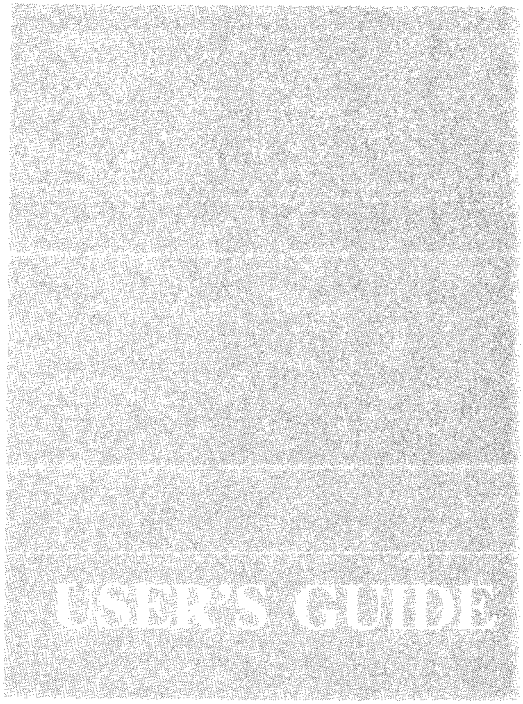

MODEL 7500
T1/DS1
Facility and Channel
Test Set

TAU-TRON INC., A UNIT OF GENERAL SIGNAL
10 LYBERTY WAY, WESTFORD, MA 01886 (508) 692-5100
1-800-TAU-TRON (Outside MA) Telex 750245 FAX 508-692-1938

— WARRANTY —

ALL TAU-TRON TEST SETS ARE WARRANTED AGAINST ANY DEFECTS IN MATERIAL AND WORKMANSHIP, FOR A PERIOD OF *3 YEARS.*

This Warranty applies from the date of delivery for all Tau-tron test sets. Other manufacturers products offered by Tau-tron such as printers, cables, etc. are covered to the extent of their own warranty. Calibration of Tau-tron test sets is covered for 1 year from date of delivery. However, some restrictions apply; see your salesman for further details.

We will repair or replace test sets which, upon our examination, prove to be defective during the warranty period, except in cases of product abuse or attempted field repair.

No other Warranty, expressed or implied, including fitness for purpose, merchantability or otherwise, is given.

For assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction; see Repair Returns below.

SHIPPING DAMAGE

If any signs of damage are noticed on the outside of the carton, make a request for the carrier's agent to be present during unpacking. If external damage is found on the instrument, follow Repair Returns procedure below.

Check the electrical performance of the instrument as soon as possible after receipt. If there are any malfunctions, follow Repair Returns procedure below.

REPAIR RETURNS

For mechanical damage or electrical malfunctions, notify Tau-tron immediately. If the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Department, **(617) 692-5100** (800-TAU-TRON [800-828-8766], outside MA), for a **Repair Authorization Number**. The use of this number reduces administrative delays and ensures the prompt return of your unit.
2. Complete and attach the **Repair Tag**, located in the back of the manual, **to your unit** for positive identification.
3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb; 159 kg) and shock-absorbing material such as bubblewrap, to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.
4. Send to: Tau-tron Inc.
   10 Lyberty Way
   Westford, MA 01886
   Attn: Customer Service

MODEL 7500
T1/DS1 FACILITY and CHANNEL TEST SET

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INTRODUCTION

General Description

Tau-tron's Model 7500 T1/DS1 Facility and Channel Test Set is a portable, compact instrument for testing and analyzing T1/DS1 1.544 Mbps digital communication equipment and transmission facilities. It features Bridging, Termination, and Drop/Insert capabilities to provide T/R, T1/R1, and E/M circuits at VF and Signalling jacks for any channel. The unit supports D1D, D2, D3/D4, Extended Superframe (ESF), and unframed formats and has CSU loop and Automatic Protective Switching (APS) testing functions.

The 7500's Bit Error Rate Testing (BERT) functions include independent send and receive capabilities for one of six pseudorandom bit patterns, including the Bell Standard QRSS, Mark, and 1:3 patterns. The unit measures logic (pattern) errors, as well as bipolar violation, frame error, and Cyclic Redundancy Check (CRC) error rates. Logic, bipolar violation, and frame errors can be manually or automatically inserted.

Voice Frequency (VF) testing functions on the 7500 include selectable single-channel analysis in framed modes. Digital milliwatt or a VF input signal can be inserted on a selected output channel. Signalling bits can be controlled on the output channel. The level and frequency of a single output tone can be measured. The VF can be monitored from the VF output jack or the internal speaker. The signalling bits can be monitored for either a selected channel or for all channels.

The 7500 Test Set features a rechargeable self-contained gel/cel battery for true portability. The RS-232C interface can be used to print out alarm events and summary reports. A battery-backed-up Time and Date function provides event time-stamping. Five user-defined test configurations can be stored in the unit's memory for rapid setup during various test applications.

Scope of Publication

This manual guides you in the use of the 7500 T1/DS1 Facility and Channel Test Set. It was written to give you a better understanding of the operations you perform with your 7500.

This manual is divided into six sections: ***Getting Started***, ***Unit Description***, ***Operating Instructions***, ***Applications***, ***Maintenance***, and ***Specifications***. ***Getting Started*** and ***Unit Description*** explain unpacking and get you familiar with the 7500. ***Operating Instructions*** explains each of the unit's functions in detail. ***Applications*** offers some basic test setups and their uses. ***Maintenance*** and ***Specifications*** are for reference to help you care for the unit to get the longest work life possible.

We would appreciate your comments about any errors or omissions you discover in this manual. Using the feedback card in the back of this manual, please address all correspondence to:

Tau-tron Inc.
ATTN: Publications Manager
10 Lyberty Way
Westford, MA 01886

Section 1
GETTING STARTED

1.1 Unpacking and Inspection

Before unpacking the unit from the shipping container, carefully inspect the box for evidence of damage in transit. Open the container and carefully unpack the unit by removing its protective material and inspect it for damage. Check the unit to make sure all switches and controls are operating properly. For service assistance call the Tau-tron Customer Service Department, (617) 692-5100 or 1-800-TAU-TRON. See Repair Returns card in the back of this manual. If the shipping container was damaged, also contact the carrier and keep the shipping materials for their inspection.

1.2 Initial Setup

The 7500 Test Set may be used as a portable, battery-operated unit, or it may be powered from commercial power with the 115 Vac Power Adapter/Charger. It can also be powered with the Auto 12 Vdc Power Adapter.

The test set is equipped with rechargeable batteries that are cycled and charged prior to shipment. Storage and shipping may affect the batteries, so give them a full charge upon receipt. The batteries should always have a full charge (24 hours) before they are used to power the unit, before storing the unit for an extended period, or when leaving the unit in an environment below 0°C. Charge the batteries with the 115 Vac Power Adapter/Charger. Depending on the operating environment and test conditions, the unit operates approximately 5 hours continuously on fully charged batteries.

The unit can be operated continuously using the Adapter/Charger or the Auto 12 Vdc Power Adapter.

The test set has a non-volatile (battery-backed) clock and memory for keeping time and storing user-programmed test configurations. Refer to Section 3 for instructions on programming the time, date, and test setups. Turning the unit off does not erase these setups or the time and date. Storing the unit for more than four months, however, may affect the time and setup data.

The optional soft carrying case provides protection against shock and houses the power adapter, patch cords, and other accessories. In addition to the carrying case, use the carrying strap and attatched soft bag for portable field use.

WARNING

The following precautions must be observed when using the 7500 Test Set. Failure to follow these precautions could cause physical harm to the operator or the unit.

- ***Use only the power adapters specified for this product.***
- ***Use only a power adapter and cord that are in good condition.***
- ***The 115 Vac Power Adapter/Charger is designed to operate from a power source that does not apply more than 115 Vac between the supply conductors.***
- ***Do not operate the unit in a combustible atmosphere.***

Tau-tron assumes no liability for the customer's failure to comply with these requirements.

Section 2
UNIT DESCRIPTION

2.1 General Description

The 7500 tests and analyzes T1/DS1 digital communication equipment and transmission facilities. Various performance parameters of the T1 system under test can be monitored and various stimuli can be used to exercise the tested system. Test patterns, including pseudorandom patterns and non-random patterns such as tones, can be fed into the tested system. Input signals can be analyzed for pattern errors or tone level and frequency.

The unit can be bridged onto the test facility, or terminate the facility. The facility can also be passed through the unit in Drop/Insert mode, with the options of routing the input channel to a VF output jack or analyzing it internally. The channel can be passed through unmodified, or can be replaced with either a VF input or an internally generated signal.

An internal speaker/microphone can also monitor an input signal, or transmit speech to the output channel.

Signalling (A and B) bits on the tested facility can be monitored or simulated. The E/M jack allows the signal to be monitored and/or controlled by external equipment. The test set can also monitor and display the signalling status of the tested facility, and control the signalling bits on the selected channel of the output.

2.2 Front Panel Description

The front panel of the 7500 Test Set consists of the LCD display, membrane keypad, status indicators, and labels for the side access panel (Figure 2-1).

The three status indicators in the upper right corner of the front panel indicate the T1 facility status as follows:

DS1 AR —*Lights red* when a local alarm condition exists at the T1/DS1 IN jack. Includes loss of facility as well as frame loss in ESF or SF.

DS1 AY —*Lights yellow* when a remote alarm is detected at the T1/DS1 IN jack (Bit 2 suppressed on all channels for standard framing or yellow alarm pattern on data link for ESF).

BERT SYNC —*Lights green* when the 7500's receive pattern generator is synchronized to the input pattern (BERT modes).

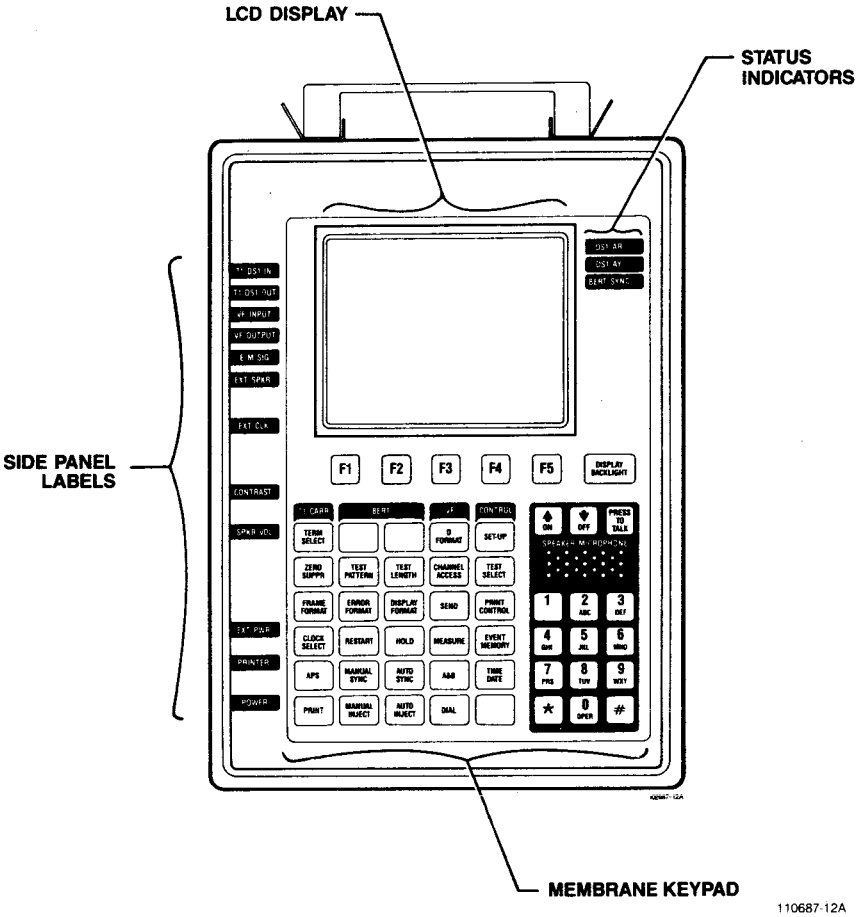

Figure 2-1. 7500 Front Panel layout

The LCD screen displays information about the test configuration of the unit and the tests being performed. The membrane keypad controls the unit during setup and testing. Switches and display information are described in detail in Section 3.

2.3 Side Panel Description

Figure 2-2 illustrates the left side of the 7500 Test Set, including the side access panel and its corresponding labels on the left side of the front panel.

The side access panel interface jacks consist of the following:

T1/DS1 IN — *T1 receiver input.* Provides 1000 Ohm termination in Bridge mode, 100 Ohms otherwise.

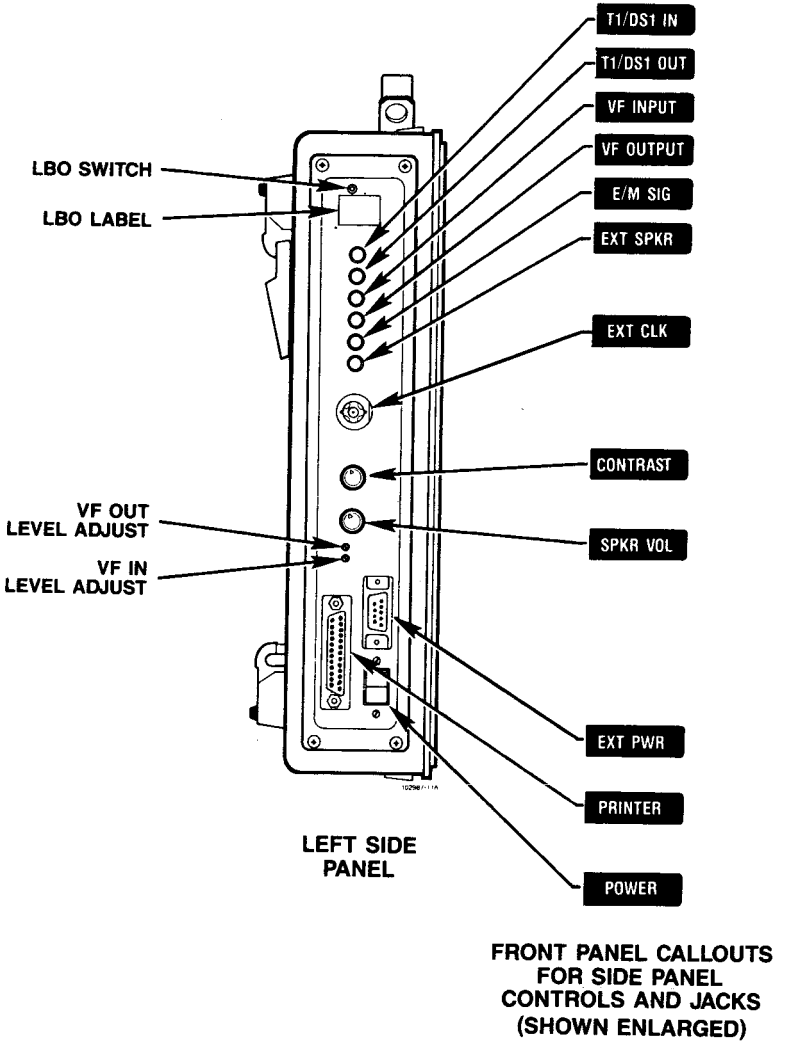

Figure 2-2. 7500 Side Panel layout

T1/DS1 OUT —*T1 transmitter output.*

VF INPUT —*600 Ohm VF input.*

VF OUTPUT —*600 Ohm VF output.*

E/M —*E and M signalling interface.* Tip is E lead output; relay contact closure to sleeve GND is active. Ring is M lead input; –48 Vdc is active, sleeve GND or open is idle.

The sleeve on the E/M jack is reference ground for the signalling leads.

EXT SPKR —*Auxiliary speaker output.* 8 Ohms, 100 mW maximum.

EXT CLK —*BNC connector.* 3000 Ohms, external 1.544 MHz clock input, TTL levels.

EXT POWER —*Input for power adapter/charger.* Use only approved adapters.

PRINTER —*RS-232C serial communications port for printer, terminal, or modem interface.* The signals used in this jack are shown in Table 2-1.

Table 2-1. Printer Interface Pinout

PIN	SIGNAL	DESCRIPTION
2	TXD	TX data from test set
3	RXD	RX data into test set
4	RTS	Request to send from test set
5	CTS	Clear to send to test set
7	GND	Signal Ground
8	CD	Carrier Detect to test set
20	DTR	Data Terminal Ready from test set

If CTS or CD are not provided by the external device, they should be tied to DTR (Pin 20).

Side panel controls and adjustments consist of the following:

LBO —T1/DS1 Output switch sets Line-Build-Out to maintain DSX-1 compatibility according to the following switch positions per line length:

switch up — 0 to 100 feet
switch center — 100 to 350 feet
switch down — 350 to 650 feet

Contrast —LCD screen control adjusts the viewing angle of the display.

SPKR Volume —*Speaker volume control.*

Power Switch —*On/Off switch for DC power.* Event memory, Test Configurations, and Real Time Clock are continuously powered regardless of switch position.

VF IN level adj. —*VF input level calibration adjustment.* See Section 5 for calibration procedures.

VF OUT level adj. —*VF output level calibration adjustment.* See Section 5 for calibration procedures.

Section 3
OPERATING INSTRUCTIONS

3.1 General Operating Principles

7500 Test Set operation is menu-driven. The LCD screen displays menu prompts, current configuration status, and information about detected events and measurements being made. Use the keypad to enter commands and configuration selections.

3.1.1 Primary Function Display

The primary function display presents configuration and measurement information about an indicated primary function. Figure 3-1 is an example of a Primary function display.

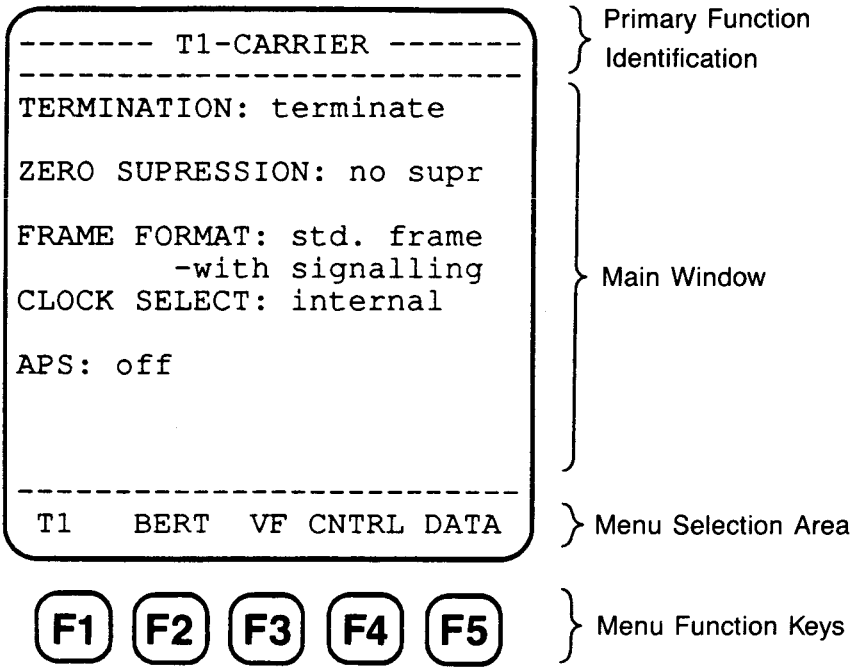

Figure 3-1. Example Primary Function display

The primary functions are indicated above the five columns of selection keys labeled T1 CARR, BERT, VF, and CONTROL. A fifth primary function, Data Acquisition, can be activated from any of the other primary functions. The Data Acquisition display presents general measurement information, without specific emphasis on any one primary function.

The bottom two lines of the primary function display are the menu selection area. The menu selections correspond to the function keys (F1, F2, etc.) and enable the operator to select one of the other primary functions.

3.1.2 Selection Function Display

Figure 3-2 shows an example of a selection function display, the T1 Termination display. For most selection functions, pressing a function key calls up a corresponding primary function display in the main window of the screen.

For some selection functions, there is more information than can be displayed in the main window. These functions have an alternate display to provide the additional information.

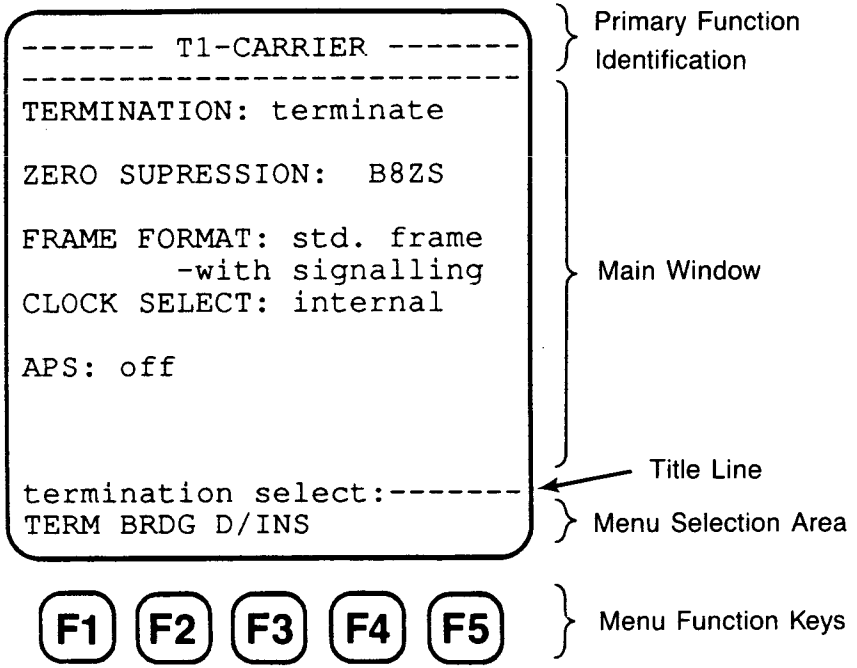

Figure 3-2. Example Selection Function display

The title line of the menu selection area indicates the active selection function, except in cases where both screen lines are needed for menu option labels.

3.1.3 Selection Function Keys

Figure 3-3 shows the selection function section of the front panel.

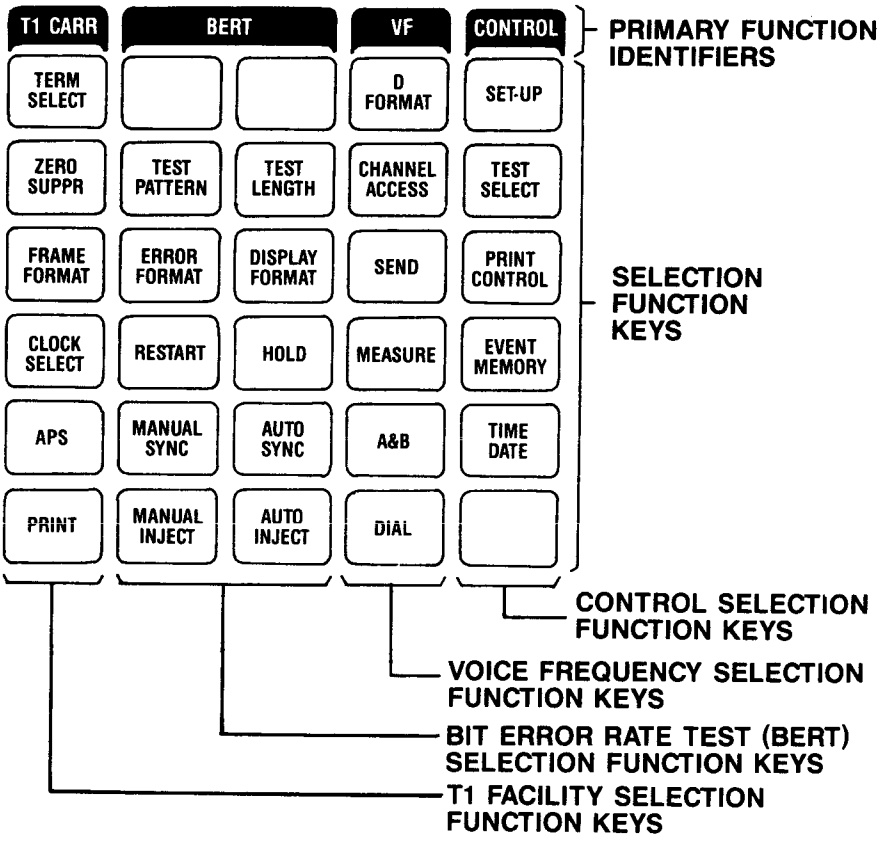

Figure 3-3. Selection Function keypad

The selection function keys are grouped into four labeled columns. If a selection function key is pressed while the same function is active (indicated in the title line of a selection display), the function is deactivated and the screen returns to the primary function display. This enables the user to exit any function without making a selection. Most selection functions can be exited directly by pressing another function key.

The selection function mechanism is designed to make it difficult to make mistakes that would destroy measurements in progress or impair performance of the facility under test. Most functions are accessible through a menu in each selection function, therefore from a primary function display it takes a minimum of two key presses to change a critical performance parameter. If a selection function is entered by mistake, the user can exit that function by pressing the same key again, or by pressing another selection function key.

3.1.4 Menu Function Keys

Five menu function keys (F1–F5) are located immediately below the LCD screen (Figures 3-1, 3-2). These keys choose menu selections or an alternate primary function display. Pressing a function key with no indicated menu selection has no effect. Only menu selection keys with valid menu selections work.

3.1.5 Auxiliary Keys

Figure 3-4 illustrates the Auxiliary Keys on the test set's front panel.

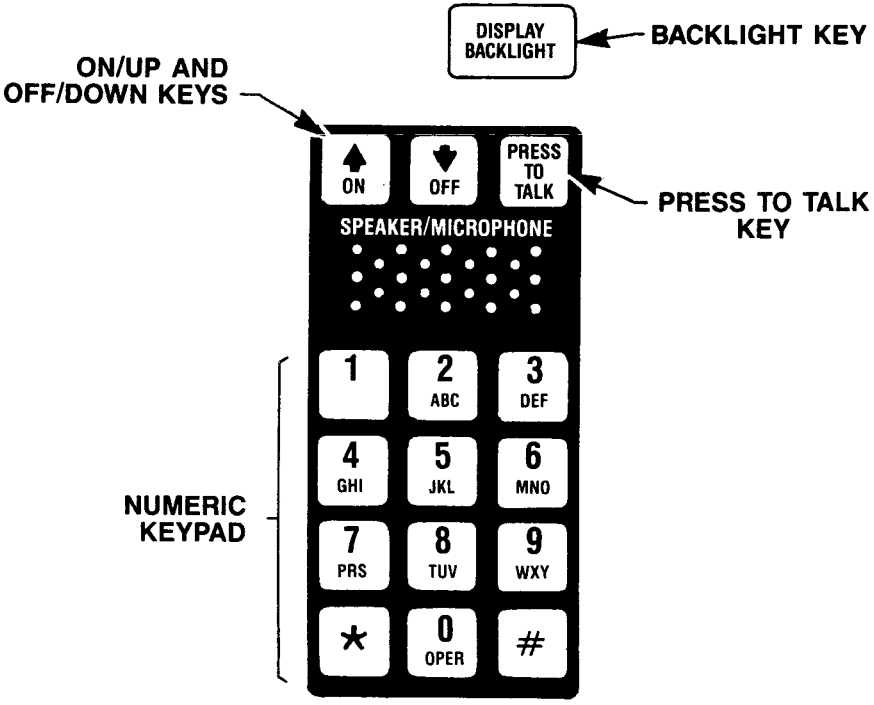

Figure 3-4. Auxiliary keys

The numeric keypad is used with the Dial Selection function. The Backlight key controls the Display Backlight. The Press-to-Talk key activates the microphone, turning off the speaker. This is a momentary key, and is only enabled when the unit is in single channel voice frequency mode with VF input selected from the Send selection function.

The ON↑ and OFF↓ keys are used in some selection functions and described in the specific selection function sections of this manual.

3.2 T1 Facility Selection Functions

Figure 3-5 shows the T1 Facility Primary Function display. This display contains the T1 Facility configuration information and the status of any APS testing. The controls are grouped in the T1 CARR column.

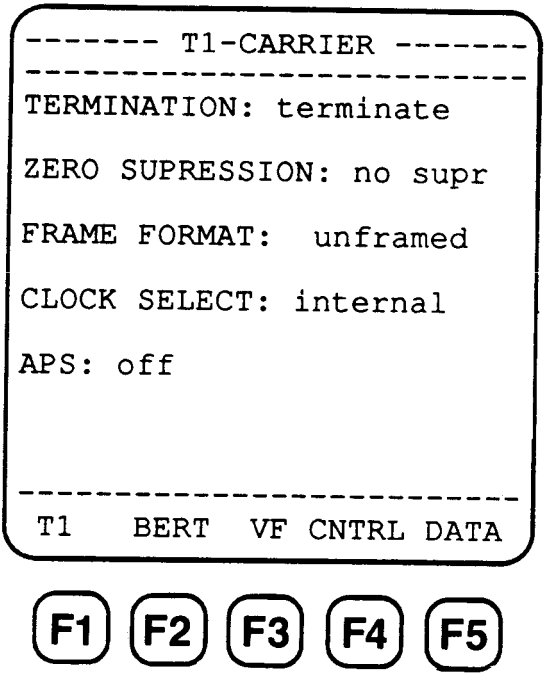

Figure 3-5. T1 Carrier primary display

3.2.1 TERM SELECT

Figure 3-6 illustrates the Termination selection function display.

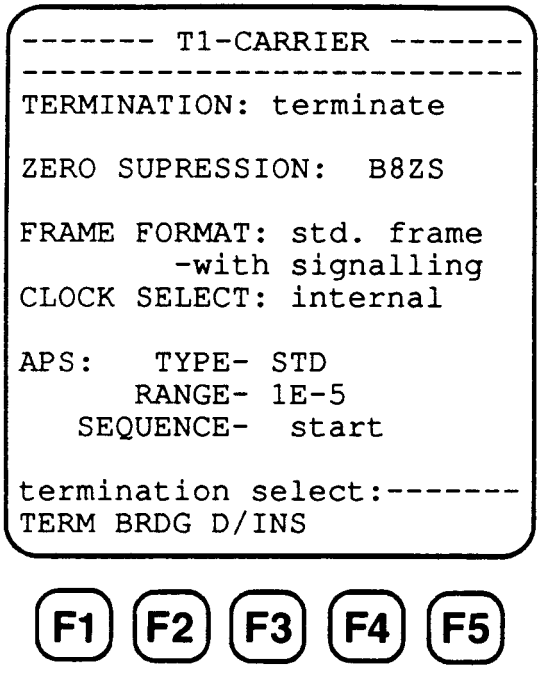

Figure 3-6. Termination selection display

This selection function configures the specific 7500 termination mode. To activate the function, press TERM SELECT. The Termination selection display appears on the screen. Next select the desired termination mode by pressing:

TERM (F1) — *Terminate mode*. This mode provides a 100 Ohm DS1 input for use at a DSX OUT jack and allows any of the clock input selections to be active. It does not force transmit T1 facility synchronization with the receive T1 facility. This mode can allow complete independence between the transmit and receive T1 facilities.

BRDG (F2) — *Bridge mode*. This mode bridges onto the T1/DS1 IN jack with impedance of 1000 Ohms, forces recovered clock selection, and forces transmit and receive T1 facility frame synchronization. This mode is virtually

identical to Drop/Insert mode (F3) except for the termination impedance. The mode can be used to make non-interactive T1 performance or status measurements, or to generate a "duplicate" of the tested T1 facility without disturbing the actual circuit.

D/INS (F3) — *Drop/Insert mode*. This mode terminates the T1/DS1 IN jack with impedance of 100 Ohms, forces recovered clock selection, and forces transmit and receive T1 facility frame synchronization. This mode can be used to repeat a T1 facility with the option of dropping a single channel for analysis or monitoring. The transmit side of the channel can remain unaltered or can be driven by a source selected under the Voice Frequency Send selection function. All other channels of the receive facility are passed on to the transmit facility unaltered.

3.2.2 ZERO SUPPR

Figure 3-7 illustrates the Zero Suppression selection function display.

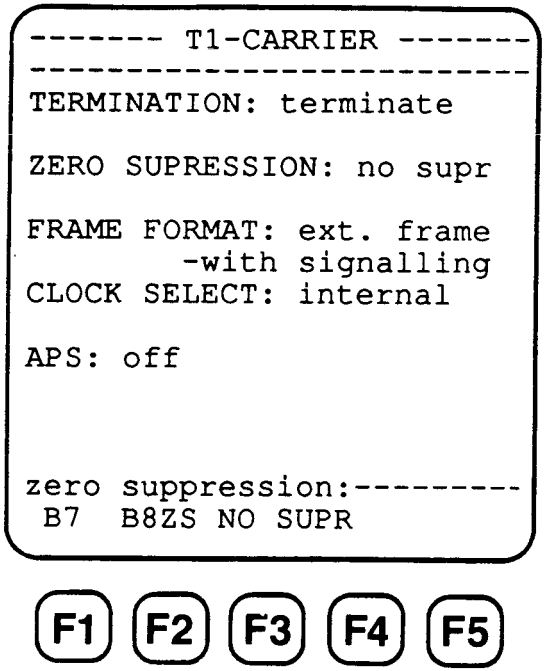

Figure 3-7. Zero-suppression selection display

The Zero Suppression selection function chooses a mode for control of zero density on the output T1 facility. Most T1 facility circuits require a minimum average of 1 pulse per 8-bit times to maintain input clock synchronization with the facility. Many of these facility circuits require successive zeros to be limited to 15.

To activate this function press ZERO SUPPR. The Zero Suppression function display appears on the screen. Next select the desired zero suppression mode by pressing:

B7 (F1) — *Bit 7 zero code suppression (B7).* This mode substitutes a binary one for Bit 7 in any T1 channel that would otherwise contain eight zero bits. Bit 7 is the next to least significant bit of the channel code. Bit 7 is used instead of Bit 8 to avoid potential interference with signalling bits.

Note: This mode is not available in unframed or ESF no-signalling modes. If one of these modes is selected, B7 zero suppression mode will not appear on the F-key menu and zero suppression defaults to no-suppression mode.

B8ZS (F2) — *Bipolar 8 Zero Suppression (B8ZS).* This mode substitutes a specific pattern of pulses and bipolar violations for any 8-bit interval containing only zeros. This pattern is recognizable by B8ZS receivers so that the inserted pulses can be removed later to restore the original data pattern.

The B8ZS pattern consists of pulses in bits 4, 5, 7, and 8 of the original 8 zero bits, with bipolar violations in bits 4 and 7. The dual violations result in one violation in a positive direction, and one in a negative so that no net line-charging effects result.

Since the B8ZS code is not matched to any particular channel alignments, it can be used in unframed or framed modes.

NO SUPPR (F3) — *No Suppression mode.* This mode makes no data substituion for zero suppression. The operator must ensure that minimum pulse densities are maintained.

Note: B8ZS suppression circuits can not be activated when the unit is in T1 Loop mode.

3.2.3 FRAME FORMAT

Figure 3-8 illustrates the Frame Format selection function display. This

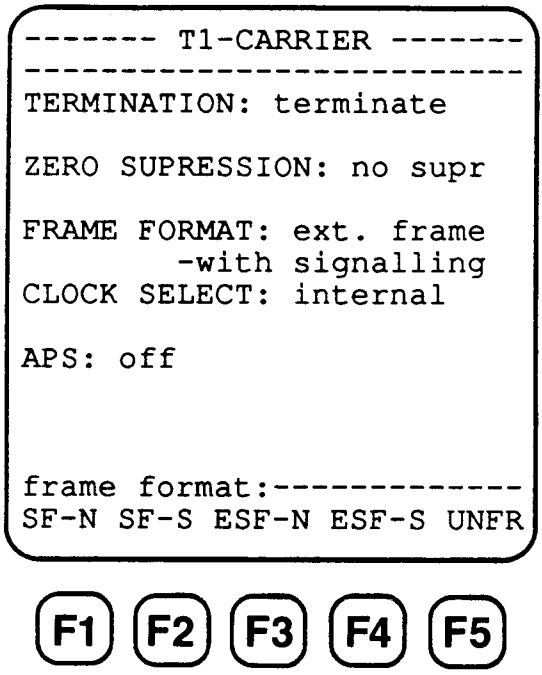

Figure 3-8. Frame Format selection display

function selects the T1 framing format. To activate it, press FRAME FORMAT. The appropriate display shows on the screen, similar to Figure 3-8. Select the desired frame format by pressing:

SF-N (F1) — *Super Frame, no signalling*. This is the standard T1 frame format, similar to AT&T's Pub 43801, except that no multiframe pattern is used and robbed-bit signalling is disabled.

SF-S (F2) — *Super Frame, with signalling*. This is the standard T1 frame format as described in AT&T Pub 43801, with robbed-bit signalling enabled.

ESF-N (F3) — *Extended Super Frame, no signalling*. This is the T1 extended superframe format as described in AT&T Compatibility Bulletin 142, with robbed-bit signalling disabled.

ESF–S (F4) — *Extended Super Frame, with signalling*. This is the extended superframe format as described in AT&T Compatibility Bulletin 142, with robbed-bit signalling.

UNFR (F5) — *Unframed Format*. This allows any 1.544 Mbps data stream meeting DS1 electrical and pulse density specifications to be used.

Note: The unit's display refers to normal super framing as "Standard" (Std.) Framing. "Std." framing is Super Framing.

3.2.4 CLOCK SELECT

Figure 3-9 illustrates the Clock selection function display.

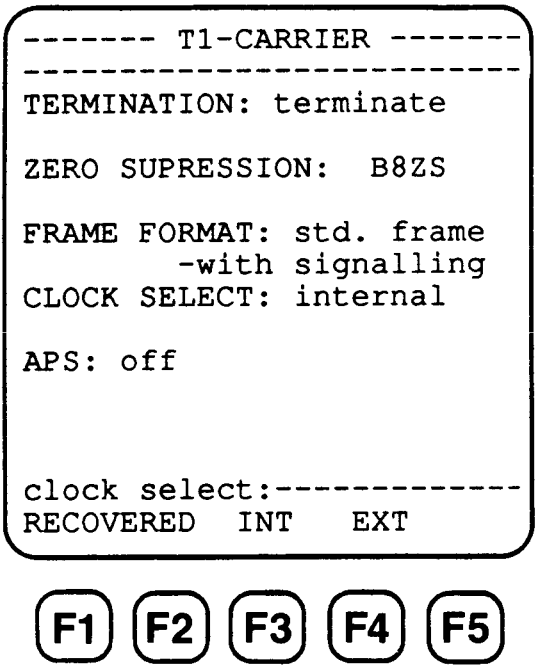

Figure 3-9. Clock Select function display

This function identifies the clock source for the T1 transmit facility. To activate the Clock selection function, press CLOCK SELECT. The Clock selection display appears on the screen. Select the desired transmit clock source by pressing:

RECOVERED (F1 or F2) — *Recovered Clock*. This mode uses clock recovered from the T1 input facility to time data onto the output facility. Note that the recovered clock will run free if the incoming facility pulses stop. It is used for Drop/Insert work as a loop-timed channel bank.

INT (F3) — *Internal Clock*. This mode uses an internal, precision 1.544 MHz clock to time data onto the output facility. This mode does not work in Bridge or Drop/Insert configurations.

EXT (F4) — *External Clock*. This mode uses a clock source input at the External Clock jack on the 7500's side panel to time data onto the output facility. This mode does not work in Bridge or Drop/Insert configurations. It is used for DACs.

Note: The recovered clock is always used to time data through the T1 receiver and analysis circuits.

3.2.5 APS

The Automatic Protection Switching (APS) selection function (Figure 3-10 shows display) generates specific bipolar violation (BPV) insert rates to exercise external APS equipment. To activate this function, press APS.

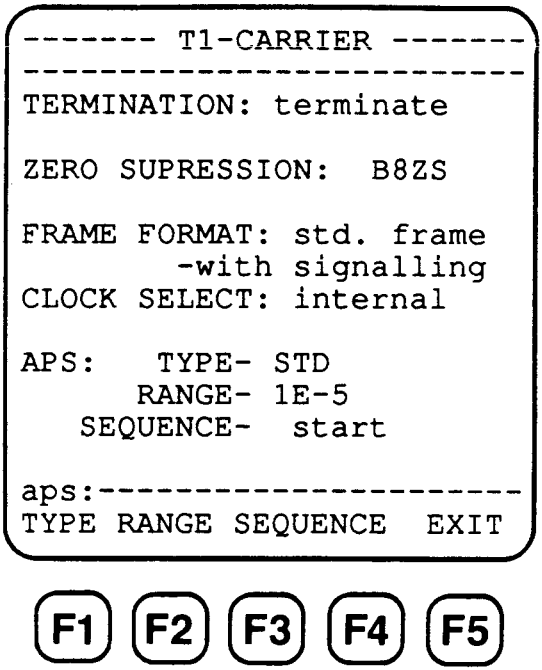

Figure 3-10. APS selection display

The APS selection display appears on the screen. To select APS parameter options, press:

TYPE (F1) — *Selects APS equipment type*. Each time this menu function key is pressed, the Type selection toggles between STD (Bell System hysteresis-type switching equipment) and 51A (Culbertson and similar non-hysteresis equipment). This selection changes BPV insertion characteristics, as shown in Tables 3-1 and 3-2.

Table 3-1

Automatic Protective Switching Bipolar Violation Rates

SEQUENCE	TYPE	RANGE				
		1E-3	1E-4	1E-5	1E-6	1E-7
Start	STD	0	0	0	0	0
No Transfer	STD	5.0E-4	5.0E-5	5.0E-6	3.2E-7	5.0E-8
Transfer	STD	2.0E-3	2.0E-4	2.0E-5	1.3E-6	2.0E-7
No Restore	STD	5.0E-4	5.0E-5	5.0E-6	3.2E-7	5.0E-8
Restore	STD	3.2E-5	3.2E-6	3.2E-7	2.0E-8	3.2E-9
Start	51A	N/A	0	0	0	0
No Transfer	51A	N/A	5.0E-5	5.0E-6	5.0E-7	5.0E-8
Transfer	51A	N/A	2.0E-4	2.0E-5	2.0E-6	2.0E-7
No Restore	51A	N/A	1.3E-4	1.3E-5	1.3E-6	1.3E-7
Restore	51A	N/A	5.0E-5	5.0E-6	5.0E-7	5.0E-8

RANGE (F2) — *Selects the range of BPV insertion for APS testing*. Pressing this key cycles the Range selection through 1E-3, 1E-4, 1E-5, 1E-6, and 1E-7. This selection switches groups of BPV insertion rates as shown in Tables 3-1 and 3-2.

SEQUENCE (F3) — *Selects the Sequence operation for APS testing*. Pressing this key cycles through ***start***, ***no transfer***, ***transfer***, ***no restore***, and ***restore***. This selection activates the BPV insertion rates for each APS testing sequence as shown in Tables 3-1 and 3-2.

Table 3-2

APS Bipolar Violation Rates as Approximate Powers of Ten

SEQUENCE	TYPE	RANGE				
		1E-3	1E-4	1E-5	1E-6	1E-7
Start	STD	0	0	0	0	0
No Transfer	STD	$10^{-3.3}$	$10^{-4.3}$	$10^{-5.3}$	$10^{-6.5}$	$10^{-7.3}$
Transfer	STD	$10^{-2.7}$	$10^{-3.7}$	$10^{-4.7}$	$10^{-5.9}$	$10^{-6.7}$
No Restore	STD	$10^{-3.3}$	$10^{-4.3}$	$10^{-5.3}$	$10^{-6.5}$	$10^{-7.3}$
Restore	STD	$10^{-4.5}$	$10^{-5.5}$	$10^{-6.5}$	$10^{-7.7}$	$10^{-8.5}$
Start	51A	N/A	0	0	0	0
No Transfer	51A	N/A	$10^{-4.3}$	$10^{-5.3}$	$10^{-6.3}$	$10^{-7.3}$
Transfer	51A	N/A	$10^{-3.7}$	$10^{-4.7}$	$10^{-5.7}$	$10^{-6.7}$
No Restore	51A	N/A	$10^{-3.9}$	$10^{-4.9}$	$10^{-5.9}$	$10^{-6.9}$
Restore	51A	N/A	$10^{-4.3}$	$10^{-5.3}$	$10^{-6.3}$	$10^{-7.3}$

APS testing is only enabled in the Terminate configuration. Activating APS functions turns off any other test functions. Exit the APS selection function with the Sequence parameter in the ***start*** setting.

3.2.6 PRINT

Pressing PRINT dumps a copy of the current screen to the RS-232C serial printer port. The printer characteristics are set using the Print Control Selection function (Section 3.5.3).

3.3 BERT Selection Functions

Figure 3-11 illustrates the Bit Error Rate Testing (BERT) primary function display showing the BERT configuration information. The main window of this display is used by most of the BERT selection functions, which are described in the following sections.

The BERT controls are grouped in a double column labeled "BERT" on the keypad.

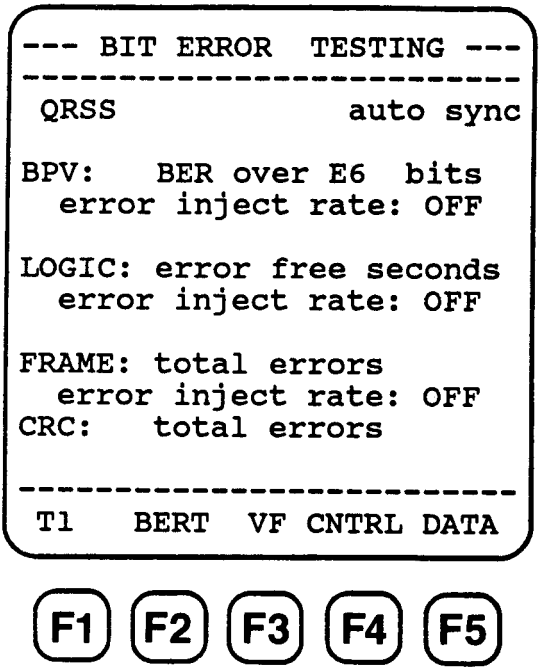

Figure 3-11. Bit Error Rate Testing primary display

3.3.1 TEST PATTERN

Figure 3-12 shows the Test Pattern selection function display. This function selects the BERT test pattern to be used to make logic measurements in the Data Acquisition function. To activate this function press TEST PATTERN. The Test Pattern selection function display shows on the screen. To select logic patterns press:

QRSS (F1) — *QRSS pattern*. This pattern is a 2E20–1 pattern modified to limit the number of consecutive zero bits to 14. The modification is performed by substituting ones for the leading zeros of any string of zeros until the number of zeros is 14 or less. The QRSS pattern is compatible with the Bell System's J98710R T1 Quasi-Random Signal Source (QRSS). A modified 2E20–1 pattern, the pattern's length is 1,048,575 bits.

2 ^ X–1 (F2) — *2EX–1 pattern*. X can be 6, 9, 11, 15, or 20. These patterns have lengths of 63, 511, 2,047, 32,767, and 1,048,575, respectively. Each 2EX–1 pattern has no more than X sequential ones or X–1 sequential zeros. The longer patterns produce longer sequences of

consecutive zeros, so the can be used to stress the clock recovery mechanisms in T1 facility systems.

Each time F2 is pressed, the 2EX-1 pattern selection cycles between the 63 (2E6-1), 511 (2E9-1), 2047 (2E11-1), 2E15-1 (32767), and 2E20-1 (1,048,575) bit patterns.

1:N (F3) — *1:3 pattern*. This pattern consists of a single binary one followed by three zeros, repeated. This is a non-random signal that can be used for error analysis.

1:7 (F4) — *1:7 pattern*. This pattern consists of a single binary one followed by seven zeros, repeated. This is a non-random signal that can be used for error analysis.

OFF (F5) — Disables test pattern usage.

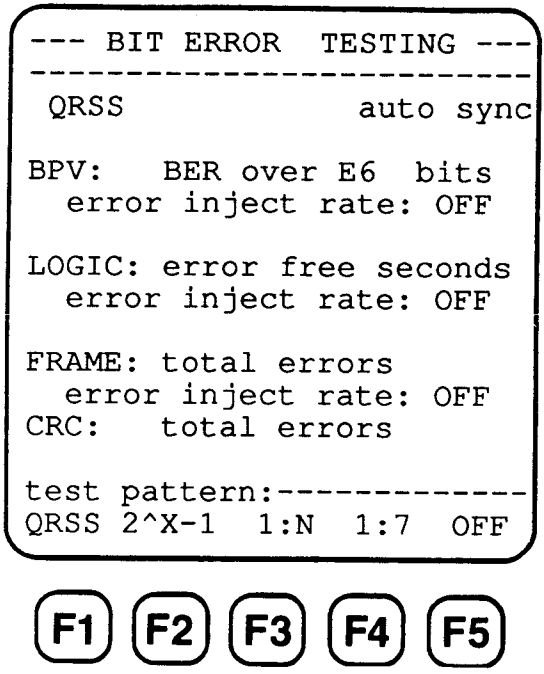

Figure 3-12. Test Pattern selection display

The selected test pattern is indicated in the upper left corner of both the BERT primary function display main window, and the Data Acquisition primary function display.

In framed modes, logic test pattern transmissions occupy all but the framing bits of the T1 facilities. In unframed modes, all bits of the T1 facility are occupied by the test pattern.

In Drop/Insert and Bridge modes, logic test pattern transmissions are disabled.

3.3.2 TEST LENGTH

Figure 3-13 shows the Test Length selection function display. This function selects the duration of the error rate test. To activate this function, press TEST LENGTH. The Test Length function display appears on the

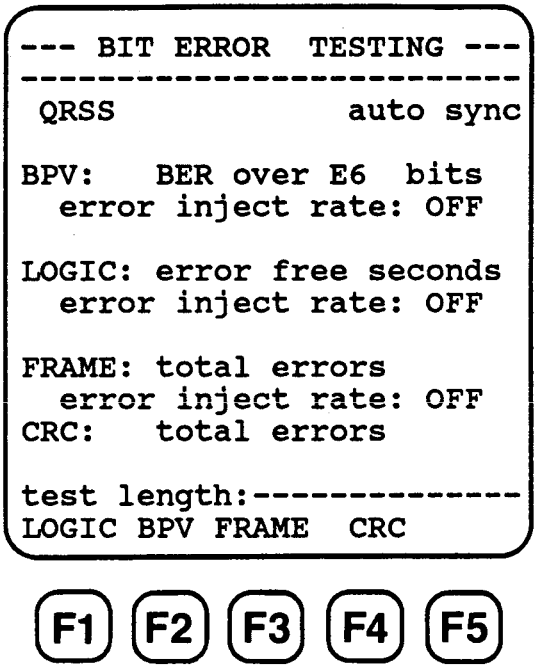

Figure 3-13. Test Length selection display

screen. Select the desired test lengths for the various measurements by pressing:

LOGIC (F1) — *Logic test length*. This menu key cycles the logic error measurement test length selection through E5, E6, E7, and E8 bits and Auto-ranging. In Auto-ranging, the test set automatically adjusts the test length to maintain one significant digit of precision in the Error Rate display.

The Logic test length selection is disabled if the unit is not in BERT mode.

BPV (F2) — *Bipolar Violation test length*. Pressing this key cycles the bipolar violation test length through E5, E6, E7, E8, and Auto-ranging.

FRAME (F3) — *Frame test length*. This key cycles through the frame error rates (FER) over 1K, 10K, and 100K frames or Auto-ranging. In standard framing modes, these bits occur every 250 microseconds. In ESF, these bits occur every 500 microseconds.

CRC (F4) — *Cyclic Redundancy Check test length*. Pressing this menu function key cycles through the CRC error rates over 100, 1K, 10K s-frms, and Auto-ranging. In ESF, these multiframes occur every 3 milliseconds.

The CRC test length selection is only enabled in ESF mode.

If a current error format does not match the error rate, selecting a test length for that particular error measurement changes the error format so it matches the error rate. The selected test length is always shown in the main window of the display as selections are made.

3.3.3 ERROR FORMAT

Figure 3-14 shows the Error Format selection function display.

This function selects the format for the display of error measurement information on the set's LCD screen (all forms of error formatting are maintained in the event memory for printout). To activate this function, press ERROR FORMAT. The Error Format selection function display appears on the screen. To select the error format for the various error measurements, press:

LOGIC (F1) — *Logic error format*. Pressing this key cycles through the logic measurement error formats of Total Errors (ERR), Errored Seconds (ERS), Error-Free Seconds (EFS), and Bit Error Rate (BER).

The Logic test length selection is disabled if the unit is not in a BERT test pattern mode.

BPV (F2) — *Bipolar Violation error format*. Pressing this key cycles the BPV measurement error format display through ERR, ERS, EFS, and BER.

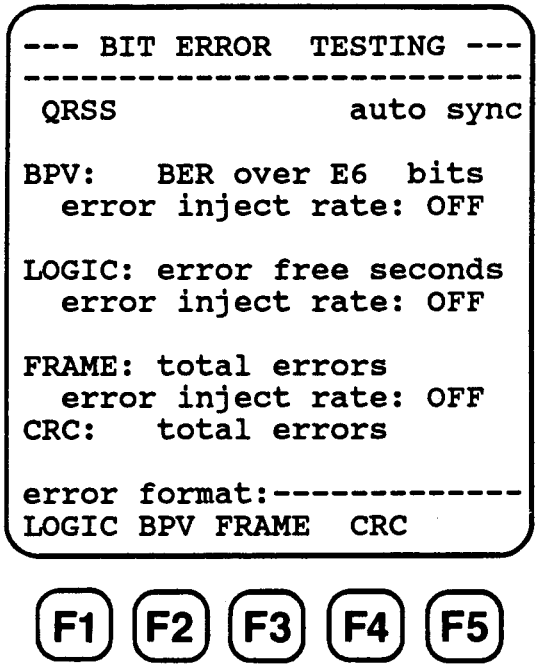

Figure 3-14. Error Format selection display

FRAME (F3) — *Frame error format*. Pressing this key cycles through the frame error measurement formats of ERR, ERS, EFS, and Frame Bit Error Rate (FER).

The Frame error format selection is disabled in unframed mode.

CRC (F4) — *Cyclic Redundancy Check error format*. Pressing this key cycles through the CRC error measurement formats of ERR, ERS, EFS, and CRC Error Rate (CER).

The CRC error format selection is only enabled in ESF mode.

The selected Error Format is shown in the display's main window.

3.3.4 DISPLAY FORMAT

The DISPLAY FORMAT is not used. Pressing it returns the unit to the BERT primary function display.

3.3.5 RESTART

Figure 3-15 shows the Restart selection function display. This function restarts error measurement.

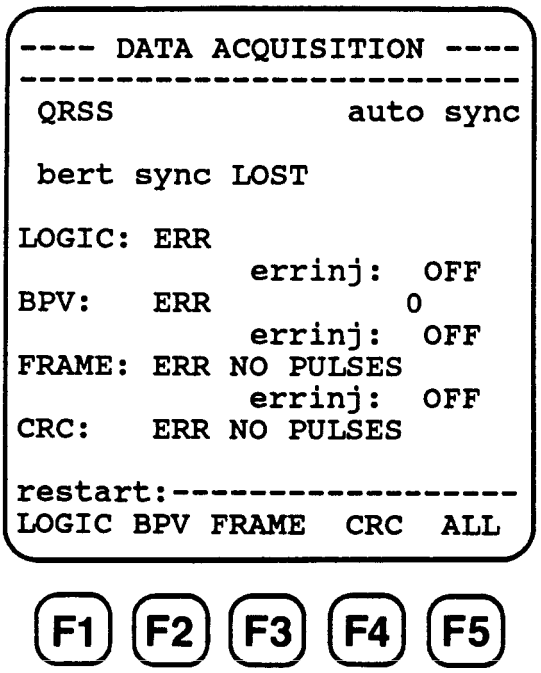

Figure 3-15. Restart selection display

To activate the Restart selection function, press RESTART. The Restart selection function display appears on the screen. Restart the measurement of selected errors by pressing:

LOGIC (F1) — *Logic error restart*. This menu function key restarts logic error measurement, clearing all logic error counters to zero. The time base for Errored Seconds is also restarted at zero.

The Logic error restart selection is disabled if the test set is not in a BERT test pattern mode.

BPV (F2) — *Bipolar Violation error restart*. This key restarts BPV error measurement, clearing all BPV counters to zero. The time base for Errored seconds and Error-Free Seconds is also restarted at zero.

FRAME (F3) — *Frame error restart*. This key restarts frame error measurement, clearing all frame error counters to zero and restarting the time base for Errored Seconds and Error-Free Seconds at zero.

The Frame error restart selection is disabled in unframed mode.

CRC (F4) — *Cyclic Redundancy Check error restart*. This key restarts CRC error measurement, clearing all CRC error counters to zero and restarting the Errored Seconds and Error-Free Seconds time bases at zero.

The CRC error restart selection is only enabled in ESF mode.

ALL (F5) — *All error measurements*. This key restarts all error counters at zero and restarts all time bases for Errored Seconds and Error-Free Seconds at zero.

3.3.6 HOLD

Figure 3-16 illustrates the Hold selection function display. This function momentarily freezes the selected error measurement display. This is useful

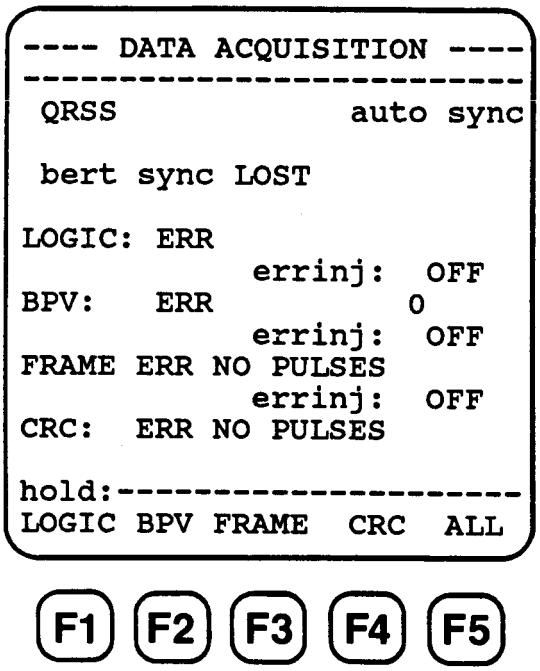

Figure 3-16. Hold selection display

for freezing a rapidly changing display to read its value at any time. The error measurement is frozen and labeled HOLD on the display. The actual measuring process is not stopped, only the display information from the point when HOLD was enabled. When the hold is released, the display will jump to the current measurement.

To activate the Hold selection function, press HOLD. To hold or release a specific measurement display, press:

LOGIC (F1) — *Logic hold*. Pressing this key toggles between hold and release of the Logic measurement display.

The Logic hold selection is disabled if the unit is not in a BERT pattern mode.

BPV (F2) — *Bipolar Violation hold*. Pressing this key toggles between hold and release of the Bipolar Violation measurement display.

FRAME (F3) — *Frame hold*. This key toggles between the hold and release of the Frame error measurement display.

CRC (F4) — *Cyclic Redundancy Check hold*. This key toggles between hold and release of the CRC error measurement display.

The CRC hold selection is only enabled in ESF mode.

ALL (F5) — *All hold*. This key toggles between hold and release for all error measurement displays.

3.3.7 MANUAL SYNC

This function puts the 7500 in Manual Logic (pattern) Synchronization mode. In Manual Sync mode, pattern receiver resynchronization to the input pattern will only begin when you press MANUAL SYNC.

To activate this function, press MANUAL SYNC. The words "manl sync" appear in the upper right of the Data Acquisition display, and the pattern receiver will begin resynchronization. This is an immediate function and does not invoke a selection function display.

The Manual Sync mode is useful when bursts of errors produce error rates greater than one in ten over 100,000 bit intervals. In Manual Sync mode, the 7500 bridges over the error bursts to obtain an accurate error count. However, if pattern synchronization is truly lost, resynchronization will not begin until the operator initiates it.

3.3.8 AUTO SYNC

This function puts the unit in Automatic Logic (pattern) Synchronization mode. In Auto Sync mode, resynchronization to the input pattern begins as soon as pattern sync loss is detected (10,000 or more bit errors in 100,000 bits).

To activate this function, press AUTO SYNC. The words "auto sync" appear in the upper right of the Data Acquisition primary function display. This is an immediate function and does not invoke a selection function display.

3.3.9 MANUAL INJECT

Figure 3-17 shows the Manual Error Inject selection function display. This

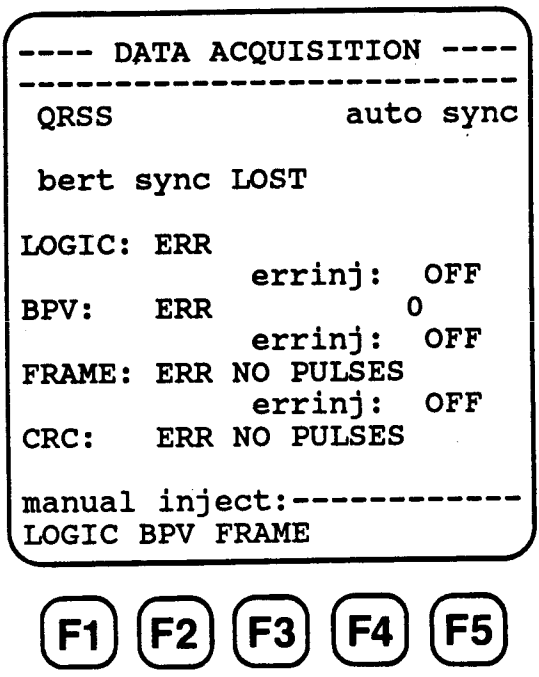

Figure 3-17. Manual Inject selection display

function forces single errors into the output T1 facility. To activate the function, press MANUAL INJECT. The Manual Inject display appears on the screen. To force single errors into the output T1 facility, press:

LOGIC (F1) — *Logic error insertion*. Each time this key is pressed, a single logic bit error is inserted in the output pattern.

The Logic Error insertion selection is disabled if the unit is not in a BERT test pattern mode.

BPV (F2) — *Bipolar Violation insertion*. Each press of this key inserts a single BPV into the output T1 facility.

The BPV is created by deleting a single bipolar pulse. Depending on the unit's configuration, the pulse deletion can also cause a logic, frame, and/or CRC error.

FRAME (F3) — *Frame error insertion*. Pressing this key inserts a single frame error into the output T1 facility.

The Frame error insertion selection is disabled in unframed mode.

3.3.10 AUTO INJECT

Figure 3-18 shows the Auto Error Inject selection function display.

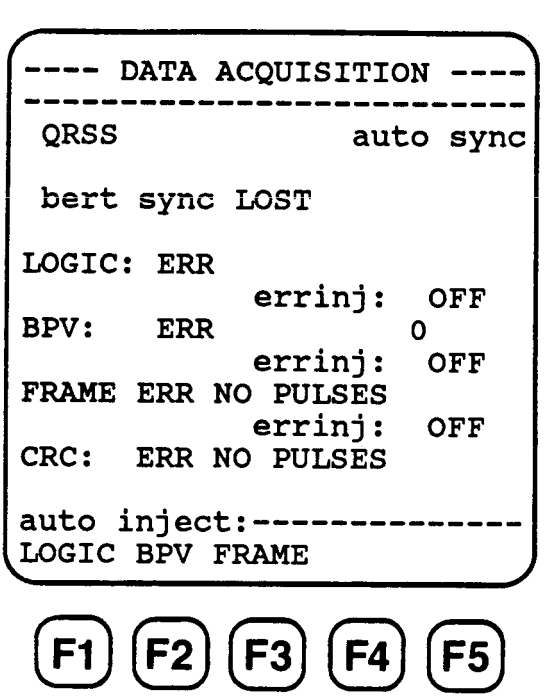

Figure 3-18. Automatic Inject selection display

The Auto Inject function automatically inserts controlled rates of selected errors into the output DS1 facility. To activate the function, press AUTO INJECT. The Auto Inject display appears on the screen. To select the automatic error insertion rate for a specific error type, press:

LOGIC (F1) — *Logic error inject*. This key cycles through the logic error injection rates of OFF, E3, E4, E5, E6, E7, and E8.

The logic error injection selection is disabled if the unit is not in a BERT test mode.

BPV (F2) — *Bipolar Violation error inject*. This key cycles through the BPV error injection rates of OFF, E3, E4, E5, E6, E7, and E8.

The BPV's are created by deleting a single bipolar pulse for each violation. Depending on the unit's configuration, pulse deletions may also cause logic, frame, and CRC errors.

FRAME (F3) — *Frame error inject*. This key cycles through the frame error injection rates of OFF, 1:100 (one error in 100 frame bits), 1:50, 1:10, 1:5, and 1:2.

The frame error inject selection is disabled in unframed mode.

Note: In Drop/Insert and Bridge modes, all automatic error insertion selections are disabled.

3.4 Voice Frequency Selection Functions

Figure 3-19 illustrates the Voice Frequency primary function display.

The display contains the Voice Frequency (VF) function configuration information. The main window of the display is used by the VF functions and is described under their specific headings.

Most of the VF functions are disabled if the unit is not in VF mode. The Channel Access selection function puts the unit into VF modes. The controls are grouped in the keypad column labeled "VF."

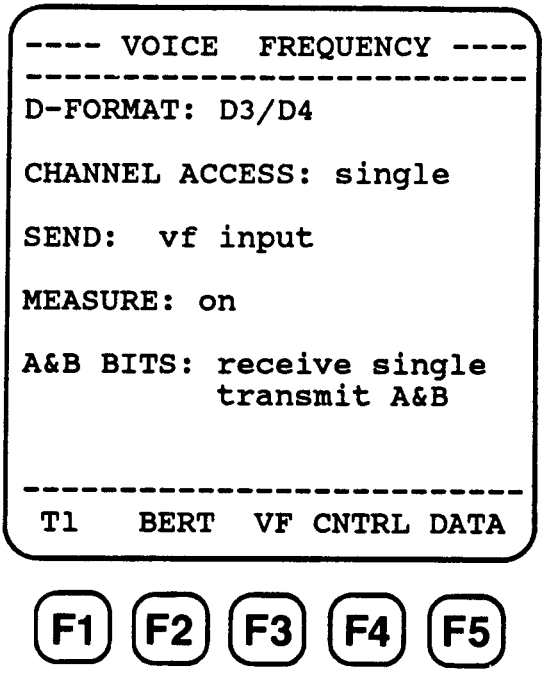

Figure 3-19. Voice Frequency primary display

3.4.1 D-FORMAT

Figure 3-20 illustrates the D-Format display.

This function selects the D-Format for VF functions. The D-Format determines the channel numbering of sequential channels on the DS1 facility, as shown in Table 3-3.

To activate the function, press D Format. The D-Format display appears on the screen. To select a D-Format, press:

F1 — D1D format.

F2 — D2 format.

F3 — D3/D4 format.

The D-Format selection function is disabled in unframed mode.

Table 3-3
D-Format Channel Numbering

SEQUENCE IN T1 CARRIER	CHANNEL NUMBER		
	D1D	D2	D3/D4
1st	1	12	1
2nd	13	13	2
3rd	2	1	3
4th	14	17	4
5th	3	5	5
6th	15	21	6
7th	4	9	7
8th	16	15	8
9th	5	3	9
10th	17	19	10
11th	6	7	11
12th	18	23	12
13th	7	11	13
14th	19	14	14
15th	8	2	15
16th	20	18	16
17th	9	6	17
18th	21	22	18
19th	10	10	19
20th	22	16	20
21st	11	4	21
22nd	23	20	22
23rd	12	8	23
24th	24	24	24

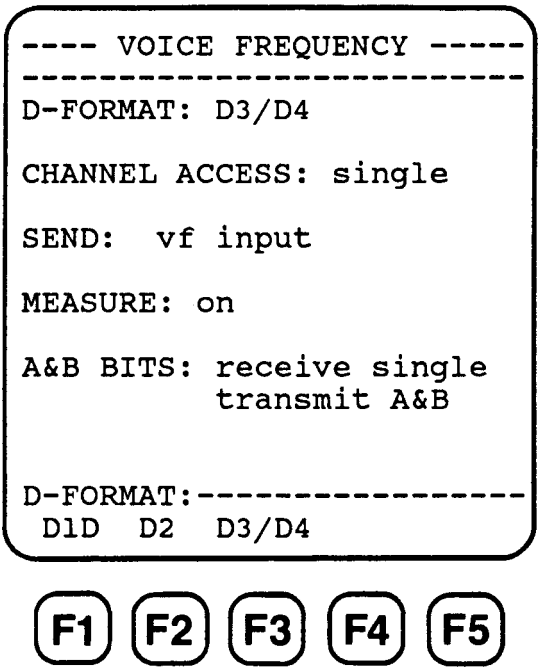

Figure 3-20. D-Format selection display

3.4.2 CHANNEL ACCESS

Figure 3-21 shows the Channel Access display.

This function selects the VF channel access method. Selecting any method other than OFF configures the unit in VF mode, disabling BERT logic functions.

To activate the function, press CHANNEL ACCESS in the VF column. The Channel Access display appears on the screen. To select the access method, press:

SNGL (F1) —*Single DS1 channel*. This mode selects a single DS1 channel for VF functions. Pressing F1 invokes the Channel Access secondary display, described below, to select the channel number.

SCAN (F2) —*Scan*. This mode repeatedly sequences through all DS1 channels, each channel selected for approximately 5 seconds at a time.

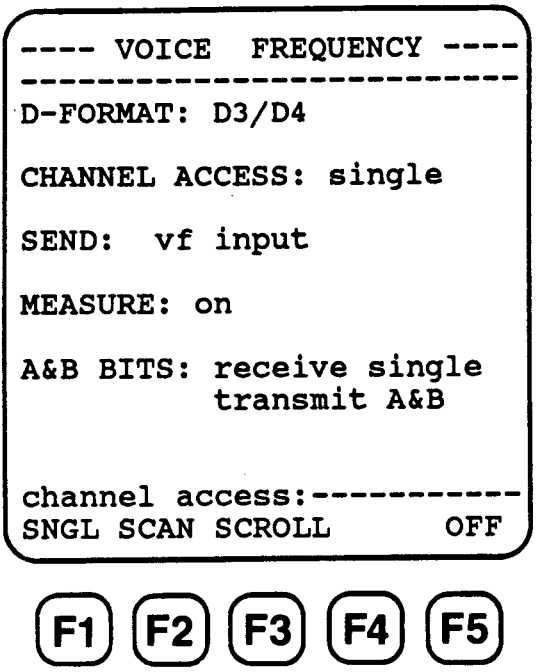

Figure 3-21. Channel Access selection display

SCROLL (F3) —*Scroll enable.* Pressing this key allows you to scroll through all of the DS1 channels while you are in the VF Data Acquisition display. Use the On↑ and Off↓ keys on the dial keypad to increment and decrement the selected channel number shown in the top line of the display.

OFF (F5) —*Off.* This key disables VF mode, turning off every VF function except D-Format.

VF channel selections are disabled in unframed mode. Any VF channel access selection turns off all active logic functions.

If the unit is in Drop/Insert mode, the Scan selection (F2) turns off any active Send and A&B signalling functions and disables them until Scan mode is deactivated.

Selecting the DS1 Single Channel Access mode (F1), invokes the secondary channel access display (see Figure 3-22). The current channel is indicated in the menu selection area. The selected channel number can be increased or decreased using the ON↑ or OFF↓ keys on the auxiliary keypad. When the desired channel number is displayed, enter that number by pressing F5.

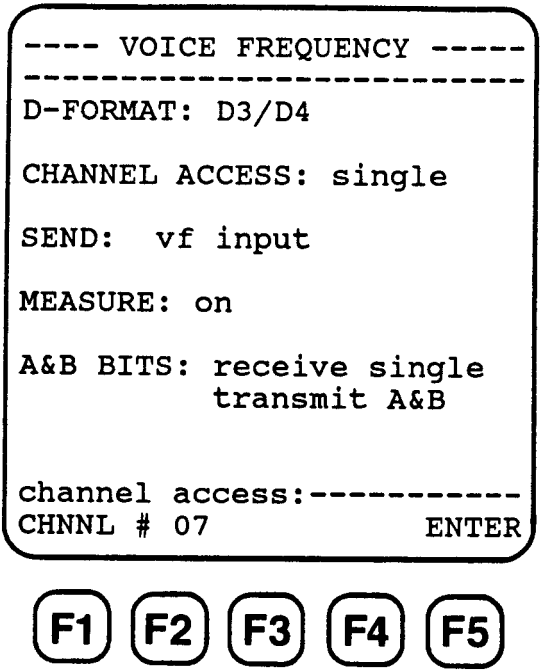

Figure 3-22. Channel Access secondary selection display

3.4.3 SEND

Figure 3-23 illustrates the Send display. This function selects specific information for transmission on the DS1 output facility. A&B signalling transmit functions will only work when Digital Milliwatt or VF Input (below) are selected. All Send functions are disabled in unframed mode.

To activate the Send selection function, press SEND. The Send display appears on the screen. To select the transmit source, press:

DS1 IDLE (F1)—*DS1 Idle*. This key forces idle codes (PCM code 01111111 binary) to be transmitted on all channels.

The DS1 idle selection is only enabled in Terminate mode.

The DS1 idle overrides any other send, including Alarm Yellow in standard framing modes.

DMW (F2)—*Digital Milliwatt*. This key selects the standard Digital Milliwatt for transmission on the selected channel.

Digital Milliwatt is only enabled in T1 single-channel access mode.

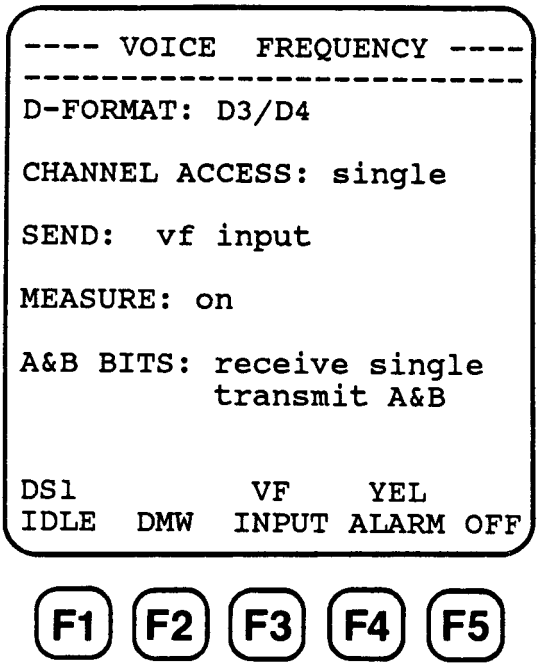

Figure 3-23. Send selection display

VF INPUT (F3) —*VF Input*. This key selects the VF input for transmission on the selected channel.

The VF Input selection is only enabled in T1 Single Channel access mode.

YEL ALARM (F4) —*Alarm Yellow*. This key toggles the selection of Alarm Yellow to the output facility. In standard framing modes, this consists of Bit-2 suppression, while in ESF it consists of 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 binary code in the data link.

OFF (F5) —*Off*. This key turns off any active Send functions.

3.4.4 MEASURE

This function enables the level and frequency measure function on a selected channel. Pressing MEASURE toggles the function on and off. The measured level and frequency can be viewed by selecting the Data Acquisition display with Measure on.

The measured level is displayed as UND if the input level is below −66.1 dBm0.

3.4.5 A&B

Figure 3-24 shows the A&B Signalling display. This function configures the A&B (C&D in ESF) Signal handling and is only enabled in framing modes with signalling.

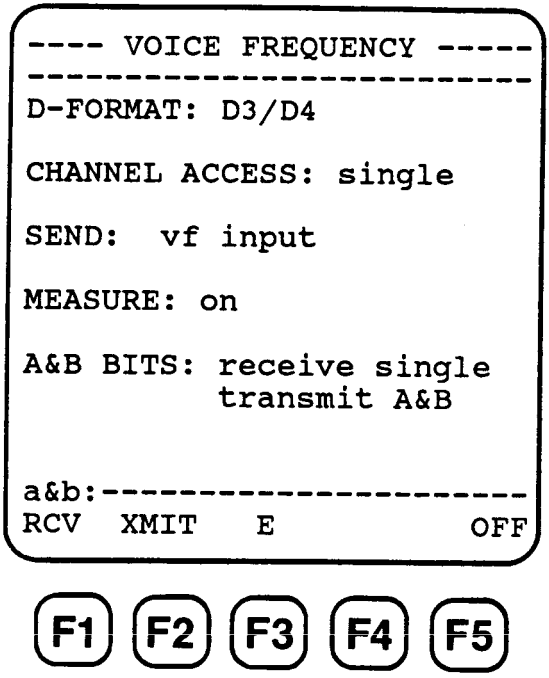

Figure 3-24. A&B Signalling selection display

To activate the function press A&B. The A&B Signalling display appears on the screen. To configure the signalling, press:

RCV (F1)—*A&B Receive toggle*. This key alternates the signalling receive mode between Receive Single and Receive All.

In Receive Single the signalling bits are displayed for the selected DS1 channel. In Receive All, the signalling bits can be displayed for all channels simultaneously.

The Receive All mode disables VF Send functions and all other signalling functions.

In Receive All, the input signalling bits can be viewed by selecting the Data Acquisition display (Figure 3-25).

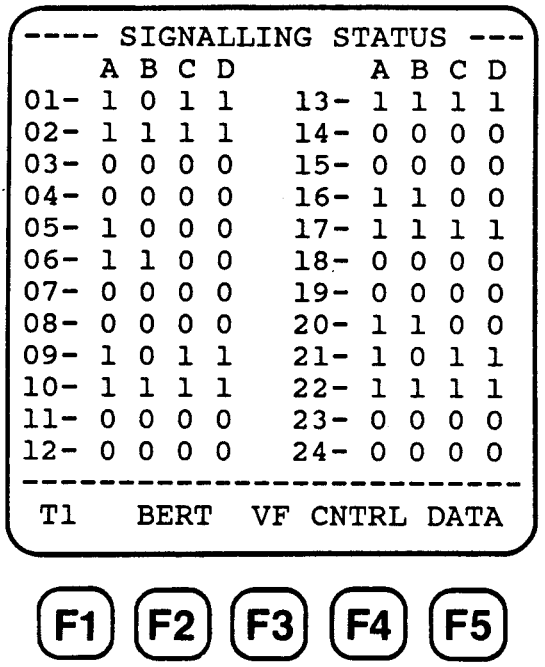

Figure 3-25. A&B—All Signalling status display

XMIT (F2)—*A&B Transmit toggle*. This key alternates the signalling transmit mode between Transmit A&B and Transmit M.

In Transmit A&B, the A and B signalling bits can be individually controlled from the Transmit A&B secondary display (Figure 3-26). In Transmit M, the A and B signalling bits are both controlled by the M lead of the E/M jack on the unit's side panel.

In ESF mode, the output C and D bits are copies of the output A and B bits, respectively, when Transmit A&B or Transmit M is enabled.

Transmit A&B mode is the default when a VF Send function is activated. Both Transmit modes are disabled if the unit is not in an active VF Input Send, or Digital Milliwatt Send mode.

When Transmit A&B is activated in Insert/Drop mode, the initial output A and B signalling will be preset to the last received A and B signalling of the selected channel. They can then be controlled by the operator.

In Terminate mode the output A and B (C and D for ESF) for all unselected channels is idle (0). In Drop/Insert and Bridge modes, the output signalling is passed through unchanged from the input facility for all unselected channels.

E (F3) —*E-enable toggle*. This key switches the E-lead on and off. When enabled, the E-lead of the side-panel E/M jack tracks the state of the input A signalling bit. When disabled, the E-lead is idle.

The E-lead should be disabled when it isn't being used to save battery power. E-lead disabled is the default state.

3.4.5.1 When Transmit A&B mode (F2) is selected, the Transmit A&B secondary display is invoked (Figure 3-26). To set the transmit A and B signalling bits, press:

A= (F1) —*A bit (C in ESF)*. This key toggles A (or C) transmit bits of a selected channel on and off.

B= (F2) —*B bit (D in ESF)*. This key toggles B (or D) transmit bits of a selected channel on and off.

EXIT (F5) —Exit Transmit A&B secondary Display.

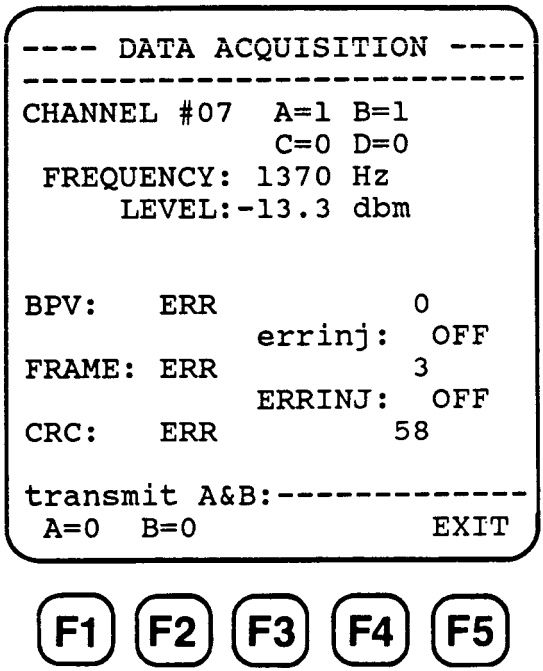

Figure 3-26. A&B Transmit secondary selection display

3.4.6 DIAL

Figure 3-27 shows the DIAL display. The DIAL function provides telephone dialing capabilities to the test set.

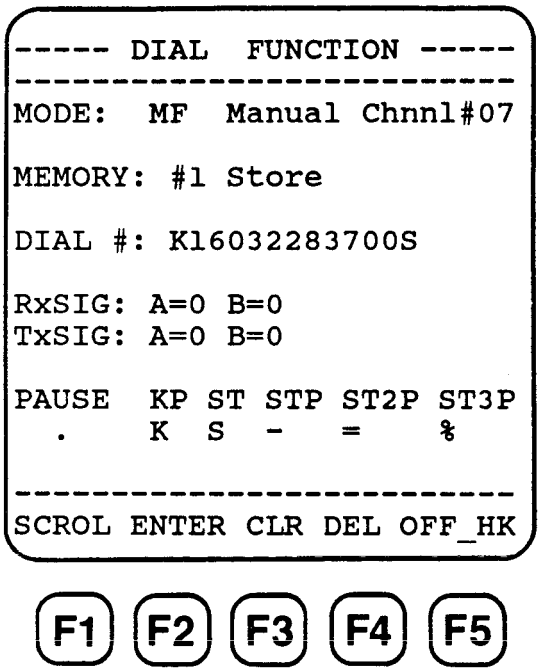

Figure 3-27. Dial function display

You must first select one of the 24 T1 timeslots for Terminate or Drop/Insert operation. Next select a type of signalling and a pulsing method. By manipulating the signalling bits, the trunk can be put into off-hook and on-hook states.

While the trunk is off-hook you can monitor the test set's built-in speaker for the dial tone, and use the telephone keypad to dial out. The Push-to-Talk microphone allows you to speak to the dialed end of the system. The DIAL function is enabled only when a channel has been selected in Terminate or Drop/Insert mode and after the Channel Access parameters have been configured (D3/D4, Single, etc). When you are in this configuration, press the DIAL key to edit dial-related parameters such as pulsing type, dialing mode, and channel number (if Scroll was selected in Channel Access function). In single channel access mode, the channel number in the DIAL display remains fixed.

Move the DIAL display's cursor by using the On↑ and Off↓ keys to highlight the parameter to be modified. To edit the parameter, use the function keys as follows:

SCROL (F1)—Cycles through all of the choices for the current parameter.

ENTER (F2)—Selects the indicated choice for the currrent parameter.

CLR (F3)—Clears the number to be dialed.

DEL (F4)—Deletes the last digit of the number to be dialed.

ON_HK/OFF_HK (F5)—Toggles the unit between the on- and off-hook states.

Display parameter indicators include:

RxSIG—This information line shows you the current receive A&B or A&B&C&D (ESF) bit status. This indicates that wink, delay dial, or answer supervision has been received from the far end of the system under test.

TxSIG—This area of the display shows current transmit A&B or A&B&C&D (ESF) bit status. This indicates the on-hook, off-hook, or pulsing condition of the transmitted signalling bits.

Note: You can get hard copy of all parameters using the screen dump function and a printer.

3.4.6.1 Dialing Methods

The DIAL function provides three types of dialing:

- **Manual**, or dribble dialing outpulses as the digits are pressed.
- **Auto** dialing mode automatically dials a number which has been previously entered into the dialing memory.
- **Repeat** dialing repetively transmits any number in dial memory.

Manual Dialing

In this mode, a digit key's pulse is sent for as long as you hold down the key. This allows you to send short or long tone pulsing. The digits are also held on the screen in case you want to store them to be sent later as a formatted dial sequence.

Auto Dial

This mode sends a previously entered pulsing sequence retreived from the dialing memory (see next section). The retreived sequence is dialed out according to the current pulsing type.

Enter special digits such as PAUSE, A, B, C, D (DTMF), and KP, ST, STP, ST2P, ST3P (MF) by pointing at them with the cursor and then pressing ENTER (F2). When the digits are all entered, point the cursor at AUTO SEND and the digits are pulsed out each time you press ENTER (F2). If the sequence contains digits which are not valid in the current pulsing type (example: KP if in DPAB),those digits are ignored.

This mode does not affect on-hook and off-hook states. Pressing Auto Send transmits the sequence once, and leaves the channel in the same hook state.

Repeat Send

In this mode, the unit dials the selected pulsing sequence as described in Auto Dial, but goes off-hook before starting transmission. After transmitting the sequence, the unit waits 5 seconds for call completion and then goes on-hook for 3.3 seconds before starting the whole procedure over again. If you want a longer pause, enter as many PAUSE digits as desired *preceding* the dialed number. Each PAUSE is one second. This continues until you interrupt the function.

3.4.6.2 Store and Recall

You can store or recall one of five numbers of up to 30 digits each.

To store a number, move the cursor to the MEMORY line and SCROL (F1) until STORE appears. Next move the cursor to the numeric label and SCROL to the desired memory location number. Press ENTER (F2) to execute the storage.

To recall a number, choose RECALL on the MEMORY line and indicate the desired memory location number as above. When you press ENTER, the recalled number is displayed on the screen and immediately dialed out if the unit is in Manual or Auto Dial mode.

3.4.6.3 Signalling Types

The DIAL function offers two standard types of signalling as well as user control of the signalling bits. In each of the standard signalling types, you have the ability to initiate on-hook and off-hook states.

E&M Signalling—The E&M signalling function provides on-hook and off-hook signalling compatibility with E&M-lead end-office signalling equipment.

Once E&M signalling has been selected, pressing Off-Hook (F5) sets both A and B signalling bit to a logic 1 state (in ESF C=A and D=B). Press On-Hook (F5) to set the bits to a logic 0 state.

SF Signalling—This mode is identical to E&M signalling except that instead of using the A–D bits to control supervision, a 2600 Hz tone conveys on- and off-hook information.

3.4.6.4 Pulsing Types

The 7500 DIAL function provides four types of digit outpulsing. When you have chosen a pulsing type, use the dial keypad to dial out. The 7500 displays the received signalling for the selected channel, but does not provide automatic delay-dial or wink-start methods for controlling the outpulsing. It is up to you to pause after seizing the line (off-hook) and wait any necessary delay for a particular circuit before starting to dial. The unit can be programmed for delay dial/wink applications by inserting PAUSE digits (1 second each) in front of the number to be dialed.

Dial Pulse/A&B (DPAB)—The Dial Pulse/A&B outpulsing method dials digits using repetitive on-hook and off-hook indications on the transmitted signalling bits. The pulsing rate is ten pulses per second with 60% break, and 600 milliseconds between digits.

Dial Pulse/SF (DPSF)—The Dial Pulse/SF outpulsing method lets digits be dialed using repetitive insertion and removal of a 2600-Hz tone on the selected channel. The pulsing speed is ten pulses per second with a 60% break and 600 milliseconds between digits.

With Single Frequency (SF) signalling, a steady 2600-Hz tone at −20 dBm0 indicates an idle channel. When going on-hook, a 2600-Hz at −8 dBm0 is transmitted for 100 milliseconds followed by the 2600-Hz tone at −20 dBm0 until the channel is seized.

When the off-hook state is initiated, the channel is seized and the 2600-Hz tone is replaced by the "quiet tone" (7F hexadecimal) on the channel (see Figure 3-28).

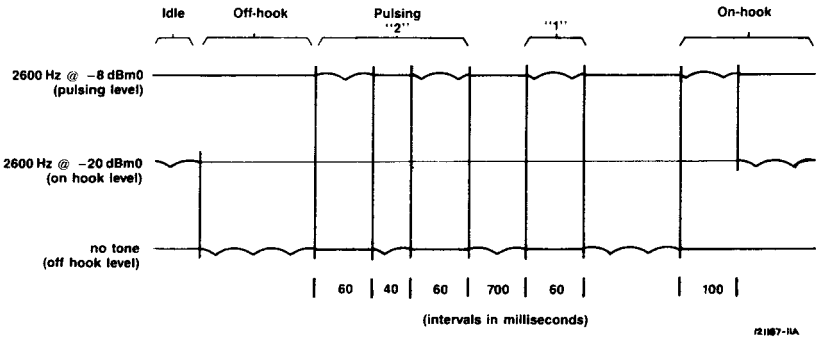

Figure 3-28. DPSF Pulsing

DTMF *(touch tone)*—The Dual Tone Multiple Frequency (DTMF) or touch-tone outpulsing method allows digits to be dialed by transmission of non-harmonically related pairs of frequencies. The pairs are assigned as shown in Table 3-4.

Table 3-4

DTMF Frequency Pairs

Low-Group Frequencies (Hz)	High-Group Frequencies (Hz)			
	1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

The frequency tolerance of each individual frequency is ± 1.5% at a tone level of −7 dBm0 ± 0.5 dB. The pulsing speed is ten pulses per second with digit and between-digit times of 50 ± 0.5 milliseconds. A 7 dB quiet tone is transmitted between each tone.

MF—The Multiple Frequency (MF) outpulsing method allows digits to be dialed by transmitting on the selected channel combinations of only two frequencies from a set of six. The six frequencies are

spaced 200 Hz apart in the voice band, and provide fifteen possible two-frequency combinations.

The tolerance of each generated frequency is ± 1.5% at a tone level of −7 dBm0 ± 0.5%. Digit and between-digit times are 70 milliseconds each (compatible with ESS equipment numbers 1,2,3, and 4). The frequency combinations and their uses are shown in Table 3-5.

Table 3-5

MF Frequency Combinations

FREQUENCIES in Hz	SIGNALS			
	Digit and Control	Expanded Inband	CCITT System 5	TSPS
700 + 900	1			
700 + 1100	2	Coin Collect		
700 + 1300	4			
700 + 1500	7			
700 + 1700		Ringback	Code 11	ST3P
900 + 1100	3			
900 + 1300	5			
900 + 1500	8	Operator Released		
900 + 1700			Code 12	STP
1100 + 1300	6			
1100 + 1500	9			
1100 + 1700	KP	Coin Return	KP1	
1300 + 1500	0	Operator Attached		
1300 + 1700			KP2	ST2P
1500 + 1700	ST	Coin Collect Operator Released		

3.5 Control Selection Functions

Figure 3-29 illustrates the Control display. The Control selection configures various common unit control functions, and initiates the self-test functions.

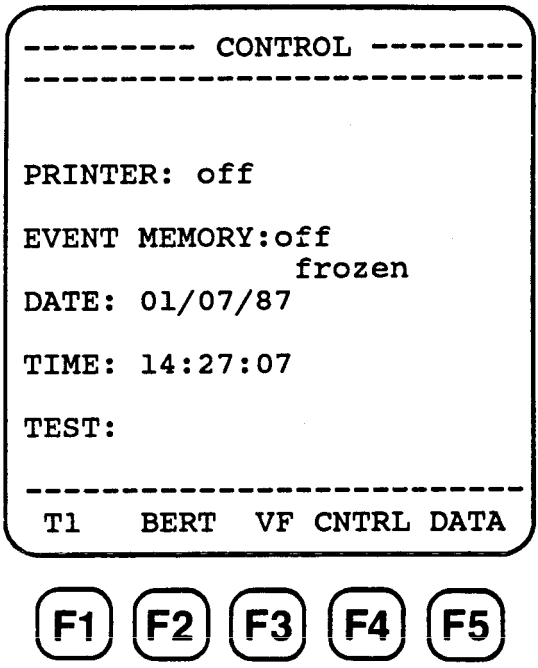

Figure 3-29. Control primary display

These controls are grouped in the CONTROL keypad column.

3.5.1 SET-UP

Figure 3-30 shows the Set-up selection function display. This function saves and recalls up to five unit configurations. It is useful for saving the most commonly used configurations for rapid retrieval later. The stored setups are maintained in battery-backed-up memory for at least four months between full chargings of the battery (see Section 5 for details on battery maintenance).

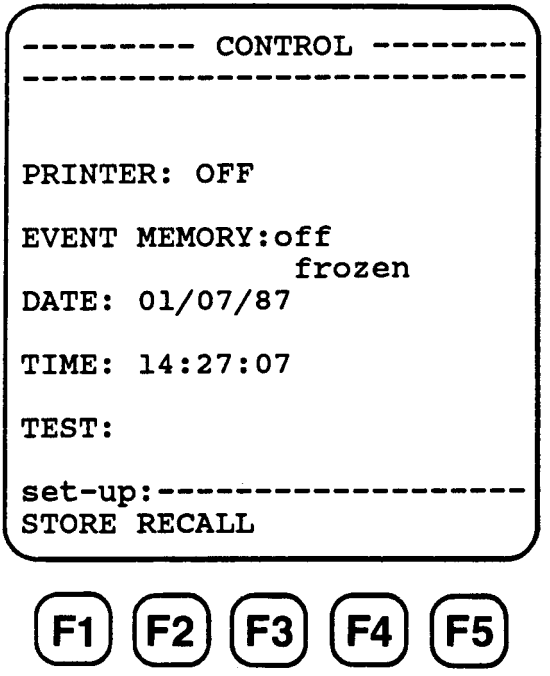

Figure 3-30. Set-up selection display

To activate the Set-up selection function, press SET-UP. The Set-up selection display appears on the screen. To select the set-up function, press:

STORE (F1) —*Store setup*. This key saves the current unit configuration in the setup memory.

RECALL (F2) —*Load setup*. This key configures the unit to a setup previously saved in memory.

If you press STORE (F1) you get a check-prompt on the screen (see Figure 3-31). Press YES (F4) to save the configuration, or NO (F5) to return to the Data Acquisition display. YES calls the set-up STORE menu (Figure 3-32).

If you press RECALL (F2), you get the set-up RECALL menu (see Figure 3-33).

To select a configuration for use in the set-up memory functions, press any one of the menu function keys. These keys correspond to the available preset configurations. In Store Set-up mode, the set-up is saved and the unit returns to the previous mode of operation. In Load Set-up, the unit is automatically reconfigured according to the set-up selected from memory.

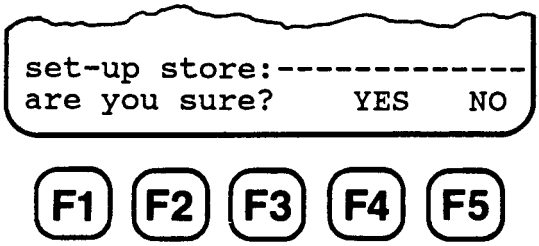

Figure 3-31. Set-up Store secondary selection display

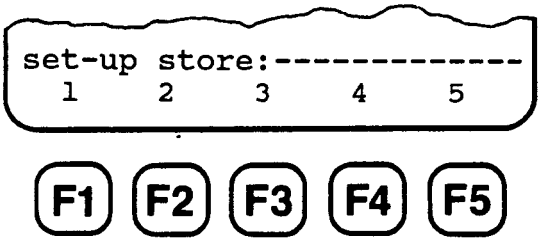

Figure 3-32. Set-up Store tertiary selection display

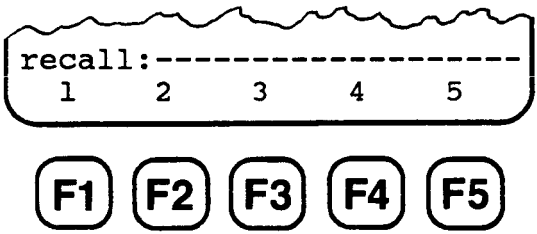

Figure 3-33. Set-up Recall secondary selection display

3.5.2 TEST SELECT

Figure 3-34 shows the Test selection display. This selection function configures the test set to one of four possible test modes. To activate the function, press TEST SELECT. The Test selection function display appears on the screen. To select the type of test, press:

T1 LOOP (F1) — *T1 Loop*. This key toggles the 7500 between normal and T1 Loop mode. In T1 Loop mode, the input facility is repeated onto the output facility and the T1 input is taken from the unit's T1 output. This loop

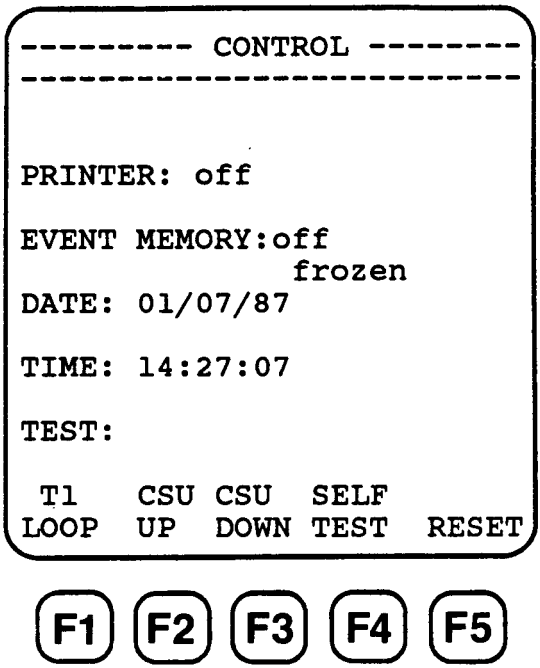

Figure 3-34. Test selection display

mode can be used for unit self verification, as well as for specific tests (Section 4).

While in this mode, "T1-LOOP" is shown in the TEST line of the Control primary function display.

CSU UP (F2) — *CSU-Up testing*. This key activates a 5-second transmission of the CSU-Up code sequence. The code consists of the bit sequence 1 0 0 0 0 repeated, and causes a CSU at the far end of the output facility to go into loopback mode.

CSU DOWN (F3) — *CSU-Down testing*. This key activates the 5-second transmission of the CSU-Down code sequence. The code consists of the bit sequence 1 0 0 repeated, and causes a CSU at the far end of the output facility to return to normal from loopback mode.

The CSU Loop codes do not interfere with framing.

SELF TEST (F4) — *Self Tests*. This key invokes the Self Test secondary display (Figure 3-35) to allow activation of the internal self tests.

RESET (F5) — *Software Reset*. This key restarts the 7500 software, as if the power had been turned off and back on.

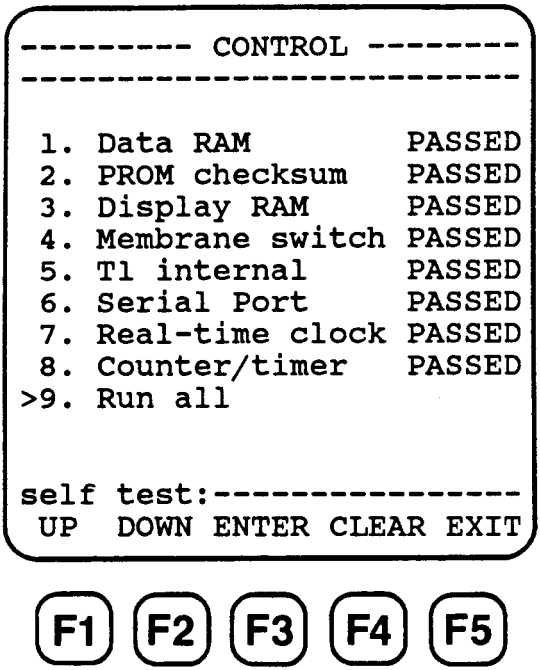

Figure 3-35. Self Test secondary selection display

3.5.2.1 When the Self Test selection is activated (F4), the Self Test secondary display appears on the screen.

To select a self test to run, use F1 and F2 to move the selector arrow on the left of the screen to the desired test. Press F3 (ENTER menu selection) to activate the test. The test results (PASSED/FAILED) are displayed to the right of the test name on the screen. To erase previous test results, press F4 (CLEAR menu selection). Press F5 to exit.

3.5.3 PRINT CONTROL

Figure 3-36 illustrates the Print Control selection function display. This function configures the unit for specific printer characteristics and turns printer output on and off.

To activate the function, press PRINT CONTROL. The Print Control selection display appears on the screen. To configure the printer characteristics, press:

ON/OFF (F1) — This key toggles the printer output on and off. When the printer output is off, alarms and statistics are held in the Event Memory until the printer is turned on or

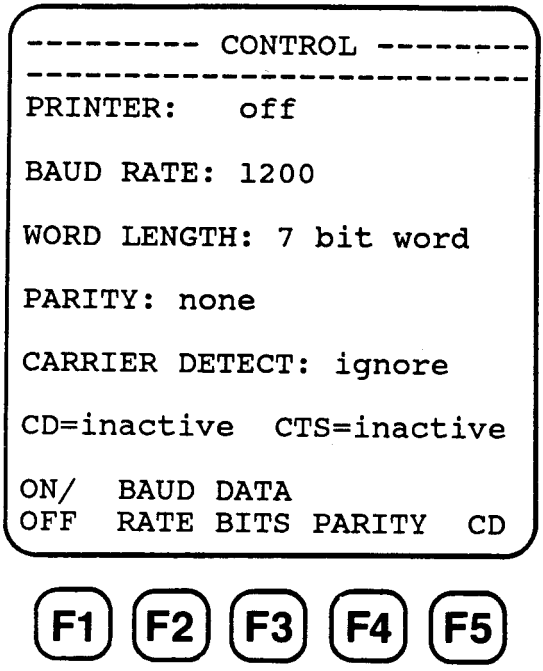

Figure 3-36. Print Control selection display

the Event Memory overflows. When the printer output is on, alarms and statistics are sent from the Event Memory to the RS-232C interface to be printed. As new events occur, they are sent to the printer in sequence.

BAUD RATE (F2) — *Baud Rate selection*. This key cycles through the baud rate selections for the RS-232C interface of 300, 600, 1200, and 2400 baud.

DATA BITS (F3) — *Data Bits per character selection*. This key toggles word length between 7-Bit Words and 8-Bit Words. Length does not include parity bits.

PARITY (F4) — *Parity selection*. This key chooses the parity options of odd, even, or none. The selected parity controls the outgoing serial data format.

CD (F5) — *Carrier Detect*. This key toggles between carrier detect monitor, and carrier detect ignore.

3.5.4 EVENT MEMORY

Figure 3-37 shows the Event Memory selection function display. The Event Memory function configures the statistics collection rate and clears the

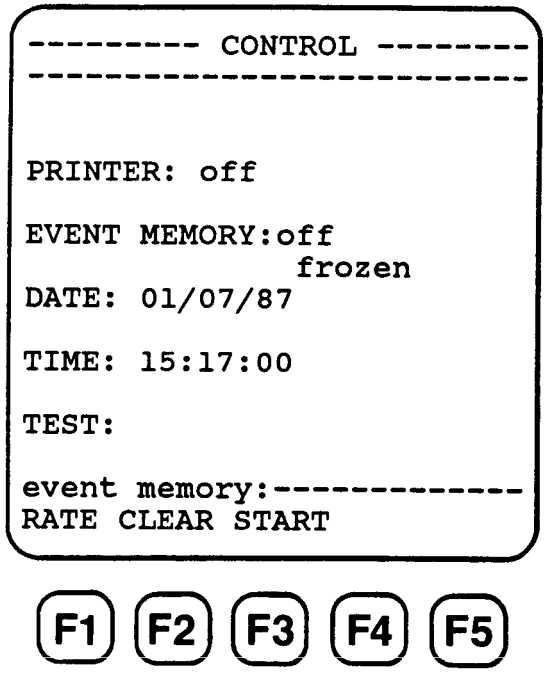

Figure 3-37. Event Memory selection display

event memory. To activate this function press EVENT MEMORY. The Event Memory selection function display appears on the screen. The menu selections are:

RATE (F1) — *Update Rate selection*. This key cycles through the statistics collection rates of Off, 1, 5, 15, 30, and 45 minutes; 1, 6, 12, and 24 hour reports. This function determines how often accumulated error statistics are dumped to the event memory for storage or printing. Alarm reports are recorded in event memory as they occur, and are not affected by this function.

When statistics are dumped to memory, the error counters are cleared and new statistics begun. This function includes error measurements displayed on the LCD screen.

CLEAR (F2) —*Clear event memory*. This key clears the event memory of any saved alarms or statistics reports. This is useful for initializing the event memory for a new test if the previously stored information is not needed.

START or **STOP (F3)** —*Start/Stop event memory*. This key alternately starts and stops the event memory logging system. This can be used to freeze the event memory when stored information is needed for later retrieval.

The 7500's event memory can save test results until a printer is available. The test results are maintained in memory even if the unit is turned off. To print the data, connect the unit to a printer and turn it back on. Configure the unit for the printer and then print the stored test information.

The time and date are recorded and printed along with each alarm and statistic report.

The statistics recorded in the event memory depend on the unit's configuration. When Logic testing or BPV measurement is active, the recorded statistics are:

- Bit Error Rate
- Total Errors
- Errored Seconds
- Error-free Seconds

In framed modes, the recorded statistics are:

- Frame Error Rate
- Total Errors
- Errored Seconds
- Error-free seconds

They are recorded as frame error measurements.

In ESF modes, the following are recorded as CEC error measurements:

- CRC Error Rate
- Total Errors
- Errored Seconds
- Error-free Seconds

The number of alarm reports that can be recorded in event memory depends on the number of alarms encountered, the selected event memory update rate, and the unit's configuration which determines the number of recorded statistics per update. As an example, in standard framing mode

with logic analysis selected and no alarms, the event memory can hold about 8 statistics reports. With statistics collection turned off, the event memory can hold about 40 alarm measurements.

If an event memory overflow occurs, the newest information replaces the oldest information so that the most recent reports are always available.

3.5.5 TIME/DATE

Figure 3-38 shows the Time and Date selection function display. This function sets the time and date in the Real-Time Clock. This function is useful for adjusting clock drift, or to reset the clock after long periods of storage. To activate this function, press TIME/DATE. The Time and Date selection function display will appear on the screen.

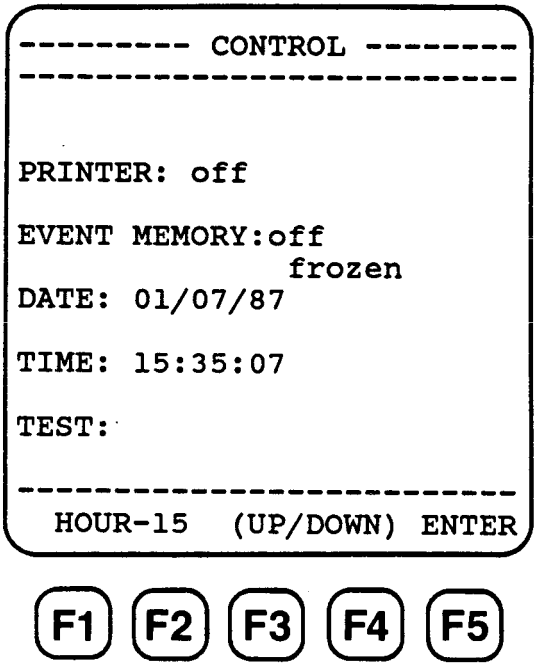

Figure 3-38. Time/Date selection display

The Time and Date function cycles through the Hour, Minute, Second, Month, Day, and Year. Each item is preset to a "current" value which may be adjusted for accuracy using the ON↑ and OFF↓ keys. Enter the selected value by pressing F5. The next value of the sequence is then presented until all of the Time and Date parameters have been set. The unit then returns to the Control primary function display.

3.6 Data Acquisition Primary Display

The Data Acquisition display shows measured information on the LCD screen. There are two basic forms of this display. One form for when the unit is in BERT mode, the other when the unit is in VF mode.

3.6.1 BERT Mode

Figure 3-39 shows the BERT mode Data Acquisition display. This display provides information about measured BERT mode parameters. The pattern and sync mode in use are displayed below the Data Acquisition identifier at the top of the main window.

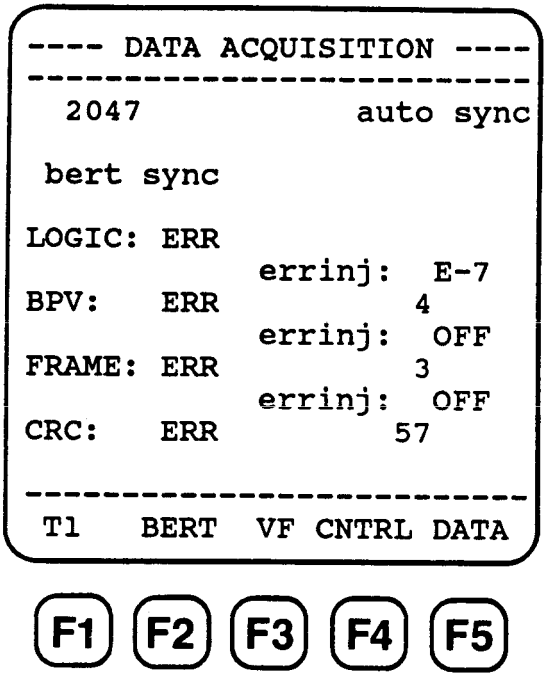

Figure 3-39. BERT Mode data acquisition display

The next line on the screen indicates the BERT pattern synchronization status. If synchronization is lost, this line indicates "bert sync LOSS." This indicator remains until sync restart is initiated so that momentary sync losses are captured.

Current sync status can always be verified by checking the BERT SYNC indicator to the right of the LCD screen. The light is on if synchronization is present, and off if the BERT pattern is out of sync or no BERT pattern is selected.

The rest of the BERT Data Acquisition main window displays the following error performances being measured:

- ERR for total errors
- ERS for errored seconds
- EFS for error-free seconds
- BER for bit error rate
  (bits in error over total bits)
- FER for frame error rate
  (frame bits in error over total frame bits)
- CER for CRC error rate
  (CRC errors over total number of superframes)

Following the error format identifier, the current measurement value is displayed.

The error format can be changed using the Error Format function without affecting the accumulated error statistics. You can switch from Total Errors to Bit Error Rate to check the error rate, and then switch back without disturbing the accumulated error count. Only a restart command or terminating an error measurement restarts the appropriate counters to zero. The Hold selection function may be used to temporarily freeze a measurement display, but actual error counts will still be accumulated. When the Hold is released, the display jumps to the updated error count totals.

Below each error measurement, the current error injection status is displayed for that error type.

3.6.2 Voice Frequency Mode

Figure 3-40 illustrates the Voice Frequency Data Acquisition display. This display provides a combination of VF and error measurement information. The BPV, FRAME, and CRC displays are retained from the BERT Data Acquisition display, but the Logic and Sync displays are replaced by the number of the selected channel, and received signalling or level and frequency measurement information as appropriate.

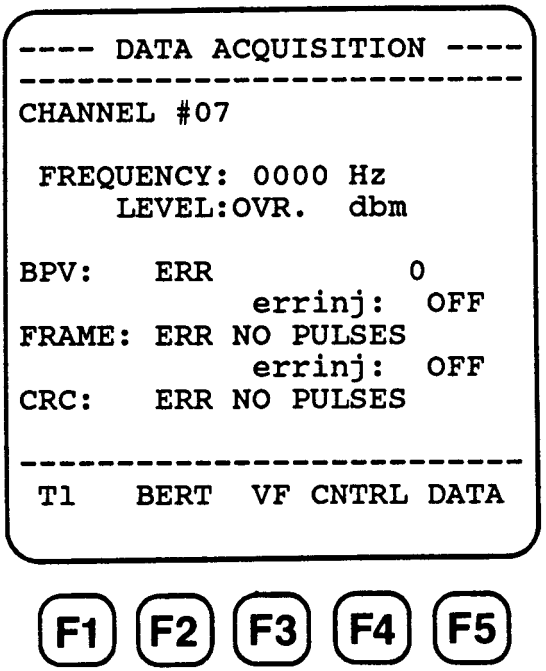

Figure 3-40. VF Mode data acquisition display

Section 4
APPLICATIONS

4.1 General Discussion

This section of the manual is intended to provide the beginning operator with basic procedures for set-up and use of the 7500. While following the suggested procedures, feel free to experiment with the unit to learn more about its operation and its potential for analyzing T1 facility performance.

4.1.1 Startup Procedures

The startup procedure depends on whether or not the desired set-up configuration has been stored in memory.

If the configuration has been stored in memory, load the set-up using the Set-up selection function (Section 3.5.1). Next connect the unit to the circuit to be tested and the unit is ready to go.

To prevent irrelevant alarms and error reports while the unit is installed, a set-up's printer interface is loaded OFF. To enable the printer for a test, initialize the unit on the circuit under test, clear the event memory, and then turn on the printer interface.

If the set-up configuration has not been stored in set-up memory, then you need to configure the unit before beginning a test. The following procedure is a guideline for systematic initial configuration:

1) Turn on the 7500 Test Set and wait for the startup logo to clear.
2) Select Termination mode (Section 3.2.1).
3) Select Frame format (Section 3.2.3).
4) Select Zero Suppression mode (Section 3.2.2).
5) Select Transmit Clock source if in Terminate mode (Section 3.2.4).

A. If out-of-service, Bit Error Rate testing will be performed:

6a) Select test pattern (Section 3.3.1).
7a) Select test length (Section 3.3.2).
8a) Select error format for the display (Section 3.3.3).

9a) Select Manual or Automatic pattern synchronization (Sections 3.3.7, 3.3.8).

10a) Restart error counts using Restart function (Section 3.3.5).

B. If Voice Frequency testing will be performed:

6b) Select D-Format (Section 3.4.1).

7b) Select channel access mode (Section 3.4.2).

8b) Select Send function, if any (Section 3.4.3).

9b) Enable or disable the measure function as desired (Section 3.4.4).

10b) Select Signalling (A&B) functions (Section 3.4.5).

Complete the set-up by checking and setting the common control functions:

11) Adjust Time and Date if necessary (Section 3.5.5).

12) Set Event Memory update rate and clear the event memory (Section 3.5.4).

13) Initialize the Print Control parameters and turn the printer on, if desired (Section 3.5.3).

This startup sequence properly configures the unit for most test applications. Other sequences may be used to configure the unit for specific tasks.

After the unit is configured, the set-up may be saved for future use by using the Set-up selection function and Storing the configuration. (Section 3.5.1)

4.1.2 Notes on Application Examples

The following application examples describe the tests by first defining the test objective, outlining the key sequences that configure the unit for the test, and then discussing how to perform the test.

Follow these sequences using the test set to see the effect of each step until you become familiar with the many possible applications of the 7500.

Note: *You can listen to a channel for noise while observing BPVs. If there is noise and no BPVs, the signal could be analog noise or the system could be multiplexed. If noise and BPVs occur together, it could be a digital signal.*

4.2 In-Service Monitoring

The test set performs in-service monitoring in Bridged mode on an in-use circuit, without interfering or interacting with that circuit. Figure 4-1 illustrates a bridging application.

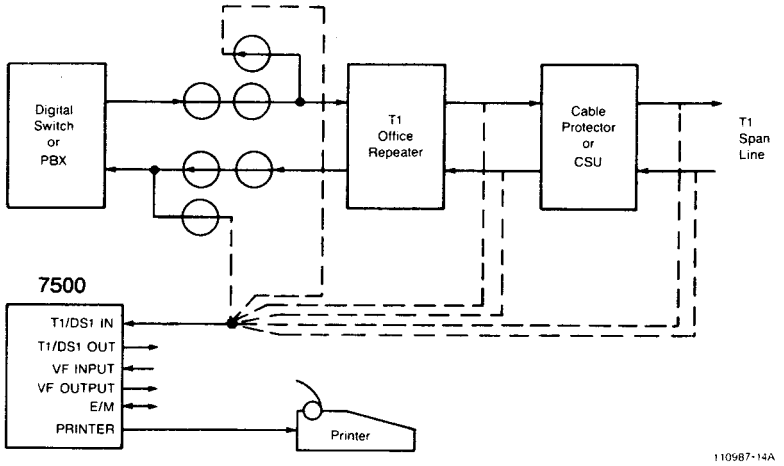

Figure 4-1. In-service Monitor application

The unit can be bridged onto the monitored circuit at any of the illustrated points. If the unit is connected using DSX bridging jacks with built-in bridging resistors, it should be in Terminate mode. If the unit is connected directly onto the circuit without bridging resistors, it should be in Bridge mode.

If the unit is used in Bridge mode and connected through bridging jacks with built-in bridging resistors, the combined signal attenuation of the resistors in the jacks and the bridging resistance in the unit itself can cause distortion and improper signal recovery.

The following discussion assumes that the unit is bridged onto the switch-input T1 circuit between the office repeater and the cable protector. The following key sequence configures the unit for one possible monitoring arrangement. Press:

TERM SELECT

BRDG **(F2)**—to select Bridge mode.

FRAME FORMAT

SF–S **(F2)**—to select standard framing

ZERO SUPPR

NO SUPPR **(F3)**
(Clock Select configuration is not needed because Bridge mode forces recovered clock)

D FORMAT

D3/D4 **(F3)**—to select D3/D4 channel format

CHANNEL ACCESS

SCAN **(F2)**—to place the unit in VF mode and to select a scan mode for all channels to be monitored for VF characteristics.

MEASURE—required to turn on the level and frequency measurement for monitored channels.

RESTART

ALL **(F5)**—to restart all error counts.

ERROR FORMAT

As required to select the error display format for BPV and Frame errors.

EVENT MEMORY

UPDATE RATE **(F1)**—as required to select the statistical update rate for printout.

CLEAR **(F5)**—to clear out previously logged alarms and reports.

PRINT CONTROL

BAUD RATE **(F2)**—as required to match baud rate for printer being used.

DATA BITS **(F3)**—as required to select the character length for the printer being used.

PARITY **(F4)**—as required to the output parity for the printer being used.

ON/OFF **(F1)**—to turn the printer on and off.

PRINT CONTROL—to exit the Print Control function.

DATA (F5)—to activate the Data Acquisition display.

These steps configure the test set to bridge onto the T1 facility as a monitor, without interfering with the in-service operation of the facility. The unit was configured in Bridge mode because the line was not monitored from jacks with bridging resistors. This keeps the unit from loading the T1 facility.

In Scan VF mode the unit monitors all channels of the T1 facility in a cycled sequence. Each channel is monitored for about 5 seconds.

As each channel is selected, the signalling status for that channel is displayed together with its VF tone level and frequency. The level represents the power level of periodic 32-millisecond samples of the channel. The frequency is only meaningful if the channel has a single tone on it. The channel can also be monitored on the built-in speaker.

The BPV's and frame errors received on the monitored T1 facility are also displayed, in the selected format. The format for error display can be altered during the test using the Error Format function.

The printer outputs records of any detected alarms along with the periodic statistics reports (if enabled). Each report indicates the error over the time period of that report, with each report covering a different time period. Error statistics are reported for all related error functions (BPV and Frame errors in this case), with all four forms of error formatting reported for each type of error. A sample error-statistics report for the above configuration is shown in Figure 4-2:

```
----------------------
16:45:25          1/7/87

BPV ERRORS

TOTAL ERRORS:          33
AVERAGE BER:     1.19E-08
ERROR SECONDS:         33
ERROR FREE SEC:      1767

FRAME ERRORS

TOTAL ERRORS:           1
AVERAGE FER:     3.47E-08
ERROR SECONDS:          1
ERROR FREE SEC:      1799

----------------------
```

Figure 4-2. Sample error-statistics report

4.3 Out-of-Service Loop Testing

Out-of-service T1 facility loop testing can be performed by using the unit in Terminate mode to interact with the T1 carrier circuit. Figure 4-3 illustrates a Terminate application.

This type of test is an out-of-service test because the data on the facility is received and driven by the test set and not live traffic. When the unit is jacked into the circuit as shown in Figure 4-3, the digital equipment is

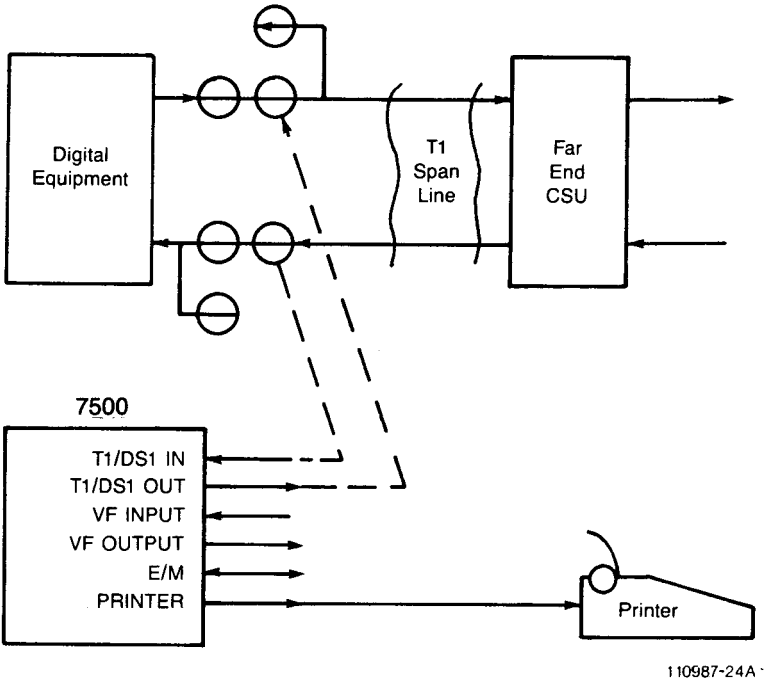

Figure 4-3. Out-of-service Loop Test application

disconnected from the T1 span line and the unit has complete control of the circuit.

This example assumes that the bit error rate testing is being done on an extended-frame circuit, as might be done to verify a circuit being installed or one that is suspected of having problems. The following set-up steps configure the 7500 for this test. Press:

TERM SELECT

TERM **(F1)**—to select Terminate mode.

FRAME FORMAT

ESF–S **(F4)**—to select extended framing.

ZERO SUPPR

B8ZS **(F2)**—to select B8ZS zero suppression.

CLOCK SELECT

INT **(F3)**—to select internal clock as transmit clock.

TEST PATTERN

QRSS **(F1)**—to select BERT mode and QRSS pattern for testing.

ERROR FORMAT

As required to select the desired error display format for Logic, BPV, Frame, and CRC errors.

TEST SELECT

CSU UP **(F2)**—to place the far-end CSU in loopback mode. Wait for the CSU UP display window to clear, to ensure that the full CSU Up code sequence has been sent.

RESTART

ALL **(F5)**—to restart all error counts.

EVENT MEMORY

UPDATE RATE **(F1)**—as required to select the desired statistics update rate for printout.

CLEAR **(F5)**—to clear out previously logged alarms and reports.

PRINT CONTROL

BAUD RATE **(F2)**—as required to match the baud rate to the printer being used.

DATA BITS **(F3)**—to select the character lengths for the printer being used.

PARITY **(F4)**—as required to select the output parity for the printer being used.

ON/OFF **(F1)**—as required to turn on the printer interface.

PRINT CONTROL—to exit the Print Control function.

DATA (F5)—to activate the Data Acquisition display.

These steps configure the unit in Terminate mode, driving the T1 span line with a QRSS test pattern, and monitoring the returned data for errors. Because the CSU UP code was sent during set-up to loop the far-end CSU, the returned data will have travelled from the test set to the CSU and back again. Any detected errors will have been introduced by the circuit under test.

The logic errors, BPV's, frame errors, and CRC errors received on the monitored T1 facility are displayed in the format selected in the above procedure. The format for error display can be changed during the test as desired using the Error Format function.

The printer records any detected alarms along with the periodic statistics reports (if enabled). Each report indicates the error over the time period of that report, with each report covering a different time period. Error statistics are reported for all related error functions (BPV and Frame errors in this case), with all four forms of error formatting reported for each type of error. A sample error-statistics report for the above configuration is given below in Figure 4-4:

```
--------------------
12:45:25          1/7/87

LOGIC ERRORS

TOTAL ERRORS:        42
AVERAGE BER:      1.52E-08
ERROR SECONDS:       40
ERROR FREE SEC:    1760

BPV ERRORS

TOTAL ERRORS:        33
AVERAGE BER:      1.19E-08
ERROR SECONDS:       33
ERROR FREE SEC:    1767

FRAME ERRORS

TOTAL ERRORS:         1
AVERAGE FER:      1.74E-08
ERROR SECONDS:        1
ERROR FREE SEC:    1799

CRC ERRORS

TOTAL ERRORS:        42
AVERAGE CER:      7.00E-03
ERROR SECONDS:       40
ERROR FREE SEC:    1760

--------------------
```

Figure 4-4. Sample error-statistics report

When the test is complete, remember that the CSU is in loopback mode. To return the CSU to normal mode, send the CSU DOWN code as follows:

TEST SELECT

CSU DOWN **(F3)**—restores the far-end CSU to normal operation. Wait for the CSU DOWN display to clear in the main window display to ensure that the full CSU Down code has been sent.

After this step is performed, the far-end CSU returns to normal service. Normal T1 service will be restored when the test set is removed from the circuit .

If this test sequence indicates an error rate considered too high for adequate service, the faulty link can be identified by using a test set at each end of the T1 span line. At the far end, a test set can be connected into the circuit instead of the CSU. The same configuration described above can be used on both units, except that the CSU Up and Down sequences are not required. The resulting measurements at each end of the span line reflect the performance of one side of the full-duplex circuit, and thus identify the faulty link.

An alternate method of fault isolation is to use the first set-up described above, but add the second test set at the CSU end of the span line bridged onto the T1 circuit coming into the CSU. Use the same set-up as above for the CSU-end (bridged) set, except configure the unit in Bridge mode. Clock Selection is not required as Bridge mode forces recovered-clock selection, and the bridged unit does not need the CSU Up and Down codes.

4.4 Drop/Insert Testing

Drop/Insert testing of an in-service T1 facility is performed with the unit in Drop/Insert mode passing all channels except for one channel which is dropped for analysis or used for testing. Figure 4-5 illustrates a Drop/Insert application.

This arrangement allows drop/insert testing of the T1 facility outbound from the digital switch onto the T1 span line. The following set-up prepares the test set for insertion into the circuit, assuming standard T1 framing with signalling (SF-S) and Bit-7 zero suppression. This set-up should be performed prior to insertion into the circuit to minimize the service interruption as the unit is jacked into the circuit. Press:

TERM SELECT

D/INS **(F3)**—to select Drop/Insert mode.

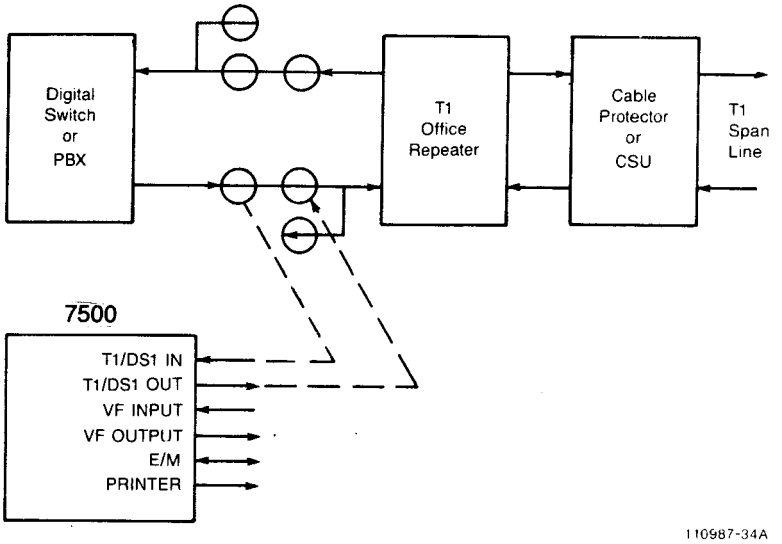

Figure 4-5. Drop and Insert application

FRAME FORMAT

SF–S **(F2)**—to select standard framing.

ZERO SUPPR

B7 **(F1)**—to select Bit 7 zero code suppression.

Clock configuration is not needed because Drop/Insert mode forces recovered clock.

D FORMAT

D3/D4 **(F3)**—to select D3/D4 channel format.

CHANNEL ACCESS

SCAN **(F2)**—to activate VF mode and to select a scan of all channels to be monitored for VF characteristics.

MEASURE—as required to turn on the level and frequency measurement for the monitored channels.

DATA (F5)—to activate the Data Acquisition display.

This set-up prepares the unit to frame up to the incoming facility and to re-transmit all channels to the output facility while scanning them in VF mode. Once the set-up is established, the unit can be jacked into the circuit. It will then reframe to its input and retransmit the facility unmodified to the output facility. The scanning function then begins.

To select a specific channel to be dropped use the Channel Access selection function, specifying the Single Channel option. Using the ON↑ and OFF↓ keys, select the desired channel and press ENTER (F5) to activate the channel selection. The selected channel is dropped to the VF Output jack and the internal speaker while still being monitored by the measure function (if enabled). The channel is also passed onto the output T1 facility.

External VF equipment can also be used to monitor the selected channel by jacking the equipment into the unit's VF Output jack. A VF signalling test set could be attached to capture DTMF/MF number-dialed information. If an E/M signalling test set is used, connect it through the E/M jack. Enable the E output using the A&B selection function (E-On option). Be aware that this selection drains the internal battery faster than other functions. To disable the E-lead and conserve the battery, again use the A&B selection function (E-OFF option).

To send a test tone or test signalling onto the output T1 facility, use the Send selection function to select the desired PCM source. After making this selection the A&B selection function can be used to either control the A and B signalling bits on the channel, or to enable the bits to be controlled from the M-lead input.

A PCM source must be selected using the Send selection function before any control of the outgoing signalling bits is enabled. When the Send selection is first made in Drop/Insert mode, the output signalling is initialized to match the input A and B signalling bits. After that, you can control the signalling bits as desired.

If VF Input is selected for the Send function, an external TIMS or VF signalling test instrument can be used to send tones or MF/DTMF signalling on the selected channel of the T1 output facility. An E/M signalling test instrument can be used through the unit's E/M jack to send pulse signalling if the M-lead input is selected in the A&B selection function.

If the Send function is used and OFF is selected, the selected channel will again be repeated onto the output T1 facility from the test set's input facility.

Using two test sets, full-duplex Drop/Insert testing can be performed. An example of such an arrangement is shown in Figure 4-6.

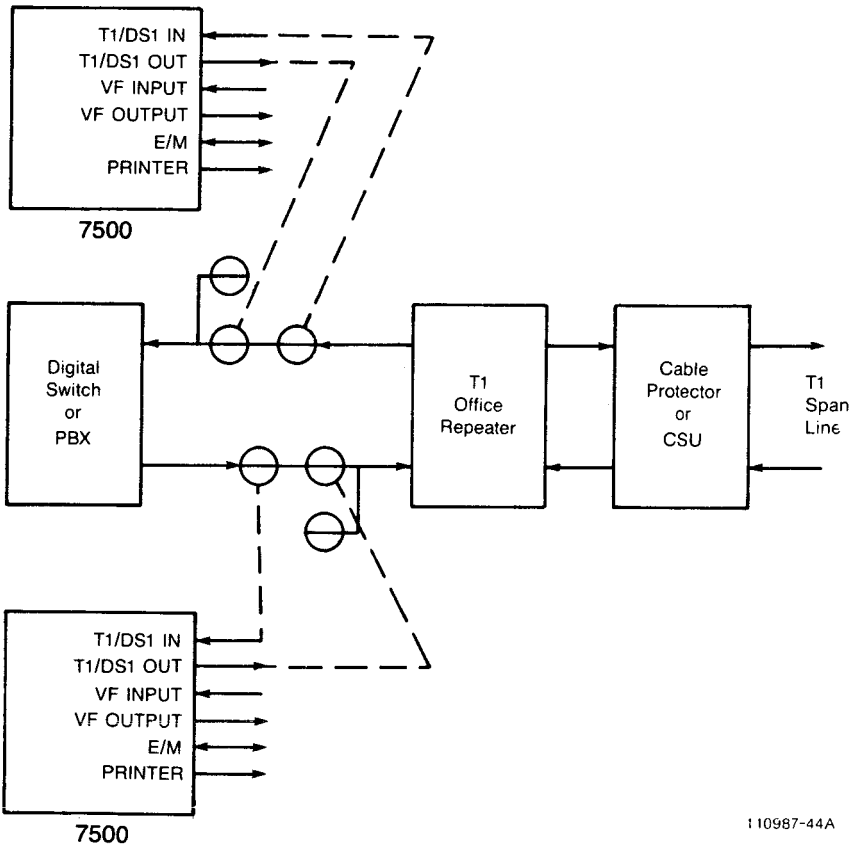

Figure 4-6. Full Duplex Drop and Insert application

4.5 VF Level Measurement

Although the 7500 is designed primarily as a T1 test set, it can be used to perform limited VF port tests and measurements.

The measure function accesses a channel of the input T1 facility, so any VF port signals to be measured or monitored must be placed on a channel of an input T1 facility. Do this as follows:

1) Activate the T1 LOOP function of the Test Select function to loop the output T1 data back into the test set.

2) Configure the unit in Terminate mode, a framed-format mode, and internal-clock mode.

3) Select the VF mode using a single channel select.

4) Select the VF input source of the Send selection function.

5) Turn on the Measure function.

These steps convert the VF input signals to PCM format, placing them on the T1 output facility which is looped back into the unit. The input channel data is routed to the measure circuits for analysis and to the speaker monitor and VF Output port.

4.6 VF Tone Generation

The unit can be used to send a quiet tone or digital milliwatt tone out from the VF port for testing. The Send function places the send data onto the selected channel of the output facility, so the data must be extracted from that facility for transmission to the unit's VF Output port. Do this as follows:

1) Activate the T1 LOOP function in the Test Select function to loop the T1 output data back into the test set. An external loopback could be used as an alternative by connecting the T1 output back to the T1 input.

2) Configure the unit in Terminate mode, framed format mode, and internal clock mode.

3) Select the VF mode using a single channel select.

4) Select the desired Send function; DS1 idle for quiet tone or DMW for 1000 Hz digital milliwatt tone.

This procedure places the desired tone onto the selected channel of the looped facility and then extracts that data from the input (looped) facility, sending the VF signals to the VF output port.

Section 5
MAINTENANCE

5.1 Battery Care

The 7500 is equipped with rechargeable gel/cel batteries that allow portable operation in the field. Proper care will prolong the service life of these batteries.

The batteries are essentially maintenance-free, but they should be kept charged as much as possible. The batteries are capable of 200 to 500 charge/discharge cycles from 50% capacity. If the discharge is less than 50% per cycle, the number of cycles increases proportionately. For this reason, the unit should be powered with the AC adapter/charger whenever possible.

Temperature significantly affects battery shelf life, capacity, and service life. In storage at 20° to 25°C, the batteries discharge at about 2–3% per month. At 35°C, the rate increases to 10–12% per month. At −18°C the rate decreases to less than 0.5% per month.

Battery capacity decreases as the temperature decreases. A battery will have greater capacity at higher temperature, but this reduces its service life. If possible, the unit should not be stored in high temperature environments.

Before storing the test set, or leaving it in a below-freezing environment, the batteries should have a full charge (24 hours).

The unit can be charged continuously using the AC adapter/charger without degrading the batteries. The unit can also be operated continuously powered by the AC adapter/charger.

5.2 VF Port Calibration

The 7500's VF Input and VF Output ports can be calibrated using the level adjustments shown in Section 2, Figure 2-2. This adjustment is typically a lab adjustment, requiring a Transmission Impairment Measurement Set (TIMS) or similar equipment.

5.2.1 VF Input Port

The VF input port gain can be adjusted to provide a minimum range of 16 dB gain to 7 dB loss. A −20 dB tone received at the Input port can be encoded onto the T1 facility Output at a level between −4 dBm and −27 dBm, depending on the level adjustment. The test set is factory preset to 0 dB gain.

To calibrate the VF Input port, configure the unit to receive and measure a tone from this port (see "VF Port Measurement," Section 4). Use a TIMS or equivalent to input a 1004 Hz tone into the the VF Input port at a level that produces a 0 dBm on the T1 facility. If 0 dB is desired, input a 0 dB tone; if 16 dB of gain is required, input a −16 dB tone, etc. Using the measure function, tune VF Input Level Adjustment (Figure 2-2) until 0 dBm is measured.

5.2.2 VF Output Port

The VF Output port gain can be adjusted to provide a minimum range of 0 to 23 dB of gain. A −20 dBm tone received from an input facility can be output from the this port at a level from −20 dBm to +3 dBm, depending on the VF Output level adjustment. The output level without distortion is limited to 7 dBm into 600 ohms.

To calibrate the VF Output port, first calibrate the VF Input port as shown in Section 5.2.1. Then, with the unit still configured to receive and measure a tone from the VF Input, use a TIMS or equivalent to input a tone through the 7500's VF Input port while simultaneously measuring the VF Output port level, terminated at 600 ohms. Adjust the input tone level so that the measured level, amplified by the desired gain, produces a 0 dBm level at the VF Output port. If 16 dBm of gain is desired, input a −16 dBm tone. Next tune the VF Output Level Adjustment (Figure 2-2) until 0 dBm is measured by the TIMS at the VF Output port.

Section 6
SPECIFICATIONS

T1/DS1 INTERFACE

Input Signal Level	Term +3 dB to −26 dB (DSX-1 or Mon) Bridg +3 dB to −34 dB (Cable) Bridg +3 dB to −6 dB (Non-Cable)
Input Impedance	100 Ohms—Termination Mode; 1000 Ohms—Bridged Mode
Input Clock Frequency	1.544 MHz ±300 ppm
Output	DSX-1 Compatible, and Selectable Line Build Out of 0–100, 100–350, 350–655 feet
Transmit Clock	Recovered or Internal Oscillator—1.544 MHz ±25 ppm, 0° to 70°C (32° to 158°F); or External 3000 Ohms TTL Clock
Frame Formats	D4 with Signaling, D4 No-Signaling (SLC*-96), ESF with Signaling, ESF No-Signaling, Unframed
Line Code (Zero Suppression)	AMI, AMI with data limit of 7 0's, B8ZS

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BERT FUNCTIONS

Test Patterns	QRSS (Bell Spec. CB113) 2^{20}–1, 2^{15}–1, 2047, 511, 63, 1:3, 1:7, Mark
Test Lengths	10E5 to 10E8 or Autoranging
Error Measurement	Logic, Frame, Bipolar Violations, CRC
Error Formats	Bit, BER, Error-Second, Error-Free-Second
BERT Synchronization	Auto or Manual
Error Injection	Automatic: Logic 10E−3 to 10E−8, BPV 10E−3 to 10E−8, Frame 1:2, 1:5, 1:10, 1:50, 1:100 Manual: Single Logic, BPV, Frame
Automatic Protection Switch Test Sequences	STD or 51A Formats

VF FUNCTIONS	
D-Formats	D1D, D2, D3/4
Channel Access	VF Input/Output, VF Channel Selection, Single, Scan, or Scroll—Idle Pattern on *all* VF Channels, Digital Milliwatt to VF, VF Input
Measure	Level and Frequency on Selected Channel
A and B Signaling *(C and D for ESF)*	Receive Single Channel, Receive All Channels, Transmit Single DS-0 Channel
E/M Signaling	M-Lead (−48 Vdc), E-Lead (Open/Closed Relay Contacts)
Speaker/Microphone	Enables VF Signal Monitoring and a Two-way Telephone Conversation
USER INTERFACES	T1/DS1 IN, T1/DS1 OUT, VF INPUT, VF OUTPUT, E/M Jack, External Speaker—Bantam Jack, External Clock—BNC Connector, LCD Display Contrast Control, Speaker Volume Control, Printer/Terminal Interface—RS-232, DB-25 connector, External Power Jack for Charger/AC Adapter, Power Switch
CONTROL FUNCTIONS	
Set-Up	Up to Five User-Defined Test Configurations can be stored in a Non-Volatile Memory
Test Select	LOOP-Internal Loopback CSU-Up (10000) Code, 5 Second Duration CSU-Down (100) Code, 5 Second Duration Self-Test Diagnostics Reset—CPU Soft Reset
Print Control	ON/OFF BAUD—300, 600, 1200, 2400 Word Length—7 or 8 Bits Parity—None, Odd, Even

Control Functions *(cont)*	
Event Memory	Alarms and Error Statistics on time intervals of 1, 5, 15, 30, 45 minutes and 1, 6, 12, or 24 hours each. Clear memory or dump memory contents via RS-232 Printer/Terminal port. Freeze, to hold contents for later printer dump.
GENERAL	
Size (H×W×D)	12.5 × 8.2 × 4.8 in. (31.8 × 20.8 × 12.2 cm)
Weight	10.2 lb (4.63 kg)
Environmental	0° to 50°C (32° to 122°F) operation range; −40° to +80°C (−40° to 176°F) storage
Power	2.5 Watts internal consumption, 12 Vdc input from 120 Vac charger/adapter or 12 Vdc charger/adapter Battery Life of gel/cel—5 hours (under normal conditions)

Specifications Subject to Change Without Notice.