SUNRISE TELECOM
INCORPORATED

SunSet MTT Basic
User's Manual

SA941

MAN-13899-US001 Rev. A

Sunrise Telecom®..... A Step Ahead

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Warnings!

Do not remove or insert the module while the test set is on. Inserting or removing a module with the power on may damage the module.

Do not remove or insert the software cartridge while the test set is on. Otherwise, damage could occur to the cartridge.

Using the supplied equipment in a manner not specified by Sunrise Telecom may impair the protection provided by the equipment.

SunSet MTT User's Manual
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You will soon find your SunSet MTT (Modular Test Toolkit) Basic chassis an indispensable tool for troubleshooting and qualifying access network services. Plug-in modules allow you to assemble the test set you need for testing digital subscriber lines or other technologies. The modular platform extends the life of your test equipment investment. You simply need to add a new module whenever the requirement for a new technology arises. Currently, the following modules are available:

Alcatel ADSL ATU-R (SSxDSL-2)

This module performs Alcatel ATU-R emulation for both installing and troubleshooting ADSL circuits. A one-button acceptance test turns up the link with the DSLAM (ATU-C) and displays vital information such as: current rate, maximum attainable rate, and noise margin, all within seconds.

Additional information helps you troubleshoot marginal or troublesome circuits. A bits per tone graphic displays the precise bit assignment per tone. By checking the frequencies of low bit levels, you can detect possible interferers. Alarm status & link measurements show any alarm or error conditions that have occurred at the near or far end. Both current and history information provides you with the full picture.

Alcatel ADSL ATU-R (SSxDSL-3)

This module performs Alcatel ATU-R emulation for both installing and troubleshooting ADSL circuits. A one-button acceptance test turns up the link with the DSLAM (ATU-C) and displays vital information such as: current rate, maximum attainable rate, and noise margin, all within seconds.

Additional information helps you troubleshoot marginal or troublesome circuits. A bits per tone graphic displays the precise bit assignment per tone. By checking the frequencies of low bit levels, you can detect possible interferers. Alarm status & link measurements show any alarm or error conditions that have occurred at the near or far end. Both current and history information provides you with the full picture. Optional software adds a second step by pinging the far end gateway to verify completion of virtual circuit provisioning.

Alcatel ADSL ATU-C (SSxDSL-4)

This module performs Alcatel ATU-C emulation for both installing and troubleshooting ADSL circuits. ATU-C emulation is a key application for qualifying ADSL circuits before the DSLAM is installed and working in the central office. A one-button acceptance test turns up the link with the far end modem (ATU-R) and quickly displays vital information such as: current rate, maximum attainable rate, and noise margin.

Comprehensive setup configurations gives the user a wide range of troubleshooting tools. You may set the exact rate, noise margin, etc. for rate adaptive or fixed rate circuits. A carrier mask feature enables you to manually control the 256 tones to experiment and determine optimum settings for the DSLAM.

IDSL (SSxDSL-5)

This module supports both IDSL and ISDN BRI testing. The IDSL capabilities support BERT Testing on both the U and the S/T Interface in a point-to-point mode. In addition, EOC commands support B1, B2, and 2B+D Loopbacks from the Central Office side (LT Interface) of the circuit. They allow for U-BRiTE cards, Repeaters, and NT1 looping. ISDN Basic Rate testing includes call setup and X.25 call setup.

VF TIMS (SSxDSL-6/6A)

This module provides baseband 20 Hz to 20 kHz TIMS testing from both 2-wire and 4-wire interfaces. Tone generation includes fixed tone, 3-tone slope, and configurable frequency sweep tests. Measurements include signal-to-noise, impulse noise, and noise with filters (3k-flat, 15k-flat, C-message). The module also contains signaling and dialing functions for placing calls.

SDSL (SSxDSL-7)

The SDSL module is designed for line qualification, installation, and troubleshooting of SDSL circuits. Based on the Conexant RS8973 SDSL chipset, it can be configured as a general SDSL tester to prequalify a copper pair for any rate from 144 kbps to 2320 kbps. It also can emulate a specific SDSL modem, HTU-C at the central office or HTU-R at the customer premise, for service verification and troubleshooting applications. Currently, modem emulation supports systems compatible with the Conexant RS8973 chip set, including Lucent TNT and Stinger, Nokia Speedlink, and Copper Mountain Copper Edge.

Dual T1 (SSxDSL-8)

The Dual T1 module offers full T1 functionality including: T1, ISDN, PRI, GR-303, SS7, Looping Repeaters and VF Dialing and Analysis.

Datacom/DDS (SSxDSL-9)

The Datacom/DDS module provides transmission and BERT testing from both Datacom and DDS-4W interfaces. Datacom testing supports DTE, DCE, and monitor modes from a V.35, RS232, RS449, RS530, or X.21 interface. The DDS mode provides DDS-4 wire testing at the CPE (DSU/CSU emulation) for both primary and secondary channels.

ADI ADSL ATU-R (SSxDSL-10)

This module performs ADI ATU-R emulation for both installing and troubleshooting ADSL circuits. This module performs the same tests as the SSxDSL-3, but with ADI chipset standards.

Alcatel ADSL-over-ISDN (SSxDSL-11)

The Alcatel ADSL-over-ISDN module is designed for Euro ADSL-over-ISDN systems. It is compliant to the ITU G.992.1 Annex B standard

IP (SSxDSL-12)

The IP module provides an efficient way to verify end to end provisioning from the customer ADSL modem to the far end ISP gateway and beyond.

Verifies provisioning and IP connectivity all the way to the customer's ISP by using PING testing.

The IP module offers Service Level Agreement (SLA) verification between the ISP and the customer. This verification is critical for business customers with minimum bandwidth guarantees.

Throughput testing is designed to verify the available upstream and downstream bit rates between the ISP gateway and the customer premises. The user can generate a specific load, measure the quality of the transfer, and determine the bit rate limit separately in each direction, thus verifying the SLA separately for both upstream and downstream transmission. This asymmetric load test is superior to ATM cell loopback methods of other vendors which can only verify connectivity but cannot verify full bandwidth asymmetric transmission in both upstream and downstream directions.

HDSL2/G.SHDSL (SSxDSL-14)

The HDSL2/G.SHDSL module provides HDSL2/G.SHDSL modem emulation. Modem emulation includes both H2TU-C/STU-C and H2TU-R/STU-R emulation to verify link turn-up, *eoc* transmission to read performance data, and system loopbacks for troubleshooting. The module also provides basic T1 measurements with loopback and span control.

Alcatel ATU-R (SSxDSL-15)

This module performs Alcatel ATU-R emulation for both installing and troubleshooting ADSL circuits. It offers an optional 10baseT pass through emulation feature.

TDR/DMM (SSxDSL-16)

This module provides Time Domain Reflectometer and Digital Multimeter functions. The DMM functions include DC and AC voltages, DC current, resistance and capacitance measurements.

HSSI (SSxDSL-17)

This module provides High Speed Serial Interface (HSSI) testing for speeds up to 52 Mbps. The main application is installing routers and high speed links with DTE emulation and BERT testing. Loopback testing and control lead analysis can be used for troubleshooting.

GlobeSpan ADSL-CAP ATU-R (SSxDSL-18)

This module emulates the ATU-R at the customer premises. It supports CAP line coding.

ADSL ATU-R Annex A (SSxDSL-21)

This module performs ATU-R emulation for both installing and troubleshooting ADSL circuits. This module performs the same tests as the SSxDSL-3, but with GlobeSpan Titanium G7000 ADSL chipset standards.

Chapter 2 Initial Setup

Use the following procedure for unpacking and testing your new SunSet MTT:

1. Remove the packing list from the shipping container.
2. Remove the SunSet MTT and accessories from the shipping container.
3. Inspect all parts and immediately report any damage to the carrier and to Sunrise Telecom.
4. Verify that all parts specified on the packing list were received.
5. Complete the Warranty Registration Card and return it immediately to Sunrise Telecom.

Note: Sunrise Telecom must receive your Warranty Registration Card in order to provide you with updated software releases.

6. Ensure that the software cartridge is fully seated in it's slot. When properly installed, the top of the cartridge is pushed flush with the top of the ejector button. The SunSet MTT has two software card slots:

- The inside card contains the actual software and options needed to operate the SunSet MTT. This card may be upgraded in the field to provide you with new software options or software releases.
- The outside slot may be used in the future for extra memory storage.

7. Plug the AC Battery Charger into an AC wall outlet and connect it to the SunSet MTT. The charger plugs in at the top of the SunSet MTT, where it is labelled 15 VDC.

- The SunSet MTT uses a NiMH battery. Use only the SS138D adapter supplied with the test set. The SS138D AC adapter should be used for charging the test set batteries only.
- For optimum performance, the SunSet MTT should be used on batteries only.

8. Turn the SunSet MTT on by pushing the red POWER key and verify that it passes the SELF TEST. If the test set does not turn on immediately, it may need to charge for up to 5 minutes before it can run.

- Upon first powering up, the screen should show several Download and Calibrate messages. All should display "PASS" on the right side. The final message should read "Downloading (type of module) Module PASS."

- The SunSet MTT main screen now appears.

9. Setting the System Clock:
   A. To set the System Clock to the current time, press the MENU key.
   B. Select SYSTEM using the keypad arrow keys and press the ENTER key.
   C. Select SYSTEM CLOCK using the up/down keypad arrow keys and press the ENTER key.
   D. At DATE: Use the INC (F1) and DEC (F2) F-keys to set the month, date, and year. Use the right and left arrow keys to move the cursor. When you're finished setting the date, cursor to time by pressing the down arrow keypad key.
   E. At TIME: Use the INC (F1) and DEC (F2) F- keys to set the hour, minutes, and seconds.
   F. When you have finished entering the date and time, press the SET (F3) F-key to save your entries.

10. Charge the unit overnight before its first use on battery.

Note: For optimum performance, use with batteries only.

11. If ordered, put the test set and accessories into the soft carrying case.

Chapter 3 Product Description

This chapter describes the general features of the SunSet MTT. It explains the physical features of the product: the LEDs, keypad functions, and connector panels. The front view of the SunSet MTT is shown in Figure 1.

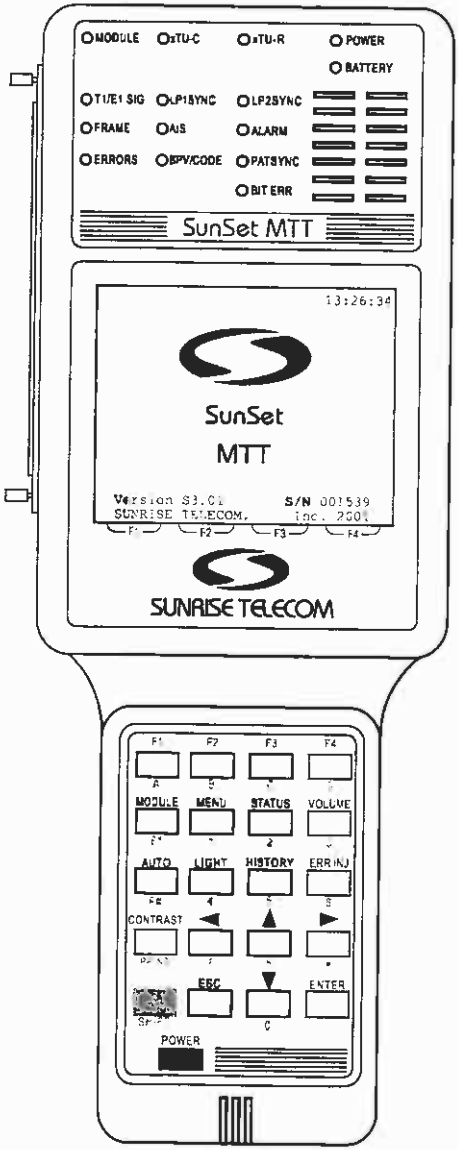

Figure 1 SunSet MTT Front View

1.0 Keypad Functions

The SunSet MTT keypad is shown in Figure 2.

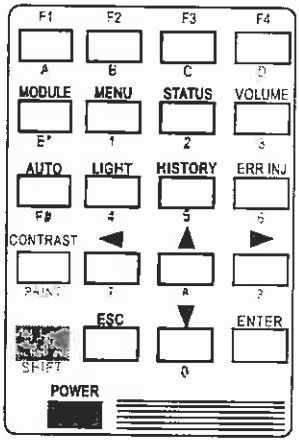

Figure 2 SunSet MTT Keypad

SunSet MTT keys can have two distinct meanings:

- The **White Label** above the key indicates what function will be performed if the key is pressed by itself (i.e. MODULE or HISTORY).
- The **Orange Label** below the key shows what function will be performed if the SHIFT function is activated (i.e. numbers or PRINT).

Shift Key Functions

To activate the Shift function, press the orange SHIFT key. The SHIFT key should not be pressed simultaneously with another key. Instead, the SHIFT key should be pressed and released. At this point, a SHIFT indicator will appear in the upper left-hand corner of the screen. Then the other key should be pressed. The set will then perform the function indicated on the orange label. SHIFT will remain activated until the SHIFT key is pressed again and the SHIFT indicator disappears.

Note: The SHIFT indicator should be checked if the keys are not behaving as expected. If the SHIFT indicator at the upper left-hand corner of the screen indicates the wrong status, simply press the SHIFT-lock key.

White Label Keys

F1-F4: The F-keys are used to select choices F1 through F4 at the bottom of the LCD display. If more than four F-key options are available, a "more" indicator will appear in the F4 position. Pressing the F4 key will display the other available F-keys.

MODULE: The MODULE key brings up the main menu of the module installed in the left side. Use this key to access all module functions.

MENU: The MENU key brings up the MAIN MENU. Use this key to access non-module functions. Figure 3 shows the menu screen. Figure 5 shows the SunSet MTT menu tree.

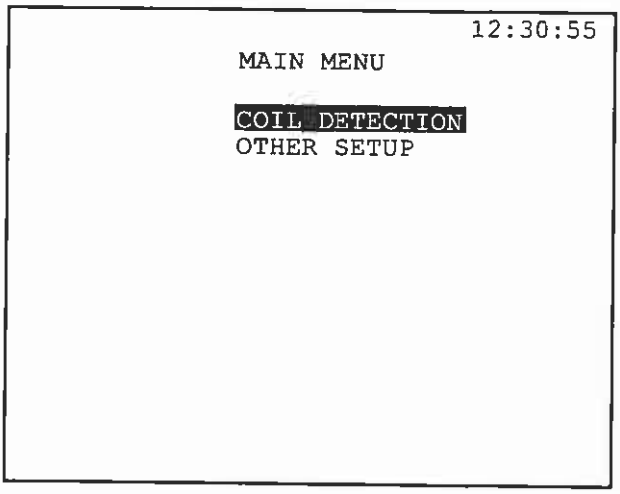

Figure 3 Main Menu Screen

To access a particular function, use the keypad up/down arrow keys to move the cursor to the line representing the function you want, then press the ENTER key.

Note: Throughout this manual the following convention is used to access functions. For example, "Select MAIN MENU > OTHER SETUP > SYSTEM CLOCK. This means; select MAIN MENU and press the keypad ENTER key, select OTHER SETUP and press the keypad ENTER key, select SYSTEM CLOCK and press the keypad ENTER key.

The menu tree, shown in Figure 4 gives you a quick reference to the functions of the SunSet MTT.

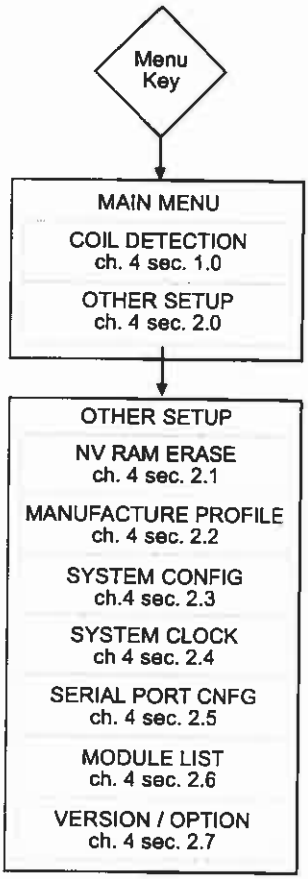

Figure 4 SunSet MTT **Menu Tree**

STATUS: The STATUS key will be implemented in future software revisions.

VOLUME: The VOLUME key adjusts the speaker's volume for talk/listen applications, like ISDN or VF TIMS testing.

AUTO: The AUTO key is applicable only to certain modules. Refer to the individual module chapters for specific details on the use of the AUTO key.

LIGHT: The LIGHT key manually turns on/off the LCD screen backlight. You may also set a timer to turn off the backlight. To program the timer for the backlight:

1. Press the MENU key and select OTHER SETUP > SYSTEM CONFIG.
2. Select BACK LIGHT.
3. Select the desired on time by using the +5 MIN and -5 MIN F-keys.
4. Press the keypad ESC key untill you reach the MAIN MENU Screen.

HISTORY: The HISTORY key clears the flashing LEDs. LEDs flash to indicate that an error or alarm condition occurred, but is no longer present.

ERR INJ: The ERR INJ key injects errors on the transmit signal. This is applicable only to certain module functions.

CONTRAST: The CONTRAST key adjusts the contrast of the LCD display. Continue to press the CONTRAST key until you have achieved the desirable contrast level.

ESC: The escape key moves you back toward the main menu. Each key press brings you a single step backward.

ENTER: The ENTER key accesses the highlighted menu choice.

▲, ▼, ▶, ◀: The cursor keys move the highlighted cursor in the indicated direction.

Orange Label Keys

The SHIFT key activates the orange label function written below some of the keys. The orange SHIFT key activates the SHIFT, meaning that the keys perform the orange label function written below the key. You will need to press the SHIFT key again to deactivate the SHIFT and return the keys to their normal, white label functions.

The orange shift keys have the following functions:

0 - 9: The 0-9 keys are used to enter numbers during testing. Examples are entering IP addresses during PING testing or entering user test patterns.

A - F: The A - F keys are used to enter hexadecimal values.

PRINT: This key is currently not supported.

2.0 LEDs

The LEDs provide valuable information on:

- The SunSet MTT's current test mode.
- The status of the received signal. When the SunSet MTT detects an alarm, the ALARM LED lights red.
- The status of modem synchronization. In DSL testing, a solid green LED for XTU-R (for ATU-R testing) indicates the SunSet MTT has achieved synchronization with the DSLAM.

Figure 5 shows the SunSet MTT LED panel.

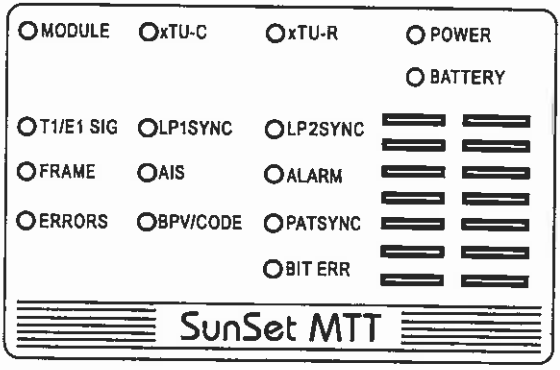

Figure 5 SunSet MTT **LED Panel**

The LEDs have the following meanings:

MODULE

- Green: The MODULE LED lights green to indicate that the test set is in the module mode.

xTU-C

The xTU-C LED is active when the test set is emulating an xTU-C.

- Green: The xTU-C LED lights green when the test set has synched with the xTU-R.
- Red: The test set has not connected with the xTU-R.
- Blinking Red: The test set is attempting to open the link with the xTU-R.

xTU-R

The xTU-R LED is active when the test set is emulating an xTU-R.

- Green: The xTU-R LED lights green when the test set has synched with the xTU-C at the Central Office.

- Red: The test set has not connected with the xTU-C.
- Blinking Red: The test set is attempting to open the link with the xTU-C.

T1/E1 SIG

The T1/E1 SIG LED is active during test modes with T1 and E1 signals. For example, HDSL T1/E1 tests the T1/E1 signal.

- Green: The T1/E1 SIG LED lights green when the test set is receiving a T1 or E1 signal.
- Red: The test set is not receiving a T1/E1 signal as expected.

LP 1 SYNC

The LP 1 SYNC LED is active during test modes with 2 loops. For example, in HDSL T1/E1 testing this LED displays the status of HDSL loop 1.

- Green: The LP 1 SYNC LED lights green when loop 1 (i.e. HDSL Loop 1) is in sync.
- Red: The LP 1 SYNC LED lights red when loop 1 is not in sync.

LP 2 SYNC

The LP 2 SYNC LED is active during test modes with 2 loops. For example, in HDSL T1/E1 testing this LED displays the status of HDSL loop 2.

- Green: The LP 2 SYNC LED lights green when loop 2 (i.e. HDSL Loop 2) is in sync.
- Red: This LED lights red when loop 2 is not in sync.

FRAME

The FRAME LED is active when the test set is in a framed test mode (i.e. T1 testing).

- Green: A green FRAME LED indicates that the test set has achieved frame sync and the framing found on the received signal matches the framing set in Test Configuration.
- Red: A red LED indicates that the configured framing type is not found on the received signal. This could indicate either a loss of framing on the received signal or a framing mismatch.

AIS

- Red: The test set is currently detecting AIS (Alarm Indication Signal).
- Blinking Red: The test set previously detected AIS, but that alarm condition is no longer present. Pressing the HISTORY key will clear the flashing lights.

ALARM

The Alarm LED has functions specific to the module in use.

ERRORS

- Red: The test set is currently detecting an error.
- Blinking Red: The test set previously detected an error, but that error is no longer present. Pressing the HISTORY key will clear this flashing LED.

BPV/CODE

- Red: The test set is currently detecting a Bipolar Violation (BPV) or Code error.
- Blinking Red: The test set previously detected a BPV or code error, but that error condition is no longer present. Pressing the HISTORY key will clear this flashing LED.

PAT SYNC

The PAT SYNC LED is active whenever the test set is performing a BERT test with a known test pattern. For example, it is active in HDSL, IDSL, Datacom/DDS, or T1 testing.

- Green: The PAT SYNC LED lights green when the test set has achieved pattern synchronization.
- Red: The test set has lost pattern synchronization or cannot achieve pattern sync.

BIT ERR

The BIT ERR LED is active whenever the test set is performing a BERT test with a known test pattern. For example, it is active in HDSL, IDSL, Datacom/DDS, or T1 testing.

- Red: The test set is currently detecting bit errors.
- Blinking Red: The test set previously detected bit errors, but they are no longer present. Pressing the HISTORY key will clear this flashing LED.

POWER

- Green: The test set is powered on.

BATTERY

- Green: The SS138D AC Adapter/Charger is connected and that the SunSet MTT is charging.
- Red: This indicates a low battery. You should connect the unit to the SS138D charger as soon as possible.

3.0 Connector Panels

The SunSet MTT has two side panels and one top panel. The left side contains a slot to insert plug-in modules. The right side contains an RJ-45 jack for load coil testing. The top panel has a serial port ,DC power adapter jack and two slots for PCMCIA softwar cards.

3.1 Main Side Panel

The right side of the MNU contains a single RJ-45 jack for Load Coil Detection. You should use this connector whenever you are performing a Load Coil Detection test. Refer to Figure 6.

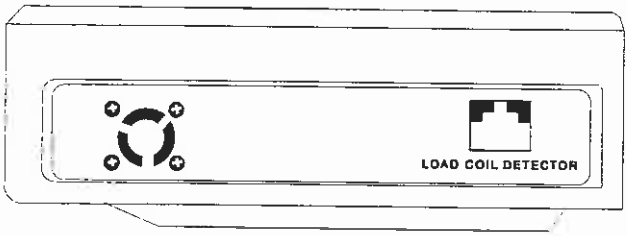

Figure 6 Right Side Panel

3.2 Module Side Panel

The left side of the test set contains a module slot to insert plug-in modules. Upon ordering the SunSet MTT with module, the module will already be inserted upon delivery. To change modules, use the following procedure:

Warning!

Changing modules with the power on will damage the module and or the SunSet MTT. Always verify that the SunSet MTT is off before changing modules. The SunSet MTT will not turn on without a module installed as an added precautionary measure.

1. Verify that the test set is off and loosen the two thumb screws on either side of the module.
2. Gently pull the module out from the slot. Place it in its hard case or protective wrapper.
3. Insert the other module. Make sure it is firmly seated in the slot.
4. Screw in the two thumb screws. Make sure these are secure.
5. Turn on the test set. The screen should show that the test set is downloading the new module and should read PASS.
7. Perform an NV RAM ERASE. Refer to chapter 4, section 2.1 for the procedure.

3.3 Top Panel

The top panel is shown in Figure 7.

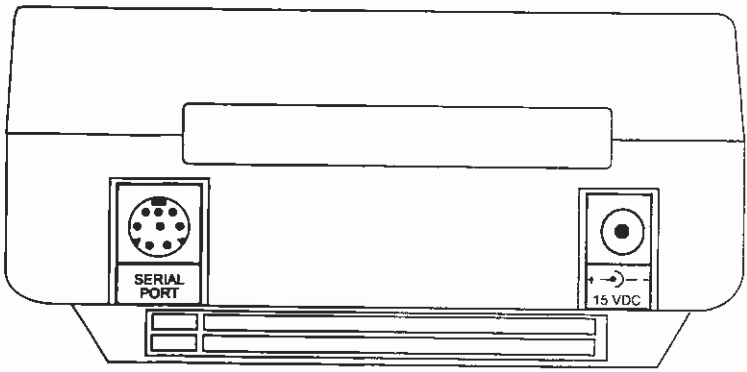

Figure 7 SunSet MTT **Top Panel**

15 VDC

Warning!
Do not use a charger other than the SS138D charger provided with your SunSet MTT. **Use of other chargers may cause damage to the** SunSet MTT **and will void your warranty.**

Caution
Whenever possible, do not use the SS138D charger during normal operation. For optimum results, we recommend fully charging the SunSet MTT **then performing your tests on battery power alone.**

Plug the AC Adapter/Charger into this 15 VDC port. Sunrise Telecom provides the SS138D Adapter/Charger; its output is 15 VDC, input 100-240 VAC. The unit may be operated while charging, but optimum performance will be with battery operation.

Serial Port

The DIN-8 serial port should be used for printing results. Sunrise Telecom provides three different cables for connecting to a printer: SS115 (DIN-8 to DB25), SS115C (DIN-8 to 6-PIN RJ11, compatable with STAR DP-8340), and SS115D (DIN-8 to DB9). Refer to chapter 5, Storing & Printing Results, for more details on the printer cables and connections.

Software Card

The SunSet MTT software can be upgraded via the PCMCIA card. The software card is inserted into the inner card slot of the SunSet MTT. Refer to Figure 8.

Warning!

Do not remove or insert the software card while the SunSet MTT is on, the cartridge can be damaged.

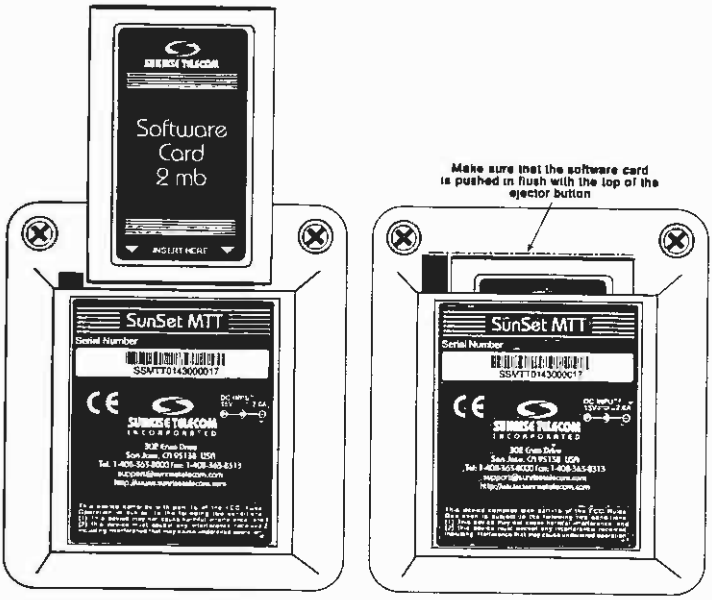

Figure 8 Software Card Installation

After inserting a new software card, perform an NV RAM ERASE. This procedure should always be performed after inserting a new software cartridge. Refer to chapter 4, section 2.1 for the procedure.

3.4 Replacing the Battery Pack

The SunSet MTT is designed with a field-replaceable 9-cell NiMH battery pack. You may order a battery replacement (SS140) from Sunrise Telecom customer service (1-800-701-5208 or 1-408-363-8000). Follow these steps to replace the battery pack:

1. Push down on the battery cover on the back panel, in the direction indicated by the arrow, to remove the battery cover Refer to Figure 9.
2. Pull the SS140 NiMH battery pack off its Velcro backing, and out of the set.
3. Unclip the battery pack, as indicated on Figure 9.
4. Clip in your new battery pack, replace it against the Velcro inside the unit, and slide the battery cover back on, hooking the cover clips into the provided slots.

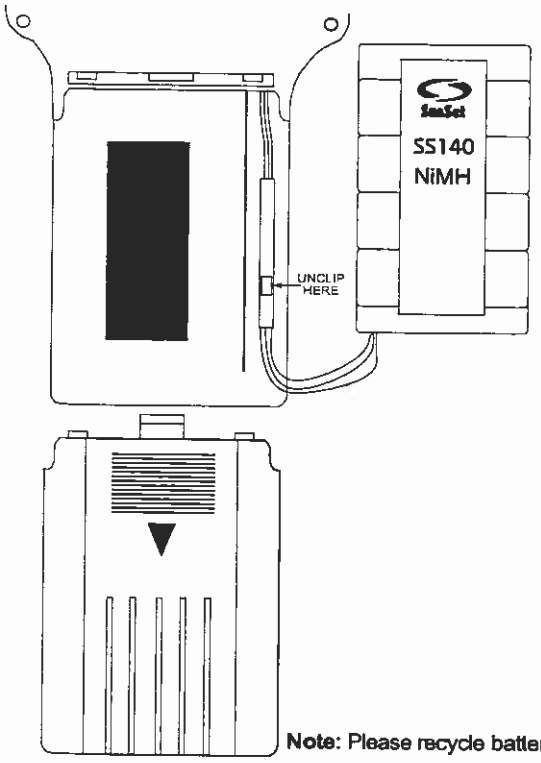

Figure 9 Replacing the Battery Pack

Press the MENU key to access all non-module functions. Refer to Figures 4 and 5 in chapter 3.

The MAIN MENU contains two items: LOAD COIL and OTHER SETUP. Enter LOAD COIL to check for load coils. Enter OTHER SETUP for all other items related to SunSet MTT setup.

1.0 Load Coil Detection (SWMTT-LC)

The Coil Detection test is a quick and easy way to check for load coils on your cable. It does not provide a location for the load coils (you will need to use a TDR for this) but it will show you if any are present.

The standard spacing for load coils is every 6000ft. For the most accurate results, there should be 3000ft. between load coils.

1.1 What is a Load Coil?

Over long cable lengths, voice signals are attenuated due to increased capacitance. Phone companies typically deal with these long loops (greater than 18,000 feet) by placing load coils at regular intervals. A load coil is an inductor, typically 88 mH. Load coils are placed at regular intervals on cable longer than 18,000 feet. The first appears 3,000 feet from the C.O. (central office) or exchange. Then, load coils are placed every 6,000 feet.

Loaded cable enables transmission in 300 Hz to 3.1 kHz at a higher power level than unloaded cable. However, above 4 kHz, the power level drops below that of an unloaded circuit. The result is that frequencies above 4 kHz are more heavily attenuated with load coils. *Therefore, high frequency signals, like ADSL, cannot pass through load coils.*

1.2 Performing a Coil Detection Test

Follow this procedure to perform the Coil Detection test. For accurate results, the load coils on the circuit should comply to standard spacing rules.

1. Connect the SunSet MTT to the circuit as shown in Figure 10. Plug an RJ-45 into the SunSet MTT Load Coil Detector jack. Connect the alligator clips at the other end directly to the cable pair. There must be an open at the far end for this test.

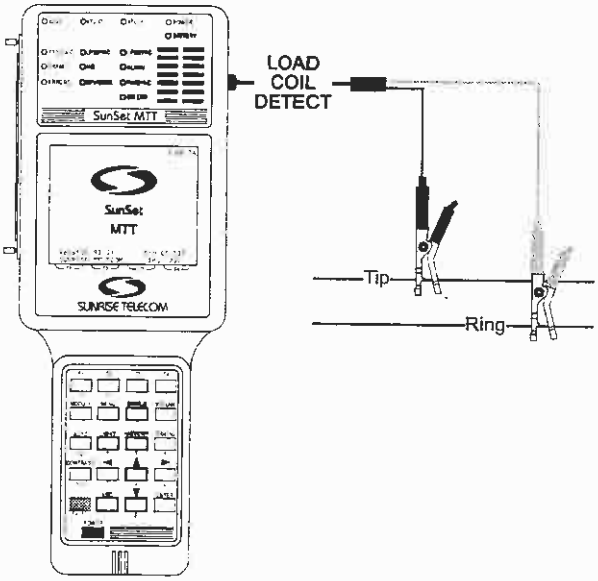

Figure 10 Connecting the SunSet MTT to the Cable Pair

2. Press the MENU key and select COIL DETECTION.
3. Refer to the top row on the screen to read the status messages. There are three states:

- INITIAL: The SunSet MTT is initializing and calibrating the load coil detection circuitry. This is required before taking the measurement.
- PROCESSING: The SunSet MTT has finished initializing and is in the process of making the measurement. The processing stage takes approximately 20 seconds.
- COMPLETED: The SunSet MTT has completed the measurement and now displays the results. These results do not constantly update; you will need to press the RESTART (F4) F-key to restart the test and update the results.

4. Refer to the graph in Figure 11. The plot measures impedance (y-axis) by frequency (x-axis).

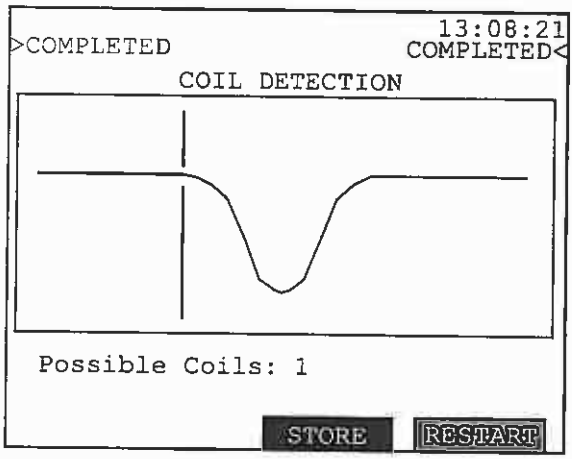

Figure 11 Coil Detection

- A load coil causes a change in impedance. This is displayed in the graph. A big dip in the impedance (y) represents a load coil.
- The number of load coils is displayed at the bottom of the screen. In Figure 11, there is one dip in the graph indicating a load coil.
- The screen display does not update. Press the RESTART (F4) key to retake the measurement.

1.3 Removing Load Coils

The Coil Detection test is the fastest method for determining the *presence of load coils*. If this test proves the presence of load coils, you will need to use a TDR to determine the exact location of the load coils for removal. The safest method to ensure that all load coils are removed is to remove the first load coil, then run the test again to check if there are more farther down the cable. Continue this same process: find a load coil, remove it, then check for another one.

Remember all load coils must be removed for DSL transmission.

2.0 Other Setup

The OTHER SYSTEM SETUP menu is shown in Figure 12.

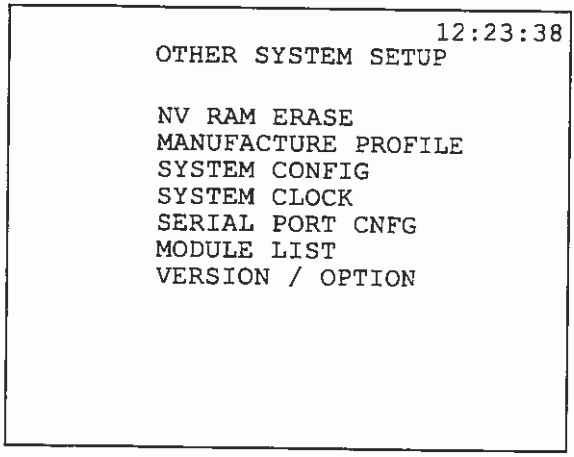

Figure 12 Other System Setup Menu Screen

2.1 NV Ram Erase

NV (Non Volatile) RAM ERASE erases all the user-storable information entered into the SunSet MTT. This operation should always be performed after inserting a new software cartridge. This operation should also be performed as a last resort if the set is not performing properly. If this is the case, you should initiate NV RAM ERASE, only after attempting to correct the problem by:

1. Making sure that the SunSet MTT is properly configured for the application being attempted.
2. Turning the power switch off and on has not corrected the problem.

WARNING
Performing the NV RAM ERASE operation will erase all the user-storable information the user has entered into the test set. All stored results will be erased.

Use the following procedure to erase NV RAM:

1. Select MAIN MENU > OTHER SETUP and record any settings you need from the setup screens.
2. When ready select NV RAM ERASE and follow the on-screen instructions.
3. When the procedure is complete the SunSet MTT will shut down.
4. Press POWER > MENU > OTHER SETUP and configure the test set if the factory defaults do not suit your needs.

2.2 Manufacture Profile

This function resets the SunSet MTT to factory defaults. It will not erase any stored information.

To use select MAIN MENU > OTHER SETUP > MANUFACTURE PROFILE and follow the on-screen instructions.

2.3 System Configuration

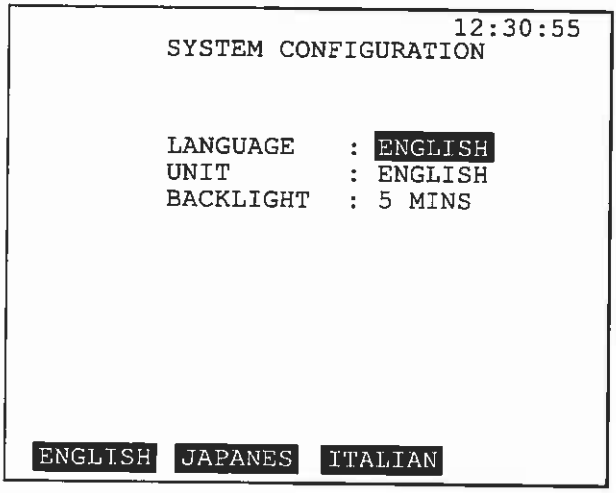

Figure 13 System Configuration

Configure the following items as needed:

LANGUAGE
Options: ENGLISH (F1), JAPANES (F2), ITALIAN (F3)

Select which language to display. Select English, Japanese katakana characters, or Italian.

UNIT
Options: ENGLISH (F1), METRIC (F2)

Select the measurement system to use. Select ENGLISH to display measurements in feet or METRIC to display measurements in meters.

BACKLIGHT
Options: 5 - 60 minutes

This timer controls how long the backlight will remain lit when you press the LIGHT key.

To enter in the duration, use the +5 MIN (F1) and the -5 MIN (F2) F-key to set.

2.4 System Clock

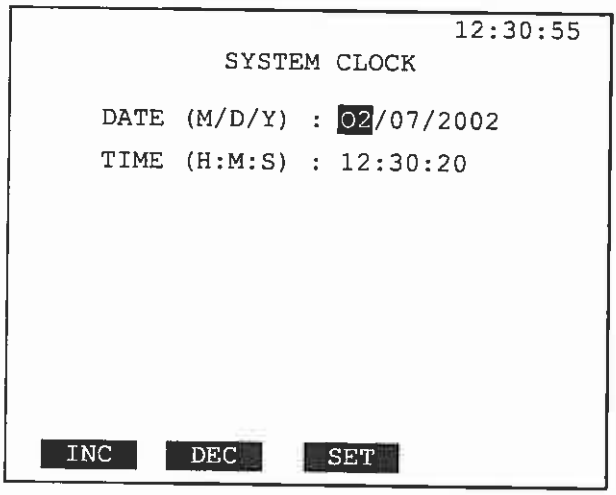

Figure 14 System Clock

Access this screen to set the SunSet MTT's date and time. To enter the system date:

1. At month, use the INC (F1) and DEC (F2) F-keys to set the correct month.
2. Press the right keypad arrow key to move the cursor to the day setting. Use the same procedure to enter the day.
3. Press the keypad right arrow key to year and enter the year.
4. Once you have entered the correct date, press SET (F4) F-key.

To enter the system time:

1. At hour, use the INC (F1) and DEC (F2) F-keys to set the correct hour.
2. Press the keypad right arrow key to move the cursor to the minute setting. Use the same procedure to enter the minutes.
3. Press the keypad right arrow key to second and enter the seconds.
4. Once you have entered the correct time, press SET (F4) F-key.

2.5 Serial Port Configuration

This screen configures the set's serial port for printing. Refer to Figure 15.

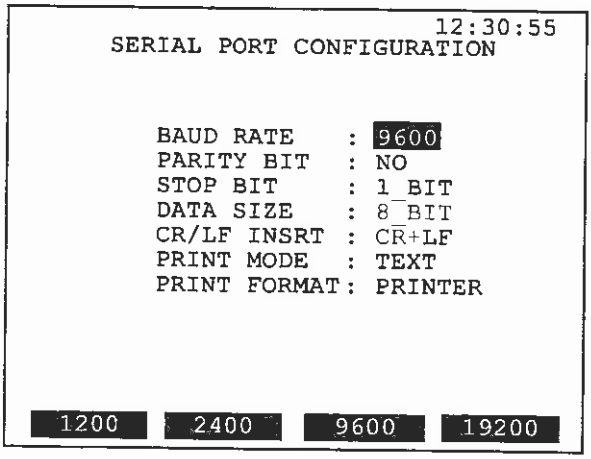

Figure 15 Serial Port Configuration

BAUD RATE
Options: 1200 (F1), 2400 (F2), 9600 (F3), 19200 (F4)

Press the F-key that correspond to your desired baud rate setting. *Make sure this setting matches that of the destination printer.*

PARITY BIT
Options: NO (F1), ODD (F2), EVEN (F3)

Parity is a method of checking the accuracy of transmitted or stored data. An extra bit, known as a parity bit, is added to the data as an accuracy check. *Make sure this setting matches that of the destination printer.*

- Odd Parity (F2), the total number of ones (including the added parity bit) is odd.
- Even Parity (F3), the total number of ones (including the added parity bit) is even.
- None (F1) signifies no parity checking.

STOP BIT
Options: 1-BIT (F1), 2-BIT (F2)

In asynchronous transmission, the stop bit is the last transmitted character which permits the receiver to come into an idle condition before accepting another character. *Make sure this setting matches that of the destination printer.*

DATA SIZE
Options: 5_BIT (F1), 6_BIT (F2), 7_BIT (F3), 8_BIT (F4)

Data Size specifies the number of bits per character. *Make sure this setting matches that of the destination printer.*

CR/LF INSRT
Options: CR (F1), CR+LF (F2)

- Press CR (F1) to select carriage return.
- Press CR+LF (F2) to select carriage return and line feed. This mode inserts an extra line space after every line.

PRINT MODE
Options: TEXT (F1), GRAPHIC (F2)

Text prints a text-only format. If you are in text mode, you can only print from the ATU-R Stored Results screen. The Print screen key is disabled. From the Stored Results menu, text mode prints out the Link Turn-up results and General Status information. You cannot print any load coil measurements. You should use text mode when your printer does not support graphics.

Graphic allows you to print both load coil and ATU-R results. Graphic mode also allows you to print any single screen display using the PRINT Shift-function key. In ATU-R, graphic mode prints out: Link Turn-up Results, General Status, Link Measurements, and Alarm Status. Not all printers support graphics. Sunrise Telecom guarantees graphical printing only with the SS118 printer provided by Sunrise Telecom.

PRINT FORMAT
Options: PRINTER (F1), VT100 (F2)

PRINTER: Support SunSet printers.

VT100: Supports terminal programs, such as Windows HyperTerminal™.

2.6 Module List

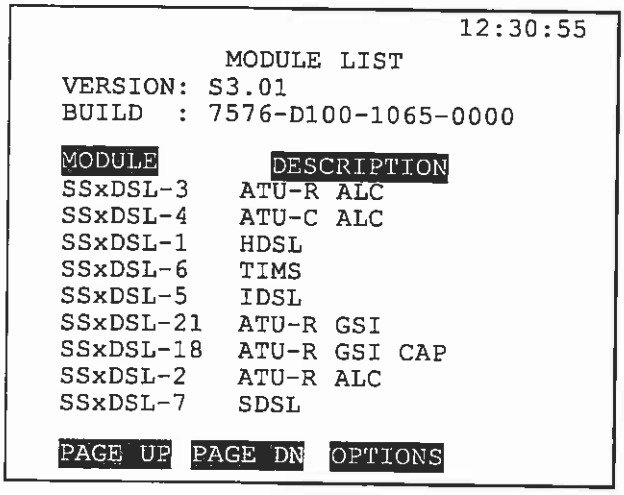

Figure 16 Module List Screen

The Module List screen displays a list of SunSet modules that the installed software will support.

The Module List screen contains the following F-keys.

PAGE UP (F1), PAGE DN (F2): allow viewing of any listings not shown on the first screen. These F-keys will not appear if the list can be displayed on one screen.

OPTIONS: Displays the VERSION/OPTION list screen.

This screen provides the following information:

VERSION: this is the software version currently installed.

BUILD: Sixteen character software build ID.

MODULE: Provides the SunSet part number of the modules that the installed software will support.

DESCRIPTION: Provides a description of the listed module.

2.7 Version/Option

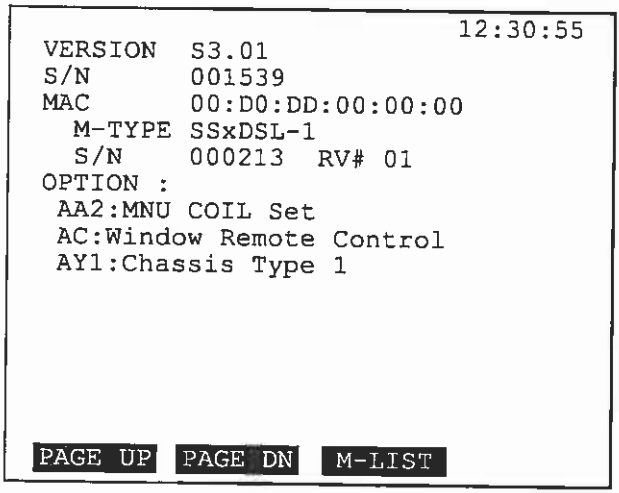

Figure 17 Version/Option Screen

The Version/Option screen contains the following F-keys.

PAGE UP (F1), PAGE DN (F2): allow viewing of any OPTIONs not shown on the first screen. These F-keys may not appear if the OPTION listings can be displayed on one screen.

M-LIST: Displays Module List screen.

This screen provides the following information:

VERSION: this is the software version currently installed.

S/N: serial number of the SunSet MTT.

MAC: Media Access Control address, a hardware address that uniquely identifies each device on a network.

M-TYPE: module type currently installed.

S/N: serial number is the currently installed module.

OPTION: This lists the software options currently installed on the SunSet MTT. It also lists software options supported by the modules.

Chapter 5 Storing and Printing Results

1.0 Storing Results

You may store results to view/print at a later time. Each result can be labelled with both a Label name and Circuit ID for easy identification. For ATU-R/C testing, you may store up to 50 separate sets of results. Each result includes Link Turn up, General Status, Link Measurements, and Alarm Status information. For physical layer testing, you may store up to 10 results for each test (i.e 10 COIL DETECT results).

In a results screen, a STORE F-key is available. For example, in the COIL DETECT screen, STORE is F3.

Upon pressing a STORE F-key, you will see the STORED RESULTS list screen. The screen in Figure 18 lists all other results that have already been stored.

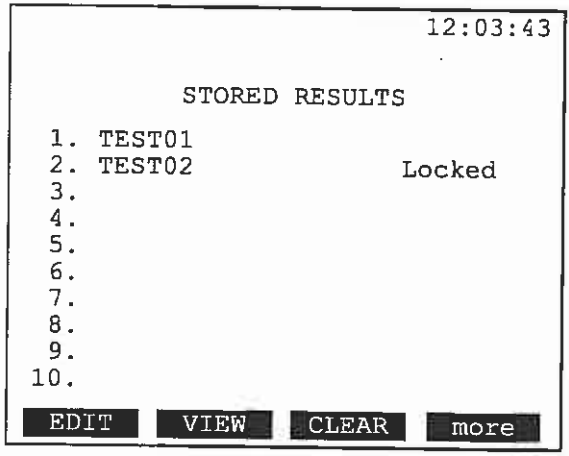

Figure 18 Stored Results List Screen

Use the following procedure to store your results:

1. Press the STORE F-key found in any of the results screens.
2. The STORED RESULTS list screen appears as in Figure 18.
3. Use the keypad down arrow key to move the cursor to a blank line.
4. Press the EDIT (F1) F-key.
5. The STORED RESULTS detail screen appears. This screen contains two lines, SOURCE and CIRCUIT ID. The cursor will will be on the SOURCE line. Press the EDIT (F1) F-key to enter a SOURCE name. The STORED RESULTS character screen in Figure 19 appears as shown.

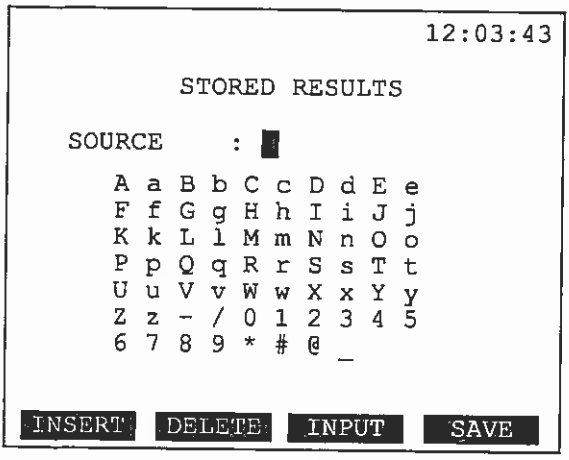

Figure 19 Stored Result Character Screen

6. The SOURCE line appears in the first STORED RESULTS screen as the label. To enter the SOURCE name, use the following procedure:
   A. Press the INPUT (F3) F-key and a cursor appears on the letter "A".
   B. Use the keypad arrow keys to move the cursor to the desired character.
   C. When the cursor is on the correct character, press the keypad ENTER key. The character appears on the SOURCE line.
   D. Continue this process until you have completed the SOURCE label. You may enter up to 15 characters.
   E. When your entry is complete, press the STOP (F3) F-key to remove the cursor from the character grid.
   F. Press the SAVE (F4) F-key to save the SOURCE label.
7. If desired, you may also enter a Circuit ID. Move the cursor to the CIRCUIT ID line and follow the same steps outlined in step 6. You may enter up to 15 characters for CIRCUIT ID.
8. To save your result, press the SAVE (F4) F-key. These results will now be stored in the menu as your SOURCE entry.

1.1 Viewing Stored Results

Refer to the following procedure to view your stored results:

1. Press the STORE F-key found in a results screen.
2. The STORED RESULTS list screen appears in Figure 18.
3. Use the keypad up/down arrow keys to select the result you wish to view.
4. When the entry you wish to view is selected, press the VIEW (F2) F-key.

1.2 Locking Stored Results

You may lock your results to prevent them from being accidentally erased. When a result is locked, it cannot be edited or deleted (except by NV RAM Erase). To lock a result:

1. In the STORED RESULTS list screen, use the keypad up/down arrow keys to select the result you wish to lock.
2. When the entry you wish to lock or unlock is selected, press the more (F4) key; then press UN/LOCK (F2). The UN/LOCK key toggles between locked and unlocked.
3. Note the right column now shows this result as locked.
4. In order to unlock this result (to edit or delete it), press the UN/LOCK F-key.

1.3 Clearing Stored Results

Refer to the following procedure to clear a stored result:

1. In the STORED RESULTS list screen, use the keypad up/down arrow keys to select the result.
2. Make sure the right column shows this result to be unlocked. If not, you will need to press more (F4), then UN/LOCK (F2). A result cannot be deleted while locked.
3. When the entry you wish to delete is selected, press the CLEAR (F3) F-key.
4. The result is now deleted and this space free to store another result.

2.0 Transferring Results to a PC

Using the SunSet Mono Remote Control PC software you can transfer most stored results to a PC and generate a test report.

1. Verify that your serial port is configured properly for both the computer and the SunSet MTT.

- 19200 baud rate is recommended.

2. Connect the SunSet MTT to the PC. You must use the following combination:

- SS115D (DIN-8 to DB9) printer cable and a SS122B Null Modem adapter.

2.1 Configuring the Serial Port

In order to print correctly, the SunSet MTT's serial port must be configured to match the destination printer/PC. To configure the serial port, refer to chapter 3, section 2.5 Serial Port Configuration.

Chapter 6 Customer Information

1.0 Customer Service

General Sunrise Telecom Customer Service is available from 7:30 AM to 5:30 PM Pacific Standard Time (California, U.S.A.).

Customer Service performs the following functions:

- Answers customer questions over the phone on such topics as product operation and repair.
- Facilitates prompt repair of malfunctioning SunSet MTTs.
- Provides information about product upgrades.

A Return Merchandise Authorization (RMA) Number is required before any product may be shipped to Sunrise Telecom for repair. Out-of-warranty repairs require both an RMA and a Purchase Order before the unit is returned. All repairs are warranted for 90 days.

Please contact Customer Service if you need additional assistance:

Customer Service
Sunrise Telecom Incorporated
302 Enzo Drive.
San Jose, CA 95138
U.S.A.
Tel: 1-408-363-2200 or 1-800-701-5208
Fax: 1-408-363-8313
Internet: http://www.sunrisetelecom.com
Email: support@sunrisetelecom.com

SunSet MTT Support Hotline

In addition to general customer service, a 24-hour SunSet MTT support line is available for dedicated SunSet MTT technical support. Our knowledgeable SunSet MTT support staff is ready to help you with any questions you might have regarding SunSet MTT testing.

Call: 1-888-922-9375

2.0 Express Limited Warranty

A. Hardware Coverage. COMPANY warrants hardware products against defects in materials and workmanship. During the warranty period COMPANY will, at its sole option, either (i) refund of CUSTOMER'S purchase price without interest, (ii) repair said products, or (iii) replace hardware products which prove to be defective; provided, however, that such products which COMPANY elects to replace must be returned to COMPANY by CUSTOMER, along with acceptable evidence of purchase, within twenty (20) days of request by COMPANY, freight prepaid.

B. Software and Firmware Coverage. COMPANY warrants software media and firmware materials against defects in materials and workmanship. During the warranty period COMPANY will, at its sole option, either (i) refund of CUSTOMER'S purchase price without interest, (ii) repair said products, or (iii) replace software or firmware products which prove to be defective; provided, however, that such products which COMPANY elects to replace must be returned to COMPANY by CUSTOMER, along with acceptable evidence of purchase, within twenty (20) days of request by COMPANY, freight prepaid. In addition, during the warranty period, COMPANY will provide, without charge to CUSTOMER, all fixes and patches to the original product specifications sold which COMPANY issues during the warranty period. COMPANY does not warrant or represent that all software defects will be corrected. In any case where COMPANY has licensed a software product "AS-IS," COMPANY'S obligation will be limited to replacing an inaccurate copy of the original material. This warranty does not cover upgrade or enhancements to product software and firmware.

C. Period. The warranty period for Hardware, Software and Firmware will be One (1) Year from date of shipment to CUSTOMER. The COMPANY may also sell warranty extensions or provide a warranty term of three years with the original sale, which provide a longer coverage period for the test set chassis, software and firmware, in which case the terms of the express limited warranty will apply to said specified warranty term.

D. Only for CUSTOMER. COMPANY makes this warranty only for the benefit of CUSTOMER and not for the benefit of any subsequent purchaser or licensee of any merchandise.

E. LIMITATION ON WARRANTY. THIS CONSTITUTES THE SOLE AND EXCLUSIVE WARRANTY MADE BY COMPANY WITH RESPECT TO HARDWARE, SOFTWARE AND FIRMWARE. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED. COMPANY SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. COMPANY'S LIABILITY UNDER THIS AGREEMENT WITH RESPECT TO A PRODUCT, INCLUDING COMPANY'S LIABILITY FOR FAILURE AFTER REPEATED EFFORTS TO INSTALL EQUIPMENT IN GOOD WORKING ORDER OR TO REPAIR OR REPLACE EQUIPMENT, SHALL IN NO EVENT EXCEED THE PURCHASE PRICE OR LICENSE FEE FOR THAT PRODUCT, NOR SHALL COMPANY IN ANY EVENT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, INDIRECT, OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, ARISING FROM OR RELATED TO THE SALE OF THE MERCHANDISE HEREUNDER, INCLUDING BUT NOT LIMITED TO DAMAGES ARISING FROM OR RELATED TO LOSS OF BUSINESS, LOSS OF PROFIT, LOSS OF GOODWILL, INJURY TO REPUTATION, OVERHEAD, DOWNTIME, REPAIR OR REPLACEMENT, OR CHARGE-BACKS OR OTHER DEBITS FROM CUSTOMER OR ANY CUSTOMER OF CUSTOMER.

G. No Guaranty, Nonapplication of Warranty. COMPANY does not guaranty or warrant that the operation of hardware, software, or firmware will be uninterrupted or error-free. Further, the warranty shall not apply to defects resulting from:
(1) Improper or inadequate maintenance by CUSTOMER;
(2) CUSTOMER-supplied software or interfacing;
(3) Unauthorized modification or misuse;
(4) Operation outside of the environmental specifications for the product;
(5) Improper site preparation or maintenance; or
(6) Improper installation by CUSTOMER.

SUNRISE TELECOM
INCORPORATED

Dual T1 Module for the SunSet xDSL

User's Manual
SSxDSL-8M
Version 2.01

MAN-11530-US001 Rev. B

Sunrise Telecom®..... A Step Ahead

22 Great Oaks Blvd. San Jose, CA 95119
Tel: 1-408-363-8000 Fax: 1-408-363-8313

Dual T1 Module
Table of Contents

Warning!

Do not remove or insert xDSL modules while the SunSet xDSL is powered on. Inserting a module with the power on may damage the module and or the SunSet xDSL.

Do not remove or insert software cartridge while the set is powered on, damage to the cartridge can occur.

1.1 Dual T1 LED's

The LEDs provide valuable information on the SunSet xDSL current test mode. In Dual T1 or module testing, the xDSL LED lights green.

Figure 1 shows the SunSet xDSL LED panel. Figure 2 shows the SunSet xDSL-Light LED panel. The definitions and functions of the LED's are the same.

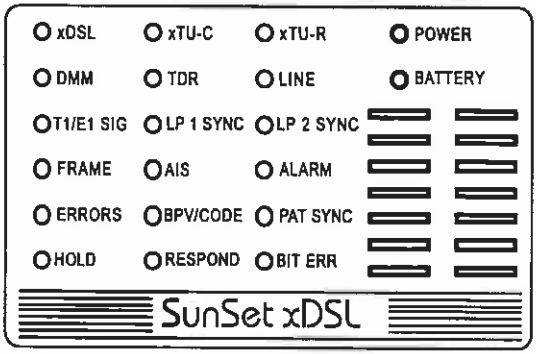

Figure 1 SunSet xDSL **LED's**

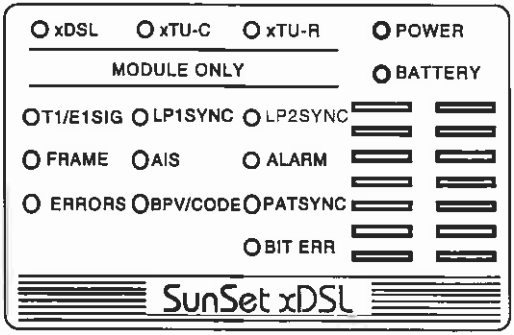

Figure 2 SunSet xDSL-**L LED's**

The LEDs are defined as follows for the Dual T1 module. Not all LEDs are used for the Dual T1 module; only the LEDs defined here are applicable to Dual T1 testing.

xDSL: The xDSL LED lights green to indicate that the SunSet xDSL is in the Dual T1 (module) mode. Pressing the MODULE key, this LED lights green.

xTU-C: This LED lights green when the SunSet xDSL is emulating an ATU-C or HTU-C. It is off when in the Dual T1 mode.

xTU-R: This LED lights green when the SunSet xDSL is emulating an ATU-R or HTU-R. It is off when in the Dual T1 mode.

DMM: This LED is green only in the DMM mode.

TDR: This LED is green only in the TDR mode.

LINE: This LED is green only in the LINE mode.

T1/E1 SIG: This LED is active when in the Dual T1 mode. It is green when the SunSet xDSL is receiving a T1 signal on the line selected in the Test Configuration/LED panel. It is red when the SunSet xDSL is NOT receiving a T1 signal as expected.

FRAME: This LED is active when the Dual T1 module is in a framed test mode. This LED is active for one line only. In the Dual T1 Mode this line is selected in the Test Configuration screen on the LED PANEL line: either LINE 1 or LINE 2 can be selected. When the TEST MODE is T1 Single, the FRAME LED default is LINE 1

and cannot be changed. The LED is green when the SunSet xDSL has achieved frame synchronization and the framing found on the received signal of the selected line matches the framing set in the Test Configuration screen on the FRAMING line. The LED is red when the configured framing type is not found on the received signal of the line selected in the Test Configuration screen on the FRAMING line. This could indicate either a loss of framing on the received signal or a framing mismatch.

PAT SYNC: This LED is active for the Dual T1 module when performing a BERT test with a known test pattern. The LED is red if there is no pattern synchronization or if synchronization has been lost. The LED lights green when the SunSet xDSL has achieved pattern synchronization. This happens when the receiver of the line selected in the Test Configuration/RxDrop is receiving the same pattern as the one transmitted by the SunSet xDSL. This LED is inactive in VF Channel Testing.

HOLD: This LED is green when the HOLD key on the keypad has been pressed in the TDR mode.

RESPOND: This LED is green only in the RESPONDER mode, and only for LINE testing.

BIT ERR: This LED is active for the Dual T1 module when performing a BERT test with a known test pattern. The LED is red if the SunSet xDSL is currently detecting a bit error on the receiver of the line selected in the Test Configuration/RxDrop. It will be blinking red if the SunSet xDSL has previously detected bit errors on the receiver of the line selected in the Test Configuration/ RxDrop, but there are no errors currently. Pressing the HISTORY key on the keypad will clear this flashing LED.

POWER: This LED is green when the SunSet xDSL is powered on.

BATTERY: This LED is green when the SunSet SS138 AC adapter/ charger is connected and the SunSet xDSL is charging. It is red when the SunSet xDSL detects a low battery condition.

The following LEDs are active for one line only. In the Dual T1 Mode this line is selected in the Test Configuration screen on the LED PANEL line: either LINE 1 or LINE 2 can be selected. When the TEST MODE is T1 Single, the default is LINE 1, and cannot be changed.

AIS: This LED is red when the SunSet xDSL is currently detecting an AIS (all 1 signal without framing). It will be blinking red if the SunSet xDSL previously detected an AIS on the line, but there are no errors currently. Pressing the HISTORY key on the keypad will clear this flashing LED.

ALARM: This LED will be red if the SunSet xDSL is currently detecting an alarm condition. It will be blinking red if the SunSet xDSL has previously detected an alarm condition. Pressing the HISTORY key on the keypad will clear this flashing LED.

ERRORS: This LED is red if the SunSet xDSL is currently detecting an error. This can be a framing bit, CRC-6 or other errors other than BPV or bit error. It will be blinking red if the SunSet xDSL has previously detected errors. Pressing the HISTORY key on the keypad will clear this flashing LED.

BPV/CODE: This LED is red if the SunSet xDSL is currently detecting a Bipolar Violation (BPV) or code error. This LED will be blinking red if the SunSet xDSL has previously detected a Bipolar Violation (BPV) or code error but it is no longer present. Pressing the HISTORY key on the keypad will clear this flashing LED.

1.2 Dual T1 Connector Panel

The Dual T1 module connector panel is shown in Figure 3.

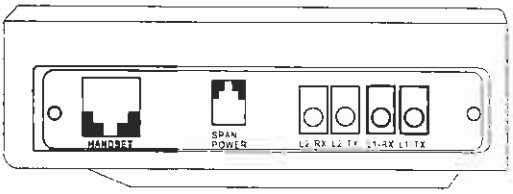

Figure 3 Dual T1 Connector Panel

Handset: You may connect the handset to the RJ-9 port for VF talk and listen functions.

SPAN POWER: This port is for future applications

L2-RX & L2-TX: These jacks are used when T1 DUAL is selected in TEST CONFIGURATION. The L2-RX jack port can also be used as the reference frequency input in T1SINGL mode.

L1-TX & L1-RX: These jacks are used both for T1SINGL and T1DUAL access modes

Section 2 Menus

The Dual T1 module operates with a menu-driven format. Before you can select a menu item, you must first highlight the desired line using the arrow keys. You can easily recognize a highlighted item, because the area around the item is dark, while the writing is light. After highlighting the item, execute the selection by pressing the ENTER key on the keypad. In a few cases, such as in the SEND TEST PATTERN menu, the simple act of highlighting an item will execute the selection.

The following menu tree shows the location of major menu items.

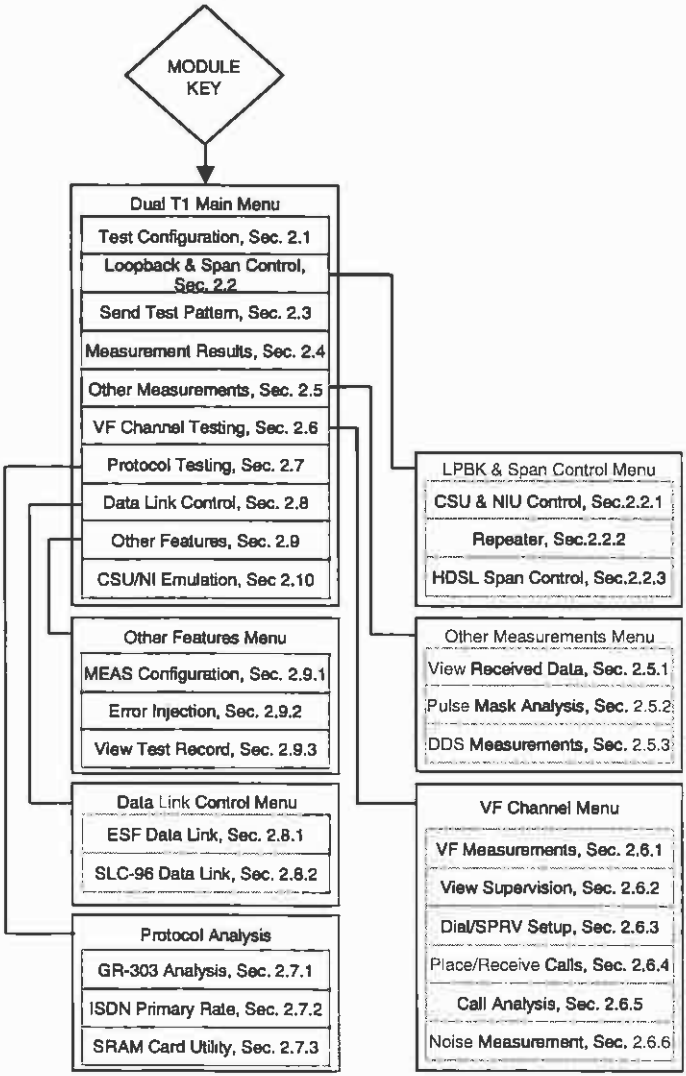

Figure 4 Menu Tree

2.1 Using the Test Configuration Menu

A circuit is accessed by:

1. Configuring the TEST CONFIGURATION menu to correspond to the circuit under test.
2. Connecting the test set to the circuit.

The Dual T1 module can be configured to automatically detect incoming framing and test pattern by pressing the AUTO key on the keypad.

Note: Configuration is the most important part of the entire test procedure. If the items in the Test Configuration Screen are configured incorrectly, all measurement results will be meaningless.

To configure the test set for DS1 testing, use the following procedure:

1. From the DUAL T1 MAIN MENU > TEST CONFIGURATION .
2. With TEST MODE highlighted, press the F1 key to choose T1SINGL or F2 for T1DUAL

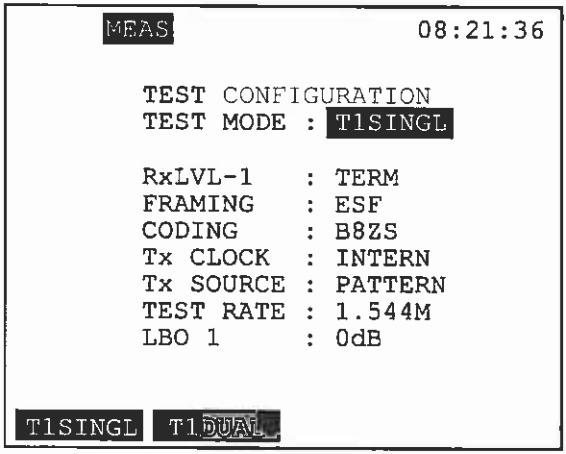

Figure 5 T1 Single Test Configuration

3. RxLVL-1

Options: TERM (F1), MONITOR (F2) or BRIDGE (F3)

Configure the receiver.

TERM: The TERM mode is used when you will send and receive a T1 signal. TERM mode requires that the circuit be disrupted for testing.

The received signal is terminated by the test set. It is not obtained through a MONITOR jack, and it can have up to 36 dB of cable transmission loss (this is a different kind of loss than the 20 dB of resistive loss provided by a DSX MON jack.). Note that if you plug into a DSX MON jack in the TERM mode, the BPV/CODE LED will probably come on. Use the MONITOR mode instead.

MONITOR: The MONITOR access mode is used where a monitor measurement will be made. Further, the signal is provided from the MON jack of a DSX, DS1 plug-in card, CSU, or NI. The DSX has isolated the MON signal from the live signal with a high impedance circuit. The transmitter is turned on and is sending the selected test pattern.

This mode is useful because the DSX monitor jack protects the live signal from any possible disruptions caused by the testing process. It allows the technician to observe the line while the customer is actually using it and to see if there are any problems. Note that if MONITOR mode is selected when a 3 volt signal is received, then the red ERRORS LED will be lit. This often happens if MONITOR is selected when the test set is plugged into an OUT jack. In this case, TERM should be selected instead of MONITOR.

In some cases, it may not be clear if the MON jack provides a bridged access or a 20 dB isolated monitor access. In this case, you should try BRIDGE first to see if this works and then try MONITOR if it doesn't.

BRIDGE: The BRIDGE monitor is similar to the MONITOR mode. However, in BRIDGE the test set taps into a live, in-service, terminated DS1 signal with up to 36 dB cable loss. The set applies isolation resistors to protect the circuit from a hit.

Be sure to select BRIDGE before clipping onto the live circuit. This will put the isolation resistors in place and ensure that the test set does not place a hit on the circuit.

If you use BRIDGE mode on a DSXMON jack, there will be a total of 40 dB resistive isolation and the test set will likely report loss of signal. Also, in some cases it may not be clear if the monitor jack being used provides a bridged access or a 20 dB isolation monitor access. In this case, you should try BRIDGE first to see if this works and then try DSXMON if it doesn't. If BRIDGE mode is selected for a 3 volt signal from an OUT jack, then the ERRORS LED will probably light. Use the TERM mode instead.

4. FRAMING

Options: ESF (F1), SF-D4 (F2), SLC-96 (F3), UNFRAME (F4)

Select the framing type which is present on the T1 line.

ESF: refers to Extended Super Frame; 24 frames are grouped together.

SF-D4: for the simplest framing, where 12 frames are grouped together.

SLC-96®: was introduced by AT&T and later standardized by Bellcore.

UNFRAME: for no framing.

Note: A specific framing type should be chosen when:

A. the circuit is provisioned for a specific type of framing.
B. there is no T1 signal available when the test set is plugged in.
C. the test set will be used with another test set that is already configured for auto framing.
D. the test set will control the framing that is put on the T1 line.
E. the test set will provide a signal to itself without first passing through network equipment which will force a specific framing.

If the framing on the received signal does not match the framing specified in the FRAMING menu, the test set will show a frame loss. If the received framing changes during the middle of a test, the test set will also show frame loss, even in the AUTO mode.

If no framing was present when the SunSet xDSL was first configured, but then framing appeared, you can force the test set to synch onto the framing by pressing the AUTO key on the keypad.

5. CODING

Options: B8ZS (F1) or AMI (F2).

Select the coding to be transmitted on the DS1 signal.

B8ZS: Bipolar 8-Zero Substitution uses a bipolar violation substitution which guarantees the 12.5% average with a maximum number of 7 consecutive zeroes. B8ZS coding is preferred, because it reduces transmission problems caused in AMI.

AMI: Alternate Mark Inversion requires the terminal transmitting data to have at least a 12.5% average 1's density and a maximum of 15 consecutive zeroes.

Note: It is not always possible to determine the line coding of a circuit. For instance, an all 1's signal will mask the presence of B8ZS coding.

6. Tx CLOCK

Options: INTERN (F1), Rx-1 (F2), or Rx-2 (F3)

When THRU is chosen for Tx Source the set is forced to RX-1.

INTERN: Internal timing should be used when:

A. an external frequency source is not available.
B. the test set will not be transmitting towards synchronized network equipment.
C. the test set will be supplying clock to the circuit to be tested, such as a hi cap T1 loop, PBX, or remote terminal of a digital loop carrier.
D. the 5 ppm accuracy of the INTERNal clock is sufficient.
E. most kinds of loopback testing is performed.

RX-1: Timing should be used when you are plugging into a switch or other synchronous element, which requires the test set to be slave timed. Use RX-1 for placing a voice or data call into a switch or digital cross-connect system (DCS). This ensures that the signal will not slip and cause repetitive slips or stuffs, which destroy circuit integrity. However, using RX-1 in the wrong application, such as loopback testing, may cause a loss of signal.

RX-2: Timing should be used if you want to supply an external DS1 signal to the L2-RX jack in order to synchronize the signal coming out of L1-TX. You can use RX-2 as a reference clock for measuring frequency synchronization and clock slips. You can use the L2-RX jack even in T1SINGL mode, but you should realize that you cannot control the receiver level of this jack.

7. Tx SOURCE

Options: PATTERN (F1), or THRU (F2)

Select the source of your DS1 test signal.

PATTERN: Select this to transmit the selected DS1 test pattern in each time slot. Your test pattern is configured from the SEND TEST PATTERN menu.

THRU: Select this to loop each of the incoming channels from the DS1 RX to TX without placing any test pattern on the line.

Fractional T1: When TX Source equals Pattern and the Test Rate equals NX64K the test set will generate a test pattern, as selected in the SEND TEST PATTERN screen, on any of the selected channels. It will generate an IDLE CODE, either 7F or FF as selected, in the non-selected channels.

When TX Source equals THRU and the Test Rate equals NX64K the test set will generate the test pattern, as selected in the SEND TEST PATTERN screen, on any of the selected channels. It will pass all of the non-selected channels through unaffected.

Note: An application for the THRU mode, a channelized T1 line is experiencing problems with channels 1—3. The technician can test channels 1—3 while the rest of the channels stay in service.

8. TEST RATE

Options: 1.544M (F1), Nx64K (F2), Nx56K (F3)

Select the test rate.

1.544M for normal T1 and DS1 testing.

Nx64K for fractional T1 testing, where the fractional circuit is any number of 64 kbps channels within the DS1.

Nx56K where the fractional circuit is any number of 56 kbps channels within the DS1. In this case, the test set will transmit a 1 in the eighth (least significant) bit of each fractional T1 channel.

If you have chosen one of the fractional settings, you will see the following display shown in Figure 6, Fractional T1.

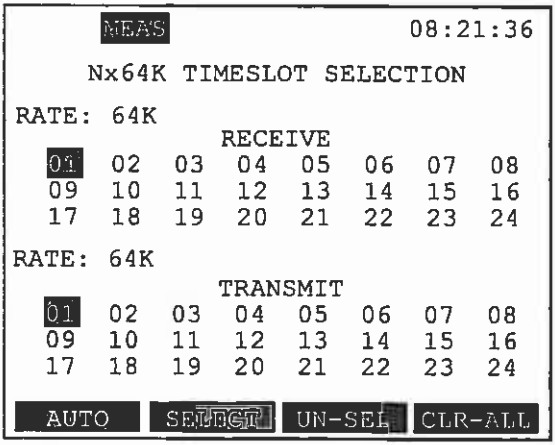

Figure 6 Fractional T1

As shown in Figure 6, Fractional T1, you have two options for selecting the desired combination of channels.

- Press F1 for AUTO, and the test set will automatically configure itself to the fractional T1 channel. The test set performs this auto configuration by looking for the 7F idle code on the unused channels.
- If you would rather select the exact channels to be tested yourself,

you may do so by pressing SELECT (F2) on each desired channel. Use the arrow keys to move the cursor to the desired time slot and press SELECT (F2). As you select the RECEIVE time slots, the test set will fill in the corresponding TRANSMIT side for you. If you wish to configure the TRANSMIT side differently, simply use the Down Arrow key to access these numbers and set up your selections manually. If you inadvertently select the wrong channel, press the UN-SEL (F3) key. Press CLR-ALL (F4) to deselect everything and start over again.

9. LBO 1

Options: 0 db (F1), -7.5dB (F2), -15 dB (F3), -22.5 dB (F4)

Select the Line Build Out you wish to appear on your transmitted T1 signal.

- 0 dB is used when:
  A. the set is plugged in at the front panel jack of a DSX, CSU equipment direction, NI equipment direction, channel bank, or other 3V test point, or
  B. there is 132 ft. or less cabling between the test set and the DSX, or
  C. under most conditions.

- -7.5 dB , -15 dB, or -22.5 dB is used when:
  A. transmitting toward the T1 span from a central office or customer premises and a 7.5 dB, 15 dB or 20 dB attenuator is not in series with the set or,
  B. when the signal should be transmitted at a lower level to prevent near-end cross talk problems or,
  C. when the signal should be attenuated so that it arrives at the next repeater at approximately -31 dB dsx level.

The following is applicable when T1DUAL is chosen. Please also refer to Figure 7, Dual T1 Test Configuration.

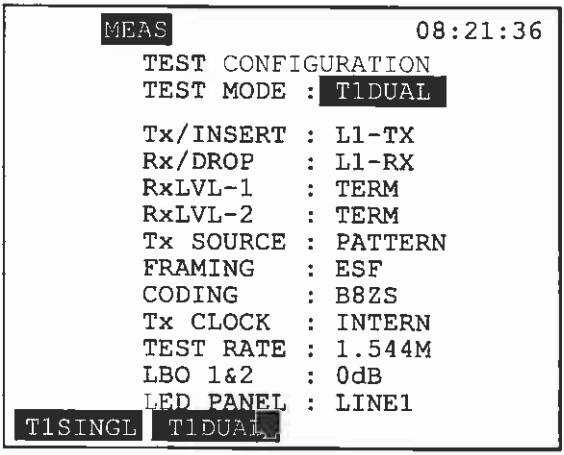

Figure 7 T1 Dual Test Configuration

10. TX/INSERT

Options: L1-TX (F1) or L2-TX (F2)

Tx/INSERT determines the line on which you will transmit your test pattern or insert the dropped signal.

Press L1-Tx (F1) to select Line 1 or L2-Tx (F2) for Line 2. This determines where the 1.544M test pattern, Nx64 kbps test pattern, Nx64 kbps multiplexed signal, Nx56 kbps multiplexed signal, or voice frequency channel will be inserted. For example, if Tx/INSERT is configured for L2-Tx, and you are talking on the test set, then your voice will be inserted on Line 2.

11. RX/DROP

Options: L1-RX (F1) or L2-RX (F2)

Rx/DROP determines the line on which you will receive your test signal.

Press L1-Rx (F1) to select Line 1 or L2-Rx (F2) for Line 2. This selection configures which receiver will be used for measuring the following: bit error rate, 1.544 Mbps frequency, voice channel frequency, voice channel level, and voice channel Rx A/B/C/D. For example, if you want to perform a bit error rate test on the received signal from Line 1, then you should choose Rx/DROP= L1-Rx. The PAT SYNC and BIT ERROR LED refer to the Rx/DROP line.

12. RxLVL-1 & 2

Options: TERM (F1), MONITOR (F2) or BRIDGE (F3)

RxLVL-1 and RXLVL-2 configure the two 1.544M receivers. These settings let the Dual T1 module electrically decode a 1.544 Mbps signal under a wide range of resistive or cable losses. They also determine which electrical load will be placed on the circuit by the Dual T1 module. There is no effect on the transmitter. In a 1.544 Mbps circuit, there must always be exactly one receiver that applies the low impedance (100 Ω) termination. There should never be two or more receivers applying a low impedance termination.

Warning!
If you are uncertain as to which option to choose, select BRIDGE. This will protect the 1.544 Mbps signal.

TERM : The TERM mode is used when you will both send and receive a T1 signal. It requires that the circuit be disrupted for testing.

The received signal is terminated by the test set and is not obtained through a MONITOR jack. The received signal can have up to 36 dB of cable transmission loss (this is a different kind of loss than the 20 dB of resistive loss provided by a DSX MON jack).

Note: If you plug into a DSX MON jack in the TERM mode, the BPV LED will probably come on. Use the MONITOR mode instead.

MONITOR : The MONITOR access mode is used when a monitor measurement will be made. The signal is provided from the MON jack of a DSX, DS1 plug-in card, CSU, or NI. The DSX has isolated the MON signal from the live signal with a high impedance circuit. The transmitter is turned on and is sending the selected test pattern.

This mode is useful, since the DSX monitor jack protects the live signal from any possible disruptions caused by the testing process. It allows the technician to observe the line and check for problems while the customer is actually using it.

If MONITOR mode is selected when a 3V signal is received, then the red BPV LED will be lit. This often happens if MONITOR is selected when the test set is plugged into an OUT jack. In this case, TERM should be selected instead of MONITOR.

In some cases, it may not be clear if the monitor jack provides bridged access or 20 dB isolated monitor access. In this case, you should try BRIDGE first to see if this works and then try MONITOR if it doesn't.

BRIDGE (F3): The BRIDGE monitor is similar to the DSXMON monitor. However, in BRIDGE, the test set taps into a live, in-service, terminated DS1 signal with up to 36 dB cable loss. The test set applies isolation resistors to protect the circuit from a hit. Be sure to select BRIDGE before clipping onto the live circuit. This will put the isolation resistors in place and ensure that the test set does not place a hit on the circuit.

If you use BRIDGE mode on a DSXMON jack, there will be a total of 40 dB resistive isolation and the test set will likely report loss of signal. In some cases, it may not be clear if the monitor jack being used provides a bridged access or a 20 dB isolation monitor access. In this case, you should try BRIDGE first to see if this works and then try DSXMON if it doesn't.

If BRIDGE mode is selected for a 3V signal from an OUT jack, then the BPV light will probably come on. Use the TERM mode instead.

13. LBO 1&2

Options: 0 db (F1), -7.5dB (F2), -15 dB (F3), -22.5 dB (F4)

- This is used for both lines, see item 6, LBO for a description.

14. LED PANEL

Options: LINE 1 (F1), or LINE 2 (F2)

- Select either line 1 or line 2 to be displayed on the SunSet xDSL LED panel.
- This selection does not apply to PAT SYNC and BIT ERR LEDs.

2.2 Loopback & Span Control

You may operate several different kinds of DS1 loopback devices using the LOOP BACK & SPAN CONTROL menu. With the circuit looped back, you can measure performance on the transmission path between the Dual T1 module and the loopback device. Before proceeding, find out if the line to be tested has one or more loopback devices installed. If so, find out what type of loopback it is and how it is intended to operate.

2.2.1 DS1 Loopback

Refer to Figure 8, CSU & NI Loopback Control and procedure.

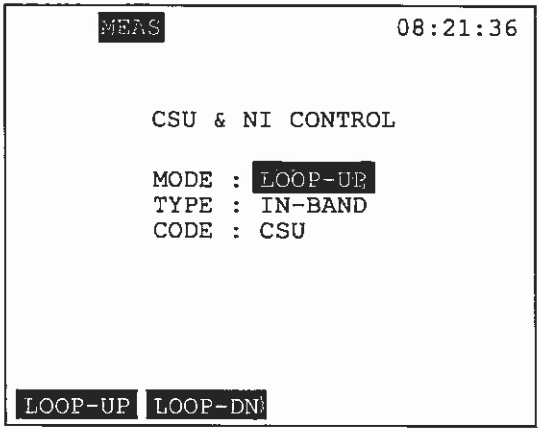

Figure 8 CSU & NI Loopback Control

2.2.1.1 Basic Loopback Procedure

1. From the Dual T1 Main Menu > LOOP BACK & SPAN CONTROL > CSU & NIU CONTROL.

Note: Do not select the MODE unless all of the other screen settings are correct. Selecting the MODE will execute the current screen settings. This should be selected last.

2. Access the loopback TYPE.
   A. Choose either an IN-BAND (F1) or ESF-DL (F2) loopback.

- IN-BAND is a common type deployed in networks today, and can be transmitted with any type of framing.

- ESF-DL can only be transmitted with ESF (extended superframe) framing, and may be required for certain NIUs.

Note: When in doubt, choose IN-BAND if you are using SF-D4 (superframe) framing, and ESF-DL if you are using ESF framing.

3. Choose the desired CODE.

The CODE will depend on the TYPE of loopback selected. IN-BAND loopbacks will have a code of either CSU, NI (also known as a smart jack), 100000, or USER. ESF-DL loopbacks will have a code of either LINE, PAYLOAD, NETWORK, or USER. To work with USER-defined loopbacks refer to the other procedures in this subsection.

- IN-BAND: Here is an explanation of what the in-band codes are used for. The NI code is used for an industry-standard Network Interface Unit (smart jack) if it is set to respond to in-band loopback codes. The loopback only regenerates the signal and should pass both BPVs and bit errors. The telephone company generally installs this unit at the customer premises.

  The CSU code is used for the customer-owned CSU. The 100000 code is used with a type of NIU (smart jack) that is standardized in some parts of the country, particularly New England.
- ESF-DL: Here is an explanation of what the ESF-DL codes are used for. The LINE code operates a line loopback at a CSU. This loopback only regenerates the signal. Bit errors and BPVs should pass through this loopback.

  The PAYLOAD code operates a payload loopback at a CSU. In this loopback, the 192 channel bits are passed through but the framing bits and line code are regenerated. Only bit errors will pass through this loopback.

  The NETWORK CODE operates an NIU (smart jack) loopback. This loopback only regenerates the signal and should pass both BPVs and bit errors.

  The codes that will be transmitted for each loopback are shown in the following two tables.

IN-BAND	CSU Loop Up: 10000
	CSU Loop Down: 100
	NI Loop Up: 11000
	NI Loop Down: 11100100000: 100000

Table 1 In-Band Network Codes

T1.403 (ESF-DL)	Line Loop Up: 11111111 01110000
	Line Loop Down: 11111111 00011100
	Payload Loop Up: 11111111 00101000
	Payload Loop Down: 11111111 01001100
	Network Loop Up: 11111111 01001000
	Network Loop Down: 11111111 00100100

Table 2 T1.403 Network Codes

4. Choose F1 (LOOP-UP) to loop the circuit up before testing.
5. Once the loopback operation is finished, you will see a message on the screen, confirming that the operation was successful.
6. Choose F2 (LOOP-DN) to loop the circuit down once the testing is complete.
7. Press the ESC key on the keypad until you return to the Dual T1 Main Menu.

Select a User Loopback Code

To select your own loopback code, use the following procedure:

1. In the CSU & NI CONTROL menu, move your cursor to the CODE item and press USER (F4).

Note: Be sure to press the F4 key even if the USER item is already displayed as the selected CODE entry. This will move you into the USER LOOPBACK CODE screen.

2. Move your cursor down to the desired loopback code and press the ENTER key on the keypad. Note that if no codes have been entered you will need to create one. Please see the following: Program a User Loopback Code.
3. You will now see the CSU & NI CONTROL menu displaying your USER pattern in the CODE position.
4. Press the ENTER key on the keypad to begin the loopback operation and proceed with the basic loopback procedure.

View a User Loopback Code

To view a pre-programmed USER loopback code, use the following procedure.

1. In the CSU & NI CONTROL menu, move your cursor to the CODE item and select USER (F4).

Note: Be sure to press the F4 key even if the USER item is already displayed as the selected CODE entry. This moves you into the USER LOOPBACK CODE screen.

2. Move your cursor down to the desired loopback code and press VIEW (F1).
3. You will now see your selected pattern on the screen.
4. When you are finished viewing, press the ESC key on the keypad to return to the USER LOOPBACK CODE menu.

Program a User Loopback Code

To program a user code, use the following procedure:

1. In the CSU & NI CONTROL menu, move your cursor to the CODE item and press USER (F4).
2. Move your cursor down to a blank position on the user pattern list. Choose CREATE (F1). A screen will appear as follows.

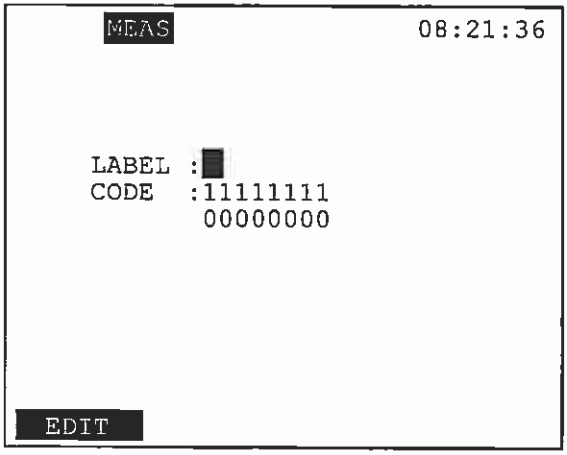

Figure 9 User Loopback Code

3. Press EDIT (F1), and the following User Code Naming Screen appears.

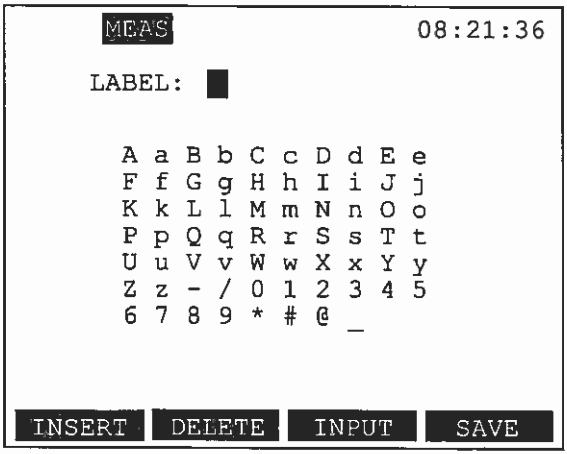

Figure 10 User Code Naming Screen

4. Choose INPUT (F3). The letter A will be highlighted within the alphanumeric grid.
   A. Use the cursor keys to move the highlighted indicator to the desired letter.
   B. Press the ENTER key on the keypad. You will see the desired letter appear next to the LABEL menu item. Continue in this fashion until you have spelled the desired name.

5. When the desired name appears in the LABEL menu item press SAVE (F4) to move out of the alphabet grid and back to the to the previous screen.
   A. Press EDIT (F1) to edit your code pattern.
   B. Press the SHIFT key on the keypad. The SHIFT indicator will turn on. Enter up to 24, 1s and 0s to make up the desired pattern. Press the SHIFT key on the keypad again to turn off the SHIFT-lock

6. When you are finished entering the code, press the SAVE (F4) key and you will return to the USER LOOPBACK CODE menu.
   A. Your new code name will be displayed for you.

Correcting a Mistake in the Label

To correct a mistake made while entering the LABEL of your USER pattern, use this procedure:

1. Access the USER LOOPBACK CODE screen, select the code you wish to correct with the cursor keys.
   A. Select EDIT (F2). The label and code screen appears. Move the cursor to the LABEL position, press EDIT (F1)
2. Place the cursor over the letter you wish to edit
   A. Press INPUT (F3) and use the cursor keys to select the new character.
   B. Press the ENTER key on the keypad. Repeat as needed.
3. When all incorrect characters have been removed, move the cursor to the right of the last character.
4. If the LABEL is now correct, press SAVE (F4) and you will return to the previous screen.

Correcting a Mistake in the Code

To correct a mistake made while entering the CODE of your loopback pattern, use this procedure:

1. This procedure assumes you are starting from step 2 of the Program a User Loopback Code procedure.
2. Move the cursor to the code line and press EDIT (F1)
3. Move the cursor to the digit you wish to correct, then press the SHIFT key on the keypad and enter the digit (0 or 1); repeat as necessary.
4. Press the SHIFT key on the keypad to release the SHIFT-lock.
5. Press SAVE (F4) when the corrected label is complete.

Edit a User Loopback Code Label

Use this procedure to edit the label of a USER code that you have created:

1. From the CSU & NI CONTROL menu, move the cursor down to the CODE menu item and select USER (F4).

Note: Be sure to press the F4 key even if the USER item is already displayed as the selected CODE entry. This moves you into the USER LOOPBACK CODE screen.

2. Move your cursor to the code that you want to edit and select EDIT (F2).
3. Edit the code's label using the "Correcting a Mistake in the Code" procedure.

Delete a User Loopback Code

Use this procedure to delete a user loopback code that you no longer want:

1. From the CSU & NI CONTROL menu, move the cursor down to the CODE menu item and select USER (F4).

Note: Be sure to press the F4 key even if the USER item is already displayed as the selected CODE entry. This moves you into the USER LOOPBACK CODE screen.

2. Move your cursor to the code that you want to delete and select CLEAR (F4).
   A. An "Are you sure" message will appear, select YES (F1) if you are, or press the ESC key on the key pad if you have changed your mind. In either case, you will return back to the USER LOOPBACK CODE list screen.

2.2.2 Repeaters

2.2.2.1 Teltrend Office & Line Repeaters

Teltrend provides a variety of office and line repeaters, which are supported by the Dual T1 module. Refer to Teltrend documentation for detailed information on the operations of these various repeaters.

2.2.2.2 Westell Office & Line Repeaters

Westell repeaters are looped back similarly to the Teltrend, but there are a few important differences in using Westell repeaters:

- The Westell central office repeater and line repeater F-key menus also include a sequential loopback (SEQLPBK) item. This allows you to quickly step through the loopbacks on a line. To use this feature, simply arm the span and then press the SEQLPBK F-key and observe which repeater loops up. You don't have to enter the repeater address. This feature is useful for tracking down misaddressed repeaters.
- If you want to do a span power down with the Westell office repeater, it must first be looped up.
- The Westell central office repeater menus do not have the fractional T1 blocking or NIU-mode commands of the Teltrend.

2.2.2.3 Repeater Setup

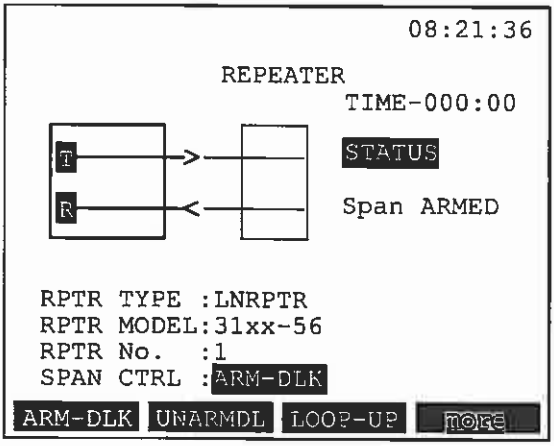

Figure 11 Repeater Screen

Figure 11 shows several aspects of the repeater control session. The items to the right of the diagram provide information on the repeater control session and can't be configured in this screen. They are:

TIME: Begins counting up from 000:00 (mmm:ss) as soon as the span is armed. This gives you an indication of how much time is remaining until the repeater automatically drops its loopback, which may occur as a result of the repeater's "time-out' circuitry.

STATUS: This bar shows you the current looping status of the span.

SPAN: This Control line, here displaying ARMED, shows you what span control function is currently under process or has just been completed.

The items appearing below the diagram in Figure 11 may be configured in this screen. They are:

RPTR TYPE
Options: LNRPTR (F1), OFFRPTR (F2)
LNRPTR: Line Repeater
OFFRPTR: Office Repeater

RPTR MODEL
Options: 31xx-56 (F1), 31xx-80 (F2), TELTRND (F3)
31xx-56: Type of Westell Repeater
31xx-80: Type of Westell Repeater
TELTRND: Teltrend Repeater

RPTR NO

Press the SHIFT key on the keypad and use the keypad to enter the desired repeater number. This specifies which repeater will be looped up.

SPAN CTRL

The Span Control line, here displaying ARMED, shows you what span control function is currently under process or has just been completed. Span Control F-keys are specific to the type of repeater selected. The following are the F-keys for supported repeaters; the definitions follow.

Span Control for Teltrend Office Repeater
Options with ESF Framing: ARM-DLK (F1), UNARMDL (F2), LOOP-UP (F3), LOOP-DN (more, F1), LPBKQRY (more, F2), POWR-UP (more, F3), POWR-DN (more, F1), DUAL-LB (more, F2), UNBLOCK (more, F3), CLR-FT1 (more, F21), TOUTDIS (more, F2).

Options with SF-D4, SLC96 and UNFRAME Framing: ARM-INB (F1), UNIVLDN (F2), LOOP-UP (F3), LOOP-DN (more, F1), LPBKQRY (more, F2), POWR-UP (more, F3), POWR-DN (more, F1), DUAL-LB (more, F2), UNBLOCK (more, F3), CLR-FT1 (more, F21), TOUTDIS (more, F2).

Span Control for Teltrend Line Repeater
Options with ESF Framing: ARM-DLK (F1), UNARMDL (F2), LOOP-UP (F3), LOOP-DN (more, F1), LPBKQRY (more, F2), PWLPQRY (more, F3), PWCUTTH (more, F1), TOUTDIS (more, F2),

Options with, SLC96, SF-D4 and UNFRAME Framing: ARM-INB (F1), UNIVLDN (F2), LOOP-UP (F3), LOOP-DN (more, F1), LPBKQRY (more, F2), PWLPQRY (more, F3), PWCUTTH (more, F1) TOUTDIS (more, F2).

Span Control for 31xx-56 Office Repeater
Options with ESF Framing: ARM-DLK (F1), UNARMDL (F2), LOOP-UP (F3), LOOP-DN (more, F1), SEQLPBK (more, F2), LPBKQRY (more, F3), POWR-UP (more, F1) POWR-DN (more, F2), TOUTDIS (more, F3).

Options with, SLC96, SF-D4 and UNFRAME Framing: ARM-INB (F1), UNIVLDN (F2), LOOP-UP (F3), LOOP-DN (more, F1), SEQLPBK (more, F2), LPBKQRY (more, F3), POWR-UP (more, F1) POWR-DN (more, F2), TOUTDIS (more, F3).

Span Control for 31xx-56 Line Repeater
Options with ESF Framing: ARM-DLK (F1), UNARMDL (F2), LOOP-UP (F3), LOOP-DN (more, F1), LPBKQRY (more, F2), PWLPQRY (more, F3), PWCUTTH (more, F1), TOUTDIS (more, F2),

Options with, SLC96, SF-D4 and UNFRAME Framing: ARM-INB (F1), UNIVLDN (F2), LOOP-UP (F3), LOOP-DN (more, F1), LPBKQRY (more, F2), PWLPQRY (more, F3), PWCUTTH (more, F1) TOUTDIS (more, F2).

The following definitions are from the functions previously outlined. Note that some functions act differently depending on the type of repeater tested, and that some functions are repeater specific.

ARM-DLK/ ARM-INB: This will arm the office and or line repeaters on the span. In most cases, ARM-DLK and ARM-INB have the same function. Arming is required before the repeaters will actually loop up.

UNARMDL: This unarms the data link.

UNIVLDN: sends the NIU in-band loop down code to drop one Teltrend or NIU at a time. When the Dual T1 module is set up for Westell type repeaters, this function causes the test set to transmit the universal loop-down code to loop-down any looped repeaters.

LOOP-UP: This commands the office repeater or specified line repeater to loop up. The repeater must be armed before using this function. If the office repeater is a Teltrend E-type, you can also choose office RPTR number 1 through 3 in RPTR NO. Do this before pressing the LOOP-UP key. However, if the E-type repeater is configured for fractional T1 blocking, only repeater number 1 can be looped up. If the Dual T1 module is set up for line, the RPTR number must be entered before the LOOP-UP command is selected. If the loop is successful, a message will appear showing the fractional configuration of the office repeater.

LOOP-DN: This commands the office or line repeater to loop down. However, it will not loop down the E-type office repeater when it is in NIU emulation mode, or does it loop-down an NIU.

LPBKQRY: Loop Back Query will query all the repeaters on the span to see which one is actually looped back. If a repeater is found, its number will be displayed in the graphic. LPBK will be displayed in a looped or in a non-looped mode.

PWRQRY: Power Query will query all the repeaters on the span to see which one is looping the span simplex power. You will see a special message if the power loop query finds a repeater in power loop.

PWCUTTH: Power Cut Through will tell the repeater, which has looped the span power, to attempt to cut that power through the other repeaters on the span.

POWR-DN: Power Down tells the office repeater to cut the power to the span. The power will remain cut until you choose another function or press the ESC key on the keypad to return to the Dual T1 Main Menu. Powering down the span resets all the repeaters. Make sure to arm the office repeater before selecting POWR-DN.

DUAL-LB: Dual Loopback, loopbacks the E-type office repeater in both directions when configured for NIU mode and has already been looped up using the ARM-INB key.

UNBLOCK: This will unblock the office repeater to allow the NIU loop up code to pass through the customer premises toward the DSX. This function is necessary when you are testing from the customer premises and want to loop back a NIU that is on the other end of the circuit. You first must send the NIU loop up code (ARM-INB). Sending the UNBLOCK code will temporarily inhibit the NIU blocking feature of the office repeater. Next, send the NIU code (ARM-INB) again and the far end NIU will loop up.

CLR-FT1: This is used to temporarily re-configure the E-type office repeater in fractional mode back to through mode. CLR-FT1 allows you to troubleshoot the span using full 1.544 Mbps testing. First you must press ARM-INB (not DL) to arm the E-type repeater. This also loops back the NIU, although you will probably not see pattern sync, because the central office repeater is still blocking the unused channels. Now press CLR-FT1 (more, F2). You should now see pattern sync and no errors. When you are finished, UNIVLDN (more, F3) will drop the NIU loop and return the office repeater to its fractional blocking mode.

TOUTDIS: This will disable the automatic time-out of the repeaters on the span. If you select this, be sure to loop down all the repeaters on the span when you are finished.

SEQLPBK: This feature is used in Westell Office and Line repeaters. This feature allows the user to quickly step through the loopbacks on the line. This feature is useful for tracking down misaddressed repeaters. You first must arm the span before activating this option.

2.2.3 HDSL Span Control

This feature allows you to test HDSL (High bit-rate Digital Subscriber Line) spans with the Dual T1 module. The HDSL Loopback screen contains a graphic which updates according to circuit status.

1. From the Dual T1 Main Menu > LOOPBACK & SPAN CONTROL > HDSL SPAN CONTROL.
2. The following screen appears, allowing you to choose the type of loopback.

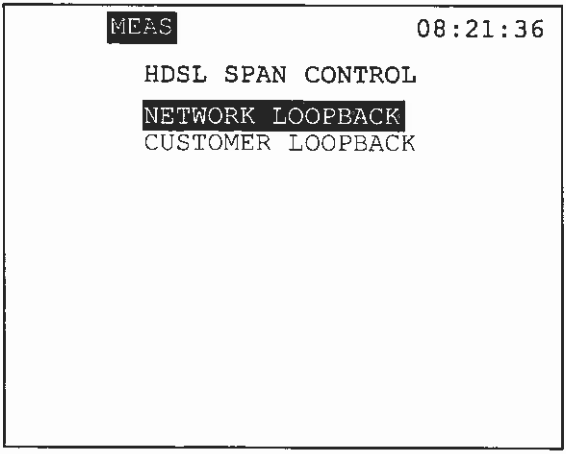

Figure 12 HDSL Span Control Menu

2.2.3.1 Network Loopback

The Network loopback enables the user to send loopback code from the Central Office HTU-C (High bit-rate Terminal Unit-Central Office) to the Customer Premises HTU-R (High bit-rate Terminal Unit-Remote Distribution).

After sending the arming code, the span is assumed to be armed and ready to receive loopback commands. BERT and error Injection testing verify the NIU loop up. If verified Figure 13 appears showing the NIU in loopback. If NIU loop up is not verified, the NIU remains in through mode.

In some cases, the HTU-R can be configured to react to Smartjack loopback commands, in which case the loop could be from the HTU-R instead of an NIU. However, in most cases a NIU is connected after an HTU-R.

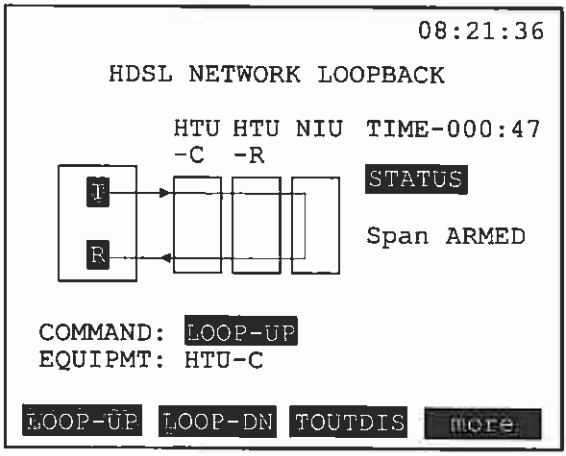

Figure 13 HDSL NIU Loopback

The following describes Figure 13, HDSL NIU Loopback.

- The box at the far left represents the Dual T1 module. The "T" indicates the L1-Tx signal; "R" indicates L1-Rx signal.
- The network boxes are labelled: HTU-C, HTU-R, NIU. When you successfully loop up a network element, the graphic updates. For example, Figure 13 shows a loopback at the NIU.
- TIME indicates the amount of time that has elapsed since arming the span.
- STATUS: indicates the span's status. This reports either "Span Idle" or "Span Armed."

COMMAND
Options: ARM-INB (F1), UNARM (F2), LOOP-UP (more, F1), LOOP-DN (more, F2), TOUTDIS (more, F3), ARM-DL (more, F1), UNARMDL (more, F2)

ARM-INB: Arm In band sends an arming code in-band. Most equipment must be armed before responding to loopback commands.

UNARMIN: Un Arm In band sends a disarming code in-band.

LOOP-UP: This sends a loop command for the specific network equipment specified below at EQUIPMT.

LOOP-DN: This sends a loop down command for the specific network equipment specified below at EQUIPMT.

TOUTDIS: This sends a Timeout Disable command. Span equipment may be provisioned for an automatic timeout where a loopback is dropped after a specified period (e.g. 1 hr). Sending the TOUTDIS command disables this feature. Therefore, if you send this command – *be sure to loop down any equipment when you're done testing.*

ARM-DL: This sends an arming command in the datalink. This arms the equipment on the span. Most equipment must be armed before responding to loopback commands. You will have this option only with ESF-DL framing.

UNARMDL: This sends a disarming command in the datalink. You will have this option only with ESF-DL framing.

EQUIPMT

Options: HTU-C (F1), HTU-R (F2)

This specifies which particular equipment will be looped up/down when you send a LOOP-UP or LOOP-DOWN command.

HTU-C: This function refers to the HDSL transceiver at the Central Office. This command invokes a loopback of the DS1 signal at the HTU-C/HLU toward the network. This loopback does not involve the 2B1Q HDSL span.

HTU-R: This function refers to the remote HDSL unit. This command invokes a loopback of the DS1 signal at the HTU-R/HRU toward the network. This is a far-end loopback and involves the 2B1Q HDSL span.

Notes:

- Sending a loopback command loops the DS1 signal toward the network.
- Often, the HDSL equipment must be armed before responding to loopback commands. First send an ARM-DL (ESF) or ARM-INB (SF), then send the loop up command.
- The arming command follows the same sequence as the standard NIU loop up code. An arming command will loop the far-end NIU, if an NIU is present and it responds to loopback commands. Or, if the NIU loopback feature for the HDSL span is enabled, the arming sequence will activate the NIU loopback in the HTU-R.

In-band Loopback Codes	
ARM-INB	11000 11000
UNARM	11100 11100
HTU-C Loop up	11010011 11010011
HTU-R Loop up	11000111 01000010
HTU-C or HTU-R Loop down	10010011 10010011
TOUTDIS Loopback time-out override	11010101 11010110
ESF-DL Loopback Codes	
ARM-DL	1111111 01001000
UNARMDL	11111111 00100100

Table 3 HDSL Span Control Network Loopback Codes

2.2.4 Customer Loopback

The structure of the Customer Loopback screen is similar to the Network Loopback screen, except that the test set is now connected to the customer premises interface of the NIU and the test direction is towards the network (note the graphic layout is reversed). Any loopback made shall be towards the customer side. The F-key choices are the same as for the Network loopback.

Since an NIU only reacts to arming codes or loopback commands issued from the central office direction, an NIU, if present, will not block a loopback command sent by a test set at the customer premises to the central office.

In-band Loopback Codes	
ARM-INB	11000 11000
UNARM	11100 11100
HTU-C Loop up	11010011 11010011
HTU-R Loop up	11000111 01000010
HTU-C or HTU-R Loop down	10010011 10010011
TOUTDIS Loopback time-out override	11010101 11010110
ESF-DL Loopback Codes	
ARM-DL	1111111 01001000
UNARMDL	11111111 00100100

Table 4 HDSL Span Control Customer Loopback Codes

2.3 Send Test Pattern Menu

Refer to following figure, Send Test Pattern.

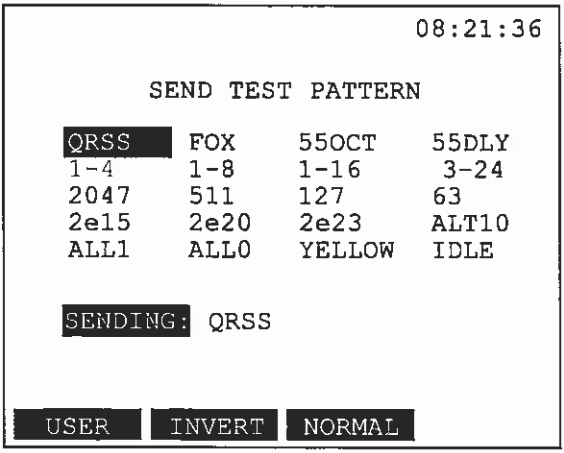

Figure 14 Send Test Pattern

2.3.1 Standard Test Patterns

This section defines the various test patterns transmitted and recognized by the test set. Use this procedure:

1. From the Dual T1 Main Menu > SEND TEST PATTERN.
2. Use the arrow keys on the keypad to move to the test pattern of interest. Note that the "SENDING:" indicator (below the list of patterns) changes as each new pattern is highlighted. As a new pattern is highlighted, the Dual T1 immediately begins transmitting the pattern.
3. Press the ENTER key on the keypad to return to the Dual T1 Main Menu.

Available Patterns: QRSS, FOX, 550CT, 55DLY, 1-4, 1-8, 1-16, 3-24, 2047, 511, 127, 63, 2e15, 2e20, 2e23, ALT10, ALL1, ALL0, YELLOW, and IDLE.

The long patterns are written in hexadecimal notation, also known as "hex". You can tell if a pattern is written in hex because it will be written with pairs of numbers separated by commas. Hex is a 16 digit number system consisting of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. The hex pattern 15 FA translates to the binary pattern 0001 0101 1111 1010, where the left most bit is transmitted first.

The following is a description of the test patterns:

QRSS: This is the industry-standard Quasi Random Signal. This signal is formed from a 20 stage shift register and is zero-constrained for a maximum of 14 consecutive zeroes. When transmitted in a framed signal, up to 15 consecutive zeroes will occur in accordance with AMI minimum density requirements.

FOX: The industry-standard FOX pattern is used in data communications applications. The ASCII translation of the pattern is the " Quick brown fox .... " sentence. The pattern is frame aligned to ensure proper ASCII translation of the bits. It is recommended that the pattern be sent with framed signals, otherwise ASCII translation is not possible. This is the pattern: 2A, 12, A2, 04, 8A, AA, 92, C2, D2, 04, 42, 4A, F2, EA, 72, 04, 62, F2, 1A, 04, 52, AA, B2, 0A, CA, 04, F2, 6A, A2, 4A, 04, 2A, 12, A2, 04, 32, 82, 5A, 9A, 04, 22, F2, E2, 04, 8C, 4C, CC, 2C, AC, 6C, EC, 1C, 9C, 0C, B0, 50

55OCT: This is the original 55 octet pattern. It is used for stress testing T1 circuits and network elements. If transmitted in a framed signal with AMI coding, it will violate the 15 zeroes constraint. It does not violate the zeroes constraint in an unframed signal. If framed, the framing bit is inserted at octet boundaries. This is the actual pattern: 80, 80, 80, 80, 80 80, 00, 80, 80, 80, 80, 80, 80, C0, 80, 80, 80, 80, E0, 80, 80, 80, 80, AA, AA, AA, AA, 55, 55, 55, 55, 80, 80, 80, 80, 80, 80, FF, FF, FF, FF, FF, FF, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80

55DLY: The 55DLY 55 Octet pattern is a special stress pattern that obeys industry standards for pulse density and maximum consecutive zeroes in both AMI and B8ZS coded circuits. Framing bits occur at octet boundaries. Note that the 55DLY octet pattern replaced the original 55 octet pattern, T1-6. This is the 55DLY octet pattern: 80, 80, 80, 80, 80, 80, 01, 80, 80, 80, 80, 80, 80, C0, 80, 80, 80, 80, E0, 80, 80, 80, 80, AA, AA, AA, AA, 55, 55, 55, 55, 80, 80, 80, 80, 80, 80, FF, FF, FF, FF, FF, FF, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80

1-4: The one-in-four pattern is used for stress testing circuits. It is frame aligned. The pattern is 0100

1-8: The industry-standard 1 in 8 pattern is used for stress testing AMI and B8ZS lines. The pattern is also called 1:7 in older literature. The pattern is frame aligned (f is the framing bit) as shown in its binary form: f 0100 0000

1-16: The industry-standard 1 in 16 pattern is used for overstressing AMI lines. It violates industry standards for pulse density. Therefore an AMI circuit that fails this test could still be a good circuit. The pattern is frame aligned ("f" is the framing bit) as shown in its binary form: f 0100 0000 0000 0000

3-24: The industry-standard 3 in 24 pattern is used for stress testing AMI lines. The pattern is frame aligned ("f" is the framing bit) as shown in its binary form: f 0100 0100 0000 0000 0000 0100

2047: This is the industry-standard 2047 bit code used for DDS applications.

511, 127, 63: These are industry-standard bit codes used for DDS applications.

2e15: This is the industry-standard $2e15^{-1}$ pseudo random bit sequence. This signal is formed from a 15 stage shift register and is not zero-constrained. This pattern contains up to 14 zeroes in a row and does not violate standards for consecutive zeroes in AMI-coded transmission.

2e20: This is the industry-standard $2e20^{-1}$ pseudo random bit sequence. This signal is formed from a 20 stage shift register and is not zero-constrained. This pattern contains up to 19 zeroes in a row and violates standards for consecutive zeroes in AMI-coded transmission. The QRS pattern is derived from the 2e20 pattern.

2e23: This is the industry-standard $2e23^{-1}$ pseudo random bit sequence. This signal is formed from a 23 stage shift register and is not zero-constrained. This pattern contains up to 22 zeroes in a row and violates standards for consecutive zeroes in AMI-coded transmission.

ALT10: This is the industry-standard alternating ones and zeroes pattern. The pattern is frame aligned with "f" showing the location of the framing bit. The pattern is: f 0101 0101

ALL1: The industry-standard all 1s pattern is used for stress testing T1 AMI and B8ZS lines. If the pattern is sent unframed, it will be interpreted as an AIS (Alarm Indication Signal). This is the pattern in its binary form: 1111

ALL0: This is the industry-standard all zeroes pattern. This pattern is often used to make sure that clear-channel lines have been properly provisioned for B8ZS during circuit turn-up. If a portion

of the circuit is AMI, then pattern synch and/or signal will be lost. The pattern is: 0000

IDLE: This is the industry-standard IDLE pattern. The pattern is: f 0001 0111

YELLOW: This is the industry-standard YELLOW alarm pattern. The pattern is: f 1011 1111

USER (F1)

This selection allows a user-defined pattern with a maximum length of 32 binary characters or 8s hexadecimal characters. Ten such patterns may be stored in the Dual T1 module.

2.3.2 Sending a USER Test Pattern

1. Press the ESC key on the keypad until you have reached the Dual T1 Main Menu. Move the cursor to highlight the SEND TEST PATTERN menu item. Press the ENTER key on the keypad.
2. Press the F1 key to bring up the USER TEST PATTERN screen.
3. The test set will present the list of USER patterns. Use the Down/Up arrow keys to move the cursor to the desired pattern and press the ENTER key on the keypad. Alternatively, you may view, edit, or delete an existing pattern, as well as create a new pattern to send.

Viewing a User Test Pattern

1. Once inside the USER TEST PATTERN screen, move your cursor down to the desired test pattern and press VIEW (F1).
2. You will see your selected pattern on the screen (in hex, binary, and ASCII). When you are finished viewing, press the ESC key on the keypad to return to the USER TEST PATTERN screen.

Programming User-Defined Patterns

To program a user test pattern, follow this procedure:

1. In the SEND TEST PATTERN menu, press the F1 key (USER) to enter the USER TEST PATTERN screen.
2. Move your cursor down to a blank position on the user pattern list. Choose CREATE (F1).
3. Choose toggle (F3). The letter A will be highlighted in the alphabet grid. Use the arrow keys to move the indicator to the desired letter. Choose SELECT (F4). You will see the letter appear next to the label.

4. Choose toggle (F3) to move out of the alphabet grid and back to the LABEL item.
   A. Press the Down Arrow key to move to the FORMAT item. Choose BINARY (F1) or HEX (F2). The binary input is often simpler for entering short patterns. Valid entries are '1' and '0' for binary. For HEX mode, valid entries are: '0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.'
   B. Press the Down Arrow key to move to the pattern entry area. Press the SHIFT-lock key on the keypad. Enter up to 2048 binary characters or 512 hexadecimal characters to make up the desired pattern. Press the SHIFT-lock key once. Verify that the SHIFT indicator no longer appears in the upper left corner of the screen.

5. Press the ENTER key on the keypad to store the pattern and to return to the USER TEST PATTERN screen. Your new code will now be displayed for you in the menu. Move the cursor to the pattern and press the ENTER key on the keypad. Your new pattern is now being transmitted.

Correcting a Mistake in the Label While Entering the Label

To correct a mistake made while entering the LABEL of your USER pattern, follow this procedure:

1. This procedure assumes you are starting in the alphabet grid as in step 3 of the Programming User-Defined Patterns procedure. A letter within the grid should be highlighted.
2. Choose toggle (F3) to move out of the alphabet grid and back to the LABEL item. Press the Left Arrow key until the cursor is over the unwanted letter.
3. Press DELETE (F2) to remove the desired letter or number. Repeat this as necessary.
4. When all of the incorrect characters have been removed, move the cursor to the right of the last character. If the LABEL is now correct, press the ENTER key on the keypad and you are done.
   A. If you need to add some more letters to the label, choose toggle (F3) to return to the alphabet grid with the highlighted letter. Cursor over to the desired letter and press SELECT (F4). Repeat this until the LABEL is complete. You can now press the ENTER key on the keypad to record the new LABEL and return to the USER TEST PATTERN screen. Or if you prefer, you can press toggle (F3) to return to the LABEL line and continue entering or editing the pattern.

2.4 Measurement Results Menu

The Dual T1 module continuously performs measurements on received signals. The user need not access the MEASUREMENT RESULTS menu item in order for the measurement results to be compiled. Measurements are automatically restarted every time the configuration is significantly changed. The MEASUREMENT RESULTS menu allows the user to view the accumulated measurement results and restart the measurement process.

A key concept for the measurement result screens is availability. A circuit is available for use only when the bit error rate is low enough that the signal can get through and be understood.

A circuit is said to be unavailable at the beginning of 10 consecutive severely errored seconds. Errors, errored seconds, and severely errored seconds are not accumulated when the circuit is unavailable. Therefore, if you start continuously injecting errors to the test set at a $1x10^{-3}$ error rate, you will see increasing bit errors, errored seconds, and severely errored seconds for the first 9 seconds. Then, at the tenth second, all the counts will decrease back to the values they had before the error injection was started, and the unavailable counter will suddenly increase by 10.

Once a circuit is unavailable, it becomes available only after 10 consecutive seconds without severe errors. To continue the previous example, if you turn the severe error injection off, and then insert 1 or 2 errors during the next 5 seconds, you will observe that the unavailable second counter continues to increase for the first 9 seconds while the error counter does not change. Then at the tenth second, the unavailable second counter decreases by 10 and the error counter increases by the 1 or 2 errors that you inserted.

While unavailable seconds are being counted, other measurements, such as AS, BPV, BIT, BER, FEB, CRC, ES, SES and %EFS are frozen. These measurements are resumed once unavailable seconds are no longer being counted.

It may take the test set one to three seconds to gain frame synch, pattern synch, coding synch, and to stop declaring any severe errors when a signal transitions from an unavailable state to an available state. If you want to know the exact number of seconds that contained a Loss of Signal condition, see the LOSS measurement result.

The actual measurement results screen and the values displayed depend upon the Test Mode chosen in the TEST CONFIGURATION menu. There are, however, some features common to all Measurement Results screens. The following two figures display sample Measurement Results screens. The first is for T1SINGL; the second for T1DUAL.

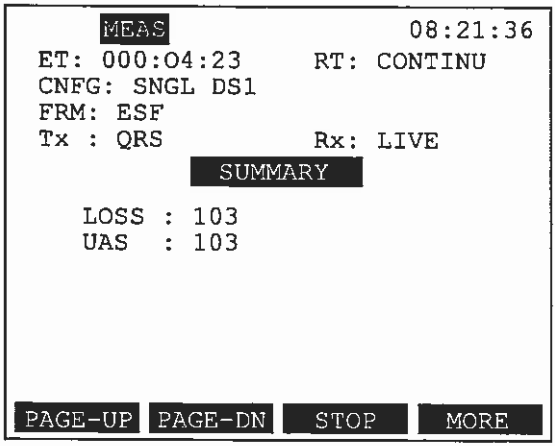

Figure 15 T1 Single Summary Screen

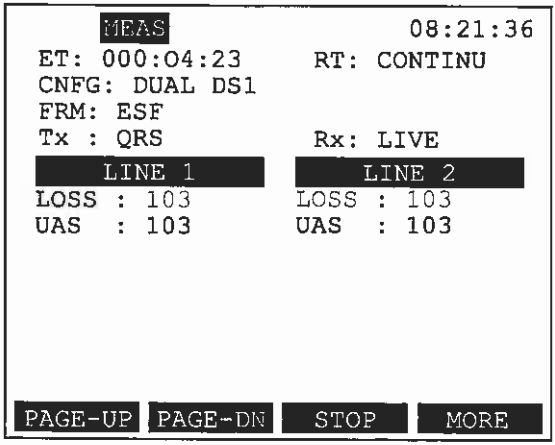

Figure 16 T1 Dual Summary Screen

These are the function keys common to each of the screens:

PAGE-UP (F1), PAGE-DN (F2): These F-keys allows you to view each of the available measurement results screens.

STOP/START (F3): Pressing STOP causes the Dual T1 module to stop the test. Pressing START restarts the measurement process.

HOLDSCR/CONTINU (more, F1): HOLDSCREEN freezes all of the measurement displays so they may be easily observed. The measurement count is still proceeding, but the counts are updated only in memory. You may now read the previous counts clearly. When you have finished viewing the screen, press the CONTINU (F1) key to view your updated measurement results, and return to a live display.

PRINT (more, F2): Press to print the results to the serial port.

SAVE (more, F3): Saves measurement results as a record that can be viewed later.

In addition to the actual measurement data, the following information is displayed in the upper portion of the measurement screens:

Current Time: The current time of day is displayed in the upper right-hand corner of the screen.

ET (Elapsed Time): Elapsed Time is the time that has passed since the test was started, or:

- since the SunSet was switched on.
- since the SunSet was re-configured using the TEST CONFIGURATION menu.
- since the process was restarted using the (F3) RESTART key.
- since the AUTO key was pressed.

RT (Remaining Time): Remaining Time is the time that remains until the end of testing. The factory default condition is that the test runs continuously until the user stops it. For this reason, CONTINU is displayed in the RT field to denote a continuous test. However, in the OTHER FEATURES menu item, you may specify the amount of test time. In this case, the remaining time will count down to zero during the measurement.

CNFG: Test mode is displayed.

FRM: The transmitted framing is displayed.

Tx: The transmitted test pattern is displayed.

Rx: The received test pattern is displayed.

To view the DS1 measurement results, use this procedure:

1. Select MEASUREMENT RESULTS from the MAIN MENU.
2. View the displayed results by using the PAGE-UP (F1) and PAGE-DN (F2) keys. See figure 15, T1 Single Summary Screen and figure 16, T1 Dual Summary Screen for sample screens. The actual measurement results screens and values which are displayed will depend up the TEST MODE configuration.
3. When you have finished viewing the measurements, press the ESC key on the keypad to return to the Main Menu.

2.4.1 Measurement Result Screens

The DS1 Measurement Results contain eight screens of results. The following screens are for T1 Single:

1. Summary
2. Line/BPV
3. Signal
4. Alarm
5. Frame
6. CRC (only with ESF framing)
7. Frequency
8. Logical/G.821

The following screens are for T1 Dual:

1. Summary: one screen shows both L1 and L2
2. Line/BPV, Line 1
3. Line/BPV, Line 2
4. Signal, Line 1
5. Alarm, Line 1
6. Alarm, Line 2
7. Frame, Line 1
8. Frame, Line 2
9. CRC (only with ESF framing), Line 1
10. CRC (only with ESF framing), Line 2
11. Frequency, Line 1, one screen for Rx/Drop line
12. Logical / G.821, one screen for Rx/Drop line

2.4.1.1 Summary Screens

The summary screens presents the most significant measurement results. The screens contains measurement results on the overall service performance measures such as errored seconds, severely errored seconds, and unavailable seconds. Bit errors are also indicated on these screens.

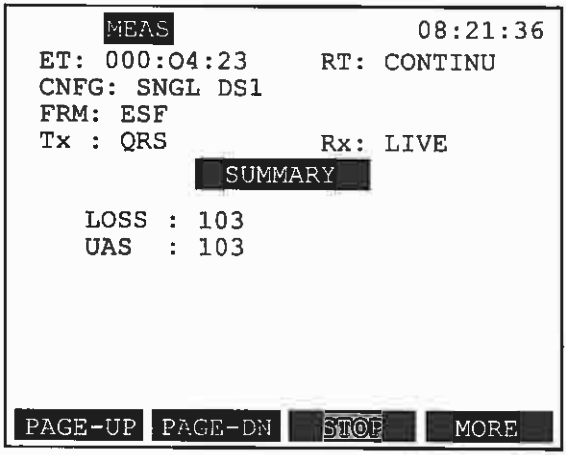

Figure 17 T1 Single Summary Screen

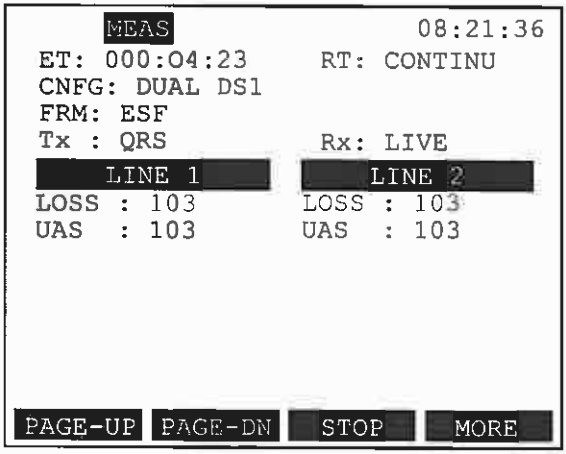

Figure 18 T1 Dual Summary Screen

The terms used on the Summary screens are defined as follows:

LOSS: Loss of Signal Seconds is a count of the number of seconds for which signal has been lost during the test.

UAS: This is a count of all the UnAvailable Seconds since the beginning of the test. Note that a T1 service is not available during an UAS.

An unavailable second is any second with a loss of signal, loss of frame, loss of pattern, or alarm indication signal. Unavailable seconds are also counted at the onset of 10 consecutive severely errored seconds. Severely Errored Seconds are defined by a 10^{-3} error rate, with error rates in this case taken as a measurement of BPV errors, Bit errors, Framing Bit errors, and CRC errors. Once an unavailable second has been declared, the following seconds continue to be counted as unavailable until the service is declared to be available again. Service becomes available at the onset of 10 consecutive available non-severely errored seconds.

Usage: Unavailable seconds are usually not permitted in any number in a 15 minute or 1-hour test. Telephone companies typically guarantee something like 3 hours maximum outage time per year on a T1 service.

2.4.1.2 Line/BPV Screens

The following screen shows Line/BPV. For T1 Single and T1 Dual the only difference is in the CNFG row. Page two of this screen shows the same information for Line 2 of a T1 Dual configuration.

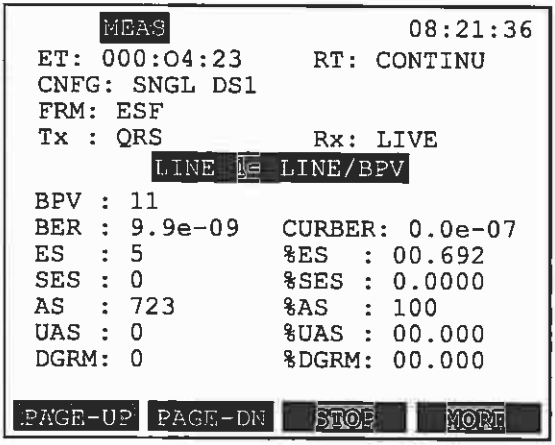

Figure 19 Line/BPV, DS1 Single

The terms used on Figure 19 Line/BPV, DS1 Single are defined as follows:

BPV: This is a count of the number of BiPolar Violations that have occurred since the beginning of the test.

Usage: This measurement detects problems with the line that the set is attached to. The problem is a local one, because any multiplexers, radio or fiber transmission links, switches, digital cross-connects, or other line-terminating devices will strip bipolar violations as the signal passes through it. Bipolar violations only pass through copper and regenerative repeaters. This measurement is also useful where the framing or data being transmitted is unknown. Finally, many telephone companies use a given number of BPV counts as the maximum acceptable for a span.

BER: This is the average bipolar violation error rate since the beginning of the test.

Usage: The rate is sometimes used instead of a count when the measurement is conducted for a longer period. 10^{-3} is a typical maintenance limit for voice transmission and 10^{-6} is a common acceptance limit for voice transmission. Many data customers require 10^{-9} or better.

ES: This is a count of Errored Seconds that have occurred since the beginning of the test. An errored second is any second with at least one BPV error. An errored second is not counted during an unavailable second.

Usage: errored seconds are a key tariff parameter for T1 services. Acceptance limits are often given for a number of errored seconds in a 5 minute, 15 minute, or 24 hour period. 7 errored seconds in 5 minutes and 20 errored seconds in 15 minutes are common acceptance limits, and 60 errored seconds in 5 minutes is a common immediate action limit. Some organizations accept no errors on a turn-up test.

The measurement is attractive because it takes out the effects of burstiness on service performance and because it measures the quality of service as the user actually sees it.

SES: This is a count of the number of Severely Errored Seconds that have occurred since the beginning of the test. A severely errored second is a second with a 10^{-3} error rate, where error rate is a measurement of BPV errors. A severely errored second is not counted during an unavailable second.

Usage: This measurement is sometimes used in combination with errored seconds to describe overall in-service transmission performance. During a severely errored second, the customer is likely to be experiencing trouble with the service but may still be able to use the service, especially for PCM voice transmission.

AS: This is a count of Available Seconds since the beginning of the test. Available Seconds equals the length of the total test time minus any UAS.

UAS: This is a count of all the UnAvailable Seconds since the beginning of the test. Note that a T1 service is not available during an UAS.

An unavailable second is any second with a loss of signal, loss of frame. Unavailable seconds are also counted at the onset of 10 consecutive severely errored seconds. Once an unavailable second has been declared, the following seconds continue to be counted as unavailable until the service is declared to be available again. Service becomes available at the onset of 10 consecutive available non-severely errored seconds.

Usage: Unavailable seconds are usually not permitted in any number in a 15 minute or 1-hour test. Telephone companies typically guarantee something like 3 hours maximum outage time per year on a T1 service.

DGRM: This is the number of DeGRaded Minutes since the beginning of the test. A DGRM is a 60 consecutive non-severely errored seconds during which at least 92 BPVs occurred.

CURBER: This is the CURrent Bipolar Violation Bit Error Rate measured during the previous averaging interval. This interval is one second.

Usage: A measure of the current rate is useful in case you are conducting a long-term measurement. In this case, a single period of high errors can skew the average error rate quite high. It is then useful to know if the errors are still occurring.

%ES: This is the percentage of Errored Seconds (as defined by ES) this percentage is calculated by the following formula, %ES=ES/AS.

%SES: This is the percentage of Severely Errored Seconds that have occurred. This percentage is calculated by the following formula, %SES=SES/AS.

%AS: This is a percentage of Available Seconds (as defined by AS) since the beginning of the test.

%UAS: This is the percentage of UnAvailable Seconds (as defined by UAS) since the beginning of the test.

%DGRM: This is the percentage of DeGRaded Minutes, as defined by DGRM, since the beginning of the test.

2.4.1.3 Signal Screens

The following screen shows Line 1 Signal. For T1 Single and T1 Dual the only difference is in the CNFG row.

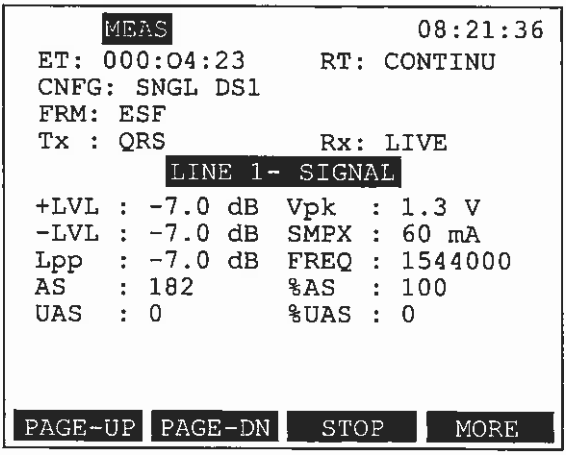

Figure 20 Line 1- Signal screen

The terms used in Figure 20 are defined as follows:

+LVL: Positive LeVeL is the level of positive pulses received by the test set.
-LVL: Negative LeVeL is the level of negative pulses received by the test set.

Usage: The +LVL and -LVL measurements are useful for finding faults with the last repeater or transmitter that is generating the signal to the test set. If the value of the positive pulses is more than 1 dB different than the value of the negative pulses, this could indicate a problem. The level at a DSX should be approximately 3 volts. The level at a repeater should be between -10 dB and -35 dB. Level and simplex current are measured only on L1-Rx.

Lpp: Peak-to-peak LeVeL is the peak-to-peak level of negative and positive pulses being received by the test set.

Usage: This measurement is used to make sure the signal has the proper level. For instance, at a DSX, the level should be 0 dB at the OUT jack, and about -20 dB at the MON jack. At the customer premises, the received signal should be no lower than -15 dB, and the transmit signal should be about 0 dB. At a repeater, the input signals should be between -7.5 and -35 dB, and the output signals should be about 0 dB.

AS: This is a count of Available Seconds since the beginning of the test. Available Seconds equals the length of the total test time minus any UAS.

UAS: This is a count of all the UnAvailable Seconds since the beginning of the test. Note that a T1 service is not available during an UAS.

An unavailable second is any second with a loss of signal. Once an unavailable second has been declared, the following seconds continue to be counted as unavailable until the service is declared to be available again. Service becomes available at the onset of 10 consecutive available non-severely errored seconds.

Usage: Unavailable seconds are usually not permitted in any number in a 15 minute or 1-hour test. Telephone companies typically guarantee something like 3 hours maximum outage time per year on a T1 service.

SMPX: SiMPleX current is the simplex DC current. Flowing from L1-Rx tip and ring through the test set to L2-Tx tip and ring.

Usage: Use this measurement to verify that you have proper simplex current flowing on a T1 span. The result should generally be 60 mA.

Warning!
Unplug the set immediately if the current measurement is over 150 mA, as this may damage the simplex current measuring circuit.

Vpk: This is the Voltage peak on the DS1 receive side.

FREQ: This is the frequency of the signal as measured against the frequency of the reference clock. The set's internal clock is used to measure frequency when no external clock source is plugged in. When an external reference clock is used this signal is used as the frequency reference to the frequency of the signal. The INTERN reference clock of the test set has Stratum 3 accuracy.

%AS: This is a percentage of Available Seconds (as defined by AS) since the beginning of the test.

%UAS: This is the percentage of UnAvailable Seconds (as defined by UAS) since the beginning of the test.

2.4.1.4 Alarm Screens

Figure 21 shows Line 1 Alarms. For T1 Single and T1 Dual the only difference is in the CNFG row. Page two of this screen shows the same information for Line 2 of a T1 Dual configuration.

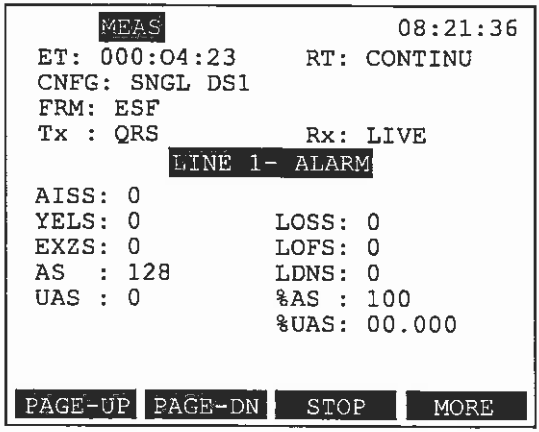

Figure 21 Alarm Screen

The terms used in Figure 21 are defined as follows:

AISS: Alarm Indication Signal is a count of the number of seconds in which AIS was detected.

Usage: This measurement can provide you with clues as to the nature of an out-of-service condition. For instance, a break in the line will cause a loss of signal for the test set if there are no line terminating elements between the break and the set. However, if there is a line terminating element, the same break will cause an AISS.

YELS: This is the count of YELlow alarm Seconds since the beginning of the test. A yellow alarm takes different forms depending on the framing of the signal. For an SF signal, the yellow alarm is signified by a zero in bit 2 for all channels. For an ESF signal, the yellow alarm is 0000000011111111 in the facility data link.

The T1 path terminating device will send a yellow alarm on its outgoing signal in response to loss of frame on its incoming signal. Thus, the yellow alarm signifies that the other side of the T1 line has failed somewhere before the end of the circuit.

Usage: Yellow alarm is the only end-to-end service indicator that is available for in-service testing on D4, SLC-96®, and some

ESF circuits. It is used to sectionize a fault in this way. If the signal on side A reaches the test set without error, but the signal on side B shows a yellow alarm, then side A must be failing somewhere downstream from the test set.

EXZS: EXcess Zero Seconds is a count of the number of seconds in which excessively long strings of zeroes were detected. For AMI coding, this is 16 or more consecutive zeroes, for B8ZS this is 8 or more consecutive zeroes.

AS: This is a count of Available Seconds since the beginning of the test. Available Seconds equals the length of the total test time minus any UAS.

UAS: This is a count of all the UnAvailable Seconds since the beginning of the test. Note that a T1 service is not available during an UAS.

An unavailable second is any second with a loss of signal, loss of frame. Unavailable seconds are also counted at the onset of 10 consecutive severely errored seconds. Once an unavailable second has been declared, the following seconds continue to be counted as unavailable until the service is declared to be available again. Service becomes available at the onset of 10 consecutive available non-severely errored seconds.

Usage: Unavailable seconds are usually not permitted in any number in a 15 minute or 1-hour test. Telephone companies typically guarantee something like 3 hours maximum outage time per year on a T1 service.

LOSS: Loss of Signal Seconds is a count of the number of seconds for which signal has been lost during the test.

Usage: This measurement can provide you with clues as to the nature

LOFS: This is the count of Loss Of Frame Seconds since the beginning of the test. A loss of frame second occurs at the onset of 3 consecutive OOFs. LOFS are counted until the onset of 10 consecutive non-SESs.

LDNS: Signal Low DeNsity Seconds is a count of the number of seconds when the n(n-1) rule is broken (see specs for better definition).

Usage: This measurement can give you clues as to whether the customer is transmitting illegal strings of data or whether B8ZS encoding equipment is working properly. For instance, if the line code is set up to be B8ZS in the test set, but you are getting

LDNS counts, then a transmitter is not correctly sending the B8ZS code to you. Or, if you have an AMI line and you get excessive LDNS counts, it will tell you that the customer is sending an unusual signal and perhaps that customer should be switched to a B8ZS line.

%AS: This is a percentage of Available Seconds (as defined by AS) since the beginning of the test.

%UAS: This is the percentage of UnAvailable Seconds (as defined by UAS) since the beginning of the test.

2.4.1.5 Frame Screens

Figure 22 shows Line 1 Frame Screen. For T1 Single and T1 Dual the only difference is in the CNFG row. Page two of this screen shows the same information for Line 2 of a T1 Dual configuration.

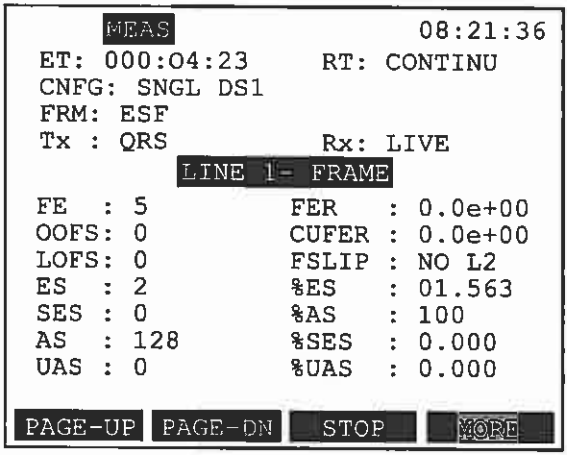

Figure 22 Frame Screen

The terms used in Figure 22 are defined as follows:

FE: This is the count of Framing Errors that have occurred since the beginning of the test.

Usage: This measurement is often used for in-service testing on SF-D4 circuits where the customer is transmitting an unknown data stream. The advantage of the measurement is that the framing stays intact as it passes through various network elements except fractional T1 circuits; hence it depicts the overall transmission quality from the far end of the circuit to the test set. One problem with the measurement is that it only measures one out of every 193 bits, and so gives only a sampling of the true transmission performance. The other problem with the measurement is that it can't measure the quality of transmission on the two outgoing directions of transmission. It can measure the quality only on the two incoming directions of transmission.

OOFS: This is a count of Out-Of-Frame Seconds that have occurred since the beginning of the test. An out-of-frame condition occurs when either 2-in-4 or 2-in-5 framing bits have been in error.

OOFS start counting when an out-of-frame condition occurs. OOFS continue to increment until framing has been reestablished

or until three consecutive seconds have been OOF. In this case, LOF is declared, OOFS are then decrement by three, and LOFS are then incremented by three.

Once an out-of-frame condition occurs, the test set begins searching for a new framing position. The out-of-frame condition ends when framing has been reestablished. If the framing remains in the original position, then no further action takes place. If the framing moves to a new position, then a Change of Frame Alignment (COFA) is declared.

Usage: A large count of OOF is an indication of significant transmission problems.

LOFS: This is the count of Loss Of Frame Seconds since the beginning of the test. A loss of frame second occurs at the onset of 3 consecutive OOFs. LOFS are counted until the onset of 10 consecutive non-SESs.

Usage: This measurement is most often used on extended tests where sporadic intermittency problems are experienced.

ES: Any second with FBE, CRC, LOF, LOSS or AIS.

SES: Severed Errored Second is any second with FBE $\geq 10^{-3}$, LOF, LOSS AIS or CRC.

AS: This is a count of Available Seconds since the beginning of the test. Available Seconds equals the length of the total test time minus any UAS.

UAS: UnAvailable Seconds after 10 consecutive SESs.

FER: This is the Framing Error Rate measured since the beginning of the test.

Usage: See the discussion For FE. The rate is a way of summarizing the information in a way that is independent of the actual measurement period.

CUFER: This is the CUrrent Framing Error Rate.

Usage: This measurement is useful for determining if the circuit recently had major error problems. However, the limitation of the measurement is that a 1 second averaging interval is so short for this measurement that it is not very useful for finding error rates below 10^{-4}.

FSLIP: This is the count of Frame SLIPs that have occurred since the beginning of the test. A frame slip is said to have occurred each time the phase of the line under test has deviated from the phase of the reference clock by 193 bits. This count is not applicable when a reference signal is not plugged in.

Usage: FSLIPs are useful for finding frequency synchronization problems in the network. Frequency synchronization can be the source of problems for channelized hi cap services that carry data and face a switch or a 1x0 digital cross-connect system.

%ES: This is a count of the percentage of Errored Seconds (as defined on the previous page) this percentage is calculated by the following formula. %ES=ES/AS

%SES: This is a count of the percentage of Severely Errored Seconds that have occurred. This percentage is calculated by the following formula. %SES=SES/AS

%AS: This is a percentage of Available Seconds (as defined by AS) since the beginning of the test.

%UAS: This is the percentage of UnAvailable Seconds (as defined by UAS) since the beginning of the test.

2.4.1.6 ESF-CRC-6 Screens

The following screen shows Line 1 ESF CRC-6. For T1 Single and T1 Dual the only difference is in the CNFG row. Page two of this screen shows the same information for Line 2 of a T1 Dual configuration.

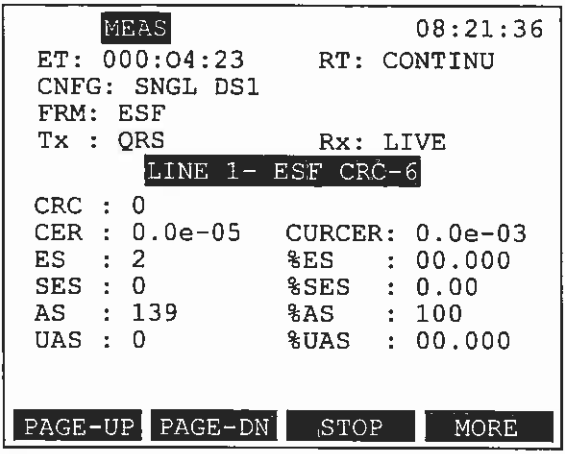

Figure 23 Line 1 ESF CRC-6 screen

The terms used in Figure 23 are defined as follows:

CRC: This is a count of the CRC-6 block errors that have occurred since the beginning of the test. Each CRC-6 block error indicates that there is at least 1 bit error within an extended super frame. An extended super frame consists of 24 frames of 193 bits each.

CER: This is the CRC-6 block error rate since the beginning of the test.

ES: Any second with FBE, CRC, LOF, LOSS or AIS.

SES: Severed Errored Second is any second with FBE $\geq 10^{-3}$, LOF, LOSS AIS or CRC.

AS: This is a count of Available Seconds since the beginning of the test. Available Seconds equals the length of the total test time minus any UAS.

UAS: UnAvailable Seconds after 10 consecutive SESs.

CURCER: This is the current CRC-6 block error rate.

%ES: This is the percentage of Errored Seconds (as defined by ES) this percentage is calculated by the following formula, %ES=ES/AS.

%SES: This is the percentage of Severely Errored Seconds that have occurred. This percentage is calculated by the following formula, %SES=SES/AS.

%AS: This is a percentage of Available Seconds (as defined by AS) since the beginning of the test.

%UAS: This is the percentage of UnAvailable Seconds (as defined by UAS) since the beginning of the test.

2.4.1.7 Frequency Screens

Figure 24 shows Line 1 Frequency. For T1 Single and T1 Dual the only difference is in the CNFG row. Only one page is used for both modes

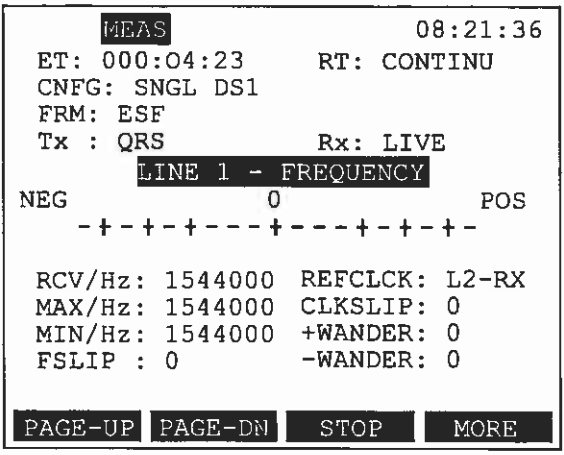

Figure 24 Frequency screen

The terms used in Figure 24 are defined as follows:

RCV/Hz: Current frequency, measured in Hertz during the last second.

MAX/Hz: Maximum frequency, measured in Hertz since the beginning of the test.

MIN/Hz: Minium received frequency, measured in Hertz since the beginning of the test.

FSLIP: This is the count of Frame SLIPs that have occurred since the beginning of the test. A frame slip is said to have occurred each time the phase of the line under test has deviated from the phase of the reference clock by 193 bits. This value represents the total number of frame slips; 1 frame slip =193 bit slips. This count is not applicable when a reference signal is not plugged in.

Usage: FSLIPs are useful for finding frequency synchronization problems in the network. Frequency synchronization can be the source of problems for channelized hi cap services that carry data and face a switch or a 1x0 digital cross-connect system.

REFCLCK: Reference Clock. When no reference signal is present the module will use it's internal clock as a reference. In this case the screen will still display the Min/Max/Avg frequency of the received signal, but it will not display any clock slip or wander information.

CLKSLIP: Clock Slip is the is the net value of the negative and positive wander.

+WANDER: This is the maximum positive phase difference between the measured frequency and the reference frequency since the beginning of the test. A signal whose frequency is wandering, i.e. whose frequency alternately goes faster and then slower than the reference frequency, will show both positive and negative wander.

-WANDER: This is the maximum negative phase difference between the measured frequency and the reference frequency since the beginning of the test.

2.4.1.8 G.821/Logic Measurement Screens

Figure 25 shows G.821/LOGIC MEASUREMENT. For T1 Single and T1 Dual the only difference is in the CNFG row. One page is used for both modes.

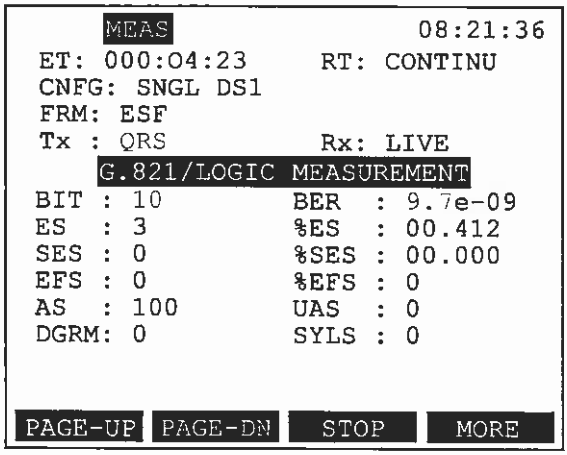

Figure 25 G.821/Logic Measurement Screen

The terms used in Figure 25 are defined as follows:

BIT: This is a count of the number of bit errors that have occurred since the beginning of the test. This measurement is reported as N/A when the test set is not synchronized on a known received pattern.

Usage: The usage of this is similar to the BPV with the following differences. First, the test set is measuring a known pattern. Hence, the measurement covers transmission performance over the entire service, not just the local span or section. As a result, this is the preferred measurement for out-of-service testing and service acceptance tests. The measurement is often performed in conjunction with a loopback device at the far end.

ES: This is a count of the bit Errored Seconds that have occurred since the beginning of the test. A bit errored second is a second with at least 1 bit error. Bit errored seconds are not counted during bit unavailable seconds.

SES: This is a count of the bit Severely Errored Seconds that have occurred since the beginning of the test. A bit severely errored second is a second with at least 1,544 bit errors 10^{-3} error rate. Bit severely errored seconds are not counted during bit unavailable seconds.

EFS: This is a count of the number of Error Free Seconds since the beginning of the test.

AS: See Line/BPV Screen for definition.

DGRM: This is a count of the bit DeGRaded Minutes that have occurred since the beginning of the test. A bit degraded minute is 60 non-severely errored seconds during which a total of at least 92 errors occurred.

BER: This is the Bit Error Rate since the beginning of the test.

%ES: This is the percentage of Errored Seconds (as defined by ES) this percentage is calculated by the following formula, %ES=ES/AS.

%SES: This is the percentage of Severely Errored Seconds that have occurred. This percentage is calculated by the following formula, %SES=SES/AS.

%EFS: This is the percentage for Error Free Seconds since the beginning of the test. An error free second has no errors at all.

Usage: This parameter is most often used for T1 services. Data customers typically expect this number to be anywhere from 95% to 99.5% or higher. %EFS and %AS are probably the two most significant parameters in gauging the quality of T1 service delivered to the end user.

UAS: This is a count of UnAvailable Seconds which is defined to occur after 10 consecutive SESs

SYLS: This is the number of Synchronization Lost Seconds. It represents the total number of seconds for which pattern synch was lost since the beginning of the test.

2.5 Other Measurements

The OTHER MEASUREMENTS menu is shown in Figure 26.

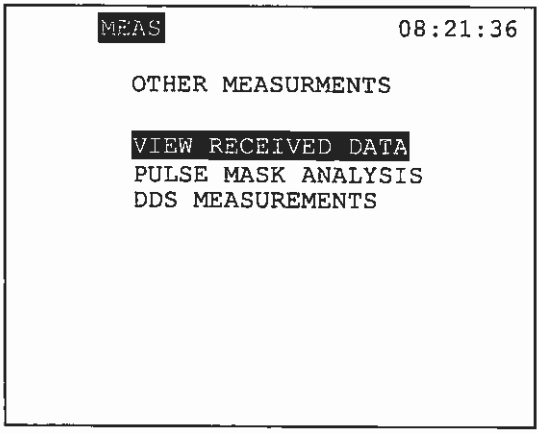

Figure 26 Other Measurements Main Menu Screen

2.5.1 View Received Data

View Received Data allows you to view and store 60 pages of live T1 received data. Refer to Figure 27 for a typical View Received Data display for DS1 traffic.

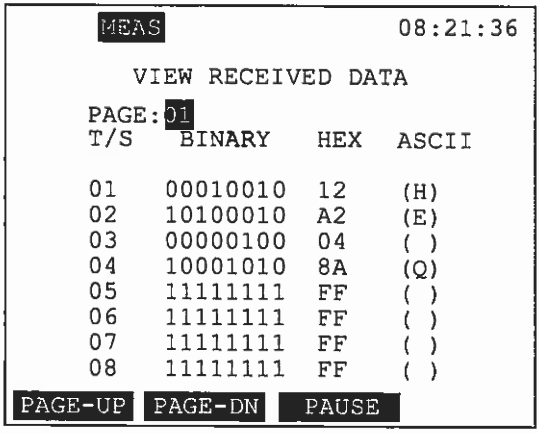

Figure 27 View Received Data Screen

The View Received Data screen displays the live data bits on each line. It displays the data in binary, hexadecimal, and ASCII format. This screen allows users to determine which channels are active or idle. Other uses are to verify a valid D-channel or determine the control channel for SS7 links.

Use this procedure:

1. From the Dual T1 Main Menu > OTHER MEASUREMENTS > VIEW RECEIVED DATA.
2. Use the PAUSE/RESUME (F3) key to trap the live data.
3. Use the PAGE-UP (F1) and PAGE-DN (F2) to access all 60 pages of data. Each line of the display is dedicated to a single timeslot.
4. When you are finished, press the ESC key on the keypad twice to return to the Main Menu

The following are the display definitions for Figure 27:

PAGE: This entry shows what page number the display is currently showing. 60 pages of data are available for viewing.

T/S: This column shows which Time Slots are currently being viewed. The screen will display 8 time slots of data at a single time. Three consecutive pages show all 24 time slots in a DS1 frame.

BINARY: This column shows the binary data actually being received on the line. Each line represents the 8 bits of the individual timeslot. The left most bit is received first.

HEX: This column shows the hexadecimal representation of the 8 bits being transmitted in each timeslot. Hexadecimal notation is often used to describe 8-bit channel codes. For instance, a digital loop carrier idle code is usually 7F or FF in hexadecimal notation. The hex number on the left side is the normal translation of the binary code. The hex number in parentheses is the hex translation of the binary code in reverse order.

ASCII: This column shows the ASCII representation of the bits being transmitted in each timeslot. Two ASCII characters are shown for each timeslot. One is created from the binary data in its normal order. The one in parentheses is created from the bits in reverse order.

2.5.2 Pulse Mask Analysis

Pulse Mask Analysis allows you to measure and view the quality of the T1 pulse. Refer to Figure 28.

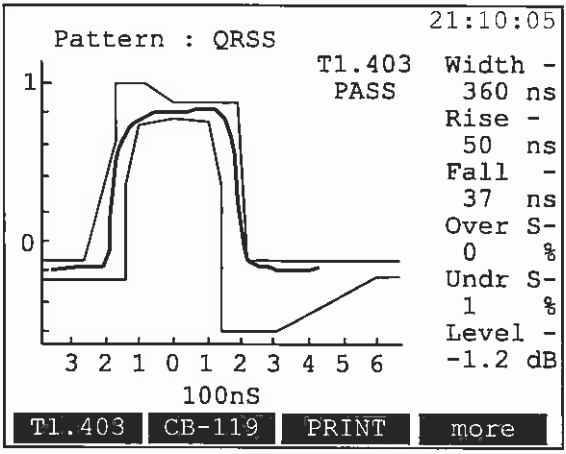

Figure 28 Pulse Mask Analysis

Use this procedure for performing a pulse shape analysis:

1. From the Dual T1 Main Menu > OTHER MEASUREMENTS> PULSE MASK ANALYSIS.
2. Access START NEW ANALYSIS, or enter VIEW LAST PULSE SHAPE if you wish to see the previous results.
3. After a few seconds the pulse shape will be displayed. The key pulse statistics will be displayed on the right-hand margin.
4. If you like, choose one of the industry standard masks for a pass/fail report. Choose T1.403 (F1), CB-119 (F2), or press the more (F4) key and choose Pub 62411 (F1) or T1.102 (F2). If you press more (F4) again, you have the options G.703 (F1) or NO-MASK (F2). After you make a choice, you will see a message like "T1.403 PASS" displayed.
5. If you like, you can also PRINT (F3) the mask.
6. When you are finished, press the ESC key on the keypad to return to the Dual T1 Main Menu.

2.5.3 DDS Measurements

DDS Measurements allows testing and maintaining of Digital Data System networks (DDS) by performing basic DDS loopbacks and measurements. Dual T1 module testing capabilities support the following data rates: 2.4, 4.8, 9.6, 19.2, 56, and 64 Kbps. Interleaved and latching loopbacks of various types are supported. Bit error and bit error rate measurements are provided. You may also send/ receive special network control codes.

The DDS menu is shown in Figure 29.

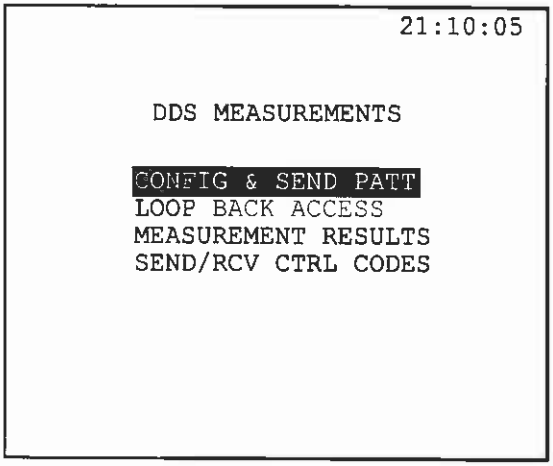

Figure 29 DDS Measurements Menu

2.5.3.1 Configuration & Send Pattern

From the Dual T1 Main Menu > OTHER MEASUREMENTS > DDS MEASUREMENTS > CONFIG & SEND PATT.

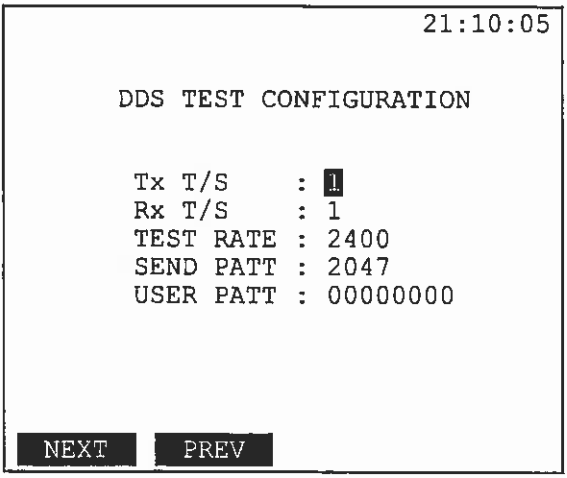

Figure 30 DDS Test Configuration

The DDS Test Configuration screen contains the following setup items:

Tx T/S
Options: 1-24

Use the F-Keys, NEXT (F1) and PREV (F2), to select your Tx timeslot. This is where you will transmit your DDS control codes. You may choose from 1 to 24.

Rx T/S
Options: 1-24

Use the F-Keys, NEXT (F1) and PREV (F2), to select your Rx timeslot. This is where you will receive your DDS control codes. You may choose from 1 to 24.

TEST RATE
Options: 2400 (F1), 4800 (F2), 9600 (F3), 19.2k (more, F1), 56k (more, F2), 64k (more, F3)

Press the appropriate F-Key to specify the rate at which testing is to occur.

SEND PATT
Options: 2047 (F1), 511 (F2), 127 (F3), 63 (more, F1), 1111 (more, F2), 0000 (more, F3), DDS-1 (more, F1), DDS-2 (more, F2), DDS-3 (more, F3), DDS-4 (more, F1), DDS-5 (more, F2), DDS-6 (more, F3), USER (More, F1), 0101 (more, F2)

Select the test pattern you wish to send. If you wish to transmit your own USER-defined test pattern, do the following:

1. At the SEND PATT line, select USER from the F-key options.
2. Press the Down Arrow key to access the USER PATT line. Using the SHIFT-lock key on the keypad, define the 8-bit test pattern you wish to transmit. The pattern specified in the USER PATT line is active only if USER appears on the SEND PATT line above it.

2.5.3.2 Loop Back Access

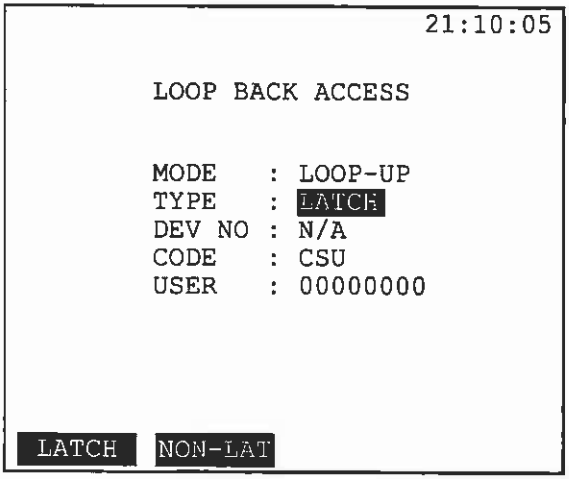

Figure 31 Loop Back Access Screen

To perform a loop-up/loop-down application, configure the following items:

MODE
Options: LOOP-UP (F1), LOOP-DN (F2)

Select this item last! Pressing one of the F-Keys here will automatically begin its respective procedure. After you have finished setting all the other items below, then press LOOP-UP (F1) to begin looping up or LOOP-DN (F2) to loop down.

TYPE
Options: LATCH (F1), NON-LAT (F2)

NON-Lat (F2) refers to the traditional loopback testing for the CSU, DSU, or OCU. This loopback type requires the continuous transmission of loopback control bytes in the test data. For latched loopback (F1), it is not necessary to continue to send the loopback code. A latched loopback will remain activated until a release code is received.

DEV NO
Options: 1-8

Use the F-Keys, NEXT (F1) and PREV (F2), to select your device number (from 1 to 8). This item applies only to the DS0-DP Code. For all other codes, this line will remain N/A.

CODE
Options: For LATCH- CSU (F1), DSU (F2), OCU (F3), USER (more, F1), DSO-DP (more, F2). For NON-LAT- CSU (F1), DSU (F2), OCU (F3), USER (more, F1).

Here you can specify the loop up/down code for the specific equipment type to be looped up/down. The F-Keys available to you will depend upon the TYPE selected above. The following codes are available:

- CSU- Channel Service Unit
- DSU- Data Service Unit
- OCU- Office Channel Unit
- DSO-DP- DS0 Dataport

If you wish to transmit your own user loopback code, press USER (more, F1). Then press the down arrow key to specify your USER loop back code. Enter this 8-bit loop back code by first pressing the SHIFT-lock key on the keypad, then entering the 0/1 values directly from the keypad. Press the SHIFT-lock key on the keypad again when you are finished. The USER pattern which you have just entered will have no effect unless "USER" was specified for the CODE.

2.5.3.3 Measurement Results

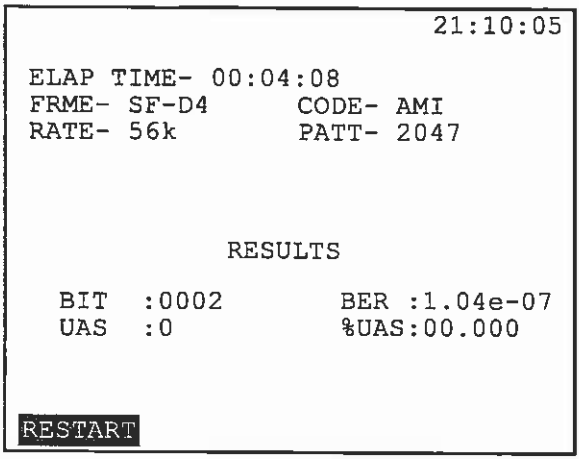

Figure 32 Measurement Results

All results relate to the total elapsed time of the test (ELAP TIME). Use the RESTART (F1) key to restart the measurements, if necessary. The measurements are defined as follows:

ELAP TIME: The total amount of time which has elapsed since the beginning of the measurement process (hhh:mm:ss).

FRME: The type of framing which you are transmitting.

CODE: The type of line coding which you are transmitting.

RATE: The test rate as specified in the CONFIG & SEND PATT menu.

PATT: The test pattern which is being transmitted, as specified in the CONFIG & SEND PATT menu.

BIT: The total number of bit errors since the beginning of the test.

BER: The bit error rate since the beginning of the test.

UAS: The total number of UnAvailable Seconds since the beginning of the test.

%UAS: The percentage of UnAvailable Seconds since the beginning of the test.

2.5.3.4 Send/Receive Control Codes

Here you may transmit DDS control codes to the far end, as well as view which code you are receiving. Figure 31 displays this screen.

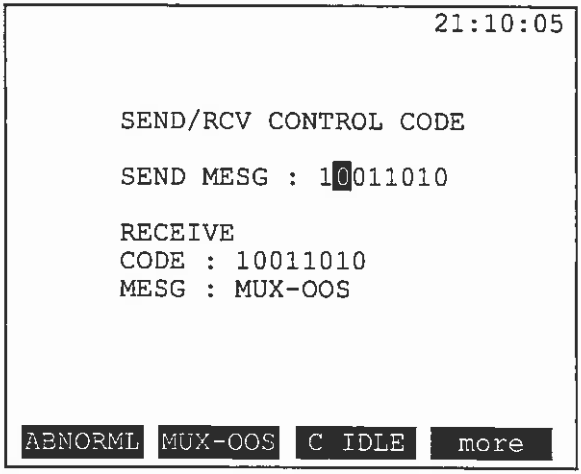

Figure 33 Send/Receive Control Code

Transmitting Codes

The SEND MESG line displays which code you are transmitting. To change this code, press the F-key of choice. These F-keys list the 9 programmed codes available to you. Alternatively, you may enter in your own code by pressing the SHIFT-lock key on the keypad and entering the binary digits (1 or 0) from the keypad. After entering a user code, you must press the ENTER key on the keypad to send those digits.

Table 5 shows the 9 DDS codes available as F-key options.

DDS Control Codes			
Item	Control Code	Control Bit b1.....b8	Description
1	ABNORMAL	10011110	Abnormal Station Condition
2	MUX-00S	10011010	Mux out of Sync
3	C IDLE	11111110	Control Idle Code
4	D IDLE	11111111	Data Idle Code
5	MAP0	10010011	Map 0 Confirmation Code (line side)
6	MAP1	11101101	Map 1 Confirmation Code (drop side)
7	T-ALERT	11101100	Test Alert
8	TEST	10011100	Test Code
9	UMC	10011000	Unassigned Mux Channel

Table 5 DDS Control Codes

Note: The least significant digit, b1, is always 1 and cannot be changed. Therefore, it appears in parentheses on the SEND MESG line.

You may send other DDS codes using the SHIFT-lock key and the number keypad; the following DDS codes may be of interest to you:

- Block: 10001010
- Far End Voice (FEV): 11011010
- MJU Alert (MA): 11110010
- Release: 11111000
- Transition in Progress (TIP): 10111010

Receiving Codes

The RECEIVE portion of the screen displays the DDS code coming from the far end. The test set will display the digits its receives. If these bits correspond to one of the 9 programmed codes, shown in Table 5, the message will be displayed below.

2.6 VF Channel Menu

Figure 34 shows the VF Channel Menu.

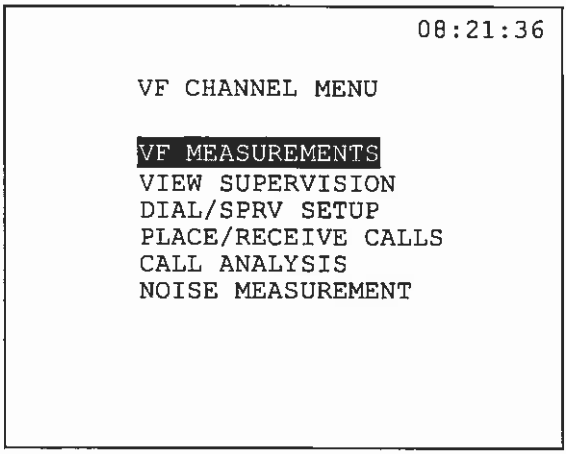

Figure 34 VF Channel Menu

2.6.1 VF Measurements

The VF Measurements menu lets you choose:

- The channel to test for both receiving and transmitting.
- Whether to talk, send a tone, or place a quiet termination on the transmit signal. In T1DUAL Mode, you can also let the test channel pass through unchanged.
- The tone frequency and level.
- The signalling bits to send.
- The line used for listening.

The VF MEASUREMENTS Menu also tells you:

- The received signalling bits.
- The received 8-bit data.
- The received frequency and level.

Figures 35 and 36 depict the VF MEASUREMENTS Menu for each mode.

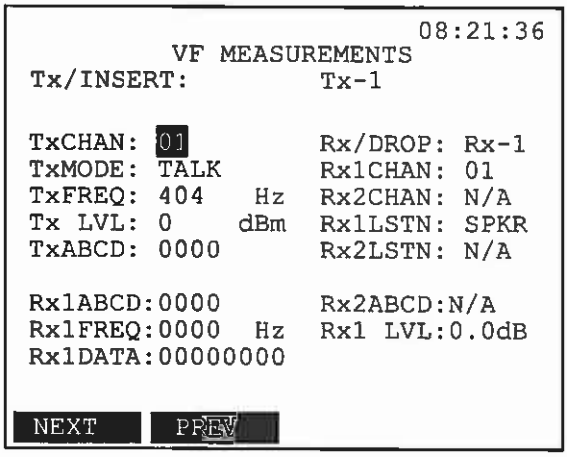

Figure 35 VF Measurements Menu, T1 Single Mode

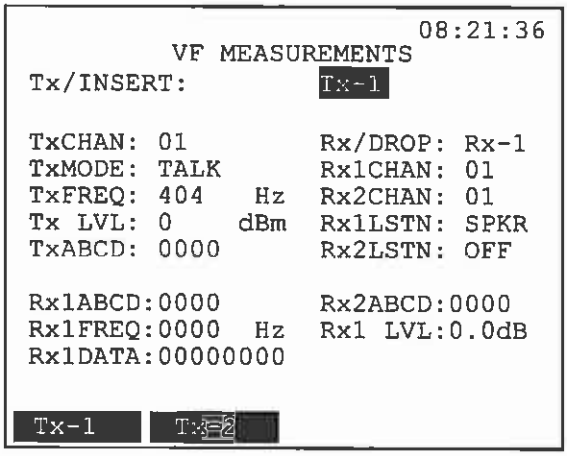

Figure 36 VF Measurements Menu, T1 Dual Mode

The following Voice Frequency features should be set in this screen:

Tx/INSERT
Options: Tx-1 (F1), Tx-2 (F2) Default is Tx-1 in T1 Single mode.

TxCHAN
Options: 1-24

Use the F-keys, NEXT (F1) or PREV (F2), to choose the desired transmit timeslot for the T1 Line. If you have selected T1 SINGL Mode in TEST CONFIGURATION, this line will be Line 1; if you have selected T1 DUAL, this will be whichever line you have chosen for Tx/INSERT.

TxMODE
Options: TALK (F1), TONE (F2), QUIET (F3)
Choose your desired insert type.

- Press (F1) to talk on the transmit signal; the SunSet xDSL will transmit speech from the microphone (located at the bottom of the test set).
- Press TONE (F2) to insert a tone on the transmit signal. If you select TONE, use the next two settings to set the tone frequency and level.
- Press QUIET (F3) to place a quiet termination on the transmit signal.

TxFREQ
Options: 50 Hz- 3950 Hz
If you selected TONE as your INSERT TYPE, you may choose the tone frequency here. The frequency may be changed in two ways.

- You may press the F-Key corresponding to your desired frequency; five frequencies are available this way: 404, 1004, 1804, 2713, or 2804 Hz.
- You can also press the SHIFT-lock key on the keypad and enter the desired value from the keypad. You may select any value from 50 to 3950 Hz. If you enter in your own frequency with the keypad numbers, you will need to press the ENTER key on the keypad or move the cursor off this line to start sending the new tone.

Tx LVL
Options: -60 to 3dBm

If you selected TONE as your INSERT TYPE, you may choose the tone level here.

The tone level may be changed by pressing the SHIFT-lock key and entering the desired value from the keypad. You may select any value from -60 to 3 dBm. Press MINUS (F1) to achieve negative values. To send your new tone level, press the ENTER key on the keypad or move the cursor off this line. There are two F-key choices provided for you: 0 dBm (F2) and -13 dBm (F3).

TxABCD
Options: ON-HOOK (F1), OFFHOOK (F2), FLASH/WINK (F3)

If desired, you may change the signalling bits that are transmitted on the selected channel. If you are in T1SINGL mode, these bits are sent on line 1; for T1 DUAL Mode, they are sent on whichever line has been selected for Tx/INSERT in TEST CONFIGURATION. For SF-D4 and SLC96 framing, you will have A/B bits; for ESF framing, you will have A/B/C/D bits. The exact bits sent for each condition will depend upon the supervision trunk chosen in DIAL/SPRVIS SETUP.

You may also change these bits manually using the SHIFT-lock key and number keys 1 and 0. Press the SHIFT-lock key and press the 1 and 0 keys as desired to enter the signalling bits. Press the ENTER key on the keypad to send the A/B/C/D bits.

RxDROP
Options: Rx-1 (F1) or Rx-2 (F2)

Rx1CHAN
Options: 1—24

Use the appropriate F-keys, NEXT (F1) or PREV (F2), to choose the desired receive timeslot for T1 Line 1. If you are in T1DUAL Mode (from TEST CONFIGURATION), this item will refer to whichever Line was selected as Rx/DROP.

As you change the transmit timeslot above, this receive line also changes. If you want the receive timeslot to be different, just cursor down to this line and change it.

Rx2CHAN
Options: 1—24

Use the appropriate F-keys, NEXT (F1) or PREV (F2), to choose the desired receive timeslot for T1 Line 2. If you are in T1SINGL Mode, you are looking at only one line; therefore, this line will read N/A (not applicable). When in T1DUAL Mode, this line refers to whichever line was not selected as Rx/DROP in TEST CONFIGURATION. It will be the opposite line to the Rx line above.

Rx1LSTN
Options: OFF (F1), SPEAKER (F2), or HANDSET (F3)

Selects the xDSL's internal speaker, external handset or off

Rx2LSTN
Options: OFF (F1), SPEAKER (F2), or HANDSET (F3)

Selects the xDSL's internal speaker, external handset or off

The last five lines pertain to received data; they are for viewing only, and may be neither edited nor changed. For T1 Dual Mode, they apply to the line selected as Rx/DROP in TEST CONFIGURATION.

Rx1ABCD

Rx-1 A/B/C/D shows the Channel Associated Signalling System (CAS) bits. For T1 Dual, the signalling on both Line 1 and 2 is shown here.

Rx1FREQ

Rx1FREQ shows the frequency received on Line 1. If Line 2 is chosen as Rx/DROP, this line will be Rx2 FRQ and applies to Line 2.

Rx1DATA

Rx1DATA shows the live 8-bit channel data as it is received from the line.

Rx2ABCD

This shows the Channel Associated Signaling system (CAS) bits. For Dual T1 the signaling on both line 1 and line 2 are shown here

Rx1 LVL

Rx1 LVL shows the level received on Line 1. If Line 2 is chosen as Rx/DROP, this line will be Rx-2 LVL and applies to Line 2.

2.6.2 View Supervision

The View Supervision screen lets you see the signalling bits for all of the 24 channels for both Lines 1 and 2. You can observe the status on all channels at the same time. Refer to the Figure 37.

```
                                        08:21:36
    T/S   ABCD    ABCD    ABCD    ABCD
L   01    0000    0000    0000    0000
I   05    0000    0000    0000    0000
N   09    0000    0000    0000    0000
E   13    0000    0000    0000    0000
1   17    0000    0000    0000    0000
    21    0000    0000    0000    0000

L   01    0000    0000    0000    0000
I   05    0000    0000    0000    0000
N   09    0000    0000    0000    0000
E   13    0000    0000    0000    0000
2   17    0000    0000    0000    0000
    21    0000    0000    0000    0000
```

Figure 37 View Supervision Screen

Time slots 1 through 4 are shown on the first line; 5 through 8 are shown on the second line, etc.

Note: SF-D4 and SLC-96® framed signals will show A/B bit signalling information. ESF will show A/B/C/D signalling bit information for every six frames, the least significant bit is "robbed" and is instead used to transmit signalling information.

2.6.3 Dial/ SPRV Setup

The Dial/Supervision Setup screen provides additional parameter settings to be used for your VF procedures. In this menu, you can vary the on and off time for the DTMF, MF, and DP digits. You can also condition the test set to send appropriate signalling bits for E & M, loop start, and ground start trunks with FX0 or FXS line cards. Refer to Figure 38, Dial/Supervision Setup Screen.

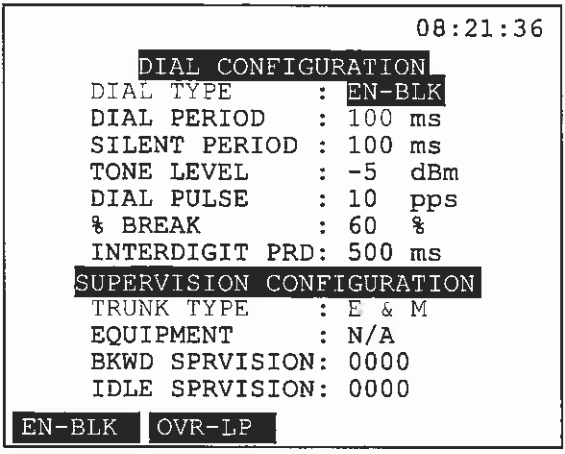

Figure 38 Dial/Supervision Setup Screen

1. From VF CHANNEL ACCESS > DIAL/SPRVIS SETUP and press the ENTER key on the keypad.

The following settings are provided in this screen under the DIAL CONFIGURATION header:

DIAL TYPE
Options: EN-BLK (F1) or OVR-LP

Determines how the dial digits will be sent.

- EN-BLK sends the digits all at once. In this mode, the user must first enter the whole number from the keypad, then press the SEND key to send the digits.
- With OVR-LP, the digits are immediately sent when the user presses the number key.

DIAL PERIOD
Options: 30 ms to 999 ms

This item specifies the dial period in milliseconds used for DTMF and MF dialing. The factory default value is 100 ms. You may select any value between 30 ms and 999 ms by pressing the SHIFT-lock key and entering the desired value from the keypad. To select a value less than 100 ms, you will need to add a 0 first (i.e. 030 ms).

SILENT PERIOD
Options: 30 ms to 999 ms

This item specifies the silent period in milliseconds used for DTMF and MF dialing. The factory default value is 100 ms. You may select any value between 30 ms and 999 ms by pressing the SHIFT-lock key and entering the desired value from the keypad. To select a value less than 100ms, you will need to add a 0 first (i.e. 030 ms).

TONE LEVEL dbm
Options: -25 to -5 dbm

Use the appropriate F-keys, NEXT (F1) or PREV (F2), to select the desired tone level.

DIAL PULSE (10 pps)
Dial pulse is permanently set to 10 pps. This item is for viewing only, and may not be changed.

% BREAK
Options: 40%, 50%, 60%

This item sets the %BREAK. Use the F-keys, NEXT (F1) and PREV (F2), to select the desired percentage. Percent break is the ratio of the break (on-hook) interval to the total pulse cycle interval.

INTERDIGIT PRD
Options: 100—900 (hundred intervals only)

Use the F-keys, NEXT (F1) or PREV (F2), to select the interdigit period.

The following settings are found under the SUPERVISION CONFIGURATION header.

TRUNKTYPE
Options: E&M (F1), G-START (F2), L-START (F3), USER (F4)

Press the F-Key corresponding to the appropriate trunk type: E&M (F1), Ground-Start (F2) or, Loop-Start (F3). These trunk types will determine the exact signalling bits transmitted for each signalling condition. To use your own on/off-hook signalling bits, you may select USER (F4). This brings up the USER SUPERVISION SELECTION screen, where you may manually enter the OFF-HOOK/ ON-HOOK signalling bits with the SHIFT-lock key and keypad numbers (1 and 0).

EQUIPMENT
Options: FXO (F1), FXS (F2). For E/M Trunk Type, this will be N/A.

If you have selected either Ground-Start or Loop-Start trunk type above, you must choose your equipment type.

BKWRD SPRVISION
Use the SHIFT-lock key and keypad numbers (1/ 0) to enter the backward supervision bits. In T1 Dual Mode, these bits are sent in the other direction from the inserted talk/tone. For example if you are inserting a tone on T/S 06 and you have selected Tx/INSERT=L1-Tx, then the set will transmit the backward supervision bits on T/S 06 of Line 2.

IDLE SPRVISION
Use the SHIFT-lock key and keypad numbers (1/0) to enter the four idle supervision bits. These bits will be placed on idle channels.

2.6.4 Place/Receive Calls

The PLACE/ RECEIVE CALLS menu lets you perform a number of dialing functions.

- Place a DTMF, MF, or DP call.
- Receive a DTMF, MF, or DP call.
- Control the transmitted and observe the received supervision.
- Speed dial a stored number.
- Record a number with a label for future dialing.
- Edit or delete speed dial numbers.

Figure 39 shows the PLACE/ RECEIVE CALLS menu.

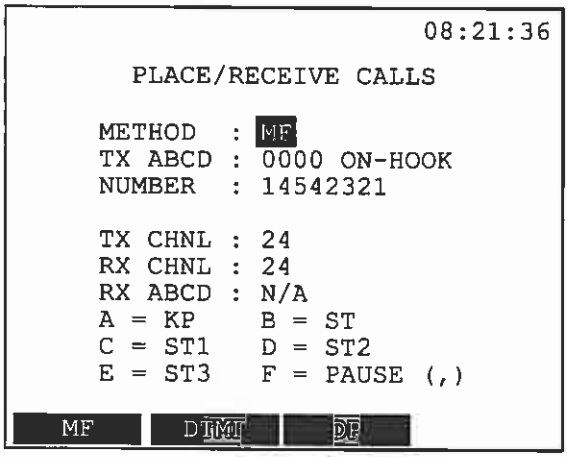

Figure 39 Place/Receive Calls Menu

The next selections are provided in the PLACE/ RECEIVE CALLS Menu:

METHOD
Options: MF (F1), DTMF (F2), DP (F3)

- MF (F1), Multi Frequency, is an addressing technique used for interoffice signalling in the telephone network. It uses a group of frequencies in pairs to form a single address tone. MF supports the digits 0 through 9, as well as many other control codes. These control codes appear at the bottom of the screen when MF is selected.

- DTMF (F2), Dual Tone Multi Frequency, is the most commonly used addressing method on today's phones. Like MF, it uses pairs of tones to send a digit. Unlike MF, it uses two separate groups of tones. DTMF supports 16 digits: 0 through 9, #, *, and A through D.
- DP (F3), Dial Pulse, is the oldest addressing technique. With pulse dialing, the phone goes on-hook and off-hook 10 times per second in order to dial a given number. For example, to dial the number 7, the test set starts off in the off-hook condition and then goes on-hook/off-hook seven times. This type of addressing is now commonly used in switched 56 services.

TX ABCD

Options: ON-HOOK (F1), OFFHOOK (F2), WINK/FLASH (F3)

This item selects the transmit signalling bits. You may select either ON-HOOK or OFF-HOOK. The exact supervision used and displayed will depend on the SUPERVISION TRUNK TYPE and EQUIPMENT settings in the DIAL/SPRVIS setup menu.

- OFF-HOOK: If this is selected, you may choose to FLASH these bits. Choosing FLASH momentarily sends ON-HOOK supervision, then returns to OFF-HOOK.
- ON-HOOK: If this is selected, you may choose WINK; a WINK momentarily sends OFF-HOOK supervision, then returns to ON-HOOK.

NUMBER

Here you may enter the digits you wish to dial. Use the SHIFT-lock key to enter the desired numbers, and letters if applicable. For DTMF and MF dialing, a legend appears at the bottom of the screen showing which keypad letters correspond to which control codes.

TxCHNL

Options: NEXT (F1), PREV (F2), SCAN (F3)

This slot assigns the transmit channel. Use the F-keys NEXT (F1) or PREV (F2), to choose the desired transmit timeslot for the T1 Line. You may choose from T/S 1 to 24. If you have selected T1 SINGL Mode in TEST CONFIGURATION, this line will be Line 1; if you have selected T1 DUAL, this will be whichever line you have chosen for Tx/INSERT.

In SCAN Mode, the Dual T1 is in a receive mode only. The test set searches all timeslots for an on-hook to off-hook transition. When it finds this transition, it locks on that timeslot and waits for the digits. The Dual T1 module will notify the user with the message, "Incoming call on Channel 01 (as appropriate)". The user may then accept or reject this call.

Rx CHNL

Options: NEXT (F1), PREV (F2), SCAN (F3)

This slot assigns the receive channel. If the transmit and receive channels are the same, changing the Tx channel will automatically change the receive channel. If you would like these channels to be different, cursor down to RxCHNL and use the (F1) or (F2) keys.

Rx ABCD

This line shows the received signalling bits; it is for viewing only.

2.6.5 Call Analysis

From VF CHANNEL ACCESS > CALL ANALYSIS. Upon entering, the screen will appear as shown in Figure 40.

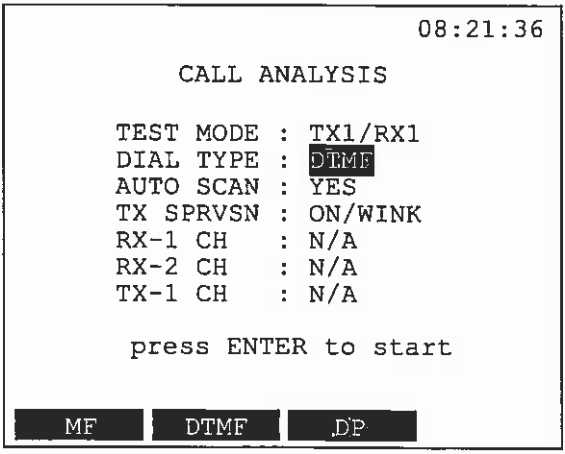

Figure 40 Call Analysis Menu

Refer to the following procedure to setup the CALL ANALYSIS.

TEST MODE
Options: TX1/RX1 (F1) or RX1/RX2 (F2)
RX1/RX2 option is only available in T1 Dual mode. In T1 Single mode the default is TX1/RX1 .

DIAL TYPE
Options: MF (F1), DTMF (F2), DP (F3)
Select the dial type

AUTO SCAN
Options: YES (F1), NO (F2)
Determine if the unit will automatically scan for active channels.

YES: When in scan mode, the Dual T1 module will rapidly scan all 24 receive channels for any channel that goes from the on-hook to off-hook state. When it finds a channel going off-hook, it will lock onto that channel and wait for digits to be transmitted.

NO: You must enter the transmit and receive timeslots below. In this mode, the Dual T1 module will analyze only on the selected receive channel.

Tx SPRVSN
Options: ON/OFF (F1), ON/WINK (F2), MANUAL (F3)

Transmit Supervision determines the reply to an off-hook. Choose from ON/OFF (F1) to start out sending on-hook while sending an off-hook in response to a received off-hook. Choose ON/WINK (F2) to start off sending an on-hook while sending a wink in response to a received off-hook. MANUAL (F3) allows you to manually send on-hooks, off-hooks, winks, and flashes in response to an off-hook.

After you have completed these settings, press the ENTER key on the keypad to begin the analysis. Continue reading if you want more information on the analysis procedure. As an example, we will scan DTMF digits; a MF or DP analysis will provide different information.

RX-1 CH
Options: 1-24, NEXT (F1), or PREV (F2)
Manually select the RX-1 channel

RX-2 CH
Options: 1-24, NEXT (F1), or PREV (F2)
Manually select the RX-2 channel

TX-1 CH
Options: 1-24, NEXT(F1), or PREV (F2)
Manually select the TX-1 channel

2.6.5.1 Call Analysis, an Example

```
                                    08:21:36

  TIME        RX-1 CH:1    TX-1 CH:1
 INIT         ABCD=1111    ABCD=0000
 04.101       DIGIT 4
 04.303       DIGIT 0
 04.502       DIGIT 8
 04.705       DIGIT 3
 04.905       DIGIT 6
 05.105       DIGIT 3
 05.303       DIGIT 8
 05.506       DIGIT 0
 05.705       DIGIT 0

 ANALYZE  RESTART  PAGE-UP  PAGE-DN
```

Figure 41 Call Analysis Digit Screen

1. Configure the Analysis setup screen as shown in Figure 41, Call Analysis Menu. When you have finished, press the ENTER key on the keypad.
2. If in the SCAN mode, you will see a flashing "SCANNING" message at CHANNEL. This message will continue to flash until the set finds a channel going from on to off- hook. It will then show you which channel it has found, as well as the Rx and Tx supervision bits. When the digits are sent, it will display them. Refer to Figure 41, Call Analysis.

You can see the receive digits 408363800. Pressing the ANALYZE (F1) key will give you a detailed analysis of each digit. Refer to Figure 42, Call Analysis Results Screen. PAGE-UP & PAGE-DN allow you to look further for more digits

The first screen shows information on the first three digits (4, 0, 8). Use the PAGE-DN (F2) key to view the other digits. The following information is provided for each digit:

- The High (H) and Low (L) frequencies in Hz and dBm.
- The interdigit period (INTD) in microseconds. Note that there is no INTD for the first digit.
- The dial period (PERD).
- The twist (TWST), which is the difference in level between two frequencies.

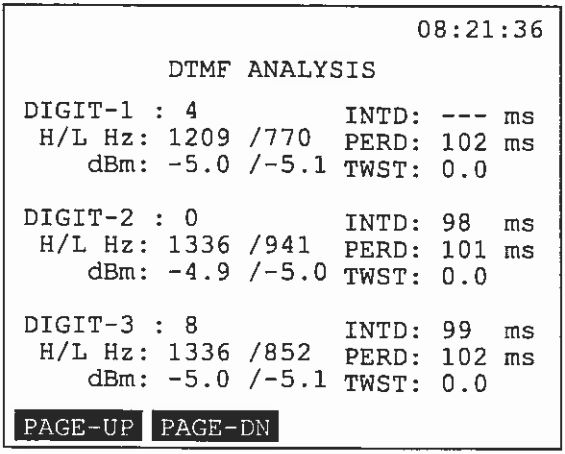

Figure 42 Call Analysis Results Screen

2.6.6 Noise Measurement

Noise Measurement lets the user measure noise using various parameters. These measurement parameters are:

- Signal to Noise
- Noise C-Message filter
- Noise 3K- Flat filter
- Noise C-Notch filter

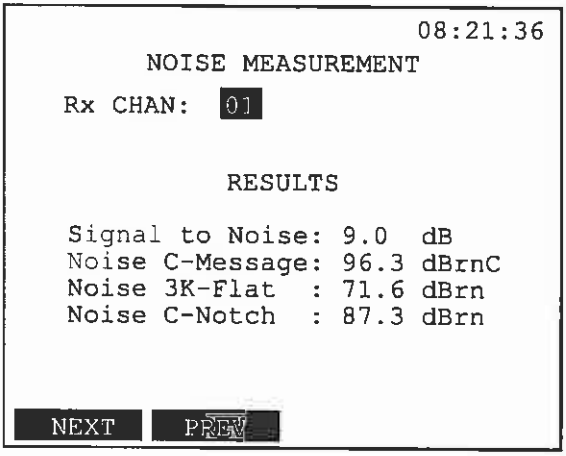

Figure 43 Noise Measurement Results

1. In the VF CHANNEL menu cursor down to the NOISE MEASUREMENT and press the ENTER key on the keypad. The Noise Measurement screen appears, refer to Figure 43, Noise Measurement Results.
2. Rx CHAN: Select the channel you wish to perform measurements on. Do this by pressing NEXT (F1) or PREV (F2). There are 24 channels you can choose from.
3. Observe the noise measurement results. These are taken from the line designated as Rx/DROP in the VF Measurements screen.

- Signal to Noise in dB
- Noise C-Message in dBrnC
- Noise 3K-Flat in dBrn
- Noise C-Notch in dBrn

2.7 Protocol Testing

Select Protocol Testing from the Dual T1 Main Menu, the following menu screen appears, Protocol Analysis.

Note: Protocol Testing requires a SRAM memory card installed in the outer slot of the Sunset xDSL.

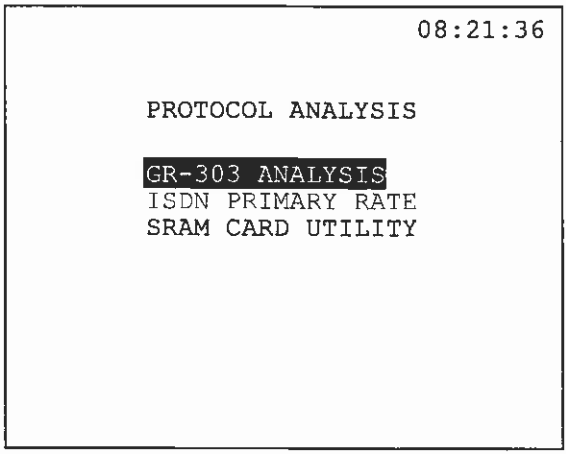

Figure 44 Protocol Analysis Menu

2.7.1 GR-303 Analysis

The Dual T1 module provides monitoring and analysis features for the TMC/CSC (Timeslot Management Channel/Common Signaling Channel) and EOC (embedded operations channel) channels.

Upon entering GR-303, select CONFIGURATION to setup for monitoring TMC/CSC (the call management channel). START TRACER allows you to view live data, VIEW/PRINT RECORD allows access to stored records, and STATISTICS presents channel statistics in accordance with your CONFIGURATION.

2.7.1.1 Configuration

The Configuration screen allows you to configure the Dual T1 for monitoring the TMC/CSC channel, including setting up filters.

The first item to configure is the PROTOCOL. Select either TMC (F1) or EOC (F2). The rest of the screen will change to match your selection.

2.7.1.1.1 TMC Configuration

You may change the TMC channel if necessary (the default setting is channel 24, as specified by GR-303-CORE).

You may configure to capture messages selectively by layer, call reference, DS1/DS0 number, or cause value.

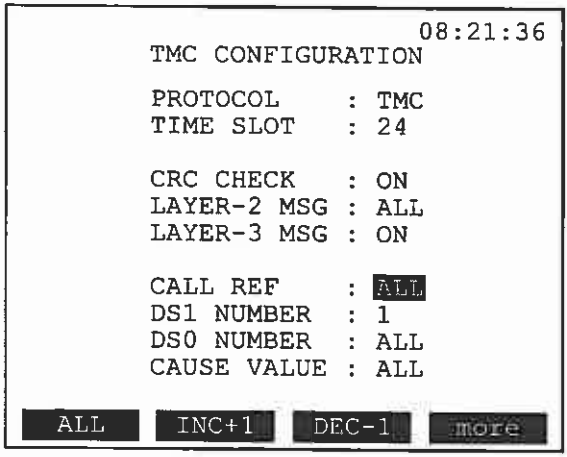

Figure 45 TMC Configuration Screen

PROTOCOL

Options: TMC (F1), EOC (F2)

Determines which protocol to monitor.

The following are the TMC configuration items:

TIME SLOT

Options: 24 (F1), 12 (F2), INC+1 (F3), DEC-1 (F4)

Determine which DS0 the Dual T1 module will monitor in the TMC Start Tracer and Statistics.

- The default channel is 24; this follows the GR-303-CORE specification.
- If required, you may look at a different channel. Use the 12 (F1) and 24 (F2) keys to select that particular channel. Press the INC+1 (F3) and DEC-1 (F4) keys to increase/decrease the channel number.

CRC CHECK
Options: OFF (F1), ON (F2)

Determines if the Dual T1 module will detect and report Layer 2 CRC errors.

- The default setting is OFF. When set for ON, the Dual T1 module will capture invalid TMC messages and report them as CRC ERROR.

LAYER-2 MSG
Options: ALL (F1), REJECT (F2)

- Select ALL, and the Dual T1 module will capture all Layer 2 messages. Select REJECT if you are interested only in the call processing messages (Setup, Connect, Release).
- Select REJECT and the Dual T1 module will not capture any Layer 2 messages: RR, RNR, REJ, DM, SABME, UA, UI, DISC.

LAYER-3 MSG
Options: ALL (F1), REJECT (F2), ON (F3)

- When set for ALL, the Dual T1 module captures all Layer 3 messages.
- When set for REJECT, the Dual T1 module does not capture/ display any Layer 3 messages.
- ON provides further Layer 3 filtering. After selecting ON, more filter choices become available, as shown in Figure 45. This allows you to filter on specific Layer 3 messages (e.g., ones containing a particular call reference value).

Layer 3 Filter Settings

The following settings are available if you select Layer 3: ON.

CALL REF
Options: ALL (F1), INC+1 (F2), DEC-1 (F3), INC+100 (MORE, F2), DEC-100 (MORE, F3), INC+10 (MORE, F2), DEC-10 (MORE, F3).

Configure to capture messages which contain a specific call reference number.

- A Call Reference number generally corresponds to the physical line termination port at the RDT, and thus, to a specific customer. If this is the case, this filter allows you to capture messages belonging to a customer.
- ALL (F1) captures all call reference numbers.

- Use the INC (F2) and DEC (F3) keys to enter a specific call reference value by a factor of 1, 10, or 100. The Dual T1 module will now only capture messages containing this value. GR-303 specifies valid call reference values from 1—2048.

DS1 NUMBER

Options: ALL (F1), INC+1 (F2), DEC-1 (F3).

Capture call control messages associated with a particular DS1 number.

- ALL (F1) captures all DS1 numbers.
- Use the INC+1 (F2) and DEC-1 (F3) keys to move to a specific DS1 number. The Dual T1 module will now only capture messages containing this DS1 number. GR-303 specifies valid DS1 values from 1–28.

DS0 NUMBER

Options: ALL (F1), INC+1 (F2), DEC-1 (F3).

Capture call control messages associated with a particular channel.

- Depending on your DS1 Number setting above, this will either be one channel on all DS1 lines or one channel on a particular DS1.
- ALL (F1) captures all DS0 numbers.
- Use the INC+1 (F2) and DEC-1 (F3) keys to enter a specific DS0 number. The Dual T1 module will now only capture messages containing this DS0 number. GR-303 specifies valid DS0 values from 1—24.

CAUSE

Options: ALL (F1), SELECT (F2)

Configure to capture messages containing a specific cause value.

- As an example, you could choose to monitor the GR-303 link and look for a protocol error (Invalid Information Content) or a release message saying channel unavailable. Refer to Table 6, Cause Values for a listing and description of possible GR-303 cause values.
- Select ALL (F1) to capture all cause values
- Select SELECT (F2), to select a cause value that will not be captured.

Value	Definition
16: Normal Clearing	Sent by the RDT/IDT to indicate that call clearing has begun, after recognizing that the customer went on-hook.
27: Destination out-of-service	Sent by the IDT to indicate that call clearing has been initiated because the customer is in a permanent signal state.
30: Response to Status Enquiry	Sent by the RDT in Status messages, which are sent in response to Status Enquiry messages.
34: Channel Unavailable	Sent by the IDT to reject a call setup when there is no DS0 available to carry the call. Also, the RDT may reject a call with this cause value if it believes that the DS0, specified by the IDT, is already in use or is unavailable.
35: Distribution Channel Unavailable	Sent by the RDT to reject call establishment when the distribution channel as indicated by the CRV is blocked.
41: Temporary Failure	Sent by the IDT to initiate call clearing after recognizing that there is a call state mismatch. The RDT may also send this message in a STATUS message if it believes there is a call state mismatch. In addition, the IDT and RDT may send this message to indicate call clearing due to a call failure event like a timer expiry, or if a resource becomes unavailable during the call.
44: Line Unit Unavailable	Sent by the IDT/RDT to reject a call setup when the line termination, as indicated by the CRV, is incapable of providing service. After receiving a Release Complete message with this cause value, the RDT/IDT immediately stops call establishment.
47: Ring Failure	Sent by the RDT to reject call establishment when the line indicated by the CRV fails the ring pre-trip test.
81: Invalid Call Reference	Sent by the RDT/IDT to reject a message that contains an invalid call reference value.
96: Mandatory Element Missing	Sent by the RDT/IDT to reject a message that does not contain a required information element.
97: Message Unimplemented	Sent by the RDT/IDT to reject an unrecognizable message.
99: Information Element Unimplemented	Sent by the RDT/IDT to indicate they did not recognize an information element in the received message.
100: Invalid Information Element Contents	Sent by the RDT/IDT to reject a message that contains an invalid information element (coded incorrectly).

Table 6 Cause Values

2.7.1.1.2 EOC Configuration

The EOC Configuration screen allows you to configure the Dual T1 for monitoring the *eoc* channel. You may change the *eoc* channel if necessary (the default setting is channel 12, as specified by GR-303-CORE). You may also set a filter to isolate a specific *eoc* datalink path. Refer to Figure 46.

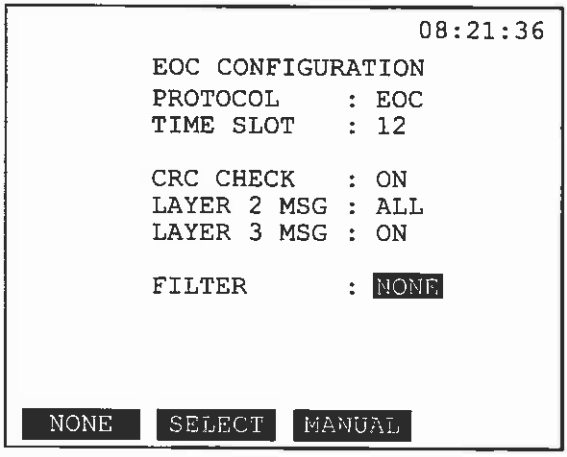

Figure 46 EOC Configuration Screen

PROTOCOL
Options: TMC (F1), EOC (F2)

Determines which protocol to monitor.

The following are the EOC configuration items:

TIME SLOT
Options: 12 (F1), 24 (F2), INC+1 (F3), DEC-1 (F4)

This determines which DS0 the Dual T1 module will monitor in EOC STATISTICS. The default channel is 12; this follows the GR-303-CORE specification. If required, you may look at a different channel. Press the INC+1 (F3) and DEC-1 (F4) keys to change the number.

CRC CHECK
Options: OFF (F1), ON (F2)

Determines if the Dual T1 module will detect and report Layer 2 CRC errors.

- The default setting is OFF. When set for ON, the Dual T1 module will capture invalid *eoc* messages and report them as CRC ERROR.

LAYER-2 MSG
Options: ALL (F1), REJECT (F2)

- Select ALL (F1), and the Dual T1 module will capture all Layer 2 messages. Select REJECT if you are interested only in the call processing messages (Setup, Connect, Release).
- Select REJECT (F2) and the Dual T1 module will not capture any Layer 2 messages: RR, RNR, REJ, DM, SABME, UA, UI, DISC.

LAYER-3 MSG
Options: ALL (F2), REJECT (F1), ON (F3)

- When set for ALL (F1), the Dual T1 module captures all Layer 3 messages.
- When set for REJECT (F2), the Dual T1 module does not capture or display any Layer 3 messages.
- ON (F3) provides further Layer 3 filtering. After selecting ON, more filter choices become available on the next line. This allows you to filter specific Layer 3 messages.

FILTER
Options: NONE (F1), SELECT (F2), MANUAL (F3)

This provides a filter when monitoring in EOC STATISTICS. The filter allows you to isolate a particular *eoc* datalink path between the RDT and IDT (remote terminal and switch). The filter is based on the SAPI/TEI values contained in the address field. Table 7 provides a listing of all valid SAPI/TEI combinations, as defined in GR-303-CORE.

SAPI	TEI	Data Link Function
1	0	EOC Path Switching Operations
1	1	RDT Provisioning/memory administrative OS
1	2	RDT Maintenance/surveillance OS
1	3	RDT Testing OS
1	4	RDT IDT
1	5	RDT Test system controller 1
1	6	RDT Test system controller 2
1	7	RDT Test system controller 3
1	8-11	User assignable

Table 7 SAPI & TEI Datalink Values

NONE: The Dual T1 module will capture all valid *eoc* SAPI/TEI values based on Bellcore's GR-303-CORE specification.

SELECT: Allows you to filter by link path. The Dual T1 module provides a listing of all Datalink paths (as specified by their SAPI/TEI combination). Upon pressing SELECT (F2), the screen displays the EOC FILTER SELECTION screen, as shown in Figure 47.

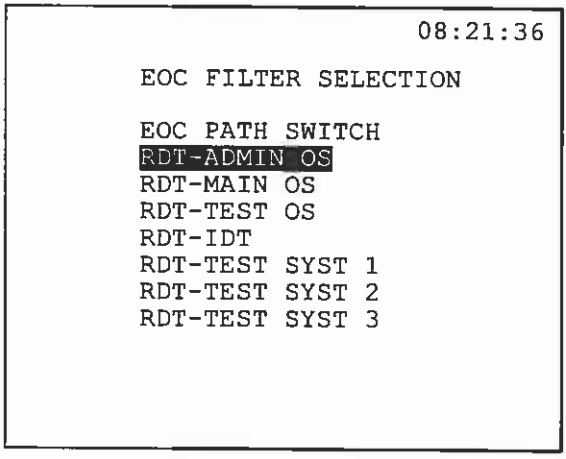

Figure 47 EOC Filter Selection

1. Use the up and down arrow keys on the keypad to move the cursor to the desired selection.
2. Press the ENTER key on the keypad to save this selection and return back to the setup screen, where the new selection is displayed in the FILTER ON field. The Dual T1 module will now capture only the messages containing the particular SAPI/TEI values associated with the selection.

MANUAL: Allows you to enter manually the specific SAPI and TEI values. Upon selecting, MANUAL, SAPI and TEI filter settings will appear. You can select any value by pressing NEXT (F1) and PREV (F2). Use the INC+10 (F3) and DEC-10 (F4) to increment/decrement the numbers by a factor of ten. Refer to Table 7 for a list of all valid SAPI/TEI combinations.

2.7.1.2 Start Tracer

Access START TRACER to capture TMC/CSC or *eoc* messages. The live messages appear on the screen and are stored in the VIEW/PRINT RECORD. You must be in the START TRACER screen to capture messages. Figure 48 shows a sample START TRACER/DECODED screen.

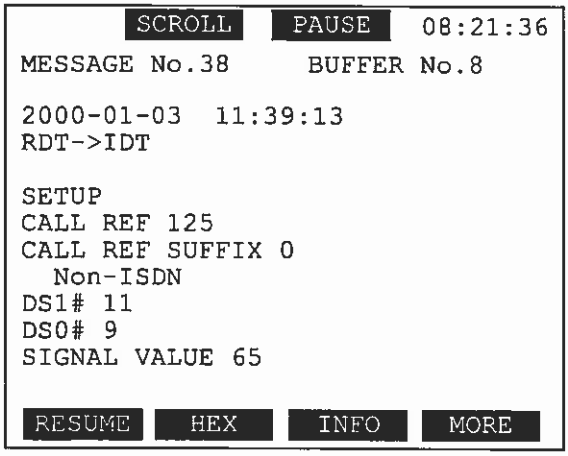

Figure 48 Start Tracer/Decoded

The following information is displayed on this screen:

Message No.: Displays the total number of messages stored in the buffer.

Current No.: Displays the total number of messages captured since entering the Start Tracer screen.

Date and time stamps correspond to when this message was captured.

RDT<-IDT: Displays the direction of the message — whether it came from the RDT (Remote Digital Terminal) or IDT (Integrated Digital Terminal).

Message Type and Information Element contents: Refer to Section 2.7.1.1.3 View/Print Record, for a description of message type and information element contents.

The following F-keys appear in Figure 48, Start Tracer/Decoded:

PAUSE (F1): Pause stops the live capture mode. After pressing the (F1) key, a PAUSE indicator appears at the top right of the screen. When this indicator is present, the Dual T1 module is not capturing messages. Press RESUME (F1) to start capturing messages again.

HEX/DECODE (F2): When a message is present, pressing HEX shows the message in hexadecimal format. Press DECODE to see the message in the decoded format. Figure 49 is in Hex format.

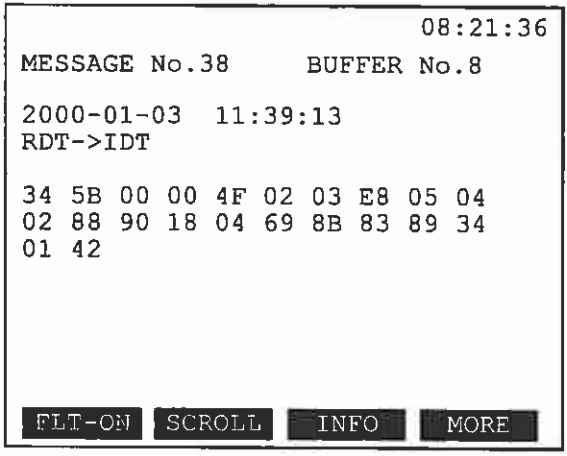

Figure 49 Start Tracer/Hex

FTR-ON (more, F1): This key sets a prefilter. When you press FTR-ON (F1), a FILTER indicator appears at the top of the screen. When this is present, the Dual T1 module captures only those messages that match the CONFIGURATION/FILTER settings. To turn off the prefilter, press FTR-OFF (F1).

Pre and Post Filtering

The Dual T1 module contains both pre- and postfilters for GR-303 tracing. A prefilter captures only your specified messages in the buffer; it ignores the rest. A postfilter captures all messages in the buffer, then allows you to selectively view messages.

- To set the Dual T1 module for prefiltering, enter Start Tracer. Press the more (F4) key, and select FLTR-ON (F1). A "FILTER" message should appear at the top right of the screen. When "FILTER" appears, the Dual T1 module is prefiltering messages; it captures/stores only those messages matching the filter settings you specified. To disable the prefilter, press the FTR-OFF (F1) key; the "FILTER" message should disappear.
- To postfilter messages, make sure the Filter is off in the START TRACER screen. Enter START TRACER and capture messages. After tracing the messages enter VIEW/PRINT RECORD. The FTR-ON (F4) key turns on the postfilter. The screen shows you the total messages captured and then the total number of messages matching your filter criteria. To turn off the postfilter, press the FTR-OFF (F4) key.

SCROLL (more, F2): Press this key to move through the available screens. PAGE-UP (F1) and PAGE-DN (F2) will appear. The SCROLL indicator appears at the top of the screen to remind you are in SCROLL mode. Press RETURN (F4) to return to live data.

2.7.1.3 View/Print Record

The VIEW/PRINT RECORD screen allows you to view all messages stored in the buffer. The initial screen appears in Figure 50.

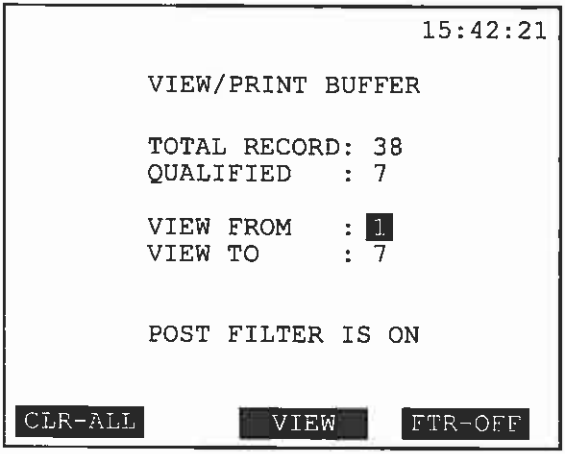

Figure 50 View/Print Tracer Screen

The following information is displayed in Figure 50.

TOTAL RECORDS: This is the number of messages in the buffer.

QUALIFIED: This is the number of messages which meet the filtering criteria. Note that the QUALIFIED number will change with the filters; usually when filtering is on, the number of QUALIFIED messages will decrease. If no messages match, it will display "No Match." If filtering is not on, the number of QUALIFIED messages will match the TOTAL RECORD number.

VIEW FROM/VIEW TO: Use the SHIFT-lock and number keys to enter the message number you want to start and stop looking at.

POST FILTER IS ON/OFF: This messages tells you whether or not a filter is engaged. Use the FTR-ON/FTR-OFF (F4) key to turn filtering on or off.

The following F-keys are available:

CLR-ALL (F1): Clears all messages stored in the buffer. Upon pressing CLR-ALL, a warning message appears to prevent you from accidentally erasing the buffer contents. As the instructions indicate, press the ENTER key on the keypad to continue (and erase) or the ESC key on the keypad to cancel (and keep the messages).

VIEW (F3): Displays the messages as specified by the VIEW FROM and VIEW TO settings.

FTR-ON (F4): Enables the postfilter. This allows you to view only those messages which match the filter parameters set in the CONFIGURATION screen. Press the FTR-OFF (F4) key to disable the postfilter and view all messages in the buffer.

Figures 51 and 52 provide sample single line messages as seen when you press VIEW (F3).

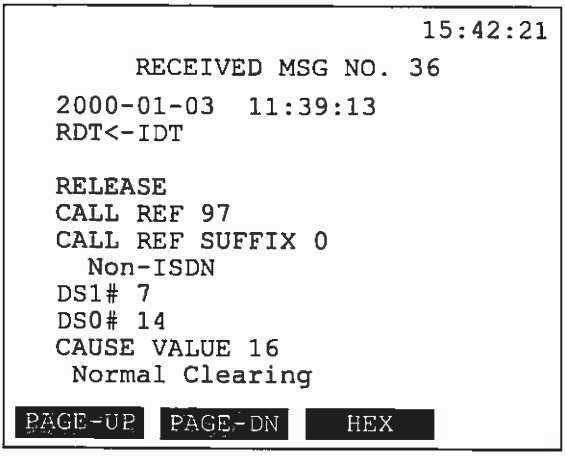

Figure 51 Release Message

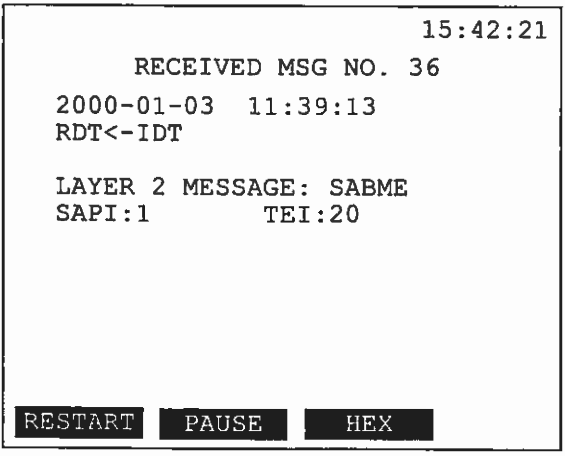

Figure 52 Layer 2 Message

The following information may be found in these messages:

- Date and time stamp indicating the exact time the message was detected.
- Direction of the message: from the IDT (Integrated Terminal) or RDT (Remote Terminal).
- Message Type: Some possible types are:

  Setup: CSC and TMC
  Setup Acknowledge: CSC only
  Alerting: CSC only
  Call Proceeding: CSC only
  Notify: CSC only
  Information: TMC and CSC
  Connect: TMC and CSC
  Connect Acknowledge: TMC only
  Disconnect: TMC and CSC
  Release: TMC and CSC
  Release Complete: TMC and CSC
  Status: TMC and CSC
  Status Enquiry: TMC and CSC

- Call Reference Value: Identifies the call (and customer) to which the message applies. Remember that in many cases the CRV is associated with the Line Circuit Address (LCA), which is the physical location where the customer's distribution pair is terminated. Therefore, the CRV identifies the customer. CRV values can range from 1–2048.
- Call Reference Suffix: Identifies the particular call that applies to the message. The possible values are:

  Non-ISDN (or the LT only supports one call at a time)
  B-channel 1 (ISDN BRI)
  B-channel 2 (ISDN BRI)

- DS1 Number: Identifies the DS1 line used for the call. This number can range from 1 — 28.
- DS0 Number: Identifies the DS0 channel used for the call. This number can range from 1 — 24.
- Cause Value: Conveys diagnostic information to the RDT or IDT as to why the call failed. Refer to Table 6 for a listing of the possible GR-303 Cause Values and their meanings. Cause Values are often contained in an Information Element screen. Press INFO (F3) to bring up the Information Element screen, as in Figure 53.

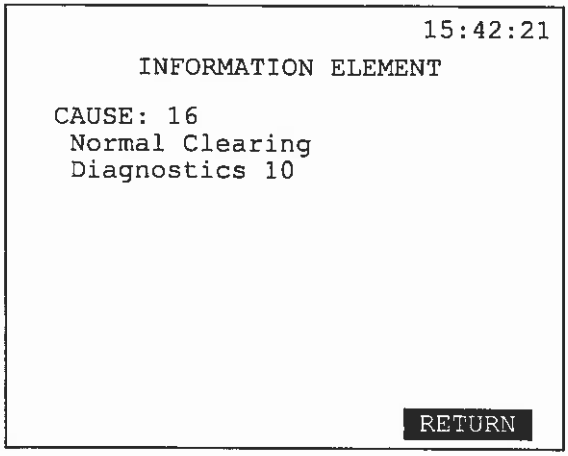

Figure 53 Information Element Screen

Press RETURN (F4) to return to the message. PAGE-UP (F1) and PAGE-DN (F2) keys may also be available, depending on the length of the information element. The following F-keys can be found in these screens:

PAGE-UP (F1): Scrolls to the previous message. For example, the message number is 36 in Figure 51. Pressing PAGE-UP displays message 37.

PAGE-DN (F2): Scrolls to the next message. For example, the message number is 36 in Figure 51. Pressing PAGE-DN displays message 35.

HEX (F3): Displays the message in hexadecimal format.

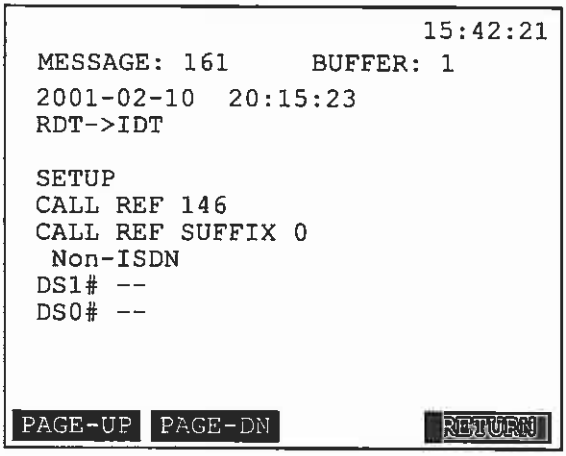

Figure 54 Setup Message

The message in Figure 54 is a Setup message sent by the RDT. The CRV is 146. The dashes next to the DS1 and DS0 numbers indicate that this information is not specified in this message. This is because the call was initiated by the RDT. When the IDT responds with a Setup ACK (CSC) or Connect (TMC) message, it will specify which DS1 and DS0 to use for the call.

2.7.1.4 Statistics

Statistics are captured in accordance with your settings in the CONFIGURATION screen.

2.7.1.4.1 TMC Statistics

The TMC Statistics page provides a running count of any cause values found in Disconnect, Release, Release Complete, and Status messages. You must be in this screen for the results to accumulate. Results are provided for both Line 1 and Line 2. Refer to Figure 55.

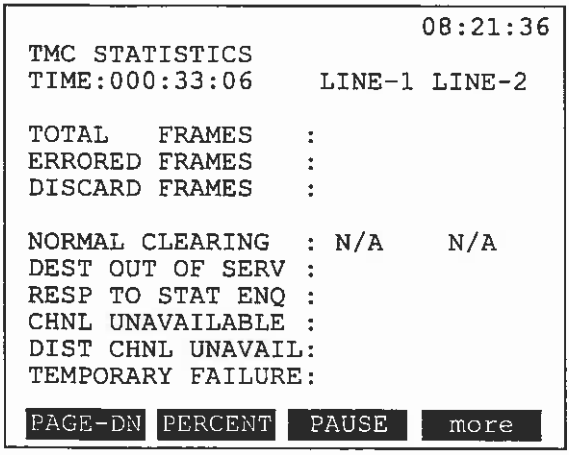

Figure 55 TMC Statistics

While you are in this screen, the messages are also stored in the View/Print Record. If you need more details and context for a certain cause value, you may look through the messages in View/Print Record. Setting a postfilter for the particular cause value will simplify the process.

The TMC filter also applies to the statistics screen. For example, if you are filtering on DS1 number 5, only messages for DS1 number 5 are recorded.

Note: The total TMC message count is recorded at the bottom. This counts up all valid TMC messages (i.e., SETUP, CONNECT, RR).

The following F-keys are available in this screen:

Pause (F3): Pause stops the measurement. All counters remain at the current value, and do not continue to increase. Press the RESUME (F3) key to return to live measurements.

PERCENT (F2): This key changes the results display to a percentage format. Press COUNT (F3) to return to a count display.

Restart (more, F1): This key restarts the measurement and resets all counters to zero.

FLT-ON (more, F2): Press to engage the Filter. FILTER will appear in reverse video at the top of the screen, and only messages matching the filter will be used for Statistics. Press FLT-OFF (F2) to turn the filter off.

The following information is provided in this screen:

Time: Time begins counting as soon as you enter the TMC Statistics screen. When you press the ESC key on the keypad, time is reset to 0.

Total Frames: A continuous count of the number of TMC messages.

Errored Frames: A count of the number of TMC messages containing FCS (Frame Check Sequence) errors.

Discard Frames: A count of the number of TMC messages that have been discarded because:

- frames are either above or below the specified length.
- the total bit count is not divisible by 8.
- the message contains more than 6 consecutive ones.

See Section 2.7.1.1.1; Table 6, Cause Values for message definitions.

2.7.1.4.2 EOC Statistics

As soon as the user enters the EOC statistics screen, the Dual T1 module begins to capture and record *eoc* message information. The following results should apply either to all valid *eoc* messages (if Filter=None) or to *eoc* messages containing the filtered SAPI/TEI. These should begin counting as soon as you enter the screen. Once you exit, all counts are reset to 0.

Two screens comprise *eoc*statistics. The first screen is shown in Figure 56.

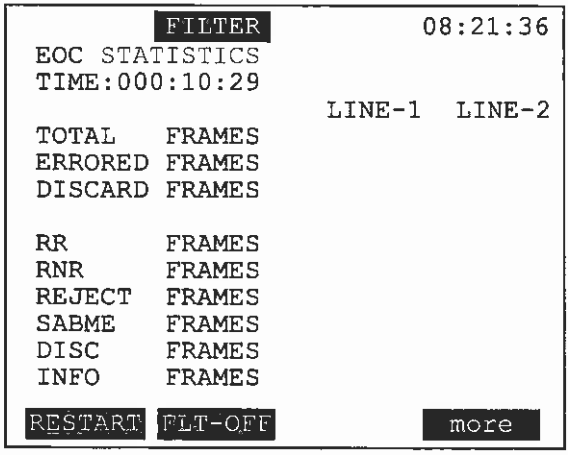

Figure 56 EOC Statistics, Screen 1

The following information is provided in this screen:

Time: Time begins counting as soon as you enter the EOC Statistics screen. When you press the ESC key on the keypad, Time is reset to 0.

Total Frames: This is a continuous count of the number of *eoc* messages.

Errored Frames: This is a count of the number of *eoc* messages containing FCS (Frame Check Sequence) errors.

Discard Frames: A count of the number of *eoc* messages that have been discarded because:

- frames are either above or below the specified length.
- the total bit count is not divisible by 8.
- the message contains more than 6 consecutive ones.

The rest of the screen provides a running count of all valid *eoc* Layer 2 message types:

- RR: Receiver Ready
- RNR: Receiver Not Ready
- REJ: Reject (layer 2)
- SABME: Set Asynchronous Balanced Mode Extended
- DM: Disconnect Mode
- INFO: Information

The F-Keys are used as follows:

PAGE-UP, PAGE-DN (F1): toggles between the two pages of statistics.

PERCENT (F3): Press PERCENT to see all values in terms of percent (i.e., the percentage of errored frames out of the total *eoc* frames received). COUNT (F3) returns the results back to a count.

PAUSE/RESUME (F3): This keys stops or restarts the current measurement; the counters are not reset. To reset the counters, press the ESC key on the keypad and return to EOC Statistics screen.

Pressing PAGE-DN (F2) provides the second EOC STATISTICS page, as shown in Figure 57.

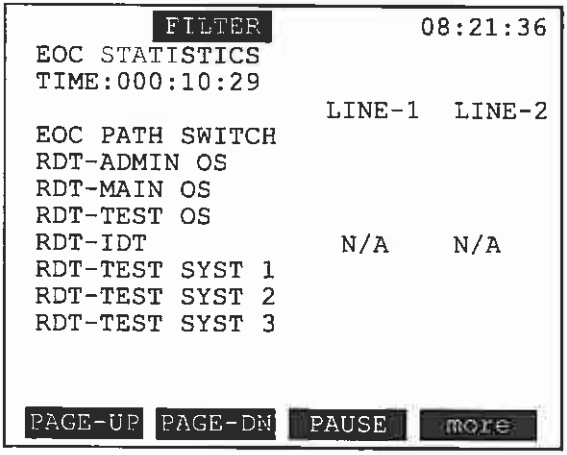

Figure 57 EOC Statistics, Screen 2

This provides a running count of the various *eoc* datalink paths. Again, these paths are determined by the SAPI/TEI values outlined in Appendix B. Counts are provided for both lines, if you are in DS1 dual mode.

2.7.2 ISDN Primary Rate

The ISDN PRIMARY RATE feature allows you to setup and place a call, receive a call, talk/listen (voice calls), or perform a BERT (data calls). This feature is available only in a DS1 point-to-point mode.

- The status of the line is shown by a reverse video message on the second line on the screen; RDY is shown if the link is up and in service, and OOS is shown if the link is not ready (out of service).
- Note that the current transmitted (Tx1) and received (Rx1 or Rx2) messages are shown on the same line to either side of the status indicator, between carrots.
- The Dual T1 module starts the Layer 2 handshake immediately. It activates the D-channel as soon as you enter the ISDN feature.
- In order to do ISDN testing you need to be in a DS1 mode. The unit will reset the framing to ESF and the coding to B8ZS.

2.7.2.1 Test Configuration

To configure for ISDN, enter PROTOCOL ANALYSIS > ISDN PRIMARY RATE. There will be a pause as the program loads. You will see the following menu:

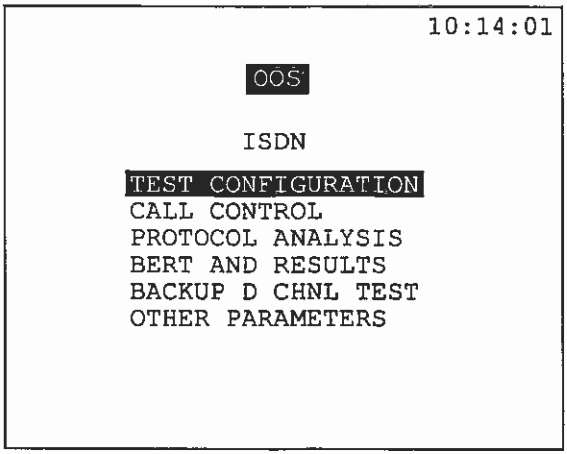

Figure 58 ISDN Menu

Enter the TEST CONFIGURATION menu.

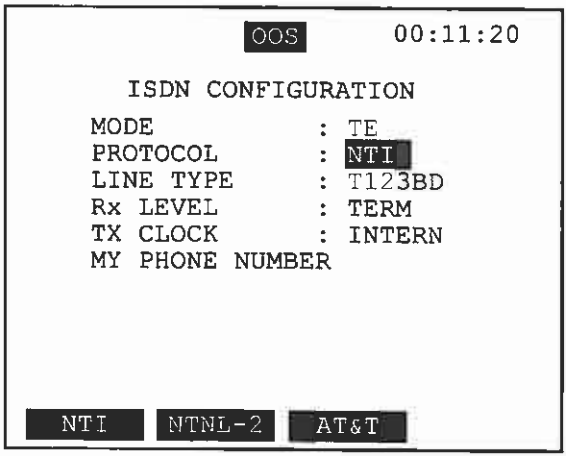

Figure 59 ISDN Configuration Screen

Configure the following items:

MODE

Options: TE (F1), NT (F2), MONITOR (F3)

Configures the test mode for the test set.

TE

- Terminating Equipment is used when the test set is emulating customer equipment, as in a PBX.
- Use TE Type when you are plugging into a Central Office switch.

NT

- Network Terminal is used when emulating an ISDN switch or exchange.
- Use NT to plug into Customer Premises.

Monitor (F3)

- Monitor is used when monitoring one or both sides of an ISDN line.

Notes:

- When MONITOR has been selected as the MODE, the options presented below will change; Tx Clock will not be present, but SIGNALLING T/S will.
- When MONITOR has been selected, CALL CONTROL and BACKUP D CHNL TEST are not available.

PROTOCOL

Options: NTI (F1), NATL-2 (F2), AT&T (F3)

The Q.931 protocol specification indicates which type of ISDN switch you intend to use for testing.

- The NTI option relate to the Northern Telecom DMS-100 switch.
- NATL-2 stands for Bellcore's National ISDN-2 protocol.
- The AT&T option refers to AT&T's Custom protocol.

LINE TYPE

Options: TI23BD (F1), T146B2D (F2), T147BD(F3)

Select the type of line you will be testing.

- T123B uses only one T1 line; there are 23 B-channels and one D-channel.
- T146B2D uses both T1 lines; there are 46 B-channels and 2 D-channels. In this case, one D-channel is active, while the other one is in a standby mode to take over if the first should go out-of-service.
- T147BD uses both T1 lines. There are 47 B-channels, and only one D-channel. In this case, there is no backup D-channel.

Note: When you select either T146B2D or T147BD, you will be using both T1-1 and T1-2. You will have to plug both lines into the circuit. Therefore, the receiver level and LBO settings apply to both lines.

RX LEVEL (L1-RX in Monitor Mode only)

Options: TERM (F1), BRIDGE (F2), MONITOR (F3)

Specify the line interface mode for your testing.

TERM is the most common mode used for out-of-service testing. BRIDGE is commonly used for testing live circuits.

TERM: The TERM mode is used when you wish to send and receive an T1 signal. The test set terminates the received signal with a low impedance termination, and requires that the circuit be disrupted for testing.

BRIDGE: The BRIDGE mode is similar to the MONITOR mode. However, in the BRIDGE mode, the test set applies high impedance isolation resistors to the circuit under test. This isolation circuitry will protect the signal from any possible disruption. Select BRIDGE before clipping onto a live circuit.

If a connection is made from the MON jack of a network element to the test set, and if the BRIDGE access mode is being used, this may result in two isolation circuits on the signal. In this case, the test set will likely report a loss of signal and be unable to perform any measurements.

MONITOR: The MONITOR mode is used for monitoring. The signal is provided from the MON jack of an DSX, DS1 plug-in card, CSU, or NI. The network element isolates the MON signal from the live signal with high impedance resistors.

The MONITOR mode is useful because it protects the live signal from possible disruptions caused by the testing process. It allows the technician to observe the line while the circuit is carrying customer traffic.

Note: The next two line items are not available in MONITOR mode.

TX CLOCK

Options: INTER (F1), L1-RX (F2), L2-Rx (F3)

TX CLOCK determines the timing source for your transmit signal.

- INTERN (F1) uses the test set's internal timing as its clock source. You should use INTERN when you want to emulate a piece of network equipment (NT).
- L1-RX (F2) and L2-RX (F3) use the timing signal received on the indicated line. Use L1/L2-Rx if you are plugging into a switch which requires the test set to be synchronized to the network. Pick L1/L2-RX if you selected TE as the MODE.

MY PHONE NUMBER

Options: Any up to 22 digit number

- Use the SHIFT-lock and numeric keys to enter the number associated with the line you are dialing from. If you arrow back to a digit and change it, all digits to the right of the changed digit will vanish.
- Use the <- (F2) key to move within the number.
- Press EDIT (F1) to change digits within the number; arrow (F2) to the digit you want to change, and press the number key. Note that the SHIFT indicator displays when you press EDIT, then vanishes when you finish the changes and press DONE (F1).

Note: The following item is only available in MONITOR mode.

SIGNALLING T/S

Options 1—24

Select the timeslot carrying the signalling; the D-channel. This is usually timeslot 24.

- Use INC+1 (F1) or DEC-1 (F2) to increase or decrease the value.

Press the ENTER key on the keypad when you are through with your configuration.

2.7.2.2 Call Control

When the unit is set up for ISDN, in the TE or NT MODE, you may enter CALL CONTROL to place calls. See the following figure for a sample screen:

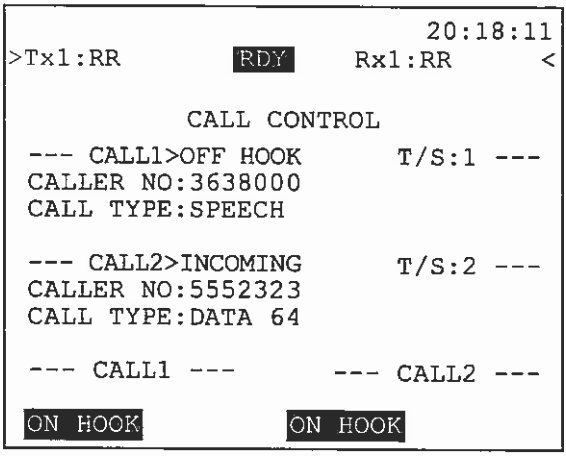

Figure 60 ISDN Call Control

The CALL CONTROL screen provides the status of both possible Line 1 calls (only one data call may be up at a time). In it you can also disconnect a call. In Figure 60, CALL1 is a SPEECH call on TimeSlot 1, and CALL2 is an INCOMING DATA-64 call on TimeSlot 2. Note that the CALLER NUMBER for each call is also shown.

Call Set Up Screen

When you press CALL (F2 or F4) in the CALL CONTROL screen, you will enter the ISDN CALL SETUP screen, as in the following figure. Note that even if you place the call using F4, it will default to CALL1, if only that one call has been placed.

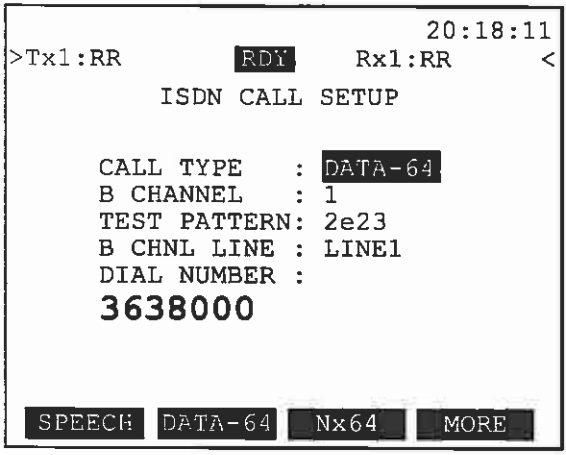

Figure 61 ISDN Call Setup Screen

To configure a call, set up the following:

CALL TYPE

Options: SPEECH (F1), DATA-64 (F2), Nx64 (F3), 3.1K (MORE, F1), DATA-56 (MORE, F2)

Determines what kind of call you are going to place.

- SPEECH to place a voice call.
- DATA-64 to place a data call at 64 kbps data rate. A BERT will start automatically once the call has connected.
- 3.1K to place an audio call at 3.1 kbps.
- DATA-56 to place a data call at 56 kbps data rate. A BERT will start automatically once the call has connected.
- Nx64 pertains to multirate ISDN PRI with 64K for each channel. Refer to Figure 62 and the text following.

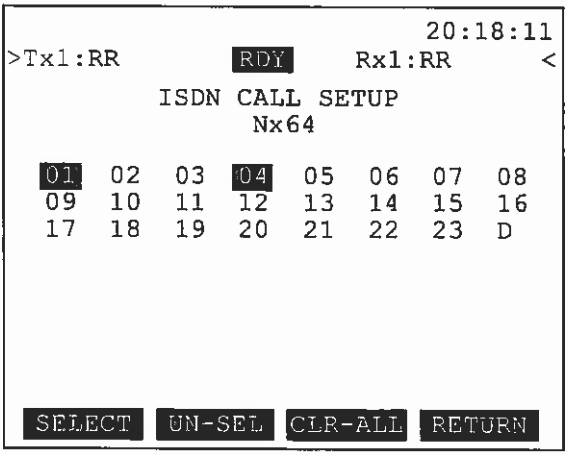

Figure 62 ISDN Call Setup, Nx64 Selection Screen

- Use the SELECT (F1) and UN-SEL (F2) keys to choose the timeslots to send data on; you may not choose the D- channel, which is ordinarily timeslot 24. These may be contiguous or noncontiguous channels. Any selected timeslots will be highlighted. Cursor between the timeslots.
- CLR-ALL (F3) clears any selected timeslots.
- After you have selected your timeslots, press RETURN (F4) to return to the Call Setup screen.

TEST PATTERN

Select the test pattern.

- Press SELECT (F1) to enter the standard SEND TEST PATTERN screen. Cursor to the pattern you want to send. See Section 2.3.1 Standard Test Patterns, for detailed information.
- The TEST PATTERN is used in Data calls for a T123BD line, and for all types of calls for T146BD and T147BD lines.

B CHANNEL (N/A on Nx64 calls)

Options: 1—23, AUTO (F3)

Specify the B channel to use for the call.

- Use the INCrease +1 (F1) or DECrease -1 (F2) key to change the channel number.
- You will not be able to select the channel chosen as the Signalling/D channel in the ISDN SETUP screen. This is normally channel 24 for North America.

- Press AUTO (F3) to have the SunSet automatically detect which channel is available, and place the call on that channel.

B CHNL LINE (only for Line Types T147BD and T146B2D)
Options: LINE1 (F1), LINE2 (F2)

Select the T1 line where your desired B-channel resides.

DIAL NUMBER

Enter the number that you intend to dial to place your call.

- The number may be entered using the SHIFT-lock and number keys.
- Use the <- (F2) key to backspace within the line.
- If a number is already present, and you wish to change it, press EDIT (F1). Press this key, and the SHFT indicator will appear at the top left of the screen. Arrow (F2) within the number to the digit you want to change, and enter the new number. Any digits to the right of the digit you are correcting will vanish. When you have finished editing, press DONE (F1). The SHFT indicator will vanish.

2.7.2.3 Protocol Analysis

This menu lets you configure filters for capturing messages, and allows you to view stored messages.

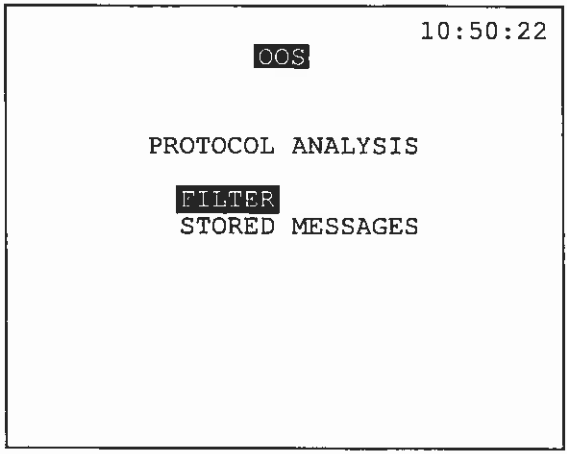

Figure 63 ISDN Protocol Analysis Menu

Here you may observe the messages on one or both sides of a line. In the MONITOR mode only, the PROTOCOL ANALYSIS menu will feature LIVE TRACER as the second line item.

2.7.2.3.1 Filter

Enter this screen to configure your message filters.

- In MONITOR mode, messages will be captured in accordance with these filter settings.
- Prefiltering does not apply when you are emulating a TE or an NT, as all messages must be received so that calls may be placed. In those modes, you may postfilter, in the PROTOCOL ANALYSIS > STORED MESSAGES > TEMPORARY BUFFER.

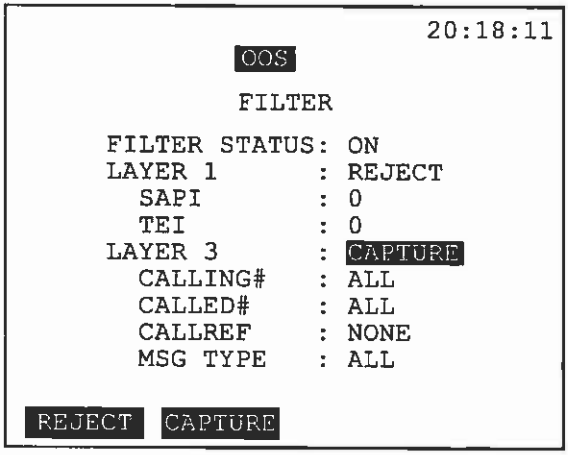

Figure 64 ISDN Filter Screen

FILTER STATUS
Options: OFF (F1), ON (F2)

- If set to OFF (F1), no filters will be used; therefore *all* messages will be captured.
- If set to ON (F2), you will be able to set Layers 1, 2, and 3 filters, as explained below. A FILTER message will appear at the top of the screen.

Note: If FILTER STATUS is set to OFF, the next time you enter the FILTER item, you will enter a screen with the single line item of FILTER STATUS. Select ON, and you will enter the regular FILTER screen.

The following items are available when the FILTER STATUS is ON:

LAYER 1
Options: REJECT (F1), CAPTURE (F2)

- Press REJECT if you wish not to display Layer 1 information.
- Press CAPTURE to display Layer 1 information.

LAYER 2
Options: REJECT (F1), CAPTURE (F2)

- Press REJECT if you wish not to capture Layer 2 messages.
- Press CAPTURE to display Layer 2 messages.

Note: To enter digits in the following items, use this procedure:

- The number may be entered using the SHIFT-lock and number keys.
- Use the <- (F2) key to backspace within the line.
- If a number is already present, and you wish to change it, press EDIT (F1). The SHFT indicator will appear at the top left of the screen. Arrow (F2) within the number to the digit you want to change, and enter the new number. Any digits to the right of the digit you are correcting will vanish. When you have finished editing, press DONE (F1). The SHFT indicator will vanish.

The following items are available when the LAYER 2 filter is set to capture:

SAPI
Options: ALL (F3), any 1 or 2 digit number

- Select ALL and all SAPIs will be captured.
- You may also enter a specific number.

TEI
Options: ALL (F3), any 1 or 2 digit number

- Select ALL and all TEIs will be captured.
- You may also enter a specific number.

LAYER 3
Options: REJECT (F1), CAPTURE (F2)

- Press REJECT (F1) to not capture Layer 3 messages.
- Press CAPTURE (F2) to capture Layer 3 messages.

The following items are available when the LAYER 3 filter is set to CAPTURE:

CALLING #
Options: ALL (F4), any 1—22 digit number

- Select ALL and all CALLING NUMBERS will be captured.
- You may also enter a specific number. Note that you have two arrow keys to move within the number, F2 and F3.

CALLED #
Options: ALL (F4), any 1—22 digit number

- Select ALL and all CALLED NUMBERS will be captured.
- You may also enter a specific number. Note that you have two arrow keys to move within the number, F2 and F3.

CALLREF
Options: NONE (F3), any 1—5 digit number

- Each call has a specific call reference value assigned to it. The value is included in the CALL SETUP message.
- Select NONE and all Call Reference values will be captured.
- You may also enter a specific number.

MSG TYPE
Options: ALL (F1), SELECT (F2)

- Select ALL and all Layer 3 Message Types will be captured.
- Choose SELECT, and you will enter a FILTER – MESSAGE TYPE screen, as in Figure 65, where you may choose a specific Message Type you want to capture.

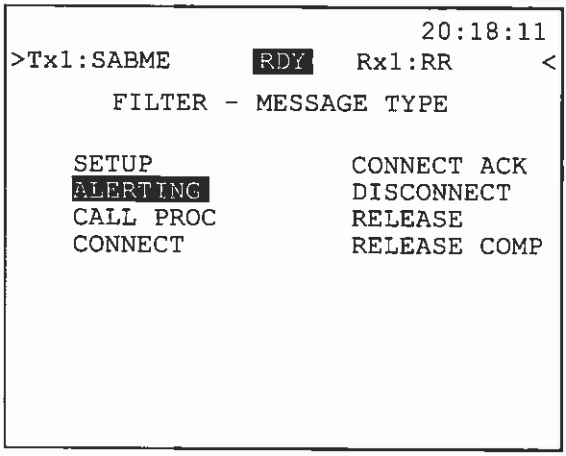

Figure 65 Select L3 Message Type Filter

The following are the message types:

SETUP: Setup message.

ALERTING: Call establishment alerting message.

CALL PROC: Call proceeding message.

CONNECT: Call connect message.

CONNECT ACK: Connection acknowledged message.

DISCONNECT: Disconnect message.

DISCONNECT ACK: Disconnect acknowledged message.

RELEASE: Release call message.

RELEASE COMP: Release completed message.

When you have completed selecting the message type, press the ENTER key on the keypad to return to the FILTER screen.

When you have the filters configured as desired, press the ESC key on the keypad to return to the ISDN menu. Messages will be captured in accordance with your filter settings. View the current messages in STORED MESSAGES > TEMPORARY BUFFER.

2.7.2.3.2 Live Tracer

- Observe the live transfer of messages, on one or both lines.
- The set must be in MONITOR mode to use this feature.

Make sure the module is configured for T1 DUAL, BRIDGE or MONITOR, in the TEST CONFIGURATION screen of the Dual T1 Main Menu. The ISDN TEST CONFIGURATION MODE line must be set for MONITOR.

If you are in Line 1 configuration only, all of the trace messages will be L1. If you are monitoring both sides of a line, you will see L1 and L2 messages, on separate screens. Figure 66 is a sample screen:

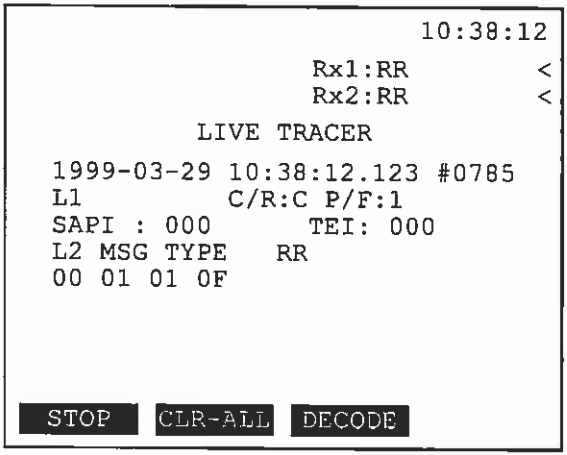

Figure 66 Monitor Live Tracer

The following information is shown in Figure 66.

Receive information for L1, or L1 and L2 (depending on your setup)

FILTER: A FILTER message will appear at the top of the screen if you have set up filters in the FILTER screen.

Date (1999-03-29 in the figure above)

Time (10:38:12.123 above)

Message number (785 above)

L1/L2: The Line on which the message is detected (Line 1 in this sample).

C/R: The Command/Response field bit, which identifies a frame as either a command or a response frame. (Command above)

P/F: Poll/Final bit (1 above); in command frames, it is the P-bit; in response frames, it is the F-bit. When the P-bit is set to 1, it demands a response (F-bit set to 1). The F-bit is then set to 1 to indicate that this frame is a response from a poll command. Messages with P-bit 0 do not require a response and may be sent consecutively without responses.

SAPI and TEI values are shown.

L2 MSG TYPE: The Layer 2 Message Type in the sample figure is SABME.

L3 MSG TYPE: No Layer 3 Message Type is shown in the sample figure; a L3 MSG TYPE will display if available. The message is shown in hex format on the sample screen.

These F-keys appear within the Monitor Live Tracer screen:

STOP (F1): Press to halt the live capturing of messages.

When stop has been pressed, new F-keys appear:

PAGE-UP (F2), PAGE-DN (F3): Use these keys to scroll through the messages.

START (F4): Press to restart the capturing of live messages.

CLR ALL (F2): Press to clear the captured messages so you may begin a new tracing.

HEX/DECODE (F3): Press as required to change the presentation of the data.

You may also enter STORED MESSAGES/TEMPORARY BUFFER to page through the messages, as well as store them.

2.7.2.3.3 Stored Messages

- View, filter, print, or delete current messages.
- Save messages for future viewing, if you have a memory card.
- View stored messages.

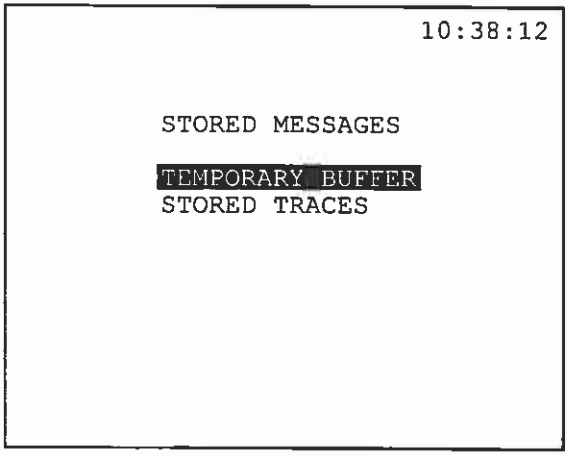

Figure 67 Stored Messages Menu

Note that a FILTER message will appear at the top of the screen when you are in MONITOR mode, if you have set up pre-filters in the FILTER screen.

Temporary Buffer

- This buffer, as shown in Figure 68, stores your current messages.
- Messages are stored by the criteria set in the FILTER screens, if the unit is in MONITOR mode, or by saving all messages, if the unit is in TE or NT mode.

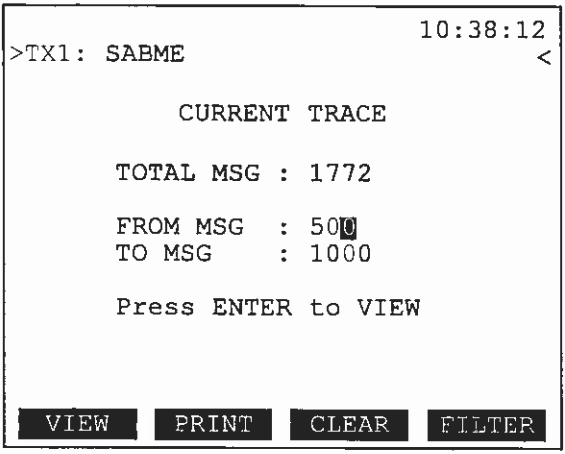

Figure 68 Current Trace Screen

TOTAL MSG shows the contents of the buffer. Select the messages to view by following this procedure:

1. Place the cursor on the FROM MSG line.
2. Press the SHIFT-lock key, then enter the number from the keypad. This will be the first message displayed. Move within the number using the cursor arrow keys. Press the SHIFT-lock key to release the SHIFT-lock.
3. Cursor down to TO MSG.
4. Enter the number from the keypad, repeating step 2. This will be the last message displayed.
5. When you have selected the message numbers, press VIEW (F1) to begin viewing the messages. See the Figure 69 for a sample trace.
6. Press FILTER (F4) to enter the FILTER screen. You may re-set the filters. Upon returning to the CURRENT TRACE screen, the TOTAL MSG will reflect the new number of messages meeting the filter criteria.

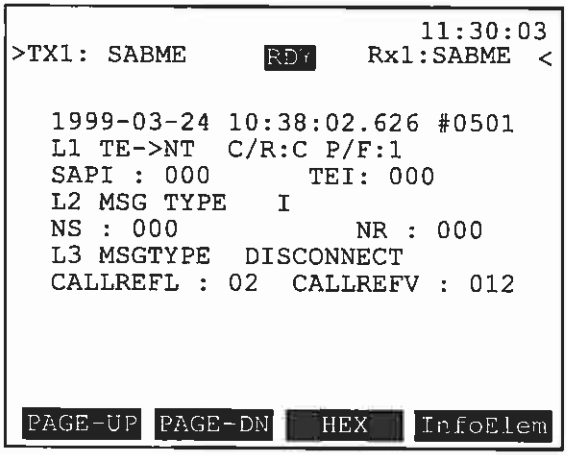

Figure 69 Sample Current Trace Screen (TE)

The following information may be shown, depending on the message as shown in the figure, Sample Current Trace Screen (TE):

Date (1999-03-24)

Time (10:38:02.626)

Message number (501)

Line, Direction: the line used, and the direction of the message (Line 1, TE to NT)

C/R: The Command/Response field bit, which identifies a frame as either a command or response. (Command)

P/F: Poll/Final bit (1 above); in command frames, it is the P-bit; in response frames, it is the F-bit. When the P-bit is set to 1, it demands a response (F-bit set to 1). The F-bit is then set to 1 to indicate that this frame is a response from a poll command. Messages with P-bit 0 do not require a response and may be sent consecutively without responses.

SAPI (000) and TEI (000) values.

L2 MSG TYPE; The Layer 2 Message Type in the sample figure is SABME.

L3 MSG TYPE: A DISCONNECT Layer 3 Message Type is shown in the sample figure; a L3 MSG TYPE will display if available.

CALLREFL: This is the Call Reference Length; the number of octets in the Call Reference value (one or two octets).

CALLREFV: This is the Call Reference Value. The value is assigned in the CALL SETUP message.

The following F-keys within the Sample Current Trace Screen (TE) are:

PAGE-UP (F1)/ PAGE-DN (F2): Press these keys to scroll through the selected messages.

DECODE/HEX (F3): Press this key to change the presentation of the data.

InfoElem (F4): An additional Information Element is sometimes available. Press the InfoElem key to view the Element. Refer to Figure 70.

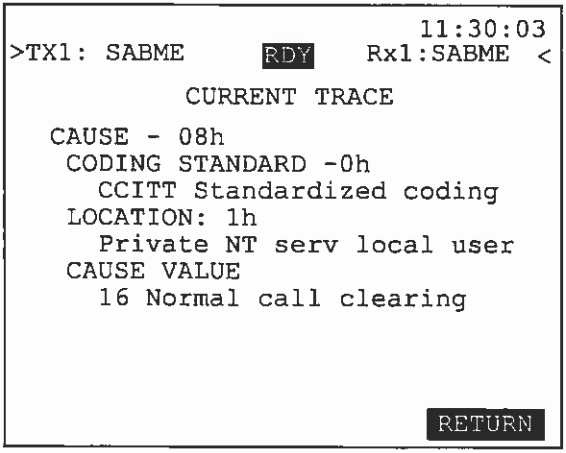

Figure 70 Info Element Screen

The Information Element provides a bit-by-bit decode of the Information Element contained in the message. In this sample, a Cause Value is translated. The Cause Information Element is a key diagnostic tool for troubleshooting. It often contains Disconnect, Release, or Status messages. It contains three fields: Location, Class, and Value. See Table 8, Q.931 Cause Values.

Class: Normal Event			
Cause			
No.	Class	Value	Cause Name
1	000	0001	Unallocated number
2	000	0010	No route to specified transit network
3	000	0011	No route to destination
6	000	0110	Channel Unacceptable
7	000	0111	Call awarded & being delivered in a established channel
16	001	0000	Normal Call Clearing
17	001	0001	User Busy
18	001	0010	No user responding
19	001	0011	No answer from user (user alerted)
21	001	0101	Call Rejected
22	001	0110	Number changed
26	001	1010	Non-selected user clearing
27	001	1011	Destination out of order
28	001	1100	Invalid number format (address incomplete)
29	001	1101	Facility Rejected
30	001	1110	Response to STATUS ENQUIRY
31	001	1111	Normal, unspecified
Class: Resource Unavailable			
Cause			
No.	Class	Value	Cause Name
34	010	0010	No circuit/channel available
38	010	0110	Network out of order
41	010	1001	Temporary Failure
42	010	1010	Switching equipment congestion
43	010	1011	Access information discarded
44	010	1100	Requested circuit Not Available
47	010	1111	Resources unavailable, unspecified
Class: Service or Option Not Available			
Cause			
No.	Class	Value	Cause Name
50	011	0010	Requested facility not subscribed
54	011	0110	Incoming calls barred
57	011	1001	Bearer capability not authorized
58	011	1010	Bearer capability not presently available
63	011	1111	Service or option not available, unspecified
Class: Service or Option Not Implemented			
Cause			
No.	Class	Value	Cause Name
65	100	0001	Bearer capability not implemented
66	100	0010	Channel type not implemented
70	100	0110	Only restricted digital information bearer capability is available
79	100	1111	Service or option not implemented, unspecified
Class: Invalid Message			
Cause			
No.	Class	Value	Cause Name
81	101	0001	Invalid call reference value
82	101	0010	Identified channel does not exist
83	101	0011	A suspended call exists, but this call identity does not
84	101	0100	Call identity in use
85	101	0101	No call suspended
86	101	0110	Call having the requested call identity has been cleared
88	101	1000	Incompatible destination
91	101	1011	Invalid transit network selection
95	101	1111	Invalid message, unspecified
Class: Protocol Error			
Cause			
No.	Class	Value	Cause Name
96	110	0000	Mandatory information element is missing
97	110	0001	Message type non-existent or not implemented
98	110	0010	Message not compatible with call state or message type non-existent or not implemented
99	110	0011	Information element non-existent or not implemented
100	110	0100	Invalid information element contents
101	110	0101	Message incompatible with call state
102	110	0110	Recovery on timer expiry
111	110	1111	Protocol error, unspecified
Class: Internetworking			
Cause			
No.	Class	Value	Cause Name
127	111	1111	Interworking, unspecified

Table 8 Q.931 Cause Values

Press the ENTER key on the keypad to return to the CURRENT TRACE screen.

Stored Traces

- This screen will give you access to your stored traces.
- You will be able to view, print, or delete previously saved traces.
- You must have a second memory card in order to have saved traces.

2.7.2.4 BERT and Results

- BERT AND RESULTS allows you to test the physical layer as well as perform a BERT test on a data call.
- To see the results, press the ESC key on the keypad until you reach the Main ISDN menu, then enter BERT AND RESULTS.

A BERT will start automatically after a DATA-64 or DATA-56 call has connected. MEAS will appear at the top of the screen. You do not need to be in the BERT AND RESULTS screen in order for measurements to be taken. For other types of calls, press START (F3) in the BERT AND RESULTS screen to begin your test of the physical layer.

There are a number of pages of measurement results to scroll through for both Line 1 and for Line 2. Refer to section 2.4.1.2, Line/BPV Screens for the results definitions.

These F-keys appear within the BERT and Results screens:

PAGE-UP (F1) and PAGE-DN (F2): Press to scroll through the pages of results.

START/STOP (F3): Press to stop a BERT, then press START (F3) to begin a new one.

HOLDSCR (MORE, F1): Press to freeze the measurement results for easy viewing. Press CONTINU (F1) to resume viewing the live presentation of data.

PRINT (MORE, F4): Press to Print the measurement results.

SAVE (MORE, F4): Press to Save the measurement results.

The following are typical result screens:

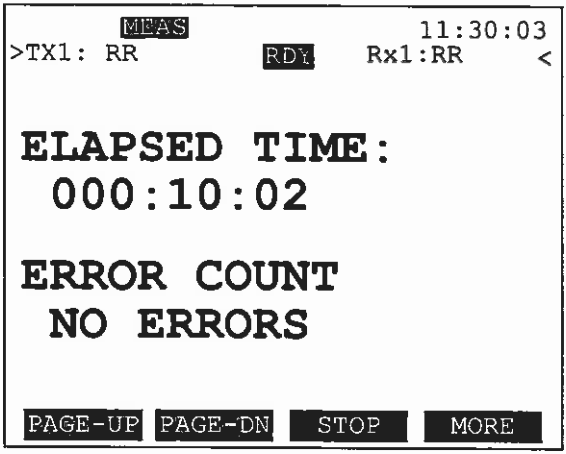

Figure 71 Status Screen

The first screen you will see is the STATUS screen. It reports the overall status of each line in large letters, such as NO ERRORS or SIGnal LOSS. PAGE-DN (F2) to see the next screen.

Summary Screens

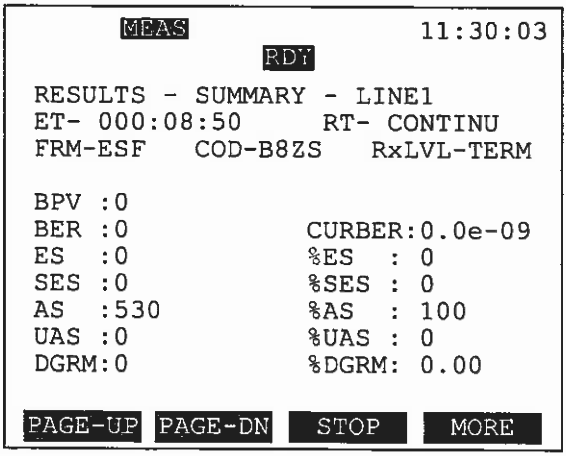

Figure 72 Summary Screen Sample

The SUMMARY screen provides the significant measurement results about the T1 signal. It contains measurement data related to specific types of impairments, like BPV errors or framing errors. It provides a count on the left side of the screen, and a rate on the right side for most measurements.

The final screen presents results according to the G.821 standard. There will be a SUMMARY screens for both lines, if both are in use. The G.821 screen is only available for data calls. Only one data call may be up at a time. See Figure 73, G.821 BERT and Results Screen

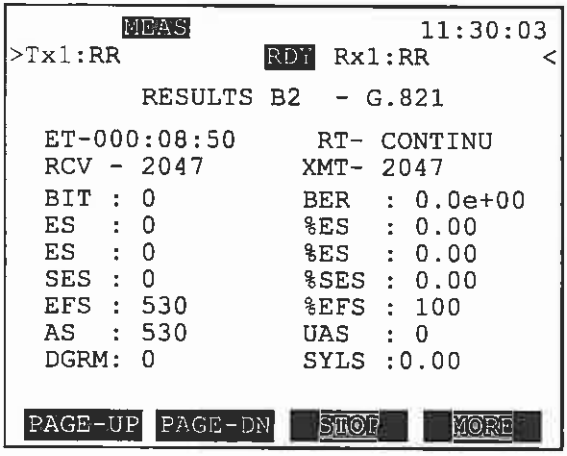

Figure 73 G.821 BERT and Results Screen

2.7.2.5 Backup D Channel Test

This test set automatically configures to 46B2D upon entering this feature. In this state, information is transferred on 46 B channels, on both T1-1 and T1-2, however, only one D channel controls the transmission. The other D channel acts as a backup. It becomes active when the first D channel is no longer in service.

You must be in DUAL DS1 configuration to use the Backup D Channel Test. You must be set to TE mode.

This feature checks the backup D channel service. It shows the status for both lines. Refer to Figure 74, Backup D Channel Test.

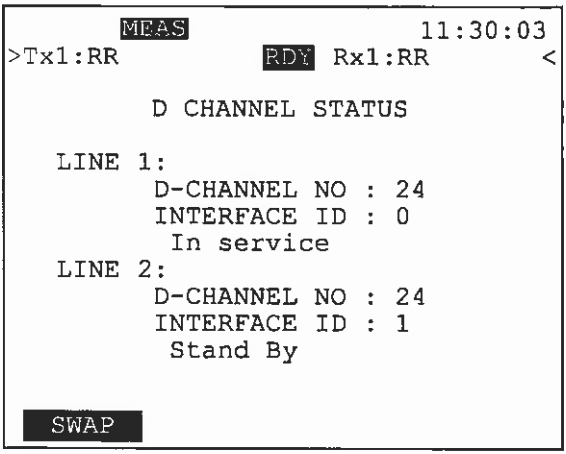

Figure 74 Backup D Channel Test

The following fields will be displayed for each line:

D-CHANNEL NO

View the channel number used for the D-channel. Set the number in the OTHER PARAMETERS menu.

INTERFACE ID

View the Interface ID configured for the line. Configure the id's in the OTHER PARAMETERS menu.

Status Messages

Here are the possible D-channel status messages:

Manual Out of Service: The D-channel is not available. It may be moved to an available state only by manual intervention on the near-end.

Out of Service: The D-channel is not available. The maintenance entity will periodically attempt to move the channel to an in-service state.

In service: The D-channel is available for transfer of call control and other Layer 3 messages.

Stand by: Only Layer 2 messages are established. The service is not yet available for the transfer of layer 3 messages. If the other line's D-channel should be made unavailable, this D-channel will move to in-service.

Press the SWAP (F1) key to drop the active D-channel. The second D-channel should go 'In Service'. Press SWAP again to return to reestablish Line 1 as the D-channel.

2.7.2.6 Other Parameters

This screen lets you configure several parameters associated with PRI applications. Figure 75 displays the screen.

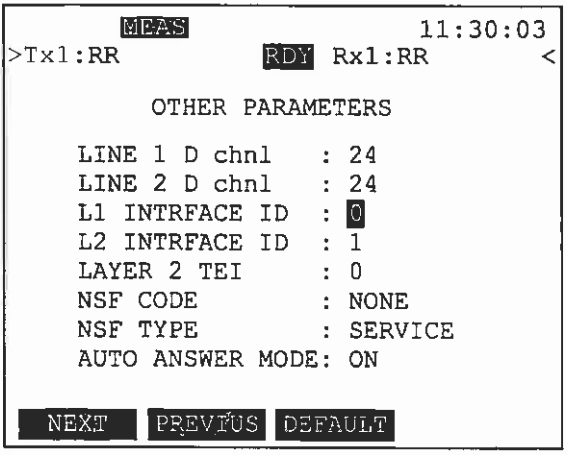

Figure 75 Other Parameters

Line 1 D chnl, Line 2 D chnl
Options: 1—24

The D-channel should normally be set to channel 24.

- Use the NEXT (F1) and PREVIUS (F2) keys to make the selection.
- Press DEFAULT (F3) to return to channel 24.
- The Line 2 D-channel can function as the backup D-ch to Line 1.

L1 INTERFACE ID, L2 INTERFACE ID
Options: 1—127

Select the interface ID for each line.

- Use the NEXT (F1) and PREVIUS (F2) keys to enter a value.
- Press DEFAULT (F3) to enter a value of 0 for Line 1, and 1 for Line 2.

Layer 2 TEI
Options: 0—127
This is the Terminal End-Point Identifier.

- Select a value for this using the F-keys to increment and decrement the value as desired.
- A value of 0 is normally used.
- The TEI identifies the terminal to which the message is intended. The values are grouped as follows:

  0 — 63: Fixed TEI assignment
  64 —126: Automatic assignment
  127: Group TEI for broadcast data link connection

NSF Code
Options: 0 — 31, NONE (F3)
Specify the NSF CODE (Network Specific Facilities)

- Use the NONE (F1) or NEXT (F2) and PREVIUS (F2) keys to specify the codes.
- This code specifies which network facilities are being invoked.
- Normally, for the TE mode, NSF is set to NONE (F3), and for the NT mode, NSF is set to 2.

NSF TYPE
Options: SERVICE (F1), FEATURE (F2), TABLE (F3)
Select the NSF TYPE corresponding to the Code selected above.

- If you have selected NONE for the NSF CODE, the NSF TYPE does not apply.
- To view the NSF Type options as specified by either Northern Telecom or National ISDN-2, press the TABLE (F3) key. FEATURE is designated by 'f', and SERVICE by "s".

AUTO ANSWER MODE
Options: OFF (F1), ON (F2)
Determine how the set will handle an accepted call.

- Select OFF, and the unit will reject all calls.
- Select ON, and you must ACCEPT or REJECT each call manually (normal operation).

2.7.3 SRAM Card Utility

The SRAM Card Utility will automatically format the SRAM memory card for use in the SunSet xDSL. This must be done when inserting a new card or when you wish to erase all data contained on a card.

The utility can be accessed via the Dual T1 Main Menu > PROTOCOL TESTING >SRAM CARD UTILITY. Refer to Figure 76.

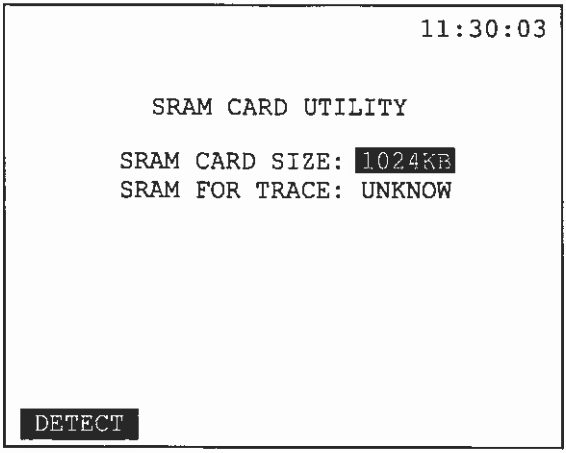

Figure 76 SRAM Card Utility

The following F-keys are available in this screen:

DETECT (F1): Automatically detects the type of SRAM card.

Moving the cursor down to SRAM FOR TRACE, the following F-keys are available.

FORMAT (F1), 64KB (F2), 128KB (F3), 256KB (MORE,F1), 512 KB (MORE, F2), 1024KB (MORE,F3)

Pressing any of the above F-keys will format the card. You will be prompted with the following, "WARNING! SRAM CARD DATA WILL BE LOST DO YOU WANT TO CONTINUE?".

Press YES (F1) to format or NO (F2) to abort the procedure. If you pressed YES the screen will change and the word "FORMATTING...." will appear. Once done the screen will change back to the SPAM CARD UTILITY screen with the memory allotment highlighted on the SRAM FOR TRACE line that you choose.

2.8 Data Link Control

The Data Link Control feature applies to ESF and SLC-96® framing. You will not be able to enter this item if you have selected UNFRAME or SF-D4 as your framing in TEST CONFIGURATION. ESF and SLC-96 have different Data Link Control menus, each with different screens and options. Section 2.8.1 pertains to ESF framing and Section 2.8.2 to SLC-96 framing.

2.8.1 Data Link Control-ESF

The Data Link Control feature applies to ESF framing. ESF Data Link Control is provided when you have chosen ESF framing in the Test Configuration menu.

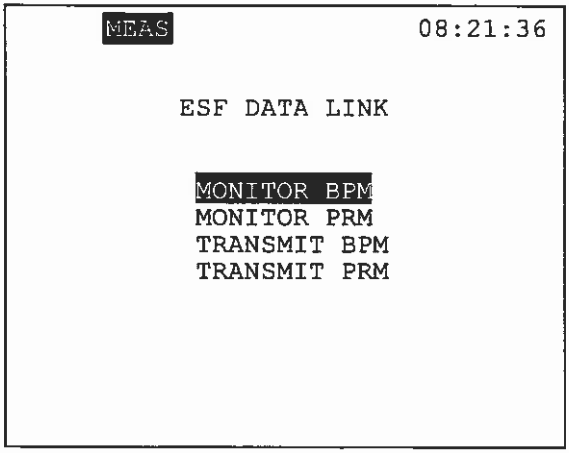

Figure 77 ESF Data Link Menu

2.8.1.1 Monitor ESF Data Link BPM

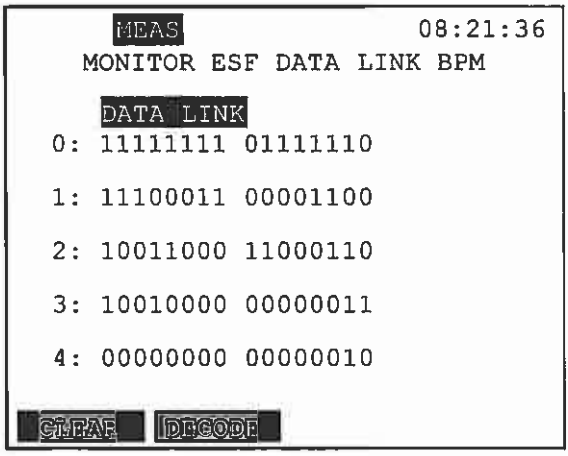

Figure 78 Monitor ESF Data Link BPM

This screen monitors the message the test set receives over the data link. The 0: line shows the current bits received if the test set is currently receiving a message on the datalink. Pressing DECODE (F2) will translate the current message. If the set is not receiving a message, the 0: line will say IDLE, and the bits of the last message that was received will be displayed under the 1:, 2:, 3:, or 4: lines with 1: being the most current and 4: being the least current. Pressing CLEAR (F1) will delete all messages.

2.8.1.2 Monitor PRM

The MONITOR PRM allows you to view the Performance Report Message (PRM) as reported on the ESF datalink. This gives you real-time end-to-end performance information, even when the circuit is in service. This screen also displays the duration (in seconds) of:

- payload loopback messages
- yellow alarm messages
- elapsed time since data link monitoring began
- valid data link message was received

Refer to the following figure, Monitor ESF Data Link PRM.

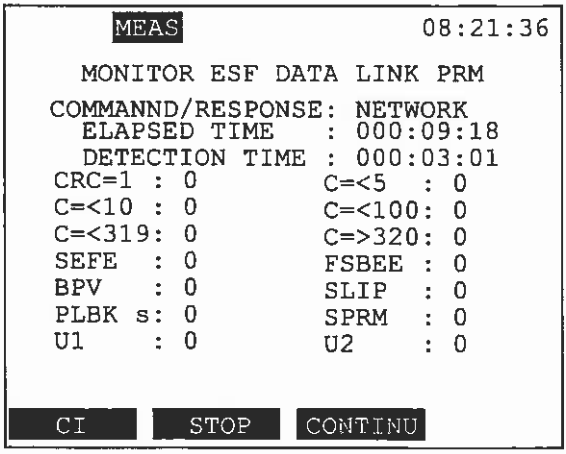

Figure 79 Monitor ESF Data Link PRM

The following are definitions of each of the items in Figure 79, Monitor ESF Data Link PRM.

ELAPSED TIME: This is the total amount of time which has passed since the data link began to be monitored.

DETECTION TIME: This is the total amount of time the test set has detected valid data link messages during the time that the test set has been monitoring the data link.

CRC=1: This is the number of seconds during which exactly 1 CRC-6 error was reported.

C=<5: This is the number of seconds during which 2 to 5 CRC-6 errors were reported.

C=<10: This is the number of seconds during which 6 to 10 CRC-6 errors were reported.

C=<100: This is the number of seconds during which 11 to 100 CRC-6 errors were reported.

C=<319: This is the number of seconds during which 101 to 319 CRC-6 errors were reported.

C=>320: This is the number of seconds during which 320 or more CRC-6 errors were reported.

SEFE: This is the number of severely errored framing events reported.

FSBEE: This is the number of frame synchronization bit error events reported.

BPV: This is the number of seconds in which at least one bipolar violation was reported.

SLIP: This is the number of seconds during which at least one frame slip occurred.

PLBK: This is the number of seconds in which the device was looped back.

SPRM: Supplementary Performance Report Message. SPRMs may be added to Performance Report Messages (PRMs). SPRMs report on trouble conditions within the specific area near the SPRM insertion point. The insertion point should be as close as is practical to the NI so that the SPRM can sectionalize the trouble within the network or within the customer interface (CI).

U1 & U2: This is the number of seconds in which these bits were not zero. These fields only apply when the R-bits show an SPRM has been added.

Three F keys are provided on this screen.

CI/NETWORK (F1): Allows the user to monitor Command/Response on network or customer interface (CI) side.

STOP/START (F2): This key allows you to stop or start the measurement.

HOLDSCR/CONTINU (F3): This key stops the screen from updating while you look at it. The measurement updates continue in the background. You can update the screen by pressing the CONTINU (F2) F-key.

2.8.1.3 Transmit BPM

You can also send a data link Bit-Patterned Message. The following figure, Transmit ESF Data Link BPM, shows an example.

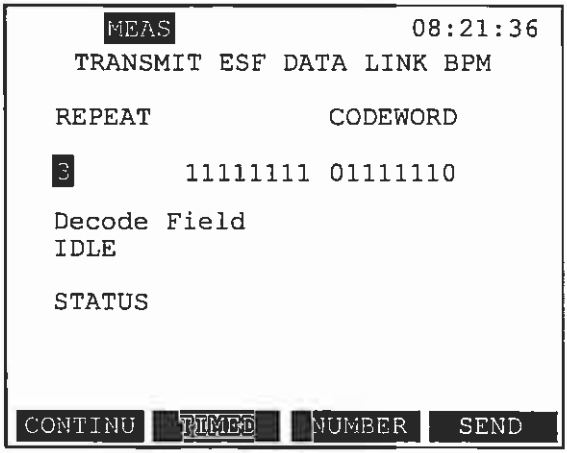

Figure 80 Transmit ESF Data Link BPM

The following is a description of the F-keys and fields in Figure 80, Transmit ESF Data Link BPM.

CONTINU (F1): changes the REPEAT field to "CONTINU". In this setting, the data link is sent continuously until F4: STOP is selected. Escaping from this window also causes the data link to stop.

TIMED (F2): changes the REPEAT field to "000:00" (MMM:SS). In this setting, the data link is sent continuously for the specified number of minutes and seconds or until F4: STOP is selected.

NUMBER (F3): changes the REPEAT field to "00" (1-99). The data link is sent for the specified number of repetitions. The default for NUMBER is 01.

SEND (F4): sends the specified data link message. While the message is being sent, lines 13 and 14 display a message based on the REPEAT setting (see below). The Remaining Time counts down while the message is sent. While the data link is being sent, the F4 key becomes STOP, which shuts down the line if selected.

Use the Up/Down arrow keys on the keypad to select CODEWORD. The Codeword field displays the last selected Codeword in LtR bit order. The default value is 00000000 11111111

EDIT/DONE (F1) allows the user to manually change the data link bits. The cursor moves to the first "x" bit in the codeword. In this state, the only F-key available is F1: DONE. When the user selects DONE, the test set automatically decodes the codeword. Engaging and disengaging the SHIFT-lock key has the same effect as EDIT/DONE.

SELECT (F2): sends the user to the BPM selection screens shown in the following subsection, Select ESF Data Link BPM (2.8.1.3.1).

IDLE (F3): sets the data link to the idle signal. When idle, the DL should contain continuous repetitions of the data link idle code, 01111110. When sending the idle code, the decode field should read, "IDLE". This is the default setting for this screen.

STATUS Field: When sending messages, the field says "SENDING". When sending a small number of messages, the field might appear to flash. When sending messages and the REPEAT is set to TIMED, the status field also displays and counts down the remaining time as "SENDING RT: 000:00:00". When not sending any messages, the set is sending the data link idle code. In this case, the Status Field says "IDLE".

Decode Field: Uses codeword decodes from the reference section and not the abbreviated decodes shown in the Select ESF Data Link BPM screens.

In this screen you select a message to send, and specify the number of times it is sent. Use this procedure:

1. Select the desired CODEWORD. You can do this by using the predefined codewords or by typing in the desired bit numbers.
- If you type in the message, move your cursor to the desired position and enter the 1s and 0s directly from the keypad using the SHIFT-lock key. You are only allowed to move the cursor between the 10th and 15th bits of the message. The rest of the 16-bit message is fixed.
- The predefined codewords are accessed by pressing the SELECT F-key. See the subsection entitled, Select ESF Data Link BPM.

2. When you have selected your CODEWORD, cursor to the REPEAT item.
- If you would like to send the message continuously, choose CONTINU (F2).

- If you would like to send the message for an exact number of repetitions, choose NUMBER (F1), then press and release the SHIFT-lock key, and type in the number of repetitions between 02 and 99.

3. Press the SEND F-key to begin transmitting the pattern on the datalink. If you chose CONTINU for the number of repetitions, the message will be sent continuously while you are in the DATA LINK CONTROL ESF menu. Exiting the menu or moving into a sub-menu will cause the message to terminate.

Note for ESF NIU Loopbacks

You can use this function to loopback a far-end NIU from the customer premises side of the near end NIU. Set the message to "Network Use". Set the repetition to 7 times. 7 repetitions will allow the far end NIU to loop up without letting the signal last long enough to loop up the near end.

2.8.1.3.1 Select ESF Data Link BPM

The following three screens allow you to select the data link message without having to know the codeword.

Within each screen, the cursor moves up or down. Moving the cursor down past the last line item moves the cursor to the top of the line in that screen; the page remains the same. In the Protection Switch selection screen, there are 29 cursor positions: Protection Switch Acknowledge, Protection Switch Release, and the 27 Protection Switch Line values. Here, the cursor can also move left and right.

Pressing SELECT (F4) or the ENTER key on the keypad selects the highlighted message. Once the message is selected, the unit returns to the Transmit BPM screen.

Pressing the ESC key on the keypad from any of these screens will cause the test set to return to the Transmit BPM screen without changing the codeword.

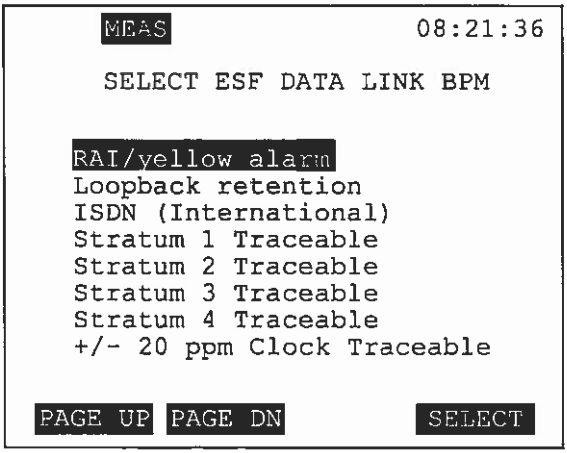

Figure 81 Select ESF Data Link BPM, Screen 1

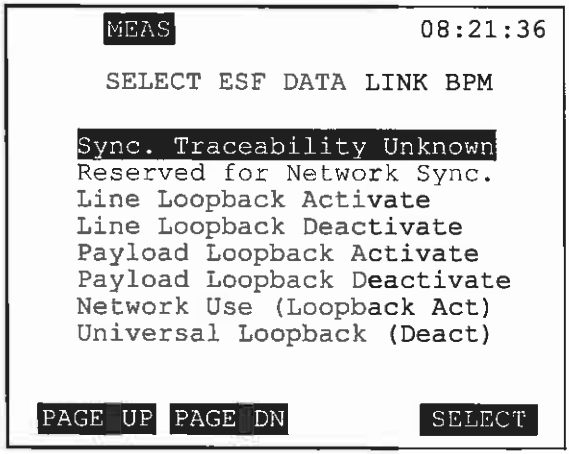

Figure 82 Select ESF Data Link BPM, Screen 2

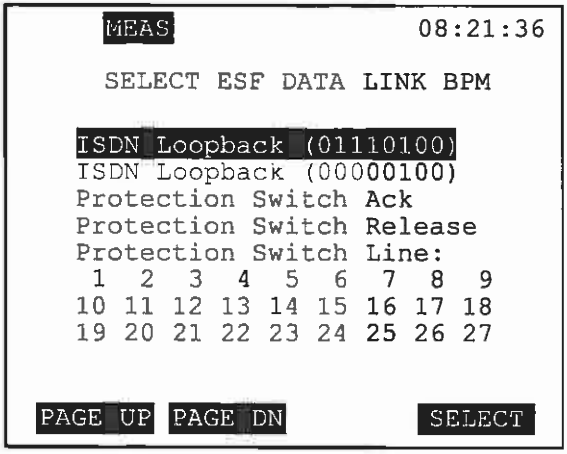

Figure 83 Select ESF Data Link BPM, Screen 3

The following Table 9, Select ESF Data Link BPM Codewords, lists the codewords and their codes.

Codewords	Codes
RAI/yellow alarm	00000000 11111111
Loopback retention	00101010 11111111
ISDN (International)	00011100 11111111
Stratum 1 Traceable	00000100 11111111
Stratum 2 Traceable	00001100 11111111
Stratum 3 Traceable	00010000 11111111
Stratum 4 Traceable	00101000 11111111
+/- 20 ppm Clock Traceable	00100010 11111111
Sync. Traceability Unknown	00001000 11111111
Reserved for Network Sync.	01000000 11111111
Line Loopback Activate	00001110 11111111
Line Loopback Deactivate	00111000 11111111
Payload Loopback Activate	00010100 11111111
Payload Loopback Deactivate	00110010 11111111
Network Use (Loopback Activate)	00010010 11111111
Universal Loopback (Deactivate)	00100100 11111111
ISDN Loopback (01110100)	00101110 11111111
ISDN Loopback (00000100)	00100000 11111111
Protection Switch Acknowledge	00011000 11111111
Protection Switch Release	00100110 11111111
Protection Switch Line: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27	01xxxxx0 11111111 Where xxxxx = 1 27 in binary

Table 9 Select ESF Data Link BPM Codewords

2.8.1.4 Transmit PRM

You can configure the test set to send the Performance Report Message by entering this menu item. In this mode, the test set will broadcast the message on the TX jack according to the quality of the received signal on the RX jack. The Transmit PRM screen will display each PRM message sent. It will count all of the various errors which have been recorded and transmitted since you entered the screen. The test set sends this message continuously until you press the ESC key on the keypad. Refer to Figure 84, Data Link Transmit Performance Report Message

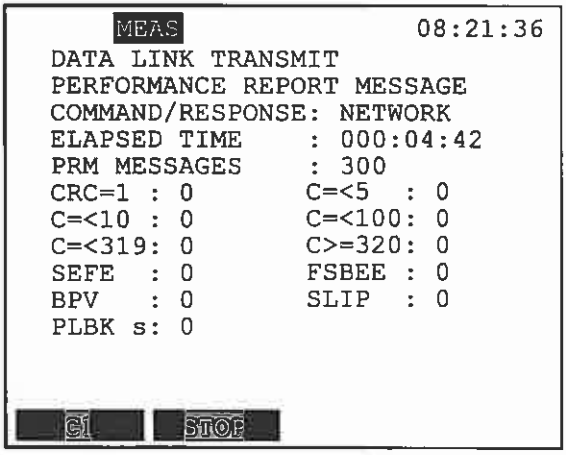

Figure 84 Data Link Transmit PRM

The following is a description of the fields and F-keys in Figure 84, Data Link Transmit PRM.

Elapsed Time: The H:M:S (Hours: Minutes: Seconds) since the start of the PRM transmission. Transmission automatically starts when entering this screen.

PRM Messages: The number of PRM messages sent by the test set. Each measurement field can hold up to 6 digits.

CRC=1: This is the number of seconds during which exactly one CRC-6 error was reported.

C=<5: This is the number of seconds during which two to five CRC-6 errors were reported.

C=<10: This is the number of seconds during which six to ten CRC-6 errors were reported.

C=<100: This is the number of seconds during which 11 to 100 CRC-6 errors were reported.

C=<319: This is the number of seconds during which 101 to 319 CRC-6 errors were reported.

C=<320: This is the number of seconds during which 320 or more CRC-6 errors were reported.

SEFE: This is the number of Severely Errored Framing Events that were reported.

FSBEE: This is the number of Frame Synchronization Bit Error Events that were reported.

BPV: This is the number of seconds in which at least one BiPolar Violation occurred were reported.

SLIP: This is the number of seconds during which at least one frame slip occurred.

PLBKs: Payload loopback activated is the number of seconds in which the device is looped back.

NETWORK / CI (F1): Changes the COMMAND RESPONSE. When set to NETWORK, the test set sends PRM messages with a C/R of 1. When set to CI, the test set send PRM messages with C/R of 0.

STOP/START (F2): Starts or Stops the transmit PRM function.

2.8.2 Data Link Control-SLC-96

Note: You must choose SLC-96 framing in the TEST CONFIGURATION menu before proceeding.

After configuration press the ESC key on the keypad to reach the Dual T1 Main Menu, and select DATA LINK CONTROL. All capabilities are in conformance with Bellcore's standard TR-TSY-000008. For further information please refer to Applications section 3.14.

Warning!
Using the SLC-96® send message capability can bring down an entire SLC system. Be sure you are properly trained before proceeding. Monitoring the SLC datalink from a MON jack should not cause a problem.

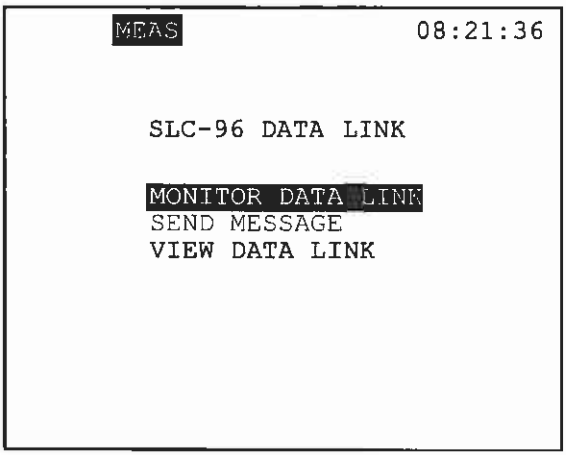

Figure 85 SLC-96 Data Link Control

2.8.2.1 Monitor Data Link

The first menu choice is the data link monitor. This monitor gives you an English-language translation of the information in the SLC data link. See Figure 86 for a sample screen and refer to Applications section 3.14.1 for setup procedure and cord hookup.

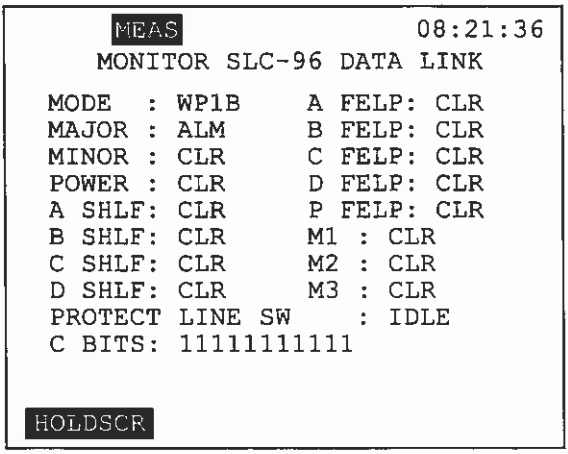

Figure 86 Monitor SLC-96 Data Link

The following is a detailed description of each of the items in the figure, Monitor SLC-96 Datalink.

MODE: There are three kinds of data link modes specified in TR-TSY-000008, NOTE, WP1B, and WP1. The mode will show as the NOTE, which indicates the 16-bit format of either the NOTE or the WP1B card. Alternatively, the mode can be indicated as the WP1, a 13-bit format.

MAJOR: A major alarm on the data link will be indicated here.

MINOR: A minor alarm on the data link will be indicated here.

POWER: A power alarm will be indicated here.

A SHLF: An A-shelf alarm will be indicated here.

B SHLF: An B -shelf alarm will be indicated here.

C SHLF: An C-shelf alarm will be indicated here.

D SHLF: An D-shelf alarm will be indicated here.

PROTECT LINE SW: The switch-to-protection line switch message is shown here.

C BITS: The 11 C-Bits are displayed here.

A-FELP: An A digroup far end loop will be indicated here.

B-FELP: A B digroup far end loop will be indicated here.

C-FELP: A C digroup far end loop will be indicated here.

D-FELP: A D digroup far end loop will be indicated here.

P-FELP: A Protection digroup far end loop will be indicated here.

M-BITS: The three M bits are displayed here.

2.8.2.2 Send Message

The test set gives you an English-language table of items that you may send on the SLC-96® data link. Refer to the Applications section 3.14.1, SLC-96 Testing, for setup procedure and cord hookup.

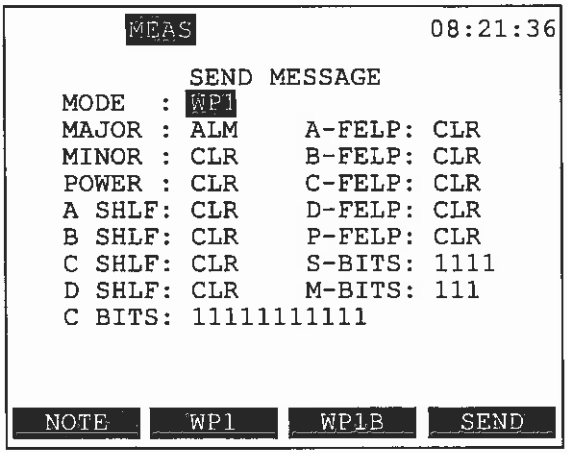

Figure 87 SLC-96 Send Message

The following is a detailed description of each of the items in the figure, SLC-96 Send Message.

MODE: This selection determines which SLC-96® element the test set will emulate as it sends the SLC-96® message. The three choices are NOTE, WP1, and WP1B.

MAJOR, MINOR, POWER, A SHLF, B SHLF, C SHLF, D SHLF: These categories allow you to set the desired alarm message.

A-FELP, B-FELP, C-FELP, D-FELP, P-FELP: These categories allow you to set a far-end loop or indicate the existence of a far-end loop.

S-BITS, M-BITS, C-BITS: These categories allow you to directly enter those SLC data link bits that are not otherwise defined.

SEND: This F4 key function allows you to send the message at any time. Alternatively, you may send a message by pressing the ENTER key on the keypad. Note that no message is sent until you press either SEND or the ENTER key. This allows you to edit your message to your liking and only send it when it is exactly the way you wish. Once you send the message, it will continue to be sent until you change it.

ACTION: Choose either SWITCH (F1) or RELEASE (F2) to carry out the desired action.

LINE: Choose the desired digroup (A through D) by pressing the appropriate F-key (F1 through F4).

ENTER: After you have configured your settings, press the ENTER key on the keypad to send the desired message.

2.8.2.3 View Data Link SLC-96

This menu item allows you to view a live SLC-96® data link. The bits are arranged according to their place in the SLC-96® data link. This screen may be useful for applications that do not follow TR-TSY-000008. See Figure 88 for an example of this screen:

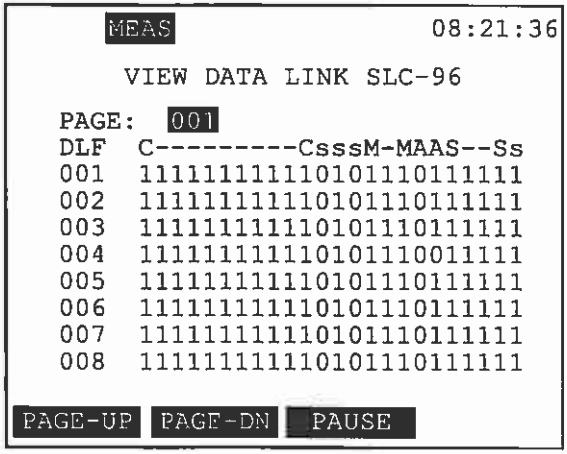

Figure 88 View Data Link SLC-96

2.9 Other Features Menu

From the Dual T1 Main Menu > OTHER FEATURES.

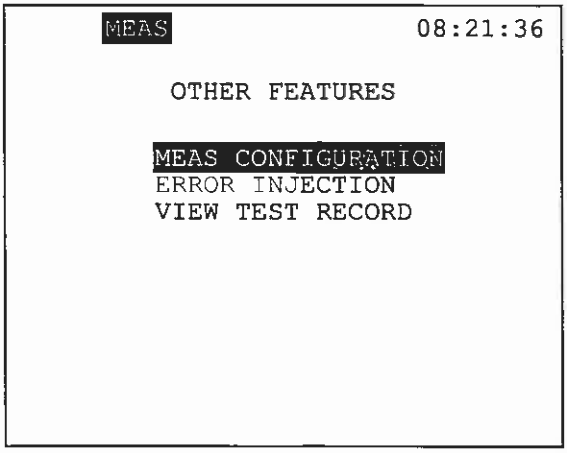

Figure 89 Other Features Menu

2.9.1 MEAS Configuration

Configure the SunSet's Measurement Configuration parameter as shown in Figure 90, Measurement Configuration.

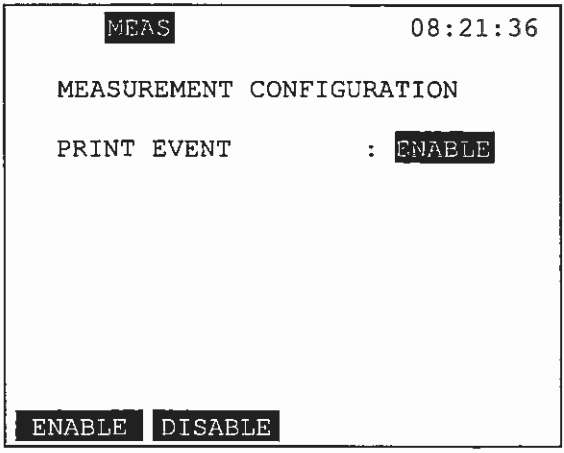

Figure 90 Measurement Configuration

PRINT EVENT
Options: ENABLE (F1) or DISABLE (F2)

- Choose ENABLE (F1), if you would like the printer to print out an error message every time that one or more errors occur. The date and time is printed with every message.
- Choose DISABLE (F2), if you do not want the printer to print out a result each time.

2.9.2 Error Injection

Configure the SunSet's ERROR INJECTION parameters as shown in the following figure, Error Injection.

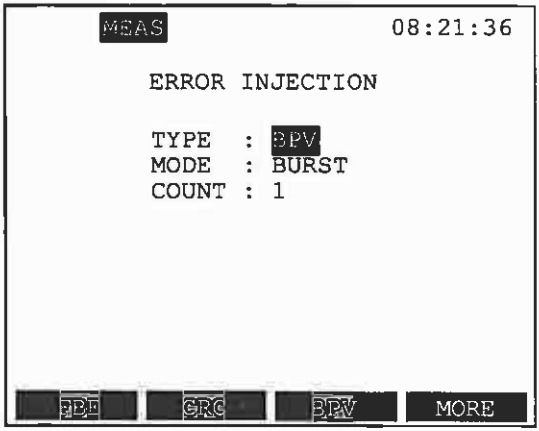

Figure 91 Error Injection

TYPE
Options: FBE (F1), CRC (F2), BPV (F3), BIT (MORE, F1), BIT +BPV (MORE, F2)

Select the type of errors you wish to insert.

- Select FBE to generate a framing error.
- Select CRC to generate a CRC-6 error.
- Select BPV for Bipolar Violations; you will be prompted to select BURST or RATE.
- Select BIT for bit error; you will be prompted to select BURST or RATE.
- Select BIT+BPV for bit error plus bipolar violations; you will be prompted to select BURST or RATE.

MODE

Options: BURST (F1), RATE (F2)

Select the error injection method.

- BURST mode allows a set number of errors to be injected with each press of the ERR INJ key.

1. Cursor down to COUNT.
2. Press the SHIFT-lock key and observe the SHIFT indicator in the upper left-hand corner of the screen.
3. Using the keypad, enter the number of errors you wish to inject each time the ERR INJ key is pressed. The SunSet xDSL will accept values between 1 and 9999.

- RATE mode allows errors to be injected continuously at a specified rate.

1. Cursor down to RATE.
2. Press the SHIFT-lock key and observe the SHIFT indicator in the upper left-hand corner of the screen.
3. Enter the constant rate at which you wish to inject errors when the ERR INJ key is pressed. The SunSet xDSL will accept values between 2e-3 and 9e-9.

COUNT

Options: 1 to 9999

Select the number of errors you wish to insert.

For BURST mode, choose the COUNT of errors to be inserted. After pressing the SHIFT-lock key, enter in any number between 1 through 9999. The errors will be inserted in approximately 1 second or less, and will cause from 1 to 3 errored seconds.

RATE

Options: 1e-3 to 9e-9

For RATE MODE, choose the error RATE number and exponent. The errors will then be inserted at a continuous rate as specified in this entry.

When the settings are complete, press the ENTER key on the keypad.

Error injection is usually performed to verify presence of a loopback. Simply press the ERR INJ key on the keypad and the SunSet will insert the type and quantity of errors you have specified. If you are looped back, the ERRORS LED will light.

When you actually inject the errors, the errors will be inserted during a 1 second period, and will cause from 1 to 2 errored seconds.

2.9.3 View Test Record

This feature allows you to view stored test results. Refer to Figure 47, View Test Record. A total of 20 Measurement Results may be stored in this menu. Records are stored by pressing the SAVE F-key (F4, MORE then F3, SAVE) in the Measurement Results menu.

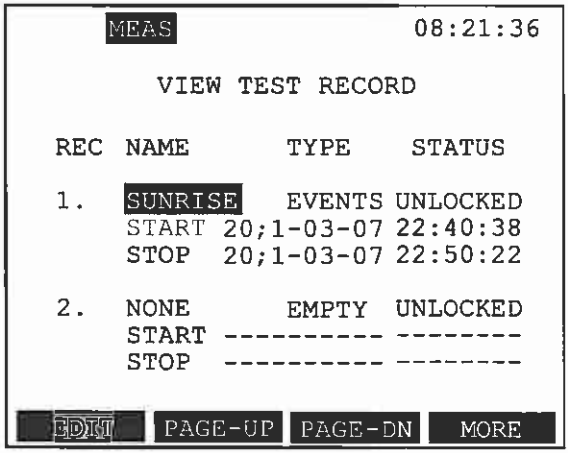

Figure 92 View Test Record

The Measurement Results numbers are shown in accordance with the events and results that are in memory. Events are errors and alarms.

1. Scroll to select the Measurement Result you want to view.
2. Press VIEW (F1).

In addition to PAGE-UP (F2) and PAGE-DN (F3), the following additional F-keys are available:

EDIT (F1): Allows you to label the highlighted record. You will enter the following screen:

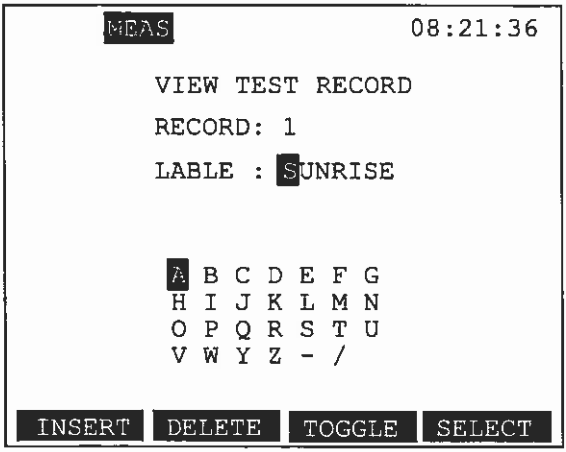

Figure 93 Record Label

1. Press TOGGLE (F3). The first letter in the alphabet grid will be highlighted.
2. Cursor to each letter you want to select, and press F4, SELECT until you have the label you want.
3. Use the INSERT (F1) and DELETE (F2) keys if you need to correct an error.
4. Press the ENTER key on the keypad to return to the VIEW RESULTS RECORDS screen.

VIEW (MORE, F1): Press to view the highlighted record. You will enter the MEASUREMENT RESULTS screen. Press the ESC or ENTER keys on the keypad to return to the VIEW TEST RECORD screen.

LOCK (more, F3)/ UNLOCK (more, F2): Press to lock the record, so it can not be deleted. Press UNLOCK to open the record.

DELETE (MORE, F1): Press to delete the highlighted record. If the highlighted record is locked you will be prompted to unlock the record.

CLR-ALL (MORE, F2): Press to clear all of the records.

PRINT (MORE F3): Press to send the record to the serial port for printing.

2.10 CSU/NI Emulation

CSU/NI EMULATION gives you a simple, full-duplex emulation of a CSU or NI. With this capability, you can unplug the CSU or NI and insert the Dual T1 module in its place. The emulation screen gives you:

- a pictorial explanation of the circuit status
- measurement results
- configuration commands to perform loopbacks

While in this mode, the test set will respond to CSU and NI loop up/down codes. You may employ CSU/NI Emulation in T1 SINGL and T1DUAL modes.

2.10.1 CSU/NI Emulation, T1 Single Mode

1. Before entering CSU/NI Emulation, you must set your configuration in TEST CONFIGURATION to the following settings:

   Mode: T1 SINGL
   RxLvL-1: TERM, BRIDGE, or MONITOR
   FRAMING: as appropriate for the circuit under test; cannot use the AUTO framing function of the test set.
   CODING: as appropriate to the circuit under test.
   Tx CLOCK: fixed at Rx-1
   TX SOURCE: PATTERN or THRU
   TEST RATE: 1.544 M. If this is set to a fractional rate, you will not be able to enter the CSU/NI Emulation screen.
   LBO 1&2: as appropriate for the circuit under test.

2. Plug the cords into the test set and circuit under test. Make sure Line 1 jacks are plugged in to the signal coming from the network. The test set will respond to loopback codes from the network.

   The CSU/NI Emulation screen appears as in Figure 94.

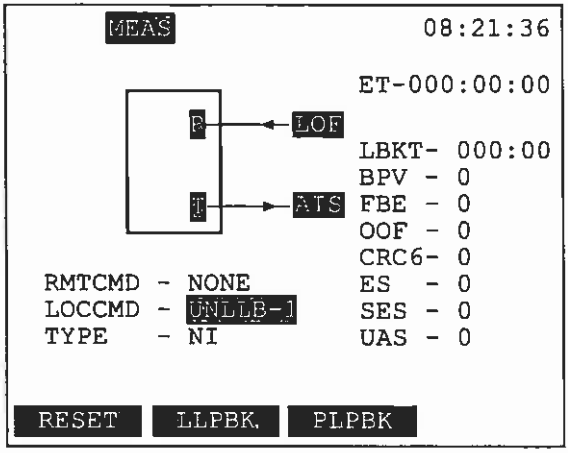

Figure 94 CSU/NI Emulation, T1 Single

3. Set the test set up for either NI emulation or CSU emulation. Do this by going to TYPE and selecting CSU (F1) or NIU (F2).
4. Observe the circuit error counts and see if a remote loopback command is being received. Note that the framing of the remote loopback command must be the same as the framing selected in the TEST CONFIGURATION menu.
5. If desired, operate any of the local commands as follows:

- RESET (F1) resets the test set to a through mode.
- LLPBK-1 (F2) operates a line loopback from L1-Rx to L1-Tx. A line loopback regenerates the signal but does not reframe the signal. Hence, BPVs and frame errors will pass through the line loopback unchanged. Once the line loop back has been invoked, the LLPBK-1 command will be replaced with the UNLLB-1 (F2) command. In this case, pressing F2 will undo the loopback.
- PLPBK-1 (F3) operates a payload loopback from L1-Rx to L1-Tx. A payload loopback regenerates the signal, and also reframes and recodes the signal. Hence, BPVs and frame errors will be eliminated as they pass through the payload loopback. Once the payload loopback has been invoked, the PLPBK-1 command will be replaced with the UNPLB-1 (F3) command. In this case, pressing F3 will undo the loopback.

6. When you are finished with the session, press the ESC key on the keypad and you will return to the Dual T1 Main Menu. All loopbacks will be dropped as you exit.

2.10.2 CSU/NI Emulation, T1 Dual Mode

1. Before entering the CSU/NI Emulation screen, set up your configuration in the TEST CONFIGURATION Menu with the following settings:

   TEST MODE: T1DUAL
   TXINSERT : L1-Tx, If this is set to Line 2, you will receive the message, "Support L1-Tx/L1-Rx Only."
   Rx/DROP: L1-Rx, If this is set to Line 2, you will receive the message, "Support L1-Tx/L1-Rx Only."
   RXLVL 1 and 2: TERM, BRIDGE, or MONITOR
   TXSOURCE : THRU or PATTERN
   FRAMING: as appropriate for the circuit under test (not AUTO).
   CODING: as appropriate for the circuit under test.
   Tx Clock: Rx-1 is preset.
   TEST RATE: 1.544M. If this is set to a fractional rate, you will not be able to enter the CSU/NI Emulation screen.
   LBO1&2: as appropriate for the line under test.
   LED PANEL: LINE 1 or 2

   The CSU/NI Emulation screen will appear as in Figure 95.

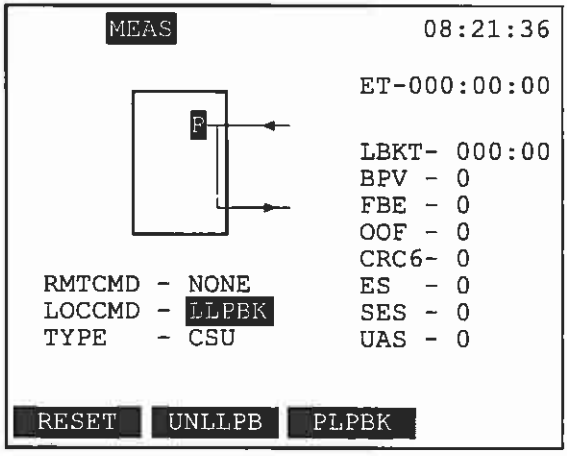

Figure 95 CSU/NI Emulation, T1 Dual

2. Plug the cords into the test set and circuit under test. Make sure LINE 1 jacks are plugged in to the signal coming from the network. The test set will respond to loopback codes from the network.
3. Set the test set up for either NI emulation or CSU emulation. Do this by going to TYPE and selecting CSU (F1) or NIU (F2).

4. Observe the circuit error counts and see if a remote loopback command is being received. Note that the framing of the remote loopback command must be the same as the framing selected in the TEST CONFIGURATION menu.
5. If desired, operate any of the local commands as follows:

- RESET (F1) resets the test set to a through mode.
- LLPBK-1 (F2) operates a line loopback from L1-Rx to L2-Tx. A line loopback regenerates the signal but does not reframe the signal. Hence, BPVs and frame errors will pass through the line loopback unchanged. Once the lineloop back has been invoked, the LLPBK-1 command will be replaced with the UNLLB-1 (F2) command. In this case, pressing F2 will undo the loopback.
- LLPBK-2 (F3) operates a line loopback from L2-Rx to L1-Tx. A line loopback regenerates the signal but does not reframe the signal. Hence, BPVs and frame errors will pass through the line loopback unchanged. Once the line loop back has been invoked, the LLPBK-2 command will be replaced with the UNLLB-2 (F3) command. In this case, pressing F3 will undo the loopback.

6. When you are finished with the session, press the ESC key on the keypad and you will return to the Dual T1 Main Menu. All loopbacks will be dropped as you exit the session, and the TEST CONFIGURATION settings will be reinstated.

Section 3 DS1 Applications

3.1 Accepting a New T1 Span

This is the procedure for accepting a new T1 span. Refer to Figure 96, Accept a New T1 Span.

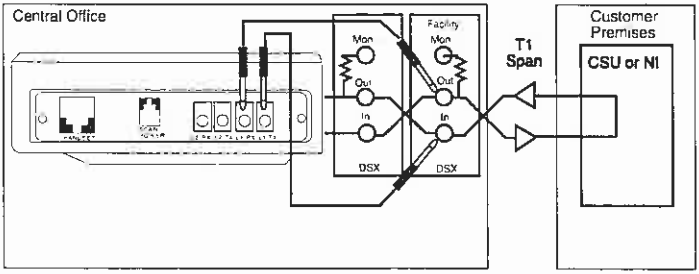

Figure 96 Accepting a New T1 Span

WARNING!
Verify that the span is not in service. This acceptance test will disrupt service.

1. Find out what kind of loopback device is installed at the end of the span, and what loopback codes operate it.
2. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure as follows:

   TEST MODE: T1SINGL
   RxLVL-1: TERM
   FRAMING: as specified by your span design
   CODING: as specified by your span design
   TxCLK: INTERN
   Tx SOURCE: PATTERN
   TEST RATE: 1.544M
   LBO1: 0 dB
   When your settings are correct, press the ENTER key on the keypad.

3. Connect the test set to the circuit as shown in Figure 96. Press the HISTORY key on the keypad to clear the blinking history lights.
4. Select LOOP BACK CONTROL > CSU & NIU CONTROL

5. Select the MODE item last.

- For SF-D4 or SLC-96® framing use these settings:

  MODE: LOOP-UP
  TYPE: IN-BAND
  CODE: as appropriate

- For ESF framing, use these settings:

  MODE: LOOP-UP
  TYPE: ESF-DL
  CODE: as appropriate (LINE and PAYLOAD are used with CSU loopbacks and NETWORK is used with an NIU loopback). Refer to Section 2.2.1, DS1 Loopback for a detailed description of each of these items.

- As soon as you select the MODE, the looping will begin. You will see a "LOOPING UP . . ." message followed by a "LOOP UP SUCCEEDED" message. If the test set detects a loopback already in place, it will warn you with a "PREEXISTING LOOP DETECTED" message.

6. Press the ESC key on the keypad until you arrive at the Dual T1 Main Menu > SEND TEST PATTERN.
   A. Using the arrow keys, select the test pattern you wish to send.

7. Press the ESC key on the keypad until you arrive at the Dual T1 Main Menu > MEASUREMENT RESULTS.
   A. Press the STOP/START (F3) key to restart the testing. Verify that the span performs to your company's specifications.

8. When your testing is complete, press the ESC key on the keypad until you arrive at the Dual T1 Main Menu > LOOP BACK CONTROL & SPAN CONTROL > CSU & NIU CONTROL.
   A. Use the same screen settings you used for LOOP-UP, but specify LOOP-DN. Your previous screen settings will remain intact.
   B. Verify that the LOOP DOWN SUCCEEDED message is displayed.

9. Unplug the test set from the circuit.

3.2 Monitor an In-service Circuit

Here is the simplest procedure for monitoring a circuit which is in-service. This test may be performed while the circuit is carrying live customer traffic.

1. From the Dual T1 Main Menu > TEST CONFIGURATION. For a DS1 circuit, configure these settings and refer to Figure 97, Monitoring an In-Service DS1 Circuit

   TEST MODE: T1SINGL
   RxLVL-1: MONITOR
   Tx SOURCE: PATTERN
   TEST RATE: 1.544M

2. Connect your test set to the circuit as shown.
   A. Press the AUTO key on the keypad to have the test set configure the remaining screen settings for you.
   B. Press the ENTER key on the keypad to go to the Dual T1 Main menu.

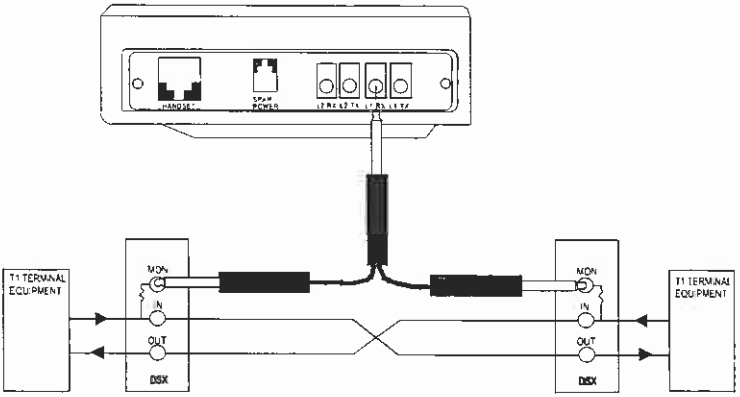

Figure 97 Monitoring an In-Service DS1 Circuit

3. Examine the LEDs and the GRAPHIC screen for information about your circuit.

- The PULSES LED should be lit green, and a valid framing type should be lit green.
- A steady ERRORS light will tell you the circuit is working, but it is experiencing trouble.
- A red FRAME LED is an indication of severe problems.
- YEL ALM indication will show a problem on the other side of the circuit.

- AIS may indicate a trouble condition, where a network element transmitting to the test set has lost its incoming signal, and has replaced it with the AIS signal.

  If you need additional information proceed to step 4. Otherwise, disconnect your test set from the circuit.

4. Press the ESC key on the key pad until you reach the Dual T1 Main Menu > MEASUREMENT RESULTS.
   A. Verify that the span performs to your company's requirements for the service delivered. If necessary, see Section 2.4.1 regarding Measurement Definitions and Usage.

5. Disconnect the test set from the circuit.

3.3 Looping a CSU or NI on a T1 Line

This procedure is for looping back a CSU and NI on a T1 line.

1. Verify the span is not in service. Looping back a device on the span will disrupt service.
2. From the Dual T1 Main Menu > Test Configuration. Configure as follows:

   TEST MODE: T1 SINGL
   RxLVL-1: TERM
   FRAMING: as specified by the span design
   CODING: as specified by the span design
   Tx CLOCK: INTERN
   Tx SOURCE: PATTERN
   TEST RATE: 1.544M
   LBO 1: 0 dB
   Press the ENTER key on the keypad when all of your settings are correct.

3. Connect the test set to the circuit as shown in Section 3.1; Figure 96, Accepting a New T1 Span.
   A. Press the HISTORY key on the keypad to clear the blinking history lights.

4. From the Dual T1 Main Menu > LOOP BACK & SPAN CONTROL >CSU & NIU CONTROL, select TYPE.

- For SF-D4 framing, use these screen settings:

  TYPE: IN-BAND
  CODE: NI or CSU, as appropriate

- For ESF framing, use:

  TYPE: ESF-DL
  CODE: LINE (for CSUs), PAYLOAD (for CSUs), or NETWORK (for NIUs/smart jacks)

5. Once your settings are correct, cursor to the MODE line and select LOOP-UP (F1). You will see a "LOOPING UP" message followed by a "LOOP UP SUCCEEDED" message. Refer to Section 2.2 for additional information about loopback capabilities and screen settings.
6. When you are finished, reenter the LOOPBACK & SPAN CONTROL > CSU & NIU CONTROL menu. Your previous screen settings will have been preserved.
7. Select LOOP-DN (F2) for MODE and the loop down action will begin. Verify that the "LOOP DOWN SUCCEEDED" message is displayed.
8. Disconnect your test set from the circuit.

3.4 Stress Testing a T1 Line

Follow this procedure for stress testing a T1 line:

1. Configure the span for testing as outlined in section 3.1, Accepting a New T1 Span. Complete steps 1 through 6 of the procedure.
2. From the Dual T1 Main Menu > SEND TEST PATTERN. Move your cursor to the desired stress pattern. The test set will begin transmitting the new pattern immediately.
3. With your new pattern, see if the BPV/CODE and/or ERRORS LED lights up. If so, you may have illustrated the customer problem with the circuit. Try additional stress patterns as desired.

The following are some common patterns used to stress T1 lines:

- QRSS: This is the original stress pattern, and is used as the factory default pattern in the test set.
- 55 DALY: This pattern stresses the ability of regenerators to follow timing circuit phase changes. It stresses the ability to pass zero patterns, and is most useful on AMI lines.
- 3-24: This pattern contains the maximum number of legal zeroes and the minimum density of allowable ones. It is most useful on AMI lines.
- 2e23 and 2e20 : These patterns are like QRS except that they are not zero-constrained. 2e23 has a maximum of 23 zeroes in a row, and 2e20 has 20 zeroes in a row. AMI circuits are only specified to carry 15 zeroes in a row, so these patterns stress these circuits beyond what they are designed to carry. Despite the long individual zero strings, the patterns average density of ones is 50%.
- 1-8: This pattern is like the 3-in-24, except it has a maximum of 7 zeroes in a row. This is the best low density pattern for stressing B8ZS circuits.
- 1-16: This pattern puts enormous stress on AMI circuits, especially line repeaters. This pattern averages only 6% density, which is far under the specified 12.5% density for AMI lines. The pattern does not cause problems for circuits with B8ZS coding.
- 1111: This pattern requires the most power from regenerating circuitry, and may cause the pulse level to drop.
- Other patterns: Several additional patterns are available for stress testing. Refer to section 2.3.1 which defines each stress pattern and usage.

4. When you are finished, release the loopback, and disconnect the test set from the circuit.

3.5 Verifying B8ZS/AMI Options on a T1 Line

A common fault in new circuits is a B8ZS/AMI options mismatch in one or more network elements. This procedure will help you determine if this problem exists in your circuit.

1. Set up the test set and circuit as shown in Section 3.1, Figure 96, Accepting a New T1 Span.
   A. Remember to repeat this procedure for each direction of the circuit.
   B. Make sure the test set's line CODE is set to the same line coding as is appropriate for the circuit.
   C. Get the circuit looped up and ready for testing.

2. Transmit an all 1s signal, and an alternating 1s and 0s signal. Verify that there are no errors with any of these signals. If there are any errors, then you have problems that are not associated with an B8ZS/AMI mismatch.
3. Transmit a 3-in-24 signal. If any equipment in the line has options for which the test set is not configured, you will see a loss of synch or excessive errors.
4. Verify the diagnosis by transmitting QRSS. QRSS will also cause errors when there is an AMI/B8ZS mismatch on the line.
5. In Figure 96, Accepting a New T1 Span, the customer's T1 terminating equipment is isolated from the circuit. Thus, if the customer's equipment has the options problem, this procedure will not expose it while the circuit is looped up.
   A. If the circuit tests fine while looped up, but fails when looped down, verify that the line code being received in one direction is the same as the line code being received in the other direction. If it is, the customer's equipment may be at fault. If the problem still isn't evident from the central office, then a trip to the customer's premises may be required.

6. Disconnect your test set from the circuit.

3.6 Checking Frame Slips & Frequency Synch

Frequency synchronization can be a problem when:

- the customer utilizes a channelized T1 circuit .
- the customer's circuit passes through a synchronous network element, such as a switch, PBX, or a digital cross-connect system.
- the T1 circuit passes through more than one carrier.

Frequency synchronization problems result in frame slips, a major source of service impairment. Referring to the following figure, Frequency Synchronization Problems, use the following procedure to identify frequency synchronization problems. This test may be performed while the span is carrying live customer traffic.

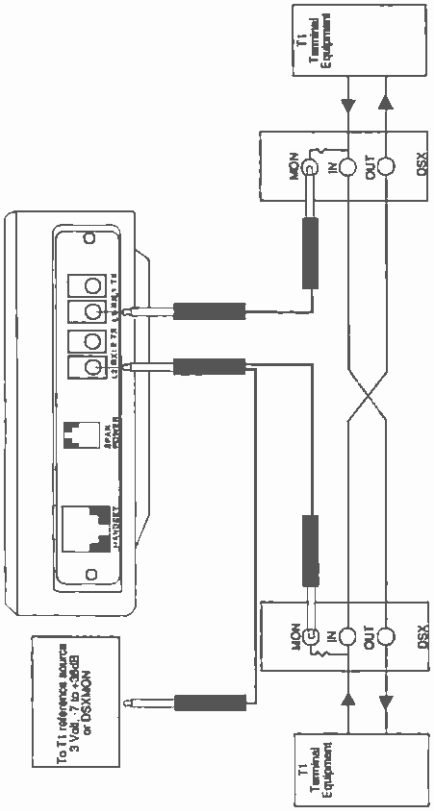

Figure 98 Frequency Synchronization Problems

1. Obtain a reference frequency source. This can be the other side of the customer's circuit or it can be a 1.544 Mbps reference signal that is traceable to a Stratum 1 level clock.
2. Switch on the test set. Select Module, then from the Dual T1 Main Menu, select Test Configuration. Configure the settings as follows:

   TEST MODE: T1DUAL
   Tx/INSERT: L1-TX
   Rx/DROP: L1-RX
   RxLVL-1: TERM, if a 3V source with up to 36 dB loss or MONITOR if a MONITOR signal is used.
   RxLVL-2: TERM, if a 3V source with up to 36 dB loss or MONITOR if a MONITOR signal is used.
   Tx SOURCE: PATTERN
   FRAMING: as specified by circuit.
   CODING: as specified by circuit
   Tx CLOCK: Rx-2
   TEST RATE: 1.544M
   LBO 1: 0 dB
   Press the ENTER key on the keypad when the settings are complete.

3. Plug the L1-RX jack from the Dual T1 module into the DSX MON jack or other MON jack of your circuit. Press the HISTORY key on the keypad to clear the blinking history lights.
4. Press the ESC key on the keypad until you arrive at the Dual T1 Main Menu > MEASUREMENT RESULTS.
   A. Press PAGE-UP until you view the LINE 1 - FREQUENCY screen. You can see if there is a problem because the frequency slip bar will be moving across the screen. If there is no bar drawn, then no slippage is occurring.

5. If you have used an external signal source, be sure to check both sides of your circuit. If you have used one side of the circuit as your reference and the other side as the tested signal, then you are done.
6. Disconnect your test set from the circuit.

3.7 Measuring Signal Level

You can measure signal level while performing one of the other tests, or you can measure signal level by itself.

At a DSX, the level should be between 2.7V and 3.3V, as measured from the DS1 OUT jack.

At a repeater housing, the voltage should generally be between 2.4V and 3.3V on either of the repeater outputs. The loss at the repeater inputs should generally be between 10 dB and 35 dB.

The signal strength at the incoming side of an office repeater bay CSU, or NI, should be from 0 dB to -15 dB.

If there is a signal on the OUT jack, use the setup shown in Figure 97, Monitoring an In-Service DS1 Circuit, to measure the level. Otherwise, use the setup shown in the Figure 99, Measuring Signal Level.

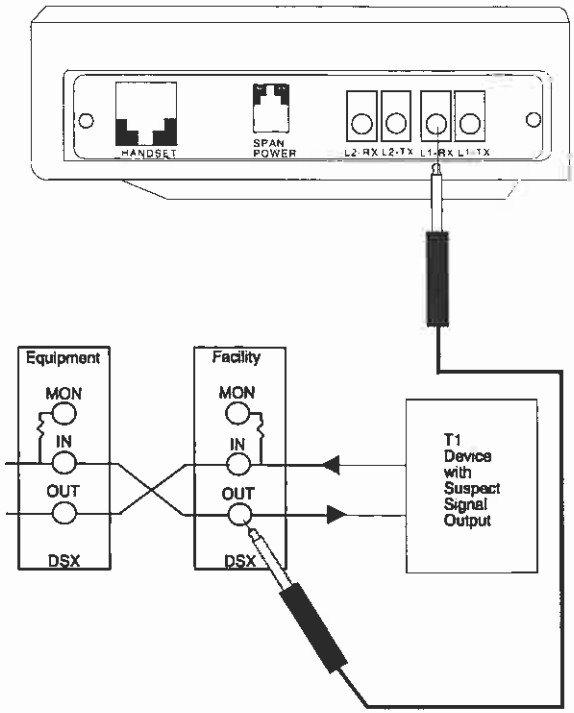

Figure 99 Measuring Signal Level

This is the procedure for measuring the signal level:

1. Choose what kind of access mode you want to use. You can make this measurement in TERM, MONITOR, or BRIDGE modes. TERM and BRIDGE provide the most accurate results, but MONITOR may be the most convenient for your circuit under test. TERM will also disrupt service. The BRIDGE measurement may be degraded by a low-quality termination at the network element terminating the T1 line. A MONITOR measurement should generally show a result of about -20 dB.

   The rest of this procedure will use the TERM mode for illustrative purposes. Verify that the span is not in service. Using the TERM mode will disrupt service.
2. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure the settings as follows:

   TEST MODE: T1SINGLE
   RxLVL-1: TERM
   FRAMING: as specified
   CODING: as specified
   Tx CLOCK: INTERN
   Tx SOURCE: PATTERN
   TEST RATE: 1.544M
   LBO 1: 0 dB
   Press the ENTER key on the keypad to return to the Dual T1 Main Menu.

3. Connect the test set to the circuit as shown in Figure 99, Measuring Signal Level.
4. Press the AUTO key on the keypad to automatically configure the test set for your circuit under test.
5. Select MEASUREMENT RESULTS and press the ENTER key on the keypad. Using the F-key, PAGE -UP until you reach LINE 1-SIGNAL. Separate readings are given for the positive and negative signals so you can get more accurate information on a faulty regenerator.
6. When you are done, disconnect your test set from the circuit.

3.8 Checking DSX Wiring

Occasionally, an incorrectly wired DSX can be the source of a circuit problem. Use the following procedure to verify that the DSX has been wired correctly. Verify that the span is not in service. This test will disrupt service.

1. If the DSX is very large, you may need two test sets or a very long cord for this test. Switch on the test set(s).
2. For each test set, from the Dual T1 Main Menu > TEST CONFIGURATION. Set up the test set(s) as follows:

   TEST MODE: T1 SINGLE
   RxLVL-1: TERM
   FRAMING: as specified by span design
   CODING: as specified by span design
   Tx CLOCK: INTERN
   Tx SOURCE: PATTERN
   TEST RATE: 1.544M
   LBO 1: 0 dB
   Press the ENTER key(s) on the keypad when your settings are complete.

4. Select the SEND TEST PATTERN menu.
   A. Select QRSS (NORMAL) as the pattern to be transmitted.
   B. Press the ENTER key on the keypad to return to the Dual T1 Main Menu.

5. Connect the test set to the circuit as shown in Figure 100, Checking DSX Wiring. You may use one test set as shown in the diagram, or two test sets if the two pieces of equipment are not reasonably close together. You will need to find a point on either side of the DSX where you can plug in the test set. This point could be at test jacks on the network equipment on either side of the DSX. You will need to make sure that you have opened the circuit at each point so that the test set is not bridge-tapped onto the existing circuit.
6. Press the HISTORY key on the keypad to clear the blinking history lights.
7. Verify that each test set lights the PAT SYNC LED as green, and that the ERRORS LEDs are off. This means that the circuit is wired through the DSX properly.
8. Configure the ERR INJ key for injecting both LOGIC and BPV errors. This is set from the Dual T1 Main Menu > OTHER FEATURES > ERROR INJECTION menu.

9. Press the ERR INJ key on the keypad of one of the test sets. Verify that the ERRORS LED comes on and then starts to blink on the other test set.
10. Repeat the procedure for the other direction of the circuit.
11. Disconnect the test set(s) from the circuit. Make sure the circuit is restored to its original condition.

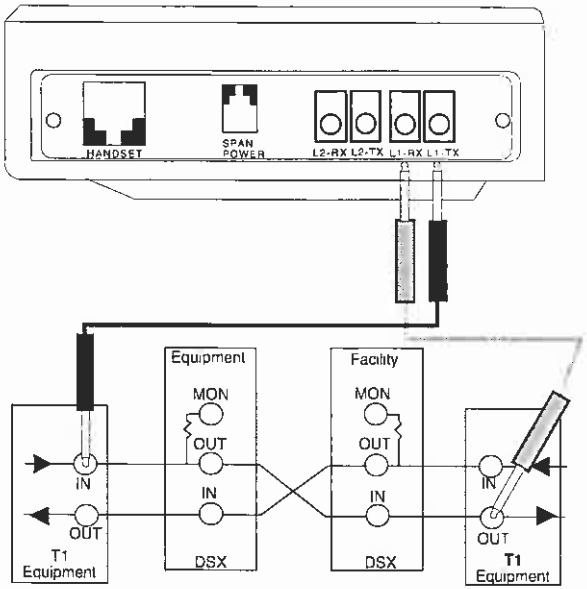

Figure 100 Checking DSX Wiring

3.9 Observing Network Codes or Channel Data

The SunSet xDSL provides a large screen display for analyzing live circuit data. This screen can provide DS1 level translations of binary, hexadecimal and ASCII data. In addition, the screen can decode T1 network control codes that are in use.

Sixty pages of DS1 data are stored so that you can scroll through the information and observe changes over time. This number of pages can also tell you whether a T1 network pattern is interleaved with the framing bit or is overwritten by the framing bit.

The following test may be performed while the span is carrying live customer traffic if a BRIDGE or MONITOR access mode is used, or out-of-service in a TERM mode for your DS1 circuit. Use this procedure:

1. From the Dual T1 Main Menu > TEST CONFIGURATION.
   A. Select your TEST MODE as T1SINGL (F1).
   B. Specify the RxLVL-1 as MONITOR or BRIDGE if the circuit is carrying live traffic.
   C. Specify the other settings as desired, or press the AUTO key on the keypad to have the test set automatically configure to the correct framing and line coding. If the test is out-of-service, and you are using a TERM setting, configure your other settings as required.

2. Plug the test set into the circuit as shown in Section 3.2 Figure 97, Monitoring an In-Service DS1 Circuit for an in-service measurement. Press the HISTORY key on the keypad to clear the blinking history lights.
3. Press the ENTER key on the keypad to access the Dual T1 Main Menu > OTHER MEASUREMENTS > VIEW RECEIVED DATA. You will now be able to view the live channel data.
4. Review the live data as it is displayed. When the codes that you are interested in appear, press the PAUSE (F3) key to trap sixty pages of DS1 data; press PAGE-DN (F2) to scroll through the screens. The data is presented as it appears in the T1 bit stream and is broken out into timeslots. Use Table 10, Channel Numbering to convert from timeslot number to channel number:

Channel Numbering			
T/S	D3/D4	D1D	D2
1	1	1	12
2	2	13	13
3	3	2	1
4	4	14	17
5	5	3	5
6	6	15	21
7	7	4	9
8	8	16	15
9	9	5	3
10	10	17	19
11	11	6	7
12	12	18	23
13	13	7	11
14	14	19	14
15	15	8	2
16	16	20	18
17	17	9	6
18	18	21	22
19	19	10	10
20	20	22	16
21	21	114	4
22	22	23	20
23	23	12	8
24	24	24	24

Table 10 Channel Numbering

5. Figure 101, 10-Bit Pattern shows an example, 1011 1111 11.

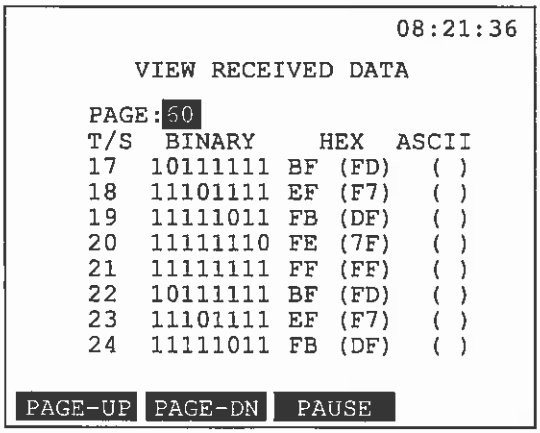

Figure 101 10-bit Pattern

6. When you are finished, disconnect your test set from the circuit.

3.10 Monitoring a Voice Frequency Channel

This is the procedure for monitoring a voice frequency channel within a T1 circuit. The setup is illustrated in Figure 102, Monitoring a Voice Channel. This test may be performed while the span is carrying live customer traffic.

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Select T1SINGL (F1) for the TEST MODE, then select MONITOR or BRIDGE, depending on how you wish to connect to the circuit for RxLVL-1.

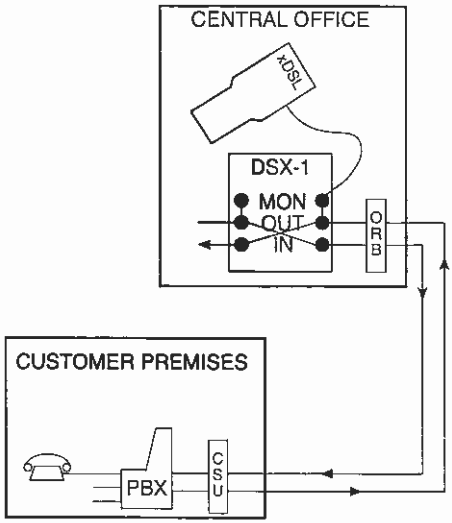

Figure 102 Monitoring a Voice Channel

2. Connect your test set to the circuit as shown in Figure 102, Monitoring a Voice Channel.
3. Press the AUTO key on the keypad to have the test set automatically determine the framing and line coding present on the received signal.
4. Press the ESC key on the keypad to return to the Dual T1 Main Menu > VF CHANNEL TESTING > VF MEASUREMENTS.

5. Select the desired receive and transmit channels using the NEXT (F1) and PREV (F2) keys. The channel numbers are automatically converted to a timeslot number for you on D4, ESF, and SLC-96® A-digroup DS1s. The test set refers to the framing type to make this conversion for you. If you are using another type of framing, refer to Table 10, Channel Numbering to determine which timeslot to specify on the test set.
6. Adjust the volume to the desired level by pressing the VOLUME key on the keypad and using the UP (F1) or DOWN (F2) F-keys to adjust. Press the EXIT (F3) key when adjusted.

Note: If you are not able to monitor the channel, verify the test set was able to synchronize on a known framing type. The test set will not perform the monitor function if framing is unavailable. Press the AUTO key to restart auto frame if a valid frame pattern is not shown

7. When you are finished, disconnect your test set from the circuit.

3.11 Simple Talk/Listen

This is the simplest procedure for talking and listening on a T1 circuit. The setup is illustrated in Figure 103, Simple Talk/Listen. However, instead of having a PBX at the far end of the circuit, you might have another test set, a loopback, a switch, channel bank, or a other T1 terminating network element. Verify the span is not in service. This test will disrupt service for the 23 channels that you are not using. Use this procedure:

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure as follows:

   TEST MODE: T1SINGL
   RxLVL-1: TERM
   FRAMING: as specified by your span design
   CODING: as specified by your span design
   Tx CLOCK: INTERN
   Tx SOURCE: PATTERN
   TEST RATE: 1.544M
   TxLBO: 0 dB
   Press the ENTER key on the keypad when your settings are correct.

Note: It is not possible to perform talk/listen on an unframed signal. The FRAME LED must be green for this procedure to work.

2. Plug the set into the circuit as shown in the Figure 103, Simple Talk/Listen.
   A. Press the HISTORY key on the keypad to clear the blinking history lights.

3. Press the ESC key on the keypad until you reach the Dual T1 Main Menu > VF CHANNEL TESTING > VF MEASUREMENTS. Select the receive (listen) and transmit (talk) channels. They are usually the same channel. Now you can talk and listen on the channel you have selected.
4. Adjust the volume to the desired level by pressing the VOLUME key on the keypad and using the UP (F1) or DOWN (F2) keys to adjust. Press the EXIT (F3) key when adjusted.

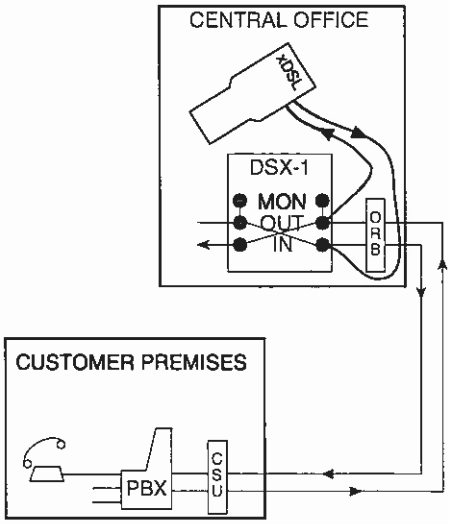

Figure 103 Simple Talk/Listen

Note: The test set will automatically convert the channel number to a timeslot for you on D4, ESF, and SLC-96® A digroups. For other framing formats or digroups, refer to Table 10, Channel Numbering to determine which "channel" to specify within the test set.

5. When you are finished, disconnect the test set from the circuit.

3.12 Advanced Talk/Listen

Use the Simple Talk/Listen procedure as a reference for this procedure. This procedure lets you use different access modes, signaling, and additional features. Verify the span is not in service if you will be using a disruptive access mode.

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure as follows:

   TEST MODE: T1SINGL
   RxLVL-1: TERM
   FRAMEING: ESF
   CODING: B8ZS
   Tx CLOCK: INTERN
   Tx SOURCE: PATTERN
   TEST RATE: 1.544M
   LBO 1: 0 dB
   Press the ENTER key on the keypad when your settings are complete.

Note: In the THRU mode, the test set receives and retransmits the other 23 channels without disruption. Using the THRU mode will cause a momentary hit on the circuit, as you are plugging into and unplugging from, the circuit. Refer to Figures 105, Advanced Talk/Listen, and 106 Connecting the Cords for illustrations of how to configure the test set for connecting to a DSX-1 access point. Other types of circuit access are possible; however, the MONITOR setup is preferable, as it provides the shortest circuit disruption.

2. From the Dual T1 Main Menu > VF CHANNEL TESTING > VF MEASUREMENTS.
3. Select the receive (listen) and transmit (talk) channels that you want and press the ENTER key on the keypad. If you need to access a D1D, D2, or SLC-96® digroups B-D, refer to Table 10, Channel Numbering. You will now be able to talk/listen on the channel you selected.
4. Plug the test set into the circuit. Refer to Figure 105, Connecting the Cords for the correct order of the connections.

Note: Be sure to connect the test cords to the circuit in the correct order. If the connections are not made in the order given, the circuit may be brought down.

5. Press the HISTORY key on the keypad to clear the blinking history lights.
6. Adjust the volume to the desired level by pressing the VOLUME key on the keypad and using the UP (F1) or DOWN (F2) keys to adjust. Press the EXIT (F3) key when adjusted.

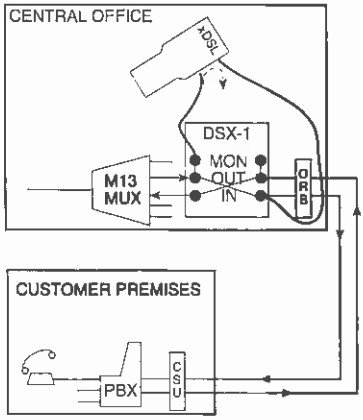

Figure 104 Advanced Talk/Listen

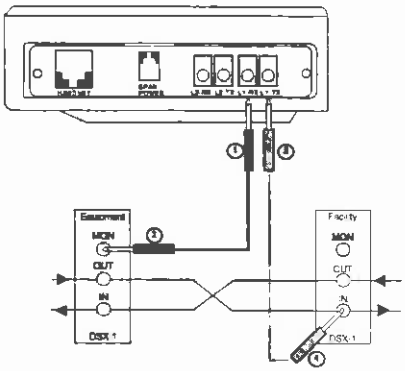

Figure 105 Connecting the Cords

7. If you need control supervision on the circuit, enter the supervision bits you want in order to go off hook, send ringing, or any other state. Send the bits by pressing ON-HOOK (F1), OFFHOOK (F2) or WINK (F3). View the supervision bits which are returned on this same screen.
8. Press the ESC key on the keypad to exit this screen. You will still be sending the supervision bits you have set for the remainder of the session.
9. If you need to dial on the circuit, from the VF CHANNEL MENU > PLACE/RECEIVE CALLS > METHOD, then enter the number you wish to dial.
10. When you are finished, disconnect the test set from the circuit.

3.12.1 D4 Channel Bank Signaling Tables

For your reference, here are many of the common signaling arrangements used on D4 channel banks. TRMT refers to the signaling bits transmitted by the channel bank equipped with the indicated channel card. RCV refers to the signaling bits received by the channel bank. * means that either a 1 or a 0 may appear.

Dial Pulse Originating (DPO)			
VF input to DPO	TRMT	RCV	DPO VF Output
	A B	A B	
Loop open	0 0	**	
Loop closure	1 1	**	
	**	0*	Normal battery
	**	1*	Reverse battery

Dial Pulse Terminating (DPT)			
VF input to DPT	TRMT	RCV	DPT VF Output
	A B	A B	
Normal battery	0 0	**	
Reverse battery	1 1	**	
	**	0*	Loop open
	**	1*	Loop closure

2- or 4-wire E&M			
E&M input	TRMT	RCV	DPO VF Output
	A B	A B	
M-lead ground or open	0 0	**	
M-lead battery	1 1	**	
	**	0*	E-lead open
	**	1*	E-ld ground or looped

Revertive Pulse Originating (RPO)			
VF input to RPO	TRMT	RCV	RPO VF output
	A B	A B	
Loop open	0 0	**	
Loop closure	1 1	**	
	**	0 1	normal battery, no RP
	**	0 0	normal battery RP
	**	1*	reverse battery

Revertive Pulse Terminating (RPT)			
VF input to RPT	TRMT	RCV	RPT VF output
	A B	A B	
Normal battery	0 0	**	
Reverse battery	1 1	**	
	**	0*	Loop open
	**	1*	Loop closure

Sleeve Diel Pulse Originating (SDPO)			
VF input to SDPO	TRMT	RCV	SDPO VF output
	A B	A B	
Loop open	0 0	**	No sleeve ground
Loop closure	1 1	**	Sleeve ground
	**	0*	Normal battery
	**	1*	Reverse battery

Duplex (DX) 2-Wire, 900 ohm or 4-Wire, 600 ohm			
VF input to DX	TRMT	RCV	DX VF output
	A B	A B	
On-hook (idle)	0 0	**	
Off-hook (busy)	1 1	**	
	**	0*	On-hook (idle)
	**	1*	Off-hook (busy)

Equalized Transmission Only (ETO), or to, 4 or 2 Wire			
VF input to ETO	TRMT	RCV	ETO VF output
	A B	A B	
No signaling	**	**	No signaling

Foreign Exchange Office End (FXO), Ground Start mode			
VF input to FXO	TRMT	RCV	FXO output
	A B	A B	
No tip ground	1*	**	
Tip ground	0*	**	
No ringing	*1	**	
Ringing	*0	**	
	**	0*	Loop open
	**	1*	Loop closure
	**	*1	No ring ground
	**	*0	Ring ground

Foreign Exchange Office End (FXO), Loop Start Mode			
VF input to FXO	TRMT	RCV	FXO output
	A B	A B	
No ringing	0 1	**	
Ringing	0 0	**	
	**	0*	Loop open
	**	1*	Loop closure

Foreign Exchange Subscriber End (FXS) Ground Start Mode			
VF input to FXS	TRMT	RCV	FXS VF output
	A B	A B	
Loop open, no ring ground	0 1	**	
Ring ground	0 0	1*	no tip ground
Loop closure, or ring ground	1 1	0*	Tip ground
	**	1*	No tip ground, no ring
	**	1*	Tip ground, no ringing
Loop open	0 1	0 0	Tip ground, ringing
Loop closure	1 1	0 0	Tip ground, no ringing

Foreign Exchange Subscriber End (FXS), Loop Start Mode			
VF input to FXS	TRMT	RCV	FXS VF output
	A B	A B	
Loop open	0 1	**	
Loop closure	1 1	**	
	*1	*1	No ringing
Loop open	0 1	*0	Ringing
Loop closure	1 1	*0	No ringing

Pulse Link Repeater (PLR)			
VF input to PLR	TRMT	RCV	PLR E&M output
	A B	A B	
E-lead open	0 0	**	
E-lead ground or loop	1 1	**	
	**	0*	M-lead ground or open
	**	1*	M-lead battery or loop

Ringdown (RD) 2-wire, 900 ohm or 4-wire, 600 ohm			
Input to RD	TRMT	RCV	RD output
	A B	A B	
No ring to t,r simplex	11	**	
20Hz ring t,r simplex	00	1*	No ring to t,r pair
20Hz ring t,r simplex	11	0*	Ring on t,r pair
sg lead at ground	11	**	
sg lead at -48 VDC	00	1*	Ground sens relay to sg
sg lead at -48 VDC	11	0*	48VDC to sg lead

Table 11 D4 Channel Bank Signaling

3.13 Send a Tone

This is a procedure for sending a tone. This is an intrusive test, be sure the T1 line is not carrying traffic, and that it will be able to withstand the hits this procedure will introduce.

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure TEST MODE: T1SINGL
2. Cursor down to the Tx SOURCE . Select either:

- PATTERN: In PATTERN mode, the test set sends the tone on the selected channel, and fills the other 23 channels with an idle code. The received signal is terminated at the test set, and is not retransmitted. Refer to Section 3.1 and Figure 96, Accepting a New T1 Span for assistance in setting up this mode.
- THRU: In THRU mode, the test set sends a tone on the selected channel. It receives and retransmits the other 23 channels without disruption. Using the THRU mode will cause a momentary hit on the circuit when the test set is plugged in, and when it is unplugged.

3. Select your RxLVL-1 configuration:

- TERM is used to terminate the line in a 100 ohm resistance, and is generally used in out-of-service testing.
- MONITOR is used when you have 20 dB of protected monitor isolation resistance built into your DSX patch panel.
- BRIDGE is used when you are clipping directly onto the tip and ring of your T1 line.

4. Press the ENTER key on the keypad when your setting is correct.
5. Once your access mode has been chosen, plug the circuit into the test set. Press the HISTORY key on the keypad to acknowledge the blinking history lights, and turn them off.
6. Move the cursor to VF CHANNEL TESTING and press the ENTER key on the keypad. Select VF MEASUREMENTS and press the ENTER key on the keypad. Use the NEXT (F1) or PREV (F2) to set up the receive and transmit channels to the correct number. Move the cursor to the TxMODE and press TONE (F2).

7. Move the cursor to TxFREQ and select the desired frequency using the MORE (F4) key to display additional alternatives. Select one of these, or enter in your frequency directly from the keypad, using the SHIFT-lock key. If you typed a value in from the keypad press the ENTER key on the keypad to begin sending the tone at the desired frequency.
8. Move the cursor to the TxLVL item and select the desired level, either 0 dBm (F2), -13 dBm (F3), or enter a value directly from the keypad using the MINUS (F1) and the SHIFT-lock keys. If you typed a value in from the keypad, press the ENTER key on the keypad to begin sending your tone at the desired level.
9. When you are finished, disconnect your test set from the circuit.

3.14 SLC-96 Testing

Here are a some application notes on SLC-96® testing. Refer to your digital loop carrier maintenance manual for detailed information. Refer also to TR-TSY-000008 for SLC-96® reference information. Note that SLC-96® systems come with maintenance capabilities built right into the system. These maintenance features should be used as a first step in troubleshooting SLC-96® problems. T1 test equipment should be used only when the SLC-96® maintenance features are not available.

Warning!
SLC-96® systems carry up to 96 channels of customer traffic. Do not use the test setups shown here unless you have been properly trained. Use these setups only in conjunction with a SLC-96® maintenance manual. Verify through that manual that your planned maintenance activities will not cause a disruption in service.

Three typical SLC-96® maintenance applications are discussed in this section. The applications cover in service data link monitoring, out of service testing, and in-service digroup testing. Use Figure 106 as a guide for each of these applications.

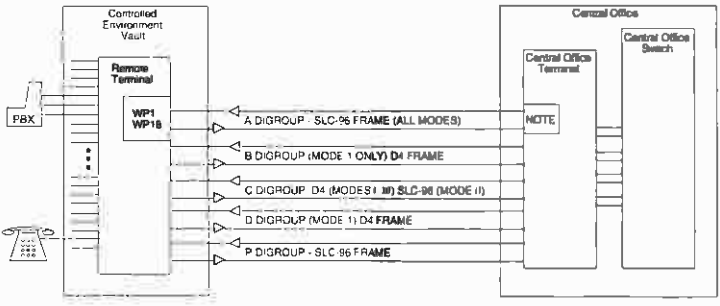

Figure 106 Typical SLC-96 System Configuration

It is highly recommended that you study the general information on SLC-96® systems before actually attempting to perform maintenance on these systems. SLC-96® systems are used to carry subscriber telephone service, as well as a variety of special services.

These systems provide pair gain by multiplexing up to 96 metallic loops onto 4 T1 lines. These systems have a remote terminal located near the customer and a central office terminal located in the central office. The central office terminal may have a

DS1 or analog metallic TEST MODE as part of the switch. Conversely, newer switches may be built with a TR-TSY-000008 TEST MODE (SLC-96® TEST MODE standard) so that there is no need for a central office SLC-96® terminal.

SLC-96® systems have three modes of operation.

- Mode I uses all 4 digroups; each channel of each digroup is reserved exclusively for a given customer.
- Mode II uses only 2 digroups for all 96 channels; the SLC-96® system keeps track of which channels are allocated to which customers through the C bits in the SLC data link.
- Mode III, the system serves only special service lines. This mode uses only two digroups, because only 48 channel units can be plugged into the terminals.

The A digroup transmits the system's data link through the SLC-96® framing format. The data link contains alarm, protection switching, far-end looping, and other maintenance information. The B and D digroups use D4 framing. These digroups are not used in modes II and III. The C digroup also uses SLC-96® framing. The C datalink is used only in mode II. In this mode it carries channel allocation information.

The SLC-96® system uses a protection digroup for ensuring a higher level of reliability. Either the remote terminal or the central office terminal may initiate a switch to the protection digroup if a transmission failure is encountered.

3.14.1 SLC-96 Data Link Monitoring

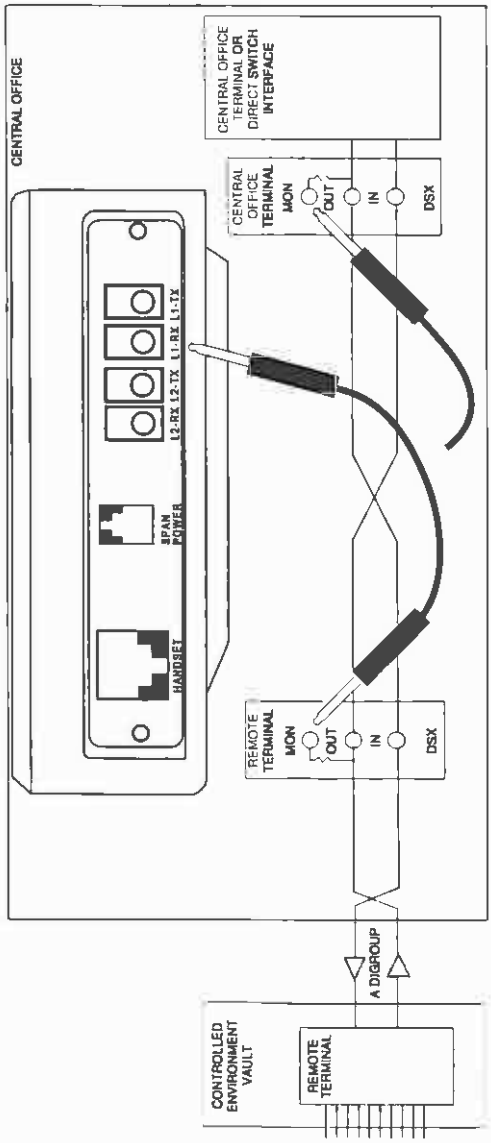

Figure 107 Monitoring SLC Data Link

This is a procedure for monitoring the A data link to observe the operational status of an in-service SLC-96® system.

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure the screen settings for:

   TEST MODE: T1SINGL
   RXLVL-1: DSXMON
   FRAMING: SLC-96
   CODING: AMI (or as provisioned)
   Tx SOURCE: NORMAL
   XMT CLOCK: INTERN
   LBO 1: 0 dB (ft) (or as req'd)
   TEST RATE: 1.544M
   When your settings are correct, press the ENTER key on the keypad

2. Connect the test set to the circuit as shown in Figure 107.
3. Enter MEASUREMENT RESULTS and see if the signal itself has any BPVs or SLC-96® framing errors.
4. Press the ESC key on the keypad and select MEASUREMENT RESULTS > DATA LINK CONTROL > MONITOR DATA LINK. Observe if a protection switch is in place. If there is one, note which digroup and the direction of transmission. Observe if a far-end loop is in place on any of the digroups - this will be signified by ALM next to the FELP category.
5. Reposition the plug into the remote terminal monitor jack. Observe:

- the mode of the remote card (WP1, WP1B).
- if there is a SLC-96® system alarm.
- if any of the remote shelves are in alarm.
- if there is a protection line switch in place.
- if there is a far end loop in place.

6. Take appropriate maintenance action. When you are finished, disconnect the test set from the circuit.

3.14.2 Out-of-service SLC-96 Testing

This is a procedure for performing out-of-service testing on a SLC-96® system. *Perform this testing only when the SLC-96® system is not carrying live customer traffic.*

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure the screen settings for:

   TEST MODE: T1SINGL
   RXLVL-1: TERM
   FRAMING: SLC-96
   CODING: AMI (or as provisioned)
   TX SOURCE: NORMAL
   XMT CLOCK: INTERN
   LBO 1: 0 dB (ft) (or as required)
   TEST RATE: 1.544M
   When your settings are correct, press the ENTER key on the keypad.

2. Connect your test set to the circuit as required for the testing you wish to perform. Refer to Figures 108 and 109. More than one set may be necessary because you may need to transmit and receive maintenance commands on the A digroup while you are performing bit error testing on another digroup. Possible tests you can perform include:

- Switching digroup A through D to protection.
- looping back digroup A through D and P to verify transmission performance.
- inducing the system to switch to protection by creating a loss of signal, loss of frame, or high bit error rate.
- verifying transmission of proper alarm indication when a shelf or power source has gone down.
- verifying that central office terminal transmits AIS (blue alarm) in the downstream direction when a signal has been lost in upstream direction.
- verifying that A digroup can do a half-switch when half of the A-digroup and half of the protection digroup is not working.
- verifying fast and transparent protection switching so that users do not notice a problem.
- verifying proper assignment of channels during mode II operation.

3. When you are finished, disconnect the test set from the circuit.

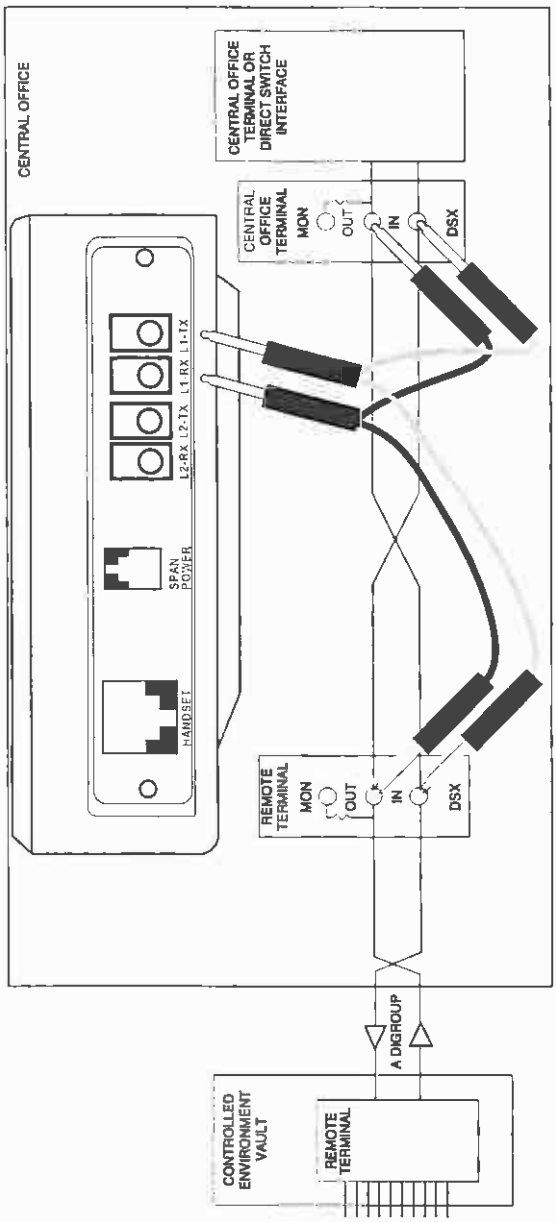

Figure 108 SLC-96 Out-of-Service Testing

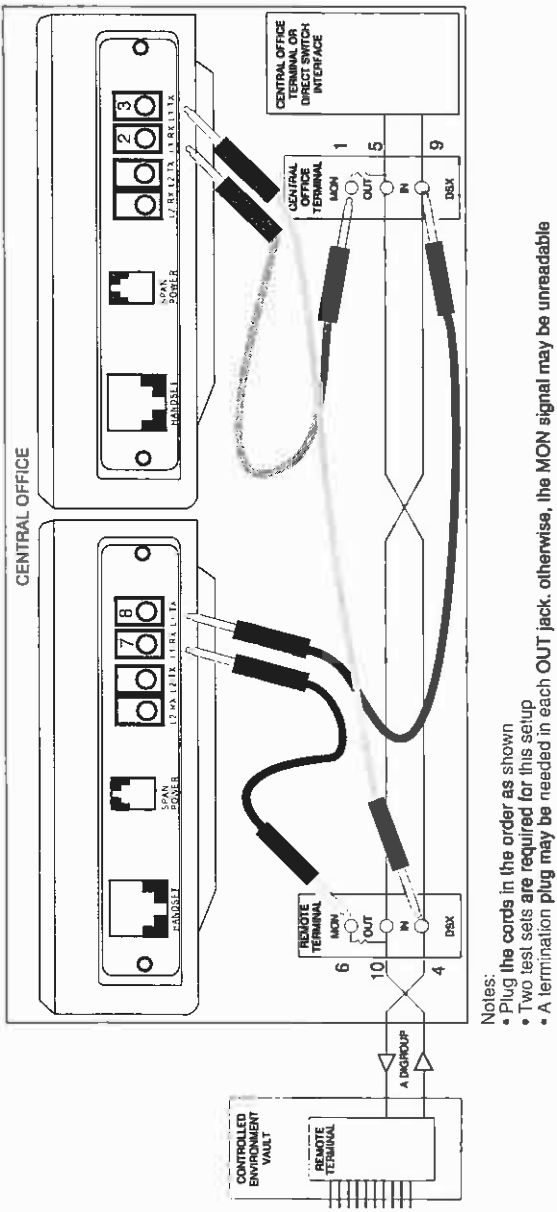

Figure 109 SLC-96 A Digroup Data Link Transmission

3.15 In-Service Hitless Dual Drop & Insert THRU Testing

In-service drop and insert testing is useful for :

- Placing a telephone call on a single channel.
- Sending and receiving tones to test channels.

Use the following procedure:

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure as follows:

   TEST MODE: T1 DUAL
   Tx/INSERT: L1-TX
   Rx/DROP: L2-RX
   RxLVL-1: MONITOR, BRIDGE
   RxLVL-2: MONITOR, BRIDGE
   Tx SOURCE: THRU
   FRAMING: as specified by the circuit design
   CODING: as specified by the circuit design
   Tx CLOCK: L1-Rx
   TEST RATE: 1.544M
   LBO 1&2: 0 dB
   LED PANEL: As desired

2. Depending on the test application, you may wish to do the following:

- For talk and listen, you should:

   A. Press the ESC key on the keypad to get to the Dual T1 Main Menu > VF CHANNEL ACCESS > VF MEASUREMENTS menu item.
   B. Select the receive (listen) and transmit (talk) channels (they are usually the same channel number) that you wish to talk on.
   C. Choose TALK for the INSERT TYPE and L1-Rx for the LISTEN SIDE.
   D. When connected to the circuit, you will be able to talk and listen on the selected channel.
   E. Adjust the volume to the desired level by pressing the VOLUME key on the keypad and using the UP (F1) or DOWN (F2) keys to adjust. Press the EXIT (F3) key when adjusted.

- To send and receive a tone:

   A. Press the ESC key on the keypad to get to the Dual T1 Main Menu > VF CHANNEL ACCESS > VF MEASUREMENTS menu item.

B. Use NEXT (F1) or PREVIUS (F2) F-keys to set up the receive and transmit channels correctly.
C. Select the rest of the menu items as follows:

Tx-1 T/S: Any
Rx-1 T/S: Any
Rx-2 T/S: Any
INSERT TYPE: TONE
TONE FREQ Hz: pick desired tone frequency
TONE LVL dBm: pick desired tone level
Tx-1 A/B/C/D: pick desired tone level
LISTEN SIDE: BOTH

Once connected to the circuit, you will be transmitting a tone on the selected channel.

Warning!
Only experienced technicians should do this procedure. Any mistakes will disrupt service. You will want to practice on an out-of-service circuit first to be sure you have the correct procedure. By entering the VF CHANNEL ACCESS menu, you will automatically be sending a tone or talking to the specified channel that is set in VF MEASUREMENTS. Make sure these are the right settings before continuing.

3. To conduct a hitless dual drop and insert THRU mode test on a line that is in service, make sure all the connections are made in accordance with the numbering procedure in Figure 110, In Service Full Duplex THRU Drop and Insert. This ensures the least amount of interruption on the live circuits. If performed properly, this test should disrupt the service for a duration of few hundred milliseconds. Press the HISTORY key on the keypad to clear them.
4. These procedures assume that both EQUIPMENT 1 and EQUIPMENT 2 are set to loopback mode.

If you were in talk and listen mode, you should now be able to talk and listen on the channel and line that you have specified.

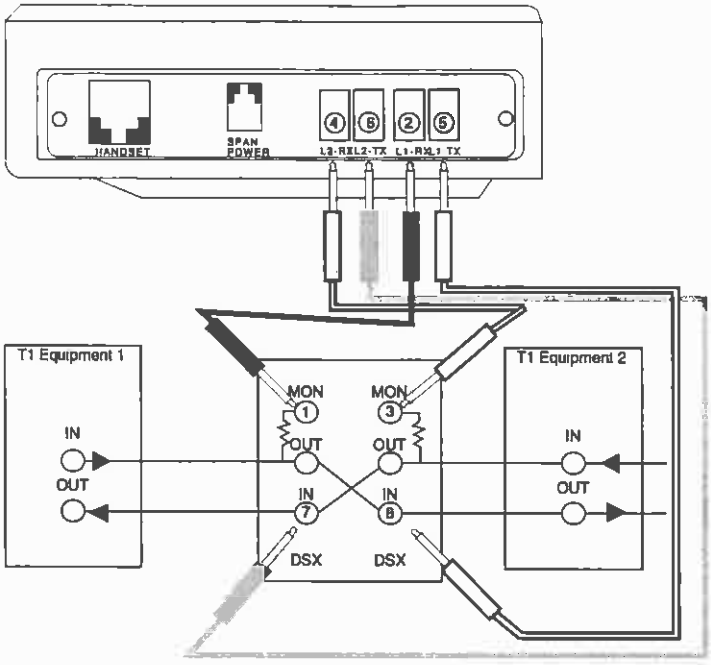

Figure 110 In Service Full Duplex THRU Drop and Insert

Refer to Figure 110, In Service Full Duplex THRU Drop and Insert. If you selected channel 1 and set the LISTEN SIDE to L1-Rx, then you should hear the voice conversation of only channel 1 from Equipment 1. Also, Equipment 2 should be able to hear your voice only on channel 1 since you are transmitting out to Line 1 on that specific channel.

If you change the selected channel, then you will be able to talk and listen on this specific channel; and the other channels of both Equipment 1 and 2 should be uninterrupted.

For tones, check to see that you are receiving the same tone frequency level that you have inserted on the specified channel (i.e. the TONE FREQ Hz specified should be the same as the Rx-1 FRQ/LVL). Also, make sure that the transmitted A/B/C/D bits are the same as the received A/B/C/D bits when you depress the ONHOOK (F1), OFF-HOOK (F2), and WINK (F3) buttons.

Try to send two different tones; have Equipment 1 send a 404 Hz tone and Equipment 2 a 1804 Hz tone on channel 1. From the test set you should be able to pick up and hear the different tones on channel 1 by looking at the RxFREQ/LEVEL from the line that

you have specified in TEST CONFIGURATION. Channel 1 of LINE 1 should be a 404 Hz tone and channel 1 of LINE 2 a 1804 Hz tone. For LINE 1, make sure that the Rx-1 A/B/C/D bits for the Dual T1 module are the same as the transmitted A/B/C/D bits from Equipment 1 and that the Tx-1 A/B/C/D bits for the Dual T1 module are the same as the received A/B/C/D bits from Equipment 2. Check that the other channels are not disturbed on both Equipment 1 and Equipment 2. Do the same checks for LINE 2.

5. When you are finished, make sure you remove the cords in the order of 8 through 1; otherwise, you may disrupt the circuit or damage the test set.

3.16 Fractional T1 Testing

3.16.1 Fractional T1 Circuits

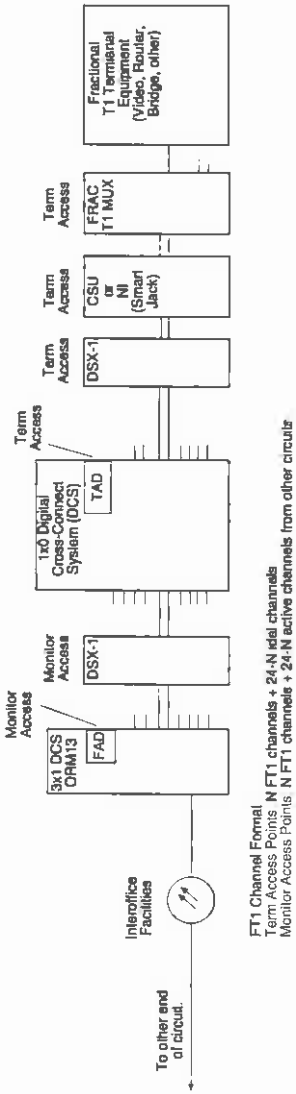

Figure 111 Fractional T1 Circuit

Fractional T1 circuits are circuits of data rate nx56 kbps or nx64 kbps, where n can be anywhere from 1 to 24 channels. N channels of the T1 line are dedicated to the fractional T1 circuit, and the remaining channels of the T1 line are either filled with an idle code or other revenue traffic.

A fractional T1 circuit typically starts out at the customer premises at a fractional T1 CSU, see Figure 111, Fractional T1 Circuit. The purpose of this CSU is to convert the signal into a standard T1 signal suitable for transmission on the telephone company network. The CSU may also multiplex other fractional signals into an aggregate fractional signal within the T1.

The CSU is configured to place the data into either an nx56 or nx64 kbps format. nx56 utilizes the first 7 bits in each channel, and allows the customer to transmit an unlimited number of zeroes, even when the T1 line is set up for AMI coding. The CSU places a 1 in the eighth bit to ensure 12.5% ones density, even when the customer is transmitting all zeroes.

Nx64 is like nx56, except the CSU inserts no ones. This format is generally used when the T1 line is configured using B8ZS line code, or alternating channel assignment. In the B8ZS case, the line code ensures adequate pulse density regardless of the number of zeroes transmitted on the circuit. In the alternating channel assignment case, the idle pattern inserted into the alternating idle channels ensures adequate ones density regardless of the customer data transmitted in the alternating active channels.

The CSU must be configured to put the fractional T1 channels in the proper positions within the 24 channels available in the T1 line. Three formats exist: sequential order, alternating order, and random order. The alternating order format was described in the previous paragraph. For example, a 384 kbps circuit (6x64) might use channels 1, 3, 5, 7, 9, and 11. Channels 2, 4, 6, 8, 10, and 12 might be filled with a 01111111 idle code. Sequential order is different from alternating order in that all the fractional channels are located contiguously within the T1 frame. For example, the same 384 kbps circuit might use channels 1 through 6 of the T1 line. A randomly configured 384 kbps circuit might use channels 4, 9, 10, 17, 20, and 24.

In a fractional T1 circuit, such as a video circuit, it is vital each channel of the circuit arrives in the same order (phase) that it left. If this does not happen, the signal becomes scrambled, and the receiver cannot properly decode the information. The signal will generally only arrive in phase if the fractional T1 circuit travels as a bundle through the various network elements and transmission media. If individual channels should become split onto two different transmission paths, the transmission delay of the two paths will probably be different, causing a decoding problem.

We have already covered the function of the CSU in the fractional T1 circuit shown in Figure 111. Other elements serve different functions. For instance, the 1x0 DCS (Digital Cross-connect System) is used to cross-connect the incoming fractional T1 line onto the desired transport line. The 1x0 DCS allows many fractional T1 circuits to be combined with other channelized circuits onto more densely-packed T1s. The idle channels are simply discarded as they pass into the DCS. This reduces costs by providing highest utilization (fill) on the T1 paths in the long-haul portion of the network.

The M13, or 3x1, DCS allows the grouping of many T1s onto selected higher-speed transmission paths for long-haul transport. The fractional circuit passes through a similar group of network elements at the far end of the circuit.

3.16.2 FT1 Circuit Acceptance Test Procedure

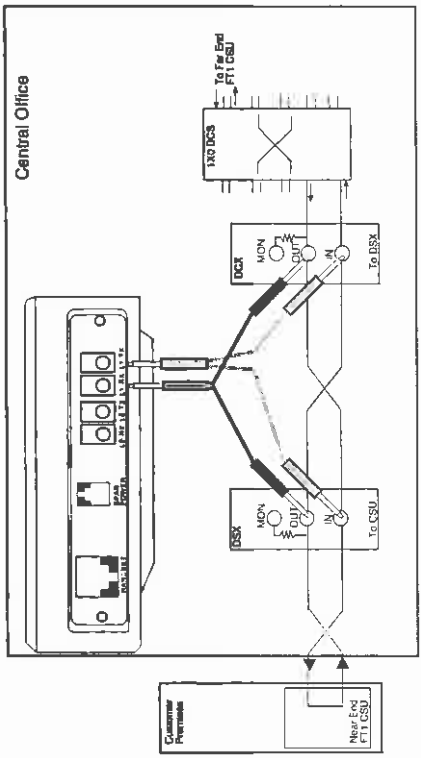

Figure 112 Plugging into the FT1 Circuit

This is an acceptance test procedure for a fractional T1 circuit. Refer to Figure 112, Plugging into the FT1 Circuit. This is an advanced test procedure, which should only be attempted if the user is already familiar with the T1 test procedures described earlier in this section. Verify that the fractional circuit is not in service. This acceptance test will disrupt service.

1. From the Dual T1 Main Menu > TEST CONFIGURATION. Configure as follows:

   TEST MODE: T1 SINGL
   RxLVL-1: TERM
   FRAMING: as specified by your design
   CODING: as specified by your design

Tx CLOCK: INTERN if facing the Fractional CSU, otherwise Rx-1 if facing the 1x0 DCS
Tx SOURCE: PATTERN
TEST RATE: nx56 or nx64, setup the desired channels for transmit and receive. When you press nx56 or nx64, the screen will switch to the FT1 TIME SLOT screen. Manually setup the timeslots to the configuration indicated in the circuit record. If the timeslot configuration is not known, press AUTO (F1) to configure the active channels. Press the ENTER key on the keypad when the timeslot settings are correct. This will return you to the TEST CONFIGURATION screen.
LBO 1: 0 dB or as required
When the TEST CONFIGURATION menu settings are correct, press the ENTER key on the keypad.

Note: Auto configuration may not yield the proper channels if any of the active channels are transmitting an idle code. Auto configuration will also not work properly if the idle code, set to 7F for the Dual T1 module, is not the same as the idle code on the circuit being tested. (7F = 01111111, FF = 11111111). One good way to observe the idle and active channels is to plug the test set in using the 1.544 Mbps test rate, and then go to the OTHER MEASUREMENTS > VIEW RECEIVED DATA menu. This will allow you to double check what the test set prompts with its AUTO configuration.

2. Connect the test set to the circuit at one of the term access points shown in Figure 112, Plugging into the FT1 Circuit. Make sure you know which end of the circuit you are facing.
3. Loop up the circuit toward the near end CSU. A standard CSU loopback code may be used. You may need to re-configure your test set back to 1.544M RATE in the TEST CONFIGURATION menu in order to loop up the CSU.
4. Enter the MEASUREMENT RESULTS menu, and perform the acceptance test. Verify the fractional T1 service performs to your company's requirements for the service delivered. If necessary, refer to section 2.4, Measurement Results Menu.
5. Change your test cords in order to look toward the far end CSU.
6. Loop back the far end FT1 CSU. You will need to find out what kind of loop code will activate the far end FT1 CSU. This may possibly require assistance at the far end.
7. Enter the MEASUREMENT RESULTS menu, and perform the acceptance test. Verify that the fractional T1 service performs to your company's requirements for the service delivered. If necessary, refer to section 2.4, Measurement Results Menu.

3.16.3 Using a T-BERD Power Lid

Using the T-Berd Power Lid is simple with the Dual T1 module. Use this procedure:

1. First read your T-Berd Power Lid manual for general operation and safety instructions.
2. At the point where you would plug in a T-Berd test set, instead plug in the Dual T1 Module. You may use the SS111 Dual Bantam to 15-pin D-subminiature Connector Cable, female.
3. Plug the cable's bantam side into the test set. The arrows should point into the DS1 RX jack and out of the DS1 TX jack.
4. Plug the cable's 15-pin female connector into the 15-pin male connector attached to the spiral cord coming out of the power lid.
5. You can now test the powered span with your test set.

Section 4.0 T1 Technology

This section gives you an overview of T1 technology and equipment. It also shows you the basics of troubleshooting and sectionizing problems with T1 circuits. T1 is a general term that refers to the transmission of 1.544 Mbps digital circuits over any media. T1 can be transported over copper, fiber, or radio. DS1 is the term for the electrical signal found at the metallic interfaces for this circuit where most testing is performed.

4.1 T1 Transmission

4.1.1 T1 Usage

T1s are used for a variety of purposes. They are widely embedded in the network distribution architecture as a convenient means of reducing cable pair counts by carrying 24 voice channels in one 4 wire circuit. End users have migrated their private networks onto leased T1s as a means of reducing their network operation costs. DS1 is a universal digital access point to traditional digital networks and newer fiber optic synchronous networks.

4.1.2 T1 Services

Telephone companies are now selling T1 point-to-point circuits in a variety of formats. Channelized T1s are often sold as a means of connecting PBXs (Private Branch Exchanges) or ACDs (Automatic Call Distributors) to a central office switch. In this case, the telephone company may also install and maintain a channel bank for the customer at their premises. T1 "pipes" are sold to more sophisticated users who only require point-to-point connectivity of a T1 circuit from the telephone company.

4.1.3 DS1 Network Elements

As shown in Figure 113, DS1 Network Elements, a rich variety of equipment is available for T1 circuits.

CSUs, or Customer Service Units, can convert a V.35 or other computer-based synchronous signal format into the DS1 format and insert the appropriate DS1 framing. CSUs also provide loopback capability, indicator lights, monitor jacks, and split access for troubleshooting and installation debugging. Network Interface Units (NIUs) are installed by the telephone company at customer premises for a variety of maintenance reasons. The NIUs also pro-

vide a loopback, but at the telephone company control. This loopback allows the telephone company to verify that the circuit works all the way to the point of interface with the customer's network. The NIUs may also be configured to loopback signal, send AIS, or send idle signal when the customer signal is unplugged. New kinds of NIUs even provide performance monitoring information and maintenance switching capability.

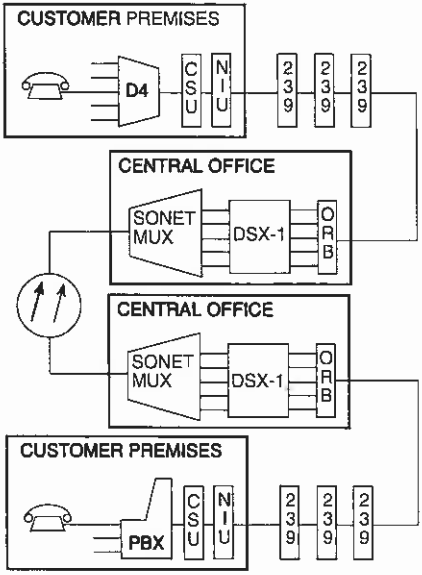

Figure 113 DS1 Network Elements

T1 can be transmitted over twisted pair, fiber, or digital radio. Twisted pair (normal telephone wire) is the most widely spread form of transmission, and has several types of associated network elements. Regenerative repeaters, for example AT&T's 239 series, are located up to 6000 feet apart on a twisted pair span. The repeaters are housed in apparatus cases. The repeaters are located within 3000 feet of the central office and the customer premises in order to avoid cross-talk problems when the signal is carried on building wiring. Newer line repeaters offer loopback capability for faster span sectionalization. Central office repeaters provide the 60 mA span current used for powering the regenerative repeaters on the span. The repeaters may be housed in Office Repeater Bays (ORBs). Newer central office repeaters automatically adjust the supplied voltage to adapt to varying numbers of repeaters plugged into the span. They also may have

fractional T1 blocking capability to allow the telephone company to sell a reduced price T1 that only carries a certain number of channels. They also may have the automated loopback capability and span power-down/power-up capability.

A variety of equipment is found at the ends of DS1 lines. D4 channel banks are a traditional form of multiplexer that converts ordinary telephone wires to 64 kbps channels for multiplexing onto a DS1. Newer D4 banks offer a wide variety of channel plug-ins to handle DDS-style circuits, private line circuits, and even ISDN. AT&T SLC-96® and SLC-5 systems are commonly found in the Bell environment and were designed as enhancements to the older D4 style.

M13 multiplexes are a traditional higher-order multiplexer for DS1s. These units take up to 28 DS1s and multiplex them into a DS3. Note that the DS1 framing and payload still exist inside the DS3 signal, but that the DS1 line coding is not passed through.

PBXs, class 5 switches (central office switches connected to local subscribers), and toll switches are often found at the end of T1 lines. These elements use DS1s as a way of concentrating their connections to local subscribers and interoffice trunks. The function of these elements is to take supervision and addressing information from subscribers, set up a call throughout the world network for the subscriber, connect the subscriber through when the path is set up, and terminate the call when the subscriber is finished.

A variety of Digital Cross-connect Switches (DCSs) connect to DS1 lines. DCSs commonly reduce the space required for achieving channel cross-connection, eliminate the manual labor associated with cross connection, and can provide amazingly fast computerized rerouting of facilities in the event of a network outage. The common DCSs are of type 1x0, 1x1, and 3x1. A 1x0 DCS has DS1 ports interfacing the network. Internally it cross-connects DS0s between the DS1s according to instructions that have been entered in through the administrative terminal. The 1x0 DCS takes the place of many racks of 1x0 multiplexes combined with a DSX-0 manual cross-connect bay. A 1x1 DCS is also called an electronic DSX-1 and is designed as a replacement for the DSX-1. A 3x1 DCS has DS3 ports and possibly DS1 ports facing the network. It replaces a bank of M13 multiplexes and the DSX-1.

A wide variety of SONET (Synchronous Optical NETwork) equipment is now being deployed in the network. This equipment operates at higher rates and introduces a wide variety of new signal formats, both optical and electrical. Much of the SONET gear is also designed to interface to the embedded network and has DS1 and DS3 interfaces. SONET equipment replaces equipment like M13 multiplexes and 3x1 DCSs.

4.1.4 DS1 Standards

Many standards govern various parts of DS1 transmission and network elements. The two most important standards are:

- ANSI T1.102 - 1987, Digital Hierarchy, Electrical Interfaces
- ANSI T1.403, Network-to-Customer Installation - DS1 Metallic Interface

4.1.5 DS1 Signal

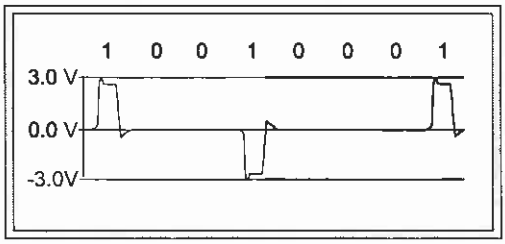

Figure 114 DS1 Pulse Transmission

The DS1 signal is a 1.544 Mbps 3.0V signal. Like the DS3 signal, it uses a bipolar format. Unlike DS3, there are two line codes used in transmission, Alternate Mark Inversion (AMI) and Bipolar 8-Zero Substitution (B8ZS). AMI was the original line code used when DS1 was first introduced. However, its use is suboptimal in today's networks, which mix data transmission with voice transmission and which require near error-free quality. The problem with AMI line coding is that it requires the terminal transmitting data to have at least a 12.5% average 1s density and a maximum of 15 consecutive zeroes. This data content is impossible to guarantee when computer data is being transmitted, so transmission quality can suffer. In comparison, B8ZS uses a bipolar violation substitution which guarantees the 12.5% average with a maximum number of 7 consecutive 0s. Most networks are moving towards B8ZS line code usage. See Figure 114, DS1 Pulse Transmission for an illustration of the DS1 signal.

4.1.6 T1 Framing

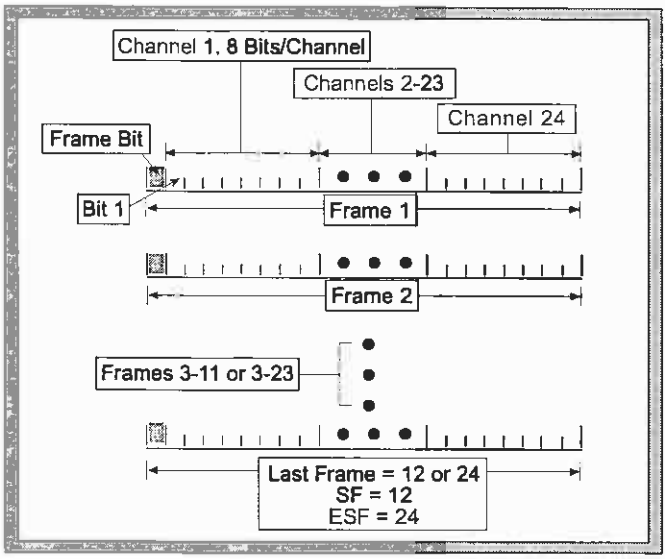

Figure 115 DS1 Frame Structure

T1 framing is simpler than DS3 framing. In T1, there are 192 data bits and one framing bit. With framing, you can tell where the first bit of the frame is. Most T1s are arranged with 24 channels of data, with one byte (8 bits) transmitted per channel per frame. Channel 1 is the first 8 bits after the frame bit, channel 2 is the second 8 bits after the framing bit and so on. 8000 frames are transmitted per second. Each channel provides 64 kbps bandwidth. Refer to Figure 115, DS1 Frame Structure.

There are 3 kinds of standardized T1 framing in use today, SF, ESF, and SLC-96®.

The simplest is SF framing. In SF framing, 12 frames are grouped together as a Super Frame (SF). The 12 framing bits are transmitted in a recognizable pattern such that the super frame is organized into frame number 1, frame number 2, and so on.

ESF (Extended Super Frame) is a newer method, which groups 24 frames together. Of the 24 framing bits, only 6 are used to establish the frame position, i.e. which frame is number 1, which frame is number 2, and so on. Another 6 are used for a CRC-6 (Cyclic Redundancy Check code - 6), and 12 are used for the ESF Facility Data Link (FDL). The CRC-6 bits are the remainder from a division of the bits of the previous frame by a sixth-order polyno-

mial. Any monitoring device along the line can do the same division process and compare its remainder to the CRC-6 bits. If the two figures are not identical, then the monitoring device can assume that a transmission error has occurred somewhere between the measurement point and the origin of the ESF-framed signal. The facility data link is a 4 kbps data channel that allows terminal to terminal communications on an in-service circuit. One example of in-service communication is the performance report message that is broadcast once per second on an in-service circuit. This message is discussed later in this section in End-to-end Performance Monitoring. The facility data link also provides a secure communication channel that the customer cannot influence. For instance, ESF NIU loopback commands are transmitted on the data link so that there is zero chance that the customer's own payload data will accidentally loop up the NIU.

The SLC-96® framing is used on AT&T's old SLC-96® product line. The framing supports a broad variety of maintenance functions such as alarm transmission, automatic switching to protection line, and far end loop back. SLC-96® framing is used on the DS1 link in between the central office terminal and the remote terminal.

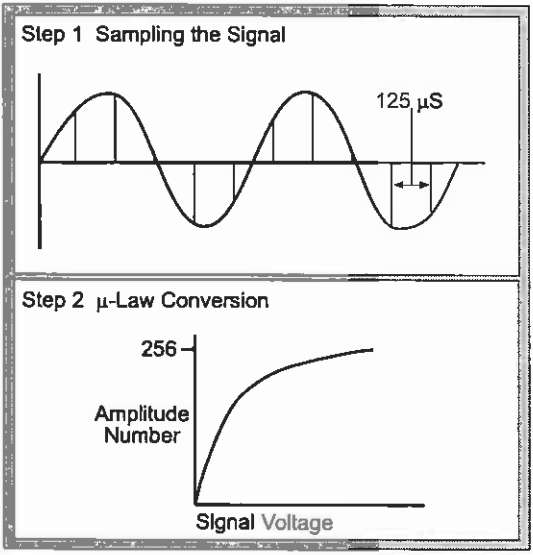

Figure 116 PCM Sampling and µ-Law Encoding

Pulse Code Modulation (PCM) is the technology that allows a voice conversation to be digitized and inserted on a T1 line. In a voice conversation, there is a 4 kHz analog bandwidth which is transmitted through the network.

Through the Nyquist theorem, 8000 samples per second must be taken in order to achieve the 4000 Hz bandwidth requirement. As shown in Figure 116, PCM Sampling and µ-Law Encoding, the analog signal is sampled at 125 micro second intervals, 8000 times per second. Each sample is a measurement of the voltage of the analog signal. The voltage level is then converted to an 8-bit binary word.

An 8-bit word provides 256 different levels, which is not very many. To produce a higher quality sound, a µ-law transformation is used which puts a constant dB level in between each voltage step. This creates a nonlinear relationship between the pulse amplitude and the level number, but it is more pleasing to the ear because it provides a more constant signal to noise ratio at a wide range of volumes.

Each 8-bit word occupies one channel in one frame. Because there are 24 channels available, up to 24 conversations can be carried on the T1 signal.

4.1.8 Switching

A basic understanding of switching is helpful when troubleshooting T1 problems. The DS3 transmission section pointed out that DS1, DS2, and DS3 signals are plesiochronous, that is, they are not frequency-locked with respect to each other. The DS2 and DS3 signals have stuff bits built into the framing, so that all signals can be slipping with respect to each other and not cause any transmission errors. The frequencies are only required to be about +/- 20 ppm to +/- 50 ppm (parts per million) of center frequency for error free transmission.

Long after this digital plesiochronous (sometimes called asynchronous) transmission technology was adopted, switches began a conversion from analog technology to newer, digital technology. Unfortunately, the original DS1 framing concept never anticipated a need to cross-connect DS0s directly from one DS1 to another DS1, which is exactly what happens inside a digital switch. A call that comes in on one channel of a DS1 goes out on another channel of another DS1.

8000 times per second, a switch takes one received frame from each of the DS1s connected to it. It disassembles each frame into the 24 independent timeslots. It looks into its call map to see where each of the received timeslot bytes should be sent. Then it sends each byte to the appropriate DS1 transmit port. Next, it assembles all the bytes for each transmit DS1, inserts any idle code on timeslots that are not actively in the middle of a call, and inserts an appropriate framing bit for the frame type being used. It then transmits each DS1 frame during 1/8000 of a second. There may be several 125 µsec periods of delay for a byte as it moves through the switch.

Not all the DS1s will have the frames ending at exactly the same moment in time. For this reason, the switch maintains a buffer for each transmitted and received DS1 signal. Each buffer provides an elastic store of bits, so that the switch will always have bits available to transmit or receive at the exact moment required.

All the DS1s must be received and transmitted at exactly the same frequency: the frequency at which the switch is operating. Any received DS1 that is going too slowly will eventually run out of bits in its buffer, because the switch is taking bits out of the buffer faster than the buffer is being filled by the DS1. When the buffer becomes empty, the switch must insert extra data in each of the timeslots that are transmitted on the cross-connected channels. An error has now occurred, because what is transmitted is not the same as what is received. Likewise, if any received DS1's frequency is higher than the switch, sooner or later the receive buffer

will overflow because bits are coming in faster than they are being taken out. Once the buffer overflows, some bits which are received will not be transmitted on the cross-connected channel. An error has again occurred; this time because data has been lost.

The universal deployment of digital switches has resulted in a massive effort to synchronize all DS1s so that errors will not occur in switched circuits that use DS1 for transport.

4.1.9 Synchronization

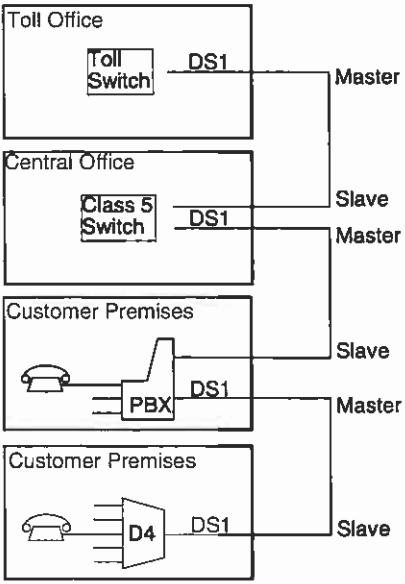

Figure 117 Timing Distribution

DS1 circuits should be synchronized to avoid the switching problems described in the previous paragraph. Minor frequency deviations will cause only pops and crackles on a voice circuit, however a data circuit can be rendered virtually useless by the regular errors resulting from frequency slippage. If a DS1 should be slipping by more than 100 to 300 bps, a digital switch may even put the DS1 out of service, and declare an alarm.

Complete synchronization is achieved only when all signals can have their frequency traced back to the same clock. When a network element is installed, its timing relationship is one of the items that needs to be engineered. The relationship is usually one of master/slave. For instance, if a PBX is connected to a central office switch via a T1 line, chances are good that the central office switch is properly synchronized to the network. Therefore, the DS1 signal received by the PBX from the central office will be synchronized to the network. Thus, the PBX should be set up to be in slave timing mode, with the DS1 signal received from the central office used as the timing source. In turn, a D4 channel bank that is connected to the PBX should be slaved to the PBX. One possible distribution of clock in the network is illustrated in Figure 117, Timing Distribution.

Note that a network element which is slave timed to another network element may also be the master to other network elements attached to it. Also note that slave timing is sometimes called loop timing, or receive timing; loop timing because the received timing is looped out the transmitter and receive timing because the received signal is used for the timing source.

Another method is to be internally timed. The advantage of this is that the element will always be able to generate a signal, so no clock signal is required. Test sets doing acceptance testing are usually set to internal timing. Note that internal timing is not acceptable when the test set will be transmitting toward a switch for nx64 kbps testing; the switch is drawing its timing from something other than the test set. In this case the test set should be loop timed.

4.1.10 Supervision

Common T1 framing methods transmit supervisory information through "robbed bit" signaling. Every 6 frames, the least significant bit in the PCM byte for every channel is "robbed," and is instead used to transmit signaling information. In SF framing, bits in the sixth and twelfth frames are "robbed" to form the A and B signaling bits for each channel. These bits are interpreted according to the kind of circuit carried in the channel. For instance, on an E&M circuit A= 0, B= 0 means that the circuit is idle, (the user is on-hook). A = 1, B = 1 means that the circuit is seized (the user has taken his phone off the hook).

With ESF framing, there are 24 frames grouped together, with bit 8 of each channel in frames 6, 12, 18, and 24 as the ABCD signaling bits. Most ESF signaling is identical to SF signaling, the C and D bits are copies of the A and B bits.

SLC-96® supervision is handled via the SLC-96® data link.

4.1.11 Addressing

Addressing is the process of sending a telephone subscriber address for the purpose of setting up a call. The oldest addressing technique in use today is pulse dialing. With pulse dialing, your phone goes on-hook and off-hook 10 times per second in order to dial a given number. For example, to dial a 7, you start out in the off-hook condition, then you go on-hook / off-hook 7 times. This is the technique that old rotary dial phones use. This addressing information is transmitted through a T1 line by toggling the A and B bits from the off-hook state to the on-hook state at a rate of 10 times per second. This sort of addressing is now commonly used in switched 56 services.

MF, Multi Frequency, is an addressing technique used for interoffice signaling in the telephone network. It uses a group of frequencies in pairs to form a single address tone. In addition to supporting the digits 0 through 9, MF offers many other control codes for specialized network applications like billing, pay phones, etc.

DTMF, Dual Tone Multi Frequency, is the commonly used addressing method on today's phones. Like MF, it uses pairs of tones to send a digit. Unlike MF, it uses two separate groups of tones. DTMF supports 16 digits, 0 through 9, #, *, and A through D.

4.1.12 AIS and Yellow Alarms

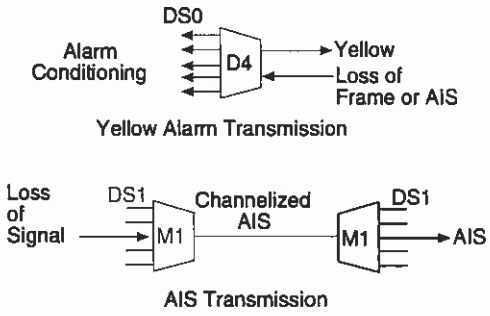

Figure 118 AIS and Yellow Alarms

In DS1, AIS and yellow alarms work just like they do in DS3. An intermediate network element such as an M13 multiplex, 1x1 DCS, or SONET mux, is supposed to transmit AIS downstream when it receives a loss of signal. The DS1 AIS is an all 1s, unframed signal. A terminating network element like a D4 channel bank, PBX, central office switch, or 1x0 DCS should send a yellow alarm back towards the other end when it receives a loss of frame. Note that a received AIS is a loss of frame.

Terminating elements also need to properly condition the DS0s that the DS1 carries when the frame is lost. For instance, A D4 channel bank is supposed to condition its channel cards to take them out of service and transmit an appropriate out-of-service signal to any low speed equipment. Refer to Figure 118 for diagrams of how the AIS and yellow alarms are transmitted.

4.1.13 Loopbacks

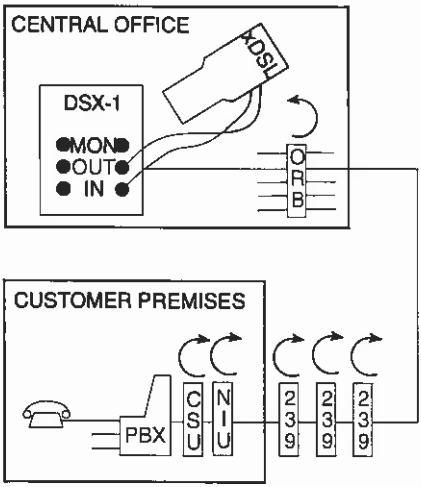

Figure 119 DS1 Loopback Testing

Loopback testing lets you quickly verify the performance of a new DS1 circuit. It can also greatly speed the fault sectionalization process on a circuit that is not working properly. Loopback capabilities are provided in a variety of equipment, new central office repeaters, new regenerative line repeaters, NIUs, CSUs, and M13 multiplexes. The general characteristics of this equipment have been discussed in the DS1 equipment section. Figure 119, DS1 Loopback Testing shows the variety of loopback points available from the central office during a fault sectionalization process.

4.1.14 End-to-End Performance Monitoring

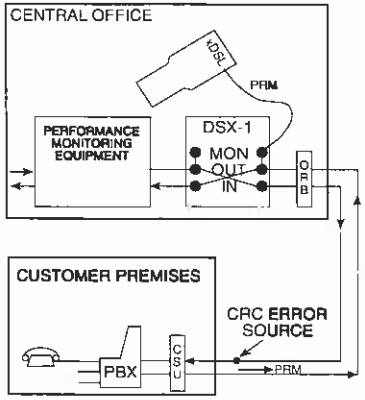

Figure 120 DS1 Performance Monitoring

End-to-end performance monitoring is made possible through ESF framing and CSUs which support the Performance Report Message (PRM) broadcast on the ESF Facility Data Link (FDL). This capability is specified in ANSI T1.403.

The concept is similar to that described in the DS3 performance monitoring section. With ESF performance monitoring, any CRC-6 error or bipolar violation which is received by the CSU is transmitted out towards the other direction in the performance report message on the facility data link. In that way, the end user, or the various telephone companies that provide transport service, can all have equal ability to see the quality of the end-to-end transmission while the circuit is in-service. Before this capability was available, the circuit would have to be taken out of service in order to measure the end-to-end transmission performance.

This new end-to-end performance monitoring capability gives the customer a way to verify the quality of the service that the telephone company is delivering. It also allows the telephone company to setup internal monitoring systems to report on the average grade of service provided to customers. The telephone company may also receive early warning of some failures, i.e. those failures that are preceded by a gradual period of deterioration. This early warning could allow the telephone company to fix the problem before the service is lost.

End-to-end performance monitoring is illustrated in Figure 120, DS1 Performance Monitoring. In this figure, a fault on the transmission line induces repeated errors on the service. The CSU at the end of the line sees the errors as CRC-6 errors and generates

a performance report message in the other direction. The installed performance monitoring equipment in the central office and the technician using their SunSet can both see the message.

4.2 Troubleshooting and Fault Sectionalization

This section helps you find problems onT1 circuits. First you will get a checklist on various problems that often happen with T1 circuits. Then you will see how the information you have learned about errors and alarms helps you quickly find the problem.

The following is a checklist of items to be checked on a T1 circuit:

- ☐ Is the circuit wired up properly? Check for loose wire wraps, bad splices, connections to wrong pairs, etc.
- ☐ Are there any cable problems? For example: bridge taps, "wet" cable, paper insulated cable, shorts, or grounds.
- ☐ Is the cable T-screened? Ideal T1 transmission cables uses a screen to separate the two directions of transmission to prevent cross talk. Are the T1s in the screened cable properly separated into Transmit and Receive binder groups?
- ☐ Has the circuit been connected properly at all the offices along its route?
- ☐ Are Transmit and Receive backwards? A surprising number of circuits get plugged in backwards. Try the other way.
- ☐ Is there any AMI/B8ZS mismatches? AMI and B8ZS line codes are incompatible with each other. Both ends of a T1 line must use the same coding. If all ones works fine, QRS has errors, and 3-in-24 will not synchronize, it's probably an AMI/B8ZS mismatch.
- ☐ Is the CSU or other element set to stuff 1s to prevent low density? This is required for AMI circuits but will cause loss of synch on 3-in-24, errors on QRS, and no errors on all 1s.
- ☐ Is there a framing mismatch? Be sure the framing is the same on both sides.
- ☐ Does the problem reappear when you drop the loopback? The problem is probably with the equipment on the far side of the loopback.
- ☐ Is the circuit connected to a switch or PBX? Look for frequency mismatch.
- ☐ Are DS1 signals used throughout? Sometimes people plug DS1 into DS1C by mistake, or create other signal format incompatibility.

- ☐ Is there a double loopback? Sometimes 2 or more loopbacks of the same type get installed where only 1 is expected. In this case a double or triple loop may occur on a loopback code, and the loopdown code may have to be transmitted 2 or more times before all the loops come down.

- ☐ Is there a termination problem? All lines should have only one 100 ohm termination. Other terminations should be high impedance. If you're not sure, try TERM, BRIDGE, and MONITOR.

- ☐ Is the level too low? The received level should be at least -15 dBdsx for most equipment.

- ☐ Is there a frequency synchronization problem? See the discussion in this chapter.

- ☐ Is there a cross-talk problem? If the signal level is lower than -12 dB, another signal could be cross-talking onto the received T1 line.

- ☐ Are repeaters installed? Are they at the right spacing?

- ☐ Is there a span powering problem? 60 mA span power needs to be delivered to all repeaters on the span; all repeaters should have their power switches properly set to LOOP or THRU. The central office automatic span powering repeater should be delivering the proper voltage to power the span. All the repeaters before the farthest one away from the central office should be set to THRU. The farthest repeater or the NIU should be set to LOOP. Too many repeaters will overload the central office repeater.

- ☐ Is the NIU span powered? Is that span power provided?

- ☐ Is the central office repeater transmitting a 6V signal that is not being padded to 3V before it gets to the next equipment?

- ☐ Is the test cord broken or dirty? This can cause misleading test results.

- ☐ Is the test set working properly? This can also cause confusion when troubleshooting problems. A quick way to check the test set is to loop the test cord from transmit to receive, checking both the cord and the set at the same time. Common test set problems are wrong termination (TERM, BRIDGE, DSXMON), wrong clock setting (INTERNAL is right for most cases), wrong framing, wrong line code, wrong Nx64 selection, and wrong test pattern.

4.2.1 Fault Sectionalization

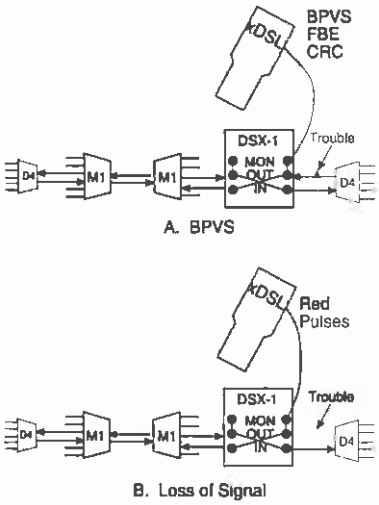

Figure 121 BPVs & LOS in DS1 Fault Sectionalization

Fault sectionalization techniques vary depending on whether the T1 circuit is in-service or out of service. If it is out of service, then you start from the middle and loop back the circuit in each direction to see which side has the problem. Next, go to the middle of the side that has the problem and do another loopback in each direction. Repeat this procedure until you find the problem. Refer to Figure 119, DS1 Loopback Testing, for an illustration of the loopback test. This figure shows many of the loopbacks that may be available in one direction from the central office. Note that there also may be DS3 loopbacks available if the circuit is a DS3 circuit, or DS1 channel loopbacks may be available in higher order multiplexes.

If the circuit is in service, non-disruptive performance monitoring techniques are used. Much can be learned simply by plugging into monitoring jacks and observing the information. Be sure to plug into the monitor jack for each direction and look at the results.

The following paragraphs tell you what conclusions you can make from various results at different monitor points. In the accompanying diagrams, a SunSet Dual T1 Module shows what abnormal conditions it is seeing from its monitor point. In the diagrams, a triangle indicates a line impairment that is causing steady or bursty errors. A loss of signal is indicated by a missing signal arrow. If CRC is listed in the diagram, it will only be seen if the circuit uses ESF framing. Likewise, If C-bit [parity] error is listed, this is only found if C-bit parity framing is used.

4.2.2 Bipolar Violations and Loss of Signal

DS1 or DS3 bipolar violations, or loss of signal, show that the fault is relatively nearby. DS1 bipolar violations pass through line repeaters, office repeaters and NIUs, but are stopped by multiplexes, DCSs, switches, signal format changes (i.e. from optical to electrical, or from radio to electrical) and possibly CSUs. DS3 bipolar violations indicate that the problem is between the test set and the nearest DS3 equipment, within a few hundred feet.

The DS3 format only exists at interconnections between equipment. Different formats are used for transmission over long distances. In comparison, the DS1 electrical signal can transmitted through regenerative line repeaters for hundreds of miles. Thus a DS1 bipolar violation indicates a transmission problem between the test set and the last multiplex, DCS, or other element that stops bipolar violations. Figure 121, BPVs & LOS in DS1 Fault Sectionalization illustrates the DS1 case.

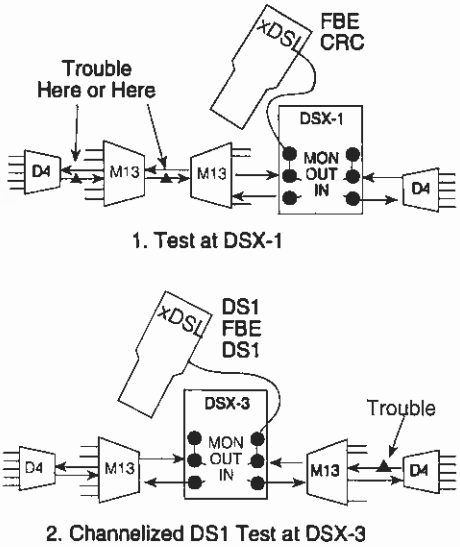

Figure 122 FBE and CRC in DS1 Testing

These errors travel with the DS1 circuit for the entire length of the circuit. They pass through higher order multiplexes. They also pass through changes in line format from copper-to-fiber, fiber-to-radio, etc. If these errors are found with bipolar violations, then the problem is local. If these errors are found without bipolar violations, then the problem is behind the last format change. Figure 122, FBE and CRC in DS1 Testing shows what these errors mean when they are seen without BPVs.

4.2.4 AIS and Yellow Alarm

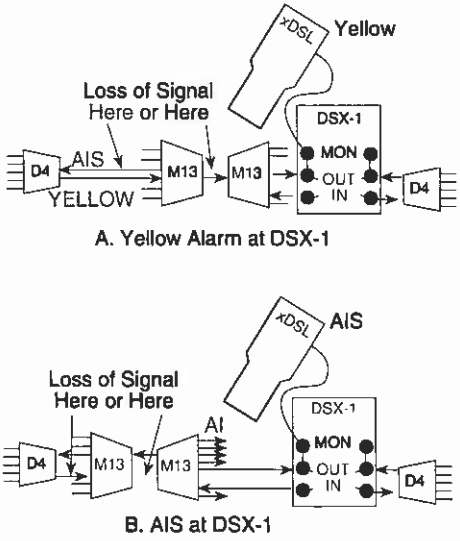

Figure 123 DS1 Yellow and AIS

AIS means there is a problem on the line somewhere behind the last multiplex, DCS, fiber mux, or other device which replaces a loss of signal with AIS.

Yellow alarm means the received signal has been lost at the end of the line that generated the signal you are monitoring. When you monitor the other direction, if the signal is framed, then the problem must exist between you and the end of the line generating the yellow. If the signal is unframed (for example AIS or loss of signal) the trouble is between you and the other end of the circuit.

Figure 123 shows how the AIS and Yellow alarms show up in DS1 and DS3 fault sectionalization.

4.2.5 FEBE or ESF PRM Errors

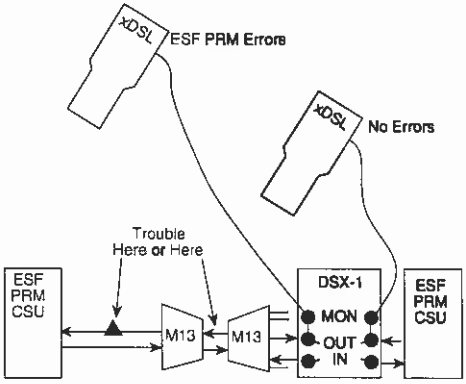

Figure 124 DS1 ESF PRM Errors

Both of these indicate that errors are being received at the end of the line that is generating these messages. If you see no errors on the other direction of the line being monitored, then the problem exists between you and the end generating the FEBE or PRM error messages. If the other side shows BPVs, CRC-6, frame or other errors, then the problem exists between you and the end of the circuit that is not generating the FEBE or PRM error messages.

If you are monitoring a DS1 circuit from a DS3 access point and you see both DS3 FEBEs and DS1 PRM errors, then the problem exists before the end of the DS3. If you are on a C-bit parity framed DS3 monitoring a DS1 and you see ESF PRM errors but you do not see FEBEs, then the problem exists in between the side of the circuit generating the ESF PRMs and the end of the DS3 mux. Figure 124, DS1 ESF PRM Errors shows a typical example of a network fault leading to this indication.

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