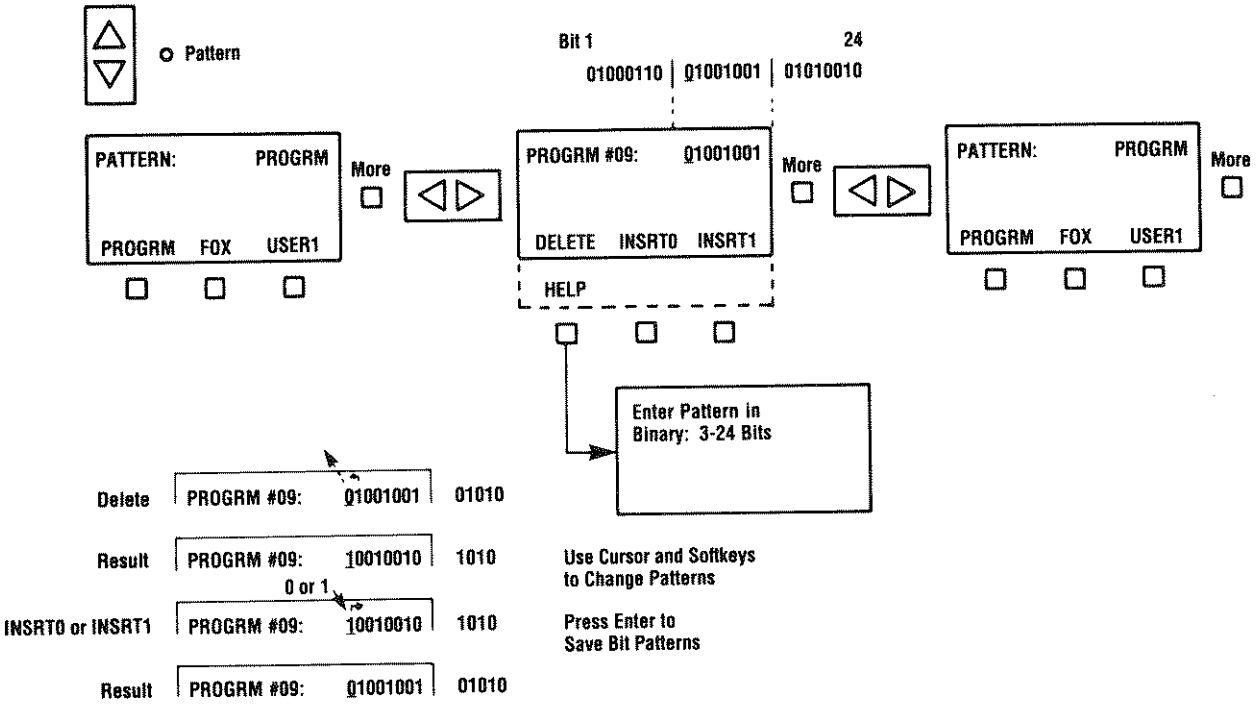


Figure 4-13
Programmable Bit Pattern Menu

INSRT1 - Inserts a one at the position of the cursor. When the **INSRT1** softkey is pressed, the bit at the cursor moves to the right.

HELP - Displays the help message: **ENTER PATTERN IN BINARY: 3 - 24 BITS.**

To enter the programmable bit pattern, proceed as follows:

(1) Select the PATTERN set-up menu and, if necessary, press the MORE key until PROGRM appears.

(2) Press the **PROGRM** softkey, then press the SETUP SELECT switch. The PROGRAM DATA menu appears.

(3) Press the **DELETE**, **INSRT0**, or **INSRT1** softkey to edit the bit pattern. Press the cursor keys to move the cursor when editing. The cursor position is indicated by the bit number (**#01**) in the display.

(4) Press the ENTER key to store the bit pattern. Pressing ENTER also removes the old pattern from memory and transmits the new pattern. Entering less than three bits, which is an invalid string, causes the HELP message to momentarily appear.

4.6.4 User Programmable Character Pattern Menu

Figure 4-14 shows how to enter a test pattern with one of the three menu selections: **USER1**, **USER2**, or **USER3**. Each character is entered or edited in hexadecimal form using the following labeled softkeys:

INSERT - Inserts 00H each time the softkey is pressed.

UP - Increments the character above the cursor from 0 to F.

DOWN - Decrements the character above the cursor from F to 0.

DELETE - Deletes the hexadecimal character above the cursor.

FIRST - Moves the cursor to the first hexadecimal character in the string.

LAST - Moves the cursor to the last hexadecimal character in the string.

PRINT - Generates a printout of the character pattern in hexadecimal form when the printer is online.

HELP - Displays the help message: **ENTER 1 - 2000 HEX CODED CHARACTERS.**

The cursor position is controlled through the use of the **FIRST** and **LAST** softkeys and the cursor keys. The location of the cursor is indicated by the character number (#0001) in the display.

To enter the character pattern, proceed as follows:

(1) Select the PATTERN set-up menu and, if necessary, press the MORE key until **USER1**, **USER2**, or **USER3** appears.

(2) Press the **USER1**, **USER2**, or **USER3** softkey, then press the SETUP SELECT switch. The USER1, USER2, or USER3 menu appears.

(3) Press the **INSERT** softkey as required to establish place holders for each character to be entered. Move the cursor from character to character with the cursor keys. Press the **UP** or **DOWN** softkeys to create the appropriate character. Refer to Appendix B for a hexadecimal-to-character conversion table.

(4) Press the ENTER key to store the character pattern. Pressing ENTER also removes the old pattern from memory and transmits the new pattern. Entering less than one character, which is an invalid string, causes the HELP message to momentarily appear.

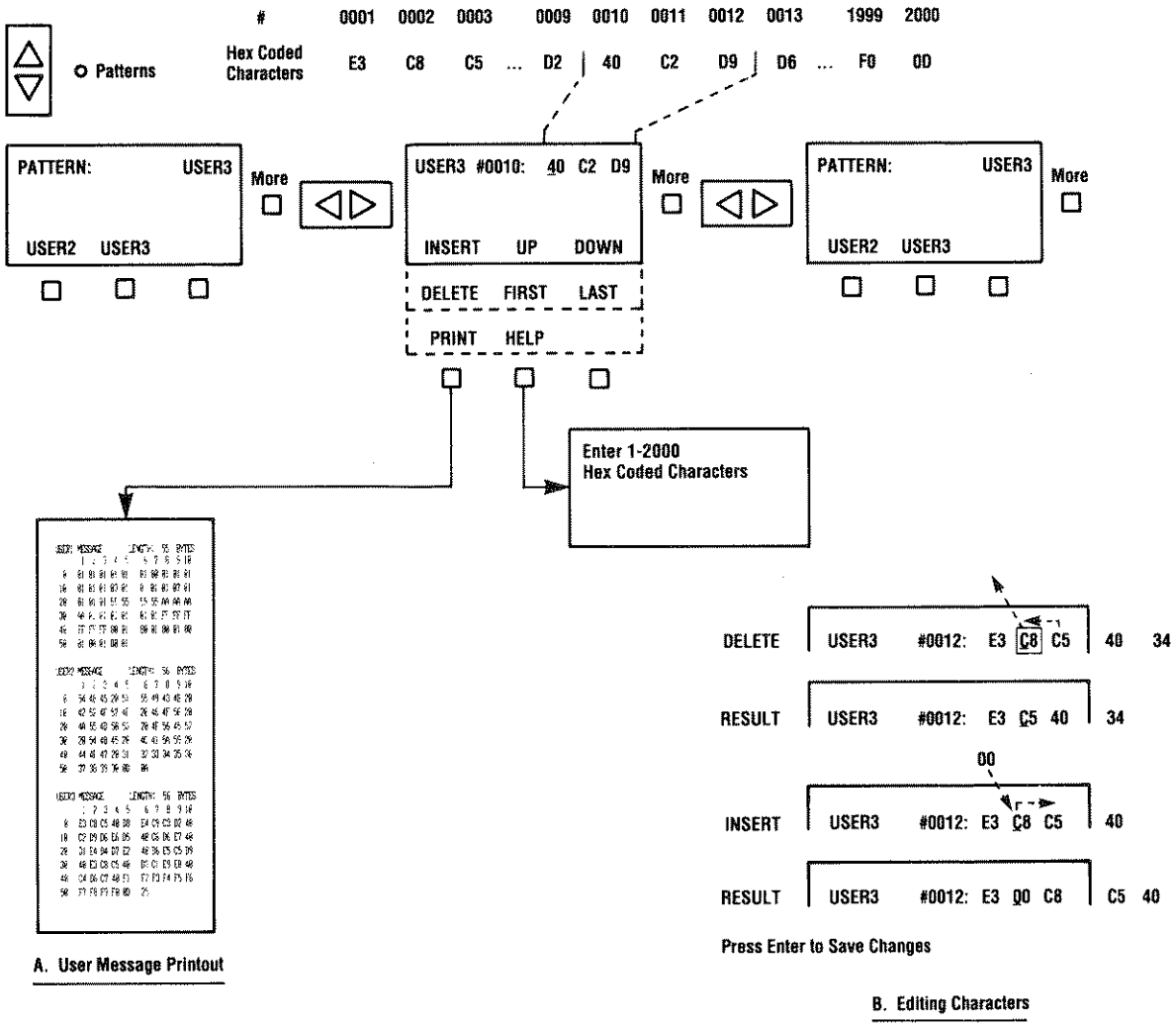
(5) If necessary, press the **PRINT** softkey to generate a printout of the character pattern.

The hexadecimal data bits are transmitted starting with the least significant bit to the most significant bit of each hex byte. In cases where the parity bit is sent, the bit follows the most significant data bit and precedes the stop bit(s). The entire pattern is stored in memory in the full 8-bit hexadecimal code. However, when the code is transmitted with a character length of 5, 6, or 7 bits, the most significant bits are dropped. This means that the actual character output differs from the entered pattern. Setting the character length to 8 bits allows the pattern to be transmitted as it was entered.

When the pattern is received, pattern synchronization is established by the User Synchronization Threshold menu found in the AUXILIARY category (refer to Section 4.9.3). The User Synchronization Threshold menu sets a minimum number of bytes that need to be detected to establish synchronization.

4.6.5 Inserting Bit Errors in the Test Pattern

Each of the patterns can be generated either uninterrupted or interrupted with bit errors. Bit errors are inserted using



A. User Message Printout

B. Editing Characters

Figure 4-14
User Programmable Character Pattern Menu

either the ERROR INSERT switch or the bit error generators provided on several data interfaces, such as the DDS DS0A/B Interface. The ERROR INSERT switch inserts a single bit error each time the switch is pressed and released. Pressing and holding the switch until it is illuminated inserts bit errors at a rate of 10^{-3} into the test pattern. Some data interfaces can generate a 10^{-6} bit error rate with the FIREBERD 4000. Refer to the appropriate data interface operating manual for details on bit error insertions.

4.6.6 Analyzing the Test Pattern

As the selected pattern is transmitted, the mainframe receiver monitors the received signal for the same pattern. Once synchronization has occurred, the receiver monitors the received signal to determine if the received signal has been altered by the circuit under test. When differences are detected, they are registered as bit errors, block errors, pattern slips, code errors, etc., and are displayed in the ANALYSIS RESULTS display. Refer to Section 4.12, FIREBERD 4000 ANALYSIS RESULTS, for the operation and description of the analysis results capabilities of the FIREBERD 4000.

4.7 SETUP SUMMARY DISPLAY

The SETUP SUMMARY display summarizes the configuration of the FIREBERD as shown in Figure 4-15. The SETUP SUMMARY display appears each time the unit is powered up and when selected with the SETUP CATEGORY switch. The display indicates the current test pattern, clock frequency, interface, and key interface settings.

4.8 RECALL/STORE CATEGORY

The RECALL/STORE category allows up to 10 front-panel switch and menu set-ups to be stored and recalled at any given time. Figure 4-16 shows the RECALL/STORE category. This eliminates the need to manually configure the FIREBERD each time a different configuration is required. Storing the front-panel configuration saves:

- The condition of the SELF LOOP, ERROR INSERT, Interface Control Panel, and PRINTER event switches. The DISPLAY HOLD switch is ignored.

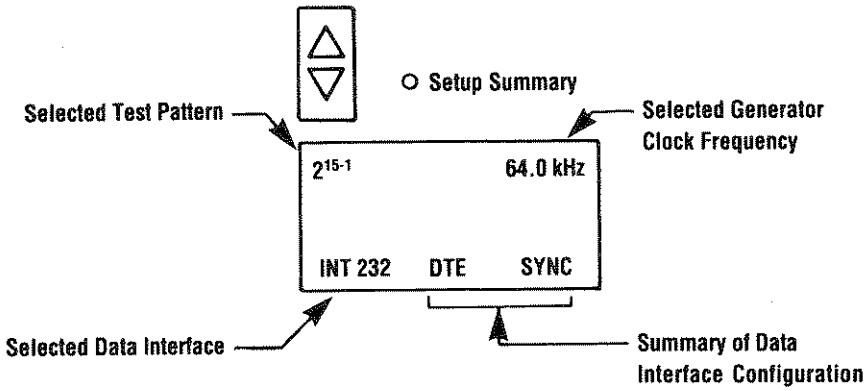


Figure 4-15
SETUP SUMMARY Display

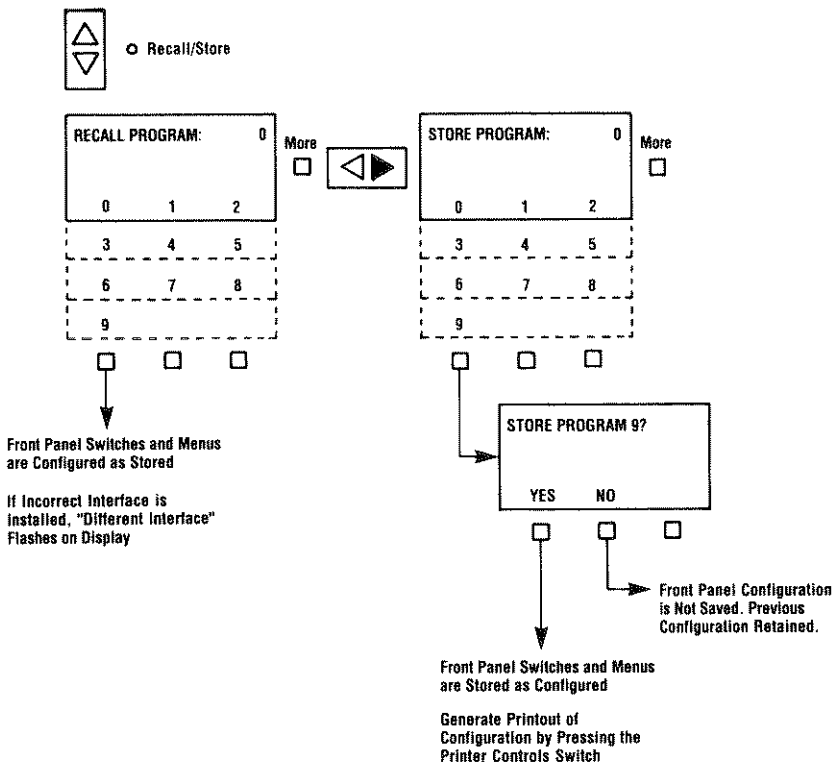


Figure 4-16
RECALL/STORE Set-up Menu

- The selected interface and INTERFACE SETUP menu selections, if the interface has a set-up menu.
- The GENERATOR CLOCK frequency.
- The selected PATTERN.
- The selected ANALYSIS RESULTS displays.
- The AUXILIARY function menu selections.

The following procedures describe how to store and recall front-panel configurations.

4.8.1 Storing Front-Panel Configurations

Perform the following procedure to store a front-panel configuration. Repeat this procedure as necessary for each configuration to be stored.

(1) Install the appropriate interface.

(2) Select and configure the interface through the INTERFACE SETUP menu or interface panel switches.

(3) Set the generator clock frequency through the GENERATOR SETUP menu.

(4) Set the test pattern through the PATTERN SETUP menu.

(5) Select the desired analysis results categories.

(6) Configure the printer, if required.

(7) Set the auxiliary functions, as required, through the AUXILIARY SETUP menu.

(8) Press the SETUP CATEGORY switch to select the RECALL/STORE menu (RECALL/STORE category LED illuminates).

(9) Press the SETUP SELECT switch to select the STORE PROGRAM menu.

(10) Press the appropriately numbered softkey to store the present configuration. When the numbered softkey is pressed, the **STORE PROGRAM? YES/NO** message appears. Pressing **YES** stores the configuration, pressing **NO** retains the previously stored configuration.

(11) If desired, press the PRINTER panel CONTROLS switch to print out a copy of the configuration.

4.8.2 Recalling Front-Panel Configurations

To recall a front-panel configuration, proceed as follows:

(1) Install the appropriate interface, if necessary.

(2) Press the SETUP CATEGORY switch to select the RECALL/STORE menu (RECALL/STORE category LED illuminates).

(3) If necessary, press the SETUP SELECT switch to select the RECALL PROGRAM menu.

(4) Locate and press the appropriately numbered softkey. The front panel is automatically configured. If the proper interface is not installed, **DIFFERENT INTERFACE** appears in the display. Verify the installed interface and repeat this procedure.

4.9 AUXILIARY SETUP CATEGORY

The AUXILIARY SETUP category provides the following menus that apply to specialized functions of the FIREBERD 4000. Each menu is described in the following sections. Press the SETUP CATEGORY switch to select the AUXILIARY SETUP category. Press the SETUP SELECT switch to scroll through the menus. After the menu is selected, use the labeled softkeys to select the appropriate parameter or function. The AUXILIARY SETUP category provides:

- Auxiliary Print Event Menu (**AUX PRI EVENT: ERROR/TIMED/HSTGRM**)
- Bit Error Print Menu (**BIT ERROR PRINT: FWD/RVRS/ON/OFF**)
- Out-of-Band Flow Control Menu (**FLOW: TR/DM/RS/CS/RR/OFF**)
- User Pattern Synchronization Threshold Menu (**USER SYN THRSH: 10BYT/100BYT/PATLEN**)
- Synchronization Loss Threshold Menu (**SYNC LOSS THRSH: NORM/HIGH**)
- Receiver Action Upon Synchronization Loss Menu (**SYNC LOSS ACT: HALT/CLEAR**)
- Block Length Menu (**BLOCK LENGTH: PATLEN/10^2/10^3/10^4/10^5/10^6**)
- Date (**DATE: DD/MM/YY**) and Time (**TIME: HH/MM/SS**) Menus
- Results Printout Format Menu (**RESULT PRINT: SUMM/STD/LONG**)
- Status Message Printout Menu (**STATUS PRINT: ON/OFF**)
- Printer Printout Format Menu (**PRINTER: WIDTH/SPEED/TERM**)
- RS232 Printer/Controller Interface Menu (**RS232: BAUD/DATA/PAR/ PR45/PR40A/PR2000/PR40/PR85**)
- IEEE-488 Interface Menu (**IEEE488: XX, SRQ: OFF/ON**)
- Fixed Frequency Editor Menu (**FREQ1: FREQ#/UP/DOWN/HELP**)
- Clear Non-Volatile RAM Menu (**CLEAR NOVRAM? YES**)

4.9.1 Auxiliary Print Event Menu

The Auxiliary Print Event menu **(AUX PRI EVENT: ERROR/TIMED/HSTGRM)** expands the capabilities of the PRINTER control panel by allowing timed **(TIMED)**, errored **(ERROR)**, or histogram **(HSTGRM)** results printouts. Figure 4-17 illustrates how to set up the Auxiliary Print Event menu. The automatic printouts are activated by selecting the AUX SETUP function in the PRINTER control panel. Refer to Section 6, Printer Operation, for printer set-up and operation.

Pressing the **TIMED** softkey allows results printouts to be generated at intervals from 1 minute to 99 hours and 59 minutes (default = 5 minutes). The timer is started when the elapsed seconds result in the SIGNAL & TIME category begins counting. The timer is reset when a test is restarted either by pressing the RESTART pushbutton, at power-up, or by changing a set-up parameter.

Pressing the **ERROR** softkey enables printouts to be generated when specific error conditions occur, i.e., bit, block, code, frame, CRC, and pattern slip errors (default = OFF). The printout is identified as AUX ERROR PRINT. Each time the selected error condition occurs a printout is generated with the errored condition(s) listed at the top, the date and time when

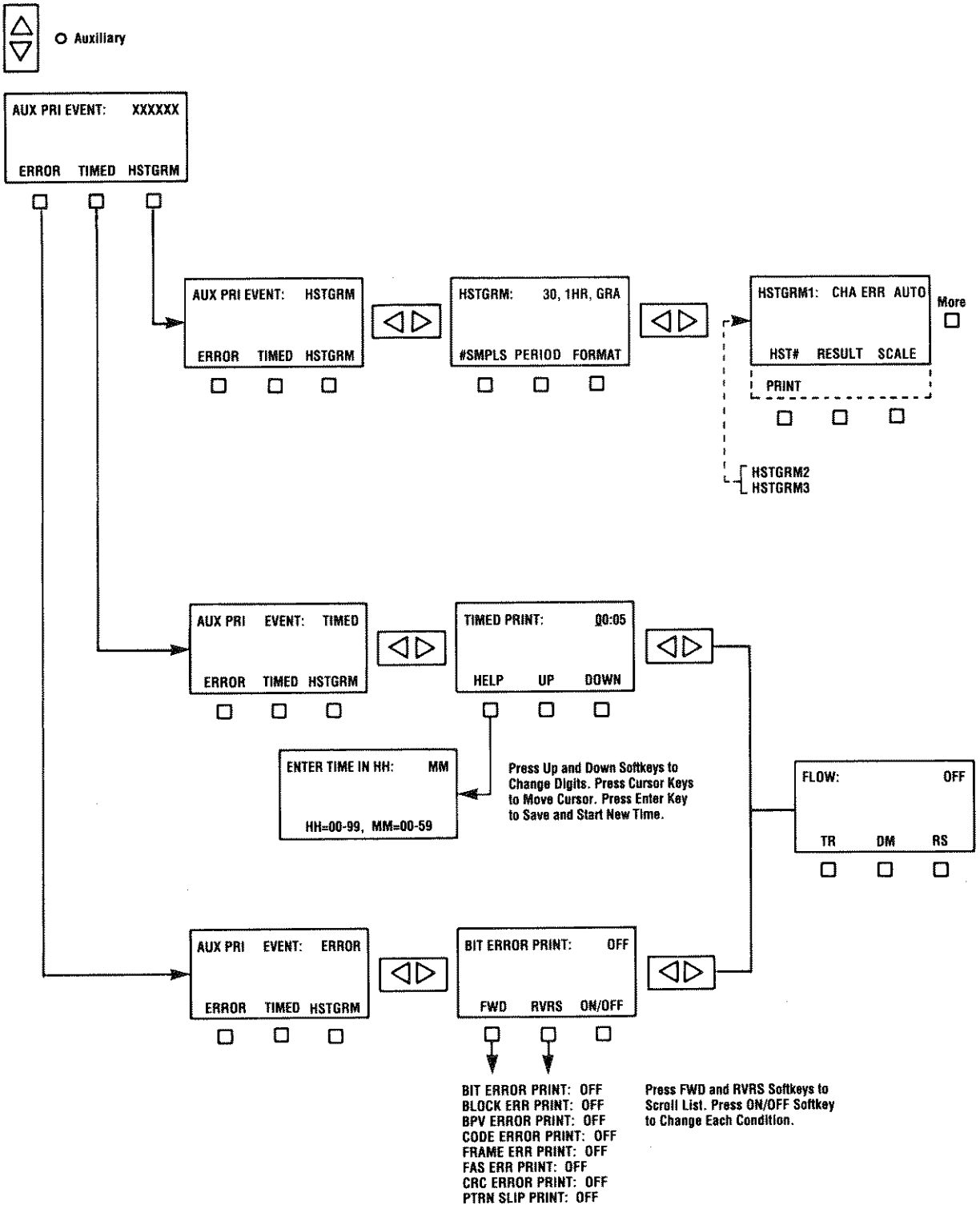


Figure 4-17
Auxiliary Print Event Menu

it occurred, and the results listed below that apply to the test. The error print event selection and the associated printed result correspond as follows:

Print Event	Printed Result
BLOCK ERR PRINT:	BLK ERRS
BPV ERROR PRINT:	BPVS
CODE ERROR PRINT:	CODE ERR
FRAME ERR PRINT:	FRA ERR
FAS ERR PRINT:	FAS ERR
CRC ERROR PRINT:	CRC ERR
PTRN SLIP PRINT:	PAT SLIP
BIT ERROR PRINT:	BIT ERRS

Press the **FWD** or **RVRS** softkey to scroll through the print event list. Press the **ON/OFF** softkey to turn on or off each of the print events.

Pressing the **HSTGRM** softkey causes histogram analysis to be performed. A histogram displays how selected results change with time. The collected data can then be displayed in either a graph or a listing format. Simultaneous histograms may be created for up to three results. Each histogram printout can contain up to 60 samples of the selected result with the time between samples equal to minutes, hours, or days. The histogram printout can be generated manually, automatically, or upon a power ON after a power fail.

#SMPLS - Pressing this softkey selects the number of samples accumulated to generate an auto-print for each of the selected results. The number of available samples ranges between 5 and 60. Each press of this softkey increments the sample number by 1. The **#SMPLS** selected is valid for all three histograms.

NOTE: Changing this parameter restarts the histogram analysis.

PERIOD - Pressing this softkey selects the amount of time between each sample. Pressing this softkey will scroll through the available selections: **1MIN, 15MIN, 1HOUR, 1DAY**. The unit selected is used on the horizontal axis on the graphic printout and is printed as the SAMPLE SIZE on the list printout. The **PERIOD** selected is used for all three histograms.

NOTE: Changing this parameter restarts the histogram analysis.

FORMAT - Pressing this softkey selects the format of the generated printout. **GRA** generates a graph of the result totals per sample period versus time. **LIS** generates a list of the result totals per sample period indexed by time. The **FORMAT** selected is used for all three histograms.

NOTE: Changing this parameter does not restart the histogram.

HST# - Pressing this softkey selects which histogram is to be configured or manually printed. Repeatedly pressing this softkey cycles through each of the three histograms: **HSTGRM1, HSTGRM2, and HSTGRM3.**

NOTE: Changing this parameter does not restart the histogram.

RESULT - Pressing this softkey selects which result is used for the selected histogram. Repeatedly pressing this softkey scrolls through the list of results that can be displayed by a histogram. See Table 4-2. Choose a result according to the selected interface. Histogram samples will only be collected if the result is valid for the selected interface. To disable an individual histogram, set the result softkey to OFF. Select **RESULT** for each **HST#**.

NOTE: Changing this parameter restarts all histograms.

Table 4-2
Available Results

Result Selection	Result Name
AVL SEC	Available Seconds
BIT ERRS	Bit Errors
BLK ERRS	Block Errors
BLOCKS	Blocks
BPVs	Bipolar Violations
CHAR ERR	Character Errors
CODE ERR	Code Errors
CRC ERR	CRC Errors
DEG MIN	Degraded Minutes
ERR SEC	Errors During Non-SES
ERR-SES	Errored SES
FAS ERR	Frame Alignment Signal Errors
FRA ERR	Frame Errors
G EFS	G.821 Error Free Seconds
GERR SEC	G.821 Errored Seconds
PAT LOSS	Pattern Synchronization Loss
PATL SEC	Pattern Loss Seconds
PAT SLIP	Pattern Slips
SES	Severely Errored Seconds
UNA SEC	Unavailable Seconds

SCALE - Pressing this softkey selects the total scale value on the vertical axis of the histogram graph. The **AUTO** selection automatically configures the vertical axis scale according to the size of the largest histogram sample. Repeatedly pressing the **SCALE** softkey scrolls through the available settings. See Table 4-3. Select **SCALE** for each **HST#**.

NOTE: Changing this parameter does not restart histogram analysis.

Table 4-3
Scale Selections

AUTO	1K	500K
10	2K	1M
20	5K	2M
30	10K	5M
50	20K	10M
100	50K	20M
200	100K	50M
500	200K	

K = thousands
M = millions

PRINT - Pressing this softkey initiates a manual print of the selected histogram. The most recent (up to 60) samples collected are used to create a printout in the selected format.

It should be noted that when stepping through the AUXILIARY menus, either the ERROR Print Event menu, the TIMED Print Event menu, or the HISTOGRAM Print Event menu is stepped through first before moving to the next menu, e.g., Out-of-Band Flow Control menu (see Figure 4-17).

4.9.2 Out-of-Band Flow Control Menu

The Out-of-Band Flow Control menu (**FLOW: TR/DM/RS/CS/RR/OFF**) allows the following control leads to be used to control data flow between the FIREBERD 4000 and the circuit being tested (default = OFF).

TR - Terminal Ready (EIA - DTR, CCITT - 108/2)
DM - Data Mode (EIA - DSR, CCITT - 107)
RS - Request to Send (EIA - RTS, CCITT - 105)
CS - Clear to Send (EIA - CTS, CCITT - 106)
RR - Receiver Ready (EIA - RLSD, CCITT - 109)

Pressing the associated softkey toggles the control lead selection on and off. The softkey label appears in the selection field when the lead is selected. **OFF** appears in the selection field when none of the leads are selected. Only the incoming leads apply, the others are ignored.

The flow control menu only applies to the following interfaces: EIA RS-232-C/V.24, EIA RS-449, CCITT V.35, MIL-STD-188C and MIL-STD-188-114. When a lead goes LOW, data flow is halted. A message is displayed in the ANALYSIS RESULTS display indicating both that data is on hold and which lead is controlling the flow. Flow control is disabled in Self-Loop mode.

4.9.3 User Pattern Synchronization Threshold Menu

The User Pattern Synchronization Threshold menu (**USER SYN THRSH: 10BYT/100BYT/PATLEN**) specifies the pattern length that must be received for pattern synchronization to be declared by the FIREBERD 4000 (default = 10BYT). This menu only applies to synchronization USER patterns (refer to Section 4.6.4).

10BYT - Pressing this softkey sets the synchronization threshold at 10 bytes.

100BYT - Pressing this softkey sets the synchronization threshold at 100 bytes.

PATLEN - Pressing this softkey sets the synchronization threshold equal to the pattern length of the programmed user pattern, which can be from 1 to 2048 bytes long.

4.9.4 Synchronization Loss Threshold Menu

The Synchronization Loss Threshold menu (**SYNC LOSS THRSH: NORM/HIGH**) sets the threshold at which the PATTERN LOSS alarm LED illuminates indicating pattern loss (default = NORM).

NORM - Pressing this softkey sets the threshold to indicate synchronization loss when 250 bit errors are counted in less than 1000 received bits for synchronous timing and 30 character errors are counted in less than 1000 received characters for asynchronous timing.

HIGH - Pressing this softkey sets the threshold to indicate synchronization loss when 20,000 bit errors are counted in less than 100,000 received bits for synchronous timing and 20,000 bit errors are counted in less than 100,000 received bits for asynchronous timing.

4.9.5 Receiver Action Upon Synchronization Loss Menu

The Receiver Action Upon Synchronization Loss menu (**SYNC LOSS ACT: HALT/CLEAR**) determines how the analysis results are treated when clock, frame, and pattern synchronization are lost (default = HALT). Table 4-4 shows the relationship of the clear and halt modes and the analysis results when clock, frame, and pattern synchronization are lost. Press the corresponding softkey to select the desired receiver action. It should be noted that this menu has no effect on the CCITT G.821 PERFORMANCE category results.

CLEAR - This selection halts the accumulation of the test results when synchronization is lost. When pattern synchronization is re-established, the result counters are cleared.

HALT - This selection only halts the accumulation of the test results when synchronization is lost. When synchronization is re-established, the results continue to be accumulated.

4.9.6 Block Length Menu

The Block Length menu (**BLOCK LENGTH: PATLEN/ 10^2/10^3/10^4/10^5/10^6**) establishes the block length of the test pattern. This menu identifies the block length used when block errors are being measured. Blocks, block errors, and average block error rate results are counted starting with pattern synchronization.

PATLEN (pattern length) - Pressing this softkey sets the block length to the pattern length established by the selected pattern.

10^2 to **10^6** - Pressing these softkeys sets a fixed block length from 100 (10^2) to 1,000,000 (10^6) bits.

4.9.7 Date and Time Menus

The Date (**DATE: DD/MM/YY**) and Time (**TIME: HH/MM/SS**) menus are used to set the date and time of the FIREBERD's internal battery-backed clock. Select the AUXILIARY function category

Table 4-4
Relationship Between Results in Clear and Halt Modes

Results	Clear Mode			Halt Mode		
	Clock Loss	Frame Sync Loss	Pattern Sync Loss	Clock Loss	Frame Sync Loss	Pattern Sync Loss
ERROR Category						
AVG BER	S/R	S/R	S/R	S/Con	S/Con	S/Con
AVG BLER	S/R	S/R	S/R	S/Con	S/Con	S/Con
BER	S/R	S/R	S/R	S/Con	S/Con	S/Con
BIT ERRS	S/R	S/R	S/R	S/Con	S/Con	S/Con
BLK ERRS	S/R	S/R	S/R	S/Con	S/Con	S/Con
BLOCKS	S/R	S/R	S/R	S/Con	S/Con	S/Con
CHAR ERR	S/R	S/R	S/R	S/Con	S/Con	S/Con
PAT LOSS	Con	Con	Con	Con	Con	Con
PAT SLIP	S/R	S/R	S/R	S/Con	S/Con	S/Con
INTERFACE Category						
1SEC CRC	S/R	S/R	No/R	S/Con	S/Con	No
AVG BPVR	S/R	No/R	No/R	S/Con	No	No
AVG CER	S/R	No/R	No/R	S/Con	No	No
AVG CRC	S/R	S/R	No/R	S/Con	S/Con	No
AVG FAS	S/R	S/R	No/R	S/Con	S/Con	No
AVG FER	S/R	S/R	No/R	S/Con	S/Con	No
BIT SLIP	R	No	No	R	No	No
BPV Rate	S/R	No/R	No/R	S/Con	No	No
BPVs	S/R	No/R	No/R	S/Con	No	No
CER	S/R	No/R	No/R	S/Con	No	No
CODE ERR	S/R	No/R	No/R	S/Con	No	No
CRC ERR	S/R	S/R	No/R	S/Con	S/Con	No

Table 4-4
Relationship Between Results in Clear and Halt Modes (Continued)

Results	Clear Mode			Halt Mode		
	Clock Loss	Frame Sync Loss	Pattern Sync Loss	Clock Loss	Frame Sync Loss	Pattern Sync Loss
DAT RATE	No	No	No	No	No	No
FAS ERR	S/R	S/R	No/R	S/Con	S/Con	No
FRA ERR	S/R	S/R	No/R	S/Con	S/Con	No
MAX O'S	R	No	No	R	No	No
RCV BOM	R	R	No	R	R	No
RCV BYTE	No	No	No	No	No	No
RCV CODE	No	No	No	No	No	No
R LVL V	No	No	No	No	No	No
R LVL dB	No	No	No	No	No	No
RX ABCD	R	R	No	R	R	No
SMPX CUR	No	No	No	No	No	No
TIME & SIGNAL Category						
BER-SES	S/R	S/R	S/R	S/Con	S/Con	S/Con
%EFS	S/R	S/R	S/R	S/Con	S/Con	S/Con
DATE	No	No	No	No	No	No
DELAY	S/R	S/R	S/R	No	No	No
ELAP SEC	No	No	No	No	No	No
ERR SEC	S/R	S/R	S/R	S/Con	S/Con	S/Con
ERR SES	S/R	S/R	S/R	S/Con	S/Con	S/Con
GEN FREQ	No	No	No	No	No	No
+LVL V	No	No	No	No	No	No
+LVL dB	No	No	No	No	No	No
-LVL V	No	No	No	No	No	No
-LVL dB	No	No	No	No	No	No
PP LVL V	No	No	No	No	No	No
LVL dBM	No	No	No	No	No	No
PATL SEC	Con	Con	Con	Con	Con	Con
RCV FREQ	N/A	N/A	No	N/A	N/A	No
TEST SEC	S/R	S/R	S/R	No	No	No
TIME	No	No	No	No	No	No
PERFORMANCE Category						
%AVL SEC	10/Con	10/Con	10/Con	10/Con	10/Con	10/Con
%DEG MIN	S/Con	S/Con	S/Con	S/Con	S/Con	S/Con
%SES	Con	Con	Con	Con	Con	Con
AVL SEC	10/Con	10/Con	10/Con	10/Con	10/Con	10/Con
DEG MIN	S/Con	S/Con	S/Con	S/Con	S/Con	S/Con
G %EFS	S/Con	S/Con	S/Con	S/Con	S/Con	S/Con
G EFS	S/Con	S/Con	S/Con	S/Con	S/Con	S/Con
GERR SEC	Con	Con	Con	Con	Con	Con
SES	Con	Con	Con	Con	Con	Con
UNA SEC	10/Con	10/Con	10/Con	10/Con	10/Con	10/Con

S = Saved during sync loss.
R = Restarted at re-sync.
Con = Continues being updated after re-sync.
No = Not affected by sync loss.
10 = First 10 seconds not affected after sync loss.

with the SETUP CATEGORY switch, then press the SETUP SELECT switch to locate the date and time menus.

The date is entered by pressing the associated softkeys until the desired day (1 - 31), month (JAN - DEC), and year (00 - 99) appear in the display. Press the ENTER key to save the new date. Once the date is entered, it does not need to be re-entered. Only enter valid dates.

The time is entered by pressing the associated softkeys until the desired hour (00 - 23), minute (00 - 59), and second (00 - 59) appears in the display. Enter the time using a 24-hour clock format. Press the ENTER key to save the new time.

NOTE: Pressing either the SETUP SELECT switch or SETUP CATEGORY switch does not save the date and time entered.

4.9.8 Results Printout Content Menu

The Results Printout Content menu (**RESULT PRINT: SUMM/STD/LONG**) controls the content of the analysis results printout. Press the corresponding softkey to select the desired results printout content. Refer to Section 6, Printer Operation, for specific information on printer set-up and operation.

SUMM - Press this softkey to generate the summary result printout that lists non-zero results, number of blocks transmitted, test seconds, elapsed seconds, generator and receiver frequencies, self-loop status, and selected interface.

STD - Press this softkey to generate the standard result printout that lists the main analysis results for the selected interface.

LONG - Press this softkey to generate the long result printout that lists all results and Interface Status and Control panel conditions.

4.9.9 Status Message Printout Menu

The Status Message Printout menu (**STATUS PRINT: ON/OFF**) controls status message printouts. The status messages are generated when specific conditions occur such as PATTERN SYNC LOSS, FRAME SYNC LOSS, PAT SYNC ACQUIRED, etc. The status message printouts are date stamped each time they occur. The status messages can be printed only when the printer is turned on through the PRINTER control panel. Refer to Section 6, Printer Operation, for specific information on printer set-up and operation.

4.9.10 Printer Printout Format Menu

The Printer Printout Format menu (**PRINTER: WIDTH/SPEED/TERM**) sets up the printer printout format. Refer to Section 6, Printer Operation, for specific information on printer set-up and operation.

WIDTH - Press this softkey to select the character line width of the printout: **20**, **40**, and **80** characters wide (default = 40).

SPEED - Press this softkey to select the print speed: **SLOW** (prints with one-half second delay between lines) or **FAST** (prints at full baud rate) modes (default = FAST). All TTC supplied printers, except the PR-2000, can use the default mode. Select **SLOW** when using the PR-2000 printer.

TERM - Press this softkey to select the line termination control: **CRLF** (carriage return, linefeed), **CR** (carriage return), **or LF** (linefeed) (default = CRLF).

4.9.11 RS232 Printer/Controller Interface Menu

The RS232 Printer/Controller Interface menu (**RS232: BAUD/DATA/PAR/PR45/PR40A/PR2000/PR40/PR85**) sets up the RS232 Printer/Controller Interface connector for remote control operation or printer operation.

BAUD - Pressing this softkey sets the RS232 connector baud rate: **300**, **1200**, **2400**, **4800**, or **9600** b/s (default = 9600).

DATA - Pressing this softkey sets the character length: **7** or **8** (default = 8).

PAR - Pressing this softkey sets the parity: **NONE**, **EVEN**, or **ODD** (default = NONE).

PR45 - Pressing this softkey sets the baud rate (9600), character length (8), and parity (NONE) to operate the TTC PR-45 lid printer (default printer setting).

PR40A - Pressing this softkey sets the baud rate (2400), character length (8), and parity (NONE) to operate the TTC PR-40A printer.

PR2000 - Pressing this softkey sets the baud rate (2400), character length (7), and parity (NONE) to operate the TTC PR-2000 printer.

PR40 - Pressing this softkey sets the baud rate (2400), character length (7), and parity (NONE) to operate the TTC PR-40 printer.

PR85 - Pressing this softkey sets the baud rate (2400), character length (8), and parity (NONE) to operate the TTC PR-85 printer.

Refer to Section 6, Printer Operation, for specific information on printer set-up and operation. Refer to Section 7, Remote Operation, for specific information on remote control set-up and operation.

4.9.12 IEEE-488 Interface Menu

The IEEE-488 Interface menu (**IEEE488: XX, SRQ: OFF/ON**) only appears when the optional IEEE-488 Interface is installed in the rear-panel slot next to the RS232 Printer/ Controller Interface connector. The interface provides Talk-Only (printer operation) and addressable (remote control) operating modes. The display indicates the operating mode (TO or an address) and whether service request (SRQ) is on. The operating mode is controlled through the IEEE-488 Interface DIP switch and the SRQ is controlled through the IEEE488 menu. Refer to Section 6, Printer Operation, for specific information on printer set-up and operation. Refer to Section 7, Remote Operation, for specific information on remote control set-up and operation.

4.9.13 Fixed Frequency Editor Menu

The Fixed Frequency Editor menu (**FREQ1: FREQ#/UP/ DOWN/HELP**) is displayed only when the optional frequency synthesizer is installed. It is used to re-order the fixed internal frequencies or change them to application specific frequencies. Refer to Section 4.5.2, Frequency Synthesizer Generator Clock Menu, to change the fixed frequencies.

4.9.14 Clear Non-Volatile RAM Menu

The Clear Non-Volatile RAM menu (**CLEAR NOVRAM? YES**) is used to clear all stored programs, patterns, user messages, mainframe, and interface configurations from memory and set them to the factory default values. Appendix D lists all of the factory defaults for the mainframe. Pressing the **YES** softkey displays **ARE YOU SURE? YES/NO**. Pressing the **YES** softkey clears the non-volatile RAM of all stored configurations and resets them to the factory defaults. Pressing **NO** ignores the question.

4.10 CONTENTION CONDITIONS

Regardless of which interface is selected, certain operating conditions can cause contentions to occur. A contention occurs when certain interface operating parameters are not compatible with other mainframe operating parameters. The three possible contentions encountered with these interfaces are: asynchronous frequency contention, asynchronous pattern contention, and synchronous pattern contention. When a contention exists, the ANALYSIS RESULTS display alternately flashes the contention message and the displayed results.

Asynchronous frequency contention exists when the interface TIMING is set to ASYNC and the CLOCK GENERATOR INTRNL frequency is greater than 20 kb/s. The message ASYNC FREQ CONTENTION flashes on the ANALYSIS RESULTS display. To eliminate the asynchronous frequency contention, select a clock generator frequency that is less than 20 kb/s, or select synchronous timing. During an asynchronous frequency contention problem, the internal clock generator defaults to 20 kHz.

Asynchronous pattern contention exists when the interface TIMING is set to ASYNC and the PATTERN is set to one of the following patterns: 1:7, 3IN24, 2^{20}-1, 2^{23}-1, QRSS, or PROGRM. The message ASYNC PATTERN CONTENTION flashes on the ANALYSIS RESULTS display. To eliminate the asynchronous pattern contention, select a different pattern or select synchronous timing. During an asynchronous pattern contention problem, the pattern generator defaults to 1:1.

Synchronous pattern contention exists when the interface TIMING is set to SYNC and the PATTERN is set to either the USER or FOX pattern. The message SYNC PATTERN CONTENTION flashes on the ANALYSIS RESULTS display. To eliminate the synchronous pattern contention, select a different pattern or select asynchronous timing. This message does not occur when the optional synchronous long user pattern (Option 4006) is installed. During a synchronous pattern contention problem, the pattern generator defaults to 1:1.

4.11 OPERATING IN SELF-LOOP MODE

The SELF LOOP switch is used to select the self-loop mode of the FIREBERD 4000. Pressing the SELF LOOP switch illuminates the LED inside the switch and loops the data interface data and clock outputs back to the data and clock inputs. This isolates the interface data and clock leads from the interface connector(s), allowing the mainframe and interface module to be tested for proper operation without disconnecting the FIREBERD from the system under test. Data is continuously transmitted and received regardless of the status of the interface signaling leads. Both in-band and out-of-band flow control are disabled during SELF LOOP. It should be noted that the interface control and signaling leads are not

looped back and remain active with the system under test. When the SELF LOOP is activated, all applicable test results are also made available for the selected interface. Refer to the appropriate data interface operating manual for additional information related to SELF LOOP.

4.12 FIREBERD 4000 ANALYSIS RESULTS

The key to the FIREBERD 4000's ability to test and analyze a variety of telecommunications circuits comes from its analysis results capabilities. These capabilities are accessed through the ANALYSIS RESULTS panel and display section and are tailored to the specific circuit being tested.

4.12.1 Front Panel Operation

The ANALYSIS RESULTS panel and display section is divided in two, allowing two results to be displayed at the same time. The RESULTS CATEGORY switches provide access to the five results categories listed above the switches. Pressing either RESULTS CATEGORY switch up or down arrow illuminates the LED above or below the currently selected category and displays the associated results. The RESULT SELECT switches enable the selected category to be viewed for results that are available for the interface in use.

The results display provides several visual indicators that identify the condition of the the mainframe and tests in progress. When the displayed result does not apply to the test in progress, **N/A** appears on the bottom line (such as testing a synchronous RS-232-C line and displaying BPVs). When the displayed result is unavailable, meaning it cannot yet be calculated, the bottom line is blank. When the displayed result is available, the information is displayed in the appropriate format, such as 3.00E-5 for BER and 64000 Hz for generator frequency. If the result overflows the eight-digit display, the value on the bottom line flashes until the test is restarted. If the result overflows its internal registers, **OVERFLOW** appears on the bottom line. When the results in the INTERFACE and PERFORMANCE categories do not apply to the selected interface, **N/A** appears on the bottom line and the category is locked out.

Each test result begins accumulating when the appropriate synchronization (e.g., frame errors with frame sync, bit errors with pattern sync, etc.) is established between the received signal and the FIREBERD 4000. The setting of the AUXILIARY Receiver Action Upon Synchronization Loss Menu (**SYNC LOSS ACT: HALT/CLEAR**), determines how the mainframe treats the results when synchronization is restored after losing synchronization. When **SYNC LOSS ACT** is set for HALT mode and synchronization is lost, the results are frozen until synchronization is reestablished. Once synchronization is reestablished, the results continue where they left off when synchronization was lost. This is very helpful when performing long-term circuit testing. As long as the test is not restarted by pressing the RESTART switch or changing a set-up parameter, the results are continuously updated. When **SYNC LOSS ACT** is set for CLEAR mode and synchronization is lost, the results are frozen until synchronization is reestablished. Once synchronization is reestablished, the results are cleared (zeroed out) and all result counts start over.

A test can be interrupted and restarted at any time by pressing the RESTART switch. Additionally, changing certain mainframe or interface parameters through the SETUP panel or interface panel switches also causes a test restart. The test restart causes any accumulated results and any alarms indicated in the ALARMS panel to be cleared.

The DISPLAY HOLD switch allows the displayed ANALYSIS RESULTS information to be halted and examined at any time. Normally, the results display is continuously updated. Pressing DISPLAY HOLD freezes the display and illuminates the LED within the switch. All results can be viewed by pressing the CATEGORY and RESULT SELECT switches. It should be noted that while the display is on hold, the mainframe continues to accumulate analysis results. Pressing DISPLAY HOLD again allows the display to resume normal operation and updates all the results from the information stored in memory.

4.12.2 Analysis Results Categories

The test results are divided into five categories: SUMMARY, ERROR, INTERFACE, TIME & SIGNAL, and PERFORMANCE (requires Option 4004). Table 4-5 lists the categories and all of the available test results provided by the FIREBERD 4000. Only those test results that apply to the selected interface are displayed in each category. Appendix B lists the results by category and by interface applicability. Appendix C provides definitions all analysis results.

SUMMARY Category

The SUMMARY category provides access to the most commonly used error results (see Table 4-5) without having to scan through the other categories to find them. This category only lists the error results that have counted errors. If none of the summary results are reporting errored conditions, RESULTS OK appears in the display. If the SUMMARY results listed in Table 4-5 do not apply to the selected interface or the mainframe has not synchronized to the received signal, RESULTS UNAVAIL appears in the display.

Table 4-5
FIREBERD 4000 Analysis Results

Displayed Category	Result Name	Full Result Name
SUMMARY	BIT ERRS	Bit Errors[1]
	BPVs	Bipolar Violations[2]
	CHAR ERR	Character Errors[1]
	CODE ERR	Code Errors[2]
	CRC ERR	CRC Errors[2]
	FAS ERR	Frame Alignment Signal Errors[2]
	FRA ERR	Frame Errors[2]
	PAT LOSS	Pattern Synchronization Loss[1]
	PAT SLIP	Pattern Slips[1]
ERROR	AVG BER	Average Bit Error Rate
	AVG BLER	Average Block Error Rate
	BER	Bit Error Rate
	BIT ERRS	Bit Errors[3]
	BLK ERRS	Block Errors
	BLOCKS	Blocks
	CHAR ERR	Character Errors[3]
	PAT LOSS	Pattern Synchronization Loss[3]
	PAT SLIP	Pattern Slips[3]
INTERFACE	1SEC CRC	One Second CRC Errors
	AVG BPVR	Average Bipolar Violation Rate
	AVG CER	Average Code Error Rate
	AVG CRC	Average CRC Error Rate
	AVG FAS	Average FAS Error Rate
	AVG FER	Average Frame Error Rate
	BIT SLIP	Bit Slips
	BPVs	Bipolar Violations[3]
	BPV Rate	Bipolar Violation Rate
	CER	Code Error Rate
	CODE ERR	Code Errors[3]
	CRC ERR	CRC Errors[3]
	DAT RATE	Data Rate
	FRA ERR	Frame Errors[3]
	MAX 0's	Maximum Zeros
	RCV BOM	Received Bit Oriented Message
	RCV BYTE	Receive Byte Code
	RCV CODE	Receive Code Name
	R LVL V	Receive Level in Volts
	R LVL dB	Receive Level in dB
	RX ABCD	Receive Bits
	SMPX CUR	Simplex Current
TIME & SIGNAL	%EFS	Percent of Error-Free Seconds
	DATE	Date
	DELAY	RTS/CTS Delay
	ELAP SEC	Elapsed Seconds
	ERR SEC	Errored Seconds
	GEN FREQ	Generator Clock Frequency
	+LVL dB	Positive Level in dB
	+LVL V	Positive Level in Volts

Table 4-5
FIREBERD 4000 Analysis Results (Cont)

Displayed Category	Result Name	Full Result Name
TIME & SIGNAL (CONT)	-LVL dB	Negative Level in dB
	-LVL V	Negative Level in Volts
	LVL dBM	Level in dBm
	PATL SEC	Pattern Loss Seconds
	PP LVL V	Peak to Peak Level in Volts
	RCV FREQ	Receiver Clock Frequency
	TEST SEC	Test Seconds
	TIME	Time
PERFORMANCE[4]	%AVL SEC	Percent of Available Seconds
	%DEG MIN	Percent of Degraded Minutes
	%SES	Percent of Severely Errored Seconds
	AVL SEC	Available Seconds
	BER-SES	Ber During Non-SES
	DEG MIN	Degraded Minutes
	ERR-SES	Errors During Non-SES
	G %EFS	G.821 Percent of Error Free Seconds
	G EFS	G.821 Error Free Seconds
	GERR SEC	G.821 Errored Seconds
	SES	Severely Errored Seconds
	UNA SEC	Unavailable Seconds

[1] Appears in ERROR Category
[2] Appears in INTERFACE Category
[3] Appears in SUMMARY Category
[4] Requires Option 4004

ERROR Category

The ERROR category displays the most commonly used error results, such as bit errors, block errors, code errors, average error rates, pattern losses and slips, etc. The mainframe only displays the error results that apply to the selected interface and the test being performed. When the NOVRAM is cleared, the ERROR category BIT ERR result is the first result displayed.

INTERFACE Category

The INTERFACE category displays interface-specific results. The interface specific results include results for T1 (bipolar violations and frame errors), CCITT G.703 and G.704 (code and FAS errors), and Digital Data Service (control codes), among others. Appendix B lists the current data interfaces and the available results for each interface. Refer to the appropriate interface operating manual for a complete list of interface-specific results.

TIME & SIGNAL Category

The TIME & SIGNAL category displays results related to time and frequency. This category indicates the length of the test from signal synchronization, the number of seconds that contained errors, the number of seconds that were not errored, and the overall percentage of error-free seconds during a test. The current system date and time are also listed in this category along with the generator and receiver clock frequencies. When the mainframe is emulating DTE, the RTS/CTS delay is measured and displayed in this category.

PERFORMANCE Category

The FIREBERD's CCITT Recommendation G.821 compatible performance analysis results provide statistical information about the performance of the equipment or system under test. The G.821 Performance Analysis Option (Option 4004) must be installed to use this category. Refer to Appendix F for a discussion on CCITT G.821 performance

analysis. This category includes G.821 based results for available and unavailable seconds, errored and error-free seconds, degraded minutes, severely-errored seconds, and percentages based on these results.

4.12.3 Performing Error Analysis on Standard Data

Error analysis refers to the ability of the FIREBERD 4000 to recognize various incoming data patterns and framing formats and to analyze them for incorrect data polarity, bit errors, data loss, clock losses, pattern slips, framing errors, etc. These conditions generate results that are counted and made available to the front panel display and/or printer. Some of the results are correlated with time and position in the incoming data stream to yield more refined information, such as bit error rates, block error rates, and error-free seconds. In most cases, error analysis can only be performed on patterns (standard data) recognized by the FIREBERD 4000 and not live data. However, timing and signal analysis can be performed on live data (this is dependent on the data interface used).

During normal system testing, clock and data outputs from the FIREBERD 4000 generator drive the system under test, and clock and data signals from the system under test are supplied to the FIREBERD receiver inputs. Data transmission and reception occurs simultaneously in full-duplex mode at all data rates.

Standard Data Patterns

The FIREBERD receiver is responsible for recognizing and synchronizing to the incoming data patterns. The receiver begins to examine the incoming data once the received signal or clock is detected and, if applicable, frame synchronization has been achieved. The receiver compares the received pattern with the expected pattern and registers any differences as errors. The errors can be generated by the circuit under test or applied to the test pattern generated by the FIREBERD 4000. The receiver accepts all of the data patterns discussed in Section 4.6 with the same timing and speed restrictions as the test pattern generator. The test results are generated through the analysis of the received test pattern generated by the FIREBERD in either an end-to-end or loopback mode. Error result analysis does not start until the receiver is synchronized to the received data, clock, or framing pattern as required by the individual result.

Acquiring Synchronization

Once the receiver has successfully synchronized to the received data, the front panel RECEIVER PATTERN SYNC LED illuminates and error analysis begins. The parameters for synchronization are determined by the timing and test pattern used to test the circuit.

When operating with synchronous timing, the receiver declares synchronization to fixed data patterns (Mark only, Space only, 1:1, 1:7, etc.) when it has received 30 consecutive unerrored bits. For pseudorandom patterns (63, 511, 2^{20}-1, etc.), synchronization is declared when 30 + n consecutive unerrored bits for a pattern length of 2^n-1 are received. So when a pattern of 2^{15}-1 is used, synchronization is declared when 45 consecutive unerrored bits are received.

When operating with asynchronous timing, the receiver declares synchronization to fixed and pseudorandom data patterns when it has received 10 consecutive unerrored characters. When using the USER 1-3 patterns, the User Synchronization Threshold menu (**USER SYN THRSH: 10BYT/100BYT/PATLEN**) determines the number of unerrored bytes that must be received to synchronize the mainframe receiver to the received pattern. If in an asynchronous timing mode and the user synchronization threshold is set to PATLEN and the USER pattern takes longer than 5 seconds to transmit, the receiver does not synchronize to the received pattern.

Losing Synchronization

The mainframe declares loss of synchronization when one of the following events occurs:

High error rate - Loss of synchronization is determined by the Auxiliary Synchronization Loss Threshold menu (**SYNC LOSS THRSH: NORM/HIGH**). When set for the NORM threshold, loss of synchronization is declared when 250 bit errors are counted in less than 1000 received bits for synchronous timing and 30 character errors are counted in less than 1000 received characters in asynchronous timing. When set for the HIGH threshold, loss of synchronization is declared when 20,000 bit errors are counted in less than 100,000 received bits for synchronous and asynchronous timing.

Loss of received data - With synchronous timing, a data loss is declared when data being clocked in does not change state for 61 bit periods. (The data loss detector is automatically disabled when patterns without transitions

are generated.) When the FIREBERD loses synchronization as a result of a data loss, the **RCV DATA LOSS** message flashes in the results display, the PAT LOSS result is incremented, and the ALARMS PATTERN LOSS LED on the front panel illuminates. In asynchronous timing, data losses do not force a pattern synchronization loss.

Loss of received clock - With synchronous timing, the absence of high-to-low state transitions on the received clock line for a period longer than 50 milliseconds causes a clock loss to be declared. When the FIREBERD loses synchronization as a result of a clock loss, the RECEIVER CLOCK PRES LED goes out and the ALARMS CLOCK LOSS LED illuminates.

Regaining Synchronization

As soon as the receiver loses synchronization it immediately tries to resynchronize. When the receiver regains synchronization, the accumulated results are affected by the Receiver Action Upon Synchronization Loss menu (**SYNC LOSS ACT: HALT/CLEAR**). When **SYNC LOSS ACT** is set for HALT mode and synchronization is lost, the results are frozen until synchronization is reestablished. Once synchronization is reestablished, the results continue where they left off when synchronization was lost. When **SYNC LOSS ACT** is set for CLEAR mode and synchronization is lost, the results are frozen until synchronization is reestablished. Once synchronization is reestablished, the results are cleared (zeroed out) and all result counts start over. It should be noted that the PERFORMANCE category results are not cleared in the CLEAR mode but continue to accumulate results. Refer to Section 4.9.5 for additional information on the HALT and CLEAR modes.

4.12.4 Performing Error Analysis on Live Data

With the appropriate interface installed, the FIREBERD 4000 can analyze live data in unframed and framed data formats. When analyzing live unframed data, the FIREBERD monitors for signal presence. When signal presence is detected, the mainframe interface recognizes the signal format and monitors for signal violations. These violations can be in the form of bipolar violations and code errors.

When analyzing live framed data, the FIREBERD monitors for signal presence and synchronizes with the framing pattern. When the signal presence is detected, the mainframe interface recognizes the signal format and monitors for signal violations as previously discussed with unframed data. Once frame synchronization is acquired, the mainframe interface recognizes known framing patterns and monitors the framing patterns for frame errors. CRC is also monitored and compared with expected formats for CRC errors. As errors are counted, the FIREBERD calculates average error rates over the length of the test. Refer to the individual interface operating manual concerning live data testing.

SECTION 5
DATA INTERFACES

5.1 INTRODUCTION

This section contains information on the FIREBERD 4000 Communications Analyzer internal and installable data interfaces. The internal data interfaces (EIA RS-232-C/CCITT V.24 and MIL-STD-188C) are fully discussed in this section. The installable data interfaces are briefly described in this section — full descriptions and operating procedures are provided in separate data interface operating manuals. The individual data interface manuals can be inserted into this section as required.

The data interfaces allow the FIREBERD 4000 to operate in a wide variety of telecommunications environments, data formats, data rates, and locations. The interfaces provide the physical connections and signal conversions needed for the FIREBERD 4000 to connect, test, and analyze a circuit being brought on line, suspected of a line impairment, or equipment failure.

5.2 OVERVIEW

The FIREBERD 4000 Communications Analyzer comes with an EIA RS-232-C compatible Data Interface (EIA RS-232-C/CCITT V.24 and MIL-STD-188C) and a rear panel slot for an installable data interface. A second optional interface slot (Option 4001) is also available to install a second interface. The mainframe selects the interfaces through the front panel SETUP Panel and Display Section (see Section 4.4, INTERFACE SETUP category). Most interfaces have either panel switches or a set-up menu to control the configuration and operation of the interface during testing. Those interfaces with panel switches and a set-up menu are only controlled through the set-up menu that is accessible through the mainframe INTERFACE SETUP category. Table 5-2 lists the available interfaces for the FIREBERD 4000 by model number, the interface operating manual number, whether or not they are switch or menu controlled, the INTERFACE menu labels for each interface, and a brief description.

5.2.1 Installing the Data Interface

The installable interfaces slide into the rear panel slot (labeled SLOT 1) and are secured with two thumbscrews on the interface front panel. Refer to the individual interface operating manuals for complete instructions on installing and removing an interface from the FIREBERD 4000. The same procedures apply to SLOT 2, if installed. Option 4001 is required for the use of the second interface slot.

WARNING: Before installing or removing the interface module, turn the mainframe AC power OFF; otherwise, damage can occur to the interface and mainframe.

5.2.2 Selecting and Configuring the Data Interface

The data interface is selected through the INTERFACE SETUP menu. Press the corresponding softkey to select the desired interface (see Table 5-2, located at the end of this section, for interface labels). The interface must be selected to allow the mainframe to control it. Once selected, the interface can be configured through the interface panel switches or interface set-up menu. Interfaces that have both switches and an interface menu can only be controlled through the menu. Refer to Table 5-2 to identify the interfaces with or without menu control. Refer to the individual interface operating manuals for complete instructions on configuring the interface from the FIREBERD 4000 SETUP panel or interface panel switches. Refer to Section 4.4 for FIREBERD 4000 front panel interface operating instructions.

5.3 INTERNAL RS-232 AND MIL188 DATA INTERFACES

Both the EIA RS-232-C and MIL-STD-188C Data Interfaces are built into the FIREBERD 4000. This allows the FIREBERD 4000 to test compatible data terminal equipment (DTE) and data communications equipment (DCE) without having to install a separate interface module to perform the test. Selection and configuration of these two interfaces is accomplished through the SETUP panel INTERFACE category. This section describes the data interface connections, configuration contentions, interface menus, functional description, and operating procedures for the internal RS-232-C (INT232) and MIL-STD-188C (INT188) Data Interfaces.

5.3.1 Data Interface Connections

Both interfaces use the two EIA RS-232-C/CCITT V.24 compatible data interface connectors on the rear panel, labeled RS-232-C/V.24 DATA INTERFACE TO DTE/TO DCE (see

Figure 3-3). Table 5-1 lists the pin assignments of both female, 25-pin D-type connectors. The TO DTE connector is used to connect the mainframe, configured as the DCE, to the DTE being tested. The TO DCE connector is used to connect the mainframe, configured as the DTE, to the DCE being tested.

5.3.2 RS-232-C Interface Menus

With the INTERFACE home menu displayed (INTERFACE: XXXXXX), pressing the softkey labeled INT232 selects the internal RS-232-CInterface and displays the selection on the top line of the SETUP display, INTERFACE: INT232. Pressing the right SETUP SELECT switch displays the first INT232 Interface menu, EMULATE: DTE/DCE. The mainframe emulation (DTE or DCE) and timing (ASYNC or SYNC) determine the number and sequence of the menus displayed in the INT232 Interface menu as shown in Figures 5-1 and 5-2. Figure 5-1 shows the menu sequence when the mainframe is emulating DTE with either synchronous or asynchronous timing selected. Figure 5-2 shows the menu sequence when the mainframe is emulating DCE with either synchronous or asynchronous timing selected. Each of the internal RS-232 Interface menus and parameters is described as follows.

EMULATE: DTE/DCE - This menu establishes the interface emulation mode. Pressing the corresponding softkey selects either DTE or DCE emulation.

DTE - This selection allows the FIREBERD mainframe to emulate DTE. Use the TO DCE interface connector on the rear panel when emulating DTE. (factory default)

DCE - This selection allows the FIREBERD mainframe to emulate DCE. Use the TO DTE interface connector on the rear panel when emulating DCE.

TIMING: ASYNC/SYNC - This menu establishes the mainframe timing mode. Pressing the corresponding softkey selects either asynchronous (ASYNC) or synchronous (SYNC) timing.

ASYNC - This selects the asynchronous timing mode. Asynchronous timing is limited to data rates up to 20 kb/s. When asynchronous timing is used, the following menus are provided to set the character length, parity, and stop bits. The character format should be consistent with the character format used by the equipment being tested.

Table 5-1
Internal RS-232-C/V.24 and MIL-STD-188C
Data Interface Connector Pin Assignments

Pin No.	Designations		Signal Description	Signal Direction	
	EIA	CCITT		TO DCE	TO DTE
1	AA	—	Protective Ground	Connected to chassis ground.	
2	BA	103	Transmit Data (TD)	Output	Input
3	BB	104	Receive Data (RD)	Input	Output
4	CA	105	Request to Send (RTS)	Output	Input
5	CB	106	Clear to Send (CTS)	Input	Output
6	CC	107	Data Set Ready (DSR)	Input	Output
7	AB	102	Signal Ground	Connected to signal ground.	
8	CF	109	Receive Line Signal Detector (RLSD)	Input	Output
15	DB	114	Transmit Clock, DCE source (TC)/ Send Timing (ST)	Input	Output
17	DD	115	Receive Clock, DCE source (RC)	Input	Output
20	CD	108/2	Data Terminal Ready (DTR)	Output	Input
22	CE	125	Ring Indicator (RI)	Output	Input
24	DA	113	Transmit Clock, DTE source (XTC)/ Terminal Timing (TT)	Output	Input

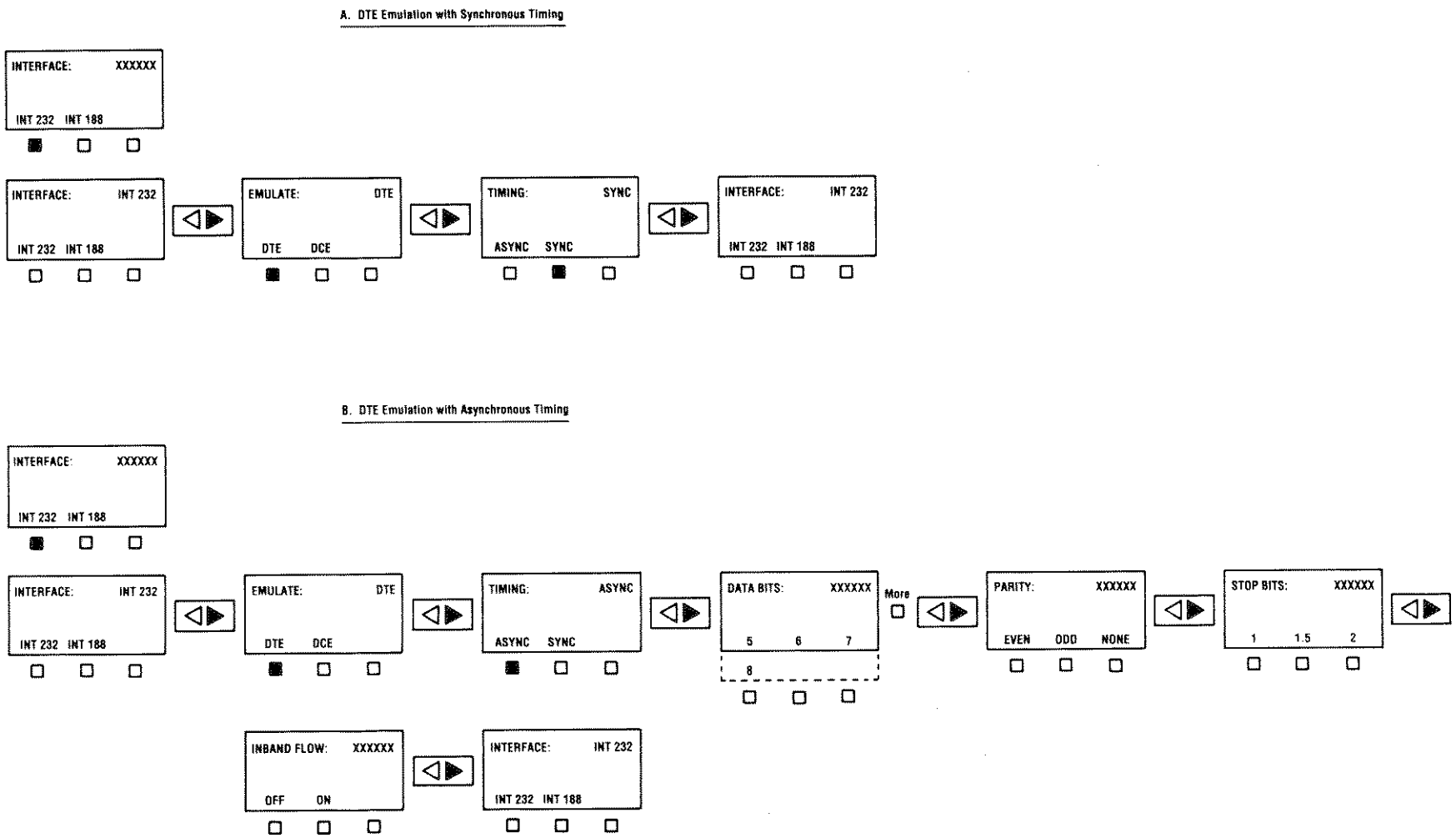


Figure 5-1
Internal RS-232 Interface Menu Configured for DTE Emulation

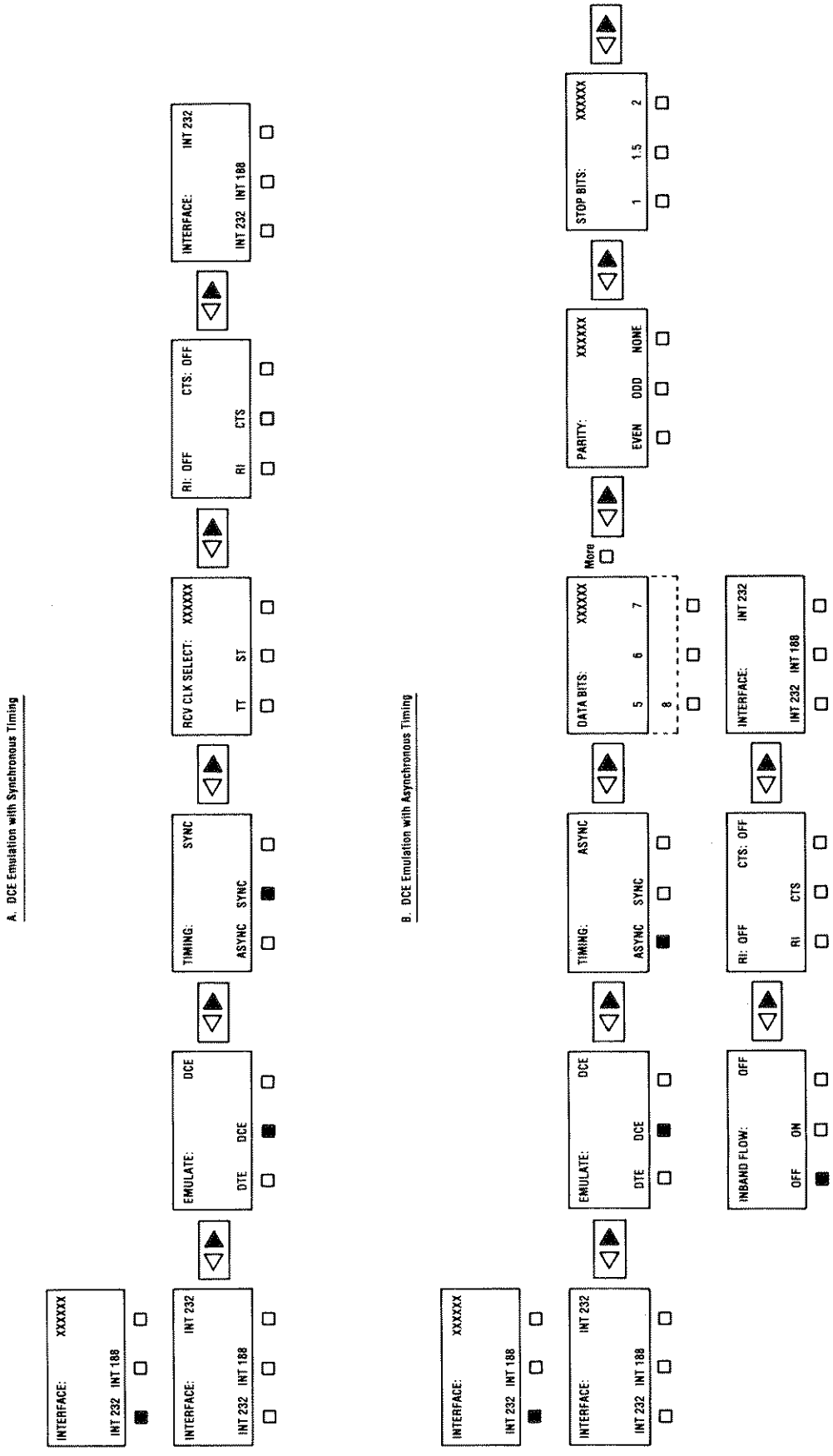


Figure 5-2
Internal RS-232 Interface Menu Configured for DCE Emulation

DATA BITS: 5/6/7/8 - This menu determines the number of bits used to create the data byte format. The bit length can be 5, 6, 7, or 8 bits long. Press the associated softkey to select the appropriate bit length. Press the MORE key to select the 8-bit format. (default = 8)

PARITY: EVEN/ODD/NONE - This menu determines the orientation of the parity bit. Parity is a form of error detection used in asynchronous data. Press the associated softkey to select the appropriate parity: EVEN, ODD, or NONE. Select EVEN when the number of ones in the data byte must be an even number. Select ODD when the number of ones in the data byte must be an odd number. Select NONE when no parity check is performed on the data. (default = NONE)

STOP BITS: 1/1.5/2 - This menu determines the number of stop bits required in the character format. Press the associated softkey to select the appropriate stop bit format: 1, 1.5, or 2. (default = 2)

SYNC - This selects the synchronous timing mode. Synchronous timing is limited to data rates up to 64 kb/s. (default = 64 kb/s)

RCV CLK SELECT: TT/ST - This menu only appears when the mainframe is emulating synchronous DCE. This menu selects the timing reference that the mainframe is synchronized to: TT (Terminal Timing), or ST (Send Timing). When TT is selected, the receiver timing source comes from Pin 24 (XTC). When ST is selected, the receiver timing source is the mainframe generator clock that is sent out on Pin 15 (TC). (default = TT)

IN BAND FLOW: OFF/ON - This menu controls the in-band flow control of the mainframe only when configured for asynchronous timing. Press the appropriate softkey to turn the in-band flow control ON or OFF. When enabled (ON displayed), XON (11 Hex) and XOFF (13 Hex) control data flow. Press OFF to disable flow control. (default = OFF)

RI: OFF/ON CTS: OFF/ON - This menu controls the operation of the RI (Ring Indicator) lead (Pin 22) and the operation of the CTS (Clear to Send) lead (Pin 5) only when the mainframe is configured for DCE emulation. Press the RI softkey to toggle the RI lead ON and OFF. ON equals a logic HIGH. OFF equals a logic LOW. Press the CTS softkey to toggle the CTS lead ON and OFF. ON equals a logic HIGH. OFF equals a logic LOW. This menu only appears when the mainframe is configured for DCE emulation.

5.3.3 MIL-188C Interface Menus

With the INTERFACE home menu displayed (INTERFACE: XXXXXX), pressing the softkey labeled INT188 selects the internal MIL-STD-188C Interface and displays the selection on the top line of the SETUP display, INTERFACE: INT188. Pressing the right SETUP SELECT switch displays the first INT188 Interface menu, EMULATE: DTE/DCE. The mainframe emulation (DTE or DCE) and timing (ASYNC or SYNC) determines the number and sequence of the menus displayed in the INT188 Interface menu as shown in Figures 5-3 and 5-4. Figure 5-3 shows the menu sequence when the mainframe is emulating DTE with either synchronous or asynchronous timing selected. Figure 5-4 shows the menu sequence when the mainframe is emulating DCE with either synchronous or asynchronous timing selected. Each of the internal MIL188C Interface menus and parameters is identical to the RS-232-C Interface menus except for the addition of the Signaling Polarity menu (SIGNALING: ON = NEG/POS). Refer to Section 5.3.2 for descriptions of the other menus.

SIGNALING: ON = POS/NEG - This menu only appears in the MIL188C Interface menu. It controls the polarity of the interface signaling control leads (RTS, CTS, DSR, RLSD, DTR, and RI). Press the appropriate softkey to set ON equal to POS (positive) or NEG (negative) polarity. Selecting ON = POS sets the ON condition to a positive value and an OFF condition to a negative value. Selecting ON = NEG sets the ON condition to a negative value and an OFF condition to a positive value.

5.3.4 Operating as Synchronous DTE

To configure the mainframe for synchronous DTE operation, select the INT232 (INT188) Interface menu from the INTERFACE category, set the EMULATE menu to DTE, and the TIMING menu to SYNC. Connect the interface cable to the TO DCE connector on the rear panel. Refer to Table 5-1 to verify connector pin assignments. Figure 5-5 illustrates a simplified block diagram of the FIREBERD 4000 emulating synchronous DTE. The diagram shows the relationship between the generator clock, test pattern generator, receiver, transmit and receive data, and clock leads.

The GENERATOR CLOCK category determines which clock source is used during testing: internal (INTRNL), interface (INTF), or external (BNC). Refer to Section 4.5 for additional information on setting the generator clock frequency. With the GENERATOR CLOCK set to INTRNL, the mainframe supplies the clock source from the internal generator clock, which is used to generate the test pattern on Pin 2

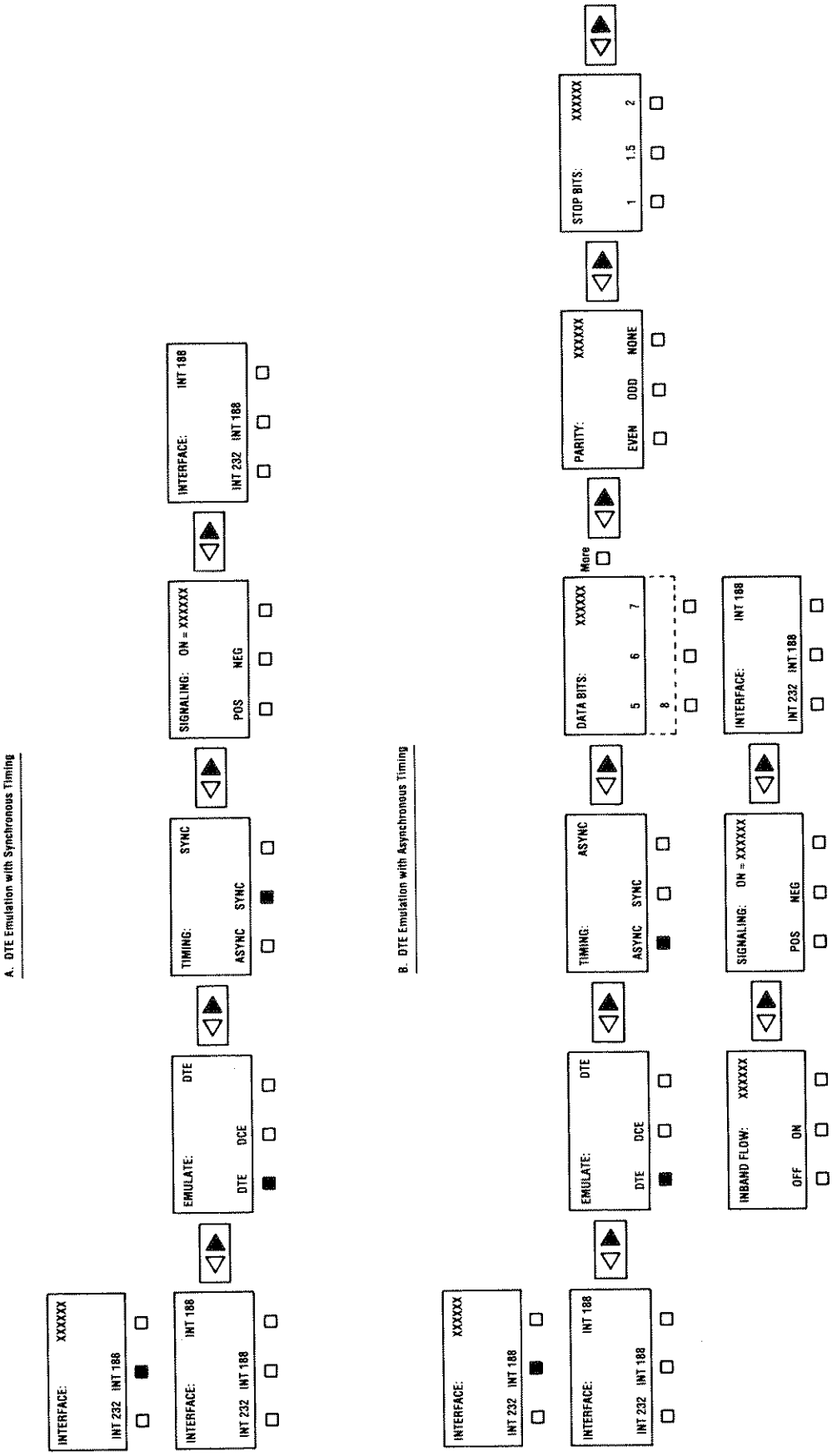


Figure 5-3
Internal MIL188C Interface Menu Configured for DTE Emulation

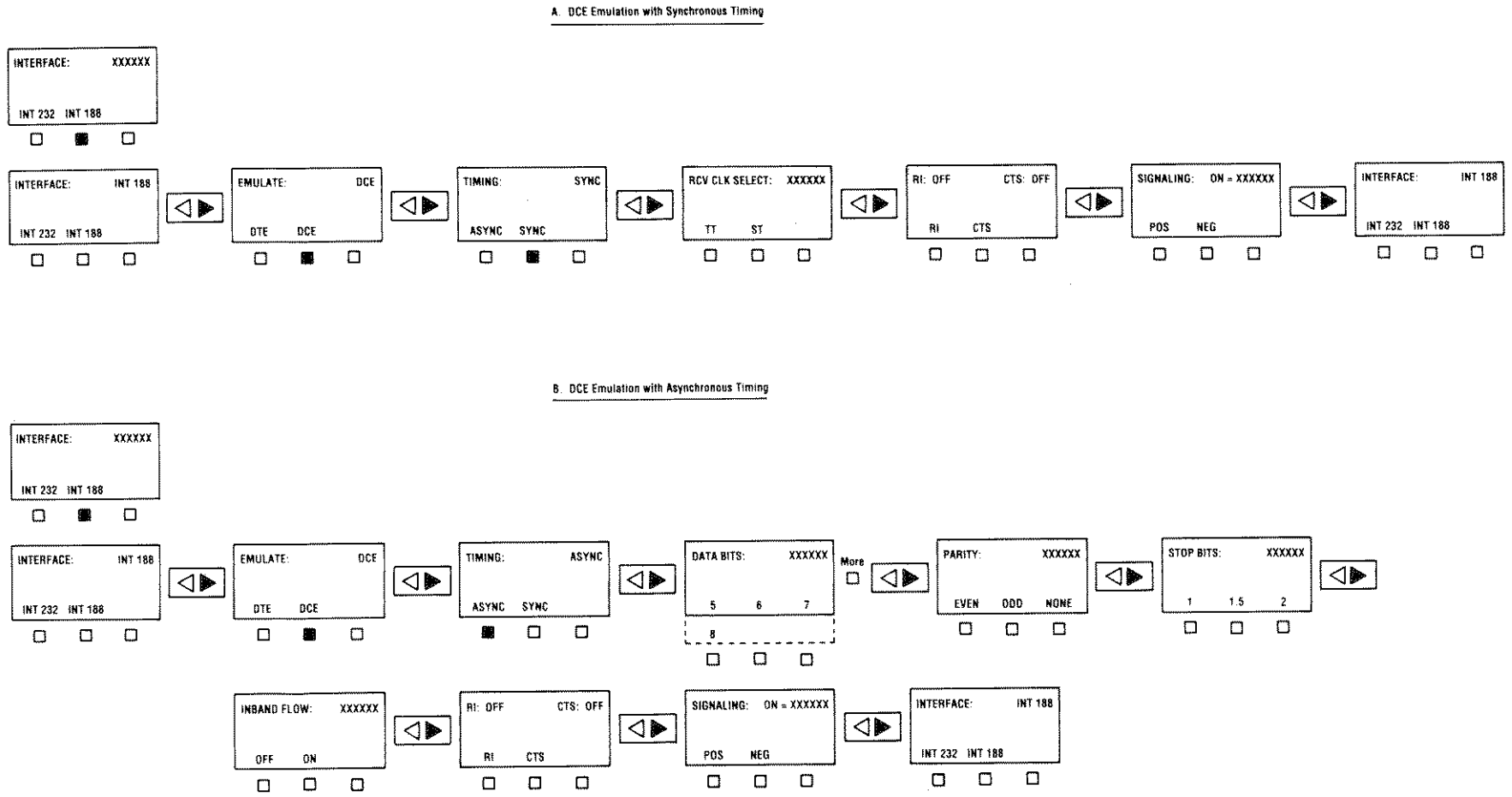


Figure 5-4
Internal MIL188C Interface Menu Configured for DCE Emulation

(Transmit Data), and supplies the external transmit clock on Pin 24 (Transmit Clock, DTE source). The DCE transmit clock on Pin 15 (Transmit Clock, DCE source) is ignored when the internal mainframe clock is used.

With the GENERATOR CLOCK set to INTF, the clock on Pin 15 is used as the transmit timing source for transmitting the test pattern on Pin 2. It also supplies the external transmit clock on Pin 24. Typically, the DCE supplies transmit timing to the DTE on Pin 15 and the DTE (FIREBERD) generates the data (test pattern) from that clock and redistributes the timing signal on Pin 24 to the DCE. Setting the GENERATOR CLOCK for INTF is the recommended selection when the FIREBERD is emulating DTE.

With the GENERATOR CLOCK set to BNC, the mainframe is supplied with the clock source through the GEN CLK IN connector on the rear panel. The GEN CLK IN clock functions the same as the internal generator clock.

The received data is clocked in on Pin 3 (Receive Data) with the receive clock from the DCE on Pin 17 (Receive Clock) supplying the timing. Signal analysis is performed on the received data and received clock signals. Refer to Section 4.12 for information concerning signal analysis results.

Any test pattern, except FOX and USER1-3 (Option 4006 is required for synchronous transmissions), can be selected through the PATTERN SETUP category to test the DCE. Refer to Section 4.6 for additional information on test patterns.

During DTE emulation, the Interface Status and Control panel switches control RTS (Request To Send) and DTR (Data Terminal Ready) by turning the leads off and on. The status of RLSD (Receive Line Signal Detector), DSR (Data Set Ready), and CTS (Clear To Send) is monitored and displayed on the front panel.

5.3.5 Operating as Synchronous DCE

To configure the mainframe for synchronous DCE operation, select the INT232 (INT188) Interface menu from the INTERFACE category, set the EMULATE menu to DCE, and the TIMING menu to SYNC. An additional step is required to select the timing source used to clock in the transmitted data (Pin 2). Connect the interface cable to the TO DTE connector on the rear panel. Refer to Table 5-1 to verify connector pin assignments. Figure 5-6 illustrates a simplified block diagram of the FIREBERD 4000 emulating synchronous DCE. The diagram shows the relationship between the generator clock, test pattern generator, receiver, transmit and receive data, and clock leads.

The GENERATOR CLOCK category determines which clock source is used during testing: internal (INTRNL), interface (INTF), or external (BNC). Refer to Section 4.5 for additional information on setting the generator clock frequency. The generator clock is used to clock out the received data test pattern on Pin 3 and generate the receive clock on Pin 17. The interface RCV CLK SELECT menu determines which timing lead is used to clock in the transmitted data on Pin 2: TT (Terminal Timing, Pin 24) or ST (Send Timing, Pin 15).

With the GENERATOR CLOCK set to INTRNL and the RCV CLK SELECT menu set for TT, the mainframe supplies the clock source from the internal generator clock to generate the test pattern on Pin 3 (Receive Data), the Receive Clock (RC) on Pin 17, and the ST clock on Pin 15. The TT clock on Pin 24 is used to clock the transmitted data in on Pin 2 where the mainframe can analyze the clock and data signals (see Section 4.12). When the RCV CLK SELECT menu is set for ST, the transmitted data is clocked in on Pin 2 using the internal clock generator as the timing source.

With the GENERATOR CLOCK set to INTF and the RCV CLK SELECT menu set for TT, the DTE supplies the clock source on Pin 24 to generate the test pattern on Pin 3 (Receive Data), the Receive Clock (RC) on Pin 17, and the ST clock on Pin 15. The TT clock on Pin 24 is also used to clock in the transmitted data on Pin 2 where the mainframe can analyze the clock and data signals (see Section 4.12).

With the GENERATOR CLOCK set to BNC, the mainframe is supplied with the clock source through the GEN CLK IN connector on the rear panel. The GEN CLK IN clock functions the same as the internal generator clock.

Any test pattern, except FOX and USER1-3 (Option 4006 is required for synchronous transmissions), can be selected through the PATTERN SETUP category to test the DTE. Refer to Section 4.6 for additional information on test patterns.

During DCE emulation, the Interface Status and Control panel switches control RLSD (Receive Line Signal Detector) and DSR (Data Set Ready) by turning the leads off and on. The status of RTS (Request to Send) and DTR (Data Terminal Ready) is monitored and displayed on the front panel.

5.3.6 Operating as Asynchronous DTE/DCE

To configure the mainframe for asynchronous DTE/DCE operation, select the INT232 (INT188) Interface menu from the INTERFACE category, set the EMULATE menu to DTE/DCE, and the TIMING menu to ASYNC (see Figures 5-1 through 5-4). When ASYNC is selected, the menus for setting

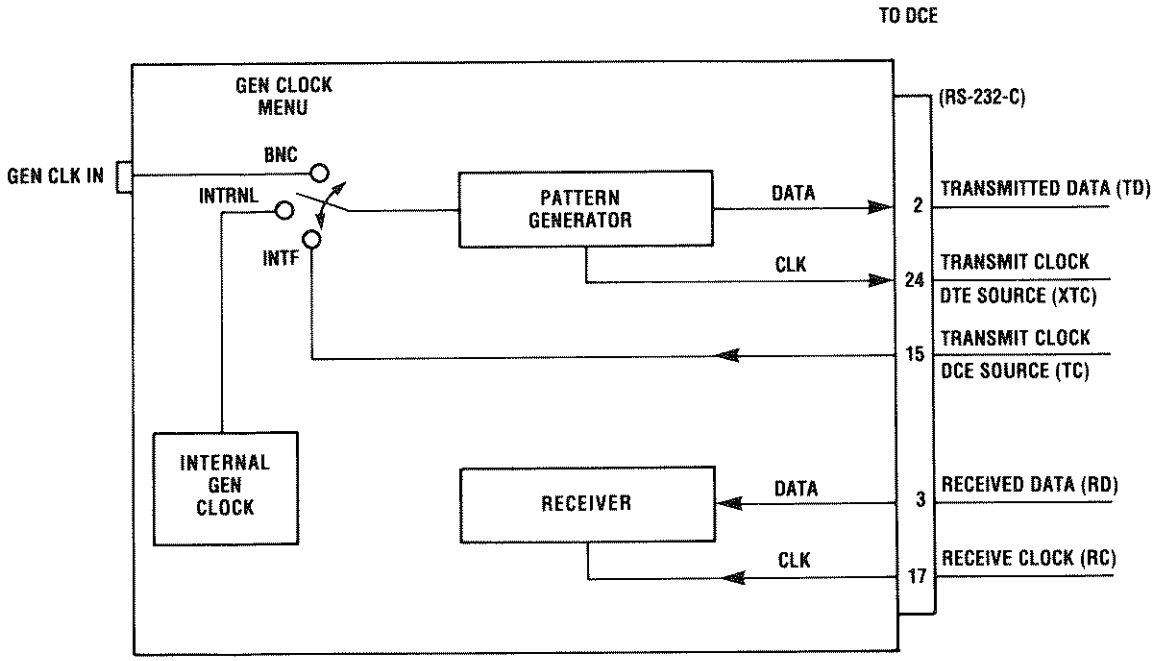


Figure 5-5
Block Diagram of the FIREBERD Emulating Synchronous DTE

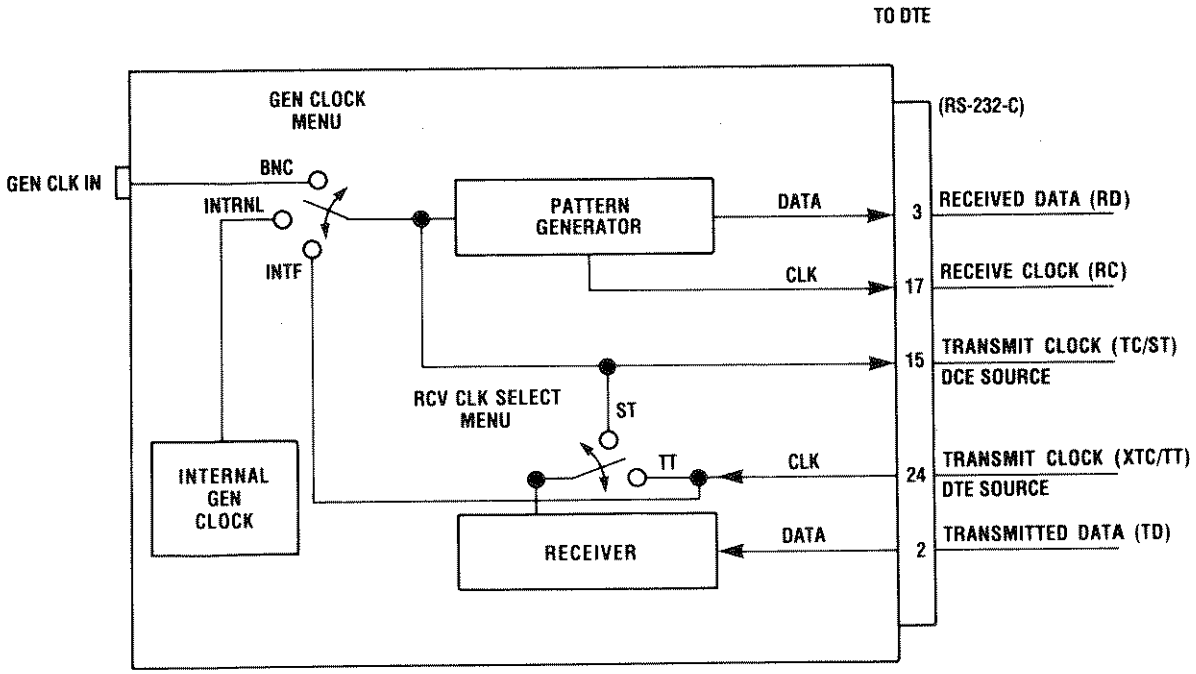


Figure 5-6
Block Diagram of the FIREBERD Emulating Synchronous DCE

the number of data bits (5, 6, 7, or 8), parity (EVEN, ODD, or NONE), and stop bits (1, 1.5, or 2) are available by pressing the SETUP SELECT switch (right arrow). These parameters need to match the parameters of the equipment being tested. In-band flow control (XON/XOFF) is selectable for both DTE and DCE emulation (menu displayed after interface stop bit menu). RI and CTS lead control is available with DCE emulation. Connect the interface cable to the rear panel TO DCE/TO DTE connector. Refer to Table 5-1 to verify connector pin assignments.

The FIREBERD 4000 can emulate asynchronous DTE/DCE through the internal RS-232-C and MIL-188C Interfaces and operate from 50 b/s to 20 kb/s. Set the GENERATOR CLOCK to INTERNAL and select the appropriate clock frequency to match the required data rate. Do not use the INTF or BNC selections when operating asynchronously. Refer to Section 4.5 for additional information on setting the generator clock frequency.

To select the desired test pattern, press the SETUP CATEGORY switch to select the PATTERN category, then press the appropriately labeled softkey. Press the MORE key as required. The following patterns are valid in asynchronous testing: MARK, SPACE, 1:1, 63, 511, 2047, 2^{15}-1, FOX, and USER1-3. If any other pattern is selected, ASYNC PATTERN CONTENTION flashes in the ANALYSIS RESULTS display. Refer to Section 4.6 for additional information on test patterns.

During DCE emulation, the Interface Status and Control panel switches control RLSD (Receive Line Signal Detector) and DSR (Data Set Ready) by turning the leads off and on. The status of RTS (Request to Send) and DTR (Data Terminal Ready) is monitored and displayed on the front panel. During DTE emulation, the Interface Status and Control panel switches control RTS (Request To Send) and DTR (Data Terminal Ready) by turning the leads off and on. The status of RLSD (Receive Line Signal Detector), DSR (Data Set Ready), and CTS (Clear To Send) is monitored and displayed on the front panel.

5.3.7 Operating in the Self-Loop Mode

In DTE emulation, the self-loop mode loops the TD lead (Pin 2) to the RD lead (Pin 3) and the XTC lead (Pin 24) to the RC lead (Pin 17). Timing can be provided by the DCE on Pin 15 (GENERATOR CLOCK set to INTF), the internal generator clock (GENERATOR CLOCK set to INTRNL), or the rear panel GEN CLK IN connection (GENERATOR CLOCK set to BNC).

In DCE emulation, the self-loop mode loops the RD lead (Pin 3) to the TD lead (Pin 2) and the RC lead (Pin 17) to the XTC lead (Pin 24). Timing can be provided by the internal generator clock (GENERATOR CLOCK set to INTRNL) or the rear panel GEN CLK IN connection (GENERATOR CLOCK set to BNC). User connections do not have to be disconnected to perform the self-loop test.

5.3.8 Internal RS-232-C and MIL-188C Interface Specifications

Refer to Section 8, Specifications, for the internal EIA RS-232-C and MIL-STD-188C Data Interface specifications.

5.3.9 Analysis Results

Refer to Section 4.12 for information on displaying the results categories and what results are displayed in each category. Refer to Appendix B for a list of analysis results that apply to the internal RS-232-C and MIL-188C Data Interfaces. Definitions for the results are provided in Appendix C.

5.4 ISU 6000 INTERFACE SWITCHING UNIT

The ISU-6000 Interface Switching Unit is a rack-mountable unit that is capable of accommodating up to four data interface modules. Installing four interface modules in an ISU-6000 expands the number of FIREBERD 4000 mainframe interfaces from three (since one interface slot is required for the ISU connector) to six (or seven, if the optional SLOT 2 is installed). Two ISU-6000s may be daisy chained together, providing control over eight interfaces from one interface slot. If the optional interface slot (Option 4001) is installed, it is possible to daisy chain four ISU-6000s together (using the two FIREBERD 4000 interface slots), providing a maximum of 18 interfaces (16 external and 2 internal) for control by one FIREBERD 4000 mainframe.

Any one of the four interfaces installed in the ISU-6000 can be placed under mainframe control at a time. This expands the flexibility of the FIREBERD 4000 mainframe and eliminates the need for removing and installing interface modules in Slot 1 and Slot 2 (if installed). Selection of the desired interface is controlled from the FIREBERD 4000 INTERFACE category.

5.4.1 FIREBERD 4000 and ISU-6000 Installation Procedures

Refer to the ISU-6000 Interface Switching Unit Operating Manual for the ISU-6000 installation options. The following procedures apply specifically to installing three or four ISU-6000s in a daisy chain configuration.

NOTE: When installing the ISU-6000, it is important to remember that the interface adaptor cable is only 3 feet (0.9m) long.

(1) Ensure that power to the FIREBERD 4000 mainframe and the ISU-6000s is OFF before changing interfaces or cable connections.

(2) Set the UNTERM/TERM switch, located on the top of the ISU-6000, to the proper position.

When installing one ISU-6000 on a single cable interface adaptor, set switch to the TERM position.

When installing one ISU-6000 on a dual cable interface adaptor, set the switch to TERM when connected to the end cable connections and UNTERM when connected to the middle cable connections.

When installing two ISU-6000s on a dual cable interface adaptor, set the switch to TERM on the ISU connected to the end cable connections and UNTERM on the ISU connected to the middle cable connections.

(3) Install up to four interface modules in each ISU-6000. Make sure the interface panel is flush with the ISU frame before turning the thumbscrews clockwise to secure the interface in the ISU-6000.

(4) Connect the dual multipin connector to the ISU-6000(s) and then route the interface adaptor module to the FIREBERD 4000 SLOT 1 or SLOT 2 (if installed).

NOTE: If more than 2 ISU-6000s are being interconnected, repeat steps 1 through 4 for the remaining ISU-6000s.

(5) Make sure the interface adaptor is properly mated with the mainframe slot and secured by rotating the two thumbscrews clockwise, until finger tight.

(6) Connect the power cords from the ISU-6000(s) and the FIREBERD 4000 to a suitable AC power source.

(7) Turn the ISU-6000 and FIREBERD 4000 power switches to the ON position.

5.4.2 Operating the FIREBERD 4000 with the ISU-6000

The ISU-6000 serves to extend the FIREBERD 4000 interface handling capabilities by interconnecting as many as 16 additional interfaces with the FIREBERD. The following steps describe the procedures for accessing and controlling the ISU-6000 with the FIREBERD.

(1) With the power turned on to both the FIREBERD 4000 and ISU-6000(s), press the SETUP CATEGORY switch to select the INTERFACE category. Verify that the interface selections are visible in the SETUP panel display. The MORE key illuminates if more than one ISU-6000 is installed. The softkey labels, ISU1, ISU2, ISU3, and ISU4, identify the ISUs attached to the mainframe.

NOTE: When the ISUs are connected to SLOT 1, the INTERFACE menu labels identify the ISUs as ISU1 and ISU2, and when connected to SLOT 2, the labels identify the ISUs as ISU3 and ISU4.

(2) Press the corresponding softkey to select the desired ISU-6000. When the desired ISU is selected, the softkey labels identify the data interface modules installed in the selected ISU. Press the MORE key to display and select the interface in the fourth ISU slot.

(3) Press the corresponding softkey to select the desired interface. The selected interface label appears on the top line of the SETUP display.

NOTE: If the selected interface has a menu, press the right SETUP SELECT switch to display the first menu for that interface. If the interface does not have a set-up menu, configure the interface with the interface panel switches.

(4) To select another ISU or interface slot, press the HOME key to return to the home INTERFACE menu and repeat the procedure.

Table 5-2
FIREBERD 4000 Data Interfaces

Model#	Manual Number	Menu/ Switch Control	Interface Label	Description
40380	ML10522	Switch	2.048M	CCITT G.703 2048 kb/s Data Interface - Meets CCITT Recommendation G.703 to test communications equipment operating at 2048 kb/s.
40323	ML10422	Switch	G.703	CCITT G.703 64 kb/s Co-Directional Data Interface - Meets CCITT Recommendation G.703 to test co-directional communications equipment operating at 64 kb/s.
30608	ML10898	Menu	64G703	CCITT G.703 64 kb/s Data Interface - Meets CCITT Recommendation G.703 to test either co-directional or contra-directional communications equipment operating at 64 kb/s.
30524	ML10706	Menu	8MG703	CCITT G.703 8448 kb/s Data Interface - Meets CCITT Recommendation G.703 to test communications equipment operating at 8448 kb/s.
30609	ML10899	Menu	2MG704	CCITT G.704 2048 kb/s Data Interface - Meets CCITT Recommendations G.703 and G.704 to test communications equipment operating at 2048 kb/s.
30481	ML10633	Menu	DS0	DDS DS0/DS0A Data Interface - Meets Bellcore and AT&T requirements for testing Digital Data Service (DDS) equipment operating at DS0 (64 kb/s) and DS0A (2.4, 4.8, 9.6, and 56 kb/s) data rates.
30678	ML11033	Menu	DS0A/B	DDS DS0A/DS0B Data Interface - Meets Bellcore and AT&T requirements for Digital Data Service (DDS) testing at DS0 (64 kb/s), DS0A (2.4, 4.8, 9.6, 19.2, and 56 kb/s), and DS0B (2.4, 4.8, and 9.6 kb/s) data rates over all DDS circuits.
40365	ML10451	Switch	T1	DS1/T1 (Unframed only) with APS Data Interface - Meets AT&T, Bellcore, and CCITT T1 1544 kb/s specifications to test unframed DS1/T1 communications equipment. It can perform APS (automatic protection switching) testing, and bipolar violation insertion.
40405	ML10552	Switch	DS1/D4	DS1/T1/D4 Data Interface - Meets AT&T, Bellcore, and CCITT recommendations to test DS1/T1/D4 communications equipment operating at 1544 kb/s.
40460	ML11034	Menu	DS1/Fe	DS1/T1/D4/ESF Data Interface - Meets AT&T, Bellcore, and CCITT specifications for T1 (DS1) 1544 kb/s, and AT&T PUB54016 specifications for extended superframe (ESF) circuits.
40540	ML11035	Menu	DS1/T1	DS1/T1/D4/ESF/SLC-96 Data Interface - Meets AT&T, Bellcore, CCITT specifications for T1 (DS1) 1544 kb/s, AT&T PUB54016 specifications for extended superframe, and AT&T specifications for Subscriber Loop Carrier (SLC) circuits.
30447A	ML10980	Switch	DS1C/2	DS1C/DS2 Data Interface - Meets AT&T and Bellcore DSX-1C, DSX-2 or DS2H interface specifications to test data communications systems operating at DS1C (3152 kb/s) and DS2 (6312 kb/s) data rates.

Table 5-2
FIREBERD 4000 Data Interfaces (Continued)

Model#	Manual Number	Menu/ Switch Control	Interface Label	Description
—	ML11063	Menu	INT188	Internal MIL-188C Data Interface - Meets MIL-STD-188C specification for testing synchronous (up to 64 kb/s) and asynchronous (up to 20 kb/s) circuits. Interface is built into the mainframe.
—	ML11063	Menu	INT232	Internal RS-232-C Data Interface - Meets EIA-RS-232-C specification for testing synchronous (up to 64 kb/s) and asynchronous (up to 20 kb/s) circuits. Interface is built into the mainframe.
40204	ML11037	Switch	LAB	Lab (TTL) Data Interface - Tests a wide variety of data handling devices. It provides BNC connections for received data and clock inputs, transmit data and clock outputs, and an external transmit clock input operating from 50 Hz to 15 MHz, with bipolar or unipolar balanced or unbalanced data. It can also control the clock and data phasing and match a number of input and output impedances.
40298	ML10511	Switch	MILBAL	MIL188-114 Balanced Data Interface - Meets MIL-STD-188-114 bipolar balanced specification.
40226	ML11267	Switch	MILUNB	MIL188C/MIL188-114 Unbalanced Data Interface - Meets MIL-STD-188-114 bipolar unbalanced and MIL-STD-188C specifications.
40236	ML11036	Switch	RS-232	RS-232 Sync DTE/DCE Data Interface - Meets EIA RS-232-C and CCITT Recommendation V.24 interface standards for testing synchronous DTE and DCE.
40232	ML11039	Switch	RS-232	RS-232 Sync/Isoch DTE Data Interface - Meets EIA RS-232-C and CCITT Recommendation V.24/V.28 interface standards for testing synchronous (up to 20 kb/s) and isochronous (up to 9.6 kb/s) circuits.
40392	ML10524	Switch	RS-232	RS-232/V.24/MIL188C DTE/DCE Data Interface - Meets EIA RS-232-C, MIL-STD-188C, and CCITT Recommendation V.24 interface standards for testing asynchronous circuits.
40200	ML11032	Switch	RS-449	RS-449 (422/423) DTE/DCE Data Interface - Meets EIA RS-449, EIA RS-422, and EIA RS-423 standards and CCITT Recommendations V.10 and V.11. Three modes of operation are provided: RS-423/V.10 (unbalanced), RS-422/V.11 (balanced) terminated, and RS-422/V.11 (balanced) unterminated.
40202	ML11031	Switch	V.35	V.35/306 DTE/DCE Data Interface - Meets CCITT V.35 Recommendation and AT&T PUB41304 for 306-type wideband data set and PUB41450 for DDS data service unit (DSU) specifications.
40182	ML11038	Switch	WEC303	WECO 303 Data Interface - Meets AT&T PUB41302 specifications for testing 303-type wideband data stations.

Table 5-2
FIREBERD 4000 Data Interfaces (Continued)

Model#	Manual Number	Menu/ Switch Control	Interface Label	Description
41131	ML11319	Menu	DDS	DDS LOCAL LOOP Interface- Meets requirements for testing DDS equipment connections to the local loop. Analysis at 2.4 to 56 kb/s with secondary channel catpability.
41400	ML 11623	Menu	RS-449/ MIL	RS-449/MIL Data Interface - Meets EIA RS-449/RS-530/RS-422/RS-423, MIL-STD-188-114, and MIL-STD-188C specifications. It can be configured as either a DTE or DCE device through the interface set-up menu and without a crossover cable.
41440	ML 11668	Menu	T1/FT1	FRACTIONAL T1 Interface - Tests full T1, fractional T1 (N x 64 or N x 56 contiguous or non-contiguous), or voice circuits, DSO Drop & Insert.

SECTION 6
PRINTER OPERATION

6.1 INTRODUCTION

This section describes how the FIREBERD 4000 can print a variety of printouts using the TTC PR-45 thermal printer, an RS-232-C compatible serial printer, or an IEEE-488 compatible printer. The set-up and operation of the mainframe, PR-45 printer, and the RS-232 Printer/Controller Interface and optional IEEE-488 Interface for printer operation are discussed in this section.

The FIREBERD 4000 can generate printouts of analysis results, current mainframe switch and menu settings, and status messages. The analysis results printouts can be initiated: (1) by setting a time interval (e.g., every 15 minutes); (2) in response to a specific error result (e.g., BIT ERRS); or (3) on demand (press PRINTER Control panel RESULTS switch). The configuration of the mainframe switch and menu settings can only be printed on demand (press PRINTER Control panel CONTROLS switch). Reportable status messages can be turned on and off through a menu selection (e.g., PAT SYNC ACQUIRED). All printouts are time stamped to provide a historical record of the test. The printout formats, printer set-up, and interface configurations are controlled from the AUXILIARY SETUP category. Printer control is provided through the PRINTER Control panel.

When configuring a printer with the FIREBERD 4000 consider the following conditions:

- If the IEEE-488 Printer/Controller Interface is used and set for Talk-Only mode, all printouts go to the IEEE-488 Interface.
- If the RS-232 Printer/Controller Interface is used and no remote control device is installed or on-line, all printouts go to the RS-232 Printer/Controller Interface.

6.2 COMPATIBLE PRINTERS

The FIREBERD 4000 can drive the TTC PR-45 thermal printer through the front panel printer connector. With the standard RS-232 Printer/Controller Interface, the FIREBERD 4000 can operate with the TTC PR-40, PR-40A, PR-85, PR-2000 or most serial EIA RS-232-C compatible printers. IEEE-488 compatible printers can also be used when the optional IEEE-488 Remote Control/Printer Interface (Option 4002) is installed.

6.3 FIREBERD PRINTER CONTROL PANEL

The FIREBERD PRINTER control switches control the occurrence of a printout. The control panel has three pushbutton switches: Print Event, RESULTS, and CONTROLS. Printouts are initiated by pressing the PRINTER Control panel RESULTS or CONTROLS switch or upon the occurrence of one of the print events enabled by the Print Event switch. The format and items listed in results and controls printouts are controlled through the AUXILIARY SETUP category RESULT PRINT and PRINTER menus.

6.3.1 PRINTER Print Event Switch

The Print Event switch turns the mainframe printer output on and off and selects when a test results printout occurs:

- **15 MIN** - Prints test results every 15 minutes. When the 15 MIN print event is selected, the results printouts are identified by the header 15 MIN PRINT.
- **1 HR** - Prints test results every hour. When the 1 HR print event is selected, the results printouts are identified by the header 1 HOUR PRINT.
- **ERROR** - Prints test results when any of the following errors occur: bit errors, block errors, BPV errors, code errors, frame errors, frame alignment signal errors, CRC errors, and pattern slips. When the ERROR print event is selected, the results printouts are identified by the header ERROR PRINT. An error printout is generated every 6 hours regardless of any errors counted.
- **AUX SETUP** - Prints test results according to the set-up of the Auxiliary Print Event menu.
- **OFF** - Turns off the automatic results printouts and the status message printouts (see Section 6.4.3). The manual printouts (pressing RESULTS or CONTROLS switch) are still available.

6.3.2 PRINTER RESULTS Switch

The RESULTS switch can be pressed at any time to generate a current test results printout. When the RESULTS switch is pressed, the results printouts are identified by the header MANUAL PRINT. Refer to Section 6.4.2 for information on the results printouts format and contents.

6.3.3 PRINTER CONTROLS Switch

The CONTROLS switch can be pressed at any time to generate a controls printout of the current mainframe front panel and interface switch and menu configurations. The mainframe controls printout lists the current state of all FIREBERD mainframe controls, switches, and menus. When applicable, the states of the interface controls are also listed. The printout provides enough information to reconfigure the mainframe for a specific test set-up. The controls printout includes the condition and/or position of the PATTERN menu, ERROR INSERT, SELF LOOP, and DISPLAY HOLD switches, the GENERATOR CLOCK source and frequency (as required), the SETUP program being used (selected from RECALL/STORE menu), the AUXILIARY SETUP menus, the selected interface, and interface configuration. Figure 6-1 shows the CONTROLS printout of the mainframe with all menus and switches set to their default settings.

```
CONTROLS PRINT          02:49:42 01 FEB 90
PATTERN        2 15-1   ERROR INSERT   OFF
SELF LOOP          ON   GEN CLOCK   INTRNL
INT FRQ      64.0 kHz   DISPLAY HOLD   OFF
SETUP PROGRAM NO.  0
AUXILIARY SETUP
FLOW TR/DTR        OFF  FLOW DM/DSR    OFF
FLOW RS/RTS        OFF  FLOW CS/CTS    OFF
FLOW RR/RLSD       OFF  SYN LOS ACT   HALT
SYN LOS THR     NORMAL  USER SYN THR    10
BLOCK LENGTH      PATT  PRINT FMTSTANDARD
STATUS PRINTS      OFF  PRINT EVENT HSTGRM
HST SAMPLES         60  HST PERIOD    1DAY
HST FORMAT       GRAPH  HST1 AUTO DEG MIN
HST2 AUTO    GERR SEC   HST3 AUTO      SES

INTERFACE               INTERNAL RS-232
EMULATE            DTE  TIMING        SYN
DTR            OFFRTS   OFF
```

Figure 6-1
Mainframe Controls Printout

When storing front panel configurations in the RECALL/STORE SETUP category, it is recommended that a controls printout be printed for a permanent record of the configuration. To make a record of the stored configuration: configure the mainframe and interface, STORE the configuration in the RECALL/STORE SETUP category, RECALL the stored configuration, then press the CONTROLS switch to print the configuration. The SETUP PROGRAM NO. line in the controls printout identifies the recalled configuration by number (0 to 9).

6.4 AUXILIARY SETUP PRINTER MENUS

The printer menus in the AUXILIARY SETUP category establish printer output requirements, printout formats, and interface configurations.

6.4.1 Auxiliary Print Event Menu

The Auxiliary Print Event menu (**AUX PRINT EVENT: ERROR/TIMED/HSTGRM**) expands the capabilities of the PRINTER control panel by allowing variable **TIMED, ERROR,** or **HISTOGRAM** results printouts. The menu selection is activated through the PRINTER control panel by selecting the AUX SETUP function. Refer to Section 4.9.1 for instructions on operating the Auxiliary Print Event menu.

The Auxiliary Timed Print Event menu expands the fixed print event periods on the PRINTER Control panel by allowing results printouts to be generated at intervals from 1 minute (00:01) to 99 hours and 59 minutes (99:59). The timed results printouts are identified by the header AUX TIMED PRINT.

The Auxiliary Error Print Event menu allows printouts to be generated when specific errors occur. Each time the selected error occurs, a results printout is generated with the header AUX ERROR PRINT, the errors that caused the printout, the date and time when it occurred, and the results that apply to the test as shown in Figure 6-2.

```
AUX ERROR PRINT     BIT ERROR
BLOCK ERROR         11:41:37 18 AUG 89
BIT ERRS      2075  AVG BER   2.34E-04
PAT SLIP         0  BLK ERRS        63
BLOCKS         270  AVG BLER  2.3 E-01
PAT LOSS         0  PATL SEC         0
ERR SEC         33  %EFS         70.80%
TEST SEC       113  ELAP SEC       114
GEN FREQ   64000.0  RCV FREQ   64000.0
DELAY               SELF LOOP ON
IF INTERNAL RS-232
```

Figure 6-2
Standard Results Printout

The Auxiliary Histogram Print Event menu allows histogram analysis to be generated that display how selected results change with time. The collected data can then be displayed in either a graph or a listing format. Simultaneous histograms may be created for up to 3 results with each histogram printout containing up to 60 samples of the selected result. The histogram printout can be generated manually, automatically, or upon a power ON after a power fail.

Automatic Histogram Printout

To automatically generate histogram printouts when the specified number of samples have accumulated, set the AUX PRINT EVENT to HSTGRM and set the PRINTER control panel to AUX SETUP. If those conditions are met, all three histograms will print in the desired format each time the specified number of samples have accumulated. The time displayed on an automatic printout reflects the time the histogram analysis began accumulating the displayed results. See Figure 6-3.

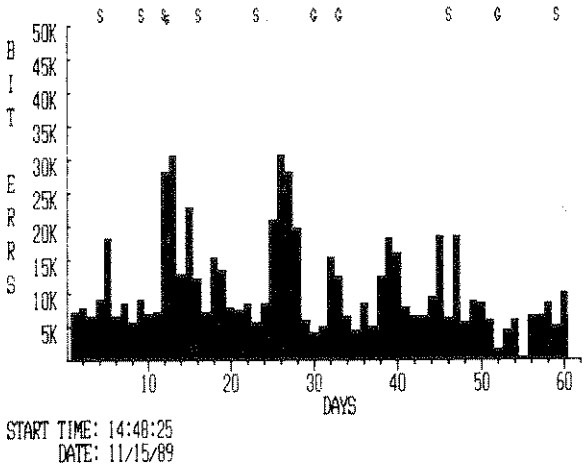


Figure 6-3
Automatic Histogram Printout

Manual Histogram Printout

The user may initiate a manual printout of a selected histogram through the use of the PRINT softkey located on the Auxiliary Histogram Print Event menu. To generate a manual print, display the selected histogram HSTGRM# on the menu status line and press the PRINT softkey. A manual print consists of the most recent (up to 60) samples collected. The time displayed on a manual printout reflects the time that the printout was initiated. A marker on the horizontal axis of the graph indicates the position of the last sample. Generating a manual print does not affect the test. See Figure 6-4.

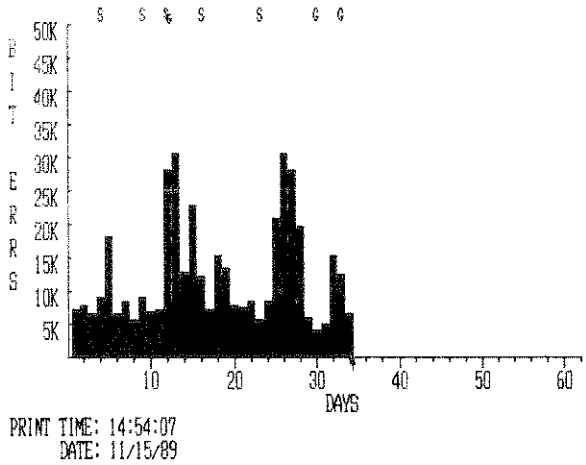


Figure 6-4
Manual Histogram Printout

Power Fail Histogram Printout

To automatically generate histogram printouts upon a power ON after a power fail, the AUX PRINT EVENT must be set to HSTGRM and the PRINTER control panel must be set to AUX SETUP. The time displayed on an Power Fail printout reflects the time the histogram analysis began accumulating the displayed results. A marker on the horizontal axis of the graph indicates the position of the last sample. Generating a Power Fail printout restarts the histogram analysis. See Figure 6-5.

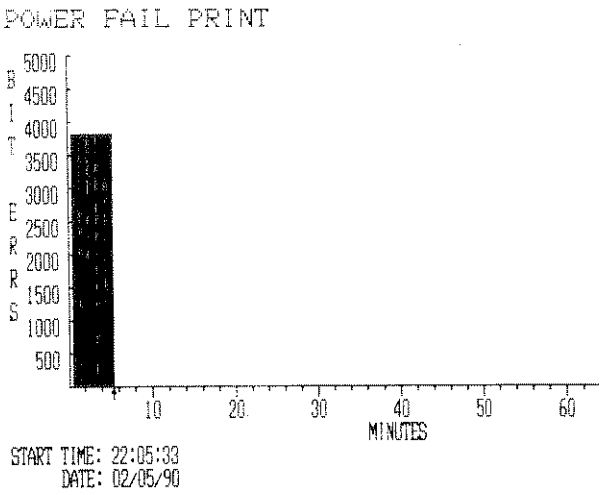


Figure 6-5
Power Fail Histogram Printout

Each histogram printout (GRAPH or LIST) contains the following information:

- The date and time. The displayed date and time are dependent on how the printout was generated.
- An "S" marks sample periods which contain sync transitions. A sync transition occurs when pattern sync is lost and then regained by the FIREBERD 4000.
- A "G" marks sample periods which contain G.821 transitions between available and unavailable time. For more information see Appendix F.
- "*" is displayed when the test has begun but the selected result has not occurred.
- **NO SAMPLES READY** displays when a manual print occurs before the sample interval is complete.
- **One or more results out of range** is printed when the total result sample exceeds the selected SCALE value.

The **HISTOGRAM GRAPH** printout shown in Figure 6-6 contains the result sampled on the vertical axis and the sample period on the horizontal axis. To generate the graph on a printer other than the PR-45 Thermal Printer, configure the selected printer in an Epson-compatible bit mapped graphics mode with the printer communications link supporting an 8 bit data transfer. For 80 column printers, set the printer width to 80. For the PR-45 printer, set the printer width to 40.

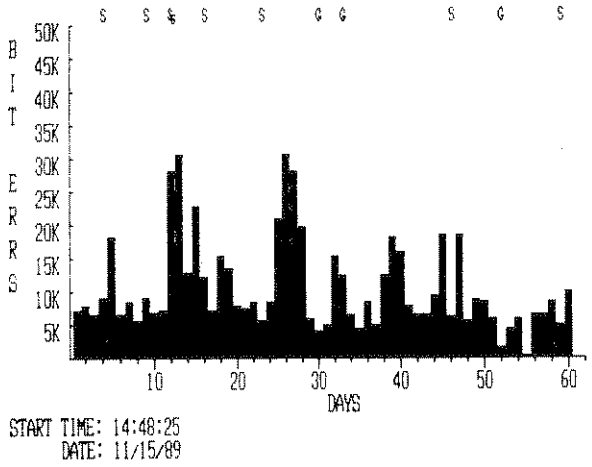


Figure 6-6
Histogram Graph Printout

The **HISTOGRAM LIST** shown in Figure 6-7 provides the sample period at the top of the list block and the sample number and result sampled head each of the data columns.

```
HISTOGRAM LIST
15:00:45 11/15/89
SAMPLE SIZE    1 DAY
SAMPLE      BIT ERRS
 1 S            9170
 2              7038
 3              7242
 4 SG          28184
 5             30880
 .
 .
 .
 .
 .
58              7573
59              6999
60              8557
```

Figure 6-7
Histogram List Printout

6.4.2 Results Printout Content Menu

The Results Printout Content menu (**RESULT PRINT: SUMM/STD/LONG**) determines the content of the analysis results printout. The results printouts can be printed in three different formats: summary (**SUMM**), standard (**STD**), or long (**LONG**). The formats are selected through the Auxiliary **RESULT PRINT: SUMM/STD/LONG** menu. Refer to Section 4.9.8 for instructions on operating the Results Printout Content menu. The following printouts were printed using the internal RS-232-C Interface in SELF LOOP.

Summary Results Printout

The **SUMM** printout shown in Figure 6-8 contains the following results:

- Date and time, selected interface, TEST SEC, ELAP SEC, GEN FREQ, RCV FREQ, and SELF LOOP status. These always appear in the Summary printout.
- Error counts (e.g., BIT ERRS) and their error ratios (e.g., BER) and averages (e.g., AVG BER) are printed when the results do not equal 0. These results appear in the printout as they apply to the interface.

- The errored and unerrored seconds results are printed when an abnormal count occurs (e.g., ERR SEC does not equal 0, G EFS does not equal AVL SEC). These results appear in the printout as they apply to the interface.

```
MANUAL PRINT          11:43:22 18 AUG 89
BIT ERRS       2087   AVG BER    2.86E-04
BER         1.00E-03  BLK ERRS         65
BLOCKS          222   AVG BLER   2.9 E-01
ERR SEC          33   %EFS          70.80%
TEST SEC        113   ELAP SEC        114
GEN FREQ    64000.0   RCV FREQ    64000.0
G EFS             80  GERR SEC         33
G %EFS       70.80%   SELF LOOP ON
IF INTERNAL RS-232
```

Figure 6-8
Summary Results Printout

Standard Results Printout

The **STD** printout shown in Figure 6-9 contains results that are applicable to the selected interface like average error rates (e.g., AVG BER) and result counters (e.g., BLOCKS, PAT SLIP, GEN FREQ). Error rate results (e.g., BER, CER, and BPV Rate) calculated during the mainframe test interval are not listed in the STD printout.

```
MANUAL PRINT          11:41:37 18 AUG 89
BIT ERRS       2075   AVG BER    2.34E-04
PAT SLIP          0   BLK ERRS         63
BLOCKS          270   AVG BLER   2.3 E-01
PAT LOSS          0   PATL SEC          0
ERR SEC          33   %EFS          70.80%
TEST SEC        113   ELAP SEC        114
GEN FREQ    64000.0   RCV FREQ    64000.0
DELAY                 SELF LOOP ON
IF INTERNAL RS-232
```

Figure 6-9
Standard Results Printout

Long Results Printout

The **LONG** printout shown in Figure 6-10 contains all the results (includes G.821 results, if option installed) that are applicable to the selected interface and the Interface Status and Control panel LED and switch status.

```
MANUAL PRINT          11:43:22 18 AUG 89
BIT ERRS       1599   AVG BER    1.67E-04
BER         1.00E-03  PAT SLIP          0
BLK ERRS         48   BLOCKS          292
AVG BLER   1.6 E-01   PAT LOSS          0
PATL SEC          0   ERR SEC          25
%EFS         83.22%   TEST SEC        149
ELAP SEC        150   GEN FREQ    64000.0
RCV FREQ    64000.0   DELAY       >9999 ms
AVL SEC         149   UNA SEC           0
%AVL SEC    100.00%   DEG MIN           0
%DEG MIN      0.00%   G EFS           124
GERR SEC         25   G %EFS       83.22%
SES               0   %SES          0.00%
EMULATE         DTE   RLSD              ON
DSR              ON   CTS               ON
RTS              ON   DTR               ON
SELF LOOP ON          IF INTERNAL RS-232
```

Figure 6-10
Long Results Printout

Overflowed Results

Overflowed results are flagged with one asterisk. Figure 6-11 shows an example of a results printout with the BLOCKS results labeled with a single asterisk indicating it has overflowed.

```
MANUAL PRINT          18:31:51 16 AUG 89
BIT ERRS     756673   AVG BER    4.99E-01
BER         5.00E-01  PAT SLIP         59
BLK ERRS           0  BLOCKS        *15151
AVG BLER    1.00E-00  PAT LOSS         36
PATL SEC          23  ERR SEC          21
%EFS           0.00%  TEST SEC         23
ELAP SEC          23  GEN FREQ      64000
RCV FREQ       64000  AVL SEC           0
UNA SEC           23  %AVL SEC      0.00%
GERR SEC           0  SES               0
%SES                  SELF LOOP OFF
IF INTERNAL RS-232
```

Figure 6-11
Overflowed Results Printout

6.4.3 Status Message Printout Menu

The Status Message Printout menu (**STATUS PRINT: ON/OFF**) controls status message printouts. The status messages are generated when specific conditions occur such as PATTERN

SYNC LOSS, FRAME SYNC LOSS, PAT SYNC ACQUIRED, etc. The status message printouts are time stamped each time they occur. The status messages can be printed only when the printer is turned on through the PRINTER control panel. Status printouts are not printed when the PRINTER Control panel print event switch is set to OFF. Refer to Section 4.9.9 for instructions on operating the Status Message Printout menu.

6.4.4 Printer Printout Format Menu

The Printer Printout Format menu **(PRINTER: WIDTH/ SPEED/TERM)** sets up the printout format. The printer output format **WIDTH** can be set for 20, 40, or 80 columns wide. The 40-column format is two sets of 20 columns each and the 80-column format is four sets of 20 columns each. The **SPEED** selection, FAST and SLOW, controls the end-of-line delay transmitted with each line. When FAST is selected, the mainframe sends the data without inter-line delays. When SLOW is selected, the mainframe sends the data with a one-half second delay between lines. Use FAST on all TTC printers, except the PR2000. SLOW is required for the TTC PR2000. The TERM selection determines the printer line terminator sent by the mainframe as it sends each line to the printer. CRLF (carriage return/linefeed), CR, and LF are available as required. Refer to Section 4.9.10 for instructions on operating the Printer Printout Format menu. This menu controls printouts going to either RS-232-C or IEEE-488 printers.

6.4.5 RS232 Printer/Controller Interface Menu

The RS232 Printer/Controller Interface menu **(RS232: 9600, 8, NONE)** sets up the RS232 Printer/Controller Interface connector data rate and format for remote control or printer operation. Refer to Section 4.9.11 for instructions on operating the RS232 Printer/Controller Interface menu. Refer to Section 6.6 for additional information on the FIREBERD 4000 printer interfaces. Refer to Section 7, Remote Operation, for specific information on remote control, set-up, and operation.

6.4.6 IEEE-488 Interface Menu

The IEEE-488 Interface menu **(IEEE488: XX, SRQ: OFF/ ON)** only appears when the optional IEEE-488 Interface is installed. The interface provides Talk-Only (printer operation) and Addressable (remote control) operating modes. The display indicates the operating mode (TO or an address) and whether service request (SRQ) signals are generated when data is available. The operating mode is controlled through the IEEE-488Interface DIP switch and the SRQ generation is selected through the IEEE488 menu. Refer to Section 4.9.12 for instructions on operating the Optional IEEE-488 Interface menu. Refer to Section 6.7 for additional information on the FIREBERD 4000 printer interfaces. Refer to Section 7, Remote Operation, for specific information on remote control set-up and operation.

6.5 OPERATING WITH THE PR-45 THERMAL PRINTER

The PR-45 thermal printer replaces the front panel cover on the standard FIREBERD 4000 (plastic case). The printer is mounted on the mainframe front panel with the hinge on the bottom front edge of the unit. When the FIREBERD is not in use the PR-45 can be closed, acting as the cover for the front panel. The power, data, and control leads are supplied through the front panel printer connector on the lower left side of the front panel (see Figure 3-1).

The PR-45 printer is a thermal dot-matrix printer that provides 40-column printouts. The data input for the printer is serial, asynchronous data, at 9600 b/s with a character format of 1 start bit, 8 data bits, no parity, and 2 stop bits.

NOTE: Do not operate the PR-45 when the cover is closed.

6.5.1 Printer Controls and Indicators

The PR-45 ON LINE and PAPER FEED pushbutton switches are the only controls on the printer. The ON LINE switch illuminates (green LED inside switch) when the printer is on line (ready to print). Press the ON LINE switch to take the printer on and off line. Pressing the PAPER FEED switch advances the paper when the printer is off line (ON LINE switch not illuminated).

6.5.2 PR-45 Printer Connector

The PR-45 printer connector is located on the lower left corner of the front panel. The connector is an 8-pin RS-232-C serial port that supplies power, control, and data leads to the PR-45 printer. This connector is connected in parallel with the RS-232 Printer/Controller Interface. If the PR-45 and RS-232 Printer/Controller Interface are both used at the same time, their interface configurations should match. The output data format is controlled through the Auxiliary RS232 and PRINTER menus **(RS232: 9600, 8, NONE** and **PRINTER: 40, FAST, CRLF)**.

6.5.3 Set-up and Operation

To set up the FIREBERD 4000 to print analysis results and controls printouts with the PR-45 thermal printer, perform the following procedure. This procedure assumes that the mainframe is already configured for the test.

(1) If the printer is not connected to the FIREBERD, turn the mainframe power OFF and plug the PR-45 connector into the FIREBERD 4000 printer connector located below the SELF LOOP switch.

(2) Press the POWER switch to apply power to the FIREBERD 4000. When power is first applied to the printer the ON LINE switch illuminates, then goes off.

(3) Press the ON LINE switch to place the printer on line. This also illuminates the green LED inside the switch.

(4) Press the SETUP CATEGORY switch to illuminate the AUXILIARY category LED.

(5) Press the left arrow on the SETUP SELECT switch several times until the Auxiliary menu **PRINTER: 40, FAST, CRLF** appears. These settings are the defaults for the PR-45. If they do not appear, press the **WIDTH** softkey to select **40**, the **SPEED** softkey to select **FAST**, and the **TERM** softkey to select **CRLF**.

(6) Press the right arrow on the SETUP SELECT switch once to select the Auxiliary menu **RS-232: 9600, 8, NONE** These settings are the defaults for the PR-45. If they do not appear, press the MORE key until the following softkey selections appear: **PR45 PR40A PR2000** Press the **PR45** softkey.

The FIREBERD 4000 is now configured for operation with the PR-45 printer. To test the printer, press the PRINTER control panel CONTROLS switch to generate a printout of the current FIREBERD switch and menu settings. If the printout is garbled, verify the Auxiliary RS232 menu settings.

If another printer is used, other than the PR-45, refer to Appendix G for a list of common default values for TTC-suppported printers.

To print current test results, press the PRINTER RESULTS switch. To print test results on a particular occurrence, press the Printer Event switch on the PRINTER control panel to select one of the following events: **15 MIN, 1 HR, ERROR**, or **AUX SETUP**. Refer to Section 6.3 for additional information on the PRINTER Control panel.

6.5.4 Loading the Printer Paper

When the printer is out of paper, the PAPER FEED switch illuminates (red LED inside switch). A 4-3/8" wide roll of thermal paper fits inside the printer paper tray. The roll cannot exceed 1-3/4" in outside diameter and 7/16" in inside diameter to accept the paper retaining rod. Perform the following procedure to load a new roll of paper.

(1) Pull any remaining paper out of the printer paper slot.

(2) Gently lift the plastic paper tray cover off the printer from the cover extractor.

(3) Pull the empty paper tube and retaining rod out of the paper tray. Slide the retaining rod out of the empty paper tube.

(4) Slide the retaining rod into the new roll of paper and remove the tape from the end of the paper. Make sure the end of the paper has a clean square cut.

(5) Position the roll of paper over the paper tray with the end of the paper coming from under the roll. When the roll is placed in the tray, the end of the paper should be at the front of the tray with the shiny side of the paper facing out and the end of the paper pointed at the mainframe front panel.

(6) Place the roll of paper (with the retaining rod in place) into the printer paper tray. Press down on each end of the roll until the retaining rod snaps into the notches on each side of the paper tray.

(7) Unroll about 3 inches of paper and loop the end of the paper toward the front of the printer. The dull side of the paper should be facing up.

(8) Look down inside the front edge of the paper tray and locate the paper feed slot located about 3/4" from the top of the printer cover.

(9) Slide the end of the paper into the slot and press the PAPER FEED switch several times until the paper is protruding through the paper slot in the top of the printer.

Refer to Section 9 to order additional rolls of paper from TTC.

6.6 OPERATING WITH RS-232 COMPATIBLE PRINTERS

6.6.1 Printers

This section covers the operation of the FIREBERD 4000 with TTC printers and most other commercially available serial RS-232-C compatible printers.

6.6.2 RS-232 Printer/Controller Interface Connection

The standard RS-232 Printer/Controller Interface is located on the lower right corner of the rear panel. The interface is configured as DCE, which allows any serial ASCII compatible printer (DTE) to be connected to the FIREBERD. The interface connection is an EIA RS-232-C, 25-pin, D-type female connector. Refer to Table 6-1 for connector pin assignments. This connector is wired in parallel with the PR-45 front panel printer connector (only on plastic mainframes). If the PR-45 printer and RS-232 Printer/Controller Interface are used at the same time, their interface configurations should match. It should be noted that the DTR lead (Pin 20) must be set HIGH by the connected printer before the FIREBERD can send any printer data.

All communications through the interface are asynchronous using the standard ASCII character format. The interface can operate at baud rates of 300, 1200, 2400, 4800, or 9600 baud. The number of data bits can be either 7 or 8. The parity can be odd, even, or none. The baud rate, data bits, and parity are controlled through the Auxiliary RS232 menu. The line terminator transmitted from the FIREBERD can be set for a carriage return (CR), linefeed (LF), or both CR and LF. The line terminator is controlled through the Auxiliary PRINTER menu. Refer to Section 6.4 for information on the AUXILIARY SETUP category printer menus.

6.6.3 Set-up and Operation

To set up the FIREBERD 4000 to print analysis results and controls printouts with RS-232 compatible printers, perform the following procedure. This procedure assumes that the mainframe is already configured for the test being carried out.

(1) If the printer is not connected to the FIREBERD, turn the mainframe power OFF and connect the printer cable to the RS-232 Printer/Controller Interface connector. A standard serial printer cable with the leads described in Table 6-1 should be used.

Table 6-1

RS-232 Printer/Controller Interface Connector Pin Assignments

Pin No.	Designations EIA	Designations CCITT	Signal Description	Commentrs
1	AA	—	Protective Ground	Connected to chassis ground.
2	BA	103	Transmit Data (TD)	Data transmitted to the FIREBERD (from printer).
3	BB	104	Receive Data (RD)	Data received from the FIREBERD (to printer).
5	CB	106	Clear to Send (CTS)	Output HIGH when the FIREBERD is ready to receive.
6	CC	107	Data Set Ready (DSR)	Output HIGH when the FIREBERD is on.
7	AB	102	Signal Ground	Connected to signal ground.
8	CF	109	Receive Line Signal Detector (RLSD)	Output HIGH when the FIREBERD is on.
20	CD	108/2	Data Terminal Ready (DTR)	Input must be HIGH before the FIREBERD can send data.

(2) Check the printer operating manual for the following information: baud rate, number of data bits, parity, number of stop bits, and the control leads used. Configure the printer to match the FIREBERD Auxiliary menu set-up.

(3) Press the POWER switches to apply power to the FIREBERD 4000 and the printer.

(4) If necessary, press the printer ON LINE switch to place it on line.

(5) On the FIREBERD, press the SETUP CATEGORY switch to illuminate the AUXILIARY category LED.

(6) Press the left SETUP SELECT switch arrow repeatedly until the Auxiliary **PRINTER** menu appears. Press the **WIDTH** softkey to set the column width (20, 40, or 80). Press the **SPEED** softkey to select FAST. Press the **TERM** softkey to select the line terminator (CR, LF, or CRLF). Configure the FIREBERD to match the printer set-up.

(7) Press the right SETUP SELECT arrow switch once to select the Auxiliary **RS-232** menu.

If one of the TTC printers is used, press the MORE key until the printer softkey labels appear: **PR45, PR40A, PR2000, PR40**, or **PR85**. Press the appropriate softkey to automatically configure the interface for the corresponding printer.

If a different printer is used, press the **BAUD** softkey to select the baud rate (300, 1200, 2400, 4800, or 9600). Press the **DATA** softkey to select the data bits used (7 or 8). Press the **PAR** softkey to select the parity (odd, even, or none). Configure the FIREBERD to match the printer set-up.

The FIREBERD 4000 is now configured for operation with the printer. To test the printer, press the PRINTER CONTROLS switch to generate a printout of the current FIREBERD switch and menu settings. If the printout is garbled, verify that the Auxiliary RS232 menu settings are correct for the printer being used.

To print current test results, press the PRINTER RESULTS switch. To print test results on a particular occurrence, press the Print Event switch on the PRINTER control panel to select one of the following events: **15MIN, 1 HR, ERROR**, or **AUX SETUP** Refer to Section 6.3 for additional information on the PRINTER Control panel.

6.7 OPERATING WITH IEEE-488 COMPAT IBLE PRINTERS

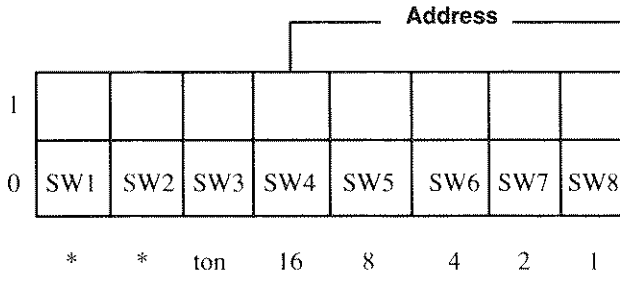
With the optional IEEE-488 Remote Control/Printer Interface installed, the FIREBERD can send data to a printer with an IEEE-488 Interface.

6.7.1 IEEE-488 Remote Control/Printer Interface

The optional IEEE-488 Remote Control/Printer Interface (Option 4002) complies with the IEEE Standard Digital Interface for Programmable Instrumentation (IEEE Std 488.1-1987). The interface offers both Talk-Only and Addressable modes. The Talk-Only mode is used to connect the FIREBERD to an IEEE-488 compatible listen-only printer. The Talk-Only mode is discussed in this section and the Addressable mode is discussed in Section 7, Remote Control.

Controls and Indicators

The interface module has an 8-segment DIP switch and an IEEE-488 compatible female connector. The DIP switch is used to select the interface mode (Talk-Only or Addressable) and the unit address when operating in the Addressable mode. The DIP switch positions are indicated in Figure 6-12.



*Not used. (1=UP=ON, 0=DOWN=OFF)

Figure 6-12
IEEE-488 Interface DIP Switch

SW 3 (labeled ton) controls the operating mode of the interface. In the UP position, the Talk-Only mode is enabled. In the DOWN position, Talk-Only mode is disabled and the Addressable mode is enabled. SW4 through SW8 are used to set the unit address in the Addressable mode (see Section 7).

NOTE: WHEN THE IEEE-488 INTERFACE IS SET FOR TALK-ONLY MODE, ALL PRINTOUTS ARE SENT TO THE IEEE-488 PRINTER, NOT TO THE RS-232 PRINTER/CONTROLLER INTERFACE OR TO THE PR-45 PRINTER.

The following IEEE-488 Interface capabilities apply to the optional TTC IEEE-488 Interface. These capabilities are listed on the interface panel as follows:

SH1	Full Source Handshake
AH1	Full Acceptor Handshake
SR1	Full Service Request Capability
RL1	Complete Remote/Local Capability
PP0	No Parallel Poll Capability
DC1	Full Device Clear Capability
C0	No Controller Capability
T5	Complete Talker Capability
L4	Complete Listener Capability without Listen Only Mode
E2	Three-state Drivers

Installing the IEEE-488 Interface

TheIEEE-488 Interface is installed in the small slot on the rear panel of the FIREBERD 4000. To install the module, remove the blank plate, slide the module into the slot, firmly press the module connector into the mainframe slot connector, and secure it with the two screws that held the blank plate in place. If the interface is removed, the blank plate must be replaced. To configure the interface to send data to a listen-only mode printer, set the DIP switch, SW3, to TALK ONLY mode (UP position).

WARNING: Turn power OFF to the FIREBERD 4000 before installing the IEEE-488 Interface.

When the FIREBERD power is turned ON for the first time, the FIREBERD tests for the IEEE-488 option, reads the interface switch positions, and clears NOVRAM.

NOTE: The mainframe menu and switch configurations must be reconfigured after the IEEE-488 option is installed.

With the interface in the Talk-Only mode, the IEEE-488 printer becomes the default printer. When the IEEE-488 Interface is set for Talk-Only mode, all printer data is transmitted to the IEEE-488 printer. The PR-45 and RS-232 Printer/Controller Interfaces are disabled. The IEEE-488 printer must be set in the listen-only mode when connected to the FIREBERD. Set the Auxiliary PRINTER menu parameters to match the printer requirements. The Auxiliary IEEE488 menu indicates the interface operating mode with TO displayed on the top line of the menu. SRQ is not required in TO mode.

6.7.2 Set-up and Operation

To set up the FIREBERD 4000 to print analysis results and controls printouts with IEEE-488 compatible printers, perform the following procedure. This procedure assumes that the mainframe is already configured for the test being carried out.

(1) If the printer is not connected to the FIREBERD, turn the mainframe power OFF and connect the printer cable to the IEEE-488 Interface connector.

(2) Check the printer operating manual for IEEE-488 operation. Configure the printer to match the FIREBERD set-up.

(3) Go to the IEEE-488 Interface on the rear panel.

(4) Set SW3 UP (1) to place the interface in the Talk-Only mode.

(5) Turn the FIREBERD 4000 power ON and go to the front panel.

(6) Press the SETUP CATEGORY switch and select the AUXILIARY category.

(7) Press the SETUP SELECT switch and locate the Auxiliary **IEEE 488** Interface menu. **TO** (Talk Only) appears in the display.

(8) Press the left SETUP SELECT arrow switch several times until the Auxiliary **PRINTER** menu appears. Press the **WIDTH** softkey to set the column width (20, 40, or 80). Press the **SPEED** softkey to select FAST. Press the **TERM** softkey to select the line terminator (CR, LF, or CRLF). Configure the FIREBERD to match the printer set-up.

(9) If necessary, press the printer ON LINE switch to place it on line.

The FIREBERD 4000 is now configured for operation with the IEEE-488 printer. To test the printer, press the PRINTER control panel CONTROLS switch to generate a printout of the current FIREBERD switch and menu settings.

To print current test results, press the PRINTER RESULTS switch. To print test results on a particular occurrence, press the Print Event switch on the PRINTER control panel to select one of the following events: **15 MIN**, **1 HR**, **ERROR**, or **AUX SETUP**. Refer to Section 6.3 for additional information on the PRINTER Control panel.

SECTION 7
REMOTE CONTROL

7.1 INTRODUCTION

This section describes how the FIREBERD 4000 can be controlled from remote devices, as well as the proper use of command syntax, definitions of remote control commands, and help menus. Remote operation is discussed in terms of which interface, RS-232-C Printer/Controller Interface or optional IEEE-488 Remote Control/Printer Interface (Option 4002), the FIREBERD 4000 is being controlled from.

The FIREBERD 4000 can operate in one of two control modes: local or remote. On power-up, the FIREBERD enters the local control mode, in which the front panel menus and switches control all functions. In remote control, the front panel menus and switches (except for the ANALYSIS RESULTS switches) are ignored and all functions are controlled by the remote device. Remote control allows a remote user full control over all normal FIREBERD functions (except power) and many remote-control-only functions. Remote control provides two forms of control, non-interactive remote mode or interactive terminal mode.

The general term "remote device" used in this section refers to dumb terminals, computers, and controllers. Any of these remote devices can be used to control the FIREBERD 4000. However, when specific mention of these remote devices appear in this section, the information only applies to that device. The term "print" is used in this section to indicate when the FIREBERD 4000 is generating an output to either the remote device or to a printer.

An on-line HELP directory provides assistance to the user when operating the FIREBERD 4000 in remote control. The directory includes information on valid remote control commands, the contents of the directory, entering commands, special control characters, a list of auxiliary functions and remote control-only commands, and entering user patterns. Type **HELP** to print the first page of the on-line manual. The HELP directory is presented in the *FIREBERD 4000 Remote Control Commands Handbook*.

7.2 RS-232-C REMOTE CONTROL OPERATION

This section describes how to set up and operate the FIREBERD 4000 from a remote device using the RS-232-C Printer/Controller Interface.

7.2.1 RS-232 Printer/Controller Interface

The standard RS-232 Printer/Controller Interface is located at the lower right corner on the rear panel. The interface connector is configured as DCE, which allows compatible serial asynchronous remote devices (DTE) to be connected to the FIREBERD. The interface connection is an EIA RS-232-C compatible, 25-pin, D-type female connector. Refer to Table 6-1 for pin assignments.

All communication through the interface is asynchronous using standard ASCII characters. The interface can operate at baud rates of 300, 1200, 2400, 4800, or 9600 baud. The number of data bits can be either 7 or 8. The parity can be odd, even, or none. The baud rate, data bits, and parity are controlled through the Auxiliary **RS232** menu. The line terminator transmitted from the FIREBERD can be set for a carriage return (CR), linefeed (LF), or both CR and LF. The line terminator is controlled through the Auxiliary **PRINTER** menu.

7.2.2 Remote Control Modes

When operating in remote control, the FIREBERD can operate in either a non-interactive remote mode or an interactive terminal mode. The non-interactive remote mode allows the remote device, such as a computer running an application program, to concentrate on sending commands and receiving predictable results from the FIREBERD 4000 without program interruptions (e.g., extra linefeeds, error messages, etc.) In terminal mode, the FIREBERD operates interactively with the remote device, such as a dumb terminal or computer running an interactive communications package, by (1) providing a prompt character whenever the FIREBERD is ready to receive a command, (2) echoing all characters back to the remote device as the user types them, and (3) transmitting error messages when an improper command or syntax error occurs.

The on-line HELP directory is available in either mode. Both control modes are possible through the RS-232 Printer Controller Interface.

7.2.3 Setting Up for Remote RS-232 Control

The following FIREBERD 4000 and remote device set up procedures apply to both remote mode and terminal mode operation.

Setting Up the FIREBERD for Remote Control

Perform the following procedure to set up the FIREBERD 4000 for remote control operation.

(1) Press the SETUP CATEGORY switch and select the AUXILIARY category.

(2) Press the SETUP SELECT switch and locate the Auxiliary **RS232** interface menu.

(3) Set the baud rate (300, 1200, 2400, 4800, or 9600), data bits (7 or 8), and parity (odd, even, or none) to match the connected remote device.

(4) Press the SETUP SELECT switch and locate the Auxiliary **PRINTER** menu in the AUXILIARY category. Set the printer printout format **WIDTH** to 80, line **SPEED** to FAST, and line **TERM**inator to CRLF. This affects the presentation of the information sent to the remote device.

(5) This step is optional. Press the SETUP SELECT switch and locate the Auxiliary **STATUS PRINT** menu. Set to OFF until configuration is complete.

(6) This step is optional. Press the SETUP SELECT switch and locate the Auxiliary **RESULT PRINT** menu. Set to SUMM until configuration is complete.

RS-232 Remote Device Interface Set-up

Use the following information as a guide to configure the remote device when using the FIREBERD 4000 RS-232-C Printer/Controller Interface.

The RS-232 Printer/Controller Interface is configured as an asynchronous DCE. The remote device should be able to communicate with the FIREBERD with the following data formats and speeds:

- Baud rate: 300, 1200, 2400, 4800, or 9600.
- Data bits: 7 or 8.
- Parity: odd, even, or none.
- Stop bits: 2.
- Command line terminator: carriage return (CR), linefeed (LF), or both CRLF.

The remote device should have control over the interface DTR lead (Pin 20). When the lead is HIGH the interface is active. The remote device should also have the capability of either being controlled by the interface CTS lead (Pin 5) to prevent FIREBERD receiver overflow or allow the FIREBERD enough time to process the commands by adding a delay of approximately 200 milliseconds to the end of the command.

7.2.4 Remote Mode Operation

When the FIREBERD is connected to a remote device and the RS-232 Printer/Controller Interface is properly configured, the FIREBERD is always looking for a valid command (e.g., **LED, GEN CLO**, etc.) from the remote device.

Setting Up for Remote Mode

Refer to Section 7.2.3 for information on setting up the FIREBERD and remote device for remote operation. Because computers vary in their execution of various commands and parameters, this information should be used as a guide when operating the FIREBERD in remote mode. Data flow control between the remote device and the FIREBERD is provided through either XON/XOFF control or hardware handshaking. The FIREBERD always generates XON and XOFF. If the remote device cannot provide XON/XOFF, flow control should be provided through the RS-232 Interface DTR lead (Pin 20) from the remote device. The remote device should also be able to monitor the CTS lead (Pin 5) from the FIREBERD.

Initiating Remote Mode Operation

To initiate remote mode operation, send a valid command from the remote device to the FIREBERD. When a valid command is received, the FIREBERD transitions from the local front panel control to the remote mode and executes the command.

An alternative to sending an executable command to place the FIREBERD in remote mode is to send the **REMOTE** command. When **REMOTE** is received, the FIREBERD only goes into remote mode and does not respond with any kind of output to the remote device.

In remote mode, the FIREBERD front panel keys and switches are disabled and the message, **232 REMOTE CONTROL <ENTER> TO ABORT**, appears in the SETUP display. If the front panel is placed in local lockout (see command

LOCAL LOCK), **<ENTER> TO ABORT** is not displayed. This prevents the front panel from inadvertently being returned to local mode.

Operating in Remote Mode

When sending a command that requires a response from the FIREBERD, the FIREBERD prints the appropriate information without generating any status messages, prompts, extra linefeeds, character echo, or error messages unless instructed to do so.

Each command must have the proper syntax and line terminator to be accepted by the FIREBERD as valid. If an invalid command is issued, the FIREBERD does not respond with any ERROR messages unless instructed to do so. Refer to Section 7.4 for information on remote control commands.

Terminating Remote Mode

To end remote mode operation and return the FIREBERD to local front panel control, send either:

LOCAL or "/" (slash, no quotes) and **<RETURN>**.

The FIREBERD front panel is released and the message, **232 REMOTE CONTROL <ENTER> TO ABORT**, is cleared from the SETUP display. An alternative is to press the FIREBERD SETUP panel ENTER key to release remote mode. Turning the unit power OFF also aborts remote mode.

7.2.5 Terminal Mode Operation

The following procedure describes how to operate the FIREBERD 4000 from a dumb terminal or computer operating in an interactive terminal mode.

Setting Up for Terminal Mode

Refer to Section 7.2.3 for information on setting up the FIREBERD and remote device for remote operation. Because terminals and computers vary in their execution of various commands and parameters, this information should be used as a guide when operating the FIREBERD in terminal mode.

Initiating Terminal Mode

Perform the following procedure to place the FIREBERD in terminal mode. From the remote device, send or type either:

"." (period, no quotes) or **TERMINAL** and **<RETURN>**.

The FIREBERD front panel is locked out and the message, **232 REMOTE CONTROL <ENTER> TO ABORT**, appears in the SETUP display. The FIREBERD also sends the following to the remote device:

```
   Terminal mode initiated.
   Type "HELP" followed by a <RETURN> for
help.

   >
```

When operating from the RS-232 Interface and there is no response from the FIREBERD to a command, the interface may not be configured properly. Either verify the interface set-up configuration at both FIREBERD and remote device, or attempt the auto-baud function from the remote device as described in Section 7.2.8.

Operating in Terminal Mode

The prompt (>), visible on the remote device display, signifies that the FIREBERD is ready to accept commands and is in an interactive terminal mode. In terminal mode, the prompt, echo, and error message functions are enabled.

When sending a command that requires a response from the FIREBERD, the FIREBERD prints the information with the appropriate status messages, prompts, extra linefeeds, character echo, or error messages unless otherwise instructed. For example, sending the command **LED** prints the status of the ALARMS and RECEIVER panel LEDs.

> LED and <RETURN> (echoed and linefeed from FIREBERD).

```
>
LED STATUS              10:33:46 04 SEP 89
PATTERN LOSS    OFF     PATTERN SYNC     ON
CLOCK LOSS      OFF     CLOCK PRESENT    ON
FRAME LOSS      OFF     FRAME SYNC      OFF
PATTERN SLIP    OFF
POWER LOSS      OFF
> _ (Cursor or next line starts here.)
```

Each command must have the proper syntax and line terminator to be accepted by the FIREBERD as valid. If an invalid command is issued, the FIREBERD responds with an ERROR message unless instructed otherwise. Refer to Section 7.4 for information on remote control commands.

Terminating Terminal Mode

To end terminal mode operation and return the FIREBERD to local front panel control, send either:

LOCAL or "/" (slash, no quotes) and **<RETURN>**.

The FIREBERD front panel is released and the message, **232 REMOTE CONTROL <ENTER> TO ABORT**, is cleared from the SETUP display. An alternative is to press the FIREBERD SETUP panel ENTER key to exit the terminal mode. Turning the power OFF to the unit also aborts terminal mode.

7.2.6 Terminal Mode Prompts

The FIREBERD generates three prompts in terminal mode: default, user-defined, and printer hold. The default prompt is the greater than sign (>) that appears when the FIREBERD 4000 is first placed in terminal mode. The user-defined prompt takes the place of the default prompt. It is created by using the command, **PROMPT STRING (ASCII characters)**. This can be used to create a prompt that identifies the FIREBERD that the terminal is attached to. The user-defined prompt is not saved when power is turned off to the FIREBERD. The printer hold prompt is the plus sign (+) and appears when the command **PRI HOL ON** is executed. The + indicates that the printer buffer is not sending printouts to the printer. Disabling Print Hold returns the prompt to the default or user-defined prompt.

7.2.7 Control Codes

The FIREBERD 4000 accepts the following control codes from the remote device. Refer to the remote device operating manual to determine the appropriate keys or codes used to execute these control codes.

<BREAK> - Used to establish communications between FIREBERD 4000 and remote device when using the FIREBERD auto-baud mode (see Section 7.2.8).

<ESCAPE> - Used to determine the character format in the auto-baud mode (see Section 7.2.8).

<BACKSPACE> - Used to backspace the cursor to delete the previous character (08 Hex, Control H).

<Control C> - Used to abort or cancel the current command line and clear the print buffer (03 Hex).

<Control Q> - Used to initiate XON to resume all printer outputs from XOFF (11 Hex).

<Control S> - Used to initiate XOFF to suspend/resume all printer outputs (13 Hex).

<Control X> - Used to cancel the current input command line (18 Hex).

7.2.8 Auto-Baud Function

To simplify setting up the RS-232 remote control communications, the FIREBERD has an auto-baud function. This allows a remote user to configure the FIREBERD baud rate, data bits, and parity to match the remote device's settings. To initiate the auto-baud mode, perform the following procedure from the remote control device.

(1) Send the **BREAK** signal three times (BREAK key on terminal) at 1-second intervals (front panel flashes **AUTOBAUD IN PROGRESS** in Results display), followed by repeatedly sending **SPACE** characters (SPACEBAR on terminal, 20 Hex) at a 5 to 10 Hz rate for about 10 seconds or until the following message appears.

```
Auto-baud achieved. Press <ESCAPE>
to continue.
```

(2) Send an **ESCAPE** character (ESC key on terminal, 1B Hex). The FIREBERD responds with:

```
Character format determined.
```

The FIREBERD is fully configured and the user can enter the terminal ("." or TERMINAL) or remote (enter valid commands or REMOTE) mode.

The following information explains conditions that might occur during the auto-baud mode.

- If auto-baud is not achieved within 30 seconds of being initiated, the FIREBERD aborts the function and reverts back to its previous RS-232 settings. This timeout is necessary since many terminals generate a BREAK signal as they power up or down, and can cause the FIREBERD to go into the auto-baud mode accidentally. If this occurs, the FIREBERD front panel flashes the message **AUTOBAUD IN PROGRESS** in the Results display until the 30-second timeout occurs which aborts the auto-baud mode.

- Since the FIREBERD has not determined the character format of the remote device to this point in the process, the message **Auto-baud achieved. Press <ESCAPE> to continue.** is always transmitted with a format of 7 data bits, 2 stop bits, and even parity. For this reason, the message may not appear normal on some terminals that are configured differently. Go ahead and send the ESCAPE character to allow the FIREBERD to determine the character format.

7.3 IEEE-488 REMOTE CONTROL OPERATION

This section describes how to set up and operate the FIREBERD 4000 from an IEEE-488 compatible controller using the optional IEEE-488 Remote Control/Printer Interface.

7.3.1 IEEE-488 Remote Control/Printer Interface

The optional IEEE-488 Remote Control/Printer Interface (Option 4002) complies with the IEEE Standard Digital Interface for Programmable Instrumentation (IEEE Std 488-1987). The interface offers both Talk-Only and Addressable modes. The Addressable mode allows the FIREBERD to be connected with up to 14 other IEEE-488 compatible devices, one of which must be a controller. The Talk-Only mode is discussed in Section 6 and the Addressable mode is discussed in this section.

Controls and Indicators

The interface module has an 8-segment DIP switch and an IEEE-488 compatible female connector. The DIP switch is used to select the interface mode (Talk-Only or Addressable) and the unit address when operating in the Addressable mode. The DIP switch segments are indicated in Figure 7-1.

				Address				
1	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
0	*	*	ton	16	8	4	2	1

*Not used. (1=UP=ON, 0=DOWN=OFF)

Figure 7-1
IEEE-488 Interface DIP Switch

SW 3 (labeled **ton**) controls the operating mode of the interface. In the UP position, the Talk-Only mode is enabled. In the DOWN position, Talk-only mode is disabled and the Addressable mode is enabled. When operating the FIREBERD 4000 from an IEEE-488 controller, set SW3 to the DOWN position (Addressable mode). SW4 through SW8 are used to set the unit address (in binary from most to least significant bit) in the Addressable mode. The unit address should be unique for each device on the IEEE-488 bus.

NOTE: The DIP switch settings are only read during power-up.

The following IEEE-488 Interface capabilities apply to the optional TTC IEEE-488 Interface and are listed on the interface panel.

SH1	Full Source Handshake
AH1	Full Acceptor Handshake
SR1	Full Service Request Capability
RL1	Complete Remote/Local Capability
PP0	No Parallel Poll Capability
DC1	Full Device Clear Capability
C0	No Controller Capability
T5	Complete Talker Capability
L4	Complete Listener Capability without Listen Only Mode
E2	Three-state Drivers

Installing the IEEE-488 Interface

The interface is installed in the small slot on the rear panel of the FIREBERD 4000. To install the module, remove the blank plate, slide the module into the slot, press the module connector into the mainframe slot connector, and secure it with the two screws that held the blank plate in place. If the interface is removed, the blank plate must be replaced.

WARNING: Turn power OFF to the FIREBERD 4000 before installing the IEEE-488 Interface.

When the FIREBERD power is turned ON for the first time, the FIREBERD tests for the option, reads the interface switch positions, and clears NOVRAM.

NOTE: The mainframe menu and switch configurations must be reconfigured after the IEEE-488 option is installed.

7.3.2 Setting Up for IEEE-488 Remote Control

The following FIREBERD 4000 and remote device set up procedures only apply to operating from an IEEE-488 bus.

FIREBERD 4000 Set-up

Perform the following procedure to set up the FIREBERD 4000 for remote control operation.

(1) Turn power OFF to the FIREBERD 4000.

(2) Go to the IEEE-488 Interface on the rear panel.

(3) Set the unit address with DIP switches SW4 tc SW8. SW4 is the most significant bit and SW8 is the least significant bit. The binary sum of the

switches in the UP position equals the unit address. Refer to Table 7-1 for unit address switch settings.

(4) Set SW3 DOWN (0) to place the interface in the Addressable mode.

(5) Turn power ON to the FIREBERD 4000 and go to the front panel.

(6) Press the SETUP CATEGORY switch and select the AUXILIARY category.

(7) Press the SETUP SELECT switch and locate the Auxiliary **IEEE488** Interface menu. Set the Service Request (SRQ) selection as required by the controller. The unit address appears in the menu.

(8) Press the SETUP SELECT switch and locate the Auxiliary **PRINTER** menu in the AUXILIARY category. Set the printout **WIDTH** to 80, line **SPEED** to FAST, and line **TERM**inator to CRLF. This affects the presentation of the information sent to the controller.

(9) This step is optional. Press the SETUP SELECT switch and locate the Auxiliary **STATUS PRINT** menu. Set this menu item to OFF until configuration is complete.

(10) This step is optional. Press the SETUP SELECT switch and locate the Auxiliary **RESULT PRINT** menu. Set this menu item to SUMM until configuration is complete.

Remote Controller Set-up

Here are some programming hints that should be observed when controlling the FIREBERD 4000 from an IEEE-488 controller, such as the HP-85.

A device must first be addressed before it responds to a command. It is possible to address any single device or any group of devices on the bus. Addressing a single device is accomplished with a statement such as **Output (701); "DAT63"** to the device at address 1 of the HP-85 port 7. To address multiple devices, the **REMOTE x,x,x** statement is used. The x's constitute the units to be addressed. Once the group of devices is addressed, the group format of the commands is used. One example is "Trigger 7" which causes all addressed devices on the bus to perform their DEVICE Trigger function.

Before attempting to read data from a device, it is necessary to know that the device has data to send. The controller has two ways of determining that the FIREBERD

Table 7-1
IEEE-488 Unit Address DIP Switch Settings

SW	4	5	6	7	8	SW	4	5	6	7	8
ADD	(16)	(8)	(4)	(2)	(1)	ADD	(16)	(8)	(4)	(2)	(1)
0	D	D	D	D	D	16	U	D	D	D	D
1	D	D	D	D	U	17	U	D	D	D	U
2	D	D	D	U	D	18	U	D	D	U	D
3	D	D	D	U	U	19	U	D	D	U	U
4	D	D	U	D	D	20	U	D	U	D	D
5	D	D	U	D	U	21	U	D	U	D	U
6	D	D	U	U	D	22	U	D	U	U	D
7	D	D	U	U	U	23	U	D	U	U	U
8	D	U	D	D	D	24	U	U	D	D	D
9	D	U	D	D	U	25	U	U	D	D	U
10	D	U	D	U	D	26	U	U	D	U	D
11	D	U	D	U	U	27	U	U	D	U	U
12	D	U	U	D	D	28	U	U	U	D	D
13	D	U	U	D	U	29	U	U	U	D	U
14	D	U	U	U	D	30	U	U	U	U	D
15	D	U	U	U	U						

has data: (1) Bit 7 of the serial poll register (dav) is asserted whenever a line of data is available, and (2) the FIREBERD SRQ is set ON in the Auxiliary **IEEE488** menu.

The statement used to read data from the FIREBERD must be one that properly terminates the read operation when the last character of the line is encountered. Since the FIREBERD's line terminator is specified, the last character can be detected by sensing the EOI signal. The statement "**ENTER 701 USING "#%,%K";A$**" reads characters from device 1 until the EOI signal is encountered.

7.3.3 Remote Mode Operation

When controlled by an IEEE-488 controller, the FIREBERD 4000 can only operate in remote mode. The IEEE-488 Interface must be set to Addressable mode. Up to 14 other devices can be connected to the same IEEE-488 bus as the FIREBERD 4000, one of which must be a controller. The following is a typical remote control input sequence.

(1) The controller addresses the FIREBERD to listen and the REN (Remote Enable) signal is asserted.

(2) The controller sends a remote control command to the FIREBERD which holds it in a buffer.

(3) The controller sends a line terminator (CR, LF, or CRLF).

(4) Upon receipt of the terminator, the FIREBERD interprets the command and responds appropriately to the command.

The service request (SRQ) signal is controlled through the Auxiliary **IEEE488** menu. When SRQ is ON, the FIREBERD generates an SRQ when it has data to transmit and asserts bits B7 (dav) and B6 (rsv) of the serial poll status byte as shown in Figure 7-2. The EOI (End or Identify) signal is asserted with the final character of each command. Bit B0 (syn) is asserted when a syntax error occurs and is cleared each time the data buffer content is read. The FIREBERD leaves remote mode when the REN signal is de-asserted.

B7	B6	B5	B4	B3	B2	B1	B0
dav	rsv						syn

dav = data available in FIREBERD print buffer
rsv = request service (SRQ)
syn = command syntax error

Figure 7-2
Serial Poll Status Byte

In the event that both IEEE-488 and RS-232 Printer/Controller Interfaces are used to control the FIREBERD, the IEEE-488 controller has priority over the RS-232 controller in establishing the remote mode. If the RS-232 controller is controlling the FIREBERD, the IEEE-488 controller will interrupt the RS-232 controlled session but not vice versa.

7.4 REMOTE CONTROL COMMANDS

The following information describes how to send remote control commands to the FIREBERD 4000 in terminal and remote modes.

NOTE: All examples shown in this section use the terminal mode format.

7.4.1 Remote Control Command Formats and Entry Sequence

The general format for a remote control command is:

command_name (parameter ...)

where **commad_name** identifies the command and **(parameter ...)** is the selectable parameter(s) associated with the command name. Table 7-2 lists the command names, parameters, and description of all FIREBERD 4000 remote control commands. Most, but not all, command names have parameters associated with them.

In general, command names are derived by shortening all words shown on the front panel switches and menus to their first three letters, while leaving all numbers unchanged and representing exponents with a caret ("^"). All commands and parameters sent to the FIREBERD 4000 must be in the form of ASCII characters with either a 'carriage return' or a 'carriage return/linefeed' terminating the command. Commands and parameters MUST be separated by spaces and can be entered in either UPPER or lower case characters. Only one command can be entered per line terminator.

Most commands can be used to either select a new command state or to print the currently selected command state (without changing it). To select a new command state, enter both the command name and the desired parameter in the command line. For example:

> AUX BLK LEN PAT <RETURN>
>

sets the auxiliary block length to pattern, where **AUX BLK LEN** is the command name and **PAT** is the parameter. The second prompt indicates the mainframe accepted the command. If the mainframe did not accept the command, it would have printed an error message. To obtain the currently selected command state, enter only the command name. For example:

```
> AUX BLK LEN <RETURN>
>
 PAT
```

Entering a command name without selecting a new state causes the mainframe to respond with the currently selected state. This is referred to as a status request for the particular command. If HELP and the command name are entered, the parameter syntax for the command is printed. For example:

```
> HELP AUX BLK LEN <RETURN>
>
   PAT
   10^2
   10^3
   10^4
   10^5
   10^6
```

7.4.2 FIREBERD Commands by Groups

The following lists serve to group the FIREBERD commands and to provide an unabbreviated command title. Table 7-2 includes in, alphabetical order, command names, their associated parameters, and a short description of each command.

Controller Commands

AUX PAT PRI	User Pattern Print Format Selection
BEEP	Sound the FIREBERD's Beeper
CLS	Clear the Terminal Screen
ECHO	Character Echo
ERR MSG	Error Message Control
ERR NUM	Print Error Message Code Number
HELP	On-Line Help
LOCAL LOCK	Local Lockout
LOCAL (/)	Local Mode
PROMPT	Command Prompt
REMOTE	Enter Remote Control Mode
TERMINAL (.)	Enter Terminal Mode
VER	Print System Software Version

Mainframe Configuration

AUD	Audio Beeper
AUX CLE NOV	Clear Non-Volatile Memory
AUX DAT	Date
AUX FLO	Out-of-Band Flow Control
AUX FRE	Fixed Frequency Editor
AUX TIM	Time
REC	Recall Instrument Configuration
STO	Store Instrument Configuration

Display Functions

ALA RES	ALARMS Panel Reset
ANA RES	Display/Change Analysis Results
DIS HOL	Analysis Results Display Hold

Interface Signaling

DSR	Data Set Ready Signal Control
DTR	Data Terminal Ready Signal Control
PRI LED	Print Interface Status and Control Panel LED Status
RLSD	Receive Line Signal Detect Signal Control
RTS	Request to Send Signal Control

Printer/Controller Configuration

AUX PRI EVE	Auxiliary Print Event Selection
AUX PRI FMT	Results Printout Format
AUX PRI RS232	RS232 Printer/Controller Interface
AUX PRI SET	Printer Printout Format
AUX PRI SRQ	IEEE-488 Interface Service Request Generation
AUX PRI STA	Print Status Messages

Printer Functions

CLEAR FIFO	Clear Print Buffer
LED	Print ALARMS and RECEIVER LED Status
PRI	Print a CONTROLS or RESULTS Printout

PRI EVE	Print Event Selection
PRI HOL	Printer Output Hold
PRINT (?)	Print One Result Value

Test Configuration

AUX BLK LEN	Block Length Selection
AUX SYN LOS ACT	Receiver Action Upon Synchronization Loss Selection
AUX SYN LOS THR	Synchronization Loss Threshold Selection
AUX USE SYN THR	User Pattern Synchronization Threshold Selection
ERR INS	Logic Error Insertion Control
GEN CLO	Generator Clock Selection
INT SEL	Interface Selection
INT SET	Interface Set-up
LOO	Generate Loop Codes
PAT	Test Pattern Selection
PRI SEL TES	Print Power-On Self-Test Results
RES	Restart Test
SEL LOO	Self Loop Control

Table 7-2
Remote Control Commands in Alphabetical Order

Command Name	Parameters	Description
ALA RES	—	ALARMS Panel Reset
ANA RES	1/2	Display/Change Analysis Results
AUD	ON/OFF	Audio Beeper
AUX BLK LEN	PAT/10^2/10^3/10^4/ 10^5/10^6	Block Length Selection
AUX CLE NOV	—	Clear Non-Volatile Memory
AUX DAT	MM/DD/YY	Date (MM = 01-12, DD = 01-31, YY = 00-99)
AUX FLO	ALL OFF: TR ON/OFF: DM ON/OFF: RS ON/OFF: CS ON/OFF: RR ON/OFF	Out-of-Band Flow Control
AUX FRE	nn ff.ff	Fixed Frequency Editor (nn = 1-13, ff.ff = 0.05-15000)
AUX PAT PRI	ASC/BIN	User Pattern Print Format Selection
AUX PRI EVE	ERR/TIM/HIS	Auxiliary Print Event Selection
AUX PRI EVE ERR	ALL ON/OFF: BIT ON/OFF: BLK ON/OFF: BPV ON/OFF: COD ON/OFF: CRC ON/OFF: FRA ON/OFF: FRW ON/OFF: PAT ON/OFF	Auxiliary Errored Print Event Selection
AUX PRI EVE TIM	HH:MM	Auxiliary Timed Print Event Selection (HH = 0-99, MM = 0-59)
AUX PRI EVE HIS	—	Auxiliary Histogram Print Event Selection
AUX PRI EVE HIS SCA	(histogram #) (scale)	Ausxiliary Print Event Histogram Scale
AUX PRI EVE HIS FOR	GRA/LIS	Auxiliary Histogram Print Event Format
AUX PRI EVE HIS PER	1MIN/15MIN/1HOU/1DAY	Auxiliary Histogram Print Event Period
AUX PRI EVE HIS PRI	(histogram #)	Auxiliary Print Event Histogram Printout

Table 7-2
Remote Control Commands in Alphabetical Order (continued)

Command Name	Parameters	Description
AUX PRI EVE HIS RES	(histogram #) (result name)	Auxiliary Histogram Print Even Result
AUX PRI EVE HIS SAM	(number)	Auxiliary Histogram Print Event Samples
AUX PRI FMT	STD/LON/SUM	Results Printout Format
AUX PRI RS232	BAU/DAT/PAR/PR45/ PR40A/PR2000/PR40/PR85	RS232 Printer/Controller Interface
AUX PRI RS232 BAU	300/1200/2400/4800/9600	RS232 Interface Baud Rate
AUX PRI RS232 DAT	7/8	RS232 Interface Data Bits
AUX PRI RS232 PAR	NON/EVE/ODD	RS232 Interface Parity
AUX PRI SET AUX PRI SET WID AUX PRI SET TER AUX PRI SET SPE	WID/TER/SPE 20/40/80 CRLF/CR/LF FAS/SLO	Printer Printout Format Printer Format, Width Printer Format, Line Terminator Printer Format, Line Speed
AUX PRI SRQ	ON/OFF	IEEE-488 Interface Service Request Generation
AUX PRI STA	ON/OFF	Print Status Messages
AUX SYN LOS ACT	CLE/HAL	Receiver Action Upon Synchronization Loss Selection
AUX SYN LOS THR	NOR/HIG	Synchronization Loss Threshold Selection
AUX TIM	HH:MM:SS	Time (HH = 0-23. MM = 0-59. SS = 0-59)
AUX USE SYN THR	PAT/10/100	User Pattern Synchronization Threshold Selection
BEEP	—	Sound the FIREBERD's Beeper
CLEAR FIFO	—	Clear Print Buffer
CLS	—	Clear the Terminal Screen
DIS HOL	ON/OFF	Analysis Results Display Hold
DSR	ON/OFF	Data Set Ready Signal Control
DTR	ON/OFF	Data Terminal Ready Signal Control
ECHO	ON/OFF	Character Echo
ERR INS	OFF/SIN/10^-3	Logic Error Insertion Control
ERR MSG	ON/OFF	Error Message Control
ERR NUM	—	Print Error Message Code Number

Table 7-2
Remote Control Commands in Alphabetical Order (continued)

Command Name	Parameters	Description
GEN CLO	INTF/BNC/INTR	Generator Clock Selection
GEN CLO INTR	SYN/0.3/1.2/2.4/4.8/9.6/ 19.2/56.0/64.0/128.0/ 256.0/512.0/1544.0/2048.0	Generator Clock, Internal
GEN CLO INTR SYN	ff.ff	Generator Clock, Internal Synthesizer (ff.ff=0.05-15000)
HELP	!/1/2/3/4/5	On-Line Help
INT SEL	INT232/INT188/SLOT1/ SLOT2/ISU1/ISU2/ISU3/ISU4	Interface Selection
INT SET	Interface labels and parameters	Interface Set-up
LED	—	Print ALARMS and RECEIVER LED Status
LOCAL (/)	—	Local Mode
LOCAL LOCK	ON/OFF	Local Lockout
LOO	OFF/UP/DOW	Generate Loop Codes
PAT	MAR/SPA/1:1/1:7/3IN24/ 63/511/2047/2^15-1/2^20-1/ 2^23-1/QRS/PRO/FOX/USE/1004HZ	Test Pattern Selection
PAT PRO	xxx	Test Pattern, Programmable Bit Pattern (xxx = 3-24 binary bits)
PAT USE	1/2/3	Test Pattern, User Character Pattern
PAT USE n	SET hh hh ...	Enter user defined message.
PAT USE n	APP hh hh ...	Append to the end of user defined message.
PAT USE n	REP pp hh hh ...	Replace user defined message starting at position pp.
PAT USE n	INS pp hh hh ...	Insert into position pp of user defined message.
PAT USE n	DEL pp dd	Delete dd bytes from user defined message starting at position pp.
PAT USE n	SIZ	Print size of message.
PAT USE n	PRI pp dd	Print dd bytes of user defined message starting at position pp. Note: n = 1-3. pp and dd = 1-2000. hh = 00H-FFH.
PRI	CON/RES	Print a CONTROLS or RESULTS Printouts
PRI EVE	OFF/15MIN/1HOUR/ ERROR/AUX	Print Event
PRI HOL	ON/OFF	Printer Output Hold
PRI LED	—	Print Interface Status and Control Panel LED Status
PRI SEL TES	—	Print Power-On Self-Test Results
PRINT (?)	Result name	Print One Result Value
PROMPT	ON/OFF/STRING	Command Prompt
PROMPT STRING	ASCII string	Command Prompt, User Defined

Table 7-2
Remote Control Commands in Alphabetical Order (continued)

Command Name	Parameters	Description
REC	0/1/2/3/4/5/6/7/8/9	Recall Instrument Configuration
REMOTE	—	Enter Remote Control Mode
RES	—	Restart Test
RLS	ON/OFF	Received Line Signal Detect Signal Control
RTS	ON/OFF	Request to Send Signal Control
SEL LOO	ON/OFF	Self Loop Control
STO	0/1/2/3/4/5/6/7/8/9	Store Instrument Configuration
TERMINAL (.)	—	Enter Terminal Mode
VER	—	Print System Software Version

7.5 ENTERING LONG USER PATTERNS FROM A REMOTE DEVICE

The User Programmable Character Pattern can be entered, edited, and printed from a remote device using the following commands. **PAT USE** is the command name and **SET, APP, REP, INS, DEL, SIZ,** and **PRI** are the parameters that are used to create and edit long user patterns. The **SIZ** and **PRI** parameters are used to check the size of the pattern and print the pattern. Appendix A is provided to assist in creating a long user pattern.

Note: The variables used in the command strings are defined as follows:

n is 1, 2, or 3. Selects the user pattern, USER 1, USER 2, or USER 3.
pp and dd are integers between 1 and 2000.
hh is a 1-byte hexadecimal number between 00H and FFH.

PAT USE n SET hh hh SET is used to initially enter the message or pattern.

PAT USE n APP hh hh APP is used to append the message by adding characters to the end of the message.

PAT USE n REP pp hh hh REP is used to replace portions of the message starting at position pp.

PAT USE n INS pp hh hh INS is used to insert new characters into the message starting at position pp.

PAT USE n DEL pp dd DEL is used to delete a specific number of bytes (dd) from the message starting at position pp.

PAT USE n SIZ SIZ prints the number of characters in the message.

PAT USE n PRI pp dd PRI is used to print dd bytes of the message starting at position pp. Without pp and dd entered, the entire message is printed.

SECTION 8
SPECIFICATIONS

8.1 INTRODUCTION

This section contains the specifications for the FIREBERD 4000 Communications Analyzer.

8.2 OPERATING MODES

Emulation:	DTE mode (connecting to DCE). DCE mode (connecting to DTE).
Mainframe configuration:	Full Duplex mode. Self-Loop mode.
Timing modes:	Synchronous timing. Asynchronous timing (internal EIA RS-232-C and MIL-STD-188C Interfaces only).

8.3 GENERATOR

8.3.1 Internal Clock Frequency Generator

Standard fixed frequencies:	300, 1200, 2400, 4800, or 9600 Hz, 19.2, 56, 64, 128, 256, or 512 kHz, 1.544 or 2.048 MHz.
Optional frequency synthesizer	
Frequency range:	50 Hz to 15.000 MHz.
Accuracy and stability:	±5 ppm (±1 ppm optional).
Resolution:	5 significant digits for frequencies starting with 10 through 15. 4 significant digits on all other frequencies.

8.3.2 External Input Clock Timing

Connector:	GEN CLK IN, BNC.
Input frequency range:	50 Hz to 15.000 MHz.
Input DC impedance:	10k ohms typical.
Input AC impedance:	60 ohms minimum.
Input signal range:	1.5 volts p-p to 25 volts p-p.

8.3.3 External Output Clock Timing

Connector:	GEN CLK OUT, BNC.
Output frequency range:	50 Hz to 15.000 MHz.
Output load:	50 ohms minimum.
Output signal levels:	TTL levels — 2.0 volts minimum high level, 0.4 volts maximum low level (50-ohm load).

8.3.4 Data Generator

Fixed patterns:	Mark Only, Space Only, 1:1 (Alternating Mark and Space), 1:7, 3IN24, or programmable 3-bit to 24-bit repeating pattern (synchronous only).
Pseudorandom patterns:	63, 511, 2047, 2^{15}-1, 2^{20}-1, 2^{23}-1, or QRSS.
Messages:	FOX message (Baudot, BCDIC, ASCII, or EBCDIC). Three user-programmable asynchronous messages of up to 2000 characters (synchronous operation with Option 4006 optional). Digitized 1004 Hz tone.
Asynchronous character format:	Character length — 5, 6, 7, or 8 bits. Parity — odd, even, or none. Stop Bits — 1, 1.5, or 2 bits.
Synchronous character format:	8-bit data with appropriate framing and control bits (with Option 4006 installed).
Error insertion:	Single error or fixed 10^{-3} bit error rate in generated data only.
Bit rates:	Asynchronous timing mode — 50 b/s to 20 kb/s. Synchronous timing mode — 50 b/s to 15 Mb/s.

8.4 RECEIVER

8.4.1 Timing Modes:

Synchronous (1x bit rate clock received through data interface for bit rates from 50 b/s to 15 Mb/s).

Asynchronous (16x bit rate clock provided for USART for bit rates from 50 b/s to 20 kb/s).

Timing sources:	Data interface.
Indicators:	RECEIVER CLOCK PRES LED illuminates when receive clock is present.

ALARMS CLOCK LOSS LED illuminates when receiver clock has been lost at least once.

RCV DATA INVERT message appears when received data is inverted.

RCV DATA LOSS message appears when received data is not detected.

ASYNC FRAMING ERROR message appears when an asynchronous framing error occurs.

8.4.2 Data Analysis Measurements

Error analysis:	Bit, block, and character errors, average bit error rate, average block error rate, pattern losses, and pattern slips.
BER Test Interval:	10 seconds following pattern synchronization.
Block lengths:	10^2 to 10^6 bits, or pattern length (minimum: 50 bits).
Digital data analysis:	BPVs, BPV rate, average BPV rate, frame errors, average frame errors, CRC errors, and average CRC errors.
Time-based analysis:	Test seconds, percent error-free seconds, errored seconds, elapsed seconds, time, and date.
Signal frequency analysis	
Frequency Range:	50 Hz to 16 MHz.
Resolution:	Less than 1,000 Hz: 0.001 Hz. 1,000 Hz to 9,999.99 Hz: 0.01 Hz. 10,000.0 Hz to 99,999.0 Hz: 0.1 Hz. Greater than 100,000 Hz: 1 Hz.
Accuracy:	±5 ppm (±1 ppm optional).
Delay analysis	
Start of measurement:	Rising edge of RTS (internal RS-232 and MIL-188C in positive signaling mode). Falling edge of RTS (internal MIL-188C in negative signaling mode).
End of measurement:	Rising edge of CTS (internal RS-232 and MIL-188C in positive signaling mode). Falling edge of CTS (internal MIL-188C in negative signaling mode).
Measurement range:	0 to 9,999.9 milliseconds.
Resolution and accuracy:	±0.1 millisecond.
Performance analysis:	Available seconds, % available seconds, unavailable seconds, degraded minutes, % degraded minutes, G.821 error-free seconds, G.821 errored seconds, G.821 % error-free seconds, severely errored seconds, and % severely errored seconds (Option 4004 required).

8.5 PROGRAMMABILITY

8.5.1 Programmable Messages:

Three user-defined asynchronous messages of 1 to 2048 characters in length (Option 4006 required for synchronous operation).

8.5.2 Front-panel Programs

Number of front-panel programs:	10.
Functions under user control:	Front-panel switch settings, auxiliary functions, etc.
Access:	Program entry and recall using the RECALL/STORE function of the SETUP switch.

8.6 NON-VOLATILE MEMORY

Information stored:	Current front-panel switch settings, keypad entries, and auxiliary functions. Three user-defined messages. Ten front-panel programs.

8.7 REMOTE CONTROL CAPABILITY

Remote control access:	RS-232 Printer/Remote Control Interface (IEEE-488 optional).
Controllable functions:	Front-panel switch settings. Keypad entries. Auxiliary functions. User-defined messages.

8.8 DATA INTERFACES

8.8.1 Internal RS-232-C Data Interface

Connectors:	Two 25-pin D-type female connectors. Labeled TO DCE and TO DTE.
Data rates:	Asynchronous - 50 b/s to 20 kb/s. Synchronous - 50 b/s to 64 kb/s.
Data Polarity:	Mark (Binary 1): -3V to -25V. Space (Binary 0): +3V to +25V.
Signal Polarity:	On: -3V to -25V. Off: +3V to +25V.

Drivers

Output Rise Time:	Greater than 20 microseconds.
Generator Impedance:	Less than 100 ohms.
Signal Swing:	+10V into 7k ohms, typical.
Short Circuit Current:	Less than 100 mA.

Receivers

Load Impedance:	3k to 7k ohms.
Maximum Input Voltage	±25V.

8.8.2 Internal MIL-STD-188C Data Interface

Connectors:	Two 25-pin D-type female connectors. Labeled TO DCE and TO DTE.
Data rates:	Asynchronous - 50 b/s to 20 kb/s. Synchronous - 50 b/s to 64 kb/s.
Data Polarity:	Mark (Binary 1): +4V to +6V. Space (Binary 0): -4V to -6V.
Signal Polarity (menu controlled):	ON = POS: ON is +4V to +6V, OFF is -4V to -6V. ON = NEG: ON is -4V to -6V, OFF is +4V to +6V.

Drivers

Output Impedance:	Less than 50 ohms.
Open Circuit Output Voltage:	5V to 6V.

Receivers

Input Impedance:	Greater than 6k ohms.
Input Threshold:	±0.2V.
Hysteresis:	200mV.

8.8.3 External Data Interface Slot:

Accepts any FIREBERD interface (second interface slot optional).

8.9 REAL TIME CLOCK

Displayed and printed functions:	Hours (24-hour format), Minutes, Seconds, Month, Day, and Year.
Accuracy:	Typically better than one second per day.

8.10 DISPLAY

Display type:	Vacuum fluorescent display.

Display size:	80 characters — 40 characters x 2 lines.
Character format:	5 x 7 dot matrix and cursor.

8.11 AUDIO OUTPUT

Audio indicator:	Multitone output.
Volume control:	Volume control — off, minimum to maximum.

8.12 POWER REQUIREMENTS

Voltage:	Two user-selectable ranges: 90-135 VAC and 195-240 VAC.
Frequency:	50 to 60 Hz.
Power:	90 W maximum.

8.13 ENVIRONMENTAL SPECIFICATIONS

Operating temperature range:	0°C to +50°C (+32°F to +122°F).
Storage temperature range:	-30°C to +75°C (-22°F to +167°F).

8.14 DIMENSIONS AND WEIGHT

8.14.1 FIREBERD 4000 with Plastic Case

Dimensions:	5.8" H x 14.2" W x 11.4" D (14.7 cm x 36.0 cm x 29.0 cm).
Weight:	Without printer: 16.7 lbs. (7.6 kg). With printer: 18.2 lbs. (8.3 kg)

8.14.2 FIREBERD MC4000 with Metal Case

Dimensions:	5.8" H x 14.4" W x 11.9" D (14.7 cm x 36.6 cm x 30.2 cm).
Weight:	17.1 lbs. (7.8 kg).

SECTION 9
OPTIONS AND ACCESSORIES

9.1 INTRODUCTION

This section contains information on the options and accessories available for the FIREBERD 4000.

9.2 OPTIONS

Table 9-1 lists the hardware and software options available for the FIREBERD 4000.

Table 9-1
FIREBERD 4000 Options

Option No.	Description
MC4000	FIREBERD 4000 Metal Case
4001	Second Interface Slot
4002	IEEE-488 Remote Control/Printer Interface
4003	Precision Time Base (±1ppm)
4004	G.821 Performance Analysis
4005	Frequency Synthesizer
4006	Synchronous User Patterns

9.3 ACCESSORIES

This section describes several FIREBERD 4000 accessories; at the end of the section is a complete list of accessories along with part numbers for ordering purposes.

9.3.1 PR-45 Lid Printer

The PR-45 is a thermal, dot-matrix printer that is encased in a FIREBERD 4000 lid and mounted on the mainframe front panel with a spring-loaded hinge. When the FIREBERD is not in use, the PR-45 can be closed to act as a cover for the front panel. Additional information on the PR-45 Printer is contained in Section 6.

9.3.2 PR-35 Thermal Printer

The PR-35 is a thermal, dot-matrix printer in rack-mount configuration for installation in a standard 19" equipment rack. This printer connects to the RS-232 Remote/Control Printer Interface through a male-to-male printer cable. A Rack Mount Extender kit is available to enable the rack mount to be installed in a 23" equipment rack.

9.3.3 Interface Switching Unit

An Interface Switching Unit (ISU) is a rack-mountable product capable of accommodating multiple data interfaces and electronically selecting one interface for use with the FIREBERD 4000. Using this device, the user can operate a FIREBERD 4000 without handling interfaces or moving cables; switching between data interfaces is controlled via the FIREBERD 4000 front panel. Front or rear mounting permits interfaces to face either the front or the back of the equipment rack.

The ISU is available in two versions:

ISU 6000-4 Accommodates 4 data interfaces.
ISU 6000-8 Accommodates 8 data interfaces.

ISU Flush Door Accessory (Model 10518)

A Flush Door Accessory is available for the ISU. It is made of smoke grey plexiglass and recesses the ISU panel approximately 4 1/2" behind the rack mount surface. It conceals the interface modules and cables while still allowing access to the interface front panels.

9.3.4 FIREBERD 4000 Rack Mounts

Rack Mounts are available for both the FIREBERD 4000 plastic case and metal case units. Each rack mount allows the FIREBERD 4000 to be mounted in a standard 19" equipment

rack and comes equipped with a power switch and AC receptacle on the front of the rack. The AC receptacle accepts a standard power cord. A Rack Mount Extender kit is available to enable the rack mount to be installed in a 23" equipment rack.

Model RM-4000
Rack Mount For FIREBERD 4000 Plastic Case
Model RM-MC4000
Rack Mount For FIREBERD MC4000 Metal Case
Model 11041
Extender Kit 19" to 23" Rack Mount Extender

9.3.5 Soft Carrying Case (Model 41169)

The FIREBERD Soft Carrying Case is of sturdy canvas construction with a top cover hinged and secured with Velcro fasteners. The case is navy blue and has an I.D. pocket on the top cover. The case is carried by a handle that supports across the bottom and up both sides. Additionally, there is a padded, adjustable, snap-on shoulder strap. The interior of the case is equipped with adjustable Velcro straps to secure the mainframe during transport. A pouch on the rear of the case holds extra interfaces, cables, and operating manuals. Empty, the case weighs 5 1/2 pounds, and it measures 17"H x 18"W x 9.5" D.

9.3.6 Hard Shipping Case (Model 40527)

This rigid, water-resistant, ABS molded case has a foam-padded interior to hold the FIREBERD 4000 and its accessories. It is equipped with stainless steel draw latches and a molded handle and measures 26.5" H x 19" W x 11.5" D.

9.3.7 Ordering Information

The following is a list of accessories available from TTC at the time this manual was printed; model numbers are listed for ordering purposes. Contact TTC for an up-to-date list.

Description	Model Number
DATA INTERFACES	
V.35/306 DTE/DCE Interface	40202
RS-449 (422/423) DTE/DCE Interface	40200
WECO 303 Interface	40182
DS0/DS0A Interface	30481
DDS Local Loop Interface	41131/41231
DDS DS0A/B Interface	30678
DS1/T1/D4/ESF Interface	40460
DS1/T1/D4/ESF/SLC-96 Interface	40540
DS1C/DS2 Interface	30447A
CCITT G.703 64 kb/s Interface	30608
CCITT G.703 2048 kb/s Interface	40380
CCITT G.704 2048 kb/s Framing Interface	30609
CCITT G.703 8448 kb/s Interface	30524
MIL-188C/MIL-188-114 Unbalanced Interface	40226
MIL-188-114 Balanced Interface	40298
Lab (TTL) Interface	40204
RS-449/MIL Interface	41400
Fractional T1 Interface	41440
INTERFACE SWITCHING UNIT AND ACCESSORIES	
Interface Switching Unit (4 interfaces)	ISU 6000-4
Interface Switching Unit (8 interfaces)	ISU 6000-8
ISU Flush Door	10518

Description	Model Number
PRINTERS AND PRINTER SUPPLIES	
Integrated Thermal Graphics Printer	PR-45
Thermal Graphics Printer (battery or ac operation)	PR-40A
Rack-Mounted Thermal Graphics Printer	PR-35
Thermal Printer Paper (10 rolls)	10966
RACK MOUNTS	
For Plastic Case FIREBERD 4000 (19" rack)	RM-4000
For Metal Case FIREBERD MC4000 (19" rack)	RM-MC4000
19" to 23" Rack Mount Extender Kit	11041
CARRYING/SHIPPING CASES	
Soft Carrying Case	41169
Hard Shipping Case	40572
OPERATING MANUALS	
Replacement FIREBERD 4000 Manual Set	ML11063
CABLES	
RS-232/V.24 male-to-male (6')	10213
RS-232/V.24 male-to-male (10')	10418
WECO 310 plug to WECO 310 plug (10')	10420
WECO 310 plug to alligator clips (10')	10558
WECO 310 plug to bantam plug (4')	10599
WECO 310 plug to bantam plug (10')	10559
Bantam plug to alligator clips (10')	10648
Bantam plug to bantam plug (10')	10615
Dual bantam plug to 15-pin D male (10')	30503
Bantam plug to 5-pin male, Wescom adaptor (14')	30518
9-pin D male to 9-pin D male OIU adaptor (10')	20309
V.35/306 34-pin male-to-male cable (6')	10214
V.35/306 34-pin male-to-male cable (10')	10419
RJ45 to RJ45 8-pin modular plugs (14')	11266
RJ45 8-pin modular plug to 4 alligator clips (10')	30837
RS-449/MIL-188 37-pin D, male-to-male (6')	10215
RS-449/MIL-188 37-pin D, male-to-male (10')	10417
RS-449 DTE 37-pin D to X.21 DTE 15-pin (6')	10562
MIL-188 male 37-pin D to male 25-pin D (6')	10496
MIL-188 male 37-pin D to female 25-pin D (6')	10538
Siemens 3-pin to Siemens 3-pin (6')	30687
Siemens 3-pin to bantam plug (6')	30761
Replacement cable for PR40A/PR85 Printer	30511
Replacement clock cable for Model 30481 DS0 Interface	30488
Replacement crossover cable V.35/306, male-to-female (9")	10204
Replacement crossover cable RS-449, male-to-female (9")	10210
Twinaxial to Twinaxial (6')	30917
Extender cable for PR45 Printer	30771
RJ45 8-pin modular plug to RS-232 (15')	30904
Handset to RJ8 4-pin modular plug (12')	11255

Description	Model Number
BREAKOUT BOXES	
Breakout Box for RS-232C, V.24/V.28, MIL-188C	Model 25
Breakout Box for V.35, Bell 306	Model 34
Breakout Box for RS-449, V.10/V.11, MIL-188-114	Model 37

SECTION 10
MAINTENANCE AND SERVICE

10.1 INTRODUCTION

This section contains information on maintenance and service for the FIREBERD 4000. Specifically, it includes steps to take should the user experience difficulty operating the FIREBERD, maintenance procedures, and a description of TTC's warranty and repair procedures.

10.2 MAINTENANCE

Basic troubleshooting, fan filter and battery service procedures, and assembly and disassembly procedures are described in this section.

10.2.1 In Case of Difficulty

If the unit fails to operate and no front panel indicators illuminate, check the following:

- AC power cord and AC supply
- AC fuse and fuse rating
- AC input voltage setting

If some indicators illuminate but the unit fails to operate, there are several checks that can be made:

(1) Determine whether the selected interface is the correct one for the desired application. Refer to Section 5 for information on the interfaces.

(2) Verify that the interface is properly inserted in the interface slot (with power OFF).

(3) Insert another interface (suitable for the application) in the event the original interface is not operating properly. Turn power OFF before removing or inserting the interface module.

(4) Check the interface cable and connections between the FIREBERD 4000 and the circuit being tested.

As an aid to localizing the problem, perform the test procedures in Section 2.8, Instrument Checkout. If the unit cannot be made to operate properly, call the TTC Customer Service Department for assistance.

10.2.2 Preventive Maintenance

Preventive maintenance consists of cleaning, visual inspection for damage, and checking unit performance. When performed regularly, it will help prevent unit malfunctions and enhance unit reliability. The environment in which the unit is used determines the required frequency of maintenance. The FIREBERD 4000 should be visually inspected and cleaned as often as conditions require. Accumulation of dust in the unit can cause overheating and component breakdown. Dust on components acts as an insulating blanket which prevents efficient heat dissipation. It also provides an electrical conduction path that could result in unit failure, especially under high-humidity conditions.

Exterior Inspection and Cleaning

Inspect the external portions of the unit for damage, wear, and missing parts. Instruments that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Deficiencies found that could cause personal injury or could lead to further damage to the unit should be repaired immediately.

Loose dust and dirt should be removed with a soft cloth. Dirt that remains can be removed with a soft cloth dampened in a mild detergent-and-water solution. Do not use abrasive cleaners.

NOTE: Use only enough water to dampen the cloth.

CAUTION: Do not get moisture inside the unit.

Interior Inspection and Cleaning

Inspect the interior of the FIREBERD 4000 for damage and wear. Deficiencies found should be repaired immediately. If heat-damaged components are found there could be other trouble in the unit; therefore, it is important that the cause of overheating be corrected to prevent a recurrence of the damage. To clean the interior, use dry low-pressure air to remove any dust.

10.2.3 Removing the FIREBERD Cover

Use the following procedures to remove the cover from the FIREBERD 4000 (plastic case) and FIREBERD MC4000

(metal case) when replacing the battery for the battery-backed memory and clock, and cleaning the fan filter.

Removing the Cover from the FIREBERD 4000

Perform this procedure to remove the top cover from a FIREBERD 4000 (plastic case).

(1) Turn the AC power OFF and disconnect the AC power cord from the unit.

(2) Remove the snap-on pouch from the top cover.

(3) Remove and retain the four screws holding the top cover in place. The screws are located next to the cover snaps.

(4) Grasp both sides of the top cover and gently lift up.

Removing the Cover from the FIREBERD MC4000

Perform this procedure to remove the top cover from a FIREBERD MC4000 (metal case).

(1) Turn the AC power OFF and disconnect the AC power cord from the unit.

(2) Remove the snap-on pouch from the top cover.

(3) Locate, remove, and retain the two front bezel screws located on each side of the case.

NOTE: If the handle is obstructing access, press the handle locking buttons on each side and rotate the handle down to expose the front bezel screws.

(4) Pull the front bezel off of the unit.

(5) Lift up on the front edge of the cover and slide it forward to free the cover from the rear bezel.

10.2.4 Installing the FIREBERD Cover

Use the following procedures to install the cover on the FIREBERD 4000 and FIREBERD MC4000 when replacing the battery for the battery-backed memory and clock, and cleaning the fan filter.

Installing the Cover on the FIREBERD 4000

Perform this procedure to install the top cover on a FIREBERD 4000 (plastic case).

(1) Place the top cover on the FIREBERD making sure the cover is positioned correctly.

(2) Fasten the cover to the FIREBERD using the four screws removed when the cover was taken off.

(3) Replace the snap-on pouch.

(4) Reconnect the AC power cord, press the POWER switch, and verify proper operation of the FIREBERD using the test procedures located in Section 2.8.

Installing the Cover on the FIREBERD MC4000

Perform this procedure to install the top cover on a FIREBERD MC4000 (metal case).

(1) Place the top cover on the FIREBERD making sure the cover is positioned inside the guides located on each side of the case.

(2) Slide the top cover along the guides and under the rear panel bezel.

(3) Replace the front bezel by pressing it back into place on the front panel and securing it with the two screws that were previously removed.

NOTE: If the handle is obstructing access, press the handle locking buttons on each side and rotate the handle down to expose the front bezel screws holes on the side panels.

(4) Reconnect the AC power cord, press the POWER switch, and verify proper operation of the FIREBERD using the test procedures located in Section 2.8.

10.2.5 Replacing the Battery

WARNING: DO NOT INCINERATE OR MUTILATE THE BATTERIES. THEY MAY BURST OR RELEASE TOXIC MATERIALS CAUSING PERSONAL INJURY.

The FIREBERD 4000 is equipped with a lithium battery located on the lower right corner of the Processor board (40884). The battery is used as a power supply for the non-volatile memory and the real time clock. It should be noted that removing the battery causes the non-volatile memory to lose any stored information and the loss of the current time. The battery should be checked annually for damage and/or leakage. Life expectancy of the battery is approximately 7 years.

NOTE: Use only a TTC-supplied replacement battery. (Part # 9-11-002769).

To replace the battery in the FIREBERD 4000 or the FIREBERD MC4000:

(1) Remove the cover as described in Section 10.2.3. Use the appropriate procedure to remove the plastic or metal cover.

(2) Locate the Processor board (40884). The Processor board is located directly behind the front panel assembly.

(3) Remove the Processor board (40884) by pulling up on the board extractors on the top edge of the board.

(4) Locate the battery in the lower right side of the Processor board.

(5) Use diagonal cutters to remove the plastic tie from around the battery and remove the battery.

(6) Properly dispose of the old battery.

(7) Insert the replacement battery into the battery holder. Verify that the polarity of the battery leads matches the polarity marked on the battery holder. The battery holder leads are marked "+" and "-".

(8) Secure the battery with a small tie wrap.

(9) Insert the Processor board into the appropriate slot. Gently press the board into the Motherboard connector by the top corners of the board.

NOTE: Be sure to install Processor board in the unit with the component side facing the front of the unit.

CAUTION: Do not force the board into the Motherboard connector. This will damage connector pins.

(10) Install the cover as described in Section 10.2.4. Use the appropriate procedure to install the plastic or metal cover.

(11) Apply power to the FIREBERD. Reset the date, time, stored front panel configurations, and any other settings that are stored in memory. All menus are returned to the factory defaults when the battery is replaced.

10.2.6 Cleaning and Replacing the Fan Filter

The fan is mounted on the left side of the FIREBERD 4000. The fan is protected by a filter which is located between the fan and the side panel vents. The filter should be checked and cleaned periodically to ensure proper cooling.

To clean or replace the filter perform the following procedure:

(1) Remove the cover as described in Section 10.2.3. Use the appropriate procedure to remove the plastic or metal cover.

(2) Facing the front panel, locate the filter on the left side of the FIREBERD. Pull the filter from the filter slot.

(4) Clean the filter with compressed air or a soft brush.

(5) Re-insert the cleaned filter into the filter slot.

(6) Install the cover as described in Section 10.2.4. Use the appropriate procedure to install the plastic or metal cover.

10.3 SERVICE

10.3.1 Warranty Policy

All equipment manufactured by Telecommunications Techniques Corporation (TTC) is warranted against defects in material and workmanship. This warranty applies only to the original purchaser and is non-transferable unless express written authorization of the warranty transfer is granted by TTC.

Liability under this warranty extends only to the replacement value of the equipment. The warranty is void under the following conditions.

- Equipment has been altered or repaired without specific authorization from TTC.

- Equipment is installed other than in accordance with instructions contained in TTC literature and operating manuals.

No other warranty is expressed or implied. TTC is not liable for consequential damages.

10.3.2 In-Warranty Service

Equipment in warranty must be returned to the factory with shipping prepaid. The equipment should be packed and shipped in accordance with instructions in Section 10.3.4 of this manual. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the TTC Repair Department. The RA number should then appear on all paperwork and be clearly marked on the outside of the shipping container.

After the equipment is repaired by TTC, it will be tested to applicable specifications, burned-in for at least 24 hours, retested, and returned to the customer with shipping prepaid. A brief description of the work performed and the materials used will be provided on the Equipment Repair Report furnished with the returned equipment.

10.3.3 Out-of-Warranty Service

The procedure for repairing out-of-warranty equipment is the same as that used for equipment still in warranty. However, there is a minimum charge applied to each request for out-of-warranty service. The minimum charge guarantees the customer an estimate of the repair costs and is used as credit against actual materials and labor costs should the equipment be repaired. Contact the TTC Repair Department for specific information on the minimum out-of-warranty charge.

The customer will be billed for parts plus standard labor rates in effect at the time of repair. The customer will also be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC before the repaired equipment may be shipped to the customer. A description of the labor and materials used will be provided in the Equipment Repair Report.

Once an out-of-warranty repair is made, the repaired part or component is warranted for 90 days. This warranty applies only to the part or component that was repaired; other parts or components are not covered under the 90-day repair warranty.

10.3.4 Equipment Return Instructions

To all equipment returned for repair, the customer should attach a tag that includes the following information.

(1) Owner's name and address.

(2) A list of the equipment being returned and the applicable serial number(s).

(3) A detailed description of the problem or service requested.

(4) The name and telephone number of the person to contact regarding questions about the repair.

(5) The Return Authorization (RA) number.

NOTE: The Return Authorization (RA) number must be obtained from TTC's Repair Department before the unit can be shipped to TTC.

If a mainframe is being returned, it is recommended that all switches be left in the positions they were in when the problem occurred. The interface in use at the time of the failure should also be returned.

When possible, the FIREBERD 4000 should be returned in the original shipping container and packing material. If the unit is returned for servicing, please attach a completed return tag. To ensure careful handling mark the shipping container "FRAGILE". In addition, mark the TTC-issued Return Authorization (RA) number on the outside of the shipping container.

If the original container is not available, the unit should be carefully packaged so that it will not be damaged in transit. The following instructions should be used for repacking the FIREBERD 4000 with commercially available materials.

(1) Attach a completed return tag to the unit.

(2) Double wrap the unit in heavy paper or plastic.

(3) Use a heavy duty, double-walled carton of 350-pound test material.

(4) Surround the unit on ALL sides with a minimum of 4 to 5 inches of shock absorbing packaging material. This will provide firm cushioning and prevent movement inside the container. Protect the front and rear panels with extra packaging material.

(5) Seal the top and bottom of the shipping container with strong shipping tape or metal bands.

(6) Clearly and legibly mark the shipping container FRAGILE.

(7) Clearly mark the TTC-issued RA number on the outside of the container and ship it prepaid and insured to TTC.

NOTE: TTC is not liable for any damage that may occur during shipping.

Telecommunication Techniques Corporation
Repair Department RA NO._____
20410 Observation Drive
Germantown, Maryland 20876

NOTE: In all accompanying correspondence to the TTC Repair Department, refer to the unit by model number and full serial number.

APPENDIX A
HEXADECIMAL CONVERSION TABLE

HEX	BAUDOT LTRS	BAUDOT FIGS	BCDIC UPPER	BCDIC LOWER	ASCII	EBCDIC
00	Blank	Blank	Space	Space	NUL (Blank)	NUL (Null)
01	E	3	=	1	SOH (Start of Header)	SOH (Start of Header)
02	LF	LF	<	2	STX (Start of Text)	STX (Start of Text)
03	A	-	:	3	EXT (End of Text)	EXT (End of Text)
04	Space	Space	:	4	EOT (End of Transmission)	PF (Punch Off)
05	S	' or BELL	%	5	ENQ (Enquiry)	HT (Horizontal Tab)
06	I	8	'	6	ACK (Acknowledge)	LC (Lower Case)
07	U	7	>	7	BEL (Bell)	DEL (Delete)
08	CR	CR	*	8	BS (Backspace)	
09	D	WRU or $	(	9	HT (Horizontal Tabulation)	RLF
0A	R	4	)	0	LF (Line Feed)	SMM (Start Manual Message)
0B	J	BELL or '	"	#	VT (Vertical Tabulation)	VT (Vertical Tab)
0C	N	,	DC2	DC2	FF (Form Feed)	FF (Form Feed)
0D	F	!	RS	RS	CR (Carriage Return)	CR (Carriage Return)
0E	C	:	UPPER	UPPER	SO (Shift Out)	SO (Shift Out)
0F	K	(	EOT	EOT	SI (Shift In)	SI (Shift In)
10	T	5	CAN	@	DLE (Data Link Escape)	DLE (Data Link Escape)
11	Z	+ or "	?	/	DC1 (Device Control 1)	DC1 (Device Control 1)
12	L	)	S	s	DC2 (Device Control 2)	DC2 (Device Control 2)
13	W	2	T	t	DC3 (Device Control 3)	DC3 (Device Control 3)
14	H	#	U	u	DC4 (Device Control 4)	RES (Restore)
15	Y	6	V	v	NAK (Negative Acknowledge)	NL (New Line)
16	P	0	W	w	SYN (Synchronization)	BS (Backspace)
17	Q	1	X	x	ETB (End of Text Block)	IL (Idle)
18	O	9	Y	y	CAN (Cancel)	CAN (Cancel)
19	B	?	Z	z	EM (End of Medium)	EM (End of Medium)
1A	G	&			SUB (Substitute)	CC (Cursor Control)
1B	FIGS	FIGS			ESC (Escape)	CU1 (Customer Use 1)
1C	M	.	BEL	BEL	FS (File Separator)	IFS (Interchange File Sep.)
1D	X	/	LF	LF	GS (Group Separator)	IGS (Interchange Group Sep.)
1E	V	= or ;	ETB	ETB	RS (Record Separator)	IRS (Interchange Record Sep.)
1F	LTRS	LTRS	DC3	DC3	US (Unit Separator)	IUS (Interchange Unit Sep.)

HEX	BAUDOT LTRS	BAUDOT FIGS	BCDIC UPPER	BCDIC LOWER	ASCII	EBCDIC
20	Blank	Blank		_	SP	DS (Digit Select)
21	E	3	J	j	!	SOS (Start of Significance)
22	LF	LF	K	k	"	FS (Field Separator)
23	A		L	l	#	
24	Space	Space	M	m	$	BYP (Bypass)
25	S	' or BELL	N	n	%	LF (Line Feed)
26	I	8	O	o	&	ETB (End Transmission Block)
27	U	7	P	p	` (Single Closing Quote)	ESC (Escape)
28	CR	CR	Q	q	(	
29	D	WRU or $	R	r	)	
2A	R	4			*	SM (Set Mode)
2B	J	BELL or '	!	$	+	CU2 (Customer Use 2)
2C	N	,	DC4	DC4	, (Comma)	
2D	F	!	CR	CR	- (Hyphen)	ENQ (Enquiry)
2E	C	:	BS	BS	. (Period)	ACK (Acknowledge)
2F	K	(	DLE	DLE	/	BEL (Bell)
30	T	5	+	&	0	
31	Z	+ or "	A	a	1	
32	L	)	B	b	2	SYN (Synchronous Idle)
33	W	2	C	c	3	
34	H	#	D	d	4	PN (Punch On)
35	Y	6	E	e	5	RS (Reader Stop)
36	P	0	F	f	6	UC (Upper Case)
37	Q	1	G	g	7	EOT (End of Transmission)
38	O	9	H	h	8	
39	B	?	I	i	9	
3A	G	&			:	
3B	FIGS	FIGS			;	CU3 (Customer Use 3)
3C	M	.	DC1	DC1	< (Less Than)	DC4 (Device Control 4)
3D	X	/	HT	HT	=	NAK (Negative Acknowledge)
3E	V	= or ;	LOWER	LOWER	> (Greater Than)	
3F	LTRS	LTRS	DEL	DEL	?	SUB (Substitute)

HEXADECIMAL CONVERSION TABLE (CONTINUED)

HEX	BAUDOT		BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
40	Blank	Blank	Space	Space	@	SP (Space)
41	E	3	=	1	A	
42	LF	LF	<	2	B	
43	A		;	3	C	
44	Space	Space	:	4	D	
45	S	' or BELL	%	5	E	
46	I	8	'	6	F	
47	U	7	>	7	G	
48	CR	CR	*	8	H	
49	D	WRU or $	(	9	I	
4A	R	4	)	0	J	¢
4B	J	BELL or '	"	#	K	. (Period)
4C	N	,	DC2	DC2	L	< (Less Than)
4D	F	!	RS	RS	M	(
4E	C	:	UPPER	UPPER	N	+
4F	K	(	EOT	EOT	O	| (Logical OR)
50	T	5	CAN	@	P	&
51	Z	+ or "	?	/	Q	
52	L	)	S	s	R	
53	W	2	T	t	S	
54	H	#	U	u	T	
55	Y	6	V	v	U	
56	P	0	W	w	V	
57	Q	1	X	x	W	
58	O	9	Y	y	X	
59	B	?	Z	z	Y	
5A	G	&			Z	!
5B	FIGS	FIGS	.	.	[(Opening Bracket)	$
5C	M	.	BEL	BEL	\ (Reverse Slant)	*
5D	X	/	LF	LF	] (Closing Bracket)	)
5E	V	= or ;	ETB	ETB	↑ (Circumflex)	;
5F	LTRS	LTRS	DC3	DC3	← (Underline)	¬ (Logical NOT)

HEX	BAUDOT		BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
60	Blank	Blank			` (Opening Single Quote)	- (Hyphen)
61	E	3	J	j	a	/
62	LF	LF	K	k	b	
63	A		L	l	c	
64	Space	Space	M	m	d	
65	S	' or BELL	N	n	e	
66	I	8	O	o	f	
67	U	7	P	p	g	
68	CR	CR	Q	q	h	
69	D	WRU or $	R	r	i	
6A	R	4			j	| (Vertical Line)
6B	J	BELL or '	!	$	k	, (Comma)
6C	N	,	DC4	DC4	l	%
6D	F	!	CR	CR	m	_ (Underline)
6E	C	:	BS	BS	n	> (Greater Than)
6F	K	(	DLE	DLE	o	?
70	T	5	+	&	p	
71	Z	+ or "	A	a	q	
72	L	)	B	b	r	
73	W	2	C	c	s	
74	H	#	D	d	t	
75	Y	6	E	e	u	
76	P	0	F	f	v	
77	Q	1	G	g	w	
78	O	9	H	h	x	
79	B	?	I	i	y	` (Opening Quote)
7A	G	&			z	:
7B	FIGS	FIGS	.	.	{ (Opening Brace)	#
7C	M	.	DC1	DC1	| (Vertical Line)	@
7D	X	/	HT	HT	} (Closing Brace)	'
7E	V	= or ;	LOWER	LOWER	~ (Overline Tilde)	=
7F	LTRS	LTRS	DEL	DEL	DEL (Delete/Rubout)	"

HEXADECIMAL CONVERSION TABLE (CONTINUED)

HEX	BAUDOT		BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
80	Blank	Blank	Space	Space	NUL (Blank)	
81	E	3	=	1	SOH (Start of Header)	a
82	LF	LF	<	2	STX (Start of Text)	b
83	A	—	:	3	EXT (End of Text)	c
84	Space	Space	:	4	EOT (End of Transmission)	d
85	S	; or BELL	%	5	ENQ (Enquiry)	e
86	I	8	`	6	ACK (Acknowledge)	f
87	U	7	>	7	BEL (Bell)	g
88	CR	CR	*	8	BS (Backspace)	h
89	D	WRU or $	(	9	HT (Horizontal Tabulation)	i
8A	R	4	)	0	LF (ne Feed)	
8B	J	BELL or '	"	#	VT (ertical Tabulation)	
8C	N	,	DC2	DC2	FF (Form Feed)	
8D	F	!	RS	RS	CR (Carriage Return)	
8E	C	:	UPPER	UPPER	SO (Shift Out)	
8F	K	(	EOT	EOT	SI (Shift In)	
90	T	5	CAN	@	DLE (Data Link Escape)	
91	Z	+ or "	?	/	DC1 (Device Control 1)	j
92	L	)	S	s	DC2 (Device Control 2)	k
93	W	2	T	t	DC3 (Device Control 3)	l
94	H	#	U	u	DC4 (Device Control 4)	m
95	Y	6	V	v	NAK (Negative Acknowledge)	n
96	P	0	W	w	SYN (Synchronization)	o
17	Q	1	X	x	ETB (End of Text Block)	p
98	O	9	Y	y	CAN (Cancel)	q
99	B	?	Z	z	EM (End of Medium)	r
9A	G	&			SUB (Substitute)	
9B	FIGS	FIGS			ESC (Escape)	
9C	M	.	BEL	BEL	FS (File Separator)	
9D	X	/	LF	LF	GS (Group Separator)	
9E	V	= or ;	ETB	ETB	RS (Record Separator)	
9F	LTRS	LTRS	DC3	DC3	US (Unit Separator)	

HEX	BAUDOT		BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
A0	Blank	Blank		—	SP (Space)	
A1	E	3	J	j	!	~
A2	LF	LF	K	k	"	s
A3	A		L	l	#	t
A4	Space	Space	M	m	$	u
A5	S	' or BELL	N	n	%	v
A6	I	8	O	o	&	w
A7	U	7	P	p	' (Single Closing Quote)	x
A8	CR	CR	Q	q	(	y
A9	D	WRU or $	R	r	)	z
AA	R	4			*	
AB	J	BELL or '	!	$	+	
AC	N	,	DC4	DC4	, (Comma)	
AD	F	!	CR	CR	- (Hyphen)	
AE	C	:	BS	BS	. (Period)	
AF	K	(	DLE	DLE	/	
B0	T	5	+	&	0	
B1	Z	+ or "	A	a	1	
B2	L	)	B	b	2	
B3	W	2	C	c	3	
B4	H	#	D	d	4	
B5	Y	6	E	e	5	
B6	P	0	F	f	6	
B7	Q	1	G	g	7	
B8	O	9	H	h	8	
B9	B	?	I	i	9	
BA	G	&			:	
BB	FIGS	FIGS			;	
BC	M	.	DC1	DC1	< (Less Than)	
BD	X	/	HT	HT	=	
BE	V	= or ;	LOWER	LOWER	> (Greater Than)	
BF	LTRS	LTRS	DEL	DEL	?	

HEXADECIMAL CONVERSION TABLE (CONTINUED)

HEX	BAUDOT		BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
C0	Blank	Blank	Space	Space	@	{
C1	E	3	=	1	A	A
C2	LF	LF	<	2	B	B
C3	A	-	:	3	C	C
C4	Space	Space	;	4	D	D
C5	S	' or BELL	%	5	E	E
C6	I	8	'	6	F	F
C7	U	7	>	7	G	G
C8	CR	CR	*	8	H	H
C9	D	WRU or $	(	9	I	I
CA	R	4	)	0	J	
CB	J	BELL or '	"	#	K	
CC	N	,	DC2	DC2	L	
CD	F	!	RS	RS	M	
CE	C	:	UPPER	UPPER	N	
CF	K	(	EOT	EOT	O	
D0	T	5	CAN	@	P	}
D1	Z	+ or "	?	/	Q	J
D2	L	)	S	s	R	K
D3	W	2	T	t	S	L
D4	H	#	U	u	T	M
D5	Y	6	V	v	U	N
D6	P	0	W	w	V	O
D7	Q	1	X	x	W	P
D8	O	9	Y	y	X	Q
D9	B	?	Z	z	Y	R
DA	G	&			Z	
DB	FIGS	FIGS			[(Opening Bracket)	
DC	M	.	BEL	BEL	\ (Reverse Slant)	
DD	X	/	LF	LF	] (Closing Bracket)	
DE	V	= or ;	ETB	ETB	^ (Circumflex)	
DF	LTRS	LTRS	DC3	DC3	_ (Underline)	

HEX			BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
E0	Blank	Blank		_	` (Opening Single Quote)	/ (Reverse Slash)
E1	E	3	J	j	a	
E2	LF	LF	K	k	b	S
E3	A		L	l	c	T
E4	Space	Space	M	m	d	U
E5	S	; or BELL	N	n	e	V
E6	I	8	O	o	f	W
E7	U	7	P	p	g	X
E8	CR	CR	Q	q	h	Y
E9	D	WRU or $	R	r	i	Z
EA	R	4			j	
EB	J	BELL or '	!	$	k	
EC	N	,	DC4	DC4	l	
ED	F	!	CR	CR	m	_ (Underline)
EE	C	:	BS	BS	n	
EF	K	(	DLE	DLE	o	
F0	T	5	+	&	p	0
F1	Z	+ or "	A	a	q	1
F2	L	)	B	b	r	2
F3	W	2	C	c	s	3
F4	H	#	D	d	t	4
F5	Y	6	E	e	u	5
F6	P	0	F	f	v	6
F7	Q	1	G	g	w	7
F8	O	9	H	h	x	8
F9	B	?	I	i	y	9
FA	G	&			z	
FB	FIGS	FIGS			{ (Opening Brace)	
FC	M	.	DC1	DC1	| (Vertical Line)	
FD	X	/	HT	HT	} (Closing Brace)	
FE	V	= or ;	LOWER	LOWER	~ (Overline Tilde)	
FF	LTRS	LTRS	DEL	DEL	DEL (Delete/Rubout)	

INTERFACE MODEL: —

DISPLAY ID: **INT188**

OPERATING MODE: ASYNC

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	CHAR ERR*	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	DATE
	TEST SEC	DAT RATE	ELAP SEC
	DELAY	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in SYNC mode

INTERFACE MODEL: — **DISPLAY ID: INT232**

OPERATING MODE: ASYNC

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	CHAR ERR*	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	DATE
	TEST SEC	DAT RATE	ELAP SEC
	DELAY	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in SYNC mode

INTERFACE MODEL: 30447A **DISPLAY ID: DS1C/2**

OPERATING MODE: NORM

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE	BPVs*	BPV Rate*	AVG BPVR*
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in BPV mode

INTERFACE MODEL: 30481 **DISPLAY ID: DS0**

OPERATING MODE: —

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 30524 **DISPLAY ID: 8MG703**

OPERATING MODE: NORM

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE	CODE ERR*	CER*	AVG CER*
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in CODE mode

INTERFACE MODEL: 30608 **DISPLAY ID: 64G703**

OPERATING MODE: —

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 30609 **DISPLAY ID: 2MG704**

OPERATING MODE: FRAMED/CRC4

ANALYSIS RESULTS

ERROR	BIT ERRS	PAT LOSS	AVG BER
	BER	PAT SLIP	
INTERFACE	CODE ERR	CER	AVG CER
	CRC ERR*	AVG CRC*	FAS ERR**
	AVG FAS**	1 SEC CRC*	
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in FRAMED/CRC4 mode

**Available in FRAMED/CRC4 and FRAMED modes

INTERFACE MODEL: 30678 **DISPLAY ID: DS0A/B**

OPERATING MODE: FRAMED

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE	FRA ERR*	AVG FER*	RCV BYTE
	RCV CODE		
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Not available in UNFRAMED mode

INTERFACE MODEL: 40112 **DISPLAY ID: RS-232**

OPERATING MODE: DTE

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS AVG
	BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40138 **DISPLAY ID: V.35**

OPERATING MODE: DTE

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40151 **DISPLAY ID: DS1**

OPERATING MODE: —

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40182 **DISPLAY ID: WEC303**

OPERATING MODE: —

		ANALYSIS RESULTS	
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40198 **DISPLAY ID: RS-449**

OPERATING MODE: BRIDGE

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40200 **DISPLAY ID: RS-449**

OPERATING MODE: DCE/DTE

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS AVG
BER	BLOCKS	BER	
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	TEST SEC	DAT RATE	ELAP SEC ERR
	GEN FREQ	TIME	DELAY
	DATE	SEC	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40202 **DISPLAY ID: V.35**

OPERATING MODE: DCE/DTE

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS AVG
BER	BLOCKS	BER	
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40204 **DISPLAY ID: LAB**

OPERATING MODE: —

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40226 **DISPLAY ID: MILUNB**

OPERATING MODE: —

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40232 **DISPLAY ID: RS-232**

OPERATING MODE: ISOCH

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40234 **DISPLAY ID: RS-232**

OPERATING MODE: ASYNC

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40236 **DISPLAY ID: RS-232**

OPERATING MODE: DTE/DCE

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40263 **DISPLAY ID: RS-449**

OPERATING MODE: DTE

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40298 **DISPLAY ID: MILBAL**

OPERATING MODE: —

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40323 **DISPLAY ID: G.703**

OPERATING MODE: 64 kb/s

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS AVG
BER	BLOCKS	BER	
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40365 **DISPLAY ID: T1**

OPERATING MODE: NORM

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE	BPVs*	BPV Rate*	AVG BPVR*
TIME & SIGNAL	PATL SEC**	% EFS**	RCV FREQ
	DATE	TEST SEC**	DAT RATE
	ELAP SEC	ERR SEC**	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in BPV mode
**Available in NORM mode

INTERFACE MODEL: 40380 **DISPLAY ID: 2.048M**

OPERATING MODE: NORM

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE	CODE ERR*	CER*	AVG CER*
TIME & SIGNAL	PATL SEC**	% EFS**	RCV FREQ
	DATE	TEST SEC**	DAT RATE
	ELAP SEC	ERR SEC**	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in BPV mode
**Available in NORM mode

INTERFACE MODEL: 40392 **DISPLAY ID: RS-232**

OPERATING MODE: CHAR

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	DELAY	PATL SEC
	ERR SEC	GEN FREQ	TIME
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 40405 **DISPLAY ID: DS1/D4**

OPERATING MODE: NORM

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE	CODE ERR*	CER*	AVG CER*
TIME & SIGNAL	PATL SEC**	% EFS**	RCV FREQ
	DATE	TEST SEC**	DAT RATE
	ELAP SEC	ERR SEC**	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in BPV mode
**Available in NORM mode

INTERFACE MODEL: 40460 **DISPLAY ID: DS1/Fe**

OPERATING MODE: D4

	ANALYSIS RESULTS		
ERROR	BIT ERRS	PAT LOSS	AVG BER
	BER	PAT SLIP	
INTERFACE	BPVs	BPV Rate	AVG BPVR
	FRA ERR**	AVG FER**	CRC ERR*
	AVG CRC*		
TIME & SIGNAL	PATL SEC**	% EFS**	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in ESF mode
**Available in D4 mode

INTERFACE MODEL: 40540 **DISPLAY ID: DS1/T1**

OPERATING MODE: D4/SLC96

ANALYSIS RESULTS

ERROR	BIT ERRS	PAT LOSS	AVG BER
	BER	PAT SLIP	
INTERFACE	BPVs	BPV Rate	AVG BPVR
FRA ERR*	AVG FER*	CRC ERR**	AVG CRC**
TIME & SIGNAL	PATL SEC*	% EFS*	RCV FREQ
	TEST SEC	DAT RATE	ELAP SEC ERR
	GEN FREQ	TIME	DATE
	SEC		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

*Available in D4/SLC96 mode
**Available in ESF mode

INTERFACE MODEL: 41131 **DISPLAY ID: DDS**

OPERATING MODE: —

	ANALYSIS RESULTS		
ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE	FRA ERR	AVG FER	SMPX CUR
TIME & SIGNAL	PATL SEC	% EFS	DATE
	TEST SEC	DAT RATE	ELAP SEC
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 41400 **DISPLAY ID: MIL-449**

OPERATING MODE: DTE/DCE

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	CHAR ERR
INTERFACE			
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	TEST SEC	DAT RATE
	ELAP SEC	ERR SEC	GEN FREQ
	TIME		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

INTERFACE MODEL: 41440 **DISPLAY ID: T1/FT1**

OPERATING MODE: —

	ANALYSIS RESULTS		
ERROR[1]	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BER	PAT SLIP
INTERFACE	BPVs	RCV BOM[2]	RX LVL dB
	AVG BPVR	MAX 0'S	BPV Rate
	BIT SLIP	AVG FER	RX ABCD[3]
	R LVL V	RCV BYTE[4]	
TIME & SIGNAL	PATL SEC	% EFS	RCV FREQ
	DATE	N LVL dB	TEST SEC
	DAT RATE	P LVL V	PP LVL V
	ELAP SEC	P LVL dB	LVL dBm
	ERR SEC	GEN FREQ	TIME
	N LVL V		
PERFORMANCE	AVL SEC	% DEG MIN	SES
	UNA SEC	G EFS	% SES
	% AVL SEC	GERR SEC	DEG MIN
	G % EFS	SES	ERR-SES
	BER-SES		

[1] Not valid in VOICE or RS232 modes
[2] ESF frame only
[3] available in VOICE mode
[4] Framed mode only

APPENDIX C
ANALYSIS RESULTS DEFINITIONS

%AVL SEC *Percent of Available Seconds* - The ratio of available seconds to the total number of seconds counted since pattern synchronization. Expressed as a percentage. See AVL SEC and Appendix F. (PERFORMANCE category, Option 4004)

%DEG MIN *Percent of Degraded Minutes* - The ratio of degraded minutes to the total number of minutes consisting of the available non-severely errored seconds counted since pattern synchronization. Expressed as a percentage. See DEG MIN and Appendix F. (PERFORMANCE category, Option 4004)

%EFS *Percent of Error-Free Seconds* - The ratio of error-free seconds to the total number of pattern synchronization seconds. Error-free seconds are the difference between pattern synchronization seconds and errored seconds. Expressed as a percentage. See Pattern Synchronization Seconds and ERR SEC. (TIME & SIGNAL category)

%SES *Percent of Severely Errored Seconds* - The ratio of severely errored seconds to the total number of available seconds. Expressed as a percentage. See SES, AVL SEC, and Appendix F. (PERFORMANCE category, Option 4004)

1SEC CRC *One-Second Cyclic Redundancy Check Errors* - The total number of CRC errors counted in the last test second. (INTERFACE category)

AVG BER *Average Bit Error Rate* - The average bit error rate occurring during the test period starting from pattern synchronization. AVG BER is calculated by dividing the total number of bit errors counted by the total number of bits counted since pattern synchronization. Expressed in exponential form. See BIT ERRS. (ERROR category)

AVG BLER *Average Block Error Rate* - The average block error rate occurring during the test starting from pattern synchronization. AVG BLER is calculated by dividing the total number of block errors counted by the total number of blocks counted since pattern synchronization. Expressed in exponential form. See BLK ERRS and BLOCKS. (ERROR category)

AVG BPVR *Average Bipolar Violation Rate* - The average bipolar violation rate occurring during a test period starting from pattern synchronization. AVG BPVR is calculated by dividing the total number of bipolar violations counted by the total number of bits counted after signal presence is detected. Expressed in exponential form. See BPVs. (INTERFACE category)

AVG CER *Average Code Error Rate* - The average code error rate occurring during the test period starting from pattern synchronization. AVG CER is calculated by dividing the total number of code errors counted by the total number of bits counted after signal presence is detected. Expressed in exponential form. See CODE ERR. (INTERFACE category)

AVG CRC *Average Cyclic Redundancy Check Error Rate* - The average CRC error rate occurring during the test period starting from pattern synchronization. AVG CRC is calculated by dividing the total number of CRC block errors counted by the total number of CRC blocks counted after signal presence is detected. Expressed in exponential form. See CRC ERR. (INTERFACE category)

AVG FAS *Average Frame Alignment Signal (FAS) Error Rate* - The average frame alignment signal error rate occurring during the test period starting from pattern synchronization. AVG FAS is calculated by dividing the total number of FAS errors counted by the total number of FAS blocks counted after signal presence is detected. Expressed in exponential form. See FAS ERR. (INTERFACE category)

AVG FER *Average Frame Error Rate* - The average frame error rate occurring during the test period starting from pattern synchronization. AVG FER is calculated by dividing the total number of frame errors counted by the total number of framing bits counted after frame synchronization occurs. See FRA ERR. (INTERFACE category)

ANALYSIS RESULTS DEFINITIONS (Continued)

AVL SEC *Available Seconds* - The total number of available seconds, as determined by CCITT Recommendation G.821 criteria. See Appendix F. (PERFORMANCE category, Option 4004)

BER *Bit Error Rate* - The total number of bit errors counted over the last test interval divided by the total number of data bits counted in the last test interval. Expressed in exponential form. See BIT ERRS. (ERROR category)

BER-SES *Bit Error Rate* - The ratio of "Errors SES" to the total number of data bits received since the initial pattern synchronization excluding those received during sync loss seconds and severely errored seconds.

BIT ERRS *Bit Errors* - The total number of errored data bits counted since pattern synchronization. (ERROR and SUMMARY categories)

BIT SLIP *Bit Slips* - The number of bit slips counted in a frame since pattern synchronization. (INTERFACE category)

BLK ERRS *Block Errors* - The total number of complete blocks received that contain one or more bit errors since pattern synchronization. See BLOCKS. (ERROR category)

BLOCKS *Blocks* - The total number of complete blocks received since pattern synchronization. The block length is set through the Auxiliary Block Length menu. (ERROR category)

BPV Rate *Bipolar Violation Rate* - The total number of bipolar violations counted in the last test interval divided by the total number of bits counted in the last test interval. See BPVs. (INTERFACE category)

BPVs *Bipolar Violations* - The total number of invalid bipolar violations counted after signal presence is detected. (INTERFACE and SUMMARY categories)

CER *Code Error Rate* - The total number of code errors counted in the last test interval divided by the total number of bits counted in the last test interval. See CODE ERR. (INTERFACE category)

CHAR ERR *Character Errors* - The total number of errored characters received that contain at least one bit error. Only appears in asynchronous timing mode. (ERROR and SUMMARY categories)

CODE ERR *Code Errors* - The total number of code errors counted after signal presence is detected. Result only applies to G.703 and G.704 interfaces. (INTERFACE and SUMMARY categories)

CRC ERR *Cyclic Redundancy Check Errors* - The total number of CRC errors counted since the beginning of the test. (INTERFACE and SUMMARY categories)

DATE *Date* - The calendar date in day, month, and year. The date is set through the Auxiliary Date menu. (TIME & SIGNAL category)

DAT RATE *Data Rate* - The receive data rate in b/s of the channel being analyzed, i.e., the primary or secondary channel. (TIME & SIGNAL category)

DEG MIN *Degraded Minutes* - The total number of minutes where the average BER is worse than 10^{-6}. Note that CCITT Recommendation G.821 relaxes this requirement somewhat at 64 kb/s so that when the average bit rate over 60 seconds is 64 kb/s, and four bit errors are counted, corresponding to an average BER of 1.042×10^{-6}, the minute is not considered to be degraded. See Appendix F. (PERFORMANCE category, Option 4004)

DELAY *RTS/CTS Delay* - The measured time interval between Request to Send (RTS) going HIGH and Clear to Send (CTS) going HIGH. The result is displayed in milliseconds from 0 to 9,999 and >9999 ms. (TIME & SIGNAL category)

ELAP SEC *Elapsed Seconds* - The total number of seconds counted, based on the time-of-day clock, since the last major switch change or test restart occurred. Test seconds may or may not start at the same time. See TEST SEC. (TIME & SIGNAL category)

ERR SEC *Errored Seconds* - The total number of test seconds where at least one bit error occurred. See TEST SEC. (TIME & SIGNAL category)

ANALYSIS RESULTS DEFINITIONS (Continued)

ERR-SES *Errors-SES* - The number of bit errors counted since the initial pattern synchronization excluding those counted during sync loss seconds and severely errored seconds.

FAS ERR *Frame Alignment Signal Errors* - The total number of errored frame alignment signal bits counted after frame synchronization occurs. (INTERFACE and SUMMARY categories)

FRA ERR *Frame Errors* - The total number of errored framing bits counted after frame synchronization occurs. RECEIVER panel FRAME SYNC LED illuminates. (INTERFACE and SUMMARY categories)

G %EFS *G.821 Percent of Error-Free Seconds* - The ratio of error-free seconds to the total number of available seconds, as error-free seconds applies to CCITT Recommendation G.821. Expressed as a percentage. See G EFS, AVL SEC, and Appendix F. (PERFORMANCE category, Option 4004)

G EFS *G.821 Error-Free Seconds* - The total number of available seconds in which no bit errors are counted, as error-free seconds applies to CCITT Recommendation G.821. See Appendix F. (PERFORMANCE category, Option 4004)

GEN FREQ *Generator Clock Frequency* - The current generator clock frequency in Hertz. (TIME & SIGNAL category)

GERR SEC *G.821 Errored Seconds* - The total number of available seconds with at least one bit error. See AVL SEC and Appendix F. (PERFORMANCE category, Option 4004)

LVL V *Level in Volts* - The receive level expressed in 0.1V steps from +6.0V to -6.0V. (TIME & SIGNAL category)

LVL dB *Level in dB* - The receive level expressed in 0.1dB steps from +6dB to -40dB. (TIME & SIGNAL category)

PP LVL V *Peak to Peak Level in Volts* - The receive peak to peak level in 0.1V steps from +12.0V to -12.0V. (TIME & SIGNAL category)

LVL dBm *Level in dBm* - The receive level in 0.1dBm steps from +22.5 to -23.5 dBm. Only available when all ones, AIS signal, is detected. (TIME & SIGNAL category)

MAX O's *Maximum Zeros* - The maximum number of consecutive zeros counted since the last test restart. (INTERFACE category)

PAT LOSS *Pattern Synchronization Loss* - The total number of pattern synchronization losses occurring during a test period. ALARMS panel PATTERN LOSS LED illuminates. (ERROR and SUMMARY categories)

PAT SLIP *Pattern Slips* - The total number of occurrences where extra or missing data bits are detected in the received data. This result only appears when pseudorandom patterns are received. ALARMS panel PATTERN SLIP LED illuminates. (ERROR and SUMMARY categories)

PATL SEC *Pattern Loss Seconds* - The number of seconds during which pattern synchronization is lost. (TIME & SIGNAL category)

Pattern Sync Seconds The number of test seconds having pattern synchronization during any portion of the second.

RCV BOM *Received Bit Oriented Message* - The ASCII message of the BOM present on the data link. (INTERFACE category)

RCV BYTE *Receive Byte Code* - The received byte in binary form every 150 milliseconds. Result only appears when the DDS DS0A/B Data Interface (Model 30678) is selected. (INTERFACE category)

RCV CODE *Receive Code Name* - The control code name of the received byte displayed in the RCV BYTE result. Result only appears when the DDS DS0A/B Data Interface (Model 30678) is selected. (INTERFACE category)

RCV FREQ *Receiver Clock Frequency* - The current receiver clock frequency in Hertz. (TIME & SIGNAL category)

ANALYSIS RESULTS DEFINITIONS (Continued)

R LVL dB — *Receive Level in dB* - The receive level expressed in 1.0 dB steps. (INTERFACE category)

R LVL V — *Receive Level in Volts* - The receive level expressed in volts in 0.01 volt steps. (INTERFACE category)

RX ABCD — *Receive ABCD* - The binary status of the ABCD signal bits of the selected DSO channel. (INTERFACE category)

SES — *Severely Errored Seconds* - The total number of available seconds during which the BER is worse than 10^{-3}, as severely errored seconds applies to CCITT Recommendation G.821. See Appendix F. (PERFORMANCE category, Option 4004)

SMPX CUR — *Simplex Current* - The simplex current level in milliamps in 1 mA steps and polarity

Test Interval — Every 10 seconds, starting with pattern synchronization. Used to calculate error rates, i.e., BER, BPV Rate, and CER.

Test Period — Starts at pattern synchronization and continues to each reading of the results.

TEST SEC — *Test Seconds* - The total number of seconds counted after initial pattern synchronization. RECEIVER panel PATTERN SYNC LED illuminates at pattern synchronization. (TIME & SIGNAL category)

TIME — *Time* - The time of day in hours, minutes, and seconds. Hours are presented in a 24-hour format. The time is set through the Auxiliary Time menu. (TIME & SIGNAL category)

UNA SEC — *Unavailable Seconds* - The total number of unavailable seconds determined by CCITT Recommendation G.821 criteria. See Appendix F. (PERFORMANCE category, Option 4004)

APPENDIX D
MAINFRAME STATUS AND ERROR MESSAGES

ASYNC FREQUENCY CONTENTION - The selected frequency is not compatible with asynchronous operation. Any frequency above 20 kHz generates this message.

ASYNC PATTERN CONTENTION - The selected test pattern is not compatible with asynchronous operation. The patterns include: 1:7, 3IN24, 2^{20}-1, 2^{23}-1, QRSS, and PROGRM.

CLEARING NOVRAM - Occurs when an option has been changed. All mainframe configurations are defaulted when the non-volatile RAM is cleared.

GENERATOR CLK NOT PRESENT - The mainframe has not detected a clock signal.

KEY STUCK - ALARM RST - The ALARM RESET key is stuck during power-up.

KEY STUCK - CTRL PRT - The PRINTER CONTROLS print key is stuck during power-up.

KEY STUCK - CUR LEFT - The left cursor key is stuck during power-up.

KEY STUCK - CUR RIGHT - The right cursor key is stuck during power-up.

KEY STUCK - DISP HOLD - The DISPLAY HOLD key is stuck during power-up.

KEY STUCK - ENTER - The ENTER key is stuck during power-up.

KEY STUCK - ERR INS - The ERROR INSERT key is stuck during power-up.

KEY STUCK - EVENT PRT - The PRINTER print event key is stuck during power-up.

KEY STUCK - HOME - The HOME key is stuck during power-up.

KEY STUCK - LOOP DOWN - The bottom Interface Status and Control Panel key is stuck during power-up.

KEY STUCK - LOOP UP - The top Interface Status and Control Panel key is stuck during power-up.

KEY STUCK - MORE - The MORE key is stuck during power-up.

KEY STUCK - RE CT1 DN - The left RESULT CATEGORY switch is stuck on the down arrow during power-up.

KEY STUCK - RE CT1 UP - The left RESULT CATEGORY switch is stuck on the up arrow during power-up.

KEY STUCK - RE CT2 DN - The right RESULT CATEGORY switch is stuck on the down arrow during power-up.

KEY STUCK - RE CT2 UP - The right RESULT CATEGORY switch is stuck on the up arrow during power-up.

KEY STUCK - RE SL1 LF - The left RESULT SELECT switch is stuck on the left arrow during power-up.

KEY STUCK - RE SL1 RT - The left RESULT SELECT switch is stuck on the right arrow during power-up.

KEY STUCK - RE SL2 LF - The right RESULT SELECT switch is stuck on the left arrow during power-up.

KEY STUCK - RE SL2 RT - The right RESULT SELECT switch is stuck on the right arrow during power-up.

KEY STUCK - RESTART - The RESTART key is stuck during power-up.

KEY STUCK - RSLT PRT - The PRINTER RESULTS print key is stuck during power-up.

KEY STUCK - SELF LOOP - The SELF LOOP key is stuck during power-up.

KEY STUCK - SOFTKEY 1 - The first softkey from the left is stuck during power-up.

KEY STUCK - SOFTKEY 2 - The second softkey from the left is stuck during power-up.

KEY STUCK - SOFTKEY 3 - The third softkey from the left is stuck during power-up.

KEY STUCK - SU CAT DN - The SETUP CATEGORY switch is stuck on the down arrow during power-up.

KEY STUCK - SU CAT UP - The SETUP CATEGORY switch is stuck on the up arrow during power-up.

KEY STUCK - SU SEL LF - The SETUP SELECT switch is stuck on the left arrow during power-up.

MAINFRAME STATUS AND ERROR MESSAGES (Continued)

KEY STUCK - SU SEL RT - The SETUP SELECT switch is stuck on the right arrow during power-up.

No frame - Appears in the RCV FREQ result of the ANALYSIS RESULTS TIME & SIGNAL category when the mainframe has not detected framing.

OPTIONS HAVE CHANGED - The configuration of the mainframe has changed. Usually occurs when an option is added or removed.

RCV DATA INVERTED - The received data is inverted. Change the interface panel switch settings to accept the inverted data.

RCV DATA LOSS - Received data is not being detected.

RESULTS OK - Appears in the ANALYSIS RESULTS SUMMARY category when the mainframe is not reporting any of the possible error results that can be reported in the SUMMARY category.

RESULTS UNAVAIL - Appears in the ANALYSIS RESULTS SUMMARY category when the mainframe has not synchronized or has lost the received signal.

SYNC PATTERN CONTENTION - The selected test pattern is not compatible with synchronous operation. The patterns include: FOX and USER1-3 patterns. This message does not appear when the Synchronous User Pattern option (Option 4006) is installed.

APPENDIX E
FIREBERD 4000 FACTORY DEFAULTS

Item	Factory Defaults	Description/Comment
Front Panel Switches		
SELF LOOP	ON	LED illuminated
ERROR INSERT	OFF	LED not illuminated
SETUP CATEGORY	SETUP SUMMARY	SETUP SUMMARY displayed
ANALYSIS RESULTS CATEGORY	ERROR	Analysis Results Error category
DISPLAY HOLD	OFF	LED not illuminated
PRINTER Event	OFF	OFF LED illuminated
Interface Control Panel	RTS: OFF. DTR: OFF	LEDs not illuminated
SETUP CATEGORY Menus		
INTERFACE:	INT232	Internal RS-232-C interface
EMULATE: TIMING:	DTE SYNC	Data terminal equipment emulation Synchronous timing
GENERATOR CLOCK:	INTRNL	Internal generator clock
INTERNAL FREQ: SYNTH:	64.0 kHz 0.05 kHz	Internal fixed frequency Optional synthesizer frequency
PATTERN:	2^{15}-1	Pseudorandom pattern
PROGRM:	0100	Programmable Bit pattern
USER1	01 01 01 01 01 01 00 01 01 01 01 01 01 03 01 01 01 01 07 01 01 01 01 55 55 55 55 AA AA AA AA 01 01 01 01 01 01 FF FF FF FF FF FF 80 01 80 01 80 01 80 01 80 01 80 01	#1 User Programmable Character pattern (T1 zeros and ones density stress test)
USER2	54 48 45 20 51 55 49 43 4B 20 42 52 4F 57 4E 20 46 4F 58 20 4A 55 4D 50 53 20 4F 56 45 52 20 54 48 45 20 4C 41 5A 59 20 44 4F 47 20 31 32 33 34 35 36 37 38 39 30 0D 0A	#2 User Programmable Character pattern (7-Bit ASCII Quick Brown Fox message)

FIREBERD 4000 FACTORY DEFAULTS (Continued)

Item	Factory Defaults	Description/Comment
USER3	E3 C8 C5 40 D8 E4 C9 C3 D2 40 C2 D9 D6 E6 D5 40 C6 D6 E7 40 D1 E4 D4 D7 E2 40 D6 E5 C5 D9 40 E3 C8 C5 40 D3 C1 E9 E8 40 C4 D6 C7 40 F1 F2 F3 F4 F5 F6 F7 F8 F9 F0 0D 25	#3 User Programmable Character pattern (8-Bit EBCDIC Quick Brown Fox message)
SETUP SUMMARY	2^{15}-1, 64.0 kHz, INT232, DTE, SYNC	Pattern, Clock, Interface, and Emulation Defaults
RECALL/STORE	All defaulted	All selections have factory defaults
AUXILIARY Functions		
AUX PRINT EVENT:	ERROR: all events OFF TIMED: 00:05	Error Print Event Menu Timed Print Event Menu
FLOW:	OFF	Out-of-Band Flow Control Menu
USER SYN THRSH:	10BYT	User Synchronization Threshold Menu
SYNC LOSS THRSH:	NORM	Synchronization Loss Threshold Menu
SYNC LOSS ACT:	HALT	Receiver Action Upon Synchronization Loss Menu
BLOCK LENGTH:	PATLEN	Block Length Menu
DATE:	Current date	Date Menu
TIME:	Current time	Time Menu
RESULT PRINT:	STD	Results Printout Format Menu
STATUS PRINT:	OFF	Status Message Printout Menu
PRINTER:	WIDTH: 40, SPEED: FAST, TERM: CRLF	Printer Printout Format Menu
RS232:	BAUD: 9600, DATA: 8, PAR: NONE	RS232 Printer/Controller Interface Menu
IEEE488:	SRQ: OFF	Optional IEEE-488 Interface Menu (if installed).
FREQ(#):	FREQ1: 0.3, FREQ2: 1.2, FREQ3: 2.4, FREQ4: 4.8, FREQ5: 9.6, FREQ6: 19.2, FREQ7: 56.0, FREQ8: 64.0,	Optional Synthesizer Fixed Frequency Editor Menu

FIREBERD 4000 FACTORY DEFAULTS (Continued)

Item	Factory Defaults	Description/Comment
	FREQ9: 128.0, FREQ10: 256.0, FREQ11: 512.0, FREQ12: 1544.0, FREQ13: 2048.0 kHz	
CLEAR NOVRAM?	n/a	Clear Non-Volatile RAM Menu
ANALYSIS RESULTS Tables		
SUMMARY	RESULTS OK	No errors detected
ERROR	BIT ERRS:	0
	AVG BER:	0. E-06
	BER:	0. E-05
	PAT SLIP:	0
	BLK ERRS:	0
	BLOCKS:	counting
	AVG BLER:	0. E-02
	PAT LOSS:	0
INTERFACE	BPVs:	N/A (Not available)
TIME & SIGNAL	PATL SEC:	0
	ERR SEC:	0
	%EFS:	100.00%
	TEST SEC:	counting
	ELAP SEC:	counting
	GEN FREQ:	64000.0
	RCV FREQ:	64000.0
	DELAY:	blank
	TIME:	counting
	DATE:	counting
PERFORMANCE		
Option not installed	OPTION NOT INSTALLED	CCITT G.821 Performance option not installed
Option installed		CCITT G.821 Performance option installed
	AVL SEC:	counting
	UNA SEC:	0
	%AVL SEC:	100.00%
	DEG MIN:	0
	%DEG MIN:	0.00%
	G EFS:	counting
	GERR SEC:	0
	G %EFS:	100.00%
	SES:	0
	%SES:	0.00%

FIREBERD 4000 FACTORY DEFAULTS (Continued)

Item	Factory Defaults	Description/Comment
ALARMS Status Panel		
PATTERN LOSS	OFF	
CLOCK LOSS	OFF	
FRAME LOSS	OFF	
PATTERN SLIP	OFF	
POWER LOSS	ON	
RECEIVER Status Panel		
PATTERN SYNC	ON	
CLOCK PRES	ON	
FRAME SYNC	OFF	
MARK	ON	
SPACE	ON	
Interface Status and Control Panel		
EMULATE DTE		
RLSD (RR)	ON	
DSR (DM)	ON	
CTS	ON	
RTS	OFF	
DTR	OFF	

APPENDIX F
OPTION 4004, CCITT G.821
PERFORMANCE ANALYSIS DISCUSSION

F.1 INTRODUCTION

This appendix discusses the criteria for performance analysis, the concept of available time versus unavailable time, and degraded minutes as specified in CCITT Recommendation G.821. This discussion is provided to familiarize users that have the G.821 Performance Analysis Module option installed (Option 4004).

F.2 PERFORMANCE ANALYSIS RESULTS

The performance results listed in Table F-1 are derived by observing the received bit error counts and received bit counts at 1-second intervals, and classifying each 1-second interval as either available, unavailable, severely errored, or error free seconds. Refer to Appendix C for definitions describing the results listed in Table F-1. This division of test time is illustrated in Figure F-1. Further calculations yield the number and percentage of degraded minutes, and percentages of available, severely errored, and error free seconds.

Table F-1
Performance Category Results

Displayed Results	Description
%AVL SEC	Percent of Available Seconds
%DEG MIN	Percent of Degraded Minutes
%SES	Percent of Severely Errored Seconds
AVL SEC	Available Seconds
BER-SES	Ber During Non-SES
DEG MIN	Degraded Minutes
ERR-SES	Errors During Non-SES
G %EFS	G.821 Percent of Error Free Seconds
G EFS	G.821 Error Free Seconds
GERR SEC	G.821 Errored Seconds
SES	Severely Errored Seconds
UNA SEC	Unavailable Seconds

Figure F-1
Division of Test Seconds for Performance Analysis

F.3 DETERMINING AVAILABLE AND UNAVAILABLE SECONDS

CCITT Recommendation G.821 defines available and unavailable time as follows.

> "A period of unavailable time begins when the bit error rate (BER) in each second is worse than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable time. The period of unavailable time terminates when the BER in each second is better than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be available time."

Available and unavailable time are measured in seconds -- available seconds (AVL SEC) and unavailable seconds (UNA SEC), respectively. All seconds after initial pattern synchronization must fall into one of the two categories (total AVL SEC + total UNA SEC = total seconds after initial pattern synchronization).

After initial pattern synchronization, seconds are considered to be available time; the AVL SEC begin counting (seconds before initial pattern synchronization are not included in performance analysis). These seconds continue to be counted until 10 consecutive seconds, each with a BER worse than 10^{-3}, occur. A sliding window, 10 seconds in length, is used to detect this transition from available time to unavailable time and vice versa.

As an example, assume a test begins and continues to run for 25 seconds and each of those 25 seconds has a BER better than or equal to 10^{-3}. After the initial pattern synchronization, the seconds are considered to be available time, so the AVL SEC count at this point is 25 as shown in Figure F-2. In the 26th second, the BER becomes worse than 10^{-3}. The same for the 27th and 28th seconds. In the 29th second, the BER improves to better than or equal to 10^{-3}. All 29 seconds are a part of available time and are, therefore, counted as AVL SEC.

Even though there were 3 consecutive seconds (the 26th, 27th, and 28th) which each had a BER worse than 10^{-3}, 10 such consecutive seconds are required to make the transition to unavailable time. Those 3 individual seconds are still in available time and they are counted as AVL SEC.

The 3 seconds with a BER worse than 10^{-3} are also included in the count of severely errored seconds (SES), which are those seconds with a BER worse than 10^{-3} that occur in available time. A signal loss second or a second in which pattern synchronization is lost is also considered to be a second with a BER worse than 10^{-3}. Therefore, the current test result values for the AVL SEC count = 29; the SES count = 3 and the UNA SEC count = 0.

Figure F-2
Sliding Window After 29th Test Second
Still in Available Time

Figure F-3
Sliding Window After 88th Test Second
Still in Available Time

The same test continues to run and remains in available time. In the 80th second, the BER for that second is worse than 10^{-3} as shown in Figure F-3. The BER for the 81st through the 85th seconds is also worse than 10^{-3}. In the 86th second, pattern synchronization is lost. This also continues for the 87th and 88th seconds. We now have 9 consecutive seconds each of which has a BER worse than 10^{-3}. As each of these seconds occurs, we are still in available time, so they are counted as AVL SEC and SES. The transition has not been made from available time to unavailable time.

Figure F-4 shows the 89th second also has a BER worse than 10^{-3}. At this point, the AVL SEC count = 89, the SES count = 13, and the UNA SEC count = 0. However, the sliding window now contains 10 consecutive seconds each having a BER worse than 10^{-3}. At this point the transition is made to unavailable time.

Those 10 seconds which had been counted as AVL SEC are deducted from the AVL SEC count and are added to the UNA SEC count; the AVL SEC count becomes 79, and the UNA SEC count becomes 10. Those same 10 seconds were also included in the SES count. However, SES is limited to only those seconds in available time which have a BER worse than 10^{-3}; therefore, those last consecutive 10 seconds must also be deducted from the SES count (the SES count is updated to 3).

Once the transition occurs from available time to unavailable time, all seconds are counted as UNA SEC until 10 consecutive seconds occur each with a BER better than 10^{-3}. As the sample test continues, the 90th through 150th seconds each have a BER worse than or equal to 10^{-3}. We are still in unavailable time, so these seconds are counted as UNA SEC; now the total AVL SEC count = 79 and the total UNA SEC count = 71.

Figure F-4
Sliding Window After 89th Test Second
Transition to Unavailable Time

Figure F-5
Sliding Window After 160th Test Second
Transition to Available Time

Beginning with the 151st second, the BER for that second falls below 10^{-3} as shown in Figure F-5. It is still counted as an UNA SEC since we are still in unavailable time and the transition has not been made to available time. A BER better than 10^{-3} also occurs for the 152nd through the 160th seconds. Since there are now 10 consecutive seconds with a BER better than 10^{-3}, the transition is made from unavailable time to available time.

As each of these 10 seconds occurred, it was added to the UNA SEC count (UNA SEC = 81, AVL SEC = 79, and SES = 3). Now that those consecutive seconds have triggered the transition to available time, they are deducted from the UNA SEC count and added to the AVL SEC count. Now the UNA SEC count = 71 and and the AVL SEC count = 89.

The monitoring of available and unavailable time continues for the duration of the test.

F.4 DETERMINING DEGRADED MINUTES

Degraded minutes (DEG MIN) is an error analysis result that is affected by available and unavailable time. DEG MIN is a count of the number of minutes during which an average BER worse than 10^{-6} occurs. The 1-minute intervals are derived by removing UNA SEC and SES from the total test time and then consecutively grouping the remaining seconds into blocks of 60. The average BER is calculated for the block of 60 seconds and, if it is worse than 10^{-6}, the block is counted as a degraded minute.

In the transition from available time to unavailable time, the DEG MIN result is unaffected. This is because a switch to unavailable time requires 10 consecutive seconds each with a BER worse than 10^{-3}. Any second in available time with a BER worse than 10^{-3} is considered to be a severely errored second and, therefore, not included in the accumulation of seconds used to calculate DEG MIN.

Moving from unavailable time to available time may affect the DEG MIN count. While in unavailable time, 10 consecutive seconds each with a BER worse than 10^{-3} are required for the transition to available time. When this happens, those 10 seconds are subtracted from the UNA SEC count and are added to the AVL SEC count. Since these seconds are now considered to be a part of available time and they are not SES, they are included in the calculation of DEG MIN.

APPENDIX G
PRINTER DEFAULT SETTINGS

Default Settings				
Printer	**Baud**	**Data Bits**	**Parity**	**Term**
PR-35	9600	8	None	CRLF
PR-40	2400	7	Any	CRLF
PR-40A	2400	8	None	CRLF
PR-45+	9600	8	None	CRLF
PR-55+	9600	8	None	CRLF
PR-85	2400	8	Even	CRLF
PR-2000	2400	7	Any	CRLF

+ 8-pin front panel connector.