



Sunset™ T10

User's Manual
Version 1.40

Sunrise Telecom a step ahead

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SunSet T10 SuperTrunk QuickReference - Testing Voice Trunks

BOLD indicates MENU NAMES, SELECTIONS or MANDATORY SETTINGS

Set up TEST CONFIGURATION

TEST MODE	:	T1SINGL
RxLVL-1	:	TERM
FRAMING	:	SF-D4 or ESF (set per circuit design)
CODING	:	AMI or B8ZS (set per circuit design)
Tx SOURCE	:	NORMAL
XMT CLOCK	:	L1-Rx
TEST RATE	:	1.544M
LBO 1	:	0 dB

Set up **SEND TEST PATTERN** to 1-8 pattern.

Connect the SunSet to the SuperTrunk circuit via LINE 1 bantam jacks.
Check LINE 1 LEDs and **MEASUREMENT RESULTS** for errors.

Set up VF CHANNEL ACCESS, VF MEASUREMENTS:

Tx-1 T/S	:	01 (set to CHAN to be TESTED)
Rx-1 T/S	:	01 (set to CHAN to be TESTED)
INSERT TYPE	:	TALK
Tx-1 A/B	:	0 0 0 0
LISTEN SIDE	:	L1-Rx

Set up DIAL/SPRVIS SETUP:

DIAL PERIOD	:	100 ms
SILENT PERIOD	:	100 ms
TONE LEVEL dBm	:	-5
SUPERVISION	:	
TRUNK TYPE	:	E+M (set per circuit design)
EQUIPMENT	:	N/A
DIAL PULSE (10pps)	:	
%BREAK	:	60
INTERDIGIT PRD	:	500
BKWRD SPRVSN	:	1 0 1 0
IDLE SUPERVISION:	:	0 0 0 0

Set up PLACE/RECEIVE CALLS:

METHOD	:	DTMF
TX ABCD	:	0 0 0 0 ONHOOK
NUMBER	:	14085551212 (set to your TEST No.)
TX CHNL	:	01 (set to CHAN to be TESTED)
RX CHNL	:	01 (set to CHAN to be TESTED)
RX ABCD	:	0 0 0 0 ONHOOK

To Place a Call from PLACE/RECEIVE CALLS menu:

Highlight **NUMBER**. Press SHIFT then Yellow Numbers to enter phone #, then SHIFT again to exit numeric mode.

Highlight **TX ABCD**. Press OFF-HOOK (F2) key.

Did you receive a WINK or Dialtone? (For WINK, Look at **RX ABCD** for momentary 1111)

Press **ENTER** to dial number.

Do Talk/Listen Testing.

Go to next channel to test (Highlight **TX CHNL** use NEXT/PREVIOUS keys to change channel).

To Receive a call from PLACE/RECEIVE CALLS menu:

Look for an OFF-HOOK from the switch (Look at **RX ABCD** for steady 1111) or Ringing tone from SunSet.

For DID Trunks ONLY: Highlight **TX ABCD**. Press WINK.

Press OFF-HOOK to answer call.

Do Talk/Listen Testing.

Go to next channel to test (Highlight **TX CHNL** use NEXT/PREVIOUS keys to change channel).

SunSet T10 PRI Quick Reference- Placing a Voice/Data Call

BOLD indicates MENU NAMES, SELECTIONS or MANDATORY SETTINGS

CAUTION: Do not connect the SunSet T10 to the circuit until you have set up your TEST CONFIGURATION.

Set up **TEST CONFIGURATION**

TEST MODE	:	T1SINGL
RxLVL-1	:	TERM
FRAMING	:	SF-D4 or ESF (set per circuit design)
CODING	:	AMI or B8ZS (set per circuit design)
Tx SOURCE	:	NORMAL
XMT CLOCK	:	L1-Rx
TEST RATE	:	1.544M
LBO 1	:	0 dB

Set up **SEND TEST PATTERN** to 1010 pattern.

Connect the SunSet to the ISDN PRI circuit via **LINE 1** bantam jacks.

Check **LINE 1** LEDs and **MEASUREMENT RESULTS** for errors.

Check **OTHER MEASUREMENTS, VIEW RECEIVED DATA**-look at T/S 24. You should see 2 consecutive zeroes (for active D-channel).

Set up **ISDN PRI CONFIGURATION:**

EMULATE TYPE	:	TE
Q.931 STD	:	set according to switch type
TEST PATTERN	:	2047 (or as desired for data call)

Set up **OTHER PARAMETERS:**

Line 1 D chnl	:	24
Layer 2 SAPI	:	0
Layer 2 TEI	:	0
L1INTERFACE ID	:	0

To Place a Call from **START/LINK CALL SETUP**

Check for Received Layer 2 Message RR or UA and reverse-video **READY** message on top. Press **CALL (F3)** key to bring up call screen.

Highlight **CALLED NUMBER**. Press **SHIFT** then Yellow Numbers to enter the phone #, then **SHIFT** again to exit numeric mode.

Highlight **CALLER NUMBER**. Press **SHIFT** then Yellow Numbers to enter the phone #, then **SHIFT** again to exit numeric mode. This field is optional.

Set up **START LINK/CALL SETUP:**

B CHANNEL #	:	select B-channel for call
NSF CODE	:	NONE
NSF TYPE	:	SERVICE
CALL TYPE	:	VOICE, DATA-56, DATA-64

Press **CALL (F4)** or **ENTER** to place the call.

Once the call is connected, talk/listen for voice calls or **BER** test a data call. To **BERT**, press more (F4), then **BER (F2)**. If you have a loop in place, press the **ERR INJ** key and verify that the errors come back to you. Press **ESCAPE** to exit the **BERT** screen.

Press **DISC (F2)** to disconnect the call.

To Receive a Call from **START/LINK CALL SETUP**

For an incoming call, the set will ring and **RECEIVE A CALL** appears on the top of screen. The **SETUP MESSAGE**, with Call Ref. and Caller #, is displayed.

Press **ACC-TERM (F2)** to accept the call.

Once the call is connected, talk/listen or **BERT** test a data call- press more (F4), **BER (F2)**

Press **DISC (F2)** to disconnect the call.

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Product Overview

Congratulations, you have just purchased the industry's leading hand-held T1 test set, the SunSet™ T10. This test set puts powerful signalling and transmission test capabilities into a single, convenient, hand-held package.

Each SunSet T10 features:

- Circuit graphics to easily keep track of complicated circuit set-ups
- SunWare cartridges for fast and convenient feature upgrades
- Full-size display for more efficient operation and faster data correlation
- Field upgrade to SunWare options not purchased with the original set
- Quad signal interface (two transmits, two receives) for accessing the complete circuit and for hitless full duplex drop and insert capabilities
- Automated span acceptance tests
- A rich selection of stress patterns
- 32 pages of received T1 data: binary, hex, and ASCII protocol displays
- Simplex loop current and level measurement
- Talk/listen with dialing capability, 24-channel supervision bit display, tone generation, view data bits
- Receive signal sensitivity to -36 dBdsx, transmit signal build out, and pre-equalization
- 5 ppm accuracy clock
- Framing: unframed, SF, ESF, SLC-96*
- Propagation delay measurement
- Menu-driven user interface for simple and efficient operation
- Full range of bi-color LED indicators for simplicity and speedy operation
- Full range of in-service and out-of-service measurements
- Line/path/service measurements, counts and rates

Optional SunWare features give you even more diagnostic power:

- VF level, frequency, & noise measurement
- MF/DTMF/DP dialing, decoding, and analysis

* SLC-96 is a registered trademark of AT&T

- Signalling analysis
- Basic DDS testing from a T1 access point
- ISDN primary rate call set-up and monitor
- Switched 56 testing
- Signalling System 7 Protocol Analysis (ANSI, CCITT, CHINA1, CHINA24)
- On-screen pulse mask analysis
- ESF datalink loopbacks, datalink read and receive. T1.403 and Pub 54016.
- SLC-96* datalink transmit and receive
- Fractional T1 testing for maintaining your newest nx56 and nx64 kbps services
- Asynchronous and synchronous datacom testing at all data rates: .3, .6, 1.2, 2.4, 4.8, 9.6, 14.4, 19.2, 38.4, 48, 56, 64, Nx56, and Nx64 Kbps
- X.21, V.35, RS-232 (V.21), RS-449 (V.36) interfaces
- Time-saving looping repeater tests for Teltrend and Westell, including distance to loopback to verify loopback location
- In-service CSU/NI emulation
- Menu-driven remote control capability
- Westell performance monitoring, NIU and maintenance switch support
- Teltrend maintenance switch support

The SUNSET T10 is designed to help anyone who maintains or works with T1 circuits. Its broad range of capabilities, combined with its convenient hand-held size, makes it the favorite of technicians in the central office, outside plant, and corporate communications center. The set helps diagnose T1 problems quickly, whether the circuit is in-service or out-of-service. At the communications center, it can verify proper signalling and transmission performance in the telco-provided service, as well as simulate a telco switch to check the operation of a PBX or other customer premises equipment. In the outside plant, it can be used at repeater housings, digital loop carrier remote terminals, and cable splice points to troubleshoot the T1 signal. In the central office, it can be plugged into the DSX or attached to T1 equipment such as multiplexers, channel banks, digital cross-connect systems, and switches. It can also monitor both directions of an in-service circuit for voice, data, and signalling.

This manual is designed to provide you with all the information you will need concerning your SUNSET T10.

If you would like further information, or if you encounter problems, please contact Sunrise Telecom Customer Service for assistance:

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Chapter 1 Technology Overview

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This section gives you an overview of T1 technology and equipment. It also shows you the basics of troubleshooting and sectionalizing problems with T1 circuits. Note that T1 is a general term that refers to the transmission of 1.544 Mbps digital circuits over any media. T1 can be transported over copper, fiber, or radio. DS1 is the term for the electrical signal found at the metallic interfaces for these circuits where most testing is performed.

Section 1 T1 Transmission

T1 usage

T1s are used for a variety of purposes. They are widely embedded in the network distribution architecture as a convenient means of reducing cable pair counts by carrying 24 voice channels in one 4 wire circuit. End users have migrated their private networks onto leased T1s as a means of reducing their network operation costs. DS1 is a universal digital access point to traditional digital networks and newer fiber optic synchronous networks.

T1 services

Telephone companies are now selling T1 point-to-point circuits in a variety of formats. Channelized T1s are often sold as a means of connecting PBXs (Private Branch Exchanges) or ACDs (Automatic Call Distributors) to a central office switch. In this case, the telephone company may also install and maintain a channel bank for the customer at their premises. T1 "pipes" are sold to more sophisticated users who only require point-to-point connectivity of a T1 circuit from the telephone company.

DS1 Network Elements

As shown in Figure 1.A, a rich variety of equipment is available for T1 circuits. This section gives you an overview of T1 technology and equipment. It also shows you the basics of troubleshooting and sectionalizing problems with T1 circuits. Note that T1 is a general term that refers to the transmission of 1.544 Mbps digital circuits over any media. T1 can be transported over copper, fiber, or radio. DS1 is the term for the electrical signal found at the metallic interfaces for these circuits where most testing is performed.

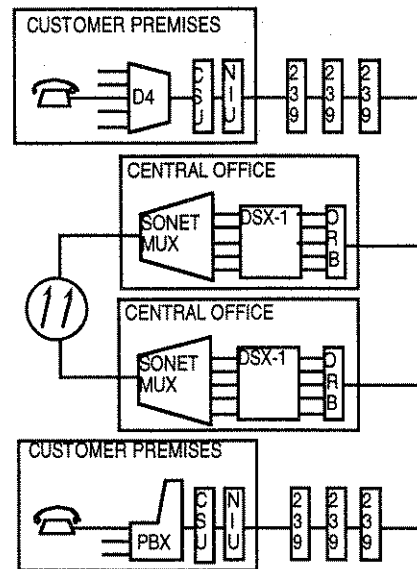


Figure 1.A
DS1 Network Elements

CSUs, or Customer Service Units, can convert a V.35 or other computer-based synchronous signal format into the DS1 format and insert the appropriate DS1 framing. CSUs also provide loopback capability, indicator lights, monitor jacks, and split access for troubleshooting and installation debugging. Network Interface Units (NIUs) are installed by the telephone company at customer premises for a variety of maintenance reasons. The NIUs also provide a loopback, but at the telephone company control. This loopback allows the telephone company to verify that the circuit works all the way to the point of interface with the customer's network. The NIUs may also be configured to loopback signal, send AIS, or send idle signal when the customer signal is unplugged. New kinds of NIUs even provide performance monitoring information and maintenance switching capability.

T1 can be transmitted over twisted pair, fiber, or digital radio. Twisted pair (normal telephone wire) is the most widely spread form of transmission and has several types of associated network

elements. Regenerative repeaters, for example AT&T's 239 series, are located up to 6000 feet apart on a twisted pair span. The repeaters are housed in apparatus cases. The repeaters are located within 3000 feet of the central office and the customer premises in order to avoid cross-talk problems when the signal is carried on building wiring. Newer line repeaters offer loopback capability for faster span sectionalization. Central office repeaters provide the 60 mA span current used for powering the regenerative repeaters on the span. The repeaters may be housed in Office Repeater Bays (ORBs). Newer central office repeaters automatically adjust the supplied voltage to adapt to varying numbers of repeaters plugged into the span. They also may have fractional T1 blocking capability to allow the telephone company to sell a reduced price T1 that only carries a certain number of channels. They also may have the automated loopback capability and span power-down power-up capability.

A variety of equipment is found at the ends of DS1 lines. D4 channel banks are a traditional form of multiplexer that converts ordinary telephone wires to 64 kbps channels for multiplexing onto a DS1. Newer D4 banks offer a wide variety of channel plug-ins to handle DDS-style circuits, private line circuits, and even ISDN. AT&T SLC-96 (SLC is a registered trademark of AT&T) and SLC-5 systems are commonly found in the Bell environment and were designed as enhancements to the older D4 style.

M13 multiplexes are a traditional higher-order multiplexer for DS1s. These units take up to 28 DS1s and multiplex them into a DS3. Note that the DS1 framing and payload still exists inside the DS3 signal, but that the DS1 line coding is not passed through.

PBXs, class 5 switches (central office switches connected to local subscribers), and toll switches are often found at the end of T1 lines. These elements use DS1s as a way of concentrating their connections to local subscribers and interoffice trunks. The function of these elements is to take supervision and addressing information from subscribers, set up a call throughout the world network for the subscriber, connect the subscriber through when the path is set up, and terminate the call when the subscriber is finished.

A variety of Digital Cross-connect Switches (DCSs) connect to

DS1 lines. DCSs commonly reduce the space required for achieving channel cross-connection, eliminate the manual labor associated with cross connection, and can provide amazingly fast computerized rerouting of facilities in the event of a network outage. The common DCSs are of type 1x0, 1x1, and 3x1. A 1x0 DCS has DS1 ports interfacing the network. Internally it cross-connects DS0s between the DS1s according to instructions that have been entered in through the administrative terminal. The 1x0 DCS takes the place of many racks of 1x0 multiplexes combined with a DSX-0 manual cross-connect bay. A 1x1 DCS is also called an electronic DSX-1 and is designed as a replacement for the DSX-1. A 3x1 DCS has DS3 ports and possibly also DS1 ports facing the network. It replaces a bank of M13 multiplexes and the DSX-1.

A wide variety of SONET (Synchronous Optical NETWORK) equipment is now being deployed in the network. This equipment operates at higher rates and introduces a wide variety of new signal formats, both optical and electrical. Much of the SONET gear is also designed to interface to the embedded network and has DS1 and DS3 interfaces. SONET equipment replaces equipment like M13 multiplexes and 3x1 DCSs.

DS1 standards

Many standards govern various parts of DS1 transmission and network elements. The two most important standards are perhaps:

- ANSI T1.102 - 1987, Digital Hierarchy, Electrical Interfaces
- ANSI T1.403, Network-to-Customer Installation - DS1 Metallic Interface

DS1 Signal

The DS1 signal is a 1.544 Mbps 3.0 Volt signal. It uses a bipolar format and there are two line codes used in transmission, Alternate Mark Inversion (AMI) and Bipolar 8-Zero Substitution (B8ZS). AMI was the original line code used when DS1 was first introduced. However, its use is suboptimal in today's networks which mix data transmission with voice transmission and which require near error-free quality. The problem with AMI line coding is that it requires the terminal transmitting data to have at least a 12.5% average 1s density and a maximum of 15 consecutive zeroes. This data content is impossible to guarantee when computer data is being transmitted, so transmission quality can suffer. In com-

parison, B8ZS uses a bipolar violation substitution which guarantees the 12.5% average with maximum number of 7 consecutive 0s. Most networks are moving towards B8ZS line code usage. See Figure 1.B for an illustration of the DS1 signal.

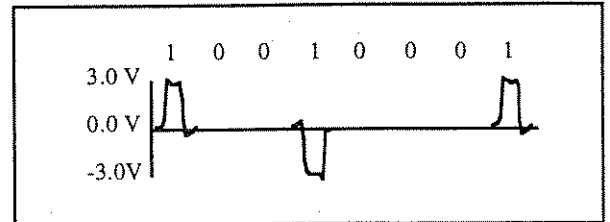


Figure 1.B
DS1 Pulse Transmission

T1 Framing

In T1, there are 192 data bits and one framing bit. With framing, you can tell where the first bit of the frame is. Most T1s are arranged with 24 channels of data, with one byte (8 bits) transmitted per channel per frame. Channel 1 is the first 8 bits after the frame bit, channel 2 is the second 8 bits after the framing bit and so on. 8000 frames are transmitted per second. Each channel provides 64 kbps bandwidth. See Figure 1.C.

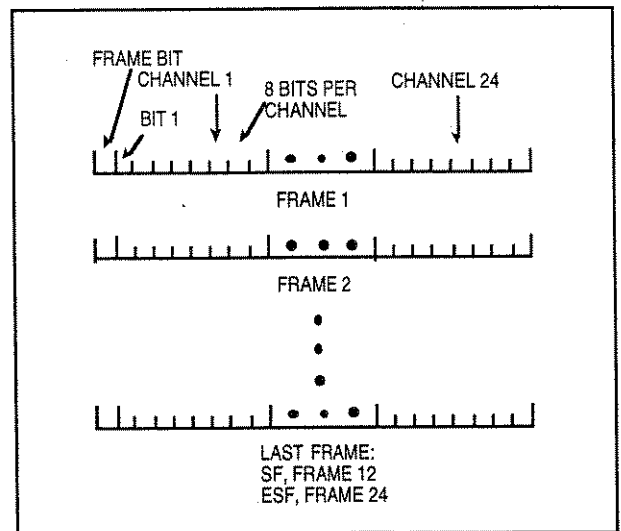


Figure 1.C
DS1 Frame Structure

There are 3 kinds of standardized T1 framing in use today, SF, ESF, and SLC-96 (SLC is a registered trade mark of AT&T).

The simplest is SF framing. In SF framing, 12 frames are grouped together as a Super Frame (SF). The 12 framing bits are transmitted in a recognizable pattern such that the super frame is organized into frame number 1, frame number 2, and so on.

ESF (Extended Super Frame) is a newer method with 24 frames grouped together. Of the 24 framing bits, only 6 are used to establish the frame position, i.e. which frame is number 1, which frame is number 2, and so on. Another 6 are used for a CRC-6 (Cyclic Redundancy Check code - 6), and 12 are used for the ESF Facility Data Link (FDL). The CRC-6 bits are the remainder from a division of the bits of the previous frame by a sixth-order polynomial. Any monitoring device along the line can do the same division process and compare its remainder to the CRC-6 bits. If the two figures are not identical, then the monitoring device can assume that a transmission error has occurred somewhere between the measurement point and the origin of the ESF-framed signal.

The facility data link is a 4 kbps data channel that allows terminal to terminal communications on an in-service circuit. One example of in-service communication is the performance report message that is broadcast once per second on an in-service circuit. This message is discussed later in this section in End-to-end Performance Monitoring. The facility data link also provides a secure communication channel that the customer cannot influence. For instance, ESF NIU loopback commands are transmitted on the data link so that there is zero chance that the customer's own payload data will accidentally loop up the NIU.

SLC-96 is a framing format introduced by AT&T and later standardized by Bellcore in TR-TSY-000008, Digital Interface between the SLC 96 Digital Loop Carrier System and a Local Digital Switch. The framing is used on AT&T's old SLC-96 product line. The framing supports a broad variety of maintenance functions such as alarm transmission, automatic switching to protection line, and far end loop back. SLC-96 framing is used on the DS1 link in between the central office terminal and the remote terminal.

PCM

Pulse Code Modulation (PCM) is the technology that allows a voice conversation to be digitized and inserted on a T1 line. In a voice conversation, there is a 4 kHz analog bandwidth that is transmitted through the network. Through the Nyquist theorem, 8000 samples per second must be taken in order to achieve the 4000 kHz bandwidth requirement. As shown in Figure 1.D, the analog signal is sampled at 125 micro second intervals, 8000 times per second. Each sample is a measurement of the voltage of the analog signal. The voltage level is then converted to an 8-bit binary word. An 8-bit word provides 256 different levels, which is not very many. To produce a higher quality sound, a μ -law transformation is used which puts a constant dB level in between each voltage step. This creates a nonlinear relationship between the pulse amplitude and the level number, but it is more pleasing to the ear because it provides a more constant signal to noise ratio at a wide range of volumes. Each 8-bit word occupies one channel in one frame. Because there are 24 channels available, up to 24 conversations can be carried on the T1 signal.

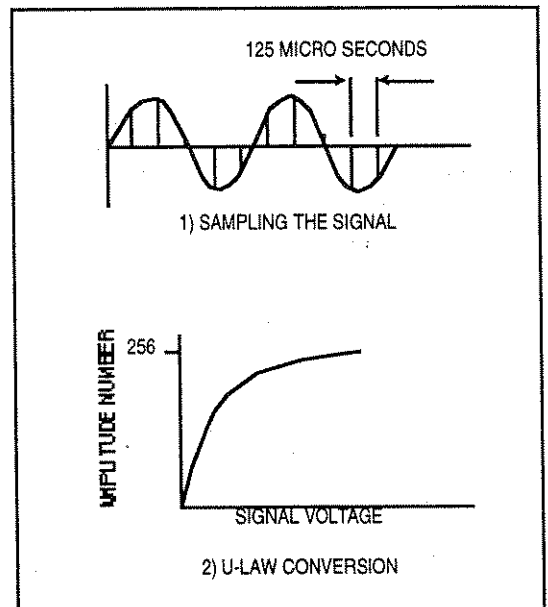


Figure 1.D PCM Sampling and μ -Law Encoding

Switching

A basic understanding of switching is helpful when troubleshooting T1 problems. DS1, DS2, and DS3 signals are plesiochronous; that is, they are not frequency-locked with respect to each other. The DS2 and DS3 signals have stuff bits built into the framing so that all signals can be slipping with respect to each other and not cause any transmission errors at all. The frequencies are only required to be about +/- 20 ppm to +/- 50 ppm (parts per million) of center frequency for error free transmission.

Long after this digital plesiochronous (sometimes called asynchronous) transmission technology was adopted, switches also began a conversion from analog technology to a newer digital technology. Unfortunately, the original DS1 framing concept never anticipated a need to cross-connect DS0s directly from one DS1 to another DS1. Unfortunately, this is exactly what happens inside a digital switch. A call that comes in on one channel of one DS1 goes out on another channel of another DS1.

8000 times per second, a switch takes one received frame from each of the DS1s connected to it. It disassembles each frame into the 24 independent timeslots inside the frame. It looks into its call map to see where each of the received timeslot bytes should be sent. Then it sends each byte to the appropriate DS1 transmit port. Then it assembles all the bytes for each transmit DS1, inserts any idle code on timeslots that are not actively in the middle of a call, and inserts an appropriate framing bit for the frame type being used. Then it transmits each DS1 frame during 1/8000 of a second. There may be several 125 µsec periods of delay for a byte as it moves through the switch.

Not all the DS1s will have the frames ending at exactly the same moment in time. For this reason, the switch maintains a buffer for each transmitted and received DS1 signal. Each buffer provides an elastic store of bits so that the switch will always have bits available to transmit or receive at the exact moment required.

All the DS1s must be received and transmitted at exactly the same frequency, the frequency that the switch is operating at. Any received DS1 that is going too slowly will eventually run out of bits in its buffer, because the switch is taking bits out of the buffer faster than the buffer is being filled by the DS1. When the

buffer becomes empty, the switch must insert extra data in each of the timeslots that are transmitted on the cross-connected channels. An error has now occurred because what is transmitted is not the same as what is received. Likewise, if any received DS1's frequency is higher than the switch, sooner or later the receive buffer will overflow because bits are coming in faster than they are being taken out. Once the buffer overflows, some bits that are received will not be transmitted on the cross-connected channel. An error has again occurred, this time because some data has been lost.

The universal deployment of digital switches has resulted in a massive effort to synchronize all DS1s so that errors will not occur in switched circuits that use DS1 for transport.

Synchronization

DS1 circuits should be synchronized to avoid the switching problems described in the previous paragraph. Minor frequency deviations will cause only pops and crackles on a voice circuit. However, a data circuit can be rendered virtually useless by the regular errors resulting from frequency slippage. If a DS1 should be slipping by more than 100 to 300 bps, then a digital switch may even put the DS1 out of service and declare an alarm.

Complete synchronization is achieved only when all signals can have their frequency traced back to the same clock. When a network element is installed, its timing relationship is one of the items that needs to be engineered. The relationship is usually one of master/slave. For instance, if a PBX is connected to a central office switch via a T1 line, chances are good that the central office switch is properly synchronized to the network. Therefore, the DS1 signal received by the PBX from the central office will be synchronized to the network. Thus, the PBX should be set up to be in slave timing mode, with the DS1 signal received from the central office used as the timing source. In turn, a D4 channel bank that is connected to the PBX should be slaved to the PBX. One possible distribution of clock in the network is illustrated in Figure 1.E.

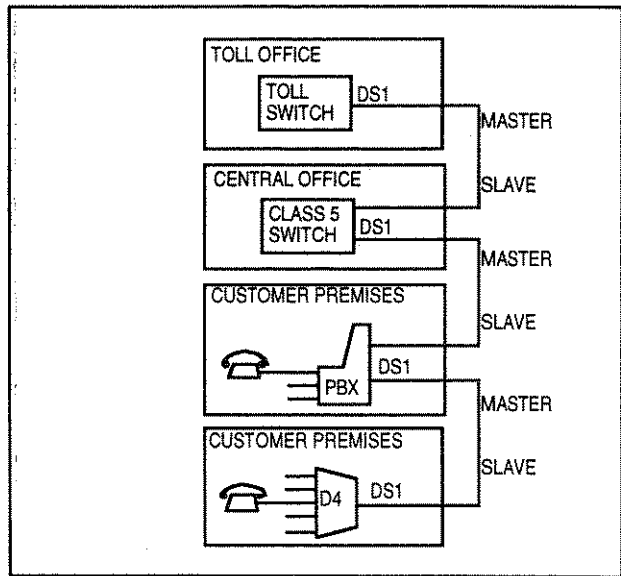


Figure 1.E
Timing Distribution

Note that a network element that is slave timed to another network element may also be the master to other network elements attached to it. Also note that slave timing is sometimes called loop timing or receive timing - loop timing because the received timing is looped out the transmitter, and receive timing because the received signal is used for the timing source.

Another timing option is internal timing. The advantage of this is that the element will always be able to generate a signal, no clock signal is required. Test sets doing acceptance testing are usually set to internal timing. Note that internal timing is not acceptable when the test set will be transmitting toward a switch for nx64 kbps testing when the switch is drawing its timing from something other than the test set. In this case the test set should be loop timed.

Supervision

Common T1 framing methods transmit supervisory information through "robbed bit" signaling. Every 6 frames, the least significant bit in the PCM byte for every channel is "robbed" and is

instead used to transmit signaling information. In SF framing, bits in the sixth and twelfth frames are "robbed" to form the A and B signaling bits for each channel. These bits are interpreted according to the kind of circuit carried in the channel. For instance, on an E&M circuit A= 0, B= 0 means that the circuit is idle, (the user is on-hook). A = 1, B = 1 means that the circuit is seized (the user has taken his phone off the hook).

With ESF framing, there are 24 frames grouped together with bit 8 of each channel in frames 6, 12, 18, and 24 as the ABCD signaling bits. Most ESF signaling is identical to SF signaling - the C and D bits are copies of the A and B bits.

SLC-96 supervision is handled via the SLC-96 data link.

Addressing

Addressing is the process of sending a telephone subscriber address for the purpose of setting up a call. The oldest addressing technique in use today is pulse dialing. With pulse dialing, your phone goes on-hook and off-hook 10 times per second in order to dial a given number. For example, to dial a 7, you start out in the off-hook condition, then you go on-hook / off-hook 7 times. This is the technique that old rotary dial phones use. This addressing information is transmitted through a T1 line by toggling the A and B bits from the off-hook state to the on-hook state at a rate of 10 times per second. This sort of addressing is now commonly used in switched 56 services.

MF, Multi Frequency, is an addressing technique used for inter-office signaling in the telephone network. It uses a group of frequencies in pairs to form a single address tone. In addition to supporting the digits 0 through 9, MF offers many other control codes for specialized network applications like billing, pay phones, etc.

DTMF, Dual Tone Multi Frequency, is the commonly used addressing method on today's phones. Like MF, it uses pairs of tones to send a digit. Unlike MF, it uses two separate groups of tones. DTMF supports 16 digits, 0 through 9, #, *, and A through D.

AIS and Yellow Alarms

In DS1, an intermediate network element such as an M13 multiplex, 1x1 DCS, or SONET mux, is supposed transmit AIS downstream when it receives a loss of signal. The DS1 AIS is an all 1s unframed signal. A terminating network element like a D4 channel bank, PBX, central office switch, or 1x0 DCS should send a yellow alarm back towards the other end when it receives a loss of frame. Note that a received AIS is a loss of frame. Terminating elements also need to properly condition the DS0s that the DS1 carries when the frame is lost. For instance, A D4 channel bank is supposed to condition its channel cards to take them out of service and transmit an appropriate out-of-service signal to the low speed equipment that is attached. See Figure 1.F for diagrams on how the AIS and yellow alarms are transmitted.

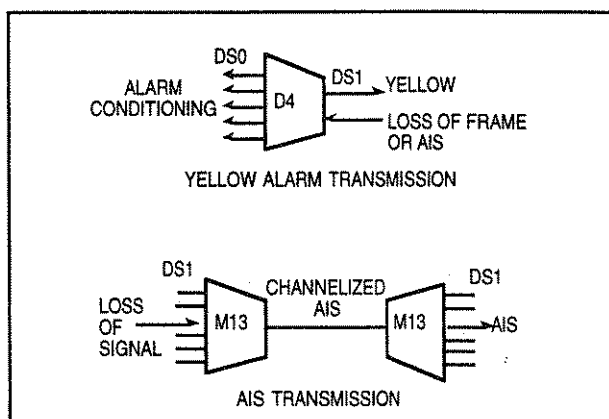


Figure 1.F
AIS and Yellow Alarms

Loopbacks

Loopback testing lets you quickly verify the performance of a new DS1 circuit. It can also greatly speed the fault sectionalization process on a circuit that is not working properly. Loopback capabilities are provided in a variety of equipment - new central office repeaters, new regenerative line repeaters, NIUs, CSUs, and M13 multiplexes. The general characteristics of these equipment have been discussed in the DS1 equipment section. Figure 1.G shows the variety of loopback points available from the central office during a fault sectionalization process.

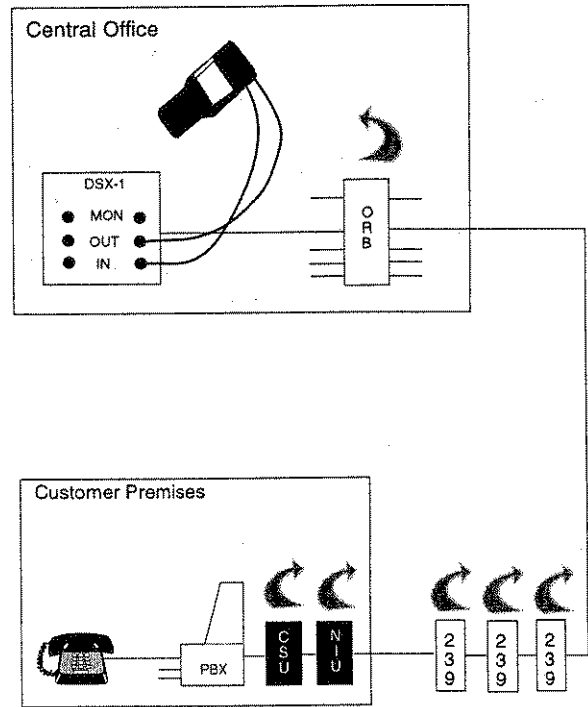


Figure 1.G
DS1 Loopback Testing

End-to-end performance monitoring

End-to-end performance monitoring is made possible through ESF framing and CSUs that support the Performance Report Message (PRM) broadcast on the ESF Facility Data Link (FDL). This capability is specified in ANSI T1.403.

With ESF performance monitoring, any CRC-6 error or bipolar violation that is received by the CSU is transmitted out towards the other direction in the performance report message on the facility data link. In that way, the end user or the various telephone companies that provide transport service can all have equal ability to see the quality to the end-to-end transmission while the circuit is in-service. Before this capability was available, the circuit would have to be taken out of service in order to measure

the end-to-end transmission performance.

This new end-to-end performance monitoring capability gives the customer a way to verify the quality of the service that the telephone company is delivering. It also allows the telephone company to set up internal monitoring systems to report on the average grade of service provided to customers. The telephone company may also receive early warning of some failures, i.e. those failures that are preceded by a gradual period of deterioration. This early warning could allow the telephone company to fix the problem before the service is lost.

End-to-end performance monitoring is illustrated in Figure 1.H. In this figure, a fault on the transmission line induces repeated errors on the service. The CSU at the end of the line sees the errors as CRC-6 errors and generates a performance report message in the other direction. The installed performance monitoring equipment in the central office and the technician using her SunSet can both see the message.

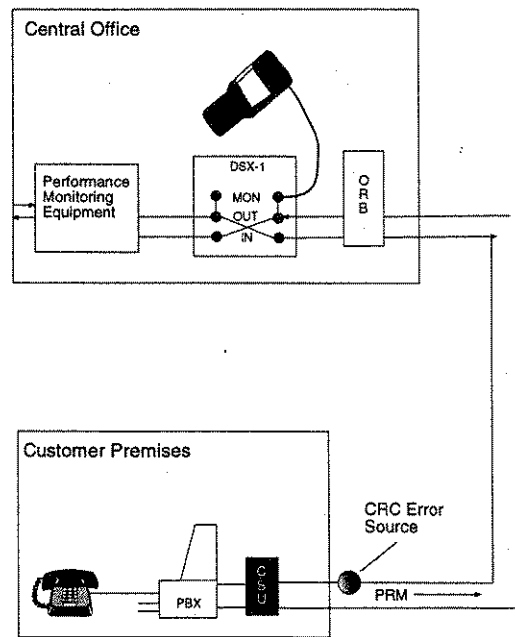


Figure 1.H
DS1 Performance Monitoring

Section 2 Circuit Troubleshooting and Fault Sectionalization

This section will help you find problems on T1 circuits. First you will get a checklist on various problems that often happen with T1 circuits. Then you will see how the information you have learned about errors and alarms helps you quickly find the problem.

Here is a checklist of items to be checked on a T1 circuit:

- Is the circuit wired up properly? Check for loose wire wraps, bad splices, connections to wrong pair, etc.
- Are there any cable problems? For example, bridge taps, "wet" cable, paper insulated cable, shorts, grounds.
- Is the cable T-screened? Ideal T1 transmission cables use a screen to separate the two directions of transmission to prevent cross talk. Are the T1s in the screened cable properly separated into Transmit and Receive binder groups?
- Has the circuit been connected through properly at all the offices along its route?
- Are Transmit and Receive backwards? A surprising number of circuits get plugged in backwards. Try the other way.
- Is there any AMI/B8ZS mismatch? AMI and B8ZS line codes are incompatible with each other. Both ends of a T1 line must use the same coding. If all ones works fine, QRS has errors, 3-in-24 will not synchronize, its probably AMI/B8ZS mismatch.
- Is there a framing mismatch? Be sure the framing is the same on both sides.
- Does the problem reappear when you drop the loopback? The problem is probably with the equipment on the far side of the loopback.
- Is the circuit connected to a switch or PBX? Look for frequency mismatch.
- Are DS1 signals used throughout? Sometimes people plug DS1 into DS1C by mistake, or other signal format incompatibility
- Is there a double loopback? Sometimes 2 or more loopbacks of the same type get installed where only 1 is expected. In this case a double or triple loop may occur on a loopback code and the loopdown code may have to be transmitted 2 or more

- times before all the loops come down.
- Is there a termination problem? All lines should have only 1 100 ohm termination. Other terminations should be high impedance. If you're not sure, try TERM, BRIDGE, and MON.
 - Is the level too low? The received level should be at least -15 dBdsx for most equipment. Line repeaters and your test set work to -35 dBdsx.
 - Is there a frequency synchronization problem? See the discussion in this chapter.
 - Is there a cross-talk problem? If the signal level is lower than -12 dB, another signal could be cross-talking onto the received T1 line.
 - Are repeaters installed? Are they at the right spacing?
 - Is there a span powering problem? 60 mA span power needs to be delivered to all repeaters on the span, all repeaters should have their power switches properly set to LOOP or THRU. The central office automatic span powering repeater should be delivering the proper voltage to power the span. All the repeaters before the farthest one away from the central office should be set to THRU. The farthest repeater or the NIU should be set to LOOP. Too many repeaters will overload the central office repeater.
 - Is the NIU span powered? Is that span power provided?
 - Is the central office repeater transmitting a 6V signal that is not being padded to 3V before it gets to the next equipment?
 - Is the test cord broken or dirty? This can cause misleading test results.
 - Is the test set working properly? This can also cause confusion when troubleshooting problems. A quick way to check the test set is to loop the test cord from transmit to receive, checking both the cord and the set at the same time. Common test set problems are wrong termination (TERM, BRIDGE, DSXMON), wrong clock setting (INTERNAL is right for most cases), wrong framing, wrong line code, wrong Nx64 selection, and wrong test pattern.

Fault sectionalization

Fault sectionalization techniques vary depending on whether the T1 circuit is in-service or out of service. If it is out of service, then you start from the middle and loop back the circuit in each direction to see which side has the problem. Then, you go to the

middle of the side that has the problem and do another loopback in each direction. You repeat this procedure until you find the problem. See Figure 1.G for an illustration of the loopback test. This figure shows many of the loopbacks that may be available in one direction from the central office. Note that there also may be DS3 loopbacks available if the circuit is a DS3 circuit, or DS1 channel loopbacks may be available in higher order multiplexes.

If the circuit is in service, non-disruptive performance monitoring techniques are used. Much can be learned simply by plugging into monitoring jacks and observing the information. Be sure to plug into the monitor jack for each direction and look at the results.

The following paragraphs tell you what conclusions you can make from various results at different monitor points. In the accompanying diagrams, a little SunSet T10 shows what abnormal conditions it is seeing from its monitor point. In the diagrams, a triangle indicates a line impairment that is causing steady or bursty errors. A loss of signal is indicated by a missing signal arrow. If CRC is listed in the diagram, it will only be seen if the circuit uses ESF framing.

Bipolar violations and loss of signal

DS1 bipolar violations or loss of signal show that the fault is relatively nearby. DS1 bipolar violations pass through line repeaters, office repeaters and NIUs, but are stopped by multiplexes, DCSs, switches, signal format changes (i.e. from optical to electrical, or from radio to electrical) and possibly CSUs. The DS1 electrical signal can be transmitted through regenerative line repeaters for hundreds of miles. Thus, a DS1 bipolar violation indicates a transmission problem between the test set and the last multiplex, DCS, or other element that stops BPVs. Figure 2.A illustrates the case.

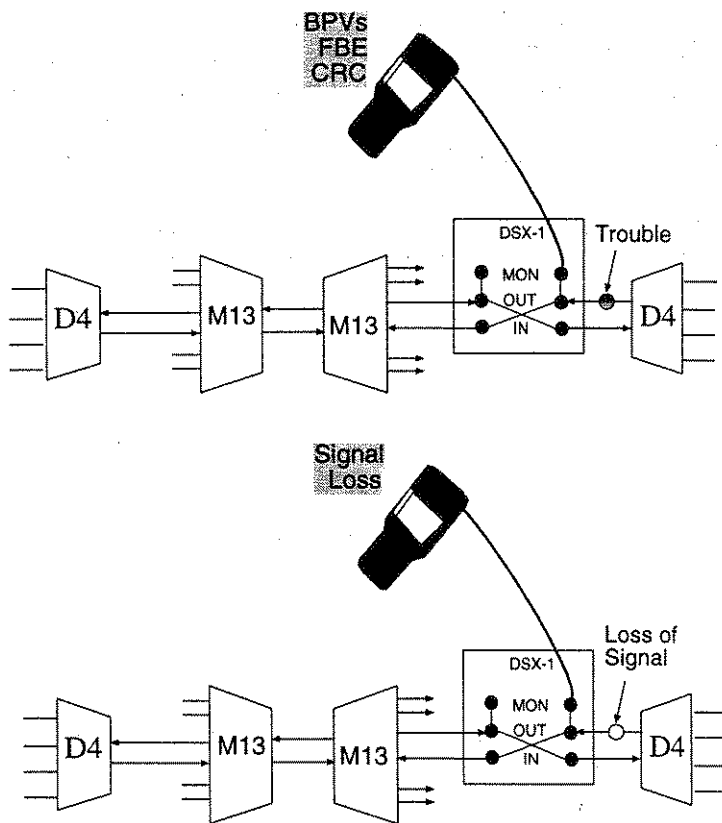


Figure 2.A BPVs and LOS in DS1 Fault Sectionalization

Frame bit errors, bit errors, CRC-6 errors

These errors travel with the DS1 circuit for the entire length of the circuit. They pass through higher order multiplexes. They also pass through changes in line format from copper to fiber, fiber to radio, etc. If these errors are found with bipolar violations, then the problem is local. If these errors are found without bipolar violations, then the problem is behind the last format change. Figure 2.B shows what these errors mean when they are seen without BPVs.

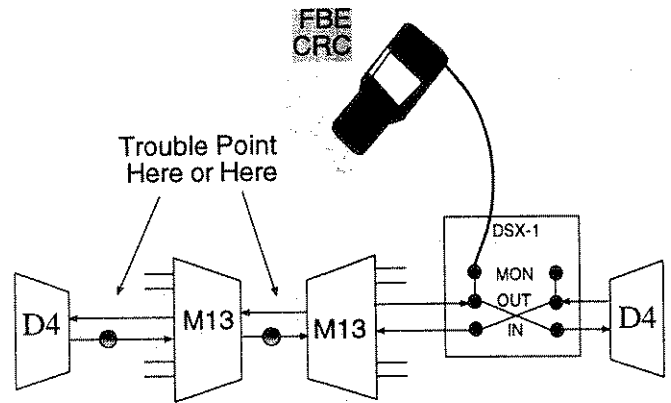


Figure 2.B
FBE and CRC in DS1 Testing

AIS and Yellow Alarm

AIS means that there is a problem on the line somewhere behind the last multiplex, DCS, fiber mux, or other device that replaces a loss of signal with AIS.

Yellow alarm means that the received signal has been lost at the end of the line that generated the signal you are monitoring. When you monitor the other direction, if the signal is framed, then the problem must exist between you and the end of the line generating the yellow. If the signal is unframed (for example AIS or loss of signal) the trouble is between you and the other end of the circuit.

Figure 2.C shows how the AIS and Yellow alarms show up in DS1 fault sectionalization.

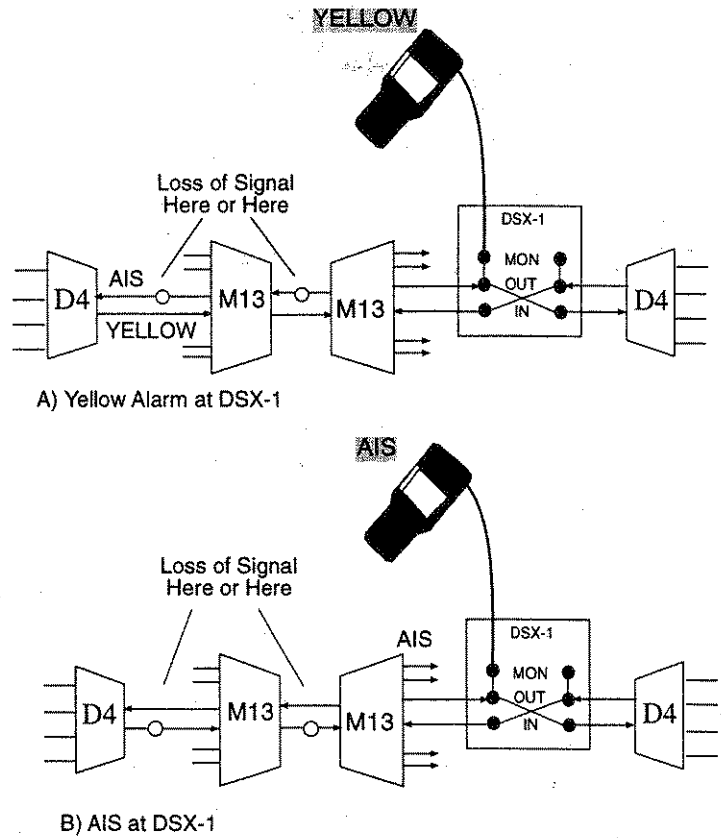


Figure 2.C
DS1 Yellow and AIS

FEBE or ESF PRM errors

Both of these indicate that errors are being received at the end of the line that is generating these messages. If you see no errors on the other direction of the line being monitored, then the problem exists between you and the end generating the FEBE or PRM error messages. If the other side shows BPVs, CRC-6, frame or other errors, then the problem exists between you and the end of the circuit that is not generating the FEBE or PRM error messages.

Figure 2.D shows a typical example of a network fault leading to this indication.

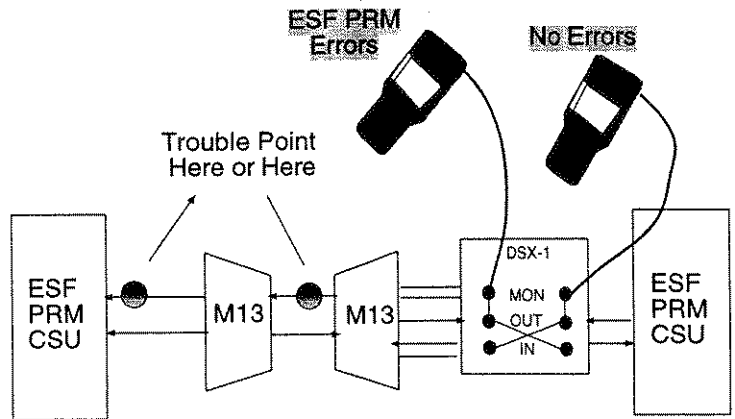


Figure 2.D
DS1 ESF PRM Errors

Chapter 2 Initial Setup

Table of Contents

Section 1	Unpacking the Test Set	2-1
Section 2	Check-out Procedure	2-5

Section 1 Unpacking the Test Set

Use the following procedure for unpacking and testing 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.

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

- 6) Ensure the SunWare cartridge is fully seated in its slot. Refer to Figure 1.A.

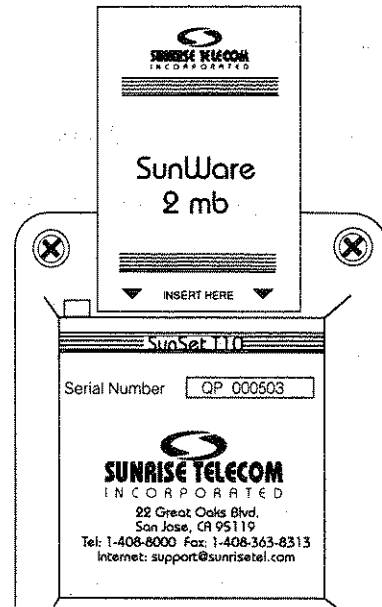


Figure 1.A
Cartridge Installation

Figure 1.B shows the cartridge after installation. Be sure that the top of the cartridge is in line with the top of the ejector button to the left.

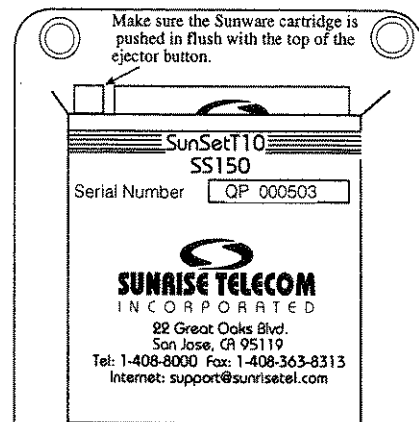


Figure 1.B
Cartridge after Installation

7) Plug the AC Battery Charger into an appropriate AC wall outlet:
120/12 V for SS128

8) If you choose to install the Instrument Stand, refer to Figure 1.B
and the following procedure:

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

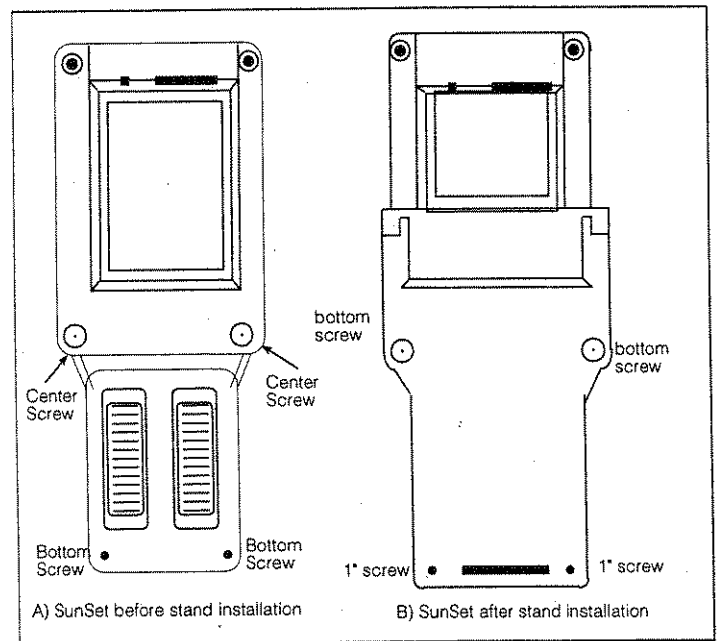


Figure 1.C
Instrument Stand Installation

- a. Remove the two center screws from the rear of the test set.
(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 test set.
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 test set.
 - d. Use the two long screws (provided with the Instrument Stand) to screw the Instrument Stand onto the test set at the two bottom positions.
 - e. Use the screws saved from step b) to screw the Instrument Stand onto the test set at the two center positions.
- 9) Switch the set on and verify that it passes the SELF TEST. If the test set does not turn on immediately, it may need to charge for up to 5 minutes before it can run.
 - 10) Charge the unit for at least one hour before its first use. Or, leave the AC Battery Charger plugged in while operating the test set.
 - 11) Put the test set and accessories into the soft Carrying Case (if it was ordered).

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

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

Section 2 Check Out Procedure

- 1) Plug in the AC charger.

WARNING: BE SURE TO USE ONLY THE SUNSET CHARGER FOR YOUR SUNSET T10. USE ONLY THE PRINTER CHARGER FOR THE PRINTER. IMPROPER USE OF ANY CHARGER MAY DAMAGE YOUR TEST SET, THE PRINTER, OR THE CHARGERS AND WILL INVALIDATE YOUR WARRANTY.

- 2) Plug a single bantam to single bantam cord into the LINE 1 RX jack and the LINE 1 TX jack. You will receive the signal you transmit on LINE 1.
- 3) Switch the power on. Observe the SELF TEST. Verify that the screen reads "NO ERRORS"
- 4) Observe the SunWare configuration screen that appears immediately after the SELF TEST COMPLETE message. Verify the serial and version number. Observe this screen again by turning off the power and turning it back on.
- 5) Press the LIGHT key to turn on your backLIGHT. Adjust the screen contrast by using the contrast control on the left side of the test set.
- 6) Press the ESCAPE or ENTER key to view the MAIN MENU. Move the cursor to the TEST CONFIGURATION item by pressing the appropriate arrow key. When the cursor is on TEST CONFIGURATION, press ENTER to set up the TEST CONFIGURATION. By pressing one of the F1-F4 keys, select T1SINGL for TEST MODE, TERM for RxLVL-1, ESF for framing, B8ZS for CODING, NORMAL for Tx SOURCE, INTERN for XMT CLK, 0 dB for LBO 1, and Nx64K for TEST RATE. Notice that you are now in a fractional T1 screen. You could AUTO configure to a received fractional T1 circuit or build up your own fractional circuit. For now, however, press ENTER to return to the TEST CONFIGURATION menu.
- 7) Study the graphic screen by pressing the GRAPHIC key. For both LINE 1 and LINE 2, the Rx is the test set's receiver; Tx is

the transmitter. Notice that LINE 2 DISABLED appears. This means that LINE 2's transmitter and receiver cannot be used. Look at your LEDs - if ERRORS is lit red, the TEST CONFIGURATION is most likely set up for BRIDGE or DSXMON instead of TERM.

- 8) Cursor to the TEST RATE item and select 1.544M (F1) for TEST RATE.
- 9) Press the GRAPHIC key and notice the changes. Press the GRAPHIC key again to return to the MAIN MENU.
- 10) Cursor down to the LPBK & SPAN CTRL menu and press the ENTER key. Move the cursor to CSU & NI CONTROL and press ENTER. Set TYPE to IN-BAND, CODE to NI, and MODE to LOOP-UP. Note that the operation begins the moment you press LOOP-UP (F1), so do this last if you make changes. You will get a pre-existing loop message.
- 11) After the set says PRE-EXISTING LOOP ONLY!...hit ENTER to continue, press the ENTER key. If you don't press the ENTER key immediately, the loop-up will be aborted. Press ESCAPE to return to the LPBK & SPAN CTRL menu.
- 12) If you have other choices available, cursor down and enter each of the items presented in the LPBK & SPAN CTRL menu. Observe all the functions presented to you. Press the "more" (F4) key to see any additional F-key selections available within each screen. When you are finished, press ESCAPE until you have returned to the MAIN MENU.
- 13) Cursor down to the SEND TEST PATTERN item and press ENTER. Observe all of the stress patterns available to you. The test set will synch only on the pattern it is sending. Quickly cursor around the screen.
Notice that a USER choice (F1) is given. You can name 10 user patterns up to 2048 bits each.
- 14) From the MAIN MENU, cursor down to MEASUREMENT RESULTS and press ENTER. NO ERRORS should display. Press the ERR INJ key and observe the measurement counts. You should have one BPV and one BIT error shown in the

SUMMARY screen. Pull out the bantam cable and put it back in after a few seconds. Notice that the unavailable second counter continues to count for 10 seconds after you put the cable back in and then it decreases by 10. Verify that the frequency displays 1544000 +/-1. Verify that the Lpp says 0 +/- 1.0 dB. Press the PAGE-DN (F2) as needed to see all the other measurements available. Press ESCAPE to return to the MAIN MENU.

- 15) Cursor down to OTHER MEASUREMENTS, enter it, and enter VIEW RECEIVED DATA. Press the PAUSE (F3) key. Press the PAGE-DN key as necessary to observe the fox message in the ASCII column. Notice also the binary and hex protocol displays and that the data is presented by timeslot number within consecutive frames. Verify that you can view 60 pages before the data repeats to page 1. Press ESCAPE to return to the OTHER MEASUREMENTS menu.
- 16) Enter the PROPAGATION DELAY menu and verify that it says 0 or 1 UI. Escape back to the OTHER MEASUREMENTS menu.
- 17) Enter the QUICK TEST - I menu. Cursor up to the TICKET line. Press the toggle (F3) key to get into the alphabet grid with the flashing letter A. Press SELECT (F4) to select A. Cursor over to B and press SELECT to choose B. Cursor over to C and press SELECT. Choose toggle (F3) to get out of the alphabet grid. Verify that the C is no longer flashing and that you see ABC as your TICKET. Cursor down to LOOPBAK and choose Ni. Observe the patterns and the times for this test. You could edit them by cursoring down. This test saves time on span acceptance tests. Press ENTER to begin the test. Observe the pre-existing loopback message. Observe NO ERRORS. ESCAPE to abort the test. Observe the results. You could PAGE-DN if you had let the test finish at least one of the TEST PATs. Escape to the OTHER MEASUREMENTS menu.
- 18) Enter and observe the BRIDGE TAP DETECT menu item. Press PAGE-DN to see the test summary. Wait 30 seconds until the first pattern is finished. A perfect score is BIT errors:0, errored seconds(ES):0, and available seconds(AS):30. ESCAPE back to the OTHER MEASUREMENTS menu.

- 19) If your set is configured for pulse mask analysis, enter the PULSE SHAPE ANALYSIS menu and press ENTER on START NEW ANALYSIS. Observe the pulse shape. Choose T1.403 (F1) and verify that the message T1.403 PASS is displayed. ESCAPE back to the MAIN MENU.
- 20) Enter the VF CHANNEL ACCESS menu (PAT SYNC turns off). Enter VF MEASUREMENTS. Use the NEXT (F1) and PREVIOUS (F2) keys to set up your RCV channel and XMT channel to 01. Turn up the volume by pressing the VOL UP on the key panel until you hear something. Blow into the microphone (located below the keypad) and verify that you hear the speaker (located on the LED panel). Set INSERT TYPE:TONE, TONE FREQ Hz:1004, TONE LVL dBm:0 dBm. If your set has level/frequency, verify the RxFRQ/LVL reads 1004Hz +/- 2 and 00.0 dBm +/- 0.3. Move the cursor to Tx A/B/C/D and choose OFFHOOK (F2). Verify that the Rx-1 A/B/C/D bits change to all 1s. Go ON-HOOK & verify Rx bits all 0s. Escape to the VF CHANNEL ACCESS menu.
- 21) Enter the PLACE/RECEIVE CALLS menu. Select METHOD to DTMF and cursor down to NUMBER. Press the SHIFT-lock key. Observe the SHIFT-lock indicator in the display. Press 4083638000. Press ENTER to dial the number. Verify that you hear it. Press the ESCAPE key.
- 22) Enter the VIEW SUPERVISION menu (speaker turns off). Verify the signaling of all channels is 0000 except for 1111 on CHNL 1. Channels 1 through 4 are on the top line. Escape back to the VF CHANNEL ACCESS menu.
- 23) Enter and observe the DIAL/SPRVIS SETUP menu. Escape back to the VF CHANNEL ACCESS menu.
- 24) Escape back to the MAIN MENU and enter OTHER FEATURES. Enter SYSTEM CONFIG. Enter and escape VERSION/OPTION to see the ordering options. Press PAGE DN (F2), if your options take more than one page. Enter FULL SELF TEST and verify that there are no errors. If your set lost PAT SYNC during the self test, press RESYNC. Enter ERASE NV RAM to reset the set's non volatile RAM and erase all your pro-

grammed patterns and profiles. Hit ENTER to continue. Turn the set off for 5 seconds when the test is complete to reload the memory. If you ever have a problem with the set, turn it off and on, or do either of these tests.

- 25) Re-configure your set in the TEST CONFIGURATION menu as in steps 7 and 8. Return to the OTHER FEATURES menu and enter SYSTEM CONFIG and SYSTEM PROFILES. Press VIEW (F1). PAGE-DN to see all pages. You can store and recall up to 10 instrument configurations here. Escape back to the OTHER FEATURES menu.
- 26) Enter MEAS CONFIGURATION and ERROR INJECTION. Observe the available options. Escape out.
- 27) Enter OTHER PARAMETERS. Observe the available options. Escape back to the MAIN MENU.
- 28) Enter DATA LINK CONTROL. See all the ESF datalink functions. SLC-96 functions would be displayed if the set was SLC-96 framed. Escape back to the MAIN MENU.
- 29) Enter CSU/NI EMULATION. Press LLPBK-1. Verify loopback picture. Escape back to the MAIN MENU.
- 30) If you have a Sunrise Telecom printer, connect the printer to its charger. Turn it on and connect the printer to the SunSet using the Sunrise Telecom mini DIN 8 to RS-232C printer cable. Press the PRN SCRN key to print out the current screen on the printer.
- 31) If you have remote control, hook it up to your PC with ProComm plus or other VT100 emulation software. Configure your PC for COM port 1, baud rate 9600, 8 bits, non parity, and stop bit set to 1. Plug the PC's 9-pin to 25-pin RS-232C adaptor to the PC 9-pin serial connector. Plug the adaptor 25-pin RS-232C end into a gender changer. Plug the gender changer into the Sunrise Telecom Null Modem Adaptor. Plug the Null Modem Adaptor into the Sunrise Telecom RS-232C to Mini DIN 8 printer cable. Plug the printer cable into the test set.
Type
logon

on your PC. The PC screen should display the remote control. On your PC type Q and RETURN for ESCAPE and ENTER. Type P to get the graphics. P, Q, and other commands are displayed at the left of the screen. The LEDs are displayed as a table of current and history conditions. The menu and graphics are just like the test set. A local user and a remote user can work on a problem together.

- 32) You have now finished. If you have any questions or if any of the verification steps failed, please read the User's Manual. If there is still a problem, please call Sunrise Telecom Customer Service at 408-363-8000 or (800) 701-5208.

Chapter 3 Product Description

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Section 1 Warnings!

T1 span lines contain high voltage. These voltages may appear on the tip and ring of the bantam jacks used to connect the signal to the SunSet T10.

Insert or remove SunWare cartridges only with the power switched off. Otherwise, damage could result to the SunWare cartridge.

Do not use the SunSet charger on the printer. Do not use the printer charger on the SunSet T10. Improper use voids the warranty and may damage the SunSet T10, the printer, or the charger.

Allow set to warm and any condensation to evaporate before use, when bringing the test set in from extreme cold to a warm environment. Condensation may interfere with the operation of the set and may result in damage if power is applied.

Do not immerse the set in water and do not expose the set to rain.

Section 2 Front View Description

Refer to Figure 2.A on the following page for the front view of the SunSet T10.

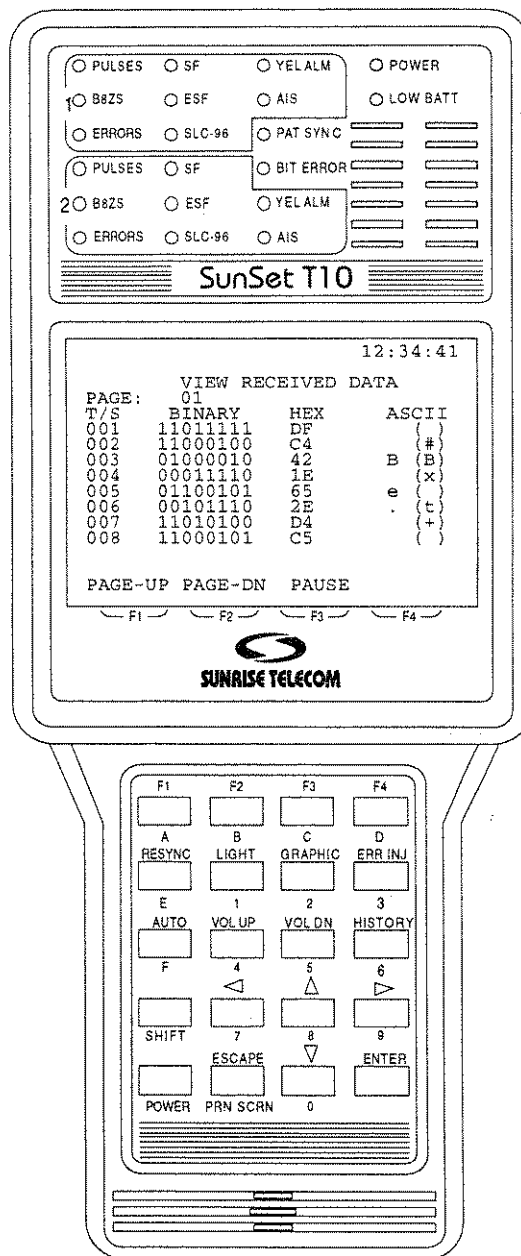


Figure 2.A
SunSet T10 Front View

There are two separate meanings for most keys. 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 reverse-video in the upper left-hand corner of the screen.

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

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

2.1 White Labels

F1 through F4

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

When you are configuring a set-up screen, a number of options are typically available for each of the set-up items in that screen.

The available choices will appear at the bottom of the screen. The desired option may be invoked by pressing the F-key directly below. Refer to Figure 2.1.A.

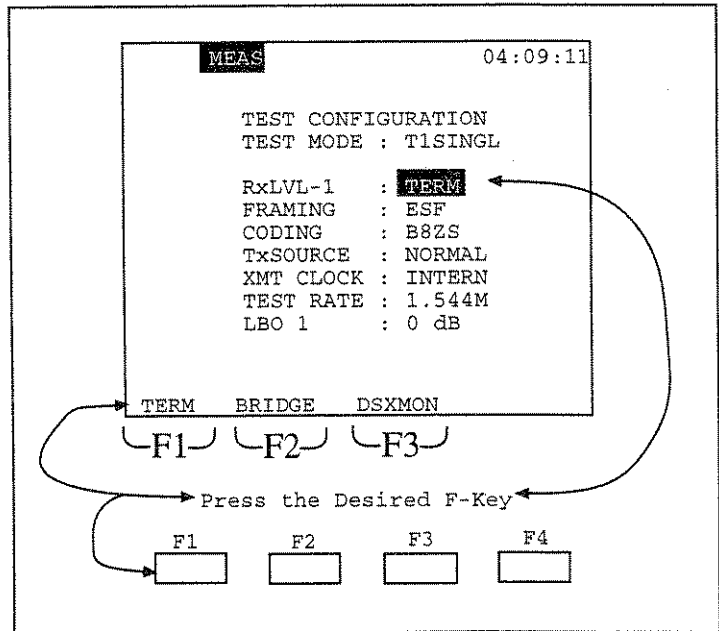


Figure 2.1.A
F-Keys

Note the following:

- 1) In most instances, when the desired F-key is pressed, the cursor will advance to the next display line 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 set-up parameter within that screen. As you change the position of the cursor within that 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" option will appear in the (F4) position. Pressing this key will show the other F-key options available.

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 PATSYNC light off. If the transmit pattern is found, then the PATSYNC LED turns green and logical measurements are made. During some operations like ISDN PRI call set up and VF CHANNEL ACCESS, bit error measurements are discontinued and the RESYNC KEY has no effect.

LIGHT

The backlight key is used to turn on and off the system backlight. Keeping the backlight off when it is not needed can add a few minutes to the battery life. Note that a timer can be set for the backlight in the OTHER FEATURES, SYSTEM CONFIG, GENERAL CONFIG menus. If this is done, the backLIGHT will automatically turn itself off after the specified amount of time has passed. The factory default is for a continuous backlight.

GRAPHIC

The graphic key draws a picture of the current circuit configuration. The graphic can be invoked during basic menus and basic operations such as TEST CONFIGURATION, SEND TEST PATTERN, MEASUREMENT RESULTS, and LPBK & SPAN CONTROL. It is wise to press the GRAPHIC key upon completing the TEST CONFIGURATION setup to ensure that you have selected the proper settings.

Graphics are also included as a basic part of several advanced features such as CSU/NI emulation, looping repeater menus, and pulse mask analysis. In these advanced menus, you will not get any additional graphics if you press the GRAPHIC key. In addition, graphics are not available while in DATACOM Mode.

The graphics will update according to successful operations within the test set.

ERR INJ

The ERRor INJect key is used to inject errors on the signal being transmitted by the test set. Errors will be injected according to the current setting in OTHER FEATURES, ERROR INJECTION. If the error injection MODE is RATE, when you press the ERR INJ key errors will be injected at the specified rate and there will be an error inject indicator in reverse-video at the top of the display.

AUTO

The AUTO key automatically synchronizes framing and test pattern. It also restarts the test in progress and clears any histor

indicators. It changes the transmit pattern to the received pattern. TEST CONFIGURATION settings are updated to the new framing. Pattern indicators are also updated in the SEND TEST PATTERN and MEASUREMENT RESULTS screens.

While the set is searching for the framing and pattern, you will not be able to perform any operations. You may continue after the framing and pattern are found.

VOL UP

The VOL UP key turns the speaker volume higher when the user is working in VF CHANNEL ACCESS/ISDN. Upon pressing the VOL UP key, a volume indicator will appear in reverse-video at the top-right corner of the screen.

VOL DN

The VOL DN key turns the speaker volume lower when the user is working in VF CHANNEL ACCESS/ ISDN. Upon pressing the VOL DN key, a volume indicator will appear in reverse-video at the top-right corner of the screen.

HISTORY

The HISTORY key is used to turn off flashing LEDs. LEDs flash to indicate an error or alarm that had occurred previously, but is no longer present.

ENTER

The ENTER key performs two functions:

- 1) When a menu item is highlighted and the ENTER key is pressed, the screen moves to the new screen indicated by the menu choice.
- 2) The ENTER key is also used in a few screens to invoke the operation, when the user is finished entering all the data in a given screen. After pressing ENTER, the test set then carries out the specified inputs. This happens in just a few cases like DTMF dialing and manual A/B(/C/D) bit entry. In almost all of the high usage functions, it is not necessary to press the ENTER key to invoke the operation. If the operation you are trying to perform does not seem to be occurring, try pressing the ENTER key. When the ENTER key is used to invoke the operation, you may need to press ESCAPE, when finished, to return to the previous menu.

ESCAPE

The Escape key has two functions:

- 1) It moves you back toward the Main Menu; keep pressing it until you get there.
- 2) The ESCAPE key may also be used to abort an unwanted action.

▲ (Cursor Up)

The Cursor up key is used to move the cursor up.

▼ (Cursor Down)

The Cursor Down key is used to move the cursor down.

▶ (Cursor Right)

The Cursor Right key is used to move the cursor right.

◀ (Cursor Left)

The Cursor Left key is used to move the cursor left.

2.2 Orange Labels

SHIFT

The SHIFT-lock (SHIFT) key is pressed to invoke any function specified by an orange label. This key is called a SHIFT-lock key because the set will be locked in the SHIFT mode until the SHIFT-lock key is pressed again.

Don't press the SHIFT-lock key at the same time as the other key. Instead, press and release the SHIFT-lock key first. Then press the other key.

The shift status of the test set can be observed in the upper left hand corner of the display. When the corner is blank, white-label key functions will be performed. When SHIFT is displayed, orange-label functions will be performed.

A, B, C, D, E, F

These keys are used to enter DTMF tones (A-D), special MF tones, letters in LABELs, and hexadecimal numbers.

0 through 9

These keys are used to enter user test patterns, user loopback patterns, numbers in LABELS, and telephone numbers.

PRN SCRN

Press PRN SCRN to print the current screen to the SS118 High Capacity Thermal Printer. The format will be bit mapped to allow any screen (menu, pulse mask, graphic) to be printed. This screen will not print to ASCII devices. Where PRINT F-keys are presented to the user, the output is generally formatted in ASCII characters and can be accepted by common printers and computers.

2.3 LEDs

The LEDs (Light Emitting Diodes) show the status of the received signal. Often, the LEDs tell you all you need to know. A LED is lit continuously when the condition for that LED is found on the received signal.

After an alarm (red LED) condition ends, the LED will begin to blink. This blinking provides a history for you in case you were absent when the condition actually occurred. Once you return and see the blinking lights, you may acknowledge the information by pressing the HISTORY key.

You can press the HISTORY key any time you want the history lights to go out. Note that the blinking will also stop automatically in some cases as you perform various operations in the test set.

BIT ERROR

The BIT ERROR LED lights if a BIT ERROR has been detected. This LED refers to the line selected as Rx/DROP in Test Configuration.

PAT SYNC

The pattern synchronization LED lights green if the unit receives the same pattern it transmits. You can select your transmit pattern in the SEND TEST PATTERN menu. You can view the transmit and receive pattern in the MEASUREMENT RESULTS and the GRAPHIC screen.

At first, the PAT SYNC LED is not lit if there is no pattern synch. Then, when pattern synch is found, the LED turns green. Once the LED turns green, if pattern synch is lost, the LED turns red. When pattern synch returns, it turns green again.

The following LEDs provide the same functions for both Line 1 and Line 2 displays. Line 2's LEDs are turned off in T1 SINGL mode. L2 and L1's LEDs are turned off in DATACOM mode.

PULSES

The pulses LED shows whether the test set is receiving a T1 signal or not. A green light means that a signal is detected; a red light means a loss of signal.

B8ZS

The B8ZS LED shows that B8ZS line coding is present on the received T1 signal. During severe BPV error conditions on an AMI line, the B8ZS light may also be on.

Note that the B8ZS coding can only be observed on a line if at least 8 consecutive data zeroes are transmitted on the line. An AIS signal or other high ones-density signal can make it impossible to determine whether the line is optioned correctly for AMI or B8ZS.

ERRORS

The errors LED lights if any kind of error has been observed. This could be a framing bit error, a bit error, CRC-6 error, or other error.

SF, ESF, SLC-96

These LEDs show whether the framing found on the received signal matches the framing selected in the TEST CONFIGURATION menu. If the framing matches, the appropriate framing LED will be green. If the framing doesn't match, then the framing LED selected in the TEST CONFIGURATION menu will be red.

SLC-96 LED framing is used on the A DS1 on the SLC-96 system. The B and D DS1s use SF framing. The C DS1 will show SLC-96 framing in mode II.

Although the SunSet T10 will recognize a SLC-96 signal from a SLC system, it may not recognize "SLC-96" framing from another test set. The other test set must include valid SLC-96 frame flags in its SLC-96 framing in order to be recognized as SLC-96 framing by the SunSet T10.

YEL ALM

The YEL ALM LED lights if the set detects a yellow alarm. An SF yellow alarm is when bit 2 is set to zero in all channels. An ESF yellow alarm is a data link message of 00000000 11111111.

AIS

The AIS LED lights red if the set detects an all ones signal without framing on its active receive jack.

POWER

The POWER LED lights green when the test set is switched on and has an adequate battery charge.

LOW BATT

The LOW BATT LED lights red when the test set's power supply voltage has dropped to a low level. The test set will shut itself down approximately 10 minutes after the LOW BATT LED lights. The auto shut down helps protect the battery from a damaging total discharge.

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

Section 3 Connector Panel

The SunSet T10 has a connector panel as shown in Figure 3.A

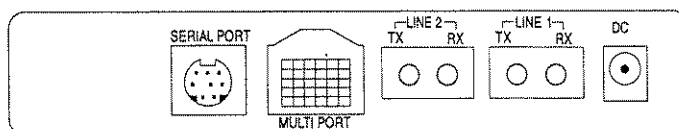


Figure 3.A Connector Panel

Line 1

The Line 1 jacks are used for both T1SINGL and T1DUAL access modes.

Line 2

The Line 2 jacks are used when T1DUAL is selected in TEST CONFIGURATION. The Line 2 Rx jack can also be used as the

reference frequency input in T1SINGL mode.

SERIAL PORT

The serial port is used for sending information to the printer. It is also used for remote control.

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 V.35, V.24/RS232, X.21, and RS449.

DC

The SS104 Cigarette Lighter Charger and the SS128 Battery Charger (120V) plug in to the DC jack. The set may be operated off a discharged battery if a charger is plugged in. Further, the battery will charge while it is being operated, if a charger is plugged in.

Section 4 Additional Controls

Contrast Control

The contrast control adjusts the contrast of the LCD screen. It is located on the left-hand side of the test set.

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Section 1 Introduction

The SunSet T10 operates with a menu-driven format. Before you can select a menu item, you first must 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. 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 SEND TEST PATTERN menu works in this way.

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

MAIN MENU

TEST CONFIGURATION

LPBK & SPAN CONTROL

- CSU & NI CONTROL
- TELTREND OFFICE REPEATER(SW184)
- TELTREND LINE REPEATER(SW184)
- WESTELL LINE REPEATER(SW184)
- WESTELL OFFICE REPEATER(SW184)
- WESTELL NIU/PM & MSS(SW184)
- TELTREND MSS, MAINTENANCE SWITCH(SW184)

SEND TEST PATTERN

MEASUREMENTS RESULTS

DATAKOM INTERFACE (if DATAKOM Mode is selected)

OTHER MEASUREMENTS

- VIEW RECEIVED DATA
- PROPAGATION DELAY
- QUICK TEST I
- QUICK TEST II
- BRIDGE TAP DETECT
- PULSE MASK ANALYSIS (SW190)
- DDS MEASUREMENTS (SW188)
 - CONFIG & SEND PATT
 - LOOP BACK ACCESS
 - MEASUREMENT RESULTS
 - SEND/RCV CTRL CODES
- ISDN PRIMARY RATE(SW186)
 - CONFIGURATION
 - START LINK/CALL SETUP
 - BACKUP D CHNL TEST

SETUP FILTER
START TRACER
VIEW/PRINT TRACER
OTHER PARAMETERS
SS#7 ANALYSIS(SW189)
CONFIGURATION
MSU MONITOR
SU ANALYSIS
SWITCHED 56 TESTING (SW187)
TEST CONFIGURATION
SW56 CALL SET UP
MEASUREMENT RESULTS
TELEOS CALL MONITOR

VF CHANNEL ACCESS

VF MEASUREMENTS
VIEW SUPERVISION
DIAL/SPRVIS SETUP
PLACE/RECEIVE CALLS (SW185)
DTMF/MF/DP ANALYSIS (SW185)
NOISE ANALYSIS (SW183)
MF TRACER
MF TRACER
MF VIEW/PRINT TRACER
SIGNALLING ANALYSIS

OTHER FEATURES

SYSTEM CONFIG
SYSTEM PROFILES
GENERAL CONFIG
ERASE NV RAM
FULL SELF TEST
VERSION / OPTION
MEAS CONFIGURATION
ERROR INJECTION
OTHER PARAMETERS
VIEW TEST RECORD
PRINT RECORDS
LOAD SAMPLES

DATA LINK CONTROL (SW182)

DATA LINK CONTROL SLC-96
MONITOR DATALINK
SEND MESSAGE
SWITCH PROTECT LINE
VIEW DATA LINK
DATA LINK CONTROL ESF
MONITOR T1.403 PRM

MONITOR T1.403 BOM

SEND T1.403 PRM

SEND T1.403 BOM

CSU/ NI EMULATION (SW 181)

Following sections within this chapter provide a detailed explanation of each menu item. However, some menu items are contained in their own chapters. All ISDN and SS#7 item descriptions are contained in chapters 7 & 8, respectively.

Section 2 TEST CONFIGURATION Menu

Before connecting the SunSet to your circuit, you must set up the TEST CONFIGURATION properly. To access the TEST CONFIGURATION screen, press ESCAPE until you return to 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 the TEST CONFIGURATION display. Within the Test Configuration screen, as each F-key is pressed, the SunSet immediately alters its configuration to reflect the new settings.

Note the following:

- 1) In order to avoid configuration mistakes, use the GRAPHIC key to confirm any changes to your TEST CONFIGURATION. However, graphics are not available for the DATACOM Mode.
- 2) The SunSet T10 can be configured to automatically detect incoming framing and test pattern by pressing the AUTO key.

The first selection in the TEST CONFIGURATION Menu is TESTMODE. Four mode choices are available: T1SINGL, T1DUAL, DATACOM, and T1-MUX. The Test Configuration menu differs for each mode selected. The Configuration screens for DATACOM and T1-MUX are discussed in Chapter 6.

2.1 T1SINGL TEST MODE

Choose T1SINGL Test Mode for common T1 Line testing applications: loopback testing, frequency/slip measurements, and simple talk/listen operations. This is the simplest T1 mode

and turns off the unused LEDs on Line 2.

Refer to Figure 2.1.A for the T1SINGL Menu.

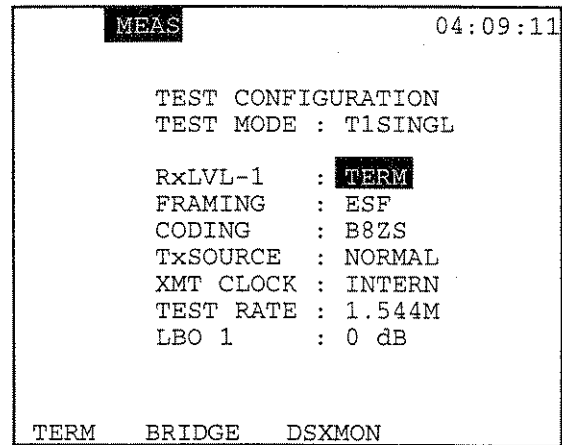


Figure 2.1.A
T1 SINGL TEST CONFIGURATION Menu

Figure 2.1.B portrays the graphic associated with the configuration in Figure 2.1.A.

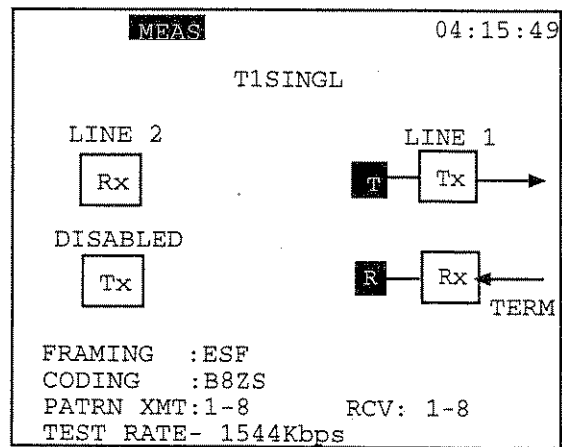


Figure 2.1.B
T1 SINGL Graphic

1) RxLVL-1

F-key Options: TERM (F1), BRIDGE (F2), DSXMON (F3)

RxLVL-1 configures the LINE1 1.544 Mbps receiver. This setting lets the SunSet electrically decode a 1.544 Mbps signal under a wide range of resistive or cable losses. This setting also determines which electrical load will be placed on the circuit by the SunSet. There is no effect on the transmitter. In a 1.544 Mbps circuit, there must always be exactly one receiver that applies the low impedance (100 ohm) termination. There should never be two or more receivers applying a low impedance termination.

WARNING

IF YOU ARE UNCERTAIN, CHOOSE BRIDGE. THIS WILL PROTECT THE 1.544 Mbps SIGNAL.

DSXMON (F3)

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

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

If DSXMON mode is selected when a 3V signal is received, then the red BPV LED will be lit. This often happens if DSX MON is selected when the test set is plugged into an OUT jack. In this case, TERM should be selected instead of DSXMON. In some cases, it may not be clear if the mon jack provides a bridged access or a 20 dB isolated monitor access. In this case, you should try BRIDGE first to see if this works and then try DSXMON if it doesn't.

If the pattern and framing on a T1 circuit is not known, the AUTO key may be pressed in place of pre-setting the framing and pattern. The AUTO key automatically synchronizes framing and test pattern. TEST CONFIGURATION menu settings are updated to the new framing; pattern indicators are also updated in the SEND TEST PATTERN and MEASUREMENT

RESULTS screens.

BRIDGE (F2)

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

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

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

TERM (F3)

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

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

Note that if you plug into a DSX MON jack in the TERM mode, the BPV LED will probably come on. Use the DSXMON mode instead.

2) FRAMING

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

Choose UNFRAME (F1) for no framing. Select SF-D4 (F2) for the simplest framing, where 12 frames are grouped together. ESF (F3) refers to Extended Super Frame; 24 frames are grouped together. SLC-96 (F4) was introduced by AT&T and later standardized by Bellcore. You may refer to Chapter 1, Technology Overview, for specific details on each framing type.

A specific framing type should be chosen when:

- a) The circuit is provisioned for a specific type of framing.
- b) There is no T1 signal available when the test set is plugged in.
- c) The test set will be used with another test set that is already configured for auto framing.
- d) The test set will control the framing that is put on the T1 line
- e) The test set will provide a signal to itself without first passing through network equipment which will force a specific framing.

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

3) CODING

F-key Options: AMI (F1), B8ZS (F2)

AMI (Alternate Mark Inversion) requires the terminal transmitting data to have at least a 12.5% average 1's density and a maximum of 15 consecutive zeroes. B8ZS (Bipolar 8-Zero Substitution) uses a bipolar violation substitution which guarantees the 12.5% average with a maximum number of 7 consecutive zeroes. B8ZS coding is preferred, because it reduces transmission problems caused in AMI.

Note: The B8ZS LED will be green only if 8 consecutive data zeroes are observed on the line. An AIS signal or other high density ones pattern will make it impossible for the SunSet T10 to determine whether the line is optioned for AMI or B8ZS.

4) Tx SOURCE

F-key Options: THRU (F1), NORMAL (F2)

THRU (F1) allows the signal received on the Rx jack to be transmitted out the Tx jack for Line 1. You will be inserting a signal on one or more channels on LINE 1. The channels and corresponding AB bits on that line that are not being used will be passed through the set unchanged from Rx to Tx.

NORMAL (F2) is used for out-of-service bit error rate testing. Ir

this case, a test pattern will be transmitted on LINE 1 Tx. During Nx64, NX56, or VF CHANNEL ACCESS testing, an idle code will be inserted on the unused channels.

For NORMAL, a reverse-video "T" is shown in the Graphic screen. The T represents where the T10 is transmitting its own pattern. For THRU, there is no "T," since the T10 is not generating its own pattern.

5) XMT CLOCK

F-key Options: L1-RX (F1), L2-RX (F2), INTERN (F3). When you choose THRU as your transmit source, XMT CLK is forced to L1-Rx.

XMT CLOCK determines the timing source for the signal transmitted out Line 1. It can be either INTERN, L1-RX, or L2-RX. Use INTERN (F3) for most applications such as: loopback testing, simple talk/listen, point-to-point testing, and any time you want the test set to provide an independent signal. If you are unsure of the correct XMT CLOCK setting, choose INTERN.

Use L1-Rx (F1) if you are plugging into a switch or other synchronous element, which requires the test set to be slave timed. Use L1-Rx for placing a voice or data call into a switch or digital cross-connect system (DCS). This ensures that the signal will not slip and cause repetitive slips or stuffs, which destroy circuit integrity. However, using L1-Rx in the wrong application, such as loopback testing, may cause a loss of signal.

Use L2-Rx (F2), if you want to supply an external DS1 signal to the L2-Rx jack in order to synchronize the signal coming out L1-Tx. You could use L2-Rx as a reference clock for measuring frequency synchronization and clock slips. You may use the L2 receiver jack even in T1SINGL Mode, but you should realize that you may not control the receiver level of this jack.

6) TEST RATE

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

Choose 1.544M (F1) for normal T1 and DS1 testing. Choose Nx64K (F3) for fractional T1 testing where the fractional circuit is any number (1-24) of 64 Kbps channels within the DS1. Choose Nx56K (F2) where the fractional circuit is any number (1-24) of 56 Kbps channels within the DS1. In this case, the test set will transmit a 1 in the eighth (least significant) bit of each fractional

T1 channel. If you have chosen one of the fractional settings, you will see the following display, shown in Figure 2.1.C.

Note: If you have chosen 1.544 and thus, do not need to enter the Fractional T1 screen, you must move the cursor off the Test Rate spot or press ESCAPE to return to the Main Menu. Pressing ENTER while the cursor is on TEST RATE will automatically bring up the T10 Time Slot screen.

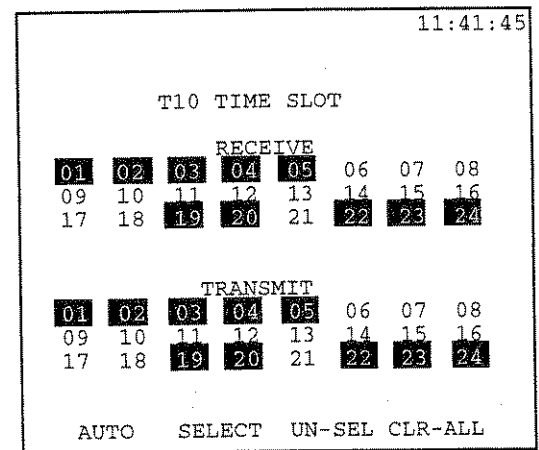


Figure 2.1.C
T10 Time Slot Screen

As shown in Figure 2.1.C, you have two options for selecting the desired combination of channels. You can press AUTO (F1) and the test set will automatically configure itself for all active fractional T1 channels. The test set performs this AUTO configuration by searching for the 7F or FF idle codes (as selected in OTHER FEATURES> OTHER PARAMETERS) on any unused channels.

If you would rather select the exact channels to be tested yourself, you may do so by pressing select (F2) on each desired channel. Use the arrow keys to move the flashing cursor to the desired timeslot and press (F2). As you select the RECEIVE timeslots, the test set will fill in the corresponding TRANSMIT side for you. If you wish to configure the TRANSMIT side differently, simply use the Down Arrow key to access these numbers and set up your selections manually. If you inadvertently select the wrong channel, simply press the UN-SEL (F4) key. Press CLR-ALL to de-select everything and start over again.

7) LBO 1

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

LBO 1 stands for Line Build Out for Line 1. Line Build Out is used to stress test a line by attenuating the dB to a certain level.

0 dB (ft) should be used:

- a) when the set is plugged in at the front panel jack of a DSX, CSU equipment direction, NI equipment direction, channel bank, or other 3V test point, or
- b) when there is 132 ft or less cabling between the test set and the DSX, or
- c) under most conditions

-7.5, -15, and -22.5 dB should be used:

- a) when transmitting toward the T1 span from a central office or customer premises and a 7.5 dB, 15 dB, or 22.5 dB attenuator is not in series with the set.
- b) when the signal should be transmitted at a lower level to prevent near-end cross talk problems.
- c) when the signal should be attenuated so that it arrives at the next repeater at approximately -31 dBdsx level.
- d) when you want to test the sensitivity of the network elements's receiver to which you are transmitting.

2.2 T1DUAL Test Mode

T1DUAL provides for the use of both LINE 1 and LINE 2. Use this mode to perform applications such as full duplex drop and insert, in-service VF channel access, ISDN PRI 46B+2D call set up/ receive, and SS7. An example menu screen is shown in Figure 2.2.A.

For T1DUAL, the LEDs for both Line 1 and Line 2 are activated. The PAT SYNC LED, BIT ERROR LED, and the logical/frequency screens in MEASUREMENT RESULTS refer to the Line selected as RX/DROP in TEST CONFIGURATION.

```

22:54:15

TEST CONFIGURATION
TEST MODE : T1DUAL

Tx/INSERT : L1-Tx
Rx/DROP   : L1-Rx
RxLVL-1  : TERM
RxLVL-2  : TERM
Tx SOURCE : TESTPAT
FRAMING  : ESF
CODING   : B8ZS
XMT CLOCK : INTERN
TEST RATE : 1.544M
LBO 1&2  : 0 dB

0 dB   -7.5dB  -15dB  -22.5dB

```

Figure 2.2.A
T1DUAL Test Mode Configuration

Figure 2.2.B shows the graphic associated with the configuration of Figure 2.2.A. You may access this graphic screen by pressing the GRAPHIC key on the keypad.

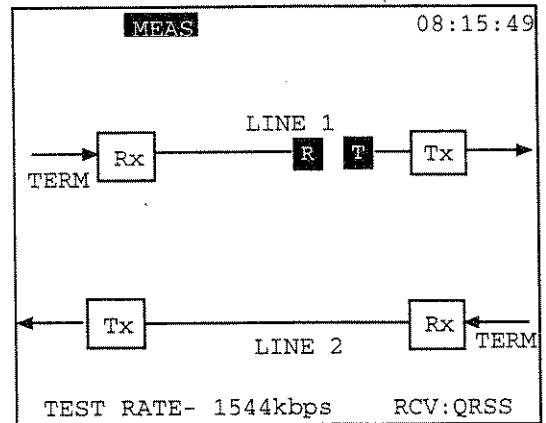


Figure 2.2.B
T1DUAL Graphic Test Mode

The following set-up parameters are associated with T1DUAL Mode:

1) Tx/INSERT

F-Key Options: L1-Tx (F1), L2-Tx (F2)

Tx/INSERT determines the line on which you will transmit your test pattern or insert the dropped signal. Press L1-Tx (F1) to select Line 1 or L2-Tx (F2) for Line 2. This determines where the 1.544M test pattern, Nx64Kbps test pattern, Nx64Kbps multiplexed signal, Nx56Kbps test pattern, Nx56Kbps multiplexed signal, or voice frequency channel will be inserted. For example, if Tx/INSERT is configured for L2-Tx, and you are talking on the test set, then your voice will be inserted on Line 2.

2) Rx/DROP

F-Key Options: L1-Rx (F1), L2-Rx (F2)

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

3/4) RxLVL-1 & 2

F-Keys: TERM (F1), BRIDGE (F2), DSXMON (F3)

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

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

DSXMON (F3)

The DSXMON access mode is used when a monitor measure-

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

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

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

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

BRIDGE (F2)

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

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

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

TERM (F1)

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

The received signal is terminated by the test set and is not

obtained through a MONITOR jack. The received signal can have up to 36 dB of cable transmission loss (this is a different kind of loss than the 20 dB of resistive loss provided by a DSX MON jack).

Note that if you plug into a DSX MON jack in the TERM mode, the BPV LED will probably come on. Use the DSXMON mode instead.

5) Tx SOURCE

F-key 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 pass through the set and 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 AB 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, NX56, 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 A/B(/C/D) bits are passed through unchanged from Rx to Tx.

6) FRAMING

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

Choose UNFRAME (F1) for no framing. Select SF-D4 (F2) for the simplest framing, where 12 frames are grouped together. ESF (F3) refers to Extended Super Frame; 24 frames are grouped together. SLC-96 (F4) was introduced by AT&T and later standardized by Bellcore. You may refer to Chapter 1, Technology Overview, for specific details on each framing type.

A specific framing type should be chosen when:

- a) The circuit is provisioned for a specific type of framing.
- b) There is no T1 signal available when the test set is plugged in.
- c) The test set will be used with another test set that is already configured for auto framing.
- d) The test set will control the framing that is put on the T1 line

- e) The test set will provide a signal to itself without first passing through network equipment which will force a specific framing.

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

7) CODING

F-key Options: AMI (F1), B8ZS (F2)

AMI (Alternate Mark Inversion) requires the terminal transmitting data to have at least a 12.5% average 1's density and a maximum of 15 consecutive zeroes. B8ZS (Bipolar 8-Zero Substitution) uses a bipolar violation substitution which guarantees the 12.5% average with a maximum number of 7 consecutive zeroes. B8ZS coding is preferred, because it reduces transmission problems caused in AMI.

8) XMT CLOCK

F-key Options: L1-Rx (F1), L2-Rx (F2), INTERN (F3)

The XMT CLOCK determines the timing source for your transmitted signal (whichever line was selected as Tx/INSERT). The other Tx signal uses the timing recovered from its Rx signal. For instance, when Tx/INSERT: L1-Tx and XMTCLK: INTERN, the L1- Tx signal uses the internal timing of the test set. The L2- Tx signal uses the recovered timing from L2- Rx. When TxSource is set for THRU, the XMT CLOCK selection defaults to the Tx/Insert setting and you will not be able to change it.

There are four different timing scenarios possible from the three F-Key options: Loop/ Slave timing, Slave to Slave timing, External timing, and Internal/Master timing.

For Loop (or Slave) timing choose the same line for Tx/INSERT and XMTCLK. For instance, if Tx/INST is L1- Rx, then XMT CLOCK should be L1-Rx also. In this case, the exchange or network element is configured to be a master timing source in relation to your test set. Loop or Slave timing is required when transmitting toward an exchange or other network element which requires synchronous signals. Figure 2.2.C provides a graphic illustration

of Loop or Slave timing.

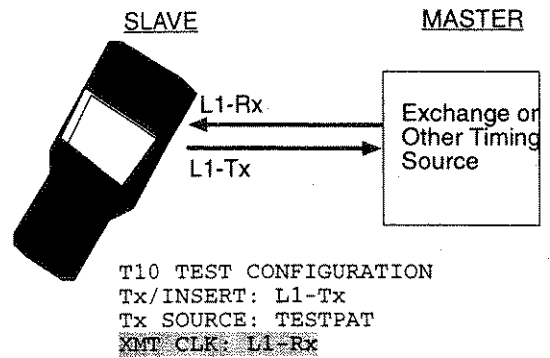


Figure 2.2.C
Loop or Slave Timing

Note: For DROP/ INSERT testing, TxSOURCE must be set to THRU and so, XMT CLOCK will automatically be set for the same line as the Rx/DROP side.

If you are using Loop timing and the timing source is also using loop timing, there is no real clock source and the transmit signal may die. This is known as Slave to Slave timing, since there is no master timing source. Figure 2.2.D depicts Slave to Slave timing.

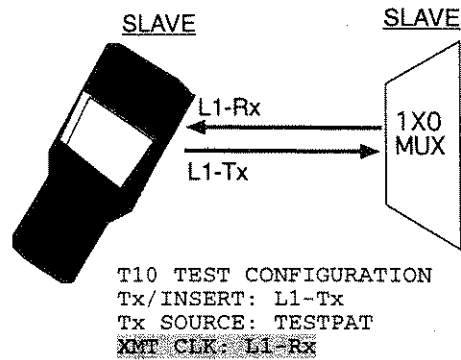


Figure 2.2.D
Slave to Slave Timing

External timing uses an external clock source to time the Tx/INST signal. The XMT CLOCK should be set to the opposite line of the Rx/DROP selection. For instance, if Rx/DROP is L2-Rx, XMT CLOCK should be L1-Rx. Figure 2.2.E demonstrates external timing.

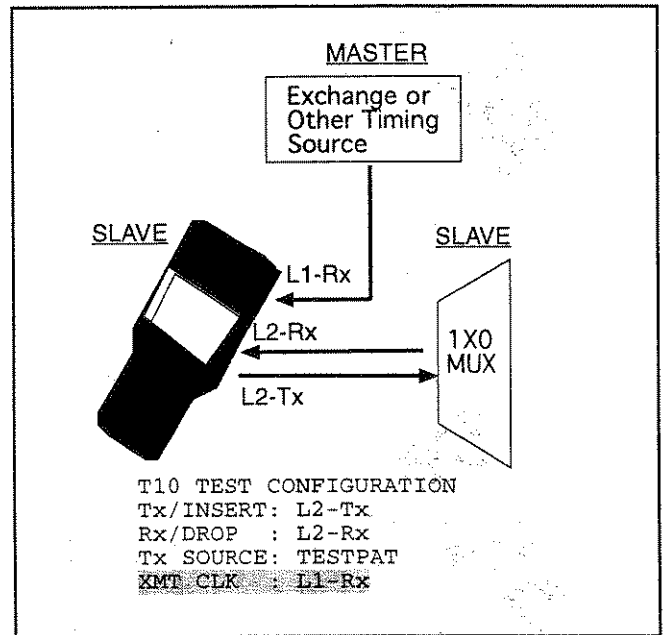


Figure 2.2.E
External Timing

Internal, or Master, timing is used in loopback testing where synchronization is not required. An internal clock provides a timing source, but the source is not synchronized to the network. The SunSet T10 uses a stratum 3 clock for its internal timing. Figure 2.2.F depicts Internal Timing.

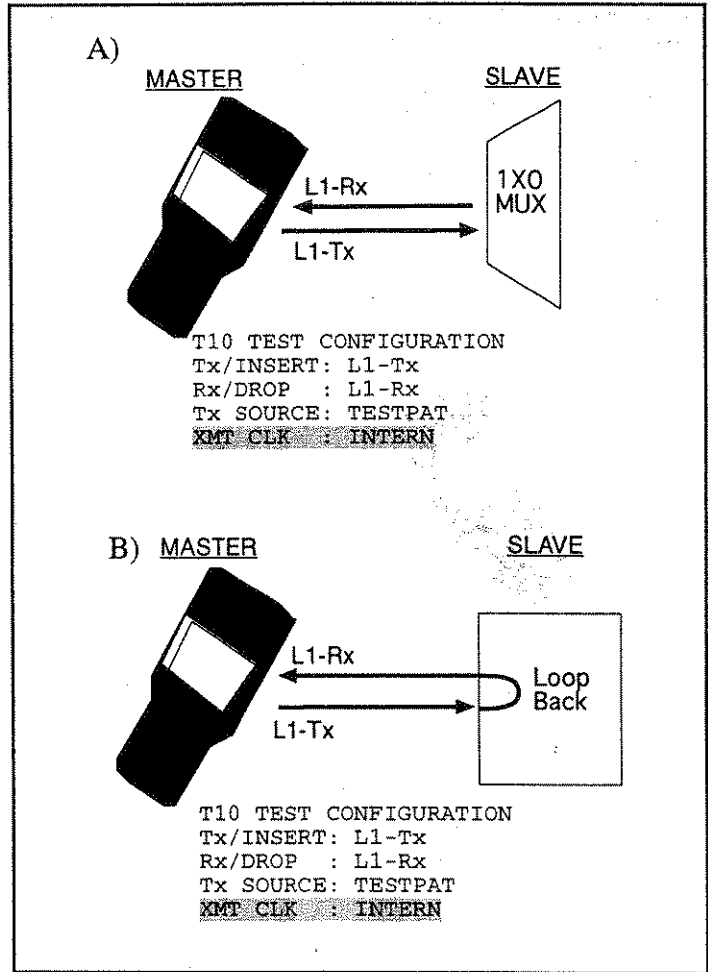


Figure 2.2.F
Internal Timing

9) TEST RATE

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

Choose the desired TEST RATE. Choose 1.544M for normal T1 and DS1 testing. Choose Nx64K for fractional T1 testing where the fractional circuit is any number of 64 kbps channels within the

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

Note: If you have chosen 1.544 and thus, do not need to enter the Fractional T1 screen, you must move the cursor off the Test Rate spot or press ESCAPE to return to the Main Menu. Pressing ENTER while the cursor is on TEST RATE will automatically bring up the T10 Time Slot screen.

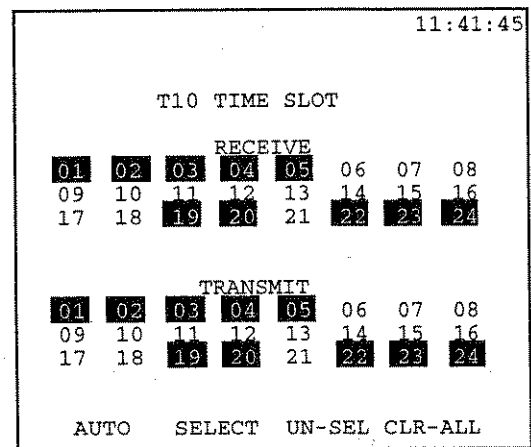


Figure 2.2.G
T10 Time Slot Screen

As shown in Figure 2.2.G you have two options for selecting the desired combination of channels. You can press AUTO (F1) and the test set will automatically configure itself for all active fractional T1 channels. The test set performs this AUTO configuration by searching for the 7F or FF idle codes (as selected in OTHER FEATURES> OTHER PARAMETERS) on any unused channels.

If you would rather select the exact channels to be tested yourself, you may do so by pressing select (F2) on each desired channel. Use the arrow keys to move the flashing cursor to the desired timeslot and press SEL (F2). As you select the RECEIVE timeslots, the test set will fill in the corresponding TRANSMIT side for you. If you wish to configure the TRANSMIT side differently simply use the Down Arrow key to access these numbers and set up your selections manually. If you inadvertently select the wrong

channel, simply press the UN-SEL (F4) key. Press CLR-ALL to de-select everything and start over again.

10) LBO 1&2

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

LBO 1 stands for Line Build Out for Line 1. Line Build Out is used to stress test a line by attenuating the dB to a certain level.

0 dB (ft) should be used:

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

-7.5, -15, and -22.5 dB should be used:

- a. when transmitting toward the T1 span from a central office or customer premises and a 7.5 dB, 15 dB, or 22.5 dB attenuator is not in series with the set.
- b. when the signal should be transmitted at a lower level to prevent near-end cross talk problems.
- c. when the signal should be attenuated so that it arrives at the next repeater at approximately -31 dBdsx level.
- d. when you want to test the sensitivity of the network elements' receiver to which you are testing.

Note: DATACOM & T1-MUX Modes are discussed in Chapter 6.

Section 3 LPBK & SPAN Control

You may operate several different kinds of loopback devices on the T1 line using the LPBK & SPAN CONTROL menu. With the circuit looped back, you can measure transmission performance on the transmission path between your test set and the loopback device. Figure 3.A shows the various options that are presented in the LPBK & SPAN CONTROL menu.

21:15:14

LPBK & SPAN CONTROL

CSU & NI CONTROL

TELTREND OFFICE RPTR

TELTREND LINE RPTR

WESTELL OFFICE RPTR

WESTELL LINE RPTR

WESTELL NIU/PM & MSS

TELTREND MSS

Figure 3.A
Loopback and Span Control Menu

Before proceeding, find out if the line to be tested has one or more loopback devices installed. If so, find out what type of loopback it is and how it is supposed to operate.

3.1 CSU & NI CONTROL

You may use the CSU & NI CONTROL screen to loop up/down a CSU or NI. Refer to Figure 3.1.A.

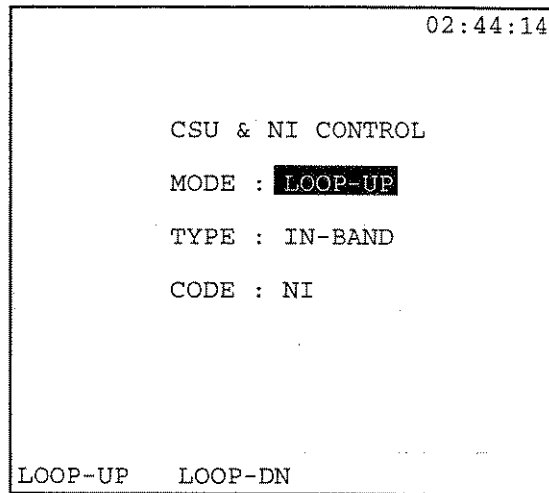


Figure 3.1.A
CSU and NI Control

Three items appear in this screen. They should be configured as follows:

1) MODE

F-Key Options: LOOP-UP (F1), LOOP-DN (F2)

Select this item last! Pressing (F1) or (F2) causes the SunSet to begin the specified procedure. So, if you want to change either of the two settings below, change those first. Choose LOOP-UP (F1) to loop up the circuit before testing. Choose LOOP-DN (F2) to restore the circuit to normal once your testing is complete.

2) TYPE

F-Key Options: IN-BAND (F1), ESF-DL (F2). However, if you are using SF-D4 or SLC-96 framing, TYPE must be IN-BAND; you will not be able to change this.

This item determines the type of loopback code to be sent. ESF-DL codes are sent in the ESF framing data link; therefore, you must be using ESF framing to select ESF-DL. IN-BAND is the common type deployed in the network today. It can be transmit-

ted with any type of framing. However, some loopback devices will not respond to IN-BAND loopback codes when transmitted with ESF framing. When in doubt, choose IN-BAND if you are using SF framing and ESF-DL if you are using ESF framing.

3) CODE

F-Key Options: the options available depend upon the TYPE selected above.

CODE determines which loopback code will be sent. You want to make sure that the code you specify is the same as the equipment you are trying to loopback. You may also send your own USER code by pressing the (F4) key.

In-Band Codes: CSU (F1), NI (F2), 100000 (F3), USER (F4)

The NI (F2) code is used for an industry-standard Network Interface Unit (smart jack) if it is set to respond to in-band loopback codes. This loopback regenerates only the signal and should pass both BPVs and bit errors. The telephone company generally installs this unit at the customer premises. The CSU (F1) code is used for the customer-owned CSU. The 100000 code is used with a type of NIU (smart jack) that is installed in some parts of the country, particularly New England.

The inband codes that will be transmitted for each loopback are:

CSU Loop Up: 10000
CSU Loop Down: 100
NI Loop Up: 11000
NI Loop Down: 11100
100000: 100000

ESF-DL Codes: LINE (F1), PAYLOAD (F2), NETWORK (F3), USER (F4)

The LINE code operates a line loopback at a CSU. This loopback regenerates only the signal. Bit errors and BPVs should pass through this loopback. The PAYLOAD code operates a payload loopback at a CSU. In this loopback, the 192 channel bits are passed through but the framing bits and line code are regenerated. Only bit errors will pass through this loopback. The NETWORK CODE operates an NIU (smart jack) loopback. This

loopback regenerates only the signal and should pass both BPVs and bit errors.

The ESF-DL codes that will be transmitted for each loopback are:

Line Loop Up: 11111111 01110000

Line Loop Down: 11111111 00011100

Payload Loop Up: 11111111 00101000

Payload Loop Down: 11111111 01001100

Network Loop Up: 11111111 01001000

Network Loop Down: 11111111 00100100

Basic Loopback Procedure

1) From the MAIN MENU, move the cursor to LPBK & SPAN CTRL and press ENTER. Then move the cursor to CSU & NI CONTROL and press ENTER. If TYPE and CODE are correct, proceed to step 4.

2) TYPE: Move your cursor to the TYPE item. Choose either an IN-BAND (F1) or ESF-DL (F2).

3) CODE; Cursor down to Code. Select your code depending upon the equipment you are trying to loopback.

4) MODE. Choose LOOP-UP (F1) to loop the circuit up before testing. Choose LOOP-DN (F2) to restore the circuit to normal once your testing is complete.

5) Once the loopback operation is finished, you will see an appropriate message on the screen.

6) Press ESCAPE as required to return to the MAIN MENU.

If you would like to send a USER code, refer to the following:

Select a User Loopback Code

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

1) In the CSU & NI CONTROL menu, move your cursor to the CODE item and press USER (F4). Be sure to press the F4 key even if the USER item is already displayed as the selected CODE entry. This moves you into the USER LOOPBACK CODE screen.

2) Move your cursor down to the desired loopback code and press ENTER.

3) Press ENTER to begin the loopback operation and proceed to step 4 of the basic loopback procedure.

View a User Loopback Code.

To view a preprogrammed USER loopback code, use this method:

1) In the CSU & NI CONTROL menu, move your cursor to the CODE item and select USER (F4). Be sure to press the (F4) key even if the USER item is already displayed as the selected CODE entry. This moves you into the USER LOOPBACK CODE screen.

2) Move your cursor down to the desired loopback code and press VIEW (F1).

3) You will now see your selected pattern on the screen. When you are finished viewing, press ESCAPE to return to the USER LOOPBACK CODE menu.

Program a User Loopback Code

To program a USER code, use this method:

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

2) Move your cursor down to a blank position on the user pattern list. Choose CREATE (F1). The USER LOOPBACK CODE screen will now be displayed.

3) Choose toggle (F3). The letter A will begin to flash on and off within the alphabet grid. Use your cursor keys to move the flashing indicator to the desired letter. Choose SELECT (F4). You will see the desired letter appear next to the LABEL item. Continue in this fashion until you have spelled out the desired name.

4) When the name appears in the LABEL, choose toggle (F3) to move out of the alphabet grid. Press the Down Arrow key to move to the CODE item. Press the SHIFT-lock key. Enter up to 32 1s and

0s to make up the desired pattern.

5) When you are finished entering the code, press the ENTER key and you will return to the USER LOOPBACK CODE menu. Your new code will be displayed for you.

Correcting a Mistake in the Label While Entering the Label
To correct a mistake made while entering the LABEL of your USER pattern, use this procedure:

1) This procedure assumes you are starting from step 3 of the Program a User Code procedure while you are in the alphabet grid. A letter within the grid should be flashing on and off.

2) Choose toggle (F3) to move out of the alphabet grid. Press the Left Arrow key until the cursor is over the incorrect letter or number.

3) Press DELETE (F2) to remove this letter or number. Repeat this as necessary.

CODE item and select USER (F4). Be sure to press the F4 key, even if the USER item is already displayed as the selected CODE entry. This moves you into the USER LOOPBACK CODE screen.

2) Move your cursor to the code that you want to delete and select DELETE (F3). The code is deleted and you are finished. Press ESCAPE to return to the CSU & NI CONTROL screen.

3.2 Teltrend Office RPTR

Teltrend provides a variety of office repeaters which are supported by the SunSet T10. Refer to Teltrend documentation for detailed information on the operations of these various repeaters. Figure 3.2.A shows the Teltrend Office Repeater screen.

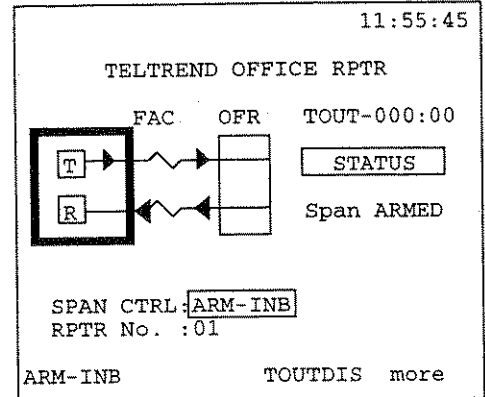


Figure 3.2.A
Teltrend Office Repeater

This diagram shows several aspects of the repeater control session. The items to the right of the diagram provide information on the repeater control session and may not be configured here. They are:

1) TIME

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

2) STATUS

The Status bar shows you the current looping status of the span.

3) SPAN

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

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

1) SPAN CTRL

F-Key Options: ARM-DL (F1), UNARMDL (F2), TOUTDIS (F3),

LPBKQRY (more, F1), POWR-DN (more, F2), LOOP-UP (more, F1), LOOP-DN (more, F2), DUAL-LB (more, F3), UNBLOCK (more, F1), CLR-FT1 (more, F2), ARM-INB, more, F3).

The exact options available depend upon the DS1 framing selected in SET UP INTERFACE. The options above correspond to ESF framing. For SF-D4, ARM-INB replaces ARM-DL as the first option (F1); there is no ARMDL (F2) equivalent. UNIVLDN (more, F3) is available for SF-D4.

Press ARMDL/INB (F1) to arm the office repeater and the other repeaters on the span. In most cases, ARMDL and ARM-INB have the same function. Arming is required before the repeaters will actually loop up. UNARMDL (F2) unarms the data link. Press TOUTDIS (F3) to disable the automatic timeout of the repeaters on the span. If you press this, be sure to loop down all the repeaters on the span when you are finished. Selecting LPBKQRY (more, F1) will query all the repeaters on the span to see which one is actually looped back. If a repeater is found, its number will be displayed in the graphic. Otherwise, LPBK will be displayed in either the looped more or unlooped mode. POWR-DN (more, F2) tells the office repeater to cut the power to the span. The power will remain cut until you choose another function or escape to the Main Menu. Powering down the span resets all the repeaters. Make sure to arm the office repeater before selecting POWR-DN. UNIVLDN (more, F3) sends the NIU in-band loop down code to drop one Teltrend or NIU at a time.

Pressing the LOOP-UP (more, F1) key loops up the office repeater. The repeater must be armed before using this function. If the office repeater is an E-type, you can also choose office RPTR number 1 through 3 in RPTR NO. Do this before pressing the LOOP-UP (F1) key. However, if the E-type repeater is configured for fractional T1 blocking, only repeater number 1 can be looped up. After the loop is successful, a message will be displayed showing the fractional configuration of the office repeater. Pressing LOOP-DN loops down the office repeater. However, it will not loop down the E-type office repeater when it is in NIU emulation mode.

DUAL-LB (more, F3) loopbacks the E-type office repeater in both directions when it is configured for NIU mode and has already been looped up using the ARM-INB key. Pressing UNBLOCK (more, F1) will unblock the office repeater to allow the NIU loop up code to pass through the customer premises toward the

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

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

2) RPTR NO

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

3.3 Teltrend Line RPTR

This screen shows several aspects of the repeater control session. Figure 3.3.A provides the Teltrend Line Repeater

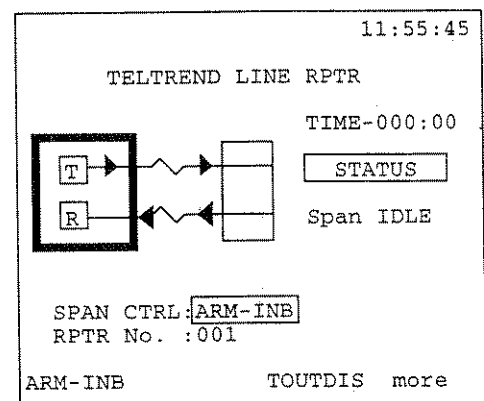


Figure 3.3.A
Teltrend Line Repeater

The items to the right of the diagram provide information on the repeater control session and may not be configured here. They are:

1) TIME

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

2) STATUS

The Status bar shows you the current looping status of the span.

3) SPAN CTRL

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

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

1) SPAN CTRL

Options: ARM-DL (F1), UNARMDL (F2), TOUTDIS (F3), LPBKQRY (more, F1), PWR-QRY (more, F2), PWCUTTH (more, F3), UNIVLDN (more, F1), LOOP-UP (more, F1), LOOP-DN (more, F2).

The exact options available depend upon the DS1 framing selected in SET UP INTERFACE. The options listed above correspond to ESF framing. For SF-D4, ARM-DL is replaced with ARM-INB (F1) and there is no UNARMDL (F2) equivalent.

Press ARM-DL/INB (F1) to arm the office repeater and the line repeaters on the span. In most cases, ARM-INB and ARM-DL have the same function. UNARMDL (F2) unarms the data link. Press TOUTDIS (F3) to disable the automatic timeout of the repeaters on the span. If you press this, be sure to loop down all the repeaters on the span when you are finished. Selecting LPBKQRY (more, F1) will query all the repeaters on the span to see which one is actually looped back. If a repeater is found, its number will be displayed in the graphic. Otherwise, LPBK will be displayed in either the looped more or unlooped mode. PWRQRY (more, F2) will query all the repeaters on the span to see which one is looping the span simplex power. You will see a special

message if the power loop query finds a repeater in power loop. Pressing PWCUTTH (more, F3) will tell the repeater, which has looped the span power, to attempt to cut that power through the other repeaters on the span. UNIVLDN (more, F1) causes the set to transmit the universal loopdown code to loop-down any looped repeaters. Pressing the LOOP-UP (more, F1) key loops up the specified line repeater. The repeater must be armed before using this function. The RPTR number must be entered before the LOOP-UP command is selected. Pressing LOOP-DN loops down any line repeater; it does not loop down the NIU.

Note: Arming is required before the repeaters will actually loop up.

2) RPTR NO

Activate the SHIFT key and use the keypad to enter in the desired repeater number.

3.4 Westell Office RPTR

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

- 1) The Westell central office repeater and line repeater F-key menus also include a sequential loopback (SEQLPBK) item. This allows you to quickly step through the loopbacks on a line. To use this feature, simply arm the span and then press the SEQLPBK F-key and observe which repeater loops up. You don't have to enter the repeater address. This feature is useful for tracking down misaddressed repeaters.

- 2) If you want to do a span power down with the Westell office repeater, it must first be looped up.

- 3) The Westell central office repeater menus do not have the fractional T1 blocking or NIU-mode commands of the Teltrend

This screen shows several aspects of the repeater control session. Figure 3.4.A depicts the Westell Office RPTR screen.

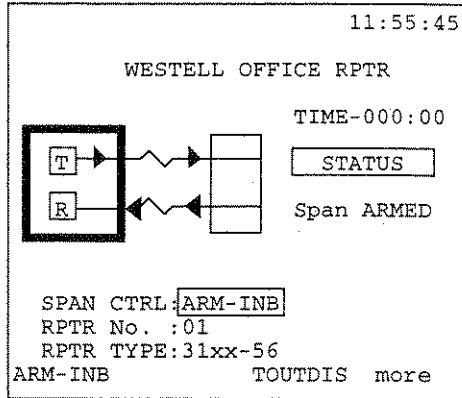


Figure 3.4.A
Westell Office RPTR

The items to the right of the diagram provide information on the repeater control session and may not be configured here. They are:

1) TIME

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

2) STATUS

The Status bar shows you the current looping status of the span.

3) SPAN

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

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

1) SPAN CTRL

F-Key Options: ARM-DL (F1), UNARMDL (F2), TOUTDIS (F3), LPBKQRY (more, F1), PWR-QRY (more, F2), UNIVLDN (more, F3), LOOP-UP (more, F1), LOOP-DN (more, F2), SEQLPBK (more, F3).

The exact options available depend upon the DS1 framing selected in SET UP INTERFACE. The options listed above correspond to SF-D4 framing. For ESF, ARM-DL is replaced with ARM-INB (F1) and there is no UNARMDL (F2) equivalent.

Press ARM-DL/INB (F1) to arm the office repeater and the line repeaters on the span. In most cases, ARM-INB and ARM-DL have the same function. UNARMDL (F2) unarms the data link. Press TOUTDIS (F3) to disable the automatic timeout of the repeaters on the span. If you press this, be sure to loop down all the repeaters on the span when you are finished. Selecting LPBKQRY (more, F1) will query all the repeaters on the span to see which one is actually looped back. If a repeater is found, its number will be displayed in the graphic. Otherwise, LPBK will be displayed in either the looped more or unlooped mode. PWRQRY (more, F2) will query all the repeaters on the span to see which one is looping the span simplex power. You will see a special message if the power loop query finds a repeater in power loop.

UNIVLDN (more, F3) causes the set to transmit the universal loopdown code to loop-down any looped repeaters. Pressing the LOOP-UP (more, F1) key loops up the specified line repeater. The repeater must be armed before using this function. The RPTR number must be entered before the LOOP-UP command is selected. Pressing LOOP-DN loops down any line repeater; it does not loop down the NIU. The last F-key option, SEQLPBK (more, F3) allows you to quickly step through the loopbacks on the line. This feature is useful for tracking down misaddressed repeaters. You first must arm the span before activating this option.

Note: Arming is required before the repeaters will actually loop up.

2) RPTR NO

Activate the SHIFT control and use the keypad to enter the desired repeater number. This specifies which repeater will be looped up.

3) RPTR TYPE

F-Key Options: 31xx-56 (F1), 31xx-80 (F2)

This item determines the type of Westell repeater.

3.5 WESTELL LINE RPTR

The Westell Line Repeater screen shows several aspects of the repeater control session. Refer to Figure 3.5.A for this screen.

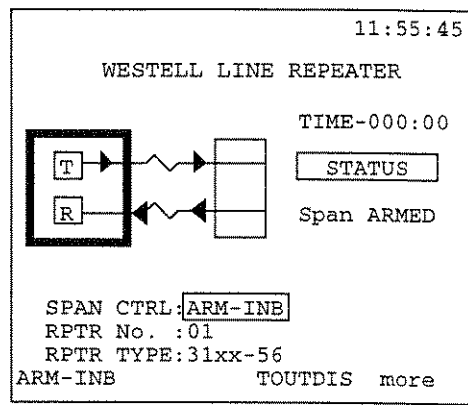


Figure 3.5.A
WESTELL LINE RPTR

The items to the right of the diagram provide information on the repeater control session and may not be configured here. They are:

1) TIME

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

2) STATUS

The Status bar shows you the current looping status of the span.

3) SPAN

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

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

1) SPAN CTRL

Options: ARM-DL (F1), UNARMDL (F2), TOUTDIS (F3), LPBKQRY (more, F1), PWR-QRY (more, F2), UNIVLDN (more, F3), LOOP-UP (more, F1), LOOP-DN (more, F2), SEQLPBK (more, F3).

The exact options available depend upon the DS1 framing selected in SET UP INTERFACE. The options listed above correspond to SF-D4 framing. For ESF, ARM-DL is replaced with ARM-INB (F1) and there is no UNARMDL (F2) equivalent.

Press ARM-DL/INB (F1) to arm the office repeater and the line repeaters on the span. In most cases, ARM-INB and ARM-DL have the same function. UNARMDL (F2) unarms the data link. Press TOUTDIS (F3) to disable the automatic timeout of the repeaters on the span. If you press this, be sure to loop down all the repeaters on the span when you are finished. Selecting LPBKQRY (more, F1) will query all the repeaters on the span to see which one is actually looped back. If a repeater is found, its number will be displayed in the graphic. Otherwise, LPBK will be displayed in either the looped more or unlooped mode. PWRQRY (more, F2) will query all the repeaters on the span to see which one is looping the span simplex power. You will see a special message if the power loop query finds a repeater in power loop.

UNIVLDN (more, F3) causes the set to transmit the universal loopdown code to loop-down any looped repeaters. Pressing the LOOP-UP (more, F1) key loops up the specified line repeater. The repeater must be armed before using this function. The RPTR number must be entered before the LOOP-UP command is selected. Pressing LOOP-DN loops down any line repeater; it does not loop down the NIU. The last F-key option, SEQLPBK (more, F3) allows you to quickly step through the loopbacks on the line. This feature is useful for tracking down misaddressed repeaters. You first must arm the span before activating this option.

Note: Arming is required before the repeaters will actually loop up.

2) RPTR NO

Activate the SHIFT control and use the keypad to enter the desired repeater number. This specifies which repeater will be looped up.

3) RPTR TYPE

F-Key Options: 31xx-56 (F1), 31xx-80 (F2)

This item determines the type of Westell repeater.

3.6 Westell NIU/PM & MSS

Use the Westell NIU/PM & MSS menu options when you are working with the Westell Performance Monitoring NIU, Maintenance Switch, or ramp feature.

The Westell Performance Monitoring NIU is a smart jack which constantly measures the performance of the received signals from both the network and the customer equipment. You can use your SunSet T10 to poll the smart jack to provide valuable information when troubleshooting the network. The Westell Maintenance Switch is a 1xN protection device which is used for manually restoring service to HiCap lines upon a failure. With the Maintenance Switch Ramp Access, you can use your SunSet T10 to non-intrusively poll the performance monitoring information from the NIU through the protection line.

All of these functions require the NIU to be looped back before you begin operations. The test set takes care of this function automatically as you enter the menu. Further, the set will automatically switch itself into the required ESF mode if you have not already done this before entering the menu.

Use this procedure for using the Westell Performance Monitoring NIU, Maintenance Switch, and Ramp feature:

- 1) Plug into the DS1 line to be tested. This will be the customer's circuit if just using the PM NIU feature, or it will be the maintenance spare if you are using RAMP or the Maintenance Switch. Make sure your test set is configured for SINGLE,

TERM , and ESF.

- 2) From the Main Menu, enter the LPBK & SPAN CTRL menu. Then enter the WESTELL NIU/PM & MSS menu. Note: the test set will proceed only if it is able to verify a successful loopback is established.
- 3) Refer to Figure 3.6.A for the Westell NIU/PM & MSS Menu.

```
2:30:02  
  
WESTELL NIU/PM & MSS  
  
RTRV/VIEW ALL PM RPT  
RETRIEVE PM REPORT  
RESET PM COUNTERS  
RETRIEVE NIU HEADER  
SET NIU TIME & DATE  
MSS SWITCH CONTROL  
MSS RAMP ACCESS
```

Figure 3.6.A
Westell NIU/PM & MSS Menu

3.6.1 RTRV/VIEW ALL PM RPT

This command retrieves all the performance information from the NIU. Use the following procedure:

- 1) ENTER the RTRV/VIEW ALL PM RPT menu item.
- 2) If you have performed this operation since the last time you erased the NVRAM , skip to step 3. The set will then retrieve the data. This operation will take up to several minutes to complete. You can tell the operation is complete when the "Retrieving data ..." changes to "All PM reports retrieved." Press ENTER to return to the WESTELL NIU/PM & MSS menu. Press ENTER to reenter the RTRV/VIEW ALL PM RPT menu.
- 3) Refer to Figure 3.6.B for the Retrieve/View All PM RPT screen.

```
2:30:02
RTRV/VIEW ALL PM RPT
LAST REPORT IS AVAILABLE
SELECT OPTION : SCRVIEW
SCRVIEW PRINT RMTDUMP DELETE
```

Figure 3.6.B
RTRV/VIEW All PM RPT

- 4) Choose SCRVIEW (F1) if you would like to see the performance data printed on the screen. Then press PAGE-UP (F1) or PAGE-DN (F2) as desired to view all the data. If you see a STAT message that you don't understand, press STATUS (F3) to get an interpretation of the STAT code. Press ESCAPE to get out of the STATUS interpretation screen and back to the pages of performance results.
- 5) Choose DELETE (F4) if you would like to delete the performance history that the test set has and you would like to poll the NIU all over again. Note that if you never print your results, when you enter this menu you will have to choose DELETE in order to delete the old results and retrieve the current results.

Here is what the data means:

PM PERIOD is the month-day-hour
of the period being observed

ACCUM PRD is the period of time that the data was collected
over, either 1 hour or 1 day.

DIRECT is the direction that was measured. AZ is from the
central office to the customer premises and ZA is from the
customer premises to the central office.

CVL is a coding violation-line (BPV).

CVP is a coding violation-path (CRC-6 or SF error).

ESL is a errored second-line.

ESP is an errored second-path.
SESL is a severely errored second-line.
SESP is a severely errored second-path.
UASL is an unavailable second-line.
UASP is an unavailable second-path.
PDVS is a pulse density violation second.
B8ZS is a second in which B8ZS was observed.
MSEC is the number of measured seconds.
STAT is the coded status message.

3.6.2 Retrieve PM Report

Refer to the previous procedure and definitions in 3.6.1. This menu item allows you to retrieve the performance information from a single time period. You must specify the month, date, hour and direction of transmission that you wish to poll. Simply press the SHIFT-lock key so that the SHIFT indicator is displayed. Then type in the numbers of the day, date, and hour that you want. Then press the SHIFT-lock key again so that you can enter the desired F-keys for accumulation period and direction. When all the numbers and entries are as desired, press ENTER to retrieve and view the data.

3.6.3 Reset PM Counters

Occasionally the data at the NIU may become corrupted. This command allows you to reset all the NIU performance registers to zero. Simply press the ENTER key when it gives you the warning message and all the counters will be reset to 0.

3.6.4 Retrieve NIU Header

This simple command tells you the date and time set at the PM NIU.

3.6.5 Set NIU Time & Date

This command allows you to set the NIU time and date in year-month-day and hour-minute-second format. Note that setting the

NIU time and date will cause all the registers to be reset to n/a (not available). You may wish to retrieve the available performance information before resetting the time and date.

3.6.6 MSS Switch Control

This command sends the control sequence to initiate the maintenance switch. Figure 3.6.C portrays the MSS Switch Control screen.

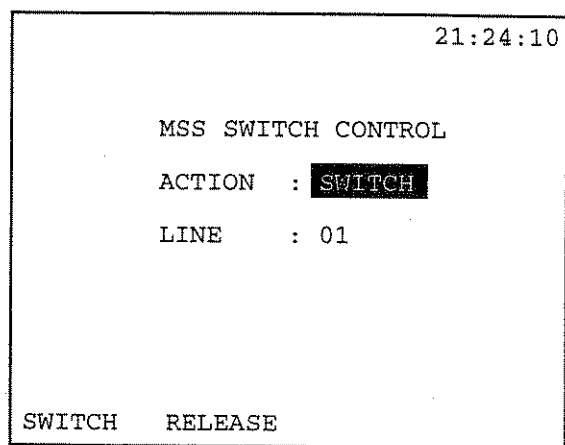


Figure 3.6.C
MSS Switch Control

The following items should be configured in this screen:

1) ACTION

F-Key Options: SWITCH (F1), RELEASE (F2)

Choose SWITCH (F1) if you are connected to the maintenance switch and you are ready to switch a circuit over to the spare. Choose RELEASE (F2) if you are connected to the customer's span and the customer is using the maintenance span.

2) LINE

You need to specify the line number if you have selected SWITCH above. Activate the SHIFT-Lock key and use the keypad to enter the desired numbers.

Use the following procedure to initiate the maintenance switch:

- 1) Be sure you have a loopback established at the maintenance switch. Press the ERR INJ key and verify that you see your errors coming back. If you don't, ESCAPE back to the LPBK & SPAN CTRL menu. Then re-ENTER the WESTELL NIU/PM & MSS menu. This will automatically loop up the T1 Maintenance Switch card or NIU.
- 2) ENTER the MSS SWITCH CONTROL menu.
- 3) SWITCH (F1) the line if you are connected to the maintenance switch and you are ready to switch a circuit over to the spare. Or, RELEASE (F2) the line if you are connected to the customer's span and the customer is using the maintenance span.
- 4) If you chose RELEASE, proceed to step 5). Otherwise, choose which line to switch to the maintenance spare. Press the SHIFT-Lock key to display the SHIFT indicator, then press the desired numbers. Deactivate the SHIFT-Lock key and press ENTER to begin the operation. Once the control sequence is successful, you will receive a message saying to go ahead and press the ENTER key to activate the 10 second timer at the maintenance switch. Do this. Connect the customer's span to the maintenance spare for the duration of the switch. You are now finished.
- 5) If you chose RELEASE in step 3), you do not need to specify which line to release - this will be taken care of automatically. Press ENTER and the control sequences will start. When the maintenance switch is ready, reposition the cables on the span, and then press ENTER to release the protection switch.
Note that you need to have a loopback in place to perform these commands. If you go directly from a switch to a release you will first be plugged into the control unit, and then you will be plugged into the PM NIU. The control unit will be automati

cally looped up when you enter the WESTELL NIU/PM & MSS menu item. However, when you plug into the PM NIU to perform the release command, then you will need to ESCAPE out of the Westell PM NIU/MSS menu and then enter back into it as described in step 1 to reestablish the loopback at the PM NIU. You are now finished.

Consult the Westell Maintenance Switch System practices for extensive information on the operation of the switch.

3.6.7 MSS Ramp Access

This command sends the control codes necessary to retrieve the performance information from the desired NIU. The advantage of this form of information retrieval is that the line remains in service while the information is polled. Figure 3.6.D shows the MSS Ramp Access screen.

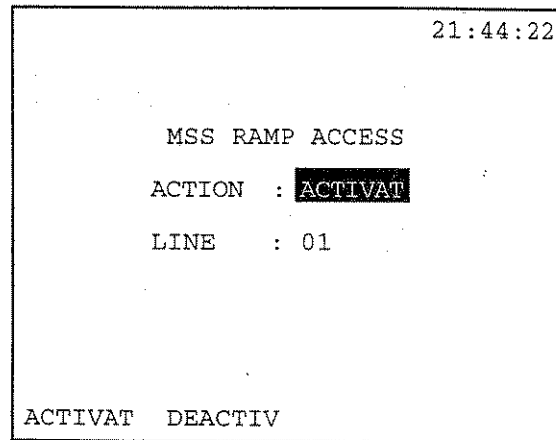


Figure 3.6.D
MSS Ramp Access

The following items should be configured:

1) ACTION

F-key Options: ACTIVAT (F1), DEACTIV (F2)

Choose ACTIVAT (F1) to activate this command and retrieve the performance information from the NIU. Choose DEACTIV (F2)

when you are finished viewing the data.

2) LINE

Activate the SHIFT-Lock key and use the keypad to enter the desired number.

Use the following procedure to send the control codes necessary to retrieve the performance information:

- 1) ENTER the MSS RAMP ACCESS menu.
- 2) Choose ACTIVATE (F1).
- 3) Choose the line that you want to read the RAMP from. Press the SHIFT-lock key to display the SHIFT indicator on the screen. Then enter the number of the line to be read. Then press ENTER.
- 4) When the "RAMP control has completed message" is shown, escape back to the WESTELL NIU/PM & MSS menu.
- 5) Press ENTER on RTRV/VIEW ALL PM REPORT. Choose F4 (DELETE). Retrieve the performance monitoring data as described in the "RTRV VIEW ALL PM RPT" procedure. View and print the data as desired.
- 6) When finished viewing the data, return to the MSS RAMP ACCESS menu.
- 7) Choose DEACTIVAT and press ENTER. When the control sequences finish, you are finished with this procedure.

3.7 Teltrend MSS

Upon entering Teltrend MSS, you will see the Teltrend MSS menu containing one item- MSS SWITCH CONTROL. Press ENTER again to reach the MSS Switch Control screen. Figure 3.7.A shows this screen.

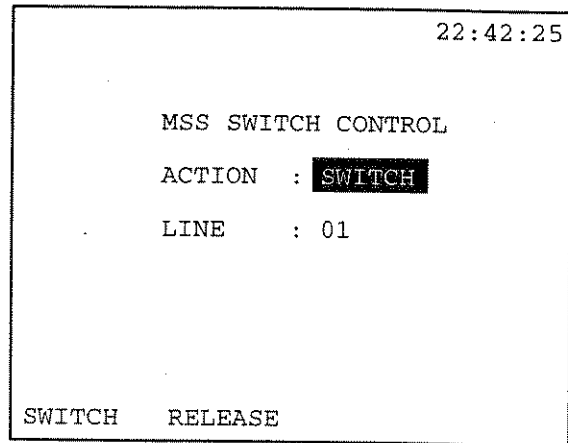


Figure 3.7.A
Teltrend MSS Switch Control

The following items should be configured in this screen:

1) ACTION

F-key Options: SWITCH (F1), RELEASE (F2)

Choose SWITCH (F1) if you are connected to the maintenance switch and you are ready to switch a circuit over to the spare. Choose RELEASE (F2) if you are connected to the customer's span and the customer is using the maintenance span.

2) LINE

This specifies the position of the line to be switched/ released. Activate the SHIFT-Lock key and use the key pad to enter the desired numbers.

Use the following procedure to initiate the maintenance switch:

- 1) Verify that the settings you have specified in the SET UP INTERFACE menu are correct.
- 2) Upon entering the TELTREND MSS menu item, the SunSet will attempt to loop up the CCU (maintenance switch Common Control Unit).

- 3) Ensure that a successful loopback has been established at the maintenance switch by pressing the ERR INJ key. Any errors which are received should be indicated on the LED display panel.

If a successful loopback has not been established, escape to the LPBK & SPAN CTRL menu. Re-enter the TELTREND MSS menu item. This will automatically attempt to loop up the CCU or NIU.

- 4) Enter the TELTREND MSS CONTROL menu item.
- 5) Select F-Key SWITCH (F1) if you are connected to the maintenance switch and you are ready to switch the circuit over to the spare. Select RELEASE (F2) if you are connected to the customer's span and the customer is using the maintenance span. Using the SHIFT-lock key, enter the position of the LINE to be switched/released. Press ENTER to start the control sequences.
- 6) If you have chosen SWITCH, the SunSet will indicate that it is sending the switch code, then it will attempt to verify the switch. Once this operation has succeeded, a message will be displayed for the user to press ENTER to switch the line. After pressing ENTER, connect the customer's span to the maintenance spare for the duration of the switch. You are now finished.
- 7) If you have chosen RELEASE in step 5, reposition the cables on the span. Press ENTER and wait until the control sequences have been executed. The switch has now been released.

Note the following important points:

- 1) A loopback must be in place to perform the switch/release commands. If you go directly from a switch to a release, you will first be plugged into the control unit, and then you will be plugged into the NIU.
- 2) The CCU will automatically loop up when the TELTREND MSS menu item is entered. However, when you plug into the NIU

to perform the release command, then you will need to ESCAPE from the TELTREND MSS menu and then re-enter it (as in step 2) to re-establish a loopback at the NIU.

Consult the Teltrend Maintenance Switch System practices for extensive information on the operation of the switch.

Section 4 SEND TEST PATTERN

4.1 Sending Standard Patterns

The SEND TEST PATTERN screen, as displayed in Figure 4.1.A, may be accessed through the Main Menu.

```
03:10:27
SEND TEST PATTERN
QRSS  55DLY  2e23  2047
1-8   FOX    2e20  511
1-16  ALL1    2e15  127
3-24  ALL0    ALT10  63
T1-1  T1-2    T1-3   T1-4
T1-5  T1-6    DDS-1  DDS-2
DDS-3 DDS-4    DDS-5  DDS-6

SENDING: 2e23

USER
```

Figure 4.1.A
Send Test Pattern Menu

Use the following procedure to select/ send a test pattern:

- 1) Press the ESCAPE key until you have reached the Main Menu. Move the cursor to highlight the SEND TEST PATTERN menu item. Press ENTER.
- 2) Press the down, up, left, and right arrow keys until you have highlighted the desired pattern.

NOTE: The SunSet begins transmitting a new test pattern each time a different pattern is highlighted with the cursor.

This section defines the various test patterns transmitted and recognized by the SunSet T10. The long patterns are written in hexadecimal, also known as "hex". You can tell if a pattern is written in hex, because it is written with pairs of numbers separated by commas. Hex is a 16-digit number system consisting of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. The hex pattern 15 FA translates to the binary pattern 0001 0101 1111 1010, where the left-most bit is transmitted first. Here are the test patterns:

QRSS

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

55DLY

The Daly 55 Octet pattern is a special stress pattern that obeys industry standards for pulse density and maximum consecutive zeroes in both AMI and B8ZS coded circuits. Framing bits occur at octet boundaries. Note that the Daly 55 octet pattern replaced the original 55 octet pattern (see T1-6). Here is the Daly 55 octet pattern:

```
80, 80, 80, 80, 80, 80, 01, 80, 80, 80, 80, 80,
80, C0, 80, 80, 80, 80, E0, 80, 80, 80, 80, AA,
AA, AA, AA, 55, 55, 55, 55, 80, 80, 80, 80, 80,
80, FF, FF, FF, FF, FF, FF, 01, 80, 01, 80, 01,
80, 01, 80, 01, 80, 01, 80
```

2e23

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

2047

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

1-8

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

f 0100 0000

FOX

The industry-standard FOX pattern is used in data communications applications. The ASCII translation of the pattern is the "Quick brown fox...." sentence. The pattern is frame aligned to ensure proper ASCII translation of the bits. It is recommended that the pattern be sent with 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

2e20

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

511

511 is the industry standard 511-bit code used for DDS applications.

1-16

The industry-standard 1 in 16 pattern is used for over-stressing AMI lines. It violates industry standards for pulse density. Therefore an AMI circuit that fails this test could still be a good circuit. The pattern is frame

aligned ("f" is the framing bit) as shown in its binary form:

f 0100 0000 0000 0000

ALL 1

The industry-standard all 1s pattern is used for stress testing AMI and B8ZS lines. If the pattern is sent unframed, it will be inter-

preted as an AIS (Alarm Indication Signal). Here is the pattern in its binary form:

1111

2e15

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

127

127 is the industry-standard 127-bit code used for DDS applications.

3-24

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

f 0100 0100 0000 0000 0000 0100

ALL 0

ALL 0 is the industry-standard all zeroes pattern. This pattern is often used to make sure that clear-channel lines have been properly provisioned for B8ZS during circuit turn-up. If a portion of the circuit is AMI, pattern synch and/or signal will be lost. The pattern is:

0000

ALT10

ALT 10 is the industry-standard alternating ones and zeroes pattern. The pattern is frame aligned with "f" showing the location of the framing bit. The pattern is:

f 0101 0101

63

63 is the industry-standard 63-bit code used for DDS applications.

T1-1

This 72-octet pattern is used for stress testing T1 circuits and network elements. Here is the actual pattern, with "f" showing the locations of the framing bit:

```
f 01, 01, 01, 01, 80, 00, 80, 80, 80, C0, 01,
80, 01, 80, 80, 01, 80, 44, 00, 04, 44, 00, 04,
55, f 55, 55, 55, 55, AA, AA, AA, AA, 55, 55,
55, 55, AA, 55, 55, AA, AA, AA, 01, 01, FF, FF,
FF, FF, f FF, FF, FF, 7F, FF, FF, 24, 92, 49,
11, 11, 11, 08, 42, 10, 84, 21, 04, 10, 41, 02,
04, 08, 01
```

T1-2

This 96-octet pattern is used for stress testing T1 circuits and network elements. The pattern can cause framing problems and should not be used with SF framing. Here is the actual pattern, with "f" showing the locations of the framing bit:

```
f FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, f FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, f 55, 55, 55, 55, 01, 80, 01, 80, 01,
80, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80, 01,
80, 01, 80, f 55, 55, 55, 55, 01, 80, 01, 80,
01, 80, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80,
01, 80, 01, 80
```

T1-3

This 54-octet pattern is used for stress testing T1 circuits and network elements. The framing bit is inserted at octet boundaries. The pattern violates the 15 zeroes constraint when transmitted in a framed AMI signal. However, in unframed transmission or B8ZS transmission it meets the zeroes constraint. Here is the actual pattern:

```
80, 80, 80, 80, 80, 80, 00, 80, 80, 80, 80, 80,
80, C0, 80, 80, 80, 80, E0, 80, 80, 80, 80, AA,
AA, AA, AA, 55, 55, 55, 80, 80, 80, 80, 80, 80,
FF, FF, FF, FF, FF, FF, 01, 80, 01, 80, 01, 80,
01, 80, 01, 80, 01
```

T1-4

This 120-octet pattern is used for stress testing T1 circuits and network elements. Here is the actual pattern, with "f" showing the locations of the framing bits:

```
f FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
```

```

FF, f  FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, f  FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, FF, FF, f  55, 55, 55, 55, 08, 08, 08,
08, 08, 08, 08, 08, 08, 08, 08, 08, 08, 08, 08,
08, 08, 08, 08, 08, f  55, 55, 55, 55, 08, 08,
08, 08, 08, 08, 08, 08, 08, 08, 08, 08, 08, 08,
08, 08, 08, 08, 08, 08

```

T1-5

This 53-octet pattern is used for stress testing T1 circuits and network elements. The framing bit is inserted at octet boundaries. Here is the actual pattern:

```

01, 80, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80,
01, 80, 01, 80, 01, 80, 01, 80, 01, 80, 01, 80,
01, 80, 01, 80, 01, 80, 80, F5, 55, 80, 80, 80,
80, FF, FF, FF, FF, F5, 55, 80, 80, 80, 80, FF,
FF, FF, FF, FF, 80, 80, 80, 80, FF, FF, FF, FF,
FF, FF, FF, D3

```

T1-6 (55 octet)

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

```

80, 80, 80, 80, 80 80, 00, 80, 80, 80, 80, 80,
80, C0, 80, 80, 80, 80, E0, 80, 80, 80, 80, AA,
AA, AA, AA, 55, 55, 55, 55, 80, 80, 80, 80, 80,
80, FF, FF, FF, FF, FF, FF, 01, 80, 01, 80, 01,
80, 01, 80, 01, 80, 01, 80

```

DDS Pattern Notes

The DDS patterns were developed specifically for DDS applications. DDS-1, DDS-2, and DDS-6 should not be used as 1.544 Mbps T1 test patterns on AMI coded lines, because they have an excess of 150 consecutive zeroes. This will cause the T1 line to record a loss of signal. These patterns are recorded for DDS, fractional nx56 T1 applications, and special laboratory applications.

4.2 Sending a USER Test Pattern

Use the following procedure to send a User-defined pattern:

- 1) Press ESCAPE until you have reached the Main Menu. Move the cursor to highlight the SEND TEST PATTERN menu item. Press ENTER.
- 2) Press the F1 key to bring up the USER TEST PATTERN screen.
- 3) The test set will present the list of USER patterns. Use the Down/ Up arrow keys to move the cursor to the desired pattern. The SunSet T10 offers two pre-programmed User-defined patterns. These patterns are IDLE and YELLOW and are stored in the (9) and (10) slots, respectively. To send a pre-programmed pattern, cursor down to slot (9) or (10) and press ENTER. Alternatively, you may view, edit, or delete an existing pattern, as well as create a new pattern to send.

Viewing a User Test Pattern

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

Programming User-Defined Patterns

To program a user test pattern, follow this procedure:

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

to the LABEL item.

Press the Down Arrow key to move to the FORMAT item. Choose BINARY (F1) or HEX (F2). The binary input is often simpler for entering short patterns. Valid entries are '1' and '0' for binary. For HEX mode, valid entries are: '0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.'

Press the Down Arrow key to move to the pattern entry area. Press the SHIFT-lock key. Enter up to 2048 binary characters or 512 hexadecimal characters to make up the desired pattern. Press the SHIFT-lock key once. Verify that the SHIFT indicator no longer appears in the upper left corner of the screen.

- 5) Press the ENTER key 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.

Correcting a Mistake in the Label While Entering the Label

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

- 1) This procedure assumes you are starting in the alphabet grid as in step 3 of the Programming User-Defined Patterns procedure. A letter within the grid should be flashing on and off.
- 2) Choose toggle (F3) to move out of the alphabet grid and back to the LABEL item. Press the Left Arrow key until the cursor is over the unwanted letter.
- 3) Press DELETE (F2) to remove the desired letter or number. Repeat this as necessary.
- 4) When all of the incorrect characters have been removed, move the cursor to the right of the last character. If the LABEL is now correct, press ENTER and you are done.

If you need to add some more 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

- 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.

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).
- 3) Edit the code's label using the "Correcting a Mistake..." procedure.
- 4) Press ENTER to store the pattern.

Deleting a User Test Pattern Label

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.

Section 5 MEASUREMENT RESULTS

The SunSet T10 continuously performs measurements on its received signal(s). The user need not access the Measurement Results menu in order for measurement results to be compiled. The SunSet T10 is taking measurements whenever a reverse-video MEAS message appears at the top of the screen. Measurements are automatically restarted every time the configuration is significantly changed (i.e. when you change TEST MODES). Pressing the AUTO key will also restart the measurements. The Measurement Results screen allows you to view the accumulated measurements and restart the measurement process.

The actual measurement results screen and the values displayed depend upon the Test Mode chosen in TEST CONFIGURATION. There are, however, some features common to all Measurement Results screens. Figure 5.A displays a sample Measurement Results screen.

```
MEAS 18:06:48
ET- 000:05:55 RT- CONTINU
FRM-ESF COD-B8ZS CNFG-TERM
RCV-QRSS XMT- QRSS

LINE 1- SUMMARY

BPV : 1 BPVR: 1.2e-09
BIT : 1 BER : 1.2e-09
FBE : 0 CRC : 0
ES : 1 %EFS: 99.817
SES : 0 Lpp : -0.2 dB
UAS : 0 FREQ: 1544000

PAGE-UP PAGE-DN STOP more
```

Figure 5.A
Measurement Results Screen

Measurements may have a count number displayed on the left hand side and the corresponding rate or percentage displayed on the same line on the right hand side. For example, BPV, the

count of bipolar violations, is displayed on the left-hand, while BPVR, bipolar violation rate, is displayed on the right-hand.

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

PAGE-UP (F1): This key allows you to view other pages of results. PAGE-UP brings up the previous screen.

PAGE-DN (F2): This key allows you to view other pages of results. PAGE-DN brings up the next screen.

RESTART/STOP (F3): STOP stops the measurement process, while RESTART restarts the measurement process from within this menu. Remember that changing the Test Mode or pressing the AUTO key will restart the measurements from any screen.

HOLDSCR (more, F1): this key will freeze the measurement counts 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.

PRN-SAV (more, F2): PRN-SAV will either print the current displayed measurement results or save them in VIEW TEST RECORD.

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 beginning of the measurement process, or:

1. since the SunSet was switched on
2. since the SunSet was reconfigured using the TEST CONFIGURATION menu.
3. since the process was restarted using the (F3) RESTART key.
4. since the AUTO key was pressed.

Note: In the LOGICAL results screens, ET is replaced with LET. LET stands for Logical Elapsed Time; it does not start counting until PAT SYNC has been achieved.

RT (Remaining Time): Remaining Time is the time that remains until the testing has been completed. 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 CONFIGURATION item, you may enter a specific time up to 999 hours and 59 minutes.

FRM: The transmitted framing is displayed here.

COD: The transmitted line coding is displayed here.

RCV: The received test pattern is displayed here.

XMT: The transmitted test pattern is displayed here.

Note: When you have finished viewing the measurements, press the ESCAPE key to return to the Main Menu.

5.1 T1 Singl Mode Measurements

The T1 SINGL Measurement Results contain seven pages of results. The different pages may be reached by the PAGE-UP and PAGE-DN F-keys. The pages are:

- 1) Line 1 Summary
- 2) Line 1 Line
- 3) Line 1 Signal
- 4) Line 1 Frame
- 5) Line 1 ESF CRC-6
- 6) Line 1 Logical
- 7) Line 1 Frequency

5.1.1 Line 1 Summary Screen

The summary screen presents the most significant measurement results. The screen contains measurement data related to specific types of impairments like bipolar violations, bit errors

framing bit errors, and CRC-6 block errors. It also reports overall service performance measures such as errored seconds and percent errored free seconds.

The Line 1 Summary Screen is shown in Figure 5.1.A.

```
MEAS 18:06:48
ET- 000:05:55 RT- CONTINU
FRM-ESF COD-B8ZS CNFG-TERM
RCV-QRSS XMT- QRSS

LINE 1- SUMMARY

BPV : 1 BPVR: 1.2e-09
BIT : 1 BER : 1.2e-09
FBE : 0 CRC : 0
ES : 1 %EFS: 99.817
SES : 0 Lpp : -0.2 dB
UAS : 0 FREQ: 1544000

PAGE-UP PAGE-DN STOP more
```

Figure 5.1.A
Summary Screen

The terms used in this screen are defined as follows:

BPV

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

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

BPVR

This is the average BiPolar Violation error Rate since the beginning of the test.

Usage: The rate is sometimes used instead of a count when

the measurement is conducted for a longer period. 10^{-3} is a typical maintenance limit for voice transmission and 10^{-6} is a common acceptance limit for voice transmission. Many data customers require 10^{-9} or better.

BIT

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

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

BER

This is the average bit error rate since the beginning of the test. This measurement is reported as N/A when the test set is not synchronized on a known received pattern.

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

FBE

This is a count of the number of Framing Bit Errors that have occurred since the beginning of the test. This measurement is reported as N/A when the test set is not synchronized on a known framing pattern within the received signal.

Usage: This measurement is often used for in-service testing on SF-D4 circuits where the customer is transmitting an unknown data stream. The advantage of the measurement is that the framing stays intact as it passes through various network elements (fractional T1 circuits excepted), hence it depicts the overall transmission quality from the far end of the circuit to the test set. One problem with the measurement is that it only measures one out of every 193 bits, and so gives only a sampling of the true transmission performance. The other problem with the

monitor measurement is that it can't measure the quality of transmission on the outgoing directions from the test set to the end of the circuit. It can only measure the quality on the two incoming directions of transmission.

Lpp

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

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

CRC

This is a count of the number of CRC-6 errors that have occurred since the beginning of the test. This measurement is reported as N/A when the test set is not synchronized on a received ESF signal.

Usage: This measurement is a valuable complement to the BPV measurement. BPVs identify errored in-service transmission in the local part of the T1 path, and CRCs identify errored in-service transmission on the entire path from the origination point to the test set. If the number of BPV errors is about the same or a little bit less than the CRC errors, then you have a problem on the local span. However, if there are no BPV errors but many CRC errors, then your problem is on the other side of multiplexers or other line-terminating equipment.

Note that for an in-service test, both CRCs and BPVs only give information about errors on the incoming signal directions but do not give information about errors on the outgoing signals. To fully test the line with these measurements, you must take it out of service and operate a loopback at the far end.

FREQ

FREQuency is the frequency of the signal as measured against the frequency of the reference clock. The set's internal clock is used to measure frequency when just one signal is plugged in. When both Rx jacks have signals plugged in, one of the signals is used as the frequency reference of the other. The INTERN

reference clock of the set has stratum 3 accuracy.

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-6 error. An errored second is not counted during an unavailable second.

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

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

SES

This is a count of the number of Severely Errored Seconds that have occurred since the beginning of the test. A severely errored second is a second with a 10^{-3} error rate, where error rate is measured off of bit errors, BPV errors, framing bit errors, and CRC-6 errors. An out of frame error will also generate a severely errored second. A severely errored second is not counted during an unavailable second.

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

%EFS

This is a count of percentage of Error Free Seconds since the beginning of the test. An error free second has no errors at all.

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

UAS

This is a count of all the UnAvailable Seconds since the beginning

of the test. Note that a T1 service is not available during an UAS.

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

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

5.1.2 Line Screen

The LINE 1 or LINE 2 - LINE screen measurements are calculated from bipolar violation occurrences. You may want to use this screen if you have an unframed signal and you are performing an in-service test. The T1 SINGL Line screen is shown in Figure 5.1.B.

```
MEAS 18:12:52
ET- 000:11:40 RT- CONTINU
FRM-ESF COD-B8ZS CNFG-TERM
RCV-QRSS XMT- QRSS

LINE 1- LINE

BPV : 11
BER : 9.9e-09 CURBER: 0.0e-07
ES : 5 %ES : 00.692
SES : 0 %SES : 00.000
AS : 723 %AS : 100
UAS : 0 %UAS : 00.000
DGRM: 0 %DGRM : 00.000
PAGE-UP PAGE-DN STOP more
```

Figure 5.1.B
Line 1 Line Screen

The result terms appearing in this screen are defined as follows:

BPV

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

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

BPV BER

This is the Bipolar Violation Error Rate measured since the beginning of the test.

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

BPV CURBER

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

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

BPV ES

BPV Errored Seconds is the count of seconds with at least one bipolar violation since the beginning of the test. BPV ESs are not counted during BPV UASs.

BPV %ES

This is the percentage of BPV ESs that has occurred since the beginning of the test. BPV %ES is not counted during BPV UASs

BPV SES

BPV Severely Errored Seconds is the count of seconds with at least a 10^{-3} bipolar violation error rate since the beginning of the test. BPV SESs are not counted during BPV UASs.

BPV %SES

This is the percentage of BPV SESs that has occurred since the beginning of the test.

BPV AS

This is the number of available seconds that has occurred since the beginning of the test. A BPV AS is any second that is not a BPV UAS.

BPV %AS

This is the percentage of available BPV seconds that has occurred since the beginning of the test.

BPV UAS

This is the count of bipolar violation UnAvailable Seconds since the beginning of the test. BPV UASs are counted if there is a loss of signal. They are also counted at the onset of 10 consecutive BPV SESs. BPV UAS continue to be counted until the onset of 10 consecutive available non-SESs.

BPV %UAS

This is the percentage of BPV UASs that has occurred since the beginning of the test.

BPV DGRM

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

BPV %DGRM

This is the percentage of BPV DGRMs that has occurred since the beginning of the test.

5.1.3 Line 1 Signal Screen

The LINE 1 SIGNAL screen presents all those measurements that are based on the actual T1 signal itself. You should use this

screen if you are interested in the signal itself. Several of the measurements are useful in just about any application.

The Line 1 Signal screen is shown in Figure 5.1.C.

```
18:16:44
ET- 000:00:24      RT- CONTINU
FRM-ESF          COD-B8ZS  CNFG-TERM
RCV-QRSS          XMT- QRSS

          LINE 1- SIGNAL
AS  : 24          FREQ : 1544000
UAS : 0           +LVL : 2.93 V
LOSS: 0          -LVL : 2.92 V
LDNS: 0         Lpp  : 5.85 V
EXZS: 0         +LVL : -0.2 dB
AISS: 0         -LVL : -0.2 dB
%AS : 100       Lpp  : -0.2 dB
%UAS: 00.000   SMPX : 0.   mA
PAGE-UP PAGE-DN RESTART more
```

Figure 5.1.C
Line 1 Signal Screen

The measurement terms are defined as follows:

Signal AS

Signal Available Seconds is the number of seconds during which signal was not lost.

Signal UAS

Signal UnAvailable Seconds is the number of seconds during which signal was lost. Signal is lost during a LOS condition.

Signal %UAS

Signal percent UnAvailable Seconds is the percentage of seconds during which LOS was detected since the beginning of the test.

Usage: This is a very quick way to see the percentage of time in which there was no signal on the line.

Signal LOSS

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

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

Signal LDNS

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

Usage: This measurement can give you clues as to whether the customer is transmitting illegal strings of data or whether B8ZS encoding equipment is working properly. For instance, if the line code is set up to be B8ZS in the test set, but you are getting LDNS counts, then a transmitter is not correctly sending the B8ZS code to you. Or, if you have an AMI line and you get excessive LDNS counts, it will tell you that the customer is sending an unusual signal and perhaps that customer should be switched to a B8ZS line.

EXZS

EXcess Zero Seconds is a count of the number of seconds in which excessively long strings of zeroes were detected. For AMI coding, this is 16 or more consecutive zeroes, for B8ZS this is 8 or more consecutive zeroes. This measurement is different than LDNS in that it looks for individual strings of zeroes rather than an average ones density over a large number of bits.

Usage: Refer to the usage for LDNS.

AISS

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

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

+LVL

Positive LeVeL is the level of positive pulses received by the test set.

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

-LVL

Negative LeVeL is the level of negative pulses received by the test set.

Usage: The +LVL and -LVL measurements are useful for finding faults with the last repeater or transmitter that is generating the signal to the test set. If one value is different from the other by more than 1 dB, you may have a problem. The level at a repeater should be between -10 dB and -35 dB.

Lpp

Peak-to-peak Level is the peak-to-peak level of negative and positive pulses received by the test set.

Usage: The Lpp measurement saves you the time of adding the +LVL and -LVL values to calculate your own Lpp.

FREQ

Frequency is the frequency of the signal as measured against the frequency of the reference clock. The set's internal clock is used to measure frequency when just one signal is plugged in. When both Rx jacks have signals plugged in, one of the signals is used as the frequency reference of the other. The INTERN reference clock of the set has stratum 3 accuracy.

SMPX

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

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

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

5.1.4 Line 1 Frame Screen

The LINE 1 FRAME screen reports all the measurements that are related to the framing of the line being tested. These measurements are reported regardless of the type of framing on the line. An unframed signal will not have measurements reported here. Usage: The LINE 1 FRAME screen is particularly useful for D4 signals where CRC-6 errors are not available.

The Line 1 Frame Screen is shown in Figure 5.1.D.

```
18:16:44
ET- 000:02:08      RT- CONTINU
FRM-ESF          COD-B8ZS  CNFG-TERM
RCV-QRSS          XMT- QRSS

      LINE 1- FRAME
FBE : 5           FSLIP : NO L2
FBER: 9.8e-06    CUFBER: 0.0e-04
OOPS: 0          COFA : 0
YELS: 0          LOFS : 0
ES : 2           %ES : 01.563
SES : 0          %SES : 00.000
AS : 128         %AS : 100
UAS : 0          %UAS : 00.000
PAGE-UP PAGE-DN RESTART more
```

Figure 5.1.D
Line 1 Frame Screen

FBE

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

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

the quality only on the two incoming directions of transmission.

FSLIP

This is the count of Frame SLIPs that have occurred since the beginning of the test. A frame slip is said to have occurred each time the phase of the line under test has deviated from the phase of the reference clock by 193 bits.

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

FBER

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

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

CUFBER

This is the CUrrent Framing Bit Error Rate.

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

OOFS

This is the count of Out-Of-Frame seconds that have occurred since the beginning of the test. Note that the conditions for out-of-frame may be adjusted in the MEASUREMENT PARAMETERS screen. An out-of-frame condition occurs when either 2-in-4 or 2-in-5 framing bits have been in error.

OOFS start counting when an out-of-frame condition occurs. OOFS continue incrementing until framing has been reestablished, or until 3 consecutive seconds have been OOFS. In this case, LOF is declared, OOFS is decremented by 3, and LOFS is incremented by 3.

Once an out-of-frame condition occurs, the test set begins searching for a new framing position. The out-of-frame condition ends when framing has been reestablished. If the framing remains in the original position, then no further action takes place.

If the framing moves to a new position, then a Change of Frame Alignment (COFA) is declared.

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

COFA

This is the count of Changes of Frame Alignment that have occurred since the beginning of the test. See the previous explanation for the conditions that result in the declaration of a change of frame alignment.

YELS

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

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

Usage: Yellow alarm is the only end-to-end service indicator that is available for in-service testing on D4, SLC-96, and some ESF circuits. It is used to sectionalize a fault in this way. If the signal on side A reaches the test set without error, but the signal on side B shows a yellow alarm, then side A must be failing somewhere downstream from the test set.

LOFS

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

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

FRAME ES

This is the count of frame Errored Seconds since the beginning of the test in which at least one framing bit error has occurred. A frame errored second is not counted during a frame unavailable second.

FRAME %ES

This is the percentage of frame Errored Seconds that have occurred since the beginning of the test.

FRAME SES

A frame Severely Errored Second is a second in which 4 or more frame errors have occurred, or during which at least one out-of-frame has occurred. A frame severely errored second is not counted during a frame unavailable second.

FRAME %SES

This is the percentage of frame Severely Errored Seconds since the beginning of the test.

FRAME AS

This is a count of the frame Available Seconds since the beginning of the test. A frame available second is any frame error-free second, frame errored second, or frame severely errored second.

FRAME %AS

This is the percentage of frame Available Seconds since the beginning of the test.

FRAME UAS

A frame UnAvailable Second occurs at the onset of 3 consecutive OOFs or 10 consecutive SESs. Frame unavailable seconds continue to be counted until the onset of 10 consecutive frame error-free seconds or frame errored seconds.

FRAME %UAS

This is the percentage of frame UnAvailable Seconds since the beginning of the test.

5.1.5 Line 1 ESF CRC-6 Screen

The LINE 1 ESF CRC-6 screen shows all the results that are derived from the CRC-6 (Cyclic Redundancy Check code - 6) bits within the ESF signal. These results are reported only with an ESF signal. Figure 5.1.E shows the ESF CRC-6 screen.

```

MEAS 18:16:44
ET- 000:02:19 RT- CONTINU
FRM-ESF COD-B8ZS CNFG-TERM
RCV-QRSS XMT- QRSS

LINE 1- ESF CRC-6
CRC : 0
CER : 0.0e-05 CURCER: 0.0e-03
ES : 2 %ES : 00.000
SES : 0 %SES : 00.000
AS : 139 %AS : 100
UAS : 0 %UAS : 00.000

PAGE-UP PAGE-DN STOP more

```

Figure 5.1.E
ESF CRC-6 Screen

The measurements seen in this screen are defined as follows:

CRC

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

CER

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

CURCER

This is the CurrenT CRC-6 Error Rate since the beginning of the test.

CRC-6 ES

This is a count of seconds with at least one CRC-6 since the beginning of the test. A CRC-6 errored second is not counted during a CRC-6 unavailable second.

CRC-6 %ES

This is the percentage of CRC-6 Errored Seconds since the beginning of the test.

CRC-6 SES

CRC-6 Severely Errored Seconds is a count of the seconds with at least 320 CRC-6 errors since the beginning of the test. A CRC-6 severely errored second is not counted during a CRC-6 unavailable second.

CRC-6 %SES

This is the percentage of CRC-6 Severely Errored Seconds since the beginning of the test.

CRC-6 AS

CRC-6 Available Seconds is a count of the CRC-6 error-free seconds, CRC-6 errored seconds, and CRC-6 severely errored seconds since the beginning of the test.

CRC-6 %AS

This is the percentage of CRC-6 Available Seconds since the beginning of the test.

CRC-6 UAS

This is a count of the CRC-6 UnAvailable Seconds since the beginning of the test. Also, CRC-6 unavailable seconds are counted at the onset of 10 consecutive CRC-6 severely errored seconds or immediately on LOF or LOS. CRC-6 UAS continue to be counted until the onset of 10 CRC-6 error-free or CRC-6 errored seconds.

CRC-6 %UAS

This is the percentage of CRC-6 UnAvailable Seconds since the beginning of the test.

5.1.6 Line 1 Logical Screen

The LINE 1 LOGICAL screen reports all the parameters that are measured from a known test pattern. These results are only reported if the test set is synchronized on a known test pattern.

Usage: most users will refer only to the bit error rate and bit error count offered on the SUMMARY screen. However, the bit slip measurement offered on this screen is a useful means of detecting this unusual circuit impairment.

Figure 5.1.F shows the Logical Screen.

```
MEAS 18:37:58
LET- 000:10:44 RT- CONTINU
FRM-ESF COD-B8ZS CNFG-TERM
RCV-QRSS XMT- QRSS

LINE 1- LOGICAL
BIT : 10 BTSLP : 0
BER : 9.7e-09 CURBER: 0.0e-07
ES : 3 %ES : 00.412
SES : 0 %SES : 00.000
AS : 685 %AS : 100
UAS : 0 %UAS : 00.000
DGRM: 0 %DGRM : 00.000
SYLS: 0 %SYLS : 00.000
PAGE-UP PAGE-DN STOP more
```

Figure 5.1.F
Line 1 Logical Screen

BIT

This is a count of the BIT errors since the beginning of the test.

BTSLP

This is a count of the BIT SLIPs that have occurred since the beginning of the test. A bit slip is said to occur when the synchronized pattern either loses a bit or has an extra bit stuffed into it.

Usage: The bit slip can be useful for finding frequency slip problems that are symptomized by a network element that periodically drops or stuffs a bit.

BER

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

CURBER

This is the CURrent Bit Error Rate during the last AVERAGING INTERVAL. The averaging interval is one second.

BIT ES

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

during bit unavailable seconds.

BIT %ES

This is the percentage of BIT Errored Seconds that have occurred since the beginning of the test.

BIT SES

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

BIT %SES

This is the percentage of the bit Severely Errored Seconds that have occurred since the beginning of the test.

BIT AS

This is a count of the bit Available Seconds that have occurred since the beginning of the test. A bit available second is any bit error-free, bit errored, or bit severely errored second.

BIT %AS

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

BIT UAS

This is a count of the bit UnAvailable Seconds since the beginning of the test. A bit unavailable second is a second during which the test pattern has lost synchronization. Bit unavailable seconds are also counted at the onset of 10 consecutive bit severely errored seconds. Bit unavailable seconds continue to be counted until the onset of 10 bit non-severely errored seconds.

BIT %UAS

This is the percentage of bit UnAvailable Seconds since the beginning of the test.

BIT DGRM

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

occurred.

5.2 T1 Dual Measurements

The T1 Dual Measurement Results contain eleven pages of results. The different pages may be reached by the PAGE-UP and PAGE-DN F-keys.

The pages are:

- 1) Line 1 & 2 Summary
- 2) Line 1 Line
- 3) Line 2 Line
- 4) Line 1 Signal
- 5) Line 2 Signal
- 6) Line 1 Frame
- 7) Line 2 Frame
- 8) Line 1 ESF CRC-6
- 9) Line 2 ESF CRC-6
- 10) Line 1 or 2 Logical
- 11) Line 1 or 2 Frequency

Note: The ESF CRC-6 screens appear only if ESF framing has been selected in the TEST CONFIGURATION screen.

For most results, there are pages for both Line 1 and Line 2 results. However, the Logical and Frequency screens refer only to whichever line was selected as Rx/DROP in TEST CONFIGURATION.

5.2.1 T1 Dual Summary Screen

The T1Dual Summary screen presents different information than the T1 Singl Summary. Figure 5.2.A give a sample T1 Dual Summary screen.

```

MEAS 00:33:16
ET- 000:03:11 RT- CONTINU
FRM-SF-D4 COD-B8ZS CNFG-TERM
RCV- DDS-1 XMT- DDS-1

SUMMARY

- LINE 1 - - LINE 2 -
ES : 1 ES : 1
SES : 0 SES : 0
UAS : 0 UAS : 0
%EFS: 99.476 %EFS: 99.476
Lpp : 0.4 dB  FREQ: 1544000
BIT : 1

PAGE-UP PAGE-DN STOP more

```

Figure 5.2.A
T1 Dual Line 1 & 2 Summary Screen

Note: In Figure 5.2.A, Line 2 was selected as Rx/DROP in the TEST CONFIGURATION screen. If Line 1 had been selected, then the FREQ and BIT results would be provided for line 1 instead.

The following definitions are used in this screen:

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-6 error. An errored second is not counted during an unavailable second.

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

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

SES

This is a count of the number of Severely Errored Seconds that have occurred since the beginning of the test. A severely errored second is a second with a 10^{-3} error rate, where error rate is measured off of bit errors, BPV errors, framing bit errors, and CRC-6 errors. An out of frame will also generate a severely errored second. A severely errored second is not counted during an unavailable second.

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

UAS

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

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

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

%EFS

This is a count of percentage of Error Free Seconds since the beginning of the test. An error free second has no errors at all.

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

Lpp

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

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

FREQ

FREQuency is the frequency of the signal as measured against the frequency of the reference clock. The set's internal clock is used to measure frequency when just one signal is plugged in. When both Rx jacks have signals plugged in, one of the signals is used as the frequency reference of the other. The INTERN reference clock of the set has stratum 3 accuracy.

BIT

This is a count of the BIT errors since the beginning of the test.

All the other Line 1 & 2 measurement result pages are similar to those of T1 SINGL Mode. Therefore, you may refer to the corresponding T1 SINGL sections for sample screens and definitions of the associated terms.

5.3 DATACOM Measurement Results

The Measurement Results for DATACOM Mode consist of only one page, the Datacom Bit Error screen. Figure 5.3.A shows the Datacom Bit Error screen.

```

MEAS 01:19:21
ET- 000:02:44 RT- CONTINU
TYPE- X.21 MODE- DTE
RATE- 48k Hz RxHz- 48000
RCV- ALT10 XMT - ALT10

DATACOM- BIT ERROR
BIT - 0 RATE - 0.0e-07
ES - 0 %ES - 00.000
SES - 0 %SES - 00.000
EFS - 164 %EFS - 100
AS - 164 %AS - 100
UAS - 0 %UAS - 00.000
DGRM- 0 %DGRM - 00.000
HOLDSCR PRN-SAV STOP

```

Figure 5.3.A
DATACOM Bit Error Screen

This screen contains the following measurement terms:

BIT

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

RATE

Rate is the total number of bit errors divided by the total number of bits during available time since the beginning of the test.

ES

This is a count of the number of bit Errored Seconds that have occurred since the beginning of the test. An errored second is any second with at least one bit error. An errored second is not counted during an Unavailable Second.

%ES

This is the percentage of Bit Errored Seconds since the beginning of the test.

SES

This is a count of Severely Bit Errored Seconds since the begin-

ning of the test. A severely errored second is a second with a 10^{-3} bit error rate. A Severely Bit Errored Second is not counted during an Unavailable Second.

%SES

This is percentage of Severely Bit Errored Seconds 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 bit Error Free Second since the beginning of the test.

AS

This is the count of bit Available Seconds since the beginning of the test. Bit 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.

UAS

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

%UAS

This is the percentage of Bit UnAvailable Seconds since the beginning of the test.

DGRM

This is a count of the bit degraded minutes that have occurred since the beginning of the test. A bit degraded minute is 60 non-severely errored seconds with a total of at least 92 errors.

%DGRM

This is the percentage of bit degraded minutes that have occurred since the beginning of the test.

5.4 T1-MUX Mode Measurement Results

The measurement results presented for T1-MUX mode depend upon the BERT side you selected in the TEST CONFIGURATION menu. The first nine screens are the same for both sides. They are:

1. Line 1 & Line 2 Summary
2. Line 1 Line
3. Line 2 Line
4. Line 1 Signal
5. Line 2 Signal
6. Line 1 Frame
7. Line 2 Frame
8. Line 1 ESF
9. Line 2 ESF

If you have chosen MUX BERT: T1DRP and therefore, are looking at the signal dropped from the T1 side, Line Frequency and Line Logical screens appear at pages ten and eleven. If you have selected Line Rx/DROP, these screens will present information for Line 1; Line 2 is shown if Rx/DROP= L2-Rx.

If you have selected MUX BERT: Datacom type (i.e. X.21, RS232), a DATACOM Bit Error screen will appear at page ten (in place of Line Frequency and Logical).

If you have already looked through the measurement results sections for T1SINGL, DUAL, and DATACOM modes, the screen titles above should already look familiar to you. If not, you should refer to T1 Dual's results, Section 5.2, for sample screens and definitions of all the Line result pages; refer to DATACOM's results, Section 5.3, for a sample screen and definitions for the DATACOM BIT ERROR screen.

Section 6 Other Measurements

Figure 6.A shows the Other Measurements menu.

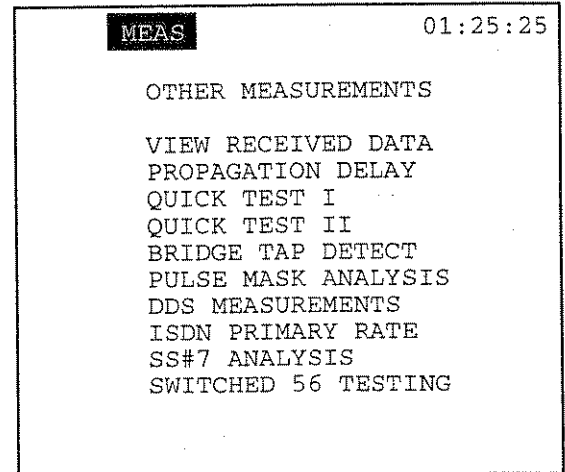


Figure 6.A
Other Measurements Menu

Many of the Other Measurements menu items are SunWare options and may or may not be present in your menu depending on which options you have purchased.

All of these menu items are discussed here in Section 6, except for SS#7 Analysis and ISDN Primary Rate. Both of these are handled in their own chapters: SS#7 in Chapter 8 and ISDN in Chapter 7.

6.1 View Received Data

View Received Data displays the patterns (in binary, HEX, and ACSII) received on all 24 timeslots. Refer to Figure 6.1.A for a typical screen display.

Note: View Received Data is not available in DATACOM Mode.

MEAS		18:35:33	
VIEW RECEIVED DATA			
PAGE : 01			
T/S	BINARY	HEX	ASCII
01	00010010	12	(H)
02	10100010	A2	(E)
03	00000100	04	()
04	10001010	8A	(Q)
05	11111111	FF	()
06	11111111	FF	()
07	11111111	FF	()
08	11111111	FF	()
PAGE-UP PAGE-DN RESUME STORE			

Figure 6.1.A
View Received Data

To view the data, 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 T1 data. In Figure 6.1.A, Timeslots 1-4 had been selected in the Nx64K Select Timeslot screen (from TEST CONFIGURATION). Therefore, the live pattern, which happens to be FOX, can be seen in timeslots 1-4, while the IDLE pattern (FF) is seen in the other timeslots. The IDLE pattern can be determined in OTHER FEATURES, OTHER PARAMETERS.
- 4) Choose PAUSE (F3) to trap the current data on the T1 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. 60 pages (20 T1 frames) of data are available.
- 6) When you have finished, press the ESCAPE key twice to return to the MAIN MENU.

Observe the following display definitions:

PAGE

Indicates which of the available 60 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

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.

The following F-Keys are available in this screen:

PAGE-UP (F1)

Page-up allows you to see the other pages of data by displaying the previous page. In Figure 6.1.A, pressing PAGE-UP (F1) would bring up Page 60.

PAGE-DN (F2)

Page-down allows you to see the other pages of data by displaying the next page. In Figure 6.1.A, pressing PAGE-DN (F2) would bring up Page 2.

PAUSE/RESUME (F3)

Pause traps the current data on the T1 line so the patterns may be easily observed. Resume continues the live presentation of data.

STORE (F4)

Store saves the current received pattern in the SEND TEST PATTERN User menu. Upon pressing STORE (F4), a message will appear at the bottom of the screen stating the label of the received pattern. You may view this pattern at any time by using the following procedure:

- 1) From the Main Menu, enter SEND TEST PATTERN
- 2) In the Send Test Pattern screen, press USER (F1)
- 3) Cursor down (using the down arrow key) to the correct label and press VIEW (F1).
- 4) You may also delete the pattern, edit the label, or edit the pattern. For more details on these procedures, refer to Section 4. 2, User Test Pattern.

Note: You must have an empty space in the User Test Pattern menu in order to store your pattern.

6.2 PROPAGATION DELAY

You may measure the propagation delay only in T1 SINGL/T1DUAL mode. The Propagation Delay screen shown in Figure 6.2.A displays the propagation delay on a looped back signal.

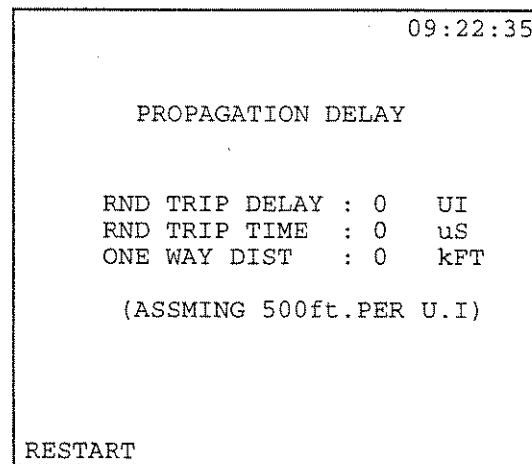


Figure 6.2.A
Propagation Delay

Use this procedure to measure propagation delay:

- 1) Be sure you have selected TERM in the TEST CONFIGURATION menu.
- 2) Enter LPBK & SPAN CONTROL, CSU & NI CONTROL and loop up your test set following the procedure cited in Section 2.1 of this chapter.
- 2) From the main menu, enter OTHER MEASUREMENTS, then enter PROPAGATION DELAY.
- 3) View the propagation delay. Refer to the following comments for an explanation.
- 4) When you are done, ESCAPE back to the Main Menu.

In the propagation delay measurement, the set measures the number of unit intervals that it takes for the signal to return. A unit interval is the amount of time it takes to transmit one bit (647 nS for a T1 signal). This number is translated into an exact number of microseconds of round trip delay. It is also translated into an equivalent number of kilofeet.

However, note that the exact number of kilofeet to the loopback will also be dependent on several items such as number of regenerators, gauge of cable, type of transmission media, existence of any transmission devices with appreciable delay, and so on. In the absence of equipment with dejittering circuits or other sources of significant delay, the kilofeet measurement is generally accurate to about +/- 1000 feet, and +/- 10%. It is suitable for determining where a looped repeater is.

6.3 QUICK TEST - I and - II

Quick tests are provided for your convenience. They can save you about a half an hour each time you need to accept a new HICAP service. In the Quick test, the test set sends out five patterns. You may specify the patterns and their respective durations or you may use the default settings already provided. If you want to use the default settings provided by the factory, then you need adjust nothing. Simply press the ENTER key to begin. Check the detailed procedure that follows if you have any

problems.

Note: Unlike MEASUREMENT RESULTS, the Quick Test will not run in the background. Once you escape out of the Quick Test screen, the test will be stopped.

Use this procedure to adjust the default settings and run the quick test:

1) Before using the quick test, configure your line interface in the TEST CONFIGURATION menu to the following settings:

- Test Mode: T1SINGL. **You cannot enter Quick Test in Dual Mode.**
- RxLVL-1: TERM
- Tx SOURCE: NORMAL
- framing per the line specification
- coding per the line specification
- XMT CLOCK: INTERN
- LBO 1&2: as appropriate for your test access point
- TEST RATE: 1.544M

2) Plug your cords into the appropriate jacks on the test set that you have specified in TEST CONFIGURATION and also into the IN and OUT jacks on your DSX.

3) From the Main Menu, enter OTHER MEASUREMENTS, then enter QUICK TEST - I.

4) At the LOOPBAK item choose CSU (F1), NI (F2), or NONE (F3) as appropriate. The test set will attempt to automatically loop back the far end based on your setting.

5) At the PRINT item choose YES (F1) or NONE (F2) as appropriate.

6) Cursor down to the first pattern. Observe all of the F-key options for different patterns that you can send. Change the pattern if necessary.

7) Press the Down Arrow to access the DURATION for the first pattern. If necessary, change the time. First press the SHIFT-lock key so that the SHIFT indicator is shown in the upper left-hand

corner of the screen. Then enter in any number between 001 and 999. The cursor will automatically advance to the next line. Do not press the ENTER key.

8) Repeat 6 and 7 as necessary.

9) If you don't need to print your new Quick Test configuration, proceed to step 10. Otherwise, refer to Figure 6.3.B.

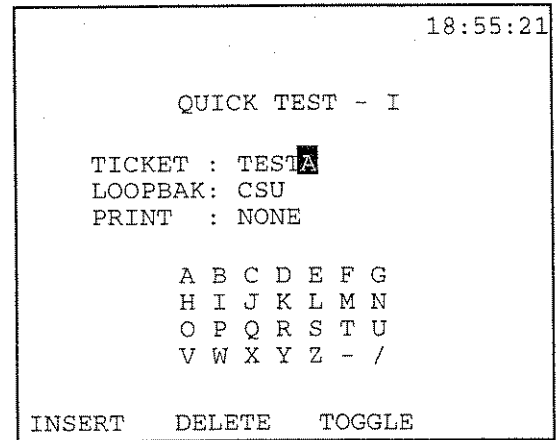


Figure 6.3.B
Ticket Label Entry

Position the cursor on the TICKET line. Choose toggle (F3) to enter the alphabet grid. The letter A will flash. Cursor over to your letter of choice and choose SELECT (F4). Repeat this step until you have selected all of the letters in your ticket name. You may enter a maximum of ten characters and/or numbers. When you are finished, press toggle (F3) to get out of the alphabet grid.

If you made a mistake while entering the letters for your ticket, simply cursor over to the incorrect letter. Then press the DELETE key (F2) to get rid of the letter. You can only use the DELETE key when you are out of the alphabet grid. When you have finished deleting letters, move the cursor back to the end of the TICKET name, press toggle (F3) to return to the alphabet grid, and enter any additional letters. Press toggle (F3) to get back out of the alphabet grid and back to the TICKET name.

10) When you have configured the Quick Test to your liking, press ENTER to begin your testing.

11) When the Quick Test is finished, you will see summary results. You can see if the loopback operations were successful. Press the page down key to view the test results from each pattern that was transmitted. Press the ESCAPE key when you are finished.

Quick Test I and Quick Test II are similar. Two quick tests allow you to store two different acceptance tests. Because of the specific patterns supplied by the factory, Quick Test I may be used for AMI lines (3-24 pattern) and Quick Test II for B8ZS lines (1-8 pattern).

Many users find it convenient to use the following two standard tests outlined in Figures 6.3.C and 6.3.D. These standard tests are already provided as your default entries for Quick Test I and II.

```
13:22:25  
  
QUICK TEST - I  
TICKET : AMI  
LOOPBAK: NONE  
PRINT  : YES  
  
TEST PATTERN  DURATION  
1.3-24        05 min  
2.ALL1        05 min  
3.QRSS        15 min  
4.QRSS        15 min  
5.NONE        00 min  
CSU  NI  NONE
```

Figure 6.3.C
Quick Test- I

		13:26:33
QUICK TEST - II		
TICKET :	B8ZS	
LOOPBAK:	NONE	
PRINT :	YES	
	TEST PATTERN	DURATION
	1.1-8	05 min
	2.ALL1	05 min
	3.QRSS	15 min
	4.QRSS	15 min
	5.NONE	00 min
CSU	NI	NONE

Figure 6.3.D
Quick Test -II

6.4 Bridge Tap Detect

The bridge tap detect test sends 21 different patterns down a span that you have previously looped up. Each pattern is transmitted for 30 seconds.

To run this test, use the following procedure:

- 1) Be sure that you have a loopback in place on the circuit to be tested and that the test set has been properly configured in the TEST CONFIGURATION menu.
- 2) Enter OTHER MEASUREMENTS from the main menu, then enter BRIDGE TAP DETECT. The testing will begin immediately.
- 3) You can observe the test in progress by looking at the LINE 1 or LINE 2 - LOGICAL screen. You can PAGE-DN (F2) and see the summary results. There are 21 patterns in all. Each pattern name is listed for you as it is sent. IN PROG means that the 30 second measurement for that test pattern is still in progress. A score of BIT ERRORS:0, ES:0, and AS:30 is perfect.
- 4) When the test is finished, press ESCAPE as needed to return to the Main Menu.

Note that only a few of the results are stored in the summary listing. The information that is listed includes the pattern number (1 to 21), the pattern name, the number of bit errors detected, the number of errored seconds detected, and the number of available seconds detected.

For perfect performance, there will be 0 errors, 0 errored seconds, and 30 available seconds. If there is a loss of signal or other unavailable service condition, then there will be less than 30 available seconds. Note that an errored second will only be triggered if there are one or more errors during an available second. Per the new ANSI and Bellcore standards, an errored second is not counted during an unavailable second.

Here are the patterns that are transmitted during the test:

#	Name	Pattern
1	All 1s	11111...
2	1-in-2	010101...
3	1-in-4	0100...
4	1-in-6	010000...
5	1-in-7	0100000...
6	1-in-8	01000000...
7	2-in-10	1100000000...
8	2-in-11	11000000000...
9	2-in-12	110000000000...
10	2-in-13	1100000000000...
11	2-in-14	11000000000000...
12	2-in-15	110000000000000...
13	2-in-16	1100000000000000...
14	3-in-18	11010000000000000...
15	3-in-19	110010000000000000...
16	3-in-20	1100010000000000000...
17	3-in-21	01000100000000000001...
18	3-in-22	010001000000000000010...
19	3-in-23	0100010000000000000100...
20	3-in-24	0100010000000000000100...
21	QRSS	Quasi-Random

6.5 PULSE MASK ANALYSIS (option SW190)

If you have SunWare option SW190, Pulse Mask Analysis, you can measure and view the quality of the T1 pulse. Refer to Figure 6.5.A.

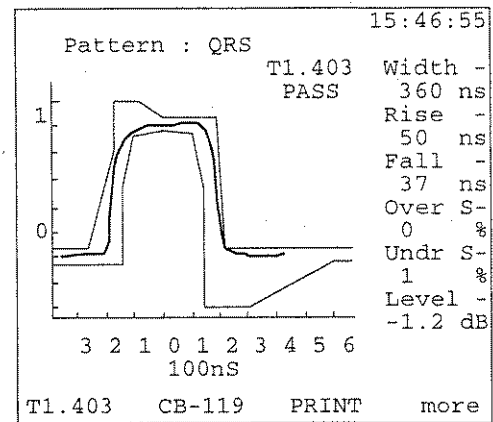


Figure 6.5.A
Pulse Mask Analysis

Use this procedure for performing a pulse shape analysis:

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

6) When you are finished, press ESCAPE as necessary to return to the Main Menu.

6.6 DDS MEASUREMENTS (option SW188)

The SunWare SW188 option enables the SunSet T10 to test and maintain Digital Data System networks (DDS) by performing basic DDS loopbacks and measurements. The SunSet T10's testing capabilities support the following data rates: 2.4, 4.8, 9.6, 19.2, 56, and 64 Kbps. Interleaved and latching loopbacks of various types are supported. Bit error and bit error rate measurements are provided. You may also send/ receive special network control codes.

The DDS menu is shown in Figure 6.6.A.

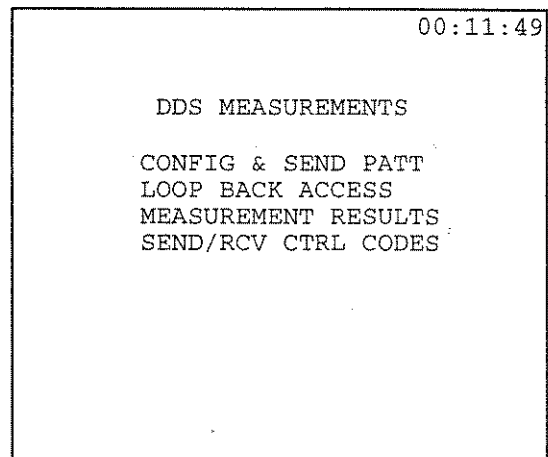


Figure 6.6.A
DDS Measurements Menu

6.6.1 CONFIG & SEND PATTERN

1) From the Main Menu, enter OTHER MEASUREMENTS, DDS MEASUREMENTS, CONFIG & SEND PATT.

```
00:26:41
TEST CONFIGURATION
Tx T/S : 01
Rx T/S : 01
TEST RATE: 9600
SEND PATT: 511
USER PATT: 00000000
2047      511      127      more
```

Figure 6.6.B
DDS Config & Send Patt Screen

This screen contains the following setup items:

1) Tx T/S

Options: 1-24

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

2) Rx T/S

Options: 1-24

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

3) TEST RATE

F-key Options: 2400 (F1), 4800 (F2), 9600 (F3), 19.2k (more, F1), 56k (more, F2), 64k (more, F3)

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

4) SEND PATT

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

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

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

6.6.2 LOOP BACK ACCESS

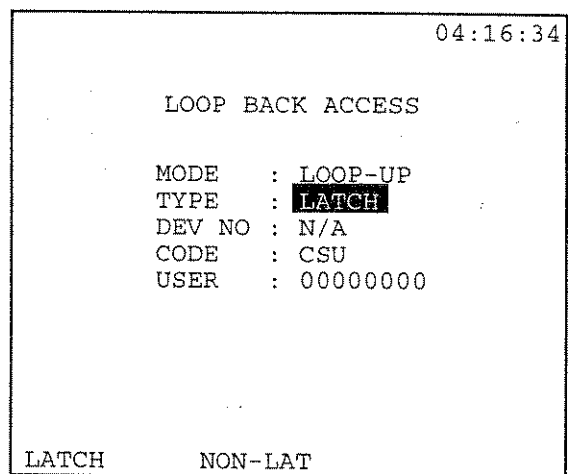


Figure 6.6.C
DDS Loop Back Access Screen

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

1) MODE

F-Key Options: LOOP-UP (F1), LOOP-DN (F2)

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

2) TYPE

F-Key Options: LATCH (F1), NON-LAT (F2)

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

3) DEV NO

Options: 1-8

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

4) CODE

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

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

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

If you wish to transmit your own user loopback code, press USER (more, F1). Then press the down arrow key to specify your USER loop back code. Enter this 8-bit loop back code by first pressing the SHIFT-lock key, then entering the 0/1 values directly

from the keypad. Press the SHIFT-lock key again when you are finished. The USER pattern which you have just entered will have no effect unless "USER" was specified for the CODE.

6.6.3 Measurement Results

```
04:49:12
ELAP TIME- 00:04:08
FRME- SF-D4      CODE- AMI
RATE- 56k       PATT- 2047

RESULTS

BIT :0002      BER :1.04e-07
UAS :0        %UAS:00.000

RESTART
```

Figure 6.6.C
Measurement Results

All results relate to the total elapsed time of the test (ELAP TIME). Use the RESTART (F1) key to restart the measurements, if necessary. Here are the measurement definitions:

ELAP TIME

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

FRME

The type of framing which you are transmitting.

CODE

The type of line coding which you are transmitting.

RATE

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

PATT

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

BIT

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

BER

The bit error rate since the beginning of the test.

UAS

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

%UAS

The percentage of UnAvailable Seconds since the beginning of the test.

6.6.4 SEND/RCV CTRL CODES

Here you may transmit DDS control codes to the far end, as well as view which code you are receiving. Figure 6.6.D displays this screen.

```
18:05:53  
  
SEND/RCV CONTROL CODE  
  
SEND MSG : (1) 0011010  
  
RECEIVE  
CODE : 10011010  
MSG : MUX-OOS  
  
ABNORML MUX-OOS C IDLE more
```

Figure 6.6.D
Send/Rcv Control Code

Transmitting Codes:

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

Figure 6.6.E shows the 9 DDS codes available as F-key options.

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

Figure 6.6.E
DDS Control Codes

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

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

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

Receiving Codes:

The RECEIVE portion of the screen displays the DDS code coming from the far end. The test set will display the digits its

receives. If these bits correspond to one of the 9 programmed codes, shown in Figure 6.6.E, the message will be displayed below.

ISDN Primary rate and SS#7 Analysis are discussed in Chapters 7 and 8, respectively.

6.7 Switched 56 Testing (SW187)

Switched 56 is a 56Kbps digital transmission where the eighth bit is stuffed 1 to gain the DS1 ones density on AMI lines. The SunWare Switched 56 option is designed to check the operation of switched 56 services at a DS1 access point. It allows the technician to set up a call to a digital loopback, choose a test pattern, and verify a successful bit error rate performance. It also allows the technician to observe a Teleos call setup in process, monitoring both directions in sequence.

From the Main Menu, enter OTHER MEASUREMENTS then enter SWITCHED 56 TESTING. Four choices appear in this menu:

- TEST CONFIGURATION
- SW56 CALL SET UP
- MEASUREMENT RESULTS
- TELEOS CALL MONITOR

6.7.1 Test Configuration

Figure 6.7.A shows the SW56 Configuration screen.

```
22:41:24
TEST CONFIGURATION
XMT CHANNEL : 24
RCV CHANNEL : 24
TEST PATTERN : 2047
USER PATTERN : 00000000
ON-HOOK ABCD : 0 0 0 0
OFF-HOOK ABCD: 1 1 1 1
2047      511      127      more
```

Figure 6.7.A
SW56 Test Configuration

1) XMT CHANNEL

Options: 1-24

Use the F-keys, NEXT (F1) and PREVIUS (F2), to choose the transmit channel. You may choose from 1 to 24. Upon changing the channel, the number will flash five times. The test set will not actually begin transmitting on that channel until the flashing stops.

2) RCV CHANNEL

Options: 1-24

Use the F-keys, NEXT (F1) and PREVIUS (F2), to choose the receive channel. You may choose from 1 to 24.

3) TEST PATTERN

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

Select the pattern you wish to transmit. Pressing the more (F4)

key gives you 13 standard patterns. You may also enter in your own pattern. Be sure to select USER on this line and then cursor down to User Pattern to enter your digits.

4) USER PATTERN

To enter a user pattern, first select USER above. Then press the SHIFT-lock key to display the SHIFT indicator in the upper left-hand corner of the screen. Next, press the 1 and 0 keys as appropriate. If you make a mistake, press the SHIFT-lock key to turn off the indicator, cursor back to the digit to be changed, press the SHIFT-lock key, then press the correct number. When your digits are correct, press the SHIFT-lock key to release the SHIFT indicator.

5) ON-HOOK A/B/C/D

Use the SHIFT key and keypad numbers to enter your signaling bits for an ON-HOOK condition. For ESF framing, you will have four bits; for SLC96 and SF framing, you will have two.

6) OFF-HOOK A/B/C/D

Use the SHIFT key and keypad numbers to enter your signaling bits for an OFF-HOOK condition. For ESF framing, you will have four bits; for SLC96 and SF framing, you will have two.

When your settings are correct, press ENTER.

6.7.2 SW56 CALL SET UP

This screen allows you to place a SW56 call. Refer to Figure 6.7.B.

```
17:39:40
SW56 CALL SET UP
METHOD : MF
NUMBER : 2124596543
Rx A/B/C/D - 1 0 1 0
Tx A/B/C/D : 0 0 0 0
A = KP          B = ST
C = ST1         D = ST2
E = ST3         F = PAUSE (,)
MF             DTMF             DP
```

Figure 6.7.B
SW56 Call Setup Screen

1) METHOD

F-Key Options: MF (F1), DTMF (F2), DP (F3)

Use the F-keys to select your dial method: Multi Frequency (F1), Dual Tone Multi Frequency (F2), or Dial Pulse (F3).

2) NUMBER

Enter the NUMBER you wish to dial. To do this, press and release the SHIFT-lock key to display the SHIFT indicator. Enter the numbers to be dialed. The keypad letters A, B, etc. can be used to enter the special MF tones. A Pause (,) for one second is entered with the letter "F" key for MF and DP dialing.

If you make a mistake while entering the number, simply press and release the SHIFT-lock key to remove the SHIFT indicator. Then cursor over to the digit that needs to be changed. Press the SHIFT key and enter the correct digit. Note that all digits to the right will also be erased. You may also enter a USER number, either by entering the digits on this line and pressing STORE (more, F2) or by pressing USER (more, F1), and then entering the digits.

Once the number is entered, apply the appropriate supervi-

sion. You may do so by pressing the F-key: ON-HOOK (F1), OFF-HOOK (F2), or WINK (F3). If you are expecting to receive dial tone, press the VOL UP key repeatedly until you can hear it. Dial the number by pressing ENTER.

6.7.3 Measurement Results

Refer to Figure 6.7.C for the Measurement Results screen.

```
19:44:52
ELAP TIME - 000:09:51
FRME - SF-D4      CODE - B8ZS
RATE - 56K       PATT - 2047

Rx A/B - 0 0 0 0
Tx A/B : 0 0 0 0

RESULTS
BIT : 0003      BER : 8.8e-08
UAS : 0        %UAS : 00.000

RESTART  ON-HOOK  OFFHOOK  WINK
```

Figure 6.7.C
Measurement Results

The following items are displayed in this screen:

- ELAP TIME- the Elapsed time; this count starts counting once you enter the SWITCHED 56 TESTING menu.
- FRME- the transmitted framing type.
- CODE- the transmitted coding type.
- RATE- the test rate (56K).
- PATT- the transmitted test pattern.
- RXA/B- the received signalling bits (A/B for SF-D4 or SLC96; A/B/C/D for ESF framing).
- TXA/B- the transmitted signalling bits. To change your transmit bits, press the appropriate F-key: ON-HOOK (F1), OFFHOOK (F2), or WINK (F3). The actual bits sent for each condition can be set in SW56 Test Configuration.

- BIT- the count of bit errors during the Elapsed Time.
- BER- the rate of bit errors during Elapsed Time.
- UAS- the number of Unavailable Seconds during Elapsed Time.
- %UAS- the percentage of Unavailable seconds during Elapsed Time.

To RESTART the measurements press F1. Press ESCAPE when your testing is complete.

6.7.4 TELEOS CALL MONITOR

This item allows the technician to observe a Teleos call setup in process, monitoring both directions in sequence. Refer to Figure 6.7.D.

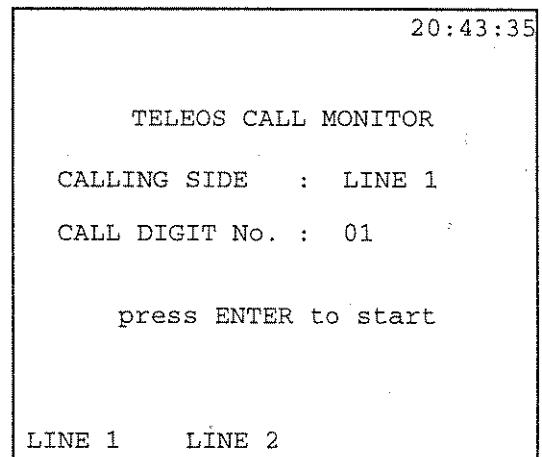


Figure 6.7.D
Teleos Call Monitor

The first selection is the CALLING SIDE. This is selected from either FACility (F1) or EQUIPment (F2). Next, select the CALL DIGIT No. Using the NEXT (F1) and PREVIUS (F2) keys, select a value between 1 and 40.

Note: The menu item DATACOM INTERFACE is discussed in Chapter 6.

Section 7 VF Channel Access

Note: Do not attempt to enter the VF CHANNEL ACCESS if the SF, ESF, or SLC-96 LED is not lit. These three 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 7.A for the VF Channel Access Menu.

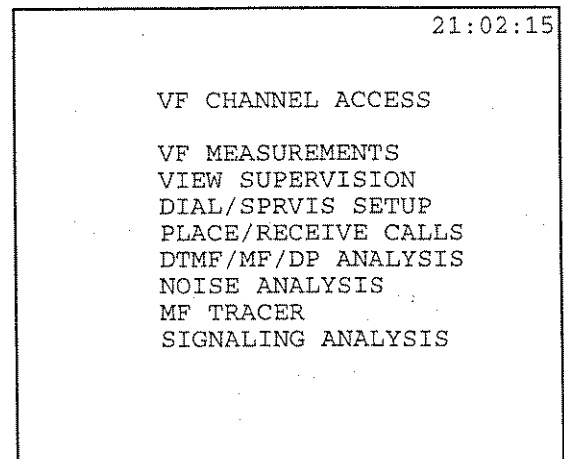


Figure 7.A
VF CHANNEL ACCESS Menu

Note: During VF CHANNEL ACCESS, when the TxSOURCE (in TEST CONFIGURATION) is set to NORMAL/ TESTPAT, an idle channel code and signalling will be inserted into unselected channels. The idle channel code may be programmed in MAIN MENU, OTHER FEATURES, OTHER PARAMETERS, IDLE CHNL CODE.

7.1 VF Measurements

The VF Measurements menu lets you choose:

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

The VF MEASUREMENTS Menu also tells you:

- the received signalling bits
- the received 8-bit data
- the received frequency and level

Figure 7.1.A depicts the VF MEASUREMENTS Menu.

```
21:25:00
VF MEASUREMENTS
Tx-2 T/S      : 04
Rx-1 T/S      : 04
Rx-2 T/S      : 01
INSERT TYPE   : TONE
TONE FREQ Hz  : 1004
TONE LVL dBm  : 0 dBm
Tx-2 A/B      : 1 1
LISTEN SIDE   : L1-Rx
Rx1/2 ABCD    - 11/ 10
Rx-1 DATA    - 11001010
Rx-1 FRQ/LVL  - 1003 00.0
NEXT          PREVIOUS
```

Figure 7.1.A
VF MEASUREMENTS Menu

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

1) Tx-1 T/S

Options: 1-24

Use the appropriate F-keys, NEXT (F1) or PREVIUS (F2), to choose the desired transmit timeslot for the T1 Line. If you have selected T1SINGL Mode in TEST CONFIGURATION, this line will be Line 1; if you have selected T1DUAL, this will be whichever line you have chosen for Tx/INSERT.

The test set does not automatically begin inserting on a timeslot. You will notice that as you scroll through the timeslots with the F-keys, the number will flash five times. The test set will not begin transmitting on a timeslot until the flashing stops. This allows you to move throughout the timeslots without interrupting them.

2) Rx-1 T/S

Options: 1-24

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

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

3) Rx-2 T/S

Options: 1-24

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

4) INSERT TYPE

Options: TALK (F1), TONE (F2), QUIET (F3)

Choose your desired insert type. Press (F1) to talk on the transmit signal; the SunSet will transmit speech from the microphone (located at the bottom of the test set). Press TONE (F2) to

insert a tone on the transmit signal. If you select TONE, use the next two settings to set the tone frequency and level. Press QUIET (F3) to place a quiet termination on the transmit signal.

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

6) TONE LEVEL 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. To send your new tone level, press ENTER or move the cursor off this line. There are two F-key choices provided for you: 0 dBm (F1) and -13 dBm (F3).

7) Tx-1 A/B/C/D

Options: ON-HOOK(F1), OFFHOOK(F2), FLASH/WINK(F3), SEND (F4)

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

You may also change these bits manually using the SHIFT key and number keys 1 and 0. Press/release the SHIFT key and press

the 1 and 0 keys as desired to enter the signalling bits. Press ENTER or SEND (F4) to send the A/B/C/D bits.

8) LISTEN SIDE

F-Key Options: L1-Rx (F1), L2-Rx (F2), BOTH (F3)

This setting determines the line(s) on which you will listen. You may listen on Line 1, on Line 2, or on both lines. For T1SINGL Mode, the Listen Side is automatically set for Line 1; you will not be able to change this.

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

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

Rx-1 A/B/C/D shows the Channel Associated Signalling System (CAS) bits. For T1Dual, the signalling on both Line 1 and 2 is shown here.

10) Rx-1 DATA

Rx-1 DATA shows the live 8-bit channel data as it is received from the line. If Line 2 is chosen as Rx/DROP, this line will be Rx-2 FRQ/LVL and applies to Line 2.

11) Rx-1 FRQ/LVL

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

7.2 View Supervision

The View Supervision screen lets you see the signalling bits for all of the 24 channels for both Lines 1 and 2. You can observe the status on all channels at the same time. Refer to Figure 7.2.A

03:38:17				
T/S	ABCD	ABCD	ABCD	ABCD
L 01	0000	0000	0000	0000
I 05	0000	0000	0000	0000
N 09	0000	0000	0000	0000
E 13	0000	0000	0000	0000
1 17	0000	0000	0000	0000
21	0000	0000	1111	0000
T/S	ABCD	ABCD	ABCD	ABCD
L 01	0000	0000	0000	0000
I 05	0000	0000	0000	0000
N 09	0000	0000	0000	0000
E 13	0000	0000	0000	0000
2 17	0000	0000	0000	0000
21	0000	0000	0000	0000

Figure 7.2.A
View Line 1 & 2 CAS

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

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

7.3 DIAL/ SPRVIS SETUP

The Dial/Supervision Setup screen provides additional parameter settings to be used for your VF procedures. In this menu, you can vary the on and off time for the DTMF, MF, and DP digits. You can also condition the test set to send appropriate signalling bits for E&M, loop start, and ground start trunks with FX0 or FXS line cards. Refer to Figure 7.3.A.

```
03:50:20
DIAL/SPRVIS SETUP
DIAL PERIOD : 100ms
SILENT PERIOD : 100ms
TONE LEVEL dbm: -5
SUPERVISION
TRUNK TYPE : E & M
EQUIPMENT : N/A
DIAL PULSE (10pps)
%BREAK : 60
INTERDIGIT PRD: 500
BKWD SPRVISN : 1 0
IDLE SPRVISN : 0 0
E & M G-START L-START USER
```

Figure 7.3.A
Dial/Supervision Setup

1) From the VF CHANNEL ACCESS menu, cursor down to the DIAL/SPRVIS SETUP menu and press ENTER.

The following settings are provided in this screen:

1) DIAL PERIOD

Options: 30 ms to 999 ms

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

2) SILENT PERIOD

Options: 30 ms to 999 ms

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

030ms).

3) TONE LEVEL dbm

Options: -25 to -5 dbm

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

4) SUPERVISION TRUNK TYPE

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

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

5) EQUIPMENT

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

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

6) DIAL PULSE (10pps)

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

7) % BREAK

Options: 40%, 50%, 60%

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

8) INTERDIGIT PRD

Options: 100- 900 (hundred intervals only)

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

9) BKWRD SPRVISN

Use the SHIFT key and keypad numbers (1/0) to enter the backward supervision bits. In T1Dual Mode, these bits are sent in the other direction from the inserted talk/tone. For example if you are inserting a tone on T/S 06 and you have selected Tx/INSERT=L1-Tx, then the set will transmit the backward supervision bits on T/S 06 of Line 2.

10) IDLE

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

7.4 Place/Receive Calls

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

- place a DTMF, MF, or DP call
- receive a DTMF, MF, or DP call
- control the transmitted supervision and observe the received supervision
- speed dial a stored number
- record a number with a label for future dialing
- edit or delete speed dial numbers

Figure 7.4.A shows the PLACE/ RECEIVE CALLS menu.

```
05:02:14  
  
PLACE/RECEIVE CALLS  
  
METHOD : DTMF  
TX AB : 0 1 ON-HOOK  
NUMBER : 14542321  
  
TX CHNL : 01  
RX CHNL : 01  
RX AB : 0 1 OFFHOOK  
  
E = '*' F = '#'  
MF DTMF DP
```

Figure 7.4.A
PLACE/RECEIVE CALLS Menu

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

1) METHOD

F-Key Options: MF (F1), DTMF (F2), DP (F3)

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

DTMF (F2), Dual Tone Multi Frequency, is the most commonly used addressing method on today's phones. Like MF, it uses pairs of tones to send a digit. Unlike MF, it uses two separate groups of tones. DTMF supports 16 digits: 0 through 9, #, *, and A through D.

DP (F3), Dial Pulse, is the oldest addressing technique. With pulse dialing, the phone goes on-hook and off-hook 10 times per second in order to dial a given number. For example, to dial the number 7, the set starts off in the off-hook condition and then goes on-hook/ off-hook seven times. This type of addressing is now commonly used in switched 56 services.

2) TX AB

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

This item selects the transmit signalling bits. You may select either ON-HOOK or OFF-HOOK. When OFF-HOOK is selected, you may choose to FLASH these bits. Choosing FLASH momentarily sends ON-HOOK supervision, then returns to OFF-HOOK. When ON-HOOK is selected, you may choose WINK; a WINK momentarily sends OFF-HOOK supervision, then returns to ON-HOOK.

The exact supervision used and displayed will depend on the SUPERVISION TRUNK TYPE and EQUIPMENT settings in the DIAL/SPRVIS setup menu.

3) NUMBER

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

4) Tx CHNL

F-Key Options: NEXT (F1), PREVIUS (F2), SCAN (F3)

This slot assigns the transmit channel. Use the F-keys NEXT (F1) or PREVIUS (F2), to choose the desired transmit timeslot for the T1 Line. You may choose from T/S 1 to 24. If you have selected T1SINGL Mode in TEST CONFIGURATION, this line will be Line 1; if you have selected T1DUAL, this will be whichever line you have chosen for Tx/INSERT.

The test set does not immediately begin inserting on a timeslot. You will notice that as you scroll through the timeslots with the F-keys, the number will flash five times. The test set will not begin transmitting on a timeslot until the flashing stops. This allows you to move throughout the timeslots without interrupting them.

In SCAN (F3) Mode, the T10 is in a receive mode only. The test set searches all timeslots for an on-hook to off-hook transition. When it finds this transition, it locks on that timeslot and waits for the digits. The SunSet will notify the user with the message,

"Incoming call on Channel 01 (as appropriate)". The user may then accept or reject this call.

5) Rx CHNL

F-Key Options: NEXT (F1), PREVIUS (F2), SCAN (F3)

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

6) Rx ABCD

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

7.5 DTMF/ MF/ DP ANALYSIS

Enter the DTMF/MF/DP ANALYSIS menu through the VF CHANNELACCESS Menu. Upon entering, the screen will appear as in Figure 7.5.A.

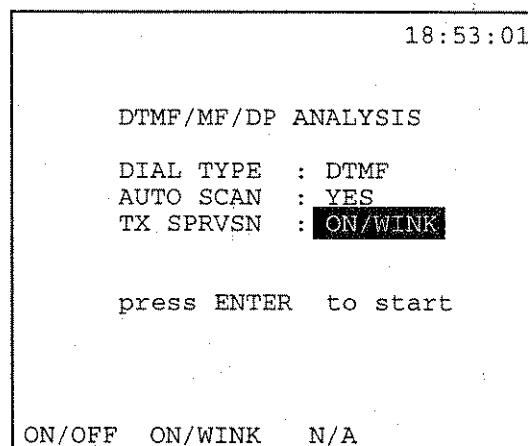


Figure 7.5.A
DTMF/MF/DP ANALYSIS

Refer to the following procedure to setup the DTMF/ MF/ DP

ANALYSIS:

1) DIAL TYPE

F-Key Options: MF (F1), DTMF (F2), DP (F3)

Using the function keys, choose among MF, DTMF, or DP for the dial type.

2) AUTO SCAN

F-Key Options: YES (F1), NO (F2)

You can enable the AUTO SCAN by choosing YES (F1). When in scan mode, the T10 will rapidly scan all 24 receive channels for any channel that goes from the on-hook to off-hook state. When it finds a channel going off-hook, it will lock onto that channel and wait for digits to be transmitted.

If you select NO (F2), you must enter the transmit and receive timeslots below. In this mode, the T10 will analyze only on the selected receive channel.

3) Tx SPRVN

F-Key Options: For Auto Scan- ON/OFF (F1), ON/WINK (F2), N/A (F3). For 1 channel- ON/OFF (F1), ON/WINK (F2), MANUAL (F3)

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

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

DTMF Analysis, an example

- 1) Configure the Analysis setup screen as shown in Figure 7.5.A. When you have finished, press the ENTER key.

2) If in the SCAN mode, you will see a flashing "SCANNING" message at CHANNEL. This message will continue to flash until the set finds a channel going from on to off-hook. It will then show you which channel it has found, as well as the Rx and Tx supervision bits. When the digits are sent, it will display them below. Refer to Figure 7.5.B.

```
07:20:34  
  
DTMF/MF/DP ANALYSIS  
  
DIAL TYPE : DTMF  
CHANNEL   : 01  
RX AB     : 1 1   OFFHOOK  
TX AB     : 0 0   ON-HOOK  
  
RxDIGIT:  
4083638000  
  
ANALYZE   SCAN
```

Figure 7.5.B
DTMF Analysis

You can see the receive digits 4083638000. If you want to scan again, press SCAN (F2) and the set will start looking for another channel going on to off-hook. Pressing the ANALYZE (F1) key will give you a detailed analysis of each digit. Refer to Figure 7.5.C.

```

07:24:06

DTMF/MF/DP ANALYSIS

DIGIT-1 : 4          INTD:----ms
H/L Hz 1209/ 0767   PERD:0101ms
dbm-6.4/-4.6       TWST:+1.8

DIGIT-2 : 0          INTD:0099ms
H/L Hz 1336/ 0944   PERD:0101ms
dbm-6.4/-4.5       TWST:+1.9

DIGIT-2 : 8          INTD:0099ms
H/L Hz 1336/ 0852   PERD:0101ms
dbm-6.4/-4.6       TWST:+1.8

PAGE-UP    PAGE-DN

```

Figure 7.5.C
DTMF Analysis

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

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

7.6 Noise Analysis (SW 183)

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

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

Refer to Figure 7.6.A for the Noise Analysis Menu.

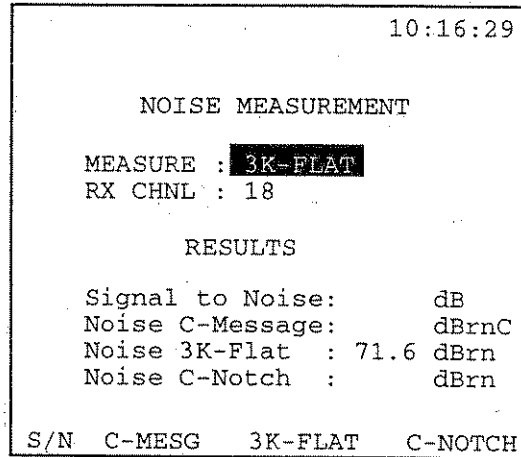


Figure 7.6.A
Noise Analysis Menu

Press a function key to begin one of four noise measurements: Signal to Noise (F1), C-Message (F2), 3 kHz flat (F3), or C-Notch (F4). After a function key is pressed, the selected measurement will start. You may change the noise measurement at any time by choosing a different F-key. The previous measurement results for the different types will not be erased, but only the result for the current measurement type will be updated regularly. When you have completed the noise analysis, press ESCAPE to return to the VF CHANNEL ACCESS Menu.

7.7 MF TRACER

The MF TRACER analyzes the ABCD bits and MF digits on both lines. MF TRACER is not supported in the T1 SINGL Test Mode. Thus, make sure you have selected T1 DUAL in Test Configuration.

The MF TRACER Menu offers two options: MF TRACER and MF VIEW/ PRINT TRACER. MF TRACER traces the received ABCD bits for both lines with time and date information. MF VIEW/ PRINT TRACER allows the user to view and print specific MF ABCD bits with time and date information.

7.7.1 MF TRACER

MF TRACER traces the received ABCD bits and MF digits. The tracer may be used to time winks or other changes of state in the ABCD bits. Refer to Figure 7.7.A.

```
14:17:41
L1- RX CHANL : 21  L2- RX CHNL  :18
LINE-1#01/ sec    LINE-2#24/ sec
ABCD = 00 / INIT  ABCD= 00/ INIT
ABCD = 11 / 00.000
MFR1 =  KP/ 01.568
MFR1 =  1 / 01.768
MFR1 = ST1 / 01.968
MFR1 =  8 / 02.168
MFR1 =  6 / 02.368
MFR1 = ST2 / 02.568
MFR1 = ST1 / 02.768
                                ABCD= 11/05.587

STOP                          RESTART
```

Figure 7.7.A
MF Tracer Screen

In Figure 7.7.A, the T10 receives MF forward digits from Line 1 (on timeslot 1). The initial signalling state is shown for both Line 1 and Line 2; they both start on-hook (00, E&M signalling). We then can see Line 1 receiving an off-hook, followed by the digits. Note that the time records a 200ms between digits; this is a combination of the dial period and silent period. The KP and ST codes represent control signals used in the MF system. KP stands for beginning of pulsing and ST for the end of pulsing.

Note: Two F-Keys are shown on this screen: STOP (F1) and RESTART (F3). Pressing RESTART will erase any results shown and begin again. STOP will stop the tracing, so you may view what is on the screen.

When you press STOP (F1), a cursor appears at L1-Rx and L2-Rx. You can change your receive channels here by pressing the F-Key and entering a number from 01 to 24.

7.7.2 MF VIEW/PRINT TRACER

This second option in the MF TRACER Menu allows the user to view and print specific MF ABCD bits and digits.

This screen provides three F-key options:

CLR-ALL (F1) - This clears all stored data. Clear All is actually a two step procedure, as you must press ENTER to continue. This second step provides a safeguard from accidentally clearing wanted data.

PRINT (F2) - This option allows you to print selected pages.

VIEW (F3) - View allows the user to view the selected pages of ABCD bits. The VIEW screen is depicted below in Figure 7.7.B.

If you only wish to view/print a limited number of these pages, use the SHIFT key and keypad numbers to enter in the desired numbers in the VIEW FROM and VIEW TO slots.

```
02:56:14  
  
LINE 1    96-12-02  01:52:07  
          ST2/01.000  
  
LINE 1    96-12-02  01:52:07  
          ST1/01.200  
  
LINE 1    96-12-02  01:52:33  
ABCD=00  /INIT  
  
LINE 2    96-12-02  01:52:33  
ABCD=00  /INIT  
  
PAGE-UP  PAGE-DN
```

Figure 7.7.B
MF View Tracer Screen

As seen above in Figure 7.7.B, the View screen displays the Line (1 or 2), the digit or signalling bits, and the time. A date/time stamp

is also provided for each digit and initial signalling state, Use the PAGE-UP (F1) and PAGE-DN keys to view all available pages of data.

7.8 Signalling Analysis

The Signalling Analysis analyzes the ABCD bits and timing from 1 ms resolution. This analysis is now supported in both T1SINGL and T1DUAL modes. The Signalling Analysis displays simultaneous ABCD changes from 3 ms resolution for both lines when set is in T1DUAL Mode. Figure 7.8.A shows the analysis for T1 Singl; the bits are received only on Line 1.

```
00:04:01
L1-RX CHNL : 01
LINE-1#01/sec
ABCD=0000/INIT
ABCD=OFHK/00.000
ABCD=ONHK/00.213
ABCD=OFHK/02.723
ABCD=ONHK/16.384
ABCD=OFHK/16.893

STOP          RESTART  AB-bits
```

Figure 7.8.A
Signalling Analysis, T1SINGL

A timestamp appears to the right of the bits; this represents the time since the beginning of the test. Three F-Keys are shown in Figure 7.8.A:

STOP (F1)- This stops the analysis so you can view the results.

RESTART (F3)- This restarts the analysis

AB-bits (F4)- This displays the actual signalling bits received, as opposed to the signalling condition shown in Figure 7.8.A. DECODE (F4) displays the decoded state, as defined by the signalling type chosen in DIAL/SPRVS SETUP. Figure 7.8.B

shows the AB bits.

```
03:32:48
L1- RX CHNL: 01      L2- RX CHNL: 24
LINE-1#01/sec       LINE-2#24/ sec
ABCD= 00 /INIT      ABCD= 00/ INIT
                    ABCD= 11/ 00.000
ABCD= 11 /02.726
ABCD= 00 /02.932
                    ABCD= 00/64.041
                    ABCD= 11/64.556

PAGE-UP  PAGE-DN  RESTART  DECODE
```

Figure 7.8.B
Signalling Analysis, T1DUAL

There are a couple different aspects in Figure 7.8.B. The AB-bits are shown, instead of the signalling state. You need to press the DECODE/AB-bits F-Key before you receive the digits; this key will not change the display of earlier bits. The analysis has been stopped in Figure 7.8.B. PAGE-UP and PAGE-DN F-Keys appear to allow you to view multiple pages of results, if they are available.

Section 8 Other Features

Refer to Figure 8.A for the Other Features menu.

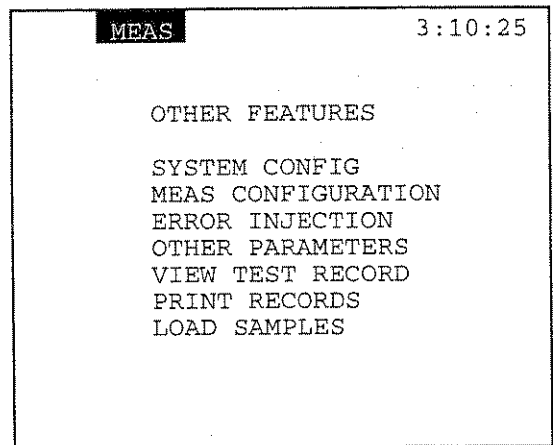


Figure 8.A
Other Features Menu

8.1 SYSTEM CONFIG

The following menu items are contained in SYSTEM CONFIG:

- SYSTEM PROFILES
- GENERAL CONFIG
- ERASE NV RAM
- FULL SELF TEST
- VERSION/ OPTION.

8.1.1 SYSTEM PROFILES

You may store a maximum of 10 system profiles in the test set. These profiles can save you time in configuring the test set for your applications. The test set can store the current configuration as a system profile. You provide a name for the profile so that it may be conveniently recalled at a later time. Items that are stored in the profile are: GENERAL CONFIG settings, TEST CONFIGURATION, MEAS CONFIGURATION, DIAL/SPRVIS SETUP, ERROR INJECTION, OTHER PARAMETERS, SEND TEST PATTERN.

NOTE: The SYSTEM PROFILES menu does not operate like the user pattern menus. You may not edit an existing system profile

in the SYSTEM PROFILES menu. If you wish to modify an existing profile, use the modification procedure described in this section.

Enter a New System Profile

- 1) From the MAIN MENU, select OTHER FEATURES> SYSTEM CONFIG > SYSTEM PROFILES.
- 2) Press the STORE (F2) key.
- 3) Type in the LABEL you wish to give the profile. Do this by pressing toggle (F3) to toggle to the alphabet grid with the flashing A. Cursor to the desired letter and press SELECT (F4). Repeat this as necessary until the desired label is spelled. Then press toggle (F3) to leave the alphabet grid.
- 4) Observe the file number that the test set will store the new profile under. You may change the file number if you wish by pressing the Down Arrow key to access the FILE No. line. Now press the SHIFT-lock key to display the SHIFT indicator. Type in the desired number from the keypad.
- 5) Press ENTER to store the SYSTEM PROFILE.

Invoke a Stored System Profile

- 1) Enter the SYSTEM PROFILES menu.
- 2) Cursor down to the desired system profile.
- 3) Press the ENTER key.

View an Existing Profile

- 1) Enter the SYSTEM PROFILES menu.
- 2) Cursor down to the desired profile and press the VIEW (F1) key.
- 3) Press the PAGE-DN (F2) key to view all the pages contained in this profile.

Activate the Default Profile

This is a way to return all the T10's settings to the factory defaults.

- 1) Enter the SYSTEM PROFILES menu.

- 2) Select the DEFAULT (F4) key, then press ENTER. You will be returned to the SYSTEM CONFIG menu and the test set's configuration will be set to the factory default.

Delete a Profile

- 1) Enter the SYSTEM PROFILES menu.
- 2) Cursor down to the desired profile.
- 3) Press the DELETE (F2) key.

Modify an Existing Profile

NOTE: The SYSTEM PROFILES menu does not operate like the user pattern menus. You may not edit an existing system profile in the SYSTEM PROFILES menu. If you wish to modify an existing profile, you must change the settings in the original menus and then restore the profile. Refer to the following modification procedure:

- 1) Enter the SYSTEM PROFILES menu.
- 2) Cursor down to the desired system profile
- 3) Press the ENTER key to invoke this profile. This will also exit you from the screen.
- 4) Move to the other menus within the test set where you will change the set-up items.
- 5) Enter the SYSTEM PROFILES menu.
- 6) Press the STORE (F2) key.
- 7) Give the profile a new name. If you want, you can give this modified profile the same name as the original, but pay close attention to which file number it is stored under so that you will be able to tell which profile is old, which is new.
- 8) Press ENTER to return to the SYSTEM PROFILES menu.
- 9) Cursor down to the old version of the profile which you no longer need.

- 10) Press the DELETE (F2) key.
- 11) Cursor down to the new profile.
- 12) Press the ENTER key. You are finished.

8.1.2 GENERAL CONFIG

The GENERAL CONFIGURATION screen lets you set the time and date, backlight duration, and several printer port characteristics. See Figure 8.1.A.

```
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 8.1.A
General Configuration

The following items are available for configuration:

1) DATE (Y- M - D)

Here you may 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. When you are finished, press the SHIFT-lock key again to remove the SHIFT indicator.

2) TIME (H :M :S)

Here you may set the time by pressing 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. When you are finished, press the SHIFT-lock key again to remove the SHIFT indicator.

3) BACK LIGHT

F-Key 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) means that the backlight will automatically turn itself off after the indicated number of minutes has elapsed. If you choose TIMED, press the SHIFT-lock key to display the SHIFT indicator. You may then type in any number of minutes between 1 and 99. Press the SHIFT-lock key again to remove the SHIFT indicator.

Printer items: the following selections refer to printing. The factory default settings work with the printer supplied by the factory. However, you can alter these settings in case you want to use the SunSet T10 with another printer.

You are free to use this information to attempt to set the SunSet T10 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.

4) BAUD RATE

F-Key Options: 1200 (F1), 2400 (F2), 9600 (F3), 19.2K (F4)

The Baud rate indicates the number of changes in tone per second. The default setting is 9600, meaning that there are 9600 changes per second. This setting is recommended for remote control operations. The rates 1200 and 2400 will not support remote control features.

5) PARITY

F-Key Options: NONE (F1), EVEN (F2), ODD (F3)

Parity is a method of checking the accuracy of transmitted or stored data. It defines whether the sum, the total number of ones, of all bits is odd or even. An extra bit, known as a parity bit, is added to the data as an accuracy check. This bit will be set to either 0 or 1 depending on what value is needed to pass the parity test. For example, if there is Odd Parity and the data is 10101010, the parity bit must be set to 1 in order to pass. 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.

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

6) STOP BIT

F-Key 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. This can be set to either 1-BIT (F1) or 2-BIT (F2).

7) BITS/CHAR

F-Key Options: 7-BIT (F1), 8-BIT (F2)

BITS/CHAR determines the number of bits per character. Press (F1) to select 7 bits per character or (F2) to select 8 bits per character.

8) CR/LF INSRT

F-Key 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.

8.1.3 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 after inserting a new SunWare cartridge. This

operation should also be performed as a last resort if the set is not performing properly. If this is the case, you should initiate 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 has not corrected the problem.
- 3) Performing a self test and turning the power off and on again has not fixed the problem.

WARNING

Performing the NV RAM ERASE operation will erase all the user-storable information the user has entered into the test set. All user transmit patterns, telephone numbers, and system profiles will be erased.

Use the following procedure to perform the ERASE NV RAM procedure:

- 1) From the main menu, enter the SYSTEM CONFIG menu item, 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 and then turn the power back on.
- 4) Reconfigure the set for the operations you need to perform. TEST CONFIGURATION, SEND TEST PATTERN, and all other areas of the set will be restored to the factory defaults.

8.1.4 FULL SELF TEST

Use the SELF TEST to perform a hardware test within the SunSet T10. If an error message is shown after the SELF TEST is completed, please contact Sunrise Telecom Customer Service at 1 408 363 8000/ 1-800-701-5208 (telephone) or 1 408 363 8313 (fax) for assistance.

8.1.5 VERSION/OPTION

This displays the SunWare version, serial number, and options installed in your SunSet T10. Figure 8.1.C depicts a sample Version/Option screen.

```
20:04:44  
Version 1.40V0  
S/N 000603  
OPTION:  
A: SW180 - Remote Control  
B: SW190 - Pulse Mask  
C: SW185 - MF/DTMF/DP  
D: SW183 - Noise Analysis  
F: SW186 - ISDN Analysis  
K: SW182 - Data Link Control  
L: SW181 - CSU/NI Emulation  
M: SW187 - Switch 56 Test  
N: SW184 - Westell/Teltrend  
PAGE-UP PAGE-DN
```

Figure 8.1.C
Version/ Option screen

8.2 MEAS CONFIGURATION

As shown in Figure 8.2.A, several measurement configuration items may be adjusted by the user.

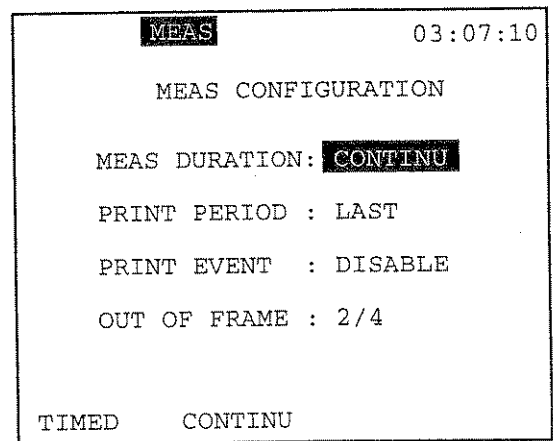


Figure 8.2.A
Measurement Configuration

1) MEAS DURATION

F-Key Options: TIMED (F1), CONTINU (F2)

A timed measurement (F1) will be stopped after the indicated 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. When a timed test is in progress, the Remaining Time (RT) counter shows how much time is left before the end of the test. 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.

A CONTINUous test will run indefinitely until you press the RESTART key or until you change some other setting on the test set that restarts the test.

2) PRINT PERIOD

F-Key Options: TIMED (F1), LAST (F2)

In Timed Mode (F1), the test results are printed and saved to the buffer every 1 to 99 minutes. If you select TIMED, you will need to press the SHIFT key to enter in the desired time (between 1 and 99 minutes). In Last Mode (F2), the test results are printed only at the end of a timed test or a continuous test that has ended due to a RESTART.

3) PRINT EVENT

F-Key Options: ENABLE (F1), DISABLE (F2)

Choose ENABLE (F1), if you would like the printer to print out an error message every second that one or more errors occur. The date and time is printed with every message. Choose DISABLE (F2), if you do not want the printer to print out a result each time.

4) OUT OF FRAME

F-Key Options: 2/4 (F1), 2/5 (F2)

This item determines the condition for declaring an Out Of Frame (OOF) error. For 2/4 (F1), an OOF occurs every time there are two framing bits in error out of 4 framing bits. For 2/5 (F2), there is an OOF when there are 2 framing bit errors out of every 5 framing bits. These standards may be useful on a corporate basis so that all test and monitoring equipment report an OOF under exactly the same conditions. OOF errors are recorded in the MEASUREMENT RESULTS Frame screen.

8.3 Error Injection

In this screen, you may configure the type of errors, as well as the number, to be sent when you press the ERRINJ key. Refer to Figure 8.3.A.

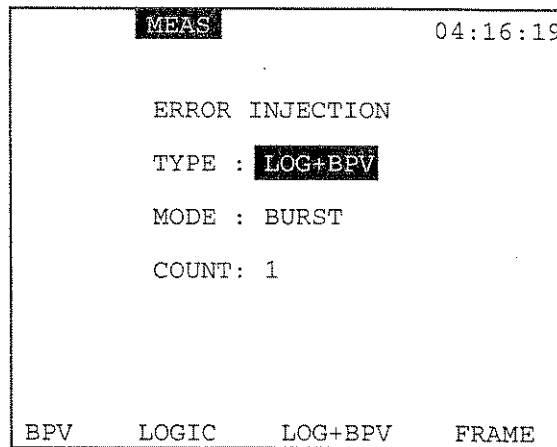


Figure 8.3.A Error Injection Screen

1) TYPE

F-Key Options: BPV (F1), LOGIC (F2), LOG+BPV (F3), FRAME (F4)

This item specifies the type of errors to be inserted.

2) MODE

F-key Options: RATE (F1), BURST (F2)

This item specifies the mode of error injection. For BURST (F2), a specified number of errors are inserted at once when the ERRINJ key is pressed. For RATE (F1), the errors are inserted at a specified rate. When you inject errors at a rate mode, an ERRINJ message is displayed at the top of the screen. This message specifies the type of errors you are inserting. To stop injecting errors, press the ERRINJ key again and verify that the error indicator no longer appears on the screen.

The third item will vary depending upon the Mode selected above. For Rate Mode, this line will be RATE; for Burst Mode, this line will be COUNT. See below.

3) COUNT

Options: 1 to 9999

For BURST MODE, choose the COUNT of errors to be inserted. After pressing the SHIFT key, 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: 1e-3 to 9e-9

For RATE MODE, choose the error RATE number and exponent. The errors will then be inserted at a continuous rate as specified in this entry.

To start error injection, simply press the ERR INJ key and the test set will insert errors as you have specified. If the error injector is set to RATE mode, an ERINJ indicator will be displayed on the screen.

Programming a burst of 10 errors

Here is a sample procedure for programming a burst of 10 Logic errors.

- 1) Power up the set and wait for the self test to finish. At the graphic screen, press ENTER to go to the main menu.
- 2) Use the cursor keys to move the cursor to OTHER FEATURES and press ENTER.
- 3) In the OTHER FEATURES menu, move the cursor to ERROR INJECTION and press ENTER.
- 4) At TYPE, choose LOGIC (F2).
- 5) The cursor automatically moves down to MODE selection. Press BURST (F2) key.
- 6) The cursor automatically moves down to COUNT. Press the SHIFT-lock key once to display the SHIFT indicator.
- 7) Press the 1 key followed by 0 key. The COUNT should show 10. Press the SHIFT key again to release the SHIFT-lock.
- 8) Press ENTER; you have just programmed the set to inject 10 CODE errors each time you press the ERRINJ key.

Programming a 1e-06 bit error rate

Use this procedure to program a 1e-06 bit error rate:

- 1) Power up the set and wait for the self test to finish. At the graphic screen, press ENTER to go to the main menu.
- 2) Use the cursor keys to move the cursor to OTHER FEATURES and press ENTER.
- 3) In the OTHER FEATURES menu, move the cursor to ERROR INJECTION and press ENTER.

- 4) At TYPE, select LOGIC (F2).
- 5) The cursor automatically moves down to MODE selection. Choose RATE (F1).
- 6) 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.
- 7) Press the '1' key once. The multiplier position is showing '1'. The cursor moves to the exponent position.
- 8) Press the '6' key once. A '6' is entered. Press SHIFT key to remove the SHIFT-lock indicator.
- 9) Press ENTER, you have just programmed the set to inject Bit errors at 1×10^{-6} rate each time you press the ERRINJ key.

8.4 Other Parameters

Figure 8.4.A provides the Other Parameters screen.

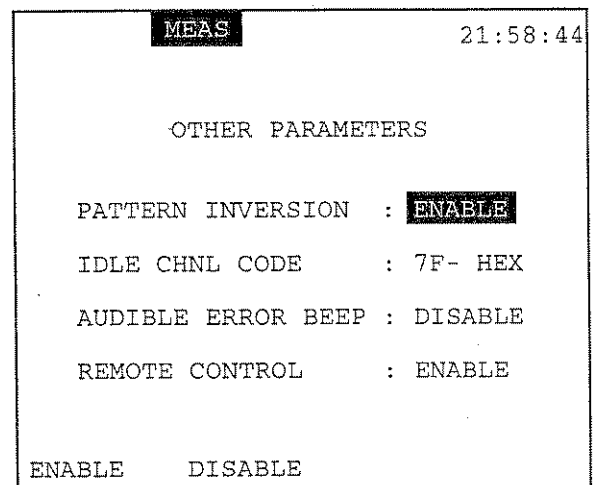


Figure 8.4.A
Other Parameters

The Other Parameters menu contains the following items:

1) PATTERN INVERSION

F-Key Options: ENABLE (F1), DISABLE (F2)

Here, you may 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. Also, the PAT SYNC LED will light only if the test set receives the same inverted pattern as it transmits.

2) IDLE CHANNEL CODE

F-Key Options: 7F-HEX (F1), FF-HEX (F2)

The idle 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 T1 testing to fill up the unused channels.

3) AUDIBLE ERR BEEP

F-Key Options: ENABLE (F1), DISABLE (F2)

Press (F1) to enable the audible error beep. When enabled, you will hear a beep whenever the test set receives an error (i.e. BPV, FBE) on the line. Press (F2) if you do not wish to hear this beep at every error.

4) REMOTE CONTROL

F-Key Options: ENABLE (F1), DISABLE (F2)

Press (F1) to enable the remote control feature. This item will appear only if you have purchased SunWare option SW180.

8.5 VIEW TEST RECORD

This screen lets you view the results and events stored in the SunSet. Figure 8.5.A displays the VIEW TEST RECORD screen.

```
16:59:28  
  
VIEW TEST RECORD  
  
TOTAL EVENT - 0  
TOTAL RESULT - 21  
  
EVENT RECORD  
VIEW FROM :0  
VIEW TO :0  
RESULT RECORD  
VIEW FROM :1  
VIEW TO :21  
  
ALL NONE CLR-ALL
```

Figure 8.5.A
View Test Record

The Total Event and Total Result numbers are shown in accordance with the events and results that are in memory. Event refers to an alarm or error; result refers to all errors, measurements, etc.

The cursor automatically is placed at the VIEW FROM of the EVENT RECORD. You may choose ALL (F1) to view all events, NONE (F2) to view no events, or CLR-ALL (F3) to clear all events stored in memory. If you wish to view specific events, press the SHIFT key and enter the desired event range with the keypad numbers.

Place the cursor at the VIEW FROM of the RESULT RECORD. The same three function keys as above, as well as the SHIFT key options, are available for the Result range.

If an Event is selected, pressing ENTER will first display all the EVENT records that have been selected. Use NEXT (F1) or PREVIOUS (F2) to view each Event record. When the Result records are displayed, use PAGE-UP (F1) or PAGE-DN (F2) to view different pages of the Result records.

8.6 PRINT RECORDS

The PRINT RECORDS provides the ability to print the test

results stored in the print buffer to the printer. Select either ALL (F1) to print all test records, NONE (F2) to print none of the test records, or NEXT (F3) to select a particular test record to print out.

8.7 LOAD SAMPLES

Load Samples loads five sample messages in the VIEW/PRINT TRACER for SS#7, ISDN, and MF TRACER. These messages will automatically clear and replace all messages currently stored in these storage buffers.

Section 9 DATA LINK CONTROL

The Data Link Control feature applies to ESF and SLC-96 framing. You will not be able to enter this item if you have selected UNFRAME or SF-D4 as your framing in TEST CONFIGURATION. ESF and SLC-96 have different Data Link Control menus, each with different screens and options. Section 9.1 pertains to SLC-96 framing and Section 9.2 to ESF.

9.1 Data Link Control- SLC-96

You must choose SLC-96 framing in the TEST CONFIGURATION menu before proceeding. Press ENTER on DATA LINK CONTROL within the main menu to see Figure 9.1.A. All capabilities are in conformance with Bellcore's standard TR-TSY-000008.

WARNING: Using the SLC-96 send message capability can bring down an entire SLC system. Be sure you are properly trained before proceeding. Monitoring the SLC

datalink from a MON jack should not cause a problem.

```
22:15:42  
DATA LINK CONTROL SLC-96  
  
MONITOR DATA LINK  
SEND MESSAGE  
VIEW DATA LINK
```

Figure 9.1.A
Data Link Control

9.1.1 MONITOR DATA LINK

The first menu choice is the data link monitor. This monitor gives you an English-language translation of the information in the SLC data link. See Figure 9.1.B for a sample screen.

```
06:44:12  
SLC-96 SEND MESSAGE  
  
MODE : WPL A-FELP: CLR  
MAJOR : ALM B-FELP: CLR  
MINOR : CLR C-FELP: CLR  
POWER : CLR D-FELP: CLR  
A SHLF: CLR P-FELP: CLR  
B SHLF: CLR M1 : CLR  
C SHLF: CLR M2 : CLR  
D SHLF: CLR M3 : CLR  
PROTECT LINE SW : IDLE  
C BITS: 1111111111  
  
HOLDSCR
```

Figure 9.1.B
SLC-96 Monitor Data Link

Here is a detailed description of each of the items:

MODE

There are three kinds of data link modes specified in TR-TSY-000008, NOTE, WP1B, and WP1. The mode will show as the NOTE, which indicates the 16-bit format of either the NOTE or the WP1B card. Alternatively, the mode can be indicated as the WP1, a 13-bit format.

MAJOR

A major alarm on the data link will be indicated here.

MINOR

A minor alarm on the data link will be indicated here.

POWER

A power alarm will be indicated here.

A SHLF

An A-shelf alarm will be indicated here.

B SHLF

An B -shelf alarm will be indicated here.

C SHLF

An C-shelf alarm will be indicated here.

D SHLF

An D-shelf alarm will be indicated here.

PROTECT LINE SW

The switch-to-protection line switch message is shown here.

C BITS

The 11 C-Bits are displayed here.

A-FELP

An A digroup far end loop will be indicated here.

B-FELP

A B digroup far end loop will be indicated here.

C-FELP

A C digroup far end loop will be indicated here.

D-FELP

A D digroup far end loop will be indicated here.

P-FELP

A Protection digroup far end loop will be indicated here.

M-BITS

The three M bits are displayed here.

9.1.2 SEND MESSAGE

The set gives you an English-language table of items that you may send on the SLC-96 data link. Before entering this menu, be certain that you are set for TERM, SLC-96, and Tx SOURCE:NORMAL for T1SINGL or TxSOURCE:TESTPAT for T1DUAL and that you have both your transmit and receive cords plugged into the circuit and the test set. Refer to Applications for diagrams on how to plug in the set. See Figure 9.1.C for a picture of the screen.

```
06:44:12
SLC-96 SEND MESSAGE
MODE : WP1
MAJOR : ALM   A-FELP: CLR
MINOR : CLR   B-FELP: CLR
POWER : CLR   C-FELP: CLR
A SHLF: CLR   D-FELP: CLR
B SHLF: CLR   P-FELP: CLR
C SHLF: CLR   S-BITS: 1111
D SHLF: CLR   M-BITS: 111
C BITS: 111111111111
NOTE      WP1      WP1B      SEND
```

Figure 9.1.C
SLC-96 Send Message

MODE

This selection determines which SLC-96 element the test set will emulate as it sends the SLC-96 message. The three choices are

NOTE, WP1, and WP1B.

MAJOR, MINOR, POWER, A SHLF, B SHLF, C SHLF, D SHLF
These categories allow you to set the desired alarm message.

A-FELP, B-FELP, C-FELP, D-FELP, P-FELP
These categories allow you to set a far-end loop or indicate the existence of a far-end loop.

S-BITS, M-BITS, C-BITS
These categories allow you to directly enter these SLC data link bits that are not otherwise defined.

SEND
This F4 key function allows you to send the message at any time. Alternatively, you may send a message by pressing the ENTER key. Note that no message is sent until you press either SEND or ENTER. This allows you to edit your message to your liking and only send it when it is exactly the way you wish. Once you send it, it will continue to be sent until you change it.

ACTION
Choose either SWITCH (F1) or RELEASE (F2) to carry out the desired action.

LINE
Choose the desired digroup (A through D) by pressing the appropriate F-key (F1 through F4).

ENTER
When you have put your settings the way you want them, press the ENTER key to send the desired message.

9.1.3 VIEW DATA LINK SLC-96

This menu item allows you to view a live SLC-96 data link. The bits are arranged according to their place in the SLC-96 data link. This screen may be useful for those applications that do not follow TR-TSY-000008. See Figure 9.1.D for an example of this screen:


```
06:44:12
SLC-96 VIEW DATA LINK
PAGE :01
DLF C-----CsssM-MAAS--Ss
001 111111111101011101111111
002 111111111101011101111111
003 111111111101011101111111
004 111111111101011100111111
005 111111111101011101111111
006 111111111101011101111111
007 111111111101011101111111
008 111111111101011101111111
PAGE-UP PAGE-DN PAUSE
```

Figure 9.1.D
View Data Link SLC-96

9.2 DATA LINK CONTROL (ESF)

ESF DATA LINK CONTROL is provided when you have chosen ESF framing in the TEST CONFIGURATION menu. See Figure 9.2.A.

```
11:26:59
DATA LINK CONTROL ESF
MONITOR T1.403 PRM
MONITOR T1.403 BOM
SEND T1.403 PRM
SEND T1.403 BOM
```

Figure 9.2.A
Data Link Control ESF

9.2.1 MONITOR T1.403 PRM

The MONITOR T1.403 PRM allows you to view the Performance Report Message (PRM) as reported on the ESF data link. This gives you real-time end-to-end performance information, even when the circuit is in service. This screen also keeps a record of how many seconds payload loopback messages and yellow alarm messages have appeared. The screen shows how much total time has elapsed since you began to monitor the data link, as well as how much time a valid T1.403 data link message was received. Figure 9.2.B shows a sample screen:

```
MEAS 21:28:49
DATA LINK MONITOR
T1.403 PRM
ELAPS TIME - 000:04:46
DETEC TIME - 000:01:33
CRC=1 - 0      C=<=5 - 0
C=<=10 - 0     C=<=100- 0
C=<=319- 0    C>320 - 0
SEFE - 0      FSBEE - 0
BPV - 0       SLIP - 0
PLBsec- 0     YELsec- 0
RESTART  HOLDSCR
```

Figure 9.2.B
MONITOR T1.403 PRM

The following items appear on the screen:

ELAPS TIME

This is the total amount of time which has passed since you started monitoring the data link.

DETEC TIME

This is the total amount of time (during the elapsed time) that the set has detected valid data link messages.

CRC-1

This is the number of seconds in which exactly 1 CRC-6 error was

reported.

C=<5

This is the number of seconds during which 2 to 5 CRC-6 errors were reported.

C=<10

This is the number of seconds during which 6 to 10 CRC-6 errors were reported.

C=<100

This is the number of seconds during which 11 to 100 CRC-6 errors were reported.

C=<319

This is the number of seconds during which 101 to 319 CRC-6 errors were reported.

C>320

This is the number of seconds during which 320 or more CRC-6 errors were reported.

SEFE

This is the number of severely errored framing events that were reported.

FSBEE

This is the number of FSBEEs that were reported. A FSBEE is a Frame Synchronization Bit Error Event.

BPV

This is the number of seconds in which at least one bipolar violation was reported.

SLIP

This is the number of seconds during which at least one frame slip occurred.

PLBsec

This is the number of seconds in which the device is looped back.

YELsec

This is the number of seconds in which at least one yellow alarm

message was received.

Two F-keys are given in this screen:

RESTART

The RESTART (F1) key allows you to start measurement over again.

HOLDSCR/CONTINU

The HOLDSCR (F2) key stops the screen from updating while you look at it. The measurement continues in the background. You can let the screen update again by pressing the CONTINU (F2) key.

9.2.2 MONITOR T1.403 BOM

Refer to Figure 9.2.C This screen displays the message that the test set receives over the data link. The receive status line shows MESSAGE if the test set is currently receiving a message on the data link. The message will be displayed under the LAST MESSAGE line. If the set is not receiving a message, the MESSAGE line will say IDLE, and the last message that was received will be displayed under the LAST MESSAGE line.

```
MEAS 06:40:12  
  
VIEW DATA LINK T1.403 BOM  
RECEIVE STATUS : MESSAGE  
  
LAST MESSAGE:  
  (left most bit received 1st)  
  
CURRENT: 000000000001111111  
1st last:11100011000011000  
2nd last:11000110001100010  
3rd last:10011000110001101  
4th last:10010000000000011
```

Figure 9.2.C
Moniotr T1.403 BOM

9.2.3 SEND T1.403 PRM

You can configure the test set to send the T1.403 Performance Report Message by entering this menu item. In this mode the test set will broadcast the message on the currently selected TX jack according to the quality of the received signal on the currently selected received jack. It will display for you a count of all the various errors that have been recorded and transmitted since you entered the menu. The set sends this message continuously until you ESCAPE from this menu. Refer to Figure 9.2.D.

```
MEAS 21:48:49
DATA LINK TRANSMIT
T1.403 PRM
ELAPS TIME - 000:02:22
CRC=1 - 0      C=<5 - 0
C=<10 - 0      C=<100- 0
C=<319- 0      C>320 - 0
SEFE - 0      FSBEE - 0
BPV - 0       SLIP - 0
PLBsec- 0     YELsec- 0
```

Figure 9.2.D
Data Link Transmit

9.2.4 SEND T1.403 BOM

You can also send a data link Bit Oriented Message if you wish. Figure 9.2.E shows an example of this screen:

```
MEAS 06:44:12
DATA LINK SEND MESSAGE
ESF - T1.403
MESSAGE - 1111111100101000
REPETITION - CONTINU
YEL-ALM PLPK-UP PLPK-DN more
```

Figure 9.2.E
DATA LINK SEND MESSAGE

In this screen you select a message to send and specify a number of repetitions to send the message. Use this procedure:

- 1) Select the desired message. You can do this by using the F-keys for pre-defined messages or by typing in the desired numbers. If you type in the message, move your cursor to the desired position and enter the 1s and 0s. You are only allowed to move the cursor between the 10th and 15th bits of the message. The rest of the 16-bit message is fixed.

Here is what each of the predefined messages does:

- YEL-ALM sends the ESF datalink yellow alarm
- PLPK-UP sends the CSU payload loop up command.
- PLPK-DN sends the CSU payload loop down command.
- LLPK-UP sends the CSU line loop up command.
- LLPK-DN sends the CSU line loop down command.
- NLPK-UP sends the NIU loop up command.
- NLPK-DN sends the NIU loop down command.

- 2) When you have selected your MESSAGE, cursor down to the REPETITION item. If you would like to send the message continuously, choose CONTINU (F2). If you would like to send the message for a certain number of repetitions, choose NUMBER (F1). Then press and release the SHIFT-lock key and type in the number of repetitions you desire between 01 and 99.
- 3) Press the ENTER key to actually send the pattern on the data link. You will automatically exit from the SEND T1.403 BOM screen and the desired message will be sent for you. If you chose CONTINU for the number of repetitions, the message will be sent continuously while you are in the DATA LINK CONTROL ESF menu. Exiting the menu or moving into a sub-menu will cause the message to stop.

Note on ESF NIU Loopbacks:

You can use this function to loopback a far-end NIU from the customer premises side of the near end NIU. Set the message to NLPK-UP. Set the repetition to 7 times. 7 repetitions will allow the far end NIU to loop up without letting the signal last long enough to loop up the near end.

SECTION 10 CSU/NI EMULATION (SW181)

CSU/NI EMULATION gives you a simple, full-duplex emulation of a CSU or NI. With this capability, you can unplug the CSU or NI and insert the SunSet T10 in its place. The emulation screen gives you:

- a pictorial explanation of the circuit status
- measurement results
- configuration commands to perform loopbacks

While in this mode, the test set will respond to CSU and NI loop up/down codes. You may employ CSU/NI Emulation in T1 SINGL and T1DUAL modes.

10.1 CSU/NI Emulation, T1 SINGL Mode

- 1) Before entering CSU/NI Emulation, you must set up your configuration in TEST CONFIGURATION to the following settings:

Mode: T1 SINGL

RxLvL-1: TERM, BRIDGE, or DSXMON

FRAMING: as appropriate for the circuit under test; cannot be AUTO

CODING: as appropriate to the circuit under test

TX SOURCE: THRU, NORMAL

LBO 1&2: as appropriate for the circuit under test

TEST RATE: 1.544 M. If this is set to a fractional rate, you will not be able to enter the CSU/NI Emulation screen.

- 2) Plug the cords into the test set and circuit under test. Make sure Line 1 jacks are plugged in to the signal coming from the network. The test set will respond to loopback codes from the network.

The CSU/NI Emulation screen appears as in Figure 10.1.A.

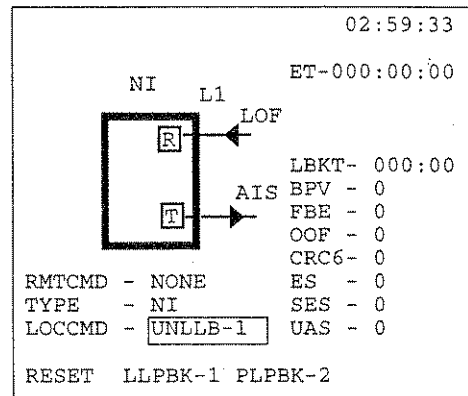


FIGURE 10.1.A
CSU/NI EMULATION, T1 SINGL

- 3) Set the test set up for either NI emulation or CSU emulation. Do this by going to TYPE and selecting CSU (F1) or NIU (F2).
- 4) Observe the circuit error counts and see if a remote loopback

command is being received. Note that the framing of the remote loopback command must be the same as the framing selected in the TEST CONFIGURATION menu.

5) If desired, operate any of the local commands as follows:

- RESET (F1) resets the test set to a through mode.
- LLPBK-1 (F2) operates a line loopback from L1-Rx to L1-Tx. A line loopback regenerates the signal but does not reframe the signal. Hence, BPVs and frame errors will pass through the line loopback unchanged. Once the line loop back has been invoked, the LLPBK-1 command will be replaced with the UNLLB-1 (F2) command. In this case, pressing F2 will undo the loopback.
- PLPBK-1 (F3) operates a payload loopback from L1-Rx to L1-Tx. A payload loopback regenerates the signal, and also reframes and recodes the signal. Hence, BPVs and frame errors will be eliminated as they pass through the payload loopback. Once the payload loopback has been invoked, the PLPBK-1 command will be replaced with the UNPLB-1 (F3) command. In this case, pressing F3 will undo the loopback.

6) When you are finished with the session, press ESCAPE and you will return to the MAIN MENU. All loopbacks will be dropped as you exit

10.2 CSU/NI Emulation, T1 DUAL Mode

1) Before entering CSU/NI Emulation screen, set up your configuration in the TEST CONFIGURATION Menu with the following settings:

TEST MODE: T1DUAL

TXINSERT : L1-Tx If these are set to Line 2, you will receive Rx/DROP: L1-Rx the message, "Support L1-Tx/L1-Rx Only."

RXLVL 1 AND 2: TERM, BRIDGE, or DSXMON

TXSOURCE : THRU or TESTPAT

FRAMING: as appropriate for the circuit under test (not AUTO)

CODING: as appropriate for the circuit under test

XMTCLK: L1-Rx or INTERN

LBO1&2: as appropriate for the line under test
 RATE: 1.544M. If this is set to a fractional rate, you will not be able to enter the CSU/NI Emulation screen.

The CSU/NI Emulation screen will appear as in Figure 10.2.A.

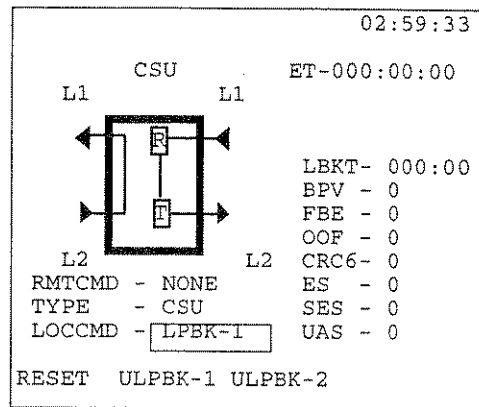


Figure 10.2.A
CSU/NI Emulation

- 2) Plug the cords into the test set and circuit under test. Make sure LINE 1 jacks are plugged in to the signal coming from the network. The test set will respond to loopback codes from the network.
- 3) Set the test set up for either NI emulation or CSU emulation. Do this by going to TYPE and selecting CSU (F1) or NIU (F2).
- 4) Observe the circuit error counts and see if a remote loopback command is being received. Note that the framing of the remote loopback command must be the same as the framing selected in the TEST CONFIGURATION menu.
- 5) If desired, operate any of the local commands as follows:
 - RESET (F1) resets the test set to a through mode.
 - LLPBK-1 (F2) operates a line loopback from L1-Rx to L2-Tx. A line loopback regenerates the signal but does not reframe the signal. Hence, BPVs and frame errors will pass

through the line loopback unchanged. Once the line loop back has been invoked, the LLPBK-1 command will be replaced with the UNLLB-1 (F2) command. In this case, pressing F2 will undo the loopback.

- LLPBK-2 (F3) operates a line loopback from L2-Rx to L1-Tx. A line loopback regenerates the signal but does not reframe the signal. Hence, BPVs and frame errors will pass through the line loopback unchanged. Once the line loop back has been invoked, the LLPBK-2 command will be replaced with the UNLLB-2 (F3) command. In this case, pressing F3 will undo the loopback.

6) When you are finished with the session, press ESCAPE and you will return to the MAIN MENU. All loopbacks will be dropped as you exit the session, and the TEST CONFIGURATION settings will be reinstated.

Chapter 5 Applications

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Section 1 Basic Applications

1.1 Connecting the Cords

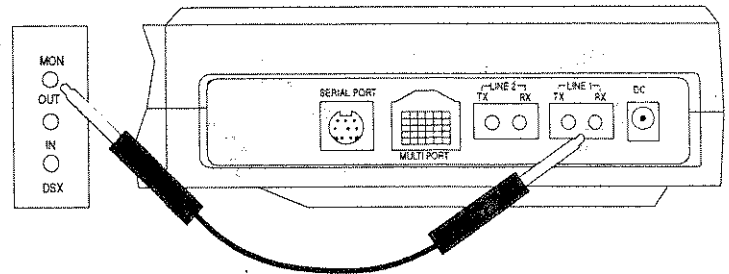
WARNING!

Plugging into a live T1 circuit may cause a loss in service for multiple customers. Be sure you are properly trained before proceeding.

Hazardous voltages may be present on T1 spans. When plugging in at a repeater housing, plug the cord into the set before plugging into the repeater extender or repeater housing.

If you want to perform a BRIDGE monitor access, do not plug into the circuit until you have selected BRIDGE in the TEST CONFIGURATION menu. This ensures that the isolation resistors are in place before the circuit is accessed.

The following figures, 1.1.A, 1.1.B, and 1.1.C, display various ways to plug the set into the circuit.



Note: this MON jack may be from a DSX or other T1 network equipment.

Figure 1.1.A
Plugging in- DSXMON Mode

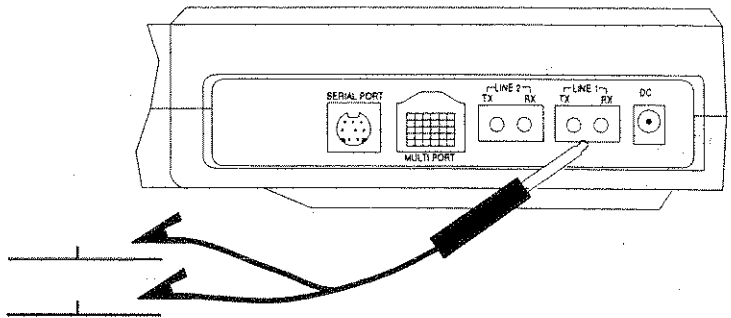


Figure 1.1.B
Plugging in- BRIDGE Mode

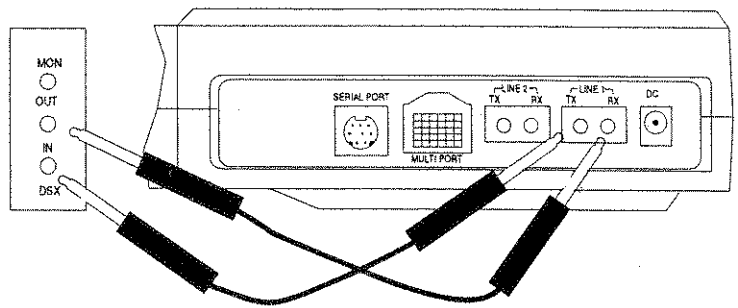


Figure 1.1.C
Plugging in- TERM Mode

1.2 Accepting a New Span/ Loopback Test

- 1) Verify that the span is not in service. This acceptance test will disrupt service. Find out what kind of loopback device is installed at the end of the span, and what loopback codes operate it.
- 2) Switch on the test set. Press the ENTER key to advance to the

MAIN MENU.

- 3) Enter the TEST CONFIGURATION item. Set the screen settings to:

TEST MODE: T1SINGL
RXLVL-1: TERM
FRAMING: as specified by your design
CODING: as specified by your design
Tx SOURCE: NORMAL
XMT CLOCK: INTERN
LBO 1: 0 dB (ft)
TEST RATE: 1.544M

Press ENTER when your settings are correct.

- 4) Connect the test set to the circuit as shown in Figure 1.2.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

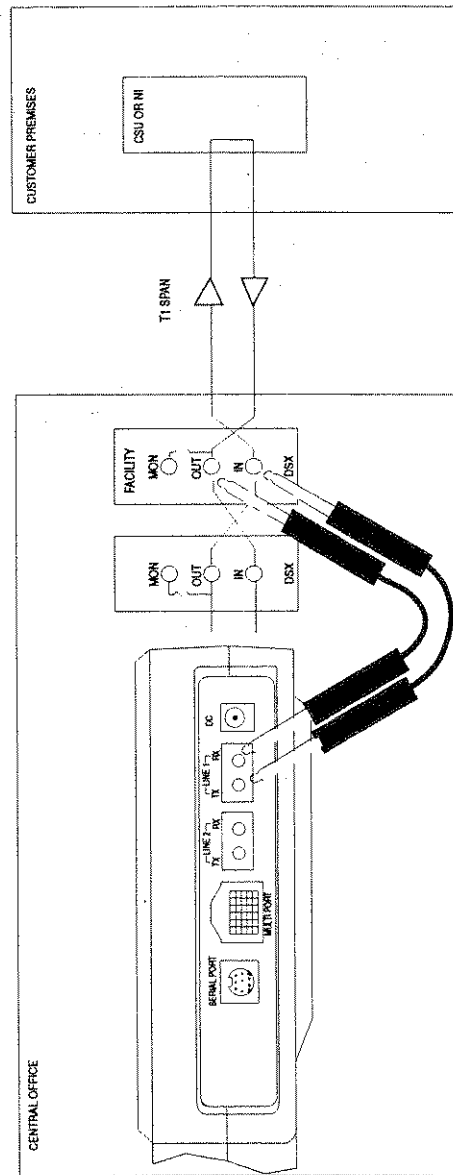


Figure 1.2.A
Accepting a New Span

- 5) Move the cursor to the LPBK & SPAN CONTROL menu and press ENTER. Press ENTER on CSU & NI CONTROL. For SF framing, set up the screen with:

TYPE: IN-BAND

CODE: NI or CSU, as appropriate.

Do not actually select the LOOP-UP entry until last.

For ESF framing, set up the screen with:

TYPE: ESF-DL

CODE: NETWORK (NIU) or LINE (CSU), as appropriate.

Do not actually select the LOOP-UP entry until last.

When you press the ENTER or LOOP-UP key, you will see a "LOOPING UP" message followed by a "LOOP UP SUCCEEDED" message.

- 6) Press ESCAPE until you have returned to the MAIN MENU. Move the cursor to the SEND TEST PATTERN menu item and press ENTER. Select the pattern you would like to send.
- 7) Enter the MEASUREMENT RESULTS menu item. Verify that the span performs to your company's requirements for the service delivered.
- 8) When you have finished with the MEASUREMENT RESULTS, press ESCAPE to return to the MAIN MENU. Enter the LPBK & SPAN CONTROL item. Enter the CSU & NI CONTROL item. Set the MODE to LOOP-DN to release the loopback. You should be able to leave the other settings as they were. Verify that the LOOP DOWN SUCCEEDED message is shown.
- 9) Disconnect your test set from the circuit.

1.3 Monitoring an In-service Circuit

- 1) This test may be performed while the span is carrying live customer traffic.
- 2) Switch on the test set.
- 3) From the MAIN MENU, enter the TEST CONFIGURATION item.

Configure the test set for TEST MODE:T1DUAL; RXLVL:DSXMON; FRAMING and CODING as specified by the circuit (or press AUTO to find the correct framing); TxSOURCE:THRU; TxCLK: INTERN;LBO 1&2: 0dB(ft); TEST RATE:1.544M.

- 4) Connect the SunSet's Line 1 and 2 Rx jacks to the MON jacks, as shown in Figure 1.3.A. Press the HISTORY key to acknowledge any blinking history lights and turn them off.

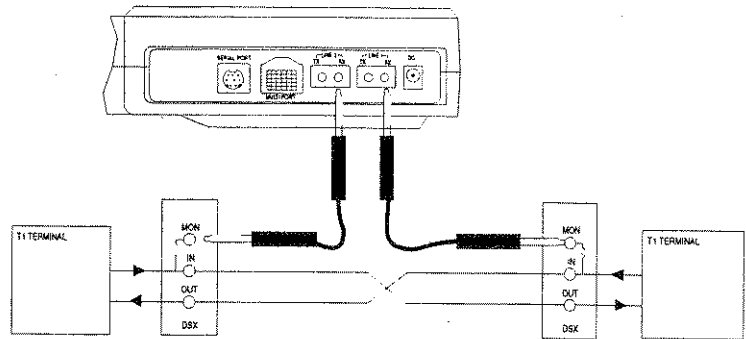


Figure 1.3.A
Monitoring an In-Service Circuit

- 5) Examine the LEDs and the GRAPHIC screen for information about the circuit under test.

The Pulses LED should be green, and a valid framing type (SF, ESF, or SLC-96) should be indicated in green. An ERRORS light will tell you that the circuit is working, but is experiencing trouble. A red Pulses or framing LED is an indication of severe problems. A YEL ALM indication will show a problem on the other side of the circuit. AIS may indicate a trouble condition where a network element transmitting to the test set has lost its incoming T1 signal and has replaced it with the AIS signal.

If you need additional information proceed to step 6. Otherwise, disconnect your test set from the circuit.

- 6) You may make a basic measurement by using this procedure. Press ESCAPE as necessary until you arrive at the MAIN MENU. Enter the MEASUREMENT RESULTS menu. Verify that the span performs to your company's requirements for the

service delivered.

7) When you are finished, disconnect your test set from the circuit.

1.4 Stressing a T1 Line

Using SEND TEST PATTERN

- 1) Set up the span for testing as outlined in 1.2 of this chapter. Proceed up to the point where measurements are to be performed.
- 2) Before performing the MEASUREMENT RESULTS, select a stress pattern for the line. Do this by pressing ESCAPE as necessary until you arrive at the MAIN MENU. Then enter the SEND TEST PATTERN menu. Cursor over to the desired stress pattern. The test set will immediately begin transmitting the highlighted test pattern.
- 3) Once the pattern has been sent, see if the BPV and/or ERRORS LEDs are lit. If they are, you may have illustrated how the customer could be having a problem with the circuit. Try additional stress patterns as desired. QRSS is the original stress pattern and is used as the default stress pattern in the test set. Here are some other stress patterns and their applications:

55 Daly

This pattern stresses the ability of regenerators to follow timing circuit phase changes. It stresses the ability to pass zero patterns and is most useful on AMI lines.

3-in-24

This pattern contains maximum number of legal zeroes and minimum allowable ones density. It is most useful on AMI lines.

2e23 and 2e20

These patterns are like QRSS except that they are not zero-constrained. 2e23 has a maximum of 23 zeroes in a row; 2e20 has 20 zeroes in a row. Note that AMI circuits are specified to

carry only 15 zeroes in a row, so these patterns stress these circuits beyond what they are designed to carry. Despite the long individual zero strings, the patterns average 50% ones density.

1-in-8

This pattern is similar to 3-in-24 except it has a maximum of 7 zeroes in a row. This is the best low density pattern for stressing B8ZS circuits.

1-in-16

This pattern puts enormous stress on AMI circuits, especially line repeaters. This pattern averages only 6% density which is far under the specified 12.5% density for AMI lines. The pattern does not cause problems for circuits with B8ZS coding.

All 1s

This pattern requires the most power from regenerating circuitry and may cause the pulse level to drop.

- 4) When you are finished, release the loopback and disconnect your test set from the circuit.

Using Bridge TapDetect

- 1) Set up the span for testing as outlined in Section 1.2 of this chapter. Proceed up to the point where measurements are to be performed.
- 2) Go to BRIDGE TAP DETECT in OTHER MEASUREMENTS. BRIDGE TAP DETECT is a collection of patterns that have been known to show the presence of bridge taps. You can observe the test in progress by looking at the RESULTS - LOGICAL screen and the BRIDGE TAP DETECT screen by pressing PAGE-DN. A performance score of 0 bit errors, 0 errored seconds, and 30 available seconds is perfect.
- 3) When you are finished, release the loopback and disconnect your test set from the circuit.

1.5 Verify Proper B8ZS/AMI Optioning

A common fault in new circuits is a B8ZS/AMI optioning mismatch in one or more network elements. This procedure will help you determine if this problem exists in your circuit.

- 1) Set up the test set and circuit as described in Section 1.2 of this chapter. If you test to one end of the circuit first, as in section 1, be sure to repeat the procedure to the other end of the circuit as well.

Make sure the test set's line CODING is set to the same line coding as is supposed to be present on the circuit. Get the circuit looped up and ready for testing.

- 2) Transmit an all 1s signal and an alternating 1s and 0s signal. Verify that there are no errors with any of these signals. If there are any errors, then you have problems that are not associated with a B8ZS/AMI mismatch.
- 3) Transmit a 3-in-24 signal. If any equipment in the line has optioning that disagrees with the test set, you will see a loss of pattern synchronization.
- 4) Verify the diagnosis by transmitting QRSS. QRSS will also cause errors when there is an AMI/B8ZS mismatch in the circuit, but it will not cause a loss of pattern synchronization.
- 5) Note that in the set-ups of Section 1.2 of this chapter, the customer's T1 terminating equipment is isolated from the circuit. Thus, if the customer's equipment has the optioning problem, the previous procedure will not expose it while the circuit is looped up.

If the circuit tests fine while looped up, but fails when looped down, check if the line code monitored in one direction is not the same as the line code monitored in the other direction. If it isn't, then the customer's equipment may be at fault. Try a loop back from the central office to the network equipment (customer premises), as shown in Figure 1.5.A. If the problem still isn't evident from the central office, then a trip to the customer's premises may be required.

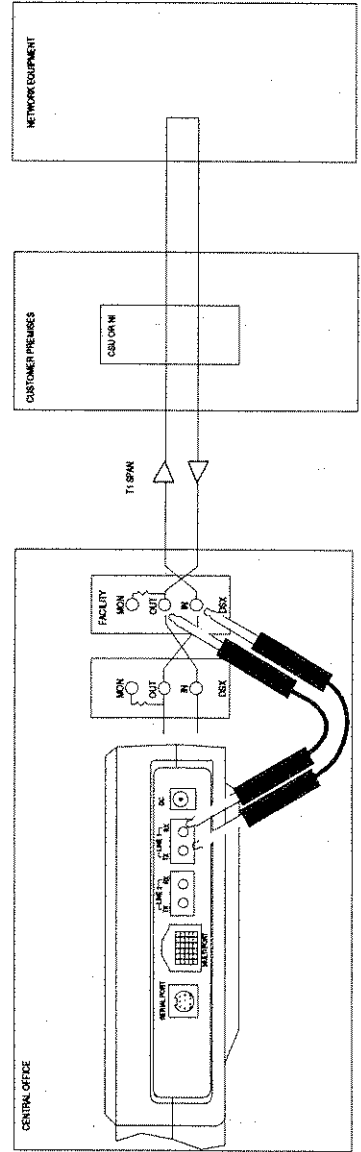


Figure 1.5.A
Verify Proper B8ZS/ AMI Optioning

1.6 Checking for Frame Slips and Frequency Sync

Frequency synchronization can be a problem when:

- the customer purchases a channelized T1 circuit
- the customer's circuit passes through a synchronous network element such as a switch, PBX or a digital cross-connect system (DCS)
- the T1 circuit passes through more than one carrier

Use this procedure to identify frequency synchronization problems:

- 1) Obtain a reference frequency source. This can be the other side of the customer's circuit or it can be a 1.544 Mbps reference signal that is traceable to a stratum 1 level clock.
- 2) This test may be performed while the span is carrying live customer traffic.
- 3) Turn the power on to the test set.

- 4) From the main menu, enter the TEST CONFIGURATION item.

Configure the screen settings for:

TEST MODE: T1DUAL

TxINSERT: L1-Tx

RxDROP: L1-Rx

RXLVL-1: TERM (if a 3V source with up to 36 dB loss),
DSXMON (if a DSXMON signal is used)

RXLVL-2: TERM (if a 3V source with up to 36 dB loss),
DSXMON (if a DSXMON signal is used)

Tx SOURCE: TESTPAT

FRAMING: As specified by the circuit

CODING: As specified by the circuit

XMT CLOCK: L2-Rx

LBO 1: 0 dB (ft)

TEST RATE: 1.544M

Press ENTER when your screen settings are correct. Connect the reference T1 signal to the LINE 2 jack on the side of the test set. Refer to Figure 1.6.A.

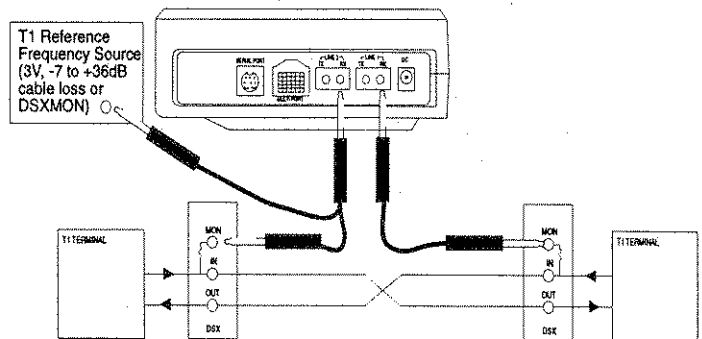


Figure 1.6.A
Frequency Synchronization Problems

- 5) Plug the LINE 1 jack (side of test set) into the DSX MON jack or other MON jack of your circuit. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 6) Press ESCAPE as necessary until you arrive at the MAIN MENU. Enter the MEASUREMENT RESULTS menu. Press the PAGE-UP (F1) key once to view the LINE 1 - FREQUENCY screen. You can see if there is a problem because the frequency slip bar will be moving across the screen. If there is no bar drawn, then no slippage is occurring.
- 7) If you have used an external signal source, be sure to check both sides of your circuit. If you have used one side of the circuit as your reference and the other side as the tested signal, then you are done. Disconnect your test set from the circuit.

1.7 Measuring Signal Level

You may measure the signal level while performing one of the other tests, or you may measure the signal level by itself.

At a DSX, the level should be between 2.7 and 3.3 volts as measured from the OUT jack. At a repeater housing, the voltage should generally be between 2.4 and 3.3 volts on either of the repeater outputs. The loss at the repeater inputs should generally be between 10 dB and 35 dB.

The signal strength at the incoming side of an office repeater bay CSU, or NI should be from 0 dB to -15 dB.

If there is a signal on the OUT jack, use the set-up shown in Figure 1.7.A to measure the level. Otherwise, use the set-up shown in Figure 1.A, Accepting a New Span.

- 1) Choose what kind of access mode you want to use. You can make the measurement in TERM, DSXMON, and BRIDGE modes. TERM and BRIDGE provide the most accurate results, but DSXMON may be the most convenient mode. TERM also will disrupt service. BRIDGE is accurate, but the result may be degraded by a low-quality termination at the network element terminating the T1 line. A DSXMON measurement should generally show a result of about -20 dB.

For the rest of this procedure we will use the TERM mode for illustrative purposes. Verify that the span is not in service. Using the TERM mode will disrupt service.

- 2) Switch on the test set. From the main menu, enter the TEST CONFIGURATION menu and set the TESTMODE to T1SINGL RxLVL-1 to TERM, FRAMING and CODING as specified, Tx Source to NORMAL, XMT CLOCK to INTERN, LBO 1 to 0 dB. Now press ENTER to return to the main menu.
- 3) Connect the test set to the circuit as shown in Figure 1.7.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

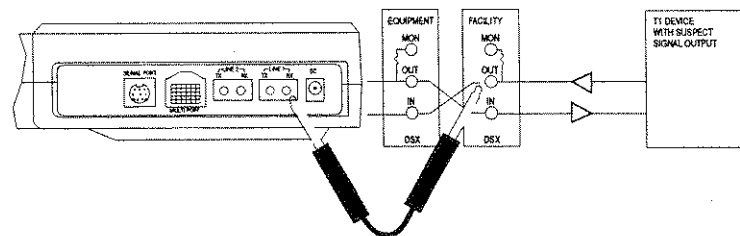


Figure 1.7.A
Measuring Signal Level

- 4) Enter the MEASUREMENT RESULTS menu. Press the PAGE

DN (F2) key twice to move to the LINE 1 - SIGNAL screen. 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.

5) When you are finished, disconnect your test set from the circuit.

1.8 Running 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 set up the timer for one of these tests. Use the following procedure:

- 1) Use the desired procedure from Section 1.2 or 1.3 in this chapter as the basis for your testing.
- 2) Switch on the test set.
- 3) From the MAIN MENU, enter the OTHER FEATURES item. Enter the MEASUREMENT CONFIGURATION item. For the MEAS DURATION, press TIMED (F1). Now press and release the SHIFT-lock key. The SHIFT indicator will appear in the upper left-hand corner of the screen. Enter the number of hours and minutes that you want the test to run. The format is (hhh:mm). Press ENTER when your setting is correct. Press ESCAPE until you arrive at the main menu.
- 4) Proceed with the test procedure as outlined in Section 1.2 or 1.3 of this chapter. 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 corner of the screen.

1.9 Checking the DSX Wiring

Occasionally, a miswired DSX can be the source of a circuit problem. Use the following procedure to verify that the DSX has been wired correctly:

- 1) Verify that the span is not in service. This test will disrupt service.
- 2) If the DSX is very large, you may need two test sets or a very long cord for this test. Switch on both of the test sets. Press ENTER to move to the Main Menu.
- 3) For each test set, enter the TEST CONFIGURATION menu. Configure the screen settings for:
 - TEST MODE: T1SINGL
 - RXLVL-1: TERM
 - FRAMING: as specified by your design
 - CODING: as specified by your design
 - XMT CLOCK: INTERN
 - LBO 1: 0 dB (ft)
 - TEST RATE: 1.544M

Press the ENTER key when all the settings are as desired.

- 4) Connect the test set to the circuit as shown in Figure 1.9.A You may use one test set as shown in the diagram or two test sets if the two pieces of equipment are not located close to each other. You will need to find a point on either side of the DSX where you can connect the test set. This point could be at test jacks on the network equipment on either side of the DSX. You will need to make sure that you have opened the circuit at each point so that the test set is not bridge-tapped onto the existing circuit. Once you have connected to the circuit, press the HISTORY key to acknowledge the blinking history lights and turn them off.

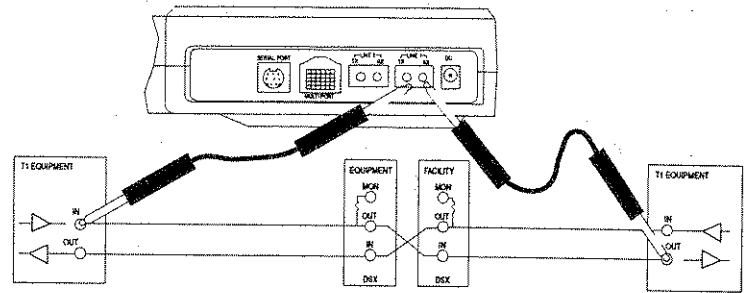


Figure 1.9.A
Checking the DSX Wiring

- 5) Verify that the test set shows the PAT SYNC LED is green and the BIT ERROR and ERRORS LEDs are off. This means that the circuit is wired through the DSX properly. Next, press the ERR INJ key. Verify that the BIT ERROR and ERRORS lights come on and then start to blink. This assumes that the test set is configured to inject 1 BPV and 1 LOGIC error. This verifies that the test set didn't synch on a signal source on another circuit.
- 6) Repeat the procedure for the other direction of the circuit.
- 7) When you are finished, disconnect the test set from the circuit. Make sure the circuit is restored to its original through condition.

1.10 Observing Network Codes or Channel Data

The SunSet T10 provides a large screen display which is useful for analyzing live circuit data. In addition to a display of the binary data, hexadecimal and ASCII translations are provided to you. This display can be used to decode T1 network control codes that are in use, and can also be used to verify the contents of DDS channels.

Sixty pages of data are stored at once so that you can scroll down through the information and observe changes over time. This number of pages can also tell you whether a T1 network

pattern is interleaved with the framing bit or is overwritten by the framing bit. Use this procedure:

- 1) This test may be performed while the span is carrying live customer traffic if a BRIDGE or DSXMON access mode is used. The test can also be performed out-of-service if the TERM mode is used.
- 2) Switch on the test set.
- 3) From the main menu, enter the TEST CONFIGURATION menu and specify DSXMON or BRIDGE mode in if the circuit is carrying live traffic. Specify your other settings as desired. If you want to have frame alignment on the received signal, be sure to set the frames up properly.
- 4) Connect the test set to the circuit as shown in Figures 1.1.A (DSXMON) or 1.1.B (Bridge) in this chapter. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 5) Press ESCAPE as necessary to arrive at the main menu. Enter the OTHER MEASUREMENTS menu. Enter the VIEW RECEIVED DATA item. You will now receive a display of the data.
- 6) Review the live data as it is displayed. When the codes that you are interested in appear, press the PAUSE (F3) key to trap 60 pages of data. Then press PAGE-DN (F2) to scroll through the data. The data is presented as it appears on the T1 bit stream. The data is broken out into timeslots for you. Use this table to convert from timeslot number to channel number:

Channel Numbering

T/S	D3/D4	D1D	D2
1	1	1	12
2	2	13	13
3	3	2	1
4	4	14	17
5	5	3	5
6	6	15	21
7	7	4	9
8	8	16	15
9	9	5	3

10	10	17	19
11	11	6	7
12	12	18	23
13	13	7	11
14	14	19	14
15	15	8	2
16	16	20	18
17	17	9	6
18	18	21	22
19	19	10	10
20	20	22	16
21	21	114	4
22	22	23	20
23	23	12	8
24	24	24	2

Channel Numbering - SLC-96

T/S	SHLF A	SHLF B	SHLF C	SHLF D
1	1	25	49	73
2	13	37	61	85
3	2	26	50	74
4	14	38	62	86
5	3	27	51	75
6	15	39	63	87
7	4	28	52	76
8	16	40	64	88
9	5	29	53	77
10	17	41	65	89
11	6	30	54	78
12	18	42	66	90
13	7	31	55	79
14	19	43	67	91
15	8	32	56	80
16	20	44	68	92
17	9	33	57	81
18	21	45	69	93
19	10	34	58	82
20	22	46	70	94
21	11	35	59	83
22	23	47	71	95
23	12	36	60	84
24	24	48	72	96

7) Figure 1.10.A shows an example of the ten-bit pattern, 1011 1111 1

09:59:33

VIEW RECEIVED DATA

PAGE : 01

T/S	BINARY	HEX	ASCII
001	10111111	BF (FD)	()
002	11101111	EF (F7)	()
003	11111011	FB (DF)	()
004	11111110	FE (7F)	()
005	11111111	FF (FF)	()
006	10111111	BF (FD)	()
007	11101111	EF (F7)	()
008	11111011	FB (DF)	()

PAGE-UP PAGE-DN RESUME

Figure 1.10.A
Ten-Bit Pattern

8) When you are finished, disconnect your test set from the circuit.

1.11 Determining Round Trip Circuit Delay

1) Verify that the span is not in service. This test will disrupt service.

2) Switch on the test set.

3) From the main menu, enter the TEST CONFIGURATION item.

Configure the screen settings for:

TEST MODE: T1SINGL

RXLVL-1: TERM

FRAMING: as specified by your design

CODING: as specified by your design

Tx SOURCE: NORMAL

XMT CLOCK: INTERN

LBO 1: 0 dB (ft)

TEST RATE: 1.544M

Press the ENTER key when all the settings are as desired.

4) Connect the test set to the circuit as shown in Figure 1.2.A, Accepting a New Span. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

- 5) Move the cursor to the LPBK & SPAN CONTROL menu item and press ENTER. Then enter the CSU & NI CONTROL item. For SF framing, set up the screen with:
MODE: LOOP-UP (Do not select this item until the other settings are correct)
TYPE: IN-BAND
CODE: NI or CSU, as appropriate

For ESF framing, set up the screen with:
MODE: LOOP-UP (Do not select this item until the other settings are correct)
TYPE: ESF-DL
CODE: Network (NIU) or LINE (CSU), as appropriate

You will see a "LOOPING UP" message followed by a "LOOP UP SUCCEEDED" message. You may press the GRAPHIC key if you would like a visual confirmation. Refer to Section 6 for additional information about the loopback capabilities.

- 6) From the main menu, enter OTHER MEASUREMENTS > PROPAGATION DELAY item. The set will then perform a propagation delay measurement for you on the looped-up circuit. Read the value of circuit delay reported in μS (microseconds).
- 7) When you are finished, ESCAPE back to the Main Menu. Enter the LPBK & SPAN CONTROL menu, then enter the CSU & NI CONTROL item. Set the MODE to LOOP-DN in order to release the loopback. Verify that the "LOOP DOWN SUCCEEDED" message is displayed.
- 8) Disconnect your test set from the circuit.

1.12 Determine Distance to Loopback

- 1) Verify that the span is not in service. This test will disrupt service.
- 2) Switch on the test set.

3) From the Main Menu, enter the TEST CONFIGURATION item.

Configure the screen settings for:

TEST MODE: T1SINGL

RXLVL-1: TERM

FRAMING: as specified by your design

CODING: as specified by your design

Tx SOURCE: NORMAL

XMT CLOCK: INTERN

LBO 1: 0 dB (ft)

TEST RATE: 1.544M

Press the ENTER key when all the settings are as desired.

4) Connect the test set to the circuit as shown in Figure 1.2.A, Accepting a New Span. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

5) Move the cursor to the LPBK & SPAN CONTROL menu item and press ENTER. Then enter the CSU & NI CONTROL item.

For SF framing, set up the screen with:

MODE: LOOP-UP (Do not select this item until the other settings are correct)

TYPE: IN-BAND

CODE: NI or CSU, as appropriate

For ESF framing, set up the screen with:

MODE: LOOP-UP (Do not select this item until the other settings are correct)

TYPE: ESF-DL

CODE: Network (NIU) or LINE (CSU), as appropriate

You will see a "LOOPING UP" message followed by a "LOOP UP SUCCEEDED" message. You may press the GRAPHIC key if you would like a visual confirmation..

Note that you could do this for any type of loopback - hardware loopback, repeater loopback, and so on.

6) From the main menu, enter the OTHER MEASUREMENTS item.

Enter the PROPAGATION DELAY item. The set will then perform a propagation delay measurement for you on the looped-up circuit.

Read the value of circuit delay reported in kFt. This will tell you how many kilofeet there are between the test set and the

loopback device. This measurement is accurate to about 1000 feet and is useful for making sure that the looped repeater is in the apparatus case that you expect it to be in.

This measurement is valid only if the line does not pass through any network elements and/or transmission elements that introduce appreciable delay. Line repeaters will not cause a problem. Fiber muxes, 3x1 muxes, and 3x1 digital cross-connect systems definitely will cause a problem. Office repeater bays that are equipped with dejittering circuits can cause a problem.

Even if you have devices that cause excessive delay, you can still get good data by looking at the difference in delay time between a loopback at a known location and a loopback at the unknown location.

- 7) When you are finished, ESCAPE back to the main menu. Enter the LPBK & SPAN CONTROL menu, then enter the CSU & NI CONTROL item. Set the MODE to LOOP-DN in order to release the loopback. Verify that the "LOOP DOWN SUCCEEDED" message is displayed.
- 8) Disconnect your test set from the circuit.

1.13 Basic Dialing Procedure

This outlines the simplest dialing procedure, which will be used by most users.

- 1) In the VF CHANNEL ACCESS menu, move the cursor to PLACE/RECEIVE CALLS and press ENTER.
- 2) Select the dialing method by choosing MF, DTMF, or DP.
- 3) Before dialing, make sure that OFFHOOK (F2) has been selected for TXAB and that you can hear a dial tone. The last phone number, if any, that was dialed will be shown below. To dial the previous number, simply press the ENTER key. You can also delete the previous number by pressing the DELETE (F2) key as needed until the existing number is completely deleted.
- 4) You can enter a new number. First press and release the

SHIFT-lock key to display the SHIFT indicator, then you can enter the numbers 1 through 9, A, B, C, D, E and F. For MF method, * and # can not be used. For DTMF dialing, the E and F keys represent * and # respectively. 32 digits may be programmed.

Note: For MF dialing, A=KP, B=ST, C=ST1, D=ST2, E=ST3, F=PAUSE (,).

- 5) After the new number is entered, press the ENTER key to dial the number (remember to be OFFHOOK and listen for a dial tone). This will send the indicated digits with DIAL PERIOD and SILENT PERIOD as indicated in VF CHANNEL ACCESS, DIAL/SPRVIS SETUP.

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

- 1) From the VF CHANNEL ACCESS menu, cursor down to DTMF/MF/DP DIALING and press ENTER to get into the DTMF/MF/DP DIALING screen. Choose the dialing method and cursor down to the NUMBER.
- 2) Choose USER (F1) to get the list of USER DIAL NUMBERS. This is your speed dialing list.
- 3) Move the cursor down to the desired number and press ENTER twice to dial the number (Remember to be OFFHOOK and listen for a dial tone). You will be returned to the VF CHANNEL ACCESS screen.

1.14 Speed Dialing Procedure Entering & editing speed dialing (USER) numbers

The SunSet T10 allows you to program and store up to 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*#C

with a label of TEST01:

- 1) From the VF CHANNEL ACCESS menu, use the cursor keys to move the cursor to PLACE/RECEIVE CALLS and press ENTER.
- 2) In the PLACE/RECEIVE CALLS screen, cursor down to NUMBER. Choose USER (F1).
- 3) At the USER DIAL NUMBER menu, move the cursor to a blank space anywhere between 1 to 10 and choose CREATE (F1).
- 4) The cursor should now stay at the LABEL editing position, ready to accept the entry.
- 5) Choose TOGGLE (F3). The letter A on the alphabet grid starts blinking. Also, a SELECT (F4) option is shown.
- 6) Use the cursor keys to move around the alphabet grid until T starts blinking. 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.
- 7) 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.
- 8) Press the 0 key, then press the 1 key.
- 9) 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.
- 10) Press the cursor key down once to move the cursor to the NUMBER section. Now you are ready to enter the telephone number.
- 11) Press the SHIFT-lock key once. 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*#0. 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. Choose INSERT (F1) if you need to start inserting more digits at that position. Or choose DELETE (F2) if you need to remove one or more digits at that position. You can also move your cursor to the right before using INSERT or DELETE. 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.

Choose INSERT (F1) if you need to start inserting more digits at that position. Or choose DELETE (F2) if you need to remove one or more digits at that position. You can also move your cursor to the right before using INSERT or DELETE.

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.

1.15 Monitor a Voice Frequency Channel

Here is a procedure for monitoring a voice frequency channel within a T1 circuit. The setup is illustrated in Figure 1.15.A.

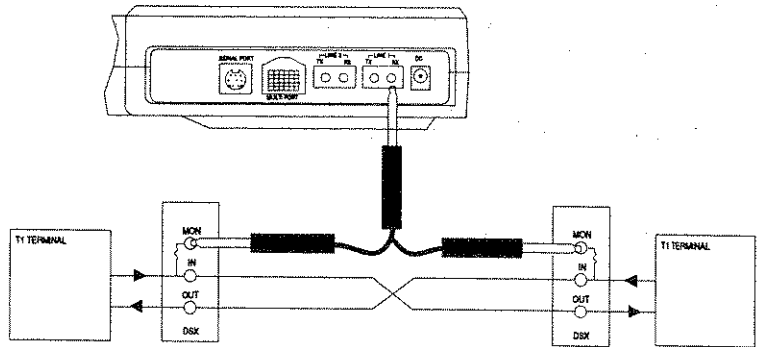


Figure 1.15.A
Monitoring an In-Service Circuit

- 1) This test may be performed while the span is carrying live customer traffic.
- 2) Switch on the test set.
- 3) From the main menu, enter the TEST CONFIGURATION item.
 Set the screen settings to:
 TEST MODE: T1SINGL
 RXLVL-1: BRIDGE or DSXMON
 FRAMING: As specified by the circuit
 CODING: As specified by the circuit
 TX SOURCE: THRU
 XMT CLOCK: L1-Rx
 LBO 1: 0 dB (ft)
 TEST RATE: 1.544M
 Press ENTER when your settings are correct.
- 4) Connect the test set to the circuit. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 5) Press ESCAPE until you arrive at the main menu.
 Enter the VF CHANNEL ACCESS menu. Enter the VF MEASUREMENTS item. Select your desired transmit and receive channels and LISTEN SIDE from which you wish to monitor. The channel number is automatically converted to a

timeslot number for you on SF-D4, ESF, and SLC-96 A-digroup DS1s. The set refers to the framing type to make this conversion for you. If you are using another type of framing, refer to the channel numbering tables at the end of this subsection to determine which timeslot to specify within the test set.

Adjust the volume to the desired level by using the volume keys on the test set.

NOTE: If you are not able to monitor the channel, verify that frame synch is present. If it is not, press the AUTO key. If framing is still not synchronized, try changing the RxLVL in the TEST CONFIGURATON Menu. The test set will not perform the monitor function if framing is unavailable.

1.16 Simple Talk/Listen

Here is the simplest procedure for talking and listening on a T1 circuit. Use this procedure:

- 1) Verify that the span is not in service. This test will disrupt service for the 23 channels that you are not using.
- 2) Switch on the test set. Then press ENTER to move to the main menu.
- 3) Enter the TEST CONFIGURATION menu. Configure the screen settings for:
 - TEST MODE: T1SINGL
 - RXLVL-1: TERM
 - FRAMING: as specified by your design
 - CODING: as specified by your design
 - Tx SOURCE: NORMAL
 - XMT CLOCK: INTERN
 - LBO 1: 0 dB (ft)
 - TEST RATE: 1.544M

Press ENTER when your settings are correct.

NOTE: Beware if you select UNFRAME for the framing type. It is not possible to perform talk and listen on an unframed signal. One of the framing LEDs must light for this procedure.

to work.

- 4) Connect the test set to the circuit as shown below in Figure 1.16.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

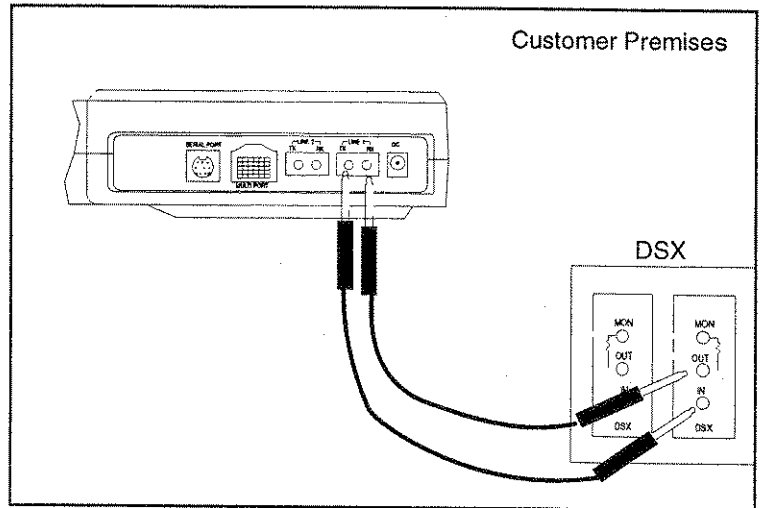


Figure 1.16.A
Simple Talk/Listen

- 5) From the Main Menu, enter the VF MEASUREMENTS item. Select the receive (listen) and transmit (talk) channels - they are usually the same. You can now talk and listen on the channel which you have selected. Adjust the volume to the desired level by using the volume keys on the test set.

NOTE: The test set will automatically convert the channel number to a timeslot for you on SF-D4, ESF, and SLC-96 A digroups. For other framing formats or digroups, refer to the channel numbering tables in Figures 1.16.B and C to determine which "channel" to specify within the test set.

Channel Numbering

T/S	D3/D4	D1D	D2
1	1	1	12
2	2	13	13
3	3	2	1
4	4	14	17
5	5	3	5
6	6	15	21
7	7	4	9
8	8	16	15
9	9	5	3
10	10	17	19
11	11	6	7
12	12	18	23
13	13	7	11
14	14	19	14
15	15	8	2
16	16	20	18
17	17	9	6
18	18	21	22
19	19	10	10
20	20	22	16
21	21	114	4
22	22	23	20
23	23	12	8
24	24	24	24

Figure 1.16.B
Channel Numbering

Channel Numbering- SLC-96				
T/S	SHLF A	SHLF B	SHLF C	SHLF D
1	1	25	49	73
2	13	37	61	85
3	2	26	50	74
4	14	38	62	86
5	3	27	51	75
6	15	39	63	87
7	4	28	52	76
8	16	40	64	88
9	5	29	53	77
10	17	41	65	89
11	6	30	54	78
12	18	42	66	90
13	7	31	55	79
14	19	43	67	91
15	8	32	56	80
16	20	44	68	92
17	9	33	57	81
18	21	45	69	93
19	10	34	58	82
20	22	46	70	94
21	11	35	59	83
22	23	47	71	95
23	12	36	60	84
24	24	48	72	96

Figure 1.16.C
Channel Numbering- SLC-96

6. When you are finished, disconnect your test set from the circuit.

1.17 Sending a Tone

Here is a procedure for sending a tone:

- 1) This is an intrusive test. Be sure the T1 line is not carrying traffic or that it will be able to withstand the hits that this procedure will introduce.
- 2) Configure the set for the appropriate TEST CONFIGURATION mode for sending the tone:

- A) Tx SOURCE: NORMAL In the TERM mode, the test set drops and inserts on the selected channels and fills the other 23 channels with idle code. The received signal is terminated at the test set and is not retransmitted.
- B) Tx SOURCE: THRU: In THRU modes, the talk/listen will be performed on the LINE 1 or LINE 2 side of a full-duplex circuit access. The other 23 channels of that side will be transmitted through without disruption. All 24 channels of the other side will be transmitted without disruption.
- There will be a momentary hit on both sides when the test set is plugged into the circuit and when it is unplugged. There will also be a hit if you change access modes from one side to the other side, even when the cords are not touched.
- 3) Once the access mode has been set up, plug the test set into the circuit. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 4) From the main menu, enter the VF CHANNEL ACCESS item. Enter the VF MEASUREMENTS menu item. Use the NEXT (F1) or PREVIOUS (F2) to set up the receive and transmit channels. Move the cursor to the INSERT TYPE menu item and press TONE (F2). Move the cursor to TONE FREQ Hz and select the desired frequency, using the more (F4) key to display additional alternatives. If you wish, you may enter a tone frequency directly from the keypad using the SHIFT-lock key. Enter a value between 50 Hz and 3950 Hz. Move the cursor to the TONE LVL dBm item and select either a 0 dBm level or a -13 dBm level. If you wish, you may enter your own tone level directly from the keypad. Use the F1 (MINUS) key if your entry is lower than 0 dBm. You are now transmitting a tone on the selected channel. Press ENTER when you have completed your settings.
- 5) When you are finished, disconnect your test set from the circuit.

1.18 Using the Battery & AC Charger

The battery is designed to provide power for portable testing. The battery is charged by a custom-designed charger for optimum performance. This charger is powerful enough to run the test set continuously, while keeping the battery charged.

The charger features a special fast-charge feature which recharges your discharged battery quickly so that you can get it out into the field again. This fast charging is non-damaging to the battery. The charger recognizes when the battery is nearly fully charged. When this happens the charger converts over to a trickle-charging mode that completes the charging process for maximum battery output. This trickle-charging mode is also non-damaging to the battery over extended periods. However, to get maximum life from your battery, remove it from the charger when it is fully charged.

Here are some tips for getting the best performance out of your battery:

- 1) Leave the backLIGHT off if you don't need it.
- 2) Switch the power off on the set when it is not in use.
- 3) Use the Cigarette Lighter Battery Charger when you are driving from place to place in a vehicle in between tests. This will help keep the battery charged when AC power is not available.
- 4) If you are going to run an extended test and you are not sure if the battery will last long enough, plug the charger in at the beginning of the test so that the set will run indefinitely. If you wait to plug in the charger until the battery is low during the middle of the test, the set's processor may reset and drop the current test as the charger is plugged in.
- 5) Recharge the battery in-between uses, even if the time available for a recharge is short. The AC Battery Charger is a special two-stage design which charges the battery to approximately 80% of it's capacity in just a few hours. The set will fully charge over night.
- 6) Do not use any other charger with this test set. Using another

charger will void your warranty. Other 12V chargers may not supply enough power for continuous operation, or may drastically reduce the life of the battery if left plugged in continuously, or may have reverse voltage polarity, or may only provide a maximum of a 60% charge.

- 7) You can tell when the battery is nearly fully charged by observing the light on the charger. If the light is on solidly, then the charger is in a high-output mode and is either fast-charging the set or powering it during normal operation. When the light begins to blink, the charger is converting over to a trickle-charge mode. When the light barely flickers at all, the battery is fully charged.

1.19 Printing from the Serial Port

The test set is equipped with a standard serial port for both printing and remote control operations.

1.19.1 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 OTHER FEATURES, SYSTEM CONFIG, GENERAL CONFIG. In general, the SunSet's serial port settings will need to match the settings of your printer or remote control. Configuring the SunSet's serial port is described in detail in the procedures which follow.

1.19.2 Configuring for Printing

The test set may be ordered with an optional High Capacity Thermal Printer (SS118). This printer operates by an 8-bit serial RS-232C method, and uses thermal paper (ie. 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. In addition to the printer which may be ordered with the test set, the TTC PR40A printer will work, although it requires an optional Null Modem Adapter (SS122).

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.

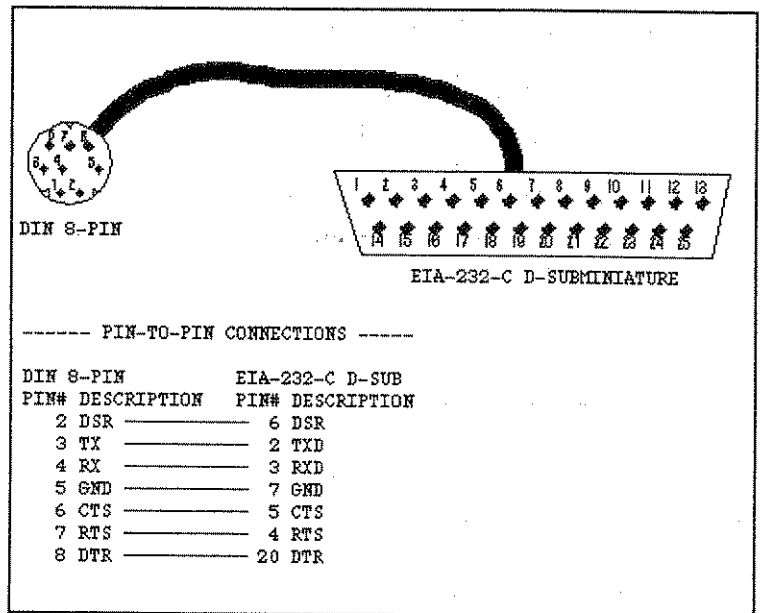


Figure 1.19.A
Printer Cable Pin Assignments

If you wish to connect to a mode or other brand of printer, you may find the SS122 Null Modem Adaptor useful. Refer to Figure 1.19.B.

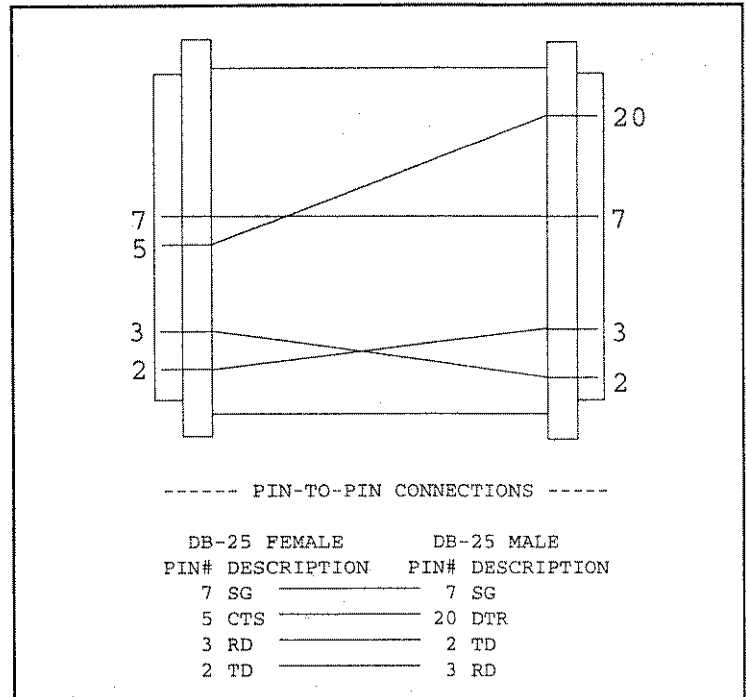


Figure 1.19.B
Null Modem Pin Assignments

To begin printing, follow this procedure:

- 1) Connect the Sunrise Telecom DIN-8 to RS232C Printer Cable (SS115) to the SunSet T10.
- 2) If you are using a Sunrise Telecom printer, skip this step. Otherwise, you may need to connect the Sunrise Telecom Null Modem Adapter (SS122) to the free end of the Printer Cable. Note that the Adapter is labeled for the "Test Set Cord" end and the "Printer, Terminal" end.
- 3) Confirm that the SunSet's serial port settings match those of your printer. The switches to configure your printer's serial port and print characteristics are usually located on the back or bottom of the printer. If you are using the Sunrise Telecom thermal printer, refer to Figure 1.19.C for the correct switch

To begin remote operation, follow this procedure:

- 1) Connect the Sunrise Telecom DIN-8 to RS232C Printer Cable (SS115) to the SunSet T10.
- 2) Connect the Sunrise Telecom Null Modem Adapter (SS122) to the free end of the Printer Cable. Note that the Adapter is labeled for the "Test Set Cord" end and the "Printer, Terminal" end.
- 3) Connect the Null Modem Adapter to a "gender changer". Normally this will be a female-to-female conversion.
- 4) Connect the gender changer to the cable which connects to your computer or terminal.
- 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, then SYSTEM CONFIG.
- b) Select the GENERAL CONFIG item.
- c) Use the Down Arrow key to access the BAUD RATE setting. Four selections are available: 1200 (F1), 2400 (F2), 9600 (F3) and 19.2K (F4). 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) Plug a modem into the serial port. 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 1.19.A and B 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.

7) Plug the modem into the telephone network.

8) Set up a terminal to dial up the modem and commence communications. Any terminal or personal computer with VT100 terminal emulation software should work.

9) Call up the far modem with your terminal.

10) Once communication has been established with the far modem, log on to the SunSet T10 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 with the main menu and other information. 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.

11) Use the SunSet T10 just like you would use it locally. The same menus will be presented to you. There will be a prompt on the screen to show you which keys to press to move the cursor (your terminal cursor keys will probably also work just fine), to

inject errors, and so on. For instance refresh means that you press the s key to repaint the screen. Press the Return key on your terminal to simulate pressing the Enter key on your test set.

12) When you are finished with the SunSet T10, type in:
 logoff
and press ENTER.

13) Then terminate the phone connection by hanging up your near-end modem.

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. 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:

- 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 printer port. For instance, if a remote user is logged on, pressing the PRNT SCRN key will log the user off.

- The pulse mask feature is supported for pass/fail report and pulse statistics, however, the specially bit-mapped pulse graph is not drawn on the remote terminal screen.
- Talk/listen is not supported remotely.

1.21 Printing to your Parallel Printer

In addition to printing out your results on the SS118 Thermal printer, you may also print on a parallel printer, i.e. HP or Epson. Refer to Figure 1.21.A and use the following procedure:

1) Connect the Sunrise Telecom DIN-8 to RS232C Printer Cable (SS115) to the Serial Port on the SunSet. Connect the other end to your Serial to Parallel Converter. We recommend the

Black Box PI 115A. You may order this part yourself, or may call Sunrise Telecom and have us order this part for you .

- 2) Configure your Black Box converter settings:
 - Set the Black Box for DCE, since the SunSet is DTE
 - Make sure that the Black Box is set for the Serial -> Parallel Direction
 - Also, make sure that the converter's DIP settings correspond to those of the SunSet's serial port. You may configure the SunSet's serial port settings in OTHER FEATURES, GENERAL CONFIG. 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

Note that your converter must supply its own power (or receive power from the parallel port). The SunSet will not supply any power through the serial port.

- 3) Connect the Centronix cable (Black box #BC 001 01) to the Parallel connector on the Black Box converter and to the Parallel Port of your printer. The Centronix cable is a male-male parallel connector. Feel free to order this part yourself, or SunriseTelecom would be happy to order it for you.
- 4) You may use this printer whenever a PRINT F-key option is available, as in the MEASUREMENT RESULTS or a VIEW/PRINT TRACER screen. Simply press the correct F-Key and your results will print out on the Laser Jet. The PRINT SCREEN key does not work with the Laser Jet. Since HP Printers are not able to handle the SunSet's graphics, you will not be able to print out HISTOGRAM ANALYSIS or PULSE MASK ANALYSIS results, even though the PRINT F-Key is available.

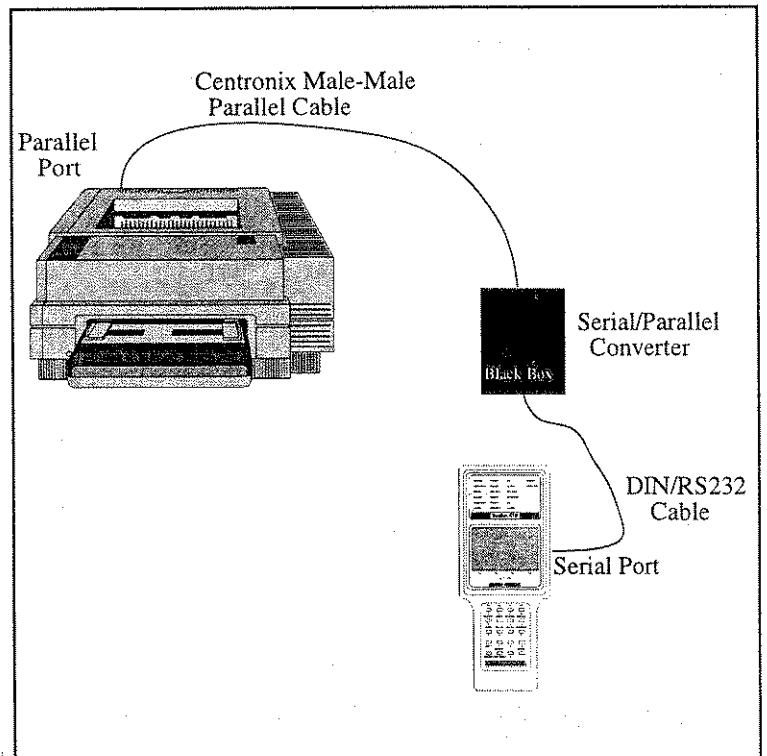


Figure 1.21.A
Printing to your Laser Jet

Section 2 Advanced Applications

2.1 Fractional T1 Testing

Fractional T1 circuits are circuits with a data rate of $n \times 56$ kbps or $n \times 64$ kbps, where n can be anywhere from 1 to 24 channels. N channels of the T1 line are dedicated to the fractional T1 circuit. The remaining channels of the T1 line are filled with either an idle code or other revenue traffic.

A fractional T1 circuit typically starts out at the customer premises at a fractional T1 CSU. Refer to Figure 2.1.A. The

purpose of this CSU is to convert the signal into a standard T1 signal suitable for transmission on the telephone company network. The CSU may also multiplex other fractional signals into an aggregate fractional signal within the T1.

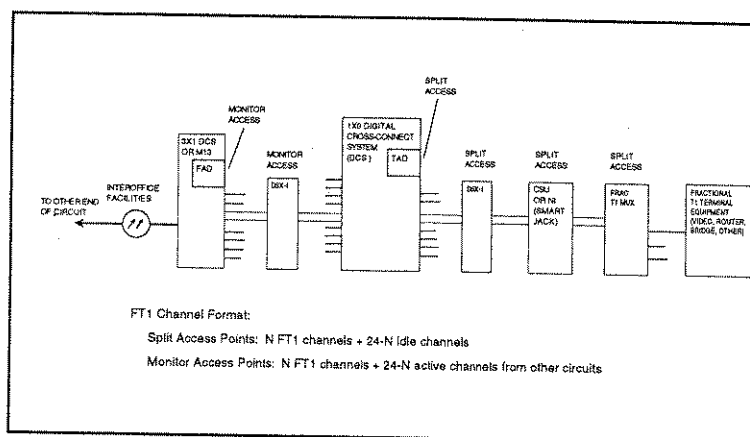


Figure 2.1.A
Fractional T1 Circuit

The CSU is configured to place the data into either an nx56 or nx64 kbps format. Nx56 utilizes the first 7 bits in each channel and allows the customer to transmit an unlimited number of zeroes even when the T1 line is optioned for AMI coding. The CSU places a 1 in the eighth bit to ensure 12.5% ones density even when the customer is transmitting all zeroes.

Nx64 is like nx56, except the CSU inserts no ones. This format is generally used when the T1 line is configured using B8ZS line code or alternating channel assignment. In the B8ZS case, the line code ensures adequate pulse density regardless of the number of zeroes transmitted on the circuit. In the alternating channel assignment case, the idle pattern inserted into the alternating idle channels ensures adequate ones density regardless of the customer data transmitted in the alternating active channels.

The CSU must be configured to put the fractional T1 channels in the proper positions within the 24 T1 channels available in the T1 line. Three formats exist: sequential order, alternating order,

and random order. The alternating order format was described in the previous paragraph. For example, a 384 kbps circuit (6x64) might use channels 1, 3, 5, 7, 9, and 11. Channels 2, 4, 6, 8, 10, and 12 might be filled with a 01111111 idle code. Sequential order is different from alternating order in that all the fractional channels are located contiguously within the T1 frame. For example the same 384 kbps circuit might use channels 1 through 6 of the T1 line. A randomly configured 384 kbps circuit might use channels 4, 9, 10, 17, 20, and 24.

In a fractional T1 circuit, such as a video circuit, it is vital that each channel of the circuit arrive in the same order (phase) that it left. If this does not happen, the signal becomes scrambled and the receiver cannot properly decode the information. The signal will generally arrive in phase only if the fractional T1 circuit travels as a bundle through the various network elements and transmission media. If individual channels should become split onto two different transmission paths, the transmission delay of the two paths will probably be different.

We have already covered the function of the CSU in the fractional T1 circuit shown in Figure 2.1.A. Other elements serve different functions. For instance, the 1x0 DCS (Digital Cross-connect System) is used to cross-connect the incoming fractional T1 line onto the desired transport line. The 1x0 DCS allows many fractional T1 circuits to be combined with other channelized circuits onto more densely-packed T1s. The idle channels are simply discarded as they pass into the DCS. This reduces costs by providing highest utilization (fill) on the T1 paths in the long-haul portion of the network.

The M13 or 3x1 DCS allows the grouping of many T1s onto selected higher-speed transmission paths for long-haul transport. The fractional circuit passes through a similar group of network elements at the far end of the circuit.

2.1.1 FT1 Circuit Acceptance Test Procedure

Here is an acceptance test procedure for a fractional T1 circuit. This is an advanced test procedure which should be attempted only if users are already familiar with the T1 test procedures described earlier in this section.

- 1) Verify that the fractional circuit is not in service. This acceptance test will disrupt service.

- 2) Switch on the test set.
- 3) From the main menu, enter the TEST CONFIGURATION item.
Configure the screen settings for:
TEST MODE: T1DUAL
Tx/INSERT: L1-Tx or L2-Tx
Rx/DROP: opposite of Tx/INSERT
RXLVL-1: DSXMON
RXLVL-2: DSXMON
Tx SOURCE: TESTPAT
FRAMING: as specified by your design
CODING: as specified by your design
XMT CLOCK: INTERN if facing the Fractional CSU, otherwise
LOOP if facing the 1x0 DCS
LBO 1&2: 0 dB (ft) (or as required)
TEST RATE: nx56 or nx64, set up the desired channels for
transmit and receive.

When you press nx56 or nx64, the screen will switch to the FT1 TIMESLOT screen. Manually set up the timeslots to the configuration indicated in your circuit record. If the timeslot configuration is not known, AUTO configure to the active channels.

Note that AUTO configuration may not yield the proper channels if any of the active channels are transmitting an idle code. It will also not work properly if the idle code set in the OTHER FEATURES, OTHER PARAMETERS, IDLE CHANNEL CODE item is not the same as the idle code on the circuit being tested (7F = 01111111, FF = 11111111). One good way for you to observe the idle and active channels for yourself is to plug the test set in using the 1.544 Mbps test rate and then go to the VIEW RECEIVED DATA menu. This will allow you to double check what the test set comes up with in an AUTO configuration.

Press ENTER when the timeslot settings are as desired. This will return you to the TEST CONFIGURATION menu. When the TEST CONFIGURATION menu settings are as desired, press ENTER.

- 4) Connect the test set to the circuit as shown in Figure 2.1.B.

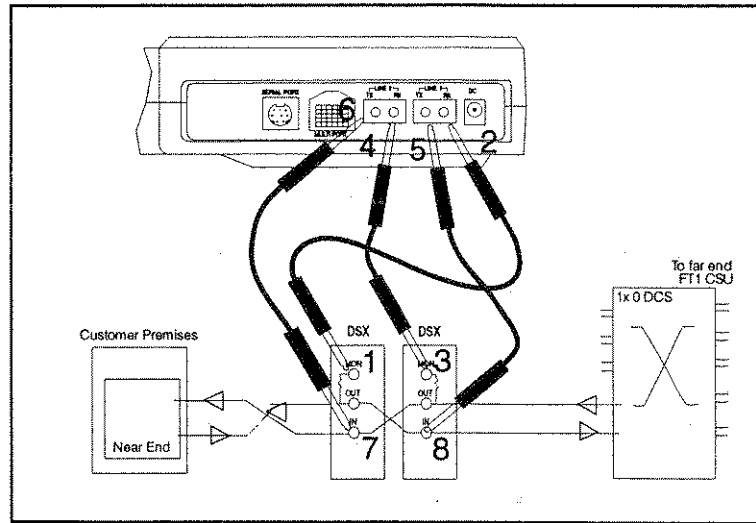


Figure 2.1.B
Plugging into the FT1 Circuit

- 5) Loop up the circuit toward the near end CSU. A standard CSU loopback code may be used from the access point illustrated in Figure 2.1.A, because the test set has access to the entire T1 terminating at the CSU.

You may need to reconfigure your test set back to 1.544M TEST RATE in the TEST CONFIGURATION menu in order to loop up the CSU.

- 6) Change the Tx/INSERT to L1-Tx and Rx/DROP to L2-Rx to look towards the far end.
- 7) Loopback the far-end FT1 CSU. You will need to find out what kind of loop code will activate the far-end FT1 CSU. This may possibly require asisance at the far end.
- 8) Change the access Tx/INSERT to L1-Tx and Rx/DROP to L1-Rx. View the graphic to verify that you are sending and receiving across the entire length of the span from end to end.
- 9) Enter the MEASUREMENT RESULTS menu and perform the acceptance test. Verify that the fractional T1 service performs to your company's requirements for the service delivered.

2.2 SLC-96 Testing

Here are a few application notes on SLC-96 testing. Refer to your digital loop carrier maintenance manual for detailed information. Refer also to TR-TSY-000008 for SLC-96 reference information. Note that SLC-96 systems come with maintenance capabilities built right into the system. These maintenance features should be used as a first step in troubleshooting SLC-96 problems. T1 test equipment should be used only when the SLC-96 maintenance features are not available.

WARNING!

SLC-96 systems carry up to 96 channels of customer traffic. Do not use the test set-ups shown here unless you have been properly trained. Use these set-ups only in conjunction with a SLC-96 maintenance manual. Verify through that manual that your planned maintenance activities will not cause a disruption in service.

Three typical SLC-96 maintenance applications are discussed in this section. The applications cover in service data link monitoring, out of service testing, and in-service digroup testing. Use Figure 2.2.A as a guide for each of these applications.

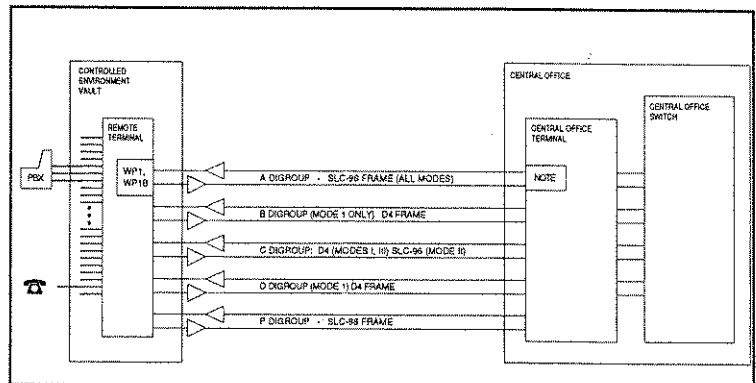


Figure 2.2.A
Typical SLC-96 System Configuration

It would be useful to read some general information on SLC-96 systems before actually attempting to perform maintenance on the systems. SLC-96 systems are used to carry subscriber telephone service, as well as a variety of special services. The

systems provide pair gain by multiplexing up to 96 metallic loops onto 4 T1 lines. The systems have a remote terminal located near the customers and a central office terminal located in the central office. The central office terminal may have a DS1 or analog metallic TEST MODE to the switch. Conversely, newer switches may be built with a TR-TSY-000008 TEST MODE (SLC-96 TEST MODE standard) so that there is no need for a central office SLC-96 terminal.

SLC-96 systems have three modes of operation. Mode I is where all 4 digroups are used; each channel of each digroup is reserved exclusively for a given customer. Mode II is where only 2 digroups are used for all 96 channels; the SLC-96 system keeps track of which channels are allocated to which customers through the C bits in the SLC data link. In mode III, the system serves only special service lines. This mode uses only two digroups, because only 48 channel units can be plugged into the terminals.

The A digroup transmits the system's data link through the SLC-96 framing format. The data link contains alarm, protection switching, far-end looping, and other maintenance information. The B and D digroups use D4 framing. These digroups are not used in modes II and III. The C digroup also uses SLC-96 framing. The C datalink is used only in mode II. In this mode it carries channel allocation information.

The SLC-96 system uses a protection digroup for ensuring a higher level of reliability. Either the remote terminal or the central office terminal may initiate a switch to the protection digroup if a transmission failure is encountered.

2.2.1 SLC-96 Data Link Monitoring

Here is a procedure for monitoring the A data link to observe the operational status of an in-service SLC-96 system.

- 1) Switch on the test set.
- 2) From the Main Menu, enter the TEST CONFIGURATION item.
Configure the screen settings for:
TEST MODE: T1SINGL
RXLVL-1: DSXMON
FRAMING: SLC-96
CODING: AMI (or as provisioned)
Tx SOURCE: NORMAL

XMT CLOCK: INTERN
LBO 1: 0 dB (ft) (or as req'd)
TEST RATE: 1.544M

When your TEST CONFIGURATION settings are correct, press ENTER.

3) Connect the test set to the circuit as shown in Figure 2.2.B.

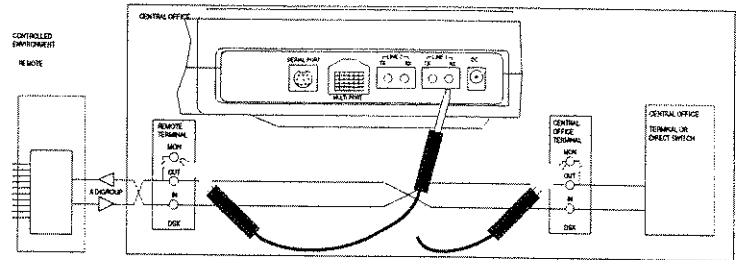


Figure 2.2.B
Monitoring the SLC Data Link

- 4) Enter MEASUREMENT RESULTS and see if the signal itself has any BPVs or SLC-96 framing errors.
- 5) Escape from the MEASUREMENT RESULTS and enter the DATA LINK CONTROL item. Enter the MONITOR DATA LINK item. Observe if a protection switch is in place. If there is one, note which digroup and the direction of transmission. Observe if a far-end loop is in place on any of the digroups - this will be signified by ALM next to the FELP category.
- 6) Reposition the plug into the remote terminal monitor jack. Observe:
 - the mode of the remote card (WP1, WP1B),
 - if there is a SLC-96 system alarm,
 - if any of the remote shelves are in alarm,
 - if there is a protection line switch in place,
 - and if there is a far end loop in place.
- 7) Take appropriate maintenance action. When you are finished,

disconnect the test set from the circuit.

2.2.2 Out-of-service SLC-96 Testing

Here is a procedure for performing out-of-service testing on a SLC-96 system. Perform this testing only on those rare occasions when the SLC-96 system is not carrying live customer traffic.

- 1) Switch on the test set.
- 2) From the main menu, enter the TEST CONFIGURATION item. Configure the screen settings for:

TEST MODE: T1SINGL
RXLVL-1: TERM
FRAMING: SLC-96
CODING: AMI (or as provisioned)
TX SOURCE: NORMAL
XMT CLOCK: INTERN
LBO 1: 0 dB (ft) (or as required)
TEST RATE: 1.544M

When your settings are correct, press ENTER.

- 3) Connect your test set to the circuit as required for the testing you wish to perform. Refer to Figures 2.2.B, 2.2.C, and 2.2.D. More than one set may be necessary because you may need to transmit and receive maintenance commands on the A digroup while you are performing bit error testing on another digroup. Possible tests you can perform include:
 - Switching digroup A through D to protection
 - Looping back digroup A through D and P to verify transmission performance
 - Inducing the system to switch to protection by creating a loss of signal, loss of frame, or high bit error rate
 - Verify transmission of proper alarm indication when a shelf or power source has gone down
 - Verify that central office terminal transmits AIS (blue alarm) in downstream direction when signal has been lost in upstream direction.
 - Verify that A digroup can do a half-switch when half of the A-

- Verify fast and transparent protection switching so that users do not notice a problem.
- Verify proper assignment of channels during mode II operation.

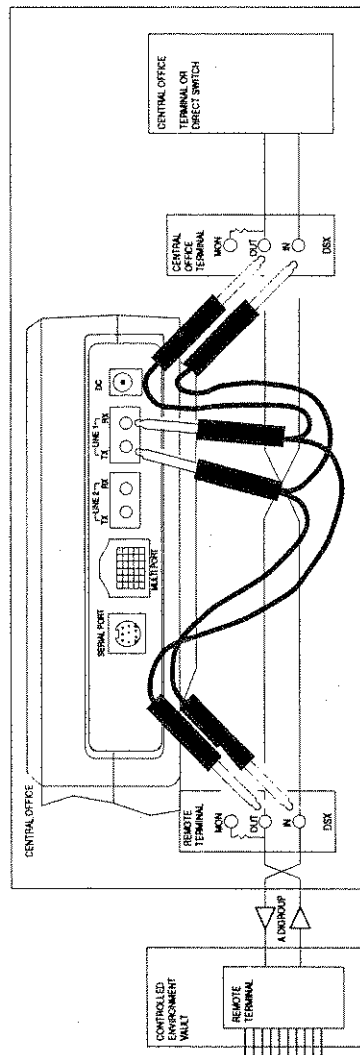
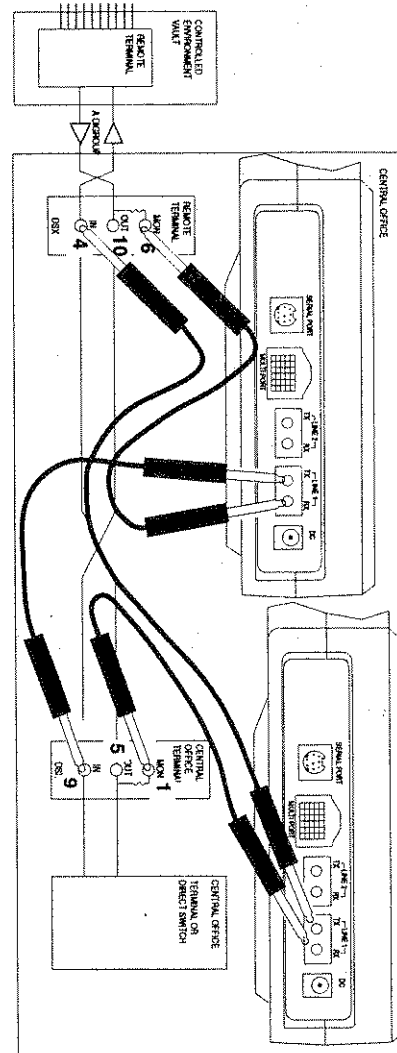


Figure 2.2.B
SLC-96 Out-of-Service Testing



NOTE:

- 1) Plug the cords in the order shown.
- 2) Two sets are required for this setup.
- 3) A termination plug may be needed in each OUT jack. Otherwise, the MON signal may be unreadable.

Figure 2.2.C
SLC-96 A Digirup Data Link Transmission

4) When you are finished, disconnect the test set from the circuit.

2.3 In-Service Hitless Dual Drop and Insert THRU Testing

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.

Use the following procedure:

- 1) Switch on the SunSet. 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 : T1DUAL
- Tx/INSERT : L1-Tx
- Rx/DROP : L2-Rx
- RxLVL-1 : DSXMON, BRIDGE
- RxLVL-2 : DSXMON, BRIDGE
- Tx SOURCE : THRU
- FRAMING : as specified by the circuit design
- CODING : as specified by the circuit design
- XMT CLOCK : L1-Rx
- LBO 1&2 : 0 dB
- TEST RATE : 1.544M

- 3) Depending on the test application, you may wish to do the following:

For talk and listen, you should:

Press ESCAPE to get to the MAIN MENU. Move your cursor to the VF CHANNEL ACCESS menu item and press the ENTER key. Press the ENTER key on the VF MEASUREMENTS menu item. Select the receive (listen) and transmit (talk) channels (they are usually the same channel number) that you wish to talk on. Choose TALK for the INSERT TYPE and L1-Rx for the LISTEN SIDE. When connected to the circuit, you will be able to talk and listen on the selected channel. Adjust the volume

to the desired level by pressing the volume keys.

To send and receive a tone:

Press ESCAPE until you reach the MAIN MENU. Move the cursor down to the VF CHANNEL ACCESS menu item and press ENTER. Press ENTER on the VF MEASUREMENTS menu item. Use the NEXT (F1) or PREVIUS (F2) to set up the receive and transmit channels correctly. Select the rest of the menu items as follows:

- Tx-1 T/S : Any
- Rx-1 T/S : Any
- Rx-2 T/S : Any
- INSERT TYPE : TONE
- TONE FREQ Hz : pick desired tone frequency
- TONE LVL dBm : pick desired tone level
- Tx-1 A/B/C/D : pick desired tone level
- LISTEN SIDE : BOTH

Once connected to the circuit, you will be transmitting a tone on the selected channel

WARNING: Only experienced technicians should do this procedure. Any mistakes will disrupt service. You might want to practice on an out-of-service circuit first to be sure you have the correct procedure. By entering the VF CHANNEL ACCESS menu, you will automatically be sending a tone or talking to the specified channel that is set in VF MEASUREMENTS. Make sure these are the right settings before continuing.

- 4) To conduct a hitless dual drop and insert THRU mode test on a line that is in service, make sure all the connections are made in accordance with the numbering procedure in Figure 2.3.A. This ensures the least amount of interruption on the live circuits. If performed properly, this test should disrupt the service for a duration of few hundred milliseconds. Press the HISTORY key to acknowledge them.

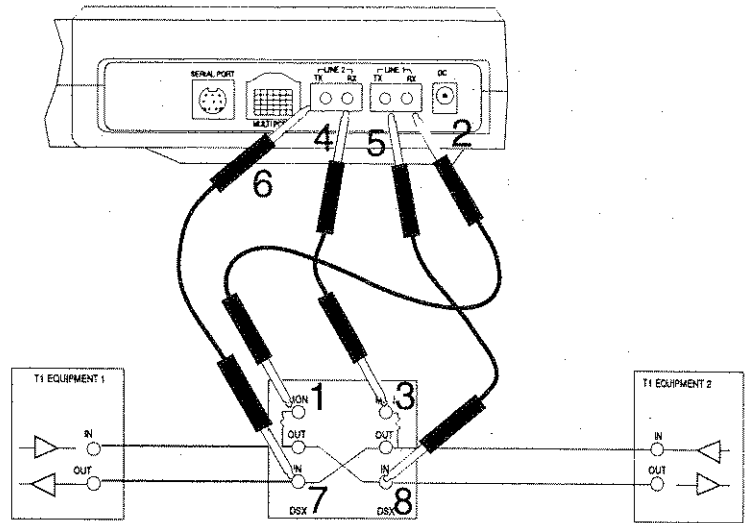


Figure 2.3.A
In Service Full Duplex THRU Drop and Insert

- 5) These procedures assume that both EQUIPMENT 1 and EQUIPMENT 2 are set to loop back mode.

If you were in talk and listen mode, you should now be able to talk and listen into the channel and line that you have specified.

Referring to Figure 2.3.A, if you had selected channel 1 and set the LISTEN SIDE to L1-Rx, then you should hear the voice conversation of only channel 1 from EQUIPMENT 1. Also, EQUIPMENT 2 should be able to hear your voice only on channel 1 since you are transmitting out to Line 1 on that specific channel. If you change the selected channel then you will be able to talk and listen on this specific channel and the other unselected channels of both EQUIPMENT 1 and 2 should be uninterrupted.

For tones, check to see that you are receiving the same tone frequency level that you have inserted on the specified channel (i.e. the TONE FREQ Hz specified should be the same as the Rx-1 FRQ/LVL). Also, make sure that the transmitted A/B/C/D bits are the same as the received A/B/C/D bits when you depress the ONHOOK (F1), OFF-HOOK (F2), and WINK (F3) buttons.

Try to send two different tones, have EQUIPMENT 1 send a 404 Hz tone and EQUIPMENT 2 a 1804 Hz tone on channel 1.

From the test set you should be able to pick up and hear the different tones on channel 1 by looking at the RxFREQ/LEVEL from the line that you have specified in TEST CONFIGURATION. Channel 1 of LINE 1 should be a 404 Hz tone and channel 1 of LINE 2 a 1804 Hz. For LINE 1, make sure that the Rx-1 A/B/C/D bits for the SunSet T10 are the same as the transmitted A/B/C/D bits from EQUIPMENT 1 and that the Tx-1 A/B/C/D bits for the SunSet T10 are the same as the received A/B/C/D bits at EQUIPMENT 2. Check that the other channels are not disturbed on both EQUIPMENT 1 and EQUIPMENT 2. Do the same checks for LINE 2.

- 5) When you are finished, make sure you remove the cords in the order of 8 through 1; otherwise, you may disrupt the circuit or damage the test set.

2.4 Advanced Talk/ Listen

Use the Simple Talk/Listen procedure as a reference for this one. This procedure lets you use different access modes, signaling, and other additional features.

- 1) Verify that the span is not in service if you will be using a disruptive access mode.
- 2) Switch on the test set. Press ENTER to move to the main menu.
- 3) Configure the set for the appropriate TEST CONFIGURATION mode:
 - A) Tx SOURCE: NORMAL In the TERM mode, the test set drops and inserts on the selected channels and fills the other 23 channels with idle code. The received signal is terminated at the test set and is not retransmitted.
 - B) Tx SOURCE: THRU: In THRU modes, the talk/listen will be performed on the LINE 1 or LINE 2 side of a full-duplex circuit access. The other 23 channels of that side will be transmitted through without disruption. All 24 channels of the other side will be transmitted without disruption.
There will be a momentary hit on both sides when the

test set is plugged into the circuit and when it is unplugged. There will also be a hit if you change access modes from one side to the other side.

- 4) Connect the test set to the circuit according to the access mode you have selected. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 5) From the Main Menu, enter the VF CHANNEL ACCESS menu.
- 6) Enter the VF MEASUREMENTS item. Select the receive (listen) and transmit (talk) channels that you want. Make sure that the INSERT TYPE is TALK. If you need to access a D1D, D2, or SLC-96 digroups B-D, refer to the timeslot charts in the previous sections. You will now be able to talk and listen on the channel you selected. Adjust the volume to the desired level by using the volume keys on the test set.
- 7) If you need to control supervision of the circuit, go to Tx-1 or Tx-2 A/B/C/D and enter the supervision bits you want in order to go off hook, on hook, or wink. Use the appropriate function keys ON-HOOK (F1), OFFHOOK (F2), WINK (F3), or SEND (F4) to send the ABCD bits. View the supervision bits that are returned on this same screen in Rx-1 or Rx-2 A/B/C/D. Press the ESCAPE key to exit this screen. You will still be sending the last supervision bits you sent for the remainder of the session.

For your reference, here are many of the common signaling arrangements used on D4 channel banks. TRMT refers to the signaling bits transmitted by the channel bank equipped with indicated channel card. RCV refers to the signaling bits received by the channel bank. * means that either a 1 or a 0 may appear.

Dial Pulse Originating (DPO)

VF input to DPO	TRMT		RCV		DPO VF Output
	A	B	A	B	
Loop open	0	0	*	*	
Loop closure	1	1	*	*	
	*	*	0	*	Normal battery
	*	*	1	*	Reverse battery

Dial Pulse Terminating (DPT)

VF input to DPT	TRMT		RCV		DPT VF output
	A	B	A	B	
Normal battery	0	0	*	*	
Reverse battery	1	1	*	*	

*	*	0	*	Loop open
*	*	1	*	Loop closure

2- or 4-wire E&M

E&M input	TRMT	RCV	E&M output
	A B	A B	
M-lead grd or open	0 0	* *	
M-lead battery	1 1	* *	
	* *	0 *	E-lead open
	* *	1 *	E-ld grd or looped

Revertive Pulse Originating (RPO)

VF input to RPO	TRMT	RCV	RPO VF output
	A B	A B	
Loop open	0 0	* *	
Loop closure	1 1	* *	
	* *	0 1	Normal batt, no RP
	* *	0 0	Norm batt and RP
	* *	1 *	Reverse battery

Revertive Pulse Terminating (RPT)

VF input to RPT	TRMT	RCV	RPT VF output
	A B	A B	
Normal battery	0 0	* *	
Reverse battery	1 1	* *	
	* *	0 *	Loop open
	* *	1 *	Loop closure

Sleeve Dial Pulse Originating (SDPO)

VF input to SDPO	TRMT	RCV	SDPO VF output
	A B	A B	
Loop open	0 0	* *	No sleeve ground
Loop closure	1 1	* *	Sleeve ground
	* *	0 *	Normal battery
	* *	1 *	Reverse battery

Duplex (DX) 2-wire, 900 ohm or 4-wire, 600 ohm

VF input to DX	TRMT	RCV	DX VF output
	A B	A B	
On-hook (idle)	0 0	* *	
Off-hook (busy)	1 1	* *	
	* *	0 *	On-hook (idle)
	* *	1 *	Off-hook (busy)

Equalized Transmission Only (ETO), or TO, 4- or 2-wire

VF input to ETO	TRMT	RCV	ETO VF output
	A B	A B	
No signaling	* *	* *	No signaling

Foreign Exchange Office End (FXO), Ground Start mode

VF input to FXO	TRMT	RCV	FXO output
	A B	A B	
No tip ground	1 *	* *	
Tip ground	0 *	* *	
No ringing	* 1	* *	
Ringing	* 0	* *	

*	*	0	*	Loop open
*	*	1	*	Loop closure
*	*	*	1	No ring ground
*	*	*	0	Ring ground

Foreign Exchange Office End (FXO), Loop Start mode

VF input to FXO	TRMT	RCV	FXO output	
	A	B	A B	
No ringing	0	1	* *	
Ringing	0	0	* *	
	*	*	0 *	Loop open
	*	*	1 *	Loop closure

Foreign Exchange Subscriber End (FXS) grd start mode

VF input to FXS	TRMT	RCV	FXS VF output	
	A	B	A B	
Loop open, no ring ground	0	1	* *	
Ring ground	0	0	1 *	no tip ground
Loop closure, or ring ground	1	1	0 *	Tip ground
	*	*	1 *	No tip grd, no ring
	*	*	0 1	Tip grd, no ringing
Loop open	0	1	0 0	Tip grd, ringing
Loop closure	1	1	0 0	Tip grd, no ringing

Foreign Exchange Subscriber End (FXS), loop start mode

VF input to FXS	TRMT	RCV	FXS VF output	
	A	B	A B	
Loop open	0	1	* *	
Loop closure	1	1	* *	
	*	1	* 1	No ringing
Loop open	0	1	* 0	Ringing
Loop closure	1	1	* 0	No ringing

Pulse Link Repeater (PLR)

VF input to PLR	TRMT	RCV	PLR E&M output	
	A	B	A B	
E-lead open	0	0	* *	
E-lead grd or loop	1	1	* *	
	*	*	0 *	M-lead grd or open
	*	*	1 *	M-lead batt or loop

sg lead at grd	1	1	* *	
sg lead at -48 Vdc	0	0	1 *	Grd sens relay to sg

Ringdown (RD) 2-wire, 900 ohm or 4-wire, 600 ohm

Input to RD	TRMT	RCV	RD output	
	A	B	A B	
No ring to t,r simp'x	1	1	* *	
20Hz ring t,r simp'x	0	0	1 *	No ring to t,r pair
20Hz ring t,r simp'x	1	0	* *	ring on t,r pair
sg lead at -48 Vdc	1	1	0 *	48Vdc to sg lead

9) If you need to dial on the circuit, move your cursor down to the

DTMF DIALING menu item and press ENTER. Enter the number you wish to dial and then press the ENTER key.

- 10) When you are finished, disconnect your test set from the circuit.

2.5 Testing SUPERTRUNK VF DS-0

- 1) Enter TEST CONFIGURATION and configure your set as follows:

TEST MODE: T1SINGL
RxLVL- 1 : TERM
FRAMING : SF-D4 or ESF, based on the design of the circuit.
CODING : AMI
TxSOURCE : NORMAL
XMT CLOCK: L1- Rx
LBO 1 : 0 dB
TEST RATE : 1.544M

When you are finished with the configuration, press ESCAPE to return to the Main Menu.

- 2) Enter SEND TEST PATTERN and select 1-8. Press ENTER to return to the Main Menu.

Warning: Failure to transmit this code back to the switch while measuring the T-1 signal may result in the switch automatically removing the trunks from service and failing the T1 circuit.

- 3) Connect the SunSet T10 to the T1 circuit using the appropriate cord plugged into the Line 1 Tx and Rx jacks. If using the SunSet Dual Bantam to Modular Plug cord, the marked side of the Dual Bantam cord should be inserted into the Line 1 Rx jack.
- 4) Enter MEASUREMENT RESULTS. Press the HISTORY key; the flashing ERRORS LED should no longer be lit. Press STOP (F3) and then RESTART (F3) to restart the machine. Verify that the PULSES LED is lit green, as well as a framing LED (SF or ESF). Line 1, Summary Measurements, should indicate NO

ERRORS. Press ESCAPE until the Main Menu is displayed.

- 5) Enter VF CHANNEL ACCESS and select VF MEASUREMENTS. Cursor down to Rx-1 T/S and use the NEXT (F1) or PREVIOUS (F2) keys to select the DS- 0 to be tested (1-24). Next, cursor down to INSERT TYPE and select TALK (F1). Press ESCAPE to return to the VF CHANNEL ACCESS Menu.
- 6) Enter DIAL/ SPRVIS SETUP. Cursor down to TRUNK TYPE and select the appropriate trunk type (E&M, G-START, or L-START). If you selected G-START or L-START, cursor down to EQUIPMENT. Choose FXO or FXS, as appropriate. EQUIPMENT is not applicable for Type E&M. Press ENTER to return to the VF CHANNEL ACCESS Menu.
- 7) Enter PLACE/ RECEIVE CALLS. Place the cursor on METHOD and press DTMF (F2). Next, cursor down to NUMBER. Press the SHIFT key to enable numeric mode. Enter the number to be dialed. Press the SHIFT-key again and verify that SHIFT no longer appears in the top left corner.
- 8) While still remaining in the PLACE/ RECEIVE CALLS screen, cursor up to Tx ABCD. Press OFF-HOOK (F2). If you do not receive a dial tone, refer trouble to the control office. Next, look at the Rx ABCD bits. If you are using G- START or L-START trunk type, you should see OFF-HOOK. If you are using the E&M trunk type, you should receive a wink.
- 9) After cursoring down to NUMBER, press SEND (F2) or ENTER. DIALING A should be displayed on the screen. You may or may not hear the test set sending DTMF tones.
- 10) Your call should now be completed and you may perform a "Talk/Listen" test.

Chapter 6 Datacom

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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 1.2.A depicts the relationship between these data communication terms and your everyday equipment.

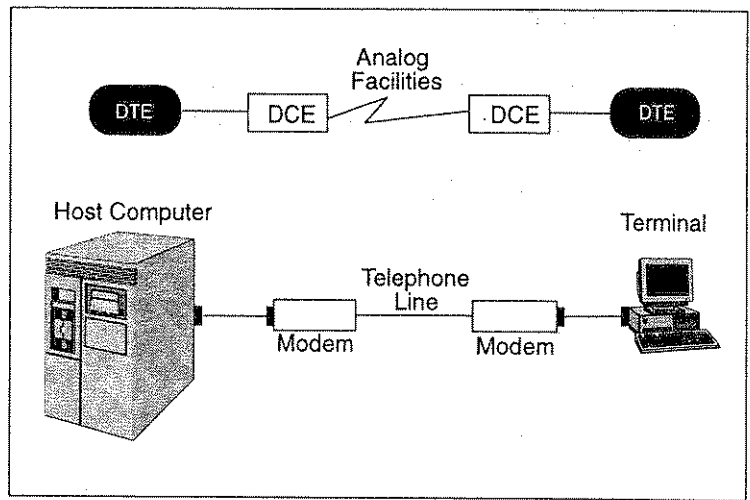


Figure 1.2.A
Data Communication Elements

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 1.5.A 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 1.5.A, 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 1.5.A, 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.

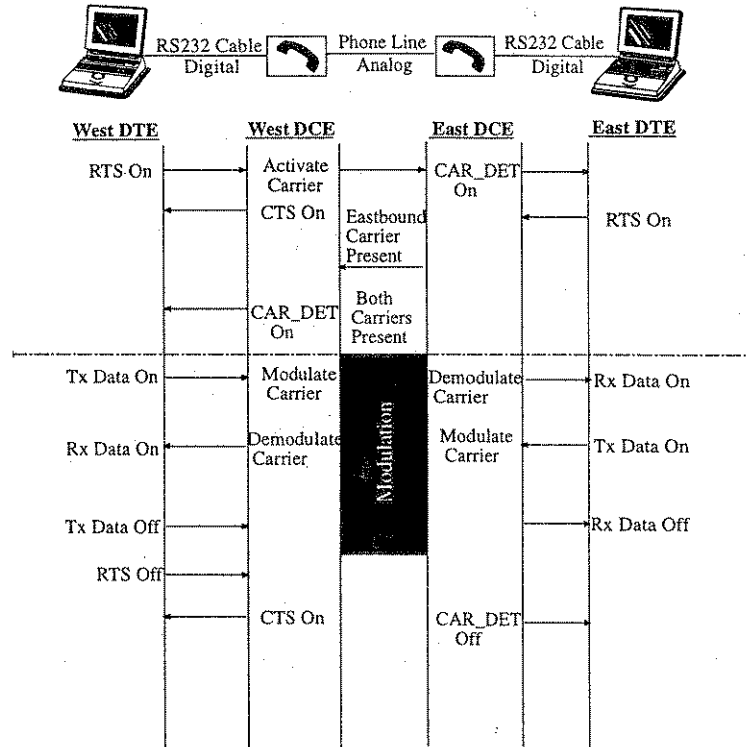


Figure 1.5.A
Full-Duplex Call Procedure

1.6 Physical Layer Protocol

There are several different standards which describe the cable wires connecting DTE and DCE. These specifications define the voltage level and the electrical characteristics of the signal. They also define the functions of the signals which make up the interface. The SunSet T10 supports four standards: X.21(V.11), V.35, RS232 (V.24), and RS449 (V.36).

RS232

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. Figure 1.6.A provides the pin assignments for the RS232 interface. It also shows the connection between the RS232 (DB 25) connector and the HDI (DB 37) connector.

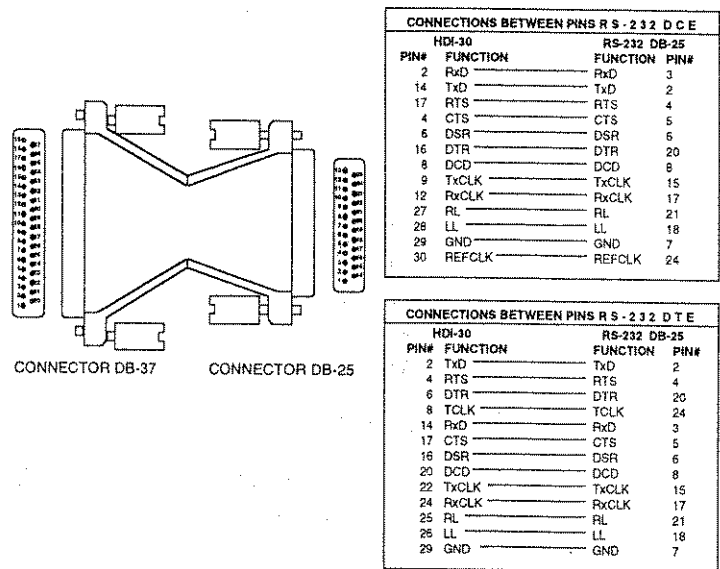
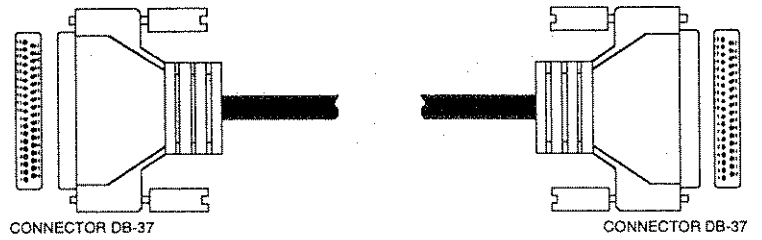


Figure 1.6.A
RS232 Pin Assignments

RS449

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.

Figure 1.6.B shows the pin assignments for RS449 and the connection between the RS449 interface and the HDI 30 connector.

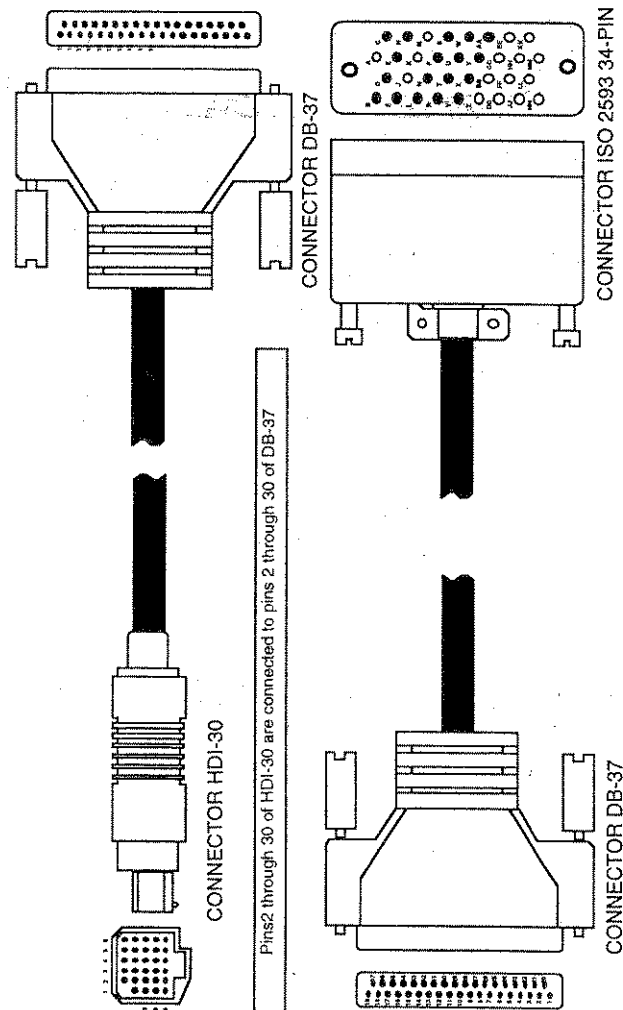


CONNECTIONS BETWEEN PINS R S - 4 4 9 D C E			CONNECTIONS BETWEEN PINS R S - 4 4 9 D T E		
HDI-30 PIN#	FUNCTION	RS-449 DB-37 PIN#	HDI-30 PIN#	FUNCTION	RS-449 DB-37 PIN#
2,30	RxD	RxD	2,30	TxD	4,22
3,4	CTS	CTS	3,4	RTS	25,7
5,6	DSR	DSR	5,6	DTR	30,12
7,8	DCD	DCD	7,8	T CLK	35,17
9,10	RxCLK	RxCLK	13,14	RxD	24,9
11,12	TxCLK	TxCLK	15,16	DSR	29,11
13,14	TxD	TxD	17,18	CTS	27,9
15,16	RTS	RTS	19,20	DCD	31,13
17,18	DTR	DTR	21,22	TxCLK	23,5
19,20	T CLK	T CLK	23,24	RxCLK	26,8
27	RL	RL	25	RL	14
28	LL	LL	26	LL	10
29	GND	GND	29	GND	19

Figure 1.6.B
RS449 Pin Assignments

V.35

V.35 is ITU's specification for a balanced interface. It is typically implemented on a 34-pin block-type connector. Figure 1.6.C provides its pin assignments and its connection with the HDI 30.



CONNECTIONS BETWEEN PINS V.35 D C E		
HDI-30	FUNCTION	ISO 2593 (DB-34)
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
28	LL	LL L
29	GND	GND B

CONNECTIONS BETWEEN PINS V.35 D T E		
HDI-30	FUNCTION	ISO 2593 (DB-34)
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
28	GND	GND B

Figure 1.6.C
V.35 Pins

X.21

X.21 is a general recommendation by ITU for synchronous operation on public data networks. It has a 15-pin connector. The signals may be used as either balanced or unbalanced circuits. Figure 1.6.D provides the X.21 interface pin-outs.

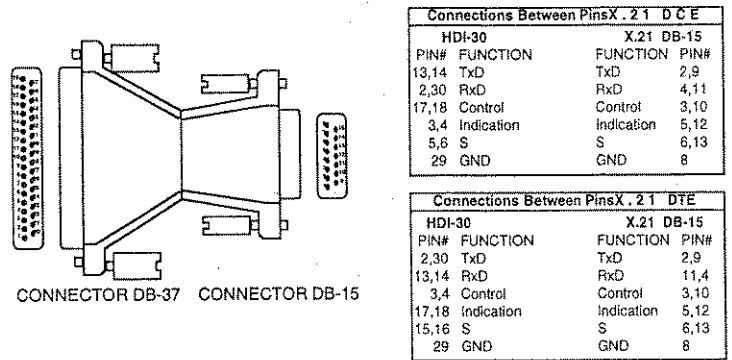


Figure 1.6.D
X.21 Pins

Pin Abbreviations

CTS: Clear to Send, sent by DCE- indicates that the carrier is turned on and the DTE can start to send its data.

DCD: Data Carrier Detect, sent by DCE- says that the DCE has sensed an incoming carrier.

DSR: Data Set Ready, sent by DCE- indicates that call connection has been established.

DTR: Data Terminal Ready, sent by DTE- says that DTE is ready and can accept incoming calls.

GND: This pin provides the grounding.

LL: This pin initiates a Local Loopback.

RL: This pin initiates a Remote Loopback.

RTS: Request To Send, sent by DTE- tells modem to activate its outgoing carrier.

Section 2 Datacom Operation Menus

Datacom testing allows the SunSet to send and receive signals with other data communication equipment. Datacom uses a standard interface in order for two equipment elements to communicate with each other. The standard protocols available are: V.35, RS449, X.21, and RS232. You test only the low speed synchronous or asynchronous signal on the MULTIPOINT. A graphic diagram of the test set configuration is not provided in the Datacom Mode.

2.1 Datacom Test Configuration

In order to use the SunSet for datacom testing, you must enter Test Configuration and select TEST MODE: DATACOM. Figure 2.1.A shows the Datacom Configuration screen.

```
2:32:11
TEST CONFIGURATION
TEST MODE: DATACOM

TYPE      : RS449
MODE      : DCE
TEST RATE: 02x64k
REF CLOCK: INTERN

press Nx64K (F3) to
change test rate.

48k      Nx56K      Nx64K      more
```

Figure 2.1.A
Datacom Configuration Menu

1) TYPE

F-key Options: V.35 (F1), RS449 (F2), X.21 (F3), RS232 (F4)

TYPE determines the electrical interface at the multipoint: V.35, RS449(V.36), X.21(V.11), or RS232(V.24).

2) MODE

F-Key Options: DTE (F1), DCE (F2)

Choose DTE (F1) if the test set will emulate Data Terminal Equipment. In other words, choose DTE if the test set will plug into DCE equipment. Choose DCE (F2) if the test set will emulate Data Circuit Equipment and will plug into DTE equipment.

RS232 support both synchronous and asynchronous transmission. For RS232, you will be given four options: DTE-SYN (F1), DCE-SYN (F2), DTE-ASY (F3), DCE-ASY (F4). SYN and ASY represent a synchronous and asynchronous data signal, respectively. DTE refers to Data Terminal Equipment and DCE for Data Circuit Equipment.

3) TEST RATE

F-key Options: 300 (F1), 600 (F2), 1200 (F3), 2400 (more, F1), 4800 (more, F2), 9600 (more, F3), 14.4k (more, F1), 19.2k (More, F2), 38.4k (more, F3), 48k (more, F1), Nx56k (more, F2), Nx64k (more, F3)

Choose the desired test rate for the datacom circuit being tested. For Nx56k and Nx64k, you may select any number (1-24) of channels by pressing the corresponding F-key until you reach that value. For RS232, you can have only one 64K or 56K channel.

4) REF CLOCK

F-key Options: INTERN (F1), RECEIVE (F2)

The REF CLOCK allows you to select the test set's INTERNAL clock or the external timing RECEIVED at the Multiport for the transmit signal source. With the INTERN selection, the test set is the master timing source on the circuit. With the RECEIVED selection, the test set is the slave to the device to which it is sending signals. On a synchronous circuit, one end should be the master timing source and the other end should be the slave.

For X.21, DTE is automatically configured for Receive and DCE for Intern; therefore, you will not be able to change the reference clock for X.21.

The REF CLOCK selection applies only to synchronous transmission modes. If your Type is RS232, your mode must be either DCE-SYN or DTE-SYN in order to change the REF CLOCK.

The following three items apply only to asynchronous datacom transmission (RS232 DTE-ASY or DCE-ASY):

5) BIT / CHAR

F-key Options: 6 (F1), 7 (F2), 8 (F3)

This selection allows you to set up how many bits will be transmitted for each character of information. Both DTE and DCE should have the same number of bits per character.

6) STOP BITS

F-Key Options: 1 (F1), 2 (F2)

This selection allows you to choose how many bit stop bits you want for each character of information.

7) PARITY

F-Key Options: EVEN (F1), ODD (F2), NONE (F3)

This item 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 parity bit) is odd. In Even parity, the total number of ones (including the 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 (F3) signifies no parity.

2.2 T1- MUX Test Configuration

T1-MUX provides the multiplexing capability between the T1 line and multiport datacom signals. You should use this mode when you need to perform a synchronous Nx64K test through both the datacom connector and the 1.544 Mbps connectors at the same time. See Figure 2.2.A, T1-MUX menu.


```

MEAS 16:12:12
TEST CONFIGURATION
TEST MODE : T1-MUX

T1                                DATACOM
Tx/INST: L1-Tx                    TYPE : V.35
Rx/DROP: L1-Rx                    TxSRC : T1DRP
FRAMING: ESF                       MODE : DCE
CODING : B8ZS                       MUX
RxLVL-1: TERM                      BERT : V.35
RxLVL-2: TERM                      T1INS : PATRN
XMTCLK : L1-RX                     T1T/S : Nx64
LBO 1&2: 0 dB

V.35      RS449      X.21      RS232

```

Figure 2.2.A
T1-MUX Mode Configuration

The T1-MUX Configuration screen is divided into three sections. The T1 column at left provides the setup parameters for the 1.544Mbps T1 transmit and receive jacks. The Datacom section at top right configures the multiport. The MUX settings determine the test set's multiplexing operation.

T1

If necessary, you may refer to Chapter 4, Sections 1.1 and 1.2, the T1 Test Configuration description, for a more detailed description of each T1 setup option.

1) Tx/INSERT

F-Key Options: L1-Tx (F1), L2-Tx (F2)

Select the 1.544 Mbps line 1 (either L1-Tx or L2-Tx) for the test signal insertion using the appropriate F-key. This is where the Nx64 Kbps multiplexed signal will be inserted. For example, if you insert a received V.35 signal onto the line and you select L2-Tx, the signal will be inserted on line 2.

2) Rx/DROP

F-Key Options: L1-Rx (F1), L2-Rx (F2)

Select the 1.544 Mbps line (either L1-Rx or L2-Rx) to be used for dropping a NX64 Kbps signal to the multiport. This selection also configures 1.544 Mbps line frequency and view received data. For example, if you want to drop out a 64 Kbps signal to V.35 from Line 1, you should choose Rx/DROP as L1-Rx.

3) FRAMING

F-Key Options: SF-D4 (F2), ESF (F3), SLC-96 (F4)

Choose the desired framing type by pressing the appropriate F-key on the FRAMING menu item. The three options are: ESF, SLC-96, and SF-D4.

4) CODING

F-Key Options: AMI (F1), B8ZS (F2)

Choose the line coding that is appropriate for your circuit by pressing the F-Keys: (F1) for AMI coding or (F2) for B8ZS.

5/6) RxLVL-1 & RxLVL-2

F-Key Options: TERM (F1), BRIDGE (F2), DSXMON (F3)

RxLVL-1 and RxLVL-2 configure the two 1.544M receivers. These settings let the SunSet electrically decode a 1.544 Mbps signal under a wide range of resistive or cable losses. They also determine which electrical load will be placed on the circuit by the SunSet. There is no effect on the transmitter. TERM (F1) terminates the received signal. In BRIDGE (F2), the SunSet applies high impedance resistors to the circuit under test; this isolation will protect the signal from disruption. Choose DSXMON (F3) when you are plugged into a DSX monitor jack that has isolated the MONsignal from the live signal with a high impedance circuit.

7) XMTCLK

T1-MUX Mode uses a loop timing clock. For loop timing, the same line is chosen for Tx/INSERT and XMTCLK. Therefore, you will not be able to change XMTCLK; it is forced automatically to your Tx/INSERT choice.

8) LBO 1&2

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

Choose the desired Line Build Out for both lines 1 and 2. This value should be set to 0 dB under most conditions. However, the T1 Test Configuration Menu description, Section 2.1, provides further information on which distance should be selected.

DATAKOM

The DATAKOM settings configure the multiport. The multiport will automatically be configured for DCE. Press the right arrow key to move the cursor over to the right side of the screen.

1) TYPE

F-Key Options: V.35 (F1), RS449 (F2), X.21 (F3), RS232 (F4)

TYPE determines the electrical interface at the multiport. The available options are: V.35, RS449(V.36), X.21(V.11), or RS232(V.24).

2) Tx Source

F-Key Options: PATRN (F1), T1DRP (F2)

Tx Source sets the transmit source for the multiport. Set TxSRC to either PATRN or T1DRP. Choose PATRN (F1) to send a test pattern out the multiport; choose T1DRP (F2) to send the dropped NX64 Kbps signal out the multiport.

3) MODE

For T1-MUX Mode, the SunSet is DCE; you will not be able to change the mode.

MUX

The MUX settings define the multiplexing configuration for the T10.

1) BERT

F-Key Options: T1DRP (F1), (F2) is the Datacom TYPE selected above, i.e. RS232

BERT determines which direction of the multiplexed circuit will be bit error tested. T1DRP means that the NX64 Kbps signal dropped from the 1.544 Mbps signal will be bit error tested. V.35 means the signal received coming from the low speed side will

be tested.

2) T1INS

F-Key Options: LOOP (F1), DATACOM TYPE, i.e. RS232 (F2), PATRN (F3).

T1 Insert determines which signal will be inserted into the 1.544 Mbps line. It may be changed only if TxSRC is set to T1DRP. In this case, it may be set to LOOP, your Datacom Type, or PATRN. LOOP (F1) means that all 24 channels will be looped through from 1.544 Mbps receive to 1.544 Mbps transmit; nothing will be inserted. The Datacom Type (F2) means that the low speed NX64 Kbps signal will be inserted on the 1.544 Mbps transmit. PATRN (F3) means that your test pattern will be inserted on the 1.544 Mbps transmit signal.

When your Datacom transmit source (TxSRC) is configured for pattern (PATRN), T1INS is set for the Datcom type (F2); you will not be given an option to change this. In this case, you are transmitting your pattern out the multiport and inserting the received multiport lowspeed signal onto the T1 line.

3) T1T/S

F-key Options: Nx64K (F1)

T1T/S lets you select which NX64 Kbps T1 timeslots on which you want to insert and drop the multiplexed signal. Press Nx64K (F1) to enter the T10 Time Slot screen. Refer to Chapter 4, Section 2.1 Test Rate for further details on selecting timeslots. For RS232, you may select only one timeslot.

2.3 DATACOM INTERFACE

When the TEST MODE is configured to DATACOM or T1-MUX in the TEST CONFIGURATION setup, Datacom Interface appears in the Main Menu. This screen provides access to the major signal wires involved in DTE-DCE communication. As stated earlier, these wires may be turned on/off. In this screen, you can view the status of the major received signals (on/off). You may also control the status of several transmit signals.

Since the direction of these signals (Tx/Rx) differs between DCE and DTE, the signals will either be Transmit or Receive

depending on the mode chosen. Figure 2.3.A shows the Datacom Interface screen for RS232, DTE Mode.

```
00:39:20  
  
          DATACOM INTERFACE  
  
MODE - DTE      TYPE - RS232  
  
  TRANSMIT      RECEIVE  
RTS  : ON      CTS  - ON  
DTR  : ON      DSR  - ON  
RL   : ON      DCD  - ON  
LL   : ON      TxCLK-LIVE  
                      RxCLK-LIVE  
                      DATA -LIVE  
  
ON      OFF
```

Figure 2.3.A
Datacom Interface Screen, DTE

The top line shows the Mode and Type of your SunSet. These may not be changed in this screen, but in TEST CONFIGURATION.

The left column lists the different transmit signals which you may change. These may be turned ON or OFF to test whether the other data communication equipment is receiving the SunSet's signal. To change the status of one of these wires, place the cursor on that line and press either ON (F1) or OFF (F2). The four transmit signals shown in Figure 2.3.A are defined as follows:

- RTS- Request To Send, DTE → Modem, tells the modem to activate its outgoing carrier.
- DTR- Data Terminal Ready, DTE → Modem, indicates that the DTE is ready to accept incoming calls.
- RL- Remote Loopback, DTE → Modem, tells the local modem to send a message to the remote modem to have the remote modem loop back its Rx Data to its Tx Data.
- LL- Local Loopback, DTE → Modem, tells the local modem to activate a local loopback, where its modulated output is disconnected from the phone line and is looped back to its

demodulated output.

The Receive signals are defined as follows:

- CTS- Clear to Send, Modem → DTE, indicates that the outgoing carrier is on and that the DTE should begin sending data.
- DSR- Data Set Ready, Modem → DTE, indicates that a call connection has been established.
- DCD- Data Carrier Detect, Modem → DTE, indicates that the modem senses an incoming carrier from the phone line.
- TxCLK- Transmit Clock, Modem → DTE, drives the transmit shift register inside the DTE.
- RxCLK- Receive Clock, Modem → DTE, flashes on at the midpoint of each bit on the Receive Data wire.
- DATA- Modem → DTE, where the actual data is carried.

When you have selected DCE Mode, the Transmit and Receive signals are switched. Refer to Figure 2.3.B.

```
00:34:08  
  
          DATACOM INTERFACE  
  
MODE - DCE      TYPE - RS232  
  
  TRANSMIT      RECEIVE  
CTS : ON        RTS - ON  
DSR : ON        DTR - ON  
DCD : ON        RL  - ON  
                LL  - ON  
                DATA -LIVE  
  
ON      OFF
```

Figure 2.3.B
Datacom Interface, RS232-SYNC, DCE

As you can see in Figure 2.3.B, DCE, CTS, DSR, and DCD are the transmit signals, while RTS, DTR, RL, and LL are the receive signals. Please note that DATA is always on the Receive side for both modes. For DTE, DATA refers to the modulated data; for DCE, Data refer to the unmodulated data. For DCE, no clocking signals are shown .

The Datacom Interface screens for Interface types RS449 and

V.35 are similar to that of RS232. Type X.21, however, is quite different. The X.21 interface uses a very economical 15-pin connector. Due to this small connector, there are fewer signals. X.21 has transmit, receive wires, some grounds, a clock for synchronous transmission, and two control wires. The DTE and DCE signals are represented by the status of these control wires, as well as sending control characters on the receive and transmit data wires. The two control wires are C (Control), sent DTE to DCE, and I (Indication) sent DCE to DTE. Figure 2.3.C shows the Datacom Interface screen for X.21; you can see the status of the C and I signals.

```
MEAS 00:46:12
DATACOM INTERFACE
MODE - DTE      TYPE - X.21
TRANSMIT       RECEIVE
C : ON         I - ON
               DATA - LIVE
ON OFF
```

Figure 2.3.C
Datcom Interface, X.21, DTE

Section 3 Applications

3.1 Point to Point Datacom Testing

In this application, we will connect the SunSet T10 (DTE) to a modem (DCE) to perform a simple BERT test. We will use the V.35 interface. This test will allow the SunSet T10 to send and receive signals with a DCE.

Use the following procedure:

- 1) Verify that the datacom circuit is not in service. This test will

disrupt the service.

2) Switch on the SunSet. From the Main Menu, enter TEST CONFIGURATION.

Configure the interface as follows:

- TEST MODE	: DATACOM
- TYPE	: as required by interface; we will use V.35 as an example for this application.
- MODE	: DTE
- REF CLOCK	: INTERN
- TEST RATE	: as required by modem

Note:

If the test set must supply the timing source, select INTERN for REF CLOCK. If the test set should follow timing from the network, select RECEIVE. When the SunSet uses received timing, the test rate selection is not significant, since the set will use its received rate.

3) Connect the SunSet to the modem as shown in Figure 3.1.A.

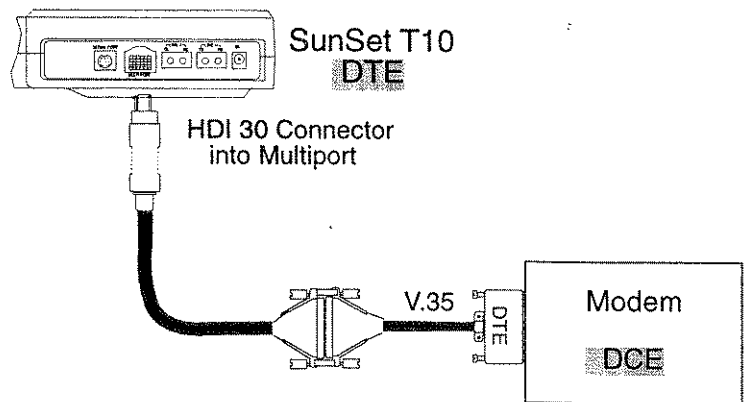


Figure 3.1.A
Modem Testing with Datacom

4) Press ENTER to return to the Main Menu. Enter SEND TEST

PATTERN. Use the arrow keys to select your pattern. Certain patterns may not be available to you depending on your test rate. If a pattern is not available, a message will appear at the bottom of the display screen.

- 5) Escape back to the Main Menu. Enter DATACOM INTERFACE. This screen is shown in Figure 3.1.B.

```
MEAS 03:50:45
DATACOM INTERFACE
MODE- DTE TYPE - V.35
TRANSMIT RECEIVE
RTS : ON CTS - ON
DTR : ON DSR - ON
RL : OFF DCD - ON
LL : ON TxCLK- LIVE
RxCLK- LIVE
DATA- LIVE
ON OFF
```

Figure 3.1.B
Datacom Interface Screen

- 6) Make sure that the transmit leads RTS and DTR are turned on. If not, place the cursor on the lead and press the ON (F1) key. You can also try turning these signals ON or OFF to test whether the modem is receiving the SunSet's signal.
- 7) Cursor down to LL, Local Loop, and press ON (F1). This should activate a loop on you modem.
- 8) Examine the received information. TxCLK, RxCLK, and DATA should all show LIVE.
- 9) Escape to the Main Menu, cursor up to MEASUREMENT RESULTS, and press ENTER. Make sure that the RCV and XMT patterns are the same and that your PAT SYNC LED is lit green. If not, try pressing the RESYNC key. If the PAT SYNC LED still is not green, the modem may have a problem

regenerating the pattern.

- 10) Still in Measurement Results, verify that your RxHz is the same as your transmitted rate. If there is a discrepancy, your modem may have a problem retransmitting the clock.
- 11) You can test the validity of your loop by injecting errors and making sure they come back to you. Press the ERR INJ key. The BIT ERROR LED should light red and one bit error should be recorded in Measurement Results.
- 12) When you are finished, unplug the test set, turn it off, and put it away.

3.2 Fault Location with Remote & Local Loopbacks

This application provides a troubleshooting procedure using the remote and local loopback capabilities of the T10. Figure 3.2.A shows a remote and local loopback.

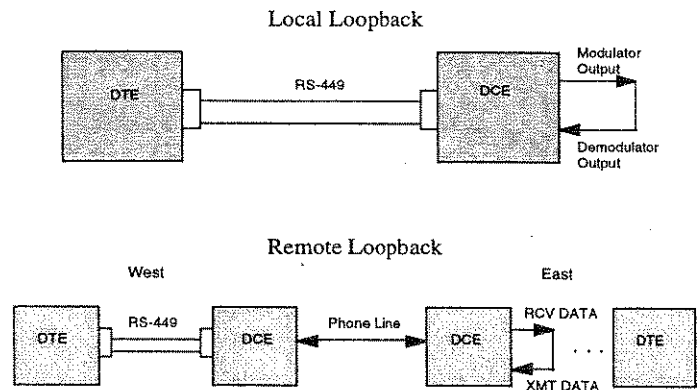


Figure 3.2.A
Local and Remote Loopback

- 1) Turn the SunSet on.
- 2) From the Main Menu, enter TEST CONFIGURATION. Select

TEST MODE: DATACOM. Configure the rest as follows:

TYPE: per interface

MODE: DTE

RATE: per modem

REF CLOCK: INTERN

When your settings are complete, press ENTER.

- 3) Connect the test set to the modem under test.
- 4) From the Main Menu, enter DATACOM INTERFACE. Make sure that the transmit leads RTS and DTR are turned on. If not, place the cursor on the lead and press the ON (F1) key. Cursor down to LL, Local Loop, and press ON (F1). This should activate a loop on your modem; the transmit and receive data LEDs should light up. If the Received data LED of the modem lights up, but not the Transmit data LED, then the modem under test is faulty because it can't transmit the received data back to the T10.
- 5) Escape back to the Main Menu and enter MEASUREMENT RESULTS. Verify that the RxHz is equivalent to your Test Rate. If there is a discrepancy, your modem has a problem retransmitting the clock.
- 6) Make sure that the RCV and XMT patterns are the same and that your PAT SYNC LED is lit green on the T10. If it isn't, try pressing the RESYNC key. If the LED is still red, your local modem may have a problem regenerating the pattern.
- 7) Test the validity of your loop by pressing the ERR INJ key. Verify that these errors come back to you. The BIT ERROR LED should light red and a bit error should be recorded in MEASUREMENT RESULTS.
- 8) If you have completed the above steps successfully, then your local modem is not at fault. Return to the DATACOM INTERFACE screen and turn off the Local Loop.
- 9) Now that you have established that the problem does not lie with your local modem, you now should test the far end modem using a remote loopback.

10) To test the remote loopback, make sure that the far end modem has a loopback capability at the interface (make sure the modem can loop TxDATA to the RxDATA and also TxCLK, RxCLK, and TCLK).

11) To use the modem, it may be necessary to connect a computer to dial out. Once the connection is in place, disconnect the computer and replace it with the T10 datacom connector.

Note: It may also be necessary to set DTR to be always on by using the computer so you don't drop the line when switching from the computer to T10 datacom connector.

12) Escape to the Main Menu. Enter DATACOM INTERFACE. Make sure that the transmit leads RTS and DTR are turned on. If not, place the cursor on the lead and press the ON (F1) key. Cursor down to RL and press the ON (F1) key.

13) Escape back to the Main Menu and enter MEASUREMENT RESULTS. Verify that the RxHz is equivalent to your Test Rate. If you have a low RxHz, then the clock is not being received properly from the far end modem.

14) Check the RCV and XMT patterns. They should be the same and the PAT SYNC LED on the T10 should be green. If they are, you can perform a BERT test by pressing the ERR INJ key. Verify that these errors come back to you. The BIT ERROR LED should light red and a bit error should be recorded in MEASUREMENT RESULTS. If this is successful, then the phone line and the far end modem are working properly.

15) If your BERT test is not successful, this points to a problem with either the phone line or the far end modem. To test the far end modem, you need to perform a local loopback on that end, following the procedure outlined in steps 4-9. If there are no problems with this local loopback, then the problem is with the phone line. If there are problems, the modem is at fault.

3.3 Emulating a Terminal Multiplex

In the T1-MUX Mode, the SunSet T10 emulates a 64Kbps to 1.544 Mbps multiplexer. Use the following procedure to multiplex one or more 64Kbps signals onto a 1.544 Mbps signal. This application is useful if you suspect you have a faulty multiplex. By successfully substituting the T10 for a MUX, you can isolate the problem to that replaced MUX.

1. Turn the SunSet T10 on using the red POWER button located at the bottom left of the keypad.
2. From the Main Menu, enter TEST CONFIGURATION. Select T1-MUX for Test Mode. Configure the rest as follows:

T1

Tx/INSERT : L1-Tx

Rx/DROP : L1-Rx

FRAMING : As specified by the span design

CODING : As specified by the span design

RxLVL-1 : TERM

RxLVL-2 : TERM

XMT CLK : L1-Rx

Note: In T1-MUX, the set is forced to received timing.

LBO 1&2 : As specified by the span design

DATACOM

TYPE : Select the datacom interface type that will provide the 64Kbps frame.

TxSRC : T1DRP

MODE : DCE

Note: In T1-MUX, the T10 is automatically set for DCE.

MUX

BERT : T1DRP

T1INS : The datacom TYPE selected above (i.e. RS232)

T1T/S : Select the 64Kbps timeslot(s) to be multiplexed from the datacom to the T1 side (See step 3 below).

3. The last setup item in the TEST CONFIGURATION screen is T1T/S. In this line, you select the 64Kbps timeslot(s) to be multiplexed. Press Nx64K (F1) or ENTER to enter the T10 TIME

SLOT screen. Use the arrow keys to move the flashing cursor to the desired receive timeslot. Once your desired timeslot is flashing, press SELECT (F2). You may also press UN-SEL (F3) to de-select a particular timeslot or CLR-ALL (F4) to erase all the selected timeslots and start with a clear screen. As you select your receive timeslots, the respective transmit timeslots will also be highlighted. This is because the receive and transmit timeslots should normally be set to the same numbers. If you want these timeslots to differ, cursor down to the transmit section and manually set up the desired timeslots.

Note: For RS232, you may select only one receive and transmit timeslot.

4. Connect the T10 to the circuit according to Figure 3.3.A. Press the HISTORY key to acknowledge any blinking history lights and turn them off. Verify that the PAT SYNC LED is lit green. If it is not, try pressing the RESYNC key.

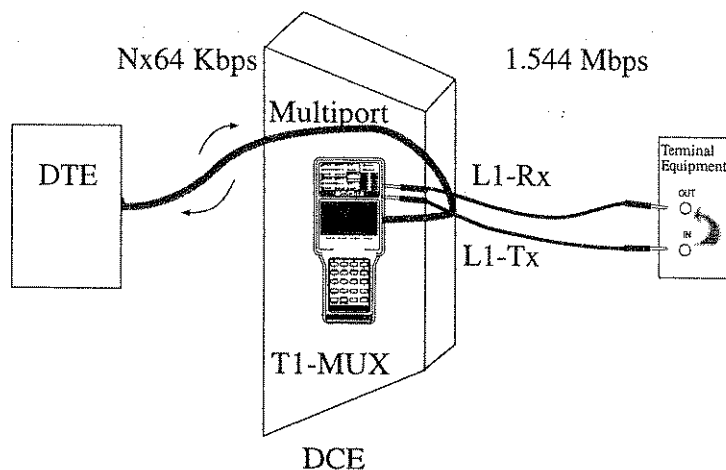


Figure 3.3.A
Emulating a Terminal Multiplex

In this diagram, the DTE supplies the 64Kbps signal, which is transmitted to the SunSet T10 through the multiport. The T10 multiplexes this 64Kbps signal onto a 1.544 Mbps T1 signal, which is then transmitted out the T1 L1-Tx jack. In Figure 3.3.A,

the test set is connected to a IN/OUT monitor jack. The 1.544M 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 1.544M signal.

5. Inject an error from the Data Terminal Equipment. Make sure that the BERT setting in TEST CONFIGURATION is set to T1DRP. This means that the LEDs will show information about the signal received on the T1 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 T10.

With this ability, the SunSet T10 can replace a MUX. If you suspect a faulty multiplex, simply replace it with the T10 by following the previous steps. If your circuit problems clear up with the T10, you have verified that the problems exist with that replaced MUX.

3.4 Emulating an Add/Drop Multiplexer

The SunSet T10 has the capability to emulate an Add/Drop Multiplex. Use the following procedure to drop and insert 64Kbps timeslots between a datacom device and T1 lines.

1. Turn the test set on using the red POWER key located at the bottom left of the keypad.
2. From the Main Menu, enter TEST CONFIGURATION. Select T1 DUAL Mode and configure the other settings as follows:

Tx/INST : L1-TX
RX/DROP: L2-RX
RXLVL-1 : TERM
RXLVL-2 : TERM
TxSOURCE: THRU
FRAMING: As provisioned
CODING : As provisioned
XMTCLK : L1-RX
TEST RATE: 1.554M
LBO 1&2: As provisioned

3. Connect the test set to two terminal equipments in the order shown in Figure 3.4.A. Plug into the OUT jack of Equipment 1; connect the same cord to Line 1 Rx on the test set. Next plug a second bantam cord to The OUT jack on Equipment 2; connect this cord to Line 2 Rx on the test set. Next, plug your third bantam 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. Verify that the T10'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. Press the GRAPHIC key and verify that you are in THRU Mode. Next, you should connect the cord from Line 2 Tx to the IN jack of Equipment 1. 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.

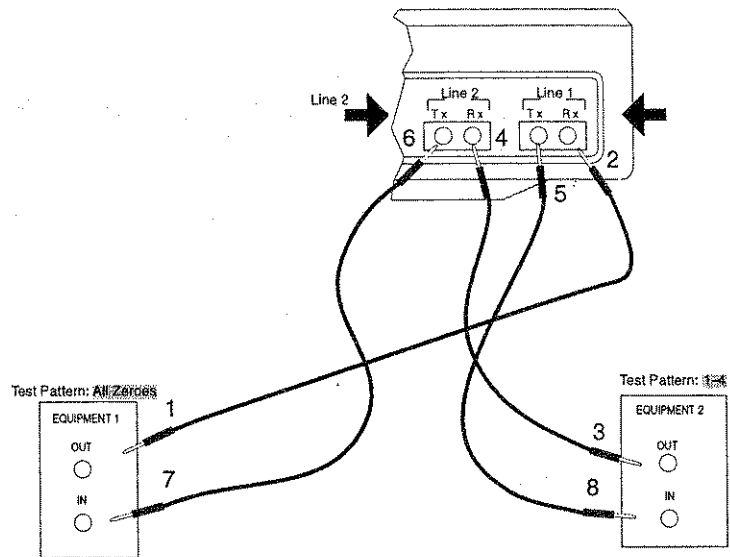


Figure 3.4.A
Emulating an Add/Drop Multiplex

4. Press the HISTORY key to acknowledge any blinking lights and turn them off. Verify that the PAT SYNC LED is lit green.
5. Press the ESCAPE key to return to the Main Menu. Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA. Since you selected Rx/DROP= L2-Rx in TEST CONFIGURATION, the data displayed here is from Line 2 Rx. Verify that the pattern sent by Equipment 2 is shown here on all the timeslots. According to Figure 3.4.A, you should see the 1-4 pattern. You have just ascertained that Line 2 is being received properly by the SunSet T10.
6. Press the ESCAPE key to return to the Main Menu. Enter TEST CONFIGURATION. Change Rx/DROP to L1-Rx.
7. Escape back to the Main Menu. Enter OTHER MEASUREMENTS, VIEWRECEIVEDDATA. This time, the data displayed refers to Line 1 Rx. Verify that the pattern transmitted by Equipment 1 is shown on all available timeslots in this screen. With reference to Figure 3.4.A, 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 T10. Now you are ready to connect the test set to the Datacom device.
8. Escape to the Main Menu. Enter TEST CONFIGURATION. Select T1-MUX Mode and configure the other settings as follows:

T1

Tx/INSERT : L1-Tx

Rx/DROP : L1-RX

RxLVL-1 : TERM

RxLVL-2 : TERM

FRAMING : As specified by the span design

CODING : As specified by the span design

XMT CLK : L1-RX

Note: In T1-MUX, the set is forced to received timing.

LBO 1&2 : As specified by the span design

DATACOM

TYPE : Select the datacom interface type that will provide the 64Kbps frame.

TxSRC : T1DRP

MODE : DCE

Note: In T1-MUX, the T10 is automatically set for DCE.

MUX

BERT : The Datacom TYPE selected above (i.e. RS232)

T1INS : The Datacom Type

T1T/S : Select the 64Kbps timeslot(s) to be multiplexed from the datacom to the T1 side (See step 9 below).

9. The last setup item in the TEST CONFIGURATION screen is T1T/S. In this line, you select the 64Kbps timeslot(s) to be multiplexed. Press Nx64K (F1) or ENTER to enter the T10TIME SLOT screen. Use the arrow keys to move the flashing cursor to the desired receive timeslot. Once your desired timeslot is flashing, press SELECT (F2). You may also press UN-SEL (F3) to de-select a particular timeslot or CLR-ALL (F4) to erase all the selected timeslots and start with a clear screen. As you select your receive timeslots, the respective transmit timeslots will also be highlighted. This is because the receive and transmit timeslots should normally be set to the same numbers. If you want these timeslots to differ, cursor down to the transmit section and manually set up the desired timeslots.

Note: For RS232, you may select only one receive and transmit timeslot.

10. Connect the test set to the datacom device through the multiport. Refer to Figure 3.4.B.

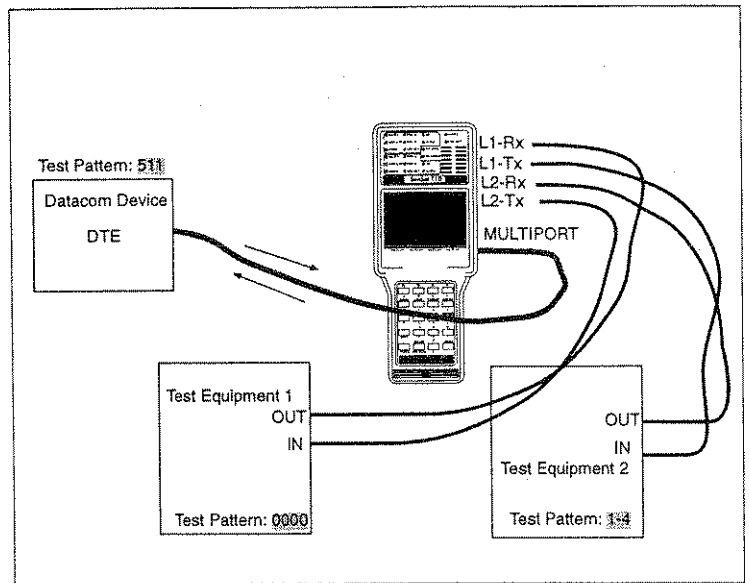


Figure 3.4.B
Emulating Add/Drop MUX

10. Press the HISTORY key to acknowledge any blinking lights and turn them off. Verify that the PAT SYNC LED is lit green and no red error LEDs appear.
11. Escape to the Main Menu. Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA. Verify that the T10 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 3.4.B, 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.
12. In the previous steps, you have verified that the SunSet is receiving a proper signal on both T1 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 T10 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.

13. If Test Equipment 2 is not capable of displaying its received data, you will need to plug a second SunSet T10 into the monitor jack. Turn the second T10 on and enter TEST CONFIGURATION. Configure this second T10 as follows:

TEST MODE: T1SINGL
RxLVL-1: DSXMON
FRAMING: As required
CODING: As required
Tx Source: NORMAL
XMTCLK: INTERN
TEST RATE: 1.544M
LBO 1&2 :As required

14. Connect Line 1 Rx to the MON jack of Equipment 2. Press the HISTORY key to acknowledge any blinking lights and turn them off.
15. Escape to the Main Menu. Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA. Verify that the Datacom's pattern is on the selected timeslots and that Equipment 1's pattern is on the other timeslots.
16. You have just verified the proper insert operation of the SunSet T10. Disconnect the test set(s) from the circuit and turn them off.

Chapter 7

ISDN Primary Rate

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Section 1 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 23B+D for high speed PRI (Primary Rate). Each B channel has 64 kbps availability for voice or data transport. The D channel is used for signalling and data communication; its capacity for BRI and PRI is 16 kbps and 64 kbps 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 digitized video communication.

1.2 ISDN Network Architecture

ISDN provides complete digital capabilities. In accordance with Figure 1.2.A, 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

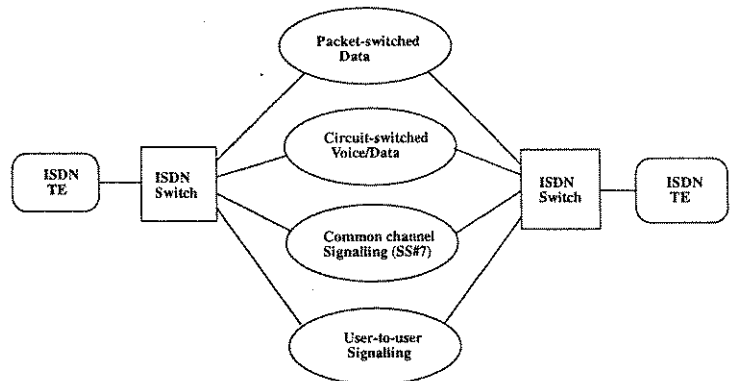


Figure 1.2.A
ISDN Architecture

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 when 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 1.3.A, 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 1.3.A
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 ISDN 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 E 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 1.4.A. There is an 8 bit flag at the end of each frame. Sixteen bits are used as the frame check sequence. The Address Field, Control Field, and Information Field are explained on the next page.

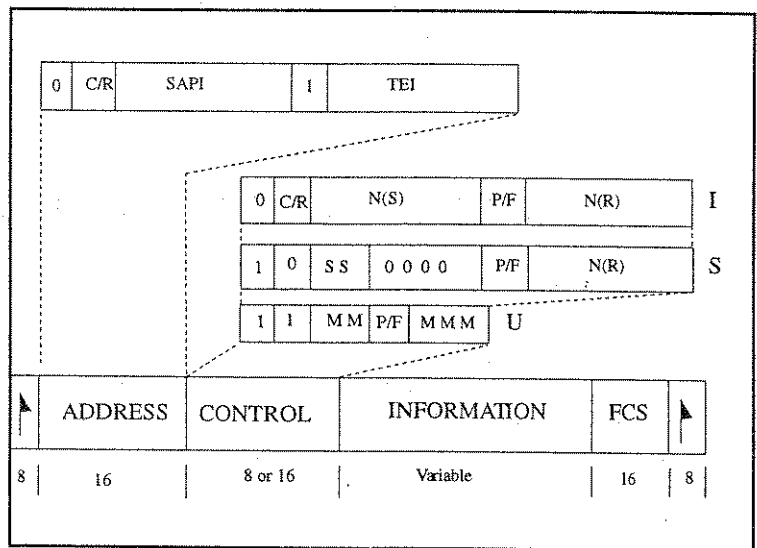


Figure 1.4.A
ISDN Frame Structure

Address Field

Address is composed of the TEI (Terminal Endpoint Identifier) and SAPI (Service Access Point Identifier). The TEI identifies the user device. SAPI 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. A SAPI of 0 is used for call control procedures for managing B channel circuits; the value 16 is reserved for packet-mode communication on the D channel using X.25 level 3; and a value of 63 is used for the exchange of layer 2 management information. Value 1 is 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 inter-exchange calls using SS#7.

Section 2 ISDN Primary Rate Analysis Menus (Option SW186)

ISDN Primary Rate provides the user with a comprehensive analysis of the ISDN protocol based on the CCITT Q.931 standard. The ISDN PRIMARY RATE menu, shown below in Figure 2.A, may be accessed through the OTHER MEASUREMENTS item in the Main Menu.

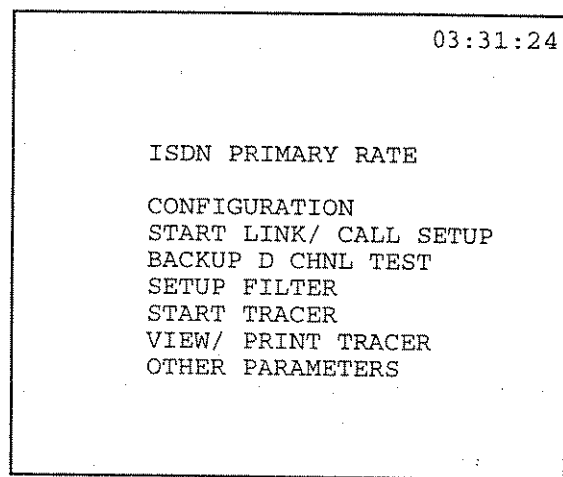


Figure 2.A
ISDN Primary Rate Menu

2.1 ISDN CONFIGURATION

ISDN CONFIGURATION allows you to configure your emulation type, standard protocol, and test pattern (for data calls) to be used during your ISDN analysis. Figure 2.1.A displays the ISDN CONFIGURATION screen.

```
03:31:27
CONFIGURATION
EMULATE TYPE : TE
Q.931 STD   : NTI
TEST PATTERN : 2047
USER PATTERN : 00110011
TE          NT
```

Figure 2.1.A
ISDN Configuration

1) EMULATE TYPE

F-Key Options: TE (F1), NT (F2)

This item configures the emulation mode for the test set. The two choices are: Terminating Equipment (F1) or Network Terminal (F2). TE is used when the test set is emulating a piece of customer equipment, while NT is used when the test set is emulating an ISDN switch, such as a DMS-100 or 5ESS. Figure 2.1.B displays the two uses.

The choice of emulation type temporarily changes the DS1 transmit clock source. NT uses the internal clock. TE uses the received signal to clock the transmitter. When you enter the ISDN PRIMARY RATE Menu, the clocking is determined by your Emulate Type setting. When you escape out of the ISDN PRIMARY RATE Menu, the set's transmit clock reverts to the TEST CONFIGURATION XMT CLOCK setting. There may be no clock at all if the test set is plugged into an ISDN PRI network element (i.e. PBX) and is set to TE.

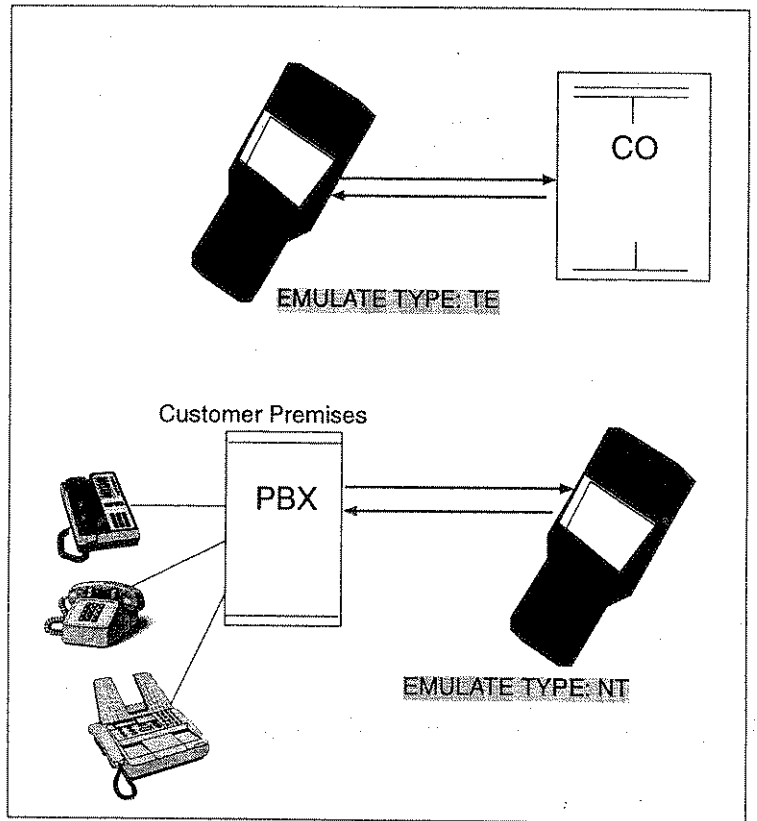


Figure 2.1.B
EMULATE TYPE

2) Q.931 STD

F-Key Options: AT&T (F1), NTI (F2), NATNL-2 (F3), ETSI (F4)

The Q.931 specification indicates which type of ISDN switch you intend to use for testing. Four choices are available: AT&T, NTI, ETSI, and NATNL-2. The AT&T option relates to the 5ESS switch. NTI relates to the Northern Telecom DMS-100 switch. If you are not certain which type of switch you are testing, then you may need to try each of the types.

3) TEST PATTERN

F-Key Options: 2047 (F1), 511 (F2), 127 (F3), 63 (more, F1), 1111 (more, F2), 0000 (more, F3), USER (more, F1)

The test pattern chosen here will be transmitted on the B channel during data calls. You may select your pattern by pressing the corresponding F-Key, as shown above. If you would like to transmit a USER pattern instead, press F1 (USER) and then enter your binary digits.

4) USER PATTERN

To send a USER pattern, you must first select USER (more, F1) for TEST PATTERN. Change the user pattern by pressing the SHIFT key and entering either a 1 or 0 to change the bit settings. You may also use the INSERT (F1) key to insert a bit, or the DELETE (F2) key to delete the length of the user pattern by one bit. The length of the user pattern may be up to one byte long.

After you escape the CONFIGURATION, the specified values become the configuration for the ISDN Analysis.

2.2 Start Link/ Call Setup

Upon entering this menu, the test set will automatically start the Layer 2 link. You should receive a message indicating USE LINE 1 ONLY FOR CALL SETUP! Then you should see flashing messages and a screen like Figure 2.2.A.

In the Start Link screen, a reverse-video indicator appears at the top of the screen. This indicator tells you the status of your D-channel and Layer 2 link. "READY" means that your D-channel is up and running and that your test set can send and receive calls. "NOT READY" means that your set is not yet able to place calls or receive them.

Note:

Make sure that you have specified the correct settings in the ISDN PRIMARY RATE, CONFIGURATION and OTHER PARAMETERS menus before entering the START LINK/CALL SETUP menu.

```
READY 23:38:41
CALL SETUP
SEND L1 SABME
SEND L1 UA
LINE 1
RECEIVED MESSAGE
Layer 2 mesg UA
SAPI:0 TEI:0
CALL more
```

Figure 2.2.A
Call Setup Screen

You will see the layer 2 ISDN messages. The screen will display the SEND and RECEIVED messages on the line. In Figure 2.2.A, the set has sent a SABME and UA and has received a UA on Line 1. These two are Layer 2 messages and are defined as:

- SABME- Set Asynchronous Balanced Mode Extended
- UA- Unnumbered Acknowledgment

You want to make sure that you have received either a UA or RR, Receive Ready, before placing a call.

To stop ISDN messages, press the more (F4), then press the STOP (F1) key. To see the previous or next messages press NEXT (F2) or PREVIOUS (F3). To restart the messages, simply press the RESTART (F1) key. Pressing STOP removes all connections to the D channel and the layer 2 messages will be stopped.

You should use this screen to place a voice/data call, receive a voice/data call, or see more information about your call.

2.2.1 Placing a Call

Press the CALL (F3) key to set up your call and then place it. Pressing this key brings up a second Call Setup screen, shown in Figure 2.2.B.

READY	23:58:16
START LINK/ CALL SETUP	
CALLED No. :	3638000
CALLER No. :	7771111
B CHANNEL #:	4
NSF CODE :	NONE
NSF TYPE :	SERVICE
CALL TYPE :	VOICE
NEXT	PREVIOUS call

Figure 2.2.B
Call Setup

To configure the call setup portion, review the following:

1) CALLED No.

The screen will prompt you to enter the CALLED No. This is the number that you intend to dial to place your call. The number may be entered directly from the keypad. To do this, press and release the SHIFT-lock key. Then enter your number. When you are finished, press and release the SHIFT-lock key to remove the SHIFT indicator (upper left-hand corner of the screen).

2) CALLER No.

Specifying a CALLER No. is optional. This is the telephone number which the ISDN switch uses to identify you on the network. If you wish to put in a number, press the SHIFT key. Then enter the digits directly from the keypad. When you are finished,

press the SHIFT-key again to release the SHIFT lock. If you do not wish to enter a number, press NONE (F4).

3) B CHANNEL

Options: 1-24, except for whichever channel you selected as your D-channel in Other Parameters. Channel 24 is normally used as the D-channel.

Specify the B channel onto which you will place the call. Use the NEXT (F1) or PREVIOUS (F2) keys to change the channel number. If you are placing a 46B + 2D call or a 47B + D call, you must also specify the B CHNL LINE. This selection specifies the PRI line on which you will place a call. Press (F1) for Line 1 or (F2) for Line 2.

4) NSF CODE

F-Key Options: NONE (F1), NEXT (F2), table (F4)

Specify the NSF CODE (Network Specific Facilities) using the NONE (F1) or NEXT (F2) keys. If you wish to enter a NSF CODE, it can be in the range from 0 to 31. This code specifies which network facilities are being invoked. Normally, for the TE mode, NSF is set to NONE, and for the NT mode, NSF is set to 2.

Also, you may wish to view NSF options as specified by either AT&T or Northern Telecom by pressing the table (F3) key. This table gives the NSF CODE for certain options.

5) NSF TYPE

F-Key Options: SERVICE (F1), FEATURE (F2), table (F4)

Specify the NSF type; this can either be FEATURE (F2) or SERVICE (F1). Also, you may wish to view the NSF Type options as specified by either AT&T or Northern Telecom by pressing the table (F3) key. This table gives the NSF TYPE and NSF CODE for certain options.

6) CALL TYPE

F-Key Options: VOICE (F1), DATA-56 (F2), DATA-64 (more, F1), Nx56K (more, F2), 3.1k-AUD (more, F1)

This item determines what kind of call you are going to place. Specify the CALL TYPE by pressing the corresponding F-Key.

Press (F1) to place a voice call. DATA-56 (F2) pertains to the 56 Kbps data rate and DATA-64 (more, F1) to the 64 Kbps data rate. Nx64 (more, F2) pertains to the multirate ISDN PRI with 64K for each channel. For Nx64, select the 64k channels using the SELECT (F2) key. You may also press the AUTO (F1) key to automatically configure onto active received Nx64 channels. Lastly, press 3.1k-AUD (more, F1) to use the 3.1 kHz audio bearer service for voice (analog) data.

Note:

At any time, you may press the call (F4) key or ENTER to begin your call.

Disconnecting:

By pressing F2, you will be disconnecting (hanging up) and releasing the line. If you are satisfied with your call after it has connected with the switch, you should press the DISC key.

2.2.2 Viewing Call Information

When a data/voice call is successfully placed or received, press the INFO (F1) key to display information about the call. Refer to Figure 2.2.C.

```
CALL No: 1
CREF No: 1      DIR - SEND OUT
Bch CFG: TERM
BEARER .: DATA-56 CHANNEL: 1
CLED ID: 363-8000
```

Figure 2.2.C
ISDN INFO Screen

CALL NO.

This is the called number.

CREF NO.

This identifies which of the active cells is affected by the message.

DIR

This shows the direction of the call. Either SEND OUT, for placing a call, or RECEIVE, for receiving a call, will be displayed.

Bch CFG

This specifies the B channel configuration: TERM or LOOP.

BEARER

This displays the type of call. Either VOICE, DATA-56, or DATA-64 will be displayed.

CHANNEL

This displays the B channel that is being used to make or receive the call.

CLED ID

The called id displayed.

2.2.3 Performing a BERT test

After a data call is successful, the BER (more, F2) F-Key is available. This key brings up the BER measurement screen. The screen presents the measurement parameters specified in G.821. It includes BIT, BER, ES, %ES, SES, %SES, EFS, %EFS, UAS, %UAS, AS, and %AS. Only DATA-64, DATA-56, and NX64 CALL TYPES in the CALL mode can give BER measurements. Refer to Figure 2.2.D.

```
03:31:27
ET - 000:00:40
TX B#- 1      RX B#- 1
PATT - 2047   RATE - 56K
RESULTS
BIT  : 13      BER  : 1.4e-06
ES   : 4       %ES  : 02.345
SES  : 4       %SES  : 00.000
EFS  : 341     %EFS  : 98.349
UAS  : 0       %UAS  : 00.000
AS   : 435     %AS   : 1000
RESTART HOLDSCR
```

Figure 2.2.D
ISDN BER Measurements

Note: When viewing BER measurements, verify that the PAT SYNC LED is lit green, as well as the appropriate framing LED. These two LEDs signify that the patterns and framing match for the transmitting and receiving patterns.

Two F-Keys are given in this screen:

RESTART (F1)- This key restarts the measurements. All results will be cleared and the ET (Elapsed Time) starts at 00:00.

HOLDSCR (F2)- This key freezes the measurement screen so you may read your results clearly. The SunSet will continue to take measurements in the background, but the measurements will not be updated on the screen until you press CONTINU (F2).

2.2.4 Receiving a Call

You must be in the START LINK/CALL SETUP screen with the READY indicator showing to receive a call. When there is an incoming voice or data call, the SunSet will ring and the screen will appear as in Figure 2.3.E.

```
14:05:23  
  
CALL SETUP  
RECEIVE A CALL  
  
LINE 1  
RECEIVED MESSAGE  
SETUP MESSAGE :  
CREF No. : 549  
BEARER : VOICE CHANNEL : 1  
CLER ID: 4083631331  
TYPE- 2 NPI- 1  
CLED ID: 408363800  
TYPE- 4 NPI- 1  
  
REJECT ACC-TERM
```

Figure 2.2.E
Receiving a Call Screen

You have the option to accept this call, ACC-TERM (F2), or to reject it, REJECT (F1). ACC-TERM accepts the call in a terminated mode. This means that you can talk and listen for voice calls (as opposed to only listening). For data calls, you will be transmitting your own pattern, as selected in ISDN CONFIGURATION, and can inject errors.

If a second call should come in while you are still connected to your first call, the set will ring. You have the choice of accepting or rejecting this second call. For accepting, there are two options available to you:

ACC-TERM (F2)

Press ACC-TERM (F2) to accept the call in the terminated mode. For voice calls, this means that you may talk and be heard on the other side of the call. For data calls, you may insert errors to the other side.

ACC-LOOP (F3)

In this mode, you can only hear the incoming voice but not be heard on the other side for voice calls. For data, you can only receive the data and not insert errors on the other side.

2.3 BACKUP D CHANNEL TEST

The test set automatically configures to 46B+D+D upon entering the Backup D Channel Test. In this state, information is transferred on 46 B channels on both Line 1 and Line 2; however, only one D channel controls the transmission. The other D channel acts as a backup and becomes activated when the first D channel is no longer in service.

NOTE: You must be in T1DUAL mode to use the backup D channel. Also, your Emulation Mode must be set to TE to access the Backup D Channel Test.

This feature checks the backup D channel service. It shows the status for both Line 1 and Line 2. In this screen, the F-keys provide three options. D1SC (F2) disconnects and releases the line. When you are satisfied with your call after it has connected with the switch, press the DISC key. CALL (F3) brings you to the CALL SETUP screen, where you may place a call. L-STAT (F1) displays the status for both Line 1 and Line 2. The L-STAT screen is shown below in Figure 2.3.A.

```
00:15:33  
  
LINE 1:  
D-CHANNEL NO - 24  
INTERFACE ID - 0  
In service  
  
LINE 2:  
D-CHANNEL NO - 24  
INTERFACE ID - 0  
Stand By  
  
DROP-L1   DROP-L2
```

Figure 2.3.A
Backup D Channel Status Screen

The following fields will be displayed for each line:

D-CHANNEL No.

This displays the channel number used for the D-channel. The D-channel numbers for each line may be set in OTHER PARAMETERS.

INTERFACE ID

This displays the Interface ID configured for the line. Both line's interface id's may be configured in OTHER PARAMETERS.

Status Message

Depending on the status of the D-channel, one of the following messages will be displayed:

Manual out of service (MOOS): In this state, the D-channel is not available. The D-channel may be moved to an available state only by manual intervention on the near-end.

Out of Service: In this state, the D-channel is not available and the maintenance entity will periodically attempt to move the channel to an in-service state.

In service: In this state, the D-channel is available for transfer of call control and other Layer 3 messages.

Stand by: In this state, only Layer 2 messages are established, but the service is not yet available for the transfer of Layer 3 messages. If the other line's D-channel should be made unavailable, then this D-channel will move to In-service.

Note: Depending on the status of the particular line, one of the following messages may be displayed:

Sig Loss: This indicates that the line has a loss of signal.

Frm Loss: This indicates that the line has a loss of framing.

2.4 SETUP FILTER

There are 4 parameters for filtering the ISDN messages. After selecting the particular parameter, enter the numeric value in the NUMBER field. The 4 parameters are as follows:

1. CALLREF - Call REFERENCE number. This number identifies which active call a message belongs to. The call reference number is established with Set-up message and is used on all following messages for that call. This value should be entered in decimal format.
2. CALLED# - CALLED Number is the destination number of the transaction. This value should be entered in octet format.
3. CALLER# - CALLER number is the originating number of the transaction. This value should be entered in octet format.
4. NONE - NONE provides no filtering elements. This allows the test set to capture all ISDN messages.

If you selected either CALLREF, CALLER #, or CALLED #, cursor down to NUMBER and enter the desired number using the SHIFT and number keys. If you should make a mistake while entering, unlock the SHIFT command and move the cursor to the incorrect number. Then press the SHIFT- key and enter the correct number. However, please be aware that any entered numbers to the right will be erased with this typeover.

2.5 START TRACER

START TRACER begins the tracing of ISDN messages in accordance with the filtering parameters set up in SETUP FILTER. Three function keys are available in this screen.

RESTART

RESTART will empty the existing buffer and restart the tracing process.

PAUSE/ RESUME

PAUSE stops the tracing process, but does not empty the buffer. No tracing is performed while the test set is in pause. RESUME will continue the tracing.

DECODE/ HEX

DECODE will decode the ISDN messages in detail. HEX will display the messages in hexadecimal format.

2.6 VIEW/ PRINT TRACER

This feature allows you to view and print specific data captured by the SunSet. The VIEW/ PRINT screen is displayed in Figure 2.6.A.

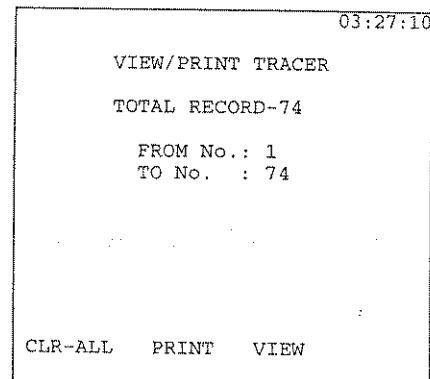


Figure 2.6.A
ISDN VIEW/ PRINT TRACER Screen

Three function keys are available in this screen:

CLR-ALL (F1)

This option 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 contents.

PRINT (F2)

This option will print the contents of the buffer.

VIEW (F3)

VIEW shows the contents of the buffer, as specified by the VIEW FROM and VIEW TO settings. First set these settings, then press (F3). The received messages will be shown individually on the screen. A sample screen is shown below in Figure 2.6.B.

```
02:21:46  
  
RECEIVE MSG NO 11  
  
RECEIVED MESSAGE  
LINE 1  
95- 01- 01      01: 13: 51. 18  
02 01 06 04 08 01 00 46 18 03  
A9 83 97 79 01 80 10 22  
  
PAGE-UP      PAGE-DN      DECODE
```

Figure 2.6.B
ISDN VIEW Screen

This screen displays one message. You may view other pages of messages by pressing the (F1) and (F2) keys to page-up or page-down respectively. The message in Figure 2.6.B is shown in hexadecimal code. The third F-key, DECODE, will decode the hexadecimal digits. Figure 2.6.C shows the decoded version of Figure 2.6.B's hex. message.

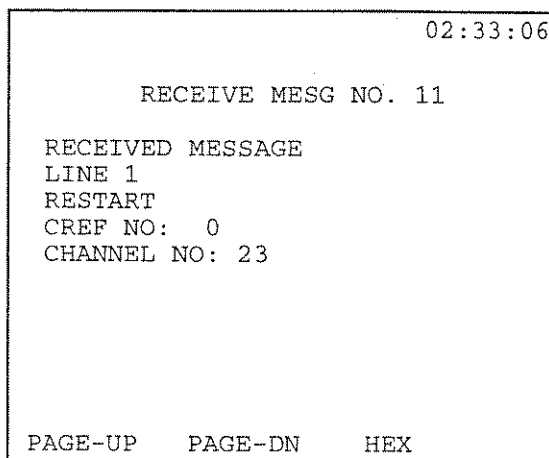


Figure 2.6.C
ISDN VIEW Message Screen, DECODE

In the decoded screen, we can see that this is a RESTART message with a call reference number 0. In this screen, (F3) gives us the option to show the message in hexadecimal format. Press ESCAPE when you are finished viewing.

2.7 OTHER PARAMETERS

OTHER PARAMETERS allows you to set other specifications for the ISDN analysis. The OTHER PARAMETERS Menu is shown in Figure 2.7.A.

```
03:31:27

OTHER PARAMETERS

LINE 1 D chnl : 24
L2 Bkup D chnl : 24
Layer 2 SAPI : 0
Layer 2 TEI : 0
L1 INTRFACE ID : 0
L2 INTRFACE ID : 1
47B + D CONFIG : DISABLE

NEXT PREVIUS
```

Figure 2.7.A
ISDN Other Parameters

You may configure the following specifications in OTHER PARAMETERS.

1) Line 1 D chnl

Options: 1-24

Use the F-Keys, NEXT (F1) or PREVIUS (F2), to select a D Channel from 1 to 24. This specifies the Line 1 D channel for ISDN 23B+D, 46B+2D, and 47B+D.

2) L2Bkup D chnl

Options: 1-24

Use the F-Keys, NEXT (F1) or PREVIUS (F2), to select a D Channel from 1 to 24. This specifies the backup D channel for Line 2 for 46B+2D. In 46B + 2D, one D channel is active at a time; the other channel is in standby mode and can become active if the first one should go out of service. You can view the status of the B channels in Backup D Channel Test.

3) Layer 2 SAPI

Options: 0-63

Use the F-Keys, INC+10 (F1), INC+1 (F2), DEC-10 (F3), DEC-

1 (F4), to select your SAPI value. The Service Access Point Identifier identifies the point where Layer 2 services are provided to a Layer 3 entity. For your SAPI value, you may select a number in the range of 0 to 63. At this point, there are four assigned SAPI values:

- 0 Call Control Procedures
- 1 Packet Mode using Q.931 Call procedures.
- 16 Packet communications conforming to X.25 Level 3 procedures.
- 63 Layer 2 management procedures.

All other values are reserved for future use.

Note: A value of 0 is normally used.

4) Layer 2 TEI

Options: 0-127

Use the F-Keys, INC+10 (F1), INC+1 (F2), DEC-10 (F3), DEC-1 (F4), to select the TEI number. The Terminal Endpoint Identifier identifies the terminal to which the message is intended. You may select a value in the range of 0 to 127. The values are grouped as follows:

- 0-63 Fixed TEI assignment
- 64-126 Automatic assignment
- 127 Group TEI for broadcast data link connection

Note: A value of 0 is normally used.

5) L1 INTERFACE ID

Options: 0-127

You may enter a value from 0 to 127.

6) L2 INTERFACE ID

Options: 0-127

You may enter a value from 0 to 127.

7) 47B + D CONFIGURE

F-Key Options: ENABLE (F1), DISABLE (F2)

Choose ENABLE (F1) to configure for a 47B+D ISDN emulation or DISABLE (F2) for 23B+D or 46B+2D ISDN emulation.

Section 3 Applications

3.1 ISDN PRI Call Setup

This procedure outlines an ISDN call.

- 1) Verify that the span is not in service. This ISDN call will disrupt service.
- 2) Switch on the test set.
- 3) From the main menu, enter the TEST CONFIGURATION item. Configure the screen settings for:
 - TEST MODE: T1SINGL
 - RXLVL-1: TERM
 - FRAMING: as specified by your design
 - CODING: as specified by your design
 - Tx SOURCE: NORMAL
 - XMT CLOCK: L1-Rx
 - LBO 1: 0 dB (ft)
 - TEST RATE: 1.544M
- 4) Enter SEND TEST PATTERN and select 1-in-8. You should use 1-in-8 for all ISDN applications; QRS may bring down the switch.
- 5) Connect the test set to the circuit as shown in Figure 3.1.A, if you are emulating terminal equipment (TE) or 3.1.B, if you're emulating a network terminal (NT). Press the HISTORY key to acknowledge the blinking history lights and turn them off.

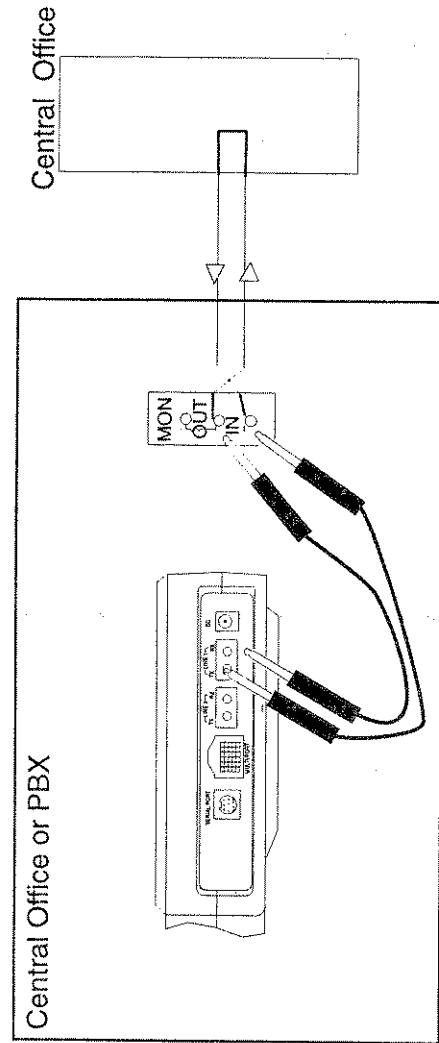


Figure 3.1.A
ISDN Call Setup- TE Mode

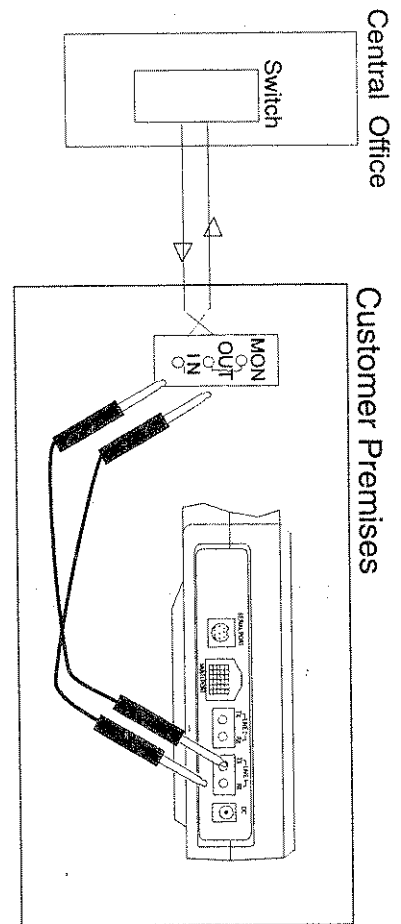


Figure 3.1.B
ISDN Call Setup- NT Mode

- 6) Move the cursor to OTHER MEASUREMENTS, VIEW RECEIVED DATA. Page down using the PAGE-DN (F2) key to view T/S 24. You should see six consecutive ones together with two zeroes. If you do not see this, then your D-channel may not be set up to handle ISDN messages.

- 7) Escape out and go to ISDN PRIMARY RATE. Set up the CONFIGURATION and OTHER PARAMETERS screen according to your circuit.
- 8) Escape out and enter the START LINK/CALL SETUP menu. Check to see if a READY message is displayed. This signifies that the D-channel is up and running. Set up the call by pressing CALL (F3). Enter the desired parameters. Press call (F4) to place a call.

Note: The SunSet T10 is able to call itself. If you choose to do so, you must acknowledge the call. When you hear ringing or see the "Receive a Call" message, press Acc-Loop (F3) to accept the looped call. When you are finished, you may press either DISC-1 or DISC-2, if it is an option, to disconnect the line. This ability allows you to test two channels at once.

- 9) You should see a SEND L1 CONNECTION ACKNOWLEDGE message. After you are finished with the call press DISC (F2).
- 10) Disconnect your test set from the circuit and turn the set off.

3.2 ISDN PRI Monitoring

This procedure illustrates making an ISDN call.

- 1) This test may be performed while the PRI line is in-service.
- 2) Switch on the test set.
- 3) From the Main Menu, enter TEST CONFIGURATION. Configure the screen settings for:
 - TEST MODE: T1DUAL
 - Tx/INSERT: L1-Tx
 - Rx/DROP: L1-Rx
 - RXLVL-1: DSXMON
 - RXLVL-2: DSXMON
 - Tx SOURCE: TESTPAT
 - FRAMING: as specified by your design
 - CODING: as specified by your design
 - XMT CLOCK: L1-RX

TEST RATE: 1.544M
LBO 1&2: 0 dB (ft) (or as required)

When you have completed these settings, press ENTER to return to the Main Menu.

- 4) Enter SEND TEST PATTERN and select 1-8. 1-8 is a good pattern to use for ISDN applications; QRS may bring down the switch.
- 5) Connect the your Line 1 and Line 2 Rx jacks to the DSX Monitor jacks, as shown in Figure 3.2.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off. You may perform this test anywhere you have access to the T1 circuit, i.e. central office, customer premises, span.

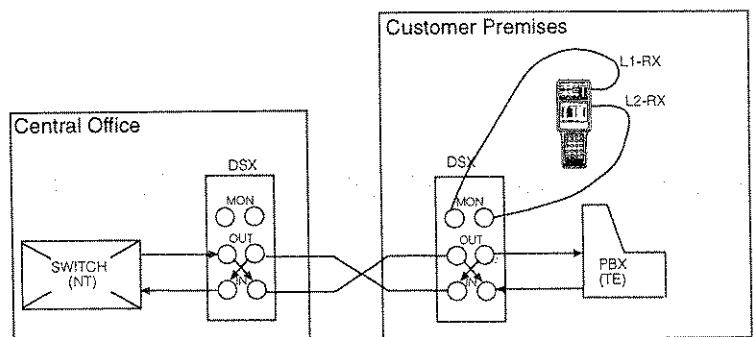


Figure 3.2.A
ISDN Monitoring

- 6) Move the cursor to OTHER MEASUREMENTS, VIEW RECEIVED DATA. Page down using the PAGE-DN (F2) key to view T/S 24. You should see six consecutive ones together with two zeroes, for example, 00111111, 11001111, 11110011. The zeroes may or may not be scrolling depending on your switch. 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 and go to ISDN PRIMARY RATE. Enter CONFIGURATION. Select TE as your Emulate Type and choose your Q.931 standard according to your circuit.

- 8) Escape out to the ISDN Menu and enter Other Parameters. Check these settings and decide if you need to change any. Refer to Section 2.7 of this Chapter for information on the particular settings.
- 9) If you want to capture only a select group of messages, enter SETUP FILTER from the ISDN Menu. Here you may choose to capture only messages with a certain Call Reference value, Called Number, or Caller Number. To do so, with the cursor at FILTER TYPE, press the F-Key corresponding to your desired type. Then use the down arrow key to cursor down to NUMBER. Press the SHIFT key so the SHIFT indicator appears at top. Then enter the correct numbers from the keypad. When you have finished, press the SHIFT key again to release the SHIFT indicator. If you want to capture all messages, select NONE (F4) for Filter Type.
- 10) Escape out and enter the START TRACER. You should now see both LINE 1 and LINE 2 ISDN messages being sent and received if a call is being placed at either end. Press PAUSE (F2) to pause the messages. The RESTART (F1) key will restart the tracing process.
- 11) Escape and enter into the VIEW/PRINT TRACER screen. At the initial screen, you may choose to view or print all the messages, or a certain number of messages. To view/print a select number, make sure that the cursor is on the VIEWFROM line. Press the SHIFT key and enter the number of the message you wish to start viewing at. Press the SHIFT key again to release the SHIFT indicator and cursor down to VIEW TO. Use the same process to enter in the message number where you will stop viewing.
- 12) When you have finished monitoring, disconnect your test set from the circuit and turn the set off.

3.3 ISDN PRI Data Call Setup

This procedure illustrates making an ISDN Data call. You can make a point to point call as shown in Figure 3.3.A, or you can call

a loopback device as shown in Figure 3.3.B. Calling a loopback device is quicker and less labor intensive. If you call point to point, be sure each test set is transmitting the same pattern.



Figure 3.3.A
Point to Point Call

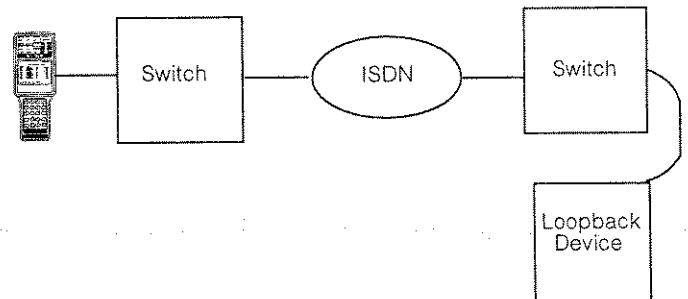


Figure 3.3.B
Loopback Call

- 1) Verify that the span is not in service. This ISDN call will disrupt service.
- 2) Switch on the test set.
- 3) From the Main Menu, enter the TEST CONFIGURATION item.
Configure the screen settings for:
TEST MODE: T1SINGL
RXLVL-1: TERM
FRAMING: as specified by your design
CODING: as specified by your design
Tx SOURCE: NORMAL
XMT CLOCK: L1-RX
LBO 1: 0 dB (ft)
TEST RATE: 1.544M

- 4) Connect the test set to the circuit as shown in Figure 3.1.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 5) Move the cursor to OTHER MEASUREMENTS, VIEW RECEIVED DATA. Page down using the PAGE-DN (F2) key to view T/S 24. You should see six consecutive ones together with two zeroes; for example, 00111111, 11001111, 11110011. If you do not see this, then your D-channel may not be set up to handle ISDN messages.
- 6) Escape out and go to ISDN PRIMARY RATE. Set up the CONFIGURATION and OTHER PARAMETERS screen according to your circuit.
- 7) Escape out and enter the START LINK/CALL SETUP menu. Wait and verify that the reverse video word on top says READY to signify the D-Channel is operational. Set up the call by pressing CALL (F3). Enter the desired parameters making sure that the CALL TYPE is DATA-56 (F3) or DATA-64 (F2) using the more (F1) key. Press call (F4) to place the call.
- 8) You should see a SEND L1 CONNECTION ACKNOWLEDGE message. Once a connection has been made press the BER (F2) key to display your BERT measurements.
- 9) After you are finished with the call press DISC (F2).
- 10) Disconnect your test set from the circuit and turn the set off.

3.4 Emulate a ISDN Network Terminal or PBX

This procedure illustrates how the SunSet T10 can replace a NT or PBX.

- 1) Verify that the span is not in service. This ISDN call will disrupt service.
- 2) Switch on the test set.
- 3) From the Main Menu, enter the TEST CONFIGURATION item.

Configure the screen settings for:

TEST MODE: T1SINGL

RXLVL-1: TERM

FRAMING: as specified by your design

CODING: as specified by your design

Tx SOURCE: NORMAL

XMT CLOCK: INTERN

LBO 1: 0 dB (ft)

TEST RATE: 1.544M

- 4) Enter SEND TEST PATTERN and select 1-8. QRSS may bring down the switch.
- 5) Connect the test set to the circuit as shown in Figure 3.1.B. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 6) Move the cursor to OTHER MEASUREMENTS, VIEW RECEIVED DATA. Page down using the PAGE-DN (F2) key to view T/S 24. You should see six consecutive ones together with two zeroes; for example, 00111111, 11001111, 11110011. If you do not see this, then your D-channel may not be set up to handle ISDN messages.
- 7) Escape out and go to ISDN PRIMARY RATE. Set up the CONFIGURATION and OTHER PARAMETERS screen according to your circuit. Make sure to set up EMULATE TYPE to NT in CONFIGURATION.
- 8) Escape out and enter the START LINK/CALL SETUP menu. Wait and verify that the reverse video word on top says READY to signify the D-Channel is operational.
- 9) You are now emulating a ISDN NT device able to receive or place a call.
- 10) Once finished, escape out, disconnect your test set from the circuit and turn the set off.

3.5 46B+2D Call Setup

This procedure illustrates making an ISDN call on a 46B+2D ISDN line. AT&T requires NATL-2 protocol to perform this test.

- 1) This test is performed while the line is out of service.
- 2) Switch on the test set.
- 3) From the Main Menu, enter TEST CONFIGURATION. Configure the screen settings for:
TEST MODE: T1DUAL
Tx/INSERT: L1-Tx
Rx/DROP: L1-Rx
RXLVL-1: TERM
RXLVL-2: TERM
Tx SOURCE: TESTPAT
FRAMING: as specified by your design
CODING: as specified by your design
XMT CLOCK: L1-Rx
LBO 1&2: 0 dB (ft) (or as required)
TEST RATE: 1.544M
- 4) Connect the test set to the circuit as shown in Figure 3.5.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

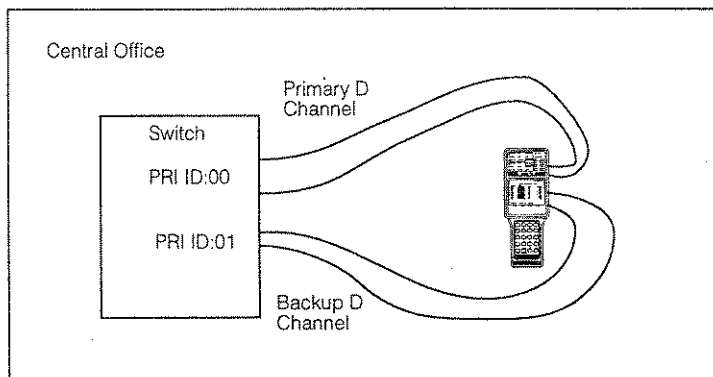


Figure3.5.A
Back-up D Channel

- 5) Escape out and go to ISDN PRIMARY RATE. Set up the CONFIGURATION screen according to your circuit making sure the EMULATE TYPE is set for TE.
- 6) Escape out and enter the OTHER PARAMETERS menu. Set up LINE 1 D-Channel and LINE 2 BACKUP D-Channel found in Line 1 D chnl and L2 Bkup D chnl, respectively.
- 7) Escape out and enter the BACKUP D CHNL TEST. You should now see both LINE 1 and LINE 2 ISDN messages being sent and information about a message being received for either LINE 1 or LINE 2.
- 8) Press the L-STAT (F1) to display the status of both lines. LINE 1 should display "In service" and LINE 2 should display "Standby". If you wish to test whether or not LINE 2 acts as a backup PRI line, then press DROP-L1 (F1) to manually drop LINE 1. LINE 1 should display "Manual out of service" and LINE 2 should change now to "In service". To establish LINE 1 once again press EST-L1 (F1) and it should now display "Stand by". Wait until this changes to "In-Service."
- 9) Escape out and press CALL (F3). Now enter the specific parameters related to your call making sure to select either LINE 1 or LINE 2 for your B channel (B CHNL LINE). When you have completed your settings, press CALL (F3).
- 10) When your call has been successfully placed and received, you should see SEND L1 CONNECTION ACKNOWLEDGE.
- 11) After you are finished with the call press DISC (F2).
- 12) Disconnect your test set from the circuit and turn the set off.

3.6 47B+D Call Setup

This procedure illustrates making an ISDN call on a 47B+D ISDN line. This test must be performed while the circuit is out-of-service.

- 1) Switch on the test set.
- 2) From the Main Menu, enter TEST CONFIGURATION. Configure

the screen settings for:
TEST MODE: T1DUAL
Tx/INSERT: L1-Tx
Rx/DROP: L1-Rx
RXLVL-1: TERM
RXLVL-2: TERM
Tx SOURCE: TESTPAT
FRAMING: as specified by your design
CODING: as specified by your design
XMT CLOCK: L1-Rx
LBO 1&2: 0 dB (ft) (or as required)
TEST RATE: 1.544M

- 3) Connect the test set to the circuit as shown in Figure 3.6.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

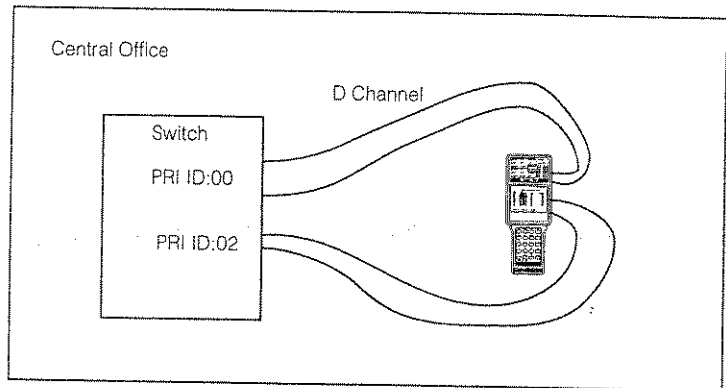


Figure 3.6.A
47B + D

- 4) Move the cursor to OTHER MEASUREMENTS, VIEW RECEIVED DATA. Page down using the PAGE-DN (F2) key to view T/S 24. You should see six consecutive ones together with two zeroes. If you do not see this, then your D-channel is not set up to handle ISDN messages.
- 5) Escape out and go to ISDN PRIMARY RATE. Set up the CONFIGURATION screen according to your circuit making sure the EMULATE TYPE is set for TE.

- 6) Escape out and enter the OTHER PARAMETERS menu. Set up LINE 1 D-Channel. Set up for 47B+D emulation by setting the 47B+D CONFIG to ENABLE. Note that the L2 INTERFACE ID will automatically change to 2, when 47B + D is enabled.
- 9) Escape out to the ISDN menu and enter PLACE/RECEIVE CALLS. Press the CALL (F3). Now enter the specific parameters related to your call making sure to select either LINE 1 or LINE 2 to place the B-channel call found in B CHNL LINE.
- 10) When your call has been successfully placed and received, you should see either a SEND L1 CONNECTION ACKNOWLEDGE.
- 11) After you are finished with the call press DISC (F2).
- 12) Disconnect your test set from the circuit and turn the set off.

3.7 Receiving two simultaneous B-Channel calls

This procedure illustrates receiving two simultaneous B-Channel calls.

- 1) Verify that the span is not in service. This ISDN call will disrupt service.
- 2) Switch on the test set.
- 3) From the main menu, enter the TEST CONFIGURATION item. Configure the screen settings for:
TEST MODE: T1SINGL
RXLVL-1: TERM
FRAMING: as specified by your design
CODING: as specified by your design
Tx SOURCE: NORMAL
XMT CLOCK: L1-Rx
LBO 1: 0 dB (ft)
TEST RATE: 1.544M
- 4) Enter SEND TEST PATTERN and select 1-in-8; QRSS may

bring down the switch.

- 5) Connect the test set to the circuit as shown in Figure 3.1.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
- 6) Move the cursor to OTHER MEASUREMENTS, VIEW RECEIVED DATA. Page down using the PAGE-DN (F2) key to view T/S 24. You should see six consecutive ones together with two zeroes; for example, 00111111, 11001111, 11110011. If you do not see this, then your D-channel is not set up to handle ISDN messages.
- 7) Escape out and go to ISDN PRIMARY RATE. Set up the CONFIGURATION and OTHER PARAMETERS screen according to your circuit. Make sure to set up EMULATE TYPE to TE in CONFIGURATION.
- 8) Escape out and enter the START LINK/CALL SETUP menu. Wait and verify that the reverse video word on top says READY to signify the D-Channel is operational.
- 9) When a call is received you should see a "RECEIVE A CALL" message, press the ACC-TERM (F2) message to accept the first call in a terminated mode. Press INFO (F1) for more information on the first call. Press escape to return to the CALL SETUP screen.
- 10) When another call is received you should see a "RECEIVE A CALL" message, now ACC-TERM (F2) and ACC-LOOP (F3) keys are available. Pressing INFO (F1), you should now have a display information about both calls. A sample INFO screen is shown on the following page.

CALL No.1
CREF No:579 DIR - RECEIVE
Bch CFG: TERM Bch LN#: LINE 1
BEARER: VOICE CHANNEL: 3
CLER ID: 4083638000

CALL No.2
CREF No:580 DIR - RECEIVE
Bch CFG: LOOP Bch LN#: LINE 1
BEARER: VOICE CHANNEL: 10
CLER ID: EMPTY

11) Once finished disconnect from either call by pressing the DISC-1 (F2) for CALL No.1 or DISC-2 (F3) for CALL No. 2.

12) Disconnect your test set from the circuit and turn the set off.

Annex Q.931 Cause Values

Class: Normal Event

No.	Cause Value		Definition
	Class	Value	
	7 6 5	4 3 2 1	
1	0 0 0	0 0 0 1	Unallocated (unassigned) number
2	0 0 0	0 0 1 0	No route to specified transit network
3	0 0 0	0 0 1 1	No route to destination
6	0 0 0	0 1 1 0	Channel Unacceptable
16	0 0 0	0 1 1 0	Normal call clearing
17	0 0 1	0 0 0 0	User Busy
18	0 0 1	0 0 1 0	No user responding
19	0 0 1	0 0 1 1	No answer from user (user alerted)
21	0 0 1	0 1 0 1	Call rejected
22	0 0 1	0 1 1 0	Number changed
27	0 0 1	1 0 1 1	Destination out of order
28	0 0 1	1 1 0 0	Invalid number format (address incomplete)
29	0 0 1	1 1 0 1	Facility rejected
30	0 0 1	1 1 1 0	Response to <i>STATUS ENQUIRY</i>
31	0 0 1	1 1 1 1	Normal, unspecified

Class: Resource Unavailable

No.	Cause Value		Definition
	Class	Value	
	7 6 5	4 3 2 1	
34	0 1 0	0 0 1 0	No circuit/channel available
41	0 1 0	1 0 0 1	Temporary failure
42	0 1 0	1 0 1 0	Switching equipment congestion
43	0 1 0	1 0 1 1	Access information discarded
44	0 1 0	1 1 0 0	Requested circuit not available
47	0 1 0	1 1 1 1	Resources unavailable, unspecified

Class: Service or Option not Available

No.	Cause Value	Definition
	<u>Class Value</u>	
	7 6 5 4 3 2 1	
50	0 1 1 0 0 1 0	Requested facility not subscribed
54	0 1 1 0 1 1 0	Incoming calls barred
57	0 1 1 1 0 0 1	Bearer capability not authorized
58	0 1 1 1 0 1 0	Bearer capability not presently available
63	0 1 1 1 1 1 1	Service or option not available, unspecified

Class: Service or Option not Implemented

No.	Cause Value	Definition
	<u>Class Value</u>	
	7 6 5 4 3 2 1	
65	1 0 0 0 0 0 1	Bearer capability not implemented
66	1 0 0 0 0 1 0	Channel type not implemented
70	1 0 0 0 1 1 0	Only restricted digital information, bearer capability is available
79	1 0 0 1 1 1 1	Service or option not implemented, unspecified

Class: Invalid Message

No.	Cause Value	Definition
	<u>Class Value</u>	
	7 6 5 4 3 2 1	
81	1 0 1 0 0 0 1	Invalid call reference value
82	1 0 1 0 0 1 0	Identified channel does not exist
88	1 0 1 1 0 0 0	Incompatible destination
90	1 0 1 1 0 1 0	Destination address missing, and direct call not subscribed
95	1 0 1 1 1 1 1	Invalid message, unspecified

Class: Protocol Error

No.	Cause Value		Definition
	<u>Class</u>	<u>Value</u>	
	7 6 5	4 3 2 1	
96	1 1 0	0 0 0 0	Mandatory information element is missing
97	1 1 0	0 0 0 1	Message type non-existent or not implemented
99	1 1 0	0 0 1 1	Information element non-existent or not implemented
100	1 1 0	0 1 0 0	Invalid information element contents
101	1 1 0	0 1 0 1	Message incompatible with call state
102	1 1 0	0 1 1 0	Recovery on timer expiry
111	1 1 0	1 1 1 1	Protocol error, unspecified

Class: Interworking Class

No.	Cause Value		Definition
	<u>Class</u>	<u>Value</u>	
	7 6 5	4 3 2 1	
127	1 1 1	1 1 1 1	Interworking, unspecified

Chapter 8 SS7 Analysis

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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 inter-processor transaction for call/remote control, maintenance/network management signalling. This is 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 1.1.A.

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 1.1.A, 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.

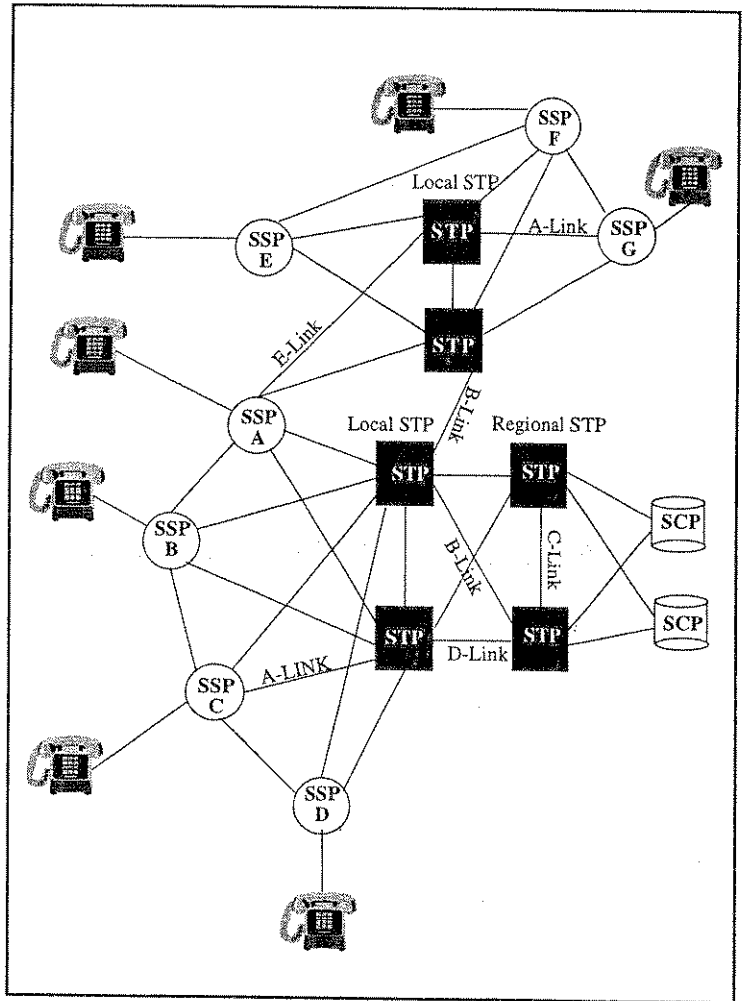


Figure 1.1.A
SS#7 Network

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 1.2.A illustrates the correlation.

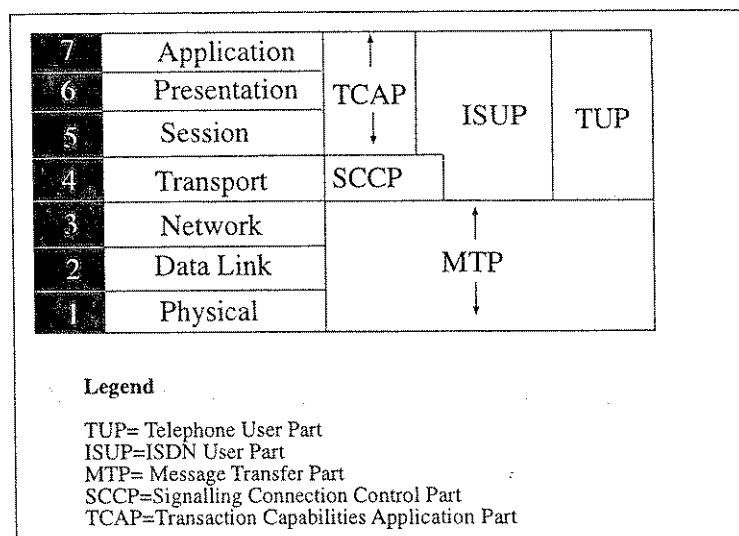


Figure 1.2.A
SS#7 and OSI Protocol Architecture

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 function.

- *Level 1 (Physical Level)*- provides the physical, electrical, and procedural characteristics of a SS7 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 segmentation 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 Kb/s 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 SS7

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 1.3.A.

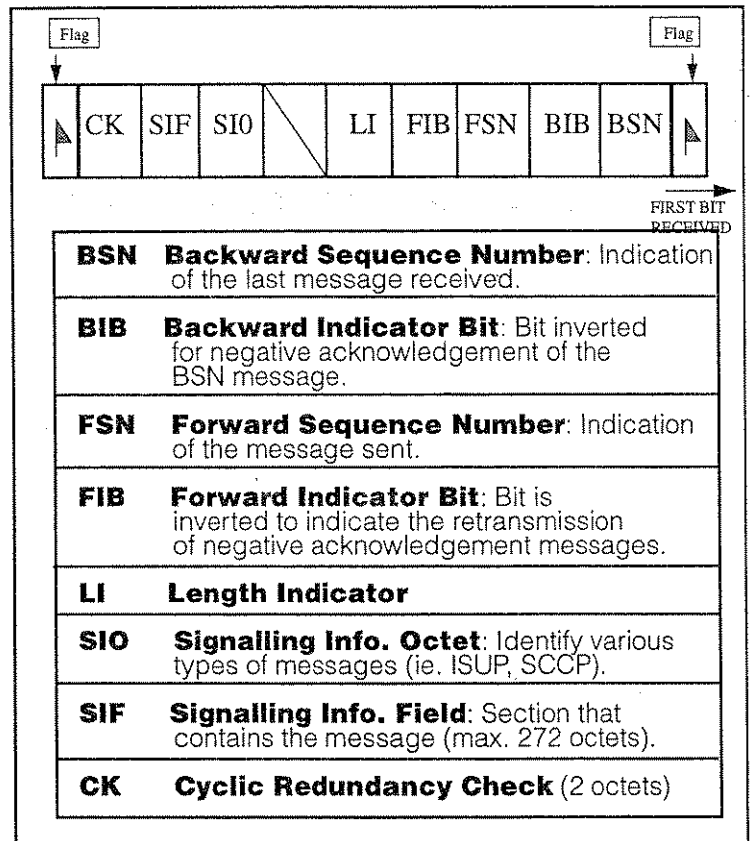


Figure 1.3.A
MSU Message Structure

- *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 1.3.B

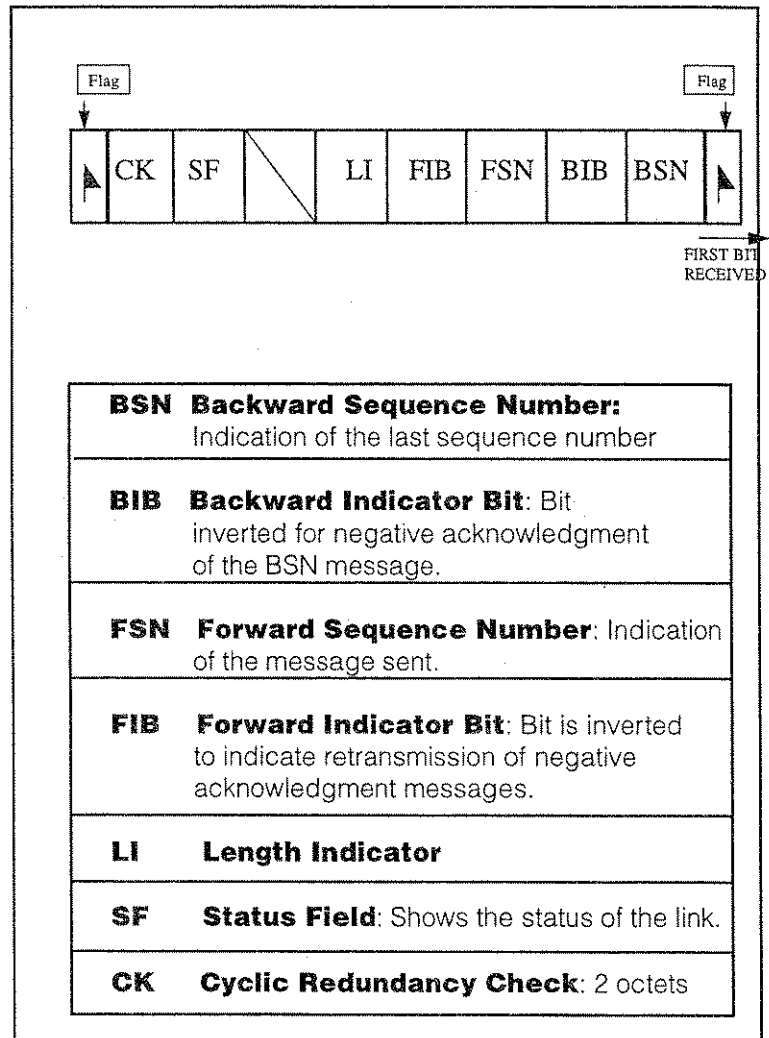


Figure 1.3.B
LSSU Message Structure

- *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.

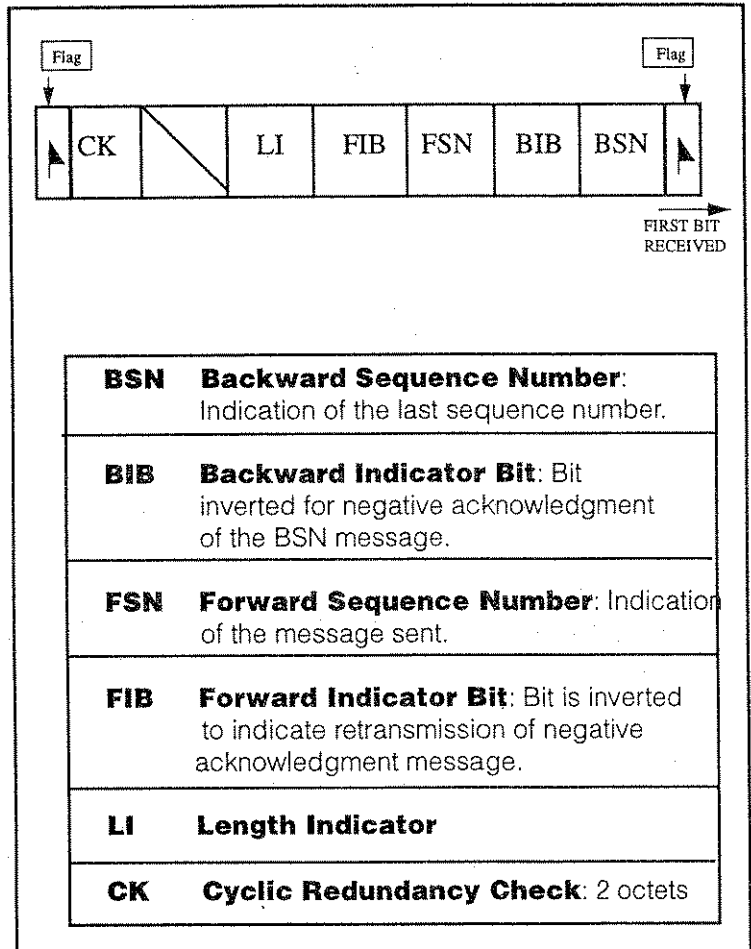


Figure 1.3.C
FISU Message Structure

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 set-up. 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 1.4. A shows the complete call process.

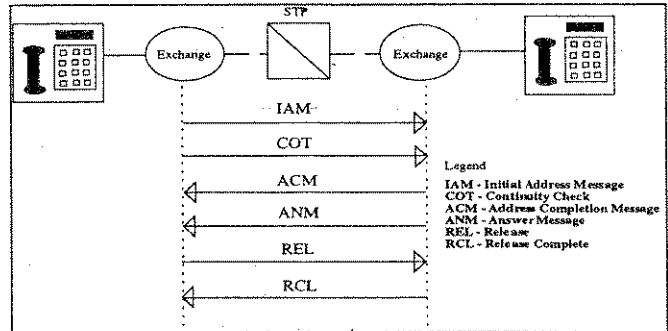


Figure 1.4.A
ISUP Messages used in Typical Phone Call

IAM contains the essential information required for the call. It has the flexibility to expand with additional parameters as new service is required. Figure 1.4.B 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 1.4.B
Typical IAM Information Fields

Section 2 SS#7 Analysis (Option SW189)

The SS#7 Analysis Menu may be accessed through the OTHER MEASUREMENTS selection in the Main Menu. Refer to Figure 2.A for the SS#7 Analysis Menu.

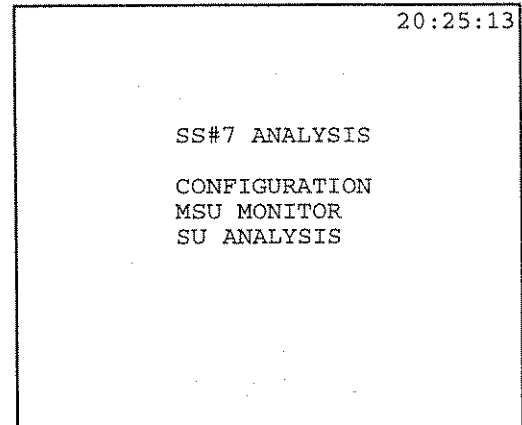


Figure 2.A
SS#7 Analysis Menu

The SS#7 ANALYSIS menu item contains three options:

- 1) CONFIGURATION
- 2) MSU MONITOR
- 3) SU ANALYSIS

Note: You must be in T1DUAL Mode to enter SS7.

2.1 CONFIGURATION

Refer to Figure 2.1.A, SS7 Configuration.

```
20:30:23  
  
CONFIGURATION  
  
Line 1 Rx T/S: 2  
Line 2 Rx T/S: 2  
SS7 VERSION : ANSI  
TRUNK RATE : 64k  
HEX INPUT : YES  
  
ANSI CCITT CHINA24 CHINA14
```

Figure 2.1.A
SS7 Configuration

The following configuration items are present in this screen:

1) Line 1 Rx T/S

Options: 1-24

Use the F-keys, NEXT (F1) and PREVIUS (F2), as appropriate to select your receive timelsot for Line 1.

2) Line 2 Rx T/S

Options: 1-24

Use the F-keys, NEXT (F1) and PREVIUS (F2), as appropriate to select your receive timelsot for Line 2.

3) SS7 VERSION

F-Key Options: ANSI (F1), CCITT (F2), CHINA24 (F3), CHINA14(F4)

This line determines the SS#7 protocol standard to be used during your analysis.

4) TRUNK RATE

F-Key Options: 56k (F1), 64k (F2)

Press (F1) to select a trunk rate of 56k or (F2) for a rate of 64k.

5) HEX INPUT

F-Key Options: YES (F1), NO (F2)

You may choose to enter the OPC, DPC, and CIC codes in either decimal or hexadecimal in your SETUP FILTER. Select YES (F1) to enter these code in hex, NO (F2) for decimal. This item also determines how these codes are displayed in the tracer.

2.2 MSU MONITOR

MSUs (Message Signalling Units) are the units used by ISUP, TCAP, and TUP messages. They carry the content of the signalling message. There are three menu items under the MSU MONITOR selection: SETUP FILTER, START TRACER, and VIEW/PRINT TRACER

2.2.1 SETUP FILTER

The Setup Filter screen allows you to select different parameters for filtering SS#7 messages. These parameters will be used during SS#7 trace procedures. Refer to Figure 2.2.A.

```
21:03:14
          SETUP FILTER
LAYER 3
LINE 1 DPC: 02-00-02
LINE 1 OPC: XX-XX-XX
SI FIELD  : ISUP
CIC CODE  : NONE
MSG TYPE  : 01
ADDR SGNL : CALLED#
ADDR NUMB : 3638000
-----LAYER 2-----
BSN/BIB   : XX/X
FSN/FIB   : XX/X
FISU/LSSU : ON
NONE      TUP      ISUP      more
```

Figure 2.2.A
Setup Filter

You may select the following filter items:

1) LINE 1 DPC

Options: 00-00-00 to FF-FF-FF

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to enter a Destination Point Code in hexadecimal form. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F1) if you don't want to filter messages based on a particular DPC. The Destination Point Code indicates the signalling point for which the message is intended. You may enter this code in decimal if you select NO (F2) for HEX INPUT.

2) LINE 1 OPC

Options: 00-00-00 to FF-FF-FF

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to enter an Originating Point Code in hexadecimal form. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F1) to capture all OPCs. The Originating Point Code (OPC) indicates the signalling point that is the source of the message. You may enter this code in decimal if you select NO (F2) for HEX INPUT.

3) SI FIELD

F-Key Options: NONE (F1), SCCP (F2), ISUP (F3), SNT (more, F1), SNM (more, F2), TUP (more, F3)

The next filtering item is the SI FIELD. 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. Select NONE (F1) to search for messages belonging to all SI fields. Choose SCCP (F2) to look for messages belonging to the Signalling Connection Control Part. ISUP (F3) causes the set to search for ISDN User Part messages. Press SNM (more, F2) for Signalling Network Maintenance messages or SNT (more, F1) for Signalling Network Testing messages.

Select TUP (more, F3) to search for those belonging to the Telephone User Part. Since ANSI protocol does not use the Telephone User Part, TUP will not be an available option if you

have selected ANSI as your SS7 Version in the SS7 CONFIGURATION screen.

Upon selecting a particular SI Field, more filtering choices will appear below.

Filtering fields for TUP:

1) CIC CODE

Options: NONE (F1), 000 to FFF

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to enter a Circuit Identification Code in hexadecimal form. The (F4) key determines the increment/decrement value used in the (F2) and (F3) keys. Press NONE (F1) to capture all CICs. The Circuit Identification Code is used as a label for circuit-related messages. It identifies the telephone circuit connecting the Destination Point and the Originating Point. 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.

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. Figure 2.2.B lists the TUP Head codes.

<u>TUP Heading</u>	<u>Code (hex)</u>	
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-up Information 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 2.2.B
TUP Heading Codes

3) ADDR SGNL

Options: NONE (F1), CALLED# (F2), CALLER# (F3)

This item allows you to 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. Here you may 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. Here you may enter the specific number by pressing/releasing the SHIFT key and pressing the desired keypad number keys.

Filtering fields for ISUP:

1) CIC CODE

Options: NONE (F1), 0000 to 3FFF for ANSI protocol; 000 to FFF for CCITT, CHINA24, & CHINA14.

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to select a Circuit Identification Code. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all CICs. The Circuit Identification Code is used as a label for circuit-related messages. It identifies the telephone circuit among those interconnecting the Destination Point and the Originating Point. ANSI protocol uses 14 bits for CIC; ITU (CHINA14 & 24) uses 12 bits. Therefore, if you have selected ANSI in the SS7 CONFIGURATION screen, this field will be 4 hex digits long. For all other versions, this will be three hex digits long.

2) MESG TYPE

Options: NONE (F1), 00 to FF

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to select a Message Type. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all ISUP Message Types. The ISUP message types are shown in Figure 2.2.C.

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 ^c	1D
CMR	Call Modification Request ^c	1C
CMRJ	Call Modification Reject ^c	1E
CON	Connect ^c	07
COT	Continuity	05
CPG	Call Progress	2C
CQM	Circuit Query	2A
CQR	Circuit Query Response	2B
CRA	Circuit Reservation Acknowledgment ^A	79
CRG	Charge Information ^c	31
CRM	Circuit Reservation ^A	7A
CVR	Circuit Validation Response ^A	7B
CVT	Circuit Validation Test ^A	7C
DRS	Delayed Release ^c	27
EXM	Exit ^A	20
FAA	Facility Accepted ^c	1F
FAR	Facility Request ^c	08
FOT	Forward-Transfer	21
FRJ	Facility Reject ^c	29
GRA	Circuit Group Reset-Acknowledgment	17
GRS	Circuit Group Reset	01
IAM	Initial Address Message	04
INF	Information	03
INR	Information Request	24
LPA	Loop Back Acknowledgment	30
OLM	Overload ^c	28
PAM	Pass Along	0C
REL	Release	0E
RES	Resume	10
RLC	Release Complete	12
RSC	Reset Circuit	02
SAM	Subsequent Address Message ^c	0D
SUS	Suspend	16
UBA	Unblocking Acknowledgment	14
UBL	Unblocking Signal	2E
USIS	Unequipped Circuit Identification Code	2D
USR	User-to-User Information	

^c CCITT Only

^A ANSI Only

Figure 2.2.C
ISUP Message Types

3) ADDR SGNL

F-Key Options: NONE (F1), CALLED# (F2), CALLER# (F3)

This item allows you to 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. Here you may 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. Here you may enter the specific number by pressing/releasing the SHIFT key and pressing the desired keypad number keys.

Filtering fields for SCCP:

Upon selecting SCCP, a new screen, the SCCP SETUP FILTER, will appear. A sample screen is shown in Figure 2.2.D.

```
00:09:11
SCCP SETUP FILTER
SLS CODE   : NONE
MSG TYPE   : 006
ADDR SIGNL : NONE
SUBSYS NO. : 003
SIG PT COD : XXX XXX XXX
TCAP FILTR : OFF
NONE INC+1 DEC-1 1/10/50
```

Figure 2.2.D
SCCP Setup Filter

Note: If you wish to enter Layer 2 information, do so before selecting SCCP. This order should be followed because upon pressing the SCCP F-key at SI FIELD, you will automatically enter the SCCP Filter screen, where Layer 2 information is not available.

You may select the following filtering items:

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.

2) MMSG TYPE

Options: NONE (F1), 000 to 255 in decimal

Use the F-keys, NONE (F1), INC+x (F2), DEC-x (F3), 1/10/50 (F4) to select a Message Type. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all SCCP Message Types. The SCCP message types are shown in Figure 2.2.E.

<u>SCCP Messages</u>		<u>Code (decimal)</u>
AK	Data Acknowledgment	8
CC	Connection Confirm	2
CR	Connection Request	1
CREF	Connection Refused	3
DT1	Data Form 1	6
DT2	Data Form 2	7
EA	Expedited Data Acknowledgment	12
ED	Expedited Data	11
ERR	Error	15
IT	Inactivity Test	16
RLC	Release Complete	5
RLSD	Released	4
RSC	Reset Confirm	14
RSR	Reset Request	13
UDT	Unitdata	9
UDTS	Unitdata Service	10
XUDT	Extended Unitdata ^A	17
XUDTS	Extended Unitdata Service ^A	18

^A ANSI Only

Figure 2.2.E
SCCP Message Types

3) ADDR SGNL

F-Key Options: NONE (F1), CALLED# (F2), CALLER# (F3)

- This item allows you to filter messages using address num-

bers. 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. Here you may 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. Here you may enter the specific number by pressing/releasing the SHIFT key and pressing the desired keypad number keys.

4) SUBSYS NO

Options: NONE (F1), 000 to 255

Use the F-keys, NONE (F1), INC+x (F2), DEC-x (F3), 1/10/50 (F4) to select a Message Type. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all Subsystem numbers. The Subsystem Number (SSN) identifies a SCCP user function. The Subsystem number consists of one octet, which is used as follows:

<u>Subsystem Number</u>	<u>Code (decimal)</u>
SSN not known/ not used	0
SCCP Management	1
reserved	2
ISDN User Part	3
OMAP (operations, Maintenance, and Administration Part)	4
MAP (Mobile Application Part)	5
Home Location Register	6
Visited Location Register	7
Mobile Switching Center	8
Equipment Identification Register	9
Authentication Center	10
spare	11 to
	254
reserved for expansion	255

Figure 2.2.F
Subsystem Numbers

Network specific subsystem numbers should use the spare octets, 11 to 254 (decimal), in descending order (starting with 254).

Note: To enter a Subsystem Number, you must specify an address Signal above.

5) SIG PT COD

Options: NONE (F1), 000 to 255 - 000 to 255 - 000 to 255

Use the F-keys, NONE (F1), INC+x (F2), DEC-x (F3), 1/10/50 (F4) to enter a Signalling Point Code in decimal format. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all Signalling Point Codes. The Signalling Point Code consists of three octets. These octets are transmitted in the following order: Network Cluster Member, Network Cluster, Network Identifier.

Note: To enter a Subsystem Number, you must specify an address Signal above.

6) TCAP FILTR

F-Key Options: OFF (F1), ON (F2)

In this line, you may decide to turn on/off the Transaction Capability Application Part filter. If you do not want to use the TCAP filter, press NONE (F1). If you do want to use this filter, press (F2) and two new filtering items appear below, as shown in Figure 2.2.G.

```
00:09:11
SCCP SETUP FILTER
SLS CODE      : NONE
MSG TYPE      : 006
ADDR SIGNL    : NONE
SUBSYS NO.    : 003
SIG PT COD    : XXX XXX XXX
TCAP FILTR    : ON
ORIG TRXID    : 00000002h
&& DEST TRXID : XXXXXXXX
OFF  ON
```

Figure 2.2.G
TCAP Filter

7) ORIG TRXID

F-Key Options: OFF (F1), ON (F2)

This field contains the Transaction ID assigned by the originator. It consists of 4 octets. If you would like to capture a specific Originating Transaction ID, press ON (F2); then activate the SHIFT key and enter the correct numbers for all 8 digits. As indicated by the "h" at the right of this field, the Orig ID is entered in hexadecimal form.

8) DEST TRXID

F-Key Options: OFF (F1), ON (F2)

This field contains the Transaction ID assigned by the responder. It consists of 4 octets. If you would like to capture a specific Destination Transaction ID, press ON (F2); then activate the SHIFT key and enter the correct numbers for all 8 digits. As indicated by the "h" at the right of this field, the Destination ID is entered in hexadecimal form.

Note: There is an AND/OR option for the above two filtering fields. To access this option, place the cursor on the first digit of the DEST TRXID; then move the cursor one spot to the left. You should see AND (F1) + OR (F2) appear at the bottom of the screen. AND (F1) means that the test set will capture only those messages containing both IDs. OR (F2) means that the set will capture any message with one of the above IDs.

Layer 3 Filtering fields for SNM:

1) SLS CODE

Options: NONE (F1); 0 to F

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to select a Signalling Link Selection Code. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all SLS codes.

2) HEAD CODE

Options: NONE (F1), 00 to FF

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to select a Heading Code. The (F4) key determines the

increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all SNM Heading Codes. These codes are shown in Figure 2.2.H.

<u>SNM Heading Codes</u>	<u>Code (hex)</u>	
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 Uninhibit Acknowledgment	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 Restart Allowed Signal	17
UPU	User Part Unavailable Signal	1A

Figure 2.2.H
SNM Heading Codes

The Layer 3 Filtering items for SNT:

1) SLS CODE

Options: NONE (F1); 0 to F

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to select a Signalling Link Selection Code. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all SLS codes.

2) HEAD CODE

Options: NONE (F1), 00 to FF

Use the F-keys, NONE (F1), INC+1 (F2), DEC-1 (F3), 1/10/50 (F4) to select a Heading Code. The (F4) key determines the increment/decrement value used for the (F2) and (F3) keys. Press NONE (F4) to capture all SNT Heading Codes. These codes are shown in Figure 2.2.1.

<u>SNTHeading Codes</u>	<u>Code (hex)</u>
SLTA Signalling Link Test Acknowledgment	12
SLTM Signalling Link Test Message	11

Figure 2.2.1
SNT Heading Codes

The Layer 2 Filtering items:

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, along 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.

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.

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 may be accessed through the MSU MONITOR menu. This feature begins the tracing process based on those filter values specified in SETUP FILTER. The tracer screen can update twice per second and can capture 50 messages per second.

In this screen, there are three function keys to choose from:

RESTART (F1)

Restart causes the SunSet to restart the trace process.

PAUSE/ RESUME (F2)

Pause freezes the display so that 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 (F3)

Decode displays the message contents for analysis.

2.2.3 View/Print Tracer

View/Print Tracer allows you to view and print specific data captured by the SunSet. Figure 2.2.J shows the initial View/Print Tracer screen which appears upon entering.

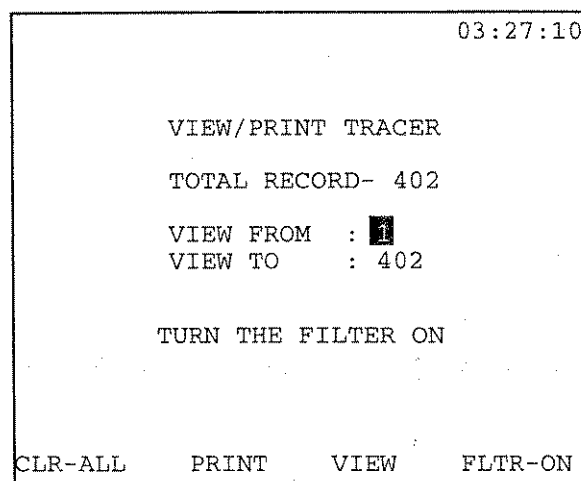


Figure 2.2.J
View/Print Tracer

This screen shows the total number of records captured by the SunSet. You may specify which of these records you wish to view. Place the cursor on the FROM NO. item. Press the SHIFT key and enter the desired numbers from the keypad. Press the SHIFT key again to de-activate the SHIFT lock and cursor down to TO NO. Enter in this number. When you are satisfied with the viewing settings, press VIEW (F3).

The four F-keys available in this screen are:

CLR-ALL (F1)

This key is the first step in erasing the buffer contents. After pressing (F1), you will be asked to press the ENTER key to continue the process. This second step provides security against

accidentally erasing the buffer contents.

PRINT (F2)

This option will print the contents of the buffer.

VIEW (F3)

VIEW displays the contents of the buffer, as specified by the FROM NO. and TO NO. settings. You may refer to the sample SCCP message shown at the end of this section.

FLTR-ON/ FLTROFF (F4)

The (F4) key gives you the option of keeping the filter assignments on or off. Turning the filter off allows you to display 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).

ANSI SCCP Message Example

Here is a sample ANSI SCCP message.

```
02:08:58  
RCV MESG NO.1 (ANSI)  
LINE 2 95-01-02 00:10:48.77  
SCCP  
DPC: 194-000-000  
  
FF F0 2E 03 F0 00 00 6B 18 00  
01 06 03 00 00 82 01 1F E2 1D  
C7 04 00 00 00 00 E8 15 ED 13  
CF 01 00 D0 02 85 01 F2 0A 84  
08 01 02 11 07 37 17 11 01 57  
5B  
  
PAGE-UP PAGE-DN DECODE
```

Figure 2.2.K
Sample ANSI SCCP Message (hex)

The following information is shown in this screen:

- The message number, in this case No.1, shows the number

- of the message.
- The Line (1 or 2) on which the message was received . In Figure 2.2.K, the message came on Line 2.
- The date and time at which the message was received.
- The Service Indicator Field of the message. This is SCCP in Figure 2.2.K.
- The DPC, Destination Point Code in decimal.
- The message in hexadecimal form.

Three F-keys are available in this screen:

PAGE-UP (F1)

The PAGE-UP key allows you to view other pages of data by showing the previous message. In Figure 2.2.K, pressing PAGE-UP would bring the last message.

PAGE-DN (F2)

The PAGE-DN key allows you to view other pages of data by showing the next message. In Figure 2.2.K, pressing PAGE-DN would bring the message 2.

DECODE (F3)

The (F3) key decodes the hexadecimal form and displays the decoded message contents. Figure 2.2.L shows the decoded message.

```

02:15:34
RCV MESG NO.1 (ANSI)
LINE 2 95-01-02 00:10:48.77
MSU- SCCP BSN:7F 1 FSN:42 1
SI :3 SSF:0 SLS:01
DPC: 194-000-000 OPC:139-024-000
msg type 06h (DT1)
DEST REF: 03 00 00
SEG/REAS: 82
DATA :D C7 04 00 00 00 00 >>
PAGE-UP PAGE-DN HEX L4deco

```

Figure 2.2.L
ANSI SCCP message (decode)

The following information is shown in this screen:

- The message number, in this case No.1, shows the number of the message.
- The Line (1 or 2) on which the message was received . In Figure 2.2.L, the message came on Line 2.
- The date and time at which the message was received.
- The Message Signalling Unit Service Indicator Field of the message. This is SCCP in Figure 2.2.L.
- The DPC, Destination Point Code, and OPC, Originating Point Code, in decimal.

The following information has been decoded:

- **mesg type:** This screen shows both the hexadecimal form (in Figure 2.2.L, 06), as well as the message type in parentheses. In Figure 2.2.L, the message type is DT1. DT1 is the Dataform 1 message, which is sent by either end of a signalling connection to transparently pass SCCP user data between two SCCP nodes. Looking back at Figure 2.2.K, we can see the hex code 06 in the second row. Figure 2.2.E (on page 8-18) lists the different SCCP message types.
- **DEST REF:** The Destination Local Reference field is three octets long. This reference number is included in the SCCP message to allow the receiving node to identify the message with one particular connection session. It identifies a signalling connection in a node.
- **SEG/RES:** The Segmenting/Reassembling parameter field is included in the data to serve a segmenting/reassembling function. This is the "more data bit" (M-bit). In this octet, bits 8-2 are spare. Bit 1 is the More Data indication and is coded as:
 - 0= no more data
 - 1= more data

In Figure 2.2.L, the SEG/RES has a value of 82. In binary code, this translates to 10000010. Bit 1 equals 0 indicating no more data.

- **DATA:** This shows the rest of the data in hexadecimal form. The arrow sign at the right indicates that here is more data; you could press HEX (F3) to view all the data in hex. When the cursor is placed on the DATA line, a L4dec (F4) key appears at the bottom of the screen. This key will bring up the Layer 4 decode information. This decodes several parts of the TCAP message. Refer to Figure 2.2.M.

The F-keys available in this screen are:

PAGE-UP (F1)

The PAGE-UP key allows you to view other pages of data by showing the previous message. In Figure 2.2.L, pressing PAGE-UP would bring the last message.

PAGE-DN (F2)

The PAGE-DN key allows you to view other pages of data by showing the next message. In Figure 2.2.L, pressing PAGE-DN would bring the message 2.

HEX (F3)

The (F3) key displays the message in hexadecimal form.

L4deco (F4)

This key appears only when the cursor is placed on the DATA line. L4 decode key decodes several parts of the TCAP (Layer 4) message. Figure 2.2.M shows the Layer 4 Decode screen, which can be accessed through this key.

```

02:19:01

TCAP MESSAGE

PACKAGE TYPE- QRY With PER
ORIG TRX ID : 00000000h
COMP TYPE   : Invoke (Not Last)

CompDec

```

Figure 2.2.M
Layer 4 Decode/ TCAP Message Screen

The following information is shown in this screen:

1) PACKAGE TYPE: Package Type tells you what kind of TCAP interaction has taken place between two signalling nodes. This is one octet long and is mandatory for all TCAP messages. The Package Types are listed below in Figure 2.2.N.

Package Type Identifiers	H	G	F	E	D	C	B	A	(hex)
Unidirectional	1	1	1	0	0	0	0	1	E1
Query with Permission	1	1	1	0	0	0	1	0	E2
Query w/out Permission	1	1	1	0	0	0	1	1	E3
Response	1	1	1	0	0	1	0	0	E4
Conversation with Permission	1	1	1	0	0	1	0	1	E5
Conversation w/out Permission	1	1	1	0	0	1	1	0	E6
Abort	1	1	0	1	0	1	1	0	D6

Figure 2.2.N
TCAP Package Types

In Figure 2.2.M, The Package Type is Query with Permission. If we go all the way back to our hex message in Figure 2.2.K, we see E2 (the corresponding hex code) in the second row. Messages with these Package Types do the following:

- Unidirectional- sends information in only one direction; no reply is expected and no TCAP interaction is made.
- Query with Permission- initiates a TCAP transaction; informs the TCAP node that it may end the TCAP transaction.
- Query without Permission- initiates a TCAP transaction, but informs the destination node that it may not end the transaction.
- Response- ends the TCAP transaction.
- Conversation with Permission- a continuation of a TCAP transaction; informs the destination node that it may end the TCAP transaction.
- Conversation without Permission- a continuation of a TCAP transaction, but informs the destination node that it may not end the TCAP transaction.
- Abort- informs the destination node that the originating node has terminated the TCAP transaction.

2) **ORIG TRX ID:** This is the Transaction ID assigned by the originator. It consists of 4 octets and as indicated by the "h" at right, is shown in hexadecimal form in this screen.

3) **COMP TYPE :** The Component Types are as follows:

Component Type Identifier	H	G	F	E	D	C	B	A	(hex)
Invoke (Last)	1	1	1	0	1	0	0	1	E9
Return Result (Last)	1	1	1	0	1	0	1	0	EA
Return Error	1	1	1	0	1	0	1	1	EB
Reject	1	1	1	0	1	1	0	0	EC
Invoke (Not Last)	1	1	1	0	1	1	0	1	ED
Return Result (Not Last)	1	1	1	0	1	1	1	0	EE

Figure 2.2.O
TCAP Component Types

In Figure 2.2.M, our Component Type is Invoke (Not Last), ED in hex. If we look back at Figure 2.2.K, we can see ED at the end of the third row. Invoke (Not Last) invokes an operation and indicates that further responding Components are expected.

The Component Types are defined as:

- Invoke (Last)- invokes an operation and indicates that there are no further responding Components.
- Return Result (Last)- returns the results of an invoked

- operation; indicates that there are no further responding Components.
- Return Error- reports the unsuccessful completion of an operation.
 - Reject- reports the rejection of an incorrect Package or Component Type.
 - Invoke (Not Last)- invokes an operation and indicates that further responding Components are expected.
 - Return result (Not Last)- returns the results of an invoked operation; indicates that there are further responding Components.

When the cursor is placed on the Component Type field, the CompDec (F4) key appears at the bottom of the screen. Refer to Figure 2.2.M. This F-key provides further decoding of the Component Type. Figure 2.2.P shows a sample Component Decode screen.

```
SCROLL 02:22:06
iinvoke (Not Last)
CORRELATN ID: 00h
OPERATION CODE - NATIONAL
HGFEDCBA
10000101
H: Reply Required
G-A: Operation Family
      Caller Interaction
01h: Operation Specifier
      Play Announcement

LIST OF PARAMETERS
```

Figure 2.2.P
Component Decode Screen

This screen contains the following information:

CORRELATN ID - A correlation ID needs to be included in a Return Result and an Invoke Component, if the Invoke Component is responding to a previous Invoke with an Invoke ID. The Correlation ID is identical to the Invoke ID of the Component

which is being responded.

OPERATION CODE - The Operation Code Identifier indicates the particular standard the operation code follows. National, as seen in Figure 2.2.P, indicates that the Operation Code is defined in ANSI T1.114 standard. Private Code identifier states that the Operation Code is defined within a network specific TCAP application.

The Operation Code is divided into an Operation Family followed by an Operation Specifier. Each is one octet long. The Operation Family is shown in Figure 2.2.P. (10000101). This represents the Caller Interaction Family, as shown in Figure 2.2.N. This family tells the exchange to interact with the caller as determined by the Operation Specifier. In Figure 2.2.P, the Operation Specifier is Play Announcement; this identifies the announcement to be played to the caller. You can refer to ANSI T1.114.5 specification for the definitions of other Operation Families and Specifiers.

A SCROLL indicator, appears in Figure 2.2.P's Component Decode screen. This tells you that more information is available to you. Use the up /down arrow keys to move the cursor as needed to view the other data.

2.3 SU Analysis

You will find the SU (Signalling Unit) Analysis selection in the SS#7 Analysis Menu. The SU Analysis screen shows the type, number, and percentage of statistics of SS#7 messages. The SunSet captures all types of signalling units based on the specified filtering setup. First, the analysis breaks the messages into the three basic message types: FISUs, LSSUs, and MSUs. Then, it further divides the MSU messages into five types: SNM, SNT, TUP, ISUP, and SCCP. In the Statistics screen, FIB (Forward Indicator Bit) and BIB (Backward Indicator Bit) counts are also available.

There are four function key options:

PAUSE

Pause freezes the display so the data may be easily observed. Measurements are still occurring, but the counts are updated only in memory, not on the display. RESUME will update all the data to their current values.

RESTART

Restart causes the SunSet to restart the trace process.

STATIST

Statist brings up another SU Analysis screen, where the FISU%, LSSU%, and MSU% are displayed for both lines, as well as the count of FIB and BIB retransmission bits.

COUNT

Count returns you to the original SU Analysis screen from the statistic screen.

Section 3 SS#7 Applications

This application demonstrates how you can pick up SS#7 messages using the SunSet T10. In the following procedure, two SS#7 nodes (SSPs) are sending basic call procedure messages to each other. The SunSet T10 can pick up and decode these messages to monitor the call procedure.

Figure 3.1.A shows part of the SS7 network..

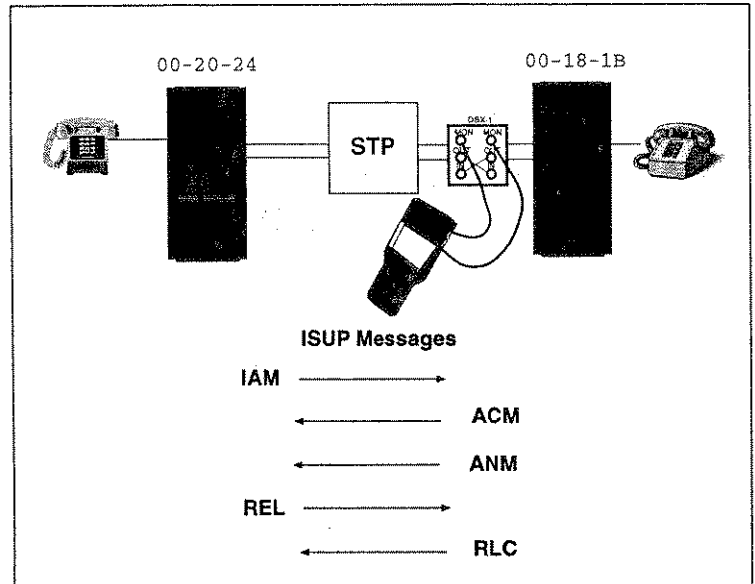


Figure 3.1.A
SS7 Network

Use the following procedure:

- 1) Turn the SunSet T10 on (using the red POWER button at the bottom left corner of the keypad).
- 2) From the Main Menu, enter TEST CONFIGURATION. Setup the screen as shown in Figure 3.1.B.

```
04:53:59
TEST CONFIGURATION
TEST MODE : T1DUAL

Tx/INSERT : L1-Tx
Rx/DROP   : L1-Rx
RxLVL-1  : DSXMON
RxLVL-2  : DSXMON
TxSOURCE  : THRU
FRAMING   : SF-D4
CODING    : B8ZS
XMT CLOCK : L1-Rx
TEST RATE : 1.544M
LBO 1&2   : 0 dB

TERM      BRIDGE    DSXMON
```

**Figure 3.1.B
TEST CONFIGURATION**

The above settings are a common configuration when testing a link. If you have red LEDs for framing, press the AUTO key so the T10 can attempt to synchronize on the received framing.

- 3) Connect both Line 1 and Line 2 Rx to the DSX Monitor jacks.
- 4) Escape back to the Main Menu and enter OTHER MEASUREMENTS, SS#7 ANALYSIS. From the SS#7 menu, enter CONFIGURATION.
- 5) Set up this screen as shown in Figure 3.1.C.

```
20:30:23  
  
CONFIGURATION  
  
Line 1 Rx T/S: 2  
Line 2 Rx T/S: 2  
SS7 VERSION : ANSI  
TRUNK RATE : 64k  
HEX INPUT : YES  
  
ANSI CCITT CHINA24 CHINA14
```

Figure 3.1.C
SS#7 Configuration Screen

In the above screen, we selected T/S 2 for both Line 1 & 2, since that is our timeslot for the SS#7 link. We also selected a Trunk Rate of 56k, since that is a common rate for the U.S.

- 6) Escape back to the SS7 Analysis and enter SU ANALYSIS. You should see a high number of FISUs and a low number of MSUs, unless you have a high traffic SS7 network.
- 7) Escape back to the SS7 menu and enter MSU MONITOR, START TRACER. You should see messages appear on the screen. If you like to capture only a select group of messages, you may enter some filtering fields in SETUP FILTER. Refer to Section 2.2.1 of this Chapter for more information on each of the filtering types. In this application, we are going to capture ISUP messages; therefore, we could select SI FIELD: ISUP.
- 8) To view each message individually, escape back to the MSU MONITOR menu and enter VIEW/PRINT TRACER. To begin viewing, press the VIEW (F3) KEY. Figure 3.1.D shows a sample screen.

```

02:08:58

RCV MSG NO.65 (ANSI)
LINE 1 95-01-01 03:42:51.08

ISUP
DPC: 00-20-24

9C C1 26 85 24 20 00 1B 18 00
00 19 00 01 00 00 10 0A 03 05
0C 02 90 98 07 80 18 61 31 37
47 00 01 06 11 00 00 09 2D 20
00

PAGE-UP PAGE-DN DECODE

```

Figure 3.1.D
View Message, hexadecimal

We can see that this message is number 65 and was received on Line 1 This message shows the DPC in hexadecimal.

8) Press the DECODE (F3) to see the decoded message. Refer to Figure 3.1.E.

```

02:15:34

RCV MSG NO.65 (ANSI)
LINE 1 95-01-01 03:42:51.08
MSU- ISUP BSN:1C 1 FSN:41 1
SI :5 SSF:8 CIC:0019
DPC: 036-032-000 OPC:027-024-000
msg type 01 IAM
NOC INDI:00
FRW INDI:00 10
CLN CTGY:0A
USR INFO:90 98
CALLD NO:>> 161373740
CALL REF:11 00 00 09 2D 20

PAGE-UP PAGE-DN HEX L4deco

```

Figure 3.1.E
View Message, decoded

The decoded screen shows the DPC and OPC in decimal format. We learn from our decoding that this message is an ISUP Message Signalling Unit. The message type is IAM, Initial Address Message. Also shown on this screen are the hex values for:

- Nature of Connection Indicator
- Forward Call Indicator
- Calling Party Category
- User Service Information
- Called Party Number
- Call Reference

You can find out the translation of these hex values by placing the cursor (with the arrow keys) on the corresponding field and pressing the L4deco (F4) key. Figure 3.1.F shows an example of one of these Layer 4 decodings.

```
bits HGFEDCBA      02:22:06
      00000000

bits BA: Satellite Indicator
      00 no satellite circuit in
           the connection

bits DC: Continuity check ind
      00 continuity check not
           required

bit   E: Echo control device
      0 outgoing half echo
           control device not
           included

bits F-H: Spare
```

Figure 3.1.F
Nature of Connection Layer 4 Decode

This screen shows the decoding bit-by-bit according to ANSI documentation.

9) When you have finished viewing your messages, disconnect your test set from the circuit and turn it off.

Chapter 9

Specifications & Configurations

Section 1	Specifications	9-1
Section 2	Configurations	9-9

Section 1 Specifications

1.1 Connectors

Bantam jacks (LINE 1 Tx, LINE 1 Rx, LINE 2 Tx, LINE 2 Rx)
8-pin mini DIN RS232C serial port, DTE
HDI-30 datacom port
12 VDC input for charger

1.2 Access

1.2.1 Single or Dual Mode

DSX Monitor: 100 ohms
Bridged Monitor: > 1000 ohms
Terminated: 100 ohms

1.3 Transmitter

Framing: SF-D4, ESF, SLC-96
Coding: AMI, B8ZS
Line Build Out (LBO): 0, 7.5, 15, 22.5 dB
Clock: internal (1.544 MHz +/- 5 ppm), looped, external
Pulse shape to TR-TSY-000499; reference: G.703, CB113,
CB119, CB132, CB143, PUB62508, PUB62411

Transmit Patterns:

Repeating: 3 in 24, 1 in 8 (1:7), all 1s, 1 in 16, 55 octet,
alternating 1010, all 0s, FOX, 256 Octet, T1-T6, DDS1-
DDS6
User programmable pattern 1 to 2048 bits
Store up to 10 programmable patterns with alphanumeric
names
Pseudo random: QRS, PRBS $2^n - 1 = 6, 7, 9, 11, 15, 20, 23$
Test pattern inversion

Insert errors: BPV, logic, frame errors; programmable error burst
1 to 9999 counts, or error rate 2×10^{-3} to 1×10^{-9}

1.4 Receiver

Input sensitivity:
Terminate, Bridge: +6 to -36 dB cable loss

DSXMON: -15 to -30 dB, resistive
Coding: AMI, B8ZS
Framing: SF, ESF, SLC-96
Frequency range: 1542 kHz to 1546 kHz
Auto pattern and framing synchronization
Received pattern synch independent of transmitted pattern
Programmable loss of frame criteria, error averaging interval

1.5 Measurement Results

1.5.1 Summary Measurements

Elapsed time, remaining time, framing, line coding, configuration, received pattern, transmitted pattern, errored seconds, severely errored seconds, unavailable seconds, percent error free seconds, line peak to peak pulse level (dB), line frequency, and bit errors.

1.5.2 Line Error Measurements

BPV count and rate (current and average), BPV error seconds count and percent, BPV SES count and percent, BPV AS count and percent, BPV UAS count and percent, BPV degraded minutes count and percent

1.5.3 Signal Measurements

Signal available seconds count and percent, loss of signal seconds count and percent, low density seconds count, excess 0s seconds count, AIS seconds count, signal unavailable seconds percent

Simplex current, 1 to 200 mA, +/- 1 mA +/- 5%.

Receive bit rate, 1542 to 1546 kbps, +/- 1 bps, +/- clock source accuracy, external or internal clock

Receive level (volts and dBdsx):

Peak to peak: 60 mV to 15V, +/- 10 mV, +/- 5%.

Positive pulse: 30 mV to 7.5V, +/- 10 mV, +/- 5%.

Negative pulse: -30 mV to -7.5V, +/- 10 mV, +/-5%.

1.5.4 Path - Frame Measurements

Frame bit error count and rate (current and average), frame slip count, OOF second count, COFA count, frame synch loss seconds, yellow alarm second count, frame error second count and percent, frame severely errored second count and rate, frame available second count and percent, frame unavailable second count and percent

1.5.5 Path - CRC-6 Measurements

CRC-6 block error count and rate (current and average), CRC-6 errored second count and percent, CRC-6 severely errored second count and percent, CRC-6 available second count and percent, CRC-6 unavailable second count and percent

1.5.6 Logical Error Measurements

Bit error count and current rate, bit error rate since start, bit slips, current bit error rate, errored seconds and percent, severely errored seconds and percent, available seconds and percent, unavailable seconds and percent, degraded minutes count and percent, loss of synch seconds count and percent

1.5.7 Frequency Measurements

Moving bar graph of slip rate, received signal frequency, max frequency, min frequency, clock slips, frame slips, max positive wander, max negative wander

1.6 Other Measurements

1.6.1 View Received Data

View T1 data in binary, hex, ASCII
Shows data in bytes by time slot
Shows 8 time slots per display page
Captures 256 consecutive time slots as test pattern

1.6.2 Propagation Delay

Measure round trip propagation delay in unit intervals +/- 1 UI, with translation to microseconds and one way distance over cable.

1.6.3 Quick Test I and II

2 programmable automated loopback tests that save time when performing standardized acceptance tests.

1.6.4 Bridge Tap

Automated transmission and measurement of 21 different patterns to identify possible bridge taps at some point on line.

1.6.5 Loopbacks

Loopback Control, In-band

Nonstandard loop up: 100000
NIU loop up: 11000
NIU loop down: 11100
CSU loop up: 10000
CSU loop down: 100
10 programmable user patterns, 1 to 32 bits

Loopback Control, ESF-Facility Data Link

Payload loop up: 111111110 010100 0
Payload loop down: 111111110 100110 0
Line loop up: 111111110 111000 0
Line loop down: 111111110 001110 0
Network (NIU) loop up: 111111110 100100 0
Network (NIU) loop down: 111111110 010010 0
10 programmable user patterns, 1 to 32 bits

Westell & Teltrend Looping Devices Control

Automated looping of Westell and Teltrend line and central office repeaters. Includes SF and ESF modes, arm, loop up/down, loopback query, sequential loopback, power loop query, span power down/up, unblocking.

1.7 Voice Frequency Capability

Generator: 50 to 3950 Hz @ 1Hz step. +3 to -60dBm @ 1dBm step.

Level, Freq measurements: 50 to 3950 Hz. +3dBm to -60dBm.
Monitor speaker with volume control

Built-in microphone for talk

View all 24 channel A,B (C,D) bits

Control A,B (C,D) bits (E&M ground/loop start, FXO, FXS, on/off hook, wink)

Generator: 404, 1004, 1804, 2713, 2804 Hz @ 0dBm and -13dBm
DTMF dialing, 32 digits, 10 sets preprogrammable speed dial number

Programmable tone and interdigital period

Companding law: u Law

Programmable idle channel A,B (C,D) bits

Selectable idle channel code, 7F or FF hex

1.8 Noise Measurement (SW183)

Noise: 3 kHz flat, C-message, C-notch, S/N

1.9 MF/DTMF/DP Dialing, Decoding and Analysis (SW185)

MF/DTMF/DP dialing

Programmable DTMF/MF tone level, dial period, silent period

Programmable DP %break and interdigital period (10pps)

MF/DTMF decode up to 40 received digits. Analyze number, high/low frequencies, high/low levels, twist, tone period, interdigital time.

DP decode up to 40 digits. Analyze number, %break, PPS, interdigital time.

Signaling Analysis:

Live - graphical display of A,B(C,D) signaling state changes for Line 1 and Line 2

Trigger - programmable A,B (C,D) trigger state to start analysis on the opposite side

MFR1 - timing analysis of signaling transition states and decoding of dialed digits

MFR1M - Modified MFR1 CO switches signaling analysis

MIXTONE - Decode a signaling sequence that has both MF and DTMF digits

1.10 Fractional T1

Error measurements, channel configuration verification

Nx64 Kbps, Nx56 Kbps, N=1 to 24

Sequential, alternating, or random channels

Auto scan for active channels and auto configure to any FT1 order
Rx and Tx do not need to be same channels

1.11 ESF Facility Data Link (SW182)

Read and Send T1.403 message on FDL (PRM and BOM)

Automatic HDLC protocol handling

YEL ALM, LLB ACT, LLB DEA, PLB ACT, PLB DEA

AT&T 54016 24 hr performance report retrieval

T1.403 24 hour PRM collection per 15 min interval

1.12 SLC-96 Data Link (SW182)

Send and receive message
WP1, WP1B, NOTE formats
Alarms, switch-to-protect, far-end loop
To TR-TSY-000008 specifications

1.13 CSU/NI Emulation (SW181)

Bidirectional (Line 1 & 2)
Responds to loopback commands - inband and datalink
Graphic indication of incoming signal status in both directions
Simultaneous display of T1 line measurements
Automatic generation of AIS
Loopbacks:
 Line 1 - line and payload loopback
 Line 2 - line loopback
 Simultaneous loopbacks in both directions
 Local and remote loopback control

1.14 Remote Control (SW180)

VT100 emulation with same graphical interface used by test set
Circuit status table provides current and historical information on
test set LEDs
All test set functions supported except for printing
Controls through 8 pin MINI DIN, RS232C, 9600 baud preferred

1.15 Westell, Teltrend Maintenance Switch, PM NIU and RAMP (SW184)

Supports Westell and Teltrend performance monitoring network
interface unit and maintenance switch system with RAMP.
Set/query NIU time and date.
Query performance data by hour or all.
Reset performance registers.
Read data over RAMP line.
Perform maintenance switch.

1.16 Pulse Mask Analysis (SW190)

Scan Period: 800 ns

Measurements: Pass/Fail, ns Rise time, ns fall time, ns pulse width, % overshoot, % undershoot

Resolution: 1 ns or 1%, as applicable

Masks: ANSI T1.102, T1.403. AT&T CB119, Pub 62411

Pulse Mask Display: test set screen and SS118 printer

1.17 DDS Testing (SW188)

Choose receive and transmit timeslots independently

Test rates: 2.4, 4.8, 9.6, 19.2, 56, 64 kbps

Patterns: 2047, 511, 127, 63, all 1s, all 0s, DDS-1, DDS-2, DDS-3, DDS-4, DDS-5, DDS-6, 8-bit user

Loopbacks: Latching, interleaved. CSU, DSU, OCU, DSO-DP, 8-bit user.

Measurements: Bit errors, Bit error rate

Control code send/receive: abnormal, mux out of synch, idle

1.18 ISDN PRA call set up and monitor (SW186)

Bi-directional Primary Rate Access (PRI)

User programmable trace filter, view bi-directional real time message flow. Messages are interpreted up to bit level layer 3 or displayed in hex format.

Trace storage holds up to 1000 messages with time stamps

Voice and data call set up and receive

Built-in microphone and speaker for B channel talk/listen

Bit error rate test with G.821 analysis

Generates 2047, 511, 127, 63, and user programmable 8 bit test patterns

Supports Nx64K and Nx56K data calls

Programmable received data call loop back or send test pattern

Supports 23B+D, 47B+D, and 46B+D+D

NT & TE emulation

National ISDN-2, AT&T 5ESS, ETSI, and Northern Telecom DMS-100 compatible

On-screen help for special optional call feature programming

1.19 Switched Call Set Up and BERT (SW187)

Switched 56 call set up: supervision and dialing

Send test patterns: 2047, 511, 127, 63, all 1s, all 0s, FOX, DDS1-6, USER

Bit error, bit error rate measurement

Teleos signaling sequence timing analysis and dial digits decoding

1.20 SS#7 Protocol Analysis (SW189A)

Layer 2, 3, 4 analysis to bit level

SU traffic analysis:

Counters for FISU, LSSU, TUP, ISUP, SNM, SNT messages

Counters for FIB and BIB retransmissions

% analysis on different types of messages

MSU tracer:

User programmable trace filter; CIC, DPC, OPC, H1H0, Signalling address.

View bi-directional real time message flow.

Messages are interpreted up to layer 4 or displayed in hex format. The trace storage holds up to 1000 messages.

1.21 TCAP Analysis (SW189B)

1.22 Datacom Module (SS151)

Supports V.35, X.21, RS232 (V.24), RS449 (V.36) interfaces

DTE, DCE Emulation

Bit error injection

30-pin High Density Interface (HDI) connector to test set: optional adapter cables for V.35, X.21, RS232 (V.24), RS449 (V.36), G.703

Synchronous data rates (kbps): 0.3, 0.6, 1.2, 2.4, 4.8, 9.6, 14.4, 19.2, 38.4, 48, 56, 64, Nx56, Nx64, up to 1.536Mbps

Asynchronous data rates (kbps): 0.3, 0.6, 1.2, 2.4, 4.8, 9.6, 14.4, 19.2, 38.4 (RS232-V.24 only), 25 ppm

Send test patterns and make G.821 measurements

View transmit and receive signal status: TxD, TxC, RxD, RxC, DTR, RTS, CTS, DSR, RL, LL, RI

Control signal leads: DTR, RTS, CTS, DSR, RL, LL, RI

Invoke Local Loopback (LL), Remote Loopback (RL)
Internal or received clock selectable
Hitless 1.544K, Nx56k and Nx64K E1 drop and insert, via V.35,
X.21, RS449 (V.36) interface, DCE mode only

1.23 Environmentals

Operating temperature: 0 °C to 50 °C
Operating humidity: 5% to 90%, noncondensing
Storage temperature: -20 °C to 70 °C
Size: 2.4"(max) x 4.2"(max) x 10.5"
Weight: 2.5 lb (1.1 Kg)
Battery operation time: 2 hr nominal
AC operation: 110V/120V @ 60 Hz, or 220V/240V @ 50/60 Hz

Section 2 Configurations

Here are the various items that can be ordered in addition to the basic SunSet T10 SS150.

Test Set

SS150 SunSet T10

Includes test set chassis, 120 VAC Battery Charger (SS128-A), SunWare cartridge, instrument stand, and SunSet T10 User's Manual.

CLEI: T1TUAAAHAA

CPR: 674818

Hardware Option

SS151 Datacom Module

Includes HDI-30 to DB-37 (female) Adapter Cable. Includes adapters for V.35 DTE and DCE, X.21/V.11 DTE and DCE, RS232/V.24 DTE and DCE, RS449/V.36 DTE, and DCE.

SunWare Options

SW180 Remote Control

Allows menu-driven remote control of basic test functions using a dumb terminal or personal computer equipped with VT100 terminal emulation software. Includes printer cable and null modem adapter.

SW181 CSU/NIU Emulation

Upgrades SunWare T10 to include full duplex CSU/NIU emulation.

SW182 ESF and SLC-96 Datalink Send and Receive

Upgrades SunWare T10 to include T1.403 and Pub 54016 ESF data link send and receive capabilities. Also includes SLC-96 data link send and receive.

SW183 VF Noise Measurement

Includes Signal to Noise, C-Message, C-Message Notched, and 3 KHz flat filters.

SW184 Westell, Teltrend Intelligent Products

Provides menu-driven support for the Westell Maintenance Switch, and Performance Monitoring NIU, including the RAMP feature. Includes Teltrend Maintenance Switch operation. Loopback and span control for Westell and Teltrend office and line repeaters.

SW185 MF/DTMF/DP Dialing, Decoding and Analysis

Provides dialing, decoding and digit analysis. MFR1, MFR1M, and mixtone analysis. Bi-directional signaling transition analysis.

SW186 ISDN PRA (also known as PRI) Call Set Up & Monitor

Provides the ability to monitor D-channel messages, place a call, receive a call, talk/listen/BERT, and disconnect on an ISDN Primary Rate Access T1 line. Supports 23B+D, 47B+D, 46B+D+D formats. Supports AT&T 5ESS, NT DMS100, National ISDN-2, and ETSI protocols.

SW187 Switched 56 Call Set Up and BERT

Quicktests designed to check the operation of switched 56 services using Teleos equipment and Northern Telecom DMS 100 switches. First test allows a technician to set up a call to a digital loopback, choose a test pattern, and verify successful bit error rate performance. Second test observes a Teleos call outgoing set-up in process, monitoring both directions in sequence.

SW188 DDS Testing

Provides support for basic DDS applications involving interleaved loopbacks, latched loopbacks, and error measurements.

SW189A SS#7 Protocol Analysis

Provides elementary english-language decoding of SS7 call progress information up to layer 4, bit level decoding. Includes SU statistic analysis, MSU monitor/tracer. MSU supports TUP, ISUP, SCCP, SNM, SNT.

SW189B SS#7 TCAP Analysis

Provides for additional TCAP Analysis. Must have SS189A in order to function.

SW190 Pulse Mask Analysis

Accessories

SS101 Carrying Case

SS104 Cigarette Lighter Battery Charger

SS105 Repeater Extender

SS106 Single Bantam to Single Bantam Cable, 6'

SS107 Dual Bantam to Dual Bantam Cable, 6'

SS108 Single Bantam to Single 310 Cable, 6'

SS109 Single Bantam to Alligator Clip Cable, 6'

SS110 Two Single Bantams to 15-pin D Connector Cable, Male, 6'. Used for T1 CSUs.

SS111 Two Single Bantams to 15-pin D Connector Cable, Female, 6'. Used for T1 CSUs and T-Berd Power Lid.

SS112 Two Single Bantams to 8- position Modular Plug Cable Fits RJ-48 jacks per ANSI T1.403, 6'. Used for NIUs (smart jacks).

- SS115 DIN-8 to RS232C Printer Cable
Printer cable used to connect the SUNSET T10 to a serial printer, modem, or VT100 terminal.
- SS116 Instrument Stand
Provides a convenient, hands-free viewing stand for the SUNSET T10.
- SS117 Printer Paper
5 rolls, for SS118 Thermal Printers
- SS118 High Capacity Thermal Printer
Includes rechargeable battery for operation without AC. Includes cable for connection to SUNSET T10 and AC charger.
CPR: 674622
CLEI: T1TUW07HAA
- SS122 Null Modem Adapter
Modified null modem adapter which allows SUNSET T10 to control TTC PR40A printer. Also allows SW100 Remote Control to operate on a direct connection w/ many personal computers.
- SS123 SunSet Jacket
Provides additional protection against handling, weather, splashes, dust, mud, etc for SunSets. Includes elastic hand-strap, connector panel access, see-through front panel membrane, front panel zip-up cover, carabiner hook, rugged padded synthetic fabric.
- SS127 Printer Charger, 220 VAC, 50/60 Hz
Charger for SS118 printer.
- SS128-A 120V/12V 1.2A SunSet Charger
For USA and Canada. Provides continuous operation from 120 VAC source. Provides 1.2A output at 12 VDC. Charges battery. 2-stage operation for fast recharge then slow trickle charge.
- SS128-B 110V/12V 1.2A SunSet Charger

For Taiwan and Korea. Provides continuous operation from 110 VAC source. Provides 1.2A output at 12 VDC. Charges battery. 2-stage operation for fast recharge then slow trickle charge.

- SS130A 19"/23" SunSet Rack Mount - Removable
Allows a Sunset to be mounted in 19" or 23" racks. However, SunSet must still be powered by its charger plugged into AC supply. Unit is strapped into rack mount and may be removed for portable use.
- SS130B 19"/23" SunSet Rack Mount - Permanent

Allows a Sunset to be mounted in 19" or 23" racks. However, SunSet must still be powered by its charger plugged into AC supply. Unit is screwed down for permanent installation.
- SS132 Two Single Bantams to 4-position Modular Plug Cable
Used for downloading performance monitoring information from a Westell NIU at the front panel jack without disrupting service.
- SS136 SunSet T10 User's Manual
Describes all functions available to SunSet T10 users.
- SS150 SunSet T10 Extended Warranty
Extends the standard 1 yr. domestic factory warranty to 3 yrs. Includes the SunSet chassis, but excludes the battery and accessories, which are warranted for 1 yr.
- SS152 SunSet T10 Training Tape
English language (152K for Korean)

Chapter 10 Troubleshooting

Section 1 Troubleshooting 10-1

Section 2 Calibration 10-3

Section 3 Customer Service 10-6

Section 1 Troubleshooting

Here are some helpful suggestions for those occasions when your test set is not performing as expected.

Problem: Continuous BPVs show on screen even though there should be no problem with the signal

Suggestion:

- 1) Check the line interface:
 - do not use DSXMON for a full 3V signal
 - do not use TERM for a monitor jack
 - try both BRIDGE and DSXMON for a mon jack
 - do not use BRIDGE or DSXMON on a signal that has been opened and is no longer properly terminated

Problem: Test set performs improperly

Suggestions:

- 1) Perform a SELF TEST and see if the problem has been resolved. If the SELF TEST shows an ERROR CODE, repeat the test to see if the set was able to automatically correct the problem.
- 2) Try turning the set off and then on again.
- 3) Try ERASE NV RAM in the OTHER FEATURES, SYSTEM CONFIG, ERASE NVRAM.

WARNING: This procedure will erase all of your user-programmed information, measurement results and history buffers.

Be sure to turn the power off for at least 4 seconds after completing the ERASE NV RAM operation

Problem: Test set does not power up properly

Suggestions:

- 1) Make sure the battery is charged or the charger is plugged in. The test set's charger is powerful enough to power the test set and recharge the battery simultaneously.
- 2) Make sure the SunWare cartridge is inserted firmly and seated correctly. A flickering screen usually indicates that the SunWare cartridge is either loose or missing. Refer to the cartridge installation procedure if necessary.

Problem: Test set shows Security Violation when switched on

Suggestion:

- 1) Make sure the serial number of the SunWare cartridge matches the serial number on the back of the test set. Each SunWare cartridge is programmed for a specific test set. If SunWare cartridges are swapped between test sets, the test set may not work properly.

Problem: Keys do not work properly

Suggestions:

- 1) Verify the SHIFT status by pressing and releasing SHIFT-lock key. Press and release the SHIFT-lock key until the SHIFT-lock status indicator in the upper left-hand corner of the screen achieves the desired condition.
- 2) Do not press SHIFT-lock key simultaneously with another key.
- 3) Press the key again. The test set may not have registered it the first time.
- 4) Turn the power off and then back on again.

Problem: Measurement is not working properly (loss of signal, no pattern synch)

Suggestion:

- 1) Verify signal TEST MODE and RxLVL-1 or RxLVL-2 settings in the TEST CONFIGURATION menu.
- 2) Verify that jacks are plugged in properly according to the circuit graphic.
- 3) Make sure that OUT is plugged to IN and vice-a-versa.
- 4) Twist plugs inside of jacks and make sure that plugs are inserted all the way.

Problem: Test Patterns will not synch

Suggestions:

- 1) Press RESYNCH to force the test set resynchronize on the pattern, framing type, and line coding.
- 2) Verify that the desired pattern is sent in the SEND TEST PATTERN menu.
- 3) Verify that there is not an AMI/B8ZS mismatch.

Problem: Test patterns will not synch with other test equipment

Suggestions:

- 1) Verify that PATTERN INVERSION is DISABLE in the OTHER FEATURES, OTHER PARAMETERS menu.
- 2) Examine the pattern that the other test set is sending. Use VIEW RECEIVED DATA to look at the pattern.

Problem: Voice Frequency section does not work

Suggestions:

- 1) Verify that the set has a valid framing type showing in the LED indicators. If no valid framing is shown, put proper framing on the T1 signal.
- 2) Make sure that you have not confused the timeslot number with the channel number.
- 3) Make sure the received channel and the transmit channel are correct.

Section 2 Calibration

The SunSet T10 is a self-calibrating test set. It does not require you to perform any adjustments and does not need to be returned to Sunrise Telecom for calibration.

If you are required to perform a periodic calibration on the test set, use this procedure:

- 1) Switch the test set on.
- 2) Verify that all LEDs blink in sequence and that each LED lights properly. The POWER light should always light as green and the LOW BATT light should light only when the battery is nearly fully discharged.
- 3) Verify that there are no errors listed at the completion of the self test.
- 4) Connect a single bantam to single bantam cord from LINE 1 TX to LINE 1 RX.
- 5) Enter the TEST CONFIGURATION item from the MAIN MENU.

6) Configure the set for:

TEST MODE: T1SINGL

RxLVL-1: TERM

FRAMING: ESF

CODING: B8ZS

Tx SOURCE: NORMAL

XMT CLOCK: INTERN

LBO - 1: 0 dB

TEST RATE: 1.544M

Press ENTER when your settings are correct.

7) If necessary, press the HISTORY key to acknowledge the flashing history lights and turn them off. Verify that the green PULSES, ESF, and PAT SYNC lights are on. The B8ZS light may also be on, depending on the test pattern which you are transmitting.

8) From the MAIN MENU, enter MEASUREMENT RESULTS. Using the PAGE-UP (F1) and PAGE-DN (F2) keys, access the "LINE 1 - SIGNAL" screen. Verify that the +LVL is 3.00V +/- 10% and that the -LVL is 3.00V +/- 10%.

9) Verify that the FREQ is 1544000 +/- 1 Hz.

10) Press ESCAPE to return to the MAIN MENU.

11) Connect a single bantam to single bantam cord from LINE 2 TX to LINE 2 RX.

12) Go to TEST CONFIGURATION.

13) Configure the set for:

TEST MODE: T1DUAL

Tx/INSERT: L2-Tx

Rx/DROP: L2-Rx

RxLVL-1: TERM

RxLVL-2: TERM

Tx SOURCE: TESTPAT

FRAMING: SF-D4

CODING: AMI

XMT CLOCK: INTERN
LBO 1&2: 0 dB
TEST RATE: 1.544M

- 14) If necessary, press the HISTORY key to acknowledge the flashing history lights and turn them off. Verify that the green PULSES, SF and PAT SYNC lights are on.
- 15) From the MAIN MENU, enter MEASUREMENT RESULTS. Using the PAGE-UP (F1) and PAGE-DN (F2) keys, access the "LINE 1 SIGNAL" screen. Verify that the +LVL is 3.00V +/- 10% and that the -LVL is 3.00V +/- 10%.
- 16) Verify that the FREQ is 1544000 +/- 1 Hz.
- 17) Press ESCAPE to return to the MAIN MENU.
- 18) The calibration procedure is now complete.

Section 3 Customer Service

Sunrise Telecom Customer Service is available from 7:30 AM to 5:00 PM Pacific Standard Time (California, U.S.A.).

Customer Service performs the following functions:

- Answers customer questions over the phone on such topics as product operation and repair
- Repairs malfunctioning SunSets promptly
- Provides information about product upgrades

The warranty period covering the SunSet T10 is 1 year from the date of shipment. A Return Merchandise Authorization (RMA) Number is required before any product may be shipped to Sunrise Telecom for repair. Out-of-warranty repairs require both an RMA and a Purchase Order before the unit is returned. All repairs are warranted for 90 days.

Please contact Customer Service if you need additional assistance:

Customer Service
Sunrise Telecom Inc.
22 Great Oaks Blvd.
San Jose, CA 95119
U.S.A.
Tel: 1 408 363 8000 or 1-800-701-5208 (24hr)
Fax: 1 408 363 8313

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.

Address. The destination of a message in a communication system.

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, but of equal amplitude. A space designates zero amplitude.

ANSI - American National Standards Institute. The principal standards-development organization in the US.

ARM-INB - Arm Inband

AS - Available Second

ASCII - American Standard Code for Information Interchange

AVBER - Average Bit Error Rate

AVCER - Average CRC-6 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.

B8ZS - Bipolar 8-Zero Substitution. A line coding format for T1 lines that uses bipolar violations to encode strings of eight consecutive zeroes.

BATT - Battery

BPV - Bipolar Violation

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

CCITT- Comite Consultatif Internationale de Telegraphique et Telephonique. An international consultative committee that set worldwide communications standards.

CER - CRC-6 Error Rate

Checksum. The total of a group of data items used for error-checking purposes.

CLR - Clear

COD - Code

COFA - Change of Frame Alignment. Indicates when the framing has moved to a new position.

CONFIG - Configuration

CRC-6 - Cyclic Redundancy Check Code - 6. A method of error detection for link-layer data transmissions.

CSU - Customer Service Unit. A digital DCE used to terminate digital circuits (i.e. DDS, T1 lines) at the customer site.

CTL - Control

CUFBER - Current Framing Bit Error Rate

CURBER - Current Bit Error Rate

D

dB - decibel

dBdsx - decibel referenced to dsx power level

DC - Direct Current. Current flowing in one direction.

DCE - Data Communication Equipment. The equipment that enables a DTE to communicate over a telephone line or data circuit.

DCS - Digital Cross-connect System.

DDS - Dataphone Digital Service. A private line digital service with typical data rates of 2.4, 4.8, 9.6, and 56 Kbps.

DENS - Density

DGRM - Degraded Minute

DIG - Digital

DLF - Data Link Frame

DN - Down

DS1 - Digital Signal 1. The term for the electrical signal found at the metallic interfaces of T1 circuits where most testing is performed.

DSX - Digital Signal Cross-connect.

DSXMON - DSX Monitor signal

DTE - Data Terminal Equipment. User device such as terminals

and computers that connects to DCE.
DTMF - Dual Tone Multi Frequency. The audio signalling frequency generated by touchtone push button telephones.

E

E - Equipment
E&M Signalling. A method of signalling between junction equipment in an exchange and a signalling unit associated with a transmission equipment using two leads- a receive (E) lead and a transmit (M) lead.
EQP - Equipment
ERR INJ - Error Injection
ES - Errored Second
ESF - Extended Super Frame. A framing method with 24 frames grouped together.
ET - Elapsed Time. Total time during which a circuit is occupied by a connected call.
EXTERN - External
EXZS - Excess Zeroes Seconds

F

F - Facility
F1 - Function 1
FAC - Facility
FBE - Framing Bit Error
FBER - Framing Bit Error Rate
FDL - Facility Data Link
FELP - Far End Loop
FREQ - Frequency
FRM - Frame. In data transmission, the sequence of contiguous bits bracketed by by and including beginning and ending flag sequences.
FSLIP - Frame Slip. Occurs each time the phase of the line under test has deviated from the phase of reference by 193 bits.
ft - feet
FT1 - Fractional T1. A service aimed at customers who do not need all 24 channels of a full T1 line.

H

HEX - hexadecimal. The base-16 number system often used in

computers.
HOLDSCRN - Hold Screen
Hz - Hertz. A unit of frequency; one cycle per second.

I

INTERN - Internal
INV - Inverted
ISDN - Integrated Services Digital Network. A CCITT standard for a network that accomodates a variety of mixed digital transmission services.

K

kFt - kilo Feet

L

LBO - Line Build Out
LDNS - Low Density Seconds. A count of the number of seconds where the n(n-1) rule is broken.
LED - Light Emitting Diode. Shows the status of the received signal.
LLPBK - Line Loopback
LOFS - Loss of Frame Second. Occurs at the onset of three consecutive OOFS (Out Of Frame Seconds).
LOG - Logical
LOS - Loss of Signal
LOSS - Loss of Signal Second.
LPBK - Loopback. A diagnostic procedure used for transmission devices. A test message is sent to the device being tested and then sent back to the originator, where it is compared to the original message.
LPBKQRY - Loopback Query
Lpp - Level peak-to-peak. The peak-to-peak level of negative and positive pulses being received by the test.
LVL - Level

M

mbps - megabits per second.
MON - Monitor
mW - milliwatt

N

NI - Network Interface

NOTE - Network Office Terminating Equipment

NV RAM - Non Volatile Random Access Memory

O

OOF - Out Of Frame

OOFS - Out of Frame Second. The count of out of frame seconds that have occurred since the beginning of the test.

P

PAT - Pattern

PLPBK - Payload Loopback

ppm - parts per million

PRBS - Pseudo Random Bit Sequence

PRN SCRIN - Print Screen

PRNT - Print

PRNTR - Printer

PWRLPQRY - Power Loop Query

PWCUTTH - Power Cut Through

Q

QRS - Quasi Random Signal. This signal is formed from a 20-stage shift register and is zero-constrained for a maximum of 14 consecutive zeroes.

R

R - Receive

REF - Reference

RT - Remaining Time

RX - Receive

S

SABME- Set Asynchronous Balanced Mode Extended

SAPI- Service Access Point Identifier

SCRIN - Screen

SES - Severely Errored Second

SF - Super Frame.

SIG - Signal
SHLF - Shelf
SLC-96 - Subscriber Loop Carrier - 96 channel
SMPX - Simplex
SPLT - Split
SS - SunSet
SW - SunWare, also Switch
SYNC - Synchronized
SYLS - Synchronization Loss Second

T

T - Transmit
T/S - Time Slot
TEI- Terminal Endpoint Identifier
TERM - Terminated
TOUT - Time Out
TOUTDIS - Timeout Disable
TX - Transmit

U

UA- Unnumbered Acknowledgement
UAS - Unavailable Second
UI - Unit Interval
UNIVLDN - Universal Loopdown
uS - microsecond

V

V - Volts
VAC - Volts AC
VF - Voice Frequency

Y

YEL - Yellow
YELS - Yellow Alarm Second

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SS 136-SM1
T10 Supplement Version 2.01

This supplement covers the additions incorporated in SunWare version 2.01.

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Section 1 Other Parameters

SunWare 2.01 adds two new items to the Other Parameters menu. You may find this menu by entering OTHER FEATURES, OTHER PARAMETERS. Refer to Figure 1.A.

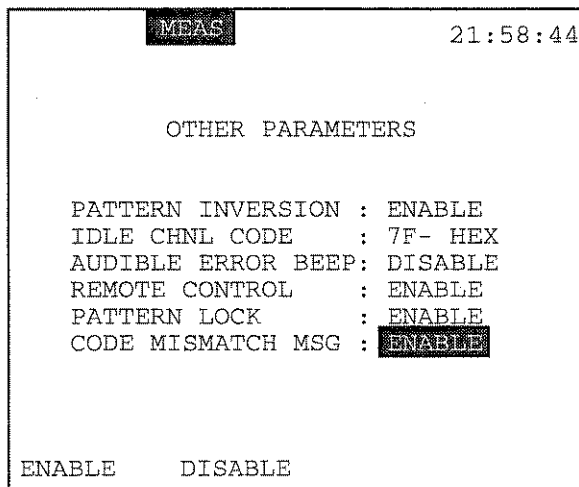


Figure 1.A Other Parameters

The two new menu items are:

1) Pattern Lock

F-Key Options: ENABLE (F1), DISABLE (F2)

The Pattern Lock feature determines the way the SunSet achieves pattern synchronization.

- When ENABLED (F1), the SunSet T10 searches for and can synchronize only on its transmit pattern, which is specified in the SEND TEST PATTERN screen. When the user presses the AUTO key, the SunSet then searches through all the patterns and changes its transmit pattern to match the receive pattern.
- When DISABLED (F2), the SunSet T10 attempts to synchronize on any known test pattern, regardless of its transmit pattern. When the user presses the AUTO key, the SunSet searches through all known patterns for synchronization and does not change its transmit pattern.

2) Code Mismatch Msg

F-key Options: ENABLE (F1), DISABLE (F2)

The SunSet T10 may provide a warning message when its line coding is configured differently than the coding it receives. If you do not wish to see this message, select DISABLE (F2), which is the default condition.

To be warned whenever a coding mismatch arises, select ENABLE (F1).

- When the T10's code is AMI, and the set detects B8ZS coding, it flashes the message.
- When the T10's coding is set for B8ZS and the set detects AMI coding (as represented by a string of 7 consecutive 0's), the screen flashes a warning message. Refer to Figure 1.B.

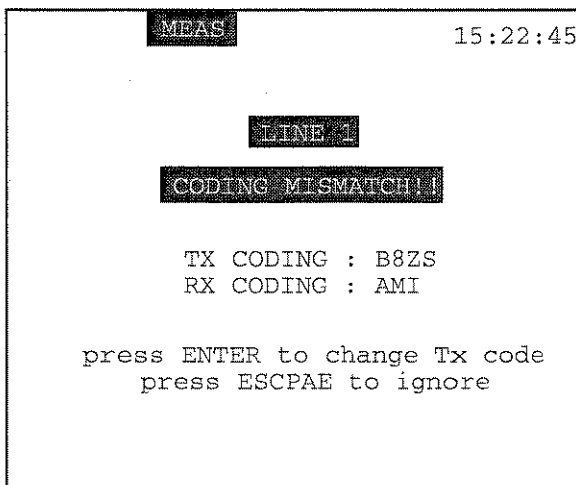


Figure 1.B Coding Mismatch Message

When this message appears, you have two options:

- Press ENTER to change the T10's transmit coding to match the received coding.
- Press ESCAPE to ignore the message and keep the same coding. In this case, the Mismatch Message will not be displayed again until you press the AUTO key or cycle the power.

Section 2 ISDN PRI Enhancements (SW186)

SunWare 2.01 adds two features to the existing ISDN PRI option (SW186): Sequential Call and Information Element decode.

2.1 Sequential Call

The Sequential Call feature is an excellent automated turn-up test. The SunSet places a voice or data call on all 23 B channels sequentially. It then provides the results of each call attempt, and even provides the cause values for any failed calls.

- 1) In the ISDN PRIMARY RATE menu, enter START LINK/CALL SETUP.
- 2) Press SEQTEST (F2) to setup the sequential call test. The setup screen appears in Figure 2.A.

```
READY 15:07:03
      SEQUENTIAL CALL
HOLD TIME(S)      : 10
MY PHONE NUMBER  : 3638000
SELF CALL        : OFF
CALL TYPE        : DATA-56
DIAL NUMBER :
3638313█
'*' '#' call
```

Figure 2.A
Sequential Call Setup screen

The following setup items must be configured:

1) HOLD TIME

Options: 1 to 255 seconds

Hold Time determines how long the SunSet will hold each call before releasing. You may choose from 1 to 255 seconds. For data calls, the minimum hold time is 10 seconds in order to provide BERT results.

To change the Hold Time, you may use the NEXT (F1) and PREV (F2) to scroll through the different amounts. You may also press the SHIFT key and enter the amount directly from the keypad.

2) MY PHONE NUMBER

Use the SHIFT key and keypad numbers to enter your phone number.

3) SELF CALL

F-Key Options: OFF (F1), ON (F2)

- Select ON (F2) to place a self call during the test. In this case, the SunSet will call MY PHONE NUMBER as entered above.
- Select OFF (F2) if you do not wish to place a self call. In this case, the SunSet will call the number entered as DIAL NUMBER below.

4) CALL TYPE

F-Key Options: VOICE (F1), DATA-56 (F2), DATA-64 (F3), 3.1k-AUD (F4)

This determines the type of calls the SunSet will place during the sequential call test.

- Select VOICE (F1) to place voice calls during the test.
- Select DATA-56 (F2) to place data calls at a 56 Kbps rate.
- Select DATA-64 (F3) to place data calls at a 64Kbps rate.
- Select 3.1k-AUD (F4) to place 3.1k audio calls.

The set's speaker/microphone will be activated for the VOICE and 3.1k-AUD call types. The T10 will run a BERT test for the data calls.

5) DIAL NUMBER

If you are not placing a self call, this will be the number called. You may enter the numbers directly from the keypad.

When you have finished configuring these items, press CALL (F3) to begin the sequential call test. A sequential call results screen appears showing you the status of each B channel. Refer to Figure 2.B.

			15:20:32
SEQUENTIAL CALL			
1 PASS	2 PASS	3 PASS	
4 PASS	5 PASS	6 FAIL	
7 PASS	8 PASS	9 PASS	
10PASS	11PASS	12PASS	
13PASS	14ACTIVE	15	
16	17	18	
19	20	21	
22	23	24 D	
PAUSE	PRINT	CAUSE	STOP

Figure 2.B
Sequential Call Results, Voice Calls

All 23 B channels are shown on this screen (note that channel 24 is marked as the D-channel). Each channel may display one of the following status messages:

- PASS: A call has been successfully connected and released.
- FAIL: A call was attempted on the channel, but was not successful.
- ACTIVE: The call is still in progress for this channel.
- A blank indicates that a call has not yet been attempted for that channel.

Sequential BERT Test

For data calls, the SunSet T10 runs a BERT test on each channel and provides results. Figure 2.C shows the live display.

```
READY 15:24:33
CH: 1 CONNECT
ET - 000:00:14 LINE - 1
Tx B#- 1 RX B#- 1
PATT - 2047 RATE - 56K

RESULTS

BIT : 3 BER : 3.8e-06
ES : 1 %ES : 07.143
SES : 0 %SES : 00.000
EFS : 13 %EFS : 92.857
UAS : 0 %UAS : 00.000
AS : 14 %AS : 100

PAUSE
```

Figure 2.C BERT Test

This screen provides the live account of the BERT test for the data call. The important features in this screen are:

- The top line displays the B channel currently used and the call status: CONNECT (call has successfully connected) or FAIL (Call did not connect).
- ET shows the Elapsed Time, the amount of time since the call connected.
- Tx B#, Rx B# show the B channel currently used.
- PATT displays the test pattern used.
- RATE displays the line rate for the data call (either 56K or 64K).

The following results are provided:

- BIT: Bit error count
- BER: Bit Error Rate
- ES: Errored Seconds
- SES: Severely Errored Seconds
- EFS: Error Free Seconds
- AS: Available Seconds
- UAS: Unavailable Seconds

When the Sequential BERT is finished, the screen displays a summary of all 23 data calls. Refer to Figure 2.D.

READY		15:30:27		
SEQUENTIAL BERT RESULTS				
Bch	STATUS	BIT	ES	UAS
1	PASS	3	1	0
2	PASS	0	0	0
3	PASS	0	0	0
4	PASS	0	0	0
5	PASS	0	0	0
6	17 USER BUSY			
7	PASS	0	0	0
8	17 USER BUSY			

PAGE-UP PAGE-DN PRINT

Figure 2.D BERT Results

For each B-channel, the following information is provided:

STATUS: Pass indicates that the call successfully connected. If the call did not connect, the cause value number and decode are provided. In Figure 2.D, the calls for B-channels 6 & 8 failed; the release message contained the cause value 17, User Busy.

For successful calls, the summary screen provides the bit error count, Errored Seconds (ES), and Unavailable Seconds (UAS).

2.2 Information Element Decoding

SunWare 2.01 enhances the D-channel decoding; it provides full decoding of the information elements contained in each message.

- If the message contains an Information Element, the InfoElem (F4) key appears. Pressing this key brings up the Information Element screen. Refer to Figure 2.E.

```
22:29:01
INFORMATION ELEMENT
AT&T Info Element Protocol

BEARER CAPABILITY - 04h
CODING STANDARD:0h
  CCITT Standardized coding
INFO TRANSFER CAP:00h
  Speech
TRANSFER MODE:0h
  Circuit mode
INFO TRANSFER RATE:10h
  64 kbit/s
USER INFO LAYER 1 PROTOCOL:02h

PAGE-UP  PAGE-DN  RETURN
```

Figure 2.E
Information Element Screen

This screen shows the decoded information elements. Press RETURN (F4) to return to the normal summary display. If more than one page of info decoding is available, use the PAGE-UP and PAGE-DN F-keys to scroll through the various pages.

Section 3 NPRM/SPRM ESF Datalink Analysis (SW182)

The ESF Datalink Analysis (SW 182) feature includes SPRM and NPRM analysis, as defined in ANSI T1.403 Annex E & F.

The main benefit of NPRM/SPRM Analysis is fault sectionalization. These message types allow network equipment to determine if a T1 signal was in error before it was sent to the customer, or for the other direction, if the T1 was in error before it entered the network.

SPRMs, Supplementary Performance Report Messages, define 3 bits of the familiar PRM message. These bits carry sectionalization information, recording whether the error originated at the Network or Customer Interface. NPRMS, Network Performance Report Messages, are separate from PRMs, although they both share the same Q.921 LAPD message structure. These messages locate trouble to either the near-end or far-end of the NI.

Supplementary Performance Report Message, SPRM

SPRM information is contained inside of the MONITOR T1.403 PRM screen. From the Main Menu, enter DATALINK CONTROL, MONITOR T1.403 PRM. Refer to Figure 3.A.

```
19:06:44  
DATA LINK MONITOR T1.403 PRM  
ELAPS TIME - 000:00:24  
DETEC TIME - 000:00:24  
CRC=1 - 0      C=<5 - 0  
C=<10 - 0      C=<100 - 0  
C=<319 - 0     C>320 - 0  
SEFE - 0      FSBEE - 0  
BPV - 0       SLIP - 0  
PLBsec- 0     YELsec- 0  
R - 22       U1 - 22  
U2 - 0  
RESTART HOLDSCR SPRM
```

Figure 3.A Monitor PRM Screen

The following information is added to this screen:

R: The R-bit is the SPRM flag. This bit indicates if SPRMs are included in the PRM message. A count indicates the number of seconds that SPRMs have been added.

U1: The U1-bit carries information on the DS1 signal as received from the *network* side. The count records the number of times that the U1 bit has been set to logical 1, indicating an error condition (CRC, BPV, SLIP, Yellow, frame synchronization bit error, or payload loopback) from the network direction.

U2: The U2-bit carries information on the DS1 signal as received from the *Customer Interface* (CI) side. The count records the number of times that the U2 bit has been set to logical 1, indicating an error condition (CRC, BPV, SLIP, Yellow, frame synchronization bit error, or payload loopback) from the customer direction.

Press the SPRM (F4) key to view a graphical display of the SPRM information. Refer to Figure 3.B.

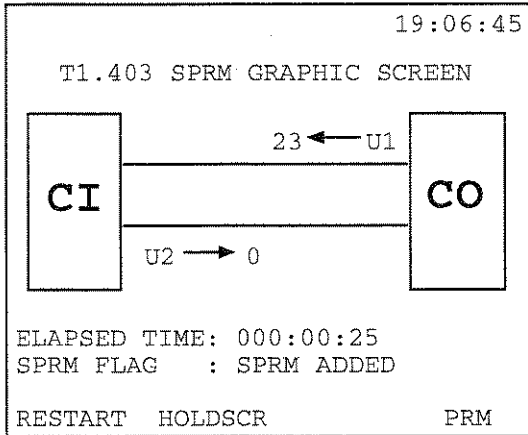


Figure 3.B SPRM Graphic Screen

The U1 and U2 counts provide the number of times an error condition was reported from either the Central Office (CO) or Customer Interface (CI), respectively.

Network Performance Report Message (NPRM)

NPRM information is contained within the MONITOR T1.403 NPRM screen. From the Main Menu, enter DATA LINK CONTROL, MONITOR T1.403 NPRM. Refer to Figure 3.C.

```
19:06:44
MONITOR T1.403 NPRM
ELAPS TIME - 000:32:21
DETEC TIME - 000:32:21

NEAR-END ERRORS
CRC=1 - 0      C=<100- 0
C=<319- 0      C>320 - 0
SES - 0

FAR-END ERRORS
CRC=1 - 21     C=<100- 8
C=<319- 0      C>320 - 0
SES - 0
PerAlert: 0    FrConv: 0
RESTART HOLDSCR
```

Figure 3.C Monitor NPRM Screen

This screen divides the CRC-6 error counts and SES counts between near-end and far-end errors.

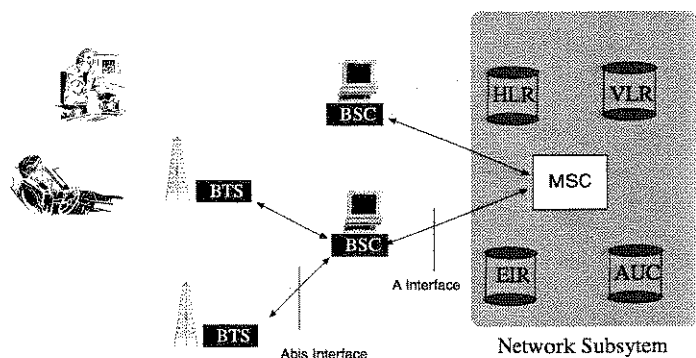
Two other reports are provided:

- Per Alert: Performance Alert. The network provider may define a performance threshold. This PA bit will increment whenever the near-end or far-end error count has exceeded that pre-defined threshold. This feature may not be supported by your network equipment.
- FrConv: Frame Conversion. This field increments when the SF to ESF frame format conversion occurs.

Section 4 GSM TRAU Testing (SW191)

The SunSet T10 is a powerful tool for maintaining/installing GSM networks. It offers three main tests for testing the Transcoder and Rate Adaption Unit (TRAU):

- 16k TRAU frame BER testing
- Check voice quality with real-time 13k speech monitoring
- Insert GSM encoded speech message to test TRAU/BTS



BTS: Base Transceiver Station
 BSC: Base Station Controller
 MSC: Mobile Switching Center

HLR: Home Location Register
 VLR: Visitor Location Register
 AUC: Authentication Center
 EIR: Equipment Identity Register

Figure 4.A GSM Network

GSM, Global System for Mobile communication, is governed by ETSI transmission standards. GSM technology uses a digital standard for voice and data applications.

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).

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.

When the transcoder is positioned remotely to the BTS (i.e. at the BSC), the CCU (Channel Codec Unit) in the BTS controls some of the functions of the remote TRAU at the BSC. This remote control is performed by inband signalling. These signalling bits are known as C-bits. C-bits control:

- Shift between data and speech frames
- Rate adaptation for data calls
- Downlink time framing for speech frames
- Transfer DTX information

TRAU Frame

The TRAU frame structure is shown in Figure 4.B.

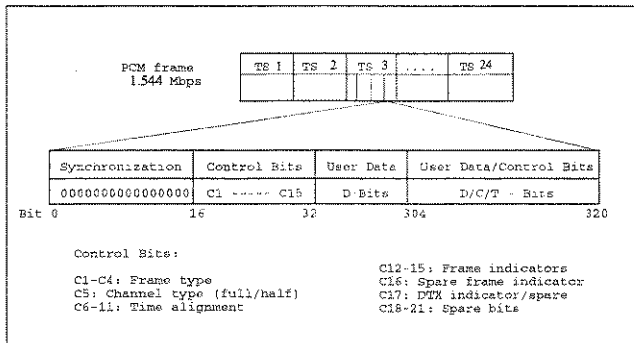


Figure 4.B
16 Kbit TRAU Frame

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.

4.1 GSM VOICE/TRAU/BERT Menus

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. See Figure 4.C.

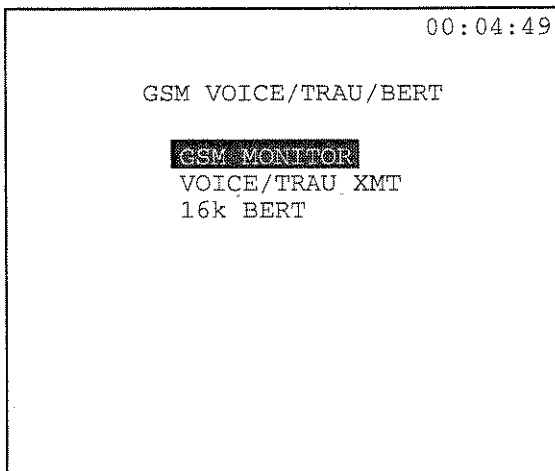


Figure 4.C
GSM VOICE/TRAU/BERT menu

4.1.1 GSM Monitor

The GSM Monitor screen displays all 24 timeslots and all 96 subchannels for either Line 1 and Line 2. You can view the activity on each subchannel. You can also use this screen to drop the 16Kbps GSM channel at 13Kbps voice rate to the speaker. Refer to Figure 4.D.

To monitor speech calls with the T10, move the cursor to a "S" frame. Then press the D&I (F2) key; the speech will be played on the set's speaker.

The following F-Keys are available in this screen:

LINE 1/LINE 2 (F1): When you are in T1DUAL Mode, use this key to determine your monitor line. Press LINE 1 to monitor Line 1; Line 2 for Line 2.

D & I (F2)- This key plays the 16k speech channel on the set's speaker. It will play the "S" frame that is highlighted.

JUMP (F3)- Use this key to move the cursor from channel to channel. The arrow keys will move the cursor at a subchannel interval; this key moves it a channel interval.

PAUSE/RESUME (F4)- PAUSE freezes the live presentation of traffic. RESUME updates the screen and continues the live presentation.

4.1.2 VOICE/TRAU XMT

You may use the Voice/TRAU XMT feature to:

- Transmit a pre-recorded speech message on any subchannel.
- Observe received C-bits

```
00:04:49  
  
VOICE & TRAU XMT  
  
LINE NUMBER: LINE 1  
TIME SLOT : 7  
SUB CHANNEL: 1  
IDLE CODE : 11111111  
LINK DIRCTN: UPLINK  
TIME ALGMNT: DELAY 0 x500us  
  
RCV CBITS :  
  
PAUSE UPLINK DNLINK
```

Figure 4.E
VOICE/TRAU XMT screen

Upon entering this screen, the T10 begins transmitting a 16k voice message on the selected timeslot and subchannel. The following settings are provided in this screen.

1) LINE NUMBER

F-Key Options: LINE 1 (F1), LINE 2 (F2)

In T1 Dual Mode, you may select to transmit the voice message on either Line 1 (F1) or Line 2 (F2).

2) TIME SLOT

Options: 1-24

This setting determines which timeslot will be used for the transmitted message. Press INC+1 (F2) to increment the timeslot number by one. Press DEC-1 (F3) to decrement the timeslot number by one

3) SUB CHANNEL

Options: 1-4

This setting determines which 16k subchannel will be used for the transmit message. Press INC+1 (F2) to increment the

subchannel number by one. Press DEC-1 (F3) to decrement the subchannel number by one

4) IDLE CODE

F-key options: 7F-HEX (F2), FF-HEX (F3)

Select the T10's idle code.

5) LINK DIRCTN

F-key Options: UPLINK (F2), DOWNLINK (F3)

This setting determines the link direction of the transmitted message. Uplink (F2) refers to the uplink direction- from customer up to the network (or BTS to BSC). Downlink (F3) refers to the downlink direction- from the network down to the customer (or BSC to BTS). Figure 4.F illustrates the directions.

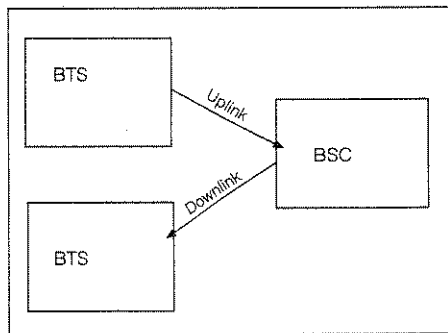


Figure 4.F
Uplink/Downlink Directions

6) TIME ALGMNT

Options: Delay- from 1 to 39 x 500 μ s Advance- 1 x 250 μ s

You may adjust the timing of the T10's transmit signal by either advancing or delaying the time. 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

7) RCV CBITS

This menu line displays the received C-bits.

4.1.3 GSM 16k BERT

This item allows you to observe the quality of transmission for a selected timeslot subchannel by running a BERT test at 16 kbps. Since this is a BERT test, verify that the Test Configuration's TxSource is set for Normal or Testpat.

See Figure 4.G.

```
00:04:49
GSM 16K BERT

LINE NUMBER: LINE 1
TIME SLOT   : 02
SUB CHANNEL : 2
PATTERN     : 2047

ELAPSED TIME:000:08:37
ERROR:0      RATE:
ES   :0      EFS :0
SES  :0      UAS :0
LOSS :0

STOP  ALL 1  more  PRINT
```

Figure 4.G
GSM 16K BERT

Configure the following items:

1) LINE NUMBER

F-Key Options: LINE 1 (F2), LINE 2 (F3)

This setting applies only to T1Dual Mode. This corresponds to the Line used for your BER test. This will be the line used for transmitting your test pattern, as well as the receive line.

2) TIME SLOT

Options: 1-24

Select the timeslot to use for your BER test. You may choose from 1 to 24 using the following F-keys:

- INC+1 (F2) to increase the timeslot number by one
- DEC-1 (F3) to decrease the timeslot number by one

3) SUB CHANNEL

Options: 1-4

Select the 16k subchannel used for your BER test. You may change the selection using the following F-keys:

- INC+1 (F2) to increase the subchannel number by one
- DEC-1 (F3) to decrease the subchannel number by one

4) PATTERN

Options: 2047, 1111, 1010, 0000

Select the test pattern. Your pattern options are displayed in the (F2) position. Use the more (F3) key to toggle between the pattern choices. When the desired pattern is displayed in the (F2) spot, press the (F2) key to begin transmitting that pattern.

The following measurements are displayed in the lower portion of the screen:

- ELAPSED TIME: The elapsed time since the beginning of the test. This counter begins counting when you enter the 16K BERT screen, or when you press STOP/RESUME (F1) key.
- ERROR: The number of bit errors that have occurred since

the start of the test.

- **ES:** The number of errored seconds since the beginning of the test.
- **EFS:** The number of error-free seconds since the beginning of the test.
- **SES:** The number of severely-errored seconds since the beginning of the test. A severely-errored second contains a $10e-03$ error rate.
- **UAS:** The number of unavailable seconds since the beginning of the test. An unavailable second begins after 10 consecutive severely-errored seconds (SES). It also occurs when there is a loss of signal.
- **LOSS:** Loss of Synchronization Seconds are the number of seconds with pattern loss since the beginning of the test.

The following F-keys are constant on the screen:

- **STOP/RESUME (F1):** Press STOP (F1) to stop your current measurement. Pressing RESUME (F1) causes a new measurement cycle to begin; the Elapse Time resets at 0.
- **PRINT (F4)** sends this data to a printer.

