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DS3 INTERFACE MODULE (MODEL 41945) OPERATING MANUAL

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SECTION 1 GENERAL INFORMATION

1.1 MANUAL SUMMARY

This manual describes the set-ups, operating instructions, specifications, maintenance, and service information for TTC's DS3 Interface Module.

1.2 DS3 INTERFACE MODULE OVERVIEW

The DS3 Interface Module gives the FIREBERD 6000 and FIREBERD 4000 Communications Analyzers the ability to test circuits and equipment operating at the DS3 rate of 44.736 Mb/s. This Module does all of the following:

- operates in untrained, M13, and C-bit parity environments
- monitors DS3 signals using frame errors, Bipolar Violations (BPVs), and parity results
- performs full Bit Error Rate Testing (BERT) on DS3s that are out-of-service
- transmits and monitors Far End Alarm Control Codes (FEAC) sequences (e.g., alarm conditions and loopbacks)
- inserts logic errors, frame errors, and BPVs on live traffic or test patterns. Logic errors and/or BPVs can be inserted singly or at programmable rates; frame errors can be inserted consecutively, to a maximum of 15.

1.3 INTERFACE COMPATIBILITY

The DS3 Interface Module complies with the following publications and specifications:

- Bell Publication CB 1 19 — Interconnection Specification for Digital Cross-Connects
- ANSI Specification TI.403
- CCITT 44.736 MB/S RECOMMENDATIONS — APPLICABLE SECTIONS OF G.703

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1.4 CABLES

The following cables are available for use with the ~DS3 Interface Module:

Model 10830 — 440A to BNC adaptor plug

Model 10831 — 358 to BNC adaptor plug

Model 30598-01 — 10' 440A to 440A cable

Model 30598-02 — 1' 440A to 440A cable

Model 30599-01 — 10' 440A to 358 adaptor cable

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SECTION 2 PHYSICAL DESCRIPTION

2.1 INTRODUCTION

This section describes the physical features of the DS3 Interface Module.

2.2 PHYSICAL DESCRIPTION

The DS3 Interface Module has three connectors on its front panel (Figure 2-1):

- DS3 IN
- DS3 OUT
- CLOCK IN

Each is described in the section immediately following.

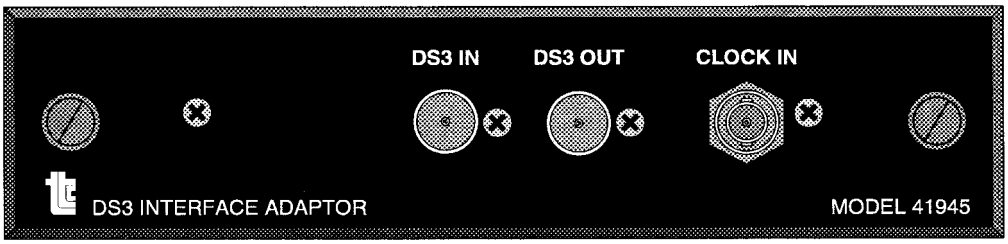


Figure 2-1. The DS3 Interface Module

NOTE

The DS3 Interface Module is controlled at the FIREBERD's front panel. If you are a FIREBERD 6000 user, see Section 3 to learn how to install, configure, and operate this Module; if you are a FIREBERD 4000 user, see Section 5.

2.2.1 DS3 IN/DS3 OUT/CLOCK IN

Designed to accept WECO 440A cables, DS3 IN is a WECO 560 connector that enables the transmission of an incoming DS3 input signal to the FIREBERD's receiver circuitry. The characteristics of this signal (DSX or HIGH) are defined in the INPUT category of the interface's set-up menu (see NOTE in Section 2.2).

DS3 OUT is a WECO 560 connector that allows the FIREBERD to transmit a DS3 signal to the circuit under test. The characteristics of this signal (DSX or HIGH) are defined in the OUTPUT category of the interface's set-up menu. Like the DS3 IN connector, DS3 OUT is designed to accept WECO 440A cables.

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CLOCK IN is a BNC input that permits an external clock source to be connected to the DS3 Interface Module. It accepts both 440A-to-BNC adaptor plugs (Model 10830) and 358-to-BNC adaptor plugs (Model 10831).

2.3 FUNCTIONAL DESCRIPTION

The DS3 Interface Module gives the FIREBERD the ability to test DS3 in Normal and Test Loopback (TLB) modes of operation. Operating modes are selected using the MODE category of the interface's set-up menu (see NOTE in Section 2.2).

2.3.1 Normal Mode

In the Normal Mode of operation, the FIREBERD performs all functions associated with in-service monitoring and out-of-service testing.

When monitoring live data, the FIREBERD analyzes DS3 traffic for frame, BPV, and parity results. This type of testing enable you to proactively maintain your network without taking your circuits and equipment out of service.

When testing out-of-service, all live traffic is removed from the DS3 circuit. In its place, the FIREBERD transmits a specific test pattern to another FIREBERD or to itself using loopbacks. The received data is then comprehensively analyzed using over 40 simultaneous test results that permit full correlation between errors and specific events. Out-of-service testing is typically performed when installing new DS3 equipment or when errors are detected during in-service monitoring.

2.3.2 Test Loopback TLB

In Test Loopback (TLB) mode, the FIREBERD retransmits received data on the transmit circuit. This enables logic errors, BPVs, or both to be inserted on live data. In TLB mode:

- The FIREBERD monitors framing and parity bits for errors in framed data
- BPVs which are not part of standard B3ZS coding are removed

2.4 SELF-LOOP OPERATION

The DS3 Interface Module includes a relay that is activated by the FIREBERD's SELF LOOP switch. When pressed, the FIREBERD's transmit signal is connected to the receive buffer. This establishes an internal loop for testing the FIREBERD and the DS3 Interface Module. The SELF LOOP switch also enables you to disconnect the FIREBERD from the DS3 circuit under test without removing cables from the interface.

NOTE

In SELF-LOOP mode, only the receiver is disconnected; thus, the transmitter can be used as per normal operation.

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SECTION 3 FIREBERD 6000 INSTALLATION AND OPERATION

3.1 INTRODUCTION

This section describes how to install, configure, and operate the DS3 Interface Module when it is used in a FIREBERD 6000. Refer to the *FIREBERD 6000 User's Guide* or the *FIREBERD 6000 Reference Manual* for mainframe operating procedures.

NOTE

To avoid unnecessary downtime, configure the FINBERD 6000 and the DS3 Interface Module before connecting to the circuit under test.

3.2 INSTALLING THE INTERFACE

To install the DS3 Interface Module, use the procedure immediately following Figure 3-1.

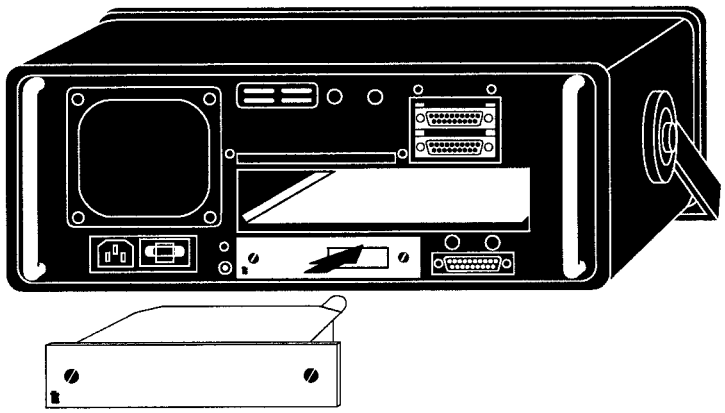


Figure 3-1. FIREBERD Interface Installation

1. Turn the FIREBERD's AC power OFF.
2. Facing the FIREBERD's rear panel, position the Module as shown in Figure 3-1 (faceplate facing out).
3. Slide the Module into the FIREBERD until the interface panel is flush with the rear panel. Make sure the interface PC board edges fit into the card guides in the mainframe.
4. Secure the interface with the thumbscrews on the interface panel.
5. Turn the FIREBERD mainframe AC power ON and configure the FIREBERD and interface as described in the following sections.

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3.3 CONFIGURING THE DS3 INTERFACE MODULE FOR FIREBERD 6000 OPERATION

To configure the DS3 Interface Module for FIREBERD 6000 use, do the following:

1. If not applied, turn the FIREBERD's AC power ON. If illuminated, press SELF LOOP to turn the switch OFF.
2. Using the appropriate cables, connect the DS3 signal source to the DS3 IN jack and the DS3 output to the DS3 OUT jack (where applicable).
3. Press the GEN CLK switch to select the signal timing source. If BNC is selected, the external clock source must be connected to *the interface's* BNC input jack.

NOTE

Since the timing mode is automatically set by the DS3 Interface Module, the TIMING MODE switch is disabled.

4. Press the MENU switch until the LED next to the INTF SETUP label is illuminated.
5. Press the DS3 softkey to select the DS3 Interface Module. Configure the interface for operation.
6. Use the MENU switch to select other test criteria.
7. Set the ANALYSIS RESULT, ANALYSIS MODE, and PRINTER switches as required.

Section 4 offers specific set-up procedures for a variety of T3 test applications.

3.4 THE DS3 INTERFACE MODULE SET-UP MENU

The DS3 Interface Module set-up menu has five selections that configure and control interface operation (Figure 3-2).

Select:	To:
CONFIG	Choose a framing format and input/output termination
MODE	Choose normal or Test Loopback (TLB) mode of operation
PATTRN	Choose a data pattern for out-of-service testing
ERRINS	Insert errors into the data stream
AUX	Do any of the following: — Configure X bits — Set the Far End Alarm Control (FEAC) codeword — Set the frame synchronization loss threshold — Determine the way parity-based results are calculated

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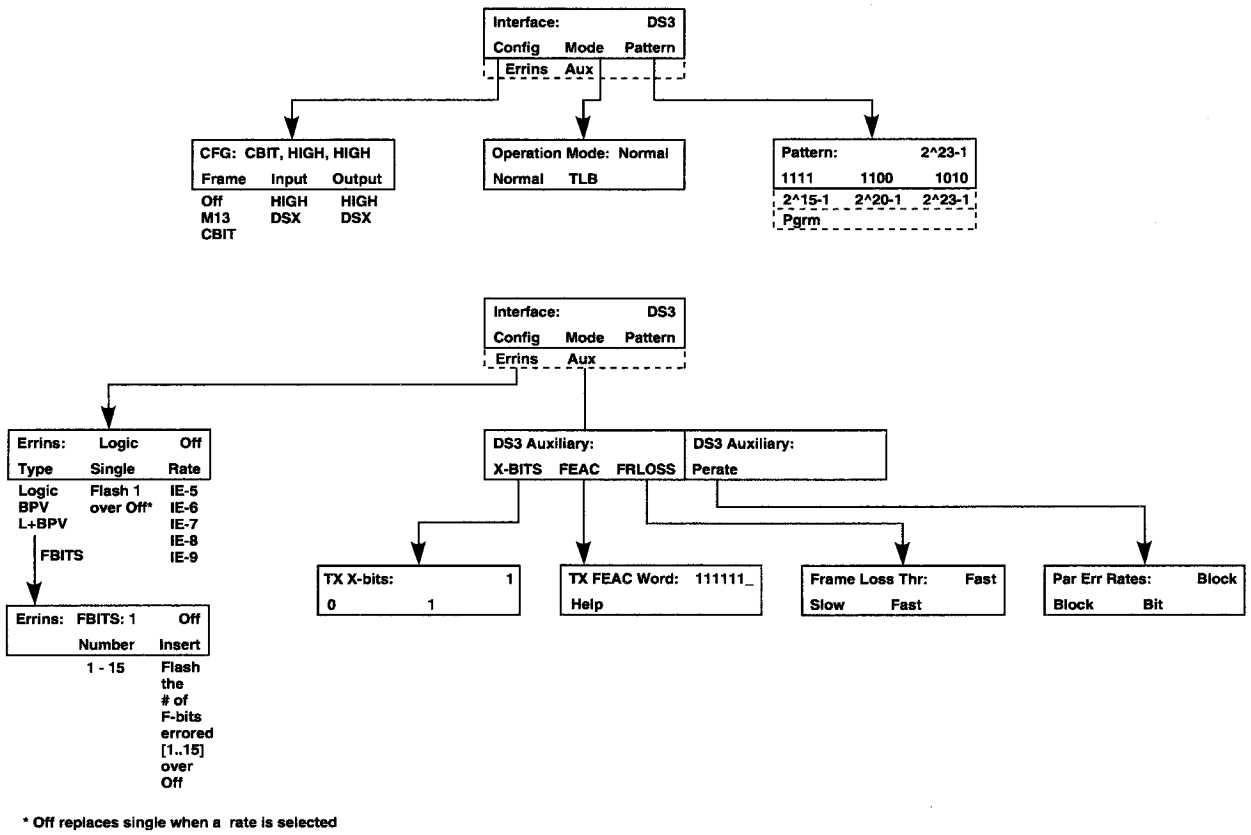


Figure 3-2. The DS3 Interface Module Set-Up Menu

3.4.1 Interface Set-Up Review

The DS3 Interface Module menu is accessed through the mainframe INTF SETUP menu. Pressing a softkey within this menu either scrolls a fist of parameters, executes a function, or provides help.

To:	**Do the Following**:
Access the DS3 Interface Module menu	Press the DS3 softkey
Select a menu function or select another menu	Press the corresponding softkey
Return to the previous menu display	Press the UP ARROW (^) key
Return to the menu's top level	Press the ENTER key

Some menus require additional information to be entered via the mainframe keypad. When the information is correct, press the ENTER key to store the information in memory.

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3.4.2 CONFIGURATION Menu

CONFIG - The CONFIGURATION menu allows you to select the framing format, input signal termination, and output signal termination. CBIT is the default selection.

FRAME - Select the framing format for transmission and analysis.

OFF - UNFRAMED format. No framing bits are added during transmission and no data bits are stripped when received. Select for DS3 circuits where framing is not required.

M13 - Select when testing DS3 circuits that use the Ml3 framing format. See Appendix B for a technical description of this format.

CBIT - Select when testing DS3 circuits that use the C-Bit framing format. See Appendix B for a technical description of this format.

INPUT - Select the input gain and equalization. HIGH is the default selection. Refer to Table 3-1 to learn how input gain and equalization are defined.

HIGH - Select high input termination. Select when terminating or monitoring a HIGH level signal directly at the output of a DS3 terminal.

DSX - Select DSX input termination. Select when terminating or monitoring signals at a DS3 Cross-Connect (DSX-3).

OUTPUT - Select output pulse shape and amplitude. HIGH is the default selection. Refer to Table 3-1to learn how output pulse shape and amplitude are defined.

HIGH - Select high (normal) signal output termination. When selected, the DS3 output signal consists of rectangular pulses of approximately 0.9 volts peak.

Table 3-1. Input and Output Level Settings

Access Point:	Description	Set INPUT To:	Set OUTPUT To:
Mux output	Signal may be at HIGH level if there is 450 feet of cabling to the crossconnect	HIGH	DSX
Mux Input	Typically originates from a DSX-3 bay at the DSX level, and modified by any interconnecting cable attenuation	DSX	DSX
DSX-3	Signal at the IN and OUT jack is at the DSX level, and is attenuated by 20 dB at the MON jack	DSX	DSX
Transmission Equipment Input	Signal at the DSX level is modified by any attenuation from interconnecting cables.	DSX	DSX

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Table 3-1. Input and Output Level Settings (Continued)

Access Point:	Description	Set INPUT To:	Set OUTPUT To:
Transmission Equipment Output	Signal may be at HIGH level if there are 450 feet of cabling to the cross-connect	HIGH	HIGH
	If cable interconnections are short, this signal is at the DSX level	DSX	DSX

DSX - Select DSX output termination. When selected, the DS3 output signal meets the requirements set forth in AT&T Compatibility Bulletin 11 9 for use at a DSX-3. (The DSX signal is equivalent to the HIGH signal when passed through 450 feet of 728A coaxial cable attenuation.) This output signal has a sawtooth shape, with an amplitude of approximately 0.5 volts peak.

3.4.3 MODE Menu

MODE - The MODE menu allows you to select an interface operating mode. NORMAL is the default selection.

NORMAL - Standard operating mode. Select NORMAL to perform the standard activities associated with the in-service monitoring or out-of-service testing of T3 circuits and equipment. *The only activity that cannot be performed in NORMAL mode is the insertion of errors on live traffic* (see TLB).

TLB - Test Loopback mode. Select TLB to insert logic errors, BPVs, or both on live data. In this mode, the FIREBERD retransmits received data on the transmit circuit and monitors framing and parity bits for errors in framed data. *Frame errors cannot be inserted in TLB mode.*

3.4.4 PATTERN Menu

PATTRN - The PATTERN menu allows you to select a data pattern for out-of-service testing. 2^{23}-1 is the default selection.

1111 - Fixed “all marks” pattern. Provides low stress as a result of its high pulse density.

1100 - Fixed pattern of two marks followed by two spaces. Provides the equivalent of an idle signal when either Ml3 or C-bit framing is selected. When specified, **<IDLE>** is displayed on the status line.

1010 - Fixed pattern of one mark and one space. Provides the equivalent of a blue (AIS) signal when either Ml3 or C-bit framing is selected. When specified, **<BLUE>** is displayed on the status line.

2^{15}-1 - 32,000-bit pseudorandom pattern with a maximum of 14 sequential zeroes and 15 sequential ones. Provides compatibility with older DS3 test equipment.

2^{20}-1 - One million-bit pseudorandom pattern with a maximum of 19 sequential zeroes and 20 sequential ones.

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2^{23}-1 - Eight million-bit pseudorandom pattern with a maximum of 22 sequential zeroes and 23 sequential ones. Recommended for general purpose testing and qualifying. Provides an excellent simulation of live data.

PRGM - Choose a customized, user-programmed pattern. These patterns can be 3 to 24 bits long, and are created using the FIREBERD 6000's Auxiliary Function 33. See Section 4 of the *FIREBERD Reference Manual* to learn more about this function.

NOTE

When the DS3 Interface Module is active, patterns are only selectable through the INTF SETUP menu; the DATA switch on the FIREBERD's front panel is disabled.

3.4.5 ERROR INSERT Menu

ERRINS - The ERROR INSERT menu allows you to insert BPV, logic, or frame errors into the data stream. Logic errors and BPVs may be inserted singly or at a selected rate; frame errors may be inserted singly or consecutively, to a maximum of 15.

TYPE - select logic errors, BPVs, logic errors and BPVs, or frame errors for insertion into the data stream.

OFF - turn off single error insertion. OFF only appears as a softkey choice when RATE is the current selection.

SINGLE - insert a single error into the data stream. The error inserted can be a logic error, BPV, or logic error and BPV, based on the current TYPE selected.

RATE - select the BPV and/or LOGIC error insertion rate. The error insertion rate can be within the range 1E-5 to 1E-9. Press the RATE softkey until the desired value appears in the upper right corner of the display.

NUMBER - select the number of consecutive frame errors to be inserted into the data stream. Press the NUMBER softkey until the desired value appears next to **FBITS**: (located immediately above the softkey). The valid range is 1-15. NUMBER appears only when FBITS is the currently selected TYPE.

INSERT - insert frame errors into the data stream, based on the value specified using the NUMBER softkey. Frame errors are not inserted in unframed mode (i.e., FRAME = off). INSERT appears only when FBITS is the currently selected TYPE.

NOTE

When the DS3 Interface Module is active, error insertion is only controllable through the INTF SETUP menu; the ERROR INSERT switch on the FIREBERD's front panel is disabled.

3.4.6 AUXILIARY Menu

AUX - The AUXILIARY menu allows you to configure four additional interface functions, as follows:

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X-BITS - select 0 or 1as the transmitted X-bit for framed applications. When C-bit framing is specified, and 0 is selected as the transmitted X-bit, **<YELLOW>** is displayed to indicate that the FIREBERD sends a yellow alarm under this criteria. One (1) is the default selection.

FEAC - transmit the alarm or loopback code of your choice by editing the last six digits of the Far-End Alarm Control (FEAC) codeword. The left and right arrow keys (< and >) on the MENU keypad position the cursor under the bit you wish to edit; the 0 and 1 keys edit the binary digits as required. 111111 is the default selection. Table 3-2 lists many of the FEAC codes that you can specify using this auxiliary function.

FR LOSS - set the frame synchronization loss criteria. FAST sets the frame synchronization loss criteria at 3 of 15 frame bits in error *or* 2 of 3 M bits in error in a single frame; SLOW sets the frame synchronization loss criteria at 6 of 15 frame bits in error in a single frame. When exceeded, the FIREBERD's FRM SYNC LED does not illuminate. FAST is the default selection.

Table 3-2. Transmittable FEAC Codes

Code	Meaning
000111	Line Loopback Activate
011100	Line Loopback Deactivate
011011	DS3 Line
011001	DS3 Equipment Failure (Type 1)
001110	DS3 Signal Loss/High Bit Error Rate
000000	DS3 Out-Of-Frame
010110	DS3 Alarm Indication Signal Received
011010	DS3 Idle Code Received
001111	DS3 Equipment Failure (Type 2)
011101	Common Equipment Failure (Type 2)
010101	Multiple DS1Loss/High Bit Error Rate
000101	DS1 Equipment Failure (Type 1)
011110	Single DS1 Loss/High Bit Error Rate
000011	DS1 Equipment Failure (Type 2)

NOTE

Type 1 equipment failures affect service; Type 2 equipment failures do not affect service.

PERATE - select the way that parity error rate results are calculated. When BLOCK is specified, parity error, C-bit parity error, and Far-End Block Error (FEBE) rates are calculated on an *errors per frame* basis; BITS calculates these measurements on *an errors per data bit* basis, which provides an approximation of the bit error rate. The resulting rate equations follow (based on 28 framing bits and 4704 data bits per M frame):

$$\text{BLOCK RATE: } \frac{\text{errors}}{\text{frame bits}/28} = \frac{28 * \text{errors}}{\text{frame bits}}$$

$$\text{BIT RATE: } \frac{\text{errors}}{\text{frame bits}/28 * 4704} = \frac{\text{errors}}{168 * \text{frame bits}}$$

BLOCK is the default selection.

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3.5 FIREBERD 6000 TEST RESULTS

Table 3-3 lists the test results that are available when the DS3 Interface Module is installed in the FIREBERD 6000. Refer to the *FIREBERD 6000 Reference Manual* for the test results definitions not described in this section.

Table 3-3. FIREBERD 6000 Analysis Results

Category	Displayed Result	Description
ERROR	BIT ERRS	Bit Errors
	BER	Test Interval Bit Error Rate
	AVG BER	Average Bit Error Rate
	PAT SLIP	Pattern Slips
PERFORMANCE	GERR SEC	G.821 Errored Seconds
	G EFS	G.821 Error-Free Seconds
	G %EFS	G.821 Percent Error-Free Seconds
	DEG MIN	Degraded Minutes
	%DEG MIN	Percent Degraded Minutes
	SES	Severely Errored Seconds
	%SES	Percent Severely Errored Seconds
	UNA SEC	Unavailable Seconds
	AVL SEC	Available Seconds
	%AVL SEC	Percent Available Seconds
	ERR-SES	Bit Errors Less Severely Errored Seconds
	BER-SES	Bit Error Rate Less Severely Err. Secs.
TIME	PATL SEC	Pattern Synchronization Loss Seconds
	%PAT SEC	Percent Pattern Synchronization Seconds
	SIGL SEC	Signal Loss Seconds
	ELAP SEC	Elapsed Seconds
	EA SEC	Error Analysis Seconds
	ERR EAS	Errored Error Analysis Seconds
	EF EAS	Error-Free Error Analysis Seconds
	CPE S A	C-Bit Parity Errored Seconds (Type A)
	CPE S B	C-Bit Parity Errored Seconds (Type B)
	CPE S C	C-Bit Parity Errored Seconds (Type C)
	FEBE S A	Far-End Block Errored Seconds (Type A)
	FEBE S B	Far-End Block Errored Seconds (Type B)
	FEBE S C	Far-End Block Errored Seconds (Type C)
	BPV SEC	BPV Errored Seconds
	BPV %EFS	Percent BPV Error-Free Seconds
	DATE	Calendar Date
	TIME	Time of Day
SIGNAL	RCV FREQ	Receiver Frequency
	GEN FREQ	Generator Frequency

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Table 3-3. FIREBERD 6000 Analysis Results (Continued)

Category	Displayed Result	Description
T-CARRIER	BPVs	Bipolar Violations (BPVs)
	BPV Rate	Test Interval BPV Rate
	AVG BPVR	Average BPV Rate
	FRA ERR	Frame Errors
	AVG FER	Average Frame Error Rate
	FE Rate	Frame Error Rate
	FRA LOSS	Frame Loss
	PAR ERR	Parity Errors
	AVG PER	Average Parity Error Rate
	PAR E Rt	Test Interval Parity Error Rate
	CPAR ERR	C-Bit Parity Errors
	AVG CPER	Average C-Bit Parity Error Rate
	CP E Rt	Test Interval C-Bit Parity Error Rate
	FEBE	Far End Block Errors (FEBEs)
	AVG FEBE	Average FEBE Rate
	FEBE Rt	Test Interval FEBE Rate
	RCV FEAC	Received Far End Alarm Control Code
	RX X1:X2	Received X bits
ALARM	PAT LOSS	Pattern Synchronization Losses
	SIG LOSS	Signal Losses
	FEOOF S	Far End Out-Of-Frame Seconds
	NEOOF S	Near End Out-Of-Frame Seconds
	PWR LOSS	Power Losses

The results that are unique to the DS3 Interface Module are described below. See the *FIREBERD 6000 Reference Manual for* a description of the results that are common to all modular interfaces.

3.5.1 TIME Results Category

CPE S A - C-Bit Parity Errored Seconds (Type A)
The number of seconds in which a single C-bit parity error was received. This result appears only when C-bit framing is selected.

CPE S B - C-Bit Parity Errored Seconds (Type B)
The number of seconds in which 2-44 C-bit parity errors were received. This result appears only when C-bit framing is selected.

CPE S C - C-Bit Parity Errored Seconds (Type C)
The number of seconds in which more than 44 C-bit parity errors were received. This result appears only when C-bit framing is selected.

FEBE S A - Far End Block Errored Seconds (Type A)
The number of seconds in which a single FEBE was received. This result appears only when C-bit framing is selected.

FEBE S B - Far-End Block Errored Seconds (Type B)
The number of seconds in which 2-44 FEBEs were received. This result appears only when C-bit framing is selected.

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FEBE S C - Far-End Block Errored Seconds (Type C)
The number of seconds in which more than 44 FEBEs were received. This result appears only when C-bit framing is selected.

3.5.2 T-CARRIER Results Category

BPVs - Bipolar Violations
The number of bipolar violations that are *not pail of B3ZS encoding.* The Bipolar Violation Rate (BPV RATE) and Average Bipolar Violation Rate (AVG BPVR) are calculated on a per bit basis. The DS3 Interface Module also computes Bipolar Violation Seconds (BPV SEC) and the percent of Bipolar Violation Error-Free Errored Seconds (BPV %EFS); both are available in the TIME results category.

FRA ERR - Frame Errors
The number of errored frame bits counted since the start of the test. The Frame Error Rate (FE RATE) and Average Frame Error Rate (AVG FER) are calculated on a per frame bit basis. This result is displayed only when M13 or C-bit framing is selected.

PAR ERR - Parity Errors
The number of parity errors counted since the start of the test. A parity error is counted when a received parity bit does not match the parity of the previous frame. The Parity Error Rate (PAR E Rt) and Average Parity Error Rate (AVG PER) are calculated as specified in Section 3.4.6. This result is displayed only when M13 or C-bit framing is selected.

CPAR ERR - C-Bit Parity Errors
The number of C-bit parity errors counted since the start of the test. A C-bit parity error is counted when a received C-bit does not match the parity of the previous frame. The C-Bit Parity Error Rate (CP E Rt) and Average C-Bit Parity Error Rate (AVG CPER) are calculated as specified in Section 3.4.6. This result is displayed only when C-bit framing is selected.

FEBE - Far End Block Errors
The Number of FEBEs counted since the start of the test. A FEBE is counted when a received FEBE bit is set to 0. The FEBE Error Rate (FEBE Rt) and Average FEBE Error Rate (AVG FEBE) are calculated as specified in Section 3.4.6. This result is displayed only when C-bit framing is selected.

RX X1:X2 - Received X-Bits
The current value of the received Xl and X2 bits (i.e., 0 or 1). This results is displayed only when M13 or C-bit framing is selected.

RCV FEAC - Received Far End Alarm Control Code
The significant six bits of the currently received FEAC word (two bytes in length). This result appears only when C-bit framing is selected. RCV FEAC offers a series of defined status words, *where an eight-character mnemonic is displayed in lieu of the six-bit code.* These six-bit codes, associated mnemonics, and their meanings are described in Table 3-4.

Table 3-4. C Status Words

Code	Mnemonic	Meaning
011001	DS3 EQFI	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

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Table 3-4. C Status Words (Continued)

Code	Mnemonic	Meaning
001111	DS3 EQF2	DS3 Equipment Failure (Type 2)
011101	COM EQF2	Common Equipment Failure (Type 2)
010101	MDSI LOS	Multiple DS1 Loss/High Bit Error Rate
000101	DS1 EQF1	DS1 Equipment Failure (Type 1)
0~11110	DS1 LOS	Single DS1 Loss/High Bit Error Rate
000011	DS1 EQF2	DS1 Equipment Failure (Type 2)

NOTE

Type 1 equipment failures affect service; Type 2 equipment failures do not affect service.

3.5.3 ALARM Status Category

FEOOF S - Far-End Out-Of-Frame Seconds
The number of seconds in which the far-end of a DS3 circuit is out of frame synchronization. This result is calculated as the number of seconds where a yellow alarm is received.

NEOOF S - Near-End Out-Of-Frame Seconds
The number of seconds in which the DS3 Interface Module is out of frame synchronization or an Alarm Indication Signal (AIS, also known as the *blue alarm)* is received. This result appears only when M13 or C-bit framing is selected.

3.6 INTERFACE STATUS INDICATORS

The DS3 Interface Module uses the FRM SYNC, CODE, ALM 1, ALM 2 LEDs as status indicators, as shown in Table 3-5.

Table 3-5. DS3 Status Indicators

Status Indicator:	Illuminates When:
FRM SYNC	The DS3 Interface Module has synchronized to the appropriate framing format (M13 or C-bit)
CODE	The idle signal is received
ALM1	A yellow alarm is received (i.e., X1 and X2 bits are both set to zero)
ALM2	A blue signal is received (i.e., C-bits are set to zero and 1000 bits of the 1010 pattern are detected)

NOTE

For remote control applications, the ALM1 and ALM2 indicators also map to the IEEE 488.2 interface status, history, and loss registers in bit positions 3 and 2, respectively.

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3.7 FIREBERD 6000 PRINTER OPERATION

Figure 3-3 and Figure 3-4 respectively depict a typical DS3 Interface Module Controls and Results printout. Refer to the *FIREBERD 6000 Reference Manual* for printer set-up and operating instructions.

```
CONTROLS            PRINT
10:44:04       16 OCT 91    SITE Alpha
DATA:                MARK    ERROR INS:          OFF
SELF LOOP:             ON    GEN CLOCK:        SYNTH
TIMING MODE:          N/A    SYN FRQ:     8.956 kHz
INTF ISUL SLOT1:             DS3
FRAME:               CBIT    INPUT:             HIGH
OUTPUT:              HIGH    MODE:            NORMAL
PATTERN:           2^23-1    ERR INS:            OFF
ERR TYPE:           LOGIC    X BITS:               I
FEAC WORD:         111111    FRLOSS THR:        FAST
PERR RATES:         BLOCK    TEST INT:          10^5
PRINT EVENT:         NORM    TEST INT PRNT:      OFF
SYNC LOSS PRNT:       OFF    ERROR PRNT          OFF
TIME PRNT:            OFF    ANALY MODE:         CON
DISPLAY HOLD:         OFF    BLOCK LENGTH:
                1000 BITS    DELAY: DTR/        DTR/
XON CHARACTER:         11    XOFF CHARACTER:     13
AUX FUNC IN USE:             NONE
PRINT SPEED:         FAST    PRINT TERM:      CR LF
REMOTE:              NONE    PRINTER:        RS-232
RS-232:                      DATA BITS:           8
BAUD                 9600    PARITY:           NONE
```

Figure 3-3. Controls Printout

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MANUAL	PRINT		
09:55:02	25 SEP 91	SITE ID	Alpha
BIT ERRS	0	AVG BER	0. E-10
BER	0. E-04	PAT SLIP	0
EA EAS	394	ERR EAS	0
EF EAS	394	BPVs	0
AVG BPVR	0. E-10	BPV Rate	0. E-05
BPV SEC	0	BPV %EFS	100.00%
FRA ERR	0	AVG FER	0. E-02
FE RATE	0. E~-02	PAR ERR	0
AVG PER	0. E~-06	PAR E Rt	0. E-01
CPAR ERR	0	AVG CPER	0. E-06
CP E Rt	0. E-01	CPE S A	0
CPE S B	0	CPE S C	0
FEBE	0	AVG FEBE	0. E-06
FEBE Rt	0. E-01	FEBE S A	0
FEBE S B	0	FEBE S C	0
RCV FREQ	44736460	GEN FREQ	44736090
RCV FEAC	111111	RX X1:X2	1:1
PAT LOSS	0	PATL SEC	0
%PAT SEC	100.00%	FRA LOSS	0
SIG LOSS	0	SIGL SEC	0
PWR LOSS	0	NEOOF S	0
FEOOF S	0	ERR-SES	0
BER-SES	0. E-10	GERR SEC	0
G EFS	3.94	G %EFS	100.00%
UNA SEC	0	AVL SEC	394
%AVL SEC	100.00%	DEG MIN	0
%DEG MIN	0.00%	SES	0
%SES	0.00%	ELAP SEC	394
FRAME SYNC	PRESENT	IDLE SIGNAL	NO
YELLOW ALARM	NO	BLUE SIGNAL	NO
IF	DS3		

Figure 3-4. Results Printout

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3.8 FIREBERD 6000 REMOTE CONTROL COMMANDS

The FIREBERD 6000 features remote control of the DS3 Interface Module using the remote control commands listed in Table 3-6. The spacing used on each command line must be used as indicated. For detailed instructions on remotely controlling the FIREBERD 6000, refer to the *FIREBERD 6000 Reference Manual.*

Table 3-6. DS3 Interface Module Remote Control Commands

Remote Command	Result
INTF:DS3:CONFIG:FRAME? INTF:DS3:CONFIG:FRAME [OFF|M13|CBIT]	Show the current framing selection Set framing
INTF:DS3:CONFIG:INPUT? INTF:DS3:CONFIG:INPUT [HIGH|DSX]	Show current input selection Set input
INTF:DS3:CONFIG:OUTPUT? INTF:DS3:CONFIG:OUTPUT [HIGH|DSX]	Show current output selection Set output
INTF:DS3:MODE? INTF:DS3:MODE [NORMAL|TLB]	Show current mode of operation Set mode of operation
INTF:DS3:PATTERN? INTF:DS3:PATTERN [1111|1100|1010|2^15-1| 2^20-1|2^ 23-1|PRGM]	Show current data pattern Set data pattern
INTF:DS3:ERR_INSERT? INTF:DS3:ERR_INSERT [OFF|BPV|LOGIC| L+BPV|SINGLE|RATE] INTF:DS3:ERR_INSERT:FBIT (number)	Show current error insertion-type Set the error insertion-type Select F-bit error insertion (1-15)
INTF:DS3:ERR_RATE? INT'F:DS3:ERR_RAT'E [1E-5|1E-6|1E-7|1E-8|1E-9]	Show current error insertion rate Set error insertion rate
INTF:DS3:AUX:X_BITS? INT'F:DS3:AUX:X_BITS [0|1]	Show current X bit value Set current X bit value
INTF:DS3:AUX:FEAC? INTF:DS3:AUX:FEAC (six-bit string)	Show current FEAC codeword Set six-bit FEAC codeword
INTF:DS3:AUX:FRLOSS_THR? INTF:DS3:AUX:FRLOSS_THR [SLOW|FAST]	Show current frame sync loss threshold Set frame sync loss threshold
INTF:DS3:AUX:PERR_RATES? INTF:DS3:AUX:PERR_RATES [BLOCK|BIT]	Show current method of calculating parity results Set method of calculating parity results

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SECTION 4 FIREBERD 6000 APPLICATIONS

4.1 INTRODUCTION

This section describes how the FIREBERD 6000 can be used in a variety of test applications when the DS3 Interface Module is installed in the instrument's rear panel (or an Interface Switching Unit). Test and instrument set-ups are provided for the following applications:

- In-service monitoring of DS3 circuits and equipment using M13 and C-bit framing
- Out-of-service testing
- Stress testing of T3 multiplexers prior to installation

The information that follows requires a working knowledge of the DS3 Interface Module and the FIREBERD 6000. If you are unfamiliar with the Interface Module, see Section 3 of this manual; if you are unfamiliar with the FIREBERD 6000, see the *FIREBERD 6000 Reference Manual.*

4.2 IN-SERVICE MONITORING

The FIREBERD can be used to monitor live DS3 traffic while circuits and equipment are in-service. In-service monitoring is performed at a Digital Cross-Connect (DSX-3) access point, where a cable can be connected from the DS3 IN jack on the FIREBERD-installed DS3 Interface Module to the MONITOR jack on the DSX patch bay.

The way in which the performance of your T3 circuits and equipment can be measured in-service is determined by the framing format of your network. The sections that follow describe in-service monitoring techniques for M13 and C-bit framing formats.

4.2.1 Monitoring M13-Framed Networks

For networks with the M13 framing format, you can use a FIRIEBERD to monitor a section of your T3 network for certain types of errors. For example, Figure 4-1 shows that a DSX-3 multiplexer or DSX-3 span can be monitored as a means of troubleshooting a local problem.

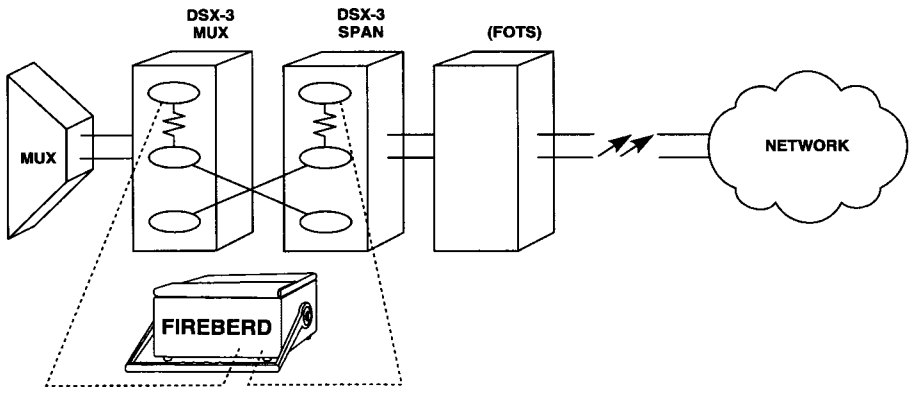


Figure 4-1. Troubleshooting a Local Problem

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When troubleshooting local problems in an M13-framed network, these error measurements are significant:

- Parity errors (PAR ERR)
- Bipolar violations (BPVs)
- Frame errors (FRA ERR)

4.2.1.1 Parity Errors

Parity errors strongly indicate incorrect data, which can be caused by faulty equipment within the section of the T3 network under test. The FIREBERD tallies a parity error when the parity values of the transmitting and receiving DS3 equipment do not match (see Section B. 1 for a complete explanation of parity).

The major limitation of parity is that higher-order transmission systems may recalculate P-bits at intermediate points in a T3 network. Thus, although parity errors are very useful for troubleshooting a particular section of your network, they should not be used to monitor end-to-end performance.

4.2.1.2 BPVs

BPVs can signal any of the following:

- Bad termination
- A faulty coaxial cable
- A failing DS3 terminal

The FIREBERD tallies a BPV when the rules of bipolar pulse coding are violated; intentional violations that are part of zero substitution code are not tallied. Like parity errors, BPVs cannot pass through higher-order transmission systems. As such, they cannot be used to measure overall T3 network performance.

4.2.1.3 Frame Errors

Frame errors can be monitored to indicate a high error rate within the section of the T3 network under test. The FIREBERD tallies a frame error when it detects a deviation from the expected framing bit (i.e., F-bit) sequence. Because F-bits represent less than 1% of all bits in an M 13-framed DS3 signal, performance calculations based on framed errors are valid only at high error rates.

4.2.2 Monitoring C-Bit-Framed Networks

Networks using the C-bit framing format have enhanced in-service monitoring capabilities. Like M13-framed networks, you can troubleshoot local problems by monitoring for BPVs and frame errors. However, the performance of C-bit-framed DS3 networks can also be monitored end-to-end using these measurements:

- C-bit parity errors (CPAR ERR)
- Far-end bit errors (FEBE)

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4.2.2.1 C-Bit Parity Errors

C-bit parity errors are strong indicators of the end-to-end performance of your DS3 network because, unlike Ml3 parity errors, they are not recalculated by intermediate equipment along the transmission path. The FIREBERD tallies a C-bit parity error when the parity values of the transmitting and receiving T3 equipment do not match. (See Section B.2 for a complete explanation of C-bit parity.)

C-bit parity (CP) bits can be monitored at any point in your T3 network, and are useful for sectionalizing problems at specific network locations. As such, standard P-bit parity errors are usually ignored in C-bit framed systems.

4.2.2.2 FEBEs

FEBEs are useful for end-to-end troubleshooting. The FIREBERD tallies a FEBE when it detects a three-bit FEBE value of 000. This value is assigned by network equipment when a C-bit parity error or frame error is detected. (See Section B.2 for a more detailed explanation of C-bit parity.)

Like CP bits, FEBEs can be monitored at any point in your T3 network. Although they are useful for sectionalizing problems to the transmit or receive side, they cannot pinpoint problems to specific networks locations.

4.2.2.3 How C-Bit Parity Errors and FEBEs Work

Figure 4-3 illustrates how C-bit parity errors and FEBEs actually work. The drawing shows errors occurring between Monitor A and Monitor B on the *West-Transmit-to-East-Receive* leg of a T3 network. These errors have caused the C-bit parity calculated at Monitor B to differ from that calculated at Monitor A. As a result, C-bit parity errors are detected at Monitor B and Monitor C, and the EAST terminal generates a FEBE that is detected on all monitor points on the *East-Transmit-to-West-Receive* leg of the T3 network.

By counting C-bit parity and FEBE errors, both EAST and WEST terminals can track network performance in both directions of transmission. Similarly, a FIREBERD located at either terminal can measure performance in either direction by monitoring the receive (incoming) signal for C-bit parity errors and FEBES.

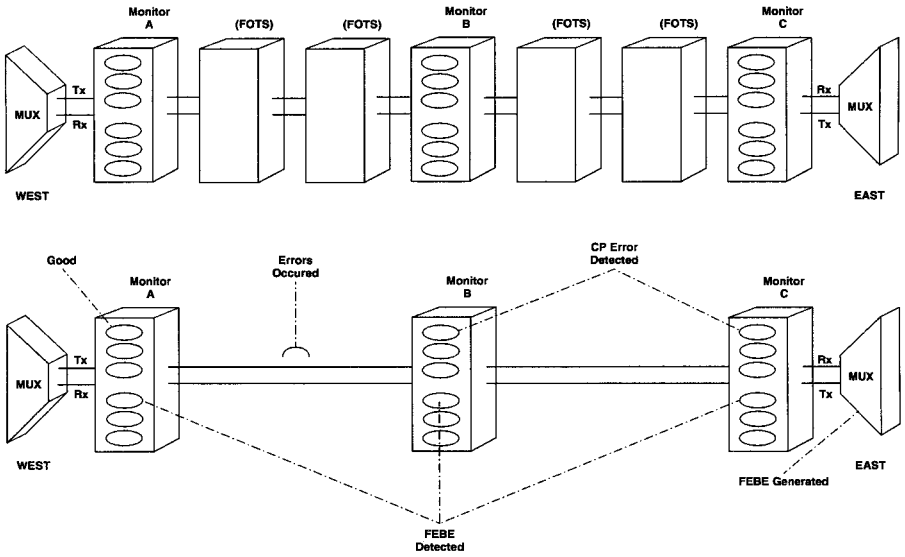


Figure 4-2. How C-Bit Parity Errors and FEBEs Work

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4.2.3 Setting Up The FIREBERD 6000 For In-service Monitoring

To perform in-service monitoring at a DSX-3 Patch Bay, follow the procedures described in Table 4-1.

Table 4-1. In-Service Monitoring Set-Up Procedure

Step	Activity
1.	With the power to the FIREBERD 6000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 6000. **NOTE:** If the FIREBERD 6000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Using the MENU switch; a. Configure the DS3 Interface Module using INTF SETUP. Make these selections by pressing the MENU softkeys underneath their display. 1. DS3 to select the DS3 Interface Module. 2. CONFIG to access the configuration menu. 3. FRAME to select framing (OFF, Ml 3, or CBIT). 4. Δ INPUT to select DSX input gain and equalization. 5. MODE to enter the mode menu. 6. NORMAL to select normal mode of operation.
4.	Set the ANALYSIS MODE switch to the CONTINUOUS position.
5.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the MONITOR jack on the DSX patch bay.
6.	Press the FIREBERD's RESTART switch to clear all results counters.
7.	Verify that the FRM SYNC LED (below the SYNC LOST LED on the FIREBERD's front panel) is illuminated.
8.	If monitoring an M13-framed network, set the left half of the ANALYSIS RESULTS switch to PAR ERR (in the T-CARRIER category); set the right half of the ANALYSIS RESULTS switch to either BPV or FRA ERR (also in the T-CARRIER category). If monitoring a C-bit-framed network, set the left half of the ANALYSIS RESULTS switch to CPAR ERR (in the T-CARRIER category); set the right half of the ANALYSIS RESLTLTS switch to FEBE (also in the T-CARRIER category).

Legend:

Δ = Press the UP ARROW key

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4.3 OUT-OF-SERVICE TESTING

The FIREBERD can be used to test T3 circuits and equipment out-of-service. Out-of-service testing is so named because live traffic must be removed from the DS3 link before analysis can begin. In its place, the FIREBERD transmits a specific data pattern either to another FIREBERD or to itself via loopback. Any deviations from the transmitted pattern are tallied as *bit errors* or *pattern slips* by the receiving test instrument.

This section describes these out-of-service tests:

- Out-of-service testing using far-end loopbacks
- Isolating problems out-of-service using two FIREBERDs
- Installing a fiber optic or microwave system
- Testing multiplexers

When performing any out-of-service test, these error measurements are significant:

- Bit errors (BIT ERR)
- Receive frequency (RCV FREQ)
- Pattern slips (PAT SLIP)

Bit Errors

Bit errors are the basic performance evaluator in out-of-service testing. The FIREBERD tallies a bit error when the received value of a bit is the opposite of what is expected (i.e., zeros that should be ones and vice versa).

Receive Frequency

The valid receive frequency for a DS3 signal is 44.736 MHz ±880 Hz. Values outside of this frequency range indicate that the far-end DS3 multiplexer's transmitter card or cable is faulty.

4.3.1 Out-of-Service Testing Using Far-End Loopbacks

Figure 4-3 shows a FIREBERD connected to the near-end DSX-3 cross-connect panel. After a loopback is established at the far-end DSX-3 cross-connect panel, the FIREBERD transmits a pseudorandom pattern across the T3 link. The loopback enables the pattern to be returned to the FIREBERD on the receive side of the link for analysis.

NOTE

Far-end loopbacks can be established manually, or can be established by the FIREBERD when you specify the appropriate FEAC control code sequence.

Using far-end loopback testing techniques, a single FIREBERD can evaluate the general performance of a T3 span. The presence of bit errors in a far-end loopback test is an indication of a problem in some portion of the DS3 span. Point-to-point testing (Section 4.3.2) is required so that the faulty card or cable can be isolated and replaced.

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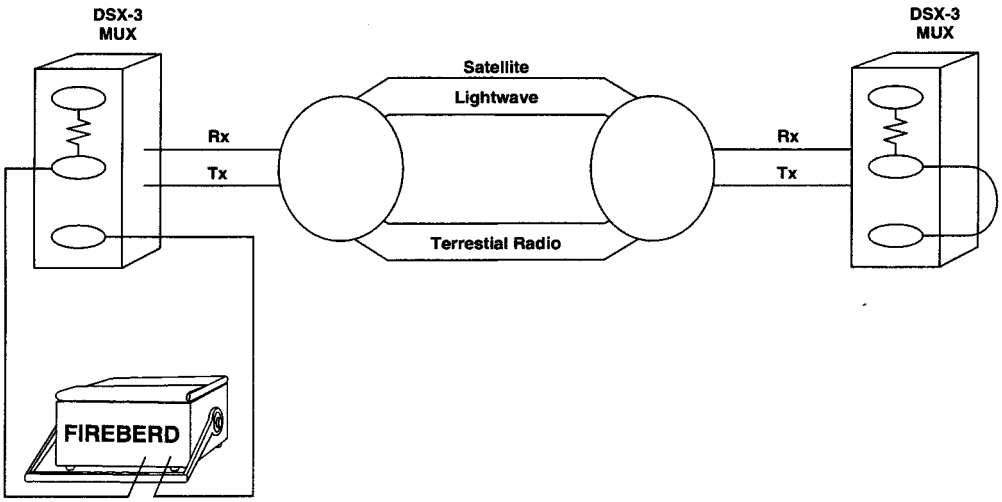


Figure 4-3. Out-of-Service Testing Using Far-End Loopbacks

NOTE

Loopback tests cannot isolate a problem to a specific direction.

Setting Up The FIREBERD 6000 For a Far-End Loopback Test

To set up the FIREBERD for a far-end loopback test, follow the procedures described in Table 4-2.

Table 4-2. Far-End Loopback Test Set-Up Procedure

Step	Activity
1.	With the power to the FIREBERD 6000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 6000. If the FIREBERD 6000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Set the GEN CLK switch to the SYNTH position to derive the transmit clock from the interface's internal crystal.
4.	Using the MENU switch: a. Configure the DS3 Interface Module using INTF SETUP. Make these selections by pressing the MENU softkeys underneath their display. 1. DS3 to select the DS3 Interface Module. 2. CONFIG to access the configuration menu. 3. FRAME to select framing (OFF, M13, or CBIT). 4. INPUT to select DSX input gain and equalization. 5. Δ OUTPUT to select DSX output termination. 6. MODE to enter the mode menu. 7. Δ NORMAL to select normal mode of operation. 8. **MORE** PATTRN to enter the pattern menu. 9. Δ + **MORE** 2^23-1 to select the 2^23-1 pattern.

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Table 4-2. Far-End Loopback Test Set-Up Procedure (Continued)

Step	Activity
4. cont	10. AUX to enter the auxiliary menu. 11. FEAC to select the Far-End Alarm Control menu. 12. Enter the six-bit FEAC loop-up code to establish far-end loopback. **NOTE:** When the test is complete, enter the six-bit FEAC loop-down code to terminate the far-end loopback. b. If hardcopy test results are desired, set the print event criteria using PRINTEVENT, then enable the printer control block (located to the left of the POWER switch) by setting the OFF/ON switch to the ON position.
5.	Set the ANALYSIS MODE switch for a CONTINOUS test or a SINGLE timed test. If SINGLE is selected, define the test length using the TIMED softkey, available in the TEST INTERVAL category of the MENU switch.
6.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the IN jack on the DSX-3 patch bay. Connect another cable from the DS3 OUT jack on the Module to the OUT jack on the DSX-3 patch bay.
7.	Set the left half of the ANALYSIS RESULTS switch to the BIT ERR position (in the ERROR category); set the right half of the ANALYSIS RESULTS switch to the RCV FREQ position (in the signal category).
8.	Check frame and pattern synchronization by verifying that the FRM SYNC and SYNC LEDs on the FIREBERD's front panel are illuminated, and reading the pattern slips result in the ERROR category.
9.	Press the FIREBERD's RESTART switch to clear all results counters.

Legend:

Δ = Press the UP ARROW key
MORE = Press the MORE key

4.3.2 Point-To-Point Out-of-Service Testing

When bit errors are detected in a far-end loopback test, point-to-point testing is conducted to isolate and repair the problem. Two FIREBERDs are required in point-to-point testing - one at the near-end and one at the far-end DSX-3 (Figure 4-4). With each instrument transmitting and receiving, the part of the T3 link that is creating the problem can be identified, and the faulty card or cable quickly replaced.

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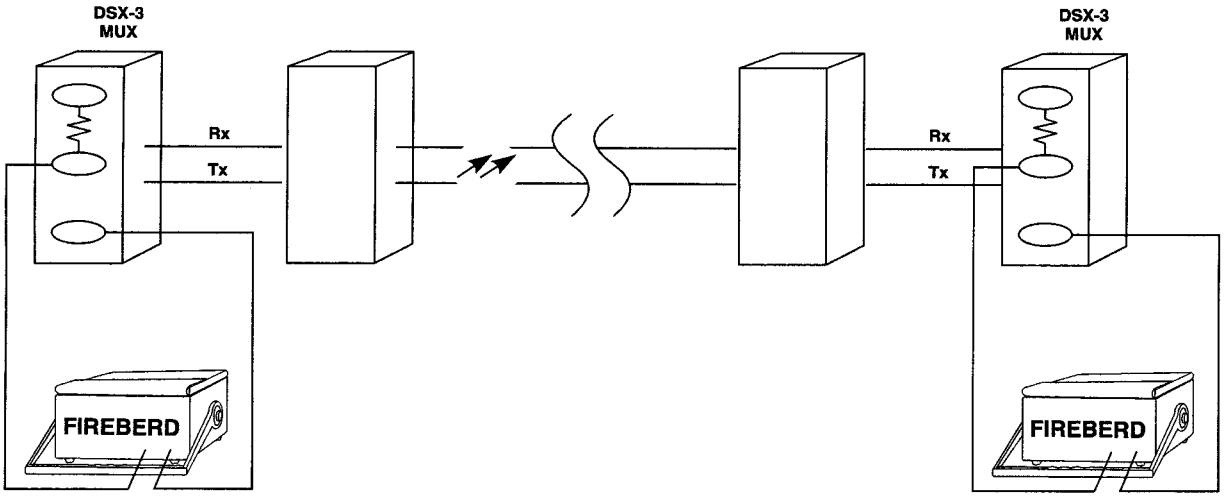


Figure 4-4. Point-to-Point Out-of-Service Testing

The presence of bit errors in a point-to-point test is a good indication that the problem detected in the far-end loopback test has been isolated.

Setting Up The FIREBERD 6000 For a Point-To-Point Test

To set up two FIREBERDs for a point-to-point loopback test, follow the procedures described in Table 4-3.

NOTE

These procedures apply to both instruments, except when setting the GEN CLK switch (seeStep3).

Table 4-3. Point-To-Point Test Set-Up Procedure

Step	Activity
1.	With the power to the FIREBERD 6000 turned off. insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 6000. **NOTE:** If the FIREBERD 6000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	At the near-end DSX-3, set the GEN CLK switch to the INTF position to recover timing from the DS3 network. At the far-end DSX-3, set the GEN CLK switch to the SYNTH position to derive timing from the FIREBERD's internal synthesizer.
4.	Using the MENU switch: a. Configure the DS3 Interface Module using INTF SETUP. Make these selections by pressing the MENU softkeys underneath their display. 1. DS3 to select the DS3 Interface Module. 2. CONFIG to access the configuration menu. 3. FRAME to select framing (OFF, Ml 3, or CBIT). 4. INPUT to select DSX input gain and equalization. 5. Δ OUTPUT to select DSX output termination.

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Table 4-3. Point-To-Point Test Set-Up Procedure

Step	Activity
4. con't	6. MODE to enter the mode menu. 7. A NORMAL to select normal mode of operation. 8. **MORE** PATTRN to enter the pattern menu. 9. 2^23-1 to select the 2^23-1 pattern. b. If hard copy test results are desired, set the print event criteria using PRINT EVENT, then enable the printer control block (located to the left of the POWER switch) by setting the OFF/ON switch to the ON position.
5.	Set the ANALYSIS MODE switch for a CONTINUOUS test or a SINGLE timed test. If SINGLE is selected, define the test length using the TIMED softkey, available in the TEST INTERVAL category of the MENU switch.
6.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the OUT jack on the DSX-3 patch bay. Connect another cable from the DS3 OUT jack on the Module to the IN jack on the DSX-3 patch bay.
7.	Set the left half of the ANALYSIS RESULTS switch to the BIT ERR position (in the ERROR category); set the right half of the ANALYSIS RESLTLTS switch to the RCV FREQ position (in the signal category).
8.	Check frame and pattern synchronization by verifying that the FRM SYNC and SYNC LEDs on the FIREBERD's front panel are illuminated, and by reading the pattern slips result in the ERROR category.
9.	Press the FIREBERD's RESTART switch to clear all results counters.

Legend:

Δ = Press the UP ARROW key
MORE = Press the MORE key

4.3.3 Installation Testing of a Fiber Optic or Microwave System

Once a new fiber optic or microwave system is installed, the entire system must be tested at the T3 points before it is placed in-service. To verify successful operation, the transmission system, coaxial connectors, and cross-connect panels must all be analyzed.

This type of installation testing can be performed by looping the far-end DSX-3s and "daisy chaining" the near-end cross-connect points as shown in Figure 4-5. Far-end loopbacks can be established manually, or can be established by the FIREBERD when you specify the appropriate FEAC control code sequence.

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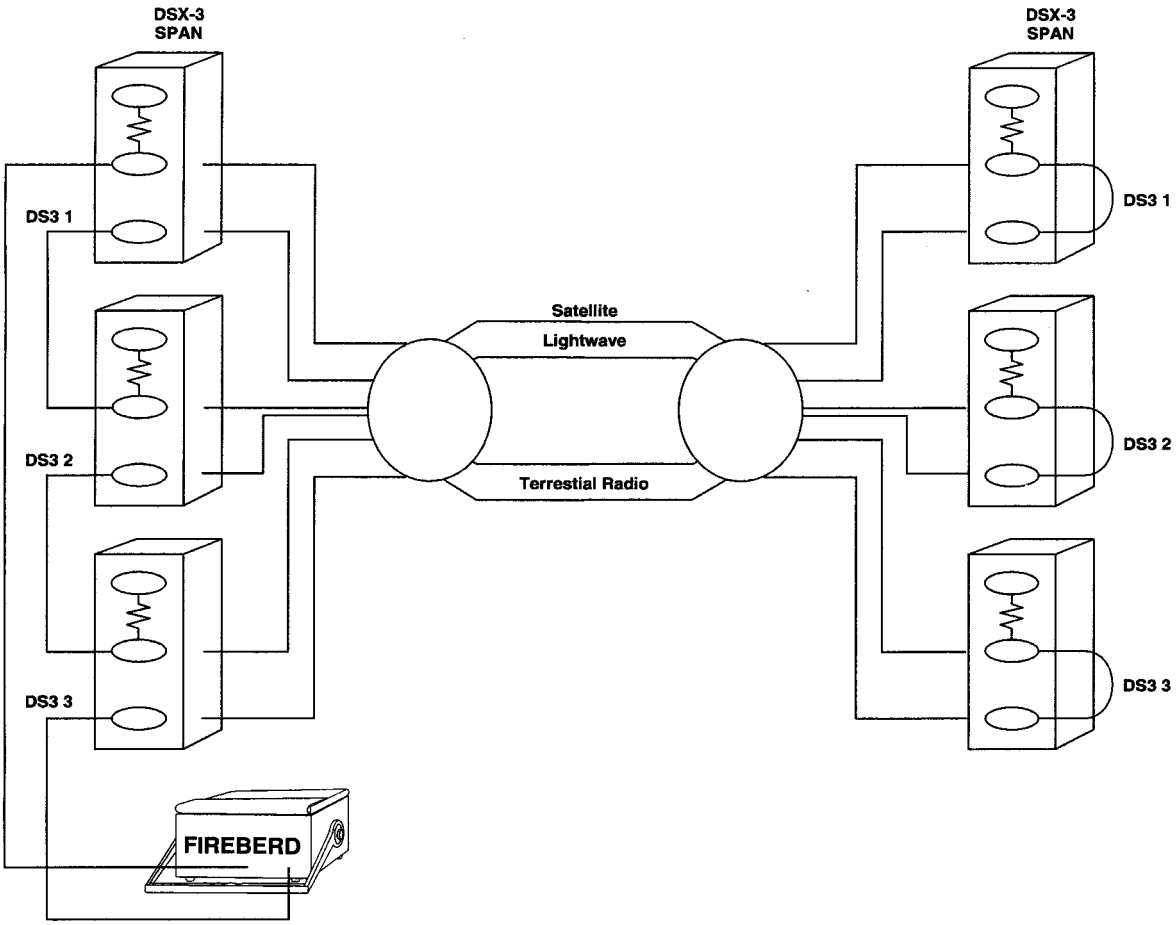


Figure 4-5. Installation Testing of a Fiber Optic or Microwave System

Setting Up The FIREBERD 6000 For an Installation Test

To set up the FIREBERD for an installation test, follow the procedures described in Table 4-4.

Table 4-4. Installation Test Set-Up

Step	Activity
1.	With the power to the FIREBERD 6000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 6000. **NOTE:** If the FIREBERD 6000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Set the GEN CLK switch to the INTF position to derive the transmit clock from the network.
4.	Using the MENU switch: a. Configure the DS3 Interface Module using INTF SETUP. Make these selections by pressing the MENU softkeys underneath their display. 1. DS3 to select the DS3 Interface Module.

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Table 4-4. Installation Test Set-Up (Continued)

Step	Activity
4. cont	2. CONFIG to access the configuration menu. 3. FRAME to select framing (OFF, Ml 3, or CBIT). 4. INPUT to select DSX input gain and equalization. 5. Δ OUTPUT to select DSX output termination. 6. MODE to enter the mode menu. 7. Δ NORMAL to select normal mode of operation. 8. **MORE** PATTRN to enter the pattern menu. 9. Δ+ **MORE** 2^23-1 to select the 2^23-1 pattern 10. AUX to enter the auxiliary menu. 11. FEAC to select the Far-End Alarm Control menu. 12. Enter the six-bit FEAC loop-up code to establish far-end loopback. **NOTE:** When the test is complete, enter the six-bit FEAC loop-down code to terminate the far-end loopback. b. If hardcopy test results are desired, set the print event criteria using PRINTEVENT, then enable the printer control block (located to the left of the POWER switch) by setting the OFF/ON switch to the ON position.
5.	Set the ANALYSIS MODE switch for a CONTINUOUS test or a SINGLE timed test. If SINGLE is selected, define the test length using the TIMED softkey, available in the TEST INTERVAL category of the MENU switch.
6.	Connect a cable from the DS3 OUT jack on the DS3 Interface Module to the IN jack on the DSX-3 patch bay at the beginning of the daisy chain. Connect another cable from the DS3 IN jack on the DS3 Interface Module to the OUT jack on the DSX-3 patch bay at the end of the daisy chain.
7.	Set the left half of the ANALYSIS RESULTS switch to the BIT ERR position (in the ERROR category); set the right half of the ANALYSIS RESULTS switch to the RCV FREQ position (in the signal category).
8.	Check frame and pattern synchronization by verifying that the FRM SYNC and SYNC LEDs on the FIREBERD's front panel are illuminated.
9.	Press the FIREBERD's RESTART switch to clear all results counters.

Legend:

Δ = Press the UP ARROW key
MORE = Press the MORE key

4.3.4 Stress Testing Multiplexers

To ensure the correct passing of information through your network, you can use a FIREBERD to stress-test a T3 multiplexer. Stress testing ensures that your multiplexer will switch to a protection system when the error rate degrades to a defined level (e.g., one error in one million bits), and verifies that alarm systems are operating correctly.

In this type of test, the DS3 signal transmitted by the multiplexer is received by the FIREBERD; the FIREBERD adds errors to the signal and retransmits it to the multiplexer (Figure 4-6). This activity should result in a switch to a redundant system, as well as create an alarm condition. Stress testing is performed in the Thru Loopback (TLB) mode of operation; in TLB mode, the FIREBERD retransmits received data on the transmit circuit.

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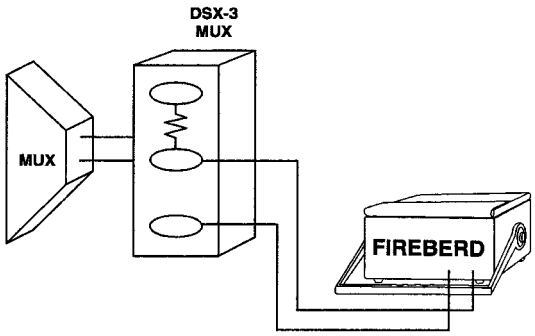


Figure 4-6. Stress-Testing a Multiplexer

NOTE

Although this application is classified as an out-of-service test, you can also use the FIREBERD to insert errors on live traffic.

Setting Up The FIREBERD 6000 For a Stress-Test

To stress-test a T3 multiplexer, follow the procedures described in Table 4-5.

Table 4-5. Stress-Testing a T3 Multiplexer

Step	Activity
1.	With the power to the FIREBERD 6000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 6000. **NOTE:** If the FIREBERD 6000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Set the GEN CLK switch to the INTF position to derive the transmit clock from the network.
4.	Using the MENU switch: a. Configure the DS3 Interface Module using INTF SETUP. Make these selections by pressing the MENU softkeys underneath their display. 1. DS3 to select the DS3 Interface Module. 2. CONFIG to access the configuration menu. 3. FRAME to select framing (OFF, Ml 3, or CBIT). 4. INPUT to select HIGH input gain and equalization. 5. Δ OUTPUT to select HIGH output termination. 6. MODE to enter the mode menu. 7. Δ + **MORE** TLB to select test loopback mode of operation. 8. ERRINS to enter the error insert menu. 9. LOGIC to insert bit errors into the transmitted signal. 10. RAT'E to set the insertion rate to 10-6 or your applicable threshold rate. b. If hardcopy test results are desired, set the print event criteria using PRINT EVENT, then enable the printer control block (located to the left of the POWER switch) by setting the OFF/ON switch to the ON position.

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Table 4-5. Stress-Testing a T3 Multiplexer

Step	Activity
5.	Set the ANALYSIS MODE switch for a CONTINUOUS test or a SINGLE timed test. If SINGLE is selected, define the test length using the TIMED softkey, available in the TEST INTERVAL category of the MENU switch.
6.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the OUT jack on the DSX-3 patch bay.
7.	Connect another cable from the DS3 OUT jack on the Module to the IN jack on the DSX-3 patch bay.
8.	Press the FIREBERD's RESTART switch to clear all results counters.

Legend:

Δ = Press the UP ARROW key

MORE = Press the MORE key

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SECTION 5 FIREBERD 4000 INSTALLATION AND OPERATION

5.1 INTRODUCTION

This section describes how to install, configure, and operate the DS3 Interface Module when it is used in a FIREBERD 4000. Refer to the *FIREBERD 4000 User's Guide* or the *FIREBERD 4000 Reference Manual* for mainframe operating procedures.

NOTE

To avoid unnecessary downtime, configure the FIREBERD 4000 and the DS3 Interface Module before connecting to the circuit under test.

5.2 INSTALLING THE INTERFACE

To install the DS3 Interface Module, use the procedure immediately following Figure 5-1.

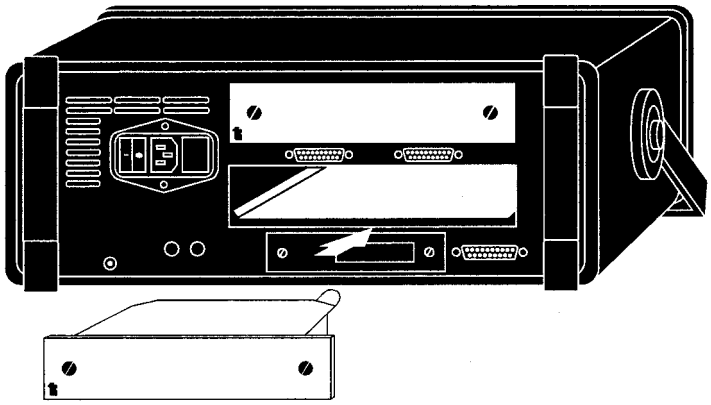


Figure 5-1. FIREBERD Interface Installation

1. Turn the FIREBERD's AC power OFF.
2. Facing the FIREBERD's rear panel, position the Module as shown in Figure 5-1 (faceplate facing out).
3. Slide the Module into the FIREBERD until the interface panel is flush with the rear panel. Make sure the interface PC board edges fit into the card guides in the mainframe.
4. Secure the interface with the thumbscrews on the interface panel.
5. Turn the FIREBERD mainframe AC power ON and configure the FIREBERD and interface as described in the following sections.

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5.3 CONFIGURING THE DS3 INTERFACE MODULE FOR FIREBERD 4000 OPERATION

To configure the DS3 Interface Module for FIREBERD 4000 use, do the following:

1. If not applied, turn the FIREBERD's AC power ON. If illuminated, press SELF LOOP to turn the switch OFF.
2. Using the appropriate cables, connect the DS3 signal source to the DS3 IN jack and the DS3 output to the DS3 OUT jack (where applicable).
3. Set the CATEGORY switch to the GENIERATOR CLOCK position to select a signal timing source. If BNC is selected, the external clock source must be connected to *the inter.face's* BNC input jack.
4. Press the CATEGORY switch until the LED next to the INTERFACE label is illuminated.
5. Press the DS3 softkey to select the DS3 Interface Module. Configure the interface for operation.
6. Use the CATEGORY switch to select other test criteria.
7. Set the ANALYSIS RESULTS and PRINTER switches as required.

Section 4 offers specific set-up procedures for a variety of T3 test applications.

5.4 THE DS3 INTERFACE MODULE SET-UP MENU

The DS3 Interface Module set-up menu (Figure 5-2) has ten selections that configure and control interface operation.

Select:	**To:**
FRAMING	Choose a framing format
INPUT	Select input gain and equalization
OUTPUT	Select output pulse shape and amplitude
OPERATION MODE	Choose normal or Test Loopback (TLB) mode of operation
PATTERN	Choose a data pattern for out-of-service testing
ERRINS	Insert errors into the data stream
TX X-BITS	Configure X bits
TX FEAC WORD	Set the Far End Alarm Control (FEAC) codeword
FRAME LOSS THR	Set the frame synchronization loss threshold
PAR ERR RATES	Determine the way parity-based error rate results are calculated

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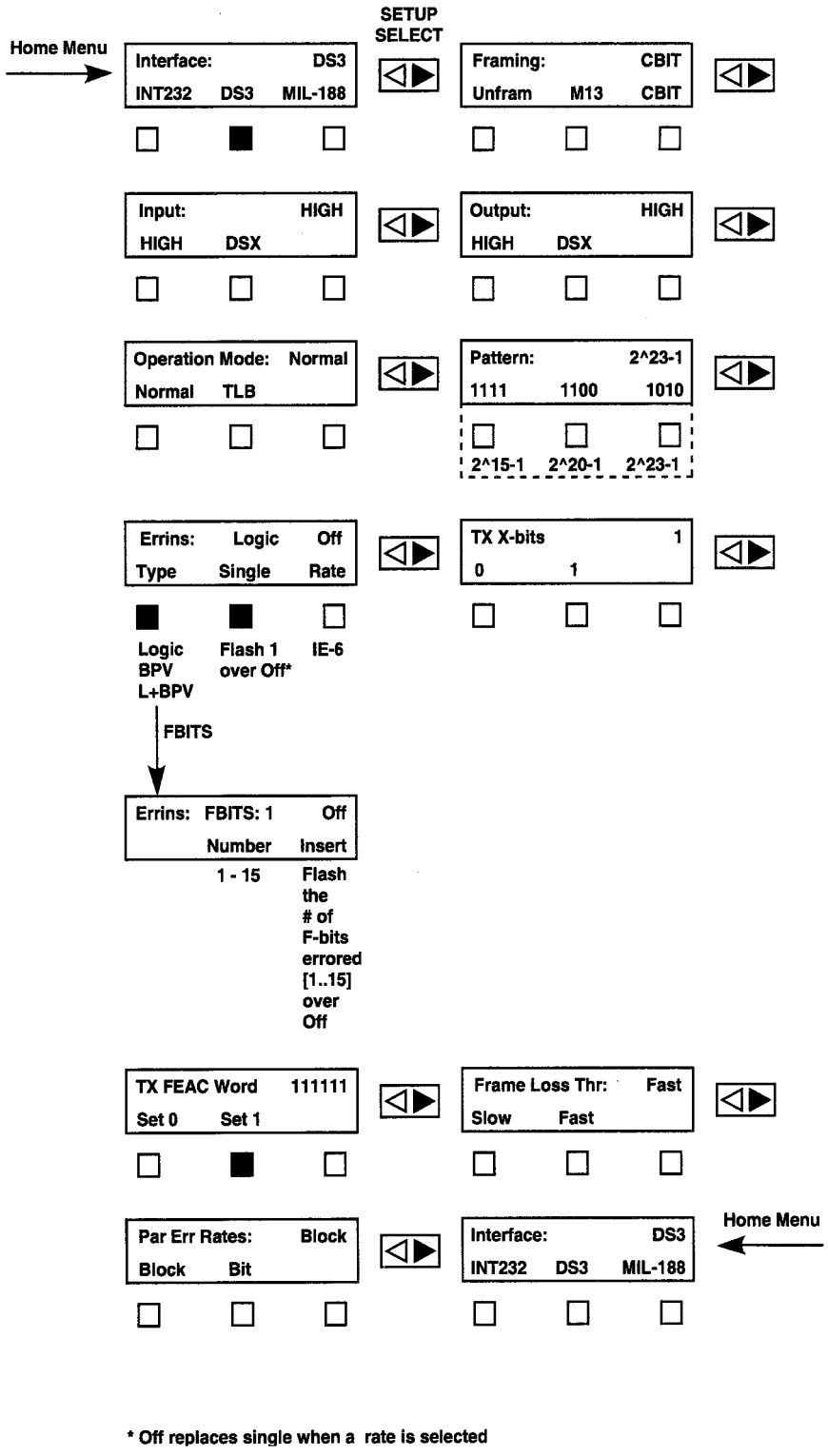


Figure 5-2. The DS3 Interface Module Set-Up Menu

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5.4.1 Interface Set-Up Review

The DS3 Interface Module menu is accessed using the INTERFACE portion of the CATEGORY switch.

To:	Do the following:
Access the DS3 Interface Module menu	Press the DS3 softkey
Step through the individual submenus	Press the SETUP SELECT switch
Select a DS3 menu function	Press the corresponding softkey
Return to the previous submenu display	Press the left half of the SETUP SELECT switch
Return to the top level of the DS3 Interface Module's menu	Press the HOME key

5.4.2 FRAMING Menu

FRAMING — The FRAMING menu allows you to select the framing format. CBIT is the default selection.

UNFRAM — UNFRAMED format. No framing bits are added during transmission and no data bits are stripped when received. Select for DS3 circuits where framing is not required.

M13 — Select when testing DS3 circuits that use the Ml3 framing format. See Appendix B for a technical description of this format.

CBIT — Select when testing DS3 circuits that use the C-Bit framing format. See Appendix B for a technical description of this format.

5.4.3 INPUT Menu

INPUT — Select the input gain and equalization. HIGH is the default selection. Refer to Table 5-1 to learn how input gain and equalization are defined.

HIGH — Select high input termination. Select when terminating or monitoring a HIGH level signal directly at the output of a DS3 terminal.

DSX — Select DSX input termination. Select when terminating or monitoring signals at a DS3 Cross-Connect (DSX-3).

Table 5-1. Input and Output Level Settings

Access Point:	Description	Set INPUT To:	Set OUTPUT To:
Mux Output	Signal may be at HIGH level if there is 450 feet of cabling to the cross-connect	HIGH	DSX

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Table 5-1. Input and Output Level Settings

Access Point:	Description	Set INPUT To:	Set OUTPUT To:
Mux Input	Typically originates from a DSX-3 bay at the DSX level, and modified by any interconnecting cable attenuation.	DSX	DSX
DSX-3	Signal at the IN and OUT jack is at the DSX level, and is attenuated by 20 dB at the MON jack.	DSX	DSX
Transmission Equipment Input	Signal at the DSX level is modified by any attenuation from interconnecting cables.	DSX	DSX
Transmission Equipment Output	Signal may be at HIGH level if there are 450 feet of cabling to the cross-connect.	HIGH	HIGH
	If cable interconnections are short, this signal is at the DSX level	DSX	DSX

5.4.4 OUTPUT Menu

OUTPUT — Select output pulse shape and amplitude. HIGH is the default selection. Refer to Table 5-1 to learn how output pulse shape and amplitude are defined.

HIGH — Select high (normal) signal output termination. When selected, the DS3 output signal consists of rectangular pulses of approximately 0.9 volts peak.

DSX — Select DSX output termination. When selected, the DS3 output signal meets the requirements set forth in AT&T Compatibility Bulletin 119 for use at a DSX-3. (The DSX signal is equivalent to the HIGH signal when passed through 450 feet of 728A coaxial cable attenuation.) This output signal has a sawtooth shape, with an amplitude of approximately 0.5 volts peak.

5.4.5 OPERATION MODE Menu

OPERATION MODE — The OPERATION MODE menu allows you to select an interface operating mode. NORMAL is the default selection.

NORMAL — Standard operating mode. Select NORMAL to perform the standard activities associated with the in-service monitoring or out-of-service testing of T3 circuits and equipment. *The only activity that cannot be performed in NORMAL mode is the insertion of errors on live traffic* (see TLB).

TLB — Test Loopback mode. Select TLB to insert logic errors, BPVs, or both on live data. In this mode, the FIREBERD retransmits received data on the transmit circuit and monitors framing and parity bits for errors in framed data. *Frame errors cannot be inserted in TLB mode.*

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5.4.6 PATTERN Menu

PATTERN — The PATTERN menu allows you to select a data pattern for out-of-service testing. 2^{23}-1 is the default selection.

1111 — Fixed "all marks" pattern. Provides low stress as a result of its high pulse density.

1100 — Fixed pattern of two marks followed by two spaces. Provides the equivalent of an idle signal when either M13 or C- bit framing is selected. When specified, **<IDLE>** is displayed on the status line.

1010 — Fixed pattern of one mark and one space. Provides the equivalent of a blue (AIS) signal when either Ml3 or C-bit framing is selected. When specified, **<BLUE>** is displayed on the status line.

2^{15}-1 — 32,000-bit pseudorandom pattern with a maximum of 14 sequential zeroes and 15 sequential ones. Provides compatibility with older DS3 test equipment.

2^{20}-1 - One million-bit pseudorandom pattern with a maximum of 19 sequential zeroes and 20 sequential ones.

2^{23}-1 - Eight million-bit pseudorandom pattern with a maximum of 22 sequential zeroes and 23 sequential ones. Recommended for general purpose testing and qualifying. Provides an excellent simulation of five data.

PROG — Choose a customized, user-programmed pattern. These patterns can be 3 to 24 bits long, and created by accessing the PRGM submenu in the FIREBERD 4000's PATTERN category.

NOTE

When the DS3 Interface Module is active, patterns are only selectable through the INTERFACE menu; the current selection of the PATTERN portion of the CATEGORY switch is ignored.

5.4.7 ERRINS Menu

ERRINS — The ERRINS menu allows you to insert BPV, logic, or frame errors into the data stream. Logic errors and BPVs may be inserted singly or at the 10^{-6} (1E-6) rate; frame errors may be inserted singly or consecutively, to a maximum of 15.

TYPE — select logic errors, BPVs, logic errors and BPVs, or frame errors for insertion into the data stream.

OFF — turn off single error insertion. OFF only appears as a softkey choice when RATE is the current selection.

SINGLE — insert a single error into the data stream. The error inserted can be a logic error, BPV, or logic error and BPV, based on the current TYPE selected.

RATE — select the BPV and/or LOGIC error insertion rate of 1E-6.

NUMBER — select the number of consecutive frame errors to be inserted into the data stream. Press the NUMBER softkey until the desired value appears next to **FBITS:** (located immediately above the softkey). The valid range is 1-15. NUMBER appears only when FBITS is the currently selected TYPE.

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INSERT - insert frame errors into the data stream, based on the value specified using the NUMBER softkey. Frame errors are not inserted in untrained mode (i.e., FRAME = off). INSERT appears only when FBITS is the currently selected TYPE.

NOTE

When the DS3 Interface Module is active, error insertion is only controllable through the INTERFACE menu; when the ERROR INSERT switch on the FIREBERD 4000's front panel is pressed, the message *not applicable for this interface* appears in the ANALYSIS RESULTS display.

5.4.8 TX X-BITS Menu

TX X-BITS — select 0 or 1 as the transmitted X-bit for framed applications. When C-bit framing is specified, and 0 is selected as the transmitted X-bit, **<YELLOW>** is displayed to indicate that the FIREBERD sends a yellow alarm under this criteria. One (1) is the default selection.

5.4.9 TX FEAC WORD Menu

TX FEAC — transmit the alarm or loopback code of your choice by editing the last six digits of the Far-End Alarm Control (FEAC) codeword. The SET 0 and SET 1 softkeys set the currently selected bit (indicated by the blinking cursor) to zero or one, respectively; the > and < keys can be used to manipulate the cursor. 111111 is the default selection. Table 5-2 lists many of the FEAC codes that you can specify using this auxiliary function.

Table 5-2. Transmittable FEAC Codes

Code	Meaning
000111	Line Loopback Activate
011100	Line Loopback Deactivate
011011	DS3 Line
011001	DS3 Equipment Failure (Type 1)
001110	DS3 Signal Loss/High Bit Error Rate
000000	DS3 Out-Of-Frame
010110	DS3 Alarm Indication Signal Received
011010	DS3 Idle Code Received
001111	DS3 Equipment Failure (Type 2)
011101	Common Equipment Failure (Type 2)
010101	Multiple DS1 Loss/High Bit Error Rate
000101	DS1 Equipment Failure (Type 1)
011110	Single DS1 Loss/High Bit Error Rate
000011	DS1 Equipment Failure (Type 2)

NOTE

Type 1 equipment failures affect service; Type 2 equipment failures do not affect service.

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5.4.10 FRAME LOSS THR Menu

FRAME LOSS THR — set the frame synchronization loss criteria. SLOW sets the frame synchronization loss criteria at 6 of 15 frame bits in error in a single frame; FAST sets the frame synchronization loss criteria at 3 of 15 frame bits in error or 2 of 3 M bits in error in a single frame. When exceeded, the FIREBERD's FRM SYNC LED will not illuminate. FAST is the default selection.

5.4.11 PAR ERR RATES Menu

PAR ERR RATES — select the way that parity error rate results are calculated. When BLOCK is specified, parity error, C-bit parity error, and Far-End Block Error (FEBE) rates are calculated on an errors per frame basis; BIT calculates these measurements on an *errors per data bit* basis, which provides an approximation of the bit error rate. The resulting rate equations follow (based on 28 framing bits and 4704 data bits per M frame):

$$\text{BLOCK RATE: } \frac{\text{errors}}{\text{frame bits}/28} = \frac{28 * \text{errors}}{\text{frame bits}}$$

$$\text{BIT RATE: } \frac{\text{errors}}{\text{frame bits}/28 * 4704} = \frac{\text{errors}}{168 * \text{frame bits}}$$

BLOCK is the default selection.

5.5 FIREBERD 4000 TEST RESULTS

Table 5-3 Lists the test results that are available when the DS3 Interface Module is installed in the FIREBERD 4000. Refer to the *FIREBERD 4000 Reference Manual* for the test results definitions not described in this section.

Table 5-3. FIREBERD 4000 Analysis Results

Category	Displayed Result	Description
ERROR	BIT ERRS	Bit Errors
	BER	Test Interval Bit Error Rate
	AVG BER	Average Bit Error Rate
	PAT SLIP	Pattern Slips
	PAT LOSS	Pattern Synchronization Losses
PERFORMANCE	GERR SEC	G.821 Errored Seconds
	G EFS	G.821 Error-Free Seconds
	G %EFS	G.821 Percent Error-Free Seconds
	DEG MIN	Degraded Minutes
	%DEG MIN	Percent Degraded Minutes
	SES	Severely Errored Seconds
	%SES	Percent Severely Errored Seconds

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Table 5-3. FIREBERD 4000 Analysis Results (Continued)

Category	Displayed Result	Description
PERFORMANCE (continued)	UNA SEC	Unavailable Seconds
	AVL SEC	Available Seconds
	%AVL SEC	Percent Available Seconds
	ERR-SES	Bit Errors Less Severely Errored Seconds
	BER-SES	Bit Error Rate Less Severely Err. Secs.
TIME & SIGNAL	PATL SEC	Pattern Synchronization Loss Seconds
	ELAP SEC	Elapsed Seconds
	TEST SEC	Test Seconds
	ERR SEC	Errored Seconds
	%EFS	Percent Error-Free Seconds
	CPE S A	C-Bit Parity Errored Seconds (Type A)
	CPE S B	C-Bit Parity Errored Seconds (Type B)
	CPE S C	C-Bit Parity Errored Seconds (Type C)
	FEBE S A	Far-End Block Errored Seconds (Type A)
	FEBE S B	Far-End Block Errored Seconds (Type B)
	FEBE S C	Far-End Block Errored Seconds (Type C)
	BPV SEC	BPV Errored Seconds
	BPV %EFS	Percent BPV Error-Free Seconds
	DATE	Calendar Date
	TIME	Time of Day
	RCV FREQ	Receiver Frequency
	GEN FREQ	Generator Frequency
INT'ERFACE	BPVs	Bipolar Violations (BPVs)
	BPV Rate	Test Interval BPV Rate
	AVG BPVR	Average BPV Rate
	FRA ERR	Frame Errors
	AVG FER	Average Frame Error Rate
	PAR ERR	Parity Errors
	AVG PER	Average Parity Error Rate
	CPAR ERR	C-Bit Parity Errors
	AVG CPER	Average C-Bit Parity Error Rate
	FEBE	Far End Block Errors (FEBES)
	AVG FEBE	Average FEBE Rate
	RCV FEAC	Received Far End Alarm Control Codes
	RX Xl:X2	Received X bits

The results that are unique to the DS3 Interface Module are described below. See the *FIREBERD 4000 Reference Manual* for a description of the results that are common to all Modular Interfaces.

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5.5.1 TIME & SIGNAL Results Category

CPE S A - C-Bit Parity Errored Seconds (Type- A)
The number of seconds in which a single C-bit parity error was received. This result appears only when C-bit framing is selected.

CPE S B - C-Bit Parity Errored Seconds (Type B)
The number of seconds in which 2-44 C-bit parity errors were received. This result appears only when C-bit framing is selected.

CPE S C - C-Bit Parity Errored Seconds (Type C)
The number of seconds in which more than 44 C-bit parity errors were received. This result appears only when C-bit framing is selected.

FEBE S A - Far End Block Errored Seconds (Type A)
The number of seconds in which a single FEBE was received. This result appears only when C-bit framing is selected.

FEBE S B - Far-End Block Errored Seconds (Type B)
The number of seconds in which 2-44 FEBEs were received. This result appears only when C-bit framing is selected.

FEBE S C - Far-End Block Errored Seconds (Type C)
The number of seconds in which more than 44 FEBEs were received. This result appears only when C-bit framing is selected.

5.5.2 INTERFACE Results Category

BPVs - Bipolar Violations
The number of bipolar violations that are not part of B3ZS encoding. The Bipolar Violation Rate (BPV RATE) and Average Bipolar Violation Rate (AVG BPVR) are calculated on a per bit basis. The DS3 Interface Module also computes Bipolar Violation Seconds (BPV SEC) and the percent of Bipolar Violation Error-Free Errored Seconds (BPV %EFS); both results are available in the TIME & SIGNAL category.

FRA ERR - Frame Errors
The number of errored frame bits counted since the start of the test. The Average Frame Error Rate (AVG FER) is calculated on a per frame bit basis. This result is displayed only when M13 or C-bit framing is selected.

PAR ERR - Parity Errors
The number of parity errors counted since the start of the test. A parity error is counted when a received parity bit does not match the parity of the previous frame. The Average Parity Error Rate (AVG PER) is calculated as specified in Section 3.4.6. This result is displayed only when M13 or C-bit framing is selected.

CPAR ERR - C-Bit Parity Errors
The number of C-bit parity errors counted since the start of the test. A C-bit parity error is counted when a received C-bit does not match the parity of the previous frame. The Average C-Bit Parity Error Rate (AVG CPER) is calculated as specified in Section 3.4.6. This result is displayed only when C-bit framing is selected.

FEBE - Far End Block Errors
The Number of FEBEs counted since the start of the test. A FEBE is counted when a received FEBE bit is set to 0. The Average FEBE Error Rate (AVG FEBE) is calculated as specified in Section 3.4.6. This result is displayed only when C-bit framing is selected.

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RX XI:X2 - Received X-Bits
The current value of the received X1 and X2 bits (i.e., 0 or 1). This results is displayed only when Ml3 or C-bit framing is selected.

RCV FEAC - Received Far End Alarm Control Code
The significant six bits of the currently received FEAC word (two bytes in length). This result appears only when C-bit framing is selected. RCV FEAC offers a series of defined status words, *where an eight-character mnemonic is displayed in lieu of the six-bit code.* These six-bit codes, associated mnemonics, and their meanings are described in Table 5-4.

Table 5-4. Defined FEAC Status Words

Code	Mnemonic	Meaning
011001	DS3 EQF1	DS3 Equipment Failure (Type 1)
001110	DS3 LOS	DS3 Signal Loss/High Bit Error Rate
000000	DS3OOF	DS3 Out-Of-Frame
010110	DS3 AIS	DS3 Alarm Indication Signal Received
011010	DS3 IDLE	DS3 Idle Code Received
001111	DS3 QF2	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)

NOTE

Type 1 equipment failures affect service; Type 2 equipment failures do not affect service.

5.6 INTERFACE STATUS INDICATORS

The DS3 Interface Module uses the FRAME SYNC, CODE, ALM 1, ALM 2 LEDs as status indicators, as shown in Table 5-5.

Table 5-5. DS3 Status Indicators

The Status Indicator:	Illuminates When:
FRAME SYNC	The DS3 Interface Module has synchronized to the appropriate framing format (Ml3 or C-bit).
CODE	The idle signal is received.
ALM1	A yellow alarm is received (i.e., X1 and X2 bits are both set to zero).
ALM2	A blue signal is received (i.e., C-bits are set to zero and 1000 bits of the 1010 pattern are detected).

NOTE

For remote control applications, the ALMl and ALM2 indicators also map to the IEEE 488.2 interface status, history, and loss registers in bit positions 3 and 2, respectively.

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5.7 FIREBERD 4000 PRINTER OPERATION

Figure 5-3 and Figure 5-4 respectively depict a typical DS3 Interface Module Controls and Results printout. Refer to the *FIREBERD 4000 Reference Manual* for printer set-up and operating instructions.

```
CONTROLS            PRINT   10:44:04    16 OCT 91
PATTERN:           2^15-1   ERROR INS:         OFF
SELF LOOP:             ON   GEN CLOCK:      INTRNL
INT FRQ:        8.956 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:          NORM   USER SYN THR:       10
BLOCK LENGTH:         PATT   PRINT FMT:    STANDARD
STATUS PRINTS:         OFF   PRINT EVENT:       OFF
INTERFACE SLOT2:             DS3
FRAME:                CBIT   INPUT:            HIGH
OUTPUT:               HIGH   MODE:           NORMAL
PATTERN:             2^23-1   ERR INS:           OFF
ERR TYPE:             LOGIC   X BITS:              1
FEAC WORD:           111111   FRLOSS THR:       FAST
PERR RATES:           BLOCK   REMOTE:           NONE
PRINTER:             RS-232   RS-232:
DATA BITS:                8   BAUD:             2400
PARITY:               NONE   IEEE-488:            1
```

Figure 5-3. Controls Printout

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```
MANUAL              PRINT
05:49:41        19 NOV 91    BIT ERRS             0
AVG BER            0. E-9    BER            0. E-08
PAT SLIP                0    PAT LOSS             0
PATL SEC                0    G %EFS          100.00%
BPVs                    0    AVG BPVR       0. E-09
BPV Rate          0. E-08    BPV SEC              0
BPV %EFS          100.00%    FRA ERR              0
AVG FER           0. E-07    PAR ERR              0
AVG PER           0. E-05    CPAR ERR             0
AVG CPER          0. E-05    CPE S A              0
CPE S B                 0    CPE S C              0
FEBE                    0    AVG FEBE       0. E-05
FEBE S A                0    FEBE S B             0
FEBE S C                0    GEN FREQ      44735870
RCV FREQ         44735880    RCV FEAC        111111
RX X1:X2              1:1    ERR-SES              0
BER-SES           0. E-09    GERR SEC             0
G EFS                  56    UNA SEC              0
DEG MIN                 0    %DEG MIN         0.00%
SES                     0    %SES             0.00%
ELAP SEC               64    FRAME SYNC     PRESENT
IDLE SIGNAL            NO    YELLOW ALARM        NO
BLUE SIGNAL            NO    SELF LOOP           ON
IF                    DS3
```

Figure 5-4. Results Printout

5.8 FIREBERD 4000 REMOTE CONTROL COMMANDS

The FIREBERD 4000 features remote control of the DS3 Interface Module using the remote control commands listed in Table 5-6. The spacing used on each command line must be used as indicated. For detailed instructions on remotely controlling the FIREBERD 4000, refer to the *FIREBERD 4000 Reference Manual.*

Table 5-6. DS3 Interface Module Remote Control Commands

Remote Command	Result
INTF:DS3:CONFIG:FRAME?	Show the current framing selection
INTF:DS3:CONFIG:FRAME [OFF|M13|CBIT]	Set framing
INTF:DS3:CONFIG:INPUT?	Show current input selection
INTF:DS3:CONFIG:INPUT [HIGH|DSX]	Set input
INTF:DS3:CONFIG:OUTPUT?	Show current output selection
INTF:DS3:CONFIG:OUTPUT [HIGH|DSX]	Set output
INTF:DS3:MODE?	Show current mode of operation
INTF:DS3:MODE [NORMAL|TLB]	Set mode of operation

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Table 5-6. DS3 Interface Module Remote Control Commands (Continued)

Remote Command	Result
INTF:DS3:PATT'ERN?	Show current data pattern
INTF:DS3:PATTERN [1111|1100|1010|2^15-1|2^20-1|2^23-1|PRGM]	Set data pattern
INTF:DS3:ERR INSERT?	Show current error insertion-type
INTF:DS3:ERR_INSERT [OFF|BPV|LOGIC|L+BPV|SINGLE|RATE]	Set the error insertion-type
INTF:DS3:ERR_INSERT:FBIT (number)	Select F-bit error insertion (1 - 15)
INTF:DS3:AUX:X_BITS?	Show current X bit value
INTF:DS3:AUX:X_BITS [0|1]	Set current X bit value
INTF:DS3:AUX:FEAC?	Show current FEAC codeword
INTF:DS3:AUX:FEAC (six-bit string)	Set six-bit FEAC codeword
INT'F:DS3:AUX:FRLOSS_THR?	Show current frame sync loss threshold
INTF:DS3:AUX:FRLOSS_THR (SLOW|FAST]	Set frame sync loss threshold
INTF:DS3:AUX:PERR_RATES?	Show current method of calculating parity results
INTF:DS3:AUX:PERR_RAT'ES [BLOCK|BIT]	Set method of calculating parity results

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SECTION 6 FIREBERD 4000 APPLICATIONS

6.1 INTRODUCTION

This section describes how the FIREBERD 4000 can be used in a variety of test applications when the DS3 Interface Module is installed in the instrument's rear panel (or an Interface Switching Unit). Test and instrument set-ups are provided for the following applications:

- In-service monitoring of DS3 circuits and equipment using M13 and C-bit framing
- Out-of-service testing
- Stress testing of T3 multiplexers prior to installation

The information that follows requires a working knowledge of the DS3 Interface Module and the FIREBERD 4000. If you are unfamiliar with the Interface Module, see Section 3 of this manual; if you are unfamiliar with the FIREBERD 4000, see the *FIREBERD 4000 Reference Manual.*

6.2 IN-SERVICE MONITORING

The FIREBERD can be used to monitor live DS3 traffic while circuits and equipment are in-service. In-service monitoring is performed at a Digital Cross-Connect (DSX-3) access point, where a cable can be connected from the DS3 IN jack on the FIREBERD-installed DS3 Interface Module to the MONITOR jack on the DSX patch bay.

The way in which the performance of your T3 circuits and equipment can be measured in-service is determined by the framing format of your network. The sections that follow describe in-service monitoring techniques for M13 and C-bit framing formats.

6.2.1 Monitoring M13-Framed Networks

For networks with the M13 framing format, you can use a FIREBERD to monitor a section of your T3 network for certain types of errors. For example, Figure 6-1 shows that a DSX-3 multiplexer or DSX-3 span can be monitored as a means of troubleshooting a local problem.

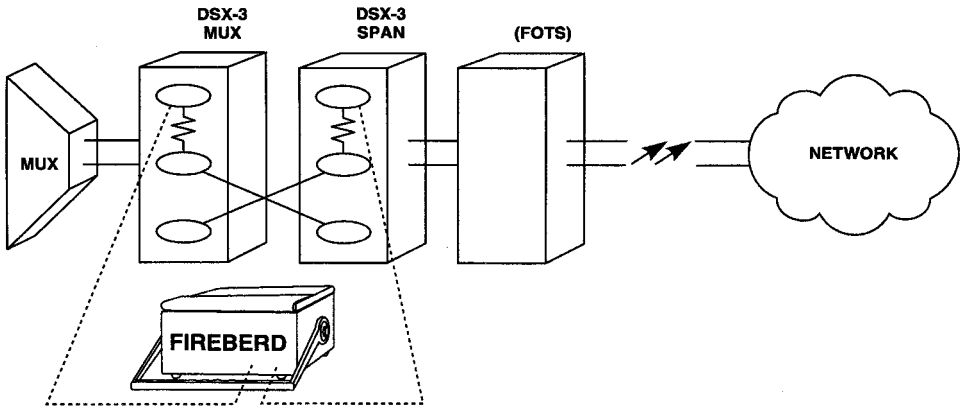


Figure 6-1. Troubleshooting a Local Problem

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When troubleshooting local problems in an M13-framed network, these error measurements are significant:

- Parity errors (PAR ERR)
- Bipolar violations (BPVs)
- Frame errors (FRA ERR)

Parity Errors

Parity errors strongly indicate incorrect data, which can be caused by faulty equipment within the section of the T3 network under test. The FIREBERD tallies a parity error when the parity values of the transmitting and receiving DS3 equipment do not match (see Section B. 1 for a complete explanation of parity).

The major]incitation of parity is that higher-order transmission systems may recalculate P-bits at intermediate points in a T3 network. Thus, although parity errors are very useful for troubleshooting a particular section of your network, they should not be used to monitor end-to-end performance.

BPVs

BPVs can signal any of the following:

- Bad termination
- A faulty coaxial cable
- A failing DS3 terminal

The FIREBERD tallies a BPV when the rules of bipolar pulse coding are violated; intentional violations that are part of zero substitution code are *not* tallied. Like parity errors, BPVs cannot pass through higher-order transmission systems. As such, they cannot be used to measure overall T3 network performance.

Frame Errors

Frame errors can be monitored to indicate a high error rate with in the section of the T3 network under test. The FIREBERD tallies a frame error when it detects a deviation from the expected framing bit (i.e., F-bit) sequence. Because F-bits represent less than 1% of all bits in an M13-framed DS3 signal, performance calculations based on framed errors are valid only at high error rates.

6.2.2 Monitoring C-Bit-Framed Networks

Networks using the C-bit framing format have enhanced in-service monitoring capabilities. Like M13-framed networks, you can troubleshoot local problems by monitoring for BPVs and frame errors. However, the performance of C-bit-framed DS3 networks can also be monitored end-to-end using these measurements:

- C-bit parity errors (CPAR ERR)
- Far-end bit errors (FEBE)

C-Bit Parity Errors

C-bit parity errors are strong indicators of the end-to-end performance of your DS3 network because, unlike M13 parity errors, they are not recalculated by intermediate equipment along the transmission path. The FIREBERD tallies a C-bit parity error when the parity values of the transmitting and receiving T3 equipment do not match. (See Section B.2 for a complete explanation of C-bit parity.)

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C-bit parity (CP) bits can be monitored at any point in your T3 network, and are useful for sectionalizing problems at specific network locations. As such, standard P-bit parity errors are usually ignored in C-bit framed systems.

FEBEs

FEBEs are useful for end-to-end troubleshooting. The FIREBERD tallies a FEBE when it detects a three-bit FEBE value of 000. This value is assigned by network equipment when a C-bit parity error or frame error is detected. (See Section B.2 for a more detailed explanation of C-bit parity.)

Like CP bits, FEBEs can be monitored at any point in your T3 network. Although they are useful for sectionalizing problems to the transmit or receive side, they cannot pinpoint problems to specific networks locations.

How C-Bit Parity Errors and FEBEs Work

Figure 6-2 illustrates how C-bit parity errors and FEBEs actually work. The drawing shows errors occurring between Monitor A and Monitor B on the *West-Transmit-to-East-Receive* leg of a T3 network. These errors have caused the C-bit parity calculated at Monitor B to differ from that calculated at Monitor A. As a result, C-bit parity errors are detected at Monitor B and Monitor C, and the EAST terminal generates a FEBE that is detected on all monitor points on the *East-Transmit-to-West-Receive* leg of the T3 network-

By counting C-bit parity and FEBE errors, both EAST and WEST terminals can track network performance in both directions of transmission. Similarly, a FIREBERD located at either terminal can measure performance in either direction by monitoring the receive (incoming) signal for C-bit parity errors and FEBES.

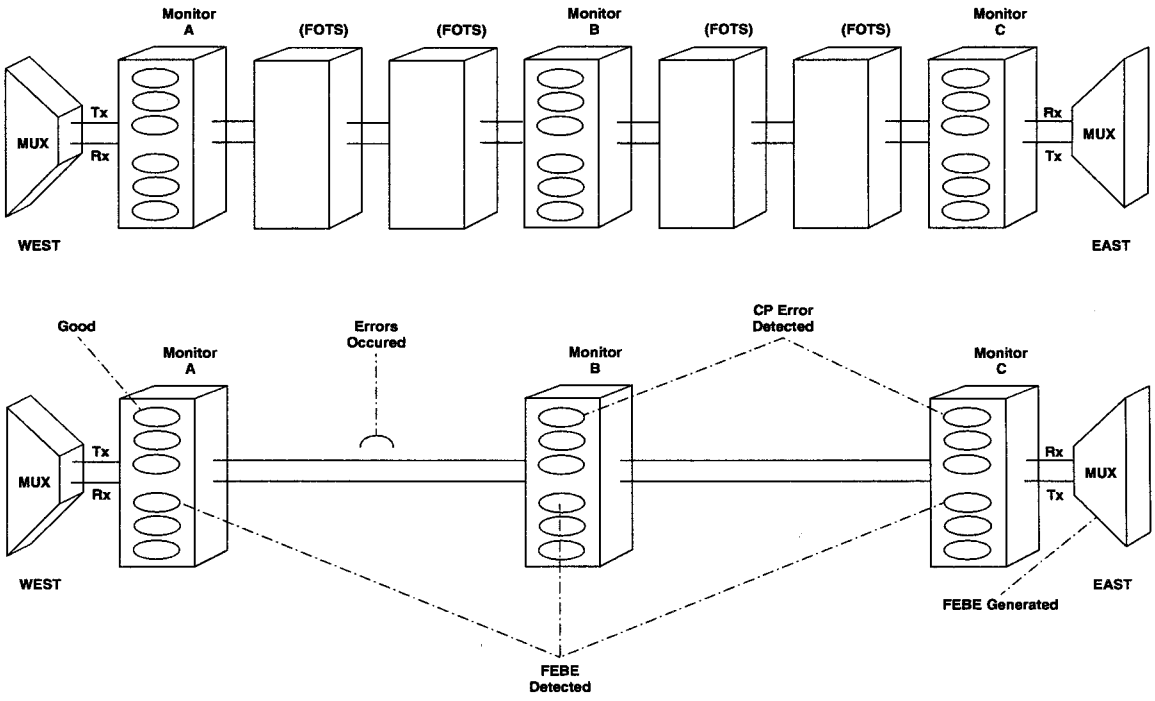


Figure 6-2. How C-Bit Parity Errors and FEBEs Work

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6.2.3 Setting Up The FIREBERD 4000 For In-Service Monitoring

To perform in-service monitoring at a DSX-3 Patch Bay, follow the procedures described in Table 6-1.

Table 6-1. In-Service Monitoring Set-Up Procedure

Step	Activity
1.	With the power to the FIREBERD 4000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 4000. **NOTE:** If the FIREBERD 4000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Press the CATEGORY switch until the INTERFACE label is illuminated.
4.	Use the SETUP SELECT switch and the softkeys below the SETUP display to configure the interface set-up menu as follows: Select: 1. DS3 to select the DS3 Interface Module. 2. FRAMING to select framing (UNFRAMED, M13, or CBIT). 3. INPUT to select DSX input gain and equalization. 4. OPERATION MODE to select normal mode of operation.
5.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the MONITOR jack on the DSX patch bay.
6.	Press the FIREBERD's RESTART switch to clear all results counters.
7.	Verify that the FRAME SYNC LED (below the CLOCK PRES LED on the FIREBERD's front panel) is illuminated.
8.	If monitoring an M13-framed network, set the left half of the ANALYSIS RESULTS switch to PAR ERR (in the INTERFACE category); set the right half of the ANALYSIS RESULTS switch to either BPV or IRA ERR (also in the INTERFACE category). If monitoring a C-bit-framed network, set the left half of the ANALYSIS RESULTS switch to CPAR ERR (in the INTERFACE category); set the right half of the ANALYSIS RESULTS switch to FEBE (also in the INTERFACE category).

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6.3 OUT-OF-SERVICE TESTING

The FIREBERD can be used to test T3 circuits and equipment out-of-service. Out-of-service testing is so named because live traffic must be removed from the DS3 link before analysis can begin. In its place, the FIREBERD transmits a specific data pattern either to another FIREBERD or to itself via loopback. Any deviations from the transmitted pattern are tallied as bit errors or pattern *slips* by the receiving test instrument.

This section describes these out-of-service tests:

- Out-of-service testing using far-end loopbacks
- Isolating problems out-of-service using two FIREBERDs
- Installing a fiber optic or microwave system
- Testing multiplexers

When performing any out-of-service test, these error measurements are significant:

- Bit errors (BIT ERR)
- Receive frequency (RCV FREQ)
- Pattern slips (PAT SLIP)

Bit Errors

Bit errors are the basic performance evaluator in out-of-service testing. The FIREBERD tallies a bit error when the received value of a bit is the opposite of what is expected (i.e., zeros that should be ones and vice versa).

Receive Frequency

The valid receive frequency for a DS3 signal is 44.736 MHz ±880 Hz. Values outside of this frequency range indicate that the far-end DS3 multiplexer's transmitter card or cable is faulty.

6.3.1 Out-of-Service Testing Using Far-End Loopbacks

Figure 6-3 shows a FIREBERD connected to the near-end DSX-3 cross-connect panel. After a loopback is established at the far-end DSX-3 cross-connect panel, the FIREBERD transmit a pseudorandom pattern across the T3 link. The loopback enables the pattern to be returned to the FIREBERD on the receive side of the link for analysis.

NOTE

Far-end loopbacks can be established manually, or can be established by the FIREBERD when you specify the appropriate FEAC control code sequence.

Using far-end loopback testing techniques, a single FIREBERD can evaluate the general performance of a T3 span. The presence of bit errors in a far-end loopback test is an indication of a problem in some portion of the DS3 span. Point-to-point testing (Section 6.3.2) is required so that the faulty card or cable can be isolated and replaced.

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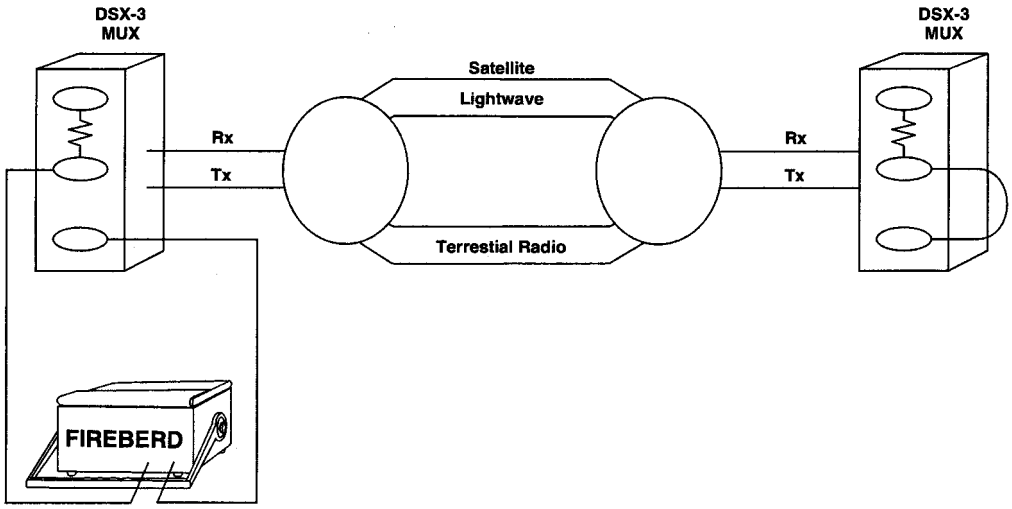


Figure 6-3. Out-of-Service Testing Using Far-End Loopbacks

NOTE

Loopback tests cannot isolate a problem to a specific direction.

Setting Up The FIREBERD 4000 For a Far-End Loopback Test

To set up the FIREBERD for a far-end loopback test, follow the procedures described in Table 6-2.

Table 6-2. Far-End Loopback Test Set-Up Procedure

Step	Activity
1.	With the power to the FIREBERD 4000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 4000. **NOTE:** If the FIREBERD 4000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Press the CATEGORY switch until the INTERFACE label is illuminated.
4.	Use the SETUP SELECT switch and the softkeys below the SETUP display to configure the interface set-up menu as follows: Select: 1. DS3 to select the DS3 Interface Module. 2. FRAMING to select framing (UNFRAMED, Ml3, or CBIT). 3. INPUT to select DSX input gain and equalization. 4. OUTPUT to select DSX output termination. 5. OPERATION MODE to select normal mode of operation. 6. **MORE** PATTERN to enter the PATTERN menu. 7. 2^ 23-1 to select the 2^23-1 pattern. 8. TX FEAC WORD to select far-end alarm control.

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Table 6-2. Far-End Loopback Test Set-Up Procedure

Step	Activity
	Enter the six-bit FEAC loop-up code to establish far-end loopback. **NOTE:** When the test is complete, enter the six-bit FEAC loop-down code to terminate the far-end loopback.
5.	Press the CATEGORY switch until the GENERATOR CLOCK label is illuminated, then press the INTRNL softkey to derive the transmit clock from the DS3 Module Interface's internal crystal.
6.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the IN jack on the DSX patch bay. Connect another cable from the DS3 OUT jack on the Module to the OUT jack on the DSX-3 patch bay.
7.	Verify that the FRAME and PATTERN SYNC LEDs separated by the CLOCK PRES LED on the FIREBERD's front panel) are illuminated.
8.	Set the left half of the ANALYSIS RESLJLTS switch to BIT ERRS (in the ERROR category); set the right half of the ANALYSIS RESULTS switch to RCV FREQ (in the TIME & SIGNAL category).
9.	Press the FIREBERD's RESTART switch to clear all results counters.

Legend:

MORE = Press the MORE key

6.3.2 Point-To-Point Out-of-Service Testing

When bit errors are detected in a far-end loopback test, point-to-point testing is conducted to isolate and repair the problem. Two FIREBERDs are required in point-to-point testing - one at the near-end and one at the far-end DSX-3 (Figure 6-4). With each instrument transmitting and receiving, the part of the T3 link that is creating the problem can be identified, and the faulty card or cable quickly replaced.

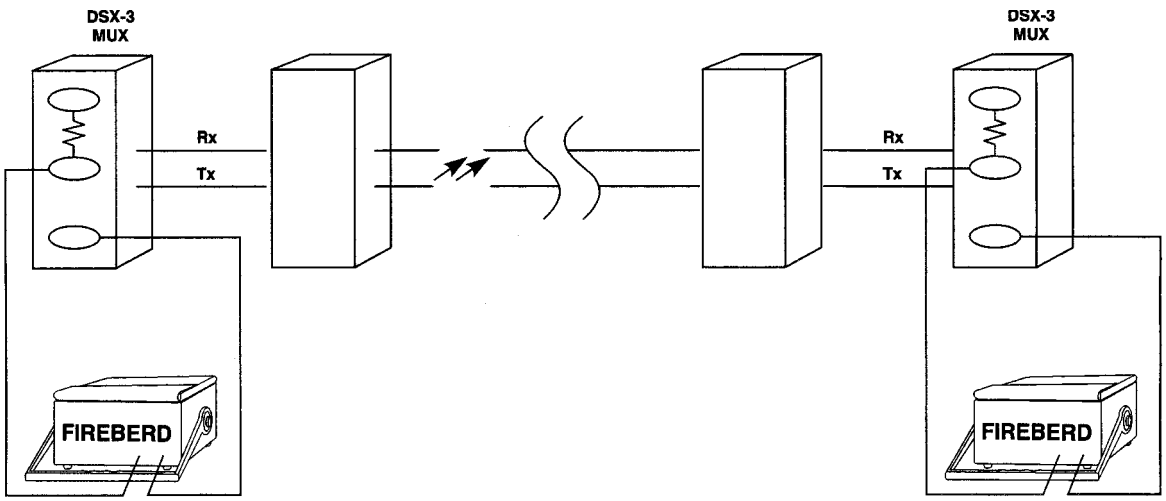


Figure 6-4. Point-to-Point Out-of-Service Testing

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The presence of bit errors in a point-to-point test is a good indication that the problem detected in the far-end loopback test has been isolated.

Setting Up The FIREBERD 4000 For a Point-To-Point Test

To set up two FIREBERDs for a point-to-point loopback test, follow the procedures described in Table 6-3.

NOTE

These procedures apply to both instruments, except when setting the GENERATOR CLOCK (see Step 5).

Table 6-3. Point-To-Point Test Set-Up Procedure

Step	Activity
1.	With the power to the FIREBERD 4000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 4000. **NOTE:** If the FIREBERD 4000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Press the CATEGORY switch until the INTERFACE label is illuminated.
4.	Use the SETUP SELECT switch and the softkeys below the SETUP display to configure the interface set-up menu as follows: Select: 1. DS3 to select the DS3 Interface Module. 2. FRAMING to select framing (UNFRAMED, Ml3, or CBIT). 3. INPUT to select DSX input gain and equalization. 4. OUTPUT to select DSX output termination. 5. OPERATION MODE to select normal mode of operation. 6. **MORE** PATTERN to enter the PATTERN menu. 7. 2^ 23-1 to select the 2^23-1 pattern.
5.	At the near-end DSX-3, press the CATEGORY switch until the GENERATOR CLOCK label is illuminated, then press the INTF softkey to derive the transmit clock from the DS3 network. At the far-end DSX-3, press the CATEGORY switch until the GENERATOR CLOCK label is illuminated, then press the INTRNL softkey to derive the transmit clock from the DS3 Modular Interface's internal crystal.
6.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the OUT jack on the DSX patch bay. Connect another cable from the DS3 OUT jack on the Module to the IN jack on the DSX-3 patch bay.
7.	Verify that the FRAME and PATTERN SYNC LEDs separated by the CLOCK PRES LED on the FIREBERD's front panel) are illuminated.
8.	Set the left half of the ANALYSIS RESULTS switch to BIT ERRS (in the ERROR category); set the right half of the ANALYSIS RESULTS switch to RCV FREQ (in the TIME & SIGNAL category).
9.	Press the FIREBERD's RESTART switch to clear all results counters.

Legend:

MORE = Press the MORE key

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6.3.3 Installation Testing of a Fiber Optic or Microwave System

Once a new fiber optic or microwave system is installed, the entire system must be tested at the T3 points before it is placed in-service. To verify successful operation, the transmission system, coaxial connectors, and cross-connect panels must all be analyzed.

This type of installation testing can be performed by looping the far-end DSX-3s and "daisy chaining" the near-end cross-connect points as shown in Figure 6-5. Far-end loopbacks can be established manually, or can be established by the FIREBERD when you specify the appropriate FEAC control code sequence.

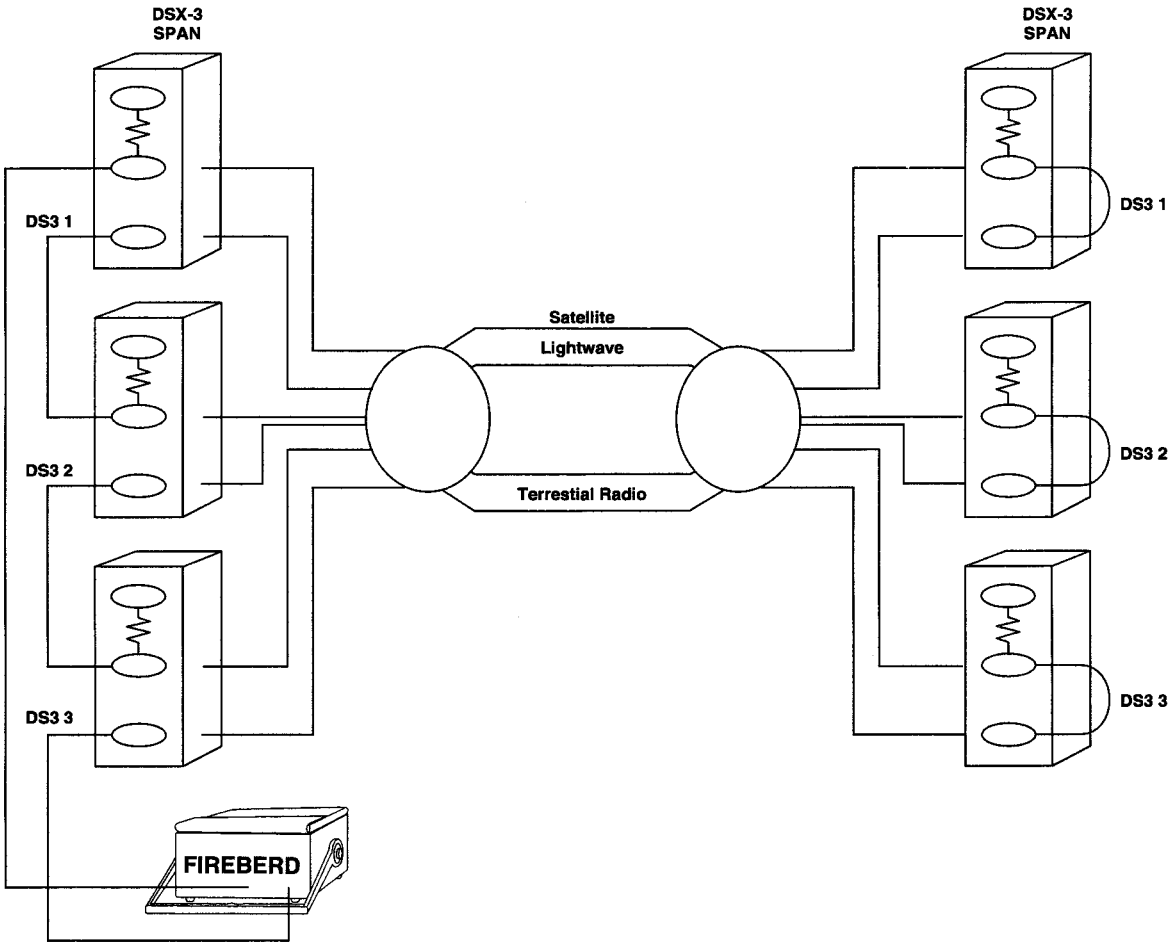


Figure 6-5. Installation Testing of a Fiber Optic or Microwave System

Setting Up The FIREBERD 4000 For an Installation Test

To set up the FIREBERD for an installation test, follow the procedures described in Table 6-4.

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Table 6-4. Installation Test Set-Up

Step	Activity
1.	With the power to the FIREBERD 4000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 4000. **NOTE:** If the FIREBERD 4000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Press the CATEGORY switch until the LED next the INTERFACE label is illuminated.
4.	Use the SETUP SELECT switch and the softkeys below the SETUP display to configure the interface set-up menu as follows: Select: 1. DS3 to select the DS3 Interface Module. 2. FRAMING to select framing (UNFRAMED, M13, or CBIT). 3. INPUT to select DSX input gain and equalization. 4. OUTPUT to select DSX output termination. 5. OPERATION MODE to select normal mode of operation. 6. **MORE** PATTERN to enter the PATTERN menu. 7. 2^23-1 to select the 2^23-1 pattern. 8. TX FEAC WORD to select far-end alarm control. 9. Enter the six-bit FEAC loop-up code to establish far-end loopback. **NOTE:** When the test is complete, enter the six-bit FEAC loop-down code to terminate the far-end loopback.
5.	Press the CATEGORY switch until the GENERATOR CLOCK label is illuminated, then press the INTF softkey to derive the transmit clock from the DS3 network.
6.	Connect a cable from the DS3 OUT jack on the DS3 Interface Module to the IN jack on the DSX-3 patch bay at the beginning of the daisy chain. Connect another cable from the DS3 IN jack on the DS3 Interface Module to the OUT jack on the DSX-3 patch bay at the end of the daisy chain.
7.	Verify that the FRAME and PATTERN SYNC LEDs separated by the CLOCK PRES LED on the FIREBERD's front panel) are illuminated.
8.	Set the left half of the ANALYSIS RESULTS switch to BIT ERRS (in the ERROR category); set the right half of the ANALYSIS RESULTS switch to RCV FREQ (in the TIME & SIGNAL category).
9.	Press the FIREBERD's RESTART switch to clear all results counters.

Legend:

MORE = Press the MORE key

6.3.4 Stress Testing Multiplexers

To ensure the correct passing of information through your network, you can use a FIREBERD to stress-test a T3 multiplexer. Stress testing ensures that your multiplexer will switch to a protection system when the error rate degrades to a defined level (e.g., one error in one million bits), and verifies that alarm systems are operating correctly.

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In this type of test, the DS3 signal transmitted by the multiplexer is received by the FIREBERD; the FIREBERD adds errors to the signal and retransmits it to the multiplexer (Figure 6-6). This activity should result in a switch to a redundant system, as well as create an alarm condition. Stress testing is performed in the Thru Loopback (TLB) mode of operation; in TLB mode, the FIREBERD retransmits received data on the transmit circuit.

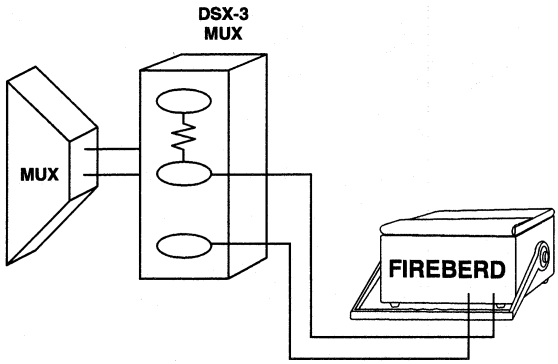


Figure 6-6. Stress-Testing a Multiplexer

NOTE

Although this application is classified as an out-of-service test, you can also use the FIREBERD to insert errors on live traffic.

Setting Up The FIREBERD 4000 For a Stress-Test

To stress-test a T3 multiplexer, follow the procedures described in Table 6-5.

Table 6-5. Stress-Testing a T3 Multiplexer

Step	Activity
1.	With the power to the FIREBERD 4000 turned off, insert the DS3 Interface Module in the rear-panel interface slot.
2.	Press the POWER switch to apply power to the FIREBERD 4000. If the FIREBERD 4000 is in Self-Loop mode after power-up, press the SELF LOOP switch to extinguish the LED inside the switch.
3.	Press the CATEGORY switch until the LED next the INTERFACE label is illuminated.
4.	Use the SETUP SELECT switch and the softkeys below the SETUP display to configure the interface set-up menu as follows: Select: 1. DS3 to select the DS3 Interface Module. 2. FRAMING to select framing (UNFRAMED, M13, or CBIT). 3. INPUT to select HIGH input gain and equalization. 4. OUTPUT to select HIGH output termination. 5. OPERATION MODE to select TLB mode of operation. 6. ERRINS to select the error insert menu. 7. LOGIC to insert bit errors into the transmitted signal. 8. RATE to set the insertion rate to 10^{-6}.

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Table 6-5. Stress-Testing a T3 Multiplexer (Continued)

Step	Activity
5.	Press the CATEGORY switch until the GENERATOR CLOCK label is illuminated. then press the INTF softkey to derive the transmit clock from the DS3 network.
6.	Connect a cable from the DS3 IN jack on the DS3 Interface Module to the OUT jack on the DSX-3 patch bay. Connect another cable from the DS3 OUT jack on the DS3 Interface Module to the IN jack on the DSX-3 patch bay.
7.	Press the FIREBERD's RESTART switch to clear all results counters.

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SECTION 7 SPECIFICATIONS

7.1 INTRODUCTION

This section lists the specifications for the DS3 Interface Module.

Framing Modes

- T3 unframed
- T3 framed (M13 or C-Bit)

Operating Modes

- Normal
- Test loopback

DS3 Input

- Input Connector: WECO56OA jack
- Input Frequency: 44.736 MHz ± 100 ppm
- Input Impedance: 75 ohms nominal, unbalanced to ground
- Operating Range:
  HIGH Level: +6 dB to -26 dB of flat loss from nominal high level
  DSX Level: +6 dB to -26 dB of flat loss from nominal DSX level

DS3 Output

- Output Connector: WECO 560A jack
- Output Frequency: 44.736 MHz ± 10 ppm
- Output Impedance: 75 ohms nominal, unbalanced to ground
- Output Pulse:
  HIGH Level: Rectangular pulse
  Amplitude: .91 peak ±. 1 1 volt peak
  Width (at 1/2 amplitude): 11.2 ns ±1.l ns
  Rise/Fall Times (10%-90% amplitude): 4.5 ns ± 1.5 ns, overshoot -10% pulse amplitude
  DSX Level: Per CB 1 19, Table 8 CCITT G.703
- 0 Line Code: B3ZS

Error Insertion

- Logic Errors: Single insertion or insertion at specified rate
- BPVs: Single insertion or insertion at specified rate
- Logic and BPVs: Single or rate
- Frame: Single insertion of 1-15 consecutive frame errors
- Error Insertion Rates: FIREBERD 6000 = 1E-5 to IE-9; FIREBERD 4000 = IE-6

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Indicators

- Frame Sync: DS3 frame synchronization achieved
- Code: Idle signal received
- ALM1: Yellow alarm received
- ALM2: Blue signal received

Alarm Criteria

- Yellow Alarm: Detects a far-end out-of-frame condition (i.e., framing is lost) (X1 and X2 bits set to zero)
- Blue Alarm (AIS): “Keepalive” pattern detects complete system failure (C-bits = 0 and l000 bits of l0l0 pattern)

Signal Loss

- 0.02 ms without valid input pulses

Patterns

- Fixed: 1111, 1100, 1010, and 3- to 24-bit programmable
- Pseudorandom: 2^{15}-1, 2^{20}-1, and 2^{23}-1

Pattern Synchronization Criteria

- Fixed Patterns: 64 consecutive error-free bits
- Pseudorandom Patterns: 60 + n consecutive error-free bits for length 2^{n}-l

Pattern Synchronization Loss Criteria

- 1,024 errors per 32,767 bits

Frame Synchronization Criteria

- 15 consecutive error-free F bits and two consecutive error-free M_0-M_1-M_0 sequences

Frame Synchronization Loss Criteria

- Selectable:
  Fast = 3 of 15 F-bits in error, or two of three M_0-M_1-M_0 sequences in error
  Slow = 6 of 15 F-bits in error

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SECTION 8 MAINTENANCE AND SERVICE

8.1 INTRODUCTION

This section contains information on maintenance and service for the DS3 Modular Interface. It also describes TTC's warranty policies and repair procedures.

8.2 MAINTENANCE

8.2.1 In Case of Difficulty

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

- The FIREBERD's AC line power and AC power supply
- AC fuses and fuse rating

If some indicators illuminate and the unit fails to operate:

- Verify that the interface is properly inserted in the FIREBERD (turn off power before inserting or removing interface).
- Check the interface and/or mainframe cabling and connections to the FIREBERD.
- Substitute another interface, if one is available.

Follow the self-test procedures in the *FIREBERD Operating Manual to* localize the problem. If the unit still does not operate, refer to the sections that immediately follow for service information or call the TTC Technical Assistance Center for applications assistance.

NOTE

Verify that the interface clock source is connected before attempting self-test.

8.3 SERVICE

8.3.1 Warranty Policy

All equipment manufactured by 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 if:

1. Equipment has been altered or repaired without specific authorization from TTC.
2. Equipment is installed or operated 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.

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8.3.2 In-Warranty Service

Equipment in warranty must be returned to the factory with shipping prepaid. The equipment should be packed and shipping prepaid. The equipment should be packed and shipped in accordance with the instructions in Section 8.3.4 of this manual. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the TTC Repair Department. The RA number should then appear on all paperwork and be clearly marked on the outside of the shipping container.

After the equipment is repaired by TTC, it will be tested to ensure it meets applicable specifications, aligned and retested where required, 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.

8.3.3 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 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 repair 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 is 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.

8.3.4 Equipment Return Instructions

The customer should attach a tag to all equipment returned for repair that includes the following information:

1. Owner name and address.
2. A fist of equipment being returned and the applicable serial number(s).
3. A detailed description of the problem or service requested.
4. The name and telephone number of the person to contact regarding questions about the repair.
5. The RA number.

If possible, the customer should return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. TTC is not liable for any damage that may occur during shipping. The customer should clearly mark the TTC issued RA number on the outside of the package and ship it prepaid and insured to TTC.

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APPENDIX A FACTORY DEFAULT SETTINGS

Table 1-1. Factory Default Settings

Item	Factory Default
FRAME	C-BIT
INPUT	HIGH
OUTPUT	HIGH
MODE	NORMAL
PATTERN	2^{23}-1
ERRINS: TYPE RATE FRAME BITS (NUMBER) FRAME (INSERT)	 LOGIC OFF 1 OFF
TRANSMIT X BITS	1
TRANSMIT FEAC WORD	111111
FRAME LOSS THRESHOLD	FAST
PARITY ERROR RATES	BLOCK

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APPENDIX B M13 AND C-BIT FRAMING FORMATS

B.1 M13 FRAMING FORMAT

The DS3 M13 frame consists of seven subframes, each with eight overhead bits. There are 84 data bits between each of these overhead bits, as shown in Table 2-1.

Table 2-1. M13 Framing Format

X	F_1	C_{11}	F_0	C_{12}	F_0	C_{13}	F_1	subframe1
X	F_1	C_{21}	F_0	C_{22}	F_0	C_{23}	F_1	subframe 2
P	F_1	C_{31}	F_0	C_{32}	F_0	C_{33}	F_1	subframe 3
P	F_1	C_{41}	F_0	C_{42}	F_0	C_{43}	F_1	subframe 4
M_0	F_1	C_{51}	F_0	C_{52}	F_0	C_{53}	F_1	subframe 5
M_l	F_1	C_{61}	F_0	C_{62}	F_0	C_{63}	F_1	subframe 6
M_0	F_1	C_{71}	F_0	C_{72}	F_0	C_{73}	F_1	subframe 7

Table Key:

F_l F_0 F_0 F_1, = 1001:
Frame Alignment Bits

M_0 M_1M_0 = 010:
Multiframe Alignment Bits

XX = 00 or 11:
User-Defined Bits - X-bits must be the same in a given frame and should not change more than once per second.

PP = 00 or11:
Parity Bits - Parity is calculated over the preceding frame's 4,704 data bits. Each M-frame contains two parity bits or “P-bits.” The transmitting equipment initially sets these parity bits to the digital sum of all of the information bits in the previous M-frame — 00 if the number of ones is even, or 11 if the number of ones is odd. The receiving network equipment performs the sane calculation on the information bits and compares the result with the parity values specified in the next M-frame. If the transmitting and receiving parity results match, it strongly indicates error-free transmission; if the results do not match, it indicates that information has been lost between the transmitting and receiving devices.

C_{n1} $C_{n2}C_{n3}$ = 000 or 11:
Stuff Indicator Bits - The 21 stuff indicator bits are identical for a given frame. These bits follow an 18-frame pattern: 001 001 001 001 001 011. When a blue signal is transmitted, C-bits are all set to zero. 111 is specified when bit stuffing has occurred; 000 is specified when bit stuffing has *not* occurred.

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B.2 C-BIT FRAMING FORMAT

C-bit framing differs from M13 framing in that all C-bits are redefined for more extensive performance monitoring. Because C-bit framing is synchronous in format, stuff bits are not required. X-bits are given also more specific definition; however, framing, multiframing, and parity bit definitions are identical to the M13 framing format (Table 2-2).

Table 2-2. C-Bit Framing Format

X	F_1	AIC	F_0	N_a	F_0	FEAC	F_1	subframe 1
X	F_1	DL	F_0	DL	F_0	DL	F_1	subframe 2
P	F_1	CP	F_0	CP	F_0	CP	F_1	subframe 3
P	F_1	FEBE	F_0	FEBE	F_0	FEBE	F_1	subframe 4
M_O	F_1	DL	F_0	DL	F_0	DL	F_1	subframe 5
M_1	F_1	DL	F_0	DL	F_0	DL	F_1	subframe 6
M_0	F_1	DL	F_0	DL	F_0	DL	F_1	subframe 7

Table Key:

AIC = 1:
The value of the Application Identification Channel (AIC) is always one to indicate C-bit framing. If more than 4 of 16 zeros are detected in this bit position, regular bit framing is assumed.

XX = 00 or 11:
Transmits a near-end out-of-frame signal to the far-end of a DS3 circuit. X-bits must always be the same in a given frame and should not change more than once per second.

PP = 00 or 11:
Parity Bits - Parity is calculated over the preceding frame's 4,704 data bits. Parity equals 11 if the number of marks is odd and 00 if the number of marks is even.

N_a:
Reserved: Network Application Bit

FEAC:
Far-End Alarm Control Bits

DL:
Datalink Bits

CP = 000 or 111:
C-bit Parity Bits - Same as parity bits (PP), but with the added ability to allow end-to-end performance monitoring. Uses "best of-three" majority CP bits to determine parity:

FEBE = 000 or 111:
Far-End Block Errors are generated when a C-bit parity or framing error is detected. When the FEBE =111, no errors are detected; when the FEBE = 000, errors are detected. Majority voting among the three FEBE bits is not used to declare a far-end block error.

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