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Rev. C

T-BERD 2310
COMMUNICATION ANALYZER
USER'S GUIDE

October 1999

20400 Observation Drive, Germantown, Maryland 20876-4024 USA
USA 1-800-638-2049 • +1-301-353-1550 • FAX +1-301-353-0234
Canada 1-888-689-2165 • +1-905-507-4117 • FAX +1-905-507-4126
www.ttc.com

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Organization	Contact
TTC Headquarters	20400 Observation Drive Germantown, Maryland 20876-4023 USA Toll-free: 1-800-638-2049 In Maryland: 1-301-353-1550 Fax: 1-301-353-0731 Web: www.ttc.com *Technical Assistance Center (TAC), for technical questions* Toll-free: 1-800-638-2049 Phone: 1-301-353-1560, ext. 2300/2301 Fax: 1-301-353-1239 Email: tac@ttc.com *Customer Care Center (CCC), for product repair and orders* Toll-free: 1-800-638-2049 Phone: 1-301-353-1560, ext. 2850 Fax: 1-301-353-9216 Email: isc@ttc.com (instrument repair) custserv@ttc.com (customer service) *Technical Training, for product/technology training* Toll-free: 1-800-638-2049, ext. 2131 (USA East) Phone: 1-714-680-3004, ext. 592 (USA West) Fax: 1-301-353-0731
TTC Asia Pacific Ltd.	Room 4205, Tower II, Metroplaza 223 Hing Fong Road, Kwai Chung New Territories, Hong Kong Phone: 011 852 2892 0990 Fax: 011 852 2892 0770
TTC Australia, Melbourne	41 Stamford Road Oakleigh, 3166 Victoria, Australia Phone: 011 61 3 9563 4800 Fax: 011 61 3 9563 4900
TTC Australia, Sydney	Suite 3, Level 12 100 Walker Street North Syndney, 2060 NSW, Australia Phone: 011 61 2 9926 1447 Fax: 011 61 2 9460 0101

TTC Worldwide Contacts (Continued)

Organization	Contact
TTC Benelux (Belgium)	Battelsesteenweg 455E 2800 Mechelen, Belgium Phone: 011 32 1528 7686 Fax: 011 32 1528 7687
TTC Canada, Toronto Office	234 Matheson Boulevard East Mississauga, Ontario L4Z 1X1, Canada Toll-free: 1-888-689-2165 Phone: 1-905-507-4117 or 4118 Fax: 1-905-507-4126
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TTC France	Division of Dynatech Communications Batiment GAIA 9, Parc Ariane 78284 Guyancourt Cedex, France Phone: 011 33 1 30 48 83 90 or 00 Fax: 011 33 1 30 48 06 46

TTC Worldwide Contacts (Continued)

Organization	Contact
TTC Germany, Frankfurt Office	TTC Deutschland Max-Planck-Str. 22 61381 Friedrichsdorf, Germany Phone: 011 49 6172 5911 00 Fax: 011 49 6172 72065
TTC Germany, Munich Office	TTC Deutschland Riemer Str. 358 81829 Muenchen, Germany Phone: 011 49 89 907874 Fax: 011 49 89 907087
TTC United Kingdom	TTC (UK) Ltd. Marlborough House 3-5 Worton Drive Worton Grange Reading, Berks RG2 OTG, United Kingdom Free Phone: 800 TTC UKTAC (800 882 85822), Europe Phone: 011 44 1189 759696 Fax: 011 44 1189 227200 Email: eurotac@ttc.com

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SECTION 1 GETTING STARTED

1.1 WELCOME TO THE T-BERD 2310

The T-BERD 2310 Communication Analyzer is the perfect telecommunications installation and maintenance tool for a mobile workforce. A hand-held tester, its ease-of-use, flexibility, and functionality has established it as the next generation in test instruments. The T-BERD 2310 is the *smallest* optical, battery-powered, integrated tester available. As a member of the TTC 2000 Test Pad™ family of products, it combines a graphical user interface with a touch-sensitive screen to simplify test setup and reduce test configuration time. The "smart tester," icon-driven interface is easy to learn, and the large display screen provides ample space for displaying test results.

Even though the T-BERD 2310 weighs only 5 pounds, it provides integrated test capabilities including:

- DS1, DS3, and SONET interfaces.
- Dual Receive for DS1, DS3, and STS-1 (optional).
- OC-3 and OC-12 interfaces (optional).
- DS0, DS1, Muxed DS3, and VT1.5 in SONET testing.
- Controls and Results Print capability.
- On-Line Help.

The touch-screen user interface enables these test capabilities in an easy, step-by-step manner:

- Monitor/Thru and Terminate applications for DS1, DS3, STS-1, OC-3 and OC-12 interfaces.
- DS1, DS3, and SONET (OC-3/3c and OC-12/12c) BERT patterns.
- Dual RX, single TX for DS1, DS3, STS-1. Single RX/TX for OC-3/3c and OC12/12c.
- DS1 Unframed, D4, ESF and SLC 96 framing, T1 BERT, VF tone testing, and insertion of frame, BPVs, and logic errors.
- DS3 Unframed, M13, C-bit BERT or Muxed DS3 testing, internal or recovered timing, RX/TX at HIGH, DSX, and LOW levels, insertion of frame, BPVs, and logic errors, as well as, FEBE and yellow alarm emulation.
- SONET SPE Payloads (Async DS1 mapping, DS3 mapping, full SPE BERT), SPE pointer manipulation, STS-1 RX/TX at HIGH, DSX, and LOW levels, insertion of Line and Path AIS alarms, FEBE, LOP, and BIP errors, as well as frame, logic, and BPV (STS-1 only) errors, and RX path trace for viewing.

1.2 MANUAL OVERVIEW

This manual is organized to help you to quickly become familiar with the T-BERD 2310 and its capabilities. It is divided into the following sections:

1. **Getting Started** — includes welcome statement, manual overview, instrument description, and instrument checkout procedures.
2. **Operation** — explains the application module design, describes the graphical user interface, and provides information on battery charging and replacement.
3. **Common Applications** — provides the instrument setup and application procedures for many common applications.
4. **Printer Operation** — presents information on connecting the T-BERD 2310 to a serial printer to provide test setup and test results printouts.
5. **Test Results** — provides test results for DS1, DS3, and SONET, dependent on installed options.
6. **Specifications** — includes the physical, environmental, and electrical specifications of the instrument.
7. **TTC Customer Services** — describes customer support services, training, warranty information, and repair procedures.

1.3 INSTRUMENT DESCRIPTION

The T-BERD 2310 is a hand-held tester that is designed around a powerful and flexible TTC 2000 Test Pad architecture, which includes a touch-sensitive screen that supports various application modules. The modular design enables the TTC 2000 to easily convert from one test technology to another.

The modular design includes one 1/4-turn screw (counterclockwise to release; clockwise to secure) on the front of the application module for simple release and swapping of modules (see Figure 1-1). The T-BERD 2310 also comes with a hand strap that can be mounted on the left side of the test pad. The LED display for Primary and Secondary DS1/DS3/SONET signals in both current and history is also depicted.

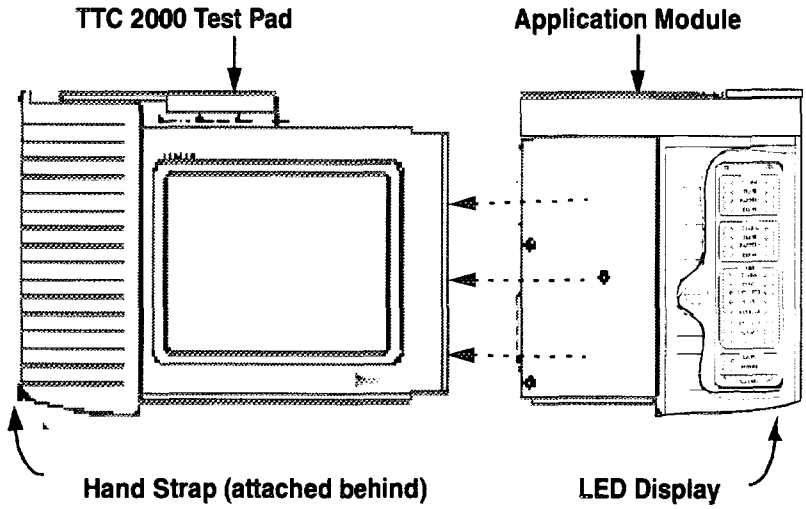


Figure 1-1. TTC 2000 Test Pad and T-BERD 2310 Module

1.3.1 Front-Panel Features

The T-BERD 2310 provides transmitters and receivers for DS1/DS3/SONET circuit analysis and offers a touch-sensitive liquid crystal display (LCD) for test configuration and results selection (see Figure 1-2).

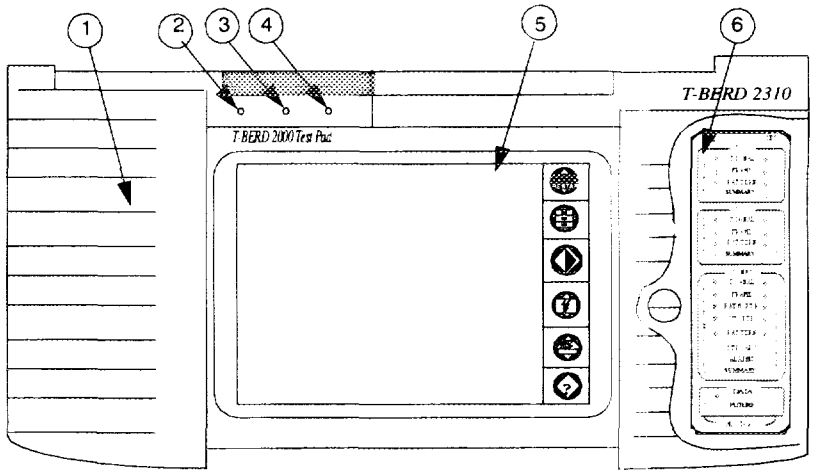


Figure 1-2. T-BERD 2310 Front Panel

Callouts in Figure 1-2 are described in Table 1-1.

Table 1-1. Front-Panel Features

#	Item	Description
1	Speaker	Provides audio output for active voice calls.
2	Power LED	Illuminates when power is supplied either from the battery or the AC power adaptor.
3	Charging LED[1]	Illuminates when the battery is charging. The battery charges when AC power is connected to the unit. However, if performing an optical test, the battery does not recharge.
4	Battery Low LED	Illuminates when only 25% or less of battery power remains. Use the AC power adaptor to recharge the battery and continue testing.

Table 1-1. Front-Panel Features (Continued)

#	Item	Description
5	LCD	Touch-sensitive screen divided into separate areas for test configuration and test results display. Refer to Section 2 for a detailed description of the LCD and how it works.
6	LED Display Panel	Illuminates whenever physical errors from the signal, frame, or pattern appear in the Summary Result Window of the LCD for DS1, DS3, and/or SONET signals.

1. The charging LED is not always on when plugged into the AC adapter. If the battery is above 85% charged, the charging LED blinks. If the battery is above 95%, the charging LED does not illuminate.

1.3.2 Bottom-Panel Features

The T-BERD 2310 bottom panel provides the **Power** switch, AC adaptor plug and battery access panel (see Figure 1-3).

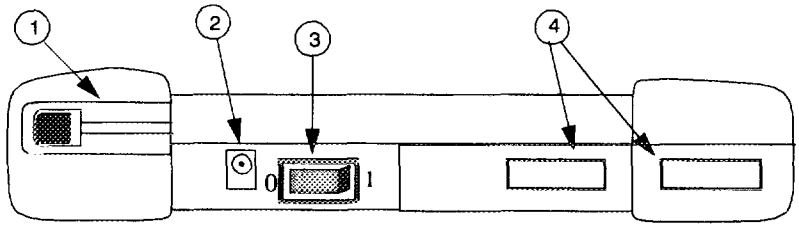


Figure 1-3. T-BERD 2310 Bottom Panel

Callouts in Figure 1-3 are described in Table 1-2.

Table 1-2. Bottom-Panel Features

#	Item	Description
1	Battery Access Door	Provides access to the rechargeable battery compartment.
2	Adaptor Plug	18 VDC connector for the AC Power Adaptor.
3	Power Switch	Turns the test set on or off.
4	Bottom Vent	Allows air to circulate through the module to the side-mounted fan.

1.3.3 Top-Panel Features

The T-BERD 2310 top panel provides the printer connector, Dual-PCMCIA card slot, and DS1/DS3/SONET connections (see Figure 1-4).

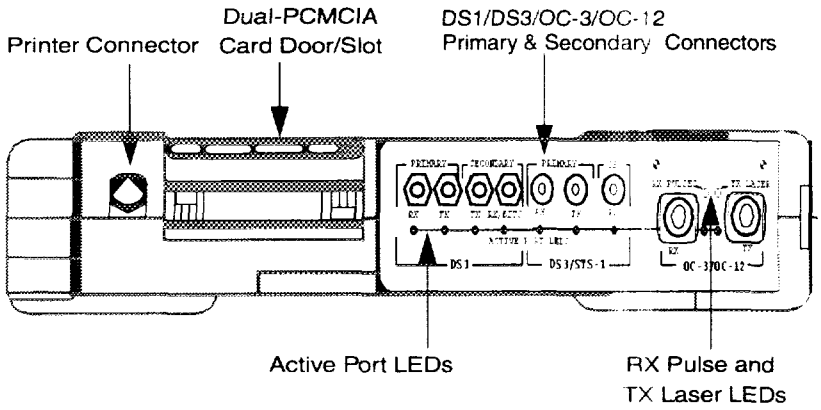


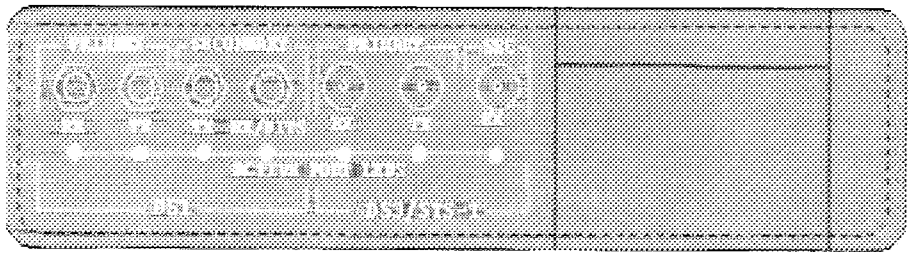
Figure 1-4. T-BERD 2310 Top Panel

Table 1-3 describes the top panel of the test unit.

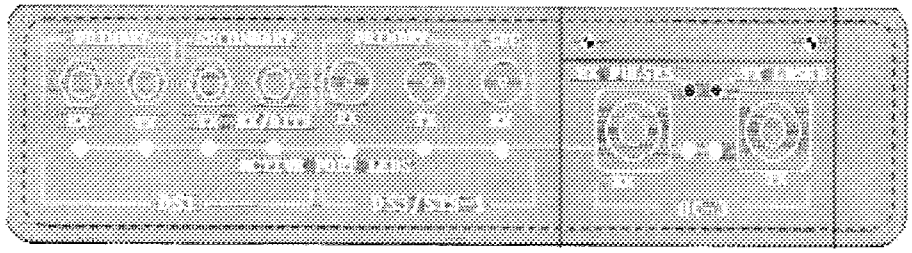
Table 1-3. Top-Panel Features

Item	Description
Printer Connector	Provides the connection for a serial printer (TTC PR-40A/B) for printing the test configuration and test results.
Dual-PCMCIA Card Door/Slot	Allows for software upgrades via two Type II PCMCIA cards or one Type III PCMCIA card.
DS1/DS3/STS-1 Primary and Secondary RX & TX Jacks	Supplies the DS1 and DS3/STS-1 connections to the Primary and Secondary Receiver and Transmitter.
OC-3/OC-12 Primary and Secondary RX & TX Jacks	FC, SC, or ST jacks supply the OC-3 and OC-12 connections to the SONET Receiver/Transmitter.
Active Port LEDs	Illuminates yellow to indicate which specific jack is active as designated by the test setup.
RX Pulse and TX Laser LEDs	RX Pulse LED illuminates red when optical power is received. TX Laser LED illuminates red when the T-BERD 2310 laser transmits an optical signal.

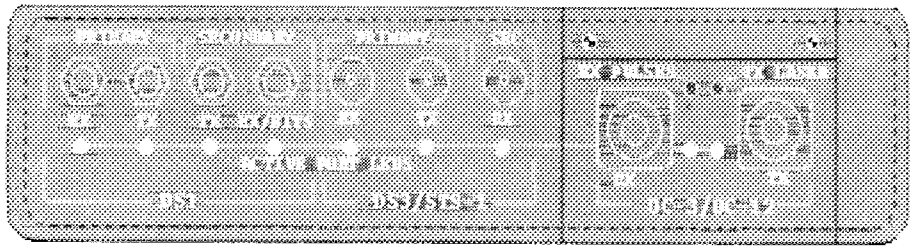
Figure 1-5 depicts three external interface connector layouts for the T-BERD 2310.



Dual DS1/DS3/STS-1 or Single DS1/DS3/STS-1



Single OC-3 with Dual DS1/DS3/STS-1 or with Single DS1/DS3/STS-1



Single OC-3/OC-12 with Dual DS1/DS3/STS-1 or with Single DS1/DS3/STS-1

Figure 1-5. Available Interface Connectors

SECTION 2 OPERATION

2.1 USER INTERFACE DESCRIPTION

When you activate the T-BERD 2310, it displays the main screen (see Figure 2-1), which is the application configuration area. The main screen is used to provide setup and configuration data and to display test-specific action buttons.

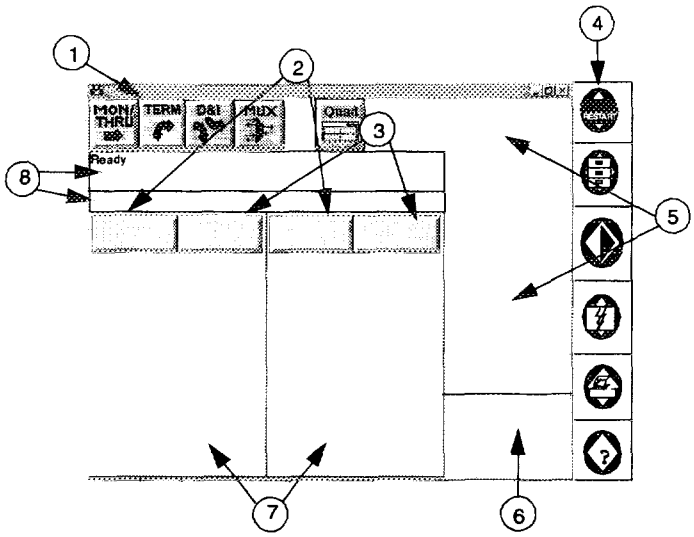


Figure 2-1. Main Screen

The Main Screen is divided into eight areas (see Figure 2-1). Each area has a function, as described in the following paragraphs:

1. **Application Icon Selection** — This area displays the **MON/THRU** (Monitor and Through), **TERM** (Terminate), **D&I** (Drop and Insert), **MUX** (Multiplexer), and **QUAD** (Quadruple Split Screens) icons used to select a test application. Refer to Figure 2-2 for a display of the icons and their associated pull-down menus.

   - For **MON/THRU** modes, the timing of the interface is set to recovered and the data is passed from the primary receiver to the primary transmitter, unchanged, except for automatically correcting BPVs and SONET BIPs.

THRU mode allows error and alarm insertion to be performed. Outside of changing test applications for output levels, the transmit data stream does not fluctuate when you change setups or restarts. If installed and applicable to the test, the secondary receiver is active and collects results.

- For **TERM** mode, unless otherwise noted by special test operations (such as loopbacks), the transmitter and receiver are entirely independent except for setup. If a secondary receiver is activated (for DS1, DS3/STS-1), results are collected on that receiver.
- **D&I** mode allows for in-service testing of one channel (DS0) from a higher rate signal (DS1). Example: Place a call on one channel while allowing the T1 to remain operational.
- **MUX** mode allows for simultaneous testing of two signals. Example: Transmit a T1 signal and Receive an OC-3 signal.
- **QUAD** results is a results function that displays up to four embedded signal rates at once in the Results Window of the T-BERD 2310. For example, by pressing the Quad Results icon, you could monitor a STS-1 signal with a DS3 mapped payload, a T1 signal, and measure the VF tone within a specific DS0, in both the primary *and* secondary directions (if the dual Rx option is installed).

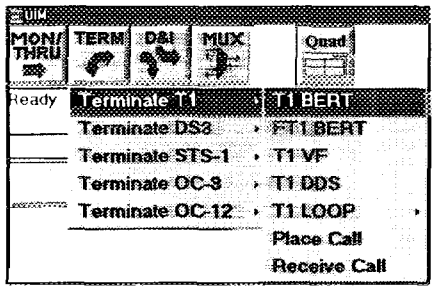


Figure 2-2. Application Icons with Pull-Down Lists

2. **Results GROUP Display** — The first button in this dual-feature display depicts a pull-down list of the current test results, and lets you change the *source* between the Primary and Secondary receivers, such as **T1 Pri** (T1 Primary), **T1 Sec** (T1 Secondary), **DS3 Pri**, **DS3 Sec**, **SONET Pri**, and **SONET Sec** (see Figure 2-3).

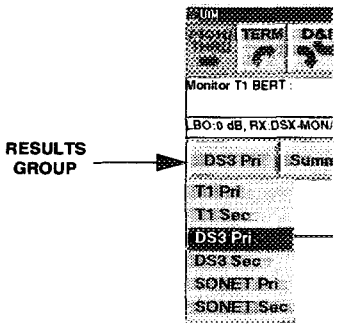


Figure 2-3. Results GROUP Selection on Main Menu Screen

3. **Results CATEGORY Display** — The second button in this dual-feature display offers a pull-down list allowing you to choose test results in numerous *categories*. Categories change according to the application selected. Figure 2-4 shows an example of categories listed for SONET applications.

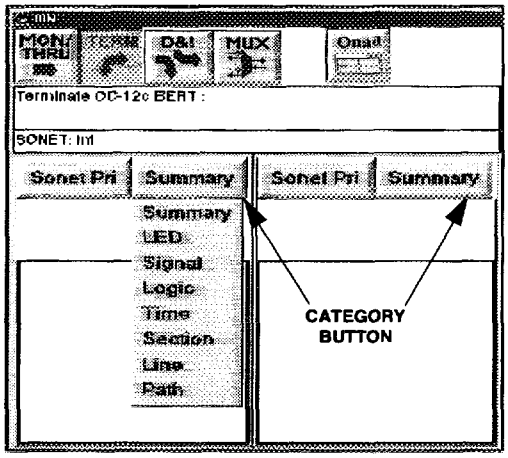


Figure 2-4. Pull-down List In Results CATEGORY

The following categories are available:

Summary — This is the default category that automatically displays results that are non-zero or out-of-specification.

LED — Selection of this category activates the Signal Alarm LEDs display. Two columns of LEDs reflect the current and history condition for each alarm. When an alarm first occurs, the appropriate current LED illuminates and remains illuminated until the condition clears. If the condition clears, the History LED for that alarm illuminates and the current LED is extinguished. If the condition occurs again, the current LED illuminates and the History LED remains illuminated to show the condition also occurred in the past.

Signal — The Signal category results include signal losses, frequency, level, and power measurements. Timing slips, as well as BPVs for STS-1 applications, are also recorded in this category.

BPV — Bipolar Violations are caused by successive pulses with the same polarity being detected (except those pulses that are part of the B8ZS encoding). Bipolar violation results are accumulated when the signal is present.

Frame — Frame errors are based on counting framing bits and identifying frame errors in the incoming signal after initial frame synchronization. The results are available whenever the receiver detects a valid framed signal, regardless of the transmitter framing mode. For DS3 analysis, DS2 frame errors and FEAC history are recorded here. CRC errors found in DS1 analysis are also recorded in this category.

Logic — Logic errors are based on discrepancies between the transmitted and received bit stream. The accumulation of logic errors is dependent on frame synchronization (if in a framed mode) and pattern synchronization. During loss of frame or pattern synchronization, the accumulation of errors halts. Pattern losses and slips are also recorded under this category.

Channel — The Channel category displays the indicated channel in binary format. This measurement is not recorded in the event of a frame loss.

Parity — Parity errors are based on detecting whether bits of data have been altered during transmission of that data. Parity errors, C-bit errors, and FEBEs are recorded in this category.

Section — The Section category is only available when performing SONET testing. Frame errors and Section BIP errors are recorded in this category.

Line — The Line category is only available when performing SONET testing. Here, APS and Pointer analyses are recorded, as well as Line BIP errors and Line FEBEs. These measurements are available once SONET frame synchronization has occurred.

Path — The Path category is present when performing SONET testing. Path BIP errors and FEBEs, as well as viewing the Path Trace, are recorded in this category. SONET frame synchronization is required before results can be obtained.

VT — The VT category is active when performing VT analysis. VT BIP errors and FEBEs are recorded here as well as VT pointer analysis. SONET frame synchronization must be established prior to recording these results.

Path Trace — SONET Path Trace enables one of three default or user-defined messages to be transmitted over the path trace byte (J1) of the inserted STS-1 signal. SONET frame synchronization must be established prior to recording these results.

Traffic — The Traffic category displays results for all 24 DS0 timeslot or channel signaling bits, data bits, and channel assignments.

Call Sig — The Call Signal category is active when placing, receiving, and monitoring a call. It displays supervisory events, digits, and their associate parameters.

Time — The Time category shows elapsed time of the test, current date, and time.

4. **Permanent Softkeys** — This area includes six permanent softkeys that provide housekeeping functions for the T-BERD 2310. These keys perform the functions described in Table 2-1.

Table 2-1. Permanent Softkey Icons

Icon	Description
	**RESTART** — Performs the test restart function, including resetting the current test result totals and clearing any errors and/or alarms.
	**AUX Functions** — Activates the Auxiliary Functions screen, which allows you to view the Software Revision Level and Installed Options, as well as set the Speaker Volume, Time and Date, and Brightness Control.
	**Screen Contrast** — Adjusts the level of detail on the screen display. Pressing the left side lightens the images, and pressing on the right side darkens the images.
	**Battery Status** — Activates the Battery Status Screen, which displays the current battery strength.
	**Printer Setup** — Activates the Printer Setup Screen, which enables selection of the printer interface parameters (Baud Rate and Parity), and allows you to clear the print buffer, print results, or abort printout.
	**Help (?)** — Provides on-line help screens to aid in test setup or T-BERD 2310 operation.

5. **QUICK CONFIGURATION Softkeys** — These multiple configuration buttons display setups based upon the type of test initiated. Only those pertaining to the specific test display, depending on what test application you choose. The following figures show two depictions; Figure 2-5 is a diagram showing various possible configurations, while Figure 2-6 shows real-test usage. Refer to Section 2.1.1 for information on how these buttons apply to the Property Sheets.

6. **ACTION Softkeys** — These action buttons are designed to take specific action during a test to initiate and measure the test (see Figure 2-5 and Figure 2-6).

NOTE

There are two different types of ACTION buttons: State and Momentary. (1) State: Button visibly changes (from dark grey to light grey color) between depressed and normal and remains changed. (2) Momentary: Button color flickers when pressed but does not stay changed color.

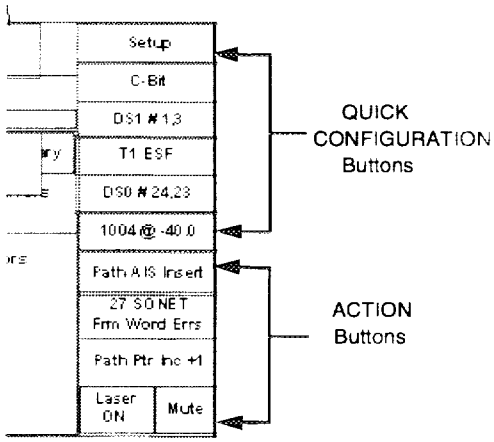


Figure 2-5. Quick Configuration/Action Buttons Diagram

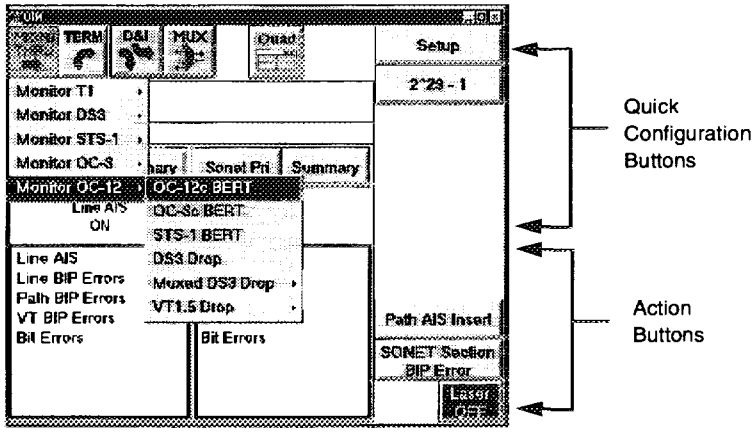


Figure 2-6. Sample Configuration/Action Buttons Usage

7. **Dual Test Results Display** — This area (see Figure 2-7) displays two test results windows associated with the current test application. Each window has a button for selecting the Result GROUP, a button for selecting the Result CATEGORY, a Result VALUE display window, and a Result LIST box. Figure 2-7 shows a sample depiction of the Dual Test Results Display.

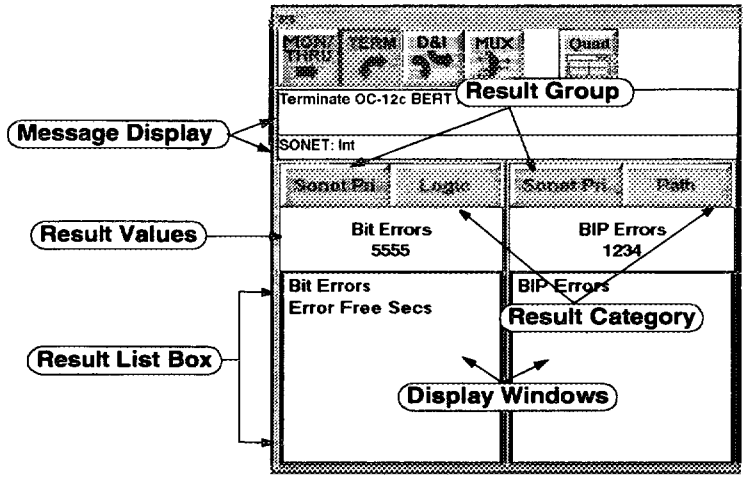


Figure 2-7. Dual Test Results Display (Labeled)

8. **Message Display** — This area (see Figure 2-1 and Figure 2-7) displays messages regarding activity associated with the current test application. The message display is comprised of:

   - **Test State/Status**: Shows the current test application.
   - **Setup:** Shows what part of the segment is being tested.

In the example above (see Figure 2-7), the Message Display indicates that the test pad is in Terminate OC-3c BERT *state*, *set up* to test SONET Internal Timing *using* SONET Primary transmission as its source, and *choosing* Signal as the target for test results. The BPV Err Secs in the Result Value window appear *after* you choose one of the selections from the Result List.

2.1.1 Application Setup Property Screens

When any of the QUICK CONFIGURATION buttons are pressed, Setup Property Sheets (which are tabulated for subsequent choices) display on the LCD. These Property Sheets consist of a Setup **Summary** (see Figure 2-8) and tabulated Property Sheets (see Figure 2-9) that provide the parameters for all test settings not already determined by the test application (default settings).

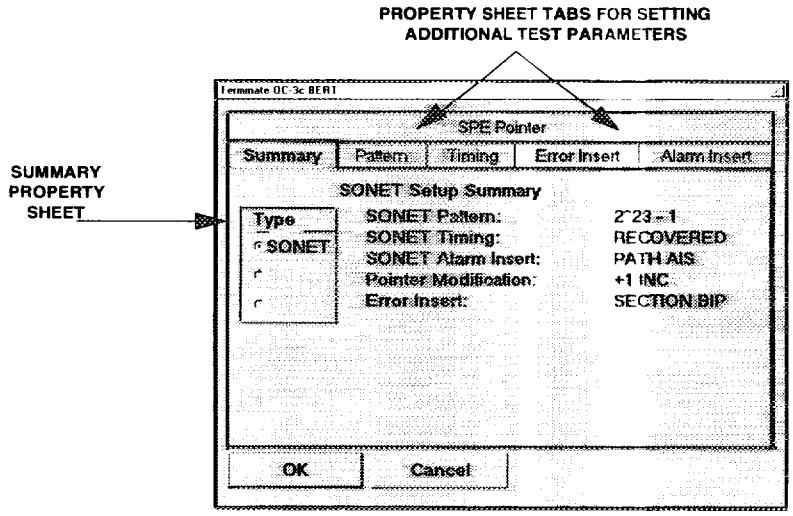
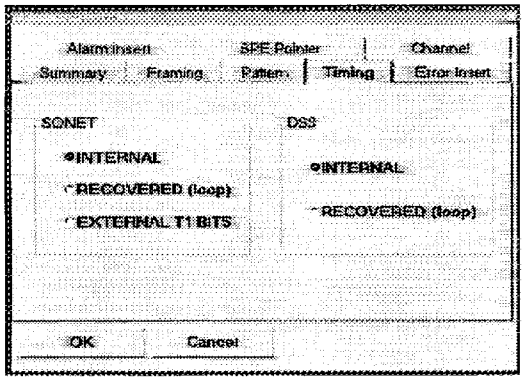


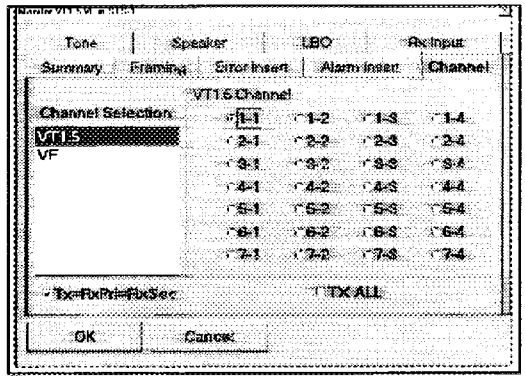
Figure 2-8. Setup Summary Property Sheet

When pressed, the **Setup** configuration key prompts a **Summary** Sheet that allows you to confirm the configuration of the test set matches the test to be performed. Behind the **Summary** Sheet, there are tabs of additional setup sheets that prompt you to set additional parameters for the test application.

Actually, pressing any of the QUICK CONFIGURATION buttons will activate the T-BERD 2310 to bring up the Property Sheets, and by pressing any of the tabs, you can immediately bring up the desired screen to set parameters. Figure 2-9 shows a random sampling of property tabs within the Property Sheets.



TIMING PROPERTY SHEET TAB
This is the Internal Timing Property Sheet Tab that displays after selecting the **Setup** Configuration Button. (For Terminate DS3 Bert in OC-3)



CHANNEL PROPERTY SHEET TAB
This is the Channel Property Sheet Tab that displays after selecting the **Setup** Configuration Button. (For Monitor VT1.5 Bert in OC-3)

Figure 2-9. Property Sheet Tabs Set Test Parameters

NOTE

Using the Setup Property Sheets disables the extended digitized softkeys (RESTART, PRINT, AUX, BATTERY, CONTRAST, and HELP).

Remember to press **OK** on the Property Sheet to set the value. You can also cancel the settings by pressing **CANCEL**.

2.2 LED DISPLAY PANEL

The Current/History Error LED Display Panel illuminates to visually display the performance of the test being performed. Figure 2-10 depicts the LED Display Panel.

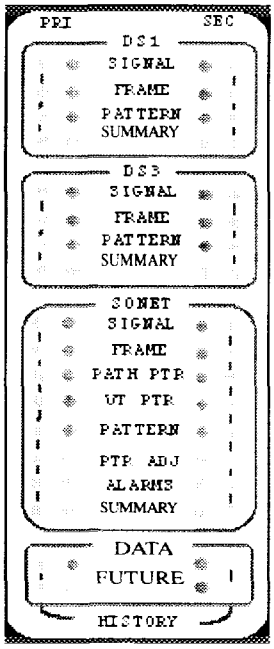


Figure 2-10. LED Display for Current/History Signal Alarm

The red Alarm LEDs provide information about the current and historical alarm conditions related to the received signal. These LEDs are divided into two columns (Current and History). When the Current alarm condition is cleared (e.g., pattern sync reestablished), its History LED illuminates. The History LEDs are located on the outside column and indicate past occurrences of the alarm and remain illuminated until a test restart occurs.

The inside "green" LEDs for Signal, Frame, Pattern, and Path/VT PTR (SONET only) are key to knowing the Current status of the test, and you need to wait to see if they illuminate when performing a test. If any one of these conditions is lost while performing the specified test, a History red LED illuminates and the green Current LED light extinguishes. The remaining Current LED lights are red (ERRORS, ALARMS, PTR ADJ) and illuminate when errors are present in the Current test, then change to History when error alarm is removed. Table 2-2 describes the green status LEDs.

Table 2-2. Green Status LEDs

LED	Description
SIGNAL	Recognition of a Signal Present.
FRAME	Established synchronization with Framing of Signal.
PATTERN	Established synchronization with Pattern of Signal.
PATH & VT	Established synchronization with SONET Pointer Bytes and VT Pointer Bytes.

Table 2-3 describes the red Alarm LEDs.

Table 2-3. Red Alarm LEDs

LED	Description
DS1 Signal	
SIGNAL	Displays alarms if DS1 signal is lost.
FRAME	Displays alarms if DS1 frame synchronization is lost.
PATTERN	Displays alarms if pattern synchronization is lost.
ERROR	Displays alarms if an error has been recorded by the unit, as shown in the Results Summary window.
DS3 Signal	
SIGNAL	Displays alarms if DS3 signal is lost.
FRAME	Displays alarms if DS3 frame synchronization is lost.
PATTERN	Displays alarms if pattern synchronization is lost.
ERROR	Displays alarms if an error has been recorded by the unit, as shown in the Results Summary window.
SONET Signal	
SIGNAL	Displays alarms if SONET signal is lost.

Table 2-3. Red Alarm LEDs (Continued)

LED	Description
FRAME	Displays alarms if SONET frame synchronization is lost.
PATH PTR	Displays alarms when the path pointer byte is lost after initial synchronization.
VT PTR	Displays alarms when the virtual tributary overhead path pointer byte changes after initial synchronization.
PATTERN	Displays alarms if pattern synchronization is lost.
PTR ADJ	Displays alarms if overhead path pointer byte pointer adjustments are recorded.
ALARMS	Displays alarms when an AIS (blue alarm) or RDI (yellow alarm) is detected since the last test restart or history reset.
ERROR	Displays alarms if an error has been recorded by the unit, as shown in the Results Summary window.

2.3 OPERATING THE T-BERD 2310

2.3.1 Basic Test Setup

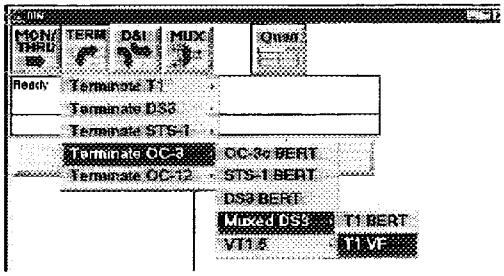
To operate the T-BERD 2310, you only need to turn on the test set, wait for the Main Screen to appear, then perform the following steps:

NOTE

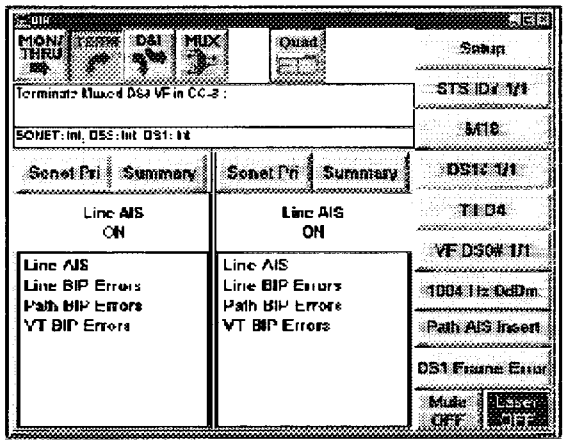
We recommend using the stylus supplied with the T-BERD 2310 to activate functions on the touch-sensitive screen. However, any blunt device, including your finger, can be used.

1. Select an Application Icon, the FIRST STEP of any test.

2. Select an Application from the list of applications in the pull-down menu that appears when the icon is selected (you can choose up to three levels deep).



When you have reached the desired level of test setup, the unit automatically configures to a default starting point for testing.



3. The buttons below **Setup** in the Configuration section show the current settings. To change a setting, press the appropriate button to go to the Setup Property Screen. (Remember, you can press **Setup** or any of the QUICK CONFIGURATION buttons.)

   - To check or change the configuration, press **Setup**, which replaces the main screen with the Setup Property Sheets (which are tabulated for subsequent choices). These setup sheets consist of a Setup **Summary** (see Figure 2-8) and Property Sheets (see Figure 2-9) that provide the parameters for all test settings not already determined by a default test setup.

   - By pressing any of the tabs, you can immediately bring up the desired screen to set parameters. To change a parameter, press or click on the appropriate tab folder to move it to the front. Set the desired parameters accordingly. Figure 2-11 shows how Step 1 through Step 3 could look for a possible test setup using the Tabulated Property Sheets.

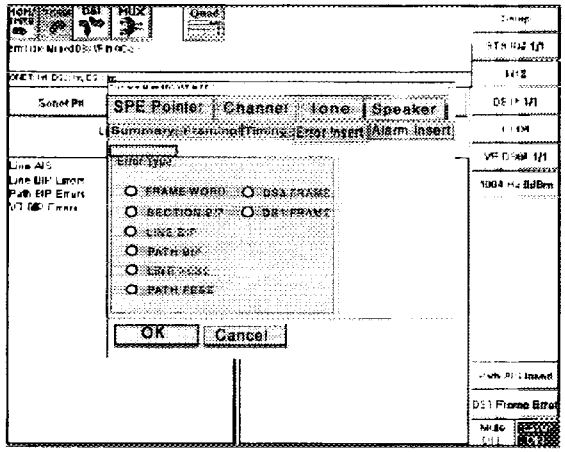


Figure 2-11. Tabulated Property Sheets for Test Setup

4. When all parameters are correct, connect to the circuit being tested using the Primary and/or Secondary TX and RX jacks. For instrument safety, we recommend connecting the cables to the T-BERD 2310 first, then the circuit. Test results begin accumulating automatically.

5. For several applications, secondary ACTION buttons appear in the QUICK CONFIGURATION area. Press the appropriate button to perform the labeled function.

6. To clear alarms and begin testing, press the RESTART Permanent Softkey.

7. Observe the test results in the Dual Test Results Display. To observe specific test results, select the source receiver using the Result GROUP button, then press the Result CATEGORY button to reveal the list of categories. Press the desired category. The Test Results List immediately shows all the test results in that category.

8. All available results are listed in the Test Results List, while the currently selected result is shown in the Test Result display above the list. Press a specific test result in the Test Results List to see it in the Test Result display.

NOTE

The Dual Test Results Display enables selection of two different categories to show on the screen.

2.4 ERRORS CATEGORY

The ERRORS category consists of traffic measurement values that are updated via the Summary CATEGORY button (see see Figure 2-4). The following results/messages appear in the summary category for SONET if they are applicable and meet the conditions outlined below.

Some of these summary items will illuminate a red error LED on the front panel when they appear in summary. The possible error LEDs are DS1, DS3, and SONET. A blank indicates that the result does not cause any error LED to light when present in summary.

2.5 BATTERY OPERATION

The T-BERD 2310 comes equipped with a rechargeable Nickel-Metal Hydride (NiMH) battery. A fully-charged battery is good for about 1.5 hours of continuous use for electrical testing and 0.5 hours for optical testing. The recharge time is approximately 1.5 hours with the unit turned OFF. The recharge period begins as soon as an external AC or DC power supply is connected to the unit. Overcharge protection is provided, so continuous operation from an AC power supply is possible.

2.5.1 Recharging the Battery

The Low Battery LED illuminates when the battery is at 25% of full charge to indicate the battery needs to be recharged.

To fully charge the battery quickly, turn the unit off, connect the AC Adaptor from the power adaptor plug to a 120 VAC power supply and let the T-BERD 2310 sit for about 1.25 hours. The battery can also be charged by using the optional car adapter.

2.5.2 Battery Replacement

The Nickel-Metal Hydride (NiMH) battery is easy to replace.

1. Turn off the T-BERD 2310.
2. Tilt the unit onto the back panel. (The bottom panel faces you.)
3. Lift up the latch on the battery cover. Pull the battery out of the battery compartment.
4. Install the replacement battery by lining up the contacts and snapping it into place.
5. Secure the battery cover.
6. Turn on the T-BERD 2310 and continue testing.

3 COMMON APPLICATIONS

SECTION 3 COMMON APPLICATIONS

3.1 INTRODUCTION

The following setup procedures are the most commonly used T1 tests for the T-BERD 2310. They are broken down into a series of tests organized per options. *As in any test, always configure the T-BERD 2310 before connecting the test set to the circuit.*

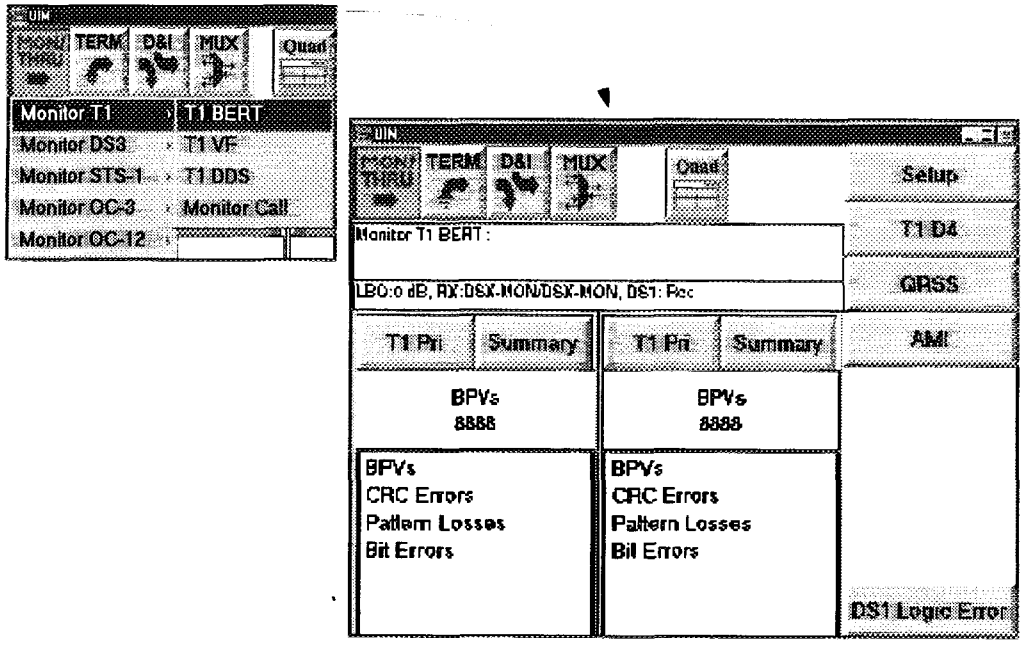
3.2 T1 OPTION

This test allows you to qualify T1 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.

3.2.1 Monitoring T1 Performance

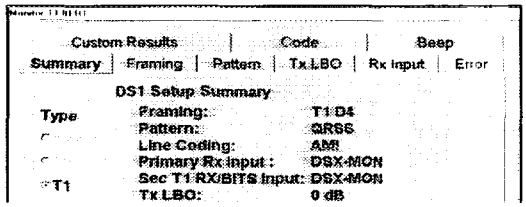
Configuring the T-BERD 2310:

1. Press **MON/THRU**. Then, select **Monitor T1** from the pull-down menu, followed by **T1 BERT**. The unit automatically configures to a default setup.

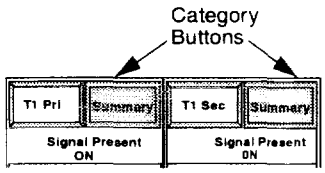


2. Press **Setup**. Ensure the characteristics shown in the Setup Summary Screen match the network characteristics (such as T1D4, etc.).

   To change the settings, select the desired tabs in the Property Setup Sheets.



3. Press **OK**. If monitoring a second signal, press one of the buttons labeled **T1 PRI** in the Results GROUP window and select **T1 Sec** from the pull-down menu. Set both Results CATEGORY buttons to **Summary**.



4. Verify the yellow active port LEDs next to the DS1 PRIMARY RX and SECONDARY RX jack are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the PRIMARY RX jack to the DSX-1 A-Side MON jack.
2. Connect a cable from the SECONDARY RX jack to the DSX-1 Z-Side MON jack.
3. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

4. Verify the green SIGNAL and FRAME LEDs are illuminated and the Primary and Secondary Results Displays show RESULTS OK.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-1 diagram is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for T1 monitoring.

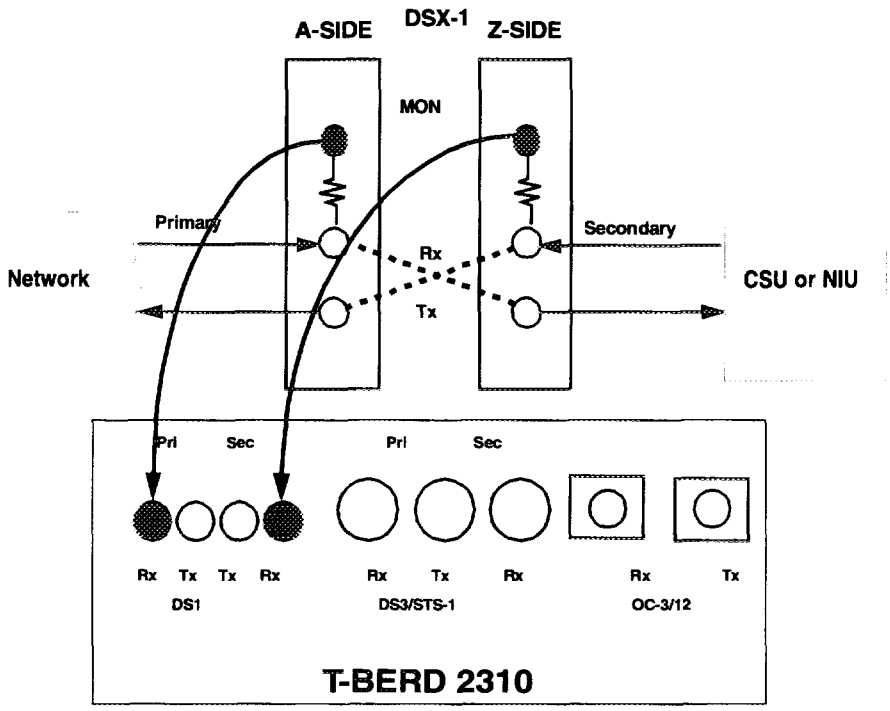
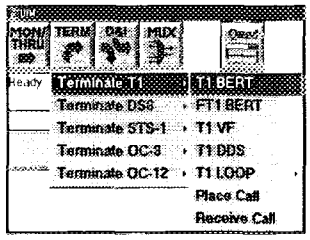


Figure 3-1. Simulation of T1 Monitor Test Setup

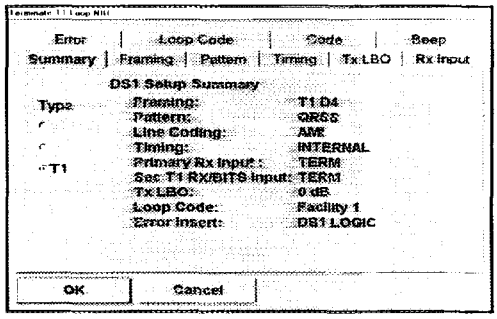
3.2.2 T1 BERT Termination Setup

Configuring the T-BERD 2310:

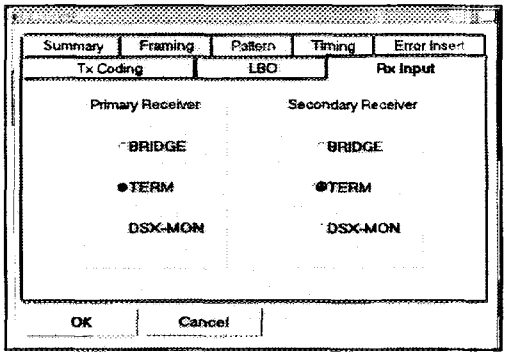
1. Press **TERM**. Then, select **Terminate T1** from the pull-down menu, followed by **T1 BERT**. The unit automatically configures to a default setup.



2. Press **Setup**. The **Summary** Property Sheet displays. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics (such as T1D4, etc.).

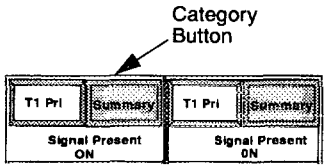


3. Press **RX Input** tab and select **TERM.**



4. Press **LBO** tab and select appropriate dB level.
5. Press **Error Insert** tab and select **DS1 Logic**.
6. Press **Timing** tab and select **Internal**.
7. Press **OK**.

8. Ensure Results CATEGORY is set to **Summary**.



9. Verify the yellow DS1 PRIMARY RX and TX active port LEDs are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack.
2. Connect a cable from the DS1 PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack.
3. Loop the Far-end DSX-1.
4. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

5. Verify the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated, and the SUMMARY Results displays RESULTS OK.
6. Press the **DS1 Logic Error** ACTION button five times. Verify five logic errors are received in the Results Display windows.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-2 is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for T1 TERMINATION testing.

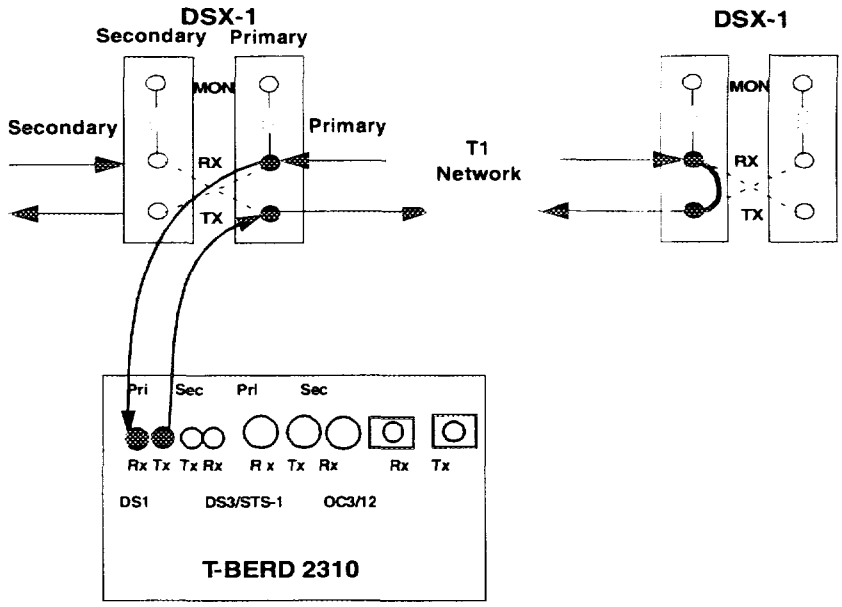
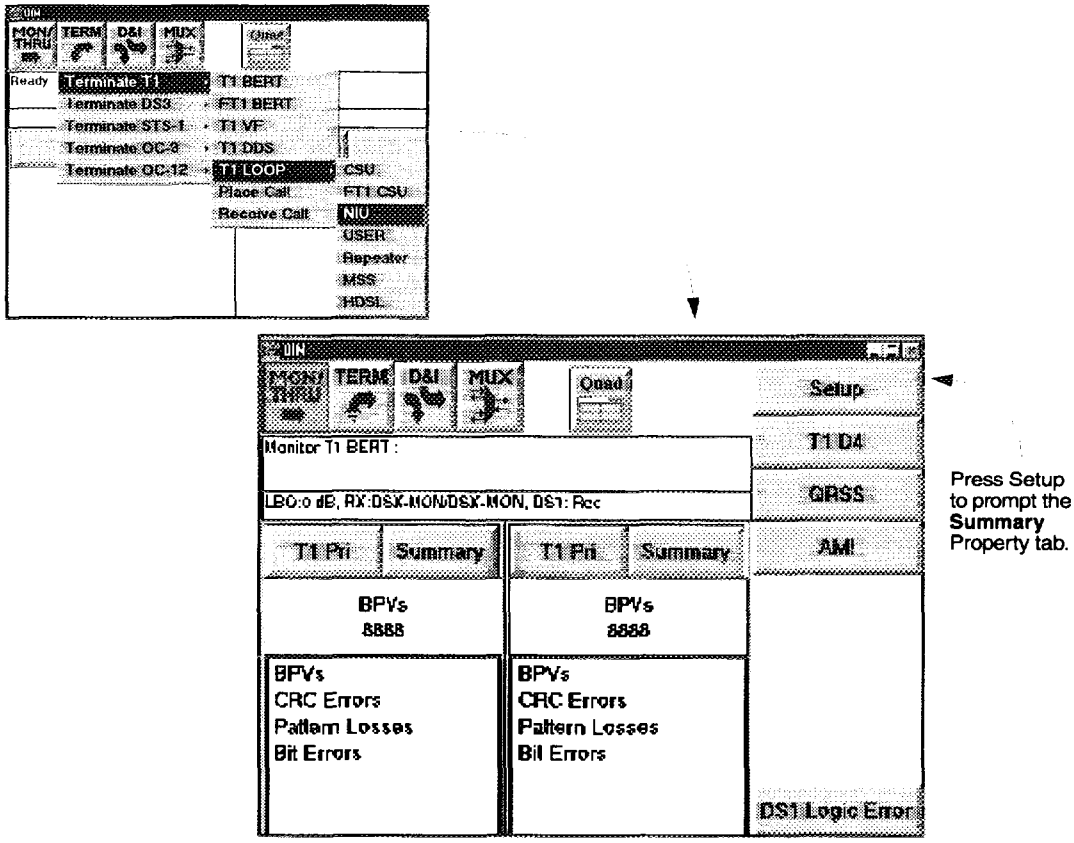


Figure 3-2. Simulation of T1 Termination Test Setup

3.2.3 T1 Loopback BER Testing

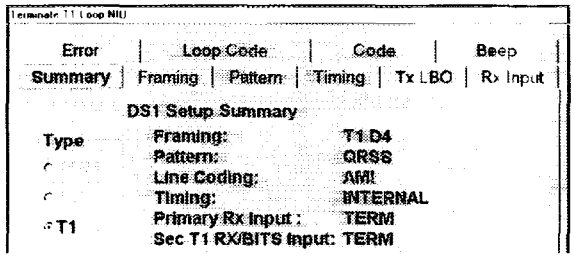
This test allows you to qualify T1 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.

1. Press **TERM**. Select **Terminate T1**. Then, select **T1 LOOP**, followed by the appropriate T1 loop code from the pull-down menu (such as **NIU**). The unit automatically configures to a default setup screen.

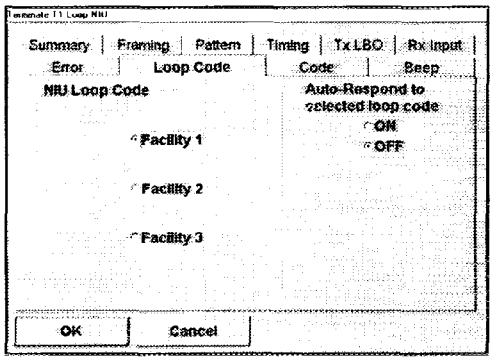


2. Press **Setup**. Ensure the characteristics shown in the Setup Summary Screen match the network characteristics (such as T1D4, etc.).

To change the settings, select the desired tabs in the Property Setup Sheets.

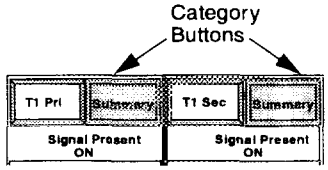


3. Select the **Loop Code** tab. Select the appropriate Loop Code.



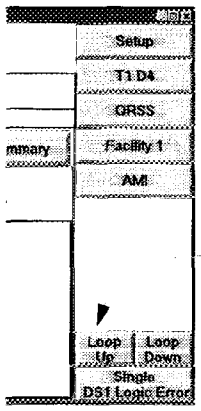
Depending upon your choice in the third pull-down menu during Setup, the **Loop Code** tab displays the possible selections which pertain to that menu selection. In this case, NIU was selected during the setup process.

4. Press **OK**. Set Results CATEGORY buttons to **Summary**.



5. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

6. Press **Loop Up**. Verify the green SIGNAL, FRAME, and PATTERN LEDs are illuminated, and the SUMMARY Results displays RESULTS OK.



Loop Up on the **Setup** screen enables you to send the appropriate Loop Code.

7. Send Bit Errors to verify loop.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the PRIMARY RX jack to the DSX-1 Primary MON jack.
2. Connect a cable from the SECONDARY RX jack to the DSX-1 Secondary MON jack.
3. Verify the green SIGNAL and FRAME LEDs are illuminated and the Primary and Secondary Results Displays show RESULTS OK.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-3 diagram is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for T1 Loopback BER testing.

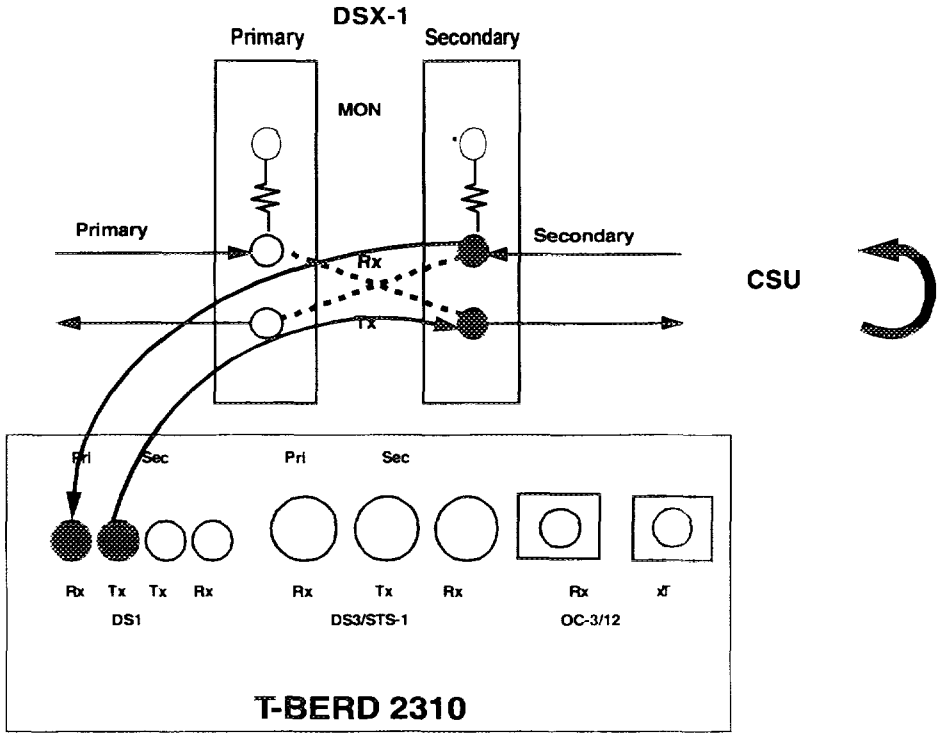
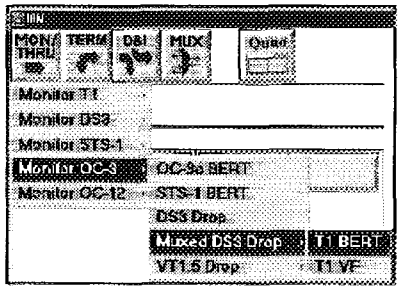


Figure 3-3. Simulation of T1 Loopback Test Setup

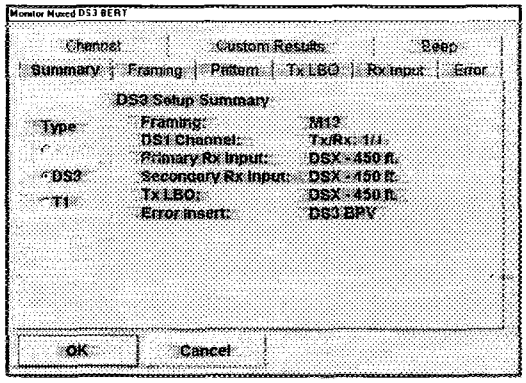
3.2.4 T1 Timing Slip Analysis

Configuring the T-BERD 2310:

1. Press **MON/THRU**. Select appropriate signal to be tested. Then select the mapping for the DS1 within the signal (**VT1.5** or **DS3 Muxed** until **T1 BERT** is available). Select **T1 BERT**. The unit automatically configures to a default setup.

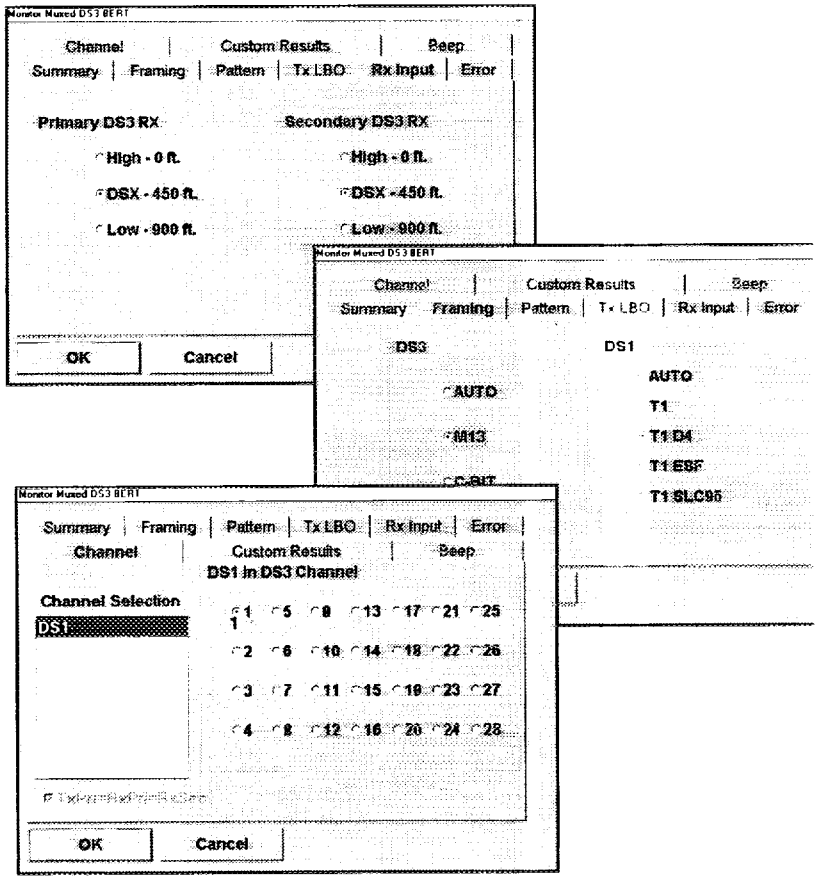


2. Press **Setup.** The **Summary** Property Sheet displays.



3. Press **Rx Input**. For DS1, DS3, or STS-1 access, select the appropriate **Rx Input** level (DSX for DS3/STS-1 and DSX MON, BRIDGE, or TERM for DS1).

4. Press **Framing**. Select **T1** (unframed) and the appropriate DS3 framing (**M13/C-BIT**).



5. Press **Channel**. Select the appropriate SONET, DS1, and VT1.5 channel.
6. Press **OK**.
7. Verify yellow DS1 Secondary RX/BITS and appropriate signal level Rx active port LED's are illuminated.

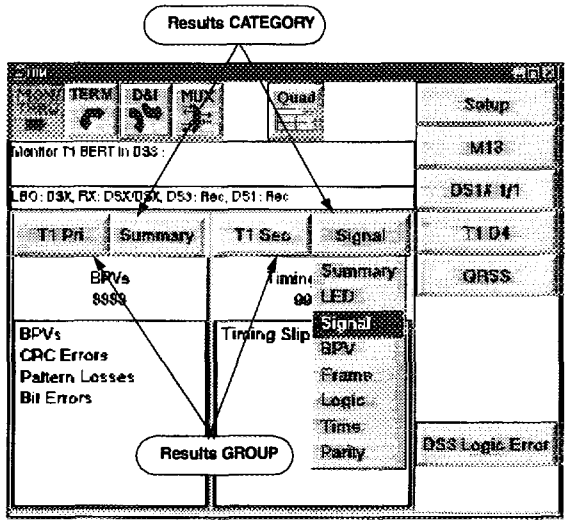
Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the SECONDARY RX/BITS jack to the DS1 BITS Clock or a known good reference signal (see Figure 3-4).
2. Connect a cable from the DSX RX jack to the signal to be tested (see Figure 3-4).

3. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

4. Verify the appropriate green signal LEDs are illuminated for the tested signal (DS3 or SONET) and DS1.

5. To display timing calculations, press one of the Results GROUP buttons and select **T1 Pri**. Press Results CATEGORY button and select **Signal**, then **Timing Slips** as the result.



6. Verify test results in the RESULTS display windows. If the signal is error free, "All Results OK" displays.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-4 is a sample depiction of cable connections from the Master Clock to the inputs on the T-BERD 2310 for DS1 Timing Slips testing.

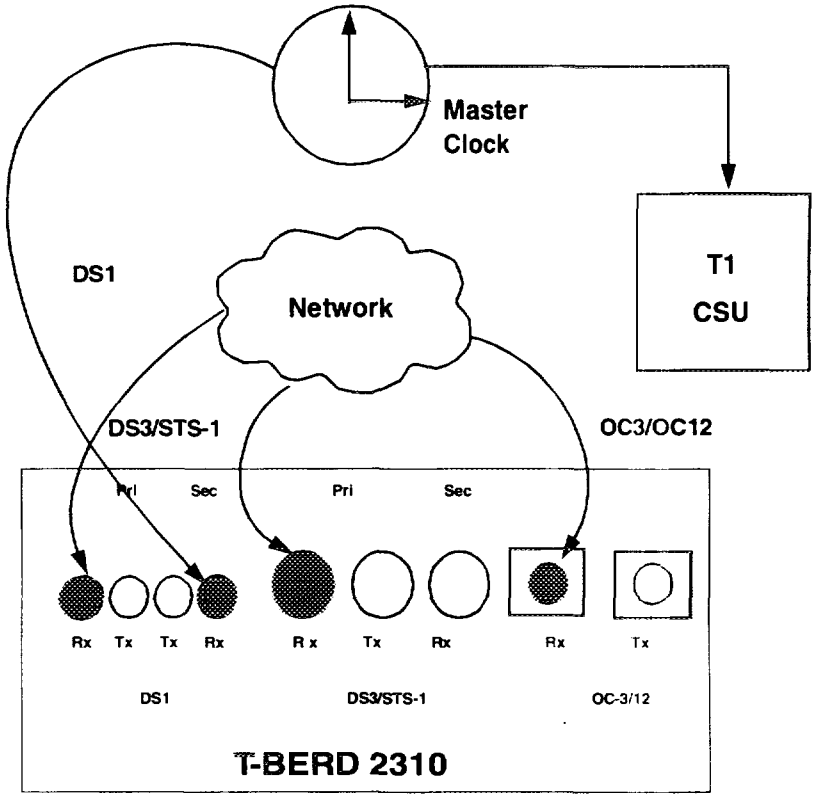


Figure 3-4. Simulation DS1 Timing Slips

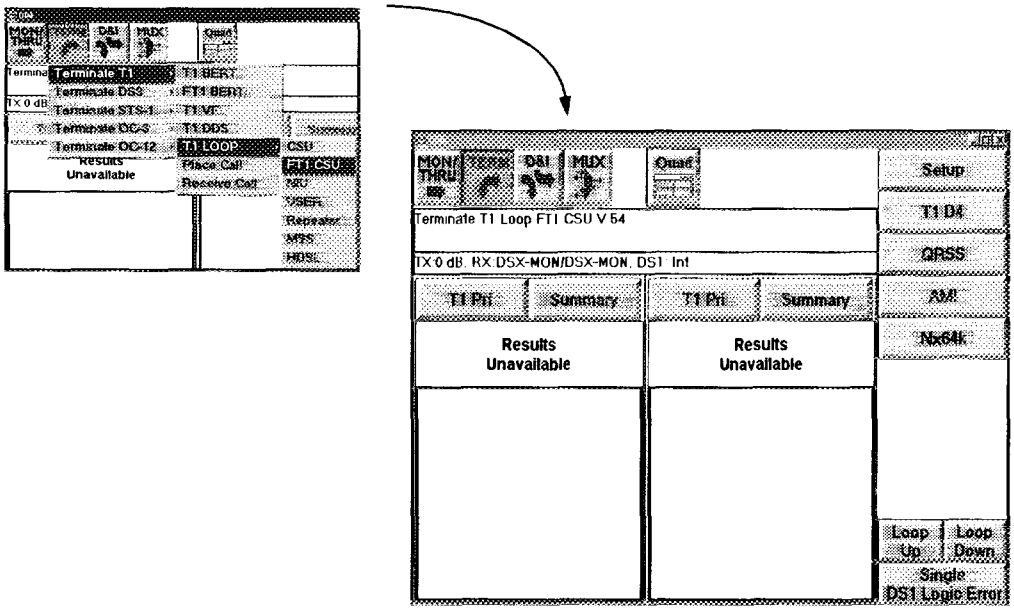
3.3 FT1 OPTION

This option provides Fractional-T1 (FT1) modes for contiguous and noncontiguous, 56KxN and 64KxN, channel formats. This option enables complete qualification and testing of new FT1 circuits before connecting customer premises equipment. The V.54 FT1 loop code is also added to the feature list and allows for single test set testing of FT1 circuits from a convenient T1 access point. These tests allow you to:

- Test aggregate bandwidths on contiguous/non-contiguous channels in 56xN or 64xN format.
- Test Fractional T1 circuits bandwidths and measure the round trip path delay of any group of channels.
- Confirm that the Fractional T1 signal is properly received by the network equipment.

3.3.1 FT1 Loopback BER Testing

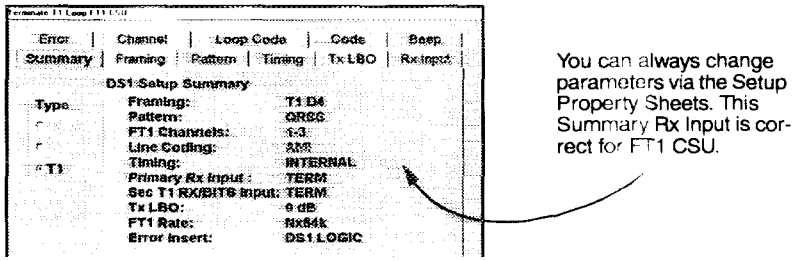
1. Press **TERM**. Then, select **Terminate T1,** followed by **T1 LOOP,** and then **FT1 CSU** from the pull-down menu. The unit automatically configures to a default setup screen.



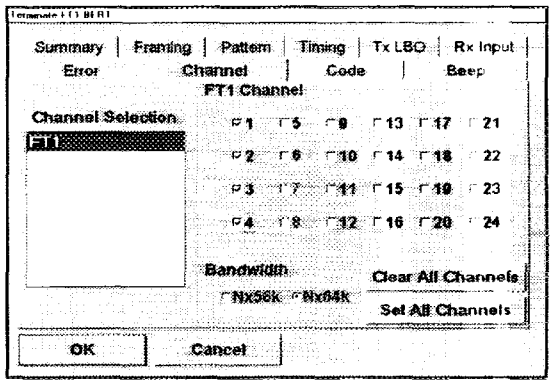
2. Press **Setup**. Ensure the characteristics shown in the Setup Summary Screen match the network characteristics (such as T1D4, etc.).

To change the settings, select the desired tabs in the Property Setup Sheets.

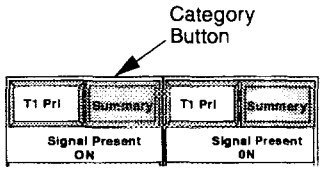
3. Press **Rx Input** tab and select **TERM**.



4. Press **LBO** tab and select appropriate dB level.
5. Press **Error Insert** tab and select **DS1 Logic**.
6. Press **Timing** tab and select **Internal**.
7. Press **Channel** tab and select the appropriate FT1 channels and bandwidth (Nx56 or Nx64k).



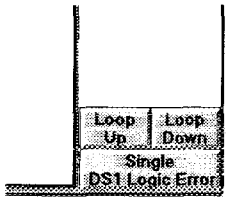
8. Press **OK**.
9. Ensure Results CATEGORY is set to **Summary**.



10. Verify the yellow DS1 PRIMARY RX and TX active port LEDs are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack.
2. Connect a cable from the DS1 PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack.
3. Press the **Loop Up** ACTION button.



4. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

5. Verify the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated and the Primary and Secondary Results Displays show RESULTS OK.
6. Send Bit Errors to verify loop.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-5 diagram is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for T1 Loopback BER testing.

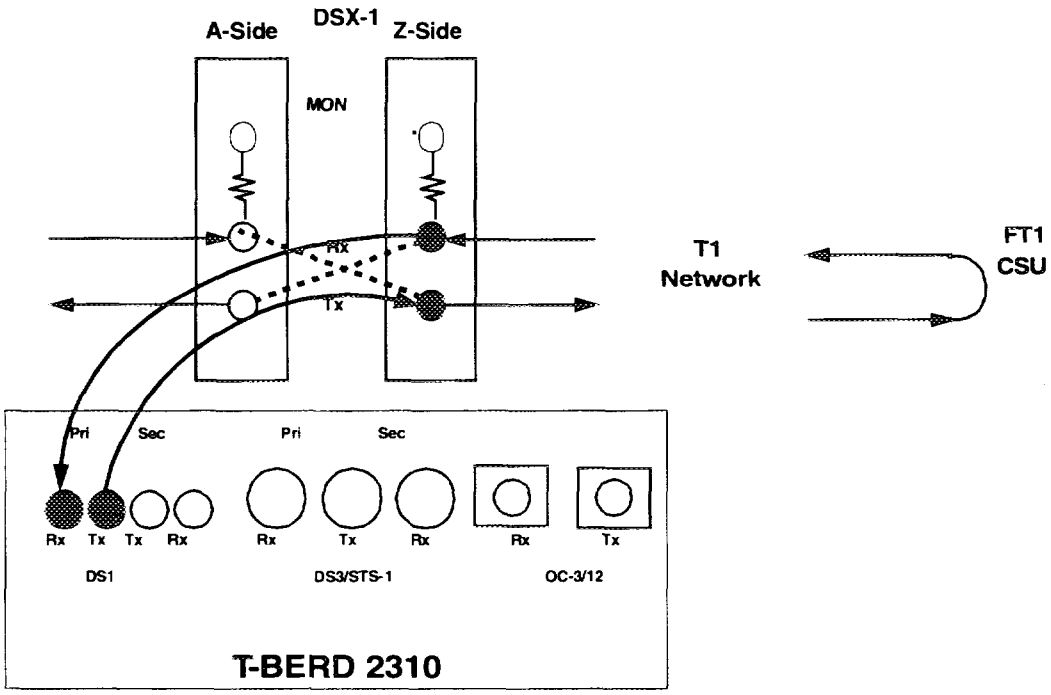
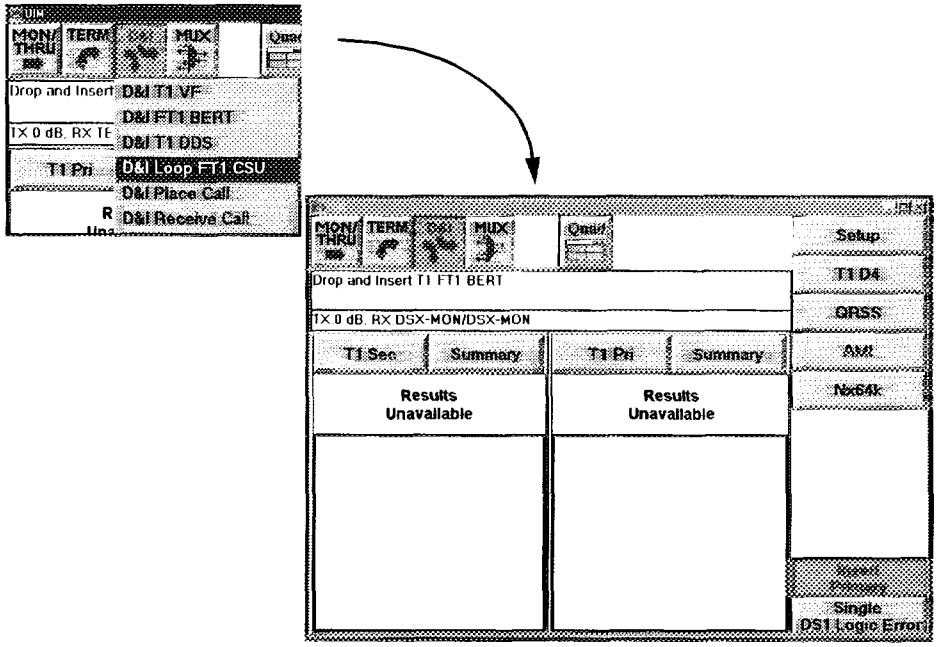


Figure 3-5. Simulation of FT1 Loopback Test Setup

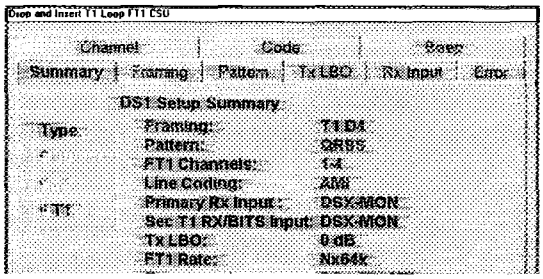
3.3.2 FT1 Drop and Insert Testing

Configuring the T-BERD 2310:

1. Press **D&I**. Then, select **D&I Loop FT1 CSU** from the pull-down menu. The T-BERD 2310 configures to a default setup.

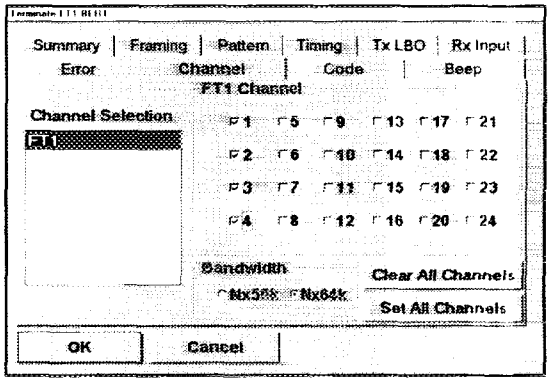


2. Press **Setup**. Ensure the characteristics shown in the **Summary** property sheet match the network characteristics (such as T1D4, etc.). To change the settings, select the desired tabs in the Property Setup Sheets.

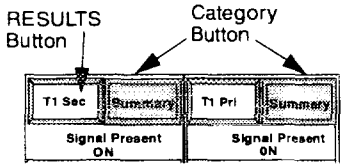


3. Press **Rx Input** tab and select **MON**.

4. Press **Error** tab and select **DS1 Logic**.
5. Press **Timing** tab and select **Recovered**.
6. Press **Channel** tab and select the appropriate FT1 channels and bandwidth (Nx56 or Nx64k).



7. Press **OK**.
8. Press one of the buttons labeled T1 Pri in the RESULTS category window and select T1 Sec from the pull-down menu. Set both Results CATEGORY buttons to **Summary**.



9. Verify the yellow DS1 PRIMARY TX/RX active port LEDs and SECONDARY TX/RX LED are illuminated.

Connecting the T-BERD 2310 to the Circuit:

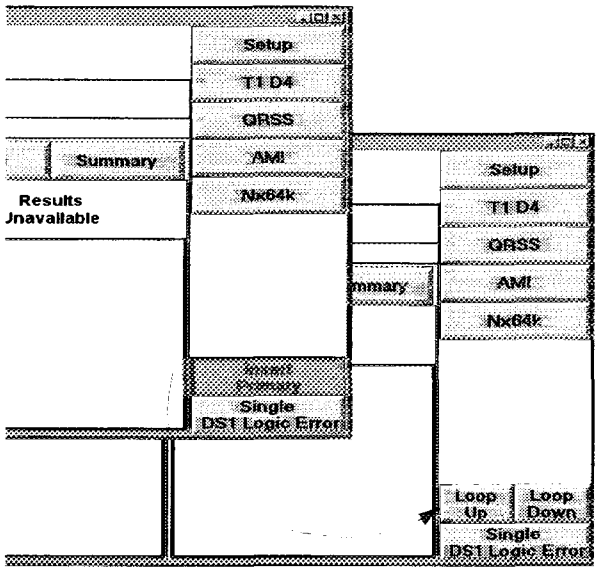
1. Connect a cable from the DS1 PRIMARY and SECONDARY RX jack to the appropriate DSX-1 MON jacks.
2. Connect a cable from the PRIMARY TX jack to the appropriate DSX-1 A-Side IN jack. Immediately insert a 100 ohm terminating plug into the Z-Side OUT jack. *Never insert the terminating plug first.*

NOTE

The PRIMARY TX should face the direction of the device under test.

3. Connect a cable from the SECONDARY TX jack to the appropriate DSX-1 Z-Side OUT jack. Immediately insert a 100 ohm terminating plug into the Z-Side jack. *Never insert the terminating plug first.*

4. Press **Insert Primary.** Then press **Loop Up**.



5. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

6. Verify the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated and the Primary and Secondary Results Displays show RESULTS OK.

7. Press **DS1 Logic Error** Action button five times. Verify five logic errors are received in the Results Display windows.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-6 diagram is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for FT1 Drop and Insert testing.

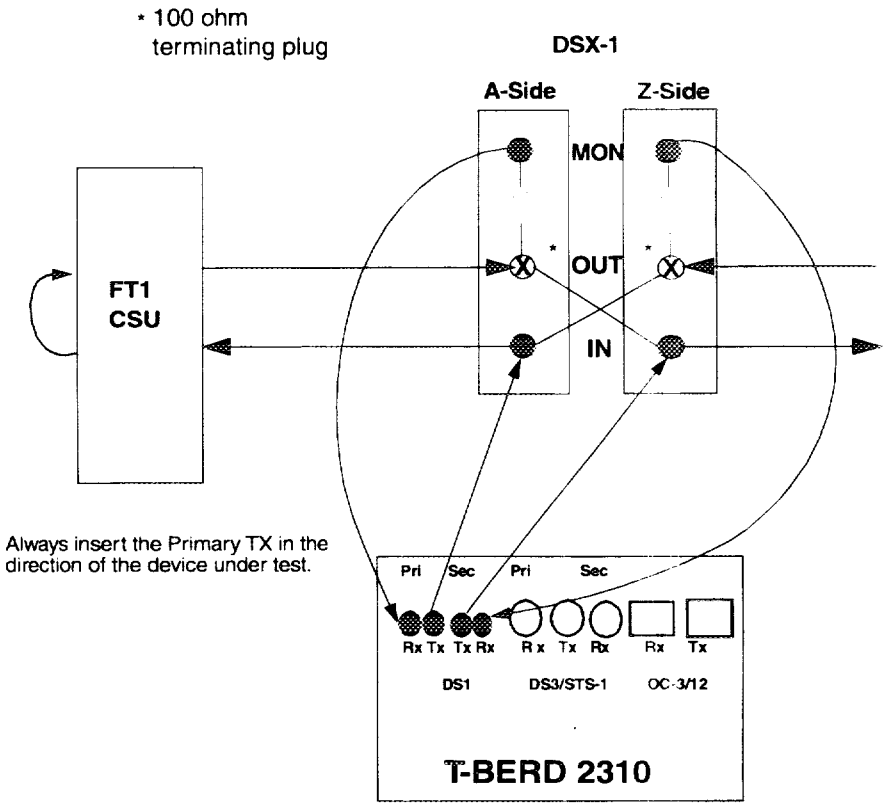


Figure 3-6. Simulation FT1 Drop and Insert Setup

3.4 DDS OPTION

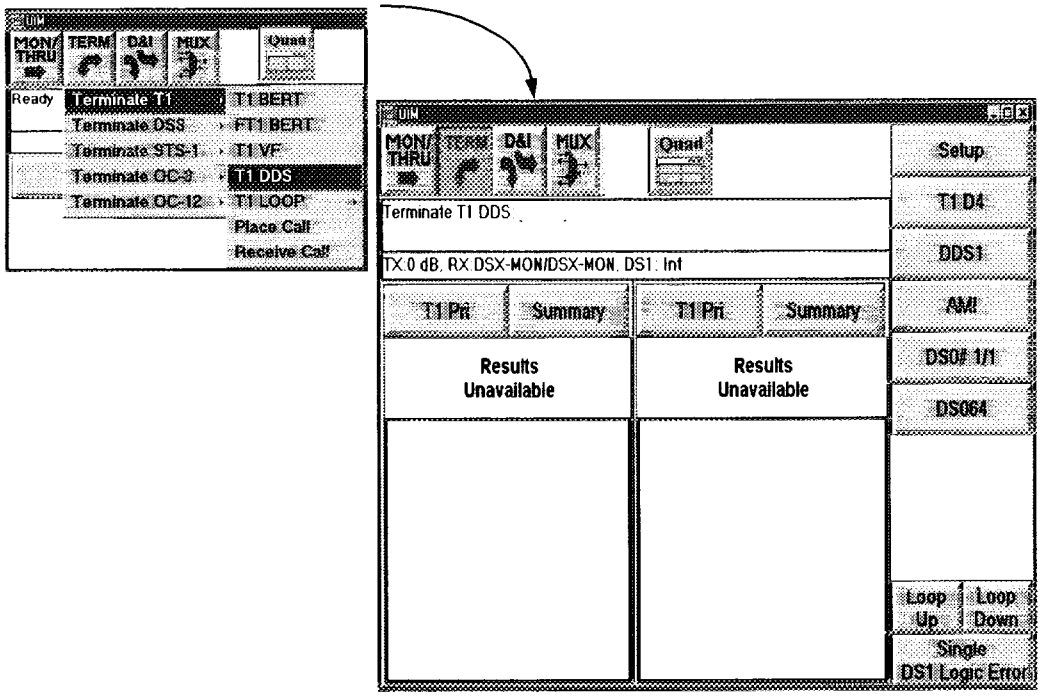
These tests allow you to:

- Test DDS circuits and generate alternating/latching DDS loop codes for sectionalizing and troubleshooting DDS circuits.
- Display the logic states of the received byte for dropped channels for both DDS Primary and Secondary channels.

3.4.1 DDS Loopback BER Testing

Configuring the T-BERD 2310:

1. Select **TERM**. Then, select **Terminate T1,** followed by **T1 DDS** from the pull-down menu. The unit automatically configures to a default setup screen.



4. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

5. Verify the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated and the Primary and Secondary Results Displays show RESULTS OK.
6. Send Bit Errors to verify loop.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-7 diagram is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for DDS Loopback BER testing.

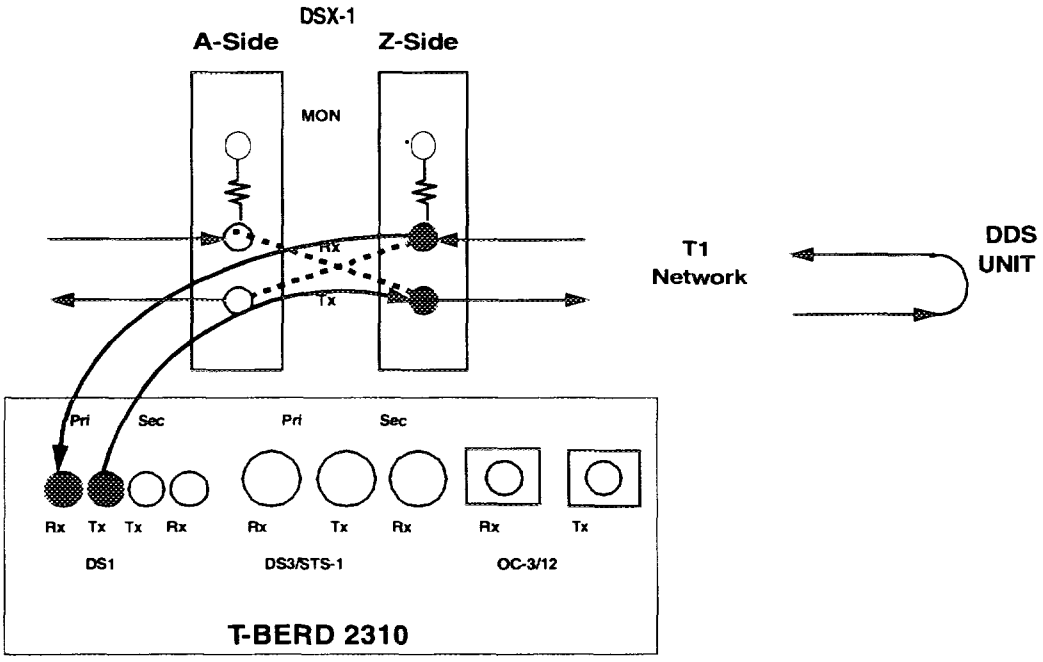
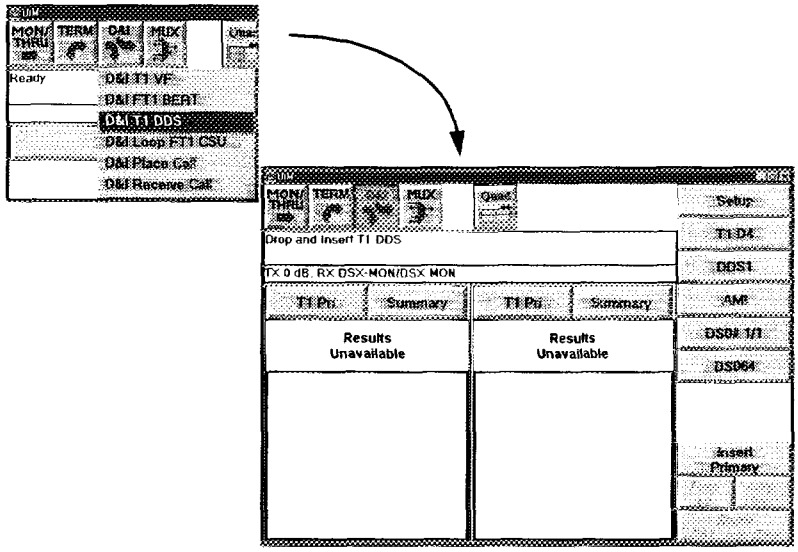


Figure 3-7. Simulation of DDS Loopback BER Test Setup

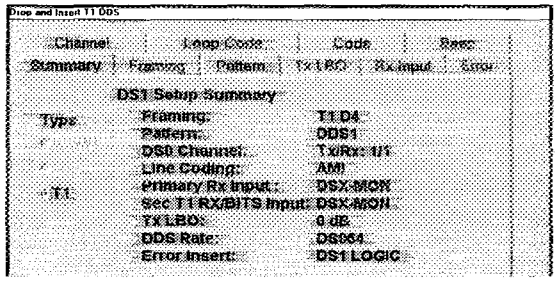
3.4.2 DDS Drop and Insert Testing

Configuring the T-BERD 2310:

1. Press **D&I**. Then, select **D&I T1 DDS** from the pull-down menu. The T-BERD 2310 configures to a default setup.

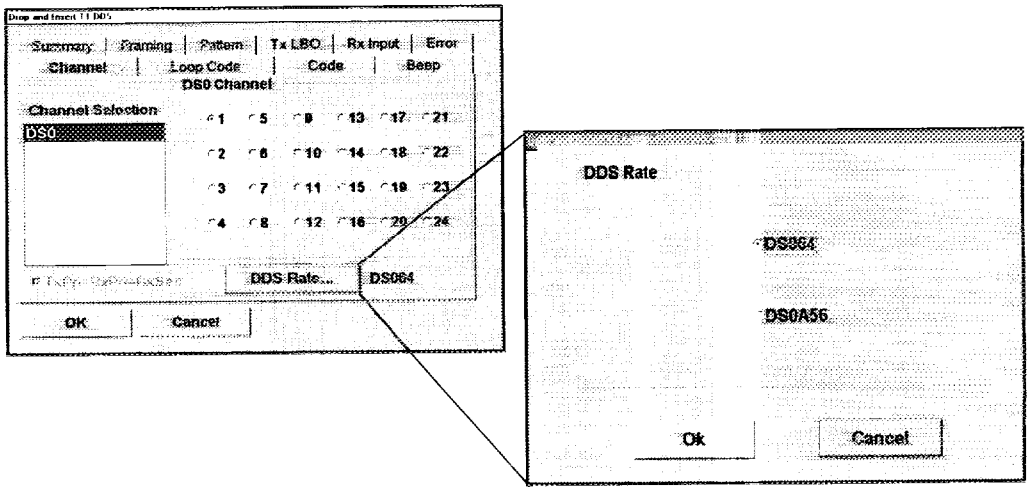


Press **Setup**. Ensure the characteristics shown in the **Summary** property sheet match the network characteristics (such as T1D4, etc.). To change the settings, select the desired tabs in the Property Setup Sheets.



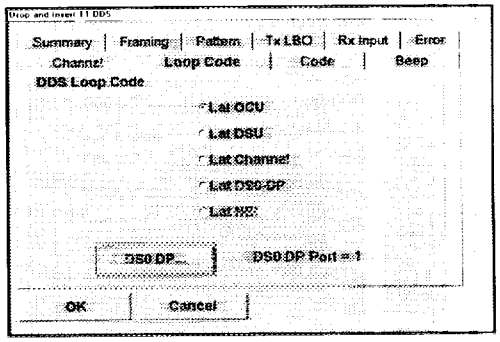
2. Press **Rx Input** tab and select **MON**.
3. Press **Error** tab and select **DS1 Logic**.

4. Press **Channel** tab and select the appropriate DDS channels and rate (DS0A56 or DS064k).



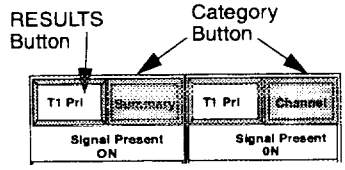
5. Press **OK**.

6. Press **Loop Code** tab and select the appropriate DDS piece of equipment to be looped.



7. Press **OK**.

8. Press one of the buttons labeled T1 Pri in the RESULTS category window and select T1 Pri from the pull-down menu. Set the left Results CATEGORY button to **Summary** and right to **Channel**.



9. Verify the yellow DS1 PRIMARY TX/RX active port LEDs and SECONDARY TX/RX LED are illuminated.

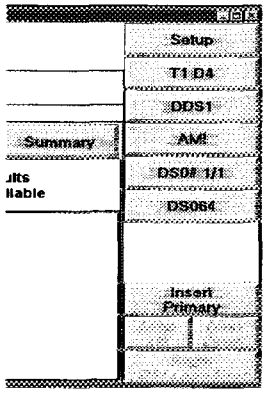
Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS1 PRIMARY and SECONDARY RX jack to the appropriate DSX-1 MON jacks.
2. Connect a cable from the PRIMARY TX jack to the appropriate DSX-1 A-Side IN jack. Immediately insert a 100 ohm terminating plug into the Z-Side OUT jack. *Never insert the terminating plug first.*

NOTE

The PRIMARY TX should face the direction of the device under test.

3. Connect a cable from the SECONDARY TX jack to the appropriate DSX-1 Z-Side OUT jack. Immediately insert a 100 ohm terminating plug into the Z-Side jack. *Never insert the terminating plug first.*
4. Press **Insert Primary** ACTION button, followed by **Loop Up**.



5. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

6. Verify the green PRI DS1 SIGNAL, FRAME, and PATTERN LEDs are illuminated and the Primary and Secondary Results Displays show RESULTS OK.

7. Press **DS1 Logic Error** Action button five times. Verify five logic errors are received in the Results Display windows.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-8 diagram is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for DDS Drop and Insert testing.

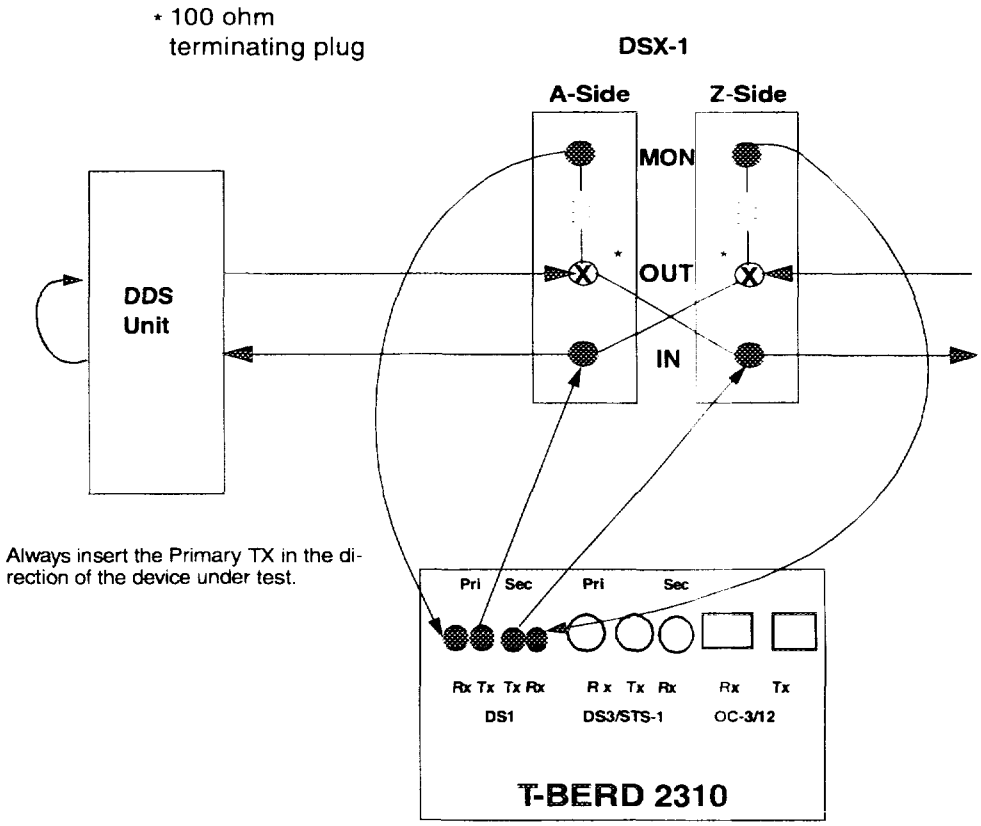


Figure 3-8. Simulation DDS Drop and Insert Setup


Signaling
Option

3.5 SIGNALING OPTION

This option enables you to test the ability of a switch/PBX to handle incoming calls and allows you to emulate switch-to-switch communications. The option allows you to place, receive and monitor calls over several trunk types. Features include: Send/receive DP, DTMF, and MF digits to/from switches and PBXs. Measure inter-digit delay and digit/tone duration.

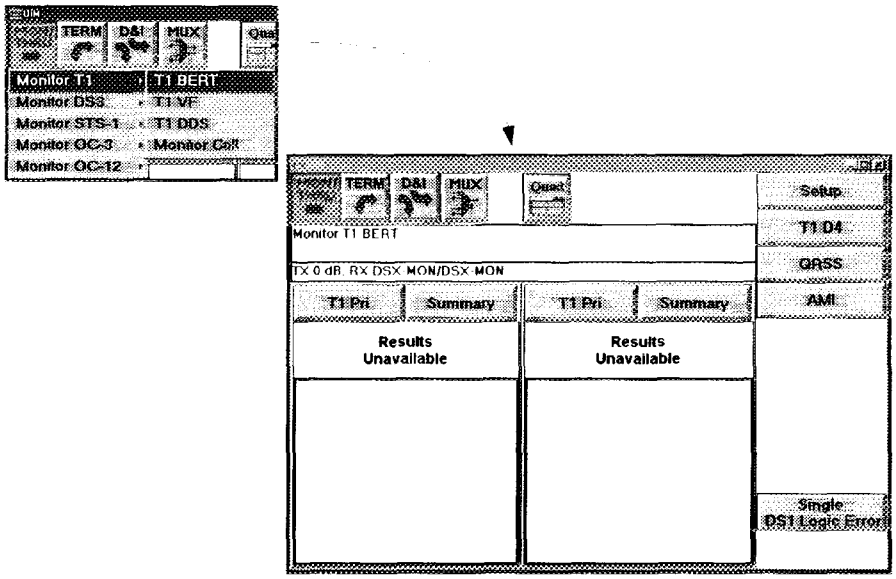
These tests allow you to:

- View the signaling bits for all of the 24 channels for both the Primary and Secondary lines, simultaneously.
- Outlines how to perform Call Capture, Originate a Call, and Terminate a Call.

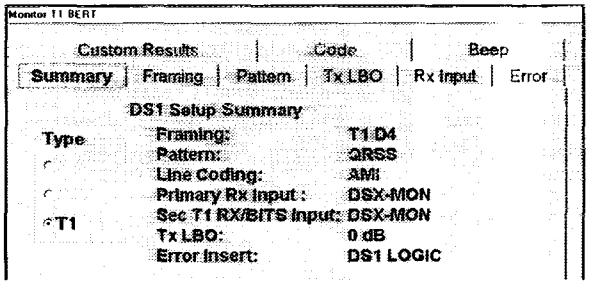
3.5.1 Monitoring A/B/C/D Signaling Bits

Configuring the T-BERD 2310:

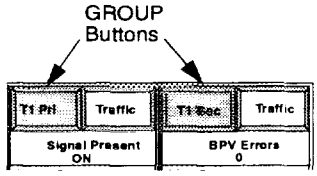
1. Press **Mon/Thru**. Then, select **Monitor T1** and **T1 BERT** from the pull-down menu. The unit automatically configures to a default setup screen.



2. Press **Setup**. Ensure the characteristics shown in the Setup **Summary** Screen match the network characteristics (such as T1D4, etc.). To change settings, select the desired Property Sheet tabs in the Property Setup Sheets.



3. Exit Configuration Setup Screen by pressing **OK**.
4. Set Result GROUP buttons to **T1 Pri** (left) and **T1 Sec** (right).

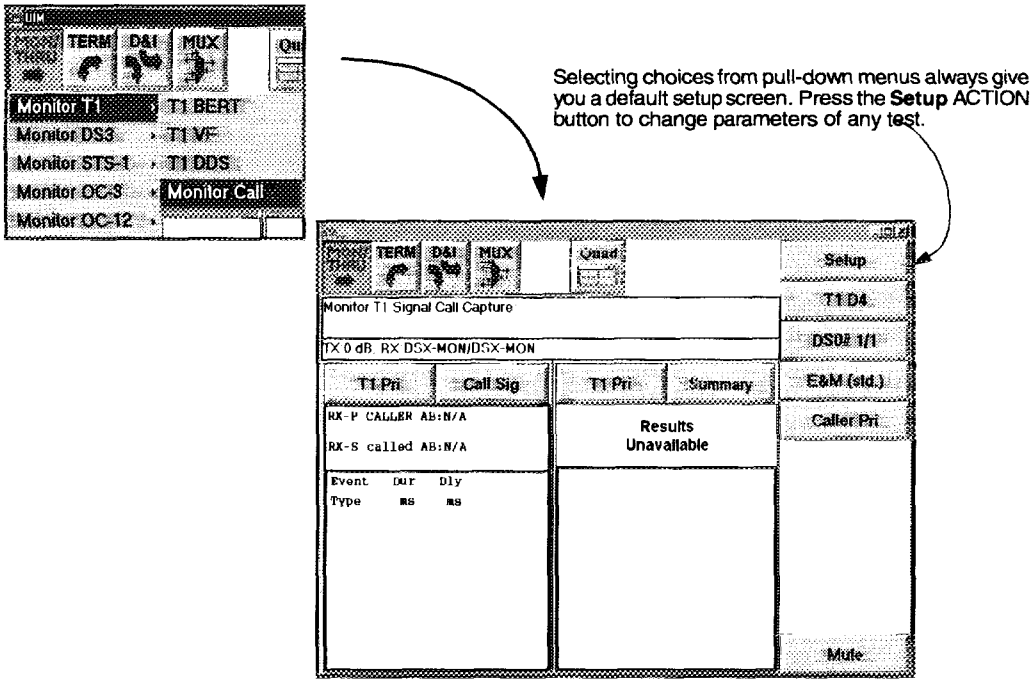


5. Set Result CATEGORY buttons to **Traffic**.
6. Connect two cables, one from the PRIMARY RX jack, and the other from the SECONDARY RX jack to the DSX-1 MON access point.
7. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.
8. Verify the SIGNAL and FRAME LEDs are illuminated. Observe all 24 channels for Primary and Secondary.

3.5.2 Signaling Monitor (Call Capture)

The following procedure outlines how to use the T-BERD 2310 to perform Call Capture. The TB2310-SIG Option is required.

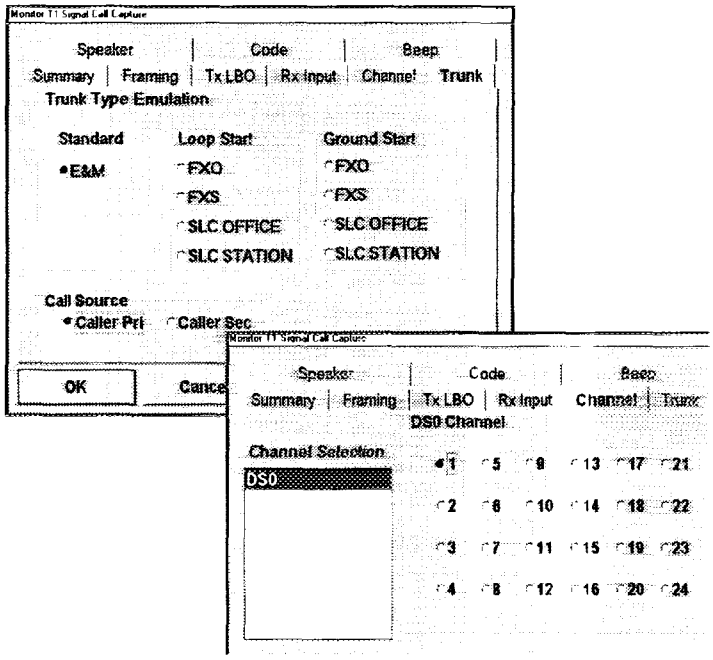
1. Press **MON.** Select **Monitor T1** and then **Monitor Call** from the pull-down menu. The unit automatically configures to a default setup screen.



2. Press **Setup**. Ensure the characteristics shown in the **Summary** Property Setup Screen match the network characteristics. To change the settings, select the desired tabs in the Property Setup Sheets.

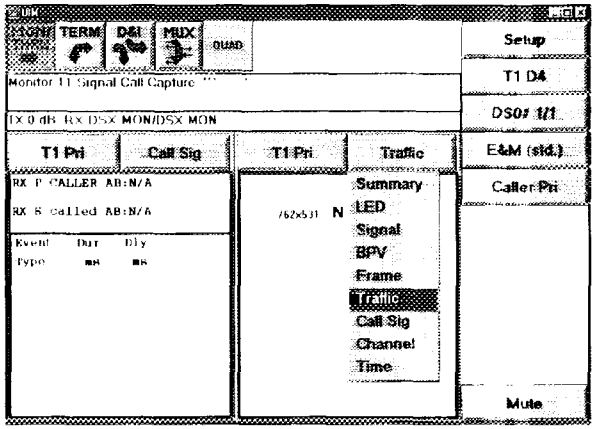
3. Select the appropriate trunk type (e.g., Loop Start, Ground Start, or E&M) using the **Trunk** tab. Select the type of circuit equipment (e.g., SLC office, SLC station, FXO, or FXS) of the source of the call. Select the side from which the call is originating using the **Call Source** button.

4. Select the **Channel** tab and select the DS0 that you want to monitor. Press **OK**.



5. Set both Result GROUP buttons to **Primary**.

6. Set Result CATEGORY buttons to **Call Sig** on the left and **Traffic** on the right.



7. Connect two cables, one from the PRIMARY T1 interface, and the other from the SECONDARY T1 interface to the DS1 test access point (DSX-1 patch panel).

8. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

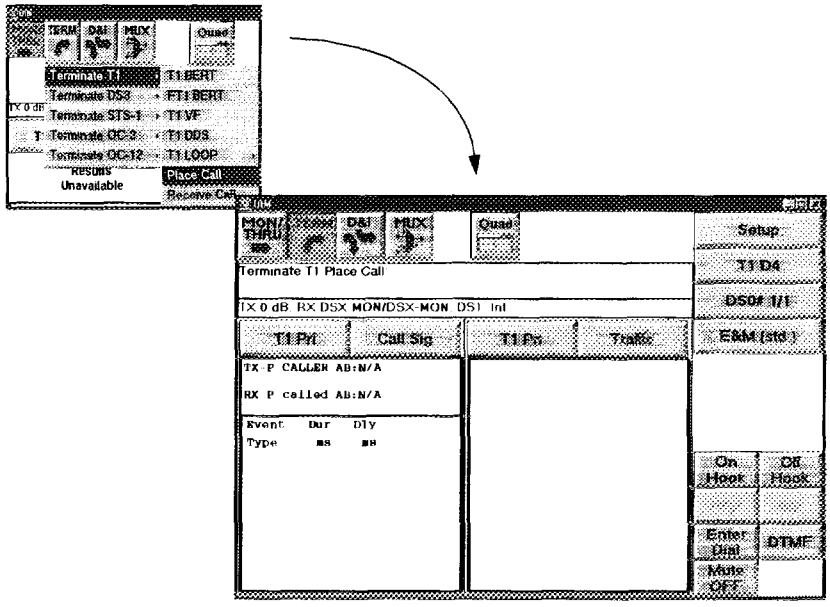
9. Verify the SIGNAL and FRAME LEDs are illuminated (green).

10. Observe the signaling activities in the results display.

3.5.3 PBX/Switch Emulation (Originating a Call)

The following procedure outlines how to use the T-BERD 2310 to place a call. The TB2310-SIG Option is required.

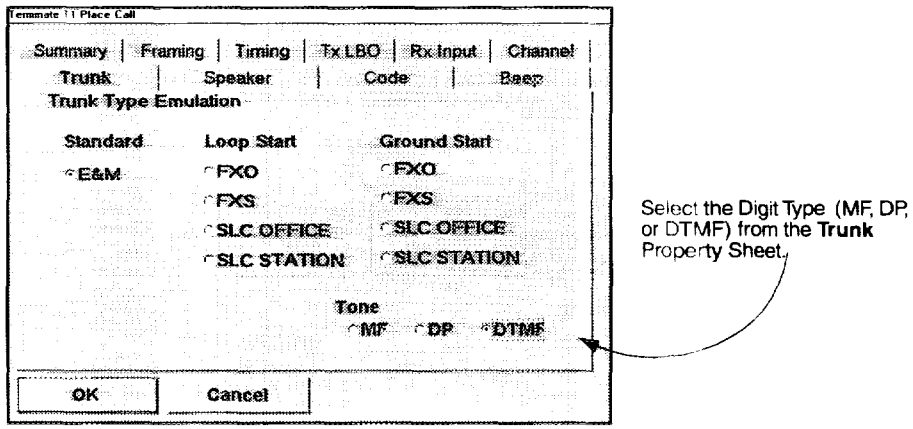
1. Press **TERM**. Select **Terminate T1** and then **Place Call** from the pull-down menus. The unit automatically configures to a default setup screen.



2. Press **Setup**. Ensure characteristics shown in the Setup **Summary** Screen match the network characteristics. To change settings, select the desired Property Sheet tabs in the Property Setup Sheets.

3. Select **Channel** tab in Property Sheet to choose the T1 channel (DS0) on which to transmit the call.

4. Select the appropriate trunk type (e.g., Standard E&M, Loop Start, or Ground Start) using the **Trunk** tab. If Loop Start or Ground Start is selected, choose FX or SLC as circuit type.

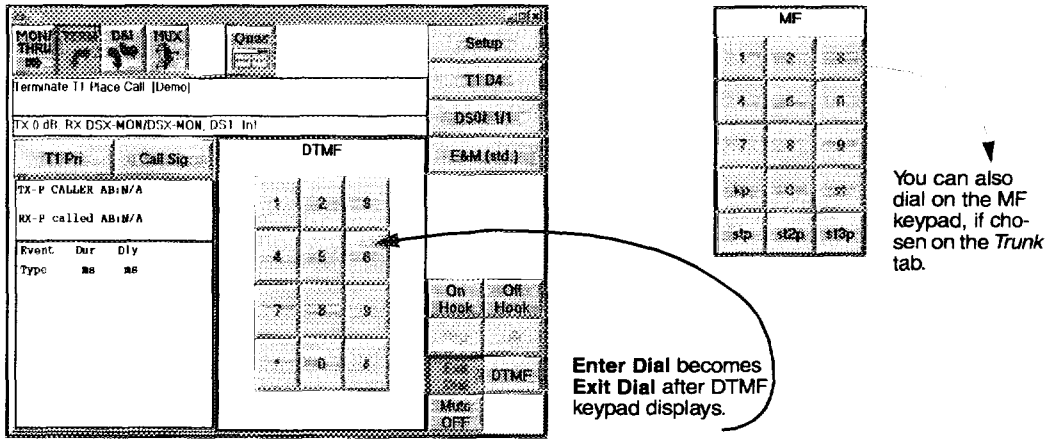


5. Press **OK**.

6. Connect a cable from the PRIMARY RX jack to the OUT jack of the DSX-1. Connect a cable from the PRIMARY TX jack to the IN jack of the DSX-1.

7. Press the **RESTART** Permanent Softkey to clear alarms. Verify the SIGNAL and FRAME LEDs are illuminated (green).

   - Select **Call Sig** Results CATEGORY display beside the Primary Results GROUP selection.
   - Verify that **On Hook** is observed in the **Call Sig** Results CATEGORY.
   - Press the **Off Hook** ACTION button. Verify that **Off Hook** appears in the Results display, followed by either a **WINK** (on standard E&M trunks) or **Dial Tone** (on Loop and Ground Start trunks).
   - Press **Enter Dial** ACTION button to display the signaling keypad.

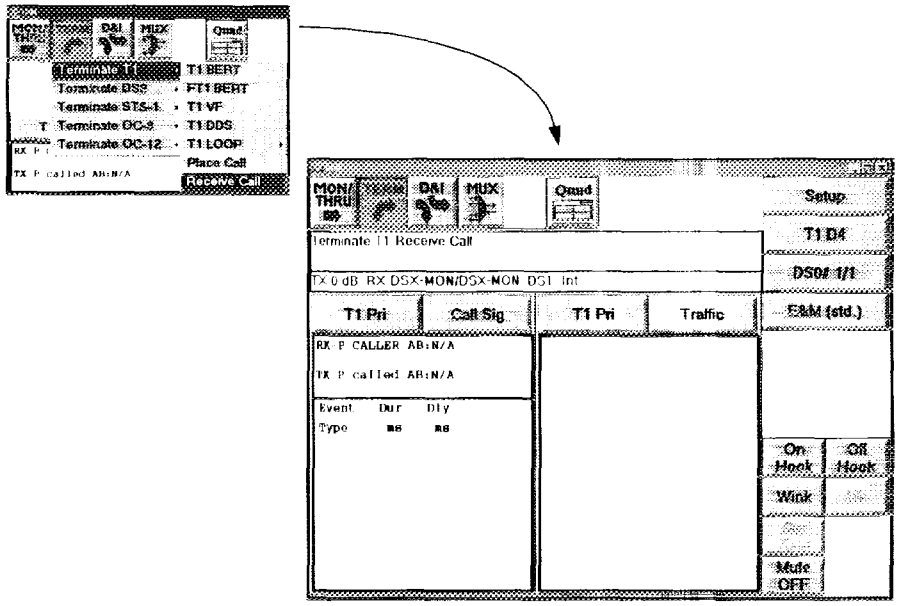


8. Dial test number on the numeric keypad. Press the **Push 2 Talk** button or use the handset when you want to talk into the T-BERD 2310 (keep button pressed while talking).
9. Press **On Hook** to complete the call.
10. Select **DS0# X/X** Quick Configuration key to select another DS0 channel to test.

3.5.4 PBX/Switch Emulation (Terminating a Call)

The following procedure outlines how to use the T-BERD 2310 to terminate or receive a call. The TB2310-SIG Option is required.

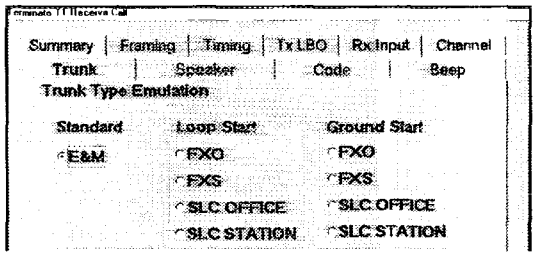
1. Press **TERM**. Then, select **Terminate T1,** then **Receive Call** from the pull-down menu. The unit automatically configures to a default setup screen.



2. Press **Setup**. Ensure characteristics shown in the Setup **Summary** Screen match the network characteristics. To change settings, select the desired Property Sheet tabs in the Property Setup Sheets.

3. Select **Channel** tab in Property Sheet to choose the T1 channel (DS0) on which to receive the call.

4. Select the appropriate trunk type (e.g., Standard, Loop Start, or Ground Start) using the **Trunk** tab. If Loop Start or Ground Start is selected, choose FX or SLC as circuit type. Press **OK**.



5. Connect a cable from the PRIMARY TX jack to the IN jack of the DSX-1. Connect a cable from the PRIMARY RX jack to the OUT jack of the DSX-1.

6. Press the **RESTART** Permanent Softkey to clear alarms. Verify the SIGNAL and FRAME LEDs are illuminated (green).

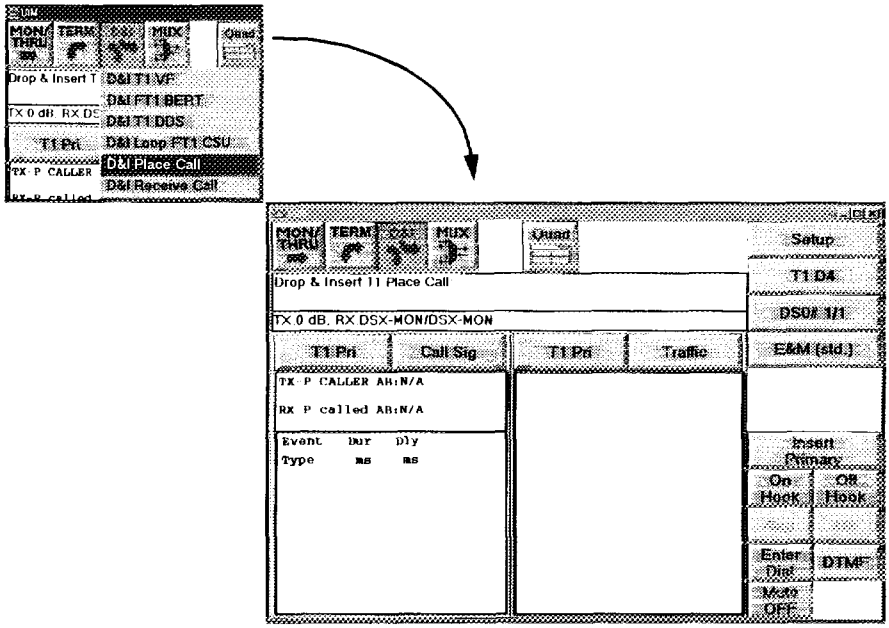
7. Select **Call Sig** Results CATEGORY display beside the Primary Results GROUP selection. Verify that **On Hook** and **Off Hook** are observed in **Call Sig** Results CATEGORY display.

8. Observe call sequence events as the call is established.

3.5.5 T1 Drop and Insert Setup (Place Call)

The TB2310-SIG Option is required for this D&I (drop and insert) test.

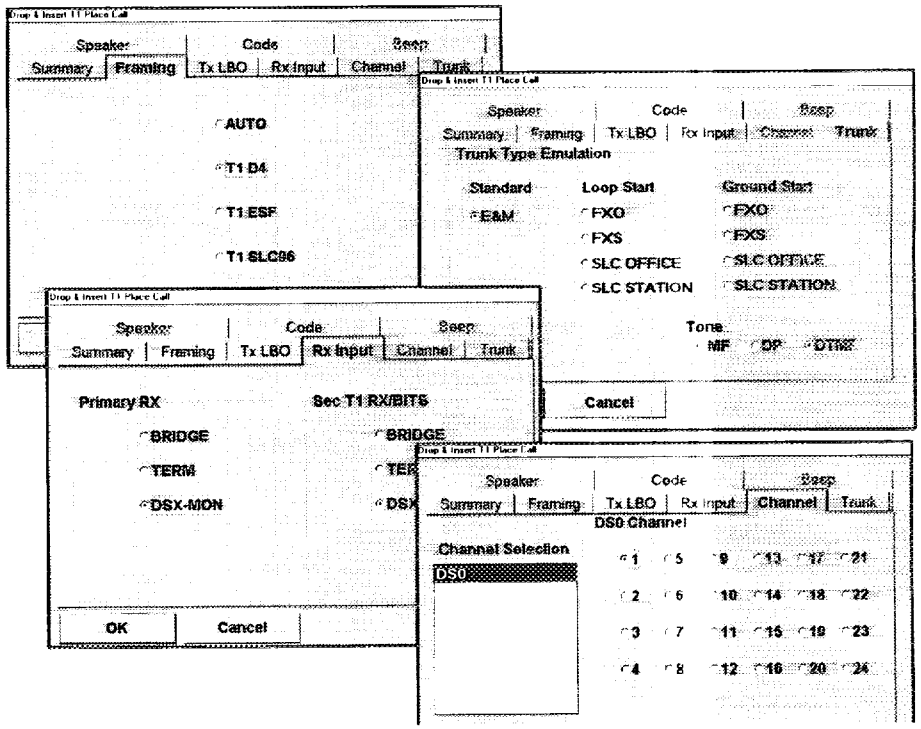
1. Select **D&I**. Then, select **D&I Place Call** from the pull-down menu. The T-BERD 2310 configures to a default setup.



2. Press **Setup**. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics.

3. To change baseline settings, select the desired Property Sheet tabs in the Property Setup sheets. Select appropriate T1 **Framing**, **Code**, **Rx Input**, and **Channel** to appropriate settings.

4. Select **Trunk** tab. Select the appropriate trunk type (standard E&M, Loop Start, Ground Start). If Loop Start or Ground Start is selected, choose FXS or SLC as the type of card emulation. Remember to also select the appropriate digit type (MF, DP, or DTMF). Press **OK**.



5. Connect a cable from the PRIMARY RX jack to the appropriate DSX-1 A-Side MON jack (see Figure 3-9).
6. Connect a cable from the Secondary RX jack to the appropriate DSX-1 Z-side MON jack (see Figure 3-9).
7. Simultaneously, connect a cable from the Primary TX jack to the appropriate DSX-1 A-side IN jack (see Figure 3-9) while inserting a 100 ohm terminating plug into the DSX-1 Z-side OUT jack. *Never insert the terminating plug first.*

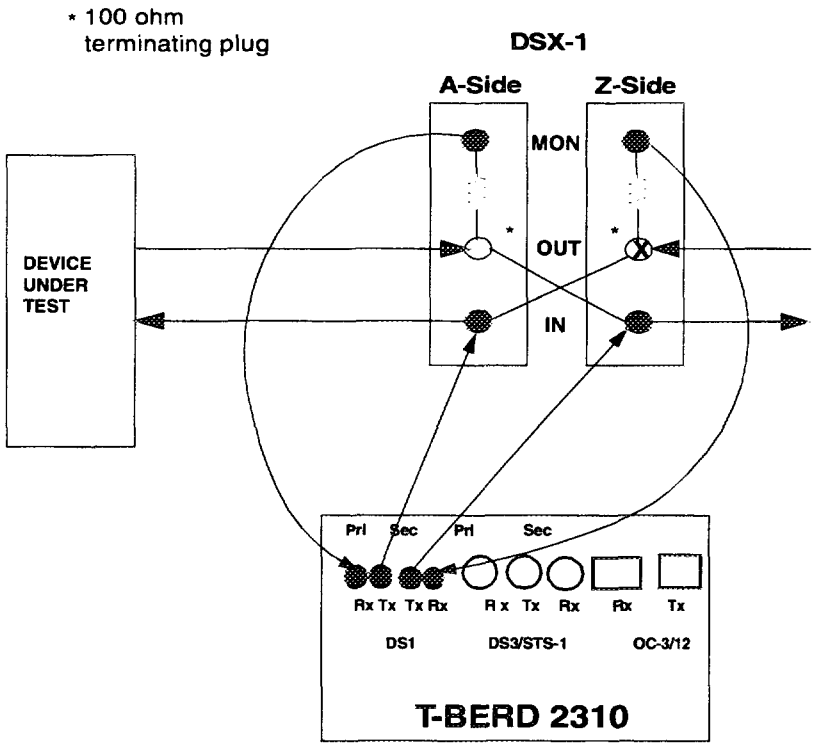


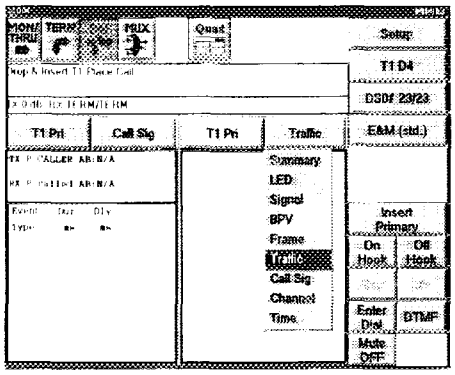
Figure 3-9. Simulation Drop and Insert Setup

8. Press the **RESTART** Permanent Softkey to clear alarms.

   Verify the Primary and Secondary SIGNAL and FRAME LEDs are illuminated and the Primary and Secondary Results display shows RESULTS OK (under **Summary** CATEGORY).

9. Press the **Insert Primary** and **Enter Dial** ACTION buttons to bring up the numerical keypad.

10. Select **Call Sig** in left Results CATEGORY display and **Traffic** in right Results CATEGORY. Verify that **ON Hook** is observed in the **Call Sig** Results CATEGORY.



ACTION buttons enable variances in testing. Use them for **ON Hook**, **Off Hook**, **Ring**, **Idle**, access to the Keypad (**Enter** Dial), and **Mute**.

11. Press the **Off Hook** ACTION button. Verify that **Off Hook** appears in the Results display, followed by either a **WINK** (on standard E&M trunks) or **Dial Tone** (on Loop and Ground Start trunks).
12. Dial test number on the numeric keypad.
13. Press **ON Hook** to complete the call.
14. Select **DS0# X/X** Quick Configuration key to select another DS0 channel to test.
15. Repeat procedures from Step 11 to continue testing remaining DS0 channels.
16. Disconnect from the circuit in the reverse order to prevent service disruption.

3.6 VF OPTION

The following procedure outlines how to use the T-BERD 2310 to monitor DS0 (VF) channels out of a DS1 signal. The TB2310-TIM Option is required.

These tests allow you to:

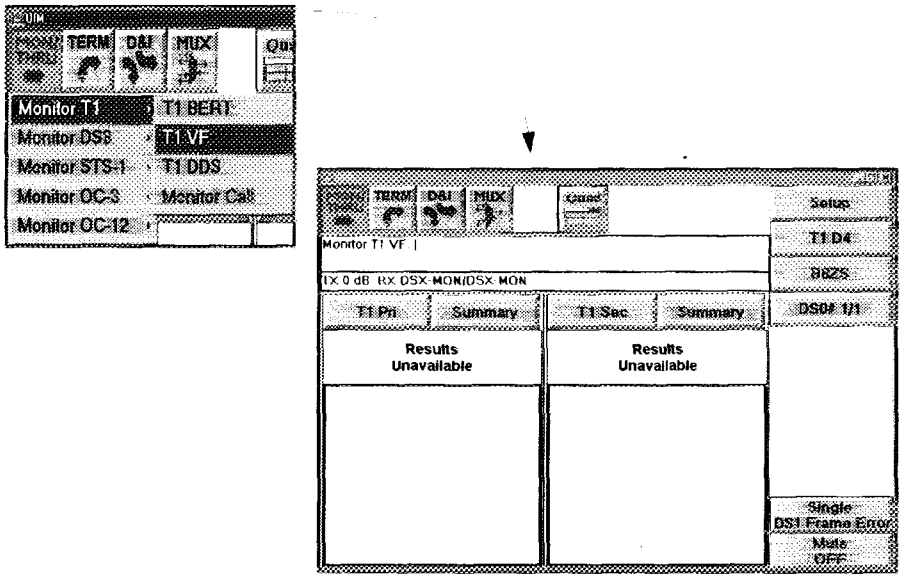
- Qualify voice-grade VF circuits by measuring Signal-to-Noise ratio (S/N), C-Message, and C-Notch.
- Qualify data-grade VF circuits with the 3 kHz Flat, and 3 kHz Notch filters.
- Perform automated frequency sweeps.

3.6.1 VF Channel Drop/Monitor Setup

The following procedure outlines how to use the T-BERD 2310 to drop and monitor DS0 (VF) Channels out of a DS1 signal.

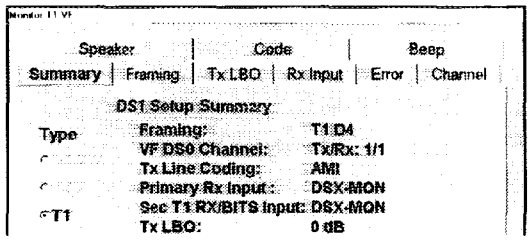
Configuring the T-BERD 2310:

1. Press **MON/THRU**. Then, select **Monitor T1** from the pull-down menu, followed by **T1 VF**. The unit automatically configures to a default setup.



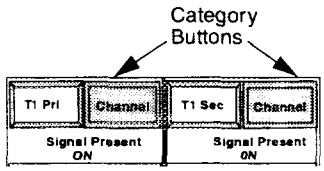
2. Press **Setup**. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics (such as AMI, etc.), as well as the desired VF/DS0 channel.

   To change the settings, select the desired tabs in the Property Setup Sheets.



3. Press **OK**.

4. If monitoring a second line, press one of the buttons labeled **T1 PRI** in the Results GROUP window and select **T1 Sec** from the pull-down menu. Set both Results CATEGORY buttons to **Channel**.



5. Verify the yellow active port LEDs next to the DS1 PRIMARY RX and SECONDARY RX jacks are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS1 RX jack to the appropriate monitor point.

2. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

3. Verify the green SIGNAL and FRAME LEDs are illuminated and the Primary and Secondary Results displays show RESULTS OK.

4. Press **DS0# X/X** Quick Configuration button to change the channel that is dropped to the speaker if you want to test another channel.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-10 depicts a diagram sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for a DS0 (VF) Drop/Monitor test.

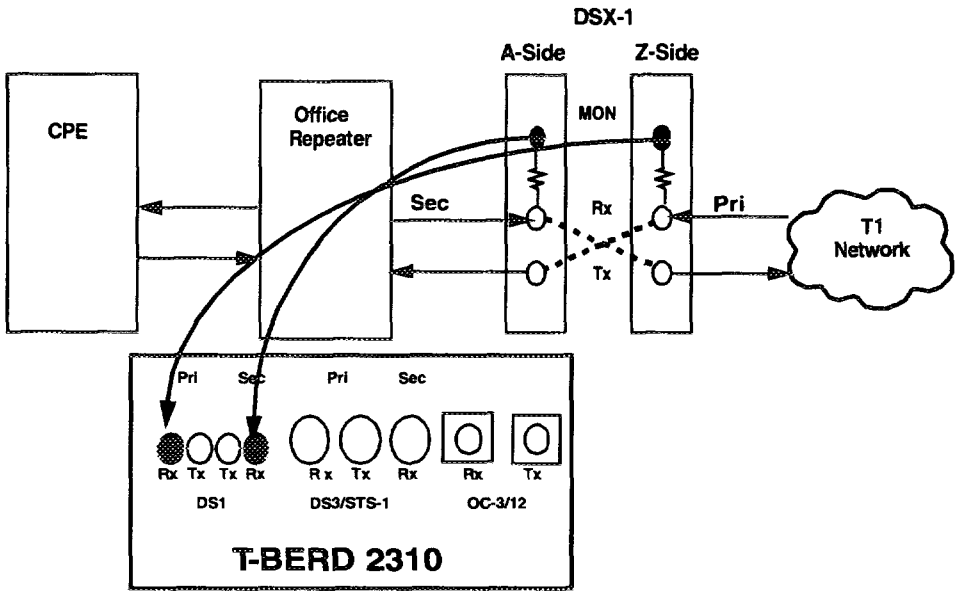
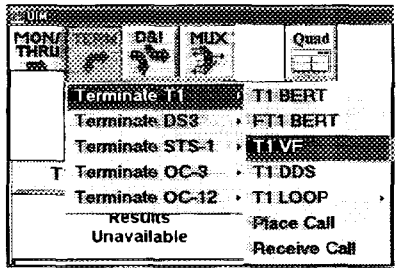


Figure 3-10. Simulation of DS0 (VF) Drop/Monitor Test Setup

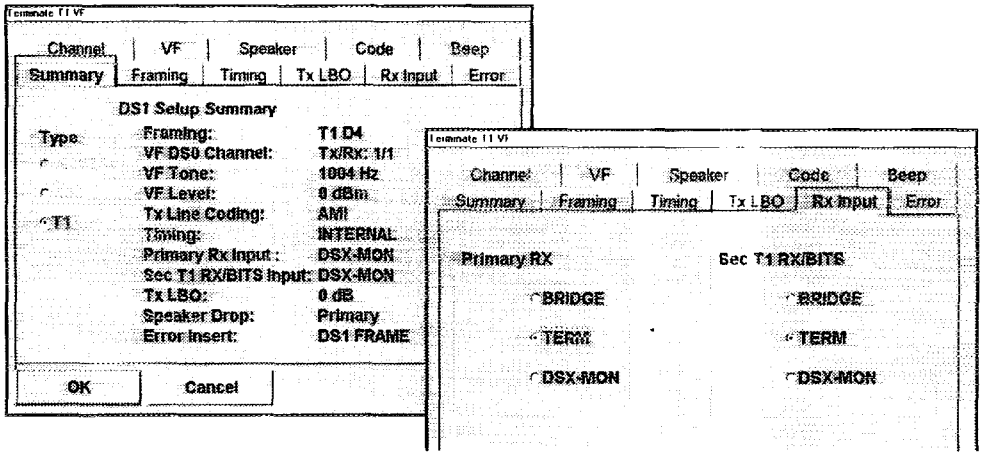
3.6.2 Transmitting VF Tones

Configuring the T-BERD 2310:

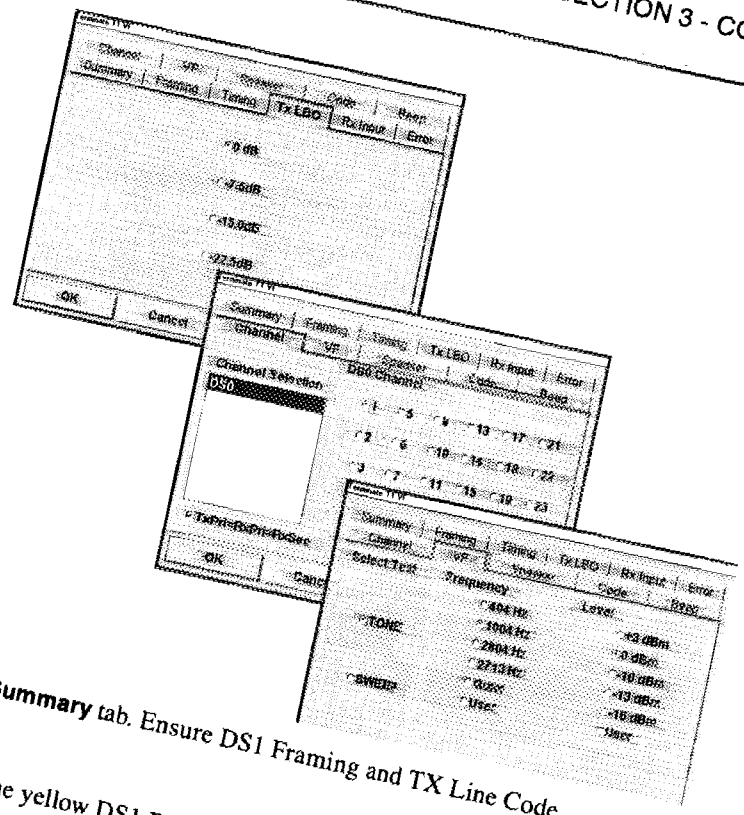
1. Press **TERM**. Then, select **Terminate T1** from the pull-down menu, followed by **T1 VF**. The unit automatically configures to a default setup.



2. Press **Setup**. From the **Summary** window, select the **RX Input** tab and select **TERM**.



3. Press the **Tx LBO** tab and select the appropriate dB level.
4. Press the **Channel** tab and select the appropriate channel to transmit tone.
5. Press the **VF** tab and select tone to be transmitted.
6. Press the **Timing** tab and set timing to **Internal**.



7. Press the **Summary** tab. Ensure DS1 Framing and TX Line Code.
8. Press **OK**.
9. Verify that the yellow DS1 PRIMARY TX and RX active port LEDs are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS1 PRIMARY RX jack to the appropriate DSX-1 RX (OUT) jack.
2. Connect a cable from the DS1 PRIMARY TX jack to the appropriate DSX-1 TX (IN) jack.
3. Loop the end of the network to be tested.
4. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

5. Verify the green PRI DS1 SIGNAL, and FRAME LEDs are illuminated.
6. If the Primary DS1 signal is free of errors, the SUMMARY Results displays All RESULTS OK.

7. Press **DS0# X/X** Quick Configuration button to change the channel that is dropped to the speaker if you want to test another channel.

NOTE

To adjust the volume level, press the File Cabinet Permanent Softkey and select the Speaker tab.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-11 is a sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310 for VF Tone Insertion testing.

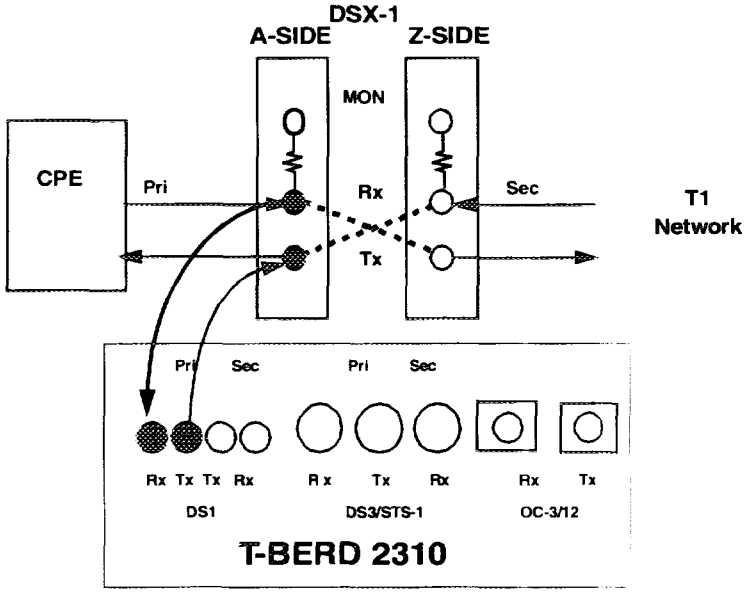


Figure 3-11. Simulation of VF Tone Insertion Setup


Intelligent
Repeater
Span Option

3.7 INTELLIGENT REPEATER SPAN OPTION

The following test application provides an example of how you can sectionalize addressable repeater spans by transmitting appropriate pre-programmed loop codes from the C.O. (central office).

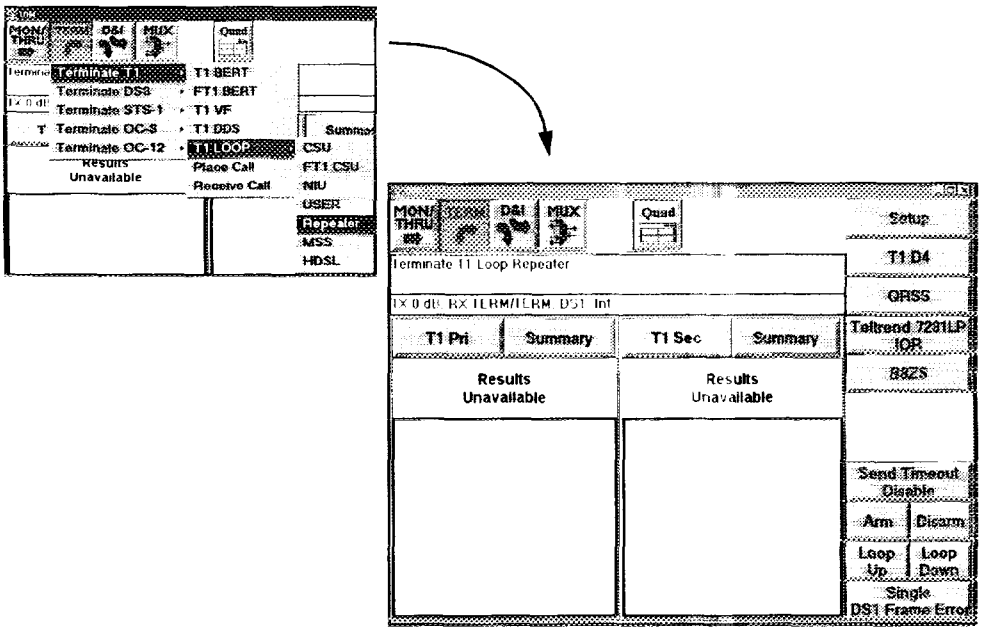
The Intelligent Repeater Span Option option provides the intelligent span equipment loop codes used to loop up and loop down individual, addressable, office repeaters and line repeaters, or to transmit maintenance switch commands.

The following devices can be armed, disarmed, queried, and looped back when the TB2310-ILE option is installed.

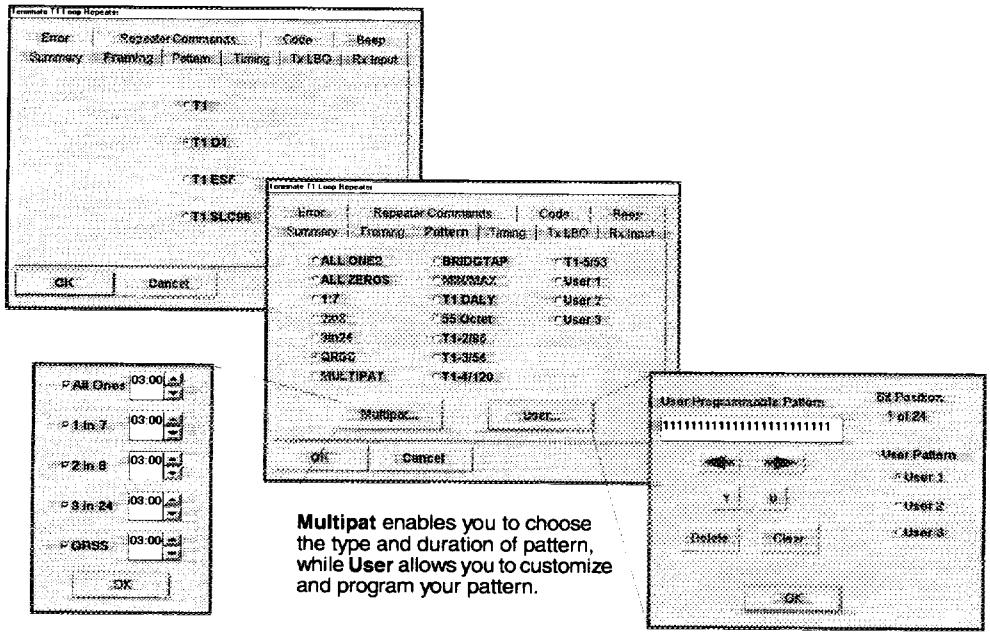
- Teltrend Model 7231LP IOR/ 7239LP ILR Intelligent Repeaters
- Teltrend Model 9132LP IHR Intelligent Repeater
- Teltrend Model 7231LW IOR / 7239LW ILR Intelligent Repeaters
- Teltrend Model 9132LW IHR Intelligent Repeater
- Westell 3130-80 IOR Intelligent Repeater
- Westell 3150-80 ILR Intelligent Repeater
- Westell 3150-81 ILR Intelligent Repeater
- Westell 3150-56 ILR Intelligent Repeater
- Westell 3151-56 ILR Intelligent Repeater
- Westell 3130-56 IOR Intelligent Repeater
- XEL 7853-200 ILR Intelligent Repeater
- Westell 3171 T1 Network Interface and Maintenance System (60 Series)

This test allows you to qualify T1 circuit error performance by testing for logic errors, BPVs, and frame errors (if applicable) on T1 spans.

1. Select **TERM**. Then, select **Terminate T1** followed by **T1 Loop**, and lastly, **Repeater** from the pull-down menu. The unit automatically configures to a default setup screen.



2. Press **Setup**. Ensure the characteristics shown in the Summary setup screen match the network characteristics. To change settings, select the desired tabs in the Property Setup Sheets. *Make sure you select the* **Receive Input** *Tab and select TERM for each receiver for this test.*
3. Select proper **Framing** (AUTO, T1, T1D4, T1 ESF, or T1 SLC96).
4. Select appropriate **Pattern**.

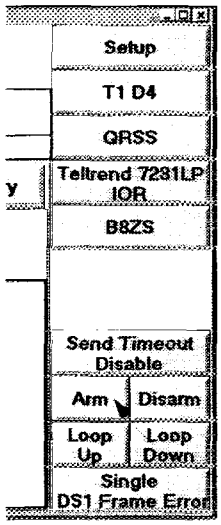


5. Set **Tx Coding** as appropriate (B8ZS or AMI).
6. Set **Timing** to INTERNAL if emulating central office equipment. Set Timing to RECOVERED (loop) if emulating customer premises equipment.
7. Set **Tx LBO** to appropriate value (typically 0 dB).
8. Set **Rx Input** to TERM.
9. Set **Error** to DS1 LOGIC.
10. Set **Insertion Type** to SINGLE.
11. Press **OK**.

Connecting the T-BERD 2310 to the Circuit

1. Connect a cable from the PRIMARY TX jack to the appropriate DSX-1 IN jack.
2. Connect a cable from the PRIMARY RX jack to the appropriate DSX-1 OUT jack.

- Press the **Arm** button.



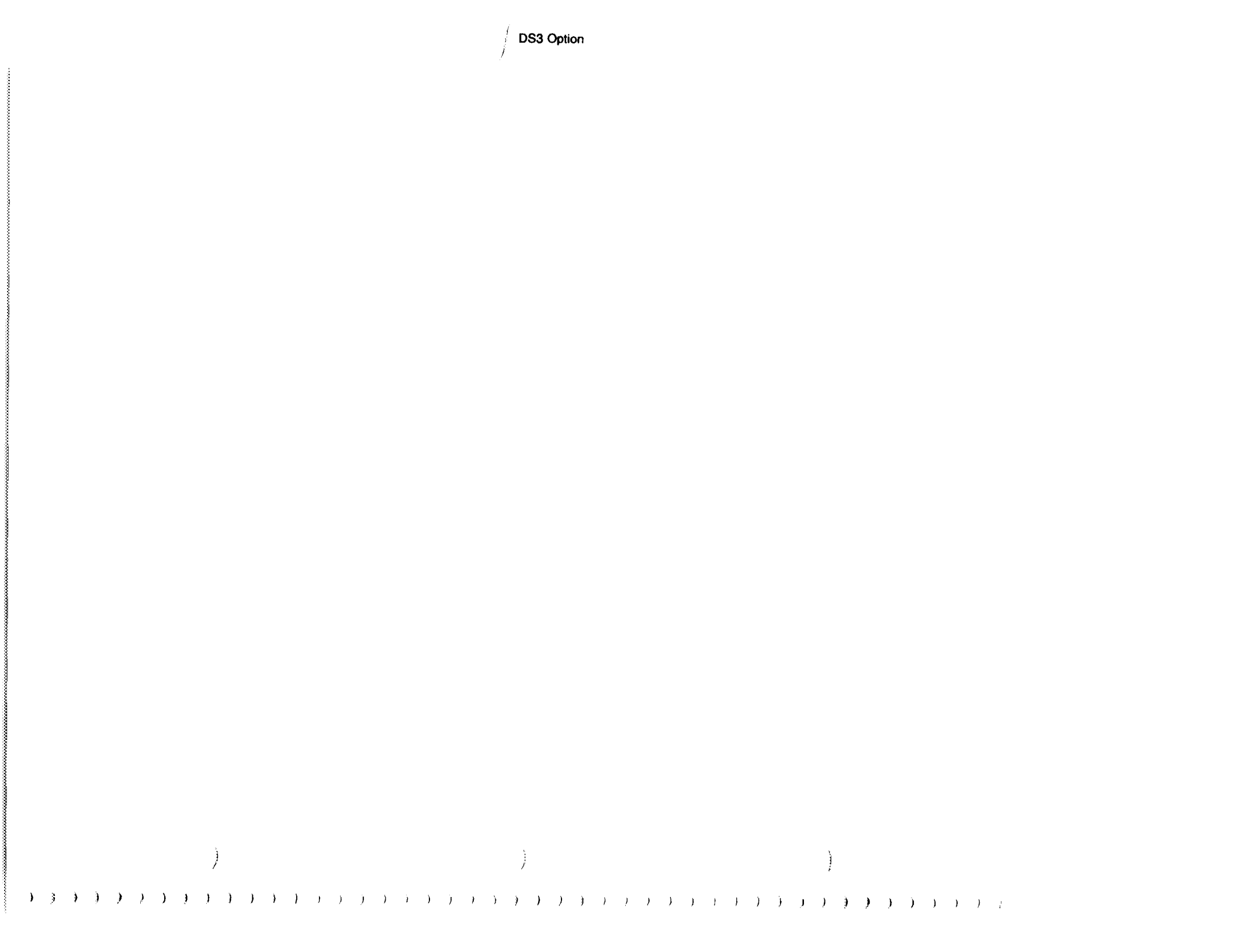
Pressing the **Arm** ACTION button equips the T1 Span.

- Press **Loop Up**.

3. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

Verify the Primary SIGNAL, FRAME, and PATTERN LEDs are illuminated and the Primary Results display shows RESULTS OK.

4. Insert one or two errors by pressing the **Start DS1 Logic Error** ACTION button to verify connectivity.


DS3 Option

3.8 DS3 OPTION

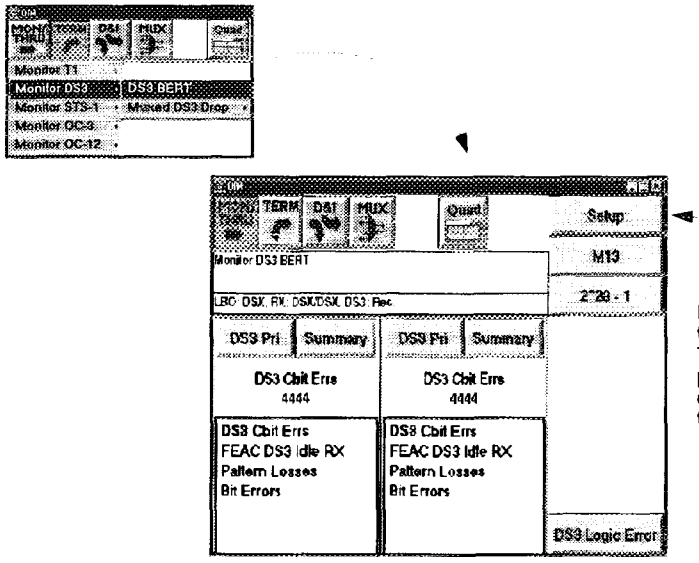
This option adds DS3 testing to the already extensive DS1/DS0 testing capabilities of the T-BERD 2310. Without adding any size to the existing test set, this option lets one qualify DS3 circuits with BERT patterns for both M13 and C-bit framing, insert patterns on one or all DS3 channels, drop DS1 and DS0 channels from DS3 signals to test and monitor, and verify frame synchronization on DS3 lines.

3.8.1 Monitoring DS3 Performance

The following procedure outlines how to setup the T-BERD 2310 to monitor DS3 signals.

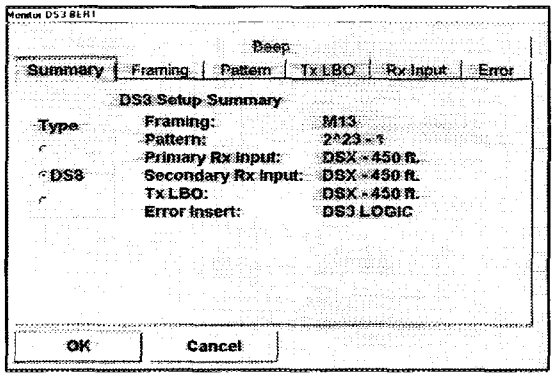
Configuring the T-BERD 2310:

1. Press **MON/THRU**. Then, select **Monitor DS3** from the pull-down menu, followed by **DS3 BERT**. The unit automatically configures to a default setup for the chosen application.



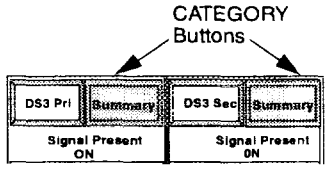
Initial Setup Screen for DS3 Monitor Testing. You can press **Setup** to change configurations.

2. Press **Setup**. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics.
3. To change these default settings, select the desired tabs in the Property Setup Sheets.



Property Setup Tabs for DS3 Monitor Testing. You can press any tab to change configurations.

4. Press **OK**.
5. If monitoring a second signal, press one of the buttons labeled **DS3 PRI** in the Results GROUP window and select **DS3 Sec**. Set both CATEGORY buttons to **Summary**.



6. Verify the yellow active port LEDs next to the DS3 PRIMARY RX and SECONDARY RX jacks are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS3 PRIMARY RX jack to the DSX-3 A-SIDE MON jack.
2. Connect a cable from the DS3 SECONDARY RX jack to the DSX-3 Z-SIDE MON jack.
3. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

4. Verify the green SIGNAL and FRAME LEDs are illuminated and the Primary and Secondary Results displays show RESULTS OK.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-12 depicts a diagram sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310.

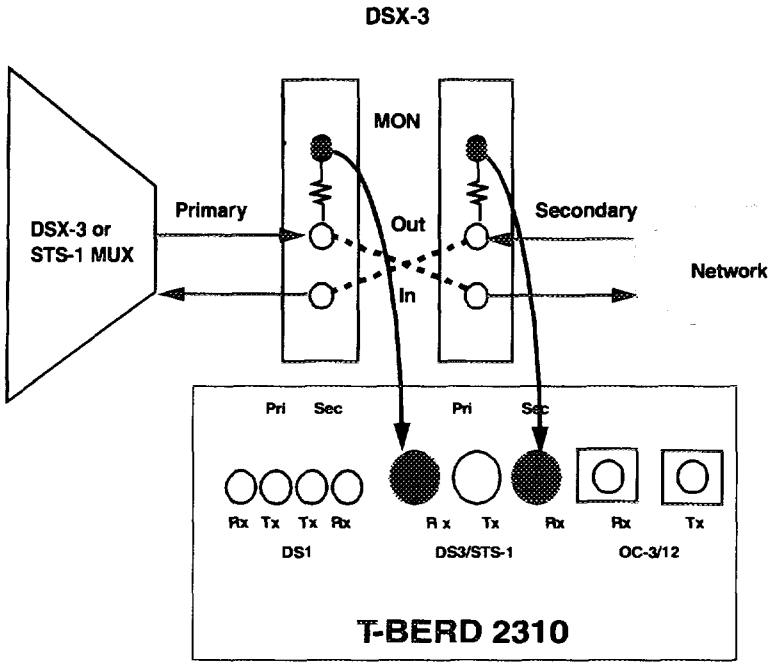
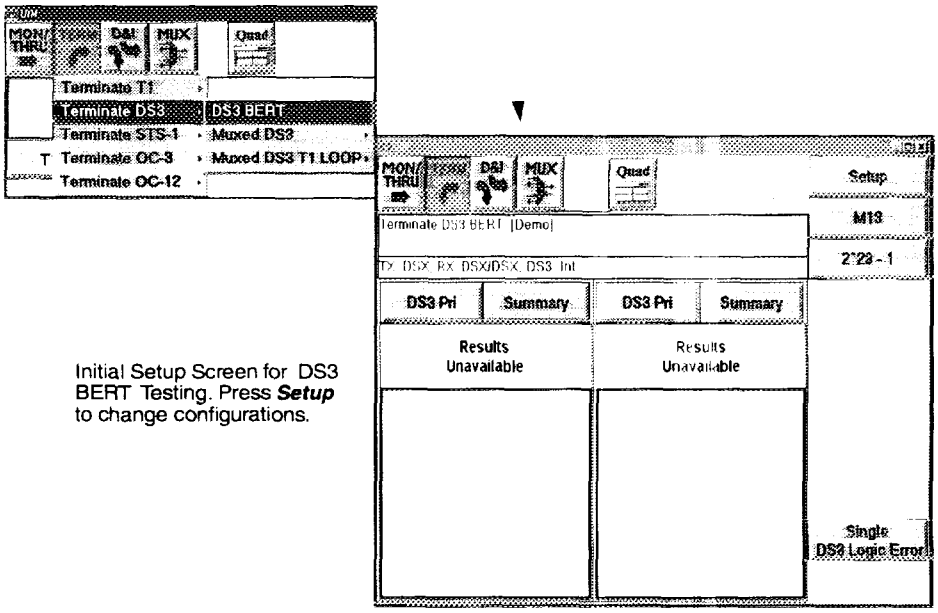


Figure 3-12. Simulation of DS3 Monitor Test Setup

3.8.2 DS3 BER Testing

Configuring the T-BERD 2310:

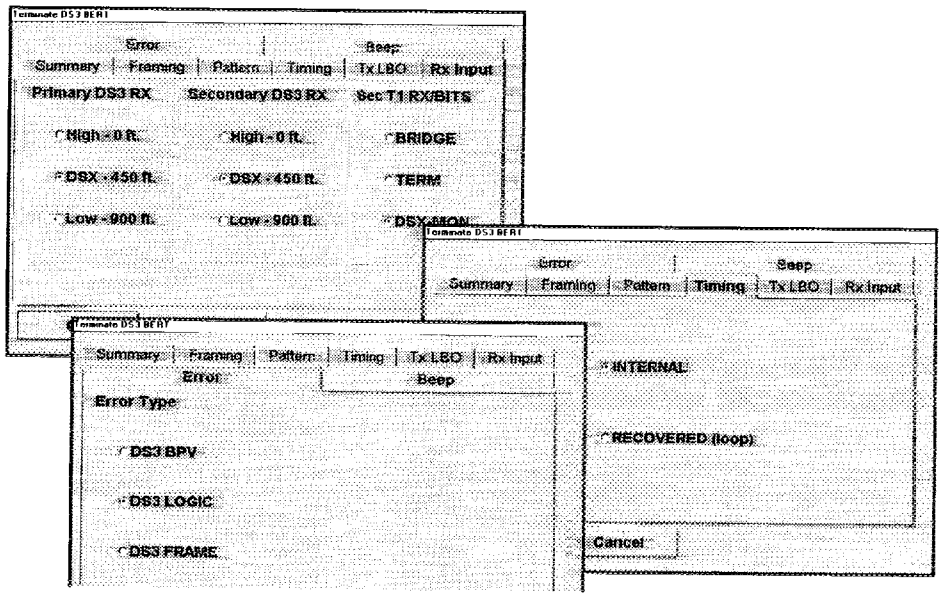
1. Press **TERM**. Then, select **Terminate DS3** from the pull-down menu, followed by **DS3 BERT**. The unit automatically configures to a default setup.



Initial Setup Screen for DS3 BERT Testing. Press ***Setup*** to change configurations.

2. Press **Setup**. The **Summary** Property Sheet displays.
3. Press the **Tx LBO** tab and select the appropriate level. (DSX-450 ft. if accessing from DSX-3)
4. Press the **Rx Input** tab and select the appropriate **Receiver Input** (DSX-450 ft. if accessing from DSX-3).
5. Press the **Timing** tab and select **Internal**.

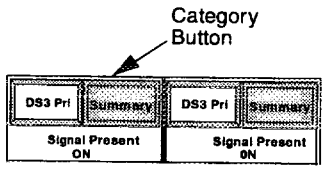
6. Press the **Error** tab and select **DS3 Logic**.



7. Press the **Summary** tab. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics and test to be performed.

8. Press **OK**.

9. Set the Results CATEGORY button to **Summary**.



10. Verify the yellow DS3 PRIMARY RX and TX active port LEDs are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS3 PRIMARY RX jack to the appropriate side of the DSX-3 RX (OUT) jack.

2. Connect a cable from the DS3 PRIMARY TX jack to the appropriate DSX-3 TX (IN) jack.

3. Loop back the far-end DSX-3.

4. Press **RESTART** to clear alarms and begin the test.

5. Verify the green PRI DS3 SIGNAL, FRAME, and PATTERN LEDs are illuminated and the SUMMARY Results displays RESULTS OK.

6. Press the **Logic Error Insert** ACTION button five times. Ensure five logic errors are received in the Results Summary.

Connecting the T-BERD 2310 to the Circuit Diagram:

Figure 3-13 is a sample depiction of cable connections from the DSX-3 panel to the inputs on the T-BERD 2310 for DS3 Termination testing.

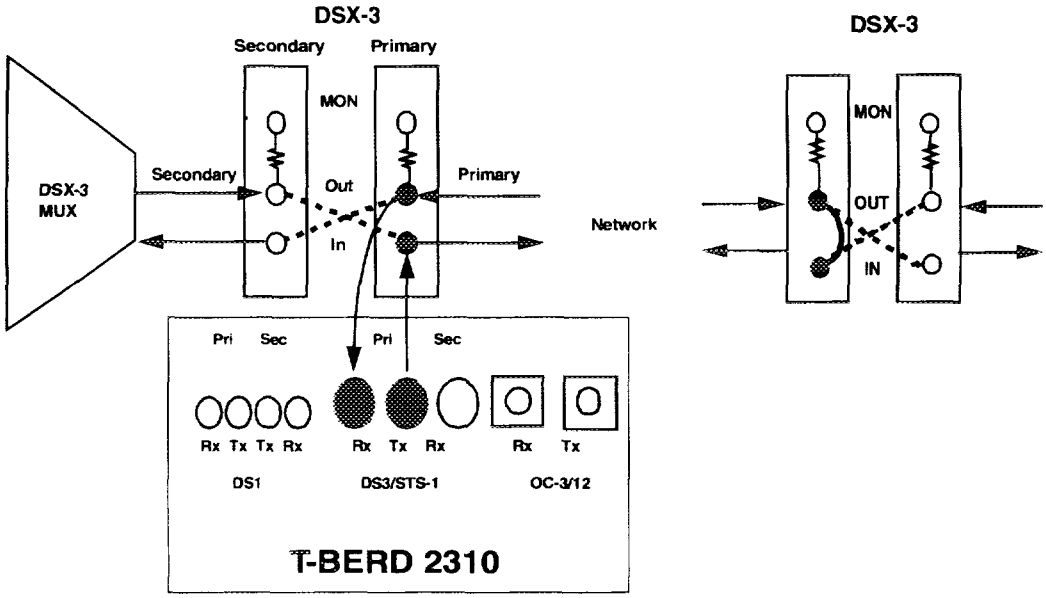


Figure 3-13. Simulation of DS3 Termination Test Setup

STS-1
Option

3.9 STS-1 OPTION

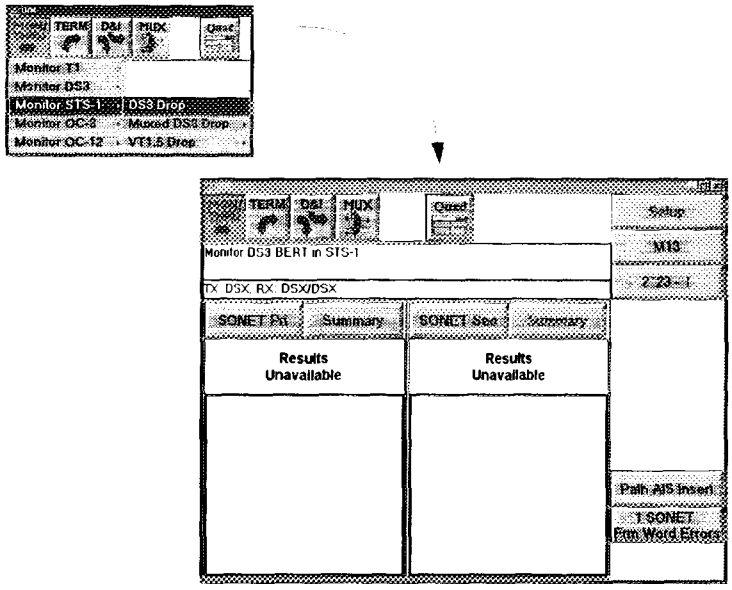
The STS-1 Option provides SONET receive and transmit signal and payload insert error and alarm capabilities at the Synchronous Transport Signal - Level 1 (STS-1) Rate.

3.9.1 Monitoring STS-1 Performance

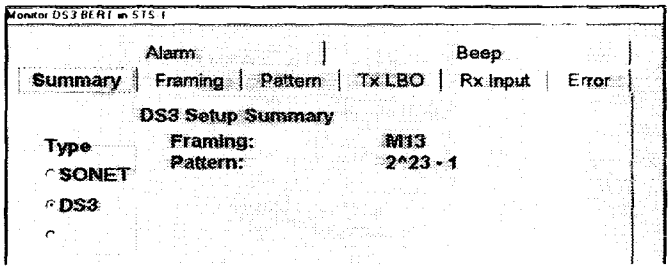
The following procedure outlines how to setup the T-BERD 2310 to monitor STS-1 signals.

Configuring the T-BERD 2310:

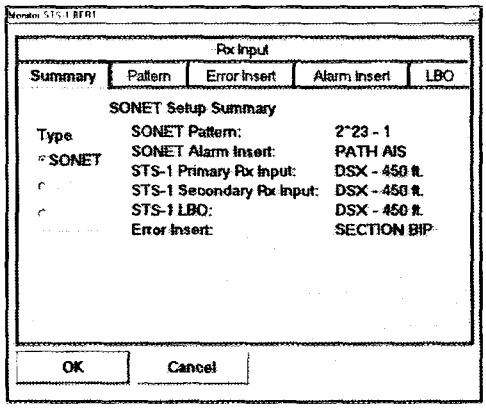
1. Press **MON/THRU**. Then, select **Monitor STS-1** from the pull-down menu, followed by the appropriate payload mapping (in this case, **DS3 BERT** was chosen). The unit automatically configures to a default setup for the chosen application.



2. Press **Setup**. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics.



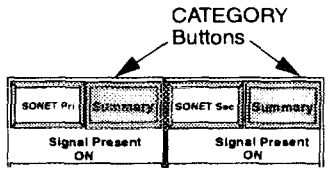
3. To change these default settings, select the desired tabs in the Property Setup Sheets. Note the differences between the baseline DS3 setup Property Sheets and the baseline STS-1 setup Property Sheets.



Property Setup Tabs for STS-1 Monitor Testing. You can press any tab to change configurations.

4. Press **OK**.

5. If monitoring a second signal, press one of the buttons labeled **STS-1 PRI** in the Results GROUP window and select **STS-1 Sec**. Set both CATEGORY buttons to **Summary**.



6. Verify the yellow active port LEDs next to the STS-1 PRIMARY RX and SECONDARY RX jacks are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the STS-1 PRIMARY RX jack to the STS-1 PRIMARY MON jack.
2. Connect a cable from the STS-1 SECONDARY RX jack to the STS-1 SECONDARY MON jack.
3. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

4. Verify the green SIGNAL, FRAME, PATTERN, and if applicable, PATH PTR LEDs, are illuminated and the Primary and Secondary Results displays show RESULTS OK.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-14 depicts a diagram sample depiction of cable connections from the DSX-1 panel to the inputs on the T-BERD 2310.

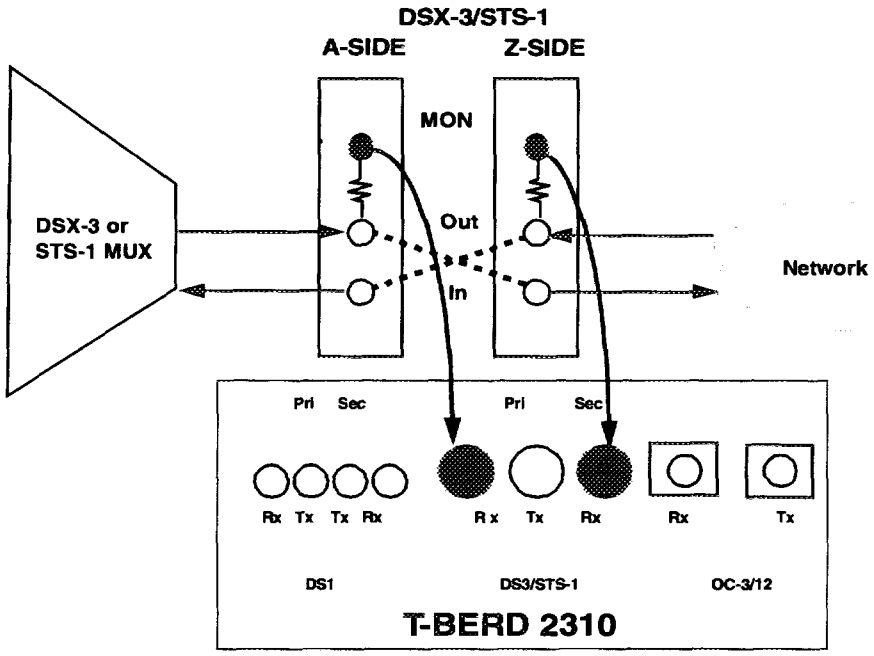


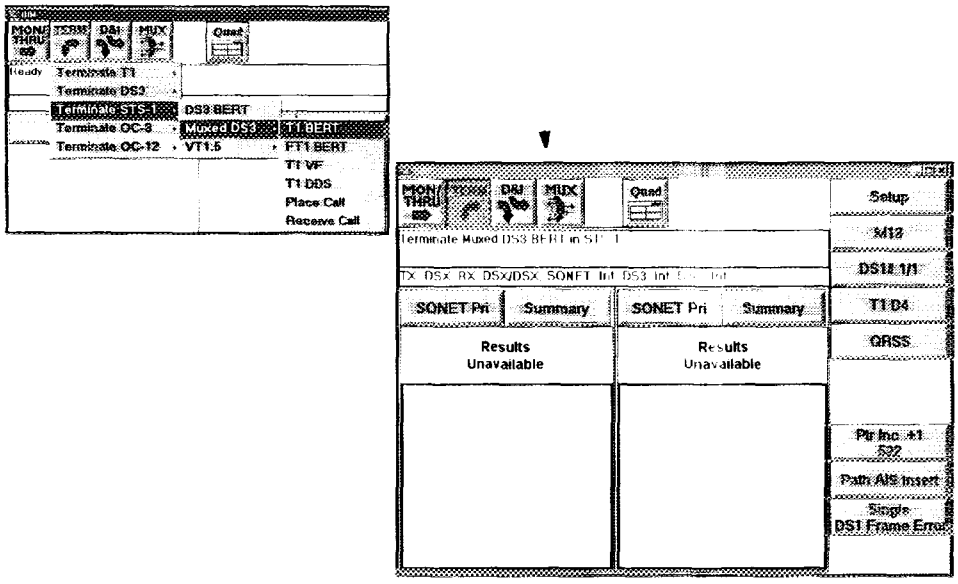
Figure 3-14. Simulation of STS-1 Monitor Test Setup

3.9.2 STS-1 BER Testing

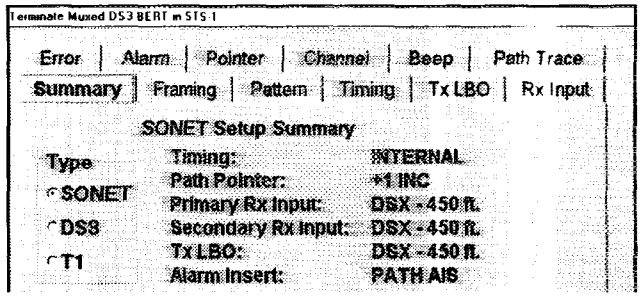
The following procedure outlines how to setup the T-BERD 2310 to perform STS-1 BERT tests.

Configuring the T-BERD 2310:

1. Press **TERM**. Then, select **Terminate STS-1** from the pull-down menu, followed by the appropriate payload mapping (in this case, **Muxed DS3** and **T1 BERT** were chosen). The unit automatically configures to a default setup for the chosen application.

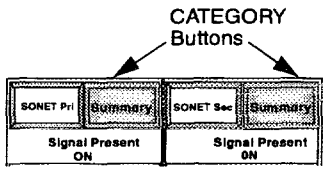


2. Press **Setup**. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics.



3. To change these default settings, select the desired tabs in the Property Setup Sheets.

4. Press **OK**.
5. Set both Results GROUPS to **SONET Pri** and CATEGORY buttons to **Summary**.



6. Verify the yellow active port LEDs next to the STS-1 PRIMARY TX and RX jacks are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the STS-1 PRIMARY RX jack to the DSX OUT jack.
2. Connect a cable from the STS-1 PRIMARY TX jack to the DSX IN jack.
3. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

4. Verify the green SIGNAL, FRAME, PATTERN, and if applicable, PATH PTR LEDs, are illuminated and the Primary and Secondary Results displays show RESULTS OK.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-15 depicts a diagram sample depiction of cable connections from the STS-1 panel to the inputs on the T-BERD 2310.

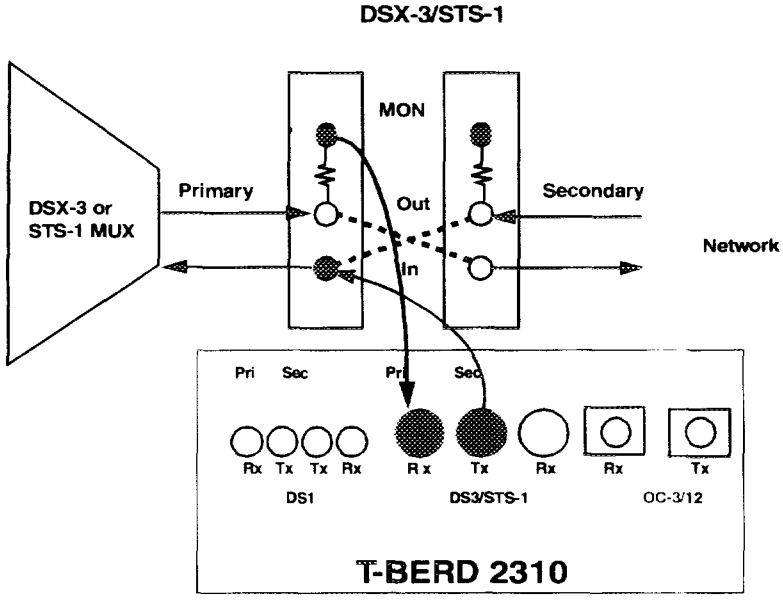


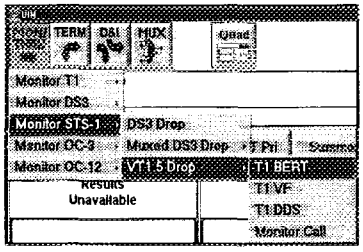
Figure 3-15. Simulation of STS-1 BER Test Setup

3.9.3 VT1.5 Drop/Monitoring From STS-1

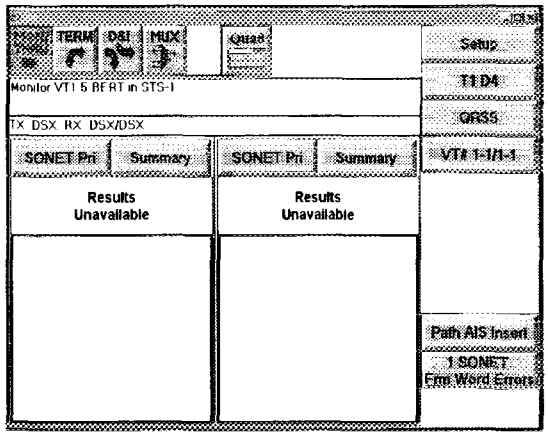
The following procedure outlines how to setup the T-BERD 2310 to monitor VT1.5 or DS1 signals dropped from a STS-1 signal.

Configuring the T-BERD 2310:

1. Press **MON/THRU**. Select **Monitor STS-1** (or OC-3/OC-12), then **VT1.5 Drop**, then **T1 BERT**.



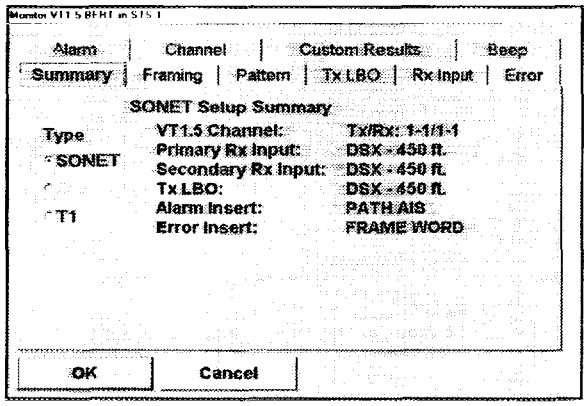
Initial pull-down menu for STS-1 VT 1.5, DS1 Monitor Testing.



Initial Setup Screen for VT 1.5 from STS-1 Monitor Testing. Press **Setup** to change configurations.

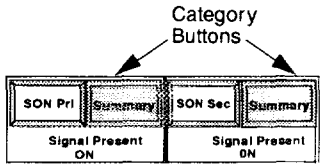
The unit automatically configures to a default setup for the chosen application.

2. Press **Setup**. Ensure the characteristics shown in the **Summary** setup screen match the network characteristics.
3. To change these baseline settings, select the desired tabs in the Property Setup Sheets.



Property Setup Tabs for VT 1.5 from an STS-1 Monitor Testing. You can press any tab to change configurations.

4. Press **OK**.
5. If monitoring a second line, press one of the buttons labeled **STS-1 PRI** in the Results GROUP window and select **STS-1 Sec** from the pull-down menu.
6. Set both Results CATEGORY buttons to **Summary**.



7. Verify the yellow active port LEDs next to the DS3/STS-1 PRIMARY RX and SECONDARY RX jacks are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a cable from the DS3/STS-1 PRIMARY and SECONDARY RX jack to the Primary and/or Secondary side of the DSX-3/STX-1 MON jack.
2. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

3. Verify the green SIGNAL, FRAME, PATTERN, and if applicable, PATH PTR LEDs, are illuminated and the Primary and Secondary Results displays show RESULTS OK.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-16 depicts a diagram sample depiction of cable connections from the DSX-3/STS-1 panel to the inputs on the T-BERD 2310 for a DS1/VT1.5 Drop/Monitor test.

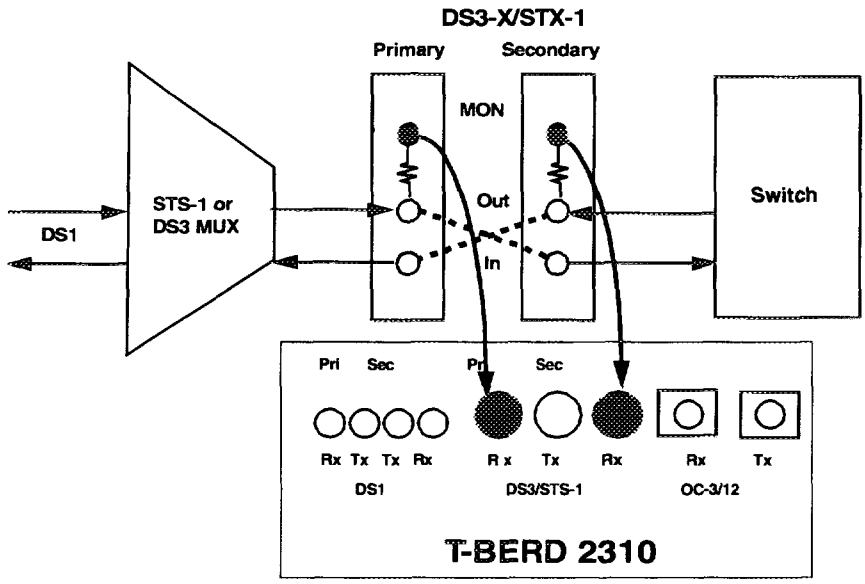


Figure 3-16. Simulation of STS-1/VT 1.5 Drop/Monitor Test Setup

3.10 OC-3 AND OC-12 OPTION

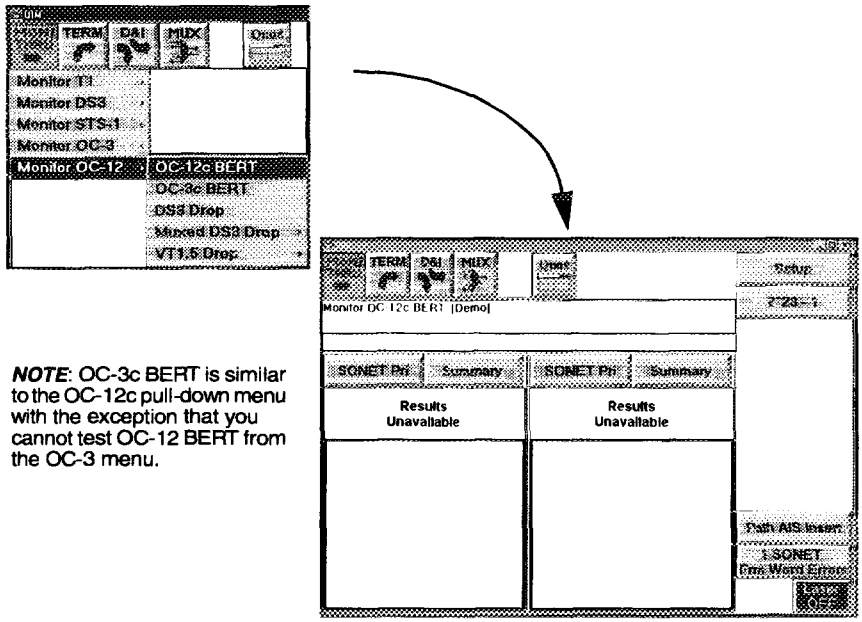
This option adds OC-3 and OC-12 testing to the already extensive testing capabilities of the T-BERD 2310. Without adding any size to the existing test set, this option enables transmitting or receiving SONET signals from optical carriers, as well as, concatenated Optical Carrier- Level 3 (OC-3) and Optical Carrier- Level 12 (OC-12) signals. It can analyze signal overhead, drop or insert payloads, and asynchronous frame synchronization.

3.10.1 Monitoring OC-3 and OC-12 Performance

The following procedure outlines how to setup the T-BERD 2310 to monitor and perform Error/Alarm Insertion using Thru mode.

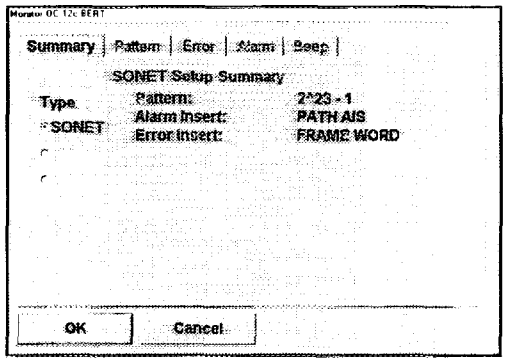
Configuring the T-BERD 2310:

1. Press **MON/THRU**. Then, select **Monitor OC-3 or Monitor OC-12** from the pull-down menu, followed by **OC-3c BERT or OC-12c BERT**. The unit automatically configures to a default setup screen.



NOTE: OC-3c BERT is similar to the OC-12c pull-down menu with the exception that you cannot test OC-12 BERT from the OC-3 menu.

2. Press **Setup.** The **Summary** Property Sheet displays.



3. Press the **Summary** Property Sheet tab. Ensure the settings shown in the **Summary** tab match the network characteristics and the test to be performed. Press **OK**.
4. Verify the yellow active port LEDs next to the OC-3/OC-12 jacks are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a fiber cable from the OC-3/OC-12 RX jack to the network's RECEIVE optical splitter access jack.
2. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

3. Verify the green PRI SONET SIGNAL, FRAME, and PATH PTR LEDs are illuminated (green) and the Results Window displays "All Results OK".
4. Press the **RESTART** Permanent Softkey to clear old test results and start a new test.
5. Verify test results in the RESULTS display windows. If the signal is error free, "All Results OK" displays.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-17 is a sample depiction of cable connections from the OC-3c/OC-12c panel to the inputs on the T-BERD 2310 for OC-3/OC-12 Monitoring and Error/Alarm Insert testing.

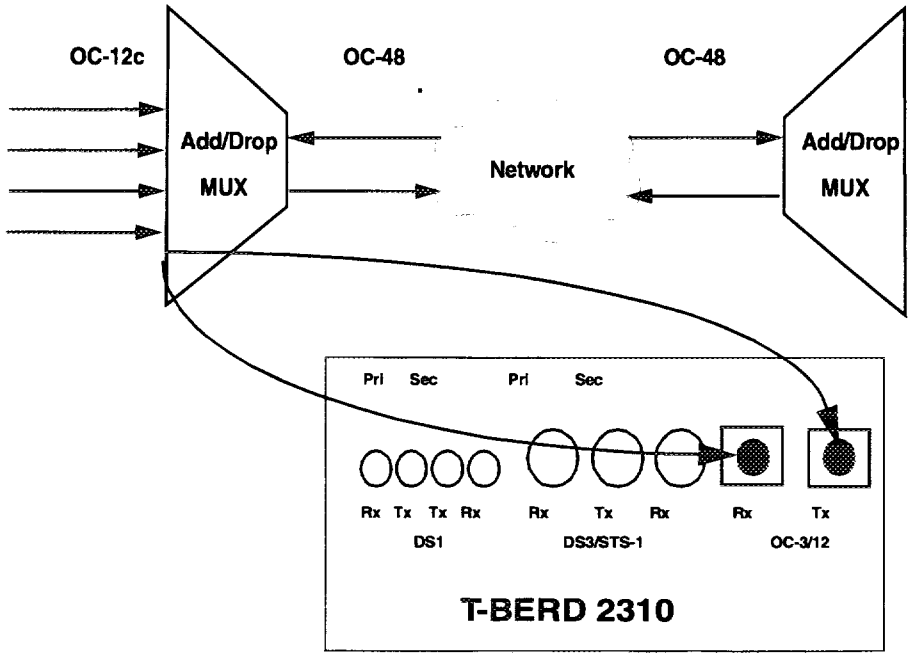
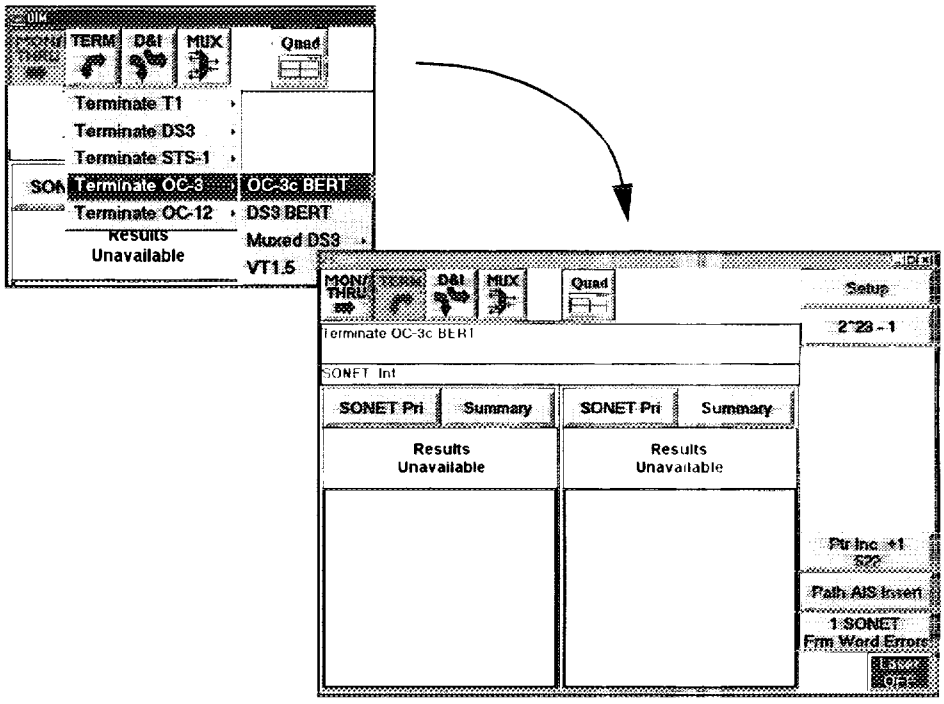


Figure 3-17. MON/THRU Mode Error/Alarm Insert Test Setup

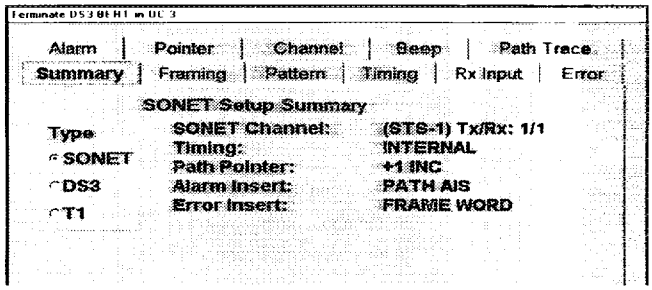
3.10.2 OC-3 and OC-12 BER Testing

Configuring The T-BERD 2310:

1. Press **TERM**. Then, select **Terminate OC-3/OC-12** from the pull-down menu, followed by **OC-3c/OC-12c BERT**. The unit automatically configures to a default setup.

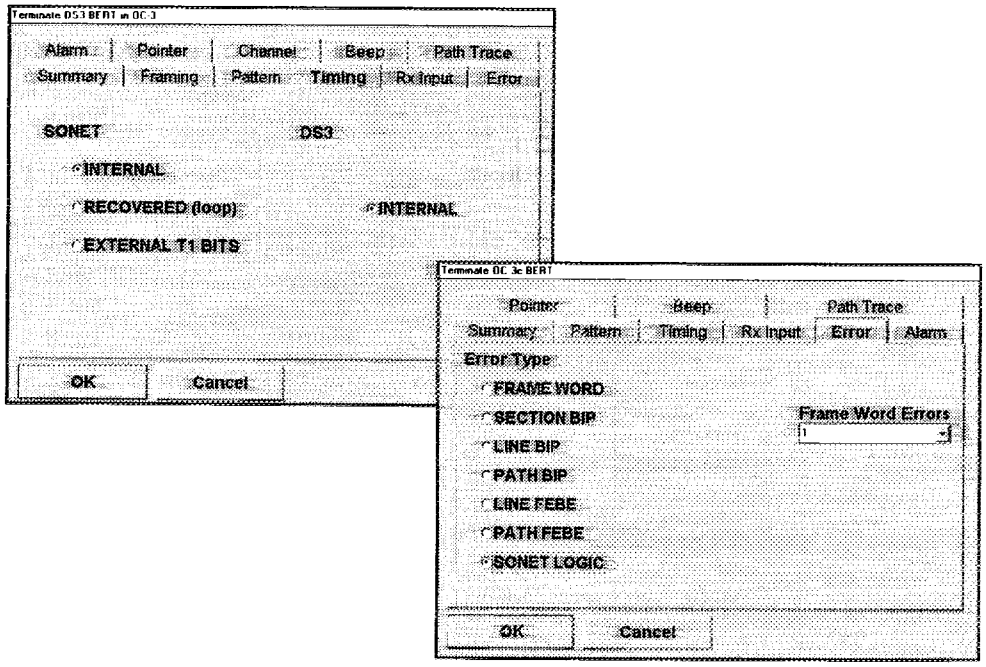


2. Press **Setup**. The **Summary** Property Sheet displays.



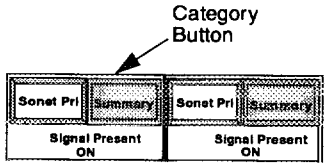
3. Press the **Timing** tab. If an external timing source is used, select **EXTERNAL T1 BITS**. If the timing is received from the network, select **RECOVERED**. If the T-BERD 2310 is the timing source, select **INTERNAL**.

4. Press the **Error** tab. Select **SONET LOGIC**.



5. Press **OK**.

6. Set the Results CATEGORY button to **Summary**.

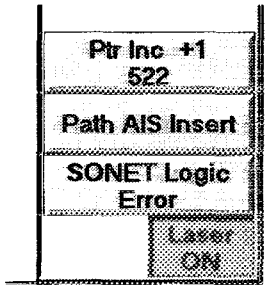


7. Verify the yellow OC-3/OC-12 active port LEDs are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect a fiber cable from the OC-3/OC-12 RX jack to the network's RECEIVE optical splitter access jack.

2. Connect a fiber cable from the OC-3/OC-12 TX jack to the network's TRANSMIT optical splitter access jack.
3. Press the **Laser ON** Action button.



4. Loop back the far-end of the network.
5. Press **RESTART** to clear alarms and begin the test.

6. Verify the green PRI SONET SIGNAL, FRAME, PATTERN, and PATH PTR LEDs are illuminated and the Results Window displays "All Results OK".
7. Press the **SONET Logic Error** ACTION button five times to insert errors. Verify five logic errors are received.
8. Press **RESTART** to clear old test results and start a new test.

Connecting the T-BERD 2310 to the Circuit Diagram:

Figure 3-18 is a depiction of cable connections from the OC-3c/OC-12c panel to the inputs on the T-BERD 2310 for OC-3/OC-12 Termination BER testing.

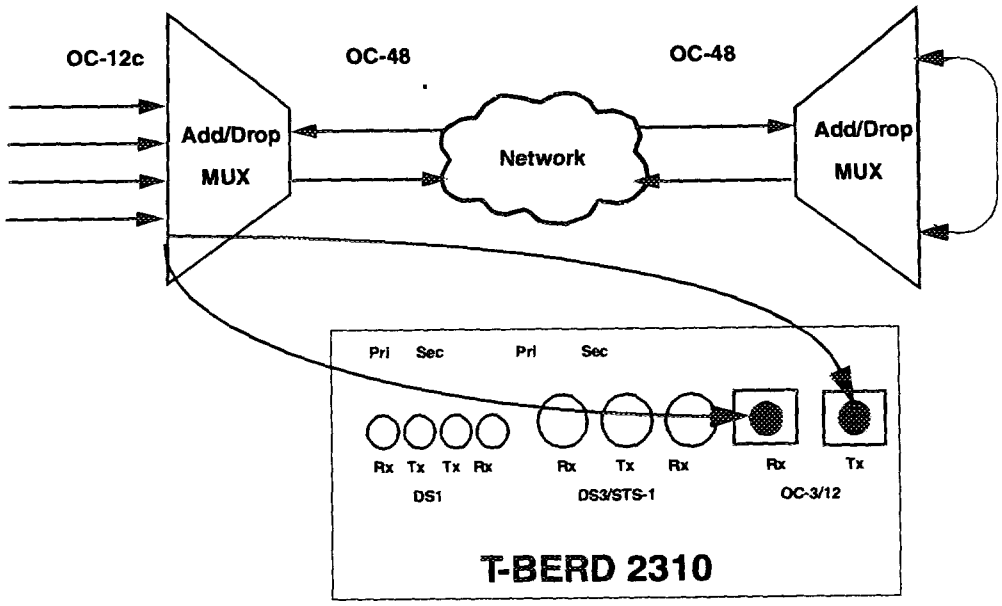


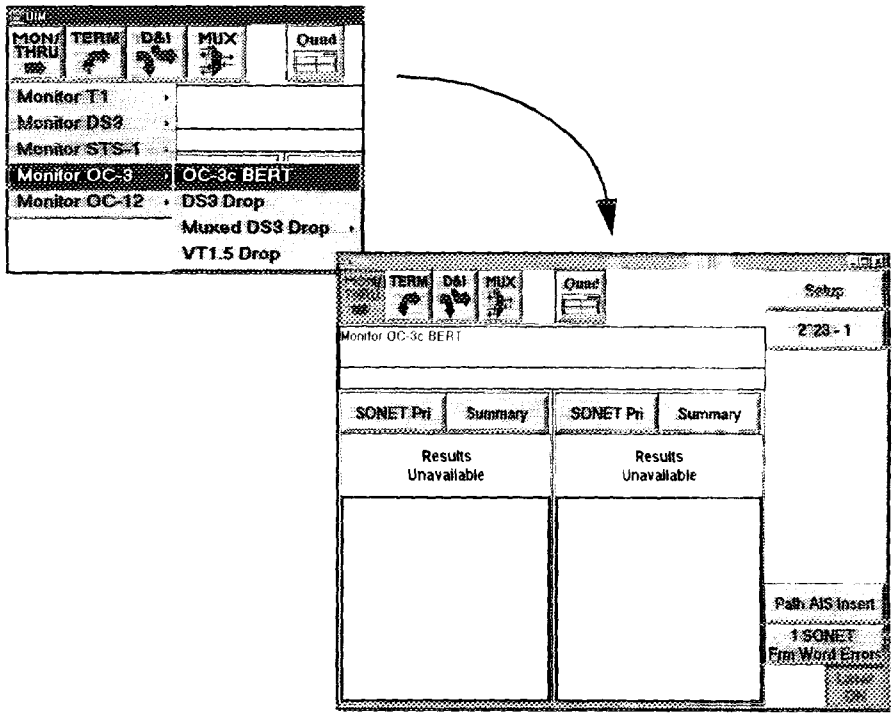
Figure 3-18. Simulation OC-3/OC-12 Termination BERT Setup

3.10.3 Optical Power Measurement

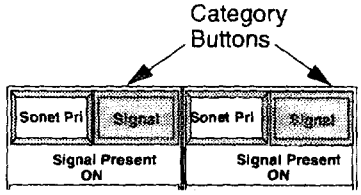
Use the following procedures to measure the optical power of a signal in an optical fiber using the T-BERD 2310.

Configuring the T-BERD 2310:

1. Press **MON/THRU**. Select **Monitor OC-3/O C-12,** followed by **OC-3/OC-12 BERT** from the pull-down menu. The unit automatically configures to a default setup.



2. Set CATEGORY button to **Signal**, then select **Optical Power dBm**.



3. Verify that the yellow OC-3/OC-12 active port LEDs are illuminated.

Connecting the T-BERD 2310 to the Circuit:

1. Connect the fiber to be tested to the OC-3/OC-12 RX jack.
2. Press the **RESTART** Permanent Softkey to clear alarms and begin the test.

3. Ensure the green PRI SIGNAL LED is illuminated.
4. Read the optical power measured in the Results Screen.

Connecting the T-BERD 2310 to the Circuit:

Figure 3-19 depicts cable connections from the OC-3c/OC-12c panel to the inputs on the T-BERD 2310 for OC-3c/OC-12c Power Measurement.

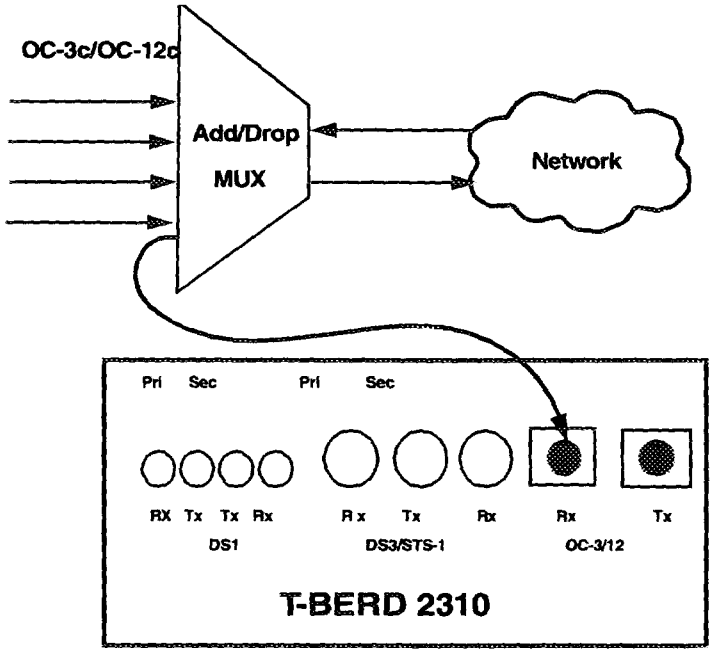
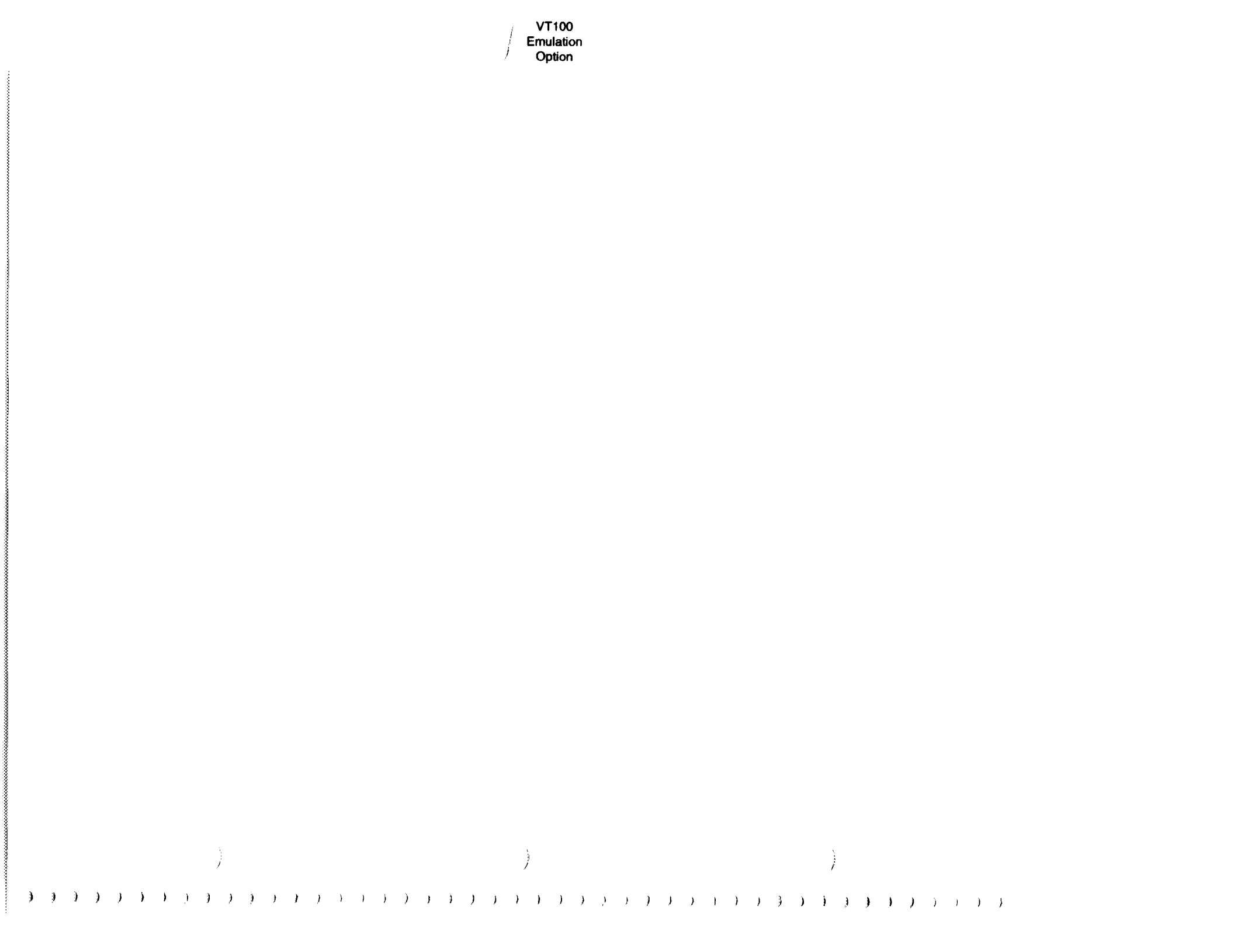


Figure 3-19. Simulation OC-3c/OC-12c Power Measurement


VT100
Emulation
Option

3.11 VT100 EMULATION OPTION

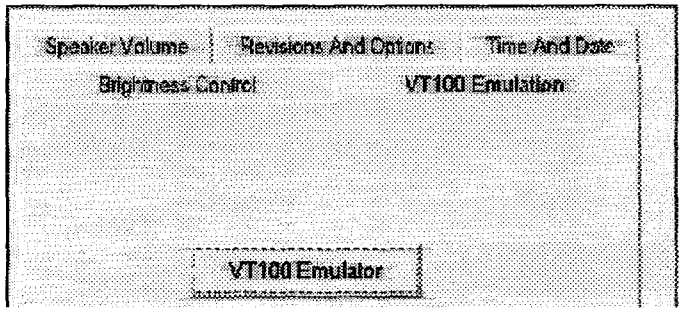
The T-BERD 2310 can be configured to perform VT-100 terminal emulation. For this function, the TB2310-VT100 option is required.

In this mode, you can locally access network components, such as HDSL units or performance monitoring devices (e.g., PMNIU or PMDNI), and provision them or obtain performance information from them. When the VT100 Option is installed in your T-BERD 2310, there is no need to carry a laptop computer to do VT100 emulation.

VT100 Setup Procedure:

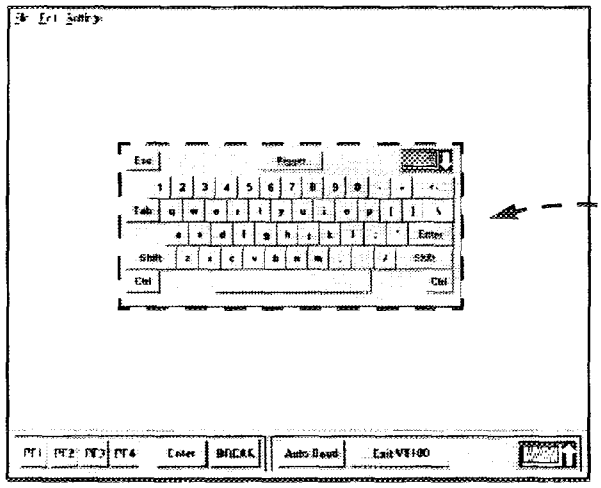
1. Connect the RS-232 interconnect cable (supplied) from the printer port on the T-BERD 2310 to the network device under test (e.g., HDSL unit). If necessary, connect a "gender changer" to the DB-9 connector end.
2. Access the VT100 emulator by pressing the **Aux Functions** Permanent Softkey icon (File Cabinet).

3. Press the **VT100 Emulation** tab in the auxiliary functions screen, followed by **VT100 Emulator** in the middle of the screen.

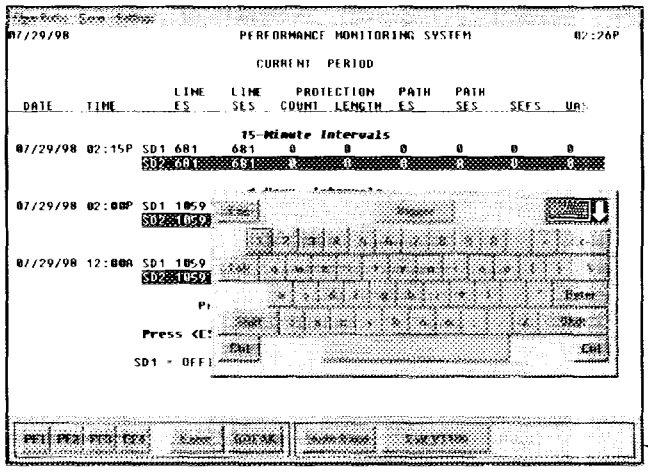


The screen turns into a VT100 terminal with a cursor blinking at the top left hand corner.

4. Press the keypad icon located on lower right of the screen to access the keypad.

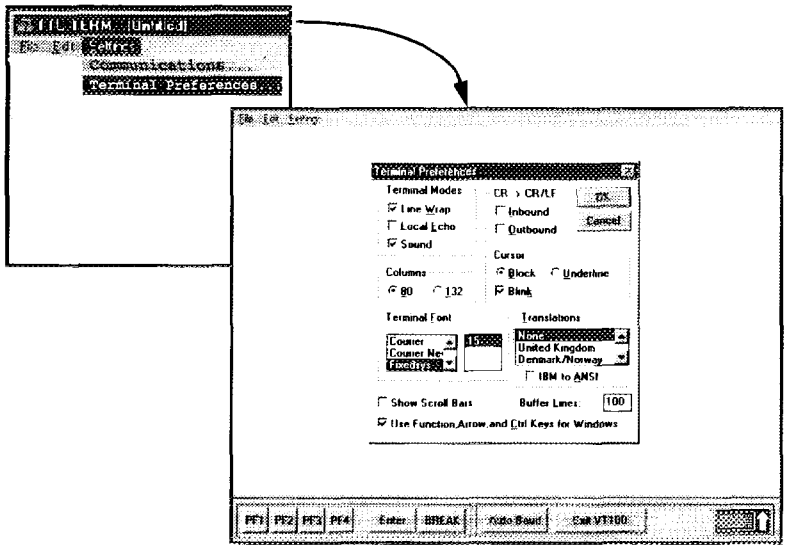


5. Change the size of the keypad by clicking the **Bigger/Smaller** button on the keyboard. You can also move/drag the keyboard to any desired location.



6. To access the menu of the network unit, either wait a few seconds (e.g., Westell devices) or hit the **<ESC>** key (e.g., Teltrend devices). Often, pressing the space bar works. If nothing appears on the screen after trying the above procedures, press **Settings** from the main menu bar, followed by either **Terminal Preferences** or **Communications** from the pull-down menu to

ensure settings are correct. For example, in the **Terminal Preferences** screen, you may want to have **Local Echo** turned off, especially if double characters are appearing on the screen. If settings are incorrect, change and save the settings. Try step 6 again.



NOTE

*In the **Communications Screen**, NO NOT change the **Connector** setting. Setting is correct for the application.*

The menu for the network unit should appear and the format should be correct. If not, go back to **Settings/Terminal Preferences** and check the **CR/LF** insert. You may want to move or minimize the keypad at this time. To minimize keypad, press its icon.

7. Perform operation(s) according to menu selections of the network device connected to the T-BERD 2310 VT100 Emulator.

8. Press **Exit VT100** to exit VT100 Emulation (*minimize keyboard, first*).

SECTION 4 PRINTER OPERATION

4.1 INTRODUCTION

The T-BERD 2310 provides print capability for both test configuration (Controls Print) and test results (Results Print). This section describes each of the printouts and how to generate them using the Print feature.

The T-BERD 2310 can generate a printout manually or automatically (via timed and errored event prints). When a results printout is initiated either manually or automatically, the test results are dumped to the print buffer.

4.2 PRINTER SETUP

The following connections and controls are used to set up the printer and the T-BERD 2310.

4.2.1 Printer Connection

The Printer connector on the top of the mainframe is an 8-pin connector used to connect the T-BERD 2310 to a serial printer like the TTC PR-40A/B. The connector is configured as a Data Communications Equipment (DCE) connection, which allows you to connect the T-BERD 2310 to Data Terminal Equipment (DTE).

4.2.2 Printer Settings

The T-BERD 2310 printout generation is controlled through the Printer Screen (see Figure 4-1), which is activated by pressing the **Printer** Permanent Softkey on the right side of the Main Display.

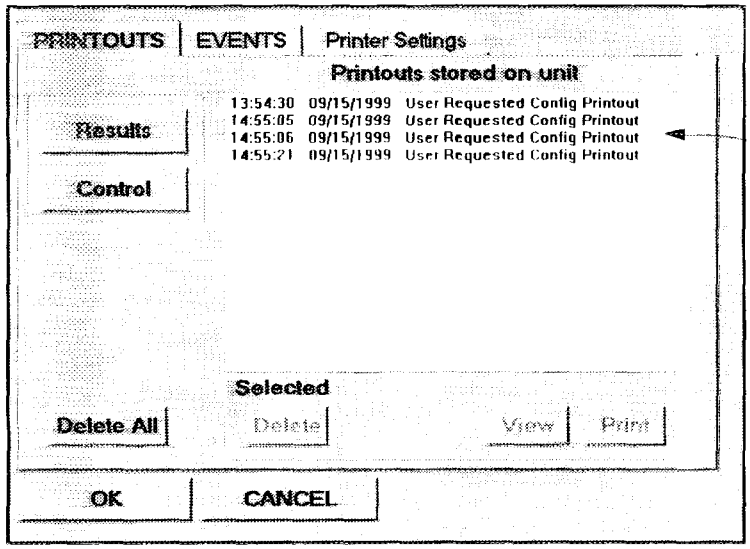
4.2.3 Printout Controls Property Sheets

The print function displays three property sheets:

- **Printouts**
- **Events**
- **Printer Settings**

4.2.3.1 PRINTOUTS Property Sheet

When you press the **Printer** Permanent Softkey, the **PRINTOUTS** Property Sheet is the first tab (see Figure 4-1) to exhibit. **PRINTOUTS** allows you to generate and print current results, print the configuration of controls that generated the test results, and to preview the printout.



Printouts stored on unit is a window displaying all printouts that are currently stored on the T-BERD 2310. The print buffer stores up to 20 printouts. After storing 20 printouts, the oldest printout is deleted if a new printout is added.

Figure 4-1. PRINTOUTS Property Sheet

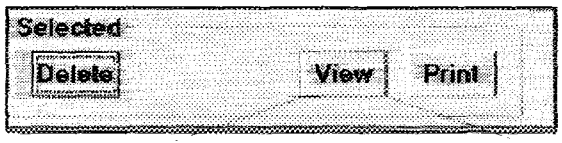
Results — generates a date-and-time, stamped printout of current test results. Test results become available only after the T-BERD 2310 has received a valid signal.

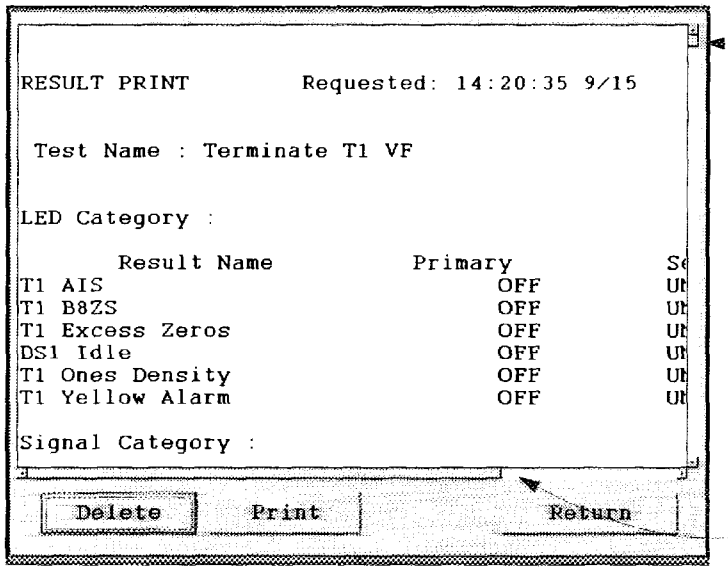
Control — generates a date-and-time, stamped printout of the current test configuration. This printout includes the test application and parameters associated with the test setup.

Delete All — deletes all print files contained in the print buffer of the T-BERD 2310.

Delete — deletes a selected print file contained in the print buffer of the T-BERD 2310.

View — previews each print file as it would be printed. Select a file in the Print Buffer using your stylus and press the view button to review it (see Figure 4-2).





Pressing **View** prompts a preview screen. Use the scrool bars at the bottom and right of the screen to view top-to-bottom and left-to-right.

Figure 4-2. Preview Screen of Files within Print Buffer

Print — sends each print file contained in the print buffer to the T-BERD 2310 external printer port. Select the appropriate file and press **Print** to send the file to the printer port.

4.2.3.2 EVENTS Property Sheet

Selecting the **EVENTS** Property Sheet (see Figure 4-3) allows you to set timed result printouts, automatically create a Print File when an error is detected, and allows you to specify a test duration before the T-BERD 2310 creates a Results print file.

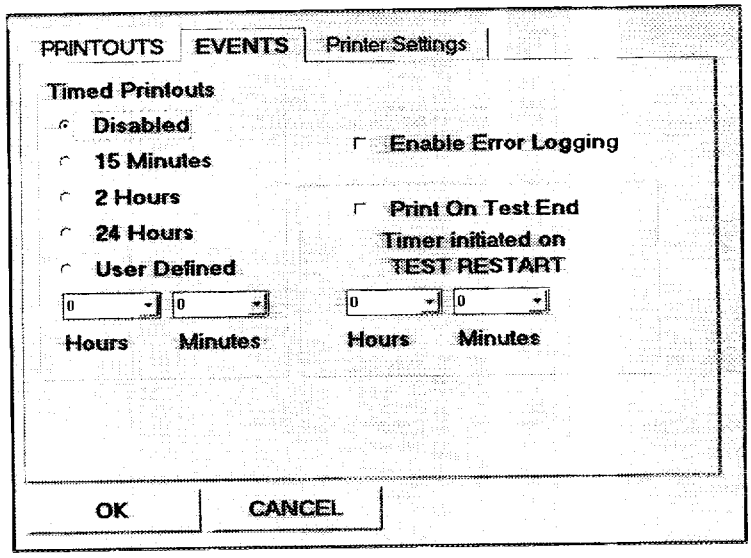


Figure 4-3. EVENTS Property Sheet

Timed Printouts — allows results to be printed every 15 minutes, every 2 hours, every 24 hours, or at user-defined timed intervals. If you select **Disabled**, printouts are performed manually only if you press **Results** or **Control** on the **PRINTOUTS** Tab.

Enable Error Logging — automatically creates a print file when an error is detected. The file will contain a time/date stamp and the type of error detected.

Print on Test End — allows you to specify a test duration before the T-BERD 2310 creates a Results print file.

4.2.3.3 Printer Settings Property Sheet

Selecting the **Printer Settings** Property Sheet (see Figure 4-4) allows you to select the baud rate and parity for the printer interface.

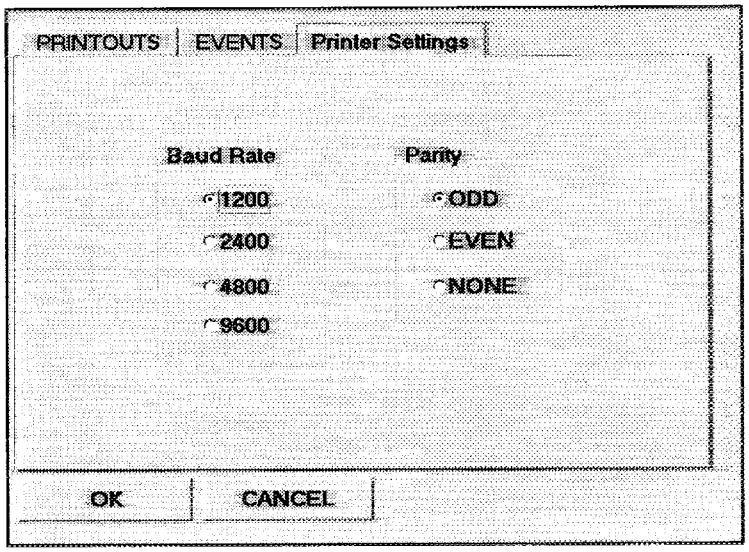


Figure 4-4. Printer Settings Property Sheet

Baud Rate — allows you to specify which baud rate (transmission speed) to set when printing a file.

Parity — allows you to specify odd, even, or no parity before the T-BERD 2310 creates a Results print file.

SECTION 5 TEST RESULTS

5.1 INTRODUCTION

The T-BERD 2310 test results for DS1, DS3, and SONET are displayed in the RESULTS windows. The available test results depend on the installed options. Categories where all results are unavailable display the message *Unavailable*.

5.2 QUAD RESULTS

Quad Results is a results function that displays up to four embedded signal rates at once in the Results Window of the T-BERD 2310. For example, by pressing the Quad Results icon, you could monitor a STS-1 signal with a DS3 mapped payload, a T1 signal, and measure the VF tone within a specific DS0, in both the primary *and* secondary directions (if the dual Rx option is installed).

Quad Results contain a pre-defined list of results called Custom Results. Table 5-1 lists the Custom Results that apply for each line rate as they appear on the Custom Results Property Sheets. For definitions on any of the results, look in the appropriate results section of this manual.

Table 5-1. Custom Results for DS0, T1, DS3, and SONET

DS0 Rate	T1 Rate	DS3 Rate	SONET Rate
Receive Byte	Rx Level dBdsx	Level dBdsx	STS-1 Rx Freq
VF Level dB	Rx Level Vpp	Level dBm	OC-n Rx Freq
VF Frequency	Rx Frequency	Rx Frequency	Path PTR Just
DDS Control Codes	Timing Slips	BPV Errors	Path BIP Errors
	Error Secs	BPV Rate	Sec BIP Errors
	Bit Errors	BPV Err Secs	Line BIP Errors
	Bit Error Rate	Frame Errors	
	BPVs	Frame Error Rate	
	BPV Rate	Parity Errors	
	BPV Err Secs	Parity Error Rate	
	Frame Errors	DS2 Frame Error	
	Frame Error Rate	DS2 Fr Err Rate	
	Frame Loss Secs	Bit Errors	
		Bit Error Rate	

Table 5-1. Custom Results for DS0, T1, DS3, and SONET (Continued)

DS0 Rate	T1 Rate	DS3 Rate	SONET Rate
		C-Bit Errors	
		C-Bit Error Rate	
		FEBE's	
		FEBE Rate	
		Err Secs	

5.2.1 Using Quad Results

The Quad Results icon is applicable in all applications and tests. To engage, first use any of the test procedures described in Section 3, Common Applications. *After* you have selected the type of test and rate, you are now ready to apply the Quad Results feature. Pressing the Quad icon automatically configures the application specific results for which you are testing to the Quad Results screen.

To use Quad Results, press the **Quad** icon. The Quad Results screen automatically displays (see Figure 5-1). The results setup is automatically configured to the application in which you are testing.

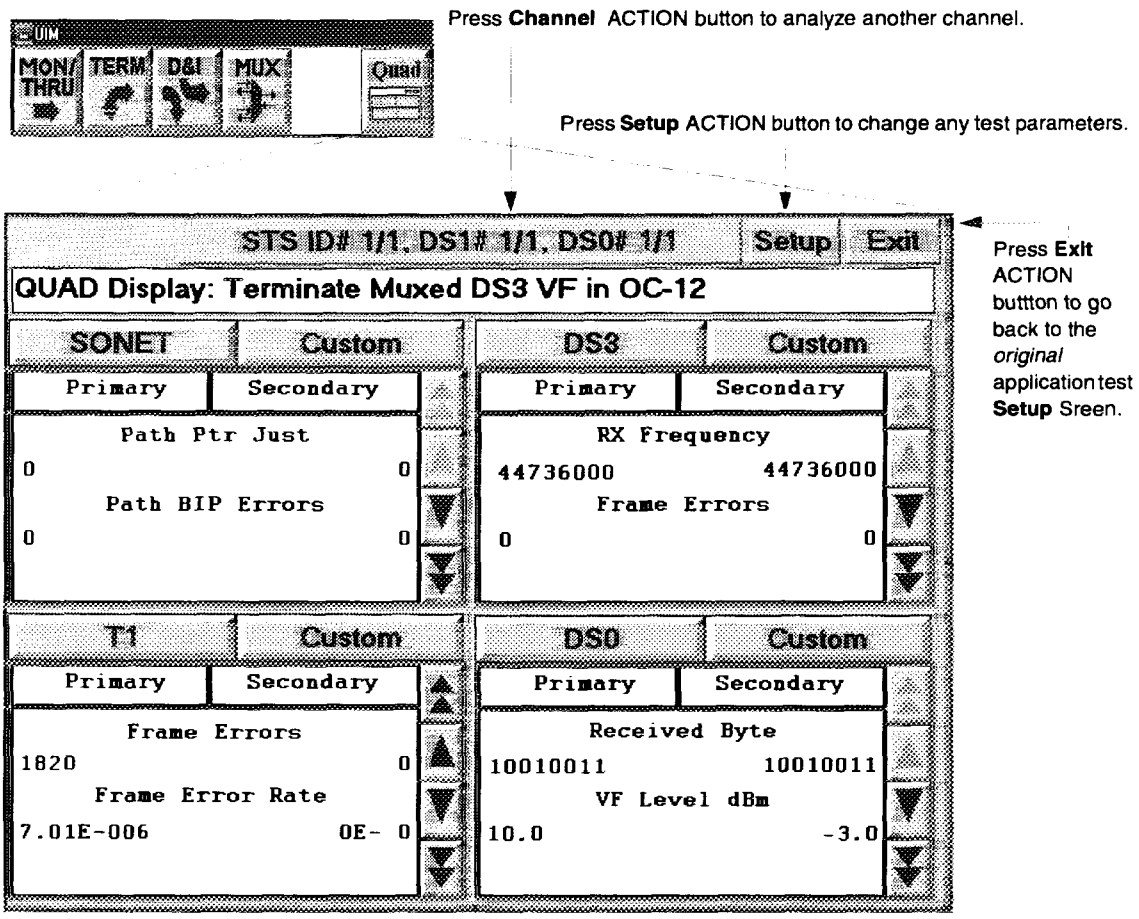
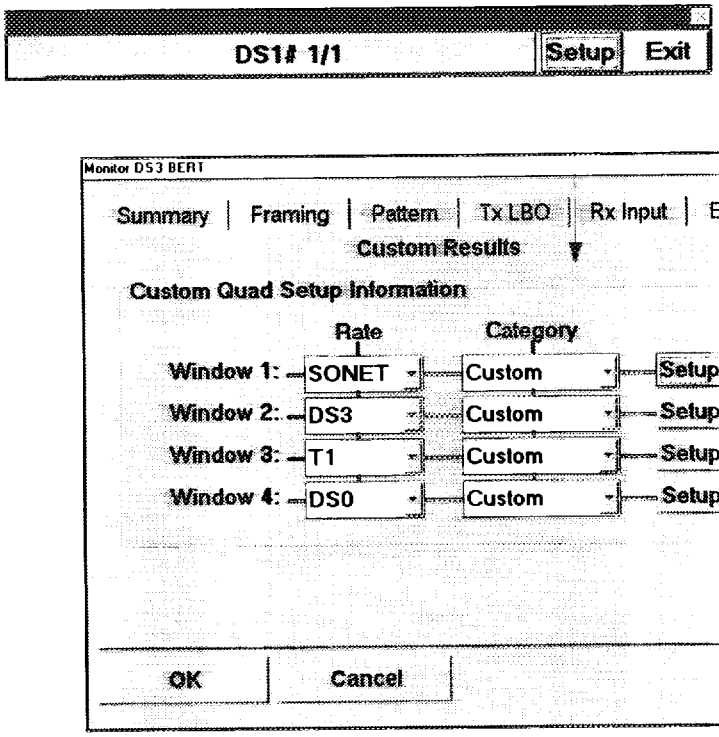


Figure 5-1. Sample Quad Results Screen on T-BERD 2310

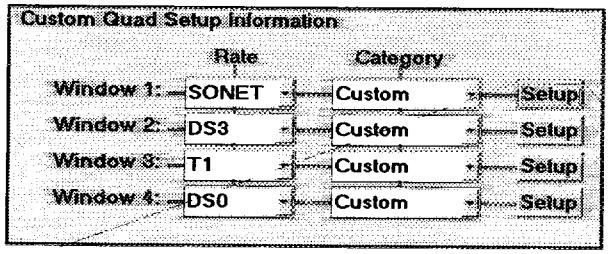
After you are in the Quad Results Setup Screen (see Figure 5-1), pressing **Setup** on this menu bar prompts the **Custom Results** tab associated with the applications to display, as shown in Figure 5-2.



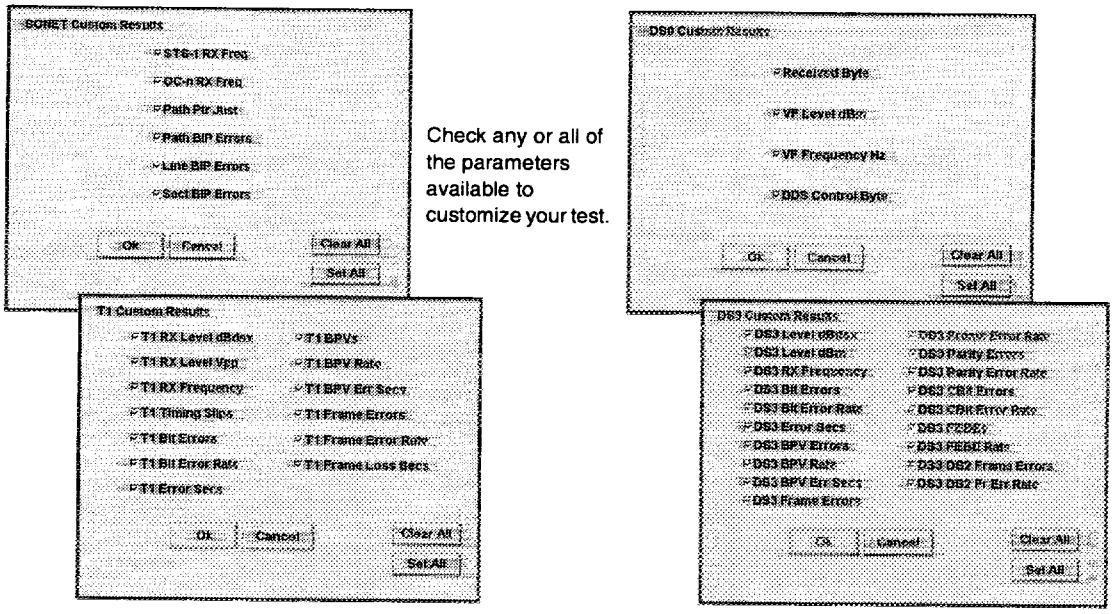
Pressing **Setup** from the Quad Results Screen promots the **Custom Results** Property Sheet to display.

Figure 5-2. Custom Results Property Sheet

Select the appropriate **Rate** and **Category**. If you press **Setup** here, a selection screen that pertains to that signal rate allows you to enable or disable results. Choose the appropriate settings as in the examples shown in Figure 5-3.



Pressing **Setup** in the **Custom Quad Setup Information** box enables detailed parameter sheets to display. Set your parameters for each Rate.



Check any or all of the parameters available to customize your test.

Figure 5-3. Custom Results Enable/Disable Property Sheets

As stated previously, the available test results depend on the installed options. Categories where all results are unavailable display the message *Unavailable*.

Table 5-2 lists the results categories and the section where they are discussed.

Table 5-2. Test Result Categories

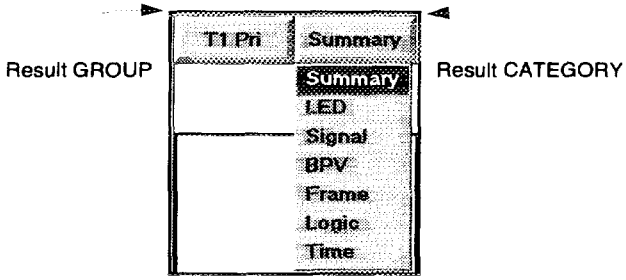
Category	Section
Summary	Section 5.2
LED	Section 5.4
Signal	Section 5.5
BPV	Section 5.6
Frame	Section 5.7
Parity	Section 5.8
Section	Section 5.9
Line	Section 5.10
Path	Section 5.11
Path Trace	Section 5.12
VT	Section 5.13
Channel	Section 5.14
Call Signal	Section 5.15
Traffic	Section 5.16
Logic	Section 5.17
Time	Section 5.18

5.3 SUMMARY CATEGORY

The **Summary** Category automatically displays key results that are non-zero or out-of-specification. This allows quick access to the results without having to search through the other categories. When all **Summary** results are error-free, the message **Results OK** displays. When an error is detected, the appropriate test result appears in the **Summary** Category window.

5.3.1 DS1 Summary Category Test Results

Select **T1 Pri/Sec** from the Results GROUP pull-down menu and **Summary** from the Result CATEGORY pull-down menu for test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, SONET Pri/Sec**).



The results that appear in the **Summary** Category for DS1 include:

- Results OK
- CRC Errors
- Pattern Slips
- Frame Slips
- Signal Losses
- Signal Present
- BPVs
- Yellow Alarm
- AIS
- B8ZS Detected
- Frame Losses
- Framesync
- Ones Density
- Bit Errors
- Frame Errors
- Rx Frequency
- Pattern Losses
- Patternsync

5.3.2 DS3 Summary Category Test Results

The results that appear in the Summary Category for DS3 include:

- Results OK
- Pattern Slips
- BPVs
- FEBEs
- Frame Errors
- Parity Slips
- C-Bit Errors
- DS2 Framesync
- RX Frequency
- FEAC Codes
- DS2 Frame Losses
- Bit Errors

5.3.3 SONET Summary Category Test Results

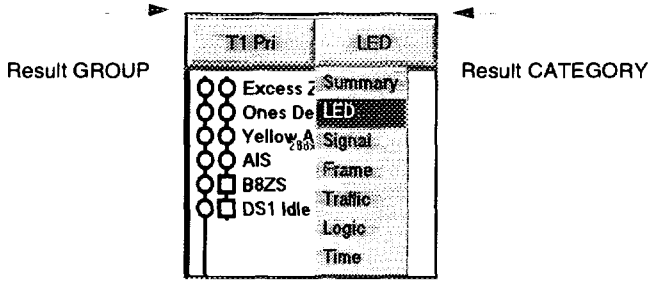
The results that appear in the Summary Category for SONET include:

- Results OK
- Line AIS
- Line RDI
- Path AIS
- Path RDI
- VT AIS
- Frame Word Errors
- Frame Losses
- Framesync
- Severely Errored Frame
- Bit errors
- Section BIP Errors
- APS Message Count
- Line BIP Errors
- Severely Errored Frame Defect
- Line FEBEs
- SPE Pointer Justifications
- SPE Pointer NDFs
- SPE Pointer Size
- Path BIP Errors
- Path FEBEs
- Path Pointer Present
- VT FEBEs
- VT BIP Errors
- VT RDI
- BPVs
- STS-1 RX Frequency
- OC-3 RX Frequency
- OC-12 RX Frequency
- VT RDI
- VT Pointer Justifications
- VT Pointer NDFs
- VT Pointer Justifications
- Pattern Slips
- Signal Present
- Signal Losses

5.4 LED CATEGORY

For DS1, DS3, and SONET signal testing, green Status LEDs provide information about the current condition of the received primary and secondary (optional) signals. The Status LEDs are divided into two groups, PRI (Primary) and SEC (Secondary). The PRI Status LEDs refer to the signal received through the RECEIVE jack. The PRI Status LEDs also indicate the condition of the signal dropped

from a payload. The SEC Status LEDs refer to the signal received through the Secondary RECEIVE jack. Select **LED** from the pull-down menu for LED Category test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, SONET Pri/Sec**).



5.4.1 DS1 LED Category

As the received signal is recognized, the appropriate Status LEDs illuminate. The DS1 Led Category test results are defined in Table 5-3.

Table 5-3. DS1 LED Test Results

Displayed Test Result	Description
Excess Zeros	***Excess Zeros*** — Illuminates when excess zeros (more than 8 consecutive) are detected in B8ZS coding and 15 in AMI coding.
Ones Density	***Ones Density*** — The T1 signal violates the ones density criteria if there is at least n ones in 8(n+1) bits.
Yellow Alarm	***Yellow Alarm*** — Illuminates when the Far-End Qut-of-Frame (FEOOF) signal (X-bits set to zero) is detected. FFOO in FDL for ESF, bit 2 set to 0 for 255 consecutive DS0 channels for T1-D4.
AIS	***Alarm indication Signal*** — (AIS) alarm is declared when unframed pattern is all ones. AIS indicates to downstream equipment that an upstream piece of equipment has detected loss of signal or loss of framing.
B8ZS	***Bipolar with 8-Zero Substitution*** — Illuminates when B8ZS clear channel coding is detected in the received DS1 signal.
DS1 Idle	***DS1 Idle*** — DS1 signal is present but not DS1 frame synchronization. It transmits the appropriate T1 D4 inband (all DS1 channels contain 0001 0111 bit pattern) or T1 ESF out-of-band (FFOO) idle code (Yellow Alarm).

5.4.2 DS3 LED Category

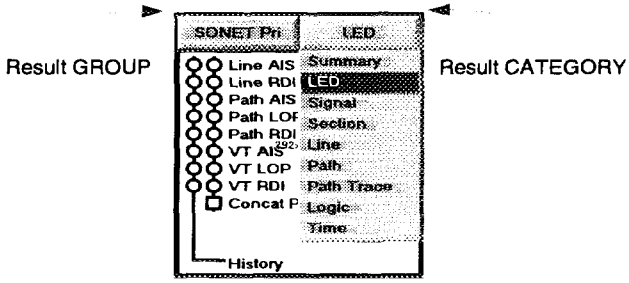
As the received signal is recognized, the appropriate Status LEDs illuminate. The DS1 LED Category test results are defined in Table 5-4.

Table 5-4. DS3 LED Test Results

Displayed Test Result	Description
Far End Alarm	***Far-End Alarm*** — Illuminates when Far-End Alarm and Control (FEAC) messages in the C-bit parity framing format (third C-bit in the M1 subframe) are detected.
Blue Alarm	***Blue Signal Alarm*** — Illuminates when the Blue Signal (Alarm Indication Signal) is detected (1010 pattern or stuck C bit). AIS indicates to downstream equipment that an upstream piece of equipment has detected loss of signal or loss of framing.
Yellow Alarm	***Yellow Alarm*** — Illuminates when the Far-End Out-of-Frame (FEOOF) signal (X-bits set to zero) is detected.
DS2 Frame Loss	***DS2 Frame Loss*** — Illuminates when frame synchronization to the DS2 signal is lost.
DS2 Frame Sync	***DS2 Frame Sync*** — Illuminates when synchronization to the DS2 framing format is lost.
C-Bit Frame	***C-Bit Frame*** — Illuminates when the T-BERD 2310 acquires C-bit frame synchronization.
DS3 Idle	***DS3 Idle*** — Illuminates when a DS3 signal is received in a 1100 pattern aligned in the payload for one M-frame.

5.4.3 SONET LED Category

Select **SONET Pri/Sec** from the pull-down menu for STS-1, OC-3, or OC-12 from the Results GROUP pull-down menu. Select **LED** from the Result CATEGORY pull-down menu for test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, SONET Pri/Sec**).



As the received signal is recognized, the appropriate Status LEDs illuminate. The SONET LED Category test results are defined in Table 5-5.

Table 5-5. SONET LED Test Results

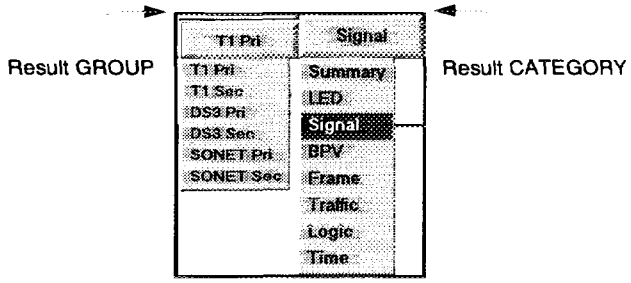
Displayed Test Result	Description
Line AIS	***Line Alarm Indication Signal*** — Line (AIS) detects a 111 pattern in the Line overhead APS byte (K2), Bits 6 to 8, for five consecutive frames. Line AIS is removed after detecting a pattern other than 111 in Bits 6-8 of byte K2 for five consecutive frames. Line AIS indicates to downstream equipment that an upstream section terminating equipment (STE) has detected loss of signal or loss of framing.
Line RDI	***Line Remote Defect Indication*** — (RDI) alarm (also known as far-end receive fail (FERF) alarm) detects a 110 pattern in the Line overhead APS byte (K2), Bits 6 to 8, for five consecutive frames. Line RDI is removed after detecting a pattern other than 110 in Bits 6-8 of byte K2 for five consecutive frames. Line RDI alerts an upstream device of a downstream failure, such as loss of signal, loss of frame, or Line AIS.
Path AIS	***Path Alarm Indication Signal*** — Path AIS alarm detects an all ones pattern in the Line overhead pointer bytes (H1 and H2) for three consecutive frames. Path AIS is removed when a valid set of pointer bytes and active new data flags (NDFs) are received, or when a valid pointer value is observed in three consecutive frames. Path AIS alerts the downstream path terminating equipment (PTE) that an upstream failure occurred.

Table 5-5. SONET LED Test Results (Continued)

Displayed Test Result	Description
Path LOP	***Path Loss Of Pointer*** — Path LOP alarm detects a valid pointer value cannot be determined from the Line overhead pointer bytes (H1 and H2). Specifically, Path LOP is declared if a valid pointer is not found in eight consecutive frames, if eight consecutive active NDFs are received without the corresponding concatenation indication. The Path LOP alarm is removed when a consistent pointer value or concatenation indication is received for three consecutive frames.
Path RDI	***Path Remote Defect Indication*** — Path RDI alarm (also known as RAI or Yellow Alarm) detects a one in Bit 5 of the Path status byte (G1) for five consecutive frames. STS Path RDI is removed after Bit 5 of byte G1 contains a zero for five consecutive frames. Path RDI indicates to the upstream PTE that a downstream failure has been detected.
VT AIS	***Virtual Tributary Alarm Indication Signal*** — VT AIS alarm detects an all ones pattern in the VT pointer bytes (V1 and V2) for three consecutive VT superframes. VT Path AIS is removed under two conditions: when a valid VT pointer, valid VT size, and the NDF 1001 flag are detected, or three consecutive VT superframes containing a valid VT pointer, valid VT size, and a normal NDF are detected. VT AIS alerts the downstream VT PTE of an upstream failure.
VT LOP	***Virtual Tributary Loss Of Pointer*** — VT LOP alarm detects a valid pointer value cannot be determined from the VT Path overhead bytes (V1 and V2). Specifically, VT Path LOP is declared if a valid pointer is not found in eight consecutive frames, if eight consecutive active NDFs are received without the corresponding concatenation indication. The VT Path LOP alarm is removed when a consistent pointer value or concatenation indication is received for three consecutive frames.
VT RDI	***Virtual Tributary Remote Defect Indication*** — VT RDI alarm (also known as RAI or Yellow Alarm) detects a one in Bit 8 of the VT Path overhead byte (V5) for five consecutive VT superframes. The VT Path RDI alarm is removed when a zero is detected in Bit 8 of byte V5 for five consecutive frames. VT RDI indicates to the upstream VT PTE that a downstream failure has been detected.
Concat Payload	***Concat Payload*** — A Concatenated pointer value is detected in the current receive STS.

5.5 SIGNAL CATEGORY

The SIGNAL Category results include signal level, frequency, and loss seconds. The results are accumulated after initial signal detection. Select **T1 Pri/Sec** from the pull-down menu for STS-1, OC-3, or OC-12 from the Results GROUP pull-down menu and **Signal** from the Result CATEGORY pull-down menu for Signal Category test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, SONET Pri/Sec**).



5.5.1 DS1 Signal Test Results

The DS1 Signal Category test results are defined in Table 5-6.

Table 5-6. DS1 Signal Test Results

Displayed Test Result	Description
Signal Loss Count	***Signal Loss Count*** — Illuminates when a T1 signal is lost or absent equal to 1 loss in every 100 milliseconds.
Signal Loss Secs	***Signal Loss Seconds*** — The number of seconds during which the received DS1 signal was lost for all or part of a second since initial signal detection.
RX Frequency	***Receive Frequency*** — Frequency of the clock recovered from the received DS1.
TX Frequency	***Transmit Frequency*** — The frequency of the clock recovered from the transmitted data measured in Hz.
Simplex Curr mA	***Simplex Current measured in milliamps*** — DS1 electrical signal received in the primary T1 test, the value is displayed as xxx mA in a range from 10 mA to 200 mA.
RX Level dBdsx	***Receive Level Decibels dsx*** — DS1 power of signal received in a T1 test. The value is displayed as xxx dBdsx in a range from +6.0 dBdsx to -40.0 dBdsx.

Table 5-6. DS1 Signal Test Results (Continued)

Displayed Test Result	Description
RX Level dBm	***Receive Level Decibels below 1 Milliwatt*** — DS1 power of signal received in a T1 test. The value is displayed as + xx.x dBm in a range from +23.0 dBdsx to -23.5 dBdm. Will only be valid for unframed ones.
RX Level Vpp	***Receive Level Volts peak-to-peak*** — DS1 power of signal received in a T1 test. The value is displayed as + xx.x V in a range from +12.0 V to 1.0 V.
Timing Slips	***Timing Slips*** — The number of bit slips (+/-) and frame slips (absolute value) counted when the DS1 test signal slips from the DS1 reference signal after both signals are present simultaneously. Counts from 0 to + or - 192 and then rolls over to 0. Resets to 0 if signal present is lost on the analyzed T1 or on the reference T1. A positive results indicates that the analyzed T1 is faster than the reference T1.
Frame Slips	***Frame Slips*** — The number of frame slips (absolute value) counted when the DS1 test signal slips from the DS1 reference signal after both signals are present simultaneously.

5.5.2 DS3 Signal Test Results

The DS3 Signal Category test results are defined in Table 5-7.

Table 5-7. DS3 Signal Test Results

Displayed Test Result	Description
Signal Loss Count	***Signal Loss Count*** — Illuminates when a DS3 signal is lost or absent equal to 1 loss in every 100 milliseconds.
Signal Loss Secs	***Signal Loss Seconds*** — The number of seconds during which the received DS3 signal was lost for all or part of a second since initial signal detection.
RX Frequency	***Receive Frequency*** — The frequency of the clock recovered from the received data measured in Hz.
TX Frequency	***Transmit Frequency*** — The frequency of the clock recovered from the transmitted data measured in Hz.
Level Volts	***Level Volts*** — This represents the receive level on the incoming STS-1 in volts. Accuracy is (+/-) 10% or 20 millivolts, whichever is greater. Range is .00 to 1.99 Vp, and resolution is 0 millivolts.

Table 5-7. DS3 Signal Test Results (Continued)

Displayed Test Result	Description
RX Level dBdsx	***Receive Level Decibels dsx*** — DS3 power of the signal received.
RX Level dBm	***Receive Level Decibels below 1 Milliwatt*** — DS3 power of signal received in the primary DS3 test. The value is displayed as + xx.x dBm. This is not a true power measurement and is instead derived from the peak level measurement.

5.5.3 SONET Signal Test Results

The SONET Signal Category test results are defined in Table 5-8.

Table 5-8. SONET Signal Test Results

Displayed Test Result	Description
Signal Losses	***Signal Losses***— Occurs during transition from *ON* to *OFF* of SONET signal (STS-1 or OC-3).
Signal Loss Secs	***Signal Loss Seconds*** — An asynchronous test second in which the appropriate loss of signal was present at least some portion of the second. Occurs for modes when STS-1 receive is active the signal is defined as STS-1 signal present. For other modes it is OC-3 signal present.
STS-1 RX Frequency	***STS-1 Receive Frequency*** — Total number of STS-1 clocks received during the last second. The resolution is 4 Hz. If the signal is further than (+/ -) 1% from the nominal, a message displays indicating that the signal is not STS-1.
OC-3 RX Frequency	***OC-3 Receive Frequency*** — Total number of OC-3 clocks received during the last second. If the signal is further than (+/ -) 1% from the nominal, a message displays indicating that the signal is not OC-3.
OC-12 RX Frequency	***OC-12 Receive Frequency*** — Total number of OC-12 clocks received during the last second. If the signal is further than (+/ -) 1% from the nominal, a message displays indicating that the signal is not OC-12.
STS -1 TX Frequency	***STS-1 Transmit Frequency*** — Total number of STS-1 clocks transmitted during the last second.
OC-3 TX Frequency	***OC-3 Transmit Frequency*** — Total number of OC-3 clocks transmitted during the last second.

Table 5-8. SONET Signal Test Results (Continued)

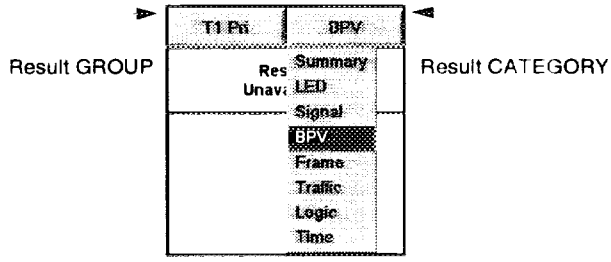
Displayed Test Result	Description
OC-12 TX Frequency	***OC-12 Transmit Frequency*** — Total number of OC-12 clocks transmitted during the last second.
STS-1 Level Volts	***STS-1 Level Volts*** — This represents the receive level on the incoming STS-1 in volts. Accuracy is (+/-) 10% or 20 millivolts, whichever is greater. Range is .00 to 1.99 Vp, and resolution is 10 millivolts.
STS-1 Level dBdsx	***STS-1 Level Decibels dsx*** — This represents the receive level on the incoming STS-1 in dBdsx. If the result is too high, the T-BERD 2310 indicates the signal is too high and out of range. If the result is 0.00 Volts, it indicates the signal is too low.
STS-Power dBm	***Receive Level Decibels below 1 Milliwatt*** — Represents the receive level on the incoming STS-1 in dBm. This is not a true power measurement and is instead derived from the peak level measurement. If the result is too high, the T-BERD 2310 indicates the signal is too high and out of range. If the result is 0.00 Volts, it indicates the signal is too low.
Optical Power dBm	***Optical Power Decibels below 1 Milliwatt*** — Represents the receive level on the incoming STS-1 in dBm.

5.6 BPV CATEGORY

The BPV Category results include signal level\ and loss seconds. The results are accumulated after initial signal detection.

5.6.1 DS1 BPV Test Results

Select **T1 Pri/Sec** from the Results GROUP pull-down menu and **BPV** from the Result CATEGORY pull-down menu for BPV test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec**).



The DS1 BPV Category test results are defined in Table 5-9

Table 5-9. DS1 BPV Test Results

Displayed Test Result	Description
BPVs	***Bipolar Violations*** — The number of bipolar violations (BPVs) detected since the beginning of the test. Intentional B8ZS code violations are excluded from the count.
BPV Rate	***Bipolar Violation Rate*** — The ratio of BPVs to received bits since initially acquiring signal presence.
BPV Err Secs	***BPV Errored Seconds*** — The number of seconds during which one or more BPVs occurred since the beginning of the test.

The DS3 BPV Category test results are defined in Table 5-10

Table 5-10. DS3 BPV Test Results

Displayed Test Result	Description
BPVs	***Bipolar Violations*** — The number of bipolar violations (BPVs) detected since the beginning of the test. Intentional B3ZS code violations are excluded from the count.
BPV Rate	***Bipolar Violation Rate*** — The ratio of BPVs to received bits since initially acquiring signal presence.
BPV Err Secs	***BPV Errored Seconds*** — The number of seconds during which one or more BPVs occurred since the beginning of the test.

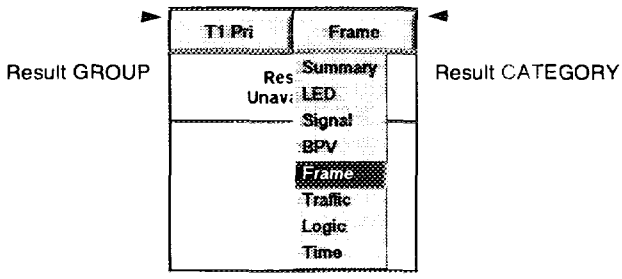
The SONET BPV Category test results are defined in Table 5-11

Table 5-11. SONET (STS-1) BPV Test Results

Displayed Test Result	Description
BPVs	***Bipolar Violations*** — The number of bipolar violations (BPVs) detected since the beginning of the test.
BPV Rate	***Bipolar Violation Rate*** — The ratio of BPVs to received bits since initially acquiring signal presence.
BPV % Err Free Secs	***BPV Percentage of Error-Free Seconds*** — The percentage of the number of seconds during which no BPVs occurred since the beginning of the test.

5.7 FRAME CATEGORY

Frame errors begin accumulating after initial frame synchronization on the incoming DS1 signal. Select **T1 Pri/Sec** from the Results GROUP pull-down menu and **Frame** from the Result CATEGORY pull-down menu for Frame test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, SONET Pri/Sec**).



5.7.1 DS1 Frame Test Results

The DS1 Frame Category test results are defined in Table 5-12

Table 5-12. DS1 Frame Test Results

Displayed Test Result	Description
Frame Losses	***Frame Losses*** — A count of discrete losses of frame synchronization since initial frame synchronization or last test restart.
Frame Errors	***Frame Errors*** — The number of frame errors detected since initial DS1 frame synchronization.
Frame Error Rate	***Frame Error Rate*** — The ratio of frame errors to received framing bits since initially acquiring frame synchronization.
Frame Erred Secs	***Frame Errored Seconds*** — The number of seconds during which one or more frame errors occurred since initial DS1 frame synchronization.
Frame Loss Secs	***Frame Loss Seconds*** — The number of seconds during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved, since initial DS1 frame synchronization.
Frame SES	***Frame Severely Errored Seconds*** — The number of seconds during which the total number of frame errors equals 12 or more (D4 framing only).
CRC Errors	***Cyclic Redundancy Check Errors*** — The number of CRC errors detected since initial DS1 frame synchronization. CRC errors are counted only when ESF framing is present in the received T1 data.
CRC Erred Secs	***Cyclic Redundancy Check Errored Seconds*** — The number of seconds during which one or more CRC errors occurred.
CRC Erred Rate	***Cyclic Redundancy Check Error Rate*** — The ratio of CRC errors to the number of extended superframes received.
CRC SES	***Cyclic Redundancy Check Severely Errored Seconds*** — The number of seconds during which the total number of CRC errors and frame synchronization losses equaled 320 or more.

5.7.2 DS3 Frame Test Results

The DS3 Frame Category test results are defined in Table 5-13.

Table 5-13. DS3 Frame Test Results

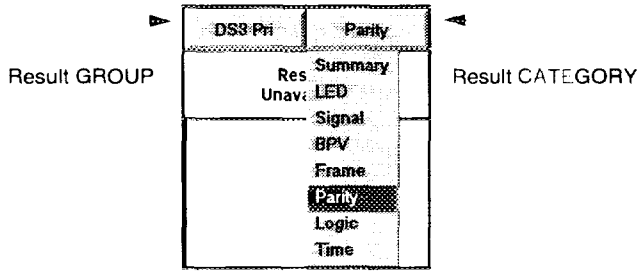
Displayed Test Result	Description
Frame Losses	***Frame Losses*** — The detection of frame synchronization lost since the beginning of the test.
Frame Errors	***Frame Errors*** — The number of frame errors detected since initial DS3 frame synchronization.
Frame Error Rate	***Frame Error Rate*** — The ratio of frame errors to received framing bits since initially acquiring frame synchronization.
Frame Erred Secs	***Frame Errored Seconds*** — The number of seconds during which one or more frame errors occurred since initial DS3 frame synchronization.
Far-End OOF Sec	***Far-End Out-of-Frame Seconds*** — The number of seconds during which the received X-bits are zero within the 1 second interval.
Near-End OOF Sec	***Near-End Out-of-Frame Seconds*** — The number of seconds during which an out-of-frame condition or an AIS is detected.
DS2 Frame Errors	***DS2 Frame Errors*** — The number of DS2 frame errors detected since initial DS2 frame synchronization.
DS2 Frame Error Rate	***DS2 Frame Error Rate*** — The ratio of detected DS2 frame errors to the total DS2 framing bits received.
DS2 Frame Losses	***DS2 Frame Losses*** — The number of DS2 frame losses occurring after initial frame synchronization.
TX X-Bits	***Transmitted X-bit*** — The current setting of the transmitted X-bits when in a framed mode.

Table 5-13. DS3 Frame Test Results (Continued)

Displayed Test Result	Description
RX X-Bits	***Received X-bit*** — The current status of the received X-bits when in a framed mode. The result is available after receiving DS3 frame synchronization.
FEAC, History	***Far-End Alarm and Control (FEAC) message History*** — The reception of at least 2 consecutive repetitions of one of the following FEAC messages in the C-bit FEAC channel.: Comm Equip Fail NSA: DS3 Equipment Failure, Service Affecting (Type 1 equipment failure) DS3 Idle: DS3 Idle Signal Received DS3 AIS: DS3 Alarm Indication Signal Received DS3 Out of Frame: DS3 Out-of-Frame, Loss of DS3 Frame Synchronization DS3 LOS/HBER: DS3 Loss-of-Signal/High Bit Error Ratio DS3 Equip Fail SA: DS3 Equipment Failure, Service Affecting (Type 1 equipment failure) DS3 Equip Fail NSA: DS3 Equipment Failure, Non-Service Affecting (Type 2 equipment failure) Mult DS1 LOS/HBER: Multiple DS1 Loss-of-Signal/High Bit Error Ratio Single DS1 LOS/HBER: Single DS1 Loss-of-Signal/High Bit Error Ratio DS1 Equip Fail SA: DS1 Equipment Failure, Service Affecting (Type 1 equipment failure) DS1 Equip Fail NSA: DS1 Equipment Failure, Non-Service Affecting (Type 2 equipment failure)

5.8 PARITY CATEGORY

Parity errors begin accumulating after initial frame synchronization on the incoming DS3 signal. The DS3 PARITY Category results depend on the current framing mode and the received framing signal. Select **DS3 Pri/Sec** from the Results GROUP pull-down menu and **Parity** from the Result CATEGORY pull-down menu for Parity test results.



5.8.1 DS3 Parity Test Results

The DS3 Parity Category test results are defined in Table 5-14

Table 5-14. DS3 Parity Test Results

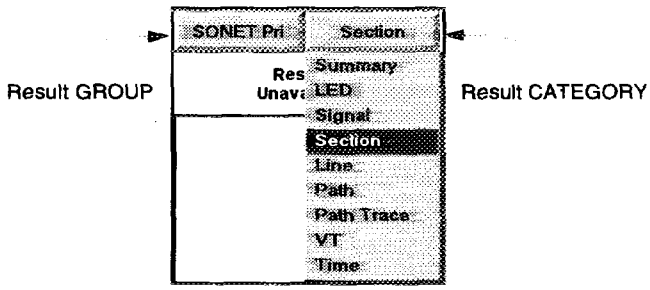
Displayed Test Result	Description
Parity Errors	***Parity (P-bit) Errors*** — An M-Frame that contains a mismatch between either parity bit (P-bits) and the parity calculated from the information bits in the previous M-frame.
Parity Error Rate	***Parity (P-bit) Error Rate*** — The ratio of parity errors to (1) the number of bits over which parity was calculated.
Parity Error Seconds	***Parity (P-bit) Errored Seconds*** — The number of seconds during which one or more parity errors occurred since initial DS3 frame synchronization.
C-Bit Errors	***C-bit Parity Errors*** — An M-Frame that contains a mismatch between the majority rule of the C-Bit path parity bits (CP-bits) and the parity calculated from the information bits in the previous M-frame.
C-Bit Error Rate	***C-bit Parity Error Rate*** — The ratio of C-bit parity errors to (1) the number of bits over which C-bit parity was calculated.

Table 5-14. DS3 Parity Test Results (Continued)

Displayed Test Result	Description
C-Bit Error Seconds	***C-bit Parity Errored Seconds*** — The number of seconds during which one C-bit parity error occurred since initial DS3 C-bit frame synchronization.
FEBEs	***Far-End Block Errors*** — Far-end block errors (FEBEs) detected since initial DS3 C-bit frame synchronization caused by an M-Frame in which any of the three FEBE bits is a zero.
FEBE Rate	***Far-End Block Error Rate*** — The ratio of FEBEs to (1) the number of bits over which C-bit parity was calculated.
FEBE Errored Seconds	***Far-End Block Errored Seconds*** — The number of seconds during which at least one FEBE occurred since initial DS3 C-bit frame synchronization.

5.9 SONET SECTION CATEGORY

SONET Section overhead test results enable the T-BERD 2310 to analyze the SONET Section of a network. The results are only available when a SONET option is installed. Select **SONET Pri/Sec** from the Results GROUP pull-down menu and **Section** from the pull-down menu for Section test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



5.9.1 SONET Section Test Results

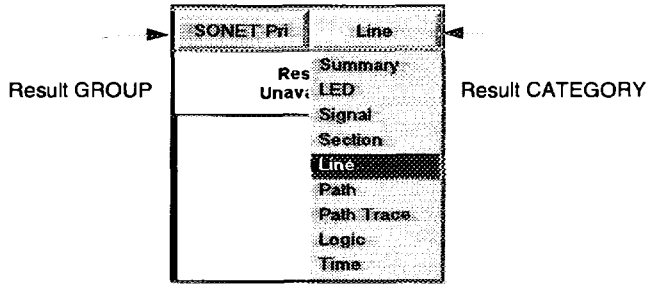
The SONET Section Category test results are defined in Table 5-15

Table 5-15. SONET Section Test Results

Displayed Test Result	Description
Frame Word Errors	***Frame Word Errors*** — Counts the number of errored frame alignment signal (FAS) subsets (subset of bytes A1 and A2) received since gaining initial frame synchronization.
Section BIP Errors	***Section BIP Errors*** — An error in the even parity Section BIP-8 (B1) byte when used as a parity check against the preceding STS-n frame. Up to 8 BIP errors may be counted per STS-n frame. Section BIP errors are only defined for the first STS-1 on an STS-n.
Section BIP Error Rate	***Section BIP Error Rate*** — The ratio of Section BIP Errors to the total number of received bits.
Section BIP Error Sec	***Section BIP Errored Seconds*** — Counts the number of seconds in which one or more Section BIP errors occurred since test restart. The errored second interval is not synchronous to the occurrence of the BIP error.
SEF Defect	**Severely Errored Frame Defects** — Four contiguous errored frame alignment words (A1/A2 pair).
Sect SES	***Section BIP Severely Errored Seconds*** — An asynchronous test second in which 2500 or more Section BIP Errors were counted. For OC-12 the range 8800 or more Section BIP Errors.
SEF Secs	**Severely Errored Frame Seconds** — An asynchronous test second in which a Severely Errored Frame was counted.

5.10 SONET LINE CATEGORY

SONET Line overhead test results enable the T-BERD 2310 to analyze the SONET Line of a network. The results are only available when a SONET option is installed. Select **SONET Pri/Sec** from the Result Group pull-down menu and **Line** from the Result CATEGORY pull-down menu for SONET Line test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



5.10.1 SONET Line Test Results

The SONET Line Category test results are defined in Table 5-16.

Table 5-16. SONET Line Test Results

Displayed Test Result	Description
APS Msg Count	***APS Message Count*** — Counts the number of transitions occurring in the switch priority field of the line overhead byte (K1), Bits 1 to 4. This is an indication of protection switch activity; it is not a direct count of protection switches.
APS Bridged Line	***APS Bridged Line*** — Bits 1-4 provide the number of the channel bridged onto the protection line. If 0, then no line is bridged to the APS line.

Table 5-16. SONET Line Test Results (Continued)

Displayed Test Result	Description
APS Request Msg	***APS Request Message*** — This result displays the current protection switch request message and channel as indicated by the line overhead byte (K1). Each message will have a Channel Number Code Assignment and a type of request. **K1 Bits 1234** — **Type of Request** 1111 — Lockout of Protection 1110 — Forced Switch 1101 — Signal Fail — High Priority 1100 — Signal Fail — Low Priority 1011 — Signal Degrade — High Priority 1010 — Signal Degrade — Low Priority 1001 — (not used) 1000 — Manual Switch 0111 — (not used) 0110 — Wait-to-Restore 0101 — (not used) 0100 — Exercise 0011 — (not used) 0010 — Reverse Request 0001 — Do Not Revert 0000 — No Request **5678** — **Channel Number Code Assignment** 0000 — Null Channel 0001-1111 — Actual number (1-15)

Table 5-16. SONET Line Test Results (Continued)

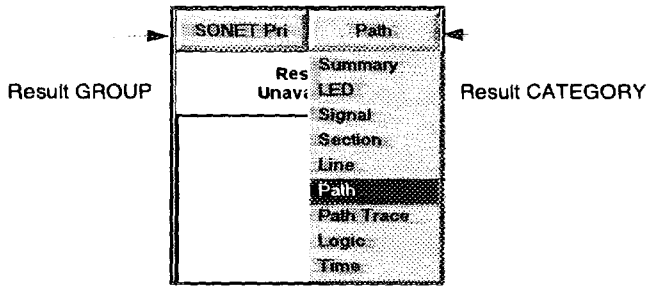
Displayed Test Result	Description
APS Switch Mode	***APS Switching Mode*** —This result displays the current protection switching mode. **K2 Bits 5678** — **Mode** 0xxx — Provisioned for 1+1 1xxx — Provisioned for 1:n x101 — Bidirectional switching x100 — Unidirectional switching
Line BIP Errors	***Line BIP Errors*** — An error in the even parity line BIP-8 (B2) byte when used as a parity check against the preceding STS-1 frame less the SOH. Up to 8 BIP errors may be counted per STS-1 frame. Line BIP errors are defined for all STS-1s on an STS-n. In OC-3c mode, the 3 line BIPs from each STS-1 are treated as one 24 bit BIP and hence up to 24 BIP errors may be counted per OC-3c frame.
Line BIP Error Rate	***Line BIP Error Rate*** — Line BIP Errors/Total number of received bits in the previous STS-n frame less the SOH.The denominator of the message is the total number of non-section received bits instead of the number of BIPs so that the result is used to approximate overall received bit error rate. This approximation works on the assumption that only 1 bit error occurs per SONET frame per bit position (1-8 or 1-24 for OC-3c).
Line BIP Error Secs	***Line BIP Error Seconds*** — Counts the number of seconds in which one or more Line BIP errors occurred since initial SONET frame synchronization. The errored second interval is not synchronous to the occurrence of the BIP error.
Line SES	***Line BIP Severely Errored Seconds*** — Counts the number of seconds in which more than 2500 Line BIP errors occurred in 1 second for an STS-1, OC-1, or OC-3 signal; or more than 10,000 errors occurred for an OC-12 signal.
Line Unavailable Seconds	***Line Unavailable Seconds*** — Counts the number of seconds in which the line is not available based on counts of consecutive line severely errored seconds, or the presence of an AIS alarm.
Line AIS Seconds	***Line Alarm Indication Signal Seconds*** — Any asynchronous test second in which Line AIS was present for any portion of the test second.
Line FEBEs	***Line Far-End Block Errors*** — A FEBE count present in the Z2 byte.

Table 5-16. SONET Line Test Results (Continued)

Displayed Test Result	Description
Line FEBE Rate	***Line Far-End Block Rate*** — The ratio of line FEBEs to total number of received bits in the previous STS-n frame, less the SONET overhead.
SPE Pointer Justification	***SPE Pointer Justifications*** — Counts the number of times the synchronous payload envelope (SPE) pointer changed since initial SONET frame synchronization.
SPE Pointer Increments	***SPE Pointer Increments*** — Counts the number of times the pointer bytes (H1 and H2) indicated an increment to the path payload pointer since initial SONET frame synchronization.
SPE Pointer Decrements	***SPE Pointer Decrements*** — Counts the number of times the pointer bytes (H1 and H2) indicated a decrement to the path payload pointer since initial SONET frame synchronization.
SPE Pointer NDFs	***SPE Pointer New Data Flags*** — Counts the number of times the pointer bytes (H1 and H2) indicated an active new data flag (arbitrary change in pointer) since initial SONET frame synchronization. An active NDF occurs during a change in payload content, or after an AIS or some other failure condition. If a change in the pointer is detected for three consecutive frames, the change is counted as an NDF, even if the pointer never has an active NDF.
SPE Pointer Value	***SPE Pointer Value*** — Presents the current STS path pointer value from 0 to 782. *UNAVAILABLE* appears under a number of error conditions, such as line AIS, etc. *OUT OF RANGE* appears if the pointer value is outside 0 to 782.
SPE Pointer Size	***SPE Pointer Size Bits*** — Indicates the binary setting of the size bits in the SONET H1 byte. The normal setting for the pointer size bits is 00 to indicate a SONET payload. If the received bits are other than 00, the result appears in the SUMMARY category.

5.11 SONET PATH CATEGORY

Select **SONET Pri/Sec** from the Result GROUP pull-down menu and **Path** from the Result CATEGORY pull-down menu for SONET Path test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



The SONET Path Category test results are defined in Table 5-17

Table 5-17. SONET Path Test Results

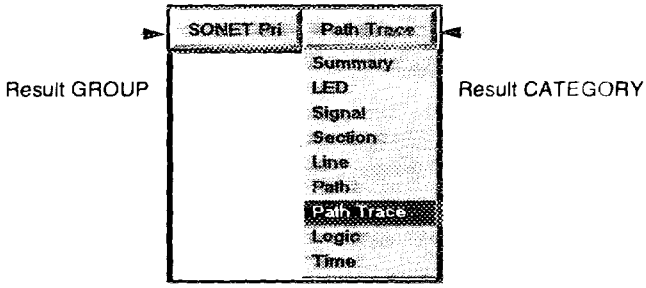
Displayed Test Result	Description
Path BIP Errors	***Path BIP Errors*** — An error in the even parity Path BIP-8 (B3) byte when used as a parity check against the preceding STS-1 frame less the SOH and LOH. Up to 8 BIP errors may be counted per STS-1 frame. Path BIP errors are defined for all STS-1s on an STS-n. In OC-3c mode, the 3 Path BIPs from each STS-1 are treated as one 24 bit BIP and hence up to 24 BIP errors may be counted per OC-3c frame.
Path BIP Error Rate	***Path BIP Error Rate*** — Derived from the number of times in which the Path BIP byte (B3) indicates an error in the previous frame since initial SONET frame synchronization. Path BIP Errors are divided by the total number of received bits in the previous STS-n frame less the SOH and LOH.
Path BIP Error Secs	***Path BIP Errored Seconds*** — Counts the number of seconds in which one or more Path BIP errors occurred since initial SONET frame synchronization. The errored second interval is not synchronous to the occurrence of the BIP error.
Path SES	***Path BIP Severely Errored Seconds*** — Counts the number of seconds in which 2500 or more Path BIP errors occurred since initial SONET frame synchronization.

Table 5-17. SONET Path Test Results (Continued)

Displayed Test Result	Description
Path Unavail Secs	***Path Unavailable Seconds*** — Counts the number of seconds in which the path is considered unavailable. It is an asynchronous test second in which a Path BIP Severely Errored Second was counted or Path AIS was present for any portion of the test second.
Path AIS Secs	***Path Alarm Indication Signal Seconds*** – An asynchronous test second in which Path AIS was present for any portion of the test second.
Path AIS/LOP Secs	***Path Alarm Indication Signal/Loss Of Pointer Seconds*** — Counts the number of seconds in which one or more Path AIS or LOP occurs.
Path LOP Secs	***Path Loss Of Pointer Seconds*** — Asynchronous test seconds in which Path LOP was present for any portion of the test second.
Path FEBEs	***Path Far-End Block Errors*** — A FEBE count present in the Z2 byte. Up to 8 FEBEs errors may be counted per STS-1 frame. Path BIP errors are defined for all STS-1s on an STS-n. In OC-3c mode, the 3 path BIPs from each STS-1 are treated as one 24 bit BIP and hence up to 24 BIP errors may be counted per OC-3c frame.
Path FEBE Rate	***Path Far-End Block Rate*** — The ratio of FEBEs to (1) the number of bits over which C-bit parity was calculated.

5.12 SONET PATH TRACE CATEGORY

SONET Path Trace enables one of three default or user-defined messages to be transmitted over the path trace byte (J1) of the inserted STS-1 signal. Select **SONET Pri/Sec** from the Result GROUP pull-down menu and **Path Trace** from the Result CATEGORY pull-down menu for test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



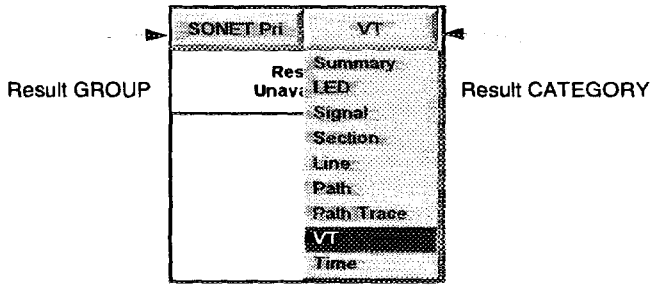
The SONET Path Trace Category test results are defined in Table 5-18

Table 5-18. SONET Path Trace Test Results

Displayed Test Result	Description
Path Trace	***Path Trace Message*** — Displays the 64-byte path trace ASCII message which is carried in the path overhead byte (J1).
STS Path Signal Label	***STS Path Signal Label*** — Presents the payload type being carried in the current position of the current STS. The information is derived from the Path signal label (C2) and VT overhead (V5) bytes. Any C2/V5 combinations which cannot be decoded appear as *UNRECOGNIZED*.

5.13 SONET VIRTUAL TRIBUTARY (VT) CATEGORY

The SONET Virtual Tributary overhead test results enable the T-BERD 2310 to analyze the SONET VT of a network. The results are only available when a SONET option is installed. Select **SONET Pri/Sec** from the Result GROUP pull-down menu and **VT** from the Result CATEGORY pull-down menu for SONET VT test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



The SONET VT Category test results are defined in Table 5-19.

Table 5-19. SONET Virtual Tributary Overhead Category Test Results

Displayed Test Result	Description
VT BIP Errors	***Virtual Tributary Bit Interleaved Parity (BIP) Errors*** — Counts the number of times in which the VT BIP byte (V5, Bits 1 and 2) indicates an error in the received signal. A maximum of two VT BIP errors can be counted in each SONET frame.

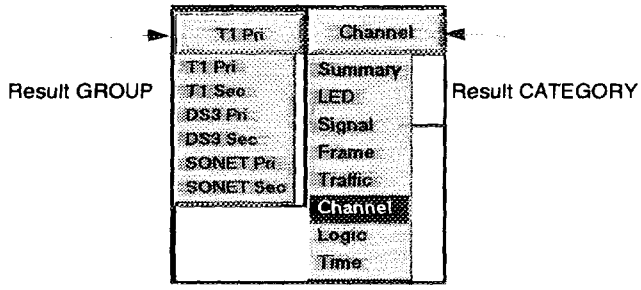
Table 5-19. SONET Virtual Tributary Overhead Category Test Results (Continued)

Displayed Test Result	Description
VT BIP Error Rate	***Virtual Tributary BIP Error Rate*** — Ratio of VT BIP errors to the total of received bits in the previous VT frame.
VT BIP Error Secs	***Virtual Tributary BIP Errored Seconds*** — Counts the number of seconds in which one or more VT BIP errors, an AIS, or VT LOP occurred.
VT SES	***Virtual Tributary BIP Severely Errored Seconds*** — Counts the number of seconds in which 600 or more VT BIP errors occurred during a single second.
VT Unavail Secs	***Virtual Tributary Unavailable Seconds*** — Counts the number of seconds in which the VT path is unavailable. It is an asynchronous test second in which a Path BIP Severely Errored Second was counted or Path AIS was present for any portion of the test second.
VT AIS/LOP Secs	***Virtual Tributary Alarm Indication Signal/Loss Of Pointer Seconds*** — Counts the number of seconds in which one or more VT AIS or LOP occurs.
VT FEBE	***Virtual Tributary FEBE*** — Counts the number of VT BIP errors detected by the downstream PTE. It is calculated by summing the FEBE counter of the path status byte (V5, Bit 3) from each received VT superframe.
VT FEBE Rate	***Virtual Tributary FEBE Rate*** — Ratio of VT FEBEs to the total number of received bits in the previous VT frame.
VT Ptr Just	***Virtual Tributary Pointer Justifications*** — The occurrence of a VT pointer increment, a VT pointer decrement, or a VT pointer NDF.
VT Ptr Incs	***Virtual Tributary Pointer Increments*** — A increment of 1 in the SPE pointer that is recognized when a majority vote of the 5 D bits in the V1, V2 bytes indicate an inversion.
VT Ptr Decs	***Virtual Tributary Pointer Decrements*** — A decrement of 1 in the SPE pointer that is recognized when a majority vote of the 5 D bits in the V1, V2 bytes indicate an inversion.
VT Ptr NDFs	***Virtual Tributary Pointer New Data Flags*** — The presence of an NDF recognized by an invert of the 4 N Bits in the V1, V2 bytes, or the presence of an new SPE pointer that persists for 3 consecutive frames.
VT Ptr Value	***Virtual Tributary Pointer Value*** — Presents the current VT pointer value from 0 to 103. **Out Of Range** appears if the pointer value is outside 0 to 103.

5.14 CHANNEL CATEGORY

Results for tone analysis and tone noise analysis measurements are presented below. The VF measurements are categorized into the following result types:

Select appropriate rate from the Result GROUP pull-down menu and **Channel** from the Result CATEGORY pull-down menu for Channel VF and DDS test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



The Channel VF Category test results are defined in Table 5-20.

Table 5-20. Channel VF and DDS Category Test Results

Displayed Test Result	Description
81 VF Freq	***n81 Voice Frequency*** — The frequency (Hz) of a VF tone within a selected DS0 channel.
82 VF LVL	***n82 Voice Frequency Level*** — The level (dBm) of a VF tone within a selected DS0 channel.
3K NCH	***n84 3 kHz Flat Noise*** — A measure of the noise (dBm) weighted with a 3 kHz flat filter. Used when qualifying data-grad circuits.
85 NCH	***n85 3 kHz Notch Noise*** — A measure of the noise (dBrn) against a weighted 3 kHz flat filter. A transmitted 1004 Hz tone is filtered out prior to the measurement for analog data-grade analysis. This measurement includes quantization noise caused by analog/digital conversion in the CODEC.
n86C-MSG	***n86 C-Message Noise*** — A measure of the noise (in dBrnC) weighted with a C-Message filter for voice-grade analysis. This measurement determines the noise on an idle channel.

Table 5-20. Channel VF and DDS Category Test Results (Continued)

Displayed Test Result	Description
n87 C-NCH	***n87 C-Message Notch Noise*** — A measure of the noise (in dBrnC) against a weighted C-message filter. A transmitted 1004 Hz tone is filtered out prior to the measurement for voice-grade analysis.
n88 S/N	***n88 Signal-to-Noise Ratio*** — The ratio (in dB) of received signal level to noise level. The noise level is measured with a C-message filter and the transmitted 1004 Hz tone is filtered out prior to measurement.
Receive Byte	***DDS Received Byte*** — Displays the received 8-bit byte of the selected channel. If the received byte is recognized as a control code, the control code name is displayed in the RCODE result.
DDS Control Code	***DDS Control Code*** — Displays the name of the received DS0 code identified in the DDS Receive Byte (see Table 5-21).

The Reportable DS0 Control Codes are defined in Table 5-21.

Table 5-21. Reportable DS0 Control Codes

Code ID	Control Byte	Description
ASC	x001 1110	Abnormal Station Code. Generated by the OCU due to a signal loss from the DSU/CSU, the DSU/CSU isn't attached, or a faulty OCU.
C IDLE	x111 1110	Control Mode Idle. Equivalent to RTS set to OFF. Neither the customer nor the network is using the channel.
CHAN	x010 1000	Alternating Channel (CSU) Loopback.
D IDLE	x111 1111	Data Mode Idle. Equivalent to RTS set to ON, but no data is being sent by the computer.
DSU	x010 1100	Alternating DSU Loopback.
FEV	x101 1010	Far End Voice Byte. Last (Fourth) byte sent in latching loop up sequence.
LBE	x101 0110	Loopback Enable. Third byte sent in the latching loop up sequence.
MA	x111 0010	MJU Alert Code. Second byte sent during an MJU loop up sequence.
MAP0	x001 0011	MAP 0 Confirmation Code (line/T1 side). Sent by the second DS0-DP being looped.
MAP1	x110 1101	MAP 1 Confirmation Code (drop/DS0 side). Sent by the first DS0-DP being looped.
MOS	x001 1010	Multiplexer Out of Synchronization. Sent by SRMU when it loses subrate frame synchronization.
OCU	x010 1010	Alternating OCU Loopback.
RELEASE	x111 1000	MJU Release Code.

Table 5-21. Reportable DS0 Control Codes (Continued)

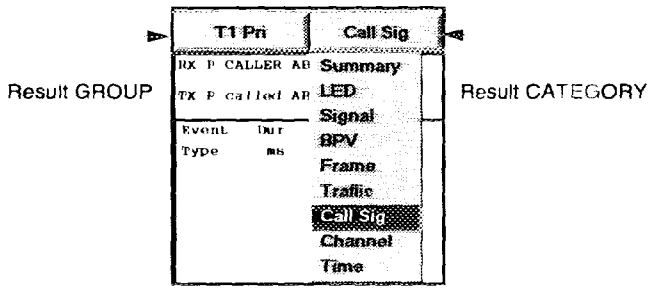
Code ID	Control Byte	Description
TA	x110 1100	Test Alert. First byte sent during an MJU loop up sequence.
TEST	x001 1100	Test Code. Sent in opposite direction during loop up.
TIP	x011 1010	Transition In Progress. First byte sent during a DDS latching loop up sequence. Also sent for DDS latching loop down.
UMC	x001 1000	Unassigned Multiplexer Channel. Sent by DS0-DP when no OCU-DP installed in channel bank.

x = a subrate framing bit when the byte is transmitted or received as a DS0B signal. Framing bit pattern determined by DS0B data rate.
x = a *don't care* mode when the byte is received at a DS0A subrate.
x = a 1 when the byte is transmitted at a DS0A subrate.
x = a 0 when control codes (except IDLE) are transmitted at DS0A 56 kb/s rate.
x = a *don't care* mode when control codes (except IDLE) are received at DS0A 56 kb/s rate.
x = a 1 when the IDLE code is transmitted or received at DS0A 56 kb/s rate.

5.15 CALL SIGNAL CATEGORY

Results for the Call Signal Category provide a means to scan signaling bit transitions on all channels of a duplex T1 circuit.

Select appropriate rate from the Result GROUP pull-down menu and **Call Sig** from the Result CATEGORY pull-down menu for Call Signal test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



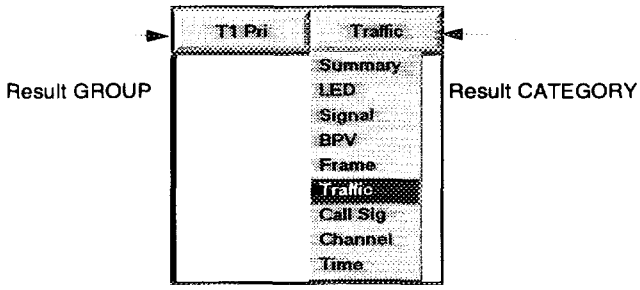
The Call Signal Category test result types are defined in Table 5-22.

Table 5-22. Call Signal Category Test Results

Displayed Test Result	Description
Signaling Delay	Measures the delay between the conclusion of the previous signaling event/digit and the start of the current signaling event/digit under examination. This result is applicable to all signaling events/digits in the chronological sequence except the first event/digit in the sequence.
Signaling Duration	Measures the duration of certain signaling events and all digits in the chronological sequence. This result is applicable for all interpretable digits received, and the signaling events ring, wink, and dial tone.This result is measured in milliseconds. Any result whose value is above 9999 milliseconds (~10 seconds) will be flagged as greater than 10 seconds.

5.16 TRAFFIC CATEGORY

Results for the Traffic Category provide a means to scan signaling bit transitions on all channels of a duplex T1 circuit. Select appropriate rate from the Result GROUP pull-down menu and **Traffic** from the Result CATEGORY pull-down menu for Traffic test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



The Traffic Category test result type is defined in Table 5-23.

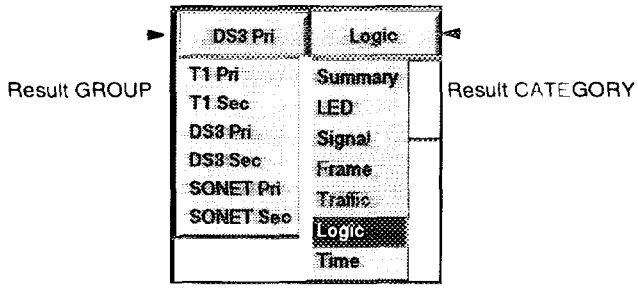
Table 5-23. Traffic Category Test Result Type

Displayed Test Result	Description
Signaling Bits	Provide the current ABCD signaling bits for either the Primary or Secondary receivers. This result is available during all T1 signaling tests with T1 frame synchronization. This result is measured as a group.

5.17 LOGIC CATEGORY

Logic errors are based on discrepancies between the transmitted and received bit stream. The accumulation of logic errors is dependent on frame synchronization (if in a framed mode) and pattern synchronization. Logic errors are not available until initial pattern synchronization is obtained. The results are also not available when sending loop codes. During loss of frame or pattern synchronization, the accumulation of errors is halted.

Select appropriate rate from the Result GROUP pull-down menu and **Logic** from the Result CATEGORY pull-down menu for Logic test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



5.17.1 DS1, DS3, and SONET Logic Category

As the received signal is recognized, the appropriate test result displays in the message window. All three rates (DS1/DS3/SONET) share the same test result messages. Therefore, the Logic Category test results are defined in Table 5-24.

Table 5-24. DS1, DS3, and SONET Logic Category Test Results

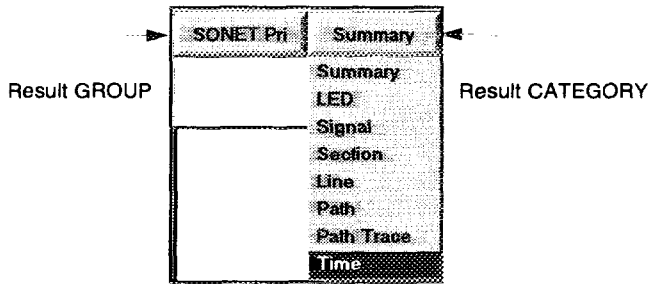
Displayed Test Result	Description
Pattern Losses	***Pattern Losses*** — The number of times the received pattern is lost relative to the expected (i.e., internally generated) test pattern.
Pattern Slips	***Pattern Slips*** — The number of times the received pattern becomes skewed relative to the expected (i.e., internally generated) test pattern. When a slip is detected, the T-BERD 2310 automatically re-synchronizes to the received pattern. However, pattern bit errors are not suppressed during this process. Pattern slips are available only when using pseudorandom patterns.
Bit Errors	***Bit Errors*** — The number of received pattern bits which have a value opposite that of the corresponding transmitted bit pattern since initial DS1 pattern synchronization.
Bit Error Rate	***Bit Error Rate*** — The ratio of pattern bit errors to received pattern bits since initially acquiring pattern synchronization.
Sync Loss Secs	***Out-of-Synchronization Loss Seconds*** — The number of seconds during which the receiver has lost pattern synchronization, even momentarily, since initial DS1 pattern synchronization.
Error Secs	***Errored Seconds*** — The number of seconds during which one or more pattern bit errors occurred since initial DS1 pattern synchronization.

Table 5-24. DS1, DS3, and SONET Logic Category Test Results (Continued)

Displayed Test Result	Description
Error-Free Secs	***Error-Free Seconds*** — Seconds during which no pattern bit errors are detected while DS1 pattern synchronization is present.
% Error-Free Secs	***Percentage of Error-Free Seconds*** — The ratio, expressed as a percentage, of seconds during which no pattern bit errors were detected, to the total number of seconds while DS1 pattern synchronization is present.

5.18 TIME CATEGORY

The TIME category lists current date, time, and timed results for DS1, DS3, and SONET. Select appropriate rate from the Result GROUP pull-down menu and **Time** from the Result CATEGORY pull-down menu for Time test results. Always select the signal rate from the Result Group (**T1 Pri/Sec, DS3 Pri/Sec, Son Pri/Sec**).



The Time category results are defined in Table 5-25.

Table 5-25. Time Category Test Results

Displayed Test Result	Description
Time	***Current Time of Day*** — The current time of day in hours, minutes, and seconds. The time is set through the FILE CABINET Softkey.
Date	***Current Date*** — The current day and month. The date is set through the FILE CABINET Softkey.
Elapsed Time	***Elapsed Time*** — The elapsed time in hours, minutes, and seconds since the last test restart.

6 SPECIFICATIONS

SECTION 6 SPECIFICATIONS

6.1 INTRODUCTION

This section contains the specifications for the T-BERD 2310 and its options.

6.2 GENERAL

Physical Characteristics:

Height:	7.5" (19 cm)
Width:	11.5" (29.2 cm)
Depth:	2.25" (5.7 cm)
Weight:	5 lb. (11.02 kg.)

Environmental Characteristics:

Temperature:	
Operating:	32°F to 113°F (0°C to +45°C)
Non-Operating:	-4°F to 158°F (-20°C to +70°C)
Humidity:	10% to 90% Relative Humidity, non-condensing
Shock and Vibration:	Meets IEEE-743

Electrical Characteristics:

Battery Type:	10.8 V Nickel-Metal Hydride (NiMH)
Operating Time:	Typically provides up to 1.5 hours performing DS3/DS1 tests. Typically provides up to 30 minutes performing SONET tests.
Recharging Period:	Maximum of 1.5 hours.
AC Adaptor:	19 VDC, 2.6 amps; 90-240 VAC, 45-65 Hz
Cable (used in specifying the input and/or output signal characteristics):	75 Ohm RG59 B/U cable, attenuation measured at 22.368 MHz is 5.7 ± 0.2 dB per 450 ft. of cable.

6.3 INPUT SPECIFICATIONS FOR DS1

Connector Type: Bantam jack

Frequency: 1.544 MHz ± 50 ppm

Impedance:

BRIDGE: 1000 ohms minimum

TERM: 100 ohms ±5%

DSX-MON: 100 ohms ±5%

Range:

BRIDGE: +6 to -35.0 dBdsx

TERM: +6 to -35.0 dBdsx

DSX-MON: -10 to -26.0 dBdsx of resistive loss

Jitter Tolerance:

Per Reference: Bell PUB 62411 - 1990

Accuracy:

Receive Level Measurement: From 6 dBdsx to -15 dBdsx, accuracy of ±1 dB
From -16 dBdsx to -30 dBdsx, accuracy of ±2 dB
From -31 dBdsx to -40 dBdsx, accuracy of ±3 dB

Simplex Current Measurement: ± 2% or ±2 mA up to 60 mA
± 3% or ±3 mA up to 61 mA to 175 mA

Receive Frequency Measurement: ± 3 ppm ±1 ppm per year

6.4 OUTPUT SPECIFICATIONS FOR DS1

Connector Type:	Bantam jack
LBO Level:	Line build-out of 0, -7.5, -15.0, and -22.5 dB of cable loss at 772 Hz
LBO Tolerance:	± 2 dB for -22.5 at 772 kHz ± 1 dB for 0, -7.5 and -15 at 772 kHz.
Internal Timing:	± 3 ppm ± 1 ppm per year ± 1 ppm per year
Line Codes:	AMI or B8ZS
Error Insert Type:	Logic, BPV, or Frame
Pulse Shape:	Per applicable specifications

6.5 INPUT SPECIFICATIONS FOR DS3 AND STS-1

Input Connector: Two WECO 560A connectors.

Input Level Range: HIGH — Accepts a nominal signal level of 1.2 Vp (0 feet of cable attenuation from a HIGH source). With cable attenuation, accepts signal levels from +5dB (-450 feet) of gain to -5 dB (450 feet) of loss from the nominal signal level (1.2 Vp). With resistive attenuation, accepts signal levels from +5 dB of gain to -28 dB of loss from the nominal signal level (1.2Vp).

DSX — Accepts a nominal signal level of 0.6 Vp (450 feet of cable attenuation from a HIGH source). With cable attenuation, accepts signal levels from +5 dB (-450 feet) of gain to -5dB (450 feet) of loss from the nominal signal level (0.6 Vp). With resistive attenuation, accepts signal levels from +6 dB of gain to -26 dB of loss from the nominal signal level (0.6 Vp).

LOW — Accepts a nominal signal level of 0.3 Vp (900 feet of cable attenuation from a HIGH source). With cable attenuation, accepts signal levels from +5 dB (-450 feet) of gain to -5 dB (450 feet) of loss from the nominal signal level (0.3 Vp). With resistive attenuation, accepts signal levels from +5 dB of gain to -5 dB of loss from the nominal signal level (0.3 Vp).

NOTE

The maximum signal that the T-BERD 2310 can recover without errors is 1.7 Vp. The minimum signal that the T-BERD 2310 can recover without errors is 0.025 Vp. The absolute maximum input signal level is 2.5 Vp.

Input Impedance: 75 ohms nominal, unbalanced to ground.

Jitter Tolerance: Exceeds TR-TSY-000499

6.6 OUTPUT SPECIFICATIONS FOR DS3 AND STS-1

Output Connector: One WECO 560A jack.

Output Level Range: HIGH — Nominal 1.20 Vp. DS3 Signal meets ANSI T1.102-1993, Table 5, and CCITT Recommendation G.703 for DS3 pulse mask when transmitted through 450 feet of coaxial cable (WECO 728A, RG59B/U, or equivalent). STS-1 pulse mask meets BELL CORE GR-253-CORE-1995 and the DS3 ANSI T1.102-1993.

DSX — Nominal 0.61 Vp. DS3 Signal meets ANSI T1.102-1993, Table 5, and CCITT Recommendation G.703, Section 5. The STS-1 signal meets ANSI T1.102-1993 and BELL CORE GR-253-CORE-1995.

LOW — Nominal 0.31 Vp. Signal is equivalent to a DSX signal transmitted through 450 feet of coaxial cable (WECO 728A, RG59B/U, or equivalent).

Output Impedance: 75 ohms nominal, unbalanced to ground.

Jitter Transfer: Per TR-TSY-000499

Frequency: DS3 = 44.736 MHz ± 10 ppm.

STS-1 = 51.84 MHz ± 3 ppm ± 1 ppm per year.

6.7 OPTICAL SPECIFICATIONS FOR OC-3/12

Optical Connector: 1 OC-3/12 Receive — FC, SC, or ST
1 OC-3/12 Transmit — FC, SC, or ST

Transmit Measurement Range:

Output Level:	- 8 dBm to -15 dBm
Eye Diagram:	Per BELL CORE GR-253-CORE-1995
Clock Frequency Accuracy:	± 3 ppm ± 1 ppm per year

Receive Measurement Range:

Receive Level Sensitivity:	- 8 dBm to -28 dBm
Frequency Range:	± 500 ppm
Frequency Measurement Accuracy:	± 3 ppm ± 1 ppm per year
Jitter Tolerance	Per BELL CORE GR-253-CORE-1995
Level Measurement:	
Range:	- 5 to -45 dBm
Accuracy:	± 2 dB
Resolution	± 0.1dB

NOTE

The receiver is a multimode compatible receiver so that it will work with multimode or single mode fiber. The transmitter is a single mode so that it will work with multimode or single mode fiber.

SECTION 7 TTC CUSTOMER SERVICES

7.1 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.

7.2 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.

7.3 SERVICES

7.3.1 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.

7.3.2 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.

7.3.3 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.

7.3.4 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.

7.4 WARRANTY INFORMATION

The warranties described herein shall apply to all commercially available TTC products. Any additional or different warranties shall apply only if agreed to by TTC in writing. These warranties are not transferable without the express written consent of TTC.

Hardware Warranty — TTC warrants that Hardware Product sold to customer shall, under normal use and service, be free from defects in materials and workmanship. The warranty period shall be three (3) years for mainframes and options (parts and labor), and (1) one year for accessories and field-replaceable batteries. If installation services have been ordered, the warranty period shall begin on the earlier of (1) completion of installation, or (2) thirty (30) days after shipment to Customer. If Installation Services have not been ordered, the warranty period shall begin upon shipment to Customer. Hereafter these periods of time shall be collectively referred to as the "Initial Warranty Period".

TTC's obligation and customer's sole remedy under this Hardware Warranty is limited to the repair or replacement, at TTC's option, of the defective product. TTC shall have no obligation to remedy any such defect if it can be shown: (a) that the Product was altered, repaired, or reworked by any party other than TTC without TTC's written consent; (b) that such defects were the result of customer's improper storage, mishandling, abuse, or misuse of Product; (c) that such defects were the result of customer's use of Product in conjunction with equipment electronically or mechanically incompatible or of an inferior quality; or (d) that the defect was the result of damage by fire, explosion, power failure, or any act of nature.

TTC warrants that Products returned to TTC for repair shall be warranted from defective materials and workmanship for one (1) year for the same repair issue, and ninety (90) days for a different repair issue from date of shipment from TTC to customer, or until the end of the Initial Warranty Period, whichever is longer. Risk of loss or damage to Product returned to TTC for repair or replacement shall be borne by customer until delivery to TTC. Upon delivery of such product, TTC shall assume the risk of loss or damage until that time that the product being repaired or replaced is returned and delivered to customer. Customer shall pay all transportation costs for equipment or software shipped to TTC for repair or replacement. TTC shall pay all transportation costs associated with returning repaired or replaced product to customer.

Software Warranty — TTC warrants that Software Products licensed to Customer shall, under normal use and service, and for a period of ninety (90) days from the date of shipment of the Software to Licensee (the "Warranty Period"), perform in all material respects in accordance with the published specifications for such Software as established by TTC. However, TTC does not warrant that the Software will operate uninterrupted or error free, operate in the combination with other software, meet Customer's requirements, or that its use will be uninterrupted.

TTC's obligation and Customer's sole and exclusive remedy under this Software Warranty is limited to, at TTC's option, either (i) correcting the material errors reported to TTC in writing by Customer during the Warranty Period and which TTC is able to reproduce, (ii) replacing such defective Software, provided that TTC received written notice of such defect within the Warranty Period, or (iii) provided that TTC received written notice of such defect within the Warranty Period, terminating the License and, upon return to TTC of the Software, Documentation and all other materials provided by TTC under the applicable License, providing Customer with a refund of all charges paid with respect thereto. TTC shall have no warranty obligations hereunder if (a) the Software is altered or modified or is merged with other software by Customer or any third party or (b) all or any part of the Software is installed on any computer equipment other than the Designated Server or used with any operating system for which the Software is not designed.

Services Warranty — TTC warrants that the Services provided by TTC, if any, shall be performed promptly, diligently and in a professional manner in accordance with the commercial standards of the industry. TTC shall not, however, be responsible for any delays that are not due to TTC's fault or negligence or that could not have reasonably been foreseen or provided against.

WARRANTY DISCLAIMER — FOR HARDWARE, SOFTWARE, AND/OR SERVICES FURNISHED BY TTC, THE FOREGOING WARRANTEES ARE IN LIEU OF ALL OTHER WARRANTEES AND CONDITIONS, EXPRESS OR IMPLIED. TTC SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, ON ANY HARDWARE, SOFTWARE, DOCUMENTATION OR SERVICES INCLUDING BUT NOT LIMITED TO WARRANTIES RELATING TO QUALITY, PERFORMANCE, NONINFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS THOSE ARISING FROM ANY COURSE OF DEALING, USAGE OR TRADE PRACTICE. UNDER NO CIRCUMSTANCES WILL TTC BE LIABLE FOR ANY INDIRECT OR CONSEQUENTIAL DAMAGES RELATED TO BREACH OF THIS WARRANTY.

7.4.1 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.

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