SUNRISE TELECOM
INCORPORATED

SunSet™ E10

User's Manual
SS257
Version 2.37

MAN-11350-US001 Rev. A

Sunrise Telecom...a step ahead

22 Great Oaks Blvd., San Jose CA 95119 USA

SunSet E10 ◢ Version 2.37

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SUNRISE TELECOM
INCORPORATED

DECLARATION OF CONFORMITY
for

SUNRISE TELECOM
SunSet E10

Manufacturer
Sunrise Telecom
22 Great Oaks Boulevard
San Jose, CA 95119
USA

Statement of Conformity
Based on test results using appropriate standards, the
product is in conformity with
Electromagnetic Compatability Directive
89/336/EEC
Low Voltage Direction 73/23/EEC

Sample Tests
Standards used:

EN 55011 (1993)
Radio Frequency Product
Family Emission Standard
EN 50082-1 (1992)
Electromagnetic Compatability;
Generic Immunity Standard
IEC 801-2, IEC 801-3, IEC 801-4
IEC 950(1991)
Safety of Information Technology Equipment

The tests have been performed in a
typical configuration.

The conformity is indicated by the symbol

$C \epsilon$ i.e., "Conformité eurpoéenne"

SunSet E10 ◢ Version 2.37

Chapter 1
Unpacking

SunSet E10   Version 2.37

Section 1 Unpacking the SunSet

Use the following procedure for unpacking your new SunSet:

1) Remove the packing list from the shipping container.

2) Remove the SunSet and accessories from the shipping container.

3) Inspect all parts and immediately report any damage to both the carrier and 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 or your national distributor.

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

6) Ensure the software cartridge is fully seated in its slot (refer to Figure 1–1, Software Cartridge Installation).
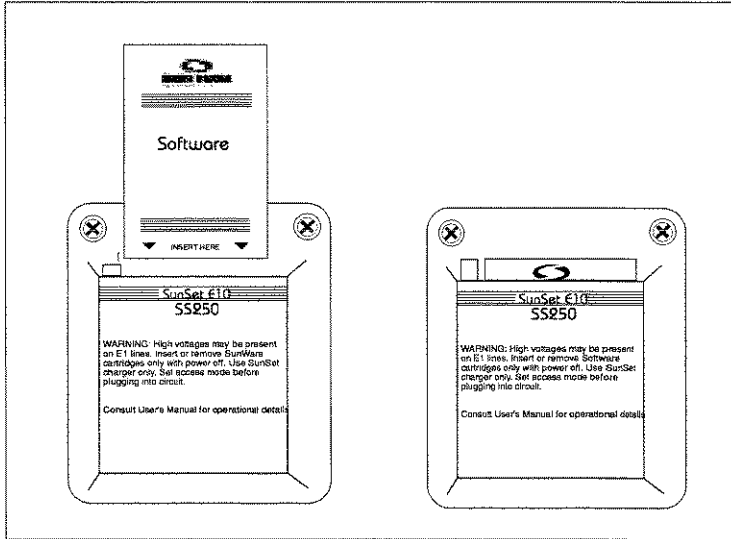
Figure 1–1
Software Cartridge Installation

7) Plug the AC Battery Charger into an appropriate AC wall outlet: 220 VAC, 50/60 Hz or 110 VAC, 50/60 Hz (SS113).

8) If you choose to install the instrument stand, refer to Figure 1–2, Instrument Stand Installation.
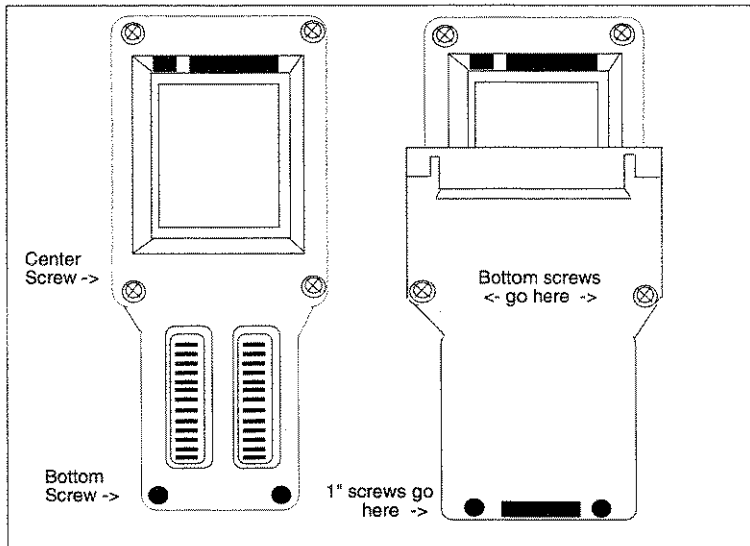
Figure 1–2 Instrument Stand Installation

NOTE: If you plan to use the SunSet with its optional Protective Jacket (SS123), then do not install the Instrument Stand.

Use the following procedure:

a) Remove the two center screws from the rear of the SunSet. (Save these screws should you decide to remove the stand at a later date).

b) Remove the two bottom screws from the rear of the SunSet. These screws are slightly longer than the ones removed in step a). Save both of these screws for step e) below.

c) Fit the Instrument Stand onto the back of the SunSet.

d) Use the two long screws (provided with the Instrument Stand) to screw the Instrument Stand onto the SunSet at the two bottom positions.

e) Use the screws saved from step b) to screw the Instrument

Stand onto the SunSet at the two center positions.

9) Switch the set on and verify that it passes the SELF TEST. If the SunSet does not turn on immediately, it may need to charge for up to 5 minutes before it can run.

10) Charge the unit for at least one hour before its first use. Or, leave the AC Battery Charger plugged in while operating the SunSet.

11) Put the SunSet and accessories into the soft Carrying Case (if it was ordered).

NOTE: Each software cartridge is mated to a single SunSet. If your SunSet does not start properly, verify that the Serial Number printed on the software cartridge matches the Serial Number on the back of your SunSet.

When ordering software upgrades, be sure to specify the Serial Number of the SunSet into which the new cartridge will be installed.

Chapter 2
Test Set Description

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Section 1 Warnings

1) Insert and remove software cartridges ONLY with the power switched OFF. Otherwise, software cartridges may become damaged.

2) Use the SunSet charger only. It is marked with the Sunrise Telecom logo AC Battery Charger name.

3) When bringing the SunSet from an extreme cold to warm environment, allow the SunSet to warm for at least 4 hours prior to use. Condensation may interfere with the operation of the test set and may result in damage if power is applied.

4) Do not immerse the set in water or expose the set to rain.

Section 2 Front View Description

Refer to Figure 2-1, SunSet E10 Front View, on the following page for the front view of the SunSet E10.

2.1 Keys

Most SunSet keys perform two distinct operations. The white label above the key indicates what function will be performed if the key is pressed by itself. The orange label below the key shows what function will be performed if the SHIFT-lock key is pressed first and the SHIFT indicator is displayed in the upper left-hand corner of the screen.

The SHIFT-lock key should not be pressed simultaneously with another key. Instead, the SHIFT-lock key should be pressed and then released. At this point, a SHIFT indicator, in reverse-video, will appear in the upper left-hand corner of the screen. Any other key can now be pressed and released, and the SunSet will perform the function indicated by the orange label.

If the keys are not behaving as expected, check the SHIFT indicator. If the SHIFT indicator (upper left-hand corner of the screen) indicates the wrong shift status, simply press the SHIFT-lock key again.
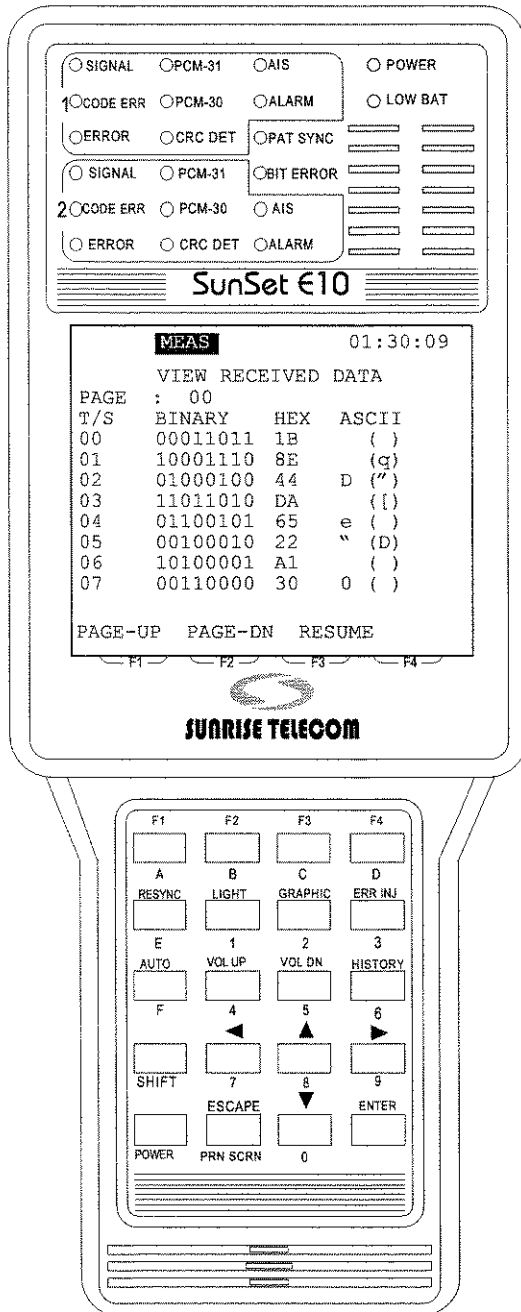
Figure 2–1 SunSet E10 Front View

2.2 White Labels

F-keys (F1, F2, F3, F4)

These keys are used to select choices F1 through F4 at the bottom of the LCD display.

When you configure a setup screen, a number of options are typically available for each setup item. The available choices appear on the bottom of the screen. The desired option may be invoked by pressing the corresponding F-key directly below. Refer to Figure 2–2.


```
                                    2:30:02
        TEST CONFIGURATION
        TEST MODE : E1

        Tx/INSERT  : L1-Tx
        Rx/DROP    : L1-Rx
        Tx SOURCE  : TESTPAT
        FRAMING    : PCM-30
        CRC-4      : YES
        TEST RATE  : 2.048M
        RxLVL-1    : TERM
        RxLVL-2    : TERM
        XMT CLOCK  : INTERN

   PCM-30   PCM-31  UNFRAME
      F1      F2      F3      F4
        Press the Desired F-Key
      F1      F2      F3      F4
```
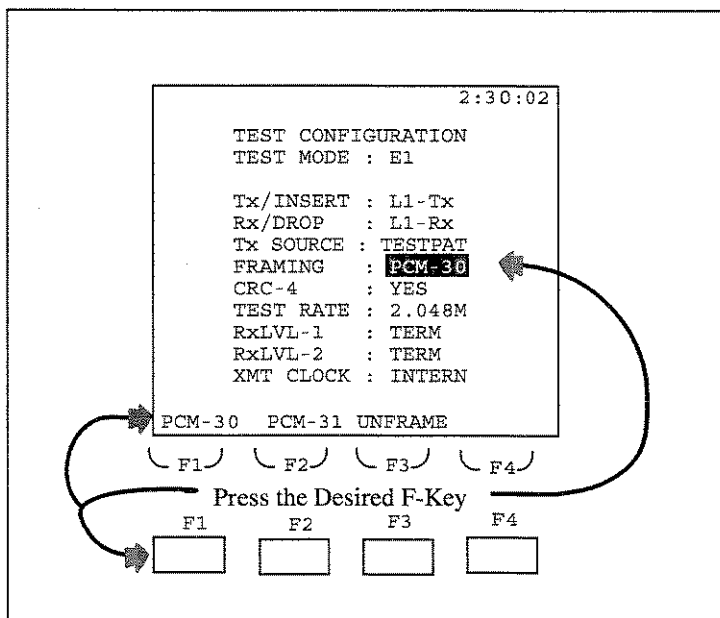
Figure 2–2   F-Keys

In Figure 2–2, the Framing is set to PCM-30 by pressing the F1 key.

Note the following:

1) In most instances, when the desired F-key is pressed, the cursor will advance to the next line of the display automatically. If you wish to change the settings of a previous line, simply press the

Up Arrow key, then re-select the option using the appropriate F-key.

2) The options appearing at the *bottom* of the screen are associated with a *particular* setup parameter within that screen. As you change the position of your cursor within a setup screen, the F-key options available to you will also change.

3) If more than four F-key options are available to the user, a "more" indicator will appear in the F4 position. Pressing the F4 key will change the options associated with the F-keys.

RESYNC

The RESYNC key resynchronizes on the transmit pattern and restarts the measurement in progress. If the transmit pattern is not found, the measurement begins in a live mode with the PAT SYNC light off. If the transmit pattern is found, then the PAT SYNC LED turns green and logical measurements are made. During some operations like ISDN PRI CALL SETUP and VF CHANNEL ACCESS, bit error measurements are discontinued and the RESYNC KEY has no effect.

LIGHT

The LIGHT key is used to switch the system backlight off and on. Keeping the backlight off when it is not needed will allow the SunSet to maintain its battery charge approximately 15% longer.

The SunSet's backlight has a programmable timer for automatic shut-off. This timer can be set from 1 to 99 minutes or continuous operation. This feature is configured in SYSTEM PARAMETERS, GENERAL CONFIG, BACK LIGHT.

GRAPHIC

The graphic key displays a picture of the current circuit configuration and status. After graphically viewing the configuration, you may return to your previous location by pressing either GRAPHIC, ESCAPE, or ENTER. The graphic may be invoked during basic menu setups and basic operations, such as: TEST CONFIGURATION, SEND TEST PATTERN, and VF CHANNEL ACCESS. The GRAPHIC screen is useful in verifying that the TEST CONFIGURATION is correct for the circuit under test.

Graphics are not available in VIEW screens, i.e. VIEW X.50 INFO, VIEW RECEIVED DATA, VIEW FAS WORDS, VIEW MFAS WORDS, PULSE MASK ANALYSIS.

The graphics will update according to successful operations within the test set.
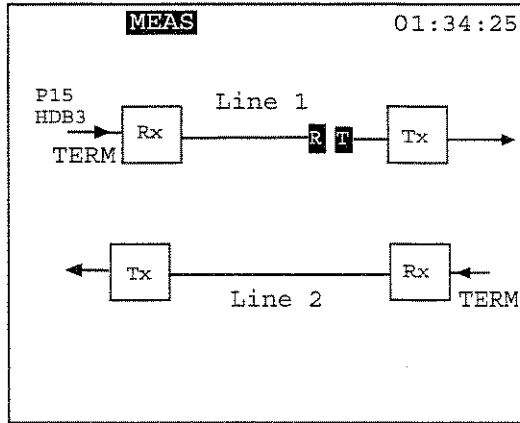
Figure 2-3   Graphic Screen Example

Here is a description of some of the elements common to a graphic display:

The following letters will often be present, in reverse video:
R = this is where the SunSet performs its received measurement
   results
T= this is where the Sunset transmits a test pattern

Arrows denote the direction the signal is travelling.

Boxed words, or abbreviations provide additional information:
Tx- the transmit port of the noted line (1 or 2)
Rx- the receive port of the noted line

HDB3 or AMI reports the transmitted coding type.
The test pattern is shown above the coding; P15 (2e15) in the
   sample figure.
TEST RATE is provided at the bottom of the screen if the unit is in
   a fractional setup, reporting the fractional test rate.
BRiDGe, TERM, or MONitor is noted by each line.

ERR INJ

The ERRor INJect key is used to inject errors into the SunSet's transmitted signal. Errors are injected according to the current settings in the OTHER FEATURES / ERROR INJECTION menu. If the error injection mode is set to rate, an error inject indicator will appear on the top of the screen when you press this button.

AUTO

AUTO lets the test set auto-sync on the received line code, frame, and pattern, and adjusts the set's transmit settings accordingly. It may not be always possible to determine the line code of a circuit. For instance, an all 1s signal will mask the presence of HDB3 coding. The test set reports HDB3 coding if it actually sees the code; otherwise, it reports AMI coding.

VOL UP

The VOL UP key turns the speaker volume higher when the user is in the VF CHANNEL ACCESS, ISDN PRI, or GSM TRAU menus. A small bar indicator will appear at the top right of the screen, visually indicating changes.

VOL DN

The VOL DN key turns the speaker volume lower when the user is in the VF CHANNEL ACCESS , ISDN PRI, or GSM TRAU menus. A small bar indicator will appear at the top right of the screen, visually indicating changes.

HISTORY

The HISTORY key is used to turn off any flashing LEDs. The LEDs flash to indicate any error, alarm, or caution condition which occurred previously but which is no longer present.

Arrow Keys

▲ (Cursor Up Arrow)
The up arrow key is used to move the cursor up.

▼ (Cursor Down Arrow)
The down arrow key is used to move the cursor down

▶ (Cursor Right Arrow)
The right arrow key is used to move the cursor to the right.

◀ (Cursor Left Arrow)

The left arrow key is used to move the cursor to the left.

ESCAPE

The ESCAPE key moves you back toward the main menu. To return to the main menu, keep pressing ESCAPE until you arrive there.

ENTER

The ENTER key performs three functions:

1) When a menu item is highlighted and the ENTER key is pressed, the SunSet will display the screen for the highlighted menu item.
2) If setups are complete in a data entry screen, pressing ENTER will often return you to the previous menu.
3) In a few cases, pressing the ENTER key is required after the user finishes entering data in a given screen. In these cases, the SunSet will execute the inputs *only* after the ENTER key has been pressed. Such situations are not common in SunSet operations; an example is DTMF/MFR2/DP dialing in VF CHANNEL ACCESS. In most of the high usage functions, it is not necessary to press ENTER to invoke the operation. If the operation you are trying to perform will not begin, try pressing the ENTER key. When the ENTER key is used to invoke the operation, you may need to press ESCAPE to return to the previous menu.

2.3 Orange Labels

SHIFT

The SHIFT-lock key is pressed to provide access to the functions specified by orange labels. The SHIFT-lock key should always be pressed first, then must be released before the desired orange-label key is selected. SHIFT-lock status is displayed in reverse video in the upper left-hand corner of the screen. The SHIFT-lock indicator must not be present when the white label functions are to be used. The SHIFT-lock indicator must be present when the orange-label functions are to be used.

A, B, C, D, E, F

These keys are used to enter hexadecimal numbers and to provide labels for user-defined information.

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

These keys are used to enter user test patterns and telephone numbers. They can also be used to provide labels for user-defined information.

PRN SCRN

The PRiNT SCReeN key is used to print any alphanumeric and graphical information appearing on the screen.

2.4 LEDs

The bi-color LEDs (Light Emitting Diodes) provide a visual indication for the condition of the received signal. The LEDs provide enough diagnostic information at a glance that additional testing may not be required by some users. A LED will be lit green continuously when the particular condition for that LED is detected. For example, a continuous green light for PCM-30 indicates that the test set has detected PCM-30 framing; receiving the MFAS 16 frame pattern, as well as the basic FAS pattern. A continuous red light denotes an alarm condition for the item. For example, the ERROR LED lights red if an error (CRC or framing) has been observed.

Blinking lights provide historical information for the circuit condition. This is quite helpful if the user happened to be away from the set when the error or alarm condition occurred. Pressing the HISTORY key stops the blinking.

Common LEDS

POWER

The POWER LED lights green when the SunSet is switched on and has an adequate power source.

LOW BATT

The LOW BATT LED lights when the SunSet's power supply voltage has dropped to a low level. Approximately 5 minutes after the LOW BATT LED lights, the SunSet will automatically shut

down.

Plugging in the AC Battery Charger will allow you to use the SunSet indefinitely. However, if you plan to use the SunSet for an extended period of time, it is best to plug the AC Battery Charger in first. If the charger is plugged in while a measurement is in process and while the battery is not fully charged, the SunSet may automatically reset itself. In this case, the current measurement results would be lost.

PAT SYNC

The PATtern SYNChronization LED lights green if the unit has synchronized on a the same pattern in the received signal as it is transmitting. Pattern sync is derived from the line designated as Rx/DROP in the TEST CONFIGURATION. The exact pattern may be observed in MEASUREMENT RESULTS. When the test set is in BER mode, the SunSet will automatically attempt to synchronize on the pattern that is being sent. If synchronization is lost, the PAT SYNC LED lights red. In LIVE mode (BER or LIVE is set in OTHER FEATURES/MEAS CONFIGURATION1/ MEASURE MODE), the LED is turned off.

BIT ERR

The BIT ERR LED lights if a BIT ERRor has been detected.

The following LEDs provide the same functions for both Line 1 and Line 2 displays.

SIGNAL

A green signal LED indicates that the SunSet is receiving valid 2.048 Mbps signals. In contrast, red LED indicates no signal.

PCM-31, PCM-30

Green LEDs specify the type of framing detected on the received signal. PCM-31 indicates that the basic FAS (Frame Alignment Signal) has been detected. PCM-30 indicates that the MF 16 (Multiframe) pattern has been detected, as well as the basic FAS pattern. Red LEDs indicate that the specified frame has not been detected. If the received signal is unframed, neither LED will be lit.

If the SunSet is configured for a particular type of framing in the TEST CONFIGURATION menu, it will continuously search for that type of framing. The appropriate LED will light whenever the framing

is found.

CRC DET

When CRC is enabled in the TEST CONFIGURATION menu, the
CRC DETect LED lights green if CRC-4 check sequences are
detected by the SunSet. If CRC is enabled, but no CRC is detected,
the LED lights red. When CRC is disabled, it does not light.

ERROR

The ERROR LED lights red if any of the following errors have been
observed: CRC errors, frame errors, E-bit errors. The ERROR Led
will light if CRC-4 errors are detected when CRC error checking has
been enabled, and frame errors are detected when the signal is a
framed signal. CRC-4 and framing are both configured in the TEST
CONFIGURATION menu.

CODE ERR

The CODE ERR LED lights red if a coding violation is detected on
the received signal. A code error is a bipolar violation that is not part
of a valid HDB3 substitution.

AIS

The AIS LED lights red if the SunSet detects an *unframed* all ones
signal on its receive jack.

ALARM

The ALARM lights if the SunSet detects FAS ALM, MFAS ALM, or
AIS T/S-16.

2.5 Connector Panel

The SunSet E10 has a connector panel as shown in Figure 2–4.
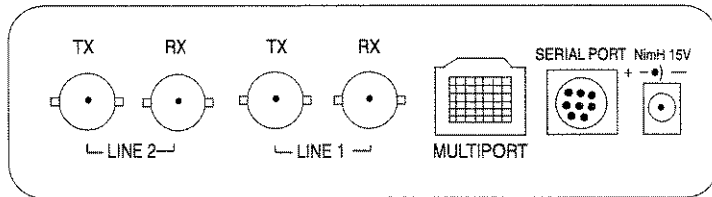
Figure 2–4   Connector Panel

SERIAL PORT

The serial port is used for sending information to the Sunrise Telecom thermal printer or for operating the Remote Control. This port uses an RS-232C DTE configuration with hardware flow control when the 8-pin DIN to 25-pin D-Sub conversion cable is connected.

MULTI PORT

The MULTI PORT is provided for DATACOM testing. This port uses an HDI (30 pin connector) interface to connect with other industry standard interfaces such as RS-232/V.24, V.35, X.21/V.11, RS449/V.36, RS530, and 64Kbps G.703 codirectional.

15V NimH

The 15V NimH jack is where the AC Battery Charger is connected. Only use a Sunrise Telecom charger. The SunSet may be operated with a discharged battery, provided the charger is connected. The battery will charge while the SunSet is being operated if the charger remains connected.

The following ports are duplicated for Line 1 and 2.

TX

The TX 75 ohm BNC connector is where the 2.048 Mbps line signal is transmitted from the SunSet. Optionally, 75 ohm 1.6/5.6 mm or 120 ohm BR2 connectors are available.

RX

The RX 75 ohm BNC connector is where the 2.048 Mbps line signal is received by the SunSet. Optionally, 75 ohm 1.6/5.6 mm or 120 ohm BR2 connectors are available.

Chapter 3
Menu Descriptions

Section 1 Introduction

The SunSet E10 operates by 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 surrounding area is darkened while the writing is light-colored. This appearance will be referred to as reverse video in this manual. After highlighting the item, you may execute the selection by pressing the ENTER key. In a few specific cases, the simple action of highlighting an item will execute the selection.

The following menu tree shows the location of each menu item. Some menu items are offered only with certain software options. Parentheses at the right (including the software option number) indicate such items.

MAIN MENU
TEST CONFIGURATION
(select parameters here)

TEST PATTERN
(select or user defined test pattern)

MEASUREMENT RESULTS

OTHER MEASUREMENTS
    VIEW RECEIVED DATA
    VIEW FAS WORDS
    VIEW MFAS WORDS
    PULSE MASK ANALYSIS
    SS#7 ANALYSIS   (SW253)
    ISDN ANALYSIS   (SW254)
    GSM ANALYSIS   (SW258A)
    GSM VOICE/TRAU/BERT   (SW258C)
    X.50 ANALYSIS   (SW255)
    C-BIT ANALYSIS   (SW257)
    HISTOGRAM ANALYSIS
    PROPAGATION DELAY

VF CHANNEL ACCESS
(Dialing & VF measurement)
    VF MEASUREMENTS
    VIEW LINE 1&2 CAS

DIAL PARAMETERS
DTMF/MFR2/DP DIALING   (SW251)
DTMF/MF/DP/CAS ANALYSIS
NOISE ANALYSIS   (SW252)
MFC/SS#5 DIALING/ANALYSIS (SW259)
SIGNALLING EMULATION

DATACOM INTERFACE   (SS251)

OTHER FEATURES
MEAS CONFIGURATION 1
MEAS CONFIGURATION 2
ERROR INJECTION
OTHER PARAMETERS
ALARM GENERATION
VIEW TEST RECORD
SEND FRAME WORDS
LOAD SAMPLES
MEMORY ALLOCATION

SYSTEM PARAMETERS
GENERAL CONFIG
ERASE NV RAM
FULL SELF TEST
CLR PRINT BUFFER
VERSION/OPTION
FACTORY DEFAULTS

LANGUAGE SELECTION

Following selections within this chapter provide a detailed explanation for each menu item. However, the menu items for datacom, ISDN, GSM, X.50, and SS#7 are contained in their own chapters later in this manual.

Section 2 Test Configuration

Before connecting the SunSet E10 to the circuit, the TEST CONFIGURATION must be properly configured. To access the TEST CONFIGURATION screen, press the ESCAPE key until you have reached the Main Menu. Move the cursor to the Test Configuration selection and press ENTER.

The F-keys show the available options for each setup parameter in this screen. As each F-key is pressed, the SunSet E10 immediately alters its configuration to reflect these new settings.

Note the following:

1) In order to avoid configuration mistakes, use the GRAPHIC key to confirm any changes to your setup.
2) Press the AUTO key in E1 or E1 MUX modes to automatically detect incoming framing, coding, and CRC-4, and test patterns.

Refer to Figure 3–1 for the Test Configuration menu.

```
                              23:22:10

              TEST CONFIGURATION
              TEST MODE : E1

              TX/INSERT : L1-Tx
              Rx/DROP   : L1-Rx
              Tx SOURCE : TESTPAT
              FRAMING   : PCM-30
              CRC-4     : YES
              TEST RATE : 2.048M
              RxLVL-1   : TERM
              RxLVL-2   : TERM
              XMT CLOCK : INTERN

    E1   E1-MUX   MUXTEST   DATACOM
```

Figure 3–1 Test Configuration Menu

The first selection in the TEST CONFIGURATION Menu is TEST MODE. Four choices are available: E1, E1-MUX, MUX-TEST, and DATACOM. The Test Configuration menu differs for each mode selected.

2.1 E1 TEST MODE

• E1 is the standard test rate of 2.048 Mbps.
• Use for voice frequency, SS#7, ISDN, SS#5, GSM, and 2.048
   Mbps BERT (Bit Error Rate Test) applications.

Figure 3–1 provides the E1 Mode Test Configuration Menu, and
Figure 3–2 shows the graphic associated with the settings in Figure
3–1. Note that the reverse-video MEAS indicates measurements
are being taken. P15 (2e15) indicates the pattern being received,
and HDB3 is the line coding.

The following items must be configured in the E1 Mode. Press
the corresponding F-key to select the desired setting.
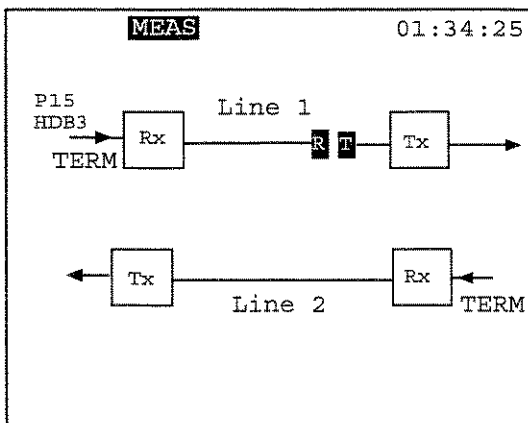
Figure 3–2   E1 Mode Graphic

1) Tx/INSERT
Options: L1-TX (F1), L2-TX (F2)

Selects the 2.048 Mbps test line onto which you insert the test
signal.

• Select either L1-Tx (F1 selects Line 1) or L2-Tx (F2 selects Line
   2).
• This determines where the 2.048 Mbps test pattern, Nx64 kbps
   test pattern, Nx64 kbps multiplexed signal, or voice frequency
   channel will be inserted. For example, if Tx/INSERT is L2-Tx
   and you are talking on the test set, then your voice will be
   inserted on line 2.

2) Rx/DROP

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

Selects the received test signal from either L1-Rx or L2-Rx

• This selection configures bit error rate, 2.048 Mbps line frequency, E-bit error measurements, M.2100/550 measurements, voice channel frequency, voice channel level, voice channel Rx ABCD, view received data, view FAS words, view MFAS words, etc. For example, if you are running a bit error rate test on the received signal from line 1, then you should choose Rx/DROP as L1-Rx.

3) Tx SOURCE

Options: THRU (F1), TESTPAT (F2)

• THRU (F1) is used for full duplex drop and insert testing on an in-service line.

In this case the signal received on the Rx jack will be transmitted out the Tx jack for Line 1 and Line 2. You will be inserting a signal on one or more channels on the line you chose in Tx/INSERT. The channels and corresponding ABCD bits on that line that are not being used will be passed through the set unchanged from Rx to Tx.

• TESTPAT (F2) is used for out-of-service bit error rate testing.

In this case, a test pattern will be transmitted on the selected Tx/INSERT jack. During Nx64 or VF CHANNEL ACCESS testing, an idle code will be inserted on the unused channels. On the line that is not selected, the channels and ABCD bits are passed through unchanged from Rx to Tx.

4) FRAMING

Options: PCM-30 (F1), PCM-31 (F2), UNFRAME (F3)

Choose the framing that is appropriate for the circuit under test.

• If you are unsure of the proper framing, push the AUTO key. Use the combination which synchronizes properly and/or allows error free measurement results

• PCM-30 means the set will synchronize on both Frame Alignment Signal (FAS) and MultiFrame Alignment Signal (MFAS).

• PCM-31 means that the set will synchronize only on Frame Alignment Signal (FAS). It will disregard MultiFrame Alignment Signal.

Note: If the framing and CRC-4 state of the received signal do not exactly match the framing and CRC-4 settings, the SunSet will display Loss of Frame condition and may display loss of CRC DET.

Note that HDB3 is the default line code. The line code can be configured for AMI or HDB3 in: MAIN MENU, OTHER FEATURES, MEAS CONFIGURATION 1.

5) CRC-4
Options: YES (F1), NO (F2)

• Choosing YES allows the SunSet to measure CRC-4 errors on the incoming signal and also to transmit the CRC-4 bits on the outgoing signal. CRC-4 works with PCM-31 and PCM-30 framing only.
• If UNFRAME has been selected for framing, the SunSet will force the CRC-4 configuration to NO.

6) TEST RATE
Options: 2.048 (F1), Nx64K (F2)

• 2.048M (F1) configures the set for full rate testing.
• Nx64 (F2) for fractional testing.
• If you are not certain about which one to choose, press the F1 key for full rate testing at 2.048 Mbps.
• Upon pressing (F2), you will immediately enter the fractional E1, SELECT TIME SLOT, screen. In this screen, you may choose each timeslot for testing. A sample screen is shown in Figure 3-3.

```
                                      11:41:45

                  SELECT TIME SLOT
                       RECEIVE

  01  02  03  04  05  06  07  08
  09  10  11  12  13  14  15
  17  18  19  20  21  22  23  24
  25  26  27  28  29  30  31

                      TRANSMIT
  01  02  03  04  05  06  07  08
  09  10  11  12  13  14  15
  17  18  19  20  21  22  23  24
  25  26  27  28  29  30  31

   AUTO   SELECT   UN-SEL   CLR-ALL
```
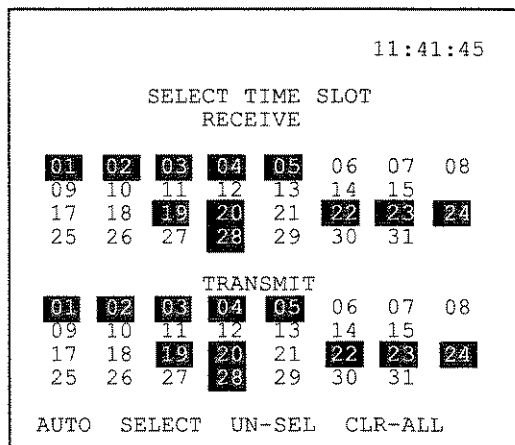
Figure 3–3   Select a Timeslot

This screen provides two methods for selecting timeslots: Auto or manual.

To manually select the timeslots, use the following procedure:

1) Place cursor on desired timeslot by pressing the respective arrow keys, then press the SELECT (F2) key. Repeat until you have selected all the necessary timeslots. Selected timeslots remain highlighted, as shown in Figure 3–3.

a) Press UN-SEL (F3) key to deselect a timeslot. Pressing the CLR-ALL (F4) key erases all selections. Press (F4) if you want to start the selection process over again.

To automatically select the timeslots, use the following procedure:

1) If you are receiving a signal which is already formatted in the N (or M) x64Kbps fractional E1 format, the quickest method for selecting time slots is to press the AUTO (F1) key.

a) Press ENTER to set your choices, and return to the MAIN MENU.

• In AUTO, the SunSet will automatically configure the timeslots by looking for active data. It will configure the transmit side to be the same as the active timeslots on the receive side. The set determines which timeslots are active by first determining which timeslots are idle. Any timeslot that is not idle is assumed to be active. The set determines that a timeslot is idle when it finds the line's idle code (specified in

the MAIN MENU, OTHER FEATURES, OTHER PARAM-
ETERS, IDLE CHNL CODE). If the SunSet does not find this
idle code, it will also look for the 01111111, 11111111, or
11010101 idle channel codes.

Note: In PCM-31 framing, timeslots 1 through 31 correspond to
channels 1 through 31. In PCM-30 framing, timeslots 1 through 15
correspond to channels 1 through 15, and timeslots 17 through 31
correspond to channels 16 through 30. In PCM-30, timeslot 16 is
used for the multiframe alignment signal also. Fractional E1 is not
offered with unframed signals, because framing is required to
determine the location of timeslots.

The time slots specified for transmit and receive need not be
the same. Also, the number of selected timeslots can differ from
the Tx side to the Rx side. The SunSet will assume that all incoming
data is received byte by byte in ascending channel order.

7) RxLVL-1 and RxLVL-2
Options: TERM (F1), BRIDGE (F2), MONITOR (F3)
Configures the two 2.048 Mbps receivers.

• These settings let the SunSet electrically decode a 2.048 Mbps
signal under a wide range resistive or cable losses. These
settings also determine which electrical load will be placed on
the circuit by the SunSet. These settings have no effect on the
transmitters. On a 2.048 Mbps circuit, there must always be
exactly one receiver that applies the low impedance (75 ohm/
120 ohm) termination. There should never be two or more
receivers applying a +low impedance termination.

WARNING!
**IF YOU ARE UNCERTAIN, CHOOSE BRIDGE. THIS WILL PRO-
TECT THE 2.048 SIGNAL.**

TERM (F1): The TERM mode terminates the received signal with
a 75ý or 120ý impedance termination. The signal being tested has
been transmitted over real cable and is at a level between approxi-
mately +6 and -43 dB. Usually, you should use TERM whenever
you disrupt the circuit for testing.
BRIDGE (F2): In the BRIDGE mode, the SunSet applies high-
impedance isolation resistors to the circuit under test. This isolation
circuit will protect the signal from any possible disruption. These

bridging resistors are the only protection available to the signal. The signal being tested has been transmitted over regular cable and is at a level of approximately +6 to -43 dB.

Note that if a connection is made from the protected MONITOR jack of a network element to the SunSet, and if the BRIDGE RxLVL is being used, there are too many isolation circuits on the signal. In this case, the SunSet might show a loss of signal and be unable to perform any measurements.

MONITOR (F3): The MONITOR access mode is used when a monitor measurement will be made. The signal is provided from the protected MONITOR jack of a network equipment at a level between -15 dB and -30 dB. The equipment has isolated the MONITOR signal from the live signal with a high impedance circuit.

This mode is useful because the monitor jack protects the live signal from any possible disruptions caused by the testing process. It allows the technician to test the line while it is in service.

Note that if MONITOR mode is selected when a 0 dB signal is received, then the red CODE 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 a bridged access or a protected monitor access. In this case, you should try BRIDGE first to see if this works. Then try MONITOR if it doesn't.

8) XMT CLOCK
Options: L1-RX (F1), INTERN (F2), L2-RX (F3), MLTIPRT (F4)
The XMT CLOCK is used to time the Tx/INSERT signal. The other Tx signal uses the timing recovered from its Rx signal.

L1-Rx:
a) Choose Tx/INSERT L1-Tx and INTERN as your XMT CLOCK, and the L1-Tx signal will use the internal timing of the test set. The L2-Tx signal will use the recovered timing from L2-Rx.
b) Choose XMT CLOCK=L1-Rx, and the test set receives its timing from the signal received on Line 1.

Figures 3–4, 3–5, and 3–6 portray three different timing scenarios possible when L1-Rx is selected. Figure 3–4 represents slave timing. Here, XMT CLK= L1-Rx, but the signal received on L1-Rx is timed off of the L1-Tx source. Thus, there is no true clock source. In this case, the transmit signal may die.
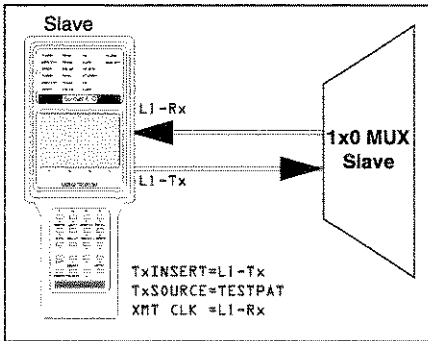
Figure 3–4   Slave to Slave Timing

Figure 3–5 depicts loop or slave timing. Tx/INST and XMT CLK are set for the same line. Loop timing is necessary when transmitting toward an exchange or other network element that requires synchronous signals. This network element must be configured to be a master timing source in relation to your signal, lest you have slave to slave timing.
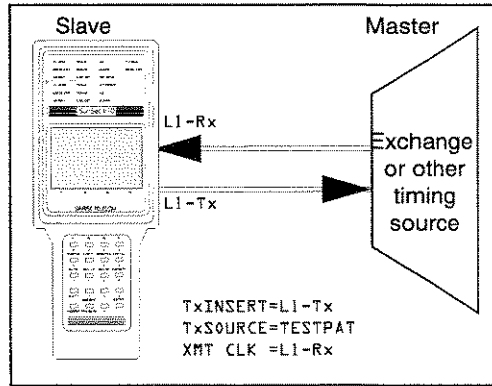
Figure 3–5   Loop/Slave Timing

Figure 3–6 depicts external timing. External timing uses an external clock source to time the Tx/INSERT signal. The external clock source should be configured for the opposite line from the Rx/DROP selection. In this case, Rx/DROP and Tx/INSERT are set for Line 2. Therefore, XMT CLK is set for Line 1 (L1-Rx).
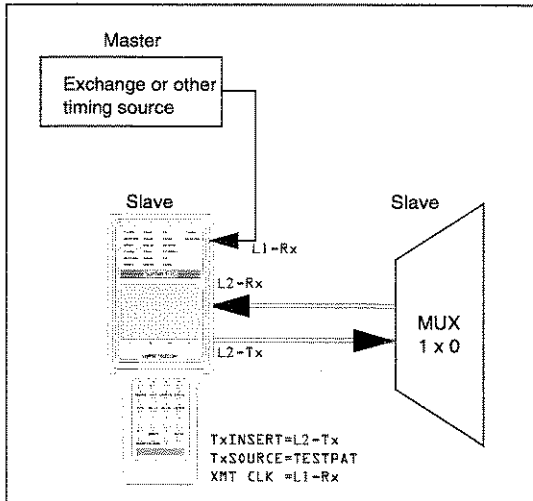
Figure 3—6 External Timing

Notes:

1) in the past three graphics, TxSOURCE has always been set for TESTPAT. The XMT CLK setting is ignored if TX SOURCE is set for THRU. In THRU, both Lines 1 and 2 pass timing from Rx to Tx.

2) For DROP/INSERT testing, XMT CLOCK must be set for the same line as Rx/DROP.

INTERN (F2): INTERN uses the internal timing of the test set. This timing is not synchronized to the network. You should use internal timing in loopback testing where synchronization is not required.

• If you set TX/INSERT as L1-Tx, and choose INTERN, the L1-Tx signal will use the internal timing of the test set. The L2-Tx signal will use the timing recovered from L2-Rx. Figure 3—7 portrays Internal Timing.
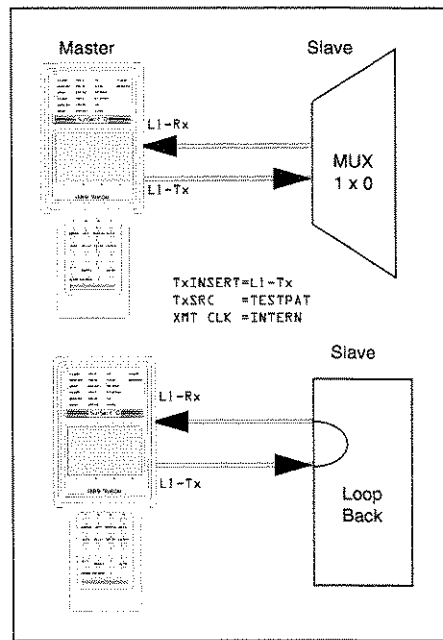
Figure 3-7   Internal Timing

L2-Rx (F3): Timing is received from the signal received on Line 2.

For loop timing, you should set Tx/INST and XMT CLK for L2-Rx. For external timing, set XMT CLK for L2-Rx and TxINST as L1-Tx.

MLTIPRT (F4) : Uses the timing source received on the multiport.

• This feature may be used in conjunction with a special order

external clock cable (SS261). This cable has a DB37 connector on one end and a 75ý 2.048 BNC connector on the other. Therefore, you may connect the SunSet E10 to any G.703 sinusoidal clock source through the multiport and use this clocking source as a reference to measure the frequency of the Rx/DROP signal.

2.2 E1-MUX MODE

E1-MUX provides multiplexing capabilities between the E1 line and synchronous multiport datacom signals. Use this mode to make the E10 emulate a terminal multiplex, or an add/drop multiplex. This mode allows you to send a test pattern in either direction. The E1-MUX configuration screen is shown in Figure 3–8.

```
┌─────────────────────────────────────┐
│  MEAS                     2:31:03    │
│         TEST CONFIGURATION           │
│         TEST MODE  :  E1-MUX         │
│                                      │
│ E1                  DATACOM          │
│ Tx/INST: L1-Tx      TYPE  : RS232    │
│ Rx/DROP: L1-Rx      TxSRC: E1DRP     │
│ FRAMING: PCM-30     MODE  : DCE      │
│ CRC-4  : YES        MUX              │
│ RxLVL-1: TERM       BERT  : RS232    │
│ RxLVL-2: TERM       E1INS: PATRN     │
│ XMTCLK : L1-RX      E1T/S: Nx64K     │
│                                      │
│                                      │
│ L1-Tx    L2-Tx                       │
└─────────────────────────────────────┘
```

Figure 3–8   E1-MUX Menu

E1
The only difference in the E1 Mux settings in the Transmit Clock. If necessary, you may refer to the more detailed descriptions of each E1 configuration selection in Section 2.1 of this chapter.

7) XMT CLOCK
XMT CLK will automatically be set for the Tx/INST selection:

• If Tx/INST= L1-Tx, then XMT CLK= L1-Tx. If Tx/ INST= L2-Tx,

then XMT CLK= L2-Tx.
- E1 MUX uses a loop timing clock. For loop timing, the same line is chosen for Tx/INST and XMT CLK.

DATACOM

The datacom settings configure the multiport.

1) TYPE

Options: V.35 (F1), RS449 (F2), X.21 (F3), G.703 (more, F1), RS232 (more, F2)

TYPE determines the electrical interface at the multiport.

2) Tx Source

Options: PATRN (F1), E1DRP (F2)

Tx Source sets the transmit source for the multiport.

- Choose PATRN to send a test pattern out the multiport.
- Choose E1DRP to send the dropped NX64 Kbps signal out the multiport.

MUX

The MUX settings define the multiplex configuration for the E10.

1) BERT

Options: E1DRP (F1), DATACOM TYPE selected above (F2): RS232, G.703, etc.

Determines which multiplexed circuit direction will be bit error tested.

- E1DRP means the NX64 Kbps signal dropped from the 2.048 Mbps signal will be bit error tested.
- RS232 (V.35 etc.) means the signal coming from the low speed RS232 side will be tested.

2) E1INS

Options: LOOP (F1), DATACOM TYPE (F2) is the type selected above: X.21, RS449, etc., PATRN (F3)

- If DATACOM TxSRC is set to PATRN, E1INS will automatically be configured for the specific DATACOM TYPE.
- E1 Insert controls which signal will be inserted into the 2.048 Mbps line. It may be changed only if TxSRC is set to E1DRP.

- LOOP (F1) means all 30 or 31 channels will be looped through from 2.048 Mbps receive to 2.048 Mbps transmit. Nothing will be inserted.
- X.21 (V.35 etc.) means the low speed NX64 Kbps signal will be inserted on the 2.048 Mbps transmit.
- PATRN (F3) means that the TEST PATTERN will be inserted on the 2.048 Mbps transmit signal.

3) E1 T/S
Options: Nx64K

Select which NX64 Kbps channels to insert or drop the signal on.

- Press Nx64K (F1) to enter the Select Time Slot screen. Refer to E1 T/S in Section 2.1 for further details on selecting time slots. However, the AUTO F-key is available only when E1DRP is selected in BERT.

2.3 MUXTEST MODE

MUXTEST provides testing through a multiplex from either the low speed datacom side to the high speed 2.048 Mbps side or from the high speed 2.048 Mbps side to the low speed datacom side. Figure 3–9 shows the MUXTEST menu.

E1 SIDE
Refer to Section 2.1 for a detailed description of each E1 configuration selection. The Transmit Clock is the only variable.

1) XMT CLOCK
Options: L1-Rx (F1), INTERN (F2), L2-Rx (F3)

The XMT CLOCK is used to time the Tx/INSERT signal.

```
┌─────────────────────────────────────────┐
│  MEAS                    3:10:31         │
│                                          │
│     TEST CONFIGURATION                   │
│     TEST MODE : MUXTEST                  │
│                                          │
│  E1                    DATACOM           │
│  Tx/INST: L1-Tx        TYPE : RS232      │
│  Rx/DROP: L1-Rx        MODE : DTE        │
│  FRAMING: PCM-30                         │
│  CRC-4  : YES          BERT              │
│  RxLVL-1: TERM         E1T/S: Nx64K      │
│  RxLVL-2: TERM         Rx   : RS232      │
│  XMTCLK : INTERN       Tx   : E1         │
│                                          │
│                                          │
│  L1-Tx   INTERN   L2-Tx                  │
└─────────────────────────────────────────┘
```

Figure 3–9   MUXTEST Menu

• INTERN (F2) configures the set for master timing. Here, the set
  supplies the timing source, but the source is not synchronized
  to the network. Figure 3–10 depicts internal timing.
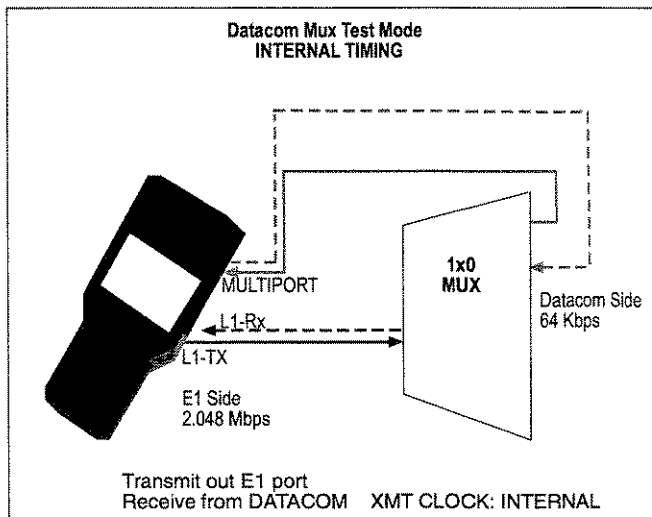
Figure 3–10   Internal Timing

- To configure the set for slave timing, where the MUX supplies the timing source, set the XMT CLK for the same line as Tx/INST. If Tx/INST is L1-Tx, then XMT CLK should be L1-Rx. Conversely, if Tx/INST is L2-Tx, then XMT CLK should be L2-RX.
- Figure 3–11 displays slave timing.
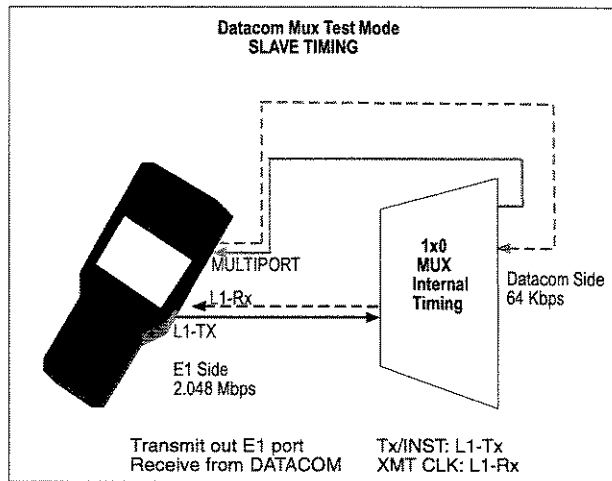
Figure 3–11   Slave Timing

DATACOM SIDE
1) TYPE
Options: V.35 (F1), RS449 (F2), X.21 (F3), G.703 (more, F1), RS232 (more, F2)

Determines the electrical interface at the multiport.

BERT SIDE
1) E1 T/S
Options: Nx64

Select which NX64 Kbps channels to insert or drop the signal on.

- Pressing the (F1) key on this slot will lead you to the SELECT TIME SLOT screen. Here you may select your transmit/receive time slots.
  a) Cursor to the desired timeslot, then press SELECT (F2). This timeslot will remain highlighted. Continue selecting timeslots as needed.
  b) You may deselect the timeslot highlighted by the cursor by

pressing UN-SEL (F3). Pressing CLR-ALL (F4) will erase all the selections so you may start the process over. Figure 3–3 provides the SELECT TIME SLOT screen for E1 mode.

2) Rx

Options: E1 (F1), DATACOM TYPE selected above (i.e. RS449)
Determines the side Bit Error Rate Test measurements are performed on.

• The test set will automatically configure the Rx and Tx selections to be opposite sides. Thus, if you select E1 for Rx, The Tx side will automatically be changed to the low speed datacom side.

3) Tx

Options: E1 (F1), DATACOM TYPE selected above (F2)
This determines the side to which you send the test pattern.

• The test set automatically configures the Rx and Tx to be opposite sides. Thus, if you select E1 for Tx, the Rx side will automatically be changed to the low speed datacom side.
• Figures 3-12 and 3–14 illustrate the Rx and Tx selections.
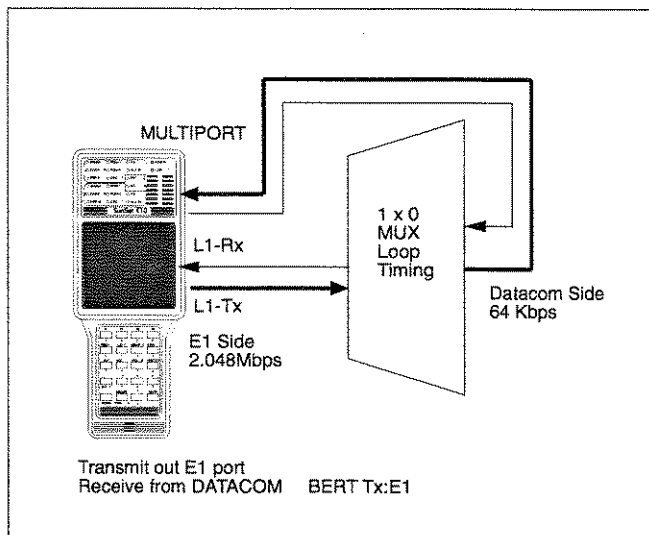
Figure 3–12   MUXTEST Configuration, Tx:E1
Figure 3–13 displays the configuration associated with the above graphic. BERT Tx is set to E1 and BERT Rx is set to RS232,

which is the DATACOM TYPE selected. The DATACOM will transmit ALL ONES, while the unused E1 channels will receive IDLE codes.

```
┌─────────────────────────────────────┐
│ ▐MEAS▌                     2:31:03   │
│         TEST CONFIGURATION           │
│         TEST MODE : E1-MUX           │
│                                      │
│ E1                  DATACOM          │
│ Tx/INST: L1-Tx      TYPE : RS232     │
│ Rx/DROP: L1-Rx      MODE : DTE       │
│ FRAMING: PCM-30                      │
│ CRC-4  : YES        BERT             │
│ RxLVL-1: TERM       E1T/S: Nx64K     │
│ RxLVL-2: TERM       Rx   : RS232     │
│ XMTCLK : ▐INTERN▌   Tx   : E1        │
│                                      │
│                                      │
│                                      │
│ L1-Rx   INTERN   L2-Tx               │
└─────────────────────────────────────┘
```

Figure 3–13 MUXTEST Configuration, BERT TX: E1

Figure 3–15 is analogous to Figure 3–13. However, now the DATACOM will transmit out a test pattern and the E1 will receive it. The unused E1 channels will receive IDLE codes. BERT Rx is set to E1 and BERT Tx is set to RS232, the DATACOM TYPE selected.
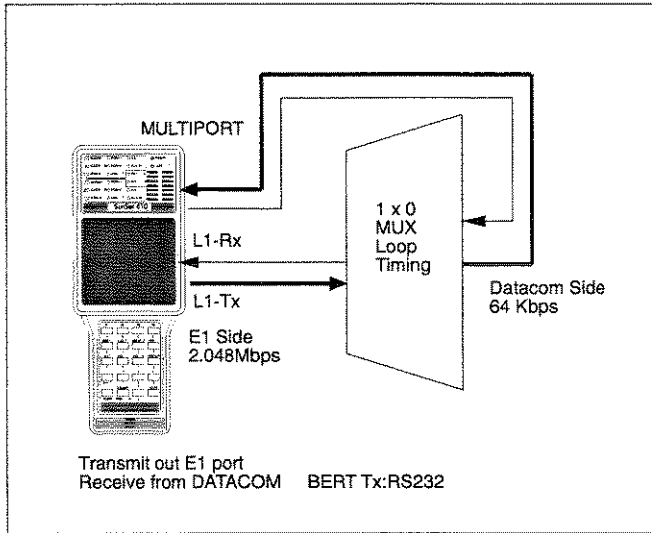
Figure 3–14 MUXTEST Mode, BERT TX: RS232

Figure 3–15 displays the Configuration associated with the above graphic.


```
     MEAS                    2:31:03

            TEST CONFIGURATION
            TEST MODE : MUXTEST

E1                       DATACOM
Tx/INST: L1-Tx           TYPE  : RS232
Rx/DROP: L1-Rx           MODE  : DTE
FRAMING: PCM-30
CRC-4  : YES             BERT
RxLVL-1: TERM            E1T/S : Nx64K
RxLVL-2: TERM            Rx    : E1
XMTCLK : INTERN          Tx    : RS232



L1-Rx    INTERN   L2-Tx
```

Figure 3–15 MUXTEST, BERT TX: RS232

Section 3 Send Test Pattern

From the Main Menu, enter Test Pattern. The screen displays a list of the patterns available for transmitting/ receiving. Figure 3-16 shows the Test Pattern screen.

```
┌─────────────────────────────────┐
│  MEAS              15:03:27      │
│                                 │
│                                 │
│        TEST PATTERN             │
│                                 │
│    2e23   2e20   2e15   20ITU   │
│    2047   511    127    63      │
│    1111   1010   0000   FOX     │
│    1-3    1-4    1-8    3-24    │
│                                 │
│                                 │
│    PATTERN: 2e23                │
│                                 │
│  USER                           │
└─────────────────────────────────┘
```
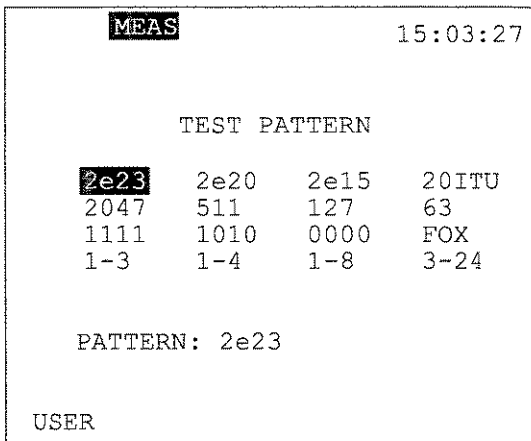
Figure 3-16 Test Pattern Screen

Note: When X.50 Analysis is enabled (OTHER MEASUREMENTS/ X.50 ANALYSIS/ X.50 SETUP), the test patterns available are limited and the screen appears quite differently. Section 3.3 discusses the X.50 patterns.

3.1 Standard Patterns

To send one of the standard patterns shown above in Figure 3-16:

1) Use the arrow keys to highlight the desired pattern.

• As each pattern is highlighted, the SunSet begins transmitting that pattern.

This section defines the various patterns transmitted and recognized by the SunSet E10. Here are the test patterns:

2^m-1, where m=15, 20, 23: are pseudo random bit sequences. The signal is formed from a 15, 20 or 23-stage shift register and is not zero-constrained. The patterns conform to the ITU O.151 technical standard.

20ITU: 2e20 is the 2e20-1 pseudo random bit sequence. This signal is formed from a 20-stage shift register and is not zero-constrained. This pattern conforms to the ITU O.153 technical standard. However, this pattern is not identical to 2e20, because different feedback mechanisms are used when the patterns are produced by means of shift registers. 20ITU suppresses consecutive sequences of more than 18 ZEROS, as opposed to 14 ZEROS in 2e20.

2047, 511, 63: These are bit codes, also known as 2e11, 2e9, and 2e6 respectively. They conform to ITU-T O.152.

1111: The all 1s pattern is used for stress testing circuits. If the pattern is sent unframed, it will be interpreted as an AIS (Alarm Indication Signal).

1010: 1010 is the 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

0000: 0000 is the all zeroes pattern. If the circuit is AMI, the pattern synch and/or signal will be lost.

1-3, 1-4, 1-8, or 3-24: These patterns are used for stress testing circuits. The patterns are frame aligned ("f" is the framing bit), as shown in its binary form; as an example, 1-3 : f 010

FOX: This pattern is used in data communications applications. The ASCII translation of the pattern is the "Quick brown fox jumps over the lazy dog 1234567890" 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. Here 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
```

3.2 User Test Patterns

In addition to these standard patterns, you may program and
send a user pattern.

1) Press USER (F1) in the TEST PATTERN screen.

- The user test pattern screen now appears listing any stored
  patterns.
- This screen allows you to create, edit, view, send, or delete a
  pattern.
- See Figure 3–17.

Sending a User Test Pattern
1) In the TEST PATTERN screen, press USER (F1).

2) The test set will present a list of USER patterns.
a) Use the Up/Down arrow keys to cursor to the desired pattern.

3) Press ENTER.

Viewing a User Test Pattern
1) From the USER TEST PATTERN screen, move your cursor
   down to the desired test pattern

2) Press VIEW (F1).

3) You will see your selected pattern on the screen (in hex, binary,
   and ASCII).
a) When you are finished viewing, press ESCAPE to return to the
   USER TEST PATTERN screen.

```
                           15:03:27
          USER TEST PATTERN
    0.    CURRENT-NEW
    1.    ▉
    2.
    3.
    4.
    5.
    6.
    7.
    8.
    9.
   10.

   VIEW     EDIT     STORE    CLEAR
```
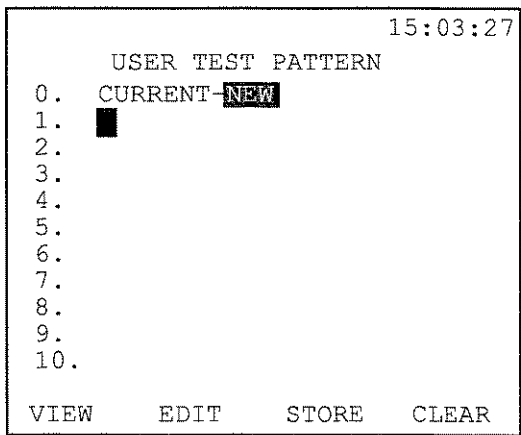
Figure 3–17   User Test Pattern screen

Creating 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.

3) Choose CREATE (F1). You will enter the USER TEST PATTERN
    Label screen, with the cursor at the LABEL position. See Figure
    3–18.

4) Choose TOGGLE (F3). The letter A will begin to flash on and off
    in the alphabet grid.

5) Use the arrow keys to move the flashing indicator to the desired
    letter.
a) Choose SELECT (F4). The letter appears next to the label.

6) Choose TOGGLE (F3) to move out of the alphabet grid and back
    to the LABEL item.

```
                              17:03:38

          USER TEST PATTERN
  LABEL   : AF
  FORMAT  : BINARY
  No.
  001



          A  B  C  D  E  █  G
          H  I  J  K  L  M  N
          O  P  Q  R  S  T  U
          V  W  X  Y  Z  -  /


 INSERT    DELETE    TOGGLE    SELECT
```
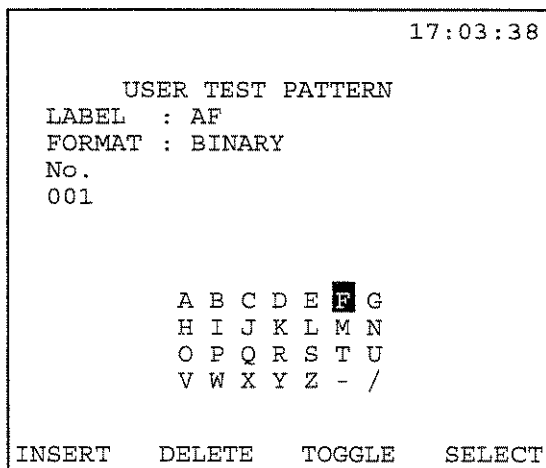
Figure 3–18   User Test Pattern Label Screen

7) Press the Down Arrow key to move to the FORMAT item.
a) 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.'

8) Press the Down Arrow key to move to the pattern entry area.
a) Press the SHIFT-lock key.
   • You may enter up to 2048 binary characters or 512 hexadeci-
     mal characters, to make up the desired pattern.
b) Press the SHIFT-lock key once.
   • Verify that the SHIFT indicator no longer appears in the upper
     left corner of the screen.

9) Press the ENTER key 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 ENTER. Your new
  pattern is now being transmitted.

Editing a User Test Pattern
Use this procedure to edit the label of a test pattern that you have

created:

1) From the SEND TEST PATTERN menu, press F1 (USER) to move into the USER TEST PATTERN screen.

2) Move your cursor to the code that you want to edit and select EDIT (F2). You will enter the LABEL screen as in Figure 3–18.

3) When the cursor is placed on the Label code, press TOGGLE (F3). A letter within the alphabet grid should be flashing on and off.

4) 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 letter you want to remove.

5) Press DELETE (F2) to remove the desired letter or number. Repeat this as necessary.

6) 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 ENTER and you are done.

• If you need to add letters to the label, choose TOGGLE (F3) to return to the alphabet grid with the flashing letter. Cursor over to the desired letter and press SELECT (F4). Repeat this until the LABEL is complete. You can now press ENTER 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.

Correcting a Mistake in the Pattern While Entering the Pattern
The following procedure may be implemented to correct any mistakes made while entering the pattern.

1) This procedure assumes you are starting from step 4 of the Programming User-Defined Patterns procedure.

2) While entering the 1s and 0s, you notice an incorrect digit. Press the SHIFT to remove the SHIFT indicator in the screen. Cursor back to the incorrect digit and press the SHIFT key to display the SHIFT indicator.

3) Enter the correct digit. Press the SHIFT key to remove the SHIFT indicator. Cursor to the end of the line. Press the SHIFT key again to display the SHIFT indicator. Enter in the rest of the digits. Edit the code's label using the "Correcting a Mistake..." procedure.

4) Press ENTER to store the pattern.

Deleting a User Test Pattern
Follow this procedure to delete a user test pattern you no longer want:

1) From the SEND TEST PATTERN menu, press the F1 key (USER) to enter the USER TEST PATTERN screen.

2) Move the cursor to the test you want to delete and select DELETE (F3). The pattern is deleted and you are finished. Press ESCAPE to return to the main menu.

3.3 X.50 Test Patterns

If you have enabled X.50 Analysis (OTHER MEASUREMENTS/ X.50 ANALYSIS/ X.50 SETUP), the test patterns available to you are limited. The X.50 test pattern screen appears in Figure 3–19.

```
┌─────────────────────────────────────┐
│        ▐X50▌          04:21:10      │
│                                      │
│                                      │
│        X.50  TEST  PATTERN          │
│                                      │
│                                      │
│   BERT  PATTERN  :  ▐2e15-1▌        │
│   USER  PATTERN  :  F000000S        │
│                                      │
│                                      │
│                                      │
│                                      │
│  0000     1111     1010     more    │
└─────────────────────────────────────┘
```
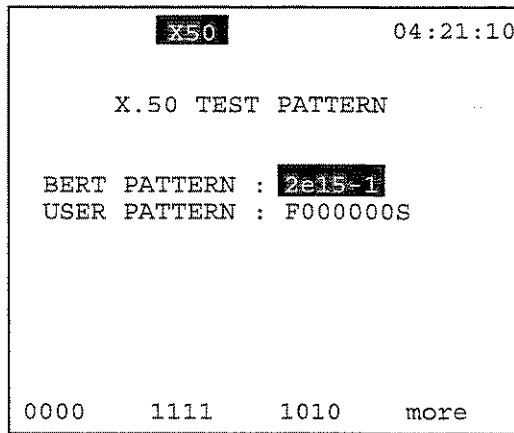
Figure 3–19 X.50 Test Pattern Screen

This screen contains the following items:

1) BERT PATTERN
Options: 0000 (F1), 1111 (F2), 1010 (F3), 511 (more, F1), 2047
    (more, F2), 2e15-1 (more, F3), USER (more, F1)
    Select a standard pattern to use for your bit error rate testing
here.

• Refer to Section 3.1 for definitions of each of these patterns.

2) USER PATTERN

• Enter six digits in binary code (0 or 1).
    The first bit is reserved as the framing bit (F) and the last as the
        status bit (S).
• To enter your code, press the SHIFT key, then enter 0 and 1 as
    desired.

Section 4 Measurement Results

To observe MEASUREMENT RESULTS:

1) Select MEASUREMENT RESULTS from the MAIN MENU

2) Press START to begin taking results.

3) Press the ESCAPE key when you are finished.

The SunSet E10 continuously performs measurements on its received signal(s) when the START F-key has been pressed. While a measurement is being made, the MEAS status indicator appears in reverse video at the top of the screen. When the measurement is stopped, the indicator will disappear.

The user need not access the Measurement Results menu in order for results to be compiled, once the START key has been pressed. Measurements are automatically restarted every time the configuration is significantly changed. The Measurement Results screens allow you to view the accumulated measurements and restart the measurement process.

The actual measurement results screens and the values displayed depend upon the Test Mode chosen in TEST CONFIGURATION. There are, however, some common features in all the Measurement Results screens. Figure 3–20 displays a sample Measurement Results screen.

```
┌─────────────────────────────────┐
│        MEAS          16:47:42   │
│ET -  000:24:37  RT-  CONTINU    │
│FRM - PCM-30     CLK SR- INTERN  │
│RCV - 2e20       XMT   - 2e20    │
│INPUT- TERM      TEST R- 2.048M  │
│       LINE 1 - SUMMARY          │
│CODE - 0         RATE - 0.0e-10  │
│CRC  - 0         RATE - 0.03-08  │
│FASE - 0         RATE - 0.0e-08  │
│MFASE- 0         RATE - 0.0e-07  │
│BIT  - 0         BER  - 0.0e-10  │
│EBIT - 0         EBER - 0.03-07  │
│+RxLVL-0.4 dB    -RxLVL--0.4 dB  │
│Rx CLK-2048000   Hz/PPM:0.0      │
│PAGE-UP    PAGE-DN   STOP   more │
└─────────────────────────────────┘
```

Figure 3–20 Measurement Results Screen

Measurements may have a count number displayed on the left hand side and the corresponding rate or percentage displayed on the right hand side of the same line. For example, in Figure 3–20, CODE appears on the left and RATE on the right.

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, which is are seconds with an error rate of 10-3 or higher. 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 2x10-3 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 suddenly 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 suddenly decreases by 10 and the error counter increases by the 1 or 2 errors that you inserted.

You may wish to practice this for yourself so that you will not be confused while taking actual measurements.

The following F-key options are shared by all Measurement Results screens:

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

STOP/START (F3): Pressing STOP causes the SunSet to stop the test. Pressing START restarts the measurement process from within this menu. This function is useful if some undesired occurrence has rendered the current test invalid.

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.

LOCK/UNLOCK (more, F2): Press LOCK to disable the keypad. The measurement process continues as usual, but any keypad strokes have no affect on the test set. This is useful if you are running a long-term test and do not wish to have the test disturbed. When LOCK is pressed, an indicator appears in reverse video at the top of the LCD display. Pressing the F2 key again (UNLOCK) will re-enable the test set's keypad. Using the LOCK/UNLOCK key will not disturb any of your measurement results.

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 restarted.

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 / MEAS CONFIGU-RATION 1 menu item, you may specify the amount of test time. In this case, the remaining time will count down to zero during the measurement.

FRM: The configured framing is displayed here.

CLK SR: The clock source is reported here.

RCV: The received pattern is displayed here.

XMT: The test pattern the SunSet is transmitting is displayed here.

INPUT: This shows your receive level (bridge, monitor, terminate).

TEST R: The test rate is shown here.

4.1 E1 Results and General Definitions

E1 Mode Measurement Results contain nine pages of data. Page 1, which appears when you first enter Measurement Results, is the status page. This screen simply displays the status of each line. In large font, a status message is displayed for both lines 1 and 2. These messages (for example: NO ERRORS, FRM LOSS, SIG LOSS, ERROR DET) represent the condition of the line during testing.

MEASUREMENT RESULTS Definitions
The following measurements are displayed in the E10 screens. The definitions are listed here in alphabetical order.

IMPORTANT NOTE: Each measurement is proprietary to its screen; e.g. "bit error" refers to E-Bit errors in the E-BIT screen, and to all Summary errors in the SUMMARY screen, etcetera.

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

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

%AS: This is the percentage of Available Seconds since the beginning of the test.

BIT: This is a count of bit errors that have occurred since the beginning of the test. Bit errors are not counted during unavailable time.

BER: The Bit Error Rate is the total number of bit errors divided by the total number of bits during available time since the beginning of the test.

CLKSLIP: This is the number of clock slips, which occur when the measured frequency deviates from the reference frequency by one unit interval, that have occurred since the beginning of the test.

CODE: This is a count of the number of line Code Errors (Bipolar Violations that violate the coding rules) that have occurred since the beginning of the test. In HDB3 coding, a Code Error is a bipolar violation that is not part of a valid HDB3 substitution.

(CODE) RATE: This is the average BiPolar Violation error rate since the beginning of the test.

CRC: This is a count of the number of CRC-4 block errors that have occurred since the beginning of the test. This measurement is reported as N/A when the SunSet is not synchronized on a received CRC-4 check sequence.

(CRC) RATE: This is the average CRC-4 block error rate since the beginning of the test. This measurement is reported as N/A when the SunSet is not synchronized on a received FAS or MFAS signal.

DGRM: This is the count of DeGRaded Minutes since the beginning of the test. A Degraded Minute occurs when there is a 10-6 bit error rate during 60 available, non-severely bit errored seconds. Errors during bit unavailable or severely bit errored seconds are not counted while the 60 available, non-severely bit errored seconds are being accumulated.

%DGRM: This is the percentage of summary degraded minutes since the beginning of the test.

EBIT: EBIT count shows the number of E-bit errors that have occurred.

EBER: This is the average E-bit error rate since the beginning of the test.

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

%EFS: This is the percentage of Error Free Seconds since the beginning of the test. A summary Error Free Second is a second in which the signal is properly synchronized and no errors or defects occur.

ES: This is a count of the number of Errored Seconds that have occurred since the beginning of the test. An errored second is any second with at least one BPV, bit error, FBE, or CRC-4 error. An errored second is not counted during an Unavailable Second.

%ES: This is the percentage of errored seconds that have occurred since the beginning of the test.

FALM: Frame ALarM seconds is a count of seconds that have had far end frame alarm (FAS Remote Alarm Indication, RAI) since the beginning of the test.

FASE: This is a count of the Frame Alignment Signal Errors received since the beginning of the test. Applies to both PCM-30 and PCM-31 framing.

FE: This is a count of the number of Frame bit Errors that have occurred since the beginning of the test. This measurement is reported as N/A when the SunSet has not synchronized on a known framing pattern within the received signal.

Hz/PPM: The hertz/part per million count records any variance from 2.048 Mbps in the received frequency.

LOFS: Loss of Frame Seconds is a count of seconds since the beginning of the test that have experienced a loss of frame.

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

+LVL: Positive LeVeL is the level of positive pulses being received by the SunSet. Measurements are displayed in both Volts (V) and decibels variance from G.703 specified level (dB).

-LVL : Negative LeVeL is the level of negative pulses being received by the SunSet. Measurements are displayed in both Volts (V) and decibels variance from G.703 specified level (dB).

Lpp : Peak-to-peak Level is the peak-to-peak level of negative and positive pulses being received by the SunSet. Measurements are displayed in decibels variance from DSX level (dB).

MAX Hz: This is the maximum frequency measured since the beginning of the test.

MIN Hz: This is the minimum frequency measured since the beginning of the test.

MFAL: MultiFrame ALarm seconds is a count of seconds that have had far end multiframe alarm (MFAS Remote Alarm Indication, RAI) since the beginning of the test.

MFASE: This is a count of the Multiframe Alignment Signal Errors received since the beginning of the test. Applies only to PCM-30 framing.

MFE : This is a count of the number of Multi-Frame bit Errors that have occurred since the beginning of the test. This measurement is reported as N/A when there is no framing pattern within the received signal.

RCV Hz: This is the current frequency measured during the last second.

SES: This is the count of summary Severely Errored Seconds since the beginning of the test. A severely errored second has an error rate of 10-3 or higher. Severely errored seconds are not counted during unavailable time.

%SES: This is the percentage of seconds since the beginning of the test that are summary Severely Errored Seconds.

SLIP: This is a count of bit slips which have occurred since the beginning of the test. A slip occurs when the synchronized pattern either loses a bit or has an extra bit stuffed into it.

UAS: This is the count of UnAvailable Seconds that have occurred since the beginning of the test. Unavailable time begins at the onset of 10 consecutive severely errored seconds. The displayed value of unavailable seconds updates after the tenth consecutive severely errored second occurs. Unavailable time also begins at a loss of signal or loss of frame.

%UAS: This is the percentage of summary unavailable seconds since the beginning of the test.

+WANDR: This is the total positive phase difference between the measured frequency and the reference frequency since the beginning of the test. The +WANDR value increases whenever the measured frequency is larger than the reference frequency.

-WANDR: This is the total negative phase difference between the measured frequency and the reference frequency since the beginning of the test. The -WANDR increases whenever the measured frequency is less than the reference frequency.

Following is a description of the available results screens.

SUMMARY Screens

Screens 2 and 3 contain the summary results for Lines 1 and 2, respectively. Figure 3–21 displays the Summary screen for Line 1.

The Summary screens present the most significant measurement results. These screens contain data related to the specific types of impairments, like code errors, CRC-4 block errors, framing, and multi-framing bit errors. They also report overall performance measures such as errored seconds and percent errored seconds.

```
┌─────────────────────────────────────┐
│        ▐ MEAS ▌         16:47:42     │
│ ET  -  000:24:37  RT-   CONTINU      │
│ FRM - PCM-30      CLK SR- INTERN     │
│ RCV - 2e20        XMT   - 2e20       │
│ INPUT- TERM       TEST R- 2.048M     │
│       LINE 1  - SUMMARY              │
│ CODE - 0          RATE - 0.0e-10     │
│ CRC  - 0          RATE - 0.03-08     │
│ FASE - 0          RATE - 0.0e-08     │
│ MFASE- 0          RATE - 0.0e-07     │
│ BIT  - 0          BER  - 0.0e-10     │
│ EBIT - 0          EBER - 0.03-07     │
│ +RxLVL-0.4 dB     -RxLVL--0.4 dB     │
│ Rx CLK-2048000    Hz/PPM:0.0         │
│                                      │
│ PAGE-UP    PAGE-DN   STOP    more    │
└─────────────────────────────────────┘
```

Figure 3–21   Line 1 Summary Screen (E1 Mode)

RESULTS-FREQUENCY Screen

Screen 3 of E1 Mode's Measurement Results is the Frequency screen, which shows relevant frequency information.

• The bar graph indicates how fast the signal is slipping in relation to the reference clock. In the TEST CONFIGURATION, RxDROP determines which line measurements are taken on. The other (not selected) line is the reference clock. For example, if RxDROP is L1-Rx, L1 will be measured, and the reference clock will be derived from the L2-Rx signal.
• The reference clock may also be taken from the multiport.
• To change the source of the reference clock to the multiport:
    a) Enter the OTHER FEATURES menu.
    b) Enter OTHER PARAMETERS.
    c) Cursor to REFERENCE CLOCK.
    d) Press NORMAL (F1) to use a line source; press MLTIPRT (F2) to use timing off of the multiport.
• It is important to know the source of the reference clock, to meaningfully interpret your graph results.
• Note that the bar graph slips most rapidly at the center position and then gradually slows down as the length of the bar increases.
• A count of the number of clock slips is kept at the end of the bar.
• At 256 clock slips the graph resets itself.
• One clock slip occurs when the measured frequency deviates from the reference frequency by one unit interval. A unit interval

is equal to 488 nano seconds.

- The bar graph is only valid when both L1-Rx and L2-Rx have valid signals, under NORMAL conditions. If, for example, L2-Rx has no signal it will show a NO LINE 2 REF SIGNAL, and no graph will be shown. If you are have chosen the multiport as the reference clock, it must have a valid signal, or you will get a NO REFERENCE CLOCK! message.
- Figures 3–22 and -23 show the Line Frequency screen used for E1 Mode.

```
         MEAS                  17:13:40

ET- 000:50:21      RT- CONTINU
FRM- PCM-30        COD- HDB3


          LINE 1 - FREQUENCY

 NEG              0              POS
   -+--+--+----+----+--+--+-
 051        <<<<<


 RCV/Hz: 2047999    CKSLIP: 51
 MAX/Hz: 2047999    +WANDR: 0
 MIN/Hz: 2047999    -WANDR: 51


PAGE-UP    PAGE-DN   STOP    more
```
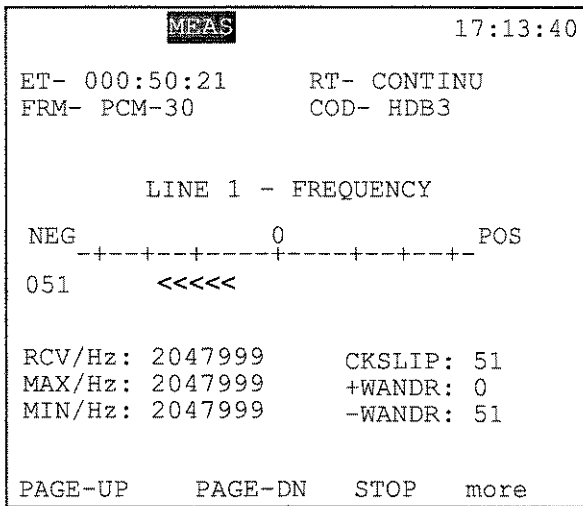
Figure 3–22   Line Frequency Screen (E1 Mode)

```
┌──────────────────────────────────┐
│        [MEAS]          20:50:45  │
│                                  │
│  ET  : 000:14:19    RT  : CONTINU│
│  FRM : PCM-30/C     TxCK: INTERN │
│  PATT: 1-4          RATE: 2.048M │
│                                  │
│        LINE 1 - FREQUENCY        │
│                                  │
│      NO LINE 2 REF SIGNAL        │
│                                  │
│                                  │
│  RCV/Hz: 2048003    CKSLIP: N/A  │
│  MAX/Hz: 2048003    +WANDR: N/A  │
│  MIN/Hz: 2048002    -WANDR: N/A  │
│                                  │
│                                  │
│  PAGE-UP    PAGE-DN   STOP   more│
└──────────────────────────────────┘
```

Figure 3–23 Line Frequency/No Ref Signal

Note: When no reference clock signal is present, the test set will default to its internal clock, for the measurement of MAXimum, MINimum, and current ReCeiVed bit rates of the selected signal. Refer to the Measurement Definitions section as needed

LINE 1 G.821 Screen

The G.821 screen presents the measurement parameters specified in ITU G.821. It includes ES, SES, EFS, AS, UAS, DGRM and their related percent values. Figure 3–24 provides a sample screen.

```
        ┌──────────────────────────────────┐
        │      ███MEAS███      17:20:11    │
        │  ET-  000:56:49    RT-  CONTINU  │
        │  FRM- PCM-30       COD- HDB3     │
        │  RCV- 63           XMT- 63       │
        │          LINE 1 - G.821          │
        │                                  │
        │  BIT - 0         BER  - 0.0e-10  │
        │  ES  - 0         %ES  - 00.000   │
        │  SES - 0         %SES - 00.000   │
        │  EFS - 3541      %EFS - 100      │
        │  AS  - 3541      %AS  - 100      │
        │  UAS - 0         %UAS - 00.000   │
        │  DGRM- 0         %DGRM- 00.000   │
        │  SLIP- 0                         │
        │                                  │
        │  PAGE-UP   PAGE-DN   STOP   more │
        └──────────────────────────────────┘
```

Figure 3–24   G.821 Screen

Refer to the Measurement Definitions section as needed.

SIG/ALM Screen

    This screen presents alarm and measurement parameters relating to the E1 signal. Refer to Figure 3–25.

Refer to the Measurement Definitions section as needed.

```
        ┌──────────────────────────────────┐
        │      ███MEAS███      17:25:41    │
        │                                  │
        │  ET-  001:02:26    RT-  CONTINU  │
        │  FRM- PCM-30       COD- HDB3     │
        │                                  │
        │        LINE 1 - ALM/ SIG         │
        │                                  │
        │  LOSS- 0         +LVL - -0.3 dB  │
        │  AISS- 0         -LVL - -0.3 dB  │
        │  LOFS- 0         Lpp  - -0.3 dB  │
        │  FALM- 0         +LVL - 2.30 V   │
        │  MFAL- 0         -LVL - 2.29 V   │
        │                                  │
        │                                  │
        │  PAGE-UP   PAGE-DN   STOP   more │
        └──────────────────────────────────┘
```

Figure 3–25   SIG/ALM screen (E1 Mode)

LINE 2 ALM/SIG Screen

Page 7 of E1 Mode's Measurement Results displays the Alarm/ Signal measurements for Line 2. This screen is similar to Line 1 ALM/SIG screen. However, the level measurements (+LVL, -LVL, Lpp) are not given for Line 2.

LINE 1 E-BIT Screen

The E-BIT screen presents all measurements related to the E-BIT information.

The 2.048 Mbps terminating equipment transmits an E-bit error on the 2.048 Mbps line when it receives a CRC error on its incoming 2.048 Mbps signal. E-bit error transmission is a relatively new feature in 2.048 Mbps transmission equipment. Therefore, it is likely there is embedded equipment which does not transmit the E-bit error information correctly. For this reason, when the test set receives an E-bit error, it does not light the Error LED, and it does not update the summary measurements. E-bit errors are only shown on the E-BIT results screen.

E-bit errors are the best way to test the performance of a 2.048 Mbps line that is in-service. E-bit errors allow you to see trouble anywhere on the circuit even when you do not have synchronization on a test pattern and even when you are testing only at one point on the circuit. E-bit errors are available only on a line with MFAS framing (PCM-30) where CRC-4 capability is enabled.

Refer to Figure 3-26.

The following measurement terms are used slightly differently in this screen:

UAS: This is a count of E-bit UnAvailable Seconds since the beginning of the test. E-bit UnAvailable Seconds begin at the onset of 10 consecutive severely E-bit errored seconds and end at the onset of 10 consecutive non-severely E-bit errored seconds. Loss of signal, loss of frame, and loss of pattern synchronization will also cause an E-bit UnAvailable Second.

```
      MEAS             17:30:06
ET-   001:07:48    RT-   CONTINU
FRM- PCM-30        COD- HDB3


         LINE 1 - E-BIT

EBIT- 0            EBER - 0.0e-07
ES  - 0            %ES  - 00.000
SES - 0            %SES - 00.000
AS  - 4177         %AS  - 100
UAS - 0            %UAS - 00.000
DGRM- 0            %DGRM- 00.000



PAGE-UP   PAGE-DN   STOP    more
```

Figure 3–26 Line 1 E-Bit screen (E1 Mode)

M2100/550 Screen

This screen provides pass/fail measurements in accordance
with ITU M.2100/550 specifications.

This specification is used where a 2.048 Mbps circuit passes
through international boundaries. It allocates a certain allowable
error rate to each nation that carries the circuit. The technician
merely needs to enter the appropriate HRP model that is to be
allowed for the line under test. The SunSet makes the M.2100/550
calculations and reports whether the line passed or failed.

Refer to Figure 3–27. The definitions following pertain particu-
larly to this results screen.

```
┌─────────────────────────────────┐
│    ▐MEAS▌          00:34:29      │
│                                 │
│ ET-  000:09:07   RT-  CONTINU   │
│ FRM- PCM-30      COD- HDB3      │
│                                 │
│      LINE 1 - M.2100/550        │
│                                 │
│ PERIOD           P/F  %ES  %SES │
│ 01-01 00:27/00:29  P  00.0 00.0 │
│ 01-01 00:29/00:31  P  00.0 00.0 │
│ 01-01 00:31/00.33  P  00.0 00.0 │
│ 01-01 00:33/00:35  P  00.0 00.0 │
│                                 │
│                                 │
│ PAGE-UP   PAGE-DN   STOP   more │
└─────────────────────────────────┘
```

Figure 3-27   Line 1- M.2100/550 screen (E1 Mode)

PERIOD: This parameter identifies the date and time interval of
each of the reported pass or fail results. The period interval used
in Figure 3-27 is 2 minutes. You may change this interval in the
OTHER FEATURES, MEAS CONFIGURATION 2. Valid en-
tries may range from 00 to 99 minutes.

P/F: P/F shows whether the test result was a pass or fail during the
period.

%ES: This is the percentage of M.2100 Errored Seconds since the
beginning of the test. An errored second is any second with a
Code, Bit, Frame, Multiframe or CRC error.

%SES: This is the percentage of Severely Errored Seconds since
the beginning of the test. An M.2100 Severely Errored Second
is any second with >10-3 bit error rate, 10-3 code error,
excessive frame, multiframe or CRC bit errors, loss of frame,
loss of pattern, synchronization, or loss of signal.

LINE 1 BLOCK ERROR Screen
A block is a group of consecutive bits associated with the path;
data messages are usually transmitted in blocks. Many data
transmission systems reject blocks containing bit errors and
retransmit the entire block of data. Therefore, block measurements
can be more meaningful. Figure 3-28 shows a Block Error screen.

```
┌────────────────────────────────────┐
│         ▐MEAS▌        17:30:06     │
│  ET-  001:07:48    RT-   CONTINU   │
│  FRM- PCM-30       COD-  HDB3      │
│  RCV- 63           XMT-  63        │
│       LINE 1 - BLOCK ERROR        │
│                                    │
│   BLOCK SIZE   - 1000             │
│   # of BLOCKS  - 539428           │
│   BLOCK ERROR  - 0                │
│   BLK ERR RATE- 0.0e-06           │
│                                    │
│                                    │
│                                    │
│   PAGE-UP   PAGE-DN   STOP   more │
└────────────────────────────────────┘
```

Figure 3–28   Line 1- Block Error (E1 Mode)

The following measurements are particular to this screen:

BLOCK SIZE: This indicates the number of bits in the block size used for the measurements. As in Figure 3–28, one block is typically 1000 bits long. You may change the block size used in OTHER MEASUREMENTS, MEAS CONFIGURATION 1.

# of BLOCKS: This shows the total number of blocks received by the Sunset E10.

BLOCK ERROR: Block error shows the number of blocks received by the E10 which contain bit errors.

BLK ERR RATE: The block error rate refers to the fraction of blocks in error- the number of blocks received with 1 or more bit errors (BLOCK ERROR) divided by the total number of blocks received (# of BLOCKS).

LINE 1 G.826 Screen

Page 9 of E1 Mode's Measurement Results shows the Line 1-G.826 results. Refer to Figure 3–29.

```
          ┌──────────────────────────────┐
          │        MEAS          01:19:54 │
          │ DATE-99-05-02                 │
          │ ET-  000:14:25    RT-  CONTINU│
          │ FRM- PCM-30       COD- HDB3   │
          │ RCV- P15          CRC4- YES   │
          │ E-BIT- YES        RDI- N/A    │
          │        LINE 1 - G.826         │
          │ EB  - 4                       │
          │ BBE - 4        %BBE  - 00.0004 │
          │ ES  - 4        %ES   - 00.3831 │
          │ SES - 0        %SES  - 00.0000 │
          │ UAS - 0        %UAS  - 00.0000 │
          │ AS  - 1001     %AS   - 100    │
          │                               │
          │ PAGE-UP   PAGE-DN  STOP   more │
          └──────────────────────────────┘
```

Figure 3–29   Line 1- G.826 Screen (E1 Mode)

Note: You must turn on G.826 measurements in OTHER FEATURES/MEAS CONFIGURATION 2. This ITU standard, a replacement of the earlier G.821, specifies required performance characteristics of 2.048 Mbps lines. The parameter definitions given in G.826 are block-based. This makes in-service measurement convenient.

The following definitions are specific to this screen:

AS: This is the count of bit Available Seconds since the beginning of the test. G.826 Available Seconds equals the length of the total test time minus any UAS.

%AS: This is the percentage of bit Available Seconds since the beginning of the test.

BBE: A Background Block Error is an errored block not occurring as part of a SES (Severely Errored Second).

%BBE: The percentage of errored blocks since the beginning of the test, excluding all blocks during SES and unavailable time.

EB: An Errored Block is a block containing one or more bit errors.

RDI: A Remote Defect Indication is used by the near end to estimate far end errors, particularly SES's.

SES: A Severely Errored Second is a one second period which contains greater or equal to 30% errored blocks.

%SES: This is the percentage of Severely Errored Seconds since the beginning of the test.

Note: The test set looks for E-bits when CRC-4 has been set to YES in the TEST CONFIGURATION.

4.2 E1-MUX Mode Measurement Results

The Measurement Results for E1-MUX Mode follow the same outline as the E1 Mode results. See the Measurement Definitions section as needed. Only one screen differs in this mode. Page 5 of the E1-MUX results contains Datacom G.821 results, as opposed to the Line 1 G.821 results for E1 Mode, when BERT has been set to the datacom type.

See the Measurements Definitions section as necessary

Figure 3–30 shows the Datacom G.821 results screen.

```
         MEAS            17:20:11
ET-  000:56:49    RT-   CONTINU
FRM- PCM-30       COD-  AMI
RCV- 63           XMT-  63
         DATACOM - G.821

BIT - 0           BER  - 0.0e-10
ES  - 0           %ES  - 00.000
SES - 0           %SES - 00.000
EFS - 3541        %EFS - 100
AS  - 3541        %AS  - 100
UAS - 0           %UAS - 00.000
DGRM- 0           %DGRM- 00.000
SLIP- 0

 PAGE-UP   PAGE-DN   STOP   more
```

Figure 3-30 Datacom G.821 Results (E1-MUX Mode)

4.3 MUXTEST Mode Measurement Results

The Measurement Results for MUXTEST Mode are exactly the same as those of E1-MUX Mode. Please refer to Section 4.1, E1 Mode, for descriptions of all the screens, except for Page 5, Datacom G.821. The Datacom G.821 screen may be found in Section 4.2.

4.4 DATACOM Mode Measurement Results

The Datacom Measurement Results contain two pages of data. See Chapter 9 for further information.

Section 5 Other Measurements

The Other Measurements Menu list is displayed in Figure 3–31.

```
                                01:25:25

     OTHER MEASUREMENTS

     VIEW RECEIVED DATA
     VIEW FAS WORDS
     VIEW MFAS WORDS
     PULSE MASK ANALYSIS
     SS#7 ANALYSIS
     ISDN ANALYSIS
     GSM ANALYSIS
     X.50 ANALYSIS
     C-BIT ANALYSIS
     HISTOGRAM ANALYSIS
     PROPAGATION DELAY
```
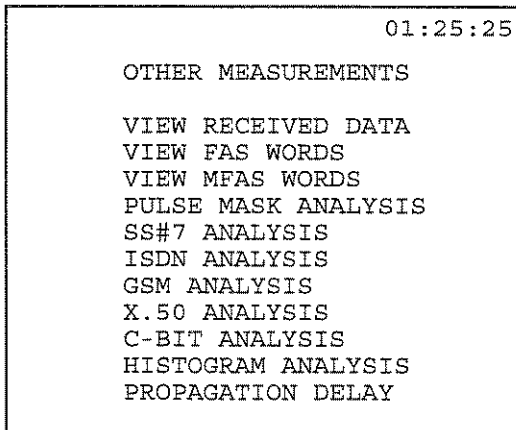
Figure 3–31 OTHER MEASUREMENTS

Most of these menu choices are described here in Section 5. A few, however, are discussed within their own chapters. SS#7 is handled in Chapter 5, ISDN in Chapter 6, GSM in Section 7, X.50 in Chapter 8, and Datacom in Chapter 9. You may find all other selections in this section.

5.1 View Received Data

Refer to Figure 3–32, View Received Data, for a typical screen display.

Note: This item is not available when in DATACOM Mode, or when X.50 Analysis has been enabled.

```
┌─────────────────────────────────────┐
│        MEAS          01:30:09        │
│        VIEW RECEIVED DATA            │
│ PAGE   :  00                         │
│ T/S      BINARY      HEX   ASCII     │
│ 00       00011011    1B      ( )     │
│ 01       10001110    8E      (q)     │
│ 02       01000100    44    D (Ö)     │
│ 03       11011010    DA      ([)     │
│ 04       01100101    65    e ( )     │
│ 05       00100010    22    Ô (D)     │
│ 06       10100001    A1      ( )     │
│ 07       00110000    30    0 ( )     │
│                                      │
│ PAGE-UP   PAGE-DN   RESUME           │
└─────────────────────────────────────┘
```

Figure 3–32   View Received Data

To view this screen, use the following procedure:

1) Move the cursor to the OTHER MEASUREMENTS item in the MAIN MENU and press ENTER.

2) Move the cursor to the VIEW RECEIVED DATA item. Press ENTER.

3) View the live presentation of the data.

4) Choose PAUSE (F3) to trap the current data on the E1 line.

5) Choose PAGE-UP (F1) or PAGE-DN (F2) to view more data.
• Note the PAGE number in the upper left-hand portion of the screen.
• 64 pages of data are available.

---

6) When you have finished, press the ESCAPE key twice to return to the MAIN MENU.

The following display definitions are used in this screen:

PAGE: Indicates which of the available 64 pages of data is currently being displayed.

T/S: Specifies the Time Slot being viewed.

BINARY: This column shows the binary data actually being received on the line. Each line represents the 8-bit time slot.

HEX: This column shows the hexadecimal representation of the 8 bits being transmitted in each time slot.

ASCII: This column displays the ASCII representation of the 8-bit binary framing word which has been received. The character displayed to the left of the parentheses represents the 8-bit framing words translated in their present order. The character displayed within the parentheses represents the 8 bits translated in reverse order.

5.2 View FAS Words

View FAS Words may be accessed via the Other Measurements menu list. Valid framing is required to enter this screen. View FAS Words allows you to view the live presentation of E1 framing binary words. Time slots 0 of frames 0 through 15 are displayed in this screen. Refer to Figure 3–33, FAS Frame Words.

```
   MEAS                    08:07:56

        FAS  FRAME  WORDS

FRM   12345678      FRM   12345678
      c0011011            i1asssss
  0   10011011        1   01011111
  2   00011011        3   01011111
  4   10011011        5   11011111
  6   10011011        7   01011111
  8   00011011        9   11011111
 10   00011011       11   11011111
 12   10011011       13   11011111
 14   10011011       15   11011111


                 RESUME
```

Figure 3–33 FAS Frame Words

The even frames, 0 through 14, contain the FAS, Frame Alignment Signal, in bits 2 through 8. As shown in Figure 3–33, FAS is represented by 0011011. The first bit (c or Si) of these frames is reserved for international use. It can be used for the CRC-4, cyclic redundancy check-4, when enhanced performance monitoring is required. Therefore, when CRC is enabled in the TEST CONFIGU- RATION screen, these bits depend upon the CRC calculation and should continually change between 0 and 1. When CRC-4 is not enabled, these bits are set to 1.

The odd frames do not contain the frame alignment signal. The top row of these frames in Figure 3–33 shows the allocation of bits 1-8 in these frames. The first bit, i, is similar to the first bit in the even frames. Bit 2 is set to 1 to avoid simulations of the frame alignment signal. The third bit in the odd frames is used for the remote alarm indication. For undisturbed operation, this bit is set to 0. In alarm condition, the third bit should be 1. Figure 3–33 represents an undisturbed condition. The last 5 bits, 4-8, are additional spare bits. When they have no specific use, as defined by CCITT G.704, these bits should be set at 1 for crossing an international border.

When you have set your framing at PCM-30 Multiframe, there is a slight variation in the odd framing bits, those not containing the frame alignment signal. Bit 1 is used to transmit the 6-Bit CRC-4 multiframe alignment signal and 2 CRC-4 error indication bits. The

CRC-4 multiframe alignment signal has the form 001011. Figure 3–34 shows the FAS frame words seen when in PCM-30 framing.

```
┌─────────────────────────────────────┐
│        MEAS          07:31:55        │
│                                      │
│         FAS  FRAME  WORDS            │
│                                      │
│   FRM    12345678   FRM   12345678   │
│          c0011011         ilasssss   │
│   0      00011011    1    01011111   │
│   2      10011011    3    11011111   │
│   4      00011011    5    11011111   │
│   6      00011011    7    11011111   │
│   8      10011011    9    11011111   │
│   10     00011011   11    01011111   │
│   12     00011011   13    01011111   │
│   14     00011011   15    11011111   │
│                                      │
│              RESUME                  │
└─────────────────────────────────────┘
```

Figure 3–34   FAS Frame Words (PCM-30)

In Figure 3–34, the first bits of frames 1-11 (odd) send the pattern 001011, the CRC-4 multiframe alignment signal. The first bits of frames 13 and 15 transmit the two E-bits, which are CRC-4 error indication bits. A zero in this bit denotes received errored sub-multiframes; a one represents received frames free of errors. You may refer to Chapter 10, Section 1.8 for a deeper understanding of PCM framing, CRC-4, and E-bit technology.

5.3 View MFAS Words

In View MFAS Words, you may view the live presentation of Timeslot 16, Frames 0-15. Refer to Figure 3–35.

To enter View MFAS Words:
1) From the MAIN MENU, select OTHER MEASUREMENTS.
2) Select View MFAS words.

Note: It is necessary to select PCM-30 framing in the TEST CONFIGURATION menu to enter this screen.

```
                              06:30:55

            MFAS  FRAME  WORDS

  FRM   12345678     FRM   12345678
        0000xyxx           ABCDabcd
   0    00001011      1    11011101
   2    11011101      3    11011101
   4    11011101      5    11011101
   6    11011101      7    11011101
   8    11011101      9    11011101
  10    11011101     11    11011101
  12    11011101     13    11011101
  14    11011101     15    11011101
                  RESUME
```

Figure 3–35   MFAS Frame Words

In the Multiframe, timeslot 16 is used for either common channel or channel associated signalling, as required. Please note that in Figure 3–35, the template for the even frames (0000xyxx) applies only to Frame 0. All other frames follow the template shown above the odd frames (ABCDabcd).

Bits 1-4 of frame 0 are used as the multiframe alignment signal (MFAS). As seen in Figure 3–35, MFAS is 0000. The last four bits of frame 0 are designated as xyxx. X is a spare bit and is set to 1 if not used. Y represents an alarm indication to the remote end. In undisturbed operation, y will be 0. In an alarm condition, y will be 1.
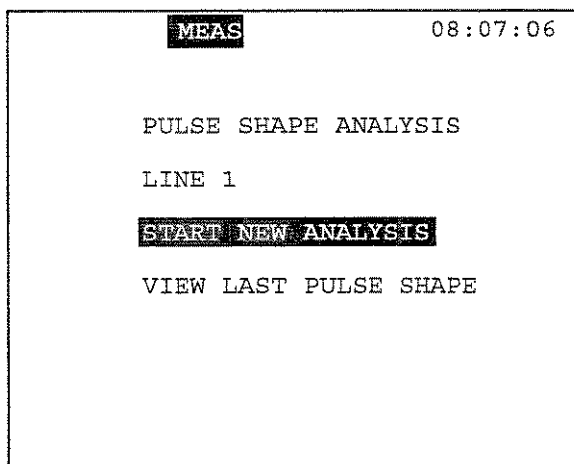
The rest of the frames contain signalling channels designated a, b, c, and d. Frame 1 contains channels 1 and 16, frame 2 contains channels 2 and 17, and so forth until frame 15, which contains channels 15 and 30.
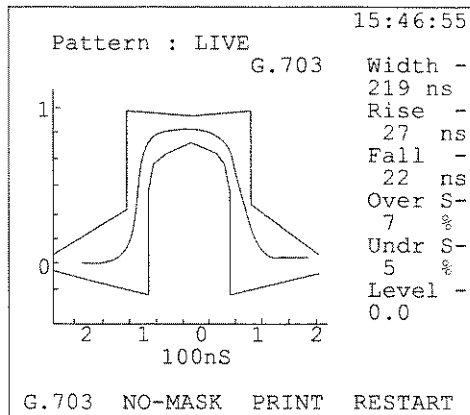
5.4 Pulse Mask Analysis

The Pulse Mask Analysis option enables you to measure the quality of an E1 wave form. The measured results compare favorably with pulse shape measurements obtained from testing with a digital oscilloscope.

- The Pulse Mask Analysis is performed for any received test pattern or live signal, and line interface mode.
- The received signal shape is displayed on the SunSet's LCD screen.
- The ITU G.703 pulse mask can be superimposed for fast inspection.
- The SunSet will store the present pulse shape for later viewing.

The Pulse Mask Analysis menu is shown in Figure 3–36.

```
┌─────────────────────────────────────┐
│  MEAS              08:07:06          │
│                                      │
│                                      │
│  PULSE SHAPE ANALYSIS                │
│                                      │
│  LINE 1                              │
│                                      │
│  START NEW ANALYSIS                  │
│                                      │
│  VIEW LAST PULSE SHAPE               │
│                                      │
│                                      │
│                                      │
└─────────────────────────────────────┘
```

Figure 3–36 Pulse Shape Analysis Menu

```
                        15:46:55
   Pattern : LIVE
                G.703    Width -
                         219 ns
  1                      Rise  -
                          27  ns
                         Fall  -
                          22  ns
                         Over S-
                          7   %
  0                      Undr S-
                          5   %
                         Level -
                         0.0
     2    1    0    1    2
          100nS

  G.703  NO-MASK  PRINT  RESTART
```

Figure 3–37 Pulse Shape Analysis

5.4.1 Start New Analysis

Follow this procedure to start a new pulse shape analysis:

1) Select the correct line interface in the TEST CONFIGURATION menu.

2) In the Main Menu, move the cursor to OTHER MEASURE-MENTS; press ENTER.

3) Cursor to PULSE MASK ANALYSIS and press ENTER.

4) Cursor to START NEW ANALYSIS; press ENTER.

In three to five seconds, the captured pulse shape will be displayed on the screen. In this screen, there are four F-key choices:

G.703 (F1): Displays the ITU G.703 mask with the captured signal.

NO-MASK (F2): Removes the G.703 mask.

PRINT (F3): Print the pulse shape screen on the Sunrise Thermal Printer.

RESTART (F4): Starts a new pulse shape capture and analysis.

Definitions for this screen are:
Width - Pulse Width, in ns
Rise - Rise Time, in ns
Fall - Fall Time, in ns
Over - Over Shoot, percentage
Undr - Undershoot, percentage
Level - Signal level, in dB

5.4.2 View The Last Pulse Shape

• View the last pulse shape captured by the SunSet E10.
• You may view this pulse shape at any time, even after the SunSet
   has been turned off for an extended period of time.

Follow this procedure:

1) In the Main Menu, move the cursor to OTHER MEASURE-
   MENTS; press ENTER.

2) Cursor to PULSE SHAPE ANALYSIS; press ENTER.

3) Cursor to VIEW LAST PULSE SHAPE; press ENTER.

   The last pulse shape will be displayed on the screen, along
with the same four F-keys used in the START NEW ANALYSIS
screen. See the previous section for screen definitions.

Note: Although datacom, SS#7, ISDN, GSM, and X.50 Analyses
are contained in the OTHER MEASUREMENTS menu, their menu
descriptions (along with technology overview and applications)
are covered in separate chapters. Please refer to the following
Chapters for each:

Chapter 5: SS#7 Analysis
Chapter 6: ISDN Analysis
Chapter 7: GSM Analysis
Chapter 8: X.50
Chapter 9: Datacom

5.5 C-Bit Analysis

The C-Bit Analysis option allows the user to send and receive C-Bit frames.

To enter C-Bit Analysis:
1) From the MAIN MENU, enter OTHER MEASUREMENTS.
2) Select C-BIT Analysis.

You may receive C-bits on both Line 1 and Line 2, but you may transmit C-bits on only one line. This will be the line set for Tx/ INSERT in the TEST CONFIGURATION menu. Refer to Figure 3–38, C-Bit Analysis.

```
                              23:08:38
              C-bit SEND/RECEIVE

L1-Tx T/S:01      TRANSMIT :IDLE
L1-Rx T/S:01      L2-Rx T/S:01


SEND bits    123456789012345
             S10001000010001

RECEIVED
     LINE-1  S10001000010001
     LINE-2  C-BIT NOT FOUND

NEXT    PREVIUS
```

Figure 3–38   C-bit Analysis

Note: The SunSet will transmit IDLE pattern upon entering the C-bit Analysis screen.

The following programmable fields are available in this screen:

1) L1-Tx T/S
Options: 1—15, 17—31
   Select the desired transmit timeslot on which to send C-bits.

• Press NEXT (F1) or PREVIUS (F2) as necessary.
• To send C-bits on Line 2 (and thus, this item changes to L2-Tx

T/S), set Tx/INSERT to L2-Tx in the TEST CONFIGURATION screen
- As PCM-30 framing is required for this C-bit analysis, you may not select timeslot 16.

2) TRANSMIT
Options; USER (F1), IDLE (F2)
   This setting determines bit 2.

- IDLE (F2) sends logic 1 as bit 2. When 1 is placed in this spot, C-bit framing will be ignored.
- USER (F1) activates the C-bit framing and sets the user programmable bits.
   a) Cursor down to the SEND bits.
   b) At each bit, press the SHIFT key and enter either 0 or 1. The cursor automatically moves one spot to the right once a bit is entered. When the cursor highlights a specific bit, information about this C-bit will be displayed at the bottom of the screen.

Definitions of C-bits 2—15 are shown below:

Bit #	Assignment
bit 2 ESCAPE	0 - C-Frame active 1 - C-Frame ignored
bit 3 2Mb loops	0 - Subscriber 1 - Network
bit 4 Loop 2 or Loop 3	0 - Subscriber 1 - Network
bit 5 Loop 2 instruction	0 - Active 1 - Non-active
bit 6 Loop 3 instruction	0 - Active 1 - Non-active
bit 7 HDB3 command	0 - Active 1 - Non-active
bit 8 Loop acknowledge	0 - Acknowledge 1 - No acknowledgment
bit 9 Not defined...	
bit 10 Local Fault	0 - Active 1 - Non-active
bit 11 Remote/ Line fault	0 - Active 1 - Non-active
bit 12 C Frame loss	0 - Active 1 - Non-active
bits 13-15 Spare	

3) L1-Rx

Options: 1-15, 17-31

Select the desired Line receive timeslot on which to receive C-bits.

•Press NEXT (F1), or PREVIUS (F2) as needed.

Because PCM-30, MFAS, framing is required, you may not select

timeslot 16.

This screen also shows the received C-bits for both Lines 1 & 2. If C-bits are not found on a line, a C-BIT NOT FOUND message will be displayed for that line.

5.6 Histogram Analysis

• View/print either the current file, or a previously saved one.

Figure 3–39 shows the Histogram Analysis menu, which appears upon entering this item.

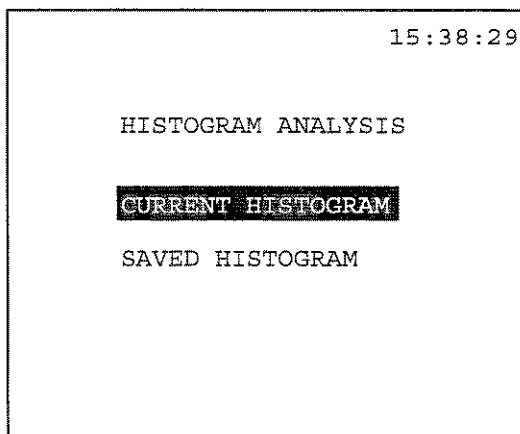**Note:** Interrupting your timed measurement to view results will result in a new histogram analysis beginning when you return to measuring.

```
                              15:38:29


        HISTOGRAM ANALYSIS


      CURRENT HISTOGRAM

      SAVED HISTOGRAM
```

Figure 3–39   Histogram Analysis Menu

5.6.1 Current Histogram

Use this procedure:

1) From the MAIN MENU, enter the OTHER MEASUREMENTS menu.

2) Select HISTOGRAM ANALYSIS.

3) Select CURRENT HISTOGRAM.

• The Current Histogram menu will be displayed, as depicted in Figure 3–40.

4) The CURRENT date and time correspond to the last time you entered MEASUREMENT RESULTS.
a) Select VIEW (F1) to view the current histogram. Figure 3–41 shows a sample histogram screen.
b) Pressing STORE (F2) will erase any previously stored data.
   • Your CURRENT histogram data is also being stored, but it will be erased the next time you enter MEASUREMENT RESULTS.
   • If you do not want to save the current file and erase the one already saved, simply press ESCAPE instead of ENTER at the warning message screen.

```
                                    09:28:06


          CURRENT HISTOGRAM

          STARTING TIME STAMP
          96-01-16   08:39:26

          ENDING TIME STAMP
          96-01-16   09:29:32



VIEW    STORE
```

Figure 3–40   Current Histogram Menu

```
                              17:50:45

                    CURRENT HISTOGRAM
        TYPE  :  BIT          LINE  :  1
        DATE  :  96-04-12  00:00      Cursor

        100K  ┌ ─ ─ ─ ─ ─ ─ ─ ─ ┐ ╲
         10K  ├ ─ ─ ─ ─ ─ ─ ─ ─ ┤ ▶
          1K  ├ ─ ─ ─ ─ ─ ─ ─ ─ ┤
         100  ├ ─ ─ ─ ─ ─ ─ ─ ─ ┤
          10  ├ ─ ─ ─ ─ ─ ─ ─ ─ ┤
           0  └───────────────────┘

        DAY  0    15   30   45   60

          ZOOM    JUMP   PRINT    more
```
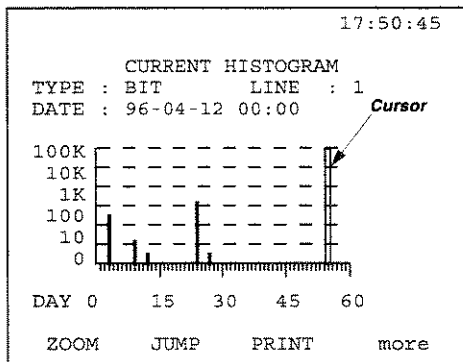
Figure 3–41   Current Histogram Screen

The following function keys are available for the histogram analysis:

TYPE (F1): Use this key to select the measurement parameter type.

- The history of each error type is displayed individually.
- The error type is specified in the upper portion of the screen.
- Pressing TYPE automatically changes the type options displayed.

In Figure 3–41, bit error was selected as the error type. In this manner, you may examine the history of certain errors or parameters depending on the test mode.

The following table, Figure 3–42, provides the parameters/errors available with their respective modes.

MODE	SIDE	INFO
E1	LINE 1 or LINE 2	BIT, CODE, CRC, FE, LOSS, AISS, LOFS, FALM, MFAL
E1-MUX	LINE 1 or LINE 2	BIT, CODE, CRC, FE, LOSS, AISS LOFS, FALM, MFAL
	DATACOM	BIT
MUXTEST	LINE 1 or LINE 2	BIT, CODE, CRC, FE, LOSS, AISS LOFS, FALM, MFAL
	DATACOM	BIT
DATACOM		BIT, ES, SES, UAS

Figure 3–42 Measurement Types

LINE 1/2 (F2): Selects the parameters of either E1 Line 1, E1 Line 2, or Datacom.
  • When the set is configured to the DATACOM, MUXTEST, or E1MUX test mode, the datacom's parameters will automatically be selected and you will not be given the LINE 1/ 2 option.

ZOOM (F3): Use this key to zoom into the next lower time period at the display cursor location.
  • Select a minute, hour, or day interval as your time period.

JUMP (more, F2) Moves the display cursor by 10 steps in the display period.
  • Use the left or right arrow keys on the keypad to move the cursor one period at a time.

PRINT (more, F3): Print the current histogram display page.
  • The print result is in the graphic format shown on the LCD screen.
  • A current PRINT session can be aborted by pressing the

ESCAPE key.

Note the following important points:
• The HISTOGRAM ANALYSIS will display either the current or
  saved results.
• Each time MEASUREMENTS RESULTS is entered, the SunSet
  will replace the file in the CURRENT HISTOGRAM data.
• For each file, the HISTOGRAM ANALYSIS feature will store the
  most recent 60 hours of data with a display resolution (PE-
  RIOD) of 1 minute.
• For each file, the HISTOGRAM ANALYSIS feature will also store
  the previous 60 days of histogram data with a resolution
  (PERIOD) of one hour.

5.7 Propagation Delay

• Measures the propagation delay of a looped back signal. See
  Figure 3–43.
• The set measures the number of unit intervals it takes for the
  signal to return. A unit interval is the amount of time it takes to
  transmit one bit (488 nS for a E1 signal). This number is
  translated into an exact number of microseconds of round trip
  delay.

```
┌──────────────────────────────────┐
│  ▄▄▄▄▄▄              01:44:02    │
│  █MEAS█                          │
│  ▀▀▀▀▀▀                          │
│       PROPAGATION DELAY          │
│                                  │
│  Prop. DELAY: 44      UI         │
│             : 21      uS         │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│ Restart                          │
└──────────────────────────────────┘
```
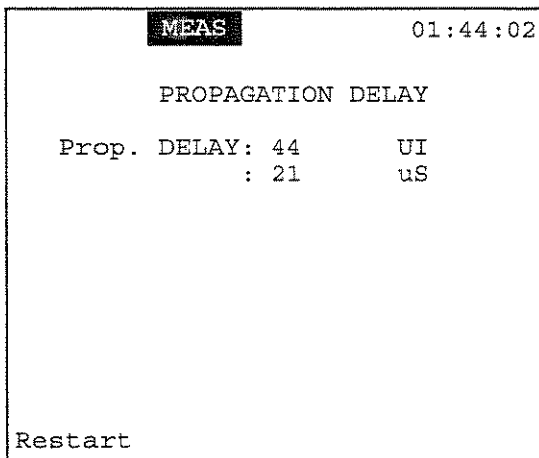
Figure 3–43 Propagation Delay

Section 6 VF Channel Access

The VF CHANNEL ACCESS menu performs a variety of talk/ listen functions.

Do not attempt to enter the VF CHANNEL ACCESS menu if the PCM-31 LED or the PCM-30 LED is not lit green. Green LEDs indicate that the framing found on the received signal matches the framing selected in the TEST CONFIGURATION menu. It is impossible to talk, listen, or perform other channelized functions in the absence of frame synchronization, since channels can be identified only within a framed signal.

Refer to Figure 3–44 for the VF CHANNEL ACCESS menu list.

```
                                    08:22:56

   VF CHANNEL ACCESS

   VF MEASUREMENTS
   VIEW LINE 1&2 CAS
   DIAL PARAMETERS
   DTMF/MFR2/DP DIALING
   DTMF/MF/DP/CAS ANALYSIS
   NOISE ANALYSIS
   MFC/SS#5 DIAL/ANALYSIS
   SIGNALLING EMULATOR
```

Figure 3–44 VF CHANNEL ACCESS Menu

Note: During VF CHANNEL ACCESS, when the TEST CONFIGU-RATION TxSOURCE is set to TESTPAT, idle channel code and signalling (A/B/C/D bits) will be inserted into the unselected channels. The idle channel code and signal can be programmed in the MAIN MENU, OTHER FEATURES, OTHER PARAMETERS, IDLE CHNL CODE and IDLE CHNL A/B/C/D menu items.

6.1 VF Measurements

The VF MEASUREMENTS menu lets you choose:
• which channel to test for both transmitting and receiving

•whether to talk, send a tone, or place quiet termination on the transmit signal
• the tone frequency and level
• which signalling bits to send
• to listen for both or either line

It also tells you:
• the received signalling bits
• the received 8-bit data
• the received frequency and level

Refer to Figure 3–45, VF Measurements.

```
                                    08:22:56

                VF  MEASUREMENTS
            Tx-1  T/S      :  01
            Rx-1  T/S      :  01
            Rx-2  T/S      :  01
            INSERT TYPE    :  TALK
            TONE FREQ Hz   :  1020
            TONE LVL dBm   :  0
            Tx-1 A/B/C/D   :  1001
            LISTEN SIDE    :  BOTH
            RX-1 A/B/C/D   -  1001
            Rx-1 DATA      -  11010011
            Rx-1 FRQ/LVL   -  1004/+00.3


       NEXT     PREVIUS
```

Figure 3–45 VF Measurements

Using Figure 3–45 as an example, the following features were set. The Tx T/S and Tx A/B/C/D are set for Line 1 in this screen, since Tx/INSERT was set for Line 1 in the TEST CONFIGURATION screen. To insert on Line 2 (and consequently, see Tx-2 T/S on this screen), select Tx/INSERT: L2-TX in TEST CONFIGURA-TION. Similarly, the labels Rx-1 A/B/C/D, Rx-DATA, and Rx-FREQ can all be changed to Rx-2 by setting Rx/DROP to L2-Rx in the TEST CONFIGURATION screen.

1) Tx-1 T/ S
Options: 1—31
    Choose the transmit timeslot for E1 Line 1.

• Press NEXT (F1) or PREVIUS (F2) as needed.
• The Tx-1 T/S normally should be the same as the Rx-1 T/S, but you do have the option to set them for different channels.
• Upon selecting a timeslot, the number will flash five times before actually inserting on the timeslot.

2) Rx-1 T/S
Options: 1—31
Choose the receive timeslot for E1 Line 1.

• Use the appropriate F-keys, NEXT (F1) or PREVIUS (F2) as needed.

3) Rx-2 T/S
Options: 1—31
Choose the receive timeslot for E1 Line 2.

• Press NEXT (F1) or PREVIUS (F2) to make the selection.
• To receive on Line 2, be sure to select either BOTH or L2-Rx in the LISTEN SIDE setting below.

4) INSERT TYPE
Options: TALK (F1), TONE (F2), QUIET (F4)

• Press (F1) to talk on the transmit signal; the SunSet will transmit speech from the microphone (located at the bottom of the test set, below the POWER button).
• 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 (F4) to place a quiet termination on the transmit signal.

5) TONE FREQ Hz
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 by pressing the SHIFT key and entering the desired value from the keypad. You may select any value from 50 to 3950 Hz.
• The default tone is set at 1020 Hz.

• Press SEND (F4) or press ENTER to send the tone.

6) TONE LVEL dBm
Options: -60 to 3 dBm
    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 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.
• Press SEND (F4) or ENTER to send the tone.

7) Tx-1 A/B/C/D
Options: IDLE (F1), SEIZE (F2), WINK (F3), SEND (F4)
    You may change the signalling bits that are transmitted with the associated transmit channel.

• These signalling bits will be transmitted only if the set is using
    MFAS (PCM-30) framing.

Pressing IDLE (F1), SEIZE (F2), or WINK (F3) will place that signal
    onto the A/B/C/D position.
    • Program the IDLE signal in the DIAL PARAMETERS setup.

To change these bits manually:
1) Press/release the SHIFT key and press the 1 and 0 keys as
    desired to enter the signalling bits.
2) Press ENTER or SEND (F4) to send the A/B/C/D bits.

8) LISTEN SIDE
Options: L1-RX (F1), L2-RX (F2), BOTH (F3)
    Determine the line(s) on which you will listen.

• Listen on Line 1 (F1), on Line 2 (F2), or on both lines (F3).

    The last three lines pertain to received data. As the dash indicates, they are for viewing only, and may be neither edited nor changed. They apply to the Rx/drop line.

9) Rx-1 A/B/C/D

Rx-1 A/B/C/D shows the Channel Associated Signalling System (CAS) bits.

Note: These bits are meaningful only if the PCM-30 LED is lit green. Ignore these bits if this LED is not green.

10) Rx-1 DATA

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

11) Rx-1 FRQ/LVL

View the frequency and level received on Line 1.

6.2 View Line 1 & 2 CAS

- View the signalling bits for all of the 30 channels for both Lines 1 and 2.
- You must select PCM-30 framing in TEST CONFIGURATION.
- The PCM-30 LED must be lit green in order for the signalling bits to be displayed.
- Note that time slots 1 through 5 are shown on the first line, 6 through 10 are shown in the second line, etc.
- The idle channels will be displayed in reverse video. For instance, if IDLE CHNL A/B/C/D is set to 1101 (in OTHER FEATURES, OTHER PARAMETERS), the timelsots will be displayed as in Figure 3–46.

```
                              07:31:55

     T/S   ABCD   ABCD   ABCD   ABCD  ABCD
  L  01   0000   1101   1101   1101  1101
  I  06   1101   1101   1101   1101  1101
  N  11   1101   1101   1101   1101  1101
  E  17   1101   1101   1101   1101  1101
  1  22   1101   1101   1101   1101  1101
     27   1101   1101   1101   1101  1101


     T/S   ABCD   ABCD   ABCD   ABCD  ABCD
  L  01   0000   1101   1101   1101  1101
  I  06   1101   1101   1101   1101  1101
  N  11   1101   1101   1101   1101  1101
  E  17   1101   1101   1101   1101  1101
  2  22   1101   1101   1101   1101  1101
     27   1101   1101   1101   1101  1101
```

Figure 3–46   View Line 1 & 2 CAS

6.3 Dial Parameters

• Set additional parameter settings to be used for your VF procedures. Refer to Figure 3–47.

```
                           15:59:59
              DIAL PARAMETERS

     DIAL PERIOD     : 150 ms
     SILENT PERIOD   : 200 ms
     TONE LEVEL dbm  : -5
     SUPERVISION       A B C D
     IDLE            : 1 0 1 1
     FRWD SEIZE      : 0 0 1 1
     BAK SEIZE ACK   : 1 1 1 1
     DIAL PULSE   (10pps)
     % BREAK         : 60
     INTERDIGIT PRD  : ▓▓▓
     B-BIT DIALING   : NO
  NEXT     PREVIUS
```

Figure 3–47   Dial Parameters

The following settings are provided in this screen:

1) DIAL PERIOD
Options: 30 ms to 999 ms
   Specify the dial period in milliseconds used for DTMF and MF dialing.

• The factory default value is 100 ms.
• Press the SHIFT key, and enter the desired value from the keypad. Select any value between 30 ms and 999 ms.

2) SILENT PERIOD
Options: 30 ms to 999 ms
   Specify the silent period in milliseconds used for DTMF and MF dialing.

• Press the SHIFT key, and enter the desired value from the keypad. Select any value between 30 ms and 999 ms.

3) TONE LEVEL dbm
Options: -20 to -5 dbm
  Select the tone level.

• Press NEXT (F1) or PREVIUS (F2) as necessary.

The next three items allow you to program your supervision A/B/C/D bits:

4) IDLE

• Use the SHIFT key and keypad numbers to enter the four idle supervision bits.
  These bits will be placed on the CAS bits for the timeslot being transmitted when the IDLE F-key is chosen.
  All other transmit channels will have the ABCD bits passed through the set in THRU Tx SOURCE (from TEST CONFIGURATION).
  If TxSOURCE is TESTPAT, then the idle channels will have the CAS bits specified in OTHER FEATURES, OTHER PARAMETERS, IDLE CHNL A/B/C/D.

5) FRWD SEIZE
A forward seizure signal is transmitted at the beginning of a call to initiate circuit operation.

• Use the SHIFT key and keypad numbers to enter the four forward seizure supervision bits.

6) BAK SEIZE ACK
These bits are used to acknowledge a seizure signal in the backward direction in MFC backward dialing mode.

• Use the SHIFT key and keypad numbers to enter the four backward seize acknowledgment supervision bits.

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

---

8) % BREAK
Options: 40%, 50%, 60%
 Select the desired BREAK percentage.

• Press NEXT (F1) and PREVIUS (F2) as necessary.
• Percent break is the ratio of the break (IDLE) interval to the total
 pulse cycle interval.

9) INTERDIGIT PRD
Options: 200—900 (hundred intervals only)
 Select the desired interdigit period.

• Use the F-keys, NEXT (F1) or PREVIUS (F2) as necessary.

10) B-BIT DIALING
Options: YES (F1), NO (F2)

• B-Bit dialing applies to pulse calls. When B-bit dialing is
 enabled and you place a call, the B supervision bit of the
 selected timeslot toggles between 0 and 1.
• Before you dial, change the transmit CAS bits to the seizure
 condition. When dialing , the set pulses the B-bit according
 to the timing selected in %BREAK and INTERDIGIT period.
 When the dialing is complete, the set remains in the seizure
 condition.

6.4 DTMF/MFR2/DP Dialing

The DTMF/MFR2 dialing menu lets you perform a number of
dialing functions:
 - dial a DTMF, MF-Forward, MF- Backward and DP number
 - speed dial a stored number
 - record a number with a label for future dialing
 - edit or delete speed dial numbers

For MFR2 Compelled Dialing, also see the MFC/SS#5 DIAL/
ANALYSIS menu. Refer to Figure 3–48.

```
                                        17:06:58
                    DTMF/MFR2/DP  DIALING

        METHOD       :   MF-FRWD

        NUMBER       :   98765432F

        TX-1  T/S    : 01
        RX-1  T/S    : 01
        RX  A/B/C/D  -  1  0  1  1
        TX  A/B/C/D  :  1  0  1  1
        A=  10/0     B=  11
        C=  12       D=  13
        E=  14       F=  15

      MF-FRWD     MF-BKWD     DTMF     DP
```

Figure 3—48   DTMF/MFR2/DP Dialing

This screen consists of the following elements:

1) METHOD
Options: MF-FRWD (F1), MF-BKWD (F2), DTMF (F3), DP (F4)
   This item determines the dialing method.

- Multifrequency forward (F1)
- Multifrequency backward (F2)
- Dual-tone Multifrequency (F3)
- Dial Pulse (F4)

2) NUMBER

- The last phone number dialed, if any, will be shown on the screen.
- To dial this number, simply press the ENTER key.
- Delete the previous number by pressing the DELETE (F2) key as needed until the existing number is completely deleted.

To enter a New Number:
a) Press and release the SHIFT-lock key to display the SHIFT indicator.
b) Enter the numbers 1 through 9, *, #, A, B, C, and D. 32 digits may be programmed.
c) For MF method, * and # can not be used.

d) For DTMF dialing, the E and F keys represent * and #, respectively.

Note: MF '0' is combination '10' and is shown on the display as 'A'.

- Press the ENTER key to dial the number. This will send the indicated digits with DIAL PERIOD and SILENT PERIOD as indicated in VF CHANNEL ACCESS, DIAL PARAMETERS.

Speed Dialing Procedure
Use this procedure to speed dial a user number which was programmed at an earlier time:

1) From the VF CHANNEL ACCESS menu, enter the DTMF/MFR2/ DP DIALING item.

2) Press ENTER to get into the DTMF/MFR2/DP DIALING screen.

3) Choose the dialing method, and cursor down to the NUMBER.

4) Choose more (F4) twice, and then choose USER (F1), to get the list of USER DIAL NUMBERS. This is your speed dialing list.

5) Move the cursor down to the desired number and press ENTER twice to dial the number. You will be returned to the VF CHANNEL ACCESS screen.

Entering & Editing Speed Dialing (USER) Numbers
- Program and store up 10 DTMF, DP, or MF user numbers.
- Each user number can have up to 32 digits.
- An alphanumeric label 10 characters long can also be programmed for each phone number. The label makes it easier to remember what the number is used for.

    Follow this procedure to program the number 12345ABCD. with a label of TEST01:

1) From the VF CHANNEL ACCESS menu, use the cursor keys to move the cursor to DTMF/MFR2/DP DIALING, and press ENTER.

2) In the DTMF/MFR2/DP DIALING screen, choose the dial METHOD: MF-FRWD (F1); MF-BKWD (F1), DTMF (F3), MF and (F4) are also available.

3) At the NUMBER line, select USER (more, F1).

4) At the USER DIAL NUMBER menu, move the cursor to a blank space anywhere between 1 to 10.
   a) Choose CREATE (F1).

5) The cursor should now stay at the LABEL editing position, ready to accept the entry.

6) Choose TOGGLE (F3). The letter A on the alphabet grid starts blinking.

7) Use the cursor keys to move around the alphabet grid until T starts blinking.
a) Choose SELECT (F4). You should now see T as the first character of the label. Select the E, S, and T letters by following the same procedure.

8) After you have selected the last T, choose TOGGLE (F3). The alphabet grid should stop blinking. Press the SHIFT-lock key to display the SHIFT indicator.

9) Press the 0 key, then press the 1 key.

10) Now you have entered the label. You should see TEST01 displayed next to LABEL. Press the SHIFT-lock key to remove the SHIFT indicator.

• DO NOT PRESS the ENTER key.

11) Press the cursor key down once to move the cursor to the NUMBER section. Now you are ready to enter the telephone number.

12) Press the SHIFT-lock key once.
a) Verify that the SHIFT indicator is shown on the upper left corner of the screen.

12) Enter the phone number. Press the keys to enter the following number: 12345ABCD. When you are finished, press the SHIFT-lock key to remove the SHIFT indicator.

13) Press the ENTER key to accept the new USER DIAL NUMBER. You will now see it displayed on the list of USER DIAL NUMBERs.

14) If you wish to edit the number, move the cursor down until the number is highlighted. Choose EDIT (F2).

15) The cursor will now be on the first character of the LABEL.
a) Choose INSERT (F1) if you need to start inserting more digits at that position.
b) Choose DELETE (F2) if you need to remove one or more digits at that position.
c) You can move your cursor to the right before using INSERT or DELETE.
d) You may also toggle into the alphabet grid as described in steps 5 through 9.

16) When you are done with the LABEL as described in step 15, be sure the SHIFT indicator is off and the letter on the alphabet grid has stopped blinking. Then you can move the cursor down to the number.
a) Choose INSERT (F1) to start inserting more digits at that position.
b) Choose DELETE (F2) to remove one or more digits at that position.
c) You can move your cursor to the right before using INSERT or DELETE.
d) Press SHIFT-lock to display the SHIFT indicator if you would like to enter different numbers.

17) If you made a mistake while editing an existing user number, press the ESCAPE key to abort editing. The original user number will not be affected.
If you want to keep the edited changes when you are done editing the number, press ENTER. You will see the edited label in the list. You have finished this procedure. Press ESCAPE as necessary to return to the VF CHANNEL ACCESS menu.

MF Signals

According to the ITU Q.441 specification, the tables and diagram on the following pages represent the MF Forward and Backward signals.

Combi-nation	Destination of the Signal	Meaning of the Signal	Remarks
1	II-1	Subscriber without priority	These signals are used solely for national working
2	II-2	Subscriber with priority	
3	II-3	Maintenance equipment	
4	II-4	Spare	
5	II-5	Operator	
6	II-6	Data Transmission	
7	II-7	Subscriber (or operator without forward transfer facility)	These signals are used for international working
8	II-8	Data transmission	
9	II-9	Subscriber with priority	
10	II-10	Operator with forward transfer facility	
11	II-11		
12	II-12		
13	II-13		
14	II-14		
15	II-15		

Figure 3–49   Group II Forward Signals

Combination	Designation of the signal	Meaning of the signal (c)	(d)	Remarks
1	I - 1	Language digit: French	Digit 1	Column (c) - These signals make up the first signal transmitted on an international link when it terminates in the country of destination of the call. When a link terminates in an international transit centre, however, these signals may be transmitted on the link after the country code indication and the country code.
2	I - 2	Language digit: English	Digit 2	
3	I - 3	Language digit: German	Digit 3	
4	I - 4	Language digit: Russian	Digit 4	
5	I - 5	Language digit: Spanish	Digit 5	
6	I - 6	Spare (language digit)	Digit 6	
7	I - 7	Spare (language digit)	Digit 7	
8	I - 8	Spare (language digit)	Digit 8	
9	I - 9	Spare (language digit)	Digit 9	
10	I - 10	Discriminating digit	Digit 0	
11	I - 11	Country code indicator, outgoing half-echo suppressor required	i) Access to incoming operator (Code 11)	Column (c) - First signal on an international link when it terminates in an international transit centre.
12	I - 12	Country code indicator, no echo suppressor required	i) Access to delay operator (Code 12) ii) Request not accepted	Column (d) - Other than the first signal on an international link.
13	I - 13	Test call indicator (call by automatic test equipment)	i) Access to test equipment (Code 13) ii) Satellite link not included	
14	I - 14	Country code indicator, outgoing half-echo suppressor inserted	i) Incoming half echo suppressor required ii) Satellite link included	
15	I - 15	Signal is not used	i) End of pulsing (code 15) ii) End of identification	

Figure 3–50   Group 1 Forward Signals

Combi-nation	Destination of the Signal	Meaning of the Signal
1	B-1	Spare for national use
2	B-2	Send special information tone
3	B-3	Subscriber line busy
4	B-4	Congestion (encountered after changeover from Group A signals to Group B signals)
5	B-5	Unallocated number
6	B-6	Subscriber's line free, charge
7	B-7	Subscriber's line free, no charge
8	B-8	Subscriber's line out of order
9	B-9	
10	B-10	
11	B-11	Spare for
12	B-12	National Use
13	B-13	
14	B-14	
15	B-15	

Figure 3–51   Group B Backward Signals

Combi-nation	Destination of the Signal	Meaning of the Signal
1	A-1	Send next digit (n + 1)
2	A-2	Send last but one digit (n - 1)
3	A-3	Address-complete, changeover to reception of Group B signals
4	A-4	Congestion in national network
5	A-5	Send calling party's category
6	A-6	Address-complete, charge, set-up speech conditions
7	A-7	Send last but two digits (n - 2)
8	A-8	Send last but three digits (n - 3)
9	A-9	Spare for National Use
10	A-10	
11	A-11	Send country code indicator
12	A-12	Send language or discriminating digit
13	A-13	Send nature of circuit
14	A-14	Request for information on use of an echo suppressor (Is an incoming echo suppressor required?)
15	A-15	Congestion in an international exchange or at its output

Figure 3–52   Group A Backward Signals

		Frequencies (Hz)						
		Forward direction signals of Groups I and II)	1380	1500	1620	1740	1860	1980
		Backward direction signals of Groups A and B)	1140	1020	900	780	660	540
	Numerical value = x+y	Index (x)	f0	f1	f2	f3	f4	f5
		Weight (y)	0	1	2	4	7	11
1	0+1		x	y				
2	0+2		x		y			
3	1+2			x	y			
4	0+4		x			y		
5	1+4			x		y		
6	2+4				x	y		
7	0+7		x				y	
8	1+7			x			y	
9	2+7				x		y	
10	4+7					x	y	
11	0+11		x					y
12	1+11			x				y
13	2+11				x			y
14	4+11					x		y
15	7+11						x	y

Figure 3–53   MF Combinations

6.5 DTMF/MF/DP/CAS Analysis

Enter the DTMF/MF/DP/CAS Analysis via the VF CHANNEL ACCESS menu list. Upon entering, the screen will appear as in Figure 3–54.

```
                              21:33:36


    DTMF/MF/DP/CAS  ANALYSIS


        TONE  TYPE  :  DTMF
        Rx-1  T/S   :  01
        Rx-2  T/S   :  01



    press  ENTER  to  start


CAS     MFR2       DTMF       DP
```
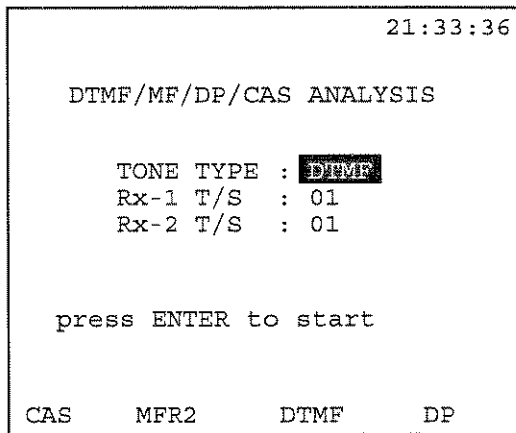
Figure 3–54   DTMF/DP/CAS Analysis

Select the following:

1) TONE TYPE
Options: CAS (F1), MFR2 (F2), DTMF (F3), DP (F4)
    Select the tone type to be analyzed:

- Channel Associated Signalling (F1)
- Multifrequency signalling for Register 2 (F2)
- Dual Tone Multifrequency (F3)
- Dial Pulse (F4)

2) Rx-1 T/S
Options: 1-31
    Select the Line 1 transmit timeslot to be analyzed.

- Press NEXT (F1) or PREVIUS (F2) as necessary.

3) Rx-2 T/S
Options: 1-31
    Select the Line 2 receive timeslot to be analyzed.

- Press NEXT (F1) or PREVIUS (F2) as necessary.

4) When your settings are correct, press ENTER. Note that the actual Rx T/S you will monitor is determined by the Rx/DROP setting in your TEST CONFIGURATION.

5) In the next screen, press ANALYZE (F1) to view the analysis of the received digits.

6) Press ESCAPE as necessary to return to the VF CHANNEL ACCESS menu.

    The following three screens are sample printouts of the CAS, DTMF, and DP analyses:

```
                              19:05:28

          DTMF/MF/DP/CAS  ANALYSIS
DIGIT-1 : f10        INTD: 097 ms
  L/H Hz 1740/ 1877 PERD: 105 ms
      dBm-6.5 /-4.8  TWST: 1.7

DIGIT-2 : f12        INTD: 097 ms
  L/H Hz 1502/ 1982 PERD: 105 ms
      dBm-6.5 /-4.8  TWST: 1.8

DIGIT-3 : f11        INTD: 097 ms
  L/H Hz 1385/ 1983 PERD: 102 ms
      dBm-6.5 /-4.7  TWST: 1.8

PAGE-UP   PAGE-DN   PRINT   RESTART
```

Figure 3–55 DTMF/MF Analysis

The DTMF/MF Analysis shows the following for the received digit:

- High and low frequencies
  For example, the second digit 2 has high and low frequencies
  of 1982 and 1502 Hz respectively.
- dBm level
- Interdigit - the silent time between digits (tones)
- Period - the duration of a multitone digit
- Twist - the difference in power between the two frequencies of
  a digit

   Press Page Up (F1) and Page Down (F2) to see the rest of the
digits received.

```
                              03:27:56

LINE-1#01/sec    LINE-2#01/sec
ABCD=0000/INIT   ABCD=0000/INIT
ABCD=0011/00.00  ABCD=0011/00.20
ABCD=1011/00.60  ABCD=1011/00.65
ABCD=0000/00.70  ABCD=0000/00.75




       STOP          RESTART
```

Figure 3–56 CAS Analysis

- For CAS, live signals are displayed.
- The STOP function key will freeze the screen.
- The RESTART key will restart the analysis.
- Press PAGE-UP and PAGE-DN to scroll through the analysis.

```
                              19:05:28

        DTMF/MF/DP/CAS ANALYSIS

No.   DIGIT PPS   PPRD  %BRK   INDT
 1      2    8    120   58
 2      6    8    120   58      510
 3      3    8    120   58      500
 4      8    8    120   58      510
 5      0    8    120   58      510
 6      0    8    120   58      510
 7      0    8    120   58      510



PAGE-UP   PAGE-DN   PRINT   RESTART
```

Figure 3–57 DP Analysis

- PPS: Pulses Per Second
- PPRD: Pulse Period - duration of a complete off-hook/on-hook cycle.

- %BRK - the percentage of time a pulse is OFF, compared to the full pulse off-hook/on-hook period.
- Interdigit - the silent time between digits (pulses)

6.6 Noise Analysis

Measure noise using various parameters, as follows:

- Signal to Noise
- Noise Psophometric filter
- Noise 3K-Flat filter
- Noise 1010 Hz filter

Refer to Figure 3–58 for the Noise Analysis menu.

```
                               22:09:44

                       NOISE MEASUREMENT

               MEASURE    :  S/N
               RX-1 T/S  :  01

                          RESULTS

          Signal to Noise    :  60.0  dB
          Noise Psophometric:  -33.6  dBm
          Noise 3K-Flat      :  -9.5  dBm
          Noise 1010 Hz      :  -68.9  dBm

         S/N    PSOPHO   3K-FLAT     1010Hz
```

Figure 3–58   Noise Analysis

Press a function key to begin one of the four measurements:

Signal to Noise (F1)
Noise Psophometric (F2)
Noise 3-K Flat (F3)
Noise 1010 Hz (F4)

- You may change the noise measurement at any time by choosing a different F-key.
- Measurement results previously made will not be erased.

• Only the measurement result for the current measurement type will be updated regularly.

6.7 MFC/SS#5 Dial/ Analysis

The MFC/SS#5 menu is shown in Figure 3–59.

```
                              15:54:46

    MFC/SS#5 DIAL/ANALYSIS


    MFC DIALING
    MFC TRACER
    MF/CAS VIEW/PRINT TRACER
    SS#5 DIALING
    SS#5 TRACER
    SS#5 VIEW/PRINT TRACER
    VIEW MFC/SS5 EXAMPLE
```
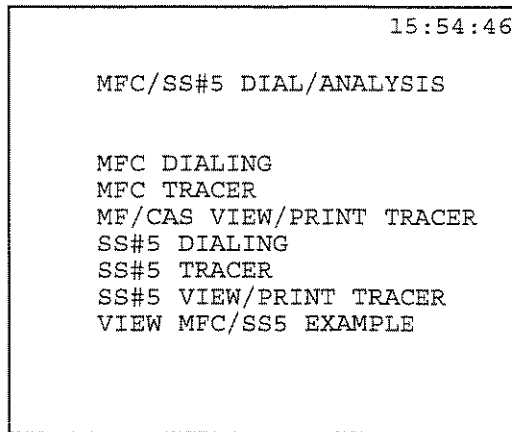
Figure 3–59   MFC/SS#5 Menu

6.7.1 MFC Dialing

MFC, MultiFrequencyCompelled, dialing allows two exchanges to send digits to each other in both the forward and backward direction. Each exchange, or register, must receive a signal before it begins sending the next signal.

Compelled signalling operates as follows:
• Upon seizure, the outgoing register starts sending the first forward signal.
• When the incoming register recognizes this signal, it sends a backward signal, which serves as acknowledgment.
• When the outgoing register recognizes this acknowledgment, it stops sending the forward signal.
• When the incoming register recognizes that this forward signal has stopped, it stops sending its backward signal.

• When the outgoing register sees that this acknowledging signal has ceased, it may begin sending the next forward signal.

Figure 3–60 shows the basic cycle of compelled signalling.
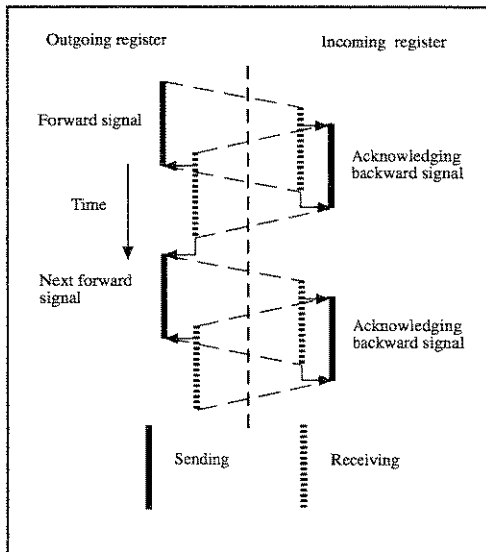
Figure 3–60   MFC Cycle

Figure 3–61 shows the MFC Dialing screen.


```
                                      17:12:46

                    MFC DIALING

      METHOD    : MF-FRWRD
      SIGNALING: AUTO
      NUMBER    : █


        RX A/B/C/D  - 1000
        TX A/B/C/D  : 0011
        A = 10/0    B = 11011
        C = 12      D = 13
        E = 14      F = 15


   IDLE    SEIZE                      more
```

Figure 3–61   MFC Dialing

MFC Dialing screen provides the following options:

1) METHOD
Options: MF-FRWD (F1), MF-BKWD (F2)
   This item determines the mode/direction of your calling.

• Press (F1) to send forward signals.
• Press (F2) to send backward signals.

2) SIGNALLING
Options: AUTO (F1), MANUAL (F2)

Forward dialing, AUTO (F1) mode:
• The test set automatically seizes the line by transmitting the FRWD SEIZE ABCD bits specified in the DIAL PARAMETERS menu.
• After it receives the BAK SEIZE ACK ABCD bits specified in the DIAL PARAMETERS menu, it sends the first digit and dialing proceeds as shown in Figure 3–60.
• Press ENTER to start the process.

Forward dialing, MANUAL (F2) mode:
• Cursor down to the number and enter the desired dialing number.
• Press SEIZE (F2) and the ENTER key to begin dialing.

   The test set will ignore the ABCD bits that are received. It will dial the first forward digit and wait for the acknowledging backward digit. Then it will dial the next forward digit and so on.

Backward dialing:
• Choose AUTO (F1) to automatically acknowledge the seizure from the other end.
• Choose MANUAL (F2) to perform the seizure acknowledgment yourself; you must enter the expected digit responses.

Manual dialing:
• Enter a 1 for each incoming digit that is to be accepted with more digits still required.
• Enter a 3 as the response to the last digit.
• Enter a 6 in response to the called subscriber service code.

BKWD Signalling Auto:
* Enter the send next digit using the NEXT (F1) or PREVIUS (F2) key. If uncertain, choose SEND NEXT 1.
* Choose FRWD END. If uncertain choose F.
* When finished entering the digits, press ENTER to start the backward dialing sequence.

In BKWD-AUTO mode the set will await for the seizure, acknowledge the seizure, wait for a digit, acknowledge the digit, wait for the next digit, acknowledge the next digit, and so on. If the FRWD END digit is received, it will not acknowledge the digit and will not acknowledge following digits. In BKWD-MANUAL mode the test set will ignore the seizure. It will send the entered digits in response to the received digits.

If dialing backward:
* Choose signalling AUTO to automatically acknowledge the seizure from the other end, OR
* Choose SIGNALLING MANUAL to perform the seizure acknowledgment yourself.

3) NUMBER
Options: IDLE (F1), SEIZE (F2), more (F4), INSERT (more, F1), DELETE (more, F2), USER (more, F1), STORE (more, F2)

* Press the IDLE (F1) key to send Idle signalling bits (1011).
* Press SEIZE (F2) to seize the line by sending 0011 A/B/C/D bits.
* Press INSERT/ TYPEOVR (more, F1).
* Press USER (more, F1) to enter the User Dial Number menu. This menu lists any user numbers already stored, which you may view and edit, and also gives you the opportunity to create new user numbers.

To create a new user number directly from the MFC Dialing screen:
* Press STORE (more, F2). You will enter the USER DIAL NUMBER screen, at the LABEL item. Use the alphabet grid to enter a label, as explained in 2) of the following procedure, then press ENTER.

To view or edit a user number, move the cursor to the desired label.
* Press VIEW (F1) or EDIT (F2) as needed.

Use the following procedure to create a new number:

1) In the USER DIAL NUMBER menu , use the arrow keys to move the cursor to a blank line.
   a) Press CREATE (F1).
   b) Alternatively, you may press STORE (more, F2) in the MFC DIALING screen.

2) Enter the LABEL first.
   a) With the cursor placed on the LABEL entry, press TOGGLE (F3) to access the alphabet grid below.
   b) Use the arrow keys to move the cursor to the desired letter.
   c) Press SELECT (more, F4). Continue this process as necessary.
   d) When you are finished with the alphabet grid, press TOGGLE (F3) to return to the LABEL entry.
   e) Press INSERT (F1) key to enter the letters A—F or numbers 0—9.
   f) Use the DELETE (F2) key to delete any unwanted digits.
   g) You may enter up to 10 digits for the Label.

3) Next, enter the number. Move the cursor to the NUMBER entry.
   a) Use the INSERT (F1) key to enter the letters A—F and the numbers 1—9.
   b) Press the DELETE (F2) key to delete any unwanted digits.
   c) You may enter up to 32 digits for the NUMBER.

4) When you have finished, press the ENTER key. This stores your new number and returns you to the USER DIAL NUMBER menu.

6.7.2 MFC Tracer

This menu displays and stores MFR2 Compelled signalling sequences. It simultaneously monitors both directions and records both the CAS bits and the dialled digits. It also shows a timestamp for each sequence. Refer to Figure 3–62.

```
                        17:42:29

LINE-1#01/sec    LINE-2#01/sec
ABCD=101/INIT    ABCD=1001/INIT
ABCD=0001/00.00
ABCD=0001/04.05
ABCD=0001/04.07
                 ABCD=1101/04.26
MFR2= f10/04.36
                 MFR2= b01/04.04
MFR2= f12/04.58
                 MFR2= b01/04.61
MRF2= f11/04.80


STOP             RESTART   SCAN
```

Figure 3–62   MFC Tracer

The following function keys are available in this screen:

STOP (F1): STOP stops the tracing process.
a) Press PAGE-UP (F1) or PAGE-DN (F2) to view the traced MFC messages.

RESTART (F3): RESTART empties the existing buffer and restarts the tracing process.

SCAN (F4): SCAN starts the test set looking for the first channel to go off hook, enabling you to trace signalling even when you don't know which channel to look at. When a channel goes off hook, the entire call is traced.

6.7.3 MF/CAS View/Print Tracer

• Clear, print, or view the buffer that stores the MF/CAS records.

Upon entering this item, an initial View/Print Tracer screen appears. This screen shows the total number of records stored.

```
                              01:21:06

        MF/CAS VIEW/PRINT TRACER

           TOTAL RECORD-2

              FROM No.: 1
              TO No.  : 2




CLR-ALL   PRINT   VIEW
```

Figure 3–63   MF/CAS View/Print Tracer Screen

1) Specify which records to view in the FROM No and TO No lines.

This screen gives you three F-key options:

CLR-ALL (F1): This key clears all records stored in the MF/CAS buffer. You will be asked to press ENTER to continue the clearing process. This two-step process safeguards against accidentally erasing important records from the buffer. Press ESCAPE if you decide not to continue erasing.

PRINT (F2): Press PRINT to print the buffer contents.

VIEW (F3): Press VIEW to view all the contents, or the specified records, of the buffer. Pressing VIEW will bring up the first record. An example is given in Figure 3–64.

```
                                          16:01:23

LINE 1          96-01-08   15:56:46
ABCD=1001/INIT

LINE 2          96-01-08   15:56:46
ABCD=0000/INIT

LINE 1          96-01-08   15:56:46
ABCD=1010/00.00

LINE 1          96-01-08   15:56:46
ABCD=1000/00.28


PAGE-UP   PAGE-DN
```

Figure 3–64   MF/CAS View Tracer

Use the PAGE-UP (F1) and PAGE-DN (F2) keys to view all the
pages of data.

6.7.4 SS#5 Dialing

• Perform SS#5 dialing in the forward direction.
• Reverse direction signalling is not provided.
• Refer to Figure 3–65.

To see a description of how SS#5 signalling works, enter the
VIEW MFC/SS5 EXAMPLE, and press (F2). Note the tracer
decodes the actual signalling signal in a more simplified fashion.

```
                            23:09:01


              SS#5  DIALING


       DIAL  NUMBER:
       ■



       A=KP1,   B=KP2,   C=ST
       D=CODE  11,   E=CODE  12



 DIAL
```
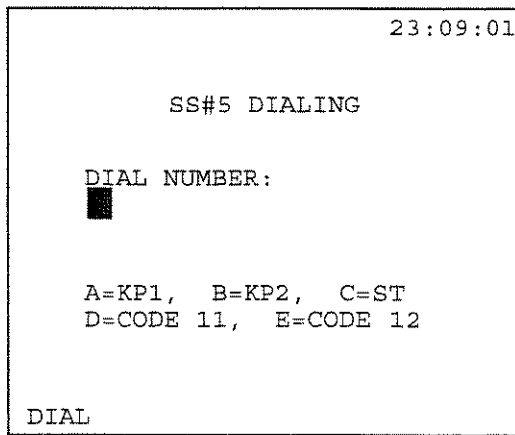
Figure 3–65   SS#5 Dialing

To enter the number for dialing:

1) Press/release the SHIFT key.

2) Enter numbers 0—9 and letters A—E from the keypad.

As shown in Figure 3–65, each letter represents a SS#5 signal defined in ITU Q.140. These signals are defined as:

   KP1 (A): terminal start-of-pulsing signal
   KP2 (B): transit start-of-pulsing signal
   ST   (C): end-of-pulsing signal
   Code 11 (D): code 11, Access to incoming operator
   Code 12 (E): code 12, Access to delay operator

3) Press the (F1) key to Dial.

   A new SS#5 Dialing screen should appear. This screen shows the Dial Number, as well as the transmit and receive signals.

4) When you have completed your call, press HANGUP (F1).

5) Press ESCAPE to return to the MFC/SS#5 menu.

6.7.5 SS#5 Tracer

•This tracer traces SS#5 messages.
• Use the STOP (F1), and RESTART (F3) keys. Once you have
    stopped the tracer, use the PAGE-UP (F1) and PAGE-DN (F2)
    keys to scroll through the tracer screens.

6.7.6 SS#5 View/Print Tracer

• Clear, print, or view the buffer that stores the SS#5 records.

    Upon entering this item, an initial View/Print Tracer screen
should appear.

• Observe the total number of records stored.
• Specify which records to view in the FROM No and TO No lines.

This screen gives you three F-key options:

CLR-ALL (F1): This key clears all records stored in the MF/CAS
    buffer.

• You will be asked to press ENTER to continue the clearing
    process. This two-step process safeguards against acciden-
    tally erasing important records from the buffer.
• Press ESCAPE if you decide not to continue erasing.

PRINT (F2): Press PRINT to print the buffer contents.

VIEW (F3): Press VIEW to view all the contents, or the specified
records, of the buffer.

• Pressing VIEW will bring up the first record.

```
                              23:48:49
              SS#5 TRACER
LINE 1            LINE 2
ABCD=1001/INIT   ABCD=1001/INIT
                 2400hz   /02.96
2600hz    /14.46
                 (KP1)    /33.84
                     3    /34.04
                     6    /34.24
                     3    /34.44
                     0    /34.46
                     5    /34.84
                 (ST)     /35.04


STOP             RESTART
```

Figure 3-66   SS#5 View Tracer

6.7.7 View MFC/SS#5 Example

- View an example of a stored MFC or SS#5 message.
- Press the MFC (F1) to view a MFC message.
- Press the SS#5 (F2) key to view a SS#5 message.

An example of each is shown in Figures 3-67 and 3-68.

```
                              17:42:29
              MFC TRACER
LINE-1/forward    LINE-2/backward
ABCD=1011/idle    ABCD=1011/idle
ABCD=0011/seiz ->
                  <-ABCD= 1111/ack
MFR2= f03      ->
                  <-MFR2= b01/next
MFR2= f06      ->
                  <-MFR2= b01/next
MFR2= f03      ->
                  <-MFR2= b01/next
MFR2= f15/end  ->

MFC     SS#5
```
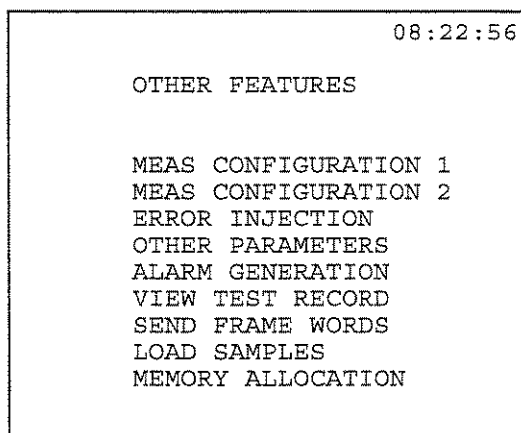
Figure 3-67   MFC Example

```
                           17:48:01
            SS#5 ANALYSIS

LINE-1/send      LINE 2/receive
2400hz/seize  ->
                 <-2600hz/proceed

(KP1)/start   ->
    0/no.0    ->
    1/no.1    ->
(ST)/stop     ->
                 <-2400hz/answer
                 <-(2600hz/busy)

2400hz/ack    ->
24+26hz/clr   ->
                 <-24+26hz/release

MFC     SS#5
```

Figure 3–68 SS#5 Example

6.8 SIGNALLING EMULATOR

• Program up to 10 different signalling sequences.
• Save 50 events in each signalling sequence.
• The Signalling Emulator menu contains two items: EDIT EMU-
  LATOR and START EMULATION.

```
                           08:22:56


   VF CHANNEL ACCESS

   VF MEASUREMENTS
   VIEW LINE 1&2 CAS
   DIAL PARAMETERS
   DTMF/MFR2/DP DIALING
   DTMF/MF/DP/CAS ANALYSIS
   NOISE ANALYSIS
   MFC/SS#5 DIAL/ANALYSIS
   SIGNALLING EMULATOR


```

Figure 3–69   VF Channel Access Menu

```
                                06:45:12


           SIGNALLING EMULATOR

           EDIT EMULATOR
           START EMULATION
```
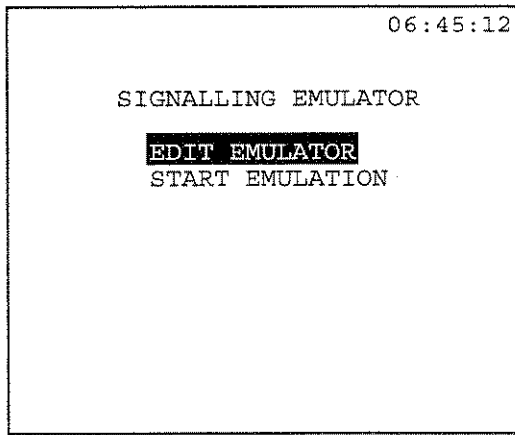
Figure 3–70   Signalling Emulator Menu

6.8.1 Edit Emulator

• Create, save, and edit your signalling sequences
• The Edit Emulator, as shown in Figure 3–71, contains the list of
    your ten emulator files.

```
                                00:41:42

                  EDIT EMULATOR

      1.  DTMF1
      2.  DTMF2
      3.  DP0000
      4.  TESTA
      5.
      6.
      7.
      8.
      9.
     10.

     EDIT    DELETE
```
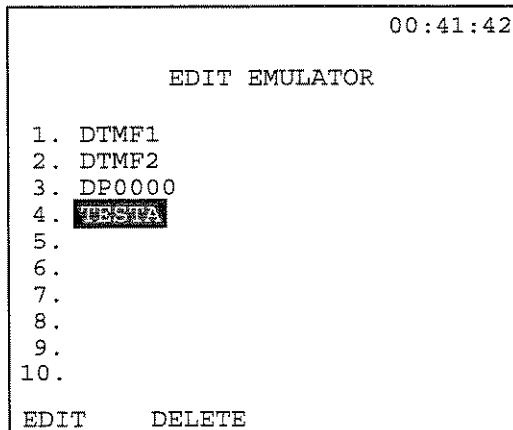
Figure 3–71   Edit Emulator Screen

To create a new file:

1) Place the cursor on an empty line and press EDIT (F1). A new
   screen will appear with the cursor at the LABEL entry.

2) To create a LABEL, press the EDIT (F1) key. You will enter the
   Signalling Emulator Label screen, shown in Figure 3–72.

Follow these steps to create a label:

1) Press TOGGLE (F3) to enter the alphabet grid.

2) Use the arrow keys to move the flashing cursor to the desired
   letter.

3) Press SELECT (F4).

4) Continue steps 2 and 3 until you have completed your label.
   When you have finished, press TOGGLE (F3) to escape the
   alphabet grid.

```
                               17:03:38
              SIGNALLING  EMULATOR

      LABEL      :  M█


                A  B  C  D  E  F  G
                H  I  J  K  L  M  N
                O  P  Q  R  S  T  U
                V  W  X  Y  Z  -  /



   INSERT    DELETE   TOGGLE   SELECT
```
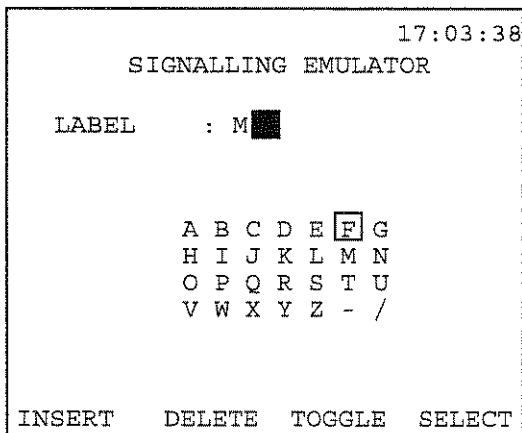
Figure 3–72   Signalling Emulator Label Screen

5) If you make a mistake while entering the letters, press DELETE
   (F2).

• You may also use the SHIFT key and the alphanumeric digits
   available on the keypad for entering the label.

6) When your label is complete, press the ENTER key to return to

the Signalling Edit Emulator screen.

Refer to Figure 3–73.

```
                                00:52:08
LABEL: MFC
No.SEND               RECEIVE
   TYPE CODE PERD TYPE CODE TOUT
01 CAS  1100      >
                  <CAS  0100 70
02 MFR2 4         >
                  <MFR2 1     70
03 █

04



 NONE      CAS    DTMF    more
```

Figure 3–73 Edit Emulator (2)

Use the arrow keys to move the cursor to the desired field.

The following features appear on this screen:

SEND Side

The Send side refers to the signalling digits which will be sent by the SunSet E10 on whichever line has been selected as Tx/ INSERT in TEST CONFIGURATION.

Three items are available for sending:

1) TYPE

Options: NONE (F1), CAS (F2), DTMF (F3), MF-F (more, F1), MF-B (more, F2), DP (more, F3)
Determines the type of signalling used.

• Press the desired F-key:

Channel Associated Signalling (F2)
Dual Tone MultiFrequency (F3)
Multi-frequency-forward (more, F1)
Multi-frequency-backward (more, F2)

Dial Pulse (more, F3)
NONE (F1)

2) CODE

Options: any keypad alphanumeric digits; four digits maximum
    for CAS. 20 digits maximum for all other types.
    These are the actual bits to be transmitted by the E10.

• Press the SHIFT key and enter the desired signalling bits

3) PERD

Options: up to 9999 ms

    PERD determines the elapsed time before proceeding to the
next step in the emulation.

RECEIVE Side

    The receive side refers to the signalling digits which you
require to be received by the E10 on the line selected in Rx/DROP
in TEST CONFIGURATION, before progressing to the next step.
These digits will be the response to your transmitted bits.

    Three items are available for the receive side; the first two,
Type and Code, work in the same manner as in the send side.

3) TOUT

Options: NONE (F1), up to 9999 ms

    TOUT refers to Time Out. This determines the length of time
which the SunSet will wait for its received digits/CAS before
aborting the signalling sequence.

a) To select a time limit, press the SHIFT key and enter the desired
    number digits up to 9999 (ms).
b) Press either the ENTER or ESCAPE key to exit the editor screen
    and save the settings.

6.8.2 Start Emulation

To begin an emulation sequence, place the cursor on START
EMULATION and press ENTER. The screen which appears upon
entering is shown in Figure 3–74.

```
                              16:08:17

           START EMULATION

   EMULATION FILE:  03
   TX-1 T/S       :  08
   RX-1 T/S       :  08




   NEXT     PREVIUS
```
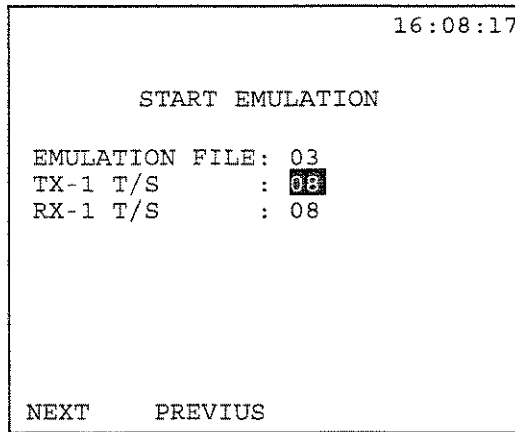
Figure 3–74   Start Emulation

The following three items should be configured in this screen:

1) EMULATION FILE

The labels here refer back to the EDIT EMULATOR list. Thus,
if you would like to use the emulator file saved with the label 04 in
th EDIT EMULATOR list, select 04 here.

• Press NEXT (F1) and PREVIUS (F2), to select the emulation file
  you would like to begin.

2) Tx-1 T/S
Options: 1—15/17—31 for PCM-30 framing; 1—31 for PCM-31
  framing.

• Press NEXT (F1) and PREVIUS (F2), to select the timeslot on
  which you will transmit your signalling bits during the emula-
  tion process.
• This item will be Tx-2 T/S, if Line 2 has been selected as Tx/
    INSERT in TEST CONFIGURATION.

3) Rx-1 T/S

Options: 1—15/17—31 from PCM-30 framing; 1—31 for PCM-31
    framing

- Press NEXT (F1) and PREVIUS (F2) to select the timeslot on
    which you will receive the signalling bits during emulation.
- Upon selecting the transmit timeslot, the receive timeslot will
    automatically change to the same number.
- The Tx and Rx timeslots do not need to be the same.
- Note that this item will be Rx-2 T/S, if line 2 has been selected
    as Rx/DROP in TEST CONFIGURATION.

Press ENTER to send your first transmit signalling bits, and
begin the emulation process.

Section 7 OTHER FEATURES

Refer to Figure 3–75 for the OTHER FEATURES Menu.

```
                              08:22:56

         OTHER FEATURES


         MEAS CONFIGURATION 1
         MEAS CONFIGURATION 2
         ERROR INJECTION
         OTHER PARAMETERS
         ALARM GENERATION
         VIEW TEST RECORD
         SEND FRAME WORDS
         LOAD SAMPLES
         MEMORY ALLOCATION

```

Figure 3–75
OTHER FEATURES Menu

7.1 MEAS CONFIGURATION 1

As shown in Figure 3–76, the user may adjust several Measurement Configuration items in this screen.

```
┌─────────────────────────────────┐
│ ▐MEAS▌              21:59:33     │
│                                  │
│     MEAS CONFIGURATION 1         │
│  MEAS DURATION  : ▐CONTINU▌      │
│  START          : MANUAL         │
│  PROG DATE YMD  : --:--:--       │
│  PROG TIME HMS  : --:--:--       │
│  CODE CONFIGUR  : HDB3           │
│  MEASURE MODE   : BER            │
│  BLOCK SIZE     : 1000           │
│  PRINT RESULT   : LAST           │
│  PRINT EVENT    : DISABLE        │
│                                  │
│                                  │
│  TIMED    CONTINU                │
└─────────────────────────────────┘
```

Figure 3–76   MEAS CONFIGURATION 1 Screen

The following items are available. Press the respective F-key to choose the desired option.

1) MEAS DURATION
Options: TIMED (F1), CONTINU (F2)
Set the MEASurement Duration.

- A timed measurement will stop automatically when the specified amount of time has elapsed. This option is useful for making measurements of a specified length; 15 minute and 1 hour tests are commonly used in the industry.
- If you choose TIMED, press the SHIFT-lock key to display the SHIFT indicator. Then enter a number between 1 min to 999 hr: 59 min.
- When a timed test is in progress, the Remaining Time (RT) counter shows how much time is left before the end of the test.
- A CONTINUous test will run indefinitely until you press the STOP key in MEASUREMENT RESULTS, or until you change some other setting on the test set that restarts the test.

2) START

Options: PROGRAM (F1), MANUAL (F2)

Select the method by which you begin your test measurements

- PROGRAM (F1) allows you to program a specified time in the future to begin taking measurements. Once you have selected PROGRAM, you must enter the desired time in the next two items.
- In MANUAL (F2), you must manually begin the test measurements at the desired time.

3) PROG DATE YMD

Applies if you have selected PROGRAM for START above.

- Enter the Year, Month, and Day to begin measurements, by pressing the SHIFT-key and the desired number keys.

4) PROG TIME HMS

Applies if you have selected PROGRAM for START.

- Specify the Hour, Minute, and Seconds to begin measurements, using the SHIFT and numeric keys.

5) CODE CONFIGUR

Options: HDB3 (F1), AMI (F2)

Select the line coding.

HDB3 line coding is used almost everywhere throughout the world in 2.048 transmission. A detailed explanation of the related technology is located in Chapter 10, Technology Overview.

6) MEASURE MODE

Options: BER (F1), LIVE (F2)

- Select BER to search for the test pattern, and make bit error measurements with all other measurements.
- Choose LIVE to ignore the test pattern and make all measurements, except for bit error measurement.
- Most people leave the test set in BER mode, even when they are monitoring live, in-service circuits. In this case, they expect the PAT SYNC light to remain RED, because there is no pattern sync. The bit error measurements will also show 100% UAS.
- If the LIVE mode is selected, the PAT SYNC LED is turned OFF

and the bit error measurement screen is not displayed in
MEASUREMENT RESULTS.

7) BLOCK SIZE
Options: 1000 (F1), 2e15-1 (F2), 2e11-1 (F3), 2e9-1 (more, F1), 2e6-
  1 (more, F2)
  Determines the block size used in the Block Error Ratio measure-
ment.

* One block is typically 1000 bits long.
* BLER (Block Error Ratio) is the fraction of blocks in error (the
  number of blocks received with one or more bit errors divided by
  the total number of blocks transmitted).

8) PRINT RESULT
Options: TIMED (F1), LAST (F2)

* Select TIMED to have the test results printed every 2 to 99
  minutes. Press the SHIFT key, then enter the number of
  minutes (between 2 and 99 minutes).
* In LAST mode, the test results are printed only at the end of a
  timed test, or a continuous test that has ended due to a
  RESTART.

9) PRINT EVENT
Options: ENABLE (F1), DISABLE (F2)

* Choose ENABLE if you would like the printer to print out a time and
  date-stamped error message every second that one or more
  errors occur.
* Choose DISABLE if you do not want the printer to print out a result
  each time.

7.2 MEAS Configuration 2

This configuration screen relates to ITU standards for 2.048 Mbps transmission, G.821, G.826, and M.2100. Refer to Figure 3–77.

```
┌─────────────────────────────────────┐
│  ▐MEAS▌              00:58:29        │
│  --- MEAS CONFIGURATION 2   ---      │
│  G.821 : ▐OFF▌                       │
│  G.826 : ON                          │
│  M.2100: OFF                         │
│                                      │
│   -- M.2100/550 PARAMETERS --        │
│  MEAS PERIOD : 01 min                │
│  HRP MODEL % : 040.0                 │
│                                      │
│                                      │
│                                      │
│                                      │
│  ON      OFF                         │
└─────────────────────────────────────┘
```

Figure 3–77   MEAS Configuration 2

The first three items relate to ITU standards on measurements and performance characteristics for 2.048 Mbps.

1) G.821
Options: ON (F1), OFF (F2)

• When the G.821 Measurement is turned ON, the Bit Error screen is shown in the Measurement Results.
• This G.821 screen presents the measurement parameters specified in ITU G.821: Bit Errors (and Rate), Errored Seconds (and %), Severely Errored Seconds (and %), Error Free Seconds (and %), Available Seconds (and %), Unavailable Seconds (and %), Degraded Minutes (and %).

2) G.826
Options: ON (F1), OFF (F2)

• When the G.826 Measurement is turned on, the G.826 screen is displayed in MEASUREMENT RESULTS.
• This G.826 screen presents the measurement parameters defined

in G.826: Available Seconds (and %), Background Block Error (and %), Errored Block, Errored seconds (and %), Severely Errored Seconds (and %), Unavailable Seconds (and %).

3) M.2100
Options: ON (F1), OFF (F2)

* When M.2100 is turned on, the M.2100 screen is shown in MEASUREMENT RESULTS.
* This section refers to ITU specifications used when a 2.048 Mbps circuit passes through international boundaries. It allocates a certain allowable error rate to each nation that carries the circuit. The technician merely needs to enter the appropriate percentage allowed for the line under test.
* The SunSet makes the M.2100/550 calculations and reports whether the line passed or failed in the MEASUREMENT RESULTS, M.2100/550 screen.

The next two settings refer to the M.2100/550 measurements:

4) MEAS PERIOD
Options: 01-99 min.
   This setting controls how often a new result is displayed in MEASUREMENT RESULTS - LINE 1(2) M.2100/550.

* Use the SHIFT key and the numeric keys to set the period.

5) HRP MODEL %
Options: .1 to 99.9 %

* Refer to M.2100, or to the older M.550, for information on how to select the Hypothetical Reference Performance model percent (HRP %).
* This percentage is chosen when more than one telephone company is providing a 2.048 Mbps circuit, and each company is allocated a percentage of the total allowable end-to-end error rate.

7.3 Error Injection

Figure 3–78 displays the ERROR INJECTION screen.

```
                              11:41:45

          ERROR  INJECTION

          TYPE     : ▮BIT+CODE▮

          MODE     : BURST

          COUNT    : 1




 CODE     BIT     BIT+CODE     more
```
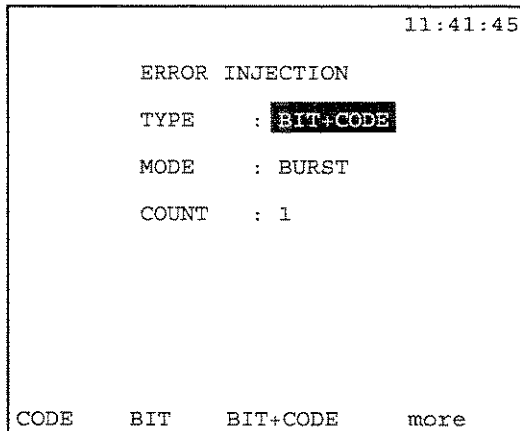
Figure 3–78 ERROR INJECTION Screen

• To start error injection, press the ERR INJ key. The test set will
   insert errors as you specify below.
• If the error injection is set to RATE mode, an ERR INJ indicator
   will be displayed on the screen.

1) TYPE
Options: CODE (F1), BIT (F2), BIT+CODE (F3), CRC-4 (more, F1),
    FRAME (more, F2), EBIT (more F3)
    This item specifies the type of errors to be inserted.

2) MODE
Options: RATE (F1), BURST (F2)
    This item specifies the mode of error injection .

• RATE mode applies only to BPV and LOGIC errors.
• Other types of errors may be inserted one at a time under BURST
   mode.

3) COUNT
Options: 1 to 9999
    For BURST MODE, choose the COUNT of errors to be inserted.
• Press the SHIFT key, then type in any number between 1 and

9999. The errors will be inserted in approximately 1 second or less, and will cause from 1 to 3 errored seconds.

4) RATE
Options: 2×10^{-3} to 1×10^{-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.

Programming a Burst of 10 Errors
Here is a sample procedure for programming a burst of 10 CODE errors:

1) From the MAIN MENU, use the cursor keys to move the cursor to OTHER FEATURES, and press ENTER.

2) In the OTHER FEATURES menu, cursor to ERROR INJECTION and press ENTER.

3) Choose CODE (F1) to select the error type.

4) The cursor automatically moves down to MODE selection. Press BURST (F2) key.

5) The cursor automatically moves down to COUNT. Press the SHIFT-lock key once to display the SHIFT indicator.

6) Press the 1 key followed by 0 key. The COUNT should show 10.

7) Press ENTER; you have just programmed the set to inject 10 CODE errors each time you press the ERR INJ key.

Programming a 10^{-6} Bit Error Rate
Use this procedure to program a 10^{-6} error rate:

1) From the MAIN MENU, cursor to OTHER FEATURES, and press ENTER.

2) In the OTHER FEATURES menu, move the cursor to ERROR INJECTION, and press ENTER.

3) Choose BIT (F2) to select the error type.

4) The cursor automatically moves down to MODE selection. Choose RATE (F1).

5) The cursor automatically moves down to RATE. Press the SHIFT-lock key once. Verify that the SHIFT indicator is shown on the upper left corner of the screen. Your key pad now allows you to enter the numeric number.

6) Press the '1' key once. The multiplier position is showing '1'. The cursor moves to the exponent position.

7) Press the '6' key once. A '6' is entered.
a) Press SHIFT key to remove the SHIFT-lock indicator.

8) Press ENTER. You have just programmed the set to inject Bit errors at 1x10-6 rate each time you press the ERR INJ key.

   Note: when the set is injecting errors at a constant rate, an ERR INJ indicator will be shown at the upper center of the screen.

   To turn off the error rate injection, press the ERR INJ key once, and verify that the ERR INJ indicator on the screen has turned off.

   Note: Code error injection is disabled when you are using a test pattern which includes long strings of zeroes, such as 1-8, 3-24, and 0000, unframed. The rationale is that injected code errors violate the intentional bipolar violations of HDB3 coding, and cause bit errors. If you change the framing to PCM-30 or PCM-31, you will be able to inject and detect code errors.

7.4 Other Parameters

Figure 3–79 depicts the OTHER PARAMETERS screen.

```
                              11:26:59

             OTHER PARAMETERS

     PATTERN INVERSION: DISABLE

     IDLE CHNL CODE    :11010101
     IDLE CHNL A/B/C/D:1101

     REFERENCE CLOCK   : NORMAL

     TEST PAT SELECT   : 20ITU


ENABLE      DISABLE
```

Figure 3–79 Other Parameters Screen

1) PATTERN INVERSION
Options: ENABLE (F1), DISABLE (F2)
    Enable or disable pattern inversion.

* When pattern inversion is enabled, transmitted 1s will be turned
    into 0s, and transmitted 0s will be turned into 1s.
    - For instance, with pattern inversion selected, a 3-in-24 pattern
        will actually be transmitted as a 21-in-24 pattern.
* The PAT SYNC LED will light green only if the test set receives
    the same inverted pattern as it transmits.

2) IDLE CHANNEL CODE
Options: any 8-bit pattern
    Program the idle code to be any 8-bit pattern.

* This code is used during VF channel access operations, when the
    Tx Source is set to the TESTPAT mode.
* The idle code is also used in fractional E1 testing to fill up the
    unused channels.

3) IDLE CHANNEL ABCD
Options: any 4-bit pattern

Program the idle channel signalling bits of channels 1 through 30 in the MFAS framing mode.

- These signalling bits are found in time slot 16 of frames 1 through 15.
- The factory default, 1101, is set in accordance with ITU G.704.

4) REFERENCE CLOCK
Options: NORMAL (F1), MLTIPRT (F2)
Determine the source of the reference clock.

- Press (F1) to use the normal reference clock, as configured in TEST CONFIGURATION (INTERN, L1-RX).
- Press (F2) to use a reference source from the Multiport.

5) TEST PAT SELECT
Options: 20ITU (F1), QRS (F2)
Determines whether to place 20ITU (F1) or QRS (F2) in the SEND TEST PATTERN screen.

7.5 ALARM GENERATION

Figure 3–80 depicts the ALARM GENERATION screen.

```
                              17:31:55
             ALARM GENERATION

         FAS  DISTANT    :  ENABLE

         MFAS  DISTANT  :  ENABLE

         AIS             :  DISABLE

         T/S-16 AIS      :  DISABLE




   ENABLE      DISABLE
```
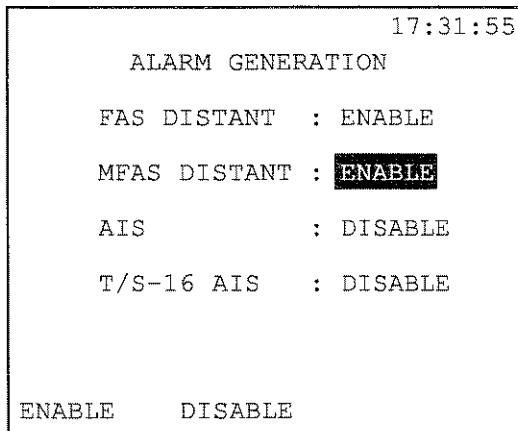
Figure 3–80   ALARM GENERATION

• View a listing of the alarms you may transmit.
• These alarms allow you to test the response of various network equipment to alarms and thus, ensure that the network is performing as expected.

To invoke the desired alarm:

Move the cursor down to the respective item and choose ENABLE (F1).

• Note that some alarms conflict with the transmission of other alarms or selected framing.
• The test set will transmit the enabled alarm after you exit the ALARM GENERATION menu.
• You can continue to transmit alarms while making measurements, viewing data, performing talk/listen, etc.
• If you do not intend to transmit alarms when you exit this screen, be sure to disable all the alarms first.

These are the choices:

1) FAS DISTANT
Options: ENABLE (F1), DISABLE (F2)

• The test set transmits a 1 in every third bit of each timeslot 0 frame that does not contain frame alignment signal.
• FAS DISTANT alarm may be transmitted only with PCM 30 or PCM 31 framing.

2) MFAS DISTANT
Options: ENABLE (F1), DISABLE (F2)

• The test set transmits a 1 in the sixth bit of each time slot 16 in the zero frame.
• The MFAS distant alarm may be transmitted only with PCM framing.

3) AIS
Options: ENABLE (F1), DISABLE (F2)

• The test set transmits all ones in an unframed signal.
• This alarm overrides the framing choice in the TEST CONFIGURATION menu.

- For instance, even though you have selected MFAS framing, generating an AIS alarm will cause the set to transmit an unframed signal (all ones).

4) T/S-16 AIS
Options: ENABLE (F1), DISABLE (F2)

- The test set transmits all ones in timeslot 16 of all frames.
- T/S-16 AIS overwrites the MFAS, MultiFrame Alignment Signal.
- A test set or network equipment that receives this alarm will lose PCM-30 framing.
- This alarm should be transmitted only when the test set is configured for FAS framing.
- It is not possible to transmit voice frequency signalling bits while sending this alarm, because the T/S-16 AIS signal overwrites all the channel associated signalling (CAS) information.

7.6 VIEW TEST RECORD

The SunSet E10 can store up to 26 Records, and up to 2000 events. Figure 3–81 displays the VIEW TEST RECORD screen.

```
 MEAS                    03:31:27

        VIEW TEST RECORD

 01   RESULT   RECORD : UNLOCK
      START    98-11-23 11:48:31
      STOP     98-11-23 12:10:14

 02   NONE     RECORD : LOCK
      START    98-11-23 17:50:45
      STOP     98-11-23 17:55:44

  Press ENTER to View


PAGE-UP PAGE-DN  UN/LOCK CLR-ALL
```

Figure 3–81   View Test Record

- The Measurement Results numbers are shown in accordance with the events and results that are in memory, which are stored in accordance with the PRINT RESULT and PRINT EVENT

(ENABLE to store events) items in MEAS CONFIGURATION 1. Events are errors and alarms.

In addition to PAGE-UP (F2) and PAGE-DN (F3), the following additional F-keys are available:

Press UN/LOCK (F3) to lock the record, so it can not be deleted. Press again to open the record.

Press CLR-ALL (F4) to clear the buffer.

1) Scroll to select the Measurement Result you want to view.

2) Press ENTER.

a) PAGE-UP (F1) and PAGE-DN (F2) to scroll through the screens.

b) Press PRINT (F3) to print the record you are viewing.

7.7 Send Frame Words

• Manually specify the E and Sa bit states, and the MFAS ABCD.

• Transmit the desired FAS and MFAS framing information.

• Refer to Figure 3–82, Send Frame Words.

```
┌─────────────────────────────────────┐
│  MEAS                    19:27:02    │
│        SEND  FRAME  WORDS            │
│ CRC: YES        NFAS  WORD           │
│ E-BIT: 1█       S       S S S S  S   │
│                 i 1 A a a a a a      │
│ FAS WORD        C 1 0 1 1 1 1 1      │
│ C0011011        C 1 0 1 1 1 1 1      │
│                 C 1 0 1 1 1 1 1      │
│ MFAS WORD       C 1 0 1 1 1 1 1      │
│ 00001011        C 1 0 1 1 1 1 1      │
│                 C 1 0 1 1 1 1 1      │
│ MFAS ABCD       1 1 0 1 1 1 1 1      │
│ 1101            1 1 0 1 1 1 1 1      │
│                                      │
│ SET=0   AUTO    DEFAULT      SEND    │
└─────────────────────────────────────┘
```

Figure 3–82 Send Frame Words

• You may not change certain items in this screen.

• The cursor will land on and highlight only those items which can be changed.

• Use the left and right arrow keys to move the cursor to the desired

location. You cannot enter the left-hand side of the screen by continuously pressing the right arrow key.
The following information is shown on this screen:

1) CRC

Options: for viewing only.

This selection displays the CRC option chosen in TEST CON-FIGURATION.

- Change the CRC option in the TEST CONFIGURATION screen, from the Main Menu.

2) E-BIT

Options: MANUAL/AUTO (F2), DEFAULT (F3), SEND (F4)

- If MANUAL is selected, SET (F1)=1 or 0 ; the SET F-key value is the opposite of the value already displayed.
- The E-bit item may be changed only if CRC is activated in TEST CONFIGURATION, and consequently, YES is displayed in the CRC slot in this screen.
- If E-bit is set to AUTO, the E-bits will be transmitted on the TX/ INSERT side any time a CRC error is received on the Tx/ INSERT side Rx.
- Do not look at the RxDROP setting.
- Refer to Figure 3–83, Automatic E-BIT Transmission.
- Press SEND (F4) to transmit.

L1Rx CRC Error

1 E-bit Error

L1Tx

```
TxINST = L1-Tx
Rx/DROP= L1Rx or L2-Rx
E-bit  =AA
```
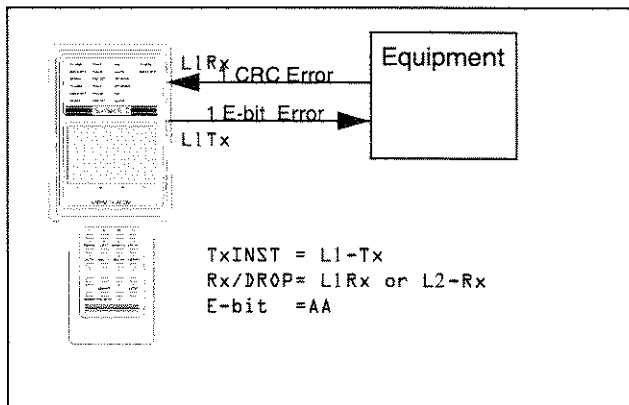
Figure 3–83 Automatic E-Bit Transmission

The E-bits may be transmitted manually:
- 11 is used for no E-bit errors.
- 10 or 01 for 500 E-bit errors per seconds.
- 00 for 1000 E-bit errors per second.
- The default setting is for 11.

3) FAS WORD

FAS WORD displays the FAS (Frame Alignment Signal- 0011011) Words. This line is for viewing only.

4) MFAS WORD

Set bits 5-8 to any combination.

- Bits 5-8 have the pattern xyxx, where x represents spare bits; they should be set to 1 when not used.
- Y is used for the MFAS remote alarm; it should be set to 1 if MFAS synchronization is lost.

5) MFAS ABCD bits

These are the default ABCD bits used for channels 1 through 30 in PCM-30 Framing.

- They are transmitted in timeslot 16 of frames 2 through 16 of the MFAS.
- Avoid using 0000 which will cause false framing for PCM-30.

6) NFAS WORDS

These are the Non Frame Alignment Signal words.

In FAS framing, the odd frames do not contain the frame alignment signal. The bits are defined as follows:

i: When CRC is enabled, bit 1 is used for the cyclic Redundancy Check-4 performance monitoring. When CRC is enabled, this bit may not be changed here. It may be changed when CRC is disabled.

1: The second bit is always set to 1 to avoid FAS signal simulations.

A: Bit A is used for the Remote (FAS) Distant Alarm. Set this bit to 1 to indicate an alarm condition.

a (bits 4-8): Spare bits; they should be set to 1 when not in use.

- Press SEND (F4) to transmit the words.

7.8 Load Samples

• Load samples of both SS#7, SS#5, and ISDN messages, with 5 total records into the VIEW/PRINT TRACER.

For example, in the OTHER MEASUREMENTS, SS#7 ANALYSIS, MSU MONITOR, VIEW/PRINT TRACER, there should be a total of 5 MSU/ ISUP messages stored in the buffer.

For ISDN, the buffer can be found in the OTHER MEASUREMENTS, ISDN ANALYSIS, VIEW/PRINT TRACER Menu.

Load Samples can also store samples of SS#5 and MF/ CAS These buffers are located in the VF CHANNEL ACCESS, MFC/ SS#5 DIAL ANALYSIS menu.

Warning: If you already have stored records in any of these VIEW/PRINT TRACERs, these records will be replaced by the Load Samples, and thus, you will lose your existing database. When you enter LOAD SAMPLES, the test set will warn you of this fact, and allow you to press the ENTER key to continue the process. If you no longer wish to continue, simply press the EXIT key.

7.9 Memory Allocation

This screen allows you to divide your buffer memory among certain options. A sample screen is provided in Figure 3–84.

```
                                09:21:56


            MEMORY ALLOCATION

    SS#7       MEM SIZE  : 600
    ISDN       MEM SIZE  : 600
    GSM Abis   MEM SIZE  : 600
    GSM A      MEM SIZE  : 600




INCRS     DECRS
```

Figure 3-84   MEMORY ALLOCATION

- There are a total of 2400 blocks of memory space allocated for
  storing the SS#7, ISDN, and GSM messages.
- Use the INCRS (F1) to allocate more memory to one type of
  message buffer.
- Use the DECRS (F2) to reduce the amount of buffer space.
- When you change one allotment, the allotment for the next
  protocol in the list will correspondingly change (for example,
  increase ISDN by 100, and GSM Abis will decrease by 100). You
  may change each option individually as well.
- The minimum required buffer space is 100. The maximum
  possible buffer space for one type is 2100. Notice that after the
  memory allocation, all the existing messages will be erased.

Section 8 System Parameters

```
                              19:37:03


        SunSet-E10 MAIN MENU

          TEST CONFIGURATION
          TEST PATTERN
          MEASUREMENT RESULTS
          OTHER MEASUREMENTS
          VF CHANNEL ACCESS
          OTHER FEATURES
          SYSTEM PARAMETERS
          LANGUAGE SELECTION
```

Figure 3–85   Main Menu/System Parameters

Figure 3–86 displays the System Parameters menu.

```
                              05:28:22


          SYSTEM PARAMETERS

          GENERAL CONFIG
          ERASE NV RAM
          FULL SELF TEST
          CLR PRINT BUFFER
          VERSION/ OPTION
          FACTORY DEFAULTS
```

Figure 3–86   SYSTEM PARAMETERS Menu

8.1 General Configuration

• Set the correct time and date.
• Set the backlight duration.
• Set several printing options.

Figure 3–87 depicts a sample screen.

```
                              20:21:11
              GENERAL CONFIG


   DATE (Y-M-D) : 96-01-03
   TIME (H:M:S) : 20:13:24

   BACK LIGHT   : CONTINU
   PRINTER
     BAUD RATE  : 9600
     PARITY     : NONE
     STOP BIT   : 1-BIT
     BITS/CHAR  : 8-BIT
     CR/LF INSRT: CR+LF
 TIMED    CONTINU
```

Figure 3–87   General Configuration Screen

The following items are available for configuration:

1) DATE (Y- M - D)

• Set the date by pressing the SHIFT key and the appropriate
  number keys for the year, month and day. The test set inserts
  the hyphens for you. Numbers that are out of range will be
  rejected.
•Press the SHIFT-lock key again to remove the SHIFT indicator.

2) TIME (H :M :S)

• Set the time by pressing the SHIFT key and the appropriate
  number keys, for the hour, minute, and second. The test set
  inserts the colons for you. Numbers that are out of range will be
  rejected.
• Press the SHIFT-lock key again to remove the SHIFT indicator.

3) BACK LIGHT

Options: TIMED (F1), CONTINU (F2)

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

- Choosing CONTINU (F2) means that the backlight will stay on continuously until you press the LIGHT key again. CONTINU is the default setting.
- Choosing TIMED (F1), and the backlight will automatically turn itself off after the indicated number of minutes.
  a) Press the SHIFT-lock key to display the SHIFT indicator.
  b) Type in any number of minutes between 1 and 99.
  c) Press the SHIFT-lock key again to remove the SHIFT indicator.

Printer items:

The factory default settings work with the printer supplied by the factory. However, you can alter these settings if you want to use the SunSet E10 with another printer. Figure 3–88 shows the pin-to-pin assignments of the DIN to EIA 232-C cable supplied by Sunrise Telecom.

You are free to use this information to attempt to set the SunSet E10 up with another printer. However, Sunrise Telecom does not warrant the operation of the test set with any printer other than the one supplied by Sunrise Telecom.

```
              ┌─────────────────────────────────────────┐
              │                                         │
              │        _____              │
              │       /                   \             │
              │    .·6·7·8·.                \           │
              │   (·3·4·5·)                  \          │
              │    ·.·2·.·                    \         │
              │     '·1·'                      _____│
              │                                         │
              │   DIN 8-PIN            ·1·2·3·4·5·       │
              │                       ( · · · · · )      │
              │                        ·6·7·8·9·         │
              │                         DB9             │
              │                                         │
              │   ------ PIN-TO-PIN CONNECTIONS -----    │
              │                                         │
              │   DIN 8-PIN           EIA-232-C D-SUB    │
              │   PIN# DESCRIPTION    PIN# DESCRIPTION   │
              │      2 DSR ─────────── 6 DSR             │
              │      3 TX  ─────────── 3 TXD             │
              │      4 RX  ─────────── 2 RXD             │
              │      5 GND ─────────── 5 GND             │
              │      6 CTS ─────────── 8 CTS             │
              │      8 DTR ─────────── 4 DTR             │
              │                                         │
              └─────────────────────────────────────────┘
```
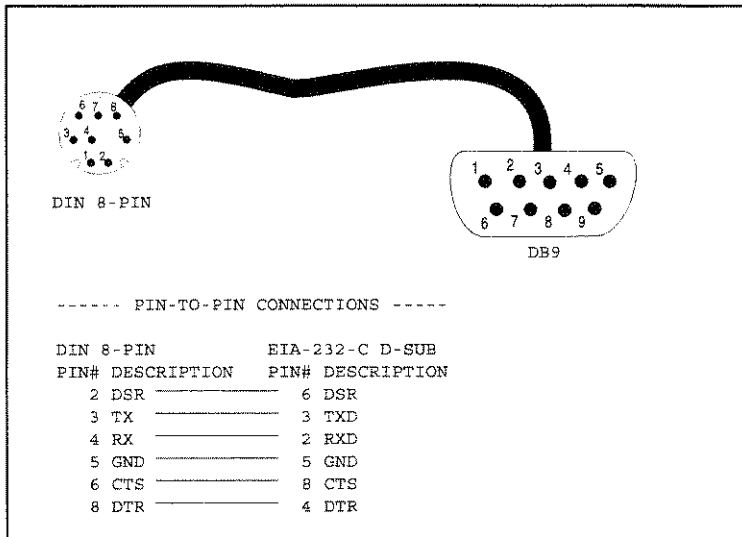
Figure 3–88   Printer Cable Pin Assignments

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

The Baud rate determines the number of shortest signalling elements per second on a transmission medium.

- The default setting is 9600; this setting is recommended for remote control operations.
- 1200 and 2400 will not support remote control features.

5) PARITY
Options: NONE (F1), EVEN (F2), ODD (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.

- In Odd Parity (F3), the total number of ones (including the added parity bit) is odd.
- In even parity, the total number of ones (including the added parity bit) is even.
- The receiving element checks the parity bit, and indicates an error if the total number of ones does not add up to the correct total.

• None (F1), the factory default setting, signifies no parity checking.

6) 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.

• Select 1-BIT (F1) or 2-BIT (F2).
• The factory default setting is 1-BIT.

7) BITS/CHAR
Options: 7-BIT (F1), 8-BIT (F2)

BITS/CHAR determines the number of bits per character.

• Press (F1) to select 7 bits per character.
• Press (F2) to select 8 bits per character.

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

• Press CR (F1) to select carriage return.
• Press CR+LF (F2) for carriage return and line feed.
• In carriage return and line feed, an extra line space is inserted after every line.

8.2 ERASE NV RAM

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

1) Making sure that the test set is properly configured for the application being attempted.
2) Turning the power switch off and on.
3) Performing a self test and turning the power off and on again.

WARNING: Performing the NV RAM ERASE operation will erase all the user-storable information the user has entered into the test set. All user transmit patterns, telephone numbers, and system profiles will be erased.

Use the following procedure to perform ERASE NV RAM :

1) From the main menu, enter the SYSTEM PARAMETERS menu, then enter the ERASE NV RAM menu item.

2) Press ENTER again after the warning message is displayed. A WORKING message will be displayed.

3) When the test set is finished with the operation, turn the power off for 5 seconds, then turn the power back on.

4) Reconfigure the set for the operations you need to perform. TEST CONFIGURATION, TEST PATTERNS, and all other areas of the set will be restored to the factory defaults.

8.3 Full Self Test

• Use the FULL SELF TEST to perform a hardware test within the SunSet E10.
• If an error message is shown after the FULL SELF TEST is completed, please contact Sunrise Telecom Customer Service at 1 408 363 8000 (telephone) or 1 408 363 8313 (fax) for assistance.
• Press ENTER to run the SELF TEST.
• Press a key, as prompted, when the test completes.

8.4 CLR PRINT BUFFER

• Prevent unwanted printing by clearing the print buffer before using the printer.
• If you don't clear the print buffer, the test set will print the entire contents of the buffer when you first enable the printer.
    For instance, the test set may have over 10 BASIC MEASURE-MENTS, or 800 events, stored in the print buffer. These must all be printed before the desired current tests or events are printed.

• To clear the print buffer, enter CLR PRINT BUFFER. You will see the screen flash quickly. The print buffer is now erased.

8.5 VERSION/OPTION

This screen displays the software version, type, serial number, and options installed in your SunSet E10. Figure 3–89 depicts a sample Version/option screen.

```
                                          22:09:42
Version 2.30
S/N: QP 000962
OPTION :
A: SW100 - Remote Control
B0:75ohm/2.37V interface
C: SW251 - MF/DTMF/DP
D: SW252 - NOISE
E: SW253 - SS#7 analysis
F: SW254 - ISDN analysis
G: SS251 - DATACOM module
H: E-BIT, BLK ERR, PROP DELAY
I: SW259 - SS#5/MFC

PAGE-UP      PAGE-DN
```

Figure 3–89   Version/ Option Screen

Note: The serial number displayed in the screen should agree with the serial number written on the cartridge as well as the serial number written on the back of the set.

8.6 FACTORY DEFAULTS

• Resets all settings to the factory default settings

Upon pressing ENTER at the FACTORY DEFAULTS line, the screen should read "Working...." There is no Factory Defaults screen, and this process does not include a second step (as in pressing ENTER a second time to continue). Therefore, do not press the ENTER key on the Factory Default selection, unless you

want all the settings to return to the default settings.

Section 9 LANGUAGE SELECTION

• Select the test set's working language.

```
┌─────────────────────────────────┐
│ MEAS              20:00:39       │
│                                  │
│     SELECTION LANGUAGE           │
│   SELECTION LANG.:  FRANC        │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│                                  │
│ANGLAIS  FRANC.  ITALIEN ESPAGNL  │
└─────────────────────────────────┘
```
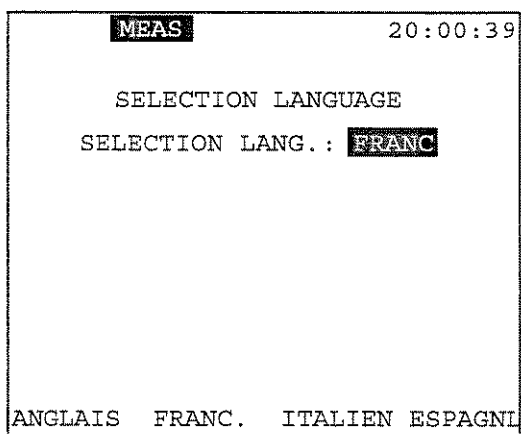
Figure 3–90
Language Selection Screen

a) Press the corresponding F-key to select a language:

• English (F1)
• French (F2)
• Italian (F3)
• Spanish (F4)

   All menu choices and settings will be shown in the language
selected.

Chapter 4
Applications

Section 1 Connecting the Cords

WARNING!
Plugging into a live E1 circuit may cause a loss of service for multiple customers. Be sure you are properly trained before proceeding.

WARNING!
To perform a BRIDGE access, do not plug into the circuit until you have pre-selected the BRIDGE Rx-LVL. The SunSet will not place isolation resistors on the line unless this Rx-LVL is specified.

Figures 4-1 through 4-4 show the various ways in which to connect the SunSet to the circuit.
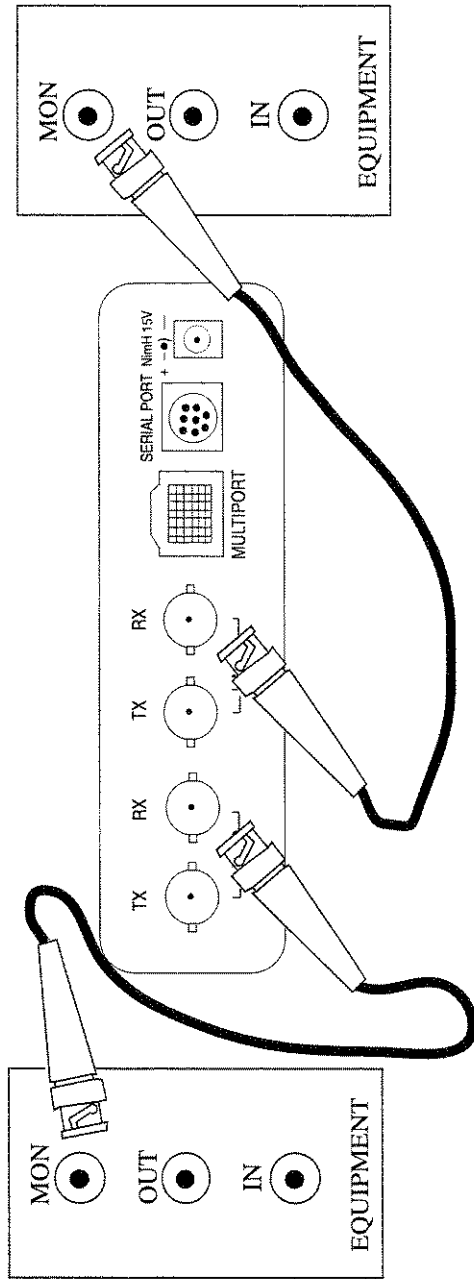
Figure 4–1   Plugging In - Monitor Mode
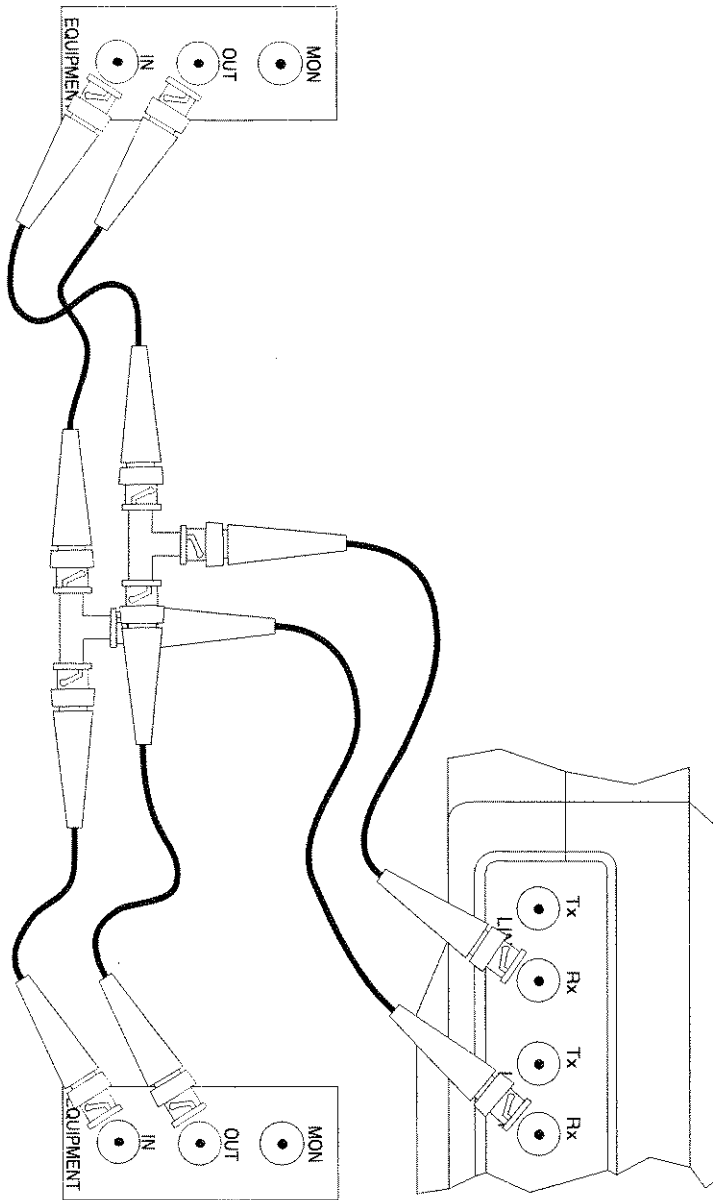
Figure 4–2 Plugging In - Bridge Mode
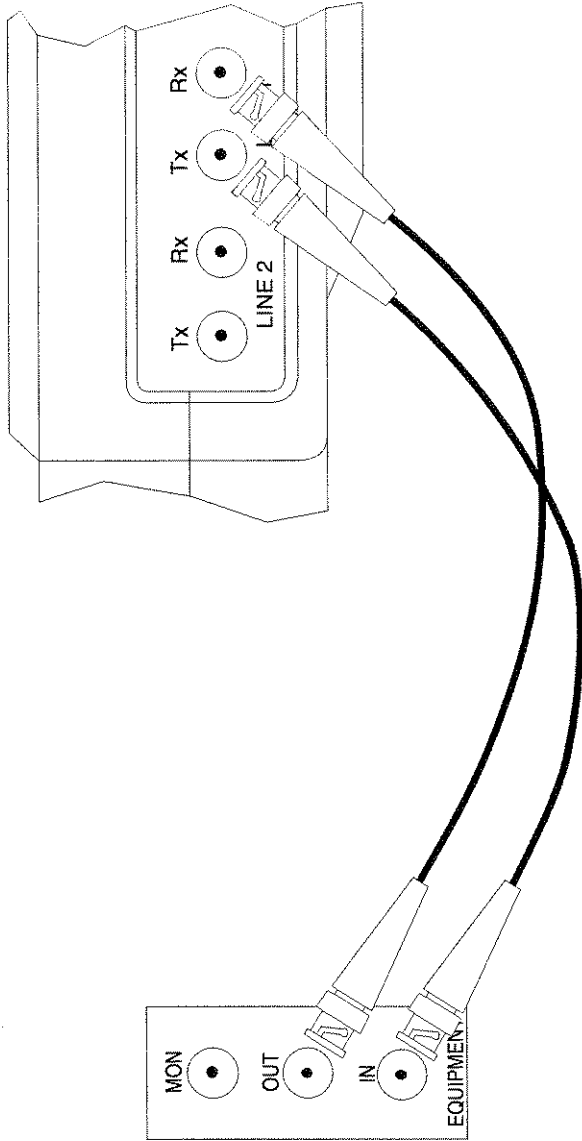
Figure 4–3
Plugging in- TERM Mode
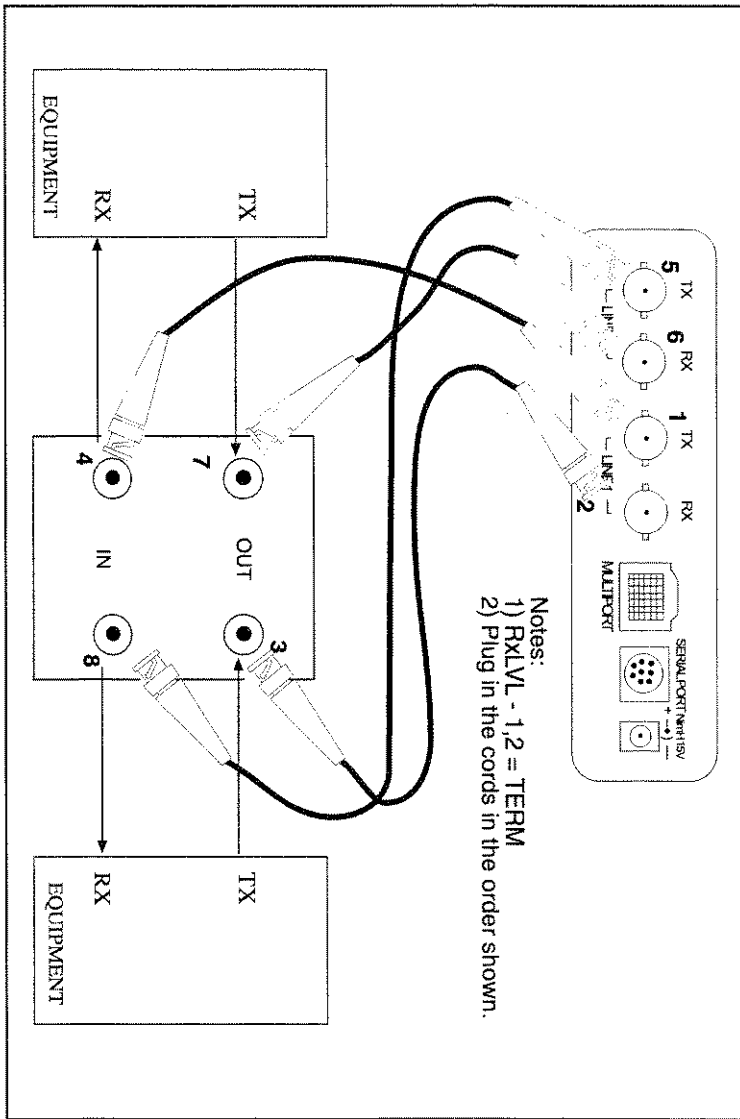
Figure 4–4   Plugging in- THRU Mode

Section 2 Basic Applications

2.1 Accept a New Circuit

Here is a procedure for accepting a new circuit. The setup is illustrated in Figure 4–5.

1) Verify that the span is not in service. This acceptance test will disrupt service. Ensure that there is a loopback device at the far end of the span.

2) From the MAIN MENU, enter the TEST CONFIGURATION menu; press ENTER. Use the following configuration:

    - TEST MODE   : E1
    - Tx/INSERT   : L1-Tx
    - Rx/DROP   : L1-Rx
    - Tx SOURCE   : TESTPAT
    - FRAMING   : as specified by the circuit design
    - CRC-4   : as specified by the circuit design
    - TEST RATE   : 2.048M
    - RxLVL-1   : TERM
    - RxLVL-2   : TERM
    - XMT CLOCK   : INTERN

a) Press the ENTER key when all of the settings are correct.

3) Move the cursor to the TEST PATTERN menu item and press ENTER.
a) Highlight the pattern you want to send. Press ENTER.

4) Connect the SunSet to the circuit as shown in Figure 4–5.
a) Press the HISTORY key to acknowledge any blinking history lights and turn them off.
b) Verify that the PAT SYNC LED is lit green.
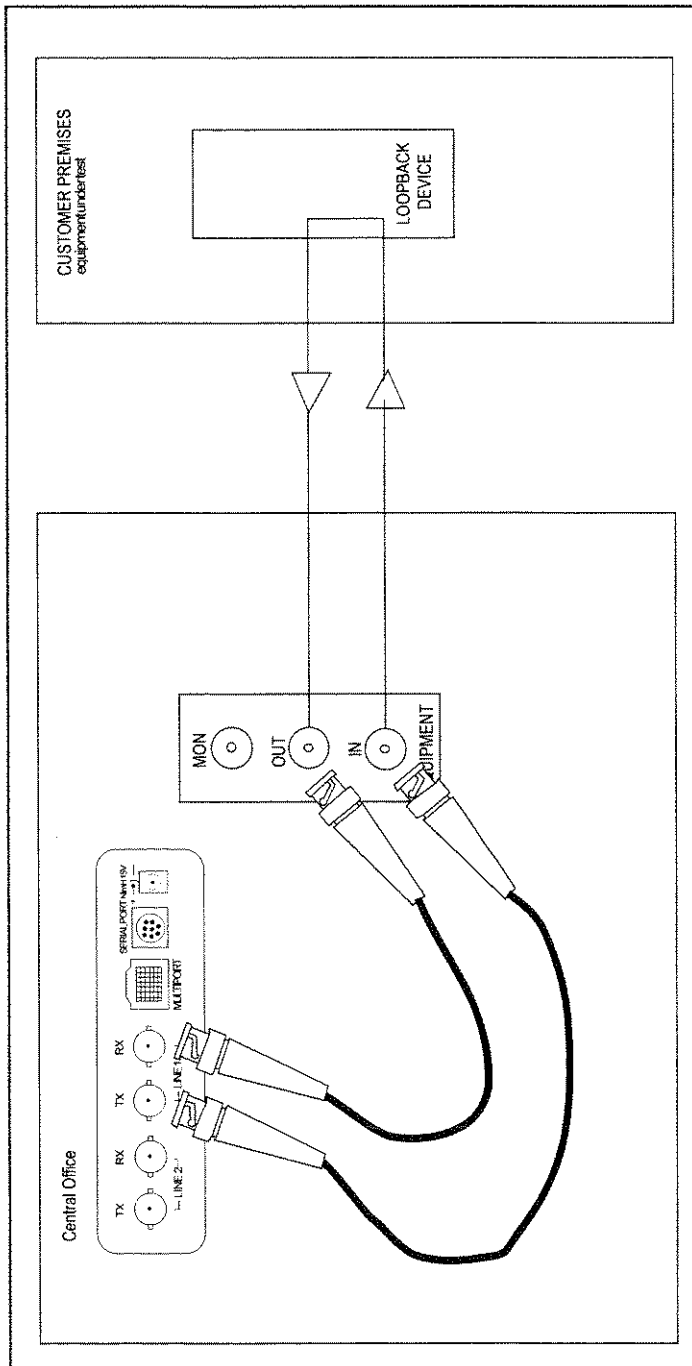
Figure 4–5   Accept a New Span

5) Enter the MEASUREMENT RESULTS menu item. Verify that the circuit performs to your company's requirements for the service delivered. If necessary, refer to the Measurement Definitions section for an explanation of the MEASUREMENT RESULTS parameters.

a) Use the PAGE-UP (F1) and PAGE-DN (F2) to access each of the individual measurement screens.

6) When your MEASUREMENT RESULTS have been completed, press the ESCAPE key to return to the MAIN MENU.

7) Remove the loop at the far end of the circuit.

2.2 Monitor an In-Service Circuit

Here is a procedure for monitoring a span that is in-service. The setup is illustrated in Figures 4-6, 4-7, and 4-8.

1) This test may be performed while the span is carrying live customer traffic.

2) Press the ESCAPE key until you arrive at the MAIN MENU. Move your cursor to the TEST CONFIGURATION menu item and press ENTER.

a) Use the following configuration:

```
- TEST MODE    :  E1
- Tx/INSERT    :  L1-Tx
- Rx/DROP      :  L1-Rx
- Tx SOURCE    :  TESTPAT
- FRAMING      :  as specified by the span design
- CRC-4        :  as specified by the span design
- TEST RATE    :  2.048M
- RxLVL-1      :  MONITOR or BRIDGE
- RxLVL-2      :  MONITOR or BRIDGE
- XMT CLOCK    :  INTERN
```

NOTE: If you are not sure what RxLVL to use, then use BRIDGE. This will protect the circuit from disruption. MONITOR may cause a disruption if the test set is not plugged in to a protected MONITOR point.

a) Press the ENTER key when all of the settings are correct.

3) Connect the SunSet to the circuit as shown in Figure 4–6, 4–7, or 4–8.

a) Press the HISTORY key to acknowledge any blinking history lights and turn them off.
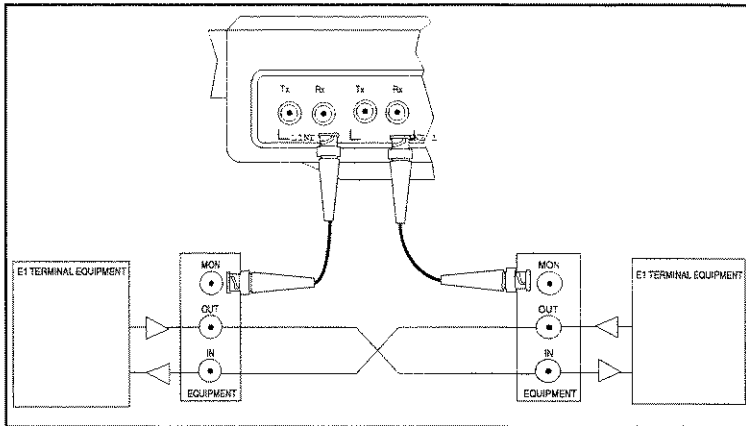
Figure 4–6
Monitor an In-Service Circuit, MONITOR
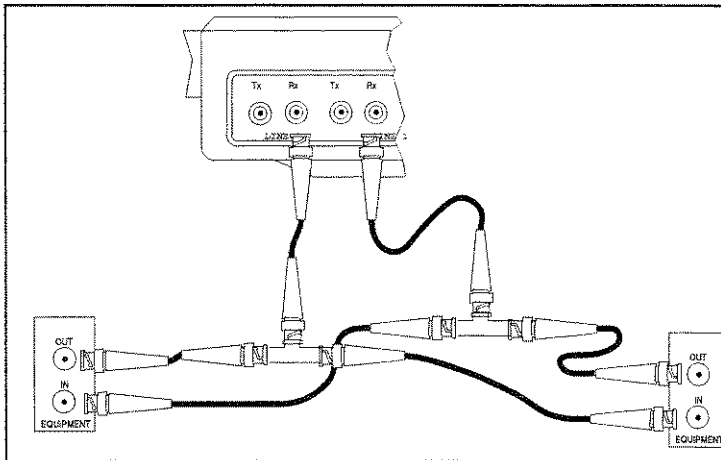
Figure 4–7   Monitoring an In-Service Circuit, BRIDGE
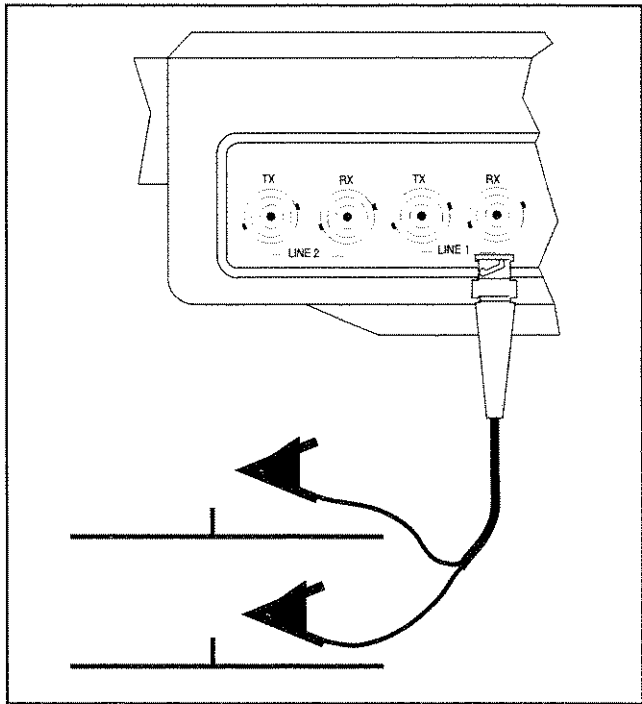
Figure 4–8
Monitoring an in-Service Circuit
BRIDGE Mode with Alligator Clips

4) Examine the LEDs and the GRAPHIC screen for information about the circuit under test.

• The pulses light should be lit green.
• Valid framing type should be indicated.
• A steady ERROR or CODE light will tell you that the circuit is working but is experiencing trouble.
• Red SIGNAL is an indication of no signal.
• An ALARM indication shows a problem on the other side of the circuit.
• AIS indicates 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.

5) To make a basic measurement:
a) From the MAIN MENU move to the MEASUREMENT RESULTS

menu item. Press the ENTER key.

b) Verify that the span performs to your company's requirements for the service delivered.

The MEASUREMENT RESULTS screen also shows you what kind of pattern, if any, is being received by the test set.

6) Unplug the test set and turn it off.

2.3 Checking for Frequency Synchronization

Frequency synchronization can be a problem when:
- the customer purchases a channelized E1 circuit
- the customer's circuit passes through a synchronous network element such as an exchange, PBX, or a digital cross-connect system
- the E1 circuit passes through more than one carrier

Frequency synchronization problems result in bit slips, a major source of service impairment. Referring to Figure 4–9 for the setup illustration, use this procedure to identify frequency synchronization problems:

1) This test may be performed while the span is carrying live customer traffic.

2) Obtain a 2.048 Mbps reference frequency source. On a 2.048 Mbps circuit, one side will usually be known to generate a synchronized signal. This side can be used as the reference. The other side can be measured for frequency synchronization.

3) Move to the MAIN MENU by pressing the ENTER key. Enter the TEST CONFIGURATION menu item by pressing the ENTER key.

a) Set the screen settings to:
   - TEST MODE   : E1
   - Tx/INSERT   : L1-Tx
   - Rx/DROP   : L1-Rx
   - Tx SOURCE   : TESTPAT
   - FRAMING   : as specified by the span design
   - CRC-4   : as specified by the span design

```
- TEST RATE      :  2.048M
- RxLVL-1        :  MONITOR
- RxLVL-2        :  MONITOR
- XMT CLOCK      :  L2-Rx
```

a) Press the ENTER key when all of the settings are correct.

5) Plug the reference E1 signal into the Line 2 RX jack.

• This is usually the MONITOR jack of the known synchronized signal.

6) Plug the Line 1 RX jack into the MONITOR jack of the side to be tested. Line 1 was set as the Rx/DROP line, which determines the measured line and reference line.

7) Press the HISTORY key to acknowledge any blinking history lights and turn them off.
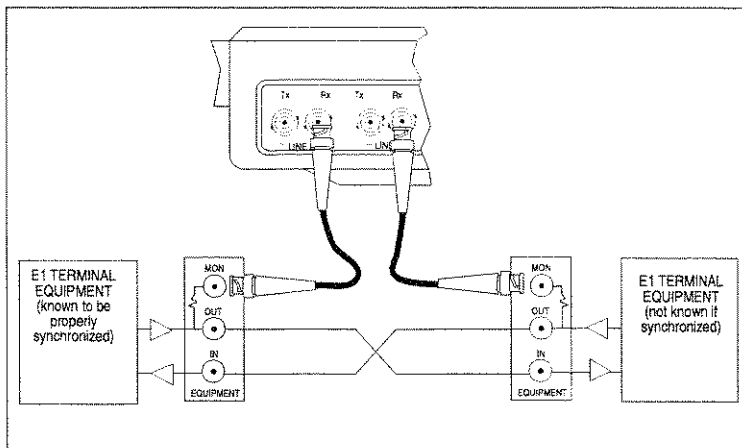
Figure 4–9 Frequency Synchronization

8) From the MAIN MENU move your cursor to the MEASUREMENT RESULTS menu item and press the ENTER key.

a) Press the PAGE-DN (F2) key until you are reviewing the FREQUENCY screen.

b) Observe if the frequency value will vary from the 2.048 MHz reference frequency. You will also see >>> or <<< indicating

the rate of frequency slippage.
c) Note the WNDR value. This will provide an indication of any low-
frequency variation in the E1 signal's frequency.

2.4 Measure Signal Level

A signal level measurement can be performed by itself or in conjunction with one of the other tests.

1) Choose what kind of RX-LVL you want to use.

- You can make the measurement in TERM, MONITOR, and BRIDGE modes.
- An all ones pattern in RxLVL TERM and BRIDGE provides the most accurate results.
- MONITOR may be the most convenient mode.
- TERM will also disrupt service.
- A BRIDGE measurement result may be degraded by a low-quality termination at the network element terminating the E1 line.
- A MONITOR measurement should generally show a result of about -20 dB or -30 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 method described here will disrupt service.

2) Switch on the SunSet. Press the ENTER key to move to the main menu. Enter the TEST CONFIGURATION menu and set the parameters as follows:
   - TEST MODE   : E1
   - Tx/INSERT   : L1-Tx
   - Rx/DROP   : L1-Rx
   - Tx SOURCE   : TESTPAT
   - FRAMING   : as specified by the circuit design
   - CRC-4   : as specified by the circuit design
   - TEST RATE   : 2.048M
   - RxLVL-1   : TERM
   - RxLVL-2   : TERM
   - XMT CLOCK   : INTERN

a) Press ENTER to return to the main menu.

3) Plug the set into the circuit as shown in Figure 4-10.
a) Press the HISTORY key to acknowledge the blinking history lights and turn them off.

4) Move the cursor to the MEASUREMENT RESULTS menu item and press ENTER.

5) Press the PAGE-DN (F2) key until you move to the LINE 1 - SIG/ ALM screen.
a) Read the signal level. Note that separate readings are given for the positive and negative signals so that you can get more accurate information on a faulty regenerator.
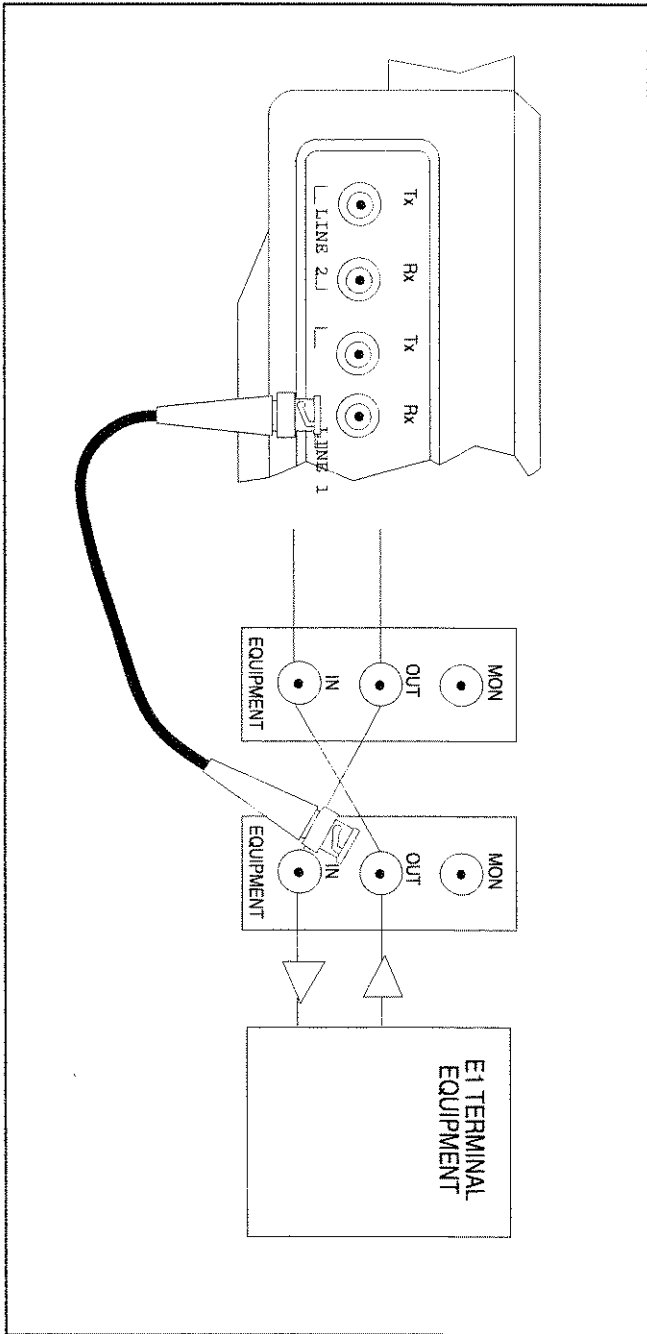
Figure 4–10   Measuring Signal Level

2.5 Run a Timed Test

Many network tests require the use of an exact time period such as 15 minutes, 1 hour, or 24 hours over which to conduct a test. In this section you will configure the timer for one of these tests. Use one of the following procedures:

2.5.1 Manual Start

1) Use the desired procedure from Application 2.1 or 2.2 as the basis for your test.

2) In the MAIN MENU move the cursor to the OTHER FEATURES menu item and press ENTER.

3) Move the cursor to the MEAS CONFIGURATION 1 and press ENTER.

4) Move the cursor to the MEAS DURATION menu item and press TIMED (F1).

5) Press the SHIFT-lock key to display the SHIFT indicator in the upper left-hand portion of the screen.

6) Enter in the number of hours and minutes that you want the test to run.
a) When you are satisfied that the entry is correct, press ENTER. Press the ESCAPE key until you have returned to the MAIN MENU.

7) Proceed with the test procedure outlined in Application 2.1 or 2.2.

• When you perform the MEASUREMENT RESULTS, the test will now be timed.
• You can see how much time is remaining by viewing the RT (Remaining Time) indicator in the upper right-hand portion of the screen.

2.5.2 Auto Start

To have the test set begin measuring at a future date and time, use the following procedure:

1) In MEAS CONFIGURATION 1, and press TIMED (F1).

2) Press the SHIFT key.

3) Use the numeric keys to enter the length of the test. Press the SHIFT key again to release it.

4) Cursor to START, and press PROGRAM (F1).

5) Cursor down to PROG DATE YMD, and enter the Year, Month, and Day you wish the timed test to begin, using the SHIFT and number keys.

6) At PROG TIME HMS, enter the Hour, Minute, and Second you wish the test to begin. Press SHIFT again.

• The test set will begin measuring at your programmed time.

2.6 Observe Network Codes or Channel Data

The SunSet E10 provides a large screen display which is useful for analyzing live circuit data. In addition to the binary data, hexadecimal and ASCII translations are also provided for you in this display. This display can be used to decode E1 network control codes that are in use, and can also be used to verify the content of individual channels. Refer to Figure 4–11.

```
┌─────────────────────────────────┐
│      MEAS          01:30:09     │
│                                 │
│      VIEW RECEIVED DATA         │
│  PAGE  :  00                    │
│  T/S      BINARY      HEX   ASCII│
│  00     00011011      1B     ( ) │
│  01     10001110      8E     (q) │
│  02     01000100      44    D (")│
│  03     11011010      DA     ([) │
│  04     01100101      65    e ( )│
│  05     00100010      22    " (D)│
│  06     10100001      A1     ( ) │
│  07     00110000      30    0 ( )│
│                                 │
│  PAGE-UP   PAGE-DN   RESUME     │
└─────────────────────────────────┘
```

Figure 4-11   View Received Data

64 pages of data are stored at once so that you can scroll down through the information and observe the changes which have occurred over time. Use this procedure:

1) This test may be performed while the span is carrying live customer traffic if either a BRIDGE or MONITOR access mode is used. The test can also be performed out-of-service if the TERM mode is used.

2) Move to the MAIN MENU by pressing the ENTER key. Enter the TEST CONFIGURATION menu and specify MONITOR or BRIDGE mode if the circuit is carrying live traffic. Specify the other settings as desired. The SunSet must detect valid framing on the received signal.

3) Connect the SunSet to the circuit as shown in Figure 4-6 or 4-7.

a) Press the HISTORY key to acknowledge the blinking history lights and turn them off.

4) Press ESCAPE to arrive at the MAIN MENU.

5) Move your cursor to the OTHER MEASUREMENTS menu item and press the ENTER key.

6) Enter the VIEW RECEIVED DATA menu item and press the ENTER key. You will now receive a live display of the E1 data. Note that valid framing is required in order to enter the VIEW RECEIVED DATA menu item.

7) Review the live data as it is displayed.
a) When the codes that you are interested in appear, press the PAUSE key (F3) to trap 64 pages of data.
b) Press PAGE-DN (F2) to scroll through the data.

The data is presented as it appears in the E1 bit stream. The data is broken out into timeslots for you.

• Note the presence of control information in time slot 00 for FAS framing, and the presence of control information in time slots 00 and 16 for MFAS framing.
• All other channels (time slots) should contain actual voice/data signals (or your transmitted test pattern).

2.7 Monitor a Voice Frequency Channel

Here is a procedure for monitoring a voice frequency channel within an E1 circuit. The setup is illustrated in Figure 4–6 or 4–7.

1) This test may be performed while the span is carrying live customer traffic.

2) Move to the MAIN MENU by pressing the ENTER key.
a) Enter the TEST CONFIGURATION menu by pressing the ENTER key.
b) Use the following configuration:

- TEST MODE	:	E1
- Tx/INSERT	:	L1-Tx
- Rx/DROP	:	L1-Rx
- Tx SOURCE	:	TESTPAT
- FRAMING	:	as specified by the circuit design
- CRC-4	:	as specified by the circuit design
- TEST RATE	:	2.048M
- RxLVL-1	:	DSXMON or BRIDGE
- RxLVL-2	:	DSXMON or BRIDGE
- XMT CLOCK	:	INTERN

c) Press the ENTER key when all of the settings are as desired.

3) Plug the set into the circuit as shown in Figure 4–6 or 4–7.
a) Press the HISTORY key to acknowledge the blinking history lights and turn them off.
b) Verify that the PCM-30 or PCM-31 LED is lit.

4) Press ESCAPE as necessary until you arrive at the MAIN MENU.

5) Move your cursor to the VF CHANNEL ACCESS menu item and press ENTER.

6) Move the cursor to VF MEASUREMENTS and press ENTER.
a) Enter the desired transmit and receive timeslots for Lines 1 and 2.

- The channel number will bypass any time slots containing the E1 framing information.
- In FAS framing, no access is granted to time slot 00, while in MFAS framing, access to time slots 00 and 16 is denied.

7) Use BOTH for the LISTEN SIDE menu item. This will allow you to monitor both sides of the line.

- Adjust the volume to the desired level by using the VOL UP and VOL DN keys.

  NOTE: If you are not able to monitor the channel:
  a) Verify that you have frame sync. The AUTO framing function does not work while you are in VF MEASUREMENTS. Back out to the MAIN MENU and press the AUTO key to restart the auto framer if a valid frame pattern is not shown. The test set will not perform the monitor function if framing is unavailable.
  b) If this doesn't work, try unplugging and replugging the receive cord. This will positively verify that there is no recognizable framing at this moment.

2.8 Simple Talk/Listen

Here is the simplest procedure for talking and listening on an E1 circuit. The setup is illustrated in Figure 4–5. However, instead of having a loopback at the far end of the circuit, your setup may have another test set, a channel bank, a switch, or other E1 terminating network element.

Use this procedure:

1) Verify that the span is not in service. This test will disrupt service for all of the channels that you are not using. If a hitless drop insert is required, you may wish to read Application 3.1, Dual Drop and Insert THRU Testing, before continuing this procedure.

2) Press the ENTER key to move to the MAIN MENU.

3) Enter the TEST CONFIGURATION menu by pressing the ENTER key. Configure the interface as follows:

          - TEST MODE   : E1
          - Tx/INSERT   : L1-Tx
          - Rx/DROP   : L1-Rx
          - Tx SOURCE   : TESTPAT
          - FRAMING   : as specified by the span design
          - CRC-4   : as specified by the span design
          - TEST RATE   : 2.048M
          - RxLVL-1   : TERM
          - RxLVL-2   : TERM
          - XMT CLOCK   : L1-Rx

a) Press the ENTER key when all the settings are as desired.

NOTE: It is not possible to perform talk and listen on an unframed signal. One of the framing LEDs must light green for this procedure to work.

4) Connect the SunSet to the circuit as shown in Figure 4–5.
a) Press the HISTORY key to acknowledge the blinking history lights and turn them off.

---

5) Press ESCAPE to get to the MAIN MENU.
a) Move your cursor to the VF CHANNEL ACCESS menu item and press the ENTER key.
b) Press the ENTER key on the VF MEASUREMENTS menu item.
c) Select the receive (listen) and transmit (talk) channels (they are usually the same channel number).
d) Choose TALK for the INSERT TYPE and L1-Rx for the LISTEN SIDE. You can now talk and listen on the channel which you have selected.
e) Adjust the volume to the desired level by using the volume keys.

2.9 Send a Tone

Here is a procedure for sending a tone:

1) This is an intrusive test. Be sure the E1 line is not carrying traffic or that it will be able to withstand any hits that this procedure will introduce. If a hitless drop insert is required, you may wish to read Application 3.1, Dual Drop and Insert THRU Testing, before continuing this procedure.

2) Enter the TEST CONFIGURATION menu.
a) Configure the interface as follows:

          - TEST MODE   : E1
          - Tx/INSERT   : L1-Tx
          - Rx/DROP   : L1-Rx
          - Tx SOURCE   : TESTPAT
          - FRAMING   : as specified by the span design
          - CRC-4   : as specified by the span design
          - TEST RATE   : 2.048M
          - RxLVL-1   : TERM
          - RxLVL-2   : TERM
          - XMT CLOCK   : INTERN

b) Press the ENTER key when all the settings are as desired.

3) Connect the SunSet to the circuit as in Figure 4–5.
a) Press the HISTORY key to acknowledge the blinking history lights and turn them off.
4) Press ESCAPE until you reach the MAIN MENU.

a) Move the cursor down to the VF CHANNEL ACCESS menu item and press ENTER.
b) Press ENTER at the VF MEASUREMENTS menu item.
c) Use the NEXT (F1) or PREVIUS (F2) to set up the receive and transmit channels correctly.
d) Select the rest of the menu items as follows:

```
- INSERT TYPE  :  TONE
- TONE FREQ Hz:  pick desired tone frequency
- TONE LVL dBm :  pick desired tone level
- LISTEN SIDE  :  BOTH
```

You are now transmitting a tone on the selected channel. You can also view the received Level and Frequency.

2.10 Place a Voice Call

This application allows you to access dialing modes and signalling. Verify the span is not in service, if you will be using a disruptive access mode.

1) This test must be performed in out-of-service mode.

2) Move to the MAIN MENU by pressing the ENTER key.
a) Enter the TEST CONFIGURATION menu by pressing the ENTER key.
b) Use the following configuration:
```
- TEST MODE    :  E1
- Tx/INSERT    :  L1-Tx
- Rx/DROP      :  L1-Rx
- Tx SOURCE    :  TESTPAT
- FRAMING      :  as specified by the circuit design
- CRC-4        :  as specified by the circuit design
- TEST RATE    :  2.048M
- RxLVL-1      :  TERM
- RxLVL-2      :  TERM
- XMT CLOCK    :  L1-Rx
```

c) Press the ENTER key when all of the settings are as desired.

3) Move your cursor to the VF CHANNEL ACCESS menu item and

press ENTER.

4) Move the cursor to VF MEASUREMENTS and press ENTER.
a) Enter the desired transmit and receive timeslots for Line 1.

• The channel number will bypass any time slots containing the E1 framing information.
• In FAS framing, no access is granted to time slot 0, while in MFAS framing, access to time slots 0 and 16 is denied.

b) Choose your INSERT TYPE; TALK will allow you to talk and listen.
c) Choose the line you want to listen to (probably L1-Rx) for the LISTEN SIDE menu item. You will be able to receive (listen) and transmit (talk) on the selected channel.

5) Plug the set into the circuit as shown in Figure 4–12.
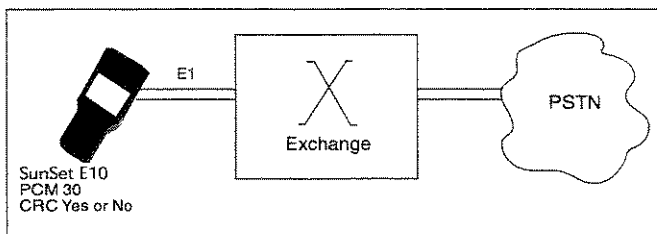
Figure 4–12   Place a Call

a) Press the HISTORY key to acknowledge the blinking history lights and turn them off.
b) Verify that the PCM-30 or PCM-31 LED is lit green.

6) Note that in the VF MEASUREMENTS screen you may observe the received DATA, FReQuency, and LeVeL.

• Adjust the volume to the desired level by using the VOL UP and VOL DN keys; note the indicator bar at the top right of the screen.

7) Escape back to the VF CHANNE: ACCESS menu.
a) Enter the line item for the type of dialing you want to use. We will use MFC as an example. Enter the MFC/SS#5 DIAL/ANALY-SIS item.

8) Enter MFC DIALING.

```
                                17:12:46
              MFC DIALING

    METHOD    : MF-FRWRD
    SIGNALING: AUTO
    NUMBER    : █


      RX A/B/C/D  - 1000
      TX A/B/C/D  : 0011
      A = 10/0    B = 11011
      C = 12      D = 13
      E = 14      F = 15

  IDLE    SEIZE                more
```

Figure 4–13   MFC Dial Screen

a) Configure as follows:

METHOD: MF-FRWD
SIGNALLING: AUTO
NUMBER: Enter the number you want to dial.

9) Press enter to place the call.
a) You will be able to talk and listen on the selected channel.

Note: If you select MANUAL as your SIGNALLING, you will first
need to SEIZE (F2) the line before placing the call. When the call
is completed, be sure to press IDLE (F1) to release the line.

10) Press HANGUP (F1) when you want to terminate the call.

2.11 Fractional E1 Testing

Fractional E1 circuits are circuits of data rate Nx64 Kbps, where N can be anywhere from 1 to 31 channels. N channels of the E1 line are dedicated to the fractional E1 circuit, and the remaining channels of the E1 line are either filled with an idle code, other revenue traffic or framing information.

Use the following procedure:

1) Verify that the fractional circuit is not in service. This test will disrupt service. If a hitless drop insert is required, you may wish to read Application 3.1, Dual Drop and Insert THRU Testing, before continuing this procedure.

2) From the MAIN MENU, enter the TEST CONFIGURATION menu. Configure the interface as follows:

        - TEST MODE   : E1
        - Tx/INSERT   : L1-Tx
        - Rx/DROP   : L1-Rx
        - Tx SOURCE   : TESTPAT
        - FRAMING   : as specified by the span design
        - CRC-4   : as specified by the span design
        - TEST RATE   : Nx64K
        - RxLVL-1   : TERM
        - RxLVL-2   : TERM
        - XMT CLOCK   : INTERN

   • Note that when you press Nx64K, the SunSet will display a fractional E1 TIMESLOT screen.
   • Manually configure the timeslots as desired.
   • If the timeslot configuration is not known, AUTO configure to the active channels.

   AUTO configuration may not yield the proper channels if:
   • Any of the active channels are transmitting an idle code
   • The idle code set up in the OTHER FEATURES, TEST PARAMETERS, OTHER PARAMETERS, IDLE CHNL CODE item is not the same as the idle code of the circuit being tested.

• A good way for you to observe the idle and active channels for yourself is to plug the set in using the 2.048 Mbps test rate and then go to OTHER MEASUREMENTS, VIEW RECEIVED DATA. This will allow you to double check the information being transmitted on a channel-by-channel basis.

a) Press the ENTER key when the timeslot settings are as desired. This will return you to the TEST CONFIGURATION menu.
b) When the TEST CONFIGURATION menu settings are as desired, press the ENTER key.

3) Connect the SunSet to the circuit as shown in Figure 4–14.

4) Ensure that a loop is in place at the far end of the circuit.

5) Press the HISTORY key to acknowledge any blinking history lights and turn them off.

6) Enter the MEASUREMENT RESULTS menu item and perform your acceptance test.
a) Verify that the fractional E1 service performs to your company's requirements for the service delivered.
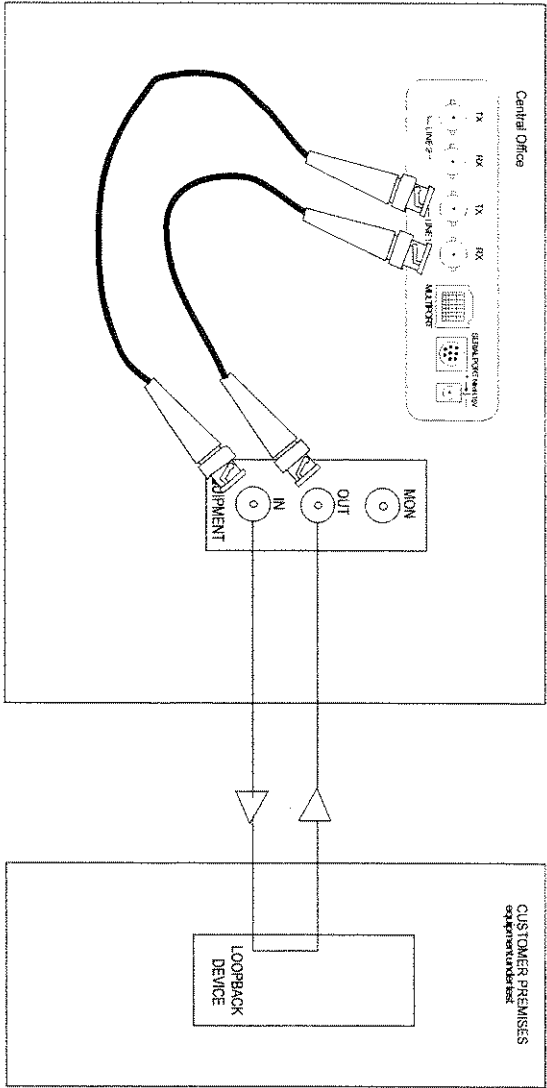
Figure 4–14   Fractional E1 Testing

SunSet E10 ⬧ Version 2.37

2.12 Using the Battery and AC Charger

Warning! Do not use any charger other than the one provided by Sunrise Telecom with the SunSet E10. Using another charger will cause permanent damage and will void the Sunrise Telecom warranty.

The battery is designed to provide ample power for portable testing applications. The SunSet battery is charged by a custom-designed charger for optimum performance. This charger is powerful enough to run continuously while keeping the battery charged.

The charger contains a special fast-charge feature which recharges the battery quickly. This enables the user to return to the field as soon as possible. This fast-charging action causes no damage to the battery.

The charger recognizes when the battery is fully charged. At this point, the charger switches from fast-charging to a trickle-charging mode. Trickle-charging completes the charging cycle for maximum battery output. This trickle-charging mode does not damage the battery over long periods of time. However, to get maximum life from your battery, remove it from the charger when it is fully charged. Here are some tips for obtaining the best performance out of your SunSet battery:

1) Use the backlight only if it is needed. The SunSet will operate a little longer if the backlight is left off.

2) Turn the power key off when the set is not in use.

3) Use the Cigarette Lighter Battery Charger (SS104B) when transporting the SunSet in the field. This will help maintain a full battery charge when AC power is not available.

4) If you are going to perform extended testing and you are not sure if the battery will last, plug the charger in at the beginning of the test so that the set will run indefinitely. If you wait until the battery is low during the middle of the test to plug the charger in, the set's processor may reset and drop the current test as the charger is plugged in.

5) Recharge the battery between uses, even if the time available for a recharge is short. The AC Battery Charger's two-stage design

---

charges the battery to approximately 80% of its full capacity in just a few hours. The set will fully charge overnight.

6) Do not use any other charger with the SunSet. Other chargers will damage the SunSet and will void the Sunrise Telecom warranty.

7) To determine if the battery is fully charged, observe the LED indicator on the charger. If the light is lit continuously, then the charger is in a high-output mode and is either fast-charging or powering it during normal operation. When the LED begins to blink, the charger is in a trickle-charge mode. When the light barely flickers at all, the battery is fully charged.

2.13 Printing from the SunSet E10

The test set is equipped with a standard serial port for both printing and remote control operations.

2.13.1 Serial Port Settings

The Serial Port is configurable for: baud rate, parity, stop bit, bits/character and carriage return/line feed. These settings are configured from within SYSTEM PARAMETERS, GENERAL CONFIG. In general, the SunSet's serial port settings will need to match the settings of your printer. Configuring the SunSet's serial port is described in detail in the procedures which follow.

2.13.2 Configuring for Printing

The test set may be ordered with an optional High Capacity Thermal Printer (SS118B or 118C). This printer operates by an 8-bit serial RS-232C method, and uses thermal paper (i.e. it has no ink cartridge or ribbon which needs to be replaced). Many other serial printers are available to the user; however, not all of these printers will operate correctly with the SunSet.

You are free to use this information to attempt to set up the test set with another printer. However, Sunrise Telecom does not warrant the operation of the test set with any printer other than the one supplied by Sunrise Telecom.

If you wish to connect to a mode or other brand of printer, you may find the SS122A Null Modem Adaptor useful. Refer to Figure

4–15.

```
      8
      5                                         5
                                               4

      3                                         3
      2                                         2
```
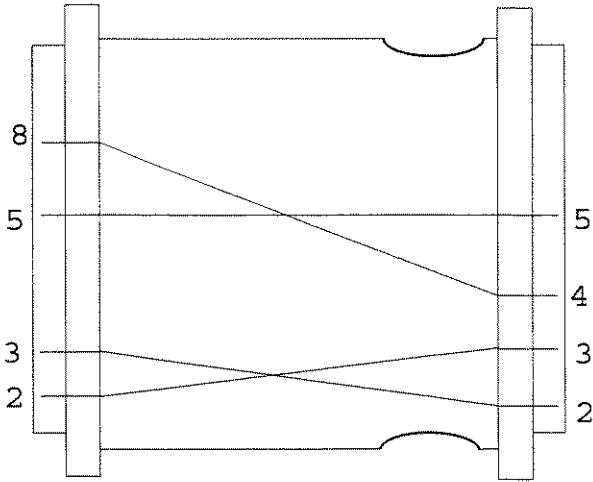
```
------ PIN-TO-PIN CONNECTIONS -----

     DB-9 FEMALE          DB-9 FEMALE
  PIN# DESCRIPTION     PIN# DESCRIPTION
     5 SG  ---------------  5 SG
     8 CTS ---------------  4 DTR
     3 RD  ---------------  2 TD
     2 TD  ---------------  3 RD
```

Figure 4–15   SS122A Null Modem Pin Assignments

To begin printing, follow this procedure:

1) Connect the Sunrise Telecom DIN-8 to DB-9 Printer Cable (SS115B) to the SunSet E10. Figure 4–16 displays the cable pin assignments of the DIN to EIA-232-C Printer Cable.

```
DIN 8-PIN

                                          1   2   3   4   5
                                           •   •   •   •   •
                                            •   •   •   •
                                          6   7   8   9
                                               DB9


------ PIN-TO-PIN CONNECTIONS -----

DIN 8-PIN              EIA-232-C D-SUB
PIN# DESCRIPTION       PIN# DESCRIPTION
   2 DSR  ─────────────   6 DSR
   3 TX   ─────────────   3 TXD
   4 RX   ─────────────   2 RXD
   5 GND  ─────────────   5 GND
   6 CTS  ─────────────   8 CTS
   8 DTR  ─────────────   4 DTR
```
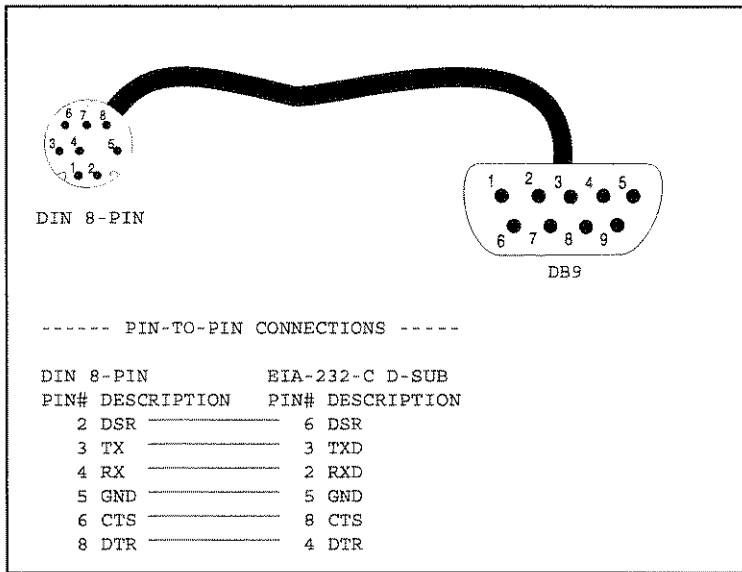
Figure 4–16   SS115B Printer Cable Pin Assignments

2) If you are using a Sunrise Telecom printer, skip this step.
a) Otherwise, you may need to connect the Sunrise Telecom Null Modem Adapter (SS122A) to the free end of the Printer Cable.

3) Confirm that the SunSet's serial port settings match those of your printer.
a) The switches to configure your printer's serial port and print characteristics are usually located on the back or bottom of the printer.
b) If you are using the Sunrise Telecom thermal printer, refer to Figure 4–17 for the correct switch settings.

DIP SWITCH 1

POSITION	DIP SW SETTING	PARAMETERS	PARAMETER SETTING
1	OFF	INPUT	SERIAL
2	ON	PRINTING SPEED	HIGH
3	ON	AUTO LOADING	ON
4	OFF	AUTO LINE FEED	OFF
5	ON	SETTING COMMAND	ENABLE
6	OFF	PRINTING DENSITY	100%
7	ON		
8	ON		

DIP SWITCH 2

POSITION	DIP SW SETTING	PARAMETERS	PARAMETER SETTING
1	ON	PRINTING COLUMNS	40
2	ON	USER FONT BACK-UP	ON
3	ON	CHARACTER SELECT	NORMAL
4	ON	ZERO	NORMAL
5	ON	INTERNATIONAL CHARACTER SET	ENGLISH
6	ON		
7	OFF		
8	OFF		

DIP SWITCH 3

POSITION	DIP SW SETTING	PARAMETERS	PARAMETER SETTING
1	ON	DATA LENGTH	8 BITS
2	ON	PARITY SETTING	NO
3	ON	PARITY CONDITION	ODD
4	ON	BUSY CONTROL	H/W BUSY
5	OFF	BAUD RATE SELECT	9600 bps
6	ON		
7	ON		
8	ON		

Figure 4-17   Printer Switch Settings

The test set's factory default serial port settings are:

BAUD RATE: 9600
PARITY: NONE
STOP BIT: 1-BIT
BITS/CHAR: 8-BIT
CR/LF INSRT: CR+LF

If you need to reconfigure the SunSet's serial port settings to match the settings of your printer, use the following procedure:

a) From the MAIN MENU, select the SYSTEM PARAMETERS item.
b) Select the GENERAL CONFIG item.
c) Use the Down Arrow key to access the BAUD RATE setting. Three selections are available: 1200 (F1), 2400 (F2), and 9600 (F3).

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- These settings determine the rate at which the SunSet transmits data (characters) to the printer.
- This setting must match the setting on your printer; otherwise random characters will appear on your printout.

d) Access the PARITY setting. Three options are available here: NONE (F1), EVEN (F2), and ODD (F3). This setting must match with the configuration of your printer.

e) Access the STOP BIT setting. Two options are available: 1-BIT (F1) and 2-BIT (F2). This setting must match with the configuration of your printer. Normally this is configured as 1-BIT.

f) Access the BITS/CHAR setting. Two options are available: 7-BIT (F1) and 8-BIT (F2). This setting must match with the configuration of your printer. Normally this is configured as 8-BIT.

g) Access the CR/LF INSRT setting. Two options are available: CR+LF for a carriage return and a line feed, or CR for a carriage return only. This setting must be opposite the configuration of your printer.

4) Set up printer's printing instructions in the OTHER FEATURES, MEAS CONFIGURATION 1.

PRINT RESULT

TIMED: Choose TIMED (F1) if you would like to have the printer print out results at a regular interval during a MEASUREMENT RESULTS.
- The default time is 1 minute
- You may enter any interval between 1 minute and 9999 minutes.
- To change the interval, press the SHIFT-lock key to display the SHIFT indicator.
- Enter the desired numbers from the keypad.
- Press SHIFT-lock again to remove the SHIFT indicator.

LAST: Choose LAST (F2) if you would like the printer to print out a result only at the conclusion of a test.

PRINT EVENT

ENABLE: Choose ENABLE (F1) if you would like the printer to print out a result every time an error or alarm condition is reported.

DISABLE: Choose DISABLE (F2) if you do not want the printer
to print out a result every time an error or alarm condition is
reported.
  • Note that each result can only be printed once. The printer
    buffer is then emptied.

5) Confirm that the DIP switch settings (or other switch settings) on
your printer correspond to those of the SunSet's serial port
above.

• If you have changed the DIP switch settings, switch the printer off
and then on before continuing.

6) Ensure that the printer is powered up and "on-line".

7) Ensure that the SunSet is not displaying its GRAPHIC screen.
This screen is non-printable.

8) Press the PRN SCRN (print screen) key on the SunSet's keypad.

9) The SunSet's current screen should now print.

• If it doesn't, check the connections, configuration, and switch
settings.

2.14 Using the Remote Control

The SunSet E10 comes with an optional remote control feature.
Controlling the SunSet through the remote control is similar to
controlling the SunSet directly. The remote control allows a remote
user and a local user to use the test set together at the same time.
This simultaneous-usage feature can help a team of people fix a
problem faster.
Refer to Figure 4–16 for a diagram of the pin-to-pin assignments
of the DIN to DB-9 cable supplied by Sunrise Telecom. Refer to
Figure 4–15 for the pin-to-pin assignments of the Sunrise Telecom
Null Modem Adapter.
You may need a break-out box, null modem, patch-box and
other RS-232C communications tools if you wish to set up your own
serial communications. Here are some helpful hints. The test set

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is configured as a DTE. You will need a modified null modem cable if you wish to connect directly to a terminal.

It often is successful if pin 4 (DTR) of the modem or terminal is connected to pin 8 (CTS) of the test set DB25 connector. Pin 8 of the test set DB9 connector must show green on a breakout box in order for the test set to print.

To begin remote operation, follow this procedure:
1) Connect the Sunrise Telecom DIN-8 to DB-9 Printer Cable (SS115B) to the SunSet E10.

2) If you are plugging directly into a terminal, connect the Sunrise Telecom Null Modem Adapter (SS122A) to the free end of the Printer Cable.
a) Connect the Null Modem Adaptor to your computer or terminal.
b) Skip steps 3, 4, 5, 6, 7.

3) Connect the printer cable's DB9 end into a modem. A 9600 baud error-correcting modem is highly recommended. Some functions such as VF MEASUREMENTS will only work properly if a 9600 baud modem is used. Refer to Figures 4–15 and 4–16 for cable pinouts. You may need a breakout box, appropriate tools, and training to make sure the test set is appropriately connected to the modem the first time you set it up.

4) If not already connected to an analog phone line, plug the modem into the telephone network (usually done with an RJ-4 cable).

5) Confirm that the SunSet's serial port settings correspond to those of your communications software or terminal. The SunSet's factory default settings are:

BAUD RATE: 9600
PARITY: NONE
STOP BIT: 1-BIT
BITS/CHAR: 8-BIT
CR/LF INSRT: CR+LF

If you need to reconfigure the SunSet's serial port settings, use the following procedure:

a) From the MAIN MENU, select OTHER FEATURES.

b) Select the GENERAL CONFIG item.

c) Use the Down Arrow key to access the BAUD RATE setting. Three selections are available: 1200 (F1), 2400 (F2), and 9600 (F3). These settings determine the rate at which the SunSet transmits data (characters) to the computer or terminal. This setting must match the setting on your computer or terminal, otherwise random characters will appear on your remote screen.

d) Access the PARITY setting. Three options are available here: NONE (F1), EVEN (F2), and ODD (F3). This setting must match with the configuration of your remote control.

e) Access the STOP BIT setting. Two options are available: 1-BIT (F1) and 2-BIT (F2). This setting must match with the configuration of your remote control. Normally this is configured as 1-BIT.

f) Access the BITS/CHAR setting. Two options are available: 7-BIT (F1) and 8-BIT (F2). This setting must match with the configuration of your remote control. Normally this is configured as 8-BIT.

6) Set up a terminal to dial up the far modem and commence communications. Any terminal or personal computer with VT100 terminal emulation software should work.

7) Call up the far modem with your terminal.

8) Once communication has been established with the far modem, log on to the SunSet E10 by typing in: logon

• You do not need to press the return key after typing the letters. The test set will automatically repaint the screen. If you make a mistake while typing logon, just type it again.

Note: If you log into the set while it is in graphic mode, the graphic may be distorted. Simply press the return key on your terminal and then P (for graphic) to see the graphic in its proper form.
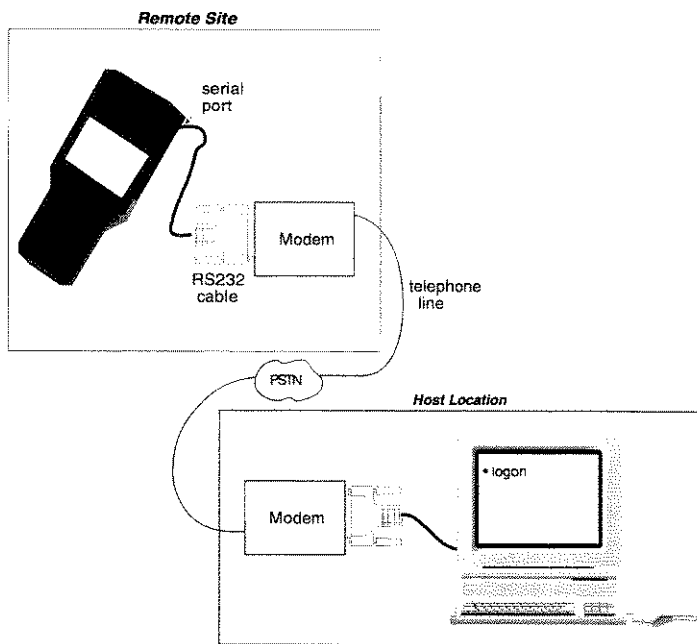
Figure 4–18 Typical Setup

9) Use the SunSet E10 just like you would use it locally. The same menus will be presented to you.

• The key options are listed under the Status Panel heading.
• The letter presented in bold is the key you push to initiate the command.

The cursor commands are: **U**p, do**W**n, lef**T** and **R**ight. In addition, you may find that the arrow keys on your computer/terminal will work.

Refre**S**h repaints the screen.

Press **Q**uit functions as the ESCAPE key.

Other key functions are **I**nj err, **H**istory, and res**Y**nch.

Pressing the Return key on your computer/terminal is the same as pressing the ENTER key on your test set.

F-key functions are provided by the - (F1), = (F2), [(F3), and] (F4) keys.

When you wish to enter letters or numbers in a setup screen, instead of using the SHIFT key and the orange test set key labels, just type in the numbers or letters directly from your computer/terminal keyboard.

10) When you are finished with the SunSet E10, type in: logoff

11) Then terminate the phone connection by hanging up your near-end modem.

In remote control, you have access to most of the test set's capability. However, you will notice a few differences, such as the following:
• You will not have access to the GRAPHIC screen, or the AUTO key.
• The MEASUREMENT RESULTS screen will be updated about once every 5 seconds, instead of once each second.
• Local usage of print commands is not recommended during a remote control session, because both the printer and the remote control use the same port. For instance, pressing the PRNTR key will log the user off.
• Talk/Listen is not supported remotely.

Note that you can use a variety of asynchronous communications in addition to modems over the public switched telephone network. Direct local connection, dedicated line, and packet are other communication alternatives.

Using Remote Control from Windows 95

Here's a brief rundown on how to get your SunSet to work by remote control, when you are operating out of Windows 95.

1) From Accessories, start HyperTerminal.
a) Click to open the Hyper Terminal window.

2) Double click on Hypertrm.

3) At New Connection, enter "Sunrise Remote".
a) Select an icon.
b) Click on Ok.

4) In the Phone Number screen, click on the down arrow of the "Connect using:" box.
a) Select the modem or com port number you are using (note: if you are connected directly to a com port, you will need to use a Null Modem Adaptor).
b) Click Ok.

5) At the Port Settings, configure the settings as follows (matching those of your SunSet as set in the General Config screen):
    Bits per second: 9600
    Data (or Char) bits: 8
    Parity: none
    Stop bits: 1
    Flow Control: none

a) Click Ok when done.

6) In the HyperTerminal screen, click on VIEW (IMPORTANT!).

7) Highlight and click on FONT.

8) Highlight Terminal.
a) Set the Style and Size as you wish.

9) Type "LOG-ON".

10) Remote control should work.

Section 3 Advanced Applications

3.1 In Service Dual Drop and Insert THRU Testing

To conduct a dual drop and insert THRU mode test on a line which is in service, make sure all the connections are made in accordance with the numbering procedure in Figure 4–19 to ensure the least amount of interruption on the live circuits.

In-service drop and insert testing is useful for :
a) Placing a telephone call on a single channel.
b) Sending and receiving tones to test channels.
c) Sending and receiving test patterns to test NX64 Kbps circuits.

WARNING: only experienced technicians should do this procedure. Any mistakes will disrupt service.

Use the following procedure. If performed properly, this test should disrupt the service for a duration of few hundred milliseconds.

1) Press the enter key to move to the MAIN MENU.

2) Press ENTER to enter the TEST CONFIGURATION. Configure the interface as follows:

- TEST MODE	:	E1
- Tx/INSERT	:	L1-Tx
- Rx/DROP	:	L2-Rx
- Tx SOURCE	:	THRU
- FRAMING	:	as specified by the circuit design
- CRC-4	:	as specified by the circuit design
- TEST RATE	:	2.048M or NX64K (for fractional E1)
- RxLVL-1	:	MONITOR, BRIDGE
- RxLVL-2	:	MONITOR, BRIDGE
- XMT CLOCK	:	L1-Rx

3) Connect the SunSet to the circuit as shown in Figure 4–19 or 4–20. Figure 4–19 provides a BNC-BNC diagram using equipment without a monitor point, while Figure 4–20 shows bantam to BNC cables, using monitor points. This mode allows an in-service

2.048 Mbps circuit to pass through the test set. Be sure to plug in the cords in the order shown in the two diagrams. First plug in cords one through six.

a) Verify that the test Line 1 and Line 2 LEDs show proper framing, coding, and no errors. Verify that the Graphic shows the test set is in THRU mode.

b) Then, plug in cords seven and eight.

Warning! You might want to practice on an out-of-service circuit first to make sure you can perform this procedure correctly.
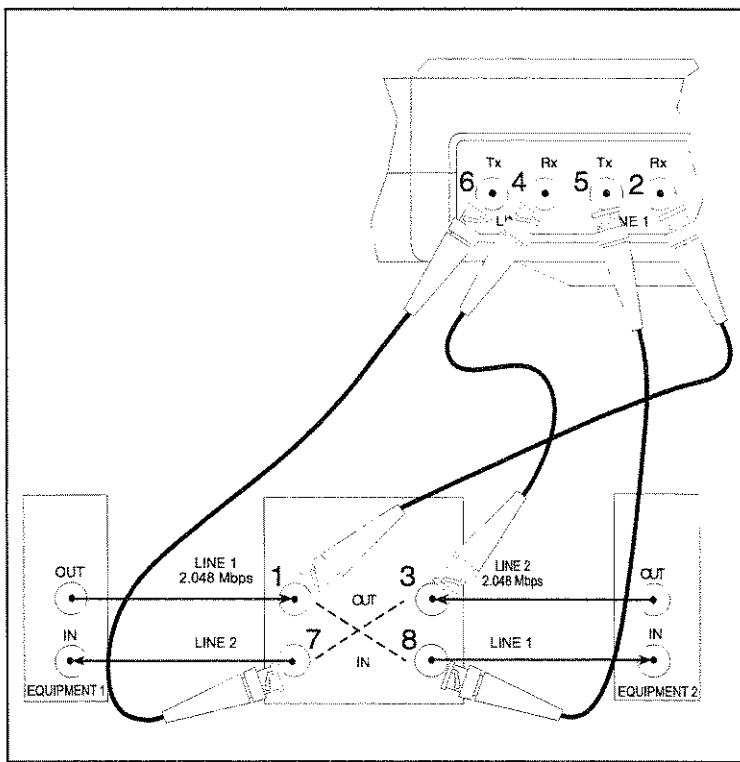
Figure 4–19
Dual Drop and Insert THRU Mode Test (BNC-BNC)

Note: The circuit will be disrupted for two or more seconds while the cords are moved.
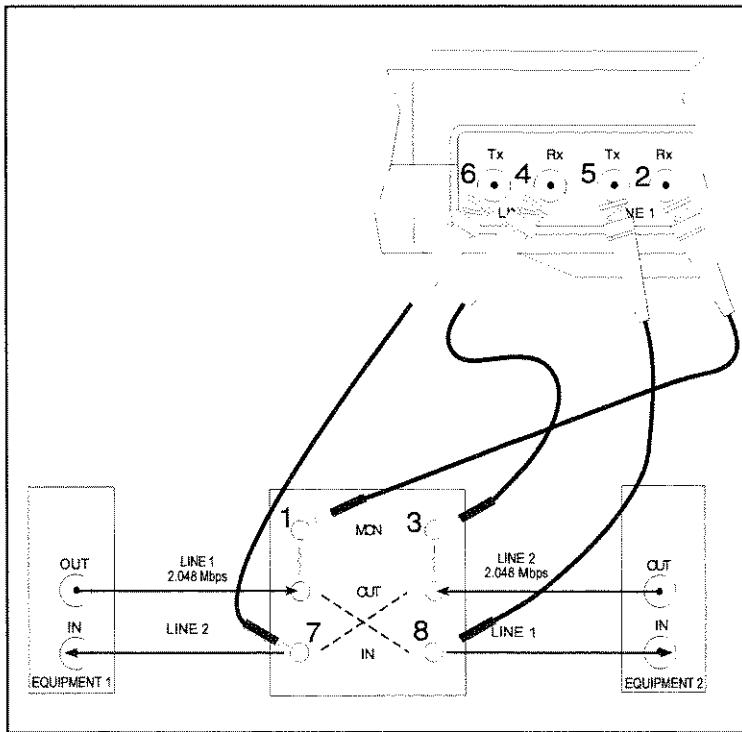
Figure 4–20
In Service Dual Drop and Insert THRU (BNC to Bantam)

4) Depending on the test application you may wish to do the following:

For talk and listen, you should:
a) Press ESCAPE to get to the MAIN MENU.
b) Move your cursor to the VF CHANNEL ACCESS menu item and press the ENTER key.
c) Press the ENTER key on the VF MEASUREMENTS menu item.
d) Select the receive (listen) and transmit (talk) channels (they are usually the same channel number).
e) Choose TALK for the INSERT TYPE and L2-Rx for the LISTEN SIDE.
f) You can now talk and listen on the channel you have selected. Adjust the volume to the desired level by using the volume

keys on the keypad.

To send and receive a tone:
a) Press ESCAPE until you reach the MAIN MENU.
b) Move the cursor down to the VF CHANNEL ACCESS menu
   item and press ENTER.
c) Press ENTER on the VF MEASUREMENTS menu item.
d) Use the NEXT (F1) or PREVIUS (F2) to set up the receive and
   transmit channels correctly.
e) Select the rest of the menu items as follows:
   - 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 supervision bits
   - LISTEN SIDE   :   BOTH

f) You are now transmitting a tone on Line 2.
   You can also view the received Level and Frequency.

To test NX64 Kbps, fractional E1:
a) First, make sure the TEST RATE is set for NX64K in the
   TEST CONFIGURATION.
b) Press ESCAPE to get to the MAIN MENU.
c) Enter the MEASUREMENT RESULTS menu item and
   perform your acceptance test.
d) Verify that the fractional E1 service performs to your company's
   requirements for the service delivered.

3.2 Testing a Terminal Multiplex

The SunSet E10 can perform an out-of-service through multi-
plex test. Here is the procedure.

1)   Connect the SunSet E10 according to the Figure 4–21,
     MUXTEST Setup.
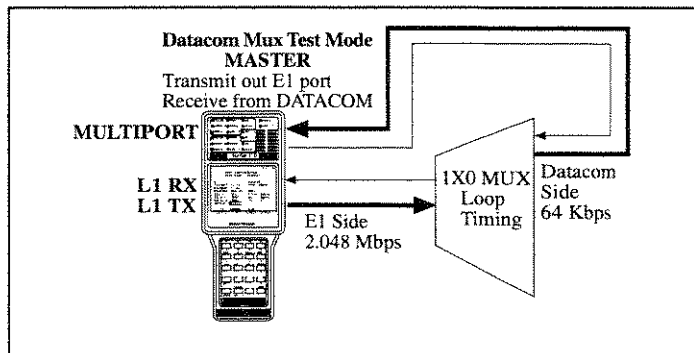
Figure 4-21 MUXTEST Setup

2) Turn on the SunSet E10. Enter the TEST CONFIGURATION
menu, and select MUXTEST (F3) for the Test Mode.

3) Set the configuration according to the Figure 4-22, MUXTEST
Configuration.

```
   MEAS                        2:31:03

              TEST  CONFIGURATION
              TEST  MODE  :  MUXTEST

E1                           DATACOM
Tx/INST:  L1-Tx              TYPE  :  RS232
Rx/DROP:  L1-Rx              MODE  :  DTE
FRAMING:  PCM-30
CRC-4   :  YES               BERT
RxLVL-1:  TERM               E1T/S:  Nx64K
RxLVL-2:  TERM               Rx    :  RS232
XMTCLK  :  INTERN            Tx    :  E1



L1-Rx    INTERN   L2-Tx
```

Figure 4-22   MUXTEST Configuration

NOTE: In this procedure the multiplex must be DCE. The SunSet
E10 is DTE. The above figure uses RS232 as the Datacom
Type. You may also select G.703, V.35, RS449, or X.21.

4) Set the XMTCLK to INTERN, if the multiplex receives timing
from the test set's 2.048 Mbps Tx. Set the XMTCLK to L1-Rx,

if the test set should receive timing from the multiplex.

5) Verify that the PAT SYNC LED is lit green.
a) Press the ERR INJ key to insert a bit error. You should see a flashing red BIT ERROR LED, indicating that a bit error has taken place. You have just injected an error from the E1 side through the multiplex to the datacom port.
b) Press the HISTORY key to stop the blinking.

6) Now, you should check to see if you can inject an error from the datacom port through the multiplex to the E1 side.
a) Set the Tx to the datacom type that you have selected in DATACOM TYPE. Automatically, the Rx will change to E1.
b) Press the GRAPHIC key and verify that you are now transmitting out of the datacom port and receiving on the E1 side.

7) Verify that the PAT SYNC LED is green.
a) Inject one bit error by pressing the ERR INJ key once. You should now see the flashing red LEDs for both ERROR and BIT ERROR indicating one bit error has occurred.
b) Press the HISTORY key to stop the blinking.

8) If more comprehensive tests are required, you may wish to change the test patterns and other settings in TEST CONFIGU-RATION such as XMT CLK.

3.3 Emulating a Terminal Multiplex

In the E1-MUX Mode, the SunSet E10 emulates a 64Kbps to 2Mbps multiplexer. Use the following procedure to multiplex one 64Kbps signal onto a 2Mbps signal

1) From the Main Menu, enter TEST CONFIGURATION.
a) Select E1-MUX for Test Mode.
b) Configure the rest as follows:

```
E1
Tx/INSERT   : L1-Tx
Rx/DROP     : L1-RX
FRAMING     : As specified by the span design
```

```
CRC-4        : As specified by the span design
RxLVL-1      : TERM
RxLVL-2      : TERM
XMT CLK      : L1-RX

DATACOM
TYPE         : Select the datacom interface type that will
               provide the 64Kbps frame.
TxSRC        : E1DRP
MODE         : this is set as DCE

MUX
BERT         : E1DRP
E1INS        : The datacom TYPE selected above (i.e. RS232)
E1T/S        : Select the 64Kbps timeslot to be multiplexed
               from the datacom to the E1 side (See step 3).
```

2) The last setup item in the TEST CONFIGURATION screen is E1T/S. In this line, you select the 64Kbps timeslot to be multiplexed.
a) Press Nx64K (F1) to enter the SELECT TIME SLOT screen.
b) Use the arrow keys to move the flashing cursor to the desired receive timeslot.
c) Once your desired timeslot is flashing, press SELECT (F2).
d) You may also press UN-SEL (F3) to deselect a particular timeslot or CLR-ALL (F4) to erase all the selected timeslots and start with a clear screen.
e) Repeat this procedure for the Transmit timeslot. You may select only one receive and transmit timeslot. The receive and transmit timeslots should normally be set to the same number.

3) Connect the E10 to the circuit according to Figure 4–23.
a) Press the HISTORY key to acknowledge any blinking history lights and turn them off.
b) Verify that the PAT SYNC LED is lit green.
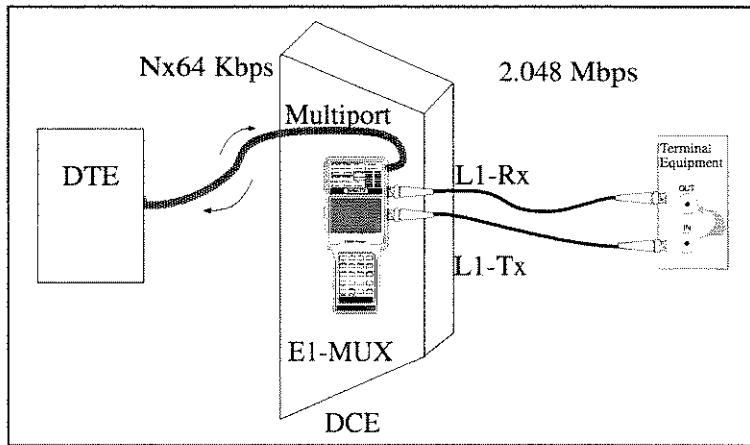
Figure 4–23 Emulating a Terminal Multiplex

The DTE supplies the 64Kbps signal, which is transmitted to the SunSet E10 through the multiport. The E10 multiplexes this 64Kbps signal onto a 2 Mbps signal, which is then transmitted out the E1 L1-Tx jack. In Figure 4–23, the test set is connected to a IN/OUT monitor jack. The 2M signal is passed from the IN to the OUT jack and back to the L1-Rx jack on the test set. This setup allows you to check the multiplexed signal. The following steps outline the procedure for checking the multiplexed 2M signal.

4) Inject an error from the Data Terminal Equipment. Make sure that the BERT setting in TEST CONFIGURATION is set to E1DRP. This means that the LEDs will show information about the signal received on the E1 L1-Rx port. Upon injecting the error, a red error LED should light up on the test set. If it does, you have just verified the proper multiplexing ability of the SunSet E10.

You may also want to check the de-multiplexing ability of the E10.
1) To do so, keep the same setup as shown in Figure 4–23.
2) Change the BER setting in TEST CONFIGURATION to the datacom type selected above.

3.4 Emulating an Add/Drop Multiplexer

The SunSet E10 has the capability to emulate an Add/Drop Multiplex. Use the following procedure to drop and insert 64Kbps timeslots between a datacom device and E1 lines.

1) From the Main Menu, enter TEST CONFIGURATION. Select E1 Mode and configure the other settings as follows:

        Tx/INST   : L1-TX
        RX/DROP   : L2-RX
        TxSOURCE   : THRU
        FRAMING   : As provisioned
        CRC-4   : As provisioned
        RXLVL-1   : TERM
        RXLVL-2   : TERM
        XMTCLK   : L1-RX

2) Connect the test set to two terminal equipments in the order shown in Figure 4–24.
a) Plug into the OUT jack of Equipment 1; connect the same cord to Line 1 Rx on the test set.
b) Next plug a second BNC cord to The OUT jack on Equipment 2; connect this cord to Line 2 Rx on the test set.
c) Next, plug your third BNC cord to Line 1 Tx of the test set and then plug a fourth cord into Line 2 Tx. Do not connect either of these cords to the Terminal equipment yet.
d) Verify that the E10's LEDs for Line 1 and Line 2 show proper framing, coding, and no errors. In other words, you should see green LEDs for CODING, FRAMING, and you should see no red LEDs.
e) Press the GRAPHIC key and verify that you are in THRU Mode.
f) Next, you should connect the cord from Line 2 Tx to the IN jack of Equipment 1.
g) Lastly, connect the cord from Line 1 Tx to the IN jack of Equipment 2.

Note: The circuit will be disrupted for two or more seconds while the cords are moved.
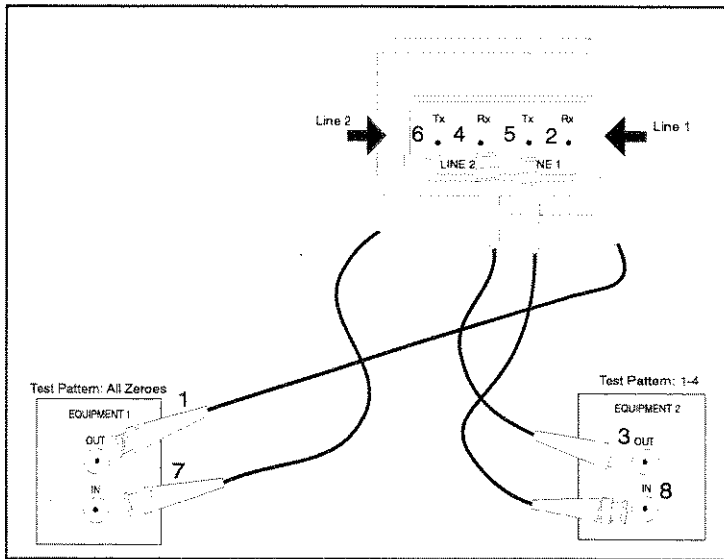
Figure 4-24 Emulating an Add/Drop Multiplex

3) Press the HISTORY key to acknowledge any blinking lights and
turn them off.
a) Verify that the PAT SYNC LED is lit green.

4) Press the ESCAPE key to return to the Main Menu.
a) Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA.
Since you selected Rx/DROP= L2-Rx in TEST CONFIGURA-
TION, the data displayed here is from Line 2 Rx.
b) Verify that the pattern sent by Equipment 2 is shown here on all
the timeslots. According to Figure 4-24, you should see the 1-
4 pattern. You have just ascertained that Line 2 is being received
properly by the SunSet E10.

5) Press the ESCAPE key to return to the Main Menu. Enter TEST
CONFIGURATION. Change Rx/DROP to L1-Rx.

6) Escape back to the Main Menu.
a) Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA.
This time, the data displayed refers to Line 1 Rx.
b) Verify that the pattern transmitted by Equipment 1 is shown on
all available timeslots in this screen. With reference to Figure 4-
24, you should see the ALL ZEROES pattern on all timeslots.

You have just verified the Line 1 signal is being received properly by the Sunset E10. Now you are ready to connect the test set to the Datacom device.

7) Escape to the Main Menu.
a) Enter TEST CONFIGURATION.
b) Select E1-MUX Mode and configure the other settings as follows:

```
E1
TX/INST    : L1-TX
RX/DROP    : L2-RX
FRAMING    : as provisioned
CRC-4    : as provisioned
RxLVL-1    : TERM
RxLVL-2    : TERM
XMTCLK     : L1-RX


DATACOM
TYPE       : Interface type of connector
TxSRC      : E1DRP
MODE       : this is set as DCE


MUX
BERT       : Interface type chosen above
E1INS      : E1DRP
E1T/S      : As required
```

8) Connect the test set to the datacom device through the multiport. Refer to Figure 4–25.
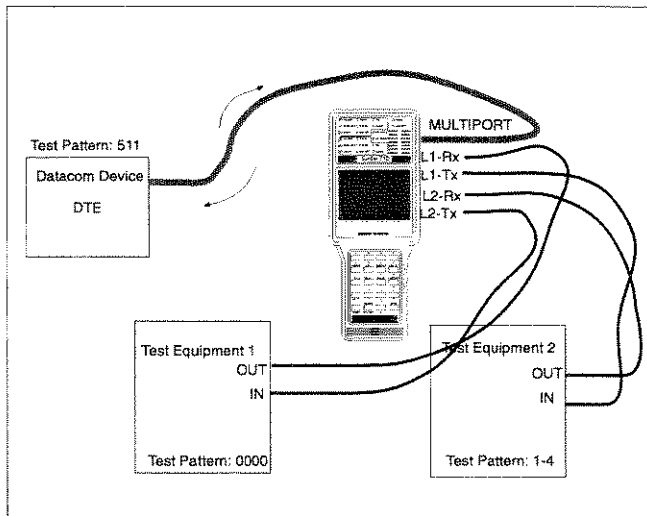
Figure 4-25 Emulating Add/Drop MUX

9) Press the HISTORY key to acknowledge any blinking lights and
turn them off.
a) Verify that the PAT SYNC LED is lit green and no red error LEDs
appear.

10) Escape to the Main Menu.
a) Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA.
b) Verify that the E10 is receiving DTE's test pattern on its multiport.
Since you have selected the datacom type for BERT on TEST
CONFIGURATION, the pattern received on the multiport should
be displayed in this screen. For Figure 4-25, you should see
511. Even if you have selected only a few Nx64 timeslots in
TEST CONFIGURATION, expect to see the datacom pattern on
all timeslots here.

11) In the previous steps, you have verified that the SunSet is
receiving a proper signal on both E1 Line receive jacks, as well
as on the multiport. Next, you must verify that the SunSet is
inserting the datacom's signal on the selected timeslots.
On Line 1, the SunSet E10 transmits the signal received on
L1-Rx, but it inserts the signal received on the multiport on the
Nx64K timeslots selected in TEST CONFIGURATION. For this

reason, Equipment 2 is the best place to check the SunSet's insert capability. Equipment 2 should receive the Datacom's pattern, here 511, on the selected timeslots and Equipment 1's pattern, here ALL ZEROES, on all the other timeslots.

12) If Test Equipment 2 is not capable of displaying its received data, you will need to plug a second SunSet E10 into the monitor jack. Turn the second E10 on and enter TEST CONFIGURATION. Configure this second E10 as follows:

TEST MODE: E1
INST   : L1-TX
RX/DROP   : L1-RX
TXSRC   : TESTPAT
FRAMING   : As required
CRC-4   : As required
TEST RATE : 2.048M
RXLVL-1   : MONITOR
RXLVL-2   : MONITOR
XMTCLK   : INTERN

13) Connect Line 1 Rx to the MON jack of Equipment 2.
a) Press the HISTORY key to acknowledge any blinking lights and turn them off.

14) Escape to the Main Menu.
a) Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA.
b) Verify that the Datacom's pattern is on the selected timeslots and that Equipment 1's pattern is on the other timeslots.

15) You have just verified the proper insert operation of the SunSet E10.

Chapter 5
SS#7

Section 1: SS#7 Technology Overview

SS#7/CCS7 (Signalling System Number 7) is a common channel signalling system conceived to provide services such as interprocessor transaction for call/remote control, maintenance/network management signalling, as well as a reliable means for information transfer in the correct sequence, without loss or duplication.

A number of applications are supported by SS#7: PSTN (Public Switching Telephone Network), ISDN (Integrated Services Digital Network), SCP (Service Control Point) services, PLMN (Public Land Mobile Network), and Operations administration and Maintenance of networks.

1.1 SS#7 Network Architecture

The SS#7 network is comprised of signalling points (SPs) connected together by dedicated circuits identified as signalling links. There are three types of SPs: Service Switching Point (SSP), Signalling Transfer Point (STP), and Service Control Point (SCP). A typical SS#7 network is depicted in Figure 5–1.

The primary purpose of the SSP is to originate and process requests for trunks. Also, it originates requests for network services. Every SSP is connected to a pair of STPs for load sharing and backup purposes.

The primary purpose of a STP is to route signalling messages between different SSPs in the network. Usually, there are two levels of hierarchy in arranging STPs: local level and regional level. The local level STP pair routes signalling traffic within a specified local area. While regional level STPs route traffic between the specified local areas.

SCP's primary function is to process database query messages for advanced network services such as 800 numbers and alternative billing. SCPs are paired to protect the SS#7 against loss of data in case of SCP failure. Each SCP is connected to the regional STP, thus providing regional service.

In reference to Figure 5–1, the following list identifies the link nomenclature:

- A link: Access links that connect switching offices to the STPs.
- B link: Bridge links that connect one mated pair of STPs to the second mated pair.
- C link: Cross links that connect a mated pair of STPs to each other.
- D link: Down links that connect the RSTPs to the LSTPs
- E link: Extended links that connect the switching offices to the STP pairs other than its home pair.
- F link: Links that connect one SP to another, but neither SP is an STP.
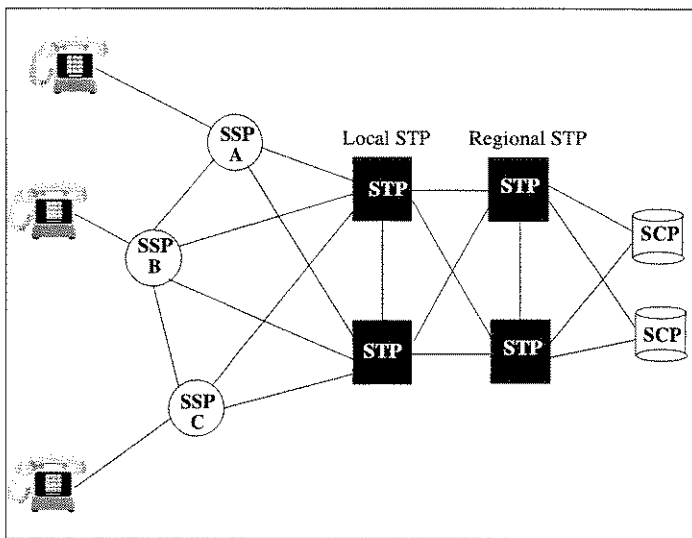
Figure 5–1   SS#7 Network

1.2 SS#7 Protocol

The first three levels of the SS#7 protocol follow the OSI (Open System Interconnect) definition quite closely. However, due to the dedicated link nature of SS#7, many of the upper OSI layer functionalities were deemed redundant. Figure 5–2 illustrates the correlation.

7	Application	TCAP	ISUP	TUP	
6	Presentation				
5	Session				
4	Transport	SCCP			
3	Network	MTP			
2	Data Link				
1	Physical				

Legend

TUP= Telephone User Part
ISUP=ISDN User Part
MTP= Message Transfer Part
SCCP=Signalling Connection Control Part
TCAP=Transaction Capabilities Application Part
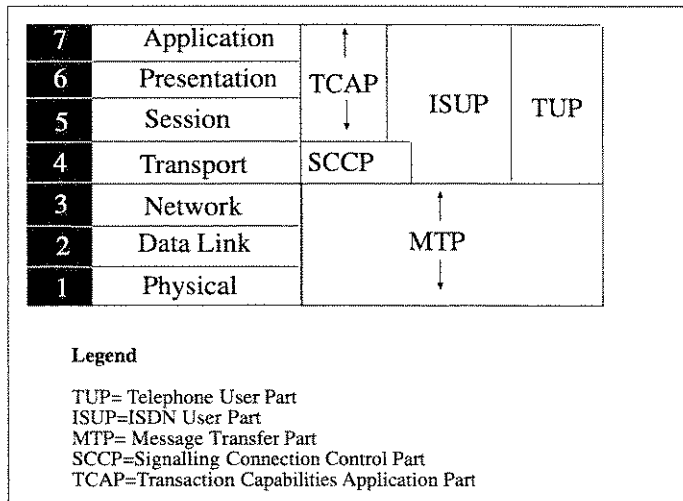
Figure 5–2   SS#7 and OSI Protocol Architecture

MTP

The MTP (Message Transfer Part) performs functions such as transmitting bits, detecting and correcting errors, and end-to-end routing. The MTP layer is divided into three levels, each of which provides a unique functionality.

• *Level 1 (Physical Level)* - provides the physical, electrical, and procedural characteristics of a SS#7 link.
• *Level 2 (Data Link Level)* - provides the functionality needed to do SU alignment, error detection/ correction, link synchronization, and flow control.
• *Level 3 (Signalling Network Level)* - provides two major subfunctions: signalling message handling and signalling network management. Signalling message handling contains a discrimination function (determining if a message is destined to its node), a distribution function (delivering a message to the appropriate user part), and a routing function (picking the appropriate route to a destination node). The signalling network management provides the procedures needed to restore normal signalling conditions in the event of failure or link congestion.

SCCP

The Signalling Connection Control Part provides the routing capabilities for signalling messages through the GTT (Global Title Translation) process. Using the SCP as the main data base for storing SP addresses, other SPs can be freed of this task.

SCCP provides the functionality needed for non-circuit services (i.e. transactional services for database access). These services are divided into two groups: connection-oriented and connectionless. Connection-oriented services provide segmenting and reassembly capabilities of the network service data units that need to be transmitted through the SS#7 network. Connectionless services provide the capability to transfer one data unit. Segmentation and reassembly are not available in connectionless services.

ISUP

The ISDN User Part is used in SS#7 to support basic bearer services (which involve the setup and release of 64 Kbps network switched circuit exchanges), and supplementing services such as call forwarding, calling, line identification, user-to-user signalling, closed user groups, and direct dialing. Another service supported by ISUP is call switching of basic phone calls for both speech and data calls, as specified by its standards for international semiautomatic and automatic telephone and circuit switched traffic.

TUP

The Telephone User Part is used with SS#7 to support international telephone call control signalling.

TCAP

Transaction Capability Application Part refers to the building blocks of the Application layer network services used by SS#7 users to provide a standard procedure of adding network services. The current list of application uses includes:
• mobile service application
• operation and maintenance
• non circuit control related exchange of signalling information
• registration and activation of supplementary services

1.3 SS#7 Messages

There are three basic message types:

- *Message Signalling Unit (MSU)*- The MSUs are the units used by the ISUP, TUP, and TCAP messages. They provide the structure to house the messages. A description of each field is shown in Figure 5-3.

BSN **Backward Sequence Number**: Indication of the last message received.

BIB **Backward Indicator Bit**: Bit inverted for negative acknowledgment of the BSN message.

FSN **Forward Sequence Number**: Indication of the message sent.

FIB **Forward Indicator Bit**: Bit is inverted to indicate the retransmission of negative acknowledgment messages.

LI **Length Indicator**

SIO **Signalling Info. Octet**: Identify various types of messages (i.e.. ISUP, SCCP).

SIF **Signalling Info. Field**: Section that contains the message (max. 272 octets).

CK **Cyclic Redundancy Check** (2 octets)

Figure 5-3   MSU Message Structure

• *Link Status Signal Unit (LSSU)* - LSSUs are used to indicate the status of a node's level 2 message handling capabilities over a specific link. They are used to inform other nodes in the event of congestion, outage, link reset, etc. A description of each field is shown in Figure 5–4.

BSN **Backward Sequence Number:**
    Indication of the last sequence number

BIB **Backward Indicator Bit:** Bit
    inverted for negative acknowledgment
    of the BSN message.

FSN **Forward Sequence Number:** Indication
    of the message sent.

FIB **Forward Indicator Bit:** Bit is inverted
    to indicate retransmission of negative
    acknowledgment messages.

LI **Length Indicator**

SF **Status Field:** Shows the status of the link.

CK **Cyclic Redundancy Check:** 2 octets

Figure 5–4   LSSU Message Structure

• *Fill-In Signal Unit (FISU)* - As named, FISUs are used to "fill in" when there is no traffic on the link. This keeps the link aligned. A description of each field is shown in Figure 5–5.

BSN   Backward Sequence Number:
Indication of the last sequence number.

BIB   Backward Indicator Bit: Bit
inverted for negative acknowledgment
of the BSN message.

FSN   Forward Sequence Number: Indication
of the message sent.

FIB   Forward Indicator Bit: Bit is inverted
to indicate retransmission of negative
acknowledgment message.

LI   Length Indicator

CK   Cyclic Redundancy Check: 2 octets

Figure 5–5   FISU Message Structure

1.4   ISUP Message Example

ISUP messages are used to provide circuit-related control
information. In general, the most basic application used today for
ISUP is call setup. The IAM (Initial Address Message) is the first
message sent for setting up a call. Subsequently, there are a
number of other messages being exchanged to connect and
eventually release the call. Figure 5–6 shows the complete call
process.
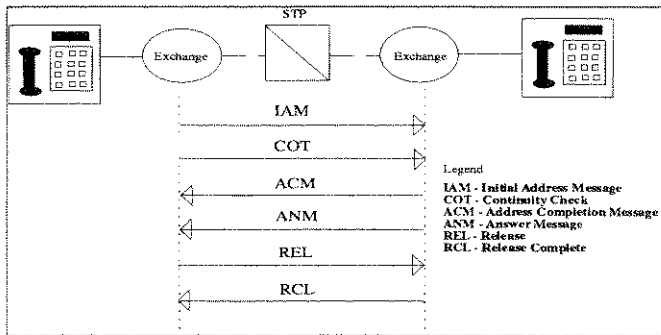
**Figure 5–6   ISUP Messages Used in a
Typical Phone Call**

IAM contains the essential information required for the call. It has the flexibility to expand with additional parameters as new service is required. Figure 5–7 illustrates the typical information in an IAM message.

IAM Message Information Fields	
- Message Type:	IAM
- Nature of Connection:	Continuity Check
- Forward Call Indicator:	National; no interworking; caller: ISDN
- Calling Party's Category:	Ordinary
- User Service Information:	Speech; Circuit
- Called Party Number:	14158552301
- Calling Party Number:	14083638000; presentation allowed

Figure 5–7   Typical IAM Information Fields

Section 2 SS#7 Analysis Menus

The SS#7 Analysis Menu may be accessed through the OTHER MEASUREMENTS menu list. Refer to Figure 5–8, SS#7 Analysis Menu.

```
                              16:43:32


        SS#7 ANALYSIS

        CONFIGURATION
        SU MONITOR
        SU ANALYSIS
```
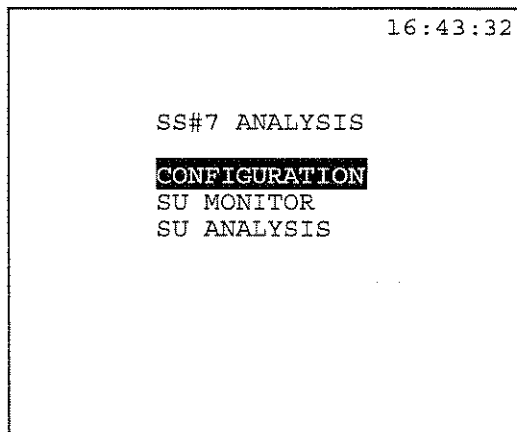
Figure 5–8   SS#7 Analysis Menu

2.1 Configuration

• Select the timeslots to receive SS#7 signals.
• Select the SS#7 standard version to be used.

The items selected here will be used in following SS#7 procedures. Figure 5–9 displays the Configuration screen.

```
                              02:18:50


              CONFIGURATION


          Line 1 Rx T/S : 1
          Line 2 Rx T/S : 1
          SS7 VERSION   : CCITT
          PC DISP FORMAT: DECIMAL




     HEX   DECIMAL
```

Figure 5–9   SS#7 Configuration Screen

Select the following:

1) Line 1 Rx T/S

Options: 1—31

    Select the Line 1 timeslot on which you will receive the SS#7 signal.

• Press NEXT (F1) or PREVIUS (F2) to select the timeslot.

2) Line 2 Rx T/S

Options: 1—31

    Select the Line 2 timeslot on which you will receive the SS#7 signal.

• Use the F-keys, NEXT (F1) or PREVIUS (F2), to select a timeslot.

3) SS7 VERSION

Options: CCITT (F1), CHINA24 (F2), CHINA14 (F3), ITALY (F4)

    Determines the SS#7 standard to be used during your analysis.

• Press F1 to use the CCITT/ITU version.
• Press F2 to use the CHINA 24 bit.
• Press F3 to select the CHINA14 bit version.
• Press F4 to select the ITALY version.

4) PC DISP FORMAT
Options: HEX (F1), DECIMAL (F2)
   Determine the display format for DPC (Destination Point Code)
and OPC (Originating Point Code).

• Press (F1) to view the received data in hexadecimal format.
• Press (F2) to view the received data in decimal format.

2.2 SU Monitor

The SU (Signalling Unit) Monitor menu contains three items:

1. SETUP FILTER
2. START TRACER
3. VIEW/PRINT TRACER

2.2.1 Setup Filter

• Select various filter items to be used during the trace process,
     including both Layer 2 (Data Link Layer) and Layer 3 (Network
     Layer) information.
• The SunSet will search for SS#7 messages which match the
     filtering items specified here.
• You may choose NONE for each item; in this case, the SunSet
     will search for all SS#7 messages.

   Figure 5–10 shows the SU MONITOR screen, followed by
Figure 5–11, the Setup Filter screen.

```
                          19:37:44


         SU  MONITOR

         SETUP FILTER
         START TRACER
         VIEW/PRINT TRACER
```

Figure 5–10 SU Monitor Screen

```
                          02:23:07
                SETUP FILTER

     LAYER 3
        LINE  1  DPC:  XX-XX-XX
        LINE  1  OPC:  XX-XX-XX
        SI FIELD   :  TUP


     ----------- LAYER 2 -----------
        BSN / BIB  :  XX/ X
        FSN / FIB  :  XX/X
        FISU /LSSU:  ON

     ON    OFF
```

Figure 5–11   Setup Filter

To enter a number in the following items, use the 1/10/50 (F4) key to set the scale of the numeric change; correspondingly, the (F2) key will read INC+1, +10, or +50, and (F3) will display -1, -10, or -50. As an example, when starting from 00, to enter a value of 55, press the more (F4) key until (F2) reads +50, then press (F2); next press 'more' again until (F3) reads +1, then press (F3) five times, until the digits read 55. The following filter items are available:

Layer 3 (Signalling Network)
1) LINE 1 DPC
Options: NONE (F1), 0 to 16383 in Decimal
    NONE (F1), 00-00-00 to 07-FF-07 in Hexadecimal

    The Destination Point Code (DPC) indicates the signalling point for which the message is intended.

- The Line 2 OPC defaults to the same number set as the Line 1 DPC. Thus, the filtering applies to all SS#7 messages being received (Line 1 DPC) and sent (Line 2 OPC) from the selected signalling point.

2) LINE 1 OPC
Options: NONE (F1), 0 to 16383 in Decimal
        NONE (F1), 00-00-00 to 07-FF-07 in Hexadecimal

    The Originating Point Code (OPC) indicates the signalling point that is the source of the message.

- The Line 2 DPC defaults to the same number as selected here. Thus, the filtering applies to all SS#7 messages being sent (Line 1 OPC) and received (Line 2 DPC) from the selected signalling point.

3) SI FIELD
Options: NONE (F1), TUP (F2), ISUP (F3), SCCP (more, F1), SNM (more, F2), SNT (more, F3)

- The Service Indicator Field is used by signalling handling functions to perform message distribution.
- The SI field indicates the user part to which the message belongs.
- This field further specifies the type of messages to filter.

The choices are:
- NONE (F1) to search for messages belonging to all SI Fields.
- TUP (F2) to search for those belonging to the Telephone User Part.
- ISUP (F3) to search for ISDN User Part messages.
- SCCP (more, F1) to search for Signalling Connection Control Part messages.

SNM (more, F2) to look for Signalling Network Management
messages.
SNT (more, F3) to look for Signalling Network Testing messages.

More filtering options will appear once a specific (not NONE) SI
Field has been chosen. The options available depend upon the
specific SI Field chosen above. Figure 5–12 displays the options
with their respective SI fields.

	SI FIELD				
SNT	NONE	TUP	ISUP	SCCP	SNM
CIC CODE		•	•		
SLS CODE				•	•
MESG TYPE			•	•	
HEAD CODE		•		•	•
ADDR SIGNL		•	•		

Figure 5–12   SI Field Filtering Options

The filtering items available for TUP are:

1) CIC CODE
Options: NONE (F1), 000 to FFF

• The Circuit Identification Code is used as a label for circuit-related
  messages.
• Identifies the telephone circuit among those interconnecting the
  Destination Point and the Originating Point; each phone call
  shares the same CIC code.
• For TUP, the least significant 4 bits of the CIC field are the SLS
  (Signalling Link Selection).
• SLS is used to perform loadsharing when needed.
• Use the 1/10/50 (F4) key to select the rate at which the F2 and F3
  will increment/decrement; use the F2 and F3 keys to select the
  number.

2) HEAD CODE
Options: NONE (F1), 00 to FF

The TUP Heading Code indicates the group to which the message belongs, as well as the name of the message.
• Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.

Table 5–13 lists the TUP Head codes.

3) ADDR SGNL
Options: NONE (F1), CALLED# (F2), CALLER# (F3)
　Filter messages using address numbers.

• Select NONE (F1), if you want the SunSet to search for all numbers.
• Press CALLED# (F2) to look for a specific called number; the destination of the call.
　a) After pressing the (F2) key, a new line, ADDR NUMB, will appear below.
　b) Enter the specific number by pressing/releasing the SHIFT key and pressing the desired keypad number keys.
• Press CALLER# (F3) to look for a specific caller number, the origin of the call.
　a) After pressing the (F3) key, a new line, ADDR NUMB, will appear below.
　b) Enter the specific number by pressing/releasing the SHIFT key and pressing the desired keypad number keys.

TUP Heading		Code (hex)
ACB	Access Barred Signal	A5
ACC	Automatic Congestion Control Info. Message	1A
ACM	Address Complete Message	14
ADI	Address Incomplete Signal	45
ANC	Answer Signal, Charge	16
ANN	Answer Signal, No charge	26
ANU	Answer Signal, Unqualified	06
BLA	Blocking-Acknowledgment Signal	37
BLO	Blocking Signal	27
CBK	Clear-back Signal	36
CCF	Continuity Failure Signal	32
CCL	Calling Party Clear Signal	76
CCR	Continuity-Check-Request Signal	67
CFL	Call Failure Signal	55
CGC	Circuit-Group-Congestion Signal	25
CHG	Charging Message	24
CLF	Clear-Forward Signal	46
COT	Continuity Signal	32
DPN	Digital Path Not Provided Signal	B5
EUM	Extended Unsuccessful Backward Set-up Information Message	F5
FOT	Forward-Transfer Signal	66
GRA	Circuit Group Reset-Acknowledgment Message	A8
GRQ	General Request Message	13
GRS	Circuit Group Reset Message	98
GSM	General Forward Set-upInformation Message	12
HGU	Hardware Failure Oriented Group Unblocking Message	78
HUA	Hardware Failure Oriented Group Unblocking Acknowledgment Message	88
IAI	Initial Address Message with Additional Info	21
IAM	Initial Address Message	11
LOS	Line-out-of-Service Signal	85
MBA	Maintenance Oriented Group Blocking-Acknowledgment Message	28
MGB	Maintenance Oriented Group Blocking Message	18
MGU	Maintenance Oriented Group Unblocking Message	38
MPR	Misdialled Trunk Prefix	C5
MUA	Maintenance Oriented Group Unblocking Acknowledgment Message	48
RLG	Release-Guard Signal	17
RSC	Reset-Circuit Signal	77
SAM	Subsequent Address Message	31
SAO	Subsequent Address Message with One Signal	41
SBA	Software Generated Group Blocking-Acknowledgment Message	C8
SEC	Switching-Equipment-Congestion Signal	15
SGB	Software Generated Group Blocking Message	B8
SGU	Software Generated Group Unblocking Message	D8
SSB	Subscriber-Busy Signal	65
SST	Send-Special-Information Tone Signal	95
SUA	Software Generated Group Unblocking-Acknowledgment	E8
UBA	Unblocking-Acknowledgment Signal	57
UBL	Unblocking Signal	47
UNN	Unallocated Number Signal	75

Figure 5–13 TUP Head Codes

The following filter options are available for ISUP messages:

1) CIC CODE
Options: NONE (F1), 000 to FFF

- The Circuit Identification Code is used as a label for circuit-related messages.
- Identifies the telephone circuit among those interconnecting the Destination Point and the Originating Point.
- The least five significant bits of the ISUP CIC code are a binary representation of the actual number of the timeslot which is assigned to the speech circuit.
- Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.

2) MESG TYPE
Options: NONE (F1), 00 to FF

- Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.

The ISUP message type are shown in the following table, Table 5-14.

ISUP Message Types		Code (hex)
ACM	Address Complete Message	06
ANM	Answer	09
BLA	Blocking-Acknowledgment	15
BLO	Blocking	13
CCR	Continuity Check Request	11
CFN	Confusion	2F
CGB	Circuit Group Blocking	18
CGBA	Circuit Group Blocking Acknowledgment	1A
CGU	Circuit Group Unblocking	19
CGUA	Circuit Group Unblocking Acknowledgment	1B
CMC	Call Modification Completed	1D
CMR	Call Modification Request	1C
CMRJ	Call Modification Reject	1E
CON	Connect	07
COT	Continuity	05
CPG	Call Progress	2C
CQM	Circuit Query	2A
CQR	Circuit Query Response	2B
CRG	Charge Information	31
DRS	Delayed Release	27
FAA	Facility Accepted	20
FAR	Facility Request	1F
FOT	Forward-Transfer	08
FRJ	Facility Reject	21
GRA	Circuit Group Reset-Acknowledgment	29
GRS	Circuit Group Reset	17
IAM	Initial Address Message	01
INF	Information	04
INR	Information Request	03
LPA	Loop Back Acknowledgment	24
OLM	Overload	30
PAM	Pass Along	28
REL	Release	0C
RES	Resume	0E
RLC	Release Complete	10
RSC	Reset Circuit	12
SAM	Subsequent Address Message	02
SUS	Suspend	0D
UBA	Unblocking Acknowledgment	16
UBL	Unblocking Signal	14
USIS	Unequipped Circuit Identification Code	2E
USR	User-to-User Information	2D

Table 5-14 ISUP Message Types

3) ADDR SGNL

Options: NONE (F1), CALLED# (F2), CALLER# (F3)

Filter messages using address numbers.

• Select NONE (F1), if you want the SunSet to search for all

numbers.

- Press CALLED# (F2) to look for a specific called number, the destination of the call.

  After pressing the (F2) key, a new line, ADDR NUMB, will appear below.

  a) enter the specific number by pressing/releasing the SHIFT key and pressing the desired keypad number keys.

- Press CALLER# (F3) to look for a specific caller number, the origin of the call.

  After pressing the (F3) key, a new line, ADDR NUMB, will appear below.

  a) Enter the specific number by pressing/releasing the SHIFT key and pressing the desired keypad number keys.

The filtering options for SCCP are as follows:

1) SLS CODE
Options: NONE (F1), 0 to F

- The Signalling Link Selection Code is a 4-bit long code. It is used, where appropriate, in load sharing.
- Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.

2) MESG TYPE
Options: 00 to FF

- Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.
- The message types for SCCP are given in table 5–15.

SCCP Messages		Code (hex)
AK	Data Acknowledgment	08
CC	Connection Confirm	02
CR	Connection Request	01
CREF	Connection Refused	03
DT1	Data Form 1	06
DT2	Data Form 2	07
EA	Expedited Data Acknowledgment	0E
ED	Expedited Data	0B
ERR	Error	0F
IT	Inactivity Test	10
RLC	Release Complete	05
RLSD	Released	04
RSC	Reset Confirm	0E
RSR	Reset Request	0D
UDT	Unitdata	09
UDTS	Unitdata Service	0A

Table 5–15 SCCP Messages

The filtering options for SNM are:

1) SLS CODE
Options: NONE (F1), 0 to F
    The Signalling Link Selection Code is a 4-bit long code. It is
used, where appropriate, in load sharing.

• Use the 1/10/50 (F4) key to select the rate at which the F2 and F3
    will increment/decrement; use the F2 and F3 keys to select the
    number.

2) HEAD CODE
Options: 00 to FF

• Use the 1/10/50 (F4) key to select the rate at which the F2 and F3
    will increment/decrement; use the F2 and F3 keys to select the
    number.

The Heading codes for SNM are shown in Table 5–16.

SNM Heading Codes		Code (hex)
CBA	Changeback Acknowledgment Signal	61
CBD	Changeback Declaration Signal	51
CNP	Connection-Not-Possible Signal	48
CNS	Connection-Not-Successful Signal	38
COA	Changeover Acknowledgment Signal	21
COO	Changeover Order Signal	11
CSS	Connection Successful Signal	28
DLC	Signalling Data Link Connection Order Signal	18
ECA	Emergency Changeover Acknowledgment Signal	22
ECO	Emergency Changeover Order Signal	12
LFU	Link Forced Uninhibit Message	66
LIA	Link Inhibit Acknowledgment Message	36
LID	Link Inhibit Denied Message	56
LIN	Link Inhibit Message	16
LLI	Link Local Inhibit Test Signal	76
LRI	Link Remote Inhibit Test Signal	86
LUA	Link UninhibitAcknowledgment	46
LUN	Link Uninhibit Message	26
RCP	Signalling Route Set Test Cluster Prohibited Signal	35
RCR	Signalling Route Set Test Cluster Restricted Signal	45
RCT	Signalling Route Set Congestion Test Signal	13
RSP	Signalling Route Set Test Prohibited Signal	15
RSR	Signalling Route Set Test Restricted Signal	25
TFA	Transfer Allowed Signal	54
TFC	Transfer Controlled Signal	23
TFP	Transfer Prohibited Signal	14
TFR	Transfer Restricted Signal	34
TRA	Traffic RestartAllowedSignal	17
UPU	User Part Unavailable Signal	1A

Table 5–16   SNM Heading Codes

The filtering options available for SNT are:

1) SLS CODE
Options: NONE (F1), 0 to F

- The Signalling Link Selection Code is a 4-bit long code. It is used, where appropriate, in load sharing.
- Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.

2) HEAD CODE
Options: 00 to FF

- Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the

number.

• The Heading Codes for SNT are shown in Table 5–17.

SNTHeading Codes	Code (hex)
SLTA Signalling Link Test Acknowledgment	12
SLTM Signalling Link Test Message	11

Table 5–17   SNT Heading Codes

• The layer 2 filtering options are shown at the bottom of the screen.
• These options remain the same for each SI FIELD.

Layer 2, the Signalling Link Control Layer, defines the functions and procedures for transmitting signalling information over one individual data link. Layer 2, long with Layer 1, provides a signalling link for reliable transfer of signalling messages between two points.

The Layer 2 filtering options are:

1) BSN/BIB
Options: BSN- NONE (F1), 00 to 7F BIB- NONE (F1), 0 (F2), 1 (F3)

Each message to be transmitted is numbered in sequence from 0 to 127. For backward signal units, this number takes the form of the BSN, Backward Sequence Number. When a backward message has been received correctly, the receiving terminal sends back the Backward Sequence Number and the Backward Indicator Bit (BIB) retains its present value. If there is an error in this backward message, the receiving terminal rejects this message, sending back the BSN of the last correctly received signal, as well as an inverted BIB.

• Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.

2) FSN/FIB
Options: FSN- NONE (F1), 00 to 7F FIB- NONE (F1), 0 (F2), 1 (F3)
Each number to be transmitted is numbered in sequence from 0 to 127. For forward signal units, this number takes the form of the

FSN, Forward Sequence Number. When a forward message has been received correctly, the receiving terminal sends back the Forward Sequence Number and the Forward Indicator Bit (FIB) retains its present value. If there is an error in this forward message, the receiving terminal rejects this message, sending back the FSN of the last correctly received signal, as well as an inverted FIB.

• Use the 1/10/50 (F4) key to select the rate at which the F2 and F3 will increment/decrement; use the F2 and F3 keys to select the number.

3) FISU/ LSSU
Options: ON (F1), OFF (F2)

FISU, Fill-In Signal Unit, is an idle signal used for error surveillance. LSSU, Link Status Signal Unit, is mainly used at start-up or when an error is found on the line.
Please note that FISU/LSSU can be turned ON (F1) only when one of the above filters (BSN, BIB, FSN, FIB) has been set to 0 or 1. If NONE has been selected for all these filters, then FISU/LSSU can't be turned on.

2.2.2 Start Tracer

• Start Tracer begins the trace process, using the filter values specified in the Setup Filter screen.
• The tracer display updates twice a second.

In this screen, there are three function keys to choose from:

RESTART: Restart causes the SunSet to restart the trace process. Messages stored in the buffer will be erased.

PAUSE/ RESUME: Pause freezes the display so the data can be easily observed. Measurements are still occurring, but the counts are updated only in memory, and not on the display. RESUME will update all the data to their current values.

DECODE/HEX: Displays the message contents for analysis.

• Select HEX to show the message in hexadecimal format.

- The E10 provides detail decoding for SS7 messages in levels 3 and 4.
- Remember you are given the option of viewing the coded OPC or DPC in either hexadecimal or decimal format in the Configuration screen.

2.2.3 View/ Print Tracer

- View and print specific data.

Figure 5–18 shows the initial View/Print Tracer screen which appears upon entering.

```
                              03:27:10

        VIEW/PRINT TRACER

        TOTAL RECORD-74

           FROM No.: 1
           TO No.  : 74


        THE FILTER IS OFF




CLR-ALL    PRINT    VIEW    FLTR-ON
```
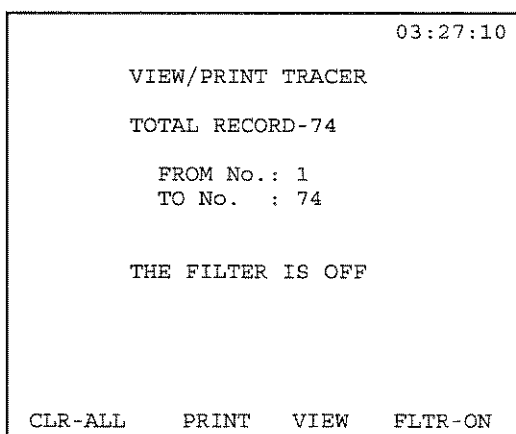
Figure 5–18   View/Print Tracer Screen

CLR-ALL (F1): This key is the first step in erasing the contents of the buffer. After pressing CLEAR, you will be asked to press ENTER to continue the process. This second step provides security against accidentally erasing the buffer contents.

PRINT (F2): Prints the contents of the buffer. Figure 5–19 shows a sample printout.

```
╭──┬──┬──┬──┬──┬──┬──┬──┬──┬──╮
LINE 1              03:31:08

TUP
DPC:00-03-06

00 00 17 84 1E 80 02 90 14 11
01 00 A7 04 38 36 08 00 A6 00

LINE 1              03:31:08
LAYER 3 - TUP
SI:4    SSF:8      CIC:149
DPC:00-03-06      OPC:00-01-02
LAYER 4 - IAM     H0 :1  H1 :1
CLN PRTY:01
MSG INDI:700
ADDR SIG:04 38 36 08 00

CLN PRTY:
bits FEDCBA
     000001
     language French
```

Figure 5–19   Sample Printout

VIEW (F3): Press to view any messages captured by the Sunset.
• Specify which messages to view. The second line in this screen
   displays the total number of messages captured.
• Make sure the cursor is placed on the FROM No. line.
• Specify the message number at which you wish to begin the
   viewing process, by pressing the SHIFT key and entering the
   desired numbers from the keypad.
• Cursor down to To No., and repeat the process to determine where
   you will stop viewing.

FLTR-ON/ FLTR-OFF (F4): This key gives you the option of
keeping the filter assignments on or off.
• Turning the filter off allows you to view all messages, while saving
   any filter settings you may have selected in the Setup Filter
   screen (without this option, you would need to select NONE for
   all setup items). FLTR-ON allows you to post-filter the captured
   messages.

Upon pressing VIEW (F3), you will see the first specified
message. Figure 5–20 shows a sample screen.

```
                            21:58:49
             RECEIVE MESG NO.7

LINE 1    96-01-05  21:12:28.526
MSU - TUP      BSN:76 0 FSN:26 1
SI :4   SSF: 0     CIC:BE1
DPC:01-0D-05       OPC:06-57-02
H0 :2  H1 :1       GSM
RESPONSE : CD
CLN PARTY: 31
CLN ID   : EMPTY
T.EXCHG  : 78
IN TRUNK : B2 14 5A 2E
ORG ADDR : EMPTY

 PAGE-UP  PAGE-DN   HEX  L4deco
```

Figure 5–20   View Message Sample

The following F-keys are available in this screen:

PAGE-UP (F1): View other pages of data by showing the previous page. In Figure 5-20, pressing PAGE-UP (F1) would bring up Message number 6.

PAGE-DN (F2): View other pages of data by showing the next page. In Figure 5–20, pressing PAGE-DN (F2) would bring up Message number 8.

HEX/ DECODE (F3): Displays the message contents for analysis.
• Hex shows the message in hexadecimal format.
• If you selected DECIMAL in the Configuration screen, pressing HEX will show the OPC and DPC in decimal format.

L4deco (F4): Decodes the Layer 4 message contents for analysis
• Press F4 to decode whichever item is highlighted by the cursor. In Figure 5–20, this is Response: CD.
• Figure 5–21 shows a bit by bit decode for a specific example.

```
                            22:04:04
bits  PONMLKJIHGFEDCBA
      0000000011011000
bits  BA:  no indication
bits  DS:  connect when free
bits  FE:  ordinary subscriber
bits  HG:  pass along & SCCP avail
bit   I:   no interworking encuntr
bit   J:   no end-to-end info
bit   K:   ISUP not all teh way
bit   L:   holding not requested
bit   M:   terminating non-ISDN
bit   N:   w/o income echo control
bits  PO:  no indication

                             Return
```

Figure 5–21   Layer 4 Decode

The Layer 4 decode screen defines each bit. After viewing, press Return (F4) to return to the message screen.

2.3 SU Analysis

You will find the SU Analysis selection in the main SS#7 menu.

- The SU (Signalling unit) Analysis screen shows the type, number and % statistics of SS7 messages.
- The SunSet captures all types of signaling units based on the specified filtering setup.
- The analysis breaks the messages into three basic types: FISUs, LSSUs, and MSUs.
- MSU messages are divided into five types, SNM, SNT, TUP, ISUP and SCCP.
- In the Statistics screen, retransmission FIB (Forward Indicator Bit) and BIB (Backward Indicator Bit) counts are also available.
- See Figures 5–22, 5–23, and 5–24.

```
                        16:43:32

         SS#7 ANALYSIS


         CONFIGURATION
         SU MONITOR
         SU ANALYSIS
```

Figure 5–22   SS7 Menu/SU Analysis

```
                        23:02:22
              SU ANALYSIS
      LINE 1           LINE 2

      FISU -3771       FISU -0
      LSSU -28         LSSU -0
      MSU  -18         MSU  -0
      TOTAL-3817       TOTAL-0
              MSU MESSAGES
      SNM   -2         SNM  -0
      SNT   -2         SNT  -0
      TUP   -1         TUP  -0
      ISUP  -9         ISUP -0
      SCCP  -4         SCCP -0

RESUME    RESTART          STATIST
```

Figure 5–23   SU Analysis, pg. 1

```
                            02:23:07
             SU ANALYSIS
LINE 1              LINE 2

FISU%-00.4         FISU%-00.6
LSSU%-00.9         LSSU%-00.9
MSU %-98.5         MSU %-98.4

             RETRANSMISSION
FIB   -319         FIB   -323
BIB   -315         BIB   -319


RESUME   RESTART          COUNT
```

Figure 5–24   SU Analysis screen, pg. 2

There are three available function keys in this screen:

PAUSE/ RESUME (F1): Pause freezes the display so the data can be easily observed.

• When paused, measurements are still occurring, but the counts are updated only in memory, and not on the display.
• RESUME will update all the data to their current values.

RESTART (F2): Restart causes the SunSet to restart the trace process.

STATIST/ COUNT (F4): By pressing STATIST, the FISU%, LSSU%, MSU%, as well as the count of FIB and BIB retransmission bits, are displayed for both LINE 1 and LINE 2.

• COUNT returns you to the count screen, and shows the counts of FISUs, LSSUs, MSUs, etc.

Section 3 Applications

3.1 Monitoring the Transmit/ Receive Links of a SS#7 Network

• Monitor the sending and receiving links of the SS#7 network using the dual line receive jacks.

Use the following procedure:

1) This test may be performed while the span is carrying live SS#7 traffic.

2) From the Main Menu, enter TEST CONFIGURATION. Select the following setup choices:

TEST MODE	: E1
TX/INSERT	: L1-TX
RX/DROP	: L1-RX
FRAMING	: as required by circuit
CRC-4	: as required by circuit
TEST RATE	: 2.048M
RxLVL-1	: MONITOR
RxLVL-2	: MONITOR
XMT CLOCK	: INTERN

a) When your settings are correct, press ENTER.

3) Connect the SunSet to the circuit as shown in Figure 5–25.
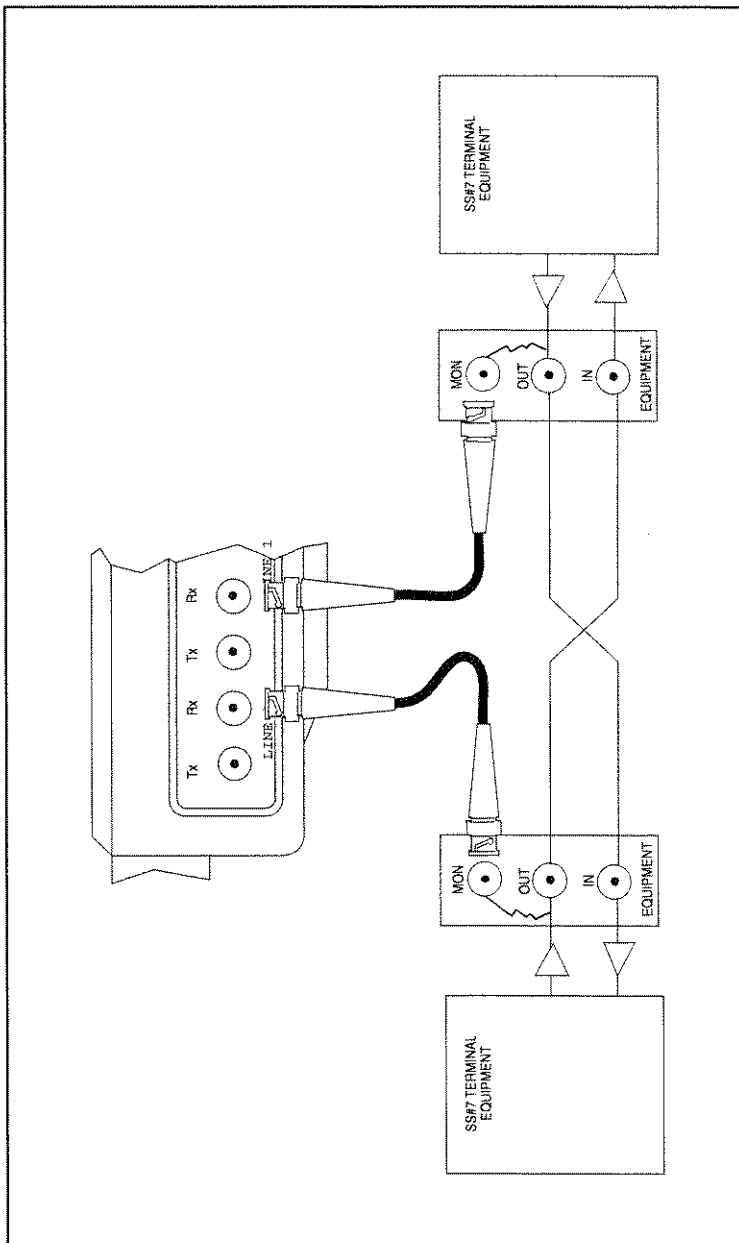
**Figure 5–25   Monitoring In-service SS#7 Links-
Monitor Mode**

4) Press the HISTORY key to acknowledge any blinking lights, and turn them off.
5) Escape to the Main Menu.
a) Enter OTHER MEASUREMENTS, SS7 ANALYSIS, CONFIGU-
RATION.
b) Select the receive timeslots for lines 1 & 2.
 • Use the NEXT (F1) and PREVIUS (F2) keys to select a
 timeslot for each line between 1 and 31 on which you will
 receive the SS#7 signal.
c) Cursor to SS7 VERSION.
d) Press (F1) to use the ITU/CCITT standard.
 You may also choose either CHINA 24 (F2) or CHINA14 (F3),
 ITALY (F4).
e) The last configuration item, PC DISP FORMAT, determines the
 display format for the OPC and DPC codes.
 • Press HEX (F1) to view/enter these codes in hexadecimal
 format, or press DECIMAL (F2) for decimal format.
f) When you have finished, press ENTER to return to the SS7
 Analysis menu.

6) Scroll down to SU MONITOR and press ENTER.
a) Select SETUP FILTER.

7) Refer to Figure 5–26 for a sample SETUP FILTER screen.

```
                                   02:23:07
                 SETUP FILTER

LAYER 3
  LINE 1 DPC: XX-XX-XX
  LINE 1 OPC: XX-XX-XX
  SI FIELD  : TUP


----------- LAYER 2 -----------
  BSN / BIB : XX/ X
  FSN / FIB : XX/X
  FISU /LSSU: ON

ON    OFF
```

Figure 5–26   Setup Filter Screen

8) The SunSet E10 uses the Originating Point Code (OPC) and the Destination Point Code (DPC) to filter SS#7 messages.
a) To capture all messages regardless of these point codes, press NONE (F1) for each, as was done in Figure 5–26.
   • Depending on your PC DISP selection in the Configuration screen, you can enter specific codes in either decimal or hexadecimal format.
b) Specify a particular Service Indicator Field to filter.
c) Upon selecting a SI Field, more filtering choices will be provided below.
   • For TUP in Figure 5–26, CIC CODE, HEAD CODE, ADDR SGNL, and ADDR NUMB are provided below.
   • You may enter specific values in each by first pressing the (F4) key as needed to set the desired increment/decrement values at 1, 10 , or 50. Then, use the (F2) and (F3) keys.

The specific filtering options appearing below SI FIELD depend upon the SI Field chosen.

• For ISUP messages, there will be a MESG TYPE instead of a HEAD CODE.
• For SCCP messages, there are only SLS CODE and MESG TYPE fields.
• For SNM and SNT messages, there are only SLS CODE and HEAD CODE fields.

Refer to Section 2.2 of this chapter for a more detailed description of each of these filtering fields.

9) When your settings are complete, press ENTER to return to the SU MONITOR Menu.
a) Select START TRACER.

   • The SunSet now begins the tracing process using the filter selections from SETUP FILTER.
   • You may pause the screen to look at the message closely by pressing the PAUSE (F2) key.
   • Use DECODE (F3) to decode the message.
   • Use the (F1) key to restart the filtering process.

b) When you are finished, press ESCAPE.

10) From the SU MONITOR Menu, enter VIEW/PRINT TRACER.
This screen allows you to view and print specific data
captured by the SunSet E10.
a) Use the PAGE-UP and PAGE-DN keys to view all the captured
messages.

Refer to section 2.2.3 of this chapter for more details and sample
screens.

11) Press the ESCAPE key twice to return to the SS#7 ANALYSIS
Menu.
a) Select SU ANALYSIS.

• Both Line 1 and Line 2 message counters are displayed in this
screen. As the various types of messages are coming across
Lines 1 and 2, the counter will increment the counts appropri-
ately. See Figure 5–27.
• Press the F1 key to PAUSE the measurements, and F2 to
RESTART them.
• Press F4 for a STATIStical display. See Figure 5–28.

```
                                   02:23:07

                  SU ANALYSIS
        LINE 1                LINE 2

        FISU -0               FISU -0
        LSSU -0               LSSU -0
        MSU  -7358            MSU  -1661
        TOTAL-7358            TOTAL-1661
                  MSU MESSAGES
        SNM  -66              SNM  -40
        SNT  -972             SNM  -182
        TUP  -63              TUP  -88
        ISUP -2516            ISUP -234
        SCCP -71              SCCP -101

      RESUME   RESTART              STATIST
```

Figure 5–27 SU Analysis

```
                                    02:23:07
                SU ANALYSIS
        LINE 1              LINE 2

        FISU%-00.0          FISU%-00.0
        LSSU%-00.0          LSSU%-0
        MSU %-100           MSU %-100

                RETRANSMISSION
        FIB  -938           FIB  -466
        BIB  -334           BIB  -351



RESUME    RESTART                 COUNT
```

Figure 5–28 SU Analysis, Statistical View

Chapter 6
ISDN

1.0 ISDN Technology Overview

1.1 Introduction

ISDN (Integrated Services Digital Network) was conceived to provide digital services to the end users using regular phone lines. Specifically, ISDN targets both residential and business customers.

Two configurations were designed, 2B+D for BRI (Basic Rate Interface) and 30B+D for high speed PRI (Primary Rate). Each B channel has 64 kbit/s availability for voice or data transport. The D channel is used for signalling and data communication; its capacity for BRI and PRI is 16 kbit/s and 64 kbit/s respectively.

Using ISDN, users can transport data at a higher rate in addition to utilizing a variety of new services such as Group IV FAX and personal digitialized video communication.

1.2 ISDN Network Architecture

In accordance with Figure 1, an ISDN user can access the following services using an ISDN TE (Terminal Equipment):
- Packet-switched data
- Circuit-switched data
- Circuit-switched voice
- Common Channel Signalling
- User-to-user signalling
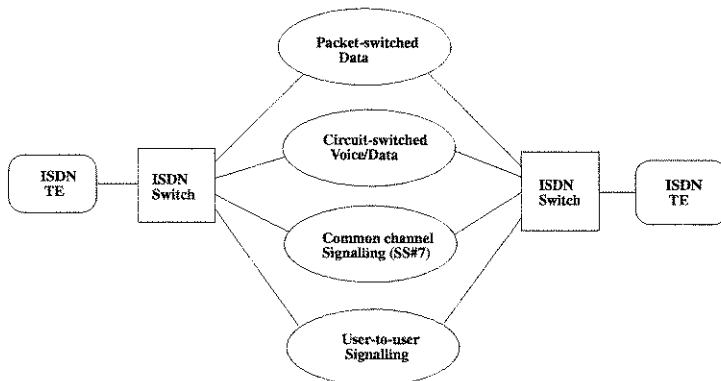
Figure 1   ISDN Architecture

1.3 ISDN Protocol

The D channel provides the signalling for all the B channel connections. Therefore, the ISDN protocol is mainly concerned with the first three layers of the D channel signalling. However, there are occasions in which the B channel is connected to a packetized network where it can provide its own signalling.

The signalling at the Data Link Layer for channels B and D are called LAP-B (Link Access Protocol Balance) and LAP-D respectively. Referring to Figure 2, here are the different layers of the protocol:

Application	End-to-end user signalling					
Presentation						
Session						
Transport						
Network	Call control I.451	X.25 Packet level	(Further study)			X.25 Packet level
Data Link	LAP-D (I.441)					X.25 LAP-B
Physical	Layer 1 (I.430, I.431)					
	Signal	Packet	Telemetry	Circuit switching	Leased circuit	Packet switching
	D Channel			B Channel		

**Figure 2   ISDN Protocol Architecture Layer 1
(I.430, I.431)**

The ISDN physical layer functions are listed below:
- Encoding of digital data for transmission across the interface
- Full-duplex transmission of B-channel data
- Full-duplex transmission of D-channel data
- Multiplexing of channels to form basic or primary access transmission structure
- Activation and deactivation of physical circuit
- Terminal identification
- Faulty terminal isolation
- D-channel contention access

The last function is needed when there is a multipoint configuration for basic access.

Layer 2 LAP-D (I.441)

The purpose of LAP-D is to convey user information between layer 3 entities across the ISDN network using the D-channel. The LAP-D service will support:

- Multiple terminals at the user-network installation
- Multiple layer 3 entities

The LAP-D standard provides two forms of service to LAP-D users; the unacknowledged and the acknowledged information transfer services. Their characteristics are described as follows:

- *Unacknowledged operation:* Layer 3 information is transferred in unnumbered frames. Error detection is used to discard damaged frames, but there is no error control or flow control.
- *Acknowledged operation:* Layer 3 information is transferred in frames that include sequence numbers and that are acknowledged. Error control and flow control procedures are included in the protocol. This type is also referred to in the standard as multiple-frame operation.

These two types of operation may coexist on a single D channel. With the acknowledged operation, it is possible to simultaneously support multiple logical LAP-D connections. This is analogous to the ability in X.25 level 3 to support multiple virtual circuits.

Layer 3

For call control signalling, the D-channel layer 3 interface is defined in Recommendations I.450 and I.451. It specifies the procedures for establishing connections on the B channels that share the same interface to ISDN as the D channel. It also provides user-to-user control signalling over the D channel.

As mentioned before, packet switching signalling is also available using X.25 layer 3 protocol. This is the same for using B channel packet switching service.

Layer 3 provides higher layer information for supporting various ISDN functions. Two basic types of user terminals are supported by ISDN: functional and stimulus. Functional terminals are considered to be intelligent devices and can employ the full range of I.451 messages and parameters for call control. All signalling information is sent in a single control message (en bloc sending).

Stimulus terminals are devices with a rudimentary signalling capability. A simple digital telephone is an example of a stimulus

terminal.

1.4 ISDN Messages and their Functionalities

The message structure is shown below in Figure 3. There is an 8 bit flag at the end of each frame. Sixteen bits are used as the frame check sequence.
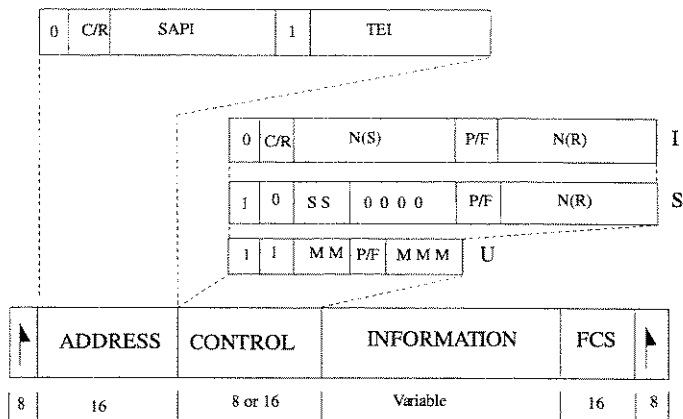
Figure 3   ISDN Frame Structure

Address Field

The Address field is composed of:

• TEI (Terminal Endpoint Identifier); identifies the user device.

• SAPI (Service Access Point Identifier): identifies a layer 3 user of LAP-D, and thus corresponds to a layer 3 protocol entity within a user device. Four values have been assigned:

    0: used for call control procedures for managing B-channel circuits

    16: reserved for packet-mode communication on the D-channel using X.25 level 3

    63: used for the exchange of layer 2 management information.

    1:   used for packet-mode communication using I.451. This could be used for user-user signalling.

The combination of TEI and SAPI is referred to as DLCI (Data Link Connection Identifier). At any one time, LAP-D may maintain multiple logical connections, each with a unique DLCI.

Control Field

LAP-D defines three types of frames, each with a different control field format. Information transfer frames (I-frames) carry the data to be transmitted for the user. Additionally, flow and error control data, using the go-back-N ARQ (Automatic Repeat Request) mechanism, are piggybacked on an information frame. Supervisory frames (S-frames) provide the ARQ mechanism when piggybacking is not used. Unnumbered frames (U-frames) provide supplemental link control functions and are also used to support unacknowledged operation.

All of the control field formats contain the poll/final bit (P/F). In command frames, it is referred to as the P bit, and is set to 1 to solicit (poll) a response frame from the peer LAP-D entity. In response frames, it is referred to as the F bit, and is set to 1 to indicate the response frame transmitted as a result of a soliciting command.

Information Field

The information field is present only in I-frames and some unnumbered frames. In the case of both control signalling and packet information, maximum length is 260 octets.

The information field contains the message type and parameters. For example, the SETUP message is used to set up a call. It contains the bearer capability, originating and destination addresses, transit network selection and other pertinent data.

Layer 3 information is used for intra, as well as interexchange calls using SS#7.

1.5 DASS2 Technology

Digital Access Signalling System 2 (DASS2) is a common channel signalling system intended for use between the customer's equipment (PBX) and an ISDN local exchange. DASS2 is specified in BTNR 190 (British Telecom). A 2.048 Mbps line connects the PBXs to the ISDN exchange. This 2.048M, 32 timeslot signal is divided as follows:

30 x 64 Kbps	Circuit Switched Traffic Channels
	(Timeslots 1-15 and 17-31)
1 x 64 Kbps	Frame Alignment Signal
	(Timeslot 0)
1 x 64 Kbps	Signalling Channel
	(Timeslot 16)

The common channel signalling (Link Access Protocol) is always carried on timeslot 16; no other timeslots are used for DASS2 signalling. DASS2 is based on the first three layers of the ISO reference model. Layer 1, Physical Layer, involves the activating/deactivating of the physical connection. Layer 2, Link Access Protocol, provides secure, error-free transmission of the Layer 3 messages. Layer 3, Call Handling Layer, contains the call control messages conveyed within a HLDC (High Level Data Link) standard frame.

1.5.1 DASS2 Layer 2

Layer 2, Data Link Layer, provides a transport mechanism for the Layer 3 messages. Link Access Protocol (LAP) operates in parallel with each other over the signalling channel (timeslot 16). LAP control is effected using one of the two frame formats shown in Figure 5.

```
┌─────────────────────────────────────────────┐
│  ┌──────┬──────┬──────┬──────┐               │
│  │      │      │      │      │               │
│  │ FCS  │  I   │  C   │  A   │  ────────▶    │
│  │      │      │      │      │               │
│  └──────┴──────┴──────┴──────┘               │
│   16 bits        8 bits  16 bits             │
│                                              │
│  ┌──────┬──────┬──────┐                      │
│  │      │      │      │                       │
│  │ FCS  │  C   │  A   │   ────────▶          │
│  │      │      │      │                       │
│  └──────┴──────┴──────┘                      │
│   16 bits  8 bits   16 bits                  │
│                                              │
│       FCS:   Frame Check Sequence            │
│       I:     Information Field               │
│       C:     Control Field                   │
│       A:     Address Field                   │
└─────────────────────────────────────────────┘
```
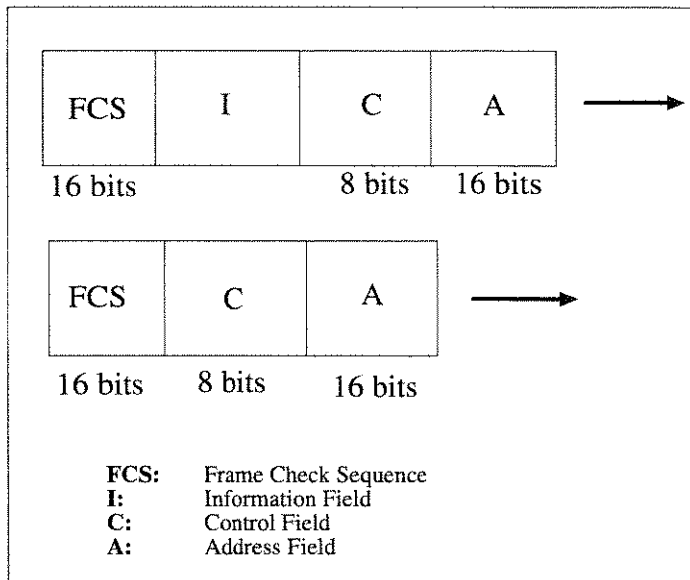
Figure 5   LAP Frames

In brief, the LAP fields shown above are defined as:

Address Field:
- Transmitted first   • Contains 2 octets
- Identifies the traffic channel (carried on timeslot 0) associated with its signalling frame.

Control Field:
- Transmitted second   • One octet long
- Contains a frame type code and, sometimes, a sequence number

Information Field:
- Not always present in the LAP frame
- Contains an information block, from 0-45 octets long, which is transferred transparently across the link.

Frame Check Sequence:
- Transmitted last   • Composed of two octets
- Conveys the Cyclic Redundancy Code corresponding to the

Address, control, and possibly Information fields.
- FCS is calculated according to the method defined in BTNR vol. 190 5.5.

1.5.2 DASS2 Frame Types

There are three frame types: Unnumbered Information (UI), Set Asynchronous Balanced Mode Restricted (SABMR), and Unnumbered Acknowledgment (UA).

A frame may be transmitted as either a command or response frame, as indicated by the Command/Response bit within the Address Field. Command frames are used to carry information and control the link. Response frames acknowledge the receipt of a command frame. UI may be either a command (UIC) or a response (UIR). SABMR is only a command, while UA is only a response.

UIC's control field carries a Send Sequence Number, which identifies this UIC in a sequence of UIC frames. The UIC frame conforms to the top framing format of Figure 5 (FCS, I, C, A). It contains an Information Field (up to 45 octets long) that may carry higher level signalling information. The UIR conveys an acknowledgment that a particular UIC frame has been received correctly.

The control field contains a Receive Sequence Number, which corresponds to the Send Sequence Number of the acknowledged UIC. The UIR frame conforms to the bottom framing format of Figure 5 (FCS, C, A). It is lacking the Information Field.

A SABMR message may only be sent as a command frame. Upon receiving a SABMR message, the remote ET/PBX resets its variables (a variable is an operational value against which the sequence number or received UI frames are checked to determine the appropriate action) and sends a UA as response. Upon receiving the UA response, the initial PBX/ET resets its variables as well. Figure 6 provides an illustration.

```
                                        00:11:20

                    CONFIGURATION
          Q.931 STD     :  ETSI
          EMULATE TYPE  :  TE
          Line 1 Tx T/S :  16
          Line 2 Tx T/S :  16
          B CHNL MODE   :  1-30
          TEST PATTERN  :  63
          USER PATTERN  :  00001111
          LAYER 2 SAPI  :  0
          LAYER 2 TEI   :  0



     ETSI    DASS2    DPNSS    AUSSIE
```

Figure 6-7 ISDN Configuration

1) Q.931 STD

Options: ETSI (F1), DPNSS (F2), DASS2 (F3), AUSSIE (F4)

The Q.931 specification indicates whihc type of ISDN switch you intend to use for testing.

DPNSS (F2) and DASS2 (F3) are defined in BTNR volumes 188 and 190, respectively.
ETSI (F1) refers to the European Telecommunicatino Standard.
AUSSIE (F4) is tAustrailian nainal standard.

If you are not certain as to which type of switch you are testing, you may need to try all four types.

2) EMULATE TYPE

Options: TE (F1), NT (F2) for ETSI and AUSSIE
        PBX B (F1), PBX A (F2) for DPNSS
        PBX (F1), ET (F2) for DASS2
Configures the emulation mode for the test set.

The choices available vary depedning on the Q.931 STD chosen in the line above.

For ETSI and AUSSIE:

Terminating Equipment (F1):
- TE is used when the test set is emulating a piece of customer's equipment, as in a PBX.
- Use TE Type when you are plugging into a Central Office switch.

Network Terminal (F2):
- NT is used when emulating an ISDN switch or exchange.
- Use NT to plug into Customer Premises.

The choise of emulation type temporarily changest he transmit clock source:
- NT uses the internal clock.
- TE uses the received signal.
- The set's transmit clock reverts tot he TEST CONFIGURATION XMT CLK setting when you escape out of the ISDN PRIMARY RATE menu.
- When you enter the ISDN PRIMAREY RATE menu, the clock changes to internal (NT) ore received (TE).
- There may be no clock at all if the test set is plugged into an ISDN PRI netowrk (i.e,. PBX) and is set to TE.

DASS2 is intended for use between the customer's equipment and an ISDN local exchange. Therefore, the two choices available iwth DASS2 are PBX (F1) and ET (F2):

- Select PBX (F1) to emaulate customer's equipment and plug into an ISDN exchange.
- Select ET to emulate an exchange to plug into a piece of customer equpement.

DPNSS was conceived to provide signaling between PBXs connected to a private digital network. The two chioces available her are:

- PBX B (F1)
- PBX A (F2)

3) Line 1 Rx T/s

Optiosn 1—31

Select the desired Line 1 E1 timeslot on which to receive the ISDN signal. The D channel is usually channel 16.

- Use the F-keys, NEXT (F1) or PREVIUS (F2) to make the selectinon.

3) Line 2 Rx T/s
Optiosn 1—31

Select the desired Line 2 E1 timeslot on which to receive the ISDN signal. The D channel is usually channel 16.

- Use the F-keys, NEXT (F1) or PREVIUS (F2) to make the selectinon.

5) B CHNL MODE
No options. ETSI, DASS2 and DPNSS are set at 1—15/17—31; AUSSIE is set at 1—30.

- In 1—30, B-channel 16 is placed in timeslot 17, and B-channel 30 is placed in timeslot 31.
- In 1—15/17—31, the 16 B-channel is omitted in order to realign the channesl with timeslots. Therefore, B-channel 17 is placed in timeslot 17 and B-channel 31 is placed in teimslot 31.

These two settings refer to two different concepts in B-channel placement. The D-channel is usually placed in *timeslot* 16; therefore timeslot 16 does not contain a B-chanel, which would have been B-channel 16. Instead, B-channel 16 is placed in timeslot 17 and B-channel 17 in timeslot 18, etc.

6) TEST PATTERN
Options: 63 (F1), 127 (F2), 511 (F3), 2047 (more, F1), 1111 (More, F2), 0000 (more, F3), 10101 (more, F1), USER (More, F2)
Select the test pattern to send on a data call.

- If you select USER, cursor down to the next line, and enter the pattern you want to send.

7) USER PATTERN

Use the 0 (F1) and 1 (F2) keys to enter the eight-bit pattern, if you have selected USER as your TEST PATTERN.

The next two items refer to the ETSI/AUSSIE protocol. These two parameters will not appear if DPNSS or DASS2 were selected.

8) Layer 2 SAPI
Optiosn: 0—63
Selected the desired SAPI value.

- Press the appropriate F-keys to reach the desired value:
F1 increments by tens, F2 increments by one
F3 decrements by tens, F3 decrements by one.

The Service Access Poitn Identifier:
- Comprises bits 3—8 in the fist octet of Layer 2's Address Field
- The SAPI value identifies a point at which data link layer services are provided by a data link layer entity to a layer 3 or management entitiy.
- Identifies a data lnik layer entity, which processes a data link layer frame.
- Identiifcies a layer 3 3ntity to recie the information carried by the data link layer frame.

As defined in CCITT Q.921, there are four valid SAPI values:
- 0   Call control procedures (normally used)
- 1   Packet mode using Q.931 call procedures
- 16 Packet communications (X.25 level 3)
- 63 Layer 2 management procedures
- All other values are reserved for future implmentation.

9) LAYER 2 TEI
Options: 0—127
Select the desired TEI value.

- Press the appropriate F-keys to reach the desired value:
F1 increments by tens, F2 increments by one
F3 decrements by tens, F3 decrements by one.

The Terminal Endpoint Identifier (TEI):
- Identifies the user device.
- Comprises the Address Field's second octet, bits 2—8.
- Identifies the user device.
- For a point-to-point data link connection, TEI may be associated with a single Termianl Equipment (TE).

CCITT Q.921 has defined three groups of TEI values:
0—63: Fixed, or nonautomatic, TEI assignment user equipment
64—126: Automatic TEI assignment user equipment
127: Group TEI for broadcast data link connection

Note: A value of 0 is normally used.

2.2 Start Link/Call Setup

The test set will automaatically attempt to start the lnk on the
channel entered in the CONFIGURATION menu.
You should receive a message indicating USE LINE 1 only for
CALLS SETUP!
The screen will appear as in Figure 6-8.

```
┌─────────────────────────────────────┐
│          ▐READY▌   00:16:31          │
│                                      │
│                                      │
│            CALL SETUP                │
│                                      │
│   SEND  RR                           │
│   SEND  UA                           │
│   LINE  1                            │
│   RECEIVED MESSAGE                   │
│   Layer  2  mesg  RR                 │
│      SAPI:0    TEI:0                 │
│                                      │
│                                      │
│                                      │
│   STOP      CALL                     │
└─────────────────────────────────────┘
```

Figure 6-8 Call Setup Screen

Upon entering, the test set will begin transmitting the 7E idle
code on the D-channel. The set will automatically being setting up
a link with the other end by sending the SABME, Sey Asynchronous
Balanced Mode Extended, command. The SABME command
initiates the resetting of a data link connectino.

In response to receiving SABME, the data link layer entity
sends a UA, unnumbered Acknowledgement, response. UA con-
firms that the DAta Link Connection has been reset. You should not

proceed any further until a UA message is sent or received.

After the connection has been reset, the test set is now ready to receive/transmit informatino (I) frames. In Figure 6-8, this Receive Ready message is both sent and received by the test set. A READY indicator will appear in reverse video at the top of the LCD screen to indicate the unit is ready to receive and place calls.

Caution!

Choose a 1010 or 1-8 test pattern before plugging your test set transmitter intot he ISDN line. Transmitting any pseudorandom pattern toward an ISDN exchange may put the line out of service.

The initail Call Setup screen provides two F-key options:

• Press STOP (F1) to stop the ISDN messages. This will bring you into the Message screen, where you may:
  a) View other messages by pressing the NEXXT (F2) or PREVIUS (F3) keys.
  b) Press the RESTART (F1) key to restart the messages.

• Press CALL (F2) to bring up the second Call Setup scree, shown in Figure 6-9.

```
              READY        11:08:47


  START LINK/CALL SETUP

  CALLED No. :
             █
  CALLER No. :

  B CHANNEL #: 1
  CALL TYPE  : VOICE

  NSF CODE   : NONE




  ' * '      ' # '            CALL
```
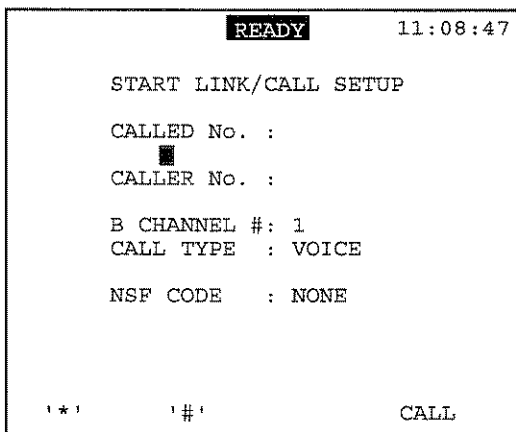
Figure 6-0   Start Link/ Call Setup Screen (2)

Figure 6-9 shows a sample screen for the ETSI and AUSSIE standards. The screen for DASS2 and DPNSS varies slightly. DIAL METHOD replaces NSF CODE as the fourth item displayed.

The following items should be configured in the Call Setup screen:

1) CALLED NO
Options: 22 digits
　Select the number you intend to dial to setup your call.

- Press the SHIFT key, and enter the numbers directly from the keypad. You may also use the F-keys (without the SHIFT key) for * and #.

2) CALLER NO
Options: 14 digits
　Select the number which the ISDN switch uses to identify you on the network.

- Press the SHIFT key and enter the numbers directly from the keypad. You may also use the F-keys (without the SHIFT key) for * and #.
- Specifiying a CALLER NO is optional.

3) B CHANNEL #
Options: 1—30, if you are in 1-30 B-channel Mode (ETSI, DASS2, DPNSS), or 1-15/17-31 B-channel Mode (AUSSIE).
　Specify the B-channel onto whihc you wish to place the call.

- Press the NEXT (F1) or PREVIUS (F2) keys to make the selection.

4) CALL TYPE
Options: VOICE (F1), DATA (F2)
　Select the type of call to place.

- Choose VOICE to place and receive voice calls.
- Choose DATA calls to place anad receive data calls, and to run a BERT.

5) NSF CODE (ETSI/AUSSIE)
Optiosn: 0—31 or NONE (F3)
　Choose the Network Specific Facilities code.

- Press the NEXT (F1), PREVIUS (F2), or NONE (F3) F-keys to make the selection.

This code specifies which network facilities are invoked. Generally:
    For the TE mode, NSF is set to NONE (F3).
    For the NT mode, NSF is set to 2.

6) DIAL METHOD (DASS2/DPNSS)
Options: EN-BLOC (F1), OVERLAP (F2)

A calling PBX may send at ET either an ISRM (C) or an ISRM (I) followed by further information. ISRM (C), Initial Service Request Message (Complete), contains all the called digits to initial the message flow between two PBX/or a PBX and ET. If the originating PBX knows the whole selection block is available and is not too long for the ISRM Selection Field, then the ISRM (C) is sent. EN-BLOC (F1) corresponds to the transmission of the complete selection block.

However, if the PBX does not know if the whole selection block is available, or if the block cannot fir into the Selection Field of an ISRM, then an incomplete ISRM message will be sent. If necessary, the following parts of the selection block will be transmitted one at a time in sequence. When the PBX sends an incomplete ISRM, followed by SSRMs (Subsequent Service Request Messages), this is referred to as Overlap Sending. Thus, press OVERLAP (F2) to send sections on e at a time, or press EN-BLOC (F1) to send all of the digits at once.

7) Press the CALL (F4) key to begin establishing your connection to the switch, after you see the reverse video READY at the top of the screen.

The screen will display the SEND and RECEIVED messages on the line.
- When the messages indicate that the test set is communicating with the switch correctly (messages stop flashing), press the CALL (F2) key to begin dialing the CALLED number.
- If you are satisfied with your call after it has connected with the switch (you will see a reverse video CONNI message at the top of the screen), you may press DISC-1 or DISC-2 F-key, as appropriate, to disconnect (hang up) and release the line.

- While you are connected, you may talk/listed on the line to ensure that it is working properly.
- Press STOP (F1) to stop sending and receiving ISDN messages.
  a) When this has been selected, NEXT (F2) and PREVIUS (F3), as well as RESTART (F1) options will appear.
  b) Use these to scroll through the various messages which you have just captured on the D-channel.

2.3 Setup Filter

- Select parameters for filtering ISDN messages.
- These parameters will be used during ISDN trace procedures.
- This screen varies depending on the Q.931 standard chosen in CONFIGURATION.

2.3.1 Setup Filter for ETSI

The Setup Filter screen appears in Figure 6-10. Select ON (F1) to use filters. Select OFF (F2) to not filter messages.

```
                            00:22:25

        D  CHANNEL  FILTER

     FILTER          :  ON

     Layer  2  SAPI  :  0
     Layer  2  TEI   :  NONE

     FILTER  TYPE    :  CALLER#

     NUMBER  :
      4083638000


 NEXT    PREVIUS    NONE
```

Figure 6-10 D-channel Filter (ETSI)

You should select the following filter items, once FILTER is set to ON:
1) Layer 2 SAPI
Options: 0—63, NONE (F3)

Select the SAPI value.

- Use NEXT (F1) or PREVIUS (F2) to make the selection.

This refers to the Service Access Point Identifier. There are four valid SAPI values defined by CCITT:
- 0 Call control procedures
- 1 packet mode using Q.932 call procedures
- 16 Packet communication (X.25 level 3 procedures)
- 63 Layer 2 management procedures

2) LAYER 2 TEI
Options: 0—127
Select the desired TEI value.

- Press the NEXT (F1) or PREVIUS (F2) keys to reach the desired value.

The Terminal Endpoint Identifier (TEI) identifies the user device. CCITT Q.921 has defined three groups of TEI values:
0—63: Fixed, or nonautomatic, TEI assignment user equipment
64—126: Automatic TEI assignment user equipment
127: Group TEI for broadcast data link connection

3) FILTER TYPE
Options: CALLREF (F1), CALLED# (F2), CALLER# (F3), NONE (F4)

a) Select the filter type:
- CALLREF (F1) identifies the call based on the Call Reference number the ISDN switch puts on each particular call transaction.
- CALLED# (F2) refers to the destination number of the transaction.
- CALLER# (F3) refers to the originating number of the transaction.
- NONE (F4) provides no filtering elements; this allows the SunSet to capture all ISDN messages.

b) Enter the numeric value in the number field. Press/release the SHIFT key and enter the numbers directly from the keypad.

2.3.2 Setup Filter for DPNSS and DASS2

The Setup Filter used for DPNSS and DASS2 is shown in the next figure.

```
                                   00:05:21

               D  CHANNEL  FILTER

           L2  MONITR   :NO
           C/R  BIT     :CMD
           TIME  SLOT   :XX
           MSG  GROUP   :X
           TYPE  CODE   :4
           SIC  TYPE    :2
           DA  NUMBER   :YES
           #:2



      CMD    RESPNSE    NONE
```

Figure 6-11   D-channel Filter (DNPSS, DASS2)

The following filter items are available:

1) L2 MONITR
Options: YES (F1), NO (F2)
Display or do not display the layer 2 information fields in the captured messages.

• This item refers to the Layer 2 Monitor Flag.

2) C/R BIT
Options: CoMmanD (F1), RESpoNSe (F2), NONE (F3)
Determine which C/R bit(s) to capture.

• Press CMD (F1) to trance only command frames.
• Press RESPNSE (F2) to trace only response frames.
• Selecting NONE (F3) allows the set to trace both commands and responses.

A frame may be transmitted as either a command or a response, as indicated by the command/response bit located in the first octet, bit 2 of the address field. A command frame carries information or

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controls the link. A response frame acknowledges the receipt of a command frame.

3) TIME SLOT
Options: 1—31, NONE (F3)
   Select the timeslot to capture related B-channel messages for.

• Press NEXT (F1) or PREVIUS (F2), to select a timeslot.
• Select NONE (F3) to trace messages for all timeslots.

4) MSG GROUP
Options: 0—9, A—F, NONE (F3)
   Determine if a specific Message Group's messages will be captured.

• Use the NEXT (F1) and PREVIUS (F2) keys to select a specified Message Group.
• Select NONE (F3) to capture all Message Group messages.

The message group identifier is a 4-bit binary coded field used to discriminate between message groups. The following codes have been defined in BTNR 190:

8765	#	Message Group
0000	0	Call Control Message Group: messages related to call establishment/ control.
0001	1	Reserved for extension of the Call Control
0010	2	User-to-user data message group (DASS2) End-to-end message group (DPNSS)
0100	4	Maintenance message group (DASS2) Link-by-link message group (DPNSS)

5) TYPE CODE
Options: 0—F, or NONE (F3)

• Press NEXT (F1) or PREVIUS (F2), to select a message type.
• Select NONE (F3) to not filter on a message type.

The message type discriminates between different messages within a given message group. It is a 4-bit binary coded field. The message group and message type both comprise the message header octet. The following tables show the message types for their respective groups.

1. Message Types for Group 0000 (Call Control)

Type # Message Type (PBX———► ET) (ET———► PBX)

0	Initial Service Request (C)	Incoming Call Indication (C)
1	Initial Service Request (I)	Incoming Call Indication (I)
2	Recall (C)	Reserved
3	Recall (I)	Reserved
4*	Reserved	Channel Seized
5	Call Connected	Call Connected
6	Reserved	Network Indication
7*	Reserved	Call Arrival
8	Clear Request/ Confirmation	Clear Indication
9	Call Accepted	Number Acknowledge
A	Reserved	Recall Rejection
B	Subsequent Service Request (I)	Subsequent Call Indication
C	Subsequent Service Request	Subsequent Call (C) Indication
D	Reserved	Send Service Request
E	Service Request Withheld	Withhold Service Request
F	Reserved	Reserved

C = Complete / I = Incomplete

2. Message Types for Group 0010 (End-to-End, DPNSS, and
   User-to-User, DASS2)

2.a 0010 End-to-End Message, DPNSS

Type #   Message Type

2   End-to-End Message (C)
3   End-to-End Message (I)
4   Single Channel Clear Request Message
5   Single Channel Clear Indication Message
6   End-to-End Recall Message (C)
7   End-to-End Recall Message (I)

2.b 0010 User-to-User Message, DASS2

Type #   Message Type (PBX -> ET)   (ET -> PBX)

0   Swap   Swap
1   Reserved   Reserved
2   User-to-User Data (C)   User-to-User Data (C)
3   User-to-User Data (I)   User-to-User Data (I)
4-7   Reserved   Reserved

3. Message Group 0100

3.a   0100 Link-by-link Group, DPNSS

Type # Message Type

0   Link-by-link Message (C)
1   Link-by-link Message (I)
2   Link-by-link Reject Message
4   Swap Message
5   Link-Maintenance Message
6   Link-Maintenance Reject Message

3.b   0100 Maintenance Message Group

Type #   Message Type (PBX -> ET)   (ET -> PBX)

0-2   Reserved   Reserved
3   Maintenance Info. Msg (C)   MIM (C)
4-6   Reserved   Reserved

---

6) SIC TYPE
Options: 0—7, NONE (F3)
   Select the desired SIC TYPE number

- Press NEXT (F1) or PREVIUS (F2) to select a number.
- Select NONE (F3) to not use this filter.

   The Service Indicator Code (SIC) indicates the type of call requested (i.e. speech or data). It is used by the recipient PBX to select an outgoing path. This code ensures that the path selected is capable of supporting the type of call requested. The portion of the SIC code specifying the type of data is a three- bit binary coded field. These codes are defined in BTNR 188, 190.

This code, defined for DASS2, is as follows:
0	Speech
1	Speech
2	Data
3	Data
4	Teletex
5	Videotex
6	Facsimile
7	SSTV

This code, defined for DPNSS, is as follows:

1	Speech
2	Data
3	Data
4-7	Data (used for interworking with DASS2, will be treated as if code 2 has been received).

7) DA Number
Options: YES (F1), NO (F2)

- To choose a DA number, press YES (F1).
- Use the down arrow key to move the cursor to the next line.
- Press/release the SHIFT key, and enter the desired numbers, 1—9, from the keyboard.
- Please not that you are given the F-key options for entering * and #. The DA should not be prefixed by either.

- You are allowed to enter up to 16 digits here.
- The Destination Address (DA) is a digit sequence which causes a call to be routed to the correct destination, after it is sent over the network boundary.

2.4 Start Tracer

START TRACER begins the tracing of ISDN messages in accordance with the filtering parameters which have been set up. Three function keys are available in this screen:

RESTART (F1)
- Empties the existing buffer and restarts the tracing process.

PAUSE/RESUME (F2)
- Stops the tracing process.
- Does not empty the buffer.
- No tracing is being performed while the test set is in PAUSE.
- RESUME will continue the tracing.

DECODE/HEX (F3)
- Decodes the ISDN messages in detail.
- HEX will display the messages in hexadecimal format.

2.5 View/Print Tracer

- View and print specific data capture by the test set.
- The Vie/Print screen is shown in the next figure.
- The data is presented in accordance with the filters set in SETUP FILTERS.

```
                            04:21:48
          VIEW/PRINT TRACER

          TOTAL RECORD- 600

               FROM No.: ▮
               TO  No.  : 600


          RAW  DATA  DISPLAY  :  HEX
               FILTER IS OFF



CLR-ALL    PRINT    VIEW    ASCII
```

Figure 6-12 View/Print Tracer

There are four function keys available in this screen:

CLR-ALL (F1): This key is the first step in erasing the contents of the buffer. After pressing (F1), you will be asked to press ENTER to continue the process. This second step provides security against accidentally erasing the buffer contest.

PRINT (F2): Print the contents of the buffer; date/timestamp, hexadecimal and full decode formats.

VIEW (F3): View the contents of the buffer, as specified from the VIEW FROM, VIEW TO settings.
* The total record of data pages shown at top.
* You may view all of the pages, or you may limit your viewing to a certain number of pages:
  1) Place the cursor on the FROM No. line.
  2) Press the SHIFT key, then enter the number from the keypad. This will be the first message displayed. Move within the number using the cursor arrow keys. Release the SHIFT key.
  3) Cursor down to TO No.
  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 (F3) to begin viewing the messages. The received

messages will be shown, as in the next figure.

ASCI/HEX (F3): Change the Raw Data Display setting; whether the message will be displayed in HEX or ASCII before decoding.

```
                           04:43:49
        RECEIVE MESG NO. 577


    RECEIVED MESSAGE
    LINE 1
    96-01-18  04:18:20.454
    CALL PROCEEDING CHNL #  : 1
    CREF NO:1




PAGE-UP   PAGE-DN   HEX      INFO
```

Figure 6-13 View Message Screen

- This screen displays one message.
- View other pages of messages by pressing the (F1) or (F2) keys to page-up or page-down, respectively.
- Some screens will have an additional Information Element available; this is noted by the presence of an INFO (F4) key. See the following sample figure.

```
                           04:43:49
      INFORMATION ELEMENT   1/2
ETSI Info Element Protocol

CHANNEL IDENTIFICAION - 18h
  INTERFACE ID PRESENT:0h
   Interface implicitly identfed
  INTERFACE TYPE:1h
   Primary rate interface
  PREFERRED/EXCLUSIVE:1h
   excclusive: only identified B
  D CHANNEL INDICATOR:0h
   Channel is not the D-channel



        PAGE-DN        RETURN
```

Figure 6-14 Info Element Screen

Section 3 RJ-48 Pin-Outs

The following diagram illustrates the pin-outs of an RJ-48 connector.
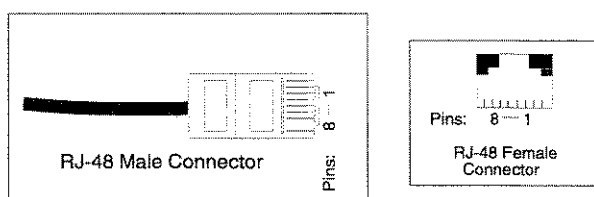
Pin #		1	2	3	4	5	6	7	8
PRI	TE	Rx	Rx		Tx	Tx			
	NT	Tx	Tx		Rx	Rx			
BRI	U				Tx/Rx				
	S/T			Tx(+)	Rx(+) PS1(+)	Rx(-) PS1(-)	Tx(-)	PS2 (-)	PS2 (+)

Figure 6-15 RJ-48 Pin-outs

Section 4.0 ISDN Applications

4.1 ISDN Call Setup (ETSI)

This procedure outlines an ISDN call for the ETSI standard.

1) Verify the span is not in service; this ISDN call will disrupt service.

2) From the Main Menu, enter TEST CONFIGURATION.

a) Configure the settings as follows:

TEST MODE: E1
TX/INSERT: L1-TX
RX/DROP: L1-RX
TXSOURCE: TESTPAT
FRAMING: PCM-31
CRC-4: as needed
TEST RATE: 2.048M
TXLVL-1: TERM
RXLVL-2: TERM
XMTCLOCK: INTERN

Note: You must select PCM-31 framing for any ISDN application.

b) When your settings are correct, press ENTER.

3) Escape to the Main Menu.

4) Enter TEST PATTERN.
a) Select your test pattern; 1-8 is a good pattern to use. 20ITU may bring down the switch.

5) Connect to the test set as shown in either of the next two figures.
a) Press the HISTORY key to acknowledge any blinking lights and turn them off.
b) If you plan to emulate Terminal Equipment (TE), refer to Figure 6-16.
c) Refer to Figure 6-17 is you plan to emulate a Network Terminal.
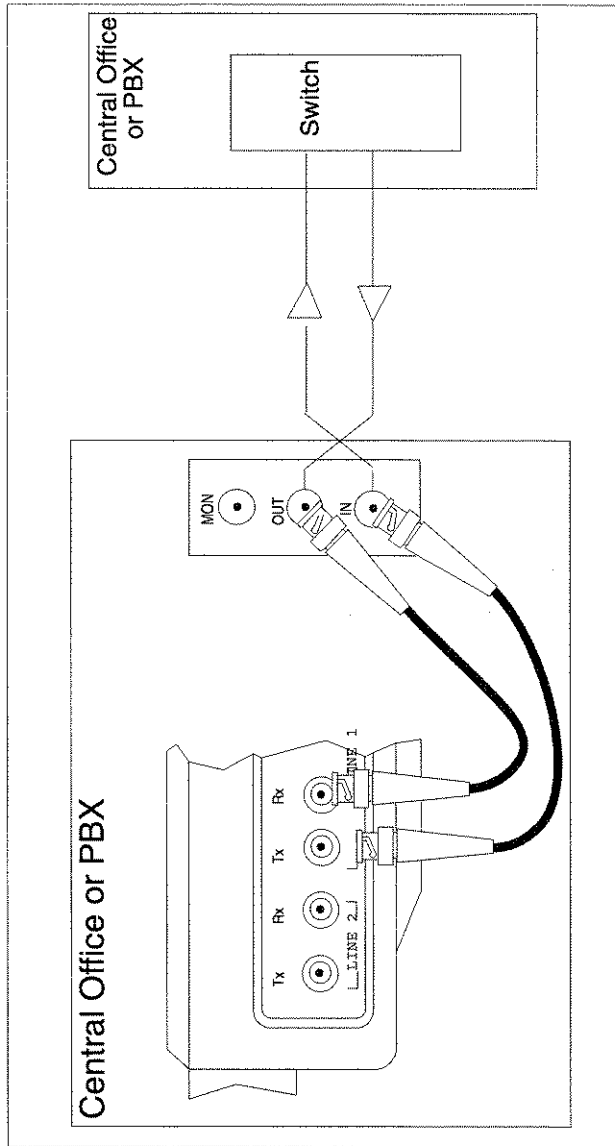
Figure 6-16 ISDN Call Setup—TE

SunSet E10 Version 2.37
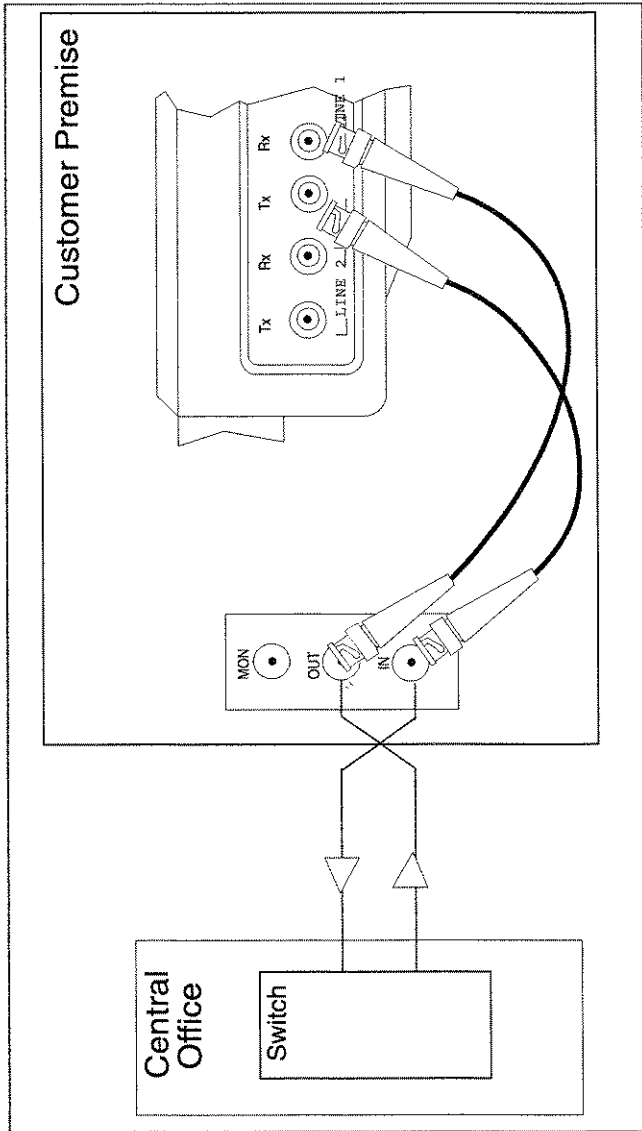
Figure 6-17   ISDN Call Setup—NT

6) Escape to OTHER MEASUREMENTS.
a) Enter VIEW RECEIVED DATA.
b) You should see six consecutive ones with two zeroes on your D-channel (hex: 9F, FC, 7E, 3F, etc.). This verifies that your D-channel is set up; if you do not see this, then your D-channel may not be set up to handle ISDN messages.

7) Escape out to the OTHER MEASUREMENTS menu.
a) Select ISDN ANALYSIS.
b) Enter CONFIGURATION.
c) Set the configuration settings according to your circuit.
   • Refer to section 2.1 for additional details.
   • To emulate a Network Terminal, as in Figure 6-17, select NT for the EMULATE TYPE.
   • To emulate Terminal Equipment, as in Figure 6-16, select TE.
d) Configure the other five settings as desired.
   • Refer to section 2.1 of this chapter for details on each item.
e) Once your settings are correct, press ENTER to return to the ISDN menu.

8) Cursor down to START LINK/CALL SETUP, and press ENTER.
a) Check to see if a UA message has either been sent or received.
   • UA confirms that the Data Link Connection has been reset, and that the set is ready to transmit/receive Information (I) frames.
   • A READY indicator at the of the screen indicates the link is up.

9) Set up the call by pressing CALL (F2). In the following screen, you may enter four other call parameters. Enter the desired information.
   • Refer to section 2.2 of this chapter for further details on each item.

a) When your parameters are correct, press CALL (F4) to begin establishing your connection with the switch.

10) When you are finished, press DISC-1 (F3) to disconnect.

4.2 ISDN Call Setup (DASS2, DPNSS)

This procedure outlines an ISDN call for DASS2 and DPNSS standards.

1) Verify the span is not in service; this ISDN call will disrupt service.

2) From the Main Menu, enter TEST CONFIGURATION.

a) Configure the settings as follows:

TEST MODE: E1
TX/INSERT: L1-TX
RX/DROP: L1-RX
TXSOURCE: TESTPAT
FRAMING: PCM-31
CRC-4: as needed
TEST RATE: 2.048M
TXLVL-1: TERM
RXLVL-2: TERM
XMTCLOCK: INTERN

Note: You must select PCM-31 framing for any ISDN application.

b) When your settings are correct, press ENTER.

3) Escape to the Main Menu.

4) Enter TEST PATTERN.
a) Select your test pattern; 1-8 is a good pattern to use. 20ITU may bring down the switch.

5) Connect the test set to the switch.

- If you are using DASS2 protocol, you may emulate either a PBX or an ET. Refer to Figure 6-18 for PBX mode, or to 6-19 for ET mode.
- If you use DPNSS, you may emulate a PBX in a PBX-PBX network.

6) Press the HISTORY key to acknowledge any blinking LEDs and

turn them off.
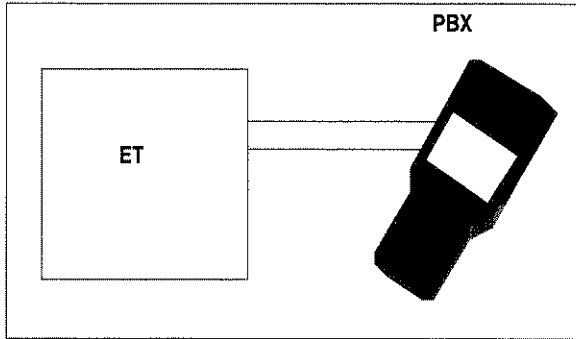
Figure 6-18 DASS2 Standard, PBX Mode
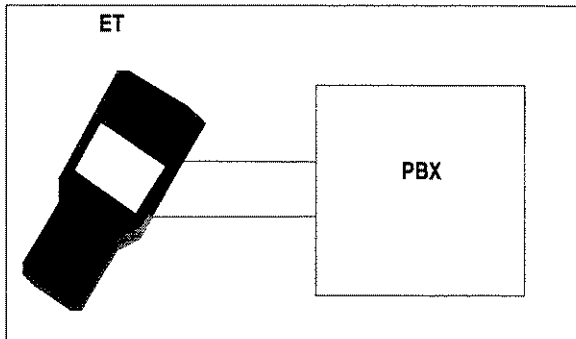
Figure 6-19 DASS2 Standard, ET Mode

6) From the Main Menu, enter OTHER MEASUREMENTS, ISDN ANALYSIS, CONFIGURATION.

a) Select the Q.931 standard. This application refers to DPNSS or DASS2.
 - Use the previous application, 4.1, if you would like to use the ETSI standard.

b) Choose your EMULATE TYPE.
 - For DASS2, you may emulate either PBX or ET.
 - For DPNSS, you may only emulate a PBX.

c) Configure the other four settings as desired.
 - Refer to section 2.1 of this chapter for details on each item.

d) Once your settings are correct, press ENTER to return to the

ISDN menu.

8) Cursor down to START LINK/CALL SETUP, and press ENTER.

9) Set up the call by pressing CALL (F2). In the following screen, you may enter four other call parameters. Enter the desired information.
   • Refer to section 2.2 of this chapter for further details on each item.

a) When your parameters are correct, press CALL (F4) to begin establishing your connection with the switch.

10) When you are finished, press DISC-1 (F3) to disconnect.

4.3 ISDN Monitoring

Use this procedure to monitor an ISDN line.

1) This test may be performed while the line is in service.

2) From the Main Menu, enter TEST CONFIGURATION.
a) Configure the settings as follows:

TEST MODE: E1
TX/INSERT: L1-TX
RX/DROP: L1-RX
TXSOURCE: TESTPAT
FRAMING: PCM-31
CRC-4: as needed
TEST RATE: 2.048M
TXLVL-1: MONITOR
RXLVL-2: MONITOR
XMTCLOCK: INTERN

b) When your settings are correct, press ENTER.

3) Escape to the Main Menu.

4) Connect the test set to the circuit as shown in the next figure.
a) Press the HISTORY key to acknowledge any blinking LEDs and

---

turn them off.

You may perform this test anywhere you have access to an E1 circuit, i.e. central office, customer premises, span. In the sample figure, the E10 is plugged in at the customer premises.
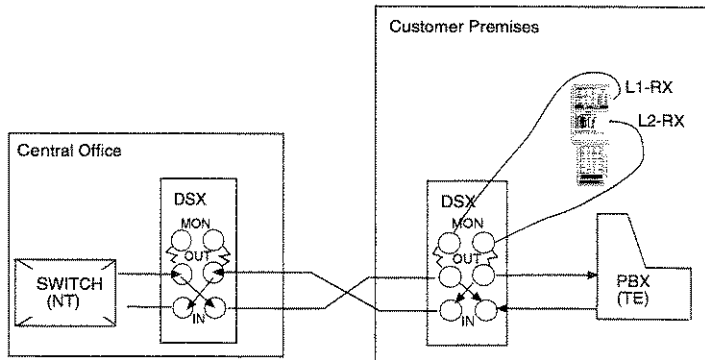
Figure 6-20 ISDN Monitoring

4) From the Main Menu, enter OTHER MEASUREMENTS, VIEW RECEIVED DATA.
a) Page down using the PAGE-DN (F2) key to view TS 16.
b) You should see six consecutive ones together with two zeroes.

5) Escape back to the OTHER MEASUREMENTS menu, and enter ISDN ANALYSIS.
a) Enter CONFIGURATIONS, and select your settings according to the circuit.
  • Refer to section 2.1 of this chapter for a description of each of the choices.

6) Escape back to the ISDN menu and enter SETUP FILTER.
a) Set up the D-channel filter as desired.
  • Refer to section 2.3 of this chapter for further details.

b) Once you have finished setting up the filters, press the ENTER key to return to the ISDN menu.

7) Cursor down to START TRACER and press ENTER.
a) View both Line 1 and Line 2 ISDN messages sent and received, if a call is placed on the other end.

c) Press the PAUSE (F2) key to view a message.

8) Escape out and enter VIEW/PRINT TRACER. View all of the messages, or select a limited number in the FROM and TO lines.
a) Press VIEW (F3) to begin viewing the messages.
b) Press PRINT (F2) to print the messages.
c) When viewing the messages, use the PAGE-UP (F1) and PAGE-DN (F2) keys to view all the pages.

4.4 Placing a Data Call (ETSI) & Running a BERT

This outlines the procedure for placing an ISDN data call at a 64k rate. You can perform a data call two ways:
- Point-to-Point: call another piece of test equipment (which is also TE). Make sure both test sets are transmitting the same pattern.
- Loopback: call a loopback device, which will loop your transmitted test pattern back to you. Calling a loopback device is quicker and less labor intensive. This may also be a self call.

1) Verify the span is not in service; this ISDN call will disrupt service.

2) From the Main Menu, enter TEST CONFIGURATION.
a) Configure the settings as follows:

TEST MODE: E1
TX/INSERT: L1-TX
RX/DROP: L1-RX
TXSOURCE: TESTPAT
FRAMING: PCM-31
CRC-4: as needed
TEST RATE: 2.048M
TXLVL-1: TERM
RXLVL-2: TERM
XMTCLOCK: INTERN

Note: You must select PCM-31 framing for any ISDN application.

b) When your settings are correct, press ENTER.

3) Escape to the Main Menu.

4) Enter OTHER MEASUREMENTS/ISDN ANALYSIS.

5) Enter CONFIGURATION.
a) Configure the screen settings as follows:

Q.931 STD: ETSI
EMULATE TYPE: TE
Line 1 Rx T/S: 16
Line 2 Rx T/S: 16
B CHNL MODE: 1-15/16-31 (no choice)
TEST PATTERN: 2047 is typically used to qualify ISDN lines;
　　you may also enter a USER pattern.
LAYER 2 SAPI: 0
LAYER 2 TEI: 0

6) Press ENTER when you are done.

7) Connect the test set to the circuit in one of the ways shown in the next figure.
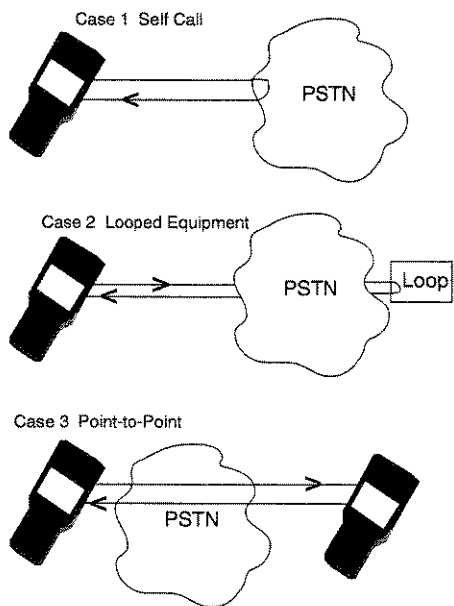
Figure 6-21　Place a Data Call

8) Verify that you have green LEDs for L1 SIGNAL and PCM-31. Flashing red lights indicate a history condition. Press the HISTORY key to acknowledge the blinking LEDs and turn them off.

9) Enter START LINK/CALL SETUP.
a) Confirm that you have a READY indication at the top right of the screen. This indicates that Layer 2 handshaking has been established, and the set is ready to handle calls.
b) Press CALL (F2).
c) Set up this screen as required.

CALLED NO: Enter the number you want to call.

CALLER NO: Enter the number of the line you are calling from (optional).

B CHANNEL: This is the B channel you plan to use to place your call. Use the (F1) and (F2) keys to scroll through the B channels.

CALL TYPE: DATA

NSF CODE: NONE

d) Press CALL (F4) to place the call.

10) To perform a BER test on the data call, press BER (F4). You will enter the RESULTS screen.

```
┌──────────────────────────────────────┐
│    MEAS      CONN1      00:16:31      │
│ ET-000:07:03      RT- CONTINU        │
│ LINE - 1          RATE - 64K         │
│ Tx B#- 1          Rx B#- 1           │
│ PATT - 2047                          │
│            RESULTS                   │
│                                      │
│ BIT : 0           BER  : 00.000      │
│ ES  : 0           %ES  : 00.000      │
│ SES : 0           %SES : 00.000      │
│ EFS : 423         %EFS : 100         │
│ UAS : 0           %UAS : 00.000      │
│ AS  : 423         %AS  : 100         │
│                                      │
│ STOP                                 │
└──────────────────────────────────────┘
```

Figure 6-22 BERT Results

- Press STOP (F1) to stop the test. Press RESTART (F1) to begin a new BERT.
- View any received bit errors.
- Observe the B-channel at the Tx B# and Rx B# items.
- The test pattern is reported at the PATT line.
- If you have a loopback in place, you may want to inject errors with the ERR INJ key, and verify that they return back to you. Refer to Chapter 3, section 4.1 for definitions and descriptions of the measurement items seen in this screen.
- Press SHIFT and PRN SCRN to send the results to the serial port for printing.

Chapter 7
GSM

Section 1 GSM Technology Overview

1.1 GSM Network Architecture

GSM, Global System for Mobile communication, is governed by ETSI transmission standards. GSM technology uses a digital standard for voice and data applications. Figure 7–1 shows the different parts of a GSM network.
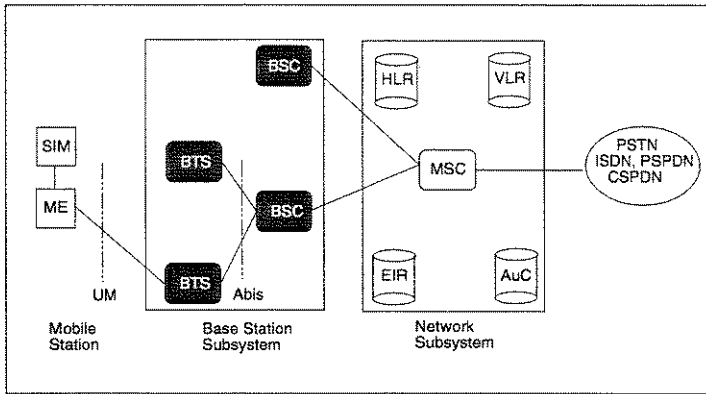
Figure 7–1   GSM Network

The three major components of a GSM network include the Mobile Station (MS), Base Station Subsystem (BSS), and Network Subsystem (NSS). This GSM network is then connected to a fixed network like a Public Switched Telephone Network (PSTN).

A Mobile Station (MS) consists of a Mobile Equipment (ME) and Subscriber Identity Module (SIM). The SIM is physically a smart card which identifies the subscriber to the GSM network. It also authenticates and encrypts a subscriber's voice identified by the International Mobile Subscriber Identity (IMSI). Once a SIM card is inserted to a GSM terminal, or Mobile Equipment (ME), it becomes a Mobile Station (MS). Like the SIM, the ME can also be identified using the International Mobile Equipment Identity (IMEI).

While a subscriber roams or is stationary, the Mobile Station transmits a radio signal to one of the many Base Transceiver Station (BTS). These rugged, compact BTS cells are equipped with radio transceivers to send and receive signals using a radio-link protocol via a Um interface.

The BTSs are in turn managed by a Base Station Controller

(BSC). Using the A-bis interface, the BSC handles radio-channel setup, frequency hopping for security measures, and handovers. In some instances a Transcoder Rate Adaption Unit (TRAU) is placed at a BTS to perform transcoding between 64 Kbps A-law speech and 13 Kbps RPE/LTP speech. The TRAU may also be located at or in conjunction with the BSC. The BSC then connects the Mobile Station to the Mobile Switching Center (MSC) using the A-interface.

Using four registers, the Mobile Switching Center (MSC) handles subscriber registration, authentication, location updates, handovers, and call roaming. The Home Location Register (HLR) is the central database for all subscribers holding identity of the subscriber, services accessible to the subscriber, and current location of the Mobile Station. Given a Mobile Subscriber ISDN (MSISDN) number, a call can be routed by looking up the corresponding IMSI found in the HLR.

The Visitor's Location Register (VLR) contains information about all Mobile Stations within the area served by the MSC. Information such as the Mobile Station's identity, the area in which it was last registered, additional information pertaining to the subscriber, and any supplementary services available are found in the VLR.

A MSC refers to the VLR each time a Mobile Station receives or makes a call. A security register called the Authentication Centre (AUC) validates a SIM and performs complex mathematical calculation on the same secret information stored in SIM. Another security register is the Equipment Identity Register (EIR). Using a list of three categories, the EIR ensures that all ME's being used are valid and authorized to function on the Public Land Mobile Network (PLMN). Together, the MSC, HLR, VLR, AUC, and EIR make up the Network Subsystem that connects the GSM network to a fixed network.

1.2 GSM Radio Transmission

At the physical layer, Mobile Stations and Base Station Subsytems use a combination of Frequency-Division Multiple Access (FDMA) and Time-Division Multiple Access to send information. The 890-915 Mhz range is used for uplink transmission from MS to BSS and the 935-960 Mhz range for downlink from BSS to MS transmission.

Each 25 Mhz bandwidth is divided into 124 carrier frequencies

spaced 200 Khz with one or more carrier frequency allocated to each base station. A GSM Traffic Channel TCH multiframe comprises of 26 TDMA frames as shown in Figure 7–2, GSM Framing.

Frames 0-11: TCH   Frame 12: SACCH   Frames 13-141: TCH   Frame 25: Unused

| 0 | 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-frame multiframe
Duration 120 ms

| BP 0 | BP 1 | BP 2 | BP 3 | BP 4 | BP 5 | BP 6 | BP 7 |

TDMA Frame
Duration 60/13 ms

| 3 | 57 | 1 | 26 | 1 | 57 | 3 | 8.25 |

| TAIL BITS | DATA BITS | STEALING BIT | TRAINING SEQUENCE | STEALING BIT | DATA BITS | TAIL BITS | GUARD BIT |

Normal Burst
Duration 15/26 ms
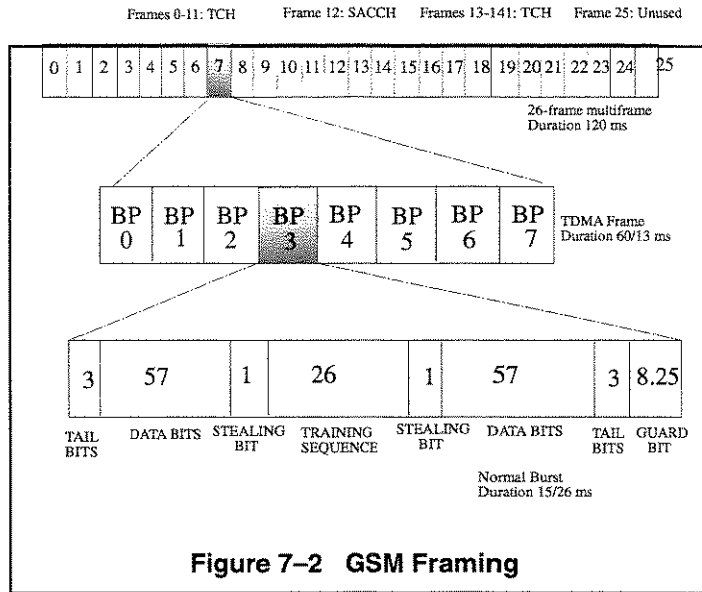
Figure 7–2   GSM Framing

Traffic CHannels (TCH), used to carry speech and data, represent frames 0-11 and 13-24. Frame 12 is occupied by the Slow Associated Control CHannel (SACCH) used for radio-signal measurement. Frame 25 is set to idle.

Each TDMA frame consists of eight Burst Periods (BP) lasting approximately 0.577 ms. A normal burst consists of two 57 bits of information, 26 bits Training Sequence for equalization, 1 stealing bit for each information block used for the Fast Associated Control CHannel (FACCH) for handover purposes, 3 tail bits at each end, and a 8.25 bit guard sequence.

In addition to TCHs, there are Control Channels (CCH) framed in a 51 TDMA format. The following table lists the different types of CCH or common control channels and their functions.

Broadcast Control CHannel   Downlinks info., e.g. base
            (BCCH)   station id, frequency allo-

	cation,& frequency hop-
ping sequences.	Fre-
quency Correction CHannel (FCCH)	Synchronizes TS structure
Synchronization CHannel (SCH)	Synchronizes TS structure
Random Access CHannel (RACH)	Uplinks requests for access to GSM network
Paging CHannel (PCH)	Downlinks alert signal to MS for use
Access Grant CHannel (AGCH)	Downlinks access to use network using a Stand-alone
	Dedicated Control Channel (SDCHH)

Figure 7–3   CCH Functions

1.3 GSM Protocol

The GSM signaling protocol uses a combination of GSM, modified ISDN, and SS7 standards between the Um, Abis, and A interfaces. Figure 7–4, GSM Signaling Protocol, shows the different standards that govern the physical, data link, and network layers of GSM.
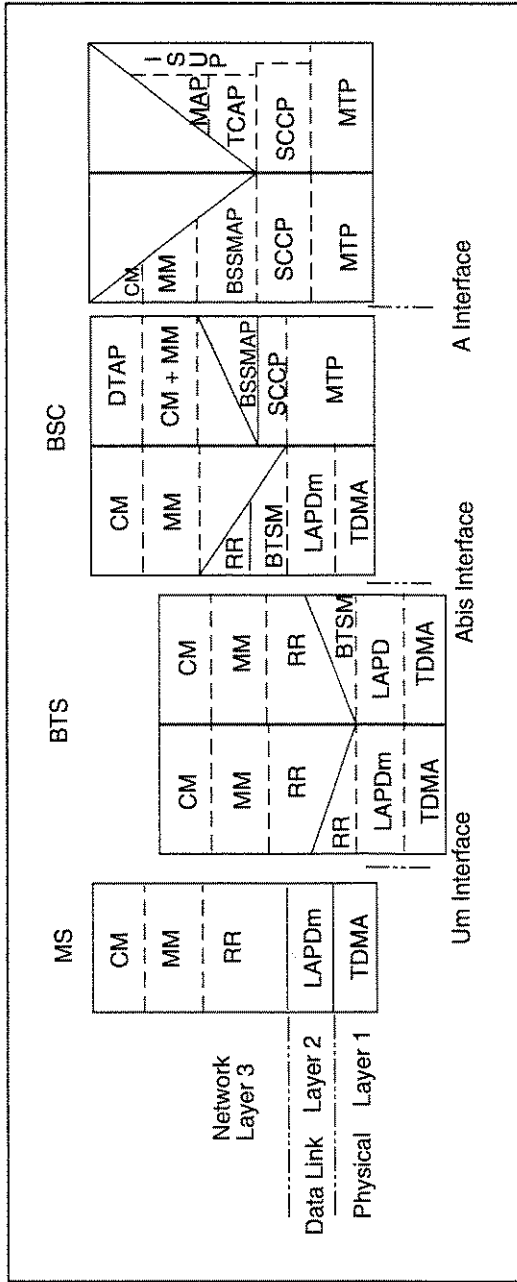
Figure 7–4   GSM Signalling Protocol

As seen, TDMA frames are sent at the physical layer between the Mobile Station and the Base Transceiver Station via the Um interface. At the Data Link Layer, a modified version of the Link Access Protocol-D channel (LAPD-m) is used. Layer 3 GSM Signalling protocol includes the Call Management (CM), Mobility Management (MM), and Radio Resource Management (RR). A table of these protocols and functions is shown below.

Call Management (CM)	Handles Call Control (CC), Supplementary Services, & Short Message Services (SMS).
Mobility Management (MM)	Manages roaming update, registration, security, and authorization.
Radio Resources (RR)	Controls setup, maintenance, & termination of radio and fixed channels.

Figure 7–5   Layer 3 Protocols

The GSM signaling protocols, CM, MM, and RR, are passed through the BTS transparently and via the A-bis interface. However, in some cases, RR messages are mapped directly to the BTS Management (BTSM) protocol which handles major BTS functions, such as paging.

At the Abis interface, the Link Access Protocol-D channel is used for transferring signalling through the data link. The BSC uses the BTSM protocol and RR to control signals. RR then gets mapped to the BSS Management Application Part (BSSMAP).

Again at Layer 3, CM and MM pass transparently through the BSC with the BSC using the Direct Transfer Application Part (DTAP) to transfer both the CM and MM via the A interface.

Sending information through the A interface, the BSC uses the Message Transfer Part (MTP) and the Signaling Connection Control Part (SCCP) of Signaling System 7 (SS7). On top of the SCCP are the BSSMAP, MM, and CM.

Between MSCs, the MTP of SS7 sends both ISUP and TUP messages dealing with circuit related information. Also, the MTP, SCCP, Transaction Capability Application Part (TCAP) are used by the SS7 Mobile Application Part (MAP) which transfer information such as authentication, location, security, and handover procedures for a MSC.

1.4 TRAU Frames
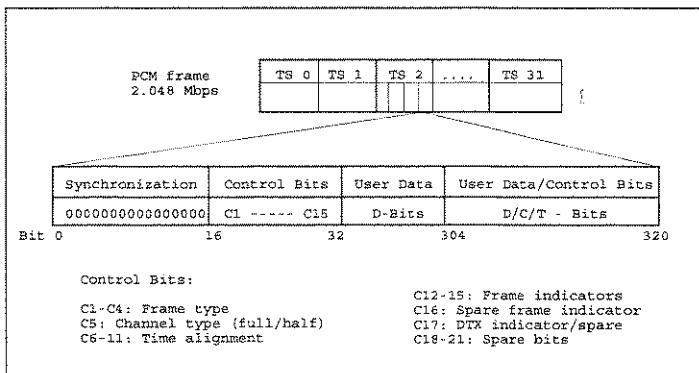
Figure 7–6   16 Kbit TRAU Frame

The 64 kbps timeslots are divided into four 16 kbps subchannels. Each devotes 13 kbps to voice, with 3 kbps remaining for spare bits. A Transcoder and Rate Adaption Unit (TRAU) does the required transcoding between the 64 kbps and 16 kbps channels. A TRAU may be located at the BTS, BSC or MSC. If located outside the BTS, the TRAU can be controlled by in-band signalling, using some of the spare bits.

A TRAU frame, containing 320 bits, is used to send signals between the BSC and the TRAU. Its use is mandatory when the Abis interface is applied. See Figure 7–6. The specific C-bit coding for speech frames is shown in Figure 7–7.

Speech Frame Coding		
Bit	**Uplink**	**Downlink**
C1-C4 (Frame type)	0 0 0 1 (speech)	1 1 1 0 (speech)
C5 (Channel type)	0 (full rate)	0 (full rate)
C6-C11 (Time Align.)	000000 No change in timing 000001 1x500µs delay 000010 2x500µs delay 100111 39x500µs delay 101000 Not used 111101 Not used 111110 1x250µs delay 111111 250µs advance	
C12-16 (Frame Ind.) C12	 0: BFI=0 1: BFI=1	 Spare Spare
C13&C14 (DTX Ind.)	C13 0: C14 0: SID=0 C13 0: C14 1: SID=1 C13 1 C14 0 SID=2	Spare Spare Spare
C15	0 TAF=0 1 TAF=0	Spare
C16	Spare	0 SP=0 1 SP=1
C17 (DTX Ind.)	0 DTX=no 1 DTX=yes	Spare
C18-C21	Spare	Spare

BFI: Bad FrameIndicator   DTX: Discontinuous Trans.
SID: Silence Descriptor   SP: Speech Indicator
TAF: Time Alignment Flag

Figure 7–7 TRAU Speech C-bit Coding

Section 2 GSM Analysis Menus

Enter the GSM ANALYSIS item in the MAIN MENU, then enter A-bis INTERFACE. The A-bis Interface Menu contains four items: CONFIGURATION, A-bis MONITOR, A-bis TRAFFIC, and LAYER 2 TRAFFIC.

2.1 A-bis Interface

```
                      04:45:32
          CONFIGURATION

      LINE 1 RX T/S: 31
      LINE 2 RX T/S: 1
      L3 Decode    : YES
      GSM Abis rate: 64 kbps
      SAPI & TEI   : DECIMAL




NEXT    PREVIUS
```
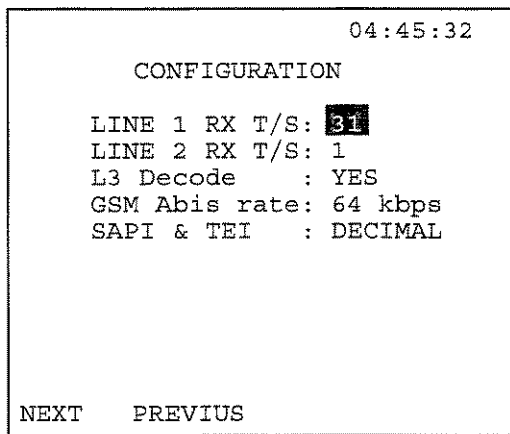
Figure 7-8   GSM Configuration Screen

2.1.1 Configuration

From the A-bis INTERFACE menu, enter CONFIGURATION. The following items should be set up in this screen:

1) LINE 1 RX T/S
Options: 1—31

• Use the F-keys, NEXT (F1) and PREVIUS (F2), to select the desired number. This item specifies the received time slot for Line 1.

2) Line 2 RX T/S
Options: 1—31

• Use the F-keys, NEXT (F1) and PREVIUS (F2), to select the
  desired number. This item specifies the received time slot for
  Line 2.

3) L3 Decode
Options: YES (F1), NO (F2)
    Decide whether to have the test set decode Layer 3 messages.

4) GSM Abis rate
Options: 64 kbps (F1), 16 kbps (F2)
    Select the Abis rate

• If you select 16 kbps, you will be presented with two additional line
  items:

```
                              04:45:32

              CONFIGURATION

         LINE 1 Rx T/S: 31
         LINE 2 Rx T/S: 1
         L3 Decode    : YES
         GSM Abis rate: 16 kbps
         SAPI & TEI   : HEX
         Line 1 Rx S/C: 1
         Line 2 Rx S/C: 3




      1       2        3         4
```

Figure 7-9   16 kbps Config

a) Select the receive Subchannels, from 1-4 (F1-F4), for each line.

5) SAPI & TEI
Options: HEX (F1), DECIMAL (F2)
    Select the formatting of the SAPI and TEI.

2.1.2 A-bis Monitor

The A-bis MONITOR menu contains three items: SETUP FILTER, START TRACER, VIEW/PRINT TRACER.

2.1.2.A Setup Filter

The Setup Filter screen appears in Figure 7–10

```
                              13:57:35

                SETUP  FILTER

        L2MON    :   YES
        SAPI     :   001
        TEI      :   001
        MSG DISC:    CC-MGT
        MSG TYPE:    04
        CHNL NUM:    1F
        TM SLOT  :   6
        IMSI     :   NO


   YES    NO
```

Figure 7–10   A-bis Setup Filter Screen

The following filtering items should be configured:

1) L2MON
Options: YES (F1), NO (F2)

This item refers to the L2 monitor flag. It allows you to display/ not display layer 2 information fields in the captured message.

• Press YES (F1) to display these fields or NO (F2) to not display them.

2) SAPI
Options: NONE (F1), INC +x (F2), DEC - x (F3), 1/10/50 (F4).

• Use the F- keys to enter a hex code from 00 to 3F.
• SAPI, Service Access Point Identifier, identifies the layer 3 signalling protocol.
• This filter allows you to zoom in on GSM messages only.

- Use the F-keys to enter the desired value in hexadecimal code.
- Pressing 1/10/50 (F4) sets the increment/decrement value used in options (F2) and (F3).

   Thus far, five SAPI values have been defined:
   00   identifies radio signalling
   01   reserved for packet mode Q.931
   1F   reserved for packet mode X.25
   3E   operation & maintenance
   3F   Layer 2 management

   A value of 0 is normally used.

3) TEI
Options: NONE (F1), INC+X (F2), DEC-X (F3), 1/10/50 (F4).

- Use the F-keys to enter in a hex code from 00 to 7F. The 1/10/50 (F4) key sets the increment/decrement value used in options (F2) and (F3).
- The TEI, Terminal Endpoint Identifier, identifies the TRX.
- TEI values 0—63 (00 to 3F, hex) are reserved for fixed addresses.
- Values 64—126 (40 to 7E, hex) are used for additional addresses to TRXs needing more than one signalling link.

4) MSG DISC
Options: NONE (F1), RLL-MGT (F2), DC-MGT (F3), CC-MGT (more, F1), TRX-MGT (more, F2), RESERVED (more, F3)

   The Message Discriminator allows you to discriminate between radio link (RLL), dedicated channel (DC), common channel (CC), and TRX management.

5) MSG TYPE
Options: Hex code from 00 to 7F.

   This filter allows you to capture a specific message. The following tables, 7-11 to 7-14, outline the different message types implemented on the SunSet E10.

Hex Code	Message Type
01	Data Request- .•sent in BCS-BTS direction to request sending of a message in multi-frame mode.
02	Data Indication- sent in BTS-BSC direction to indicate the reception of a message in multi-frame mode.
04	Establish Request - sent in BSC-BTS direction to request the establishment of a radio link layer connection in multi-frame mode.
05	Establish Confirm- sent in BTS-BSC direction to confirm the establishment of a radio link layer connection in multi-frame mode.
06	Establish Indication- sent in BTS-BSC direction to indicate the establishment of a radio link layer connection in multi-frame mode
07	Release Request- sent in BSC-BTS direction to request the release of a radio link layer connection in multi-frame mode.
08	Release Confirm- sent in BTS-BSC direction to confirm the release of radio link connection in multi-frame mode.
09	Release Indication- sent in BTS-BSC direction to indicate the release of a radio link layer connection in multi-frame mode.
0A	Unit Data Request- sent in BSC-BTS direction to request the sending of a message in unacknowledged mode on a radio link layer connection.
0B	Unit Data Indication- sent in BTS-BSC direction to indicate the reception of a message in unacknowldeged mode on a radio link layer connection.

Figure 7-11 RLL Message Types

Common Channel Management Messages

Hex. Code	Message Type
13	Channel Required- sent in BTS-BSC direction to indicate the reception of a Channel Request message from a MS.
15	Paging Command- sent in BSC-BTS direction to request the paging of a MS.
16	Immediate Assign Command- sent in BSC-BTS direction to request the transmission of an immediate assign message to the MS.

Figure 7-12 CC Message Types

Dedicated Channel Management Messages

Hex. Code	Message Type
21	Channel Activation- sent in BSC-BTS direction to activate a radio channel.
22	Channel Activation Acknowledge- sent in BTS-BSC direction to indicate requested radio channel activation has been completed successfully.
23	Channel Activation Negative Ack.- sent in BTS-BSC direction to indicate requested radio channel could not be performed.
26	Encryption Command- sent in BSC-BTS direction to start cyphering mode operation.
27	Handover Detection- sent in BTS-BSC direction when BTS detects a Handover Access message from a MS on the Handover activation channel.
28	Measurement Result- sent in BTS-BSC direction to report to BSC the results of radio channel measurements for a particular MS.

Figure 7-13 DC Message Types

TRX Management Messages

Hex. Code	Message Type
1A	SACCH Filling- sent in BSC-BTS direction to indicate the new broadcast information to be used as filling information on SACCH.
1B	Overload- sent in BTS-BSC direction to indicate an overload situation.

Figure 7-14 TRX Message Types

6) MSG TYPE

Options: NONE (F1), INC+X (F2), DEC-X (F3), 1/10/50 (F4).

Select the Message Type, if you have chosen a Discriminator in the line above.

- Use the F-keys to enter a value.
- 1/10/50 (F4) sets the increment/decrement value of the INC+X (F2) and INC-X (F3) keys.

7) CHNL NUM

Options: NONE (F1), INC+X (F2), DEC-X (F3), 1/10/50 (F4).

- Use the F-keys to enter a value from 00—1F in hexadecimal code.

- 1/10/50 (F4) sets the increment/decrement value of the INC+X (F2) and INC-X (F3) keys.
- This filter corresponds to the last 5 bits of the 2nd octet of the channel number information element.
- This filter allows the user to capture messages with a specific physical channel/ subchannel number.

8) TM SLOT
Options: NONE (F1), INC+X (F2), DEC-X (F3), 1/10/50 (F4)

- Use the F-keys to enter a value from 0 to 7.
- 1/10/50 (F4) sets the increment/decrement value of the INC+X (F2) and INC-X (F3) keys.
- This filter enables you to capture messages using a specific time slot number.
- This filter corresponds to the first three bits of the second octet of the channel number information element.

9) IMSI
Options: YES (F1), NO (F2)

Choose whether to filter for messages containing the International Mobile Subscriber Identity information.

2.1.2.B Start Tracer

Start Tracer may be accessed through the A-bis MONITOR menu. It begins the trace process using the filter values specified in the SETUP FILTER screen. The tracer display updates twice a second and can capture 50 messages per second. Figure 7–15 depicts a sample Start Tracer screen.

```
                            04:53:25
TOTAL No.176      DISPLAY No.133
LINE 1    99-01-04   04:52:42.894
I/UI SAPI:00   TEI:32 NS:42 NR:5F
MD :Reserved   MT:78 Reserved


02 65 85 BE DE 78 87 2A 61 05
ED 4A E2 9F 91 0F 0F EC 9A 8D
1E 30 D0 28 A8 AA 1F 20 EE




RESTART   RESUME
```

Figure 7–15   A-bis Start Tracer

You may choose between two function keys in this screen:

RESTART (F1): Restart causes the SunSet to restart the trace process.

PAUSE/ RESUME (F2): Pause freezes the display so that messages can be easily observed. Messages are still passing, but are updated only in memory, not on the display. RESUME (F2) will update all the messages to their current state.

2.1.2.C View/Print Tracer

View/Print Tracer may be accessed through the A-bis MONITOR menu. Tracer allows you to view and print specific data captured by the SunSet.

Upon entering, a preliminary View/Print screen appears stating the total numbers of records in the SunSet. You may now specify which of these records you wish to view.

    a) Place the cursor on the FROM No. item.
    b) Press the SHIFT key and enter in the desired numbers from the keypad.
    c) Press the SHIFT key again to deactivate the SHIFT-lock and cursor down to TO No. Use the same procedure to enter the desired number.

d) When you are satisfied with the viewing settings, press VIEW (F3) to begin viewing.

Figure 7–16 shows a sample VIEW display, showing both Layer 2 and Layer 3 messages.

```
                              04:59:18

            RECEIVE MESG NO.1

  LINE 1    99-01-04   05:05:55.370
  I/UI SAPI:00 TEI:2D NS:68 NR:69
  MD: Reserved    MT:7A Reserved


  L2:C4 C3 F8 6E
  L3:00 5A D0 D3 E5 7A 93 53 72 E1
  5C C1 66 A0 1E DB



  PAGE-UP   PAGE-DN   DECODE
```

Figure 7–16   A-bis View Display

If you have selected more than one record in the previous screen, use the PAGE-UP (F1) and PAGE-DN (F2) keys to view all the pages of records. Figure 7–16 displays the message in hexadecimal code. You may press DECODE (F3) to decode the message contents for analysis.

In some decoded screens, you will be offered a further BITdeco(de) (F4). After viewing the BITdeco screen, press ENTER to return to the message. See figure 7–17.

```
                                    04:59:18

                    RECEIVE MESG NO.1

LINE 1       99-05-02   05:45:55.370
I/UI SAPI:00 TEI:07   NS:03 NR:68
MD: Reserved MT:23 CHAN ACTV N A
CH#19 SDCCH/8 +   ACCH'S 1
TS#5
CAUSE : 2




PAGE-UP   PAGE-DN          BITdeco
```

$\downarrow$

```
  bits HGFEDCBA
   10000010

   bits G-E:class
        Normal Event

   bits D-A:value
        handover access failure
```

Figure 7–17   BITdeco screens

2.1.3 A-bis Traffic

The A-bis Traffic screen may be accessed through the A-bis
INTERFACE menu. Figure 7–18 shows the A-bis TRAFFIC Screen.

```
                              06:29:53

              A-bis TRAFFIC

        LINE 1           LINE 2

        RLM  -2          RLM  -14
        DCM  -1          DCM  -12
        CCM  -1          CCM  -16
        TRXM -6          TRXM -14
        TOTAL-10         TOTAL-56




RESUME   RESTART            STATIST
```

Figure 7–18   A-bis Traffic Screen

This screen shows the A-bis Interface traffic on both lines 1 & 2. It separates this traffic into four management types:

Radio Link (RLM)
Dedicated Channel (DCM)
Common Channel (CCM)
TRX (TRXM)

This information is provided in a count or percentage format. Pressing STATIST (F4) in the screen above would convert all counts into percentages of the total Abis traffic.

2.1.4 Layer 2 Traffic

This screen provides records regarding the layer 2 traffic. Layer 2 refers to the Logical Layer of the A-bis protocol layers. It controls the logical signalling links between the BSC and its BTSs. Figure 7–19 depicts the Layer 2 traffic screen.

```
                          06:34:47


              LAYER 2 TRAFFIC

   LINE 1                LINE 2

      S   -33              S   -121
      U   -21              U   -128
   I/UI   -210          I/UI  -1202
   TOTAL  -264          TOTAL -1451




   RESUME    RESTART          STATIST
```

Figure 7–19   Layer 2 Traffic Screen

This screen divides the traffic on both lines by the following formats:

S- Supervisory Format: used for control functions.
U- Unnumbered Format: used for additional control functions and
   information transfer.
I/UI- Information transfer: used for information transfer between
   layer 3 entities.

This screen provides this information in either a count or percentage format. Pressing STATIST (F4) in the screen shown above would convert all the counts to percentages.

2.2 A/ MAP Interface

The A/Map Interface is the interface between the Base Station Controller (BSC) and the Mobile Switching Center (MSC). Figure 7–20 depicts the A Interface menu which appears upon entering A INTERFACE. Figure 7–21 shows the A/Map Configuration screen.

```
                                    07:04:23

        A/MAP  INTERFACE

        CONFIGURATION
        SETUP  FILTER
        START  TRACER
        VIEW/PRINT  TRACER
```
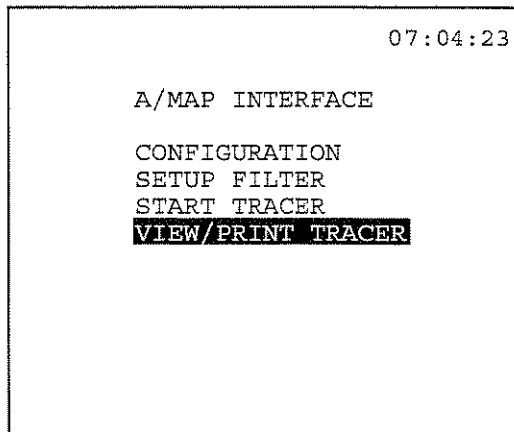
Figure 7–20   A/MAP Interface Menu

2.2.1 A/Map Configuration

```
                                    04:45:32

              CONFIGURATION

        LINE  1  Rx  T/S: 31
        LINE  2  Rx  T/S: 1
        A  INTR  MODE   : CCITT




    NEXT     PREVIUS
```
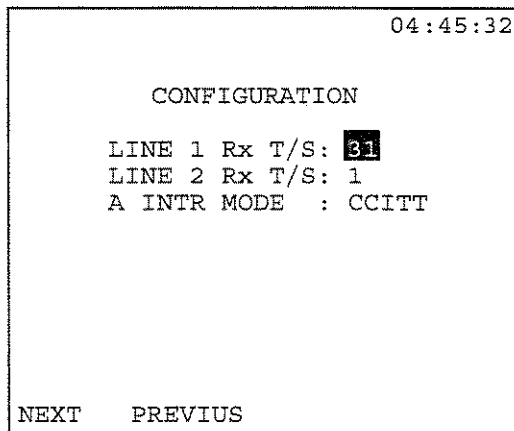
Figure 7–21   A/Map Configuration screen

1) Line 1 Rx T/S

Options: 1—31

• Use the NEXT (F1) and PREVIUS (F2) keys to select the line 1
  receive timeslot.

Ch.7 GSM   7-21

2) Line 1 Rx T/S

Options: 1—31

• Use the NEXT (F1) and PREVIUS (F2) keys to select the line 2
receive timeslot.

3) A INTR MODE

Options: CCITT (F1), CHINA24 (F2), CHINA14 (F3)

A INTR MODE specifies the signalling protocol used at the A-
interface.

• Press CCITT to use the standards defined by CCITT.
• Press CHINA 24 to use the China 24 bits standard.
• Press CHINA14 to use the China 14 bits standard.

2.2.2 Setup Filter

```
                              04:40:39


                  SETUP FILTER


      LSSU MON  : DISABLE
      LINE 1 DPC: 06-FE-02
      LINE 1 OPC: 02-0B-06
      INTERFACE : A




  NONE      A      MAP(B-G)
```
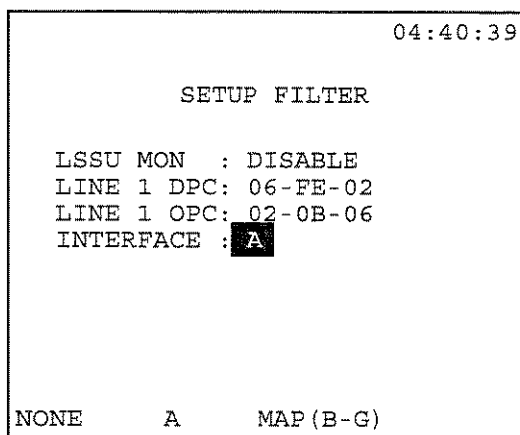
Figure 7–22   Setup Filter Screen

1) LSSU MON

Options: ENABLE (F1), DISABLE (F2)

LSSU refers to the Link Status Signal Unit.

• LSSUs are used to indicate the status of node's level 2 message
handling capabilities.
• ENABLE (F1) or DISABLE (F2) LSSU in the filtering process.

2) LINE 1 DPC
Options: NONE (F1), INC+X (F2), DEC-X (F3), 1/10/50 (F4)

The Destination Point Code indicates the signalling point for which the message is intended.

- Use the F-keys to enter the desired hexadecimal values for the DPC. Pressing 1/10/50 (F4) sets the increment/decrement value used in options (F2) and (F3).
- The Line 2 OPC defaults to the same number set as the Line 1 DPC.

3) LINE 1 OPC
Options: NONE (F1), INC+X (F2), DEC-X(F3), 1/10/50 (F4)

The Originating Point Code indicates the signalling point that is the source of the message.

- Use the F-keys to enter the desired hexadecimal values for the OPC. Pressing 1/10/50 (F4) sets the increment/decrement value used in options (F2) and (F3).
- The Line 2 DPC defaults to the same number as selected here.

4) INTERFACE
Options: NONE (F1), A (F2), MAP B-G (F3)

Specify the desired interface.

- A Interface (F2) is the interface between the BSC, Base Station Center, and the MSC, Mobile Switching Station.
- MAP B-G (F3) refers to the inter-MSC interfaces.
- MAP, Mobile Application Part, is used for the transfer of non circuit-related signalling information on inter-MSC interfaces.

Upon selecting MAP B-G, more filtering settings appear below:

The following filter items apply only to MAP B-G Interface:

5) ADDR SGNL
Options: NONE (F1), CALLED# (F2), CALLER# (F3)

Specify the addressing signalling direction.

- CALLED# (F2) refers to the destination number of the call.
- CALLER# (F3) refers to the origination number of the call.
  If you select either (F2) or (F3), you may specify the number in

the next two lines:

6) SCCP SSN
Options: NONE (F1), MAP (F2), HLR (F3), VLR (more, F1), MSC
(more, F2), EIC (more, F3), AUC (more, F1)
The Subsystem Number (SSN) identifies a SCCP user function.

• Select NONE (F1) to capture all subsystem numbers.
• The following Subsystem numbers may be chosen:

MAP (F2)- Mobile Application Part
HLR (F3) - Home Location Register
VLR (more, F1) - Visitor Location Register
MSC (more, F2) - Mobile Switching Center
EIC (more, F3) - Equipment Identifier Center
AUC (more, F1) - Authentication Center

7) ADDR NUMB
Options: YES (F1), NONE (F2)

• Select NONE (F2) to capture all address numbers.
• When you press YES (F1), you must enter in the desired number.
If you have previously entered a number in this spot, that
number will appear again.
• To enter a new number, press the SHIFT key and enter in the
necessary numbers from the keypad.

8) TCAP OTID
Options: YES (F1), NONE (F2)
MAP uses the SS#7 TCAP (Transaction Capability Action
Part) to control end to end dialogue and remote operation handling.
The Originating Transaction ID is part of the TCAP sublayer.

• Upon selecting YES (F1), the previously-entered ID number will
appear.
• You may enter a new number by pressing the SHIFT key and
entering the necessary numbers from the keypad.
• You may enter up to ten decimal digits.
• Remember to press the SHIFT key when you are finished.

9) TCAP DTID

Options: YES (F1), NONE (F2)

    TCAP DTID refers to the TCAP Destination Transaction ID.

- Upon selecting YES (F1), the previously-entered ID number will appear.
- You may enter a new number by pressing the SHIFT key and entering the necessary numbers from the keypad.
- You may enter up to ten decimal digits.
- Remember to press the SHIFT key when you are finished.

10) INVOKE ID

Options: YES (F1), NONE (F2)

    The Invoke ID is part of TCAP's component portion information element tag (part of the TCAP Transaction Sublayer).

- Select YES (F1) to enter the ID number in hexadecimal code from 00 to FF.
- Remember to press the SHIFT key when you are finished.

2.2.3 Start Tracer

    Start Tracer may be accessed through the A/MAP INTERFACE Menu. It begins the tracing process using the filters specified in SETUP FILTER. The tracer display updates twice a second and can capture 50 messages per second. Figure 7–23 depicts the Start Tracer screen.

```
                               07:15:39
TOTAL NO. 3         DISPLAY NO.3
LINE 2 99-01-04     07:14:52.879

SNM
DPC: CC-85-5D

0E 46 90 20 5D 85 CC 1B 6F 60
36 8D D6 0E 81 09 42 6E 4D 6B
D7 BA



RESTART   RESUME   DECODE
```

Figure 7–23 Start Tracer Screen

You may choose between three function keys in this screen:

RESTART (F1): Restart causes the SunSet to restart the trace process.

PAUSE (F2): Pause freezes the display so that messages can be easily observed. Messages are still passing, but are updated only in memory, not on the display. RESUME (F2) will update all the messages to their current state..

DECODE/HEX (F3): Decode displays the message contents for analysis. Select HEX to show the message in hexadecimal form. Figure 7–23 shows the message in hex.

2.2.4 VIEW/PRINT TRACER

• View and print specific data captured by the SunSet.

Upon entering, a preliminary View/Print screen appears stating the total numbers of records in the SunSet. You may now specify which of these records you wish to view.

1) Place the cursor on the FROM No. item.

2) Press the SHIFT key and enter in the desired numbers from the

keypad.

3) Press the SHIFT key again to deactivate the SHIFT-lock and cursor down to TO No.

4) Use the same procedure to enter the desired number.

5) When you are satisfied with the viewing settings, press VIEW (F3) to begin viewing.

Figure 7–25 shows a sample VIEW display.

```
                                    07:04:23

     A/MAP  INTERFACE

     CONFIGURATION
     SETUP  FILTER
     START  TRACER
     VIEW/PRINT  TRACER
```
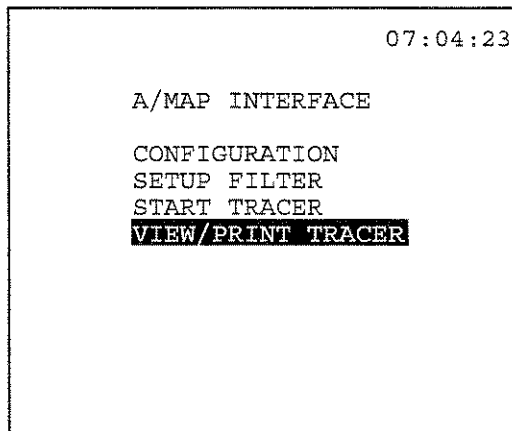
Figure 7–24   A Interface/View/Print Tracer Screen

```
                              07:18:48

               RECEIVE MESG NO.1
LINE 2    96-01-04     07:14:50.382

SCCP
DPC: 5B-82-0C

CD CA 65 03 0C 82 5B 0D 37 D1
37 96 D1 42 79 4E 20 59 31 70
A1 50 C6 AC 86 A2 BA 19 EA D6
9C 79 D7 02 46 F4 F8 B3 E0 29
46 BB

PAGE-UP   PAGE-DN   DECODE
```

Figure 7–25   A-Interface VIEW Display

- If you have selected more than one record in the previous screen, use the PAGE-UP (F1) and PAGE-DN (F2) keys to view all the pages of records.
- Figure 7–25 displays the message in hexadecimal code.
- You may press DECODE (F3) to decode the message contents for analysis.

Section 3 GSM VOICE/TRAU/BERT

To enter the GSM VOICE/TRAU/BERT menus:

1) From the MAIN MENU, enter OTHER MEASUREMENTS.

2) Cursor to GSM VOICE/TRAU/BERT; press enter.

You will be presented with the GSM VOICE/TRAU/BERT screen, after the E10 takes a few seconds to configure. See Figure 7–26.

```
                              04:53:25


      GSM VOICE/TRAU/BERT

            GSM MONITOR
            VOICE/TRAU XMT
            GSM 16K BERT
```
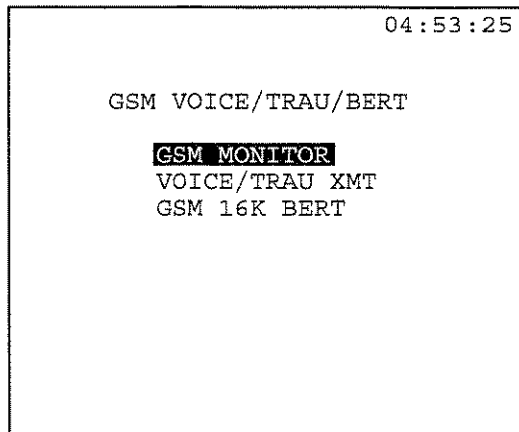
Figure 7–26   GSM VOICE/TRAU/BERT menu

3.1 GSM Monitor

See Figure 7–27. Use this procedure to monitor GSM transmissions:

```
                              02:39:53
 T/S          GSM LINE 2

 1    S--- Abis ---- II-- ---- --D-
      ^
 7    ---- -S-- ---A Abis --O- A-A-
           ^
 13 I--- A-AA ---D ---- ---A --OC

 19 Abis A--- ---- I--- -S-- ----
                        ^
 25 D--- ---A Abis --A- ---- ---I

 31 AA--   TIMING N/A

 LINE 1   D&I                 JUMP
```
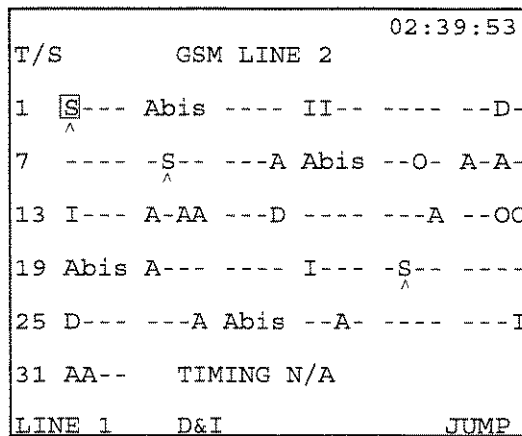
Figure 7–27   GSM Monitor screen

1) From the GSM VOICE/TRAU/BERT menu, cursor to GSM
   MONITOR; press enter.

2) Observe the received TimeSlot/subchannel activity, reading the
   TimeSlots across the screen.

   Definitions:
       A = 16 kbps Abis signalling
       Abis = 64 kbps Abis signalling
       D = Data
       I = Idle (speech idle)
       O = Operations & Maintenance
       S = Speech
       Up Arrow = uplink direction
       Down Arrow = downlink direction

       - = Unknown

   Note: When you are on a speech channel (highlighted S),
   Timing Alignment will be reported in the bottom right side of
   the screen, in microseconds, if applicable.

a) Press F1 to change the observed line (Line 1 or Line 2).
b) Press F3 to Jump the cursor between timeslots.

3) Press D&I (F2) for Drop & Insert testing.

   The dropped signal will be received at the test set speaker. A
   prerecorded Sunrise Telecom message will be inserted onto the
   same timeslot/subchannel of the transmitted signal.

Note: You must be in RESUME mode to listen to the decoded RPE-
LTP speech signal. Press PAUSE (F3) to mute the speaker, and
RESUME (F3) to listen.

3.2 VOICE/TRAU XMT

• Transmit a prerecorded speech message.
• Observe received C-bits.
• At any time, you may press the PAUSE key to freeze the display.
   Press RESUME (F1) to resume measurements.

```
                               04:53:25
                VOICE/TRAU XMT

     LINE  NUMBER: LINE 1
     TIME  SLOT  : 7
     SUB  CHANNEL: 1
     IDLE  CODE   : 10101010
     LINK  DIRCTN: UP
     TIME  ALGMNT: N/A

     RCV  CBITS   :
        1110  0 100000 1111011111



     PAUSE   DOWN
```

Figure 7–28   VOICE/TRAU XMT screen

1) From the GSM VOICE/TRAU/BERT menu, select and enter
   VOICE/ TRAU XMT. See Figure 7–28.

2) LINE NUMBER
Options: LINE 1 (F2), LINE 2 (F3)
   Select the transmit line.

• Press the F-key corresponding with the line you wish to transmit
  on.

3) TIME SLOT
   Select the timeslot to transmit on, from 1-31.

• The default is timeslot 1. You may change the timeslot by pressing
  the F-keys:
     a) Press INC+1 (F2) to increment the timeslot number by one.
     b) Press DEC-1 (F3) to decrement the timeslot number by one.
     c) Press INC +10 (F4) to increment the timeslot number by ten.

4) SUB CHANNEL
   Select the subchannel to transmit on, from 1—4.

• The default is subchannel 1.
• You may change the selection by pressing the F-keys:
     a) Press INC+1 (F2) to increment the subchannel number by

one.

b) Press DEC-1 (F3) to decrement the subchannel number by
one.

5) IDLE CODE
Set the idle code inserted on the nonselected channels.

a) Use the arrow keys to move the cursor to a desired digit.
b) Press the 1 (F2) and 0 (F3) keys to enter the idle code.

6) LINK DIRCTN
Options UP, DOWN

• Press the F2 key to select the link direction you wish to transmit.
• See Figure 7–29.


```
┌─────────────────────────────────────────────┐
│  ┌──────────┐     Uplink      ┌──────────┐   │
│  │          │  ──────────►    │          │   │
│  │   BTS    │                 │   BSC    │   │
│  │          │  ◄──────────    │          │   │
│  └──────────┘    Downlink     └──────────┘   │
│            Base Station Subsystem             │
└─────────────────────────────────────────────┘
```
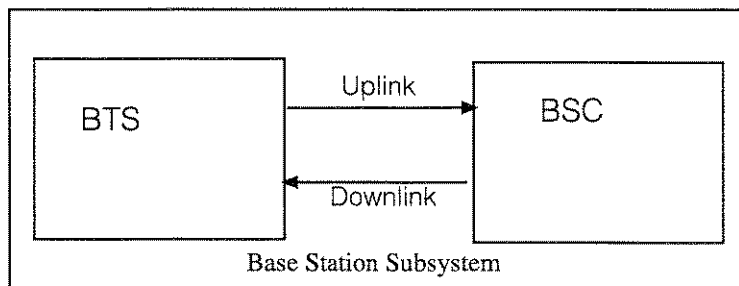
Figure 7–29   Uplink/Downlink Directions

7) TIME ALGMNT

• The default is no delay to the voice signal.
• You may change the delay time by pressing the F-keys:
   a) Press INC+1 (F2) to increment the delay by steps of 500µs.
   b) Press DEC-1 (F3) to decrement the delay by steps of 500µs.
   c) Press INC +10 (F4) to increment the delay by steps of 10 x
      500µs.

8) RCV CBITS
Observe the received C-bits.

C-bits are received on the same timeslot/subchannel as se-
lected for transmit. See Figure 7–28.

9) PAUSE (F1)

At any time, you may press the PAUSE key to freeze the display. Press RESUME (F1) to resume measurements.

3.3 GSM 16k BERT

This item allows you to observe the quality of transmission of a selected timeslot subchannel. You will transmit a test pattern, and observe the results. See Figure 7–30.

Configure the following items:

```
                              02:12:59
                GSM 16K BERT

     LINE  NUMBER:  LINE  2
     TIME  SLOT   :  7
     SUB  CHANNEL:  2
     PATTERN     :  2047

     ELAPSED  TIME:000:08:37
     ERROR:0          RATE:0.0e-05
     ES    :0         EFS  :0
     SES   :0         UAS  :0
     LOSS  :0

 STOP    LINE  1    LINE  2
```

Figure 7–30   GSM 16K BERT

1) From the GSM VOICE/TRAU/BERT menu, select GSM 16K BERT.

2) LINE NUMBER
Options: LINE 1, LINE 2

• Press F2 to change the selected transmit line.

3) TIME SLOT
Select the transmit timeslot, from 1—31.

- The default is Timeslot 1. You may change the timeslot by pressing the F-keys:
  a) Press INC+1 (F2) to increase the timeslot number by one.
  b) Press DEC-1 (F3) to decrease the timeslot number by one.
  c) Press INC +10 (F4) to increase the timeslot number by ten.

4) SUB CHANNEL
Select the transmit subchannel, from 1—4.

- The default is subchannel 1. You may change the selection by pressing the F-keys:
  a) Press INC+1 (F2) to increment the subchannel number by one.
  b) Press DEC-1 (F3) to decrement the subchannel number by one.

5) PATTERN
Options: 2047 (F2), 1111 (F3), 1010 (more, F2), 0000 (more, F3)
Select the test pattern to transmit, pressing the appropriate F-key.

6) Observe the measurements:
a) ELAPSED TIME: measurement begins when you enter the screen; the time elapsed since measurements began is reported here.
b) Here is a listing of the measurements:

ERROR: A count of all errors
RATE: The rate at which errors are being received
ES: A count of Errored Seconds; seconds with at least one BPV, bit error, FBE, or CRC-4 error.
EFS: A count of Errored Free Seconds
SES: A count of Severely Errored Seconds; seconds with an error rate of 10-3 or higher.
UAS: A count of UnAvailable Seconds; unavailable time begins at the onset of 10 consecutive SESs, or at loss of signal or loss of frame.
LOSS: A count of Loss of Signal Seconds; seconds during which signal was lost.
See the Measurement Definitions section in Chapter 3 as necessary.

Note: LOSS here refers to the loss of the entire 64 kbps signal.

Press the STOP (F1) key when you wish to begin new measurements. Press RESTART (F1), and a new measurement cycle will begin.

Chapter 8
X.50

Section 1 X.50 Technology Overview

X.50 is an ITU-T standard for sub-rate data multiplexing. It arose from the need to standardize a multiplexing scheme to be used on interworking data networks on international links. In sub-rate data multiplexing, several low-speed signals are combined in a single 64 kbps circuit. Sub-rate multiplexing enables a service-provider to split the bandwidth (64 Kbps) into lower rate sections and thus pack several customer's data into one timeslot.

The Rec. X.50 defines different framing structures distinguished by the length used. The SunSet E10 supports two framing structures: X.50 Division 2 and X.50 Division 3.

1.1 X.50 Byte Structure

The X.50 Division 2 & 3 format is based on the 8-bit envelope, as shown in Figure 8–1.
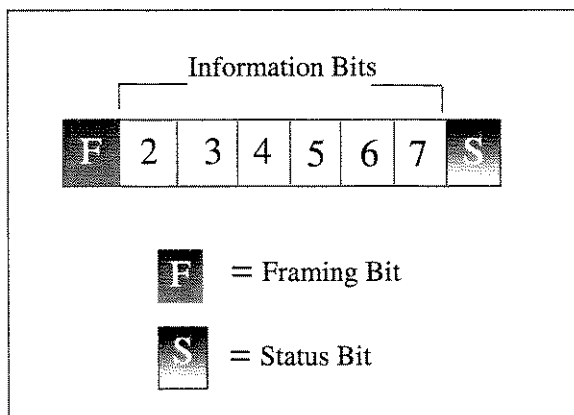
Figure 8–1   X.50 Byte Structure

In this 8-bit envelope, bit 1 (F) is reserved for framing purposes; bit 8 (S) carries the status bit. Bits 2 through 7 contain the user information bits. Therefore, the multiplexing overhead uses 25% of the available bandwidth. The maximum user payload carried by a timeslot, which has been multiplexed in accordance with Rec. X.50, is 48 kbps. The actual user payload rate is 75% of the subchannel rate required to carry it. Figure 8–2 shows the

equivalent subchannel and user payload rates.

Sub-Channel Rate	User's Payload	# of Sub-channels in 64Kbps
12.8 Kbps	9.6 Kbps	5
6.4 Kbps	4.8 Kbps	10
3.2 Kbps	2.4 Kbps	20

Figure 8–2   Channel Rates

1.2 X.50 Framing

The SunSet E10 supports Division 2 and Division 3 framing.
• X.50 Division 2 uses an 80-byte frame.
• Division 3 uses a 20-byte frame.

1.2.1 Division 2 Framing

Division 2 uses 80 8-bit envelopes and has a gross bit-rate of 64 kbps. This structure will allow the multiplexing of channels at the following bearer rates:

12.8 kbps channels- every 5th 8-bit envelope
6.4 kbps channels- every 10th 8-bit envelope
3.2 kbps channels- every 20th 8-bit envelope
800 bps channels - every 80th 8-bit envelope

The list above also shows where the interleaved 8-bit envelopes appear on the 64 kbps bearer.

The first F-bit is used to carry the distant end alarm indication, when an absence of incoming pulses or the loss of frame alignment has been detected at the local end.

1.2.2 Division 3 Framing

The X.50 division 3 frame consists of 20 8-bit envelopes. Each of the 20 frame positions carries 2.4 kbps of user data. The framing position of the first 8-bit envelope is used to convey distant alarm indications, indicating an absence of incoming pulses or a loss of

frame alignment detected at the local end.

	bit1	bits 2-7		bit8
0	**A**	Information bits (2-7)		S
1	F			S
2	F			S
3	F			S
4	F			S
5	F			S
6	F			S
7	F			S
8	F			S
9	F			S
10	F			S
11	F			S
12	F			S
13	F			S
14	F			S
15	F			S
16	F			S
17	F			S
18	F			S
19	F			S

= position of a 9.6 Kbps call

Figure 8–3   X.50 Division 3 Frame

Sub-rate calls are multiplexed within the 64 kbps bearer by

specifying the frame position they will occupy in the envelope. A 9.6 kbps call could occupy four positions in the frame. As with Division 2, a 9.6 data rate call repeats every 5th 8-bit envelope. Figure 8–3 shows the positions occupied by a 9.6 kbps call in the D3 frame.

Section 2 X.50 Analysis

To enter the X.50 menu:
1) From the MAIN MENU, enter OTHER MEASUREMENTS.
2) Enter X.50 Analysis.

```
                                01:25:25
      OTHER MEASUREMENTS

      VIEW RECEIVED DATA
      VIEW FAS WORDS
      VIEW MFAS WORDS
      PULSE MASK ANALYSIS
      SS#7 ANALYSIS
      ISDN ANALYSIS
      GSM ANALYSIS
      GSM VOICE/TRAU/BERT
      X.50 ANALYSIS
      C-BIT ANALYSIS
      HISTOGRAM ANALYSIS
      PROPAGATION DELAY
```

Figure 8–4 Other Measurements/X.50 Analysis

```
                                    18:16:30



              X.50 ANALYSIS

              X.50 SETUP
              VIEW X.50 INFO
```
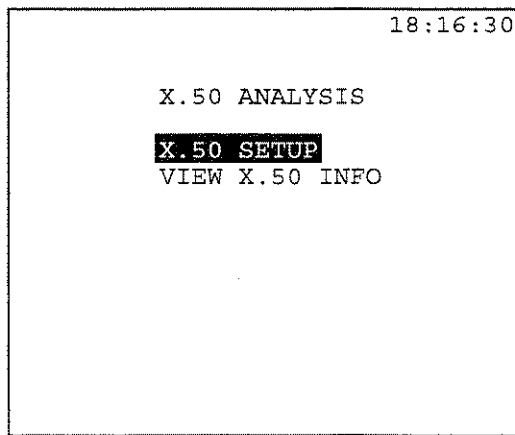
Figure 8–5   X.50 Analysis screen

2.1 X.50 Setup

Enter X.50 SETUP

- Enable the X.50 analysis feature.
- Configure a specific division, phase, rate, octet, idle pattern, and other information related to the X.50 frame being sent and received.
- Refer to Figure 8–6, X.50 Setup.

```
                        X50     22:27:34
                    X.50 SETUP
     X.50     : ENABLE
     TRIBU    : D2
     PHASE    : 1
     RATE     : 2400
     OCTET    : 1

     IDLE PATRN : 0000
     BERT S-bit : 0
     IDLE S-bit : 0
     A..H bits  : 01100110
     X.50 signal: 1111


     D2        D3
```
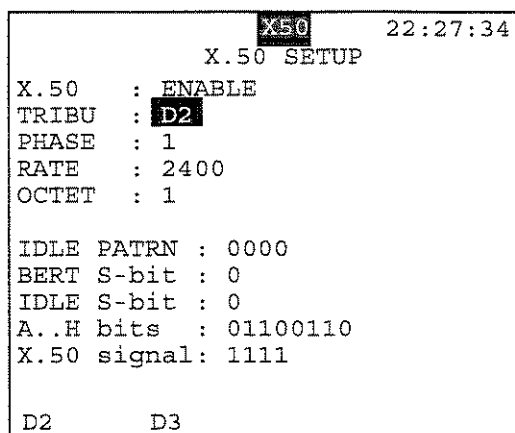
Figure 8–6   X.50 SETUP Screen

The following items should be configured in this screen:

1) X.50
Options: ENABLE (F1), DISABLE (F2)
    Enables/ disables the X.50 analysis feature.

• Press ENABLE (F1) to perform any X.50 analysis procedure with
    the E10. After enabling X.50, a reverse video X50 message
    appears on the top of the screen.

2) TRIBU
Options: D2 (F1), D3 (F2)
    Select a sub-rate structure tributary.

• Press F1 for X.50 Division 2, D2
    X.50 division 2 uses an 80-byte frame
• Press F2 for X.50 Division 3, D3
    Division 3 uses a 20-byte frame

    Please refer to the Technology Overview section within this
chapter for a more detailed explanation of each framing type.

3) PHASE
Options: NEXT (F1), PREVIUS (F2), + (F3), ALL (F4)
    Select the phase(s) to be tested.

• To test only one 9.6 kbps phase, use the NEXT (F1) or PREVIUS
    (F2) keys, as appropriate, to enter the desired number, from 1-
    5.
• To test a pair of phases (x+y=19.2 kbps), press + (F3).
    This line now shows two phase slots separated by a plus sign.
    Use the (F1) and (F2) keys as needed to enter the desired
        phase numbers in the two slots.
• To test all five phases (48 Kbps), press the ALL (F4) key. This
    automatically sets the RATE to 48 kbps.
• The E10 will not allow the same phase number to be entered in
    both slots.
• When you choose to enter a pair of phases, the rate is automati-
    cally set to 19.2K.

    The X.50 frame is divided into 5 phases. Each phase contains
16 octets and a rate of 9.6 kbps.
    Figure 8–7 shows the phase structure for Division 2. This

figure demonstrates how 5 customers with a bandwidth of 9.6 Kbps could easily share one 64Kbps line. As another example, twenty customers, each with a bandwidth of 2.4 Kbps could share this line; in this case, four customers are placed in each phase.

Phase	Octet															
1	1	6	11	16	21	26	31	36	41	46	51	56	61	66	71	76
2	2	7	12	17	22	27	32	37	42	47	52	57	62	67	72	77
3	3	8	13	18	23	28	33	38	43	48	53	58	63	68	73	78
4	4	9	14	19	24	29	34	39	44	49	54	59	64	69	74	79
5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80

Figure 8–7   X.50 Division 2 Phases

4) RATE
Options: The RATE options available will depend on the TRIBU selected above

- For D2, Division 2, the options are: Nx600 (F1), 600 (F2), 1200 (F3), 2400 (more, F1), 4800 (more, F2), 9600 (more, F3)
- For D3, Division 3, the options are: Nx2400 (F1), 2400 (F2), 4800 (F3), 9600 (F4)
- If a rate of 9600 kbps, for either D2 or D3, is selected, the octet number (in the line below) will be forced to 1, and the cursor will move to the IDLE PATRN line.

Since the RATE and OCTET values are linked, they will be discussed together below.

5) OCTET
Options: NEXT (F1), PREVIUS (F2); the exact values available depend upon the RATE selected above

- For a specified rate, there are NxOCTETs selectable, where N=9600/RATE.
  For example, if a rate of 2400 is selected, then there are four octets from which to choose (since 9600/24000= 4). After selecting RATE =2400, use the NEXT (F1) or PREVIUS (F2) keys to select an octet 1-4.

For Division 2, Nx600 (F1):
- SEL appears in the OCTET slot.
- SEL appears as F1.

- Press F1 to enter the Division 2 screen, shown in Figure 8–8.
- Use the arrow keys to move the cursor to the desired octet number; then press SELECT (F1).
- To deselect an octet, follow the same procedure, but press UN-SEL (F3) instead.
- To select all sixteen octets in the phase, press SEL-ALL (F2).
- To deselect all sixteen octets in the phase, press CLR-ALL (F4)
- Once you have selected the octets, press ENTER to return to the X.50 SETUP screen.
- If you accidentally do not select any octets, you will automatically be set to the default rate of 2400 for octet of one.

```
            MEAS  X50              16:10:27

                 X.50 DIVISION 2

P1       00  05  10  15  20  25  30  35
         40  45  50  55  60  65  70  75
P2       01  06  11  16  21  26  31  36
         41  46  51  56  61  66  71  76
P3       02  07  12  17  22  27  32  37
         42  47  52  57  62  67  72  77
P4       03  08  13  18  23  28  33  38
         43  48  53  58  63  68  73  78
P5       04  09  14  19  24  29  34  39
         44  49  54  59  64  69  74  79
SELECT  SEL-ALL   UN-SEL   CLR-ALL
```

Figure 8–8   X.50 Division 2 Select Screen

As shown in Figure 8–8, there are five phases labelled P1-P5. Sixteen octets are assigned to each phase. Each octet, or subrate channel, has a bandwidth of 600 kbps. Since there are five phases with 16 octets each, a total of 80 x 600 bps octets are displayed from 00-79. Therefore, 80x6000 bps= 48 kbps for a full X.50 frame.

Notice that four octets are chosen (highlighted) for the phase selected, Phase 1 for Figure 8–8. The reason is that at Division 2 the default rate is set for 2400 bps (4 x 600 bps= 2400 bps). For Division 2, Nx600 (F1), SEL appears in the OCTET slot and SEL (F1) is shown below.

- Press the SEL (F1) key to select specific octets within each phase.
- For Division 3, Nx2400 (F1), SEL appears in the OCTET slot and SEL (F1) is shown below.
- Press the SEL (F1) key to select specific octets within each phase.
- A X.50 Division 3 screen will be displayed; Figure 8–9 shows this screen.

As shown in Figure 8–9, there are five phases labelled P1-P5. Four octets are assigned to each phase. Each octet, or subrate channel, has a bandwidth of 2400 bps. Since there are five phases with four octets, a total of twenty 2400 bps octets are displayed from 00 to 19. Therefore, 20x2400 bps= 48 kbps, a full X.50 frame.

Notice that one octet should be highlighted upon entering this screen.

```
┌─────────────────────────────────────────┐
│     MEAS   X50        16:36:33           │
│                                          │
│      X.50 DIVISION 3                     │
│                                          │
│   PHASE 1    00 05 10 15                 │
│                                          │
│   PHASE 2    01 06 11 16                 │
│                                          │
│   PHASE 3    02 07 12 17                 │
│                                          │
│   PHASE 4    03 08 13 18                 │
│                                          │
│   PHASE 5    04 09 14 19                 │
│ SELECT SEL-ALL  UN-SEL  CLR-ALL          │
└─────────────────────────────────────────┘
```

Figure 8–9 X.50 Division 3 Select Screen

- At Division 3, the default rate is set for 2400 bps for octet number one in the selected phase.
- To select a specific octet in the phase, use the arrow keys to move the cursor to the desired octet number; then press the SELECT (F1) key.
- To deselect a specific octet, follow the same procedure but press UN-SEL (F3) instead.
- To select all four octets in the given phase, press SEL-ALL (F2).

- To deselect all four octets, press CLR-ALL (F4).
- Once you have selected the octets, press ENTER to return to the X.50 SETUP screen.
- If you accidentally do not select any octets, you will automatically be given the default rate of 2400 and octet of 1.

6) IDLE PATRN
Options: 0000 (F1), 1111 (F2), 2e7-1 (F3)

Determines the idle pattern to be transmitted on those phase(s) and octet(s) not selected in the lines above.

- Press F1 for all zeroes.
- Press F2 for all ones.
- Press F3 for a pseudorandom pattern.

7) BERT S-bit
Options: 0 or 1

Set the status bit for those phase(s) and octets(s) being tested.

- Activate the SHIFT key, and press either 0 or 1 from the keypad to set the BERT status bit.
- Remember to deactivate the SHIFT key when finished.

8) IDLE S-bit
Options: 0 or 1

Set the idle status bit for those phase(s) and octet(s) not being tested.

- Activate the SHIFT key, and press either 0 or 1 from the keypad to set the IDLE status bit.
- Remember to deactivate the SHIFT key when finished.

9) A..H bits
Options: for D2, eight bits of either 0 or 1. For D3, 1 bit of either 0 or 1.

For Division 2, this item sets the housekeeping bits, A, B, C, D, E, F, G, and H:
- Activate the SHIFT key and press either 0 or 1 from the keypad.
- Notice that the cursor automatically moves to the right each time you press a 0 or 1.

- If you should make a mistake while entering the bits, deacti-
vate the SHIFT key and use the arrow keys to move the
cursor to the bit in error. Repress the SHIFT key and re-enter
the bit.
- When you are finished, remember to deactivate the SHIFT
key.

For Division 3, this item sets the housekeeping bit A:
- Activate the SHIFT key and press either 0 or 1.
- Remember to deactivate the SHIFT key when finished.

10) X.50 Signal
Options: 4 bits of either 0 or 1
Determines the four-bit (A/B/C/D) channel associated signal-
ling (CAS) which will be transmitted in the selected phase(s) and
octet(s).

- Activate the SHIFT key, and press either a 0 or 1 for each bit.
- Notice that the cursor automatically moves to the right once a 0
or 1 is entered.
- If you make a mistake while entering the bits, deactivate the
SHIFT key and use the arrow keys to move the cursor to the bit
in error. Repress the SHIFT key and re-enter the bit.
- When you are finished, remember to deactivate the SHIFT key.

2.2 View X.50 Info

- View information about the received housekeeping bits A through
H.
- This screen is for viewing only.
- To change your transmitted housekeeping bits, you may do so in
the X.50 SETUP screen.

An example of the Division 2 VIEW X.50 INFO is shown in
Figure 8–10.

```
┌─────────────────────────────────────┐
│   ▐MEAS▌   ▐X50▌    17:17:28        │
│                                     │
│                                     │
│          VIEW X.50 INFO             │
│                                     │
│    HOUSE KEEPING: ABCDEFGH          │
│                   01100110          │
│                                     │
│                                     │
│                                     │
│                                     │
│                                     │
└─────────────────────────────────────┘
```
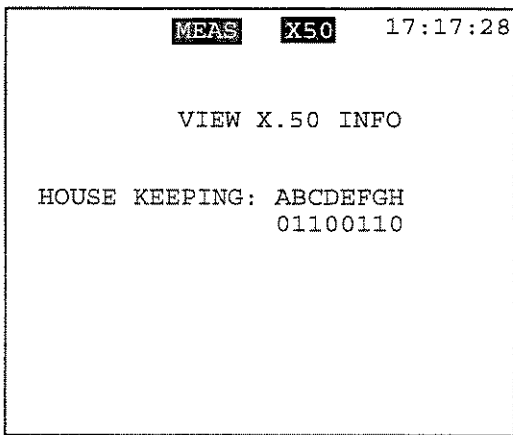
Figure 8–10   Division 2 View X.50 Info

Please note that for Division 3, only the A housekeeping bit is displayed.

Section 3 X.50 Applications

3.1 Testing a 64K X.50 Frame Within a 2 Mbps Signal

In the following procedure, the E10 receives and transmits a single 64 kbps X.50 frame inside a 2 Mbps signal.

1) From the Main Menu, enter OTHER MEASUREMENTS, X.50 ANALYSIS, X.50 SETUP.
a) At the top line, X.50, select ENABLE (F1) to set up your X.50 frame.
b) Before continuing, make sure that the reverse video X50 message is displayed at the top of the screen Escape to the Main Menu.

2) Enter Test Configuration.
a) Choose E1 Mode and the configure the set as in Figure 8–11.

```
┌─────────────────────────────────────────┐
│ ▌MEAS▐  ▌X50▐          20:30:24          │
│      TEST CONFIGURATION                  │
│      TEST MODE : E1                      │
│                                          │
│      Tx/INSERT : L1-TX                   │
│      Rx/DROP   : L1-RX                   │
│      Tx SOURCE : TESTPAT                 │
│      FRAMING   : PCM-30                  │
│      CRC-4     : YES                     │
│      TIME SLOT : ▌09▐                    │
│      RXLVL-1   : TERM                    │
│      RXLVL-2   : TERM                    │
│      XMT CLOCK : L1-RX                   │
│                                          │
│  NEXT    PREVIUS                         │
└─────────────────────────────────────────┘
```

Figure 8–11 Test Configuration

Note: FRAMING, CRC-4, and TIMESLOT may be set as specified by the span design. Therefore, for these items, Figure 8–11 shows only sample settings and other selections may also be valid for this procedure.

b) For TIME SLOT, you may choose among timeslots 1—31 for PCM-31 framing or timeslots 1—15/17—30 for PCM-30.

3) Connect the E10 according to Figure 8–12.
a) Press the HISTORY key to acknowledge any blinking history lights and turn them off.
b) Verify that the PAT SYNC LED is lit green.

4) Enter OTHER MEASUREMENTS, X.50 ANALYSIS, VIEW X.50 INFO.
a) Verify the housekeeping bits.
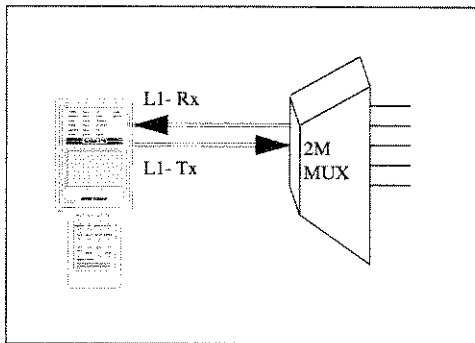
**Figure 8–12   Testing 64K X50 Frame from a
2M Multiplex**

5) Escape out to the Main Menu.
a) Enter TEST PATTERN.
b) Select a BERT or USER pattern.

6) Escape out to the Main Menu.
a) Enter the MEASUREMENT RESULTS menu item.
b) Verify that the circuit performs to your company's requirements
   for the service delivered.
   • If necessary, refer to the Measurement Results section,
     Section 4, in Chapter 3 for definitions of the measurement
     parameters.
c) Use PAGE-UP (F1) and PAGE-DN (F2) keys to view each of the
   measurement screens.

7) When you have finished viewing the measurement results,
   press the ESCAPE key to return to the Main Menu.

3.2 Multiplexing a 64K X.50 Frame onto one T/S of a 2Mbps Signal

In E1-MUX Mode, the SunSet E10 emulates a 64K X.50 to 2 Mbps multiplexer. Use the following procedure to multiplex a single 64 kbps X.50 frame onto one timeslot of a 2 Mbps frame.

1) From the Main Menu, enter OTHER MEASUREMENTS, X.50 ANALYSIS, X.50 SETUP.
a) At the top line, X.50, select ENABLE (F1).
b) Before continuing, make sure that the reverse video X50 message is displayed at the top of the screen.
c) Escape to the Main Menu.

2) Enter TEST CONFIGURATION.
a) Choose E1-MUX MODE.
b) Configure the set as follows:

E1 Settings:
Tx/INSERT   : L1-TX
RX/DROP   : L1-RX
FRAMING   : As specified by your span design
CRC-4   : As specified by your span design
RxLVL-1   : TERM
RxLVL-2   : TERM
XMTCLOCK : L1-RX

DATACOM SETTINGS:
TYPE: Select the datacom interface that will provide the 64Kbps X.50 frame. Choose from V.35 (F1), RS449 (F2), X.21 (F3), G.703 (more, F1), and RS232 (more, F2). For RS232, only the synchronous mode is available.

TxSRC: Select the source of the signal transmitted onto the datacom 64 kbps X.50 side.
   • If PATRN (F1) is chosen, the E10 will internally transmit the test pattern (selected in the TEST PATTERN screen) on the datacom 64 kbps X.50 side. You should see a reverse video T located next to the datacom port.
   • If E1DRP (F2) is selected, the E10 will drop a 64 kbps time slot (selected in E1 T/S) onto the datacom 64 kbps X.50 side. You should see a line connecting the DROP from LINE 1 to the datacom port in the graphic screen.
   •You can verify your selection by pressing the GRAPHIC

key.

MODE: This is set as DCE.

MUX settings:
BERT: Select the side for BER testing. This selection will determine which side will be displayed in MEASUREMENT RESULTS and in the LEDS.
  • You may choose to display the information about the dropped 64Kbps timeslot on the E1 side by pressing E1DRP (F1).
  • You may display information about the datacom type selected above by pressing TYPE (F2).
  • Verify your selection by pressing the GRAPHIC key.
    For datacom, you should see a reverse video R located next to the DROP of LINE 1. For datacom, you should see a reverse video R located next to the datacom port.

E1 INS: Select the source to insert onto a 64 kbps timeslot on the E1 side.
  • For LOOP (F1), the received E1 signal from Line 1 Rx will be transmitted back out Line 1 Tx.
  • If TYPE (F2) is selected, the 64 kbps X.50 signal received from the multiport will be transmitted onto the E1 side.
  • If PATRN (F3) is chosen, the E10 will internally transmit the test pattern (selected in the TEST PATTERN screen) onto the E1 side.

  • Verify your selection by pressing the GRAPHIC key.
  If LOOP is chosen, You should see a straight line from Line 1 Rx to Line 1 Tx.
  For Datacom, you should see a connecting line from the datacom port through the INST to the Line 1 Tx.
  For PATRN, you should see a reverse video T connecting through the INST and Line 1 Tx.

E1 T/S: Select the 64 kbps timeslot to be multiplexed from the X.50 to the E1 side.
  • Choose from timeslots 1—31 for PCM-31 framing.
  • Choose from timeslot 1—15/17—31 for PCM-30.

3) Connect the E10 according to Figure 8–13.
a) Press the HISTORY key to acknowledge any blinking lights and turn them off.

4) Enter OTHER MEASUREMENTS, X.50 ANALYSIS, VIEW X.50 INFO.
a) Verify the housekeeping bits.

5) Escape back to the Main Menu.
a) Enter TEST PATTERN.
b) Select a BERT or USER pattern.

6) Escape out to the Main Menu.
a) Enter MEASUREMENT RESULTS.
b) Verify that the circuit performs to your company's requirements for the service delivered.
   If necessary, refer to Chapter 3, Section 4 for definitions of each of the measurement parameters used in these screens.
c) Use the PAGE-UP (F1) and PAGE-DN (F2) keys to access each of the measurement results pages.
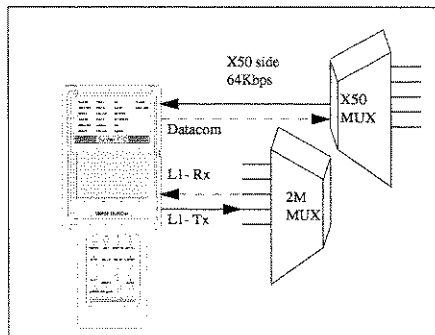
Figure 8–13   E1-MUX Mode

3.3 Test a Multiplex
(64 kbps X.50 frame to 2Mbps frame)

MUXTEST Mode tests either the 64 kbps X.50 multiplexed through the 2Mbps multiplexer, or the 64 kbps 2Mbps timeslot demultiplexed onto the 64 kbps X.50 signal.

The following procedure tests the multiplexing operation.

1) From the Main Menu, enter OTHER MEASUREMENTS, X.50 ANALYSIS, X.50 SETUP.
a) At the top line, X.50, select ENABLE (F1) to set up your X.50 frame.
b) Before continuing, make sure that the reverse video X50 message is displayed at the top of the screen.
c) Escape to the Main Menu.

3) Enter TEST CONFIGURATION. Select MUXTEST Mode
a) Configure the other settings as follows:
E1
Tx/INST : L1-Tx
Rx/DROP : L1-Rx
FRAMING: As specified by your span design
CRC-4   : As specified by your span design
RxLVL-1 : TERM
RxLVL-2 : TERM
XMTCLK : Select the clocking to be transmitted with the test
   pattern.
      •To receive timing from the multiplex choose L1-Rx (F1).
      •Set the clock to INTERN (F2), if the 2 Mbps multiplex
         receives timing from the E10's Line 1-Tx.

DATACOM
TYPE: Select the datacom interface that will provide the 64 kbps X.50 frame. Choose from either V.35 (F1), RS449 (F2), X.21 (F3), G.703 (more, F1), or RS232 (more, F2).
MODE: This is set to DCE.

MUX
E1 T/S: Select the 64 kbps timeslot to be multiplexed from the X.50 to the E1 side. Select 1—31 for PCM-31 framing, or timeslots 1—15/17—31 for PCM-30 framing.
Rx : Select the side for receiving and BER testing. Since we are

testing the multiplexing operation of the multiplex, press E1 (F1).

Tx: Select which side transmits the test pattern. Since we are testing the multiplexing operation of the multiplex, select the datacom type (F2).

NOTE: Upon selecting either the Tx or Rx setting, the other setting will automatically be changed to the other choice. For example, if you select E1 for Tx, the test set automatically sets Rx to the datacom type.

3) Connect the test set to the circuit according to Figure 8–14.
a) Press the HISTORY to acknowledge any blinking lights, and turn them off.

4) Enter OTHER MEASUREMENTS, X.50 ANALYSIS, VIEW X.50 INFO.
a) Verify the housekeeping bits.

5) Escape out to the Main Menu.
a) Enter TEST PATTERN.
b) Select a BERT or USER pattern.

6) Verify that the PAT SYNC LED is lit green.
a) Press the ERR INJ key to insert a bit error.
   You should see flashing red LEDs for both ERROR and BIT ERROR to indicate that a bit error has taken place.
   You have injected an error from the datacom port through the multiplex to the E1 side. Therefore, you have verified proper multiplexing operation.

7) If desired, you may check the de-multiplexing operation of the 2M multiplex.
a) In TEST CONFIGURATION, set Tx to E1 and set Rx to the datacom type you have selected above.
b) Press the GRAPHIC key to verify that you are transmitting out the E1 port and receiving on the datacom port.
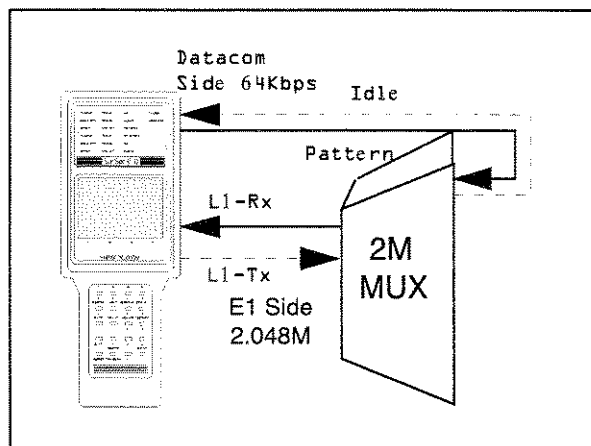
Figure 8—14   Testing a 2M MUX

8) Verify that the PAT SYNC LED is lit green.

a) Inject one bit error by pressing the ERR INJ key.
   You should see flashing red LED for BIT ERROR indicating that one bit error has occurred.

b) Press the HISTORY key to turn the blinking lights off.
   You have injected an error from the E1 side through the multiplex to the datacom port. Therefore, you have verified the proper de-multiplexing operation of the 2M multiplex.

10) If more comprehensive testing is required, you may wish to change the test patterns or other TEST CONFIGURATION settings, such as XMTCLK.

3.4 Test a 64Kbps X.50 Signal from a X.50 MUX

Datacom Mode tests a single X.50 signal being received or sent to a X.50 MUX. Use the following procedure:

1) From the Main Menu, enter OTHER MEASUREMENTS, X.50 ANALYSIS, X.50 SETUP.
a) At the top line, X.50, select ENABLE (F1) to set up your X.50 frame.
b) Before continuing, make sure that the reverse video X50 message is displayed at the top of the screen.
c) Escape to the Main Menu.

2) From the Main Menu, enter TEST CONFIGURATION.
a) Select DATACOM Test Mode.
b) Configure the other settings as shown in Figure 8–15.

```
  MEAS     X50            19:04:23


      TEST CONFIGURATION
      TEST MODE  : DATACOM

      TYPE       : RS232
      MODE       : DCE-SYN
      TEST RATE  : 64K
      TxDATA CLK : RECEIVE




INTERN    RECEIVE
```

Figure 8–15   Datacom Configuration

3) Connect the set to the circuit as shown in Figure 8–16.
a) Verify that the PAT SYNC LED is lit green.
b) Press the HISTORY key to turn off any blinking lights.
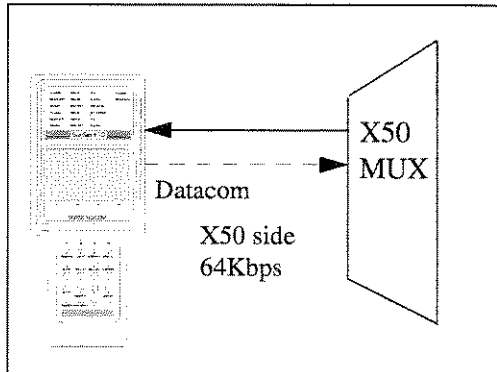
Figure 8–16   Testing 64K X.50 Signal from X.50 MUX

4) Enter OTHER MEASUREMENTS, X.50 ANALYSIS, VIEW X.50 INFO.
a) Verify the housekeeping bits.

5) Escape out to the Main Menu.
a) Enter the TEST PATTERN menu item.
b) Select a BERT or USER pattern.

6) Escape out to the Main Menu. Enter MEASUREMENT RE-SULTS.
a) Verify that the circuit performs to your company's requirements for the service delivered.
b) If necessary, refer to Chapter 3, Section 4.1.1 for definitions of each of the measurement terms used in these screens.

7) Using the ERR INJ key, inject a bit error to the other end and verify.
a) Insert a bit error from the equipment to the E10.
b) Verify that your BIT ERROR and ERROR LED s light up.
c) Verify that a Bit Error is measured in the Datacom X.50 Error screen.

Chapter 9
Datacom

Section 1 Datacom Technology Overview

1.1 Introduction

Data communication touches upon every area of our lives. Since the rapid technological development in the areas of ICs (Integrated Circuits), almost every form of communication can be transmitted digitally. Most people associate data communication with computers; however, recent applications of data communication include voice, video and image digitization.

Due to the accuracy and cost effectiveness of digitizing, it is important to understand the components and the process in a data communications network.

1.2 Communication Components

In digital computers, data is stored in individual bits. These bits can have two defined states- 1 (on) and 0 (off). On the other hand, analog logic has a range of possible states. When graphed, analog signals are sine waves, while digital signals are square. Sound, since it is always changing, is analog. Therefore, phone lines carry analog signals. In order for a computer to send its digital data over the phone line, this data must be converted into an analog signal. A modem reads the computer's digital signals and converts them into tones that can be sent over the phone line. The modem on the other end picks up these tones and turns them back into digital signals that are sent to the receiving computer.

Modulation is the process of converting the digital waveform into an analog signal suitable for phone line transmission; demodulation is the inverse, analog to digital. A Modem (as in Modulation/Demodulation) carries out these processes.

The three major components of data communication are: the terminal, the modem, and the host computer. At the terminal, analog information (meaning information from the outside world) is translated into digital format. This digital data is then transmitted to a host computer. A host computer is a large computer system which is able to run programs from several different users at the same time.

The terminal equipment is referred to as DTE (Data Terminal Equipment). The Modem is called DCE (Data Communication Equipment) and sometimes Data Set. Figure 9–1 depicts the

---

relationship between these data communication terms and your everyday equipment.
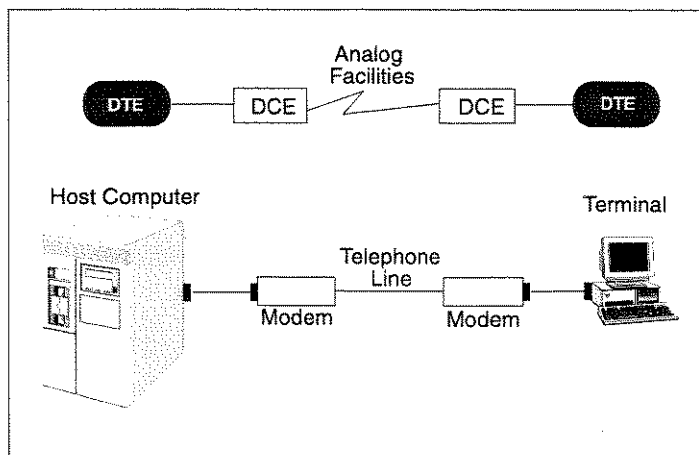
Figure 9-1 Data Communication Facilities

1.3 Transmission Basics

The communications medium is composed of a primary channel and a secondary channel. A secondary channel is not always present in modems. A channel has the capacity to transfer data in either direction; each channel actually has two signals, one for each direction. When both directions can be active simultaneously, then the channel is called full-duplex. When only one direction can be active at a time, the channel is half-duplex. The channel's capacity is equal to the number of bits per second it can carry. The secondary channel's capacity is always less than that of the primary channel.

Another associated concept is that of carrier. A carrier is a continuous sine wave signal that passes over the medium. This is the actual pipeline that allows the data to travel from DCE to DCE. The presence of carrier does not necessarily mean that there is data transfer. In order to send data from DCE to DCE, the data must be modulated.

1.4 Data Networks

Here is a brief introduction to the various options available in data networks. Circuits can differ in the following ways:
1) The direction of transmission
2) The number of devices that are connected to the network
3) The method of customer payment
4) The method of transmission

The Direction of Transmission

A simplex channel transmits data in only one direction. A half-duplex channel transmits in either direction; however, only one direction can be active at a time. A full-duplex channel can send data in both directions simultaneously.

The Number of Connected Devices

A Point-to-Point circuit connects two devices. For example, a line connecting two modems is Point-to-Point. A Point-to-Multipoint circuit can connect several different devices.

The Method of Payment

In a Switched circuit, a customer is charged for the setup, duration, and termination of the call. A normal telephone call uses a switched circuit. A dedicated, also called leased, line maintains a permanent connection between two points. The customer pays a fixed rate for this connection.

The Method of Transmission

In asynchronous transmission, data is coded into a series of pulses with a start and stop bit. A start bit is sent by the sending modem to say that it is going to send a character. It then sends the character and follows with a stop bit which states that the transfer is complete. After transmission of the character, the line can send the next character with start/stop bits or can go into an idle state (here it remains in the mark, 1, position).

In synchronous transmission, data is sent via a bit stream, which sends groups of characters in a single stream. Modems gather groups of characters into a buffer, where they are prepared to be sent in a stream. In order for this stream to be sent, the modems must be in perfect synchronization with each other. The idle time between characters is eliminated. The first bit of a character immediately follows the last bit of the previous character;

there are no start/stop bits.

1.5 Call Control Procedure

A standard call procedure is outlined in Figure 9–2 and described below. This procedure pertains to a full-duplex circuit. Since both carriers can be present simultaneously in a full-duplex circuit, it does not matter which side turns on RTS first. In Figure 9–2, the West DTE happens to be first. For half-duplex circuits, the side to transmit first must be arranged beforehand.

The West DTE sends RTS to the West DCE. **RTS**, Request To Send, tells the modem to activate its outgoing carrier. RTS results in two steps for the West DCE. It turns on the Eastbound carrier, as shown in Figure 9–2, and also sends CTS back to the West DTE. **CTS**, Clear To Send, indicates that the carrier has been turned on and so the DTE may begin to transmit its data. The East DCE senses that the Eastbound carrier from the West DCE is now present. Consequently, it sends **CAR_DET** to the East DTE. CAR_DET, Carrier Detect, means that the DCE has sensed an incoming carrier. This alerts the East DTE that it should shortly receive data from the West.

The East DTE also turns on its **RTS**. This results in the same steps as outlined above for the West. The RTS is received by the East DCE. The East DCE now activates its Westbound carrier and thus, both carriers are present. It also sends **CTS** back to East DTE. The West DCE, recognizing the incoming (Westbound carrier) turns on the **CAR_DET** to the West DTE. At this stage, both carriers are active, but no modulation or data transfer has taken place.

When the West and East DTE recognize that the CTS signal is on, they can begin to transmit data on the Transmit Data wire. When the West DTE places data on its Tx wire, the West DCE begins to modulate its carrier. The data is sent to the East DTE, where it is demodulated and sent on the Receive data wire. The East DTE receives exactly what was sent by the West DTE. A similar procedure takes place when the East DTE places data on its Tx wire. The East DCE begins modulation and sends the analog information to the West DCE. The West DCE demodulates this data and sends it to the West DTE on the Rx wire.

When the West (or East) DTE has sent all its data, it turns off its TX wire and the East DTE turns off its Rx wire. The West DTE turns off RTS. The West DCE turns off CTS and deactivates its

carrier. The East DCE senses the loss of carrier and turns off CAR_DET. When the East DTE has finished transmitting its data, the same steps are followed.
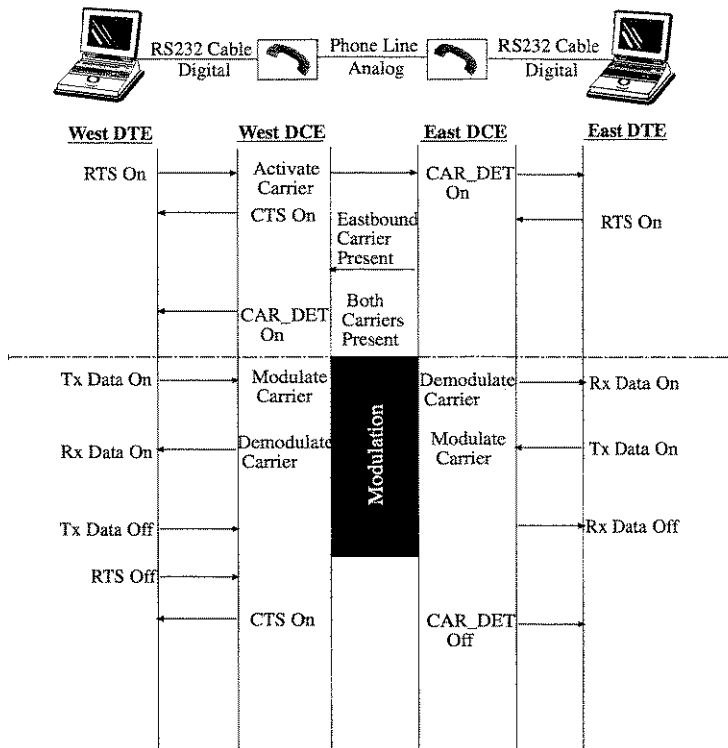
Figure 9–2 Full-Duplex Call Procedure

1.6 Physical Layer Protocol

As discussed in the ISDN Overview, the data communication process involves protocol. The OSI standard is commonly used.

At the upper layer protocol, some frequently used standards are TCP/IP, HDLC and X.25, etc. The physical level also has an extensive suite of standards available. For the physical layer functions, V.35 is the more dominant standard used internationally.

For discussion, we will use a V.35 DB-34 pin connector to illustrate the physical layer functions. Also for the purpose of

discussion, DCE and DTE are represented by a modem and a computer respectively. Figure 9–3 shows the pin assignment of a V.35 interface. Here is a brief description of each pin function:

- Pin B - Provides for grounding
- Pins P,S and R,T - The DTE transmits data on pins P,S, and receives data on pins R,T. This is reversed for the DCE.
- Pins C and D - The DTE can use RTS (Request to Send) on pin C, and receives CTS (Clear to Send) on pin D, from the DCE.
- Pins E and H - When the DCE is powered on, and is not in test mode, the DTE receives a DSR (Data Set Ready) on pin E. When terminal is ready, it transmits a DTR (Data Terminal Ready) on pin H.
- Pin F - The modem asserts DCD (Data Carrier Detect) whenever it receives a signal on the telephone line that meets its internal criteria for amount of energy at the carrier frequency.
- Pin N - Initiates a remote loopback (RL)
- Pin L - Initiates a local loopback (LL)
- Pin Y,AA - Used for the transmit clock
- Pin V,X - Used for the receive clock

V.35 DB-34 Interface

NN JJ DD Z V R L F B	PIN #	Function
○ ○ ○ ○ ○ ○ ○ ○ ○	P,S	TxD
	C	RTS
LL FF BB X T N J D	H	DTR
○ ○ ○ ○ ○ ○ ○ ○	U,W	T CLK
	R,T	RxD
MM HH CC Y U P K E A	Y,AA	TxCLK
○ ○ ○ ○ ○ ○ ○ ○ ○	E	DSR
	V,X	RxCLK
KK EE AA W S M H C	D	CTS
○ ○ ○ ○ ○ ○ ○ ○	F	DCD
	N	RL
	L	LL
	B	GND
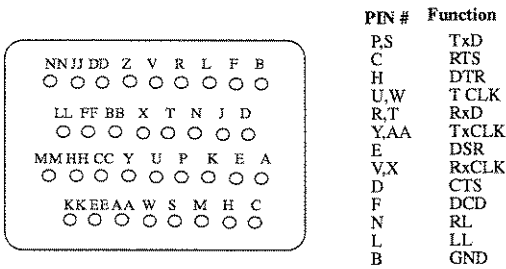
Figure 9–3   V.35 DB-34 Interface

The following pin connections are required as minimum between a DTE and DCE: P,S; R,T; Y,AA; V,X; and B.

- Pin P,S and R,T are for the DTE to transmit and receive data.
- Pin Y,AA and V,X are used for clocking purposes.
- Pin B is the signal ground between the DTE and the DCE.

Section 2 DATACOM Menus

2.1 DATACOM Mode Test Configuration

The DATACOM Test Mode provides testing using standard protocols V.35, RS449, X.21, G.703, and RS232.
- The 2.048 Mbps interfaces are ignored.
- You test only the low speed synchronous/asynchronous signal on the MULTIPORT.
- See the Graphic screen to confirm your setup.
- Figure 9–4 displays the DATACOM Configuration screen.

```
                              01:41:25



         TEST  CONFIGURATION
         TEST  MODE   :  DATACOM

         TYPE        :  RS232
         MODE        :  DCE-SYN
         TEST  RATE  :  48k
         TxDATA CLK  :  INTERN




   V.35     RS449      X.21      more
```

Figure 9–4   DATACOM Mode

The following items should be configured for the DATACOM Mode:

1) TYPE

Options: V.35 (F1), RS449 (F2), X.21 (F3), G.703 (more, F1),
RS232 (more, F2)
Type determines the electrical interface at the multiport.

• Press the F-key corresponding to the desired interface type:
RS449 (F2) is analogous to V.36
X.21 (F3) to V.11
G.703 (more, F1) to V.24

2) MODE

Options: The MODE options depend upon the specific TYPE
chosen in the slot above:
For V.35, RS449, X.21: DTE (F1), DCE (F2)
For G.703: None; Mode is forced to CO-DIR
For RS232: DTE-SYN (F1), DCE-SYN (F2), DTE-ASY (F3),
DCE-ASY (F4)

For V.35, RS449, and X.21:
• Choose DTE (F1) to emulate Data Terminal Equipment; choose
DTE to plug the test set into DCE equipment.
• Select DCE (F2) to emulate Data Circuit Equipment, and be
plugged into DTE equipment.

The same rules for selecting DTE/DCE apply to RS232's
options.
For RS232, additionally:
• Choose between a synchronous (SYN) or asynchronous (ASY)
data signal, with either DTE or DCE configuration.
For example, DTE-SYN (F1) configures the set to emulate Data
Terminal Equipment with synchronous transmission.

3) TEST RATE

Options: The TEST RATE options available to you depend upon
the MODE selected above.

For V.35, RS449, X.21, and RS232 Synchronous, the following
rates are available:

48K (F1)	NX56 (F2)	NX64 (F3)
300 (more, F1)	600 (more, F2)	1200 (more, F3)
2400 (more, F1)	4800 (more, F2)	9600 (more, F3)
14.4K (more, F1)	9.2K (more, F2)	38.4K (more, F3)

Note: For RS232 SYN, substitute 56K for (F2) and 64K for (F3).

For RS232 Asynchronous, the following rates are available:

14.4k (F1)	19.2k (F2)	38.4k (F3)
50 (more, F1)	150 (more, F2)	300 (more, F1)
600 (more, F2)	1200 (more, F3)	2400 (more, F1)
4800 (more, F2)	9600 (more, F3)	

For G.703, the test rate is automatically configured for 64K.

- Choose the desired rate for the circuit being tested by pressing the corresponding F-key for Modes V.35, RS449, X.21, and RS232.
  a) For G.703 Mode, you are given only the Nx64K option, where N=1-8.
  b) Press the Nx64 (F1) key to change the N value.

4) TxDATA CLK

Options: INTERN (F1), RECEIVE (F2).
Determines the transmit signal clock source.

Note: Clocking applies only to synchronous transmission. Thus, for RS232 asynchronous signals, this item will not appear in the menu. Additionally, X.21 DCE is forced to INTERNAL timing and DTE is forced to RECEIVED timing.

- Press INTERN (F1) to select the test set's internal clock.
  The set is the master timing source on the circuit.
- Press RECEIVE (F2) to use the signal received at the multiport as the transmit signal clock source.
  The test set is slave to the device to which it is sending signals.

The following three items apply only to asynchronous datacom transmission. They appear in the menu if RS232 Type, DCE-ASY/ DTE-ASY Mode is selected:

5) BIT/ CHAR

Options: 6 (F1), 7 (F2), 8 (F3)
Determines how many bits will be transmitted for each character of information.

---

6) STOP BITS

Options: 1 (F1), 2 (F2)

    Determines how many stop bits will be transmitted for each character of information.

• A stop bit signifies the end of a byte.

7) PARITY

Options: EVEN (F1), ODD (F2), NONE (F3)

    Determines how many parity bits are transmitted for each character of information.

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

    The receiving element checks the parity bit and indicates an error if the total number of ones does not add up to the correct total.

2.2 Datacom Interface

    When you have selected E1-MUX, MUXTEST, or DATACOM Mode in TEST CONFIGURATION, the DATACOM INTERFACE menu item appears in the Main Menu.

• Datacom testing allows the SunSet E10 to send and receive signals with another datacom communication equipment element.
• Datacom uses a standard interface in order for two equipment elements to communicate with each other. V.35 is a commonly used interface, but RS232, RS449, X.21, and G.703 may also be selected in the Test Configuration setup.

    The DATACOM INTERFACE screen displays the Mode and Type selected in Test Configuration, as well as the received signals. It also allows you to turn on/off the transmit signals. Refer

to Figure 9–5.
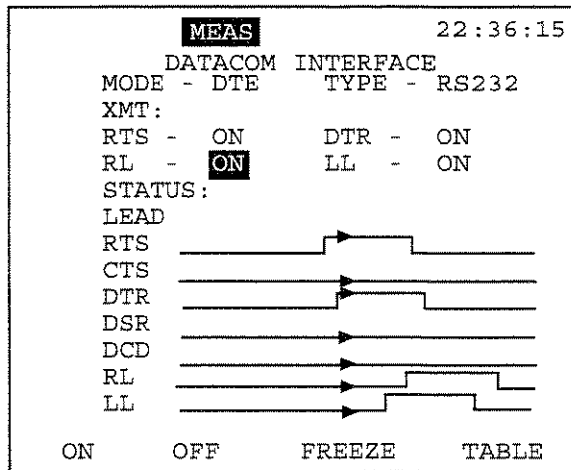
Figure 9–5 Datacom Interface Screen, Graph

•Signals available in this screen depend on the selected MODE and
   TYPE.
   For example, when the Mode is set to DTE (as in Figure 9–5),
      the test set emulates Data Terminal Equipment.

• For DCE, in V.35, RS449, and RS232, the available transmit
   signals to set are:
   CTS (Clear To Send)
   DSR (Data Set Ready)
   DCD (Data Carrier Detect)

• For DCE, in V.35, RS449, and RS232, the received signals
   available to monitor are:
   RTS (Ready To Send)
   DTR (Data Terminal Ready)
   RL (Remote Loopback)
   LL (Local Loopback)

• For V.35, RS449, and RS232, when the Mode is set to DTE, the
   test set emulates Data Terminal Equipment.
   The receive and transmit signals are reversed:
   CTS, DSR, and DCD are now the receive signals to monitor.

RTS, DTR, RL, and LL may be set for transmitting.

For X.21, the transmit and receive signals change:
• Signal C, Control, is used as the receive signal for DCE Mode and as the transmit signal for DTE Mode.
• Signal I, Indication, is the transmit signal for DCE and the receive signal for DTE.

Note: When the Test Mode is E1-MUX, the test set always emulates Data Circuit Equipment (DCE). Thus, CTS, DSR, and DCD will always be the transmit signals for E1-MUX Mode.

When the Test Mode is MUXTEST, the test set always emulates Data Terminal Equipment (DTE). Thus, RTS, DTR, RL, and LL will always be the transmit signals for MUXTEST Mode.

When G.703 Type is chosen in the Test Configuration screen, the Datacom Interface screen changes quite drastically. The screen appears as in Figure 9–6.

```
┌─────────────────────────────────────┐
│ █MEAS█                     06:56:23  │
│                                      │
│                                      │
│        DATACOM  INTERFACE            │
│                                      │
│                                      │
│        TYPE       -  G.703           │
│        MODE       -  CO-DIR          │
│        TEST RATE  -  64k             │
│        REF CLOCK  -  EXTERN          │
│                                      │
│                                      │
│                                      │
│                                      │
│                                      │
└─────────────────────────────────────┘
```
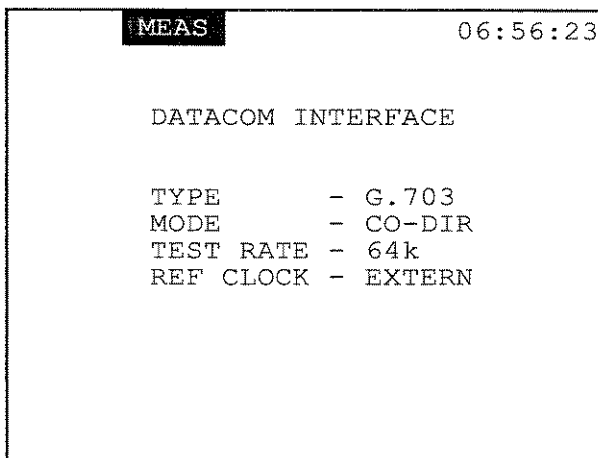
Figure 9–6   Datacom Interface (G.703)

•Only the test rate may be changed. All other items are for viewing only.

1) TEST RATE
Options: 01x64K to 08x64K

• Press the Nx64K (F1) key to select the Test Rate of your G.703
co-directional interface; 01x64K = 64K to 08x64K = 512K.

2.2.1 Datacom Timing

The timing in Datacom Analysis is often a critical issue. This
feature allows the user to change the status the control leads, and
observe the response time of the system. The user may also
observe how long each datacom lead was active, and in which
state. Refer to Figure 9-5.

a) Observe each lead, and its On/Off state; indicated by the height
of the graph line. The arrowhead on the graph line indicates when
the SunSet is capturing traces.
   • The leads available to observe depend on your TYPE and
    MODE settings.

b) You may change the status of the transmit leads:
   • The G.703 DATACOM INTERFACE does not present options
    which may be changed.
   • While in the GRAPH mode, move the cursor to the control
    leads you want to change, using the arrow keys.
   • Press the ON (F1) or OFF (F2) key to change the state.

The following F-keys are available:
• On (F1), OFF (F2): press to change the state of the highlighted
lead.
• FREEZE/RESUME (F3): press to stop or restart the reporting of
lead state data.
• TABLE/GRAPH (F4): press this key to change the presentation
of the data. See Figure 9-7 for the Table screen:

```
┌─────────────────────────────────┐
│        ▐MEAS▌          22:36:15  │
│        DATACOM  INTERFACE        │
│   MODE  -  DTE      TYPE  -  RS232│
│   XMT:                           │
│   RTS  -  ON        DTR  -  ON    │
│   RL   -  ▐ON▌      LL   -  ON    │
│   STATUS:           PAGE :   011  │
│   LEAD    STATE    TIME          │
│   RTS     ON       22:36:12.473  │
│   CTS     OFF      22:36:12.473  │
│   DTR     ON       22:36:12.473  │
│   DSR     OFF      22:36:12.473  │
│   DCD     OFF      22:36:12.473  │
│   RL      ON       22:36:12.473  │
│   LL      ON       22:36:12.473  │
│                                  │
│ ON       OFF     FREEZE    GRAPH │
└─────────────────────────────────┘
```

Figure 9–7 Datacom Interface, Table

• In the TABLE mode, you will also see the TIME the state of a lead last changed.

c) When FREEZE is selected, new F-keys appear:
  • Use the PREVIUS (F1) and NEXT (F2) keys to scroll through the pages of data.

2.3 DATACOM Measurement Results

• 2 pages of measurement results are available
• See Chapter 3.1.1 for Measurement Results Definitions

  See Figure 9–8 for screen 1 bit error results, and Figure 9–9 for screen 2 block error results.

Results definitions specific to this screen are:

DL: This is a count of the number of occurrences of Data Loss.

DLS: This is the number of seconds during which data was lost.

PATL: This is a count of the number of occurrences of PATtern

Loss.

PATLS: PATtern Loss Seconds indicates the number of seconds during which pattern was lost

SLIPS: This is a count of the number of seconds which have had bit slips.

```
┌─────────────────────────────────┐
│ ▐MEAS▌              06:45:12     │
│                                 │
│ ET - 000:04:55   RT - CONTINU   │
│ TYPE- V.35       MODE - DCE     │
│ TxHz- 48k        RxHz - 48001   │
│ RCV - 511        XMT  - 511     │
│ DL  - 0          DLS  - 0       │
│ BIT - 0          RATE - 0.0e-06 │
│ ES  - 0          %ES  - 00.000  │
│ SES - 0          %SES - 00.000  │
│ EFS - 295        %EFS - 100     │
│ AS  - 295        %AS  - 100     │
│ UAS - 0          %UAS - 00.000  │
│ DGRM- 0          SLIPS- 0       │
│ PATL- 0          PATLS- 0       │
│ PAGE-UP PAGE-DN  STOP    more   │
└─────────────────────────────────┘
```

Figure 9–8   Datacom Measurement Results, pg. 1

```
┌─────────────────────────────────┐
│ ▐MEAS▌              06:45:12     │
│                                 │
│                                 │
│ ET - 000:02:35  RT-   CONTINU   │
│ TYPE- RS232     MODE - DCE-SYN  │
│ TxHz- EXTERN    RxHz - 64k      │
│ RCV - PAT LOSS  XMT  - 511      │
│                                 │
│   BLOCK ERRROR MEASUREMENT      │
│                                 │
│ BLOCK SIZE    -  1000           │
│ # of BLOCKS   -  68688          │
│ BLOCK ERRORS  -  0              │
│ BLK ERR RATE  -  0.0e-05        │
│                                 │
│ PAGE-UP  PAGE-DN   STOP   more  │
└─────────────────────────────────┘
```

Figure 9–9   Datacom Measurement Results, pg. 2

Definitions specific to this screen are:
# of BLOCKS: This shows the total number of blocks received.

BLOCK ERROR: Block error shows the number of blocks which contain any number of bit errors.

BLK ERR RATE: The block error rate refers to the fraction of blocks in error- the number of blocks received with 1 or more bit errors (BLOCK ERROR) divided by the total number of blocks received (# of BLOCKS).

2.4 Other Measurements

2.4.1 Propagation Delay
Propagation Delay is available for measuring when V.35 is the selected type. The test set must be configured for DTE.
The Propagation Delay screen shown in Figure 9–10 displays the propagation delay on a looped back signal. The circuit must be looped back at the far end in order for the test set to perform this measurement

```
┌─────────────────────────────────────┐
│  ▐MEAS▌              01:44:02        │
│                                     │
│       PROPAGATION DELAY             │
│                                     │
│  Prop. DELAY: 44       UI           │
│             : 21       uS           │
│                                     │
│                                     │
│                                     │
│                                     │
│                                     │
│                                     │
│  Restart                            │
└─────────────────────────────────────┘
```

Figure 9–10 Propagation Delay

The test set measures the number of unit intervals required for the signal to travel down the line and then return. This number is translated into an exact number of microSeconds of round trip delay. A UI (Unit Interval) equals the amount of time it takes to transmit one bit (.488 uS for an E1 signal).
Use this procedure:

1) From the MAIN MENU, move the cursor to OTHER MEASURE-MENTS; press ENTER.

2) Move the cursor to PROPAGATION DELAY; press ENTER.

3) The propagation delay measurement will automatically be performed, then displayed.

• Use the RESTART (F1) key to perform another propagation delay measurement, if necessary.

Section 3 Datacom Interface Pin-outs

The following figures on the next pages depict all the datacom interface pin-outs. The available interfaces are:

- V.35 (ISO 2593)
- G.703 Kbps co-directional
- RS-449 (ISO 4902)
- X.21 (ISO 4903)
- RS-232 (ISO 2110)
- RS-530 (ISO 2110)

CONNECTOR HDI-30

Pins 2 and 30 of HDI-30 are connected to pins 2 and 30 of DB-37

CONNECTOR DB-37

CONNECTOR DB-37

CONNECTOR ISO 2593 34-PIN

Connection between pins V . 3 5   D C E

HDI-30		ISO 2593 (DS-34)	
PIN#	FUNCTION	FUNCTION	PIN#
2,30	RxD	RxD	R,T
4	CTS	CTS	D
6	DSR	DSR	E
7,8	TxCLK	TxCLK	AA,Y
9,10	RxCLK	RxCLK	X,V
12	DCD	DCD	F
13,14	TxD	TxD	S,P
17,18	TCLK	TCLK	W,U
16	DTR	DTR	H
22	RTS	RTS	C
27	RL	RL	N
26	LL	LL	L
29	GND	GND	B

Connection between pins V . 3 5   D T E

HDI-30		ISO 2593 (DB-34)	
PIN#	FUNCTION	FUNCTION	PIN#
2,30	TxD	TxD	P,S
4	RTS	RTS	C
6	DTR	DTR	H
7,8	TCLK	TCLK	U,W
13,14	RxD	RxD	R,T
17,18	TxCLK	TxCLK	Y,AA
16	DSR	DSR	E
19,20	RxCLK	RxCLK	V,X
22	CTS	CTS	D
24	DCD	DCD	F
25	RL	RL	N
26	LL	LL	L
29	GND	GND	B

Figure 9–11   V.35 Pin-out Diagram

V.35 is ITU's specification for a balanced interface. It is typically implemented on a 34-pin block-type connector.

CONNECTOR DB-37   CONNECTOR DB-25
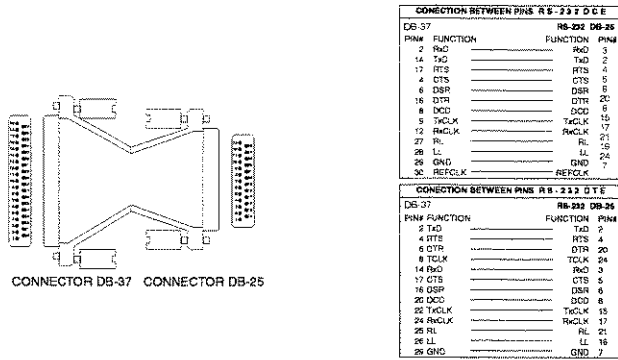
Figure 9–12   RS-232 Pin-outs

RS232 is an EIA recommended standard which is functionally identical to ITU's V.24. It specifies a 25-pin connector, where 20 pins are used for routine operation. Three pins (11, 18, & 25) are unassigned and two pins (9 & 10) are used for modem testing.
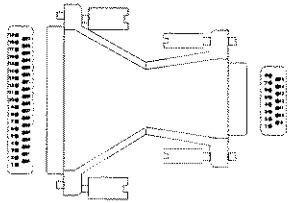
CONNECTOR DB-37   CONNECTOR DB-15

Connections Between Pins X.21 DCE		Connections Between Pins X.21 DTE	
DB-37 Pin #	X.21 DB-15 Pin #	DB-37 Pin #	X.21 DB-15 Pin #
14	2	2	2"
13	9	30	9
2	4	14	4
30	11	13	11
18	3	4	3
17	10	3	20
4	5"	18	5
3	12"	17	12
6	6	16	6
5	13	15	13
29	8	29	8

Figure 9–13   X.21 Pin-outs

X.21 is a general recommendation by ITU for synchronous opera-
tion on public data networks. It has a 15-pin connector. The signals
may be used as either balanced or unbalanced circuits.

DATACOM Cable
Provides HDI-30 to DB-37r interface
direct one-to-one connection

CONECTOR DB-37

CONECTOR DB-3

G.703 Pin Assignments				
HDI-30		**Dual DB-3**		
PIN#	FUNCTION	FUNCTION	PIN#	
25	TxTIP	TxTIP	1	Plug 1
26	TxRIN	TxRIN	2	Plug 1
27	RxTIP	RxTIP	1	Plug 2
28	RxRIN	RxRIN	2	Plug 2
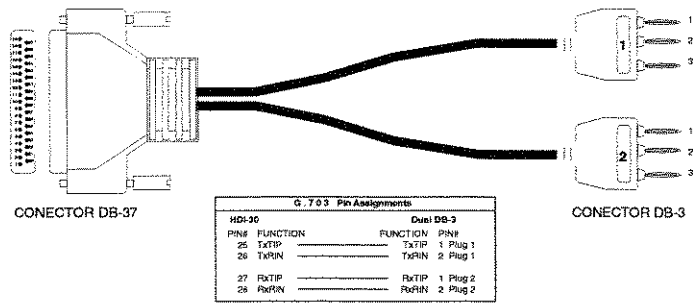
Figure 9–14
G.703 Pin-outs

G.703 is the co-directional interface. It uses a different coding than the other standards, allowing for the use of less bandwidth.

CONNECTOR DB-37   CONNECTOR DB-37

CONNECTION BETWEEN PINS RS-449 DCE				CONNECTION BETWEEN PINS RS-449 DTE		
HDI-30		**RS-449 DB-37**		**HDI-30**		**RS-449 DB-37**
PIN#	FUNCTION	FUNCTION PIN#		PIN#	FUNCTION	FUNCTION PIN#
2,30	RxD	RxD 24,6		2,30	TxD	TxD 4,22
3,4	CTS	CTS 27,9		3,4	RTS	RTS 25,7
5,6	DSR	DSR 29,11		5,6	DTR	DTR 30,12
7,8	DCD	DCD 31,13		7,8	T CLK	T CLK 35,17
9,10	RxCLK	RxCLK 26,8		13,14	RxD	RxD 24,6
11,12	TxCLK	TxCLK 23,5		15,16	DSR	DSR 29,11
13,14	TxD	TxD 22,4		17,18	CTS	CTS 27,9
15,16	RTS	RTS 25,7		19,20	DCD	DCD 31,13
17,18	DTR	DTR 30,12		21,22	TxCLK	TxCLK 23,5
19,20	T CLK	T CLK 35,17		23,24	RxCLK	RxCLK 26,8
27	RL	RL 14		25	RL	RL 14
28	LL	LL 10		26	LL	LL 10
29	GND	GND 19		29	GND	GND 19

Figure 9–15 RS-449 Pin-outs

RS449 is an EIA specification describing the signals that make up the DTE-DCE connection. It has a 9-pin connector used for the secondary channel and a 37-pin connector used for everything else. If a modem does not have a secondary channel, this 9-pin connector is not present.

RS530/EIA530 revised
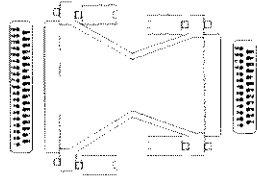
CONNECTOR DB-37   CONNECTOR DB-25

CONNECTIONS BETWEEN PINS R S - 5 3 0 D C E			
HDI-30		**RS-530 DB-25**	
PIN# FUNCTION		FUNCTION	PIN#
2,30	RxD	RxD	3,16
3,4	CTS	CTS	5,13
5,6	DSR	DSR	6,22
7,8	DCD	DCD	8,10
9,10	RxCLK	RxCLK	17,9
11,12	TxCLK	TxCLK	15,12
13,14	TxD	TxD	2,14
15,16	RTS	RTS	4,19
17,18	DTR	DTR	20,23
19,20	T CLK	T CLK	24,11
27	RL	RL	21
28	LL	LL	18
29	GND	GND	7

CONNECTIONS BETWEEN PINS R S - 5 3 0 D T E			
HDI-30		**RS-530 DB-25**	
PIN#	FUNCTION	FUNCTION	PIN#
2,30	TxD	TxD	2,14
3,4	RTS	RTS	4,19
5,6	DTR	DTR	20,23
7,8	T CLK	T CLK	24,11
13,14	RxD	RxD	3,16
15,16	DSR	DSR	6,22
17,18	CTS	CTS	5,13
19,20	DCD	DCD	8,10
21,22	TxCLK	TxCLK	15,12
23,24	RxCLK	RxCLK	17,9
25	RL	RL	21
26	LL	LL	18
29	GND	GND	7

Figure 9–16   RS530 Pin-outs Diagram

RS530 was derived from the RS449 standard. It uses 25 pins rather than 37.

Section 4   Applications

4.1 Point-to-Point Datacom Testing

Data communication uses a standard interface in order for two equipment elements to communicate with each other. For example, V.35 is a commonly used interface.

In this test, we will use the V.35 as the data communication interface.

• Use the SunSet E10 to send and receive the signals with another data communication equipment.

Connect the SunSet and the test equipment as shown in Figure 9–17.

Use the following procedure:

1) Verify that the datacom circuit is not in service. This test will disrupt the service.

2) From the MAIN MENU, enter the TEST CONFIGURATION.

3) Configure the interface as follows:

- TEST MODE   : DATACOM
- TYPE   : V.35
- MODE   : DTE
- TEST RATE   : as specified by the span design
- TxDATA CLK   : RECEIVE

Note:
If the test set must supply the clock then select INTERN for TxDATA CLK. If the test set should follow timing from the network select RECEIVE.

4) Connect the SunSet E10s to the circuit as shown in Figure 9–17.

5) Press ENTER to return to the MAIN MENU.
a) Select DATACOM INTERFACE and press ENTER.
   The DATACOM INTERFACE menu is displayed.
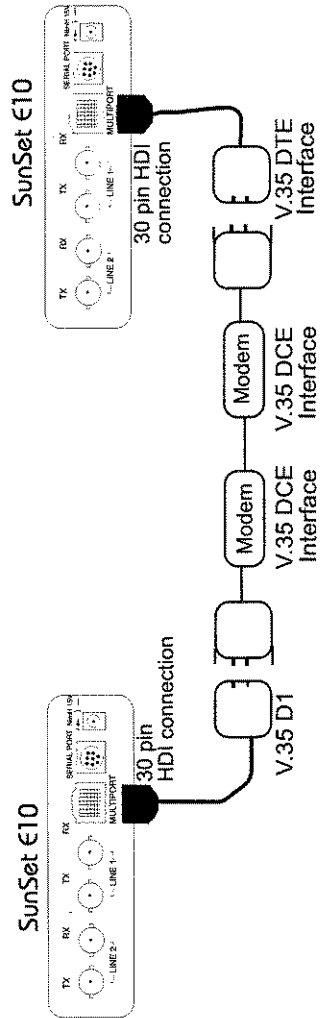
Figure 9–17 V.35 Datacom Test

6) Examine the receive information. The terms are defined as follows:

    - CTS   : Clear to Send
    - DSR   : Data Set Ready
    - DCD   : Data Carrier Detect

7) On the transmit side, turn the following signals ON or OFF, to test whether the other data communication equipment is receiving the SunSet's signal. The moving arrow will go up to indicate a lead is active, or down to indicate it is inactive:

    - RTS   : Ready to Send
    - DTR   : Data Terminal Ready
    - RL   : Remote Loopback
    - LL   : Local Loopback

8) Escape to MAIN MENU, cursor down to MEASUREMENT RESULTS, press ENTER. One can extract all the measurement information.

4.2 Testing the Datacom Port of a 2M Multiplex

• Test the low speed datacom port of a 2M multiplex using the E10 in DATACOM mode.

1) Turn your SunSet E10 on using the red POWER key located on the bottom left of the keypad.

2) From the Main Menu, enter TEST CONFIGURATION. Select DATACOM Test Mode. Configure the other settings as follows:

    TYPE: Select whichever datacom interface type you are using
    MODE: DTE
    TEST RATE: as desired
    TxDATACLK: RECEIVE

3) When your settings are correct, press ENTER.

4) Connect the test set to the circuit as shown in Figure 9–18.
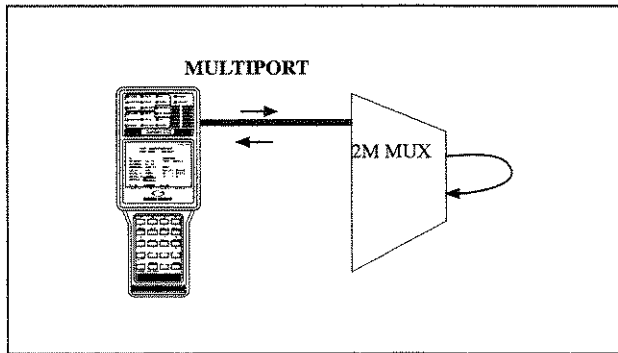
**Figure 9–18 Testing the Datacom Port of a
2M Multiplex**

• Verify the PAT SYNC LED is lit green.
• Press the HISTORY key to acknowledge any blinking lights and
  turn them off.

5) From the Main Menu, enter DATACOM INTERFACE.
a) Check the status of the control leads. CTS, DSR and DCD should
   be active.

6) Inject an error from the test set using the ERR INJ key.

• You can verify that this error returns to the test set by seeing if the
  BIT ERROR LED lights red.
• You may also want to enter MEASUREMENT RESULTS (from the
  MAIN MENU) and make sure that an error has been recorded.

7) You have just checked the low-speed datacom port of the 2M
   multiplex.

Chapter 10
Technology Overview

Section 1 E1 Technology Overview

1.1 Introduction

E1 Technology Overview covers the fundamental concepts in 2.048 Mbps technology: sampling a signal, converting this information into a bitstream, and dividing the bitstream into segments (channels). This section also touches upon the basics of signalling technologies like MFR2 and CAS.

1.2 Technical Standards

E1 transmission technology is defined by a number of technology standards. Such standards allow equipment designers and service providers to ensure that various pieces of equipment are compatible and that networks operate in a predictable, reliable manner.

The following standards cover many of the important aspects of E1 transmission technology:

- ITU G.703 Physical/electrical characteristics of interfaces
- ITU G.704 Synchronous frame structures
- ITU G.706 Frame alignment and CRC
- ITU G.821 Error performance of an international connection
- ITU G.826
- ITU M.550/M.2100 Bringing an international connection into service
- Q.140
- Q.400

Consult these standards when you need detailed information on particular aspects of E1 transmission technology.

1.3 Basic Definitions

Binary Data:
A signal which has been converted into a format of 0s and 1s.

Bit Stream:
Binary Data which has been placed in a sequence at a fixed rate.

Channel:

A single portion of the bit stream which is available for bidirectional communication.

1.4 Converting a Voice Signal

To transmit voice in a digital medium, such as a 2.048 Mbps line, we first need to encode the analog voice signal in a binary format. Then we must convert it to a bit stream suitable for digital transmission.

This conversion can be achieved through Pulse Code Modulation. Refer to Figure 10–1.
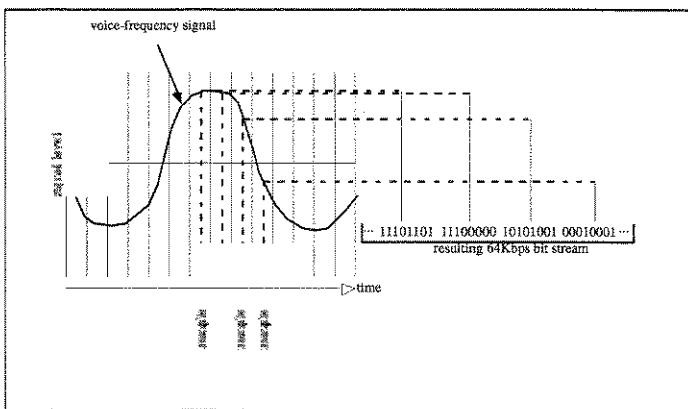
Figure 10–1   Converting a Voice Signal

The Nyquist theorem requires that the signal be sampled at twice the signal's maximum frequency in order for the signal to be reproduced without a loss of information. For voice signals, the maximum frequency is approximately 4000 Hz. This provides adequate clarity while conserving transmission bandwidth. Thus, we must sample our 4000 Hz voice signal at a frequency of 8000 Hz (8000 samples/second).

The amplitude of the analog voice signal is sampled 8000 times per second. Each amplitude value is expressed as an 8-bit code "word". These 8-bit words occurring 8000 times per second form

a 64 Kbps digital bit stream.

The 8-bit code word is formed by comparing the amplitude of the analog sample to a "companding characteristic." The companding characteristic is a formula which translates the amplitudes of the samples into the 8-bit code words. Internationally, a companding characteristic known as "A-law" is used. The purpose of A-law is to provide optimum signal to noise performance over a wide ranger of transmission levels. Linear encoding provides a poorer signal to noise ratio at the -20 dB level typical of speech. In North America, the encoding is done according to the Mu-Law. Therefore, the companding law used for encoding the voice signal must match that for decoding, for distortion-free transmission.

1.5 2.048 Mbps Data Rate

The E1 signal (bitstream) is transmitted at a rate of 2.048 Mbps (2 048 000 bits per second). This transmission rate is achieved by combining 32 individual 64 kbps bitstreams:

64 (kbps/Channel)
x 32 (Channels) = 2048 kbps = 2.048 Mbps

This 2.048 Mbps signal is the overall E1 transmission rate.

1.6 Line Coding

Two common types of line coding are defined for use in a E1 network: AMI or HDB3.

AMI
This is the simplest of the two line coding formats. AMI stands for Alternate Mark Inversion, and is used to represent successive 1 values in a bitstream with alternating positive and negative pulses. Figure 10–2 depicts these alternating pulses. AMI is not used in most 2.048 Mbps transmission because synchronization loss occurs during long strings of data zeros.
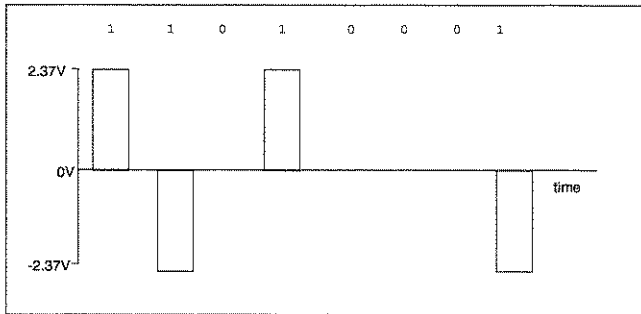
Figure 10–2　AMI Line Coding

HDB3
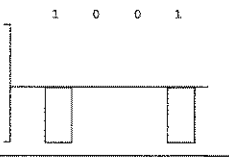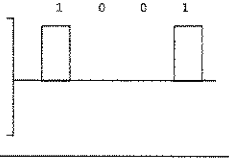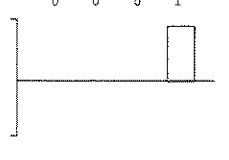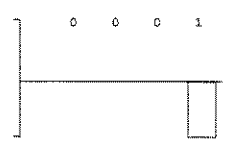
The HDB3 line coding format was adopted in order to eliminate these synchronization problems occurring with AMI.

In the HDB3 format, a string of four consecutive zeros is replaced with a substitute string of pulses containing an intentional bipolar violation. As the far end equipment receives the E1 signal, it examines the bit stream for these intentional bipolar code violations. It will then extract the code and reconstruct the original data. The HDB3 code substitutions provide high pulse density so that the receiving equipment is always able to maintain synchronization with the received signal. For example, in the code `1000 0000`, HDB3 coding substitutes bipolar violations for the string of zeroes. Figure 10–3 portrays the HDB3 format.
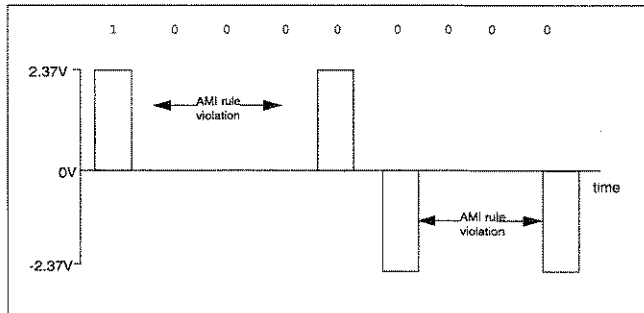
Figure 10–3   HDB3 Line Coding

General rules apply to the substitutions. The particular substitution made is governed by the polarity of the last inserted bit, as well as the number of pulses following the previous violation bit. If there is an odd number of pulses, 000V is substituted; the polarity of V is the same as that of the bit immediately preceding it. If there is an even number of pulses, B00V is inserted; the polarity of B is opposite to that of the bit immediately preceding it and the polarity of V is the same as that of B. Refer to Figure 10–4 to see the types of HDB3 zero substitution codes.

Figure 10–4 HDB3 Encoding

The SunSet E10 is configured to detect the two types of HDB3 substitution codes, even if they are not matched to the proper number of pulses since the last substitution.

1.7 Signal Levels

Once a signal has been encoded into a binary format and assembled into a bit stream, the pulses in the bit stream are then converted to actual voltage levels suitable for E1 transmission.

Referring to Figures 10–1 and 10–2, we see that a typical signal level for an E1 pulse with 75 ohm impedance is either +/- 2.37 volts (for a binary "1" value) or 0 volts (for a binary "0" value). Real-world signal values would typically be +/- 10%.

Ideally, each pulse transmitted would be perfectly symmetrical. However, in a real-world situation, each pulse becomes slightly distorted when it is generated and when it travels down the E1 line. Refer to Figure 10–5 for the shape of an "ideal" pulse vs. an actual pulse that would be encountered on an E1 line.

An E1 pulse may be required to conform to a standardized pulse shape. This is often determined by comparing it to a specified "mask". A common pulse mask is given by the ITU-T G.703 recommendation.

Note: For an E1 pulse with 120 ohm impedance, the signal level is either +/- 3 volts (for a binary "1" value) or 0 volts (for a binary "0" value) with real world values typically be +/- 10%.
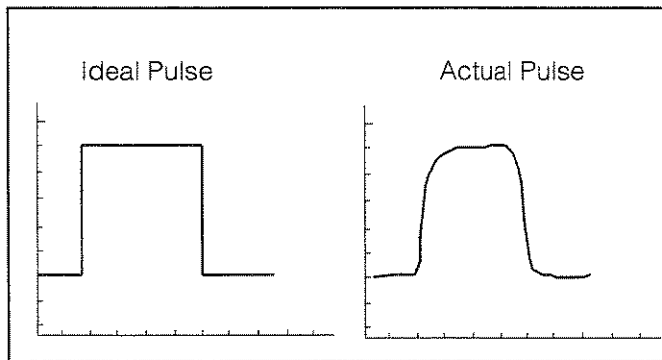
Figure 10–5 Pulse Shape

1.8 2.048 Mbps Framing

E1 transmission utilizes two main types of framing: Frame Alignment Signal (FAS) and MultiFrame Alignment Signal (MFAS). Framing is necessary so that the equipment receiving the E1 signal is able to identify and extract the individual channels. PCM-31 uses FAS framing and PCM-30 uses MFAS framing with FAS framing.

Frame Alignment Signal (FAS)

The 2.048 Mbps frame consists of 32 individual time slots (numbered 0-31). As described previously, each time slot consists of an individual 64 kbps channel of data. PCM-31 uses FAS.

In the FAS format, time slot 0 of every other frame is reserved for the frame alignment signal (FAS) pattern. Alternate frames contain the FAS Distant Alarm indication bit and other bits reserved for National and International use. Hence, there are 31 time slots into which we can place data. Refer to Figure 10–6, FAS Framing Format.

The FAS format does not accommodate voice channel signal-

ling.

The first bit (c or Si) of these frames is reserved for international use. It can be used for the CRC-4, Cyclic Redundancy Check-4, when enhanced performance monitoring is required. Therefore, when CRC is enabled in the TEST CONFIGURATION screen, these bits depend upon the CRC calculation and should continually change between 0 and 1. When CRC-4 is not enabled, these bits are set to 1.

In FAS framing, the odd frames do not contain the frame alignment signal. The bits are defined as follows:

i: When CRC is enabled, bit 1 is used for the Cyclic Redundancy Check-4 performance monitoring. When CRC is enabled, this bit may not be changed here. It may be changed when CRC is disabled.

1: The second bit is always set to 1 to avoid FAS signal simulations.

A: Bit A is used for the Remote (FAS) Distant Alarm. Set this bit to 1 to indicate an alarm condition. For undisturbed operation, this bit is set to 0.

a (bits 4-8): Spare bits; they should be set to 1 for crossing an international border, when not in use, as defined by ITU-T G.704.

The first bits of frames 13 and 15 transmit the two E-bits, which are CRC-4 error indication bits. A zero in this bit denotes received errored sub-multiframes; a one represents received frames free of errors.

```
                    ONE 2.048 MBPS FRAME

            TIME SLOT 0 | 1 |  ...  | 31

                         BITS

Even Frame:
Contains Frame Alignment    1 | 2 | 3 | 4 | 5 | 6 | 7 | 8
  Signal (FAS)
                            E | 0 | 0 | 1 | 1 | 0 | 1 | 1

Odd Frame:
Does Not Contain Frame      E | 1 | A | Sa| Sa| Sa| Sa| Sa
  Alignment Signal (NFAS)
```

Sa= Bit Reserved for National use

E= Error Indication Bit

A=Remote Alarm (FAS Remote Alarm Indication)

Frame Alignment Signal = 0011011

8 bits per timeslot x 8000 frames per second

= 2.048 Mbps transmission rate
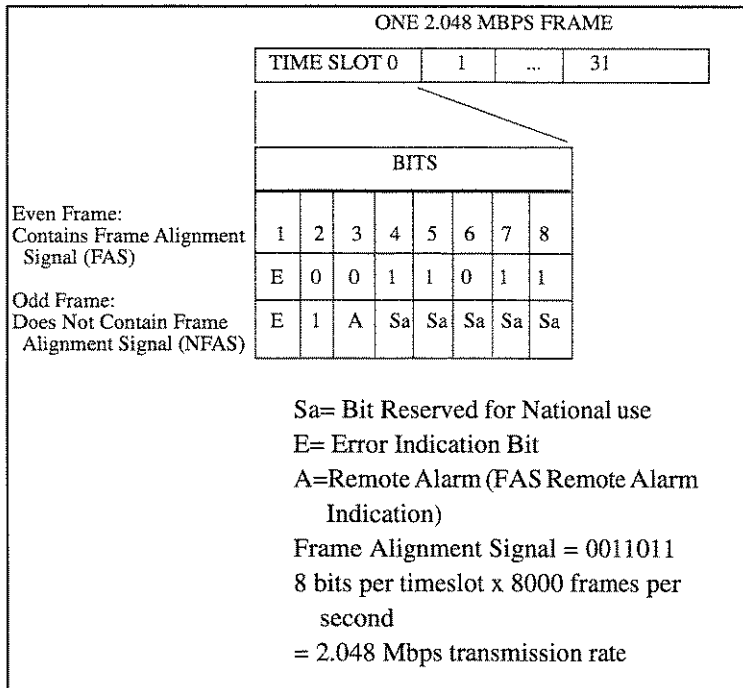
Figure 10–6   FAS Framing Format

MultiFrame Alignment Signal (MFAS)

MFAS framing provides Channel-Associated Signalling (CAS) to transmit A/B/C/D bit supervision information for each channel. This method uses the 32 timeslot frame format including timeslot 0 for the FAS. This method also uses timeslot 16 for the MultiFrame Alignment signal and the Channel Associated Signalling. It takes 16 frames to make up a MultiFrame.

When we transmit the MFAS frame, we leave all of our individual FAS frames and framing information intact. We merely assemble 16 FAS frames together, dedicate timeslot 16 of the first frame to our MFAS framing information, then dedicate timeslot 16 of the remaining 15 frames to our A/B/C/D bits. Refer to Figure 10–7.

Frame 0, timeslot 16: 8-bit MFAS signal

Frames 1-15, timeslot 16: (4 signalling bits/channel) x (30 channels) / (8 signalling bits/frame timeslot 16) = 15 frames of timeslot 16 signalling

Frame 0 TS16 bits: MFAS=0000XYXX
    X= spare bits (=1, if not used)
    Y= MFAS remote alarm (=1, if MFAS synchronization is lost)

Note:
1) Frames are transmitted with 30 voice channels on time slots 1-15 and 17-31.
2) Timeslot 16 (TS16) contains A/B/C/D bits for signaling (CASS).
3) MFAS framing still includes the original FAS frames and the FAS framing information.
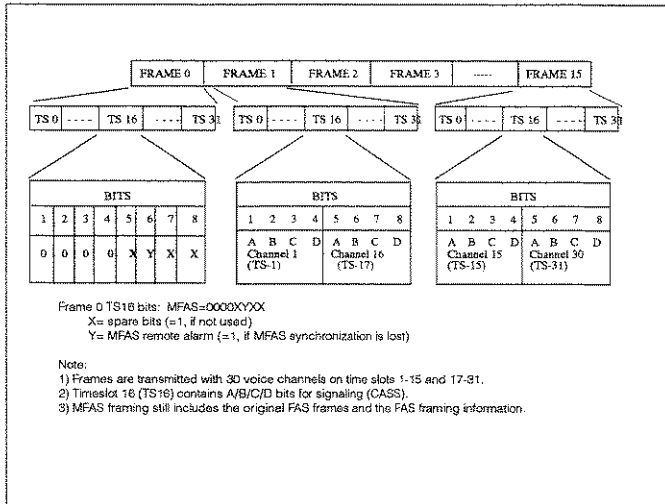
Figure 10–7   MFAS Framing Format

CRC-4 Error Checking in a MultiFrame Format

A Cyclic Redundancy Check-4 (CRC-4) is often used in E1 transmission to identify possible bit errors. CRC-4 allows us to detect errors within the 2.048 Mbps signal while it is in service.

CRC-4 is based on a simple mathematical calculation performed on each submultiframe of data. The equipment which originates the E1 data calculates the CRC-4 bits for one submultiframe. Then it inserts the CRC-4 bits in the CRC-4 positions in the next submultiframe. The receiving equipment then performs the reverse mathematical computation on the submultiframe. It examines the CRC-4 bits which were transmitted in the next submultiframe, then it compares the transmitted CRC-4 bits to the calculated value. If there is a discrepancy in the two values, a CRC-4 error is reported.

There are two things to remember when using CRC-4 errors to determine the performance of an E1 circuit. Each individual CRC-4 error does not necessarily correspond to a *single* bit error. Multiple bit errors within the same submultiframe will lead to only one CRC-4 error for the block. Also, it is possible that errors could occur such that the new CRC-4 bits are calculated to be the same as the original CRC-4 bits.

CRC-4 error checking provides a convenient method of identifying bit errors within an in-service system. On an in-service system, it is generally not possible to measure the actual bit errors because there is no pattern synch. Bit error measurement is used on an out-of-service system because the results are slightly more precise.

CRC-4 also uses a multiframe structure consisting of 16 frames, as shown in Figure 10–8. However, the CRC-4 multiframe is not necessarily aligned with the MFAS multiframe. Each CRC-4 multiframe can be divided into 2 sub multiframes (SMF). These are labeled SMF#1 and SMF#2 and consist of 8 frames apiece. We associate 4 bits of CRC information with each submultiframe.

The CRC-4 bits are calculated for each submultiframe, buffered, and inserted into the following submultiframe to be transmitted across the E1 span.

When the terminating equipment calculates an error using CRC-4, it should transmit an E-bit to the far end, thus informing the far end equipment of the error.

Multiframe	Sub-Multiframe	Frame#	bit1	bit2	bit3	bit4	bit5	bit6	bit7	bit8
						TIME SLOT 0				
						Bits				
	SMF #1	0	c1	0	0	1	1	0	1	1
		1	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		2	c2	0	0	1	1	0	1	1
		3	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		4	c3	0	0	1	1	0	1	1
		5	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		6	c4	0	0	1	1	0	1	1
		7	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	SMF #2	8	c1	0	0	1	1	0	1	1
		9	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		10	c2	0	0	1	1	0	1	1
		11	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		12	c3	0	0	1	1	0	1	1
		13	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		14	c4	0	0	1	1	0	1	1
		15	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8

Figure 10–8   CRC-4 Multiframe Format

E-bit Performance Monitoring

When the terminal equipment of a 2.048 circuit is optioned for CRC-4 transmission, E-bit transmission may also be enabled. E-bit performance monitoring of the circuit is now possible. The terminating equipment transmits an E-bit error on the 2.048 Mbps line, when it receives a CRC-4 error. However, E-bit error transmission is a relatively new feature in 2.048 transmission. Therefore, it is likely that the embedded equipment does not transmit the E-bit error information correctly. You should check the specifications of your network. Refer to Figure 10-9.
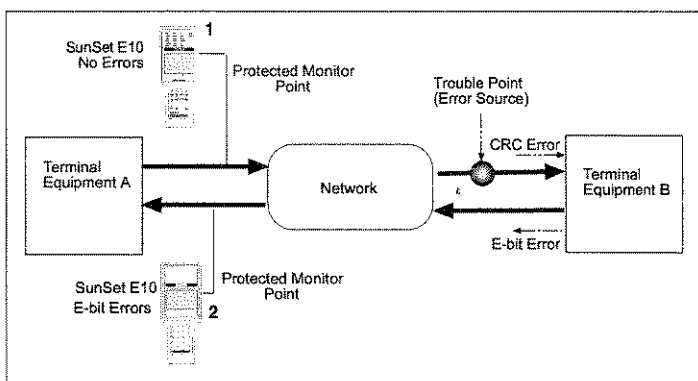
**Figure 10-9   E-bit Performance Monitoring,
In-service Circuit**

When this type of terminal equipment detects an incoming CRC-4 error, it will respond by transmitting an E-bit error toward the other terminal. Test set 2, shown in Figure 10-9, will be able to see the E-bit errors by plugging into a protected monitoring point. Note that the test set can not see the actual code errors, framing bit errors and CRC errors introduced at the trouble point. The test set can see only the E-bit errors transmitted by Terminal B. Thus, E-bit error transmission allows a 2.048 Mbps in-service circuit to be reliably monitored for transmission performance from any point on the circuit.

Without E-bit error transmission, only a complete circuit failure can be reliably determined at any point on the circuit. With a complete circuit failure, the test set will see either loss of signal, alarm indication signal, or remote alarm indication.

1.9 MFR2/DTMF/DP Technology

There are a number of signalling methods used by public telephone networks. The methods are divided between the local loop and interoffice signalling. Referring to Figure 10–10, the signalling applied for each environment is as follows:

LOCAL LOOP:
• Pulse
• DTMF (Dual Tone Multi-Frequency)
• ISDN (Integrated Services Digital Network)

INTEROFFICE:
• MFR2 (Multi-Frequency)
• MFC (Multi-Frequency Compelled)
• SS#7 (Signalling System #7)
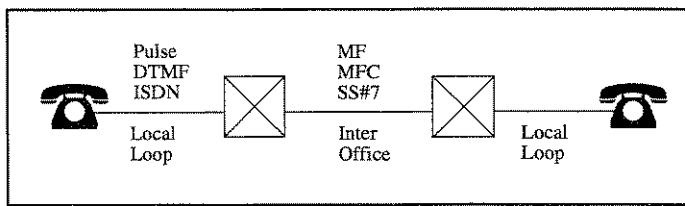
Figure 10–10
Local Loop and Interoffice Signalling Methods

Local Loop

In the local loop environment, a common signalling method is DTMF. It uses two tones, a high and a low, to represent a digit. The frequency chart is indicated in Figure 10–11.

Figure 10–11 DTMF Frequency Key Pad

For example, if the number 5 button is pressed, frequencies of 1336 Hz and 770 Hz are generated. DTMF registers, converters, or receivers then recognize these tones as representing the digit 5 and translate them into digital signals.

Pulse signalling is an older technology than DTMF, and was originally used for rotary phone sets. When a number is dialled, a series of short IDLE/SEIZURE signals are created with specific timing, usually 10 pulses per second. If a number 3 is dialled, the wheel will send 3 IDLE/SEIZURE signals with a specific inter-digit timing between the digits. The switch will interpret the number of IDLE/SEIZURE signals, and the inter-digit duration to determine the digit that has been dialled.

B-bit dialing is used to toggle the B-bit when seizing the line. In the seizure state, the B supervision bit is toggled (ABCD ˆ ABCD). If the number 463 is dialled, the B bit will flash 4 times, then rest for approximately one second, toggle six times, rest again, and toggle 3 times.

ISDN provides digital services to end users with regular phone lines.

Interoffice Signalling

MFR2 is a common signalling method used in the interoffice environment. Similar to DTMF, MFR2 uses two tones for each digit being dialled. However, these tones are selected from a group of only six frequencies. A and B bit signalling is used to seize and acknowledge the line. The references can be found in the following standards tables:

• ITU Q.441 Tables 5 to 9

MFC (Multi Frequency Compelled) dialling allows the two exchanges to send digits to each other in both the forward and backward direction. This helps ensure accurate transmission of the digits in a noisy environment.

The SS#7 signalling method is described in Chapter 5.

Chapter 11
Troubleshooting

SunSet E10   Version 2.37

Section 1 Troubleshooting

Occasionally, your SunSet E10 may not operate as expected.

Here is a general troubleshooting procedure:
a) Check the manual for instructions on how to perform the desired procedure.
b) Verify that the Test Configuration is set up properly.
c) Check that cords are connected properly to the right jacks.
d) If the set still does not behave as expected, try turning the power off, then on.
e) If the set still does not behave properly, try an NVRAM erase in SYSTEM PARAMETERS.
   Note: This will erase all user programmed information.
   Turn the power off for 5 seconds, then turn it back on.

Here are some helpful suggestions for specific problems that might occur.

Problem: CODE light, frame loss light, and other error lights are on, but there should be no problem.
Suggestion:
1) TEST CONFIGURATION MODE may be wrong. Try, TERM, BRIDGE, MONITOR.
2) Check the cords—they may be loose or dirty.
3) Try reversing the Tx and Rx cords.

Problem: CODE ERR LED is lit continuously for no apparent reason
Suggestion:
1) The Line Code might accidentally be set to AMI, even though the received code is HDB3. Try pressing the AUTO key to automatically reconfigure the line code.
2) You may manually configure the line code in OTHER FEATURES, MEAS CONFIGURATION 1, CODE CONFIGUR.

Problem: Keys do not work properly.
Suggestion:
1) Verify shift status by pressing and releasing the SHIFT-lock key. Press and release the SHIFT-lock key until the SHIFT status indicator in the upper left hand side of the screen achieves the desired condition.

2) Do not press SHIFT-lock key simultaneously with another key.
3) Press the key again. The set may not have registered it the first time.

Problem: Test set will not power up properly.

Suggestion:
1) Make sure the battery is charged or the charger is plugged in.
2) Make sure the software cartridge is inserted firmly and seated correctly.

Problem: SunSet shows Security Violation when switched on.

Suggestion:
1) Make sure the serial number of the software cartridge matches the serial number of the SunSet.

Problem: Set performs improperly.

Suggestion:
1) Try switching the set off, then switching it on again.
2) Try the ERASE NV RAM. menu option. NOTE: this will erase all user-programmed information and history buffers within the SunSet. When the ERASE NV RAM has completed, switch off the SunSet for 5 seconds, then switch it on.

Problem: Measurements are not working properly (Loss of Signal, no Pattern Synch).

Suggestion:
1) Verify signal INTERFACE and MODE settings in the TEST CONFIGURATION menu.
2) Verify that all jacks are connected properly, according to the circuit graphic.
3) Ensure that Tx is plugged to Rx and vice-versa.
4) Twist the plugs inside of the jacks and ensure that all plugs are inserted fully.

Problem: Test Patterns will not synch.

Suggestions:
1) Press AUTO to force the SunSet to resynchronize on the Pattern, Framing type, and line Coding type.
2) Verify that desired pattern is being sent in the SEND TEST PATTERN menu.

Problem: Test patterns will not synch with another test set.
Suggestions:
1) Verify that PATTERN INVERSION is DISABLED in the OTHER
   FEATURES, OTHER PARAMETERS menu.
2) Use VIEW RECEIVED DATA to examine the pattern being
   received.

If you are still having difficulty, contact your distributor directly
or contact Sunrise Telecom at Tel: 1 800 701 5208 (24 hours), or
Fax: 1 408 363 8313.

Section 2 Calibration

2.1 Calibration Procedure

The SunSet E10 calibrates itself every time a full self test is
performed. This auto calibration should take care of all the adjust-
ment that the set will need during normal circumstances. However,
once per year the set may also be given this calibration test
procedure. If the test set fails any part of this procedure, then you
should contact Sunrise Telecom Customer Service or your national
distributor for further advice about possible repairs.

1) Connect a cable from LINE 1 Tx to LINE 1 Rx.
a) Turn on the set and go to SYSTEM PARAMETERS, FULL SELF
   TEST.
b) Check that all LED's (except POWER and LOW BATT) function
   correctly. They should turn green first and then red during the
   self test.
c) Verify that no error codes are displayed on the SELF TEST
   COMPLETE screen.
d) Verify that no error codes are displayed in the upper left hand
   corner of the screen during power-up.
e) Perform ERASE NV RAM. Turn the power off for 5 seconds and
   then turn the power back on as directed on the test set screen.

2) Verify that the backlight and contrast control both work.

3) Configure the TEST CONFIGURATION for E1, L1-Tx, L1-Rx,
   TESTPAT, PCM-30, ENABLE, 2.048M, TERM, TERM, IN-
   TERN.

a) Escape back to the SunSet E10 MAIN MENU. Then configure SEND TEST PATTERN for 2e23.

4) Verify that line 1 LED's are correct (press the HISTORY key if necessary): SIGNAL, PCM-30, and CRC DET are green; all other line 1 LED's should be off. Also verify that the PAT SYNC LED is green and the BIT ERROR LED is off. The line 2 LED's don't matter.

5) Enter the MEASUREMENT RESULTS section and press the ERR INJ key 3 times.
a) Verify that 3 BPV's were detected.
b) Page down to the LINE 1 - FREQUENCY screen and verify that RCV/hz is 2048000.
d) Page down to the LINE 1 - G.821 screen and verify that 3 BIT's were detected.
d) Page down to the LINE 1 - SIG/ALM screen, and verify there are no alarms.

5.1) FOR BNC (75ý) CONNECTORS ONLY: Verify that +LVL and -LVL are both between 2.07 and 2.67volts.

5.2) FOR BR2 (120ý) CONNECTORS ONLY: Verify that +LVL and -LVL are both between 2.60 and 3.40 volts.

6) Enter the OTHER MEASUREMENTS, PULSE MASK ANALY- SIS screen and select START NEW ANALYSIS.
a) Select G.703 and verify that the pulse shape does not fall outside the template boundaries by more than 2 pixels.

7) Return to the MAIN MENU. In SEND TEST PATTERN, change the pattern to FOX.
a) Verify that the LED's are as they were in step 4.
b) Return to the MAIN MENU.
c) Enter the OTHER MEASUREMENTS, VIEW RECEIVED DATA screen.
d) Press the PAUSE (F3 key) and then PAGE-DN key several times.
e) Verify that the FOX pattern is displayed correctly in the ASCII column inside the parentheses. (THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 1234567890). Note that the message is not displayed in time slots 00 and 16.

8) Return to the MAIN MENU.
a) Enter the VF CHANNEL ACCESS, VF MEASUREMENTS screen.
b) Change INSERT TYPE to TONE.
c) Change LISTEN SIDE to L1-Rx.
d) Listen to the speaker and verify that the volume control keys work.

9) Verify that Rx-1 FRQ is between 1003 and 1005, and that Rx-1 LVL is between -00.5 and +00.5.

10) Change INSERT TYPE to TALK
a) Check the microphone by blowing into it and hearing it on the speaker.

11) Connect a cable from LINE 2 TX to LINE 2 RX.

12) From the MAIN MENU, set the TEST CONFIGURATION for E1, L2-Tx, L2-Rx, TESTPAT, PCM-30, ENABLE, 2.048M, TERM, TERM, INTERN.

13) Verify that line 2 LEDs are correct (press the HISTORY key if necessary): SIGNAL, PCM-30, and CRC DET are green; all other line 2 LED's should be off.
a) Verify that the PAT SYNC LED is green and the BIT ERROR LED is off. The line 1 LED's don't matter.

14) Connect an HDI-30 to DB37 (female) interface cable to the first test set configured for DCE.
a) To this cable, connect an RS449/V.36 DCE adapter cable (DB37 male to DB37 female).
b) To this cable, connect a Sunrise Telecom RS449/V.36 DTE adapter cable (DB37 male to DB37 male). Make sure that the ends of the cables with the labels are together (they should be the ends without the nuts).
c) Finally, connect another HDI-30 to DB37 (female) cable between the second SunSet E10 and the other cables.
d) Verify the PAT SYNC LED is green; all other LED's should be off (press the HISTORY key if necessary).

15) Enter the MEASUREMENT RESULTS screen for both sets
a) Press the RESTART key on each.

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b) Inject 3 errors from each set.

c) Verify that both sets report 3 BIT errors.

16) Remove all cables from the test sets.

a) Configure the TEST CONFIGURATION for DATACOM, G.703, CO-DIR, 64K, INTERN.

b) Connect an HDI-30 to DB-37 (female) interface cable to the set being tested.

c) To this cable, connect a DB37 (male) to 3 pin banana connector.

d) Use two 3-pin Female to Female Adapter Plugs (SS214) to short the IN and OUT banana plugs.

e) The PAT SYNC LED should be green; all other LED's should be off (press the HISTORY key if necessary).

17) Enter the MEASUREMENT RESULTS screen

a) Press the RESTART key.

b) Inject 3 errors.

c) Verify that 3 BIT errors are detected.

18) Check each key to make sure it works.

19) Return to the MAIN MENU.

a) If you purchased a printer with the test set, plug the printer into the test set, press the SHIFT key to display the SHIFT indicator in the window, then press the PRN SCRN key and observe the main menu being printed on the printer.

20) The procedure is now complete.

Please contact Customer Service if you need additional assistance.

Section 3 Customer Service

Sunrise Telecom Customer Service is available from 7:30 AM to 5:00 PM Pacific Standard Time (California).

Customer Service performs the following functions:
- Answers customer questions over the phone on such topics as product operation and repair.
- Repairs malfunctioning SunSets promptly.
- Provides information about product upgrades.

The warranty period covering the SunSet E10 is 1 year from the date of shipment. Please see the Warranty at the end of this manual. A Return Merchandise Authorization (RMA) number is required before any product may be shipped to Sunrise Telecom for warranty repair. All SunSets are "burn-in" tested for 24 hours after repair. All repairs are warranted for 90 days. Out-of-warranty repairs require both an RMA and a Purchase Order before the unit is returned.

Please contact Customer Service if you need additional assistance:

Customer Service
Sunrise Telecom Incorporated
22 Great Oaks Blvd.
San Jose, CA 95119
U.S.A.
Tel: 408-363-8000 or 1-800-701-5208
Fax: 408-363-8313
Email: support@sunrisetelecom.com
web: http://www.sunrisetelecom.com

Chapter 12
Specs & Configs

Section 1 Specifications

CONNECTORS/PORTS
2.048 Mbps Bi-directional E1 interfaces
Line 1 Tx, Line 1 Rx, Line 2 Tx, Line 2 Rx
75 ohm unbalanced BNC (f)
75 ohm (optional): Replaces BNC with 1.6/5.6 mm (f)
120 ohm (optional): Replaces BNC with BR2 (f), balanced
Serial port: 8-DIN, RS232C (V.24), DTE
Datacom interface: 30 pin HDI (High Density Interface) connector
(optional)
DC input for charging internal battery

STATUS/ALARM INDICATORS
Power and low battery LED indicators
16 dual-color LED indicators for Line 1 & Line 2
Current status and alarm history for: signal, code error, PCM-30,
PCM-31, AIS, alarm, CRC detected, any error
Pattern sync and bit error LED indicators

TEST PATTERN GENERATOR
General: 1111, 0000, 1010, 100100 (1-in-3), 1-in-4, 1-in-8, 3-in-
24, FOX
PRBS: 2^n-1, n=6, 7, 9, 11, 15, 20, 23
Selectable QRS or 2^{20}-1 ITU
Conforms to ITU-T O.151, O.152, O.153
Programmable: 10 patterns, 2048 bits long with user definable
labels
Test pattern inversion

E1 GENERAL
Bit Error Test rates: 2.048 Mbps, N (contiguous) and M (non-
contiguous) x64 kbps (N & M=1 to 31)
Full duplex bi-directional hitless in-service drop and insert
Drop and insert to internal test circuitry, datacom interface (op-
tional), Nx64 kbps test pattern; or 64kbps A-law decoded VF
channel to built-in speaker/microphone
Automatic configuration
Line Coding: HDB3, AMI
Framing: Unframed, PCM-30, PCM-31, with or without CRC-4,
conforms to ITU-T G.704
Programmable Send Frame Words: manual/auto E-bits, MFAS

Word bit 5, bit 6 (MFAS RAI), bit 7, bit 8, MFAS ABCD, FAS RAI, Display and Print Send and Receive FAS/NFAS and MFAS/NMFAS Words, auto CRC-4 generation, freely settable Sa4, Sa5, Sa6, Sa7, and Sa8 bits to 1 or 0 for 8 frames
Set idle channel code and ABCD bits

E1 TRANSMITTERS
Clock source:
Internal: 2.048 MHz (± 5 ppm)
External: Through Line 1 Rx or Line 2 Rx, AMI or HDB3. Through Multiport, sinusoidal, 50% duty cycle; requires optional SS251 Datacom Module
Loop: Recovered through Line 1 Rx or Line 2 Rx signal, selectable AMI or HDB3
Pulse shape: $3.0V_{bp}$ (± 10%) at 120 ohm , $2.37V_{bp}$ (± 10%) at 75 ohm. Conforms to ITU-T G.703

ERROR/ALARM INJECTION
Code and/or bit error: programmable burst of 1 to 9999 errors manually, or continuous rate of $2x10^{-3}$ to $1x10^{-9}$
CRC-4, FAS, E-bit : single error
Generate AIS, TS16-AIS(PCM-30), MFAS RAI(PCM-30), FAS RAI (PCM-30 & 31) alarms

E1 RECEIVERS
Frequency: 2.048 Mbps ± 6000 bps
Input sensitivity:
Terminate, Bridge: +6 to -43 dB with Automatic Line Build Out
Monitor: -15 to -30 dB resistive
Impedances:
Terminate, Monitor: 75 ohm or (optional) 120 ohm
Bridge: > 5000 ohm
Jitter tolerance to ITU-T G.823

MEASUREMENTS
Error Type: Code, bit, CRC-4, FAS, MFAS, E-bit errors, slips
Typical error type reports: error count, error rate, ES, %ES, SES, %SES, UAS, %UAS, EFS, %EFS, AS, %AS, DM, %DM
ITU-T G.821 Analysis, error type reports: Bit error and rate, ES, %ES, SES, %SES, EFS, %EFS, UAS, %UAS, AS, %AS, DM, %DM
ITU-T G.826 Analysis, CRC-4 block based; error type reports: EB, BBE, %BBE, ES, %ES, SES, %SES, UAS, %UAS, AS, %AS,

DM, %DM

M.2100/550 pass/fail analysis: programmable time period and %HRP

Alarm statistics: LOS seconds, LOF seconds, AIS seconds, FAS RAI seconds, MFAS RAI seconds

Frequency (Max hold, Min hold, Current), clock slips, wander

Signal level (V_{bp+}, V_{bp-} in V and dBdsx) +7 to -36 dB

Block Errors, Block Error Rate

Print on event, can be enabled or disabled

Print at timed interval (selectable over 1 to 9999 minutes) or at end of test

Measurement duration continuous or timed; settable up to 999 hours, 59 minutes.

Programmable time and date for start and stop

OTHER MEASUREMENTS

Pulse mask analysis

    Scan period, 500 ns

    On screen pulse shape display with G.703 Pulse Mask verification

    Displays pulse width, rise time & fall time in nano-seconds, %overshoot, %undershoot

    Pulse shape storage and printing

Histogram analysis

    Graphical display of accumulated errors (Bit, Code, CRC, FAS/MFAS) and alarms (LOS, AIS, LOF, FAS RAI, MFAS RAI) events for L1 Rx and L2 Rx

    Stores and prints 60 days by hour and 60 hours by minute

    Storage of one complete histogram & current

Propagation delay

    Round trip signal transmission delay

    Measures in micro-seconds and UIs (Unit Intervals)

View received data

    View live traffic 4096 bits long (16 full frames/one multi-frame) in PCM- 30 or PCM-31

    Displays 8 time slots per screen

    Stores 64 scrollable screens, hold screen, print

    Information displayed in ASCII, reverse ASCII, Binary, and HEX

View time slot 16 (MFAS, NMFAS ABCD) in PCM-30: 16 Frames

View time slot 0 (FAS, NFAS, CRC, MFAS/CRC words, E-bits Sa4 to Sa8, A-bit) in PCM-30 & 31: 16 Frames

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Save test results, error and alarm events (1000 events) available
   to screen view or print

VOICE FREQUENCY CAPABILITY
Tone generation: 50 to 3950 Hz, res. 1Hz; +3 to -60 dBmO, res. 1
   dB
Level and frequency measurement: 50 to 3950 Hz, +3 to -60 dBmO
Talk and listen, ABCD bits monitor & transmit in selected channel
Built-in microphone for talk
Monitor speaker for line 1, 2, or both with volume control
Bi-directional, full duplex, hitless in-service drop/insert
Simultaneously view bi-directional 30 channels ABCD bits
Programmable idle channel ABCD bits and code
Programmable IDLE and SEIZE ABCD
Companding: A-Law
View channel data 1-byte long (binary format)

DATACOM INTERFACE (SS251)
V.35, X.21/V.11, RS232 /V.24, RS449/V.36, G.703 co-directional
DTE, DCE Emulation
30-pin High Density Interface (HDI) connector to test set: includes
   adapters for DCE and DTE V.35, X.21/V.11, RS232 (V.24),
   RS449 (V.36); G.703 co-directional. 3-pin CF connectors for Tx
   and Rx.
RS232/V.24 Async data rates: 50, 150, 300 and 600 bps; 1.2, 2.4,
   4.8, 9.6, 14.4, 19.2 and 38.4 kbps, 6/7/8 data bits, 1/2 stop bits,
   odd/even/none parity.
RS232/V.24 Sync data rates: 300 and 600 bps; 1.2, 2.4, 4.8, 9.6,
   14.4, 19.2, 38.4, 48, 56 and 64 kbps
G.703 co-directional data rate: Nx64 kbps (N=1 to 8)
RS449 DTE/DCE data rates: 300 bps to 48 kbps, Nx56, Nx64 (N=1
   to 32)
V.35 DTE/DCE data rates: 300 bps to 48 kbps, Nx50.6, Nx64 (N=1
   to 32)
X.21 DTE/DCE data rates: 300 bps to 48 kbps, Nx56, Nx64 (N=1
   to 32)
Send test patterns:
   RS232/V.24 Async DCE and DTE: 2047, 511, 127, 63, 1111....,
   0000.... and FOX
   All other interfaces: all available patterns
Automatic pattern synchronization
G.821 measurements
Measurement of Data Loss, Data Loss Seconds, Slips, Slip

Seconds. Pattern Sync Loss and Pattern Sync Loss Seconds

Bit error injection

Histograms for Bit Error, ES, SES, UAS

Datacom Timing Analysis (Resolution: 300ms)

  Change of state of the following control leads is recorded and
    displayed (Table or Graphic Mode):

      RS232/V.24 (Async, Sync, DTE, DCE), V.35 (DCE, DTE),
      RS449/V.36 (DTE, DCE): RTS, CTS, DTR, DSR, DCD, RL,
        LL

      X.21 (DTE, DCE): C, I

  Transmit control leads (selectable on/off)

      RS232/V.24 Sync and Async DTE: RTS, DTR, RL, LL
      RS232/V.24 Sync and Async DCE: CTS, DSR, DCD
      V.35 DTE: RTS, DTR, RL, LL
      V.35 DCE: CTS, DSR, DCD
      RS449/V.36 DTE: RTS, DTR, RL, LL
      RS449/V.36 DDE: CTS, DSR, DCD
      X.21 DTE: C
      X.21 DCE: I

  Storage Capability

      Graphical Mode: Last 40s of change
      Table Mode: 100 pages

Tx data clock selectable (internal or receive)

Receiver ranges: V.35 (high 0.2 to 7.0V, low -7.0 to -0.2V), RS449/
    V.36 (high 0.2 to 6.0V, low -6.0 to -0.2V), RS232/V.24 (high +3.0
    to +25.0V, 1 low -25.0 to -3.0V)

Transmitter ranges: V.35 (± 0.44 to ±0.66V differential output),
    RS449/ V.36 (±2.0 to ±5.0V differential output), RS232/V.24
    (+12 to +15V high, -12 to -15V low)

Modes:

  Datacom: via HDI-30 multiport

  E1-Mux: Hitless 2048 kbps and Nx64 kbps E1 drop and
    insert,via V.35, RS449/V.36, X.21/V.11; DCE only

  Hitless 64 kbps E1 drop and insert via RS232 DCE sync

  Hitless Nx64 kbps drop and insert, N = 1 to 8 via G.703 co-
    directional

  Emulates terminal multiplex or add/drop multiplex

    Muxtest: tests 2.048 Mbps/Nx64 kbps terminal multiplex

MFR2/DTMF/DP DIALING & ANALYSIS (SW251)

Programmable dial 1 to 32 digits, 10 sets, alphanumeric label

Programmable dial tone level -5 to -20 dBm, res. 1 dB

Programmable dial tone period and interdigit timing

Programmable dial pulse %break/period

MFR2/DTMF freq/level/twist/tone period/interdigital period received
digit decode and analysis

DP %break/PPS/period received digit analysis

Bi-directional CAS (ABCD signalling) transition analysis

VF NOISE MEASUREMENTS (SW252)

Signal to noise ratio measurement

Noise measurements with 3.1 kHz flat, psophometric weighting,
1010 Hz notch with flat filters

SS7 ANALYSIS (SW253)

Supports ITU-T Q.700 series, Chinese (14 or 24 bits), Italian
standards

Bi-directional analysis to bit level, layers 2, 3 & 4

Configurable analysis channels (Line 1/2)

SU traffic analysis

Statistical counters for FISU, LSSU, MSU, SNM, SNT, TUP, ISUP
and SCCP messages. %FISU, %LSSU, %MSU and retrans-
mission counts on FIB and BIB (% based on number of
messages)

MSU tracer

Supports TUP, ISUP, SCCP, SNM, SNT messages

User programmable trace filter; OPC, DPC, SI, CIC, H0/H1,
address signal (called number) Layer 2 FISU/LSSU filter; BSN/
BIB, FSN/FIB.

Real time view of bi-directional messages. Messages are trans-
lated into clear text up to layer 4 down to bit level or are displayed
in hex format. Trace storage holds up to 2100 messages.

View trace buffer with or without display filter

Print, clear buffer

LSSU analysis

Captures and display of LSSUs, FISUs, BSN/BIB, FSN/FIB.
Status cause display in hex format and decode to bit level.

Message decode performance: 99% of messages captured at 15%
channel utilization, 91 bytes per message

ISDN PRI ANALYSIS & CALL SET UP (SW254)

Bi-directional Primary rate interface analysis and call set ups, layers 2 & 3

Protocol analysis

Supports ITU-T Q.921/Q.931, ETSI

User programmable trace filter: Call reference number, Called number, Caller number, SAPI, TEI. C/R bit, time slot, message group, type code, SIC type. View bi-directional message flow. Messages are translated into clear text up to layer 3 or are displayed in hex format. Trace storage holds up to 2100 messages.

Trace buffer view, print, and clear

Emulates both TE & NT mode

Generates and receives voice, data calls

  Capable of 2 calls

  Supports self call

Talk/listen, send/receive tones

DPNSS/DASS2 ANALYSIS & CALL SETUP (SW260)

Supports BTNR 188 & BTNR 190 standards

Bi-directional Primary rate interface analysis layers 2 & 3

Protocol analysis

User programmable trace filter: C/R bit, time slot, message group, type code, SIC type, DA number. View bi-directional message flow. Messages are translated into clear text up to layer 3 or are displayed in hex format. Trace storage holds up to 2100 messages.

Trace buffer view, print, and clear

Call Setup / Call Receiving

Emulates PBX A or PBX B for DPNSS and PBX or ET for DASS2

Generates and receives voice calls

Talk/listen

X.50 64 kbps TESTING (SW255)

Conforms to ITU-T X.50 Division 2 and 3

Bit error rate testing with ITU-T G.821 analysis

Test rate: Nx600bps, N = 1 to 8 within 64 kbps signal

Hitless bi-directional E1 64 kbps channel drop/insert to multiport

Standard or random selection of octets

View and transmit housekeeping bits A to H, and status S-bit

Programmable idle pattern, BERT and IDLE S-bit, X.50 signall (ABCD bits)

Bit or Frame Error Injection

Histogram analysis
Modes: Datacom (64 kbps, X.50 Formatted signal)
  Muxtest (Test 2.048 Mbps/64 kbps multiplex)
  MUX (Emulate 2.048 Mbps/64 kbps multiplexed within X.50 format)
  E1 (Send/Receive X.50 formatted channels inside 2.048 Mbps signal)

C-bit FRAME TESTING (SW257)

Send and receive C-bits 2 through 15 (ESCAPE, 2 MB loops, loop 2 or loop 3, loop 2 instruction, loop 3 instruction, HDB3 command, loop acknowledge, not defined, local fault, remote/line fault, C frame loss, spare, spare, spare)
Bit level decoding
Loopback channel

GSM A & Abis ANALYSIS (SW258A)

A-bis interface:
  Supports GSM 16 kbps or 64 kbps A-bis interface to GSM 08.58, 04.08, 08.56
  A-bis traffic statistics include counters for RLM, DCM, CCM, TRXM and total number of messages for both L1 and L2
  A-bis Layer 2 traffic statistics include counters for supervisory, unnumbered, information and total number of frames for both L1 and L2
  Programmable trace filter; layer 2 messages, SAPI, TEI, message discriminator, message type, channel number, time slot number
  Bi-directional message tracing with up to 2100 message storage
  Trace buffer view, print, and clear
  Message decode performance: 99% of messages captured at 15% channel utilization
A interface:
  Supports GSM A interface Phase 1 to GSM 08.08, 08.06, 04.08, 04.11, 04.80
  Programmable trace filter; LSSU, DPC, OPC.
  Bi-directional message tracing with up to 2100 message storage
  Trace buffer view, print, and clear

GSM MAP (B...G Interface) ANALYSIS (SW258B)

Supports GSM 09.02 Phase 2

Programmable trace filter; LSSU, DPC, OPC, caller number, called
number, TCAP originating and destination transaction ID, in-
voke ID.

Bi-directional message tracing with up to 2100 message storage

Trace buffer view, print, and clear

Message decode performance: 100% of messages captured at
15% channel utilization

MAP Dialogue information decoded messages:

MAP-Dialogue PDU:

map-open, map-accept, map-close, map-refuse, map userAbort,
map-providerAbort

MAP operation decoded and error messages:

MAP-Mobile Service Operations:

UpdateLocation	CancelLocation
PurgeMS	SendIdentification
PerformHandover	PrepareHandover
SendEndSignal	ProcessAccessSignalling
ForwardAccessSignalling	PerformSubsequentHandover
PrepareSubsequentHandover	SendAuthenticationInfo
CheckIMEI	SendParameters
InsertSubscriberData	DeleteSubscriberData
Reset	ForwardCheckSS-Indication
RestoreData	

MAP-Operation and Maintenance Operations:

ActivateTraceMode	DeactivateTraceMode
TraceSubscriberActivity	NoteInternalHandover
SendIMSI	

MAP-Call Handling Operations:

SendRoutingInfo	ProvideRoamingNumber

MAP-Supplementary Service Operations:

RegisterSS	EraseSS
ActivateSS	DeactivateSS
InterrogateSS	ProcessUnstructuredSS-Data
ProcessUnstructuredSS-Request	UnstructuredSS-Request
UnstructuredSS-Notify	RegisterPassword
GetPassword	BeginSubscriberActivity

MAP-Short Message Service Operations:

SendRoutingInfoForSM	ForwardSM
ReportSM-DeliveryStatus	NoteSubscriberPresent

AlertServiceCentreWithoutResult   AlertServiceCentre
InformServiceCentre   ReadyForSM
MAP-Errors:

SystemFailure   DataMissing
UnexpectedDataValue   FacilityNotSupported
UnknownSubscriber   NumberChanged
UnknownBaseStation   UnknownMSC
UnidentifiedSubscriber   UnknownEquipment
RoamingNotAllowed   IllegalSubscriber
IllegalEquipment   BearerServiceNotProvisioned
TeleserviceNotProvisioned InvalidTargetBasestation
NoRadioResourceAvailable   NoHandoverNumberAvailable
SubsequentHandoverFailure TracingBufferFull
NoRoamingNumberAvailable   AbsentSubscriber
CallBarred   ForwardingViolation
CUG-Reject   IllegalSS-Operation
SS-ErrorStatus   SS-NotAvailable
SS-SubscriptionViolation   SS-Incompatibility
UnknownAlphabet   USSD-Busy
PW-RegistrationFailure   NegativePW-Check
NumberOfPw-AttemptsViolation SubscriberBusyForMT-SMS
SM-DeliveryFailure   MessageWaitingListFull

GSM Voice and TRAU Analysis (SW258C)

Supports GSM 06.10, 08.60
Drop/Monitor 16 kbps GSM channel at 13 kbps voice rate to built-
   in speaker
Selectable sub-channel (1 to 4) and time slot (1 to 31)
Codification RPE LTP at 13 kbps
Monitor/Decode/Programmable C1 to C21, T1 to T4 control bits
Frame type decode of 16 kbps subchannel (Voice, Data, Idle, O&M,
   Signaling, Unknown)
Identify Uplink or Downlink direction.
Identify 64 kbpsor 16 kbps signalling time slot
THRU mode, pass E1 & TRAU for all sub-channels & Insert
   recordable encoded 13 Kps voice message
Transmit mode, user definable framing/control bits & Insert record-
   able encoded 13 Kps voice message
Tx/Rx Test(out-of-service) & in-service monitor
BERT(G.821) on 16kbps subchannel: Bit error/rate, ES, SES,
   EFS, UAS, LOSS
Send test pattern on 16 kbps: 2047, All 1, All 0, Alt 1010

MFR2C/SS5 ANALYSIS & CALL SET UP (SW259)
MFR2/Compelled
    Conforms to ITU-T Q.400 series standards (MFR2)
    Supports forward and backward call setups
    Talk/listen, send/rreceive tones, or noise measurement on dialed channel
    Automatic seizure and seizure acknowledgement
    Programmable idle, seizure, and seizure ack CAS (ABCD) states
    Bi-directional MFR2 dial digits decoding with time stamp & CAS(1000 events)
SS5
    Conforms to ITU-T Q.140 series standards
    Supports 2400Hz, 2600Hz, 2400+2600Hz SS5 line signalling
    Call setup with on-line call progress status display
    Talk/listen, send/receive tones, or noise measurement on dialed channel
    Bi-directional SS5 dial digit and control tones decode with time stamp
    Control frequencies decode; SOCOTEL - 1700 Hz, 1900 Hz, AON - 425 Hz, 500 Hz, Echo suppressor/canceller - 2100 Hz

SIGNALLING EMULATION (SW261)
10 sets of stored user signalling emulation set ups
Each signalling emulation holds up to 50 total events
Programmable send and receive signalling (CAS), digits (MFR2, DP, DTMF),wait and time out periods
Send period from 0 to 9999 ms, time out for response from 0 to 9999 ms, program up to 20 digits (MFR2, DP, and/or DTMF)

GENERAL
CE mark
Languages: English, French, Italian, Spanish
2 Mbyte Field upgradable PCMCIA memory card
512 kbyte internal NVRAM data buffer
Dynamic memory allocation for protocol analysis
16 lines x 32 character LCD with backlight
Internal Battery: 6-cell NimH battery pack
Battery operation time: 4 hours nominal (3.5 hours nominal with optional SS251 Datacom Module installed)
Printer/Communication port:
8-DIN, RS232 (V.24) serial port
Text: standard ASCII scape sequence code

Graphics: standard Bit-image Graphics Mode (dot matrix)
Remote: VT102 terminal emulation remote control (optional)
Operating Temperature: 0×C to 50×C
Storage Temperature : -20×C to 70×C
Humidity: 5% to 90% non-condensing
Size: 10.5 cm x 6 cm x 27 cm
Weight: 1.2 kg (approx)

2.0 Configurations

Here are the various items which can be ordered in addition to
the basic SunSet E10. The following E10 packages provide
everything you will need in one convenient order number. However,
if you prefer, you may order most items seperately.

Model   Name and Description

Test Set
SSE10   SunSet E10
with 75Ω unbalanced BNC (f) connectors. Includes
NimH internal battery, Universal Charger (SS138), Us-
ers' Manual (SS257) and software cartridge.

Alternate connectors may be specified at time of order:
- -A Replace all 75Ω BNC (f) with 1.6/5.6 mm 75Ω unbal
  connectors
- -B Replace all 75Ω BNC (f) with BR2 (f) 120Ω bal connec
  tors

Modularized Datacom
SS251   Datacom Module
Includes HDI-30 to DB-37 (f) Adapter Cable, DCE and
DTE adapters for V.35, X.21/V.11, RS232/V.24, RS449/
V.36 ; G.703 co- directional Tx/Rx, 3-pin CF.

SS251DC
Installed datacom module hardware in E10 (function
disabled)

12-12   SunSet E10 Version 2.37

SW251DC

Software for datacom testing SS251DC required

SS251 DCC

Full datacom cables and adapter package. Includes 1-each of SS306, SS252, SS253, SS254, SS255, & SS256

<u>Software Options</u>
SW100   Remote Control

Includes printer cable (SS115B) and null modem adapter (SS122A). VT 100/102 terminal emulation required.

SW251   MFR2/DTMF/DP Dialing & Analysis

SW252   VF Noise Measurements

SW253   SS7 Analysis

SW254   ISDN PRI Analysis & Call Setup

SW255   X.50 64Kbps Testing

SW257   C-bit Frame Testing

SW258A GSM A & Abis Analysis

SW258B GSM MAP (B..G Interface) Analysis
(SW258A required)

SW258C GSM Voice and TRAU Access

SW259   MFC/SS#5 Analysis & Call Set Up

SW260   DPNSS/DASS2 Analysis & Call Set Up
(SW254 required)

SW261   Signalling Emulation

SW2502 2 Mb Software Replacement Cartridge

ACCESSORIES

SS101   Carrying Case

SS104B Cigarette Lighter Battery Charger

SS107   Cable, Dual Bantam to Dual Bantam, 2m

SS108   Cable, Single Bantam to Single 310, 2m

SS109   Cable, Single Bantam to Probe Clip 8, 2m

SS112   Cable, Dual Bantam to RJ-48 (m), 2m

SS115B DIN-8 to DB-9 Printer Cable

SS116   Instrument Stand

S1117A Printer Paper
5 rolls, for SS118B/C

SS118B High Capacity Thermal Printer
Includes cable (SS115B) and 110 VAC charger.

SS118C High Capacity Thermal Printer
Includes cable (SS115B) and 220 VAC charger.

SS122A Null Modem Adapter
DCE to DCE, DB9 conversion. Included with SW100.

SS123   SunSet Jacket

SS130A 19"/23" SunSet Rack Mount - Removable

SS130B 19"/23" SunSet Rack Mount - Permanent

SS138   SunSet AC Adapter
100 - 240 VAC, 50/60 Hz input, output 15 VDC @ 2A.

SS139   6-Cell NimH Battery Pack
7.2 VDC, 1.8 Ahr

SS210   Conversion Cable
BNC (m) 75 ohm to 3-pin banana (m) 120 ohm , 2m

SS211 Cable
BNC (m) 75 ohm to BNC (m) 75 ohm , 2m

SS212 Conversion Cable,
BNC (m) 75 ohm   to Bantam 120 ohm , 2m

SS214 3 ea. Female to Female Adapter Plugs
Changes 3-pin banana male to female.

SS217 Cable
1.6/5.6 mm (m) 75 ohm to 1.6/5.6 mm (m) 75 ohm , 2m

SS218 Conversion Cable,
1.6/5.6 mm (m) 75 ohm to 3-pin (m) 120 ohm , 2m

SS219 Conversion Cable,
BNC (m) 75 ohm to BR2 120 ohm , 2m

SS220 Cable
BNC (m) 75 ohm to 1.6/5.6 mm (m) 75 ohm , 2m

SS221 Cable
3-pin banana (CF) 120 ohm to 3-pin banana (CF) 120
ohm, 2m

SS223 Cable
BR2 120 ohm to 3-pin banana 120 ohm , 2m

SS224 Conversion Cable
BNC (m) 75 ohm to 3- pin banana (CF) female 120 ohm,
35 cm

SS252 V.35 DTE (SS252T) and DCE (SS252C) Interface
Adapters DB37 to ISO 2593 34 pin connectors

SS253 X.21/V.11 DTE (SS253T) and DCE (SS253C)
Interface Adapters DB37 to ISO 4903 DB15 connectors

SS254 RS232/V.24 DTE (SS254T) and DCE (SS254C)
Interface Adapters DB37 to ISO 2110 DB25 connectors

SS255 RS449/V.36 DTE (SS255T) and DCE (SS255C)
Interface Adapters. DB37 to ISO 4902 DB37 connectors

SS256   **G.703 64 co-directional to banana 3-pin Adapter.**
             DB37 to CF 3-pin banana TX and RX connectors

SS257   **SunSet E10 User's Manual**
             English (Spanish, specify SS257SP)

SS257-TM SunSet E10 Service Manual

SS261   **External Clock Input Cable**
             DB-37 to BNC (m) 75ohm

SS262   **RS530 DTE (SS262T) & DCE (SS262C) Interface
             Adapter**
             DB37 to ISO2110 DB25 connectors

SS306   **HDI-30 Datacom Cable**
             HDI-36 to DB37 Interface Cable, 2m

SSE10W   **SunSet E10 Extended 3-Year Warranty**

Chapter 13 Abbreviations

A

AC - Alternating Current. A continuously variable current usually following a sinusoidal growth and decay curve.

ACK - Acknowledge. A control character signalling that the receiver is ready to accept the next block.

AFBER - Average Framing Bit Error Rate

AIS - Alarm Indication Signal. Indicates an all ones signal on the active receive jack.

AISS - Alarm Indication Signal Seconds. The count of the number of seconds in which AIS was detected.

ALM - Alarm

AMI - Alternate Mark Inversion. A method of transmitting binary digits, in which successive "marks" are of alternating polarity.

AS - Available Second

AVBER - Average Bit Error Rate

AVCER - Average CRC-4 block Error Rate

AVG - Average

B

B Channel- Bearer Channel. A 64 Kbps ISDN user channel which carries digital data, PCM-encoded digital voice, or a mixture of lower-speed data traffic.

BATT - Battery

BERT - Bit Error Rate Testing

BIB- Backward Indicator Bit. Bit inverted for the negative acknowledgment of the BSN message.

BIT - Bit Error

BPV - Bipolar Violation

BRI - Basic Rate Interface

BSC- Base Station Controller. Part of the GSM network; manages the radio resources for one or more BTS.

BSN- Backward Sequence Number. Indication of the last message received.

BSS- Base Station Subsystem. A major component of the GSM network; contains the radio link with the Mobile Station.

BTS- Base Transceiver Station. Part of the BSS; contains the radio transmitters and receivers.

BTSLP - Bit Slip. Occurs when the synchronized pattern either

loses a bit or gains an extra bit through stuffing.
BUFF - Buffer. A device that stores data temporarily from a faster device.

C

CAS - Channel Associated Signalling
CC- Connection Confirm
CCH - Control Channels
CER - CRC-4 Error Rate
CIC- Circuit Identification Code. A label for circuit-related messages.
CK- Checksum. The total of a group of data items used for error checking purposes.
CLKSLP - Clock Slip
COD - Code
CONFIG - Configuration
CR- Connection Request.
C/R- Command/ Response. A field bit indicating whether the frame transmitted is a command or response.
CR - Carriage Return
CRC-4 - Cyclic Redundancy Check Code - 4

D

D Channel - Demand Channel; carries signalling information
DASS2 - Digital Access Signalling System 2
dB - decibel
dBdsx - decibel referenced to G.703 power level
DC - Direct Current
DCE - Data circuit equipment
DCS - Digital Cross-connect System
DET - Detected
DGRM - Degraded Minute
DIG - Digital
DN - Down
DPNSS - Digital Private Network Signalling System
DTE - Data Terminal Equipment
DTMF - Dual Tone Multi Frequency

E

E1 - 2.048 Mbps signal

EBER - E-bit Error Rate
EBER- E-bit Error Rate
EBIT - E-bit
EIR - Equipment Identity Register
ERR INJ - Error Injection
ES - Errored Second
ESF - Extended Super Frame
ET - Elapsed Time
EXTERN - External

F

F1 - Function 1
FALM - Frame Alarm Seconds
FAS - Frame Alignment Signal
FBE - Framing Bit Error
FBER - Framing Bit Error Rate
FE - Frame Error
FE1 - Fractional E1
FREQ - Frequency
FRM - Frame

G

GSM - Global System for Mobile communications

H

HDB3 - High Density Bipolar Three
HEX - hexadecimal
HOLDSCRN - Hold Screen
HLR - Home Location Register
Hz - Hertz

I

INTERN - Internal
INV - Inverted
ISDN - Integrated Services Digital Network
ISUP - ISDN User Part

K

Kbps - KiloBits Per Second

L

LAP-B - Link Access Protocol - Balance
LBO - Line Build Out
LED - Light Emitting Diode
LOFS - Loss of Frame Second
LOG - Logical Error (BIT error)
LOS - Loss of Signal
LOSS - Loss of Signal Second
Lpp - Level peak-to-peak
LVL - Level

M

MAX - Maximum
Mbps - megabits per second
MFAL - Multiframe Alarm Seconds
MFAS - Multiframe Alignment Signal
MFC - Multi-Frequency Compelled
MFE - Multiframe Bit Error
MIN - Minimum
MSC - Mobile Switching Centre
MON - Monitor
msec - 1 millisecond (1/1000 of a second)
μ-law - mu-law; voice companding law
μsec - 1 microsecond (1 millionth of a second)

N

nsec - nano second (one billionth of a second)
NE - Network Element
NT - Network Termination
NV RAM - Non Volatile Random Access Memory

P

P/F - Pass/Fail
PAT - Pattern
PBX - Private Branch Exchange
ppm - parts per million

PRBS - Pseudo Random Bit Sequence
PRI -Primary Rate Interface
PRN SCRN - Print Screen
PRNT - Print
PRNTR - Printer

Q

QRS - Quasi Random Signal

R

R - Receive
RAI - Remote Alarm Indication
RCV - Receive
REF - Reference
RESYNCH - Resynchronization
RLL - Radio Link Layer
RT - Remaining Time
RX - Receive

S

SABME - Set Asynchronous Balanced Mode Extended
SAPI - Service Access Point Identifier
SCCP - Signalling Connection Control Part
SCRN - Screen
SES - Severely Errored Second
SF - Super Frame
SIG - Signal
SLIPS - Clock Slips
SPLT - Split
SS - SunSet
SW - Software
SYNC - Synchronized

T

T - Transmit
TCH - Traffic Channels
TE - Terminal Equipment
TEI - Terminal Endpoint Identifier
TERM - Terminated

T/S - Time Slot
TS-16 - Time Slot 16
TERM - Terminated
TRAU - Transcoder and Rate Adaptation Unit
TX - Transmit

U

UAS - Unavailable Second
UI - Unit Interval

V

V - Volts
VAC - Volts AC
VF - Voice Frequency

W

WNDR - Wander

X

XMT - Transmit

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 FIRM- WARE. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED. COMPANY SPECIFICALLY DISCLAIMS THE IM- PLIED 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 EQUIP- MENT, SHALL IN NO EVENT EXCEED THE PURCHASE PRICE OR LICENSE FEE FOR THAT PRODUCT, NOR SHALL COMPANY IN ANY EVENT BE LIABLE FOR ANY INCIDEN- TAL, CONSEQUENTIAL, INDIRECT, OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, ARISING FROM OR RELATED TO THE SALE OF THE MERCHANDISE HERE- UNDER, INCLUDING BUT NOT LIMITED TO DAMAGES ARIS- ING 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.

F. No Guaranty, Nonapplication of Warranty. COMPANY does not guaranty or warrant that the operation of hardware, soft- ware, 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.

JUNRIJE TELECOM
INCORPORATED

Certificate of Origin

To Whom It May Concern:

We, Sunrise Telecom, with principle location of business at 22 Great Oaks Blvd., San José CA 95119, do hereby certify that the following product is manufactured in the United States of America.

Model	Name
SSE10	SunSet E10

All versions of software.

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