ML# 12150
Rev. -
Software Revision 5

FIREBERD™ 4000

REFERENCE MANUAL

February, 1992

This Reference Manual applies to all FIREBERD 4000
Communications Analyzers Incorporating Software Revision 5.

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SECTION 1
GETTING STARTED

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 internal data interfaces available for use with the FIREBERD 4000.

This section provides an overview of the FIREBERD 4000, power requirements, line power selection, ground jumper selection, operator warnings, operating convention, instrument checkout, internal RS232 Interface selection, and optional interface installation.

1.2 INSTRUMENT OVERVIEW

The FIREBERD 4000 (Figure 1-1) is a multifunction communications analyzer that uses internal and modular interfaces to test the quality of a wide variety of digital communications networks and equipment. It provides the analysis capabilities to isolate circuit malfunctions and report the results on the front panel, on a printout, or on a remote terminal. Highly versatile, the FIREBERD 4000 is used in locations, such as central offices, technical control centers, end-user sites, engineering laboratories, and earth stations. The location where access to the circuit can be gained determines the interface that is installed in the FIREBERD 4000. The interface provides the physical connection to the circuit under test. The interface also provides proper termination, signal conditioning, framing (if required), and timing. See Section 5 for a list of optional interfaces available for use with the FIREBERD 4000. These interfaces can be divided into the following categories:

- DDS Interfaces (DDSLL, DS0A/B, and DS0/A)
- T-Carrier Interfaces (T1/FT1, DS1/T1, T1C/2, and T3)
- CCITT Interfaces (64K/G.703, 2M/n64, 2M/G.704, and 8M/G.703)
- Data Interfaces (RS-232-C, RS-449, V.35, and MIL449)
- Specialty Interfaces (ISDN, LAB, and Access)

One or two optional interfaces can be inserted in the FIREBERD interface rear panel slot(s), depending on whether the second interface option (Option 4001) is installed, and then either controlled locally or remotely. This allows the user to operate the FIREBERD locally by using the front panel switches and controls, or remotely by using a suitable remote controller. (Refer to Section 4 for a description of FIREBERD remote control operation.)

With the required interface installed, the FIREBERD can be configured to perform in-service or out-of-service analysis of the circuit under test. Analysis results of the circuit under test are accumulated simultaneously and stored internally. Accumulated results can be viewed one at a time, with any two results displayed simultaneously on the front panel. If desired, a variety of printouts (e.g., results print or controls print) can be generated manually or automatically. (Refer to Section 3 for a description of the types of printouts available and how to generate them.)

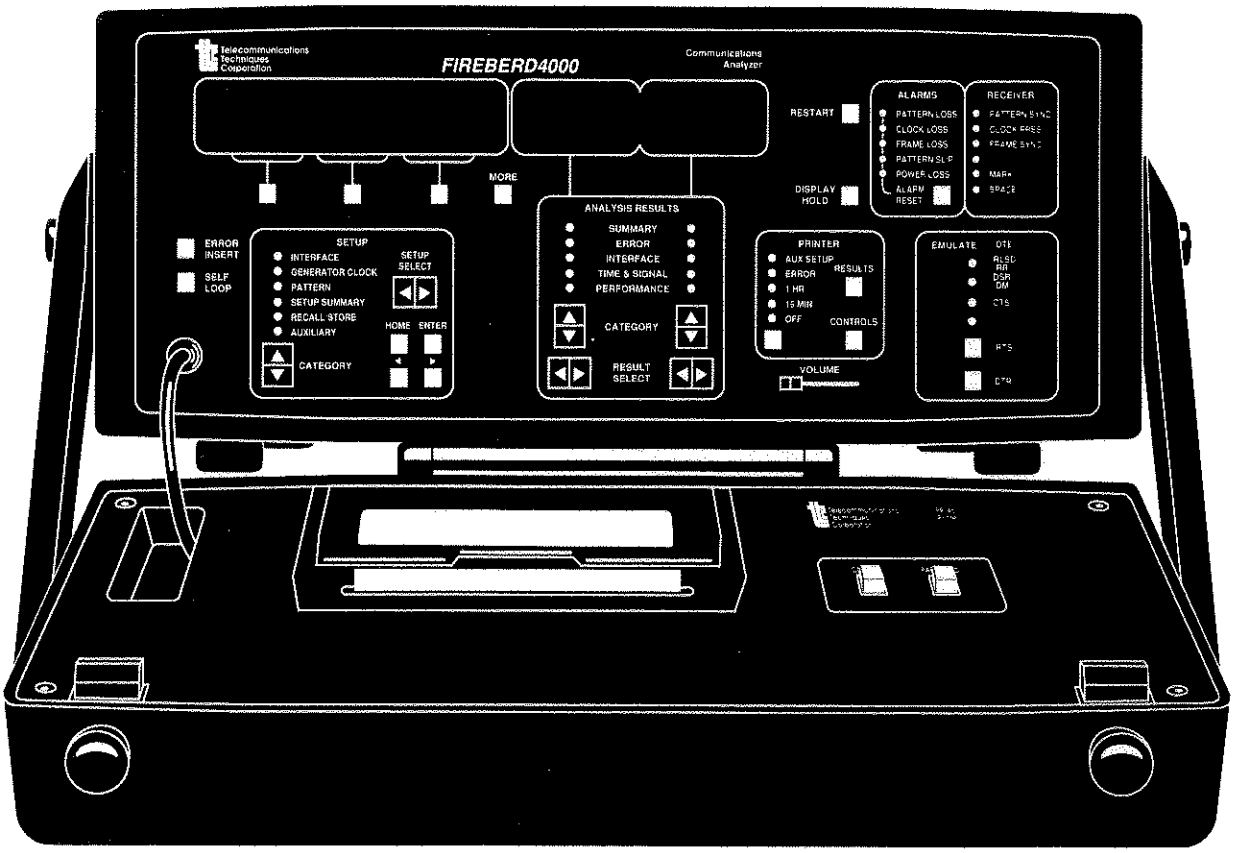


Figure 1-1
The FIREBERD 4000

1.3 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 1-2 shows the power input module.

1.3.1 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.

1.3.2 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.

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

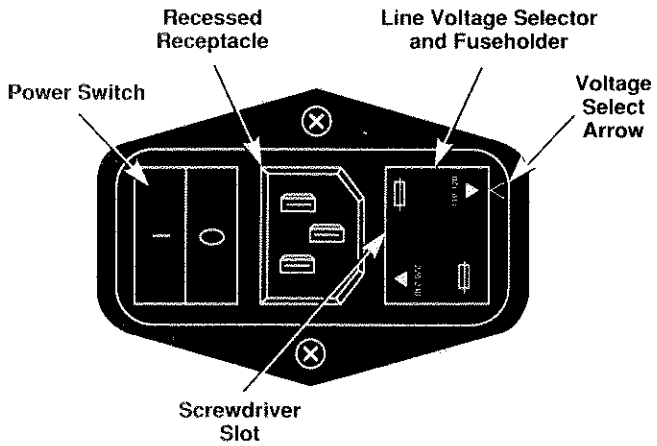


Figure 1-2
Power Input Module

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

1.3.4 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 1-2) 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 1-2).
6. Press the line voltage and fuseholder module securely back into place.

1.3.5 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 1-3 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.

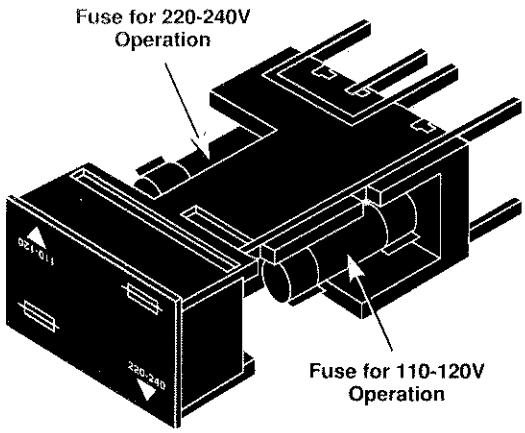


Figure 1-3
Fuse Locations

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 1-2). 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 1-2) 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.

1.4 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 POWER REQUIREMENTS, FOUND EARLIER IN THIS SECTION, 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.

DO NOT OPERATE THIS UNIT IN AMBIENT TEMPERATURES THAT EXCEED 50° C. OPERATING THIS UNIT IN TEMPERATURES ABOVE 50° C CAN CAUSE DAMAGE.

1.5 OPERATING CONVENTION

The FIREBERD 4000 operation is determined by the interface selected and by the switch settings. The FIREBERD is configured by using the front panel controls or by using a suitable remote controller. Refer to Figure 1-1 for a front panel view of the FIREBERD 4000.

Two types of switches are used to select, control, and display unit operating conditions. Switch types are: push button or rocker. Push-button switches control the associated function (e.g., ERROR INSERT, RESULTS, CONTROLS, DISPLAY HOLD, or MORE) or cycle through a series of function-related choices (e.g., PRINTER). Rocker switches allow selection of a category or movement through menu choices for a selected category (e.g., SETUP CATEGORY, SETUP SELECT, and RESULT SELECT). When more than three menu items are available for a displayed menu, the LED in the MORE switch illuminates. Pressing the MORE switch displays the next menu item choice. ANALYSIS RESULTS menu items are cyclical. This means that repeatedly pressing the left or right arrow on the associated RESULT rocker switch scrolls through all result menu items for the selected category and begins cycling through again. Refer to Section 2 for an explanation of the switches and available choices.

1.6 TEST CONFIGURATION

Due to the variety of interfaces that can be used with the FIREBERD 4000 and the type of tests that can be performed, only an overview of a typical test configuration will be described. The following steps are typically performed when conducting an out-of-service test with the FIREBERD 4000.

1. PATTERN - selects the data pattern to be inserted on the circuit under test.

2. GENERATOR CLOCK - determines the transmit timing source.

3. INTERFACE - set the required categories for the interface selected and test to be performed.
   AUXILIARY - allows a variety of features and controls to be determined.

4. Connect the cable(s) to the FIREBERD 4000.

5. RESTART - pressing this switch clears all accumulated results and begins the test.

6. Print out desired results.

Keep in mind that the FIREBERD configuration varies depending on the interface selected and the type of testing that is to be performed. For example, if the test to be performed is an in-service test, no data pattern needs to be selected.

1.7 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 2 of this manual.

1.7.1 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.

1.7.2 Manual Self-Test

The manual self-tests are performed in the Self-Loop mode. The FIREBERD 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 Interface 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 the appropriate interface operating manual 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.

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. 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.

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. Adjust the VOLUME control as necessary.
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.

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.

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.

1.8 INTERFACE SELECTION

The FIREBERD 4000 requires an interface to be selected in order to perform data analysis. The selected interface provides the physical connection to the circuit under test, provides the proper termination, and allows access to framing, signaling, and other parameters necessary to connect to the circuit under test.

An internal RS232 Interface and internal 188 Interface are standard interfaces in every FIREBERD 4000. Any other optional interface must be inserted into the interface slot(s), located in the rear panel of the FIREBERD. With no optional interface installed, pressing the SETUP CATEGORY switch until the LED next to the INTERFACE label is illuminated displays the available interfaces (INT232 and INT188) in the display window. Pressing the softkey below the INT232 menu item selects the internal RS232 Interface as the active interface.

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. Table 1-1 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.

Once selected, the interface can be configured through the interface panel switches or interface set-up menu. 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 2 for FIREBERD 4000 front panel interface operating instructions.

1.8.1 Internal RS232 And MIL188 Date 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.

1. RS-232-C Interface Menus

With the INTERFACE home menu displayed (INTERFACE: XXXXXX), pressing the softkey labeled INT232 selects the .internal RS-232-C Interface 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 1-4 and 1-5. Figure 1-4 shows the menu sequence when the mainframe is emulating DTE with either synchronous or asynchronous timing selected. Figure 1-5 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.

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

Pin No.	Designations EIA	Designations CCITT	Signal Description	Signal Direction TO DCE	Signal Direction TO DTE
1	AA	101	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

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.

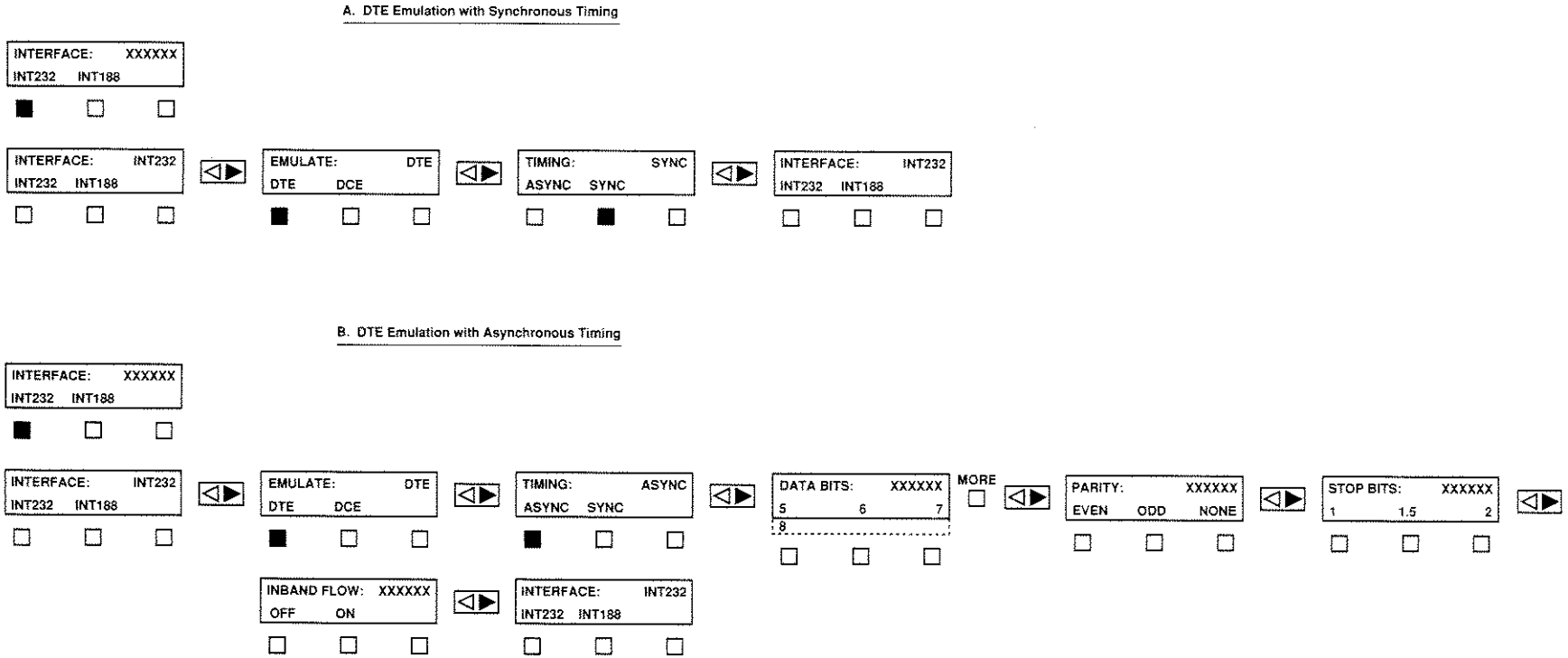


Figure 1-4
Internal RS-232 Interface Menu Configured for DTE Emulation

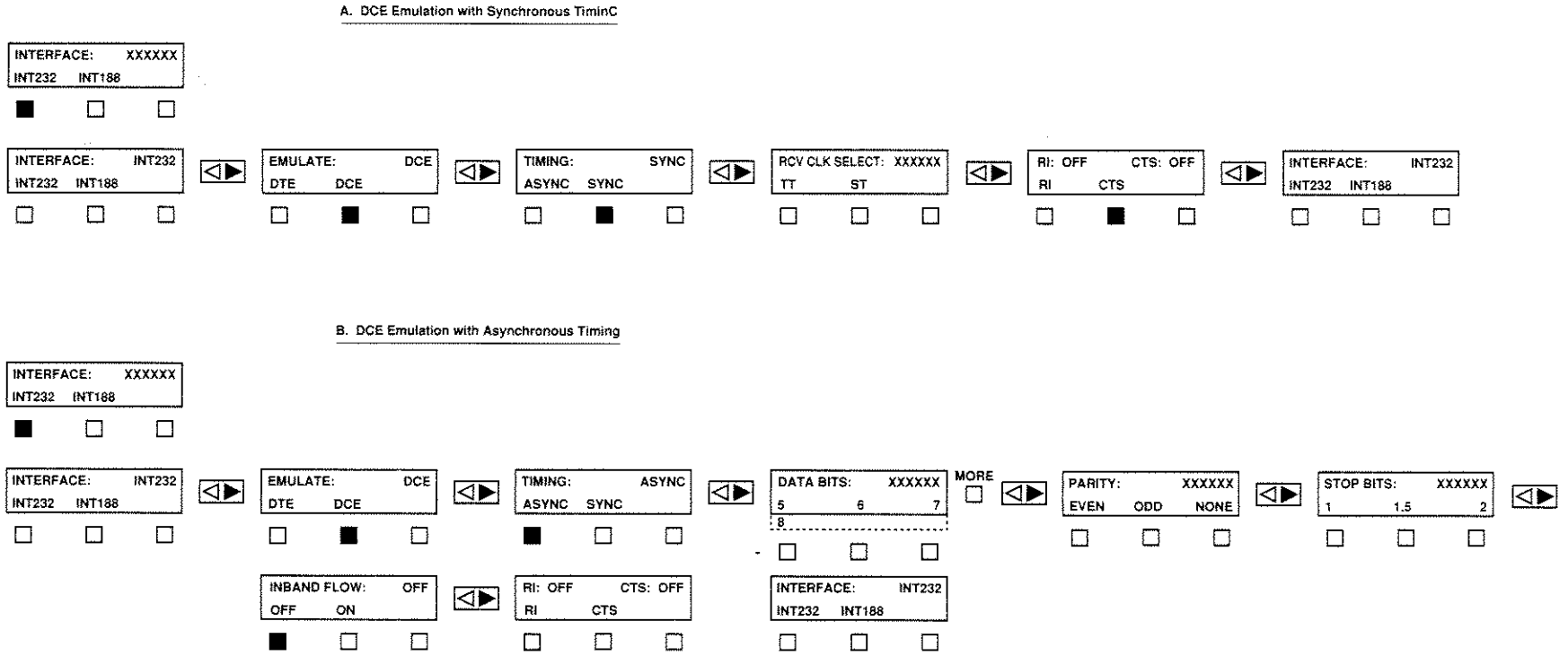


Figure 1-5
Internal RS-232 Interface Menu Configured for DCE Emulation

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)

Number of Data Bits	Code
5	Baudot
6	BCDIC
7	ASCII
8	EBCDIC

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.

2. 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 1-6 and 1-7. Figure 1-6 shows the menu sequence when the mainframe is emulating DTE with either synchronous or asynchronous timing selected. Figure 1-7 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.

1.8.1 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 1-1 to verify connector pin assignments. Figure 1-8 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.

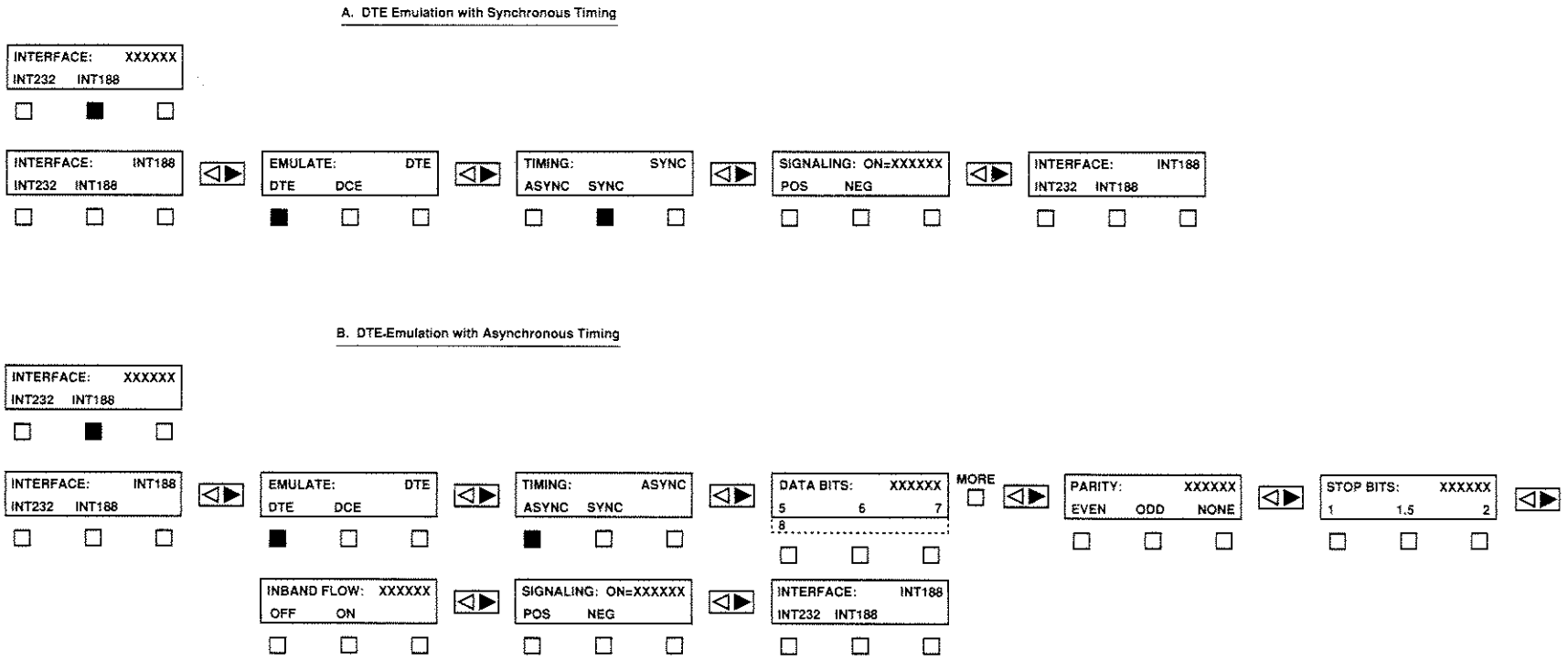


Figure 1-6
Internal MIL188C Interface Menu Configured for DTE Emulation

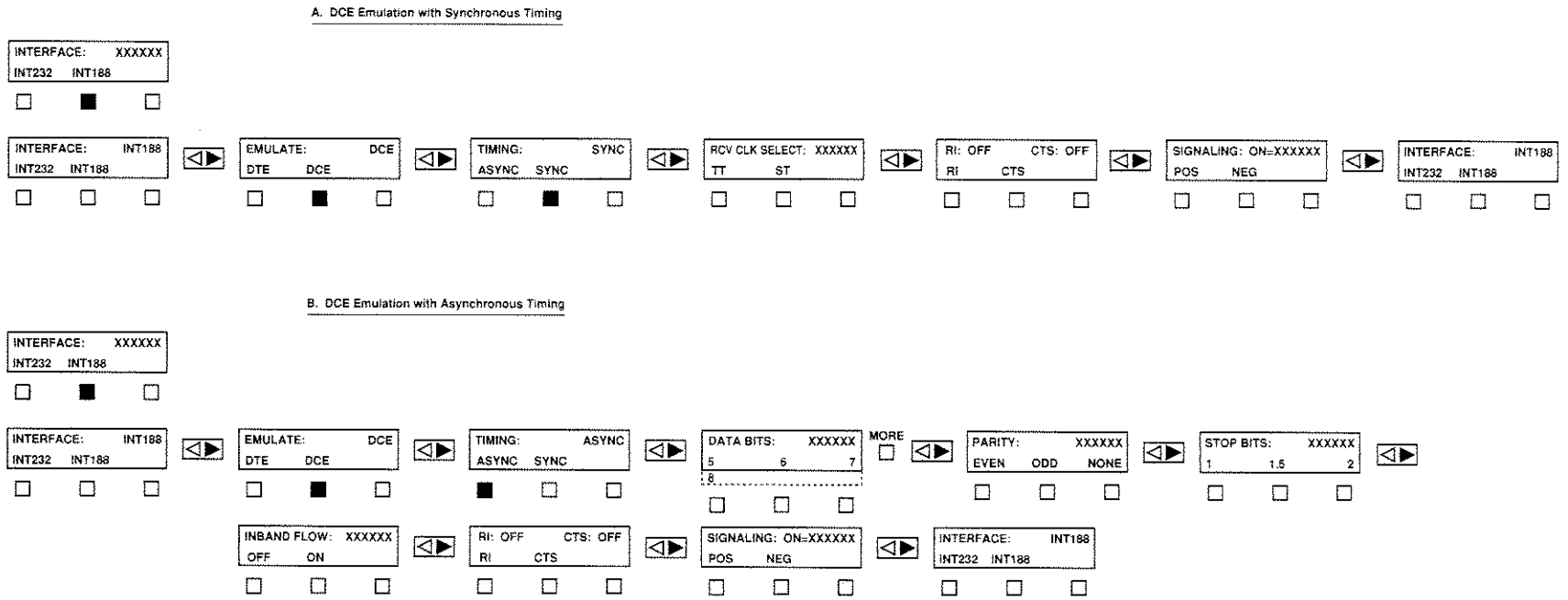


Figure 1-7
Internal MIL188C Interface Menu Configured for DCE Emulation

The GENERATOR CLOCK category determines which clock source is used during testing: internal (INTRNL), interface (INTF), or external (BNC). Refer to Section 2 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 (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 2 for information concerning signal analysis results.

Any test pattern, except FOX and USER 1-3 (Option 4006 is required for synchronous transmissions), can be selected through the PATTERN SETUP category to test the DCE. Refer to Section 2 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.

1.8.2 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 1-1 to verify connector pin assignments. Figure 1-9 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 2 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 2). 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 2).

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.

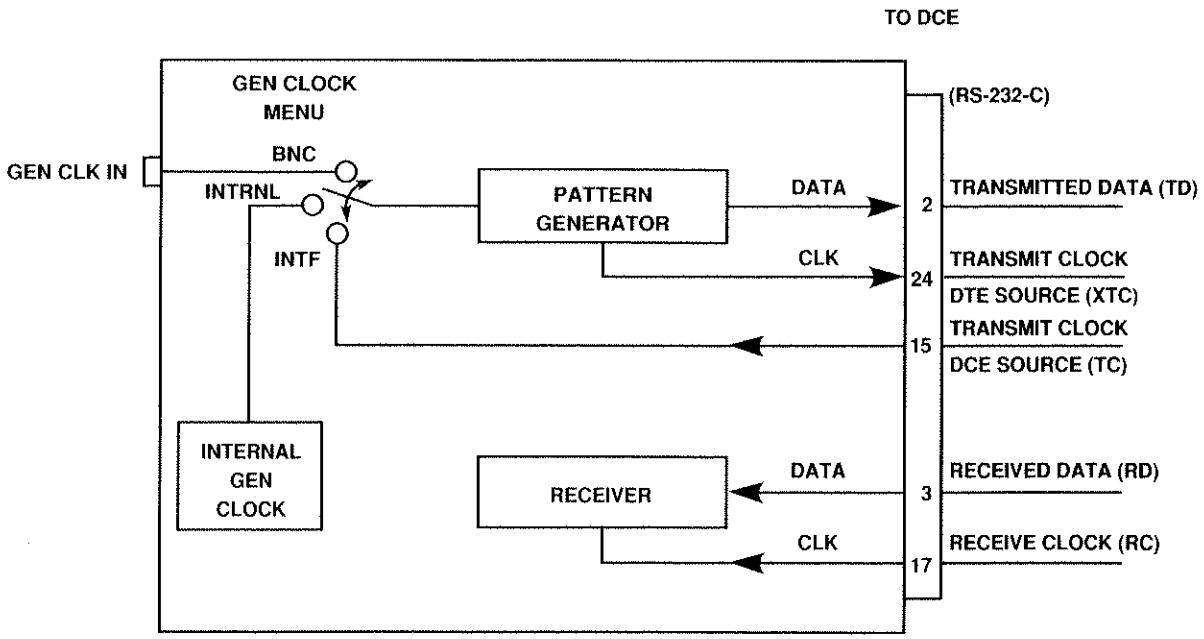


Figure 1-8
Block Diagram of the FIREBERD Emulating Synchronous DTE

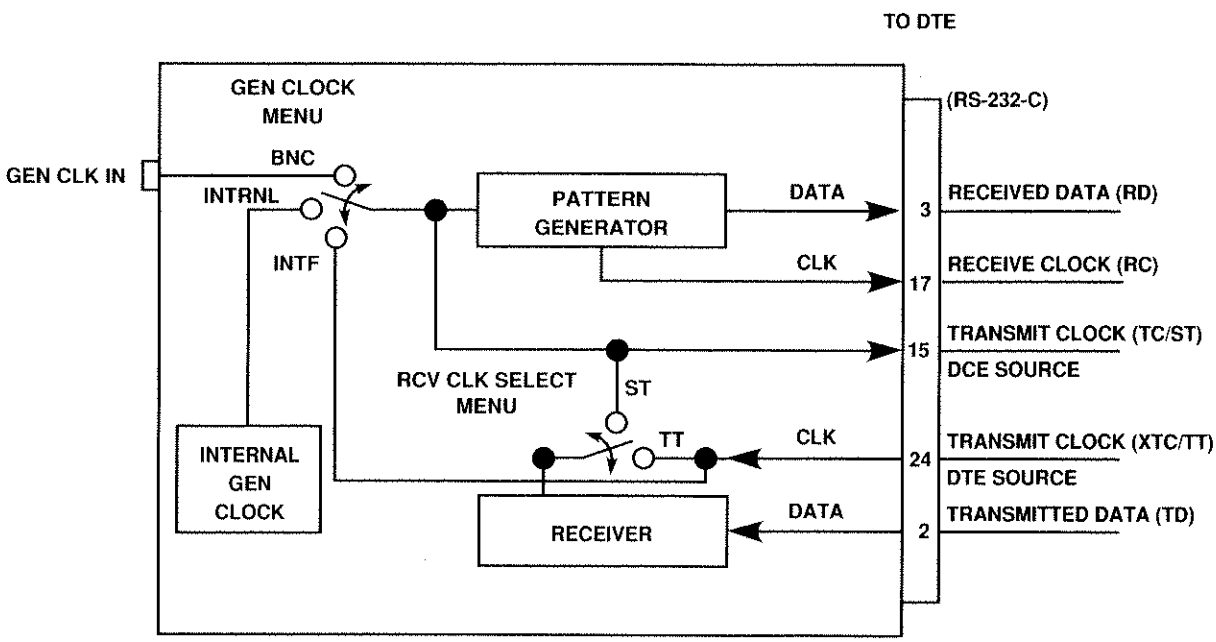


Figure 1-9
Block Diagram of the FIREBERD Emulating Synchronous DCE

Any test pattern, except FOX and USER1-3 (Option 4006 is required for synchronous transmissions), can be selected through the category:PATTERN SETUP category to test the DTE. Refer to Section 2 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.

1.8.3 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 1-4 through 1-7). When ASYNC is selected, the menus for setting 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 1-1 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 2 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 2 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.

1.8.4 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.

1.8.5 Analysis Results

Refer to Section 2 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.

1.9 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 interfaces by three (since one interface slot is required for the ISU connector). 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.

1.9.1 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.

1.9.2 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.

1.10 OPTIONAL INTERFACE INSTALLATION

The following procedure describes the steps for installing an interface module in a FIREBERD 4000. Refer to Figure 1-10 for the interface slot location. Section 5 provides a complete list of interfaces currently supported by the FIREBERD 4000.

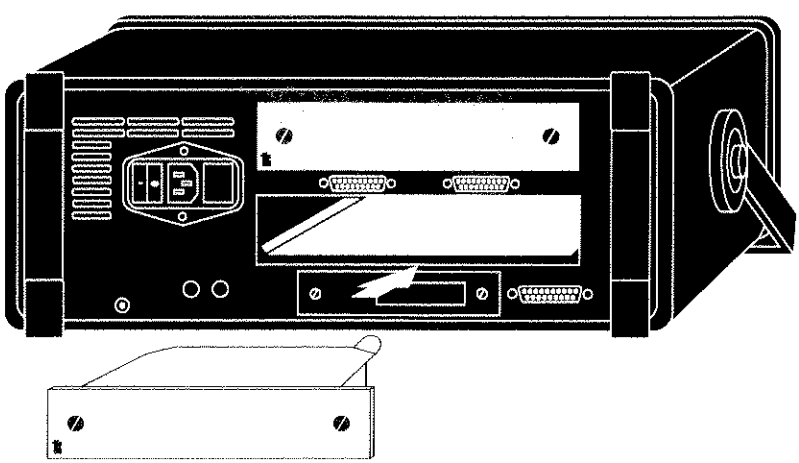


Figure 1-10
Installing an Optional Interface Module in a FIREBERD 4000

CAUTION:

TURN THE MAINFRAME POWER OFF BEFORE INSTALLING THE INTERFACE MODULE IN THE FIREBERD.

1. Ensure that the POWER switch, on the FIREBERD front panel, is in the OFF position.

2. Turn the FIREBERD 4000 around to expose the vacant rear panel interface slot(s). Slot 1 (the bottom slot) is the standard slot and SLOT 2 (the top slot) is the optional slot.

3. Insert the interface module into the vacant interface slot, with the printed circuit (PC) board facing up. The PC board edges fit into slides on either side at the top edges of the interface slot.

4. Press the interface module firmly into the mainframe mating connector, until the back of the interface faceplate is flush with the mainframe rear panel.

5. Secure the interface module in the mainframe by turning the two thumbscrews on the interface front panel clockwise, until finger tight.

This completes the interface installation procedure. The installed interface can be selected from the front panel by pressing the SETUP CATEGORY switch to illuminate the LED next to the INTERFACE category label and then pressing the softkey below the installed interface label. Refer to Section 4 of this manual or the interface operating manual on how to remotely select the installed interface.

SECTION 2
INSTRUMENT DESCRIPTION

2.1 INTRODUCTION

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

2.2 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 (Option 4001) 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.

2.3 FUNCTIONAL DESCRIPTION

The FIREBERD 4000 Communications Analyzer is a multifunction analyzer that uses modular interfaces to access a wide variety of circuits for analysis. Selecting an optional interface, installed in the rear panel interface slot, or the internal RS232 Interface allows the FIREBERD 6000 to connect to a circuit and perform in-service analysis or out-of-service BER (bit error rate) testing. All controls for configuring the FIREBERD 4000 are located on the front panel and are grouped according to function.

Menus, messages, and configuration information are displayed on the front panel on an 80-character, vacuum fluorescent display. The display window is divided in half, with the left half providing configuration information, such as interface selection and other configuration settings. The right half of the display permits two analysis result to be displayed at one time.

After configuring the FIREBERD 4000 for the test to be performed, attach the circuit to be tested to the selected interface. Observe the LEDs located at the right of the FIREBERD front panel. The MK (Mark) and SP (Space) LEDs illuminate when the corresponding signal activity is detected. If a pattern is being transmitted and DATA is set for the same pattern, the SYNC (pattern synchronization) LED, located below the SP LED, illuminates when pattern synchronization is declared.

NOTE: Depending on the interface selected and the type of testing being performed not all of these LEDs will necessarily be illuminated. For example, the FRAME SYNC (frame synchronization) LED illuminates when frame synchronization is achieved only on frame-compatible interfaces.

After connection and full synchronization has been achieved, pressing the RESTART switch clears all accumulated results and starts another test period.

Using the four ANALYSIS RESULTS rocker switches (two for CATEGORY and two for RESULT SELECT), the accumulated results from the selected category can be scrolled through. Pressing the DISPLAY HOLD switch allows the displayed result values to be halted. The LED in the DISPLAY HOLD switch illuminates to indicate that the displayed result values are not the current values. This allows the operator to view all accumulated result values that were current at that point in time. Even though the displayed result values are halted, the current values continue to accumulate. Pressing the DISPLAY HOLD switch again extinguishes the LED in this switch and updates the result values to their current value.

If a printout of the current operating control settings or result values is desired, press the RESULTS or CONTROLS switch to generate the associated printout. Pressing the RESULTS switch generates a manual results printout listing a series of result values. Pressing the CONTROLS switch generates a printout of the current FIREBERD switch settings. This allows the unit configuration to be verified without having to scroll through all of the available SETUP categories. If desired, the unit configuration can be saved and named through the RECALL/STORE category operation. Press the SETUP CATEGORY switch to illuminate the LED next to the RECALL/STORE category. Press the softkey below the STORE menu item and then press the softkey below the number (0 to 9) where the configuration is to be stored. Additional information on the RECALL/STORE/NAME operation is contained later in this section.

The printout generated is determined by the following auxiliary menu selections.

AUX PRI EVENT
RESULT PRINT
STATUS PRINT
PRINTER
RC/PRINT
RS232

These auxiliary functions and others are described later in this section. Samples of different printouts can be found in Section 3.

2.4 SPECIFICATIONS

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

2.4.1 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, and optional MIL449).

GENERATOR

2.4.2 Internal Clock Frequency Generator

Standard fixed frequencies:	300, 1200, 1800, 2400, 4800, or 9600 Hz, 19.2, 48, 56, 64, 128, 256, 512, or 704 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.

2.4.3 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.

2.4.4 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).

2.4.5 Data Generator

Fixed patterns:	Live, 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). Six T1 stress patterns (T1-1 to T1-6) or T1 digital milliwatt. Five DDS stress patterns (DDS-1 to DDS-5). Digitized 1020 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.

RECEIVER

2.4.6 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.

2.4.7 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).

PROGRAMMABILITY

2.4.8 Programmable Messages

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

2.4.9 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.

2.4.10 Non-Volatile Memory

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

2.4.11 Remote Control Capability

Remote control access:	RS-232 Printer/Remote Control Interface (IEEE-488 optional); complies with IEEE-488.2.
Controllable functions:	Front-panel switch settings. Keypad entries. Auxiliary functions. User-defined messages.

DATA INTERFACES

2.4.12 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.

2.4.13 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.

2.4.14 External Data Interface Slot

Accepts any FIREBERD interface (second interface slot optional).

2.4.15 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.

2.4.16 Display

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

2.4.17 Audio Output

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

2.4.18 Electrostatic Discharge

IEC 801-2	Withstands a direct discharge of 8kv at 50% relative humidity.

2.4.19 Power Requirements

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

2.4.20 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).

2.4.21 Dimensions and Weight

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).

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).

2.4.22 Safety Approvals

The FIREBERD 4000 has been tested and successfully passed the following specifications. In addition, it has received licenses and approvals for UL/NRTL certification from MET Laboratory (listing number T-31143-Q) and GS license (issued by the German Government) and IEC certificate from TUV ESSEN Laboratory (license numbers 815/90 and 816/90). These approvals are so indicated by MET/NRTL and TUV/GS stickers, located on the rear panel of the unit.

UL 478	Information Processing and Business Equipment (5th edition).
UL 746	Polymeric Materials Use in Electrical Equipment Evaluations (2nd edition).
UL 1459	Telephone Equipment (2nd edition).
IEC 348	Safety Requirements for Electronic Measuring Apparatus (Rev. 1978).
IEC 950	Safety of Information Technology Equipment (including EN 60950 Electrical Business Equipment [Rev. 1990]).
DIN VDE 0805/5.90	Safety of Information Technology Equipment (including EN 60950 Electrical Business Equipment [Rev. May 1990]).
DIN VDE 0411/10.73 teil 1a/2.80	Protective Measures for Electronic Measuring Instruments (Rev. October 1973).

2.5 FRONT PANEL CONTROLS AND INDICATORS

Figure 2-1 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.

2.5.1 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 by 2-line vacuum fluorescent display capable of displaying upper- and lower-case 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.

Softkeys - These three push-button 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 push-button 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 later in this section.

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

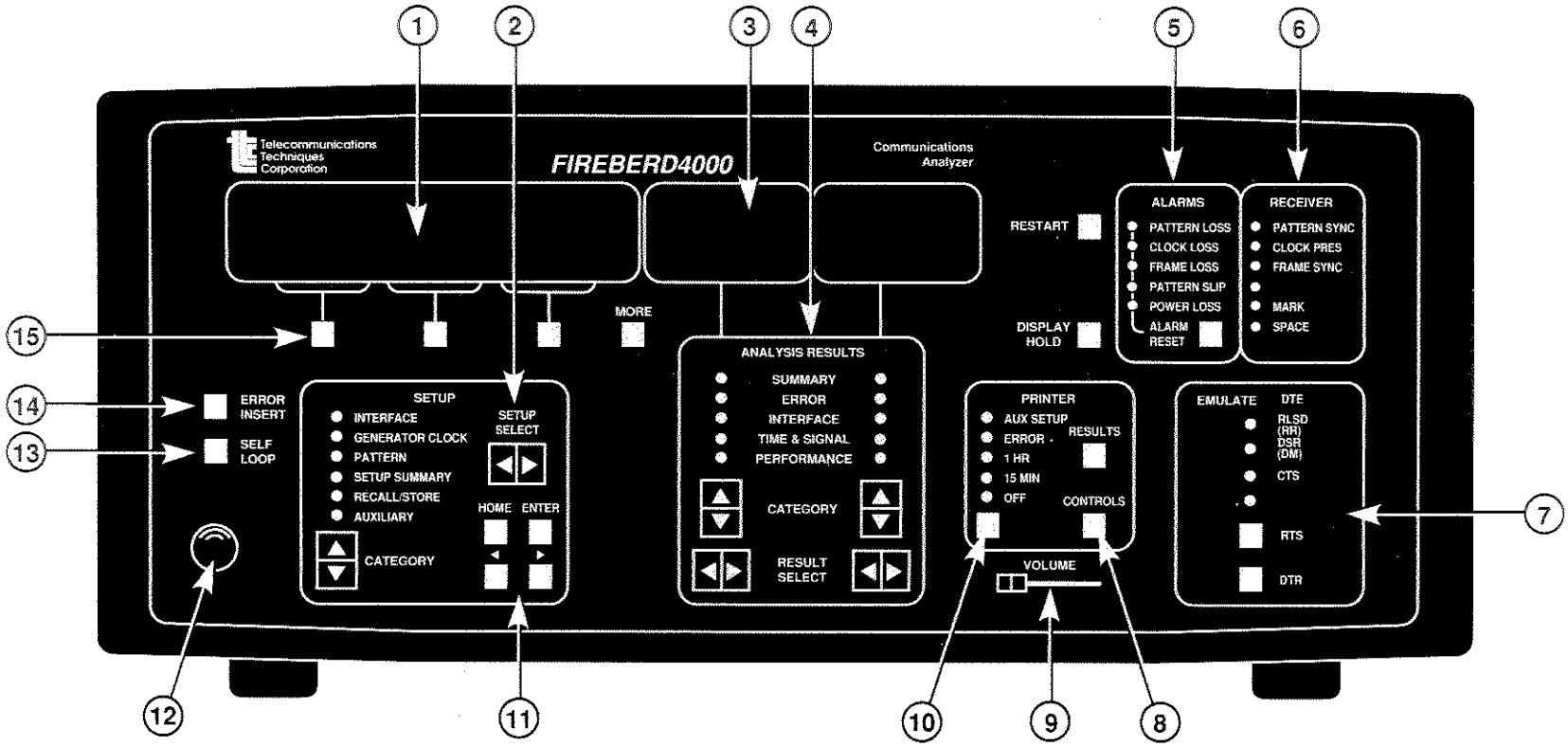
INTERFACE - Indicates the Interface category is displayed. This category contains menus to control interface selection and operation of menu controlled interfaces.

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, named, and recalled at any time.



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 Connetcor
13 SELF LOOP Switch
14 ERROR INSERT Switch
15 Softkey (x3)

Figure 2-1
The FIREBERD 4000 Front Panel

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 push-button 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 (top level) 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.

2.5.2 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.

ANALYSIS RESULTS DISPLAY - The display is a 17-character by 2-line, vacuum fluorescent display capable of displaying upper-case and lower-case 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. These 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 push-button 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 push-button 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.

2.5.3 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.

2.5.4 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 push-button switch clears and resets the illuminated alarms.

2.5.5 Interface Status and Control Panel

The interface status and control panel contains four yellow LEDs, two push-button switches, and three columns of panel labels. Figure 2-2 shows all of the indicators and switches illuminated during the power-up, self-test sequence. The panel operation and significance of the LEDs are 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 control 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 when in the ON position. The function of these switches is determined by the selected interface. For many interfaces, these switches control the RTS and DTR signaling leads when emulating DTE; and control the RLSD (RR) and DSR (DM) signaling leads when emulating DCE. With certain T1 interfaces installed, these switches control the transmission of LOOP UP and LOOP DOWN codes. When the LED in the switch is on, the loop code is being transmitted.

Depending on the data interface selected and its configuration, the LEDs and switches are identified by one of three columns of illuminated panel labels. Because the FIREBERD can emulate either DTE or DCE, or function in digital transmission networks, the panel labels define the function of the LEDs and switches for the selected application. It should also be noted that not all of the LEDs and switches are used at one time. Only those LEDs needed for the selected application are identified by illuminating the appropriate panel label. Again, refer to the appropriate interface operating manual for specific information on the panel labels.

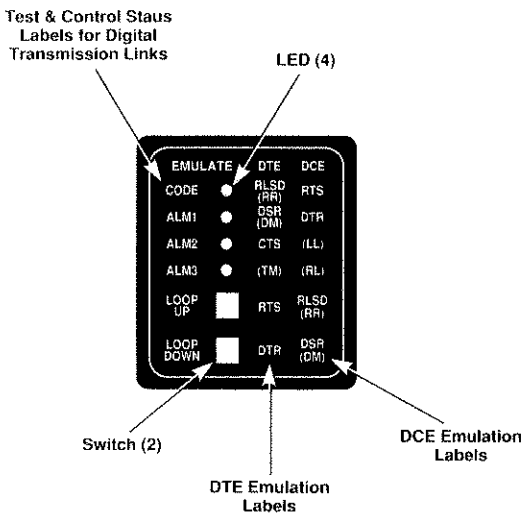


Figure 2-2
Interface Status and Control Panel

The EMULATE DTE label and the panel labels below it illuminate when the FIREBERD is emulating DTE (Data Terminal Equipment). The EMULATE DCE label 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. 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.

2.5.6 PRINTER Control Panel

The PRINTER control panel contains three push-button switches that are used to turn a printer on and off and initiate specific printouts at set periods, or as desired. The LEDs illuminate to indicate the automatic printout status. Refer to Section 3, Printer Interfaces, for setting up and operating a printer with the FIREBERD.

Print Event Switch - This push-button 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, in the SETUP AUXILIARY category, determines the printout generation.

ERROR - Indicates that printouts are generated each time an error is detected. 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 automatically generated.

PRINTER RESULTS Switch - This push-button switch causes the current results values 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 push-button switch causes a printout of the current front panel switch and set-up menu settings to be printed.

2.5.7 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.

2.5.8 PR-45 Printer Connector

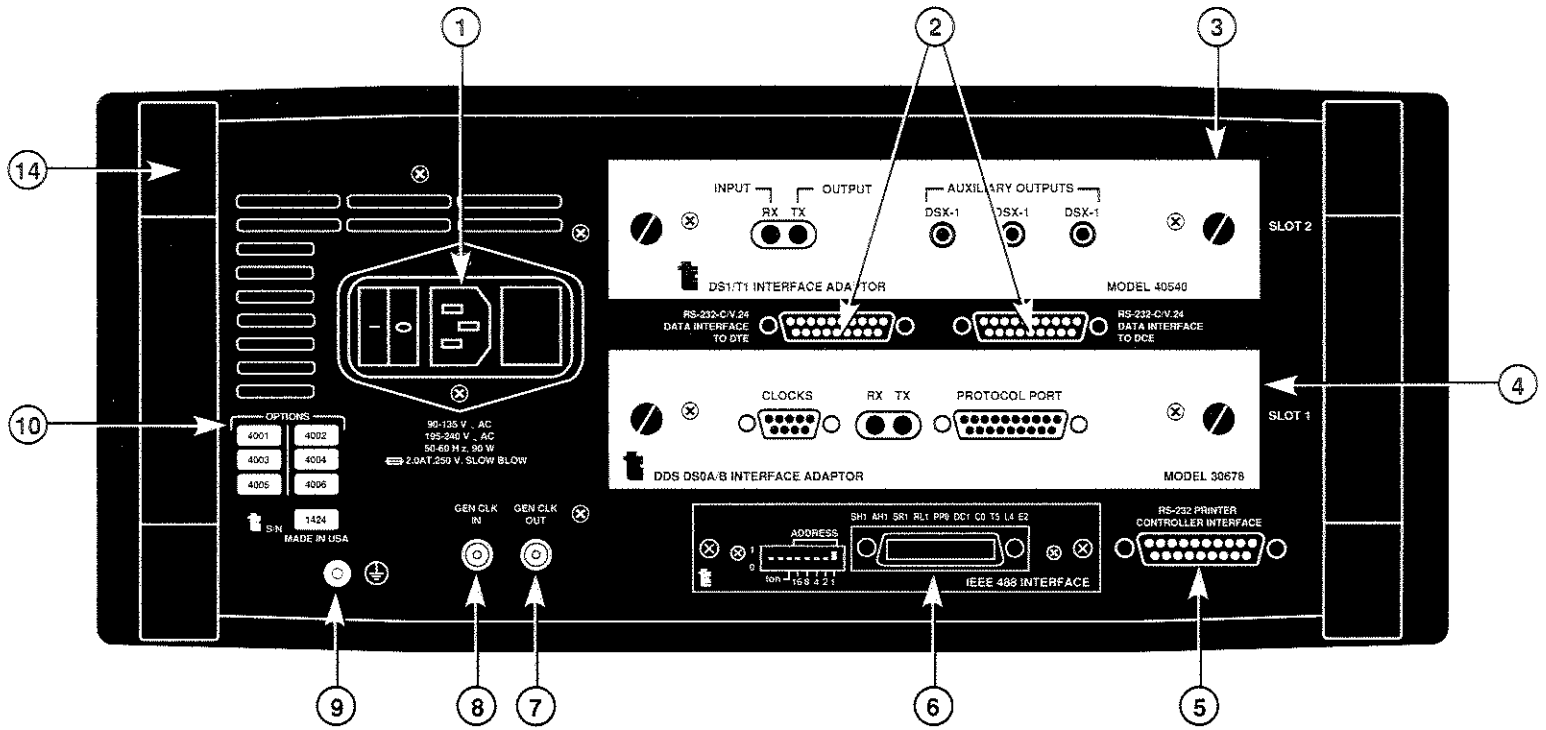
The 8-pin DIN connector provides power, data, and control leads for the optional PR-45 thermal printer (see Section 5).

2.5.9 SELF LOOP Switch

The SELF LOOP push-button 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 mode, the LED in the SELF LOOP switch illuminates, 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 the 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 releases the self-loop mode and extinguishes the LED in the switch.

2.5.10 ERROR INSERT Switch

The ERROR INSERT push-button switch allows bit errors to be inserted in the test pattern data stream either one at a time 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 LED in the switch illuminates. Momentarily pressing the switch, while the LED is illuminated, returns the test pattern to the error-free state and the switch LED is extinguished.



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 - 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 2-3
The FIREBERD 4000 Rear Panel

2.6 FIREBERD 4000 REAR PANEL

The FIREBERD 4000 rear panel, shown in Figure 2-3, provides the connections for an external RS-232-C or IEEE-488 Interface printer or for remote control device. External clock sources can be connected to or from the mainframe. A standard interface slot allows different interface modules to be installed, allowing the FIREBERD the capability to access a wide variety of communications circuits. An optional second interface slot can be added so two interfaces can be installed and operated, 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 contains the power switch and fuse, provides the physical connection, and input voltage range selection for the mainframe. The rocker switch controls power to the mainframe and is labeled 1 (ON) and 0 (OFF). The power receptacle is the IEC (International Electrotechnical Commission) 320 "cold" connector receptacle, accepting the mating connector for the line power cord with hot, neutral, and ground leads. The voltage selector and fuse holder module allows the user 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 1, Getting Started, for the FIREBERD 4000 voltage and fuse requirements.

Data Interface Module Slot(s) - Slot 1 (on the bottom) is the standard interface slot where the interface module is plugged into the mainframe. Slot 2 (on the top) is the optional interface slot allowing 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.

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 information later in this section for additional information on configuring and operating the internal interface.

RS-232 PRINTER/CONTROLLER INTERFACE Connector - This connector is a female, 25-pin, D-type connector (located at the bottom right on the rear panel) 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 3, Printer Interfaces, and Section 4, Remote Control, for printer and remote control operation. The device attached to this connector determines which auxiliary functions must also be set.

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

GEN CLK IN Connector - An external clock source can be connected to the FIREBERD through this BNC connector. The input signal is selected through the GENERATOR CLOCK menu, BNC selection. The FIREBERD accepts a 50% duty cycle, 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 5, Options and Accessories, for information on options and accessories.

Option	Description
4001	Second Interface Slot
4002	IEEE-488
4003	Precision Time Base (±1 ppm)
4004	G.821 Performance Analysis
4005	Frequency Synthesizer
4006	Synchronous User Pattern

2.7 OPERATION

The following paragraphs describe 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 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.

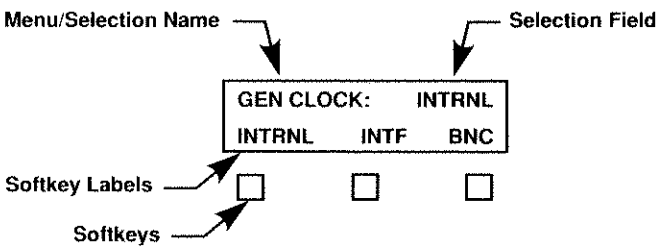


Figure 2-4
The SETUP Menu Display

2.8 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 as shown in Figure 2-4.

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.

2.8.1 SETUP Panel Display

The SETUP panel display provides the user with a menu name, a selection field, and softkey labels, as shown in Figure 2-4. 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.

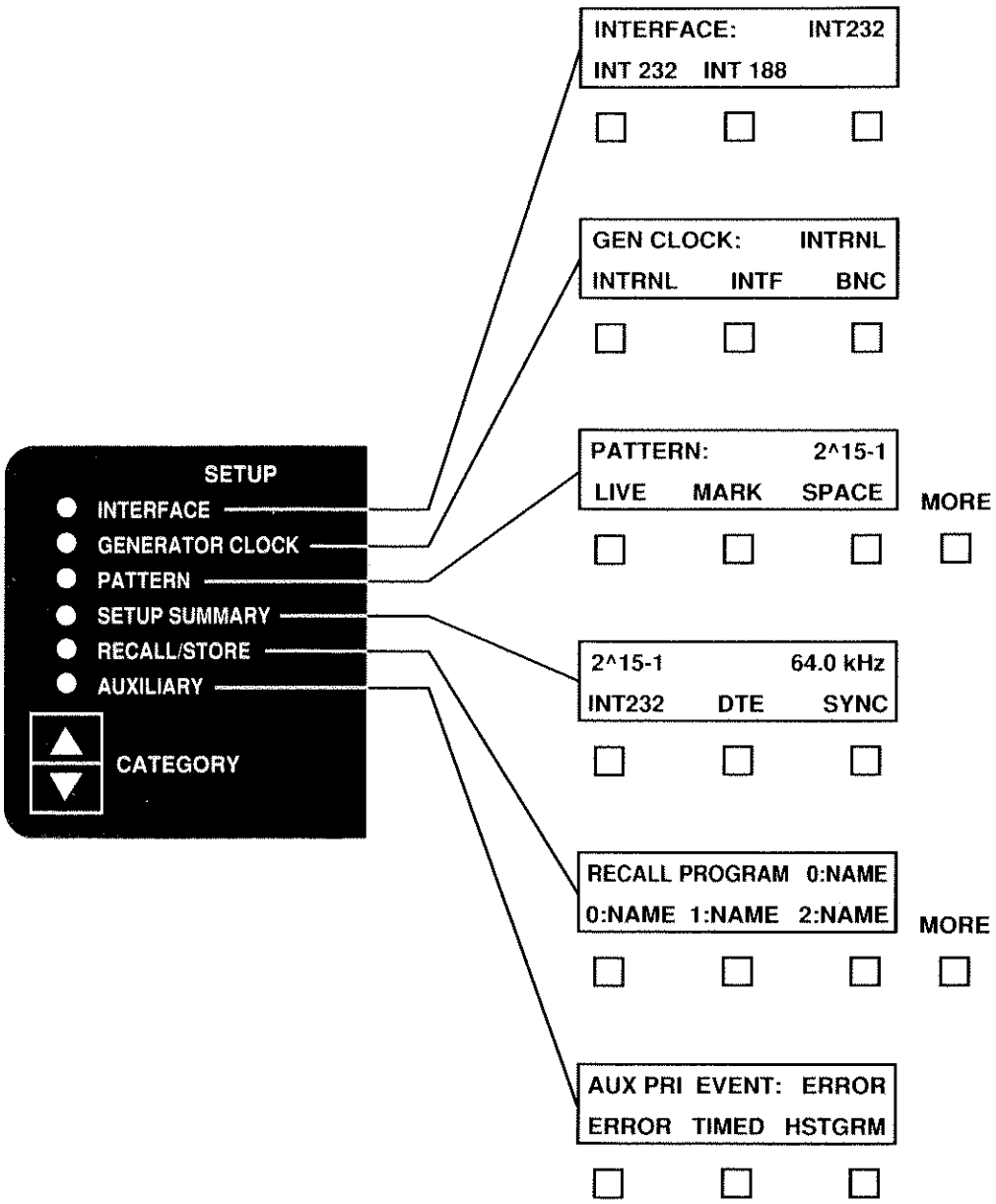


Figure 2-5
The SETUP CATEGORY Switch and Home Menus

2.8.2 SETUP CATEGORY Switch

The SETUP CATEGORY rocker switch provides access to the six categories listed above this switch, as shown in Figure 2-5. Pressing the up or down arrow on this switch selects the category above or below the currently displayed category. The displayed menus shown in Figure 2-5 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.

2.8.3 Softkeys

The softkeys are software-controlled switches that change functionality and definition according to the menu selected (see Figure 2-6). The softkeys have three basic functions:

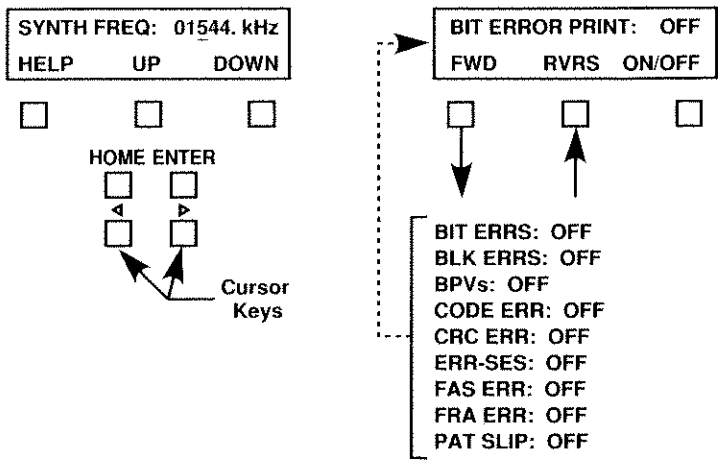


Figure 2-6
Softkey Scrolling and Cursor Keys

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 controls 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 view lists of options or change numerical values in the selection field, as shown in Figure 2-6. The softkeys are labeled FWD (forward), **RVRS** (reverse), **UP**, **DOWN**, or by a parameter, such as **BAUD** or **DATA** as in the AUXILIARY RS232 Interface 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 whether you want 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.

2.8.4 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 2-7. Pressing the MORE key when it is illuminated changes the softkey labels to the next set of labels.

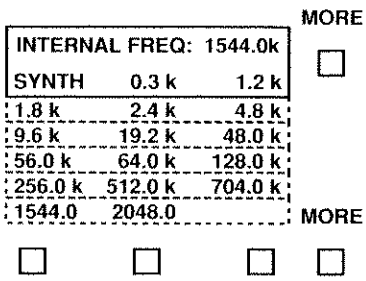


Figure 2-7
The MORE Key

2.8.5 SETUP SELECT Switch

The SETUP SELECT rocker switch allows movement forward or backward through the selected category when more than one menu is available, as shown in Figure 2-8. Figure 2-8 shows the GEN CLOCK menu when the INTERNAL FREQ menu has been selected. Pressing the SETUP SELECT switch displays the next GENERATOR CLOCK menu. If the menu displayed does not have another menu associated with it, pressing the SETUP SELECT switch does not display another menu.

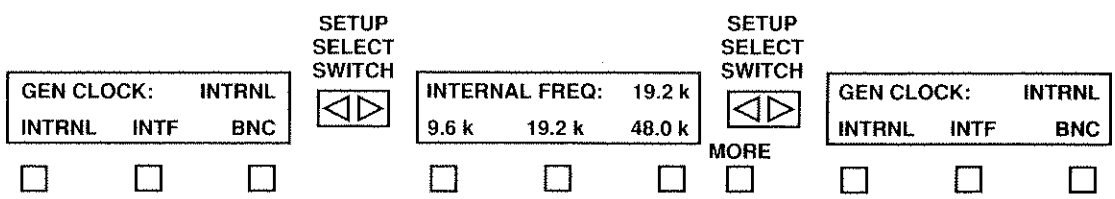


Figure 2-8
The SETUP SELECT Switch

2.8.6 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 2-9. Each of the category home menus are shown in Figure 2-5.

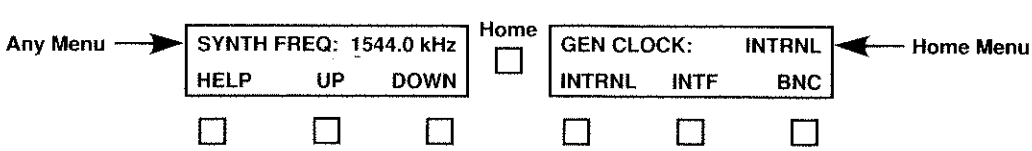


Figure 2-9
The HOME Key

The cursor keys are only used to position the cursor in the selection field (see Figure 2-6). The character above the cursor can be changed using the corresponding 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 the new parameters in memory. When the cursor appears in the display, 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 2-10 illustrates two ways of saving a keyed-in entry using the ENTER key, SETUP SELECT, or SETUP CATEGORY switch. Once the changes have been set as desired, pressing the ENTER key saves the new entry. If the entered value 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 new value entered, pressing the SETUP SELECT or SETUP CATEGORY switch displays the message

<ENTER> CHANGES?
YES NO

Pressing the softkey below **YES** stores the selected entry and returns the display to the current menu. Pressing the softkey below **NO** does not retain the current entry, but the previous entry is retained and displayed. If an invalid value is entered, and the softkey below **YES** is pressed, the associated HELP message momentarily appears. The displayed menu reappears with the invalid entry displayed. Verify that the new value is within limits 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. 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.

2.9 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 optional 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 category with the SETUP CATEGORY switch (INTERFACE LED illuminates), then press the corresponding softkey, as shown in Figure 2-10. The selected interface label appears on the top line of the display. 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 2-11(A) shows the INTERFACE menus available when only the internal RS-232-C/V.24 and MIL-STD-188C Interfaces (labeled INT232 and INT188) are available. Figure 2-11(B) shows the INTERFACE menu when two optional interfaces are installed. Figure 2-11(B) also shows how an installed interface is treated without a set-up menu.

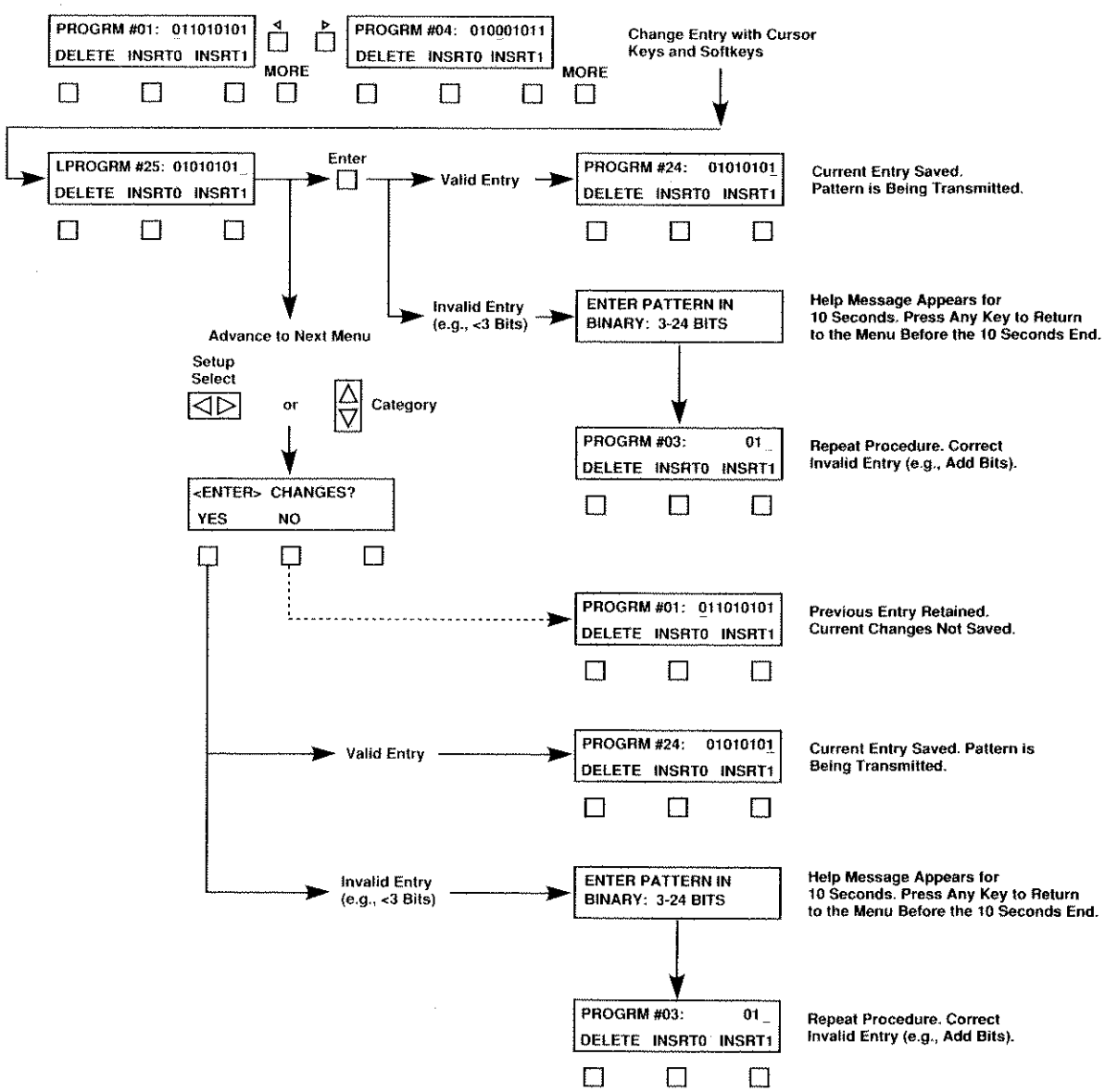


Figure 2-10
Entering Data in the SETUP Menus

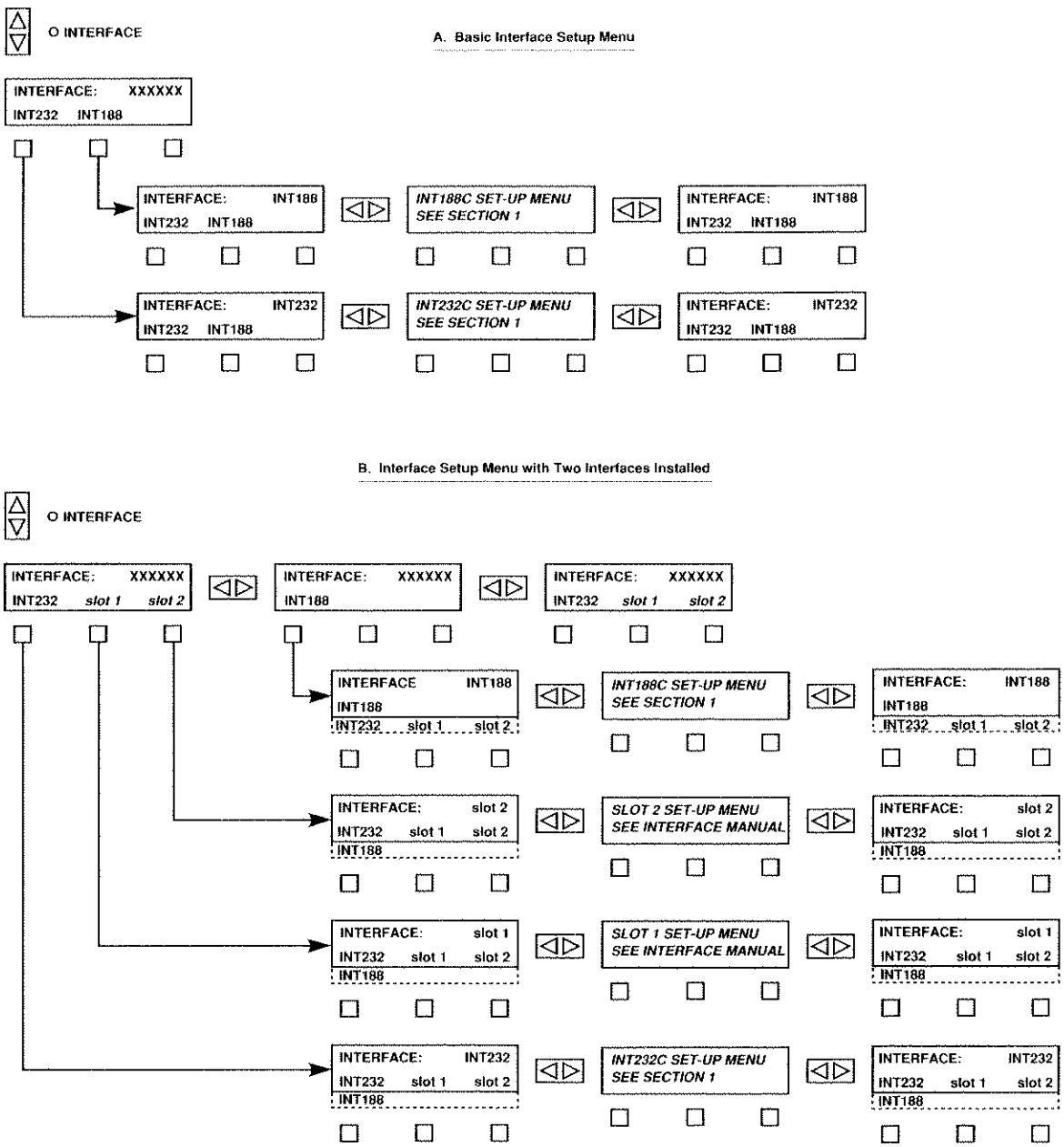


Figure 2-11
INTERFACE SETUP Menu

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 2-11). 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 2-11). The interface listed after INT232 in the INTERFACE menu is installed in the standard interface slot, SLOT 1. The third interface listed is the interface installed in the optional interface slot (SLOT 2) or the INT188 Interface, if no interface is installed in SLOT 2.

Another interface configuration available for the FIREBERD 4000 is having two or four ISU-6000s connected to the FIREBERD 4000 through the two interface slots. The first two ISU softkey labels, **ISU1** and **ISU2**, appear in the INTERFACE SETUP menu. Pressing the illuminated MORE key displays the other two ISU labels. Pressing one of the softkeys below the ISU menu items allows access to the interfaces in that ISU. An ISU can contain up to four interfaces. With four ISU-6000s connected to one FIREBERD 4000, up to 8 interfaces (16 with Option 4001 installed and 4 ISUs connected) can be controlled by the FIREBERD, 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*.

2.10 GENERATOR CLOCK SETUP CATEGORY

The GENERATOR CLOCK SETUP category, shown in Figure 2-12, 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 (**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 corresponding softkey (see Figure 2-12). The selected timing source label appears in the 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.

2.10.1 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 2-12). The fixed frequencies include:

0.3k	56.0k
1.2k	64.0k
1.8k	128.0k
2.4k	256.0k
4.8k	512.0k
9.6k	704.0k
19.2k	1544.0k
48.0k	2048.0k

To select a frequency:

1. Press the INTRNL softkey and SETUP SELECT switch to access the INTERNAL FREQ menu (see Figure 2-11).
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.

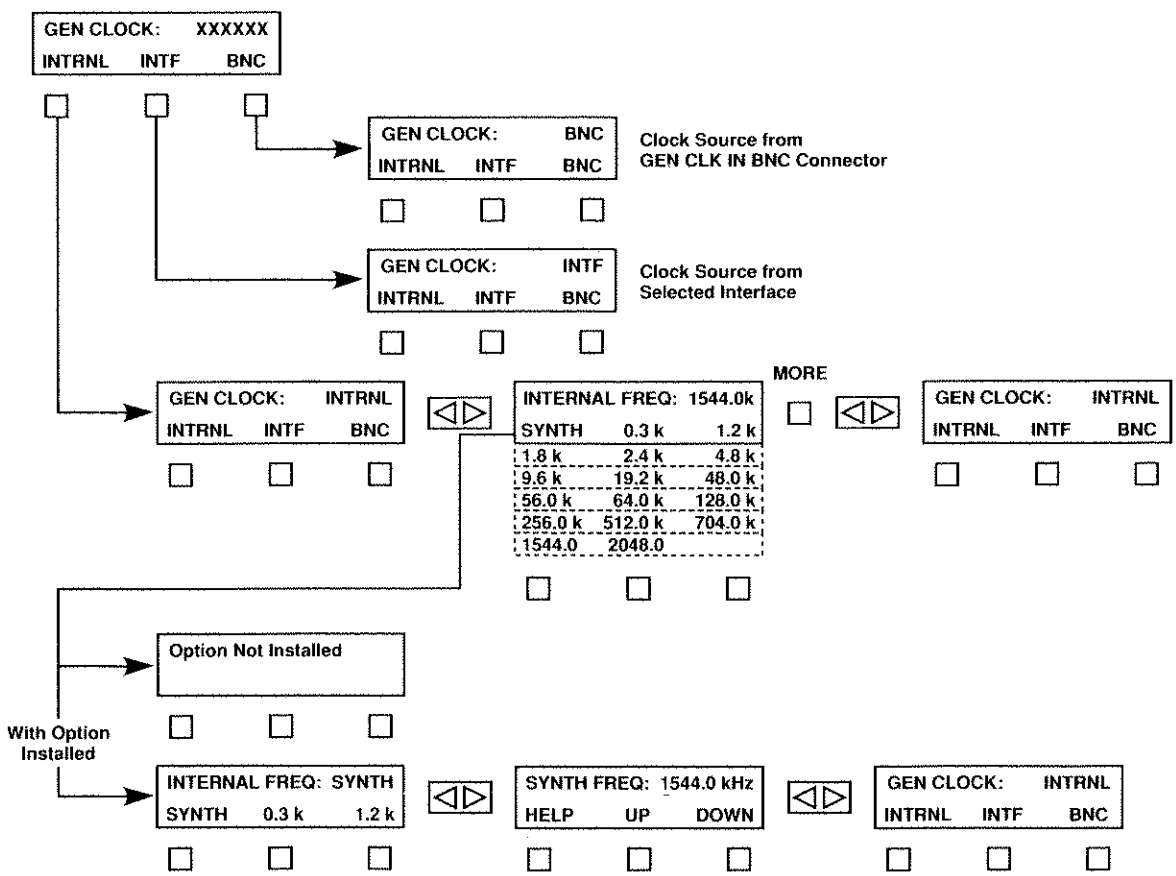


Figure 2-12
Generator Clock Menu

2.10.2 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 (0.05 kHz) to 15 MHz (15000 kHz) 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 category Frequency menu.

Entering the Synthesizer Frequency

Enter the synthesizer frequency as follows:

1. Select the GENERATOR CLOCK category, INTERNAL FREQ or SYNTH FREQ menu, as shown in Figure 2-13.

2. Use the cursor keys (left/right) to move the cursor and the **UP** and **DOWN** softkeys to set the digit 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 set, press the ENTER key to save the new frequency.

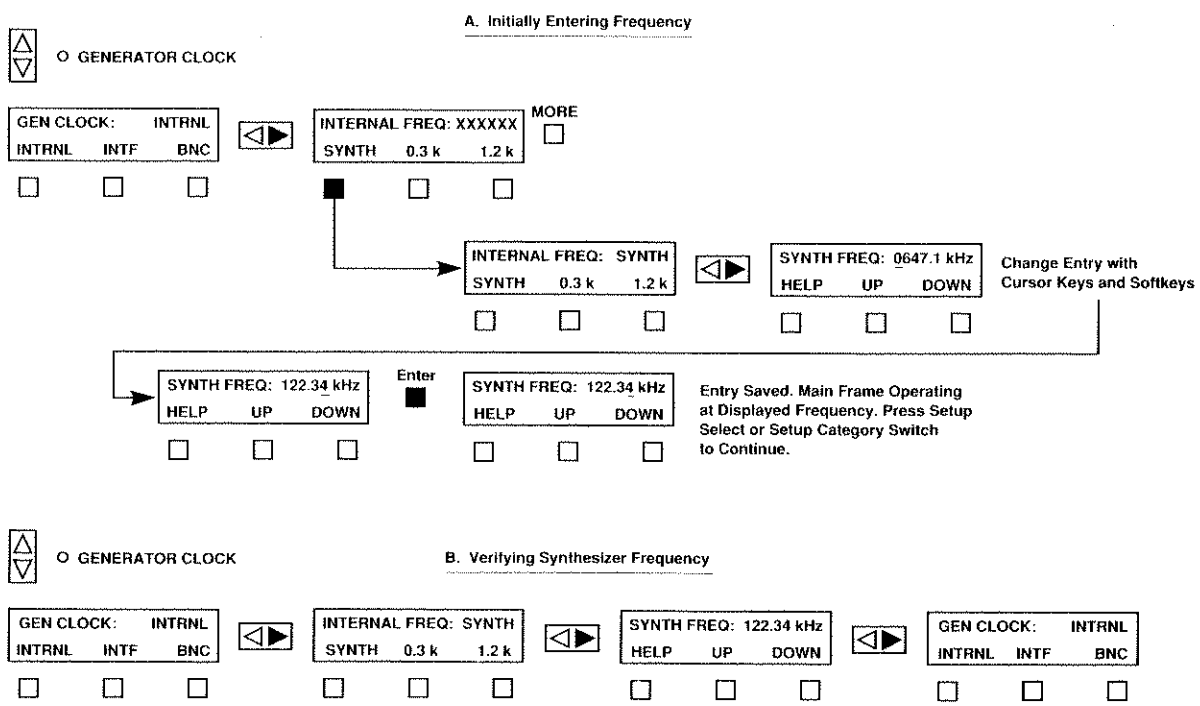


Figure 2-13
Generator Clock Synthesizer Menu

Changing the Fixed Internal Frequencies

All fixed frequencies in the INTERNAL FREQ menu, listed under the GENERATOR CLOCK category, 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 2-14 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 2-14).

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 desired frequency is displayed, press the ENTER key to save the new frequency.

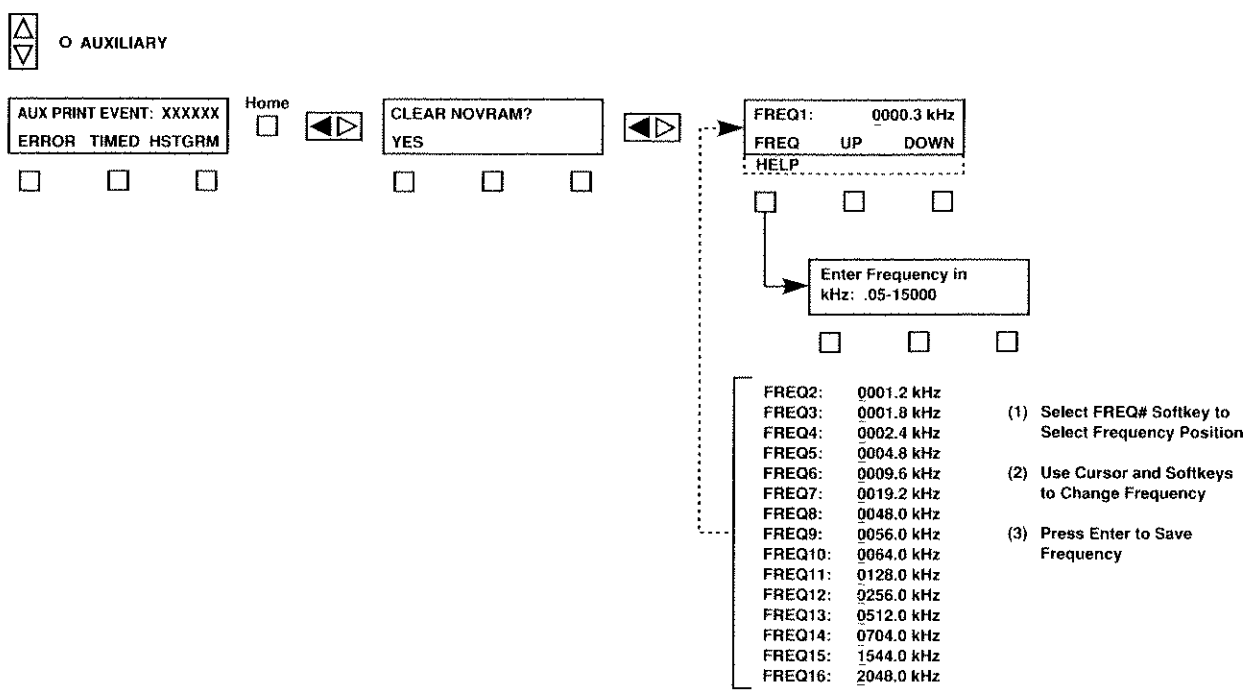


Figure 2-14
Changing the Fixed Generator Clock Frequencies

2.10.3 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.

2.10.4 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 base clock frequency minus the framing bit frequency.

2.11 PATTERN SETUP CATEGORY

The PATTERN SETUP category provides a list of fixed, pseudorandom, and programmable test patterns, as shown in Figure 2-15. 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 2-1 describes the test patterns that are generated by the FIREBERD 4000.

2.11.1 Test Patterns and Testing Asynchronous Circuits

The following patterns are valid when testing asynchronous circuits: LIVE, MARK, SPACE, 1:1, 63, 511, 2047, 2^{15}-1, FOX, and USER(1 to 3). The following patterns are not valid when testing asynchronous circuits: 1:7, 3IN24, 2^{20}-1, 2^{23}-1, QRSS, PRGM, T1-1 to T1-6, T1-mW, DDS-1 to DDS-6, and 1020Hz. 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 LIVE, 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.

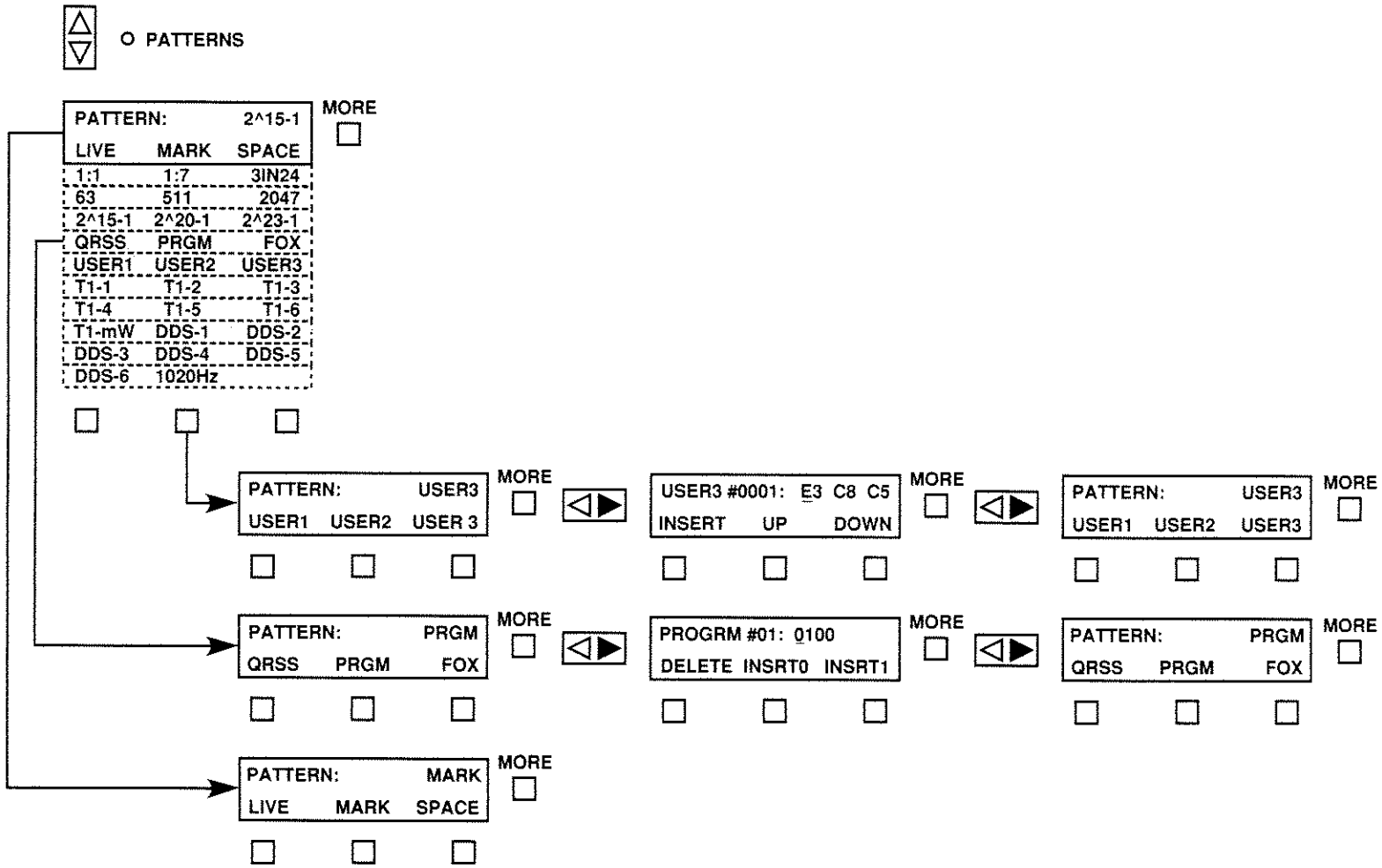


Figure 2-15
PATTERN Set-up Menu

Table 2-1
FIREBERD 4000 Test Patterns

Pattern	Description
LIVE	This selection provides a fixed alternating Mark and Space test pattern. The pattern is used whem monitoring live data. The PATTERN SYNC LED never illuminates with this pattern selected.
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. This 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. This 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 the maximum number of zeros allowed for framed, non-B8ZS testing.
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. This 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. This pattern cannot be used to test asynchronous circuits.
PRGM	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 the paragraphs following this table for instructions on entering a programmable bit pattern.

Table 2-1
FIREBERD 4000 Test Patterns (Continued)

Pattern	Description
USER1	A user-created message of up to 2048 hexadecimal characters. When a USER1 message is not programmed, the default pattern is T1-6. A lengthy, user-specific test pattern. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required when in synchronous or recovered timing mode.
USER2	Same as USER1, with the exception of the default pattern: a 7-bit ASCII QUICK BROWN FOX message. A lengthy, user-specific test pattern. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required in synchronous or recovered timing mode.
USER3	Same as USER2, with the exception of the default pattern: an 8-bit ASCII QUICK BROWN FOX message. A lengthy, user-specific test pattern. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required in synchronous or recovered timing mode.
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
T1-1	Long User 72-octet pattern: 80 80 80 80 01 00 01 01 01 03 80 01 80 01 01 80 01 22 00 20 22 00 20 AA AA AA AA AA 55 55 55 55 AA AA AA AA 55 AA AA 55 55 55 80 80 FF FF FF FF FF FF FF FE FF FF 24 49 92 88 88 88 10 42 08 21 84 20 08 82 40 20 10 80. Stress testing of the repeater preamplifier and automatic line build-out (ALBO) circuitry. Detect marginal equipment using rapid transitions from a low ones density to a high ones density. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Not available in asynchronous timing mode.
T1-2	Long User 96-octet hex pattern: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF

Table 2-1
FIREBERD 4000 Test Patterns (Continued)

Pattern	Description
T1-2 (Continued)	AA AA AA AA 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 AA AA AA AA 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01. Empirical stress testing of T1 circuits and equipment. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Not available in asynchronous timing mode.
T1-3	Long User 54-octet hex pattern: 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. Empirical stress testing of T1 circuits and equipment. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Not available in asynchronous timing mode.
T1-4	Long User 120-octet hex pattern: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF AA AA AA AA 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 AA AA AA AA 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10. Empirical stress testing of T1 circuits and equipment. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Not available in asynchronous timing mode.
T1-5	Long User 53-octet hex pattern: 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 80 01 01 AF AA AF 01 01 01 01 FF FF FF FF 01 01 01 01 FF FF FF FF FF FF CB. Empirical stress testing of T1 circuits and equipment. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Not available in asynchronous timing mode.

Table 2-1
FIREBERD 4000 Test Patterns (Continued)

Pattern	Description
T1-6	Long User 55-octet hex pattern: 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. Empirical stress testing of T1 circuits and equipment. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Not available in asynchronous timing mode.
T1-mW	Long User Pattern digitized 1004 Hz tone with a 0 dBm0 level on one DS-0 channel. This pattern length is 238 bytes. Standard tone (μ-law) used in Voice Frequency (VF) testing. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required.
DDS-1	Long User Pattern of 100 octets with all ones (11111111), followed by 100 octets with all zeros (00000000). Stresses any DDS circuit's minimum and maximum power requirements for signal recovery. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Cannot be used in asynchronous timing mode.
DDS-2	Long User Pattern of 100 octets of 01111110, followed by 100 octets of all zeros. Simulation of an HDLC packet frame. A FIREBERD equipped with Option 4006 is required. Cannot be used in asynchronous timing mode.
DDS-3	Fixed pattern 00110010. Minimum stress test of a DDS circuit. Cannot be used in asynchronous timing mode.
DDS-4	Fixed pattern 01000000. Moderate stress on DDS clock recovery circuits. Cannot be used in asynchronous timing mode.
DDS-5	Long User Pattern, a 7-octet fixed pattern of 1111 1110 followed by 1 octet of 1111 1111. Simulation of a DDS signal transition from IDLE mode to DATA mode. Detects marginal equipment in multipoint applications. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required. Cannot be used in asynchronous timing mode.
DDS-6	Long User Pattern, consisting of DDS patterns 1-4. A quick test for those wishing to test a circuit with DDS patterns 1-4.
1020Hz	Long User Pattern digitized 1020 Hz tone with a 0 dBm0 level on one timeslot. This pattern length is 400 bytes. Standard tone (A-law) used in CCITT Voice Frequency (VF) testing. A FIREBERD equipped with Option 4006 (Synchronous Long User Patterns) is required.

NOTE: Certain data patterns are designed for use with specific data interfaces. The T1-1 to T1-6 patterns are designed for use with the T1 interfaces (e.g., T1/FT1 and DS1/T1). The DDS-1 to DDS-6 patterns are designed for use with the DDS interfaces. These patterns are not compatible when used with another type of interface.

2.11.2 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): USER(1-3), FOX, T1-1 to T1-6, T1-mW, DDS-1, DDS-2, DDS-5, DDS-6, and 1020Hz. 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.

2.11.3 Programmable Bit Pattern Menu

Figure 2-16 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 2-16). The #XX (#01 to 24) value indicates the cursor bit position in the bit string. A maximum of nine bit values is visible in the display window.

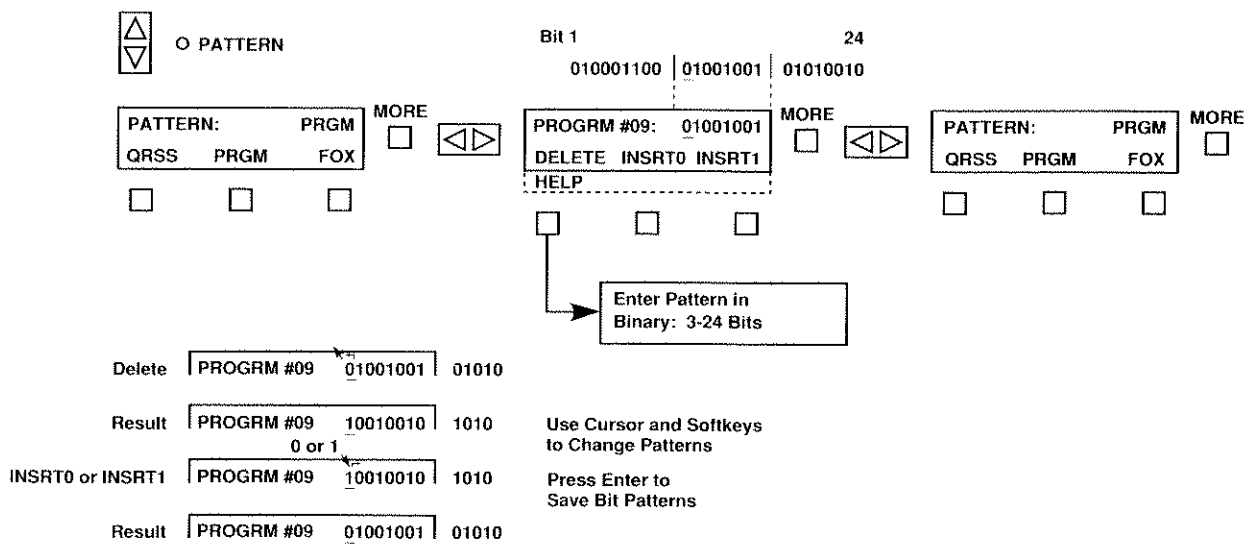


Figure 2-16
Programmable Bit Pattern Menu

Each bit is entered or edited in binary form using the following softkeys:

DELETE - Deletes the bit over the cursor.

INSRT0 - Inserts a zero at the position of the cursor. When the **INSRT0** softkey is pressed a 0 is inserted in the bit string and the previous bit moves one position to the right.

INSRT1 - Inserts a one at the position of the cursor. When the **INSRT1** softkey is pressed a 0 is inserted in the bit string and the previous bit moves one position 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 the PRGM menu item is displayed.

2. Press the **PRGM** softkey, then press the right arrow on the SETUP SELECT switch. The PROGRAM DATA menu is visible in the display window.

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

4. Press the ENTER key to store the revised bit pattern. Pressing ENTER also replaces the old pattern in memory and transmits the new pattern. Entering less than three bits, which is an invalid string, causes the HELP message (**ENTER PATTERN IN BINARY: 3 - 24 BITS**) to momentarily appear.

2.11.4 User Programmable Character Pattern Menu

Figure 2-17 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 - 2048 HEX CODED CHARACTERS.**

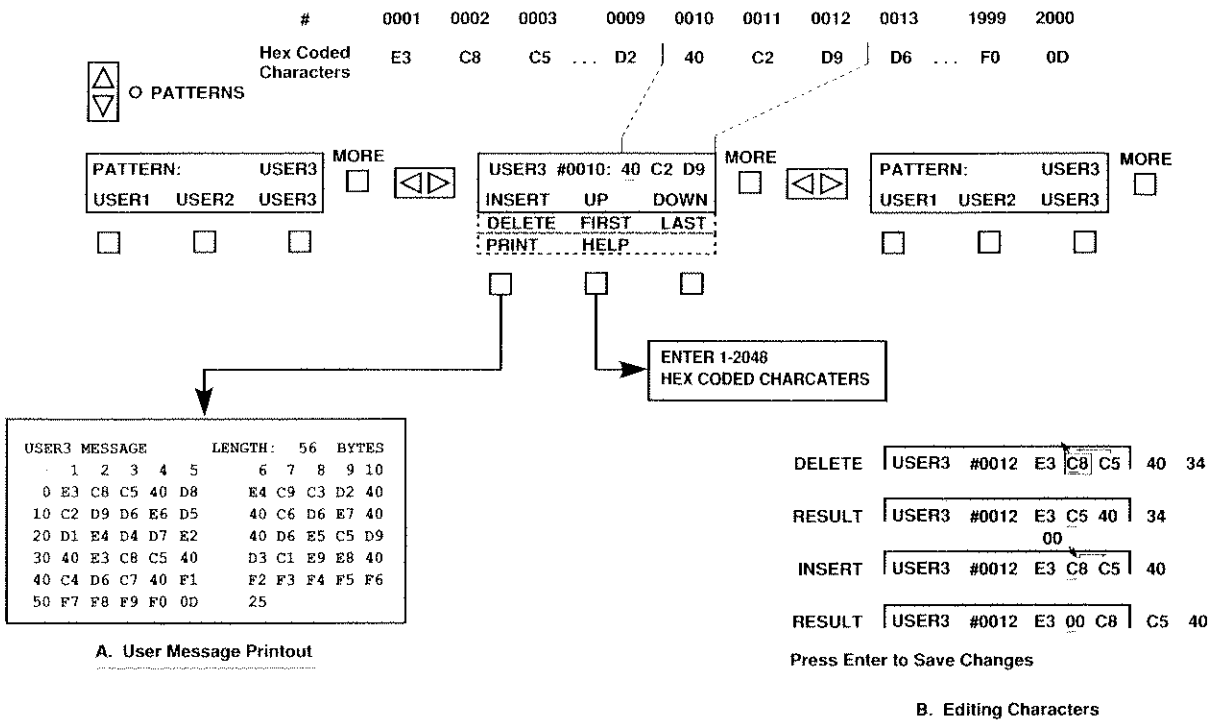


Figure 2-17
User Programmable Character Pattern Menu

Refer to the Appendix section for a hexadecimal conversion table.

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** is displayed.

2. Press the **USER1**, **USER2**, or **USER3** softkey, then press the right arrow on the SETUP SELECT switch. The selected USER menu is displayed.

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 left and right cursor keys. Press the **UP** or **DOWN** softkeys to display the desired character value. Refer to Appendix H for a hexadecimal-to-character conversion table.

4. Press the ENTER key to store the new character pattern. Pressing ENTER also replaces the old pattern in 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 parity 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 Subsection 2.14.3). The User Synchronization Threshold menu sets a minimum number of bytes that need to be detected to establish synchronization.

2.11.5 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 either the ERROR INSERT switch or the bit error generators provided on certain 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 in, until the LED in 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.

2.11.6 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 recorded as bit errors, block errors, pattern slips, code errors, etc., and can be viewed in the ANALYSIS RESULTS display. Refer to ANALYSIS RESULTS, found later in this section, for the operation and description of the analysis results capabilities of the FIREBERD 4000.

2.12 SETUP SUMMARY DISPLAY

The SETUP SUMMARY display summarizes the configuration of the FIREBERD as shown in Figure 2-18. The SETUP SUMMARY display is the default SETUP CATEGORY selection and appears each time the unit is powered up. It is also displayed when selected with the SETUP CATEGORY switch. The display indicates the current test pattern, clock frequency, interface, and key interface settings.

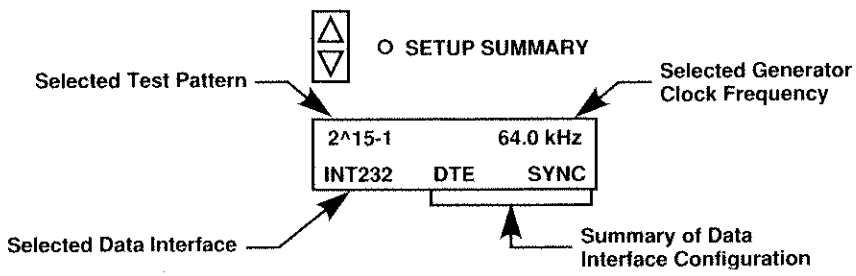


Figure 2-18
SETUP SUMMARY Display

2.13 RECALL/STORE CATEGORY

The RECALL/STORE category allows up to 10 front-panel switch and menu set-ups to be stored, named, and recalled. Figure 2-19 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.
- 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.

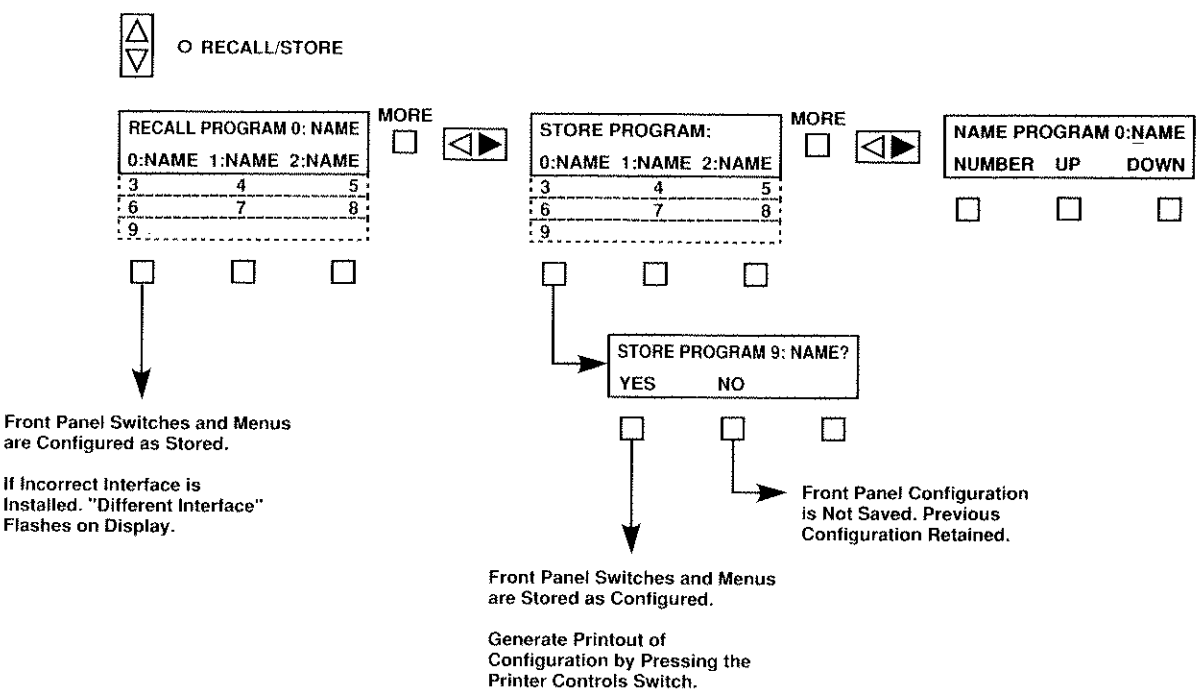


Figure 2-19
RECALL/STORE Set-up Menu

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

2.13.1 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 hard copy of the configuration.

2.13.2 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 view the desired 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.

2.13.3 Naming Front-Panel Configurations

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

1. Press the SETUP CATEGORY switch to select the RECALL/STORE menu (RECALL/STORE category LED illuminates).
2. Press the right arrow in the SETUP SELECT switch 2 times to display the NAME PROGRAM menu and menu choices.

3. Press the necessary softkey (NUMBER, DOWN, or UP) to display the desired program number and/or change the character at the cursor position. Pressing the NUMBER softkey scrolls through the program numbers (0 to 9). Pressing the UP/DOWN softkeys scrolls through the character choices at the cursor position. Pressing the left or right cursor arrow moves the cursor in the corresponding direction.

4. Name the selected program number, using up to 4 characters. The default name for each program number is NAME.

2.14 AUXILIARY SETUP CATEGORY

The AUXILIARY SETUP category provides the following menus that apply to specialized functions of the FIREBERD 4000. Each auxiliary menu is described in the following paragraphs. Press the SETUP CATEGORY switch to select the AUXILIARY SETUP category. Press the right arrow on the SETUP SELECT switch to scroll through the auxiliary 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**). This selection determines the next displayed menu. When ERROR is selected, the following menu is displayed.

- Bit Error Print Menu (**BIT ERROR PRINT: FWD/RVRS/ON/OFF**)

If ERROR is not selected for the AUX PRI EVENT menu, the other two menu item choices (**TIMED** or **HSTGRM**) cause their respective menu to be displayed when selected and the right arrow on the SETUP SELECT switch is pressed.

- Timed Print Menu
- Histogram Print Menu
- 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: CLEAR/HALT)
- Block Length Menu (BLOCK LENGTH: PATLEN/10^2/10^3 10^4/10^5/10^6)
- Date (DATE: DD/MMM/YY) Menu
- Time (TIME: HH/MM/SS) Menu
- Result Printout Format Menu (RESULT PRINT: SUM/STD/LONG)
- Status Message Printout Menu (STATUS PRINT: ON/OFF)
- Printer Printout Format Menu (PRINTER: WIDTH/MODE/TERM)
- RS232 Printer/Controller Interface Menu (RC/PRINT)
- RS232 Printer Format Menu (RS232: BAUD/DATA/PAR PR45/PR40A/PR2000 PR40/PR85)
- IEEE-488 Address (display only) menu (00-31)*
- Fixed Frequency Editor Menu (FREQ1: FREQ#/UP/DOWN HELP)†
- Clear Non-Volatile RAM Menu (CLEAR NOVRAM? YES)

* Requires IEEE-488 option (Option 4002).
† Requires Frequency Synthesizer option (Option 4005).

2.14.1 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 errored (**ERROR**), timed (**TIMED**), or histogram (**HSTGRM**) results printouts. The menu item selected for this menu determines the next menu displayed when the right arrow on the SETUP SELECT switch is pressed.

Figure 2-20 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 3, Printer Interfaces, for printer set-up and operation information.

Pressing the **ERROR** softkey causes enabled error events to generate printouts when the corresponding error condition occurs, 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 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

With ERROR selected for the AUX PRI EVENT, pressing the right arrow on the SETUP SELECT switch displays the first error (BIT ERRS) menu item and its status on the top line. The bottom line displays the three softkey choices (FWD, RVRS, and ON/OFF).

Pressing the softkey below the ON/OFF menu item toggles the displayed error event between OFF and ON. The FWD and RVRS softkeys are used to scroll through the following error event menu items.

BIT ERRS
BLK ERRS
BPVs
CODE ERR
CRC ERR
ERR-SES
FAS ERR
FRA ERR
PAT SLIP

Pressing the **TIMED** softkey allows results printouts to be generated at timed intervals, from 1 minute (00:01) to 99 hours and 59 minutes (99:59). The default is 5 minutes (00:05).

With the TIMED menu item selected, pressing the right arrow on the SETUP SELECT switch displays the TIMED PRINT interval on the top line with the cursor flashing under the left-most value. The three menu choices (HELP, UP, and DOWN) are displayed on the bottom line. Pressing the softkey below the UP or DOWN menu item increments or decrements the value at the cursor position. Use the left or right cursor key to move the cursor in the desired direction.

Pressing the softkey below the HELP menu item displays **ENTER TIME IN HH:MM** HH=00-99, MM=00-59. Entering an invalid parameter value (e.g., 60 for the minutes) and pressing the ENTER switch causes the help message to be displayed for several seconds before the invalid value is redisplayed. After a valid parameter value is entered, press the ENTER switch to save the new value as the desired time interval.

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 POWER switch, pressing the RESTART push button, or by changing a parameter for the test in-progress.

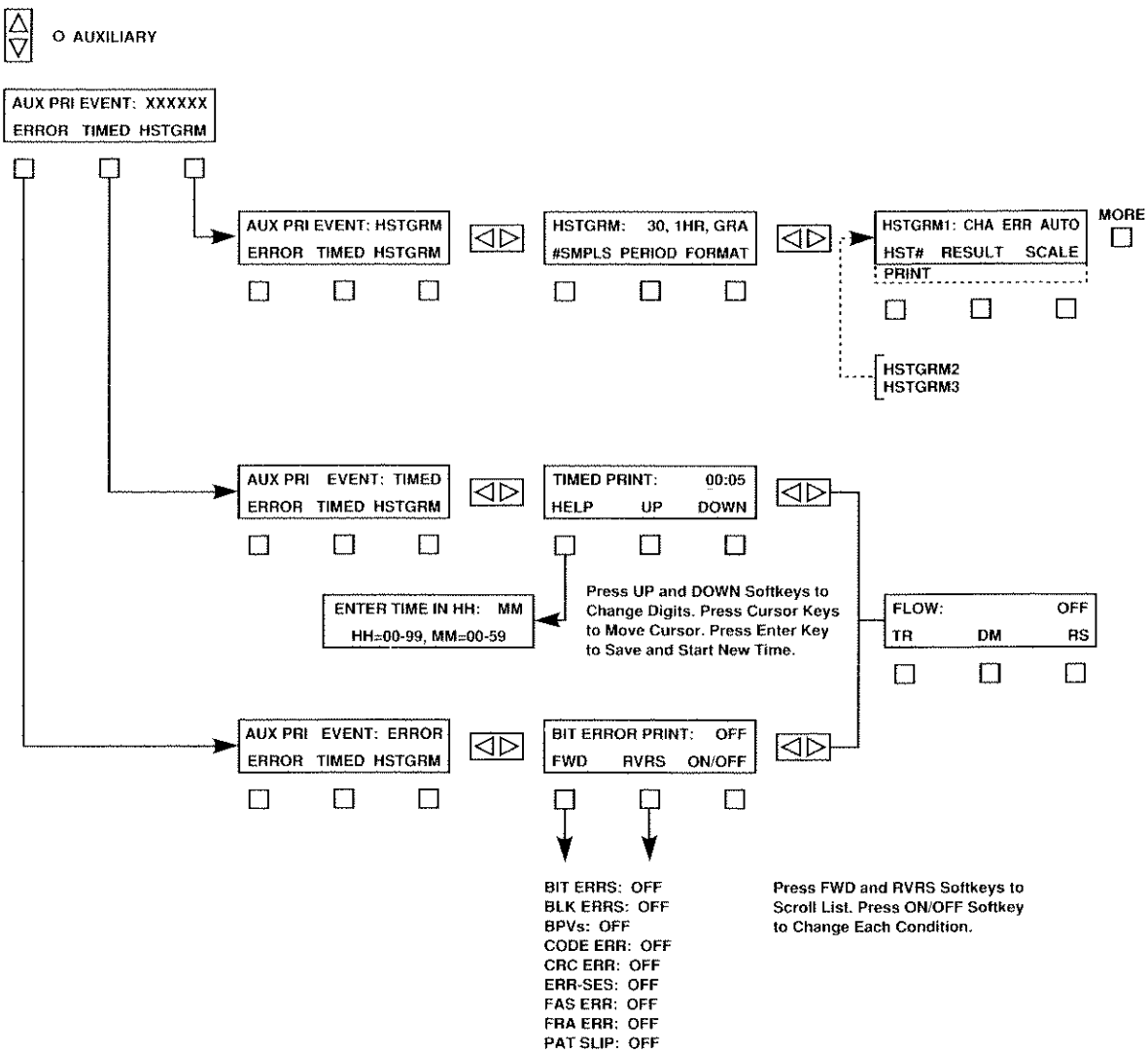


Figure 2-20
Auxiliary Print Event Menu

Pressing the **HSTGRM** softkey enables histogram analysis to be performed. Pressing the right arrow on the SETUP SELECT switch displays the histogram menu. The current histogram selections are visible on the top line and the three menu item choices (#SMPLS, PERIOD, and FORMAT) are visible on the bottom line. 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 can 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 the selected period value. 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 time this softkey is pressed, the sample number increments by 1. Once 60 is displayed, pressing the #SMPLS softkey once more displays a value of 5. 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 scrolls 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 type of format for 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.

Pressing the right arrow on the SETUP SELECT switch displays the HSTGRM1 selection on the top line and the three softkey menu items (HST#, RESULT, and SCALE) on the bottom line. The LED in the MORE key illuminates, indicating additional menu items are available for the displayed menu. Pressing the MORE key displays the last menu item (PRINT). Pressing the MORE key once more displays the first three menu items again.

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 cause the histogram to restart.

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 2-2. 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#**.

Histogram result choices are:

1SEC CRC	CPE S C	G EFS
AVL SEC	CRC ERR	GERR SEC
BIT ERRS	DEG MIN	MFAS ERR
BLK ERRS	ERR-SES	PAR ERR
BLOCKS	FAS ERR	PAT LOSS
BPV SEC	FCS ERR	PAT SLIP
BPVs	FEBE	PATL SEC
CHAR ERR	FEBE S A	REBE
CODE ERR	FEBE S B	SES
CPAR ERR	FEBE S C	T16AIS S
CPE S A	FRA ERR	UNA SEC
CPE S B	FRMR	OFF

NOTE: Changing this parameter restarts all histograms.

Table 2-2
Available Histogram Results

Result Selection	Result Name
1SEC CRC	One-Second CRC Errors
AVL SEC	Available Seconds
BIT ERRS	Bit Errors
BLK ERRS	Block Errors
BLOCKS	Blocks
BPV SEC	Bipolar Violation Seconds
BPVs	Bipolar Violations
CHAR ERR	Character Errors
CODE ERR	Code Errors
CPAR ERR	C-Bit Parity Errors
CPE S A	C-Bit Errored Seconds (Type A)
CPE S B	C-Bit Errored Seconds (Type B)
CPE S C	C-Bit Errored Seconds (Type C)
CRC ERR	CRC Errors
DEG MIN	Degraded Minutes
ERR-SES	Bit Errors in Non-Severely Errored Seconds
FAS ERR	Frame Alignment Signal Errors
FCS ERR	Frame Check Sequence Errors
FEBE	Far End Block Errors
FEBE S A	Far End Bit Errored Seconds (Type A)
FEBE S B	Far End Bit Errored Seconds (Type B)
FEBE S C	Far End Bit Errored Seconds (Type C)
FRA ERR	Frame Errors
FRMR	Frame Reject Frames
G EFS	G.821 Error Free Seconds
GERR SEC	G.821 Errored Seconds
MFAS ERR	Multiframe Signal Alignment Word Errors
PAR ERR	Parity Errors
PAT LOSS	Pattern Synchronization Loss
PAT SLIP	Pattern Slips
PATL SEC	Pattern Loss Seconds
REBE	Remote End Block Errors
SES	Severely Errored Seconds
T16AIS S	Timeslot 16 Alarm Indication Signal Seconds
UNA SEC	Unavailable Seconds
OFF	Off

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 2-3. Select **SCALE** for each **HST#**.

NOTE: Changing this parameter does not restart histogram analysis.

Table 2-3
Scale Selections

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

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 2-20).

2.14.2 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).

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

Pressing the corresponding softkey toggles the control lead selection on and off. The softkey label appears in the selection field when the lead is enabled. **OFF** appears in the display when none of the leads are enabled. 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.

2.14.3 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 subsection 2.11.4).

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.

2.14.4 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 both synchronous timing and asynchronous timing.

2.14.5 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 2-4 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.

Table 2-4
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

Table 2-4
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
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 CPER	S/R	S/R	No/R	S/Con	S/Con	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 FEBE	S/R	S/R	No/R	S/Con	S/Con	No
AVG FER	S/R	S/R	No/R	S/Con	S/Con	No
AVG MFAS	S/R	S/R	No/R	S/Con	S/Con	No
AVG PER	S/R	S/R	No/R	S/Con	S/Con	No
AVG REBE	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
CPAR ERR	S/R	S/R	No/R	S/Con	S/Con	No
DAT RATE	No	No	No	No	No	No
FAS ERR	S/R	S/R	No/R	S/Con	S/Con	No
FEBE	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 ZERO	R	No	No	R	No	No
PAR ERR	S/R	S/R	No/R	S/Con	S/Con	No
R LVL V	No	No	No	No	No	No
R LVL dB	No	No	No	No	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
RCV FAS	R	R	No	R	R	No
RCV FEAC	R	R	No	R	R	No
RCV MFAS	R	R	No	R	R	No
RCV NFAS	R	R	No	R	R	No
REBE	S/R	S/R	No/R	S/Con	S/Con	No
RX ABCD	R	R	No	R	R	No
RX X1 X2	R	R	No	R	R	No
SMPX CUR	No	No	No	No	No	No
TIME & SIGNAL Category						
BPV SEC	S/R	No/R	No/R	S/Con	No	No
BPV %EFS	S/R	No/R	No/R	S/Con	No	No
BER-SES	S/R	S/R	No/R	S/Con	S/Con	S/Con
CPE S A	S/R	S/R	No/R	S/Con	S/Con	No
CPE S B	S/R	S/R	No/R	S/Con	S/Con	No
CPE S C	S/R	S/R	S/R	S/Con	S/Con	No
%EFS	S/R	S/R	S/R	S/Con	S/Con	S/Con

Table 2-4
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
TIME & SIGNAL Category (Continued)						
DATE	No	No	No	No	No	No
DAT RATE	N/A	N/A	No	N/A	N/A	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
FEBE S A	S/R	S/R	No/R	S/Con	S/Con	No
FEBE S B	S/R	S/R	No/R	S/Con	S/Con	No
FEBE S C	S/R	S/R	No/R	S/Con	S/Con	No
GEN FREQ	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
-LVL V	No	No	No	No	No	No
LVL dBm	No	No	No	No	No	No
PATL SEC	Con	Con	Con	Con	Con	Con
PP LVL V	No	No	No	No	No	No
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[1]						
%AVL SEC	Con	Con	Con	Con	Con	Con
%DEG MIN	Con	Con	Con	Con	Con	Con
%SES	Con	Con	Con	Con	Con	Con
AVL SEC	Con	Con	Con	Con	Con	Con
DEG MIN	Con	Con	Con	Con	Con	Con
ERR-SES	Con	Con	Con	Con	Con	Con
G %EFS	Con	Con	Con	Con	Con	Con
G EFS	Con	Con	Con	Con	Con	Con
GERR SEC	Con	Con	Con	Con	Con	Con
SES	Con	Con	Con	Con	Con	Con
UNA SEC	Con	Con	Con	Con	Con	Con

S = Saved during sync loss.
R = Restarted at re-sync.
Con = Continues being updated after re-sync.
No = Not affected by sync loss.
[1]For additional Information about Performance analysis results, refer to Appendix F.

2.14.6 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.

2.14.7 Date and Time Menus

The Date (**DATE: DD/MMM/YY**) and Time (**TIME: HH/MM/SS**) menus are used to set the date and time of the internal battery-backed clock. Select the AUXILIARY function category with the SETUP CATEGORY switch, then press the left arrow on the SETUP SELECT switch to locate the date and time menus. Note that clearing NOVRAM does not reset the date and time values.

The date is entered by pressing the corresponding softkeys until the desired day (1 - 31), month (JAN - DEC), and year (00 - 99) are visible in the display. Press the ENTER key to save the new date. Invalid dates are not saved.

The time is entered by pressing the associated softkeys until the desired hour (00 - 23), minute (00 - 59), and second (00 - 59) are visible in the display. Enter the time using a 24-hour clock format. Press the ENTER key to save the new time. Invalid times are not saved.

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

2.14.8 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 3, Printer Interfaces, for specific information on printer set-up and operation.

SUMM - Press this softkey to generate the summary result printout that lists key 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.

2.14.9 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 DATA LOSS, CLOCK LOSS, SIGNAL LOSS, SYNC LOSS (PATTERN), FRAME SYNC LOSS, SYNC ACQUIRED (PATTERN), or POWER UP. 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.

2.14.10 Printer Printout Format Menu

The Printer Printout Format menu (**PRINTER: WIDTH/MODE/TERM**) sets up the printer printout format.

WIDTH - Press this softkey to select the printout character line width. Width choices are: **20**, **40**, or **80** (default = 40).

MODE - 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 FAST 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).

2.14.11 RC/PRINT Menu

The RC/PRINT menu (**RC:None PRINT:232**) selects determines the remote control format and the printer port selected. In a standard FIREBERD 4000, the following RC/PRINT menu choices in the left columns are available. When the IEEE-488 option (Option 4002) is installed the menu choices in the right columns are available.

RC:None	PRINT:232	RC:None	PRINT:232
RC:232	PRINT:Remote	RC:488	PRINT:232
RC:None	PRINT:None	RC:None	PRINT:488
RC:232	PRINT:None	RC:232	PRINT:488
		RC:232	PRINT:Remote
		RC:488	PRINT:Remote
		RC:None	PRINT:None
		RC:232	PRINT:None
		RC:488	PRINT:None

RC - The remote control selection determines which connector port the FIREBERD monitors for remote control commands. Remote control choices are: None, 232, or 488 (if Option 4002 is installed). If RC is set to None, the FIREBERD does not respond to any remote control commands.

PRINT - The printer selection determines which connector port the FIREBERD uses when printing out information. Printer choices are: None, 232, Remote, or 488 (if Option 4002 is installed). Setting PRINT to Remote causes the FIREBERD to direct printouts to the Print Buffer. Information stored in the Print Buffer can be retrieved using the print remote commands described in Section 4.

2.14.12 RS232 Printer/Controller Interface Menu

The RS232 Printer/Controller Interface menu (**RS232: BAUD/DATA/PAR PR45/PR40A/PR2000 PR40/PR85**) sets up the RS-232 Printer/Controller Interface connector for remote control operation or printer operation.

BAUD - Pressing this softkey sets the RS-232 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 3 for information on printer set-up and operation. Refer to Section 4 for information on remote control set-up and operation.

2.14.13 IEEE-488 Interface Menu

The IEEE-488 Interface menu (**IEEE-488:ADDR:XX**, or **IEEE-488:TALK**) only appears when the optional IEEE-488 Interface is installed. The IEEE-488 Interface menu is a status-only menu. This means that the IEEE-488 status can only be viewed and cannot be changed from the menu. At power-up, the FIREBERD reads the DIP switch on the IEEE-488 module, located in the back panel, and is the unit's IEEE-488 address. Changing the IEEE-488 address after the unit power is on does not change the IEEE-488 address until power is turned off and on again.

When the PRINT menu item on the RC/PRINT auxiliary menu is set to None, 232, or Remote, the address menu (**IEEE-488:ADDR:XX**) is displayed. Address values are from 0 to 30 and are set by the switch segments. Changing the switch settings does not change the displayed IEEE-488 address until the unit is turned off and on again. When the PRINT menu item on the RC/PRINT auxiliary menu is set to 488, the the talk menu (**IEEE-488:TALK**) is displayed. Refer to Section 3 for specific information on printer set-up and operation. Refer to Section 4 for specific information on remote control set-up and operation.

2.14.14 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 arrange the fixed internal frequencies or change frequencies for application-specific frequencies. Refer to subsection 2.10.2, Frequency Synthesizer Generator Clock Menu, to change the fixed frequencies.

2.14.15 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.

2.15 CONTENTION CONDITIONS

Regardless of the interface 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, PROGRM, T1-1 to T1-6, T1-mW, DDS-1 to DDS-6, or 1020Hz. 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.

2.16 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 for the circuit 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.

2.17 FIREBERD 4000 ANALYSIS RESULTS

The key to the ability of the FIREBERD 4000 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.

2.17.1 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 rocker switches provide access to the five results categories listed above the switches. Pressing either the up or down arrow on the RESULTS CATEGORY switch illuminates the LED above or below the currently selected category and displays the associated results. The RESULT SELECT rocker 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 is displayed in exponential notation. If the result overflows its internal registers, the result is flashed on the bottom line until the test is restarted. 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 re-established. Once synchronization is re-established, the results are cleared (set to their zero value) 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. Normally, the results display is continuously updated. Pressing the DISPLAY HOLD switch freezes the display and illuminates the LED within the switch. All available 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 the DISPLAY HOLD switch again extinguishes the LED in the switch, allows the display to resume normal operation, and updates all the results from the information stored in memory.

2.17.2 Analysis Results Categories

The test results are divided into five categories: SUMMARY, ERROR, INTERFACE, TIME & SIGNAL, and PERFORMANCE (requires Option 4004). Table 2-5 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.

Table 2-5
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]
	CPAR ERR	C-bit Parity Errors
	CRC ERR	CRC Errors[2]
	FAS ERR	Frame Alignment Signal Errors[2]
	FEBE	Far End Block Errors
	FRA ERR	Frame Errors[2]
	MFAS ERR	Multiframe Alignment Signal Errors
	PAR ERR	Parity Errors
	PAT LOSS	Pattern Synchronization Loss[1]
	PAT SLIP	Pattern Slips[1]
	REBE	Remote End Block Errors
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]

Table 2-5
FIREBERD 4000 Analysis Results (Continued)

Displayed Category	Result Name	Full Result Name
INTERFACE	1SEC CRC	One Second CRC Errors
	AVG BPVR	Average Bipolar Violation Rate
	AVG CER	Average Code Error Rate
	AVG CPER	Average C-bit Parity Errors
	AVG CRC	Average CRC Error Rate
	AVG FAS	Average FAS Error Rate
	AVG FEBE	Average Far End Block Errors
	AVG FER	Average Frame Error Rate
	AVG MFAS	Average Multiframe Alignment Signal Word Errors
	AVG PER	Average Parity Error Rate
	AVG REBE	Average Remote End Block Errors
	BIT SLIP	Bit Slips
	BPVs	Bipolar Violations[3]
	BPV Rate	Bipolar Violation Rate
	CER	Code Error Rate
	CODE ERR	Code Errors[3]
	CPAR ERR	C-bit Parity Errors
	CRC ERR	CRC Errors[3]
	FEBE	Far End Block Errors
	FRA ERR	Frame Errors[3]
	FAS ERR	Frame Alignment Signal Errors
	MAX ZERO	Maximum Zeros
	MFAS ERR	Multiframe Alignment Signal Word Errors
	PAR ERR	Parity Errors
	R LVL DB	Received Level in Decibels
	R LVL V	Received Level in Volts
	RCV BOM	Received Bit Oriented Message
	RCV BYTE	Receive Byte Code
	RCV CODE	Receive Code Name
	RCV FAS	Received Frame Alignment Signal Word
	RCV FEAC	Received Far End Alarm Control Code
	RCV MFAS	Received Frame Alignment Signal Word
	RCV NFAS	Received Not Frame Alignment Signal Word
	REBE	Remote End Block Errors
	RX ABCD	Receive Bits
	RX X1X2	Received X Bits
	SMPX CUR	Simplex Current
	T16AIS S	Timeslot 16 Alarm Indication Signal Seconds
TIME & SIGNAL	+LVL dB	Positive Level in dB
	+LVL V	Positive Level in Volts
	+ WNDR	Positive Wander
	- WNDR	Negative Wander
	-LVL dB	Negative Level in dB
	-LVL V	Negative Level in Volts
	15m WNDR	15 Minute Wander
	24h WNDR	24 Hour Wander

Table 2-5
FIREBERD 4000 Analysis Results (Continued)

Displayed Category	Result Name	Full Result Name
TIME & SIGNAL (Continued)	BPV %EFS	Percent of Seconds Without BPVs
	BPV SEC	Bipolar Violation Seconds
	CPE S A	C-bit Parity Errors Type A
	CPE S B	C-bit Parity Errors Type B
	CPE S C	C-bit Parity Errors Type C
	%EFS	Percent of Error-Free Seconds
	DATE	Date
	DAT RATE	Data Rate
	DELAY	RTS/CTS Delay
	ELAP SEC	Elapsed Seconds
	ERR SEC	Errored Seconds
	FEBE S A	Far End Block Error Seconds Type A
	FEBE S B	Far End Block Error Seconds Type B
	FEBE S C	Far End Block Error Seconds Type C
	GEN FREQ	Generator Clock Frequency
	LVL dBm	Level in dBm
	PATL SEC	Pattern Loss Seconds
	PP LVL V	Peak to Peak Level in Volts
	PP WNDR	Peak to Peak Wander
	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

SUMMARY Category

The SUMMARY category provides access to the most commonly used error results (see Table 2-5) 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 2-5 do not apply to the selected interface or the mainframe has not synchronized to the received signal, RESULTS UNAVAIL appears in the display.

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 test time length since 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 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.

2.17.3 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 displayed on the front panel display. 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 on 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 pattern expected and records detected 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 Table 2-1 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. Table 2-6 lists all available analysis results, in alphabetical order.

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 LED, next to the PATTERN LOSS label, 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 LED, next to the CLOCK PRES label, goes out and the ALARMS LED, next to the CLOCK LOSS label, 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 re-established. Once synchronization is re-established, 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 re-established. Once synchronization is re-established, the results are cleared (set to their zero value) and all result counts start over. Note that the PERFORMANCE category results are not cleared in the CLEAR mode but continue to accumulate results. Refer to Table 2-4 for additional information on the HALT and CLEAR modes.

2.17.4 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.

Table 2-6
FIREBERD 4000 Analysis Results

Result Name	Full Result Name
+LVL dB	Positive Level in dB
+LVL V	Positive Level in Volts
+WNDR	Positive Wander
-LVL dB	Negative Level in dB
-LVL V	Negative Level in Volts
-WNDR	Negative Wander
%AVL SEC	Percent of Available Seconds
%DEG MIN	Percent of Degraded Minutes
%EFS	Percent of Error-Free Seconds
%SES	Percent of Severely Errored Seconds
15m WNDR	15-Minute Wander
24h WNDR	24-Hour Wander
1SEC CRC	One Second CRC Errors
AVG BER	Average Bit Error Rate
AVG BLER	Average Block Error Rate
AVG BPVR	Average Bipolar Violation Rate
AVG CER	Average Code Error Rate
AVG CPER	Average C-bit Parity Errors
AVG CRC	Average CRC Error Rate
AVG FAS	Average FAS Error Rate
AVG FEBE	Average Far End Block Errors
AVG FER	Average Frame Error Rate
AVG MFAS	Average Multiframe Alignment Signal Word Errors
AVG PER	Average Parity Error Rate
AVG REBE	Average Remote End Block Errors
AVL SEC	Available Seconds
BER	Bit Error Rate
BER-SES	BER During Non-SES
BIT ERRS	Bit Errors[1]
BIT ERRS	Bit Errors[3]
BIT SLIP	Bit Slips
BLK ERRS	Block Errors
BLOCKS	Blocks
BPV %EFS	Percent of Seconds Without BPVs
BPV Rate	Bipolar Violation Rate
BPV SEC	Bipolar Violation Seconds
BPVs	Bipolar Violations[2]
BPVs	Bipolar Violations[3]
CER	Code Error Rate
CHAR ERR	Character Errors[1]
CHAR ERR	Character Errors[3]

Table 2-6
FIREBERD 4000 Analysis Results (Continued)

Result Name	Full Result Name
CODE ERR	Code Errors[2]
CODE ERR	Code Errors[3]
CPAR ERR	C-bit Parity Errors
CPE S A	C-bit Parity Errors Type A
CPE S B	C-bit Parity Errors Type B
CPE S C	C-bit Parity Errors Type C
CRC ERR	CRC Errors[2]
CRC ERR	CRC Errors[3]
DAT RATE	Data Rate
DATE	Date
DEG MIN	Degraded Minutes
DELAY	RTS/CTS Delay
ELAP SEC	Elapsed Seconds
ERR SEC	Errored Seconds
ERR-SES	Errors During Non-SES
FAS ERR	Frame Alignment Signal Errors
FAS ERR	Frame Alignment Signal Errors[2]
FEBE	Far End Block Errors
FEBE S A	Far End Block Error Seconds Type A
FEBE S B	Far End Block Error Seconds Type B
FEBE S C	Far End Block Error Seconds Type C
FRA ERR	Frame Errors[2]
FRA ERR	Frame Errors[3]
G %EFS	G.821 Percent of Error Free Seconds
G EFS	G.821 Error Free Seconds
GEN FREQ	Generator Clock Frequency
GERR SEC	G.821 Errored Seconds
LVL dBm	Level in dBm
MAX ZERO	Maximum Zeros
MFAS ERR	Multiframe Alignment Signal Errors
MFAS ERR	Multiframe Alignment Signal Word Errors
PAR ERR	Parity Errors
PAT LOSS	Pattern Synchronization Loss[1]
PAT LOSS	Pattern Synchronization Loss[3]
PAT SLIP	Pattern Slips[1]
PAT SLIP	Pattern Slips[3]
PATL SEC	Pattern Loss Seconds
PP LVL V	Peak to Peak Level in Volts
PP WNDR	Peak to Peak Wander
RCV BOM	Received Bit Oriented Message
RCV BYTE	Receive Byte Code
RCV CODE	Receive Code Name
RCV FAS	Received Frame Alignment Signal Word
RCV FEAC	Received Far End Alarm Control Code
RCV FREQ	Receiver Clock Frequency
RCV MFAS	Received Frame Alignment Signal Word
RCV NFAS	Received Not Frame Alignment Signal Word
REBE	Remote End Block Errors
RX ABCD	Receive Bits
RX X1X2	Received X Bits
SES	Severely Errored Seconds

Table 2-6
FIREBERD 4000 Analysis Results (Continued)

Result Name	Full Result Name
SMPX CUR	Simplex Curren
T16AIS S	Timeslot 16 Alarm Indication Signal Seconds
TEST SEC	Test Seconds
TIME	Time
UNA SEC	Unavailable Seconds

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

SECTION 3
PRINTER INTERFACES

3.1 INTRODUCTION

This section describes how the FIREBERD 4000 can print a variety of printouts using the 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, 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. 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 three PRINTER switches (RESULTS, CONTROLS, OFF/ON), located on the FIREBERD front panel. Printer selection is accomplished using the auxiliary functions.

3.2 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 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.

3.3 FIREBERD PRINTER CONTROL PANEL

The FIREBERD PRINTER control switches control the occurrence of a printout. The control panel has three push-button 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.

3.3.1 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 Subsection 3.4.3). The manual printouts (pressing RESULTS or CONTROLS switch) are still available.

3.3.2 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 printout is identified by the MANUAL PRINT header. Refer to Subsection 3.4.2 for information on the results printout format and content.

3.3.3 PRINTER CONTROLS Switch

The CONTROLS switch can be pressed at any time to generate a controls print of the current mainframe front panel and interface switch and menu configurations. The mainframe controls print lists the current state of all FIREBERD mainframe controls, switches, and menus. When applicable, the states of the interface controls are also listed. The controls print provides enough information to reconfigure the mainframe for a specific test set-up. The controls print 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 3-1 shows a CONTROLS print 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 FMT              STANDARD
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                       OFF     RTS                       OFF
```

Figure 3-1
Mainframe Controls Print

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 (either by name or number), 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).

3.4 AUXILIARY SETUP PRINTER MENUS

The printer menus in the AUXILIARY SETUP category establish printer output requirements, printout formats, and interface configurations. These auxiliary menus are as follows:

AUX PRI EVENT
RESULT PRINT
STATUS PRINT
PRINTER
RC/PRINT
RS232

3.4.1 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 2 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 prints to be generated at intervals from 1 minute (00:01) to 99 hours and 59 minutes (99:59). Timed results print 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 print 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 3-2. The following 40-characters wide prints were generated using the internal RS-232-C Interface in SELF LOOP.

```
AUX ERROR PRINT                  BIT ERROR
BLOCK ERROR          1           1:41:37          18 AUG 92
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 3-2
Standard Results Print

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. Histogram prints can be generated manually, automatically, or upon a power ON after a power fail.

Automatic Histogram Printout

To automatically generate histogram prints 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 3-3.

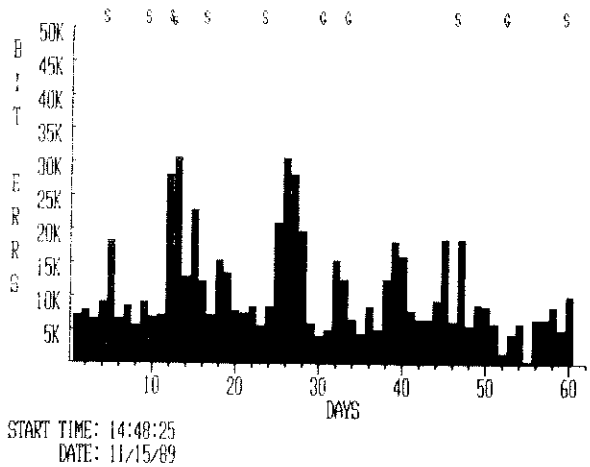


Figure 3-3
Automatic Histogram Print

Manual Histogram Printout

The user may initiate a manual print 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 3-4.

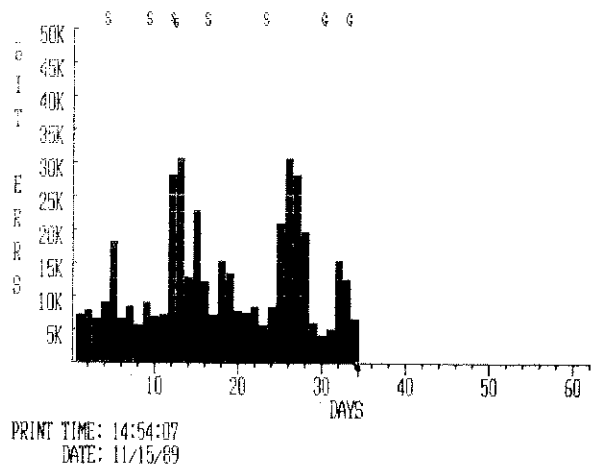


Figure 3-4
Manual Histogram Print

Power Fail Histogram Printout

To automatically generate histogram prints 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 a 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 print restarts the histogram analysis. See Figure 3-5.

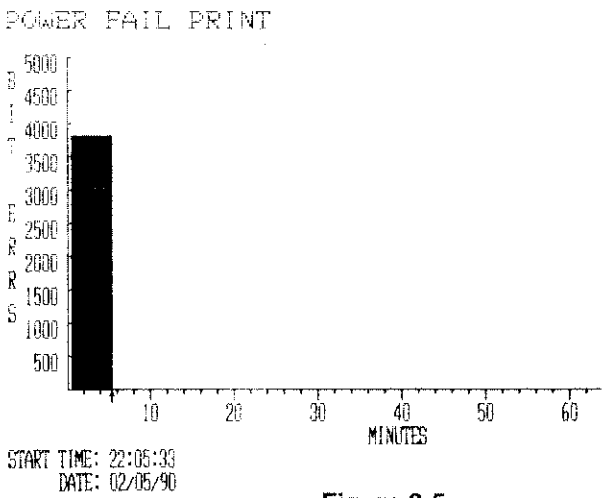


Figure 3-5
Power Fail Histogram Print

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 on G.821, refer to the Appendix section.
- "*" 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** print shown in Figure 3-6 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.

The **HISTOGRAM LIST** shown in Figure 3-7 provides the sample period at the top of the list block and the sample number and result sampled head each of the data columns.

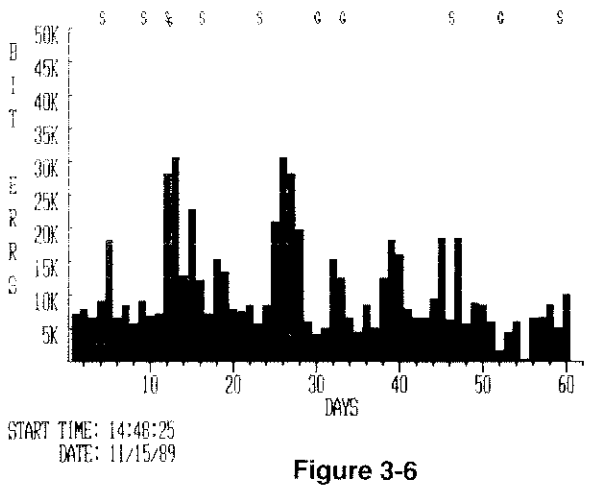


Figure 3-6
Histogram Graph Print

```
HISTOGRAM LIST
15:00  1/24/92
SAMPLE SIZE          1 DAY
SAMPLE             BIT ERRS
1 S                    9170
2                      7038
3                      7242
4 SG                  28184
5                     30880
•
•
•
•
58                     7573
59                     6999
60                     8577
```

Figure 3-7
Histogram List Print

3.4.2 Results Printout Content Menu

The Results Printout Content menu (**RESULT PRINT: SUMM/STD/LONG**) determines the content of the analysis results printout. Results prints 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 2 for instructions on operating the Results Printout Content menu.

Summary Results Printout

The **SUMM** print, shown in Figure 3-8, contains the following results:

- Date and time, selected interface, TEST SEC, ELAP SEC, GEN FREQ, RCV FREQ, and SELF LOOP ON 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 92
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 3-8
Summary Results Print

Standard Results Printout

The **STD** print, shown in Figure 3-9, 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                1       1:41:37       18 AUG 92
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 3-9
Standard Results Print

Long Results Printout

The **LONG** print, shown in Figure 3-10, 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	17 AUG 92
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 3-10
Long Results Printout

Overflowed Results

Overflowed results are flagged with one asterisk. Figure 3-11 shows an example of a results print with the BLOCKS results labeled with a single asterisk indicating it has overflowed.

MANUAL PRINT	1	8:31:51	16 AUG 92
BIT ERRS	756673	AVG BER	4.99E-01
BER	5.00E-01	PAT SLIP	59
BLK ERRS	0	BLOCKS	*15151
AVG BLER	1.00E-01	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 3-11
Overflowed Results Printout

3.4.3 Status Message Printout Menu

The Status Message Printout menu **(STATUS PRINT: ON/OFF)** controls status message prints. The status messages are generated when specific conditions occur such as PATTERN SYNC LOSS, FRAME SYNC LOSS, PAT SYNC ACQUIRED, etc. The status message prints 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 prints are not printed when the PRINTER control panel print event switch is set to OFF. Refer to Section 2 for instructions on operating the Status Message Printout menu.

3.4.4 Printer Printout Format Menu

The Printer Printout Format menu **(PRINTER: WIDTH/MODE/TERM)** sets up the printout format. The printer output format **WIDTH** can be set for 20, 40, or 80 characters wide. The 40-character format is two columns, 20-characters wide and the 80-character format is four columns, 20-characters wide. The **MODE** 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 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 2 for instructions on operating the Printer Printout Format menu. This menu controls printouts going to either RS-232-C or IEEE-488 printers.

3.4.5 RC/PRINT Menu

The RC/PRINT (Remote Control/Printer Driver) selection menu determines the remote control format and the printer port selected. In a standard FIREBERD 4000, the following RC/PRINT menu choices in the left columns are available. When the IEEE-488 option (Option 4002) is installed the menu choices in the right columns are available.

RC:None	PRINT:232	RC:None	PRINT:232
RC:232	PRINT:Remote	RC:488	PRINT:232
RC:None	PRINT:None	RC:None	PRINT:488
RC:232	PRINT:None	RC:232	PRINT:488
		RC:232	PRINT:Remote
		RC:488	PRINT:Remote
		RC:None	PRINT:None
		RC:232	PRINT:None
		RC:488	PRINT:None

RC - The remote control selection determines which connector port the FIREBERD monitors for remote control commands. Remote control choices are: None, 232, or 488 (if Option 4002 is installed). If RC is set to None, the FIREBERD does not respond to any remote control commands.

PRINT - The printer selection determines which connector port the FIREBERD uses when printing out information. Printer choices are: None, 232, Remote, or 488 (if Option 4002 is installed). Setting PRINT to Remote causes the FIREBERD to direct printouts to the Print Buffer. Information stored in the Print Buffer can be retrieved using the print remote commands described in Section 4.

3.4.6 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 2 for instructions on operating the RS232 Printer/Controller Interface menu. Refer to Subsection 3.6 for additional information on the FIREBERD 4000 printer interfaces. Refer to Section 4 for specific information on remote control, set-up, and operation.

3.4.7 IEEE-488 Interface Menu

The IEEE-488 Interface menu (**IEEE-488:ADDR:XX**, or **IEEE-488:TALK**) only appears when the optional IEEE-488 Interface is installed. The IEEE-488 Interface menu is a status-only menu. This means that the IEEE-488 status can only be viewed and cannot be changed from the menu. At power-up, the FIREBERD reads the DIP switch on the IEEE-488 module, located in the back panel, and is the unit's IEEE-488 address. Changing the IEEE-488 address after the unit power is on does not change the IEEE-488 address until power is turned off and on again.

When the PRINT menu item on the RC/PRINT auxiliary menu is set to None, 232, or Remote, the address menu (**IEEE-488:ADDR:XX**) is displayed. Address values are from 0 to 31 and are set via the switch segments. Changing the switch settings does not change the displayed IEEE-488 address until the unit is turned off and on again. When the PRINT menu item on the RC/PRINT auxiliary menu is set to 488, the the talk menu (**IEEE-488:TALK**) is displayed.

Refer to Subsection 3.7 for additional information on the FIREBERD 4000 printer interfaces. Refer to Section 4 for specific information on remote control set-up and operation.

3.5 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.

WARNING:

IF RC IS SET TO 232, ON THE RC/PRINT AUXILIARY MENU, THE PR-45 SHOULD BE DISCONNECTED TO PREVENT OUTPUT SENT TO THE CONTROLLER FROM BEING PRINTED ON THE PR-45.

3.5.1 PR-45 Printer Controls and Indicators

The PR-45 ON LINE and PAPER FEED push-button 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).

3.5.2 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**).

3.5.3 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 **RC/PRINT** appears. Verify that the PRINT menu item is set to 232.

6. 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 **MODE** softkey to select **FAST**, and the **TERM** softkey to select **CRLF**.

7. 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 the Appendix section for a list of common default values for TTC-supported 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 Subsection 3.3 for additional information on the PRINTER control panel.

3.5.4 Loading 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 5 for the part number to order additional rolls of thermal printer paper from TTC.

3.6 OPERATING WITH RS-232 COMPATIBLE PRINTERS

3.6.1 Printers

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

3.6.2 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 3-1 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 Subsection 3.4 for information on the AUXILIARY SETUP category printer menus.

3.6.3 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.

Table 3-1
RS-232 Printer/Controller Interface Connector Pin Assignments

Pin No.	Designations EIA	CCITT	Signal Description	Comments
1	AA	101	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.

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 3-1 should be used.

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 **MODE** 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 Subsection 3.3 for additional information on the PRINTER control panel.

3.7 OPERATING WITH IEEE-488 COMPATIBLE PRINTERS

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

3.7.1 IEEE-488 Remote Control/Printer Interface

The optional IEEE-488 Remote Control/Printer Interface (Option 4002) complies with the IEEE Standard 488.2 Codes, Formats, Protocols, and Common Commands (ANSI/IEEE Std 488.2-1987). This interface offers both Talk and Addressable modes of operation. The IEEE-488 address is set by the DIP switch setting and the operating mode is determined by the Auxiliary RC/PRINT menu item selection.

The Talk mode is used when the FIREBERD is connected to an IEEE-488 compatible listen-only printer. The Talk mode is selected by setting the PRINT menu item, on the RC/PRINT menu, to 488. This allows printouts to be sent to the IEEE-488 connector.

Controls and Indicators

The IEEE-488 Interface module has an 8-segment DIP switch and an IEEE-488 compatible female connector. The DIP switch is used to select the unit's IEEE-488 address. The DIP switch positions are indicated in Figure 3-12. Switch segments SW4 through SW8 are used to set the unit address as listed in Table 3-2.

Figure 3-12
IEEE-488 Interface DIP Switch

The following IEEE-488 Interface capabilities apply to the optional 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

Table 3-2
IEEE-488 Address Selections

SW4 (16)	SW5 (8)	SW6 (4)	SW7 (2)	SW8 (1)	Address (Weight)
Down	Down	Down	Down	Down	0
Down	Down	Down	Down	Up	1
Down	Down	Down	Up	Down	2
Down	Down	Down	Up	Up	3
Down	Down	Up	Down	Down	4
Down	Down	Up	Down	Up	5
Down	Down	Up	Up	Down	6
Down	Down	Up	Up	Up	7
Down	Up	Down	Down	Down	8
Down	Up	Down	Down	Up	9
Down	Up	Down	Up	Down	10
Down	Up	Down	Up	Up	11
Down	Up	Up	Down	Down	12
Down	Up	Up	Down	Up	13
Down	Up	Up	Up	Down	14
Down	Up	Up	Up	Up	15
Up	Down	Down	Down	Down	16
Up	Down	Down	Down	Up	17
Up	Down	Down	Up	Down	18
Up	Down	Down	Up	Up	19
Up	Down	Up	Down	Down	20
Up	Down	Up	Down	Up	21
Up	Down	Up	Up	Down	22
Up	Down	Up	Up	Up	23
Up	Up	Down	Down	Down	24
Up	Up	Down	Down	Up	25
Up	Up	Down	Up	Down	26
Up	Up	Down	Up	Up	27
Up	Up	Up	Down	Down	28
Up	Up	Up	Down	Up	29
Up	Up	Up	Up	Down	30

NOTE: When the IEEE-488 Interface is set for Talk mode, all printouts are sent to the IEEE-488 connector, not to the RS-232 connector or to the PR-45 printer.

IEEE-488 Interface Installation

The IEEE-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.

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 mode, the IEEE-488 printer becomes the default printer. When the IEEE-488 Interface is set for Talk 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 IEEE-488 menu indicates the interface operating mode with TALK displayed on the top line of the menu.

3.7.2 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 performed.

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

4. Press the SETUP CATEGORY switch and select the AUXILIARY category.

5. Press the left arrow on the SETUP SELECT switch several times until the Auxiliary menu **RC/PRINT** appears. Ensure that the PRINT menu item is set to 488.

6. Press the left arrow on the SETUP SELECT switch until the Auxiliary IEEE-488 Interface menu is visible in the display. Verify that **IEEE-488:TALK** appears in the display. Talk appears when the PRINT menu item on the RC/PRINT menu is set to 488).

7. 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.

8. 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 Subsection 3.3 for additional information on the PRINTER control panel.

SECTION 4
REMOTE CONTROL

4.1 INTRODUCTION

While the FIREBERD 4000 can be controlled directly from the front panel, it is often desirable to control the mainframe and run tests by remote control. For example, a FIREBERD can be set up permanently at a remote site, complete with appropriate connections to network equipment; by running the FIREBERD in remote control mode, the equipment at the remote site can be tested automatically from a central office.

This section provides information on controlling the FIREBERD 4000 from a remote device using either the RS-232 Controller Interface or the optional IEEE-488 Controller Interface (Option 4002).

This section contains information on the following subjects:

- OPERATION - describes the basic set-up and operation of the FIREBERD 4000 from a remote device.
- REMOTE CONTROL CONVENTIONS - describes how to set up tests and read results when under remote control.
- COMMANDS - presents all remote control commands alphabetically by group, describes each command's parameters, and provides examples.
- STATUS REPORTING STRUCTURES - describes the registers and queues that can be used to monitor the FIREBERD 4000.
- REMOTE CONTROL ERROR MESSAGES - contains error messages generated by the FIREBERD 4000.

4.1.1 Basic Concepts of Remote Control Operations

In remote control operations a remote control device (controller)—usually either a terminal or a computer—is connected to the FIREBERD 4000 by a cable. The controller sends commands and queries to the FIREBERD. The commands configure the FIREBERD for testing, and initiate and modify test operations; the queries are used to verify the status of the FIREBERD and to request test results. Responses to queries are sent from the FIREBERD to the controller.

The commands sent from the controller to the FIREBERD duplicate the functions available through the front panel switches, except for the POWER switch and volume control. Similarly, the replies sent by the FIREBERD provide the same information that is available from the front panel displays and LEDs. In addition, there are a few commands and queries that enable functions unique to remote control operations.

There are three possible modes of remote control operation:

- RS-232 Terminal Mode
- RS-232 Computer Mode
- IEEE-488 Computer Mode

1. RS-232 Terminal Mode

In RS-232 Terminal Mode a user communicates interactively with the FIREBERD using a dumb RS-232 terminal (or by a computer with RS-232 communications software). The user types in remote control commands at the prompt (an arrow ">" by default), and the FIREBERD responds with on-screen messages, if appropriate. The user can also type in queries for test results, and the FIREBERD responds by sending the results to the terminal, which displays them on screen. Instructions for setting up the FIREBERD 4000 to run in RS-232 Terminal Mode are presented in Subsection 4.2.3 of this section.

Figure 4-1 shows an excerpt from a typical interactive remote control session. Lines without the prompt (>) are the FIREBERD response to user commands/queries.

```
> intf:select?
DS1/T1
> intf:select int188
> intf:select?
INT188
> intf:int188?
DTE
> intf:int188 dce
> intf:int188?
DCE
> omyg
"ERROR(107): Unrecognized command."
> intf:int188:char_format?
8, ODD, 1
> config:err_insert 1.0e-3
> config:loop up
"ERROR(212): Inconsistent with interface or interface mode."
> result? avg_ber
1.1E-03
```

Figure 4-1
RS-232 Interactive Terminal Mode

2. RS-232 Computer Mode

In RS-232 Computer Mode a batch file or computer program conveys a series of remote control commands and queries from the computer to the FIREBERD. Batch mode can be used if the commands are sent by RS-232 communications software. The communications program sends all commands and queries to the FIREBERD, and displays the FIREBERD responses.

Alternatively, the user can write a program that implements communications over the computer RS-232 port. The program can send commands and queries to the FIREBERD, and alter the program flow based on responses received from the FIREBERD.

Instructions for setting up the FIREBERD 4000 to run in RS-232 Computer Mode are presented in Subsection 4.2.4 of this section.

Notes for RS-232 programming with the FIREBERD in computer mode:

- The FIREBERD does not transmit a prompt indicating it has finished processing one command and is waiting for another.
- When receiving a query or command, the FIREBERD looks for a linefeed as the line terminator.
- Error messages are not sent by the FIREBERD until specifically requested. The FIREBERD has a series of registers that record the internal state of the mainframe. The Error Available bit (EAV) of the Status Byte Register indicates if an error message has been issued and is waiting in the Error Buffer.

  The program should periodically check the EAV bit of the Status Byte Register to see if an error has occurred. The Event Status Register provides information on the type of error that occurred. Since errors can occur after any command has been issued, the programmer may choose to check either of these registers after every command. For information on the FIREBERD register groups see Subsection 5 of this section; for information on error messages see Subsection 6; for queries used to read the registers and read error messages, see the **STATUS** commands and **488 COMMON** commands in Subsection 4.

3. IEEE-488 Computer Mode

When the FIREBERD and the controller are connected by an IEEE-488 Interface, all communications are in computer mode. Therefore, only a computer is used as the controller, and it should perform the function of a controller for the IEEE-488 bus.

A set of functions is necessary to establish communications between a computer and the FIREBERD 4000. The required function set depends on the type of 488 hardware installed in the controller. These functions should be documented in your IEEE-488 controller manual and programming language reference manual. Generally, the IEEE-488 software must include functions that allow the controller to put the FIREBERD in a read mode (addressed to LISTEN) or a write mode (addressed to TALK). FIREBERD 4000 commands and queries are coded as parameters to the IEEE-488 function calls. For example, a line of code might read:

488WRITE(FB_ADDRESS, "config:pattern 1:7")

where **488WRITE()** is a bus routine supplied by your IEEE-488 vendor, **FB_ADDRESS** is the address of the FIREBERD (determined by a previous IEEE-488 function call), and **config:pattern 1:7** is one of the FIREBERD 4000 remote control commands documented later in this section.

Figure 4-2 shows an excerpt from a typical BASIC program used in T1 test applications. **IBCLR()** is a 488 bus routine that resets a device connected to the bus, while **IBWRT()** and **IBRD()** are 488 bus routines that write to and read from a device, respectively.

```
100 REM ------------------------------------
110 REM call IBFIND to establish a link with the FIREBERD
120 REM (This sets the address UD% which is used in other calls)
130 REM ------------------------------------
140     UDNAME$ = "FB4000"
150     CALL IBFIND(USNAME$, UD%)
160     IF UD% < 0 THEN PRINT "Error in IBFIND": END
170 REM
180 REM ----------
190 REM Clear the FIREBERD
200 REM ----------
210     CALL IBCLR(UD%)
220 REM
220 REM ----------------
230 REM Send *idn? query to FIREBERD
240 REM ----------------
250     WRT$ = "*idn?"+CHR$(10)   :REM query ends with Line-Feed
260     CALL IBWRT(UD%, WRT$)     :REM Send query to FIREBERD
270
280 REM ------------------------
290 REM Read the FIREBERD's response into rd$
300 REM ------------------------
310     RD$ = SPACES$(100)    :REM Must initialize the string
320     CALL IBRD(UD%, RD$)   :REM Read the FIREBERD's response
330     PRINT RD$       :REM print the response so we know it worked
340 REM
350 REM The program continues with test routines....
```

Figure 4-2
Sample IEEE-488/FIREBERD Computer Code

Instructions for configuring the FIREBERD 4000 to run in IEEE-488 Computer Mode are presented in Subsection 3 of this section.

Notes for IEEE-488 programming with the FIREBERD:

- When a query is sent to the FIREBERD, the FIREBERD does not immediately send its response over the interface to the controller, but instead places it in the Output Queue. (This is unlike the case for RS-232 programming, discussed previously, where the FIREBERD sends its response immediately.) Thus, after the query is sent to the FIREBERD, additional code is used to tell the FIREBERD to send the response contained in its Output Queue. This is illustrated in lines 220 through 320 of the sample code in Figure 4-2.

  Your IEEE-488 hardware vendor provides the software to control the IEEE-488 bus. That software enables your program to write to and read from the FIREBERD. Very possibly your IEEE-488 software contains functions similar to **IBRD**, **IBWRT**, and **IBCLR** used in Figure 4-2.

- The FIREBERD has a series of registers that record the internal state of the mainframe. The program can be notified of changes in the FIREBERD's state by the *Service Request interrupt* (SRQ) line of the IEEE-488 Interface. The SRQ alerts the program when there have been changes in the internal status of the FIREBERD, either as a result of changing test events or as a consequence of problems with commands/queries. Enabling a program to respond to the SRQ involves two basic steps:

  1. For the FIREBERD: The programmer must configure the FIREBERD's internal enable registers to respond to events of interest.

     When events of interest occur, the enable registers set the Master Status Summary (MSS) bit of the Status Byte Register. Any time the MSS bit is set to '1' an SRQ is asserted on the IEEE-488 bus. For more information on the FIREBERD register groups see Subsection 5 of this section; for commands used to configure the enable registers, see the **STATUS** commands and **488 COMMON** commands in Subsection 4.

     and;

  2. For the computer: The programmer must set the controller to respond to an SRQ.

     Your IEEE-488 controller software contains a function to support this operation. Some lines of code located early in your program might read:

     ```
     488SRQ(7) ;
     ON INTERRUPT(7) CALL CHECK_REGISTERS() ;
     ```

     where **488SRQ()** is a routine supplied by your IEEE-488 vendor that sets a controller interrupt to be triggered when the SRQ is asserted; and **CHECK_REGISTERS** is a routine that you write to service your interrupt. To determine the cause of the interrupt your program needs to read the FIREBERD internal registers; see the **STATUS** commands and **488 COMMON** commands in Subsection 4 for FIREBERD register queries.

- Error messages are not sent by the FIREBERD until they are specifically requested. (For information on error messages see Subsection 6 of this section.) In IEEE-488 mode there are two ways the controller can verify the existence of error messages:

  1. As with RS-232 mode, the program can periodically check the FIREBERD. In particular, the Error Available bit (EAV) of the Status Byte Register can be checked to see if an error message has been issued and is waiting in the Error Buffer.

     or;

  2. The Status Byte Register and its enable register can be configured so that an error causes the FIREBERD to assert the SRQ. If the remote controller has been programmed to respond to service request interrupts, then errors can be detected by the SRQ interrupt.

- When commands and queries are sent to the FIREBERD, each line must be terminated with either:

  1. a linefeed; or
  2. any character sent with an EOI.

For more information on IEEE-488 programming, see TTC's application note *Automated Testing with the FIREBERD 6000 Using IEEE-488.2 Remote Control* (the discussion in that application note applies fully to the FIREBERD 4000).

4.1.2 Programming Conventions

The following paragraphs provide information on the conventions used by the FIREBERD 4000 while under remote control. Communication between the FIREBERD and the controller is based on the IEEE-488.2 Specification, that standardizes the way instruments communicate with one another.

1. Message Exchange Protocol

The communication between the FIREBERD 4000 and the controller consists of messages known as commands, queries, and responses.

COMMANDS — Program the FIREBERD
Commands are sent from the controller to the FIREBERD. The FIREBERD interprets and executes each command issued. Commands can alter the FIREBERD set-up or affect the test in progress. Each command is composed of a header, associated data, and a terminator.

QUERIES — Obtain Set-Up Information and Results from the FIREBERD
Queries are sent from the controller to the FIREBERD. The FIREBERD interprets and responds to each query. Queries are composed of a header, immediately followed by a question mark (?) and a terminator.

RESPONSES — Answer a query
Responses are sent from the FIREBERD to the controller to answer a query.

Example of command:	**CONFIG:GEN_CLK INTERNAL**
Example of query:	**CONFIG:GEN_CLK?**
Example of response:	**INTERNAL**

2. Program Messages

All communication sent from the controller to the FIREBERD 4000 is in the form of <program messages>. A <program message> is a series of commands and/or queries, each separated by a semicolon (;). This is useful when several commands may have to be coupled into one <program message> to avoid unit contention. A terminator is sent by the controller to identify the end of the <program message>. In RS-232 Terminal Mode operation, the terminator is either a CR (Carriage Return), LF (Linefeed), or CRLF (Carriage Return/Linefeed); in RS-232 Computer Mode operation, the terminator is LF; in IEEE-488 operation, the terminator can be LF or any character sent with an EOI (End or Identify) signal asserted.

In RS-232 Terminal Mode, the FIREBERD executes all commands and queries of the last program message in sequence when receiving a terminator from the controller. As commands and queries are processed and executed, space is made available in the input buffer. If the input buffer is full, the result is lost data, that generates errors.

In IEEE-488 and RS-232 Computer Mode, the FIREBERD executes commands and queries as they are received. Commands and queries in the input buffer cannot be overwritten; thus, the FIREBERD stops accepting commands while the input buffer is full.

3. Response Messages

The basic communication rule between the FIREBERD 4000 and the controller is that the FIREBERD only responds when the controller sends a query. In turn, the FIREBERD sends its response to the query before a new program message is sent.

In RS-232 applications, the FIREBERD sends a response as it is generated. In IEEE-488 applications, the response is stored in the output queue until the FIREBERD is addressed to TALK. If a new program message is sent to the FIREBERD before the initial response, the initial response is discarded and a RESPONSE INTERRUPTED error is generated. The new program message is executed normally.

The communication sent from the FIREBERD 4000 to the controller is in the form of a <response message>. When using either the RS-232 Terminal or Computer Mode of operation, the <response message> is sent immediately after the query is received. When using IEEE-488, the response message is sent when the FIREBERD is addressed to TALK; this, in turn, is controlled by the IEEE-488 bus and its supporting IEEE-488.2 software.

A <response message> consists of one <response message unit> per query of the preceding <program message>. If several responses are contained in a <response message> each is separated by a semicolon (;). The entire <response message> is ended by a terminator. The terminator for RS-232 Terminal Mode operation is CRLF; for RS-232 Computer Mode operation, LF; and for IEEE-488 operation, LF accompanied by an EOI signal. To determine the exact format of the <response message unit> for any given query, refer to the command and query examples in Subsection 4 of this section.

4.2 REMOTE CONTROL OPERATION

This subsection provides specific instructions for configuring the FIREBERD 4000 to run under the control of a remote device (controller) – either a dumb terminal, or a programmed computer. A controller can be connected to either the FIREBERD rear panel RS-232 Printer/Controller Interface, or to the optional IEEE-488 Printer/Controller Interface (Option 4002).

The IEEE-488 Interface only allows for programmed control of the FIREBERD. (Note that software is available that can make a smart computer mimic a dumb terminal; these programs can effectively create an interactive mode of operation between the FIREBERD and a user. This emulation of interactive operation is accomplished strictly by software; at the hardware level the IEEE-488 bus and 488.2 protocols can only support non-interactive, device-to-device communications.)

Subsections 4.2.1 through 4.2.7 explain how to configure the FIREBERD for RS-232 remote control operation. Subsections 4.2.8 through 4.2.14 shows how to configure the FIREBERD for IEEE-488 operations. Subsection 4.2.15 describes how the FIREBERD 4000 implements IEEE standard 488.2.

4.2.1 RS-232 Remote Control Operation

The RS-232 Printer/Controller Interface is located on the rear panel of the FIREBERD 4000. This interface allows for connection by an asynchronous controller. The interface connector is configured as a DCE and is an EIA RS-232-C-compatible, 25-pin, D-type female connector. Refer to Table 4-1 for connector pin assignments.

To communicate, the communication parameters of the FIREBERD and the remote controller must match. All communications through the RS-232 Printer/Controller Interface are 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 all set using the **AUXILIARY** category of the SETUP panel. See your remote control device literature for information on the settings appropriate to your controller.

Table 4-1
RS-232 Pin Configuration

Pin No.	EIA Dgn.	Signal Description	Comments
1	AA	Protective Ground	Connected to chassis ground.
2	BA	Transmitted Data (TD)	Data transmitted to the FIREBERD.
3	BB	Received Data (RD)	Data received from the FIREBERD.
5	CB	Clear to Send (CTS)	Output HIGH when the FIREBERD is ready to receive.
6	CC	Data Set Ready (DSR)	Output HIGH when the FIREBERD is on.
7	AB	Signal Ground	Connected to circuit ground.
8	CF	Data Carrier Detect (DCD)	Output HIGH when the FIREBERD is on.
20	CD	Data Terminal Ready (DTR)	Input must be HIGH before FIREBERD can send data.

4.2.2 RS-232 Remote Control Modes

When under RS-232 remote control, the FIREBERD 4000 can operate in either an interactive terminal mode or a non-interactive computer mode.

In the interactive terminal mode, the FIREBERD operates interactively with a controller, such as a dumb terminal or computer by: (1) providing a prompt character when the FIREBERD is ready to receive a command; (2) echoing all characters back to the controller as they are typed; and (3) transmitting error messages when an execution or command error occurs.

In non-interactive computer mode, a programmed computer sends commands and receives expected results from the FIREBERD. Thus, when in computer mode, the FIREBERD 4000 does not set prompts, echo characters, or error messages.

In both of these RS-232 remote control modes, the FIREBERD front panel keys and switches are disabled (except for the ANALYSIS RESULTS switches and the ENTER key); the message **232 REMOTE CONTROL <ENTER> TO ABORT** appears in the display. If the front panel is placed in local lockout (see LOCKOUT command), **<ENTER> TO ABORT** is not displayed. This prevents the front panel from being inadvertently returned to local mode.

4.2.3 RS-232 Terminal Mode

In terminal mode, the FIREBERD 4000 operates interactively with the controller.

1. Initiating Terminal Mode

To set up the FIREBERD 4000 for terminal remote control (using the RS-232 Printer/Controller Interface), do the following:

1. Turn on the POWER switch on the rear panel to apply power to the FIREBERD.

2. Repeatedly press the SETUP CATEGORY rocker switch until the **Auxiliary** LED is illuminated, indicating that **Auxiliary** functions can be accessed.

3. Repeatedly press the SETUP SELECT rocker switch until **RC: PRINT:** is shown in the SETUP display.

4. Repeatedly press the SELECT softkey until **RC:232** appears in the display. This selects the RS-232 Interface and RS-232 protocols for remote control. (If desired, the printer output port—488, None, or Remote—may also be selected at this time by using the SELECT softkey.)

5. Press the right side of the SETUP SELECT rocker switch once to access the RS-232 configuration menu.

6. Using the BAUD, DATA, and PAR softkeys, set the BAUD rate (300, 1200, 2400, 4800, or 9600), DATA bits (7 or 8), and PARITY (odd, even, or none) to match the RC terminal or terminal emulator settings.

7. Connect a cable from the remote control device to the RS-232 Data Interface Connector on the rear panel of the FIREBERD 4000. The remote control device must be either a dumb RS-232 terminal, or a computer running RS-232 communications software with an interactive mode.

8. From the controller, send a <Control C>. (By default, the FIREBERD 4000 is in computer mode; pressing <Control C> signals the FIREBERD to switch itself to interactive terminal mode. The user can instead send the **RC_MODE TERMINAL** command to achieve the same result.)

   RESULT: A prompt (>) appears on the terminal to indicate that the FIREBERD is ready to receive a command or query. If a prompt does not appear on the terminal, the interface may not be configured properly. Verify the set-up configuration and connections at both the FIREBERD and terminal, or attempt the auto-baud function from the controller as described later in this section.

   When under remote control, the message **232 REMOTE CONTROL** appears in the FIREBERD display. The FIREBERD is placed in remote control mode once it has received a valid command or query.

2. Operating in Terminal Mode

In terminal mode, the prompt, echo, and error message functions are enabled. The prompt (>) indicates that the FIREBERD is ready to accept commands and is in interactive terminal mode. Wait for the prompt before sending additional commands to the FIREBERD. All characters are echoed on the terminal as they are typed. Commands can be edited using the backspace key and recalled by pressing the <ESC> key. Once the command has been correctly typed, press the ENTER key or RETURN key on your terminal to execute the command.

Each command must have the proper syntax and line terminator to be accepted by the FIREBERD. Valid line terminators are: LF (Linefeed), CR (Carriage Return), or CRLF (Carriage Return/Linefeed). When the FIREBERD receives a line terminator it executes all commands entered since the last terminator received. Each output generated in response to a command from the controller is terminated by a Carriage Return and Linefeed (<CR><LF>) and is sent to the terminal before the next prompt.

3. Ending Terminal Mode

End terminal mode operation and return control of the FIREBERD to the front panel by sending the LOCAL command or pressing the ENTER key, on the FIREBERD front panel.

4.2.4 RS-232 Computer Mode

In non-interactive computer mode, a programmed computer sends commands to the FIREBERD 4000 and, in turn, receives expected results from the test instrument.

1. Initiating Computer Mode

To set up the FIREBERD 4000 for computer remote control (using the RS-232 Printer/Controller Interface), perform the following steps.

1. Turn on the POWER switch, located on the rear panel, to apply power to the FIREBERD.

2. Press the CATEGORY rocker switch on the SETUP panel until the **AUXILIARY** LED is illuminated, indicating that **Auxiliary** functions can be accessed.

3. Press the SETUP SELECT rocker switch on the SETUP panel until **RC: PRINT:** is shown in the SETUP display.

4. Press the SELECT softkey until **RC:232** appears in the display. This selects the RS-232 Interface and RS-232 protocols for remote control. (If desired, the printer output port — 488 or Remote — may also be selected at this time by using the SELECT softkey.)

5. Press the right side of SETUP SELECT rocker switch once to access the RS-232 configuration menu.

6. Using the BAUD, DATA, and PAR softkeys, set the BAUD rate (300, 1200, 2400, 4800, or 9600), DATA bits (7 or 8), and PARITY (odd, even, or none) to match the RC terminal or terminal emulator settings.

7. Connect a cable from the controller to the RS-232 Data Interface Connector on the rear panel of the FIREBERD 4000. The controller must be a computer running RS-232 communications software.

   NOTE: If the FIREBERD has not been placed in terminal mode since power has been applied, it is now in computer mode. If the FIREBERD is in interactive terminal mode, it can be switched to computer mode by sending the following command:

   RC_MODE COMPUTER

The FIREBERD is placed in remote control mode once it receives a valid command or query. (The FIREBERD can be placed in terminal mode by pressing <Control C>, or by issuing the command **RC_MODE TERMINAL**.)

2. Operating in Computer Mode

Computer mode allows a programmed computer to control the FIREBERD. In computer mode, the prompt (>), echo, and immediate error responses are disabled; thus, the programmer can be sure that any data received from the computer is data that was specifically requested (by query).

Each command must have the proper syntax and line terminator to be accepted by the FIREBERD. The valid line terminator is LF (Linefeed - 0A Hex). If an invalid command is issued, the FIREBERD does not respond with an error message unless instructed to do so. (See the **STATUS:ERROR?** query described later in this section.)

3. Ending Computer Mode

End computer mode operation and control the FIREBERD from the front panel by having the program send the LOCAL command, or by pressing the ENTER key on the FIREBERD front panel.

4.2.5 RS-232 Auto-Baud Function

The FIREBERD 4000 features an auto-baud function that simplifies RS-232 remote control set-up. This function can be used to place the FIREBERD in terminal or computer mode, and allows a remote user to automatically configure the instrument's baud rate, data bits, and parity settings to those of the controller. To initiate auto-baud from the remote controller, do the following:

1. Turn on the POWER switch to apply power to the FIREBERD.

2. Press the SETUP CATEGORY rocker switch until the **AUXILIARY** LED is illuminated.

3. Press the SETUP SELECT rocker switch until **RC: PRINT:** is shown in the SETUP display.

4. Press the SELECT softkey until **RC:232** appears in the display. This selects the RS-232 Interface and RS-232 protocols for remote control. (If desired, the printer output port—488 or Remote—may also be selected at this time by using the SELECT softkey.)

5. Press the BREAK key on your terminal twice at one-second intervals.

   RESULT: The flashing message **AUTOBAUD IN PROGRESS** is visible in the FIREBERD 4000 RESULTS display.

6. Repeatedly press the SPACE bar on your terminal at a rate of 5 to 10 times per second for about 10 seconds or until the following message appears at the controller.

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

7. Press the ESC key on the terminal. The FIREBERD responds as follows:

   Character format determined.

   RESULT: The FIREBERD is placed in the mode of choice prior to auto-baud (TERMINAL or COMPUTER). To place the FIREBERD in the opposite mode, see the **RC MODE** command found later in this section. (Note that <Control C> can be used to place the FIREBERD in TERMINAL mode.)

8. The following conditions can occur in auto-baud mode:

   - If auto-baud is not achieved within 30 seconds of initiation, the FIREBERD aborts the function and reverts to its previous RS-232 settings. This timeout is required because many terminals generate a BREAK signal as they power up or down, that causes the FIREBERD to enter auto-baud mode accidently. Under such conditions, the FIREBERD flashes the message **AUTO BAUD IN PROGRESS** in the RESULTS display until the 30-second timeout occurs. Note that the space bar also aborts auto-baud (if all instrument settings are correctly configured).

   - The message **Auto-baud achieved. Press <ESCAPE> to continue.** is transmitted with a format of 7 data bits, 2 stop bits, and even parity. For this reason, the message may appear garbled on terminals that are configured differently. Press the ESC key on your terminal to determine the character format. After the ESC key is pressed, the FIREBERD has determined the correct settings for data bits and parity.

4.2.6 Installation Test for RS-232 Operation

To confirm that the FIREBERD 4000 has been properly configured and cabled for remote operation, do the following:

1. Turn on the POWER switch to apply power to the FIREBERD.

2. Press the CATEGORY rocker switch on the SETUP panel until the **Auxiliary** LED is illuminated, indicating that **Auxiliary** functions can be accessed.

3. Press the SETUP SELECT rocker switch on the SETUP panel until **RC: PRINT:** is shown in the SETUP display.

4. Press the SELECT softkey until **RC:232** appears in the SETUP display. This selects the RS-232 Interface and RS-232 protocols for remote control. (If desired, the printer output port — 488 or Remote — may also be selected at this time by using the SELECT softkey.)

5. Press the right side of SETUP SELECT rocker switch once to access the RS-232 configuration menu.

6. Using the BAUD, DATA, and PAR softkeys, set the BAUD rate (300, 1200, 2400, 4800, or 9600), DATA bits (7 or 8), and PARITY (odd, even, or none) to match the RC terminal or terminal emulator settings.

7. Connect a cable from the controller to the RS-232 Data Interface Connector on the rear panel of the FIREBERD 4000. The controller must be either a dumb RS-232 terminal, or a computer running RS-232 communications software with an interactive mode.

8. Send the FIREBERD the following query with the proper terminator.

   ***IDN?**

(The query can be sent either by a program, or from the terminal mode prompt. By default, the FIREBERD 4000 is in computer mode; press <Control C> to signal the FIREBERD to switch itself to terminal mode.)

9. Verify that the FIREBERD sends the following response:

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4.2.7 If Test Fails

1. Check all cable connections.

3. Verify under the **Auxiliary** function that RS232 has been selected as the driver for remote control.

2. Verify that the RS-232 parameters are set properly.

4. Verify that the pins in Table 4-1 are set for their proper output level, e.g., verify that the DTR is high.

4.2.8 IEEE-488 Printer/Controller Interface

The optional IEEE-488 Interface operates in two modes: TALK-ONLY and ADDRESSABLE. When operating in TALK-ONLY mode, the FIREBERD should be connected to a listen-only printer. In ADDRESSABLE mode, the FIREBERD can be connected with up to 14 other devices, one of which must be a controller.

To set the IEEE-488 Interface to TALK-ONLY, select the 488 Interface as the printer device (PRINT:488) by the **Auxiliary** function **RC:PRINT** menu on the front panel SETUP display. (In other words, toggle the SELECT softkey through the display until the display shows **PRINT:488**.)

This section is primarily concerned with remote control operations, so the rest of the discussion focuses on 488 Interface operations in ADDRESSABLE mode.

4.2.9 IEEE-488 Remote Control Mode

The FIREBERD IEEE-488 Printer/Controller Interface (Option 4002) complies with the IEEE Standard 488.2 Codes, Formats, Protocols, and Common Commands (ANSI/IEEE Std 488.2 1987). Located on the FIREBERD rear panel, the optional IEEE-488 Interface allows the test instrument to become part of an IEEE-488 bus system. By connecting the FIREBERD IEEE-488 Interface to an IEEE-488 bus, the FIREBERD can be controlled by a programmed computer.

A DIP switch, located on the IEEE-488 Interface, is used to specify an address for the interface (in ADDRESSABLE mode only). Set each switch to DOWN for 0 or UP for 1. The DIP switch weightings are as follows:

SW4	SW5	SW6	SW7	SW8
16	8	4	2	1

Switches 4-8 specify the unit address; switches 1, 2, and 3 are not used. Note that remote control is only available in ADDRESSABLE mode. ADDRESSABLE mode is automatically selected when the IEEE-488 Interface is as the remote control device by the **Auxiliary** function **RC:PRINT** menu.

For example, to set the FIREBERD to address 28, perform the following steps.

1. Set SW7 and SW8 to 0 (down).
2. Set SW4, SW5, and SW6 to 1 (up).

Table 4-2 shows the values of all possible combinations of settings.

Table 4-2
DIP Switch Settings for IEEE-488 Addressing

SW ADD	4 (16)	5 (8)	6 (4)	7 (2)	8 (1)	SW ADD	4 (16)	5 (8)	6 (4)	7 (2)	8 (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						

4.2.10 Installing the IEEE-488 Remote Control Interface

The IEEE-488 Interface is a user-installable option, as follows:

1. Make sure that power to the FIREBERD 4000 is turned OFF.
2. Insert the IEEE-488 card into the IEEE-488 connector in the FIREBERD rear panel.
3. Use DIP switches 4-8 to specify a unique address.

4.2.11 Setting Up the IEEE-488 Remote Control Interface

To set up the FIREBERD 4000 for remote control operation, do the following:

1. Turn on the POWER switch on the rear panel to apply power to the FIREBERD.
2. Press the CATEGORY rocker switch on the SETUP panel until the **AUXILIARY** LED is illuminated, indicating that **Auxiliary** functions can be accessed.
3. Press the SETUP SELECT rocker switch on the SETUP panel until **RC:PRINT:** is visible in the SETUP display.
4. Press the SELECT softkey until **RC:488** is visible in the display. This selects the IEEE-488 Interface and IEEE 488.2 protocols for remote control. (If desired, the printer output port — 232 or Remote — may also be selected at this time by using the SELECT softkey.)
5. Press the right side of SETUP SELECT rocker switch twice to access the IEEE-488 configuration display. Make sure that the address displayed corresponds to the one set using DIP switches 4 through 8.
6. Connect a cable from the controller to the IEEE-488 Data Interface Connector on the rear panel of the FIREBERD 4000. The remote control device must be a computer with its own IEEE-488 port, and running communications software consistent with 488.2 protocols.

When under remote control, the message **488 REMOTE CONTROL** appears in the FIREBERD display. The FIREBERD is placed under remote control once it receives a valid command or query.

4.2.12 Initiating and Terminating Communication with the IEEE-488

The routines that allow a controller to maintain communications between itself and the FIREBERD depends on the type of IEEE-488 hardware installed in the remote control device. These commands are documented in your IEEE-488 controller manual and programming language reference manual. To initialize and terminate communication over the IEEE-488 Interface, please refer to those manuals.

4.2.13 Installation Test

To verify that the FIREBERD 4000 is configured and cabled correctly, do the following:

1. Turn on the POWER switch on the rear panel to apply power to the FIREBERD.

2. Press the CATEGORY rocker switch on the SETUP panel until the **AUXILIARY** LED is illuminated, indicating that **Auxiliary** functions can be accessed.

3. Press the SETUP SELECT rocker switch on the SETUP panel until **RC:PRINT:** is visible in the SETUP display.

4. Press the SELECT softkey until **RC:488** is visible in the display. This selects the IEEE-488 Interface and IEEE 488.2 protocols as being operational for remote control. (If desired, the printer output port—232 or Remote—may also be selected at this time by using the SELECT softkey.)

5. Press the right side of SETUP SELECT rocker switch twice to access the IEEE-488 configuration display. Make sure that the address displayed corresponds to the one set using DIP switches 4 through 8.

6. Send the FIREBERD the following command with the proper terminator:

   ***IDN?**

   NOTE: Controlling the FIREBERD over the IEEE-488 bus requires a combination of FIREBERD 4000 and IEEE 488.2 controller commands. A line of code might be: **CALL 488WRITE (FB_ADDRESS, *IDN?")**, where **488WRITE()** is a controller-specific function that tells the controller to send data to the device address indicated. Refer to your IEEE-488 controller documentation for details on how to address external devices and how to issue commands.

7. Verify that the FIREBERD sends the following response:

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4.2.14 If The Test Fails

If the FIREBERD 4000 does not provide the specified results:

1. Check all cable connections.

2. Verify that the FIREBERD has been properly enabled and addressed.

3. Verify that the controller is configured properly using the documentation provided with the controller.

4.2.15 Implementation of the IEEE-488.2-1987

This section addresses the Device Documentation Requirements listed in Section 4.9 of the IEEE-488.2 Specification (ANSI/IEEE Std 488.2-1987). The italicized items 1-22 correspond to the specific information required by the IEEE-488.2 Specification; the information supplied after each of these items responds to these requirements. Some of the responses reference sections of this manual where the information can be obtained.

NOTE: In this section, "device" refers to the FIREBERD 4000.

All devices shall supply information to the user about how the device has implemented this standard. This information shall include:

1. A list of IEEE-488.1 Interface Function subsets implemented.

   The 488.1 Interface Functions subsets are implemented in the FIREBERD 4000 as follows:

   SH1: Source Handshake capability
   AH1: Acceptor Handshake capability
   T5: Basic Talker capability with Serial Poll, Talk Only, and Unaddress if MLA
   L4: Basic Listener capability with Unaddress if MTA
   SR1: Status Request capability
   RL1: Remote/Local capability
   DC1: Device Clear capability
   DT1: Device Trigger capability
   PP1: Parallel Poll capability
   C0: No controller capability
   E2: Three-state drivers used

2. A description of when a user-initiated address change is recognized by the device.

   If the address is changed using the DIP switches on the interface, the change takes effect immediately. The valid address range is 0-30.

   NOTE: Verify that this command is executed before attempting to communicate with the FIREBERD at its new address.

3. A description of the device settings at power-on and any commands which modify the power-on setting.

   All of the device settings are preserved from power-off to power-on; thus, all commands that configure the FIREBERD 4000 modify the power-on settings. The FIREBERD is shipped with the factory-default settings listed under the ***RST** command. These settings are restored when the user performs the CLEAR NOVRAM operation or when the ***RST** command is executed.

   NOTE: The RS-232 remote control mode always powers-on in the computer mode.

4. A description of message exchange options.

   a. The size and behavior of the input buffer.

      The input buffer is 100 bytes long. This does not restrict the length of a program message to 100 bytes, since program messages are parsed as they are received.

   b. Which queries return more than one <RESPONSE MESSAGE UNIT>.

      No queries return more than one <RESPONSE MESSAGE UNIT>.

c. Which queries generate a response when parsed.

All queries generate a response when parsed.

d. Which queries generate a response when read.

No queries wait until the device is read to generate a response.

e. Which commands are coupled.

The configuration selection commands (**CONFIG:TIMING_MODE**, **CONFIG:FREQ**, and **CONFIG:PATTERN**) are coupled. For more information on these commands refer to the corresponding command paragraphs found later in this section.

5. A list of functional elements used in constructing the device-specific commands, including whether <compound command program header> elements are used.

<Compound command program header> elements are used. Each functional element is listed later in this section.

6. A description of any buffer size limits related to block data.

Block data elements are not used.

7. A list of the <PROGRAM DATA> elements which may appear within an <expression>, as well as the maximum sub-expression nesting depth. Any additional syntax restrictions which the device may place on the <expression> shall also be included.

<expression>s are not implemented.

8. A description of the response syntax for every query.

This information is offered later in this section.

9. A description of any device-to-device message transfer traffic which does not follow the rules for <RESPONSE MESSAGE> elements.

No device-to-device message transfer traffic is implemented.

10. The size of any block data responses.

No block data responses are implemented.

11. A list of common commands and queries which are implemented.

See the COMMON COMMANDS found later in this section.

12. A description of the state of the device after successful completion of the Calibration query.

The Calibration query is not implemented.

13. The maximum length of the block used to define the trigger macro, if *DDT is implemented.

*DDT is not implemented.

14. The maximum length of macro labels, the maximum length of the block used to define a macro, and how recursion is handled during macro expansion, if the macro commands are implemented.

Macro commands are not implemented.

15. A description of the response to the identification common query, *IDN?

    See the command ***IDN**, described later in this section.

16. The size of the protected user data storage area, if the *PUD command and *PUD? query are implemented.

    *PUD and *PUD? are not implemented.

17. The size of the resource description, if the *RDT command and *RTD? query are implemented.

    *RDT and *RTD? are not implemented.

18. A description of the states affected by *RST, *RCL, and *SAV.

    These commands all affect the same set of instrument settings. Refer to the instrument settings listed under the ***RST** command in the common command paragraphs.

19. A description of the scope of the self-test performed by the *TST? query.

    See the ***TST** command, described in the common command paragraphs.

20. A description of additional status data structures used in the devices status reporting.

    The Status Reporting paragraphs, found later in this section, describe this topic.

21. For each command, a statement describing whether it is sequential or overlapped.

    All commands are sequential. None overlap.

    NOTE: The execution order is modified in the case of coupled commands, but it is still sequential (i.e., not overlapped).

22. For each command the device documentation shall specify the functional criteria that are met when an operation complete message is generated in response to that command.

    When the **OPERATION COMPLETE** message is generated, the function of any given command has been performed. This means that the general description of each command, found later in this section, constitutes the criteria met when this message is generated.

4.3 UNIT CONTENTION

The FIREBERD 4000 can be in contention, due to front panel control settings, when in local control. However, contention is not permitted when under remote control. If a contention condition exists when remote control is entered, settings are automatically selected that eliminate the contention condition. For example, if a synchronous pattern contention, asynchronous pattern contention, or asynchronous frequency contention exists, the 2^{15}-1 pseudorandom pattern and synchronous timing mode are selected.

Certain combinations of synthesizer frequency, data pattern, and timing mode settings are not valid. Thus, if a command causes a contention condition, a contention error appears in the error buffer and the previous setting is retained.

To help avoid contention, the execution of certain command combinations is delayed until all the commands of a <program message> have been read by the FIREBERD. For example, if the FIREBERD is set for synchronous timing mode and a synthesizer frequency of 64 kHz, then, sending the <program message> **CONFIG:TIMING_MODE ASYNC;FREQ 1.2** would result in an asynchronous frequency contention if the commands were executed one after the other. This is because the FIREBERD would try to go to asynchronous timing mode, but the synthesizer frequency would still be set to 64 kHz, resulting in the FIREBERD remaining in the synchronous timing mode.

In actual operations, however, the FIREBERD delays execution of the two commands until they have both been read and checked for lack of contention. Then the commands are executed simultaneously, so that both the synthesizer frequency and timing mode are changed by the FIREBERD.

4.4 REMOTE CONTROL COMMANDS

The following paragraphs describe how to enter remote control commands with the proper command syntax, lists the commands by group, alphabetically describes each of the commands and parameters, and provides examples.

All examples shown in this section use the terminal mode format with printouts in a 40-column width. The commands are shown in upper-case characters. The commands can be entered in either upper-case or lower-case characters.

Each remote control command is associated with a command group, as follows:

AUXILIARY COMMANDS: Provide remote control access to the FIREBERD 4000 auxiliary functions.

488 COMMON COMMANDS: Commands and queries that are common to all instruments, and are mandated by IEEE-488.2 standards.

CONFIGURATION COMMANDS: Remotely control any test configuration.

INTERFACE COMMANDS: Provide the ability to operate the FIREBERD 4000 interfaces by remote control. Only commands that apply to all interfaces and to the two internal interfaces are documented here. For interface commands specific to optional interfaces, see the appropriate interface manuals.

PRINT COMMANDS: Control the FIREBERD 4000 print capability.

REMOTE CONTROL COMMANDS: Set functions that are not grouped with other commands.

RESULT COMMANDS: Retrieve test results.

STATUS COMMANDS: Set and read the status reporting registers, queues, and buffers.

4.4.1 Remote Control Commands and Queries

The following paragraphs present all of the remote control commands, in their associated group, in alphabetical order. Each command and/or query includes an explanation of the command/query and a brief example of its usage.

Bold characters are used throughout this section to indicate the commands, as well as the variables to be entered with the commands. The variable choices are listed within brackets and separated by vertical lines (the vertical lines represent logical OR). Command syntax requires that one, and only one, of the options between brackets must be selected by the user and included with the command. For example:

INTF:SELECT [INT232 | INT188 | EXT1 | EXT2]

In the preceding command, which is used to select an interface for testing, one of the four interfaces named must be selected. If the Internal RS-232 Interface is to be used, the command issued would read:

INTF:SELECT INT232

AUXILIARY COMMANDS

The FIREBERD 4000 features a set of commands and queries that offer remote access to the auxiliary functions.

The auxiliary commands and queries accepted by the FIREBERD 4000 are:

Commands	Queries
AUX:BLOCK_LEN	AUX:BLOCK_LEN?
AUX:CLEAR_MEM	
AUX:COMMON_FREQS	AUX:COMMON_FREQS?
AUX:DATE	AUX:DATE?
AUX:DELAY:START	AUX:DELAY:START?
	AUX:DEVICE_SEL?
AUX:IN_USE:CLEAR	
	AUX:IEEE488:ADDR?
AUX:OUTBAND_FLOW	AUX:OUTBAND_FLOW?
AUX:PATTERN:APPEND	
AUX:PATTERN:INSERT	
AUX:PATTERN:REPLACE	
AUX:PATTERN:DELETE	
AUX:PATTERN:DATA	AUX:PATTERN:DATA?
	AUX:PATTERN:SIZE?
AUX:PRGM_PATTERN	AUX:PRGM_PATTERN?
AUX:RCV_CLK_SEL	AUX:RCV_CLK_SEL?
AUX:RS232?	
AUX:RS232:BAUD	AUX:RS232:BAUD?
AUX:RS232:DATA_BITS	AUX:RS232:DATA_BITS?
AUX:RS232:PARITY	AUX:RS232:PARITY?
AUX:SYNCLOSS_ACT	AUX:SYNCLOSS_ACT?
AUX:SYNCLOSS_THR	AUX:SYNCLOSS_THR?
AUX:TIME	AUX:TIME?
AUX:USR_SYNC_THR	AUX:USR_SYNC_THR?
AUX:USR_SYNC_THR:BYTES	AUX:USR_SYNC_THR:BYTES?

BLOCK_LEN

Block Length — **command/query**

AUX:BLOCK_LEN (PATLEN|1.0e2|1.0e3|1.0e4|1.0e5|1.0e6] set block length

AUX:BLOCK_LEN? requests the current block length

The **AUX:BLOCK_LEN** command sets the number of bits in each block. The number of bits can either be a power of 10 from two through six (10^2, 10^3, 10^4, 10^5, 10^6); or it can be the length of the pattern in use (the pattern is set using the **CONFIG:PATTERN** command).

This remote control command is identical to the **Auxiliary** function **BLOCK LENGTH** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:BLOCK_LEN? requests the current block length
1000 bits

>AUX:BLOCK_LEN 1.0e2 make the new block length 100 bits

CLEAR_MEM

Clear NOVRAM **command**

AUX:CLEAR_MEM clear NOVRAM

The **AUX:CLEAR_MEM** command clears all of the FIREBERD 4000 non-volatile RAM (NOVRAM) in the FIREBERD.

This command should be used with extreme caution since it wipes out all pre-set configurations, auxiliary functions, saved user-configurations, etc. It leaves in place configurations that might pertain to remote control; but if the FIREBERD is in 232 Terminal Mode, the **AUX:CLEAR_MEM** command switches it to Computer Mode. (The user can issue a Control C to return the FIREBERD to Terminal Mode.)

This remote control command is identical to the **Auxiliary** function **CLEAR NOVRAM** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:CLEAR_MEM clear NOVRAM

COMMON_FREQS

Program Common Frequencies **command/query**

AUX:COMMON_FREQS (number), (frequency) associate a frequency with an integer from 1 to 16

AUX:COMMON_FREQS? (number) requests the current synthesizer frequency assigned to a specific number

The **AUX:COMMON_FREQS** command allows the user to program commonly used synthesizer frequencies by number. The (number) can be any integer within the range 1-16; (frequency) can be any frequency within the range .05-15000 kHz. The default frequencies are identical to those on the FIREBERD 4000's front panel: 0.3 kHz, 1.2 kHz, 1.8 kHz, 2.4 kHz, 4.8 kHz, 9.6 kHz, 19.2 kHz, 48 kHz, 56 kHz, 64 kHz, 128 kHz, 256 kHz, 512 kHz, 704 kHz, 1544 kHz, 2048 kHz.

NOTES:

1. *The* **AUX:COMMON_FREQS (number), (frequency)** *command is only applicable if the optional Frequency Synthesizer (Option 4005) is installed in the FIREBERD.* If Option 4005 is not installed, the only frequencies available are the defaults; they are assigned in order of increasing value to the integers 1 through 16 (e.g., '1' maps to 0.3 kHz, '2' maps to 1.2 kHz, etc).

2. This command is *not* used to set the FIREBERD frequency for purposes of remote control use. For remote control purposes the appropriate command is **CONFIG:FREQ**. The **AUX:COMMON_FREQS** command is used only to program the desired set of frequencies for FIREBERD front panel control; a particular frequency is then selected by the front panel **Generator Clock** function **INTERNAL FREQ**.

The **AUX:COMMON_FREQS?** query requests the current frequency assigned to the (number) specified. The query can be used whether or not Option 4005 is installed.

This remote control command is identical to the **Auxiliary** function **FREQ#** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:COMMON_FREQS? 14 requests the current synthesizer frequency assigned to No. 14
2.4

>AUX:COMMON_FREQS 14,2000 change synthesizer frequency No. 14 to 2000 kHz

DATE

Set and Display Date **command/query**

AUX:DATE "mm/dd/yy" set the date

AUX:DATE? requests the date

The **AUX:DATE** command sets the current date. The date is entered within quotes by month, day, and year.

The **AUX:DATE?** query requests the currently set date.

This remote control command is identical to the **Auxiliary** function **DATE** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:DATE "10/14/92" set the date to Oct. 14, 1992

>AUX:DATE? requests the current date
"10/14/92"

DEVICE_SEL

Report Current Remote Control and Printer Settings — query

AUX:DEVICE_SEL? requests the currently selected standard for remote control and print devices

The **AUX:DEVICE_SEL?** query requests the currently selected standard for remote control and print devices (RS-232 or IEEE-488). When issuing the query, the remote control setting is displayed first, followed by the printer setting.

This remote control command is identical to the **Auxiliary** function **RC:PRINT:** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:DEVICE_SEL? requests the currently selected standard for remote control and printing
488, 232

IEE488:ADDR

Return the Current IEEE-488 Address — query

AUX:IEEE488:ADDR? requests the current IEEE-488 address

The **AUX:IEEE488:ADDR?** query requests the current IEEE-488 address. This address is controlled by dip switches on the 488 interface itself; these DIP switches are accessible on the rear panel of the FIREBERD 4000 when the IEEE-488 Interface is installed. The address is read in only when the FIREBERD first powers up; changes made to the switches while the FIREBERD is running do not effect the IEEE-488 address until the mainframe is turned off and restarted.

This command is only applicable if the optional IEEE-488 Remote Control/Printer Interface (Option 4002) is installed in the FIREBERD rear panel. This remote control command is identical to the **Auxiliary** function **IEEE-488:ADDR** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:IEEE488:ADDR? requests the current IEEE-488 address
20

INBAND_FLOW

In-Band Flow Control **command/query**

AUX:INBAND_FLOW [OFF|ON]	enable or disable in-band flow control
AUX:INBAND_FLOW?	requests the current status of in-band flow control (on or off)

The **AUX:INBAND_FLOW** command supports in-band flow control. The command and query are only valid for the following asynchronous interfaces: Internal RS-232, Internal MIL-188, and MIL-449.

The **AUX:INBAND_FLOW** command turns in-band flow control off or on, respectively. When OFF is selected, the FIREBERD does not respond to XON and XOFF characters in the received data.

The **AUX:INBAND_FLOW?** query requests the current status of in-band flow control (i.e., on or off).

This remote control command is identical to the **Interface** function **IN BAND FLOW** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:INBAND_FLOW?	requests the current state of in-band flow control
OFF	in-band flow control is off
>AUX:INBAND_FLOW ON	turn in-band flow control on

OUTBAND_FLOW

Out-of-Band Flow Control **command/query**

AUX:OUTBAND_FLOW [OFF]	disable all five out-of-band flow control signaling leads
AUX:OUTBAND_FLOW?	requests the current status of out-of-band flow control
AUX:OUTBAND_FLOW: [TR|DM|RS|CS|RR] [OFF|ON]	turn individual signaling leads on or off
AUX:OUTBAND_FLOW: [TR|DM|RS|CS|RR]?	requests the status of the individual signaling leads

Out-of-band flow control is a function that allows data transmission to take place only when certain signaling leads are placed in the ON state (i.e., enabled).

The **AUX:OUTBAND_FLOW OFF** command turns all five out-of-band signalling leads off. This command is equivalent to issuing five separate commands to turn the five leads off one at a time. Note that after issuing this command, one or more of the five leads can be turned back on using the following command:

The **AUX:OUTBAND_FLOW:[TR|DM|RS|CS|RR]** command enables or disables the signaling lead(s) that control data transmission.

The **AUX:OUTBAND_FLOW?** query requests the current status of out-of-band flow control (i.e., ON or OFF). The value is ON if one or more of the five signaling leads are enabled; the value is OFF only if all five leads are disabled.

The **AUX:OUTBAND_FLOW:[TR|DM|RS|CS|RR]?** query requests the status of the individual signaling leads (i.e., ON or OFF).

This remote control command is identical to the **Auxiliary** function **FLOW** that is used when the FIREBERD is controlled from the front panel.

Note that RS-449-standard signal names are used in this command. The relationship between RS-449 and RS-232 signal names is as follows:

RS-449	RS-232
TR†	DTR†
DM*	DSR*
RS†	RTS†
CS*	CTS*
RR*	RLSD*

† Signal from the DTE to the DCE.
* Signal from the DCE to the DTE.

Example:

>AUX:OUTBAND_FLOW?	requests the current state of out-of-band flow control
ON	at least one of the five signaling leads is enabled
>AUX:OUTBAND_FLOW OFF	turn out-of-band flow control off (i.e., turn off all five leads)
>AUX:OUTBAND_FLOW:TR?	requests the current status of the TR signaling lead
>OFF	the TR signaling lead is disabled
>AUX:OUTBAND_FLOW:TR ON	turn the TR signaling lead on (i.e., enable it)
>AUX:OUTBAND_FLOW:DM?	requests the current status of the DM signaling lead
>OFF	the DM signaling lead is off (disabled)
>AUX:OUTBAND_FLOW:DM ON	turn the DM signaling lead on

PATTERN

User Message Selection	command/query
AUX:PATTERN:DATA [USER1|USER2|USER3], "(string)"	create a data pattern and assign it to the USER message specified
AUX:PATTERN:APPEND [USER1|USER2|USER3], "(string)"	append string to the specified USER message
AUX:PATTERN:INSERT [USER1| USER2|USER3], (position),"(string)"	insert string into USER message beginning at the byte position specified
AUX:PATTERN:REPLACE [USER1| USER2|USER3], (position),"(string)"	replace string in the USER message beginning at the byte position specified
AUX:PATTERN:DELETE [USER1| USER2|USER3], (position),(bytes)	delete a number of bytes in the string of the USER message beginning at the byte position specified
AUX:PATTERN:DATA? [USER1| USER2|USER3]	requests the current pattern assigned to the USER message specified
AUX:PATTERN:SIZE? [USER1| USER2|USER3]	requests the length of the user pattern specified

This series of commands and queries is dedicated to the creation, modification, and selection of user patterns and messages.

The **AUX:PATTERN:DATA** is used to create a data pattern and assign it to the USER message specified. The pattern can consist of anywhere from 1 to 2048 ASCII characters. Each ASCII character is represented by one byte, which is coded using two adjacent hex characters. Spaces must be inserted between each byte in the data pattern. The examples below illustrate this coding scheme.

As their names imply, the **AUX:PATTERN:APPEND**, **AUX:PATTERN:INSERT**, **AUX:PATTERN:REPLACE**, and **AUX:PATTERN:DELETE** commands are used to modify the specified user-created pattern.

The **AUX:PATTERN:DATA? [USER1|USER2|USER3]** query requests the structure of the indicated user-created pattern.

The **AUX:PATTERN:SIZE? [USER1|USER2|USER3]** query requests the length of the indicated user-created pattern.

These remote control commands operate the same as the **Pattern** function **USER#** that is used when the FIREBERD is controlled from the front panel. (Note that when using front panel control, the **Pattern:USER#** function is available only if the user first selects a **USER1**, **USER2**, or **USER3** from the **Pattern** menu.)

Example:

>AUX:PATTERN:DATA? USER1 "48 45 4C 4C 4F"	requests the current user-created pattern assigned to USER1 the USER1 pattern is HELLO in ASCII
>AUX:PATTERN:DATA USER2, "48 49"	set USER2 pattern to HI in ASCII

>AUX PATTERN:DATA? USER2 "48 49"	requests the current user-created pattern assigned to USER2 the USER2 pattern is 48 49
>AUX:PATTERN:APPEND USER2, "AA BB 40"	append three bytes to USER2
>AUX:PATTERN:DATA? USER2 "48 49 AA BB 40"	requests the new USER2 pattern the new bytes have been appended to USER2
>AUX:PATTERN:REPLACE USER2, 3,"CC DD"	replace current USER2 string with CC DD starting at position 3
>AUX:PATTERN:DATA? USER2 "48 49 CC DD 40"	requests the new USER2 message
>AUX:PATTERN:INSERT USER2,3,"00 01"	insert 00 and 01 in USER2 starting at position 3
>AUX:PATTERN:DATA? USER2 "48 49 00 01 CC DD 40"	requests the new USER2 pattern
>AUX:PATTERN:DELETE USER2,4,2	delete two bytes from the USER2 beginning at position 4
>AUX:PATTERN:DATA? USER2 "48 49 00 DD 40"	requests the new USER2 pattern
>AUX:PATTERN:SIZE? USER2 5	requests the current size of the USER2 pattern the USER2 message size is 5 bytes

PRGM_PATTERN

Programmable Data Pattern **command/query**

AUX:PRGM_PATTERN "bit pattern"	set a 3- to 24-bit programmable pattern
AUX:PRGM_PATTERN?	requests current bit pattern

The **AUX:PRGM_PATTERN** command allows the user to program a data pattern. The (bit pattern) can be any sequence of 3 to 24 ones (1's) and/or zeros (0's), corresponding to the desired binary bit pattern, with the left-most bit transmitted first.

The **AUX:PRGM_PATTERN?** query requests the user-programmed data pattern that is currently in use.

The programmed pattern is used when the configuration pattern is set to PRGM using the **CONFIG:PATTERN PRGM** command. See the CONFIG section of this chapter for more information on choosing patterns using the **CONFIG:PATTERN** command.

This remote control command to create a pattern is identical to the **Pattern** function **PROGRM** that is used when the FIREBERD is controlled from the front panel. When the FIREBERD is controlled from the front panel, the programmed pattern would be used when **Pattern** is set to the **PRGM** option.

Example:

>AUX:PRGM_PATTERN "11010011" set the programmable pattern to 11010011

>AUX:PRGM_PATTERN? returns the programmable pattern 11010011
"11010011"

NOTE: When entering a lengthy user-created pattern, the number of characters that can be entered on any given line is limited in RS-232 Terminal Mode. If the pattern to be entered is longer than a single line, press the RETURN or ENTER key before the bytes entered exceed line space; in such instances, a new prompt appears on the line immediately following and you can continue entering bytes until pattern entry is completed. *Note that the entire pattern must be enclosed with quotation marks.*

RS232

RS-232 Printer/Remote Control Configuration — command/query

AUX:RS232:BAUD [300|1200|2400|4800|9600] set baud rate

AUX:RS232:DATA_BITS [7|8] set data bits

AUX:RS232:PARITY [ODD|EVEN|NONE] set parity

AUX:RS232? requests the current baud, data, and parity settings

AUX:RS232:BAUD? requests the current baud rate

AUX:RS232:DATA_BITS? requests the current data bits

AUX:RS232:PARITY? requests the current parity

This series of commands and queries are dedicated to RS-232 printer/remote control configuration.

The **AUX:RS232:BAUD** command is used to specify baud rates of 300, 1200, 2400, 4800, or 9600.

The **AUX:RS232:DATA_BITS** command is used to select 7 or 8 data bits.

The **AUX:RS232:PARITY** command is used to select odd, even, or no parity.

The **AUX:RS232?** query requests the current baud, data, and parity settings. The **AUX:RS232:BAUD?**, **AUX:RS232:DATA_BITS?**, and **AUX:RS232:PARITY?** queries individually request the current baud rate, data bits, and parity, respectively.

This remote control command is identical to the **Auxiliary** function **RS232** that is used when the FIREBERD is controlled from the front panel.

NOTE: These commands cannot change these parameters when RS-232 is used by remote control. These commands can change the parameters when remote control is exercised by the IEEE-488 Interface.

Example:

>AUX:RS232:BAUD? requests the current baud rate
9600 the current baud rate is 9600

>AUX:RS232:BAUD 300 change the baud rate to 300

>AUX:RS232:PARITY? requests the current parity setting
EVEN parity is even

>AUX:RS232:PARITY ODD change the parity to odd

>AUX:RS232? requests the current baud, data, and parity settings
300, 7, ODD

SYNCLOSS_ACT

Receiver Action on Synchronization Loss **command/query**

AUX:SYNCLOSS_ACT [CLEAR|HALT] set the action on synchronization loss

AUX:SYNCLOSS_ACT? requests the current action on synchronization loss

The **AUX:SYNCLOSS_ACT** command sets the receiver action during the loss of synchronization. CLEAR resets all results counters and restarts the test when synchronization is reacquired. HALT freezes all test results for the duration of the synchronization loss; the test continues when synchronization is re-acquired. CLEAR is the default selection.

The **AUX:SYNCLOSS_ACT?** query requests the current action on synchronization loss.

This remote control command is identical to the **Auxiliary** function **SYNC LOSS ACT** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:SYNCLOSS_ACT CLEAR restart the test after reacquiring receiver synchronization

>AUX:SYNCLOSS_ACT? display the current action on receiver synchronization loss
CLEAR

SYNCLOSS_THR

Synchronization Loss Error Threshold — **command/query**

AUX:SYNCLOSS_THR [NORM|HIGH]	set the synchronization loss error rate threshold
AUX:SYNCLOSS THR?	requests the current synchronization loss error rate threshold

The **AUX:SYNCLOSS_THR** command sets the error rate threshold required for the FIREBERD to declare a loss of synchronization. NORM sets the threshold to 250 bit errors in less than 1000 bits in synchronous timing and 30 character errors in less than 1000 characters in asynchronous timing; HIGH sets the threshold to 20,000 bit errors in less than 100,000 bits for both synchronous and asynchronous timing.

The **AUX:SYNCLOSS_THR?** query requests the current synchronization loss threshold error rate.

This remote control command is identical to the **Auxiliary** function **SYNC LOSS THRSH** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:SYNCLOSS_THR NORM	set medium sync loss threshold
>AUX:SYNCLOSS_THR? NORM	requests current sync loss threshold

TIME

Set and Display Time — **command/query**

AUX:TIME "hh:mm:ss"	set the time of day
AUX:TIME?	requests the time of day

The **AUX:TIME** command sets the current time of day. The time is entered in 24-hour format, and is always placed between quotation marks; seconds are always set to zero (and can be omitted).

The **AUX:TIME?** query requests the current time of day.

This remote control command is identical to the **Auxiliary** function **TIME** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:TIME "13:45"	set the time of day to 1:45 P.M.
>AUX:TIME? "13:45:00"	requests the current time of day

USR_SYNC_THR

User Message Sync Acquisition Threshold **command/query**

AUX:USR_SYNC_THR [PATTERN|BYTES] set the synchronization acquisition threshold

AUX:USR_SYNC_THR:BYTES [10|100] set the byte length of the synchronization acquisition threshold

AUX:USR_SYNC_THR? requests the byte length of the synchronization acquisition threshold

AUX:USR_SYNC_THR:BYTES? requests the byte length of the synchronization acquisition threshold

The **AUX:USR_SYNC_THR** command sets the synchronization acquisition threshold. PATTERN tells the FIREBERD that the length is to be the same as that of the currently selected user message (which is selected by the **AUX:PATTERN** commands). BYTES tells the FIREBERD that the length is a specific number of bytes; the actual number is specified in the following command:

The **AUX:USR_SYNC_THR:BYTES** command sets the length of the synchronization acquisition threshold if it is set to BYTES. The valid parameters are 10 bytes and 100 bytes.

The **AUX:USR_SYNC_THR?** query requests the state of the synchronization acquisition threshold (i.e., reports that the threshold is set to either PATTERN or BYTES).

The **AUX:USR_SYNC_THR:BYTES?** query requests the byte length of the synchronous acquisition threshold if it is set to BYTES.

This remote control command is identical to the **Auxiliary** function **USER SYN THRSH** that is used when the FIREBERD is controlled from the front panel.

Example:

>AUX:USR_SYNC_THR? requests whether the synchronization acquisition threshold is currently set to BYTES or PATTERN

PATTERN

>AUX:USR_SYNC_THR BYTES set the synchronization acquisition threshold to the length specified in the command immediately following

>AUX:USR_SYNC_THR:BYTES 10 set the synchronization threshold to 10 bytes

>AUX:USR_SYNC_THR:BYTES? requests the length in bytes of the synchronization acquisition threshold
10

COMMON COMMANDS

The IEEE-488.2 Standard defines a set of commands and queries that should be common to all instruments. Some commands are mandatory, while others are optional.

The common commands and queries accepted by the FIREBERD 4000 are:

Commands	Queries
*CLS	
*ESE	*ESE?
	*ESR?
	*IDN?
	*IST?
*OPC	*OPC?
	*OPT?
*PRE	*PRE?
*PSC	*PSC?
*RCL	
*RST	
*SAV	
*SRE	*SRE?
	*STB?
*TRG	
	*TST?
*WAI	

Figure 4-3 shows an abbreviated view of the registers, buffers, and queues in the FIREBERD 4000. Note that only the *unshaded* registers and buffers can be read from or written to using the common commands. Shaded registers and buffers are addressed by other means (usually **STATUS** commands). The contents of the Error Buffer and Remote Control Print Queue can be read using **STATUS** commands; however, it is necessary to read the Status Byte Register (using the IEEE common query ***STB?**) to determine if printouts or error messages are present.

*CLS

Clear Status **command**

***CLS** clear the Standard Event Status Register

The ***CLS** command clears the Standard Event Status Register, including the device-defined print queue and the error buffer. The ***CLS** command does not clear the output queue if it is part of a <program message> containing a query. This means the Message Available (MAV) bit of the Status Register may not be cleared. (See Subsection 4.5.1 for additional information on the FIREBERD registers.)

Example:

>***CLS**	clear the status register, queues, and buffers
>***ESR?**	read the register
0	status registers cleared

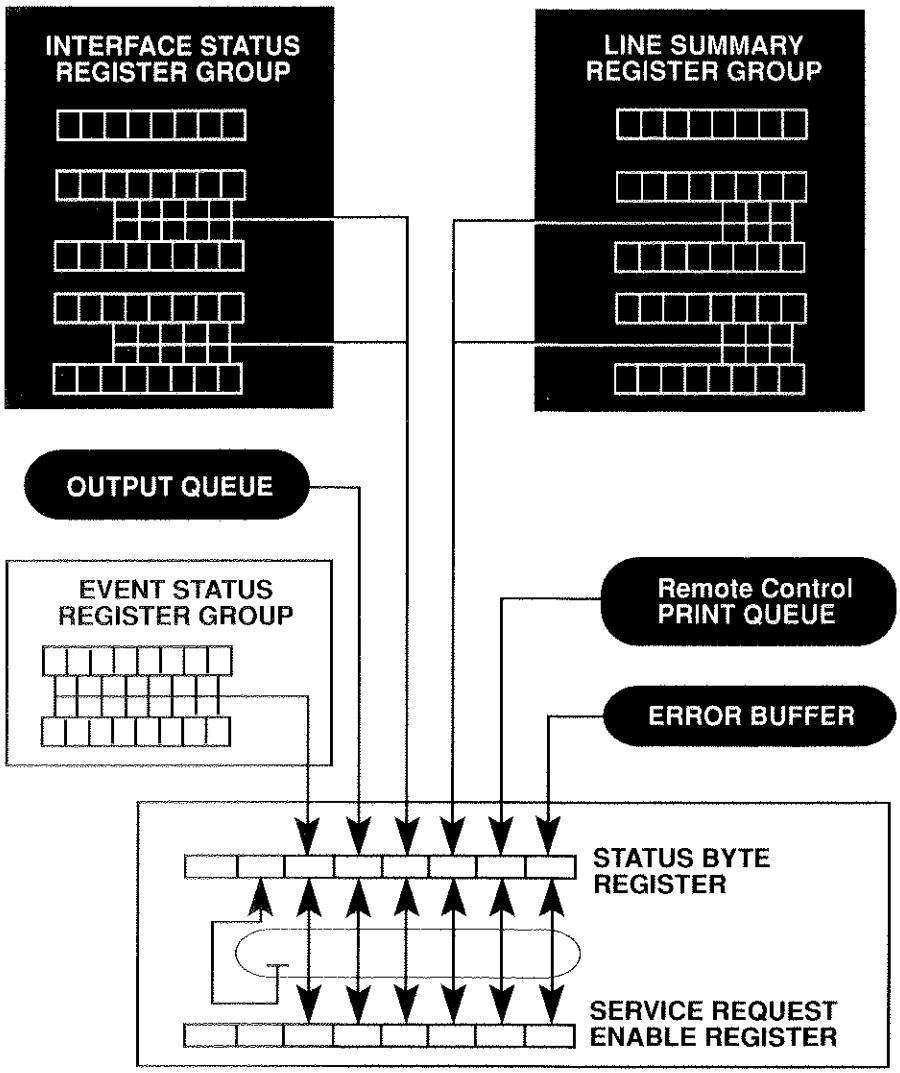

Figure 4-3
Registers & Buffers Addressable By Common Commands

*ESE

Event Status Enable **command/query**

***ESE** set the bits in the Standard Event Status Enable Register

***ESE?** return the status of the bits in the Standard Event Status Enable Register

The ***ESE** command sets the bits in the Standard Event Status Enable Register. The value of the bits determine which bits in the Standard Event Status Register are enabled. When a bit in the Standard Event Status Register and its corresponding enable bit are set, the Event Status Bit 5 (ESB) of the Status Register is also set. (See the ***ESR** and ***STB** commands, and Subsection 5 for additional information.)

The ***ESE?** query returns the status of the bits in the Standard Event Status Enable Register. The value returned is the total bit weight of all the bits that are enabled when the byte is read. Table 4-3 offers information on the bits in the Standard Event Status Enable Register.

Table 4-3
Standard Event Status Enable Register

Bit	Weight	Enables:
7	128	PON - Power On
6	64	URQ - User Request
5	32	CME - Command Error
4	16	EXE - Execution Error
3	8	DDE - Device Dependent Error
2	4	QYE - Query Error
1	2	RQC - Request Control
0	1	OPC - Operation Complete

Example:

>*ESE 32 enable bit 5 (Command Error) of the register

>*ESE? requests the enabled bit(s) in the register
32

*ESR

Event Status Register **query**

***ESR?** return the current contents of the Standard Event Status Register

The ***ESR?** query returns the contents of the Standard Event Status Register. The value returned is the total weight of all the bits that are enabled when the byte is read. After reading the register, this query is cleared. Table 4-4 offers information on each bit in this register. (See the ***SRE** and ***OPC** commands, and Subsection 5 for additional information.)

Table 4-4
Standard Event Status Register

Bit	Weight	Bit Name	Condition
7	128	PON	0 = Not powered-on since last reading. 1 = Powered-on since last reading.
6	64	URQ	Not defined. Always zero.
5	32	CME	Set to one when a Command error occurs.
4	16	EXE	Set to one when an Execution error occurs.
3	8	DDE	Not defined. Always zero.
2	4	QYE	Set to one when a Query error occurs.
1	2	RQC	Request control - not used - always zero.
0	1	OPC	Set to one when a program message containing the ***OPC** command is executed.

Example:

>*ESR? read the Event Status Register
32 a Command error occurred

*IDN

Identification Query **query**

***IDN?** return FIREBERD 4000 identification information

The ***IDN?** query returns the FIREBERD 4000 identification information, as follows: manufacturer, model, serial number (always 0), and software revision.

The ***IDN?** query must be the last query in a program. Queries following ***IDN?** in a program message are ignored.

Example:

>*IDN? return the FIREBERD identification information
Telecommunications Techniques Corporation, Fireberd 4000, 0, 5

*IST

Individual Status **query**

***IST?** return the Individual Status message (IST)

The ***IST?** query returns the Individual Status message (IST), which determines how the FIREBERD 4000 responds to a parallel poll.

When the controller issues a parallel poll, it sends a sense bit. The FIREBERD responds to the parallel poll only if the IST (Individual Status) value matches the sense of the serial poll. The value of the IST message is determined by the Status Byte Register and the Parallel Poll Enable Register. (See the ***PRE** and ***STB** commands, and Subsection 5 for additional information.) This command returns either '1' or '0', where '1' indicates a match between corresponding bits of the Status Byte Register and Parallel Poll Enable Register.

Example:

>*IST? return the Individual Status message
0

*OPC

Operation Complete **command/query**

***OPC** set the Operation Complete (OPC) bit of the Standard Event Status Register

***OPC?** return the status of the OPC bit

The ***OPC** command sets the Operation Complete (OPC) bit of the Standard Event Status Register to a value of 1 when all pending device operations are completed.

The ***OPC?** query places an ASCII "1" in the output queue when all pending device operations are completed (i.e., no operations are pending).

Example:

>CONFIG:SELF_LOOP ON;*OPC set the OPC bit to a value of 1 after self-loop mode has been established

>CONFIG:SELF_LOOP ON;*OPC? returns a 1 after self-loop mode has been established
1

*OPT

Option Identification **query**

***OPT?** return a list of installed options

The ***OPT?** query reports on the options that are installed in the FIREBERD 4000. Options are reported by field, as follows:

Field 1:	IEEE488 (IEEE-488 Interface)
Field 2:	SYNC_USER_MSG (Synchronous User Message)
Field 3:	SYNTH
Field 4:	G.821
Field 5:	Reserved for future use
Field 6:	Reserved for future use
Field 7:	Reserved for future use

When an option is not installed, a zero (0) appears in place of the option name.

Example:

>OPT? identify the options that are installed in the FIREBERD
IEEE488,0,0,G.821,0,0,0

*PRE

Parallel Poll Enable **command/query**

***PRE** set the bits in the Parallel Poll Enable Register

***PRE?** return the status of the bits in the Parallel Poll Enable Register

The ***PRE** command sets the bits in the Parallel Poll Enable Register. The value of these bits determine which bits of the Status Byte set the Individual Status (IST) message. The IST message is enabled whenever a bit in the Parallel Poll Enable Register and the corresponding bit in the Status Byte Register are set. The IST message is used to determine the response to a parallel poll. (See the ***STB** and ***IST** commands, and Subsection 5 for more information.)

The ***PRE?** query returns the current status of the enable register. The value returned is the total weight of all the bits that are enabled when the byte is read. Table 4-5 offers information on each bit in the Parallel Poll Enable Register.

Table 4-5
Parallel Poll Enable Register

Bit	Weight	Enables this bit to set IST:
7	128	Not Defined.
6	64	MSS - Master Status Summary.
5	32	ESB - Event Status Bit.
4	16	MAV - Message Available.
3	8	IEB - Interface Event Bit.
2	4	LEB - Line Event Bit.
1	2	PAV - Print Available.
0	1	EAV - Error Message Available.

Example:

>*PRE 16 enable MAV to set IST

>*PRE? read current value of the Parallel Poll Enable Register
16

*PSC

Power-On Status Clear **command/query**

***PSC [0|1]** clear all Status Enable Registers at FIREBERD 4000 power-on

***PSC?** return the current status of the activity

The ***PSC** command sets the FIREBERD 4000 status clear bit. When set to 1, the FIREBERD automatically clears all Status Enable Registers at power-on, which prevents the instrument from generating a service request; when set to 0, the FIREBERD does not clear the Status Enable Registers.

The ***PSC?** query returns the current status of the activity.

Example:

>*PSC 0 preserve all Status Enable Register settings at power-on

>*PSC? return the current setting of the bit
0

*RCL

Recall Stored Test Set-ups **command**

***RCL** recall a stored test set-up

The ***RCL** command recalls a stored test set-up for immediate use by the FIREBERD 4000. This command is identical to the RECALL function of the FIREBERD 4000 MENU switch. Note, however, that the remote control and printer settings specified in the RC/PRINT Auxiliary menu are not changed; neither are the RS-232 settings in the RS232 Format Auxiliary menu or the Status Clear bit (see the ***PSC** command.) This ensures that remote control operation can continue after the ***RCL** command is issued. Valid program numbers are 0-9.

Example:

>*RCL 3 recall stored test set-up number 3

*RST

Reset **command**

***RST** reset the FIREBERD 4000 to its factory-default settings

The ***RST** command sets the FIREBERD 4000 to its factory-default settings.

Example:

>*RST set the FIREBERD 4000 to its factory-default settings

*SAV

Save **command**

***SAV n** save a stored test set-up

The ***SAV** command saves a test set-up (n = 0-9). This command is similar to the **Recall/Store** function **STORE PROGRAM** available on the FIREBERD 4000 SETUP panel. Valid program numbers are 0-9.

>*SAV 3 save current configuration as test set-up number 3

*SRE

Service Request Enable **command/query**

***SRE** set the bits in the Service Request Enable Register

***SRE?** return the status of the bits in the Service Request Enable Register

The ***SRE** command sets the bits in the Service Request Enable Register. The value of these bits determine which bits in the Status Byte Register are enabled. When a bit in the Service Request Register and its corresponding enable bit are set, the Master Summary Status (MSS) bit of the Status Register is also set. The MSS bit represents the summary of all the status registers, queues and buffers. When set to 1, a service request (SRQ) is signaled by the FIREBERD 4000 when operating under IEEE-488 remote control. (See the ***STB** command, and Subsection 5 for more information.)

The ***SRE?** query returns the status of the bits in the Service Request Enable Register. The value returned is the total weight of all the enabled bits at the time the byte is read. Table 4-6 offers information on the bits in the Service Request Enable Register.

Table 4-6
Service Request Enable Register

Bit	Weight	Enables:
7	128	Not defined. Always zero.
6	64	Not defined. Always zero.
5	32	ESB - Event Status Bit.
4	16	MAV - Message Available.
3	8	IEB - Interface Event Bit.
2	4	LEB - Line Event Bit.
1	2	PAV - Print Available.
0	1	EAV - Error Message Available.

Example:

>*SRE 16 bit 4 MAV (Message Available) sets the MSS bit

>*SRE? read the SRE register
16 FIREBERD responds with the current value of the SRE register

*STB

Status Byte **query**

***STB?** return the current value of the FIREBERD 4000 status byte

The ***STB?** query returns the current value of the FIREBERD 4000 status byte. The value returned is the total weight of all the bits that are enabled when the byte is read. The Status Byte Register contains the same value that is read by a serial poll over the IEEE-488 bus. Table 4-7 offers information on each bit in the Status Byte Register. (See the ***SRE** command, and Subsection 5 for more information.)

Table 4-7
Status Byte Register

Bit	Weight	Enables:
7	128	Not defined. Always zero.
6	64	MSS - Master Status Summary.
5	32	ESB - Event Status Bit.
4	16	MAV - Message Available.
3	8	IEB - Interface Event Bit.
2	4	LEB - Line Event Bit.
1	2	PAV - Print Available.
0	1	EAV - Error Message Available.

Example:

>***STB?** read the FIREBERD Status Byte Register
33 indicates that the ESB and EAV bits are set

*TRG

Trigger **command**

***TRG** clear all results

The ***TRG** command executes a device trigger that clear all results. This command is identical to the **RESULT:CLEAR** command, and performs the same function as a device trigger over the IEEE-488 bus.

Example:

>***TRG** FIREBERD 4000 clears results

*TST

Self-Test **query**

***TST?** requests self-test results

The ***TST?** query indicates whether the FIREBERD 4000 passed or failed its last self-test. If the ***TST?** query returns a value of 0, no problems were encountered; if a value other than 0 is returned, it indicates that problems occurred during the self-test (e.g., ROM failure, RAM failure, NOVRAM loss, etc.). Table 4-8 offers information on the value returned for the Self Test Byte value.

Example:

>*TST? requests on the last self-test
0 self-test was successful

Table 4-8
Self Test Bit Response Value

Weight	Self-Test Failure
1	ROM Failure.
2	RAM Failure.
4	NOVRAM Failure.
8	NOVRAM Lost.
16	Real-Time Clock Failure.

*WAI

Wait **command**

***WAI** delay execution of any commands until all operations are complete

The ***WAI** command causes all previous commands to complete before executing any other commands or queries.

NOTE: Since the FIREBERD executes all commands serially, the ***WAI** command does not need to be used. However, because it is a required IEEE-488-standard command, it is included in the Common Command set.

Example:

>MODE 2M;*WAI enables all commands prior to ***WAI** to be executed prior to completing those that were issued after this command was invoked

CONFIGURATION COMMANDS

The FIREBERD 4000 features a set of commands and queries that can remotely configure the instrument switches and LEDs. These commands and queries are:

Commands	Queries
	CONFIG:CHAR_FORMAT?
CONFIG:CHAR_FORMAT:DATA_BITS	CONFIG:CHAR_FORMAT:DATA_BITS?
CONFIG:CHAR_FORMAT:PARITY	CONFIG:CHARFORMAT:PARITY?
CONFIG:CHAR_FORMAT:STOP_BITS	CONFIG:CHAR_FORMAT:STOP_BITS?
CONFIG:CHAR_ERR_INSERT	CONFIG:CHAR_FORMAT:ERR_INSERT?
CONFIG:DM	CONFIG:DM?
CONFIG:DSR	CONFIG:DSR?
CONFIG:DTR	CONFIG:DTR?
CONFIG:FREQ	CONFIG:FREQ?
CONFIG:GEN_CLK	CONFIG:GEN_CLK?
CONFIG:LOOP	CONFIG:LOOP?
CONFIG:PATTERN	CONFIG:PATTERN?
CONFIG:RLSD	CONFIG:RLSD?
CONFIG:RR	CONFIG:RR?
CONFIG:RTS	CONFIG:RTS?
CONFIG:SELF_LOOP	CONFIG:SELF_LOOP?
CONFIG:TEST_INT	
CONFIG:TIMING_MODE	CONFIG:TIMING_MODE?
CONFIG:TPZ	

CHAR_FORMAT

Asynchronous Character Format — **command/query**

CONFIG:CHAR_FORMAT: DATA_BITS [5|6|7|8] — set the number of data bits*

CONFIG:CHAR_FORMAT: PARITY [ODD|EVEN|NONE] — set the parity

CONFIG:CHAR_FORMAT: STOP_BITS [1|1.5|2] — set the number of stop bits

CONFIG:CHAR_FORMAT: DATA_BITS? — requests the current number of data bits

CONFIG:CHAR_FORMAT: PARITY? — requests the current parity setting

CONFIG:CHAR_FORMAT: STOP_BITS? — requests the current number of stop bits

CONFIG:CHAR_FORMAT? — requests the current data bit, parity, and stop bit settings

This series of commands and queries is dedicated to selection of the asynchronous character format. Note that these commands and queries are valid *only* for the following asynchronous interfaces: Internal RS-232, Internal MIL-188, and MIL-449.

The three **CONFIG:CHAR_FORMAT** commands set data bits, parity, and stop bits.

These remote control command are identical to the **Interface** functions **DATA BITS**, **PARITY,** and **TIMING** that are available by the SETUP panel when the FIREBERD is controlled from the front panel.

*5=BCD, 6=BAUDOT, 7=ASCII, 8=EBCDIC

Example:

>CONFIG:CHAR_FORMAT? requests the data bit, parity, and stop bit settings
7, ODD, 1.5

>CONFIG:CHAR_FORMAT:PARITY EVEN change the parity setting to even

>CONFIG:CHAR_FORMAT:PARITY? requests the new parity setting
EVEN

DM / DSR

DM/DSR Line Control — command/query

CONFIG:DM [ON|OFF] set the DM signaling lead

CONFIG:DSR [ON|OFF] set the DSR signaling lead

CONFIG:DM? request the current state of the DM signaling lead

CONFIG:DSR? request the current state of the DSR signaling lead

The **CONFIG:DM** and **CONFIG:DSR** commands set the state of the DM or DSR signaling lead to ON or OFF. Note that these two commands are identical, i.e., they affect the same lead, and either form will work for both an RS-449 and RS-232 Interface. The two different commands are provided only because DM is associated with RS-449, and DSR is associated with RS-232.

These remote control commands provide the same function offered by the **DSR (DM)** control switch on the FIREBERD interface status and control panel. (This switch is identified by an adjacent LED that is illuminated when the FIREBERD 4000 is emulating a DCE. When the FIREBERD is emulating a DTE, the same switch is identified by an LED as **DTR**.)

These commands are only valid when the FIREBERD 4000 is operating in DCE mode. These commands belong to a set of related commands: **CONFIG:DM**, **CONFIG:DSR**, **CONFIG:DTR**, **CONFIG:RLSD**, **CONFIG:RR**, and **CONFIG:RTS**. They are all used to set the appropriate signaling leads ON or OFF, or to report the state of the signaling leads. Table 4-9 summarizes the commands, and indicates the FIREBERD emulation mode (DCE or DTE) in which the commands are operational.

Table 4-9
Emulation Modes for DM and DSR

DCE Emulation Mode	DTE Emulation Mode
CONFIG:DM, CONFIG:DSR **CONFIG:RLSD, CONFIG:RR**	**CONFIG:DTR** **CONFIG:RTS**

NOTES:

1. The FIREBERD emulation mode (DTE or DCE) is set by an interface-specific command (e.g., **INTF:INT232 [DTE|DCE]**).

2. The **CONFIG:DM/DSR** commands—along with the commands listed in Table 4-9—should be distinguished from the **AUX:OUTBAND_FLOW[TR|DM|RS|CS|RR]** commands. The latter commands are used to determine the FIREBERD response to *incoming* signaling leads. The **CONFIG:DM/DSR** commands are used to set the state of *outgoing* leads.

3. In addition to the signaling leads indicated in Table 4-9, the FIREBERD can set interface-specific leads ON or OFF by interface-specific commands, e.g., **INTF:INT232:DCE:CTS [OFF|ON]**.

Example:

>CONFIG:DM? requests the current state of the DM signaling lead
OFF

>CONFIG:DSR ON turn the DM signaling lead on

DTR

DTR Line Control **command/query**

CONFIG:DTR [ON|OFF] set the DTR signaling lead

CONFIG:DTR? requests the current state of the DTR signaling lead

The **CONFIG:DTR** command sets the state of the DTR (for RS-232) or the TR (for RS-449) signaling lead to ON or OFF. It is only valid when the FIREBERD 4000 is operating in DTE mode.

The **CONFIG:DTR?** query requests the current state of the DTR signaling lead.

This remote control command provides the same function offered by the **DTR** control switch on the FIREBERD interface status and control panel. (This switch is identified by an adjacent LED that is visible when the FIREBERD 4000 is set to emulate DTE. When the FIREBERD is emulating DCE, the same switch is identified by an LED as **DSR (DM)**.)

Note that this command is part of a set of related commands: **CONFIG:DM**, **CONFIG:DSR**, **CONFIG:DTR**, **CONFIG:RLSD**, **CONFIG:RR**, and **CONFIG:RTS**. These commands are used to set the appropriate signaling leads ON or OFF, or to report on the state of the signalling leads. Table 4-10 summarizes the commands, and indicates the FIREBERD emulation mode (DCE or DTE) in which the commands are operational.

Table 4-10
Emulation Modes for DTR

DCE Emulation Mode	DTE Emulation Mode
CONFIG:DM, CONFIG:DSR **CONFIG:RLSD, CONFIG:RR**	**CONFIG:DTR** **CONFIG:RTS**

NOTES:

1. The FIREBERD emulation mode (DTE or DCE) is set by an interface-specific command (e.g., **INTF:INT232 [DTE/DCE]**.

2. The **CONFIG:DTR** command—along with the commands listed in Table 4-10—should be distinguished from the **AUX:OUTBAND_FLOW[TR|DM|RS|CS|RR]** commands. The latter commands are used to determine the FIREBERD response to *incoming* signaling leads. The **CONFIG:DTR** command is used to set the state of an *outgoing* lead.

3. In addition to the signaling leads indicated in Table 4-10, the FIREBERD can set interface-specific leads ON or OFF by interface-specific commands, e.g., **INTF:INT232:DCE:CTS [OFF|ON]**.

Example:

>CONFIG:DTR? requests the current state of the DTR signaling lead
OFF

>CONFIG:DTR ON turn the DTR signaling lead on

ERR_INSERT

Logic Error Insertion **command/query**

CONFIG:ERR_INSERT [OFF|SINGLE|1.0E-3] set error insertion status

CONFIG:ERR_INSERT? requests the current error insertion status

The **CONFIG:ERR_INSERT** command sets the desired error insertion status. OFF turns automatic error insertion off; SINGLE causes a single error to be inserted into the generated data; 1.0E-3 causes 1 error to be inserted per 1000 bits of generated data.

NOTE: Single error insertion terminates 1.0E-3 insertion, if it is in effect.

The **CONFIG:ERR_INSERT?** query requests the current error insertion status.

This remote control command is identical in function to the **ERROR INSERT** switch on the FIREBERD 4000 front panel.

Example:

>CONFIG:ERR_INSERT OFF	turn off automatic error insertion
>CONFIG:ERR_INSERT? OFF	requests the current error insertion status
>CONFIG:ERR_INSERT 1.0E-3	enable automatic error insertion
>CONFIG:ERR_INSERT SINGLE	insert a single error
>CONFIG:ERR_INSERT? OFF	requests the current error insertion status the 1.0E-3 rate is terminated

FREQ

Set Synthesizer Frequency **command/query**

CONFIG:FREQ (frequency)	set the FIREBERD 4000 internal frequency, in kHz.
CONFIG:FREQ?	requests the current internal or synthesizer frequency

In the FIREBERD 4000 standard configuration, the only allowed frequencies are 0.3, 1.2, 1.8, 2.4, 4.8, 9.6, 19.2, 48, 56, 64, 128, 256, 512, 704, 1544, and 2048 (the values are entered as shown, but are interpreted by the FIREBERD in units of kHz). With the optional Frequency Synthesizer (Option 4005) installed in the FIREBERD, the (frequency) can be any valid kHz value within the range .05 to 15000.

This remote control command offers the same function as the **Generator Clock** functions **INTERNAL FREQ** and **SYNTH FREQ** that are available by the SETUP panel when the FIREBERD is controlled from the front panel. (The **SYNTH FREQ** front panel command is only available if the optional Frequency Synthesizer (Option 4005) is installed in the FIREBERD.)

Certain combinations of synthesizer frequency, data pattern, and timing mode settings are not valid. If the new timing mode setting is invalid, a contention error appears in the error buffer and the previous timing mode setting is retained.

To reduce the possibility of an invalid configuration, the FIREBERD delays execution of this command until all other commands of the program message are read. The delayed commands are considered simultaneously and an error is flagged only if the final configuration is invalid.

See Section 2 of this manual for a description of the invalid settings.

Example:

>CONFIG:FREQ? 9.6	requests the current synthesizer frequency
>CONFIG:FREQ 64; **TIMING_MODE SYNC**	set the frequency synthesizer to 64 kHz and timing mode to synchronous. This prevents a potential asynchronous frequency contention

GEN CLK

Generator Clock Select **command/query**

CONFIG:GEN_CLK [INTERNAL|SYNTH|INTF|BNC] set the generator clock

CONFIG:GEN_CLK? requests the current generator clock setting

The **CONFIG:GEN_CLOCK** command sets the FIREBERD 4000 generator clock. INTERNAL and SYNTH are both used to set the FIREBERD to use an internally generated frequency. INTF selects the clock originating from the network or the clock in the interface module as the source of signal timing. BNC selects an external timing source.

If the generator clock is set to either INTERNAL or SYNTH, the **CONFIG:GEN_CLK?** query returns INTERNAL.

NOTES:

1. If the generator clock is set to either INTERNAL or SYNTH, then the exact frequency is determined by the **CONFIG:FREQ** command.

2. If BNC is selected, the external timing source must be connected to the GEN CLK IN BNC connector on the FIREBERD 4000 rear panel.

This remote control command offers the same function as the **Generator Clock** function **GEN CLOCK** that is available by the SETUP panel when the FIREBERD is controlled from the front panel.

Example:

>CONFIG:GEN_CLK SYNTH select the synthesizer as the source of signal timing

>CONFIG:FREQ? requests the current synthesizer frequency
9.6

>CONFIG:GEN_CLK? requests the current generator clock setting
INTERNAL

LOOP

Generator Loop Codes **command**

CONFIG:LOOP [UP|DOWN] generate loop up or loop down codes

When using a T1 interface, the **CONFIG:LOOP** command generates LOOP UP or LOOP DOWN code. LOOP UP tells the network Channel Service Unit (CSU) to form a closed circuit by "looping" the signal transmitted by the FIREBERD back to the FIREBERD. The LOOP UP command should only be issued when testing is done out-of-service. LOOP DOWN tells the CSU to return the circuit to its normal state (suitable for carrying live traffic).

When using the DDS DS0A/B Interface (Model 30678), the **CONFIG:LOOP** command also generates LOOP UP or LOOP DOWN code. To send either loop code, the interface must be placed in either alternating or latching loopback mode.

NOTE: The **CONFIG:LOOP DOWN** command should always be used at the conclusion of any loopback test to remove the effect of loop-up code (transmitted by the **CONFIG:LOOP UP** command) on the circuit under test.

This remote control command is identical to the **LOOP UP** and **LOOP DOWN** switches on the FIREBERD 4000 front panel when a T1 interface is in use.

Example:

>CONFIG:LOOP UP	generate loop up code
Transmitting Loop Code	
>	loop-up code transmission is successful
.	
.	
.	
>CONFIG:LOOP DOWN	loop-down code is transmitted at the conclusion of the test to return the circuit to normal operation
Transmitting Loop Code	
>	loop-down code transmission is successful

PATTERN

Select a Data Pattern — command/query

CONFIG:PATTERN [LIVE | MARK | SPACE | 1:1 | 1:7 | 3in24 | 63 | 511 | 2047 | 2^15-1 | 2^20-1 | 2^23-1 | QRSS | PRGM | FOX | 1020Hz |USER1] USER2 | USER3 | DDS-1 | DDS-2 | DDS-3 | DDS-4 | DDS-5 | T1-1 | T1-2 | T1-3 | T1-4 | T1-5 | T1-6 | t1-mW] — select a data pattern

CONFIG:PATTERN? — request the current pattern

The **CONFIG:PATTERN** command selects a data pattern to be generated by the FIREBERD.

The **CONFIG:PATTERN?** query requests the currently selected data pattern.

Section 2 of this manual describes all data patterns generated by the FIREBERD 4000.

This remote control command is identical to the **Pattern** function that is available on the SETUP panel when the FIREBERD is controlled from the front panel.

Certain combinations of synthesizer frequency, data pattern, and timing mode settings are not valid. If the new timing mode setting is invalid, a contention error appears in the error buffer and the previous timing mode setting is retained.

To reduce the possibility of an invalid configuration, the FIREBERD delays execution of this command until all other commands of the program message are read. The delayed commands are considered simultaneously and an error is flagged only if the final configuration is invalid.

See Section 2 of this manual for a description of the invalid settings.

Example:

>CONFIG:PATTERN? requests the current data pattern
511

>CONFIG:PATTERN QRSS select the QRSS data pattern

RLSD / RR

RLSD/RR Line Control **command/query**

CONFIG:RLSD [ON|OFF] set the RLSD signaling lead

CONFIG:RR [ON|OFF] set the RLSD signaling lead

CONFIG:RLSD? requests the current state of the RLSD signaling lead

CONFIG:RR? requests the current state of the RLSD signaling lead

The **CONFIG:RLSD** and **CONFIG:RR** commands set the state of the RR or RLSD signaling lead to ON or OFF. Note that these two commands are identical (i.e., they affect the same lead, and either form will work for both an RS-449 and RS-232 Interface). The two different commands are provided only because because RR is associated with RS-449, and RLSD is associated with RS-232.

These remote control commands provide the same function offered by the **RLSD (RR)** control switch on the FIREBERD interface status and control panel. (This switch is identified by an adjacent LED that is visible when the FIREBERD 4000 is set to emulate DCE. When the FIREBERD is emulating a DTE, the same switch is identified by an LED as **RTS**.)

These commands are only valid when the FIREBERD 4000 is operating in DCE mode. Note that these commands belong to a set of related commands: **CONFIG:DM**, **CONFIG:DSR**, **CONFIG:DTR**, **CONFIG:RLSD**, **CONFIG:RR**, and **CONFIG:RTS**. They are all used to set the appropriate signaling leads ON or OFF, or to report on the state of the signaling leads. Table 4-11 summarizes the commands, and indicates the FIREBERD emulation mode (DCE or DTE) in which the commands are operational.

Table 4-11
Emulation Modes for RR and RLSD

DCE Emulation Mode	DTE Emulation Mode
CONFIG:DM, CONFIG:DSR **CONFIG:RLSD, CONFIG:RR**	**CONFIG:DTR** **CONFIG:RTS**

NOTES:

1. The FIREBERD emulation mode (DTE or DCE) is set by an interface-specific command (e.g., **INTF:INT232 [DTE/DCE]**).

2. The **CONFIG:RLSD/RR** commands—along with the commands listed in Table 4-11—should be distinguished from the **AUX:OUTBAND_FLOW[TR|DM|RS|CS|RR]** commands. The latter commands are used to determine the FIREBERD response to *incoming* signaling leads. The **CONFIG:RLSD/RR** commands are used to set the state of *outgoing* leads.

3. In addition to the signaling leads indicated in Table 4-11, the FIREBERD can set interface-specific leads ON or OFF by interface-specific commands (e.g., **INTF:INT232:DCE:CTS [OFF|ON]**).

Example:

>CONFIG:RLSD? requests the current state of the RLSD signaling lead
ON

>CONFIG:RR OFF turn the RLSD signaling lead off

RTS

RTS Line Control **command/query**

CONFIG:RTS [ON|OFF] set the RTS signaling lead

CONFIG:RTS? requests the current state of the RTS signaling lead

The **CONFIG:RTS** command sets the state of the RS-232 RTS or the RS-449 signaling lead to ON or OFF. It is only valid when the FIREBERD 4000 is operating in DTE mode.

The **CONFIG:RTS?** query requests the current state of the RTS signaling lead.

This remote control command provides the same function offered by the **RTS** control switch on the FIREBERD interface status and control panel. (This switch is identified by an adjacent LED that is visible when the FIREBERD 4000 is set to emulate DTE. When the FIREBERD is emulating DCE, the same switch is identified by an LED as **RLSD (RR)**.)

Note that this command is part of a set of related commands: **CONFIG:DM**, **CONFIG:DSR**, **CONFIG:DTR**, **CONFIG:RLSD**, **CONFIG:RR**, and **CONFIG:RTS**. These commands are used to set the appropriate signaling leads ON or OFF, or to report on the state of the signaling leads. Table 4-12 summarizes the commands, and indicates the FIREBERD emulation mode (DCE or DTE) in which the commands are operational.

Table 4-12
Emulation Modes for RTS

DCE Emulation Mode	DTE Emulation Mode
CONFIG:DM, CONFIG:DSR **CONFIG:RLSD, CONFIG:RR**	**CONFIG:DTR** **CONFIG:RTS**

NOTES:

1. The FIREBERD emulation mode (DTE or DCE) is set by an interface-specific command (e.g., **INTF:INT232 [DTE/DCE]**).

2. The **CONFIG:DTR** command—along with the commands listed in Table 4-12—should be distinguished from the **AUX:OUTBAND_FLOW[TR|DM|RS|CS|RR]** commands. The latter commands are used to determine the FIREBERD response to *incoming* signaling leads. The **CONFIG:DTR** command is used to set the state of an *outgoing* lead.

3. In addition to the signaling leads indicated in Table 4-12, the FIREBERD can set interface-specific leads ON or OFF. These signaling leads are controlled by interface-specific commands (e.g., **INTF:INT232:DCE:CTS [OFF|ON]**).

Example:

>CONFIG:RTS?	requests the current state of the RTS signaling lead
ON	
>CONFIG:RTS OFF	turn the RTS signaling lead off

SELF_LOOP

Self-Loop Select **command/query**

CONFIG:SELF_LOOP [ON|OFF]	place the FIREBERD in self-loop mode
CONFIG:SELF_LOOP?	requests the current self-loop state

The **CONFIG:SELF_LOOP** command takes the FIREBERD 4000 in and out of self-loop mode (i.e., ON and OFF).

The **CONFIG:SELF_LOOP?** query requests the current self-loop state.

This remote control command is identical in function to the **SELF LOOP** switch on the FIREBERD 4000 front panel.

Example:

>CONFIG:SELF_LOOP?	requests the current self-loop state
OFF	self-loop is OFF
>CONFIG:SELF_LOOP ON	turn self-loop ON

TIMING_MODE

Select Timing Mode **command/query**

CONFIG:TIMING_MODE [SYNC|ASYNC] select a timing mode

CONFIG:TIMING_MODE? requests the currently selected timing mode

The **CONFIG:TIMING_MODE** command selects a timing mode. SYNC selects synchronous timing; ASYNC selects asynchronous timing.

The **CONFIG:TIMING_MODE?** query requests the currently selected timing mode. When the current interface does not require a timing mode setting, the message **N/A** is returned.

This remote control command and query are valid for asynchronous interfaces only.

This remote control command is identical to the **Interface** function **TIMING** that is available on the SETUP panel when the FIREBERD is controlled from the front panel.

Certain combinations of synthesizer frequency, data pattern, and timing mode settings are not valid. If the new timing mode setting is invalid, a contention error appears in the error buffer and the previous timing mode setting is retained.

To reduce the possibility of an invalid configuration, the FIREBERD delays execution of this command until all other commands of the program message are read. The delayed commands are considered simultaneously and an error is flagged only if the final configuration is invalid.

See Section 2 of this manual for a description of the invalid settings.

Example:

>CONFIG:TIMING_MODE? requests the current timing mode
SYNC synchronous timing is currently selected

>CONFIG:TIMING_MODE ASYNC;
FREQ 1.2 change the current timing mode to asynchronous and frequency to 1200 baud. This avoids a potential asynchronous frequency contention

INTERFACE COMMANDS

INTERFACE commands and queries are used to select one interface among several that are available to the FIREBERD 4000. Interface commands are also used to control features that are unique to specific interfaces.

1. Commands that select the interface to be used; and

2. Commands specific to the two built-in interfaces, the INT232 and the INT188.

For interface commands used by optional interfaces that can be inserted into the FIREBERD 4000, see the appropriate interface operating manual.

The interface commands and queries covered in this subsection are:

Commands	Queries
INTF:SELECT	INTF:SELECT?
INTF:SELECT:ISU	INTF:SELECT:ISU?
INTF:INT188 [DTE/DCE]	INTF:INT188?
	INTF:INT188:CHAR_FORMAT?
INTF:INT188:CHAR_FORMAT:DATA_BITS	INTF:INT188:CHAR_FORMAT:DATA_BITS?
INTF:INT188:CHAR_FORMAT:PARITY	INTF:INT188:CHAR_FORMAT:PARITY?
INTF:INT188:CHAR_FORMAT:STOP_BITS	INTF:INT188:CHAR_FORMAT:STOP_BITS?
INTF:INT188:DCE:RI	INTF:INT188:DCE:RI?
INTF:INT188:DCE:CTS	INTF:INT188:DCE:CTS?
INTF:INT188:INBAND_FLOW	INTF:INT188:INBAND_FLOW?
INTF:INT188:RCV_CLK_SEL	INTF:INT188:RCV_CLK_SEL?
INTF:INT188:SIGNAL	INTF:INT188:SIGNAL?
INTF:INT188:TIMING_MODE	INTF:INT188:TIMING_MODE?
INTF:INT232 [DTE/DCE]	INTF:INT232?
	INTF:INT232:CHAR_FORMAT?
INTF:INT232:CHAR_FORMAT:DATA_BITS	INTF:INT232:CHAR_FORMAT:DATA_BITS?
INTF:INT232:CHAR_FORMAT:PARITY	INTF:INT232:CHAR_FORMAT:PARITY?
INTF:INT232:CHAR_FORMAT:STOP_BITS	INTF:INT232:CHAR_FORMAT:STOP_BITS?
INTF:INT232:DCE:RI	INTF:INT232:DCE:RI?
INTF:INT232:DCE:CTS	INTF:INT232:DCE:CTS?
INTF:INT232:INBAND_FLOW	INTF:INT232:INBAND_FLOW?
INTF:INT232:RCV_CLK_SEL	INTF:INT232:RCV_CLK_SEL?
INTF:INT232:TIMING_MODE	INTF:INT232:TIMING_MODE?

SELECT

Interface Selection — **command/query**

INTF:SELECT [INT232 | INT188 | EXT1 | EXT2]

select the desired interface from either of the two internal interfaces, or the external interface(s) installed in the rear panel interface slot(s)

INTF:SELECT:ISU [1 | 2 | 3 | 4], [1 | 2 | 3 | 4]

the first digit selects an Interface Switching Unit (ISU) that can be connected to the FIREBERD (up to four ISUs can be connected to one mainframe). The second digit selects an interface installed in one of the four interface slots in the ISU

INTF:SELECT? — requests identification of the currently selected interface. If an external interface installed in the back panel is selected, the FIREBERD 4000 returns the name of the interface. If an external interface installed in an ISU is selected, the FIREBERD 4000 returns the number of the ISU unit, the number of the slot, and the name of the interface

INTF:SELECT:ISU? [1 | 2 | 3 | 4], [1 | 2 | 3 | 4] — requests identification of the interface installed in the indicated ISU (first #), and the indicated slot within that ISU (second #)

An interface must be selected prior to executing the interface-specific commands and queries.

Examples:

>INTF:SELECT INT232 — selects the FIREBERD internal RS-232 Interface

>INTF:SELECT?
INT232 — requests identification of the current interface
the internal RS-232 Interface is currently selected

>INTF:SELECT EXT2 — selects the interface currently installed in the rear panel interface slot 2

>INTF:SELECT?
2MG704 — requests identification of the current interface
the currently selected interface is the 2MG704; note that by virtue of the previous command (**INTF:SELECT EXT2**), this must be the interface currently installed in the rear panel interface slot 2

>INTF:SELECT:ISU? 2,4
EMPTY — requests identification of the interface installed in ISU number 2, slot 4
slot 4 in ISU 2 has no interface installed

>INTF:SELECT:ISU? 2,3
DS1_FE — requests identification of the interface installed in ISU number 2, slot 3
slot 3 in ISU 2 has the DS1/Fe Interface installed

>INTF:SELECT:ISU 2,3 — selects the interface installed in slot 3 of ISU 2

>INTF:SELECT?
ISU2,S3,DS1_FE — requests identification of the current interface
the currently selected interface is DS1/Fe, installed in slot 3 of ISU 2

INT232

Internal RS-232 Interface Control — **command/query**

INTF:INT232 [DTE|DCE] — emulate DTE or DCE

INTF:INT232:CHAR_FORMAT: DATA_BITS [5|6|7|8] — sets the number of data bits (only applicable in asynchronous timing mode)

INTF:INT232:CHAR_FORMAT: PARITY [EVEN|ODD|NONE] — sets the parity (only applicable in asynchronous timing mode)

INTF:INT232:CHAR_FORMAT: STOP_BITS [1|1.5|2] — sets the number of stop bits (only applicable in asynchronous timing mode)

INTF:INT232:DCE:RI [ON|OFF]	control RI signal
INTF:INT232:DCE:CTS [ON|OFF]	control CTS signal
INTF:INT232:INBAND_FLOW [OFF|ON]	enables or disables in-band flow control
INTF:INT232:RCV_CLK_SEL [ST|TT]	sets the timing reference to which the mainframe is synchronized: TT (Terminal Timing) or ST (Send Timing); (only applicable with DCE emulation and synchronous timing mode)
INTF:INT232:TIMING_MODE [SYNC|ASYNC]	selects synchronous or asynchronous timing mode
INTF:INT232?	requests the current emulation
INTF:INT232:CHAR_FORMAT?	requests the current character format (data bits, parity, and stop bits)
INTF:INT232:CHAR_FORMAT: DATA_BITS?	requests current setting for data bits
INTF:INT232:CHAR_FORMAT: PARITY?	requests the current setting for parity
INTF:INT232:CHAR_FORMAT: STOP_BITS?	requests the current setting for stop bits
INTF:INT232:DCE:RI?	requests current RI signal status
INTF:INT232:DCE:CTS?	requests current CTS signal status
INTF:INT232:INBAND_FLOW?	requests the current setting for in-band flow
INTF:INT232:RCV_CLK_SEL?	requests the current setting for the timing reference to which the mainframe is synchronized
INTF:INT232:TIMING_MODE?	requests the current timing mode

This series of commands and queries enables remote control of the FIREBERD 4000 internal RS-232 Interface.

For more information on the RS-232 Interface, refer to Section 2 of this manual.

Examples:

>INTF:INT232?	requests the current emulation
DTE	
>INTF:INT232 DCE	enable DCE emulation
>INTF:INT232:DCE:RI?	requests the current RI signal status
OFF	
>INTF:INT232:DCE:RI ON	turn the RI signal on

INT188

Internal MIL188 Interface Control — **command/query**

INTF:INT188 [DTE|DCE]	emulate DTE or DCE
INTF:INT188:CHAR_FORMAT: DATA_BITS [5|6|7|8]	sets the number of data bits (only applicable in asynchronous timing mode)
INTF:INT188:CHAR_FORMAT: PARITY [EVEN|ODD|NONE]	sets the parity (only applicable in asynchronous timing mode)
INTF:INT188:CHAR_FORMAT: STOP_BITS [1|1.5|2]	sets the number of stop bits (only applicable in asynchronous timing mode)
INTF:INT188:DCE:RI [ON|OFF]	control RI signal
INTF:INT188:DCE:CTS [ON|OFF]	control CTS signal
INTF:INT188:INBAND_FLOW [OFF|ON]	enables/disables in-band flow control
INTF:INT188:RCV_CLK_SEL [ST|TT]	sets the timing reference to which the mainframe is synchronized: TT (Terminal Timing) or ST (Send Timing); (only applicable with DCE emulation and synchronous timing mode)
INTF:INT188:SIGNAL [POSITIVE|NEGATIVE]	selects the polarity of the interface signaling control leads (RST, CTS, DSR, RLSD, DTR, and RI). **POSITIVE** means that ON corresponds to a positive value; **NEGATIVE** means that ON corresponds to a negative value.
INTF:INT188:TIMING_MODE [SYNC|ASYNC]	selects synchronous or asynchronous timing mode
INTF:INT188?	request current emulation
INTF:INT188:CHAR_FORMAT?	requests current character format (data bits, parity, and stop bits)
INTF:INT188:CHAR_FORMAT: DATA_BITS?	requests current setting for data bits
INTF:INT188:CHAR_FORMAT: PARITY?	requests the current setting for parity
INTF:INT188:CHAR_FORMAT: STOP_BITS?	requests the current setting for stop bits
INTF:INT188:DCE:RI?	requests current RI signal status
INTF:INT188:DCE:CTS?	requests current CTS signal status
INTF:INT188:INBAND_FLOW?	requests the current setting for in band flow
INTF:INT188:RCV_CLK_SEL?	requests the current setting for the timing reference to which the mainframe is synchronized

INTF:INT188:SIGNAL? requests the polarity of the interface signaling control leads (RST, CTS, DSR, RLSD, DTR, and RI)

INTF:INT188:TIMING_MODE? requests the current timing mode

This series of commands and queries enables remote control of the FIREBERD 4000 internal RS-188 Interface.

For more information on the RS-188 Interface, refer to Section 2 of this manual.

Examples:

>INTF:INT188? requests the current emulation
DTE

>INTF:INT188 DCE enable DCE emulation

>INTF:INT188:DCE:RI? requests the current RI signal status
OFF

>INTF:INT188:DCE:RI ON turn the RI signal on

PRINT COMMANDS

PRINT commands control the FIREBERD 4000 print capability. These commands can be used to obtain a hard copy of test results or a printout of the current FIREBERD configuration.

The print commands and queries are:

Commands	Queries
PRINT:CLEAR	
PRINT:CONTROLS	PRINT:CONTROLS?
PRINT:DEVICE	PRINT:DEVICE?
PRINT:EVENT	PRINT:EVENT?
PRINT:EVENT:ERROR	PRINT:EVENT:ERROR?
PRINT:EVENT:TIMED	PRINT:EVENT:TIMED?
PRINT:HISTOGRAM	
PRINT:EVENT:HISTOGRAM:FORMAT	PRINT:EVENT:HISTOGRAM:FORMAT?
PRINT:EVENT:HISTOGRAM:PERIOD	PRINT:EVENT:HISTOGRAM:PERIOD?
PRINT:EVENT:HISTOGRAM:RESULT	PRINT:EVENT:HISTOGRAM:RESULT?
PRINT:EVENT:HISTOGRAM:SAMPLES	PRINT:EVENT:HISTOGRAM:SAMPLES?
PRINT:EVENT:HISTOGRAM:VSCALE	PRINT:EVENT:HISTOGRAM:VSCALE?
PRINT:MODE	PRINT:MODE?
PRINT:PRINTER	PRINT:PRINTER?
PRINT:RESULTS	PRINT:RESULTS?
PRINT:RESULTS:TYPE	PRINT:RESULTS:TYPE?
PRINT:STATUS	PRINT:STATUS?
PRINT:TERM	PRINT:TERM?
PRINT:WIDTH	PRINT:WIDTH?

CLEAR

Clears the Print Buffer — command

PRINT:CLEAR clears the printer buffer of all data. This function can be used when the buffer becomes backed up with old test results

Example:

>PRINT:CLEAR clears the printer buffer. New data may continue to enter the buffer and be printed

CONTROLS

Controls Printouts — command/query

PRINT:CONTROLS? requests a controls printout be sent to the currently selected remote control port. A controls print lists the current state of all FIREBERD 4000 mainframe controls. When applicable, the state of interface controls are also listed

PRINT:CONTROLS sends a controls printout to the currently selected printer port or device

This remote control command is almost identical in function to the CONTROLS switch on the PRINTER control panel. However, the front panel CONTROLS switch can only send the listing to the printer, while the **PRINT:CONTROLS?** query can be used to send the listing the computer or terminal used for remote control.

Example:

>PRINT:CONTROLS? requests a CONTROLS printout be sent to the remote control device

.
.
. a controls print is sent to your terminal or computer

>PRINT:CONTROLS provides a CONTROLS printout to the printer

DEVICE

Printer Device Selection — command/query

PRINT:DEVICE [NONE|232|488|REMOTE] select a printer output device. 232, 488, or REMOTE select a print device at an RS-232, IEEE-488, or remote output, respectively. NONE indicates that none of the three printer output devices are selected

PRINT:DEVICE? requests the current printer output selection

Note that a printer and an controller cannot share the same output (e.g., if the controller is assigned to IEEE-488, the printer must be assigned to RS-232 or remote output). RS-232 requires that a printer be connected to the built-in RS-232 Interface on the rear panel, or that the optional FIREBERD PR-45 lid printer be connected to the front panel PR-45 Printer Connector. IEEE-488 requires that a printer be connected to the optional IEEE-488 Interface on the rear panel.

REMOTE does not send output to an external printer; instead, the data is stored in an internal buffer in the FIREBERD 4000. Note that more than one printout can be stored in the buffer. Printouts can be retrieved from the buffer in first-in-first-out (FIFO) order using the **STATUS:PRINT?** query. **STATUS:PRINT?** sends the retrieved printout to the controller.

This remote control command offers the same functionality as the **Auxiliary** function **RC:PRINT:** that is available on the SETUP panel when the FIREBERD is controlled from the front panel.

Example:

>PRINT:DEVICE? requests the current printer output device selection
232

>PRINT:DEVICE NONE change the current printer output device selection to none

EVENT

Print Event Selection and Printing Control **command/query**

All the following commands and queries are dedicated to *print events*. Print events determine when the FIREBERD 4000 automatically generates a printout of results.

NOTE: In order for any of the **PRINT:EVENT** settings below to be operational, the printer must be set to either AUX or EVENT (i.e., one of the following two commands must be issued: **PRINT:PRINTER AUX** or **PRINT:PRINTER EVENT**).

PRINT:EVENT [ERROR|TIMED|HISTOGRAM] tells the FIREBERD the kind of event that triggers printing. Print when: (1) certain specific errors occur; or (2) a designated amount of time has elapsed; or (3) a sufficient number of data samples have been collected to generate a histogram

PRINT:EVENT? requests the current setting of **PRINT:EVENT** (error, timed, or histogram)

Commands pertaining to *error* print events:

PRINT:EVENT:ERROR (result), [OFF|ON] sets the kinds of results that triggers printing when errors occur, *provided* the **PRINT:EVENT ERROR** command has been issued. Results can be:

BIT_ERRS	bit errors	**ERR-SES**	bit errors minus SES
BLK_ERRS	block errors	**FAS_ERR**	frame alignment signal errors
BPVS	bipolar violations	**FRA_ERR**	frame errors
CODE_ERR	code error	**PAT_SLIP**	pattern slips
CRC_ERR	cyclic redundancy check errors		

ON and OFF enable or disable the print error event activity. Note that more than one kind of error event can be set to ON, and trigger printing

PRINT:EVENT:ERROR? (result) requests the current print event status of any error (enabled or disabled). Results that are enabled trigger printing when an error occurs, provided the **PRINT:EVENT ERROR** command has been issued

Commands pertaining to *timed* print events:

PRINT:EVENT:TIMED ["(hh:mm)"] sets the amount of time that elapses until printing, *provided* the **PRINT:EVENT TIMED** command has been issued. Error events can be a timed interval that is specified in units of hours and minutes. (hh) can be any value from 0-99; (mm) can be any value within the range 1-59.

PRINT:EVENT:TIMED? requests the current timed print event setting

Commands pertaining to *histogram* print events:

Histograms offer a way to measure how a FIREBERD 4000 test result changes with time. For example, a histogram can be used to monitor bit errors that have accumulated in each hour over a 60-hour period. For more information on histograms—including histogram scales, samples, and periods—see Section 3 of this manual.

PRINT:EVENT:HISTOGRAM [1|2|3] sends a manual histogram to the printer. The most recent samples collected (up to 60) are used to create a printout. The FIREBERD can be instructed to generate histograms automatically, at selected time intervals, using the **PRINT:EVENT:HISTOGRAM:SAMPLES** and **PRINT:EVENT:HISTOGRAM:PERIOD** commands

PRINT:EVENT:HISTOGRAM: FORMAT [GRAPH|LIST] select a histogram format (either a graph or a table listing)

PRINT:EVENT:HISTOGRAM:PERIOD [1MIN|15MIN|1HOUR|1DAY] set the duration of a single sampling period. This command, along with the **PRINT:EVENT:HISTOGRAM:SAMPLES** command, determines the time interval between automatic printouts. (Multiply the 'number of samples' times 'period per sample' to get the total time interval between printings.)

PRINT:EVENT:HISTOGRAM:RESULT [1|2|3],[OFF|(result)] select the result to be histogrammed and assign it a number (1-3). Any of '1', '2', or '3' may be set to OFF; histograms are only generated for the numbers with results assigned to them. For example, BPVs can be assigned to '1', and FRMR assigned to '3', while '2' may be set to OFF. Histograms are only generated for BPVs and FRMR

PRINT:EVENT:HISTOGRAM: SAMPLES [5-60] select the number of samples for automatic histograms (i.e., the number of samples that are collected before a printout is generated automatically). Any number within the range 5-60 can be specified

PRINT:EVENT:HISTOGRAM:VSCALE: [1|2|3],(scale) select the vertical scale for the histogram number specified. The (scale) can be any of the following: **10, 20, 50, 100, 200, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M, 5M, 10M, 20M, 50M, AUTO**

PRINT:EVENT:HISTOGRAM: FORMAT? requests the current histogram format

PRINT:EVENT:HISTOGRAM: PERIOD? requests the current sampling period

PRINT:EVENT:HISTOGRAM:RESULT? [1|2|3] requests the current result to be histogrammed by number (1-3)

PRINT:EVENT:HISTOGRAM: SAMPLES? requests the current number of samples for automatic histograms

PRINT:EVENT:HISTOGRAM:VSCALE? [1|2|3] requests the current vertical scale for the histogram number specified (1-3)

The **PRINT:EVENT:HISTOGRAM:RESULT** command allows the selection of up to 3 results by number (1-3). The (result) can be set **OFF** or to any of the following:

Table 4-13
Histogram Results

1SEC_CRC	one-second CRC errors	**FEBE_S_A**	far end bit errored seconds (Type A)
AVL_SEC	available seconds	**FEBE_S_B**	far end bit errored seconds (Type B)
BIT_ERRS	bit errors	**FEBE_S_C**	far end bit errored seconds (Type C)
BLK_ERRS	block errors	**FRA_ERR**	frame error
BLOCKS	block errors	**G_EFS**	G.821 error-free seconds
BPV_SEC	bipolar violation seconds	**GERR_SEC**	G.821 errored seconds
BPVs	bipolar violations	**MFAS_ERR**	MFAS errors
CHAR_ERR	asynchronous character errors	**PAR_ERR**	parity errors
CODE_ERR	code error	**PAT_LOSS**	pattern synchronization loss
CPAR_ERR	C-bit parity errors	**PAT_SLIP**	pattern slip
CPE_S_A	C-bit errored seconds (type A)	**PATL_SEC**	pattern loss seconds
CPE_S_B	C-bit errored seconds (type B)	**REBE**	remote end block errors
CPE_S_C	C-bit errored seconds (type C)	**SES**	severely errored seconds
CRC_ERR	cyclic redundancy check error	**T16AIS_S**	timeslot 16 AIS seconds
DEG_MIN	degraded minutes	**UNA_SEC**	unavailable seconds
ERR-SES	bit errors minus severely errored seconds		
FAS_ERR	frame alignment signal error		
FEBE	far end bit errors		

Examples:

>PRINT:PRINTER EVENT enable printer output according to criteria defined in a **PRINT:EVENT** command. (Note: **PRINT:PRINTER AUX** can be used in place of **PRINT:PRINTER EVENT**. The command action is the same.)

>PRINT:EVENT? request the current print event
HISTOGRAM

>PRINT:EVENT ERROR set the print event to ERROR

>PRINT:EVENT:ERROR? BPVS requests the status of print events caused by bipolar violations
OFF bipolar violations currently do not generate print events

>PRINT:EVENT:ERROR BPVS,ON — enable printouts during the occurrence of BPVs

>PRINT:EVENT TIMED — set the print event to TIMED

>PRINT:EVENT:TIMED?
00:15 — requests the current interval between timed print events; the interval is currently 15 minutes

>PRINT:EVENT:TIMED "01:30" — set the interval between timed print events to 1.5 hours

>PRINT:EVENT HISTOGRAM — set the print event so that HISTOGRAMS are generated

>PRINT:EVENT:HISTOGRAM:RESULT 1,BIT_ERRS — assign bit errors as histogram 1

>PRINT:EVENT:HISTOGRAM:PERIOD?
15MIN — requests the current histogram sampling period

>PRINT:EVENT:HISTOGRAM:PERIOD 1DAY — the new histogram sampling period is 1 day

>PRINT:EVENT:HISTOGRAM:SAMPLES 5 — a new histogram is generated automatically after every five sampling periods

>PRINT:EVENT:HISTOGRAM:VSCALE? 1
100 — requests the current vertical scale for histogram 1

>PRINT:EVENT:HISTOGRAM:VSCALE 1,AUTO — the new vertical scale is chosen automatically; the vertical axis is scaled to include the largest histogram sample

>PRINT:EVENT:HISTOGRAM:FORMAT GRAPH — select a histogram graph

>PRINT:EVENT:HISTOGRAM 1
HISTOGRAM GRAPH — print histogram 1; this is a manual printout, since it is generated by direct command rather than by the FIREBERD reading the selected number of samples

MODE

Select Fast or Slow Print Mode — **command/query**

PRINT:MODE [FAST|SLOW] — set the printer mode. FAST enables printing as fast as the FIREBERD can print; SLOW sets the print speed to no more than 20 characters per second with an additional one-half second delay at the end of each printed line

PRINT:MODE? — requests the current print mode

This remote control command functions the same as the **MODE** softkey that is available on the **Auxiliary** function **PRINTER** on the FIREBERD front panel.

Example:

>PRINT:MODE?	requests the current print mode setting
SLOW	
>PRINT:MODE FAST	change the print mode to fast

PRINTER

Enable/Disable Printer Output — command/query

PRINT:PRINTER [OFF | 15MIN | 1HOUR | ERROR | AUX | EVENT]	enable or disable printer output, and set the trigger for the output
PRINT:PRINTER?	requests the current state of printer output. If either **AUX** or **EVENT** is currently selected, the query returns **EVENT**

This remote control command provides the same function as the front panel **Print Event** switch:

OFF disables almost all print functions and clears the print buffer. When **OFF** is selected, no printouts are generated except those specifically requested by the **PRINT:RESULTS** or **PRINT:CONTROLS** commands. Automatic results printouts (error, timed, or histogram) and status message printouts are both suppressed.

15MIN and **1HOUR** instruct the FIREBERD to print test results every 15 minutes or every hour, respectively. The degree of detail in the printed results is determined by the **PRINT:RESULTS:TYPE** command. (To set time intervals other than 15 minutes or one hour set **PRINT:PRINTER** to **EVENT**, and use the **PRINT:EVENT ERROR** command.)

ERROR enables the printing of 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, or pattern slips. Printouts are generated every six hours. The degree of detail in the printed results is determined by the **PRINT:RESULTS:TYPE** command. (To custom control the set of error triggers, set **PRINT:PRINTER** to **EVENT** and use the **PRINT:EVENT ERROR** command.)

AUX and **EVENT** both instruct the FIREBERD to print according to the custom criteria defined by the **PRINT:EVENT** command.

Example:

>PRINT:PRINTER?	requests the current print mode setting
OFF	
>PRINT:PRINTER 15MIN	enable printer output every 15 minutes
>PRINT:PRINTER AUX	enable printer output according to criteria defined in a **PRINT:EVENT** command. (Note: **PRINT:PRINTER EVENT** could be used in place of **PRINT:PRINTER AUX**. The command action is the same.)
>PRINT:EVENT TIMED	sets the print event trigger to TIMED
>PRINT:EVENT:TIMED "00:17"	sets the time interval for printing to 17 minutes
>PRINT:PRINTER?	requests the current print mode setting
EVENT	"EVENT" is the reply whether the printer has been set by the user to **EVENT** or **AUX**
>PRINT:EVENT TIMED?	requests the current timed print event setting
"00:17"	

RESULTS

Results Printouts — command/query

PRINT:RESULTS? — send a results printout to the selected RC device

PRINT:RESULTS — send a results printout to the currently selected printer

PRINT:RESULTS:TYPE [SUMMARY|STD|LONG] — select a results printout format. SUMMARY prints an abbreviated list of key results; STD (Standard) and LONG prints progressively print more comprehensive test results. See Section 3 of this manual for listings of the results printed for each format

PRINT:RESULTS:TYPE? — requests the current results printout format

This series of commands and queries is dedicated to results printouts. A results print is a hard copy of the results accumulated by the FIREBERD 4000. The RC device and the printer are determined by using the **INTF:SELECT** and **PRINT:DEVICE** commands, respectively.

NOTE: When the printer is set to Remote (by **PRINT:DEVICE REMOTE**), the printout is sent to an internal remote control buffer and is not sent to an external printer. The remote control buffer is accessed by sending **STATUS:PRINT?** query. This causes the printout information to be sent to the RC device.

Example:

>PRINT:RESULTS_TYPE LONG — select long results printout

>PRINT:RESULTS? — requests the long results printout be generated and sent to the RC device

. — a results print is sent to your terminal or computer

>PRINT:RESULTS — sends a long results printout to the printer

STATUS

Status Printouts — command/query

PRINT:STATUS [OFF|ON] — Enabling the status event (i.e., turning it ON) allows status messages to be generated when specific conditions occur. These conditions are: PATTERN SYNC LOSS, PAT SYNC ACQUIRED, FRAME SYNC LOSS, DATA LOSS, CLOCK LOSS, SIGNAL LOSS, and POWER UP

PRINT:STATUS? — requests the current state of status printouts

This remote control command offers the same function as the **Auxiliary** function **STATUS PRINT** that is available by the SETUP panel when the FIREBERD is controlled from the front panel. Note that status printouts are only generated when the **PRINT:PRINTER** command is in any of its "ON" conditions **[15MIN, 1HOUR, ERROR, AUX, EVENT]**, (i.e., the FIREBERD 4000 print capability is enabled.)

Example:

>PRINT:STATUS? SYNC_LOSS	requests the current state of status printouts
ON	the current state is enabled
>PRINT:STATUS OFF	disable status prints

TERM

Line Terminator — command/query

PRINT:TERM [CR|LF|CRLF]	set the line terminator sequence that is transmitted at the end of each printed line. Valid line terminators are carriage return (CR), linefeed (LF), and carriage return/ linefeed pair (CRLF)
PRINT:TERM?	requests the currently selected line terminator

This remote control command is identical in function to the TERM softkey that is available by the **Auxiliary** function **PRINTING** on the FIREBERD front panel.

Example:

>PRINT:TERM LF	set the line terminator to line feed
>PRINT:TERM?	requests the current line terminator
LF	

WIDTH

Printout Width — command/query

PRINT:WIDTH [20|40|80]	set the number of characters per line; 20, 40, or 80 characters can be specified. Note that the width should be set for the line length of the printer or CRT being used
PRINT:WIDTH?	requests the current printer width

This remote control command functions the same as the **WIDTH** softkey that is available on the **Auxiliary** function **PRINTING** on the FIREBERD front panel.

Example:

>PRINT:WIDTH 40 set width to 40 characters

>PRINT:WIDTH? requests the current line width
40

REMOTE CONTROL COMMANDS

REMOTE CONTROL commands are used to set FIREBERD 4000 functions that are not grouped with other commands.

The REMOTE CONTROL commands and queries are:

Commands	Queries
LOCAL	
LOCKOUT	LOCKED?
RC_MODE	RC_MODE?
UNLOCK	

LOCAL

Local Mode **command**

LOCAL returns the FIREBERD 4000 to local mode and makes the front panel switches active. The FIREBERD remains in local mode until it receives a valid remote control command or query from the controller

This command is not valid when using the IEEE-488 Interface. When the IEEE-488 Interface is used, the Go-To-Local (GTL) bus-level command performs a similar function. See your controller documentation.

Example:

>LOCAL enter local (front panel) mode

LOCKOUT

Front-Panel Lockout (RS-232 Only) **command**

LOCKOUT lock out the front panel

UNLOCK enables the ENTER key on the FIREBERD 4000 MENU keypad. When pressed, the ENTER key returns the FIREBERD to front panel control. This command does not directly enable all front panel controls

LOCKED? requests the current front panel lock-out status. Displays the current status of this command ON indicates the front panel is completely disabled; OFF indicates that the ENTER key can be pressed to restore front panel operation

The **LOCKOUT** command disables all FIREBERD 4000 front panel control so that it is not possible to affect a test from the front panel. Note that the ANALYSIS RESULTS panel can still be controlled by the user. ANALYSIS RESULTS allows a user working at the site of the FIREBERD to directly monitor available test results without modifying the test setup.
See the **LOCAL** command.

These commands are not valid when using the IEEE-488 Interface. When the IEEE-488 Interface is used, the bus-level local-lockout (LLO) command performs a similar function. See your controller documentation.

Example:

>LOCKOUT	the front panel is disabled
>LOCKED? ON	check the locked state
>UNLOCK	press the ENTER key on the front panel to restore front panel operation

RC_MODE

Remote Control Mode **command/query**

RC_MODE [TERMINAL|COMPUTER]	place the FIREBERD in terminal or computer mode
RC_MODE?	requests the current remote control mode

When using the RS-232 Remote Control Interface, the **RC_MODE** command places the FIREBERD 4000 in either terminal or computer remote control mode. Computer mode is specified when using a programmed controller; terminal mode is specified when using a dumb terminal. In computer mode an executable program runs the FIREBERD by remote control; such an arrangement is often used for automated monitoring of system performance. In terminal mode the FIREBERD prompts the user for a command with an arrow (>) on the terminal display. The user types in a FIREBERD command at the prompt, and the FIREBERD executes the command upon receiving a valid line terminator, and then issues another prompt.

Example:

>RC_MODE? TERMINAL	requests the remote control mode
>RC_MODE COMPUTER	place the FIREBERD 4000 in computer mode

NOTE: When using the RS-232 Printer/Controller Interface, a CTRL-C (Control C) places the FIREBERD 4000 in the terminal mode, as does the **RC_MODE TERMINAL** command.

RESULT

The RESULT commands and queries are used to retrieve test results. In addition to the basic ability to query individual measurements, it is also possible to capture all of the results that are available in a single test.

The RESULTS commands and queries are:

Commands	Queries
RESULT:CLEAR	
	RESULT?
RESULT:DISPLAY:HOLD	RESULT:DISPLAY:HOLD?
RESULT:DISPLAY	RESULT:DISPLAY?
	RESULT:HELD?
RESULT:HOLD	
RESULT:RESTART	

NOTE: For a listing of all possible result names, see the discussion following the **RESULT?** query.

CLEAR

Clear Result — command

RESULT:CLEAR clears all test result values without forcing the FIREBERD to resynchronize with the circuit being tested. Communication between the FIREBERD and the test circuit continue without interruption. Immediately after the command is issued the FIREBERD resumes the accumulation of result values

To completely restart a test (i.e., initialize communications, synchronize signals, perform all required handshaking, etc.), use the **RESULT:RESTART** command.

Example:

>**RESULT:CLEAR** clear all test result values

DISPLAY

Control Results Display — command/query

RESULT:DISPLAY [1|2],(result_name) show the specified (result_name) in the left or right results display (1 or 2, respectively) on the FIREBERD front panel

RESULT:DISPLAY? [1|2] requests the name of the result currently shown in the left or right results display on the FIREBERD front panel

For a listing of all possible result names see the discussion following the **RESULT?** query.

Example:

>RESULT:DISPLAY? 1 requests the result in the left results display
BIT_ERRS

>RESULT:DISPLAY 1,BER display the current BER in the left results display

A listing of all possible results that can be displayed on the front panel is shown in Table 4-14.

Table 4-14
Results Displayed on the Front Panel

Result Command	Not-Ready Values	Result Description
%AVL_SEC	"NOT READY"	Percent Available Seconds
%DEG_MIN	"NOT READY"	Percent Degraded Minutes
%EFS	"NOT READY"	Percent of Error-Free Seconds
%SES	"NOT READY"	Percent Severely Errored Seconds
+_LVL_DB	"NOT READY"	Positive Level in Decibels
+_LVL_V	"NOT READY"	Positive Level in Volts
+_WNDR	"NOT READY"	Positive Wander
-_LVL_DB	"NOT READY"	Negative Level in Decibels
-_LVL_V	"NOT READY"	Negative Level in Volts
-_WNDR	"NOT READY"	Negative Wander
15m_WNDR	"NOT READY"	15 Minute Wander
24h_WNDR	"NOT READY"	24 Hour Wander
1SEC_CRC	-1	One-Second CRC Errors
AVG_BER	-1.0E+0	Average Bit Error Rate
AVG_BLER	-1.0E+0	Average Block Error Rate
AVG_BPVR	-1.0E+0	Average Bipolar Violation Rate
AVG_CER	-1.0E+0	Average Code Error Ratio
AVG_CPER	-1.0E+0	Average C-bit Parity Error Rate
AVG_CRC	-1.0E+0	Average CRC Errors
AVG_FAS	-1.0E+0	Average Frame Alignment Signal Error Rate
AVG_FEBE	-1.0E+0	Average Far End Block Error Rate
AVG_FER	-1.0E+0	Average Frame Error Rate
AVG_MFAS	-1.0E+0	Average Multiframe Alignment Signal Error Rate
AVG_PER	-1.0E+0	Average Parity Error Rate

Table 4-14
Results Displayed on the Front Panel (Continued)

Result Command	Not-Ready Values	Result Description
AVG_REBE	-1.0E+0	Average Remote End Block Errors
AVL_SEC	-1	Available Seconds
BER	-1.0E+0	Bit Error Rate
BER-SES	-1.0E+0	Bit Error Rate Minus Severely Errored Seconds
BIT_ERRS	-1	Bit Errors
BIT_SLIP	-1	Bit Slips
BLK_ERRS	-1	Block Errors
BLOCKS	-1	Blocks
BPV_%EFS	-1.0E+0	Bipolar Violation Percent Error Free Seconds
BPV_RATE	-1.0E+0	Bipolar Violation Rate
BPV_SEC	-1	Bipolar Violation Seconds
BPVS	-1	Bipolar Violations
CER	-1.0E+0	Code Error Rate
CHAR_ERR	-1	Asynchronous Character Errors
CODE_ERR	-1	Code Errors
CPAR_ERR	-1	C-bit Parity Errors
CPE_S_A	-1	C-bit Parity Errored Seconds (Type A)
CPE_S_B	-1	C-bit Parity Errored Seconds (Type B)
CPE_S_C	-1	C-bit Parity Errored Seconds (Type C)
CRC_ERR	-1	CRC Errors
DAT_RATE	-1.00	Data Rate
DATE	"NOT READY"	Date
DEG_MIN	-1	Degraded Minutes
DELAY	"NOT READY"	Delay
ELAP_SEC	-1	Elapsed Seconds
ERR-SES	-1	Errors Minus Severely Errored Seconds
ERR_SEC	-1	Errored Seconds
FAS_ERR	-1	Frame Alignment Signal Errors
FEBE	-1	Far End Block Errors
FEBE_S_A	-1	Far End Block Errored Seconds (Type A)
FEBE_S_B	-1	Far End Block Errored Seconds (Type B)
FEBE_S_C	-1	Far End Block Errored Seconds (Type C)
FRA_ERR	-1	Frame Errors
G_%EFS	"NOT READY"	G.821 Percent Error Free Seconds
G_EFS	-1	G.821 Error Free Seconds
GEN_FREQ	"NOT READY"	Generator Clock Frequency
GERR_SEC	-1	G.821 Errored Seconds
INTERFACE	"NOT READY"	Interface Label
LVL_DBM	"NOT READY"	Power Level of All-Ones Signal in dBm
MAX_ZERO	-1	Maximum Consecutive Zeros
MFAS_ERR	-1	Multiframe Alignment Signal Word Errors
PAR_ERR	-1	Parity Errors
PAT_LOSS	-1	Pattern Sync Loss Count
PAT_SLIP	-1	Pattern Slips
PATL_SEC	-1	Pattern Sync Loss Seconds
PP_LVL_V	"NOT READY"	Peak-to-Peak Level in Volts
PP_WNDR	"NOT READY"	Peak-to-Peak Wander
R_LVL_DB	-1.00	Receiver Signal Level in Decibels
R_LVL_V	-1.00	Receiver Signal Level in Volts
RCV_BOM	"NOT READY"	Received Bit-Oriented Message
RCV_BYTE	"NOT READY"	Receive Byte
RCV_CODE	"NOT READY"	Receive Code

Table 4-14
Results Displayed on the Front Panel (Continued)

Result Command	Not-Ready Values	Result Description
RCV_FAS	"NOT READY"	Received Frame Alignment Signal Word
RCV_FEAC	"NOT READY"	Received FEAC Code
RCV_FREQ	"NOT READY"	Receiver Clock Frequency
RCV_MFAS	"NOT READY"	Received Multiframe Alignment Signal Word
RCV_NFAS	"NOT READY"	Received Not Frame Alignment Signal Word
REBE	-1	Remote End Block Errors
RX_ABCD	"NOT READY"	DS0 ABCD Signal
RX_X1_X2	"NOT READY"	Received X Bits
SELF_LOOP	"NOT READY"	Self Loop
SES	-1	Severely Errored Seconds
SMPX_CUR	"NOT READY"	Simplex Current
T16AIS_S	-1	Timeslot 16 AIS Seconds
TEST_SEC	-1	Test Seconds
TIME	"NOT READY"	Time
TIME_DATE	"NOT READY"	Time and Date
UNA_SEC	-1	Unavailable Seconds

DISPLAY:HOLD

Control Display Hold **command/query**

RESULT:DISPLAY:HOLD [ON|OFF] turn display hold ON or OFF. ON enables display hold; OFF turns display hold off

RESULT:DISPLAY:HOLD? requests the current state of the display hold activity

When **DISPLAY:HOLD** is set to **ON**, the FIREBERD front panel displays the values for analysis results that were in effect when the command was issued. The test in progress continues and updated results are tabulated internally, but are not displayed on the front panel. When **DISPLAY:HOLD** is returned to the **OFF** condition (which is the default), the two front panel results displays are again updated in real-time.

This command is identical in function to the **DISPLAY HOLD** switch, located on the FIREBERD front panel.

NOTE: This command is *not* used to capture the current test results for reading at the remote terminal. To capture results in the RESULTS HOLD buffer use the **RESULT:HOLD** command followed by the **RESULT:HELD?** query.

Example:

>RESULT:DISPLAY:HOLD? requests the current setting
OFF

>RESULT:DISPLAY:HOLD ON enable display hold

HELD

Read Held Results — query

RESULT:HELD? (result_name) read the results that are held in the remote control RESULTS HOLD buffer

The storing of test results is invoked by the **RESULT:HOLD** command. Thus, the **RESULT:HOLD** command must be issued at least once before the **RESULT:HELD?** query is meaningful.

Example:

>RESULT:HOLD store all test results in the RESULTS HOLD buffer

>RESULT:HELD? BIT_ERRS
257 read the number of bit errors that were counted when the **RESULT:HOLD** command was specified

>RESULT? BIT_ERRS
296 show the current bit error count, which has increased since the result hold command was issued

>RESULT:HELD? BIT_ERRS
257 the number of bit errors stored in the RESULTS HOLD buffer is unchanged

>RESULT:HELD? BER-SES
2.08E-3 the displayed value for bit-error-rate-minus-severely-errored-seconds (BER-SES) was recorded at the same instant in time that the value 257 was recorded for bit errors. All results acquired by the **RESULT:HELD?** query were recorded at the same moment

HOLD

Result Hold — command

RESULT:HOLD writes the current test results in the RESULTS HOLD buffer

This allows the user to read test results current at one point in time, without their values changing. (See also: **RESULT:HELD**.)

Example:

>RESULT:HOLD store all test results in the remote control RESULTS HOLD buffer

RESTART

Test Restart **command**

RESULT:RESTART restart a test

The **RESULT:RESTART** command clears all test results and alarms, forces the receiver to resynchronize to the incoming data pattern (i.e., re-establish pattern, frame, and/or clock synchronization), and starts a new test.

This command is identical in function to the **RESTART** switch located on the FIREBERD front panel.

Example:

>RESULT:RESTART restart a test

RESULT

Result Value **query**

RESULT? (result_name) request the current value of the specified result

The **RESULT** query returns the current value of the specified (result_name). All result names are identical to front panel result names, except underscores are used in place of spaces (e.g., **BIT ERRS** on the front panel becomes **BIT_ERRS** for remote control purposes). All possible results are listed in Table 4-15.

Example:

>RESULT? BIT_ERRS requests the current value of bit errors
-1 the returned value indicates the FIREBERD is not ready to report this statistic

>RESULT? BIT_ERRS requests the current value of bit errors
2 two bit errors have occurred up to the time the query was issued

>RESULT? AVG_BER requests the current value of average bit errors
3.E-06

NOTE Some results are only applicable with certain interfaces and/or certain test set-ups (e.g., only with SYNC or only with ASYNC). If the requested result is not applicable in the current test mode, no response is generated and an error occurs. If the result is applicable but "not ready," a special value is returned, as shown in Table 4-15.

Table 4-15
FIREBERD 4000 Results (by category)

Category	Result Command	Not-Ready Values	Result Description
ERROR			
	AVG_BER	-1.0E+0	Average Bit Error Rate
	AVG_BLER	-1.0E+0	Average Block Error Rate
	BER	-1.0E+0	Bit Error Rate
	BIT_ERRS	-1	Bit Errors
	BLK_ERRS	-1	Block Errors
	BLOCKS	-1	Blocks
	CHAR_ERR	-1	Asynchronous Character Errors
	PAT_LOSS	-1	Pattern Sync Loss Count
	PAT_SLIP	-1	Pattern Slips
INTERFACE (only applicable with selected interfaces)			
	1SEC_CRC	-1	One-Second CRC Errors
	AVG_BPVR	-1.0E+0	Average Bipolar Violation Rate
	AVG_CER	-1.0E+0	Average Code Error Ratio
	AVG_CPER	-1.0E+0	Average C-bit Parity Error Rate
	AVG_CRC	-1.0E+0	Average CRC Errors
	AVG_FAS	-1.0E+0	Average Frame Alignment Signal Error Rate
	AVG_FEBE	-1.0E+0	Average Far End Block Error Rate
	AVG_FER	-1.0E+0	Average Frame Error Rate
	AVG_MFAS	-1.0E+0	Average Multiframe Alignment Signal Error Rate
	AVG_PER	-1.0E+0	Average Parity Error Rate
	AVG_REBE	-1.0E+0	Average Remote End Block Errors
	BIT_SLIP	-1	Bit Slips
	BPV_RATE	-1.0E+0	Bipolar Violation Rate
	BPVS	-1	Bipolar Violations
	BPV_SEC	-1	Bipolar Violation Seconds
	CER	-1.0E+0	Code Error Rate
	CODE_ERR	-1	Code Errors
	CPAR_ERR	-1	C-bit Parity Errors
	CRC_ERR	-1	CRC Errors
	FAS_ERR	-1	Frame Alignment Signal Errors
	FEBE	-1	Far End Block Errors
	FRA_ERR	-1	Frame Errors
	MAX_ZERO	-1	Maximum Consecutive Zeros
	MFAS_ERR	-1	Multiframe Alignment Signal Word Errors
	PAR_ERR	-1	Parity Errors
	R_LVL_DB	-1.00	Receiver Signal Level in Decibels
	R_LVL_V	-1.00	Receiver Signal Level in Volts
	RCV_BOM	"NOT READY"	Received Bit-Oriented Message
	RCV_BYTE	"NOT READY"	Receive Byte
	RCV_CODE	"NOT READY"	Receive Code
	RCV_FAS	"NOT READY"	Received Frame Alignment Signal Word
	RCV_FEAC	"NOT READY"	Received FEAC Code
	RCV_MFAS	"NOT READY"	Received Multiframe Alignment Signal Word
	RCV_NFAS	"NOT READY"	Received Not Frame Alignment Signal Word
	REBE	-1	Remote End Block Errors
	RX_ABCD	"NOT READY"	DS0 ABCD Signal
	RX_X1_X2	"NOT READY"	Received X Bits
	SMPX_CUR	"NOT READY"	Simplex Current
	T16AIS_S	-1	Timeslot 16 AIS Seconds

Table 4-15
FIREBERD 4000 Results (by category) (Continued)

Category	Result Command	Not-Ready Values	Result Description
TIME & SIGNAL			
	%EFS	"NOT READY"	Percent of Error-Free Seconds
	+_LVL_DB	"NOT READY"	Positive Level in Decibels
	+_LVL_V	"NOT READY"	Positive Level in Volts
	+_WNDR	"NOT READY"	Positive Wander
	-_LVL_DB	"NOT READY"	Negative Level in Decibels
	-_LVL_V	"NOT READY"	Negative Level in Volts
	-_WNDR	"NOT READY"	Negative Wander
	15M_WNDR	"NOT READY"	15 Minute Wander
	24H_WNDR	"NOT READY"	24 Hour Wander
	BPV_%EFS	-1.0E+0	Bipolar Violation Percent Error Free Seconds
	CPE_S_A	-1	C-bit Parity Errored Seconds (Type A)
	CPE_S_B	-1	C-bit Parity Errored Seconds (Type B)
	CPE_S_C	-1	C-bit Parity Errored Seconds (Type C)
	DAT_RATE	-1.00	Data Rate
	DATE	"NOT READY"	Date
	DELAY	"NOT READY"	Delay
	ELAP_SEC	-1	Elapsed Seconds
	ERR_SEC	-1	Errored Seconds
	FEBE_S_A	-1	Far End Block Errored Seconds (Type A)
	FEBE_S_B	-1	Far End Block Errored Seconds (Type B)
	FEBE_S_C	-1	Far End Block Errored Seconds (Type C)
	GEN_FREQ	"NOT READY"	Generator Clock Frequency
	LVL_DBM	"NOT READY"	Power Level of All-Ones Signal in dBm
	PATL_SEC	-1	Pattern Sync Loss Seconds
	PP_LVL_V	"NOT READY"	Peak-to-Peak Level in Volts
	PP_WNDR	"NOT READY"	Peak-to-Peak Wander
	RCV_FREQ	"NOT READY"	Receiver Clock Frequency
	TEST_SEC	-1	Test Seconds
	TIME	"NOT READY"	Time
PERFORMANCE			
	%AVL_SEC	"NOT READY"	Percent Available Seconds
	%DEG_MIN	"NOT READY"	Percent Degraded Minutes
	%SES	"NOT READY"	Percent Severely Errored Seconds
	AVL_SEC	-1	Available Seconds
	BER-SES	-1.0E+0	Bit Error Rate Minus Severely Errored Seconds
	DEG_MIN	-1	Degraded Minutes
	ERR-SES	-1	Errors Minus Severely Errored Seconds
	G_%EFS	"NOT READY"	G.821 Percent Error Free Seconds
	G_EFS	-1	G.821 Error Free Seconds
	GERR_SEC	-1	G.821 Errored Seconds
	SES	-1	Severely Errored Seconds
	UNA_SEC	-1	Unavailable Seconds

STATUS

The STATUS commands and queries are used to set and read the status reporting registers, queues, and buffers. For additional information see Status Registers, found later in this section.

The STATUS commands and queries are:

command	query
STATUS:CLEAR_ERR	STATUS:ERROR?
STATUS:CLEAR_PRINT	
	STATUS:INTF?
	STATUS:INTF_HIST?
STATUS:INTF_HIST_EN	STATUS:INTF_HIST_EN?
	STATUS:INTF_LOSS?
STATUS:INTF_LOSS_EN	STATUS:INTF_LOSS_EN?
	STATUS:LINE?
	STATUS:LINE_HIST?
STATUS:LINE_HIST_EN	STATUS:LINE_HIST_EN?
	STATUS:LINE_LOSS?
STATUS:LINE_LOSS_EN	STATUS:LINE_LOSS_EN?
	STATUS:PRINT?

Figure 4-4 shows an abbreviated view of the registers, buffers, and queues in the FIREBERD 4000. Note that only the *unshaded* registers and buffers can be read from or written to using the **STATUS** commands. Shaded registers and buffers are addressed by other means (usually IEEE 488.2 common queries or commands, such as ***ESR?**, ***STB?**, ***SRE**, etc.). The contents of the Error Buffer and Remote Control Print Queue can be read using **STATUS** commands; however, it is necessary to read the Status Byte Register (using the ***STB?** query) to determine if printouts or error messages are present.

CLEAR_ERR

Clear Error Buffer — **command**

STATUS:CLEAR_ERR — clear the error message buffer

Example:

>STATUS:ERROR? — requests the latest error message
"ERROR(107): Unrecognized command."

>STATUS:CLEAR_ERR — clear the error message

>STATUS:ERROR? — requests the most recent error message
"No Errors."

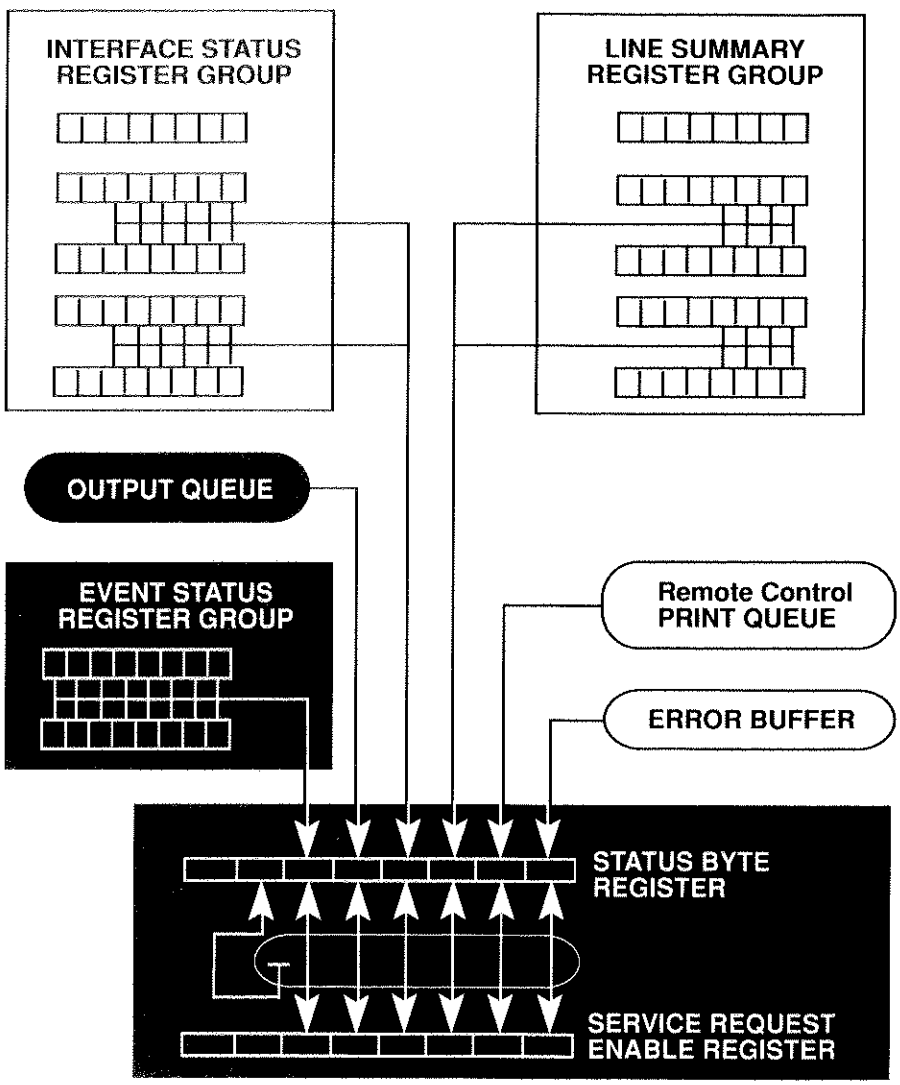

Figure 4-4
Registers and Buffers Addressable by STATUS Commands

CLEAR_PRINT

Clear Print Buffer **command**

STATUS:CLEAR_PRINT clear remote control print buffer

If printouts are sent to an external printer, or if there is no print device (**PRINT:DEVICE NONE**), then the remote control print buffer is always empty. The RC print buffer contains data only if:

1. The **PRINT:DEVICE REMOTE** command has been issued (this command instructs the FIREBERD to send all printouts to its internal RC print buffer); and

2. Either an automatic or manual print has been generated.

Example:

>STATUS:CLEAR_PRINT clear the RC print queue

>STATUS:PRINT? return the next printout in the remote control buffer
"ERROR(219): Print buffer is empty."

ERROR

Error Buffer **query**

STATUS:ERROR? return the most recent error message from the error buffer

A complete list of errors messages is located later in this section. If no errors are present in the error buffer, the message **No Error** is returned. The response is an error message enclosed in double quotes.

NOTES:

1. The error message buffer holds only one message. If a message is in the buffer and a new message comes in, the old message is overwritten. Therefore, it is *not* possible to retrieve a series of error messages by repeatedly issuing the **STATUS:ERROR?** query.

2. In terminal mode the FIREBERD automatically transmits error messages when an execution or command error occurs. In non-interactive computer mode, however, the FIREBERD does not automatically send error messages. The Status Byte Register can be polled to determine if an error message is present, or the MSS interrupt can be used to automatically signal that an error has occurred. Either way, however, the **STATUS:ERROR?** query must be issued to specifically request the error message, if any. See Subsections 1 and 5 of this section for more information on status registers and the MSS interrupt.

Example:

>ASDF ASDF is an unrecognized command
"ERROR(107): Unrecognized command."

>STATUS:ERROR? return the most recent error message
"ERROR(107): Unrecognized command."

INTF

Interface Status Register — query

STATUS:INTF? requests the current value of the Interface Status Register

This register provides the status of various DTE/DCE signaling leads. A 1 in any bit position indicates that the corresponding signaling lead is active. When read, the value returned is the total weight of the bits that are set high. Table 4-16 describes the standard bit settings for this status register, along with their corresponding weight values. This status register is also described in Subsection 5 of this section.

NOTE: The Interface Status Register Group reports on conditions that depend on the currently selected interface. Different interfaces may have different status conditions. The bit settings shown in Tables 4-16 through 4-20 are representations only for the FIREBERD internal interfaces.

Table 4-16
Interface Status Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	DSR/DTR	Set to one when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch is set to ON.
4	16	RLSD/RTS	Set to one when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch is set to ON.
3	8	RL/TM	Set to one when the RL (DCE emulation) or TM (DTE emulation) is set high.
2	4	LL/CTS	Set to one when the LL (DCE emulation) or CTS (DTE emulation) is set high.
1	2	DTR/DSR	Set to one when the DTR (DCE emulation) or DSR (DTE emulation) is set high.
0	1	RTS/RLSD	Set to one when the RTS (DCE emulation) or RLSD (DTE emulation) is set high.

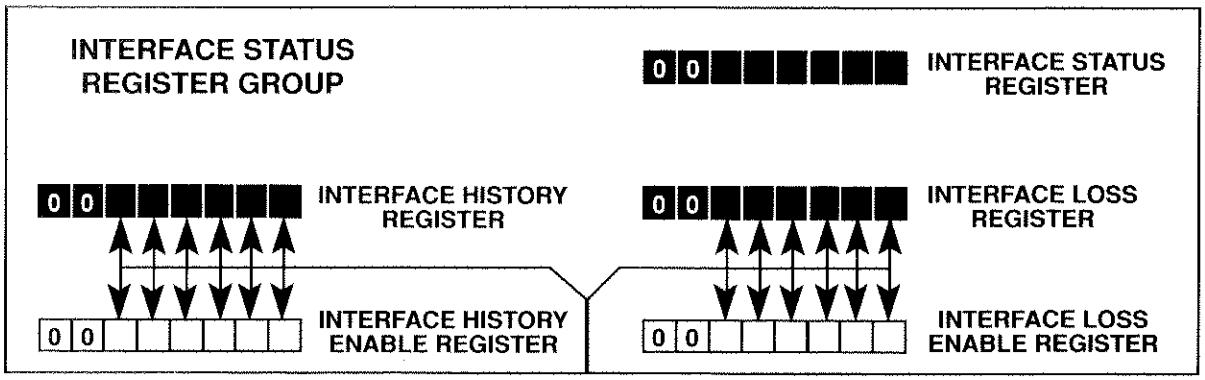

Figure 4-5
The Interface Status Register Group

Example:

>STATUS:INTF? read Interface Status Register
10 assuming the FIREBERD is emulating a DCE, the value of 10 indicates that the DTR and RL signaling leads are set high

INTF_HIST

Interface History Register — query

STATUS:INTF_HIST? requests the current value of the Interface History Register

This register provides a history of DTE/DCE signaling leads that have switched from OFF to ON since this register was last read. When read, the value returned is the total weight of the bits set high (i.e., 1) at the time the byte is read. Reading the register resets all bits to zero. Table 4-17 contains information on each bit and bit weight. The Interface History Register is one of five registers in the Interface Status Group. See Subsection 5 of this section for further information, and also Figure 4-5.

NOTE: Bits that are set to ON or OFF correspond to outgoing leads. These can be configured ON or OFF by the user by means of the appropriate **CONFIG** command. Bits that are set to high or low correspond to incoming leads. The user can determine how the FIREBERD responds to incoming leads by using the **AUX:OUTBAND_FLOW** command.

Table 4-17
Interface History Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	DSR/DTR	Set to one when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch is set from OFF to ON.
4	16	RLSD/RTS	Set to one when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch is set from OFF to ON.
3	8	RL/TM	Set to one when the RL (DCE emulation) or TM (DTE emulation) transitions from low to high.
2	4	LL/CTS	Set to one when the LL (DCE emulation) or CTS (DTE emulation) transitions from low to high.
1	2	DTR/DSR	Set to one when the DTR (DCE emulation) or DSR (DTE emulation) transitions from low to high.
0	1	RTS/RLSD	Set to one when the RTS (DCE emulation) or RLSD (DTE emulation) transitions from low to high.

Example:

>STATUS:INTF_HIST? read Interface History Register
5 assuming the FIREBERD is emulating a DCE, the value of 5 indicates that the RTS and LL signaling leads are set from low to high

INTF_HIST_EN

Set Enable Mask **command/query**

STATUS:INTF_HIST_EN (mask) set the Interface History Enable Register

STATUS:INTF_HIST_EN? return the value of the Interface History Enable Register

The Interface History Enable Register determines how the Interface Event Bit (IEB) of the Status Byte Register is set. The Interface Event Bit is set when corresponding bits in the Interface History Register and the Interface History Enable Register are set to 1.

The Interface History Enable Register contains a mask value for the bits to be enabled in the Interface History Register. Table 4-18 describes the Interface History Enable Status Register. The Interface History Enable Register is one of five registers in the Interface Status Group. See Subsection 5 of this section for further information, and also Figure 4-5.

Table 4-18
Interface History Enable Status Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	DSR/DTR	Set to one when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch is set to from OFF to ON.
4	16	RLSD/RTS	Set to one when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch is set to from OFF to ON.
3	8	RL/TM	Set to one when the RL (DCE emulation) or TM (DTE emulation) transitions from low to high.
2	4	LL/CTS	Set to one when the LL (DCE emulation) or CTS (DTE emulation) transitions from low to high.
1	2	DTR/DSR	Set to one when the DTR (DCE emulation) or DSR (DTE emulation) transitions from low to high.
0	1	RTS/RLSD	Set to one when the RTS (DCE emulation) or RLSD (DTE emulation) transitions from low to high.

Example:

>STATUS:INTF_HIST_EN 7 assuming the FIREBERD is emulating a DTE, the value of 7 enables the CTS, DSR, and RLSD signaling leads (4 + 2 + 1) to set the Interface Enable Bit of the Status Byte Register

>STATUS:INTF_HIST_EN? read the Interface History Enable Register
7 the Interface Enable Bit is set if the CTS, DSR, or RLSD bits are set in the Interface History Register

INTF_LOSS

Read Interface Loss Register — query

STATUS:INTF_LOSS? requests the current value of the Interface Loss Register

This register provides a history of signaling leads that have switched from ON to OFF. A bit is set if this event has occurred since this register was last read. Table 4-19 describes the Interface Lost Register. The Interface Loss Register is one of five registers in the Interface Status Group. See Subsection 5 of this section for further information, and also Figure 4-5.

NOTES: Bits that are set to ON or OFF correspond to outgoing leads. These can be configured by the user by means of the appropriate CONFIG command. Bits that are set to high or low correspond to incoming leads. The user can determine how the FIREBERD responds to incoming leads by using the **AUX:OUTBAND_FLOW** command.

Table 4-19
Interface Loss Status Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	DSR/DTR	Set to one when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch is set to from ON to OFF.
4	16	RLSD/RTS	Set to one when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch is set to from ON to OFF.
3	8	RL/TM	Set to one when the RL (DCE emulation) or TM (DTE emulation) transitions from high to low.
2	4	LL/CTS	Set to one when the LL (DCE emulation) or CTS (DTE emulation) transitions from high to low.
1	2	DTR/DSR	Set to one when the DTR (DCE emulation) or DSR (DTE emulation) transitions from high to low.
0	1	RTS/RLSD	Set to one when the RTS (DCE emulation) or RLSD (DTE emulation) transitions from high to low.

Example:

>STATUS:INTF_LOSS? read Interface Loss Register
20 assuming the FIREBERD is emulating a DTE, the value of 20 (16 + 4) indicates that the RTS and CTS signaling leads were switched from on to off and high to low, respectively, since this register was last read

INTF_LOSS_EN

Set Enable Mask **command/query**

STATUS:INTF_LOSS_EN (mask) set the Interface Loss Enable Register

STATUS:INTF_LOSS_EN? return the value of the Interface Loss Enable Register

The Interface Loss Enable Register determines how the Interface Event Bit (IEB) of the Status Byte Register is set. The Interface Summary Bit is set when corresponding bits in the Interface History Register and the Interface History Enable Register are set.

The Interface Loss Enable Register contains a mask value for the bits to be enabled in the Interface Loss Register. Table 4-20 describes the Interface Loss Enable Register. The Interface Loss Enable Register is one of five registers in the Interface Status Group. See Subsection 5 of this section for further information, and also Figure 4-5.

Table 4-20
Interface Loss Enable Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	DSR/DTR	Set to one when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch is set from ON to OFF.
4	16	RLSD/RTS	Set to one when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch is set to from ON to OFF.
3	8	RL/TM	Set to one when the RL (DCE emulation) or TM (DTE emulation) transitions from high to low.
2	4	LL/CTS	Set to one when the LL (DCE emulation) or CTS (DTE emulation) transitions from high to low.
1	2	DTR/DSR	Set to one when the DTR (DCE emulation) or DSR (DTE emulation) transitions from high to low.
0	1	RTS/RLSD	Set to one when the RTS (DCE emulation) or RLSD (DTE emulation) transitions from high to low.

Example:

>STATUS:INTF_LOSS_EN 7 assuming the FIREBERD is emulating a DTE, the value of 7 enables the CTS, DSR, and RLSD signaling leads to set the Interface Summary Bit (4 + 2 + 1)

>STATUS:INTF_LOSS_EN? read the Interface Loss Enable Register
7 the Interface Summary Bit is set if the CTS, DSR, or RLSD bits are set in the Interface Loss Register

LINE

Line Status Register — query

STATUS:LINE? requests the current value of the Line Status Register

This register provides the current state of various signal indicators. When read, the value returned is the total weight of the bits that are high (i.e., set to 1) at the time the byte is read. Table 4-21 describes each bit in the Line Status Register and its corresponding weight value. The Line Status Register is one of five registers in the Line Summary Register Group. See Subsection 5 of this section for further information on the Line Summary Register Group, and also Figure 4-6.

Table 4-21
Line Status Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	—	Not used. Always set to zero.
4	16	RCV DATA INV	Set to one when inverted data is received.
3	8	GEN CLK PRES	Set to one when generated clock is present.
2	4	PATTERN SYNC	Set to one when pattern sync is achieved.
1	2	FRAME SYNC	Set to one when frame sync is achieved.
0	1	SIGNAL PRESENT	Set to one when signal activity is detected at the input.

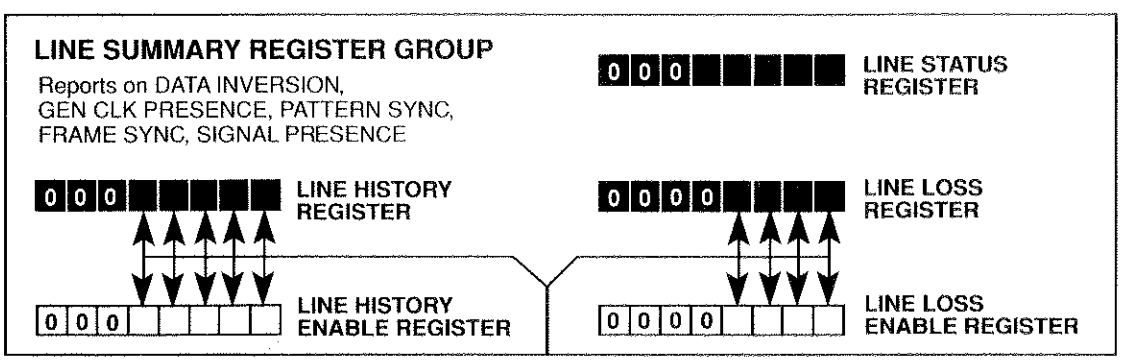

Figure 4-6
The Line Summary Register Group

Example:

>STATUS:LINE? read line status register
21 the value of 21 indicates that the FIREBERD 4000 is receiving inverted data, is in pattern sync, and detects signal presence (21 = 16 + 4 + 1)

LINE_HIST

Line History Status Register **query**

STATUS:LINE_HIST? requests the value of the Line History Register

This register provides a history of signal indicators that have switched from off to on since this register was last read. When read, the value returned is the total weight of the bits that are high (i.e., set to 1). Reading the register resets all bits to zero. Table 4-22 contains information on each bit and bit weight in the Line History Status Register. The Line History Register is one of five registers in the Line Summary Register Group. See Subsection 5 of this section for further information on the Line Summary Register Group, and also Figure 4-6.

Table 4-22
Line History Status Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	—	Not used. Always set to zero.
4	16	RCV DATA INV	Set to one when inverted data is received.
3	8	GEN CLK PRES	Set to one when generated clock is present.
2	4	PATTERN SYNC	Set to one when pattern sync is achieved.
1	2	FRAME SYNC	Set to one when frame sync is achieved.
0	1	SIGNAL PRESENT	Set to one when signal activity is detected at the input.

Example:

>STATUS:LINE_HIST? read the line history register
29 the value 29 indicates that the FIREBERD received inverted data, detected generator clock presence, achieved pattern sync, and detected signal presence since this register was last read (29 = 16 + 8 + 4 + 1)

LINE_HIST_EN

Set Enable Mask **command/query**

STATUS: LINE_HIST_EN (mask) set the Line History Enable Register

STATUS: LINE_HIST_EN? return the value of the Line History Enable Register

The Line History Enable Register determines how the Line Enable Bit (LEB) of the Status Byte Register is set. The Line Enable Bit is set when corresponding bits in the Line History Register and the Line History Enable Register are set.

The Line History Enable Register contains a mask value for the bits to be enabled in the Line History Register. Table 4-23 describes the Line History Enable Register. The Line History Enable Register is one of five registers in the Line Summary Register Group. See Subsection 5 of this section for further information on the Line Summary Register Group, and also Figure 4-6.

Table 4-23
Line History Enable Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	—	Not used. Always set to zero.
4	16	RCV DATA INV	Set to one when inverted data is received.
3	8	GEN CLK PRES	Set to one when generated clock is present.
2	4	PATTERN SYNC	Set to one when pattern sync is achieved.
1	2	FRAME SYNC	Set to one when frame sync is achieved.
0	1	SIGNAL PRESENT	Set to one when signal activity is detected at the input.

Example:

>STATUS:LINE_HIST_EN 6 the value of 6 enables pattern sync and frame sync to set the Line Enable Bit (4 + 2)

>STATUS:LINE_HIST_EN? read Line History Enable Register
6 the Line Enable Bit is set if the pattern sync or frame sync bits are set in the Line History Register

LINE_LOSS

Read Line Loss Register — query

STATUS:LINE_LOSS? requests the current value of the Line Loss Register

This register provides a history of signal loss, synchronization loss, and generated clock loss. A bit is set if any of these events have occurred since the register was last read. Table 4-24 describes the Line Loss Status Register. The Line Loss Register is one of five registers in the Line Summary Register Group. See Subsection 5 of this section for further information on the Line Summary Register Group, and also Figure 4-6.

Table 4-24
Line Loss Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	—	Not used. Always set to zero.
4	16	—	Not used. Always set to zero.
3	8	GEN CLK LOSS	Generated clock was lost since this register was last read.
2	4	PATTERN SYNC LOSS	Pattern synchronization was lost since this register was last read.
1	2	FRAME SYNC LOSS	Frame synchronization was lost since this register was last read.
0	1	SIGNAL LOSS	Signal presence was lost since this register was last read.

Example:

>STATUS:LINE_LOSS? read the line loss register
14 the value 14 indicates that the FIREBERD lost the generator clock, pattern synchronization, and frame synchronization since this register was last read (14 = 8 + 4 + 2)

LINE_LOSS_EN

Set Enable Mask — command/query

STATUS:LINE_LOSS_EN (mask) set the Line Loss Enable Status Register

STATUS:LINE_LOSS_EN? return the value of the Line Loss Enable Status Register

The Line Loss Enable Register determines how the Line Enable Bit (LEB) of the Status Byte Register is set. The Line Enable Bit is set when corresponding bits in the Line History Register and the Line History Enable Register are set.

The Line Loss Enable Register contains a mask value for the bits to be enabled in the Interface History Register. Table 4-25 describes the Line Loss Enable Register. The Line Loss Enable Register is one of five registers in the Line Summary Register Group. See Subsection 5 of this section for further information on the Line Summary Register Group, and also Figure 4-6.

Table 4-25
Line Loss Enable Register

Bit	Weight	Name	Meaning
7	128	—	Not used. Always set to zero.
6	64	—	Not used. Always set to zero.
5	32	—	Not used. Always set to zero.
4	16	—	Not used. Always set to zero.
3	8	GEN CLK LOSS	Generated clock was lost since this register was last read.
2	4	PATTERN SYNC LOSS	Pattern synchronization was lost since this register was last read.
1	2	FRAME SYNC LOSS	Frame synchronization was lost since this register was last read.
0	1	SIGNAL LOSS	Signal presence was lost since this register was last read.

Example:

>STATUS:LINE_LOSS_EN 11 — the value of 11 (8 + 2 + 1) enables the following conditions to set the Line Enable Bit: generated clock loss, loss of frame sync, and signal loss

>STATUS:LINE_LOSS_EN? — read Line History Enable Register
11 — the Line Enable Bit is set if any of the following are set in the Line Loss Register: generated clock loss, loss of frame sync, or signal loss

PRINT

Remote Control Print Buffer — query

STATUS:PRINT? — return the next printout in the remote control print buffer

Example:

>PRINT:DEVICE REMOTE — enable printing to remote control print buffer

>PRINT:CONTROLS — print controls printout

>*STB? — requests the value of the Status Byte Register
10 — the value 10 (8 + 2) indicates that the PAV and IEB bits are set to 1 in the Status Byte Register. The bit of interest is the PAV, or 'Print Available' bit. Since it is set to 1, we know there is a printout waiting for us in the remote control print buffer.

>STATUS:PRINT? — obtain printout from remote control print buffer
.
.
. — a controls print is printed at your terminal

4.5 STATUS REPORTING

The FIREBERD 4000 uses a set of internal registers, queues, and buffers to store information about test status, line conditions, alarms, error conditions, and printer data. This information can be accessed using some of the FIREBERD queries. There are four register groups and three buffers/queues in the FIREBERD 4000 (see Figure 4-7):

- Status Byte Register Group – Summarizes the status of all the other registers and buffers/queues; contains one *summary bit* for each of the six registers and buffers listed below.
- Event Status Register Group – Reports on Power On, Command Errors, Execution Errors, Query Errors, and Operation Complete.
- Line Summary Register Group – Reports on DATA INVERSION, GEN CLK, PATTERN SYNC, FRAME SYNC, and SIGNAL PRESENCE.
- Interface Status Register Group – Reports on DSR/DTR, RLSD/RTS, RL/TM, LL/CTS, DTR/DSR, and RTS/RLSD.
- Output Queue – Holds the FIREBERD response to all queries.
- Print Queue – Holds data for printer, if printer device has been set to REMOTE.
- Error Buffer – Holds error messages.

4.5.1 Register Groups

The FIREBERD 4000 has four groups of registers: Status Byte Registers, Event Status Registers, Line Status Registers, and Interface Status Registers. These register groups capture a variety of specific events; equally important, they enable the programmer to determine which events alert the controller that something has happened.

Within each register group there are two distinct classes of registers:

- Status, history, and loss registers. These are updated by the FIREBERD, and record events and changes of status. Each register is composed of 8 bits representing up to 8 events. Status registers convey present signal status; when a specific event occurs the corresponding status register bit is set to 1. History and loss registers report changes that have occurred since these registers were last read. A history bit is set to 1 when a signal is switched from OFF to ON; a loss bit is set to 1 when a signal is switched from ON to OFF.

  Status, history, and loss registers can be read by the controller, and so provide the user with information about the test in progress. These registers cannot be written to by the controller.

- Enable registers. These can be written to — and therefore configured — by the controller. Enable registers allow the user to decide which of the events alert the controller. Specifically, the enable registers determine which events set the Master Status Summary (MSS) bit in the Status Byte Register.

  In IEEE-488 mode, setting the MSS bit causes the FIREBERD to assert the SRQ line, triggering an interrupt in the controller. In RS-232 Computer and Terminal Modes, the Status Byte Register can be polled to see if the MSS has been set to 1; if so, further polling can determine the specific event(s) that set the bit.

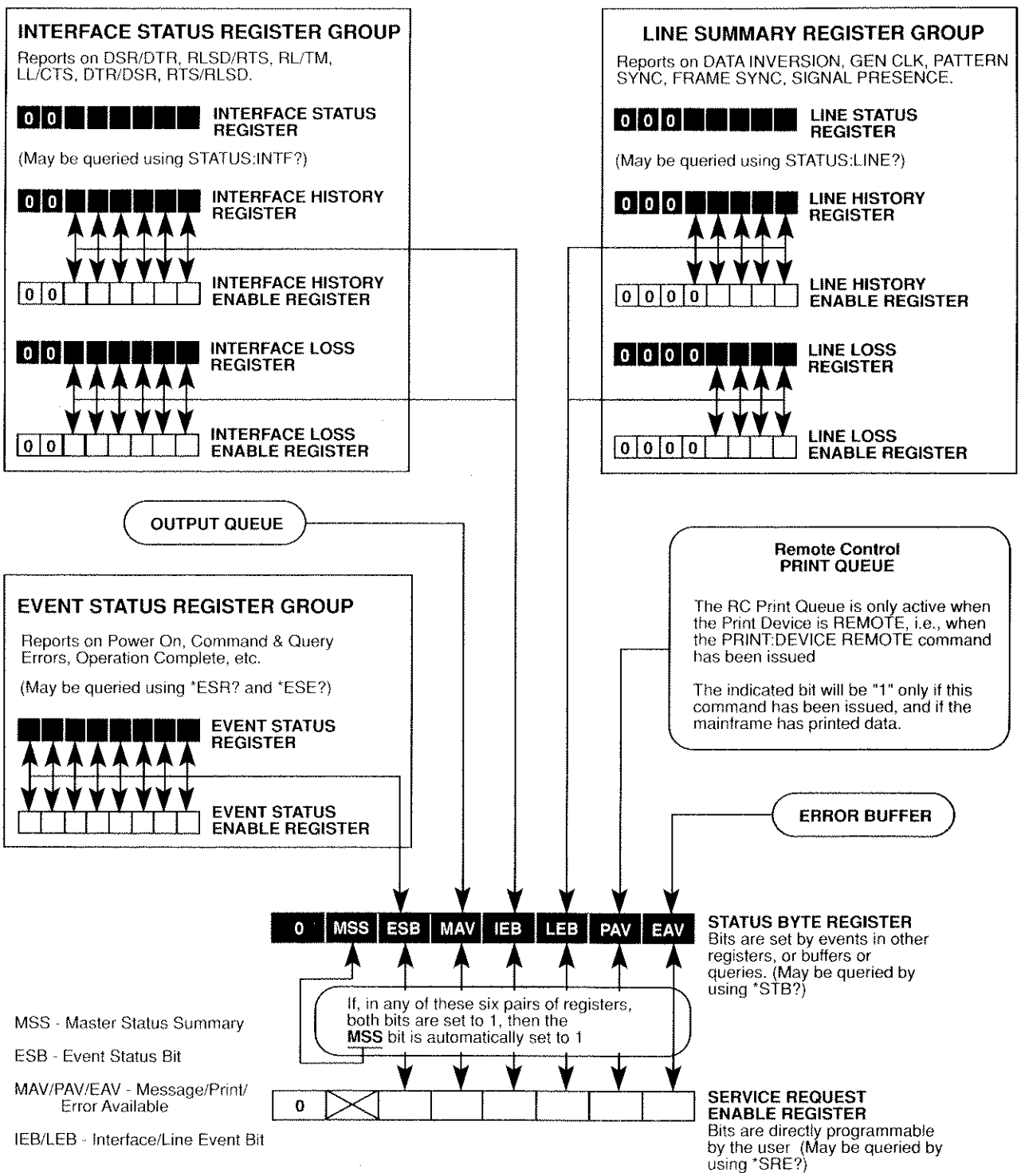

Figure 4-7
FIREBERD 4000 Registers

From the programmer's standpoint, the goal is to configure the registers so that events of interest set the MSS bit. This is a two-stage process:

1. Decide upon the specific event(s) of interest, and set the corresponding enable register bit(s) to 1 in the appropriate register group (Interface Status, Event Status, or Line Summary Register Group).
   In essence, the register bits exist in pairs for each kind of event:

   - a history or loss bit that can be set by the FIREBERD; and
   - and a corresponding enable bit that can be set by the user.

   If, within a register group, *both* bits in a pair are set to 1—indicating that the event has occurred, and that the user wishes to be notified of the event—then the FIREBERD sets a corresponding summary bit for that register group in the Status Byte Register.

2. For the register groups of interest, set the corresponding summary enable bit in the Service Request Enable Register.

   The Status Byte Register Group has one pair of bits for each of the other three register groups (Interface Status, Event Status, and Line Summary Register Groups). The first bit in each pair is a summary bit which can be set to 1 by the FIREBERD, as indicated above. The second bit in the pair is an enable bit, which the user sets to 1 to indicate that the entire register group is of interest.

   If *both* a summary bit and its matching enable bit are set to 1 — indicating that an event has been recorded in a register group, and that the user wishes to be notified of the event — then the Master Status Summary bit is set to 1.

In IEEE-488 Mode, when the MSS is set to 1 the FIREBERD asserts the SRQ interrupt; in RS-232 Mode the condition of the MSS bit can be determined by polling (i.e., by periodically reading the Status Byte Register). Once it is determined that an event has occurred, the controller can read the Status Byte Register to learn which of the other registers (or buffers) recorded an event. The appropriate register or buffer can then be read for more specific information.

For more information on reading registers and setting enable bits, see the **STATUS** commands and **488 COMMON** commands in Subsection 4.4 of this section. For information on having the controller respond to the SRQ interrupt in IEEE-488 mode, see Subsection 4.1 of this section.

An Example of Registers Operation

In Figure 4-8, the controller has written the value 36 to the Interface History Enable Register, setting bits 2 and 5 in the register. This indicates that the user (or application program) should be informed when the DSR/DTR or LL/CTS lines are asserted. Since bit 5 of both the Interface History Register and the Interface History Enable Register have been set by the FIREBERD, the corresponding summary bit (IEB) is set in the Status Byte Register.

Further, the controller has written the value 41 to the Service Request Enable Register, setting bits 0, 3, and 5. Since bit 3 in the enable register is paired with the IEB, and both are set to 1, the MSS bit is set to 1 in the Status Byte Register.

This process is duplicated with each group of registers until all of the summary information is directed to the Status Byte Register. The information contained in the Status Byte Register enables the SRQ signal on the IEEE-488 bus. In this way, programmers can have the FIREBERD signal the occurrence of an event of interest.

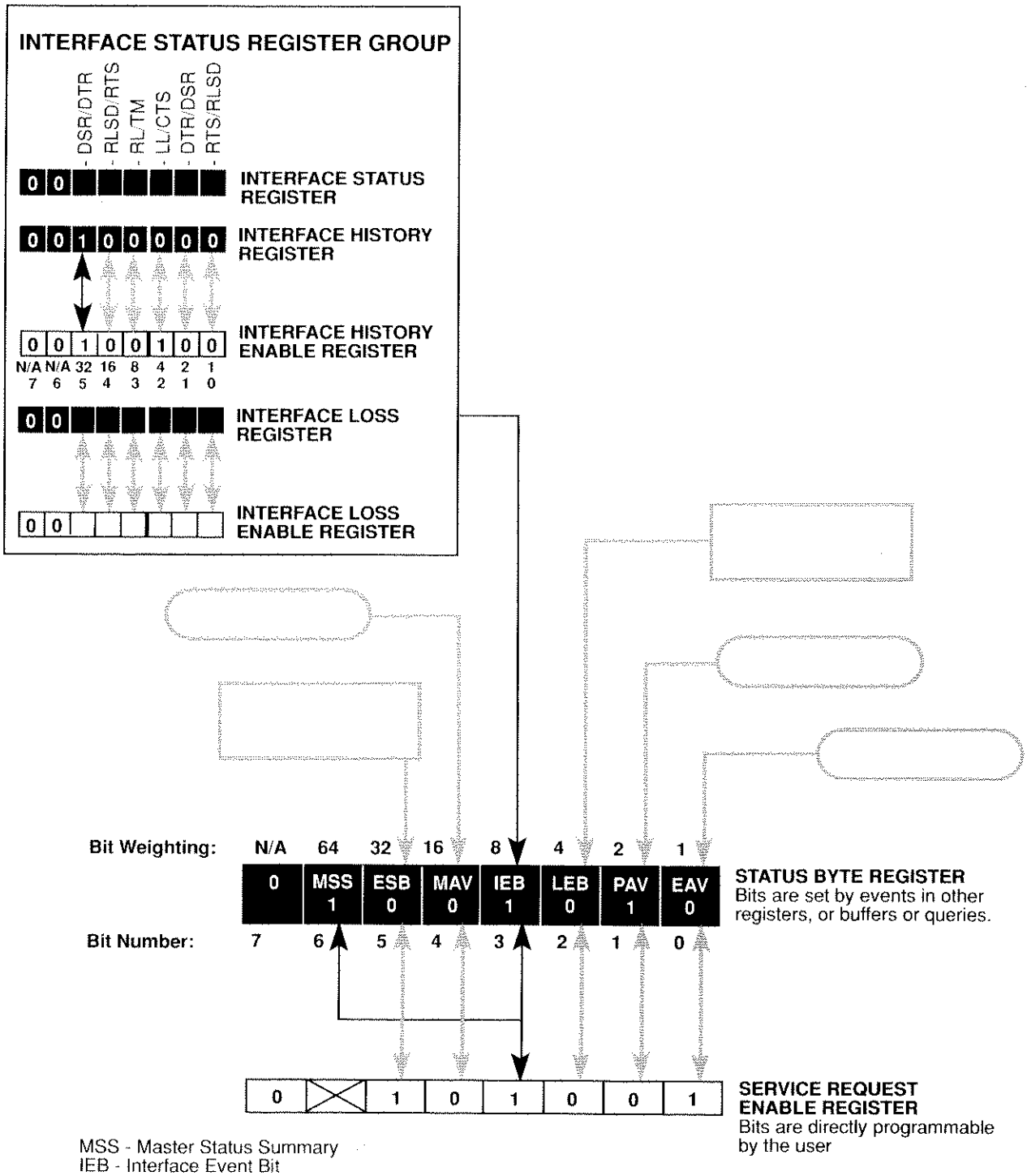

Figure 4-8
Register Operation

4.5.2 Queue and Buffer Operation

1. Output Queue

When the controller sends a query to the FIREBERD 4000, all responses generated by the FIREBERD are placed in the Output Queue. In RS-232 remote control operation, the contents of the Output Queue are immediately transmitted to the terminal. In IEEE-488 operation, responses are stored in the Output Queue until the FIREBERD is addressed to TALK[1]. When a response is in the Output Queue, the Message Available (MAV) indicator (bit 4 of the Status Byte Register) is set to 1.

2. Print Queue

Printouts generated by the FIREBERD 4000 can be sent to an internal buffer called the RC Print Queue. This activity is enabled by issuing the **PRINT:DEVICE REMOTE** command. A printout in the RC Print Queue sets the Print Available (PAV) indicator (bit 1 of the Status Byte Register) to 1. Printouts are read using the **STATUS:PRINT?** query.

3. Error Buffer

The Error Buffer is an internal buffer that stores the last generated error message. It is read using the **STATUS:ERROR?** query and is cleared using the **STATUS:CLEAR_ERR** command. When an error message is present in the Error Buffer, the Error Available (EAV) indicator (bit 0 of the Status Byte Register) is set to 1. Errors messages are also transmitted directly to the terminal in RS-232 Terminal Mode operation.

Presented below is a detailed discussion of each of the four register groups in the FIREBERD 4000.

4.5.3 Status Byte Register Group

The Status Byte Register group consists of two 8-bit registers: Status Byte Register and Service Request Enable Register. This register group summarizes the data structures reporting to it (see Figure 4-9).

1. Status Byte Register

The Status Byte Register contains summary bits from the data structures reporting to it. Each bit reports whether a change has occurred in one of the other three register groups, or one of the three buffers/queues. The FIREBERD 4000 sets the value (0 or 1) for seven of the eight bits in the Status Byte Register. The other bit is always set to 0.

The controller can read the Status Byte Register using a serial poll or using the ***STB?** query. When a serial poll is used, bit 6 is returned as a Request Service (RQS); when the ***STB?** query is used, bit 6 is returned as a Master Summary Status (MSS).

When the Status Byte Register is read, a weighted integer is returned. This integer represents the decimal equivalent of the enabled bits in the register. To determine the status of the bits in the Status Byte Register, convert the returned value to binary.

[1] The mode of communication for the FIREBERD — TALK or LISTEN — is controlled by the IEEE-488 bus. The bus, in turn, is usually controlled by IEEE-488 software provided by the 488 bus vendor. For more information on setting the FIREBERD to TALK or LISTEN see Subsection 1 of this section, and your IEEE-488 controller manuals.

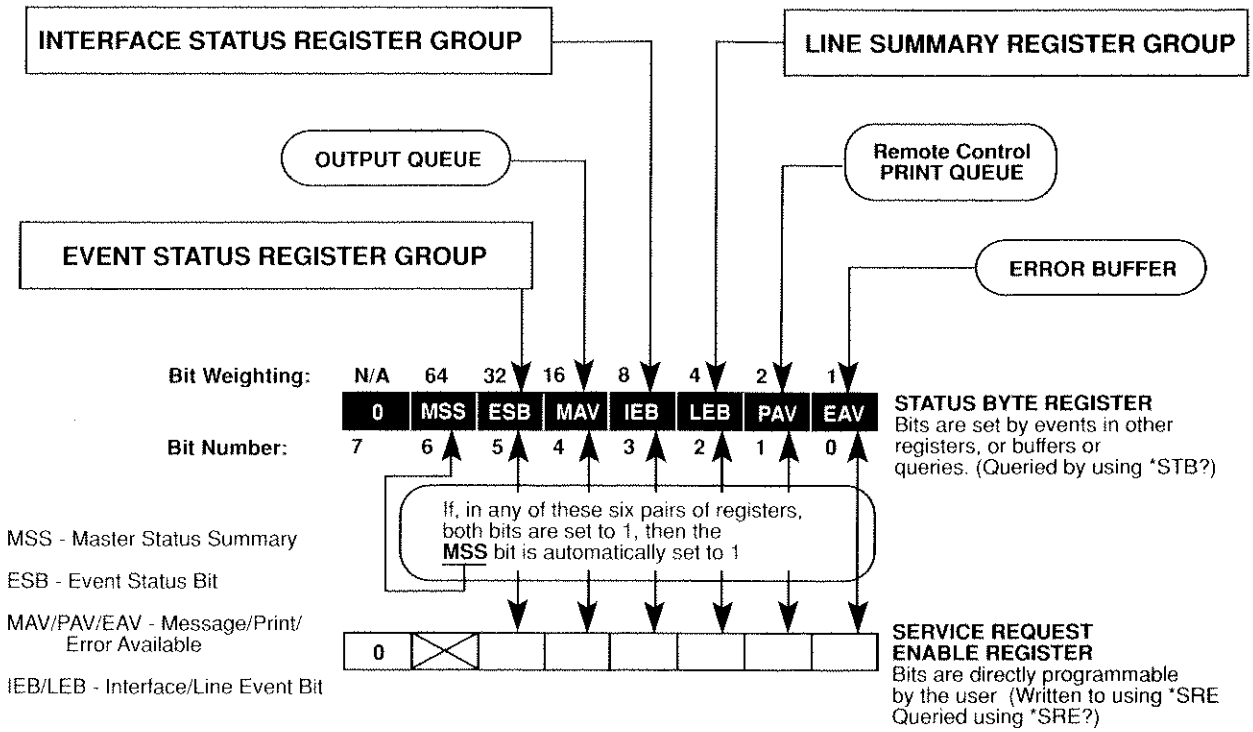

Figure 4-9
Status Byte Register Group

Bit 7 Not used. Always zero.

Bit 6 **MSS - Master Status Summary**
Represents the summary of all other bits in the Status Byte Register. The corresponding enabling bit in the Service Request Enabling Register (***SRE**) is not programmable. When this bit is set to 1, an SRQ is asserted on the IEEE-488 bus.

Bit 5 **ESB - Event Status Bit**
Indicates that an enabled event has occurred in the Event Status Register. Read the Event Status Register to determine the specifics of the event.

Bit 4 **MAV - Message Available**
Indicates that a response is available in the output queue. The FIREBERD does not talk on an IEEE-488 bus until the MAV bit is set to 1, and the FIREBERD is addressed to TALK.

Bit 3 **IEB - Interface Event Bit**
Indicates a status change in the Interface Status Register. Read the Interface History and Loss Registers to determine the specifics of the status change.

Bit 2 **LEB - Line Event Bit**
Indicates a status change in the Line Summary Register Group. Read the Line History and Loss Registers to determine the specifics of the status change.

Bit 1 **PAV - Print Available Buffer**
Indicates that a printout is available in the remote control print buffer (see **STATUS:PRINT?**).

Bit 0 **EAV - Error Available Buffer**
Indicates that an error message is available in the error buffer (see **STATUS:ERROR?** and **STATUS:CLEAR_ERR**).

2. Service Request Enable Register

The Service Request Enable Register is an 8-bit register that determines which bits of the Status Byte Register can cause the MSS bit of the Status Byte Register to be set. The MSS bit is used to assert SRQ when using an IEEE-488 bus. This means that the Service Request Enable Register effectively determines when the FIREBERD 4000 requests service. Use the ***SRE** command to write to the Service Request Enable Register.

4.5.4 Event Status Register Group

The Event Status Register group detects specific IEEE-488-defined events (Figure 4-10). It consists of two 8-bit registers: the Event Status Register and the Event Status Enable Register.

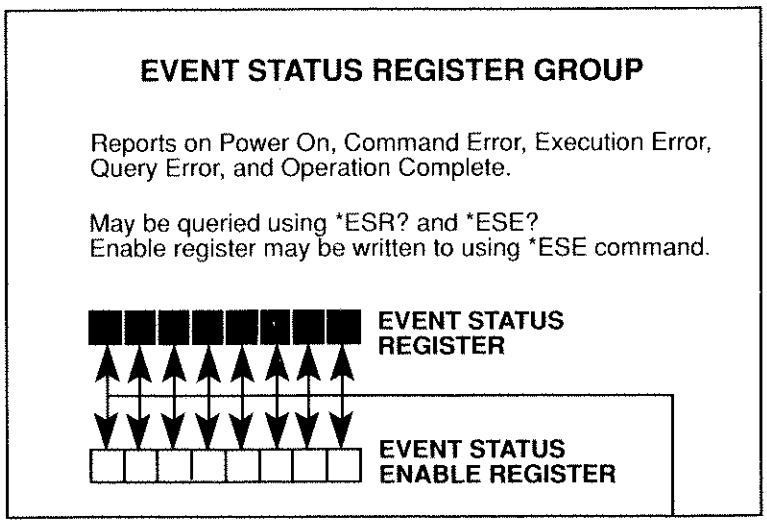

Figure 4-10
Event Status Register Group

1. The Event Status Register

The Event Status Register (ESR) assigns specific IEEE-488.2-defined events to each of the bits within the register. A bit is set in the Event Status Register when the event that corresponds to that bit has occurred since the register was last read or cleared. This register is cleared each time it is read. The Event Status Register is read using the query: ***ESR?**

Bit 7 **PON - Power On**
Power has been cycled OFF and ON since the last time the Event Status Register was read.

Bit 6 **URQ - User Request**
Not used. Always reads zero.

Bit 5 **CME - Command Error**
Indicates that a command received by the FIREBERD 4000 was not executed because it was not understood.

Bit 4 **EXE - Execution Error**
Indicates that the FIREBERD is unable to execute a command.

Bit 3 **DDE - Device-Dependent Error**
Not used. Always reads zero.

Bit 2 **QYE - Query Error**
Indicates that the controller has attempted to read the FIREBERD output queue when nothing was available to be read, or that data in that queue has been lost.

Bit 1 **RQC - Request Control**
Not used. Always reads zero.

Bit 0 **OPC - Operation Complete**
Indicates that all pending operations are complete (see the *OPC command).

2. The Event Status Enable Register

The Event Status Enable Register is an eight-bit register that determines how the Event Status Bit (ESB) of the Status Byte Register is set. The ESB is set to 1 when corresponding bits in the Event Status Register and the Event Status Enable Register are set to 1. The Event Status Enable Register is read/written to with the query/command: ***ESE[?]**.

4.5.5 Line Summary Register Group

The Line Summary Register Group consists of five registers: the Line Status Register, Line History Register, Line History Enable Register, Line Loss Register, and Line Loss Enable Register (Figure 4-6).

The following paragraphs describe the meanings of the bits in each of the Line Summary registers.

NOTE: If a specific bit does not apply to an interface, that bit always has a value of zero when that interface is in use. For example, **FRAME SYNC** does not apply to the RS-232 Interface, and therefore the **FRAME SYNC** status, history and loss bits are always set to zero when the RS-232 Interface is in use.

1. The Line Status Register

The Line Status Register gives the current state of various signal indicators. The Line Status Register is read using the query: **STATUS:LINE?**.

Bit 7 Not used. Always zero.

Bit 6 Not used. Always zero.

Bit 5 Not used. Always zero.

Bit 4 **RCV DATA INV**
Set to 1 when inverted data is received.

Bit 3 **GEN CLK PRES**
Set to 1 when generated clock is present.

Bit 2 **PATTERN SYNC**
Set to 1 when pattern sync is achieved.

Bit 1 **FRAME SYNC**
Set to 1 when the FIREBERD detects frame synchronization.

Bit 0 **SIGNAL PRESENT**
Set to 1 when an input signal is present.

2. The Line History Register

The Line History Register provides the history of various signal indicators since this register was last read. When a bit is set, it indicates that there was no generated clock, pattern sync, frame sync, etc.; and then the clock or sync was gained. This may indicate that during the preceding time interval an error occurred and was then recovered from (e.g., sync was lost and then re-established); or it can indicate a deliberate RESULT RESTART generally indicates that an error has occurred or synchronization was lost during the interval since the register was last read. This register is cleared each time it is read. The Line History Register is read using the query: **STATUS:LINE_HIST?**.

Bit 7 Not used. Always zero.

Bit 6 Not used. Always zero.

Bit 5 Not used. Always zero.

Bit 4 **RCV DATA INV**
Set to 1 when inverted data is received.

Bit 3 **GEN CLK PRES**
Indicates that the generated clock was present since this register was last read.

Bit 2 **PATTERN SYNC**
Indicates that the FIREBERD synchronized to the received pattern since this register was last read.

Bit 1 **FRAME SYNC**
Indicates that frame synchronization was detected since this register was last read.

Bit 0 **SIGNAL PRESENT**
Indicates that signal presence was detected since this register was last read.

3. The Line History Enable Register

The Line History Enable Register determines how the Line Event Bit (LEB) of the Status Byte Register is set. The LEB is set to 1 when corresponding bits in the Line History Register and the Line History Enable Register are set to 1. The Line History Enable Register is read/written to with the query/command: **STATUS:LINE_HIST_EN[?]**.

4. The Line Loss Register

The Line Loss Register provides a history of signal loss, synchronization loss, and generated clock loss. A bit is set if any of these events have occurred since the register was last read. This register is cleared each time it is read. The Line Loss Register is read using the query **STATUS:LINE_LOSS?**.

Bit 7 Not used. Always set to zero.

Bit 6 Not used. Always set to zero.

Bit 5 Not used. Always set to zero.

Bit 4 Not used. Always set to zero.

Bit 3 **GEN CLK LOSS**
Indicates that the generated clock was lost since this register was last read.

Bit 2 **PATTERN SYNC LOSS**
Indicates that the FIREBERD lost synchronization to the received pattern since this register was last read.

Bit 1 **FRAME SYNC LOSS**
Indicates that frame synchronization was lost since this register was last read.

Bit 0 **SIGNAL LOSS**
Indicates that signal presence was lost since this register was last read.

5. The Line Loss Enable Register

The Line Loss Enable Register determines how the Line Event Bit (LEB) of the Status Byte Register is set. The LEB is set to 1 when corresponding bits in the Line Loss Register and the Line Loss Enable Register are set to 1. The Line Loss Enable Register is read/written to with the query/command: **STATUS:LINE_LOSS_EN[?]**.

4.5.6 Interface Status Register Group

The Interface Status Register Group consists of five registers: the Interface Status Register, Interface History Register, Interface History Enable Register, Interface Loss Register, and Interface Loss Enable Register (Figure 4-5).

1. The Interface Status Register

The Interface Status Register indicates the current status of the interface signal. A 1 in any bit position indicates that the corresponding signal is active. The Interface Status Register is read using the query: **STATUS:INTF?**.

NOTE: The Interface Status Register Group reports on conditions that depend upon the currently selected interface. Different interfaces can have different status conditions. The conditions described in this section are representations only for the FIREBERD 4000 internal interfaces.

Bit 7 Not used. Always zero.

Bit 6 Not used. Always zero.

Bit 5 **DSR/DTR**
Set to 1 when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch is set to ON.

Bit 4 **RLSD/RTS**
Set to 1 when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch is set to ON.

Bit 3 **RL/TM**
Set to 1 when the RL (DCE emulation) or TM (DTE emulation) signaling lead is set high.

Bit 2 **LL/CTS**
Set to 1 when the LL (DCE emulation) or CTS (DTE emulation) signaling lead is set high.

Bit 1 **DTR/DSR**
Set to 1 when the DTR (DCE emulation) or DSR (DTE emulation) signaling lead is set high.

Bit 0 **RTS/RLSD**
Set to 1 when the RTS (DCE emulation) or RLSD (DTE emulation) signaling lead is set high.

2. The Interface History Register

The Interface History Register provides the history of the interface signal since this register was last read. A bit in this register is set when the corresponding bit in the Interface Status Register changes from 0 (idle) to 1 (active). The bit in the Interface History Register remains set until this register is read. This register is cleared each time it is read. The Interface History Register is read using the query: **STATUS:INTF_HIST?**.

Bit 7 Not used. Always zero.

Bit 6 Not used. Always zero.

Bit 5 **DSR/DTR**
Set to 1 when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch is set from OFF to ON.

Bit 4 **RLSD/RTS**
Set to 1 when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch is set from OFF to ON.

Bit 3 **RL/TM**
Set to 1 when the RL (DCE emulation) or TM (DTE emulation) signaling lead is set from low to high.

Bit 2 **LL/CTS**
Set to 1 when the LL (DCE emulation) or CTS (DTE emulation) signaling lead is set from low to high.

Bit 1 **DTR/DSR**
Set to 1 when the DTR (DCE emulation) or DSR (DTE emulation) signaling lead is set from low to high.

Bit 0 **RTS/RLSD**
Set to 1 when the RTS (DCE emulation) or RLSD (DTE emulation) signaling lead is set from low to high.

3. The Interface History Enable Register

The Interface History Enable Register determines how the Interface Event Bit (IEB) of the Status Byte Register is set. The IEB is set to 1 when corresponding bits in the Interface History Register and the Interface History Enable Register are set to 1. The Interface History Enable Register is read/written to with the query/command: **STATUS:INTF_HIST_EN[?]**.

4. The Interface Loss Register

The Interface Loss Register provides a history of interface signal losses. A bit is set if any interface signal has been lost since the register was last read. This register is cleared each time it is read. The Interface Loss Register is read using the query: **STATUS:INTF_LOSS?**.

Bit 7 Not used. Always zero.

Bit 6 Not used. Always zero.

Bit 5 **DSR/DTR**
Set to 1 when the DSR (DCE emulation) or DTR (DTE emulation) signaling switch goes from ON to OFF.

Bit 4 **RLSD/RTS**
Set to 1 when the RLSD (DCE emulation) or RTS (DTE emulation) signaling switch goes from ON to OFF.

Bit 3 **RL/TM**
Set to 1 when the RL (DCE emulation) or TM (DTE emulation) signaling lead goes from high to low.

Bit 2 **LL/CTS**
Set to 1 when the LL (DCE emulation) or CTS (DTE emulation) signaling lead goes from high to low.

Bit 1 **DTR/DSR**
Set to 1 when the DTR (DCE emulation) or DSR (DTE emulation) signaling lead goes from high to low.

Bit 0 **RTS/RLSD**
Set to 1 when the RTS (DCE emulation) or RLSD (DTE emulation) signaling lead goes from high to low.

5. The Interface Loss Enable Register

The Interface Loss Enable Register determines how the Interface Event Bit (IEB) of the Status Byte Register is set. The IEB is set to 1 when corresponding bits in the Interface Loss Register and the Interface Loss Enable Register are set. The Interface Loss Enable Register is read/written to with the query/command: **STATUS:INTF_HIST_EN[?]**.

4.6 ERROR MESSAGES

An error message indicates an error in an unprocessed remote control command – either the FIREBERD could not understand the command, or the FIREBERD could not act on it. Error messages are generated according to the FIREBERD 4000 remote control mode of choice: RS-232 Terminal Mode, RS-232 Computer Mode, or IEEE-488 Computer Mode.

RS-232 Terminal Mode
In terminal mode, the FIREBERD operates interactively. Therefore, error messages are transmitted to the terminal as soon as they occur. The error message is also placed in the Error Buffer, causing the Error Available indicator (bit 0 of the Status Byte Register) to be set.

RS-232 Computer Mode
In computer mode, the FIREBERD operates with a programmed computer that requires predictable results. Therefore, error messages are not sent to the computer when they occur, but are instead sent to the Error Buffer. This causes the Error Available indicator (bit 0 of the Status Byte Register) to be set.

IEEE-488 Computer Mode
When the FIREBERD 4000 operates over an IEEE-488 bus, error messages are sent to the Error Buffer. This causes the Error Available indicator (bit 0 of the Status Byte Register) to be set.

The Error Buffer holds one error message at a time. The error message currently held is the last error message generated. The Error Buffer is read using the **STATUS:ERROR?** query and is cleared using the **STATUS:CLEAR_ERR** command. When an error message is present in the Error Buffer, the Error Available indicator (bit 0 of the Status Byte Register) is set. In computer mode, an error message must be cleared before issuing the next command.

4.6.1 Error Messages

The following is a complete list of error messages reported by the FIREBERD 4000.

NOTE: Some of the error messages below apply only to the FIREBERD 6000. They are retained in the FIREBERD 4000 code for consistency across the series.

1. Command Errors

Argument Too Long (100)
Cause: An invalid command argument is specified.

Invalid Argument (101)
Cause: A command argument that does not match the expected argument syntax is specified.

Invalid Hexadecimal Argument (102)
Cause: A command argument that does not match the syntax of the expected hexadecimal argument is specified.

Invalid Numeric Argument (103)
Cause: The FIREBERD does not recognize the argument entered in the command line because it is not in numeric format.

String Argument Expected (104)
Cause: A command is issued without the argument enclosed in quotes.

String Too Long (105)
Cause: A specified command contains a string with more than 254 characters.

Syntax Error (106)
Cause: The FIREBERD does not recognize the input as a valid command. This error message may appear when a comma or semicolon is missing, or when a command is misspelled.

Unrecognized Command (107)
Cause: An unrecognizable command or query was received.

2. Execution Errors

An empty slot cannot be selected (200)
Cause: The specified interface slot is empty.

Asynchronous frequency contention (201)
Cause: The specified frequency is invalid in asynchronous timing mode.

Asynchronous pattern contention (202)
Cause: The specified pattern is invalid in asynchronous timing mode.

Cannot set while line is active (203)
Cause: A parameter change is not allowed while the line is active.

Device in use (204)
Cause: The printer driver specified is also the one used by remote control.

Illegal phone number (205)
Cause: The data specified does not constitute a legal phone number.

Illegal result name (206)
Cause: The data specified does not constitute a legal result.

Illegal type name (207)
Cause: The data specified does not constitute a legal type.

Illegal user message string (208)
Cause: The specified user message string is either not in the correct format or contains ASCII characters that are invalid.

Illegal user message byte position (209)
Cause: The byte position is not within the boundaries of the specified user message.

Illegal value (210)
Cause: The value specified with a command is not within the legal range of the requested function.

Inconsistent with current configuration (211)
Cause: The requested function is not applicable in the FIREBERD 4000 current mode.

Inconsistent with interface or interface mode (212)
Cause: The requested command is not supported by the current interface, or is not applicable or available in the current interface mode.

ISU-6000 is installed (213)
Cause: A command to select the external interface is specified while the ISU-6000 is installed.

ISU-6000 is not installed (214)
Cause: An ISU-6000 command is specified when the option is not installed.

ISU-2000 is not in remote mode (215)
Cause: A remote command was issued for the ISU-2000 while in local mode.

Jitter generation contention (216)
Cause: The command specified caused contention in the jitter generator.

Option not installed (217)
Cause: The specified command requires an option that is not installed.

Presynchronization/power loss unavailable (218)
Cause: Synchronization losses or power losses have not occurred.

Print buffer is empty (219)
Cause: A command to read the print buffer is issued when no printouts are available.

Remote control using RS232 (220)
Cause: A change in an RS-232 parameter is encountered while remote control is using the RS-232 driver.

Result not applicable (221)
Cause: The result specified is not applicable in the current timing or interface mode.

Software error (222)
Cause: An internal software error has occurred.

Synchronous pattern contention (223)
Cause: The pattern specified is invalid when synchronous timing is selected.

Unrecognized parameter (224)
Cause: The FIREBERD recognizes but cannot interpret the command parameter specified.

3. Query Errors

Command unterminated (300)
Cause: The controller tried to read a response before a complete program message had been sent to the FIREBERD. No response is sent.

Deadlock detected (301)
Cause: When a very long program message produces a very long response message, the commands in the input buffer. If this condition occurs, the entire response message is discarded. All commands sent are processed normally.

Response interrupted (302)
Cause: The controller sent the FIREBERD a command or query before reading the entire response from a previous query. The response of the previous query is discarded.

SECTION 5
OPTIONS AND ACCESSORIES

5.1 INTRODUCTION

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

5.2 OPTIONS

Table 5-1 lists the hardware and software options available for the FIREBERD 4000.

Table 5-1
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

5.3 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.

5.3.1 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 3.

5.3.2 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.

5.3.3 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.

5.3.4 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

5.3.5 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 5.5 pounds, and it measures 17"H x 18"W x 9.5" D.

5.3.6 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.

5.3.7 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	41131/41131A
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
2M/nx64k Data Interface	41800
DS3 Data Interface	41945
Test Access Interface	41910
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
PROTOCOL ANALYZERS	
Protocol Data Scope	PDS-40
Integrated Protocol Data Scope (Lid)	PDS-45
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

Description	Model Number
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
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

APPENDIX A
MAINTENANCE AND SERVICE

A.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.

A.2 MAINTENANCE

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

A.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 available interfaces.
2. Verify that the interface is properly inserted in the interface slot (with power turned 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 1, Instrument Checkout. If the unit cannot be made to operate properly, call the TTC Customer Service Department for assistance.

A.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 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 on the case 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. Clean the interior using dry, low-pressure air to remove any dust.

A.2.3 FIREBERD Cover Removal

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 the following 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.

A.2.4 FIREBERD Cover Installation

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 1.

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 1.

A.2.5 Battery Replacement

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 A.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 corner of the Processor board.
5. Use diagonal cutters to cut and remove the plastic tie wrap from around the battery, then 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 MAY DAMAGE CONNECTOR PINS.

10. Install the cover as described in Section A.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 were stored in memory. All menus are returned to the factory defaults when the battery is replaced.

A.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 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 A.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.
3. Clean the filter with compressed air or a soft brush.
4. Re-insert the cleaned filter into the filter slot.
5. Install the cover as described in Section A.2.4. Use the appropriate procedure to install the plastic or metal cover.

A.3 SERVICE

A.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.

A.3.2 In-Warranty Service

In-warranty equipment must be returned to the factory with shipping prepaid. The equipment should be packed and shipped in accordance with instructions in Subsection A.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 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.

A.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.

A.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 of service requested.

4. The name and telephone number of the person to contact regarding questions about the repair.

5. The RA number.

NOTE: The RA number must be obtained from the TTC 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 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 B
ANALYSIS RESULTS AVAILABILITY

B.1 INTRODUCTION

This appendix lists the interfaces supported by the FIREBERD 4000 and the ANALYSIS RESULTS available for the selected interface. For certain interfaces, the operating configuration determines the ANALYSIS RESULTS that are available. Superscript numbers are used to indicate when results availability is determined by the operating configuration.

The PAT SLIP (Pattern Slip) result is only available for pseudorandom patterns (63, 511, 2047, 2^{15}-1, 2^{20}-1, 2^{23}-1, and QRSS).

The interface model refers to the interface model number. The display ID is the interface name visible in the display window when that interface is installed. Please note that since the INT 232 and INT 188 Interfaces are built-in, they do not have model numbers.

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*	PAT SLIP**
INTERFACE			
TIME & SIGNAL	PATL SEC	DATE	TEST SEC
	ELAP SEC	DELAY	GEN FREQ
	TIME	RCV FREQ**	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

*Available in ASYNC mode
**Available in SYNC mode

INTERFACE MODEL: —
OPERATING MODE: ASYNC

DISPLAY ID: **INT232**

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	CHAR ERR*	PAT SLIP**
INTERFACE			
TIME & SIGNAL	PATL SEC	DATE	TEST SEC
	ELAP SEC	DELAY	GEN FREQ
	TIME	RCV FREQ**	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

*Available in ASYNC mode
**Available in SYNC mode

INTERFACE MODEL: **30447A**
OPERATING MODE: NORM

DISPLAY ID: **DS1C/2**

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	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**	ERR-SES**	BER-SES**

*Available in BPV mode
**Available in NORM 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	RCV FREQ	DATE
	TEST SEC	%EFS	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	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**	RCV FREQ	DATE
	TEST SEC**	%EFS**	ELAP SEC
	GEN FREQ	TIME	ERR SEC**
PERFORMANCE	AVL SEC**	%DEG MIN**	SES**
	UNA SEC**	G EFS**	%SES**
	%AVL SEC**	GERR SEC**	DEG MIN**
	G %EFS**	ERR-SES**	BER-SES**

*Available in CODE mode
**Available in NORM 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	RCV FREQ	DATE
	TEST SEC	%EFS	ELAP SEC
	GEN FREQ	TIME	ERR SEC
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	ELAP SEC	GEN FREQ	TIME
	%EFS	ERR SEC	TEST SEC
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

*Available in FRAMED/CRC4 mode
**Available in 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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	%EFS	ERR SEC
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

INTERFACE MODEL: **40138** **DISPLAY ID:** **V.35**
OPERATING MODE: DCE

ANALYSIS RESULTS

ERROR	BIT ERRS	BLK ERRS	PAT LOSS
	AVG BER	BLOCKS	BER
	AVG BLER	PAT SLIP	
INTERFACE			
TIME & SIGNAL	PATL SEC	RCV FREQ	DATE
	TEST SEC	%EFS	ELAP SEC
	GEN FREQ	TIME	DELAY
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	ERR SEC
	GEN FREQ	TIME	%EFS
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	%EFS	ELAP SEC
	GEN FREQ	TIME	DELAY
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	%EFS	ELAP SEC
	GEN FREQ	TIME	DELAY
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	%EFS
	ERR SEC		
INTERFACE			
TIME & SIGNAL	PATL SEC	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	%EFS	ERR SEC
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	DELAY	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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	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	ERR-SES	BER-SES

INTERFACE MODEL: **40365** **DISPLAY ID:** **T1**
OPERATING MODE: NORM

ANALYSIS RESULTS

ERROR	BIT ERRS**	BLOCKS**	BLK ERRS**
	PAT LOSS**	AVG BER**	BER**
	AVG BLER**	PAT SLIP**	
INTERFACE	BPVs*	BPV Rate*	AVG BPVR*
TIME & SIGNAL	PATL SEC**	%EFS**	RCV FREQ
	DATE	TEST SEC**	GEN FREQ
	ELAP SEC	ERR SEC**	TIME
PERFORMANCE	AVL SEC**	%DEG MIN**	SES**
	UNA SEC**	G EFS**	%SES**
	%AVL SEC**	GERR SEC**	DEG MIN**
	G %EFS**	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**	GEN FREQ
	ELAP SEC	ERR SEC**	TIME
PERFORMANCE	AVL SEC**	%DEG MIN**	SES**
	UNA SEC**	G EFS**	%SES**
	%AVL SEC**	GERR SEC**	DEG MIN**
	G %EFS**	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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	DELAY
	ERR SEC	GEN FREQ	TIME
	%EFS		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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*	BPVs*	AVG BPVR*
	BPV Rate*	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**	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*	RCV CODE	
TIME & SIGNAL	PATL SEC	%EFS	RCV FREQ
	DATE	TEST SEC	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	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**	RCV CODE	
TIME & SIGNAL	PATL SEC	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	TIME	%EFS	ERR SEC
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

*Available in D4/SLC96 mode
**Available in ESF mode

INTERFACE MODEL: **41131** **DISPLAY ID:** **DDSLL**
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
	BPVs	AVG BPVR	BPV Rate
	R LVL V	R LVL dB	
TIME & SIGNAL	PATL SEC	%EFS	DATE
	TEST SEC	DAT RATE	ELAP SEC
	TIME	ERR SEC	
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

INTERFACE MODEL: **41400** **DISPLAY ID:** **MIL449**
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	RCV FREQ	DATE
	TEST SEC	ELAP SEC	GEN FREQ
	DELAY	TIME	%EFS
	ERR SEC		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

INTERFACE MODEL: **41440** **DISPLAY ID:**
T1/FT1
OPERATING MODE: —

ANALYSIS RESULTS

ERROR[1]	BIT ERRS	PAT LOSS	AVG BER
	BER	PAT SLIP	
INTERFACE	BPVs	RCV BOM[2]	AVG BPVR
	MAX ZERO	BPV Rate	RCV CODE
	BIT SLIP	AVG FER[4]	RX ABCD[3]
	AVG CRC[2]	RCV BYTE[4]	SMPX CUR
	FRA ERR[4]	CRC ERR[2]	
TIME & SIGNAL	PATL SEC	RCV FREQ	DATE
	- LVL dB	+ LVL V	PP LVL V
	ELAP SEC	+ LVL dB	LVL dBm
	GEN FREQ	TIME	- LVL V
	%EFS	ERR SEC	TEST SEC
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	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

INTERFACE MODEL: **41910** **DISPLAY ID:** **ACCESS**
OPERATING MODE: —

ANALYSIS RESULTS

ERROR			
INTERFACE			
TIME & SIGNAL	TIME	DATE	ELAP SEC
PERFORMANCE			

INTERFACE MODEL: **41945** **DISPLAY ID:** **DS3**
OPERATING MODE: —

ANALYSIS RESULTS

ERROR	BIT ERRS	PAT LOSS	AVG BER
	BER	PAT SLIP	
INTERFACE	BPVs	PAR ERR[1, 2]	AVG BPVR
	AVG PER[1, 2]	BPV Rate	CPAR ERR[2]
	FEBE[2]	AVG FER	RX X1:X2[1, 2]
	AVG FEBE[2]	RCV FEAC[2]	FRA ERR
	AVG CPER[2]		
TIME & SIGNAL	PATL SEC	RCV FREQ	DATE
	BPV SEC	BPV %EFS	%EFS
	ELAP SEC	GEN FREQ	TIME
	CPE S A[2]	CPE S B[2]	CPE S C[2]
	FEBE S A[2]	FEBE S B[2]	FEBE S C[2]
	ERR SEC	TEST SEC	
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

[1]Available in M13 mode
[2]Available in CBIT mode

INTERFACE MODEL: **41800** **DISPLAY ID:** **2M/n64**
OPERATING MODE: FRAMED

ANALYSIS RESULTS

ERROR	BIT ERRS	PAT LOSS	AVG BER
	BER	PAT SLIP	
INTERFACE	CER	FAS ERR	AVG FAS
	MFAS ERR	AVG MFAS	REBE
	AVG REBE	1SEC CRC	CRC ERR
	AVG CRC	RCV BYTE	RX ABCD[1]
	RCV FAS	RCV NFAS	RCV MFAS
	BIT SLIP	CODE ERR	AVG CER
TIME & SIGNAL	PATL SEC	RCV FREQ	DATE
	- LVL dB	ELAP SEC	+ LVL dB
	GEN FREQ	TIME	+WNDR
	-WNDR	PP WNDR	15m WNDR
	24h WNDR		
PERFORMANCE	AVL SEC	%DEG MIN	SES
	UNA SEC	G EFS	%SES
	%AVL SEC	GERR SEC	DEG MIN
	G %EFS	ERR-SES	BER-SES

[1]Available in VOICE mode

APPENDIX C
ANALYSIS RESULTS DEFINITIONS

+WNDR *Positive Wander* - The maximum positive peak wander deviation since the beginning of the test, expressed in UIs. (TIME & SIGNAL)

-WNDR *Negative Wander* - The maximum negative peak wander deviation since the beginning of the test, expressed in UIs. (TIME & SIGNAL)

%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)

15m WNDR *15-Minute Wander* - The maximum peak-to-peak wander deviation over the last 15 minutes of the test. This result is unavailable during the first 15 minutes of the test and is updated once per minute thereafter. (TIME & SIGNAL category)

24h WNDR *24-Hour Wander* - The maximum peak-to-peak wander deviation over the last 24 hours of the test. This result is unavailable during the first 24 hours of the test and is updated once per hour thereafter. (TIME & SIGNAL category)

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)

ANALYSIS RESULTS DEFINITIONS (CONTINUED)

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 CPER *Average C-bit Parity Error* - The ratio of C-bit parity errors detected to the total number of parity bits received. (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 FEBE *Average Far End Block Errors* - the number of far end block errors detected. (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)

AVG MFAS *Average Multiframe Alignment Signal Errors* - The ratio of errored MFAS words to the total number of MFAS words detected. (INTERFACE category)

AVG PER *Average Parity Error Rate* - The ratio of errored parity bits to the total number of parity bits detected. (INTERFACE category)

AVG REBE *Average Remote End Block Errors* - The ratio of remote end block errors to the total number of blocks received. (INTERFACE category)

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 Minus Severely Errored Seconds* - The bit error rate, excluding the errors that occurred during severely errored seconds. (PERFORMANCE category)

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)

ANALYSIS RESULTS DEFINITIONS (CONTINUED)

BPV %EFS — *Percent of Bipolar Violation Error-Free Seconds* - The ratio of BPV-free seconds to the total number of signal present seconds. BPV-free seconds are the difference between pattern signal present seconds and BPV seconds. Expressed as a percentage. See Signal Present Seconds and BPV SEC. (TIME & SIGNAL 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)

BPV SEC — *Bipolar Violation Seconds* - The number of seconds where at least 1 bipolar violation occurred. (TIME & SIGNAL category)

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)

CPAR ERR — *C-bit Parity Errors* - The number of C-bit parity errors detected since the test started. (INTERFACE category)

CPE S A — *C-bit Parity Errors Type A* - The number of error analysis seconds during which 1 C-bit parity error was detected. (TIME & SIGNAL category)

CPE S B — *C-bit Parity Errors Type B* - The number of error analysis seconds during which 2 to 44 C-bit parity errors were detected. (TIME & SIGNAL category)

CPE S C — *C-bit Parity Errors Type C* - The number of error analysis seconds during which more than 44 C-bit parity errors were detected. (TIME & SIGNAL category)

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)

ANALYSIS RESULTS DEFINITIONS (CONTINUED)

ERR SEC — *Errored Seconds* - The total number of test seconds where at least one bit error occurred. See TEST SEC. (TIME & SIGNAL category)

ERR-SES — *Error Seconds Minus 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)

FEBE — *Far End Block Errors* - The number of far end block errors detected. (INTERFACE category)

FEBE S A — *Far End Block Error Seconds Type A* - The number of error analysis seconds during which 1 FEBE was detected. This result only appears when C-bit framing is selected. (TIME & SIGNAL category)

FEBE S B — *Far End Block Error Seconds Type B* - The number of error analysis seconds during which 2 to 44 FEBEs were detected. This result only appears when C-bit framing is selected. (TIME & SIGNAL category)

FEBE S C — *Far End Block Error Seconds Type C* - The number of error analysis seconds during which more that 44 FEBEs were detected. This result only appears when C-bit framing is selected. (TIME & SIGNAL category)

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 ZERO — *Maximum Zeros* - The maximum number of consecutive zeros counted since the last test restart. (INTERFACE category)

MFAS ERR — *Multiframe Alignment Signal Word Errors* - The number of errored MFAS words detected in timeslot 16. (SUMMARY and INTERFACE categories)

ANALYSIS RESULTS DEFINITIONS (CONTINUED)

PAR ERR *Parity Errors* - The number of parity errors detected 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.

PP WNDR *Peak-to-Peak Wander* - The total deviation of positive-to-negative peak wander since the beginning of the test, expressed in UIs. (TIME & SIGNAL category)

RCV BOM *Received Bit Oriented Message* - The ASCII message of the BOM present on the data link. (INTERFACE category). The received BOM has the following meaning:

YEL ALM - yellow alarm
LLB ACT - line loopback activate
LLB DEA - line loopback deactivate
PLB ACT - payload loopback activate
PLB DEA - payload loopback deactivate

RCV BYTE *Receive Byte Code* - The received byte in binary form every 150 milliseconds. (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 FAS *Received Frame Alignment Signal Word* - The received FAS word. (INTERFACE category)

RCV FEAC *Received Far End Alarm Control Code* - The number of far end alarm control codes received. (INTERFACE category). The FEAC is a 6-digit code with the following meanings:

Code	Mnemonic	Meaning
011001	DS3 EQF1	DS3 Equipment Failure (Type 1)
001110	DS3 LOS	DS3 Signal Loss/High Bit Error Rate
000000	DS3 OOF	DS3 Out-Of-Frame
010110	DS3 AIS	DS3 Alarm Indication Signal Received
011010	DS3 IDLE	DS3 Idle Code Received
001111	DS3 EQF2	DS3 Equipment Failure (Type 2)
011101	COM EQF2	Common Equipment Failure (Type 2)
010101	MDS1 LOS	Multiple DS1 Loss/High Bit Error Rate
000101	DS1 EQF1	DS1 Equipment Failure (Type 1)
011110	DS1 LOS	Single DS1 Loss/High Bit Error Rate
000011	DS1 EQF2	DS1 Equipment Failure (Type 2)

RCV FREQ *Receiver Clock Frequency* - The current receiver clock frequency in Hertz. (TIME & SIGNAL category)

RCV MFAS *Received Frame Alignment Signal Word* - The received FAS word. (INTERFACE category)

RCV NFAS *Received Not Frame Alignment Signal Word* - The received not FAS word. (INTERFACE category)

REBE *Remote End Block Errors* - The number of remote end block errors detected since the start of the test. (INTERFACE category)

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)

RX X1 X2 *Received X Bits* - The current value of the received X1 and X2 bits. (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)

Signal Present Seconds The number of test seconds having signal presence during any portion of the second.

SMPX CUR *Simplex Current* - The simplex current level in milliamps, in 1 mA steps, and polarity. (INTERFACE category)

Test Interval Every 10 seconds, starting with pattern synchronization. Used to calculate error rates, e.g., 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

This appendix lists the mainframe status messages and error messages displayed on the front panel. Accompanying the displayed message is an explanation of what caused the message to be displayed.

ASYNC FRAMING ERROR - The selected parameters are not compatible with the selected asynchronous operating mode. The baud rate, number of data bits, or parity are not the same.

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 PRGM.

AUTOBAUD IN PROGRESS - Occurs when the break key was pressed on a remote terminal connected to the mainframe and the autobaud process is in progress.

CLEARING NOVRAM - Occurs when an option has been changed. All mainframe configurations are defaulted when the non-volatile RAM is cleared.

DIFFERENT INTERFACE - Occurs when recall is executed by the mainframe with a different interface installed than the one installed when the unit configuration was stored.

GENERATOR CLK NOT PRESENT - The mainframe has not detected a clock signal.

GENERATOR HOLD RR/RS - The mainframe has detected the selected out-of-band flow control condition.

GENERATOR HOLD DM/TR - The mainframe has detected the selected out-of-band flow control condition.

GENERATOR HOLD CS - The mainframe has detected the selected out-of-band flow control condition.

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.

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 INVERT - 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.

TRANSMITTING LOOP CODE - The front panel interface control switch (LOOP UP or LOOP DOWN) was pressed causing the FIREBERD to generate the corresponding loop code.

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	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
PRGM #01:	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 FF FF FF FF FF FF 80 01 80 01 80 01 80 01 80 01 80 01	#1 User Programmable Character pattern (T1-6 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:	40, FAST,CRLF	Printer Printout Format Menu WIDTH, MODE, TERM
RC/PRINT	RC:NONE PRINT:232	Remote Control/Printer Driver Menu
RS232:	9600, 8, NONE	RS232 Printer/Controller BAUD, DATA, PAR Interface Menu
IEEE-488:	IEEE-488:ADDR: XX (XX = unit's 488 address)	Optional IEEE-488 Interface Menu (if installed).
FREQ1:	0000.3 kHz	Optional Frequency Synthesizer Default Menu

FIREBERD 4000 FACTORY DEFAULTS (CONTINUED)

Item	Factory Defaults	Description/Comment
FREQ(#):	FREQ1: 0.3, FREQ2: 1.2, FREQ3: 1.8, FREQ4: 2.4, FREQ5: 4.8, FREQ6: 9.6, FREQ7: 19.2, FREQ8: 48.0, FREQ9: 56.0, FREQ10: 64.0, FREQ11: 128.0, FREQ12: 256.0, FREQ13: 512.0, FREQ14: 704.0, FREQ15: 1544.0, FREQ16: 2048.0 kHz	Optional Synthesizer Fixed Frequency Editor Menu
CLEAR NOVRAM?	n/a	Clear Non-Volatile RAM Menu
ANALYSIS RESULTS Tables		
SUMMARY	RESULTS OK	No errors detected
ERROR	BIT ERRS: AVG BER: BER: PAT SLIP: BLK ERRS: BLOCKS: AVG BLER: PAT LOSS:	0 0. E-0X (counting) 0. E-0X (counting) 0 0 counting 0. E-0X (counting) 0
INTERFACE	BPVs:	N/A (Not available)
TIME & SIGNAL	PATL SEC: ERR SEC: %EFS: TEST SEC: ELAP SEC: GEN FREQ: RCV FREQ: DELAY: TIME: DATE:	0 0 100.00% counting counting 64000.0 64000.0 blank Current time Current date
PERFORMANCE		
Option not installed	OPTION NOT INSTALLED	CCITT G.821 Performance option not installed.
Option installed		CCITT G.821 Performance option installed.

Item	Factory Defaults	Description/Comment
PERFORMANCE (Continued)		
	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%
	ERR-SES:	0
	BER-SES:	counting
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)	OFF
	DSR (DM)	OFF
	CTS	OFF
	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

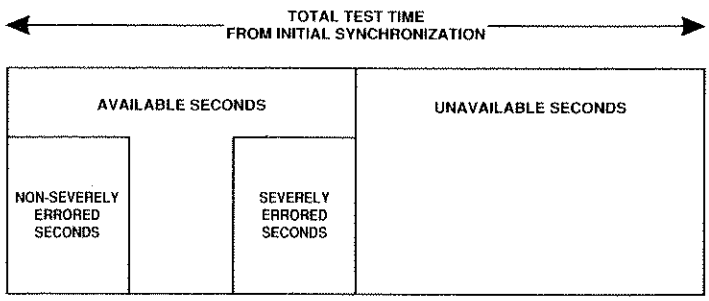

Figure F-1
Division of Test Seconds for Performance Analysis

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 con-sidered 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.

sec 20 BER <=	sec 21 BER <=	sec 22 BER <=	sec 23 BER <=	sec 24 BER <=	sec 25 BER <=	sec 26 BER >	sec 27 BER >	sec 28 BER >	sec 29 BER <=

Figure F-2
Sliding Window After 29th Test Second Still in Available Time

Even though there were 3 consecutive seconds (the 26th, 27th, and 28th) which each had a BER worse than 10^{-3}, 10 such con-secutive 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.

sec 79 BER <=	sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >

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.

sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >	sec 89 BER >

Figure F-4
Sliding Window After 89th Test Second Transition 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.

sec 151 BER <	sec 152 BER <	sec 153 BER <	sec 154 BER <	sec 155 BER <	sec 156 BER <	sec 157 BER <	sec 158 BER <	sec 159 BER <	sec 160 BER <

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-40	2400	7	Any	CRLF
PR-40A	2400	8	None	CRLF
PR-45+	9600	8	None	CRLF
PR-85	2400	8	Even	CRLF
PR-2000	2400	7	Any	CRLF

+ 8-pin front panel connector.

APPENDIX H
HEXADECIMAL CONVERSION TABLE

HEX	BAUDOT		BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
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		BCDIC		ASCII	EBCDIC
	LTRS	FIGS	UPPER	LOWER		
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	
6B	J	BELL or '	!	$	k	| (Vertical Line)
6C	N	,	DC4	DC4	l	, (Comma)
6D	F	!	CR	CR	m	%
6E	C	:	BS	BS	n	_ (Underline)
6F	K	(	DLE	DLE	o	> (Greater Than)
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	
7A	G	&			z	` (Opening Quote)
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	—	[illegible]	3	ETX (End of Text)	c
84	Space	Space	[illegible]	4	EOT (End of Transmission)	d
85	S	; or BELL	%	5	ENQ (Enquiry)	e
86	I	8	[illegible]	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 (Line Feed)	
8B	J	BELL or '	[illegible]	#	VT (Vertical Tabulation)	
8C	N	[illegible]	DC2	DC2	FF (Form Feed)	
8D	F	[illegible]	RS	RS	CR (Carriage Return)	
8E	C	[illegible]	UPPER	UPPER	SO (Shift Out)	
8F	K	(	EOT	EOT	SI (Shift In)	
90	T	5	CAN	[illegible]	DLE (Data Link Escape)	
91	Z	+ or "	[illegible]	/	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	[illegible]	[illegible]	ESC (Escape)	
9C	M	[illegible]	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	[illegible]	—	SP (Space)	
A1	E	3	J	j	!	~
A2	LF	LF	K	k	"	s
A3	A	[illegible]	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	[illegible]	DC4	DC4	, (Comma)	
AD	F	[illegible]	CR	CR	- (Hyphen)	
AE	C	[illegible]	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	[illegible]	[illegible]	;	
BC	M	[illegible]	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)	

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