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Rev. A

T-BERD 211
T-CARRIER ANALYZER
OPERATING MANUAL

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SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION

This section provides an overview of Telecommunications Techniques Corporation's (TTC's) T-BERD 211 T-Carrier Analyzer. Emphasis is placed on the T-BERD 211's primary features and operational characteristics.

1.2 INSTRUMENT OVERVIEW

The T-BERD 211 is a portable test instrument that comprehensively analyzes T1 and T1C transmission systems. Used in the central office and in the field, the T-BERD 211 is used during circuit installation, acceptance testing, and fault isolation. In the central office, the T-BERD 211 can either generate and receive test patterns for out-of-service testing or monitor T1 and T1C circuits without service interruption. In the field, the instrument detects and isolates problems related to customer-owned equipment (e.g., Customer Service Unit (CSU)) and detects problems originating from the T1 span line; no CSU is required for span line testing.

The T-BERD 211 offers these key features and characteristics:

(1) **D4, ESF, and SLC*-96** framing patterns offer compatibility with a variety of framing formats. An unframed mode is also available for applications where framing is not required.

(2) **Summary Test Results** category displays key non-zero and "out-of-spec" results, eliminating the search through long lists of test results.

(3) **Automatic Configuration Mode** lets the T-BERD 211 configure to the proper line rate (T1 or T1C), framing, coding, and pattern. No set-up is required when monitoring live circuits.

(4) **Simultaneous Logic Error, Bipolar Violation, and Frame Error Analysis** with associated error rate, errored seconds, and percent error-free seconds calculations.

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(5) **Signal Analysis** with simplex current, signal level, timing slip, and recovered clock frequency measurements.

(6) **Jitter Analysis** with jitter wideband and highband measurements, and a Spectral Analysis option that displays the relative amount of jitter as a percentage of a specification mask. The T-BERD 211 also features a jitter alarm LED that immediately illuminates when jitter is present on the received T1 signal.

(7) **Pulse Shape Analysis** allows you to measure the height, width, rise time, fall time, overshoot and undershoot of a T1 pulse. Pulse shapes can also be measured for conformance to AT&T Compatibility Bulletin 119 or ANSI T1.403 Network Interface specifications.

(8) **Slips and Wander** measurements identify wander impairments or the potential for frame slips.

(9) **Logic, BPV, and Frame Error Insertion** enables the T-BERD 211 to simulate errors as they actually occur. Errors may be inserted singly, in a burst, or at variable rates.

(10) **RS-232 Printer/Remote Control Interface** allows you to print graphic displays (e.g., pulse shapes) and error analysis results, and to remotely control the T-BERD 211.

(11) **Results History Buffer** stores up to 6 sets of your most recent test results which can be viewed from the front panel.

(12) **All Zeros test pattern** allows the T-BERD 211 to test B8ZS and ZBTSI circuits where the zeros are encoded to meet specification requirements limiting excess zeros. When transmitting all zeros, the T-BERD 211 determines if the circuit is capable of transporting B8ZS encoded data.

(13) **Automated bridge tap detection test** allows the T-BERD 211 to more thoroughly evaluate a T1 span for bridge taps. The test automatically generates 21 test patterns which are monitored for errors. The T-BERD 211 displays the cumulative test results and which patterns experienced one or more bit errors on the front panel. It also provides a RESULTS printout which indicates the number of bit errors, errored seconds, and pattern synchronization seconds for each pattern.

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(14) **Automated multipattern test** simplifies testing by generating five standard T1 test patterns in 15 minutes, eliminating the need to perform individual tests with each pattern. The T-BERD 211 displays the cumulative test results for the test and which patterns experienced one or more bit errors on the front panel. It also provides a RESULTS printout which indicates the bit error, errored second, and pattern synchronization second results for each pattern.

(15) **Clear history and printer buffers function** allows the T-BERD 211 to clear the history and printer buffers of stored results.

(16) **Printer squelch function** automatically suspends the T-BERD 211 printouts when excessive alarm, error, and severely errored second conditions occur during a test.

(17) **Optional programmable long user pattern** allows a 1- to 2000-character hexadecimal pattern to be transmitted to determine circuit sensitivity to the pattern. The option also provides a minimum/maximum density stress pattern selectable from the front panel **PATTERN** switch (MIN/MAX test pattern).

(18) **Optional T1 ZBTSI encoded Extended Superframe Mode** allows the T-BERD 211 to transmit and receive ZBTSI (Zero Byte Time Slot Interchange) encoded ESF framed T1 data. The option also allows framing errors to be inserted in the ESFz F-bits or Z-bits.

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SECTION 2

INSTRUMENT DESCRIPTION

2.1 INTRODUCTION

This section describes the T-BERD 211 T-Carrier Analyzer controls, indicators, and connectors. Operating modes, test patterns, and Auxiliary functions are described in separate sections. The test result measurements are also discussed.

2.2 CONTROLS, INDICATORS, AND CONNECTORS

This section describes the T-BERD 211 front panel controls, indicators, and connectors. The side panel power switch and connectors are also discussed. Figure 2-1 shows the T-BERD 211 front panel. The numbers for each item in Figure 2-1 correspond to the bracketed numbers in the following sections.

2.2.1 Display

Operating modes, test results, test patterns, and auxiliary functions are displayed in the three section, two-line, green fluorescent display. The first section (left side) indicates the current operating mode (top line labeled MODE) and test pattern (bottom line labeled PATTERN) of the instrument. The displayed information is selected by pressing the **MODE** [1] and **PATTERN** [2] switches. The other two sections display the test results, auxiliary functions, and signal detection and operating mode status messages. The middle display is identified as the RESULTS I display and the right display is identified as the RESULTS II display. The RESULTS I display is controlled by the two **RESULTS I** switches [3] just below the display. The RESULTS II display is controlled by the two **RESULTS II** switches [5] just below the display. When the auxiliary functions are displayed, the two displays identify the function of the **RESULTS** switches (see Section 2.2.2, **MODE** switch, AUX mode).

2.2.2 Controls and Indicators

The T-BERD 211 features two basic types of switches: rocker switches and pushbutton switches. The rocker switches use LEDs, labels, and the

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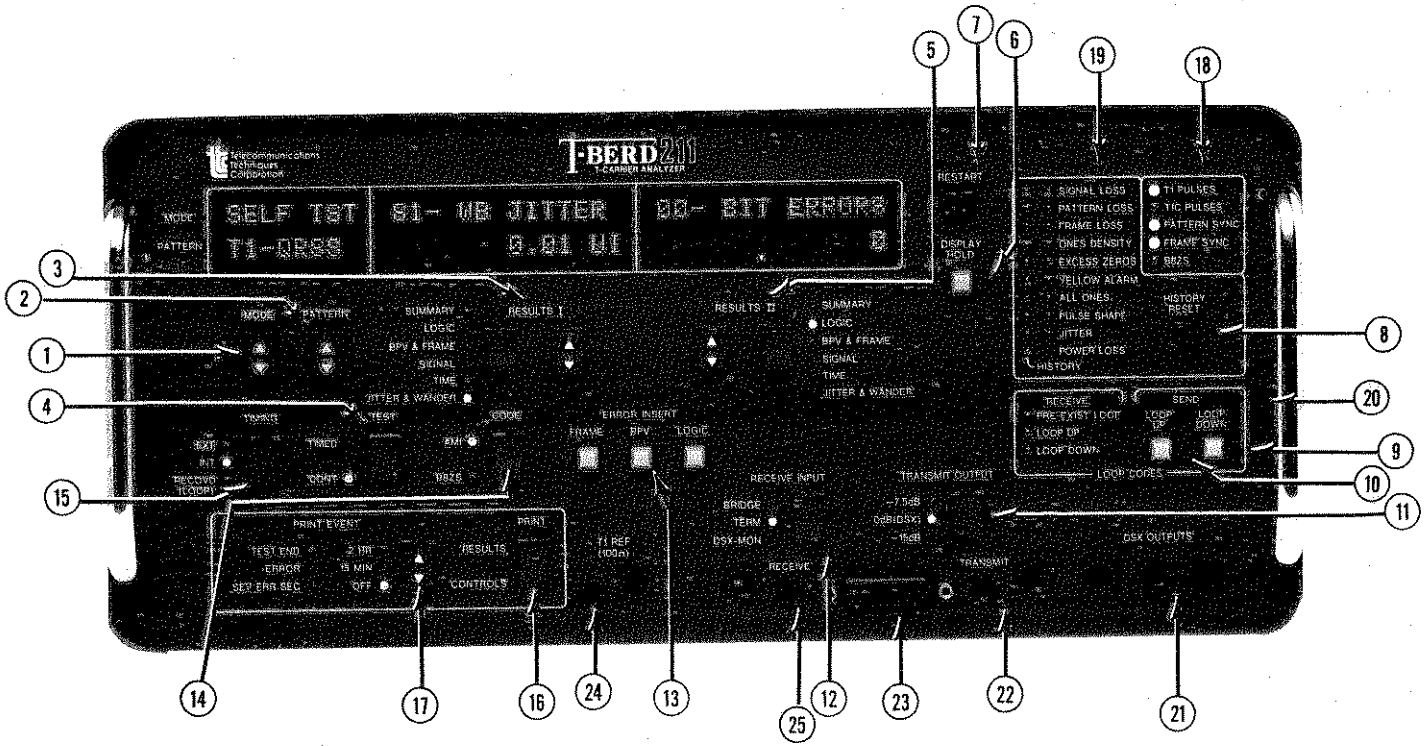

Figure 2-1
T-BERD 211 Front Panel

display to indicate the position of the switch, such as the **RESULTS I** switches. When an operating mode is selected (e.g., T1 D4), pressing the left **RESULTS I Category** switch selects the category listed to the left of the switch; the LED illuminates and the category test results are displayed in the RESULTS I display. Pressing the right **RESULTS I Results** switch scrolls the selected category results in the RESULTS I display.

The pushbutton switches are press and release (**RESTART** switch [7]) and/or press and hold (**ERROR INSERT** switches [13]) type switches. Several pushbutton switches feature LEDs inside the switch which illuminate showing the condition of the switch, such as the **DISPLAY HOLD** switch [6]. Pressing the **DISPLAY HOLD** switch turns the LED inside the switch on and off.

Aside from the display and switch LEDs, the T-BERD 211 also uses LEDs to indicate the status of the received signal. The Alarm [19] and Received Signal Status [18] LEDs provide information on the condition of the received signal.

The following information describes the T-BERD 211 front panel controls and indicators. The operating modes, auxiliary functions, and test patterns mentioned are discussed in greater detail is separate sections following this section.

MODE Switch [1]

The **MODE** switch selects the framing format (i.e., D4, ESF, SLC, or unframed) and data rate (i.e., T1 or T1C) of the transmitted data and tells the receiver what to expect; configures the T-BERD 211 for Line and Test Loopback modes for CSU or repeater loopback emulation; sets the instrument in a self-test mode to verify instrument operation; or selects an auto-configure mode which allows the instrument to automatically configure itself to the received data rate and framing format. The switch also provides access to a number of auxiliary functions.

When selecting an operating mode (e.g., T1 D4), the operating mode appears in the display MODE line immediately above the switch; the instrument is configured for that mode; and the test result categories are accessible through the **RESULTS I** and **RESULTS II** switches and displays. The selected operating mode remains in effect until another operating mode is selected. However, when the AUX mode is displayed, the Auxiliary functions are accessible (see Section 2.4), and the previously selected operating mode remains in effect.

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Pressing the **MODE** switch once steps the display between the current operating mode and the AUX mode, and vice versa. Pressing the **MODE** switch quickly two or more times allows the AUX mode to be skipped. Holding the **MODE** switch in scrolls the operating modes and AUX in the display. Releasing the **MODE** switch on a displayed mode or AUX selects that mode. With the exception of the AUX mode, the following operating modes are listed in factory default order.

NOTE: With the exception of AUX mode, changing modes causes a test restart 0.75 seconds after the **MODE** switch is released.

(a) **SELF TST** Self Test Mode
(b) **AUTO** Automatic Configure Mode
(c) **T1** T1 Unframed Mode
(d) **T1 D4** T1 D4 Superframe Mode
(e) **T1 ESF** T1 Extended Superframe Mode
(f) **T1 ESFz** Optional T1 ZBTSI encoded Extended Superframe Mode
(g) **T1 SLC** T1 Subscriber Loop Carrier Mode
(h) **T1 TLB** T1 Test Loopback Mode
(i) **T1 LLB** T1 Line Loopback Mode
(j) **T1C** T1C Unframed Mode
(k) **T1C TLB** T1C Test Loopback Mode
(l) **AUX** Auxiliary Mode

PATTERN Switch [2]

The **PATTERN** switch selects the data pattern to be transmitted and informs the receiver which data pattern to expect. Press the **PATTERN** switch to scroll through the available data patterns; the test pattern names appear in the display PATTERN line above the switch. Select a test pattern by releasing the switch when the desired pattern appears in the display. The following test patterns are listed in factory default order.

NOTE: Changing data patterns causes a test restart.

(a) **ALL ONES** All Ones Pattern
(b) **1:1** Alternating Ones and Zeros Pattern
(c) **1:7** A One and Seven Zeros Pattern
(d) **3 IN 24** Three Ones In 24-Bits Pattern
(e) **T1-QRSS** T1 Quasi-Random Signal Source Pattern
(f) **T1C-QRSS** T1C Quasi-Random Signal Source Pattern

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(g)	**2^{15}-1**	32,767-Bit Pseudorandom Pattern
(h)	**2^{20}-1**	1,048,575-Bit Pseudorandom Pattern
(i)	**2^{23}-1**	8,388,607-Bit Pseudorandom Pattern
(j)	**BRIDGTAP**	Bridge Tap Detection Test Pattern Sequence
(k)	**MULTIPAT**	Multipattern Test Pattern Sequence
(l)	**MIN/MAX**	Minimum/Maximum Density Stress Test Pattern
(m)	**LUP**	Programmable Long User Pattern
(n)	**USER1**	User 1 Programmable 3- to 24-Bit Pattern
(o)	**USER2**	User 2 Programmable 3- to 24-Bit Pattern
(p)	**ALL ZERO**	All Zeros Pattern

RESULTS I Switches [3]

The two **RESULTS I** switches provide access to the test result categories, category results, and Auxiliary functions. Pressing the left switch, **RESULTS I Category** switch, selects one of the six results categories: SUMMARY, LOGIC, BPV & FRAME, SIGNAL, TIME, and JITTER & WANDER. The category LEDs next to the **RESULTS I Category** switch illuminate as the switch is pressed.

Pressing the right switch, **RESULTS I Results** switch (with the arrows), selects the results to be displayed in the RESULTS I display. Pressing the switch for more than 1 second, automatically scrolls the entire list. When the AUX mode is selected with the MODE switch, the **RESULTS I** and **II** switches are used to make selections in the displayed Auxiliary function. Refer to Section 2.4, Auxiliary Functions, for more information.

RESULTS II Switches [5]

The two **RESULTS II** switches, **RESULTS II Results** switch (with the arrows) and **RESULTS II Category** switch, control the test results that are viewed in the right RESULTS II display. Both switches are functionally identical to the **RESULTS I** switches. The **RESULTS II** switches and display enable a result in a second category to be displayed simultaneously with the **RESULTS I** switches and display.

RESTART Switch [7]

RESTART is a pushbutton switch that restarts any test in progress. When pressed, all test results and history LEDs are cleared. The **RESTART** switch can also be used to exit AUX mode and reenter the previous mode selection; a restart also occurs.

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DISPLAY HOLD Switch [6]

DISPLAY HOLD is a pushbutton switch that freezes the result displays and alarm and status LEDs at the moment the switch is pressed. When active, a LED within the switch illuminates indicating that the displayed results are not current. If the switch is pressed again while the LED is illuminated, the test results and LED displays are immediately updated.

ALARM LEDs [19]

The red LEDs illuminate on the occurrence of specific alarm conditions. When such a condition occurs, the LED remains illuminated for at least 100 ms. History LEDs are also provided for each alarm condition; these LEDs indicate the existence of an alarm condition during the test by illuminating after an alarm condition has cleared. The following describes the alarm LEDs and their functions.

(a) **SIGNAL LOSS** - Illuminates when no pulses are detected for 150 ms.

(b) **PATTERN LOSS** - Illuminates whenever 250 bit errors are counted in 1000 or less data bits, thereby signaling a loss of pattern synchronization. A pattern loss condition clears when pattern synchronization is reacquired.

(c) **FRAME LOSS** - Illuminates when 2 out of 5 F_t bits are detected in error for D4 or SLC-96 framing, or when 2 out of 5 framing bits are detected in error for ESF or ESFz framing.

(d) **ONES DENSITY** - Illuminates when the received data contains less than n ones in 8(n+1) bits, where n = 1 to 23. This is in conformance with the pulse density criteria specified in AT&T Technical Reference PUB62411 and ANSI T1.403 Network Interface specifications. Note that the 2^{15}-1, 2^{20}-1, 2^{23}-1, and the framed 3 IN 24 test patterns all cause this LED to illuminate.

(e) **EXCESS ZEROS** - When using AMI coding, LED illuminates when 16 or more consecutive zeros are detected in T1 modes, or when 34 or more consecutive zeros are detected in T1C modes. When using B8ZS coding, LED illuminates when eight or more zeros are detected.

(f) **YELLOW ALARM** - Illuminates when bit 2 of each DS0 channel has been forced to a zero for D4 or SLC-96 framing, or when the yellow alarm pattern (0000 0000 1111 1111) is detected in the

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4 kb/s data link for ESF framing or 2 kb/s data link for ESFz framing. This alarm condition applies to framed T1 signals only.

(g) **ALL ONES** - Illuminates when 2048 consecutive ones are detected for T1C or unframed T1 signals, or when 256 consecutive DS0 channels contain all ones for T1 framed modes.

(h) **PULSE SHAPE** - Illuminates when the pulse shape does not fit within the selected mask. Pulse shape measurements are available only when the signal level is 0 dBdsx ±4 dB for BRIDGE and TERM, or when the signal level is -20 dBdsx ±4 dB for DSX-MON. The LED does not illuminate when the signal is out of range.

(i) **JITTER** - When the Spectral Analysis Option is not installed or disabled, the LED illuminates when the wideband jitter measurement exceeds 5 UI or the highband jitter measurement exceeds 0.1 UI. With the Spectral Analysis Option enabled, the JITTER LED illuminates when the jitter exceeds the selected mask. When the Spectral Analysis Option is enabled and no jitter mask is selected, the JITTER LED is disabled.

(j) **POWER LOSS** - Illuminates when the T-BERD 211 is powered up, either after being manually turned off or after an accidental power loss. If a test is in progress at the time of a power loss, it is automatically restarted when power is regained. The LED remains illuminated either until the **HISTORY RESET** switch is pressed or until a major switch change (e.g, **MODE, PATTERN**, etc.) causes a test restart. If a printer is configured, a POWER DOWN PRINT results printout is generated when power is restored.

HISTORY RESET [8]

HISTORY RESET is a pushbutton switch that clears all history LEDs. Note that this switch does not restart a test, nor does it affect any of the current LEDs or accumulated test results. This switch is not operable when the **DISPLAY HOLD** switch is activated.

SIGNAL STATUS LEDs [18]

The green LEDs illuminate for at least 100 ms providing information about the status and type of signal being received. The following describes the LEDs.

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(a) **T1 PULSES** - Illuminates when a valid T1 signal is detected at the RECEIVE input connector.

(b) **T1C PULSES** - Illuminates when a valid T1C signal is detected at the RECEIVE input connector.

(c) **PATTERN SYNC** - Illuminates when pattern synchronization is achieved. Synchronization to a fixed pattern (ALL ONES, 1:1, 1:7, 3 IN 24, and two user-programmable patterns) is declared when 30 consecutive error-free bits are received. Synchronization to a pseudorandom pattern is declared upon the reception of 30 + n consecutive error-free bits for a pattern length of 2^n-1 (for the QRSS patterns, n = 20). The PATTERN SYNC LED is turned off when pattern synchronization is lost.

(d) **FRAME SYNC** - Illuminates when the T-BERD 211 achieves synchronization to the selected framing pattern within the T1 data stream. The selected framing pattern is based on the currently selected mode (i.e., T1 D4, T1 ESF, T1 SLC, T1 TLB, or T1 LLB). In T1 TLB and T1 LLB modes, the T-BERD 211 automatically determines the framing type and configures itself to accept either unframed data, D4-framed data, ESF-framed data, or SLC-framed data.

(e) **B8ZS** - Illuminates when B8ZS clear channel codes are detected in the received T1 or T1C signal. When B8ZS code is detected in instances where the **CODE** switch is in the AMI position, the message B8ZS DETECTED is displayed in the SUMMARY results category. Refer to Section 2.5 for more information on the operation of the B8ZS LED and the ALL ZERO test pattern.

LOOP UP Switch [10]

This pushbutton switch controls the transmission of the loop-up code. The LED within the **LOOP UP** switch illuminates for the duration of loop-code transmission. The switch is disabled in T1 TLB, T1 LLB, and T1C TLB modes. The type of loop-up code transmitted is controlled by the AUX LP CODE and AUX ESF LOOP functions (see Section 2.4.24 and 2.4.25). When the **LOOP UP** switch is pressed, loop-up code is continuously transmitted until one of the following conditions occurs:

(a) The loop-up code is detected at the receiver.

(b) The **LOOP UP** switch is pressed again.

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(c) The **MODE, PATTERN, RESTART, RECEIVE INPUT**, or **TIMING** switch is pressed.

When the **LOOP UP** switch is pressed, the inband loop-up code overrides the selected data pattern and the selected loop-up code name appears in the display PATTERN line. When the loop code transmission is terminated, the test pattern reappears in the display. If the ESF out-of-band loop code is selected (see AUX ESF LOOP, Section 2.4.25), the loop code is transmitted in the data link channel and does not overwrite the test pattern.

LOOP DOWN Switch [9]

This pushbutton switch controls the transmission of the loop-down code. The LED within the **LOOP DOWN** switch is illuminated for the duration of loop-code transmission. The switch is disabled in T1 TLB, T1 LLB, and T1C TLB modes. The type of loop-down code transmitted is controlled by the AUX LP CODE and AUX ESF LOOP functions (see Section 2.4.24 and 2.4.25). When the **LOOP DOWN** switch is pressed, loop-down code is continuously transmitted until one of the following conditions occur:

(a) The loop-down code is no longer detected at the receiver.

(b) The **LOOP DOWN** switch is pressed again.

(c) The **MODE, PATTERN, RESTART, RECEIVE INPUT,** or **TIMING** switch is pressed.

When the **LOOP DOWN** switch is pressed, the inband loop-down code overrides the selected data pattern and the selected loop-down code name appears in the display PATTERN line. When the loop code transmission is terminated, the test pattern reappears in the display. If the ESF out-of-band loop code is selected (see AUX ESF LOOP, Section 2.4.25), the loop code is transmitted in the data link channel and does not overwrite the test pattern.

RECEIVE LOOP CODES Status LEDs [20]

The LEDs provide information about loop codes being received by the T-BERD 211. The following Auxiliary functions affect the operation of the LEDs: AUX ESF LOOP, AUX LP CODE, AUX PGM LPDN, and AUX PGM LPUP (see Section 2.4). The following describes the loop-code LEDs and their functions.

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(a) **PRE-EXIST LOOP** - Illuminates when an inband loop-up code is detected within 1.5 seconds from the start of loop-up code transmission. This LED remains illuminated for 5 seconds. When a pre-existing loop is detected, the transmission of the inband loop-up code is immediately halted. The LED is disabled when the ESF out-of-band (data link) loop code is selected (see AUX ESF LOOP, Section 2.4.25).

(b) **LOOP UP** - Illuminates when an inband or ESF out-of-band loop-up code is received by the T-BERD 211. The presence of a loop-up code can be detected when the error rate is 10^{-3} or less. It can also be detected with or without the presence of T1 framing.

(c) **LOOP DOWN** - Illuminates whenever an inband or ESF out-of-band loop-down code is received by the T-BERD 211. Like the loop-up code, the presence of a loop-down code can be detected when the error rate is 10^{-3} or less. It can also be detected with or without the presence of T1 framing.

TRANSMIT OUTPUT Switch [11]

TRANSMIT OUTPUT is a three-position switch that allows emulation of three different line buildouts (LBO) for T1 rates (-7.5dB, 0dB(DSX), and -15dB). The selected cable loss affects the transmit data only at the 15-pin D connector, and the TRANSMIT bantam and 310 jacks; the DSX outputs are unaffected. The position of the switch is indicated by the illumination of the appropriate LED. When the **MODE** switch is set to T1C, the 0dB (DSX) position is automatically selected.

RECEIVE INPUT Switch [12]

RECEIVE INPUT is a three-position switch that allows the selection of input impedance and signal conditioning (BRIDGE, TERM, and DSX-MON). Changing the **RECEIVE INPUT** switch position causes a test restart.

(a) **BRIDGE** - Provides an input impedance greater than 1000 ohms for bridging lines that are already terminated. The BRIDGE setting provides Automatic Line Buildout (ALBO) compensation for cable losses of up to 35 dB for T1 and 6 dB for T1C lines. This is useful for bridging directly across copper cable pairs.

(b) **TERM** - provides an input impedance of 100 ohms. The TERM setting provides ALBO compensation for cable losses of up to

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35 dB for T1 and 6 dB for T1C lines. This is useful for terminating a circuit with the T-BERD 211.

(c) **DSX-MON** - Provides both 100 ohms of input impedance and compensation for resistive loss. DSX-MON is useful for monitoring T1/T1C lines at DSX monitor points which are resistor-isolated. When ALBO is not desired, the line can be terminated with this selection.

ERROR INSERT Switches [13]

The three **ERROR INSERT** switches, **FRAME, BPV,** and **LOGIC**, insert frame errors, BPVs, and logic errors into the data stream individually or simultaneously. The error insertion duration and rate are selected through the following Auxiliary functions:

(a) **AUX ERR SEL** - controls logic and BPV error burst duration (single and bursts from 25 ms to 5 sec).

(b) **AUX FRM ERR** - controls consecutive frame error insertion (single and 2 to 6 consecutive frame errors) and ESFz errored bit type (frame or Z-Bit).

(c) **AUX ER RATE** - controls BPV and logic continuous or burst error rate (from 1.0 E-2 to 9.9 E-9).

Refer to Section 2.4, Auxiliary Functions, for additional information on the error insertion auxiliary functions.

The Auxiliary functions allow frame errors, BPVs, and logic errors to be inserted in three ways: single error, burst of errors, and continuously. When the **ERROR INSERT** switches are pressed, an internal LED illuminates indicating the error insertion duration selected as follows:

(a) **Single error** - inserted by having the AUX ERR SEL or AUX FRM ERR function set for SINGLE ERROR and pressing the **ERROR INSERT** switch once. The switch LED flashes once indicating a single error was inserted.

(b) **Burst of logic or BPV errors** - inserted by having AUX ERR SEL set for a specified duration, AUX ER RATE set for a specified error rate, and pressing the **LOGIC** or **BPV ERROR**

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INSERT switch once. The **LOGIC** or **BPV** switch LED flashes twice indicating a burst of logic or BPV errors were inserted at the specified duration and rate.

(c) **Consecutive frame errors** - inserted by having AUX FRM ERR set for a specified number of consecutive frames errors and pressing the **FRAME ERROR INSERT** switch once. The **FRAME** switch LED flashes twice indicating consecutive frame errors were inserted.

(d) **Continuous errors** - inserted by pressing the **ERROR INSERT** switches for more than 2 seconds. The switch LED flashes then illuminates continuously until the switch is pressed again. The continuous error rate is controlled by AUX ER RATE for BPVs and logic errors and AUX FRM ERR for frame errors. Pressing the illuminated **ERROR INSERT** switch again turns the error insertion off.

The **FRAME** switch causes logic errors to be inserted on transmitted synchronization bits, i.e., F_t bits in D4 and SLC, and Frame Pattern Sequence (FPS) bits in ESF. When ZBTSI encoded data is received, the **FRAME** switch is disabled in the T1 TLB, T1 LLB, and AUTO LLB modes.

The **BPV** switch causes bipolar violation (coding) errors to be inserted on any of the transmitted bits. The **LOGIC** switch causes logic errors to be inserted on any of the transmitted bits. Logic and BPV errors can be inserted in all transmitted data except when T1 LLB mode is selected. When inserting logic errors and BPVs, errors are inserted without regard to B8ZS sequences. This may cause the same error multiplication (one inserted error causing multiple errors) that occurs on a repeatered span.

PRINT Switch [16]

This is a two-position switch that initiates a test results and front panel controls printout whenever either position is pressed. The RESULTS position initiates a printout of the current test results. The CONTROLS position initiates a printout of the current T-BERD 211 configuration. Refer to Section 5, Printer/Remote Control Interface for additional information on printing RESULTS and CONTROLS printouts.

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PRINT EVENT Switch [17]

This is a six-position switch which determines the events that automatically initiate a results printout. Refer to Section 5, Printer/Remote Control Interface for additional information on printing RESULTS and alarm printouts.

(a) **OFF** - No status or alarm messages are printed; all other positions enable the printing of status and alarm messages. Only manual prints can be initiated using the **PRINT** switch [16].

(b) **TEST END** - If the T-BERD 211 is set for a timed test (selected by the **TEST** switch [4]), the results are printed when the test interval has expired. The test interval is controlled through AUX TEST LEN (see Section 2.4.22).

(c) **ERROR** - Results are printed when any of the following events occur: Logic errors, CRC errors, frame errors, BPVs, or changes in alarm conditions.

(d) **SEVERELY ERROR SEC** - Results are printed when the bit error rate exceeds 10^{-3}.

(e) **2 HR** - Results are printed every 2-hours.

(f) **15 MIN** - Results are printed every 15-minutes.

CODE Switch [14]

CODE is a two-position switch that determines whether the T-BERD 211 transmits with normal AMI-encoded data or B8ZS clear-channel encoding. The LEDs adjacent to the switch illuminate indicating the current selection. The **CODE** switch only affects the transmitter; B8ZS decoding is performed automatically on the receiver. The B8ZS status LED illuminates when zero substitution codes are detected. When B8ZS code is detected in instances where the **CODE** switch is set to the AMI position, the message B8ZS DETECTED is displayed in the SUMMARY results category. When the optional ZBTSI (T1 ESFz) mode is selected, the **CODE** switch is disabled.

TEST Switch [4]

This two-position switch controls test duration. The CONTINUOUS TEST position enables unlimited test duration. The TIMED position

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allows a timed test of up to 200 hours and 59 minutes to be conducted. The factory default setting is 200 hours. Changing from CONTINUOUS TEST to TIMED TEST causes a test restart; however, changing from TIMED TEST to CONTINUOUS TEST allows the test to continue (i.e., test results continue to accumulate). Refer to AUX TEST LEN to set the timed test duration (see Section 2.4.22).

TIMING Switch [15]

This is a three-position switch that selects the transmit timing source. The labeled LEDs, EXT, INT, and RECOVD (LOOP), illuminate showing the current position of the switch. In Self-Test mode, timing is automatically set to INT regardless of the current setting. In T1 TLB, T1 LLB, AUTO LLB, and T1C TLB modes, timing is automatically set to RECOVD regardless of the current setting of the **TIMING** switch.

(a) **EXT** - The T-BERD 211 takes transmit timing from either the external clock source attached to the BNC connector (EXT CLK IN) on the right side or from the T1 REF input on the front panel as follows:

When BNC Timing is:	And T1 REF Timing is:	The External Clock Source is:
Present	Not Present	BNC
Not Present	Present	T1 REF
Present	Present	BNC
Not Present	Not Present	Not available; EXT LED flashes

(b) **INT** - The transmit data is generated by the internal crystal oscillator at either T1 or T1C rates (as selected by the **MODE** switch).

(c) **RECOVD (LOOP)** - The transmit timing source is taken from the clock signal recovered from the received data. When choosing recovered timing in any T1 mode (except for T1 TLB or T1 LLB), jitter is removed from the clock signal before it is used as the transmit clock source.

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2.2.3 Front Panel Connectors

The T-BERD 211 features several connectors on the front panel; these connectors are described below. The numbers for each item in Figure 2-1 correspond to the bracketed numbers in the following sections.

WARNING: If any of the connectors are used to connect the T-BERD 211 to a simplex powered span line, the line voltage is also present at the other connections. Therefore, do not use the other connections.

DSX OUTPUTS Jacks [21]

Three WECO 310 jacks provide additional DSX-level transmit outputs. Each output provides a 3-volt base-to-peak output into a 100-ohm load. Any or all 3 of these outputs can be used simultaneously; however, the TRANSMIT output connectors [22] should always be used first.

TRANSMIT Jacks [22]

Three primary transmit output connectors allow either a WECO 310 jack, a bantam jack, or a 15-pin D connector [23] to be used for connecting the T-BERD 211 transmit output to the circuit being tested. The line buildout circuit (T1 only) inserts artificial line sections with either 7.5 or 15 dB of loss at 772 kHz or bypasses the artificial lines, presenting a DSX-level output (see Section 2.2.2, **TRANSMIT OUTPUT** Switch [11]). These connectors also provide the simplex current path to the receiver input jack. Note that only one of these output connectors should be used as the output source at a given time.

NETWORK INTERFACE Connector [23]

This female, 15-pin D connector allows connection to the CSU or local loop. A 15-pin male-to-male cable is used to connect to the customer side of the CSU or to the local loop network interface connector. This connector is used in lieu of the TRANSMIT and RECEIVE jacks. Refer to Section 7, Specifications, for the connector pin assignments.

T1 REF Jacks [24]

T1 REF provides a WECO 310 or bantam jack to input a T1 reference clock to the T-BERD 211. This connector accepts resistively attenuated signals over the range +6 to -24 dBdsx (DSX MON jack or T-BERD 211 DSX OUTPUT jack), and is used in measuring timing slips and wander.

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It can also be used as an external timing source input when the **TIMING** switch is set to EXT (see **TIMING** switch [15], Section 2.2.2).

RECEIVE Jacks [25]

Three receive input connectors allow either a WECO 310 jack, a bantam jack, or a 15-pin D connector to receive the input signal. The **RECEIVE INPUT** switch determines whether the input is either terminated into 100 ohms or is bridged, and whether Automatic Line Buildout (ALBO) or Automatic Gain Control (AGC) circuits are used to accommodate signals attenuated by either cable or resistive circuits (see Section 2.2.2, **RECEIVE INPUT** Switch [12]). Note that only one of these connectors should be used as the receive input at a given time.

2.2.4 Side-Panel Power Switch and Connectors

The T-BERD 211 features a side-panel **POWER** switch and three connectors.

POWER Switch

The rocker switch applies and removes power to the T-BERD 211. When power is removed, the front panel configuration is retained in memory. Pressing the **MODE** switch when power is applied displays the software and hardware revision levels. Pressing the **RESTART** switch when power is applied defaults the instrument configuration to the factory defaults.

POWER Connector

A 3-pin receptacle is provided for 115 VAC 50/60 Hz operation; the safety ground connection is wired directly to the chassis. The line fuse compartment is located directly above the 3-pin receptacle and contains a spare fuse.

WARNING: Ground the instrument. To minimize shock hazard, the instrument chassis must be connected to an electrical ground. The instrument is equipped with a three-conductor AC power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adaptor with grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

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CAUTION: The T-BERD 211 should be operated with a 1A, 250V, SLO-BLO fuse installed (Littlefuse #218001 or equivalent). Always use correct fuse size.

EXT CLK IN Connector

The BNC connector (labeled EXT CLK IN) is used to input an external clock source. This clock source can be selected and used to generate data when the front panel **TIMING** switch is set to the EXT position. A reference clock for timing slips can also be input on this connector. This input is AC coupled and has a 50-ohm input impedance. Refer to the **TIMING** switch for more information on selecting the connector.

RS-232 Connector

The female 25-pin D connector serves as the RS-232 Printer/Remote Control interface connector. It is configured with DCE pin-outs to connect the T-BERD 211 to a printer, terminal, or computer. Refer to Section 7, Specifications, for the connector pin assignments.

2.2.5 Pull-out Reference Card

The T-BERD 211 features a pull-out card which furnishes quick reference information including: (1) a list of the available MODE and PATTERN selections; (2) a list of auxiliary functions with instructions on how they are set; and (3) a list of the available results, grouped by category and sorted by result number.

The card is stored below the front panel; to pull out the card, locate the small tab at the center of the bottom edge of the front panel and slide the card straight out. The card remains attached to the instrument but is hinged so that it may be folded down for better visibility when the instrument is resting on its back panel.

2.3 OPERATING MODES

The T-BERD 211 provides operating modes for testing T1 and T1C circuits. The operating modes allow the T-BERD 211 to be configured for unframed and framed pattern generation and reception; a thru mode where the received data is regenerated by the transmitter; an automatic configuration mode which allows the T-BERD 211 to automatically configure itself to the

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received data format; and a self-test mode which tests the T-BERD 211 by connecting the transmitter to the receiver. An Auxiliary mode is also provided which allows modification of additional parameters not controlled by dedicated front panel switches. The operating modes include:

2.3.1 SELF TST — Self Test Mode

SELF TST mode configures the T-BERD 211 in a self-test loopback mode which loops the transmit output to the receive input. In SELF TST mode, data is transmitted at the T1 rate with ESF framing. The **TIMING** switch [15] is automatically set for INTernal timing in SELF TST mode. When leaving SELF TST mode, the **TIMING** switch reverts to its previous position. Any test pattern can be selected.

2.3.2 AUTO — Automatic Configure Mode

AUTO mode enables the T-BERD 211 to automatically configure itself to the received line rate, framing format, and coding when monitoring live data. When auto-configuration is successful, both the received framing mode and pattern (only if the signal is recognized as a pattern) are displayed in lower-case letters in the display MODE and PATTERN lines. When the received signal is not recognized as a pattern, the word "live" appears in the display PATTERN line.

2.3.3 T1 — T1 Unframed Mode

T1 mode configures the T-BERD 211 to transmit and receive unframed T1 data for testing T1 unframed circuits or T1 circuits with proprietary framing formats. When the T1 unframe mode is selected, the **FRAME ERROR INSERT** switch [13] is disabled.

2.3.4 T1 D4 — T1 D4 Superframe Mode

T1 D4 mode configures the T-BERD 211 to transmit and receive D4 framed T1 data for testing D4 framed circuits. The T1 D4 mode is compatible with all superframe framing formats including: D1D, D2, and D3.

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2.3.5 T1 ESF — T1 Extended Superframe Mode

T1 ESF mode configures the T-BERD 211 to transmit and receive ESF framed T1 data for testing ESF framed circuits. For loopback testing, the AUX ESF LOOP function provides inband and ESF out-of-band loop code transmission capabilities in the T1 ESF mode (see **LOOP CODES** switches [9] and [10], Section 2.2.2, and Auxiliary Functions, Section 2.4.25).

2.3.6 T1 ESFz — Optional T1 ZBTSI encoded Extended Superframe Mode

T1 ESFz mode configures the T-BERD 211 to transmit and receive ZBTSI (Zero Byte Time Slot Interchange) encoded ESF framed T1 data when testing ZBTSI encoded circuits. For loopback testing, the AUX ESF LOOP function provides inband and ESF out-of-band loop code transmission capabilities in the T1 ESFz mode (see **LOOP CODES** switches [9] and [10], Section 2.2.2, and Auxiliary Functions, Section 2.4.25). When the T1 ESFz mode is selected, the AUX FRM ERR, T1 ESFz, function allows frame error insertion in either the ESFz F-bits or Z-bits (see **FRAME ERROR INSERT** switch [13], Section 2.2.2, and Auxiliary Functions, Section 2.4.15). This operating mode is optional and requires the ZBTSI Option (see Section 8, Options and Accessories).

2.3.7 T1 SLC — T1 Subscriber Loop Carrier Mode

T1 SLC mode configures the T-BERD 211 to transmit and receive SLC framed T1 data when testing SLC-96 framed circuits. The instrument ignores the SLC data link (F_s) bits in the received signal. The SLC data link bits are set to all zeros in the transmitted test pattern.

2.3.8 T1 TLB — T1 Test Loopback Mode

T1 TLB mode configures the T-BERD 211 in a T1 Test Loopback (TLB) mode in which all received data is echoed by the transmitter; this mode allows the T-BERD 211 to emulate a CSU in loopback. The T-BERD 211 also configures itself to the received framing (or unframed) mode. If the received data pattern matches the selected test pattern (i.e., T1-QRSS), pattern synchronization is declared; PATTERN SYNC LED illuminates. BPVs are removed from the received signal. However, BPVs, logic errors, frame errors, and B8ZS line code can be inserted into the retransmitted data stream using the **ERROR INSERT** switches and the **CODE** switch, respectively.

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When testing ZBTSI encoded data, the **FRAME ERROR INSERT** switch is disabled. To obtain logic error test results, the T-BERD 211 test pattern must be set to the received test pattern.

In the T1 TLB mode, the **LOOP CODES** switches are disabled. However, the RECEIVE LOOP CODES status LEDs indicate a received loop code (when AUX LP CODE matches the received loop code), but the T-BERD 211 does not respond to the loop codes (see **LOOP CODES** switches, Section 2.2.2). The **TIMING** switch [15] automatically defaults to RECOVD (LOOP) timing in T1 TLB mode.

2.3.9 T1 LLB — T1 Line Loopback Mode

T1 LLB mode configures the T-BERD 211 in a T1 Line Loopback (LLB) mode in which all received data is echoed by the transmitter; this mode allows the T-BERD 211 to emulate a repeater. The T-BERD 211 also configures itself to the received framing (or unframed) mode. If the received data pattern matches the selected test pattern (i.e., T1-QRSS), pattern synchronization is declared; PATTERN SYNC LED illuminates. BPVs are not removed from the received signal. All **ERROR INSERT** switches are disabled in this mode. Line coding is not selectable (see **CODE** switch, Section 2.2.2). To obtain logic error test results, the T-BERD 211 test pattern must match the received test pattern.

In the T1 LLB mode, the **LOOP CODES** switches are disabled. However, the RECEIVE LOOP CODES status LEDs indicate a received loop code (when AUX LP CODE matches the received loop code), but the T-BERD 211 does not respond to the loop codes (see **LOOP CODES** switches, Section 2.2.2). The **TIMING** switch [15] automatically defaults to RECOVD (LOOP) timing in T1 LLB mode.

2.3.10 T1C — T1C Unframed Mode

T1C mode configures the T-BERD 211 to transmit and receive unframed T1C data when testing T1C circuits. When the T1C mode is selected, the **FRAME ERROR INSERT** switch [13] is disabled. When T1C data is received, the T1C PULSES status LED illuminates.

2.3.11 T1C TLB — T1C Test Loopback Mode

T1C TLB mode configures the T-BERD 211 in a T1C Test Loopback (TLB) mode in which all received data is echoed by the transmitter; this mode

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allows the T-BERD 211 to emulate a CSU in loopback. The receiver only accepts unframed T1C data in this mode. BPVs are removed from the received signal. However, BPVs, logic errors, and B8ZS line code can be inserted into the retransmitted data stream using the **ERROR INSERT** switches and the **CODE** switch, respectively. To obtain logic error test results, the T-BERD 211 test pattern must match the received test pattern.

In the T1C TLB mode, the **LOOP CODES** switches are disabled. However, the RECEIVE LOOP CODES status LEDs indicate a received loop code (when AUX LP CODE matches the received loop code), but the T-BERD 211 does not respond to the loop codes (see LOOP CODES switches, Section 2.2.2). The **TIMING** switch [15] automatically defaults to RECOVD (LOOP) timing in T1C TLB mode.

2.3.12 AUX — Auxiliary Mode

AUX mode provides access to a number of auxiliary functions which have limited use during normal testing. When AUX is selected, the selected Auxiliary function is identified in the display PATTERN line. Pressing the **PATTERN** switch scrolls the available Auxiliary functions in the display. The displayed test results in the RESULTS I and RESULTS II displays are also replaced by the auxiliary function parameters. The **RESULTS I** and **RESULTS II** switches provide control over the Auxiliary functions.

Once the desired auxiliary function is displayed, modify the function parameters with the **RESULTS I** and **RESULTS II Results** switches to select the function or parameter displayed above them. Note that the use of these switches varies with each Auxiliary function. The display MODE line identifies the **RESULTS I** and **RESULTS II Results** switch functions. The Auxiliary functions are described in detail in Section 2.4, Auxiliary Functions. Table 2-1 lists the Auxiliary functions available through the AUX mode.

2.4 AUXILIARY FUNCTIONS

The Auxiliary functions are selected using the **MODE** switch. Pressing the **MODE** switch once from an operating mode, (e.g., T1 D4), automatically selects the AUX mode. When the AUX mode is displayed, the Auxiliary functions are selected by pressing the **PATTERN** switch. This section describes each of the Auxiliary functions, their uses, related Auxiliary functions, **RESULTS** switch functions, and setup procedures.

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Table 2-1
Auxiliary Functions

Displayed Name	Description
AUX USER1	User 1 Programmable Test Pattern
AUX USER2	User 2 Programmable Test Pattern
AUX RESPONSE	Loop Code Response Function
AUX PGM LPUP	Programmable Loop-up Code
AUX PGM LPDN	Programmable Loop-down Code
AUX BAUD	RS-232 Printer/Remote Control Baud Rate Select
AUX PARITY	RS-232 Printer/Remote Control Parity Select
AUX HALT/CONT	Action on Pattern Synchronization Loss
AUX PRNT FMT	Results Printout Format
AUX TERM	RS-232 Printer/Remote Control Line Terminator
AUX PLS MASK	Pulse Shape Measurement Mask Select
AUX RES HIST	Results History Buffer
AUX HIST CLR	Clear History and Printer Buffers
AUX ERR SEL	BPV and Logic Error Burst Duration Select
AUX FRM ERR	Frame Error Insertion Select
AUX ER RATE	BPV and Logic Error Insertion Rate
AUX JIT S/A*	Jitter Spectral Analysis Control
AUX JIT MASK*	Spectral Analysis Jitter Mask Select
AUX JIT TRIG*	Spectral Analysis Jitter Trigger Select
AUX CLOCK	Set Clock Time
AUX DATE	Set Date
AUX TEST LEN	Set Timed Test Length Duration
AUX GRAPH	Print Graph Function
AUX LP CODE	Loop Code Select
AUX ESF LOOP	ESF Loop Code Transmission Method
AUX LUP**	Programmable Long User Pattern

* Requires Spectral Analysis Option.
** Requires Long User Pattern Option.

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2.4.1 AUX USER1 — User 1 Programmable Test Pattern

AUX	FORWARD▲	REV▼	TOGGLE▲	END▼
USER1	1000000			
	RESULTS I		RESULTS II	

The AUX USER1 function enables a 3- to 24-bit user programmable test pattern to be entered. This allows the T-BERD 211 to transmit specific bit patterns to test circuit sensitivity to the pattern.

Pressing the **RESULTS I Results** switch, UP arrow, moves the cursor FORWARD from left to right. Moving the cursor (blinking bit) FORWARD past the last displayed bit automatically inserts a "0" in each new position up to 24 bits. Pressing the **RESULTS I Results** switch, DOWN arrow, moves the cursor in REVerse from right to left. Pressing the **RESULTS II Results** switch, UP arrow, TOGGLEs the bit between "1" and "0" at the cursor. Pressing the **RESULTS II Results** switch, DOWN arrow, ENDs or saves the bit pattern from the position of the cursor to the first bit on the left. Any bits to the right of the cursor are deleted when END is pressed.

The pattern is generated when USER1 is selected with the **PATTERN** switch and an operating mode is displayed. Pattern is transmitted from left to right as its displayed. A test restart only occurs when the pattern is saved and being transmitted at the same time. Perform the following procedure to enter a user programmable bit pattern.

(1) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX USER1.

(2) Press the **RESULTS I Results** switch to move the cursor FORWARD or REV. Move the cursor FORWARD to add bits.

(3) Press the **RESULTS II Results** switch, UP arrow, to TOGGLE the bit at the cursor to 1 or 0.

(4) Repeat Steps (2) and (3) until the desired bit pattern is displayed.

(5) Move the cursor to end of the desired bit pattern and press the **RESULTS II Results** switch, DOWN arrow, to END and save the bit pattern.

(6) Press the **MODE** switch to select operating mode and the **PATTERN** switch to select the USER1 test pattern. Selecting the test pattern restarts the test.

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2.4.2 AUX USER2 — User 2 Programmable Test Pattern

AUX	FORWARD▲	REV▼	TOGGLE▲	END▼
USER2	100000			
	RESULTS I		RESULTS II	

The AUX USER2 function is the same as AUX USER1 function. Refer to AUX USER1 for further information.

2.4.3 AUX RESPONSE — Loop Code Response Function

AUX	RESPONSE
RESPONSE	NO RESPONSE
	RESULTS I RESULTS II

The AUX RESPONSE function determines whether or not the T-BERD 211 enters automatic line loopback mode (AUTO LLB) in response to received loop codes. Press the **RESULTS I Results** switch to select the following:

NO RESPONSE - T-BERD 211 does not respond to received loop codes except to illuminate the RECEIVE LOOP CODES LOOP UP or LOOP DOWN LED.

AUTO RESPONSE - T-BERD 211 automatically responds to received loop codes by enabling or disabling the AUTO LLB mode. The instrument only responds to loop codes matching the loop code selected from the AUX LP CODE and AUX ESF LOOP functions (see Section 2.4.24 and 2.4.25).

In AUTO RESPONSE mode, T-BERD 211 enables AUTO LLB after receiving 5 seconds of inband loop-up code or after receiving 250 ms of ESF out-of-band loop-up code (see AUX ESF LOOP, Section 2.4.25). If the T-BERD 211 is set to T1C, T1C LLB, or T1 LLB mode, the T-BERD 211 does not respond to the received loop codes except to illuminate the LOOP CODES RECEIVE LOOP UP or LOOP DOWN LED. AUTO LLB is disabled after receiving the inband or ESF out-of-band loop-down code. When disabled, the instrument also returns to the previously selected operating mode. T-BERD 211 emulates a CSU in loopback. AUTO LLB functions the same as the T1 LLB operating mode.

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Consider the following functions when changing AUX RESPONSE:

(a) AUX LP CODE (select loop code type)
(b) AUX ESF LOOP (select ESF loop code transmission method)
(c) RECEIVE loop code LEDs

2.4.4 AUX PGM LPUP — Programmable Loop-up Code

AUX	FORWARD▲	REV▼	TOGGLE▲	END▼
PGM PLUP	10000			
	RESULTS I		RESULTS II	

The AUX PGM LPUP function enables a 3- to 8-bit user programmable loop-up code to be entered. This allows the T-BERD 211 to transmit loop codes other than the standard loop codes.

Pressing the **RESULTS I Results** switch, UP arrow, moves the cursor FORWARD from left to right. Moving the cursor (blinking bit) FORWARD past the last displayed bit automatically inserts a "0" in each new position up to eight bits. Pressing the **RESULTS I Results** switch, DOWN arrow, moves the cursor in REVerse from right to left. Pressing the **RESULTS II Results** switch, UP arrow, TOGGLEs the bit between "1" and "0" at the cursor. Pressing the **RESULTS II Results** switch, DOWN arrow, ENDs or saves the bit pattern from the position of the cursor to the first bit on the left. Any bits to the right of the cursor are deleted when END is pressed.

Loop-up code is generated when the **LOOP CODES LOOP UP** switch is pressed and PGM is selected with the AUX LP CODE function. Loop code is transmitted from left to right as displayed.

Perform the following procedure to enter a user programmable loop-up code:

(1) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX PGM LPUP.

(2) Press the **RESULTS I Results** switch to move the cursor FORWARD or REV. Move the cursor FORWARD to add bits.

(3) Press the **RESULTS II Results** switch, UP arrow, to TOGGLE the bit at the cursor to 1 or 0.

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(4) Repeat Steps (2) and (3) until the desired bit pattern is displayed.

(5) Move the cursor to the end of the desired bit pattern and press the **RESULTS II Results** switch, DOWN arrow, to END and save the bit pattern.

(6) Press the **PATTERN** switch to select AUX LP CODE and the **RESULTS I Results** switch to select PGM loop code. If testing in ESF mode, press the **PATTERN** switch to select AUX ESF LOOP and the **RESULTS I Results** switch to select loop-code transmission method, IN BAND or OUT OF BAND.

(7) Return to the operating mode, then press the **LOOP UP** switch. If loop up is successful, the RECEIVE LOOP UP LED illuminates for approximately 5 seconds and the **LOOP UP** switch LED illuminates then goes out.

Consider the following functions and modes when changing AUX PGM LPUP:

(a) **LOOP CODES** switches and RECEIVE LEDs
(b) AUX LP CODE
(c) AUX ESF LOOP
(d) AUX PGM LPDN

2.4.5 AUX PGM LPDN — Programmable Loop-down Code

AUX	**FORWARD▲ REV▼ TOGGLE▲ END▼**	
PGM PLUP	**10000**	
	RESULTS I	RESULTS II

The AUX PGM LPDN is the same as AUX PGM LPUP except that AUX PGM LPDN is used to program the loop-down code and the **LOOP DOWN** switch is used to send it. Refer to AUX PGM LPUP for further information.

2.4.6 AUX BAUD — RS-232 Printer/Remote Control Baud Rate Select

AUX	**BAUD RATE**	
BAUD	**2400 bps**	
	RESULTS I	RESULTS II

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The AUX BAUD function selects the baud rate for the RS-232 Printer/ Remote Control interface. Press the **RESULTS I Results** switch to select one of the following baud rates: 300 bps, 1200 bps, 2400 bps, and 4800 bps. For further information, refer to Section 5, Printer Operation.

Consider the following functions and modes when changing AUX BAUD:

(a) AUX PARITY
(b) AUX TERM
(c) RS-232-C Printer/Remote Control Interface
(d) Printer and remote control operation

2.4.7 AUX PARITY — RS-232 Printer/Remote Control Parity Select

AUX PARITY	PARITY NONE	
	RESULTS I	RESULTS II

The AUX PARITY function selects the parity for the RS-232 Printer/ Remote Control interface connector. Press the **RESULTS I Results** switch to select one of the following parity modes:

NONE — Disables parity but configures the data output for eight data bits. Parity must be set to NONE to print the pulse shape and jitter spectral analysis graphs (see AUX GRAPH, Section 2.4.23); graphics printers require eight data bits.

EVEN — Enables EVEN parity but configures the data output for seven data bits.

ODD — Enables ODD parity but configures the data output for seven data bits.

Consider the following functions and modes when changing AUX PARITY:

(a) AUX TERM
(b) AUX BAUD
(c) RS-232-C Printer/Remote Control Interface
(d) Printer and remote control operation

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2.4.8 AUX HALT/CONT — Action on Pattern Synchronization Loss

AUX	HALT/CONTINU	
HLT/CONT	HALT	
	RESULTS I	RESULTS II

The AUX HALT/CONT function determines how the LOGIC category results are accumulated during pattern synchronization loss. Changing AUX HALT/CONT during a test, restarts the test. Press the **RESULTS I Results** switch to select one of the following conditions:

HALT - Freezes all LOGIC category results when pattern synchronization is lost; the results resume counting when synchronization is reacquired.

CONTINUOUS - Error and slip counts continue throughout synchronization loss.

NOTE: When the optional LUP and MIN/MAX patterns are selected, the instrument defaults to the HALT mode.

2.4.9 AUX PRNT FMT — Results Printout Format

AUX	FORMAT	
PRNT FMT	SHORT FORMAT	
	RESULTS I	RESULTS II

The AUX PRNT FMT function selects the RESULTS printout format transmitted through the RS-232 Printer/Remote Control interface. Press the **RESULTS I Results** switch to select the following:

SHORT FORMAT - RESULTS printout lists a standard set of results with additional results that are mode specific.

SUMMARY PRINT - RESULTS printout lists SUMMARY category results.

NORMAL FORMAT - RESULTS printout lists all test results.

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Consider the following functions and modes when changing AUX PRNT FMT:

(a) RS-232-C Printer/Remote Control Interface
(b) Printer and remote control operation

2.4.10 AUX TERM — RS-232 Printer/Remote Control Line Terminator

AUX	TERMINATOR
TERM	CR
	RESULTS I RESULTS II

The AUX TERM function selects the line termination character transmitted through the RS-232 Printer/Remote Control interface. Press the **RESULTS I Results** switch to select either CR (Carriage return) or CRLF (Carriage return/linefeed).

Consider the following functions and modes when changing AUX TERM:

(a) AUX PARITY
(b) AUX BAUD
(c) RS-232-C Printer/Remote Control Interface
(d) Printer and remote control operation

2.4.11 AUX PLS MASK — Pulse Shape Measurement Mask Select

AUX	PULSE SELECT
PLS MASK	NONE
	RESULTS I RESULTS II

The AUX PLS MASK function selects the standard pulse shape mask used to evaluate the received pulses. Press the **RESULTS I Results** switch to select the following:

NONE - The pulse shape is not evaluated against pulse mask specifications, however, the pulse shape measurements are still made.

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NI (ANSI) - The pulse shape is evaluated against the ANSI T1.403 Network Interface pulse mask specification.

DSX (CB119) - The pulse shape is evaluated against the AT&T Compatibility Bulletin 119 and ANSI T1.102 pulse mask specifications.

When NONE is selected, the PULSE SHAPE LED is disabled and no mask appears on the pulse shape printout. When a mask is selected, the PULSE SHAPE Alarm LED illuminates when the pulse shape violates the mask. Changing AUX PLS MASK during a test restarts the test.

Consider the following SIGNAL category results and functions when changing AUX PLS MASK:

(a) 44-PULSE SHAPE
(b) 45-PULSE WIDTH
(c) 46-RISE TIME
(d) 47-FALL TIME
(e) 48-UNDERSHOOT
(f) 49-OVERSHOOT
(g) AUX GRAPH
(h) Graphic printer operation

When NONE is selected, NO MASK appears in 44-PULSE SHAPE. If a mask is selected, PASS, FAIL, OUT OF RANGE, or UNAVAILABLE can appear in 44-PULSE SHAPE. Refer to Section 2.6.4, SIGNAL Category, for additional information on the pulse shape measurements. Refer to Section 4.9, Measuring Pulse Shape, to measure a pulse shape.

2.4.12 AUX RES HIST — Results History Buffer

AUX RES HIST	NO RESULT PRNT EVNT AVAILABLE
	RESULTS I RESULTS II

The AUX RES HIST function allows the most recent results generated to be reviewed from the front panel. When the message NO RESULT PRNT EVNT AVAILABLE (no result print event available) appears, the **RESULTS** switches are not functional and no results are stored in memory. However, if for example the history buffer contains stored results, the following appears:

AUX RES HIST	RESULT TIME 11JUN 03:14:12	ALL RESULTS OK
	RESULTS I	RESULTS II

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AUX RES HIST provides access to six sets of the most recent test results generated when a print event occurs or the **PRINT RESULTS** switch is pressed. The oldest result is dropped when a new result is stored.

Press the **RESULTS I Results** switch to scroll through the time-stamped RESULT TIME list displayed in the RESULTS I display. Press the **RESULTS I Results** switch, UP arrow, to scroll to the most recent result. The message MOST RECENT RESULTS flashes in the RESULTS I display when the **RESULTS I Results** switch, UP arrow, is pressed to scroll past the most recent result. Press the **RESULTS I Results** switch, DOWN arrow, to scroll to the earliest result saved. The message EARLIEST SAVED RESULTS flashes in the RESULTS I display when the **RESULTS I Results** switch, DOWN arrow, is pressed to scroll past the earliest saved result. Press the **RESULTS II Category** switch to select the desired category. Press the **RESULTS I Results** switch to scroll through all results in the selected category.

Consider the following functions when changing AUX RES HIST:

(a) AUX HIST CLR function
(b) **PRINT EVENT** and **PRINT** switches

2.4.13 AUX HIST CLR — Clear History and Printer Buffers

AUX	**HIST/PRINT BUF**	**PRESS TO CLEAR**
HIST CLR	**EMPTY**	
	RESULTS I	RESULTS II

The AUX HIST CLR function clears the History and Print buffers. When the message HIST/PRINT BUF EMPTY appears, the **RESULTS** switches are not functional and no results are stored in memory. However, if results are stored in either the results history buffer or printer buffer, the following appears:

AUX	**HIST/PRINT BUF**	**PRESS TO CLEAR**
HIST CLR	**NOT EMPTY**	
	RESULTS I	RESULTS II

When the buffers have stored results, when the message HIST/PRINT BUF NOT EMPTY appears in the RESULTS I display. To clear the buffers, press the **RESULTS II Results** switch; the message HIST/PRINT BUF EMPTY appears in the RESULTS I display when the buffers are empty.

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Consider the following functions when using AUX HIST CLR:

(a) AUX RES HIST function
(b) Printer operation

2.4.14 AUX ERR SEL — BPV and Logic Error Burst Duration Select

AUX ERR SEL **BPV/LOGIC SINGLE ERROR**
RESULTS I RESULTS II

The AUX ERR SEL function selects the duration for the BPV and logic error bursts when the **BPV** and **LOGIC ERROR INSERT** switches are pressed once. Press the RESULTS I Results switch to select one of the following:

SINGLE ERROR - Inserts a single BPV or LOGIC error when the appropriate switch is pressed once.

5.0 sec burst to 1.5 sec burst (in 0.5 sec steps) - Inserts a BPV or logic error burst from 1.5 seconds to 5.0 seconds when the appropriate switch is pressed once.

1.5 sec burst to 1.0 sec burst (in 0.1 sec steps) - Inserts a BPV or logic error burst from 1.0 seconds to 1.5 seconds when the appropriate switch is pressed once.

900 ms burst to 500 ms burst (in 100 ms steps) - Inserts a BPV or logic error burst from 500 milliseconds to 900 milliseconds when the appropriate switch is pressed once.

500 ms burst to 200 ms burst (in 50 ms steps) - Inserts a BPV or logic error burst from 200 milliseconds to 500 milliseconds when the appropriate switch is pressed once.

200 ms burst to 25 ms burst (in 25 ms steps) - Inserts a BPV or logic error burst from 25 milliseconds to 200 milliseconds when the appropriate switch is pressed once.

The error rate during the burst is controlled through the AUX ER RATE function. Changing AUX ERR SEL immediately changes the burst duration but does not restart the test.

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NOTE: When the **ERROR INSERT** switches are pressed, held, and illuminate, errors are inserted continuously at the error rate selected from the AUX ER RATE function.

Consider the following functions when using AUX ERR SEL:

(a) **BPV** and **LOGIC ERROR INSERT** switches
(b) AUX ER RATE function.

2.4.15 AUX FRM ERR — Frame Error Insertion Select

AUX FRM ERR **FRM ERR INS SINGLE ERROR**
RESULTS I RESULTS II

The AUX FRM ERR function selects the number of consecutive frame errors inserted into the framing pattern when the **FRAME ERROR INSERT** switch is pressed once. Press the **RESULTS I Results** switch to select the following:

SINGLE ERROR - Inserts a single frame error.

2 to 6 CONSECUTIVE - Inserts 2 to 6 consecutive frame errors.

When the **FRAME ERROR INSERT** switch is pressed, held, and illuminates, the number of selected frame errors are inserted into the superframe or extended superframe format. AUX FRM ERR is only functional in framed operating modes (T1 D4, T1 ESF, T1 ESFz, and T1 SLC).

Consider the following BPV & FRAME category results and functions when changing AUX FRM ERR:

(a) **MODE** (framed modes) switch
(b) **FRAME ERROR INSERT** switch
(c) 28-FRM ERR SEC
(d) 29-FRAME SES
(e) 30-FRM ERRORS
(f) 31-FRM ER RATE
(g) 34-FRM LOS CNT
(h) 35-FRM LOS SEC

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When the ZBTSI Option is installed, the frame error can be inserted on the F-bit or Z-bit through the AUX FRM ERR, T1 ESFz, function as follows:

AUX	FRM ERR INS	T1 ESFz
FRM ERR	SINGLE ERROR	FRM-BIT ERR
	RESULTS I	RESULTS II

The AUX FRM ERR, T1 ESFz, function selects where the frame errors are inserted in ESFz framed signals when the **FRAME ERROR INSERT** switch is pressed once. Press the **RESULTS II Results** switch to select the placement of the framing error:

FRM-BIT ERR - Inserts frame errors on the Frame Alignment Signal bit.

Z-BIT ERR - Inserts frame errors on the Z-bit of a ZBTSI encoded ESF formatted signal.

FRM ERR INS still controls the number of frame errors inserted. T1 ESFz does not affect the other framing formats. Perform the following procedure to insert ESFz frame errors:

(1) Press the **MODE** switch to select the T1 ESFz mode.

(2) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX FRM ERR.

(3) Press the **RESULTS I Results** switch to select the number of consecutive frame errors (1 to 6) to be inserted.

(4) Press the **RESULTS II Results** switch to select the position of the frame errors in the T1 ESFz framing format.

(5) Press the **MODE** switch to return to the selected operating mode and the **RESULTS I Category** switch to select the SUMMARY category.

(6) Press the **FRAME ERROR INSERT** switch once to insert the selected number of frame errors.

(7) Observe the SUMMARY category results.

2.4.16 AUX ER RATE — BPV and Logic Error Insertion Rate

AUX	ERROR RATE	
ER RATE	1.0 E-6	
	RESULTS I	RESULTS II

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The AUX ER RATE function selects the BPV and LOGIC error insertion rate when a burst of errors is inserted or when continuous errors are inserted (see AUX ERR SEL, Section 2.4.14 and **ERROR INSERT** switches, Section 2.2.2). Press the **RESULTS I Results** switch to select an error rate from 1.0 E-2 to 9.9 E-9. Changing the error rate does not restart the test. The displayed error rates are interpreted as follows:

1.0 E-2 = 0.01 = 1 bit error in a 100 bits sent.
1.0 E-3 = 0.001 = 1 bit error in a 1000 bits sent.
1.0 E-4 = 0.0001 = 1 bit error in a 10,000 bits sent.
1.0 E-5 = 0.00001 = 1 bit error in a 100,000 bits sent.
1.0 E-6 = 0.000001 = 1 bit error in a 1 million bits sent.
1.0 E-7 = 0.0000001 = 1 bit error in a 10 million bits sent.
1.0 E-8 = 0.00000001 = 1 bit error in a 100 million bits sent.
1.0 E-9 = 0.000000001 = 1 bit error in a 1 billion bits sent.

To insert continuous errors, perform the following procedure:

(1) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX ER RATE.

(2) Press the **RESULTS I Results** switch to select the desired error rate.

(3) Press and hold either the **BPV** or **LOGIC ERROR INSERT** switch until the switch illuminates.

Consider the following functions when changing AUX ERR INS:

(a) AUX ERR SEL function
(b) **BPV** and **LOGIC ERROR INSERT** switches

2.4.17 AUX JIT S/A — Jitter Spectral Analysis Control (Optional)

AUX	**SPEC ANALYSIS**	
JIT S/A	**OFF**	
	RESULTS I	RESULTS II

The AUX JIT S/A function controls the Jitter Spectral Analysis Option. Press the **RESULTS I Results** switch to turn the Jitter Spectral Analysis Option on and off. AUX JIT S/A is only available when the Jitter Spectral Analysis Option is installed. Perform the following setup procedure to perform jitter spectral analysis. Refer to Section 4.10, Measuring T1 Jitter, for additional information.

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(1) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX JIT S/A.

(2) Press the **RESULTS I Results** switch to select ON and enable the Jitter Spectral Analysis Option.

(3) Press the **PATTERN** switch to select AUX JIT MASK.

(4) Press the **RESULTS I Results** switch to select the appropriate jitter mask.

(5) Press the **PATTERN** switch to select AUX JIT TRIG.

(6) Press the **RESULTS I Results** switch to select the appropriate jitter trigger.

(7) If a jitter graph is required, press the **PATTERN** switch to select AUX GRAPH.

(8) Press the **RESULTS II Results** switch to print a jitter graph.

Consider the following functions, modes, and JITTER & WANDER category results when testing for jitter:

(a) AUX JIT MASK
(b) AUX JIT TRIG
(c) AUX GRAPH
(d) Printer Operation
(e) JITTER Alarm LED
(f) 88-SA P/F
(g) 89-SA FREQ
(h) 90-SA FREQ

2.4.18 AUX JIT MASK — Spectral Analysis Jitter Mask Select (Optional)

AUX	JITTER MASK	
JIT MASK	O.171 (%)	
	RESULTS I	RESULTS II

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The AUX JIT MASK function selects the jitter mask for the Jitter Spectral Analysis Option (see AUX JIT S/A, Section 2.4.17). Press the **RESULTS I Results** switch to select the following jitter masks:

NONE (UI) - The jitter measurements are displayed in Unit Intervals (UIs) and not compared to a jitter mask.

43801 (%) - The jitter measurement, made as a percentage, is compared to the AT&T Technical Reference PUB43801 jitter specifications.

62411/1985 (%) - The jitter measurement, made as a percentage, is compared to the AT&T Technical Reference PUB62411, 1985 issue, jitter specifications.

62411/1983 (%) - The jitter measurement, made as a percentage, is compared to the AT&T Technical Reference PUB62411, 1983 issue, jitter specifications.

41451 (%) - The jitter measurement, made as a percentage, is compared to the AT&T Technical Reference PUB41451 jitter specifications.

O.171 (%). - The jitter measurement, made as a percentage, is compared to the CCITT Recommendation O.171 jitter specifications.

AUX JIT MASK selects the jitter mask specification the jitter spectral analysis is measured against. When a mask is selected, the jitter measurement is displayed as a percentage between the measured jitter and the selected mask; a value greater than 100% indicates the mask has been exceeded. When NONE is selected, the jitter measurement is displayed in Unit Intervals (UIs). Appendix D shows a graph of the Jitter Masks. Refer to AUX JIT S/A for a setup procedure and additional information on measuring jitter.

Consider the following functions, modes, and JITTER & WANDER category results when testing for jitter:

(a) AUX JIT S/A
(b) AUX JIT TRIG
(c) AUX GRAPH
(d) Printer Operation
(e) JITTER Alarm LED
(f) 88-SA P/F
(g) 89-SA FREQ
(h) 90-SA FREQ.

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2.4.19 AUX JIT TRIG — Spectral Analysis Jitter Trigger Select (Optional)

AUX	TRIGGER EVENT	
JIT TRIG	CONTINUOUS	
	RESULTS I	RESULTS II

The AUX JIT TRIG function controls the selection of the jitter trigger when the Jitter Spectral Analysis Option is enabled. Jitter spectral measurements can be made continuously, or can be triggered by a specific event. Refer to AUX JIT S/A for a setup procedure and additional information on measuring jitter. Press the **RESULTS I Results** switch to select the following trigger conditions:

CONTINUOUS - Constantly measures the jitter spectrum in lieu of an event trigger. Data samples are taken at 30-second intervals, and peak values are continuously updated.

PATTN SYNC LOS - Triggers a jitter snapshot on the loss of pattern synchronization.

FRAME SYNC LOS - Triggers a jitter snapshot on the loss of frame synchronization.

ONES DENSITY - Triggers a jitter snapshot on the violation of the pulse density criteria.

SEVERE ERROR - Triggers a jitter snapshot on the occurrence of a severely errored second.

ERROR EVENT - Triggers a jitter snapshot on the occurrence of a bit error, frame error, CRC error, or BPV.

Consider the following functions, modes, and JITTER & WANDER category results when setting the jitter trigger:

(a) AUX JIT S/A
(b) AUX JIT MASK
(c) AUX GRAPH
(d) Printer Operation
(e) JITTER Alarm LED
(f) 88-SA P/F
(g) 89-SA FREQ
(h) 90-SA FREQ

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2.4.20 AUX CLOCK — Set Clock Time

AUX	HOUR	MINUTE
CLOCK	16	00
	RESULTS I	RESULTS II

The AUX CLOCK function sets the time (in 24-hour format) for the battery-backed clock. Press the **RESULTS I Results** switch to set the current hour from 0 to 23 hours. Press the **RESULTS II Results** switch to set the current minutes from 0 to 59 minutes. The clock time appears on all printouts generated by the T-BERD 211. The current time is displayed in the TIME category, 65-CLOCK TIME result.

Consider the following functions when changing AUX CLOCK:

(a) AUX DATE function
(b) Printer operation

2.4.21 AUX DATE — Set Date

AUX	MONTH	DAY
DATE	JUNE	11
	RESULTS I	RESULTS II

The AUX DATE function sets the month and day for the battery-backed clock. Press the **RESULTS I Results** switch to set the current month from January to December. Press the **RESULTS II Results** switch to set the current day of the month from 1 to 31. The month and day appear on all printouts generated by the T-BERD 211. The current month and day are displayed in the TIME category, 66-DATE result.

Consider the following functions when changing AUX DATE:

(a) AUX CLOCK function
(b) Printer operation

2.4.22 AUX TEST LEN — Set Timed Test Length Duration

AUX	HOUR	MINUTE:SECOND
TEST LEN	200	0:00
	RESULTS I	RESULTS II

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The AUX TEST LEN function sets the length of time for a timed test. The timed test is selected with the **TEST** switch. Press the **RESULTS I Results** switch to set the test length hours from 0 to 200 hours in 1 hour steps. Press the **RESULTS II Results** switch to set the test length minutes and seconds from 0:00 to 1:00 minute in 15 second steps (with 0 hours displayed) and 1:00 to 59:00 minutes in 1 minute steps (with 1 or more hours displayed). When TIMED TEST is selected with the **TEST** switch, AUX TEST LEN is enabled and the test is restarted.

Consider the following functions and TIME category results when changing AUX TEST LEN:

(a) **TEST** switch
(b) **RESTART** switch
(c) 62-TEST LENGTH
(d) 63-ELAPSE TIME
(e) 64-TEST END IN

2.4.23 AUX GRAPH — Print Graph Function

AUX	PRESS ARROW TO PRINT	
GRAPH	PULSE	JITTER
	RESULTS I	RESULTS II

The AUX GRAPH function initiates a pulse shape printout when the **RESULTS I Results** switch is pressed. When the Jitter Spectral Analysis Option is installed and AUX JIT S/A is set to ON, JITTER appears in the RESULTS II display. Pressing the **RESULTS II Results** switch initiates a jitter vs frequency graph.

The pulse shape graph can only be generated on a graphics printer like the TTC PR-40A (see Section 5, Printer Operation). The Normalized amplitude pulse, related RESULTS, and selected pulse shape mask appear on printout. If the message OUT OF RANGE appears in the related RESULTS, printing the pulse shape graph causes the message PULSE DATA NOT AVAILABLE to be printed. Perform the following procedure to print a pulse shape graph:

(1) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX PLS MASK.

(2) Press the **RESULTS I Results** switch to select the pulse mask: NONE, NI (ANSI), and DSX (CB119). If NONE is selected, only the pulse is printed.

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(3) Press the **MODE** switch once to display the operating mode and results.

(4) Press the **RESULTS I Category** switch to select the SIGNAL category.

(5) Press the **RESULTS I Results** switch to scroll through the pulse shape results. If 44-PULSE SHAPE indicates PASS, FAIL, or NO MASK, continue with the procedure to the print pulse shape graph. If OUT OF RANGE appears in the pulse shape results, do not continue with the procedure; the pulse shape amplitude cannot be normalized for measurements or printout.

(6) Press the **MODE** switch once to display AUX functions.

(7) Press the **PATTERN** switch to select AUX GRAPH.

(8) Press the **RESULTS I Results** switch to generate the pulse shape graph.

Consider the following functions, modes, and SIGNAL category results when printing a pulse shape graph:

(a) AUX PLS MASK
(b) Printer Operation
(c) 44-PULSE SHAPE (NO MASK/FAIL/PASS/OUT OF RANGE)
(d) 45-PULSE WIDTH (ns)
(e) 46-RISE TIME (ns)
(f) 47-FALL TIME (ns)
(g) 48-UNDERSHOOT (%)
(h) 49-OVERSHOOT (%)

Press the **RESULTS II Results** switch to print a jitter graph on a graphics printer (e.g., TTC PR-40A). JITTER only appears in the RESULTS II display when the Jitter Spectral Analysis Option is installed and AUX JIT S/A is set to ON. Refer to the AUX JIT S/A function and Section 4.10, Measuring T1 Jitter, to set up and measure jitter.

Consider the following functions and modes when printing a jitter graph:

(a) AUX JIT S/A
(b) AUX JIT TRIG
(c) AUX JIT MASK
(d) Printer Operation
(e) JITTER Alarm LED

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2.4.24 AUX LP CODE — Loop Code Select

AUX LP CODE	LOOP CODE CSU	
	RESULTS I	RESULTS II

The AUX LP CODE function selects the loop code type transmitted when the **LOOP CODES** switches are pressed and which loop code causes the T-BERD 211 to establish the AUTO LLB mode (see Section 2.4.3). Transmitting loop codes restarts the test. When T1 ESF and T1 ESFz modes are selected, inband and ESF out-of-band loop codes can be selected from the AUX ESF LOOP function (see Section 2.4.25). Inband loop codes are used in all of the other operating modes. Press the **RESULTS I Results** switch to select the following loop codes:

CSU - Customer Service Unit loop codes are transmitted and recognized by the T-BERD 211. Inband CSU loop codes: loop up - 10000 and loop down - 100. ESF out-of-band CSU loop codes: loop up - 0111 0000 and loop down - 0001 1100.

PGM - Programmable loop codes are transmitted and recognized by the T-BERD 211. The programmable loop codes can be 3- to 8-bits in length (see AUX PGM LPUP, Section 2.4.4 and AUX PGM LPDN, Section 2.4.5). PGM inband loop codes can be 3- to 8-bits in length. The ESF out-of-band loop codes default to the network loop codes (loop up - 0100 1000 and loop down - 0010 0100).

FAC2 - Facility or network (or smart jack) loop codes are transmitted and recognized by the T-BERD 211. Inband 5-bit loop codes: loop up - 11000 and loop down - 11100. ESF out-of-band network loop codes: loop up - 0100 1000 and loop down - 0010 0100.

FAC1 - Facility or network (or smart jack) loop codes are transmitted and recognized by the T-BERD 211. Inband 4-bit loop codes: loop up - 1100 and loop down - 1110. ESF out-of-band network loop codes: loop up - 0100 1000 and loop down - 0010 0100.

Consider the following functions and modes when sending and receiving loop codes:

(a) AUX ESF LOOP
(b) AUX PGM LPUP
(c) AUX PGM LPDN
(d) **LOOP CODES** switches

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2.4.25 AUX ESF LOOP — ESF Loop Code Transmission Method

AUX ESF LOOP	ESF LOOP CODE IN BAND
RESULTS I	RESULTS II

The AUX ESF LOOP function selects where the loop code is transmitted in the ESF and optional ESFz formatted data when the LOOP **CODES** switches are pressed. Press the **RESULTS I Results** switch to select the method of transmitting the loop code in the following manner:

IN BAND - Transmit the loop codes in place of the data or test pattern.

OUT OF BAND - Transmit the loop codes in the ESF data link.

AUX ESF LOOP is only used when testing ESF or optional ESFz formatted circuits. The loop code type is selected from the AUX LP CODE function and transmitted when the **LOOP CODES** switches are pressed. Transmitting loop codes restarts the test even when the loop is not accomplished. To establish a loopback in an ESF or ESFz framed circuit, perform the following procedure:

(1) Press the **MODE** switch to select the T1 ESF or optional T1 ESFz operating mode.

(2) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX LP CODE.

(3) Press the **RESULTS I Results** switch to select the loop code format: CSU, FAC1, FAC2, PGM.

(4) Press the **PATTERN** switch to select AUX ESF LOOP.

(5) Press the **RESULTS I Results** switch to select transmission method: IN BAND or OUT OF BAND.

(6) Press the **MODE** switch to return to the operating mode and display the test results.

(7) Press the **LOOP UP** switch to send the loop-up code. Note that the LOOP UP LED illuminates briefly to indicate the loop is established.

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Consider the following functions and modes when sending and receiving loop codes:

(a) AUX LP CODES
(b) AUX PGM LPUP
(c) AUX PGM LPDN
(d) **LOOP CODES** LEDS and switches

2.4.26 AUX LUP — Programmable Long User Pattern (Optional)

AUX	SAVE IN/DEL	FOR/REV UP/DN
LUP 1	80 80 80 80 01	00 01 01 01 03
	RESULTS I	RESULTS II

The optional AUX LUP function enables a 1- to 2000-hexadecimal (byte) user programmable test pattern to be entered. This allows the T-BERD 211 to transmit specific character patterns to test circuit sensitivity to the pattern. Both sets of **RESULTS** switches are used to create or modify LUP. The **RESULTS** switches perform the following functions:

RESULTS I Category: **SAVE** - Press the switch to save all of the current LUP pattern and cursor position.

RESULTS I Results: **IN/DEL** - Press the UP arrow to **IN**sert 00H (00 in hex) at the cursor position. Pressing the switch continuously **IN**serts 00H to the right of the cursor. Press the DOWN arrow to **DEL**ete the character at the cursor position. Pressing the switch continuously **DEL**etes characters to the right of the cursor.

RESULTS II Results: **FOR/REV** - Press the UP arrow to move the cursor **FOR**ward from left to right. Press the DOWN arrow to move the cursor in **REV**erse from right to left. The cursor location is displayed in the display PATTERN line (1 to 2000).

RESULTS II Category: **UP/DN** - Press the switch to scroll the flashing digit **UP** or **DN** to Increment/Decrement the digit from 0 to F in hexadecimal. Refer to Appendix E for a hexadecimal-to-binary conversion table.

LUP is transmitted when LUP is selected with the **PATTERN** switch (see Section 2.5.13). A test restart only occurs when LUP is being transmitted and the pattern is changed. The pattern is entered in hexadecimal form. The pattern is transmitted starting from the LSB (least significant bit) to the MSB

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(most significant bit) of each hexadecimal character. Example: 74H = (MSB) 0111 0100 (LSB); transmitted in the following order: (LSB) 0010 1110 (MSB). The LUP factory default is the MIN/MAX test pattern (see Appendix E, Long User Pattern Default Pattern).

Perform the following procedure to modify the current pattern:

(1) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX LUP.

(2) Press the **RESULTS II Results** switch to move the cursor **FOR**ward or **REV**erse. Note cursor position in the display PATTERN line.

(3) Press the **RESULTS II Category** switch to increment **UP** or decrement **D**ow**N** the flashing digit from 0 to F.

(4) Repeat Steps (2) and (3) until desired pattern is displayed.

(5) Press the **RESULTS I Category** switch to **SAVE** the pattern modifications.

(6) Press the **MODE** switch to return to the operating mode and display the test results.

Perform the following procedure to create a new pattern:

(1) Press the **MODE** switch to select AUX and the **PATTERN** switch to select AUX LUP.

(2) Press the **RESULTS II Results** switch, DOWN arrow, to move the cursor to position 1. Note cursor position in the display PATTERN line.

(3) Press and hold the **RESULTS I Results** switch, DOWN arrow, to **DEL**ete the current LUP. All characters (except the first character) to the right of the cursor are deleted.

(4) Press and hold the **RESULTS I Results** switch, UP arrow, to **IN**sert 00H several times.

(5) Press the **RESULTS II Category** switch to increment **UP** or decrement **D**ow**N** the flashing digit from 0 to F.

(6) Repeat Steps (3) and (4) until the desired bit pattern is displayed.

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(7) Press the **RESULTS I Category** switch to save the modifications.

(8) Press the **MODE** switch to return to the operating mode and display the test results.

2.5 TEST PATTERNS

Changing test patterns always restarts the T-BERD 211 (see **RESTART** switch, Section 2.2.2). All patterns can be used in any framed and unframed operating mode. The patterns cannot be transmitted in the T1 TLB, T1 LLB, or T1C TLB modes. However, for these modes the displayed pattern must match the received test pattern to obtain logic results.

When inband loop codes are transmitted (see **LOOP UP** and **LOOP DOWN** switches), the transmitted test pattern is temporarily disabled. When the loop code is transmitted, the loop code name temporarily replaces the test pattern name in the display PATTERN line. When loop code transmission is terminated, the test pattern is enabled and the name reappears in the display. When an ESF out-of-band loop code is transmitted, the test pattern is unaffected.

2.5.1 ALL ONES — All Ones Pattern

ALL ONES is a fixed test pattern of only AMI pulses (Mark). ALL ONES is generally used to stress span repeater current regulator circuits. It can be used as an Alarm Indication Signal (AIS) in unframed circuits, or a keep alive signal, idle code, or Red alarm in other circuits. The pattern is required to measure the signal power level in dBm.

2.5.2 1:1 — Alternating Ones and Zeros Pattern

1:1 is a fixed test pattern of alternating AMI ones (Mark) and zeros (Space) pulses. 1:1 is generally used to perform a minimum level stress test on clock recovery circuits.

2.5.3 1:7 — A One and Seven Zeros Pattern

1:7 is a fixed test pattern of F01000000... The pattern is aligned with the framing (F) bits as indicated. 1:7 is generally used to stress the 12.5% ones density requirement for T1 circuits.

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2.5.4 3 IN 24 — Three Ones In 24-Bits Pattern

3 IN 24 is a fixed test pattern of F0100 0100 0000 0000 0000 0100... The pattern is aligned with the framing (F) bits as indicated. 3 IN 24 provides the minimum ones density (12.5%) and the maximum excess zeros (15) requirements to stress T1 circuits. When the pattern is framed, it violates the minimum ones density requirements.

2.5.5 T1-QRSS — T1 Quasi-Random Signal Source Pattern

T1 QRSS simulates live data for T1 applications. T1 QRSS is a modified 2^{20}-1 pseudorandom pattern which allows a maximum of 14 sequential zeros and 20 sequential ones. This pattern can be used for T1C testing.

2.5.6 T1C-QRSS — T1C Quasi-Random Signal Source Pattern

T1C-QRSS simulates live data for T1C applications. Like T1-QRSS, T1C-QRSS is a 2^{20}-1 pseudorandom pattern which allows a maximum of 19 sequential zeros and 20 sequential ones; there is no zero suppression. This pattern can be used for T1 testing.

2.5.7 2^{15}-1 — 32,767-Bit Pseudorandom Pattern

2^{15}-1 is a pseudorandom pattern which generates a maximum of 14 sequential zeros and 15 sequential ones. The pattern provides a maximum number of zeros allowed for framed, non-B8ZS testing. The pattern does not meet the minimum ones density requirement.

2.5.8 2^{20}-1 — 1,048,575-Bit Pseudorandom Pattern

2^{20}-1 is a pseudorandom pattern which generates a maximum of 19 sequential zeros and 20 sequential ones. The pattern exceeds excess zeros and does not meet the minimum ones density requirements for T1 applications.

2.5.9 2^{23}-1 — 8,388,607-Bit Pseudorandom Pattern

2^{23}-1 is a pseudorandom pattern which generates a maximum of 22 sequential zeros and 23 sequential ones. The pattern exceeds excess zeros and does not meet the minimum ones density requirements for T1 applications.

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2.5.10 BRIDGTAP — Bridge Tap Detection Test Pattern Sequence

To determine if bridge taps are connected to a T1 span, the span must be tested with a number of test patterns with a variety of ones and zeros densities. Instead of testing a span for bridge taps with one test pattern at a time, the automated bridge tap detection test (BRIDGTAP) generates 21 test patterns sequentially. This allows the T-BERD 211 to effectively evaluate a span for bridge taps. The BRIDGTAP test pattern can be used during the initial installation phase to test for bridge taps, and stress the span during routine maintenance.

The BRIDGTAP test pattern is composed of test patterns with varying degrees of ones and zeros densities that have varying spectral responses over the twisted-pair copper wire span which is sensitive to bridge taps. When the bridge tap length approaches the 1/4 wavelength of the test pattern spectral response, reflections occur which interfere with the transmission performance of the T1 span. The interference causes signal attenuation, bit errors, and BPVs in the received signal. The T-BERD 211 monitors the received test pattern for bit errors, BPVs, and frame errors. If signal errors are not detected, the span does not have a bridge tap connected to it. However, if signal errors are detected, the span may have one or more bridge taps connected to it and further sectionalization is required.

Select the BRIDGTAP pattern with the **PATTERN** switch. When BRIDGTAP is selected, the instrument restarts (all results are cleared and timers reset) and the BRIDGTAP pattern is transmitted. The BRIDGTAP pattern starts with a code word followed by the first of 21 test patterns, i.e., ALL ONES. The code word also appears between each test pattern. Each time the code word is sent, "BRIDGTAP" appears in the PATTERN display line which identifies the pattern, synchronizes the receiver to the received BRIDGTAP pattern, and temporarily halts the accumulation of logic and BPV related test results between test patterns. Table 2-2 describes how the T-BERD 211 performs the BRIDGTAP test.

The 21 test patterns are transmitted continuously in the following order: ALL ONES, 1:1, 1:3, 1:5, 1:6, 1:7, 2:8, 2:9, 2:10, 2:11, 2:12, 2:13, 2:14, 3 IN 18, 3 IN 19, 3 IN 20, 3 IN 21, 3 IN 22, 3 IN 23, 3 IN 24, and T1-QRSS. Table 2-3 lists the bit patterns for the BRIDGTAP patterns. All of the BRIDGTAP patterns meet ones density and excess zeros requirements for T1 circuits. As the patterns are transmitted, they are identified in the PATTERN display line in lowercase letters (e.g., ALL ONES = all ones) and numbers. One complete BRIDGTAP test pattern sequence takes approximately 10 minutes and 30 seconds to transmit. Once the receiver is synchronized with each test pattern (PATTERN SYNC LED illuminated), the test pattern is analyzed for 23 seconds.

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Table 2-2
BRIDGTAP Test Pattern Sequence

Transmitter	Receiver
1. Select BRIDGTAP pattern. "BRIDGETAP" appears in PATTERN display line.	
2. First code word transmitted.	2a. Receiver restarts. All results reset. Logic and BPV results halted. "ALL RESULTS UNAVAILABLE" displayed in SUMMARY category. 2b. Placed in standby for code word acquisition. T1 PULSES LED illuminates. FRAME SYNC LED illuminates if framed mode selected. 2c. Code word received. **NOTE:** If BRIDGTAP is not selected and the first code word is received, "BRIDGTAP TEST DETECTED" appears in SUMMARY category.
3. ALL ONES transmitted. "all ones" appears in PATTERN display line.	3a. ALL ONES received. Test pattern acquired. 3b. PATTERN SYNC LED illuminates and logic and BPV results enabled. ALL ONES LED illuminates. 3c. Test pattern analyzed for 23 seconds. If no errors are detected, "ALL RESULTS OK" displayed in SUMMARY category. If errors are detected, cumulative test results and failed test patterns (one or more bit errors detected) displayed in SUMMARY category. Failed patterns displayed under "FAILED PATTERN". 3d. Logic and BPV results halted.

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Table 2-2
BRIDGTAP Test Pattern Sequence (Continued)

Transmitter	Receiver
4. Code word transmitted. "BRIDGTAP" appears in PATTERN display line.	4a. Placed in standby for code word acquisition. 4b. Code word received.
5. 1:1 transmitted. "1:1" appears in PATTERN display line.	5a. 1:1 received. Test pattern acquired. 5b. Logic and BPV results enabled. 5c. Test pattern analyzed for 23 seconds. If no errors are detected, "ALL RESULTS OK" displayed in SUMMARY category. If errors are detected, cumulative test results and failed test patterns (one or more bit errors detected) displayed in SUMMARY category. Failed patterns displayed under "FAILED PATTERN". 5d. Logic and BPV results halted.
6. Steps 4 and 5 repeated for each pattern.	6a. Steps 8 to 13 repeated.

The BRIDGTAP pattern can be used in AMI and B8ZS coded applications. However, the pattern sequence is designed to operate with AMI coding and therefore, AMI coding is required to test a span for bridge taps. Using B8ZS coding redistributes the test pattern energy making it less effective in detecting bridge taps. A B8ZS coded BRIDGTAP pattern can be used during routine maintenance.

The BRIDGTAP test can be performed in a half-duplex end-to-end test where only one side of the span is tested at a time. A full-duplex end-to-end test can be performed where both sides of the span are tested simultaneously.

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Table 2-3
BRIDGTAP Patterns

Pattern Name	Bit Pattern**
ALL ONES*	F 1111
1:1*	F 1010
1:3	F 0100
1:5	F 0100 00
1:6	F 0100 000
1:7*	F 0100 0000
2:8	F 1100 0000 00
2:9	F 1100 0000 000
2:10	F 1100 0000 0000
2:11	F 1100 0000 0000 0
2:12	F 1100 0000 0000 00
2:13	F 1100 0000 0000 000
2:14	F 1100 0000 0000 0000
3 IN 18	F 1101 0000 0000 0000 00
3 IN 19	F 1101 0000 0000 0000 000
3 IN 20	F 1100 0100 0000 0000 0000
3 IN 21	F 0100 0100 0000 0000 0000 1
3 IN 22	F 0100 0100 0000 0000 0000 10
3 IN 23	F 0100 0100 0000 0000 0000 100
3 IN 24*	F 0100 0100 0000 0000 0000 0100
T1-QRSS*	2^{20}-1 pseudorandom pattern with 14-zero suppression

* Selectable from PATTERN switch. All others are programmable through auxiliary USER functions.
** F = Framing bit. For framed modes, the F bit is shown in its relative position to the test pattern.

When only one T-BERD 211 is available, a loopback test can be performed which tests both sides of the span at the same time. However, if errors are detected, further sectionalization is required to determine which side of the span has a bridge tap connected to it.

The RESULTS printout provides BRIDGTAP results under the heading BRIDGTAP RESULTS (see Figure 2-2). The BRIDGTAP RESULTS include the bit errors (BIT ERR), errored seconds (ERR SEC), and pattern synchronization seconds (SYNC SEC) for each pattern. When bit errors are

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```
      15MIN PRINT    18:04:50     12 MAR
BIT ERR      225423  ASYN E SEC       74
BER       2.13 E-04  OUT SY SEC        0
SLIPS             0  BPV ERR       32301
BPV ER SEC       10  BPV RATE 3.02 E-05
FRA ER SEC       97  FRA ERR        1525
F E RATE 2.12 E-04  FRA LOS            0
FRA LS SEC        0  SIG LS SC         0
ALARM SEC       164  ELAP TIM  00:15:00

BRIDGTAP RESULTS
PATTERN     BIT ERR   ERR SEC  SYNC SEC
ALL ONES          0         0        46
1:1               0         0        46
1:3               0         0        46
1:5               0         0        46
1:6           16123         6        46
1:7           16124         5        46
2:8               0         0        46
2:9               0         0        46
2:10              0         0        46
2:11              0         0        24
2:12              0         0        23
2:13              0         0        23
2:14              0         0        23
3 IN 18       54600        18        23
3 IN 19       27903        10        23
3 IN 20       44112        14        23
3 IN 21       49785        16        23
3 IN 22           0         0        23
3 IN 23       16776         5        23
3 IN 24           0         0        23
T1-QRSS           0         0        23

    ALARM/STATUS
ONE DEN HIST   ON    EX ZERO HIST    ON
ALL ONE HIST   ON    T1              ON
PATTERN SYNC   ON     FRAME SYNC     ON
```

Figure 2-2
Simulated Bridge Tap Results Printout

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not detected, BIT ERR and ERR SEC remain at zero and SYNC SEC indicates the number of seconds the synchronized pattern was received and monitored for errors. Each synchronized pattern is monitored for only 23 seconds during each cycle of the BRIDGTAP test. In Figure 2-2, the 15-minute print event printout shows the ALL ONES to 2:10 patterns being monitored a second time (46 seconds), the 2:11 pattern being repeated as the printout is generated (24 seconds), and the 2:12 to T1-QRSS patterns having been monitored once during the BRIDGTAP test. The BIT ERR result equals the sum of the BRIDGTAP BIT ERR results. The ASYN E SEC result equals the sum of the BRIDGTAP ERR SEC results. When pattern synchronization is lost, SYNC SECs are not counted.

2.5.11 MULTIPAT — Multipattern Test Pattern Sequence

The automated multipattern test (MULTIPAT) generates five commonly used test patterns which allows the T-BERD 211 to test a T1 span without having to select each test pattern individually. The T-BERD 211 monitors the received test patterns for bit errors, BPVs, and frame errors. The MULTIPAT test pattern can be used during the acceptance testing of a new T1 span or while troubleshooting an existing T1 span. This test is designed to run for a minimum of 15 minutes, but the patterns are transmitted continuously until a new test pattern is selected from the front panel.

Select the MULTIPAT pattern with the **PATTERN** switch. When MULTIPAT is selected, the instrument restarts (all results are cleared and timers reset) and the MULTIPAT pattern is transmitted. The MULTIPAT pattern starts with a code word followed by the first of five test patterns, i.e., ALL ONES. The code word also appears between each test pattern. Each time the code word is sent, "MULTIPAT" appears in the PATTERN display line which identifies the pattern, synchronizes the receiver to the received MULTIPAT pattern, and temporarily halts the accumulation of logic and BPV related test results between test patterns. Table 2-4 describes how the T-BERD 211 transmitter and receiver perform the MULTIPAT test.

The five test patterns are transmitted continuously in the following order: ALL ONES, 1:7, 2 IN 8, 3 IN 24, and T1-QRSS. Table 2-5 lists the bit patterns for the MULTIPAT patterns. As the patterns are transmitted, they are identified in the PATTERN display line in lowercase letters (e.g., ALL ONES = all ones) and numbers. One complete MULTIPAT test pattern sequence takes 15 minutes to transmit. Once the receiver is synchronized to the test pattern (PATTERN SYNC LED illuminated), each test pattern is analyzed for 175 seconds.

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Table 2-4
MULTIPAT Test Pattern Sequence

Transmitter	Receiver
1. Select MULTIPAT pattern. "MULTIPAT" appears in PATTERN display line.	
2. First code word transmitted.	2a. Receiver restarts. All results reset. Logic and BPV results halted. "ALL RESULTS UNAVAILABLE" displayed in SUMMARY category. 2b. Placed in standby for code word acquisition. T1 PULSES LED illuminates. FRAME SYNC LED illuminates if framed mode selected. 2c. Code word received. **NOTE:** If MULTIPAT is not selected and the first code word is received, "MULTIPAT TEST DETECTED" appears in SUMMARY category.
3. ALL ONES transmitted. "all ones" appears in PATTERN display line.	3a. ALL ONES received. Test pattern acquired. 3b. PATTERN SYNC LED illuminates and logic and BPV results enabled. ALL ONES LED illuminates. 3c. Test pattern analyzed for 175 seconds. If no errors are detected, "ALL RESULTS OK" displayed in SUMMARY category. If errors are detected, cumulative test results and failed test patterns (one or more bit errors detected) displayed in SUMMARY category. Failed patterns displayed under "FAILED PATTERN". 3d. Logic and BPV results halted.

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Table 2-4
MULTIPAT Test Pattern Sequence (Continued)

Transmitter	Receiver
4. Code word transmitted. "MULTIPAT" appears in PATTERN display line.	4a. Placed in standby for code word acquisition. 4b. Code word received.
5. 1:1 transmitted. "1:1" appears in PATTERN display line.	5a. 1:1 received. Test pattern acquired. 5b. Logic and BPV results enabled. 5c. Test pattern analyzed for 175 seconds. If no errors are detected, "ALL RESULTS OK" displayed in SUMMARY category. If errors are detected, cumulative test results and failed test patterns (one or more bit errors detected) displayed in SUMMARY category. Failed patterns displayed under "FAILED PATTERN". 5d. Logic and BPV results halted.
6. Steps 4 and 5 repeated for each pattern.	6a. Steps 8 to 13 repeated.

Table 2-5
MULTIPAT Patterns

Pattern Name	Bit Pattern**
ALL ONES*	F 1111
1:7*	F 0100 0000
2 IN 8	F 0100 1000
3 IN 24*	F 0100 0100 0000 0000 0000 0100
T1-QRSS*	2^{20}-1 pseudorandom pattern with 14-zero suppression

* Selectable from PATTERN switch. All others are programmable through auxiliary USER functions.

** F = Framing bit. For framed modes, the F bit is shown in its relative position to the test pattern.

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The MULTIPAT test can be performed in a half-duplex end-to-end test where only one side of the span is tested at a time. A full-duplex end-to-end test can be performed where both sides of the span are tested simultaneously. When only one T-BERD 211 is available, a loopback test can be performed which tests both sides of the span at the same time.

The RESULTS printout provides MULTIPAT results under the heading MULTIPAT RESULTS (see Figure 2-3). The MULTIPAT RESULTS include the bit errors (BIT ERR), errored seconds (ERR SEC), and pattern synchronization seconds (SYNC SEC) for each pattern. When bit errors are not detected, BIT ERR and ERR SEC remain at zero and SYNC SEC indicates the number of seconds the synchronized pattern was received and monitored for errors. Each synchronized pattern is monitored for 175 seconds during each cycle of the MULTIPAT test. The BIT ERR result equals the sum of the MULTIPAT BIT ERR results. The ASYN E SEC result equals the sum of the MULTIPAT ERR SEC results. If pattern synchronization is lost, SYNC SEC is not counted.

```
  15MIN PRINT          18:04:50      12 MAR
BIT ERR          1340 ASYN E SEC       802
BER        9.96 E-07 OUT SY SEC          0
SLIPS               0 BPV ERR            0
BPV ER SEC          0 BPV RATE     0 E-09
FRA ER SEC          3 FRA ERR            3
F E RATE      4 E-07 FRA LOS             0
FRA LS SEC          0 SIG LS SC          0
ALARM SEC         372 ELAP TIM   00:15:00

MULTIPAT RESULTS
PATTERN     BIT ERR ERR SEC  SYNC SEC
ALL ONES        260     168       175
1:7             271     175       175
2 IN 8          270     167       175
3 IN 24         269     158       175
T1-QRSS         270     134       175

     ALARM/STATUS
ONE DEN HIST     ON  EX ZERO HIST  ON
ALL ONE HIST     ON  T1            ON
PATTERN SYNC     ON  FRAME SYNC    ON
```

Figure 2-3
Simulated Multipattern Results Printout

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2.5.12 MIN/MAX — Minimum/Maximum Density Stress Test Pattern

MIN/MAX is a minimum/maximum density stress pattern that is used to test the repeater preamplifier and equalizer automatic line buildout (ALBO) circuitry. The pattern generates rapid transitions from low ones density octets to high ones density octets. The pattern is shown in Appendix E.

2.5.13 LUP — Programmable Long User Pattern

LUP provides the ability to transmit a 1- to 2000-hexadecimal user programmable test pattern. This allows the T-BERD 211 to transmit specific character patterns to test circuit sensitivity to a particular pattern. The pattern is entered in hexadecimal form through the AUX LUP function. AUX LUP is discussed in Section 2.4.26, Auxiliary Functions. The pattern is transmitted starting from the LSB to the MSB of each hexadecimal character. Example: 74H = (MSB) 0111 0100 (LSB); transmitted in the following order: (LSB) 0010 1110 (MSB).

2.5.14 USER1 and USER2 — User 1 and User 2 Programmable Bit Pattern

USER1 and USER2 provide the ability to transmit a 3- to 24-bit user programmable test pattern. This allows the T-BERD 211 to transmit specific bit patterns to test circuit sensitivity to a particular pattern. The pattern is entered in binary form through the AUX USER1 and AUX USER2 functions. AUX USER1 and AUX USER2 are discussed in Sections 2.4.1 and 2.4.2, Auxiliary Functions. The pattern is transmitted starting from left to right in the AUX USER display. The factory default test patterns for USER1 and USER2 are 1:6 and 1:5, respectively. The factory-set USER1 and USER2 labels can be customized through the T-BERD 211 remote control capability. Refer to Section 5, Printer/Remote Control Interface for more information.

2.5.15 ALL ZERO — All Zeros Pattern

ALL ZERO allows the T-BERD 211 to test T1 circuits for B8ZS or ZBTSI (optional) clear channel capability (CCC). The pattern can be transmitted framed or unframed, and should always be transmitted with B8ZS coding selected (**CODE** switch) or with the T1 ESFz mode selected. When using the ALL ZERO pattern and B8ZS coding, the T-BERD 211 can test a circuit for spans that are not configured for or are incompatible with B8ZS encoded data.

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When the T-BERD 211 is configured for B8ZS operation (**CODE** switch set for B8ZS) and the ALL ZERO test pattern is transmitted, the T-BERD 211 monitors the received signal for the normal B8ZS sequence, 000V 10V1 (where V is a bipolar violation). However, if the T-BERD 211 receives the B8ZS sequence in an alternate mark inversion (AMI) format (0001 1011) instead of all zeros (0000 0000) after decoding, the T-BERD 211 reports the sequence as an error and displays the message NOT B8ZS COMPATIBLE in the SUMMARY category. The failure of the network to maintain the B8ZS sequence in the received ALL ZERO pattern can occur at a multiplexer or DACS with an improperly set coding option; the coding option would be set for AMI instead of B8ZS.

When the T-BERD 211 is set for B8ZS coding and testing B8ZS compatible circuits, the EXCESS ZEROS LEDs (current and history) illuminate when the T-BERD 211 detects eight or more consecutive zeros in any operating mode and pattern. (Note: The EXCESS ZEROS LEDs operate normally when testing AMI encoded T1 circuits.)

2.6 MEASUREMENTS

The T-BERD 211 T-Carrier Analyzer performs a variety of measurements. These measurements are divided into six different categories:

(1) SUMMARY
(2) LOGIC
(3) BPV & FRAME
(4) SIGNAL
(5) TIME
(6) JITTER & WANDER

The measurements and test results are displayed in both RESULTS I and II displays. This allows two different results to be displayed at the same time. The categories are selected with the **RESULTS I and II Category** switches. Pressing the switch illuminates the category LED and displays the previously displayed category result. The category results are displayed by pressing the **RESULTS I and II Results** switches. These six categories and the results available in each are discussed in the following paragraphs. The numbers displayed with each result indicate the order of the results in each category, and are also used to select the results from a remote control device (see Section 5, Printer/Remote Control Interface). Numbers not shown are for future use.

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2.6.1 SUMMARY Category

The SUMMARY category only displays key non-zero test results or test results that exceed specification boundaries without having to scroll through all of the categories to find them. The results that are available in the SUMMARY category are listed below, along with each results category:

(a) 00-BIT ERRORS (LOGIC)
(b) 09-SLIPS (LOGIC)
(c) 25-VIOLATIONS (BPV & FRAME)
(d) 30-FRM ERRORS (BPV & FRAME)
(e) 32-CRC ERRORS (BPV & FRAME)
(f) 34-FRM LOS CNT (BPV & FRAMED)
(g) 40-RX FREQ Hz (SIGNAL)
(h) 44-PULSE SHAPE (SIGNAL)
(i) 51-TIMING SLIP (SIGNAL)

In addition to the test results indicated, the following status messages appear in the SUMMARY category as required.

(a) **ALL RESULTS OK** — When all summary results are error-free or meet specification boundaries (e.g., RX FREQ Hz and PULSE SHAPE), the message appears in the display.

(b) **ALL RESULTS UNAVAILABLE** — Displayed at test restart when the instrument has not synchronized with the received signal.

(c) **SIGNAL LOSS** — The received signal has been lost. The receiver status LEDs are not illuminated, and the Alarm status LEDs are.

(d) **MULTIPAT TEST DETECTED** — The MULTIPAT test pattern is detected, but the instrument test pattern has not been set for MULTIPAT.

(e) **BRIDGTAP TEST DETECTED** — The BRIDGTAP test pattern is detected, but the instrument test pattern has not been set for BRIDGTAP.

(f) **FAILED PATTERN** — Indicates the failed test patterns when performing a BRIDGTAP or MULTIPAT test. The failed pattern is also indicated.

(g) **B8ZS DETECTED** — Indicates the presence of B8ZS coding in the received signal when the **CODE** switch is set to the AMI position.

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(h) **NOT B8ZS COMPATIBLE** — Indicates the received signal is not B8ZS compatible when transmitting B8ZS encoded ALL ZEROS.

2.6.2 LOGIC Category

The LOGIC category results (see Table 2-6) are based on a bit error count (00-BIT ERRORS); updated each time bit errors are detected in the currently selected data pattern. When pattern synchronization is lost, the bit error count continues or halts based on the AUX HALT/CONT function setting (see Section 2.4.8). The slip count (09-SLIPS) displays the total number of pattern

Table 2-6
LOGIC Category Test Results

Result Name	Description
00-BIT ERRORS	A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.
01-ASYNC ERR SEC	A count of test seconds where one or more bit errors occurred.
04-BIT ERR RT	The ratio of bit errors to received pattern data bits.
05-ER FREE SEC	A count of the seconds during which pattern synchronization is maintained through the entire second and no bit error occurred.
06-% EFS	The ratio, expressed as a percentage, of error-free seconds to the total number of seconds during which pattern synchronization is present.
07-SYN ERR SEC	A count of errored seconds synchronized to the occurrence of an error (the count and time interval begin with the occurrence of an error).
08-OUT SYN SEC	A count of the total number of seconds since the beginning of the test during which pattern synchronization was not maintained for the entire second.

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Table 2-6
LOGIC Category Test Results (Continued)

Result Name	Description
09-SLIPS	A count of the total number of pattern slips since the beginning of the test.
10-SEV ERR SEC*	A count of seconds during which the bit error ratio was worse than 10^{-3} within available time.
11-%SEV ER SEC*	The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.
12-DEGR MIN*	A count of minutes during which the bit error ratio was worse than 10^{-6}.
13-%DEGR MIN*	The ratio, expressed as a percentage, of degraded minutes to the number of available minutes.
14-UNAVL SEC*	A count of unavailable time.
15-%AVLBILITY*	The ratio, expressed as a percentage, of available seconds to the number of test seconds.
16-CSES*	A count of the number of groups of three or more contiguous seconds in which an error rate worse than 10^{-3} was found in each second.

*Available only with the Performance Analysis Option (see Appendix A and Section 8).

slips since the beginning of the test. A pattern slip is detected if one or more bits are missing from or added to the expected pseudorandom bit sequence. In addition to these results, a set of performance analysis results, such as severely errored seconds, available seconds, and degraded minutes, are included with the Performance Analysis Option (see Section 8, Options and Accessories).

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2.6.3 BPV & FRAME Category

The results in the BPV & FRAME category are designed for in-service monitoring of T-carrier spans. In this category, all test results evolve from bipolar violation (BPV) counts and frame error counts. Table 2-7 describes the BPV & FRAME category test results.

Table 2-7
BPV & FRAME CATEGORY Test Results

Result Name	Description
25-VIOLATIONS	A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).
26-BPV SECONDS	A count of the seconds within which one or more BPVs occurred.
27-BPV RATE	The ratio of BPVs to the number of data bits received.
28-FRM ERR SEC	A count of the seconds during which one or more frame errors occurred.
29-FRAME SES	A count of the seconds during which the TOTAL number of frame errors equalled 12 or more (D4 framing only).
30-FRM ERRORS	A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an F_t or an F_s frame bit is in error. For ESF framing, frame errors are counted on FPS bits. In T1 SLC mode, frame errors are counted only if an error is found on an F_t bit.
31-FRM ER RATE	The ratio of frame errors to the number of analyzed framing bits.
32-CRC ERRORS	A count of CRC errors detected. CRC error are counted only when ESF framing is present in the received T1 data.

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Table 2-7
BPV & FRAME CATEGORY Test Results (Continued)

Result Name	Description
33-CRC ERR SEC	A count of seconds within which one or more CRC errors are detected.
34-FRM LOS CNT	A count of discrete losses of frame synchronization that occurred during the test.
35-FRM LOS SEC	A count of seconds since initial frame synchronization during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved.
36-CRC SES	A count of seconds during which the total number of CRC errors and frame synchronization losses equalled 320 or more.
37-CRC ERR RT	A count of CRC errors divided by the total number of ESF superframes analyzed.

2.6.4 SIGNAL Category

Available under the VIOLATIONS test result, the BPV count increases each time that successive T1 or T1C pulses of the same polarity are detected (except when part of a B8ZS substitution code). The BPV count is also the basis for calculating BPV seconds and BPV rate.

When counting frame errors, the T-BERD 211 analyzes the framing information embedded within a T1 signal. Frame errors detected in D1D, D2, D3, D4, SLC-96, or ESF framing signals are used as the basis for calculating framing error rate and frame losses. The T-BERD 211 also displays the number of frame synchronization losses, along with the number of seconds that frame synchronization was actually lost. For T1 circuits with ESF framing, the T-BERD 211 detects and accumulates CRC-6 errors which are used to calculate the CRC error rate and CRC errored seconds.

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The SIGNAL category groups results that analyze the characteristics of the input signal. Table 2-8 describes the SIGNAL category test results. Three types of receive level measurement are obtainable. The first measures peak voltage level and is expressed in dB relative to a standard 3-volt, base-to-peak signal (dsx level). This measurement is displayed in dBdsx (41-RX LEVEL (dBdsx)) and is valid for any T1 or T1C signal. The second measurement is displayed in dBm (42-RX LEVEL (dBm)) and may be performed only on an ALL-ONES pattern. The third measurement displays the signal level in peak-to-peak volts (43-RX LEVEL (V p-p)). Section 4, Operation, provides setup and test procedures for measuring signal levels, timing slips, and simplex current.

Table 2-8
SIGNAL Category Test Results

Result Name	Description
40-RX FREQ, Hz	The frequency of the clock recovered from the received data.
41-RX LEVEL dBdsx	The level of the received signal in dB relative to a standard 3-volt base-to-peak signal (DSX level).
42-RX LEVEL dBm	The power level of an all-ones signal (applicable only when all ones is detected).
43-RX LEVEL V p-p	The level of the received signal in peak-to-peak volts. The signal level is displayed as V or mV when it is higher or lower than 1 volt, respectively.
44-PULSE SHAPE	A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.
45-PULSE WIDTH	The pulse width of a T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.
46-RISE TIME	The time interval between the 10% and 90% points of the rising edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

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Table 2-8
SIGNAL Category Test Results (Continued)

Result Name	Description
47-FALL TIME	The time interval between the 10% and 90% points of the falling edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.
48-UNDERSHOOT	The level difference from the minimum point to the 0% point of the T1 pulse. UNDERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.
49-OVERSHOOT	The level difference from the maximum point to the 100% point of the T1 pulse. OVERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.
50-SPX CURRENT	The magnitude of the simplex current flowing between the transmit output tip and ring and the receive input tip and ring.
51-TIMING SLIP	Timing slips are counted when the RECEIVER input has slipped ±193 bit time periods from the T1-REF input. Single bit slips are displayed graphically next to timing slips.
53-SLP ANA SEC	A count of test seconds during which Timing Slip Analysis has been performed.

This category also offers a series of pulse shape measurements that analyze the width, rise time, fall time, overshoot, and undershoot of a T1 pulse. Additionally, timing slips and simplex current results are also available. When measuring timing slips, the signal reference is taken from either the source attached to the side-panel EXT CLK IN connector or from the front panel T1 REF jacks. Refer to the **TIMING** switch description in Section 2.2.2 for additional information on selecting the timing source. Section 4, Operation, provides setup and test procedures for measuring pulse shapes.

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2.6.5 TIME Category

The TIME category offers time-related measurements such as signal loss seconds, test length, time remaining in a test, and current time and date. Table 2-9 describes the TIME category test results.

Table 2-9
TIME Category Test Results

Result Name	Description
60-SIG LOS SEC	A count of test seconds during which the signal was not present or during which one or more signal losses occurred.
61-ALARMED SEC	A count of test seconds during which a Yellow, All Ones, Excess Zeros, or Ones Density alarm was detected.
62-TEST LENGTH	The currently set test length for a timed test, in HHH:MM format.
63-ELAPSED TIME	The number of hours, minutes, and seconds (1) since a proper frequency and level has been detected or (2) since the last major switch change.
64-TEST END IN	Time remaining in a timed test, in HHH:MM:SS format.
65-CLOCK TIME	The time of day in HH:MM:SS format.
66-DATE	The date in DD:MMM format.

2.6.6 JITTER & WANDER Category

The JITTER & WANDER category provides results for wander, wide-band and highband jitter, and spectral jitter verses jitter mask analysis. Table 2-10 describes the JITTER & WANDER category test results.

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Table 2-10
JITTER & WANDER Category Test Results

Result Name	Description
70-WANDER +PK	The maximum positive peak wander deviation since the beginning of the test, defined in Unit Intervals (UIs).
71-WANDER -PK	The maximum negative peak wander deviation since the beginning of the test, defined in UIs.
72-P-P WANDER	The total deviation of positive-to-negative peak wander since the beginning of the test, defined in UIs.
73-15m WANDER	The maximum peak-to-peak wander deviation over the last 15 minutes of the test. This result is unavailable for the first 15 minutes of the test and is updated once per minute thereafter.
74-24h WANDER	The maximum peak-to-peak wander deviation over the last 24 hours of the test. This result is unavailable for the first 24 hours of the test and is updated once per hour thereafter.
75-TIE WANDER	Time Interval Error (TIE); the variation in time delay of a given timing signal with respect to the T1 reference signal or external clock source over the test interval. Valid range is ± 99999 UI.
80-WB/HB JIT	A pass/fail measurement of wideband and highband jitter on a received T1 signal when compared to the CCITT O.171 jitter mask. (Pass/Fail criteria: wideband jitter > 5 UI; highband jitter > 0.1 UI.)
81-WB JITTER	The current amount of peak-to-peak wideband jitter, defined in UIs, updated once per second.
82-HB JITTER	The current amount of peak-to-peak highband jitter, defined in UIs, updated once per second.
84-MAX WB JIT	The maximum amount of peak-to-peak wideband jitter since the last test restart, defined in UIs.

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Table 2-10
JITTER & WANDER Category Test Results (Continued)

Result Name	Description
85-MAX HB JIT	The maximum amount of peak-to-peak highband jitter since the last test restart, defined in UIs.
88-SA P/F*	A pass/fail comparison between the spectral content of each frequency band and the jitter mask selected in the AUX JIT MASK function. Refer to Table 2-11 for how the results are displayed when the option and mask are enabled and/or disabled.
89-SA FREQ*	The relative amount of jitter present in all 40 frequency bands. Each frequency band and result are automatically scrolled in the display. Refer to Table 2-11 for how the results are displayed when the option and mask are enabled and/or disabled.
90-SA FREQ*	The relative amount of jitter present in each of the 40 frequency bands. Each frequency band is displayed manually by pressing the RESULTS I or II Results switch. Refer to Table 2-11 for how the results are displayed when the option and mask are enabled and/or disabled.

* Only available with Spectral Analysis Option.

An extension of the timing slips measurement, six different wander-related test results identify and isolate network synchronization problems. The wander test results are available only for T1 signals, and require the presence of a T1 reference signal taken from either the side-panel EXT CLK IN connector or from the front panel T1 REF jack. Refer to the **TIMING** switch for information on selecting the timing source. Refer to Section 4.8 for wander measurement setup and test procedures.

The wideband and highband jitter measurements on a received T1 signal are made in conformance with CCITT O.171 specifications. The wideband result measures jitter over a 10 Hz to 40 kHz range; the highband result measures jitter over a 8 kHz to 40 kHz range. Note that wideband and highband measurements are interleaved, with each taking approximately 0.5 seconds to complete. Refer to Section 4.10 for jitter measurement setup and test procedures.

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In addition to the other measurements mentioned, a Spectral Analysis Option provides jitter versus jitter mask results over 40 frequency bands which can be displayed in unit intervals (UIs) or as a percentage between the spectral jitter response and the selected jitter mask (%MASK). Appendix D provides a graph of the jitter mask specifications that are selectable from the AUX JIT MASK function (see Section 2.4.18). Table 2-11 lists the Spectral Analysis results and how they are displayed with reference to the AUX JIT S/A and AUX JIT MASK functions. Refer to Sections 2.4.17 and 2.4.18 for additional information on controlling the Spectral Analysis Option and selecting the desired jitter mask. Refer to Section 4.10 for spectral analysis setup and test procedures.

Table 2-11
Spectral Analysis Results

Auxiliary Function	Selection	Results	Comments
AUX JIT S/A	OFF	88-SA P/F	N/A
AUX JIT MASK	NONE	89-SA FREQ	UNAVAILABLE
		90-SA FREQ	(not shown)
AUX JIT S/A	ON	88-SA P/F	N/A
AUX JIT MASK	NONE	89-SA FREQ	Frequencies and UI
		90-SA FREQ	Frequencies and UI
AUX JIT S/A	ON	88-SA P/F	Pass/Fail/
	Unavailable		
AUX JIT MASK	Mask	89-SA FREQ	Frequencies and % Mask
		90-SA FREQ	Frequencies and % Mask
AUX JIT S/A	OFF	88-SA P/F	UNAVAILABLE
AUX JIT MASK	Mask	89-SA FREQ	UNAVAILABLE
		90-SA FREQ	(not shown)

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SECTION 3

PREPARATION FOR USE

3.1 INTRODUCTION

This section provides information on preparing the T-BERD 211 for use. Specifically included are instructions for unpacking and inspecting the instrument; a list of the equipment that should be contained in the shipment; and an instrument checkout procedure. The procedures in this section assume that you possess a working knowledge of the T-BERD 211. If you are unfamiliar with the instrument, please refer to Section 2, Instrument Description.

3.2 UNPACKING

The T-BERD 211's shipping container should be inspected for damage when it is received. If the shipping container or shipping material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. Procedures for checking the electrical performance of the instrument are given in Section 3.4. If the contents are incomplete, or if the T-BERD 211 does not pass the performance tests, notify TTC. If the shipping container is damaged, notify the carrier as well as TTC, and keep the shipping container and materials for the carrier's inspection.

3.3 EQUIPMENT INCLUDED

The following is a list of the equipment that should be present when the T-BERD 211 shipment is received and unpacked.

(1) T-BERD 211 T-Carrier Analyzer
(2) AC Line Cord
(3) Operating Manual

3.4 INSTRUMENT CHECKOUT

The T-BERD 211 should be checked mechanically and electrically upon unpacking. To verify proper electrical operation, perform these steps.

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(1) Remove the cover of the T-BERD 211 by unsnapping the metal latches on each side of the instrument. Turn the cover upside down and access the AC line cord compartment on the compartment panel and lifting the panel out of the cover.

(2) Insert the AC line cord into the AC receptacle on the T-BERD 211's side panel and plug the other end of the cord into a 115 VAC power source.

WARNING: **Ground the instrument.** To minimize shock hazard, the instrument chassis must be connected to an electrical ground. The instrument is equipped with a three-conductor AC power cable. The power cable must either be plugged into and approved three-contact electrical outlet or used with a three-contact-to-two-contact adaptor with grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

CAUTION: The T-BERD 211 should be operated with a 1A, 250V, SLO-BLO fuse (Littlefuse #218001 or equivalent.) Always use correct fuse size. (See Fuse Replacement Instructions).

NOTE: To ensure that the proper test results are selected during this procedure, the displayed result name and number is used.

(3) Press the **POWER** switch to apply power to the T-BERD 211.

(4) Using the **MODE** switch, set the operating mode to AUX. Ensure that these auxiliary functions as are set as follows:

(a) HALT/CONT to HALT
(b) ERR SEL to SINGLE ERROR
(c) ER RATE to 1.0 E-6
(d) PLS MASK to DSX
(e) FRM ERROR to SINGLE ERROR

(5) Using the **MODE** switch, set the operating mode to self-test by scrolling through the available modes until SELF TST appears in the display. In self-test mode, the T-BERD 211's transmitter is internally connected to its receiver; ESF framing and internal timing are automatically selected.

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(6) Using the **PATTERN** switch, select the ALL ONES data pattern.

(7) Ensure that these LED indicators are illuminated:

(a) T1 PULSES
(b) PATTERN SYNC
(c) FRAME SYNC
(d) ALL ONES

(8) Set the **RECEIVE INPUT** switch to the TERM position and the **TRANSMIT OUTPUT** switch to the 0 dB position.

(9) Set the **RESULTS I Category** switch to the SIGNAL category, then use the **RESULTS I Results** switch to scroll the 41-RX LEVEL test result into the RESULTS I display. The value for this result should be 0 dBdsx ±0.5 dB.

(10) Set the **TRANSMIT OUTPUT** switch to -7.5 dB and confirm that the 41-RX LEVEL result changes to -7.5 dBdsx ±1.5 dB.

(11) Set the **TRANSMIT OUTPUT** switch to -15 dB and confirm that the 41-RX LEVEL result changes to -15 dBdsx ±1.5 dB.

(12) With the **RESULTS I Category** switch still in the SIGNAL category, scroll the 40-RX FREQ result into the RESULTS I display. Confirm that the value for this result is within the range 1543999 to 1544001 Hz.

(13) Set the **RESULTS I Category** switch to the SUMMARY category. The message ALL RESULTS OK should appear in the RESULTS I display.

(14) Press and release the **FRAME ERROR INSERT** switch several times to verify that the 30-FRM ERRORS test result appears in the display and increments by one each time the switch is pressed.

(15) Press and release the **BPV ERROR INSERT** switch several times to verify that the 25-VIOLATIONS test result appears in the display and increments by one each time the switch is pressed.

(16) Plug a bantam or WECO 310 patch cord into the front-panel transmit and receive connectors to loop the TRANSMIT output to the RECEIVE input.

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(17) Using the **MODE** switch, select the T1C operating mode, then set the **TIMING** switch to the INT position.

(18) Press and release the **LOGIC ERROR INSERT** switch several times to verify that the 00-BIT ERRORS test result appears in the display and increments by one each time the switch is pressed.

(19) Set the **RESULTS I Category** switch to the SIGNAL category, then scroll the 40-RX FREQ test result into the RESULTS I display. Confirm that the received frequency is within the range 3151968 to 3152032 Hz.

(20) Press and hold the **LOGIC ERROR INSERT** switch and the **BPV ERROR INSERT** switch until the LEDs within each switch are continuously illuminated.

(21) Set the **RESULTS I Category** switch to the LOGIC category, then scroll the 04-BIT ERR RT test result into RESULTS I display. Set the **RESULTS II Category** switch to the BPV & FRAME category, then scroll the 27-BPV RATE test result into the RESULTS II display. After 10 seconds, both of the displays should show values within the range 9.0 E-07 to 1.1 E-06.

(22) If the Performance Analysis Option is installed in your T-BERD 211, scroll to the LOGIC category to confirm that these test results are available:

(a) 10-SEV ERR SEC
(b) 11-%SEV ER SEC
(c) 12-DEGR MIN
(d) 13-%DEGR MIN
(e) 14-UNAVL SEC
(f) 15-%AVLBILITY

During the self-test, the T-BERD 211's non-volatile RAM (NOVRAM) is checked because, at power-up, the T-BERD restores the instrument to the settings that were selected before the last power-down. If any changes are found, the factory settings are reloaded and the message RELOAD NOVRAM is displayed. Press the **RESTART** switch to load the nonvolatile RAM with the factory settings and clear the front panel. The T-BERD 211 remains fully functional even though switch settings may not have been saved during the power cycle. While the instrument may be used, TTC should be called for service.

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The instrument's RAM, EPROM, and microprocessor are also checked during the self-test. If any error is found, the messages BAD RAM, BAD ROM, or BAD PROCESSOR is displayed. In such instances, call TTC for service. There are no user-serviceable parts within the T-BERD 211.

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SECTION 4

OPERATION

4.1 INTRODUCTION

This section shows how the T-BERD 211 T-Carrier Analyzer is used in a variety of common test scenarios. Scenarios and instrument set-ups are provided for:

- Out-of-service and in-service T1 testing
- Simplex current measurement and CSU emulation
- Signal level measurement
- Out-of-service and in-service SLC-96 testing
- Out-of-service and In-service T1C testing
- Multipattern and bridge tap testing
- Measuring timing slips and wander
- Measuring pulse shapes
- Measuring T1 jitter

Each section provides a brief description of the test procedure, in some cases a block diagram of the network set up, a table for the test set-up procedure, and a table describing how to collect the test results. If you are not familiar with the T-BERD 211 front panel controls and indicators, refer to Section 2, Instrument Description.

4.2 T1 TESTING

This section describes how the T-BERD 211 is used to test T1 lines in an in-service monitor and out-of-service testing analysis mode.

4.2.1 Error Analysis on a T-Carrier Circuit (Out-of-Service Loopback Test)

Figure 4-1 shows a T-BERD 211 connected to a DSX-1 patch panel. The instrument terminates the near-end of the T1 network, and transmits data to and receives data from the far-end CSU. The T-BERD 211 sends a loop-up

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coded to the far-end CSU; the far end CSU goes into loopback toward the T1 network and the T-BERD 211. By analyzing the received data for errors, the T-BERD 211 analyzes the performance of the network up to and including the far-end CSU.

Basic T1 Out-of-Service Test Set-Up

To set up a basic out-of-service test of T1 circuit, perform the steps shown in Table 4-1.

Collecting T1 Out-of-Service Test Results

Immediately upon successfully configuring the T-BERD 211 for T1 out-of-service testing, follow the procedures shown in Table 4-2 to collect test results.

SUGGESTION: If errors are detected in Step 4, use a second T-BERD 211 to perform an end-to-end test on your T1 circuit. By configuring a second T-BERD 211 at the far end of the span, both sections of the span can be tested individually.

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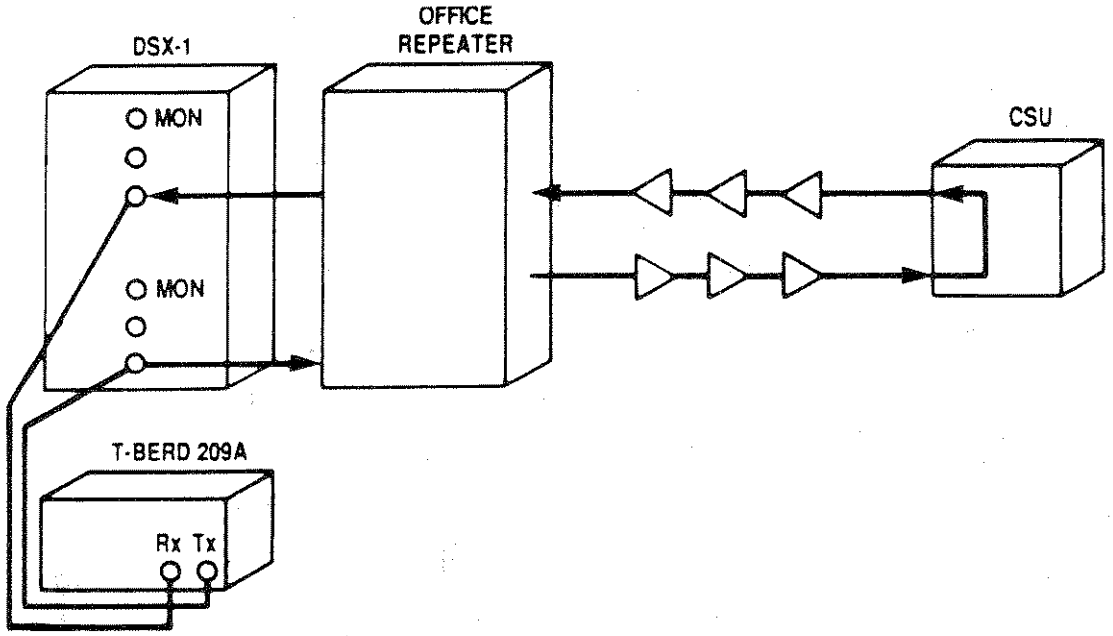

Figure 4-1
Testing a T1 Circuit in Loopback Mode

Table 4-1
Basic T1 Out-of-Service Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to the data format of the T-Carrier circuit under test (T1, T1 D4, or T1 ESF framing).
3.	Set the **PATTERN** switch to the T1 QRSS position.
	NOTE: T1 QRSS is the standard test data pattern for T1 testing.
4.	Set the **TIMING** switch to the INT position to use the T-BERD 211 internal timing source.
	NOTE: If testing is performed through a DCS, set the **TIMING** switch to the RECOVD position.
5.	Set the **TEST** switch to the CONT position.
6.	Set the **CODE** switch to either the B8ZS or AMI position, as appropriate.
7.	Ensure that all **ERROR INSERT** switches (FRAME, BPV, and LOGIC) are in the off position (i.e., switch LEDs should not be illuminated).
8.	Set the **RECEIVE INPUT** switch to the TERM position.
9.	Set the **TRANSMIT OUTPUT** switch to the 0dB(DSX) position.
10.	Using the AUX LP CODE function, select the desired loop code (CSU, FAC1, FAC2, or PGM).
11.	Connect your TRANSMIT and RECEIVE connectors to the circuit to be tested.
12.	Press the **LOOP UP** switch to send the selected loop-up code.
	NOTE: Deactivate the loopback at the conclusion of the test by pressing the **LOOP DOWN** switch.

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Table 4-1
Basic T1 Out-of-Service Test Set-Up (Continued)

Step	Activity
13.	Verify that: (a) The T1 PULSES LED is illuminated. (b) The PATTERN SYNC LED is illuminated. (c) The FRAME SYNC LED is illuminated, if either the T1 D4, T1 ESF, or T1 ESFz framing pattern is detected. (d) The B8ZS LED illuminates, if B8ZS clear channel line coding is detected.
14.	Press the **RESTART** switch to begin the test.

Table 4-2
Collecting T1 Out-of-Service Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed as they occur: (a) 00-BIT ERRORS (LOGIC Category) (b) 09-SLIPS (LOGIC Category) (c) 25-VIOLATIONS (BPV & FRAME Category) (d) 30-FRM ERRORS (BPV & FRAME Category) (e) 32-CRC ERRORS (BPV & FRAME Category) (f) 34-FRM LOS CNT (BPV & FRAME Category) (g) 40-RX FREQ Hz (SIGNAL Category)

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Table 4-2
Collecting T1 Out-of-Service Test Results (Continued)

Step	Activity
	(h) 44-PULSE SHAPE (SIGNAL Category) (i) 51-TIMING SLIP (SIGNAL Category) (j) 80-WB/HB JIT (JITTER & WANDER Category)
2.	Using the **RESULTS II Results** switch, scroll the 41-RX LEVEL result into the RESULTS II display.
3.	Verify that the 41-RX LEVEL is between -2 dBdsx and +2 dBdsx.
4.	Interpret test results as follows: ***Interpreting Results:*** (a) If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the **RESULTS I Results** switch to scroll through the errored values. (b) If 00-BIT ERRORS and 25-VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. (c) If 00-BIT ERRORS are detected, but the 25-VIOLATIONS count remains at 0, it is likely that the errors are not being introduced at the near-end span. (d) If the circuit under test is using a framed data format and 09-SLIPS are displayed without 34-FRM LOS CNT, then controlled slips are occurring. Controlled slips occur when multiplexers or DACS are used in a circuit with equipment that is not slaved (loop timed) to a common clock. (e) If the circuit under test is using a framed data format and 09-SLIPS are displayed with 34-FRM LOS CNT, then uncontrolled slips are occurring.

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4.2.2 Monitoring a Live T-Carrier Circuit (In-Service Testing)

Figure 4-2 shows a T-BERD 211 with its receive input connected to a monitor jack on a DSX-1 patch bay. Within the central office, the T1 signal passes through the DSX-1 patch bay and an office repeater before being transmitted on a repeatered span to the T1 network. In this configuration, the T-BERD 211 monitors the T1 signal for BPVs, frame errors, and signal impairments.

Basic T1 In-Service Test Set-Up

To set up an in-service test of a T1 circuit, perform the steps shown in Table 4-3.

Collecting T1 In-Service Test Results

Upon successfully setting up a T1 in-service test, follow the procedures shown in Table 4-4 to collect test results.

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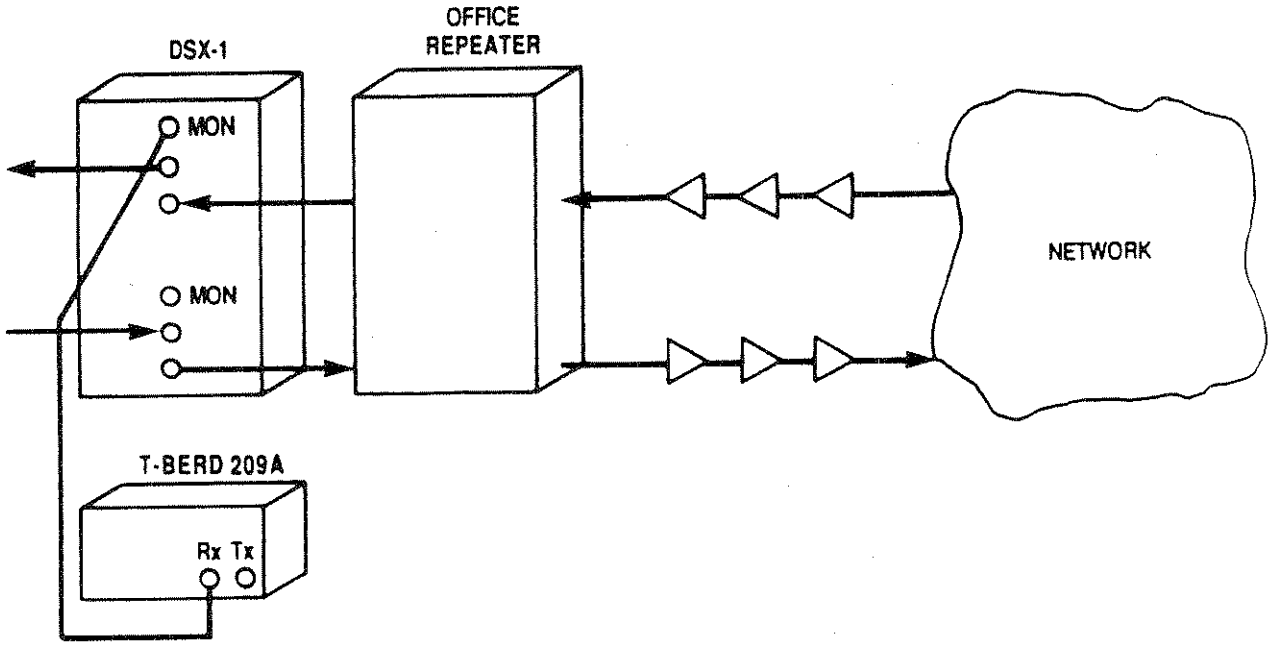

Figure 4-2
Monitoring a Live T1 Circuit

Table 4-3
Basic T1 In-Service Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to AUTO. **RESULT:** The T-BERD 211 automatically configures itself to the framing, coding, and data pattern on the live circuit.
3.	Set the **TEST** switch to the CONT position.
4.	Set the **RECEIVE INPUT** switch to the DSX-MON position.
5.	Connect the T-BERD 211 to the MON jack on the DSX patch bay (or CSU).
6.	Press the **RESTART** switch to begin the test. ***Note the Following:*** (a) The T1 PULSES LED illuminates if a T1 signal is present. (b) The FRAME SYNC LED illuminates if the signal contains T1 D4, T1 ESF, or T1 ESFz (optional) framing. (c) The name of the framing format appears in the display MODE line in lower-case letters. (d) The name of the received data pattern appears in the display PATTERN line in lower-case letters. If no pattern is detected, "live" is displayed. (e) The B8ZS LED illuminates, if B8ZS clear channel line coding is detected.

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Table 4-4
Collecting T1 In-Service Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed as they occur: (a) 00-BIT ERRORS (LOGIC Category) (b) 09-SLIPS (LOGIC Category) (c) 25-VIOLATIONS (BPV & FRAME Category) (d) 30-FRM ERRORS (BPV & FRAME Category) (e) 32-CRC ERRORS (BPV & FRAME Category) (f) 34-FRM LOS CNT (BPV & FRAME Category) (g) 40-RX FREQ Hz (SIGNAL Category) (h) 44-PULSE SHAPE (SIGNAL Category) (i) 51-TIMING SLIP (SIGNAL Category) (j) 80-WB/HB JIT (JITTER & WANDER Category)
2.	Using the **RESULTS II Results** switch, scroll the 41-RX LEVEL result into the RESULTS II display.
3.	Verify that the 41-RX LEVEL is between -18 dBdsx and -22 dBdsx. (A 20 dB loss is incurred due to the isolation resistors in the monitor jacks; if the jacks are not isolated, the level will be between -2 dBdsx and +2 dBdsx).
4.	Interpret test results as follows: ***Interpreting Results:*** (a) If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the **RESULTS I Results** switch to scroll through the errored values. (b) If 30-FRM ERRORS, 32-CRC ERRORS, and 25-VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. (c) If 30-FRM ERRORS are detected, but the 25-VIOLATIONS count remains at 0, it is likely that errors are not being introduced at the near-end repeatered span and further sectionalization is required.

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4.3 SIMPLEX CURRENT MEASUREMENT AND CSU EMULATION

Figure 4-3 shows a T-BERD 211 connected to a repeatered span. The instrument emulates the near-end CSU in transmitting data to and receiving data from the far-end. By initiating a manual loop at the DSX, the data is returned to the T1 network and the T-BERD 211. In this configuration, the T-BERD 211 also analyzes the received signal to measure simplex current.

NOTE: One of the functions of the CSU is to complete the current path for powering the regenerative repeaters on the span. **HAZARDOUS VOLTAGES EXIST ON THE LINE SIDE OF THE CSU** and local telephone company office alarms may sound when the current path is interrupted. Since telephone companies do not have a uniform policy regarding the disconnection of the CSU from the span, **LOCAL TELEPHONE COMPANY INTERVENTION IS STRONGLY RECOMMENDED.** Advance notice should be given so that power can be removed from the span prior to disconnection of the CSU.

4.3.1 Simplex Current Measurement/CSU Emulation Test Set-Up

To set up a test that measures simplex current, perform the steps shown in Table 4-5.

4.3.2 Collecting Simplex Current Test Results

Immediately upon successfully configuring the T-BERD 211 for simplex current measurement, follow the procedure shown in Table 4-6 to collect test results.

NOTE: An error analysis test can also be performed by following the steps described in Table 4-2 (Collecting T1 Out-of-Service Test Results).

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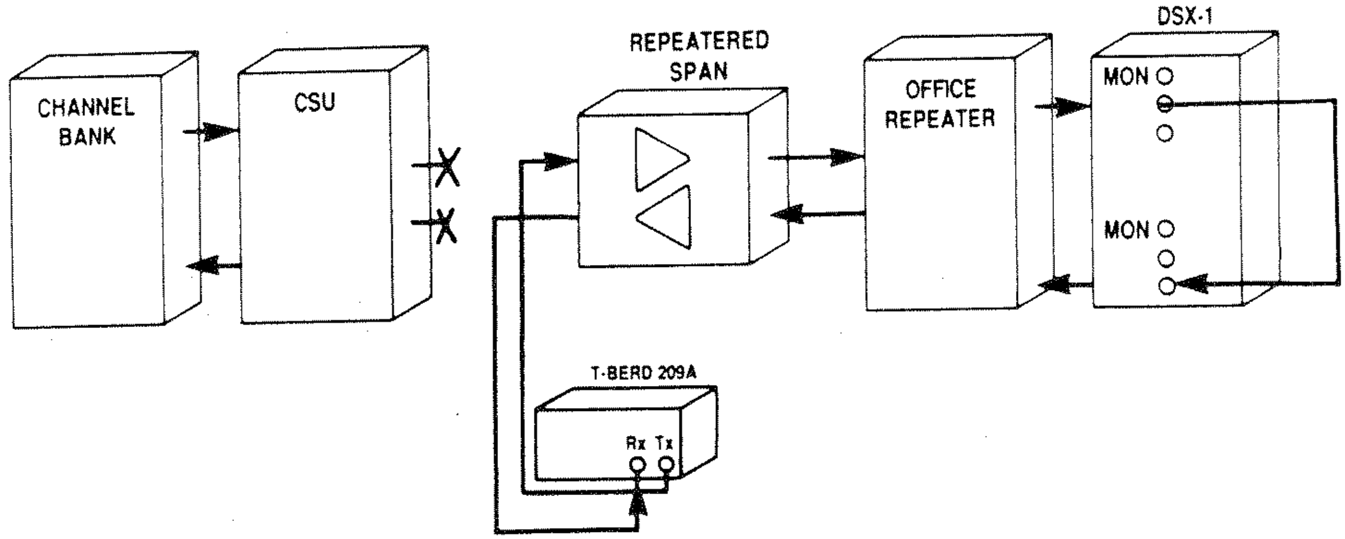

Figure 4-3
Simplex Current Measurement

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Table 4-5
Simplex Current Measurement Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to the data format of the T-carrier circuit under test (T1, T1 D4, T1 SLC, T1 ESF, or T1 ESFz framing).
3.	Set the **PATTERN** switch to the T1 QRSS position. **NOTE:** T1 QRSS is the standard test data pattern for T1 testing.
4.	Set the **TIMING** switch to the INT position.
5.	Set the **TEST** switch to the CONT position.
6.	Set the **CODE** switch to either the B8ZS or AMI position, as appropriate. The **CODE** switch is disabled when ESFz mode is used.
7.	Ensure that all **ERROR INSERT** switches are in the OFF position (switch LEDs not illuminated).
8.	Set the **RECEIVE INPUT** switch to the TERM position.
9.	Upon determining that power has been removed from the span line, disconnect the CSU from the span line. **DANGER: HIGH VOLTAGE MAY BE ENCOUNTERED.**
10.	Connect the span line to the T-BERD 211 using any of the following: (a) A 15-pin D connector. (b) A Model 10558 cable (if bare wires or spade lugs are supplied). (c) A Model 10686 cable (if RJ45 connectors are supplied). **WARNING:** If any of the connectors are used to connect the T-BERD 211 to a simplex powered span line, the line voltage is also present at the other connections. Therefore, do not use the other connections.

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Table 4-5
Simplex Current Measurement Test Set-Up (Continued)

Step	Activity
11.	Have the span line power restored.
12.	Set the **RESULTS I Category** switch to the SIGNAL position.
13.	Using the **RESULTS I Results** switch, scroll the 41-RX LEVEL result into the RESULTS I display.
14.	Verify that the **TRANSMIT OUTPUT** switch is properly set as follows: (a) If the receive level is -15 dBdsx and below (41-RX LEVEL result), set the transmit level to 0 dBdsx. (b) If the receive level is -14 to -8 dBdsx (41-RX LEVEL result), set the transmit level to -7.5 dBdsx. (c) If the receive level is -7.5 dBdsx and above (41-RX LEVEL result), set the transmit level to -15 dBdsx.
15.	Press the **RESTART** switch to begin the test.
16.	Collect test results as shown in Table 4-6.

Table 4-6
Collecting Simplex Current Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SIGNAL position.
2.	Using the **RESULTS I Results** switch, scroll the 50-SPX CURRENT result into the RESULTS I display.
3.	Verify that the simplex current is correct. **Typical Values:** 60mA and 140 mA.

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4.4 SIGNAL LEVEL MEASUREMENT

4.4.1 Signal Level Measurement Test Set-Up

The T-BERD 211 can measure input and output signal levels at any in-service CSU. To set up an in-service test for signal level measurement, perform the steps shown in Table 4-7.

4.4.2 Collecting Signal Level Test Results

Upon successfully setting up a test for measuring signal levels, follow the procedures shown in Table 4-8 to collect test results.

Table 4-7
Signal Level Measurement Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to AUTO.
	RESULT: The T-BERD 211 automatically configures itself to the framing, coding, and data pattern on the live circuit.
3.	Set the **RECEIVE INPUT** switch to the BRIDGE position.
4.	Set the **TEST** switch to the CONT position.
5.	**DANGER: HIGH VOLTAGE MAY BE ENCOUNTERED.** Connect the T-BERD 211 RECEIVE INPUT to the receive line terminals (from the central office).
6.	Observe that the T1 PULSES LED illuminates.
7.	Press the **RESTART** switch to begin the test.

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Table 4-8
Collecting Signal Level Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SIGNAL position.
2.	Using the **RESULTS I Results** switch, scroll the 41-RX LEVEL result into the RESULTS I display.
3.	Verify that the receive level is between 0 dBdsx and -22dBdsx, per Bell System Technical Reference PUB62411.
4.	**DANGER: HIGH VOLTAGE MAY BE ENCOUNTERED.** Connect the T-BERD 211 RECEIVE INPUT to the transmit line terminals (toward the central office).
5.	Using the **RESULTS II Results** switch, scroll the 41-RX LEVEL result into the RESULTS II display.
6.	Verify that the CSU line buildout (LBO) is properly set as follows: (a) If the receive level is -15 dBdsx and below, the transmit level should be 0 dBdsx. (b) If the receive level is -14 to -8 dBdsx, the transmit level should be -7.5 dBdsx. (c) If the Receive level is -7.5 dBdsx and above, the transmit level should be -15 dBdsx.

4.5 SLC-96 TESTING

The T-BERD 211 can be used for either out-of-service testing or in-service monitoring of a T1 span used in a SLC-96 system.

4.5.1 Basic Out-of-Service SLC-96 Test Set-Up

To setup a basic out-of-service test of a T1 span used in a SLC-96 system, perform the steps shown in Table 4-9.

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4.5.2 Collecting Out-of-Service SLC-96 Test Results

Immediately upon successfully configuring the T-BERD 211 for SLC-96 out-of-service testing, follow the procedures shown in Table 4-10 to collect test results.

Table 4-9
SLC-96 Out-of-Service Test Set-Up

Step	Activity
1.	Determine if the protection spare T1 span is in use by examining the LEDs of each Line Interface Unit (LIU) for shelves A, B, C, and D. The LED labeled LINE ON PROT on the LIUs illuminates when an error threshold in the corresponding T1 span is exceeded and the T1 span is placed out-of-service. This span should be tested and repaired prior to testing another span; otherwise, service may be interrupted. Note that if none of the LIUs are protected, then any of them can be tested.
2.	Install a pin plug into the pin jack labeled F END LP of the LIU to be tested.
3.	Connect an LIU Test Cord (a 15-pin D-to-edge connector cable) from the LIU to the JACK PANEL.
4.	Press the **POWER** switch to apply power to the T-BERD 211.
5.	Set the **MODE** switch to the T1 SLC position.
6.	Set the **PATTERN** switch to the T1 QRSS position.
7.	Set the **TEST** switch to the CONT position.
8.	Set the **TIMING** switch to the INT position.
9.	Set the **CODE** switch to either the B8ZS or AMI position, as appropriate.
10.	Ensure that all **ERROR INSERT** switches are in the OFF position, i.e., the switch LEDs are not illuminated.

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Table 4-9
SLC-96 Out-of-Service Test Set-Up (Continued)

Step	Activity
11.	Set the **RECEIVE INPUT** switch to the TERM position.
12.	Set the **TRANSMIT OUTPUT** switch to the 0 dB(DSX) position.
13.	Connect your TRANSMIT and RECEIVE connectors to JACK PANEL RCVG LINE connector using WECO 310 cables.
14.	Verify that: (a) The T1 PULSES LED illuminates. (b) The PATTERN SYNC LED illuminates. (c) The FRAME SYNC LED illuminates. (d) The B8ZS LED illuminates, if B8ZS clear channel line coding is detected.

Table 4-10
Collecting SLC-96 Out-of-Service Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed as they occur: (a) 00-BIT ERRORS (LOGIC Category) (b) 09-SLIPS (LOGIC Category) (c) 25-VIOLATIONS (BPV & FRAME Category) (d) 30-FRM ERRORS (BPV & FRAME Category) (e) 32-CRC ERRORS (BPV & FRAME Category)

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Table 4-10
Collecting SLC-96 Out-of-Service Test Results (Continued)

Step	Activity
	(f) 34-FRM LOS CNT (BPV & FRAME Category) (g) 40-RX FREQ Hz (SIGNAL Category) (h) 44-PULSE SHAPE (SIGNAL Category) (i) 51-TIMING SLIP (SIGNAL Category) (j) 80-WB/HB JIT (JITTER & WANDER Category)
2.	Using the **RESULTS II Results** switch, scroll the 41-RX LEVEL result into the RESULTS II display.
3.	Verify that the 41-RX LEVEL is between -2 dBdsx and +2 dBdsx.
4.	Interpret test results as follows: ***Interpreting Results:*** (a) If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the **RESULTS I Results** switch to scroll through the errored values. (b) If 25-VIOLATIONS and 30-FRM ERRORS are detected, perform an end-to-end test using a second (similarly configured) T-BERD 211 configured at the far end of the span, either at the Central Office Terminal (COT) or the Remote Terminal (RT). To perform and end-to-end test, remove the pin plug from the F END LP position and insert it into the SW TO PROT position. A second T-BERD 211 can be configured at the far-end, permitting further sectionalization of the failure.

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4.5.3 Basic SLC-96 In-Service Test Set-Up

To set up an in-service SLC-96 test, perform the steps shown in Table 4-11.

4.5.4 Collecting SLC-96 In-Service Test Results

Upon successfully setting up a SLC-96 in-service test, follow the procedures shown in Table 4-12 to collect test results.

Table 4-11
SLC-96 In-Service Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to AUTO.
	RESULT: The T-BERD 211 automatically configures itself to the T1 SLC framing, coding, and data pattern on the live circuit.
3.	Set the **TEST** switch to the CONT position.
4.	Set the **RECEIVE INPUT** switch to the DSX-MON position.
5.	Connect the LIU Test Cord (a 15-pin D-to-edge connector cable) from the LIU to the JACK PANEL.
6.	Connect the T-BERD 211 to the RCVG MONITOR jack on the JACK PANEL.
7.	Press the **RESTART** switch to begin the test.
	Note the Following:
	(a) The T1 PULSES LED illuminates if a T1 signal is present.
	(b) The FRAME SYNC LED illuminates SLC-96 framing is present.

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Table 4-11
SLC-96 In-Service Test Set-Up (Continued)

Step	Activity
	(c) The name of the framing format appears in the display MODE line in lower-case letters. (d) The name of the received data pattern appears in the display PATTERN line in lower-case letters. If no pattern is detected, "live" is displayed. (e) The B8ZS LED illuminates, if B8ZS clear channel line coding is detected.

Table 4-12
Collecting SLC-96 In-Service Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed as they occur: (a) 00-BIT ERRORS* (LOGIC Category) (b) 09-SLIPS* (LOGIC Category) (c) 25-VIOLATIONS (BPV & FRAME Category) (d) 30-FRM ERRORS (BPV & FRAME Category) (e) 32-CRC ERRORS** (BPV & FRAME Category) (f) 34-FRM LOS CNT (BPV & FRAME Category) (g) 40-RX FREQ Hz (SIGNAL Category) (h) 44-PULSE SHAPE (SIGNAL Category) (i) 51-TIMING SLIP (SIGNAL Category) (j) 80-WB/HB JIT (JITTER & WANDER Category)
2.	Using the **RESULTS II Results** switch, scroll the 41-RX LEVEL result into the RESULTS II display.

*Not applicable for in-service testing.
**Not applicable for SLC-96 testing.

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Table 4-12
Collecting SLC-96 In-Service Test Results (Continued)

Step	Activity
3.	Verify that the 41-RX LEVEL is between -18 dBdsx and -22 dBdsx. (A 20 dB loss is incurred due to the isolation resistors in the monitor jacks; if the jacks are not isolated, the level will be between -2 dBdsx and +2 dBdsx).
4.	Interpret test results as follows: ***Interpreting Results:*** (a) If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the **RESULTS I Results** switch to scroll through the errored values. (b) If 30-FRM ERRORS and 25-VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. (c) If 30-FRM ERRORS are detected, but the 25-VIOLATIONS count remains at 0, it is likely that errors are not being introduced at the near-end repeatered span and further sectionalization is required. **NOTE:** The data transmitted by the LIU can be monitored by plugging the T-BERD 211 into the TRMTG MONITOR JACK and repeating steps 1 to 4.

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4.6 T1C TESTING

This section describes how the T-BERD 211 is used to test T1C lines in an in-service monitor and out-of-service testing analysis mode.

4.6.1 Basic T1C Out-of-Service Test Set-Up

To set up a basic out-of-service test of T1C circuit, perform the steps shown in Table 4-13.

4.6.2 Collecting T1C Out-of-Service Test Results

Immediately upon successfully configuring the T-BERD 211 for T1C out-of-service testing, follow the procedures shown in Table 4-14 to collect test results.

Table 4-13
Basic T1C Out-of-Service Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to the T1C position.
3.	Set the **PATTERN** switch to the 2^{20}-1 or T1C QRSS position.
	NOTE: T1C QRSS is the standard test data pattern for T1C testing.
4.	Set the **TIMING** switch to the INT position to use the T-BERD 211 internal timing source.
	NOTE: If loop timing is required, set the **TIMING** switch to the RECOVD(LOOP) position.

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Table 4-13
Basic T1C Out-of-Service Test Set-Up

Step	Activity
5.	Set the **TEST** switch to the CONT position.
6.	Set the **CODE** switch to either the B8ZS or AMI position, as appropriate.
7.	Ensure that all **ERROR INSERT** switches (FRAME, BPV, and LOGIC) are in the off position (i.e., switch LEDs should not be illuminated).
8.	Set the **RECEIVE INPUT** switch to the TERM position.
9.	Set the **TRANSMIT OUTPUT** switch to the 0dB(DSX) position.
10.	Using the AUX LP CODE function, select the desired loop code (CSU, FAC1, FAC2, or PGM).
11.	Connect your TRANSMIT and RECEIVE connectors to the circuit to be tested.
12.	Press the **LOOP UP** switch to send the selected loop-up code. **NOTE**: Deactivate the loopback at the conclusion of the test by pressing the LOOP DOWN switch.
13.	Verify that: (a) The T1C PULSES LED is illuminated. (b) The PATTERN SYNC LED is illuminated. (c) The B8ZS LED illuminates, if B8ZS clear channel line coding is detected.
14.	Press the **RESTART** switch to begin the test.

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Table 4-14
Collecting T1C Out-of-Service Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed as they occur: (a) 00-BIT ERRORS (LOGIC Category) (b) 09-SLIPS (LOGIC Category) (c) 25-VIOLATIONS (BPV & FRAME Category) (d) 40-RX FREQ Hz (SIGNAL Category)
2.	Using the **RESULTS II Results** switch, scroll the 41-RX LEVEL result into the RESULTS II display.
3.	Verify that the 41-RX LEVEL is between -2 dBdsx and +2 dBdsx.
4.	Interpret test results as follows: ***Interpreting Results:*** (a) If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the **RESULTS I Results** switch to scroll through the errored values. (b) If 00-BIT ERRORS and 25-VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. (c) If 00-BIT ERRORS are detected, but the 25-VIOLATIONS count remains at 0, it is likely that the errors are not being introduced at the near-end span. **SUGGESTION:** If errors are detected in Step 4, use a second T-BERD 211 to perform an end-to-end test on your T1C circuit. By configuring a second T-BERD 211 at the far end of the span, both sections of the span can be tested individually.

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4.6.3 Basic T1C In-Service Test Set-Up

To monitor a T1C circuit at a DSX patch bay without disrupting the T1C service, perform the steps shown in Table 4-15.

4.6.4 Collecting T1 In-Service Test Results

Upon successfully setting up a T1C in-service test, follow the procedures shown in Table 4-16 to collect test results.

Table 4-15
Basic T1C In-Service Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to AUTO.
	RESULT: The T-BERD 211 automatically configures itself to the coding and data pattern on the live circuit.
3.	Set the **TEST** switch to the CONT position.
4.	Set the **RECEIVE INPUT** switch to the DSX-MON position.
5.	Connect the T-BERD 211 to the MON jack on the DSX patch bay (or CSU).
6.	Press the **RESTART** switch to begin the test.
	Note the Following:
	(a) The T1C PULSES LED illuminates if a T1C signal is present.
	(b) The name t1c appears in the display MODE line in lower-case letters.
	(c) The name of the received data pattern appears in the display PATTERN line in lower-case letters. If no pattern is detected, "live" is displayed.
	(d) The B8ZS LED illuminates, if B8ZS clear channel line coding is detected.

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Table 4-16
Collecting T1C In-Service Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed as they occur: (a) 25-VIOLATIONS (BPV & FRAME Category) (b) 40-RX FREQ Hz (SIGNAL Category)
2.	Using the **RESULTS II Results** switch, scroll the 41-RX LEVEL result into the RESULTS II display.
3.	Verify that the 41-RX LEVEL is between -18 dBdsx and -22 dBdsx. (A 20 dB loss is incurred due to the isolation resistors in the monitor jacks; if the jacks are not isolated, the level will be between -2 dBdsx and +2 dBdsx).
4.	Interpret test results as follows: ***Interpreting Results:*** (a) If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the **RESULTS I Results** switch to scroll through the errored values. (b) If 25-VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span.

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4.7 MULTIPAT AND BRIDGTAP TESTING

The following procedures apply to the set-up and operation of the T-BERD 211 when testing a span with the MULTIPAT and BRIDGTAP test patterns. The MULTIPAT test pattern can be used during the acceptance testing of a new T1 span or while troubleshooting an existing T1 span. The BRIDGTAP test pattern is generally used during the initial installation phase to test the span for bridge taps, but can also be used for troubleshooting an existing T1 span.

To effectively test a span with the MULTIPAT and BRIDGTAP tests, the MULTIPAT test should be performed first, followed by the BRIDGTAP test. Errors occurring during the MULTIPAT test would generally indicate a malfunctioning repeater, multiplexer, or DACS on the span. Errors detected in the BRIDGTAP test would indicate bridge taps on the span when the errors are grouped around a number of patterns. However, because the MULTIPAT patterns (except 2 IN 8) also appear in the BRIDGTAP test patterns, errored MULTIPAT patterns could also indicate a bridge tap and/or a malfunctioning circuit on the span. Table 4-17 describes the results of testing a span with the MULTIPAT and BRIDGTAP tests.

Table 4-17
MULTIPAT and BRIDGTAP Test Results

Test	Pass/ Fail	Errors Detected	Comments
MULTIPAT BRIDGTAP	Pass Pass	No No	No repeater problems. No bridge taps.
MULTIPAT BRIDGTAP	Pass Fail	No Yes	No repeater problems. Bridge taps on span, errors occur in groups around a number of patterns but do not affect MULTIPAT patterns.
MULTIPAT BRIDGTAP	Fail Fail	Yes Yes	Repeater problems or bridge taps on span. Bridge taps on span, errors occur in groups around a number of patterns including MULTIPAT patterns.

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4.7.1 End-to-End Testing

Perform the following procedure in Table 4-18 to test a span with the MULTIPAT test first, then the BRIDGTAP test. This procedure requires two T-BERD 211s. It should be noted that both sides of the span are tested with a test pattern being transmitted from both ends of the span. This allows both sides of the span to be tested individually. Unless otherwise indicated, use this procedure on both instruments.

Table 4-18
End-to-End Testing

Step	Controls/Indicators/ Connections	Activity
1.	**POWER** switch	Apply power to T-BERD 211.
2.	**MODE** switch	Select framed (T1 D4, T1 ESF, T1 SLC) or unframed (T1 or T1C) operating mode.
3.	**PATTERN** switch	Select MULTIPAT or BRIDGTAP test pattern.
4.	**TIMING** switch	Set INT timing at one site and RECOVD (LOOP) at the other site.
5.	**TEST** switch	Set for CONT or TIMED testing. MULTIPAT test: For minimum TIMED tests, set for 15 minutes. BRIDGTAP test: For minimum TIMED tests, set for 11 minutes.
6.	**CODE** switch	MULTIPAT test: set for AMI or B8ZS coding. BRIDGTAP test: set for AMI coding. B8ZS can be used, but is not recommended.
7.	**RESULTS I & II** switches	Display SUMMARY category in the RESULTS I display. Display SIGNAL category, 41-RX LEVEL result, in the RESULTS II display.

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Table 4-18
End-to-End Testing (Continued)

Step	Controls/Indicators/ Connections	Activity
8.	**TRANSMIT OUTPUT** switch	Select appropriate output level at both sites.
9.	**RECEIVE INPUT** switch	Select appropriate input impedance and signal conditioning at both sites. Typically, TERM is used in end-to-end testing.
10.	Connections	Connect T-BERD 211 to span (TX to RX). Typically, connect to IN and OUT jacks.
11.	**RESTART** switch	ONLY press at one site. The other site automatically restarts.
12.	Test Verification	Check the following conditions for an operational test. (a) T1 PULSES LED - Illuminated if T1 signal pulses are detected. (b) T1C PULSES LED - Illuminated if T1C signal pulse are detected. (c) PATTERN SYNC LED - Illuminated if receiver synchronized with received pattern. (d) FRAME SYNC LED - Illuminated if a framed operating mode is selected and the receiver is synchronized to the received framing pattern. (e) PATTERN display - MULTIPAT test: MULTIPAT and lower case pattern alternate in display. BRIDGTAP test: BRIDGTAP and lower case pattern alternate in display.

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Table 4-18
End-to-End Testing (Continued)

Step	Controls/Indicators/ Connections	Activity
13.	RESULTS Verification	Check the SUMMARY category for one or more of the following (see Table 4-17): (a) ALL RESULTS OK - MULTIPAT test: all patterns passed, span operational. BRIDGTAP test: all patterns passed, no bridge taps. (b) Errored Results - MULTIPAT test: all or part of the patterns failed, span requires further analysis and sectionalization. BRIDGTAP test: all or part of the patterns failed, bridge taps detected. Sectionalize span to isolate bridge taps. (c) FAILED PATTERN - Test failed at indicated test pattern.

4.7.2 Loopback Testing

Perform the following procedure in Table 4-19 to test a span with the MULTIPAT test first, then the BRIDGTAP test. This procedure requires one T-BERD 211. It should be noted that both sides of the span are tested simultaneously.

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Table 4-19
Loopback Testing

Step	Controls/Indicators/ Connections	Activity
1.	**POWER** switch	Apply power to T-BERD 211.
2.	**MODE** switch	Select framed (T1 D4, T1 ESF, T1 SLC) or unframed (T1 or T1C) operating mode.
3.	**PATTERN** switch	Select MULTIPAT or BRIDGTAP test pattern.
4.	**TIMING** switch	Set for INT timing.
5.	**TEST** switch	Set for CONT or TIMED testing. MULTIPAT test: For minimum TIMED tests, set for 15 minutes. BRIDGTAP test: For minimum TIMED tests, set for 11 minutes.
6.	**CODE** switch	MULTIPAT test: set for AMI or B8ZS coding. BRIDGTAP test: set for AMI coding. B8ZS can be used, but is not recommended.
7.	**RESULTS I & II** switches	Display SUMMARY category in the RESULTS I display. Display SIGNAL category, 41-RX LEVEL result, in the RESULTS II display.
8.	**TRANSMIT OUTPUT** switch	Select appropriate output level; typically 0 dBdsx is used in out-of-service tests.
9.	**RECEIVE INPUT** switch	Select appropriate input impedance and signal conditioning; typically TERM is used in out-of-service tests.
10.	Connections	Connect T-BERD 211 to span. Typically, connect to IN and OUT jacks.
11.	**LOOP UP** switch	Send loop-up code to remote site to enable loopback. Refer to AUX LP CODE, Section 2.4.24, to select loop codes.

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Table 4-19
Loopback Testing (Continued)

Step	Controls/Indicators/ Connections	Activity
12.	**RESTART** switch	Press to restart test and clear all results. Run test for desired length of time set in Step 5.
13.	Test Verification	Check the following conditions for an operational test. (a) T1 PULSES LED - Illuminated if T1 signal pulses are detected. (b) T1C PULSES LED - Illuminated if T1C signal pulses are detected. (c) PATTERN SYNC LED - Illuminated if receiver synchronized with received pattern. (d) FRAME SYNC LED - Illuminated if a framed operating mode is selected and the receiver is synchronized to the received framing pattern. (e) PATTERN display - MULTIPAT test: MULTIPAT and lower case pattern alternate in display. BRIDGTAP test: BRIDGTAP and lower case pattern alternate in display.
14.	RESULTS Verification	Check the SUMMARY category for one or more of the following (see Table 4-17): (a) ALL RESULTS OK - MULTIPAT test: all patterns passed, span operational. BRIDGTAP test: all patterns passed, no bridge taps. (b) Errored Results - MULTIPAT test: all or part of the patterns failed, span requires further analysis.

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Table 4-19
Loopback Testing (Continued)

Step	Controls/Indicators/ Connections	Activity
		BRIDGTAP test: all or part of the patterns failed, bridge taps detected. (c) FAILED PATTERN - Test failed at indicated test pattern.
15.	**LOOP DOWN** switch	Send loop-down code to remote site to release loopback.

4.8 MEASURING TIMING SLIPS AND WANDER

4.8.1 Timing Slips

The T-BERD 211 timing slip measurements identifies frequency deviations which cause uncontrolled and controlled clock slips. When measuring timing slips, a received T1 signal is compared with a reference T1 signal connected to the T1 REF input (using a WECO 310 or bantam cable); this comparison allows the T-BERD 211 to count the number of times that the edges of the received signal move past the edges of the reference signal (see Figure 4-4).

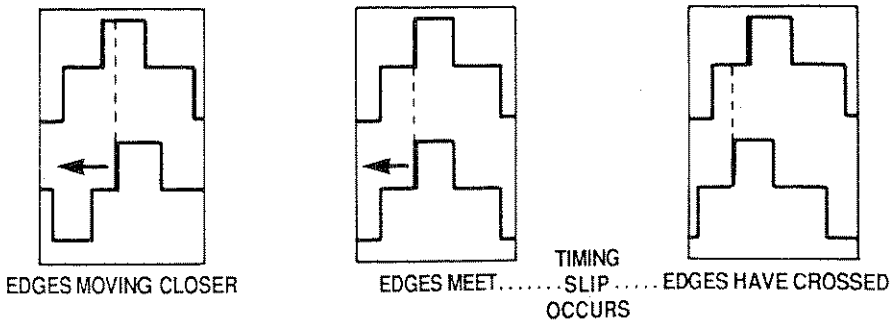

Figure 4-4
Timing Slips

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The 51-TIMING SLIP result is displayed in three portions (see Figure 4-5):

(a) a numeric value
(b) a bar graph
(c) a moving "wheel"

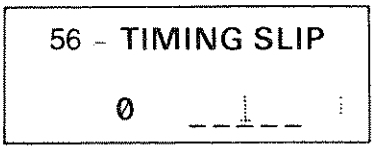

Figure 4-5
Timing Slips Results Display

The numeric value (range 0 to 9999) represents the total number of frame slips (1 frame slip = 193-bit slips). The bar graph represents partial frame slips in increments of one bar per 16 bit slips (one wheel rotation); each time the bar moves to the end of the graph, it is reset to the middle position and the frame slip count is incremented. The wheel is used in conjunction with the bar graph to graphically display the direction, rate, and magnitude of timing slips. Figure 4-6 shows the values assigned to each position of the bar graph and the wheel.

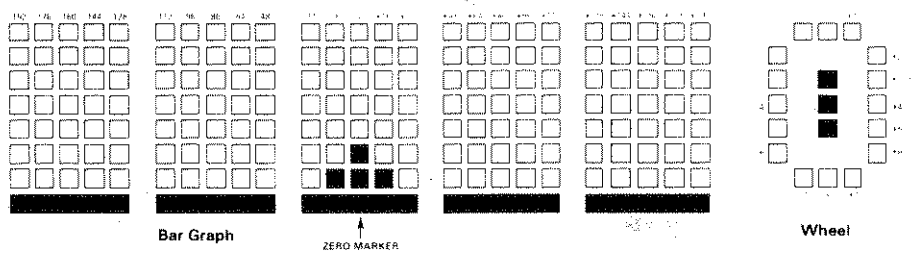

Figure 4-6
Bar Graph and Wheel Values

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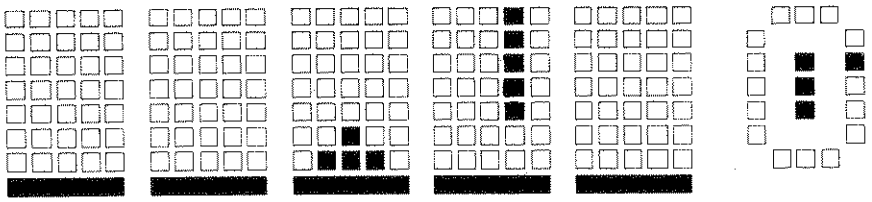
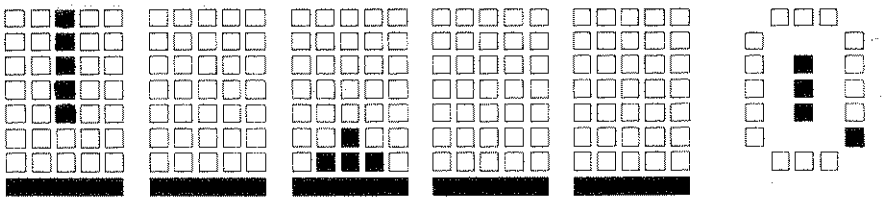
Determining the Magnitude of a Timing Slip

The magnitude of a timing slip is determined by adding the magnitude of the number indicated by the wheel position to the corresponding bar graph value. For example, if the display shows:



the bar graph value is +96 and the wheel value is +3; adding these two values results in a timing slip of +99 bits (that is, 99 more clock cycles have been received at the RECEIVE input than at the T1 REF input, or the RECEIVE input is receiving a higher frequency than the T1 REF input). If the display shows:



the bar graph value is -160 and the wheel value is +6, resulting in a timing slip of -154 bits.

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Timing Slip Test Set-Up

To test for the presence of timing slips, perform the steps shown in Table 4-20.

Table 4-20
Timing Slips Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Using a WECO 310 or bantam cable, connect the T1 timing reference to the T1 REF front-panel input. **NOTE:** The T1 REF input accepts full DSX signals (OUT jack) or DSX-MON (monitor jack) point signals.
3.	Set the **RECEIVE INPUT** switch to the appropriate line termination position. Typically, set for DSX-MON when connecting to a monitor jack.
4.	Connect the **RECEIVER INPUT** to the line under test.
5.	Set the **MODE** switch to the appropriate T1 format.
6.	Set the **RESULTS I Category** switch to the SIGNAL position, then scroll the 51-TIMING SLIP result into the RESULTS I display.
7.	Set the **RESULTS II Category** switch to the SIGNAL position, then scroll the 53-SLIP ANA SEC result into the RESULTS II display.
8.	Press the **RESTART** switch to begin the test. **RESULT:** The 53-SLP ANA SEC result should accumulate if both the T1 REF and RECEIVER signals are present. This result will not accumulate when either input is lost.

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Analyzing Timing Slip Test Results

Timing slip results vary according to the timing relationship between the T1 REF and RECEIVER signals.

If:	Then:
The T1 REF and RECEIVER signals are perfectly synchronized	The timing slip count remains at 0, the bar graph remains at center, and the wheel remains at top-center.
The T1 REF and RECEIVER signals are synchronized, but one of the signals exhibits low-speed wander (e.g., Doppler shifts from satellites)	The timing slip count remains at 0; both the bar graph and the wheel move to the right as the satellite nears, and to the left as the satellite moves further away. Note that the 70-WANDER +PK, 71-WANDER-PK, and 72-P-P WANDER results DER results record the maximum deviation due to satellite Doppler shifts.
The T1 REF and RECEIVER signals are unsynchronized, and the RECEIVER frequency is higher than the T1 REF frequency rapidly.	The wheel moves clockwise, the bar graph moves to the right, and the timing slip count increments every 193 bit slips. When the frequency difference is more than a few cycles, the 51-TIMING SLIP count, bar graph, and wheel move very
The T1 REF and RECEIVER signals are unsynchronized, and the RECEIVER frequency is lower than the T1 REF frequency	The wheel moves counter-clockwise, the bar graph moves to the left, and the timing slip count increments every 193 bit slips. When the frequency difference is more than a few cycles, the 51-TIMING SLIP count, bar graph, and wheel move very rapidly.

4.8.2 Wander

The T-BERD 211 wander measurements identify the deviations in time between when pulse transitions ideally occur and when digital decoding gear expect them to occur. Wander is basically a slow form of jitter, occurring at frequencies less than 10 Hz; jitter time displacement occurs at rates greater

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than 10 Hz. If the received bit stream is impaired by wander, the receive frequency is different from that of the transmit frequency. As a result of such frequency differences, the terminal clocks in more bits or fewer bits than it can clock out. Terminal devices typically compensate for the presence of wander with buffers that store additional bits. As long as wander does not occur in the same direction for an extended period of time, these buffers can compensate for wander's presence. But if wander exceeds the buffer length, the buffer overflows and data is lost or disrupted.

Measuring Wander

Wander and timing slips are measured the same way — the received T1 signal is compared to a reference signal connected to the T1 REF input (using a WECO 310 cable). Wander is measured in UIs; 1 UI is equivalent to a single T1 time slot or one bit space in a buffer. When measuring wander, the primary goal is to ensure that the amount of wander on the T1 signal is not exceeding an amplitude for which terminal buffers cannot compensate. The six wander measurements that are available with the T-BERD 211 are:

(1) 70-WANDER +PK indicates the maximum positive peak wander deviation since the beginning of the test, expressed in UIs.

(2) 71-WANDER -PK indicates the maximum negative peak wander deviation since the beginning of the test, expressed in UIs.

(3) 72-P-P WANDER displays the total of the 70-WANDER +PK and 71-WANDER -PK measurements since the beginning of the test. The maximum amount of peak-to-peak wander that can be tolerated without buffer overflow is equal to buffer length.

(4) 73-15m WANDER measures the maximum peak-to-peak wander deviation over the last 15 minutes of the test. Note that this result is unavailable for the first 15 minutes of the test and is updated once per minute thereafter.

(5) 74-24h WANDER measures the maximum peak-to-peak wander deviation over the last 24 hours of the test. Note that this result is unavailable for the first 24 hours of the test and is updated once per hour thereafter.

(6) 75-TIE WANDER measures the instantaneous displacement of the received T1 signal from the reference since the beginning of the test. This result can be positive or negative and is measured in UIs.

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Wander Test Set-Up

To test for the presence of wander, perform the steps shown in Table 4-21.

Table 4-21
Wander Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Using a WECO 310 or bantam cable, connect the T1 timing reference to the T1 REF front-panel input.
	NOTE: The T1 REF input accepts full DSX signals (OUT jack) or DSX-MON (monitor jack) point signals.
3.	Set the **RECEIVE INPUT** switch to the appropriate line termination position. Typically, set for DSX-MON when connecting to a monitor jack.
4.	Connect the RECEIVER INPUT to the line under test.
5.	Set the **MODE** switch to the appropriate T1 format.
	NOTE: Wander is only available for T1 modes, not T1C modes.
6.	Set the **RESULTS I Category** switch to the JITTER & WANDER position, then scroll the 72-P-P WANDER result into the RESULTS I display.
7.	Set the **RESULTS II Category** switch to the JITTER & WANDER position, then scroll the 75-TIE WANDER result into the RESULTS II display.
8.	Press the **RESTART** switch to begin the test.

4.9 MEASURING T1 PULSE SHAPE

The T-BERD 211 can measure the characteristics of a DS1 pulse waveform. In order to design equipment which can optimally receive a DS1 signal, constraints are placed on the shape of the signal that can be transmitted by DS1 equipment. This constraint is referred to as the pulse mask. A pulse

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mask is a graphical representation of the restrictions which are placed on the pulse shape. Figure 4-7 depicts a sample T-BERD 211 pulse mask and pulse waveform. The pulse shape results are also identified along with the pulse mask specifications.

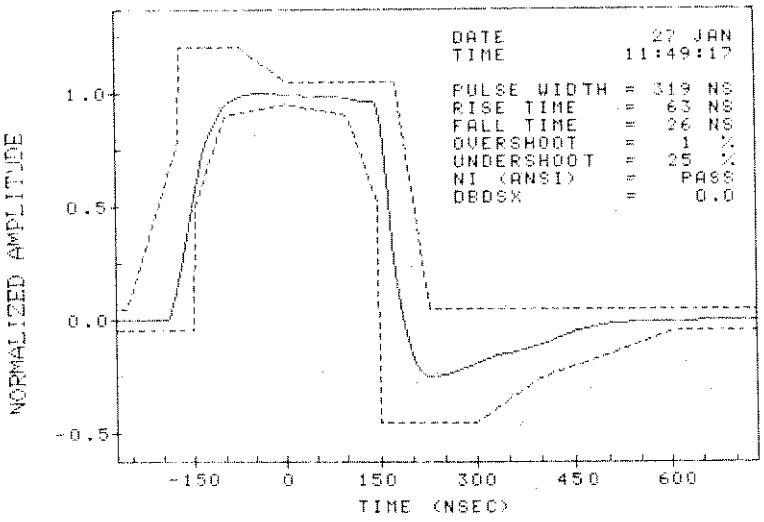

Figure 4-7
Sample Pulse Shape

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You can use the T-BERD 211 to determine if a DS1 pulse is within specification by comparing the pulse shape to a pulse mask like the one shown in Figure 4-7. The T-BERD 211 is equipped with two such masks, both of which are selectable via the AUX PLS MASK function:

(1) **DSX (CB 119)** — Selects the pulse mask conforming to AT&T Compatibility Bulletin 119 and ANSI T1.102 specifications. This mask is used to analyze the pulse shape at a DSX cross-connect.

(2) **NI (ANSI)** — Selects the pulse mask conforming to the ANSI T1.403 Network Interface specification. This mask is used to analyze the pulse shape at the network interface.

If desired, you can evaluate a DS1 pulse without comparing it to a mask by setting the AUX PLS MASK function to NONE. The T-BERD 211 is also equipped to output the pulse shape and mask to a graphics printer. The pulse shape printout is initiated by selecting the AUX GRAPH function and pressing the **RESULTS I Results** switch. Note that when NONE (no pulse mask) is specified, the pulse shape is printed without the pulse mask.

4.9.1 Pulse Shape Test Set-Up

To analyze a DS1 pulse shape, perform the steps shown in Table 4-22. To accurately evaluate the pulse shape against the selected pulse mask specification, the test instrument must terminate the span; and a test pattern of two or more zeros between each one is required (the 1:7 pattern is recommended). The procedure in Table 4-22 follows these prerequisites. However, the T-BERD 211 can be used to perform qualitative pulse shape measurements when performing an in-service monitoring test.

4.9.2 Collecting Pulse Shape Test Results

Immediately upon successfully configuring the T-BERD 211 for pulse shape testing, follow the procedures shown in Table 4-23 to collect test results.

If the SIGNAL category is selected and OUT OF RANGE appears in the pulse shape results, the DS1 pulse signal level is not within prescribed limits. The results are not available until the signal level reaches the following levels:

(1) BRIDGE or TERM - +4 to -4 dBdsx.
(2) DSX-MON - -16 to -24 dBdsx.

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Table 4-22
Out-of-Service Pulse Shape Test Set-Up

Step	Activity
1.	Press the **POWER** switch to apply power to the T-BERD 211.
2.	Set the **MODE** switch to the data format of the T-Carrier circuit under test (T1, T1 D4, T1 SLC, or T1 ESF framing).
3.	Set the **PATTERN** switch to the 1:7 position. **NOTE:** 1:7 is the recommended test pattern to test the pulse shape (specifications require a pattern with 2 or more zeros between each one).
4.	Set the **TIMING** switch to the INT position to use the T-BERD 211 internal timing source. **NOTE:** If testing is performed through a DCS, set the **TIMING** switch to the RECOVD position.
5.	Set the **TEST** switch to the CONT position.
6.	Set the **CODE** switch to either the B8ZS or AMI position, as appropriate.
7.	Ensure that all **ERROR INSERT** switches (FRAME, BPV, and LOGIC) are in the off position (i.e., switch LEDs should not be illuminated).
8.	Set the **RECEIVE INPUT** switch to the TERM position (required by the pulse shape specifications).
9.	Set the **TRANSMIT OUTPUT** switch to the 0dB(DSX) position.
10.	Set the **MODE** switch to the AUX position.
11.	Using the **PATTERN** switch, scroll the AUX PLS MASK function into the RESULTS I display. Using the **RESULTS I Results** switch, set the AUX PLS MASK function to DSX (CB 119) or NI (ANSI).
12.	Using the **PATTERN** switch, scroll the AUX LP CODE function into the RESULTS I display. Using the **RESULTS I Results** switch, set the desired loop code (CSU, FAC1, FAC2, or PGM).

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Table 4-22
Out-of-Service Pulse Shape Test Set-Up (Continued)

Step	Activity
13.	Connect your TRANSMIT and RECEIVE connectors to the circuit to be tested.
14.	Press the **LOOP UP** switch to send the selected loop-up code. **NOTE**: Deactivate the loopback at the conclusion of the test by pressing the **LOOP DOWN** switch.
15.	Verify that: (a) The T1 PULSES LED is illuminated. (b) The PATTERN SYNC LED is illuminated. (c) The FRAME SYNC LED is illuminated, if either the T1 D4, T1 ESF, or T1 ESFz framing pattern is detected. (d) The B8ZS LED illuminates, if B8ZS clear channel line coding is detected.
16.	Press the **RESTART** switch to begin the test.

Table 4-23
Collecting Pulse Shape Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY category. (a) If ALL RESULTS OK appears in the display and the PULSE SHAPE alarm LED is not illuminated, the DS1 pulse meets the selected DSX specification mask; the test is complete. (b) If 44-PULSE SHAPE FAIL appears in the display and the PULSE SHAPE alarm LED illuminates, the DS1 pulse does not meet the selected mask specification; go to step 2.

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Table 4-23
Collecting Pulse Shape Test Results (Continued)

Step	Activity
2.	Set the **RESULTS II Category** switch to the SIGNAL category and scroll through the following pulse shape measurements and compare the results with the table in Figure 4-7. (a) 45-PULSE WIDTH (b) 46-RISE TIME (c) 47-FALL TIME (c) 48-UNDERSHOOT (d) 49-OVERSHOOT
3.	Perform the following steps to initiate a pulse shape printout. The printout can be made when 44-PULSE SHAPE result displays PASS, FAIL, or NO MASK. However, when OUT OF RANGE appears the printout cannot be made. (a) Press **MODE** switch once to select AUX mode. (b) Press **PATTERN** switch until AUX GRAPH appears in the display. (c) Press **RESULTS I Results** switch to print the pulse shape and mask printout. The pulse shape, pulse shape mask (is selected), and pulse shape results are printed on the printout.

4.10 MEASURING T1 JITTER

The T-BERD 211 automatically measures highband and wideband jitter whenever the appropriate T1 input signal level requirements are met. The input signal level requirements are:

(1) BRIDGE and TERM - +4 to -4 dBdsx.
(2) DSX MON - -16 to -24 dBdsx.

When the Spectral Analysis Option is not installed or disabled, the JITTER alarm LED illuminates whenever the wideband jitter content ion the

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T1 signal exceeds 5.0 UI and highband jitter exceeds 0.1 UI. Refer to Section 2.10.2 when the Spectral Analysis Option is installed for additional information on the JITTER LED.

4.10.1 Jitter Measurement of an In-Service T1 Circuit

If the JITTER alarm LED is continuously illuminated during the in-service monitoring of a T1 signal (see Section 4.2.2, Monitoring a Live T-Carrier Circuit), continue with the following procedure.

(1) Set the **RESULTS I Category** switch to JITTER & WANDER.

(2) Note and interpret the 81-WB JITTER, 82-HB JITTER, 84-MAX WB JIT, and 85-MAX HB JIT results as follows:

If:	Then.:
The 81-WB JITTER result exceeds 5.0 UI:	It is likely that the cause of the wide-band jitter is a multiplexer. Multiplexers often cause waiting time jitter, which often appears as low frequency jitter.
If the 82-HB JITTER result exceeds 0.1 UI, and the 81-WB JITTER result is similar in value:	It is likely that jitter is originating from a span line problem such as a bad repeater.
The JITTER history LED is illuminated, but the JITTER alarm LED is OFF:	Collect the 84-MAX WB JIT and 85-MAX HB JIT results. This type of jitter is difficult to isolate because it is transitional in nature. **SUGGESTION:** One of your system components may be pattern-sensitive. Place the T1 circuit out-of-service and stress suspect equipment using data patterns like 2^{23}-1 or 3 IN 24.

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4.10.2 Using the Spectral Analysis Option

When the Spectral Analysis Option is installed, the JITTER alarm LED illuminates depending on the spectral analysis setup. When the Spectral Analysis Option is disabled (AUX JIT S/A is OFF), the JITTER alarm LED operates as previously described in Section 4.10.1. When the Spectral Analysis Option is enabled (AUX JIT S/A is ON) but the jitter mask is not selected (AUX JIT MASK is NONE (UI)), the JITTER alarm LED is disabled. When the Spectral Analysis Option is enabled (AUX JIT S/A is ON) and a jitter mask is selected (e.g., AUX JIT MASK is 43801 (%)), the JITTER alarm LED illuminates when jitter exceeds the selected jitter mask specifications. The following information and procedures assume the Spectral Analysis Option is enabled (AUX JIT S/A is ON) and a jitter mask is selected (e.g., AUX JIT MASK is 43801 (%)).

If the JITTER alarm LED is continuously illuminated and the SUMMARY category shows non-zero 00-BIT ERROR, 25-VIOLATIONS, 30-FRM ERRORS, or 32-CRC ERRORS results in tandem with 80-WB/HB JITT FAIL, then jitter must be considered as a potential source for these errors. When installed, the Spectral Analysis Option can determine whether such errors are caused by jitter. Table 4-24 describes how the T-BERD 211 can be reconfigured during an out-of-service test for this purpose.

Spectral Analysis Option Set-Up

If your T-BERD 211 is already configured for out-of-service testing, Table 4-24 shows you how to set up the instrument for spectral analysis use.

Collecting Spectral Analysis Option Test Results

Immediately upon successfully configuring the T-BERD 211 for spectrum analyzer use, follow the procedures shown in Table 4-25 to collect test results.

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Table 4-24
Spectral Analysis Set-Up

Step	Activity
1.	Set the **MODE** switch to the AUX position.
2.	Set these AUX functions as follows: ***Function:*** ***Setting:*** JIT S/A ON JIT TRIG ERROR EVENT J IT MASK 62411/1983
3.	Press the **RESTART** switch to begin a new test.
4.	Set the **RESULTS I Category** switch to the SUMMARY position and wait for error results to appear.
5.	Set the **RESULTS II Category** switch to the JITTER & WANDER position. Scroll the 89-SA FREQ result into the display. **RESULT:** When the error event occurs, the jitter circuit captures and analyzes the jitter signal for 125 ms before and after its occurrence.

Table 4-25
Collecting Spectral Analysis Test Results

Step	Activity
1.	Set the **RESULTS I Category** switch to the SUMMARY position and wait for error results to appear.
2.	Set the **RESULTS II Category** switch to the JITTER & WANDER position. Scroll the 89-SA FREQ result into the display.
3.	Observe that all 40 frequency bands are displayed for a period of 1/2 second each.

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Table 4-25
Collecting Spectral Analysis Test Results (Continued)

Step	Activity
4.	After all of the frequency bands have been displayed, scroll the 90-SA FREQ result into the display.
5.	Scroll through each frequency band and note any result which exceeds 100% of the jitter mask. **ALTERNATIVE:** Generate a graphical printout of the jitter spectrum and jitter mask by selecting the AUX GRAPH function and pressing the RESULTS II Results switch.
6.	If the JITTER LED illuminates, record the wideband and highband jitter results, 81-WB JITTER and 82-HB JITTER.

Spectrum analyzer test results should be analyzed as follows:

If:	Then:
Any of the frequency bands exceed the jitter mask when the error event occurs	Jitter is the likely cause of the errors. This conclusion can be further confirmed by taking several spectrum analysis samples when no errors are present, and comparing them with the error event samples.
The JITTER LED is illuminated, but none of the frequency bands indicate jitter above 100% of mask with the errors, with no error events.	The errors may be caused by an in-phase summing of many jitter frequencies. Again, spectrum analysis samples where errors are present should be taken to further correlate the high jitter measurement and low jitter measurement

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SECTION 5

PRINTER/REMOTE CONTROL INTERFACE

5.1 INTRODUCTION

This section describes the RS-232 Printer/Remote Control Interface. Sections 5.2 through 5.4 discuss hardware and printing functions. A detailed description of remote control capabilities is available in Section 5.5.

5.2 INTERFACE DESCRIPTION

The RS-232 Printer/Remote Control Interface enables you to:

(1) Obtain hard-copy printouts of pulse shape and jitter graphs, test results, alarm messages, and front-panel set-ups.

(2) Remotely control the T-BERD 211 from a terminal or computer.

The RS-232 connector is configured to function as Data Communications Equipment (DCE); it may be directly connected to Data Terminal Equipment (DTE). Connection to other DCE is possible with the use of an adaptor cable. This RS-232 connector is a 25-pin female D connector located on the T-BERD 211's right side-panel. Auxiliary functions are used to select the baud rate, parity, and line terminator. Table 5-1 shows the selections available for configuring the RS-232 connector.

Table 5-1
RS-232 Printer/Controller Interface Configurations

Baud rate	300, 1200, 2400, 4800
Word length*	7 bits (odd or even parity)
8 bits (no parity)	
Line terminator	CR or CRLF
Column length	80 characters

*Word length controlled by parity selection, see AUX PARITY function.

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5.3 RS-232 PIN CONFIGURATION

To provide maximum operating flexibility, the use of the RS-232 signaling leads has been minimized. The interface monitors the Data Terminal Ready (DTR) line of the device to which it is connected. When this line is set true by the device, the T-BERD 211 assumes that the device is ready to accept a byte of data. The T-BERD asserts Clear To Send (CTS) true whenever it is ready to accept a byte of data from an external controller. Table 5-2 shows the RS-232 pin configuration.

Table 5-2
RS-232 Pin Configuration

Pin	Description
1 FGND	Frame ground — connected to chassis ground.
2 TD	Transmit data — The T-BERD 211 receives data on this lead.
3 RD	Receive data — Data is transmitted by the T-BERD 211 on this lead.
4 RTS	Request to Send — This lead is terminated by the T-BERD 211.
5 CTS	Clear to Send — This lead is driven to the ON state by the T-BERD 211 whenever it is ready to receive a command. This lead may be ignored by the controller if, before issuing commands, it waits for the return of a prompt character from the T-BERD signifying the completion of the previous command.
6 DSR	Data Set Ready — This lead is driven to the ON state by the T-BERD 211 whenever it has power applied.
7 SGND	Signal Ground — Connected to signal ground.
8 RLSD	Receive Line Signal Detect — Must be ON before the T-BERD 211 will accept any data.
9 +V	+12 Vdc.
10 -V	-12 Vdc.
20 DTR	Data Terminal Ready — Data is only output from the T-BERD 211 when this line is held in the ON condition by the receiving device.

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5.4 PRINTER OPERATION

Printer operation is controlled by the **PRINT** and **PRINT EVENT** switches on the T-BERD 211's front panel.

The **PRINT** switch has two positions which specify the type of printout to be generated: RESULTS and CONTROLS. Results prints are hard-copy listings of current test results. Controls prints are hard-copy listings of the T-BERD 211's current switch settings. When pressed, the **PRINT** switch generates the desired printout immediately. Results printouts and controls printouts are fully described in Sections 5.4.1 and 5.4.2, respectively.

The **PRINT EVENT** switch is a six-position electronic switch. The labeled LEDs adjacent to the switch illuminate to reflect the current position of the switch. The switch positions and their functions are as follows:

OFF — Sends no data to the RS-232 connector and clears the printer buffer. Note that results and controls prints are still available using the PRINT switch.

2 HR — Initiates a results printout every two hours or if an alarm condition changes. (see Alarm Messages.)

15 MIN — Initiates a results printout every 15 minutes or if an alarm condition changes.

TEST END — Initiates a results printout at the end of a timed test or if an alarm condition changes.

ERROR — Initiates a results printout for each second on the occurrence of logical bit errors, CRC errors, frame errors, or bipolar violations, as well as if an alarm condition changes.

SEV ERR SEC — Initiates a results printout whenever the error rate exceeds 10^{-3} per second or if an alarm condition changes.

When the setting of the **PRINT EVENT** switch is changed to the OFF position, all printer buffers are cleared; any previously stored test results or messages are not printed.

NOTE: A 6-hour backup print is provided for both the ERROR and SEVERELY ERRORED SEC positions. The printout is labeled BACKUP PRINT and occurs only if the print criterion has not been satisfied for 6 hours.

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A printer or terminal can be connected to the RS-232 Printer/Remote Control interface. Each result or control message is 20 characters long, which means that each print line has four results (or messages). All printouts are date- and time-stamped.

5.4.1 Results Print

Results prints are hard-copy listings of current test results. Using the PRNT FMT auxiliary function, you can select normal, short, or summary results print formats. The normal format includes all results available at the time the printout is initiated. The short format consists only of the results applicable to the current setting of the **MODE** switch, and the two test results currently displayed on the front panel (even if they are not applicable to the current setting of the **MODE** switch). The summary format provides a printout of all test results in the SUMMARY category. All three types of results prints also list any alarm LEDs that are illuminated at the time the printout is initiated. Figure 5-1 is an example of a normal results printout.

The results that are printed in the short form for each mode are as follows:

All Modes	D4 and SLC Framing	ESF
TIME and DATE	FRM ERR	CRC ERR
BPV	FRM ER RT	CRC ERR SEC
BPV SEC	FRM L CNT	FRM L CNT
BPV RT	FRM L SEC	FRM L SEC
SIG L SEC	TEST LEN	
ALARMS	ELAPS TIM	
BIT ERR*		
ERR SEC*		
BER*		
OUT SYN SEC*		
SLIPS*		

* Printed if pattern synchronization is detected.

A results print can be initiated manually using the **PRINT** switch, or automatically using the **PRINT EVENT** switch. A results print is also automatically initiated when a result counter overflows. Labeled OVER-FLOW PRINT, the printout also describes the reason for the overflow. Each time a result counter overflows, the test result is preceded by a double asterisk

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```
  RESULTS PRINT   15:47:20    30 APR
BIT ERR           0  ASYN E SEC        0
BER          0 E-07  EFS               40
%EFS        100.00%  SY ERR SEC        0
OUT SY SEC        0  SLIPS             0
SES               0  %SES          00.00%
DEGR MIN          0  %DEGR MIN     00.00%
UNAVL SEC         0  %AVL         100.00%
CSES              0  BPV ERR           0
BPV ER SEC        0  BPV RATE     0 E-07
FRA ER SEC        0  FRA ERR           0
F E RATE     0 E-06  CRC ERR           0
CRC ER SEC        0  FRA LOS           0
FRA LS SEC        0  CRC SES           0
CRC E RT     0 E-06  FREQ Hz     1544000
RX LVL  - 0.2dBdsx  RX VOLT 5.85 V p-p
SPX CUR UNDER 10mA  TIMING SLIPS     *0
BIT SLIPS      +  0  SLP ANA SEC      40
SIG LS SC         0  ALARM SEC         0
TEST LEN 200:00:00  ELAP TIM  00:00:00
TEST END       ****  WANDER +PK     0 UI
WANDER -PK     0 UI  P-P WANDER     0 UI
TIE WANDER     0 UI  WB/HB JITT     PASS
WB JITTER   0.01 UI  HB JITTER   0.01 UI
MAX WB JIT  0.02 UI  MAX HB JIT  0.02 UI

     ALARM/STATUS
T1                ON  PATTERN SYNC     ON
FRAME SYNC        ON
```

Figure 5-1
Results Print

(**) on the printout, indicating an "immediate overflow" condition (i.e., the results counter overflowed during the last second). Subsequent printouts of the overflowed result are preceded by a single asterisk (*) to indicate a "previous overflow" condition. All asterisks are cleared at test restart.

When 20 or more printouts are generated in 60 seconds, the printer squelch is turned on temporarily halting the printouts. The squelched printouts include alarm, error, and severely errored second conditions that occur during a test. The twentieth printout indicates the squelch is turned on

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by printing the time-stamped message SQUELCH ON. When the printouts drop to five or less in 60 seconds, the time-stamped message SQUELCH OFF is printed and a squelch summary results printout is generated. The squelch summary printout provides the cumulative results when the squelch is turned off. The printer squelch does not affect messages indicating the squelch state, timed print requests (e.g., 6-hour backup print), manual print requests, and the TEST COMPLETE message. The printer squelch is reset when a restart occurs.

5.4.2 Controls Print

The controls print lists the current setting of all front-panel switches and auxiliary functions. A controls print is initiated by pressing the **PRINT** switch to the CONTROLS position. Figure 5-2 is an example of a controls printout.

```
      CONTROLS PRINT 16:13:03     27 OCT
MODE:     SELF TEST  PATTERN:  ALL ONES
TIMED/CONT:  TIMED   DIS HOLD:       OFF
TIMING:        INT   CODE:           AMI
ERR INS BPV:   OFF   ERR INS LOG:    OFF
ERR INS FRM:   OFF   RCV INPUT:     TERM
TX LBO:        0dB   PRI EVNT:       OFF
LP CD SELECT:  CSU   LP UP CD:     10000
LP DN CD:      100   RESPONSE:  NO AUTO
PARITY:       NONE   BAUD RATE:     2400
CR/CR-LF:       CR   FORMAT:       SHORT
INS RATE:  1.0 E-6   BURST LNGTH:    0mS
FRM ERR:    SINGLE   PULSE SEL:     NONE
HALT/CONT:    HALT   JIT/SA:         OFF
JIT MASK:    0.171   JIT TRIG: CONTINUE
```

Figure 5-2
Controls Print

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5.4.3 Alarm Messages

Unless the **PRINT EVENT** switch is set to the OFF position, alarm messages are initiated automatically to inform you of any important developments related to your ongoing test. The format for an alarm message is:

```
HH:MM:SS DD:MM alarm message name
```

Alarm messages are categorized as follows:

(1) ALL ONES, EX ZERO, ONES DENSITY, YELLOW ALM, PULSE SHAPE, and JITTER are followed by either ON or OFF to indicate their status. EX ZERO is not applicable with the 2^{20}-1 or 2^{23}-1 patterns. The ONES DENSITY alarm message is not applicable when the QRSS, 2^{15}-1, 2^{20}-1, 2^{23}-1, or 3 IN 24 data patterns are selected.

(2) PATT LOSS, FRAM LOSS, SIG LOSS are followed by a count of the number of such occurrences during the test.

(3) PATT SYNC ACQUIRED, FRA SYNC ACQUIRED are printed out when synchronization is acquired.

(4) TEST COMPLETE is printed when a timed test is completed (in lieu of printing an entire results print). This alarm message applies only when in TIMED TEST mode and the **PRINT EVENT** switch is in a position other than TEST END.

(5) **TEST RESTART** is printed when you press the **TEST RESTART** switch or any major switch.

NOTE: The term **major switch** applies to the **PATTERN, MODE, RESTART, POWER, TIMING,** and **RECEIVE INPUT** switches, and the HLT/CONT and RESPONSE auxiliary functions.

(6) NEW CONFIGURATION indicates a change in status of any major switch.

(7) LOOP DOWN DETECT, LOOP UP DETECT, SIGNAL DETECT, LOOP DOWN LOSS, and LOOP UP LOSS indicate that a specific condition has either been detected or lost.

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(8) LOOP DN DURA and LOOP UP DURA indicates the duration time of loop-code transmission. Duration time is the number of seconds from the time loop up (or loop down) starts until it stops.

(9) BUFFER FULL is printed when the print buffer has overflowed. Note that this is the only message that is not date- and time-stamped.

NOTE: Print buffer overflow may result in lost information.

5.4.4 Graphic Printouts

When using a printer with graphic capability, it is possible to obtain a jitter vs frequency graph, or a printout of your current pulse shape. A graphic printout of any kind is initiated using the GRAPH auxiliary function. Figures 5-3 and 5-4 show a sample pulse shape printout and jitter vs frequency graph, respectively.

NOTE: To properly initiate a graphic printout, the T-BERD 211's RS-232 interface must be set for 8 data bits — set the PARITY auxiliary function to NONE.

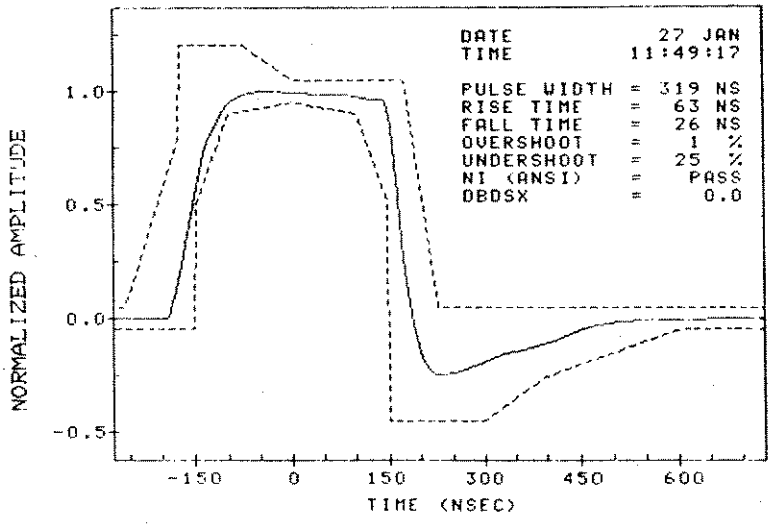

Figure 5-3
Sample Pulse Shape Printout

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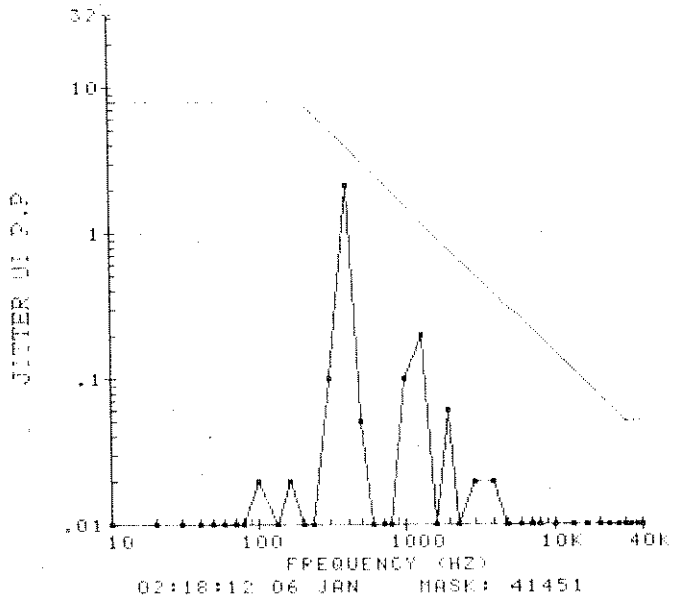

Figure 5-4
Sample Jitter vs Frequency Graph

5.5 REMOTE CONTROL OPERATION

The T-BERD 211's Remote Control Interface lets you remotely control the T-BERD 211 from a terminal or computer. Under such operation, the instrument's front-panel switches (except for the **RESULTS I** and **RESULTS II CATEGORY** and **RESULTS** switches) are disabled.

Four primary command types are available with the T-BERD 211's remote control facility:

(1) Switch commands set the T-BERD 211's front-panel switches.

(2) Auxiliary commands set the T-BERD 211's auxiliary functions.

(3) Control commands pertain exclusively to the RS-232 Printer/Remote Control Interface.

(4) BERD-BASIC commands manipulate BERD-BASIC programs.

These command sets are fully described in Section 5.5.1.

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5.5.1 Command Formats

The general format for any remote control command is:

command_name [parameter]

The command_name entry specifies the name of the command to be executed (all remote control commands are fully described in Section 5.6). Where possible, commands which represent a front-panel or auxiliary activity are abbreviated to reflect the first three characters of the switch or function. Control commands have no front-panel equivalent, and may either be abbreviated or spelled out.

The [parameter] entry specifies any optional parameter(s) associated with the command. If a parameter is entered, it should be separated from the command name by at least one space. The command name [parameter] string should always be followed by a carriage return or carriage return/line feed sequence.

Most remote control commands can be used to select a new command state or to display the current command state (without changing it). To select a new command state, enter both the command name and the desired parameter on the command line. To display the current state, enter the command name only. Note, however, that some commands (e.g., CLS) are "executable only" and have no current or changeable state.

5.5.2 Front Panel Switch Commands

Switch commands control the functions normally associated with the T-BERD 211's front panel. Mnemonics represent the first three characters of the switch name or switch position as it appears on the T-BERD 211 front-panel and in the display. Exponents are lowered to become the last digit of the number (e.g., 10^{-6} becomes 10-6).

Table 5-3 lists the switch commands along with their equivalent front-panel switch names. Brackets to the right of the switch name indicate the availability of associated parameters. The parameters associated with each command are fully described in Section 5.6.

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Table 5-3
Switch Commands

Front Panel Switches	
Command Name	**Equivalent Front Panel Switch**
COD []	CODE
CONTROLS	CONTROLS
DIS HOL []	DISPLAY HOLD
ERR INS BPV []	ERROR INSERT BPV
ERR INS FRM []	ERROR INSERT FRAME
ERR INS LOG []	ERROR INSERT LOGIC
HIS RES	HISTORY RESET
LOO DOW []	LOOP DOWN
LOO UP []	LOOP UP
MOD []	MODE
PAT []	PATTERN
PRI []	PRINT
PRI EVE []	PRINT EVENT
REC INP []	RECEIVE INPUT
RES 1 []	RESULTS I
RES 2 []	RESULTS II
RESTART	RESTART
RESULTS	RESULTS
TEST []	TEST
TIM []	TIMING
TRA OUT []	TRANSMIT OUTPUT

5.5.3 Auxiliary Function Commands

Auxiliary commands control the functions normally associated with the T-BERD 211's AUX mode. Table 5-4 lists the auxiliary function commands along with their equivalent AUX mode names. Brackets following the command name indicate the command has associated parameters. The parameters associated with each command are fully described in Section 5.6.

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Table 5-4
Auxiliary Function Commands

Command Name	Equivalent Auxiliary Function
BAUD*	BAUD
BURST LEN []	ERR SEL
CLOCK []	CLOCK
DATA BITS*	PARITY
DATE []	DATE
ERROR RATE []	ER RATE
FRM ERR LEN []	FRM ERR, FRM ERR INS
FRM ERR TYP []	FRM ERR, T1 ESFz
GRAPH []	GRAPH
HIST CLR	HIST CLR
JIT MASK []**	JIT MASK
JIT TRIG []**	JIT TRIG
LOO	ESF LOOP
LOOP CODE []	LP CODE
LUP []***	LUP
PARITY*	PARITY
PGM LPDN []	PGM LPDN
PGM LPUP []	PGM LPUP
PGMPAT 1 []	USER1
PGMPAT 2 []	USER2
PRI FMT []	PRNT FMT
PULSE MASK []	PLS MASK
RESPONSE []	RESPONSE
SPECTRUM []**	JIT S/A
SYN LOS ACT []	HLT/CONT
TERM 232 []	TERM
TIM SET []	TEST LEN

* Read-only commands; they can display but cannot change the current setting.
** Requires Spectral Analysis Option.
*** Requires Long User Pattern Option.

5.5.4 Control (Non-Switch) Commands

Control commands have no front panel or AUX equivalent. These commands are used to obtain information from the T-BERD 211 or to modify

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the remote control/printer protocol. Table 5-5 lists the control commands. Brackets following the command name indicate that the command has associated parameters. The parameters associated with each command are fully described in Section 5.6.

NOTE: With the exception of the **HELLO** and **LEDS** commands, all commands without brackets are "executable only" and have no status to return.

Table 5-5
Control Commands

ALARM []	HOLD
BEEP	LEDS
CLEAR FIFO	LOCAL (/)
CLS	MESSAGES []
DEVICE CLEAR	PRINT []
DISPLAY []	PROMPT []
ECHO []	REL
FIRST P.U.	REMOTE
FORMAT	TERMINAL (.)
HELLO	UNFORMAT
HELP []	

5.5.5 BERD-BASIC Commands

The T-BERD 211 Remote Control Interface offers you the ability to create a BERD-BASIC program. A BERD-BASIC program is simply a sequence of commands that instruct the T-BERD 211 to perform desired functions. By taking control of the T-BERD 211, a BERD-BASIC program can be executed (possibly many times) without the presence of a remote user.

A BERD-BASIC program line is composed of a remote control command and a line number. The command tells the T-BERD 211 what to do; the line number (any value between 0 and 29779) determines the order in which the commands are executed. Program lines may be entered in any sequence; the T-BERD 211 automatically sorts them in ascending order. A program is executed starting with the lowest numbered line and proceeding, in sequence, to the highest numbered line. Any line number that is not followed by a command is deleted.

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Table 5-6 lists the BERD-BASIC commands. Each BERD-BASIC command is fully described in Section 5.6.

Table 5-6
BERD-BASIC Commands

CONT	MACRO
END	NEW
GOTO	REM
INPUT	RUN
LIST	STOP
LPRINT	

5.5.6 Configuring the T-BERD 211 for Remote Control

Prior to entering Remote Control mode, you must first set baud and parity so that the T-BERD 211 is configured to communicate with the remote controller. Baud and parity can be configured as follows:

(1) Manually using the BAUD and PARITY auxiliary functions.

(2) Automatically using the Auto Baud function.

The T-BERD 211 is manually configured by setting the BAUD and PARITY auxiliary functions to values identical to those set for your remote control device. BAUD can be set to 300, 1200, 2400, or 4800. PARITY can be set to ODD, EVEN, or NONE.

NOTE: When PARITY is set to ODD or EVEN, the number of data bits equal 7; when PARITY is set to NONE, the number of data bits equal 8.

The Auto Baud function allows baud, data bits, and parity values to be automatically configured. The Auto Baud function offers possible baud rate settings of 110, 300, 600, 1200, 2400, 4800, 9600, and 19200. Possible parity settings are even, odd, or none.

NOTE: Baud, parity, and data bit settings return to their original values when control of the T-BERD 211 is returned to the front panel.

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To establish communication with the remote control unit through the Auto Baud function, perform these steps at the remote control unit.

(1) Press the BREAK key three times slowly (once per second). (On some terminals, the CTL key and the BREAK key must be pressed simultaneously.)

(2) Press and hold the space bar until the message "Auto-baud achieved. Press ESCAPE to continue" appears. (If the space bar does not have an auto-repeat function, press the space bar repeatedly until the message appears.)

(3) Press the ESCAPE key — the message "Character format determined" is displayed.

NOTE: Between each of the above steps, the T-BERD 211 waits for 30 seconds. If no key is pressed within the 30-second period, the Auto Baud function is aborted.

Once the T-BERD 211 is configured to communicate with the controller, Remote Control mode may be entered by typing a valid remote control command or a **period (.)**. The period sets the T-BERD 211 for terminal (CRT) control.

5.5.7 Input Sequence

A remote control command consists of an ASCII character string followed by either a carriage return (CR) or a carriage return/line feed (CR/LF) sequence. When specifying a remote control command, the following rules apply:

(1) Commands may be entered in lower or upper case.

(2) Spaces may be inserted before (or after) the command name. Spaces **must** be inserted between the command name and a parameter.

(3) Entering a CTL C (Control C) or a CTL X (Control X) prior to issuing a CR or LF cancels the input line.

(4) Entering a CTL H (Control H) or BACK SPACE erases the last character entered.

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(5) Up to 20 previously entered commands can be recalled using the ESC key. When the number of previously entered commands exceeds 20, the earliest command entries are overwritten.

After receiving a carriage return or a carriage return/line feed sequence, the T-BERD 211 analyzes the data in its input buffer. If a parity error, overrun error, framing error, input buffer overflow, program memory overflow, or any syntax error is detected, the appropriate error message is returned to the controller. If no errors are detected, the command is decoded and the appropriate response is generated.

If the ECHO feature is enabled, the entered characters are echoed back to the controller. If the **PROMPT** command is enabled, the default prompt (>) or a user-defined prompt (a single character or a string) indicates that previous commands have been processed and that the T-BERD 211 is ready to receive additional commands. Note that the **TERMINAL** command automatically enables ECHO and PROMPT when entering remote control mode. When either the PROMPT or ECHO feature are enabled, any characters used to cancel a line (e.g., CTL C) are echoed to the remote control unit.

5.5.8 Output Sequence

The following rules apply for output sequence:

(1) If the ECHO feature is enabled, echoed outputs have higher priority than the printer outputs. This means that printer output is suspended if there are any echoed outputs available (include user inputs or error messages) at the end of each line of printer output. Printer output resumes when the echo FIFO is empty.

(2) The **HOLD** command suspends printer output until the **REL** command is specified. When the **HOLD** command is specified, the prompt character automatically changes to a plus (+) sign to remind you that data is waiting to be printed. After the **REL** command is entered, the default prompt (>) or the user-defined prompt is returned.

(3) CTL S suspends printer output without changing the prompt character. Entering CTL Q (Control Q), a carriage return, or CTL S a second time releases printer output suspended by CTL S.

(4) Entering CTL C (Control C) clears the entire printer FIFO.

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5.5.9 Error Messages

Most error messages contain the prefix ERROR and are terminated by a CR or CRLF sequence, as selected. The following is a list of the possible error messages.

ERROR: *BAUD is not an executable command.*
You attempted to change the baud rate in remote control mode.

ERROR: *Burst length set to single.*
You attempted to insert a burst of logic or BPV errors with the ERR SEL auxiliary function set to SINGLE.

ERROR: *Can't continue.*
You attempted to continue either a BERD-BASIC program that has been altered (i.e., lines have been changed) since the last **STOP** command.

ERROR: *Characters after statement end.*
The T-BERD 211 found additional characters at the end of a valid command.

ERROR: *Command not allowed in program.*
Your BERD-BASIC program contains a command which is only executable as a direct command from the remote controller.

ERROR: *Command only allowed in program.*
You attempted to execute a command from the remote control which is only executable in a BERD-BASIC program.

ERROR: *DATA BITS is not an executable command.*
You attempted to change the data bit setting in remote control mode.

ERROR: *Illegal delimiter.*
A delimiter (colon (:), comma (,), etc.) which is required in command syntax is not found.

ERROR: *Illegal line number.*
A non-existent BERD-BASIC program line is referenced (e.g., by a **GOTO** command) or you entered a program line with a value greater than 29779.

ERROR: *Illegal value.*
The value supplied with the command is outside the valid range for the function requested.

ERROR: *Macros nested more than 5 deep.*
A macro is attempting to recall itself or another macro more than five times.

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ERROR: *Must be specified by a parameter.*
You did not specify a parameter that is required for command execution.

ERROR: *Parameter is out of range.*
You specified a parameter value that is outside the valid range (e.g., supplying the value 32 for the day of the month).

ERROR: *PARITY is not an executable command.*
You attempted to change parity value in remote control mode.

ERROR: *Program memory overflow.*
You entered a BERD-BASIC program that is too long to fit into memory.

ERROR: *RS-232 Receiver buffer overflow.*
A command is greater than 512 characters in length or commands were entered too quickly.

ERROR: *RS-232 Receiver framing error.*
The T-BERD 211 detects one or more asynchronous framing errors in the input command. This may occur if the controller's data format is different from that of the T-BERD.

ERROR: *RS-232 Receiver overrun error.*
The remote control device is sending characters to the T-BERD 211 while the Clear To Send (CTS) control signal is OFF (false), indicating that the T-BERD is not ready for more data. Solution: respond to signaling.

ERROR: *RS-232 Receiver parity error.*
The T-BERD 211 received one or more characters with a parity error.

ERROR: *There is no such page for help information.*
You requested information beyond the number of pages available for a **HELP** activity. Suggestion: issue the **HELP 1** command to learn how many pages of HELP information are currently available.

ERROR: *Unrecognized command.*
The T-BERD does not recognize the command name entered in the command line.

ERROR: *Unrecognized parameter.*
The T-BERD 211 recognizes the requested command, but cannot interpret the specified command parameter.

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ERROR: *Result is not available.*
You requested a result whose value cannot be computed. This condition can occur when the T-BERD 211 is out of frame or pattern synchronization and a result is specified that is only available when the T-BERD is in frame or pattern synchronization.

ERROR: *Result is not applicable to mode.*
The T-BERD 211 is in a mode in which the requested result is not applicable.

ERROR: *Spectrum analysis is turned off.*
You attempted to execute a command that is disabled when spectrum analysis is turned off.

ERROR: *Spectrum analysis option not included.*
You attempted to execute a command that requires spectrum analysis to be installed.

ERROR: *Timing must be INT when in SELF TEST mode.*
You attempted to change the timing source to a selection other than internal (INT) while in SELF TEST mode.

5.5.10 Warning Messages

A **WARNING** message tells you that the T-BERD 211 did something out of the ordinary to process a command.

WARNING: *External clock is not present.*
Though specified in the **TIM** command, an external clock source is not present. In such instances, timing is taken from the T-BERD 211's internal clock source.

WARNING: *Value has been rounded down.*
To be processed, the command value that you entered has been rounded to the nearest allowable lesser value (see the **BURST LEN** command).

5.6 REMOTE CONTROL COMMANDS

This section presents all of the remote control commands in alphabetical order. For each command there is an explanation of the command, references to associated commands, and a brief example of command usage.

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Alarm Message Prints

ALARM :Print the alarm message print status
ALARM [ON_OFF] :Enable or disable alarm message prints

ALARM sets or returns alarm message print status, and enables or disables the printing of alarm messages (see Alarm Messages). When the **ON** selection is chosen, alarm messages are printed. When the **OFF** selection is chosen, alarm messages are not printed. When the **PRI EVE** command is **OFF,** the **ALARM ON** command has no effect because no printouts are enabled.

EXAMPLE:

```
>ALARM OFF          : disable alarm message prints
>ALARM              : print the current alarm status
OFF
>
```


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Display the Current Baud Rate Setting

BAUD

BAUD is used to obtain the T-BERD 211's current baud rate setting. Note that BAUD is an "inquire only" command; you cannot change the baud rate via remote control. The baud rate can be set manually using the BAUD auxiliary function, or can be set automatically using the autobaud capability.

The BAUD auxiliary function provides baud rate settings of 300, 1200, 2400, and 4800. The autobaud capability can be used to obtain baud rate settings of 110, 300, 600, 1200, 2400, 4800, 9600, and 19200.

EXAMPLE:

```
>BAUD                    :display the current baud rate setting
1200
>BAUD 2400               :try to set a new baud rate
ERROR: Baud is not an executable command.
>
```


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Sound the Remote Control Unit's Beeper

BEEP

BEEP causes the remote control unit to sound a single short beep.

EXAMPLE:

```
>BEEP                    :sound the terminal beeper once
>BEEP                    :and again
>
```


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Burst Duration For BPV and Logic Errors

BURST LEN :Display the current burst duration time
BURST LEN value :Set the burst duration time

The **BURST LEN** command controls the burst duration time interval. The valid range of burst duration times is 0.025 to 5.0 seconds. Any burst duration time without a decimal point is a value expressed in milliseconds, and must be within the range of 25 to 5000. Any burst duration time with a decimal point is a value expressed in seconds, and must be within the range 0.025 to 5.0.

This command allows you to select these burst length values:

- 25 ms. to 200 ms. in increments of 25 ms.
- 250 ms. to 500 ms. in increments of 50 ms.
- 600 ms. to 1.5 seconds in increments of 100 ms.
- 2.0 seconds to 5.0 seconds in increments of 500 ms.

A value that is not one of the incremental values is always rounded to the nearest allowable lesser value. If a value has a decimal point, the digits after the third fractional position are ignored.

This command is identical in function to setting burst duration using the ERR SEL auxiliary function (see Switches).

EXAMPLE:

>BURST LEN 24 :the smallest allowed value is 25 ms.
ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 5001 :the largest allowed value is 5000 ms.
ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 0.024 :the smallest allowed decimal value is 0.025
ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 5.001 :the largest allowed decimal value is 5.000
ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 3.0 :a 3-second burst duration is specified
>

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Clear the Print FIFO

CLEAR FIFO

CLEAR FIFO command clears the print FIFO of all printouts that are awaiting printing.

EXAMPLE:

```
>CLEAR FIFO                :clear the print FIFO
>
```


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Clock Time

CLOCK	:Print the clock time (time of day)
CLOCK hh:mm	:Set the clock time

CLOCK sets or returns the clock time. The time is entered in 24-hour format; seconds are always set to zero when a new time is entered. This command is equivalent to the CLOCK auxiliary function.

EXAMPLE:

> **CLOCK**	:print the clock time
15:30:24	:time is displayed in hours, minutes, and seconds
> **CLOCK 6:28**	:set clock time to 6:28 a.m.
>	

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Clear the Terminal Screen

CLS

CLS enables you to output 30 of the selected line terminator sequences (usually CRLF for terminals) to your terminal. This has the effect of clearing the terminal screen of all previous outputs.

EXAMPLE:

```
>CLS                    :clear the terminal screen
  .                     :30 line terminators transmitted
  .
  .

>
```


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Select Code Type

COD	:Display the current code status
COD [AMI_B8Z]	:Set the code type

COD selects or returns the current code type used by the T-BERD 211 transmitter. When you select **AMI**, AMI coding is enabled; when you select **B8Z**, B8ZS coding is enabled. Note that B8ZS decoding is always available on the receive side.

This command is equivalent to the **CODE** switch on the front panel.

EXAMPLE:

>COD	:display the current COD status
AMI	
>COD B8Z	:enable B8ZS coding
>	

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Resume BERD-BASIC Program Execution

CONT

CONT resumes the running of any BERD-BASIC program which has been suspended due to execution of a **STOP** command. Using the **STOP** and **CONT** commands, you can temporarily suspend program execution and resume it at a later time.

Program execution cannot be **CONT**inued if any existing line in a program has been changed, or if a program has reached its conclusion.

See also: **STOP**

EXAMPLE:

```
>10 LPRINT "FIRST HALF"    :this program runs in two halves ...
>20 STOP                   : ...with a STOP in the middle
>30 LPRINT "SECOND HALF"
>40 END
>RUN                       :run the program
FIRST HALF                 :the program stops running ...

BREAK IN LINE 20           :...due to the STOP command in line 20

>CONT                      :continue running the program
SECOND HALF
*DONE*                     :the program is finished
>
```


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Generate a Controls Printout

CONTROLS

CONTROLS allows you to initiate a printout of all current T-BERD 211 switch settings. This command is functionally identical to pressing the CONTROLS position of the **PRINT** switch on the front panel.

The effect of this command is identical to issuing the **PRI CON** remote control command.

EXAMPLE:

>**CONTROLS**	:generate a controls print
.	:controls print follows
.	
.	
>	:controls print ends

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Display the Current RS-232 Data Bit Setting

DATA BITS

DATA BITS displays the current data bit setting for the remote RS-232 port on the T-BERD 211. Note that this is an "inquire-only" command; you cannot change the setting via remote control. The data bit setting is based on the current setting of the PARITY auxiliary function; data bits can also be automatically set using the autobaud capability.

EXAMPLE:

```
>DATA BITS              :display current data bits
7
>
```


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Calendar Date

DATE :Display the date
DATE dd/mm :Set the date

DATE sets or returns the calendar day and month.

EXAMPLE:

```
>DATE                    :display the date
4 SEP
>DATE 18/5               :set date to May 18
>
```


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Clear Device

DEVICE CLEAR

DEVICE CLEAR clears the T-BERD 211 by executing the power-up procedure. The entire instrument is reinitialized — hardware and RAM.

NOTE: When specified, this command returns control of the T-BERD 211 to the front panel of the instrument. Remote control mode must be reestablished.

EXAMPLE:

>DEVICE CLEAR :execute instrument power-up
(no longer in remote control)

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Freeze the Results Displays

DIS HOL	:Display the current status of DISPLAY HOLD
DIS HOL [ON_OFF]	:Set DISPLAY HOLD

DIS HOL controls the front panel results displays. **DIS HOL ON** freezes the results displays. Note that when **DIS HOL ON** is enabled during a test, the T-BERD 211 continues to accumulate test results. **DIS HOL OFF** disables the DISPLAY HOLD function.

This command is identical in function to the **DISPLAY HOLD** switch on the front panel.

EXAMPLE:

>DIS HOL	:view current status of DISPLAY HOLD
OFF	
>DIS HOL ON	:the results display is frozen
>	

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Front-Panel Display Mode

DISPLAY :View current mode of display control
DISPLAY [LOCAL_REMOTE] :Set display control

DISPLAY determines whether the **RESULTS I** and **RESULTS II** switches are active when the T-BERD 211 is under remote control. Note that these are the only switches that can be optionally active on the T-BERD 211.

DISPLAY LOCAL activates the **CATEGORY** and **RESULT** switches. (**DISPLAY LOCAL** is the default for Remote Control mode.) **DISPLAY REMOTE** disables the **CATEGORY** and **RESULT** switches.

EXAMPLE:

>DISPLAY :view current mode of display control
LOCAL
>DISPLAY REMOTE :set display control to remote
>

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Echo Mode

ECHO	:Display echo status
ECHO [ON_OFF]	:Set echo mode

ECHO determines whether characters entered from the remote control unit are displayed.

ECHO ON enables all characters entered from the remote control unit to be displayed. **ECHO OFF** disables echo, and inhibits the printing of characters entered from the remote control unit.

EXAMPLE:

>ECHO	:view echo status
ON	
>ECHO OFF	:turns echo off
>(CLOCK)	**:CLOCK** is specified — but not echoed
12:03:32	:the time is displayed
>	

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End a BERD-BASIC Program

END

END marks the final statement of any BERD-BASIC program, terminating execution and causing the message *DONE* to be sent to the remote control unit. Note that the *DONE* message is sent whenever the end of a program is reached successfully (even if the **END** command is not specified).

EXAMPLE 1:

```
>10 LPRINT "HI"
>RUN
HI
*DONE*
```

EXAMPLE 2:

```
>10 LPRINT "HELLO"
>20 LPRINT "HOW ARE YOU"
>30 END
>RUN
HELLO
HOW ARE YOU
*DONE*
>
```


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BPV Error Insertion

ERR INS BPV	:Display current BPV error insertion rate status
ERR INS BPV RATE	:Continuously insert BPVs into the data stream
ERR INS BPV BURST	:Insert a single burst of BPVs
ERR INS BPV SIN	:Insert a single BPV
ERR INS BPV OFF	:Stop the insertion of BPV errors

ERR INS BPV lets you control the insertion of BPVs into the data stream.

ERR INS BPV RATE inserts BPVs into the data stream at the rate specified in the ER RATE auxiliary function or the **ERROR RATE** remote control command. **ERR INS BPV OFF** stops the insertion of BPVs.

ERR INS BPV BURST inserts a single burst of BPVs into the data stream at the rate specified in the ER RATE auxiliary function or the **ERROR RATE** remote control command. The burst length is based on the length of time specified in the ERR SEL auxiliary function or the **BURST LEN** remote control command. Note that an error message is printed when the burst length is SINGLE or set to 0 ms.

ERR INS BPV SIN lets you insert a single BPV into the data stream. When specified, **ERR SEL** and **BURST LEN** are automatically set to SINGLE and 0, respectively.

See also: **ERROR RATE**

EXAMPLE:

>ERR INS BPV	:display BPV insertion rate status
OFF	:BPV insertion rate is off
>ERR INS BPV RATE	:"turn on" BPV insertion rate
>ERR INS BPV SIN	:insert a single BPV and end rate insertion
>ERR INS BPV	:view current BPV insertion rate status
OFF	
>	

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Frame Error Insertion

ERR INS FRM	:Display the current frame error insertion rate status
ERR INS FRM CONT	:Continuously insert single or multiple consecutive frame errors into the data stream
ERR INS FRM MULTI	:Insert one round of single or multiple consecutive frame errors into the data stream
ERR INS FRM SIN	:Insert a single frame error into the data stream
ERR INS FRM OFF	:Stop the insertion of frame errors into the data stream

ERR INS FRM lets you control the insertion of frame errors into the data stream.

ERR INS FRM CONT continuously inserts single or multiple consecutive frame errors into the data stream. Frame errors are inserted at the rate specified in the FRM ERR auxiliary function or the **FRM ERR LEN** remote control command (valid range: 1 to 6). **ERR INS FRM OFF** stops the insertion of frame errors.

ERR INS FRM MULTI inserts a single round of frame errors into the data stream at the rate specified in the FRM ERR auxiliary function or the **FRM ERR LEN** remote control command. **ERR INS FRM SIN** lets you insert a single frame error into the data stream.

See also: **FRM ERR LEN**

EXAMPLE:

>ERR INS FRM	:display frame error insertion rate status
OFF	:frame error insertion rate is off
>ERR INS FRM CONT	:"turn on" frame error insertion rate
>ERR INS FRM SIN	:insert a single frame error and end rate insertion
OFF	
>	

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Logic Error Insertion

ERR INS LOG	:Display the current logic error insertion rate status
ERR INS LOG RATE	:Continuously insert logic errors into the data stream
ERR INS LOG BUR	:Insert a single burst of logic errors into the data stream
ERR INS LOG SIN	:Insert a single logic error into the data stream
ERR INS LOG OFF	:Stop the insertion of logic errors into the data stream

ERR INS LOG lets you control the way logic errors are inserted into the data stream.

ERR INS LOG RATE inserts logic errors into the data stream at the rate specified in the ER RATE auxiliary function or the **ERROR RATE** remote control command. **ERR INS LOG OFF** stops the insertion of logic errors.

ERR INS LOG BURST inserts a single burst of logic errors into the data stream at the rate specified in the ER RATE auxiliary function or the **ERROR RATE** remote control command. The burst length is based on the length of time specified in the ERR SEL auxiliary function or the **BURST LEN** remote control command. Note that an error message is printed when the burst length is SINGLE or set to 0 ms.

ERR INS LOG SIN lets you insert a single logic error into the data stream. When specified, **ERR SEL** and **BURST LEN** are automatically set to SINGLE and 0, respectively.

See also: **ERROR RATE**

EXAMPLE:

>ERR INS LOG	:display logic error insertion rate status
OFF	:logic error insertion rate is off
>ERR INS LOG RATE	:"turn on" logic error insertion rate
>ERR INS LOG SIN	:insert a single logic error and end rate insertion
>ERR INS LOG	:view current logic error insertion rate status
OFF	
>	

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BPV and Logic Error Insertion Rate

ERROR RATE :Display the current error insertion rate
ERROR RATE rate-value :Set a new error insertion rate

ERROR RATE controls the rate at which BPV and logic errors are inserted into the data stream. The range of valid error insertion rate values is 1.0 E-2 through 9.9 E-9.

The **rate-value** of the **ERROR RATE** command is entered in an XX,y format, and is interpreted as X.X E-y.

See also: **ERR INS BPV** and **ERR INS LOG**

EXAMPLE:

>ERROR RATE :display the current error insertion rate
1.0 E-7 :the current error insertion rate is 1.0 E-7
>ERROR RATE 10,5 :change the error insertion rate to 1.0 E-5
>

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First Power-Up

FIRST P.U. :Resets NOVRAM to factory settings

FIRST P.U. both reloads factory settings into nonvolatile memory (NOVRAM) locations and initiates an autocalibration on the T-BERD 211. Note that you will no longer be in remote control mode after executing this command.

IMPORTANT: To continue beyond the reloading of NOVRAM, you must press the **RESTART** button on the front panel.

EXAMPLE:

```
>FIRST P.U.          :reload NOVRAM with factory settings
>                    :remain in remote control
```


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Formatted Printouts

FORMAT

FORMAT inserts blanks between words so that output from the T-BERD 211 is easy to read. The **FORMAT** command (as opposed to the **UNFORMAT** command) is the default for Remote Control mode; when the T-BERD 211 changes control mode (from local to remote or vice versa), the current setting remains unchanged.

See also: **UNFORMAT**

EXAMPLE1:

```
>10 FORMAT                  :set formatted print
>20 LPRINT THERE ARE BLANKS
>RUN
THERE ARE BLANKS            :formatted print from line 20
>
```

EXAMPLE 2:

```
>10 UNFORMAT                :set unformatted print
>20 LPRINT THERE ARE NO BLANKS
>RUN
THEREARENOBLANKS            :unformatted print from line 20
>
```


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Frame Error Insertion Rate

FRM ERR LEN :Display the current frame error insertion rate
FRM ERR LEN [1_2_3_4_5_6] :Set a new frame error insertion rate

FRM ERR LEN controls the rate at which frame errors are consecutively inserted into the data stream. The range of valid frame error insertion rate values is 1 to 6.

See also: **ERR INS FRM**

EXAMPLE:

>FRM ERR LEN :display the current frame error insertion rate
4 :the current frame error insertion rate is 4
>FRM ERR LEN 5 :change the frame error insertion rate to 5
>

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ESFz Frame Error Type

FRM ERR TYP	:Display the current frame error type status
FRM ERR TYP FRM	:Inserts frame errors in the Frame Alignment Signal (FAS) bit.
FRM ERR TYP ZBIT	:Inserts frame errors in the Z-bit of a ZBTSI encoded ESF signal.

FRM ERR TYP enables the T-BERD 211 to select where the frame errors are inserted in ESFz framed signals when the **FRAME ERROR INSERT** switch is pressed. This is only available when the ZBTSI Option is installed and does not affect other framing formats. This command is the same as the AUX FRM ERR, T1 ESFz function.

See also: **FRM ERR LEN** and **ERR INS FRM**.

EXAMPLE:

>FRM ERR TYP	:print current frame error type
FRM	
>FRM ERR TYP ZBIT	:change frame error type to Z-bit
>FRM ERR TYP	:print current frame error type
ZBIT	
>	

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Transfer Program Execution to a Specified Line

GOTO linenumber

The **GOTO** command alters the sequence in which the T-BERD 211 executes commands in a BERD-BASIC program. When encountered in a running program, the **GOTO** command transfers execution to the command associated with the specified line number (as opposed to the next line in sequence).

This command is used in a BERD-BASIC program only.

EXAMPLE:

```
>10 LPRINT START HERE
>20 GOTO 40
>30 LPRINT THIS LINE IS NEVER PRINTED
>40 LPRINT JUMP TO HERE
>RUN
START HERE
JUMP TO HERE                :line 30 is skipped
*DONE*
>
```


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Initiate a Graphic Printout

GRAPH [PULSE_JITTER] :Select graphic printout

GRAPH allows you to initiate a graphic printout of a pulse shape or a jitter vs frequency graph. **GRAPH PULSE** initiates a printout of a pulse shape; **GRAPH JITTER** initiates a jitter vs frequency graph.

This command is identical to the GRAPH auxiliary function.

NOTE: The **GRAPH** command should only be used if your remote controller has graphic capability.

EXAMPLE:

```
>GRAPH PULSE          :initiate a pulse shape printout
>.                    :pulse shape printout starts
>.
>.
>                     :pulse shape printout is completed
```


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Display T-BERD 211 Software Revision Level

HELLO

HELLO displays the T-BERD 211 hardware and software revision levels, as well as any options that are included in the instrument.

EXAMPLE:

>HELLO	:display the hardware and software revision level

T-BERD 211
SW Rev. A
HW Rev. 010..
>

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On-Line Help Function

HELP	:Display introductory help information
HELP HELP	:List an index to all help information
HELP !	:List all valid remote control commands
HELP command-name	:Display command-name syntax
HELP number	:Print a page of help information :number: 1 to 8
HELP 1	:Equivalent of **HELP**

HELP provides access to the T-BERD 211 on-line help facility. **HELP** offers summary on-line help information. **HELP HELP** provides an index to the various types of help information. **HELP !** lists all valid T-BERD 211 remote control commands.

HELP number displays a specific page of help information related to the following:

HELP 1	Introductory help information
HELP 2	Special characters
HELP 3	Front panel switch commands
HELP 4/5	Auxiliary function commands
HELP 6/7	Special Commands
HELP 8	BERD-BASIC commands

HELP command-name defines and displays the command syntax for any specified remote control command. The following conventions apply:

1. Command parameters are presented as upper case character strings (see Example 1).

2. Command and parameter summaries are preceded by three dashes (- - -) (see Examples 2 and 3).

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On-Line Help Function (Continued)

EXAMPLE 1:

```
>HELP ERR INS BPV
OFF                    :these are command parameters
RATE                   :valid commands are ERR INS BPV OFF,
BURST                  :ERR INS BPV RATE, etc.
SIN
```

EXAMPLE 2:

```
>HELP CLOCK
HH,MM                  :these are the valid formats for the CLOCK
                        command
HH.MM
HH/MM
HH;MM
HH:MM
HH-MM

- - -HH 0 TO 23 HOURS   :these are the valid ranges
- - -MM 0 TO 59 MINUTES
```

EXAMPLE 3:

```
>HELP NEW              :summarize the NEW command
- - -ERASE THE EXISTING BASIC PROGRAM.
```


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Reset Alarm History LED Indicators

HIS RES

HIS RES resets all alarm history LED indicators. This command is identical in function to the **HISTORY RESET** switch on the front panel.

EXAMPLE:

```
>HIS RES                    :clear history LED indicators
>
```


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Clear History and Printer Buffers

HIST CLR :Clear History and Printer buffers

The **HIST CLR** command provides the ability to clear the History and Print buffers. This command is the same as the AUX HIST CLR function.

EXAMPLE:

```
>HIST CLR          :Clear History and Printer buffers
>                  :Buffers are cleared
```


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Hold All Printer Outputs

HOLD

HOLD temporarily holds all printer output (in the print buffer) until a **REL** command is specified. Note that while the **HOLD** command is enabled, the prompt character changes from the standard ">" (or user-specified prompt) to a "+" to indicate that printer output is being held.

See also: **REL**

EXAMPLE:

>HOLD	:hold all printouts for now ...
+CLOCK	:... then print the time and date
+DATE	:(note that nothing is printed)
+REL	:start printing ...
>	:... and the prompt is changed back to ">"
12:34:56	:The T-BERD 211 prints the time ...
14 APR	:... and date
>	

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Enter User Input Into a Macro

INPUT m :Prompt user with a question mark
INPUT m/prompt-string :Prompt user with string

INPUT is used to enter user input into a macro. A macro is a string of characters that are defined once and recalled using one or two key strokes. Note that the **INPUT** command is a BERD-BASIC command only.

When running a BERD-BASIC program with **INPUT** commands, the T-BERD 211 prompts you with a string **(INPUT m/prompt-string)** or a question mark **(INPUT m)**. (The parameter **m** is a number from 0 to 9.) You can specify a response (to a maximum of 31 characters) which is stored as a macro.

See also: **MACRO**

EXAMPLE:

```
>10 INPUT 2
>20 INPUT 3/TIME              :TIME is a prompt string for MACRO3
>RUN
?PRINT BIT ERRORS             :respond to "?" with PRINT BIT ERRORS
TIME?PRINT CLOCK TIME         :respond to prompt with PRINT CLOCK
                               TIME
*DONE*
>&2                           :call MACRO 2 (PRINT BIT ERRORS)
1211                          :bit error results are displayed
>&3                           :call MACRO 3 (PRINT CLOCK)
11:22:33                      :the clock time is displayed
>MACRO 2                      :display the contents of MACRO 2
PRINT BIT ERRORS
>MACRO 3                      :display the contents of MACRO 3
PRINT CLOCK TIME
>
```


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Spectral Analysis Jitter Mask Selection

JIT MASK	:Display the current jitter mask
JIT MASK O.171	:Select CCITT Recommendation O.171 jitter mask
JIT MASK 41451	:Select AT&T Technical Reference PUB41451 jitter mask
JIT MASK 62411/1983	:Select AT&T Technical Reference PUB62411, 1983 issue jitter mask
JIT MASK 62411/1985	:Select AT&T Technical Reference PUB62411, 1985 issue jitter mask
JIT MASK 43801	:Select AT&T Technical Reference PUB43801 jitter mask
JIT MASK NONE	:Decline jitter mask selection

JIT MASK enables you to choose a mask that determines whether the amount of jitter on a received T1 signal meets published specifications. When a mask is selected, the jitter spectrum analysis measurement is displayed as a percentage of the selected mask. When NONE is selected, the jitter measurement is displayed in UIs.

NOTE: The **JIT MASK** command is only available when the Spectral Analysis Option is installed.

See also: **SPECTRUM** and **JIT TRIG**.

EXAMPLE:

>JIT MASK	:display currently selected jitter mask
O.171	:current jitter mask conforms to CCITT O.171
>JIT MASK 43801	:select AT&T PUB43801 jitter mask
>	

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Spectral Analysis Jitter Trigger Control

JIT TRIG	:Display the current spectrum analysis trigger
JIT TRIG ERR EVE	:Perform spectrum analysis on error event
JIT TRIG SEV ERR	:Perform spectrum analysis on severely errored second
JIT TRIG ONE DEN	:Perform spectrum analysis on ones density violation
JIT TRIG FRA ALA	:Perform spectrum analysis on frame synchronization loss
JIT TRIG PAT SYN LOS	:Perform spectrum analysis on pattern synchronization loss
JIT TRIG CON	:Perform continuous spectrum analysis

JIT TRIG controls the way in which the T-BERD 211 performs jitter spectrum analysis. **JIT TRIG ERR EVE** triggers a jitter snapshot on the occurrence of a bit error, frame error, CRC error, or BPV; **JIT TRIG SEV ERR** triggers a jitter snapshot on the occurrence of a severely errored second; **JIT TRIG ONE DEN** triggers a jitter snapshot when the pulse density rate falls below 12.5%; **JIT TRIG FRA ALA** triggers a jitter snapshot on the loss of frame synchronization; **JIT TRIG PAT SYN LOS** triggers a jitter snapshot on the loss of pattern synchronization; **JIT TRIG CONT** constantly measures the jitter spectrum in lieu of an event trigger; data samples are taken at 30-second intervals, and peak values are constantly updated.

NOTE: The **JIT TRIG** command is only available when the Spectral Analysis Option is installed.

See also: **SPECTRUM** and **JIT MASK**.

EXAMPLE:

>JIT TRIG	:display currently selected trigger
ONE DEN	:current jitter trigger is ones density violation
>JIT TRIG ERR EVE	:select error event trigger
>	

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Display the State of Front Panel LEDS

LEDS

LEDS displays the state of the T-BERD 211 alarm and status LED indicators. When specified, this command displays the LED indicators as they appear on the front panel.

EXAMPLE:

>LEDS

```
        — ALARMS —                        — STATUS —
ON      OFF     SIGNAL LOSS       OFF     T1 PULSES
ON      OFF     PATTERN LOSS      ON      T1C PULSES
OFF     OFF     FRAME LOSS        ON      PATTERN SYNC
OFF     OFF     ONES DENSITY      OFF     FRAME SYNC
ON      OFF     EXCESS ZEROS      OFF     B8ZS
OFF     OFF     YELLOW ALARM
OFF     OFF     ALL ONES
OFF     OFF     PULSE SHAPE
OFF     OFF     JITTER
OFF     OFF     POWER LOSS

—— RECEIVE LOOP CODES
OFF     PRE-EXIST LOOP
OFF     LOOP UP
OFF     LOOP DOWN
>
```


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List the Working BERD-BASIC Program

LIST :List the entire program
LIST linenumber :List starting with specified line number

LIST displays the contents of the currently active BERD-BASIC program in ascending numerical order, and displays the number of unused bytes in program memory. If a line number is not specified, the listing starts with the first line of the program; otherwise, the listing starts with the specified line number.

EXAMPLE:

```
>10 CLOCK          :enter CLOCK as line 10
>30 DATE           :enter DATE as line 30
>20 CLS            :enter CLS as line 20
>LIST

10 CLOCK
20 CLS
30 DATE
[489 BYTES FREE]
>
```


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Return the T-BERD 211 to Local Mode

LOCAL	:Enter Local mode
/ (slash)	:Alternate form of the **LOCAL** command

LOCAL returns the T-BERD 211 to Local mode from Remote Control or Terminal mode. In Local mode, all of the T-BERD 211 front-panel switches are active regardless of the display mode.

The T-BERD 211 remains in Local mode until you specify a **REMOTE, TERMINAL, period (.)**, or other valid remote control command from the remote control unit.

When Local mode is specified, note that the remote control unit is disabled if the baud rate settings of the remote control unit and the T-BERD 211 do not match.

See also: **DISPLAY, REMOTE,** and **TERMINAL.**

EXAMPLE:

>LOCAL	:enter Local (front panel) mode ...
REMOTE	: ... then return to remote control mode
/	:quickly return to Local mode (prompt and echo are not enabled)

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Select ESF Loop Code Transmission Method

LOO	:Display current ESF loop code method status
LOO IN	:Selects ESF inband loop codes
LOO OUT	:Selects ESF out-of-band loop codes

The **LOO** command selects what method the loop code is transmitted in the ESF formatted data when the **LOOP CODES SEND** switches are pressed. This is only used when testing ESF or optional ESFz formatted circuits. The loop code type is selected from the AUX LP CODE function and transmitted when the switches are pressed. This command is equivalent to the AUX ESF LOOP function.

EXAMPLE:

>LOO	:display current ESF loop code method
OUT	
>LOO IN	:change to inband loop code method
>LOO	:display current ESF loop code method
IN	

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Generate Loop-Down Code

LOO DOW	:Display current status of loop-down code
LOO DOW [ON_OFF]	:Enable or disable loop-down code transmission

LOO DOW returns loop-code transmission status. **LOO DOW ON** enables the transmission of loop-down code. The transmission of the loop-down code continues until it is no longer detected at the T-BERD 211 receiver or until you issue the **LOO DOW OFF** command.

See also: **LOOP CODE** and **PGM LPDN**

EXAMPLE:

>LOO DOW	:display status of loop-down code
OFF	
>LOO DOW ON	:activate loop-down code transmission
>	

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Select Loop Code Pattern

LOOP CODE	:Display current loop code pattern selection
LOOP CODE CSU	:Select CSU loop code pattern
LOOP CODE FAC1	:Select facility loop code pattern 1
LOOP CODE FAC2	:Select facility loop code pattern 2
LOOP CODE PGM	:Select user-programmed loop code pattern

LOOP CODE sets or returns the current loop code pattern selection. **LOOP CODE PGM** selects the user-programmed loop codes defined by the PGM LPUP and PGM LPDN auxiliary functions.

See also: **LOO DOW, LOO UP, PGM LPDN,** and **PGM LPUP**.

EXAMPLE:

```
>LOOP CODE              :display current loop code pattern selection
CSU
>LOOP CODE PGM          :select user-programmable loop code
>
```


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Generate Loop-Up Code

LOO UP	:Display current status of loop-up code
LOO UP [ON_OFF]	:Enable or disable loop-up code transmission

LOO UP returns loop-up transmission status. **LOO UP ON** enables the transmission of loop-up code. The transmission of the loop-up code continues until it is detected for 250 ms at the T-BERD 211 receiver, or until you issue the **LOO UP OFF** command.

See also: **LOOP CODE** and **PGM LPUP**

EXAMPLE:

>LOO UP	:display current status of loop-down code
OFF	
>LOO DOW ON	:activate loop-up code transmission
>	

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Print a Literal Text String

LPRINT string

LPRINT sends a text string during the execution of a BERD-BASIC program. If the string is surrounded by double quotes, printing is inhibited for any succeeding string in the program line. If quotes do not surround the string, any consecutive number of spaces in the string are condensed to one space.

EXAMPLE:

```
>10 LPRINT "HELLO" THAT'S ALL
>20 LPRINT HI  I'M  LARRY
>30 LPRINT "I  HAVE  MORE  SPACES"
>RUN

HELLO                    :words after second quote are omitted
HI I'M LARRY             :spaces condensed (no quotes)
I  HAVE  MORE  SPACES    :spaces not condensed (quotes)
*DONE*
>
```


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Enter/Modify Long User Pattern

The **LUP (parameter)** command provides the capability of entering, editing, and printing the long user pattern using the appropriate commands. **LUP** command selects and transmits **LUP**. The following command parameters and format are required to establish a long user pattern. This command requires the Long User Pattern Option.

LUP SET hh hh ...	:Enter hexadecimal characters (hh = 00H to FFH), up to 100 characters at a time.
LUP APP hh hh ...	:Append pattern by adding characters to the end of the message.
LUP REP pp hh hh ...	:Replace portions of pattern starting at position "pp".
LUP INS pp hh hh ...	:Insert new characters into pattern starting at position "pp".
LUP DEL pp dd	:Delete a specific number of bytes ("dd") from the message starting at position "pp".
LUP SIZ	:Print the number of characters in the message.
LUP PRI pp dd	:Print "dd" bytes of the message starting at position "pp". Without "pp" and "dd" entered, the entire message is printed. With "pp" and no "dd", the message is printed from "pp" to end of message.

NOTE: "hh" is a 1-byte hexadecimal number from 00H to FFH. "pp" and "dd" are integers from 1 to 2000.

See also: **PAT**

EXAMPLE:

>LUP SET 00 01 00 ... :enter pattern 00H, 01H, 00H ...
>

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Set or Display User Macros

MACRO	:Display all currently defined macros
MACRO number	:Display specified macro number
MACRO number/	:Clear specified macro number
MACRO number/string	:Define specified macro number as a string

MACRO displays and defines macros used as an aid in entering commands. A macro is a string of characters that are defined once and recalled using only one or two key strokes. Typically, they are used when a given command may need to be entered many times. **MACRO number** may range from 0 to 9; **MACRO string** may range from 1 to 80 characters in length.

Macros are recalled by specifying an ampersand (&) followed by the macro number whenever the macro substitution takes place. Note that, although the command **INPUT** is also used to define a macro, it can only be used in a BERD-BASIC program; the **MACRO** command has no such restriction.

See also: **INPUT**

EXAMPLE:

```
>MACRO 1/CLOCK          :define macro 1 as CLOCK
>MACRO 2/DATE           :define macro 2 as DATE
>&1                     :display the current time of day
20:07:13
>&1 21:08               :set the time ahead one hour (TIME 21:08)
>&2                     :display the current date (DATE)
15 JAN
>MACRO 2                :display the contents of MACRO 2
DATE
>
```


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Enable or Disable Error Message Printing

MESSAGES	:Display current status of error message printing
MESSAGES [ON_OFF]	:Enable or disable error message printing

MESSAGES controls the printing of error messages at your remote control unit. **MESSAGES ON** enables the printing of error messages when appropriate conditions exist; **MESSAGES OFF** disables the printing of error messages under such conditions.

MESSAGES ON is the default at power-up.

EXAMPLE:

>MESSAGES	:display current status
OFF	
>MESSAGES ON	:enable error message printing
>	

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Transmit and Receive Mode

MOD	:Display current mode status
MOD (mode)	:Select a mode

MOD sets or returns the current transmit and receive line rate and data format. Select **(mode)** from one of the following:

T1	:T1 line rate unframed
T1 D4	:T1 rate with D4 framing
T1 ESF	:T1 rate with ESF framing
T1 ESFZ	:T1 rate with ZBTSI encoded ESF framing (optional)
T1 SLC	:T1 rate with SLC-96 framing
T1C	:T1C line rate
T1C TLB	:T1C rate in Test Loopback mode
T1 TLB	:T1 rate in Test Loopback mode
T1 LLB	:T1 rate in Line Loopback mode
SEL TST	:Self-Test mode using T1 ESF
AUT	:Automatic configuration mode

This command is identical to the **MODE** switch.

NOTE: The AUX functions are selected and modified using separate commands (see Table 5-4).

EXAMPLE:

>MOD	:display status of mode
T1 SLC	
>MOD T1 ESF	:set mode to T1 rate with ESF framing
>	

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Enter a New BERD-BASIC Program

NEW

NEW clears the working memory of any BERD-BASIC program. It is used when entering a new program to ensure that no lines are left from a previous program. When this command is specified, 511 bytes of memory (each byte approximately equivalent to one stored character) are freed for the new program.

EXAMPLE:

```
>10 INPUT 2
>20 DATE
>LIST
>
10 INPUT 2
20 DATE
[493 BYTES FREE]
>NEW                    :purge the existing program
>LIST
>
[511 BYTES FREE]
```


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Display Current Parity Setting

PARITY

PARITY is used to obtain the T-BERD 211's current parity setting. Note that this is an "inquire-only" command; you cannot change the parity setting via remote control.

The PARITY auxiliary function provides parity settings of odd, even, and none. The autobaud capability sets parity automatically.

EXAMPLE:

```
>PARITY                    :display the current parity setting
EVEN
>PARITY ODD                :try to set odd parity
ERROR: PARITY IS NOT AN EXECUTABLE COMMAND
```


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Set Test Pattern

PAT :Display current test pattern status
PAT (pattern) :Select test pattern

PAT sets or returns the current test pattern generated by the T-BERD 211. **(pattern)** is selected from one of the following.

ALL ONES	All Ones Pattern
1:1	Alternating Ones and Zeros Pattern
1:7	A One and Seven Zeros Pattern
3 IN 24	3 Ones In 24-Bits Pattern
T1-QRSS	T1 Quasi-Random Signal Source Pattern
T1C-QRSS	T1C Quasi-Random Signal Source Pattern
2^15-1	32,767-Bit Pseudorandom Pattern
2^20-1	1,048,575-Bit Pseudorandom Pattern
2^23-1	8,388,607-Bit Pseudorandom Pattern
BRIDGTAP	Bridge Tap Detection Test Pattern
MULTIPAT	Multipattern Test Pattern
MIN/MAX*	Minimum/Maximum Stress Test Pattern
LUP*	Programmable Long User Pattern
USER1	User 1 Programmable 3- to 24-Bit Pattern
USER2	User 2 Programmable 3- to 24-Bit Pattern
ALL ZERO	All Zeros Pattern

* Requires Long User Pattern Option

This command is identical to the **PATTERN** switch on the front panel. To program the long user pattern (LUP), refer to the LUP command. The USER1 and USER2 names can be changed with the **PGMPAT1** and **PGMPAT2** commands.

See also: **PGMPAT 1, PGMPAT 2**, and **LUP**.

EXAMPLE:

>PAT :display current pattern
T1-QRSS
>PAT 2^15-1 :select new pattern
>

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Program Loop-Down Code

PGM LPDN	:Display the programmable loop-down code
PGM LPDN (bbbbb..b)	:Set programmable loop-down sequence

PGM LPDN allows you to program a loop-down code to be transmitted when you issue **LOO DOW ON** command. The loop-down code sequence is a 3- to 8-bit binary pattern (a sequence of 1's and/or 0's) with the left-most bit transmitted first. The loop-down code sequence is stored in nonvolatile memory.

See also: **LOOP CODE**

EXAMPLE:

>PGM LPDN	:display current programmable loop-down code
01001001	
>PGM LPDN 100	:set programmable loop-down code to 100
>	

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Program Loop-Up Code

PGM LPUP :Display the programmable loop-up code
PGM LPUP (bbbbb..b) :Set programmable loop-up sequence

PGM LPUP allows you to program a loop-up code to be transmitted when you issue **LOO UP ON** command. The loop-up code sequence is a 3- to 8-bit binary pattern (a sequence of 1's and/or 0's) with the left-most bit transmitted first. The loop-up code sequence is stored in nonvolatile memory.

See also: **LOOP CODE**

EXAMPLE:

>PGM LPUP :display current programmable loop-up code
10110110
>PGM LPUP 10000 :set programmable loop-up code to 10000
>

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Programmable Data Pattern

PGMPAT 1	:Display the current programmable data pattern 1
PGMPAT 2	:Display the current programmable data pattern 2
PGMPAT 1 (yyyyyy,bbb...b)	:Set programmable data pattern name and bit sequence

PGMPAT allows you to program two data patterns of your own choosing. The pattern(s) that you define is generated when the pattern name is specified as a PAT command parameter. The **PGMPAT 1** default name is USER1; the default **PGMPAT 1** bit pattern is 1000000 (1:6). The **PGMPAT 2** default name is USER2; the default **PGMPAT 2** bit pattern is 100000 (1:5).

The USER1 and USER2 names can be changed by entering a name with a maximum of seven alphanumeric characters. Specifying a new name is optional when programming a PGMPAT bit sequence; however, if a name is specified, it will appear in the data pattern display window when front-panel control is returned to the T-BERD 211.

The data pattern can be a 3- to 24-bit binary pattern (a sequence of ones (1) and/or zeros (0)); when generated, the left-most bit is transmitted first. The user-defined label and pattern are stored in nonvolatile memory.

See also: **PAT**

EXAMPLE:

>PGMPAT 1	:display current PGMPAT 1
USER1 1000000	:default name and bit sequence
>PGMPAT 1 TESTIT, 10101110000000000111010	:select name and bit sequence
>PGMPAT 1, 11010101110000	:select bit sequence, retain name
>	

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Initiate Printout

PRI [CON_RES_SUM] :Select controls or results printout

PRI enables you to initiate a result or controls print. The **PRI CON, PRI RES,** and **PRI SUM** commands generate controls, results, and summary printouts, respectively.

This command is identical in function to the **PRINT** switch on the front panel.

EXAMPLE:

```
>PRI RES                :generate results print
  .                     :results print follows
  .
  .

>PRI CON                :generate controls print
  .                     :controls print follows
  .
  .
>PRI SUM                :generate summary print
  .                     :summary print follows
  .
  .
>
```


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Print Event

PRI EVE	:Display the print event status
PRI EVE (event)	:Select print event

PRI EVE allows you to determine when (if at all) the T-BERD 211 generates automatic test results prints. The **(event)** choices are the following.

OFF	:Halt results prints, clear printer FIFO
END TES	:Print at end of test
ERR	:Print on logic, BPV, or frame error
SEV ERR SEC	:Print on severely errored second
2HR	:Print results every two hours
15M	:Print results every 15 minutes
TIM H:MM	:Print results at the time interval specified

Any setting other than **PRI EVE OFF** enables automatic results printouts when one or more alarm conditions change. When specifying **TIM H:MM**, the symbol ":" may be replaced by a dash (-), comma (,), period (.), or slash (/). The valid range for H (hours) is 0 to 5. The valid range for MM (minutes) is 0 to 59.

This command is identical in function to the **PRINT EVENT** switch on the front panel, except that **TIM**ed print events are only available in Remote Control mode.

EXAMPLE:

>PRI EVE	:display status of print event
OFF	
>PRI EVE 15M	:print results every 15 minutes
>	

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Results Print Format

PRI FMT :Display current results print format
PRI FMT [NORMAL_SHORT_SUM] :Set new results print format

PRI FMT enables you to choose a results print format. **PRI FMT NORMAL** gives you a printout of all results; **PRI FMT SHORT** gives you only those results which are specifically applicable to the current mode, plus the two results currently displayed on your front panel; **PRI FMT SUM** gives you all results in the SUMMARY category.

EXAMPLE:

>PRI FMT :display current results print format
SHORT
>PRI FMT NORMAL :change the format to NORMAL
>

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Display a Single Result Value

PRINT (result) :Display the specified result value

PRINT displays the value of any T-BERD 211 test result. (result) can be specified by name or by number. Unlike the **RES 1** and **RES 2** commands, the front panel does not reflect the result specified.

The valid result names and numbers are listed below.

00 - BIT ERRORS	:Bit errors
01 - ASYN ER SEC	:Asynchronous Error Seconds
04 - BIT ERR RT	:Bit error rate
05 - ER FREE SEC	:Error-free seconds
06 - %EFS	:% Error-free seconds
07 - SYN ERR SEC	:Synchronized error seconds
08 - OUT SYN SEC	:Out-of-synchronization seconds
09 - SLIPS	:Pattern slips
10 - SEV ERR SEC	:Severely errored seconds
11 - %SEV ER SEC	:% Severely errored seconds
12 - DEGR MIN	:Degraded minutes
13 - %DEGR MIN	:% Degraded minutes
14 - UNAVL SEC	:Unavailable seconds
15 - %AVLBILITY	:% Availability
16 - CSES	:Consecutive severely errored seconds
25 - VIOLATIONS	:Violations
26 - BPV SECONDS	:BPV seconds
27 - BPV RATE	:BPV rate
28 - FRM ERR SEC	:Frame errored seconds
29 - FRM SES	:Frame severely errored seconds
30 - FRM ERRORS	:Frame errors
31 - FRM ER RATE	:Frame error rate
32 - CRC ERRORS	:CRC errors
33 - CRC ERR SEC	:CRC errored seconds
34 - FRM LOS CNT	:Frame loss count
35 - FRM LOS SEC	:Frame loss seconds
36 - CRC SES	:CRC severely errored seconds
37 - CRC ERR RT	:CRC error rate
40 - RX FREQ, Hz	:Receive frequency in Hz
41 - RX LEVEL (dBdsx)	:Receive level in dBdsx
42 - RX LEVEL (dBm)	:Receive level in dBm

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Display a Single Result Value (Continued)

43 - RX LEVEL (Vp-p)	:Receive level in volts
44 - PULSE SHAPE	:Pulse shape
45 - PULSE WIDTH	:Pulse width
46 - RISE TIME	:Pulse rise time
47 - FALL TIME	:Pulse fall time
48 - UNDERSHOOT	:Undershoot
49 - OVERSHOOT	:Overshoot
50 - SPX CURRENT	:Simplex current
51 - TIMING SLIP	:Controlled timing slips
53 - SLP ANA SEC	:Timing slip analysis seconds
60 - SIG LOS SEC	:Signal loss seconds
61 - ALARMED SEC	:Alarmed second
62 - TEST LENGTH	:Length of a timed test
63 - ELAPSE TIME	:Elapsed time
64 - TEST END IN	:Time remaining in timed test
65 - CLOCK TIME	:Clock time of day
66 - DATE	:Date
70 - WANDER +PK	:Maximum positive wander peak
71 - WANDER -PK	:Maximum negative wander peak
72 - P-P WANDER	:Peak-to-peak wander
73 - 15m WANDER	:Maximum peak-to-peak wander over 15 minutes
74 - 24h WANDER	:Maximum peak-to-peak wander over 24 hours
75 - TIE WANDER	:Tie wander
80 - WB/HB JIT	:Wideband and highband jitter (pass/fail)
81 - WB JITTER	:Peak-to-peak wideband jitter
82 - HB JITTER	:Peak-to-peak highband jitter
84 - MAX WB JIT	:Maximum peak-to-peak wideband jitter
85 - MAX HB JIT	:Maximum peak-to-peak highband jitter
88 - SA P/F	:Spectral analysis content (pass/fail)
89 - SA FREQ (auto scan)	:Relative jitter in all 40 frequency bands
90 - SA FREQ (man. scan)	:Relative jitter in each frequency band

See also: **RES 1** and **RES 2**

EXAMPLE:

```
>PRINT SLIPS                :display number of pattern slips
  SLIPS 23
>
```


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Remote Control Command Prompt

PROMPT	:Display status of prompt
PROMPT [ON_OFF]	:Turn prompt on or off
PROMPT STRING (prompt-string)	:Define a prompt

PROMPT controls the prompt symbol at the remote control unit. **PROMPT ON** enables the display of a > as the prompt symbol when the T-BERD 211 is ready to receive a command. **PROMPT OFF** turns off the prompt symbol. **PROMPT STRING** allows you to define a prompt symbol (or prompt string) of your own.

Note that the T-BERD 211 changes any current prompt symbol to "+" when the **HOLD** command is specified.

EXAMPLE:

>PROMPT	:display prompt status
ON	
>PROMPT STRING =	:define "=" as prompt symbol
=PROMPT OFF	:turn off the "=" prompt
CLOCK	:display the time (no prompt)
10:33:04	
PROMPT ON	:turn on the "=" prompt
=	

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Pulse Mask Specification

PULSE MASK :Display current pulse mask specification
PULSE MASK [NI_DSX_NONE] :Set pulse mask specification

PULSE MASK controls the selection of a pulse mask specification. **PULSE MASK NI** selects the pulse mask conforming to the Bell T1.403 Network Interface specification; **PULSE MASK DSX** selects the pulse mask conforming to AT&T Compatibility Bulletin 119. **PULSE MASK NONE** indicates that a pulse mask specification is not selected; no mask appears on the pulse shape printout.

This command is identical in function to the PLS MASK auxiliary function.

EXAMPLE:

```
>PULSE MASK              :display current pulse mask specification
NET INT
>PULSE MASK DSX          :select new pulse mask
>
```


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Receive Input

REC INP :Display current receive input status
REC INP [BRI_TER_DSX] :Set the current receive input setting

REC INP selects input impedance and signal conditioning. **REC INP BRI** provides greater than 1000 ohms input impedance for lines already terminated; **REC INP TER** provides 100 ohms impedance; **REC INP DSX** provides both 100 ohms impedance and amplification of the signal.

This command is identical in function to the **RECEIVE INPUT** switch on the front panel. Also note that this command causes a test restart.

EXAMPLE:

>REC INP :display current receive input status
DSX
>REC INP TER :select TERM position
>

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Release All Printer Output

REL

REL releases all output in the print buffer from HOLD status. When the release command is specified, the prompt character changes from the "+" to the standard ">" (or user-specified prompt) to indicate that printer output is no longer held.

See also: **HOLD**

EXAMPLE:

>HOLD	:hold all printouts for now ...
+CLOCK	:... then print the time and date
+DATE	:(note that nothing is printed)
+REL	:start printing ...
>	:... and the prompt changes to ">"
12:34:56	:The T-BERD 211 prints the time ...
14 APR	:... and date
>	

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Remark or Comment

REM

REM is used to place a remark or comment in a BERD-BASIC program. Remarks are nonexecutable, and thus ignored by the T-BERD 211.

EXAMPLE:

```
>10 LPRINT LOOSE LIPS
>20 REM SHOULD BE TIGHTENED? :this command is ignored
>30 LPRINT SINK SHIPS
>RUN

LOOSE LIPS                    :line 20 is nonexecutable
SINK SHIPS
>
```


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Remote Control Entry

REMOTE

REMOTE places the T-BERD 211 in Remote Control mode from Local or Terminal mode. In Remote Control mode, all front-panel switches are inactive (with the exception of the **CATEGORY** and **RESULT** switches).

Unlike the **TERMINAL** command, the **REMOTE** command turns prompt and echo off.

See also: **LOCAL** and **TERMINAL**

EXAMPLE:

```
REMOTE          :enter Remote Control mode from Local mode
                :you must enable prompt and echo
```


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Result Display Control

RES 1 (result) :Display (result) in Display I
RES 2 (result) :Display (result) in Display II

The RES 1 and **RES 2** commands control the display results on the T-BERD 211 front panel. Unlike the **PRINT** command, the front panel is updated to reflect the result specified; additionally, the value of the specified result is not displayed at the remote control unit. (**result**) can be expressed as a name or number.

The valid result names and numbers are listed below.

00 - BIT ERRORS	:Bit errors
01 - ASYN ER SEC	:Asynchronous Error Seconds
04 - BIT ERR RT	:Bit error rate
05 - ER FREE SEC	:Error-free seconds
06 - %EFS	:% Error-free seconds
07 - SYN ERR SEC	:Synchronized error seconds
08 - OUT SYN SEC	:Out-of-synchronization seconds
09 - SLIPS	:Pattern slips
10 - SEV ERR SEC	:Severely errored seconds
11 - %SEV ER SEC	:% Severely errored seconds
12 - DEGR MIN	:Degraded minutes
13 - %DEGR MIN	:% Degraded minutes
14 - UNAVL SEC	:Unavailable seconds
15 - %AVLBILITY	:% Availability
16 - CSES	:Consecutive severely errored seconds
25 - VIOLATIONS	:Violations
26 - BPV SECONDS	:BPV seconds
27 - BPV RATE	:BPV rate
28 - FRM ERR SEC	:Frame errored seconds
29 - FRM SES	:Frame severely errored seconds
30 - FRM ERRORS	:Frame errors
31 - FRM ER RATE	:Frame error rate
32 - CRC ERRORS	:CRC errors
33 - CRC ERR SEC	:CRC errored seconds
34 - FRM LOS CNT	:Frame loss count
35 - FRM LOS SEC	:Frame loss seconds
36 - CRC SES	:CRC severely errored seconds
37 - CRC ERR RT	:CRC error rate
40 - RX FREQ, Hz	:Receive frequency in Hz

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Result Display Control (Continued)

42 - RX LEVEL (dBm)	:Receive level in dBm
43 - RX LEVEL (Vp-p)	:Receive level in volts
44 - PULSE SHAPE	:Pulse shape
45 - PULSE WIDTH	:Pulse width
46 - RISE TIME	:Pulse rise time
47 - FALL TIME	:Pulse fall time
48 - UNDERSHOOT	:Undershoot
49 - OVERSHOOT	:Overshoot
50 - SPX CURRENT	:Simplex current
51 - TIMING SLIP	:Controlled timing slips
53 - SLP ANA SEC	:Timing slip analysis seconds
60 - SIG LOS SEC	:Signal loss seconds
61 - ALARMED SEC	:Alarmed second
62 - TEST LENGTH	:Length of a timed test
63 - ELAPSE TIME	:Elapsed time
64 - TEST END IN	:Time remaining in timed test
65 - CLOCK TIME	:Clock time of day
66 - DATE	:Date
70 - WANDER +PK	:Maximum positive wander peak
71 - WANDER -PK	:Maximum negative wander peak
72 - P-P WANDER	:Peak-to-peak wander
73 - 15m WANDER	:Maximum peak-to-peak wander over 15 minutes
74 - 24h WANDER	:Maximum peak-to-peak wander over 24 hours
75 - TIE WANDER	:Tie wander
80 - WB/HB JIT	:Wideband and highband jitter (pass/fail)
81 - WB JITTER	:Peak-to-peak wideband jitter
82 - HB JITTER	:Peak-to-peak highband jitter
84 - MAX WB JIT	:Maximum peak-to-peak wideband jitter
85 - MAX HB JIT	:Maximum peak-to-peak highband jitter
88 - SA P/F	:Spectral analysis content (pass/fail)
89 - SA FREQ (auto scan)	:Relative jitter in all 40 frequency bands
90 - SA FREQ (man. scan)	:Relative jitter in each frequency band

See also: **PRINT**

EXAMPLE:

```
>RES 1 66          :display date in Display I
>RES 2 35          :display frame loss seconds in Display II
>
```


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T-BERD 211 Loop Code Response

RESPONSE :display current loop code response status
RESPONSE [AUTO_NONE] :set loop code response

RESPONSE controls how the T-BERD 211 responds to loop codes.

When you specify **RESPONSE AUTO**, the T-BERD 211 responds to loop codes by emulating a CSU. If five seconds of inband loop-up code are received, the T-BERD 211 automatically enters Line Loopback (AUTO LLB) mode; the instrument repeats all transmitted data until you send a valid loop-down code sequence. After receiving a loop-down code, the T-BERD 211 exits AUTO LLB mode and reenters the mode indicated by the current setting of the **MODE** switch (or MODE remote control command).

When you specify **RESPONSE NONE,** the T-BERD 211 remains in its current mode when detecting a loop code.

This command is identical to the RESPONSE auxiliary function.

EXAMPLE:

>RESPONSE :display current loop code response status
NONE
>RESPONSE AUTO :set automatic loop code response.
>

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Test Restart

RESTART

RESTART restarts the T-BERD 211 test. This command is identical in function to the **RESTART** switch on the T-BERD 211 front panel.

EXAMPLE:

```
>RESTART                    :restart test
>
```


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Generate a Results Printout

RESULTS

RESULTS allows you to initiate a printout of all current T-BERD 211 test results. This command is functionally identical to pressing the RESULTS position of the **PRINT** switch on the front panel.

This command is identical to issuing the **PRI RES** remote control command.

EXAMPLE:

>RESULTS	:generate a results print
.	:results print follows
.	
.	
>	:results print ends

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Execute a BERD-BASIC Program

RUN	:Execute a BERD-BASIC program
RUN linenumber	:Execute a BERD-BASIC program beginning at specified **linenumber.**

RUN executes the current BERD-BASIC program. Unless the **linenumber** parameter is specified, execution starts at the first line of the program.

EXAMPLE:

```
>10 LPRINT FRANKLIN
>20 LPRINT DELANO
>30 LPRINT ROOSEVELT
>RUN 30                 :run starting at line 30
ROOSEVELT               :only line 30 is executed
>RUN                    :run entire program
FRANKLIN
DELANO
ROOSEVELT
>
```


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Spectral Analysis Control

SPECTRUM	:Display current spectrum analyzer status
SPECTRUM [ON_OFF]	:Enable or disable the spectrum analyzer

SPECTRUM controls the operation of the jitter spectrum analyzer. **SPECTRUM ON** enables the operation of the spectrum analyzer; **SPECTRUM OFF** disables spectrum analyzer operation.

NOTE: The **SPECTRUM** command is only available when the Spectral Analysis Option is installed.

See Also: **JIT MASK** and **JIT TRIG**.

EXAMPLE:

>SPECTRUM	:display current status of spectrum analyzer
OFF	:the spectrum analyzer is disabled
>SPECTRUM ON	:enable the spectrum analyzer
>	

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Suspend Execution of a BERD-BASIC Program

STOP

STOP suspends the execution of a running BERD-BASIC program; execution of a BERD-BASIC program is resumed by issuing the **CONT** command. Note that the **STOP** command is a BERD-BASIC command only.

Program execution cannot be resumed if any existing line in a program has been changed, or if a program has reached its conclusion.

See also: **CONT**

EXAMPLE:

```
>10 LPRINT "FIRST HALF"          :this program runs in two halves ...
>20 STOP                         :...with a STOP in the middle
>30 LPRINT "SECOND HALF"
>40 END
>RUN                             :run the program
FIRST HALF                       :the program stops running ...
BREAK IN LINE 20                 :...due to the STOP command
>CONT                            :continue running the program
SECOND HALF
*DONE*                           :the program is finished running
>
```


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Generates a Summary Printout

SUMMARY

SUMMARY allows you to initiate a printout of all summary test results. The effect of this command is identical to issuing the PRI SUM remote control command.

EXAMPLE:

```
>SUMMARY          :generate a summary print
.                 :summary print follows
.
.
>                 :summary print ends
```


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Action on Synchronization Loss

SYN LOS ACT :Display current mode status
SYN LOS ACT [CONT_HALT] :Set mode of synchronization loss

SYN LOS ACT controls the T-BERD 211 reaction to synchronization loss. **SYN LOS ACT CONT** causes all test results to accumulate continuously throughout a loss of synchronization. **SYN LOS ACT HALT** halts test results during a loss of synchronization. This command is identical in function to the HLT/CONT auxiliary function.

EXAMPLE:

>SYN LOS ACT :display current action on synchronization loss
HALT :the T-BERD 211 is in HALT mode
>SYN LOS ACT CONT :set action on sync loss to CONT
>

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Remote Control Line Terminator

TERM 232 :Display current line terminator setting
TERM 232 [CR_CRLF] :Set the line terminator

TERM 232 controls RS-232 line termination on a printer or remote control unit. When you specify **TERM 232 CR,** a carriage return is transmitted at the end of each displayed line; when you specify **TERM 232 CRLF,** each displayed line is followed by a carriage return and a line feed.

This command is identical to the TERM auxiliary function.

EXAMPLE:

>TERM 232 :display the current line terminator
CRLF
>TERM 232 CR :select carriage return as line terminator
>

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Configure the T-BERD 211 for Remote Control Operation

TERMINAL
. (period) :Alternate form of the **TERMINAL** command

TERMINAL configures the T-BERD 211 for remote control operation by automatically setting the following:

ECHO ON	:turn echo on
PROMPT ON	:turn command prompts on
WIDTH 80	:printer width 80 columns
TERM CRLF	:line terminator of carriage return and line feed

This command is typically used as a log-in sequence just after the T-BERD 211 is powered up. You need only type a period (.) to get the T-BERD 211's attention, enter Terminal mode, and have the default prompt (>) printed on the screen.

When the **TERMINAL** command is specified, all front-panel switches (except the **CATEGORY** and **RESULT** switches) are inactive.

See also: **LOCAL**, and **REMOTE**

EXAMPLE:

	:assume that you have just powered up the T-BERD 211; you have just typed a **period (.)** which the T-BERD 211 does not echo.
>	:the T-BERD 211 responds with a prompt and is now in Terminal mode.

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Test Results Accumulation

TEST	:Display the current test duration criteria
TEST [TIMED_CONT]	:Set the test duration criteria

TEST enables you to specify how test results are accumulated. When you specify **TEST TIMED**, the T-BERD 211 accumulates test results for the duration specified in the TEST LEN auxiliary function or **TIM SET** remote control command. When you specify **TEST CONT**, the T-BERD 211 accumulates test results continuously.

This command is equivalent to the **TEST** switch located on the front panel.

EXAMPLE:

>TEST	:Display the current test duration
CONT	
>TEST TIMED	:Select a single timed test
>	

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Transmit Timing Source

TIM	:Display the current transmit timing source
TIM [EXT_INT_REC]	:Set the transmit timing source

TIM controls the selection of a timing source as follows:

TIM EXT:sets transmit timing to an external clock source, i.e., T1 REF jack or EXT CLK IN connector

TIM INT	:sets transmit timing to the T-BERD 211 internal clock source
TIM REC	:sets the transmit timing source to the clock signal recovered from the received data

This command is identical in function to the **TIMING** switch on the front panel.

EXAMPLE:

>TIM	:display the transmit timing source
INT	:transmit timing source is internal
>TIM REC	:change transmit timing source to recovered
>	

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Test Length

TIM SET :Display the current test length setting
TIM SET HHH:MM:SS :Set new test length

TIM SET controls the length of a timed test. The parameter **HHH:MM:SS** is given in hours, minutes, and seconds, respectively; each can be specified separately (HHH, MM, or SS). When setting a new test length, the symbol ":" may be replaced by a dash (-), comma (,), period (.), semicolon (;), or slash (/). The valid ranges for each time value are:

HHH :0 to 200 hours
MM :0 to 59 minutes
SS :0 to 59 seconds

This command is identical to the TEST LEN auxiliary function.

See also: **TEST**

EXAMPLE:

```
>TIM SET                :display the current test length setting
12:35:00                :current test length is 12 hrs. 35 min.
>TIM SET ; 6 ;          :test length now is 6 minutes
>
```


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Transmit Output

TRA OUT :Display current transmit output status
TRA OUT [-7.5_0_-15] :Select transmit output setting

TRA OUT controls the current transmit output setting, allowing you to select emulation of three different cable losses for T1 rates. Selectable line buildout includes **-7.5** dB, **0** dB, and **-15** dB.

EXAMPLE:

>TRA OUT :display current transmit output status
-7.5 (dB)
>TRA OUT -15 :select -15 dB position
>

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Unformatted Printouts

UNFORMAT

UNFORMAT suppresses the printing of blanks between words in printed output. The alternative is **FORMAT**, which makes printouts easier to read.

See also: **FORMAT**

EXAMPLE 1:

```
>10 FORMAT                          :set formatted print
>20 LPRINT THERE ARE BLANKS
>RUN
THERE ARE BLANKS                    :formatted print from line 20
```

EXAMPLE 2:

```
>10 UNFORMAT                        :set unformatted print
>20 LPRINT THERE ARE NO BLANKS
>RUN
THEREARENOBLANKS                    :unformatted print from line 20
```


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SECTION 6

MAINTENANCE AND SERVICE

6.1 INTRODUCTION

This section contains information on T-BERD 211 maintenance and service. Specifically, it describes the steps to take should you experience difficulty operating the T-BERD 211. Instructions for replacing the instrument's AC line fuse are also available, as is a description of TTC's warranty and repair procedures.

6.2 MAINTENANCE

6.2.1 In Case of Difficulty

If the T-BERD 211 fails to operate and no front panel indicators are illuminated:

(1) Check the AC power cord to ensure that it is securely connected to the T-BERD 211.

(2) Make sure that the power supply is uninterrupted by plugging another electrical device into the electrical outlet used by the T-BERD 211.

(3) Verify that a proper, working AC line fuse is installed. Information on the type of fuse and its installation is given in Section 6.2.2.

If the T-BERD 211 fails to operate after the AC power cord, power supply, and fuse are found to be in proper working order, contact the TTC Customer Service Department (1-800-638-2049). If front-panel indicators are illuminated, but the instrument does not operate properly:

(1) Use the Instrument Checkout Procedure in Section 3 to localize the problem.

(2) Note those areas in which the self-test failed, then contact TTC for assistance.

6.2.2 AC Line Fuse

The T-BERD 211's AC line fuse is stored in the AC fuse receptacle located just underneath the **POWER** switch. If faulty, the fuse should be

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replaced with a 1A 250-volt, SLO-BLO fuse (Littlefuse #218001 or equivalent). Always use the correct fuse size.

To replace the AC line fuse, do the following:

(1) Locate the tab to the plastic fuse cover above the T-BERD 211's **POWER** switch receptacle.

(2) Using a small screwdriver or similar instrument, gently pry the fuse cover open.

(3) Remove the old fuse and install new fuse of the correct size.

(4) Press the plastic fuse holder securely back into place.

6.2.3 Auto-Calibration

The T-BERD 211 features an auto-calibration function that allows you to automatically adjust receive level measurement, recovered clock extraction, T1/T1C detectors, and simplex current measurements. It is suggested that auto-calibration be performed once a year to compensate for the normal aging of components.

Auto-calibration is performed by simultaneously pressing the **DISPLAY HOLD** switch and applying power to the T-BERD 211. Keep the **DISPLAY HOLD** switch depressed until the message **CALIBRATING** appears in the display.

NOTE: Auto-calibration should be performed after allowing the unit to warm up at normal room temperature for a period of 30 minutes.

If an error occurs during auto-calibration, an error message appears in the display; in such instances, call TTC's Customer Service Department for assistance.

6.3 SERVICE

6.3.1 Warranty Policy

All equipment manufactured by Telecommunications Techniques Corporation (TTC) is warranted against defects in material and workmanship.

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This warranty applies only to the original purchaser and is non-transferable unless express written authorization of the warranty transfer is granted by TTC.

The T-BERD 211 will be repaired or replaced (at our option) at no charge for the period stated in the warranty after shipment to the customer. Liability under this warranty extends only to the replacement value of the equipment. The warranty is void under the following conditions.

(1) Equipment has been altered or repaired without specific authorization from TTC.

(2) Equipment is installed or operated other than in accordance with instructions contained in TTC literature and operating manuals.

No other warranty is expressed or implied. TTC is not liable for consequential damages.

6.3.2 In-Warranty Service

Equipment in warranty must be returned to the factory with shipping prepaid. The equipment should be packed and shipped in accordance with instructions in Section 6.3.4 of this manual. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the TTC Repair Department. The RA number should then appear on all paperwork and be clearly marked on the outside of the shipping container.

After the equipment is repaired by TTC, it will be tested to applicable specifications, burned-in for at least 24 hours, retested, and returned to the customer with shipping prepaid. A brief description of the work performed and the materials used will be provided on the Equipment Repair Report furnished with the returned equipment.

6.3.3 Out-of-Warranty Service

The procedure for repairing out-of-warranty equipment is the same as that used for equipment still in warranty. However, there is a minimum charge applied to each request for out-of-warranty service. The minimum charge guarantees the customer an estimate of the repair costs and is used as credit against actual materials and labor costs should the equipment be repaired. Contact the TTC Repair Department for specific information on the minimum out-of-warranty repair charge.

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The customer will be billed for parts plus standard labor rates in effect at the time of the repair. The customer will also be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC before the repaired equipment may be shipped to the customer. A description of the labor and materials used will be provided in the Equipment Repair Report.

Once an out-of-warranty repair is made, the repaired part or component is warranted for 90 days. This warranty applies only to the part or component that was repaired; other parts or components are not covered under the 90-day repair warranty.

6.3.4 Equipment Return Instructions

To all equipment returned for repair, the customer should attach a tag that includes the following information.

(1) Owner's name and address.

(2) A list of the equipment being returned and the applicable serial number(s).

(3) A detailed description of the problem or service requested.

(4) The name and telephone number of the person to contact regarding questions about the repair.

(5) The Return Authorization (RA) number.

If possible, the customer should return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit; when needed, appropriate packing materials can be obtained by contacting TTC's Repair Department. TTC is not liable for any damage that may occur during shipping. The customer should clearly mark the TTC-issued RA number on the outside of the package and ship it prepaid and insured to TTC.

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SECTION 7

SPECIFICATIONS

7.1 INTRODUCTION

This section contains the specifications for the T-BERD 211 T-Carrier Analyzer.

7.2 GENERAL SPECIFICATIONS

7.2.1 Physical

- Size: 6"H x 13.5"W x 8.5"D (15.3 cm x 34.4 cm x 16.5 cm) including cover.
- Weight: 10 pounds (4.5 kg).

7.2.2 Operational

- Operating Temperature Range: 32°F to 113°F (0C to 45C).
- Storage Temperature Range: -4°F to 158°F (-20°C to 70°C).
- Power: 115 VAC or 230 VAC (factory option only), ±10%, 50/60 Hz.
- Fuse: 1A, 250V SLO-BLO (Littlefuse #218001 or equivalent).

7.3 INPUT SPECIFICATIONS

7.3.1 Receive Input

- Input Connectors: WECO 310 jack, bantam jack, and 15-pin network interface D connector.
- Input Frequency: T1 - 1,544,000 Hz ±5000 Hz.
  T1C - 3,152,000 Hz ±5000 Hz.
- Input Impedance: BRIDGE - 1000 ohms or greater.
  TERM - 100 ohms ±5%.
  DSX-MON - 100 ohms ±5%.

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- Operating Range: BRIDGE - T1: +6 dBdsx to -35 dBdsx.T1C: +3 dBdsx to -6 dBdsx.(ALBO compensates for cable loss.)
  TERM - T1: +6 dBdsx to -35 dBdsx.T1C: +3 dBdsx to -6 dBdsx.(ALBO compensates for cable loss.)
  DSX-MON -T1 or T1C: +6 dBdsx to -24 dBdsx. No ALBO provided; resistive loss compensation only.

7.3.2 T1 Reference Input

- Input Connectors: WECO 310 and bantam jacks.
- Input Frequency: 1,544,000 Hz ±1000 Hz.
- Input Impedance: 100 ohms ±5%.
- Operating Range: +6 to -24 dBdsx resistive loss.

7.4 OUTPUT SPECIFICATIONS

- Output Connectors: Selectable line buildout in T1 of 0 dB, -7.5 dB, and -15 dB is provided on WECO 310 jack, bantam jack, and 15-pin network interface D connector. Three additional DSX-level 310 jack outputs are provided.
- Output Line Buildout Tolerance: ±1 dB attenuation at 772 kHz.
- Pulse Shape: With output terminated in 100 ohm resistive load and 0 dB line buildout selected, the T-BERD 211 meets CCITT Recommendation G.703; AT&T Publications CB113, CB119, CB132, CB143, and PUB62508; and AT&T PUB62411 pulse shape specifications.
- Internal Oscillator Accuracy: ±5 ppm.
- Jitter Attenuation: Per Figure A-5 of AT&T PUB62411, October 1985 Revision.
- Line Codes: Bipolar (pseudoternary); AMI, B8ZS, or ZBTSI (optional) selectable.

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7.5 FRONTPANEL

7.5.1 Switches

- Modes: AUTO, T1, T1 D4, T1 ESF, T1 ESFz (optional), T1 SLC, T1C, T1C TLB, T1 TLB, T1 LLB, SELF TST, and AUX.

- Patterns: Fixed - ALL ONES, 1:1, 1:7, 3 IN 24, MIN/MAX (optional), LUP (optional), two programmable 3- to 24-bit patterns, and ALL ZERO.

  Multiple - 21-pattern bridge tap detection sequence (see Table 2-3) and 5-pattern sequence (see Table 2-5).

  Pseudorandom - T1-QRSS, T1C-QRSS, 2^{15}-1, 2^{20}-1, and 2^{23}-1.

- Results: SUMMARY - Bit errors, slips (pattern), violations (BPVs), frame errors, CRC errors, frame loss count, receive frequency, pulse shape, and timing slips. (See Table 7-1 for non-zero and out-of-specification display criteria.)

  LOGIC - Bit errors, asynchronous errored seconds, bit error rate, error-free seconds, percent error-free seconds, synchronized errored seconds, out-of-synchronization seconds, and pattern slips.

  Performance Analysis Option (LOGIC Category) - Severely errored seconds, percent severely errored seconds, degraded minutes, percent degraded minutes, unavailable seconds, percent availability, consecutive severely errored seconds.

  BPV & FRAME - Violations, BPV seconds, BPV rate, frame error seconds, frame severely errored seconds, frame errors, frame error rate, CRC errors, CRC errored seconds, frame loss count, frame loss seconds, CRC severely errored seconds, and CRC error rate.

  SIGNAL - Received frequency (Hz), received level (dBdsx), received level (dBm), received level (V p-p), pulse shape (pass/fail/out of range), pulse width, rise time, fall time, undershoot, overshoot, simplex current, timing slip, and slip analysis seconds.

  TIME - Signal loss seconds, alarmed seconds, test length, elapsed time, test end in, clock time, and date.

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JITTER & WANDER - Maximum positive peak wander deviation, maximum negative peak wander deviation, total positive-to-negative peak wander deviation, 15-minute wander, 24-hour wander, TIE wander, wideband and highband jitter (pass/fail), wideband jitter (UIs), highband jitter (UI), maximum wideband jitter, maximum highband jitter, spectral analysis frequency bands (% or UI) (optional).

Table 7-1
Summary Results Display Criteria

Result	Display Criteria
Bit Errors	>0
Slips	>0
Violations	>0
Frame Errors	>0
CRC Errors	>0
Frame Loss Count	>0
Receive Frequency	T1: outside 1,543,923 to 1,544,077 Hz. T1C: outside 3,151,906 to 3,152,094 Hz.
Pulse Shape	Exceeds selected pulse shape mask criteria.
Time Slips	Not equal to 0.

- Test Lengths: Continuous - no time limit.
- Timed - 15 seconds to 200 hours, 59 minutes. Factory default: 200 hours.
- Transmit Timing: External - from EXT CLK IN BNC or T1 REF jack. Internal - crystal controlled oscillator. Recovered - from received signal.
- Transmit Codes: AMI, B8ZS, and ZBTSI (optional).
- Error Insert: BPV - single, continuous error rate, or burst. Error rate range 1.0 E-2 to 9.9 E-9. Burst length range 25 ms to 5 seconds with selected error rate.

  Logic - single, continuous error rate, or burst. Error rate range 1.0 E-2 to 9.9 E-9. Burst length range 25 ms to 5 seconds with selected error rate.

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Frame - single, 2 to 6 consecutive frame errors, or continuous 1 to 6 consecutive frame errors per superframe. Error insertion on F_t bits for D4 or SLC-96 framing; FPS bits for ESF framing; or F-bit or Z-bit for ZBTSI encoded ESF.

- Receive Input: Bridge, Terminate, and DSX-Monitor.
- Transmit Output Level: 0 dB(DSX), -7.5 dB, and -15 dB.

7.5.2 Indicators

- Alarm Indicators: Signal Loss, Signal Loss History, Pattern Loss, Pattern Loss History, Frame Loss, Frame Loss History, Ones Density, Ones Density History, Excess Zeros, Excess Zeros History, Yellow Alarm, Yellow Alarm History, All Ones, All Ones History, Pulse Shape, Pulse Shape History, Jitter, Jitter History, Power Loss History.
- Loop Code Indicators: Receive Loop Up Detect, Receive Loop Down Detect, Pre-Existing Loop, Loop Up Send, Loop Down Send.
- Error Insert Indicators: Frame Error Insert, BPV Error Insert, Logic Error Insert. Single flash for single error insertion, three flashes for burst error insertion, and illuminated continuously for continuous error insertion.
- Receive Status Indicators: T1 Pulses, T1C Pulses, Frame Sync, Pattern Sync, B8ZS Detect.

7.5.3 Alarm Criteria

- Signal Loss: 150 msec without input pulses after valid frequency and level are detected.
- Pattern Sync Loss: 250 errors detected in 1000 or fewer bits.
- Frame Sync Loss: D4 - 2 out of 5 Ft bits in error.
  ESF (ESFz) - 2 out of 5 frame bits in error.
  SLC - 2 out of 5 Ft bits in error.
- Excess Zeros: T1 - AMI: 16 consecutive zeros. B8ZS: 8 consecutive zeros.T1C - 34 consecutive zeros.
- Yellow Alarm: D4 - Bit 2 is a 0 for 255 consecutive channels.

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ESF - 256 bits ±16 bits of a repetitive (1111111100000000) pattern received in the 4 kb/s data link.
SLC - Bit 2 is a 0 for 255 consecutive channels.

- All Ones: T1 or T1C unframed - 2048 consecutive ones. T1 framed - 256 consecutive DS0 channels with all ones.

- Ones Density: Less than n ones in 8(n+1) bits, where n = 1 to 23 per AT&T PUB62411 and ANSI T1.403. Disabled when receiving a T1-QRSS pattern or any T1C signal.

- Pulse Shape: Received pulse shape exceeds selected pulse shape mask specification.

- Jitter: Without Spectrum Analysis Option - Wideband jitter exceeds 5 UI or highband jitter exceeds 0.1 UI. With Spectrum Analysis Option - Off: wideband jitter exceeds 5 UI or highband jitter exceeds 0.1 UI. On: measured jitter exceeds selected jitter mask. Disabled when Spectrum Analysis is on and no jitter mask is selected.

7.6 PATTERN SPECIFICATIONS

7.6.1 Pattern Definition

- ALL ONES: All Ones.
- 1:1: Alternating Ones and Zeros.
- 1:7: F01000000... Pattern is aligned with framing (F) patterns as indicated.
- 3 IN 24: F0100 0100 0000 0000 0000 0100... Pattern is aligned with framing (F) patterns as indicated.
- T1-QRSS: QRSS pattern (2^{20}-1 with zero suppression).
- T1C-QRSS: 2^{20}-1 bit pseudorandom (no zero suppression).
- 2^{15}-1: 2^{15}-1 bit pseudorandom.
- 2^{20}-1: 2^{20}-1 bit pseudorandom.
- 2^{23}-1: 2^{23}-1 bit pseudorandom.

- USER1/USER2: 3- to 24-bit programmable pattern. Factory default: USER1 is 1:6 pattern and USER2 is 1:7 pattern.

- BRIDGTAP: Automated 21-pattern sequence with varying degrees of ones and zeros density that detect bridge taps (see Table 2-3).

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- MULTIPAT: Automated 5-pattern sequence that includes: ALL ONES, 1:7, 2 IN 8, 3 IN 24, and T1-QRSS (see Table 2-5).

- MIN/MAX: Optional Minimum/Maximum ones and zeros density stress pattern (see Appendix E).

- LUP: Optional 1- to 2000-character hexadecimal programmable long user pattern. Factory default: Minimum/Maximum ones and zeros density stress pattern (see Appendix E).

- ALL ZERO: AMI coding - all zeros, no pulses except framing.B8ZS coding - B8ZS BPV sequence 000V 10V1 (V = bipolar violation) ZBTSI coding - stresses the ZBTSI encoding algorithm.

7.6.2 Pattern Sync Detection Criteria

- Fixed Patterns: 30 consecutive error-free bits.

- Pseudorandom Patterns: 30 + n consecutive error-free bits for a pattern length of 2^n-1. For QRSS, n = 20.

7.7 LOOP CODES

7.7.1 Generation and Detection Patterns

- CSU Loop Code: Inband - loop up: 10000; loop down: 100. ESF out-of band - loop up: 0111 0000; loop down: 0001 1100.

- Facility 1 Loop Code: Inband - loop up: 1100; loop down: 1110. ESF out-of band - loop up: 0100 1000; loop down: 0010 0100.

- Facility 2 Loop Code: Inband - loop up: 11000; loop down: 11100. ESF out-of band - loop up: 0100 1000; loop down: 0010 0100.

- Programmable Loop Codes: 3- to 8-bit repeating code independently settable for loop-up and loop-down codes. Factory default: loop up - 10000 (CSU loop-up); loop down - 100 (CSU loop-down).

NOTE: Generated codes may be sent unframed or framed. When framing is selected, inband loop codes are overwritten by the framing bit.

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7.7.2 Loop Detect Criteria

- Inband Loop Codes: At least 185 error-free bits of the selected repetitive pattern must be received (Loop Up and Loop Down).

- Out-of-Loop Codes: Data link monitored every 125 msec for loop codes (Loop Up and Loop Down).

7.8 MEASUREMENTS

7.8.1 Frequency

- Accuracy: ±5 ppm.
- Resolution: 1 Hz.
- T1 Range: 1,544,000 Hz ±5000 Hz.
- T1C Range: 3,152,000 Hz ±5000 Hz.

7.8.2 Level

The designation dBdsx is a voltage measurement; a 3-volt base-to-peak signal is defined as 0 dBdsx. Measurements for dBm are available only when all ones is detected.

- dBdsx Level Range: +6 dBdsx to -40 dBdsx.

- dBdsx Level Accuracy: ±1 dB between +6 dBdsx and -18 dBdsx; ±2 dB between -18 dBdsx and -40 dBdsx.

- dBdsx Resolution: 0.1 dB between +6 dBdsx and -6 dBdsx; 0.5 dB between -6 dBdsx and -40 dBdsx.

- dBm Level Range: +22.5 dBm to -23.5 dBm.

- dBm Level: ±5%.

- dBm Resolution: 0.1 dB between +22.5 dBm and +10.5 dBm; 0.5 dB between +10.5 dBm and -23.5 dB.

- Vp-p Range: 60 mV to 12.0 V.

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7.8.3 Simplex Current

- Range: 10 mA to 180 mA.
- Resolution: 1 mA.
- Accuracy: ±5%.
- Simplex Voltage Drop: 8.5 volts (nominal) at 60 mA.

7.8.4 Pulse Shape

- Sample Interval: 2.75 nsec.
- Analysis Interval: 648 nsec from risingedge of pulse.
- Availability: TERM & BRIDGE - +4 to -4 dBdsx.
  DSXMON - -16 to -24 dBdsx.
- Horizontal Accuracy: ±5%.
- Vertical Accuracy: ±8%.
- Resolution: Pulse Width - 2.75 nsec.
  Rise Time - 1 nsec.
  Fall Time - 1 nsec.
  Undershoot - 1%.
  Overshoot - 1%.

7.8.5 Timing Slips

- Resolution: 1 frame slip.
- Range: 9999 frame slips.
- Bar Graph Resolution: 16 bit slips.
- Bar Graph Range: ±192 bit slips.
- Wheel Resolution: 1 bit slip.
- Wheel Range: ±16 bit slips.
- Frame slip Printout Resolution: 1 frameslip.
- Frame Slip Printout Range: 9999 frame slips.
- Bit Slip Printout Resolution: 1 bit slip.
- Bit Slip Printout Range: ±192 bit slips.
- Slip Analysis Seconds Resolution: 1 second.
- Slip Analysis Seconds Range: 99999999 seconds.

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7.8.6 Wander

- Resolution: 1 UI.
- Accuracy: 1 UI.

7.8.7 Wideband and Highband Jitter

- Resolution: 0.01 UI.
- Accuracy: ±5%.
- Offset: 0.035 UI

7.9 CONNECTORS

7.9.1 External BNC

- Input Configuration: AC-coupled. Outer conductor is signal ground; inner conductor is signal.

- AC Input Impedance: 50 ohms ±10%.

- Sine-Wave Clock Waveform: 5 Vp-p minimum; 10 Vp-p maximum. 1.0 MHz minimum; 4.0 MHz maximum.

- Square-Wave Clock Waveform: 1 Vp-p minimum; 20 Vp-p maximum. 1.0 MHz minimum; 4.0 MHz maximum.

7.9.2 Front Panel 15-Pin D

- Connector Pin Configuration: See Table 7-2.

7.9.3 Optional RS-232 25-Pin D Connector

- Character Format: 7 (odd or even parity) or 8 (no parity) data bits (ASCII characters).
  2 transmitted stop bits.
  Accepts 1 or more received stop bits.

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Table 7-2
Front Panel Connector Pin Configuration

Pin Number	Name
1	TRANSMIT TIP
2, 4, 12	SIGNAL GROUND
3	RECEIVE TIP
5, 6, 7, 8, 10	NO CONNECTION
9	TRANSMIT RING
11	RECEIVE RING
13	RESERVED FOR FUTURE USE
14	RESERVED FOR FUTURE USE
15	+5 Vdc

- Baud Rates: 300, 1200, 2400, 4800. (110, 600, 9600, and 19200 baud rates are available in autobaud mode only.)
- Line Terminator: CR or CRLF.
- Print Width: 80 column.
- Connector Configuration: DCE.
- Connector Pin Assignments: See Table 7-3.

Table 7-3
RS-232 Pin Configuration

Pin		Description
1	FGND	Frame ground — connected to chassis ground.
2	TD	Transmit data — The T-BERD 211 receives data on this lead.
3	RD	Receive data — Data is transmitted by the T-BERD 211 on this lead.
4	RTS	Request to Send — This lead is terminated by the T-BERD 211.

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Table 7-3
RS-232 Pin Configuration

Pin		Description
5	CTS	Clear to Send — This lead is driven to the ON state by the T-BERD 211 whenever it is ready to receive a command. This lead may be ignored by the controller if, before issuing commands, it waits for the return of a prompt character from the T-BERD signifying the completion of the previous command.
6	DSR	Data Set Ready — This lead is driven to the ON state by the T-BERD 211 whenever it has power applied.
7	SGND	Signal Ground — Connected to signal ground.
8	RLSD	Receive Line Signal Detect — Must be ON before the T-BERD 211 will accept any data.
9	+V	+12 Vdc.
10	-V	-12 Vdc.
20	DTR	Data Terminal Ready — Data is only output from the T-BERD 211 when this line is held in the ON condition by the receiving device.

7.10 GROUNDING

- Chassis and signal grounds isolated by 100 ohm, 1/2 watt resistor.
- Bantam and 310 jack sleeves connected to chassis ground.
- Power cord center pin connected to chassis ground.
- RS-232 25-pin D connector: Pin 1 to chassis ground.
  Pin 7 to signal ground.
- Network Interface 15-pin D connector: Pins 2, 4, and 12 to signal ground.

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SECTION 8

OPTIONS AND ACCESSORIES

8.1 INTRODUCTION

This section describes the various options and accessories that are available for use with the T-BERD 211.

8.2 OPTIONS

8.2.1 Performance Analysis Option

The Performance Analysis Option (Option 211-1) is a factory-installed package which offers you test results based on CCITT Recommendation G.821. The results that are available are:

(1) Unavailable seconds
(2) Percent availability
(3) Degraded minutes
(4) Percent degraded minutes
(5) Severely errored seconds
(6) Percent severely errored seconds

Appendix A provides a general discussion of the CCITT specifications.

8.2.2 T1 Channel Monitor (Model 40849)

The T1 Channel Monitor (Model 40849) adds VF monitoring capability to the T-BERD 211, thus giving you the ability to troubleshoot T1 circuits and individual channels within a single test set. When purchased, the T1 Channel Monitor replaces the T-BERD 211's standard lid. Appendix C contains a complete description of this option.

8.2.3 Jitter Spectral Analysis Option

The Jitter Spectral Analysis Option (Option 211-2) provides the T-BERD 211 with the ability to analyze timing jitter present on T1 networks. The option is accessible from the JITTER & WANDER category. The measured jitter can be measured against five industry standards for jitter impairments or as a unit interval (UI) measurement.

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8.2.4 Programmable Long User Pattern Option

The Programmable Long User Pattern (LUP) Option (Option 211-3) is a hardware option which allows T-BERD 211 transmit and analyze a circuits sensitivity to a 1- to 2000-character test pattern. LUP is entered in a hexadecimal format from the front panel or a remote control device.

The Programmable LUP Option also adds a MIN/MAX test pattern which provides a modified 55-Octet pattern that can be used for framed or unframed testing.

8.2.5 ZBTSI Option

The ZBTSI (Zero Byte Time Slot Interchange) Option (Option 211-4) is a hardware option which allows the T-BERD 211 to test ZBTSI-encoded ESF circuits. The ZBTSI option and the ALL ZERO test pattern allow the T-BERD 211 to stress ZBTSI compatible circuits.

8.3 ACCESSORIES

Various accessories are offered with the T-BERD 211; these accessories are described in the following paragraphs. Contact TTC's Customer Service Department for ordering information.

8.3.1 19" and 23" Rack Mounts (Models 10958-01 and 10959-01)

The Rack Mount allows the T-BERD 211 to be mounted in a 19" or 23" equipment rack. The assembly requires 7" of vertical rack space. To install the T-BERD 211 in the rack mount, do the following.

(1) Loosen (but do not remove) the four #6 screws that secure the rack mount's rear bracket to the rack mount tray. Slide the rear bracket to the back of the rack mount tray.

(2) Remove the T-BERD 211's front cover. It is not necessary to remove the instrument's feet or handles.

(3) Lower the T-BERD 211 through the top of the rack mount until it sits on the rack mount tray. Slide the instrument forward so that its front panel (including the handles) protrudes through the opening in the

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front of the rack mount. The strikes on the sides of the T-BERD prevent it from being pulled through the opening. Ensure that the pull-out reference card is accessible and that it may be hinged down over the edge of the rack mount.

(4) Once the T-BERD 211 is properly seated in the rack mount, slide the rack mount's rear bracket firmly against the instrument so that the T-BERD's four rear feet protrude through the designated holes in the bracket.

(5) Tighten the four #6 screws that were loosened in Step 1 to secure the T-BERD 211 in the rack mount.

8.3.2 Cables

The following is a list of the accessory cables that are available from TTC for use with the T-BERD 211.

Model	Description
10199	15-pin D to 15-pin D (10')
10420	310 plug to 310 plug (10')
10558	310 plug to alligator clips (10')
10559	310 plug to bantam plug (10')
10615	Bantam plug to bantam plug (10')
10648	Bantam plug to alligator clips (10')
10686	15-pin D to RJ45 (10')

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APPENDIX A

DISCUSSION OF G.821

This appendix discusses the concept of available time versus unavailable time as specified in CCITT Recommendation G.821. This discussion is provided to familiarize users with the results that may be obtained with the optional Performance Analysis Package.

CCITT Recommendation G.821 defines available and unavailable time as follows:

> "A period of unavailable time begins when the bit error rate (BER) in each second is worse than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable time. The period of unavailable time terminates when the BER in each second is better than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be available time."

Available and unavailable time are measured in seconds — available seconds and unavailable seconds, respectively. All test seconds must fall into one of the two categories (total available seconds + total unavailable seconds = total test seconds).

At the beginning of a test, test seconds are considered to be available time; the available seconds begin counting. These seconds continue to be counted until 10 consecutive seconds occur each with a BER worse than 10^{-3}. A sliding window, 10 seconds in length, is used to detect this transition from available to unavailable time and vice versa.

As an example, assume a test begins and continues to run for 25 seconds and each of those 25 seconds has a BER better than 10^{-3}. When the test starts, test seconds are considered to be available time, so the available seconds count at this point is 25. In the 26th second, the BER becomes worse than 10^{-3}. The same for the 27th and 28th seconds. In the 29th second, the BER drops back to better than 10^{-3}. All 29 seconds are a part of available time and are, therefore, counted as available seconds.

sec 20 BER <=	sec 21 BER <=	sec 22 BER <=	sec 23 BER <=	sec 24 BER <=	sec 25 BER <=	sec 26 BER >	sec 27 BER >	sec 28 BER >	sec 29 BER <=

Sliding Window After 29th Test Second Still in Available Time

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Even though there were 3 consecutive seconds (the 26th, 27th, and 28th) which each had a BER worse than 10^{-3}, 10 such consecutive seconds are required to make the transition to unavailable time. Those 3 individual seconds are still in available time and they are counted as available seconds.

The 3 seconds with a BER worse than 10^{-3} are also included in the count of severely errored seconds, which are those test seconds with a BER worse than 10^{-3} that occur in available time. A signal loss second or a second in which pattern synchronization is lost is also considered to be a second with a BER worse than 10^{-3}. Therefore, the current test result values for available seconds count = 29; the severely errored seconds (SES) count = 3, and the unavailable seconds count = 0.

The same test continues to run and remains in available time. In the 80th second, the BER for that second is worse than 10^{-3}. The BER for the 81st, 82nd, 83rd, 84th, and 85th seconds is also worse than 10-3. In the 86th second, pattern synchronization is lost. This also continues for the 87th and 88th seconds. We now have 9 consecutive seconds each of which has a BER worse than 10^{-3}. As each of these test seconds occurs, we are still in available time, so they are counted as available seconds and severely errored seconds. The transition has not been made from available time to unavailable time.

sec 79 BER <=	sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >

Sliding Window After 88th Test Second Still in Available Time

The 89th test second also has a BER worse than 10^{-3}. At this point, the available seconds count = 89, the SES count = 13, and the unavailable seconds count = 0. However, the sliding window now contains 10 consecutive seconds each of which has a BER worse than 10^{-3}. A transition is made to unavailable time.

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sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >	sec 89 BER >

Sliding Window After 89th Test Second
Transition to Unavailable Time

Those 10 seconds which had been counted as available seconds are deducted from the available seconds count and are added to the unavailable seconds count; the available seconds count becomes 79, and the unavailable seconds count become 10. Those same 10 seconds were also included in the SES count. However, SES is limited to only those seconds in available time which have a BER worse than 10^{-3}; therefore, those last consecutive 10 seconds must also be deducted from the SES count (the SES count is updated to 3).

Once the transition occurs from available time to unavailable time, all test seconds are counted as unavailable seconds until 10 consecutive seconds occur each with a BER better than 10^{-3}. As the sample test continues, the 90th through 150th seconds each have a BER worse than 10^{-3}. We are still in unavailable time, so these seconds are counted as unavailable seconds; now the total available seconds count = 79 and the total unavailable seconds count = 71.

Beginning with the 151st second, the BER for that second falls below 10^{-3}. It is still counted as an unavailable second since we are still in unavailable time and the transition has not been made to available time. A BER better than 10^{-3} also occurs for the 152nd, 153rd, 154th, 155th, 156th, 157th, 158th, 159th, and 160th seconds. Since there are now 10 consecutive seconds with a BER less than 10^{-3}, the transition is made from unavailable time to available time.

sec 151 BER <	sec 152 BER <	sec 153 BER <	sec 154 BER <	sec 155 BER <	sec 156 BER <	sec 157 BER <	sec 158 BER <	sec 159 BER <	sec 160 BER <

Sliding Window After 160th Test Second
Transition to Available Time

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As each of these faulty 10-second intervals occurred, it was added to the unavailable seconds count (unavailable seconds = 81, available seconds = 79, and SES = 3). Now that the last group of seconds has triggered the transition to available time, that group of seconds is deducted from the unavailable seconds count and added to the available seconds count. Now the unavailable seconds count = 71 and the available seconds count = 89.

The monitoring of available and unavailable time continues for the duration of the test.

Degraded minutes is an error analysis result that is affected by available and unavailable time. Degraded minutes is a count of the number of minutes during which an average BER worse than 10^{-6}, but better than 10^{-3}, occurs. The 1-minute intervals are derived by removing unavailable seconds and severely errored seconds (SES) from the total test time and then consecutively grouping the remaining seconds into blocks of 60. The average BER is calculated for the block of 60 seconds and, if it is worse than 10^{-6}, the block is counted as a degraded minute.

In the transition from available time to unavailable time, the degraded minutes result is unaffected. This is because a switch to unavailable time requires 10 consecutive seconds each with a BER worse than 10^{-3}. Any second in available time with a BER worse than 10^{-3} is considered to be a severely errored second and, therefore, not included in the accumulation of seconds used to calculate degraded minutes.

Moving from unavailable time to available time may affect the degraded minutes count. While in unavailable time, 10 consecutive seconds each with a BER better than 10^{-3} are required for the transition to available time. When this happens, those 10 seconds are subtracted from the unavailable seconds count and are added to the available seconds count. Since these seconds are now considered to be a part of available time and they are not severely errored seconds, they are included in the calculation of degraded minutes.

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APPENDIX B

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APPENDIX C

T-BERD T1 CHANNEL MONITOR OPTION

Appendix C fully describes the T-BERD T1 Channel Monitor Option.

C.1 OVERVIEW

The T-BERD T1 Channel Monitor Option gives the T-BERD 211 the ability to monitor VF channels. Encased on the inside part of the T-BERD front cover, the Channel Monitor makes it possible to troubleshoot a T1 circuit and monitor the circuit's individual channels with a single test set. While the T-BERD is analyzing a T1 signal, the Channel Monitor:

(1) Displays signaling information for all 24 channels in a T1 circuit.

(2) Decodes any of the 24 channels and sends the Voice Frequency (VF) signal to a speaker.

(3) Displays the voice frequency signal level in an easy-to-read bar graph format.

The Channel Monitor attaches to the T-BERD by connecting the Channel Monitor's 15-Pin "D" coiled cable to the T-BERD's front-panel 15-pin "D" connector (see Figure C-1).

C.2 SUMMARY OF KEY FEATURES

The T-BERD T1 Channel Monitor offers these key features and characteristics:

(1) **Simultaneous Display of All 24 Signaling Bits** allows a "quick look" at the hook status of a channel or a view of the ongoing signaling on a T1 trunk.

(2) **LED Bar Display** prominently displays the VF signal level in bar graph format. The display covers the range -54 dBm to +3 dBm in 3 dBm increments.

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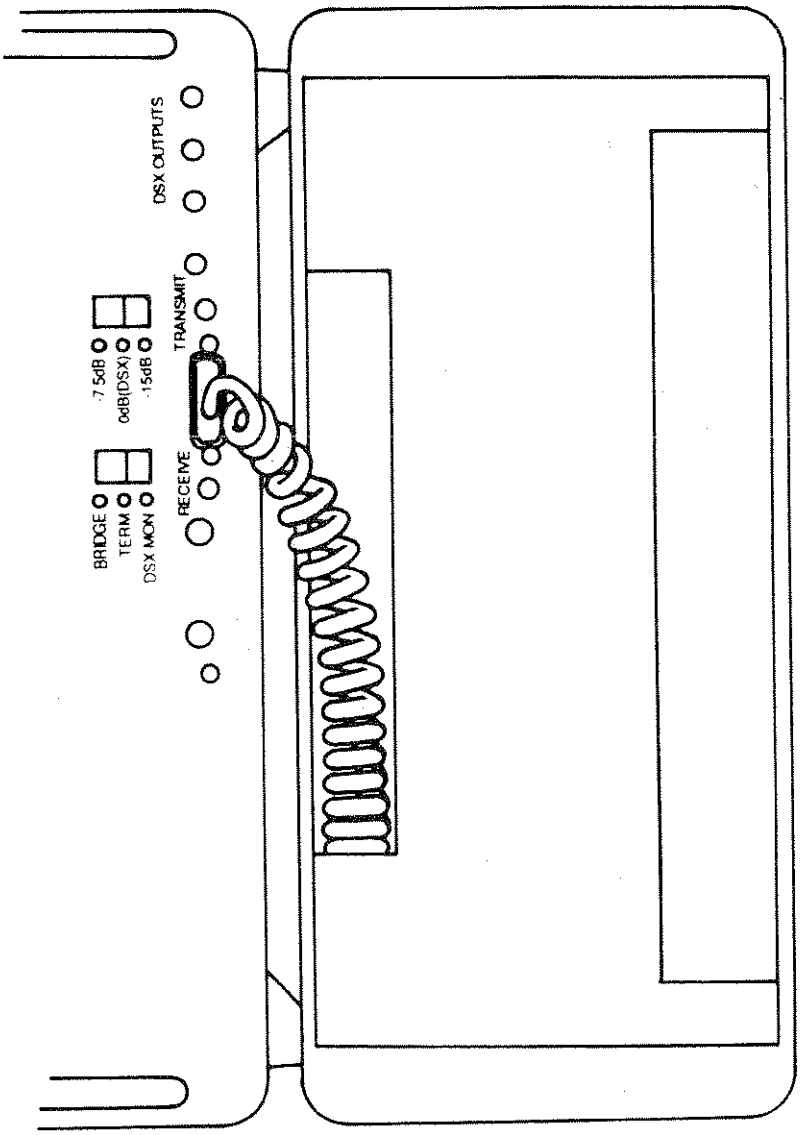

Figure C-1
Connecting the Channel Monitor to the T-BERD 209A

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(3) **Insert and Drop of ESF Data Link** permits monitoring or testing of the ESF data link.

(4) **Drop of SLC-96 4 kb/s Data Link** permits monitoring of the SLC-96 data link.

(5) **VF Output** provides access to an external VF test set via 600 ohm VF output jack.

(6) **ISDN compatibility** can be achieved by dropping any of the 24 64 kb/s channels.

C.3 INSTRUMENT DESCRIPTION

Figure C-2 shows the T-BERD T1 Channel Monitor. The numbers for each item in the figure correspond to the numbered descriptions of the instrument's switches and indicators which follow.

(1) **FRAME FORMAT** SWITCH - FRAME FORMAT is a multiposition switch that enables synchronization to the framing format of the T1 circuit under test. LED indicators show the current setting of the switch.

This selects one of five framing formats: ESF, SLC, D3/D4, D2, and D1D. Note that D3/D4 framing is the default setting at power-up time.

(2) FRAME SYNC LOSS LED - The FRAME SYNC LOSS LED illuminates when the T-BERD 211 is not synchronized to the selected frame format.

(3) **CHANNEL SELECT** SWITCH - **CHANNEL SELECT** is a rocker switch (with up and down arrows) that enables selection of the channel to be monitored on the T1 circuit. Channel 24 is always the first channel displayed at power-up. The channel number is displayed on a 2-digit, 7-segment LED display located to the left of the switch.

(4) SIGNALING DISPLAY - The SIGNALING display is a 4 x 24 LED array that shows the signaling status for each of the 24 voice channels in the T1 circuit. When the ESF framing format is selected,

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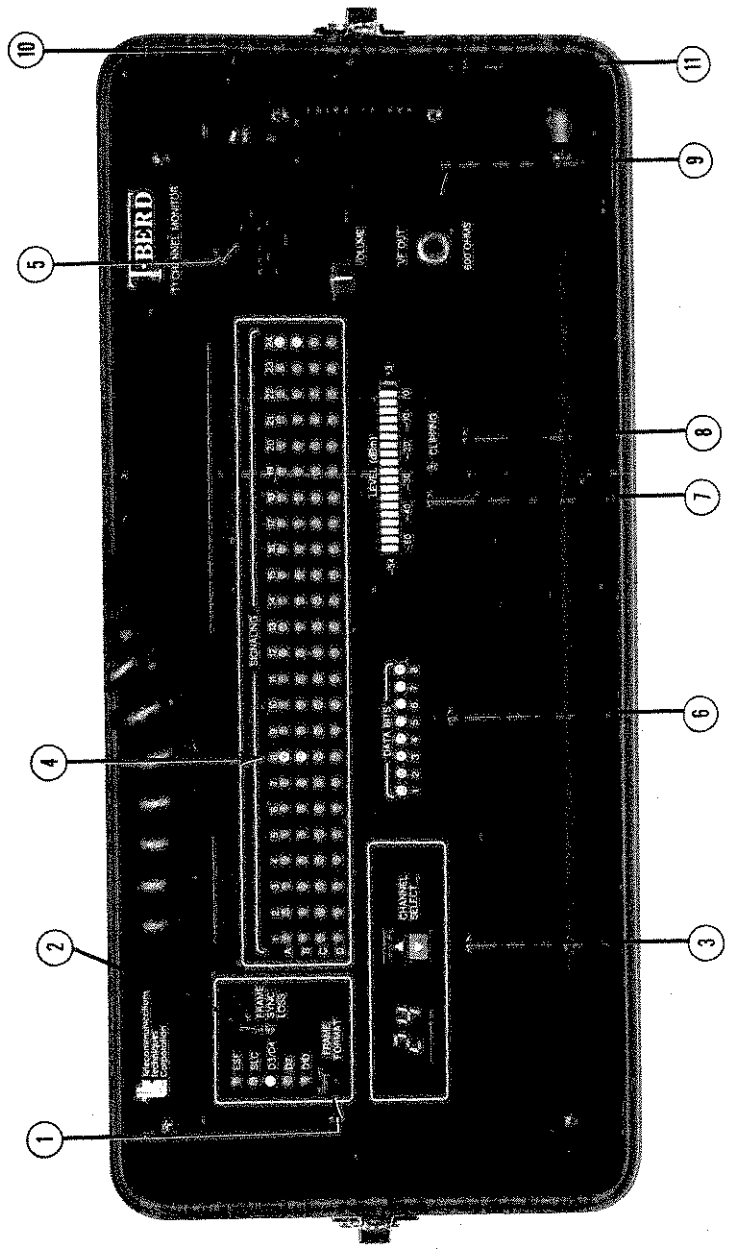

Figure C-2
The T-BERD T1 Channel Monitor

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the entire LED array (rows A-D) is multiplexed and updated at the ESF signaling rate (333 times per second). In all other framing formats, only the LEDs in rows A and B are updated.

NOTE: The SIGNALING display is blank during the absence or loss of frame synchronization.

(5) **BUILT-IN SPEAKER AND VOLUME** SWITCH - The T-BERD T1 Channel Monitor's built-in speaker allows the user to hear the audio output of the voice frequency signal once a channel is decoded. The **VOLUME** switch located below the speaker controls the volume level.

(6) DATA BITS DISPLAY - The 8-LED DATA BITS grouping displays the individual data bits for the selected channel.

NOTE: The DATA BITS display is blank during the absence or loss of frame synchronization.

(7) LEVEL (dBm) DISPLAY - LEVEL (dBm) displays the average level of the currently selected VF channel in bar-graph format. Consisting of 20 segments with 3 dB change in amplitude per segment, the bar graph features a "thermometer-style" presentation; the more segments that are illuminated, the greater the channel's amplitude.

(8) CLIPPING LED - The CLIPPING LED is illuminated when either the maximum positive or negative digital VF signal is received (while the +3 dB bar graph segment is illuminated). When the CLIPPING LED blinks during normal conversation on the selected channel, it is a signal that the gain at the source may be too high.

(9) VF OUT 600-OHM OUTPUT JACK - VF OUT is a 600-ohm output jack that allows the currently selected VF channel to be output to an external VF test set for in-depth analysis.

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(10) **DATALINK/CHANNEL** SWITCH - The **DATALINK/CHANNEL** switch enables output of either the 4 kb/s ESF or SLC-96 data link or the selected channel's data in 64 kb/s format as follows:

To:	Set the FRAMING Switch to:	and set the DATALINK/ CHANNEL Switch to:
Output the SLC-96 data link	SLC	DATALINK
Output the ESF data link	ESF	DATALINK
Output the selected channel's data in 64 kb/s format	The Desired Frame Format (ESF, SLC, D3/D4, D2, or D1D)	CHANNEL

In ESF framing format, data can be inserted on the datalink no matter what the **DATALINK/CHANNEL** switch is set to, or which channel is selected.

(11) RS-232 CONNECTOR - The RS-232 25-pin D connector collects either data link or channel data for output to terminal equipment (e.g., protocol analyzer). The type of output that is collected is based on the setting of the **DATALINK/CHANNEL** switch.

The RS-232 connector is configured as a DCE and transmits data synchronously; a transmit clock is supplied with the transmit data, and a receive clock synchronizes the receive data to be inserted into the data link. Table C-1 depicts the pin configuration for the RS-232 connector.

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Table C-1
RS-232 Pin Configuration

Signal*	DCE	Comments
PROT GND (Pin 1):	—	Connected to chassis ground.
TX DATA (Pin 2):	RCV	The Channel Monitor receives data on this lead (ESF mode only.)
RCV DATA (Pin 3):	TX	Data is transmitted on this lead; data is present when ESF, SLC, or CHANNEL is selected, and frame synchronization is achieved.
RTS (Pin 4):	RCV	This lead must be active to insert data.
CTS (Pin 5):	TX	This lead is active when RTS is active.
DSR (Pin 6):	TX	This lead is driven to the ON state when POWER is applied.
SIGNAL GROUND (Pin 7):	—	Connected to signal ground.
RLSD (Pin 8):	TX	Driven to the ON state when ESF, SLC, or CHANNEL is selected, and frame synchronization is achieved.
TX CLK (Pin 15)	TX	Synchronizes transmit data for data link insert (4 kHz).
RX CLK (Pin 17)	TX	Clock for receive data (4 kHz).

*RS-232 signals are defined from the DTE connector's point of view; TX DATA is transmitted from the DTE, and is received at the DCE.

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C.4 CHANNEL TIME SLOT ASSIGNMENTS

This section features a table of channel time slot assignments for all T1 framing format offered by the T-BERD T1 Channel Monitor.

Table C-2
Channel Time Slot Assignments

Channel Time Slot:	D1D Channel Number:	D2 Channel Number:	D3/D4 & ESF Channel Number:	SLC Channel Number:
1	1	12	1	1
2	13	13	2	13
3	2	1	3	2
4	14	17	4	14
5	3	5	5	3
6	15	21	6	15
7	4	9	7	4
8	16	15	8	16
9	5	3	9	5
10	17	19	10	17
11	6	7	11	6
12	18	23	12	18
13	7	11	13	7
14	19	14	14	19
15	8	2	15	8
16	20	18	16	20
17	9	6	17	9
18	21	22	18	21
19	10	10	19	10
20	22	16	20	22
21	11	4	21	11
22	23	20	22	23
23	12	8	23	12
24	24	24	24	24

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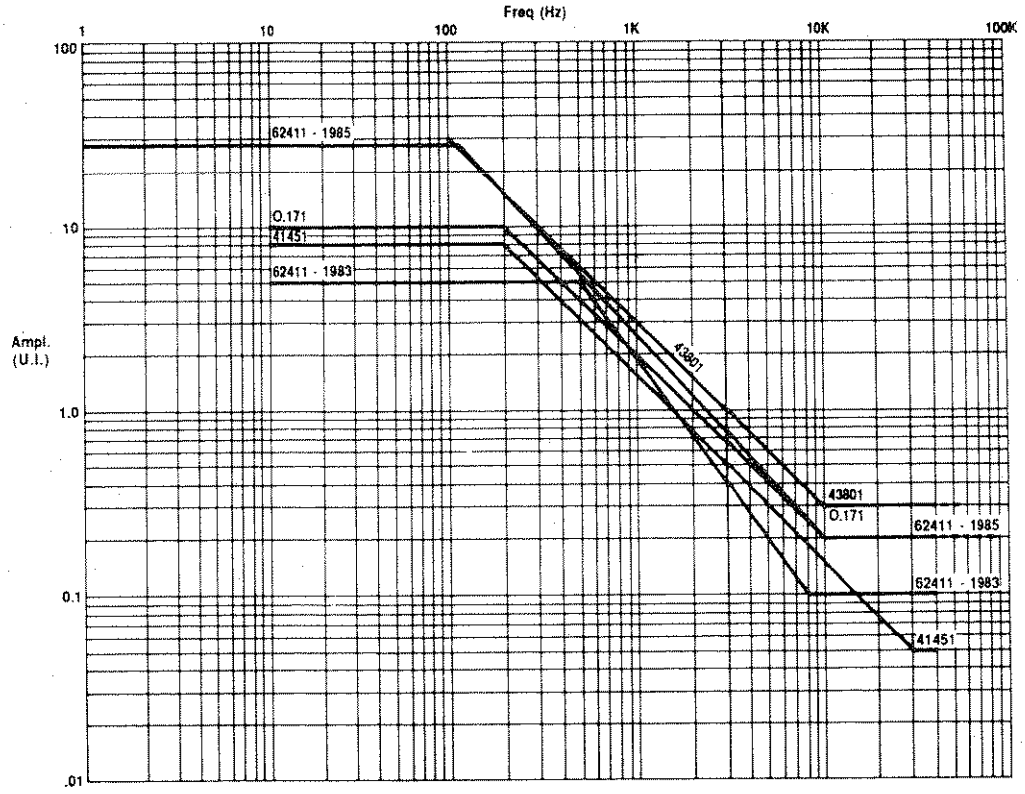
APPENDIX D

JITTER MASKS

The following is a plot of the jitter masks available in the T-BERD 211.



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APPENDIX E

MINIMUM/MAXIMUM STRESS PATTERN

A hexadecimal-to-binary conversion table appears below. On the next page is the optional MIN/MAX stress pattern. It is also the long user pattern default.

Hexadecimal-to-Binary Conversion

H	8421
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

MSB LSB
74H = 0111 0100

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MIN/MAX stress pattern

01	02	03	04	05	06	07	08	09	10
80H	80H	80H	80H	01H	00H	01H	01H	01H	03H
1000 0000	1000 0000	1000 0000	1000 0000	0000 0001	0000 0000	0000 0001	0000 0001	0000 0001	0000 0011
11	12	13	14	15	16	17	18	19	20
80H	01H	80H	01H	01H	80H	01H	22H	00H	20H
1000 0000	0000 0001	1000 0000	0000 0001	0000 0001	1000 0000	0000 0001	0010 0010	0000 0000	0010 0000
21	22	23	24	25	26	27	28	29	30
22H	00H	20H	AAH	AAH	AAH	AAH	AAH	55H	55H
0010 0010	0000 0000	0010 0000	1010 1010	1010 1010	1010 1010	1010 1010	1010 1010	0101 0101	0101 0101
31	32	33	34	35	36	37	38	39	40
55H	55H	AAH	AAH	AAH	AAH	55H	AAH	AAH	55H
0101 0101	0101 0101	1010 1010	1010 1010	1010 1010	1010 1010	0101 0101	1010 1010	1010 1010	0101 0101
41	42	43	44	45	46	47	48	49	50
55H	55H	80H	80H	FFH	FFH	FFH	FFH	FFH	FFH
0101 0101	0101 0101	1000 0000	1000 0000	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111
51	52	53	54	55	56	57	58	59	60
FFH	FEH	FFH	FFH	24H	49H	92H	88H	88H	88H
1111 1111	1111 1110	1111 1111	1111 1111	0010 0100	0100 1001	1001 0010	1000 1000	1000 1000	1000 1000
61	62	63	64	65	66	67	68	69	70
10H	42H	08H	21H	84H	20H	08H	82H	40H	20H
0001 0000	0100 0010	0000 1000	0010 0001	1000 0100	0010 0000	0000 1000	1000 0010	0100 0000	0010 0000
71	72	73							
10H	80H	- -							
0001 0000	1000 0000								