50-14950-01
Rev. D

T-BERD® 950
USER'S MANUAL

May 1999

This User's Manual applies to all T-BERD 950
Communications Analyzers incorporating Software Level 3.xx.

TTC

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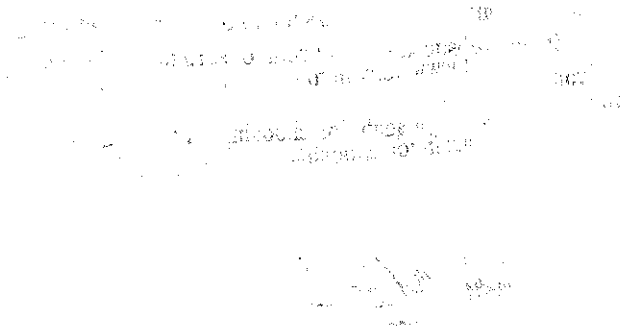

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SECTION 1 GETTING STARTED

1.1 MANUAL OVERVIEW

This T-BERD 950 User's Manual provides basic operating information for the T-BERD 950 Communications Analyzer.

To help you best use it, the manual is divided into the following sections:

- **Section 1 — Getting Started:** Describes the T-BERD 950, and quick start and preventive maintenance procedures.
- **Section 2 — Graphical Display Interface:** Describes the operation of the Graphical Display Interface, each of the screens that appear on the graphical display, and the controls for those screens.
- **Section 3 — T1 BERT Setup:** Describes the setup for T1 BER Testing and includes Smart Repeater test setups and commands.
- **Section 4 — Auxiliary Functions:** Describes of the auxiliary functions of the T-BERD 950.
- **Section 5 — Test Results:** Describes the available test results, the category of the test results, and the test type with which it is associated.
- **Section 6 — Printer Operation:** Describes the printer functions of the T-BERD 950.
- **Section 7 — Options:** Lists all the options available for the T-BERD 950 at the time the manual was printed.
- **Section 8 — Application Cards:** Contains individual application test setup cards. Each card provides information required to perform a specific test.
- **Section 9 — TTC Customer Services:** Contains information on TTCs customer services, general warranty information, and service and repair information.

NOTE

Sections 1 through 4 of the manual provide information on the T1 BER testing configuration of the T-BERD 950 Communications Analyzer. Information on each of the available options are presented in Section 7.

1.2 INSTRUMENT DESCRIPTION

The baseline T-BERD 950 Communications Analyzer is a T1/FT1 BER test set that offers several options that enable it to become a full featured multi-service test instrument. It has two T1 interfaces: **T1-LINE** and **T1-EQUIPMENT**.

Each interface consists of an independent receiver and transmitter. The interfaces can be configured for various applications. The two (1) T1 interfaces work to access different external interface connectors.

1.2.1 Modes of Operation

The T-BERD 950 can operate in four modes of operation:

- **Terminate Mode** — Separates the transmit and receive sides of a T1 path. The input signal is terminated at the receive side, and a totally independent signal is generated for the output. You can use either the Line Tx/Rx pair or the Equipment Tx/Rx pair.

- **Drop and Insert (D&I) Mode** — Enables the T-BERD 950 to access specific channels from the T1 line while leaving the other channels unaffected. The Transmit and Receive side of the T1 path are paired. The input signal is received, Bipolar Violation Breakouts (BPVs) are corrected, the signal is regenerated, and new data can be inserted onto specific bandwidths before the signal is sent to the output. No data is inserted on the transmit path unless the associated receiver has frame synchronization. The D&I mode signal paths are illustrated in Figure 1-1.

NOTE

In the event of power loss (i.e. no AC power and no batteries) to T-BERD 950, the LINE and EQUIPMENT pairs are automatically cross connected to prevent loss of service.

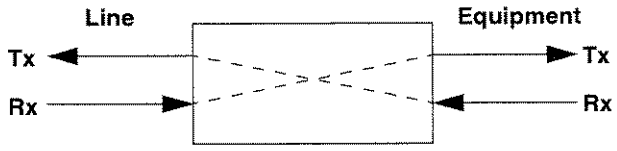


Figure 1-1 Drop and Insert Mode (D&I) Paths

- **Dual Monitor (Mon) Mode** — The T-BERD 950 measures signal parameters, monitors traffic from a resistor isolated DS1 monitor point, or bridges onto the line. One (1) or two (2) receivers may be used. If two (2) receivers are used the Line and Equipment receivers are monitored simultaneously.

- **Line Loop Back (LLB) Mode** — Places the T1 path into Full Loop Back configuration, which loops the incoming data back out the transmitter while enabling the receiver to monitor the incoming signal (BPV errors are not corrected). The line loop back mode signal paths are illustrated in Figure 1-2.

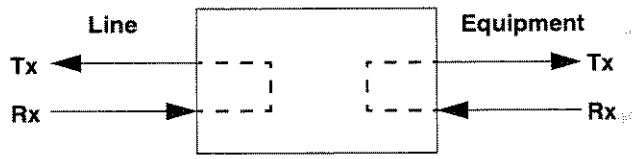


Figure 1-2 Line Loop Back Mode Paths

1.2.2 Self Loop Operating Mode

When the T-BERD 950 is placed in Self Loop mode (press **SELF LOOP** switch), a set of relays is activated. These relays are designed to pass the incoming signal through the T-BERD 950. The signal path is from Rx LINE to Tx EQUIPMENT, and from Rx EQUIPMENT to Tx LINE. This is the same configuration as for D&I Mode.

If a D&I test is being performed, and the T-BERD 950 is placed in Self Loop, the incoming signal still passes through it without interruption. If it is in Terminate Mode, where the configuration is Tx LINE to Rx LINE, the relays have no effect. The relays remain active when the unit looses power or is powered off.

1.2.3 Front Panel Controls, Indicators, and Connectors

The front panel of the T-BERD 950 mainframe is shown in Figure 1-3 with each control (or control group), indicator, and connector marked with a numbered callout. Table 1-1 provides a brief description of each control, indicator, and connector referenced to the numbered callouts in Figure 1-3.

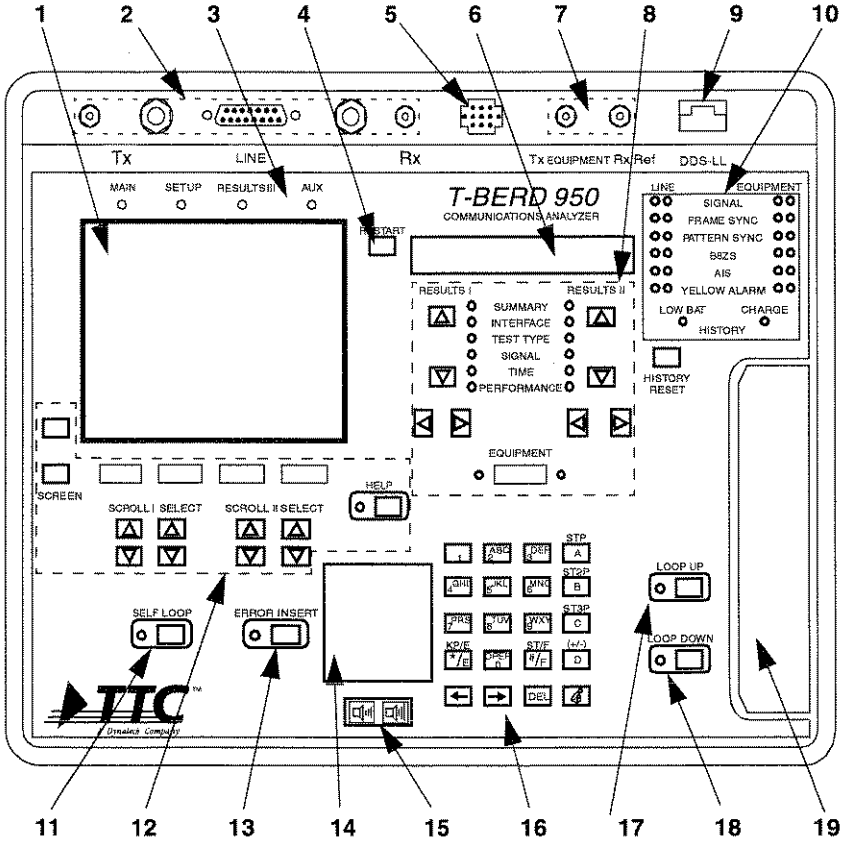


Figure 1-3 T-BERD 950 Front Panel View

Table 1-1 Front Panel Controls, Indicators, and Connectors

No.	Control Indicator	Description
1	Graphical Display Area	Displays four unique screens: **MAIN Screen** — Configures basic functions of the mainframe (i.e. interface and test type). **SETUP Screen** — Configures details of the interface and test type. **RESULTS III Screen** — Displays pages of results. **AUX Screen** — Configures general mainframe settings.
2	T1 LINE Tx and Rx Connectors	Consists of one set of WECO 310 female connectors and one set of Bantam female connectors each, and one 15-pin D connector are provided for Line Tx and Rx. This is also referred to as LINE I.
3	Graphical Display LED	Illuminates to indicate which graphical display screen is active.
4	Restart Key	When pressed, generates a manual test restart and clears any flashing messages on the Two Line Display.
5	Microphone	Used for Voice testing, activated by the push-to-talk key [4] on the keypad.
6	Two Line Display	Displays LINE and EQUIPMENT receiver results. Line receiver results are displayed unless the **Equipment Key** is used to display Equipment receiver results (see Callout #8 below). Also displays status and alarm messages.
7	T1 EQUIPMENT Tx and Rx Connectors	One set of Bantam female connectors is provided for the Equipment Tx and Rx. This is also referred to as LINE II.

Table 1-1 Front Panel Controls, Indicators, and Connectors (Continued)

No.	Control Indicator	Description
8	Results I and II Display Area Controls & Indicators	**Up/Down Arrow Keys** — Located under RESULTS I and RESULTS II. Selects the results category. **Left/Right Arrow keys** — Located under RESULTS I and RESULTS II. Selects the individual result within a category. **Category Light Emitting Diodes (LEDs)** — Illuminates to indicate the selected category. **Equipment Key and LEDs** — Selects Equipment channel results for the Results I or Results II display areas. The LEDs under Results I or Results II light to indicate that Equipment channel results are being displayed. If the LED is off, LINE side results are being displayed.
9	DDS Local Loop Connector	RJ45 connector provided for four wire Digital Data Service (DDS) local loop option.

Table 1-1 Front Panel Controls, Indicators, and Connectors (Continued)

No.	Control Indicator	Description
10	Status/Alarm Group	**Status/Alarm LEDs** — Illuminate green indicating Signal Present, Frame Sync, Pattern Sync, and B8ZS detection. Illuminate red for AIS and Yellow Alarm for LINE and EQUIPMENT channels. **History LEDs** — Illuminate red to indicate that a status/alarm condition has changed state for Signal Present, Frame Sync, Pattern Sync, B8ZS detection, AIS, and Yellow Alarm, for both Line and Equipment channels. **History Reset Key** — Clears (extinguishes) all history LEDs. It does not clear an active alarm LED. **Low Battery LED** — Illuminates indicating that the batteries have less than 15 minutes of charge remaining. **NOTE:** This LED also illuminates when the T-BERD 950 is powered on and remains on (for approximately 30 seconds) until the internal battery test circuitry determines the amount of charge remaining in the battery. **Charge LED** — Illuminates steady to indicate that the battery is being charged at the maximum rate. It blinks to indicate that the battery is being trickle charged.
11	**SELF LOOP** Key and LED	Loops the selected interface transmitter to its receiver. The LED illuminates indicating self loop is active. When in Self Loop mode, the T-BERD 950 is isolated from the LINE and EQUIPMENT connectors. When **SELF LOOP** operation is turned **On**, the T-BERD 950 operating mode is automatically set to **TERMINATE**, the transmit timing is set to **INTERNAL** and Line Build Out (LBO) is set to zero. When the **SELF LOOP** operation is turned **Off**, the T-BERD 950 returns to its previous configuration.

Table 1-1 Front Panel Controls, Indicators, and Connectors (Continued)

No.	Control Indicator	Description
12	Graphical Display Controls Group	**SCREEN Keys** — Selects the active screen, either MAIN, SETUP, RESULTS III or AUX screen. The upper key scrolls through the screens from left to right. The lower key scrolls right to left. **SCROLL and SELECT Keys** — These functions are screen dependent as follows: **MAIN Screen**: The **SCROLL I** and **SELECT I** keys control the active selection lines and the corresponding choices for the left half of the display, respectively. The **SCROLL II** and **SELECT II** keys control the right half of the display. **SETUP Screen**: The **SCROLL I** and **SELECT I** keys control the active selection lines and the corresponding choices for the left half of the display, respectively. The **SCROLL II** and **SELECT II** keys control the right half of the display. **AUX Screen**: Either **SCROLL** key can change the active selection line. Either **SELECT** key changes the choice of the selection line. **RESULTS III Screen**: The **SELECT I** and **II** keys are mapped together and control the selection of which category of results to display (i.e. Summary, Interface, Test Type, Signal, Time, Performance, or Alarm). The **SCROLL I** and **II** keys are mapped together and scroll the list of results up and down in cases where the category of results do not fit on the screen. **Softkeys** — Selects functions associated with the active selection line of the current screen. **Help** Key — Displays help for the active selection line.
13	**ERROR INSERT** Key and LED	Inserts a single error or an error rate. If the key is pressed more than two (2) seconds, the LED illuminates to indicate that error rates are being inserted.

Table 1-1 Front Panel Controls, Indicators, and Connectors (Continued)

No.	Control Indicator	Description
14	Speaker	Used when there are audible VF tones present (i.e. voice, TIMS tones etc.).
15	**Volume** Control Keys	Controls the volume of the speaker. The left key reduces the volume and the right key increases the volume.
16	Alphanumeric Keypad	Consists of a touch tone phone keypad. In addition, the keypad has keys for signaling entry, and HEX based input. The keypad also has arrow (← →) keys and a delete (**DEL**) key for use in editing information fields, as well as a push-to-talk key to activate the microphone. **Note:** The asterisk (*) key enters a decimal point (.).
17	**LOOP UP** Key and LED	Activates loop up code transmission. The LED illuminates to indicate loop up code is being transmitted.
18	**LOOP DOWN** Key and LED	Activates loop down code transmission. The LED illuminates to indicate loop down code is being transmitted.
19	Interface Module Slot	This area is provided for optional interface module use such as the Analog 2W/4W or Datacom (DTE/DCE) Interface Modules.

1.2.4 Left Side Panel Controls and Connectors

The left side panel of the T-BERD 950 mainframe is shown in Figure 1-4. Each control and connector is marked with a numbered callout. Table 1-2 describes each control and connector. Follow the numbered callouts in Figure 1-4 to the number in Table 1-2 to read a description of what it does.

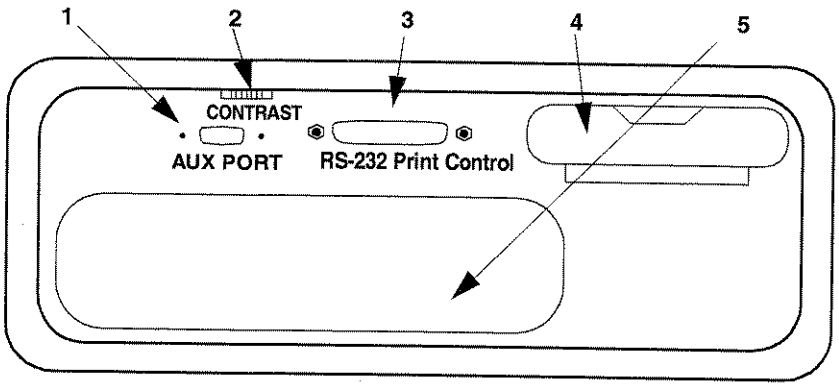


Figure 1-4 T-BERD 950 Left Side Panel View

Table 1-2 Left Side Panel Controls and Connectors

No.	Control Connector	Description
1	Auxiliary Port Connector	Future Use.
2	Graphical Display Contrast Control	Adjusts the contrast of the Graphical Display screen and the Two Line Display. If the contrast is not set properly, the displays appear blank.
3	RS-232 Printer/Control Port Connector	DB-25 female connector.
4	PCMCIA Card Slots	The bottom slot is used for the PCMCIA System software card. The top slot is reserved for future use.
5	Option Slot	Currently used for the optional Protocol Services Board (TTC Part # TB950-PSB).

1.2.5 Right Side Panel Controls and Connectors

The right side panel of the T-BERD 950 mainframe is shown in Figure 1-5. Each control and connector is marked with a numbered callout. Go to Table 1-3 for a description of each control and connector referenced to the numbered callouts in Figure 1-5.

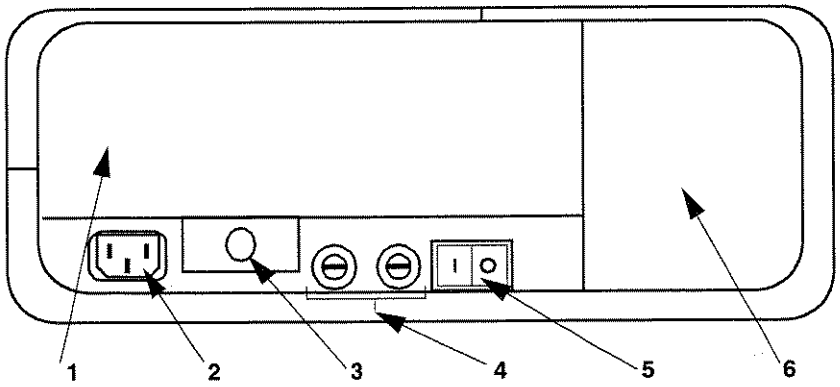


Figure 1-5 T-BERD 950 Right Side Panel View

Table 1-3 Right Side Panel Controls and Connectors

No.	Control Indicator	Description
1	Interface Module Slot	Install optional interfaces such as the Analog 2W/4W or Datacom(DTC/DCE) Interface Modules.
2	AC Power Receptacle	Connect the AC power cord to the T-BERD 950.
3	Interface Module Release Button	Removes an interface module. To release the installed interface module, press the button.
4	AC Line Fuses	Two 250 Volt, 1 Amp Slo-Blo fuses (LittleFuse p/n 218 001).

Table 1-3 Right Side Panel Controls and Connectors (Continued)

No.	Control Indicator	Description
5	Power Switch	Powers the T-BERD 950 **On** or **Off**. Press the **1** symbol to power it **On** and the **O** symbol to power it **Off**
6	Fan	The cooling fan operates at all times when the T-BERD 950 is connected to AC power and when the batteries are being charged. During test operations, the fan is controlled by its internal temperature.

1.2.6 T-BERD 950 Rear Panel

The rear panel of the T-BERD 950 mainframe is shown in Figure 1-6. As show in Figure 1-6, access to the rechargeable batteries is through the battery compartment door. The tilt stand can be adjusted to stand the T-BERD 950 at an angle for easier viewing of the display screens.

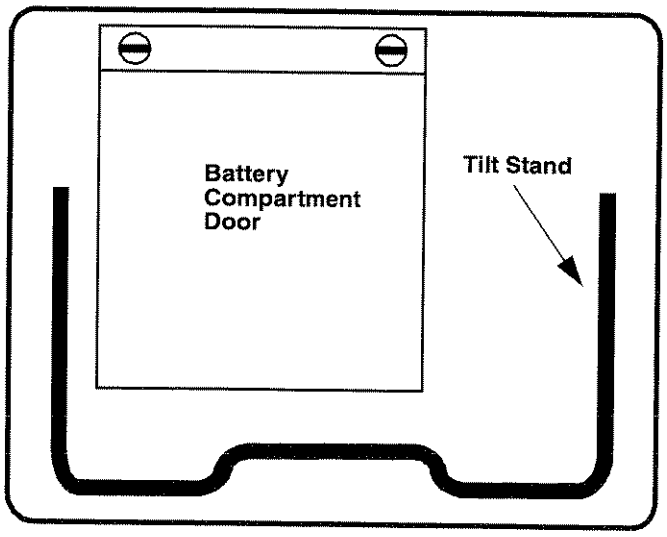


Figure 1-6 T-BERD 950 Rear Panel View

1.2.7 Battery Operation

The T-BERD 950 uses battery power when AC power is not available. It does so by automatically switching over to battery power when AC power is lost. The rechargeable batteries provide between 2 and 4 hours of operating time. Depending on the tests performed and the configuration, the operating time can vary.

1.2.7.1 Charging Batteries

The batteries are charged whenever the T-BERD 950 is connected to AC power and the **Power** switch is set to the **Off** position. When **Off**, the charging time is approximately 3 hours. When T-BERD 950 is powered **On**, the number of batteries charged and the time required to reach full power is determined by the installed options and configuration of the T-BERD 950. To reach full power, up to 8 hours may be required.

Battery charging is not supported in some configurations (i.e., Frame Relay, Primary Rate ISDN). To start charging either power off the T-BERD 950 or select a configuration that supports charging.

Two LEDs are located on the front panel of T-BERD 950 to indicate the status of the batteries: **Charge LED** and **Low Battery LED**.

- **Charge LED** — Illuminates steady to indicate that the batteries are being charged at the maximum charge rate. Blinks to indicate that the batteries are fully charged and the charger is producing a trickle charge to maintain the batteries at a full charge, while T-BERD 950 is turned Off.
- **Low Battery LED** — Illuminates to indicate that the batteries have less than 15 minutes of charge remaining.

NOTE

Providing the current configuration supports battery charging, if the Low Battery LED illuminates during operation, the batteries can be changed one at a time while the test is in progress without interrupting T-BERD 950 performance.

****
* **CAUTION** *
****

The BATT CHG result (Time Results Category) becomes invalid when the batteries are removed. The batteries must be conditioned to obtain a valid Battery Charge result.

1.2.7.2 Battery Replacement Procedure

The procedure to replace the rechargeable batteries is defined in Table 1-4. The batteries can be "hot swapped" (i.e. one at a time when T-BERD 950 is powered **ON**). If you do so, remember that the **BATT CHG** result becomes invalid until the batteries are conditioned.

Table 1-4 Battery Replacement Procedures

Step	Procedure
1	Power off the T-BERD 950 and disconnect the AC power cord.
2	Open the battery compartment door, located on the rear panel of T-BERD 950, by turning the two fasteners ¼ turn counterclockwise.
3	Remove each of the batteries individually. Use the cloth strap, lift the end of the battery away from the contacts.
4	Allow one (1) minute between removal and installation of the batteries to enable the battery capacity measurement to reset.
5	Install the new battery by inserting the contact end first and firmly press down on the end away from the contacts. **NOTE:** Battery contacts are offset to prevent incorrect installation.
6	Close the battery compartment door and secure it by turning the two fasteners ¼ turn clockwise.

NOTE

Condition the batteries to obtain accurate battery capacity readings. (Refer to page 3-2 in Chapter 3 for additional information.) Allow the batteries to charge to full capacity prior to operating T-BERD 950 on battery power. The batteries will charge when the unit has AC power.

1.3 PHYSICAL SPECIFICATIONS

The physical specifications for the T-BERD 950 Communications Analyzer are presented in Table 1-7.

Table 1-5 T-BERD 950 Specifications

Specification	Value
Physical:	
Height:	10.5" (26.68 cm)
Width:	13.25" (33.66 cm)
Depth:	4" (10.17 cm)
Weight:	10 lb. (4.55 kg.) without batteries, 13 lb. (5.9 kg.) with batteries
Environmental:	
Temperature:	
Operating:	32°F to 122°F (0°C to +50°C)
Non-Operating:	-4°F to 140°F (-20°C to +60°C)
Humidity:	10% to 90% Relative Humidity, non-condensing
Vibration:	Per BellCore NEBS TR-EOP-000063
Shock:	Per IEEE-743-1985
Altitude:	
Operating:	200 ft. (61 m) below sea level to 16,400 ft. (5000 m)
Non-operating storage or transportation:	49,210 ft, (15,000 m)
Electrical:	
AC Power:	
Input Voltage:	90 to 240 VAC, 47 to 63 Hz, autodetected.
Power Dissipation:	30 watts (typical), 68 watts (peak - two batteries receiving initial charge)
Fuse Type:	250 Volt, 1 Amp Slo-Blo (LittleFuse p/n 218 001)
DC Power:	
Battery Type:	Panasonic LCS-2012DP (2 required)
Operating Time:	Depending on configuration, up to 4 hours.

1.4 T1 SPECIFICATIONS

The T1 specifications for the T-BERD 950 are presented in Table 1-6.

Table 1-6 T1 Specifications

Item	Specification
Operating Modes:	Terminate (TERM) Drop & Insert (D&I) Monitor (MON) Line Loopback (LLB)
Framing:	ESF SF SLC Unframed Auto
t1 Input:	
Frequency:	1.544 MHz ±5000 Hz
Input Impedance:	TERM: 100 ohms ±5% BRIDGE: 1000 ohms minimum DSX-MON: 100 ohms ±5%
Operating Range:	TERM: +6 dBdsx to -35.0 dBdsx cable attenuation DSX-MON: +6 dBdsx to -35.0 dBdsx cable attenuation
T1 Output:	
Frequency:	1.544 MHz ±7 Hz
Clock Sources:	Internal Oscillator Recovered (from associated path receiver)
LBO Options:	0, -7.5, -15, -22.5 dB ± 1 dB at 772kHz
Operating Range:	DSX MON: -10 dBdsx to -30 dBdsx resistive attenuation
Line Coding:	AMI B8ZS
Error Insert Types:	BPV L&BPV (Logic and BPV errors) Logic Frame

Table 1-6 T1 Specifications (Continued)

Item	Specification
Error Insert Rates: BPV, L&BPV, Logic: Frame:	 Single, 1E-3, 1E-6 1 through 6 and continuous
Loopcodes:	CSU (Loop-up code: 10000; Loop-down code: 100) FAC1 (Loop-up code: 1100; Loop-down code: 11100) FAC2 (Loop-up code: 11000; Loop-down code: 11100) FAC3 (Loop-up code: 100000; Loop-down code: 100) DL-LLB (Data Link - Line Loopback): per ANSI T1.403-1989 DL-PLB (Data Link - Payload Loopback): per ANSI T1.403-1989 DL-Net (Data Link - Network Loopback): ANSI T1.403-1989 V.54 (Fractional T1 only) - PN127 Programmable Loop Codes: 3 to 8 bit repeating loop-up and loop-down codes. Latching Loopcodes (DDS only): *N signifies a "do not care" value.* OCU: N1010101 CSU: N0110001 DS0-DP: N0000101 LSI: N1000111 NEI: N1000001 DSU: N1110111 Alternating Loopcodes (DDS only): *N signifies a "do care" value."* *S signifies either: 1 when transmitting or receiving an idle code of a 56 kbps DS0-A signal; 0 when transmitting a DSU loopback of a 56 kbps DS0-A signal; "do not care" value when transmitting and receiving all other DS0-A signals.* OCU: S0101010 OCU+HL96: S0101010 HL96NY: S0101010 DSU: S0101100 CSU: S0101000 CSU+R: S0101000 CSU+2R: S0101000 1ST RPTR: S0101000 2ND RPTR: S0101000
Indicators:	Signal Present, Frame Sync, Pattern Sync, B8ZS Detect, AIS (Alarm Indication Signal) and Yellow Alarm.

Table 1-6 T1 Specifications (Continued)

Item	Specification
Frequency Measurements:	
Accuracy:	± 10 ppm
Resolution:	1Hz
Level:	
Peak to Peak:	20mV to 12.0 V
Positive and Negative Base to peak:	10 mV to 6.0 V
Positive and Negative Base to peak:	-48.0 dBdsx to +6.7 dBdsx
Resolution[1]:	±1 dB
Simplex Current:	
Range:	10 to 207 mA, and under 10 mA
Accuracy:	±10% or 2mA (whichever is greater)
Wander:	
Resolution:	1 UI
Accuracy:	1 UI

1. All level measurement results are based on the peak voltage level of the input signal.

Table 1-7 lists the Originating Messages that are only available when performing DDS payload for T1. Payload is set to DDS.

Table 1-7 Originating Messages

Type	Message
Loop Up Status:	Transmitting Loop Up: <Loopcode> Loop Up: Aborted <Loopcode> Loop Up: Success <Loopcode> Loop Up: Failed <Loopcode> Loop Up: Sent <Loopcode>
Loop Down Status:	Transmitting Loop Down: <Loopcode> Loop Down: Aborted <Loopcode> Loop Down: Success <Loopcode> Loop Down: Failed <Loopcode> Loop Down: Sent <Loopcode>

1.5 T-BERD 950 QUICK START

This quick start guide provides you with instructions for how to get your T-BERD 950 up and running.

1. **Remove the T-BERD 950 from the shipping container.**
   Save the container. If the T-BERD 950 requires servicing, use this container to return it to TTC.

2. **Temporarily remove the cover of the T-BERD 950.**
   Place the T-BERD 950 upright, standing on the rubber feet and the handle at the top of it while pulling the lid towards yourself. Use both thumbs, push the lid clips inward and to the right simultaneously (to unhinge them from the connector). Be sure to save the cover.

NOTE

The cover is not hinged at the bottom of the T-BERD 950, so to remove the bottom of the cover, simply raise it up from the slots on the bottom.

3. **Connect the yellow AC power cord to the T-BERD 950.**
   The power cable is included with the T-BERD 950 in the shipping container. The AC power connector is on the bottom right side of it.

4. **Apply power to the T-BERD 950.**
   The switch is on the right side of the T-BERD 950.

5. **Adjust the contrast of the graphical display to suit you.**
   The control is located on front panel, to the left of the display. The display appears blank until the contrast is adjusted.

6. **Press the SELF LOOP control.**
   The SELF LOOP control is on lower left corner of the front panel. The SELF LOOP LED illuminates to indicate the T-BERD 950 is receiving its transmitted signal.

7. **Check the Status/Alarm LEDs.**
   Status/Alarm LEDs are located in the upper right corner of the front panel. Verify SIGNAL, FRAME SYNC, PATTERN SYNC and B8ZS LEDs are illuminated green.

Once you complete these procedures, it is safe set up the T-BERD 950 for testing purposes. For additional help, please call the TTC Technical Assistance Center (TAC) at 1-800-638-2049.

1.6 PREVENTIVE MAINTENANCE

Preventive maintenance on the T-BERD 950 involves two steps: **visually inspecting** it and **cleaning** it. For best use, the T-BERD 950 should be visually inspected and cleaned as often as operating conditions require.

****
* **CAUTION** *
****

The accumulation of dirt on the T-BERD 950 can cause overheating and component failure.

The correct procedure for how to inspect and clean the exterior of T-BERD 950, as well as procedures for replacing the AC power fuse, are below.

1.6.1 Exterior Inspection

Inspect the external portions of the instrument for damage, wear, and loose or missing parts. Check all parts thoroughly to verify correct operation and performance.

WARNING

Any deficiencies found that could cause personal injury or lead to further damage indicate that the unit should not be used.

1.6.2 Exterior Cleaning

Loose dust on the outside of the instrument can be removed with a soft cloth. Remove any dirt that remains with a soft cloth dampened in a mild detergent and water solution (e.g. Miller Stephenson Cleaner MS-260).

****
* **CAUTION** *
****

Do not use abrasive cleaners on the Graphic Display screen or Two Line Display screen as the screens could be scratched. Do not get moisture inside the instrument.

Use only enough water to dampen the cloth. Any accumulated dust and dirt in the fan input area can be removed with a vacuum.

1.6.3 Fuse Replacement Procedure

The procedure to replace the AC power fuse(s) in the T-BERD 950 is presented in Table 1-8.

Table 1-8 Fuse Replacement Procedure

Step	Description
1	Power off the T-BERD 950 and disconnect AC power cord.
2	Remove the fuse holder(s) by turning it ¼ turn counterclockwise while pulling the fuse out of the holder. Replace with a fuse of the proper rating and voltage (i.e. T1A/250V). **NOTE:** The fuse holders are located on the right side panel of T-BERD 950, immediately to the left of the **Power** switch. See item 4 of Figure 1-5.

Table 1-8 Fuse Replacement Procedure (Continued)

3	Insert the replacement fuse (see the label on the bottom of the T-BERD 950 for fuse type) into the holder and reinstall the fuse holder by turning it ¼ turn counterclockwise.
4	Reconnect the AC power cord.

SECTION 2 GRAPHICAL DISPLAY INTERFACE

2.1 INTRODUCTION

This section describes the operation of the front panel controls (Screen keys, Scroll & Select keys, Help key and screen Softkeys) used to select, configure, and edit the menu items on the graphical display screens. The operation of the MAIN, SETUP, RESULTS III, and AUX display screens are also discussed. Descriptions in this section are based on a BER test with a T1 interface.

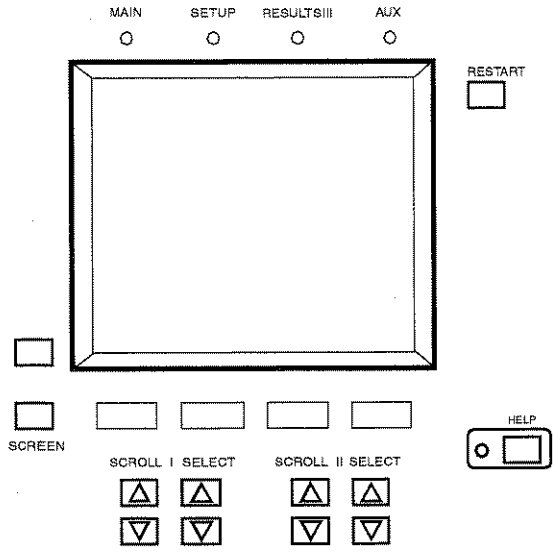


Figure 2-1 Graphical Display Screen and Controls

2.2 GRAPHICAL DISPLAY CONTROLS

The following paragraphs describe the operation of the front panel controls associated with the Graphical Display. Figure 2-1 shows the graphical display and associated controls and LEDs.

2.2.1 Screen Keys

The screen keys are used to select the display screen. The upper key cycles through the screens (MAIN, SETUP, RESULTS III, and AUX) from left to right. The LED below the screen name illuminates to indicate the screen is active. The lower key cycles through the screens from right to left.

2.2.2 Scroll and Select Keys

The following paragraphs describe the basic operation of the **Scroll** and **Select** keys. An in-depth description of the operation of these keys is included with each of the screen types (MAIN, SETUP, RESULTS III, and AUX), as the function of the keys varies with each of the screens.

2.2.2.1 Scroll I and Select I Keys

The **Scroll I** and **Select I** keys are used to select and configure menu items on the left side of the graphical display. The **Scroll I** keys (up and down arrow) are used to scroll through the menu items. The **Select I** keys (up and down arrow) are used to cycle through the available choices for each menu item.

2.2.2.2 Scroll II and Select II Keys

The **Scroll II** and **Select II** keys are used to select and configure menu items on the right side of the graphical display. The **Scroll II** keys (up and down arrow) are used to scroll through the menu items. The **Select II** keys (up and down arrow) are used to cycle through the available choices for each menu item.

2.2.3 Help Key

The **Help** key is used to display the available help for the active selection line (displayed in reverse video) on the graphical display. Pressing the key once activates the help function (the LED to the left of the key illuminates) and displays the available help for the selected menu item. Pressing the **Help** key a second time turns off the help function (LED turns off).

If the active selection line has a list of available choices, a popup window appears that contains all of the possible choices. The **Scroll** or **Select** keys for the active side of the graphical display can be used to select the desired choice. Pressing the **Help** key a second time enters the choice and turns Help off.

If the active selection line is a data entry type field, instructions are displayed which explain how to edit the field data. Help must be turned off in order to edit the field.

2.2.4 Softkeys

The softkeys (located immediately below the graphical display) are used to activate the functions that may be displayed at the bottom of the graphical display. The function may be related to a single selection line or to a group of items. In-depth descriptions of the individual softkey functions are provided later in this section as the related menu items are described.

2.3 MAIN SCREEN

The main screen (see Figure 2-2) is used to configure the basic functions of the mainframe. The screen is divided into three sections; title bar, selection area, and softkey descriptions. The selection area is further divided into the left and right selection areas. The following paragraphs describe the function of each section of the main screen.

2.3.1 Title Bar

The top line of the display, called the Title Bar (see Figure 2-2), indicates the current usage of the graphical display. The screen usage is also indicated by the illuminated LED above the graphical display.

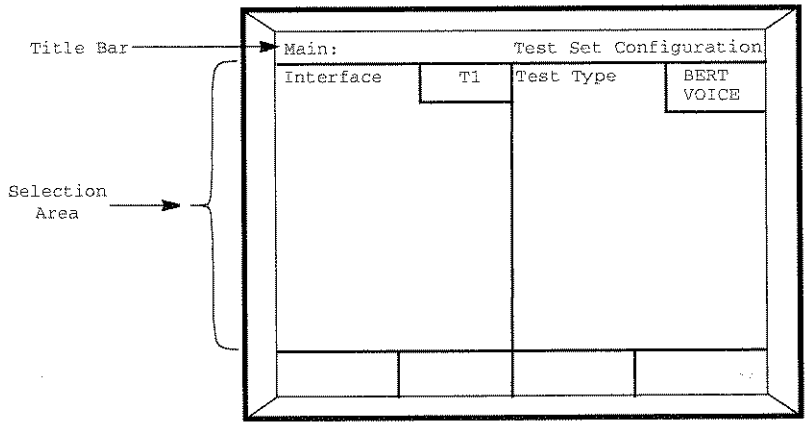


Figure 2-2 T-BERD 950 Main Screen

2.3.2 Selection Area

The user controls all of the analyzer configuration selections. The middle area of the display, called the Selection Area (see Figure 2-2), is divided into two sections, the left and right selection areas.

The left and right selection areas cannot be active at the same time. The active selection line within a given area is indicated by the selection choice being displayed in reverse video. In the inactive area the current selection line is indicated by a box drawn around the selection choice. When a change must be made in the non-active side of the display, the first depression of a **Scroll** or **Select** key on that side of the display makes that side active. The **Scroll** and

Select keys are then used to make the required change. The **Scroll** keys are used to highlight the new selection choice and the **Select** keys are used to make the change.

NOTE

The change takes effect after 1 second, by exiting the active selection line, changing to the inactive side of the display, or by changing the active display screen.

2.3.2.1 Left Selection Area

The left selection area is used to select the desired interface (if an optional interface is installed — see Section 7), either the **Scroll I** or **Select I** keys can be used to select the desired interface.

2.3.2.2 Right Selection Area

The right selection area is used to select the type of test to be performed (if optional test type software is installed — see Section 7), either the **Scroll II** or **Select II** keys can be used to select the desired test.

2.4 SETUP SCREEN

The setup screen (see Figure 2-3) is used to configure the parameters of the interface and test type selected on the Main screen. The screen is divided into three sections; title bar, selection area, and softkey descriptions. The selection area is further divided vertically into the left and right selection areas. The following paragraphs describe the function of each section of the setup screen.

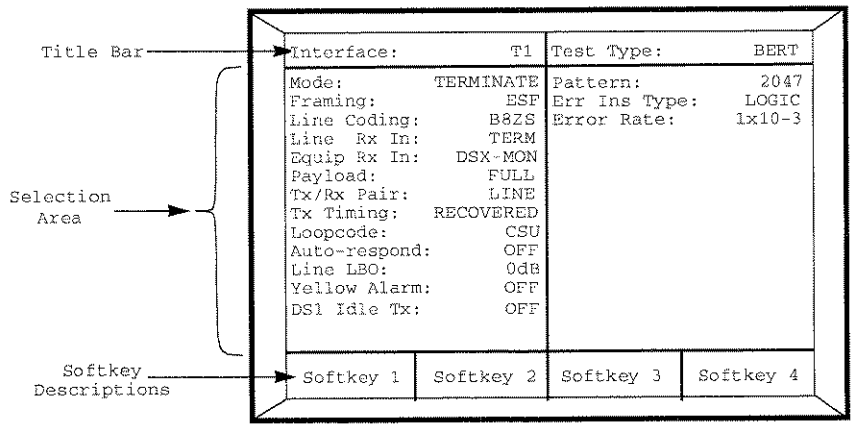


Figure 2-3 T-BERD 950 Setup Screen

2.4.1 Title Bar

The top line of the display, called the Title Bar (see Figure 2-3) indicates the interface in use and the test type to be performed. The screen usage is also indicated by the illuminated LED above the graphical display.

2.4.2 Selection Area

The middle area of the display, called the Selection Area (see Figure 2-3) is divided vertically into two sections, the left and right selection areas. The left and right selection areas cannot be active at the same time. The active selection line within a given area is displayed in reverse video. When a change must be made in the non-active side of the display, the first depression of a **Scroll** or **Select** key on that side of the display makes that side active. The **Scroll** and **Select** keys are then used to make the required change. The **Scroll** keys is used to highlight the new selection choice and the **Select** keys is used to make the change.

NOTE

If the left or right side of the screen requires more selection lines than the display can show at one time, the screen displays the ⇓ MORE ⇓ indicator on the bottom selection line in the interface category. If the display has been scrolled down to the point that there are selection lines hidden at the top of the display the ⇑ MORE ⇑ indicator is displayed on the top selection line.

2.5 RESULTS III SCREEN

The RESULTS III screen is used to display results for each of the Results Categories (i.e. Summary, Interface, Test Type, Signal, Time, and Performance). In addition, an Alarms category is also provided which lists the date and time the alarm occurred, as well as where the alarm occurred (i.e. the **LINE** (L) or **EQUIPMENT** (**E**) side) where applicable. A typical Interface Category results page is shown in Figure 2-4 and a typical Alarms Category results page is shown in Figure 2-5.

In the event that one results page is not sufficient to display all of the results for a given category, the ⇓ **MORE** ⇓ indicator is displayed on the bottom selection line of the display. Use the **Scroll** keys to scroll the results up and down. If the display has been scrolled down to view the additional results, the ⇑ **MORE** ⇑ indicator is then displayed on the top selection line.

NOTE

If all results are zero for the LINE and EQUIPMENT receivers, the message "`All Results OK`*" is displayed on the Summary Category screen.*

The screen is divided into two areas; the Title Bar and the Results Display Area. The Title Line is the only configurable item on the RESULTS III screen, and accordingly, the **Select** keys are associated with it. The following paragraphs describe the function of each section of the RESULTS III screen.

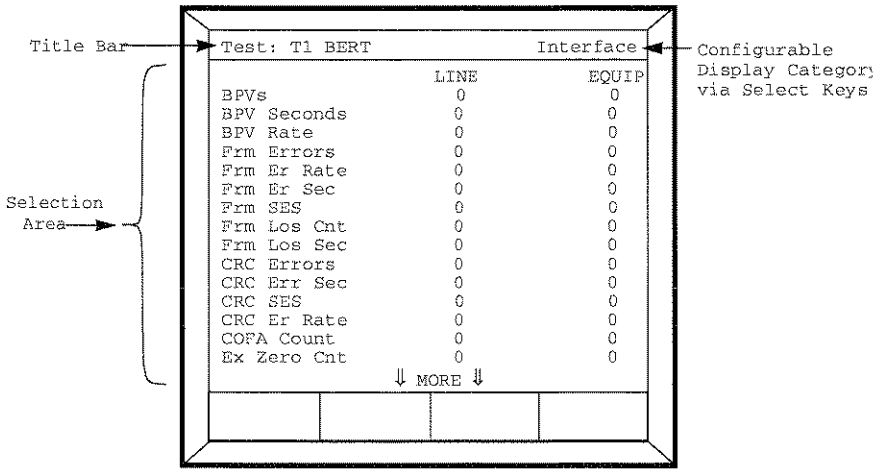


Figure 2-4 Typical Interface Category Results Page

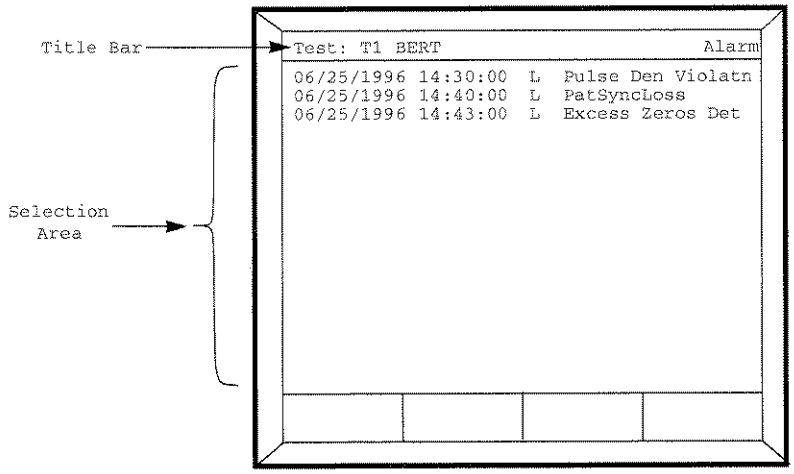


Figure 2-5 Typical Alarms Category Results Page

2.5.1 Title Bar

The Title Bar displays which results category is being displayed (Summary, Interface, Test Type, Signal, Time, Performance, or Alarm). The **Select I** or **Select II** keys can be used to select the results category to be displayed in the Display Area.

2.5.2 Display Area

The Display Area displays the list of results for the selected category. Either **Select** key (**I** or **II**) can be used to choose which category of results is displayed. Either the **Scroll I** or **Scroll II** keys can be used to scroll up and down through the list of results. The left column displays LINE results and the right column displays EQUIPMENT results.

2.6 AUX SCREEN

The AUX (Auxiliary) screen, shown in Figure 2-6, is used to configure mainframe type configurations. The screen is divided into two areas; the Title Bar and the Selection Area. For an in depth description of the Auxiliary functions available for the T-BERD 950 mainframe refer to Section 4.

2.6.1 Title Bar

The Title Bar displays the current usage for the AUX screen (General).

2.6.2 Selection Area

The Selection Area is used to configure mainframe functions. The **Scroll I** or **Scroll II** keys are used to select the active selection line. The selection line choice is changed by pressing either the **Select I** or **Select II** keys to cycle through the available choices. Data entry fields are edited using the keypad.

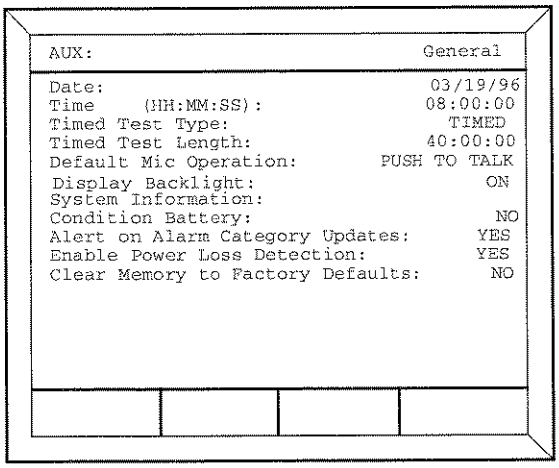


Figure 2-6 AUX Screen Display

SECTION 3 T1 BERT SETUP

3.1 INTRODUCTION

This section describes the basic test setup for the T1 interface on the T-BERD 950.

3.2 T1 SETUP SCREEN

The left selection area is used to configure the selected interface. The **Scroll ↕** and **Select ↕** keys are used to control this selection area. Figure 3-1 shows a typical representation of the T1 Interface parameters and the choices available to set up your test. The **Scroll ↕** keys select the active line, and the **Select ↕** keys (unless stated otherwise) cycle through the available choices.

3.3 T1 INTERFACE SETUP

Mode — When selected, enables selection of the operating mode (default value is **TERMINATE**). The choices include:

TERMINATE — Selects Terminate mode, both sides of a T1 path are separated, the input signal is terminated at the receive side, and a totally independent signal is generated for the output.

D&I — Selects Drop and Insert mode, which enables the analyzer to insert data onto specific channels from the T1 line while leaving the other channels unaffected.

MONITOR — Selects Dual Monitor mode, which enables the analyzer to measure signal parameters or monitor traffic from a resistor-isolated DS1 monitor point or bridge on to the line.

LLB — Selects Line Loop Back mode, which causes the analyzer to act as a repeater. All data received is echoed unchanged on the transmitter output. Not available when **VOICE** is the selected test type.

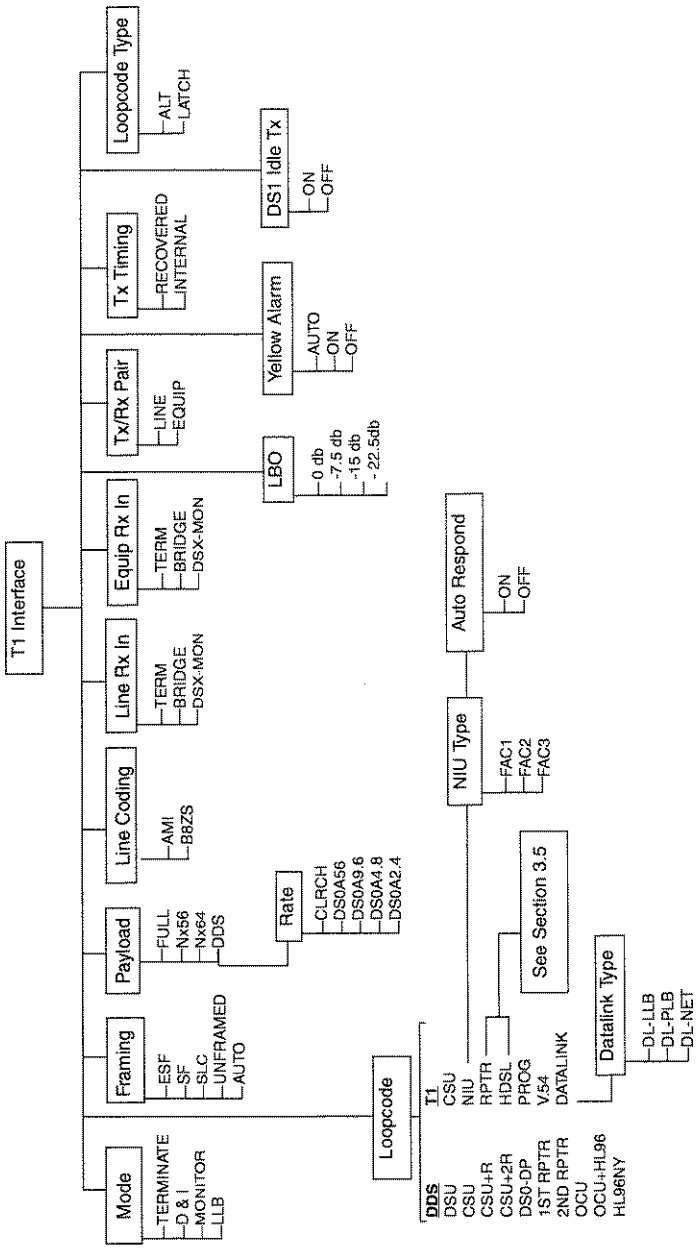


Figure 3-1 T1 Interface Parameters

NOTE

Not all of the following selection lines are available in all Operating Modes. The operating mode(s) to which a selection line applies is stated in the description of the individual selection line.

Framing — (*all operating modes*) When selected, enables selection of the framed data format for transmission and analysis (default value is **ESF**). The choices include:

ESF — Enables transmission and analysis of T1 signals with Extended SuperFrame (ESF) framing format.

SF — Enables transmission and analysis of T1 signals with SuperFrame (SF) framing format.

SLC — Enables transmission and analysis of T1 signals with SLC-96 framing.

UNFRAMED — Enables data analysis on the full 1.544 Mbps bandwidth of the T1 line. No framing bits are added during transmission, and no data bits are stripped during reception. Not available in **D&I** mode or when **VOICE** is the selected test type.

AUTO — Automatic Frame Search. The unit automatically configures the receivers and transmitters to the incoming framed and unframed T1 signals. **AUTO framing searching** is displayed on the two line Results I/II display while the unit attempts to identify the received framing mode. If frame synchronization is received, the detected mode is displayed in lowercase letters on the setup screen, as indicated in Table 3-1.

Table 3-1 AUTO Framing

T1 Signal Format	AUTO Mode Selection
D1D	*sf
D2	*sf
D4	*sf
ESF	*esf
SLC	*slc
Unframed	unframed

AUTO mode is performed concurrently on the line and equipment receivers. The T-BERD 950 tries to synchronize to the line input. If framing synchronization is achieved, the green line Frame Sync LED illuminates, the detected mode appears in lowercase letters, and the T-BERD 950 tries to synchronize to the same frame format in equipment. If equipment frame format is not the same as line, then the green equipment Frame Sync does not illuminate. If the T-BERD 950 does not achieve synchronization on the line T1 interface, then equipment T1 interface is analyzed for framing synchronization. If synchronization is achieved with equipment, the green equipment Frame Sync LED illuminates, and the detected mode appears in lowercase letter. If synchronization is not achieved for either receiver, the unit defaults to unframed.

NOTE

Neither the line nor the equipment frame sync LEDs will be illuminated in that scenario.

AUTO-R — Automatic Restart Frame Search. The unit operates in the manner described above; however, it automatically searches for frame synchronization upon the loss of frame synchronization or when signal is lost and reacquired (i.e., when the FRAME SYNC LED is no longer illuminated). Therefore, this mode should not be selected when performing long-term, unattended testing, because valid testing results will be cleared each time frame sync is reacquired.

Payload — *(not available for* **Voice** *testing)* Enables selection of the circuit type to be tested (default value is **FULL**). Choices include:

Full — Configures the analyzer to transmit and receive data at the full T1 rate. Not available in **D&I** mode.

Nx56 — Selects the channel bandwidth for Nx56 kbps data analysis. This selection line shows only the number of channels currently selected. Selecting Nx56 displays the **Channels** selection line.

Nx64 — Selects the channel bandwidth for Nx64 kbps data analysis. This selection line shows only the number of channels currently selected. Selecting Nx64 displays the **Channels** selection line.

Channels — Displays the **Edit** softkey (default value is channel **1**). When pressed, the **Edit** softkey displays the Edit Channels screen and the **Select/Deselect**, **Clear All**, **Abort Changes**, and **Save & Exit** softkeys. The Edit Channels screen enables configuration of the active channels for both the T1 LINE and EQUIPMENT interfaces (the selected channels are the same for both interfaces). Either the **Select I** or

Scroll ↕ keys can be used to change the currently selected channel, and the **Select/Deselect** softkey toggles the channel between active and inactive. The **Clear All** softkey deselects all channels. The **Abort Changes** softkey exits the Edit Channels screen without making any changes to the existing channel selections and returns the user to the previous screen. The **Save & Exit** softkey enters all changes made and returns the user to the previous screen.

DDS — Selects DDS over T1 analysis and enables the selection of an individual T1 (DS0) channel to be tested.

Channel — Selects a specific DS0 channel to be tested. Using the keypad, enter a number 1 through 24 or press the **Select ↕** keys to change the currently selected channel. The **DEL** key deletes the right-most digit of the current value (default is **1**).

Rate — Selects the unframed channel format and data transmission subrate over the DS0 64 kbps channel (default is **CLRCH**). The choices include:

CLRCH — Utilizes entire DS0 bandwidth.

DS0A56 — Utilizes the entire DS0 bandwidth, except bit 8, which is controlled by the analyzer and distinguishes customer data from network control information. This selection is used when testing DS0A formatted DDS data at 56 kbps.

DS0A9.6 — Copies all eight bits of the DS0A9.6 bandwidth five times into the selected 64 kbps channel. This selection is used when testing DS0A formatted DDS data at 9.6 kbps.

DS0A4.8 — Copies all eight bits of the DS0A4.8 bandwidth 10 times into the selected 64 kbps channel. This selection is used when testing DS0A formatted DDS data at 4.8 kbps.

DS0A2.4 — Copies all eight bits of the DS0A2.4 bandwidth 20 times into the selected 64 kbps channel. This selection is used when testing DS0A formatted DDS data at 2.4 kbps.

Line Coding — (*all operating modes*) When selected, enables selection of the line coding for the transmitted data (default value is **B8ZS**). The choices include:

AMI — Selects Alternate Mark Inversion (AMI) coding.

B8ZS — Selects Bipolar with 8 Zero Substitution (B8ZS) coding.

Line Rx Input — (*all operating modes*) When selected, enables selection of the LINE receiver input impedance and signal conditioning (default value is **TERM**). The choices include:

TERM — Provides 100 Ω ±5% resistive termination.

DSX MON — Provides resistive compensation for signals with +6.0 dBdsx to -35 dBdsx of cable loss at 772 kHz, and can accommodate signals resistively attenuated from +0.0 dBdsx through -26.0 dBdsx.

BRIDGE — Provides greater than 1000 Ω resistive termination.

Equip Rx Input — (*all operating modes*) When selected, enables selection of the EQUIPMENT receiver input impedance and signal conditioning (default value is **DSX-MON**). The choices include:

TERM — Provides 100 Ω ±5% resistive termination.

DSX MON — Provides resistive compensation for signals with +6.0 dBdsx to -35 dBdsx of cable loss at 772 kHz, and can accommodate signals resistively attenuated from +0.0 dBdsx through -26.0 dBdsx.

BRIDGE — Provides greater than 1000 Ω resistive termination.

Ins Side — *(D&I mode only)* Enables selection of the T1 interface that data is inserted on (default is **LINE Tx**). The choices include:

LINE Tx — Selects the T1 LINE transmitter.

EQUIP Tx — Selects the T1 EQUIPMENT transmitter.

Ins Payload — *(D&I mode only)* Turns payload insertion on or off (default is **OFF**).

NOTE

Whenever any of the following parameters are changed, **Ins Payload** *is reset to* **OFF**: **Mode**, **Framing**, **Line Coding**, **Line Rx In**, **Equip Rx In**, **Payload**, **Ins Side**, **Line LBO**, **Equip LBO**, **Channels**, **Tx Timing**, *and* **Test Type**. *In addition, each time D&I mode is selected,* **Ins Payload** *is reset to* **OFF**.

Tx/Rx Pair — *(terminate mode only)* When selected, enables selection of the receiver and transmitter pair (default value is **LINE**). The choices include:

LINE — Selects the LINE receiver and transmitter pair.

EQUIP — Selects the EQUIPMENT receiver and transmitter pair.

Tx Timing — *(terminate mode only)* When selected, enables selection of the signal timing source for each of the T1 transmit channels, LINE and EQUIPMENT (default value is **RECOVERED**). The choices include:

RECOVERED — Selects the receiver channel clock as the timing source for the transmitter.

INTERNAL — Selects the internal crystal oscillator as the timing source for the transmitter.

3.3.1 DDS Loop Codes

Loop Code Type — (*DDS payload only*) Enables the selection of either latching or alternating loop codes (default is **LATCH**). The choices include:

LATCH — Enables selection of a latching loop code where all eight bits of a DS0 are used to transmit network control codes. The success or failure of latching loop code operation will be reported at the end of each latching loop up or loop down operation on the two-line display.

ALT — Enables selection of an alternating (non-latching) loop code where the payload data is intermixed every other byte with the loop code. The success or failure of an alternating loop code operation shall be reported at the end of each loop up or loop down.

For LATCH and ALT loop code types (DDS loop codes) N signifies a don't care value and S signifies the subrate framing bit; "1" when transmitted/received an idle code of a 56 kbps DS0A signal; "0" when transmitted/received a DSU loopback of a 56 kbps DS0A signal; or "don't care" for all other transmitted/received DS0A signals.

Loop code — *(terminate mode only)* When selected, enables selection of the loop code sequence transmitted through the active channels or through the ESF Data Link when the **Loop Up** and **Loop Down** keys are pressed (default value is **CSU**). The choices for DDS include:

CSU — *(DDS ALT or LATCH loop code type only)* Selects Channel Service Unit loop code. The alternating loop code is: S0101000. The latching loop code is: N0110001.

CSU+R — (*ALT loop code type only*) Selects Channel Service Unit through One Repeater alternating loop code: S0101000 after "punching" through one repeater. The repeater loops up with the CSU loop up sequence. The analyzer loops down the repeater allowing the following transmission to pass through. The CSU then loops up with the standard alternating loop back activation sequence.

CSU+2R — (*ALT loop code type only*) Selects Channel Service Unit through Two Repeaters alternating loop code: S0101000 after "punching" through two repeaters. This sequence is the same as the CSU+R, except, after the second loop up sequence is transmitted, a second loop down sequence is transmitted, followed by a third loopback activation sequence.

1ST RPTR — (*ALT loop code type only*) Selects First 56 kbps Repeater alternating loop code: S0101000. The loop code is the same as the CSU loop code.

2ND RPTR — (*ALT loop code type only*) Selects Second 56 kbps Repeater alternating loop code: S0101000. The loop code is the same as the CSU+R loop code.

OCU — (*ALT or LATCH loop code type only*) Selects Office Channel Unit loop code. The alternating loop code is: S0101010. The latching loop code is: N1010101.

OCU+HL96 — (*ALT loop code type only*) Selects Office Channel Unit behind a HL96NY alternating loop code: S0101010 after "punching" through the HL96NY. This code will loop up with the OCU sequence. The analyzer will loop down the HL96NY, allowing the following transmissions to pass through. The OCU will then be looped up with the standard alternating loopback activation sequence.

HL96NY — (*ALT loop code type only*) Selects HL96NY Office Channel Unit alternating loop code: S0101010.

LSI — (*LATCH loop code type only*) Selects Line Side Interface latching loop code: N1000111.

NEI — (*LATCH loop code type only*) Selects Network Element Interface latching loop code: N1000001.

DS0-DP — (*LATCH loop code type only*) Selects DS0-Dataport latching loop code: N0000101. This loop code must be able to loop up or loop down any DS0 data port within a series of eight DS0 data ports. At the completion of the loop, feedback is read from the looped DS0 data port that determines if the DS0 data port is configured from the line side or drop side.

Location — Selects the data port location. Choices include: 1, 2, 3, 4, 5, 6, 7, or 8.

DSU — (*ALT or LATCH loop code type only*) Selects Data Service Unit loop code. The alternating loop code is: S0101100. The latching loop code is: N1110111.

3.3.2 T1 Loop Codes

Loopcode — *(terminate mode only)* When selected, enables selection of the loop code sequence transmitted through the active channels or through the ESF Data Link when the **Loop Up** and **Loop Down** keys are pressed (default value is **CSU**). The choices include:

CSU — *(not available for DDS)* Selects repeating inband Channel Service Unit (CSU) loop codes: loop-up = 10000 and loop-down = 100. These loop codes are valid in Full T1, Fractional T1, and all framing modes.

NIU — *(not available for DDS)* Enables Selection of network interface (or smart jack) inband repeating codes.

NIU Type — Selection line appears, allowing selection of the Facility Type codes listed below.

FAC1 (Facility Type 1) — Selects network interface (or smart jack) inband repeating 4-bit loop codes: loop-up = 1100 and loop-down = 1110. These loop codes are valid in Full T1, Fractional T1, and all framing modes.

FAC2 (Facility Type 2) — Selects network interface (or smart jack) inband repeating 5-bit loop codes: loop-up = 11000 and loop-down = 11100. These loop codes are valid in Full T1, Fractional T1, and all framing modes.

FAC3 (Facility Type 3) — Selects network interface (or smart jack) inband repeating 6-bit loop codes: loop-up = 100000 and loop-down = 100. These loop codes are valid in Full T1, Fractional T1, and all framing modes.

RPTR — *(Full payload only)* Selects repeater loop codes sent over the T1 interface. See **Section 3.5** for details on repeater commands and loop codes.

RPTR Type — Selects Repeater type. Choices include:

Table 3-2 Repeater Type

Central Office Repeaters	Line Repeaters
Teltrend 7231LP/LW IOR	Teltrend 7239LP/LW ILR
Teltrend 9132LP/LW IHR	WSTL 315056 ILR A/B
WSTL 313056 IOR A/B	WSTL 315056 ILR C..

Table 3-2 Repeater Type (Continued)

Central Office Repeaters	Line Repeaters
WSTL 313056 IOR C..	WSTL 315156 ILR
WSTL 313080 IOR	WSTL 313080 ILR
	WSTL 315081 ILR
	XEL 7853-200 ILR

CMD — *(RPTR loopcode only)* Selects commands to configure the repeater for testing. Based on the repeater selected, the choices dynamically appear for selection using the softkeys.

HDSL — *(Full payload only)* High bit-rate Digital Subscriber Line. Selects HDSL loop code transmitted over the HDSL circuit.

HDSL Type — Selects HDSL type. Choices include:

Table 3-3 HDSL Repeaters

Central Office Repeaters	Line Repeaters	Customer Premises Repeaters
Adtran HTU-C	Adtran HRE	Adtran HTU-R
PairGain HLU	PairGain HDU	PairGain HRU

Adtran Codes — *(HDSL loopcode only)* Choices are Standard and Abbreviated. Default is Abbreviated *(no softkeys available)*. If Standard is selected, the **REPEATER CMDS** softkey becomes available. See Repeater Commands in Section 3.5.

PairGain Codes — *(HDSL loopcode only)* Choices are A2LB and Generic. Default is Generic *(no softkeys available)*. If A2LB is selected, the **REPEATER CMDS** softkey becomes available. See Repeater Commands in Section 3.5.

Origin of Test — *(RPTR and select HDSL loopcodes only)* Selects point of origin of the test. Choices are Central Office or Customer Prem. If not available in RPTR or HDSL, then default is Central Office.

PROG — Selects user programmable inband loop codes (3 to 16 bit loop up and loop down codes), the left-most bit of each code string is transmitted first. These loop codes are valid in Full T1, Fractional T1, and all framing modes. When selected, the following selection lines are available:

Prog Set # — Allows you to program and access up to 10 user programmable loop-up and loop-down codes. Each set contains its own 16 bit loop-up code and loop-down code. You can label each of the user programmable codes **Loop Up Code (N)** and **Loop Down Code (N)** with alphanumeric characters. See Section 3.4 for details on editing this field.

Loop Up Code (N) — Enables setting the binary value of the loop-up code (default value is **10000**). The left and right arrow keys on the keypad are used to select the individual bit to be set, and the zero (0) or one (1) key on the keypad is used to set the bit value.

Loop Down Code (N) — Enables setting the binary value of the loop-down code (default value is **100**). The left and right arrow keys on the keypad are used to select the individual bit to be set, and the zero (0) or one (1) key on the keypad is used to set the bit value.

V.54 — (*FT1 rates -OR- DDS access when loop code type is LATCH*) Selects inband loop code transmitted over a Fractional T1 bandwidth.

DATALINK — (*ESF framing only*) A communications connection used to transmit data from a source to a destination. These loop codes comply with the ANSI T1.403 ('95) Specifications.

DL-LLB — Selects Out-of-band ESF Data Link Line Loopback codes. The loop codes include: loop up = 1111 1111 0111 0000 and loop-down = 1111 1111 0001 1100; the left-most bit of each code string is transmitted first. These loop codes are valid in Full T1 or Fractional T1 when ESF framing is selected.

DL-PLB — Selects Out-of-band ESF Data Link Payload Loopback codes. The loop codes include: loop-up = 1111 1111 0010 1000 and loop-down = 1111 1111 0100 1100; the left-most bit of each code string is transmitted first. These loop codes are valid in Full T1 or Fractional T1 when ESF framing is selected.

DL-NET — Selects Out-of-band ESF Data Link Network Loopback codes. The loop codes include: loop-up = 0000 0000 0100 1000 and loop-down = 0000 0000 0010 0100; the left-most bit of each code string is transmitted first. The loop codes are valid in Full T1 or Fractional T1 when ESF framing is selected.

Auto-Respond — (*Terminate and D&I Operating Modes only*) When selected, enables Auto-Respond (to loop codes) to be turned On or Off (default value is **OFF**). When Auto-Respond is set to **ON**, the analyzer is configured for automatic loop code response and the response status is displayed on the Two Line Display.

ON — Turns Auto-Respond to selected loop codes on. When the analyzer auto-responds to loop codes, the applicability of the loop code and the mode (Fractional T1 or Full T1) determine what is actually looped back (Line, Payload or Fractional Payload).

OFF — Turns Auto-Respond to selected loop codes off.

NOTE

In D&I operating mode, the only loop code responded to is V.54.

Line LBO — *(Terminate [with Tx/Rx Pair=LINE] and D&I modes only)* When selected, enables emulation of four different cable losses for the T1 LINE output signal level (default value is **0 dB**). The selected cable loss affects the transmit data only at the connectors. The choices include:

0 dB — Sets the output (TX) to the DSX level with no line build-out (0 dB attenuation).

-7.5 dB — Provides -7.5 dB line build-out, attenuating the output with 7.5 dB of simulated cable loss.

-15 dB — Provides -15 dB line build-out, attenuating the output with 15 dB of simulated cable loss.

-22.5 dB — Provides -22.5 dB line build-out, attenuating the output with 22.5 dB of simulated cable loss.

Equip LBO — *(Terminate [with Tx/Rx Pair=EQUIP] and D&I modes only)* When selected, enables emulation of four different cable losses for the T1 EQUIPMENT output signal level (default value is **0 dB**). The selected cable loss affects the transmit data only at the connectors. The choices include:

0 dB — Sets the output (TX) to the DSX level with no line build-out (0 dB attenuation).

-7.5 dB — Provides -7.5 dB line build-out, attenuating the output with 7.5 dB of simulated cable loss.

-15 dB — Provides -15 dB line build-out, attenuating the output with 15 dB of simulated cable loss.

-22.5 dB — Provides -22.5 dB line build-out, attenuating the output with 22.5 dB of simulated cable loss.

Idle Byte — *(Terminate and D&I Operating Modes only)* When selected, enables setting the binary value of the idle byte to be inserted on inactive channels (default value is **11111111**). The left and right arrow keys on the keypad are used to select the individual bit to be set, and the zero (0) or one (1)

key on the keypad is used to set the bit value. The idle byte is inserted in the opposite direction of the inserted payload in D&I mode to block looped test patterns.

Yellow Alarm — (*Terminate and D&I Operating Modes only*) When selected, enables selection of yellow alarm (default value is **OFF**). The choices include:

Auto — Automatically transmits yellow alarm upon Loss of Signal.

ON — Turns on transmission of yellow alarm.

OFF — Turns off transmission of yellow alarm.

DS1 Idle Tx — When selected, enables selection of a DS1 idle code transmission (default is **OFF**). The choices include:

OFF — Turns off transmission of the DS1 idle code.

ON — Transmits a DS1 idle code.

3.4 EDITING USER PROGRAMMABLE FIELDS

This feature allows you to enter any combination of alphanumeric characters to label your programmable loop codes for testing.

1. Select the **Loop Up Code (N)** or **Loop Down Code (N)** field. The **EDIT** softkey appears.
2. Press **EDIT** softkey and a popup window appears. Additional softkeys appear.

   Clear String — Clears the current character string.
   Clear Set — Clears the selected set, allowing you to choose another set.
   Cursor Home — Places the cursor at the beginning of the string.
   Cursor End — Places the cursor at the end of the string.
   Prev Page — Places the cursor on the previous page.
   Next Page — Places the cursor on the next page.
   Abort Changes — Clears all changes and returns to the setup screen.
   Save & Exit — Saves the changes and Exits the editing function.

3. Press the 1 through 9, or 0 key on keypad to select a character set. The assigned values for that key are displayed in the popup window.
4. Press the corresponding number for the character you want to place into the user data information. Press "0" to add spaces if needed.
5. Repeat steps 3 and 4 until your loop code label is complete.
6. Press **Save & Exit** when finished.

3.5 INTELLIGENT REPEATERS

This section provides the details to help you configure and test the Repeater and HDSL cards listed in Table 3-2 and Table 3-3.

3.5.1 Repeater Commands

The **REPEATER CMDS** softkeys become available when loop code **RPTR** or **HDSL** is selected and dynamically change based on the Repeater or HDSL type is selected. The available softkeys depend on the card selected, the codes (PairGain or Adtran), and origin of test.

Timeout Disable — Disables the loopback, time-out function of the repeater.

Loopback Query — Returns address of the repeater that is in loopback.

Power Query — Returns address of the repeater that is currently looping back the power.

Issues Query — Returns the issue (revision) of the repeater.

Power Down/Power Up — The Teltrend IHR and the IOR accept **Power Down** commands because both are capable of supplying power to the span. When **Power Down** command is set, the command is received and turns the power off the span. As long as the repeater is receiving this Power Down sequence command, it will continue to power down. However, when the command is no longer being received (using **Power Up**), the power is then restored. This can take up to at least 5 seconds. This function is typically used to reset the line, particularly if a repeater in loopback cannot be looped down via commands.

Sequential Loopback — Loops up/down T1 line repeaters on the span in sequence, starting with the repeater nearest the T-BERD 950, and proceeds down the span, regardless of the repeater's address. Pressing **Seq Loopback** transmits the sequential loopback code. The first repeater on the span will loop up, return its address, then loop down. This loopback procedure continues for each repeater on the span.

Table 3-4 lists the command sets and addresses for the Repeater Type.

Table 3-4 Commands and Addresses for Repeaters

Command Set	Address	Repeater Type
1	—	Teltrend 7231LP/LW IOR
	—	Teltrend 9132LP/LW IHR
2	up to 20	Teltrend 7239LP/LW ILR
3	up to 1999	Westell 3130-80 IOR
	up to 2	Westell 3130-56 IOR
4	up to 1999	Westell 3150-80 ILR
	up to 1999	Westell 3150-81 ILR
5	up to 20	Westell 3150-56 ILR
	up to 20	Westell 3151-56 ILR

Table 3-5 shows the commands available for each command set.

Table 3-5 Command Sets

Command	Set 1	Set 2	Set 3	Set 4	Set 5
Timeout Disable	✔	✔	✔	✔	✔
Loopback Query	✔	✔	✔	✔	✔
Power Query	✔	✔			✔
Issues Query	✔	✔			
Power Up	✔		✔		
Power Down	✔		✔		
Sequential Loopback	✔	✔			

3.5.2 Repeater Command Softkeys

The **REPEATER CMDS** softkey provides access to **ARM, NEAR END ARM, DISARM, ADDR UP,** and **ADDR DWN** softkeys in addition to the Repeater Commands listed in Section 3.5.1.

ARM — Transmits an arming code on the span when testing from the Central Office toward the NIU to prepare the span for receipt of loop-up or loop-down codes.

NEAR END ARM — Transmits a near end arming code on the span when testing from the NIU toward the Central Office (CO) to prepare the span for receipt of loop-up or loop codes.

DISARM — Transmits a disarming code on the span to disarm the span when testing is completed.

ADDR UP/ ADDR DWN — Increments or decrements (by one) the repeater address from the current address.

3.5.3 Loop Code Tables

The following tables list by Repeater and HDSL card type, the Repeater commands, and loop codes.

Teltrend Repeater Command Loop Codes are listed in Table 3-6.

Table 3-6 Teltrend Repeater Command Loop Codes

Repeater	Command	Loop Code
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Arm (Inband)	11000
	Arm ESF Datalink	0001 0010 1111 1111
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Disarm (Inband)	11100
	Disarm ESF Datalink	0010 0100 1111 1111
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Near End Arm	11000
7231 LP IOR 7231 LW IOR 9132 LP IHR	Loop Up	1101 0011 1101 0011
7231 LW IOR 7231 LW IHR	Loop Up	1100 0101 0100 0001
7239 LP/LW ILR	Loop Up	1100 0111 010A AAAA [1]
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Loop Down	1001 0011 1001 0011
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Loop Back Timeout Disable	1101 0101 1101 0110
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Loop Back Query	1101 0101 1101 0101
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Power Loop Query	0101 1011 0101 1011
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Issues Query	0101 0110 1011 0111

Table 3-6 Teltrend Repeater Command Loop Codes (Continued)

Repeater	Command	Loop Code
7231 LP IOR 9132 LP IHR	Power Down	0110 0111 0110 0111
7231 LW IOR 9132 LW IHR	Power Down	0101 0110 1111 1011
7231 LP/LW IOR 9132 LP/LW IHR	Power Up	Removes Power Down Code
7231 LP/LW IOR 7239 LP/LW ILR 9132 LP/LW IHR	Sequential Loop Back	1100 0111 1101 0010

1. Replace the A in the loop code with the repeater address.

Westell Repeater Command Loop Codes are listed in Table 3-7.

Table 3-7 Westell Repeater Command Loop Codes

Westell Repeater	Command	Loop Code
3130-80 IOR 3150-80 ILR 3150-81 ILR 3150-56 ILR 3151-56 ILR 3130-56 IOR	Arm (Inband)	11000
	Arm ESF Datalink	1111 0100 1000
3130-80 IOR 3150-80 ILR 3150-81 ILR 3150-56 ILR 3151-56 ILR 3130-56 IOR	Disarm (Inband)	11100
	Disarm ESF Datalink	1111 1111 0010 0100
3130-80 IOR	Loop Up	1100 0AAA AAAA AAAA [1]
3150-80 ILR 3150-81 ILR	Loop Up	1100 1AAA AAAA AAAA

Table 3-7 Westell Repeater Command Loop Codes (Continued)

Westell Repeater	Command	Loop Code
3150-56 ILR 3151-56 ILR	Loop Up	1100 0111 010A AAAA
3130-56 IOR	Loop Up	1101 0011 1101 001A
3130-80 IOR	Loop Down	1110 0AAA AAAA AAAA
3150-80 ILR 3150-81 ILR	Loop Down	1110 1AAA AAAA AAAA
3150-56 ILR 3151-56 ILR 3130-56 IOR	Loop Down	1001 0011 1001 0011
3130-80 IOR 3150-80 ILR 3150-81 ILR 3150-56 ILR 3151-56 ILR 3130-56 IOR	Timeout Disable	1101 0101 1101 0110
3130-80 IOR 3150-80 ILR 3150-81 ILR 3150-56 ILR 3151-56 ILR 3130-56 IOR	Loop Back Query	1101 0101 1101 0101
3150-56 ILR 3151-56 ILR	Power Loop Query	0101 1011 0101 1011
3130 56 IOR	Power Down	0110 0111 0110 0111
3130-80 IOR	Power Down	1100 0111 1101 0001
3130 56 IOR 3130-80 IOR	Power Up	Removes Power Down Code

1. Replace the A in the loop code with the repeater address.

XEL Line Repeater Command Loop Codes are listed in Table 3-8.

Table 3-8 XEL Line Repeater Loop Codes

Repeater	Command	Loop Code
XEL 7853-200 ILR	Arm (Inband)	11000
	Arm ESF Datalink	0001 0010 1111 1111
	Disarm	11100
	Disarm ESF Datalink	0010 0100 1111 1111
	Loop Up	16-bit BCD Exchange Code + 12-bit BCD Location Code + 1111
	Loop Down	1110 0101 0101 0101
	Timeout Disable	12-bit BCD Location Code + 1111

PairGain Generic Repeater Command Loop Codes are listed in Table 3-9.

Table 3-9 PairGain Generic Loop Codes

Repeater	Command	Loop Code
HLU	Loop Up (from Central Office)	1111000
HRU	Loop Up (from Central Office)	1110000
HDU1 (1st Doubler)	Loop Up (from Central Office)	110000
HDU2 (2nd Doubler)	Loop Up (from Central Office)	111000
HDU3 (3rd Doubler)	Loop Up (from Central Office)	1010001

Table 3-9 PairGain Generic Loop Codes (Continued)

Repeater	Command	Loop Code
HDU4 (4th Doubler)	Loop Up (from Central Office)	1010010
HLU	Loop Up (from Customer Prem)	1111110
HRU	Loop Up (from Customer Prem)	1111100
HDU1 (1st Doubler)	Loop Up (from Customer Prem)	111100
HDU2 (2nd Doubler)	Loop Up (from Customer Prem)	111110
HDU3 (3rd Doubler)	Loop Up (from Customer Prem)	1011001
HDU4 (4th Doubler)	Loop Up (from Customer Prem)	1011010
All PairGain Repeaters	Loop Down	11100

PairGain A2LB Repeater Command Loop Codes are listed in Table 3-10. Each command and loop code are will loop up repeaters from the Central Office.

Table 3-10 PairGain A2LB Loop Codes

Repeater	Command	Loop Code
All Repeaters	Arm (Inband)	11000
	Arm ESF Datalink	1111 1111 0100 1000
	Disarm (Inband)	11100
	Disarm ESF	1111 1111 0010 0100
HLU	Loop Up	1101 0011 1101 0011
HRU	Loop Up	1100 0111 0100 0010

Table 3-10 PairGain A2LB Loop Codes (Continued)

Repeater	Command	Loop Code
HDU1 (1st Doubler)	Loop Up	1100 0111 0100 0001
HDU2 (2nd Doubler)	Loop Up	1100 0111 0101 0100
HDU3 (3rd Doubler)	Loop Up	1100 0111 0100 0011
HDU4 (4th Doubler)	Loop Up	1100 0111 0100 0100
All Repeaters	Loop Down	1001001
All Repeaters	Timeout Disable	1101 0101 1101 0110

Adtran Abbreviated Repeater Command Loop Codes are listed in Table 3-11.

Table 3-11 Adtran Abbreviated Loop Codes

Repeater	Command	Loop Code
HTU-R (Central Office)	Loop Up	1110000
HTU-C (Central Office)	Loop Up	1111000
1st Repeater (Central Office)	Loop Up	110000
2nd Repeater (Central Office)	Loop Up	111000
HTU-R (Customer Prem)	Loop Up	1111100
HTU-C (Customer Prem)	Loop Up	1111110
1st Repeater (Customer Prem)	Loop Up	111100
2nd Repeater (Customer Prem)	Loop Up	111110
All Repeaters	Loop Down	11100

Adtran Standard Repeater Command Loop Codes are listed in Table 3-12.

Table 3-12 Adtran Standard Loop Codes

Repeater	Command	Loop Code
All Repeaters	Arm (Inband)	11000
	Arm ESF Datalink	0001 0010 1111 1111
	Disarm (Inband)	11100
	Disarm ESF Datalink	0010 0100 1111 1111
HTU-C	Loop Up	1101 0011 1101 0011
HTU-R	Loop Up	1100 0111 0100 0010
HRE 1 (Repeater 1)	Loop Up	1100 0111 0100 0001
HRE 2 (Repeater 2)	Loop Up	1100 0111 0101 0100
All Repeaters	Loop Down	1001 0011
All Repeaters	Timeout Disable	1101 0101 1101 0110

3.6 VOICE SETUP

Voice testing enables the user to communicate over a single DS0 utilizing the built-in microphone and speaker. The following additional menu choices are available on the T1 Interface Setup Screen (see Figure 3-2) when **VOICE** is the test type selected.

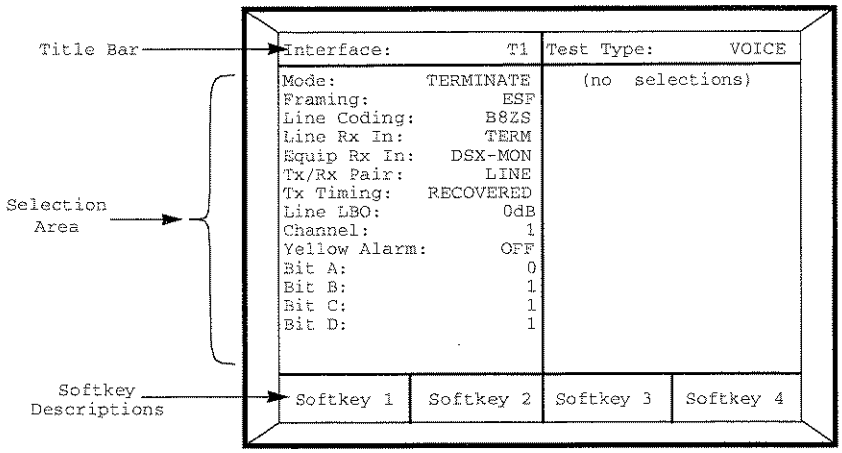


Figure 3-2 Voice Testing Setup Screen

Chan Format — (**SF** framing only) Enables selection of the desired channel format, **D1D**, **D2**, or **D3/D4** (default value is **D3/D4**).

Channel — Enables selection of the DS0 channel (1 to 24 may be selected) to be used for voice testing (default value is **1**). The numeric keypad or the **Select** keys can be used to enter the channel value. The delete key (**DEL**) on the keypad is used to delete the right-most digit of the current value.

Bit A — *(Voice Testing only)* When selected, enables setting signaling bit **A** to **0** or **1** (default value is **0**).

Bit B — *(Voice Testing only)* When selected, enables setting signaling bit **B** to **0** or **1** (default value is **1**).

Bit C — *(Voice Testing only — ESF framing only)* When selected, enables setting signaling bit **C** to **0** or **1** (default value is **1**).

Bit D — *(Voice Testing only — ESF framing only)* When selected, enables setting signaling bit **D** to **0** or **1** (default value is **1**).

3.7 BIT ERROR RATE TESTING (BERT) SETUP SCREEN

The BERT setup screen is used to configure the BER Test to be performed. The **Scroll ⇕** and **Select ⇕** keys are used to control this selection area. In the following paragraphs, the **Scroll ⇕** keys are used to select the active selection line, and the **Select ⇕** keys (unless stated otherwise) are used to cycle through the available choices.

Pattern — *(Terminate, D&I, and Monitor only)* When selected, enables the selection of the required test pattern (default is **2047**). Unless otherwise stated, all patterns are transmitted from left to right and are available for use in full T1 and fractional T1 testing. The choices include:

All Ones — Selects a fixed pattern of AMI pulses.

All Zeros — *(full T1 only)* Selects the B8ZS Clear Channel Compatibility Test Pattern.

1:7 — *(full T1 only)* Selects a fixed pattern — F01000000... where F is the frame bit.

2 in 8 — *(full T1 only)* Selects a fixed pattern — F01000010... where F is the frame bit.

3 in 24 — *(full T1 only)* Selects a fixed pattern — F010001000000000000000100... where F is the frame bit.

QRSS — Selects the 2^{20}-1 Pseudorandom pattern with a maximum of 15 sequential 0s and 20 sequential 1s.

2^23-1 — Selects the 2^{23}-1 Pseudorandom pattern, which generates a maximum of 22 sequential 0s and 23 sequential 1s.

2^20-1 — Selects the 2^{20}-1 Pseudorandom pattern, which generates a maximum of 19 sequential 0s and 20 sequential 1s.

2^15-1 — Selects the 2^{15}-1 Pseudorandom pattern, which generates a maximum of 14 sequential 0s and 15 sequential 1s.

2^15-1 INV — Selects the inverted 2^{15}-1 Pseudorandom pattern, which generates a maximum of 15 sequential 0s and 14 sequential 1s.

63 — *(fractional T1 only)* Selects the 2^{6}-1 Pseudorandom pattern, which generates a maximum of 5 sequential 0s and 6 sequential 1s.

511 — *(fractional T1 only)* Selects the 2^{9}-1 Pseudorandom pattern, which generates a maximum of 8 sequential 0s and 9 sequential 1s.

511 QRS — *(fractional T1 only)* Selects the 2^9-1 Pseudorandom pattern, which generates a maximum of 7 sequential 0s and 9 sequential 1s.

2047 — Selects the 2^{11}-1 Pseudorandom pattern, which generates a maximum of 10 sequential 0s and 11 sequential 1s.

2047 QRS — *(fractional T1 only)* Selects the 2^{11}-1 Pseudorandom pattern, which generates a maximum of 7 sequential 0s and 11 sequential 1s.

T1-1 (MIN/MAX) — *(full T1 only)* Selects a fixed pattern that generates rapid changes in ones density.

T1-2/96 — *(full T1 only)* Selects the 96 octet fixed stress pattern (transmitted right to left).

T1-3/54 — *(full T1 only)* Selects the 54 octet fixed stress pattern (transmitted right to left).

T1-4/120 — *(full T1 only)* Selects the 120 octet fixed stress pattern (transmitted right to left).

T1-5/53 — *(full T1 only)* Selects the 53 octet fixed stress pattern (transmitted right to left).

T1-6/55 — *(full T1 only)* Selects an unframed 55 octet fixed stress pattern (transmitted right to left).

T1 Daly — *(full T1 only)* Selects a framed 55 octet fixed stress pattern (transmitted right to left). This is the same as T1-6/55, except that byte 7 is 80 instead of 00.

DDS1 — Selects a pattern consisting of: 100 octets of 0xFF followed by 100 octets of 0x00, transmitted right to left.

DDS2 — Selects a pattern consisting of 100 octets of 0x7E, followed by 100 octets of 0x00, transmitted right to left.

DDS3 — Selects a fixed pattern consisting of 0xF0011 0010 [0x32], transmitted right to left, where F is the frame bit.

DDS3R — Selects a fixed pattern the reverse of DDS3.

DDS4 — Selects a fixed pattern consisting of 0xF0100 0000 [0x40], transmitted right to left, where F is the frame bit.

DDS5 — Selects a pattern consisting of DDS patterns 1-4.

DDS6 — Selects a fixed pattern consisting of seven octets of 0x7F, followed by one octet of 0xFF, transmitted right to left.

PROG — Selects a user programmable pattern from 3 to 32 bits long (transmitted left to right). The default is **01010101**. When selected, the following selection line is available:

Prog Pattern — (*Available only when* **PROG** *is the selected pattern*) Enables programming of a user programmable pattern (transmitted left to right) using the softkeys and keypad. The pattern must be at least 3 binary characters and no more than 32 binary characters in length. If an invalid pattern is entered, a Validation Error appears on the display. The following softkeys are available:

Home — Places the cursor at the beginning of the binary data string.

End — Places the cursor at the end of the binary data string.

Clear — Deletes the current binary data string.

LONG USER n — Selects Long User Pattern n (where n = 1 or 2), programmable from 3 to 2048 bytes long (transmitted right to left). The default is **T1-6**. When selected, the following selection line is available:

User Pattern n — (*Available only when* **LONG USER n** *is the selected pattern, where n = 1 or 2*) Accesses Long User Pattern n for editing. To edit the pattern, press the **SCROLL ll** key so it is positioned over User Pattern n and is displaying the **Edit** softkey. Press the **Edit** softkey to access the User Pattern n Edit Screen. The pattern can now be edited using the softkeys and the keypad. The displays shows the cursor position within the byte and nibble, along with the total number of bytes in the pattern string. The following softkeys are displayed:

Clear String — Deletes the entire pattern.

Abort Changes — Deletes all edits made to the pattern and returns the display to the Test Type Set Up Screen.

Save & Exit — Saves the current pattern and exits the editing function. This softkey appears constant in edit mode.

Pressing the displayed **More Keys** softkey displays the following additional softkeys:

Cursor Home — Places the cursor at the beginning of the pattern.

Cursor End — Places the cursor at the end of the pattern.

Save & Exit — Saves the current pattern and exits the popup User Pattern Edit Screen. This softkey appears constant in edit mode.

Pressing the displayed **More Keys** softkey displays the following additional softkeys:

Prev Page — Places the cursor at the beginning of the previous page.

Next Page — Places the cursor at the beginning of the next page.

Save & Exit — Saves the current pattern and exits the User Pattern n Edit Screen. This softkey appears constant in edit mode.

The left and right arrow keys on the keypad are used to move the cursor to an individual bit in the pattern. The **DEL** (delete) key on the keypad is used to delete individual program bits, and the zero (0) and one (1) keys on the keypad are used to enter new bit values into the pattern.

Bridgetap — *(full T1 only)* Selects an automated test that transmits 21 consecutive test patterns: ALL ONES, 1:1, 1:3, 1:5, 1:6, 1:7, 2:8, 2:9, 2:10, 2:11, 2:12, 2:13, 2:14, 3in18, 3in19, 3in20, 3in21, 3in22, 3in23, 3in24, and QRSS.

Multipat — *(full T1 only)* Selects an automated test that transmits 5 consecutive test patterns: ALL ONES, 1:7, 2:8, 3in24, and QRSS. When selected, the following selection lines are available:

Pattern n Time — Enables setting the transmission time for Pattern n (where n = 1 through 5). The time can be set from 0 to 15 minutes. The numeric keys on the keypad or the **Select II** keys can be used to set the time. The DEL (delete) key on the keypad can be used to delete the right-most digit of the time entry.

NOTE

A pattern set to 0 minutes is not transmitted. At least one pattern must be set to a non-zero value.

Auto Pattern — Automatic Pattern Search. Enables the T-BERD 950 to automatically search for and identify a known test pattern on the LINE interface. The unit displays "Auto Pattern Searching" on the two line Results display. If a pattern match occurs, the pattern name appears in the Pattern configuration field and is displayed in lowercase letters, along with an asterisk. If the unit cannot achieve pattern synchronization, it defaults to a "live" condition, indicating that live customer traffic is most likely being received on the circuit. An "All Ones" BERT will be transmitted by the T-BERD 950 in this scenario. The test set remains in this Auto Pattern mode until a BERT pattern is selected.

Table 3-13 AUTO Pattern Example

Received BERT pattern	AUTO Mode Selection
QRSS	*qrss
2047	*2047

NOTE

The unit remains in AUTO mode until a specific pattern is selected. Press RESTART key to start the auto search process again.

AUTO-R — Automatic Restart Pattern Search. The unit operates in the manner described above however, it automatically begins to search for pattern synchronization upon the loss of pattern sync. Upon re-sync, the BER results will be cleared and begin counting from zero.

NOTE

Auto mode should not be used when performing long-term, unattended testing. The test set remains in this mode until a BERT pattern is selected.

Delay Pattern — Used to measure round trip delay. Delay Pattern measurement requires a transmitter/receiver loopback, with the transmit rate equal to the receive rate. This test measures round trip delay once per second (or until previous delay measurement is complete) for the length of the test, provided pattern sync is present. Normal BER test results (i.e., bit errors and pattern sync) are not available during the DELAY testing.

Err Ins Type — *(Terminate and D&I Modes only)* When selected, enables selection of the type of error to be inserted in the data stream when the **ERROR INSERT** key is pressed (default is **LOGIC**). The choices include:

LOGIC — Enables insertion of bit (logic) errors. Single errors or an error rate can be selected by using the **Error Insert** key.

BPV — Enables insertion of bipolar violation errors. Single errors or an error rate can be selected by using the **Error Insert** key.

L&BPV — Enables insertion of logic and bipolar violation errors. Single errors or an error rate can be selected by using the **Error Insert** key.

NOTE

The logic and BPV errors are generated independently and are not guaranteed to coincide (e.g., the logic and BPV errors may not be generated on the same bit).

FRAME — Enables insertion of frame errors. One through 6 consecutive errors or Continuous can be selected.

Error Rate — *(Terminate and D&I Modes only)* When selected, enables selection of the error rate to be applied to the data stream that is inserted in the active channel when the **ERROR INSERT** key is pressed and held for approximately 2 seconds (pressing the **ERROR INSERT** key a second time cancels error rate insertion). The choices include:

1x10-3 — Inserts errors at a rate of 1x10-3.

NOTE

If while inserting errors at a rate of 1x10-3signal loss occurs, frame sync and pattern sync can only be regained by turning off **ERROR INSERT** *or changing the error rate.*

1x10-6 — Inserts errors at a rate of 1x10-6.

SECTION 4 AUXILIARY FUNCTIONS

4.1 INTRODUCTION

The T-BERD 950 mainframe Auxiliary (AUX) functions enable access to system parameters. The Auxiliary functions are accessed by use of the AUX screen of the Graphic Display. Refer to Section 2 of this User's manual for further information on the use of the Graphic Display. Information on the AUX screen can be found in 2.6 of this User's manual.

4.2 AUX FUNCTIONS

The following paragraphs provide a description of each auxiliary function, the selection choices available for the function and how the function is selected or edited.

Date — Displays the date in MM/DD/YY (Month/Day/Year) format. The **Left** and **Right** arrow keys (on the keypad) are used to move the cursor to the required digit. The **Numeric (0 - 9)** keys are used to enter the required number.

Time — Displays the time in HH:MM:SS (Hours:Minutes:Seconds) format. The **Left** and **Right** arrow keys (on the keypad) are used to move the cursor to the required digit. The **Numeric (0 - 9)** keys are used to enter the required number.

Timed Test Type — Selects the type of test to be run. The choices are **TIMED** or **CONTINUOUS**. If **TIMED** is selected the following selection line is displayed and must be configured.

Timed Test Length — Used to enter the amount of time, in HHH:MM (Hours:Minutes) format, that a timed test is to run. The **Left** and **Right** arrow keys (on the keypad) are used to move the cursor to the required digit. The **Numeric (0 - 9)** keys are used to enter the required number. A time of zero (0) causes continuous testing.

NOTE

When **CONTINUOUS** *is selected the test runs continuously until the* **Restart** *switch is pressed or the analyzer is powered off.*

Default Mic Operation — Used to set the default microphone operating mode to Push-to-Talk.

Display Backlight — Used to vary the length of time the display backlight remains on. Turning off the backlight will extend operating time when operating on battery power. The choices include:

AUTO 5 MIN — Turns the backlight on for 5 minutes when a front panel key is pressed. If no front panel key is pressed for a period of 5 minutes, the backlight is turned off.

ON — Turns the backlight on.

OFF — Turns the backlight off.

System Information — Used to display system option and version information. The following softkeys are displayed when **System Information** is selected:

Software Versions — Displays the versions of all software on the system PCMCIA card.

Installed Options — Displays the hardware and software options currently installed.

Upgrade Card Info — Displays the uninstalled options available on a system PCMCIA card.

Condition Battery — Used to reset the internal fuel gauge maximum capacity to the actual available capacity of the batteries when fully charged. This function should be used whenever the batteries are changed, the Battery Performance Index (BPI) or Battery Capacity result is "Invalid", or the reported capacity of the batteries does not correlate to the actual operating time available.

The battery conditioning cycle can take as long as 12 hours if it is started with fully discharged batteries. During the cycle, the analyzer should be left **On** and not disturbed. At the end of conditioning, the BPI result is updated to reflect the total capacity of the batteries when fully charged. This capacity will diminish over time as the batteries wear (this is normal). At BPIs below 50%, the user should contact TTC to obtain new batteries

Alert on Alarm Category Updates — Controls whether a notification message is displayed on the Two Line display when an alarm is detected. If set to "**Yes**", a message flashes until the user verifies the alarm logged in the Alarm Result Category. Selecting "**No**" disables the notification message but alarms are still logged.

Enable Power Loss Detection — Setting this function to "**Yes**" enables detection and incrementing of the **Power Loss** result in the Summary Category. When set to "**Yes**", the **Power Loss** result increments each time the analyzer is powered on. The **Power Loss** result is cleared whenever the **Restart** key is pressed. If detection is set to "**No**", the **Power Loss** result is not displayed.

Clear Memory to Factory Defaults — Used to clear the nonvolatile random access memory (NOVRAM). The choices are **NO** or **YES**. A confirmation popup window is displayed when "**Yes**" is selected. This window states that the NOVRAM will be reset to the factory defaults and the analyzer will reboot.

SECTION 5 TEST RESULTS

5.1 INTRODUCTION

This section provides information on the T-BERD 950 Two Line Display and the test results available for the mainframe, T1 interface, and BER testing.

5.2 TWO LINE DISPLAY

Test results for the T-BERD 950 are displayed on an LCD display referred to as the 2 Line Display. The Two Line Display and associated controls and indicators, located on the front panel above the keypad, are shown in Figure 5-1. The following paragraphs describe the Display and the use of the controls and indicators associated with it.

NOTE

Test results can also be displayed on the RESULTS III graphic display screen (refer to Section 2.5 for more information on the Results III graphic display screen).

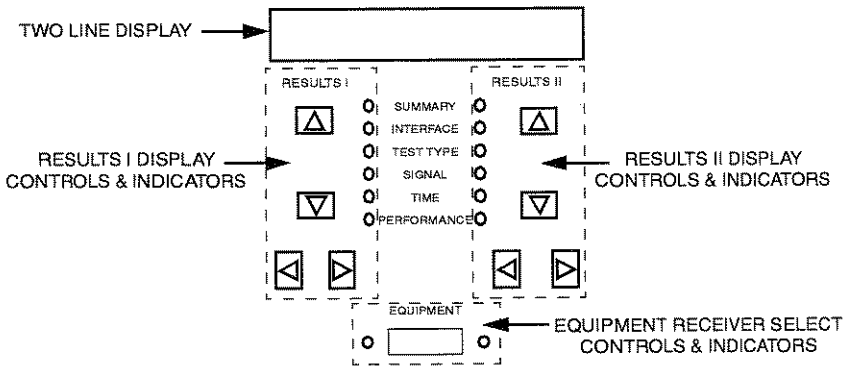


Figure 5-1 Two Line Display Area

5.2.1 LCD

The Two Line Display is a two line by 24 character liquid crystal display (LCD). The display is divided vertically into two sections; the Results I Display (left side) and the Results II Display (right side). The top line on each side of the LCD displays the result label. The bottom line on each side of the LCD displays the result.

5.2.2 Results I Display Controls and Indicators

The Results I Display controls and indicators consist of the **Results I Category** keys (up and down arrows), the **Results I Select** keys (left and right arrows), and the category LED indicators. The controls and indicators are used as follows.

- **Results I Category** keys — used to scroll up or down to select the required result category which illuminates the associated LED indicator. The available results categories include: Summary, Interface, Test Type, Signal, Time, and Performance.

NOTE

The Alarm category which is available on the Results III screen is not available on the Results I or Results II display.

- **Results I Select** keys — used to display the available results in the selected category.

5.2.3 Results II Display Controls and Indicators

The Results II Display controls and indicators consist of the Results II Category keys (up and down arrows), the Results II Select keys (left and right arrows), and the category LED indicators. The controls and indicators are used as follows.

- **Results II Category keys** — used to scroll up or down to select the required result category which illuminates the associated LED indicator. The available results categories include: Summary, Interface, Test Type, Signal, Time, and Performance.

NOTE

The Alarm category which is available on the Results III screen is not available on the Results I or Results II display.

- **Results II Select keys** — used to display the available results in the selected category.

5.2.4 Equipment Receiver Results Controls and Indicators

The **EQUIPMENT** switch is used to display EQUIPMENT Receiver results on the Two Line Display. Press the **EQUIPMENT** switch until the EQUIPMENT Receiver results are displayed on the **Results I** and/or **Results II** side of the Two Line Display (see Table 5-1 for the required settings).

Table 5-1 EQUIPMENT Switch/LEDs Settings

Left LED	Right LED	Results I Display	Results II Display
Off	Off	LINE Receiver results displayed	LINE Receiver results displayed
Off	On	LINE Receiver results displayed	EQUIPMENT Receiver results displayed
On	Off	EQUIPMENT Receiver results displayed	LINE Receiver results displayed
On	On	EQUIPMENT Receiver results displayed	EQUIPMENT Receiver results displayed

5.3 MAINFRAME TEST RESULTS

The test results available for the T-BERD 950 mainframe are described, in alphabetical order, in Table 5-2. The table provides the result name, the result category, and a description of the result.

Table 5-2 Mainframe Test Results

Result Name	Description
Time Category Results	
Batt Charge	Amount of battery charge remaining.
BPI (Battery Performance Index)	Indicates the amount of total charge capacity available when the batteries are fully charged.
Date	The date displayed in MM:DD:YY format.
Elapse Time	Number of hours, minutes, and seconds since a test start or a test restart.
Time	Time of day displayed in 24 hour format in hours, minutes, and seconds.

5.4 T1 INTERFACE TEST RESULTS

The test results available for the T-BERD 950 T1 Interface are described, in alphabetical order by category, in the following paragraphs.

NOTE

There are no **Test Type** *or* **Time** *Category results for the T1 Interface.*

5.4.1 Mainframe Alarm/Status LEDs.

Table 5-3 defines the T-BERD 950 front panel Alarm/Status LEDs as they pertain to the T1 Interface.

Table 5-3 Status/Alarm LEDs for T1 Interface

Status/Alarm LED	Description
SIGNAL	Illuminates green when the T-BERD 950 detects a T1 signal with frequency equal to 1,544,000 Hz ± 5,000 Hz and a level greater than -35 dBdsx. The LED indicates at which RECEIVE input (LINE 1 or LINE 2) the signal is detected. The red History LED illuminates when no signal is detected for a period of 150 ns.
FRAME SYNC	Illuminates green when the T-BERD 950 achieve frame synchronization with the received T1 data stream. The LED indicates at which RECEIVE input (LINE 1 or LINE 2) the signal is detected. The red History LED illuminates when two out of four received frame bits are in error.
PATTERN SYNC	Illuminates green when the received test pattern is recognized by the T-BERD 950 and pattern synchronization is achieved on the dropped line. Pattern synchronization depends on receiving a given number of consecutive error-free bits for the specific test pattern.

Table 5-3 Status/Alarm LEDs for T1 Interface (Continued)

Status/Alarm LED	Description
B8ZS	Illuminates green when the T-BERD 950 detects Bipolar 8-Zero Substitution clear-channel coding. The LED indicates which RECEIVE input (LINE 1 or LINE 2) detected the B8ZS coding. The red History LED illuminates when the B8ZS code is no longer detected at the corresponding input.
AIS	Illuminates red when the T-BERD 950 detects an Alarm Indication Signal. The LED indicates on which RECEIVE input (LINE 1 or LINE 2) the AIS is detected. The red History LED illuminates when the AIS is no longer detected.
YELLOW ALARM	Illuminates red when the T-BERD 950 detects a yellow alarm. The LED indicates on which RECEIVE input (LINE 1 or LINE 2) the yellow alarm is detected. The red History LED illuminates when a yellow alarm is no longer detected. Neither the Status nor the History LED illuminates if T1 frame sync has not been achieved.

5.4.2 Summary Category Results

The Summary category automatically displays key results that are non-zero or out-of-specification. The following results appear in the Summary category when the particular error conditions are detected.

BPVs (Bipolar Violation Count) — Interface Category
CRC Errors — Interface Category
Frm Errors (Frame Errors) — Interface Category
Frm Los Sec (Frame Loss Seconds) — Interface Category
Power Loss — Summary Category Only — A count of the number of times power has been lost since the last time the TEST RESTART key was pressed. Pressing the TEST RESTART key clears this result. This result can be enabled/disabled by a setting on the AUX screen.
T1Alarm Sec (T1 Alarm Seconds) — Summary Category Only — Count of test seconds when at least one of the following status results was present for a portion of the test second: **Yellow Alarm**, **AIS**, or **Insufficient Pulse Density**.
Timing Slip — Signal Category — Measurement of the accumulated difference between the T1 clocks: Rx Line is source and Rx Equipment is reference input (**Monitor** mode only).

NOTE

If all results are zero for the LINE or EQUIPMENT receiver, the message "`All Results OK`" is displayed on the appropriate side of the Two Line Display. If all results are zero for the LINE and EQUIPMENT receivers, the message "`All Results OK`" is displayed on both sides of the Two Line Display.

5.4.3 Interface Category Results

The Interface category results are described in Table 5-4.

Table 5-4 Interface Category Results

Result Name	Description
BPVs (Bipolar Violations)	Number of BPVs detected in the received signal (that are not embedded in valid B8ZS sequences) since start of test.
BPV Rate	Ratio of BPVs received over total bits received.
BPV Seconds (BPV Error Seconds)	Number of test seconds in which a BPV was received.
COFA Count (Change of Frame Alignment Count)	Number of times a Change of Frame Alignment occurred during the test.
CRC Errors (CRC-6 Errors)	Number of CRC-6 errors detected since the beginning of the test.
CRC Err Sec (CRC-6 Error Seconds)	Number of test seconds in which a CRC-6 error occurred.
CRC Er Rate (CRC-6 Error Rate)	Number of CRC-6 errors received divided by the total number of CRC-6s received.
Ex Zero Cnt (Excess Zeros Count)	Count of the number of strings of eight or more consecutive zeros in B8ZS or 16 or more zeros in AMI. Does not count if pattern sync present.
Frm Errors (Frame Errors)	Number of frame errors received since start of test
Frm Er Rate (Frame Error Rate)	Number of frame errors received divided by the number of framing bits received.

Table 5-4 Interface Category Results (Continued)

Result Name	Description
Frm Er Sec (Frame Error Seconds)	Number of test seconds in which a frame error occurred.
Frm Los Cnt (Frame Loss Count)	Count of the number of times frame synchronization has been lost during the test.
Frm Los Sec (Frame Loss Seconds)	Count of test seconds in which frame synchronization was not present for any part of the second.
Rcv Byte (Receive Byte)	Displays the receive data bytes for all channels in binary format.
DDS Rx Byte (DDS Receive Byte)	Displays the receive data byte for the current DS0 under test in binary format. Valid only with DDS payload.
DDS Rvc Code (DDS Receive Code)	Displays the received control code, by name when one is detected. When no control codes are detected, the message `Non Ctrl` is displayed. Table 5-5 lists the Receive Codes by name and binary. (Codes are transmitted left to right).

Table 5-5 DDS Control Codes

Control Code	Binary
ASC (Abnormal Station)	N001 1110
BLOCK (Block Code)	S000 1010
CHAN LPBK (Channel Loopback)	S010 1000
CTRL IDLE (Idle)	S111 1110
DATA IDLE (Data Idle)	S111 1111
DSU LPBK (DSU Loopback)	S010 1100
FEV (Far End Voice)	S101 1010
LBE (Loopback Enable)	S101 0110
LD ACK	S011 0010
LPBK ID (Loopback ID)	S101 0001
LSC DSU (Data Service Unit Loopback Select)	S011 0001

Table 5-5 DDS Control Codes (Continued)

Control Code	Binary
LSC NEI (Network Element Indicator Loopback Select)	S100 0001
MA (MJU Alert)	S111 0010
MAP0 (MAP0 Confirmation)	S001 0011
MAP1 (MAP1 Confirmation)	S110 1101
MOS (Mux Out Of Sync)	N001 1010
OCU LPBK (OCU Loopback)	S010 1010
RELEASE (Release Code)	S111 1000
TEST (Test Code)	S001 1100
TA (Test Alert)	S110 1100
TIP (Transition In Progress)	S011 1010
UMC (Unassigned Mux Channel)	N001 1000

5.4.4 Signal Category Results

The Signal Test Type category results are described in Table 5-6.

Table 5-6 Signal Category Results

Result Name	Description
ABCD Bits	Displays the status bits for all 24 channels. When framing is set to **SF** the AB bits are displayed, results could be 0, 1, or T (toggling between 0 and 1; only when QRSS is selected). When framing is set to **ESF** the ABCD bits are displayed. Only displayed on the RESULTS III screen.
Max Zeros (Maximum Consecutive Zeros)	Count of the maximum number of consecutive zeros on the T1 receiver since initial signal present (counts 0 to 250 with overflow indication).
R Lvl, dBdsx (Receive Level in dBdsx)	Level of received signal in dB relative to a standard 6 volt base-to-peak signal (DSX level). Measurement range is +6.0 dBdsx to -40.0 dBdsx with over and under value indication.

Table 5-6 Signal Category Results (Continued)

Result Name	Description
Rcv Lvl, dBm (Receive Level in dBm)	Power level of an all-ones signal. Measurement range is +23.0 dBm to -23.5 dBm (with over and under value indication).
Rcv Lvl, Vpp (Receive Signal Level in Volts peak-to-peak)	Level of the received signal in peak-to-peak volts. Measurement range is 12 V to 1 V if under 1 V the range is 0.99 V to 0.05 V
- Rcv Lvl, V (Negative Receive Level in Volts)	Level of the received signal in volts, measured on negative T1 pulses.
+ Rcv Lvl, V (Positive Receive Level in Volts)	Level of the received signal in volts, measured on positive T1 pulses.
Rx Freq, Hz (Receive Frequency in Hertz)	Current measurement of the receiver clock frequency in Hertz (1 Hz resolution from 0 to 9999999 Hz).
Sig Los Cnt (Signal Loss Count)	Number of times the signal has been lost.
Sig Los Sec (Signal Loss Seconds)	Count of test seconds in which the signal was not present for any part of the second.
Spx Cur, mA (Simplex Current in milliamps)	Measurement of the simplex current, in milliamps, on the T1 Line or T1 Equipment pair. Measurement range is 0 - 250 mA with accuracy of ±10% or 2mA, whichever is greater, with over range indication. **NOTE:** Only available on TX/RX pair side when in **TERMINATE** mode.
Timing Slip	Measurement of the accumulated difference between the T1 clocks: Rx Line is source and Rx Equipment is reference input. **NOTE:** Only available on **LINE** side when in **Monitor** mode.
Tx Freq, Hz (Transmit Frequency in Hertz)	Current measurement of the transmitter clock frequency in Hertz (1 Hz resolution from 0 to 9999999 Hz).

Table 5-6 Signal Category Results (Continued)

Result Name	Description
P-P Wndr, UI (Peak-to-Peak Wander)	Total deviation of the positive-to-negative peak wander since the beginning of the test, measured in unit intervals (UIs). **NOTE:** Only available on **LINE** side when in **Monitor** mode.
15m Wndr, UI (Maximum Peak-to-Peak Wander over 15 minutes)	Maximum peak-to-peak wander deviation over any 15 minute period of the test. Not available during first 15 minutes of the test, updated every minute thereafter. **NOTE:** Only available on **LINE** side when in **Monitor** mode.
24h Wndr, UI (Maximum Peak-to-Peak Wander over 24 hours)	Maximum peak-to-peak wander deviation over any 24 hour period of the test. Not available during first 24 hours of the test, updated every hour thereafter. **NOTE:** Only available on **LINE** side when in **Monitor** mode.
+ Pk Wndr, UI (Maximum Positive Peak Wander)	Maximum positive peak wander deviation since the beginning of the test, measured in UIs. **NOTE:** Only available on **LINE** side when in **Monitor** mode.
- Pk Wndr, UI (Maximum Negative Peak Wander)	Maximum negative peak wander deviation since the beginning of the test, measured in UIs. **NOTE:** Only available on **LINE** side when in **Monitor** mode.

5.5 BER TEST RESULTS

The test results available for the T-BERD 950 BER testing are described, in alphabetical order by category, in the following paragraphs.

NOTE

Interface, Signal, *and* **Time** *category results are not applicable to BER testing.*

5.5.1 Summary Category Results

The Summary category automatically displays key results that are non-zero or out-of-specification. The following results appear in the Summary category when the particular error conditions are detected.

Bit Errors — Test Type Category
Pat Slips (Pattern Slips) — Test Type Category

5.5.2 Test Type Category Results

The Test Type category results are described in Table 5-7.

Table 5-7 Test Type Category Results

Result	Description
Bit Errors	Count of the received bits that have a value opposite that of the corresponding transmitted bits, after pattern synchronization has been achieved.
BER (Bit Error Rate)	Ratio of bit errors to received pattern data bits.
Cur ST Patt (Current SyncTest Pattern)	Displays the current SyncTest pattern.
Errored Sec (Errored Seconds)	Count of test seconds where one or more bit errors occurred.
EFS (Error Free Seconds)	Count of the seconds during which pattern synchronization was maintained through the entire second and no bit error occurred.
%EFS (Percent Error Free Seconds)	Ratio, expressed as a percentage, of error free seconds to the total number of seconds during which pattern synchronization was maintained through any part of the second.
Pat Los Sec (Pattern Loss Seconds)	Count of the total number of seconds, after initial pattern synchronization, where pattern synchronization was not present for any length of time.
Pat Slips (Pattern Slips)	Count of the total number of pattern slips detected since the beginning of the test.

Table 5-7 Test Type Category Results (Continued)

Result	Description
PatSyncLoss (Pattern Synchronization Loss)	Pattern synchronization loss count.
RT Delay ms (Round Trip Delay in milliseconds)	Round trip delay in milliseconds for T1 applications (Resolution is 20 µs). **NOTE:** Only applicable when a delay pattern is selected.
SyncTest Results (Synchronous Test Results)	Displays the following test results for each pattern used in Bridgetap or Multipat testing: Bit Errors, Sync Seconds, and Errored Seconds.

5.5.3 Performance Category Results

The Performance category results are described in Table 5-8.

Table 5-8 Performance Category Results

Result	Description
Avail Sec (Available Seconds)	Count of available seconds per CCITT G.821.
% Avail Sec (Percent Available Seconds)	Ratio, expressed as a percentage, of available seconds to the number of test seconds.
Consec SES (Consecutively Severely Errored Seconds)	Count of the number of groups of three or more contiguous seconds in which an error rate greater than 10^{-3} was detected in each second.
Deg Min (Degraded Minutes)	The number of blocks of 60 non-severely errored, available seconds in which the average BER was worse than 10^{-6}.
%Deg Min (Percent Degraded Minutes)	Ratio of the number of degraded minutes to the number of minutes derived from available, non-severely errored seconds, expressed as a percentage.

Table 5-8 Performance Category Results (Continued)

Result	Description
G.821 EFS (Error Free Seconds, G.821)	Number of available seconds in which no bit errors occurred
G.821 %EFS (Percent Error Free Seconds, G.821)	Ratio of the number of available seconds in which no errors were detected to total number of available seconds.
SES (Severely Errored Seconds, G.821)	Count of the seconds in which the bit error ratio was greater than 10^{-3} within available time.
%SES (Percent Severely Errored Seconds, G.821)	Ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.
Unavail Sec (Unavailable Seconds, G.821)	Count of unavailable seconds per CCITT G.821.

5.5.4 Alarm Messages

Table 5-9 provides a list of results which appear on the RESULTS III Alarms Page along with a description of the alarm.

Table 5-9 RESULTS III Alarms Page

Result	Description
Not B8ZS Seq Det (Not B8ZS Sequence Detected)	Indicates B8ZS line coding is not present.
Pulse Den Violatn (Pulse Density Violation)	Indicates that a T1 pulse density violation which is triggered when 12.5% of the incoming pulses are spaces.

Table 5-9 RESULTS III Alarms Page (Continued)

Result	Description
DS1 Idle Present	Indicates the receiver has detected a DS1 idle code as defined by ANSI T1.403. This condition will also illuminate the YELLOW ALARM LED (ESF framing) or a blinking YELLOW ALARM LED (D4 framing).
Excess Zeros Det (Excess Zeros Detected)	Indicates more than 15 consecutive zeros have been detected.
Inv Pattern Sync (Inverted Pattern Sync)	Indicates pattern synchronization was achieved by inverting the received pattern.

SECTION 6 PRINTER OPERATION

6.1 INTRODUCTION

The T-BERD 950 printer subsystem works with a printer through the RS-232 interface (25-pin D connector). It supports the TTC PR-40A (DPU-411) and compatible printers. The T-BERD 950 printer serial interface can operate at speeds up to 9600 bps.

6.1.1 Printer Configuration

The T-BERD 950 printer supports common data rates up to 9600 bps (300, 1200, 2400, and 9600) of even, odd or no parity. It supports the follow on line terminator (CR, or CR/LF, LF, NONE) for the printer output. Standard RS-232 out-of-band flow control; stop bits and data length are also supported.

6.2 PRINTING

The T-BERD 950 printer performs manual prints by pressing the **Print Screen** softkey on the graphical display screen. This generates a Print Screen of the currently active graphical display screen ("Main," "Setup," "Results III," or "AUX").

The system prints based on your input for the AUX Screen Printer configurations. You can specify **Timed Prints** that generate Print Screens.

The T-BERD 950 uses the 39 column print format. Prints contain headers that show the product identifier, print type, user site, ID specification, and the date and time of the print. The site and ID fields can be configured from the AUX screen.

The site field is a string of from 1 up to 6 hex digits (i.e. "A1"). The ID field is a string of 2 numeric digits (00..99). The default of these fields is a blank space ( ). The time stamp is captured when screen capture is obtained for the print.

6.2.1 Manual Print Screen

With the T-BERD 950 printer, you can print the contents of the currently-active graphical screen display. Press the **Print Screen** softkey. Except for the screen borders and softkeys, they are shown as displayed on the screen. Figure 6-1 is an example of the T-BERD 950 Print Screen.

```
T-BERD 950  Print Screen
13:44:24  07/17/1998 SITE:        ID:
----------------------------------------
Test:T1 BERT                    Test Type
                    LINE
Bit Errors             3
Pat Slips              0
BER              5. E-08
Errored Sec            2
EFS                   36
%EFS               94.74%
Pat Los Sec            0
RT Delay,ms          N/A
PatSyncLoss            0
Inv Pattern        FALSE
Synctest ID          N/A
Synctest - Line      N/A
```

Figure 6-1 T-BERD 950 Print Screen

6.2.2 Timed Print Screen

The T-BERD 950 prints the current screen at a specified interval. Select this option as described in Section 6.2.4. Specify the time interval up to 999 hours in hours and 99 minutes.

6.2.3 Non-Volatile Storage of Prints

When a print is initiated, data is stored in non-volatile RAM (NOVRAM). This allows you to turn off the T-BERD 950 and retain the print buffers that have not been printed. If you connect it to a printer at a later time, the T-BERD 950 will resume printing until the buffers are empty.

NOTE

With the T-BERD 950 printer option, you can store screen information when you are out in the field and print it out later.

Always keep in mind that the T-BERD 950 printer has a fixed amount of NOVRAM reserved for storing print data. It can store at least 10 prints. These prints can be one or more manual or timed prints. If a print request is received

and there is not enough memory to store the print data, the T-BERD 950 does not store the print data. Instead, it alerts you to this condition by flashing the "Print Buffer Full" message on the 2-line display.

To temporarily clear the "Print Buffer Full" message, you can disable automatic printing in the AUX screen or press the **Restart** button. However, the message will reappear when another print request generates and the buffer is full. This is a reminder to you to clear the condition. The 2-line message is removed when the buffer becomes available.

You can use a configuration from the AUX Screen to clear the print buffer stored in NOVRAM. After setting the configuration to YES, you will be asked to confirm the operation using the softkeys. At this time you may confirm to clear the buffer or cancel the operation. The print buffer is cleared when you change the software version. Configuration errors and other system errors do not affect the print storage.

6.2.4 User Interface Configuration Requirements

The AUX screen is used to configure the Printer option for the T-BERD 950. The **Scroll II** and **Select II** keys are used to control this selection area. In the following paragraphs, the Scroll II keys are used to select the active selection line and the Select II keys (unless stated otherwise) are used to cycle through the available choices.

NOTE

The screen displays the ⇓ MORE ⇓ indicator on the bottom selection line in the test type category. If the display has been scrolled down to the point that there are selection lines hidden at the top of the display the ⇑ MORE ⇑ indicator is displayed on the top selection line.

Printer — Select one of the following choices. The default is **HIDE**.

HIDE — Hides the options.

DISPLAY — Displays other options to set up the print configuration.

NOTE

If Printer DISPLAY is selected, the remainder of the options are displayed on the AUX screen.

Site — Identifies the Site on the Print Header. Enter six characters of hex digit or leave blank. The default is blank.

Id — Identifies other characteristics of the site on the Print Header. Enter two characters of 0 to 9 or leave blank. The default is blank.

Timed Print Screen — Prints the current screen test results at a specified interval. Select **ON** or **OFF.**

Interval — **HHH:mm** Enter the print time. This only displays if the **Timed Prints** screen selection is **ON.** The default is 1:00 (one hour).

Clear Print Buffer — Use the Softkeys to select **YES** or **NO.** The default is **NO.** A dialog screen pops up to confirm your selection.

Printer Port — Use to select Printer Port options. Set the options based on your printer configuration. The default is **HIDE.**

HIDE — Hides the options.

DISPLAY — Displays other options to set up the printer port.

NOTE

If Printer Port DISPLAY is selected, the remainder of the options are displayed on the AUX screen.

Data Rate — Select the Baud Rate of **300, 1200, 2400, 4800,** or **9600.** Default is **9600.**

Stop Bits — Select the Stop Bits **1, 1.5,** or **2.** Default is **1.**

Data Length — Select the Data length **7** or **8.** Default is **8.**

Parity — Select Parity of **EVEN, ODD,** or **NONE.** Default is **NONE.**

Terminator — Select the termination of the Print. Default is **CRLF.**

CRLF — Carriage Return and Line Feed

CR — Carriage Return only

LF — Line Feed only

NONE — None

SECTION 7 OPTIONS

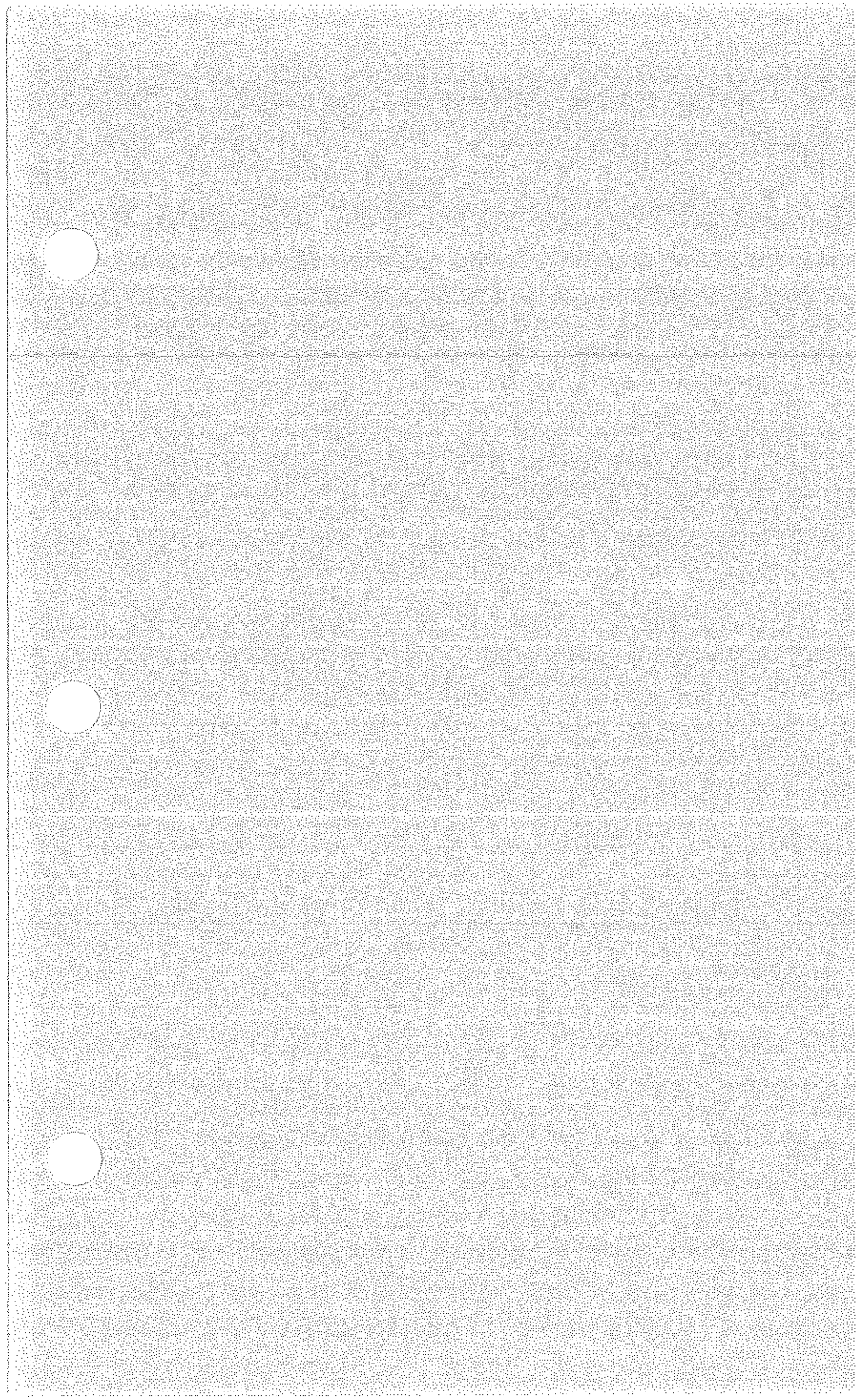
7.1 INTRODUCTION

This section lists the options available for the T-BERD 950 Communications Analyzer. The available options, each described in a separate subsection, include:

- **Digital Data System Local Loop Option** — Model No. TB950-LL.
- **Protocol Services Board** — Model No. TB950-PSB.
- **Frame Relay Option** — Model No. TB950-FR (requires Protocol Services Board).
- **ISDN Primary Rate Interface Option** — Model No. TB950-PRI (requires Protocol Services Board).
- **PCM TIMS Option** — Model No. TB950-TIMS.
- **Signaling Option** — Model No. TB950-SIG.
- **ISDN Basic Rate Interface Option** — Model No. TB950-BRI (requires Protocol Services Board).

NOTE

The Graphical Display SETUP screen displays presented in the following option sections are representative of a typical SETUP screen display. The actual SETUP screen displayed by the analyzer may vary due to the parameter choices selected or subsequent software or hardware enhancements to the analyzer.



50-14950-02
Rev. D

T-BERD® 950
DIGITAL DATA SYSTEM LOCAL LOOP (DDS LL) OPTION USER'S MANUAL

May 1999

This User's Manual applies to all T-BERD 950 Communications Analyzers incorporating Software Level 3.xx.

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DDS LL OPTION

1 GETTING STARTED

This section provides operating information for the Digital Data System Local Loop (DDS LL) option. The section is divided into the following subsections: Getting Started, Graphical Display Screens, and Test Results. The following paragraphs describe the contents of each of the subsections.

- **Subsection 1 — Getting Started**: This subsection provides an option description and the specifications for the option.
- **Subsection 2 — Graphical Display Screens**: This subsection provides a description of the Graphical Display Setup screen as it applies to the DDS LL option.
- **Subsection 3 — Test Results**: This subsection provides a description of the DDS LL option test results.

1.1 OPTION DESCRIPTION

The DDS Local Loop option enables the user to test from and analyze the DDS four-wire local loop. The electrical interface for the option is the eight position RJ-45 connector. This connector is compatible with both the RJ-45 (keyed, 8 position, 8 conductor) and RJ-48 (non-keyed) modular plugs. Only four conductors are used on the connector, Table DDS-1 explains the RJ-45 connector pin assignments in the various operating modes of the DDS Local Loop option.

Table DDS-1. RJ-45 Pin Assignments

Pin No.	Function	Pin No.	Function
OCU-DP Emulation Mode			
1	R (Receive Data, Ring Lead)	5	Not Used
2	T (Receive Data, Tip Lead)	6	Not Used
3	Not Used	7	T1 (Transmit Data, Tip Lead)
4	Not Used	8	R1 (Transmit Data, Ring Lead)

Table DDS-1. RJ-45 Pin Assignments (Continued)

Pin No.	Function	Pin No.	Function
DSU/CSU Emulation Mode			
1	R (Transmit Data, Ring Lead)	5	Not Used
2	T (Transmit Data, Tip Lead)	6	Not Used
3	Not Used	7	T1 (Receive Data, Tip Lead)
4	Not Used	8	R1 (Receive Data, Ring Lead)
Monitor Mode			
1	R (Receive Data, Ring Lead)	5	Not Used
2	T (Receive Data, Tip Lead)	6	Not Used
3	Not Used	7	T1 (Receive Data, Tip Lead)
4	Not Used	8	R1 (Receive Data, Ring Lead)

1.2 OPTION SPECIFICATIONS

Table DDS-2 lists the specifications for the DDS Local Loop Option.

Table DDS-2. Option Specifications

Item	Specification
Data Formats	Standard DDS — Two information bands utilized: the primary data channel, and out of band control codes (transmitted as BPV sequences). DDS with Secondary Channel — Three information bands utilized: the primary data channel, the secondary channel, and inband control codes.
Primary Channel Data Rates	2.4, 4.8, 9.6, 19.2, 38.4, 56, and 64 kbps.
Secondary Channel Data	Only the Idle, 511, and 2047 BER testing patterns are available — inband flow control is not available.
Clock Source	Recovered timing from received signal or internal synthesizer (menu selectable).

Table DDS-2. Option Specifications (Continued)

Item	Specification
Receive Signal	
Connection:	OCU-DP mode: RJ-45 pins 1 & 2. DSU/CSU mode: RJ-45 pins 7 & 8. MONITOR mode: RJ-45 pins 1 & 2 and 7 & 8.
Termination Impedance	Balanced, 135 Ω ±5%.
Bridging Impedance	Greater than 1900 Ω
Operating Range	+6.0 dB to -45 dB minimum (56 kbps and 64 kbps) -OR- +6.0 dB to -40 dB minimum (all other data rates).
Transmit Signal	
Connection:	OCU-DP mode: RJ-45: pins 7 & 8. DSU/CSU mode: RJ-45: pins 1& 2.
Termination Impedance	Balanced, 135 Ω, ±5%.
Output Levels	0, -3, -6, and -9 dB of simulated cable attenuation.
Test Modes	Terminate, Monitor or LLB (Line Loop Back)
Emulation Modes	DSU/CSU, OCU-DP or Metallic
Simplex Current	
Input Level	±30 mA maximum.
Measurement range	±26 mA with an accuracy of ±10% or 2 mA.
OCU-DP mode current output	4 mA to 20 mA depending on the length of the span
Error Insertion	
Operation	Single or continuous.
Error rate	1E-3.
Error insert type	Primary or secondary channel logic, BPV, L&BPV, or Frame.
Loop Response	V.54 DSU/CSU Disabled

1.2.1 Option Messages

The messages that may appear on the analyzer front panel displays during testing are provided in Table DDS-3.

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Table DDS-3. Option Messages

Message Category	Message
Receive Messages	Preexisting Loop Present In Loopback Sealing Current Loss (Alarm message)
Originating Messages	Transmitting Loop Up Transmitting Loop Down

2 GRAPHICAL DISPLAY SETUP SCREEN

This subsection provides descriptions of the analyzer Graphical Display SETUP screen (see Figure DDS-1) as it applies to the DDS LL option.

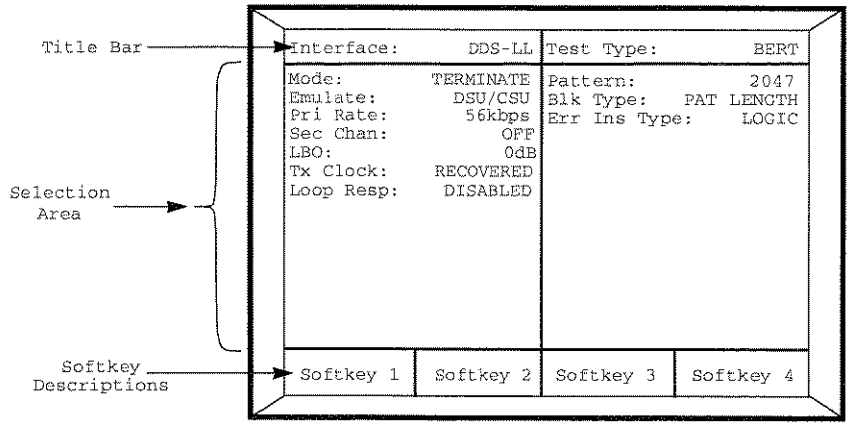


Figure DDS-1. DDS LL Option Setup Screen

2.1 DDS LOCAL LOOP INTERFACE SETUP SCREEN

The DDS Local Loop Interface setup screen is used to configure the DDS-LL interface. The DDS LL Interface parameters and the available choices for those parameters discussed in the following paragraphs. The **Scroll ↕** keys are used to select the active selection line and the **Select ↕** keys (unless stated otherwise) are used to move forward or backward through the available choices.

Mode — Enables selection of the operating mode (default value is **TERMINATE**). The choices include:

TERMINATE — Selects Terminate mode, the input signal is terminated at the receive side, and a totally independent signal is generated for the output.

MONITOR — Selects monitor mode (requires special DDS LL "Y" Cable, TTC part # 80-31591). The analyzer receives on both the T1/R1 pair and the T/R pair. In this mode the receive input is set to a high impedance bridge termination.

LLB — Selects Line Loop Back mode, which causes the analyzer to act as a repeater. All data received is echoed unchanged on the transmitter output.

Emulate — *(Terminate mode only)* Enables selection of the emulation used by the analyzer (default value is **DSU/CSU**). The choices include:

DSU/CSU — Selects DSU/CSU emulation. The analyzer receives on the T1/R1 pair and transmits on the T/R pair. In this emulation type the following parameter choice is available:

Tx Clock — enables selection of the transmit timing source (default value is **RECOVERED)**. The choices include:

RECOVERED — Selects the **LINE** receiver clock as the transmit timing source.

INTERNAL — Selects the internal frequency synthesizer as the transmit timing source.

Loop Resp — Selects the type of loopcode response performed by the analyzer (default value is **DISABLED**). The choices include:

V.54 — Enables V.54 loopcode response by the analyzer.

DSU/CSU — Enables DSU/CSU type loopcode response by the analyzer.

DISABLED — No loopcode response.

NOTE

In the DSU/CSU emulation, DSU/CSU Loop Resp responds to both alternating and latching CSU loop back requests and alternating and latching DSU loopback requests. Latching DSU is valid in framed formats (secondary channel and 64 kbps) only.

Loop Tx — Selects **V.54** loopcodes to be transmitted by the analyzer.

OCU-DP — Selects OCU-DP emulation. The analyzer receives on the T/R pair and transmits on the T1/R1 pair. **Tx Clock** is set to **Internal**. In this emulation type the following parameter choices are available:

NOTE

The T-BERD 950 when configured for OCU-DP mode can drive a non-repeater span up to 18000 feet. The OCU-DP mode simplex current conforms to 4-20 mA, 7-28 V which will not power a repeater located on the span.

Loop Resp — Selects the type of loopcode response performed by the analyzer (default value is **DISABLED**). The choices include:

V.54 — Enables V.54 loopcode response by the analyzer.

DISABLED — No loopcode response.

Loop Tx — Selects the type of loopcode transmitted by the analyzer (default value is **V.54**). The choices include:

V.54 — V.54 loopcodes are transmitted by the analyzer.

LAT CSU — Selects latching CSU (sealing current reversal).

METALLIC — Enables metallic loop testing and tip-ring short metallic testing. The following parameter is available:

Shorts — Enables selection of the type of cable test to be performed (default value is **TX-to-RX**). The choices include:

TX-to-RX — Connects the transmit tip (T) and ring (R) to the receive tip (T1) and ring (R1) respectively, via a metallic short.

TIPS-to-RINGS — Connect the transmit pair tip and ring and the receive pair tip and ring via a metallic short.

NOTE

In Metallic emulation, no DDS-LL results are gathered and BER testing is not performed.

Pri Rate — *(Terminate mode only)* When selected, enables selection of the data rate for transmission and analysis (default value is **56kbps**). The choices include: **2.4**, **4.8**, **9.6**, **19.2**, **38.4**, **56kbps**, or **64 kbps**.

When **Pri Rate** is set to 2.4, 4.8, 9.6, 19.2, 38.4, or 56 kbps the secondary channel parameter choices are available.

Sec Chan — Turns the secondary channel **ON** or **OFF** (default value is **OFF**). When set to **ON**, the following choices are available.

Analysis Chan — Selects the channel on which analysis is performed (default is **PRI**). The choices include:

PRI — Performs analysis on the Primary channel.

SEC — Performs analysis on the Secondary channel

Sec Chan Tx — Selects the type of data inserted on the secondary channel (default value is **511**). The choices include:

IDLE — Inserts idle code on the secondary channel.

511 — Inserts the 511 BER test pattern on the secondary channel.

2047 — Inserts the 2047 BER test pattern on the secondary channel.

LBO — *(Terminate mode only)* When selected, enables emulation of four different cable losses for the output signal level (default value is **0dB**). The selected cable loss affects the transmit data only at the connectors. The choices include:

0 dB — Sets the primary output (TX) to no line build-out (0 dB attenuation).

-3 dB — Provides -3 dB line build-out, attenuating the output with 3 dB of simulated cable loss.

-6 dB — Provides -6 dB line build-out, attenuating the output with 6 dB of simulated cable loss.

-9 dB — Provides -9 dB line build-out, attenuating the output with 9 dB of simulated cable loss.

2.2 TEST TYPE SETUP SCREEN

The Test Type setup screen is used to configure the test to be performed. The **Scroll ll** and **Select ll** keys are used to control this selection area. In the following paragraphs, the **Scroll ll** keys are used to select the active selection line and the **Select ll** keys (unless stated otherwise) are used to move forward or backward through the available choices.

Blk Type — When selected, enables selection of the block length for the currently selected pattern (default value is **PATT LNGTH**). The choices include:

PATT LNGTH — Sets the block length to the length of the currently selected pattern.

USER DEF — Enables the user to set a specific block length for the selected pattern. When selected the following menu choice is available:

Blk Length — Enables setting the block length to any value between 50 and 100000 (default value is **1000**). The keypad is used to enter the desired value. In addition, the **SELECT II** keys can be used to change the entered value. The delete (**DEL**) key is used to delete the right-most digit of the block length.

Err Ins Type — *(Terminate Mode only)* When selected, enables selection of the type of error to be inserted in the data stream when the **ERROR INSERT** key is pressed (default is **LOGIC**). The choices include:

LOGIC — Enables insertion of bit (logic) errors. Single errors or an error rate can be selected.

BPV — Enables insertion of bipolar violation errors. Single errors or an error rate can be selected.

L&BPV — Enables insertion of logic and bipolar violation errors. Single errors or an error rate can be selected.

NOTE

The logic and BPV errors are generated independently and are not guaranteed to coincide (e.g., the logic and BPV errors may not be generated on the same bit). In addition, the amount of errors inserted is determined by the use of the front panel **Error Insert** *key. Press the* **Error Insert** *key once to insert a single error. Press and hold the* **Error Insert** *key for approximately two (2) seconds to insert errors at a rate of 1x10-3, pressing the* **Error Insert** *key again to cancel the rate.*

FRAME — Enables insertion of a single frame error (**Sec Chan** must be set to **ON**).

NOTE

The number of frame errors inserted is set using the T1 BERT Test Type Setup screen. The errors are inserted using the **ERROR INSERT** *key.*

2.3 RESULTS III SCREEN

Refer to Section 2, of the *T-BERD 950 User's Manual* for a detailed description of the RESULTS III screen usage. A typical DDS LL Interface Category RESULTS III screen is shown in Figure DDS-2.

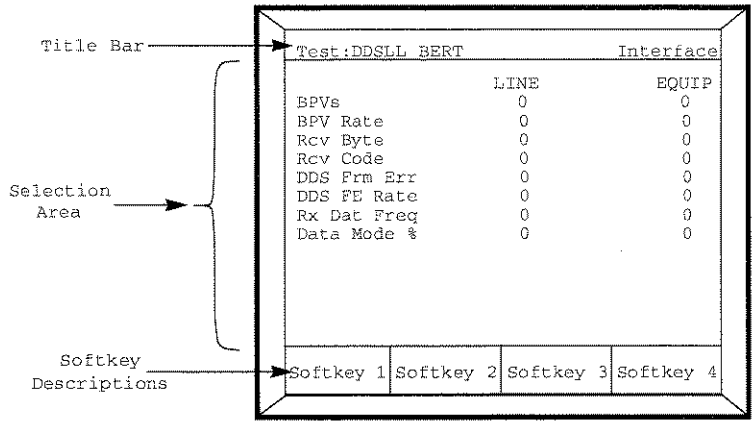


Figure DDS-2. Typical RESULTS III Interface Screen

2.4 AUX SCREEN

Refer to Section 2.6 of the *T-BERD 950 User's Manual* for a detailed description of the AUX screen usage.

3 TEST RESULTS

This subsection provides information on the analyzer Two Line Display and the test results available for the DDS LL option.

3.1 DDS LL OPTION TEST RESULTS

Test results for the DDS LL option are displayed on the analyzer Two Line Display. The Two Line Display and associated controls and indicators are located on the front panel above the keypad. Refer to Section 5 of the *T-BERD 950 User's Manual* for a detailed description of the Two Line Display.

Test results can also be displayed on the RESULTS III graphic display screen (refer to 2.5 of the *T-BERD 950 User's Manual* for more information on the RESULTS III graphic display screen).

NOTE

There are no **Time** *or* **Performance** *Category results for the DDS LL Interface.*

3.1.1 Mainframe Alarm/Status LEDs

The SIGNAL Status/Alarm LED illuminates green when a valid DDS signal is being received.

NOTE

A red illuminated LED indicates the Status/Alarm condition was previously true or present, since the start of the current test.

3.1.2 Summary Category Results

The Summary category automatically displays key results that are non-zero. The following results appear in the Summary category when the particular error conditions are detected.

BPVs (Bipolar Violation Count) — Interface Category
DDS Frm Err (DDS Frame Errors) — Interface Category

NOTE

If all results are zero for the LINE or EQUIPMENT receiver, the message "`All Results OK`*" is displayed on the appropriate side of the Two Line Display. If all results are zero for the LINE and EQUIPMENT receivers, the message "*`All Results OK`*" is displayed on both sides of the Two Line Display.*

3.2 INTERFACE CATEGORY RESULTS

The Interface category results are described in Table DDS-4.

Table DDS-4. Interface Category Results

Result Name	Description
BPVs (Bipolar Violations)	Number of BPVs detected in the received signal since start of test.
BPV Rate	Ratio of BPVs received over total bits received.
Data Mode % (Data Mode Percent)	Ratio of total control bits received in data mode to the count of total control bits received. Applicable only when secondary channel is active.

Table DDS-4. Interface Category Results (Continued)

Result Name	Description
DDS Frm Err (Frame Errors)	Number of frame errors received since start of test.
DDS FE Rate (Frame Error Rate)	Number of frame errors received divided by the number of framing bits received.
Rcv Byte (Receive Byte)	Data byte samples displayed in binary form. Applicable only when **Rate** is set to 64 kbps or secondary channel is active.
Rcv Code (Receive Code)	Displays the received bytes, which are interpreted as special network codes, in text form.
Rx Dat Freq (Receive Data Frequency)	Displays the receive data rate of the Primary or Secondary channel being analyzed, in bits per second (b/s).

3.2.1 Signal Category Results

The Signal category results are described in Table DDS-5.

Table DDS-5. Signal Category Results

Result Name	Description
Rcv Freq, Hz (Receive Frequency, in Hertz)	Current measurement of the receiver clock frequency in Hertz (.01 Hz resolution from 0000.00 to 9999.99 Hz; 0.1 Hz resolution from 10000.0 to 99999.9 Hz).
Rcv Lvl, dB (Receive Level in dB)	Power level of an all-ones signal measured in dB. Measurement range is 0 dB to -45.0 dB.
Rcv Lvl, Vpp (Receiver Signal Level in Volts peak-to-peak)	Level of received signal in peak-to-peak volts. Measurement range is 1.00 V to 4.00 V if under 1.00 V the range is 0 V to 0.999 V.

Table DDS-5. Signal Category Results (Continued)

Result Name	Description
Seal Cur, mA (Sealing Current)	Measurement of the loop up or loop down sealing current, in milliamps. Applicable in **MONITOR** and **EMULATE DSU/CSU** modes only.
Timing Slips	Measurement of the difference between the T/R and T1/R1 receivers while in **MONITOR** mode.

3.2.2 Test Type Category Results

The Test Type category results are described in Table DDS-6.

Table DDS-6. Test Type Category Results

Result Name	Description
Block Cnt[1] (Block Count)	A count of the total number of blocks received.
Block Errs (Block Errors)	Number of blocks received since the beginning of the test that contain one or more bit errors.
Blk Er Rate (Block Error Rate)	Ratio of the number of blocks with errors to the total number of blocks counted.

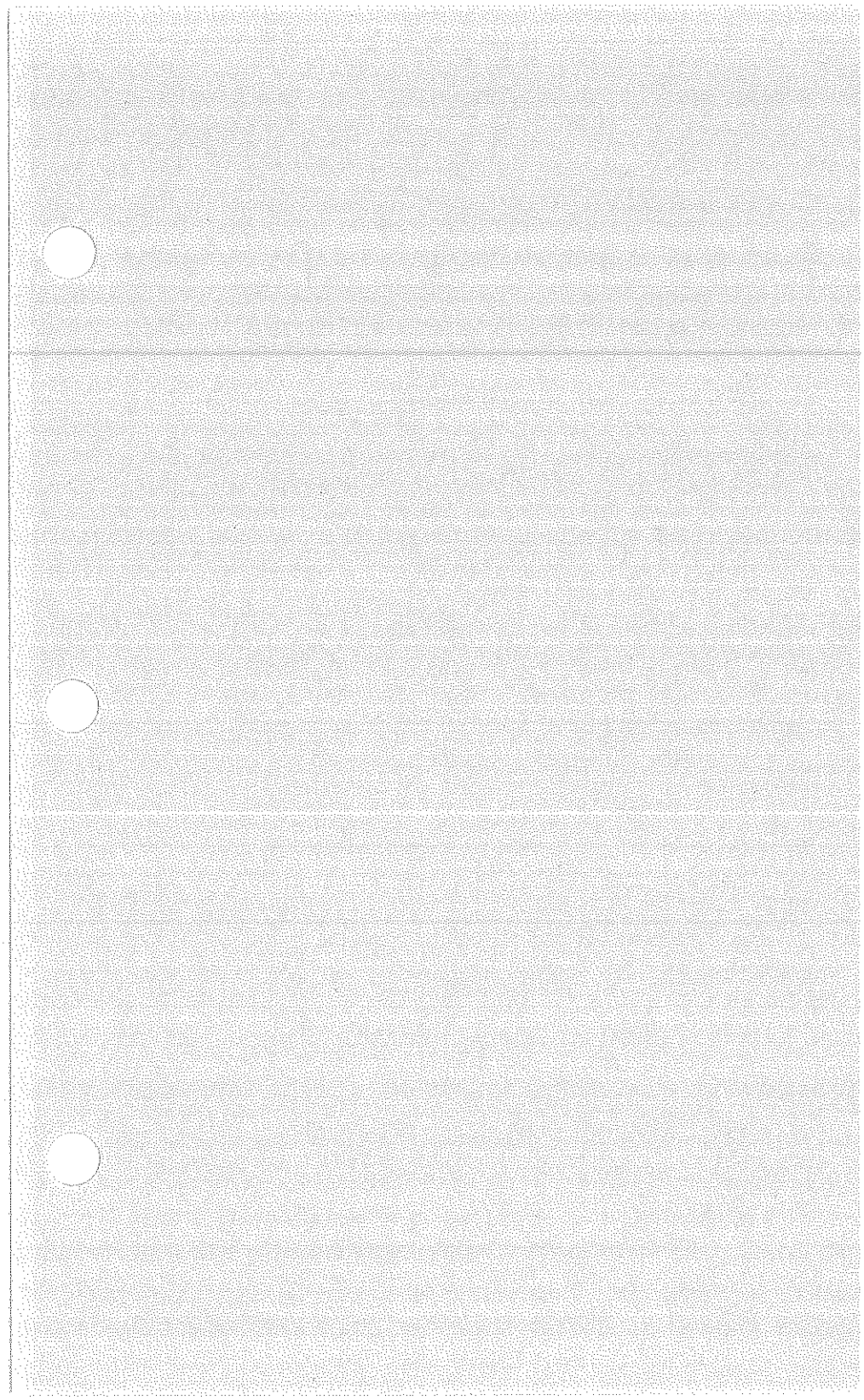
1. The Block Count result displays **NOT_READY** if the block size is less than 16 bits and the pattern is set to **PROGRAM**, **USER1**, or **USER2**.

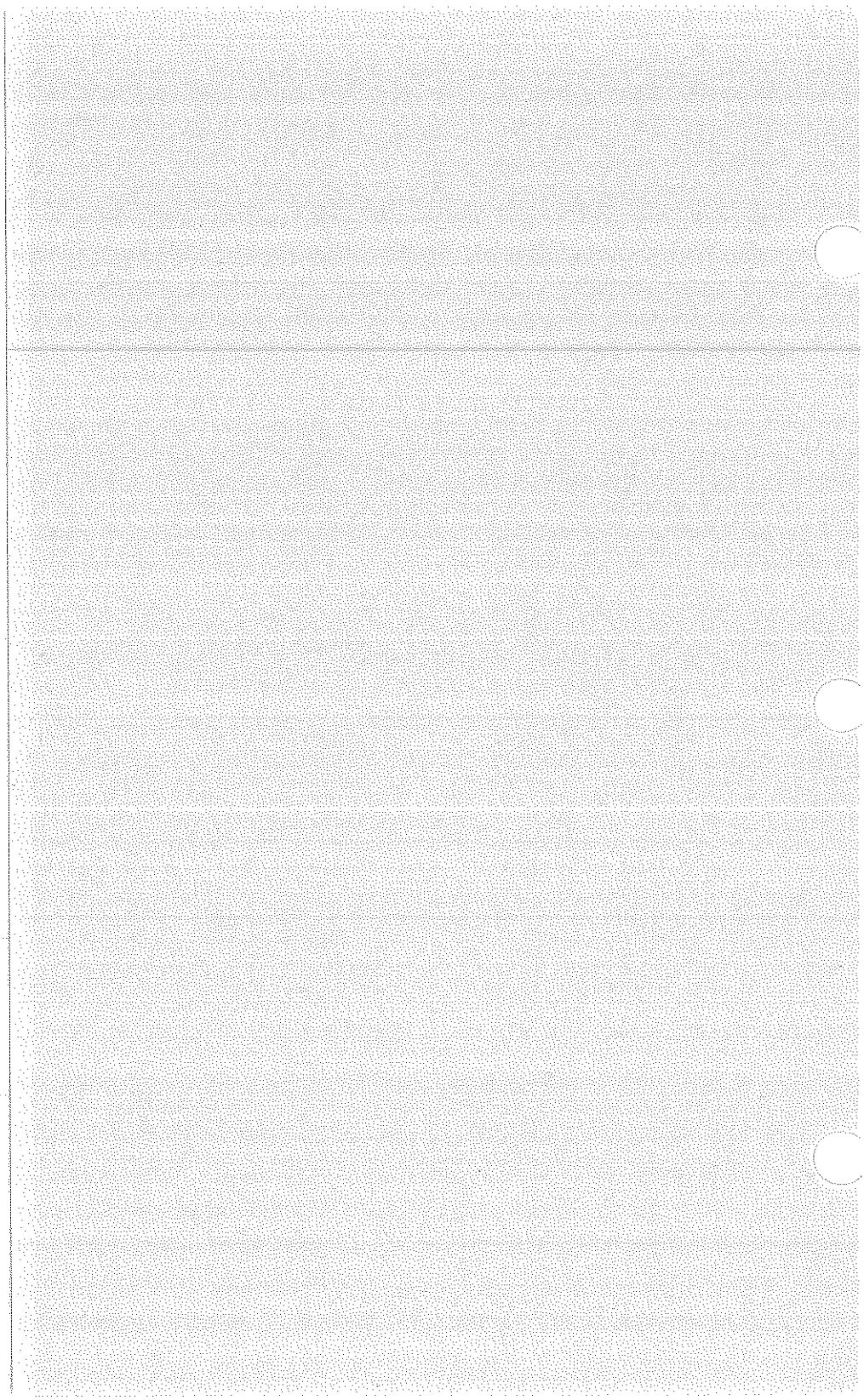
3.2.3 Alarm Messages

Table DDS-7 provides a list of results which appear on the RESULTS III Alarms Page along with a description of the alarm.

Table DDS-7. RESULTS III Alarms Page

Result	Description
Seal Curnt Range	Indicates the receive DDS sealing current is less then ±4.0 mA or greater then ±20.0 mA on the DDS circuit. Measurement range is +20 mA to -20 mA, with an accuracy of ±10% or 2.0 mA whichever is greater. Values greater in magnitude than ±20 mA or lower in magnitude than ±4 mA display "**`Out of Range`**".





50-14950-03
Rev. D

T-BERD® 950
FRAME RELAY OPTION
USER'S MANUAL

May 1999

This User's Manual applies to all T-BERD 950
Communications Analyzers incorporating Software Level 3.xx.

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FRAME RELAY OPTION

1 GETTING STARTED

This section provides operating information for the Frame Relay option for the T-BERD 950 Communications Analyzer. The section is divided into the following subsections; Getting Started, Graphical Display Screens, and Test Results. The following paragraphs describe the contents of each of the subsections.

- **Subsection 1 — Getting Started**: Describes the Frame Relay option and its specifications.
- **Subsection 2 — Graphical Display Screens**: Details the Graphical Display Setup screen as it applies to the Frame Relay option.
- **Subsection 3 — Test Results**: Explains the Frame Relay option test results.

1.1 OPTION DESCRIPTION

The Frame Relay option, in conjunction with the Protocol Services Board option, enables the T-BERD 950 Communications Analyzer to transmit and receive frame relay packets via the T1 interfaces (LINE or EQUIPMENT) or optional interfaces (e.g., TB950-LL DDS Local Loop Interface).

The Frame Relay option enables generation of frame relay packets with various traffic scenarios which include; varying the frame size and link utilization (throughput), and the ability to send data in a random or bursty manner. In addition, the Frame Relay option enables the collection of basic protocol test results concerning the frame relay circuit under test. Test results are collected on one specific Data Link Connection Identifier (DLCI) and on the aggregate frames for all DLCIs. Refer to Section 3 for a complete listing of the test results available for the Frame Relay option.

1.1.1 Operating Modes

The Frame Relay option operates in one of two modes, either Terminate mode (Drop & Insert mode also available for T1 interface) or Monitor mode. The following paragraphs discuss each mode in detail.

1.1.1.1 Terminate Mode

In Terminate mode the option utilizes one receiver/transmitter pair. The option transmits/receives frame relay packets at rates up to 1.544 Mbps. The analyzer can emulate the following types of link management (CPE only): LMI Rev. 1 or T1.617 Annex D. In addition, the analyzer can transmit TTC test frames (see Figure FRM-1) to test provisioned circuits, in a loopback configuration or in conjunction with another T-BERD 950 (or a TTC FIREBERD 6000 with the Frame Relay Option installed).

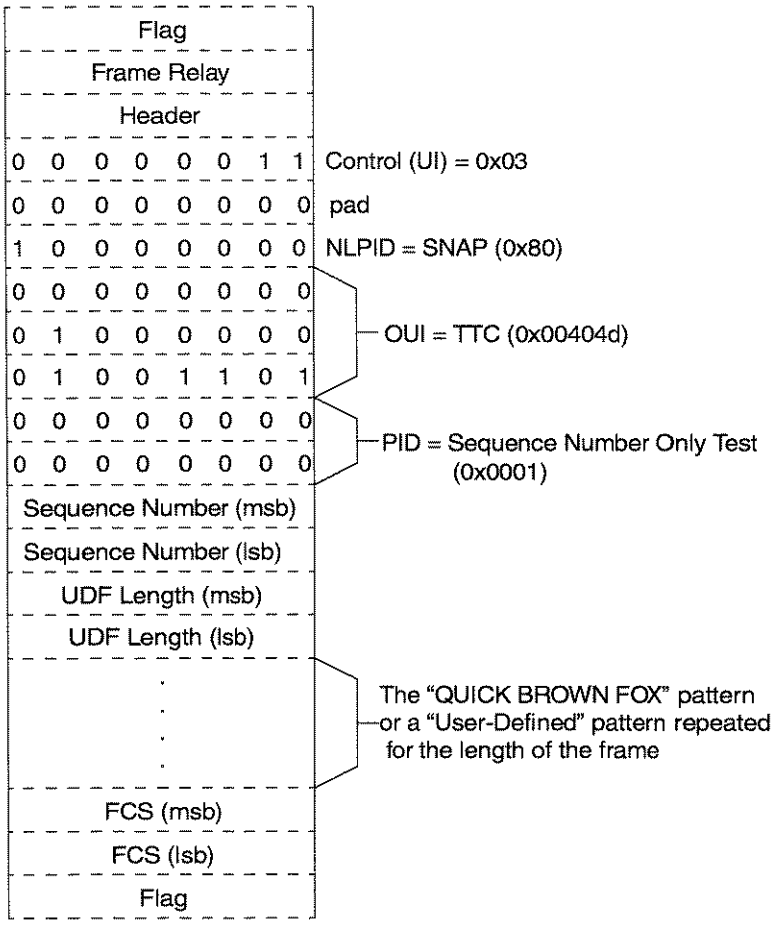


Figure FRM-1. TTC Test Frame Format

1.1.1.2 Monitor Mode

Monitor mode enables the user to monitor frame relay circuits from both receivers simultaneously and accumulate basic layer 2 statistics. The accumulated results for each receiver can be displayed separately.

1.2 OPTION SPECIFICATIONS

Table FRM-1 lists the specification for the Frame Relay option.

Table FRM-1. Option Specifications

Item	Specification
Test Modes	Terminate Drop & Insert (T1 Interface only) Monitor
Link Management Analysis	LMI Rev. 1 T1.617 Annex D Auto None
Test Frame Structure	TTC Test frames
Ping Testing	ICMP Echo Test NLPID Encapsulation

1.2.1 Option Messages

The following message flashes in the Two Line Display when frames are dropped by the receiver: `Rcv Overflow`. In addition, the Pattern Sync LED illuminates when frame relay traffic is present.

2 GRAPHICAL DISPLAY SCREENS

This subsection provides descriptions of the analyzer Graphical Display SETUP screen (see Figure FRM-2) as it applies to the Frame Relay option (utilizing the T1 interface).

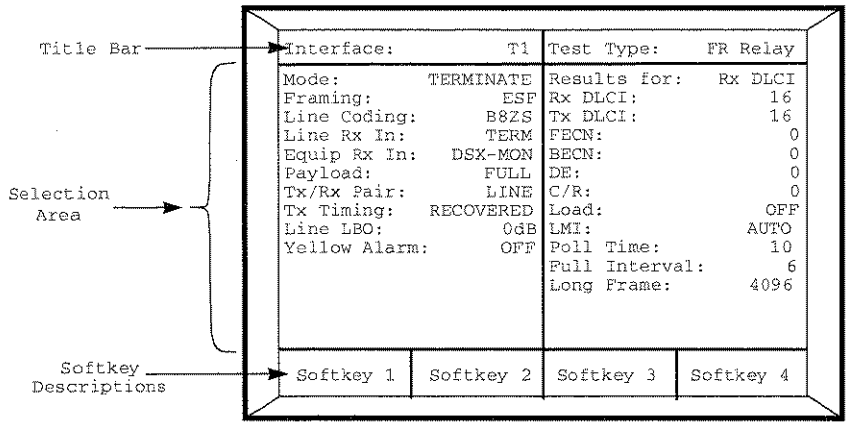


Figure FRM-2. Frame Relay Option Setup Screen

2.1 INTERFACE SETUP SCREEN

The interface setup screen is used to configure the selected interface. The **Scroll I** and **Select I** keys are used to control this selection area (see main manual Section 2 or applicable option manual).

2.2 TEST TYPE SETUP SCREEN

The Test Type setup screen is used to configure the Frame Relay option. The **Scroll II** and **Select II** keys are used to control this selection area. In the following paragraphs, the **Scroll II** keys are used to select the active selection line and the **Select II** keys (unless stated otherwise) are used to cycle through the available choices.

Results for — *(All Operating Modes)* Used to specify what results are displayed (default value is **Rx DLCI**). The choices include:

Rx DLCI — Selects results for a single DLCI (Data Link Connection Identifier).

Link — Selects the aggregate total of all frame relay packets received over a single circuit.

Rx DLCI — *(All Operating modes)* Enables entry of an individual DLCI (default value is **16**). The entry can be from 0 to 1023. Either the keypad or the **Select II** keys can be used to enter the value, the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

Tx DLCI — *(Terminate or D&I modes only)* Enables entry of an individual DLCI (default value is **16**). The entry can be from 0 to 1023. Either the keypad or the **Select II** keys can be used to enter the value, the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

FECN — *(Terminate or D&I modes only)* Enables entry of the FECN (Forward Explicit Congestion Notification) bit (default value is **0**). This is a binary entry field, the keypad keys **0** or **1** are used to enter the required value.

BECN — *(Terminate or D&I modes only)* Enables entry of the BECN (Backward Explicit Congestion Notification) bit (default value is **0**). This is a binary entry field, the keypad keys **0** or **1** are used to enter the required value.

DE — *(Terminate or D&I modes only)* Enables entry of the DE (Discard Eligibility) bit (default value is **0**). This is a binary entry field, the keypad keys **0** or **1** are used to enter the required value.

C/R — *(Terminate or D&I modes only)* Enables entry of C/R (Command/Response Indication) bit (default value is **0**). This is a binary entry field, the keypad keys **0** or **1** are used to enter the required value.

Load — *(Terminate or D&I modes only)* Selects the frame payload type (default value is **OFF**). The choices are **OFF, FIXED, BURST,** or **PING**.

When **PING** is the selected **Load** type the analyzer transmits Ping packets at a fixed rate of one per second. The following parameter choices are available:

Source IP Address — Enables entry of the source IP address, format is xxx.xxx.xxx.xxx. The keypad is used to enter the address. The **Del** key must be used to delete an unwanted digit. The left and right arrow keys are used to move to the desired digit. The ***/E** key will advance the cursor to the next subfield. The **Home** and **End** softkeys are used to move to the beginning or end of the address. **NOTE**: Leading zeros are deleted from the IP address when the user exits from this field.

Dest IP Address — Enables entry of the destination IP address, format is xxx.xxx.xxx.xxx. The keypad is used to enter the address. The **Del** key must be used to delete an unwanted digit. The left and right arrow keys are used to move to the desired digit. The ***/E** key will advance the cursor to the next subfield. The **Home** and **End** softkeys are used to move to the beginning or end of the address. **NOTE**: Leading zeros are deleted from the IP address when the user exits from this field.

When **FIXED** is the selected **Load** type, the following parameter choices are available:

Rate — Enables entry of the load transmission rate from 1 to 8192 kbps (default value is **1**). The keypad or the **Select II** keys can be used to enter the required value. The **Del** key deletes the right-most digit of the rate.

Min Length — Enables entry of the minimum frame length. The length must be between 4 and 9999 (default value is **256**). The keypad or the **Select II** keys can be used to enter the required value. The **Del** key deletes the right-most digit of the rate.

NOTE

Frame lengths of 15 octets, or less, prevents the detection of lost test frames.

Max Length — Enables entry of the maximum frame length. The length must be between 4 and 9999 (default value is **256**). The keypad or the **Select II** keys can be used to enter the required value. The **Del** key deletes the right-most digit of the rate.

Payload — Used to select the type of frame payload transmitted by the analyzer (default value is **SEQ TEST**). The choices include:

SEQ TEST — Selects a test frame structure as shown in Figure FRM-1.

USER1 — Selects the LONG USER 1 test pattern as the test frame payload.

USER2 — Selects the LONG USER 2 test pattern as the test frame payload.

SEQ+USER1 — Selects the sequential test followed by the data from the LONG USER 1 test pattern. The "FOX" payload of the test frame in Figure FRM-1 is replaced with the LONG USER 1 test pattern.

SEQ+USER2 — Selects the sequential test followed by the data from the LONG USER 2 test pattern. The "FOX" payload of the test frame in Figure FRM-1 is replaced with the LONG USER 2 test pattern.

When the **Payload** is set to **USER1**, **USER2**, **SEQ+USER1**, or **SEQ+USER2**, the following parameters choice becomes available:

USERn Data — (Where **n** is the number of the **USER** data pattern i.e. **1** or **2**) When selected, the **EDIT** softkey appears at the bottom of the screen, enabling the user to edit the data pattern. Pressing the **Edit** softkey displays the **USERn Data** screen and the and the following softkeys:

Clear String — Clears the entire pattern.

Abort Changes — Aborts any changes made to the pattern.

Save & Exit — Saves the pattern and exits the User Pattern screen.

Pressing the displayed **More Keys** softkey displays the following additional softkeys:

Cursor Home — Moves the cursor to the first digit of the pattern.

Cursor End — Moves the cursor to the last digit of the pattern.

Save & Exit — Saves the pattern and exits the User Pattern screen.

Pressing the displayed **More Keys** softkey displays the following additional softkeys:

Next Page — Moves to the next page in the pattern.

Prev Page — Moves to the previous page in the pattern.

Save & Exit — Saves the pattern and exits the User Pattern screen.

Pressing the displayed **More Keys** softkey again displays the original set of softkeys.

The left and right arrow keys on the keypad are used to move the cursor to an individual digit in the pattern. The **DEL** (delete) key on the keypad is used to delete individual program bytes, and the keys on the keypad are used to enter new bit values into the pattern.

When **BURST** is the selected **Load** type, the following parameter choices are available:

Tx Time — Enables entry of the **Burst** transmit time in seconds from 0.5 to 99.9 (default value is **0.5**). The keypad is used to enter the required time. The **Del** key is used to delete the right-most digit of the time. The ***/E** key is used to enter a decimal point (.).

Idle Time — Enables entry of the **Burst** idle time in seconds from 0.5 to 99.9 (default value is **4.5**). The keypad is used to enter the required time. The **Del** key is used to delete the right-most digit of the time. The ***/E** key is used to enter a decimal point (.).

Min Length — Enables entry of the minimum frame length. The length must be between 4 and 9999 (default value is **256**). The keypad or the **Select II** keys can be used to enter the required value. The **Del** key deletes the right-most digit of the rate.

Max Length — Enables entry of the maximum frame length. The length must be between 4 and 9999 (default value is **256**). The keypad or the

Select II keys can be used to enter the required value. The **Del** key deletes the right-most digit of the rate.

Payload — Used to select the type of frame payload transmitted by the analyzer (default value is **SEQ TEST**). The choices include:

SEQ TEST — Selects a sequential test pattern which counts from 0 to 65535.

USER1 — Selects the LONG USER 1 test pattern.

USER2 — Selects the LONG USER 2 test pattern.

SEQ+USER1 — Selects the sequential test followed by the data from the LONG USER 1 test pattern.

SEQ+USER2 — Selects the sequential test followed by the data from the LONG USER 2 test pattern.

LMI — *(All Operating modes)* Selects the Local Management Interface link management type. Choices include:

OFF — Selects no link management.

AUTO — Selects auto detection of LMI messages and determines the type of LMI being used on the link.

LMI REV. 1 — Selects the frame relay consortium LMI (Local Management Interface) link management.

T1-617 ANNEX D — Selects ANSI T1-617 Annex D link management.

When LMI is set to **AUTO**, **LMI REV.1**, or **T1-617 ANNEX D** the following parameter choices are available:

Poll Time — Sets the time interval for Heartbeat Polling of the frame relay network. The interval can be set to any number from 5 up to and including 30 seconds (default value is **10**). Either the keypad or the **Select II** keys can be used to set the required value. The **Del** key is used to delete the right-most digit of the entry.

Full Interval — Sets the Full Status Poll interval (measured in Heartbeat Poll cycles). The polling interval can be set to occur every 1 to 10 Poll cycles (default value is **6**). Either the keypad or the **Select II** keys can be used to set the required value. The **Del** key is used to delete the right-most digit of the entry.

Long Frame — *(All Operating modes)* Enables setting of the Long Frame threshold. The threshold can be set between 0 and 9999 octets (default value is **4095**). Either the keypad or the **Select II** keys can be used to set the required value. The **Del** key is used to delete the right-most digit of the entry.

2.3 RESULTS III SCREEN

Refer to Section 2.5 of the *T-BERD 950 User's Manual* for a detailed description of the RESULTS III screen usage. A typical Frame Relay Test Type results page is shown in Figure FRM-3.

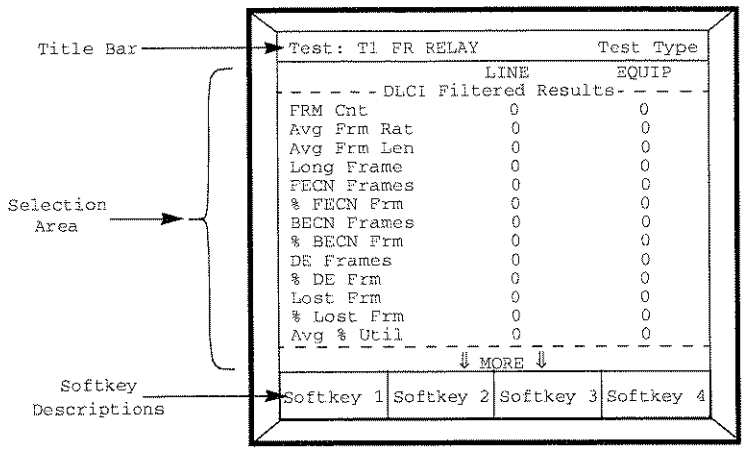


Figure FRM-3. Typical Test Type Results Page

2.4 AUX SCREEN

Refer to Section 2.6 of the *T-BERD 950 User's Manual* for a detailed description of the AUX screen usage.

3 TEST RESULTS

This subsection provides information on the analyzer Two Line Display and the test results available for the Frame Relay option.

3.1 FRAME RELAY OPTION TEST RESULTS

Test results for the Frame Relay option are displayed on the analyzer Two Line Display. The Two Line Display and associated controls and indicators are located on the front panel above the keypad. Refer to Section 5 of the *T-BERD 950 User's Manual* for a detailed description of the Results Display.

NOTE

Results can be displayed for the aggregate total (all frame relay packets received on a single circuit) or for frame relay packets on a single DLCI (DLCI filtered). The **Results for:** *selection line is used to specify which results are displayed.*

Test results can also be displayed on the RESULTS III graphic display screen (refer to Section 2.5 of the *T-BERD 950 User's Manual* for more information on the RESULTS III graphic display screen).

NOTE

There are no **Interface, Time** *or* **Signal Category** *results for the Frame Relay Option.*

3.1.1 Mainframe Alarm/Status LEDs

The SIGNAL Status/Alarm LED illuminates green when the T-BERD 950 is receiving a valid signal for the configured interface. The PATTERN SYNC Status/Alarm LED illuminates green when the T-BERD 950 is receiving a valid frame relay packet.

NOTE

A red illuminated LED indicates the Status/Alarm condition was previously true or present, since the start of the current test.

3.1.2 Summary Category Results

The Summary category automatically displays key results that are non-zero or out-of-specification. The following results appear in the Summary category when the particular error conditions are detected.

Aborted Frames — Test Type Category

FCS Err Frm (FCS Errored Frames) — Test Type Category
Short Frm (Short Frames) — Test Type Category
Long Frm (Long Frames) — Test Type Category
Lost Frm (Lost Frames) — Test Type Category

NOTE

If all results are zero for the LINE or EQUIPMENT receiver, the message "`All Results OK`" is displayed on the appropriate side of the Two Line Display. If all results are zero for the LINE and EQUIPMENT receivers, the message "`All Results OK`" is displayed on both sides of the Two Line Display.

3.1.3 Test Type Category Results

The Test Type category results are described in Table FRM-2.

NOTE

In the following table, the letter in brackets following the Result Name indicates whether the result applies to a single DLCI **[F]**, *the aggregate total of all frame relay packets received* **[A]**, *or both* **[B]**.

Table FRM-2. Test Type Category Results

Result Name	Description
Aborted Frm [A] (Aborted Frames)	A count of the aborted frames detected (only available on the Two Line Display when **Results for** is set to **Link**, always available on the **RESULTS III** screen).
Avg Frm Len [B] (Average Frame Length)	The average frame size calculated as an integer value (Frame Relay frame octets ÷ Frame Relay frame count) to x.x resolution.
Avg Frm Rat [B] (Average Frame Rate)	The number of Frame Relay frames received per second, since the start of the test.
BECN Frames [B]	A count of the frames with the BECN (Backward Explicit Congestion Notification) bit set.
% BECN Frm [B] (% BECN Frames)	The percent of frames with the BECN bit set.

Table FRM-2. Test Type Category Results (Continued)

Result Name	Description
DE Frames [B]	A count of the frames with the DE (Discard Eligibility) bit set.
% DE Frames [B]	The percent of frames with the DE bit set.
DLCIs	A list of all configured DLCIs (Data Link Connection Identifiers) for a circuit, indicating the status of the DLCI as provided by the Full Status Poll. Deleted DLCIs apply to LMI Rev. 1 only. A status of "traffic" indicates that traffic was detected on the DLCI, but that DLCI was not listed in the Full Status Poll. **NOTE:** This result is displayed on the RESULTS III screen only.
%Err Frames [A] (% Errored Frames)	The percent of errored Frame Relay frames detected calculated as FCS errored frames + short frames + aborted frames ÷ Physical frame count (only available on the Two Line Display when **Results for** is set to **Link**, always available on the **RESULTS III** screen).
FCS Err Frm [A] (FCS Errored Frames)	A count of the errored frames detected, includes FCS (Frame Check Sequence) errored frames only (only available when **Res for** is set to **Link**).
Frm Cnt [B] (Frame Count)	A count of the total number of valid Frame Relay frames detected.
FECN Frames [B]	A count of the frames with the FECN (Forward Explicit Congestion Notification) bit set.
% FECN Frm [B] (% FECN Frames)	The percent of frames with the FECN bit set.
LMI Errs (LMI Errors)	The total number of LMI "**STATUS ENQUIRY**" messages received that contained incorrect sequence numbers or an incorrect information element length. In Monitor mode this result is an aggregate of the LINE and EQUIPMENT receivers, but is displayed for the LINE receiver only.

Table FRM-2. Test Type Category Results (Continued)

Result Name	Description
LMI Count	The total number of LMI messages received since the start of the test (an incrementing count indicates a "heartbeat"). In Monitor mode this result is an aggregate of the LINE and EQUIPMENT receivers, but is displayed for the LINE receiver only.
LMI TMOS (LMI Timeouts)	The total number of LMI "**STATUS ENQUIRY**" messages sent that yielded no response from the network before the next poll cycle. In Monitor mode this result is an aggregate of the LINE and EQUIPMENT receivers, but is displayed for the LINE receiver only.
LMI Type	An indicator of the type of LMI available on the frame relay circuit. In Monitor mode this result is an aggregate of the LINE and EQUIPMENT receivers, but is displayed for the LINE receiver only.
Long Frm (Long Frames)	A count of the Frame Relay frames that exceed the user specified length in octets.
Lost Pings	The number of echo packets what were not replied to (includes out of order echo reply packets and corrupted echo reply packets). **NOTE:** This result is only available in **TERMINATE** mode.
Lost Frm [F] (Lost Frames)	A count of TTC test frames that appear to have been lost by the network based on the test frame sequence number. This result is calculated on a single DLCI only. **NOTE:** If the test frame length is less than 16 octets, lost frames are not counted.
%Lost Frm [F] (% Lost Frames)	The percent of TTC test frames that appear to have been lost by the network based on the test frame sequence number. This result is calculated on a single DLCI only.

Table FRM-2. Test Type Category Results (Continued)

Result Name	Description
Short Frm [A] (Short Frames)	A count of the short frames detected by the SCA (Serial Communications Adapter), the frame length is between 24 and 31 bits (only available when **Results for:** is set to **LINK**).
Tx Pings (Transmitted Pings)	The number of Echo packets/frames transmitted by the analyzer since the beginning of the test. **NOTE:** This result is only available in **TERMINATE** mode.
Echo Pings	The number of Echo replies transmitted by the analyzer since the beginning of the test. **NOTE:** This result is only available in **TERMINATE** mode.

3.1.4 Performance Category Results

The Performance category results are described in Table FRM-3.

NOTE

In the following table, the letter in brackets following the Result Name indicates that the result applies to both **[B]** *a single DLCI and the aggregate total of all frame relay packets received.*

Table FRM-3. Performance Category Results

Result	Description
Avg Png Dly (Average Ping Delay)	The average round trip delay, measured in milliseconds, since the beginning of the test. **NOTE:** This result is only available in **TERMINATE** mode.
Avg Thruput [B] (Average Throughput)	The average received throughput since the start of the test, calculated as (total Frame Relay Frame bits (header + UDF + CRC) ÷ total seconds).

Table FRM-3. Performance Category Results (Continued)

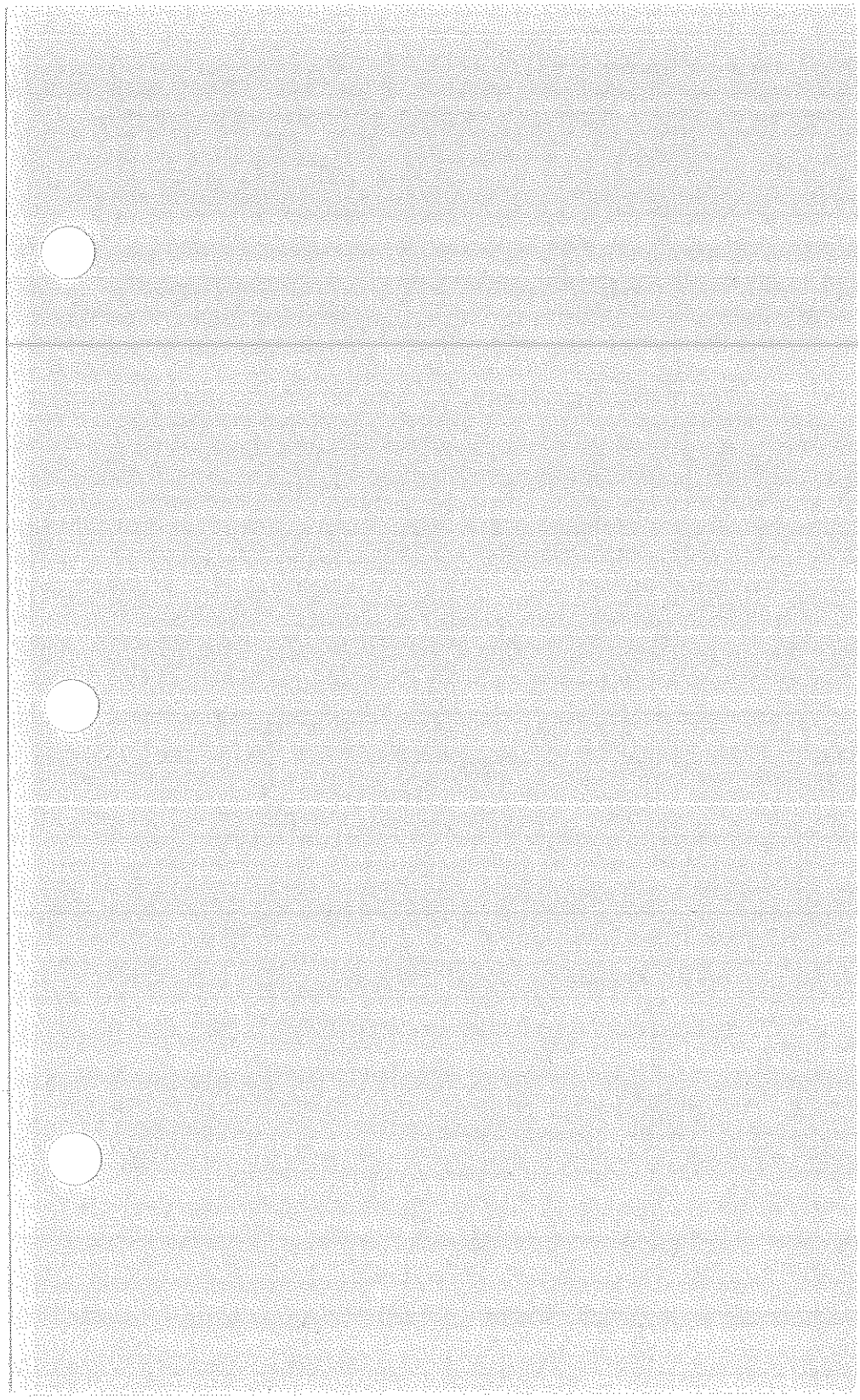
Result	Description
Avg % Util [B] (Average % Utilization)	The average percentage of link utilization on the received channel since the start of the test calculated as (total Frame Relay octets in frames (excluding flags, including overhead) ÷ total octets (idle and frame data) received).
Max Png Dly (Maximum Ping Delay)	The maximum round trip delay, measured in milliseconds, since the beginning of the test. **NOTE:** This result is only available in **TERMINATE** mode.
Max Thruput [B] (Maximum Throughput)	The maximum received throughput, in bits per second, during any one second since the start of the test.
Max % Util [B] (Maximum % Utilization)	The maximum percentage of link utilization on the received channel in any one second since the start of the test.
Min Png Dly (Minimum Ping Delay)	The minimum round trip delay, measured in milliseconds, since the beginning of the test. **NOTE:** This result is only available in **TERMINATE** mode.

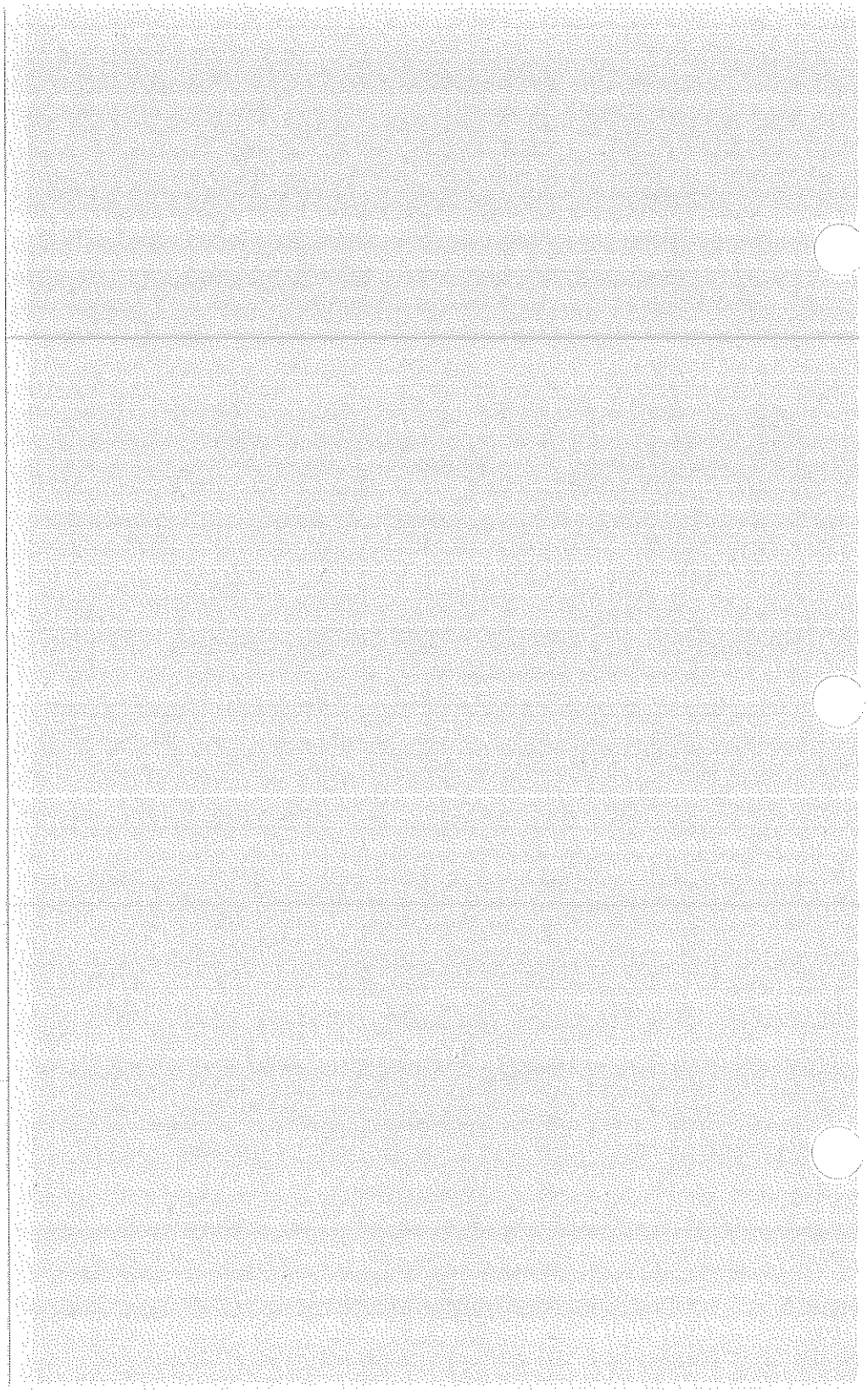
3.1.5 Alarm Messages

Table FRM-4 provides a list of results which appear on the RESULTS III Alarms Page along with a description of the alarm.

Table FRM-4. RESULTS III Alarms Page

Result	Description
Inactive Tx DLCI	Indicates the DLCI entered as the transmit address is not valid. There is not an active PVC associated with this DLCI





50-14950-04
Rev. D

T-BERD® 950
ISDN PRIMARY RATE INTERFACE (PRI) OPTION
USER'S MANUAL

May 1999

This User's Manual applies to all T-BERD 950 Communications Analyzers incorporating Software Level 3.xx.

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TABLE OF CONTENTS

ISDN PRIMARY RATE INTERFACE OPTION

1 GETTING STARTED

This section provides operating information for the ISDN Primary Rate Interface (PRI) option for the T-BERD 950 Communications Analyzer. The section is divided into the following subsections: Getting Started, Graphical Display Screens, and Test Results. The following paragraphs describe the contents of each of the subsections.

- **Subsection 1 — Getting Started**: Describes the ISDN PRI option description and its specifications.
- **Subsection 2 — Graphical Display Screens**: Details the Graphical Display Setup screen as it applies to the ISDN PRI option.
- **Subsection 3 — Test Results**: Explains the ISDN PRI option test results.

1.1 OPTION DESCRIPTION

The ISDN PRI Option, in conjunction with the Protocol Services Board option, enables the T-BERD 950 Communications Analyzer to initiate, answer, or monitor ISDN calls via the T1 interface. The option can be connected to ISDN circuits terminated by the following switches: AT&T 5ESS Ver. 9 (or later), NT DMS 100 Ver. BCS 38 (or later), and National ISDN-2 (NI-2) compliant switches.

In Terminate mode, the option has the capability to connect two calls simultaneously (two incoming, two outgoing, or one incoming and one outgoing). The call setup for these calls does not have to occur simultaneously. The call generation capability of the option enables the user to specify the type of service to be connected (voice, 56 kbps, 64 kbps, H0, H11, Nx64, or Nx56).

The ISDN PRI Option originates two calls, terminates two calls, or originates one call while terminating a second call. (For example, it can call itself on a different B-channel.) The interface can BERT up to two data calls or connect up to two voice calls.

When the call setup acknowledge message is received for incoming or outgoing calls, it connects the speaker and microphone for that call. You may also change the connection of the call dynamically. A call can be dynamically connected to BERT, 1004 Hz tone, or Speaker/Microphone.

If the ISDN PRI Option is connected to two voice calls simultaneously, the first call is connected to the push-to-talk interface and a holding tone is placed on the second call.

The unit can measure the loopback delay for each B-channel by connecting the calls to BERT.

1.1.1 ISDN Primary Rate Interface (PRI) – Definition

Primary Rate Interface (PRI) consists of 23 64kbps B-channels and one 64kbps Data D-channel, or a 23B+D connection. With a total bandwidth of 1.544Mbps, it is designed for transmission through a standard North American T-1 trunk.

PRIs are dedicated trunks that connect medium and large locations to a telephone company central office. Virtually all modern telephone and computing systems can be connected to ISDN through a PRI, including PBXs, mainframe and distributed systems, LANs and WANs, multiplexers and ISDN controllers, video conferencing units, and more. PRIs are designed to maximize the use of these systems by allocating dynamically, or call by call, the number and type of channels (e.g., data, voice in, voice out) required for each application.

1.1.2 Dynamic Allocation of B-channels in a PRI

For practical purposes, combining multiple channels in a PRI for large video conferences, data transfers, and the like is most often programmed into the digital switch serving the location. However, new bandwidth-on-demand controllers have begun to enable a network manager to combine larger bandwidths in real time to meet specific needs. They can also monitor quality and traffic on both corporate leased-line and ISDN networks, and perform dynamic allocation of B-channels to relieve bottlenecks or back up error-prone or damaged lines.

A PRI delivers 23 B-channels plus one D-channel from the telephone company to a PBX or other control device, which then distributes the B-channels throughout an organization. How this configuration is set up can vary greatly. Users with heavy data traffic, for example, might configure the connection through an ISDN router, multiplexer, or controller rather than a PBX, reducing the chance of congestion through the switch.

1.1.3 ISDN Optional Services

ISDN PRI service can be optioned for NFAS and NFAS/DCBU operation. Non-Facility Associated Signaling (NFAS) allows a single D-channel to control multiple T1 interfaces. Up to 20 T1 interfaces can be controlled via a single D-channel utilizing NFAS. Although this alleviates the customer from allocating a DS0 on every T1 for D-channel activity (i.e., this DS0 can now be used for customer data), it introduces a higher level of risk. For example, if the primary T1 carrying the D-channel is taken out of service, the remaining associated T1's also must go out of service. This risk is minimized if NFAS service is ordered with back-up D-channel functionality. This enables a standby D-channel to become activated if the In Service D-channel is no longer reliable. This standby D-channel is dedicated to a DS0 on a secondary T1.

1.1.4 Operating Modes

The ISDN PRI option operates in one of two modes, Monitor mode or Terminate mode. The following paragraphs discuss each mode in detail.

1.1.4.1 Monitor Mode

In Monitor mode, the option monitors both directions of the ISDN D-Channel. The mainframe is capable of collecting results on the D-Channel simultaneously with the T1 interface specific results. Refer to Section 3 for a listing of the ISDN PRI option results.

1.1.4.2 Terminate Mode

In Terminate mode, the option emulates a TE (Terminal Equipment) device such as a PBX, a router, or an I-MUX. The analyzer originates all required frames for terminal emulation, Layer 2 startup, and basic call processing for the AT&T 5ESS, NT DMS 100, and NI-2 switches. When terminating a link, the results collected are for the received D-channel only.

In addition, the option originates or terminates the required call setup information for two simultaneous calls and the required frames to maintain these call connections. The option is capable of generating two calls, terminating two calls, or generating one call while terminating a second call with BER testing capability.

When the call setup acknowledgment is received for an incoming or outgoing call, the option connects the CODEC (to the speaker for voice calls) or the BERT module (for data calls) to the B-channel(s) for that particular call. If the analyzer is connected to two voice calls simultaneously, a 1004 Hz tone is placed on the second call, and the push-to-talk interface is connected to the

first call. If two data calls are connected at the same time, the BERT configurations are the same for both calls; however, the BERT results displays each call's results separately.

The ISDN PRI option supports Non-Facility Associated Signaling (NFAS). NFAS allows a single D-channel to support multiple T1 interfaces.

The ISDN PRI option allows selection of T1 line numbers between 0 and 19. The T1 carrying the D-channel must be connected to the LINE Tx/Rx pair (regardless of the line number). B-channel tests on T1 lines that are not carrying the D-channel must be connected to the EQUIPMENT Tx/Rx pair.

The ISDN PRI option supports NFAS optioned with D-channel Backup (DCBU). This mode allows testing of both the primary D-channel and the backup D-channel. The option provides the flexibility of switching between the designated primary D-channel and the backup D-channel for testing. For NFAS with DCBU operation, the primary D-channel must be connected to the LINE Tx/Rx pair and the secondary D-Channel to the EQUIPMENT Tx/Rx pair.

1.2 OPTION SPECIFICATIONS

Refer to Section 1.4 of the *T-BERD 950 User's Manual* for ISDN PRI option specifications.

2 GRAPHICAL DISPLAY SCREENS

This subsection provides descriptions of the analyzer Graphical Display SETUP screen (see Figure PRI-1) as it applies to the ISDN Primary Rate Interface (PRI) option.

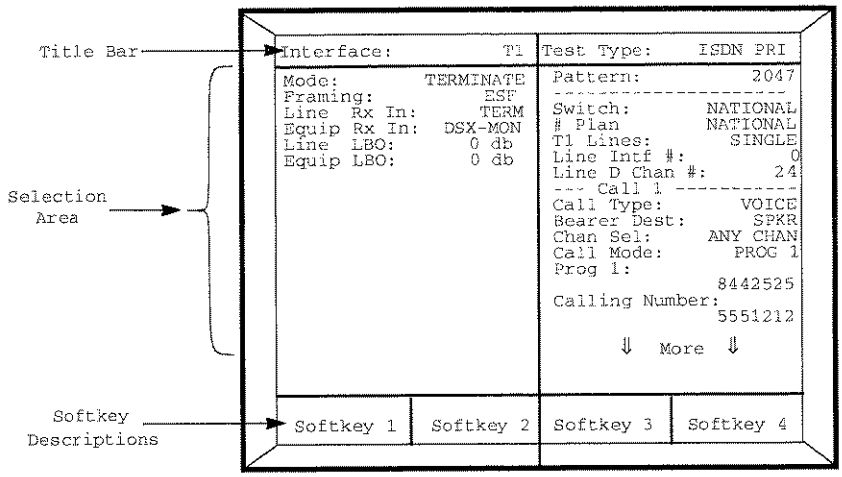


Figure PRI-1. ISDN PRI Option Setup Screen

2.1 INTERFACE SETUP SCREEN

The Interface Setup screen is used to configure the T1 interface. The **Scroll I** and **Select I** keys are used to control this selection area. (See Section 2 of the *T-BERD 950 User's Manual* for information regarding the setup of the T1 Interface.)

2.2 ISDN PRI TEST TYPE SETUP SCREEN

The ISDN PRI Test Type setup screen is used to configure the test to be performed. The **Scroll II** and **Select II** keys are used to control this selection area. In the following paragraphs, the **Scroll II** keys are used to select the active selection line, and the **Select II** keys (unless stated otherwise) are used to cycle through the available choices.

NOTE

The screen displays the ⇓ MORE ⇓ indicator on the bottom selection line in the test type category. If the display has been scrolled down to the point where selection lines are hidden at the top of the display, the ⇑ MORE ⇑ indicator is displayed on the top selection line.

Switch — Enables entry of the switch type used on the ISDN link (default value is **NATIONAL**). Choices include:

AT&T — Selects the AT&T 5ESS custom as the switch type.

NT — Selects the NT DMS 100 custom as the switch type.

NATIONAL — Selects the National ISDN-2 (NI-2) as the switch type.

 # Plan — Enables the selection of the appropriate ISDN numbering plan for the desired circuit. There are six numbering plan choices listed below:

NATIONAL —National number in the ISDN numbering plan.

NETWORK —Network-specific number in private numbering plan.

LOCAL — Local directory number in ISDN numbering plan.

ABBREVIATED —Abbreviated number in private numbering plan.

UNKNOWN —Unknown number in numbering plan.

INT'L —International number in ISDN numbering plan.

T1 Lines — *(Terminate mode only)* Specifies the number of T1 interfaces to be tested (default is **SINGLE**). The choices include:

SINGLE — Specifies a single T1 line interface to be tested. The D-channel must be located on the LINE Tx/Rx pair.

Line Intf # — Used to select the primary T1 LINE interface number; any number between 0 and 19 can be selected (default value is **0**). Either the keypad or the **Select II** keys can be used to enter the value; the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

NOTE

If the Line Interface # selected does not match the Line Interface # provided by the switch, the analyzer reconfigures to use the Line Interface # provided by the switch.

Line D Chan # —Used to select the D-channel number; any number between 1 and 24 can be selected (default value is **24**). Either the keypad or the **Select II** keys can be used to enter the value; the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

MULTIPLE — *(Terminate mode only)* Allows testing of NFAS service using multiple T1s controlled by a single D-channel. The D-channel must be located on the LINE Tx/Rx pair. When selected, the following parameter choice is available:

Equip Intf # — Used to select the T1 EQUIPMENT interface number, any number between 0 and 19 can be selected (default value is **1**). Either the keypad or the **Select II** keys can be used to enter the value; the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

NOTE

The Equip Intf # should not be the same as the Line Intf #.

NFAS/DCBU — Enables testing of Non Facility Associated Signaling (NFAS) circuits optioned with D-channel Back Up (DCBU). When selected, **Equip Intf #** and **Equip D Chan #** parameter choices are available.

NOTE

In DCBU, the primary D-channel must be located on the T1 connected to the Line Interface, and the secondary D-channel must be located on the T1 connected to the Equipment Interface.

Equip D Chan # — *(NFAS/DCBU mode only)* Used to select the D channel number; any number between 1 and 24 can be selected (default value is **24**). Either the keypad or the **Select II** keys can be used to enter the value; the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

NOTE

The following parameters must be set for each call you want to place.

Call Type — Selects the type of call to be originated by the option (default value is **VOICE**). The choices include:

VOICE — Selects a voice type call.

56K — Selects an unrestricted circuit-switched data connection with 56 kbps CCITT I.463 rate adaptation.

64K UNRES — Selects a clear channel, unrestricted, circuit-switched data connection with the full 64 kbps available for use, with no rate adaptation.

H0 — Selects an **H0** 384 kbps type data call.

H11 — Selects an **H11** 1536 kbps type data call (only available when **T1 Lines** is set to **MULTIPLE** and the call is placed on EQUIPMENT T1 Interface).

Nx64 — Selects contiguous/noncontiguous 64 kbps timeslot operation.

Nx56 — Selects contiguous/noncontiguous 56 kbps timeslot operation.

Bearer Dest — Selects the initial destination of the connected call (default value is **SPKR**). Choices include:

SPKR — The call is initially connected to speaker/microphone for voice conversation.

BERT— The call is initially connected to speaker/microphone for BER testing.

NOTE

After the call is connected, use the Dynamic Payload softkeys to change the Bearer Destination. (See ISDN Control section.)

Chan Sel — Enables the user to specify a preferred channel to be used by the switch (default value is **ANY CHAN**). The choices include:

ANY CHAN — When selected, the channel is assigned by the switch.

SPECIFIC — Enables the user to specify the preferred channel to be used by the switch.

When **Chan Sel** is set to **ANY CHAN,** and the **Call Type** is set to **Nx56** or **Nx64**, the following parameter is available:

Channels — Selects the channel to be used; any number between 1 and 24 can be entered (default value is **1**). Either the keypad or the **Select II** keys can be used to enter the value; the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

NOTE

If the channel provided by the switch is different from the channel requested, the analyzer reconfigures to use the channel provided by the switch.

When **Channel Select** is set to **SPECIFIC** and **T1 Lines** is set to **MULTIPLE** or **NFAS/DCBU**, the following parameter is available:

Interface — Selects which T1 interface the outgoing call is placed on. The choices include:

LINE — Selects the T1 LINE interface to place the outgoing call.

EQUIPMENT — Selects the T1 EQUIPMENT interface to place the outgoing call.

If the **Call Type** is set to **H0**, the following parameter choice is available:

Channels — Used to select the channel group to be used (default value is **1-6**). The channel group choices are **1-6**, **7-12**, **13-18**, **19-24**.

If the **Call Type** is set to **VOICE**, **56K**, or **64K**, the following parameter choice is available:

Channel — Selects the channel to be used; any number between 1 and 24 can be entered (default value is **1**). Either the keypad or the **Select II** keys can be used to enter the value; the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

If the **Call Type** is set to **Nx56** or **Nx64**, and the **Channel Select** is set to **Specific**, the following parameter choice is available:

Channel Map — Enables entry of the channel mapping (default value is **Channel 1** and **Channel 2**) to be used for the originated call using the **Edit** softkey. When pressed, the **Edit** softkey displays the Edit Channels screen and the **Select/Deselect**, **Clear All**, **Abort Changes**, and **Save & Exit** softkeys. The Edit Channels screen enables configuration of the active channels for both the T1 LINE and EQUIPMENT interfaces (the selected channels are the same for both interfaces). Either the **Select I** or **Scroll I** keys can be used to change the currently selected channel. The **Select/Deselect** softkey toggles the channel between active and inactive. The **Clear All** softkey deselects all channels. The **Abort Changes** softkey exits the Edit Channels screen without making any changes to the existing channel selections and returns the user to the previous screen. The **Save & Exit** softkey enters all changes made and returns the user to the previous screen.

NOTE

At least two (2) channels must be selected.

Call Mode — Selects the appropriate Program Number **(N)**. **PROG 1** through **PROG 5** (for Call 1), and **PROG 6** through **PROG 10** (for Call 2).

Prog (N) — Enables entry of the number to be called, up to 18 digits (default value is **8441212**). You may program up to five numbers on **PROG 1** through **PROG 5** (for Call 1), and five numbers on **PROG 6** through **PROG 10** (for Call 2). Use the keypad to edit this field. Valid keys are **0** through **9**. Use the left and right arrow keys to move the cursor to the required digit position, and the **Del** (delete) key to delete the unwanted digit.

Calling Number — Enables entry of the Directory Number (DN) of the circuit being analyzed, up to 15 digits (default value is **8441212**). The keypad is used to edit this field. Valid keys are **0** through **9**. The left and right arrow keys are used to move the cursor to the required digit position, and the **Del** (delete) key to delete the unwanted digit.

2.3 ISDN CONTROL

The **ISDN CONTROL** softkey provides access to **CALL 1 CONTROL, CALL 2 CONTROL**, and **SWITCH D-CHAN** softkeys. When pressed, the Results III Test Type screen is displayed.

CALL 1 CONTROL or **CALL 2 CONTROL** provides the following choices:

DIAL CALL — Places the call.

DISC CALL — Disconnects the call in progress.

ANSWER — Answers the call if there is an incoming call present.

NOTE

Dynamic Payload Softkeys provide the ability to dynamically change the payload of the call when the call is connected. (See Figure PRI-3.)

BERT — Connects the call for BERT testing

VOICE — Connects the call to the speaker/microphone.

TONE — Connects the call to a 1004 Hz tone.

SWITCH D-CHAN — *(NFAS/DCBU mode only)* This softkey initiates a D-channel backup switchover that switches the current In Service (IS) D-channel to Standby (STDBY), and the current Standby D-channel to In

Service. Successful operation transitions the D-channel from the (IS, STBY) state to the (STDBY, IS) state or vice versa. This softkey is only available in NFAS/DCBU mode.

NOTE

You must have an In Service and a Standby D-channel to perform the switch over. (See Figure PRI-4.)

NOTE

In addition to a manual switchover, the analyzer will automatically respond to the In Service T1 interface being physically removed or removed by the network.

NOTE

When physically removing the T1 jacks connected into the interface, it is recommended that you remove the T1 jacks from the analyzer, not the smart jack. Removing the connection at the smart jack could set up an automatic loopback within the smart jack that may cause problems.

2.4 HOW TO PLACE A CALL

To place a call, chose from five possible program (or memory dial) numbers, then press the call's **Dial** softkey. (See Section 2.3 for ISDN Call Control information.)

In general, the call emulation feature must simulate a normal call setup exchange. If the call setup exchange fails, extensive error reporting in the form of a call fail report is generated.

The T-BERD 950 is capable of transmitting DTMF tones if a call progresses or connects. The microphone disables briefly while the DTMF tones are transmitted. This feature allows you to enter digits such as phone extensions in response to an automated attendant.

2.5 HOW TO ANSWER A CALL

When an incoming call is detected, the T-BERD 950 displays a popup window on the current screen display. This window gives you three choices: answer the call, ignore the call, disconnect the call.

Whichever action you choose causes one of several results. Those actions and results are listed in Table PRI-1.

Table PRI-1. Incoming Call Activities

Action	Result
Press **Answer** sofkey.	The call connects to the speaker and microphone (voice). You can then choose to begin BER testing if it is a data call. Once the call is connected, you can dynamically change the connection, data to voice or voice to data, via softkeys.
Press **Disconnect** softkey.	The call is cleared.
Press **Ignore** softkey.	The call remains in the alert state until the far end cancels the call or you select the ISDN Control softkey, press the appropriate Call 1 or 2 softkey, then press the Answer softkey.

2.6 RESULTS III SCREEN

Refer to Section 2.5 of the *T-BERD 950 User's Manual* for a detailed description of the RESULTS III screen usage. Typical ISDN PRI Test Type results are displayed as follows:

Link Status Results are shown in Figure PRI-2. Call Status Results are shown in Figure PRI-3. D-channel Back Up Results are shown in Figure PRI-4. BERT Results are shown in Figure PRI-5.

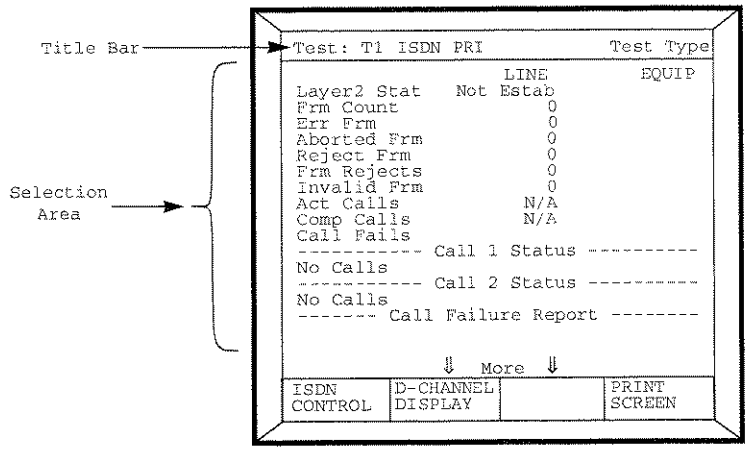


Figure PRI-2. Link Status Results

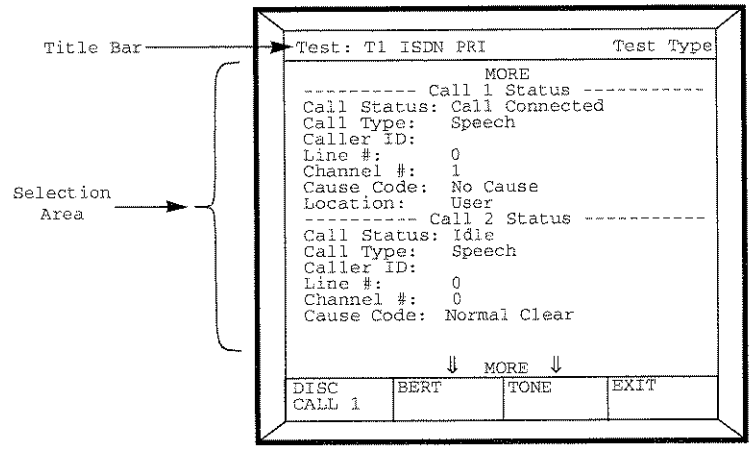


Figure PRI-3. Call Status Results

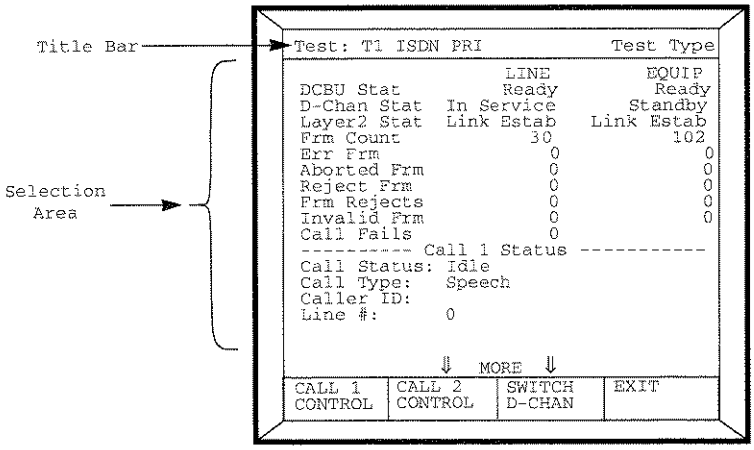


Figure PRI-4. D-channel Backup Results

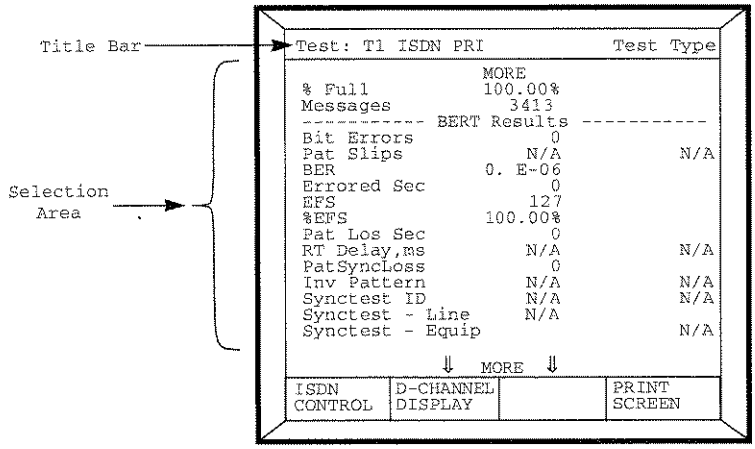


Figure PRI-5. BERT Results

2.7 D CHANNEL DISPLAY

This feature displays English translations of messages received and transmitted on the D-channel. This display provides complete Q.921 and/or Q.931 text-based information for all valid ISDN frames.

NOTE

For monitor mode operations, connect the LINE Tx/Rx pair towards the Network Termination (NT) equipment and the EQUIPMENT Tx/Rx pair towards the Customer Premise Equipment (CPE). This will provide proper information when determining the direction of the traffic on the D-channel. If the hookup is backwards, the direction of the traffic will be wrong.

You may activate the D-Channel Display by pressing the **D-channel Display** softkey. After pressing the softkey, the Graphic Display shows one message at a time. Messages are captured in the order they are transmitted and/or received. Softkeys allow you to navigate the first, last, previous, and next message. The Print softkeys are listed below:

PRINT CURRENT — Prints the currently displayed message.

PRINT TO LAST — Prints all messages from the current to the last message.

PRINT ALL — Prints messages from the first to the last message.

Press the **Clear Storage** softkey to clear all capture messages. Press the **EXIT** softkey to exit the D-Channel Display and return to the MAIN, SETUP, RESULTS III, or AUX screen.

Status messages are displayed on the two-line display to indicate print activity and capture status. A message flashes when the capture buffer is full, indicating that frame capture is inactive. You must clear the capture buffer by pressing the **Clear Storage** softkey to resume frame capture. Capture storage will also be indicated as a percentage result (% full) on the result screens.

NOTE

Capture storage is only maintained for the lifetime of the current test (for example, switching from PRI ISDN to BERT will clear the capture storage). Use the print softkeys to save relevant capture information before changing tests.

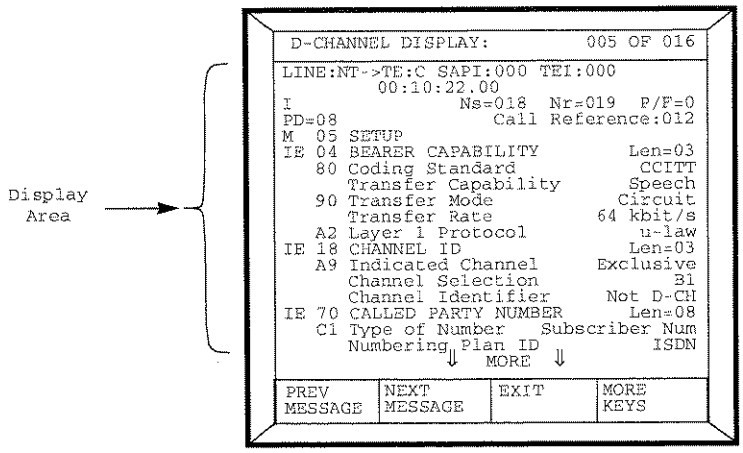


Figure PRI-6. D-channel Display

3 TEST RESULTS

This subsection provides information on the analyzer's Two Line Display and the test results available for the ISDN Primary Rate Interface (PRI) option.

3.1 ISDN OPTION TEST RESULTS

Test results for the ISDN PRI option are displayed on the analyzer Two Line Display. The Two Line Display and associated controls and indicators are located on the front panel above the keypad. Refer to Section 5 of the *T-BERD 950 User's Manual* for a detailed description of the Results Display.

Test results can also be displayed on the Results III graphic display screen (refer to Section 2.5 of the *T-BERD 950 User's Manual* for more information on the Results III graphic display screen).

3.1.1 Summary Category Results

The Summary category automatically displays key results that are non-zero. The following results appear in the Summary category when the particular error conditions are detected.

Aborted Frames — Test Type Category
Call Fails (Call Failures) — Test Type Category
Err Frm (Errored Frames) — Test Type Category

Frm Rejects (Frame Rejects) — Test Type Category
Reject Frm (Reject Frames) — Test Type Category

NOTE

If all results are zero for the LINE or EQUIPMENT receiver, the message "`All Results OK`" is displayed on the appropriate side of the Two-Line Display.

3.1.2 Test Type Category Results

Test Type category results are described in Table PRI-2. Unless stated otherwise, all results are available in **Monitor** and **Terminate** modes.

Table PRI-2. Test Type Results

Result Name	Description
Layer2 Stat	Layer 2 Status Values include: TEI Not Assigned, Awaiting TEI, Link Not Established, Awaiting Establishment, Link Established, Timer Recovery, Awaiting Release, TEI Denied, Link Unknown. If the status is Link Not Established, a flashing two-line message appears on ResI and or ResII to indicate that calls cannot be placed.
Frm Count	Counts the valid ISDN frames received.
Err Frm	Counts the errored frames received with at least one of the following conditions: undefined control field, U frame with an improper length, I frame with a length exceeding limit.
Aborted Frm	Counts the aborted ISDN frames received, excluding Out of Frame aborts.
Reject Frm	Counts the received frames with a sequence number error.
Frm Rejects	Counts the received frames with ISDN Frame Reject frames. A Frame Reject is sent when a device receives a frame with a protocol error.

Table PRI-2. Test Type Results (Continued)

Result Name	Description
Invalid Frm	Counts the frames with at least one of the following invalid conditions: short frame, FCS errored frame, single octet address, an unapproved Service Access Point Identifier (SAPI).
Call Fails	Counts the number of call attempts that ended in call failure (does not include busy replies or normal call clears).
Act Calls	Counts the total number of currently active calls. Includes calls in progress, connected calls, and calls being disconnected.
Comp Calls	Counts the number of completed calls that successfully connect and disconnect.
Call (N) Status	Displays current call status. The following information appears on the RESULTS III Screen: Call Status, Call Type, Caller ID, Channel #, Cause Code, and Location. **NOTE:** Cause Codes can be found in Table PRI-3, however, the analyzer interprets the Cause Code for you.
Call Failure Report	Displays the status of the last five failed ISDN calls. The report includes: Call Type, Channel #, Cause Code, Location, Calling #, and Called #. **NOTE:** Cause Codes can be found in Table PRI-3, however, the analyzer interprets the Cause Code for you.
Call Progress Report	Displays the status of the last five ISDN calls. The report includes: Call #, Calling #, Call Type, Channel #, and Call Status.
% Full	Displays the current amount of storage used (% full) for D-channel message capture.
Messages	Displays the current number of messages available to the D-channel display (see Section 2.7).

Table PRI-2. Test Type Results (Continued)

Result Name	Description
DCBU Stat	Displays the status of the D-channel in relation to DCBU operation. A DCBU switchover can be performed when both D channels display Ready status. **Ready** — Indicates that the D-channel is in the proper state for DCBU operation (In Service or Standby). **Not Ready** — Indicates that the D-channel is not ready and is in the Out of Service state. **Not In Serv** — Indicates that the D-channel is attempting to become the In Service D-channel. The D-channel may be in this state during normal DCBU initialization and switchover operations, and should eventually transition to Ready status indicating normal operation. **Not Standby** — Indicates that the D-channel should be in Standby state. This status occurs during normal DCBU initialization and switchover operations, and should eventually transition to Ready status indicating normal operation.
D-Chan Stat	Displays state of the D-channel for DCBU operation. **In Service** — The indicated D-channel is the In Service D-channel and is operating normally. **Standby** — The indicated D-channel is the Standby D-channel and is operating normally. **Out of Service** — The indicated D-channel is currently **Out of Service,** indicating problems in the operation of the D-channel. **Wait** — The indicated D-channel is waiting to become the In Service D-channel. **Maint Busy** — The indicated D-channel declines establishment attempts while the other D-channel is becoming In Service (Wait State).

3.2 ISDN Q.931 CAUSE CODES

Table PRI-3 provides English translations of Q.931 messages received and transmitted on the D-channel.

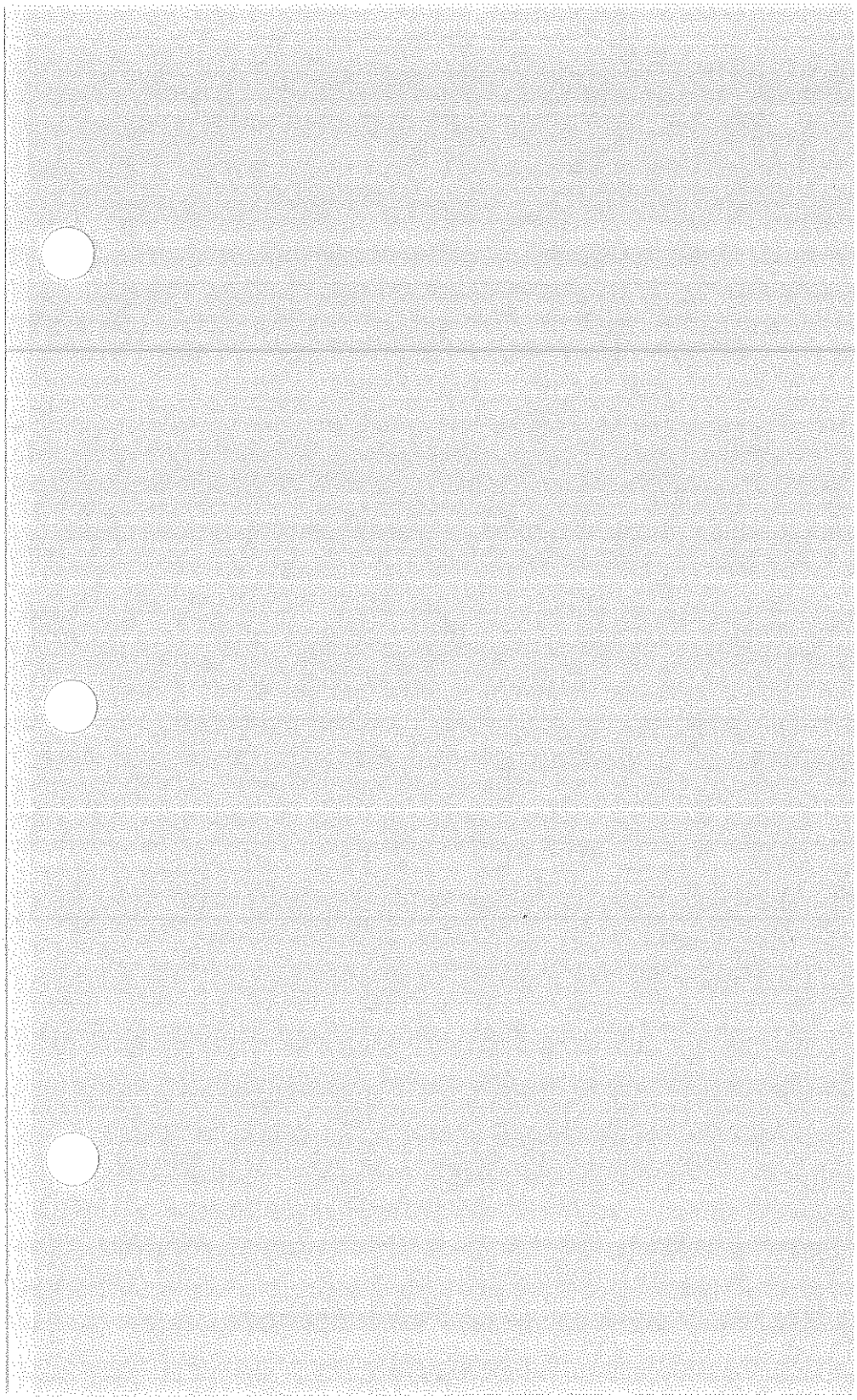
Table PRI-3. Results Reports Cause Codes

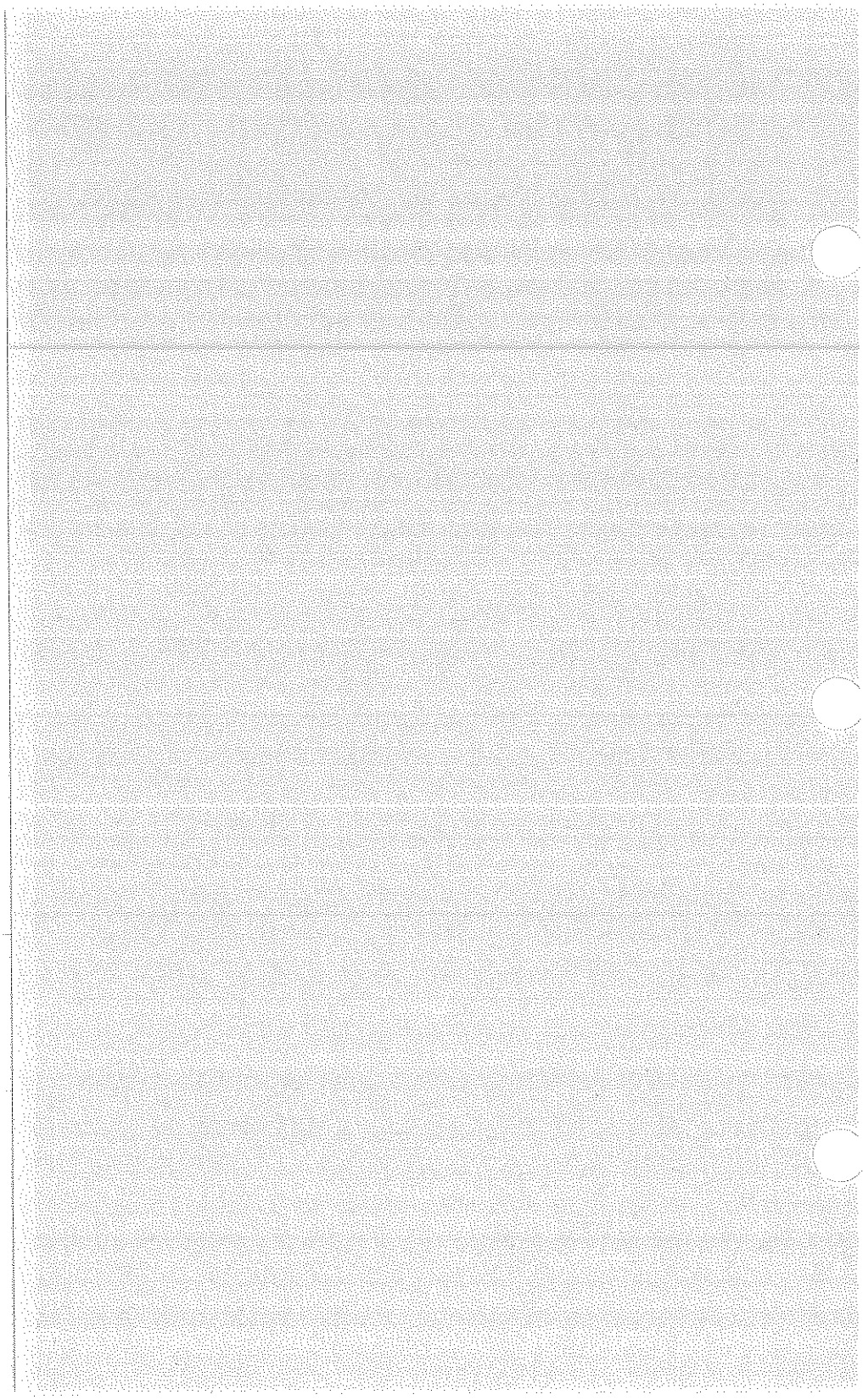
Class	Value	No.	Cause Code
			— Q.931 Cause Codes (1988) —
000	0001	1	Unassigned number.
	0010	2	No route to specified transit network.
	0011	3	No route to destination.
	0110	6	Channel unacceptable.
	0111	7	Call awarded and being delivered in an established channel.
001	0000	16	Normal call clearing.
	0001	17	User busy.
	0010	18	No user responding.
	0111	19	No answer from user (user alerted).
	0101	21	Call rejected.
	0110	22	Number changed.
	1010	26	Non-selected user clearing.
	1011	27	Destination out of order.
	1100	28	Invalid number format.
	1101	29	Facility rejected.
	1110	30	Response to STATUS INQUIRY.
	1111	31	Normal, unspecified.
010	0001	34	No circuit/channel available.
	0110	38	Network out of order.
	1001	41	Temporary failure.
	1010	42	Switching equipment congestion.
	1011	43	Access information discarded.
	1100	44	Requested circuit/channel not available.
	1111	47	Resources unavailable, unspecified.
011	0001	49	Quality of service unavailable.
	0010	50	Requested facility not subscribed.
	0110	54	Incoming calls barred[1]
	1001	57	Bearer capability not authorized.
	1010	58	Bearer capability not presently available.
	1111	63	Service or option not available, unspecified.

Table PRI-3. Results Reports Cause Codes (Continued)

Class	Value	No.	Cause Code
100	0001	65	Bearer capability not implemented.
	0010	66	Change type not implemented.
	0101	69	Requested facility not implemented.
	0110	70	Only restricted digital information bearer capability is available.
	1111	79	Service or option not implemented, unspecified.
101	0001	81	Invalid call reference value.
	0010	82	Identified channel does not exist.
	0011	83	A suspended call exists, but this call identity does not.
	0100	84	Call identity in use.
	0101	85	No call suspended.
	0110	86	Call having the requested call identity has been cleared.
	1000	88	Incompatible destination.
	1011	91	Invalid transit network selection.
	1111	95	Invalid message, unspecified.
110	0000	96	Mandatory information element is missing.
	0001	97	Message type nonexistent or not implemented.
	0010	98	Message not compatible with call state or message type nonexistent or not implemented.
	0011	99	Information element nonexistent or not implemented.
	0100	100	Invalid information element contents.
	0101	101	Message not compatible with call state.
	0110	102	Recovery on timer expired.
	1111	111	Protocol error, unspecified.
111	1111	127	Interworking, unspecified.
— National-specific Cause Codes Defined in TA-NWT-001268 —			
000	0100	4	Vacant code.
	1000	8	Prefix 0 dialed in error.
	1001	9	Prefix 1 dialed in error.
	1010	10	Prefix 1 not dialed.
	1011	11	Excessive digits received, call is proceeding.
110	0101	101	Protocol error, threshold exceeded.

1. This code was defined in the 1984 revision of Q.931 but omitted from the 1988 revision. The DMS 100 switch supports this code.





50-14950-05
Rev. D

T-BERD® 950 SIGNALING OPTION USER'S MANUAL

May 1999

This User's Manual applies to all T-BERD 950 Communications Analyzers incorporating Software Level 3.xx.

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TABLE OF CONTENTS

SIGNALING OPTION

1 GETTING STARTED

This section provides operating information for the Signaling option for the T-BERD 950 Communications Analyzer. The section is divided into the following subsections; Getting Started, Graphical Display Screens, and Test Results. The following paragraphs describe the contents of each of the subsections.

- **Subsection 1 — Getting Started**: Describes the Signaling option and its specifications.
- **Subsection 2 — Graphical Display Screens**: Details the Graphical Display Setup screen as it applies to the Signaling option.
- **Subsection 3 — Test Results**: Explains the Signaling option test results.

1.1 OPTION DESCRIPTION

The Signaling option enables the T-BERD 950 Communications Analyzer to perform signaling tests, test against different trunk types, and to program the signaling elements. In addition, this option enables the analyzer to establish a voice or data call so that the microphone, PCM TIMS option (if installed), or BERT source/sink can transmit/receive tones, voice, or data without dropping the call.

The external interface to the Signaling option is the T1 interface (both LINE and EQUIPMENT connectors are used). The PCM in-band robbed bit signaling works with channel data dropped from or inserted in a T1 line.

1.1.1 Operating Modes

The Signaling option operates in one of the following T1 operating modes; Terminate, Drop & Insert, or Monitor mode. The following paragraphs provide a brief discussion of each mode.

1.1.1.1 Terminate Mode

In Terminate mode both sides of a T1 path are separated, the input signal is terminated at the receive side, and a totally independent signal is generated for the output.

1.1.1.2 Drop & Insert Mode

Drop and Insert (D&I) mode enables the analyzer to access specific channels from the T1 line while leaving the other channels unaffected.

1.1.1.3 Monitor Mode

Monitor mode enables the user to monitor originating sequences (originating supervision events and digits) transmitted on one line and monitor terminating response sequences (terminating supervision events) on the other line. While in Monitor mode data cannot be inserted in a T1 line. This test type is used to monitor two in-service switches that are communicating with each other.

The user can select the trunk type of the lines monitored and the direction to the station or central office, thus enabling the analyzer to recognize the originating line automatically. The speaker is enabled at all times during the test so that the user can listen to the channel data being dropped. The speaker can reflect both directions of the full duplex DS0 channel being monitored.

1.1.2 Sequence Types

The following paragraphs describe the sequence types available for use with the Signaling option.

1.1.2.1 Call Origination

Call Origination enables the analyzer to transmit complex sequences of supervision events and digits (pre-defined sequences and manual dialing is supported) to switches/PBXs to test the ability of switching equipment to receive incoming calls.

NOTE

Terminate or D&I must be selected on the T1 Interface Setup screen in order to run this test.

Pre-defined Signaling Sequences — Enables the user to program complex signaling sequences that emulate switch-to-switch or PBX-to-switch communications. Both originating and terminating supervision events as well as digits can be programed in a sequence. The originating supervision events and digits are transmitted by the test set, while terminating supervision events are received by the test set and provide handshaking with the digit receiving device. Up to 64 digits/supervision events can be programmed into a sequence. Digits are transmitted as programmed in the sequence. The Dial Tone is

considered to be a terminating supervision event which can also be programmed into a sequence. Once the pre-programmed sequence is selected, the user can initiate transmission.

Manual Dialing — enables the user to originate a call just as if a regular telephone was being used. The following digit types are available for use in manual dialing: Dial Pulse (DP), Multifrequency (MF), and Dual Tone Multifrequency (DTMF). The on hook and off hook softkeys (located on the Signaling Test Type RESULTS III Test Type page) must be pressed (by the user) at the appropriate time to complete a call. The speaker is enabled at all times during the test so that the user can listen to the channel data being dropped and inserted.

1.1.2.2 Call Termination

Call Termination enables the analyzer to emulate a switch/PBX in order to receive a signaling sequence from a far end PBX/switch.

NOTE

Terminate or D&I must be selected on the T1 Interface Setup screen in order to run this test.

In Call Termination, a pre-defined sequence of originating supervision events, digits, and terminating supervision events is required. The originating supervision events and digits are received by the analyzer, while the terminating supervision events are transmitted by the analyzer and provide the handshaking with the digit sending device. Up to 64 digits/supervision events can be programed into a sequence. These sequences are the same sequences used for call origination (see 1.1.2.1). The Dial Tone is considered to be a terminating supervision event which can also be programmed into a sequence.

1.1.3 Trunk Types

The Trunk Type is used to define the ON HOOK and OFF HOOK signaling status of the A, B, C, and D signaling bits. All trunk types are available regardless of the T1 Interface framing mode (e.g. SLC trunk types can be selected without SLC framing). The available trunk types include: Standard (E&M), Ground Start, Loop Start and Defined. The following paragraphs describe each trunk type, an 'X' indicates a "don't care" condition, and a '/' indicates toggling.

1.1.3.1 Standard (E&M) Trunk Type

The standard trunk type is the E & M signaling structure used on trunks between switches in the public switched telephone network. The signal structure is as follows.

Transmit

ON HOOK:	A=0 B=0 (C=0, D=0)
OFF HOOK:	A=1 B=1 (C=1, D=1)

Receive

ON HOOK:	A=0 B=X (C=0, D=X)
OFF HOOK:	A=1 B=X (C=1, D=X)

1.1.3.2 Ground Start Trunk Type

Ground Start trunk type circuits provide additional supervision to prevent outgoing calls commencing on circuits with incoming calls present. The signaling structure for the various types of Ground Start trunks (Foreign Exchange Station — FXS, Foreign Exchange Office — FXO, SLC Station, and SLC Office) is as follows.

Foreign Exchange Station (FXS)

Transmit

ON HOOK:	A=0 B=1 (C=0 D=1)
G:	A=0 B=0 (C=0, D=0) Ground on Ring
OFF HOOK:	A=1 B=1 (C=1, D=1) Loop closed after the far end FXO sends A=0 (Ground on tip)

Receive

ON HOOK:	A=1 B=X (C=1, D=X) No Tip Ground
OFF HOOK:	A=0 B=1 (C=0 D=1) Tip Ground
RINGING:	A=X B=0 (C=X D=0)

Foreign Exchange Office (FXO)

Transmit

ON HOOK:	A=1 B=1 (C=1, D=1) No Ground on Tip
OFF HOOK:	A=0 B=1 (C=0 D=1) Ground on Tip
RINGING:	A=0 B=0 (C=0 D=0)

Receive

ON HOOK:	A=0 B=1 (C=0 D=1) Loop Idle
G:	A=0 B=0 (C=0, D=0) Ground on Ring
OFF HOOK:	A=1 B=1 (C=1, D=1) Loop closed

SLC Station

Transmit

ON HOOK:	A=0 B=0
G:	A=0 B=1 Ground on Ring
OFF HOOK:	A=1 B=0 Loop closed after the far end FXO sends B=0 (Ground on Tip)

Receive

ON HOOK:	A=0 B=0 No Tip Ground
OFF HOOK:	A=0 B=0/1 Tip Ground
RINGING:	A=1 B=1/0

SLC Office

Transmit

ON HOOK:	A=0 B=0 No Ground on Tip
OFF HOOK:	A=0 B=0/1
RINGING:	A=1 B=1/0

Receive

ON HOOK:	A=0 B=0 Loop Idle
G:	A=0 B=1 Ground on Ring
OFF HOOK:	A=1 B=0 Loop closed

1.1.3.3 Loop Start Trunk Type

The Loop Start trunk type circuits emulate standard signaling between a telephone and a switch. The signaling structure for the various types of Loop Start trunks (Foreign Exchange Station — FXS, Foreign Exchange Office — FXO, SLC Station, and SLC Office) is as follows.

Foreign Exchange Station (FXS)

Transmit

ON HOOK:	A=0 B=1 (C=0 D=1)
OFF HOOK:	A=1 B=1 (C=1, D=1) Loop closed

Receive

ON HOOK:	A=0 B=1 (C=0, D=1)
OFF HOOK:	A=0 B=1 (C=0 D=1)
RINGING:	A=X B=0 (C=X D=0)

Foreign Exchange Office (FXO)

Transmit

ON HOOK:	A=0 B=1 (C=0, D=1)
OFF HOOK:	A=0 B=1 (C=0 D=1)
RINGING:	A=0 B=0 (C=0 D=0)

Receive

ON HOOK:	A=0 B=X (C=0 D=X) Loop Idle
OFF HOOK:	A=1 B=X (C=1, D=X) Loop closed

SLC Station

Transmit

ON HOOK:	A=0 B=0
OFF HOOK:	A=1 B=0 Loop closed

Receive

ON HOOK:	A=1 B=1 Idle
OFF HOOK:	A=1 B=1 Idle
RINGING:	A=1 B=1/0

SLC Office

Transmit

ON HOOK:	A=1 B=1 Idle
OFF HOOK:	A=1 B=1 Idle
RINGING:	A=1 B=1/0

Receive

ON HOOK:	A=0 B=0 Loop Idle
OFF HOOK:	A=1 B=0 Loop closed

1.1.3.4 User Defined Trunk Type

The User Defined trunk type enables the user to specify their own signaling states for ON HOOK and OFF HOOK signaling status. Transmit states can vary from the receive states. The signaling bit settings are 0, 1, and don't care. The "don't care" is treated as a 1 when transmitted.

NOTE

The ON HOOK and OFF HOOK signaling bits are duplicated for both the transmit and receive sides.

1.1.4 Programmable Signaling Elements

A pre-defined signaling sequence can contain both originating and terminating supervision events as well as digits. Up to 64 supervision events/digits can be pre-programmed into a sequence. The analyzer can store 5 Origination sequences and 5 Termination sequences. The digit type and associated symbols are detailed in Table SIG-1, and the Supervision Events and associated symbols are detailed in Table SIG-2. When an element in a sequence does not match with the test, that element is ignored by the test.

Table SIG-1. Digit Type Symbols

Digit Type	Digit Symbol
DP	0 through 9
DTMF	0 through 9, A, B, C, D, #, *
MF	0 through 9, KP, ST, STP, ST2P, ST3P

Table SIG-2. Supervision Event Symbols

Supervision Event	Supervision Event Symbol
Originating On Hook	O
Originating Off Hook	H
Originating Ring	R
Ground on Ring	G
Originating Pause	P
Terminating On Hook	o
Terminating Off Hook	h
Terminating Wink	w
Terminating Delay Dial	d
Terminating Dial Tone	t

NOTE

For Ground Start Trunk selections, the off-hook sequence is automatically initiated.

1.2 OPTION SPECIFICATIONS

The Signaling option signaling element specifications are provided in Table SIG-3.

Table SIG-3. Signaling Option Specifications

Item	Specification
Transmit Signaling Element	
Tone Digit Duration:	70 msec
Tone Digit Inter-digit Time:	70 msec
Pulse Digit pulse Per Second:	10
Pulse Digit %Break:	60
Pulse Digit Inter-digit Time:	800 msec
Consecutive Originating Event Delay[1]:	60 msec
Consecutive terminating Event Delay:	60 msec
Tone Digit Level:	-7 dBm
Wink Delay:	200 msec
Wink Duration:	150 msec
Delay Dial Delay:	200 msec
Delay Dial Duration:	150 msec
Origination Off Hook:	> 600 msec
Receive Signaling Element	
Wink Delay:	0 to 16 sec
Wink Duration:	70 msec to 600 msec
Delay Dial Delay:	0 to 16 sec
Delay Dial Duration:	70 msec to 16 sec
Off Hook Delay:	0 to 60 sec
Off Hook Duration:	> 600 msec
Pulse Digit Pulse Per Second:	7 to 21 pps
Pulse Digit %Break:	40 to 68%
Pulse Digit Inter-digit Time:	> 300 msec
Tone Digit Frequency:	< ± 2.5%
Tone Digit Level:	> -30 dB
MF Twist:	< ± 6 dB
DTMF Twist Low Freq relative to High Freq:	-4 dB to 8 dB
Tone Digit Duration:	> 30 msec
Tone Digit Inter-digit Time:	> 25 msec
Disconnect Time:	5 sec

1. In a sequence of "H O", there is no terminating event to handshake with, the event On Hook is sent 60 msec. later after the event Off Hook.

1.3 OPTION MESSAGES

The following message flashes on the Two Line Display when a pre-defined Call Origination or Call Termination sequence is not satisfied by the signalling events which occurred on the line, or when a signalling event delays more than 60 seconds, **`Sequence Fail`**.

2 GRAPHICAL DISPLAY SCREENS

This subsection provides descriptions of the analyzer Graphical Display SETUP screen (see Figure SIG-1) as it applies to the Signaling option.

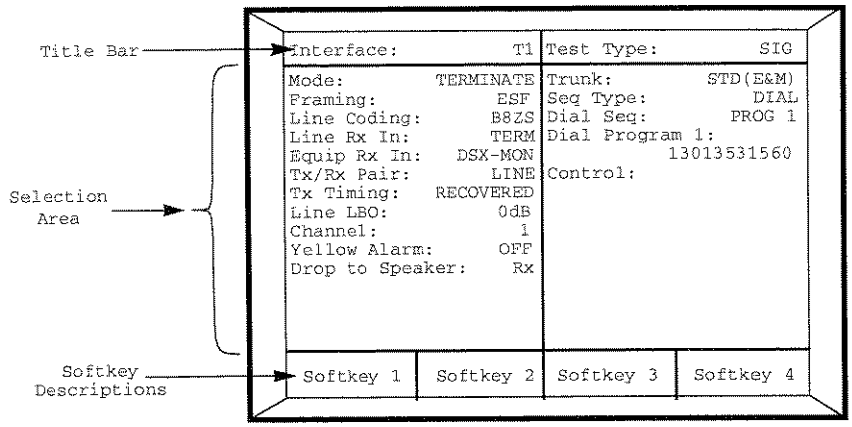


Figure SIG-1. Signaling Option Setup Screen

2.1 T1 INTERFACE SETUP SCREEN

The T1 Interface Setup Screen is used to configure the T1 interface. The **Scroll I** and **Select I** keys are used to control this selection area. The following additional parameter choices are available when Signaling is the selected test type.

When **Framing** is set to **SF**, the following parameter is available:

Channel Format — Used to select the timeslot to channel assignment format (default value is **D3/D4**). The choices include: **D1D**, **D2**, or **D3/D4**.

Drop to Speaker — *(Terminate or D&I modes)* Used to select which line is dropped to the speaker (default value is **Rx**). The choices include: **Rx**, **Tx**, or **BOTH**.

When in *Monitor mode*, the choices are **LINE Rx**, **EQUIP Rx**, or **BOTH**.

2.2 SIGNALING TEST TYPE SETUP SCREEN

The Signaling Test Type Setup Screen is used to configure the Signaling option. The **Scroll ⇕** and **Select ⇕** keys are used to control this selection area. In the following paragraphs, the **Scroll ⇕** keys are used to select the active selection line and the **Select ⇕** keys (unless stated otherwise) are used to cycle through the available choices.

The following parameters and associated choices are available when the **Test Type** (selectable on the **MAIN** Graphical Display screen of the analyzer) is set to either **SIG** or **SIG+BERT** (or **SIG+TIMS** if the PCM TIMS option is installed).

Trunk — *(All Operating modes)* Enables selection of the trunk type which defines the ON HOOK and OFF HOOK signaling status for the A, B, C, and D signaling bits (default value is **STD (E&M)**). The choices include:

STD (E&M) — Selects the standard E & M signaling structure used on trunks between switches in the public switched telephone network.

LOOP START — Selects the Loop Start trunk type which emulates standard signaling between a telephone and a switch. When selected the following parameter choice is available:

Emulate — Selects the type of emulation used on the trunk (default value is **FXS**). The choices include:

FXS — Selects Foreign Exchange Station as the emulation type.

FXO — Selects Foreign Exchange Office as the emulation type.

SLC STATION — Selects SLC Station as the emulation type.

SLC OFFICE — Selects SLC Office as the emulation type.

GROUND START — Selects the Ground Start trunk type which provides additional supervision to prevent outgoing calls on circuits with incoming calls. When selected the following parameter choice is available:

Emulate — Selects the type of emulation used on the trunk (default value is **FXS**). The choices include:

FXS — Selects Foreign Exchange Station as the emulation type.

FXO — Selects Foreign Exchange Office as the emulation type.

SLC STATION — Selects SLC Station as the emulation type.

SLC OFFICE — Selects SLC Office as the emulation type.

USER DEFINED — Enables the user to specify the ON HOOK and OFF HOOK signaling states.

When T1 **Framing** is set to **SF** the choices include:

On Hook signaling:

Bit A — Used to define the A signaling bit (default value is **1**). The choices include: **1**, or **0.**

Bit B — Used to define the B signaling bit (default value is **1**). The choices include: **1**, or **0.**

Off Hook signaling:

Bit A — Used to define the A signaling bit (default value is **1**). The choices include: **1**, or **0**

Bit B — Used to define the A signaling bit (default value is **1**). The choices include: **1**, or **0.**

When T1 **Framing** is set to **ESF** the choices include:

On Hook signaling:

Bit A — Used to define the A signaling bit (default value is **1**). The choices include: **1**, or **0.**

Bit B — Used to define the B signaling bit (default value is **1**). The choices include: **1**, or **0.**

Bit C — Used to define the C signaling bit (default value is **1**). The choices include: **1**, or **0.**

Bit D — Used to define the D signaling bit (default value is **1**). The choices include: **1**, or **0.**

Off Hook signaling:

Bit A — Used to define the A signaling bit (default value is **1**). The choices include: **1**, or **0.**

Bit B — Used to define the B signaling bit (default value is **1**). The choices include: **1**, or **0.**

Bit C — Used to define the C signaling bit (default value is **1**). The choices include: **1**, or **0.**

Bit D — Used to define the D signaling bit (default value is **1**). The choices include: **1**, or **0**.

Org Side — *(Monitor mode only)* Enables selection of the originating side of the T1 interface (default value is **LINE**). The choices include:

LINE — Selects the T1 LINE interface.

EQUIP — Selects the T1 EQUIPMENT interface.

Seq Type — *(Terminate and D&I modes only)* Enables selection of the sequence type to be used. The choices are **DIAL** or **RCV** (default value is **DIAL**).

When **DIAL** is the selected sequence type the following parameters are available:

Dial Seq — Selects the Call Origination sequence transmitted by the analyzer, both pre-programmed sequences and manual dialing are selectable (default value is **PROG 1**). The choices include:

MANUAL — Enables manual dialing.

PROG n — Selects **Dial Program n** (where ***n*** is the number of the Dial Program sequence, 1 through 5) as the sequence to be transmitted by the analyzer. The following parameter is used to program the sequence:

Dial Program *n* — (Where ***n*** is the number of the Dial Program sequence, 1 through 5) Selects the Dial Program to be programed/edited (the program string can be up to 64 supervision event/digits, see Table SIG-2 for the valid supervision event symbols). The program is edited using the keypad left and right arrow keys to move the cursor to the required position. The **DEL** (delete) key must be used to remove an existing supervision event/digit. The keypad keys are used to enter numeric values. The following softkeys are used to enter supervision events and digit types.

NOTE

The **More Keys** *softkey displays additional softkeys used in editing the sequence.*

(O)n Hook — Selects Originating On Hook supervision event.

Off (H)ook — Selects Originating Off Hook supervision event.

(R)ing — Selects Originating Ring supervision event.

(P)ause — Selects Origination Pause supervision event.

(w)ink — Selects Terminating Wink supervision event.

(o)n Hook — Selects Terminating On Hook supervision event.

off (h)ook — Selects Terminating Off Hook supervision event.

(d)elay dial — Selects Terminating Delay Dial supervision event.

dial (t)one — Selects Terminating Dial Tone supervision event.

DTMF — Selects the Dual Tone Multifrequency digit type.

DP — Selects the Dial Pulse digit type.

MF — Selects the Multifrequency digit type.

When **RCV** is the selected sequence type the following parameters are available:

Rcv Seq — Selects the pre-programmed Call Termination sequence to be used by the analyzer (default value is **PROG 1**). The choices include:

PROG n — Selects **Receive Program n** (where ***n*** is the number of the Receive Program sequence, 1 through 5) as the sequence to be received by the analyzer. The following parameter is used to program the sequence:

Rcv Program *n* — (Where ***n*** is the number of the Receive Program sequence, 1 through 5) Selects the Receive Program to be programed/edited (the program string can be up to 64 supervision event/digits, see Table SIG-2 for the valid supervision event symbols). The program is edited using the keypad left and right arrow keys to move the cursor to the required position. The **DEL** (delete) key must be used to remove an existing supervision event/digit. The keypad keys are used to enter numeric values. The following softkeys are used to enter supervision events.

NOTE

The **More Keys** *softkey displays additional softkeys used in editing the sequence.*

(O)n Hook — Selects the Originating On Hook supervision event.

Off (H)ook — Selects the Originating Off Hook supervision event.

(R)ing — Selects the Originating Ring supervision event.

(G)nd on Ring — Selects the Ground on Ring supervision event.

(P)ause — Selects the Origination Pause supervision event.

(w)ink — Selects the Terminating Wink supervision event.

(o)n Hook — Selects the Terminating On Hook supervision event.

off (h)ook — Selects the Terminating Off Hook supervision event.

(d)elay dial — Selects the Terminating Delay Dial supervision event.

dial (t)one — Selects the Terminating Dial Tone supervision event.

Any digit — Enables the analyzer to accept any digit in a particular position in the sequence.

Control — Used to control the operation of the pre-programmed signaling sequences. When selected, the following softkeys are available:

Start Program n — (Where ***n*** is the number of the pre-programmed sequence, 1 through 5) Starts the pre-programmed sequence.

Once the **Start Program n** softkey has been pressed, the following softkeys are available:

Restart Program n — (Where ***n*** is the number of the pre-programmed sequence, 1 through 5) Restarts the pre-programmed sequence.

Stop Program n — (Where ***n*** is the number of the pre-programmed sequence, 1 through 5) Stops the pre-programmed sequence.

2.3 RESULTS III SCREEN

Refer to Section 2.5 of the *T-BERD 950 User's Manual* for a detailed description of the RESULTS III screen usage. A typical Signaling Test Type results page is shown in Figure SIG-2. Up to 80 events can be displayed.

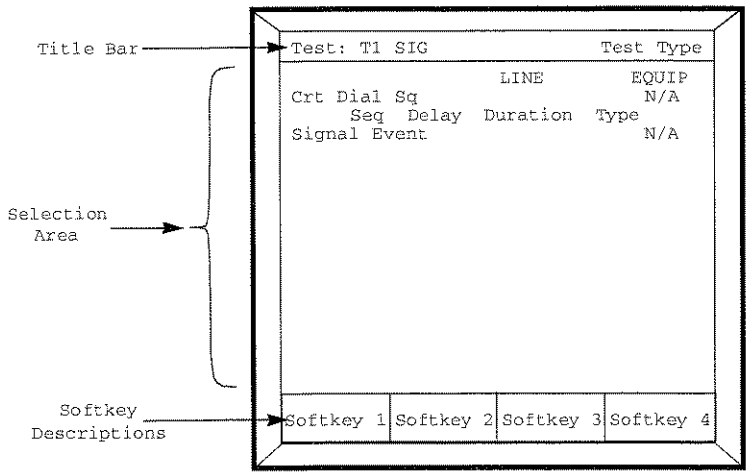


Figure SIG-2. Typical Signaling Test Type Results Page

2.4 AUX SCREEN

Refer to Section 2.6 of the *T-BERD 950 User's Manual* for a detailed description of the AUX screen usage.

3 TEST RESULTS

This subsection provides information on the analyzer Two Line Display and the test results available for the Signaling option.

3.1 SIGNALING OPTION TEST RESULTS

Test results for the Signaling option are displayed on the analyzer Two Line Display. The Two Line Display and associated controls and indicators are located on the front panel above the keypad. Refer to Section 4 of the *T-BERD 950 User's Manual* for a detailed description of the Results Display.

Test results can also be displayed on the RESULTS III graphic display screen (refer to Section 2.5 of the *T-BERD 950 User's Manual* for more information on the RESULTS III graphic display screen). In

NOTE

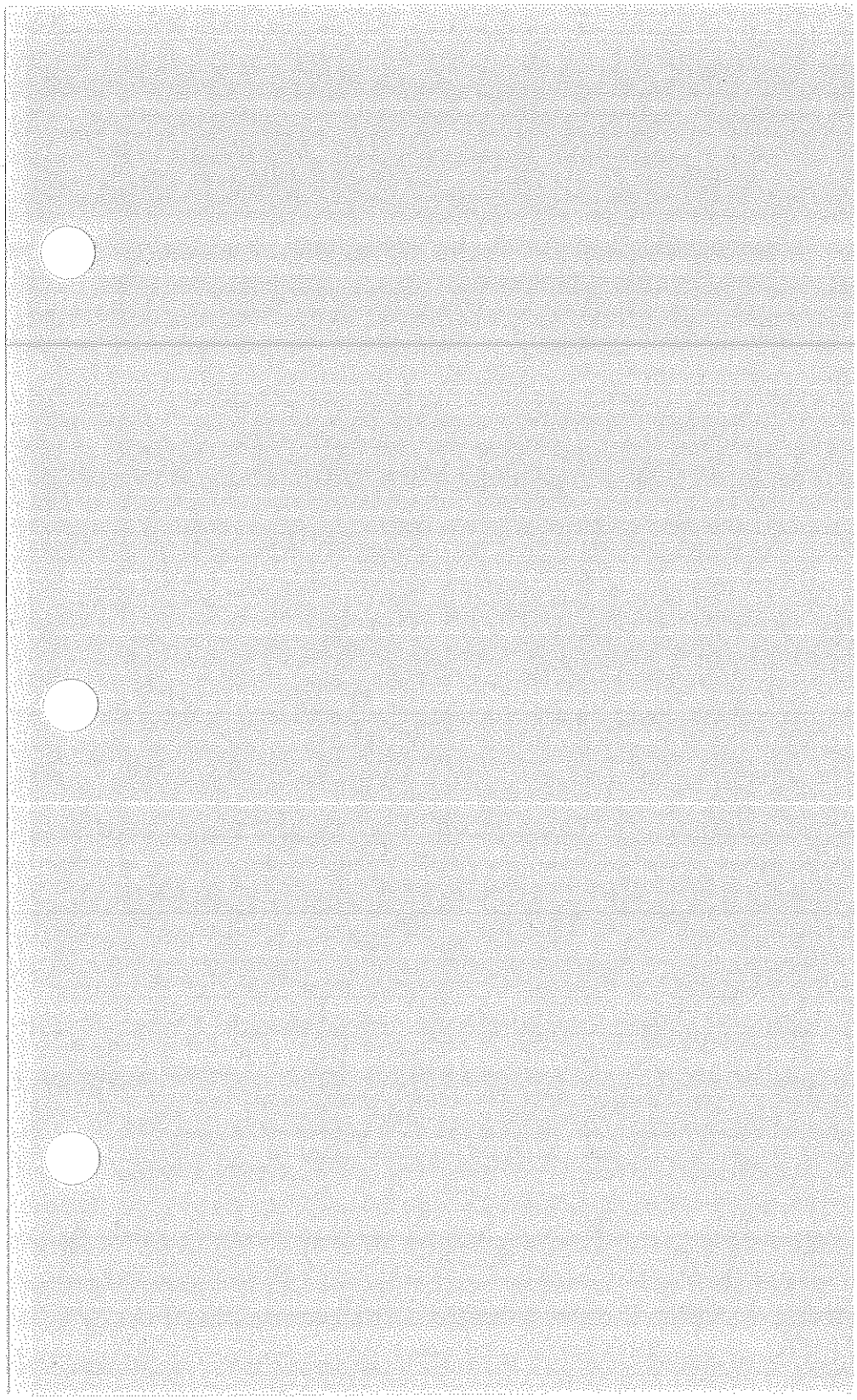
There are no **Summary**, **Interface**, **Signal**, **Time**, *or* **Performance** *Category results for the Signaling Option.*

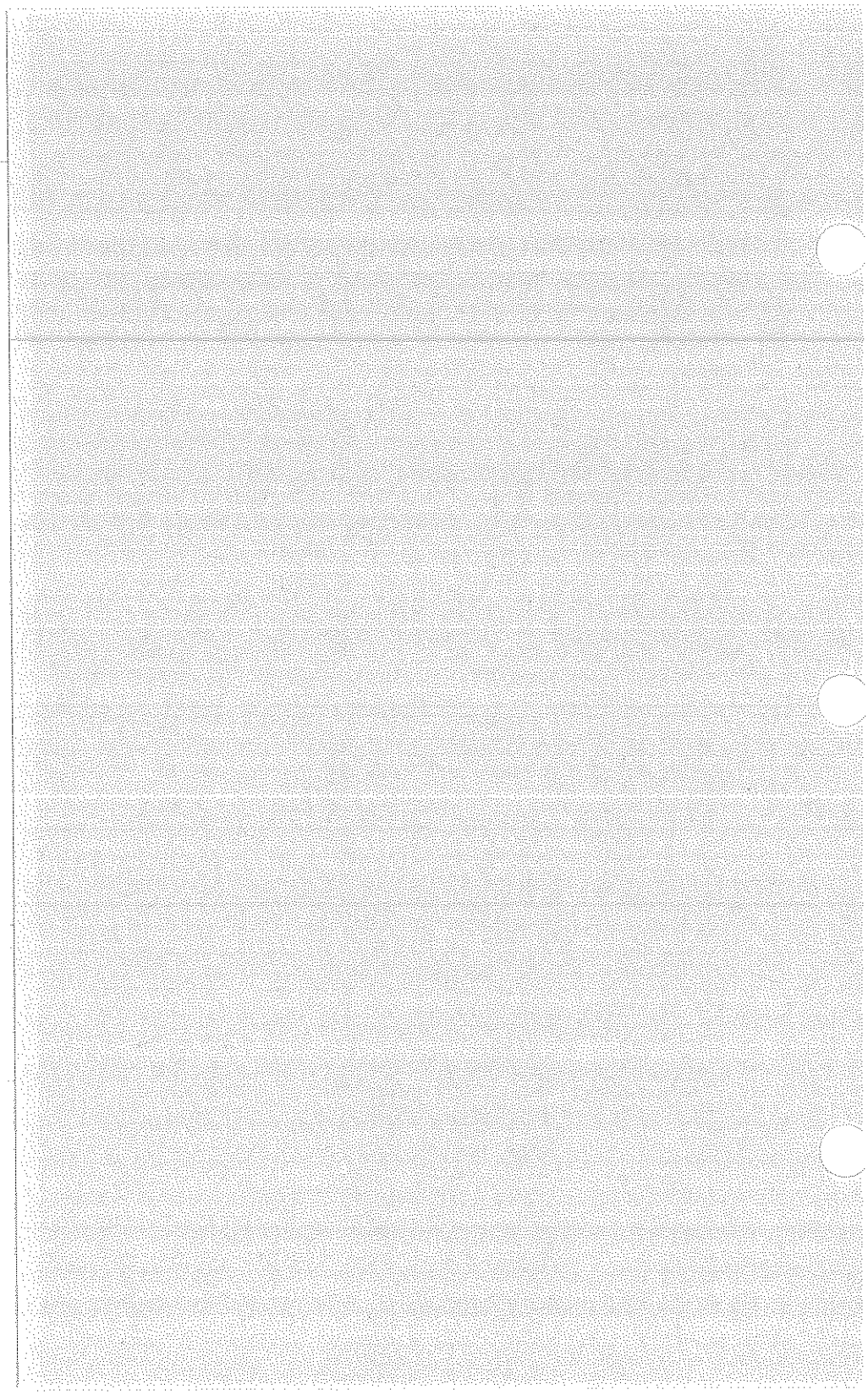
3.1.1 Test Type Category Results

The Signaling test type category results are described in Table SIG-4.

Table SIG-4. Signaling Test Type Category Results

Result	Description
Signal Event	Displays the signaling supervision events and digits for the current call. When a pre-defined Call Termination or Call Origination sequence is not satisfied by the signaling events that occurred on the line, or a signaling event delays more that 60 seconds, the message `Sequence Fail` is displayed.
Digit Type	Displays the digit type either DP, MF, or DTMF.
Event Dur (Event Duration)	Measurement of the duration of a supervision event or digit. The range is 0 through 60 seconds, with overflow indication. **NOTE:** This result is applicable to signaling supervision events 'R', 'w', 'd', and 't' or any digit.
Inter-event Delay	Measurement of the delay from one supervision event/digit to the previous supervision event/digit. The range is 0 through 60 seconds, with overflow indication.





50-14950-06
Rev. D

T-BERD® 950
PCM TIMS OPTION
USER'S MANUAL

May 1999

This User's Manual applies to all T-BERD 950
Communications Analyzers incorporating Software Level 3.xx.

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TABLE OF CONTENTS

PCM TIMS OPTION

1 GETTING STARTED

This section provides information on the PCM TIMS (Pulse Code Modulation Transmission Impairment Measurement Set) option for the T-BERD 950. The section is divided into the following subsections; Getting Started, Graphical Display Screens, and Test Results. The following paragraphs describe the contents of each of the subsections.

- **Subsection 1 — Getting Started**: Describes the PCM TIMS option and its specifications.
- **Subsection 2 — Graphical Display Screens**: Details the Graphical Display Setup screen as it applies to the PCM TIMS option.
- **Subsection 3 — Test Results**: Explains the PCM TIMS test results.

1.1 OPTION DESCRIPTION

The PCM TIMS option enables the T-BERD 950 to perform Voice Frequency (VF) testing on μ-Law encoded PCM data. The external interface to the option is via the T1 interface (LINE or EQUIPMENT, or both).

Digital Signal Processing (DSP) based testing is performed on the PCM data accessed from a DS1 access point. All option testing can be performed on DS0 channel PCM data dropped or inserted from a T1 line. The speaker output can be from either the LINE or EQUIPMENT T1 input or from both T1 inputs simultaneously (user selectable).

With the PCM TIMS option installed, the analyzer has the capability to pass through signalling bits while performing D&I (Drop & Insert) testing, or insert signalling bits while performing Terminate or D&I testing.

1.1.1 Operating Modes

The PCM TIMS option operates in one of the following T1 operating modes; Terminate, Drop & Insert, or Monitor mode. The following paragraphs provide a brief discussion of each mode.

1.1.1.1 Terminate Mode

Terminate mode separates both sides of a T1 path, terminates the input signal at the receive side, and generates a totally independent output signal.

1.1.1.2 Drop & Insert Mode

Drop and Insert mode enables the analyzer to access specific channels from the T1 line while leaving the other channels unaffected.

1.1.1.3 Monitor Mode

In Monitor mode the option measures the parameters of the received PCM data signal. With two receivers enabled the following results are provided: Level (with tone present), Frequency (with tone present), C Message Noise, C Notch Noise, C Message Signal to Noise Ratio, and DC Offset.

1.1.2 Test Modes

The PCM TIMS option operates in one of the following test modes; Holding Tone, Variable Tone, 3 Tones, or Quiet. The following paragraphs provide a brief discussion of each mode.

1.1.2.1 Holding Tone Test Mode

In Holding Tone test mode (with one receiver and/or one transmitter enabled) a tone is transmitted to the channel under test and the following parameters are measured with the corresponding results provided: Level, Frequency, C Filter Signal to Noise Ratio, D Filter Signal to Noise Ratio, 3.4 Filter Signal to Noise Ratio, C Notch Noise, 3.4 kHz Flat with Notch Noise, D Notch Noise, DC Offset, Dropouts and Impulse Noise.

NOTE

Only 1 set of measurements (C, D, or 3.4) can be derived at a time.

1.1.2.2 Variable Tone Test Mode

In Variable Tone test mode, the frequency of the transmitted tone is selected (from 20 to 3904 Hz) as is the level of the tone (from 3.0 through -40.0 dBm). The following results are provided: Level, Frequency, and DC Offset.

1.1.2.3 3 Tone Test Mode

3 Tone test mode (with one receiver and/or one transmitter enabled) measures the frequency response of a channel at three frequencies: 404, 1004, and 2804 Hz. The 3 tones are transmitted automatically and repetitively as a sweep. The transmission time of each tone is adjustable from 2 to 15 seconds (the default is 5 seconds). The following parameters are measured with the corresponding

results are provided: 404 Hz Level, 404 Hz Frequency, 1004 Hz Level, 1004 Hz Frequency, 2804 Hz Level, and 2804 Hz Frequency. A result takes approximately 4 seconds to appear on the RESULTS III display screen.

1.1.2.4 Quiet Test Mode

Quiet test mode (with one receiver and/or one transmitter enabled) is used to perform noise measurements on a PCM data circuit when no tones are present and one end of the circuit has been terminated. To simulate this condition, a code representing zero signal (0xFE) is inserted on the channel under test. This test mode provides the following results: C Message Noise, D Message Noise, 3.4 kHz Flat Noise, DC Offset and Impulse Noise.

NOTE

Only one set of measurements (C, D, or 3.4) can be performed at a time.

2 GRAPHICAL DISPLAY SCREENS

This subsection provides descriptions of the analyzer Graphical Display SETUP screen (see Figure TIMS-1) as it applies to the PCM TIMS option.

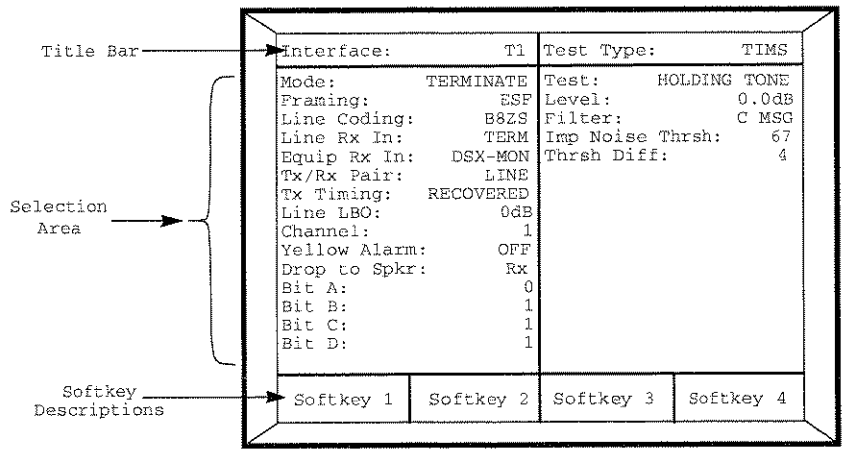


Figure TIMS-1. PCM TIMS Option Setup Screen

2.1 T1 INTERFACE SETUP SCREEN DESCRIPTION

The T1 Interface Setup screen is used to configure the T1 interface (see Section 3.2 of the *T-BERD 950 User's Manual* for further details). The **Scroll** and **Select** keys are used to control this selection area. The following parameter choices are available when PCM TIMS is the selected test type.

When **Framing** is set to **SF**, the following parameter is available:

Channel Format — Used to select the timeslot to channel assignment format (default value is **D3/D4**). The choices include: **D1D**, **D2**, or **D3/D4**.

Drop to Speaker — *(Terminate or D&I modes)* Used to select which line is dropped to the speaker (default value is **Rx**). The choices include: **Rx**, **Tx**, or **BOTH**.

When in *Monitor mode*, the choices are **LINE**, **EQUIP**, or **BOTH**.

ABCD Bits Thru — *(D&I mode)* Used to select whether the signalling bits are passed through the analyzer (default value is **YES**). The choices include: **YES** or **NO**.

When **ABCD Bits Thru** is set to **NO** (or when mode is set to **TERMINATE)** and the **Framing** is set to **ESF**, the following parameter choices are available:

Bit A — Used to set the A signalling bit (default value is **0**). The choices are **0** or **1**.

Bit B — Used to set the B signalling bit (default value is **1**). The choices are **0** or **1**.

Bit C — Used to set the C signalling bit (default value is **1**). The choices are **0** or **1**.

Bit D — Used to set the D signalling bit (default value is **1**). The choices are **0** or **1**.

When **ABCD Bits Thru** is set to **NO** (or when mode is set to **TERMINATE)** and the **Framing** is set to **SF**, the following parameter choices are available:

Bit A — Used to set the A signalling bit (default value is **0**). The choices are **0** or **1**.

Bit B — Used to set the B signalling bit (default value is **1**). The choices are **0** or **1**.

2.2 PCM TIMS TEST TYPE SETUP SCREEN DESCRIPTION

PCM TIMS Setup Screen is used to configure the PCM TIMS option. The **Scroll ⇕** and **Select ⇕** keys are used to control this selection area. In the following paragraphs, the **Scroll ⇕** keys are used to select the active selection line and the **Select ⇕** keys (unless stated otherwise) are used to cycle through the available choices.

Test — *(Terminate and D&I Modes only)* Enables selection of the test mode type to be used for PCM TIMS testing (default value is **HOLDING TONE**). The choices include:

HOLDING TONE — Selects Holding Tone as the test mode. In this operating mode a holding tone (1004 Hz) is inserted into the channel under test. The following choices are available:

Level — Sets the level of the transmitted tone, selectable from **3.0 dB** to **-40.0 dB** in 0.1 dB increments (default value is **0.0**). The keypad is used to enter the required value. The **Del** (delete) key is used to delete the right-most digit of the current level. The */E key is used to enter a decimal point (.).

Filter — Sets the filter used when performing the selected test (default value is **C MSG**). The choices include: **C MSG**, **D WEIGHT**, **3.4K FLAT**.

When **Filter** is set to **C MSG**, the following parameter choices are available:

Imp Noise Thrsh — Sets the Impulse Noise threshold, which is selectable from 30 dBrn to 90 dBrn (default value is **67**). Either the keypad or the **Select ⇕** keys can be used to enter the value, the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

Thrsh Diff — Sets the Impulse Noise Registers Difference. The choices include: **2 dB**, **4 dB**, or **6 dB** (default value is **4**). Either the keypad or the **Select ⇕** keys can be used to enter the value, the **Del** (delete) key on the keypad is used to delete the current digit of the value.

VARIABLE TONE — Selects Variable Tone as the test mode. The following choices are available:

Level — Sets the level of the transmitted tone, selectable from **3.0 dB** to **-40.0 dB** in 0.1 dB increments (default value is **0.0**). The keypad is used to enter the required value. The **Del** (delete) key is used to delete the right-most digit of the current level. The ***/E** key is used to enter a decimal point

(.). In addition, the **D** key is used to toggle a level value from a positive (+) value to a negative (-) value.

Frequency — Sets the frequency of the transmitted tone, selectable from 20 Hz to 3904 Hz. The keypad or the **Select II** keys can be used to enter the tone value, the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

QUIET — Selects Quiet Tone as the test mode. The following choice is available:

Filter — Sets the filter used when performing the selected test (default value is **C MSG**). The choices include: **C MSG**, **D WEIGHT**, **3.4K FLAT**.

When **Filter** is set to **C MSG**, the following parameter choices are available:

Imp Noise Thrsh — Sets the Impulse Noise threshold, which is selectable from 30 dBrn to 90 dBrn (default value is **67**). Either the keypad or the **Select II** keys can be used to enter the value, the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

Thrsh Diff — Sets the Impulse Noise Registers Difference. The choices include: **2 dB**, **4 dB**, or **6 dB** (default value is **4**). Either the keypad or the **Select II** keys can be used to enter the value, the **Del** (delete) key on the keypad is used to delete the current digit of the value.

3 TONES — Selects 3 Tone Slope as the test mode. The following choices are available:

Level — Sets the level of the transmitted tones, adjustable from **3.0 dB** to **-40.0 dB** in 0.1 dB increments (default value is **0.0**). The keypad is used to enter the required value. The **Del** (delete) key is used to delete the right-most digit of the current level. The ***/E** key is used to enter a decimal point (.). In addition, the **D** key is used to toggle a level value from a positive (+) value to a negative (-) value.

Tone Duration — Sets the length of time that the tones will be transmitted, selectable from 2 through 15 seconds in increments of 1 second (default value is **5**). Either the keypad or the **Select II** keys can be used to enter the value, the **Del** (delete) key on the keypad is used to delete the right-most digit of the current value.

2.3 FRONT PANEL KEYS

The following analyzer front panel keys are used in conjunction with the PCM TIMS option.

Loop Up — When pressed, transmits the 2713 Hz loop up tone at a fixed level of -10.0 dBm, until the far end is looped. Loop up is recognized when the receiver detects the 2713 Hz tone on the line.

Loop Down — When pressed, transmits the 2713 Hz loop down tone at a fixed level of -10.0 dBm, until the far end is looped down. Loop down is recognized when the receiver no longer detects the 2713 Hz tone on the line.

Volume Control (Up and Down) — Sets the volume of the speaker.

2.4 RESULTS III SCREEN

Refer to Section 2.5 of the *T-BERD 950 User's Manual* for a detailed description of the RESULTS III screen usage. A typical PCM TIMS Test Type results page is shown in Figure TIMS-2.

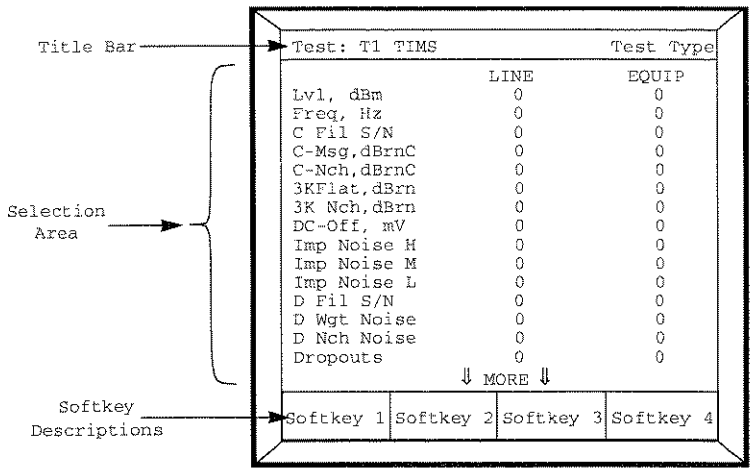


Figure TIMS-2. Typical PCM TIMS Test Type Results Page

2.5 AUX SCREEN

Refer to Section 2.6 of the *T-BERD 950 User's Manual* for a detailed description of the AUX screen usage.

3 TEST RESULTS

This subsection provides information on the analyzer Two Line Display and the test results available for the PCM TIMS option.

3.1 PCM TIMS OPTION TEST RESULTS

Test results for the PCM TIMS option are displayed on the Two Line Display. The Two Line Display and associated controls and indicators are located on the front panel above the keypad. Refer to Section 5 of the *T-BERD 950 User's Manual* for a detailed description of the Results Display.

Test results can also be displayed on the RESULTS III graphic display screen (refer to Section 2.5 of the *T-BERD 950 User's Manual* for more information on the RESULTS III graphic display screen).

NOTE

There are no **Summary, Interface, Signal, Time** *or* **Performance** *Category results for the PCM TIMS Option.*

3.1.1 Test Type Category Results

The TIMS test type category results are described in Table TIMS-1.

Table TIMS-1. TIMS Test Type Category Results

Result Name	Description
C Fil S/N (C Filter Signal to Noise Ratio)	Ratio in dB, (using C-Message weighting) of the power of the test tone signal to the power of the background noise on the channel under test, (accuracy is 1 dB, from 0 to 45 dB). For this measurement, a 1004 Hz tone is transmitted or 0xFE is inserted in the channel under test. Result available in **MONITOR** operating mode and **HOLDING TONE** and **QUIET** test modes.
C-Msg, dBrnC (C-Message Noise)	Measurement (using C-Message weighting) of the noise on an idle channel or circuit (a channel or circuit with a termination at one end and no holding tone at the transmitting end), expressed in dBrnC. Measurement range is 22 to 90 dBrnC with 1 dBrnC resolution. Result available in **MONITOR** operating mode and **QUIET** test modes.

Table TIMS-1. TIMS Test Type Category Results (Continued)

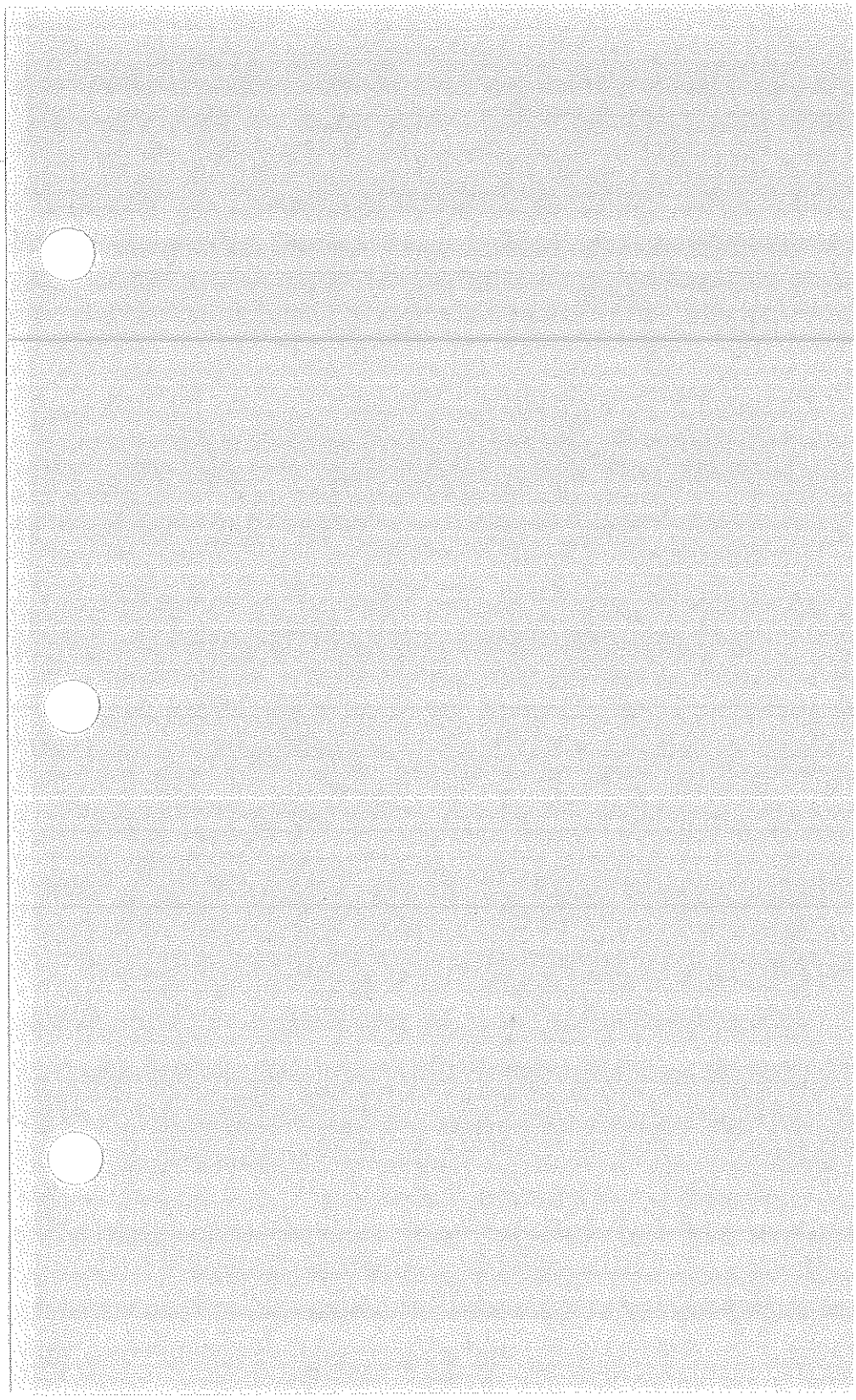
Result Name	Description
C-Nch, dBrnC (C-Notch Noise)	Measurement (using C-Message weighting and a 1010 Hz notch filter) of the noise power on a channel with a holding tone at the transmitted end, expressed in dBrnC. Measurement range is 22 to 90 dBrnC with 1 dBrnC resolution. Result available in **MONITOR** operating mode and **HOLDING TONE** test mode.
D Fil S/N (D Filter Signal to Noise Ratio)	Ratio in dB, (using D-Message weighting) of the power of the test tone signal to the power of the background noise on the channel under test, (accuracy is 1 dB, from 0 to 45 dB). For this measurement, a 1004 Hz tone is transmitted or 0xFE is inserted in the channel under test. Result available in **HOLDING TONE** test modes.
D Wgt Noise (D-Weighting Noise)	Measurement (using D-Message weighting) of the noise on an idle channel or circuit (a channel or circuit with a termination at one end and no holding tone at the transmitting end), expressed in dBrnD. Measurement range is 22 to 90 dBrnD with 1 dBrnD resolution. Result available in **QUIET** test mode.
D Nch Noise (D Notch Noise)	Measurement (using D-Message weighting and a 1010 Hz notch filter) of the noise power on a channel with a holding tone at the transmitted end, expressed in dBrnD. Measurement range is 22 to 90 dBrnC with 1 dBrnC resolution. Result available in **HOLDING TONE** test mode.
DC-Off, mV (DC-Offset)	DC offset measured from -128 mV to 128 mV with a resolution of 1 mV. Result available in **MONITOR** operating mode and **HOLDING TONE**, **VARIABLE TONE**, and **QUIET** test modes.
Dropouts	A count of holding tones whose level decreased by 12 dB (±1 dB) or more from the level established at the start of the current test, and for a period of time greater than the qualification interval (4 ±½ periods of the holding tone). Result available in **HOLDING TONE** mode.

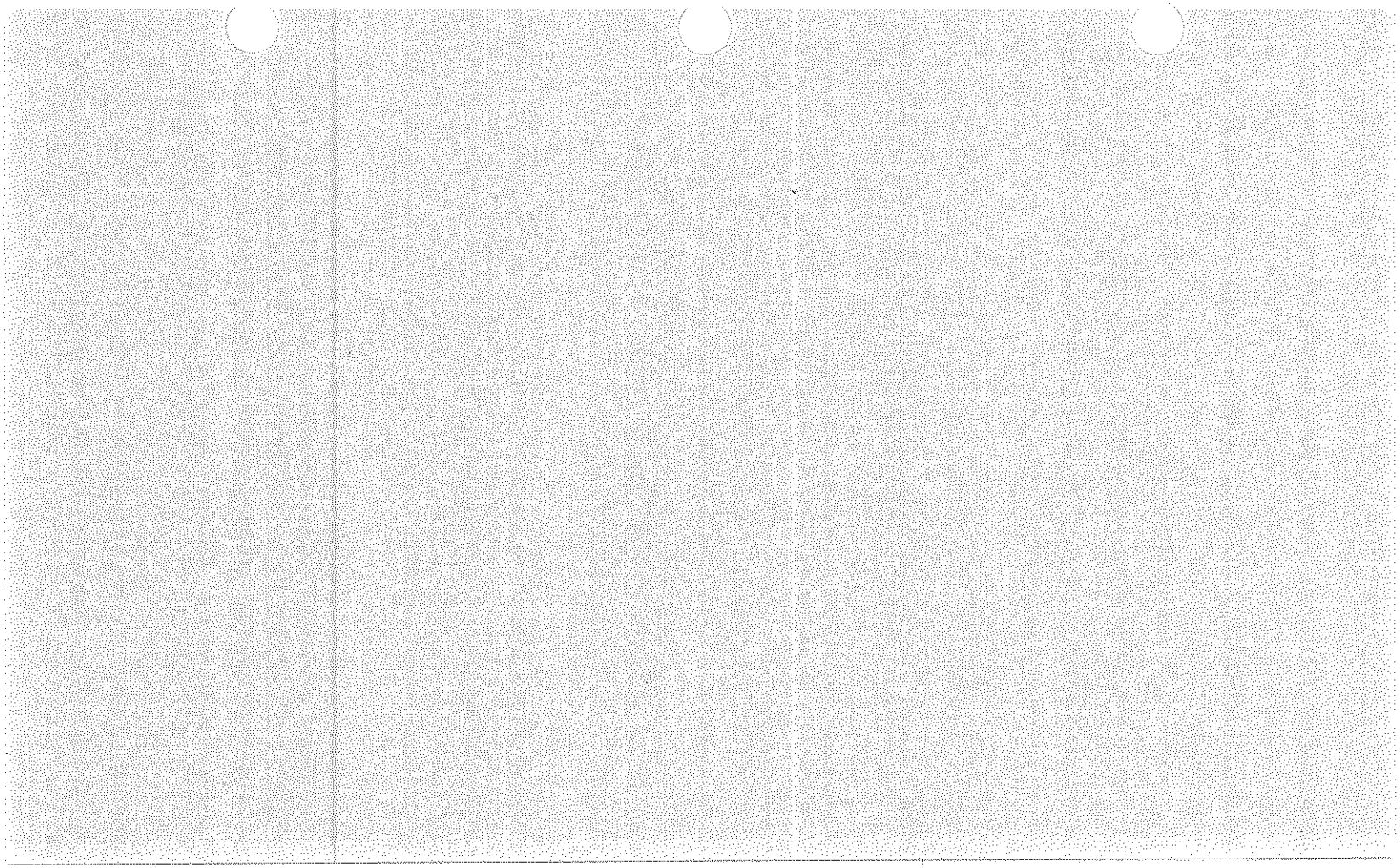
Table TIMS-1. TIMS Test Type Category Results (Continued)

Result Name	Description
Freq, Hz (Frequency)	VF frequency measured in Hertz from 20 to 3904 Hz with an accuracy of 1 Hz. Result available in **MONITOR** operating mode and **HOLDING TONE** and **VARIABLE TONE** test modes.
Imp Noise H (Impulse Noise High Count)	A count of signals exceeding the Impulse Noise threshold by 6 dB, threshold accuracy is ±1 dB. Result available in **HOLDING TONE** and **QUIET** test modes.
Imp Noise M (Impulse Noise Medium Count)	A count of signals exceeding the Impulse Noise threshold by 4 dB, threshold accuracy is ±1 dB. Result available in **HOLDING TONE** and **QUIET** test modes.
Imp Noise L (Impulse Noise Low Count)	A count of signals exceeding the Impulse Noise threshold by 2 dB, threshold accuracy is ±1 dB. Result available in **HOLDING TONE** and **QUIET** test modes.
Lvl, dBm (Level)	VF level measured in dBm, with an accuracy of 0.2 dB from 200 Hz to 3900 Hz (+3 dBm to -40.0 dBm) and 0.1 dB from 1002 Hz to 1022 Hz (0 to -19 dBm). Result available in **MONITOR** operation mode and **HOLDING TONE**, and **VARIABLE TONE** test modes.
3K Fil S/N (3.4 kHz Filter Signal to Noise Ratio)	Ratio in dB, of the power of the test tone signal to the power of the background noise on the channel under test, (accuracy is 1 dB, from 0 to 45 dB). For this measurement, a 1004 Hz tone is transmitted or 0xFE is inserted in the channel under test. Result available in **HOLDING TONE** and **QUIET** test modes.
3KFlat, dBrn (3.4 kHz Flat Noise)	Measurement of the low frequency noise present on the channel under test, expressed in dBrn. Measurement range is 22 to 90 dBrnC with 1 dBrnC resolution. Result available in **QUIET** test mode.
3K Nch, dBrn (3.4 kHz Flat with Notch-Noise)	Measurement (using a 1010 Hz notch filter) of the noise power on a channel with a holding tone at the transmitted end, expressed in dBrn. Measurement range is 22 to 90 dBrnC with 1 dBrnC resolution. Result available in **HOLDING TONE** test mode.
404Hz Lvl (404 Hz Level)	Measurement of the level of the 404 Hz test tone. Result available in **3 TONES** test mode.

Table TIMS-1. TIMS Test Type Category Results (Continued)

Result Name	Description
404Hz Freq (404 Hz Frequency)	Measurement of the frequency of the 404 Hz test tone. Result available in **3 TONES** test mode.
1004Hz Lvl (1004 Hz Level)	Measurement of the level of the 1004 Hz test tone. Result available in **3 TONES** test mode.
1004Hz Freq (1004 Hz Frequency)	Measurement of the frequency of the 1004 Hz test tone. Result available in **3 TONES** test mode.
2804Hz Lvl (2804 Hz Level)	Measurement of the level of the 2804 Hz test tone. Result available in **3 TONES** test mode.
2804Hz Freq (2804 Hz Frequency)	Measurement of the frequency of the 2804 Hz test tone. Result available in **3 TONES** test mode.





50-14950-07
Rev. B

T-BERD® 950
ISDN BASIC RATE INTERFACE (BRI) OPTION
USER'S MANUAL

May 1999

This User's Manual applies to all T-BERD 950 Communications Analyzers using Software Level 3.xx.

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ISDN BASIC RATE INTERFACE OPTION

1 GETTING STARTED

The Integrated Service Digital Network (ISDN) Basic Rate Interface (BRI) Option User's Manual provides you with operating information about the ISDN BRI Option for the T-BERD 950 Communications Analyzer.

- **Section 1 — Getting Started**: Describes the ISDN BRI Option, its specifications, and modes of operation.
- **Section 2 — Graphical Display Screens**: SETUP, RESULTS III, and AUX screens as they pertain to the ISDN BRI Option and the modes of operation.
- **Section 3 — Test Results**: Explains the ISDN BRI Option U Interface Physical Layer and ISDN Protocol Results.

1.1 OPTION DESCRIPTION

The ISDN Basic Rate Interface (BRI) Option, in conjunction with the Protocol Services Board Option, enables the T-BERD 950 Communications Analyzer to perform the following:

- Bit Error Rate (BER) testing
- Protocol analysis (D-channel analysis)
- Voice and data (call placement and receipt)
- X.25 D-channel packet calls

The ISDN BRI interface generates required frames for terminal initialization, Layer 2 start-up, and basic call processing for the AT&T 5ESS, NT DMS 100, and North American standards. It gathers and processes the proper call setup information for two simultaneous calls, and the proper frames to maintain the call connections simultaneously.

The BRI module provides physical layer status and statistics for the U side of the ISDN network. These include activation status, U interface sealing current, and framing status. Block errors are also counted. See Section 3 for detailed results information.

The ISDN BRI Option originates two circuit-switched calls, terminates two circuit-switched calls, or originates one circuit-switched call while terminating a second circuit-switched call. In addition, the unit can place and/or receive X.25 Packet Data calls over the D-channel.

When the call setup acknowledge message is received for incoming or outgoing calls, it connects the speaker and microphone for that call. You can also change the connection of the call dynamically. A call connected to BERT can be changed to connect to the speaker or microphone.

If the ISDN BRI Option is connected to two voice calls simultaneously, Call 1 is connected to the push-to-talk interface and a holding tone is placed on Call 2. If two data calls are connected, the BERT settings are the same on both calls. The unit measures the loopback delay for each B-channel. Once the D-packet call is connected, the analyzer can send the FOX message, display received data, and provide X.25 packet analysis.

1.2 OPTION SPECIFICATIONS

Table BRI-1 lists the specifications for the ISDN Basic Rate Interface Option.

Table BRI-1. U Interface Specifications

Feature	Specification
Interface	U Interface with To LT and To NT:
Devices	NT1
Physical Configuration	Point to Point, Synchronous and Full-Duplex
Bit Rate	160 kbps
User Data Rate	144 kbps
Signaling Scheme	2B1Q
Line Rate	192 kbps
Maximum Voltage	± 2.5 V
Timing Source	LE
Number of Wire Pairs	1
Full-Duplex Method	Echo Cancellation
Interleaving Scheme	$B1_8B2_8$ (12X/Frame)
Bits Per Frame	240
Bits User Data	216

Table BRI-1. U Interface Specifications (Continued)

Feature	Specification
Bits Overhead	24
Frames Per Second	666.66666...

1.3 TECHNOLOGY OVERVIEW

The ISDN BRI option is capable of emulating the ISDN Terminal Equipment (TE) device from the U access point.

The NT1 is the first customer premise device on a two-wire ISDN circuit coming in from the ISDN central office. It accomplishes several tasks. It converts the two-wire ISDN circuit (called a U interface) to a four-wire S/T so you can connect several terminals. The NT1 central office can thereby "talk" to the NT1 and do testing and maintenance by instructing the NT1 to loop signals back to the central office.

1.3.1 ISDN Characteristics

ISDN builds on groups of standard transmission channels. B-channels transmit user information at relatively high speeds, while a separate D-channel carries call setup, signaling, and other information.

B-channels are clear channel pipes for user voice and data. The D-channel is a packet-switched link for call setup and user data. Unlike some other digital communications technologies, ISDN handles types of information such as: voice, data, studio-quality sound, still and moving images. They are all digitized and transmitted at high speeds.

It handles many devices on the same line. Up to 8 separate telephones, fax machines, or computers can be linked to a single ISDN connection, and have up to 64 "call appearances" of the same or different telephone numbers.

ISDN offers variable, responsive transmission speeds. Two channels can be combined into a single larger transmission pipe. Channels can be assembled as needed for a specific application (a large video conference, for example), and then broken down and reassembled into different groups for other applications (normal voice or data transmissions). Combining B-channels in this manner is called inverse multiplexing or bonding.

ISDN can combine channels to make larger pipes; it uses switched digital connections. Perhaps the most important single feature of ISDN, however, is that it offers inexpensive dialed digital access to the worldwide

telecommunications network. With ISDN, it is no longer necessary to lease costly dedicated lines for high-speed digital transmission, or to limit data speed and accuracy by using modems to convert digital signals to analog pulses.

1.3.2 BRI – Definition

Basic Rate Interface (BRI) is defined as two 64 kbps (B) channels, and one 16 kbps Data (D) channel that carries both call setup and user packet data across the network. The BRI interface is also referred to as a 2B+D connection. A BRI delivers three separate channels.

BRIs can carry a wide and flexible range of communications. A single BRI, for example, can carry two simultaneous voice or data conversations to the same or different locations. In either example, the D-channel can also be used for packet communications to a third location, simultaneously as well. The two B-channels can also be combined for transmitting data at uncompressed speeds of up to 128 kbps.

A wide range of devices and telephone numbers can be associated with a single BRI. This capability alone offers equipment flexibility and major reductions in line, wiring, and installation costs.

1.3.3 Interface between NT and Network

The U reference point describes the interface between the Network Termination (NT) and the network Line Termination (LT). It is a two-wire interface with the 2B1Q signaling scheme. The network provides power via the U interface. Figure BRI-1 shows the relationship between the customer premises and the local loop for the S/T and U interfaces.

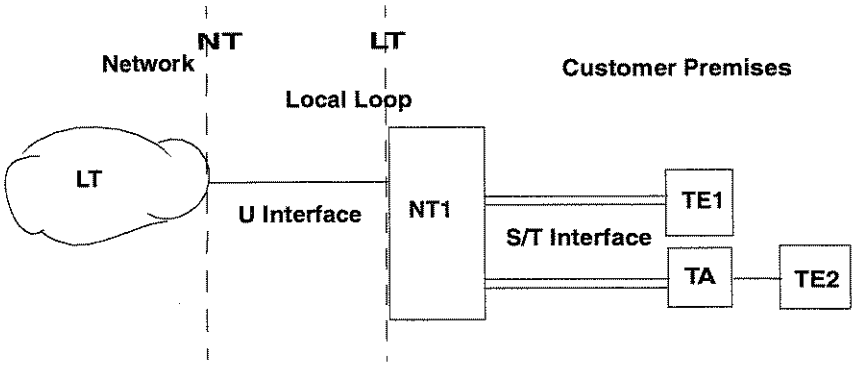

Figure BRI-1. S/T and U Reference Points

1.4 ISDN BRI OPTION EMULATION MODES

You can configure the ISDN BRI Option to operate in these modes:

- Line Termination (LT) BERT Mode
- Network Termination (NT) BERT Mode
- Network Termination and Terminal Equipment (NT1/TE) Mode
- Self-Loop Operation

Detailed descriptions of these modes of operation are found below.

1.4.1 LT BERT Mode

The purpose of the Line Termination (LT) mode is to BERT the physical layer of the U interface toward the Network Termination (NT) device. This mode is not capable of placing or receiving a call. This mode can BERT the B1, B2, B1 and B2, or 2B+D-channels. The BERT operations can either be full duplex (with another BERT device on the NT side) or looped back. Phantom power is not provided. Figure BRI-2 shows BER testing using full or partial bandwidth for this mode.

The ISDN BRI Option can request loopbacks on the B1, B2, B1 and B2, or 2B+D-channel.

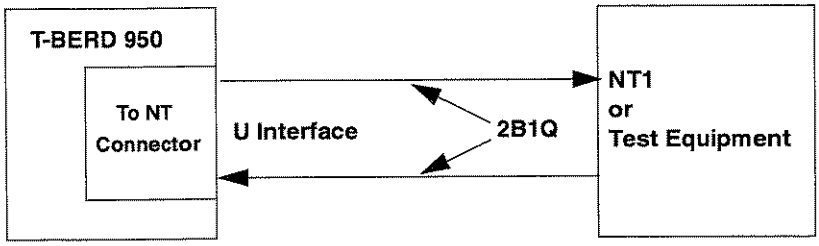

Figure BRI-2. LT Terminate Mode

1.4.2 NT1 BERT Mode

The purpose of the Network Termination (NT1) mode is to test the physical layer of the U interface toward the LT device. The NT1 mode cannot place a call, but it can BERT the B1, B2, B1 and B2, or 2B+D-channels. The test operations can only be in full duplex, with another BERT device on the LT side. Figure BRI-3 shows testing using full or partial bandwidth for this mode.

In NT1 mode, the U interface can be looped back manually or via the Rx messages received from the LT. The BRI interface can loopback the B1, B2, B1 and B2, or 2B+D-channel.

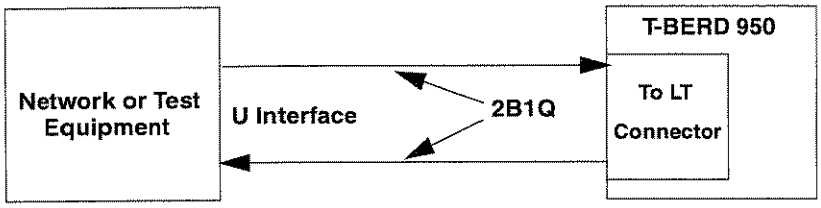

Figure BRI-3. NT1 Terminate Mode

1.4.3 NT1/TE Mode

The T-BERD 950 can originate and terminate Circuit-Switched Voice (CSV), Circuit-Switched Data (CSD) 56K, and 64K Unrestricted calls. In addition to the circuit operations listed above, the unit can originate and terminate D-packet switched calls.

The NT1/TE mode allows the unit to emulate a Network Termination (NT1) and Terminal Equipment (TE) simultaneously. This mode is used to place calls at the U interface. The ISDN BRI Option emulates Terminal Equipment (TE) at the U interface and is available with the ISDN test type. In the NT1/TE mode, you can manually loopback the U interface. Figure BRI-4 shows ISDN calls placed and received using the D-channel for either B-channel.

Call-generating capabilities include the ability to vary the type of service to connect. You can generate either 56 kbps or 64 kbps calls. Either call connects to the BERT analysis module or the push-to-talk interface based on the Bearer Destination.

Calls can be placed or received on either B-channel and dropped to the BERT engine or speaker and microphone (with DTMF dialing). Once a call is connected, that call's B-channel(s) destination (either the BERT engine or speaker and microphone) can be changed without disconnecting the call. The ISDN BRI Option can loopback the B1, B2, or B1 and B2 channel.

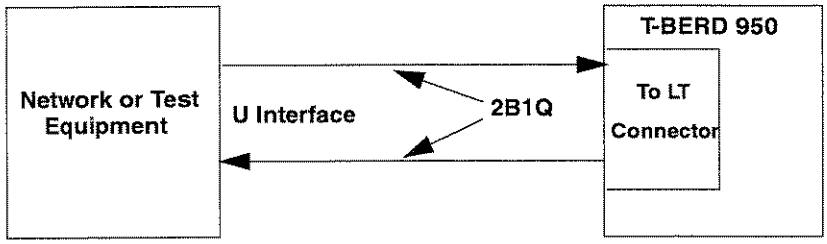

Figure BRI-4. NT1/TE in Terminate Mode

1.4.4 Self Loop Operation

In the Self Loop operation the unit defaults to the NT/LT mode and then automatically defaults to BERT analysis. The Self Loop test verifies the physical layer interface of the ISDN BRI Option and the T-BERD 950 Communications Analyzer. Press the **Self Loop** key to access Self Loop. In Self Loop, the LT transceiver is connected to the NT transceiver.

NOTE

Only 2B1Q line coding is sent or received.

1.5 MANUAL AND EOC LOOPBACKS

Depending on your mode of operation, the T-BERD 950 can be looped back manually or via Embedded Operations Channel (EOC) messages. These loopbacks are logical in that they loop the selected bandwidth. (See Table BRI-2 below for information on the different types of loopbacks available in each BRI mode.)

In LT mode, you configure the type of loopback and press the **Loop Up** key to loop up the far end. The ISDN BRI Option then transmits an EOC loopback request to the NT device. Press the **Loop Down** key to deactivate these loopbacks.

In NT1 mode, EOC automated loopback requests are enabled from the user interface. A status message appears on the Results I and Results II display that announces an active loopback. Any **manual** loopbacks are configured from the user interface.

Table BRI-2. Loopbacks Available in BRI Mode

BRI Mode	Loopback Type	Loopbacks Available
LT	Sends EOC loopback requests to the NT	B1, B2, B1 and B2, 2B+D
NT1	Either manual or responds to EOC loopback requests	B1, B2, B1 and B2, 2B+D
NT1/TE	Manual loopbacks	B1, B2, B1 and B2

1.6 EXTERNAL INTERFACE REQUIREMENTS

The ISDN BRI Option provides two RJ-45 8-pin modular jacks. The RJ connectors support BER testing, protocol analysis, and emulation over the B and D-channel. Table BRI-3 describes the **To LT** and **To NT** connectors on the U interface.

Table BRI-3. ISDN BRI Option Connectors

No.	Connectors	Description
1	To LT	An RJ-45 (8-pin) connector is used to connect the T-BERD 950 to the U interface of ISDN BRI circuit. This connector should be used when the T-BERD 950 is emulating a NT1/TE or NT1 device.
2	To NT	An RJ-45 (8-pin) connector is used to connect the T-BERD 950 to the U interface of the ISDN BRI circuit. This connector should be used when the T-BERD 950 is emulating an LT device.

1.7 LEFT SIDE PANEL CONTROLS AND CONNECTORS

A diagram of the left side of the T-BERD 950, with the U interface installed, and call out numbers is presented in Figure BRI-5. Each is explained in Table BRI-4.

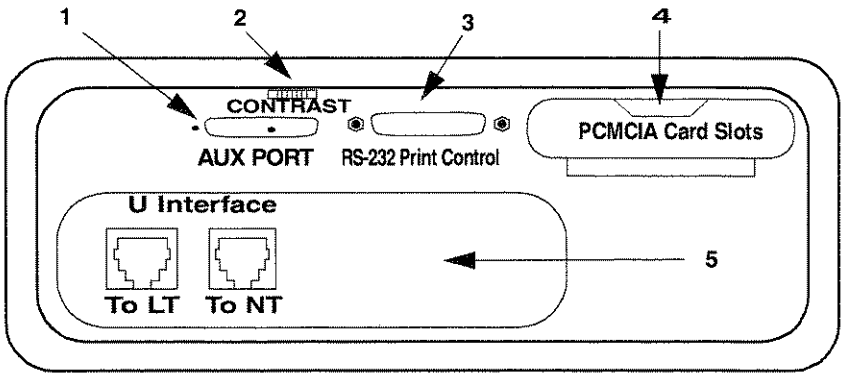

Figure BRI-5. T-BERD 950 Left Side Panel View

Table BRI-4. T-BERD 950 Left Side Panel Descriptions

No.	Description
1	**AUX port** — Future use.
2	**Contrast** — After a flashscreen with TTC's logo comes up when you turn on the T-BERD 950, you can turn the contrast knob in the upper left-hand corner until the screen suits you.
3	**RS 232 Print/Control** — Port where you insert the RS 232 side of the printer cable. Turn the screws at both ends until there is a snug fit.

Table BRI-4. T-BERD 950 Left Side Panel Descriptions (Continued)

No.	Description
4	**PCMCIA Card Slot** — Insert the T-BERD 950 software card here. To do so, with the power off, open the PCMCIA access door, the hinged cover over the port on the right side. The inside of the door is marked "OPTION - Top Eject" on the left and "SOFTWARE - Bottom Eject" on the right. Insert your software in the bottom slot. The top slot is for future use. **NOTE:** To remove the PCMCIA software card, do not try to pull it out. There is a small release button on the right side of the software slot that must be pushed to eject the software.
5	**Option Slot** — Currently used for the Protocol Services Board (TTC Part # TB950-PSB). **NOTE:** U interface connectors are present, but the ISDN BRI software Option (TTC# TB950-BRI) must be installed to perform ISDN BRI testing.

1.8 T-BERD 950 MAINFRAME STATUS AND ALARM LEDS

The ISDN BRI Option uses the mainframe Status and Alarm Light Emitting Diodes (LEDs). Depending on the interface or option in use, these LEDs have alternate meanings. Table BRI-5 gives the option specific use for the affected LEDs.

Table BRI-5. Mainframe Status/Alarm LEDs

LED	Description
SIGNAL	Illuminates green to indicate that the T-BERD 950 is receiving a 2B1Q signal.
FRAME SYNC	Illuminates green to indicate that the T-BERD 950 is receiving a valid ISDN BRI layer 1 status.

NOTE

An illuminated red LED indicates that the Status and Alarm condition was previously true or present since the start of the current test.

2 GRAPHICAL DISPLAY SCREENS

This subsection provides descriptions of the analyzer Graphical Display SETUP screen displayed in Figure BRI-6 as it applies to the Basic Rate Interface ISDN option.

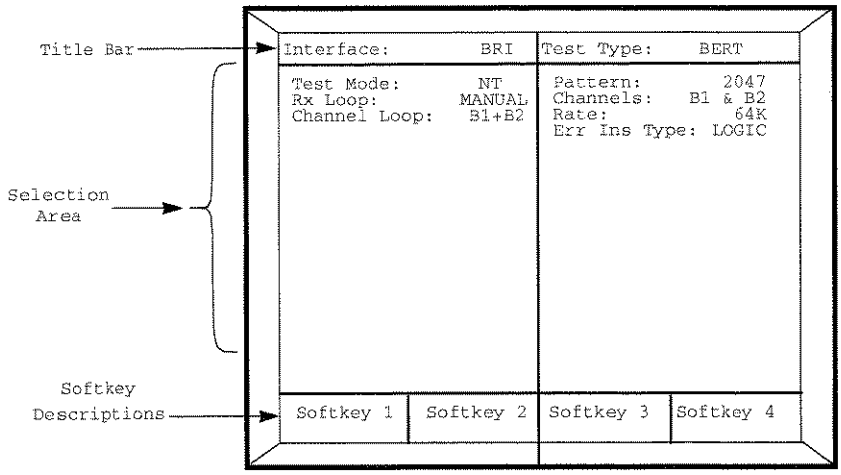

Figure BRI-6. BRI BERT Setup Screen

2.1 BRI BERT INTERFACE SETUP SCREEN

The Interface Setup screen is used to configure the T1 interface. The **Scroll** and **Select** keys are used to control this selection area.

From the Main Screen, select the **BERT** test type. Press the **SCREEN** softkey to access the **SETUP** screen.

Test Mode — Selects the test mode. The default is **NT**.

NT — The unit emulates a Network Termination device.

LT — The unit emulates a Line Termination device.

Rx Loop — Selects the type of loopback to enable on the receiver. The default is **RESP TO EOC**. Choices include:

MANUAL — Allows you to manually loop up the selected bandwidth of the received 2B1Q signal.

RESP TO EOC — Respond to Embedded Operations Channel (EOC). The unit responds automatically to a loopback request.

NOTE

Channel Loop *selects the channel to loop up. Press LOOP UP function key to activate the Loop. Press LOOP DOWN function key to deactivate the loop.*

Channel Loop — *(Manual)* Selects the channel to loop up. The default is **NONE**. Choices include:

NONE — No channel selected to be looped back on the unit.

B1 — Selects channel B1 for the test.

B2 — Selects channel B2.

B1&B2 — Selects both B-channels.

2B+D — Selects both B-channels and the D-channel.

Tx Loop — *(LT mode)* Selects the type of EOC transmit loop. Choices include:

B1 — Selects channel B1 to be looped back.

B2 — Selects channel B2 to be looped back.

2B+D — Selects both B-channels and one D-channel to be looped back.

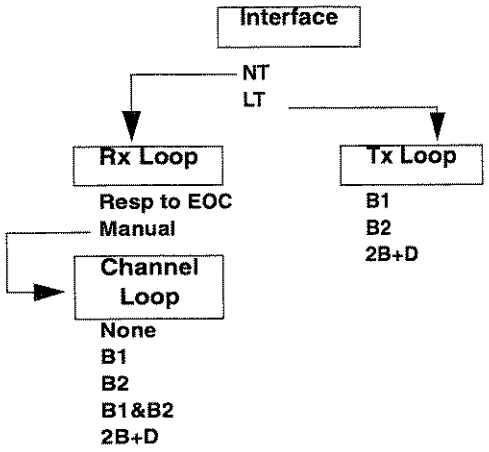

Figure BRI-7. Loop Interface Setup

2.2 BRI BERT TEST TYPE SETUP SCREEN

The ISDN BRI Test Type setup screen is used to configure the test to be performed. The **Scroll ⇕** and **Select ⇕** keys are used to control this selection area. In the following paragraphs, the **Scroll ⇕** keys are used to select the active selection line, and the **Select ⇕** keys (unless stated otherwise) are used to cycle through the available choices.

Pattern — The Bit Error Rate (BER) Test Patterns for ISDN BRI are listed here. Refer to Section 2.4 of the *T-BERD 950 User's Manual* for more information on these patterns.

Channels — Selects the channel for the test. The default is **B1**. If your Channel selection is **B1** or **B2**, you need to select the Rate. Your channel selection choices include:

B1 — Selects channel B1 to be looped back.

B2 — Selects channel B2 to be looped back.

B1&B2 — Selects both B-channels to be looped back.

2B+D — Selects both B-channels and one D-channel to be looped back.

Rate — *(B1 or B2)* Selects the kbps rate of the data call to be generated by the option. Choices include:

56K — Selects an unrestricted circuit-switched data connection with 56 kbps CCITT I.463 rate adaptation.

64K — Selects a clear channel, unrestricted, circuit-switched data connection with the full 64 kbps available for use, with no rate adaptation.

Error Ins Type — When selected, enables selection of the type of error to be inserted in the data stream when the **ERROR INSERT** key is pressed (default is **LOGIC**). The choices include:

LOGIC —Enables insertion of bit (logic) errors. Single errors or an error rate can be selected using the **ERROR INSERT** key.

FEBE — Enables insertion of Far End Block Error (FEBE) framing, parity and out of frame (OOF) errors. Single errors or an error rate can be selected by using the **ERROR INSERT** key.

CRC —Enables insertion of Cyclic Redundancy Check (CRC) errors. Single errors or an error rate can be selected by using the **ERROR INSERT** key.

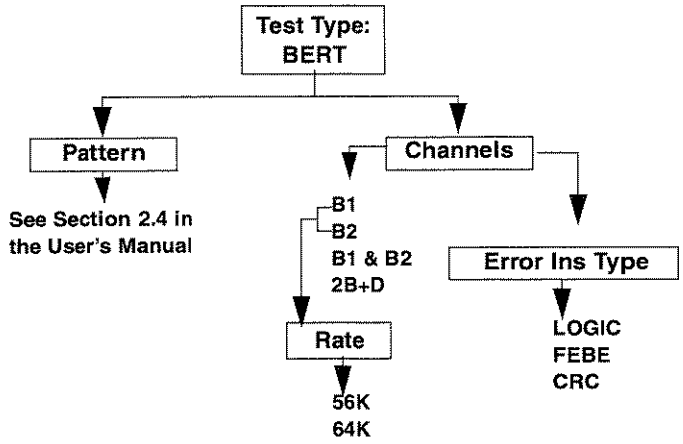

Figure BRI-8. BERT Test Type Setup

2.3 ISDN BRI INTERFACE SETUP SCREEN

The ISDN BRI Interface screen is used to configure the Basic Rate interface. The **Scroll I** and **Select I** keys are used to control this selection area. In the following paragraphs, the **Scroll I** keys are used to select the active selection line, and the **Select I** keys (unless stated otherwise) are used to cycle through the available choices.

NOTE

The screen displays the ⇓ MORE ⇓ indicator on the bottom selection line in the test type category. If the display has been scrolled down to the point that selection lines are hidden at the top of the display, the ⇑ MORE ⇑ indicator is displayed on the top selection line.

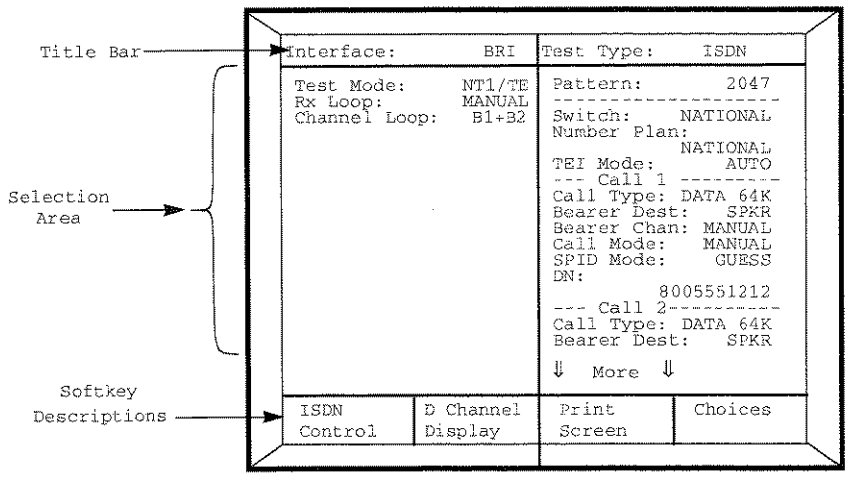

Figure BRI-9. ISDN BRI Test Setup Screen

Test Mode — The only choice is **NT1/TE** Network Termination/Terminating Equipment. In this mode, the unit emulates an integrated NT1/TE device at the U interface.

Rx Loop — Selects the type of loopback to enable on the receiver. The default is **RESP TO EOC**. Choices include:

MANUAL — Allows you to manually loop up the selected bandwidth of the received 2B1Q signal.

RESP TO EOC — Embedded Operations Channel (EOC). The unit responds automatically to a loopback request.

NOTE

Channel Loop *selects the channel to loop up. Press LOOP UP function key to activate the Loop. Press LOOP DOWN function key to deactivate the loop.*

Channel Loop — *(Manual)* Selects the channel to loop up. The default is **NONE**. Choices include:

NONE — No channel selected to be looped back on the unit.

B1 — Selects channel B1.

B2 — Selects channel B2

B1&B2 — Selects both B-channels.

2B+D — Selects both B-channels and the D-channel.

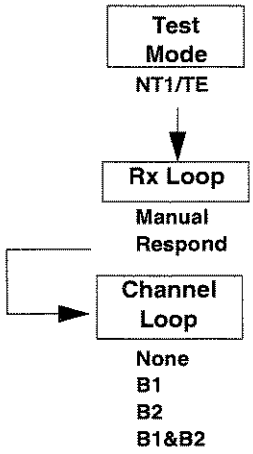

Figure BRI-10. ISDN Interface Setup

2.4 ISDN BRI TEST TYPE SETUP SCREEN

The ISDN BRI Test Type setup screen is used to configure the test to be performed. The **Scroll ⇕** and **Select ⇔** keys are used to control this selection area. In the following paragraphs, the **Scroll ⇕** keys are used to select the active selection line, and the **Select ⇔** keys (unless stated otherwise) are used to cycle through the available choices.

Pattern — The Bit Error Rate (BER) Test Patterns for ISDN BRI are listed here. Refer to Section 2.4 of the *T-BERD 950 User's Manual* for more information on these patterns.

Switch — Enables entry of the switch type used on the ISDN link (default value is **National**). Choices include:

AT&T — Selects the AT&T 5ESS Custom as the switch type. When AT&T is the switch type, the following parameter becomes available:

Line Type — Select the line type if the Switch is the AT&T 5ESS. The default is **MULT-PT**. Choices include:

PT-PT — Selects a point-to-point circuit or two-point circuit.

MULTI-PT — Selects a multipoint circuit.

NT — Selects the Northern Telecom DMS 100 Custom as the switch type. When NT is the switch type, the following parameter becomes available:

Type — Selects the NT type. Choices include:

DMS-F — DMS Functional

DMS-S — DMS Stimulus

NATIONAL — Selects National as the switch type.

Numbering Plan — Enables the selection of the appropriate ISDN numbering plan for the desired circuit. There are six numbering plan choices listed below:

NATIONAL —National number in the ISDN numbering plan.

NETWORK —Network-specific number in private numbering plan.

LOCAL — Local directory number in ISDN numbering plan.

ABBREVIATED —Abbreviated number in private numbering plan.

UNKNOWN —Unknown number in numbering plan.

INTERNATIONAL —International number in ISDN numbering plan.

TEI Mode — Terminal Equipment Identifier (TEI). *(Circuit operation only.)* Part of the layer 2 link access procedure of D-channels (Q.921) address that identifies frames to and from a particular terminal. The default is **AUTO**.

AUTO — Automatic TEI values selected by the network. Assigns TEI values 64-26.

FIXED — Non-automatic TEI values selected by the user.

TEI — *(Fixed)* The choices for fixed assignment are **[0-63]** default **0**.

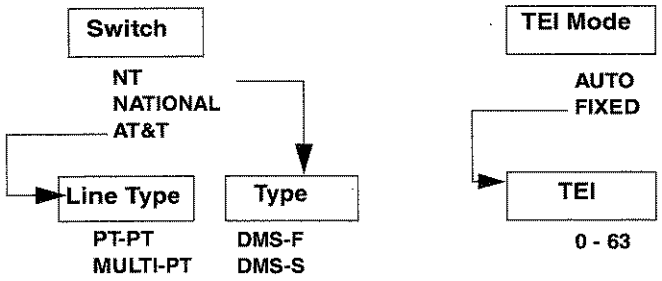

Figure BRI-11. ISDN Test Type Setup

NOTE

The following parameters must be set for both **Call 1** *and* **Call 2** *when connecting to two calls simultaneously.*

Call Type — Selects the type of call to be generated by the unit (default value is **VOICE**). The choices include:

DATA 56K — Selects an unrestricted circuit-switched data connection with 56 kbps CCITT I.463 rate adaptation.

DATA 64K — Selects a clear channel, unrestricted, circuit-switched data connection with the full 64 kbps available for use, with no rate adaptation.

VOICE — Selects a voice type call. If another call is connected to the SPKR (speaker/mike combination), a tone is sent. Otherwise the call is connected through the speaker/mike combination.

3.1K AUD — Selects a 3.1 kHz audio call type.

Bearer Dest — Selects the appropriate destination of the connected call (default value is **SPKR**). Choices include:

SPKR — The call is connected to speaker/microphone for voice conversation which allows you to place two voice calls. The first call connects to the speaker/microphone, the second connects to the 1004 Hz tone generator.

BERT— BER testing is performed on the selected channels of the connected call.

NOTE

Bearer Destination determines where the call is initially connected. Once the call is connected, it can be dynamically switched using the softkeys.

Bearer Chan — Enables selection of the bearer (B) channel for the call. Choices include:

B1 — Selects bearer channel 1.

B2 —Selects bearer channel 2.

ANY — Allows the switch to allocate the bearer channel.

NOTE

At least one digit must be entered in this field.

Call Mode — Selects **MANUAL** or the appropriate Program Number **Prog (N)**. **PROG 1** through **PROG 5** (for Call 1), and **PROG 6** through **PROG 10** (for Call 2). This selects the appropriate Prog (N).

MANUAL — Enables manual entry of the number to be called.

Prog (N) — Enables entry of the number to be called, up to 18 digits (default value is **8441212**). You may program up to five numbers on **PROG 1** through **PROG 5** (for Call 1), and five numbers on **PROG 6** through **PROG 10** (for Call 2). Use the keypad to edit this field. Valid keys are **0** through **9**. Use the left and right arrow keys to move the cursor to the required digit position, and the **Del** (delete) key to delete the unwanted digit.

Calling Number — Enables entry of the Directory Number (DN) of the circuit being analyzed, up to 15 digits (default value is **8441212**). The keypad is used to edit this field. Valid keys are **0** through **9**. The left and right arrow keys are used to move the cursor to the required digit position, and the **Del** (delete) key is used to delete the unwanted digit.

SPID Mode — This is the Service Profile ID which identifies the types of services and features supported for a given device. SPIDs are optional in the ISDN standard, but usually required in North America. The default is **USER**.

GUESS — The unit will attempt to add the most common prefix and suffix on the Directory number (DN) depending on the switch selected. Table BRI-6 shows the combinations, in order, the T-BERD 950 uses when performing a SPID Guess. For example, if configured directory number is 800.555.1212, then the seven digits used would be 555.1212.

DN — *(Guess)* Enter the [7-16 digits] default **8005551212.**

Table BRI-6. SPID Guess Table

Prefix	# Directory Number Digits Used	Suffix
01	7	000
NONE	10	0100
NONE	10	0101
01	7	0
NONE	10	1
NONE	10	0000
NONE	10	01

Table BRI-6. SPID Guess Table (Continued)

Prefix	# Directory Number Digits Used	Suffix
NONE	10	100
NONE	10	2
NONE	7	00
NONE	7	1111
NONE	10	0
NONE	10	00
NONE	10	000
NONE	10	0001
NONE	10	02
NONE	10	0200
NONE	10	10
NONE	10	0111
NONE	10	1000
NONE	10	20
NONE	10	200
NONE	10	2000
NONE	10	Repeat last digit of DN
NONE	10	Repeat last 2 digits of DN

USER — The user must enter the appropriate SPID.

SPID — *(USER mode)* Enter a 9- to 20-digit number. The default is **80055512120101.**

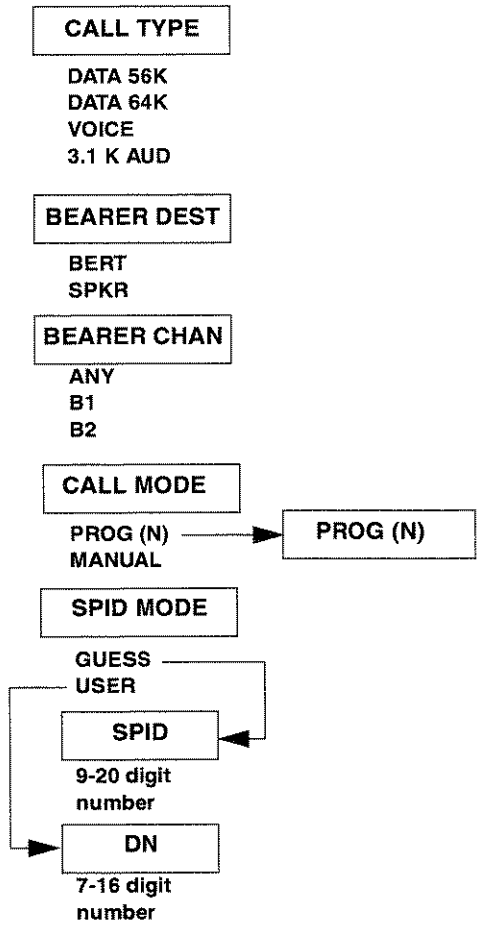

Figure BRI-12. ISDN Circuit Operation Call Type Setup

2.5 ISDN PACKET AND ADVANCED TEST TYPE SETUP

The ISDN BRI Test Type setup for Packet and Advanced features is listed after the ISDN circuit operation configurations. Use the **Scroll ll** key to scroll the list past the Call 1 and Call 2 setup areas; use the **Select ll** keys to cycle through the available choices.

TEI — Same as circuit operation mode; however, only applies to Packet operation.

LCN — Logical Channel Number values are **1** to **15**. Default value **1**.

NOTE

If the call is placed on an invalid TEI, the X.25 call status result indicates that the call was placed on an invalid LCN. See the Call Failure Report on Figure BRI-18.

PACKET ECHO — OFF, ON. Takes data packet received and echoes (sends) back to the sender.

CALLED NUMBER — User programmed (DN) Directory Number.

CALLING NUMBER — User programmed based on the switch requirements, whether 10 or 7 digits.

CALL USER DATA — OFF, ON. Select ON to edit the data string used to identify a specific user or call. This makes the data unique. A line appears that you can edit using the keypad, which emulates a keyboard. The 1- 9 plus 0 keys are assigned the alpha characters marked on the keys, plus other specific values that you can select when editing the field. The arrow keys on the keypad allow you to move forward and backward through the character string.

2.5.1 Editing CALL USER DATA

1. Select the line below **CALL USER DATA**. The **EDIT** softkey appears.
2. Press **EDIT** softkey. A popup window and additional softkeys appear.

   Clear String — Clears the current character string.
   Clear Set — Clears the selected set, allowing you to choose another set.
   Cursor Home — Places the cursor at the beginning of the string.
   Cursor End — Places the cursor at the end of the string.
   Prev Page — Places the cursor on the previous page.
   Next Page — Places the cursor on the next page.
   Abort Changes — Clears all changes and returns to the setup screen.
   Save & Exit — Saves the changes and Exits the editing function.

3. Press a 1 through 9 or 0 key on keypad to select a character set. The assigned values for that key are displayed in the popup window.
4. Press the corresponding number for the character you want to place into the user data information. Press "0" to add spaces if needed.
5. Repeat steps 3 and 4 until your User Data information is complete.
6. Press **Save & Exit** when finished.

CUG Mode — Closed User Group mode. This packet mode is used for Automatic Teller Machines (ATMs) or Point of Sales Terminals. Provides password security protection to the connection. Choices include: **ON**, **OFF**. Default Value is OFF.

CUG — Closed User Group. Displays when CUG Mode is set to **ON**. Select value of 0-9999.

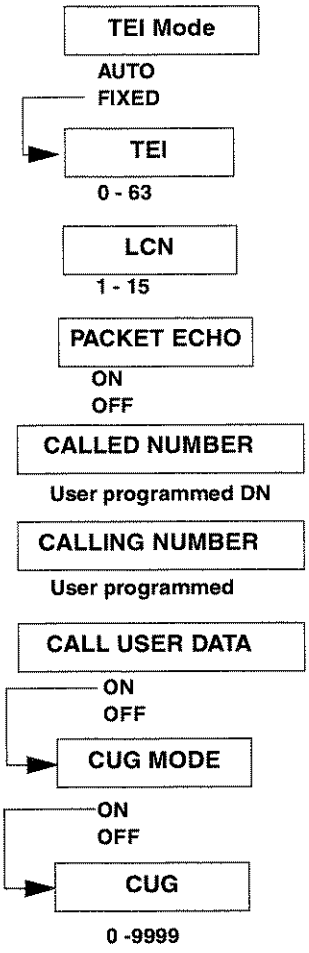

Figure BRI-13. Packet Call Setup

2.5.2 Advanced Call Setup

Call Appearance — *(National Switch)* Set to **YES**, **NO**. Default is **NO**. When **YES** is selected, Appearance Id selection appears.

Appearance Id — Appears when Call User Data is set to **ON** and Call Appearance set to **YES**. Values 1-254, default value is 1, and increments by one.

Reverse Charge — Allows placing collect packet calls. Set to **ON** or **OFF**. Default value is **OFF**.

RPOA — Registered Private Operating Agency. Routing information is similar to an area code for packet calls. Set to **ON**, **OFF**.

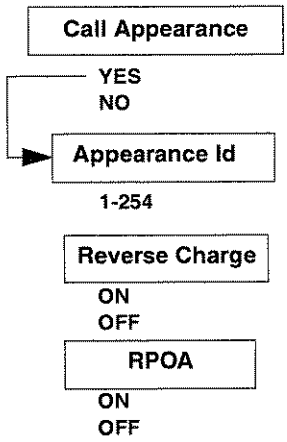

Figure BRI-14. Advanced Call Setup

2.6 ISDN CALL CONTROL

The **ISDN Control** softkey provides access to the **CALL 1 CONTROL, CALL 2 CONTROL,** and **PACKET CONTROL** softkeys. When one of the keys is pressed, the Results III Test Type screen is displayed. From this screen you may choose from the **CALL 1, CALL 2,** or **PACKET CALL** softkeys.

CALL 1 CONTROL, CALL 2 CONTROL, and **PACKET CONTROL** provides the following choices:

DIAL CALL — Places the call.

DISC CALL — Disconnects the call in progress.

ANSWER — Answers the call if an incoming call is present.

SEND FOX — Sends the FOX message *(**Packet Control** only).*

NOTE

Dynamic Payload Softkeys provide the ability to dynamically change the payload of the call when the call is connected (circuit calls only).

BERT — Connects the call for BER testing.

VOICE — Connects the call to the speaker/microphone.

TONE — Connects the call to a 1004Hz tone.

2.7 HOW TO PLACE A CALL

You can place a call in two ways: **Manually** or **Program Dial**.

- **Manually** — *(overlap dialing)* Use a called party number from the keypad. The digits are outpulsed as they are entered on the keypad.
- **Program Dial** — Program 1-5 for Call 1 and program 6-10 for Call 2.

To place a call in manual dial mode, you must first press the call's **Dial** softkey, and then enter the called party's number using the keypad. Manual dialing mode continues until the call progresses or fails.

To place a call in program dial mode, chose from five possible program (or memory dial) numbers, then press the call's **Dial** softkey.

In general, the call emulation feature must simulate a normal call setup exchange. If the call setup exchange fails, extensive error reporting in the form of a call fail report is generated.

The T-BERD 950 is capable of transmitting DTMF tones if a call progresses or connects. The microphone disables briefly while the DTMF tones are transmitted. This feature allows you to enter digits such as phone extensions in response to an automated attendant.

2.8 HOW TO ANSWER A CALL

When an incoming call is detected, the T-BERD 950 displays a popup window on the current screen display. This window gives you three choices: answer the call, ignore the call, or disconnect the call.

Whatever action you choose causes one of several results. Those actions and results are listed in Table BRI-7.

Table BRI-7. Incoming Call Activities

Action	Result
Press **Answer** sofkey.	The call connects to the speaker and microphone (voice). You can then choose to begin BER testing if it is a data call. Once the call is connected, you can dynamically change the connection, data to voice or voice to data, via softkeys.
Press **Disconnect** softkey.	The call is cleared.
Press **Ignore** softkey.	The call remains in the alert state until the far end cancels the call or you select the Call Control softkey, press the appropriate Call 1 or 2 softkey, then press the Answer softkey.

2.9 RESULTS III SCREEN

Refer to Section 2.5 of the *T-BERD 950 User's Manual* for a detailed description of the RESULTS III screen use. A typical Basic Rate Interface ISDN Test Type results page is shown in Figure BRI-15.

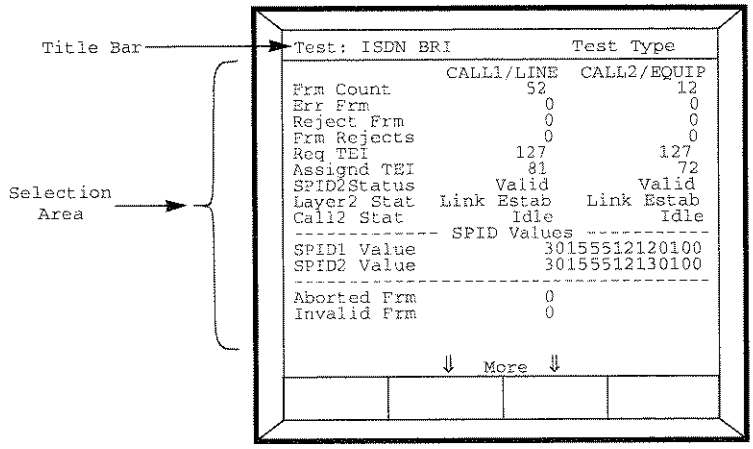

Figure BRI-15. Typical ISDN BRI Test Type Results

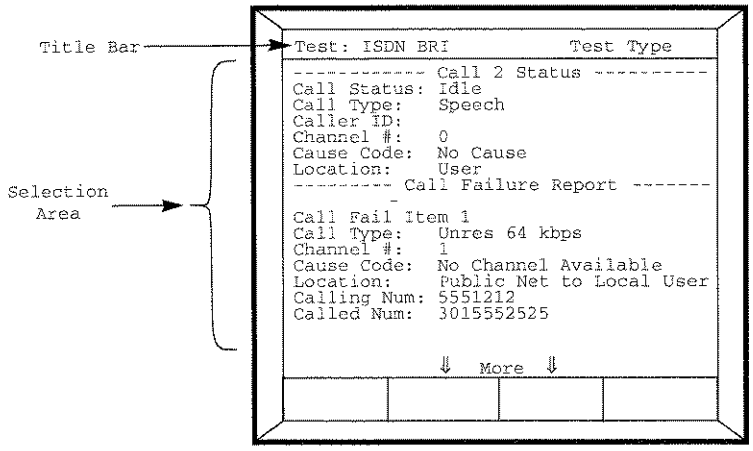

Figure BRI-16. Typical ISDN Call Status and Call Failure Report

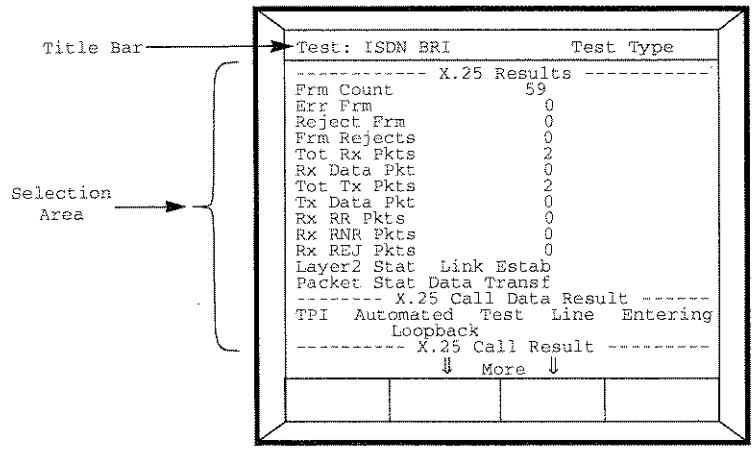

Figure BRI-17. X.25 Results

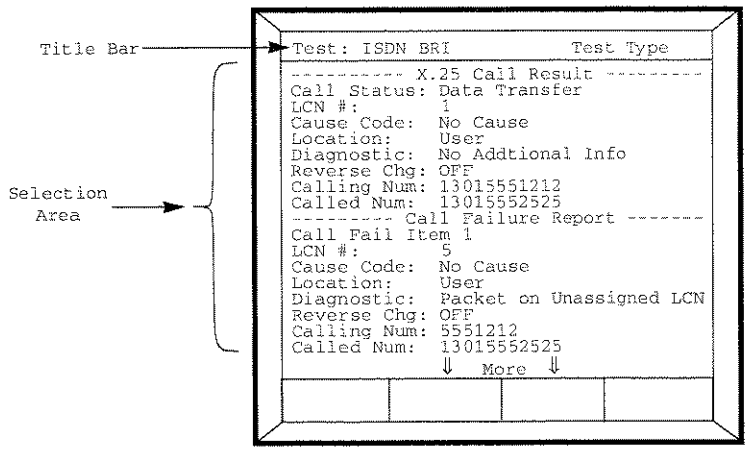

Figure BRI-18. X.25 Call Results

2.10 D-CHANNEL DISPLAY

This feature displays English translations of messages received and transmitted on the D-channel. This display provides complete Q.921 and/or Q.931 text-based information for all valid ISDN frames. See Section 3.3 for Q.931 Cause Code Table.

You may activate the D-Channel Display by pressing the **D-Channel Display** softkey. After pressing the softkey, the Graphic Display shows one message at a time. Messages are captured in the order they are transmitted and/or received. Softkeys allow you to navigate the first, last, previous, and next message. The Print softkeys are listed below:

PRINT CURRENT — Prints the currently displayed message.

PRINT TO LAST — Prints all messages from the current to the last message.

PRINT ALL — Prints messages from the first to the last message.

Press the **Clear Storage** softkey to clear all capture messages. Press the **EXIT** softkey to exit the D-Channel Display and return to the MAIN, SETUP, RESULTS III, or AUX screen.

Status messages are displayed on the two-line display to indicate print activity and capture status. A message flashes when the capture buffer is full, indicating that frame capture is inactive. You must clear the capture buffer by pressing the **Clear Storage** softkey to resume frame capture. Capture storage will also be indicated as a percentage result (% full) on the result screens.

NOTE

Capture storage is only maintained for the lifetime of the current test (for example, switching from ISDN BRI to Frame Relay will clear the capture storage). Use the print softkeys to save relevant capture information.

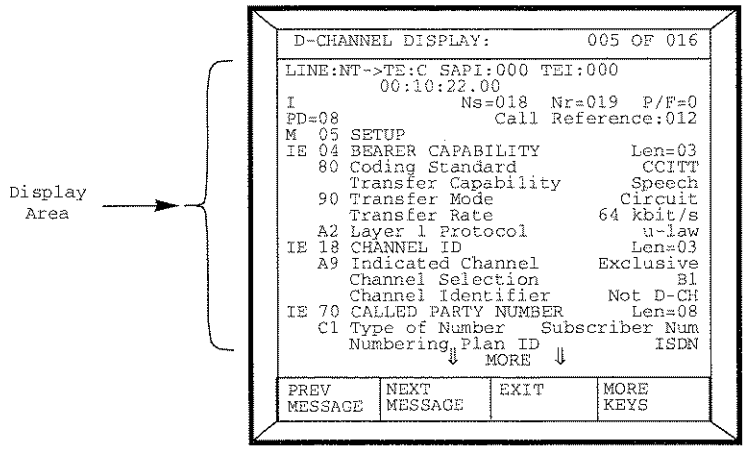

Figure BRI-19. D-Channel Display

3 TEST RESULTS

Section 3 describes U interface physical layer and ISDN protocol test results for the ISDN BRI Option. Test results are displayed on the T-BERD 950 analyzer screen on the RESULTS I and II Two-Line Display. Other common results may also be available.

The display, along with its associated controls and indicators, is located on the front panel above the keypad. Refer to Section 4 of the *T-BERD 950 User's Manual* for detailed descriptions of common results and the RESULTS I and RESULTS II Two-Line Display.

Test results can also be displayed on the RESULTS III graphic display screen (refer to the *T-BERD 950 User's Manual* for more information).

Status indicator results for the U interface are indicated on the front panel of the unit as follows:

- **U Interface Signal Detected** — Displays that the 2B1Q signal is detected,

indicated by a green illuminated signal LED on the front panel.

- **U Interface Activation** — Layer 1 activation, indicated by a green illuminated FRAME SYNC LED on the front panel.

3.1 INTERFACE CATEGORY RESULTS

The Interface Category results are described in Table BRI-8. Unless stated otherwise, all results are available in NT1, NT1/TE, and LT modes.

Table BRI-8. Interface Category Results

Result	Description
Layer1 Stat	Displays the last U interface activation state. Its activation states include: awaiting signal, synchronized, and activated.
FEBE Err	Far End Block Error (FEBE). Provides status information sent from the near-end terminal to the far-end terminal to indicate the presence of a framing error, parity error, Out of Frame (OOF), or Alarm Indication Status (AIS) events at the far-end terminal.
CRC Err	Counts the frames when the Cyclic Redundancy Check (CRC) in the frame does not agree with the CRC field received from the network.
Seal Cur	Displays sealing current if present on the U interface.
Loop State	Displays current loop state and channel looped. Valid results include: No Loop, Loop B1, Loop B2, Loop B1 & B2.
EOC Message	Embedded Operations Channel message. Valid results include: Loopback B1, Loopback B2, Loopback 2B+D, Normal, Hold, Unable to Comply, Request Corrupt CRC, Sending Corrupt CRC.

3.2 TEST TYPE CATEGORY RESULTS

The ISDN BRI Option collects Test Type Category results when it terminates a link. These results are based on the received D-channel (the transmitted frames are ignored). The mainframe collects statistics on basic rate ISDN frames at the same time that it collects interface-specific results.

Basic Rate Interface terminating ISDN statistics collected are listed in the ISDN Test Type Category Results. These results are described in Table BRI-9. Unless otherwise stated, all results are available in NT1/TE mode only.

Table BRI-9. ISDN Test Type Category Results

Result	Description
Frm Count	Counts the valid ISDN frames detected in circuit operation mode.
Err Frm	Counts the errored frames with at least one of the following conditions: undefined control field, S or U frame with an improper length, I frame with a length exceeding limit.
Reject Frm	Counts the frames with a sequence number error.
Frm Rejects	Counts the frames with ISDN Frame Reject frames. A Frame Reject is sent when a device receives a frame with a protocol error.
Req TEI	Displays the TEI that was requested. This is the value of the TEI request configuration.
Assigned TEI	Displays the TEI that was assigned. This may or may not be equal to the requested TEI value.
SPID2 Stat	Displays the SPID status. This result can have the values: Valid, Invalid, Unassigned.
Layer2 Stat	Displays the Layer 2 Status Values include: TEI Not Assigned, Awaiting TEI, Link Not Established, Awaiting Establishment, Link Established, Timer Recovery, Awaiting Release, TEI Denied, Link Unknown. If the status is Link Not Established, a flashing two-line message displays on ResI and or ResII to indicate calls that cannot be placed.
Call2 Stat	Displays the current call State.
SPID1 Value	Displays the SPID value for Call 1 that was assigned during SPID assignment. Use in NT1 and LT modes also.
SPID2 Value	Displays the SPID value for Call 2 that was assigned during SPID assignment. Use in NT1 and LT modes also.

Table BRI-9. ISDN Test Type Category Results (Continued)

Result	Description
Aborted Frm	Counts the aborted ISDN frames detected, excluding Out of Frame aborts.
Invalid Frm	Counts the frames with at least one of the following invalid conditions: short frame, FCS errored frame, single octet address, unapproved Service Access Point Identifier (SAPI).
Call Fails	Counts the number of call attempts that ended in call failure (does not include busy replies or normal call clears).
Call (N) Status	Displays current call status. The following information is displayed on the RESULTS III Screen. List of Results includes: Call Status, Call Type, Caller ID, Channel #, Cause Code, and Location. **NOTE:** Cause Codes can be found in Table BRI-11, however, the analyzer interprets the Cause Code for you.
Act Calls	Counts the total number of currently active calls. Includes calls in progress, connected calls, calls being disconnected.
Comp Calls	Counts the completed calls that sucessfully connect and disconnect.
Call Failure Report	Displays the status of the last 5 failed ISDN calls. The report contains the following: Call Type, Channel #, Cause Code, Location, Calling#, and Called #. **NOTE:** Cause Codes can be found in Table BRI-11, however, the analyzer interprets the Cause Code for you.

3.2.1 X.25 Test Type Category Results

The ISDN BRI Option collects X.25 Test Type Category results when it terminates a link. These results are based on the received D-channel (the transmitted frames are ignored). The mainframe collects statistics on basic rate ISDN frames at the same time that it collects interface-specific results. These results are described in Table BRI-9.

Table BRI-10. X.25 Test Type Category Results

Result	Description
Frm Count	Counts the valid ISDN frames detected on SAPI 16.
Err Frm	Counts the errored frames with at least one of the following conditions: undefined control field, S or U frame with an improper length, I frame with a length exceeding limit.
Reject Frm	Counts the frames with a sequence number error.
Frm Rejects	Counts the frames with ISDN Frame Reject frames. A Frame Reject is sent when a device receives a frame with a protocol error.
Tot Rx Pkts	Counts the total number of X.25 packets received.
Rx Data Pkt	Counts the received data packets.
Tot Tx Pkts	Counts the total number of X.25 packets transmitted.
Tx Data Pkt	Counts the transmitted data packets. Data packets are transmitted by pressing the **Send Fox** softkey.
Rx RR Pkts	Receiver Ready. Counts the packets acknowledged by the receiver.
Rx RNR Pkts	Receiver Not Ready. Counts the receiver-not-ready packets.
Rx REJ Pkts	Rejected Packets. Counts the Reject Packets received.
Layer2 Stat	Displays Layer 2 Status Values include: TEI Not Assigned, Awaiting TEI, Link Not Established, Awaiting Establishment, Link Established, Timer Recovery, Awaiting Release, TEI Denied, Link Unknown. If the status is Link Not Established, a flashing two-line message displays on ResI and or ResII to indicate that calls cannot be placed.
Packet Stat	Displays the current call State. Results include: Ready — no call active. DTE Waiting — waiting for far end to connect. DCE Waiting — received incoming call but not answered. Data Transfer — call is connected.

Table BRI-10. X.25 Test Type Category Results (Continued)

Result	Description
X.25 Call Data	Displays any incoming received data in the data packet in this two-line field. Appears on the RESULTS III Screen. (For example, this displays the FOX message if SEND FOX is pressed and the circuit is looped back at the far end.)
X.25 Call	Displays current call status. The following information is displayed on the RESULTS III Screen: Call Status, LCN #, Cause Code, Location, Diagnostic, Reverse Chg, Calling Num, and Called Num.
Call Failure	Displays the number of call attempts that ended in call failure (does not include busy replies or normal call clears). The following information is displayed on the RESULTS III Screen: LCN #, Cause Code, Location, Diagnostic, Reverse Chg, Calling Num, and Called Num.
% Full	Displays the current amount of storage used (% full) for D-channel message capture.
Messages	Displays the current number of messages available to the D-channel display (see Section 2.10).

3.3 ISDN Q.931 CAUSE CODES

Table BRI-11 provides translations of Q.931 messages received and transmitted on the D-channel.

Table PRI-11. Results Reports Cause Codes

Class	Value	No.	Cause Code
— Q.931 Cause Codes (1988) —			
000	0001	1	Unassigned number.
	0010	2	No route to specified transit network.
	0011	3	No route to destination.
	0110	6	Channel unacceptable.
	0111	7	Call awarded and being delivered in an established channel.

Table PRI-11. Results Reports Cause Codes (Continued)

Class	Value	No.	Cause Code
001	0000	16	Normal call clearing.
	0001	17	User busy.
	0010	18	No user responding.
	0111	19	No answer from user (user alerted).
	0101	21	Call rejected.
	0110	22	Number changed.
	1010	26	Non-selected user clearing.
	1011	27	Destination out of order.
	1100	28	Invalid number format.
	1101	29	Facility rejected.
	1110	30	Response to STATUS INQUIRY.
	1111	31	Normal, unspecified.
010	0001	34	No circuit/channel available.
	0110	38	Network out of order.
	1001	41	Temporary failure.
	1010	42	Switching equipment congestion.
	1011	43	Access information discarded.
	1100	44	Requested circuit/channel not available.
	1111	47	Resources unavailable, unspecified.
011	0001	49	Quality of service unavailable.
	0010	50	Requested facility not subscribed.
	0110	54	Incoming calls barred[1]
	1001	57	Bearer capability not authorized.
	1010	58	Bearer capability not presently available.
	1111	63	Service or option not available, unspecified.
100	0001	65	Bearer capability not implemented.
	0010	66	Change type not implemented.
	0101	69	Requested facility not implemented.
	0110	70	Only restricted digital information bearer capability is available.
	1111	79	Service or option not implemented, unspecified.

Table PRI-11. Results Reports Cause Codes (Continued)

Class	Value	No.	Cause Code
101	0001	81	Invalid call reference value.
	0010	82	Identified channel does not exist.
	0011	83	A suspended call exists, but this call identity does not.
	0100	84	Call identity in use.
	0101	85	No call suspended.
	0110	86	Call having the requested call identity has been cleared.
	1000	88	Incompatible destination.
	1011	91	Invalid transit network selection.
	1111	95	Invalid message, unspecified.
110	0000	96	Mandatory information element is missing.
	0001	97	Message type nonexistent or not implemented.
	0010	98	Message not compatible with call state or message type nonexistent or not implemented.
	0011	99	Information element nonexistent or not implemented.
	0100	100	Invalid information element contents.
	0101	101	Message not compatible with call state.
	0110	102	Recovery on timer expired.
	1111	111	Protocol error, unspecified.
111	1111	127	Interworking, unspecified.
— National-specific Cause Codes Defined in TA-NWT-001268 —			
000	0100	4	Vacant code.
	1000	8	Prefix 0 dialed in error.
	1001	9	Prefix 1 dialed in error.
	1010	10	Prefix 1 not dialed.
	1011	11	Excessive digits received, call is proceeding.
110	0101	101	Protocol error, threshold exceeded.

1. This code was defined in the 1984 revision of Q.931 but omitted from the 1988 revision. The DMS 100 switch supports this code.

SECTION 8 APPLICATION CARDS

8.1 INTRODUCTION

This section consists of the "**Quick**" cards currently available for the T-BERD 950 Communications Analyzer. Each "**Quick**" card provides the information required to configure the analyzer for a particular type of test. Cabling information is provided as well as a step by step procedure for performing the test.

SECTION 9 TTC CUSTOMER SERVICES

9.1 INTRODUCTION

TTC offers unmatched services to support purchased equipment, including a wide range of customer care, technical support, instrument maintenance, and training services. TTC customer service specialists are fully trained to help customers find the answers they are looking for. Call Customer Services for:

- Information on products and services, including upgrades, calibration, training, software enhancement agreements (SEAs), and product maintenance agreements. Our representatives can also provide assistance with product returns and repairs.
- Expert technical support, including help with product configuration, circuit qualification, and complete network trouble sectionalization. TTC is also available on a contractual basis to provide customized application development, network consulting and management services, software customization, and test procedure development.

All TTC products are backed by an industry-leading warranty that guarantees mainframe repair or replacement for 3 years and all other parts for 1 year.

9.2 CUSTOMER SERVICE LOCATIONS

For questions regarding TTC products and services, including return authorizations and repairs, technical support, training, and all other available services, contact your local distributor or TTC Customer Service at one of the locations listed in the TTC Worldwide Contact list at the beginning of the manual.

9.3 SERVICES

9.3.1 Instrument Service

To maintain your organization's long-term investment, TTC will structure a service plan to fit your network performance goals and budget. TTC understands the impact of equipment down time on operations and is staffed to ensure a quick turnaround. Available services include:

Product Repair — All equipment returned for service is tested to the same rigorous standards as newly manufactured equipment. This ensures products meet all published specifications, including any applicable product updates.

Calibration — TTCs calibration methods are ISO 9001 approved and based on NIST standards. Each calibration comes with a dated certificate, instrument stickers, and a data sheet.

Factory Upgrades — Any unit returned for a hardware feature enhancement will also receive applicable product updates and will be thoroughly tested, ensuring peak performance of the complete feature set.

Software Enhancement Agreements — These agreements assist in keeping equipment up to date with the latest software features, by providing automatic notification of any new software enhancements and changes for TTC products.

Product Maintenance Agreements — Yearly service and calibration maintenance agreements simplify billing and help ensure the equipment is always operating at optimum levels. Product maintenance agreements can be used to extend a current warranty or provide protection for out-of-warranty units.

Other Pricing Options — For out-of-warranty repairs, TTC offers two additional pricing options: time and material pricing and flat rate pricing. Under time and material pricing, customers are billed for the actual cost of the repair, making this a cost-effective method for minor repairs. Under flat rate pricing, customers pay a fixed service charge to repair unit failures (excluding damage or abuse), resulting in simplified paperwork and easier budgeting.

9.3.2 Product Enhancement Group

The Product Enhancement Group staff offers one of the broadest and most experienced resource portfolios in the communications testing industry. This team of professionals offers expertise in software development, test procedure development, and network consulting, as well as years of expert test knowledge. Support is available for all core TTC product lines:

Network Consulting and Management — Provides services such as productivity analysis, test strategy assessment, on-site applications assistance, and specialized training.

Software Customization — Develops scripts for remote and automated testing, statistics, and emulation.

Test Procedure Development — Creates procedures for automated testing, network testing, and compliance testing.

9.3.3 Test Systems Field Engineering and Installation

TTC offers a range of support services for our centralized test systems, designed around the needs of the customer's network. These services help preserve the investment over the life of the equipment. Available services include:

Critical Services Program — Provides technical support at any time, 7 days a week, 24 hours a day. Replacement parts are guaranteed to arrive within 48 hours of contacting TTC.

Maintenance Contracts — Cost-effective management for networks with multiple test systems.

Out-of-Warranty Service Agreement — Covers the test system for failures after the warranty expires, including all time and material costs and return shipping costs to the customer site.

Field Engineering and Installation Service — Provides a variety of options for implementing the test system into the network, including installation, configuration, upgrades, and on-site technical support.

9.3.4 Technical Training

By providing both experienced instructors and a hands-on atmosphere, TTC training is designed to optimize test strategies and employee development requirements. Available services include:

Customized Technical Training — Designed to incorporate real-life challenges technicians face daily, while addressing the customer's training requirements, TTC provides training at the customer's designated site, so the whole staff is trained at one time. Step-by-step reviews of current technologies and products enable new or experienced technicians to translate theory into practical, hands-on expertise.

Public Courses — Regularly scheduled, in-depth, hands-on product and technology courses are offered worldwide. Public courses provide a learning environment that allows individuals from different companies to share their knowledge and experience with their peers.

Computer-Based Training (CBT) — TTCs CBT complements our hands-on technical training. With CBT, customers can learn about emerging communications technologies at their own convenience — at work, at home, or while traveling. TTCs CBT courses cover technology topics such as ATM, frame relay, ISDN, LAN basics, and more.

Customized Multimedia Course Development — Multimedia courseware can be created to customer specifications, making it easier to learn new test instruments or applications. These custom packages provide consistent educational content and training for the entire staff. Students learn at their own pace on their own PC.

Consulting and Needs Analysis Services — TTC can help identify training needs and develop customized training curricula to maximize learning opportunities, all while providing a measurable return on investment.

9.4 WARRANTY INFORMATION

9.4.1 Warranty Policy

All equipment manufactured by Telecommunications Techniques Corporation (TTC) is warranted against defects in material and workmanship. This warranty applies only to the original purchaser and is non-transferable unless express written authorization of the warranty transfer is granted by TTC.

Mainframes will be repaired or replaced (at TTCs option) at no charge for a period of three (3) years after shipment to the customer. All other equipment, including batteries, will be repaired or replaced (at TTCs option) at no charge for a period of one (1) year after shipment to the customer. Contact TTC Customer Service to determine your equipment warranty status.

Liability under this warranty extends only to the replacement value of the equipment. The warranty is void under the following conditions.

(1) Equipment has been altered or repaired without specific authorization from TTC.

(2) Equipment is installed or operated other than in accordance with instructions contained in TTC literature and operating manuals.

No other warranty is expressed or implied. TTC is not liable for any direct, indirect, incidental, or consequential damages.

9.5 SERVICE AND REPAIR INFORMATION

9.5.1 In-Warranty Service

Equipment in warranty must be returned to the factory or authorized service center with shipping prepaid. The equipment should be packed and shipped in accordance with the *Equipment Return Instructions on page 6*. Before returning any equipment, the customer must obtain a return authorization (RA) number (reference number - European Customers) by contacting TTC Customer Service *(see page 1)*, or the TTC office serving your region (call or visit our website for a current list of worldwide TTC locations). The RA or reference number should appear on all paperwork and be clearly marked on the outside of the shipping container.

After the equipment is repaired by TTC, it is tested to applicable specifications and returned to the customer with shipping prepaid. A detailed description of the work performed and parts replaced will be provided with each repair.

9.5.2 Out-of-Warranty Service

The procedure for repairing out-of-warranty equipment is the same as the one used for equipment still in warranty. There is a minimum charge applied to each request for out-of-warranty service. The charge guarantees the customer an estimate of the repair costs and is used as credit against the actual repair costs should the equipment be repaired. There are three payment methods available for out-of-warranty service: service agreement, flat rate, and time and material. Contact TTC Customer Services or visit our website for more information on these options.

The customer will be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC before the repaired equipment may be shipped to the customer. A detailed description of the work performed and parts replaced will be provided with each repair.

Once an out-of-warranty repair is made, the repaired part or component is warranted for one (1) year. This warranty applies only to the part or component that was repaired; other parts or components are not covered under the one (1) year repair warranty.

9.5.3 Equipment Return Instructions

For each piece of equipment returned for repair, attach a tag that includes the following information:

(1) Owner's name, address, and telephone number.

(2) The serial number, product type, and model.

(3) Warranty status. (If you are unsure of the warranty status of your instrument, contact TTC Customer Service.)

(4) A detailed description of the problem or service requested.

(5) The name and telephone number of the person to contact regarding questions about the repair.

(6) The return authorization (RA) number (US customers), or reference number (European Customers).

If possible, return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit; when needed, appropriate packing materials can be obtained by contacting TTC Customer Services. TTC is not liable for any damage that may occur during shipping. The customer should clearly mark the TTC-issued RA or reference number on the outside of the package and ship it prepaid and insured to TTC.

APPENDIX A GLOSSARY

AIS	Alarm Indication Signal (Blue Alarm)
AMI	Alternate Mark Inversion
Associated Path	Configured to be on the same T1 Path
AUX	Auxiliary
B_1 or B_2	The First or Second Bearer Channel
B8ZS	Bipolar 8 Zero Substitution
BECN	Backward Explicit Congestion Notification
BER	Bit Error Rate
BERT	Bit Error Rate Test(ing)
BPV	Bipolar Violation
BRI	Basic Rate Interface
Bridgetap	An automated test that transmits 21 consecutive test patterns: ALL ONES, 1:1, 1:3, 1:5, 1:6, 1:7, 2:8, 2:9, 2:10, 2:11, 2:12, 2:13, 2:14, 3in18, 3in19, 3in20, 3in21, 3in22, 3in23, 3in24, and QRSS.
CLIP	Calling Line Identification Presentation
C/R	Command/Response Indication
CO	Central Office
CPE	Customer Premise Equipment
CSU	Channel Service Unit
D&I	Drop and Insert
DCE	Data Communications Equipment
DDS LL	Digital Data System Local Loop
DE	Discard Eligibility
DLCI	Data Link Connection Identifier
DL-LLB	Data Link - Line Loopback
DL-Net	Data Link - Network Loopback

DL-PLB	Data Link - Payload Loopback
DN	Directory Number (part of SPID)
DP	Dial Pulse
DSP	Digital Signal Processor
DSU	Data Service Unit
DSX	Digital Cross Connect
DTE	Data Terminal Equipment
DTMF	Dual Tone Multifrequency
EOC	Embedded Operations Channel (U Interface)
EQUIPMENT switch	Used to select T1 EQUIPMENT interface results to be displayed on the analyzer Two Line Display
ESF	Extended Superframe
ETSI	European Telecommunications Standards Institute
FAC	Facility Access Code
FCS	Frame Check Sequence
FECN	Forward Explicit Congestion Notification
FT1	Fractional T1
FXO	Foreign Exchange Channel Unit - Office End
FXS	Foreign Exchange Channel Unit - Station End
Graphical Display	The 3.75" x 2.75" liquid crystal display used to display the MAIN, SETUP, RESULTS III and AUX screens.
HDLC	High Level Data Link Control
Help key	Used to display help related to the active selection line, information is displayed on the Graphical Display.
ISDN	Integrated Services Digital Network
ITU	International Telecommunication Union
KP	Key Pulse
LAPD	Link Access on the D-Channel

LBO	Line Build Out
LCD	Liquid Crystal Display
LE	Local Exchange or Network Cloud, implies protocol layers
LL	Local Loop
LLB	Line Loop Back
LMI	Local Management Interface
LT	Local Termination (U Interface) implies physical layer
MF	Multifrequency
Multipat	An automated test that transmits 5 consecutive test patterns: ALL ONES, 1:7, 2:8, 3in24, and QRSS.
NLPID	Network Level Protocol Identifier
NT, NT1	Network Terminal (converts U to S/T interfaces)
OCU-DP	Office Channel Unit - Data Port
PBX	Private Branch Exchange
PCM	Pulse Code Modulation
PRI	Primary Rate Interface
PVC	Permanent Virtual Circuit
QRSS	Quasi-Random Signal Sequence
Results I Category keys	Used to select the Results Category displayed on the Results I side of the Two Line display.
Results I Select keys	Used to select the individual result displayed on the Results I side of the Two Line display.
Results II Category keys	Used to select the Results Category displayed on the Results II side of the Two Line display.
Results II Select keys	Used to select the individual result displayed on the Results II side of the Two Line display.
SAPI	Service Access Port Identifier
SF	Superframe

SLC	Subscriber Loop Carrier
SNAP	Subnetwork Access Protocol
SNOT	Sequence Number Only Test
SPID	Service Profile IDentifiers
ST	Start Signal
STP	Start Signal Prime
ST2P	Start Signal Two Prime
ST3P	Start Signal Three Prime
T1 path	Path of signal flow, a T1 receiver and its associated Transmitter.
TA	Terminal Adapter
Two Line Display	The two line liquid crystal display used to display test results and error/status messages
TERM	Terminate
TIMS	Transmission Impairment Measurement Set
UDF	User Defined Frame
VF	Voice Frequency

INDEX

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