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Rev. G

T-BERD® 224
PCM ANALYZER
USER'S GUIDE

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INTRODUCTION

The *T-BERD 224 User's Guide* offers an easy, direct method to operate the T-BERD 224. It presents the most commonly used test setups in complete and concise steps.

This user's guide is designed for the user who needs to know the basics for testing. It does not describe everything about the T-BERD 224; your *T-BERD 224 Reference Manual* fully addresses the operation of the instrument.

This manual is organized as follows:

TEST SETUPS - This section provides instrument setups and connection procedures to connect the T-BERD 224 to a T1 circuit. Read the entire *Test Setup* before connecting to the circuit. A *Test Setup* is referenced in the first step of each application.

T1 Monitor Test Setup
T1 Termination Test Setup
T1 Drop and Insert Test Setup
DCS Test Access Di-group (TAD) Test Setup

APPLICATIONS - This section provides information on operating the T-BERD 224 in a variety of common test scenarios. The required T-BERD 224 Options are identified with each test scenario. The test scenarios and instrument setups are grouped into the following applications:

T1 Testing
Fractional T1 Testing
DDS Network Testing
SLC Network Testing
ESF Network Testing
VF Testing
Signaling Testing
Level 2 Protocol Monitoring

RESULTS AND ALARMS - Refer to these sections when you are unfamiliar with the meaning of a result or an alarm.

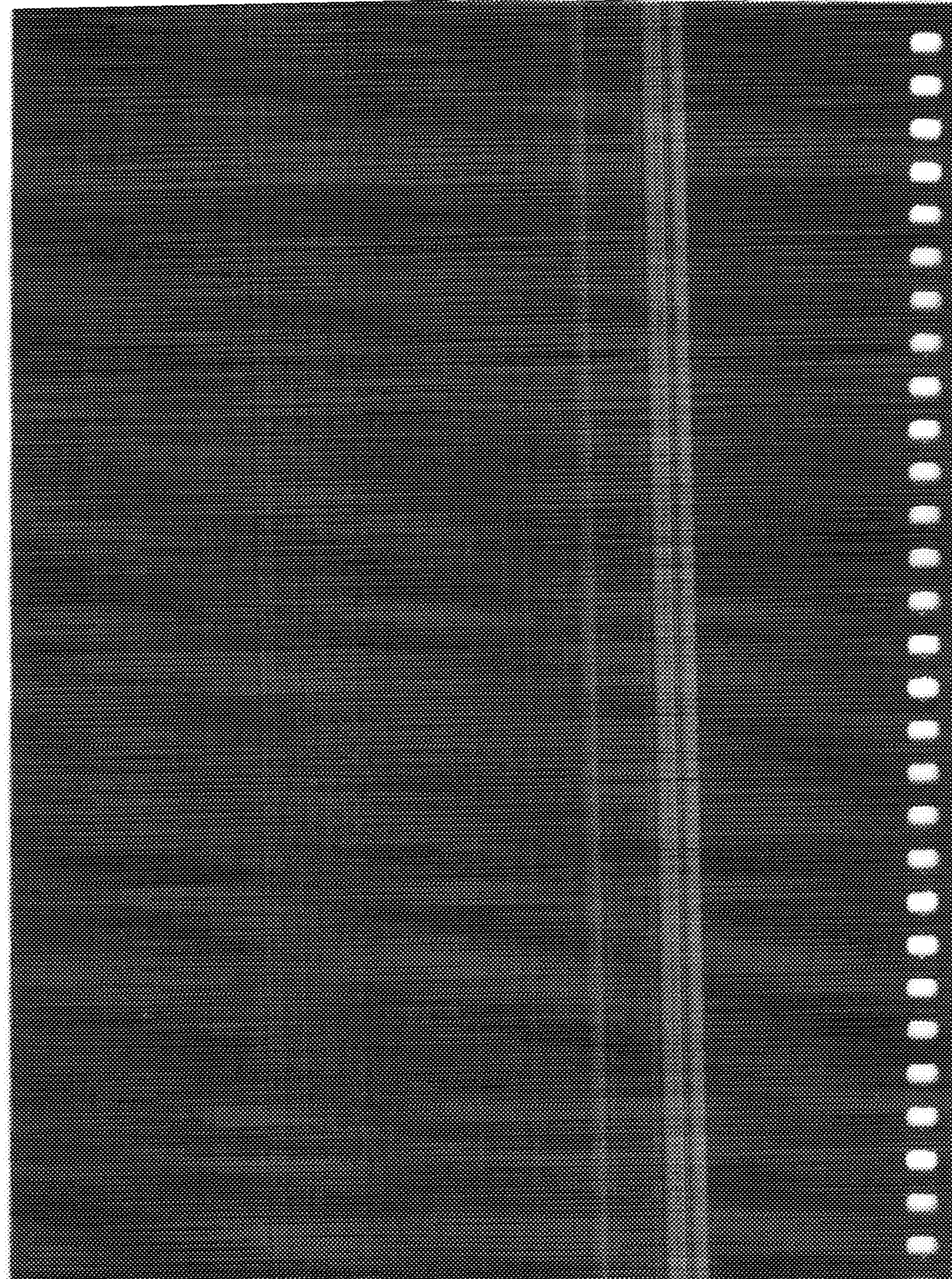
TEST SETUPS

T1 Monitor Test Setup

T1 Termination Test Setup

T1 Drop and Insert Test Setup

DCS Test Access Di-group (TAD) Test Setup



1. T1 MONITOR TEST SETUP

Use this test setup to connect the T-BERD 224 to a DSX-1 patch panel to monitor a full duplex T1 circuit and its channels (see Figure 1). This procedure is not application specific. It is referenced in the *Applications* Section when the T-BERD 224 is configured to monitor a T1 circuit. Read the entire procedure before making any connections.

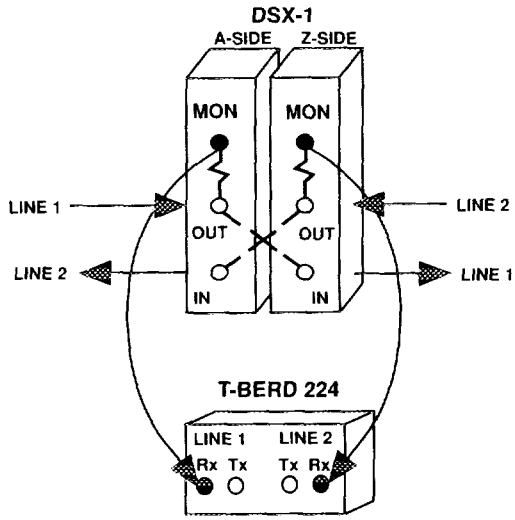


Figure 1
Monitoring a Full Duplex T1 Circuit

Configuring the T-BERD 224

1 **RESULTS I and II Blank switches**
Select SUMMARY category for both.

MODE switch

Select AUTO. Once the T-BERD 224 is connected to the circuit, it automatically configures to the proper T1 framing mode. Do not change the mode setting once the T-BERD 224 is connected to the circuit.

CODE switch

Select B8ZS or AMI (see WORD document or Circuit Description).

TEST switch

Select CONTinuous.

PRINT EVENT switch

Select OFF unless a results printout is required.

DROP (RX) switch

Select BOTH.

INSERT (TX) switch

Select NONE.

LINE 1 & 2 RECEIVE INPUT switch

Select DSX MON for both.

> If the DSX-MON jacks are not resistor isolated, set the **RECEIVE INPUT** switch to BRIDGE.

Connecting to the Circuit

LINE 1 RECEIVE jack

Connect a cable from the LINE 1 RECEIVE jack to DSX-1 A-SIDE MON jack.

LINE 2 RECEIVE jack

Connect a cable from the LINE 2 RECEIVE jack to DSX-1 Z-SIDE MON jack.

3 **RESTART switch**

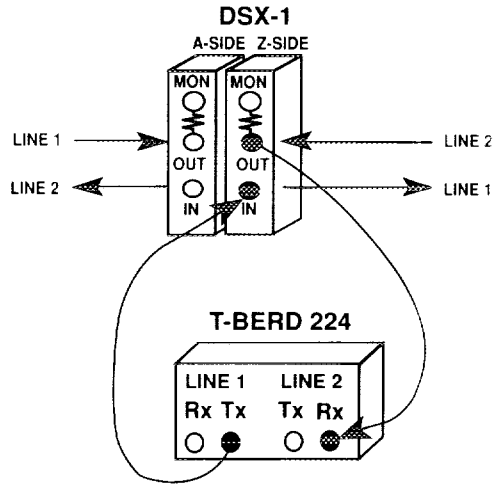
Press the **RESTART** switch to clear alarms and begin the test. Verify the Line 1 and Line 2 Signal and Frame Sync LEDs are illuminated, the framing format is displayed, and *RESULTS OK* is displayed.

4 **Proceed to a specific test in one of the *Application Sections*:**

T1, Fractional T1, SLC, ESF, DDS, VF, Signaling, or Level 2 Protocol Testing.

2. T1 TERMINATION TEST SETUP

Use this test setup to connect the T-BERD 224 to a DSX-1 patch panel to terminate a circuit (see Figure 2). This procedure is not application specific. It is referenced in the *Applications* Section when the T-BERD 224 is configured to terminate a T1 circuit and supply timing to the network or if emulating customer premises equipment and recovering timing from the Central Office. Read the entire procedure before making any connections.



Configuring the T-BERD 224

AUX switch

Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 05 LBO using the **MODE** switch. Select appropriate LBO settings (0 dB if at Central Office) for both LINE 1 and LINE 2 using the **SOURCE CONFIGURATION II** and **RESULTS I Blank** switches, respectively.

AUX 05	LINE 1	LINE 2
LBO	0 dB	0 dB

MODE and SCII switches

Scroll to AUX 06 BACK TM using the **MODE** switch. Select INTERNAL timing for both LINE 1 and LINE 2 if emulating Central Office (CO) equipment using the **SOURCE CONFIGURATION II** and **RESULTS I Blank** switches. Select RECOVERED timing if emulating customer premises equipment and recovering timing from the central office using the **SOURCE CONFIGURATION II** and **RESULTS I Blank** switches.

AUX 06	LINE 1	LINE 2
BACK TM	INTERNAL	INTERNAL

AUX switch

Press to exit the auxiliary functions (LED OFF).

RESULTS I and II Blank switches

Select SUMMARY category for both.

MODE switch
Select proper T1 framing mode (e.g., T1, T1-D4, T1-ESF, or T1-SLC).

CODE switch
Select B8ZS or AMI (see WORD document or Circuit Description).

TEST switch
Select CONTinuous.

PRINT EVENT switch
Select OFF unless a results printout is required.

DROP (RX) switch
Select LINE 2.

INSERT (TX) switch
Select LINE 1.

LINE 2 RECEIVE INPUT switch
Select TERM.

Connecting to the Circuit

LINE 1 TRANSMIT jack
Connect a cable from the LINE 1 TRANSMIT jack to the DSX-1 IN jack.

LINE 2 RECEIVE jack
Connect a cable from the LINE 2 RECEIVE jack to the appropriate DSX-1 OUT jack.

RESTART switch
Press the **RESTART** switch to clear alarms and begin the test. Verify the Line 2 Signal and Frame Sync LEDs are illuminated, the framing format is displayed, and *RESULTS OK* is displayed.

Proceed to a specific test in the *Application Sections*:
T1, Fractional T1, SLC, ESF, DDS, VF, or Signaling.

3. T1 DROP AND INSERT TEST SETUP

Use this test setup to connect the T-BERD 224 to the DSX-1 patch panel to drop a channel from Line 1, Line 2, or both lines without disrupting the T1 signal (see Figure 3). This procedure is not application specific. It is referenced in the *Applications* Section when the T-BERD 224 is configured to drop and insert a signal on a particular channel. Read the entire procedure before making any connections.

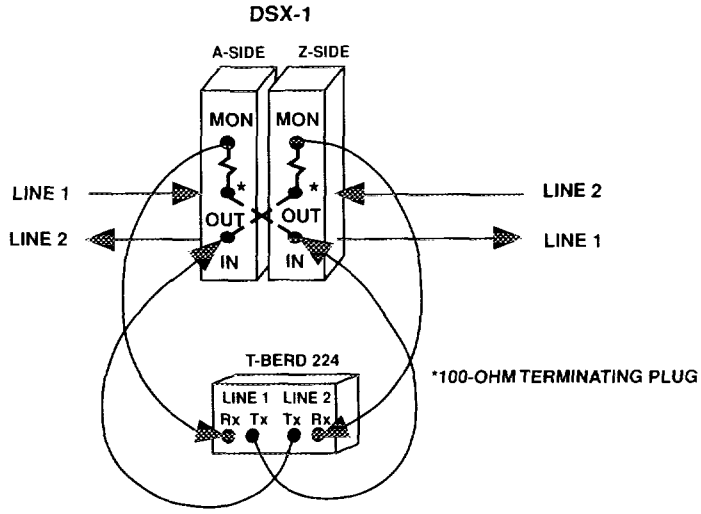


Figure 3
T1 Drop and Insert Testing

Configuring the T-BERD 224

AUX switch
Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 05 LBO using the **MODE** switch. Select 0 dB LBO settings for both LINE 1 and LINE 2 using the **SOURCE CONFIGURATION II** switch and **RESULTS I Blank** switch, respectively.

AUX 05 LBO	LINE 1	LINE 2
	0 dB	0 dB

AUX switch

Press to exit auxiliary functions (LED OFF).

RESULTS I and II Blank switches

Select the SUMMARY category.

MODE switch

Select AUTO. Once cabled in, the T-BERD 224 automatically configures to the proper T1 framing mode. Do not change the mode setting once the T-BERD 224 is connected to the circuit.

CODE switch

Select B8ZS or AMI (see WORD document or Circuit Description).

TEST switch

Select CONTinuous.

PRINT EVENT switch

Select OFF unless a results printout is required.

DROP (RX) switch

Select BOTH.

10. **INSERT (TX) switch**
    Select NONE.

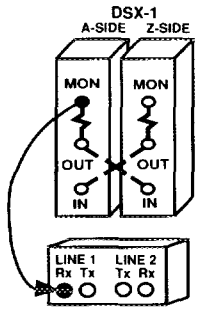
    NOTE: Initially, the **DROP (RX)** switch is set to BOTH and the **INSERT (TX)** switch is set to NONE to minimize the interruption of the T1 circuit during the connection procedure. Once the T-BERD 224 is connected to the T1 circuit, individual channels can be tested.

11. **LINE 1 & 2 RECEIVE INPUT switch**
    Select DSX MON.

    NOTE: If the DSX-MON jacks are not resistor isolated, set the **RECEIVE INPUT** switch to BRIDGE.

Connecting to the Circuit

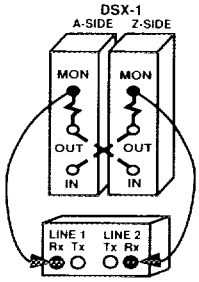
1. **LINE 1 RECEIVE jack**
   Connect a cable from the LINE 1 RECEIVE jack to the DSX-1 A-SIDE MON jack (see the following figure).



2. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Line 1 Signal and Frame Sync LEDs are illuminated, the framing format is displayed, and the SUMMARY category displays *RESULTS OK*.

LINE 2 RECEIVE jack

Connect a cable from the LINE 2 RECEIVE jack to DSX-1 Z-SIDE MON jack (see the following figure).



RESTART switch

Press **RESTART** to clear alarms and begin the test. Verify the Line 2 Signal and Frame Sync LEDs are illuminated and the SUMMARY category displays *RESULTS OK* (i.e., no BPVs, frame errors, or timing slips occur).

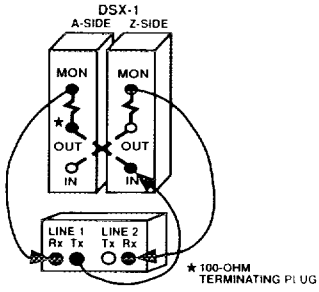
LINE 1 TRANSMIT jack

Connect a cable from the LINE 1 TRANSMIT jack to the DSX-1 Z-SIDE IN jack (see the following figure).

> First, connect the cable to the T-BERD 224, then to the DSX-1 Z-SIDE IN jack. If the cable is connected to the DSX-1 jack first, it will take down the T1 circuit.

Insert a 100-ohm terminating plug into the DSX-1 A-SIDE OUT jack.

> Never insert the termination plug before the transmit cable.



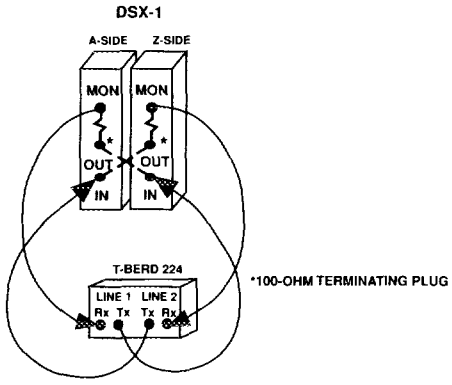
6. **LINE 2 TRANSMIT jack**

Connect a cable from the LINE 2 TRANSMIT jack to the DSX-1 A-SIDE IN jack (see the following figure).

CAUTION First, connect the cable to the T-BERD 224, then connect to the DSX-1 A-SIDE IN jack. If the cable is connected to the DSX-1 jack first, it will take down the T1 circuit.

Insert a 100-ohm terminating plug into the DSX-1 Z-SIDE OUT jack.

CAUTION: Never insert the termination plug before the transmit cable.



7. **RESTART switch**

Press **RESTART** to clear alarms and begin the test. Verify the Line 1 and Line 2 Signal and Frame Sync LEDs are illuminated and the SUMMARY category displays *RESULTS OK*. If errors are displayed, proceed to Step 9.

8. **Proceed to a specific test in the *Application Section*:**

T1, Fractional T1, SLC, ESF, DDS, VF, or Signaling.

9. **Disconnect the circuit in the reverse order to prevent service disruption**

4. DCS TEST ACCESS DI-GROUP (TAD) TEST SETUP

Use this test setup to connect the T-BERD 224 to the DSX-1 patch panel to access the T1 circuit from the DCS TAD (see Figure 4). This procedure is not application specific. It is referenced when the T-BERD 224 is configured to test the T1 circuit from the DCS TAD. Read the entire procedure before making any connections.

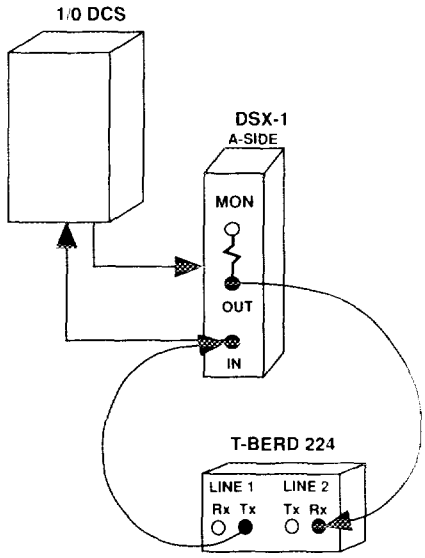


Figure 4.
DCS TAD Setup

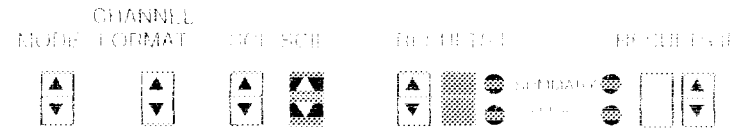
Configuring the T-BERD 224

- **AUX switch**
  Press to access auxiliary functions (LED ON).

2. **MODE, SCII, and RESULTS I Blank switches**

   Scroll to AUX 05 LBO using the **MODE** switch. Select 0 dB LBO settings for both LINE 1 and LINE 2 LBO using the **SOURCE CONFIGURATION II** switch and **RESULTS I Blank** switch, respectively.

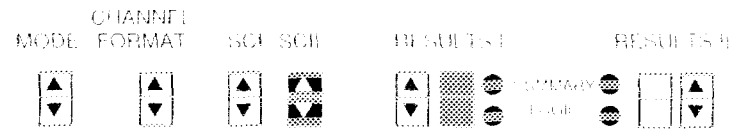
AUX 05	LINE 1	LINE 2
LBO	0 dB	0 dB



3. **MODE, SCII, and RESULTS I Blank switches**

   Scroll to AUX 06 BACK TM using the **MODE** switch. Select RECOVERED timing for both LINE 1 and LINE 2 LBO using the **SOURCE CONFIGURATION II** switch and **RESULTS I Blank** switch, respectively.

AUX 06	LINE 1	LINE 2
BACK TM	RECOVERED	RECOVERED

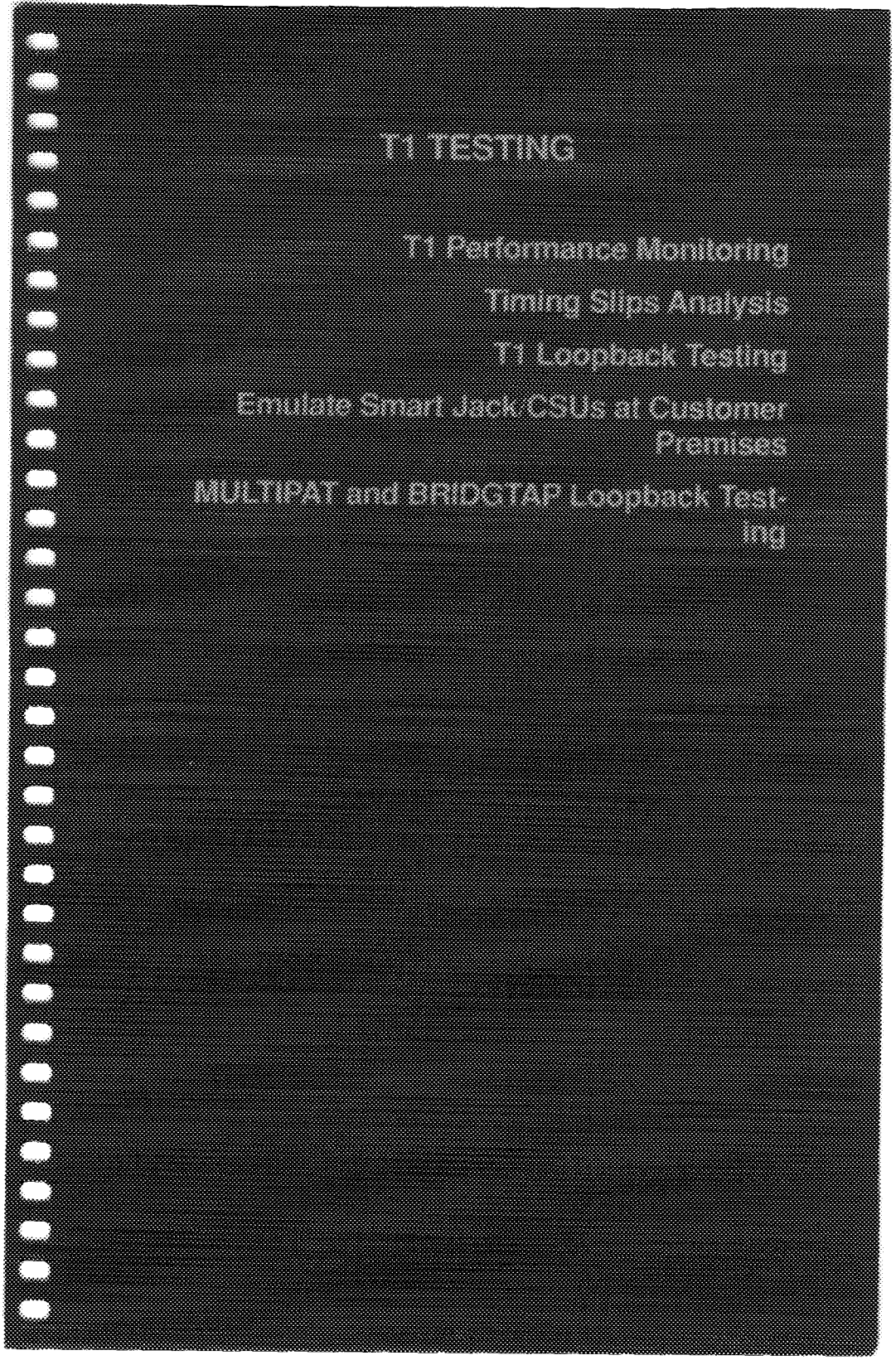


4. **AUX switch**

   Press to exit the auxiliary functions (LED OFF).

5. **RESULTS I and II Blank switches**

   Select the SUMMARY category for both.


T1 TESTING
T1 Performance Monitoring
Timing Slips Analysis
T1 Loopback Testing
Emulate Smart Jack CSUs at Customer Premises
MULTIPAT and BRIDGTAP Loopback Testing

5. T1 PERFORMANCE MONITORING

- Non-intrusively monitor the T1 facility.
- Confirms that the T1 signal is properly received by the network equipment.

Figure 5 illustrates a T-BERD 224 monitoring the T1 signal from a DSX-1.

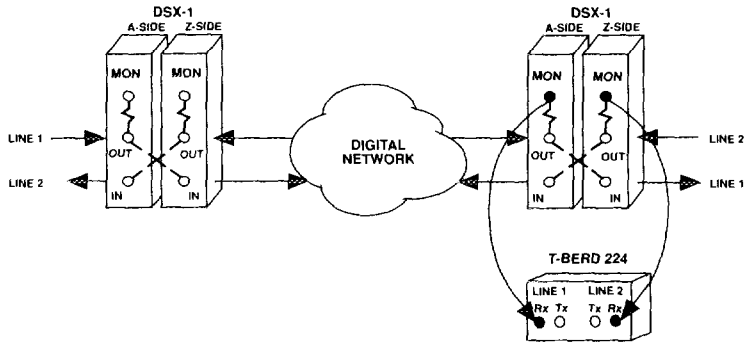


Figure 5
T1 Performance Monitoring

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to *the T1 Monitor Test Setup***

Performing the Test

1. **CHANNEL FORMAT switch**
   Select FULL T1.

2. **RESULTS I switches**
   Select the SIGNAL category using the **RESULTS I Blank** switch and the n41 RX LVL result using the **RESULTS I Arrowed** switch.

RESULTS II switches

Select the SIGNAL category using the **RESULTS II Blank** switch and the n40 RX FREQ result using the **RESULTS II Arrowed** switch.

	141 RX LVL	140 RX FREQ
FULL T1	**-20.0 dBdsx**	**1544000**

Analyzing Test Results

RX FREQ (SIGNAL Category)

The received frequency should be 1.544 MHz +/- 75 Hz. If the frequency is outside of the specification, check the transmission equipment timing or the network synchronization.

RX LVL (SIGNAL Category)

The received level should be -20 dB +/- 3 dB at resistor isolated DSX-MON jacks. Incorrect levels could be caused by a faulty facility T1 line card or poor cabling between the DSX jack and the equipment.

FRM ERR, CRC ERR, BPVs (ERRORS Category)

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

FRM ERR, CRC ERR, No BPVs (ERRORS Category)

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further upstream.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a good T1 signal. Sectionalize the T1 circuit downstream from the test point.

AIS LED

This indicates that some equipment in the signal path is not receiving a good T1 signal from the far end. Sectionalize the T1 circuit upstream from the test point.

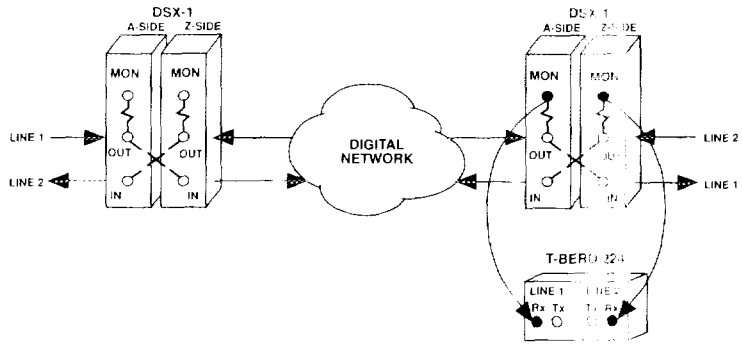
6. TIMING SLIPS ANALYSIS

- Confirms that all the network equipment is properly synchronized.

  Verify network timing.

  Isolate possible timing problems.

Figure 6 illustrates a T-BERD 224 testing for the presence of timing slips by comparing the received T1 signal on LINE 1 with a reference T1 clock source on LINE 2.



Configuring the T-BERD 224

Configure T-BERD 224 according to *the T1 Monitor Test Setup*

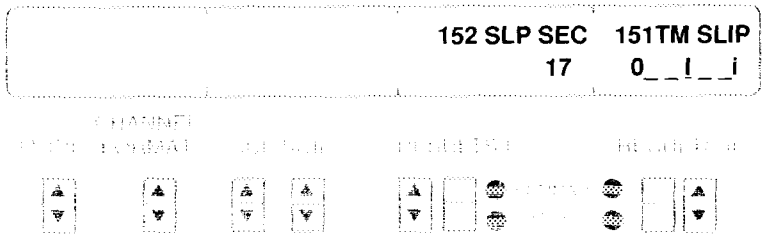
Performing the Test

CHANNEL FORMAT switch

Select the appropriate test type for the T1 signal being monitored.

2. **RESULTS I switches**
   Select the SIGNAL category using the **RESULTS I Blank** switch and the n52 SLP SEC result using the **RESULTS I Arrowed** switch.

3. **RESULTS II switches**
   Select the SIGNAL category using the **RESULTS II Blank** switch and the n51 TM SLIP result using the **RESULTS II Arrowed** switch.



The n51 TM SLP result is only available for LINE 1 when LINE 2 is acting as the T1 reference signal. However, if an external clock source is connected to the side-panel BNC connector, both LINE 1 and LINE 2 results are available.

The n52 SLP SEC result increments (accumulates) only when the T1 reference signal (LINE 2) and the received signal (LINE 1) are present.

Analyzing Test Results

- If the T1 reference and receive signals are perfectly synchronized, the timing slip count remains at 0, the bar graph remains at center, and the wheel remains at top-center.

- If the T1 reference and received signals are synchronized, but one signal exhibits low-speed wander (e.g., Doppler shifts from satellites), the timing slip count remains at 0. As the satellite gets closer, the wheel moves clockwise, and the bar graph moves to the right. As the satellite moves farther away, the wheel moves counter clockwise, and the bar graph moves to the left.

- If the T1 reference and received signals are unsynchronized, the wheel, bar graph, and timing slips count behave as follows:

  When the received signal frequency is higher than the T1 reference signal, the wheel moves clockwise, the bar graph moves to the right, and the timing slip count increments every 193 bit slips.

  When the received signal frequency is lower than the T1 reference signal, the wheel moves counterclockwise, the bar graph moves to the left, and the timing slip count increments every 193 bit slips.

  When the frequency difference is more that a few cycles (Hertz), the timing slip count, bar graph, and wheel move very rapidly.

7. T1 LOOPBACK TESTING

T1 BERT Option Required

- Qualify T1 circuit's error performance.
- Check loopback response of transmission equipment.
- Select in-band or out-of-band smart jack or CSU loop codes.
- Send 1:7, 3 IN 24, QRSS, or a variety of other test patterns.

Figure 7 illustrates a T-BERD 224 connected to the span through the DSX-1 patch panel to loop the end office equipment and test the full T1 bandwidth.

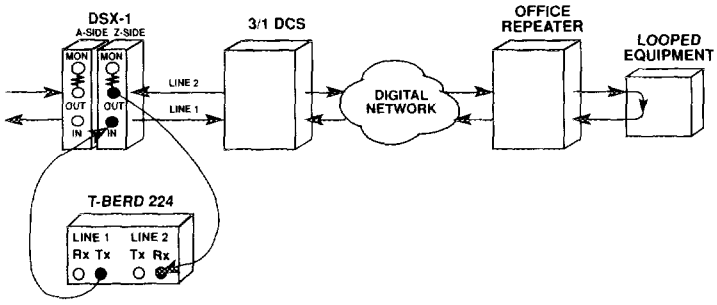


Figure 7
T1 Loopback Testing

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to *the T1 Termination Test Setup***

2. **AUX switch**
   Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 17 LOOP CD using the **MODE** switch. Set the loop code TYPE to T1 using the **SOURCE CONFIGURATION II** switch. Select the EQUIPment to be looped using the **RESULTS I Blank** switch. (Refer to the T-BERD 224 Reference Manual.)

FAC2 = Smart Jack and CSU = Customer Service Unit.

AUX 17	TYPE	EQUIP
LOOP CD	T1	FAC2

AUX switch

Press to exit auxiliary functions (LED OFF).

CHANNEL FORMAT switch

Select FULL T1.

SCI switch

Select appropriate stress pattern (e.g., MULTIPAT, QRSS, or 3 IN 24).

RESULTS I switches

Select the LOGIC category using the **RESULTS I Blank** switch and the n00BIT ERR result using the **RESULTS I Arrowed** switch.

T1	QRSS	200BIT ERR	RESULTS
FULL T1		UNAVAIL	OK

Performing the Test

1. **LOOP UP switch**
   Press the **LOOP UP** switch (LED ON) to start sending the selected loop-up code. The switch LED remains illuminated until the loop code is received by the T-BERD 224. If loop up is established, *LOOP UP SUCCESSFUL* flashes in the display.

2. **Local Status LEDs**
   Verify the green Signal, Pattern Sync, and Frame Sync (if applicable) LEDs are illuminated. This indicates the stress pattern selected in the SOURCE CONFIGURATION display is being received by the T-BERD 224.

3. **LOGIC ERROR INSERT switch**
   Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00BIT ERR result.

4. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected.

5. **LOOP DOWN switch**
   When the test is completed, press the **LOOP DOWN** switch to release the loopback. The switch LED remains illuminated until the loop down is accomplished. If loop down is successful, *LOOP DOWN SUCCESSFUL* flashes in the display and the Pattern Sync LED is extinguished. Disconnect the T-BERD 224 from span.

Analyzing Test Results

FRM ERR, CRC ERR, BIT ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors at the test set.

FRM ERR, CRC ERR, BIT ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further.

BIT ERR only

Check the span before the DCS by isolating sections and testing.

RX FREQ

The received frequency should be 1.544 MHz +/- 75 Hz. If the frequency is outside of the specification, check the transmission equipment timing or the network synchronization.

Loopback is not established

The CSU is not operating correctly or the line from you to the CSU is bad.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a signal. This indicates the line from the test set to the CSU is bad. Sectionalize the T1 equipment further.

AIS LED

This indicates that some equipment in the signal path towards your test set is not receiving a signal from the far end.

8. EMULATE SMART JACKS/CSUs AT CUSTOMER PREMISES — *T1 BERT Option Required*

- Verify the span installation.
- Terminate the T1 line and loop simplex current.
- Measure simplex current and T1 level.
- Auto-respond to T1 loop codes.
- Functionally replace a T1 CSU (Customer Service Unit)/Smart jack.

Figure 8 illustrates a T-BERD 224 emulating a CSU at the customer premises.

NOTE: If Bantam or 310 jacks are not available for testing at the customer premises, use test cables, such as the Model 41645 (dual bantam to RJ-48) or Model 41648 (dual bantam to 15-pin D-type male connector), to connect the T-BERD 224 to the network equipment or span line.

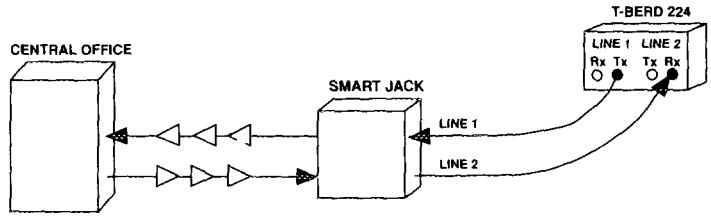


Figure 8
CSU/Smart Jack Emulation - Customer Premises Testing

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to *the T1 Termination Test Setup***

2. **AUX switch**
   Press to access auxiliary functions (LED ON).

3. **MODE, SCII, and RESULTS I Blank switches**
   Scroll to AUX 17 LOOP CD using the **MODE** switch. Set the loop code TYPE to T1 using the **SOURCE CONFIGURATION II** switch. Select the EQUIPment to be looped using the **RESULTS I Blank** switch.

   FAC2 = Smart Jack and CSU = Customer Service Unit.

AUX 17	TYPE	EQUIP
LOOP CD	T1	CSU

4. **MODE, and SCII switches**
   Scroll to AUX 18 AUT RES using the **MODE** switch. Select AUTO RESP using the **SOURCE CONFIGURATION II** switch.

AUX 18	AUTO RESPONSE TO T1 LOOP CODES
AUT RES	AUTO RESP

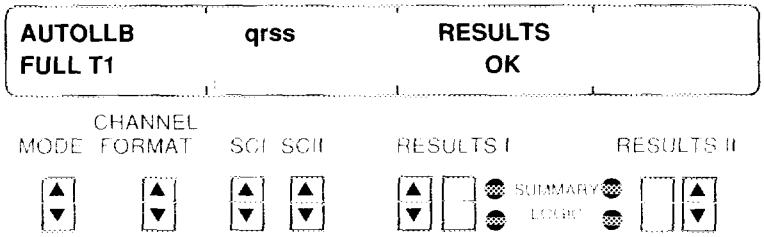
5. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

6. **CHANNEL FORMAT switch**
   Select FULL T1.

7. **SCI switch**
   Select AUTO to auto configure to the pattern being sent from the CO.

Performing the Test

1. **CO sends CSU loop-up code to T-BERD 224**
   The T-BERD 224 automatically responds in AUTO LLB mode. Internally, the T-BERD 224 loops the LINE 2 Receive to the LINE 1 Transmit. The CSU is disconnected from the T1 span (an idle code is transmitted to the CSU).



2. **Loopback verification**
   If loopback is successfully established, the Signal and Pattern Sync LEDs illuminate. If a framed mode is being used, the Frame Sync LED also illuminates.

3. **CO sends CSU loop-down code to T-BERD 224**
   When the test is complete, the CO must send a loop down code to the T-BERD 224 to release the loopback. Once loop down is successful, disconnect the T-BERD 224 from the span and reconnect the CSU.

Analyzing Test Results

FRM ERR, CRC ERR, BIT ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors at the test set.

FRM ERR, CRC ERR, BIT ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further.

BIT ERR only

Check the span before the DCS by isolating sections and testing.

RX FREQ

The received frequency should be 1.544 MHz +/- 75 Hz. If the frequency is outside of the specification, check the local transmission equipment or synchronization in the network.

Loopback is not established

The span is bad or AUX 17 LOOP CD and AUX 18 AUTOES were not set up correctly.

9. MULTIPAT AND BRIDGTAP LOOPBACK TESTING

T1 BERT Option Required

MULTIPAT®

- Automated test contains five Bellcore approved test patterns, including QRSS, 1:7, 3 IN 24, All Ones, and 2 IN 8.
- One-step qualification of T1 span lines.

BRIDGTAP™

- Automated test detects the presence of most bridge taps on T1 span lines.
- Transmits 21 patterns that are composed of varying degrees of ones and zeros densities.

Figure 9 illustrates the T-BERD 224 configured to loop a T1 circuit and perform automated MULTIPAT and BRIDGTAP testing.

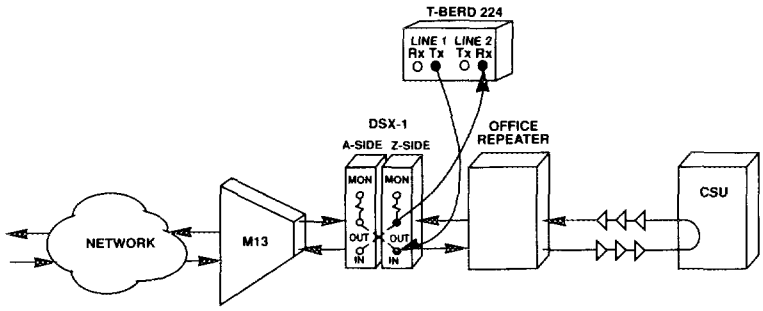


Figure 9
MULTIPAT and BRIDGTAP Testing

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to *the T1 Termination Test Setup***

2 **AUX switch**
Press to access auxiliary functions (LED ON).

3 **MODE, SCII, and RESULTS I Blank switches**
Scroll to AUX 17 LOOP CD using the **MODE** switch. Set the loop code TYPE to T1 using the **SOURCE CONFIGURATION II** switch. Select the EQUIPment to be looped using the **RESULTS I Blank** switch.

NOTE FAC2 = Smart Jack and CSU = Customer Service Unit.

AUX 17	**TYPE**	**EQUIP**
LOOP CD	**T1**	**CSU**

4 **AUX switch**
Press to exit auxiliary functions (LED OFF).

5 **CHANNEL FORMAT switch**
Select FULL T1.

6 **SCI switch**
Select MULTIPAT or BRIDGTAP.

7 **RESULTS I switches**
Select the LOGIC category using the **RESULTS I Blank** switch. Select the n00 BIT ERR result using the **RESULTS I Arrowed** switch.

8 **RESULTS II Blank switch**
Select the SUMMARY category.

Performing the Test

1. **LOOP UP switch**
   Press the **LOOP UP** switch (LED ON) to start sending the selected loop-up code. The switch LED remains illuminated until the loop code is received by the T-BERD 224. If loop up is established, *LOOP UP SUCCESSFUL* flashes in the display.

2. **Local Status LEDs**
   Verify the green Signal, Pattern Sync, and Frame Sync (if applicable) LEDs are illuminated. This indicates the stress pattern selected in the SOURCE CONFIGURATION display is being received by the T-BERD 224.

3. **LOGIC ERROR INSERT switch**
   Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00BIT ERR result.

4. **RESTART switch**
   Press **RESTART** to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected.

5. **LOOP DOWN switch**
   When the test is completed, press the **LOOP DOWN** switch to release the loopback. The switch LED remains illuminated until the loop down is accomplished. If loop down is successful, *LOOP DOWN SUCCESSFUL* flashes in the display and the Pattern Sync LED is extinguished. Disconnect the T-BERD 224 from span.

Analyzing Test Results

SUMMARY Category

RESULTS OK — No errors were detected with the MULTIPAT and BRIDGTAP tests.

FAILED MULTIPAT PATTERNS — If 3 IN 24 failed, it indicates a bad repeater (timing circuit) or one side of span is open.

If ALL ONES failed, it indicates a bad repeater (power supply).

If 1:7 failed, it indicates a bad repeater (timing circuit) or one side of span is open.

If QRSS failed, it indicates a faulty cable.

Errored Results — MULTIPAT Errors — When all or part of the patterns fails, it generally indicates a malfunctioning repeater, multiplexer, or DSX. To determine the possible cause, repeat the individual failed pattern while monitoring the RESULTS display. If errors immediately start accumulating, there is a cabling problem. If no errors occur for a few minutes, and then a burst of errors occurs, the problem is a repeater.

Errored Results — BRIDGTAP Errors — When the errors occur in the ALL ONES, 1:7, 2 IN 8, 3 IN 24, and QRSS patterns, it indicates that a bridge tap exists on the span. Sectionalize the span to isolate the bridge taps.

FRACTIONAL T1 TESTING

FT1 Performance Monitoring

FT1 Loopback Testing from the Customer Premises

FT1 Loopback Testing from the Central Office

FT1 Testing for Round Trip Delay

10. FT1 PERFORMANCE MONITORING
Fractional T1 Option Required

- Helps sectionalize FT1 circuit problems.
- Monitors FT1 test pattern from a mid-span location.

Use this application to test either a contiguous or non-contiguous fractional T1 bandwidth.

Figure 10 illustrates a T-BERD 224 monitoring a BERT test on a FT1 circuit.

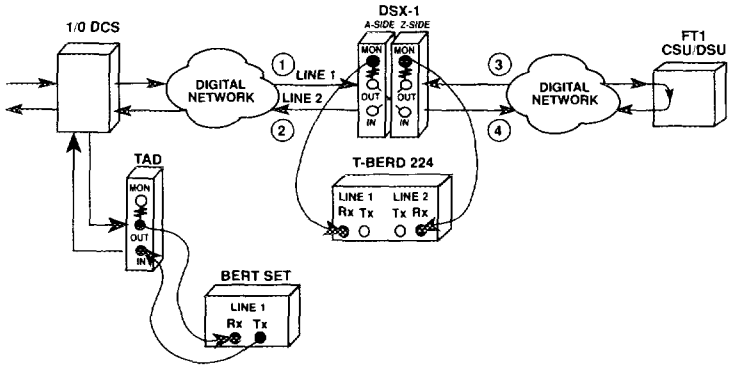


Figure 10
FT1 Performance Monitoring

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***

2. **CHANNEL FORMAT switch**
   Select 56 x N for a 56 kb/s circuit or 64 x N for a 64 kb/s circuit.

3 **SCI switch**
   Select the appropriate BERT test pattern. Refer to Section 3 of the T-BERD 224 Reference Manual for help in selecting the appropriate test pattern.

Contiguous Channels Configuration

SCII switch
Set N to the number of channels to be monitored in the FT1 bandwidth.

LINE 1 & 2 CHANNEL switches
Select the first channel of the FT1 bandwidth.

Non-Contiguous Channels Configuration

SCII switch
Select NON CONTIG (Non-contiguous channel configuration).

AUX switch
Press to access auxiliary functions (LED ON).

MODE, SCII, RESULTS I Blank, and RESULTS II Arrowed switches
Scroll to AUX 10 N-CONTG using the **MODE** switch. Select LINE 1 or LINE 2 using the **SOURCE CONFIGURATION II** switch. Scroll through the channels using the **RESULTS I Blank** switch. Press the **RESULTS II Arrowed** switch up to enter the selected channel as part of the non-contiguous bandwidth. Press the **RESULTS II Arrowed** switch down to delete the selected channel from the non-contiguous bandwidth.

> Line 1 and Line 2 bandwidths must have the same *number* of channels - but not necessarily the same channels.

AUX 10	**LINE**	**CHN UP↑/DN↓**	**ENTR↑/DEL↓**
N-CONTG	**L1:10 12 13 15 18 20**		

4. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

Performing the Test

1. **DROP (RX) switch**
   Select LINE 1.

2. **RESTART switch**
   Press **RESTART** to clear alarms and begin the test. Verify the Line 1 Pattern Sync, Signal and Frame Sync LEDs (if applicable) are illuminated, and the SUMMARY category displays *RESULTS OK*.

Analyzing Test Results

FRM ERR, CRC ERR, BIT ERR, BPVs
Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors.

FRM ERR, CRC ERR, BIT ERR, No BPVs
Typically a far-end T1 span line problem. BPVs are corrected by most transmission equipment before they are introduced onto the span.

BIT ERR only
The local T1 facility is operating correctly, however, the FT1 circuit is errored. Sectionalize further by checking the remote facilities, DCS configuration, FT1 circuit routing, or the customer premise equipment.

RX FREQ
The received frequency should be 1.544 MHz +/- 75 Hz. If the frequency is outside of the specification, check the transmission equipment timing or the network synchronization.

Sectionalizing - The circled number references the location of the problem in Figure 10.

If LINE 2 is dropped and the T-BERD 224 is not receiving errors while the BERT set is receiving errors, then a problem exists between the T-BERD 224 and the DCS (in this example). ②

If LINE 2 is dropped with the T-BERD 224 and the BERT set receiving errors, then the span needs to be sectionalized further by dropping LINE 1. ① ③ ④

If LINE 1 is dropped and the T-BERD 224 errors go away, then the problem exists between the T-BERD 224 and the CSU-DSU. ③ ④

If LINE 1 is dropped and the errors for both test sets remain, then the problem exists between the DCS and the T-BERD 224. ①

11. FT1 LOOPBACK TESTING FROM THE CUSTOMER PREMISES — *Fractional T1 Option Required*

- Qualify the fractional T1 circuit while allowing other DS0s to pass unaffected.
- Test aggregate bandwidth on contiguous or non-contiguous channels in 56 x N or 64 x N format.

Use this application to test either a contiguous or non-contiguous fractional T1 bandwidth.

Figure 11 illustrates a T-BERD 224 testing a fractional T1 circuit from the customer premises.

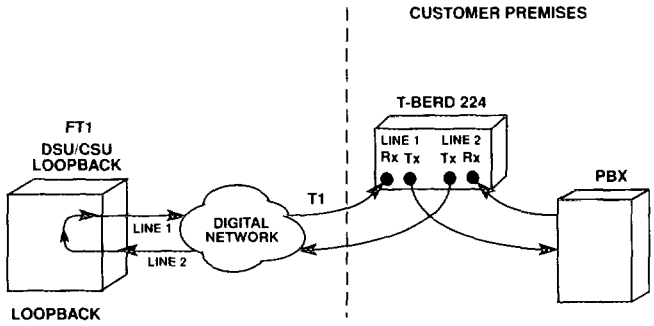


Figure 11
FT1 Customer Premise Testing

NOTE: If DSX-1 patch panels are not available for testing at the customer premises, use test cables, such as Model 41645 (dual bantam to RJ-48) or Model 41648 (dual bantam to 15-pin D-type male connector), to connect the T-BERD 224 to the network equipment.

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Drop and Insert Test Setup* or the *T1 Termination Test Setup***

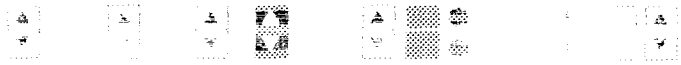
AUX switch

Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 17 LOOP CD using the **MODE** switch. Select the appropriate loop code TYPE (DDS-LATching or DDS-ALTernating) using the **SOURCE CONFIGURATION II** switch. Select an FT1 loop code (V.54 or CSU) using the **RESULTS I Blank** switch.

AUX 17	TYPE	EQUIP
LOOP CD	DDS-LAT	V.54



AUX switch

Press to exit auxiliary functions (LED OFF).

CHANNEL FORMAT switch

Select 56 x N for a 56 kb/s circuit or 64 x N for a 64 kb/s circuit.

SCI switch

Select the appropriate BERT test pattern. Refer to Section 3 of the *T-BERD 224 Reference Manual* for help in selecting the appropriate test pattern.

Contiguous Channels Configuration

SCII switch

Set N to the number of channels to be monitored in the FT1 bandwidth.

LINE 1 & 2 CHANNEL switches

Select the first channel of the FT1 bandwidth.

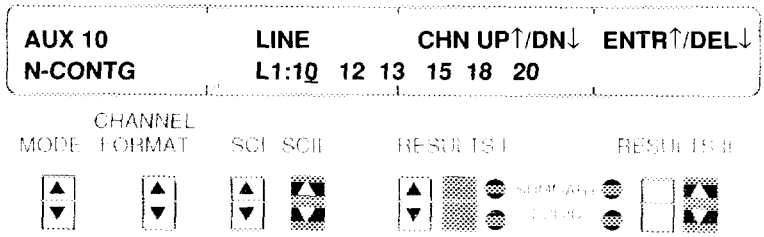
Non-Contiguous Channels Configuration

1. **SCII switch**
   Select NON CONTIG (Non-contiguous channel configuration).

2. **AUX switch**
   Press to access auxiliary functions (LED ON).

3. **MODE, SCII, RESULTS I Blank, and RESULTS II Arrowed switches**
   Scroll to AUX 10 N-CONTG using the **MODE** switch. Select LINE 1 or LINE 2 using the **SOURCE CONFIGURATION II** switch. Scroll through the channels using the **RESULTS I Blank** switch. Press the **RESULTS II Arrowed** switch up to enter the selected channel as part of the non-contiguous bandwidth. Press the **RESULTS II Arrowed** switch down to delete the selected channel from the non-contiguous bandwidth.

   NOTE: Line 1 and Line 2 must have the same *number* of channels - but not necessarily the same channels.



4. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

Performing the Test

1. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

2. **DROP (RX) switch**

   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

3. **LOOP UP switch**

   Press the **LOOP UP** switch (LED ON) to send the selected loop-up code. The switch LED remains illuminated until the loop code is received by the T-BERD 224. If loopup is established, either *LAT LOOP COMPLETE/CONFIRMED* (DDS-LAT loop code TYPE) or *DDS-ALT LOOP UP COMPLETE* (DDS-ALT loop code TYPE) flashes in the display.

4. **Local Status LEDs**

   Verify the green Signal, Pattern Sync, and Frame Sync (if applicable) LEDs are illuminated. This indicates the circuit is successfully looped, because the transmitted stress pattern selected in SOURCE CONFIGURATION is being received by the T-BERD 224.

5. **LOGIC ERROR INSERT switch**

   Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00BIT ERR result.

6. **RESTART switch**

   Press **RESTART** to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected.

7. **LOOP DOWN switch**

   When the test is completed, press the **LOOP DOWN** switch to release the loopback. The switch LED remains illuminated until the loop down is accomplished. If loop down is successful, *LOOP DOWN SUCCESSFUL* flashes in the display and the Pattern Sync LED is extinguished. Disconnect the T-BERD 224 from span.

Analyzing Test Results

FRM ERR, CRC ERR, BIT ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

FRM ERR, CRC ERR, BIT ERR, No BPVs

Typically a far-end T1 span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further downstream.

BIT ERR only

The local T1 facility is operating correctly, however, the FT1 circuit is errored. Sectionalize further by checking the remote facilities, DCS configuration, FT1 circuit routing, or the customer premise equipment.

12. FT1 LOOPBACK TESTING FROM THE CENTRAL OFFICE — *Fractional T1 Option Required*

- Qualify the FT1 circuit from the mid-point to the customer premises, while allowing other DS0s to pass unaffected.

  Test aggregate bandwidth on contiguous or non contiguous channels 56 x N or 64 x N format.

Use this application to test either a contiguous or non contiguous fractional T1 bandwidth.

Figure 12 illustrates a T-BERD 224 testing an FT1 circuit from the circuit midpoint to the customer premise.

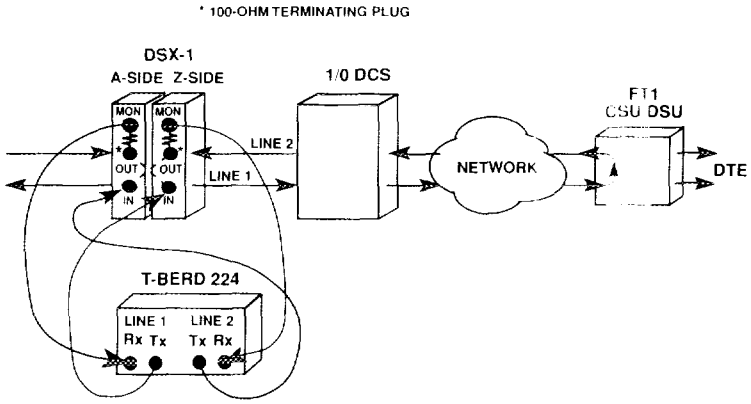


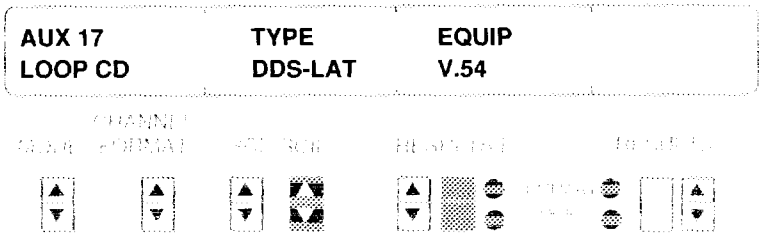
Figure 12
FT1 Central Office Testing

Configuring the T-BERD 224

- **Configure T-BERD 224 according to the *T1 Drop and Insert Test Setup* or the *DCS Test Access Di-Group (TAD) Test Setup***

- **AUX switch**
  Press to access auxiliary functions (LED ON).

3. **MODE, SCII, and RESULTS I Blank switches**
   Scroll to AUX 17 LOOP CD using the **MODE** switch. Select the loop code TYPE (DDS-LATching or DDS-ALTernating) using the **SOURCE CONFIGURATION II** switch. Select the appropriate FT1 EQUIPment (V.54, CSU, or DSU) to be looped using the **RESULTS I Blank** switch.



4. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

5. **CHANNEL FORMAT switch**
   Select 56 x N for a 56 kb/s circuit or 64 x N for a 64 kb/s circuit.

6. **SCI switch**
   Select the appropriate BERT test pattern. Refer to Section 3 of the *T-BERD 224 Reference Manual* for help in selecting the appropriate test pattern.

Contiguous Channels Configuration

1. **SCII switch**
   Set N to the number of channels to be monitored in the FT1 bandwidth.

2. **LINE 1 & 2 CHANNEL switches**
   Select the first channel of the FT1 bandwidth.

Non-Contiguous Channels Configuration

SCII switch

Select NON CONTIG (Non-contiguous channel configuration).

AUX switch

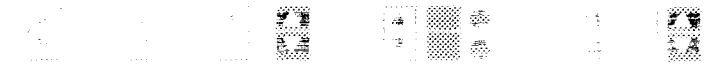
Press to access auxiliary functions (LED ON). Configure as shown.

MODE, SCII, RESULTS I Blank, and RESULTS II Arrowed switches

Scroll to AUX 10 N-CONTG using the **MODE** switch. Select LINE 1 or LINE 2 using the **SOURCE CONFIGURATION II** switch. Scroll through the channels using the **RESULTS I Blank** switch. Press the **RESULTS II Arrowed** switch up to enter the selected channel as part of the non-contiguous bandwidth. Press the **RESULTS II Arrowed** switch down to delete the selected channel from the non-contiguous bandwidth.

> Line 1 and Line 2 must have the same *number* of channels - but not necessarily the same channels.

AUX 10	LINE	CHN UP↑/DN↓	ENTR↑/DEL↓
N-CONTG	L1:10 12 13 15 18 20		



AUX switch

Press to exit auxiliary functions (LED OFF).

Performing the Test

INSERT (TX) switch

Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

2. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

3. **LOOP UP switch**
   Press the **LOOP UP** switch (LED ON) to send the selected loop-up code. The switch LED remains illuminated until the loop code is received by the T-BERD 224. If loopup is established, either *LAT LOOP COMPLETE CONFIRMED* (DDS-LAT loop code TYPE) or *DDS-ALT LOOP UP* (DDS-ALT loop code TYPE) flashes in the display.

4. **Local Status LEDs**
   Verify the green Signal, Pattern Sync, and Frame Sync (if applicable) LEDs are illuminated. This indicates the circuit is successfully looped, because the transmitted stress pattern selected in SOURCE CONFIGURATION is being received by the T-BERD 224.

5. **LOGIC ERROR INSERT switch**
   Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00BIT ERR result.

6. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected.

7. **LOOP DOWN switch**
   When the test is completed, press the **LOOP DOWN** switch to release the loopback. The switch LED remains illuminated until the loop down is accomplished. If loop down is successful, *LOOP DOWN SUCCESSFUL* flashes in the display and the Pattern Sync LED is extinguished. Disconnect the T-BERD 224 from span.

Analyzing Test Results

FRM ERR, CRC ERR, BIT ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

FRM ERR, CRC ERR, BIT ERR, No BPVs

Typically a far-end T1 span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further downstream.

BIT ERR only

The local T1 facility is operating correctly, however, the FT1 circuit is errored. Sectionalize further by checking the remote facilities, DCS configuration, FT1 circuit routing, or the customer premise equipment.

13. FT1 TESTING FOR ROUND TRIP DELAY

Fractional T1 Option Required

- Measure round trip delay on individual fractional T1 channels (DS0s).
- Locate misrouted channels (DS0s).

Use this application to test either a contiguous or non-contiguous fractional T1 bandwidth.

Figure 13 illustrates a T-BERD 224 measuring the round trip delay on an FT1 circuit.

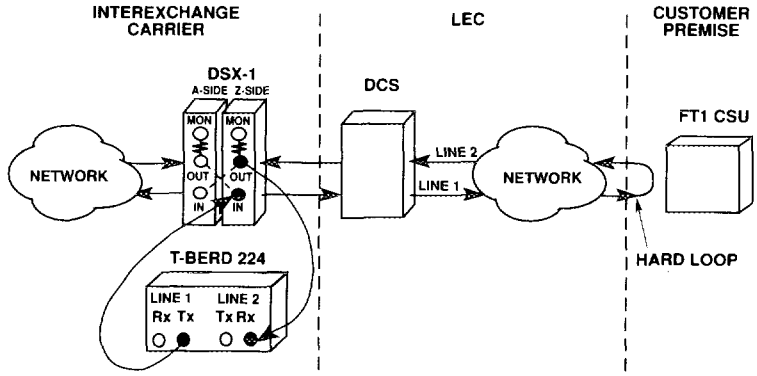


Figure 13
Round Trip Delay

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Termination Test Setup* or the *T1 Drop and Insert Test Setup***

2. **LOOP FT1 CSU**
   Establish a hard loop at the FT1 CSU or follow the *FT1 Loopback Testing from the Central Office* application.

CHANNEL FORMAT switch

Select DS0A56 if testing one channel of a 56xN circuit or DS064 if testing one channel of a 64xN circuit.

SCI switch

Select $2^{15}-1$. This pseudorandom pattern is a good length for testing round trip delay at these rates.

LINE 1 & 2 CHANNEL switches

Select first channel of the FT1 bandwidth.

INSERT (TX) switch

Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

DROP (RX) switch

Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

Performing the Test

RESTART switch

Press **RESTART** to clear alarms and begin the test. Verify the Signal, Pattern, and Frame Sync (if applicable) LEDs are illuminated. *RESULTS OK* is displayed as long as no errors are detected.

LOGIC ERROR INSERT switch

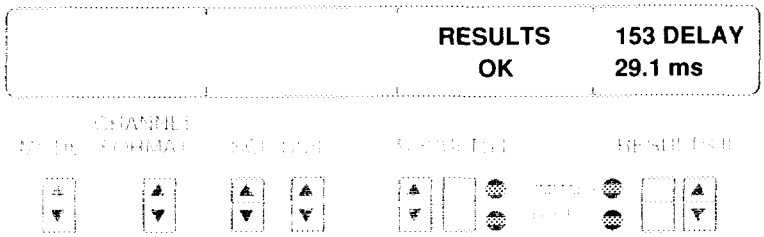
Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00BIT ERR result.

RESTART switch

Press the **RESTART** switch to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected.

4. **RESULTS II switches**

   Select the SIGNAL category using the **RESULTS II Blank** switch. Select the n153 DELAY result using the **RESULTS II Arrowed** switch.

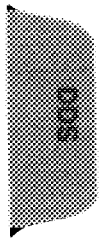


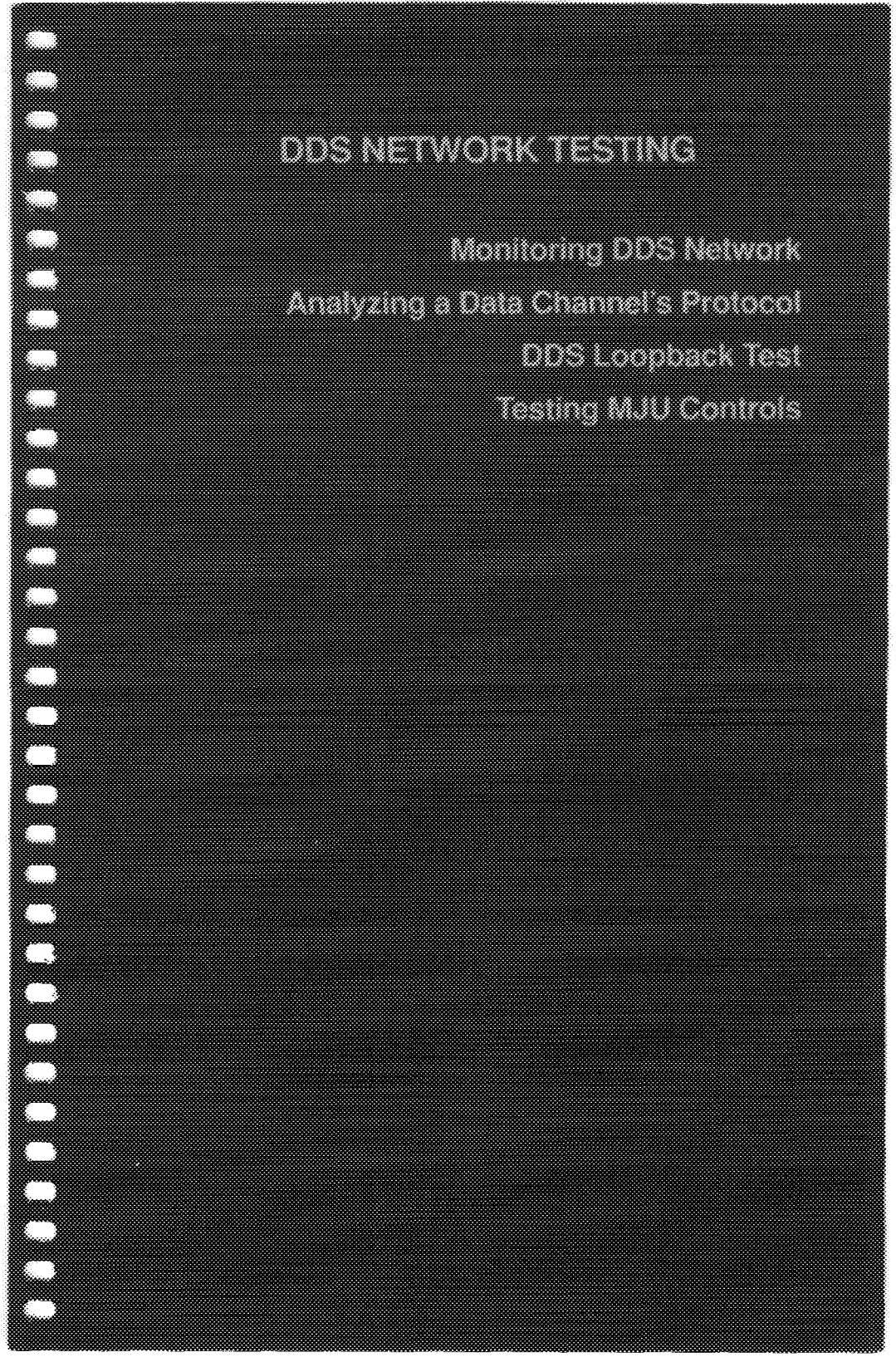
5. **Repeat for each channel of the FT1 bandwidth**

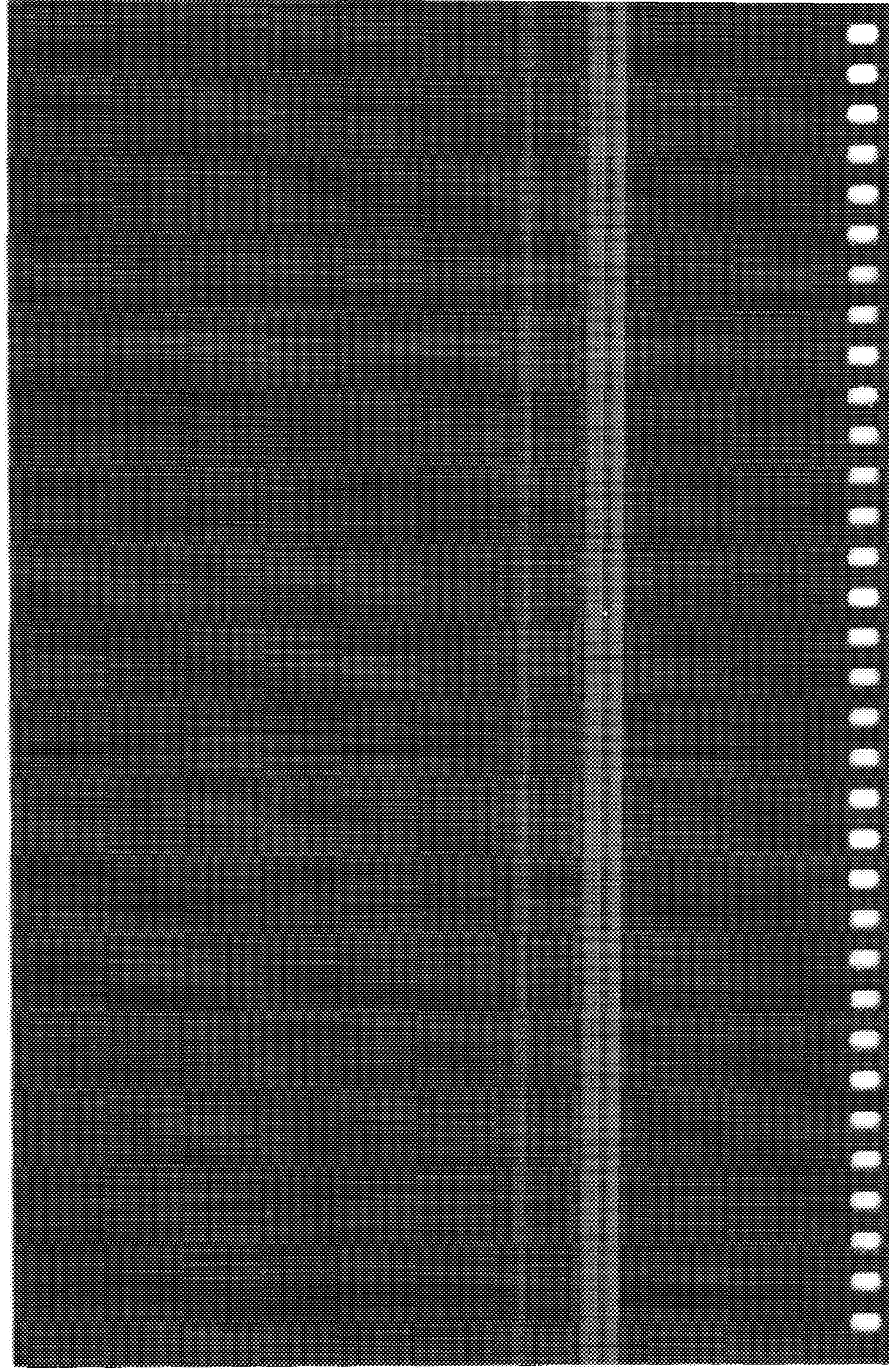
   Repeat Steps 4 through 7 of *Configuring the T-BERD 224* and Steps 1 through 4 of *Performing the Test* for each channel of the fractional T1 bandwidth.

Analyzing Test Results

The DELAY should be the same for each channel tested. If the DELAY is not the same, a DCS or another type of transmission equipment may have rerouted the signal.




DDS NETWORK TESTING
Monitoring DDS Network
Analyzing a Data Channel's Protocol
DDS Loopback Test
Testing MJU Controls



14. MONITORING DDS NETWORK

DSU-DP Option Required

- Sectionalize DDS channel problems.

Figure 14 illustrates a T-BERD 224 monitoring a DDS network.

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***

2. **CHANNEL FORMAT switch**
   Select the specific rate to match the DDS circuit configuration (Verify DS0A or DS0B circuit and appropriate rate with the WORD document or Circuit Description).

3. **LINE 1 & 2 CHANNEL switch**
   Select the T1 channel (DS0) to be monitored.

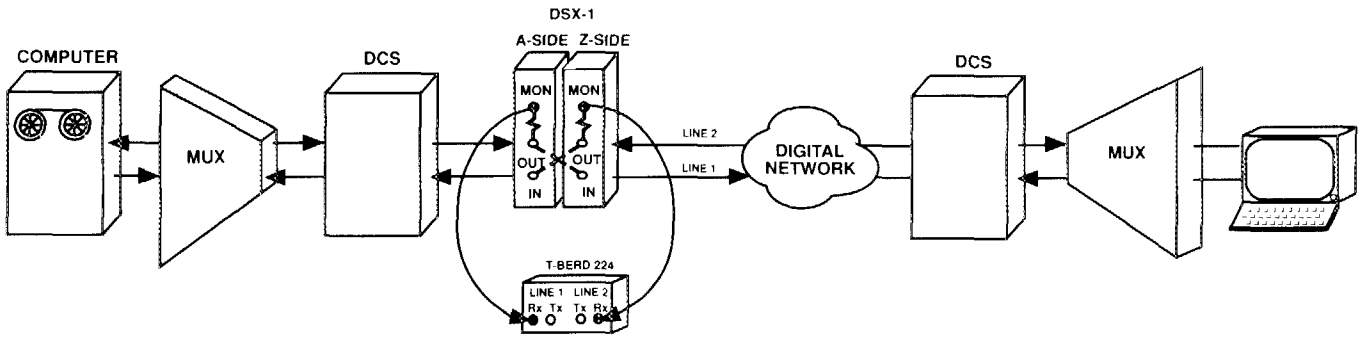
4. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed or select BOTH if only trying to identify control codes.

5. **SCII switch**
   If DS0B is selected — Set the subrate data channel.

6. **SCI switch**
   Select AUTO (this synchronizes the T-BERD 224 to any test pattern being transmitted on the specified channel). If no test pattern is on the channel selected, the T-BERD 224 remains in AUTO; proceed to Step 8.

   If the test pattern is identified, it is displayed in this window and the Pattern Sync LED illuminates; proceed to Step 7.

7. **RESULTS I switches**
   Select LOGIC category using the **RESULTS I Blank** switch. Select n00BIT ERR using the **RESULTS I Arrowed** switch. Proceed to Step 9.


DSX-1
A-SIDE Z-SIDE
COMPUTER
MUX
DCS
MON
MON
OUT
OUT
IN
IN
LINE 2
LINE 1
DIGITAL NETWORK
DCS
MUX
T-BERD 224
LINE 1 LINE 2
Rx Tx Tx Rx

8. **RESULTS I switches**

   Select CHANNEL category using the **RESULTS I Blank** switch. Select 195RCODE using the **RESULTS I Arrowed** switch. This indicates the code being received by the LINE 1 receiver.

   NOTE: The control code must be stable in order to be valid.

9. **RESULTS II switches**

   Select CHANNEL category using the **RESULTS II Blank** switch. Select 295RCODE using the **RESULTS II Arrowed** switch. This indicates the code being received by the LINE 2 receiver.

Performing the Test

1. **RESTART switch**

   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

Analyzing Test Results

FRM ERR, CRC ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors.

FRM ERR, CRC ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further downstream.

RX FREQ

The received frequency should be 1.544 MHz +/- 75 Hz. If the frequency is outside of the specification, check the transmission equipment timing or the network synchronization.

RX LVL

The received level should be -20 dB +/- 3 dB at resistor isolated DSX-MON jacks. Incorrect levels could be caused by a facility T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a signal. Sectionalize the T1 equipment further.

AIS LED

This indicates that some equipment in the signal path is not receiving a signal from the far end.

RECEIVED CODES

The received codes should be interpreted as follows:

ASC: BYTE (X0011110) - Abnormal Station Code — Generated by the OCU because of a loss of signal from the DSU/CSU or the DSU/CSU is not attached.

UMC: BYTE (X0011000) - Unassigned Multiplexer Channel Generated by the DS0-DP when no OCU-DP is installed in the end office channel bank.

D IDLE: BYTE (X1111111) - Data Mode Idle — Customer equipment is connected and ready, but no data is being sent at the moment.

C IDLE: BYTE (X1111110) - Control Mode Idle — Customer equipment is connected, but channel is not in use.

15. ANALYZING A DATA CHANNEL'S PROTOCOL

DSU-DP Option Required

- Detect transmission and protocol problems within the network.
- Measure throughput on a data channel.
- Verify ACK/NAK receptions in both transmissions directions.
- Bit 8 - Indicates when RTS is active.

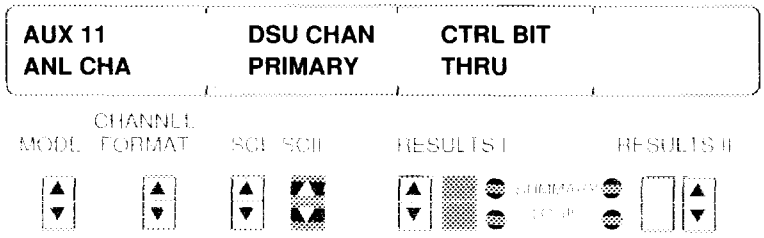
Figure 15 illustrates a T-BERD 224 collecting the results for analyzing a data channel's protocol.

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***

2. **AUX switch**
   Press to access auxiliary functions (LED ON).

3. **MODE, SCII, and RESULTS I Blank switches**
   Scroll to AUX 11 ANL CHA using the **MODE** switch. Select PRIMARY for DSU CHAN using the **SOURCE CONFIGURATION II** switch. Select THRU for CTRL BIT using the **RESULTS I Blank** switch.



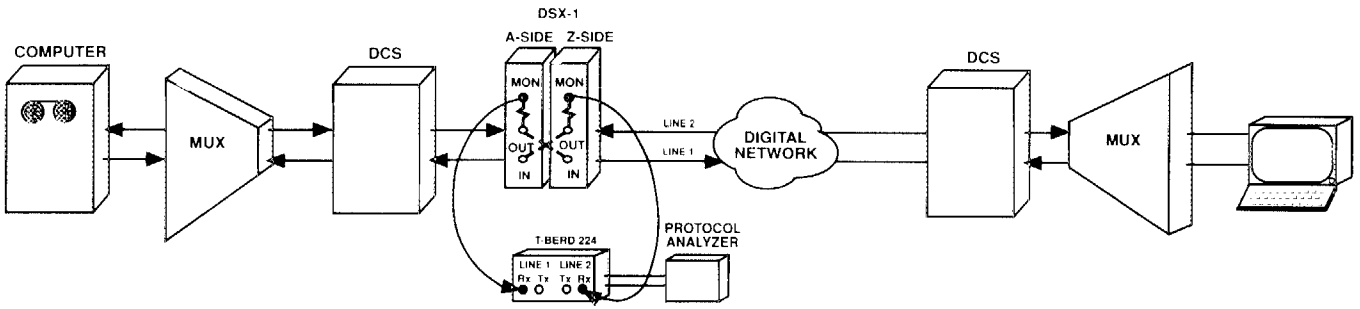
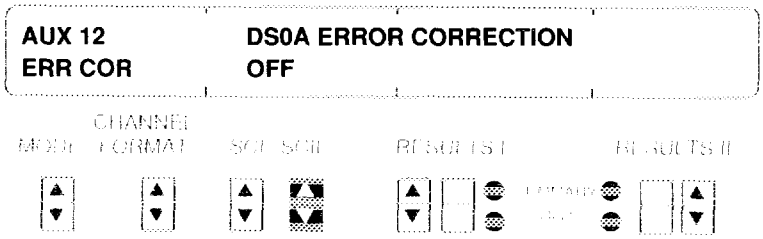


Figure 19
Analyzing a Data Channel's Protocol

4. **MODE, SCII, and RESULTS I Blank switches**
   Scroll to AUX 12 ERR COR using the **MODE** switch. Select OFF for the DS0A ERROR CORRECTION using the **SOURCE CONFIGURATION II** switch. This allows you to disable majority null error correction.



5. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

6. **CHANNEL FORMAT switch**
   Select the specific rate to match the DDS circuit configuration (Verify DS0A or DS0B circuit and appropriate rate with the WORD document or Circuit Description).

7. **SCII switch**
   If DS0B is selected — Set subrate data channel.

8. **SCI switch**
   Select DSU-DP.

9. **LINE 1 & 2 CHANNEL switches**
   Select the channel (1 to 24) under test.

Performing the Test

1. **DSU-DP Option interfaces**
   Using a cable such as Model 31141, Model 31142, or Model 31143 connect an external protocol analyzer or data scope test set. Select the appropriate DSU-DP Option interface. See Section 8 of the *T-BERD 224 Reference Manual* for details on the connector pin assignment.

2. **RESTART switch**

   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

3. **Protocol analyzer**

   Configure the protocol analyzer or data scope to the appropriate data rate, parity, protocol, etc. Set the protocol analyzer monitor timing to be received from the T-BERD 224 DSU-DP data port.

Analyzing Test Results

To interpret the data protocols throughput, the response time, etc., refer to the protocol analyzers operating manual.

The status of Bit 8 indicates when the DTE (at the customer premise) is activating the Request To Send. The status of the DSU-DP's RLSD lead indicates the Bit 8 status of LINE 1. Refer to the T-BERD 224 Reference Manual for a detailed explanation.

DDS F E only, No BPVs

Local T1 span problem. The DS0B MUX is not working properly.

FRM ERR, CRC ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors.

CRC ERR or BPVs, No FRM ERR

The DS0B MUX is not working properly.

Protocol Analyzer Errors, No FRM ERR, CRC ERR, BPVs

A problem may exist with the DSU-CSU, OCU-DP, or in the local loop. A problem does not exist with the T1 network.

16. DDS LOOPBACK TEST

DDS Option Required

- Test DS0A (2.4...56 kb/s) and DS0B (2.4...9.6 kb/s) circuits.
- Send alternating and latching DDS loop codes.
- Test with 63, 511, 2047 or DDS stress patterns.
- Test primary or secondary channels.

Figure 16 illustrates the T-BERD 224 establishing a latching loopback at a DDS CSU to test an individual DDS channel.

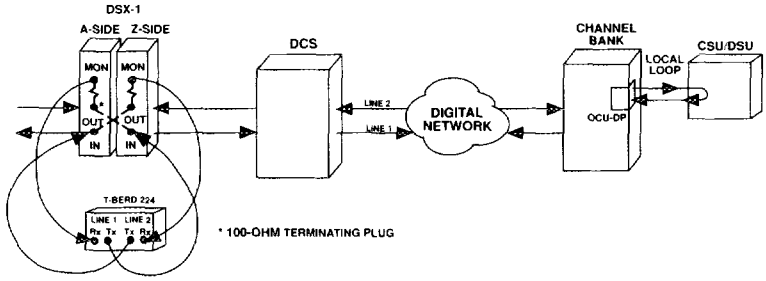


Figure 16
DDS Loopback

Configuring the T-BERD 224

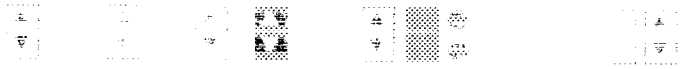
1. **Configure T-BERD 224 to suit the application**
   For in-service testing, use the *T1 Drop and Insert Test Setup*. For out-of-service testing, use the *T1 Termination Setup*. For testing at the DCS TAD, use the *DCS Test Access Di-Group (TAD) Test Setup*.

2. **AUX switch**
   Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 17 LOOP CD using the **MODE** switch. Select the loop code TYPE (DDS ALTernating or DDS LATching) using the **SOURCE CONFIGURATION II** switch. Select the EQUIPment to be looped using the **RESULTS I Blank** switch (see *T-BERD 224 Reference Manual*).

AUX 17	TYPE	EQUIP
LOOP CD	DDS-LAT	DSU



MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 19 DDS CHN using the **MODE** switch. Select PRIMARY for the TRANSMIT channel using the **SOURCE CONFIGURATION II** switch. Select PRIMARY for the ANALYZE channel using the **RESULTS I Blank** switch.

AUX 19	TRANSMIT	ANALYZE
DDS CHN	PRIMARY	PRIMARY

AUX switch

Press to exit auxiliary functions (LED OFF).

CHANNEL FORMAT switch

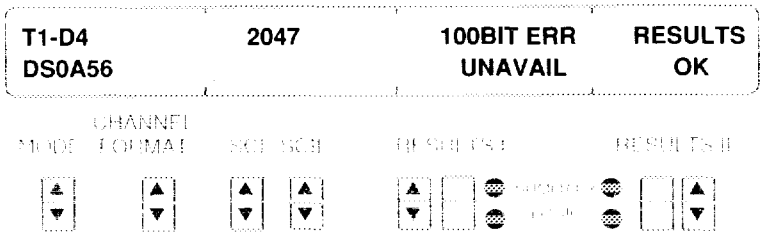
Select the proper DDS rate (see WORD document or Circuit Description).

7. **SCI switch**
   Select a DDS test pattern. (For rates at or below 56 kb/s, the 511 and 2047 patterns are suggested. For rates above 56 kb/s, the DDS5 pattern is suggested. See *T-BERD 224 Reference Manual*.)

8. **SCII switch**
   If DS0B is selected — Select subrate data channel.

9. **RESULTS I switches**
   Select LOGIC category using the **RESULTS I Blank** switch. Select n00BIT ERR using the **RESULTS I Arrowed** switch. Proceed to Step 9.

10. **RESULTS II Blank switch**
    Select SUMMARY category.



11. **LINE 1 & 2 CHANNEL switches**
    Select the T1 channel (DS0) to be tested.

Performing the Test

1. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side). The T-BERD 224 is transmitting DDS data on the selected channel at the selected rate.

2. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

3. **LOOP UP switch**

   Press the **LOOP UP** switch (LED ON) to send the selected loop-up code. The switch LED remains illuminated until the loop code is received by the T-BERD 224. If loopup is established, either *LAT LOOP COMPLETE/CONFIRMED* (DDS-LAT loop code TYPE) or *DDS-ALT LOOP UP COMPLETE* (DDS-ALT loop code TYPE) flashes in the display.

4. **Local Status LEDs**

   Verify the green Signal, Pattern Sync, and Frame Sync (if applicable) LEDs are illuminated. This indicates the pattern selected in the SOURCE CONFIGURATION is being received by the T-BERD 224.

   NOTE: If the Pattern Sync LED does not illuminate or bit errors occur, recheck AUX 19 DDS CHN to ensure the proper DDS channels are being tested.

5. **LOGIC ERROR INSERT switch**

   Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00BIT ERR result.

6. **RESTART switch**

   Press the **RESTART** switch to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected. Run for desired amount of time (can verify elapsed test time in the TIME category under n73-ELAP TM).

7. **LOOP DOWN switch**

   When the test is completed, press the **LOOP DOWN** switch to release the loopback. The switch LED remains illuminated until the loop down is accomplished. If loop down is successful, either *LAT LOOP DOWN COMPLETE* (DDS-LAT loop code TYPE) or *ALT LOOP DOWN COMPLETE* (DDS-ALT loop code TYPE) flashes in the display. Disconnect the T-BERD 224 from span.

Analyzing Test Results

FRM ERR, CRC ERR, BPVs, DDS F E

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

DDS F E and BIT ERR only

Far T1 span problem. A DCS removes FRM ERR, CRC ERR, and BPVs.

DDS F E only

Problem exists with the DS0B MUX.

BIT ERR and BPVs

Check the last repeatered span before your present location. BPVs are present only on metallic loops and are removed before the data is retransmitted by most transmission equipment except repeaters.

BIT ERR only

Check the local loop or one of the channel cards in the network. Sectionalize the network by establishing loopbacks at different locations, Ex: OCU, DS0-Data Port.

FRM ERR, CRC ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further.

Loopback is not established

The CSU, CSU-DSU, OCU, or DS0-DP is not operating correctly or the line from you to the CSU is bad.

17. TESTING MJU CONTROLS

DDS Option Required

- Control single or cascaded MJUs.

- Loop equipment off selected branch and perform BERT tests.

- Test the SELECT, BLOCK, UNBLOCK, RELEASE and RESTORE commands.

  SELECT — places the MJU in a test mode. Test data and commands are conveyed only to the selected branch. The three other branches are temporarily blocked.

  BLOCK — stops a branch from receiving and transmitting data. A BLOCK operation may be performed after the branch has been SELECTed. A BLOCK is cleared by either an UNBLOCK or a RELEASE operation.

  UNBLOCK — allows a BLOCKed branch to receive and transmit data. An UNBLOCK operation may be performed after the branch has been SELECTed. The UNBLOCK operation returns the entire MJU tree to normal operation except for any other blocked branches.

  RELEASE — returns the entire MJU tree to normal operation. A RELEASE operation may be performed after the branch has been SELECTed.

  - All BLOCKed branches are cleared by this operation.

  RESTORE — returns the MJU tree to normal operation. A RESTORE operation may be performed after the branch has been SELECTed. This command does not affect BLOCKed branches.

Figure 17 illustrates a T-BERD 224 testing the controls of a cascaded MJU. The figures accompanying the auxiliary function operations show the location in the network when the operation is complete.

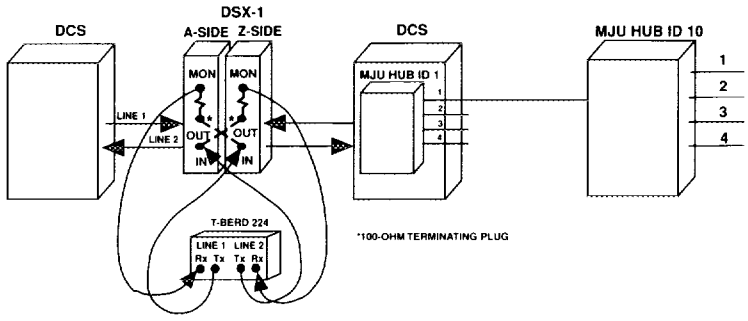


Figure 17
Cascaded MJU

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to either the *T1 Drop and Insert Test Setup* or the *DCS Test Access Di-Group (TAD) Test Setup***

2. **CHANNEL FORMAT switch**
   Select the appropriate DS0A or DS0B data rate.

3. **SCII switch**
   If DS0B is selected — Set subrate data channel.

4. **AUX switch**
   Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 19 DDS CHN using the **MODE** switch. Select PRIMARY for the TRANSMIT channel using the **SOURCE CONFIGURATION II** switch. Select PRIMARY for the ANALYZE channel using the **RESULTS I Blank** switch.

AUX 19 DDS CHN	TRANSMIT PRIMARY	ANALYZE PRIMARY

AUX switch

Press to exit auxiliary functions (LED OFF).

SCI switch

Select any BERT pattern. The test pattern is transmitted on the primary channel.

LINE 1 & 2 CHANNEL switches

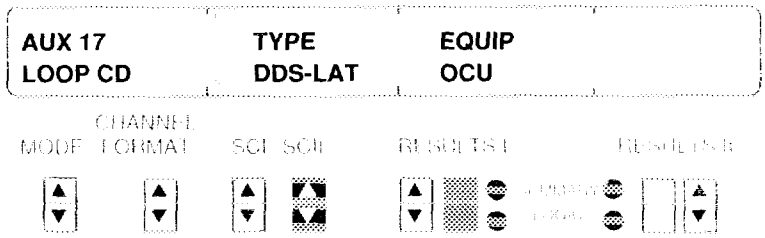
Select the channel (DS0) to be tested.

AUX switch

Press to access auxiliary functions (LED ON).

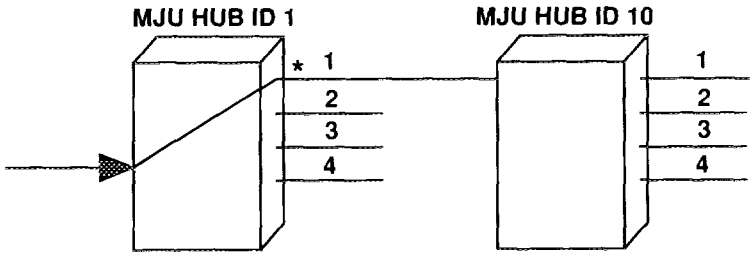
10. **MODE, SCII, and RESULTS I Blank switches**

Scroll to AUX 17 LOOP CD using the **MODE** switch. Select the loop code TYPE (DDS ALTernating or DDS LATching) using the **SOURCE CONFIGURATION II** switch. Select the EQUIPment to be looped using the **RESULTS I Blank** switch (see *T-BERD 224 Reference Manual*).



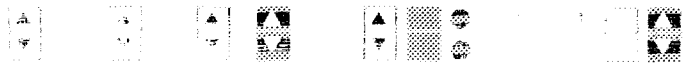
11. **MODE, SCII, RESULTS I Blank, and RESULTS II Arrowed switches**

Scroll to AUX 30 MJU using the **MODE** switch. Set the MJU operation to SELECT using the **SOURCE CONFIGURATION II** switch. Set the BRANCH number to 1 using the **RESULTS I Blank** switch. Press the **RESULTS II Arrowed** switch to execute the command.



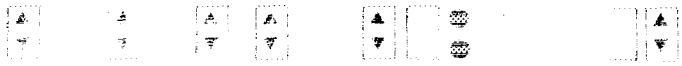
***LOCATION IN NETWORK**

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	SELECT	1	SEND?



While sending the command the display appears as shown.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	SELECT	1	SELECT

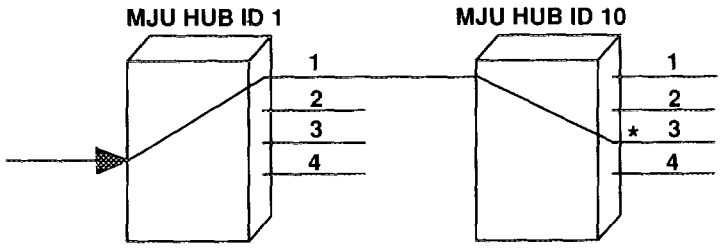


When the SELECT operation is complete the MJU responds with the HUB ID.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	SELECT	1	

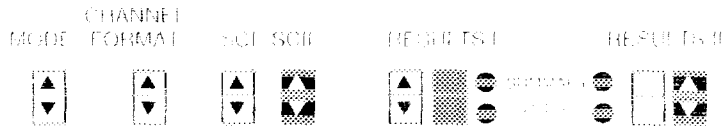
12. **SELECT BRANCH 3**

Set the BRANCH number to 3 using the **RESULTS I Blank** switch. Press the **RESULTS II Arrowed** switch to execute the command.



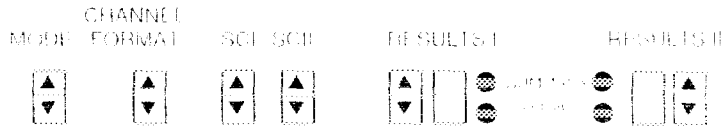
***LOCATION IN NETWORK**

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	SELECT	3	SEND?



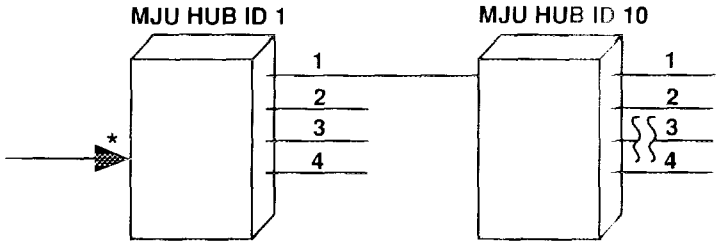
When the SELECT operation is complete the MJU responds with the HUB ID.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	SELECT	3	10



BLOCK BRANCH 3

Set the MJU operation to BLOCK using the **SOURCE CONFIGURATION II** switch. Press the **RESULTS II Arrowed** switch to execute the command.



*LOCATION IN NETWORK

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	BLOCK	3	SEND?

While sending the command the display appears as shown.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	BLOCK	3	BLOCK

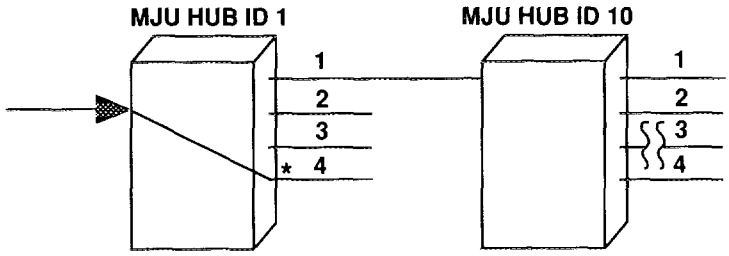
When the BLOCK operation is successful the display appears as shown.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	BLOCK	3	SEND?

NOTE: To unblock this branch, perform the same procedure using UNBLOCK instead of BLOCK.

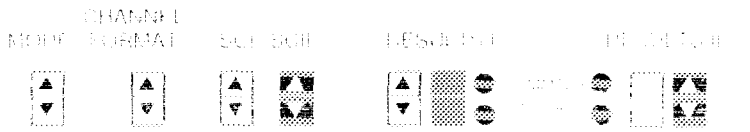
14. **SELECT BRANCH 4**

Set the MJU operation to SELECT using the **SOURCE CONFIGURATION II** switch. Set the BRANCH number to 4 using the **RESULTS I Blank** switch. Press the **RESULTS II Arrowed** switch to execute the command.



*LOCATION IN NETWORK

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	SELECT	4	SEND?



When the SELECT operation is complete, the MJU responds with the HUB ID and the display appears as shown.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	SELECT	4	9

AUX switch
Press to exit auxiliary functions (LED OFF).

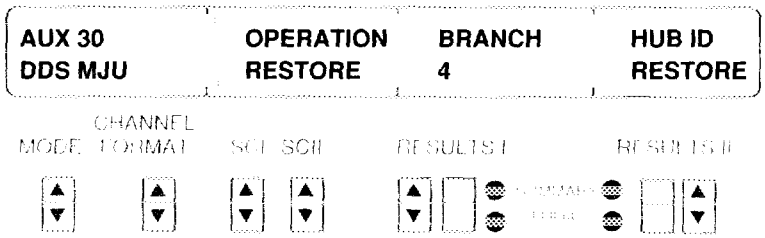
Go to *DDS Loopback Test*
Perform a loopback and BERT test on the selected branch.

AUX switch
Press to access auxiliary functions (LED ON).

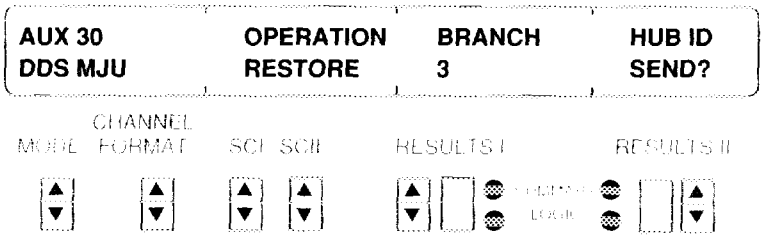
RESTORE MJU
Scroll to AUX 30 MJU using the **MODE** switch. Set the MJU operation to RESTORE using the **SOURCE CONFIGURATION II** switch. Press the **RESULTS II Arrowed** switch to execute the command.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	RESTORE	4	SEND?

While sending the command the displays appears as shown.



When the RESTORE operation is complete the display appears as shown.



NOTE: The previously blocked branch is still blocked.

19. **RELEASE MJU**

Clear entire MJU network. This command returns the MJU network to it's initial state.

WARNING: The RELEASE command clears the entire network including previously blocked branches.

Set the MJU OPERATION to RELEASE using the **SOURCE CONFIGURATION II** switch. Set the BRANCH number to 1 using the **RESULTS I Blank** switch. Press the **RESULTS II Arrowed** switch to execute the command.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	RELEASE	1	SEND?

While sending the command the display appears as shown.

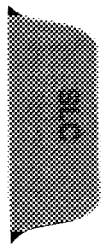
AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	RELEASE	1	RELEASE

When the RESTORE operation is complete the display appears as shown.

AUX 30	OPERATION	BRANCH	HUB ID
DDS MJU	RELEASE	1	SEND?

AUX switch

Press to exit auxiliary functions (LED OFF).



SLC NETWORK TESTING

- Monitoring SLC-96
- Transmit and Receive SLC-96 Alarms
- Verify Ring Generation and Circuit Continuity
- Dialing into the Central Office Switch
- Looping and Testing SLC Shelf Lines

18. MONITORING SLC-96

Enhanced SLC/ESF Option Required

- Test Mode 1 and Mode 2.
- Monitor the A shelf.
- Detect major, minor, power/miscellaneous alarms, protection switching, far-end loops, and maintenance activity.
- Find SLC-96 system problems independent of remote or central office terminal.

Figure 18 illustrates a T-BERD 224 connected to a SLC-96 system to monitor the A shelf.

For this application, LINE 1 monitors the signal from the CO Terminal and LINE 2 monitors the signal from the Remote Terminal. Alarms are identified with the line.

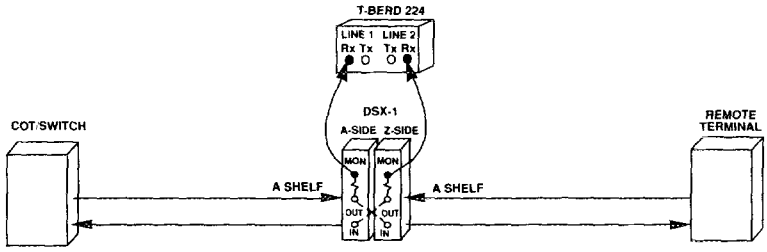


Figure 18
Monitoring the SLC-96 Datalink

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***
   Connect to A shelf. Verify auto-configured framing displays *t1-slc96*.

2. **CHANNEL FORMAT switch**
   Select the applicable format.

Performing the Test

RESTART switch

Press **RESTART** to clear alarms and begin the test. Verify the Signal, Pattern, and Frame Sync LEDs are illuminated. *RESULTS OK* is displayed as long as no errors are detected.

Analyzing Test Results

MAJOR ALARM

The signal on the indicated shelf contains a service-affecting fault. The problem exists on the opposite line.

Example: A Major Alarm received on LINE 1 (see Figure 1-1) indicates that a problem exists on the signal transmitted into the CO.

MINOR ALARM

The signal on the indicated shelf contains a non-service-affecting fault. The problem exists on the opposite line.

POWER/MISC

A physical problem exists in the remote terminal i.e., low battery, temperature, or open cabinet.

MAINTENANCE (Only available in Mode 1)

Indicate that the bypass procedure is in progress.

MAINT TEST ALRM message indicates bypass sequence fails.
MAINT ON-HOOK message indicates the bypass initiated.
MAINT SEIZE message indicates the channel has been switched.
MAINT PROCEED message indicates the bypass is complete.

SWITCH TO PROTECT

The indicated shelf has been switched to the protect line.

FAR END LOOP

The indicated shelf has been looped back to itself.

19. TRANSMIT AND RECEIVE SLC-96 ALARMS

Enhanced SLC/ESF Option Required

- Test Mode 1 and Mode 2.
- Verify system alarm response before turn-up.
- Simulate the A shelf of SLC-96 systems.
- Transmit major, minor, power/miscellaneous alarms, protection switching, far-end loops, and maintenance alarms to remote terminals or COT/switches.

Figure 19 illustrates a T-BERD 224 connected to a DSX-1 to transmit alarms and test remote terminal response.

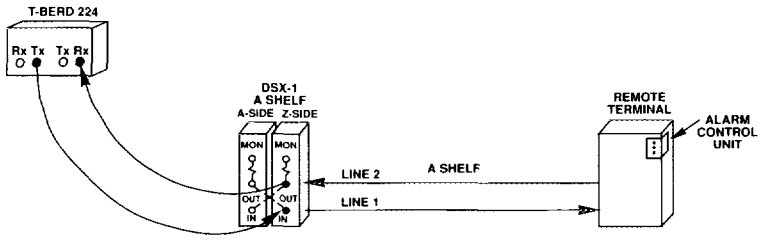


Figure 19
Transmit and Receive SLC-96 Alarms

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to either the *T1 Drop and Insert Test Setup* or the *T1 Termination Test Setup***

2. **MODE switch**
   Select T1SLC96 (for Mode 1).

3. **CHANNEL FORMAT switch**
   Select DATLINK.

4. **SCI switch**
   Select MAJOR ALRM.

5. **SCII switch**
   Select SHELF A.

6. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

7. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

Performing the Test

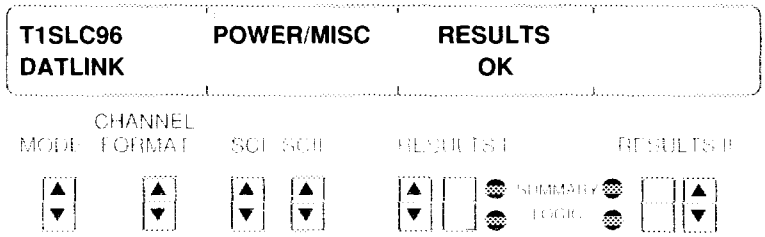
1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected. The Alarm Control Unit on the received terminal should indicate it has received a Major Alarm on the A shelf.

2. **SCI switch**
   Select MINOR ALRM.

T1SLC96	**MINOR ALRM**	**RESULTS**
DATLINK		**OK**

The Alarm Control Unit on the received terminal should indicate it has received a Minor Alarm.

3. **SCI switch**
   Select POWER/MISC.



The Alarm Control Unit on the received terminal should indicate it has received a POWER/MISC Alarm.

Analyzing Test Results

If the LEDs on ACU do not indicate the alarms, a problem exists with the facility or with the line card in the terminal.

20. VERIFY RING GENERATION AND CIRCUIT CONTINUITY — *Enhanced SLC/ESF Option Required*

Verify the operation of the ring generator at the remote terminal.

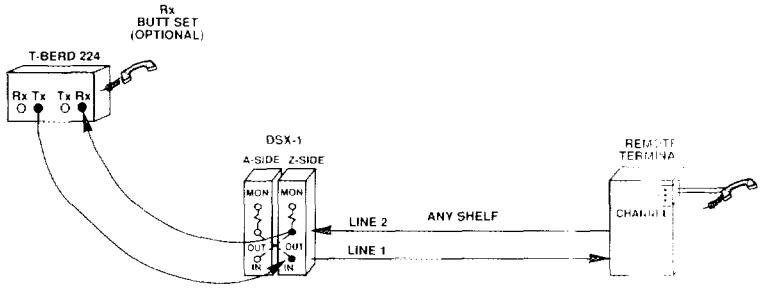
Test one or all 24 channels on a shelf.

Transmit *Ringing Signal* (A=1, B=1/0) in the signaling bits.

Talk across the T1 link using an external butt set connected to the T-BERD 224.

Test Mode 1 only.

Figure 20 illustrates the T-BERD 224 connected to a DSX-1 to ring the remote terminal and verify the ring generation.



Configuring the T-BERD 224

Configure T-BERD 224 according to either the *T1 Drop and Insert Test Setup* or the *T1 Termination Test Setup*

MODE switch

Select T1SLC96 (if connected to the A shelf) or SLC-DTD (if connected to the B, C, or D shelf).

CHANNEL FORMAT switch

Select VF.

21. DIALING INTO THE CENTRAL OFFICE SWITCH

Enhanced SLC/ESF Option Required

- Test Mode 1 only.
- Dial-through switch from T1 access point.
- Ensure that the switch correctly decodes the received digits.
- Verify the call setup procedures.
- Send *Off Hook* to switch using signaling insert (A=1, B=1).
- After dial tone, dial DTMF tones into switch with an optional butt set.
- Talk across connection with optional butt set.

The drop and insert test connections shown in Figure 21 illustrate how the T-BERD 224 connects to the span to allow the other VF channels to be passed through unaffected. Figure 21 also shows a telephone butt set connected to the T-BERD 224 to allow 2-way voice access to the selected channel.

NOTE: Dialing into a switch may also be performed with the Signaling Option.

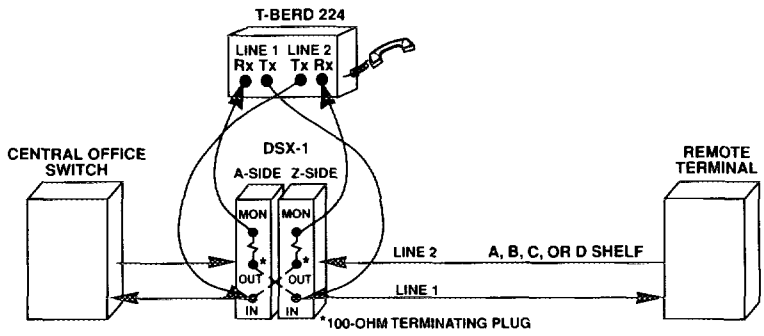


Figure 21
Dialing Into the CO Switch

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to either the *T1 Drop and Insert Test Setup* or the *T1 Termination Test Setup***

2. **MODE switch**
   Select T1SLC96 (A shelf) or SLC- D1D (B, C, or D shelf).

3. **CHANNEL FORMAT switch**
   Select VF.

4. **SCI switch**
   Select VF INTF.

5. **LINE 1 & 2 CHANNEL switch**
   Select T1 channel (1 to 24) to be tested.

6. **VOLUME switch**
   Set volume low.

Performing the Test

1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected. The Alarm Control Unit on the received terminal should indicate it has received a Major Alarm on the A shelf.

2. **Side panel VF 2-WIRE INTF terminals**
   Connect a telephone butt set to the two-wire posts.

3. **DROP (RX) switch**
   Select LINE 2.

4. **Results verification**
   Verify the signaling bits on the channel to be tested are idle with the Signaling LEDs. Monitor the signaling activity from the CO by listening to the selected channel on the T-BERD 224 speaker.

5. **INSERT (TX) switch**

   Select LINE 1. This allows 2-way access to the telephone butt set.

6. **A and B SIGNALING INSERT switches**

   Set A to logic 1 (LED ON) and B to logic 1 (LED ON). Dial tone should be heard immediately.

   NOTE: The signaling bits are different for loop and ground start lines. See the Appendices in the *T-BERD 224 Reference Manual*.

7. **Telephone butt set**

   - Verify dial tone.
   - Dial the telephone number.
   - Verify ring back and answer at far-end.
   - A talk path is now established between the T-BERD 224 butt set and the called party.

8. **A and B SIGNALING INSERT switches**

   Set A to logic 0 (LED OFF) and B to logic 0 (LED OFF). Line is returned to ON HOOK.

9. **Results interpretation**

   If the call is not established between the test set and the switch, possible sources of problem are transmission path, line card in the COT, or the switch translation. Examine the T1 circuit by verifying various elements of the network along the transmission path.

22. LOOPING AND TESTING SLC SHELF LINES

Enhanced SLC/ESF Option Required

- Loop B, C, D and Protection Line in Mode 1 and Mode 2.
- Test the transmission facility without accessing the switch terminal.
- Loop up the selected shelf, automatically switching it to the protection line.
- Perform BERT testing on the looped shelf.

Figure 22 illustrates a T-BERD 224 connected to a SLC-96 system DSX-1 patch panel. The T-BERD 224 is configured to loop the selected shelf (Shelf C for this example) and test the looped shelf with an external test set, like the T-BERD 209A.

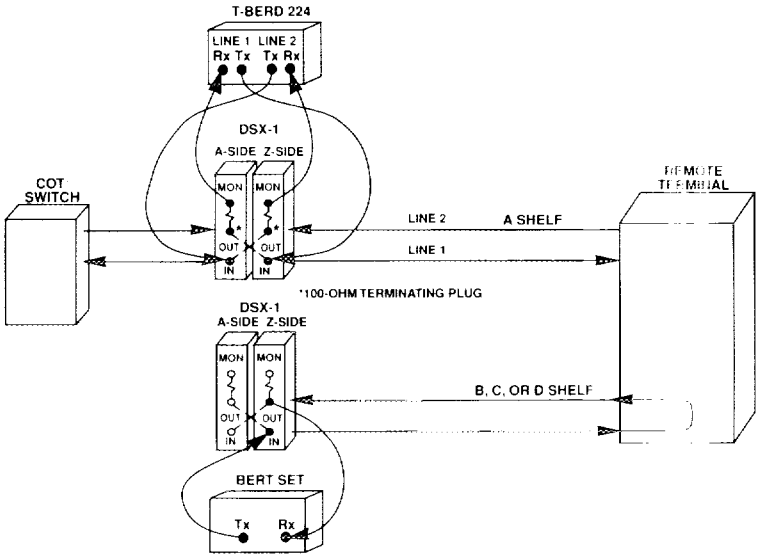


Figure 22
BERT on Switched Shelf

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Drop and Insert Test Setup***

2. **MODE switch**
   Select T1SLC96 (Mode 1).

3. **CHANNEL FORMAT switch**
   Select DATLINK.

4. **SCI switch**
   Select F END LOOP.

5. **SCII switch**
   Select Shelf C (to loop Shelf C).

Performing the Test

1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected. The Alarm Control Unit on the received terminal should indicate it has received a Major Alarm on the A shelf.

2. **DROP (RX) switch**
   Select LINE 2.

3. **Results verification**
   Verify the signaling bits on the channel to be tested are idle with the Signaling LEDs. Monitor the signaling activity from the CO by listening to the selected channel on the T-BERD 224 speaker.

4. **INSERT (TX) switch**

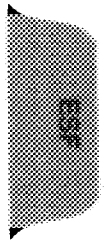
   Select LINE 1. The Switch to Protect and Shelf loop codes are now transmitted over the A Shelf datalink. Shelf C is switched to the protection line and looped. Verify alarm message. The message shown below indicates Shelf C was switched to protect and looped.

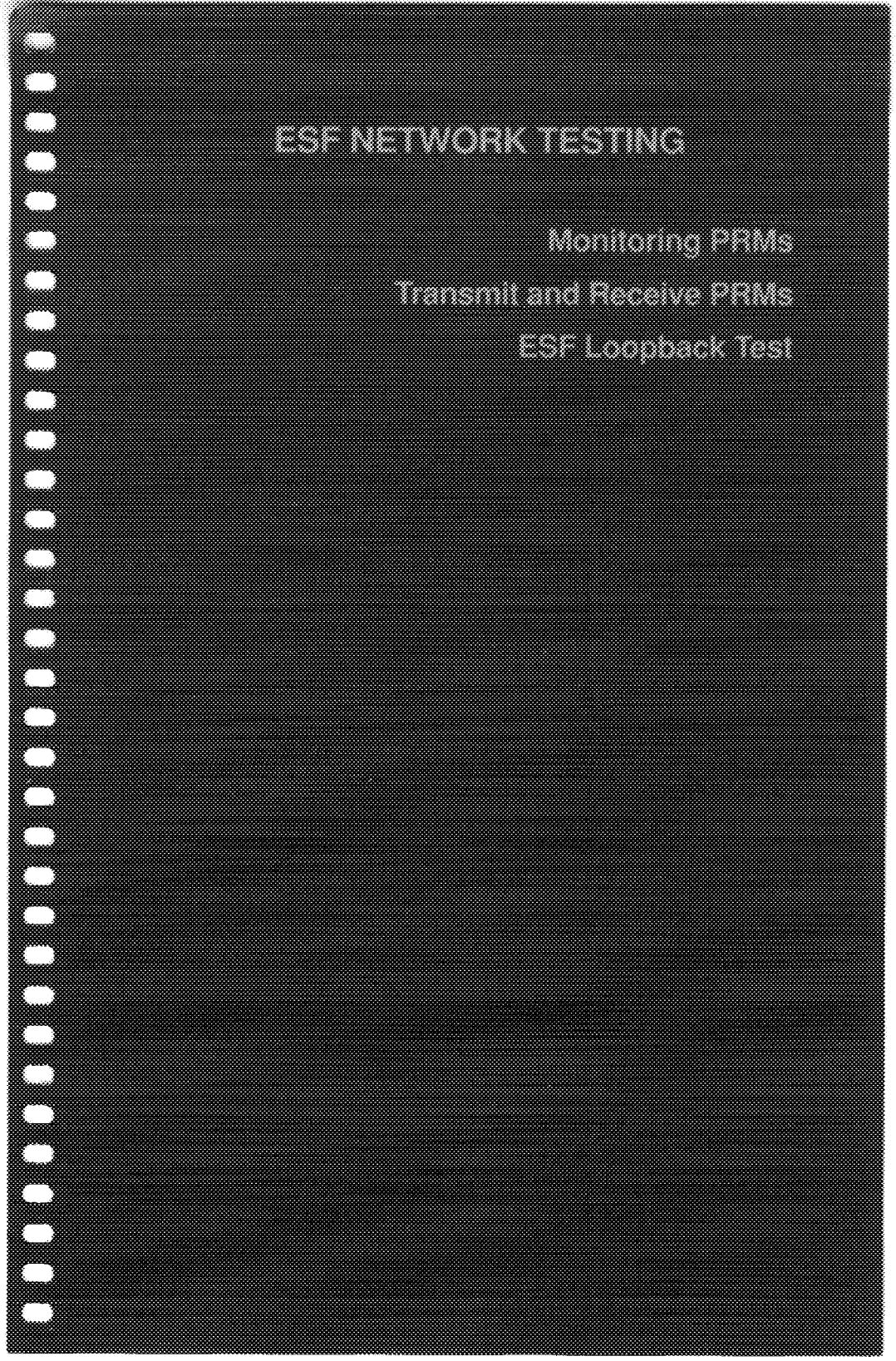
T1SLC96	**F END LOOP**	**L1 SLC ALM**
DATLINK	**SHELF C**	**C ON PROT**

   If the SLC ALM PROT message is not displayed, do not proceed; the protection line may not be available, the shelf may already be switched to protect, or a problem may exist with the transmission facility or the remote terminal.

5. **Additional BERT set**

   Upon successful loop up, the shelf is available for BER testing.




ESF NETWORK TESTING
Monitoring PRMs
Transmit and Receive PRMs
ESF Loopback Test

23. MONITORING PRMs

Enhanced SLC/ESF Option Required

- Perform full-duplex in-service error analysis on T1 circuits.
- Monitor ANSI T1.403 performance report messages generated by ESF-CSUs.

Figure 23 illustrates the T-BERD 224 monitoring a T1 circuit for PRMs.

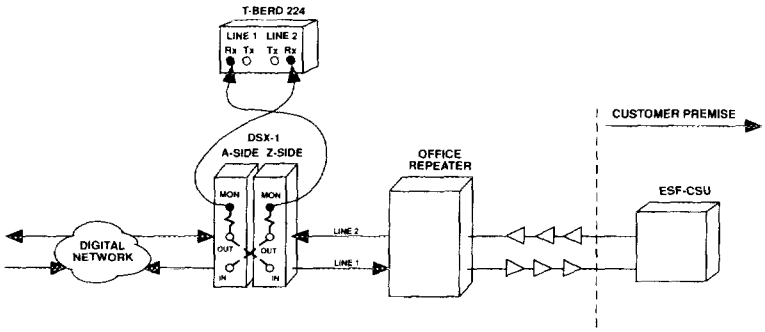


Figure 23
Monitoring T1 Circuit

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***
   Verify auto-configured framing displays *t1-esf*.

Performing the Test

1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

Analyzing Test Results

FRM ERR, CRC ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

F CRC Error, FBPV S, F FR ES, F SLP S

The problem is on the line towards the CSU.

FRM ERR, CRC ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further downstream.

RX FREQ

The received frequency should be 1.544 MHz +/- 75 Hz. If the frequency is outside of the specification, check the transmission equipment timing or the network synchronization.

RX LVL

The received level should be -20 dB +/- 3 dB at resistor isolated DSX-MON jacks. Incorrect levels could be caused by a facility T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a signal. Sectionalize the T1 equipment further.

AIS LED

This indicates that some equipment in the signal path is not receiving a signal from the far end.

24. TRANSMIT AND RECEIVE PRMs

Enhanced SLC/ESF Option Required

- Determine the quality of the ESF facility at the customer premise.
- Automatically generate PRMs based on the received signal.

Figure 24 illustrates a T-BERD 224 connected in front of the CSU.

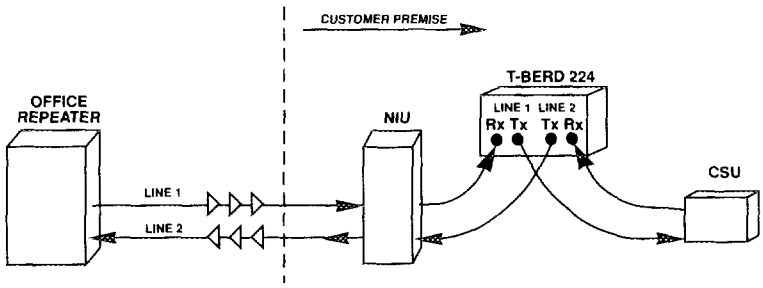


Figure 24
Transmitting and Receiving PRMs

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Drop and Insert Test Setup***

   Connect the T-BERD 224 in front of the CSU. If the CSU does not have PRM capability, the T-BERD 224 provides it. Verify auto-configured framing displays *t1-esf*.

2. **AUX switch**

   Press to access auxiliary functions (LED ON).

MODE, SCII, RESULTS I Blank, and RESULTS II Arrowed switches

Scroll to AUX 20 PRM TX using the **MODE** switch. Select the appropriate equipment to emulate for Lines 1 and 2 using the **SOURCE CONFIGURATION II** switch and the **RESULTS I Blank** switch, respectively. Toggle the PRM TRANS (PRM transmission) ON or OFF using the **RESULTS II Arrowed** switch.

AUX 20 PRM TX	L1 EMULATE CUSTOMER	L2 EMULATE CUSTOMER	PRM TRANS ON

AUX switch

Press to exit auxiliary functions (LED OFF).

MODE switch

Select T1-ESF.

CHANNEL FORMAT switch

Select FULL T1.

Performing the Test

RESTART switch

Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

Analyzing Test Results

If the test equipment in the CO detects far end errors, the transmission facility to the customer premise is errored. Further testing should then be conducted at the customer premises.

25. ESF LOOPBACK TEST

T1 BERT Option Required

- Loop ANSI T1.403 compatible CSUs and smart jacks.
- Perform end-to-end BERT testing.

Figure 25 illustrates a T-BERD 224 connected to the span through the DSX-1 patch panel to loop a ESF-CSU through the datalink.

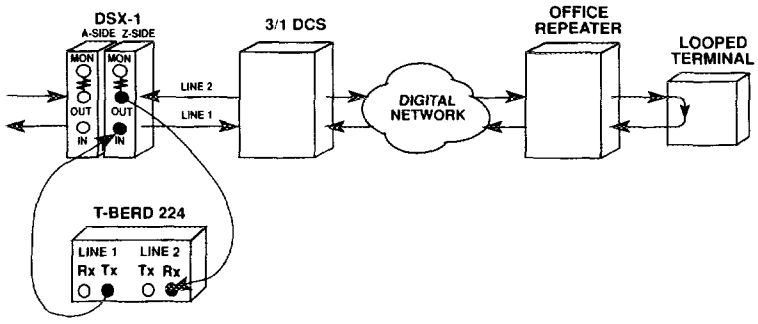


Figure 25
ESF Loopback Test

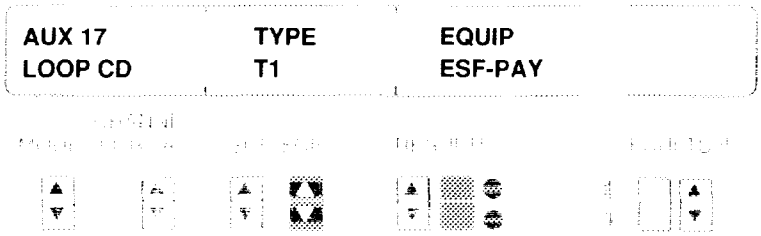
Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Termination Test Setup***

2. **AUX switch**
   Press to access auxiliary functions (LED ON).

3. **MODE, SCII, and RESULTS I Blank switches**
   Scroll to AUX 17 LOOP CD using the **MODE** switch. Set the loop code TYPE to T1 using the **SOURCE CONFIGURATION**

II switch. Select ESF-PAY (ESF out-of-band payload loop code) or ESF-LIN (ESF out-of-band Line loop code) using the **RESULTS I Blank** switch.



4. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

5. **CHANNEL FORMAT switch**
   Select FULL T1.

6. **SCI switch**
   Select the desired test pattern. Refer to Section 3 of the *T-BERD 224 Reference Manual* for help selecting the appropriate test pattern.

Performing the Test

1. **LOOP UP switch**
   Press the **LOOP UP** switch (LED ON) to start sending the selected loop-up code. The switch LED remains illuminated until the loop code is received by the T-BERD 224. If loop up is established, *LOOP UP SUCCESSFUL* flashes in the display.

2. **Local Status LEDs**
   Verify the Signal, Pattern Sync, and Frame Sync (if applicable) LEDs are illuminated. This indicates the stress pattern selected in the SOURCE CONFIGURATION is being received by the T-BERD 224.

3. **LOGIC ERROR INSERT switch**
   Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00BIT ERR result.

4. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected.

5. **LOOP DOWN switch**
   When the test is completed, press the **LOOP DOWN** switch to release the loopback. The switch LED remains illuminated until the loop down is accomplished. If loop down is successful, *LOOP DOWN SUCCESSFUL* flashes in the display and the Pattern Sync LED is extinguished. Disconnect the T-BERD 224 from span.

Analyzing Test Results

FRM ERR, CRC ERR, BIT ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors.

FRM ERR, CRC ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further.

BIT ERR only

Check the span before the DCS by isolating sections and testing.

F CRC E, F BPV S, F FR ERRORS, or F SLP S

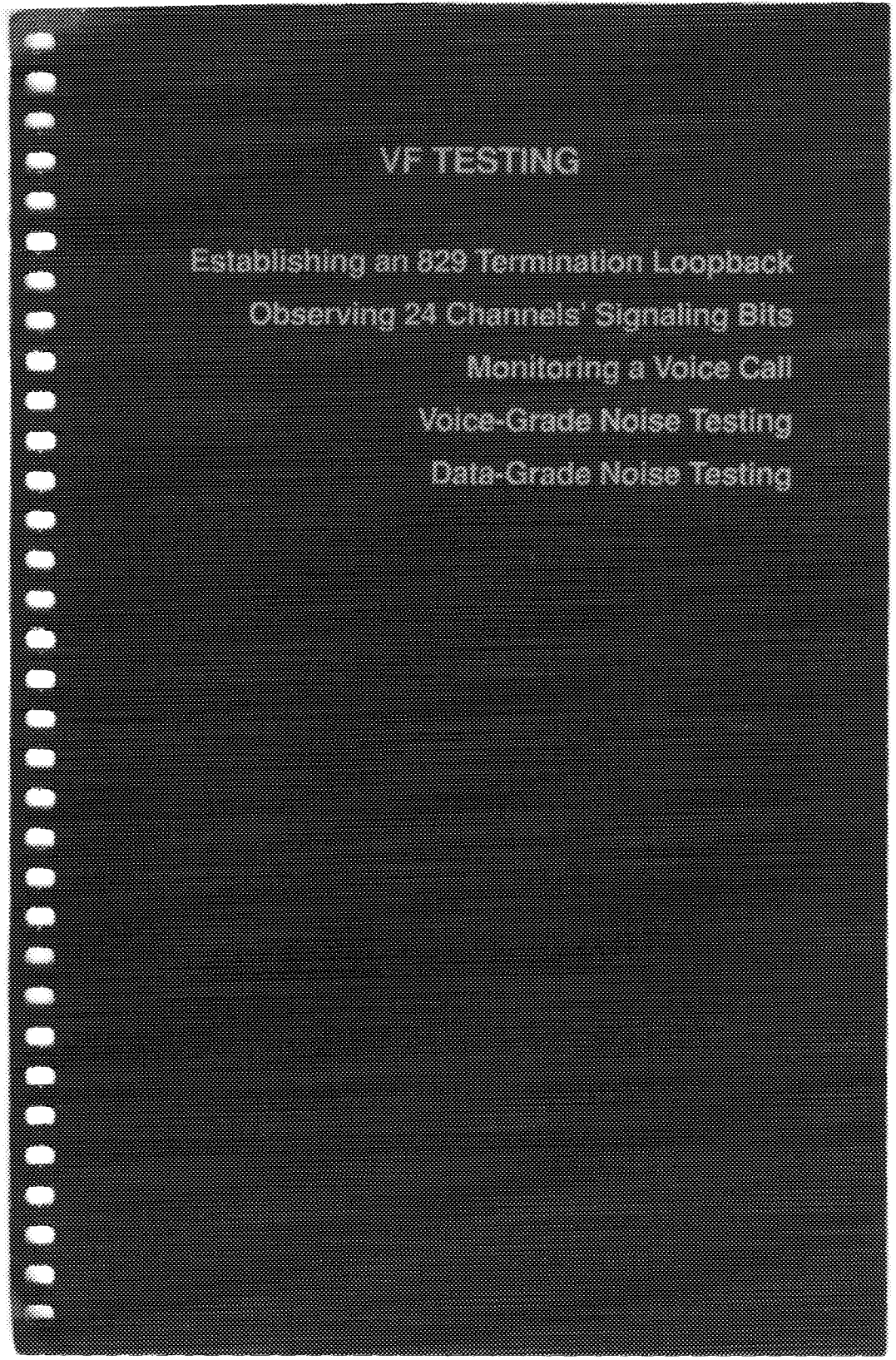
A problem exists with the transmission path to the customer.

RX FREQ

The received frequency should be 1.544 MHz +/- 75 Hz. If the frequency is outside of the specification, check the local transmission equipment or synchronization in the network.

Loopback is not established

The CSU is not operating correctly or the line from you to the CSU is bad.


VF TESTING
Establishing an 829 Termination Loopback
Observing 24 Channels' Signaling Bits
Monitoring a Voice Call
Voice-Grade Noise Testing
Data-Grade Noise Testing

26. ESTABLISHING AN 829 TERMINATION LOOPBACK — *VF Option Required*

- Establish a remote loopback by sending a 2713 Hz tone toward the 829 termination.
- Enables the performance of a single-ended VF circuit test.

Figure 26 illustrates the T-BERD 224 establishing a remote loopback.

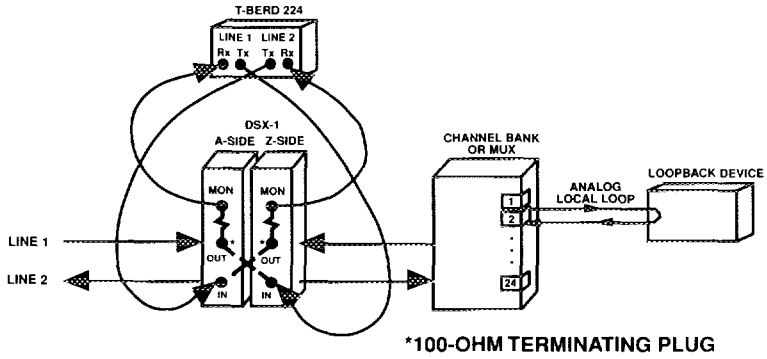


Figure 26
Loopback Testing

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to either the *T1 Drop and Insert Test Setup* or the *DCS Test Access Di-Group (TAD) Test Setup***

2. **CHANNEL FORMAT switch**
   Select VF.

3. **Volume**
   Select mid range.

4. **LINE 1 and LINE 2 CHANNEL switches**
   Select the T1 channel (DS0) to be tested.

INSERT (TX) switch

Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

DROP (RX) switch

Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

Performing the Test

RESTART switch

Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

SCI switch

Select 2713.

SCII switch

Select ON.

Volume

Verify the loopback by listening for the 2713 Hz test tone.

SCII switch

Select OFF. The far-end is now looped, enabling single-ended testing of the VF circuit.

Perform the desired test using the terminated loop.

SCII switch — Remove loopback

Select ON. The far-end is loop is now removed.

Volume

The 2713 Hz tone is no longer heard when the loopback is removed.

SCII switch

Select OFF.

27. OBSERVING 24 CHANNELS' SIGNALING BITS

- Locate the channels carrying traffic.
- Observe *handshaking* between communications equipment, such as switches and PBXs.
- Detect *stuck* or *hung* channels.

Figure 27 illustrates a T-BERD 224 monitoring a T1 circuit.

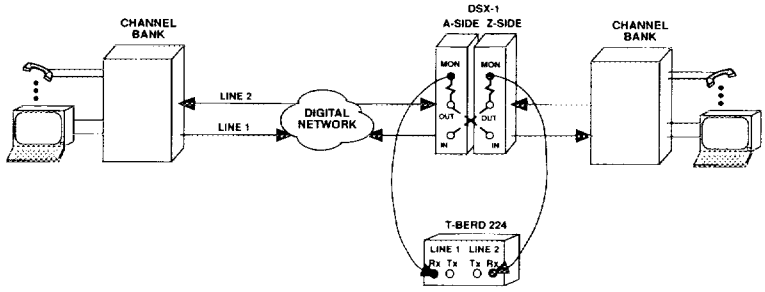


Figure 27
Observing 24 Channels' Signaling Bits

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***

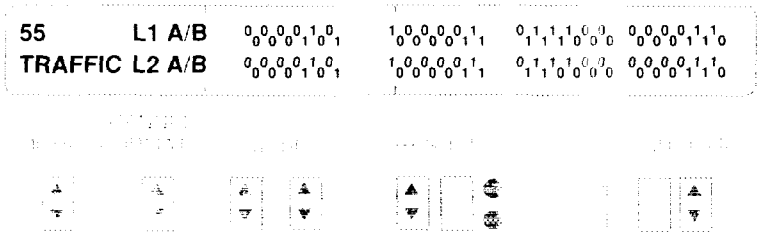
2. **CHANNEL FORMAT switch**
   Select FULL T1, VF, or SIGNLNG.

Performing the Test

1. **RESULTS I switches**

   Select the SIGNAL category using the **RESULTS I Blank** switch. Select 55 TRAFFIC using the **RESULTS I Arrowed** switch. Active channels (on-hook/off-hook states) can be determined by knowing the defined A and B states related to the specific trunk type (e.g., Loop Start).

   L1 and L2 indicate the line that is being monitored. The signaling bits for channels 01 through 24 are displayed in four groups of six bits each with channel 01 on the left and channel 24 on the far right.



2. **LINE 1 and LINE 2 CHANNEL switches**

   Select the T1 channel (DS0) to be monitored.

Analyzing Test Results

FRM ERR, CRC ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

FRM ERR, CRC ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further upstream.

A and B signaling bits

The ON HOOK, OFF HOOK, and RINGING states of each of the channels are represented by the A and B signaling bits. Use the A and B signaling bits to identify whether the channel is active, idle, or stuck. See the Appendix G of the *T-BERD 224 Reference Manual* for the individual bit patterns of the different trunk types.

28. MONITORING A VOICE CALL

VF Option Required

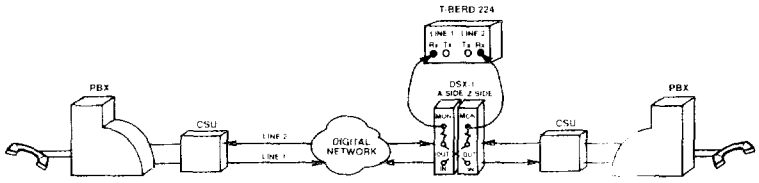
Verify continuity during circuit installations.

Check Voice Frequency (VF) signal levels audibly and visually to confirm reported fault conditions.

Determine the location of error sources by monitoring specific transmission directions.

Measure the level of the signal.

Figure 28 illustrates a T-BERD 224 monitoring a T1 circuit.



Configuring the T-BERD 224

Configure T-BERD 224 according to the *T1 Monitor Test Setup*

CHANNEL FORMAT switch
Select VF.

Performing the Test

RESTART switch
Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

2. **LINE 1 and LINE 2 CHANNEL switches**
   Select the channel (DS0) to be tested.

3. **Volume**
   Listen to each transmission direction and compare sound quality and level. The transmission direction of the fault may be determined using this method.

4. **DROP (RX) switch**
   Select monitor LINE 1, LINE 2, and then BOTH to sectionalize the fault to a transmission direction.

Analyzing Test Results

FRM ERR, CRC ERR, BPVs

Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

FRM ERR, CRC ERR, No BPVs

Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further upstream.

Audible Faults

If the volume output of one transmission direction is significantly lower than the other direction, or audible "pops" or "crackles" are received from one transmission direction, then move the test set toward the origin of the faulty transmission direction to isolate the fault source.

RX LVL

The received level should be -20 dB +/- 3 dB at resistor isolated DSX-MON jacks. Incorrect levels could be caused by a facility T1 line card or poor cabling between the DSX jack and the equipment.

29. VOICE-GRADE NOISE TESTING

VF Option Required

- Measures noise levels for voice-grade lines carrying conversations (C-Message filters).
- Test for C-Notch noise, C-Message noise, Signal to Noise Ratio.
- Send and measure level of 404, 1004, and 2804 Hz tones.

Figure 29 illustrates the T-BERD 224 performing an end-to-end test in conjunction with a VF test set located at the end of a VF local loop.

NOTE The sequence of transmitting and measuring specific tones and results must be performed at the remote test set simultaneously for proper circuit analysis.

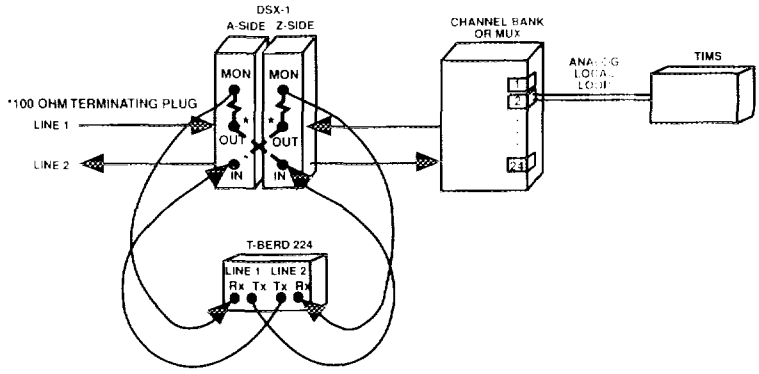


Figure 29
Measuring Voice Grade Noise

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to either the *T1 Drop and Insert Test Setup* or the *DCS Test Access Di-Group (TAD) Test Setup***

2. **CHANNEL FORMAT switch**
   Select VF.

3. **Volume**
   Select mid range.

4. **LINE 1 & 2 CHANNEL switch**
   Select the T1 (VF) channel that is carrying the voice traffic (LINE 1 or LINE 2).

5. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

6. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

Performing the Test

1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

Measuring Level, Frequency, C-Notch Noise, and S/N Ratio

This procedure assumes that a 1004 Hz, -16 dBm test tone is transmitted toward the T-BERD 224 from the remote VF test set.

1. **SCI switch**
   Select LEVEL.

2. **SCII switch**
   Select appropriate transmit level. An idle code of all ones is transmitted into the channel selected for LINE 2 to prevent loop and test tones from being transmitted throughout the rest of the circuit.

Volume

Verify continuity by listening to the 1004 Hz test tone.

RESULTS switches

Select the CHANNEL category using the **RESULTS I** and **II Blank** switches. Select n81 VF FREQ and n82 VF LVL using the **RESULTS I** and **II Arrowed** switches, respectively. Record the value for VF LVL. See *Analyzing Test Results* for more information.

RESULTS I Blank switch

Select the SUMMARY category. Verify *RESULTS OK* is displayed.

Measuring C-Message Noise

This procedure assumes that a quiet termination (i.e., 500, 600, or 1200-ohm terminating resistance) is being provided by the remote VF test set.

SCI switch

Select QUIET.

RESULTS switches

Select the CHANNEL category using the **RESULTS I** and **II Blank** switches. Select the n81 VF FREQ and the n86 C-MSG using the **RESULTS I** and **II Arrowed** switches, respectively. See *Analyzing Test Results* for more information.

QUIET	281 VF FREQ	286 C-MSG
	0	13dBrnC

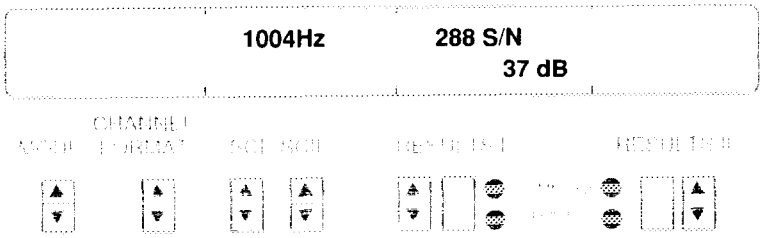
3. **RESULTS I Blank switch**
   Select the SUMMARY category. Verify *RESULTS OK* is displayed.

Measuring Signal to Noise

This procedure assumes that 1004 Hz test tone is transmitted toward the T-BERD 224 from the remote VF test set.

1. **SCI switch**
   Select 1004Hz.

2. **RESULTS switches**
   Select the CHANNEL category using the **RESULTS I Blank** switch and the n88 S/N result using the **RESULTS I Arrowed** switch. Check the following results. See *Analyzing Test Results* for more information.



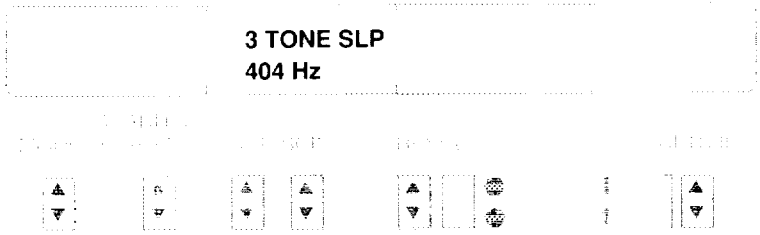
3. **RESULTS I Blank switch**
   Select the SUMMARY category. Verify *RESULTS OK* is displayed.

Measuring 3 Tone Slope

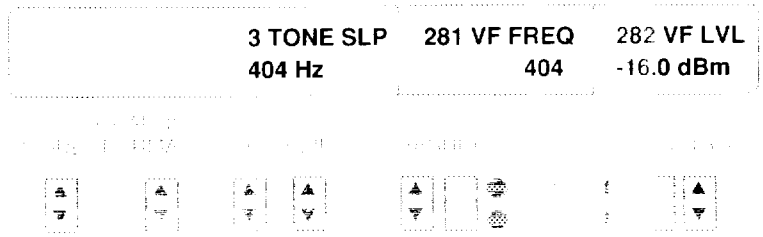
This procedure assumes that a 404 Hz, 1004 Hz, and 2804 Hz test tones are transmitted toward the T-BERD 224 from the remote VF test set.

1. **SCI switch**
   Select 3 TONE SLP.

2. **SCII switch**
   Select 404 Hz.

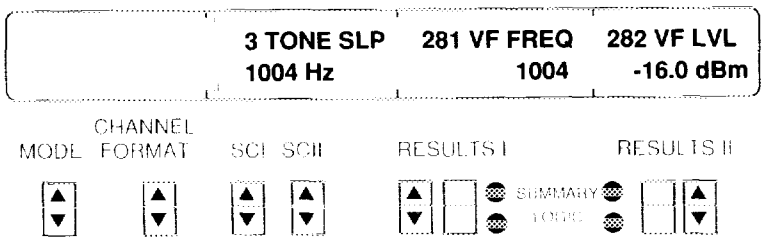


3. **RESULTS switches**
   Select the CHANNEL category using the **RESULTS I** and **II Blank** switches. Select n81 VF FREQ and n82 VF LVL using the **RESULTS I** and **II Arrowed** switches, respectively. Record the value for VF LVL. See *Analyzing Test Results* for more information.



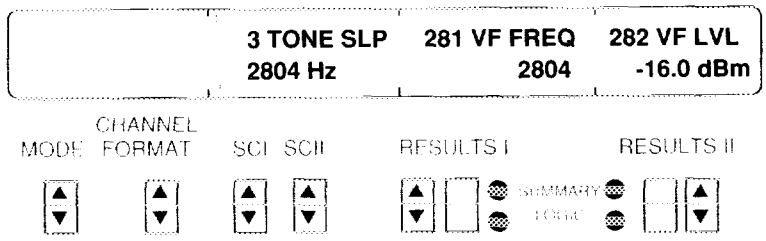
4. **RESULTS I Blank switch**
   Select the SUMMARY category. Verify *RESULTS OK* is displayed.

5. **SCII switch**
   Select 1004 Hz. Record the value for VF LVL.



6. **RESULTS I Blank switch**
   Select the SUMMARY category. Verify *RESULTS OK* is displayed.

7. **SCII switch**
   Select 2804 Hz. Record the value for VF LVL. See *Analyzing Test Results* for more information.



8. **RESULTS I Blank switch**
   Verify *RESULTS OK* is displayed.

Measuring Return Loss

This procedure assumes that a quiet termination (e.g., a 100, 600, or 1200-ohm terminating resistance) is being provided by the remote VF test set.

SCII switch
Select ERL.

AUX switch
Press to access auxiliary functions (LED ON).

AUX 22 VF BURST is displayed automatically. Select ON for BURST using the **SOURCE CONFIGURATION II** switch.

AUX 22	BURST	FREQ	LEVEL
VFBURST	ON	2125 Hz	-10.0 dBm

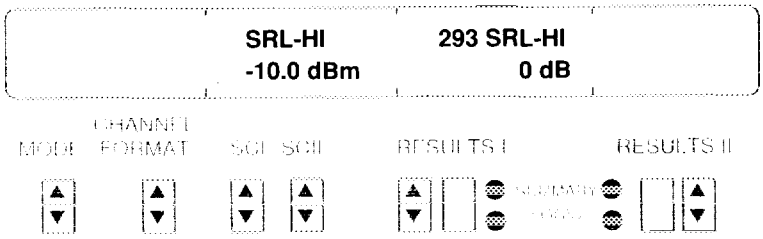
AUX switch
Press to exit auxiliary functions (LED OFF).

RESULTS I switches
Select the CHANNEL category using the **RESULTS I Blank** switch and n92 ERL using the **RESULTS I Arrowed** switch. See *Analyzing Test Results* for more information.

	ERL	292 ERL
	-10.0 dBm	0 dB

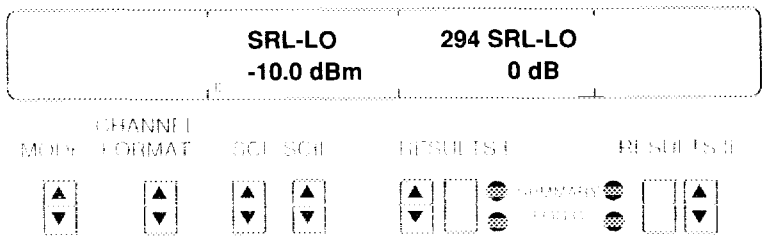
5. **SCI switch**
   Select SRL-HI.

6. **RESULTS I switches**
   Select the CHANNEL category using the **RESULTS I Blank** switch and n93 SRL-HI using the **RESULTS I Arrowed** switch. See *Analyzing Test Results* for more information.



7. **SCI switch**
   Select SRL-LO.

8. **RESULTS switches**
   Select the CHANNEL category using the **RESULTS I Blank** switch and n94 SRL-LO using the **RESULTS I Arrowed** switch. See *Analyzing Test Results* for more information.



9. **RESULTS I Blank switch**
   Select the SUMMARY category. Verify *RESULTS OK* is displayed.

Analyzing Test Results

BPVs, FRM ERR, CRC ERR

Local T1 problem. Possibly faulty T1, audible noise, repeater, span line noise, crosstalk, poor line cabling, bad cabling between test set and circuit, corroded *dirty* cable plugs.

FRM ERR, CRC ERR, No BPVs

Typically a far-end T1 span problem. Sectionalize further. Check cross-connect switches, multiplexers, and repeaters, as well as the cabling between these devices.

VF LVL out-of-spec, SUMMARY RESULTS OK

VF circuit problem. Check level and LBO settings on modems, line repeaters, channel bank plug-ins, and multiplexer cards. Check VF local loop for shorts, opens, grounds, etc.

ERL, SRL-HI, SRL-LO out-of-spec, SUMMARY RESULTS OK

2-wire/4-wire hybrid converter impedance mismatch. Check impedance settings.

Audible Distortion, SUMMARY RESULTS OK

VF circuit problem — attenuation distortion. Check VF line repeaters, and line cards containing digital/analog converters. May require re-conditioning analog local loop (remove load coils etc.).

C-MSG out-of-spec, SUMMARY RESULTS OK

VF circuit problem. Crosstalk from adjacent cable pairs, 60 Hz induction from power lines, possible VF local loop problems (one side open, unbalanced line).

C-NOTCH, S/N, SUMMARY RESULTS OK

VF circuit problem. Bad line card in channel bank, multiplexer, or SLC terminal, bad VF repeater, 1004 Hz tone is out-of-range.

30. DATA-GRADE NOISE TESTING

VF Option Required

- Tests for 3 kHz Flat Noise, PAR, Sweep, and Signal to Noise Ratio.
- Provides an overall indication of a voice-grade circuit's ability to carry high speed data.
- Gives a quick indication of a channels amplitude distortion.
- Tests beyond the minimum requirements of voice-grade service.
- Measures the *smearing* of a data signal over an analog loop and indicates the likelihood of intersymbol interference (BIT ERR).

Figure 30 illustrates the T-BERD 224 performing an end-to-end test in conjunction with a VF test set located at the end of a VF local loop.

NOTE: The sequence of transmitting and measuring specific tones and results must be performed at the remote test set simultaneously for proper circuit analysis.

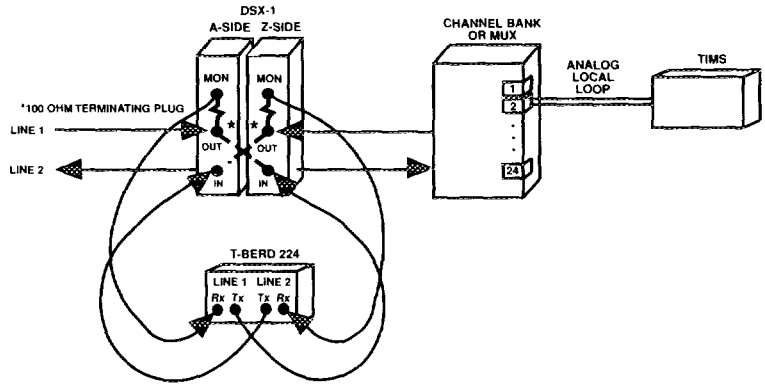


Figure 30
Measuring Noise

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to either the *T1 Drop and Insert Test Setup* or the *DCS Test Access Di-Group (TAD) Test Setup***

2. **CHANNEL FORMAT switch**
   Select VF.

3. **Volume**
   Select mid range.

4. **LINE 1 and LINE 2 CHANNEL switches**
   Select the T1 channel (DS0) to be tested.

5. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

6. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

Performing the Test

1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

Measuring 3kHz Notch Noise

1. **SCI switch**
   Select LEVEL.

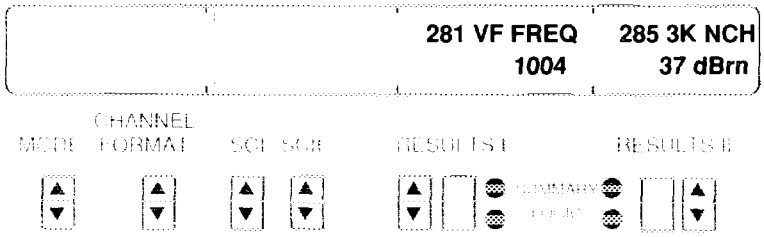
2. **SCII switch**
   Select the appropriate transmit level (e.g., -16 dBm).

3. **SCI switch**
   Select FREQ to transmit a desired tone frequency or select SWEEP to transmit the full range of audible tone frequencies in stepped increments.

4. **SCII switch**
   Select the desired frequency (e.g., 1004 Hz). An idle code of all ones is transmitted into the channel selected for LINE 2 to prevent loop and test tones from being transmitted throughout the rest of the circuit.

5. **Volume**
   Verify continuity by listening to the test tone.

6. **RESULTS switches**
   Select the CHANNEL category using the **RESULTS I** and **II Blank** switches. Select n81 VF FREQ and n85 3K NCH using the **RESULTS I** and **II Arrowed** switches, respectively. Record the values for VF FREQ and 3K NCH. See *Analyzing Test Results* for more information.

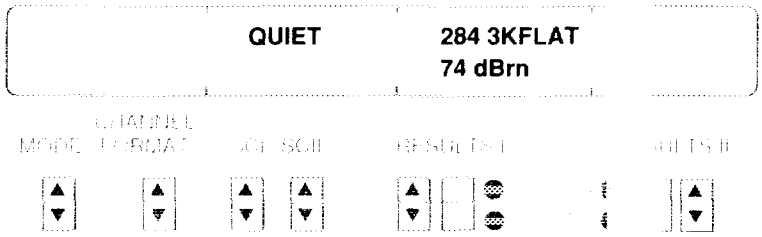


7. **RESULTS I Blank switch**
   Select the SUMMARY category. Verify *RESULTS OK* is displayed.

Measuring 3kHz Flat Noise

1. **SCI switch**
   Select QUIET.

2. **RESULTS switches**
   Select the CHANNEL category using the **RESULTS I Blank** switch and n84 3KFLAT using the **RESULTS I Arrowed** switch. Record the value for 3KFLAT.



3. **RESULTS I switches**
   Select the SUMMARY category using the **RESULTS I Blank** switch and display the step using the **RESULTS II Arrowed** switch. Verify *RESULTS OK* is displayed.

Frequency Sweep vs. Level Analysis (Channel Transfer Function)

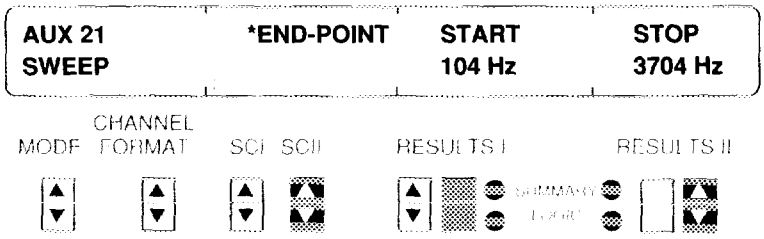
1. **SCI switch**
   Select SWEEP. The message *SEE AUX 21 TO SET SWEEP PARAMS* appears in the RESULTS I display

2. **AUX switch**
   Press to access auxiliary functions (LED ON). AUX 21 SWEEP is displayed automatically.

3. **SCII switch**
   The asterisk (*) indicates that there are three possible selections in this auxiliary function. Select END-POINT.

4. **RESULTS switches**

   Set the START end-point for the sweep using the **RESULTS I Blank** switch. Set the STOP end-point for the sweep using the **RESULTS II Arrowed** switch.

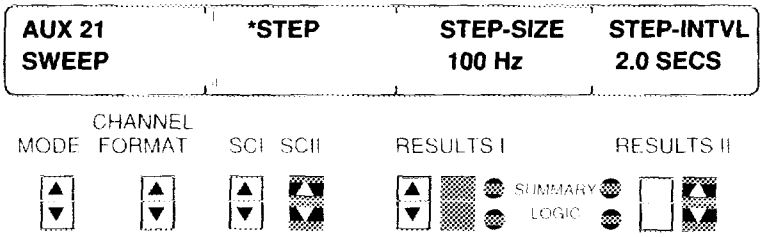


5. **SCI switch**

   The asterisk (*) indicates that there are three possible selections in this auxiliary function. Select STEP.

6. **RESULTS switches**

   Set the STEP-SIZE of the incremental frequency using the **RESULTS I Blank** switch. Set STEP-INTVL for the incremental frequency using the **RESULTS II Arrowed** switch.



7. **SCI switch**

   The asterisk (*) indicates that there are three possible selections in this auxiliary function. Select SKIP.

RESULTS switches

Set the high end of the skipped frequency bandwidth using the **RESULTS I Blank** switch. Set the low end of the skipped frequency bandwidth using the **RESULTS II Arrowed** switch. The asterisk (*) indicates that there are three possible selections in this auxiliary function.

NOTE The T-BERD 224 automatically performs a validation check of the entered values. If the parameters are inconsistent, an error message flashes for two seconds, the frequency sweep setup operation is aborted, and the original settings remain.

AUX 21	*SKIP	SKIP-HI	SKIP-LO
SWEEP		2750 Hz	2450 Hz

MODE and SCII switches

Select AUX 23 PRT OPT using the **MODE** switch. Select ON for FREQ SWP using the **SOURCE CONFIGURATION II** switch.

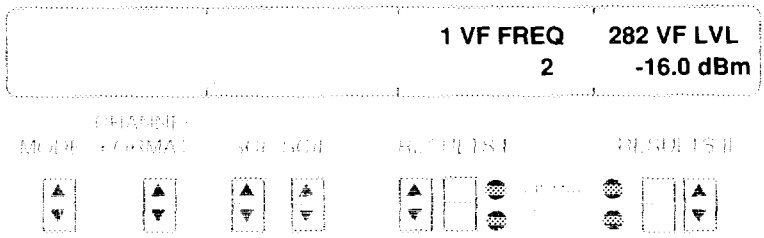
AUX 23	FREQ SWP
PRT OPT	ON

AUX switch

Press to exit the auxiliary functions (LED OFF).

11. **SCI switch**
    Select the appropriate transmit level.

12. **RESULTS switches**
    Select the CHANNEL category using the **RESULTS I** and **II Blank** switches. Select n81 VF FREQ and n82 VF LVL using the **RESULTS I** and **II Arrowed** switches, respectively. Record the value for VF LVL. See *Analyzing Test Results* for more information.



13. **RESULTS I Blank switch**
    Select the SUMMARY category. Verify *RESULTS OK* is displayed.

Measuring PAR

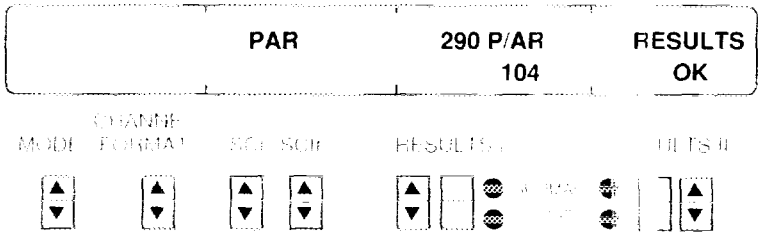
Although it is possible to perform a PAR test with a remote loopback, it is not recommended because impairments on the return path may "correct" the results which indicate faults on the transmit path.

1. **SCI switch**
   Select PAR.

2. **SCII switch**
   Select frequency level of the transmit PAR spectrum.

3. **RESULTS switches**

Select the CHANNEL category using the **RESULTS I Blank** switch and n90 P/AR using the **RESULTS I Arrowed** switch.



Analyzing Test Results

FRM ERR, CRC ERR, BPVs

Local T1 problem. Possibly faulty T1, audible noise, repeater span line noise, crosstalk, poor line cabling, bad cabling between test set and circuit, corroded "dirty" cable plugs.

FRM ERR, CRC ERR, No BPVs

Typically a far-end T1 span problem. Sectionalize further. Check cross-connect switches, multiplexers, and repeaters, as well as the cabling between these devices.

Gain vs. Frequency Curve out-of-spec, SUMMARY RESULTS OK

Possible VF circuit problem. Check local span for sources of attenuation distortion such as bridge taps, companders, and equalizers.

3K FLAT out-of-spec, SUMMARY RESULTS OK

VF circuit problem. Check for crosstalk from adjacent circuits, 60 Hz induction from power lines, possible VF local loop problem (one side open, unbalanced lines, etc.).

3K NCH out-of-spec, SUMMARY RESULTS OK

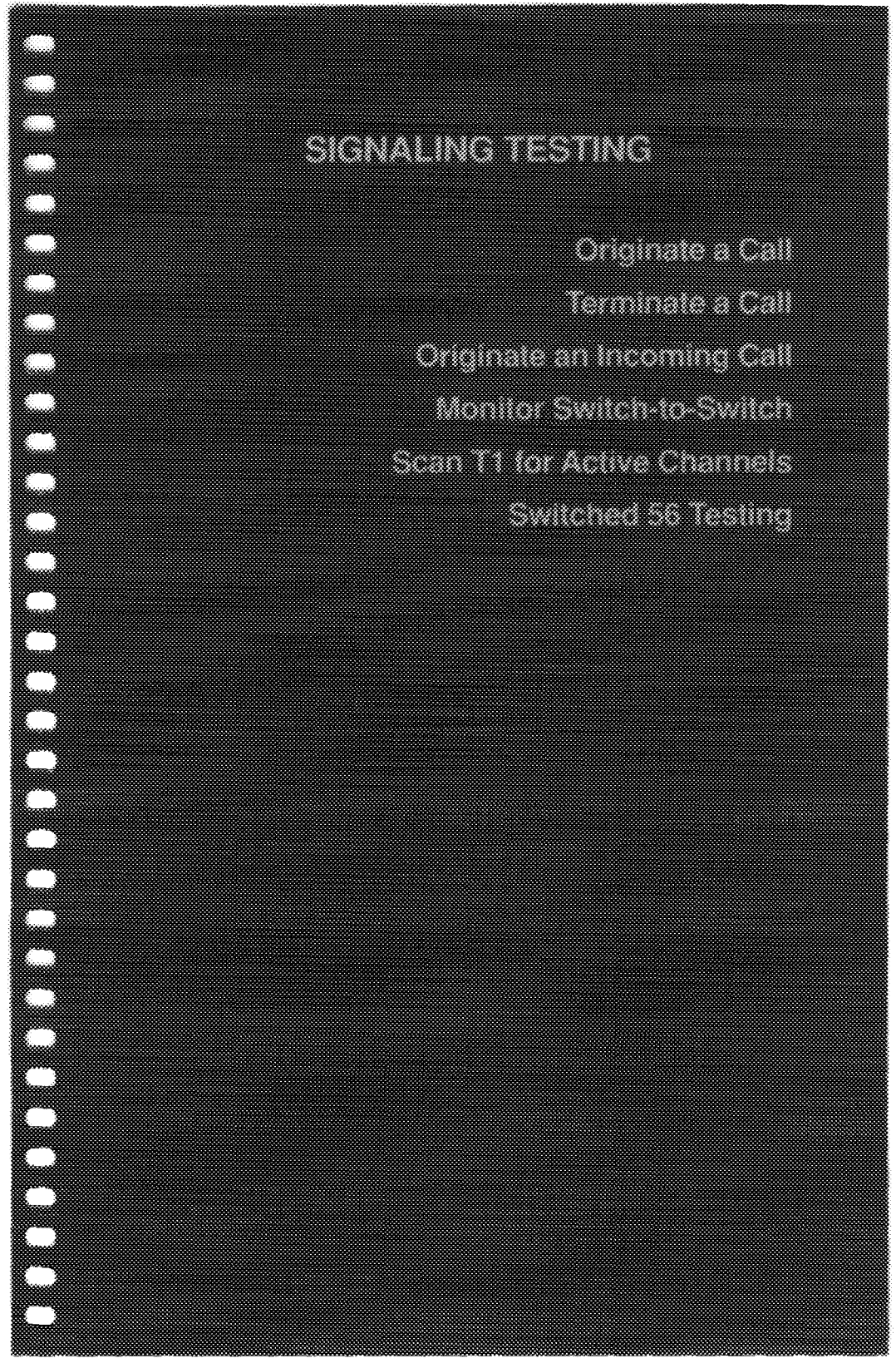
VF circuit problem. Bad line card in channel bank, multiplexer, or SLC terminal. Bad VF repeater, 1004 Hz tone out-of-range.

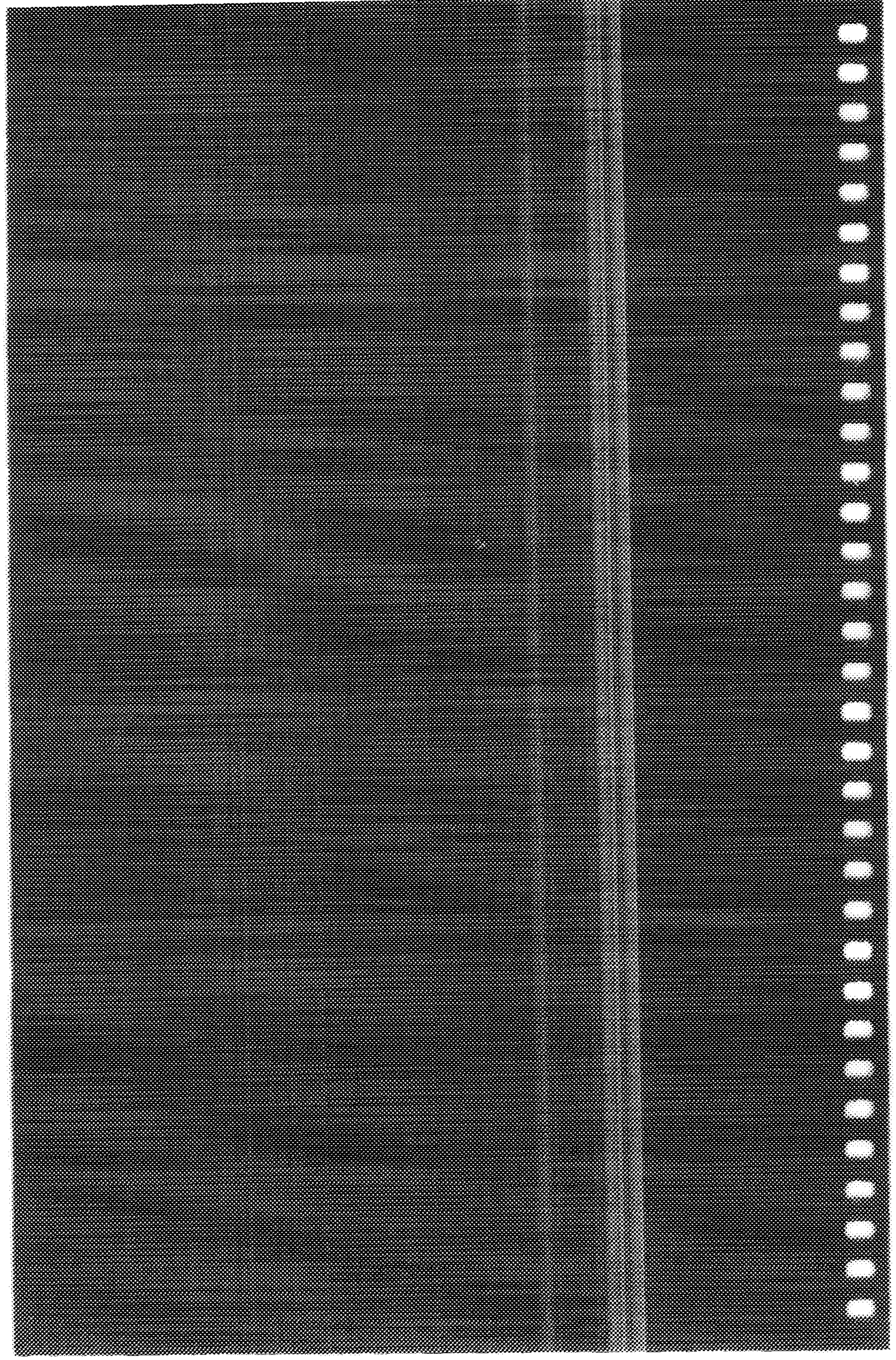
P/AR out-of-spec, SUMMARY RESULTS OK

Poor return loss, attenuation distortion, or envelope delay distortion. Perform separate return loss, frequency sweep, and Extended Delay Duration (EDD) tests.

NOTE: External TIMS set required for EDD test.


OIG


SIGNALING TESTING
Originate a Call
Terminate a Call
Originate an Incoming Call
Monitor Switch-to-Switch
Scan T1 for Active Channels
Switched 56 Testing



31. ORIGINATE A CALL

Signaling Option Required

- Emulate a PBX or an originating switch.
- Test the switches ability to handle incoming calls.
- Test whether the switch is configured and operating correctly.

Figure 31 illustrates a T-BERD 224 originating a call.

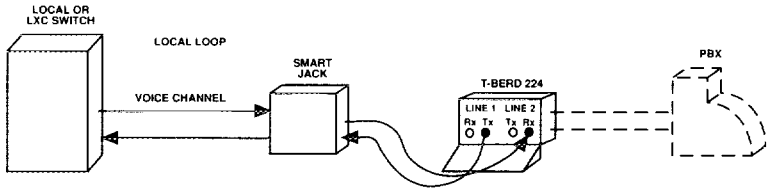


Figure 31
Originating A Call

Configuring the T-BERD 224

1. **Configure T-BERD 224 to suit the application**
   For in-service testing, use the *T1 Drop and Insert Test Setup*. For out-of-service testing, use the *T1 Termination Setup*. For testing at the DCS TAD, use the *DCS Test Access Di-Group (TAD) Test Setup*.

2. **CHANNEL FORMAT switch**
   Select SIGNLNG.

3. **SCI switch**
   Select DIALSEQ.

4. **SCII switch**
   Select the stored sequence (1-10) to be transmitted.

AUX switch

Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 24 TRK DEF using the **MODE** switch. Select the appropriate trunk type (GROUND ST, LOOP START, or STD (E&M)) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance). Select the type of circuit equipment to emulate (FXS, FXO, SLC STATION, or SLC OFFICE) using the **RESULTS I Blank** switch (no selection if STD (E&M) trunk type is selected).

AUX 24	TRUNK TYPE	EMULATE
TRK DEF	GROUND ST	FXS

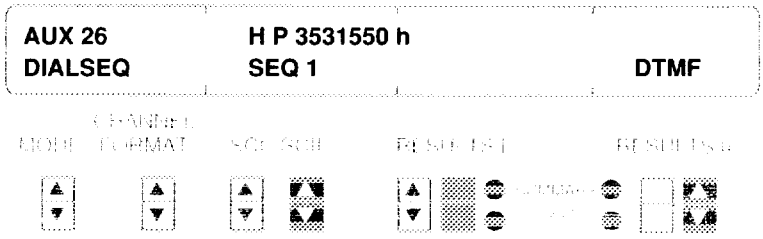
MODE and SCII switches

Scroll to AUX 26 DIALSEQ using the **MODE** switch. Select the sequence number to program (SEQ 1 to SEQ 10) using the **SOURCE CONFIGURATION II** switch. Set the address using the **RESULTS I Blank** switch. Select the digit type using the **RESULTS II Blank** switch. Use the Signaling Keypad to program the sequence: ORIGinate SUPerVision (uppercase) and the digits are transmitted by the T-BERD 224 or TERMinate SUPerVision (lowercase) and the digits are received by the T-BERD 224.

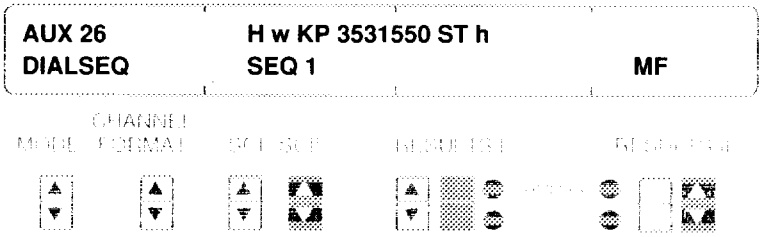
Signaling Keypad — Enter the dial sequence:

ORIG SUPV — Press OFF HOOK.
TERM SUPV — Press wink.
KEYPAD — Enter number to be dialed
ENTER — Press to store sequence.

GROUND ST or LOOP START display



STD (E&M) display



8. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

9. **LINE 1 & 2 CHANNEL switches**
   Select the T1 channel (DS0) to be tested.

Performing the Test

1. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side). When the channel display stops blinking, the T-BERD 224 is transmitting on the selected line.

2. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

3. **RESULTS II switches**

   Select the CHANNEL category using the **RESULTS II Blank** switch. Select n100 DELAY, n101 DUR, n102 ADDR, n104 FQ/LVL, or n105 FQ/LVL using the **RESULTS II Arrowed** switch.

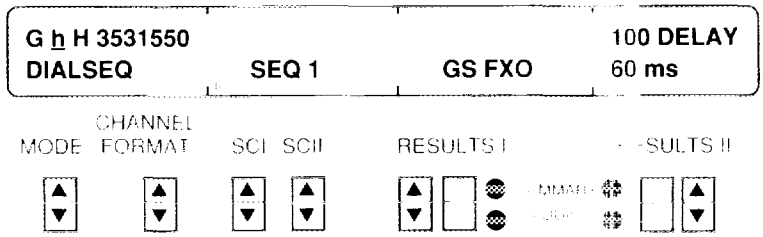
4. **RESTART switch**

   Press the **RESTART** switch to clear alarms and begin the test. Verify DIAL SEQ appears in display. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

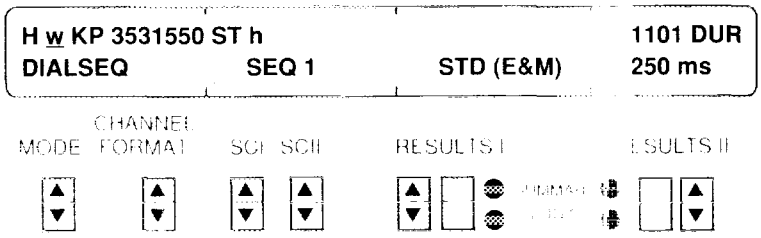
5. **Keypad Cursor**

   Use the right and left **ARROW** switches on the keypad to scroll through the received sequence. When the cursor is under the desired event, view the desired result using the **RESULTS II Arrowed** switch.

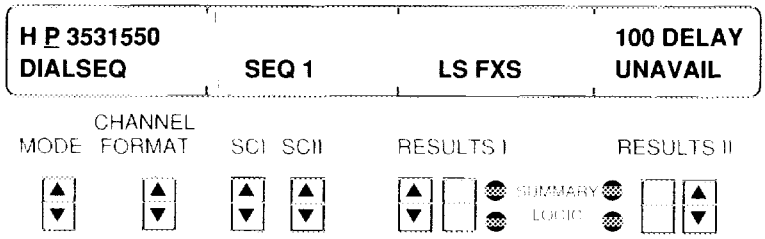
GROUND ST display



STD (E&M) display



LOOP START display



6. **SCI switch - optional testing**
   Select a standard VF test for optional testing.

7. **Butt set - optional**
   The T-BERD 224 provides a talk path through the 2-wire VF Interface.

8. **Signaling Keypad — Disconnect call**
   ORIG SUPV — Press ON HOOK (O) to hang up. The call is disconnected when the far end hangs up.

Analyzing Test Results

If ring back tone and dial tone are heard at the T-BERD 224 speaker then the dialing is successful. When far end answers the call, a talk path is established. Use a butt set to communicate with the far end.

Wink delay and duration — switch wink timing parameters need adjustment.

Incorrect digits being sent — potential switch translation problem.

Incorrect digit frequency or level — potential switch line card problem.

Incorrect number of digits — potential switch translation problem.

On hook during conversation — potential switch line/trunk card problem.

On hook/off hook delay and duration—timing parameters between on hook and off hook may need to be adjusted.

> To measure delay, duration, level, and frequency on digits requires the Digit Analysis Option.

32. TERMINATE A CALL

Signaling Option Required

- T-BERD 224 emulates a terminating switch or PBX.
- Test the ability of a PBX or a switch to originate a call.
- Test whether a PBX or an originating switch are configured and operating correctly.

Figure 32 illustrates a T-BERD 224 terminating a call.

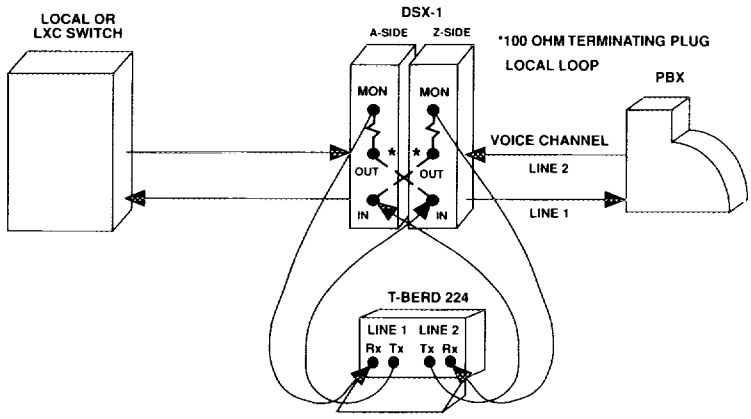


Figure 32
Terminating A Call

Configuring the T-BERD 224

1. **Configure T-BERD 224 to suit the application**
   For in-service testing, use the *T1 Drop and Insert Test Setup*. For out-of-service testing, use the *T1 Termination Setup*. For testing at the DCS TAD, use the *DCS Test Access Di-Group (TAD) Test Setup*.

2. **CHANNEL FORMAT switch**
   Select SIGNLNG.

3. **SCI switch**
   Select REC SEQ.

4. **SCII switch**
   Select the stored sequence (1-10) to be transmitted.

5. **AUX switch**
   Press to access auxiliary functions (LED ON).

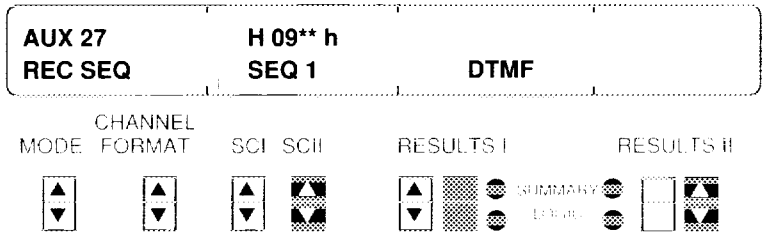
6. **MODE, SCII, and RESULTS I Blank switches**
   Scroll to AUX 24 TRK DEF using the **MODE** switch. Select the appropriate trunk type (GROUND ST, LOOP START, or STD (E&M)) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance). Select the type of circuit equipment to emulate (FXS, FXO, SLC STATION, or SLC OFFICE) using the **RESULTS I Blank** switch (no selection if STD (E&M) trunk type is selected).

AUX 24	TRUNK TYPE	EMULATE
TRK DEF	GROUND ST	FXS

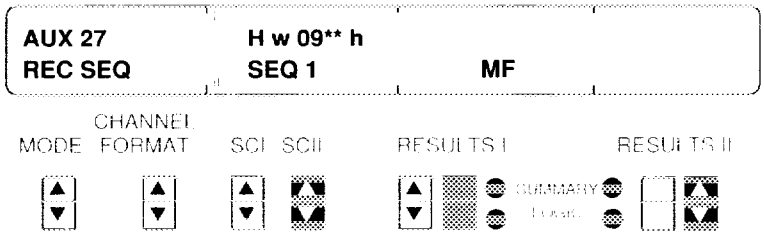
MODE and SCII switches
Scroll to AUX 27 REC SEQ using the **MODE** switch. Select the sequence number (SEQ 1 to SEQ 10) using the **SOURCE CONFIGURATION II** switch. Set the address using the **RESULTS I Blank** switch. Select the digit type using the **RESULTS II Blank** switch. Use the Signaling Keypad to program the sequence; ORIGinate SUPerVision (in uppercase) and the digits are transmitted by the T-BERD 224, while TERMinate SUPerVision (in lowercase) is received by the T-BERD 224.

Signaling Keypad — Enter the dial sequence.
ORIG SUPV — Press OFF HOOK.
KEYPAD — Enter number of digits to be received.
ENTER — Press to store sequence.

GROUND ST or LOOP START display



STD (E&M) display



** Number of digits to be received including KP, ST, and STP.

8. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

9. **LINE 1 & 2 CHANNEL switches**
   Select the T1 channel (DS0) to be tested.

Performing the Test

INSERT (TX) switch

Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

DROP (RX) switch

Select the T1 line to receive the channel to be analyzed (usually opposite the insert line). When the channel display stops blinking, the T-BERD 224 is transmitting on the selected line.

RESULTS switches

Select the CHANNEL category using the **RESULTS II Blank** switch. Select n100 DELAY, n101 DUR, n102 ADDR, n104 FQ/LVL, or n105 FQ/LVL using the **RESULTS II Arrowed** switch.

RESTART switch

Press the **RESTART** switch to clear alarms and begin the test. Verify *REC SEQ* appears in display. Verify the *Signal* and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

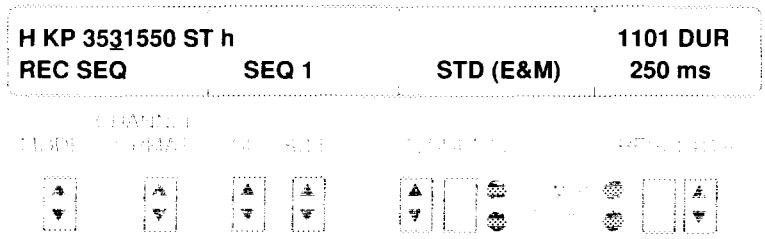
Keypad Cursor

Use the right and left **ARROW** switches on the keypad to scroll through the received sequence. When the cursor is under the desired event, view the desired result using the **RESULTS II Arrowed** switch.

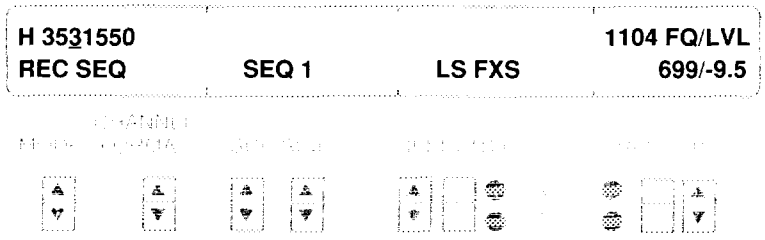
GROUND ST display

G h H 3531550			**2:00 DELAY**
REC SEQ	**SEQ 1**	**GS FXS**	**60 ms**

STD (E&M) display



LOOP START display



6. **SCI switch - optional testing**
   Select a standard VF test for optional testing.

7. **Butt set - optional**
   The T-BERD 224 provides a talk path through the 2-wire VF Interface.

8. **Signaling Keypad — Disconnect call**
   ORIG SUPV — Press ON HOOK (0) to hang up. The call is disconnected when the far end hangs up.

9. **SCI switch - optional testing**
   Select a standard VF test for optional testing.

10. **Butt set - optional**
    The T-BERD 224 provides a talk path through the 2-wire VF interface.

11. **Signaling Keypad — Disconnect call**
    TERM SUPV — Press ON HOOK.

Analyzing Test Results

T-BERD 224 receives digits from PBX and allows evaluation of digits, including digit delay, duration, level, frequency, and address type.

Wink delay and duration — switch wink timing parameters need adjustment.

Incorrect digits being sent — potential switch translation problem.

Incorrect number of digits — potential switch translation problem.

On hook during conversation — potential switch line/trunk card problem.

Incorrect digit frequency or level — potential switch line card problem.

On hook/off hook delay and duration — timing parameter between on hook and off hook may need to be adjusted.

NOTE: To measure delay, duration, level, and frequency on digits requires the Digit Analysis Option.

33. ORIGINATE AN INCOMING CALL

Signaling Option Required

- The T-BERD 224 emulates a CO switch.
- Test the PBX's ability to handle incoming calls.

Figure 33 illustrates a T-BERD 224 originating an incoming call.

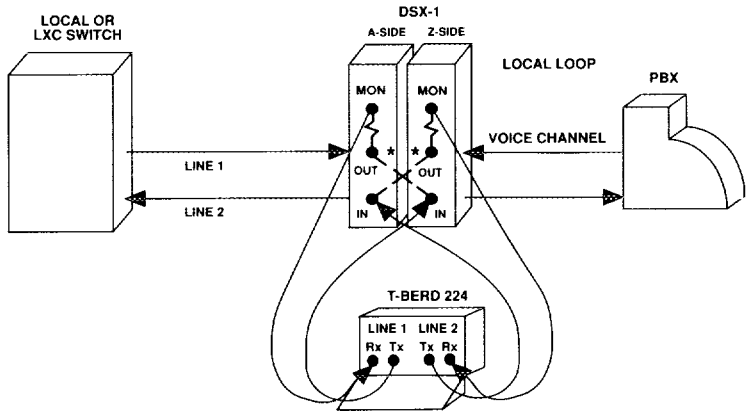


Figure 33
Originating An Incoming Call

Configuring the T-BERD 224

1. **Configure T-BERD 224 to suit the application**
   For in-service testing or replacing the PBX at the smart jack, use the *T1 Drop and Insert Test Setup*. For out-of-service testing, use the *T1 Termination Setup*. For testing at the DCS TAD, use the *DCS Test Access Di-Group (TAD) Test Setup*.

2. **CHANNEL FORMAT switch**
   Select SIGNLNG.

3. **SCI switch**
   Select DIAL SEQ.

SCII switch

Select the stored sequence (1-10) to be transmitted.

AUX switch

Press to access auxiliary functions (LED ON).

MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 24 TRK DEF using the **MODE** switch. Select the appropriate trunk type (GROUND ST, LOOP START, or STD (E&M)) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance). Select the type of circuit equipment to emulate (FXS, FXO, SLC STATION, or SLC OFFICE) using the **RESULTS I Blank** switch (no selection if STD (E&M) trunk type is selected).

AUX 24	TRUNK TYPE	EMULATE
TRK DEF	GROUND ST	FXO

MODE and SCII switches

Scroll to AUX 26 DIALSEQ using the **MODE** switch. Select the sequence number to program (SEQ 1 to SEQ 10) using the **SOURCE CONFIGURATION II** switch. Set the address using the **RESULTS I Blank** switch. Select the digit type using the **RESULTS II Blank** switch. Use the Signaling Keypad to program the sequence: ORIGinate SUPerVision (uppercase) and the digits are transmitted by the T-BERD 224 or TERMinate SUPerVision (lowercase) and the digits are received by the T-BERD 224.

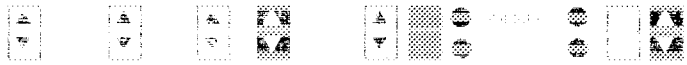
Signaling Keypad — Enter the dial sequence.

ORIG SUPV — Press OFF HOOK.

KEYPAD — Enter originating and terminating supervision events.

ENTER — Press to store sequence.

AUX 26	H R h	
DIALSEQ	SEQ 2	DTMF



5. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

6. **LINE 1 & 2 CHANNEL switches**
   Select the T1 channel (DS0) to be tested.

Performing the Test

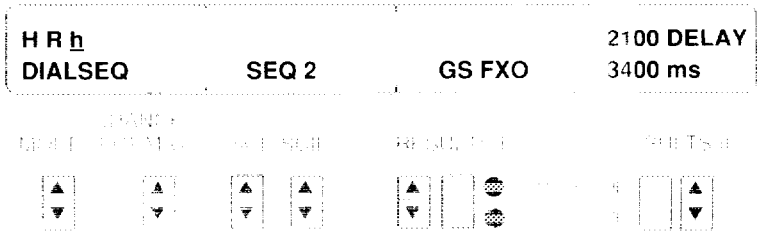
1. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side). When the channel display stops blinking, the T-BERD 224 is transmitting on the selected line.

2. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

3. **RESULTS II switches**
   Select the CHANNEL category using the **RESULTS II Blank** switch. Select n100 DELAY, n101 DUR, n102 ADDR, n104 FQ/LVL, or n105 FQ/LVL using the **RESULTS II Arrowed** switch.

4. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify DIAL SEQ appears in display. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

5. **Keypad Cursor**
   Use the right and left **ARROW** switches on the keypad to scroll through the received sequence. When the cursor is under the desired event, view the desired result using the **RESULTS II Arrowed** switch.



6. **SCI switch - optional testing**
   Select a standard VF test for optional testing.

7. **Butt set - optional**
   The T-BERD 224 provides a talk path through the 2-wire VF Interface.

8. **Signaling Keypad — Disconnect call**
   ORIG SUPV — Press ON HOOK (0) to hang up. The call is disconnected when the far end hangs up.

Analyzing Test Results

When the connection is complete, listen to other end to verify the operation of the PBX.

34. MONITOR SWITCH-TO-SWITCH

Signaling Option Required

- Monitor supervisory events and digits to ensure proper communication between switches.

Figure 34 illustrates a T-BERD 224 monitoring switch-to-switch.

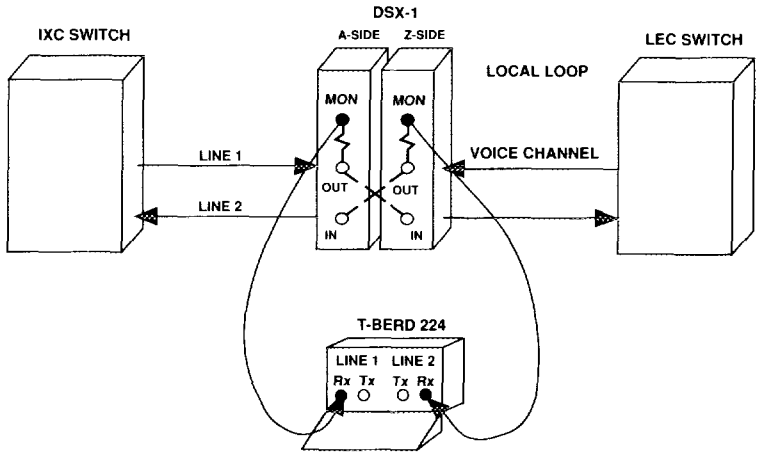


Figure 34
Monitor Switch-to-Switch

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***

2. **CHANNEL FORMAT switch**
   Select SIGNLING.

3. **SCI switch**
   Select MONITOR.

4. **LINE 1 & 2 CHANNEL switches**
   Select the T1 channel (DS0) to be monitored.

AUX switch

Press to access auxiliary functions (LED ON).

MODE and SCII switches

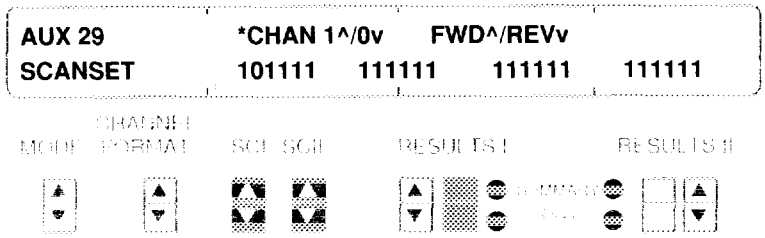
Scroll to AUX 24 TRK DEF using the **MODE** switch. Select the appropriate trunk type (GROUND ST, LOOP START, or STD (E&M)) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance). Select the type of circuit equipment to emulate (FXS, FXO, SLC STATION, or SLC OFFICE) using the **RESULTS I Blank** switch (no selection if STD (E&M) trunk type is selected).

AUX 24	TRUNK TYPE	EMULATE
TRK DEF	GROUND ST	FXO

MODE, SCI and II, and RESULTS I Blank switches

Scroll to AUX 29 SCANSET using the **MODE** switch. Select *CHAN using the **SOURCE CONFIGURATION I** switch. This allows the user to select the DS0 channels to be monitored. A one indicates the channel is available to be monitored and a zero indicates it is not. Press the **SOURCE CONFIGURATION II** up arrow to change the current bit to a 1 and down arrow to change the current bit to a 0. Press the **RESULTS I Blank** switch up arrow to move the cursor from left to right and press the **RESULTS I Blank** switch down arrow to move the cursor from right to left.

> The AUX 29 SCANSET function is only available in T-BERD 224s with Revision E or higher software.



* Indicates this is one of two possible AUX 29 SCANSET screens.

8. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

9. **SCII switch**
   If STD (E&M) is the trunk type, select AUTO to capture the call originating from either Line 1 or Line 2. If GROUND ST or LOOP START is the trunk type, set ORIGINATE to equal LINE 1 or LINE 2 depending on which side is originating the call.

10. **RESULTS II switches**
    Select the CHANNEL category using the **RESULTS II Blank** switch. Select n100 DUR using the **RESULTS II Arrowed** switch.

Performing the Test

1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

2. **Volume**
   Listen to the call to verify receipt and continuity.

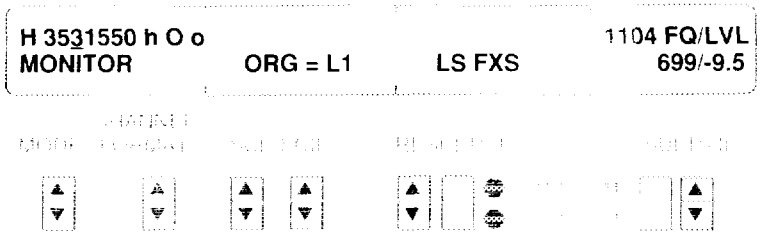
3. **Signaling Keypad**

Once a call is captured, use the right and left **CURSOR ARROW** keys to scroll through the sequence. When the cursor is under the desired event, use the **RESULTS II Arrowed** switch to view the desired results. Place the cursor under the **w** to display the wink delay and duration results. Place the cursor under a digit to display its delay, duration, level, and frequency.

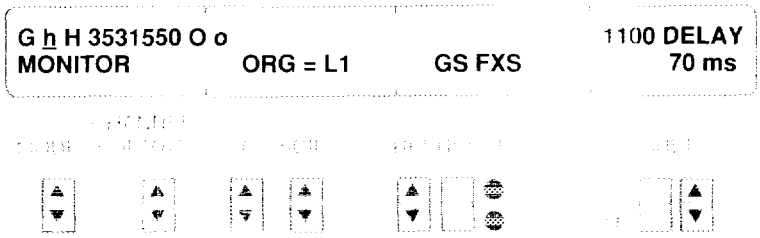
The letters in the display refer to specific characteristics of the signal depending on the mode (originate or terminate) as follows:

ORIGinate SUPerVision	TERMinate SUPerVision
G — Ground on ring	h — Off hook (ground on tip)
H — Off hook	o — On hook
O — On hook	w — Wink
R — Ring	d — Delay dial
M — Marginal digit	t — Dial tone

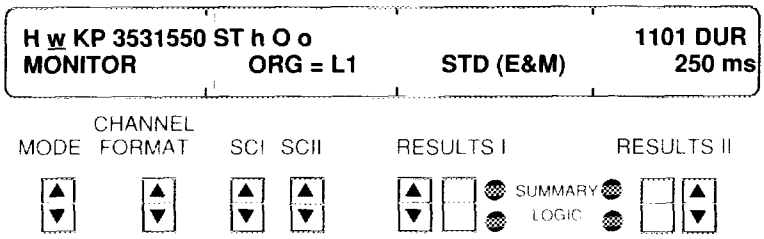
LOOP START display



GROUND ST display



STD (E&M) display



Analyzing Test Results

Wink delay and duration — switch wink timing parameters need adjustment.

Incorrect digits being sent — potential switch translation problem.

Incorrect number of digits — potential switch translation problem.

Incorrect digit frequency or level — potential switch line card problem.

On hook during conversation — potential switch line/trunk card problem.

NOTE: Measuring delay, duration, level, and frequency on digits requires the Digit Analysis Option.

35. SCAN T1 FOR ACTIVE CHANNELS

Signaling Option Required

- Scan any combination of the 24 channels for channel seizure.
- Monitor call detail on seized channel.

Figure 35 illustrates a T-BERD 224 scanning the T1 for active channels.

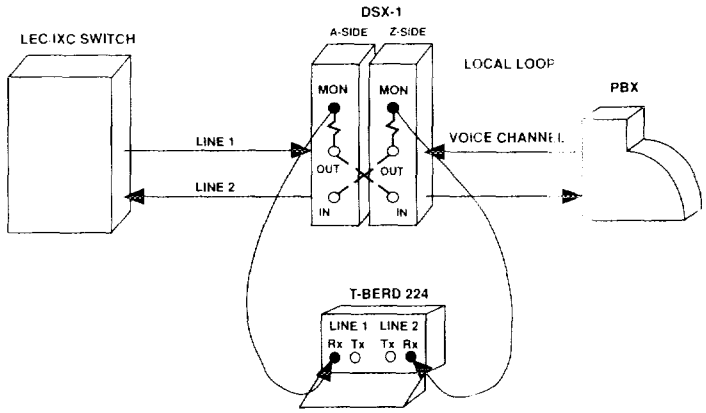


Figure 35
[illegible] T1

Configuring the T-BERD 224

1. **Configure T-BERD 224 according to the *T1 Monitor Test Setup***
2. **CHANNEL FORMAT switch**
   Select SIGNLNG.
3. **SCI switch**
   Select SCAN.
4. **LINE 1 & 2 CHANNEL displays**
   When channel is seized the channel number will display.

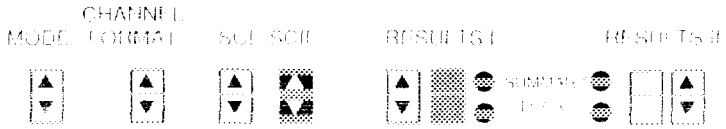
5. **AUX switch**

   Press to access auxiliary functions (LED ON).

6. **MODE and SCII switches**

   Scroll to AUX 24 TRK DEF using the **MODE** switch. Select the appropriate trunk type (GROUND ST, LOOP START, or STD (E&M)) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance). Select the type of circuit equipment to emulate (FXS, FXO, SLC STATION, or SLC OFFICE) using the **RESULTS I Blank** switch (no selection if STD (E&M) trunk type is selected).

AUX 24	TRUNK TYPE
TRK DEF	STD (E&M)



7. **MODE, SCI and II, and RESULTS I Blank switches**

   Scroll to AUX 29 SCANSET using the **MODE** switch. Select *CHAN using the **SOURCE CONFIGURATION I** switch. This allows the user to select the DS0 channels to be scanned. A one indicates the channel is available to be scanned and a zero indicates it is not. Press the **SOURCE CONFIGURATION II** up arrow to change the current bit to a 1 and down arrow to change the current bit to a 0. Press the **RESULTS I Blank** switch up arrow to move the cursor from left to right and press the RESULTS I Blank switch down arrow to move the cursor from right to left.

   NOTE: The AUX 29 SCANSET function is only available in T-BERD 224s with Revision E or higher software.

SIGNALING TESTING

APPLICATIONS

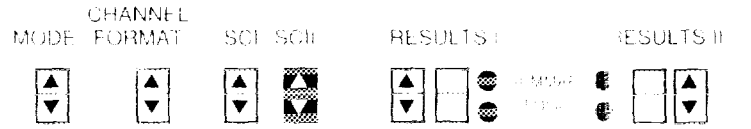
5. **AUX switch**

   Press to access auxiliary functions (LED ON).

6. **MODE and SCII switches**

   Scroll to AUX 24 TRK DEF using the **MODE** switch. Select STD (E&M) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance).

AUX 24	**TRUNK TYPE**
TRK DEF	**STD (E&M)**



7. **MODE, SCII, and RESULTS II Blank switches**

   Scroll to AUX 26 DIALSEQ using the **MODE** switch. Select the sequence number to program (SEQ 1 to SEQ 10) using the **SOURCE CONFIGURATION II** switch. Set the address using the **RESULTS I Blank** switch. Select the digit type using the **RESULTS II Blank** switch. Use the Signaling Keypad to program the sequence: ORIGinate SUPerVision (uppercase) and the digits are transmitted by the T-BERD 224 or TERMinate SUPerVision (lowercase) and the digits are received by the T-BERD 224.

   Signaling Keypad — Enter the dial sequence.

   ORIG SUPV — Press OFF HOOK.

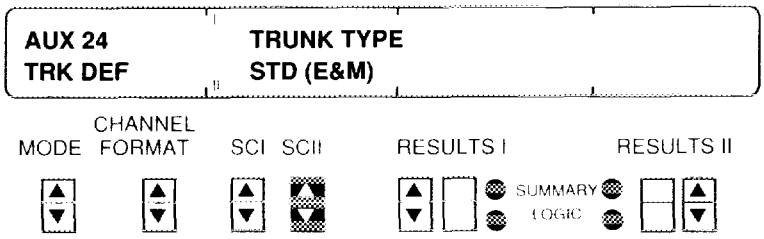
   TERM SUPV — Press wink.

   KEYPAD — Enter number to be dialed (typically dial pulse).

   ENTER — Press to store sequence.

5. **AUX switch**
   Press to access auxiliary functions (LED ON).

6. **MODE and SCII switches**
   Scroll to AUX 24 TRK DEF using the **MODE** switch. Select STD (E&M) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance).



7. **MODE, SCII, and RESULTS II Blank switches**
   Scroll to AUX 26 DIALSEQ using the **MODE** switch. Select the sequence number to program (SEQ 1 to SEQ 10) using the **SOURCE CONFIGURATION II** switch. Set the address using the **RESULTS I Blank** switch. Select the digit type using the **RESULTS II Blank** switch. Use the Signaling Keypad to program the sequence: ORIGinate SUPerVision (uppercase) and the digits are transmitted by the T-BERD 224 or TERMinate SUPerVision (lowercase) and the digits are received by the T-BERD 224.

   Signaling Keypad — Enter the dial sequence.
   ORIG SUPV — Press OFF HOOK.
   TERM SUPV — Press wink.
   KEYPAD — Enter number to be dialed (typically dial pulse).
   ENTER — Press to store sequence.

36. SWITCHED 56 TESTING

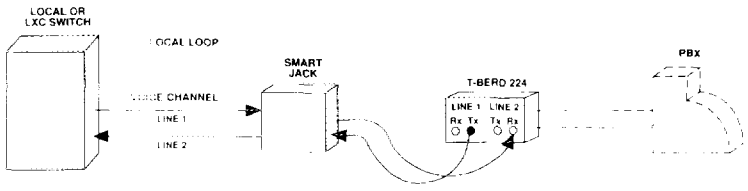
Signaling and DDS Options Required

Emulate customer premise equipment.

Test ability of a switch to receive a data call.

Test the ability of a switch to establish a data line through a public switching network.

Figure 36 illustrates a T-BERD 224 testing a Switched 56 system.



Configuring the T-BERD 224

Configure T-BERD 224 to suit the application

For in-service testing, use the *T1 Drop and Insert Test Setup*. For out-of-service testing, use the *T1 Termination Setup*. For testing at the DCS TAD, use the *DCS Test Access Di-Group (TAD) Test Setup*.

CHANNEL FORMAT switch

Select SWI 56.

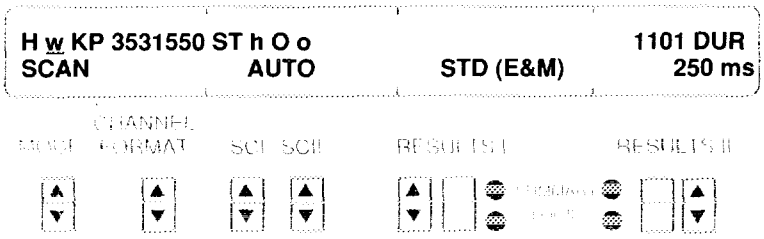
SCI switch

Select DIALSEQ.

SCIi switch

Select the stored sequence (1 to 10) to be transmitted.

STD (E&M) display



4. RESTART switch

Press the **RESTART** switch to clear alarms and recommence scanning channels for activity.

NOTE: When both lines go ON HOOK or after a user selected timeout, the T-BERD 224 resumes scanning the T1 for channel seizure. To resume the SCAN before the user selected timeout is up press the **RESTART** switch.

Analyzing Test Results

Wink delay and duration — switch wink timing parameters need adjustment.

Incorrect digits being sent — potential switch translation problem.

Incorrect number of digits — potential switch translation problem.

On hook during conversation — potential switch line/trunk card problem.

Incorrect digit frequency or level—potential switch line card problem.

NOTE: Measuring delay, duration, level, and frequency on digits requires the Digit Analysis Option.

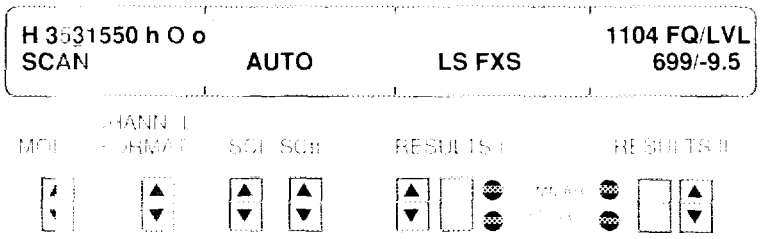
3. **Signaling Keypad**

Once a call is captured, use the right and left **CURSOR ARROW** keys to scroll through the sequence. When the cursor is under the desired event, use the **RESULTS II Arrowed** switch to view the desired results. Place the cursor under the **w** to display the wink delay and duration results. Place the cursor under a digit to display its delay, duration, level, and frequency.

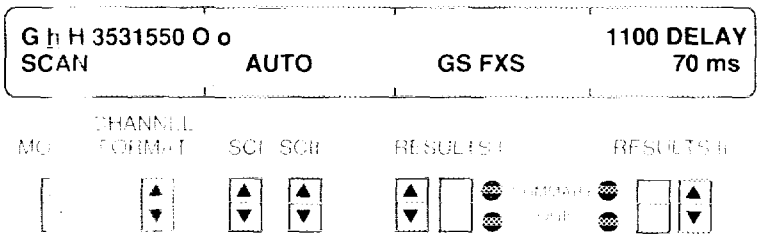
The letters in the display refer to specific characteristics of the signal depending on the mode (originate or terminate) as follows:

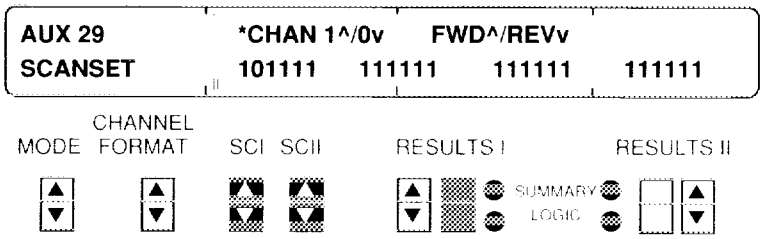
ORIGinate SUPerVision	TERMinate SUPerVision
G — Ground on ring	h — Off hook (ground on tip)
H — Off hook	o — On hook
O — On hook	w — Wink
R — Ring	d — Delay dial
M — Marginal digit	t — Dial tone

LOOP START display



GROUND ST display





* Indicates this is one of two possible AUX 29 SCANSET screens.

8. **AUX switch**
   Press to exit auxiliary functions (LED OFF).

9. **SCII switch**
   If STD (E&M) is the trunk type, select AUTO to capture the call originating from either Line 1 or Line 2. If GROUND ST or LOOP START is the trunk type, set ORIGINATE to equal LINE 1 or LINE 2 depending on which side is originating the call.

10. **RESULTS II switches**
    Select the CHANNEL category using the **RESULTS II Blank** switch. Select n100 DUR using the **RESULTS II Arrowed** switch.

Performing the Test

1. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. Verify the Signal and Frame Sync LEDs are illuminated, and *RESULTS OK* is displayed as long as no errors are detected.

2. **Volume**
   Listen to the call to verify receipt and continuity.

AUX switch

Press to access auxiliary functions (LED ON).

MODE and SCII switches

Scroll to AUX 24 TRK DEF using the **MODE** switch. Select the appropriate trunk type (GROUND ST, LOOP START, or STD (E&M)) using the **SOURCE CONFIGURATION II** switch (see WORD document or Circuit Description for assistance). Select the type of circuit equipment to emulate (FXS, FXO, SLC STATION, or SLC OFFICE) using the **RESULTS I Blank** switch (no selection if STD (E&M) trunk type is selected).

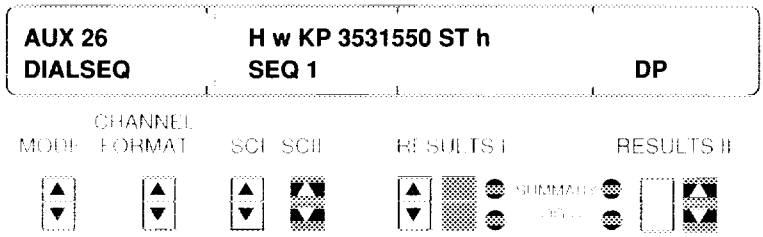
AUX 24	TRUNK TYPE
TRK DEF	STD (E&M)

MODE, SCI and II, and RESULTS I Blank switches

Scroll to AUX 29 SCANSET using the **MODE** switch. Select *CHAN using the **SOURCE CONFIGURATION I** switch. This allows the user to select the DS0 channels to be scanned. A one indicates the channel is available to be scanned and a zero indicates it is not. Press the **SOURCE CONFIGURATION II** up arrow to change the current bit to a 1 and down arrow to change the current bit to a 0. Press the **RESULTS I Blank** switch up arrow to move the cursor from left to right and press the RESULTS I Blank switch down arrow to move the cursor from right to left.

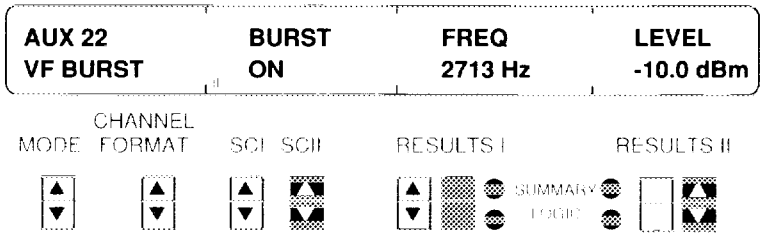
> The AUX 29 SCANSET function is only available in T-BERD 224s with Revision E or higher software.

STD (E&M) display



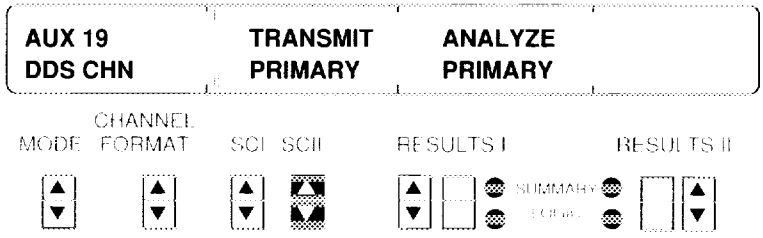
8. **MODE and SCII switches**

If echo cancellors are present, scroll to AUX 22 VF BURST using the **MODE** switch. Select ON for BURST using the **SOURCE CONFIGURATION II** switch. Select the FREQuency (usually 2713 Hz) and LEVEL using the **RESULTS I Blank** and **RESULTS II Arrowed** switches, respectively.



9. **MODE and SCII switches**

Scroll to AUX 19 DDS CHN using the **MODE** switch. Select PRIMARY for TRANSMIT using the **SOURCE CONFIGURATION II** switch. The ANALYZE selection defaults to match the TRANSMIT selection.



MODE, SCII, and RESULTS I Blank switches

Scroll to AUX 17 LOOP CD using the **MODE** switch. Select the appropriate loop code TYPE using the **SOURCE CONFIGURATION II** switch (DDS-LATching or DDS-ALTernating). Select V.54 for EQUIPment using the **RESULTS I Blank** switch, because this code will loop up most CSUs without dropping the call.

AUX 17	TYPE	EQUIP
LOOP CD	DDS-LAT	V.54

AUX switch

Press to exit auxiliary functions (LED OFF)

SCI switch

Select a BERT pattern (see the T-BERD Reference Manual).

RESULTS I switches

Select the LOGIC category using the **RESULTS I Blank** switch. Select n00BIT ERR using the **RESULTS I Arrowed** switch.

RESULTS II Blank switch

Select the SUMMARY category using the **RESULTS II Blank** switch.

LINE 1 & 2 CHANNEL switches

Select the T1 channel (DS0) being tested.

Performing the Test

1. **INSERT (TX) switch**
   Select the T1 line to insert on (LINE 1 towards the Z-side or LINE 2 towards the A-side).

2. **DROP (RX) switch**
   Select the T1 line to receive the channel to be analyzed (usually opposite the insert line).

3. **LOOP UP switch**
   Press the **LOOP UP** switch (LED ON) to send the selected loop-up code. The switch LED remains illuminated until the loop code is received by the T-BERD 224. If loopup is established, either *LAT LOOP COMPLETE/CONFIRMED* (DDS-LAT loop code TYPE) or *DDS-ALT LOOP UP COMPLETE* (DDS-ALT loop code TYPE) flashes in the display.

4. **Local Status LEDs**
   Verify the green Signal, Pattern, and Frame Sync (if applicable) LEDs are illuminated. This indicates the stress pattern selected in the SOURCE CONFIGURATION is being received by the T-BERD 224.

5. **LOGIC ERROR INSERT switch**
   Verify the loop by sending yourself bit errors with the **LOGIC ERROR INSERT** switch. The bit errors should register in the n00-BIT ERR result.

6. **RESTART switch**
   Press the **RESTART** switch to clear alarms and begin the test. *RESULTS OK* is displayed as long as no errors are detected.

7. **LOOP DOWN switch**
   When the test is completed, press the **LOOP DOWN** switch to release the loopback. The switch LED remains illuminated until the loop down is accomplished. If loop down is successful, either *LAT LOOP DOWN COMPLETE* (DDS-LAT loop code TYPE) or *ALT LOOP DOWN COMPLETE* (DDS-ALT loop code TYPE) flashes in the display. Disconnect the T-BERD 224 from span.

Disconnect call — Signaling Keypad Lid
ORIG SUPV — Press ON HOOK.

Analyzing The Results

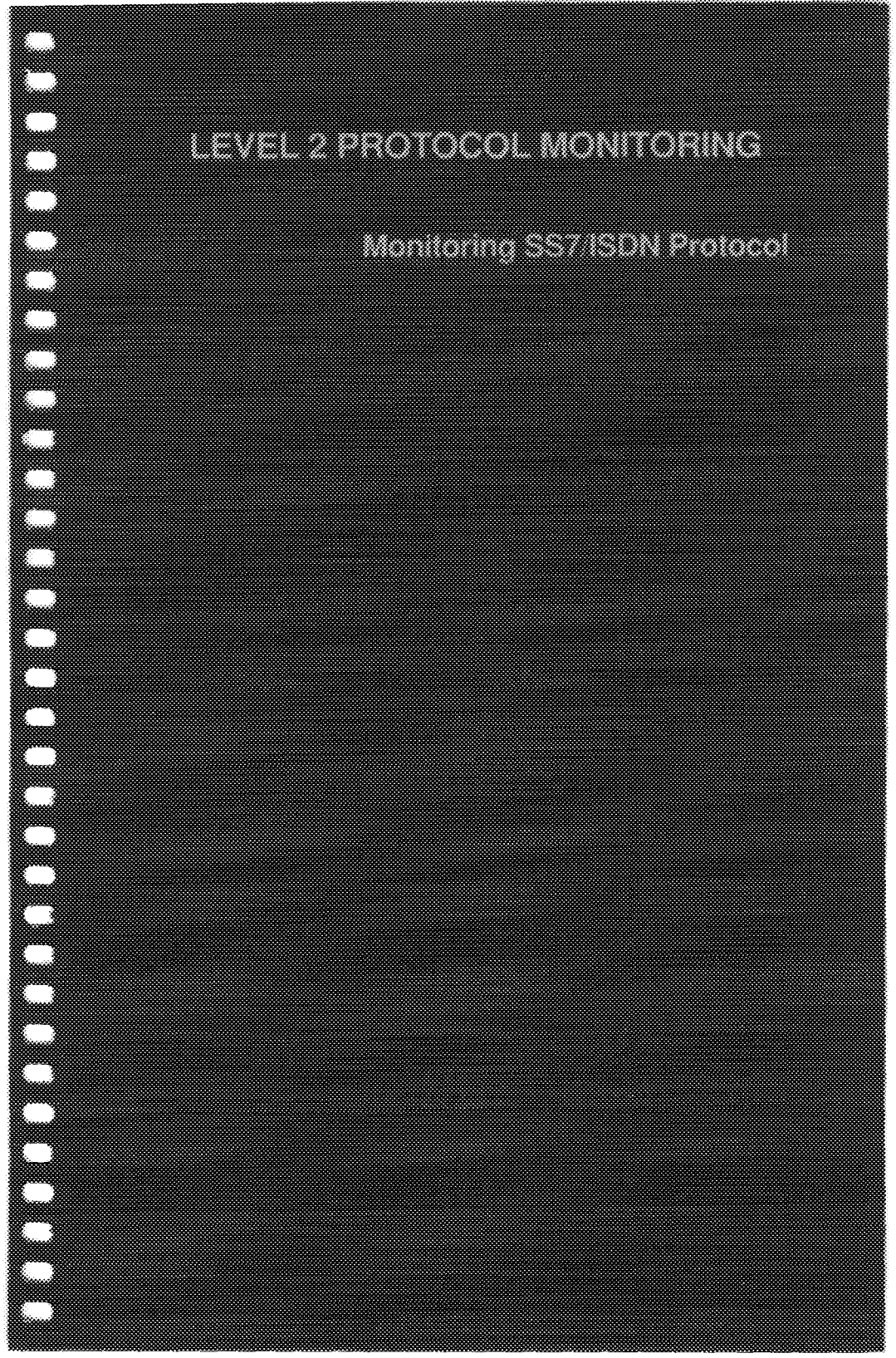
FRM ERR, CRC ERR, BPVs
Local T1 span problem. Possible faulty repeater, span line noise, cross talk, poor cabling, or defective DSX jacks. Electrical noise generated near the metallic span can also contribute to errors received at the test set.

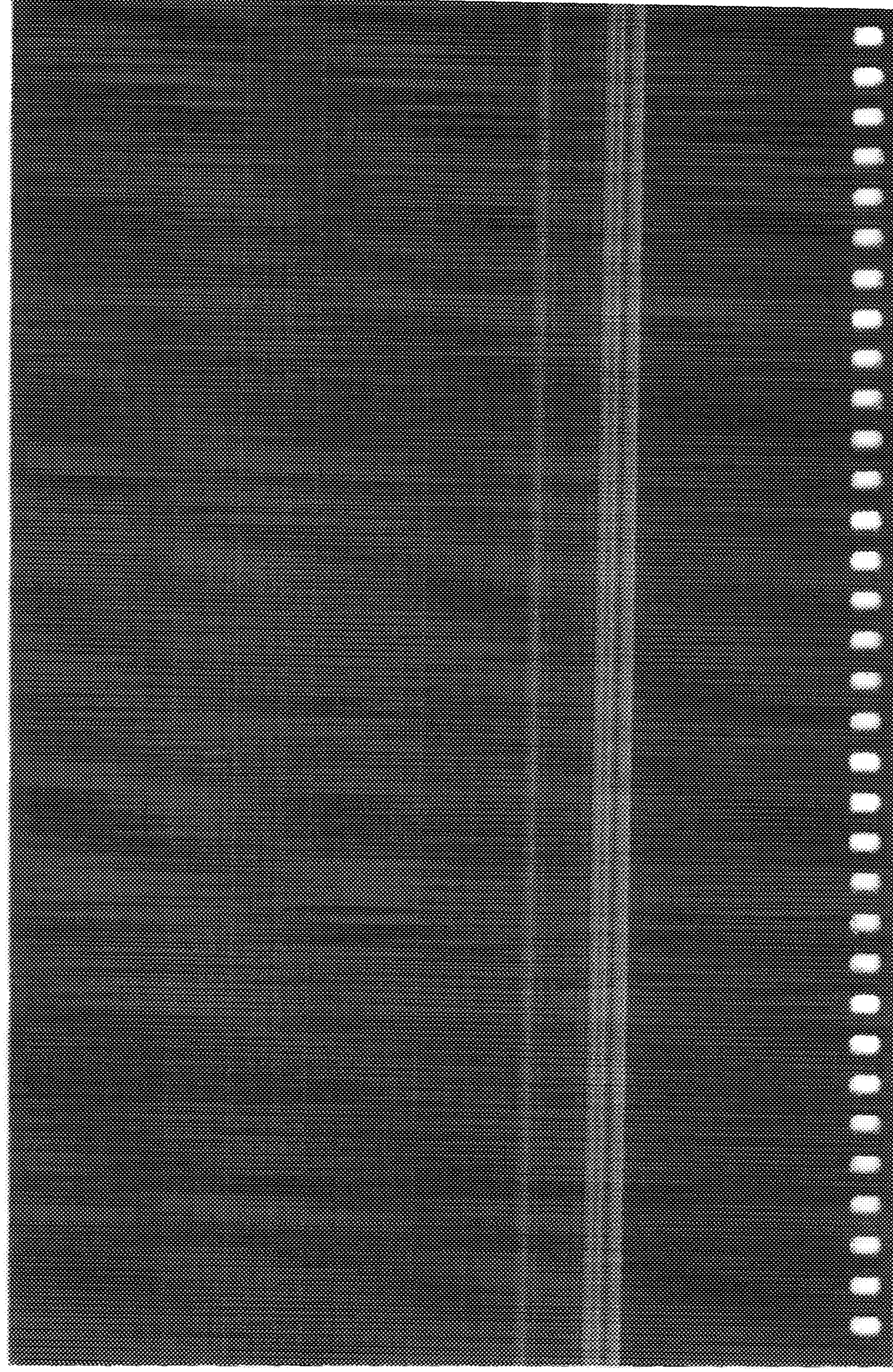
BPVs and BIT ERR
Check the last repeatered span before your present location. BPVs are present only on metallic loops and are removed before the data is retransmitted by practically every piece of transmission equipment except repeaters.

BIT ERR only
Check the local loop or one of the channel cards in the network. Sectionalize the network by establishing loopbacks at different locations. Ex: OCU, DDS-Data Port.

FRM ERR, CRC ERR, No BPVs
Typically a far-end span line problem. BPVs are corrected by most transmission equipment. Sectionalize the facility further.

Loopback is not established
The CSU is not operating correctly or the line from you to the CSU is bad.


LEVEL 2 PROTOCOL MONITORING
Monitoring SS7/ISDN Protocol

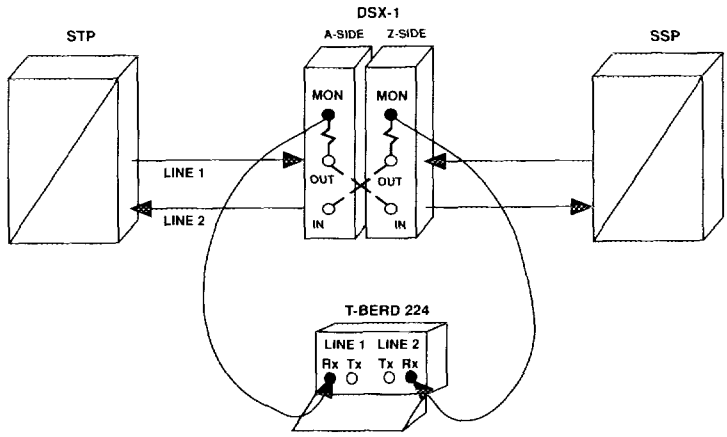


37. MONITORING SS7/ISDN PROTOCOL

Level 2 Protocol Monitor Option Required

- Non-intrusively monitor SS7 or Primary Rate ISDN (PRI ISDN) links to isolate transmission and switch problems.
- Non-intrusively sectionalize SS7 or PRI ISDN links.

Figure 37 illustrates a T-BERD 224 monitoring an SS7 or PRI ISDN facility from a DSX-1.



1. **T1 circuit connections** — ***See Monitor Test Setup***

2. **CHANNEL FORMAT switch**
   Select PROTOCL.

3. **SCI switch**
   Select SS7 MON or ISDN MON.

4. **RESULTS I switches**
   Select the CHANNEL category using the **RESULTS I Blank** switch. Select 1 PACKETS (Line 1) result using the **RESULTS I Arrowed** switch.

5. **RESULTS II switches**
   Select the CHANNEL category using the **RESULTS II Blank** switch. Select 2 PACKETS (Line 2) result using the **RESULTS II Arrowed** switch.

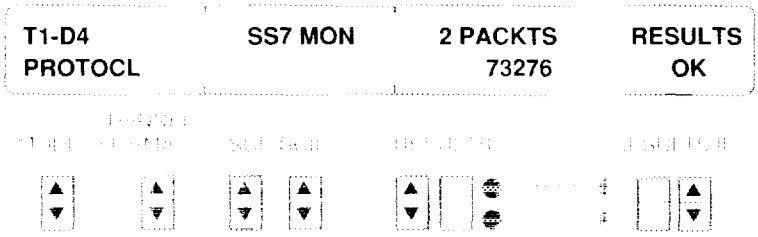
Performing the Test

1. **Local Status LEDs**
   Verify the green Signal and Frame Sync LEDs are illuminated.

2. **LINE 1 & 2 CHANNEL switches**
   Slowly scroll through the channels. When you observe that packets are being counted, you have found an active SS7/ISDN link.

3. **RESULTS I Arrowed switch**
   Scroll through the SS7/ISDN results, including packet counts, errored packets, discarded packets, and packet error rate using the **RESULTS I Arrowed** switch. Refer to *Analyzing Test Results*.

4. **RESULTS II Arrowed switch**
   The RESULTS II display should show the message *RESULTS OK*. The SUMMARY category displays any SS7/ISDN performance problems and alarms.



Analyzing Test Results

The following alarm messages may appear in the SUMMARY category when monitoring SS7 protocol.

n BUSY STATUS	Busy Status Alarm
n EMRGNCY ALIGN STAT	Emergency Alignment Status Alarm
n NORMAL ALIGN STAT	Normal Alignment Status Alarm
n OUT OF ALIGNMENT	Out of Alignment Alarm
n OUT OF SERVICE	Out of Service Alarm
n PROCESR OUTAGE	Processor Outage Alarm

The following SS7 test results provide counts of the key components on an SS7 facility.

n PACKETS — Packets
Signal units counted on the link since the start of the test.

n MSUs — Message Signal Units
Signaling units that contain messaging information (e.g., call setup).

n FISUs — Fill-In Signal Units
Signaling units that keep the signal alive when no other information is being transmitted.

n LSSUs — Link Status Signal Units
Signaling units that indicate the health of the signaling link.

n ER PKCRC — CRC Errored Packets
Number of signaling units with a bad FCS (Frame Check Sequence). The T-BERD 224 calculates the FCS and identifies errors within SS7 packets.

n PKT ES — Packet CRC Errored Seconds
Number of seconds that include errored packets; helps determine error type (constant or intermittent).

n DISC PKTs — Discarded Packets

Number of signaling units that leave the switch bad (too long, too short, not a multiple of 8 bits, or include more than 6 consecutive 1s).

n PKT ERT — Packet CRC Error Rate

Number of errored packets divided by the total number of packets.

n NACKs — Negative Acknowledgments

Number of negative acknowledgments that are transmitted to the far end when transmission errors or bad packets are received.

n ER MSU — Errored Message Signal Unit

Number of message signaling units with a bad FCS.

n %UTIL — MSU to total packet relationship (Percent utilization)

Number of MSUs divided by the total number of packets.

n LSSU Messages — Link Status Signal Unit Messages

Monitors SS7 link status. Messages (e.g., busy, processor outage, out of service, etc.) appear in the SUMMARY category.

The following PRI ISDN test results provide counts of the key components of an ISDN facility.

n PACKETS — Packets

n ER PKCRC — CRC Errored Packets

n PKT ES — Packet CRC Errored Seconds

n DISC PKTs — Discarded Packets

n PKT ERT — Packet CRC Error Rate

Refer to Application 5, *T1 Performance Monitoring* to determine the status of the T1 signal.

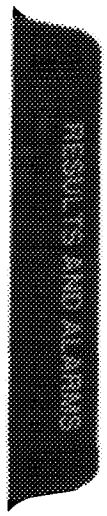
The following additional information is useful for sectionalizing the SS7/ISDN link:

Switch Problems

- Discarded Packets without Errored Packet CRCs — Use a protocol analyzer to investigate the situation at the switch.
- LSSUs — Usually indicate a major SS7 problem that should be investigated at the switch.

Link Problems

- Errored Packet CRCs — Indicate a problem upstream on the transmission line. Sectionalize the link.



Results are numbered using an nXX format where n = the line number (1 for LINE 1 and 2 for LINE 2) and XX = the result number.

SUMMARY Category

n00BIT ERR

Bit Errors — A count of received bits that have a value opposite that of the corresponding transmitted bits after pattern synchronization is achieved.

n09PAT SLP

Pattern Slips — A count of the total number of pattern slips detected since the beginning of the test. The result is only valid when using pseudorandom test patterns. A pattern slip is a difference (one or more bits are missing or added) between the transmitted and received test pattern.

n17F FR ES

Far-End Frame Error Seconds — A count of seconds in which one or more frame errors were received at the far end. This result reads the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

n18F F SES

Far-End Severely Errored Framing Seconds — A count of seconds in which two or more frame errors were received in less than 3 ms at the far end. This result reads the PRM Severely-Errored Framing Event Bit (SE = 1) status.

n19F BPV S

Far-End BPV Seconds — A count of seconds in which one or more BPVs were received at the far end. This result reads the PRM Line-Code Violation Event Bit (LV = 1) status.

n20F SLP S

Far-End Controlled Slip Seconds — A count of seconds in which controlled slips were received at the far end. This result reads the PRM Controlled-Slip Event Bit (SL = 1) status.

n22F CRC E

Far-End CRC Errored Events — A count of the minimum number of CRC errors reported in the n FSI CRC to n FSV CRC results in the BPV & FRAME category. This result reports on the accumulated PRM CRC Error Event Bit (G1 to G6) results. A ">" (greater than) preceding the count indicates that Bins 2 through 6 are non-zero.

n25 BPVS

Bipolar Violations — A count of BPVs since the last test restart (excluding intentional violations found within B8ZS codes).

n30FRM ERR

Frame Errors — A count of frame errors detected since initial frame sync or the last test restart. For D1D, D2, and D4 (Superframe) frame errors are counted if either an F_t or F_s frame bit is errored. For SLC-96 framing, frame errors are counted if F_t bits are errored. For ESF and ESFz framing, frame errors are counted only if an error is found on the FPS bits. Frame errors are not detected on CRC or datalink bits.

n32CRC ERR

CRC Errors — A count of CRC errors detected since initial frame sync or the last test restart. CRC errors are counted only when ESF or ESFz framing is detected.

n34FRM LOS

Frame Losses — A count of discrete losses of frame synchronization since initial frame sync or the last test restart.

n40RX FREQ

Receive Frequency — The frequency of the T1 clock recovered from the received data.

n51TM SLIP

Timing Slips — The frequency deviation of uncontrolled clock slips between two input signals measured in positive or negative shifts in bit and frame positions.

n96DDS F E

DDS Frame Errors — A count of the DS0B frame errors detected since the last test restart. Subrate DS0B frame synchronization must be established to display the result.

Messages

POWER LOSS — This message is displayed at power-up if the power has been turned off or when power to the unit has been interrupted. This message is cleared when power has been restored and a test restart is performed.

RESULTS OK — This message is visible in the Results display if the SUMMARY results have a zero value.

RESULTS UNAVAIL — This message is displayed if a signal has not been detected.

FAILED PATTERN — Indicates the failed test pattern(s) when performing a BRIDGTAP or MULTIPAT® test.

NOT B8ZS COMPATIBLE — The received signal is not B8ZS compatible, occurs when transmitting B8ZS encoded ALL ZEROS over a circuit containing equipment not optioned for B8ZS coding.

n 1's DENS VIOLATED — The T1 signal violated the ones density criteria, there must be at least n ones in 8(n+1) bits.

n FE LOOP PROTECTION

SLC Protection Line Far-End Loop Alarm — Indicates the protection line is in loopback.

n DATALINK SYNC LOSS

Datalink Syncronization Loss — Datalink synchronization is lost on the indicated line.

n FE LOOP SHELF (x)

SLC Shelf Far-End Loop Alarm — Indicates which DS1 shelf is in loopback. (x) indicates the looped shelf (A, B, C, or D).

n MAINT HOOK/SEIZE

SLC On-Hook/Seize RC Maintenance Message — This message appears when either the *On-hook* or *Seize RC* message is received.

n MAINT PROCEED

SLC Proceed CR (RC) Maintenance Message — Receiving the message from the COT, the COT is asking to proceed. Receiving the message from the RT, the RT is ready to continue.

n MAINT TEST ALRM

SLC Test Alarm CR (RC) Maintenance Message — Either the COT or the RT has failed the bypass procedure.

n SLC ALM (x) ON PROT

SLC Shelf on Protection Line Alarm — A DS1 shelf is switched over to the protection line. (x) indicates which shelf (A, B, C, or D) is switched.

n SLC ALM MAJOR

SLC Major Alarm — A condition characterized by a loss of service to subscribers served by a shelf or shelf group. If a shelf alarm (Ln SLC ALM SHELF (x)) is also reported, this result is not displayed.

n SLC ALM MINOR

SLC Minor Alarm — A condition characterized by a non-service affecting fault. If a far-end loop alarm message for a shelf is reported for the same line (L1 or L2), this message is not displayed.

n SLC ALM POWER/MISC

SLC Power/Miscellaneous Alarm — The RT is losing power or experiencing miscellaneous conditions.

n SLC ALM SHELF (x)

SLC Shelf Alarm — A condition characterized by a shelf's loss of operational integrity. (x) indicates the shelf (A, B, C, or D) generating the shelf alarm.

SW PROT FAILED

Switch to Protection Line Failed — During either a far end loopback or a switch to protection line sequence the switch to protection line operation failed.

Ln BUSY STATUS

Busy Status Alarm — Receiving end of the signaling link has detected traffic congestion and is sending a message to the opposite end.

Ln EMRGNCY ALIGN STAT

Emergency Alignment Status Alarm — Signaling link is being realigned with the emergency alignment procedure.

Ln NORMAL ALIGN STAT

Normal Alignment Status Alarm—Signaling link is being realigned with the normal alignment procedure.

Ln OUT OF ALIGNMENT

Out of Alignment Alarm — Signaling link is not aligned.

Ln OUT OF SERVICE

Out of Service Alarm—Signaling link terminal is out of service. The message is transmitted when the terminal cannot transmit or receive MSUs. This message does not apply during a processor outage.

Ln PROCESR OUTAGE

Processor Outage Alarm — Local processor outage or failure has occurred at the switch sending the message.

LOGIC Category

n00BIT ERR

Bit Errors— A count of received bits that have a value opposite that of the corresponding transmitted bits after pattern synchronization is achieved.

n01ASYN ES

Asynchronous Errored Seconds — A count of test seconds where one or more bit errors occurred.

n04 BER

Bit Error Rate — The ratio of bit errors to the total number of bits.

n05 EFS

Error-Free Seconds— A count of test seconds where no bit errors occurred and pattern synchronization was maintained through the entire second.

n06 % EFS

Percent Error-Free Seconds— The ratio, expressed as a percentage, of error-free seconds to the number of seconds with pattern synchronization.

n07 SYN ES

Synchronous Errored Seconds — A count of errored seconds synchronized to the occurrence of an error (the count and time begin with the occurrence of an error).

n08OOS SEC

Out-of-Synchronization Seconds — A count of seconds during which pattern synchronization was not maintained for the entire second.

n09PAT SLP

Pattern Slips — A count of pattern slips detected since the beginning of the test. The result is only valid when using pseudorandom test patterns. A pattern slip is the difference (one or more bits are missing or added) between the transmitted and received test pattern.

n10 SES

Severely Errored Seconds — A count of available seconds during which the bit error ratio was greater than 10^{-3}.

n11 % SES

Percent Severely Errored Seconds — The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.

n12 DEG MN

Degraded Minutes — A count of minutes during which the bit error ratio exceeded 10^{-6}.

n13 %DEGMN

Percent Degraded Minutes — The ratio, expressed as a percentage, of degraded minutes to the number of available minutes.

n14 UNAV S

Unavailable Seconds — A count of unavailable time as defined in CCITT G.821.

n15 %AVLBL

Percent Availability — The ratio, expressed as a percentage, of available seconds to the number of test seconds.

n16 CSES

Consecutive Severely Errored Seconds — A count of the groups of three or more contiguous seconds with an error rate greater than 10^{-3} in each second.

BPV & FRAME Category

n17F FR ES

Far-End Frame Error Seconds — A count of seconds in which one or more frame errors were received at the far end. This result reads the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

n18F F SES

Far-End Severely Errored Framing Seconds — A count of seconds in which two or more frame errors were received in less than 3 ms at the far end. This result reads the PRM Severely-Errored Framing Event Bit (SE = 1) status.

n19F BPV S

Far-End BPV Seconds — A count of seconds in which one or more BPVs were received at the far end. This result reads the PRM Line-Code Violation Event Bit (LV = 1) status.

n20F SLP S

Far-End Controlled Slip Seconds — A count of seconds in which controlled slips were received at the far end. This result reads the PRM Controlled-Slip Event Bit (SL = 1) status. In addition, the T-BERD 224 transmits the PRM with the Controlled-Slip Event Bit (SL) set to 0.

n21PRM TIM

Received Performance Report Time — A count of seconds since the last test restart in which a valid PRM was received.

n22F CRC E

Far-End CRC Errored Events — A count of the minimum number of CRC errors reported in the n F SI CRC to n F SV CRC results in the BPV & FRAME category. This result reports on the accumulated PRM CRC Error Event Bit (G1 to G6) results. A ">" (greater than) preceding the count indicates that Bins 2 through 6 are non-zero.

n F SI CRC

Far-End Single CRC Errored Seconds — A count of seconds with only 1 CRC error received at the far end. This result reports on the first PRM CRC Error Event Bit (G1 = 1).

n F LO CRC

Far-End Low CRC Errored Seconds — A count of seconds with 2 to 5 CRC errors reported in the signal received at the far end. This result reports on the second PRM CRC Error Event Bit (G2 = 1).

n F MD CRC

Far-End Medium CRC Errored Seconds — A count of seconds with 6 to 10 CRC errors reported in the signal received at the far end. This result reports on the third PRM CRC Error Event Bit (G3 = 1).

n F MH CRC

Far-End Medium High CRC Errored Seconds — A count of seconds with 10 to 100 CRC errors reported in the signal received at the far end. This result reports on the fourth PRM CRC Error Event Bit (G4 = 1).

n F HI CRC

Far-End High CRC Errored Seconds — A count of seconds with 101 to 319 CRC errors reported in the signal received at the far end. This result reports on the fifth PRM CRC Error Event Bit (G5 = 1).

n F SV CRC

Far-End Severe CRC Errored Seconds — A count of seconds with 320 to 333 CRC errors reported in the signal received at the far end. This result reports on the sixth PRM CRC Error Event Bit (G6 = 1).

n23PAY SRC

Far-End Payload Source/Loopback — Identifies the direction of the PRM according to the PRM Command/Response Bit (C/R) and the Payload Loopback Activated Bit (LB). In end-to-end applications, a customer generated PRM is indicated as CUST (C/R = 0 and LB = 0) and a carrier generated PRM is indicated as CARR (C/R = 1 and LB = 0) in the display. In payload loopback applications, the customer generated PRM is indicated as CUST LOOP (C/R = 0 and LB = 1) in the display. In customer loopback, the carrier generated PRM is indicated as CARR LOOP (C/R = 1 and LB = 1) in the display.

n25 BPVS

Bipolar Violations — A count of BPVs since the last test restart (excluding intentional violations found within B8ZS codes).

n26BPV SEC

Bipolar Violation Seconds — A count of seconds within which one or more BPVs occurred since the last test restart.

n27 BPV RT

Bipolar Violation Rate — The ratio of BPVs to total bits.

n28 FRM ES

Frame Errored Seconds — A count of seconds during which one or more frame errors occurred since the last test restart.

n29FRM SES

Frame Severely Errored Seconds — A count of seconds during which 12 or more frame errors occurred (D4 framing only).

n30FRM ERR

Frame Errors — A count of frame errors detected since initial frame sync. For D1D, D2, and D4 (Superframe) frame errors are counted if either an F_t or F_s frame bit is errored. For SLC-96 framing, frame errors are counted if F_t bits are errored. For ESF and ESFz framing, frame errors are counted only if an error is found on the frame bits. Frame errors are not detected on CRC or datalink bits.

n31FRM ERT

Frame Error Rate — The ratio of frame errors to the number of analyzed framing bits. See frame errors (FRM ERR) above.

n32CRC ERR

CRC Errors — A count of CRC errors detected since initial frame sync or the last test restart. CRC errors are counted only when ESF framing is detected.

n33 CRC ES

CRC Errored Seconds — A count of seconds within which one or more CRC errors were detected.

n34FRM LOS

Frame Losses — A count of discrete losses of frame synchronization since initial frame sync or the last test restart.

n35FR LS S

Frame Loss Seconds — A count of seconds within which frame synchronization was lost or not achieved since initial frame sync or the last test restart. This includes seconds when a signal loss also causes a frame synchronization loss.

n36CRC SES

CRC Severely Errored Seconds — A count of seconds during which the total number of CRC errors and frame synchronization losses equaled 320 or more.

n37CRC ERT

CRC Error Rate— The ratio of CRC errors to the number of extended superframes (ESFs) received.

SIGNAL Category

n40RX FREQ

Receive Frequency– The frequency of the clock recovered from the received data.

n41 RX LVL

Receive Level (in dBdsx) — The level of the received signal in dB, relative to a standard 3-volt base-to-peak signal (DSX level).

n42 RX LVL

Receive Level (in dBm)— The power level of an unframed all-ones signal (available only when AIS is detected).

n43 RX LVL

Receive Level (in V p-p)— The level of the received signal in peak-to-peak volts. The signal level is displayed as volts (V) when the signal level is greater than 1 volt or as millivolts (mV) when the signal level is less than 1 volt.

n50SPX CUR

Simplex Current — The magnitude of the simplex current flowing between the LINE 1 receiver and LINE 2 transmitter, or LINE 2 receiver and LINE 1 transmitter. The line number is determined by the DROP switch setting. The result measurement range is 0 mA to 250 mA.

n51TM SLIP

Timing Slips — The frequency deviation of uncontrolled clock slips between two input signals measured in positive or negative shifts in bit and frame positions.

n52SLP SEC

Slip Analysis Seconds — The number of test seconds during which Timing Slip Analysis occurred.

n53 DELAY

Round Trip Delay — The time it takes a pseudorandom test pattern to be transmitted and received in a loopback test. Consult Section 3 of the *T-BERD 224 Reference Manual* for the appropriate test pattern. The result can measure round trip delay from 0.324 ms to 10 seconds.

55 TRAFFIC

Traffic Results — A display of the A and B signaling bits for all 24 channels of T1 on LINE 1 and LINE 2. This result uses the entire display to show the signaling bit states for each line's 24 channels in 4 fields of 6 channels each.

NOTE: The TRAFFIC result uses the entire display window. To return to the normal display, press the appropriate **RESULTS Blank** or **Arrowed** switch.

n56 TRAFFIC

Traffic Results (For ESF and ZBTSI framed signals) — A display of the A, B, C, and D signaling bits for all 24 channels of T1 on LINE 1 or LINE 2. This result uses the entire display to show the signaling bit states for each line's 24 channels in 4 fields of 6 channels each.

NOTE: The TRAFFIC result uses the entire display window. To return to the normal display, press the appropriate **RESULTS Blank** or **Arrowed** switch.

TIME Category

n70SG LS S

Signal Loss Seconds — A count of seconds during which signal synchronization was lost or not achieved since the last test restart.

n71ALM SEC

Alarmed Seconds - A count of seconds during which a yellow alarm, unframed all ones (AIS), or excess zeros alarm was detected. Continues to count through signal loss once an alarm condition is detected.

72TST LEN

Test Length — The length for a timed test, in HHH:MM:SS format. The test length is set using AUX 03 TES LEN function.

n73ELAP TM

Elapsed Time — The time in hours, minutes, and seconds since the last test restart after a signal has been detected. Elapsed time continues to increment during signal losses.

74TST END

Test Ends — The time remaining in a TIMED test using the HH:MM:SS format. "****" is displayed when the T-BERD 224 is in CONTINUOUS test mode.

75 TIME

Clock Time — The time of day using a 24 hour (military) clock in the HH:MM:SS format.

76 DATE

Calendar Date — The date in the MMM DD format.

n79SLC A S

SLC Alarm Seconds — A count of seconds during which a SLC-96 Datalink Alarm was detected.

CHANNEL Category

n80RCV BYT

DDS Received Byte—Displays the received 8-bit byte of the selected channel. If the received byte is recognized as a control code, the control code name is displayed in the n95 RCODE result.

n81VF FREQ

Voice Frequency — The frequency (Hz) of a VF tone within a selected DS0 channel.

n82 VF LVL

VF Level — The level (dBm) of a VF tone within a selected DS0 channel.

n84 3KFLAT

3 kHz Flat Noise — A measure of the noise (dBrn) weighted with a 3 kHz flat filter. Used when qualifying data-grade circuits.

n85 3K NCH

3 kHz Notch Noise — A measure of the noise (dBrn) against a weighted 3 kHz flat filter. A transmitted 1004 Hz tone is filtered out prior to the measurement for analog data-grade analysis. This measurement includes quantization noise caused by analog/digital conversion in the CODEC.

n86 C-MSG

C-Message Noise — A measure of the noise (in dBrnC) weighted with a C-message filter for voice-grade analysis. This measurement determines the noise on an idle channel.

n87 C-NCH

C-Message Notch Noise — A measure of the noise (in dBrnC) against a weighted C-message filter. A transmitted 1004 Hz tone is filtered out prior to the measurement for voice-grade analysis.

n88 S/N

Signal-to-Noise Ratio—The ratio (in dB) of received signal level to noise level. The noise level is measured with a C-message filter and the transmitted 1004 Hz tone is filtered out prior to measurement.

n89 DC-OFF

DC-Offset — The average DC voltage level (in mV) of the received analog signal with respect to time. VF signals should have DC offsets of approximately zero millivolts (0 mV).

n90 P/AR

Peak to Average Ratio — The ratio (in P/AR units) of transmitted peak signal level of 16 non-harmonically related frequencies to the average received level of the signal. This measurement is only available when PAR is selected as the test.

n91 PAR LV

Peak to Average Ratio Level — The RMS level (in dBm) of the received signal. This measurement is only available when PAR is selected as the test.

n92 ERL

Echo Return Loss — The ratio (in dB) of the power transmitted by the T-BERD 224 to the power reflected by the terminated circuit [ERL = 10 log (TX power/RX power)].

n93 SRL-HI

Singing Return Loss - High — The ratio (in dB) of the noise power transmitted for a shaped high frequency band to the power reflected by the terminated circuit.

n94 SRL-LO

Singing Return Loss - Low — The ratio (in dB) of the noise power transmitted for a shaped low frequency band to the power reflected by the terminated circuit.

n95 RCODE

Received DS0 Control Code — Displays the name of the received DS0 code identified in the n80 RCV BYT result.

n96DDS F E

DDS Frame Errors — A count of DS0B frame errors detected since the last test restart. Subrate DS0B frame synchronization must be present.

n98%IN SRV

Percent of In-Service Bits—The percentage of time the DDS control bit (bit 8) is a 1. The control bit state is determined by a majority vote of three bits and excludes transitions caused by secondary channel activity.

n100 DELAY

Delay— The period of time between the indicated event or digit and the previous event or digit.

n101 DUR

Duration — The length of time during which the indicated event or digit occurred.

n102 ADDR

Address — The type of digit; DTMF, MF, or Dial Pulse.

n104FQ/LVL

Lower DTMF/MF Tone Frequency and Level— The lower DTMF/MF tone frequency (Hz) and signal level (dBm). Table 1 and 2 list the DTMF and MF tone frequencies.

Table 1
Dual-Tone Multifrequency Codes (DTMF)

Low Frequency Tones (Hz)	High Frequency Tones (Hz)			
	1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

n105FQ/LVL

Upper DTMF/MF Tone Frequency and Level — The upper DTMF/MF tone frequency (Hz) and signal level (dBm). Table 1 and 2 list the DTMF and MF tone frequencies.

n NACKs

Negative Acknowledgments — A count of Backward Indicator Bit (BIB) field state transitions since test restart. A NACK identifies a transmission error is received in the far-end device. Only packets with good CRCs are used for this calculation. This result is available when SS7 MON is selected.

n ER MSU

Errored Message Signal Units — A count of MSU packets with CRC errors detected since test restart. A packet is an MSU if the Length Indicator (LI) field is between 3 and 63. This result is available when SS7 MON is selected.

n %UTIL

% of MSU Utilization — A count of good MSUs (MSUs) divided by the total number of packets (PACKETS) plus discarded packets (DISC PKTs) since test restart. This result is available when SS7 MON is selected.

Excess Zeros

The corresponding (LINE 1 or LINE 2) red status LED illuminates when 16 or more consecutive zeros are detected.

Yellow Alarm

The corresponding (LINE 1 or LINE 2) red status LED illuminates when a yellow alarm is detected in the received T1 signal.

AIS

The corresponding (LINE 1 or LINE 2) red status LED illuminates upon detection of an AIS signal (2048 consecutive unframed ones).