SUNRISE TELECOM
INCORPORATED

SunSet T3

User's Manual
SS305

Version 2.64

Sunrise Telecom....a step ahead

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DECLARATION OF CONFORMITY

SUNRISE TELECOM
for
SunSet T3

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

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

Sample Tests
Standards used:

C.I.S.P.R. 22 (1993-12);
EN50081-1992, EN55022
Electromagnetic Compatability;
Generic Immunity Standard
EN 50082-1 (1992)
IEC 801-2, IEC 801-3, IEC 801-4

The tests have been performed in a
typical configuration.

The conformity is indicated by the symbol

$\mathsf{C}\mathsf{E}$ i.e., "Conformité eurpoéenne"

SunSet T3 Version 2.64
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CE Certificate

Welcome to the SunSet T3

Congratulations, you have just purchased the industry's leading hand-held T3 test set, the SunSet™ T3. This test set puts powerful test capabilities into a single, convenient, hand-held package.

The SunSet T3 is designed to help anyone who maintains or works with DS3/ 1/0 and E1 circuits. Its broad range of capabilities combined with a convenient hand-held size make it the favorite of technicians in the central office, outside plant, and corporate communications center. This test set helps diagnose T3/1/E1 problems quickly and easily, whether the circuit is in-service or out-of-service.

This manual is designed to provide you with all the information you will need concerning your SunSet T3.

Each SunSet T3 provides:
- 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
- 20 dual-color LED indicators provide circuit status at a glance
- Menu-driven user interface for simple and efficient operation
- AUTO configure to received DS3 Framing and Test Pattern
- A rich selection of stress patterns
- 5 ppm accuracy clock
- Full range of in-service and out-of-service measurements
- Line/path/service measurements, counts, and rates
- View live received T3 data in binary format
- Drop and insert one E1 channel to DS3

Optional features give you even more diagnostic power:
- DS3 FEAC
- Graphical VT100 Remote Control allows menu-driven control of basic test functions
- DS1 option:
  - Framing: unframed, SF-D4, ESF, SLC-96*, AUTO
  - View live received T1 data: binary, hex, and ASCII formats
  - 1.544 Mbps signal level measurement
- ESF & SLC-96 Datalink Control including loopbacks
- Fractional T1 allows Nx56K and Nx64K testing with any combination of Tx and Rx DS0 channels
- DS0 Drop/Insert:
  - Built-in Microphone & Speaker for Talk/Listen
  - View all 24 Channel A/B/C/D bits on a single display screen

- Generate signaling bits
- VF Level, Frequency & Noise measurement:
  - S/N, C-Message, C-Message Notched, 3 KHz Flat filters
  - Generate tones from 50 to 3950 Hz at +3 to -60 dBm
- MF/DTMF/DP Dialing, Decoding & Analysis
- CSU/NIU Emulation
- Control of Westell & Teltrend Looping Repeaters, Maintenance Switch and Performance Monitoring NIU
- ISDN Primary Rate Call Setup and Analysis:
  - Setup and receive on voice/data calls
  - BERT test on data calls, talk listen on data calls
  - 23B+D, Nx56K, Nx64K BERT
  - AT&T and Northern Telecom compatible
- Transmit and receive at the E1 interface

For further information, or if you encounter problems, please contact Sunrise Telecom Customer Service for assistance.

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

Chapter 1
Technology Overview

1.0 T3 and T1 Technology

This section gives you an overview of T3 technology and equipment. It also shows you the basics of troubleshooting and sectionalizing problems with T3 and T1 circuits. Note that T3 and T1 are general terms that refer to the transmission of 44.736 Mbps and 1.544 Mbps digital circuits over any media. T3 and T1 can be transported over copper, fiber, or radio. DS3 and DS1 are the terms for the electrical signal found at the metallic interfaces for these circuits where most testing is performed.

1.1 T3 Transmission

T3 Usage

T3s are used for a variety of purposes. They are widely embedded in the network transport architecture as a convenient means of carrying 672 voice channels in one circuit. Newer T3 applications include the transport of broadcast-quality video, ATM (Asynchronous Transfer Mode) physical layer connections, and supercomputer direct links.

T3 Services

Telephone companies are now selling T3 point-to-point circuits as a highly profitable service alternative. T3s are purchased by interexchange resellers who make a business out of slicing up their bandwidth into lower-rate pieces and selling it at a higher per unit cost. Interexchange companies sometimes purchase their local access interfaces at DS3 rates for speed and simplicity in installation. Or, these interexchange companies may be selling T3 national interconnection services to large end users, and may be purchasing the local distribution of the T3 to the customer premises through the local telephone company. Bypass companies can sell T3 radio access in metropolitan areas in competition with land-based T3 service by local telephone companies. The ever increasing appetite for digital bandwidth in combination with the merging of multimedia applications with communications are driving a strong growth in the delivery of T3 service.

T3 Network Elements

Many types of network elements (equipment) have DS3 interfaces. An M13 mux multiplexes 28 DS1s into a single DS3. A DS3 NIU (Network

Interface Unit) may be installed by the telephone company at the customer premises to isolate the customer's circuit from the network. A fiber mux may have one or more DS3 low speed tributaries and has a high speed (OC-3, OC-12, OC-48, etc.) output. A 3x1 Digital Cross-connect System (DCS) has many DS3s as inputs and cross-connects the DS1s inside the DS3s. See Figure 1.1.A for a simple example of typical equipment in a DS3 circuit.
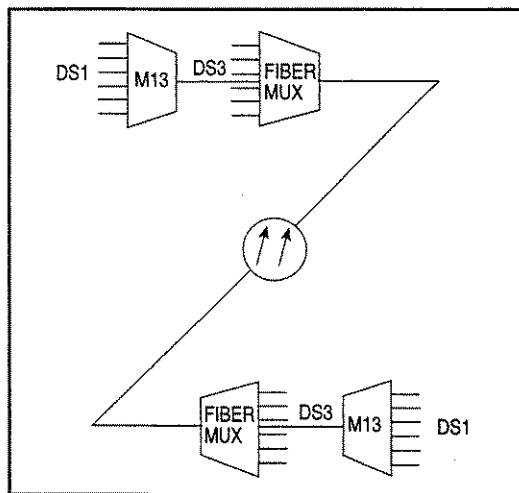
Figure 1.1.A   Typical DS3 Circuit

DS3 Standards

A number of standards govern DS3 transmission:
- ANSI T1.102 - 1987 Digital Hierarchy, Electrical Interfaces
- ANSI T1.107a - 1990 (DS3 format applications)
- ANSI T1.404-199x Network to Customer Installation DS3 Metallic Interface Specification
- Bellcore TR-TSY-000009 Asynchronous Digital Multiplexes - Requirements and Objectives
- AT&T TR 62415 Access Specification for High Capacity (DS1/DS3) Dedicated Digital Services

DS3 Signal

A DS3 signal consists of digital data transmitted at 44.736 megabits per second (Mbps), plus or minus 20 parts per million. Coaxial cables carry the DS3 signal, with the actual signal found on the center conductor and the outer conductor being grounded. The electrical signal uses a bipolar format with alternate mark inversion (AMI). See Figure 1.1.B for an example

of how data is translated into the electrical signal.
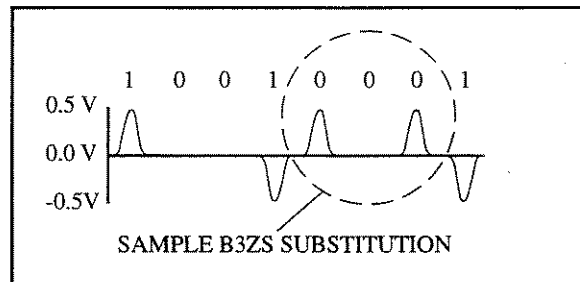
Figure 1.1.B   DS3 Data Transmission

In AMI, a 1 (mark) is represented as a pulse of either positive or negative polarity, and a zero (space) is represented by no pulse at all. The pulse is transmitted at a peak voltage of between 0.36 and 0.85 Volts base to peak. The polarity of each pulse (mark) is opposite from the previous pulse, hence the name alternate mark inversion. AMI has the benefit that the main spectral component of the signal is at 1/2 the 44.736 Mbps bit rate, so that a given signal can be transmitted farther on a coaxial cable. A B3ZS line code is used which substitutes 3 zeroes with a special bipolar violation code, see Figure 1.1.B. The bipolar violation occurs when two consecutive pulses have the same polarity. This B3ZS code prevents the DS3 receiver from losing synchronization with the signal when no 1s are present. The circuit has a characteristic impedance of 75 ohms. It can be transmitted up to 450 feet over coaxial cable with a 6 dB loss.

M23 and C-bit Parity Framing

Framing is provided on a DS3 signal for a number of reasons. It allows the two terminals of a DS3 line to synchronize on the signal and demultiplex subchannels in a pre determined order. It also allows a variety of maintenance and operational benefits.

There are two common types of DS3 framing, the original M23 multiplex framing and the newer C-bit parity framing. In the M23 multiplex framing application, 7 DS2s are multiplexed into a single DS3. Each DS2 is itself created from 4 multiplexed DS1s. The DS2 framing is called M12 framing. The DS2s are allowed to exist as independent signals which can be plugged into other equipment. The 28 DS1s, 7 DS2s, and 1 DS3 are all plesiochronous, that is, they are not frequency-locked with respect to each other. As a result, a bit-stuffing

algorithm is provided within the M12 and M23 frame formats to allow the minor frequency variations to occur without causing any bit errors in the transmitted data.

C-bit parity framing was created because DS2s typically do not need to exist independently with varying frequencies. Instead, most commercial multiplex equipment operates in an M13 mode, multiplexing 28 DS1s directly into a DS3. DS2 signals are still multiplexed within the DS3, but the DS2s' timing is frequency-locked to the DS3 which frees up the M23 stuff bits to be used for other purposes, providing additional benefits to users.

Figure 1.1.C shows the basic DS3 framing format used by both the M23 and C-bit parity framing methods.

Figure 1.1.C   DS3 Framing, C-bit parity, and M23

Idle Signal

The DS3 idle signal allows DS3 circuits to stay out of service as desired without triggering network alarms. For instance, when the telephone company first provisions a DS3 with a DS3 NIU, the customer may not yet have a DS3 signal plugged into the NIU. See Figure 1.1.D for an illustration. In this case, the NIU sends an idle signal into the network to indicate to the network that the customer is not using the circuit and there is no cause for alarm. Before the idle signal was available, the loss of signal at the customer premises might generate a false alarm at the telephone company which would waste resources and undermine the telephone company's ability to respond to real alarms.

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The DS3 idle signal is a validly framed DS3 signal with a payload consisting of a repeated 1100 signal.
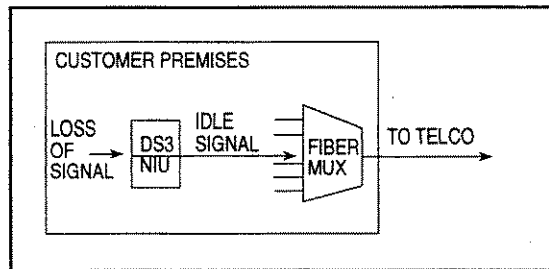
Figure 1.1.D   DS3 Idle Signal

AIS

AIS, Alarm Indication Signal, is used to indicate a transmission failure within the network. When any intermediate network element receives a loss of signal on its input, it is supposed to propagate an AIS on its output. Figure 1.1.E shows how this works. Both the intermediate element that generates the AIS and the far end terminal that receives the AIS should generate an appropriate alarm to indicate that service has been lost.

Note that a DS3 circuit passes through an intermediate network element. In this example, the DS3 is an electrical interface on one side of the fiber mux and it is a channel of a higher order signal on the other side of the fiber mux. In comparison, a terminal network element terminates the DS3 circuit so that no form of DS3 passes through to the other side of the element. An M13 multiplex is an example of a terminating network element where the DS3 stops and the DS1s continue on.

The AIS signal is a valid framed signal with payload containing a repeating 1010 pattern.
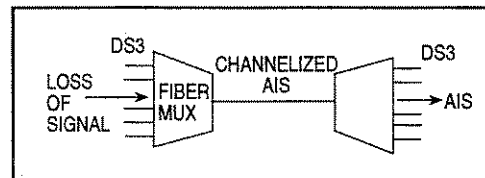
Figure 1.1.E   Generation of DS3 AIS

Yellow alarm

A yellow alarm, also known as far end alarm, is transmitted on a DS3 circuit when the terminating element such as an M13 multiplex loses framing on its received DS3 signal or receives an AIS signal. If the terminating element is an M13 multiplex, it also transmits AIS on the DS1s. See Figure 1.1.F. The yellow alarm lets the M13 multiplex at the other end know that there is a service outage on the circuit. The yellow alarm is transmitted by setting the X bits to 0.
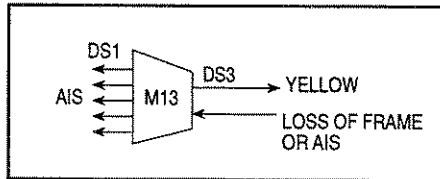
Figure 1.1.F   Generation of DS3 Yellow

Loopbacks

Loopback testing lets you quickly verify the performance of a new DS3 circuit. Loopback testing can also help sectionalize a fault on a circuit that is out of service. Loopback capabilities are provided in DS3 NIUs, just now being introduced to the network, and some DS3/1 multiplexers. In the multiplexers, DS1s can be looped back by inverting the third C bit in M12 framing, or by sending a FEAC (Far End Alarm and Control channel) message in C-bit parity framing. In this way, you can loop back a DS1 signal at a distant multiplex when you are accessing the circuit from a DS3 access point. In C-bit parity multiplexers, there are also FEAC messages for looping back the entire DS3. DS3 NIUs also let you loopback the entire DS3 signal through use of a FEAC message. Figure 1.1.G shows a new service being tested from the central office using a test set and DS3 NIU.
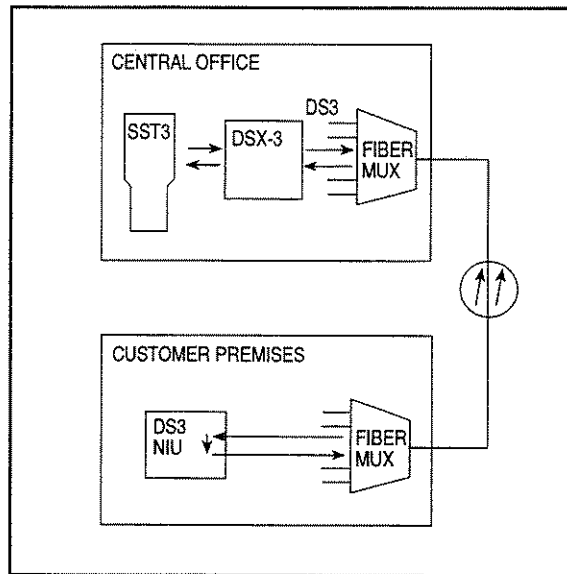
Figure 1.1.G   DS3 Loopback Testing

DS3 Performance Monitoring

C-bit parity framing enables end-to-end performance monitoring of DS3 circuits. In this way, a telephone company or end user can verify the end-to-end performance of a circuit while it is in service. C-bit parity framing has a CP-bit path parity check that catches errors that occur anywhere along a path. A path starts at one terminating element such as an M13 mux and ends at the other terminating element.

Each terminating element continuously monitors its incoming signal for CP-bit path errors. If an error is detected on the incoming DS3, the terminating elements transmits a FEBE (Far End Block Error) bit on the outgoing direction of the DS3. Network monitoring equipment located anywhere along the path then measures these FEBEs in each direction to gauge the quality of the circuit while it is in service. They can measure the FEBE even if it is impossible for them to measure the actual errors that occurred in the network.

Figure 1.1.H shows how a bit-error-generating impairment can be observed through the use of FEBEs. In this case, the errors are originating in the end office in Miami and are being received at the M13 mux in Miami. With traditional testing, a technician at Atlanta would not be

able to see the problem without first taking the circuit out of service and performing loopback tests. However, with C-bit parity framing, the mux in Miami generates FEBE error messages and the technician in Atlanta can receive the error message simply by plugging into the monitor jack.
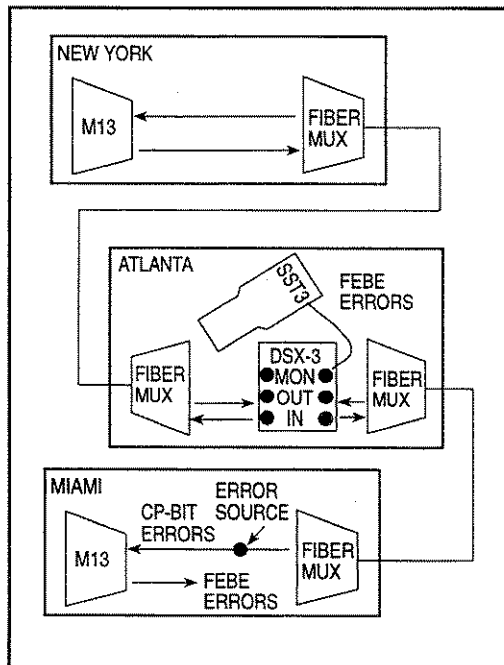
Figure 1.1.H End to End   Performance Monitoring

1.2 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 1.2.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.
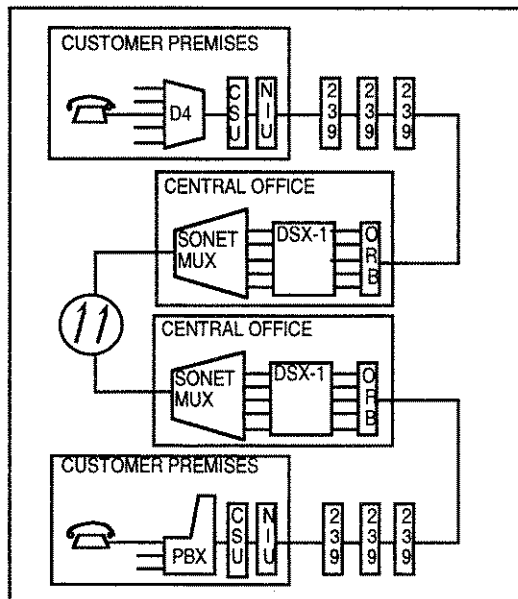
Figure 1.2.A   DS1 Network Elements

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 comparison, 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 1.2.B for an illustration of the DS1 signal.
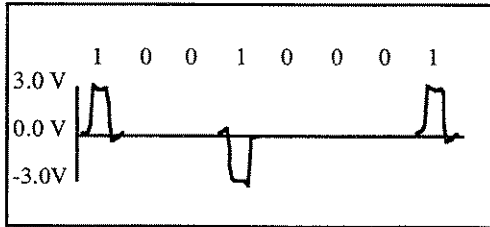
Figure 1.2.B   DS1 Pulse Transmission

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 Figure1.2.C.
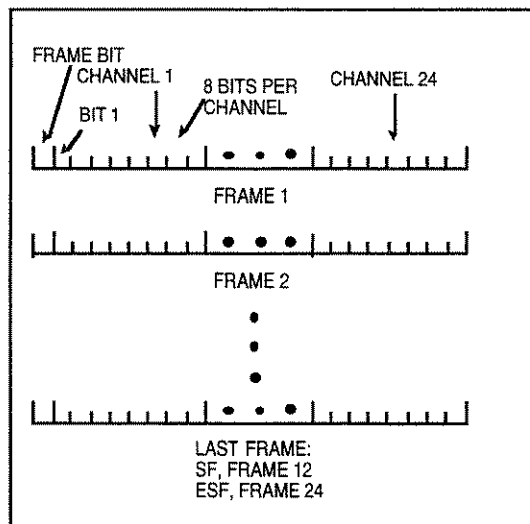
Figure 1.2.C   DS1 Frame Structure

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 1.2.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.

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125 MICRO SECONDS

1) SAMPLING THE SIGNAL

256

AMPLITUDE NUMBER

SIGNAL VOLTAGE

2) U-LAW CONVERSION
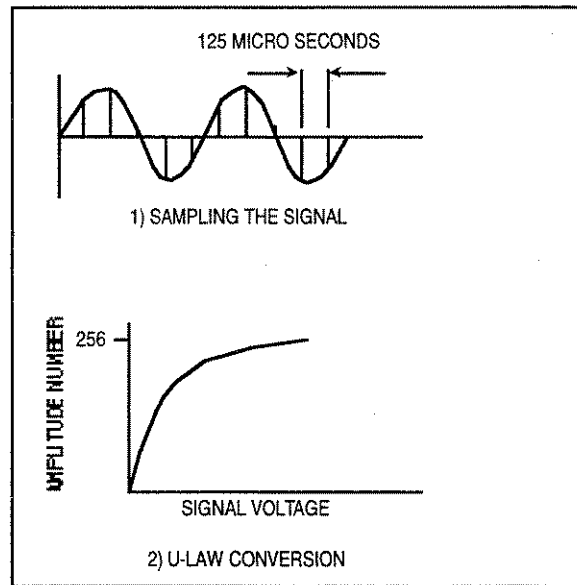
Figure1.2.D   PCM Sampling and μ-Law Encoding

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. It next 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 1.2.E.
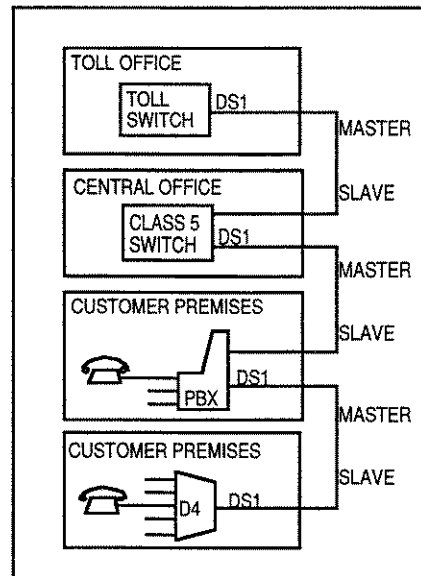
Figure 1.2.E   Timing Distribution

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 interoffice signaling in the telephone network. It uses a group of frequencies in pairs to form a single address tone. In addition to supporting the digits 0 through 9, MF offers many other control codes for specialized network applications like billing, pay phones, etc.

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

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 1.2.F for diagrams on how the AIS and yellow alarms are transmitted.
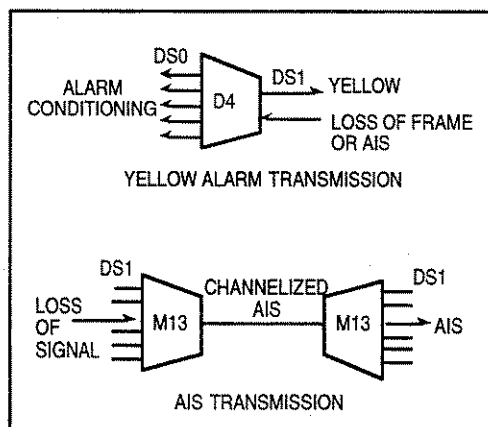
Figure 1.2.F   AIS and Yellow Alarms

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 1.2.G shows the variety of loopback points available from the central office during a fault sectionalization process.
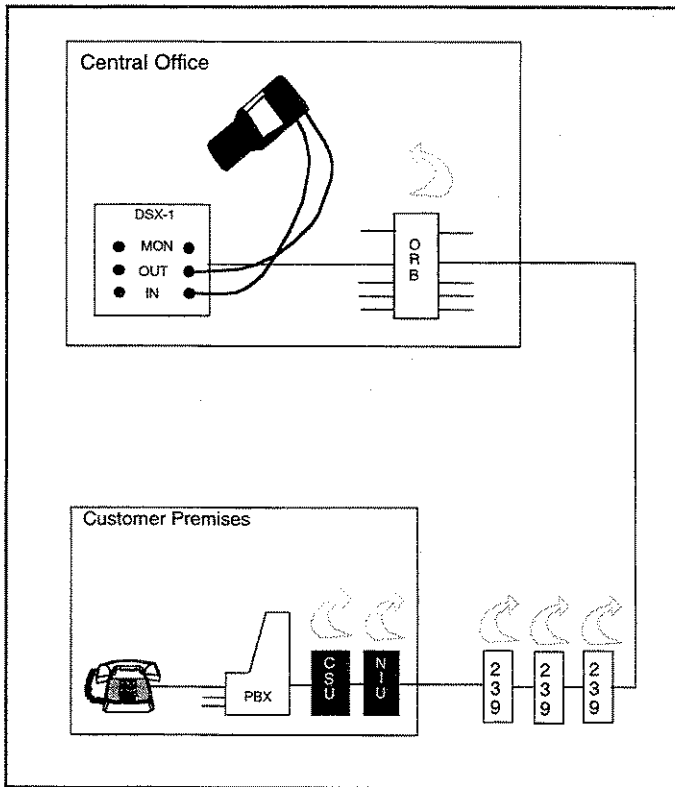
Figure 1.2.G   DS1 Loopback Testing

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 1.2.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.
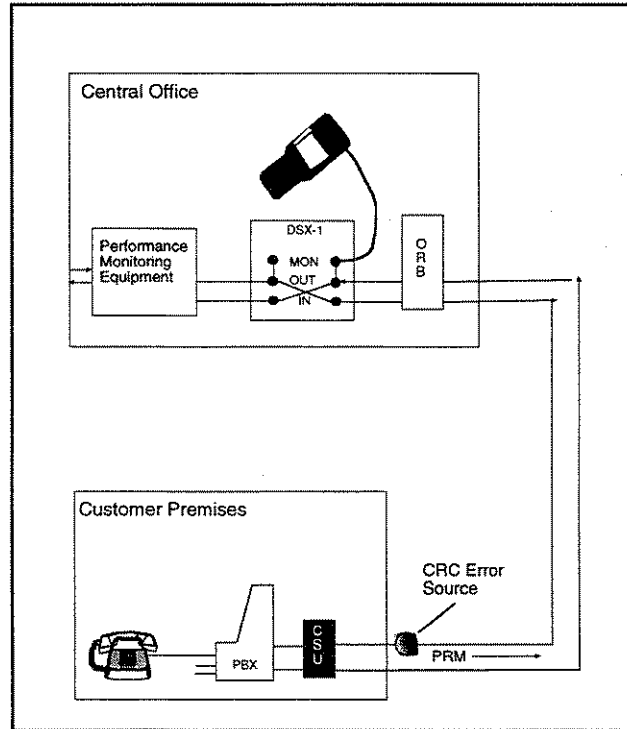
Figure1.2.H   DS1 Performance Monitoring

1.3 Circuit Troubleshooting and Fault Sectionalization

This section will help you find problems on T1 and T3 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 uses a screen to separate the two directions of transmission to prevent cross talk. Are the T1s in the screened cable properly separated into Transmit and Receive binder groups?
- Has the circuit been connected 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 1.2.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 T3 shows what abnormal conditions it is seeing from its monitor point. In the diagrams, a triangle indicates a line impairment that is causing steady or bursty errors. A loss of signal is indicated by a missing signal arrow. If CRC is listed in the diagram, it will only be seen if the circuit uses ESF framing. Likewise, if C-bit (parity) error is listed, this is only found if C-bit parity framing is used.

Bipolar violations and Loss of Signal

DS1 or DS3 bipolar violations or loss of signal show that the fault is relatively nearby. DS1 bipolar violations pass through line repeaters, office repeaters and NIUs, but are stopped by multiplexes, DCSs, switches, signal format changes (i.e. from optical to electrical, or from radio to electrical) and possibly CSUs. DS3 bipolar violations indicate the problem is between the test set and nearest DS3 equipment, within a few hundred feet.

The DS3 format only exists at interconnections between equipment. Different formats are used for transmission over long distances. In comparison, the DS1 electrical signal can transmitted through regenerative line repeaters for hundreds of miles. Thus, a DS1 bipolar violation indicates a transmission problem between the test set and the last multiplex, DCS, or other element that stops BPVs. Figure 1.3.A illustrates the case.
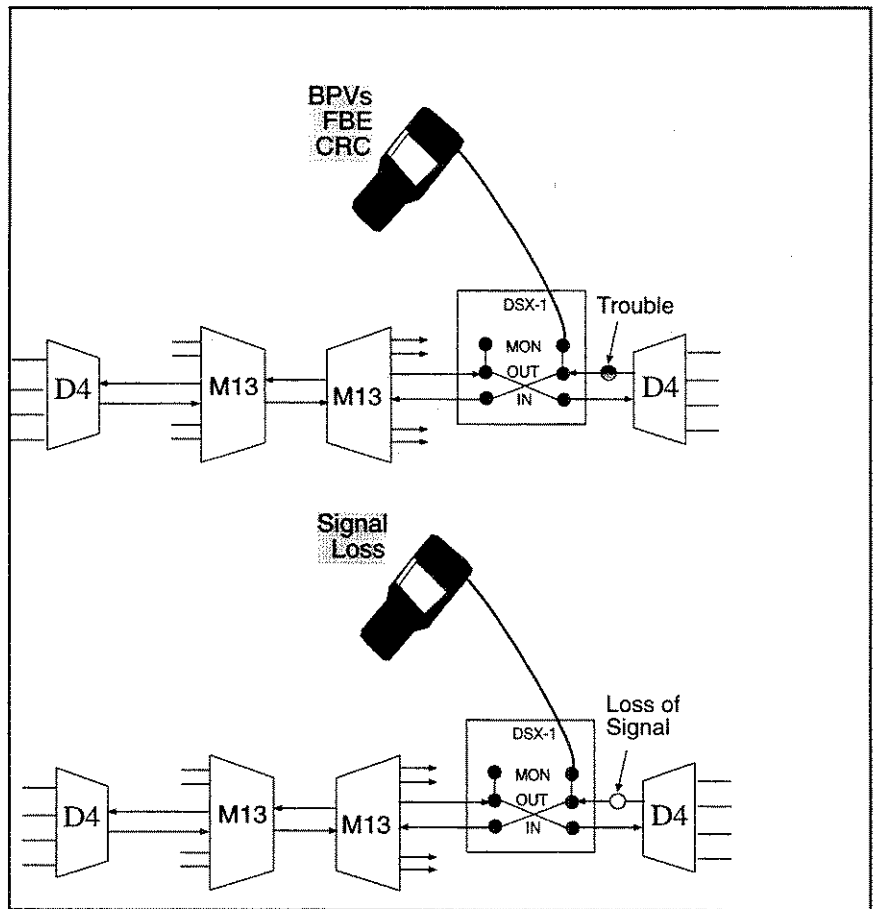
Figure 1.3.A BPVs and LOS in DS1 Fault Sectionalization

Frame Bit Errors, Bit Errors, CRC-6 Errors

These errors travel with the DS1 or DS3 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 1.3.B shows what these errors mean when they are seen without BPVs.
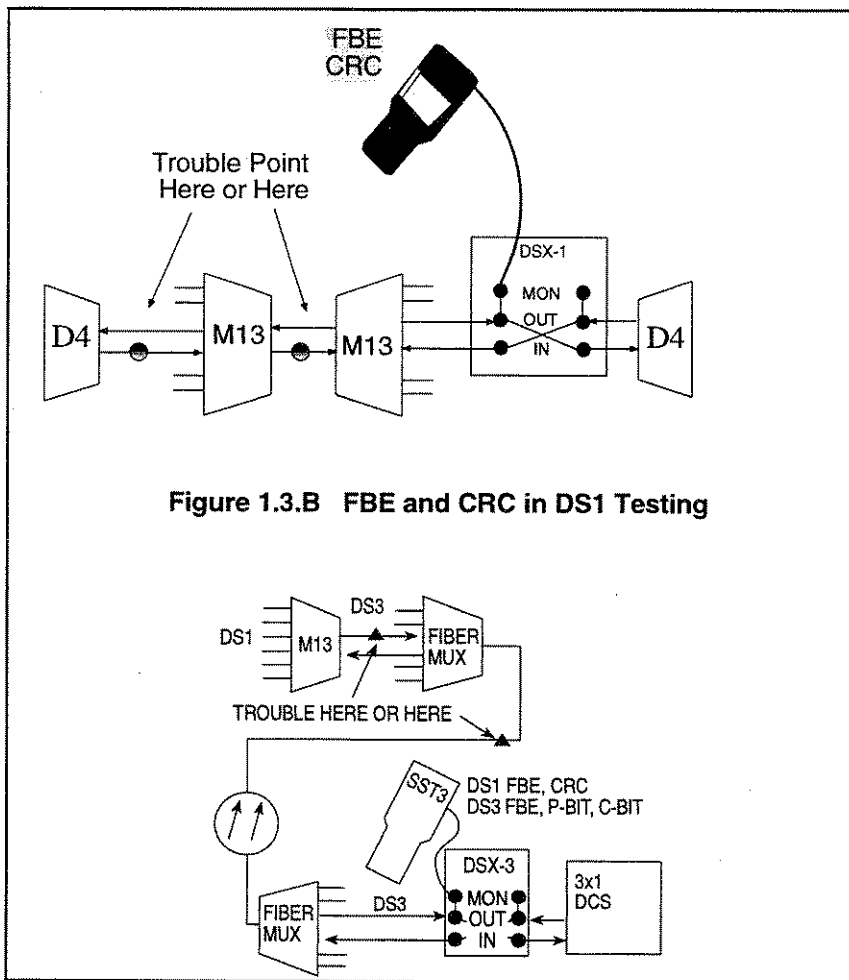
Figure 1.3.B   FBE and CRC in DS1 Testing
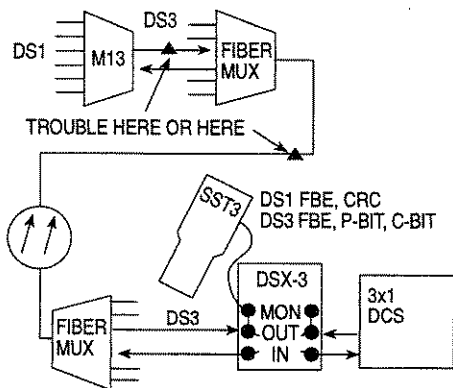
Figure 1.3.C   FBE and C-bit in DS3 testing

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)

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the trouble is between you and the other end of the circuit.

Figures 1.3.D shows how the AIS and Yellow alarms show up in DS1 fault sectionalization.
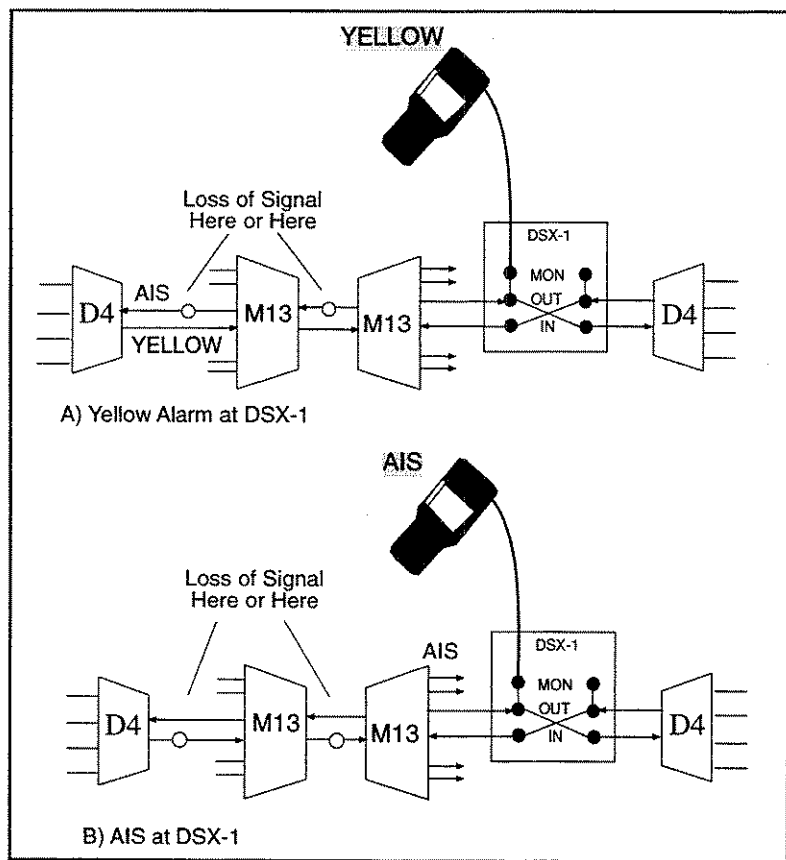
Figure 1.3.D   DS1 Yellow and AIS
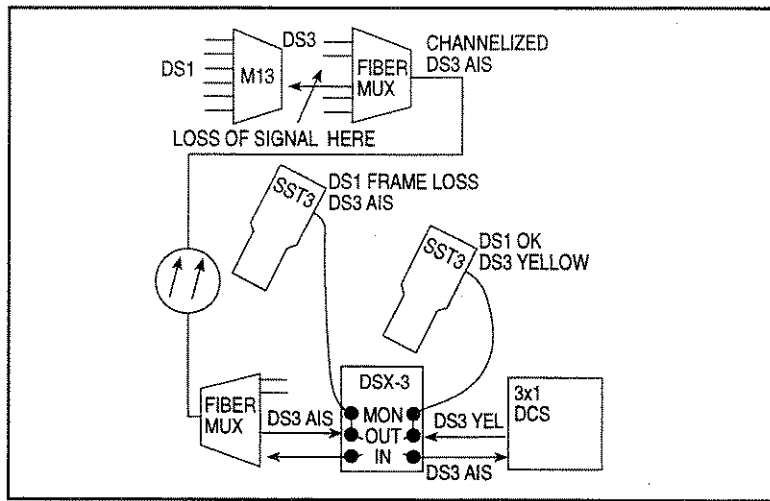
Figure 1.3.E   DS3 Yellow and AIS

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.

If you are monitoring a DS1 circuit from a DS3 access point, and you see both DS2 FEBEs and DS1 PRM errors, then the problem exists before the end of the DS3. If you are on a C-bit parity framed DS3 monitoring a DS1, and you see ESF PRM errors, but you do not see FEBEs, then the problem exists in-between the side of the circuit generating the ESF PRMs and the end of the DS3 mux.

Figures 1.3.F and G show a typical example of a network fault leading to this indication.
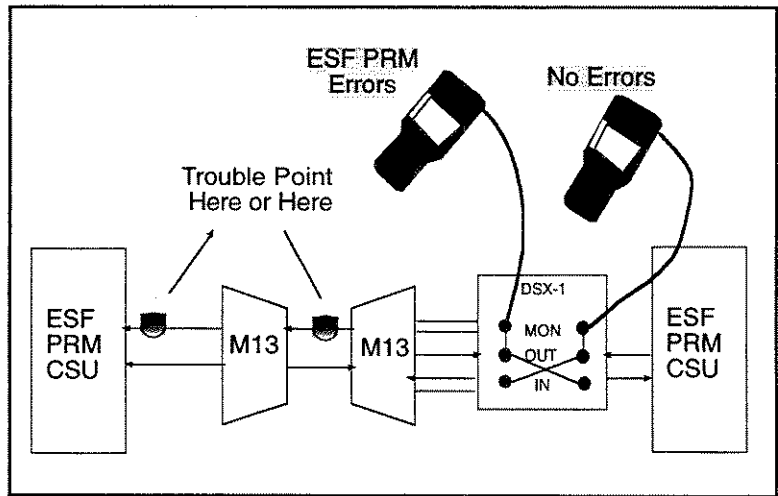
Figure 1.3.F   DS1 ESF PRM Errors
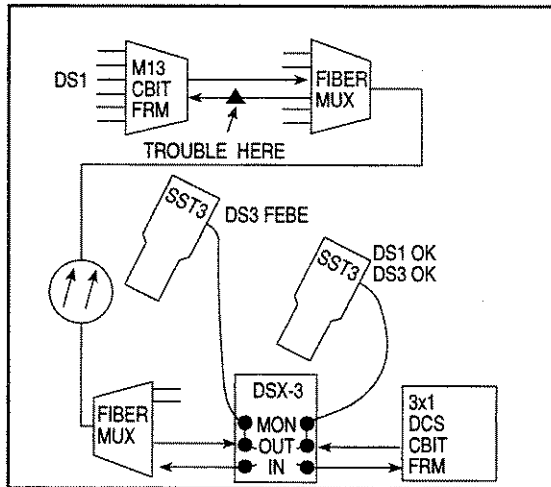
Figure 1.3.G   DS3 FEBE Errors

1.4 ISDN Technology Overview

1.4.1 Introduction

ISDN (Integrated Services Digital Network) was conceived to provide digital services to end users using regular phone lines. Specifically, ISDN targets both residential as well as 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 signaling and data communication; its capacity for BRI and PRI are 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.

1.4.2 ISDN Network Architecture

ISDN provides complete digital capabilities. In accordance with Figure 1.4.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 Signaling
- User-to-user signaling

1.4.3 ISDN Protocol

The D channel provides the signaling for all the B channel connections, therefore, the ISDN protocol is mainly concerned with the first 3 layers of the D channel signaling. However, there are occasions in which the B channel is connected to a packetized network, and it can provide its own signaling.

The signaling at the Data Link layer is called LAP-B (Link Access Protocol Balanced) and LAP-D respectively. Referring to Figure 1.4B, here are the different layers of the protocol:

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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.
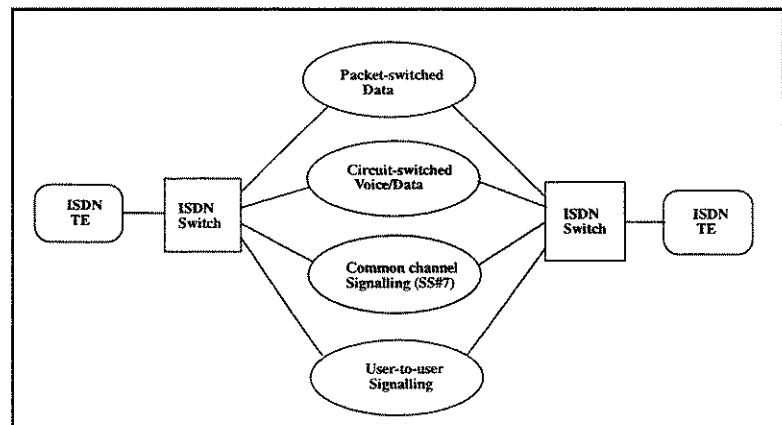
Figure 1.4.A ISDN architecture

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 1.4.B   ISDN Protocol Architecture

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 B channel packet switching service.

Layer 3 provides higher layer information for supporting various ISDN functions. Two basic types of user terminals are supported by ISDN: functional and stimulus. Functional terminals are considered to be intelligent devices and can employ the full range of I.451 messages and parameters for call control. All signalling information is sent in a single control message (en bloc sending). Stimulus terminals are devices with a rudimentary signalling capability. A simple digital telephone is an example of a stimulus terminal.

1.4.4 ISDN Messages and their Functionalities

The message structure is shown below in Figure 1.5.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.
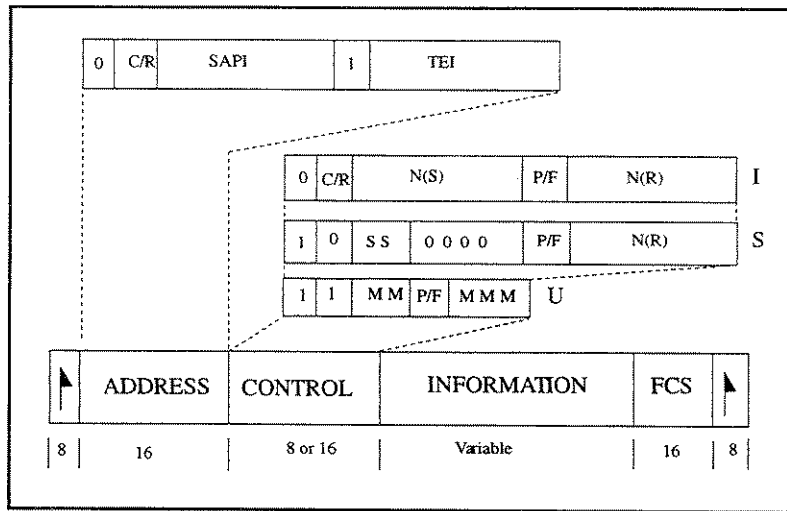
Figure 1.5.A   ISDN Frame Structure

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)

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provide supplemental link control functions and are also used to support unacknowledged operation.

All of the control field formats contain the poll/final bit (P/F). In command frames, it is referred to as the P bit, and is set to 1 to solicit (poll) a response frame from the peer LAP-D entity. In response frames, it is referred to as the F bit, and is set to 1 to indicate the response frame transmitted as a result of a soliciting command.

Information Field

The information field is present only in I-frames and some unnumbered frames. In the case of both control signalling and packet information, maximum length is 260 octets.

The information field contains the message type and parameters. For example, the SETUP message is used to set up a call. It contains the bearer capability, originating and destination addresses, transit network selection and other pertinent data.

Layer 3 information is used for intra, as well as interexchange calls using SS#7.

2.0 E1 Technology

2.1 Introduction

This section will discuss sampling a signal, converting the information into a bitstream, and dividing the bitstream into channels. This allows us to transmit data from a variety of sources simultaneously, and we can encode the data stream to detect errors and avoid physical problems with the transmission equipment.

2.2 Technical Standards

E1 transmission technology is defined by a number of technology standards. Having E1 transmissions conform to these standards allows equipment designers and service providers to ensure that various pieces of equipment are compatible, and that networks operate in a predictable, reliable manner.

The following standards cover many of the important aspects of E1 transmission technology:

- ITU-T G.703 Physical/electrical characteristics of interfaces
- ITU-T G.704 Synchronous frame structures
- ITU-T G.706 Frame alignment and CRC
- ITU-T G.821 Error performance of an international connection
- ITU-T G.826 Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate (revised draft, 7/95)
- ITU-T M.550/M.2100 Bringing an international connection into service

Consult these standards when you need detailed information on particular aspects of E1 transmission technology.

2.3 Basic Definitions

Binary Data: A signal which has been converted into a format of 0s and 1s.

Bit Stream: Binary Data which has been placed in a sequence at a fixed

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rate.

Channel: A single portion of the bit stream which is available for communication.

2.4 Converting a Voice Signal

To transmit voice in a digital medium such as a 2.048 Mbps line, we first need to encode the analog voice signal in a binary format, then convert it to a **bit stream** suitable for digital transmission.

This can be achieved through Pulse Code Modulation. Refer to Figure 2.4.A.

Sample	Voltage	A-law Binary Code
A	2.08V	11101101
B	2.01V	11100000
C	1.57V	10101001
D	-0.48V	00010001

voice-frequency signal

signal level

time

sample
sample
sample
sample

··· 11101101 11100000 10101001 00010001 ···
resulting 64Kbps bit stream
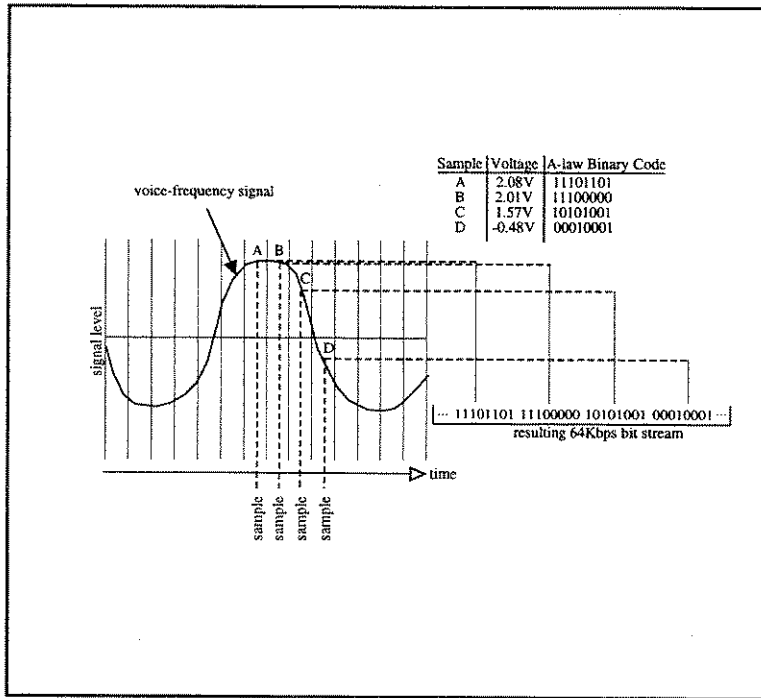
Figure 2.4.A Converting a Voice Signal

The Nyquist theorem requires that the signal be sampled at twice the signal's maximum frequency in order for it to be reproduced without a loss of information.   For voice signals, a maximum frequency of 4000 Hz

provides adequate clarity while conserving transmission bandwidth. Thus, we must sample our 4000 Hz voice signal at a frequency of 8000 Hz (8000 samples/second).

The amplitude of the analog voice signal is sampled 8000 times per second. Each amplitude value is expressed as an 8-bit code "word". These 8-bit words occurring 8000 times per second form a 64 Kbps digital bit stream.

The 8-bit code word is formed by comparing the amplitude of the analog sample to a "companding characteristic". The companding characteristic is a formula which translates the amplitudes of the samples into the 8-bit code words. Internationally, a companding characteristic known as "A-law" is used. The purpose of A-law is to provide optimum signal to noise performance over a wide range of transmission levels. Linear encoding provides a poorer signal to noise ratio at the -20 dB level typical of speech. In North America, the encoding is done according to the Mu-law. Therefore, the companding law used for encoding the voice signal must match that for decoding, for distortion-free transmission.

2.5 2.048 Mbps Data Rate

The E1 signal (bitstream) is transmitted at a rate of 2.048 Mbps (2 048 000 bits per second). This transmission rate is achieved by multiplexing 32 individual 64 Kbps bitstreams:

> 64 Kbps/Channel
> x 32 Channels = 2048 Kbps =
> 2.048 Mbps

This 2.048 Mbps signal is the overall E1 transmission rate.
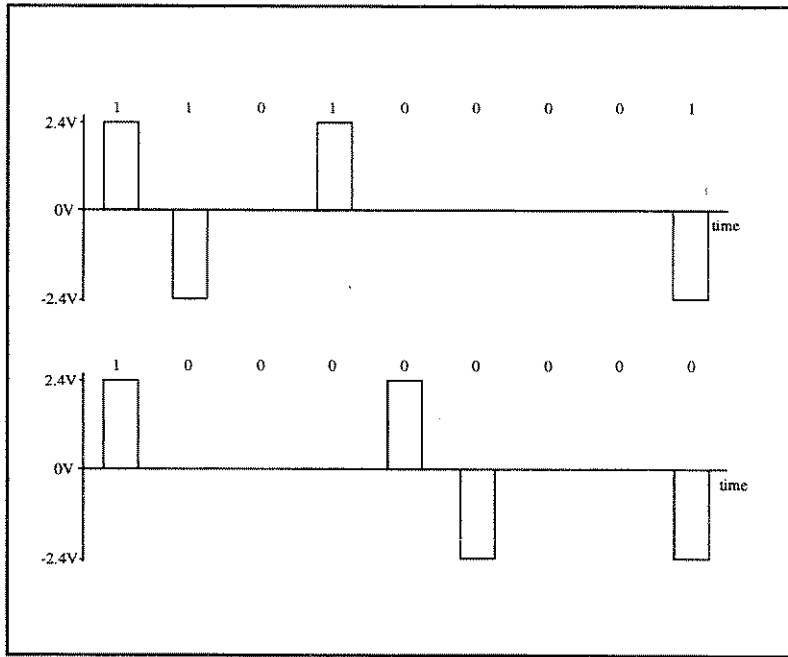
Figure 2.5.A Line Coding

2.6 Line Coding

Two types of line coding are used in a typical E1 network: AMI or HDB3.

2.6.1 AMI

This is the simpler of the two line coding formats. AMI stands for Alternate Mark Inversion, and is used to represent successive 1's values in a bitstream with alternating positive and negative pulses. Refer to Figure 2.6.A. AMI is not used in most 2.048 Mbps transmission because synchronization loss may occur during long strings of data zeros.
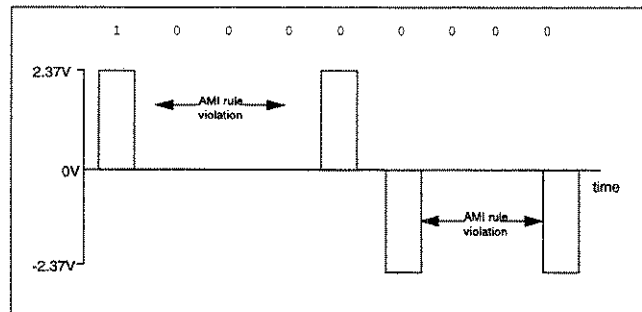
Figure 2.6.A   AMI Coding

2.6.2 HDB3

The HDB3 line coding format was adopted in order to eliminate these synchronization problems, by increasing the number of transitions even during a long string of zeros.

In the HDB3 format, a string of four consecutive zeros is substituted with a string of pulses containing an intentional bipolar violation. As the far end equipment receives the E1 signal, it examines the bit stream for these intentional bipolar code violations. It will then extract the code and reconstruct the original data. The HDB3 code substitutions provide high

pulse density so that the receiving equipment is able to maintain synchronization with the received signal.

The 2.048 Mbps transmission almost always uses HDB3 coding. The SunSet T3 is configured to detect the HDB3 substitution codes generated by older network equipment, even if they don't correspond exactly to current HDB3 standards. For instance, if an even code is used where an odd code should have been used, the SunSet T3 will still record four 0s.
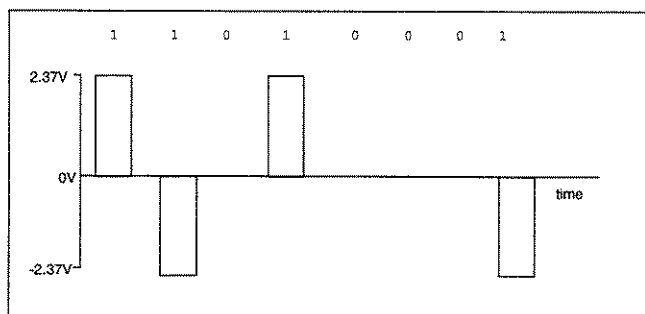
Figure 2.6.B   HDB3 Line Coding

General rules apply to the substitutions. The particular substitution made is governed by the polarity of the last inserted bit, as well as the number of pulses following the previous violation bit. If there is an odd number of pulses, 000V is substituted; the polarity of V is the same as that of the bit immediately preceding it. If there is an even number of pulses, B00V is inserted; the polarity of B is opposite to that of the bit immediately preceding it and the polarity of V is the same as that of B. Refer to Figure 2.6.C to see the types of HDB3 zero substitution codes.

Number of Pulses (since last substitution)	Polarity of Previous Pulse	
Even (Substitute B00V)	1　0　0　1	1　0　0　1
Odd (Substitute 000V)	0　0　0　1	0　0　0　1

Figure 2.6.C   HDB3 Encoding

2.7 Signal Levels & Impedances

Once a signal has been encoded into a binary format and assembled into a bit stream, the pulses in the bit stream are converted to voltage levels suitable for E1 transmission.

Referring to Figure 2.6.A, we see that a typical signal level for an E1 pulse with 75 ohm impedance is either +2.37 volts/-2.37 volts (for a binary "1" value) or 0 volts (for a binary "0" value). Actual signal values would typically be +/- 0.237V.

Note the distinction between a logic pulse and a signal pulse: the logic pulse only indicates whether we have a "1" value or a "0" value. The signal pulse is the actual electrical signal which is used on the E1 line.

Ideally, each pulse transmitted would be perfectly symmetrical. However, in an actual situation, each pulse becomes slightly distorted when it is generated and travels along the circuit. Refer to Figure 2.6.B. for the

shape of an "ideal" pulse versus. an actual pulse that would be encountered on an E1 line.

An E1 pulse may be required to conform to a standardized pulse shape. This is often determined by comparing it to a specified "mask". A common pulse mask is given by the ITU-T G.703 recommendation.

Note: For an E1 pulse with 120 ohm impedance, the signal level is either +/- 3 volts (for a binary "1" value) or 0 volts (for a binary "0" value) with real world values typically be +/- 10%.

Ideal Pulse   Actual Pulse
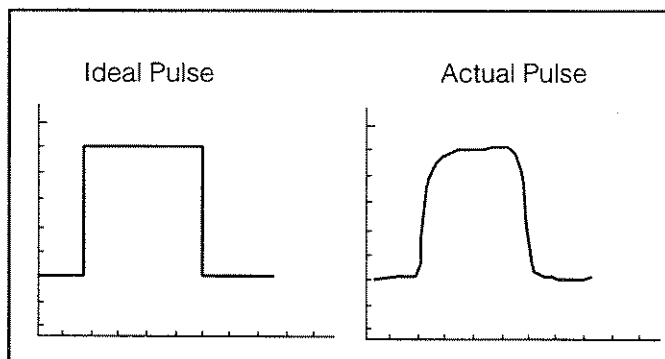
Figure 2.7.A   Pulse Shape

2.8 2.048 Mbps Framing

E1 transmission utilizes two main types of framing: Frame Alignment Signal (FAS) and MultiFrame Alignment Signal (MFAS). Framing is necessary in order for any equipment receiving the E1 signal to be able to identify and extract the individual channels. PCM-30 transmission systems use MFAS framing along with the FAS framing. PCM-31 transmission systems use only FAS framing.

2.8.1 Frame Alignment Signal (FAS)

The 2.048 Mbps frame consists of 32 individual time slots (numbered 0-31). As described previously, each time slot consists of an individual 64 Kbps channel of data.

In the FAS format, time slot 0 of every other frame is reserved for the frame alignment signal (FAS) pattern. Alternate frames contain the FAS

Distant Alarm indication bit and other bits reserved for National and International use. Hence, we utilize 31 time slots into which we can place data. Refer to Figure 2.8.A.

ONE 2.048 MBPS FRAME

| TIME SLOT 0 | 1 | ... | 31 |

Even Frame:
Contains Frame Alignment
  Signal (FAS)

Odd Frame:
Does Not Contain Frame
  Alignment Signal (NFAS)

BITS							
1	2	3	4	5	6	7	8
E	0	0	1	1	0	1	1
E	1	A	Sa	Sa	Sa	Sa	Sa

Sa= Bit Reserved for National use

E= Error Indication Bit

A=Remote Alarm (FAS Remote Alarm Indicaiton)

Frame Alignment Signal = 0011011

8 bits per timeslot x 8000 frames per second

= 2.048 Mbps transmission rate

Figure 2.8.A FAS framing format

2.8.2 MultiFrame Alignment Signal (MFAS)

MFAS framing uses Channel-Associated Signalling (CAS) to transmit A/B/C/D bit signalling information for each of 30 channels. This method uses the 32 timeslot frame format with timeslot 0 for the FAS and timeslot 16 for the MultiFrame Alignment Signal and the Channel Associated Signaling. As shown below, it takes 16 frames to make up a MultiFrame.

When we transmit the MFAS multiframe, we assemble 16 FAS frames together, dedicate timeslot 16 of the first frame to MFAS/NMFAS bits, then dedicate timeslot 16 of the remaining 15 frames to A/B/C/D bits. Refer to Figure 2.8.B.

Frame 0, timeslot 16: 8-bit MFAS signal

Frames 1-15, timeslot 16: (4 signalling bits/channel) x (30 channels) / (8 signalling bits/frame timeslot 16) = 15 frames of timeslot 16 signalling

Frame 0 TS16 bits: MFAS= 0000XYXX
    X= Spare Bits (=1, if not used)
    Y= MFAS Remote Alarm (=1, if MFS Synchronization is lost)

Note:
1) Frames are transmitted with 30 voice channels on timeslots 1-15 and 17-31.
2) Timeslot 16 (TS16) contains A/B/C/D bits for signalling (CASS)
3) MFAS framing still includes the original FAS frames and the FAS framing information.
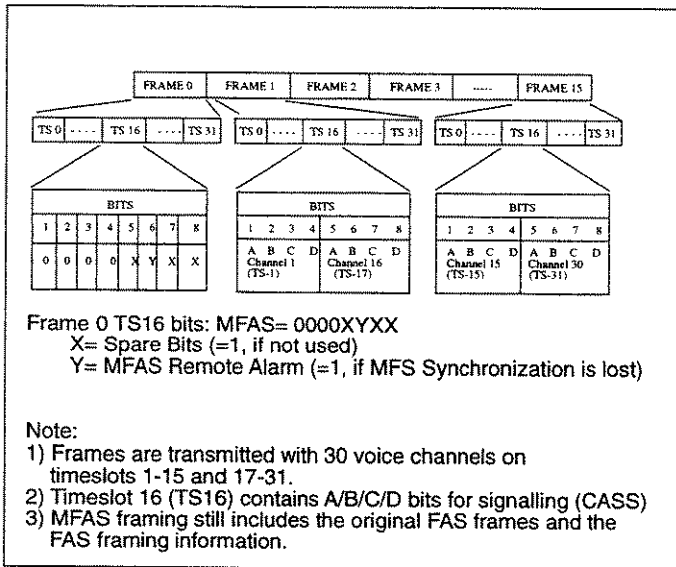
Figure 2.8.B MFAS MultiFrame format

2.8.3 CRC-4 Error Checking with CRC-4 MultiFrame

A Cyclic Redundancy Check-4 (CRC-4) is often used in E1 transmission to identify possible bit errors. CRC-4 allows us to detect errors within the 2.048 Mbps signal while it is in service.

The equipment which originates the E1 data calculates the CRC-4 bits for one sub-multiframe. Then it inserts the CRC-4 bits in the CRC-4 positions in the next sub-multiframe. The receiving equipment performs the reverse mathematical computation on the sub-multiframe. It examines the CRC-4 bits which were transmitted in the next sub-multiframe, then it compares the transmitted CRC-4 bits to the calculated value. If there is a discrepancy in the two values, a CRC-4 error is reported.

There is one major disadvantage of relying on CRC-4 errors to deter-

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mine the performance of an E1 circuit: each individual CRC-4 error does not necessarily correspond to a single bit error. Multiple bit errors within the same sub-multiframe will lead to only one CRC-4 error for the block. Also, it is possible that errors could occur such that the new CRC-4 bits are calculated to be the same as the original CRC-4 bits.

Thus, CRC-4 error checking provides a most convenient method of identifying bit errors within an in-service system, but provides only an approximate measure of the circuit's true performance.

Consider the MFAS framing, illustrated in Figure 2.8.B. Each MFAS frame can be divided into "sub-multiframes". These are labeled SMF#1 and SMF#2 and consist of 8 frames apiece. We associate 4 bits of CRC information with each sub-multiframe. Refer to Figure 2.8.C for an illustration of the CRC-4 bits and their placement.

In this figure:
>   SMF#1 = Sub-Multiframe #1
>   SMF#2 = Sub-Multiframe #2
>   Sa = Spare bit reserved for National use
>   E = E-bit errors
>   A = Remote Alarm (FAS Remote Alarm Indication)
>   Frame Alignment Signal Pattern = 0011011
>   c1, c2, c3, c4 = CRC bits
>   CRC-4 Frame Alignment signal = 001011

| | | | TIME SLOT 0 | | | | | | | |
| | | | Bits | | | | | | | |
Multiframe	Sub-Multiframe	Frame#	bit1	bit2	bit3	bit4	bit5	bit6	bit7	bit8
	SMF #1	0	c1	0	0	1	1	0	1	1
		1	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		2	c2	0	0	1	1	0	1	1
		3	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		4	c3	0	0	1	1	0	1	1
		5	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		6	c4	0	0	1	1	0	1	1
		7	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	SMF #2	8	c1	0	0	1	1	0	1	1
		9	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		10	c2	0	0	1	1	0	1	1
		11	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		12	c3	0	0	1	1	0	1	1
		13	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		14	c4	0	0	1	1	0	1	1
		15	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8

Figure 2.8.C   CRC-4 Multiframe Format

The CRC multiframe is not aligned with MFAS timeslot 16 multiframe.

The CRC-4 bits are calculated for each sub-multiframe, buffered, then inserted into the following sub-multiframe to be transmitted.

Chapter 2
Initial Setup

1.0 Unpacking Procedure

Use the following procedure for unpacking and testing your new test set:

1) Remove the packing list from the shipping container.

2) Remove the test set and accessories from the shipping container.

3) Inspect all parts and immediately report any damage to the carrier and to Sunrise Telecom.

4) Verify that all parts specified on the packing list were received.

5) Complete the Warranty Registration Card and return it immediately to Sunrise Telecom.

   NOTE: Sunrise Telecom must receive your warranty registration card in order to provide you with updated SunWare releases

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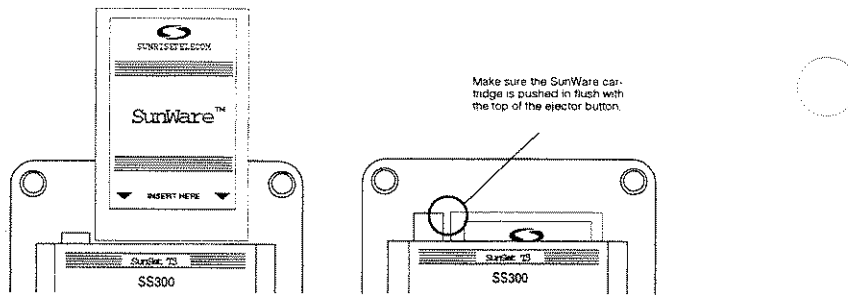
Figure 1.A
SunWare cartridge installation

7) Plug the SS138,120 VAC - 240 VAC AC Battery Charger into an appropriate AC wall outlet:

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

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

To install the instrument stand, use this procedure:

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 1) 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.
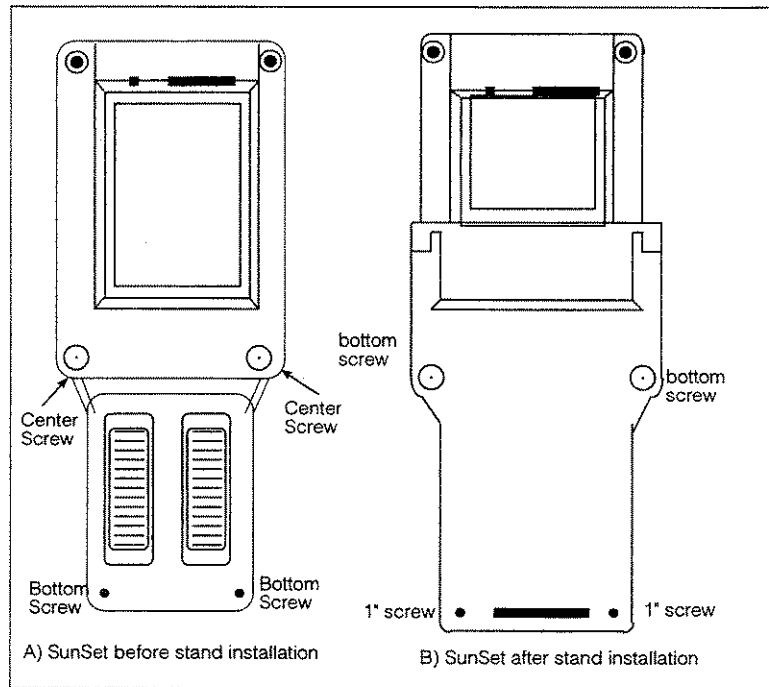
Figure 1.B
Instrument Stand installation

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 set.

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 test set.

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

2.0 Checkout Procedure

1) Plug in the appropriate AC Charger.

WARNING: Be sure to use only the SunSet charger for the SunSet T3. 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) Connect a single-bantam to single-bantam cord from the DS1 TX to RX jack. Connect a WECO 440A to 440A coaxial cord from the DS3 TX to RX. You will receive the signals you transmit.

3) Turn the POWER on. Observe the SELF TEST. Ensure that the LEDs light properly. Ensure when it say SELF TEST COMPLETE, that NO ERRORS are listed. If any errors are listed, contact Sunrise Telecom Customer Service at (408) 360-2200 for further assistance.

4) Press the LIGHT key to turn on the system backlight. Adjust the screen contrast by adjusting the contrast control on the left side of the test set.

5) Use the Down Arrow key on the keypad to highlight the OTHER FEATURES item. Press the ENTER key. Press the Down Arrow key until

you have highlighted the FACTORY DEFAULTS item; press ENTER. Press ENTER when you see the warning message.

6) Press ESCAPE to return to the SunSet T3-MAIN MENU. Using the Up Arrow key, ENTER the SET UP INTERFACE menu item.

7) Notice how the screen is divided into a DS3 side and a DS1 (E1) side. Press the GRAPHIC key and study the graphic screen. The screen is also divided into a DS3 side and a DS1 side. The DS3 and DS1 connectors are illustrated with blocks. Lines connecting the blocks indicate the specific ChanDS3 (channelized DS3) configuration which has been chosen.

   The **R** is the point at which the MEASUREMENT RESULTS are being performed on the received signal. The **T** is the Transmitted pattern. In this case, a pattern is being transmitted on a single DS1 channel. This channel number is given at the bottom of the screen. The **A** is a "keep Alive" signal for the remaining 27 channels not carrying the test pattern. For ChanDS3 configurations, a MUX will appear in the center of the screen. This illustrates the multiplexing of 28 DS1s into a single DS3 signal. The T DS1 signal represents one of the 28 DS1's which are being transmitted out the DS3 TX jack.

8) Observe the circuit status information provided at the bottom of the screen. Depending on your configuration, information is provided for DS3 framing, transmitted/received test patterns, DS1 framing and the transmitted/received DS1 of interest. The GRAPHIC screen also provides information on how the test set ports have been physically configured. Note the transmit and receive DSX levels given on the DS3 side, and the 0 dB Line Build Out and TERMinated access mode provided on the DS1 side.

9) Relate the information on the GRAPHIC screen to the LEDs at the top of the test set. These dual-color lights are divided into DS3 LEDs, DS1/E1 LEDs and common LEDs. By examining the status of these LEDs, you will be able to determine the condition of your circuit at a DS3, DS2 and DS1/E1 level, at a glance.

10) Unplug one end of the coaxial cable. Notice that the green LEDs have now turned red. This indicates a continuous error or alarm condition.

11) Reconnect the coaxial cable and observe that the LEDs return to their

original color, then begin to flash. This flashing indicates a "history" condition. If you had begun testing a circuit and then left the test set, you would notice the flashing when you returned. This HISTORY alerts you to problems with the circuit. Press the HISTORY key to stop the flashing.

12) Press ESCAPE twice to return to the MAIN MENU.

13) With the cursor at the SET UP INTERFACE item, press ENTER. The TEST MODE item should be highlighted. The choices available for this item: DS1 (F1), DS3 (F2), ChanDS3 (F3), DS3/E1(more, F1), E1 (More, F2). These appear on the bottom line of the screen, and are selected by pressing the appropriate F-key(s).

14) Press the F1 key to configure the test set for DS1 testing. The screen will provide you with the appropriate DS1 setup items. The cursor will automatically advance to the next setup parameter, and the choices (bottom line of the display) for this setup parameter are updated accordingly. For the FRAME type, select ESF (F3).

15) Press the GRAPHIC key. The graphic has been updated to reflect a DS1-only configuration. In the future, use the graphic to help you understand the various SET UP INTERFACE options available to you. Make your selections, then verify your configuration with the GRAPHIC screen.

16) Press ESCAPE twice to return to the MAIN MENU. Highlight the LOOP BACK CONTROL item and press ENTER. Note the available choices. DS1 LOOPBACK is provided for DS1-only loopback devices, while the DS3/DS1 selections are available for looping DS3 devices. Some options are available only with certain SET UP INTERFACE configurations.

17) ENTER the DS1 LOOPBACK item. Select LOOP-UP (F1) for the MODE. The test set will begin the loop up procedure.

18) The test set will indicate that a preexisting loop condition exists. This occurs because we have looped the DS1 TX to RX.

19) Press the ESCAPE key until you have returned to the MAIN MENU. If you ever become lost within sub-menus or setup screens, pressing the ESCAPE key a number of times will always return you to the MAIN

MENU.

20) Select the SEND TEST PATTERN item. Observe the available patterns. Use the arrow keys to cursor over to the pattern which you wish to transmit. As you highlight the new pattern, the test set immediately begins to transmit it. Select the QRS pattern.

21) Return to the MAIN MENU. Select MEASUREMENT RESULTS. Use the PAGE-UP (F1) and PAGE-DN (F2) keys to view the available results. Verify that the correct voltage levels are present on the test set's received signal.

22) Page down to the G.821 MEASUREMENT screen. Press the ERR INJ key. The DS1 ERRORS LED lights continuously, then begins to flash. Observe the number of BIT errors which you have just injected. RE-START the measurement process using the F3 (RESTART) key. The counters will reset.

23) Return to the MAIN MENU. Select OTHER MEASUREMENTS. Enter the VIEW RECEIVED DATA item. Observe the T1 protocol display. The T1 signal is broken down into timeslots, and by using the PAUSE (F1) key, the live data can be trapped. Use the PAGE-UP and PAGE-DN keys to view all 32 pages of trapped data.

24) Return to the MAIN MENU. Select OTHER FEATURES. Most of the test set's configuration information is set here.

25) Return to the MAIN MENU. Select VOICE FREQUENCY FUNCTIONS. Note the placement of the test set's volume controls in the center of the keypad.

26) Select the VF MEASUREMENTS item. Here you may select the VF channel of interest, send a test tone at a certain frequency and level, and control the channel's supervision bits. Measurement results are provided in the lower portion of the screen.

27) Enable the test tone by cursoring down to the INSERT TYPE item, then pressing the F2 (TONE) key. Cursor down to the TONE FREQ item and select a 404 Hz tone. Cursor down to the TONE LEVEL item and select -13 dBm. Using the VOL UP and VOL DN keypad keys, verify proper volume control and speaker operation. Verify that the received tone

frequency and level are correct.

28) Disable the test tone by pressing the TALK (F1) key. Turn up the volume using the VOL UP key. Verify proper microphone operation by speaking into the microphone at the bottom of the keypad. You should be able to hear yourself on the speaker at the top of the unit.

29) Press ESCAPE to return to the VOICE FREQUENCY FUNCTIONS menu. Enter VIEW SUPERVISION. Verify the A/B/C/D bit supervision display for all 24 channels. Press ESCAPE.

30) Enter the DIAL/SPRVIS SETUP item. Observe the various ways in which the VF dialing and signaling items may be configured. Press the Up and Down arrow keys to view the available options. Press ESCAPE.

31) Enter the PLACE/RECEIVE CALLS item. Using the F2 (DTMF) key, select the method of dialing. Press and release the SHIFT-lock key. Observe the SHIFT indicator in the upper left-hand corner of the screen. Cursor down to the NUMBER item, and enter the numbers 4083638000 from the keypad. Press and release the SHIFT-lock key. Verify that the SHIFT indicator has disappeared. Press ENTER to dial the number. Verify that you hear it. If you don't, adjust the volume control (center of the keypad), then try dialing again.

32) Enter the NOISE MEASUREMENT item from the MAIN MENU. Press the F1 key to analyze the Signal/Noise ratio on the line. The results will be continuously updated. Select other results by using the F-keys. Press ESCAPE.

33) Enter the MF/DTMF/DP ANALYSIS item. You may select the type of digits to decode by specifying the TONE TYPE. Press the Down arrow key to see the supervision which you may place on the line before the analysis occurs. Press ENTER. If you were receiving digits, they would now appear. After all of the digits are received, you may press the F1 (ANALYZE) key to perform an analysis on each of the received digits. Press ESCAPE until you have returned to the MAIN MENU.

34) Enter the CSU/NI EMULATION item. Most of the LEDs will light as red. If you were connected to the circuit as a CSU or NIU, the LEDs would light green and you would observe error counts on the right-hand side of the screen. Observe the choices available for the LOCCMD (local

command) and TYPE items. As the test set is looped up or down, the graphic will update. Press ESCAPE.

35) ENTER the DATA LINK CONTROL item. Data link control is available for both ESF and SLC-96 framing types. The ESF and SLC-96 datalink menu items vary slightly. Enter MONITOR T1.403 PRM. You will be able to view the end-to-end performance information which is passed across the datalink. Press ESCAPE.

36) ENTER the MONITOR T1.403 BOM. This item allows you to view the control messages as they are appearing on the datalink. Press ESCAPE.

37) ENTER the SEND T1.403 PRM. Here you can transmit performance information across the datalink. Press ESCAPE.

38) ENTER the SEND T1.403 BOM. This item allows you to transmit messages across the datalink. Choose from the available messages by using the F-keys. If you wish to transmit any other message, use the SHIFT-lock key to enter the message directly from the keypad, then press ENTER to begin transmitting the message. To specify the number of times the message is to be transmitted, use the Down arrow key to access REPETITION. Select from NUMBER (F1) or CONTINU (F2). If NUMBER is selected, enter the number directly from the keypad using the SHIFT-lock key, then press ENTER to transmit the message.

39) Press ESCAPE to return to the MAIN MENU. ENTER the SET UP INTERFACE item. Select DS3 (F2) for the TEST MODE. Configure the DS3 FRAME item for C-BIT (F2). Confirm your settings with the GRAPHIC screen and the LEDs. Press ESCAPE until you have returned to the MAIN MENU.

40) ENTER the MEASUREMENT RESULTS menu. Using the PAGE-UP (F1) and PAGE-DN (F2) keys, view the pages of available DS3 results. Press the RESTART (F3) key to restart the measurements. Using the ERR INJ key, inject some error into the DS3 signal. Confirm the type and quantity of errors received. Press ESCAPE to return to the MAIN MENU.

41) ENTER the DATA LINK CONTROL menu. Examine both the MONITOR DS3 FEAC and SEND DS3 FEAC items. They are similar to their DS1 equivalents. When you are finished, press ESCAPE to return to the MAIN MENU.

42) Enter the DS3 C-BIT MONITOR item. Observe the c-bits for each subframe. Escape to the MAIN MENU.

43) The check out procedure is now complete. If you have any questions or if any of the verification steps have failed, please read your User's Manual. If there is still a problem, please call Sunrise Telecom Customer Service at (408) 363-8000.

Chapter 3
Test Set Description

1.0 Front View Description

See Figure 1.A for the front view of the T3, SS300, and Figure 1.B for the T3, SS300e.
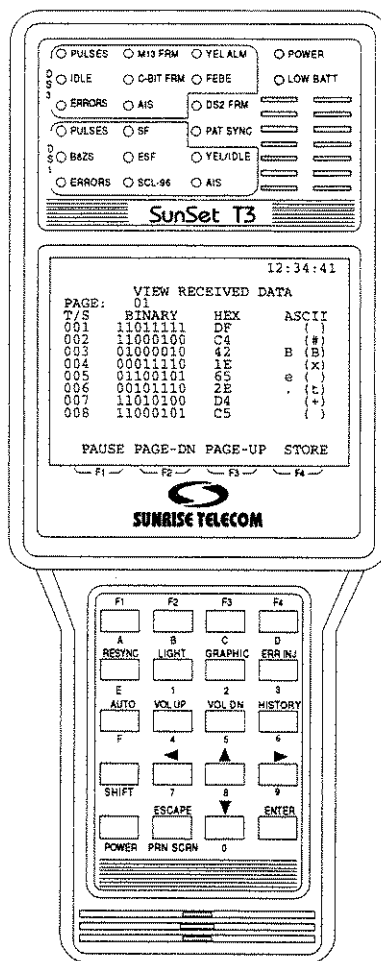
Figure 1.A T3, SS300, Front View

```
 ○ PULSES   ○ M13 FRM   ○ YEL ALM    ○ POWER
D
S ○ IDLE    ○ C-BIT FRM ○ FEBE       ○ BATTERY
3
 ○ ERRORS  ○ AIS       ○ DS2 FRM

 ○ PULSES  ○ SF         ○ PAT SYNC
           PCM-31
T1 ○ B8ZS  ○ ESF        ○ YEL ALM
   HDB3      PCM-30        ALARM
E1
 ○ ERRORS  ○ SLC-96     ○ AIS
             CRC-4
```

SunSet T3

```
                           12:34:41
              VIEW RECEIVED DATA
PAGE:     01
T/S      BINARY      HEX      ASCII
001      11011111    DF        ( )
002      11000100    C4        (#)
003      01000010    42     B  (B)
004      00011110    1E        (x)
005      01100101    65     e  ( )
006      00101110    2E     .  (t)
007      11010100    D4        (+)
008      11000101    C5        ( )


    PAUSE  PAGE-DN  PAGE-UP   STORE
     F1      F2       F3        F4
```

SUNRISE TELECOM

F1	F2	F3	F4
A	B	C	D
RESYNC	LIGHT	GRAPHIC	ERR INJ.
E	1	2	3
AUTO	VOL UP	VOL DN	HISTORY
F	4	5	6
SHIFT	◄	▲	►
	7	8	9
	ESCAPE	▼	ENTER
POWER	PRN SCRN	0	

Figure 1.B T3, SS300e, Front View

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1.1 Keys

Refer to Figures 1.A or B, for front panel keys and other features.

Most SunSet keys perform two separate operations. The white label above the key indicates what function will be performed if the key is pressed by itself. The orange label below the key shows what function will be performed if the SHIFT-lock key is pressed first.

The SHIFT-lock key should not be pressed at the same time another key is pressed. Instead, the SHIFT-lock key should be pressed and then released. A SHIFT indicator will appear in the upper left-hand corner of the screen. Any other key can now be pressed, and the test set will perform the function indicated by the orange label.

If the keys are not behaving as expected, check the SHIFT indicator. If the SHIFT indicator displays the wrong shift status, simply press the SHIFT-lock key again.

1.1.1 White Labels

F1, F2, F3, F4
These keys are used to select choices F1 through F4 shown at the bottom of the LCD display. In Figure 1.A, F1 would be used to select PAUSE, F2 to select PAGE-DN, F3 to select PAGE-UP, and F4 to select STORE.

RESYNC
The RESYNC key will force the test set to search for frame alignment, coding, and all known test patterns (including user-defined patterns). Pressing the RESYNC will automatically cause the MEASUREMENT RE-SULTS to be restarted. In VIEW RECEIVED DATA, VOICE FREQUENCY FUNCTIONS, and CSU/NI EMULATION the PAT SYNC light will go out. In these menus the RESYNC key will have no effect.

LIGHT
The backLIGHT key is used to switch the system backLIGHT off and on. Keeping the backLIGHT off when it is not needed will allow the test set to maintain its battery charge approximately 20% longer.

The test set's backLIGHT has a programmable timer for automatic shut-off. This timer can be set from 1 to 99 minutes, or disabled completely. The backLIGHT timer is set in OTHER FEATURES, GENERAL CONFIG, BACK LIGHT.

GRAPHIC

The GRAPHIC key displays a picture of the current test set configuration and status. After graphically viewing the configuration, you may return to your previous location by pressing either GRAPHIC, ESCAPE, or ENTER.

Here is an explanation of the various items shown on the GRAPHIC screen in Figure 1.1.A. The GRAPHIC screen is useful in verifying that the SET UP INTERFACE configuration is correct for the circuit under test.

Access to the GRAPHIC screen is provided by the GRAPHIC key on the keypad. Access to this screen is available from most of the screens in the test set. Press the GRAPHIC key to view the GRAPHIC screen. Press the GRAPHIC key again to return to your previous screen.

To understand each of the test set's SET UP INTERFACE configurations, it is useful to select the SET UP INTERFACE item, then alter the setup parameters while checking each new configuration with the GRAPHIC screen. With each new configuration, the GRAPHIC will update accordingly.
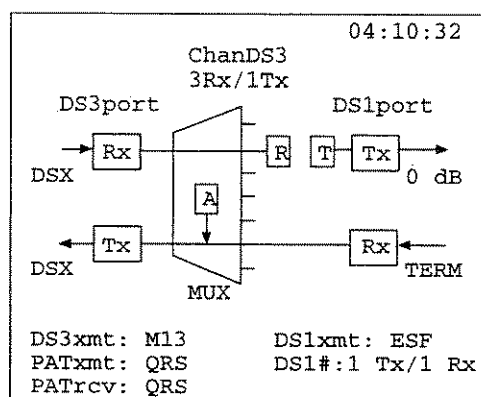
Figure 1.1.A   GRAPHIC Screen

ChanDS3: Indicates that the test set has been configured for a combination DS3/DS1 mode.

3Rx/1Tx: Indicates the specific DS3/1 configuration selected. In Figure 1.1.A, the test set is:
- • Transmitting a DS1 signal from its DS1 TX jack
- • Multiplexing the signal it receives on its DS1 RX jack with 27 other DS1

signals. In the illustration, the 27 other DS1 signals contain an AIS pattern

- Transmitting the resulting DS3 signal out its DS3 TX jack
- Receiving a DS3 signal from its DS3 Rx connector
- De-multiplexing the received DS3 signal into 28 separate DS1 signals
- Performing measurements on the selected RX DS1 signal.

DS3port: Represents the test set's DS3 port. The two WECO connectors on this port are represented with blocks.

DS1/E1port: Represents the test set's DS1/E1 port. The two bantam jacks on this port are represented with blocks.

MUX: Refers to the test set's internal multiplexer. The test set is multiplexing 28 DS1 signals into a single DS3 signal in Figure 1.1.A. The MUX will only be displayed in a ChanDS3 test mode.

T: Represents the test set's Transmitter. In Figure 1.1.A, the test set is transmitting the selected QRS test pattern on channel 1, through the DS1 Tx port.

R: Represents the test set's Receiver. In Figure 1.1.A, the test set is receiving the selected QRS test pattern at a DS1 level, after it has been de-multiplexed from the DS3 Rx port.

A: This is a keep alive signal (AIS). In this configuration, it is transmitted on the 27 DS1 channels not carrying the test pattern.

DSX: Indicates that DSX Tx and Rx signal levels have been selected for the DS3 port.

TERM: Indicates that a TERMinated DS1 configuration has been selected.

0dB: Indicates that an LBO (Line Build Out) of 0 dB has been selected on the DS1 Tx port.

PATxmt: Indicates the test pattern which is currently being transmitted.

PATrcv: Indicates the test pattern which is currently being received.

DS1xmt: Indicates what type of DS1 framing the test set is transmitting.

DS3xmt: Indicates what type of DS3 framing the test set is transmitting.

DS1#: Indicates on which DS1 channels the test pattern is being transmitted, and on which DS1 channel the measurement results are being performed. In Figure 1.1.A, channel 1 is being used for both DS1 Tx and Rx.

ERR INJ
The ERRor INJect key is used to inject errors into the test set's transmitted signal. Errors will be injected according to the current setting in OTHER FEATURES, ERROR INJECTION. If the error injection MODE is RATE, then errors will injected at your specified rate when you press the ERR INJ key. During a RATE error injection, an ERINJ indicator will appear at the top of the LCD display.

AUTO
Pressing the AUTO key will force the test set to resynchronize on the received framing, line coding, and test pattern. After the test set has reported an unframed signal or LIVE data, it will no longer search for framing or a test pattern.

VOL UP, VOL DN
The volume controls determine the loudness of the speaker during talk/listen and channel monitoring applications. Turn the volume down if you are holding the set next to your ear and mouth while using it as a telephone handset. Turn the volume up if you will be listening to a channel from several feet away.

HISTORY
The HISTORY key is used to turn off any flashing LEDs. The LEDs flash to indicate any error, alarm or caution condition which occurred previously but which is no longer present. Pressing the HISTORY key will not affect the measurement results in any manner.

▲ (Cursor Up)
Used to move the cursor up.

▼ (Cursor Down)
Used to move the cursor down.

▶ (Cursor Right)
Used to move the cursor to the right.

◀ (Cursor Left)
Used to move the cursor to the left.

ESCAPE
Pressing the ESCAPE key takes you back one menu. Pressing the key one or more times moves you back to the SunSet-T3 MAIN MENU.

ENTER
The ENTER key performs three functions:
1) When a menu item is highlighted and the ENTER key is pressed, the SunSet will display the screen for the highlighted menu item.
2) If setups are complete in a data entry screen, pressing ENTER will often return you to the previous menu.
3) In a few cases, pressing the ENTER key is required after the user finishes entering data in a given screen. In these cases, the test set will not execute the inputs until the ENTER key has been pressed. In these few cases, you may cancel all of the current entries in the screen by pressing the ESCAPE key. When this occurs, the test set will retain its previous settings, and will ignore the information that was just entered.

1.1.2 Orange Labels

POWER
The POWER key is used to switch the test set off and on.

SHIFT
The SHIFT-lock key is pressed to provide access to the functions specified by the orange labels. The SHIFT-lock key is always pressed first, then released before the desired orange-label key is pressed (except POWER). SHIFT-lock status is displayed in the upper left-hand corner of the screen. The SHIFT-lock indicator must not be present when you wish to use the white label functions.

PRN SCRN
The print screen key will print information currently being displayed on the test set's LCD screen.

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.

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

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

1.2 LEDs

The LEDs (Light Emitting Diodes) display the status of the test set's received signal. Often, the LEDs will tell you all you need to know about the status of your circuit under test.

An LED is lit continuously when the condition for that LED consistently appears on the received signal.

If an error or alarm condition is occurring, the appropriate red LED will light. After the error/alarm condition ends, this red LED will blink. The blinking indicates that a "history" condition has occurred. This is useful if you were absent when the actual error condition occurred. Acknowledge this HISTORY condition by pressing the HISTORY key on the keypad.

On some occasions, the flashing LEDs will stop blinking without the user having to press the HISTORY key. This occurs when the SET UP INTER-FACE items are reconfigured or the AUTO key is pressed, and with some other test set operations.

1.2.1 DS3 LEDs

PULSES

   green: Indicates that the test set is receiving valid T3 pulses.
   red: Indicates that the test set expects to receive valid T3 pulses, but that none are appearing. The test set expects to receive these pulses based on your SET UP INTERFACE configuration.
   no light: Indicates that T3 pulses are not expected with your particular SET UP INTERFACE configuration.

IDLE

   green: Indicates that a valid DS3 idle code currently appears on the received DS3 signal. The DS3 IDLE code is a signal with valid M-frame Alignment Channel and P-bit Channel and with an information

bit sequence of 1100...

no light: Indicates that DS3 channel is not idle.

ERRORS

red: Indicates that BIT, BPV, FBE, P-Bit parity, or C-Bit parity error(s) are currently appearing on the received DS3 signal.

no light: Indicates that no BIT, BPV, FBE, P-Bit parity, or C-Bit parity errors are appearing on the received DS3 signal.

M13 FRM, C-BIT FRM

green: Indicates valid M13 or C-BIT framing on the received DS3 signal. This will depend upon how the DS3 FRAME item has been configured in the SET UP INTERFACE menu. The LED will only light green if the test set's framing configuration matches the framing found on the received DS3 signal.

red: Indicates that M13 or C-BIT framing is specified in the SET UP INTERFACE menu, but is not present on the received signal.

no light: Indicates that the received DS3 signal is specified as UN-FRAMED in the SET UP INTERFACE menu.

AIS

red: Indicates that a valid Alarm Indication Signal is present on the received DS3 signal. The DS3 AIS is a signal with a valid M-frame Alignment Channel, M-subframe Alignment Channel and P-bit Channel. Bits X1 and X2 are set to 1, while bits C1, C2 and C3 are set to 0 and an information bit sequence of 1010... (beginning with a 1 after each M-frame Alignment, M-subframe Alignment, X-bit, P-bit and C-bit Channels) is transmitted on the returning DS3 signal.

no light: Indicates that no AIS signal is present on the received DS3 signal.

YEL ALM

red: Indicates that a valid Yellow Alarm signal is present on the received DS3 signal. The DS3 Yellow Alarm signal is formed by setting the X1 and X2 bits to 0 on the returning DS3 signal.

no light: Indicates that no Yellow Alarm signal is present on the received DS3 signal.

FEBE

red: Indicates that Far-End Block Errors are present on the received DS3 signal.

no light: Indicates that no Far-End Block Errors are present on the received DS3 signal.

1.2.2 DS1 LEDs

PULSES

green: Indicates that the test set is receiving valid T1 pulses.

red: Indicates that the test set expects to receive valid T1 pulses, but that none are appearing. The SunSet expects to receive these pulses based on your SET UP INTERFACE configuration.

no light: Indicates that T1 pulses are not expected with your particular SET UP INTERFACE configuration.

B8ZS

green: Indicates that B8ZS line coding is present on the received T1 signal. During severe BPV error conditions on an AMI line, the B8ZS light may light. B8ZS line coding will not appear on a DS1 signal which has been dropped out of a DS3.

no light: Indicates that B8ZS line coding is not present on the received T1 signal.

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 signals can make it impossible to determine whether the line is optioned correctly for AMI or B8ZS. In such cases, the test set will not indicate B8ZS coding.

ERRORS

red: Indicates that BIT, BPV, FBE, CRC, OOF, or COFA error(s) are currently appearing on the received DS1 signal.

no light: Indicates that no BIT, BPV, FBE, CRC, OOF, or COFA errors are appearing on the received DS1 signal.

SF, ESF, SLC-96

green: Indicates that valid SF, ESF, or SLC-96 framing has been observed on the received DS1 signal. This will depend upon how the DS1 FRAME item has been configured in the SET UP INTERFACE menu. The LED will only light green if the test set's framing configuration matches the framing found on the received DS1 signal.

red: Indicates that the specified SF, ESF, or SLC-96 framing is not

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present on the received signal.

no light: Indicates that the specified DS1 signal framing is UNFRAMED, or that the DS1 port is not in use.

Note that the SLC-96 LED will always light on the A DS1 on the SLC-96 system. The B and D DS1s will always indicate SF framing. The C DS1 will show SLC-96 framing in mode II.

Although the test set 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 should include valid SLC-96 frame flags in its SLC-96 framing in order to be recognized as SLC-96 framing by the SunSet T3.

YEL/IDLE

green: Indicates the test set is detecting an Idle condition. An Idle code is a pattern of 0001 0111 in all channels.

red: Indicates that the test set is detecting a yellow alarm condition. 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.

no light: No yellow alarm or idle condition detected.

AIS

red: Indicates that the test set is detecting an unframed all 1s signal.

no light: Unframed all 1s signal not detected.

1.2.3 Common LEDs

DS2 FRM

green: Indicates that valid DS2 framing has been detected on the received signal.

red: Indicates that the test set expects to detect valid DS2 frame synchronization (based on its SET UP INTERFACE configuration), but that it is not being detected.

no light: Indicates that valid DS2 frame synchronization is not expected with the current configuration.

PAT SYNC

green: Indicates that the test set has synchronized on a known test pattern or a known test pattern appearing in inverted form.

red: Indicates that pattern synchronization was previously present, but that synchronization now has been lost.

no light: Indicates that a LIVE signal is expected.

Note that the received pattern is indicated on the GRAPHIC screen. The test set will automatically attempt to synchronize on a pattern when it is first switched on, and when the SET UP INTERFACE items are configured. However, once this pattern has been determined (or a LIVE signal has been declared), the test set will no longer search for patterns. To force the test set to check for a test pattern, press the RESYNC key.

POWER
green: Indicates that the test set is switched on and has an adequate power source.
no light: Test set is either switched off, or doesn't have enough power to operate.

BATTERY or LOW BATT
red: Indicates that the test set's power supply voltage has dropped to a low level.
no light: Test set has adequate power on which to operate.

The test set will switch itself off approximately 10 minutes after the BATTERY or LOW BAT LED lights. Connecting the AC Battery Charger will allow you to use the test set indefinitely. If you plan to use the test set for an extended period of time, it is best to connect the AC Battery Charger before beginning a test. If the charger is connected while a measurement is in progress and when the battery is not fully charged, the test set may reset itself. In this case, the current measurement results will be lost.

1.2.4 E1 LEDs
On the T3 SS300e, the T1 LEDs also read as E1 LEDs. These orange label descriptions apply to the E1 LEDs. See Figure 1.B. Here are the additions:

HDB3
This LED indicates HDB3 line coding is present on the received E1 signal.
green: the expected HDB3 line coding is being received
red: HDB3 line coding is expected, but is not being received
no light: HDB3 line coding is not expected

PCM-31, PCM-30

These LEDs specify the type of framing detected on the received E1 signal. PCM-31 indicates the basic FAS (Frame Alignment Signal) has been detected. PCM-30 indicates the MFAS (MultiFrame Alignment Signal) has been detected, in addition to the basic FAS pattern.

> green: The expected framing is being received.
>
> red: If the test set is expecting a type of framing and does not receive it, the appropriate LED will light as red.
>
> no light: If the received signal is unframed, and the test set is configured that way, neither LED will light.

CRC-4

The CRC is relevant for PCM-30 and PCM-31 frame format signals.

> green: The CRC-4 LED lights if CRC-4 check sequences are detected on the received signal.
>
> red: If you get a red CRC LED, check the framing.

ALARM

The ALARM LED lights when the test set detects any frame error condition.

2.0 Connector Panel

The SunSet T3 has a connector panel as shown in Figure 2.A.
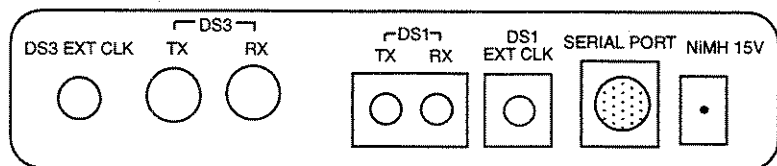
Figure 2.A Side connector panel

NiMH 15V

Used to connect to the SS104 Cigarette Lighter Charger or the appropriate AC Battery Charger. The test set may be operated with a discharged battery if the charger is connected. Under these conditions, the battery will charge while the test set is being operated.

SERIAL PORT

Used for sending information to the serial printer. It is also used for the test set's optional Remote Control.

DS1 EXT CLK

Bantam connector used for DS1 external clock input. Signal source must be AMI coding, 0 to -30 dB signal level.

DS1/E1 TX and RX

Bantam connectors used for the DS1 or E1 transmit and receive signals.

DS3 TX and RX

WECO 560 connectors used for DS3 transmit and receive signals.

DS3 EXT CLK

Coaxial SMC, TTL connector used for DS3 external clock input.

2.1 Additional Controls

Contrast Control

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

Chapter 4
Menu Descriptions

1.0 Introduction

The SunSet T3 operates with a menu-driven format. Before you can select a menu item, you must first highlight the desired line using the arrow keys. You can easily recognize a highlighted item, because the area around the item is dark, while the writing is light. After highlighting the item, execute the selection by pressing the ENTER key. In a few specific cases, such as in the SEND TEST PATTERN menu, the simple action of highlighting an item will execute the selection.

The following menu tree shows the location of each menu item. The menu items on your particular test set may vary, depending on how many SunWare options you have ordered. This menu tree displays all of the available SunWare options.

```
SunSet-T3 MAIN MENU
    SET UP INTERFACE
    LOOP BACK CONTROL
        DS1 LOOPBACK
        DS3/DS1 STUFF-BIT
        DS3/DS1 C-BIT FEAC
        DS3 C-BIT FEAC
        WESTELL LINE RPTR
        WESTELL OFFICE RPTR
        TELTREND LINE RPTR
        TELTREND OFFICE RPTR
        WESTELL NIU/PM & MSS
        TELTREND MSS
    SEND TEST PATTERN
    MEASUREMENT RESULTS
    OTHER MEASUREMENTS
        VIEW RECEIVED DATA
        BRIDGE TAP DETECT
        QUICK TEST - I
        QUICK TEST - II
        ISDN PRIMARY RATE
        PROPAGATION DELAY
        PROTECT SWITCH TIMING
    OTHER FEATURES
        ERROR INJECTION
        TEST PARAMETERS
```

```
            PRINT RECORDS
            GENERAL CONFIG
            ERASE NV RAM
            FULL SELF TEST
            CLR PRINT BUFFER
            VERSION/OPTION
            FACTORY DEFAULTS
            GENERATE ALARMS
            VIEW TEST RECORD
     VOICE FREQ FUNCTIONS
            VF MEASUREMENTS
            VIEW SUPERVISION
            DIAL/SPRVIS SETUP
            PLACE/RECEIVE CALLS
            NOISE MEASUREMENT
            MF/DTMF/DP ANALYSIS
     CSU/NI EMULATION
     DATA LINK CONTROL
            MONITOR T1.403 PRM
            MONITOR T1.403 BOM
            SEND T1.403 PRM
            SEND T1.403 BOM
     DS3 C-BIT MONITOR
```

The following sections within this chapter provide a detailed explanation of each menu items.

2.0 Using the SET UP INTERFACE menu

A circuit is accessed by:

1) Configuring the SET UP INTERFACE menu to correspond to the circuit under test.

2) Connecting the test set to the circuit.

   Note: This is the most important part of the entire test procedure. If the SET UP INTERFACE items are configured incorrectly, all measurement results will be meaningless.

In order to avoid configuration mistakes, use the GRAPHIC key to confirm any changes to your SET UP INTERFACE settings.

The SunSet T3 can be configured to automatically detect incoming framing and test pattern by pressing the AUTO key.

Configurations are available for DS1-only, DS3-only, Channelized DS3, DS3/E1 and E1 testing, depending on the TEST MODE you select.

2.1 DS1 Test Mode

To configure the test set for DS1-only testing, use this procedure:

1) From the MAIN MENU, select the SET UP INTERFACE item.

2) At the TEST MODE item, press the F1 key to choose a DS1-only configuration. Refer to Figure 2.1.A.

```
                                    04:10:32

                    SET  UP  INTERFACE

        TEST  MODE  :  DS1
                                  -  DS1  -

                              FRAME: [ESF]
                              TSTSG:  PATRN
                              RATE :  1.544M
                              RECVR:  TERM
                              CODE :  B8ZS
                              TxLBO:  0  dB
                              TxCLK:  INTERN

            UNFRM    SF-D4     ESF     SLC96
```

Figure 2.1.A   DS1 Test Mode

3) FRAME
Select the framing type which is present on the T1 line.
Options: UNFRAME (F1), SF-D4 (F2), ESF (F3), SLC-96 (F4)

- If the framing on the received signal does not match the framing selected above, the selected SF, ESF, or SLC-96 LED will light in red. The test set will only search for the type of framing the user has specified above.
- If no framing was present when the SunSet was first configured, but then framing appeared, you can force the test set to synch onto the framing by pressing the AUTO key on the keypad.

4) TSTSG

Select the source of your DS1 test signal
Options: PATRN (F1), THRU (F2)

- PATRN: Select this if you wish to transmit the selected DS1 test pattern in each time slot. (Your test pattern is configured from the SEND TEST PATTERN menu).
- THRU: Select this if you wish to loop each of the incoming channels from the DS1 RX to TX without placing any test pattern on the line.

5) RATE

Select the test rate
Options: 1.544M (F1), Nx64K (F2), Nx56K (F3)

- 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.

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

```
                                        11:41:45

              FT1  TIME  SLOT

                       RECEIVE
         01   02   03   04   05   06   07   08
         09   10   11   12   13   14   15   16
         17   18   19   20   21   22   23   24

                       TRANSMIT
         01   02   03   04   05   06   07   08
         09   10   11   12   13   14   15   16
         17   18   19   20   21   22   23   24


         AUTO     SELECT    UN-SEL  CLR-ALL
```

Figure 2.1.B   Fractional T1

As shown in figure 2.1.B, you have two options for selecting the desired combination of channels.

- Press F1 for AUTO, and the test set will automatically configure itself to the fractional T1 channel. The test set performs this auto configuration by looking for the 7F or FF idle code on the unused channels.
- If you would rather select the exact channels to be tested yourself, you may do this by pressing F2 for SELECT on the desired channels. You will need to do this for both the RECEIVE and the TRANSMIT sides.
- If you inadvertently select an undesired channel, simply press the UN-SEL key (F3).
- Press CLR-ALL (F4) to deselect everything and start over again.

6) RECVR
Configure the receiver
Options TERM (F1), DSXMON (F2), BRIDGE (F3)

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

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

Note that if you plug into a DSX MON jack in the TERM mode, the

BPV LED will probably come on. Use the DSXMON mode instead.

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

This mode is useful because the DSX monitor jack protects the live signal from any possible disruptions caused by the testing process. It allows the technician to observe the line while the customer is actually using it and to see if there are any problems.

Note that if DSXMON mode is selected when a 3V signal is received, then the red ERRORS 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: 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 set applies isolation resistors to protect the circuit from a hit.

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

If you use BRIDGE mode on a DSXMON jack, there will be a total of 40 dB resistive isolation and the test set will likely report loss of signal.

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

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

7) CODE
Select the coding to be transmitted on the test set's DS1 signal
Options AMI (F1), B8ZS (F2)

- It is not always possible to determine the line coding of a circuit. For instance, an all 1s signal will mask the presence of B8ZS coding.
- As the test set detects B8ZS line coding on its received DS1 signal, it will light the B8ZS LED.

8) TxLBO

Select the Line Build Out (TxLBO) to appear on the transmitted T1 signal
Options: 0 dB (F1), -7.5dB (F2), -15 dB (F3), -20 dB (F4)

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

- -7.5 dB , -15 dB, or -20 dB is used when:
  - a) transmitting toward the T1 span from a central office or customer premises and a 7.5 dB, 15 dB or 20 dB attenuator is not in series with the set.
  - 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.

9) TxCLK

Select the transmit clock configuration
Options INTERN (F1), EXTERN (F2), DS1-Rx (F3)

The test set uses the TxCLK for two purposes:
  - a) Frequency measurements. The test set measures frequency using the clock source specified in TxCLK. Frequency measurements are not meaningful in the DS1-Rx timing mode.
  - b) Transmitter timing. The speed of the transmitter will exactly match the selected reference clock source.

- INTERN: Internal timing should be used when:
- a) an external frequency source is not available.
- b) the test set will not be transmitting towards synchronized network equipment.

c) the test set will be supplying clock to the circuit to be tested, such as a hi cap T1 loop, PBX, or remote terminal of a digital loop carrier.

d) the 5 ppm accuracy of the INTERNal clock is sufficient.

e) most kinds of loopback testing is performed.

• EXTERN: External timing should be used when:

a) Precise frequency and frame slip measurements are required.

b) An external frequency source such as the central office clock is plugged in.

c) The frequency source is a 3V signal transmitted to the test set through up to 6000 feet of cable, or the frequency source is obtained through a monitor jack with 20 dB isolation resistors.

Note: The SunSet T3 uses AGC (Automatic Gain Control) circuitry on its DS1 EXT CLK input jack. This allows the SunSet T3 to automatically compensate for the reference clock's signal level between a 3V DSX level signal and a -20 dB monitor jack signal.

• DS1-Rx: DS1 received timing should be used when:

a) The set should use the received signal as its frequency reference.

b) The set is configured for VF drop and insert towards a switch.

c) The set is performing FT1 nx64 measurements towards a switch or DCS.

2.2 DS3 Test Mode

To configure the test set for DS3-only testing, use the following procedure:

1) From the MAIN MENU, select the SET UP INTERFACE menu item.

2) Press the F2 key to choose a DS3-only configuration. See Figures 2.2.A & B.

```
                              04:10:32
              SET UP INTERFACE
TEST MODE : DS3

  - DS3 -
FRAME:[M13]
TSTSG: PATRN
TxLVL: DSX
RxLVL: DSX




  M13      C-BIT    UNFRAME
```

Figure 2.2.A   DS3 Test Mode Menu

```
                              04:10:32
               DS3
  DS3port              DS1port
      ┌──┐                ┌──┐
  ──→ │RX│─ R            │Tx│
      └──┘                └──┘
DSX                   DISABLED

      ┌──┐                ┌──┐
  ←── │Tx│─ T            │Rx│
      └──┘                └──┘
DSX


DS3xmt: M13
PATxmt: 2e20
PATrcv: 2e20
```
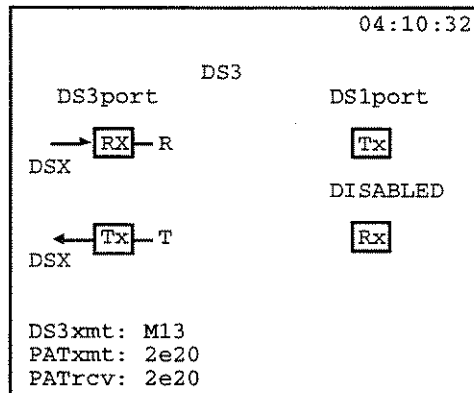
Figure 2.2.B   DS3 Test Mode Graphic

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3) FRAME

Select the framing present on the T3 line.
Options: M13 (F1), C-BIT (F2), UNFRAME (F3)

- If you prefer, you could press the AUTO key to automatically find the
  framing. You might do this if you are monitoring a live DS3 signal.

4) TSTSG

Select the source of your DS3 signal:
Options: PATRN (F1), THRU (F2)

- PATRN: Select this if you wish to transmit a DS3 test pattern. (The test
  pattern is configured in the SEND TEST PATTERN menu).
- THRU: Select this if you wish to loop the incoming DS3 signal from the
  DS3 RX to TX without placing your own test pattern on the line.

5) TxLVL

Select the transmit signal level
Options: HIGH (F1), DSX (F2), LOW (F3)

- HIGH: rectangular pulse of 0.90V base to peak nominal voltage
- DSX: adheres to ANSI T1.102 for use at DSX-3. 0.76V base to peak
  nominal voltage
- LOW: pulse of 0.15V base to peak nominal voltage.

6) RxLVL

Select the receive signal level
Options: HIGH (F1) , DSX (F2), LOW-MON (F3)

- This level does not need to be set the same as the TxLVL.
- Use DSX if you are plugged into a DSX-3 OUT jack.
- Use LOW-MON if you are plugged into a DSX-3 MON jack.

2.3   ChanDS3 Test Mode

Use the ChanDS3 mode when you want to:
1) Do DS1 or DS0 testing, and you are plugged into a DS3 circuit
2) Do DS1 or DS0 testing and you are simultaneously plugged into a DS1
   circuit and a DS3 circuit
3) You want the SunSet to act as a single channel 3/1 multiplex.

Warning: Be careful that you are not disrupting a live DS3 circuit.

The ChanDS3 mode is the most complicated mode to configure on the test set. When you are making a selection, and you are not sure what the particular selection is for, press the GRAPHIC key. The graphic will let you see exactly what has changed. It will help guide you to the choice that is best for your application.

To configure the test set for ChanDS3 testing, use the following procedure:

1) From the MAIN MENU, select the SET UP INTERFACE item.

2) Press the F3 key to choose the ChanDS3 configuration.

3) DS3/1 CNFG
Select the configuration
Options: 3Rx/3Tx (F1), 1Rx/3Tx (F2), 3Rx/1Tx (F3), Mux1Rx (more, F1), Mux3Rx (more, F2)

Note: Push the GRAPHIC key to see a diagram of how each choice changes the test configuration.

- 3Rx/3Tx: This configuration is used when you want to both send and receive on the DS3 signal. For example, you could loopback a DS1 NIU at a far end, when you are plugging into a DSX-3 at the near end. Or you could use this to test across a 3/1 DCS. Refer to Figures 2.3.A & B.

```
                              04:10:32
           SET UP INTERFACE
TEST MODE : ChanDS3
DS3/1 CNFG: 3Rx/3Tx
      - DS3 -          - DS1 -
FRAME: M13        FRAME  : SF-D4
Tx/27: AIS        TSTSG  : PATRN
TxLVL: DSX        RATE   : 1.544
RxLVL: DSX        RECVR  : TERM
TxCH : 01         CODE   : B8ZS
RxCH : 01         TxLBO  : 0 dB
                  TxCLK  : INTERN
                  PortTx: DS3drp

3Rx/3Tx 1Rx/3Tx 3Rx/1Tx    more
```

Figure 2.3.A 3Rx/3Tx Configuration
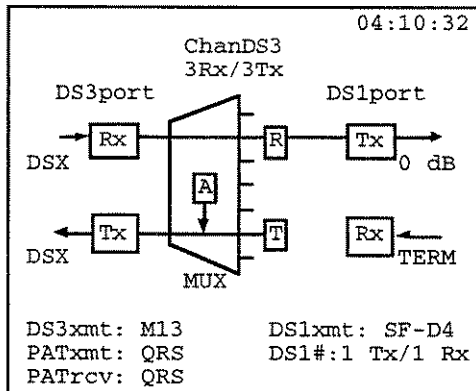
Figure 2.3.B   3Rx/3Tx Graphic

```
                                        04:10:32

             SET UP INTERFACE
     TEST MODE : ChanDS3
     DS3/1 CNFG:│1Rx/3Tx│
        - DS3 -           - DS1 -
     FRAME: M13      FRAME : SF-D4
     Tx/27: AIS       TSTSG : PATRN
     TxLVL: DSX       RATE  : 1.544
     RxLVL: DSX       RECVR : TERM
     TxCH : 01        CODE  : B8ZS
     RxCH : 01        TxLBO : 0 dB
                      TxCLK : INTERN
                      PortTx: DS3drp

     3Rx/3Tx 1Rx/3Tx 3Rx/1Tx   more
```

Figure 2.3.C   1Rx/3Tx Configuration
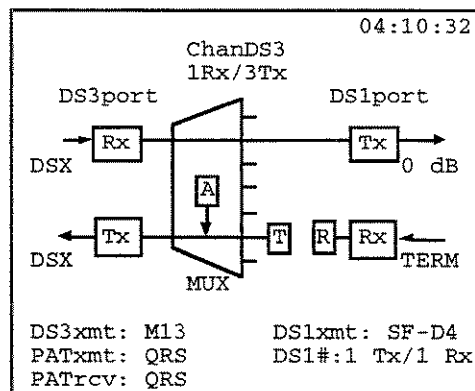
Figure 2.3.D   1Rx/3Tx Graphic

- 1Rx/3Tx and 3Rx/1Tx: These configurations are used when you are testing across an out-of-service 3/1 multiplex. Refer to Figures 2.3.C and D.

- Mux1Rx and Mux3Rx: These configurations are used when you want the SunSet T3 to multiplex a DS1 signal onto 1 channel of a DS3. The other DS1 channels are out-of-service.

```
                                 04:10:32

              SET UP INTERFACE
TEST MODE : ChanDS3
DS3/1 CNFG:| Mux3Rx |
   - DS3 -              - DS1 -
FRAME: M13        FRAME : SF-D4
Tx/27: AIS        TSTSG : THRU
TxLVL: DSX        RATE  : 1.544
RxLVL: DSX        RECVR : TERM
TxCH : 01         CODE  : B8ZS
RxCH : 01         TxLBO : 0 dB
                  TxCLK : INTERN
                  PortTx: DS3drp

3Rx/3Tx 1Rx/3Tx 3Rx/1Tx   more
```

Figure 2.3.E   Mux3Rx Configuration

```
                                 04:10:32
                  ChanDS3
                  Mux3Rx
   DS3port                   DS1port
    ____                      ____
   | Rx |    ____            | Tx |___\
DSX|____|   |R |            |____|   /
            |__|                    0 dB
           ____
          | A |
          |_|_|
    ____    |  ____          ____
   | Tx |<--  |              | Rx |<___
DSX|____|                    |____|
                MUX              TERM

DS3xmt: M13        DS1xmt: SF-D4
PATxmt: THRU       DS1#:1 Tx/1 Rx
PATrcv: QRS
```
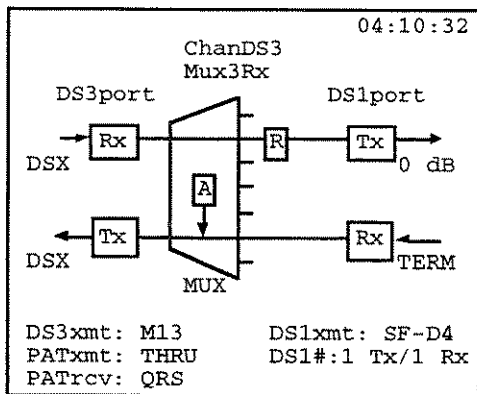
Figure2.3.F   Mux3Rx Graphic

DS3 Selections

1) FRAME
Choose the DS3 framing
Options: M13 (F1), C-BIT (F2)

2) Tx/27
In the ChanDS3 mode, you will be testing on only one of the 28 DS1s in the DS3. The Tx/27 choice lets you control what you will be transmitting on the other 27 DS1s.
Options: THRU (F1), AIS (F2), BRDCST (F3)

- Choose THRU to pass through all 27 non-test channels from DS3 Rx to DS3 Tx. This can give you a hitless insert capability on a DS3 line.
- Choose AIS (F2) to insert an AIS signal on the DS3 line. This might be used if the DS3 is out-of-service.
- Choose BRDCAST (F3) to transmit your selected test pattern on all 28 DS1s simultaneously.

3) TxLVL
Select the DS3 transmit signal level
Options: HIGH (F1), DSX (F2), LOW (F3)

- HIGH: rectangular pulse of 0.90V base to peak nominal voltage
- DSX: adheres to ANSI T1.102 for use at DSX-3. 0.76V base to peak nominal voltage
- LOW: pulse of 0.15V base to peak nominal voltage.

4) RxLVL
Select the receive signal level
Options: HIGH (F1), DSX (F2), LOW-MON (F3)

- This level does not need to be set the same as the TxLVL.
- Use DSX if you are plugged into a DSX-3 OUT jack.
- Use LOW-MON if you are plugged into a DSX-3 MON jack.

5) TxCH and RxCH
Choose the transmit and receive channels
Options: 1-28

- This selects which DS1 inside the DS3 you will transmit and receive on.
- These two choices will usually be the same unless you are testing across a 3x1 DCS where the DS1 signal has been switched from one channel to another as it passes through the DCS.

DS1 Selections

1) FRAME
Choose the DS1 FRAME type:
Options: UNFRaMed (F1), SF-D4 (F2), ESF (F3), SLC96 (F4)

2) TSTSIG
Choose the configuration of the test signal
Options: PATRN (F1), THRU (F2)

- PATRN will cause the test set to insert a test pattern on your DS1 transmit channel (TxCH). The test pattern is selected under the SEND TEST PATTERN menu.
- THRU will cause the test set to pass all 24 DS0 channels through the test set undisturbed. If you choose Tx/27: THRU and TSTSIG: THRU, you can do hitless DS0 insert in the VF measurements menu or hitless Nx64 fractional T1 insert in the RATE item. Be sure you have practiced and verified this procedure on an out-of-service DS3 line before you attempt to do this in-service.

3) RATE
Choose the desired test rate
Options: 1.544M (F1), Nx64K (F2), Nx56K (F3)

- Choose 1.544M for normal T1 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.
- When you select one of the fractional settings, you will see the display shown in Figure 2.3.G.
  a) You have two options for selecting the desired combination of channels. You can press F1 for AUTO, and the test set will automatically configure itself to the fractional T1 channels which are active. The test set performs this auto configuration by looking

for the 7F or FF idle codes on the unused channels.

```
                                    11:41:45

              FT1 TIME SLOT

                    RECEIVE
      01  02  03   04   05   06   07   08
      09  10  11   12   13   14   15   16
      17  18  19   20   21   22   23   24

                    TRANSMIT
      01  02  03   04   05   06   07   08
      09  10  11   12   13   14   15   16
      17  18  19   20   21   22   23   24


      AUTO    SELECT   UN-SEL  CLR-ALL
```

Figure 2.3.G Fractional screen

b) If you would rather select the exact channels to be tested yourself, you may do this by pressing F2 to SELECT the desired channels. As you select the RECEIVE side, the TRANSMIT side will also be selected.

 • If you would like to select the TRANSMIT side independently, then cursor down to the TRANSMIT timeslots and SELECT (F2) / UN-SELect (F3) these separately.

c) Press CLR-ALL (F4) to deselect everything and start over again.

4) RECVR

Select the DS1 receiver configuration
Options: TERM (F1), DSXMON (F2), BRIDGE (F3)

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

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

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

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

  This mode is useful because the DSX monitor jack protects the live signal from any possible disruptions caused by the testing process. It allows the technician to observe the line while the customer is actually using it and to see if there are any problems.

  Note that if DSXMON mode is selected when a 3V signal is received, then the red ERRORS 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: The BRIDGE monitor is similar to the DSXMON monitor. However, in BRIDGE, the test set taps into a live, in-service, termi-nated DS1 signal with up to 36 dB cable loss. The set applies isolation resistors to protect the circuit from a hit.

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

  If you use BRIDGE mode on a DSXMON jack, there will be a total of 40 dB resistive isolation and the test set will likely report loss of signal.

  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 ERRORS LED will probably light. Use the TERM mode instead.

5) CODE

Select the line coding to be transmitted by the test set on the T1
Options: AMI (F1), B8ZS (F2)

- It is not always possible to determine the line coding of a circuit. For

instance, an all 1s signal will mask the presence of B8ZS coding.
  • Regardless of the CODE setting, the B8ZS LED will light if the test set detects B8ZS line coding on its received signal.

6) TxLBO

Select the Line Build Out to place on your transmitted T1 signal.
Options: 0 dB (F1), -7.5 dB (F2), -15 dB (F3), -20 dB (F4)

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

  • -7.5 dB , -15 dB, or -20 dB is used when:
    a) transmitting toward the T1 span from a central office or customer premises and a 7.5 dB, 15 dB or 20 dB attenuator is not in series with the set.
    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.

7) TxCLK

Select the transmit clock configuration.
Options: INTERN (F1), EXTERN (F2), DS1-Rx (F3), DS3drp (F4)

The test set uses the TxCLK for two purposes:
    a) Frequency measurements. The test set measures frequency using the clock source specified in TxCLK. Frequency measurements are not meaningful in the DS1-Rx timing mode.
    b) Transmitter timing. The speed of the transmitter will exactly match the selected reference clock source.

  • INTERN: Internal timing should be used when:
    a) an external frequency source is not available.
    b) the test set will not be transmitting towards synchronized network equipment.
    c) the test set will be supplying clock to the circuit to be tested such

as a hi cap T1 loop, PBX, or remote terminal of a digital loop carrier.
d) the 5 ppm accuracy of the INTERNal clock is sufficient.
e) most kinds of loopback testing is performed.

- EXTERN: External timing should be used when:
  a) Precise frequency and frame slip measurements are required.
  b) An external frequency source such as the central office clock is plugged in.
  c) The frequency source is a 3V signal transmitted to the test set through up to 6000 feet of cable, or the frequency source is obtained through a monitor jack with 20 dB isolation resistors.

The SunSet T3 uses AGC (Automatic Gain Control) circuitry on its DS1 EXT CLK input jack. This allows the SunSet T3 to automatically compensate for the reference clock's signal level between a 3V DSX level signal and a -20 dB monitor jack signal.

- DS1-Rx: DS1 received timing should be used when:
  a) The set should use the received DS1 signal as its frequency reference.
  b) The set is configured for VF drop and insert towards a switch.
  c) The set is performing FT1 nx64 measurements towards a switch or DCS.

- DS3drp: DS3 drop timing should be used when the test set should use the received DS3 signal as its frequency reference.

8) PortTx
Select the signal to come out the DS1 Port
Options: DS3drop (F1), DS1Rx (F2)

- DS3drp means that the DS1 channel dropped out of the DS3 signal is also transmitted out the DS1 jack.
- DS1Rx means that you can loop the signal around from the receive jack to the transmit jack.
- This selection lets you transmit either signal out the DS1 Tx jack when the set has DS3/1 CNFG set to 3Rx/3Tx .
- You cannot change the PortTx setting in configurations besides 3Rx/3Tx, so just ignore the selection in those cases.
- If you have any questions how your set is configured, just look at the

graphic.

2.4 DS3/E1 Test Mode

The next two test modes are only available on the T3 SS300e. To configure the test set to multiplex E1 signals to or from a DS3, select DS3/E1 as the TEST MODE. Use the following procedure:

1) DS3/E1 CoNFiguration
Select your configuration
Options: 3Rx/3Tx (F1), 1Rx/3Tx (F2), 3Rx/1Tx (F3), Mux1Rx (more, F1), Mux3Rx (more, F2)

- Select 3Rx/3Tx (F1) to receive and transmit on the DS3 port
- Select 1Rx/3Tx (F2) to receive an E1 signal on the bantam port, and to transmit out the DS3 port
- Select 3Rx/1Tx (F3) to receive at the DS3 port, and transmit an E1 on the bantam port
- Select Mux1Rx (more, F1) to have the test receive an E1 signal at the bantam port, and multiplex it to transmit out the DS3 port
- Select Mux3Rx (more, F2) to receive at the DS3 port, demultiplex, and transmit out an E1 signal
- Press your GRAPHIC key to see the differences in the setups.
- Note that the E1 signal is available only through the bantam ports.
- See Figure 2.4.A, B and C for sample DS3/E1 configurations.

```
                                        09:27:44

                     SET UP INTERFACE
      TEST MODE :   DS3/E1
      DS3/E1 CNF:   3RX/1TX

        - DS3 -                  - E1 -
      FRAME: M13            FRAME : PCM-30
      TX/20: AIS            CRC-4 : YES
      TxLVL: DSX            RxLVL : TERM
      RxLVL: DSX            CODE  : HDB3
      TxCH : 20            TSTSG : PATRN
      RxCH : 20


        HIGH        DSX    LOW
```

Figure 2.4.A DS3/E1 configuration
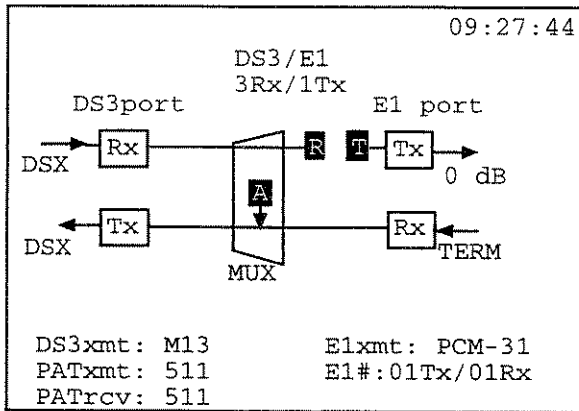
Figure 2.4.B DS3/E1 3Rx/1Tx configuration, graphic
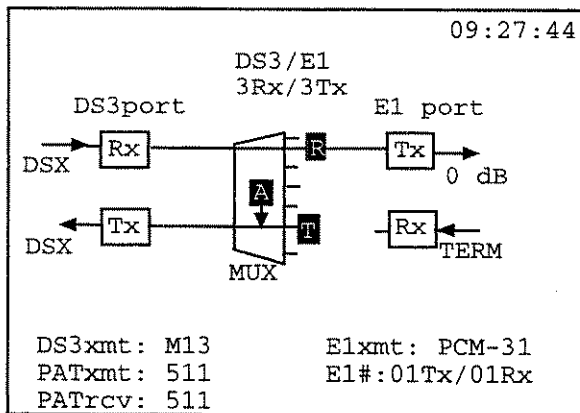
Figure 2.4.C DS3/E1 3Rx/3Tx graphic

DS3 Selections

1) FRAME

• Framing is automatically set to M13

SunSet T3   Version 2.64

www.valuetronics.com

2) TX/20

- 21 E1's fit onto a DS3
- This setting is set at AIS, which puts an AIS pattern onto the remaining channels.

3) TxLVL

Select the DS3 transmit signal level
Options: HIGH (F1), DSX (F2), LOW (F3)

- HIGH: rectangular pulse of 0.90V base to peak nominal voltage
- DSX: adheres to ANSI T1.102 for use at DSX-3. 0.76V base to peak nominal voltage
- LOW: pulse of 0.15V base to peak nominal voltage.

4) RxLVL

Select the receive signal level
Options: HIGH (F1), DSX (F2), LOW-MON (F3)

- This level does not need to be set the same as the TxLVL.
- Use DSX if you are plugged into a DSX-3 OUT jack.
- Use LOW-MON if you are plugged into a DSX-3 MON jack.

5) TxCH and RxCH

Choose the transmit and receive channels
Options: 1-21

- This selects which E1 inside the DS3 you will transmit and receive on.
- These two choices will usually be the same unless you are testing across a 3x1 DCS where the E1 signal has been switched from one channel to another as it passes through the DCS.

E1 Selections

1) FRAME

Select your E1 framing
Options: PCM-30 (F1), PCM-31 (F2), or UNFRaMed (F3)

2) CRC-4

Options: YES (F1) and No (F2)

- This will allow the test set to measure CRC-4 errors on the incoming signal, and to transmit CRC-4 bits on the outgoing signal.
- CRC-4 is applicable to PCM-30 and PCM-31 framing only.

3) RxLVL
Choose your receive signal level
Options: TERM (F1), DSXMON (F2), BRIDGE (F3)

4) CODE
Options: AMI (F1), HDB3 (F2)
Choose the line coding

- When in doubt, choose HDB3.

5) TSTSG
Select the configuration of the test signal
Options: PATRN (F1) , THRU (F2).

- PATRN will cause the test set to insert a test pattern on all E1 channels. This is the default selection for all non-multiplex modes.
- THRU will cause the selected channel to pass through the test set undisturbed. This is the default selection for both multiplex modes. See Figure 2.4.D for a sample graphic screen.

```
                                              09:27:44
                           DS3/E1
                           Mux1Rx
          DS3port                    E1 port
                    +--+                   +--+
    DSX  ──────────>|Rx|────         ─────>|Tx|──────>
                    +--+    \              +--+   0 dB
                             \   ┌─┐
                              \  │A│
                    +--+       \ └─┘    ┌─┐ +--+
    DSX  <──────────|Tx|────    \   ────│R│─|Rx|<──────
                    +--+              MUX└─┘ +--+  TERM


    DS3xmt: M13          E1xmt: PCM-31
    PATxmt: THRU         E1#:01Tx/01Rx
    PATrcv: 511
```
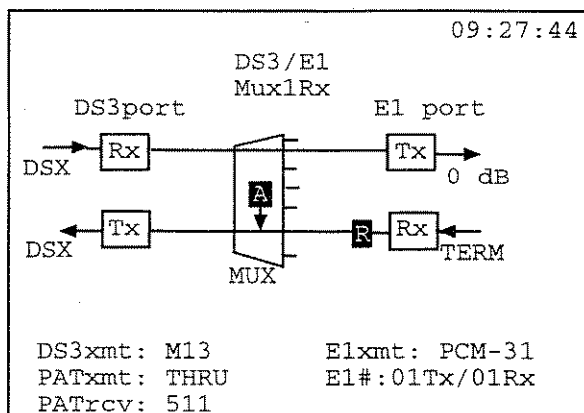
Figure 2.4.D DS3/E1 Mux1Rx graphic

2.5 E1 Test Mode

Use this configuration to observe only an E1 signal. From the MAIN MENU, enter SET UP INTERFACE. At the TEST MODE line, press the MORE (F4) key, then press E1 (F2). See Figures 2.5.A and B.

```
                                            09:47:14
                    SET UP INTERFACE
    TEST MODE :    E1

                                - E1 -
                            FRAME : PCM-30
                            CRC-4 : YES
                            RxLVL : TERM
                            CODE  : HDB3
                            TSTSG : PATRN


    PCM-30   PCM-31   UNFRM
```

Figure 2.5.A   E1 set up interface

```
                                            11:14:44
                            E1

    DS3port                       E1 port

     ┌──┐                          ┌──┐
     │Rx│                          │Tx│────►
     └──┘                          └──┘   0 dB
    DISABLED
     ┌──┐                      ┌──┐
     │Tx│                    R─│Rx│◄───
     └──┘                      └──┘  TERM


                            E1xmt: PCM-30

    PATxmt: 1-8
    PATrcv: 1-8
```
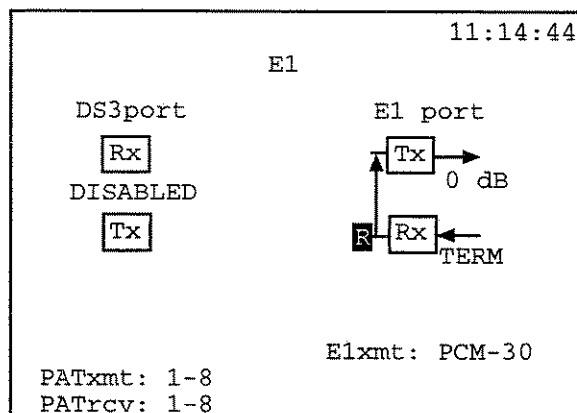
Figure 2.5.B E1 only graphic screen

1) FRAME
Select your E1 framing
Options: PCM-30 (F1), PCM-31 (F2), or UNFRaMed (F3)

2) CRC-4
Options: YES (F1) and No (F2)

- This will allow the test set to measure CRC-4 errors on the incoming signal, and to transmit CRC-4 bits on the outgoing signal.
- CRC-4 is applicable to PCM-30 and PCM-31 framing only.

3) RxLVL
Choose your receive signal level
Options: TERM (F1), DSXMON (F2), BRIDGE (F3)

- This setting lets the SunSet electrically decode a 2.048 Mbps signal under a wide range of resistive or cable losses. It also determines which electrical load will be placed on the circuit by the SunSet.
- On a 2.048 Mbps circuit, there must always be exactly one receiver that applies a low impedance termination.

4) CODE
Options: AMI (F1), HDB3 (F2)
Choose the line coding
- When in doubt, choose the HDB3.

5) TSTSG
Select the configuration of the test signal
Options: PATRN (F1) , THRU (F2)

- PATRN will cause the test set to insert a test pattern on all E1 channels.
- THRU will cause the selected channel to pass through the test set undisturbed.

3.0 Loop Back Control

You may operate several different kinds of DS3/1 loopback devices using the LOOP BACK CONTROL menu. With the circuit looped back, you can measure performance on the transmission path between the SunSet

and the loopback device This feature is not available in either E1 mode.

Figure 3.A shows all of the available options in the LOOP BACK 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 intended to operate.

```
                                    14:07:02

   LOOP BACK CONTROL

   DS1 LOOPBACK
   DS3/DS1 STUFF-BIT
   DS3/DS1 C-BIT FEAC
   DS3 C-BIT FEAC
   WESTELL LINE RPTR
   WESTELL OFFICE RPTR
   TELTREND LINE RPTR
   TELTREND OFFICE RPTR
   WESTELL NIU/PM & MSS
   TELTREND MSS
```

Figure 3.A   LOOP BACK CONTROL Menu

3.1 DS1 LOOPBACK

The DS1 LOOPBACK selection is available in the DS1 and ChanDS3 modes only. Refer to Figure 3.1.A, and use the following procedure:

```
                                    14:07:02

          DS1 LOOPBACK


          MODE : LOOP-UP

          TYPE : IN-BAND

          CODE : NI




    LOOP-UP   LOOP-DN
```
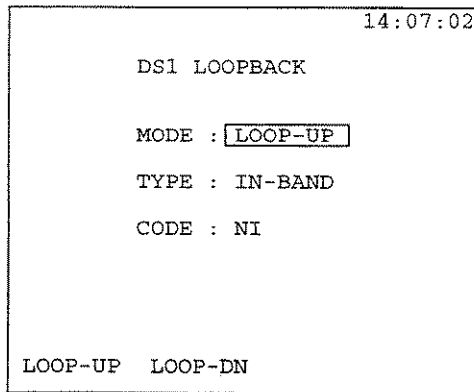
Figure 3.1.A   DS1 Loopback Menu

Basic Loopback Procedure

1) Select the LOOP BACK CONTROL item from the MAIN MENU.
   a) Select the DS1 LOOPBACK item.

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

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

   • IN-BAND is a common type deployed in networks today, and can be
     transmitted with any type of framing. ESF-DL can only be transmitted
     with ESF (extended superframe) framing, and may be required for
     certain NIUs.
   • When in doubt, choose IN-BAND if you are using SF-D4 (superframe)
     framing, and ESF-DL if you are using ESF framing.

3) Choose the desired CODE.

   • The CODE will depend on the TYPE of loopback selected.
   • IN-BAND loopbacks will have a code of either CSU, NI (also known as
     a smart jack), 100000, or USER.

- ESF-DL loopbacks will have a code of either LINE, PAYLOAD, NETWORK, or USER.
- To work with USER-defined loopbacks refer to the other procedures in this subsection.

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

- ESF-DL: Here is an explanation of what the ESF-DL codes are used for. The LINE code operates a line loopback at a CSU. This loopback only regenerates the signal. Bit errors and BPVs should pass through this loopback.

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

- The NETWORK CODE operates an NIU (smart jack) loopback. This loopback only regenerates the signal and should pass both BPVs and bit errors. The codes that will be transmitted for each loopback are:

IN-BAND:
CSU Loop Up: 10000
CSU Loop Down: 100
NI Loop Up: 11000
NI Loop Down: 11100
100000: 100000

T1.403 (ESF-DL):
Line Loop Up:
    11111111 01110000
Line Loop Down:

```
        11111111 00011100
Payload Loop Up:
        11111111 00101000
Payload Loop Down:
        11111111 01001100
Network Loop Up:
        11111111 01001000
Network Loop Down:
        11111111 00100100
```

4) Choose F1 (LOOP-UP) to loop the circuit up before testing.

- Choose F2 (LOOP-DN) to loop the circuit down once the testing is complete.

5) Once the loopback operation is finished, you will see a message on the screen, confirming that the operation was successful.

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

Select a User Loopback Code
To select your own loopback code, use the following procedure:

1) In the DS1 LOOPBACK 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 will move you into the USER LOOPBACK CODE screen.

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

3) You will now see the DS1 LOOPBACK menu displaying your USER pattern in the CODE position.
- Press ENTER to begin the loopback operation and proceed with the basic loopback procedure.

View a User Loopback Code
To view a preprogrammed USER loopback code, use this procedure:

1) In the DS1 LOOPBACK 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 LOOP-
  BACK 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 the following procedure:

1) In the DS1 LOOPBACK 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. See
     Figure 3.1.B.

```
                                       13:13:19
                  USER  LOOPBACK  CODE
      LABEL  :   ABC

      CODE   :


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


      INSERT   DELETE   toggle    SELECT
```

Figure 3.1.B   User Loopback screen

3) Choose toggle (F3).

    • The letter A will begin to flash on and off within the alphabet grid.

    a) Use your cursor keys to move the flashing indicator to the desired letter.

    b) Choose SELECT (F4). You will see the desired letter appear next to the LABEL menu item.

    c) Continue in this fashion until you have spelled the desired name.

4) When the desired name appears in the LABEL menu item choose toggle (F3) to move out of the alphabet grid and back to the LABEL menu item.

    a) Press the down cursor key to move to the CODE menu item.

    b) 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 and back to the LABEL menu item.

    a) Press the left cursor key until the cursor is over the mistaken letter or number.

3) Press DELETE (F2) to remove the desired letter or number. Repeat usage of DELETE (F2) as desired.

4) When all the undesirable 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.

a) If you need to add additional letters to the label, choose toggle (F3) to return to alphabet grid with the flashing letter. Cursor over to the desired letter and press SELECT (F4). Repeat until the LABEL is complete. You can now press ENTER to record the new LABEL and return to the USER LOOPBACK CODE 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 Code while Entering the Code
To correct a mistake made while entering the CODE of your loopback pattern, use this procedure:

1) This procedure assumes you are starting from step 4 of the Program a User Code procedure.

2) While entering the 1s and 0s, you notice a mistaken digit. Press the ENTER key to record the pattern on the USER LOOPBACK CODE list.

3) Cursor down to the pattern you just entered and select DELETE (F2). You have now deleted the errored pattern, and you can create a new one using the "Program a User Loopback Code" procedure.

Edit a User Loopback Code Label
Use this procedure to edit the label of a USER code that you have created:

1) From the DS1 LOOPBACK menu, move the cursor down to the CODE menu 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 LOOP-BACK CODE screen.

2) Move your cursor to the code that you want to edit, and select EDIT (F2).

3) Edit the code's label using the "Correcting a mistake..." procedure.

Delete a User Loopback Code

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

1) From the DS1 LOOPBACK menu, move the cursor down to the CODE menu 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 LOOP-BACK 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.

   a) Press ESCAPE to return to the DS1 LOOPBACK screen.

3.2 DS3/DS1 STUFF-BIT

This type of loopback utilizes the DS3 stuff bits to facilitate looping. It operates with both M13 and C-Bit framing.

Access to this type of looping is available only if a DS3/DS1 TEST MODE and a 3Rx/3Tx CONFIGURATION have been selected from within the SET UP INTERFACE menu item.

Use the following procedure:

1) Enter the LOOP BACK CONTROL item from the MAIN MENU. Select the DS3/DS1 STUFF-BIT option.

   Note that you will not be granted access to the CHNL (channel) number from within this screen. It is displayed here for convenience. This CHNL number must be configured from within the SET UP INTERFACE menu, and it corresponds to the TxCH and RxCH on the DS1 side. In order to activate the loopback, both the TxCH and the RxCH must be the same.

2) Select the looping MODE you wish to use: LOOP-UP (F1) or LOOP-DN (F2). As the appropriate F-key is pressed, looping will begin.

3) A status message will be displayed to confirm a successful loopback.

4) After this message has been displayed, press ESCAPE as necessary to

return to the MAIN MENU.

3.3 DS3/DS1 C-BIT FEAC

This type of loopback utilizes the DS3 Far End Alarm and Control Channel (FEAC). It operates only with C-Bit framing.

The FEAC enables loopback functions using code words. Under this arrangement, the 28 individual DS1s are looped back.

Use the following procedure:

1) Select the LOOP BACK CONTROL item from the MAIN MENU.

    a) Select the DS3/DS1 C-BIT FEAC option. See Figure 3.3.A.

```
                                    10:49:05

              DS3/DS1 C-BIT FEAC

              MODE : LOOP-UP

              TYPE : LINE

              CHNL : DS1ALL




    DS1ALL   DS1CHNL
```

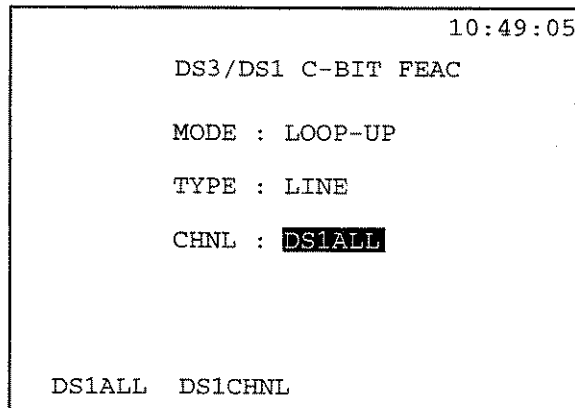**Figure 3.3.A   DS3/DS1 C-bit FEAC screen**

2) Press the Down Arrow key to access the TYPE. Two looping options are available: NETWORK (F1) and LINE (F2). The TYPE item is set at LINE.

3) Select the DS1(s) you want to loop. DS1ALL loops all of the DS1s, and DS1CHNL loops the channel selected as Tx and Rx DS1 channel in the SET UP INTERFACE.

3) Select the looping MODE you wish to use: LOOP-UP (F1) or LOOP-DN

(F2). As the appropriate F-key is pressed, looping will begin.

4) A status message will be displayed to confirm a successful loopback.

5) After this message has been displayed, press ESCAPE as necessary to return to the MAIN MENU.

3.4 DS3 C-BIT FEAC

The DS3 C-bit FEAC option (SW301) also utilizes the Far-End Alarm and Control Channel (FEAC). The third C-bit in M-subframe 1 provides a FEAC. When no alarms or control signals are being sent, this bit is set to 1. When an alarm or control signal is generated, a 16 bit code word, consisting of 0XXXXXX011111111 (RtL) is repeated a minimum of ten times.

For C-bit parity, a line loopback feature is provided. With the DS# line loopback activated, the CI signal is disconnected from the network, and the network signal is transmitted back to the network by the loopback circuitry in the TE without changing in the framing format or removal of bipolar violations.

Use the following procedure:

1) Select the Loop Back Control item from the main menu, and select the DS3 C-BIT FEAC option.

2) Press the Down Arrow key to access the TYPE. Two looping options are available: NETWORK (F1) and LINE (F2).

3) Select the looping MODE you wish to use: LOOP-UP (F1) or LOOP-DN (F2). As the appropriate F-key is pressed, looping will begin.

4) A status message will be displayed to confirm a successful loopback.

5) After this message has been displayed, press ESCAPE as necessary to return to the MAIN MENU.

3.5 WESTELL LINE REPEATER

Figure 3.5.A shows several aspects of the repeater control session. Refer to the Teltrend Line Repeater section for procedures to use.
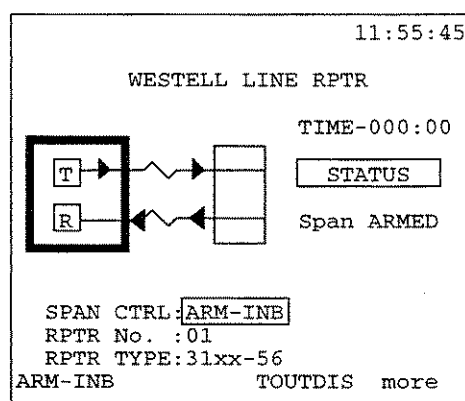


```
                                    11:55:45

              WESTELL LINE RPTR

                                  TIME-000:00

      ┌───┐ ┌─┐                  ┌─────────┐
      │ T ├→│ │→ ⌇ →┐            │ STATUS  │
      │   │ └─┘      │            └─────────┘
      │ R ├─┐   ┌← ⌇←┘            Span ARMED
      └───┘ └─┘


        SPAN CTRL:│ARM-INB│
        RPTR No. :01
        RPTR TYPE:31xx-56
      ARM-INB          TOUTDIS  more
```

Figure 3.5.A   Westell Line Repeater

3.6 WESTELL OFFICE REPEATER

Figure 3.6.A shows several aspects of the repeater control session.


```
                                    11:55:45

              WESTELL OFFICE RPTR

                                  TIME-000:00

      ┌───┐ ┌─┐                  ┌─────────┐
      │ T ├→│ │→ ⌇ →┐            │ STATUS  │
      │   │ └─┘      │            └─────────┘
      │ R ├─┐   ┌← ⌇←┘            Span ARMED
      └───┘ └─┘


        SPAN CTRL:│ARM-INB│
        RPTR No. :01
        RPTR TYPE:31xx-56
      ARM-INB          TOUTDIS  more
```
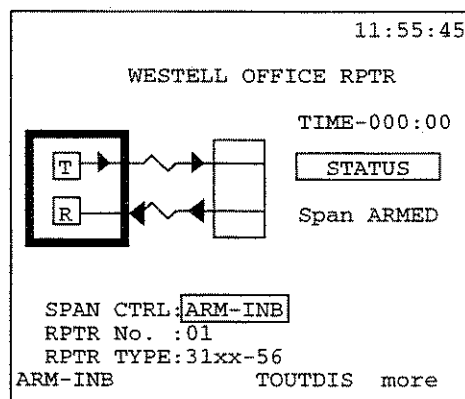
Figure 3.6.A   Westell Office Repeater

The TIME shows you how much time is remaining until the repeater will automatically drop its loopback. The STATUS bar shows you the current looping status of the span. The SPAN CTRL line shows you what span control function is currently in process or has just been completed.

The exact F-key commands presented to you will depend on whether the test set is configured for SF framing or ESF framing. The basic difference is that in one case you will see ARM-INB (arm in-band) and in the other you will see ARM-DL (arm data link) and UNARMDL (unarm data link). In most cases, ARM-INB has the same function as ARM-DL.

The RPTR TYPE line shows the type of Westell repeater selected. This will be the 31xx-56 F1-key or the 31xx-80 F2-key.

There are a few differences to note when using Westell repeaters as compared to Teltrend.

For instance, the Westell central office repeater and line repeater F-key menus also include a sequential loopback (SEQLPBK) item which allow 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.

Also, if you want to do a span power down with the Westell office repeater, it must first be looped up.

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

3.7 TELTREND LINE REPEATER

Figure 3.7.A shows the Teltrend line repeater loopback

```
                                   11:55:45
            TELTREND  LINE  RPTR

                            TIME-000:00

      ┌──────────┐          ┌─────────┐
      │ ┌─┐      │   ┌┐  ┌┐  │ STATUS  │
      │ │T├──►   ├──►├┘  └┤─►│         │
      │ └─┘      │          └─────────┘
      │ ┌─┐      │   ┌┐  ┌┐   Span IDLE
      │ │R├──    │◄──┤└  ┘├◄──
      │ └─┘      │
      └──────────┘

      SPAN  CTRL :[ARM-INB]
      RPTR  No.  :001

  ARM-INB           TOUTDIS   more
```
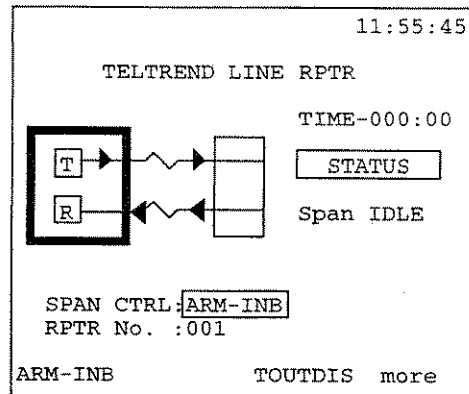
Figure 3.7.A   Teltrend Line Repeater

This diagram shows several aspects of the repeater control session. The TIME (timeout) timer shows you how much time is remaining until the repeater will automatically drop its loopback. The STATUS bar shows you the current looping status of the span. The SPAN CTRL line shows you what span control function is currently in process or has just been completed.

The exact F-key commands presented to you will depend on whether the test set is configured for SF framing or ESF framing. The basic difference is that in one case you will see ARM-INB (arm in-band) and in the other you will see ARM-DL (arm data link) and UNARMDL (unarm data link). In most cases, ARM-INB has the same function as ARM-DL.

Teltrend Line Repeater Procedures

To control the Teltrend line repeater using SF framing, you may perform the following functions.

1) Arm the office repeater and all the line repeaters on the span by pressing F1 for ARM-INB. Arming is required before the repeaters will actually loop up.

2) Disable the automatic timeout of the repeaters on the span by pressing F3 for TOUTDIS.

   • If you do this, be sure to loop down all the repeaters on the span when

you are finished.]

3) By pressing the more key, several new options will appear.

4) Pressing F1 for LPBKQRY 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 mode or the unlooped mode.

5) Pressing F2 for PWLPQRY will query all the repeaters on the span to see which one is looping the span simplex power.

- Be sure to arm the span first. You will see a special status message if the power loop query finds a repeater in power loop.

6) Pressing PWCUTTH (F3) will tell the repeater that has looped the span power to attempt to cut that power through to the other repeaters on the span.

7) Pressing the more (F4) key will yield an additional option:

8) Pressing the UNIVLDN (F1) key will cause the set to transmit universal loopdown code to loopdown any looped repeaters.

9) Pressing the more (F4) key will provide two final options.

10) Pressing the LOOP-UP key will loop up the specified line repeater. The repeater must be armed before using this function, see step 1.

- Also, the RPTR No. must be entered before the LOOP-UP command is selected. The display will show if the loop up was successful.

11) Pressing the LOOP-DN key will loop down any line repeater. It will not loop down the NIU.

3.8 TELTREND OFFICE REPEATER

Teltrend provides a variety of office repeaters which are supported in

the SunSet T3. Refer to Teltrend documentation for detailed information on the operations of these various repeaters. Figure 3.8.A shows the Teltrend office repeater loopback screen:
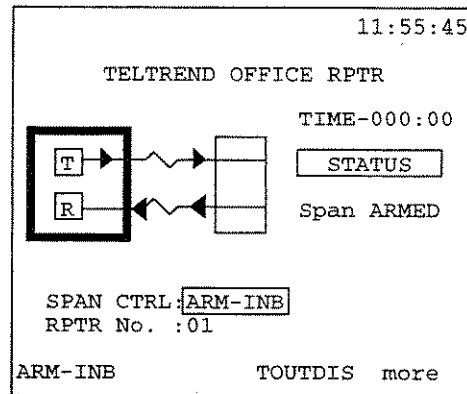


```
                                    11:55:45

                    TELTREND OFFICE RPTR

                                  TIME-000:00

      ┌───┐                       ┌─────────┐
      │ T │ ──►    ‹╱╲╲╱›  ──►     │ STATUS  │
      │ R │ ◄──    ‹╱╲╲╱›  ◄──     └─────────┘
      └───┘                        Span ARMED


            SPAN CTRL :ARM-INB
            RPTR No.  :01

      ARM-INB              TOUTDIS   more
```

Figure 3.8.A   Teltrend Office Repeater

This diagram shows several aspects of the repeater control session. The TIME indicator shows you how much time is remaining until the repeater will automatically drop its loopback. The STATUS bar shows you the current looping status of the span. The SPAN CTRL line shows you what span control function is currently in process or has just been completed.

The exact F-key commands presented to you will depend on whether the test set is configured for SF framing or ESF framing. The basic difference is that in one case you will see ARM-INB (arm in-band) and in the other you will see ARM-DL (arm data link) and UNARMDL (unarm data link). In most cases, ARM-INB has the same function as ARM-DL.

To control the Teltrend office repeater using SF framing, you may perform the following functions. Some special comments are included in case you are using ESF framing:

1) Arm the office repeater and all the other repeaters on the span by pressing F1 for ARM-INB. Arming is required before the repeaters will actually loop up.

2) Disable the automatic timeout of a looped repeater on the span by pressing F3 for TOUTDIS. If you do this, be sure to loop down all the

repeaters on the span when you are finished.

3) Press the more (F4 key) from the first F-key menu to show the following three F-keys:

    a) Pressing F1 for LPBKQRY will query all the repeaters on the span to see which one is actually looped back.

    b) Pressing F2 for POWR-DN will tell the office repeater to cut power to the span. Power will remain cut until you choose another function or escape to the main menu. Powering down the span resets all the repeaters. Be sure to arm the office repeater before selecting POWR-DN.

    c) Pressing UNIVLDN (F3) will send the NIU in-band loop down code to drop one Teltrend or NIU loopback at a time.

4) Pressing the more (F4) key from the second F-key menu will provide the following three options:

    a) Pressing the LOOP-UP (F1) key will loop up the office repeater. The repeater must be armed before using this function, see step 1). If the office repeater is an E-type, you can also choose office repeater number 1 through 3 in RPTR No. Do this before pressing LOOP-UP (F1).
        If the E-type office repeater is configured for fractional T1 blocking, then only repeater number 1 can be looped up, and after the loop up is successful a message will be displayed showing the fractional configuration of the office repeater.

    b) Pressing the LOOP-DN key will loop down the office repeater. It will not loop down the E-type office repeater when it is in NIU emulation mode.

    c) Selecting the DUAL-LB (F3) key will loopback the E-type office repeater in both directions when it is configured for NIU mode and when it has already been looped up using the ARM-INB F-key.

5) Selecting more (F4) from the third F-key menu will display the following two or three options:

a) Selecting UNBLOCK (F1) will unblock the office repeater to allow NIU loop up code to pass through from the customer premises toward the DSX. This situation arises when you are testing from the customer premises and want to loop back an NIU that is on the other end of the circuit. First you have to send NIU loop up (ARM-INB) code. This arms the central office repeater but does not loop back anything. Then you can send the UNBLOCK code, which will temporarily inhibit the NIU blocking feature of the office repeater. Then you send the NIU loop up (ARM-INB) code again and the far end NIU loops up.

b) CLR-FT1 (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:

a) The first step is to send ARM-INB command (not ARM-DL) - this arms the E-type office repeater in fractional mode. It also loops back the NIU, although you will probably not see a pattern synch because the central office repeater is still blocking the unused channels.

b) The next step is to press CLR-FT1. You will now see pattern synch and no errors if the span and equipment is working properly. You can perform a variety of tests such as bridge tap and basic measurement.

c) When you are done, UNIVLDN will drop the NIU loop and return the office repeater to its fractional blocking mode.

3.9 WESTELL PERFORMANCE MONITORING NIU MAINTENANCE SWITCH and RAMP

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 customers circuit if just using the PM NIU feature, or it will be the maintenance spare if you are using RAMP or the Maintenance Switch.

a) Make sure your test set is configured for SINGLE, TERM SF or ESF.

2) From the main menu, enter the LPBK & SPAN CTRL menu.

   a) Then enter the WESTELL NIU/PM & MSS menu. Note: the test set will only proceed if it is able to verify a successful loopback is established.

3) Refer to Figure 3.9.A, Westell PM/NIU & MSS. Continue reading on in this section for more background information and individual procedures for each capability.

   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 T3 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 hi cap lines upon a failure. With the Maintenance Switch Ramp Access, you can use your SunSet T1 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.
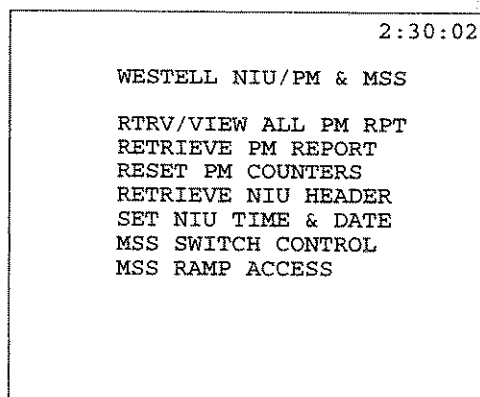
```
                                      2:30:02

          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 3.9.A Westell NIU/PM & MSS

3.9.1 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). Otherwise, press F1 (YES) to print the received
   data or F2 (NO) to not print the data. 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 3.9.B.

```
                                        2:30:02

                RTRV/VIEW ALL PM RPT

                LAST REPORT IS AVAILABLE

                SELECT OPTION : SCRVIEW




 SCRVIEW   PRINT   RMTDUMP   DELETE
```

Figure 3.9.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) Press PRINT (F2) if you would like to print the status report to the printer.

6) Press RMTDUMP (F3) if you are controlling the set over the remote
   interface and you would like to log the data to a data file.

   To do this, configure your remote terminal to log the data that it
   receives. You will have 10 seconds after pressing RMTDUMP to open
   your log file before the test set starts to transmit the data. You will also
   have 10 seconds after all the data is transmitted to close the log file
   before the test set starts retransmitting screen control characters.

7) Choose DELETE (F4) if you would like to delete the stored performance
   history, 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.

3.9.2 RETRIEVE PM REPORT
   Refer to the previous procedure. 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 the SHIFT indicator is displayed. Next, type
in the numbers of the day, date, and hour you want. Press the SHIFT-lock

key again sod 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.

3.9.3 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.

3.9.4 RETRIEVE NIU HEADER
This command tells you what the date and time is at the PM NIU.

3.9.5 SET NIU TIME & DATE
This command allows you to set the NIU time and date in year-month-day and hour-minute-second formats. 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.

3.9.6 MSS SWITCH CONTROL
This command sends the control sequence to initiate the maintenance switch. Use the following procedure:

1) Be sure you have a loopback established at the maintenance switch.

   a) 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.

a) Next, press ENTER to begin the operation.

b) When the control sequence is successful, you will get a message saying to go ahead and press the ENTER key to activate the 10 second timer at the maintenance switch. Do this.

c) 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.

a) 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 automatically 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.

3.9.7 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. Use this procedure:

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. 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.

a) 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.

3.10 TELTREND MAINTENANCE SWITCH

This feature is found in LOOP BACK CONTROL, TELTREND MSS.

TELTREND MSS SWITCH CONTROL
Use the following procedure:

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 LOOP BACK CONTROL menu. Reenter 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 either option F1 (SWITCH) if you are connected to the mainte-
   nance switch and you are ready to switch the circuit over to the spare,
   or F2 (RELEASE) 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), then 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 com-
      mands. 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 reenter it (as in step 2) to reestablish a loopback
      at the NIU.

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

4.0 Using the SEND TEST PATTERN menu

From the MAIN MENU, enter SEND TEST PATTERN. Refer to Figures 4.A and 4.B. Not all patterns will be available at all times. The user's choice of patterns will depend upon the TEST MODE selected.

Note that DDS-1, DDS-2, DDS-6, and 0000 should not be used as test patterns for DS1 AMI testing. These patterns have in excess of 150 consecutive zeroes which will cause a loss of signal.
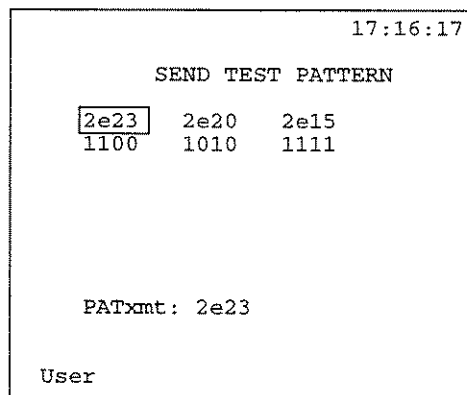
```
                                17:16:17

                    SEND  TEST  PATTERN

           ┌─────┐
           │2e23 │   2e20    2e15
           └─────┘
            1100    1010    1111







           PATxmt: 2e23


         User
```

Figure 4.A DS3 Send Test Pattern

```
                              15:26:27

               SEND TEST PATTERN

   ┌──────┐
   │ 2e23 │   2e20     2e15     2047
   └──────┘
    1100      0101     1111     0000
    QRS       511      127      63
    1-8       1-16     3-24     DALY
    T1-1      T1-2     T1-3     T1-4
    T1-5      T1-6     DDS-1    DDS-2
    DDS-3     DDS-4    DDS-5    DDS-6

    PATxmt:  2e23


   User
```

Figure 4.B   DS1, ChanDS3, and E1 Test Patterns

4.1 Standard Test Patterns

This section defines the various test patterns transmitted and recognized by the test set. Not all patterns will be available at all times. The user's choice of patterns will depend upon the TEST MODE selected.

Use this procedure:

1) Select the SEND TEST PATTERN item from the MAIN MENU.

2) Use the arrow keys to move to the test pattern of interest. Note that the PATxmt: indicator (below the list of patterns) changes as each new pattern is highlighted. As a new pattern is highlighted, the SunSet immediately begins transmitting the pattern.

3) Press ENTER to return to the MAIN MENU.

Available Patterns:
  DS3 mode:
    2e23, 2e20, 2e15, 1100, 1010, 1111, User.

ChanDS3, DS1, DS3/E1 and E1 modes:
2e23, 2e20, 2e15, 2047, 1100, 1010, 1111, 0000, QRS, 511, 127, 63, 1-8, 1-16, 3-24, DALY, T1-1, T1-2, T1-3, T1-4, T1-5, T1-6, DDS1, DDS2, DDS3, DDS4, DDS5, DDS6, User.

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

Here are the test patterns:

User
User-defined pattern, with a maximum length of 2048 bits for a User DS1 pattern, and a maximum length of 8 bits for a User DS3 pattern. 10 such patterns may be stored in the SunSet T3.

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.

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. This pattern is what the QRS pattern is derived from.

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.

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

1100

This pattern represents a DS3 idle code. The DS3 IDLE code is a signal with valid M-frame Alignment Channel and P-bit Channel and with an information bit sequence of 1100. Here is the pattern in its binary form:

    1100

1010

1010 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

This pattern also represents a DS3 Alarm Indication Signal (AIS). The DS3 AIS is a signal with a valid M-frame Alignment Channel, M-subframe Alignment Channel and P-bit Channel. Bits X1 and X2 are set to 1, while bits C1, C2 and C3 are set to 0 and an information bit sequence of 1010... (beginning with a 1 after each M-frame Alignment, M-subframe Alignment, X-bit, P-bit and C-bit Channels) is transmitted on the returning DS3 signal.

1111

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

    1111

0000

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

    0000

QRS

QRS 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.

511

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

127

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

63

63 is the industry-standard 63-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
```

1-16

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

```
f 0100 0000 0000 0000
```

3-24

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

```
f 0100 0100 0000 0000 0000 0100
```

DALY

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
```

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, 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, 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 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, 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, 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, F5, 80, 80, 80, 80, FF, FF, FF, FF,
80, 80, 80, 80, 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 (Digital Dataphone Service) 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 in excess of 150 consecutive zeroes which will cause a loss of signal to be recorded on a T1 line. These patterns are recommended for DDS, fractional Nx56 T1 applications, and special laboratory applications.

DDS-1

```
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, 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, 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, FF, FF, FF, FF, FF, FF,
```

```
FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF, FF,
FF, FF, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00
```

DDS-2

```
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00
```

DDS-3

```
00110010
```

DDS-4

```
01000000
```

DDS-5

```
FE, FE, FE, FE, FE, FE, FE, FF
```

DDS-6

```
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, 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, FF, FF, 00, 00,
```

```
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E,
7E, 7E, 7E, 7E, 7E, 7E, 7E, 7E, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00,
00, 00, 00, 00, 00, 00, 32, 32, 32, 32, 32, 32, 32, 32,
32, 32, 32, 32, 32, 32, 32, 32, 40, 40, 40, 40, 40, 40,
40, 40, 40, 40, 40, 40, 40, 40, 40, 40, FE, FE, FE, FE,
FE, FE, FE, FF
```

User 2-8

This pattern is frame aligned (f is the framing bit) as shown in its binary form:
```
f 1100 0000
```

User FOX

The industry-standard FOX pattern is used in data communications appli-
cations. The ASCII translation of the pattern is the "Quick brown fox jumped
over the fence 0123456789" sentence. The pattern is frame aligned to
ensure proper ASCII translation of the bits. It is recommended that the
pattern be sent with framed signals, otherwise, ASCII translation is not
possible. Here is the pattern:
```
2A, 12, A2, 04, 8A, AA, 92, C2, D2, 04, 42, 4A, F2, EA,
72, 04, 62, F2, 1A, 04, 52, AA, B2, 0A, CA, 04, F2, 6A,
A2, 4A, 04, 2A, 12, A2, 04, 32, 82, 5A, 9A, 04, 22, F2,
E2, 04, 8C, 4C, CC, 2C, AC, 6C, EC, 1C, 9C, 0C, B0, 50
```

User IDLE

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

User YELLOW

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

4.2 User Test Patterns

SEND a User-Defined Pattern

Use this procedure:

1) Select the SEND TEST PATTERN item from the MAIN MENU.

2) Press the F1 key to select User.

3) Using the appropriate F-key, select from VIEW, EDIT, or STORE.
   VIEW is used simply to look at the active User Test Pattern or a test
       pattern which was previously defined. No modifications can be
       made using this selection.
   EDIT is used to edit the active User Test Pattern or a test pattern which
       was previously defined.
   STORE is used to save the CURRENT pattern. You will enter the
       CREATE screen.

4) Press ENTER to return to the MAIN MENU.

You may also create a new pattern, edit an existing pattern, or delete a
pattern.

VIEW a User-Defined Pattern
To view a preprogrammed USER test pattern, use this procedure:

1) In the SEND TEST PATTERN menu, press the F1 key to select User.

2) Move your cursor down to the desired test pattern and press VIEW (F1).

3) You will now see your selected pattern on the screen. Use the PAGE-UP
   (F1) and PAGE-DN (F2) keys to scroll through the pages.
   a) When you are finished viewing, press ESCAPE to return to the USER
       TEST PATTERN menu.

4-60

CREATE a User-Defined Pattern
Use this procedure:

1) In the SEND TEST PATTERN menu, press User (F1).

2) Using the arrow keys, move the cursor down to a blank position on the list.
   a) Press the F1 key to CREATE the new pattern.

```
                                        13:13:19

                        DS1  USER  TEST  PATT
        LABEL     :
        FORMAT    : BINARY
        No.
        001


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

        INSERT   DELETE   toggle    SELECT
```

Figure 4.2.A User Test Pattern screen

3) Enter the label under which your pattern is to be stored. Label names are a maximum of 10 characters in length. Any combination of alphanumerics may be used.
   • If your label is to consist only of characters 0-9 and A-F, press the SHIFT-lock key and enter the label directly from the keypad. (Remember to press the SHIFT-lock key again when you are finished).
   • If your label is to utilize other characters, press the F3 (toggle) key to gain access to the alphabet grid displayed in the lower portion of the screen.
      a) As the F3 (toggle) key is pressed, the letter A on the alphabet grid will begin to flash. Use the arrow keys to move the flashing indicator to your desired letter.
      b) Press the F4 (SELECT) key. You will see the selected letter appear on your LABEL. Repeat this procedure for each of the letters in your label.

4) Press the F3 (toggle) key to leave the alphabet grid.

5) Press the down arrow key to select the FORMAT of the new pattern.
   - Press the F1 (BINARY) key if you wish to enter your pattern as a series of 0s and 1s. Or,
   - Press F2 (HEX) to enter the pattern in hexadecimal notation.

6) Press the down arrow key once. The cursor should now be positioned on the 001 line.
   Note that if you enter a long pattern, the cursor will automatically advance to the next line.

7) For DS1 codes, enter up to 2048 binary characters or 512 hexadecimal characters to create the desired pattern. For DS3 codes, enter up to 8 binary characters.

8) When the pattern is complete, press the SHIFT-lock key and verify that the SHIFT indicator (upper left-hand corner of the screen) has turned off.

9) Press the ENTER key to store the new pattern.

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 Test Pattern 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 and back to the LABEL menu item. Press the left cursor key until the cursor is over the mistaken letter or number.

3) Press DELETE (F2) to remove the desired letter or number. Repeat usage of DELETE (F2) as desired.

4) When all the undesirable 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.

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• If you need to add additional letters to the label, choose toggle (F3) to return to alphabet grid with the flashing letter. Cursor over to the desired letter and press SELECT (F4). Repeat 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
To correct a mistake made while entering the pattern, use this procedure:

1) This procedure assumes you are starting from step 4) of the Program a User Test Pattern procedure.

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

3) Enter the proper 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.

4) Press ENTER to store the pattern.

Edit a User Test Pattern Label
Use this procedure to edit the label of a test pattern that you have created:

1) From the SEND TEST PATTERN menu, move the cursor down to the USER menu item and press ENTER. This moves you 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.

Delete a User Test Pattern

Use this procedure to delete a user test pattern that you no longer want:

1) From the SEND TEST PATTERN menu, move the cursor down to the USER menu item and press ENTER. This moves you into the USER TEST PATTERN screen.

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

5.0 MEASUREMENT RESULTS

The SunSet T3 continuously performs measurements on its received signal(s). The user need not access the MEASUREMENT RESULTS menu item in order for the measurement results to be compiled. Measurements are automatically restarted every time the configuration is significantly changed. The MEASUREMENT RESULTS menu allows the user to view the accumulated measurement results and restart the measurement process.

Measurements may have a count displayed in the left column, and the corresponding rate or percent displayed on the right column. For instance, BPV is displayed on the left side of the top line, and BPVR is displayed on the right side of the top line. BPV is the count of bipolar violations, and BPVR is the bipolar violation error rate.

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

A circuit is said to be unavailable at the beginning of 10 consecutive severely errored seconds. Errors, errored seconds, and severely errored seconds are not accumulated when the circuit is unavailable. Therefore, if you start continuously injecting errors to the test set at a 2×10^{-3} error rate, you will see increasing bit errors, errored seconds, and severely errored seconds for the first 9 seconds. Then, at the tenth second, all the counts will suddenly decrease back to the values they had before the error injection was started, and the unavailable counter will suddenly increase by 10.

Once a circuit is unavailable, it becomes available only after 10 consecutive seconds without severe errors. To continue the previous example, if you turn the severe error injection off, and then insert 1 or 2 errors during the next 5 seconds, you will observe that the unavailable second

counter continues to increase for the first 9 seconds while the error counter does not change. Then at the tenth second, the unavailable second counter suddenly decreases by 10 and the error counter increases by the 1 or 2 errors that you inserted.

Take a moment to see how this works. Go to the MEASUREMENT RESULTS screen and ensure that you have pattern sync and frame sync. RESTART the test in order to zero the counters. Next, create unavailable seconds by pulling out the receive bantam plug, then plugging it back in. You will notice that the unavailable seconds continue to be counted for 10 full seconds after you put the plug back in. Then, after the 10th second, the available seconds jump by 10 and the unavailable seconds decrease by 10. From that point on, available seconds are counted.

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

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

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

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

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

HOLDSCR/CONTINU (more, F1)
HOLDSCREEN freezes all of the measurement displays so they may be easily observed. The measurement count is still proceeding, but the counts are updated only in memory. You may now read the previous counts clearly.

PRINT (more, F2)
Press PRINT to have the SunSet print out the results

When you have finished viewing the screen, press the CONTINU (F1) key

to view your updated measurement results.

In addition, to the actual measurement data, the following information is displayed in the upper portion of the measurement screens:
CURRENT TIME: The current time of day is displayed in the upper right-hand corner of the screen.

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

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

CONFIG: This is your test CONFIGuration.

RCV: The test pattern the SunSet is receiving is reported here.

FRM: The transmitted/received framing is displayed here.

COD: The transmitted/received line coding is displayed here.

FRAME: The mode and framing in use is reported here. For example, DS3 FRM: N/A and DS1 FRM: ESF might be reported in DS1 mode, or E1 FRM: PCM 30 in DS3/E1 mode.

To view the DS3/2/1/E1 measurement results, use this procedure:

1) Select MEASUREMENT RESULTS from the MAIN MENU.

2) View the results which are displayed by using the PAGE-UP (F1) or PAGE-DN (F2) keys. Refer to Figure 3.A and 3.B for two sample screens. The actual measurement results screens and values which are displayed will depend upon the TEST MODE configuration which you have chosen.

IMPORTANT NOTE: Each measurement is proprietary to its screen; e.g. "AS" refers to DS1 available seconds in the DS1 results screens, and DS3 available seconds in the DS3 results screen.

AISS

Alarm Indication Signal Seconds 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 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.

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 test set is connected 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 they pass the signal through. 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: This rate is sometimes used instead of a count when the measurement is conducted for a long period of time. 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 a BPVR of 10^{-9} or better.

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.

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.

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.

CRCR

This is the CRC error rate measured since the beginning of the test.

Usage: Refer to the discussion for CRC. This rate is a means of summarizing the information in a way that is independent of the actual measurement period.

DGRM

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

EFS

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

Usage: See discussion of %EFS below.

%EFS

This is the percentage of DS1 Error Free Seconds since the beginning of the test. An error free second has no errors at all. The number of Error Free Seconds is divided by the total number of seconds (both available and unavailable) since the beginning of the test.

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, T3, or E1 service delivered to the end user.

ES

This is a count of the number of Errored Seconds which 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/T3 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.

%ES

This is the percentage of DS1 Errored Seconds since the beginning of the test.

Usage: This is used as a tariffed performance parameter. It is used over longer periods of time such as a day, week or year. Common requirements are that errored seconds be less than 5%. Some customers expect performance at less than 0.5%.

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.

FBE

This is a count of the number of Framing Bit Errors which 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 FBE 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 therefore only gives a sampling of the true transmission performance. The other problem with the measurement is that it can't measure the quality of the transmission on the two outgoing directions of transmission. It can only measure the quality on the two incoming directions of transmission.

FBER

This is the Framing Bit Error Rate measured since the beginning of the test.
    Usage: Refer to the discussion for FBE. This rate is a means of summarizing the information in a way that is independent of the actual measurement period.

FREQ

This is the current frequency measured during the last second.

FSLP

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 hi cap services that carry data and face a switch or 1x0 digital cross-connect system. See Section 5.6 for a measurement procedure.

LDNS

Signal Low DeNsity Seconds is a count of the number of seconds when the n(n-1) rule is broken (see specs).
    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 to 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, this will tell you the customer is sending an unusual signal, and perhaps should be switched to a B8ZS line.

+LVL

Positive LeVeL is the level of positive pulses being received by the test set. This measurement is only reported when the signal being measured is

plugged into the DS1 RX jack. Measurements are displayed in Volts (V).

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 pulse 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 about 3 volts. The level at a repeater should be between -10 dB and -35 dB.

-LVL

Negative LeVeL is the level of negative pulses being received by the test set. This measurement is only reported when the signal being measured is plugged into the DS1 RX jack. Measurements are displayed in Volts (V).

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.

LOFS

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

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

LOSS

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

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

Lpp

Peak-to-peak Level is the peak-to-peak level of negative and positive pulses being received by the test set. Measurements are displayed in both Volts (V) and decibels variance from DSX level (dB).

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

MaxF

This is the maximum frequency measured since the beginning of the test.

MinF

This is the minimum frequency measured since the beginning of the test.

OOF

This is the count of Out-Of-Frame seconds that have occurred since the beginning of the test. The condition for out-of-frame may be adjusted in the OTHER FEATURES, TEST PARAMETERS screen. An out-of-frame condition occurs when either 2-in-4 or 2-in-5 framing bits have been in error. You may specify the exact out-of-frame criteria in OTHER FEATURES, TEST PARAMETERS, DS1 OOF.

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 OOF. In this case, LOF is declared, OOF 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.

SES

This is a count of the number of Severely Errored Seconds which 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.

%SES

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

Usage: This parameter is used over longer periods of time to give a uniform measure of the quality of service.

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

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.

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

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

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

The T1 path terminating device will send a yellow alarm on its outgoing signal in response to loss of frame on its incoming signal. Thus, the yellow

alarm signifies that the other side of the T1 line has failed somewhere before the end of the circuit.

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

5.1 DS1 Measurements

The following measurement results screens are available when using either a DS1 or ChanDS3 mode.

SUMMARY screen

The SUMMARY screen presents the most significant measurement results. The screen contains measurement data related to specific types of impairments such as bipolar violations, bit errors, and CRC-6 block errors. It also reports overall performance measures, such as errored seconds and percent error free seconds. See Figure 5.1.A.

```
                           04:10:32
ET: 000:06:50       RT: CONTINU
CONFIG: 3Rx/3Tx     RCV: QRS
DS3 FRM: M13        DS1 FRM: SF-D4
              SUMMARY
   - DS3 -              - DS1 -
ES   : 0            ES   : 0
SES  : 0            SES  : 0
UAS  : 0            UAS  : 0
Vpk  : 0.78V        Lpp  : N/A
FREQ: 44736000      FREQ: 1544000


          - LOGICAL -
BIT  : 0            UAS  : 0

PAGE-UP  PAGE-DN  RESTART
```

Figure 5.1.A   Summary Results

DS1 Measurement screen

This screen presents you with complete error measurements. See Figure 5.1.B

```
                              17:31:55
  ET: 000:07:22      RT: CONTINU
  FRM: ESF           COD: AMI
  DS2: 7             DS1: 26

         DS1 MEASUREMENT
  BPV : 1            BPVR: 1.8e-09
  FBE : 0            FBER: 0.0e-07
  CRC : 0            CRCR: 0.0e-06
  OOF : 1            COFA: 0
  ES  : 1            %ES : 00.246
  SES : 0            %SES: 00.000
  EFS : 315          AS  : 430
  DGRM: 0            UAS : 1

  PAGE-UP PAGE-DN  RESTART    more
```

Figure 5.1.B DS1 Measurement Results

Page 2 of the DS1 MEASUREMENT screen presents data pertaining to alarms and frequency measurement. See Figure 5.1.C

```
                               09:27:44
  ET:   000:01:48     RT: CONTINU
  FRM:  ESF           COD: AMI
  DS2: N/A            DS1: N/A
          DS1 MEASUREMENT
  AISS: 0             FREQ: 1543993
  LOFS: 0             MaxF: 1544000
  LOSS: 0             MinF: 1543993
  YELS: 0             +WDR: NOREF
  LDNS: 0             -WDR: NOREF
  EXZS: 0             FSLP: NOREF
  +Vpk: 3.00V         Lpk : 6.02V
  -Vpk: 3.00V         Lpk : -0.1 dB

  PAGE-UP  PAGE-DN  RESTART  more
```

Figure 5.1.C DS1 results, pg. 2

DS1 Measurement, Frequency screen

This screen presents relevant frequency information.

```
                                    08:58:23
     ET:   000:13:28      RT: CONTINU
     FRM:  ESF            COD: AMI
     DS2:  1              DS1: 1
              DS1 MEASUREMENT
   NEG                                    POS
     -+--+--+-----+-----+--+--+--+-


     RCV hz: 1544000
     Max hz: 1544001 CLKSLIP: 0
     Min hz: 1544000 +WANDER: 0
     FSLIP : 0       -WANDER: 0

   PAGE-UP  PAGE-DN  RESTART   more
```

Figure 5.1.D   DS1 Frequency screen

- The bar graph indicates how fast the signal is slipping in relation to the external reference clock.
- A count of the number of clock slips is kept at the end of the bar
- One clock slip occurs when the measured frequency deviates from the reference frequency by one unit interval.   A unit interval is equal to 488 nano seconds.

G.821 Measurement screen

The G.821 screen presents the measurement parameters specified in ITU G.821 It includes ES, SES, EFS, AS, UAS, DGRM, and their related percent values. Figure 5.1.E presents a sample screen.

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```
                                    08:58:23
ET:   000:13:28        RT: CONTINU
XMT: 1100              RCV: 1100
RATE: 1.536 Mhz


         G.821 MEASUREMENT

  BIT : 0             BER : 0.0e-09
  ES  : 0             %ES : 00.000
  SES : 0             %SES: 00.000
  EFS : 374           %EFS: 100
  AS  : 374           UAS : 0
  SYLS: 0             DGRM: 0


PAGE-UP   PAGE-DN   RESTART   more
```

Figure 5.1.E   G.821 measurement screen

5.2 DS2 Measurements

The DS2 MEASURMENT screen results are available only when using
the ChanDS3 or DS3/E1 TEST MODEs. See Figure 5.2.A.

```
                                    15:56:22
ET:   000:13:52        RT: CONTINU
FRM:  ESF              COD: N/A
DS2:  1                DS1: 1

         DS2 MEASUREMENT
AISS: 0              YELS: 0
LOFS: 0              FBE : 0




PAGE-UP   PAGE-DN   RESTART   more
```

Figure 5.2.A   DS2 Measurement Results

The following results are specific to this page:

AISS

Alarm Indication Signal Seconds is a count of the number of seconds in which AIS was detected. The DS2 AIS is an unframed all 1s signal.

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. How ever, if there is a line terminating element, then the same break in the line will cause an AISS.

FBE

This is the count of DS2 Framing Bit Errors that have occurred since the beginning of the test.

Usage: This measurement is an in-service measurement result for DS2 circuits. When 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, 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 24 out of every 6.312 Mbits, and so it only gives 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 only measure the quality on the two incoming directions.

YELS

This is the count of YELlow alarm Seconds since the beginning of the test.

The DS2 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 DS2 line has failed somewhere before the end of the circuit. The DS2 Yellow Alarm is enabled by setting the X-bit to 0 on the returning DS2 signal.

Usage: Yellow alarm is used to sectionalize a circuit fault. 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.

5.3 DS3 Measurements

The following measurement results are available when using either a DS3, DS3/E1 or ChanDS3 TEST MODE. The SUMMARY screen is shared with the DS1 or E1 SUMMARY, and features the most important measure-

ment results.   Page one of the DS3 MEASUREMENT provides complete
results. See Figure 5.3.A for a sample page 1 screen.

```
                                        09:27:44
    ET:   000:22:31          RT: CONTINU
    FRM:  C-BIT  Tx: DSX  Rx: DSX
              DS3 MEASUREMENT
    LOSS: 0             LOFS: 0
    BPV : 0             BPVR: 0.0e-11
    FBE : 0             FBER: 0.0e-09
    Pbit: 0             Cbit: 0
    FEBE: 0             AS  : 1497
    ES  : 0             %ES : 00.000
    SES : 0             %SES: 00.000
    EFS : 0             %EFS: 100
    DGRM: 0             UAS : 0

    HOLDSCR  PRINT                more
```

Figure 5.3.A   DS3 measurements, pg. 1

The following measurements are specific to this screen:

Cbit

This is the C-bit Block Error count.

   Usage: This measurement is often used for in-service error detection.
It is a more accurate error measurement than P-bit errors and is only found
with C-bit framing. It shows that a problem has occurred between the
source of the DS3 signal and the test set. This signal propagates through
all media (fiber, coax, radio) that transport a DS3 signal.

DGRM

This is a count of the bit DeGRaded Minutes that have occurred since the
beginning of the test. A BIT or BPV degraded minute is 60 non-severely
errored seconds during which a total of at least 2666 errors occurred.

   Usage: This measurement may be called out in service applications
governed by CCITT specifications.

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 M13
framed 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, hence it depicts the overall transmission quality from the far end of the circuit to the test set.

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.

FEBE

This is the count of Far End Block Errors received. FEBEs are transmitted by the DS3 terminating element at the end of the DS3 path when a C-bit error is received by the element.

Usage: This measurement is often used for in-service error detection. It finds errors that are occurring after (or downstream) from the test access point.

Pbit

This is the P-bit Parity Error count.

Usage: This measurement is often used for in-service error detection. It indicates that a problem has occurred between the source of the DS3 signal and the test set. This signal propagates through all media (fiber, coax, radio) that transport a DS3 signal.

DS3 Measurements, page 2

This screen presents alarm and frequency information. See Figure 5.3.C.

```
                                    08:58:23
   ET:   000:13:28          RT: CONTINU
   FRM:  ESF   Tx: DSX      Rx: DSX


               DS3 MEASUREMENT
   LOSS: 0              Vpk : 0.76V
   LOFS: 0              PWR : 5.1 dB
   AISS: 0
   FREQ: 44735989
   MaxF: 44735990
   MinF: 44735918



   PAGE-UP   PAGE-DN   RESTART   more
```

Figure 5.3.C DS3 MEASUREMENT, pg. 2 screen

The following defintions are specific to this screen:

AISS

Alarm Indication Signal Seconds is a count of the number of seconds in which AIS was detected. The DS3 AIS is a signal with valid M-frame alignment channel, M-subframe alignment channel and P-bit channel. The payload bits are set to a 10 pattern, starting with a 1 after each M-frame alignment, M-subframe alignment, X-bit, P-bit and C-bit channel. The C-bits are set to 0 and the X-bits are set to 1.

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.

PWR

This is a measure of the PoWeR of the received DS3 signal. The measurement is given in dBm and represents the area of a single DS3 pulse. Since the power of a signal is affected by the signal's height, this measurement is related to the height of the DS3 pulse (Vpk).

Vpk

This is the level of the received DS3 pulse from its base (0 V) to its peak. This measurement is displayed in Volts (V).

YELS

This is the count of the number of seconds for which a YELlow Alarm has occurred since the beginning of the test. A DS3 Yellow Alarm occurs when a DS3 terminating device detects a loss of signal for which framing cannot be found.

The DS3 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 DS3 line has failed somewhere before the end of the circuit. It is given by the far-end equipment setting the X1 and X2 bits to zero in the returning DS3 signal.

Usage: Yellow Alarm is used to sectionalize a circuit fault. 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.

5.4 E1 Measurements

E1 Summary Screen

The Summary screen presents the most significant measurement results. The screen reports overall performance measurements such as errored seconds and percent errored seconds. In Figure 5.4.A, the DS3 side is not active.

```
                            12:21:11
ET:   000:22:31     RT: CONTINU
CONFIG: E1          RCV: LIVE
E1 FRM: PCM-30
                SUMMARY
  - DS3 -            - E1 -
ES  : N/A        ES  : 00.000
SES : N/A        SES : 00.000
UAS : N/A        UAS : 0
Vpk : N/A        Lpp : 0.8 dB0
FREQ: N/A        FREQ: 2048000
        - LOGICAL -
BIT : N/A        UAS : N/A
HOLDSCR  PRINT            more
```

Figure 5.4.A   E1 Summary screen

The following definitions are specific to this screen:

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

E1 Measurement screen, Page 1

This screen presents basic information. See Figure 5.4.B for a sample screen.

```
                                  14:42:57
ET:    000:22:31        RT:  CONTINU
FRM:   PCM-30           COD: HDB3
DS2: N/A                E1:   01
            E1  MEASUREMENT
  CODE:  N/A           CODR:  N/A
  FASE:  0             FAER:  0.0e-0.6
  MFSE:  0             MFER:  0.0e-0.5
  CRC :  0             CRCR:  0.0e-06
  ES  :  0             %ES :  00.000
  SES :  0             %SES:  00.000
  EFS : 183            AS  : 183
  DGRM:  0             UAS : 0

HOLDSCR   PRINT                 more
```

Figure 5.4.B   E1 Measurement screen, pg. 1

The following definitions are specific to this screen.

CLKSLIP
This is the number of clock slips that have occurred since the beginning of the test. This number will increase with time.

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

HDB3 substitution.

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

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

CRCR
The test set displays the rate at which it is receiving/transmitting CRC-4 errors

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

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

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

FASE
This is the count of Framing word Errors which have occurred since the beginning of the test.

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

MFAL

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

MFER

This is the MultiFrame word Error Rate since the beginning of the test.

MFSE

This is the number of MultiFrame word errors which have been counted since the beginning of the test.

SES

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

%SES

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

UAS

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

E1 Measurement screen, page 2

This screen shows data such as alarm and frequency variances. See Figure 5.4.C for a sample screen.

```
                              14:42:57
ET:   000:22:31     RT:  CONTINU
FRM:  PCM-30        COD:  HDB3
DS2:  1             E1:   01

         E1  MEASUREMENT
  AISS:  0       FREQ:  2048001
  LOFS:  0       MaxF:  2048004
  LOSS:  0       MinF:  2048000
  FALM:  0       +WDR:  NOREF
  MFAL:  0       -WDR:  NOREF
  Vpk :  0       Lpk :  N/A


  HOLDSCR   PRINT              more
```

Figure 5.4.C   E1 Measurement screen, pg. 2

E1 Measurements, Frequency screen

Page three of an E1 mode's Measurement Results is the frequency screen, which shows relevant frequency information.

- The bar graph indicates how fast the signal is slipping in relation to the reference clock
- If an external clock is not in use, you will see a "No External Clock" message.
- Note that the bar graph slips most rapidly at the center position, and then gradually slows down as the length of the bar increases.
- A count of the number of clock slips is kept at the end of the bar
- At 356 clock slips the graph resets itself.

One clock slip occurs when the measured frequency deviates from the reference frequency by one unit interval. A unit interval is equal to 488 nanoseconds.

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```
                                    08:58:23
    ET:    000:14:58      RT: CONTINU
    FRM:   PCM-30         COD: HDB3
    DS2:   1              E1:   01

                E1 MEASUREMENT
    NEG              0                POS
     -+--+--+-----+-----+--+--+--+-
                  >>>>             043

    RCV hz: 2048005
    Max hz: 2048006 CLKSLIP:  43
    Min hz: 2048005 +WANDER:  43
                    -WANDER:   0

    PAGE-UP   PAGE-DN   RESTART   more
```

Figure 5.4.D E1 Measurement, frequency screen

The following measurements are specific to this screen:

Max, Min hz
These are the maximum and minimum frequencies measured since the beginning of the test.

6.0 OTHER MEASUREMENTS

The OTHER MEASUREMENTS menu is displayed in Figure 6.A. Note that this menu is not available in DS3/E1 or E1 test modes.

```
                                          15:53:00
        OTHER MEASUREMENTS


        VIEW RECEIVED DATA
        BRIDGE TAP DETECT
        QUICK TEST - I
        QUICK TEST - II
        ISDN PRIMARY RATE
        PROPAGATION DELAY
        PROTECT SWITCH TIMING
```

Figure 6.A   OTHER MEASUREMENTS screen

6.1 VIEW RECEIVED DATA

This menu item allows you to view and store 32 pages of live T1 received data. Refer to Figure 6.1.A for a typical VIEW RECEIVED DATA display for DS1 traffic.
In a DS3-only mode, the DS3 traffic is displayed as 8 bits.

Use this procedure:

1) Select OTHER MEASUREMENTS from the MAIN MENU.

2) Select VIEW RECEIVED DATA.

3) Use the F1 (PAUSE) key to trap the live data.

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```
                                        07:31:55

                 VIEW RECEIVED DATA
         PAGE: 01
         T/S    BINARY      HEX      ASCII
         001   11011111   DF  (FB)      (  )
         002   11000100   C4  (23)      (#)
         003   01000010   42  (42)   B  (B)
         004   00011110   1E  (78)      (x)
         005   01100101   65  (A6)   e  (  )
         006   00101110   2E  (74)   .  (t)
         007   11010100   D4  (2B)      (+)
         008   11000101   C5  (A3)      (  )


         PAUSE   PAGE-DN   PAGE-UP   STORE
```

Figure 6.1.A   View Received Data

4) Use the F2 (PAGE-DN) and F3 (PAGE-UP) to access all 32 pages of data. Each line of the display is dedicated to a single timeslot.

- If you wish to store the received data for later use, then press the F4 (STORE) key. A message will appear near the bottom of the display indicating "RCV PATTERN STORED AS RCVxx". The received pattern has now been added to the group of USER-defined patterns in the SEND TEST PATTERN MENU. You may now access this pattern for viewing or editing at any time.
- If you wish to print your newly-stored pattern, then enter the OTHER FEATURES, PRINT RECORDS menu.
    a) For the "VIEW REC'D DATA BUFFER", select F1 (YES). When you press ENTER, all of your user-defined test patterns will be printed. Unlike the TEST RESULT BUFFER, your user-defined patterns may be printed as many times as you like.
- If you wish to print only certain screens of the received data, you may want to attach a printer and use the PRN SCRN key.
- Refer to the display definitions below.

5) When you are finished, press ESCAPE twice to return to the MAIN MENU. Here are the display definitions:

PAGE
This entry shows what page number the display is currently showing. 32 pages of data are available for viewing and printing.

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

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

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

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

6.2 BRIDGE TAP DETECT

The bridge tap test, available in either DS1 or Chan DS3 Mode, sends 21 different patterns down a span that has been previously looped up. Each pattern is measured for 30 seconds.

```
                                        17:16:17
ET: 000:00:21          RT: 000:00:09
XMT: 1-8               RCV: 1-8
RATE 1.536 MHz

          G.821 MEASUREMENT

BIT : 0               BER : 0.0e-08
ES  : 0               %ES : 00.000
SES : 0               %SES: 00.000
EFS : 21              %EFS: 100
AS  : 21              UAS : 0
SYLS: 0               DGRM: 0


PAGE-UP   PAGE-DN          CONTINU
```

Figure 6.2.A   Bridge Tap G.821 results

```
                                        17:16:17
          BRIDGE TAP DETECT
PAGE:   1


    PATRN    BIT ERRS     ES    AS

1   1111     12           2     30
2   0101     0            0     30
3   1-4      16           2     30
4   1-6      0            0     30
5   1-7      0            0     30
6   1-8      8            1     30
7   2-10     IN PROG


PAGE-UP   PAGE-DN          CONTINU
```

Figure 6.2.B Bridge Tap Results

To run this test, use the following procedure:

1) Be sure that you have a loopback in place at the far end of your circuit,
   and that the SET UP INTERFACE items have been properly configured.

2) From the MAIN MENU, cursor down to the OTHER MEASUREMENTS
   menu item and press ENTER.

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a) Cursor down to BRIDGE TAP DETECT, and press ENTER to start the bridge tap test. The test will now run each of the 21 patterns for 30 seconds apiece.

b) If you wish to have the test run indefinitely, press the CONTINU (F4) key. A "CONTI" indicator will appear at the top of the display and the test will now run continuously for up to 58 hours.

c) When you wish to end your testing, press the CONTINU (F4) key again. The test will complete after the 21st pattern is finished and you may page through the results.

3) You can observe the test in progress by looking at the G.821 results 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 0 0 30 is perfect. See Figures 6.2.A and B.

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         110100000000000000...
15 3-in-19         1100100000000000000...
16 3-in-20         11000100000000000000...
17 3-in-21         01000100000000000000001...
18 3-in-22         010001000000000000000010...
19 3-in-23         0100010000000000000000100...
20 3-in-24         01000100000000000000000100...
21 QRS
```

6.3 QUICK TEST - I and - II

The quick test can save about a half an hour of your time every time you need to accept a new hi cap service. If you want to use the default settings provided by the factory, you need adjust nothing. Simply press the ENTER key to begin. Check the detailed procedure that follows if you have any problems.

If you want to adjust the settings in the quick test, use the procedure shown in this section. The test set will remember the entries you made the next time you use the quick test. Refer to Figures 6.3.A & B.

```
                              17:31:55

             QUICK TEST - I

   TICKET   : ■
   LOOPBAK  : NI
   PRINT    : NONE



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


   INSERT  DELETE  toggle  SELECT
```

Figure 6.3.A   Ticket Entry

```
                              17:31:55

             QUICK TEST - I

   TICKET   :
   LOOPBAK  : NI
   PRINT    : NONE

       TEST PATTERN   DURATION
   0.3-24              005 min
   1.1111              005 min
   2.QRS               015 min
   3.QRS               015 min
   4.NONE              000 min


   YES      NONE
```

Figure 6.3.B   Other Entries

Two different quick test menus are provided. Quick Test I has the 3 in 24 pattern, and is used for AMI lines. Quick Test II has the 1 in 8 pattern is used for B8ZS lines.

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

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1) Before using the quick test, set your line interface in the SET UP INTERFACE menu to the following settings:
   - TERM mode
   - framing per the line specification
   - coding per the line specification
   - 1.544M test rate
   - INTERN transmit clock
   - buildout as appropriate for your test access point

2) Plug your cords into the TX and RX jacks on the test set and also into the IN and OUT jacks on the DSX.

3) From the MAIN MENU, enter OTHER MEASUREMENTS. Cursor down to QUICK TEST - I, and press ENTER.

4) If you don't need to enter a ticket name for your quick test, proceed to step 5). Otherwise, refer to figure 6.3.A for the ticket entry menu.
   a) Choose toggle (F3) to enter the alphabet grid. The letter A will flash.
   b) Cursor over to the first letter in your ticket name and choose SELECT (F4). Repeat this step until you have selected all the letters.
   c) Press toggle (F3) to get out of the alphabet grid.

   - Next, if you made a mistake while entering the letters for your ticket, you can change the letters.
     a) Simply cursor over to the mistaken letter in the TICKET menu item.
     b) Then press the DELETE key (F2) to get ride of the letter. Note that you can only use the DELETE key when you are out of the alphabet grid.
     c) When you have finished deleting letters, move the cursor back to the end of the TICKET name, press toggle (F3) to get back into the alphabet grid, and enter any additional letters.
     d) Press toggle (F3) to get back out of the alphabet grid and back to the TICKET name.

5) Cursor down to the LOOPBACK menu item.
   a) Choose CSU (F1), NI (F2), or NONE (F3) as appropriate.

6) Cursor down to the PRINT menu item.
   a) Choose YES (F1) or NONE (F2) as appropriate.

7) Cursor down to the first pattern. Scroll through the F-key options to

observe all of the different patterns you can send. Change the pattern if necessary.

8) Cursor over to the time for the first pattern.
   a) If necessary, change the time. First press the SHIFT-lock key so the SHIFT indicator shows in the display. Next, enter in any number between 001 and 999. Press the SHIFT key again to eliminate the SHIFT indicator.

9) Repeat 7) and 8) as necessary.

10) When all is set up on your quick test the way you wish, press ENTER, and the quick test will begin.
   a) You also have the option of pressing CONTINU (F4). A reverse video CONTI will appear at the top of the screen.
   b) The test set will continuously repeat the quick test until you press STOP (F4).
   Note: When you press STOP, the test set will not stop until it has completed its current test pattern sequence.

11) When the quick test is finished, you will see summary results.
   a) You can see if the loopback operations were successful. Press the PAGE-DN (F2) and PAGE-UP (F1) keys to view the test results from each pattern which was transmitted.
   b) Press the ESCAPE key when you are finished.
   c) If you wish to PRINT your results, enter YES at the PRINT line before beginning the Quick Test.

6.4 ISDN PRIMARY RATE

The ISDN PRIMARY RATE feature allows you to setup and place a call, receive a call, talk/listen (voice calls), or perform a BERT (data calls). This feature is available only in the DS1 mode.

To perform your testing, use this procedure:

1) From the MAIN MENU, enter the SET UP INTERFACE item and configure the screen settings for:

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TEST MODE: DS1
FRAME: as appropriate
TSTSG: PATRN
RATE: 1.544M
RECVR: TERM
CODE: as appropriate
TxLBO: 0 dB (or as appropriate)
TxCLK: INTERN

    a) Press ENTER when your settings are correct.

2) Connect your test set to the ISDN circuit.
    a) Verify that you are receiving valid DS1 PULSES, and that the appropriate FRAMING LED is lit. You will not be able to continue unless you are receiving valid T1 framing.

3) You now need to determine which channel is being used as the D channel. In most cases, the D channel will be in timeslot 24.
    a) To confirm this, enter OTHER MEASUREMENTS, VIEW RECEIVED DATA.
    b) Using the PAGE-DN (F2) key, examine the BINARY information until you observe the following pattern: 00111111. This may appear in a cyclical format as 01111110, 11111100, 11111001, etc. This is the pattern which is present on an idle D channel. You will need this D channel number for the sections which follow.

4) From the MAIN MENU, enter OTHER MEASUREMENTS, ISDN PRIMARY RATE. Refer to Figure 6.4.A.

```
                                    14:07:02

          ISDN PRIMARY RATE

         ┌─────────────┐
         │CONFIGURATION│
         └─────────────┘
          START LINK/CALL SETUP
          SETUP FILTER
          START TRACER
          VIEW/PRINT TRACER
```

Figure 6.4.A   ISDN Primary Rate

5) Enter the CONFIGURATION menu. Refer to Figure 6.4.B.

```
                                    14:07:02

              CONFIGURATION

         D channel #    : ┌──┐
                          │24│
         EMULATE TYPE   : └NT┘
         Q.931 STD      : AT&T
         DATACALL XMT   : PATRN
         DATACALL PAT   : 2047
         USER PATTERN   : 00000000
         OTHER          : NORMAL




         NEXT    PREVIUS
```

Figure 6.4.B   ISDN Configuration

6) D channel

Select the D-channel, which you determined in step 3).
Options: 1-24

- Use the NEXT (F1) and PREVIUS (F2) keys to make the selection.

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7) EMULATE TYPE
This is the emulation mode which the test set is configured
Options: TE (F1), NT (F2)

- TE, Terminating Equipment (F1), is used when the test set is emulating a piece of customer equipment.
- NT, Network Terminal (F2), is used when the test set is emulating an ISDN switch, such as a Northern Telecom DMS-100 or AT&T 5ESS.

8) Q.931 STD
This is the Q.931 specification which indicates which type of ISDN switch you intend to perform your testing with.
Options: AT&T (F1), NTI-a (F2), NTI-B (F3), NATNL-2 (F4)

- The NTI options relate to the Northern Telecom DMS-100 switch. The difference between the -A and the -B is in the exact setup messages being passed to and from the test set.
- The AT&T ("Custom") option relates to the 5ESS switch
- NATL-2 also relates to the 5ESS switch.
- If you are not sure what type of switch you are testing, then you may need to try each of the types.

DATACALL XMT
Options: PATRN (F1), LOOP (F2)

- If you are making a data call, but do not wish to transmit any test pattern on the line, then configure this item for LOOP (F2). Selecting LOOP will cause any received B-channel test patterns to be looped through the test set from DS1 RX to TX.
- Selecting PATRN (F1) will transmit your selected test pattern.
- If you are making a voice call, you do not need to configure this item.

DATACALL PAT
Options 2047 (F1), 511 (F2), 127 (F3), 63 (more, F1), 1111 (more, F2), 0000 (more, F3), USER (more, more, F1)

- If you are making a data call on the B channel, this is where you specify the pattern to be transmitted.
- If you wish to transmit your own user-defined 8-bit pattern, then select USER. The cursor will move to the USER PATTERN line.
  a) Press the shift key

b) Use the 1 and 0 keys to enter the pattern

c) Release the shift key

- If you are making a voice call, then you do not need to configure this item.

OTHER

Specify values for Layer 2 SAPI and TEI

Options: NORMAL (F1), SPECIAL (F2)

- Under normal circumstances, the factory default values of 0 should suffice.
- If you need to select alternate values, press the SPECIAL (F2) key,
    a) then increment/decrement the values as needed using the F-keys.

Layer 2 SAPI

This is the Service Access Point Identifier

Options: 0-63

- Select a value for this, using the F-keys to increment and decrement the value as desired.
- A value of 0 is normally used.

Layer 2 TEI

This is the Terminal End-Point Identifier.

Options: 0 - 127

- Select a value for this using the F-keys to increment and decrement the value as desired.
- A value of 0 is normally used.

7) Press ENTER when your settings are complete.

6.4.1 START LINK/CALL SETUP

Refer to Figure 6.4.C. Upon entering this menu, the test set will begin to establish its connection with the switch.

The screen will display the SEND and RECEIVED messages on the line. When the messages indicate that the test set is communicating with the switch correctly (messages stop flashing), press the Call Setup (F4) key.

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You may also press the STOP (F1) key if you wish to temporarily suspend communications with your switch. Pressing this key will prevent the test set from sending and receiving messages. You will then be able to page through the accumulated messages and restart communicating with the switch.

Press DISConnect (F2) to send a disconnect message to the switch, if necessary.

6.4.2 CALL SETUP

In this screen, you will setup the call configuration. Note that a "call" (F4) key is available for each line item, so you may place the call as soon as you are ready.

1) CALLED No.

This is number you wish to dial.

• Enter this number directly from the keypad using the SHIFT-lock key.

2) CALLER No.

This is the telephone number which the ISDN switch uses to identify you on the network.

• Specifying a CALLER No. is optional.
• If you would like to clear a previous entry, press the NONE (F3) key.

3) B CHANNEL

Specify the B channel you wish to use.
Options: 1- 24

• Use the NEXT (F1) or PREVIUS (F2) keys to change the channel number.

4) CALL TYPE

Specify the type of call
Options: VOICE (F1), DATA-56 (F2), DATA-64 (F3)

• The DATA-56 type is similar to the -64, except that bit 7 (least significant bit) is always a 1.
• If you have USER-defined an 8-bit test pattern and you are using the DATA-56 selection, the full 8 bits will still be transmitted, but they will

take up more than one time slot (i.e. they will not be byte aligned)
• With the DATA-64 selection, the 8-bit user pattern will be byte aligned.

```
                                   14:07:02
                   START LINK
SEND SABME
SEND SABME

RECEIVED MESSAGE
Layer 2 mesg RR
   SAPI:0      TEI:0




   STOP     DISC            CALLSTP
```

Figure 6.4.C   Start Link

```
                                   14:07:02

      CALL SETUP

      CALLED No. :
      □
      CALLER No. :


      B CHANNEL #: 1
      CALL TYPE  : VOICE
      NSF CODE   : NONE
      NSF TYPE   : N/A

      *          #              call
```

Figure 6.4.D   Call Setup

5) NSF Code
   Specify the NSF CODE (Network Specific Facilities)
Options: NONE (F1), NEXT 1-31 (F2), table (F3), call (F4)

---

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- Use the NONE (F1) or NEXT (F2) key to specify the code The NSF CODE must 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 (F4), and for the NT mode, NSF is set to 2.
- You may wish to view NSF options as specified by either AT&T Custom or National ISDN-2 by pressing the table (F3) key, The table also specifies whether the NSF CODE which you have selected is a service or feature. Use the PAGE-UP (F3) and PAGE-DN (F4) keys to scroll through the pages.

6) NSF TYPE

Select the NSF TYPE corresponding to the Code selected above
Options: SERVICE (F1), FEATURE (F2), table (F3), call (F4)

- If you have selected NONE for the NSF CODE, the NSF TYPE will be given as N/A.
- You may wish to view the NSF Type options as specified by either AT&T Custom or National ISDN-3 by pressing the table (F3)key. This table gives the NSF TYPE and NSF CODE for certain options. In this table, FEATURE is deginated by "f", SERVICE by "s". Use the PAGE-UP (F3) and PAGE-DN (F4) keys to scroll through the pages.

7) When your settings are correct, press the "call" (F4) key to establish your call with the switch.
- If you specified a VOICE call, you may perform a talk/listen on the line to ensure that it is working properly.
- Or, verify that you have pattern synch (PAT SYNC LED) and that you are receiving no errors (ERRORS LED) for your DATA call.
- If you are satisfied with your call after it has connected with the switch, you may press DISC (F2) to disconnect (hang up) and release the line.
- While you are connected and receiving the ISDN messages, press the STOP (F1) at any time.
   When this has been selected, NEXT (F2) and PREVIUS (F3) options will appear. Use these to scroll through the various messages which you have just captured on the D channel.

6.4.3 SETUP FILTER

Refer to Figure 6.4.E. You may filter out certain messages on the D channel by using this feature.

1) FILTER TYPE;
Select a filter if desired
Options: CALLREF (F1), CALLED# (F2), CALLER# (F3), NONE (F4)

- If you select a filter, press the Down Arrow key to enter the value you have selected.
  - a) Using the SHIFT-lock key, enter this value directly from the keypad.
- If you wish to capture all of the layer 2 and layer 3 messages appearing on the D channel, then select NONE (F4).
- If you just wish to capture layer 3 messages, select CALLREF and leave the NUMBER field blank.

a) Press ENTER when your settings are correct.

```
                                    14:07:02

                  D CHANNEL FILTER

        FILTER TYPE    : [CALLREF]

        NUMBER   :        (in Decimal)




        CALLREF   CALLED#   CALLER#   NONE
```

Figure 6.4.E   Setup Filter

6.4.4 START TRACER

Refer to Figure 6.4.F. The START TRACER screen captures and

displays the messages currently appearing on the D channel, according to the SETUP FILTER configuration you specified.

> **Note:** If you are monitoring the D channel of an active ISDN circuit, be sure that you have configured your SET UP INTERFACE for a monitor application

The messages will scroll across the screen in real-time. If the messages appear too quickly for you to view, press the PAUSE (F2) key to halt the monitoring. When you are ready to continue capturing messages, press the RESUME (F2) key.

Use the F3 (HEX/DECODE) key to select the display format of the messages you receive. Choose from DECODE or HEX. This selection will not affect the way in which the messages are stored inside the test set.

6.4.5 VIEW/PRINT TRACER

This item allows you to view each of your previously-stored D channel messages.
- If you wish to view only a certain range of messages, you may enter the range value directly from the keypad.
  a) To do this, use the SHIFT-lock and numeric keys to enter the VIEW FROM and VIEW TO numbers
- Press VIEW (F3) to view the records
- Press CLR-ALL (F1) to clear the buffer
- From this menu, you may also print the stored messages, by pressing the PRINT (F2) key
- After entering the START LINK/CALL SETUP or START TRACER menus, the entire storage buffer will be cleared.

```
                              14:07:02
TOTAL No.3        DISPLAY No.3


  RECEIVED-MESSAGE

95-12-18   18:03:48.36
Layer 2 mesg SABME
  SAPI:0      TEI:0




RESTART    PAUSE    HEX
```

Figure 6.4.F   Start Tracer

6.5 PROPAGATION DELAY

The Propagation Delay screen shown in figure 6.5.A displays the propagation on a looped back signal. This function applies only to the DS1 Test Mode. The circuit must be looped back at the far end in order for the test set to perform this measurement.

```
                              11:31:05
            PROPAGATION DELAY

RND  TRIP DELAY: 28          UI
RND  TRIP TIME : 18          uS
ONE  WAY DIST  :  7          kFT

  (ASSUMING 500 ft PER U.I.)




RESTART
```

Figure 6.5.A   Propagation Delay Screen

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The test set measures the number of unit intervals required for the signal to travel down the line, and then return. This number is converted into microSeconds of round trip delay. One UI (Unit Interval) equal .488 uS (microSeconds). Use the following procedure:

1) Establish a loopback

2) From the OTHER MEASUREMENTS menu, enter PROPAGATION DELAY.
   • The measurement will automatically be performed.
   • Use the RESTART (F1) key to perform another measurement, if desired.

6.6 PROTECT SWITCH TIMING

This feature, available only in DS1 testing, is used to measure the duration a switch or a multiplexer takes to perform the Protective Switching function. Protective Switching occurs when a switch or a multiplexer detects one of its active trunks are broken; it automatically selects an alternative trunk to carry the traffic. Protective Switching Timing is usually about 50-70ms.

Enter PROTECT SWITCH TIMING from the OTHER MEASUREMENTS menu to begin timing. See Figure 6.6.A.

```
                                    11:45:47
              PROTECT  SWITCH  TIMING

          STATUS :   TIMING

          EVENT                 TIME

          FRM LOSS              00.00
          SIG LOSS              00.00
          END SIG LOSS          00.20
          SIG LOSS              00.23
          END SIG LOSS          00.26
          END FRM LOSS          00.29

     RESTART PAGE-UP   PAGE-DN    PRINT
```

Figure 6.6.A Protect Switch Timing screen

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- Press RESTART (F1) to restart the timing process
- Use the PAGE-UP (F1) and PAGE-DN (F2) keys to scroll through the results.
- Press PRINT (F4) to print the results

7.0 Using the OTHER FEATURES menu

The OTHER FEATURES menu allows the user to configure most of the SunSet T3 parameters. Items which are not configurable from this menu are:

1) The SET UP INTERFACE menu items. These relate to the manner in which the user will connect to the circuit under test.

2) The VOICE FREQ FUNCTIONS menu items. The VF setup parameters are configurable from within the VOICE FREQ FUNCTIONS, DIAL/ SPRVIS SETUP menu item.

From the MAIN MENU, select OTHER FEATURES Refer to Figure 7.A.

```
                                    12:44:56

        OTHER FEATURES

        ERROR INJECTION
        TEST PARAMETERS
        PRINT RECORDS
        GENERAL CONFIG
        ERASE NV RAM
        FULL SELF TEST
        CLR PRINT BUFFER
        VERSION/OPTION
        FACTORY DEFAULTS
        GENERATE ALARMS
        VIEW TEST RECORD
```
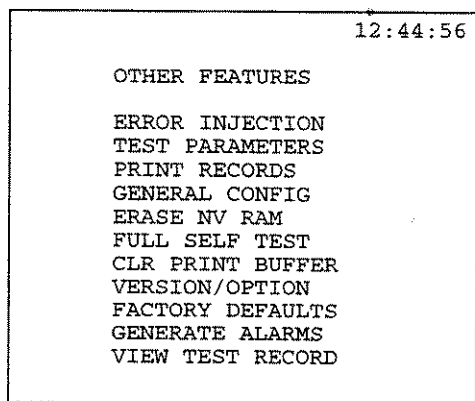
Figure 7.A OTHER FEATURES Menu

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7.1 ERROR INJECTION

Configure the SunSet's ERROR INJECTION parameters as shown in Figure 7.1.A using this procedure:

1) TYPE
Select the type of errors you wish to insert
Options: BPV (F1), LOGIC (F2), LOG&BPV (F3), FBE (F4)

- Select BPV for Bipolar Violations
- Select LOGIC for bit errors
- Select LOG+BPV to generate logic and bit errors simultaneously
- Select FBE to generate a framing bit error
- In E1 test modes, only LOGIC errors are available

```
                                    08:54:44
                  ERROR  INJECTION


              TYPE   :   LOGIC

              MODE   :   RATE

              RATE   :   1E-6



   RATE    BURST
```
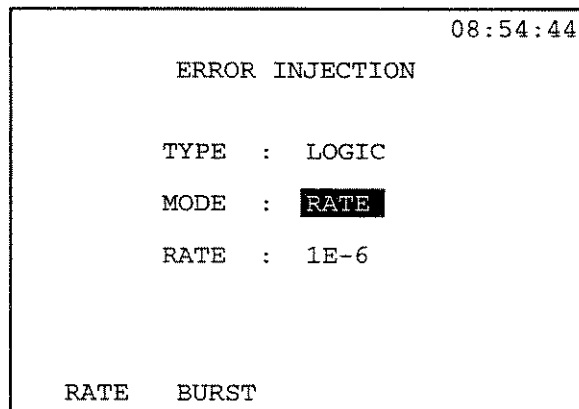
Figure 7.1.A   Error Injection screen

2) MODE
Select the error injection mode
Options: RATE (F1), BURST (F2)

- BURST mode allows a set number of errors to be injected with each press of the ERR INJ key.

a) Cursor down to COUNT.
b) Press the SHIFT-lock key and observe the SHIFT indicator in the

upper left-hand corner of the screen.

c) Using the keypad, enter the number of errors you wish to inject each time the ERR INJ key is pressed. The SunSet will accept values between 1 and 9999.

- RATE mode allows errors to be injected continuously at a specified rate.
a) Cursor down to RATE.
b) Press the SHIFT-lock key and observe the SHIFT indicator in the upper left-hand corner of the screen.
c) Enter the constant rate at which you wish to inject errors when the ERR INJ key is pressed. The SunSet will accept values between 1e-3 and 9e-9.

5) When the settings are complete, press ENTER.

Error injection is usually performed to verify presence of a loopback. Simply press the ERR INJ key, and the SunSet will insert the type and quantity of errors you have specified. If you are looped back, the ERRORS LED will light.

Note that when you actually inject the errors, the errors will be inserted during a 1 second period, and will cause from 1 to 2 errored seconds.

7.2 TEST PARAMETERS

The SunSet allows the user to customize various measurement parameters.

These parameters will not normally need to be configured by the user. Factory default settings may be restored by selecting OTHER FEATURES, FACTORY DEFAULTS from the MAIN MENU.

If you need to change the test parameter settings, refer to Figure 7.2.B, and use the following procedure:

1. Select OTHER FEATURES, TEST PARAMETERS from the MAIN MENU.

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```
                                  11:41:45

                TEST PARAMETERS

        MEAS DURATION: │CONTINU │
        DS1 OOF      : 2/5
        PATTERN INVRT: DISABLE
        DS1 IDLE CHNL: 7F-HEX
        DS3 XMT CLOCK: INTERN
        DS3 REF CLOCK: INTERN
        PATTERN LOCK : DISABLE



    TIMED   CONTINU
```
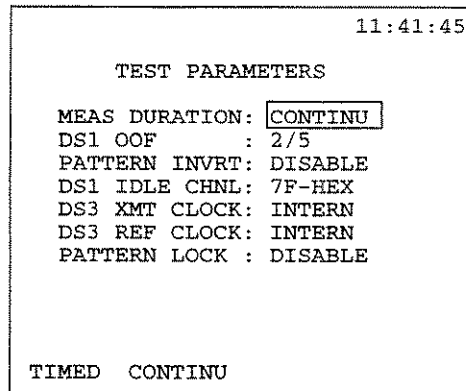
Figure 7.2.B   Test Parameters

MEAS DURATION
   Select the duration of your MEASUREMENT RESULTS testing
Options: TIMED (F1), CONTINUous (F2)

- CONTINU: The SunSet T3 is CONTINUously performing measure-
  ments on its received signal. Measurement results will continue
  indefinitely until the user either restarts the testing process or
  changes the SunSet's configuration. These results are viewed by
  selecting MEASUREMENT RESULTS from the MAIN MENU.

- TIMED: A timed measurement will be stopped after the specified
  amount of time has elapsed. This is useful for making measurements
  of a exact duration. 15 minute and 1 hour tests are commonly used
  in the industry. These results are viewed by selecting MEASURE-
  MENT RESULTS from the MAIN MENU. When a timed test is in
  progress, the Remaining Time (RT) counter in this menu shows how
  much time is left before the end of the test. The averaging interval
  is used only for DS1 results.

  If you choose TIMED:
  a) Enter a number between 1 min and 999 hr, 99 min, using the
     SHIFT-lock key to enter values directly from the keypad.

2) DS1 OOF

Select the DS1 out-of-frame criteria
Options: 2/4 (F1), 2/5 (F2)

- You may choose either 2-in-4 or 2-in-5 frame errors as the condition for declaring an OUT-OF-FRAME. This may be useful on a corporate basis if it is desired that all test and monitoring equipment report an OUT-OF-FRAME condition under exactly the same conditions.

3) PATTERN INVRT

Options: ENABLE (F1), DISABLE (F2)

- When pattern inversion is enabled, it will transmit the complement of any selected test pattern. For instance, with pattern inversion selected, a 3-in-24 pattern will actually be transmitted as a 21-in-24 pattern.
- Note that in the DS3 TEST MODE, PATTERN INVERSION is not allowed.

4) DS1 IDLE CHNL

Select the DS1 Idle Channel Code
Options: 7F-HEX (F1), FF-HEX (F2)

- You may set 7F-Hex (0111 1111) or FF-Hex (1111 1111) as your idle channel code.
- This code is then used during VF channel access operations when the line interface is set to the TERM mode.
- The idle code is also used in fractional T1 testing to fill up the unused channels.

5) DS3 XMT CLOCK

Select the clocking of the DS3 transmitted signal
Options: DS3-Rx (F1), INTERN (F2), EXTERN (F3)

- INTERN is the factory default setting, and this will be used in most cases. The SunSet provides its own clocking.
- Select DS3-RX to have the SunSet take its clock off the received DS3 port.
- Select EXTERNal to have the SunSet take clocking from the EXTernal CLocK port.

---

6) DS3 REF CLOCK

Select the reference clock that the test set will compare its received DS3 signal to

Options: INTERN (F1), EXTERN (F2)

- Normally this will be set to INTERN.
- If you select EXTERN, plug your source into the DS3 EXT CLK port on the right side connector panel.

7) PATTERN LOCK

You may ENABLE or DISABLE the PATTERN LOCK

Options: ENABLE (F1), DISABLE (F2)

- The factory default is DISABLE, which allows the test set to attempt to resynchronize on any known test pattern. When the test set loses pattern sync, it will automatically attempt to resynch onto any received pattern. If a new pattern is detected, the test set will display it on the GRAPHIC screen and the PAT SYNC LED will light. If no test pattern is detected, it will declare the signal as "LIVE". Pressing the RESYNCH key will cause the test set to search the received signal for any known test pattern.
- Having the pattern lock ENABLEd causes the test set to search the received signal only for the pattern which it is currently transmitting. This is specified in the SEND TEST PATTERN menu. If the test set does not detect this one pattern, then it will declare the signal as "LIVE". If the received pattern changes, the test set will not automatically try to resynch on the new pattern. Pressing the RESYNCH key will cause the test set to search only for the one pattern which it is currently transmitting.

7.3 PRINT RECORDS

You may print out a variety of information using the PRINT RECORDS menu. See Figure 7.3.A for a sample screen.

```
                              02:22:13

           PRINT RECORDS

   TEST RESULT BUFFER:
                  95-01-12 02:21:26
   VIEW REC'D DATA BUFFER:
                  YES




   ALL     NONE     NEXT
```
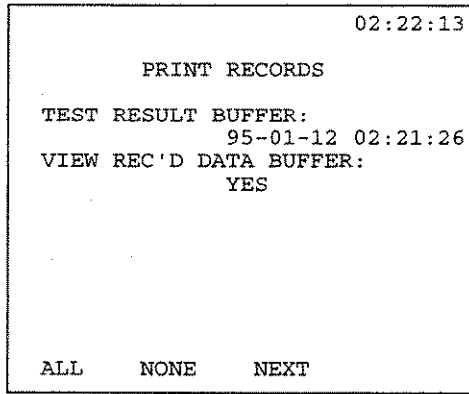
Figure 7.3.A   Print Records

Use the following procedure:

1) Connect the SunSet to the printer. Be sure power is applied to the SunSet
   and to the printer.

2) Press the PRN SCR (print screen) key to make sure the test set and printer
   are working together properly. If the PRN SCR does not print your
   current screen, refer to the Section "Using the Serial Port" in the
   Applications chapter, for detailed instructions on how the printer should
   be configured to operate with the SunSet.

3) Set up the individual records to be printed.

   a) TEST RESULT BUFFER:
   - Choose ALL (F1) to print all the last 10 results which are in the
     buffer. This function requires a lot of time to complete so don't use
     it until you are ready to leave the printer and test set in a printing
     mode for a long time.
   - Choose NONE (F2) to not print any test results.
   - Choose NEXT (F3) to print the next saved result.

   b) VIEW REC'D DATA BUFFER:
   - Choose YES (F1) to print all 32 pages of data which were stored
     the last time you exited from the OTHER MEASUREMENTS, VIEW

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RECEIVED DATA screen.
• Select NO (F2) to not print the received data.

7.4 GENERAL CONFIG

The GENERAL CONFIGuration screen allows you to set the time, date, backLIGHT duration, and serial port characteristics. Refer to figure 7.4.A.

Follow this procedure:

1) From the OTHER FEATURES menu, select GENERAL CONFIG.

```
                                    06:44:12

                    GENERAL CONFIG

            DATE (Y-M-D): 92-08-03
            TIME (H:M:S): 06:43:55

            BACK LIGHT  : CONTINU
            PRINTER
             BAUD RATE  : 1200
             PARITY     : NONE
             STOP BIT   : 1-BIT
             BITS/CHAR  : 8-BIT
             PRNT PERIOD: LAST
```

Figure 7.4.A   General Configuration

2) DATE
Set the date in the Year-Month-Day format

    a) Press SHIFT-lock to display the SHIFT indicator in the screen.
    b) Press the appropriate number keys for the year, month and day. Note that the test set inserts the hyphens for you. Numbers that are out of range will be rejected.
    c) Press SHIFT-lock to remove the SHIFT indicator from the display.

3) TIME
Set the time of day in the Hour-Minute-Second format

a) Press SHIFT-lock to display the SHIFT indicator in the screen.

b) Set the time by pressing the appropriate number keys for the hour, month, and day. Note that the test set inserts the colons for you. Numbers that are out of range will be rejected.

c) Press SHIFT-lock to remove the SHIFT indicator from the display. Cursor down to the BACK LIGHT menu item and note that the clock is started.

4) BACK LIGHT

Set the back light timer

- This timer controls how long the backlight will stay lit when you press the LIGHT key.
- Choose CONTINU (F2) if you want the backlight to stay on continuously until you press the LIGHT key again.
- Choose TIMED (F1) if you want the backlight to automatically turn itself off after the indicated number of minutes.
  a) After you choose TIMED, press the SHIFT-lock key.
  b) Type in any number of minutes between 1 and 99. 1 minute is the default time.
  c) Press SHIFT again to remove the SHIFT indicator from the display.

5) SERIAL PORT

Determine the serial port settings

- The factory default settings work with the thermal printer supplied by the factory. The factory default settings are as follows:
  BAUD RATE: 9600
  PARITY: NONE
  STOP BIT: 1-BIT
  BITS/CHAR: 8-BIT

- If you need an in-depth description of how to configure the printer, refer to the Applications chapter, the "Configuring for Printing" section.

  To change the settings for your printer:
  a) choose a baud rate of 1200 (F1), 2400 (F2), 9600 (F3), or 19.2K (F4).
  b) choose a parity NONE (F1), EVEN (F2), or ODD (F3).
  c) choose a stop bit of 1-BIT (F1) or 2-BIT (F2).
  d) choose a bits per character of 7-BIT (F1) or 8-BIT (F2).

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• Set up printer's printing instructions in the PRNT PERIOD line:

a) choose TIMED (F1) if you would like to have the printer print out results at a regular interval during a BASIC MEASUREMENT. The default time is 1 minute. You may enter any interval between 1 minute and 99 minutes.
  • To change the interval, press the SHIFT-lock key to display the SHIFT indicator.
  • Enter the desired numbers from the keypad.
  • Press SHIFT-lock again to remove the SHIFT indicator.
b) or, choose EVENT (F2) if you would like the printer to print out a result every time an error or alarm condition is reported.
c) or, choose LAST (F3) if you would like the printer to print out a result only at the conclusion of a test. If you use this setting, and you would like to print out the results of a continuous test (i.e. a test where the Remaining Time is CONTINUous), then you will need to manually press the PRINT (F2) key inside of the MEASUREMENT RESULTS menu in order to send the results to the print buffer.

Note: Each result can only be printed once and then the printer buffer is emptied.

7.5 ERASE NV RAM

This operation is performed as a last resort if the SunSet T3 is not functioning correctly.

Perform this operation only after attempting to correct the problem by:

1) Ensuring that the SunSet is configured properly for your particular circuit application.
2) Switching the SunSet's power off and then on again.

WARNING
Performing the NV RAM ERASE operation will erase all user-defined information and stored results. This includes all loopback codes, user-defined patterns, telephone numbers, and measurement data.

If the above suggestions failed to correct the problem, use this procedure:

1) From the OTHER FEATURES menu, select ERASE NV RAM.

2) A warning message will be displayed. If you wish to proceed with the erase operation, press ENTER. Otherwise, press ESCAPE to abort the erase operation.

3) Observe the "WORKING..." status message.

4) Observe the "Turn power OFF then ON now" message. Turn the POWER off now. Wait until the power has been off for a full 5 seconds.

5) Switch the POWER back on. The erase procedure is now complete. In order to determine if the SunSet is working as desired, you will need to reconfigure the SET UP INTERFACE menu items.

7.6 FULL SELF TEST

Use the FULL SELF TEST to allow the SunSet T3 to perform an internal hardware and memory check.

Use this procedure:

1) From the OTHER FEATURES menu, select FULL SELF TEST.

2) View the flashing LEDs, and confirm that each of them is functioning correctly.

3) View the results of the test. The test should complete, and a NO ERRORS message should be displayed.

Note: if one or more error messages are displayed, use the following procedure:

   a) Perform the ERASE NV RAM procedure, (as described in the preceding section).
   b) Perform the FULL SELF TEST operation again.
   c) If any errors are still reported, contact Sunrise Telecom Customer Service for further assistance at (408) 360-2200.

7.7 CLR PRINT BUFFER

This command clears the SunSet's internal print buffer. It saves you time by clearing out unwanted information before you turn on the printer.

To perform this function, use the following procedure:

1) From the main menu, enter the OTHER FEATURES menu item, then press ENTER on CLR PRINT BUFFER to clear the buffer. You will see the screen flash momentarily while the buffer is cleared. You have completed the operation.

7.8 VERSION / OPTION

This feature displays the SunWare version, serial number, and SunWare options.

Use the following procedure:

1) From the OTHER FEATURES menu, select VERSION/OPTION.

2) Observe the configuration of your SunSet T3. Use the PAGE-UP (F1) and PAGE-DN (F2) keys to scroll though the pages.

3) Press ESCAPE until you have returned to the MAIN MENU.

7.9 FACTORY DEFAULTS

This function restores all of the SunSet T3 settings to their factory default values. If another user has reconfigured your SunSet, select FACTORY DEFAULTS to ensure that the appropriate out-of-frame, dialing interval, etc. settings are restored. It may not be apparent which settings have been changed, as some of these are accessed within sub-menus.
Use the following procedure:

1) From the OTHER FEATURES menu, select FACTORY DEFAULTS.

2) Observe the "SETTING TO FACTORY DEFAULTS" status message.

3) Press ESCAPE until you have returned to the MAIN MENU.

7.10 GENERATE ALARMS

When any of these are selected, an alarm indication is displayed on the top right hand section of the screen. This screen is not available in the E1 modes. See Fig 7.10.A. The alarms available depend on the selected Test Mode.

```
                                    12:21:11

                GENERATE DS3 ALARMS

                DS3 ALARM: NONE




    NONE       AIS       YELLOW     IDLE
```
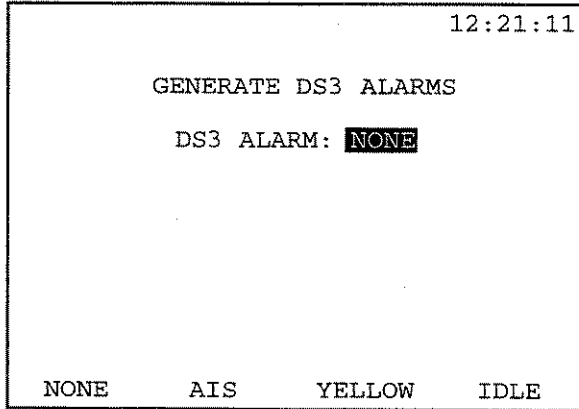
Fig 7.10.A   Generate Alarms

1) DS3, DS2 or DS1 ALARM
Select the desired alarm, if any
Options: NONE (F1), AIS (F2), YELLOW (F3), IDLE (F4)

7.11 VIEW TEST RECORD

This feature allows you to view stored test results. Refer to Figure 7.11.A for the VIEW TEST RECORD screen.

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```
                                    23:35:33

            VIEW TEST RECORD

            TOTAL EVENT    0
            TOTAL RESULT   0

            EVENT RECORD
              VIEW FROM:   0
              VIEW TO  :   0
            RESULT RECORD
              VIEW FROM:   1
              VIEW TO  :   8


    ALL     NONE   CLR-ALL    VIEW
```

Figure 7.11.A   View Test Record

1) From the MAIN MENU, ENTER the VIEW TEST RECORD item.   You will
   see the VIEW TEST RECORD screen.   The TOTAL EVENT and TOTAL
   RESULTs are shown in accordance with the events and results stored
   in memory.

2) The cursor is automatically placed at the VIEW FROM of the EVENT
   RECORD.
   a) Select ALL (F1), NONE (F2), CLR-ALL (F3), or VIEW (F4).
   b) If specific EVENTS are desired, press the SHIFT key, and enter the
      desired EVENT range.   Press SHIFT again to remove the SHIFT
      indicator.

3) Cursor to VIEW FROM of the RESULT RECORD.
   a) Select ALL (F1), NONE (F2), CLR-ALL, or VIEW (F4).
   b) If you wish to view specific RESULTS, press the SHIFT key, and enter
      the desired range.   Press SHIFT again to remove the indicator.

4) Pressing VIEW (F4) will cause the test set to display your chosen EVENT
   or RESULT.
   a) Use the NEXT (F1) and PREVIUS (F2) keys to view each record.
   b) PAGE-UP (F3) and PAGE-DN (F4) will allow you to view the different
      pages within a record.

8.0 Using the VOICE FREQ FUNCTIONS menu

In order to access the VOICE FREQ FUNCTIONS menu, the signal under test must have valid framing. Channels can only be identified in a framed signal. You must be in DS1 or ChanDS3 test mode to use all of these features. In the E1 modes, you will have the VF MEASUREMENTS option.

Refer to Figure 8.A for the available VF options. To view this screen, select the VOICE FREQ FUNCTIONS option from the MAIN MENU.

```
                              12:44:56

       VOICE FREQ FUNCTIONS

       VF MEASUREMENTS
       VIEW SUPERVISION
       DIAL/SPRVIS SETUP
       PLACE/RECIEVE CALLS
       NOISE MEASUREMENT
       MF/DTMF/DP ANALYSIS
```
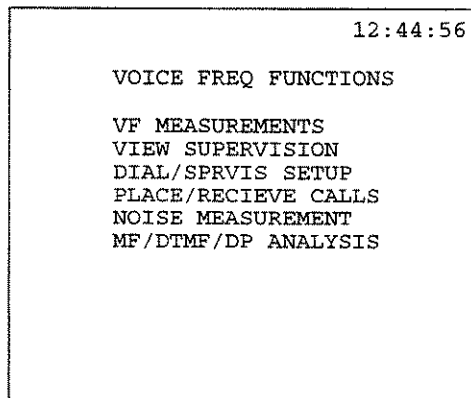
Figure 8.A   Voice Freq Functions

8.1 VF MEASUREMENTS

Refer to Figure 8.1.A. Only the RCV CHANNEL choice is available for DS3/E1 and E1 test modes.

Use the following procedure:

1) From the MAIN MENU, select the VOICE FREQ FUNCTIONS option.

2) Select the VF MEASUREMENTS option.

3) XMT CHANNEL
Configure the transmit channel
Options: 1-24 for DS1 and ChanDS3 modes

- Use the F1 (NEXT) and F2 (PREVIUS) keys to select a channel

4) RCV CHANNEL
Configure the receive channel
Options: 1-24 for DS1 and ChanDS3 modes, 1-31 for E1 modes

- Use the F1 (NEXT) and F2 (PREVIUS) keys to select a channel
- The receive channel number need not correspond to the receive number, however, these will usually be the same.
- For DS3/E1 and E1 Test Modes, you will be able to monitor voice or tone on the selected receive channel.

```
                                    12:44:56

                    VF  MEASUREMENTS

          RCV  CHANNEL  :  01
          XMT  CHANNEL  :  01
          TEST  TONE    :  ENABLE
          TONE  FREQ    :  1004
          TONE  LEVEL   :  0  dBm
          Tx  A/B       :  0  0

          Rx  A/B       :  0  0
          Rx  DATA      :  00000000
          RxFREQ/LEVEL:  1004   00.0

      MINUS    0  dBm   -13dBm
```

Figure 8.1.A   VF Measurements

5) INSERT TYPE
Select your desired insert type
Options: TALK (F1), TONE (F2), QUIET (F3).

- Select TALK to talk on the transmit signal; the SunSet will transmit speech from the microphone located at the bottom of the test set
- In the QUIET mode, the SunSet's speaker will not operate.
- Press TONE to insert a tone on the transmit signal
  a) If you have INSERTed the TONE, cursor down to the TONE FREQ item. Select the desired frequency of 404 (F1), 1004 (F2), 1804 (F3), or use the F4 (more) key to access 2713 (F1) or 2804 (F2).

• If you wish, you may enter your own tone frequency directly from the keypad using the SHIFT-lock key. Valid frequencies range from 40 Hz to 3904 Hz.

b) If you have INSERTed the test TONE, cursor down to the TONE LEVEL item and select either F2 (0 dBm) or F2 (-13 dBm).
• If you wish, you may select your own level by entering a value directly from the keypad using the SHIFT-lock key. Use the F1 (MINUS) to place the "-" sign before your value, if necessary.

6) Tx A/B(/C/D)
Select the supervision you wish to put on the line, if desired
Options: ON-HOOK (F1), OFFHOOK (F2),WINK (F3), SEND (F4)

• As you select one of these choices, the supervision will immediately be sent. Note that you can emulate different kinds of equipment by configuring the SunSet as described in 7.3 DIAL/SPRVIS SETUP.

•If you wish, you may enter the A/B(C/D) supervision state manually:

a) Press the SHIFT-lock key to display the SHIFT indicator in the upper left hand corner of the screen.
b) Press the 1 and/or 0 key as appropriate. If you make a mistake, press the SHIFT-lock key again to turn off the indicator, cursor back to the digit to be changed, press the SHIFT-lock key again to display the SHIFT indicator, press the correct number.
c) When the digits are correct, press SHIFT-lock again to remove the SHIFT indicator in the display.

• Press the F4 (SEND) key to transmit the supervision bits.
• At any time, you may look at the various measurements available on the screen.

7) Rx A/B(/C/D)
View the received channel's signaling bits

8) Rx DATA
View the received channel's data bits

---

9) RxFREQ/LEVEL
  View the received channel's level and frequency.

10) Press ESCAPE to return to the VOICE FREQ FUNCTIONS menu.

8.2 VIEW SUPERVISION

You may find it helpful to view all 24 channels of received supervision bits simultaneously. In this way, you can observe the status of all calls on the line at the same time.

Refer to Figure 8.2.A. and use the following procedure:

1) From the MAIN MENU, select the VOICE FREQ FUNCTIONS item.

2) Select the VIEW SUPERVISION menu item.

3) Observe the signaling bits of all channels simultaneously.
   - Note that SF-D4 and SLC96 framed signals will show A/B bit signaling information
   - ESF framed signals will show A/B/C/D signaling bit information.
   - Channels 1 through 4 are shown on the first line, 5 through 8 are shown in the second line, and so on.
   - Press HOLDSCR (F1) to freeze the presentation of data
   - Press CONTINU (F1) to resume the current presentation of data

4) Press ESCAPE to return to the VF CHANNEL ACCESS menu.

```
                                    16:41:50

            VIEW SUPERVISION

    CHANL    AB     AB     AB     AB
     001     01     11     11     11
     005     11     11     11     11
     009     11     11     11     11
     013     11     11     11     11
     017     11     11     11     11
     021     11     11     11     11



    HOLDSCR
```

Figure 8.2.A   View Supervision

8.3 DIAL/SPRVIS SETUP

In this menu, you can vary the on and off time for the DTMF, MF and DP digits in the dialing menus. You can also condition the test set to send the appropriate signaling bits for E&M, loop start, and ground start trunks with FX0 or FXS line cards. The set will use this conditioning in VF MEASURE-MENTS, Tx A/B/C/D. Refer to Figure 8.3.A, and use this procedure:

```
                                    04:10:32

        DIAL/SPVIS SETUP

        DIAL PERIOD    : [1]00 ms
        SILENT PERIOD  : 100 ms
        TONE LEVEL dBm: -5
        SUPERVISION
        TRUNK TYPE     : E & M
        EQUIPMENT      : N/A
        DIAL PULSE (10 pps)
        %BREAK         : 60
        INTERDIGIT PRD: 500
        IDLE SPRVISN   : 0 0 0 0
```

Figure 8.3.A   DIAL/SPRVIS SETUP

1) From the VOICE FREQ FUNCTIONS menu, cursor down to the DIAL/
SPRVIS SETUP menu and press ENTER.

2) DIAL PERIOD
Set the dial period if desired
Options: 10-999 ms

- This item specifies the dial period in milliseconds used for DTMF and
  MF dialing. The factory default value is 100 ms.

    a) Press and release the SHIFT-lock key so the SHIFT indicator is
       displayed in the upper left hand corner of the screen.
    b) Press the number keys to give the desired number of milliseconds.
       After the first three numbers are entered, the cursor will automati-
       cally move to the next line.
        - If you make a mistake, press and release the SHIFT-lock key so
          that the SHIFT indicator is no longer displayed in the screen.
          Move your cursor to the number that you want to change. Go
          into the SHIFT mode again and enter the desired number.
    c) When you are finished, press SHIFT again to get out of the SHIFT-
       lock mode.

2) SILENT PERIOD

Set the silent period if desired
Options: 10-999 ms

- This item specifies the silent period in milliseconds used for DTMF and MF dialing. The factory default value is 100 ms.
  - a) Press and release the SHIFT-lock key so the SHIFT indicator is displayed in the upper left hand corner of the screen.
  - b) Press the number keys to give the desired number of milliseconds. After the first three numbers are entered, the cursor will automatically move to the next line.
    - If you make a mistake, press and release the SHIFT-lock key so that the SHIFT indicator is no longer displayed in the screen. Move your cursor to the number that you want to change. Go into the SHIFT mode again and enter the desired number.
  - c) When you are finished, press SHIFT again to get out of the SHIFT-lock mode.

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

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

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

This item sets the %BREAK.
Options: 40%, 50%, 60%

- 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 PREVIUS (F2), to select the interdigit period.

9) 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.

8.4 Place/Receive Calls

If your set is equipped with SunWare option SW322 MF/DP/DTMF Dialing, Decoding and Analysis, you can also MF/DP/DTMF dial with your test set. MF Dialing is useful in inter-switch addressing applications. You can also DTMF dial a number in this menu. This can be useful if you are on an out-of-service T1, but still have access to a switch which will accept your supervision and dialing. This function is not available for E1 test modes.

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 super-

vision
- speed dial a stored number
- record a number with a label for future dialing
- edit or delete speed dial numbers

Figure 8.4.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
```
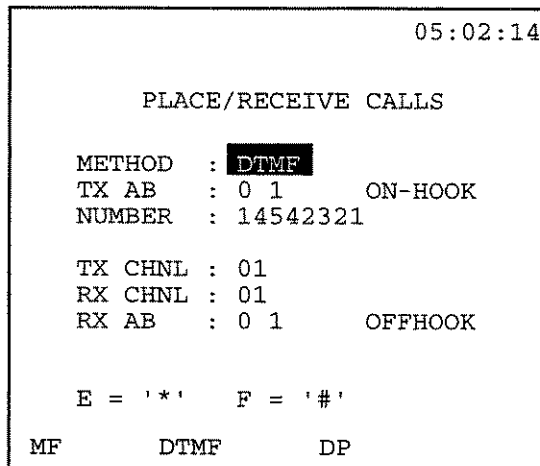
Figure 8.4.A PLACE/RECEIVE CALLS Menu

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

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

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

- DTMF (F2), Dual Tone Multi Frequency, is the most commonly used addressing method on today's phones. Like MF, it uses pairs of tones to send a digit. Unlike MF, it uses two separate groups of tones.

DTMF supports 16 digits: 0 through 9, #, *, and A through D.

- DP (F3), Dial Pulse, is the oldest addressing technique. With pulse dialing, the phone goes on-hook and off-hook 10 times per second in order to dial a given number. For example, to dial the number 7, the 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
This item selects the transmit signalling bits
Options: ON-HOOK (F1), OFFHOOK (F2), WINK/FLASH (F3)

- 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
Options: USER (F1), DTMF or MF (F2), DP (F3)

- You may enter up to 32 digits for the NUMBER

Basic Dialing Procedure
This is the simplest dialing procedure, and will be used by most users:

a) Press and release the SHIFT-lock key to display the SHIFT indicator at the top of the screen. Use the keypad to enter the number to be dialed.
  - Note that the keypad keys for A, B, etc. can be used to enter the special MF tones shown on the display. For MF and DP dialing, the Pause (,) tone is entered with the "F" key on the keypad (orange label).
  - If you make a mistake while entering the number, simply press and release the SHIFT-lock key to get rid of the SHIFT indicator in the

display. Cursor over to the digit that needs to be changed, and
type over it, using the SHIFT and numeric keys.
- In any selected dial method, the other dial methods are now
presented as F-key options while you are in the NUMBER line. For
example, in DTMF dialing, MF is F3, and DP is F4. To insert digits
dialed in one of these formats, press the appropriate F-key, then
use the shift and numeric keys as usual. Your original choice will
now be presented as an F-key; select it to go back to that method
of dialing.

- PAUSE (F2) inserts a pause period into the dial number

- Dial the number by pressing the SEND (F3) key or the ENTER key.

b) Select USER (F1) to create, view, or select a User number.
- You can view any number in the list by cursoring down to it and
selecting VIEW (F1). When you are done viewing the number you
can press ESCAPE to get back to the USER DIAL NUMBER
menu.

```
                                    13:13:19
                USER DIAL NUMBER
     LABEL    :   ▉R

     NUMBER   :   14083602200


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

   INSERT   DELETE   toggle    SELECT
```
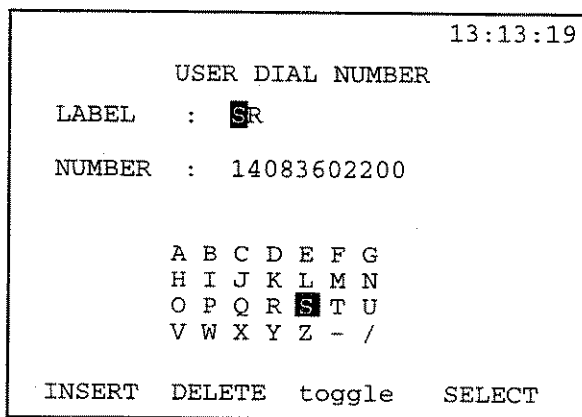
Figure 8.4.B User Dial Number screen

- In the USER DIAL NUMBER menu, you can also edit a number by
cursoring down to it and selecting EDIT (F2). At this point you can
edit the LABEL as described below. However, when the LABEL
has been edited to your satisfaction, do not press ENTER. Instead
select toggle (F3) to move out of the alphabet grid and back to the

label (there will no longer be a letter flashing on and off in the alphabet grid). Cursor down to the number, then edit the number as described above. When the number is right, press ENTER and the edited number and label will be stored in the USER DIAL NUMBER LIST.

Use the following procedure to create a new number:
1) In the USER DIAL NUMBER menu , use the arrow keys to move the cursor to a blank line.
    a) Press CREATE (F1).
    b) Alternatively, you may press STORE (more, F2) in the PLACE/ RECEIVE CALLS screen.

2) Enter the LABEL first. See Figure 8.4.B.
    a) With the cursor placed on the LABEL entry, press TOGGLE (F3) to access the alphabet grid below.
    b) Use the arrow keys to move the cursor to the desired letter.
    c) Press SELECT (more, F4). Continue this process as necessary.
    d) When you are finished with the alphabet grid, press TOGGLE (F3) to return to the LABEL entry.
    e) Cursor down to the NUMBER line
    f) Press INSERT (F1) key to enter the letters A-F or numbers 0-9.
    g) Use the DELETE (F2) key to delete any unwanted digits.
    h) You may enter up to 10 digits for the Label.
    i) When you have finished, press the ENTER key. This stores your new number and returns you to the USER DIAL NUMBER menu. It will show in the NUMBER line.

4) Tx CHNL
This slot assigns the transmit channel
Options: NEXT (F1), PREVIUS (F2), SCAN (F3)

- Use the F-keys NEXT (F1) or PREVIUS (F2), to choose the desired transmit timeslot for the T1 Line.

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 T3 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
This slot assigns the receive channel
Options: NEXT (F1), PREVIUS (F2), SCAN (F3)

- 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, use the (F1) or (F2) keys to select a channel here

6) Rx ABCD

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

8.5 NOISE MEASUREMENT

Refer to Figure 8.5.A, and use this procedure:

1) In the VOICE FREQ FUNCTIONS menu, cursor down to the NOISE MEASUREMENT menu item and press ENTER.

2) MEASURE
Press a function key to begin one of four noise measurements
Options: Signal to Noise (F1 S/N), C-Message (F2 C-MESG), 3 kHz flat (F3 3K-FLAT), C-Notch (F4 C-NOTCH).

- Note that after the function key is pressed, the selected measurement will start.
- You may change the noise measurement at any time by choosing a different F-key.
- Measurement results previously made will not be erased. Only the measurement result for the current measurement type will be updated regularly.

3) RX CHNL

Select the channel you wish to perform measurements on at the RX CHNL line.

- Use the NEXT (F1) and PREVIUS (F2) keys to change the channel.

4) After your desired measurement results are complete, press ESCAPE to return to the VOICE FREQ FUNCTIONS menu.

```
                                  12:44:56

              NOISE MEASUREMENT

        MEASURE : 3K-FLAT

                  RESULTS

        Signal to Noise:        dB
        Noise C-Message:        dBrnC
        Noise 3K-Flat  :  71.6  dBrn
        Noise C-Notch  :        dBrn


        S/N    C-MESG   3K-FLAT   C-NOTCH
```

Figure 8.5.A   Noise Measurement

8.6 MF/DTMF/DP ANALYSIS

The SW322 MF/DTMF/DP Dialing, Decoding, and Analysis option allows the test set to decode and analyze MF, DTMF and DP tones.

Use the following procedure:

1) In the VOICE FREQ FUNCTIONS menu, cursor down to the MF/DTMF/DP ANALYSIS item and press ENTER.
   - You may press ENTER again at any time to start an analysis, or you may continue with the setup.

2) AUTO SCAN
Options: YES (F1) or NO (F2)

- You can enable the AUTO SCAN by choosing YES (F1).
- When in scan mode, the T3 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 T3 will analyze only on the selected receive channel.

3) TxSPRVN

Select the supervision start sequence
Options: ON/OFF (F1), ON/WINK (F2), MANUAL (F3)

- Choose ON/OFF (F1) if you want to transmit an initial supervision state of on-hook. When the test set receives an off-hook condition on the selected receive channel, it will transmit an off-hook in response.
- Choose ON/WINK (F2) if you want to transmit an initial supervision state of on-hook. When the test set receives an off-hook condition on the selected receive channel, it will transmit a wink in response.
- Choose MANUAL (F3) if you want to transmit an initial supervision state of on-hook, then control the supervision manually using the F-keys.

a) Press enter, and the SunSet will begin to scan for the first available channel changing from its initial on-hook to an off-hook state. The test set will display the received supervision and channel number

Note: In DP decoding, the line must initially be in an off-hook state, so you will not have access to the TX SuPerViSioN item.

4) XMT CHAN

Select the transmit channel

- Use the NEXT (F1) and PREVIUS (F2) keys to make the selection

5) RCV CHAN

Select the receive channel

- Use the NEXT (F1) and PREVIUS (F2) keys to make the selection

6) Press ENTER to start receiving the digits. The MF, DTMF or DP digits will be displayed as they are received. Up to 40 digits can be displayed,

except for in the DP mode, where up to ten digits may be displayed. See Figure 8.6.A for a sample screen.

7) Press F1 to ANALYSE your results. The SunSet will stop receiving digits, and begin to analyze the received digits. You will enter the ANALYSIS screen when the test set has completed ANALYZING. See Figure 8.6.B for a sample screen.

```
                                    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 8.6.A   DTMF/MF/DP Analysis, DTMF sample

www.valuetronics.com

```
                                      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 8.6.B   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.

8) To begin a new Decode and Analysis session, escape and then reenter the MF/DTMF/DP ANALYSIS menu item. Use PRN SCRN to print the test results if desired.

9) Press ESCAPE to return to the VOICE FREQ FUNCTIONS MENU.

SunSet T3   Version 2.64

9.0 Using CSU/NI EMULATION

CSU/NI EMULATION gives you a simple, half-duplex emulation of a CSU or an NI. With this capability, you can unplug the CSU or NI and insert the SunSet T3 in its place. The emulation screen gives you :
- a pictorial explanation of the circuit status,
- measurement results,
- configuration commands to perform loopbacks

Finally, while in this mode, the test set will respond to CSU and NI loop up/down codes. Refer to Figure 9.A. Please note this function only applies to the DS1 mode.

```
                                    02:59:33

                            ET-000:00:00


                  ┌───┐
                  │ R │◄─────   LBKT-  000:00
                  └───┘         BPV  -  0
                  ┌───┐         FBE  -  0
                  │ T │─────►   OOF  -  0
                  └───┘         CRC6-  0
       RMTCMD  -  NONE          ES   -  0
       LOCCMD  - │RESET│        SES  -  0
       TYPE    -  CSU           UAS  -  0

       RESET   LLPBK    PLPBK
```
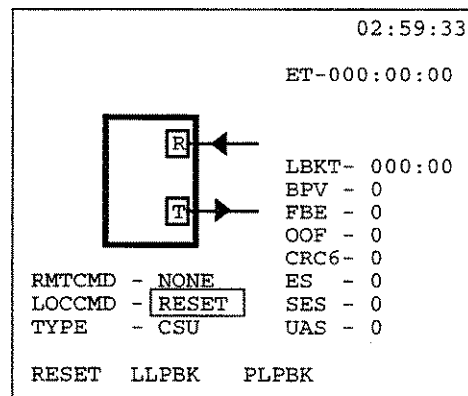
Figure 9.A   CSU/NI Emulation

Use this procedure:

1) Configure the SET UP INTERFACE menu as:
    TEST MODE: DS1
    FRAME: as appropriate
    TSTSG: PATRN
    RATE: 1.544M
    RECVR: TERM
    CODE: as appropriate
    TxLBO: as appropriate
    TxCLK: N/A

a) Press ENTER when your settings are correct.

2) ENTER the CSU/NI EMULATION menu.

3) Plug the cords into the test set and the circuit under test.

4) Set the test set up for either NI emulation or CSU emulation.
   • Use the Down Arrow to access the TYPE item, then select CSU (F1)
     or NI (F2).

5) Observe the circuit error counts and also 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
   SET UP INTERFACE menu.

6) If desired, operate any of the local commands as follows:
   • RESET (F1) resets the test set to a through mode.
   • LLPBK (F2) operates a line loopback. 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
     loopback has been invoked, the LLPBK command will be replaced
     with the UNLLB (F2) command. In this case, pressing F2 will undo
     the loopback.
   • PLPBK (F3) operates a payload loopback. 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 command will be replaced with the UNPLB
     (F3) command. In this case, pressing F3 will undo the loopback.

7) 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
   emulation screen, and your SET UP INTERFACE settings will be rein-
   stated automatically.

10.0 Using the DATA LINK CONTROL Menu

The Data Link Control feature applies to the DS1 Test Mode, with ESF or SLC-96 DS1 framing. You will not be able to enter this item if you have selected UNFRaMed or SF-D4 as your framing. ESF and SLC-96 have different menus, screens, and options. Section 10.1 applies to SLC-96, and section 10.2 to ESF.

10.1 SLC96 Data Link Control

Choose SLC96 framing in the SET UP INTERFACE menu before proceeding. From the MAIN MENU, enter the DATA LINK CONTROL item and refer to Figure 10.A. All capabilities are in conformance with the TR-TSY-000008 specification.

WARNING: Using the SLC96 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. See the Section 7 Applications for additional information.

```
                                    07:44:12

        SLC-96 DATA LINK CONTROL


            MONITOR DATA LINK
            SEND MESSAGE
            VIEW DATA LINK
```
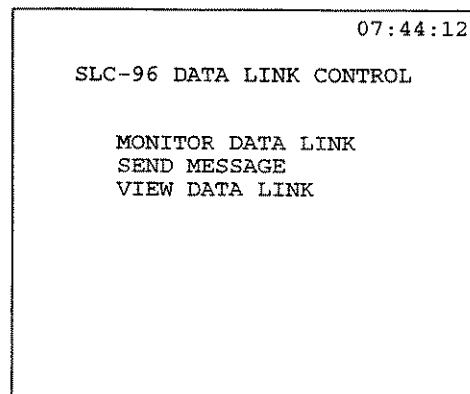
Figure 10A   DATA LINK CONTROL Menu

10.1.1 MONITOR DATA LINK

The Data Link Monitor gives you an English-language translation of the

information in the SLC data link. Refer to Figure 10.1.A.

```
                                   05:34:42

        DATA LINK MONITOR SLC-96

        MODE   : [WP1]   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: 11111111111

        PAUSE
```

Figure 10.1.A   Data Link Monitor SLC-96

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.

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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.

10.1.2 SEND MESSAGE

This item provides you with an English-language table of items that you may send on the SLC-96 data link. Before entering this menu, make sure you have a TERM setting for your RECVR configuration in the SET UP INTERFACE and have both your transmit and receive cords plugged into the circuit and the test set. See the applications section for diagrams on how to plug in the test set. Refer to Figure 10.1.B.

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```
                                    06:44:12

                SLC-96  SEND  MESSAGE

        MODE   : WP1
        MAJOR  : CVR     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: 11111111111


        NOTE     WP1      WP1B     SEND
```

Figure 10.1.B   SLC-96 Send Message

Here is an explanation of the screen items:

MODE
This selection allows you to control what 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. Alterna-
tively, 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.

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10.1.3 VIEW DATA LINK

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. Refer to Figure 00.1.C.

```
                                    06:44:12

              SLC-96 VIEW DATA LINK
      PAGE :01

      DLF   C---------CsssM-MAAS--Ss
      001   11111111111101011101111111
      002   11111111111101011101111111
      003   11111111111101011101111111
      004   11111111111101011100111111
      005   11111111111101011101111111
      006   11111111111101011101111111
      007   11111111111101011101111111
      008   11111111111101011101111111

      PAGE-UP PAGE-DN                PAUSE
```

Figure 10.1.C   View data link- SLC96

10.2 Using the DATA LINK CONTROL (ESF)

ESF DATA LINK CONTROL is provided when you have chosen ESF framing in the SET UP INTERFACE menu. See Figure 10.2.A.

```
                                        06:44:12

         ESF DATA LINK CONTROL

        ┌─────────────────────────┐
        │MONITOR T1.403 PRM        │
        └─────────────────────────┘
         MONITOR T1.403 BOM
         SEND T1.403 PRM
         SEND T1.403 BOM
```
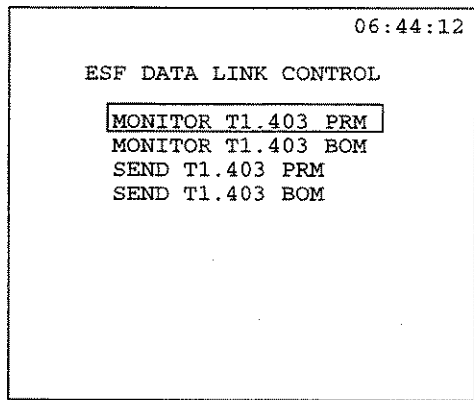
Figure 10.2.A   ESF Data Link Control

10.2.1 MONITOR T1.403 PRM

The MONITOR T1.403 PRM allows you to view the Performance Report
Message (PRM) as reported on the ESF datalink. 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 any payload
loopback messages and yellow alarm messages 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. Refer to Figure 10.2.B.

```
                                              06:44:12

                        DATA LINK MONITOR
                           T1.403 PRM

          ELAPS TIME - 000:02:22
          DETEC TIME - 000:00:00

          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 10.2.B   Data Link Monitor T1.403 PRM

Here are what each of the items mean:

ELAPS TIME

This is the total amount of time which has passed since the data link began to be monitored.

DETEC TIME

This is the total amount of time the set has detected valid data link messages during the time that the set has been monitoring the data link.

CRC-1

This is the number of seconds during which exactly 1 CRC-6 error was reported.

C=<5

This is the number of seconds during which 2 to 5 CRC-6 errors were reported.

C=<10

This is the number of seconds during which 6 to 10 CRC-6 errors were reported.

C=<100

This is the number of seconds during which 11 to 100 CRC-6 errors were

reported.

C=<319
This is the number of seconds during which 101 to 319 CRC-6 errors were reported.

C>320
This is the number of seconds during which 320 or more CRC-6 errors were reported.

SEFE
This is the number of severely errored framing events reported.
FSBEE
This is the number of frame synchronization bit error events reported.

BPV
This is the number of seconds in which at least one bipolar violation occurred were 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 messages were received

PAUSE
The PAUSE (F1) key allows you to pause the measurement so that no results are recorded again until you press the RESUME (F1) key.

RESTART
The RESTART (F1) key allows you to start the measurement over again.

HOLDSCR
The HOLDSCR (F2) key stops the screen from updating while you look at it. The measurement continues the background in the background. You can let the screen update again by pressing the CONTINU (F2) key.

10.2.2 MONITOR T1.403 BOM

Refer to Figure 10.2.C.

```
                                06:44:12

    VIEW DATA LINK T1.403 BOM

    RECEIVE STATUS: MESSAGE

    LAST MESSAGE:0000100011111111
    (left most bit received 1st)

    Current :   0000000011111111
    1st last:
    2nd last:
    3rd last:
    4th last:
```

Figure 10.2.C   Monitor T1.403 BOM

This screen displays the message 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 datalink. The bits in the message will be displayed under the LAST MESSAGE line. If the set is not receiving a message, the RECEIVE STATUS line will say IDLE, and the bits of the last message that was received will be displayed under the LAST MESSAGE line.

10.2.3 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 TX jack according to the quality of the received signal on the RX jack. It will display for you a count of all of the various errors which have been recorded and transmitted since you entered the screen. The test set sends this message continuously until you ESCAPE from this menu. Refer to Figure 10.2.D.

```
                                  06:44:12

            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 10.2.D   Data Link Transmit

10.2.4 SEND T1.403 BOM

You can also send a data link Bit Oriented Message. Figure 10.2.E shows an example.

NOTE for ESF NIU LOOPBACKS
You can use this function to loopback a far-end NIU from the customer premises side of the near end NIU. Set the message to 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.

```
                                    06:44:12

              DATA LINK  SEND MESSAGE
                   ESF  -  T1.403

         MESSAGE     -  0000000011111111
         REPETITION  -  CONTINU




YEL-ALM  PLPK-UP  PLPK-DN     more
```

Figure 10.2.E   Data Link Send Message

In this screen you select a message to send, and specify the number of times it is sent. Use this procedure:

1) Select the desired message. You can do this by using the F-keys for predefined messages or by typing in the desired bit states. If you type in the message, move your cursor to the desired position and enter the 1s and 0s directly from the keypad using the SHIFT-lock key. You are only allowed to move the cursor between the 10th and 15th bits of the message. The rest of the 16-bit message is fixed.

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). I f you would like to send the message for an exact number of repetitions, choose NUMBER (F1), then press and release

the SHIFT-lock key, and type in the number of repetitions you desire between 02 and 99.

3) Press the ENTER key to begin transmitting the pattern on the datalink. If you chose CONTINU for the number of repetitions, the message will be sent continuously while you are in the DATA LINK CONTROL ESF menu. Exiting the menu or moving into a sub-menu will cause the message to stop being sent.

10.3 DS3 FEAC CHANNEL

In the DS3 test mode, selecting the DATA LINK CONTROL menu gives you access to the DS3 FEAC CHANNEL menu. You must be using C-BIT framing in order to access this item. Refer to Figure 10.3.A.

```
                                    17:16:17

            DS3  FEAC  CHANNEL

        ┌─────────────────────┐
        │ MONITOR  DS3  FEAC   │
        └─────────────────────┘
          SEND  DS3  FEAC
```
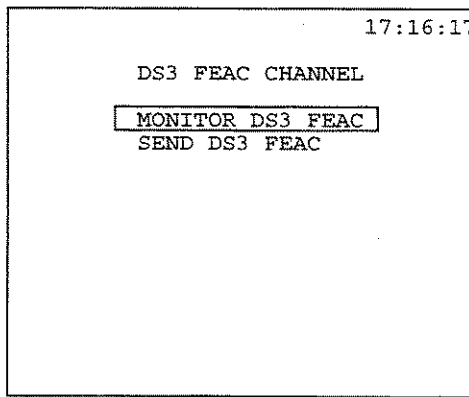
Figure 10.3.A   DS3 FEAC CHANNEL

10.3.1 MONITOR DS3 FEAC

The Monitor DS3 FEAC item allows you to view the current and past messages appearing on the DS3 FEAC datalink. Refer to Figure 10.3.B.

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```
                                        17:16:17

                  MONITOR DS3 FEAC

            RECEIVE STATUS :   MESSAGE

            LAST MESSAGE :
            (left most bit received 1st)

            Current  :   111111110 000000 0
            1st last :   111111110 100100 0
            2nd last :   111111110 000000 0
            3rd last :   111111110 100100 0
            4th last :   111111110 000000 0
```

Figure 10.3.B   Monitor DS3 FEAC

10.3.2 SEND DS3 FEAC

   The SEND DS3 FEAC allows you to transmit messages across the DS3
FEAC datalink.

   The third C-bit in subframe 1 is used as the Far-End Alarm and Control
(FEAC) Channel, where alarm or status information from the far end terminal
can be sent back to the near end terminal. A simple repeating, 16-bit code
word, of the form

   111111110XXXXXX0

where X can be a 0 or a 1 with the left-most bit transmitted first, can be
used to indicate one of several possible alarms or status conditions. When
no alarms or status condition are being transmitted, the FEAC channel is set
to all ones.

- The X-bit can be set to 0 or 1, by selecting the required bit to be
  changed, and pressing the shift key which enables you to enter a 0
  or a 1 in that position. Repeat this procedure for the required number
  of bit changes, then depress the SHIFT key. This enables you to
  again use the arrow keys.
- The REPETITION option can be selected as NUMBER in which case
  a number of repetitions is selected by pressing the SHIFT key and
  entering the required number of repetitions from the keypad. Press
  the SHIFT key again when your entry is complete. This option can

also be selected as CONTINU, for continuous sending of the selected DS3 FEAC.

11.0 DS3 C-BIT MONITOR

The DS3 C-BIT Monitor screen allows you to observe the C-bits being received in subframes 1-7 of the DS3 signal. You must be using C-bit framing to access the feature. See Figure 11.A.

```
                              04:56:21

         DS3 C-BIT MONITOR

                       C1   C2   C3

         Subframe   1    1    1    1
         Subframe   2    1    1    1
         Subframe   3    0    0    0
         Subframe   4    1    1    1
         Subframe   5    1    1    1
         Subframe   6    1    1    1
         Subframe   7    1    1    1
```

Figure 11.A   C-bit Monitor screen

Chapter 5
Applications

1.0 T1 Applications

1.1 Accept a New T1 Span

Here is a procedure for accepting a new T1 span. Refer to Figure 1.1.A.

WARNING: Verify that the span is not in service. This acceptance test will disrupt service.

1) Find out what kind of loopback device is installed at the end of the span, and what loopback codes operate it.

2) Switch on the test set. From the MAIN MENU, ENTER the SET UP INTERFACE item.

3) Using the F1 key, select DS1 for the TEST MODE.

4) Configure the screen settings for:
      FRAME: as specified by your span design
      TSTSG: PATRN
      RATE: 1.544M
      RECVR: TERM
      CODE: as specified by your span design
      TxLBO: 0 dB
      TxCLK: INTERN

    a) When your settings are correct, press ENTER.

5) Connect the test set to the circuit as shown in Figure 1.1.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

6) Move the cursor to the LOOP BACK CONTROL item and press ENTER.
    a) With the cursor on DS1 LOOPBACK, press ENTER.
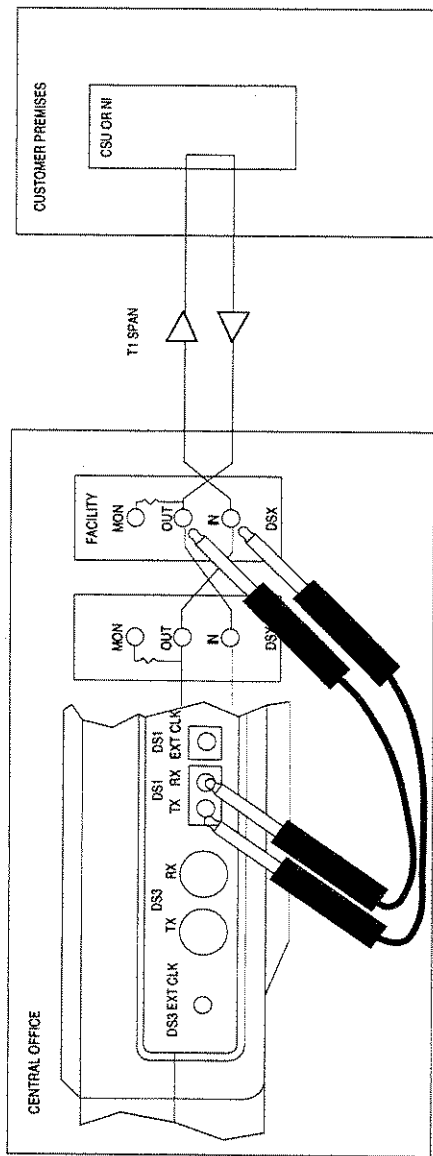
Figure 1.1.A   Accepting a New T1 span

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7) Select the MODE item last. For SF-D4 or SLC-96 framing, use these settings:

      MODE: LOOP-UP
      TYPE: IN-BAND
      CODE: as appropriate

For ESF framing, use these settings:

      MODE: LOOP-UP
      TYPE: ESF-DL
      CODE: as appropriate (LINE and PAYLOAD are used with CSU loopbacks and NETWORK is used with an NIU loopback). Refer to Chapter 5 for a detailed description of each of these items.

As soon as you select the MODE, the looping will begin. You will see a "LOOPING UP . . ." message followed by a "LOOP UP SUCCEEDED" message. If the test set detects a loopback which is already in place, then it will warn you with a "PREEXISTING LOOP ONLY" message.

8) Press ESCAPE until you arrive at the MAIN MENU.
    a) Enter the SEND TEST PATTERN item.
    b) Using the arrow keys, select the test pattern you wish to send.

9) From the MAIN MENU, enter MEASUREMENT RESULTS.
    a) Press the RESTART (F3) key to restart the testing. Verify that the span performs to your company's requirements for the service delivered. Refer to Chapter 5 for a detailed description of each of the screen items.

10) When your testing is complete, ESCAPE to the MAIN MENU and ENTER the LOOP BACK CONTROL item.
    a) ENTER the DS1 LOOPBACK item. Use the same screen settings you used above, but specify LOOP-DN. Your previous screen settings will remain intact.
    b) Verify that the LOOP DOWN SUCCEEDED message is displayed.

11) Unplug the test set from the circuit.

1.2 Monitor an In-service Circuit

Here is the simplest procedure for monitoring a circuit which is in-service.

1) This test may be performed while the circuit is carrying live customer traffic.

2) Switch on the test set.

3) ENTER the SET UP INTERFACE menu. Select either DS1 (F1), DS3 (F2) or ChanDS3 (F3) for the TEST MODE.

    For a **DS1 circuit**, configure these settings and refer to Figure 1.2.A:
        TSTSG: PATRN
        RATE: 1.544M
        RECVR: DSXMON

    For a **DS3 circuit**, configure these settings and refer to Figure 1.2.B:
        TSTSG: PATRN
        RxLVL: LOW

    For a channelized DS3 circuit (DS1 framing preserved within the DS3 signal), configure these settings and refer to Figure 1.2.B:
        DS3/1 CNFG: 3Rx/3Tx
        RxLVL: LOW
        RxCH: as appropriate
        TSTSG: PATRN
        RATE: 1.544M

4) Connect your test set to the circuit as shown.
    a) Press the AUTO key to have the test set configure the remaining screen settings for you.
    b) Press the ENTER key to go to the main menu.
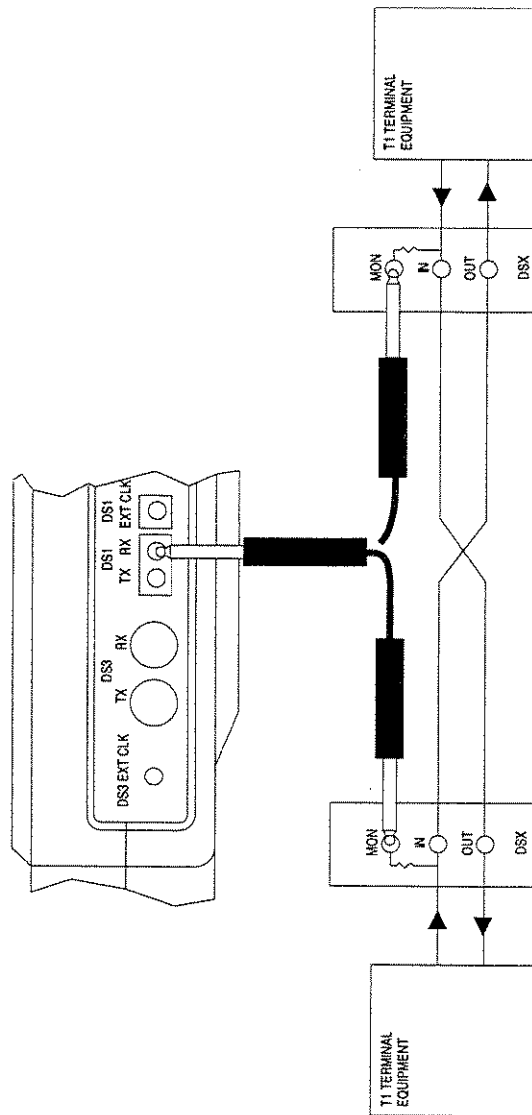
Figure 1.2.A   Monitoring an In-service DS1 circuit

5) Examine the LEDs and the GRAPHIC screen for information about your circuit.

The PULSES LED should be lit green, and a valid framing type should be lit up as green. A steady ERRORS light will tell you the circuit is working, but it 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 signal, and has replaced it with the AIS signal.

The GRAPHIC screen will show what kind of pattern, if any, is being received by the test set and will graphically reinforce your SET UP INTERFACE configuration.

If you are performing channelized DS3 testing (ChanDS3), remember that the test set's DS1 LEDs relate only to the single DS1 under test.

If you need additional information proceed to step 6. Otherwise, disconnect your test set from the circuit.

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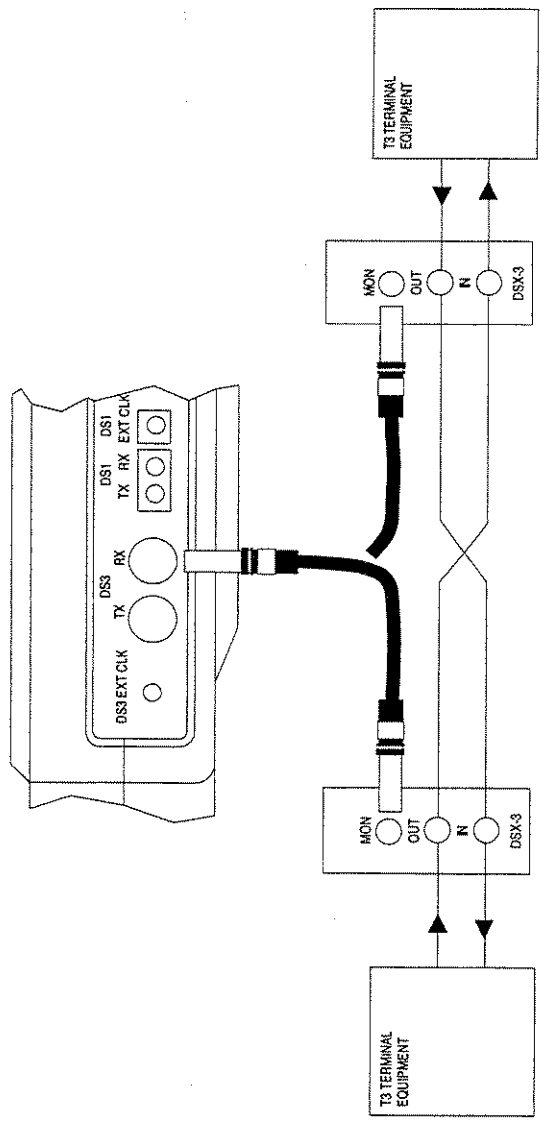
Figure 1.2.B   Monitoring an In-service DS3 circuit

6) ESCAPE to the MAIN MENU. ENTER the MEASUREMENT RESULTS item. Verify that the span performs to your company's requirements for the service delivered. If necessary, see Chapter 5 regarding Measurement Definitions and Usage.

7) Disconnect your test set from the circuit.

1.3 Loop back a CSU or NI on a T1 Line

Here is a procedure for looping back a CSU and NI on a T1 line. The setup is illustrated in Figure 1.1.A.

1) Verify the span is not in service. Looping back a device on the span will disrupt service.

2) Switch on the test set.

3) ENTER the SET UP INTERFACE menu. Select DS1 (F1) for the TEST MODE. Configure the screen settings for:
   FRAME: as specified by the span design
   TSTSG: PATRN
   RATE: 1.544M
   RECVR: TERM
   CODE: as specified by the span design
   TxLBO: 0 dB
   TxCLK: INTERN

   a) Press ENTER when all of your settings are correct.

4) Connect the test set to the circuit as shown in Figure 1.3.A. Press the HISTORY key to acknowledge the blinking history lights, and turn them off.

5) ENTER the LOOP BACK CONTROL menu
   a) ENTER the DS1 LOOPBACK item.
   b) Use the Down Arrow to access the TYPE.

   For SF-D4 framing, use these screen settings:
   TYPE: IN-BAND
   CODE: NI or CSU, as appropriate

usage.

5) When you are finished, release the loopback, and disconnect the test set
   from the circuit.

1.5 Verify Proper B8ZS/AMI Optioning on a T1 Line

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 shown in Section 1.1.

   a) Remember to repeat this procedure for each direction of the circuit.
   b) Make sure the test set's line CODE is set to the same line coding as
      is supposed to be present on the circuit.
   c) Get the circuit looped up and ready for testing.

2) Transmit an all 1s signal, and an alternating 1s and 0s signal. Verify that
   there are no errors with any of these signals. If there are any errors, then
   you have problems that are not associated with an B8ZS/AMI mismatch.

3) Transmit a 3-in-24 signal. If any equipment in the line has optioning that
   disagrees with the test set, you will see a loss of synch or excessive
   errors.

4) Verify the diagnosis by transmitting QRS. QRS will also cause errors
   when there is an AMI/B8ZS mismatch on the line.

5) In the setup of Section 1.1, 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 being received in one direction is not the same as
   the line code being received in the other direction. If it isn't, the
   customer's equipment may be at fault. If the problem still isn't evident
   from the central office, then a trip to the customer's premises may be
   required.

6) Disconnect your test set from the circuit.

1.6 Checking for Frame Slips and Frequency Synch

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
- the T1 circuit passes through more than one carrier

Frequency synchronization problems result in frame slips, a major source of service impairment. Referring to Figure 1.6.A, 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) Switch on the test set.

4) ENTER the SET UP INTERFACE menu. Using the F1 key, select DS1 for the TEST MODE.
Use the following screen settings:
    TSTSG: PATRN
    RATE: 1.544M
    RECVR: DSXMON
    TxCLK: EXTERN
    (We will AUTO configure the remaining screen settings below).

   a) Press the ENTER key when all of the settings are as desired.

5) Plug the reference T1 signal into the DS1 EXT CLK jack.

6) Connect the DS1 RX jack into your circuit's DSX MON jack, or other MON jack.
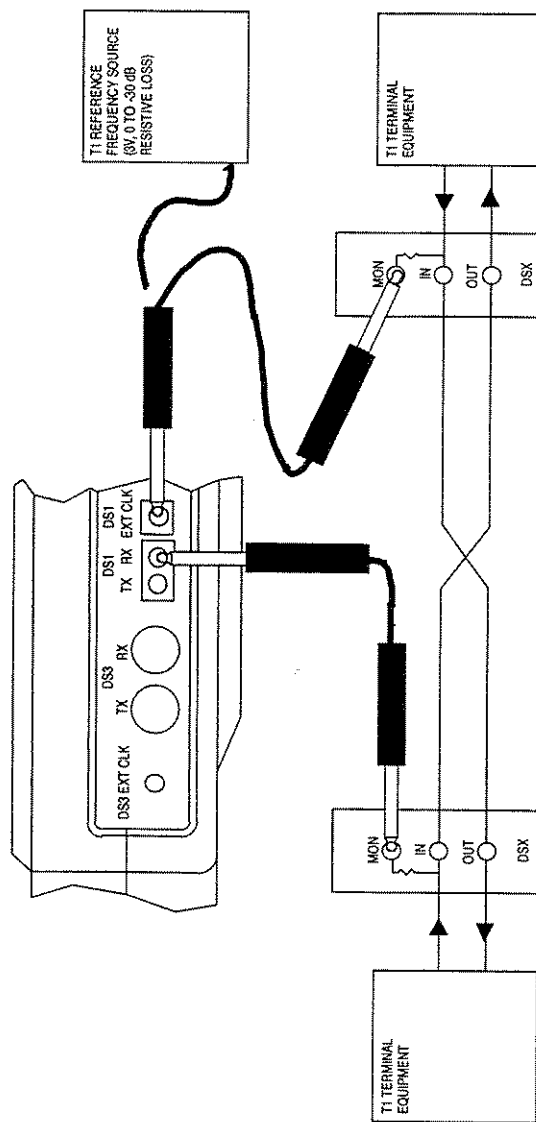
Figure 1.6.A Frequency synchronization problems

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7) Press the AUTO key to have the test set synchronize onto the T1 line's framing, coding and test pattern (if applicable).

8) ENTER the MEASUREMENT RESULTS menu.

9) Press the PAGE-DN (F2) key three times to view the screen containing the frequency information. You can see if there is a problem because the +WDR or -WDR will be counting up. If the WDR measurement is 0, or does not increment, then there is no frequency difference between your two frequency sources.

10) If you are using an external reference 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.

11) Disconnect your test set from the circuit.

1.7 Measuring Signal Level

You can measure signal level while performing one of the other tests, or you can measure signal level just by itself.

At a DSX, the level should be between 2.7 and 3.3 volts, as measured from the DS1 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 setup shown in Figure 1.1.A to measure the level. Otherwise, use the setup shown in Figure 1.1.A. Here is a procedure for measuring the signal level:

1) Choose what kind of access mode you want to use. You can make this measurement in TERM, DSXMON, and BRIDGE modes. TERM and BRIDGE provide the most accurate results, but DSXMON may be the most convenient for your circuit under test. TERM also will disrupt service. The BRIDGE measurement 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.
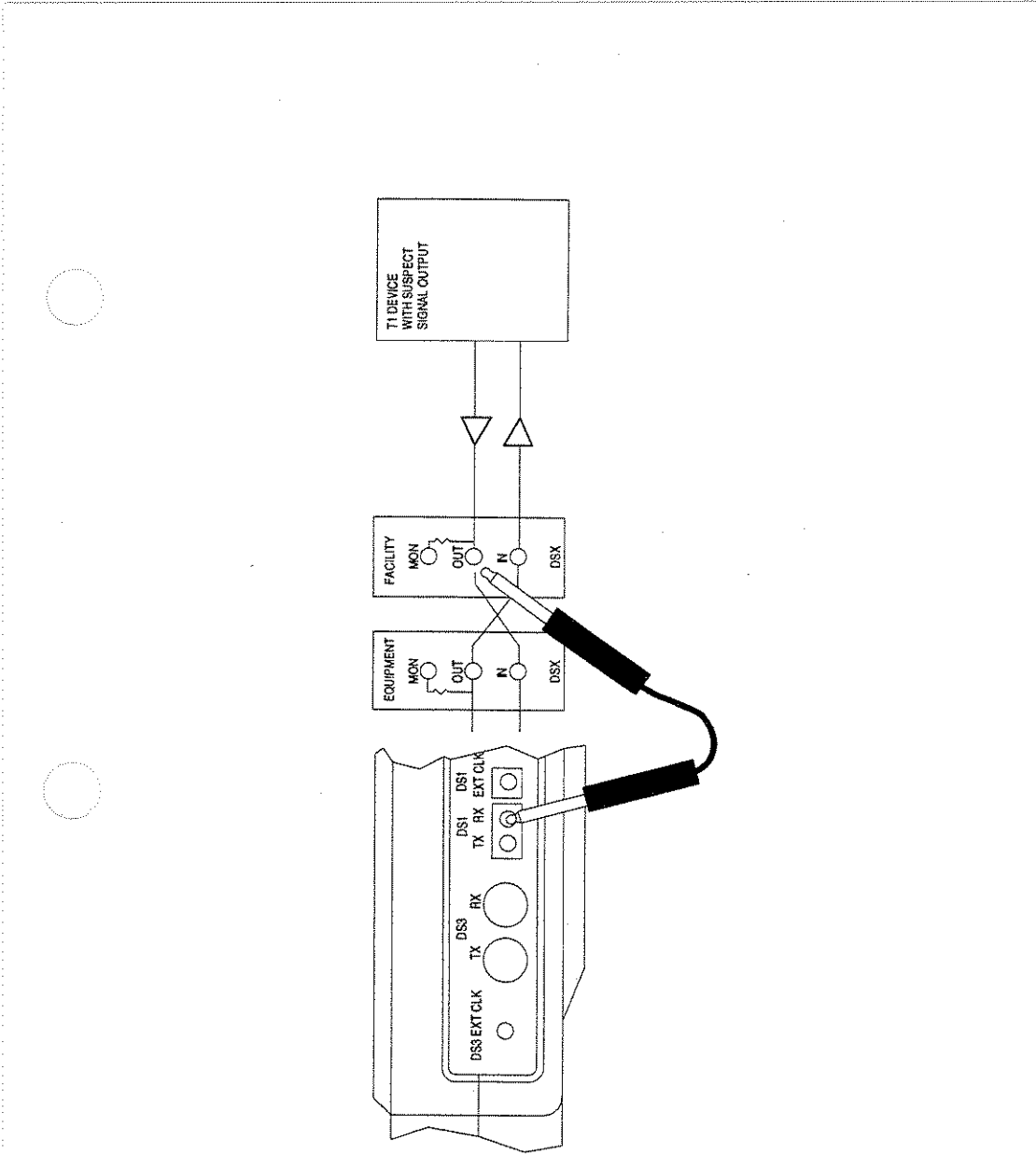
Figure 1.7.A   Measuring Signal Level

The rest of this procedure will use the TERM   mode for illustrative purposes. Verify that the span is not in service. Using the TERM mode will

disrupt service.

2) Switch on the test set. ENTER the SET UP INTERFACE item. Select DS1 (F1) for the TEST MODE. Configure the settings for:
   TSTSG: PATRN
   RATE: 1.544M
   RECVR: TERM

   Press ENTER to return to the MAIN MENU.

3) Connect the test set to the circuit as shown in Figure 1.7.A.

   a) Press the AUTO key to automatically configure the test set for your circuit under test.

4) ENTER the MEASUREMENT RESULTS item.
   a) Page through the screens of results until you can view the signal levels. Separate readings are given for the positive and negative signals so you can get more accurate information on a faulty regenerator.

5) When you are done, 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) Switch on the test set.

2) Enter OTHER FEATURES, TEST PARAMETERS.

3) The cursor will appear at the MEAS DURATION item. Select the F1 key to run a TIMED test. Press and release the SHIFT-lock key. A SHIFT indicator will appear in the upper left-hand corner of the screen.

4) Type in the desired test time. The time is given in (hours:minutes). Acceptable values range from 000:01 to 999:59. After you have set the test time, press and release the SHIFT-lock key. The SHIFT indicator will

disappear. Press the ENTER key. Now ESCAPE to the MAIN MENU.

5) Use the desired procedure from Section 1.1 or 1.2 as the basis for your timed test. When you enter the MEASUREMENT RESULTS menu, you will observe that the RT (Remaining Time) indicator at the top of the screen counts down.

1.9 Check 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.

WARNING: Verify that the span is not in service. This test will disrupt service.

1) If the DSX is very large, you may need two test sets or a very long cord for this test. Switch on the test set(s).

2) For each test set, ENTER the SET UP INTERFACE menu. Select DS1 (F1) for the TEST MODE. Use these settings:
FRAME: as specified by the span design
TSTSG: PATRN
RATE: 1.544M
RECVR: TERM
CODE: as specified by the span design
TxLBO: 0 dB
TxCLK: INTERN

a) Press ENTER when your settings are correct.

4) Enter the SEND TEST PATTERN menu.

a) Select QRS as the pattern to be transmitted.
b) Press ENTER to return to the MAIN MENU.
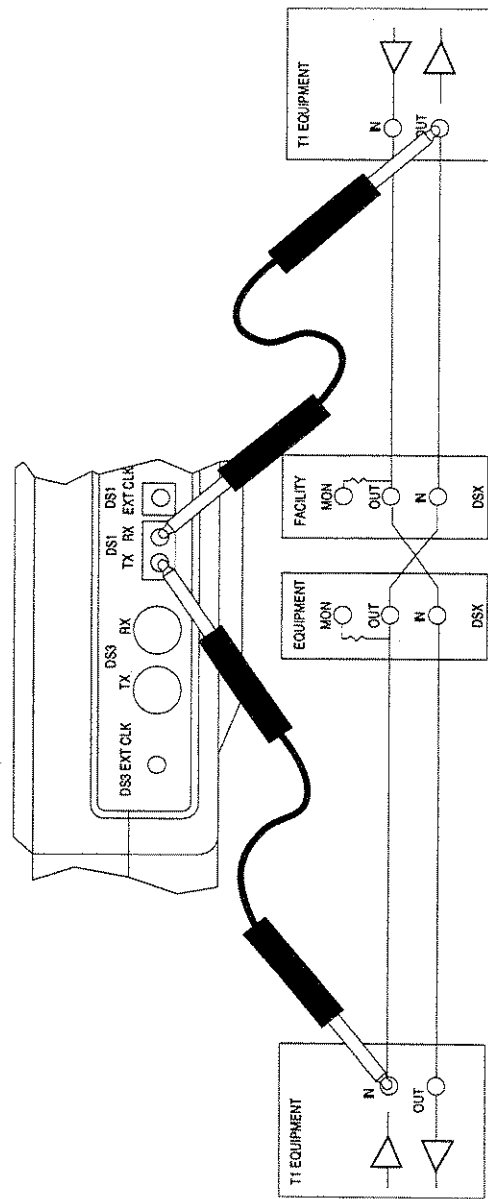
Figure 1.9.A   Checking the DSX wiring

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5) 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 reasonably close together. You will need to find a point on either side of the DSX where you can plug in the test set. This point could be at test jacks on the network equipment on either side of the DSX. You will need to make sure that you have opened the circuit at each point so that the test set is not bridge-tapped onto the existing circuit.

a) Press the HISTORY key to acknowledge the blinking history lights and turn them off.

6) Verify that each test set lights the PAT SYNC LED as green, and that the ERRORS LEDs are off. This means that the circuit is wired through the DSX properly.

7) Configure the ERR INJ key for injecting both LOGIC and BPV errors. This is set in OTHER FEATURES, ERROR INJECTION from the MAIN MENU.

8) Press the ERR INJ key on one of the test sets.

a) Verify that the ERRORS LED comes on and then starts to blink on the other test set.

9) Now repeat the process by pressing the ERR INJ key on the other test set.

a) Verify that the ERRORS LED comes on, and then starts to blink on the first test set. This verifies that each direction is properly wired through the DSX, and the test sets didn't synch on a QRS source on another circuit.

10) Repeat the procedure for the other direction of the circuit.

11) Disconnect the test sets from the circuit. Make sure the circuit is restored to its original condition.

1.10 Observe Network Codes or Channel Data

The SunSet T3 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 for you at a DS1 level. 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.

32 pages of DS1 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, or out-of-service in a TERM mode for your DS1 circuit.

   • This test can also be performed on a DS3 circuit at a DSX-3 access point, however, only 8 bits of data are available for viewing.

2) Switch on the test set.

3) Enter the SET UP INTERFACE menu.
   a) Select your TEST MODE as DS1 (F1).
   b) Specify the RECVR as DSXMON or BRIDGE if the circuit is carrying live traffic.
   c) Specify the other settings as desired, or press the AUTO key to have the test set automatically configure to the correct framing and line coding. If the test is out-of-service, and you are using a TERM setting, configure your other settings as desired.

4) Plug the set into the circuit as shown in Figure 1.2.A or B for an in-service measurement. Press the HISTORY key to acknowledge the blinking history lights and turn them off.

5) Press ENTER to access the MAIN MENU.
   a) Enter OTHER MEASUREMENTS, VIEW RECEIVED DATA. You will now be able to view the live channel data.

6) Review the live data as it is displayed. When the codes that you are interested in appear, press the PAUSE (F1) key to trap 32 pages of DS1 data or the 8 bits of DS3 data. For the DS1 data, press PAGE-DN (F2) to scroll through the screens. Also for the DS1 data, you may use the STORE (F4) key to store the received data as a test pattern for later use.
      The data is presented as it appears in the T1 bit stream and 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	24

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 11.

```
                                    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)    ( )


      PAUSE   PAGE-UP    PAGE-DN   STORE
```

Figure 1.10.A   Ten-bit Pattern

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8) When you are finished, disconnect your test set from the circuit.

1.11 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 1.11.A.

1) This test may be performed while the span is carrying live customer traffic.

2) Switch on the test set.

3) Enter the SET UP INTERFACE menu by pressing the ENTER key. Select DS1 (F1) for the TEST MODE.
   a) Configure the RECVR for DSXMON or BRIDGE, depending on how you wish to connect to the circuit. Figure 1.11.A illustrates the DSXMON setup.
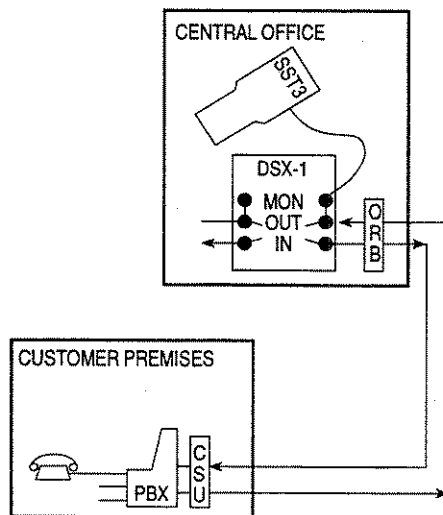
Figure 1.11.A   Monitor a Voice Channel

4) Connect your test set to the circuit as shown in Figure 1.2.A.

5) Press the AUTO key to have the test set automatically determine the framing and line coding present on the received signal.

6) Press ESCAPE to return to the MAIN MENU.
    a) ENTER the VOICE FREQ FUNCTIONS menu.
    b) ENTER the VF MEASUREMENTS menu.
    c) Select the desired receive and transmit channels using the NEXT (F1) and PREVIUS (F2) keys. The channel numbers are automatically converted to a timeslot number for you on D4, ESF, and SLC-96 A-digroup DS1s. The test set refers to the framing type to make this conversion for you. If you are using another type of framing, refer to the channel numbering tables at the end of this section to determine which timeslot to specify on the test set.

7) Adjust the volume to the desired level by using the VOL UP and VOL DN keys.

   NOTE: If you are not able to monitor the channel, verify the test set was able to synchronize on a known framing type. The test set will not perform the monitor function if framing is unavailable. Press the AUTO key to restart the auto framer if a valid frame pattern is not shown.

8) When you are finished, disconnect your test set from the circuit.

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

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

1.12 Simple Talk/Listen

Here is the simplest procedure for talking and listening on a T1 circuit. The setup is illustrated in Figure 1.12.A. However, instead of having a PBX at the far end of the circuit, you might have another test set, a loopback, a switch, channel bank, or other T1 terminating network element. Use this procedure:

1) Verify 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.

3) ENTER the SET UP INTERFACE menu. Configure the TEST MODE for DS1 by pressing the F1 key.

Set the screen settings to:

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FRAME: as specified by your span design
TSTSG: PATRN
RATE: 1.544M
RECVR: TERM
CODE: as specified by your span design
TxLBO: 0 dB
TxCLK: INTERN

a) Press ENTER when your settings are correct.

WARNING: It is not possible to perform talk/listen on an unframed signal. One of the framing LEDs must light green for this procedure to work.

4) Plug the set into the circuit as shown in Figure 7.12.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off.
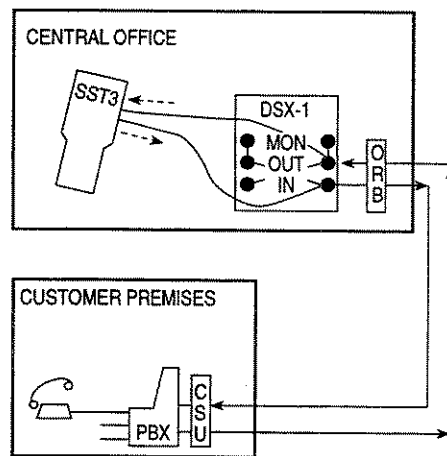
Figure 1.12.A   Simple Talk/Listen

5) ENTER the VOICE FREQ FUNCTIONS menu.
   a) ENTER the VF MEASUREMENTS item.
   b) Select the receive (listen) and transmit (talk) channels - they are usually the same channel. You can now talk and listen on the channel you have selected.

c) Adjust the volume to the desired level by using the VOL UP and VOL DN keys.

NOTE : The test set will automatically convert the channel number to a timeslot for you on D4, ESF, and SLC-96 A digroups. For other framing formats or digroups, refer to the channel numbering tables at the end of the previous sections to determine which "channel" to specify within the test set.

6) When you are finished, disconnect the test set from the circuit.

1.13 Advanced Talk/Listen

Use the Simple Talk/Listen procedure as a reference for this procedure. This procedure lets you use different access modes, signaling, and additional features.

1) Verify the span is not in service, if you will be using a disruptive access mode.

2) Switch on the test set. Enter the SET UP INTERFACE menu. Select DS1 (F1) for the TEST MODE.

3) Configure the TSTSG item for THRU. In the THRU mode, the test set receives and retransmits the other 23 channels without disruption. Using the thru mode will cause a momentary hit on the circuit, as you are plugging into and unplugging from, the circuit. Refer to Figures 1.13.A, B and C for an illustration of how to configure the test set for connecting to a DSX-1 access point.
Other types of circuit access are possible; however, the DSXMON setup is preferable, as it provides the shortest circuit disruption.

4) From the MAIN MENU, enter VOICE FREQ FUNCTIONS.
a) Enter the VF MEASUREMENTS item.

5) Select the receive (listen) and transmit (talk) channels that you want and press ENTER. 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/listen on the channel you selected.
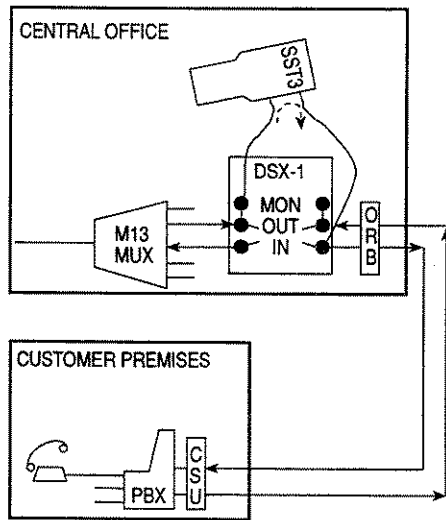
Figure 1.13.A Advance Talk/Listen

Figure 1.13.B   THRU Mode Configuration

6) Plug the test set into the circuit. Refer to Figure 1.13.C for the correct

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order of the connections.
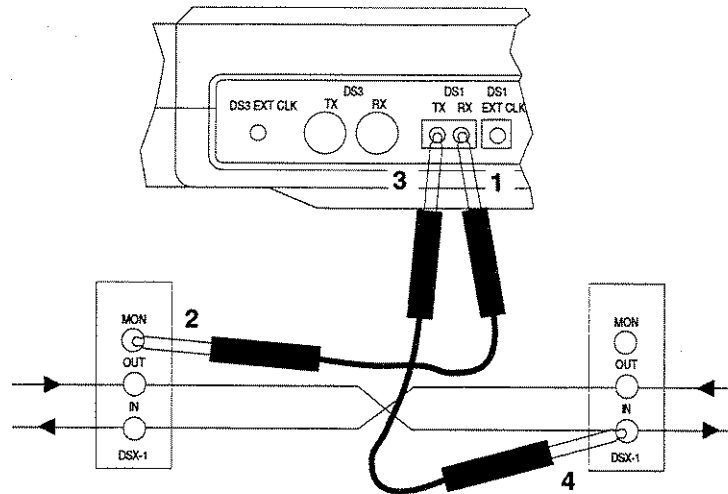
Figrure 1.13.C   Connecting the cords

WARNING: Be sure to connect the test cords to the circuit in the correct
order. If the connections are not made in the order given in Figure
1.13.C, the circuit may be brought down.

a) Press the HISTORY key to acknowledge the blinking history lights,
and turn them off. Adjust the volume to the desired level by using the
volume control on the connector panel.

7) If you need to control supervision on the circuit, enter the supervision bits
you want in order to go off hook, send ringing, or any other state.
a) Send the bits by pressing the SEND (F4) key or by pressing ON-
HOOK (F1), OFFHOOK (F2) or WINK (F3).
b) View the supervision bits which are returned on this same screen.
Press ESCAPE to exit this screen. You will still be sending the
supervision bits you have set for the remainder of the session.

For your reference, here are many of the common signaling arrange-
ments used on D4 channel banks. TRMT refers to the signaling bits
transmitted by the channel bank equipped with indicated channel card.

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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 A	TRMT B	RCV A	RCV B	DPO VF Output
Loop open	0	0	*	*	
Loop closure	1	1	*	*	
	*	*	0	*	Normal battery
	*	*	1	*	Reverse battery

Dial Pulse Terminating (DPT)

VF input to DPT	TRMT A	TRMT B	RCV A	RCV B	DPT VF output
Normal battery	0	0	*	*	
Reverse battery	1	1	*	*	
	*	*	0	*	Loop open
	*	*	1	*	Loop closure

2- or 4-wire E&M

E&M input	TRMT A	TRMT B	RCV A	RCV B	E&M output
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 A	TRMT B	RCV A	RCV B	RPO VF output
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 A	TRMT B	RCV A	RCV B	RPT VF output
Normal battery	0	0	*	*	
Reverse battery	1	1	*	*	
	*	*	0	*	Loop open
	*	*	1	*	Loop closure

Sleeve Dial Pulse Originating (SDPO)

VF input to SDPO	TRMT A	TRMT B	RCV A	RCV B	SDPO VF output
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 A	TRMT B	RCV A	RCV B	DX VF output
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 A	TRMT B	RCV A	RCV B	ETO VF output
No signaling	*	*	*	*	No signaling

Foreign Exchange Office End (FXO), Ground Start mode

VF input to FXO	TRMT A	TRMT B	RCV A	RCV B	FXO output
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 A	TRMT B	RCV A	RCV B	FXO output
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 A	TRMT B	RCV A	RCV B	FXS VF output
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 A	TRMT B	RCV A	RCV B	FXS VF output
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 A	B	RCV A	B	PLR E&M output
E-lead open	0	0	*	*	
E-lead grd or loop	1	1	*	*	
	*	*	0	*	M-lead grd or open
	*	*	1	*	M-lead batt or loop

Ringdown (RD) 2-wire, 900 ohm or 4-wire, 600 ohm

Input to RD	TRMT A	B	RCV A	B	RD output
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	1	0	*	ring on t,r pair
sg lead at grd	1	1	*	*	
sg lead at -48 Vdc	0	0	1	*	Grd sens relay to sg
sg lead at -48 Vdc	1	1	0	*	48Vdc to sg lead

9) If you need to dial on the circuit, enter the PLACE/RECEIVE CALLS menu. Select the METHOD, then enter the number you wish to dial.

10) When you are finished, disconnect the test set from the circuit.

1.14 Send 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 this procedure will introduce.

2) Switch on the test set. Enter the SET UP INTERFACE menu. Select DS1 (F1) for the TEST MODE.

3) Cursor down to the TSTSG item. Select either:

- PATRN: In the PATRN mode, the test set sends the tone on the selected channel, and fills the other 23 channels with an idle code. The received signal is terminated at the set, and is not retransmitted. Refer to Section 7.1 and Figure 7.1A for assistance in setting up this mode.

- THRU: In the THRU mode, the test set sends a tone on the selected channel. It receives and retransmits the other 23 channels

without disruption. Using the THRU mode will cause a momentary hit on the circuit when the test set is plugged in, and when it is unplugged.

4) Select your RECVR configuration:

- TERM is used to terminate the line in a 100 ohm resistance, and is generally used in out-of-service testing.

- DSXMON is used when you have 20 dB of protected monitor isolation resistance built into your DSX patch panel.

- BRIDGE is used when you are clipping directly onto the tip and ring of your T1 line.

   a) Press ENTER when your setting is correct.

5) Once your access mode has been chosen, plug the circuit into the test set.
   a) Press the HISTORY key to acknowledge the blinking history lights, and turn them off.

6) Move the cursor down to the VOICE FREQ FUNCTIONS item and press ENTER.
   a) Enter the VF MEASUREMENTS item.
   b) Use the NEXT (F1) or PREVIUS (F2) to set up the receive and transmit channels to the correct number.
   c) Move the cursor to the INSERT TYPE menu item, and press TONE (F2).

7) Move the cursor to TONE FREQ and select the desired frequency, using the more (F4) key to display additional alternatives. Select one of these, or enter in your frequency directly from the keypad, using the SHIFT-lock key. If you typed a value in from the keypad, press ENTER to begin sending the tone at your desired frequency.

8) Move the cursor to the TONE LEVEL item and select the desired level, either 0 dBm (F2), -13 dBm (F3), or enter a value directly from the keypad using the MINUS (F1) and the SHIFT-lock keys. If you typed a value in from the keypad, press ENTER to begin sending your tone at the desired level.

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9) When you are finished, disconnect your test set from the circuit.

1.15 Fractional T1 Testing

1.15.1 Fractional T1 Circuits

Fractional T1 circuits are circuits of data rate nx56 kbps or nx64 kbps, where n can be anywhere from 1 to 24 channels. N channels of the T1 line are dedicated to the fractional T1 circuit, and the remaining channels of the T1 line are either filled with an idle code or other revenue traffic.

A fractional T1 circuit typically starts out at the customer premises at a fractional T1 CSU (see Figure 7.15A). The purpose of this CSU is to convert the signal into a standard T1 signal suitable for transmission on the telephone company network. The CSU may also multiplex other fractional signals into an aggregate fractional signal within the T1. The CSU is configured to place the data into either an nx56 or nx64 kbps format. nx56 utilizes the first 7 bits in each channel, and allows the customer to transmit an unlimited number of zeroes, even when the T1 line is 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 each channel

of the circuit arrives in the same order (phase) that it left. If this does not happen, the signal becomes scrambled, and the receiver cannot properly decode the information. The signal will generally only arrive in phase if the fractional T1 circuit travels as a bundle through the various network elements and transmission media. If individual channels should become split onto two different transmission paths, the transmission delay of the two paths will probably be different, causing the problem.

We have already covered the function of the CSU in the fractional T1 circuit shown in Figure 1.15.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.

1.15.2 FT1 Circuit Acceptance Test Procedure

Here is an acceptance test procedure for a fractional T1 circuit. Refer to Figure 1.15.B. This is an advanced test procedure, which should only be attempted 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.

Figure 1.1.5.A Fractional T1 circuit
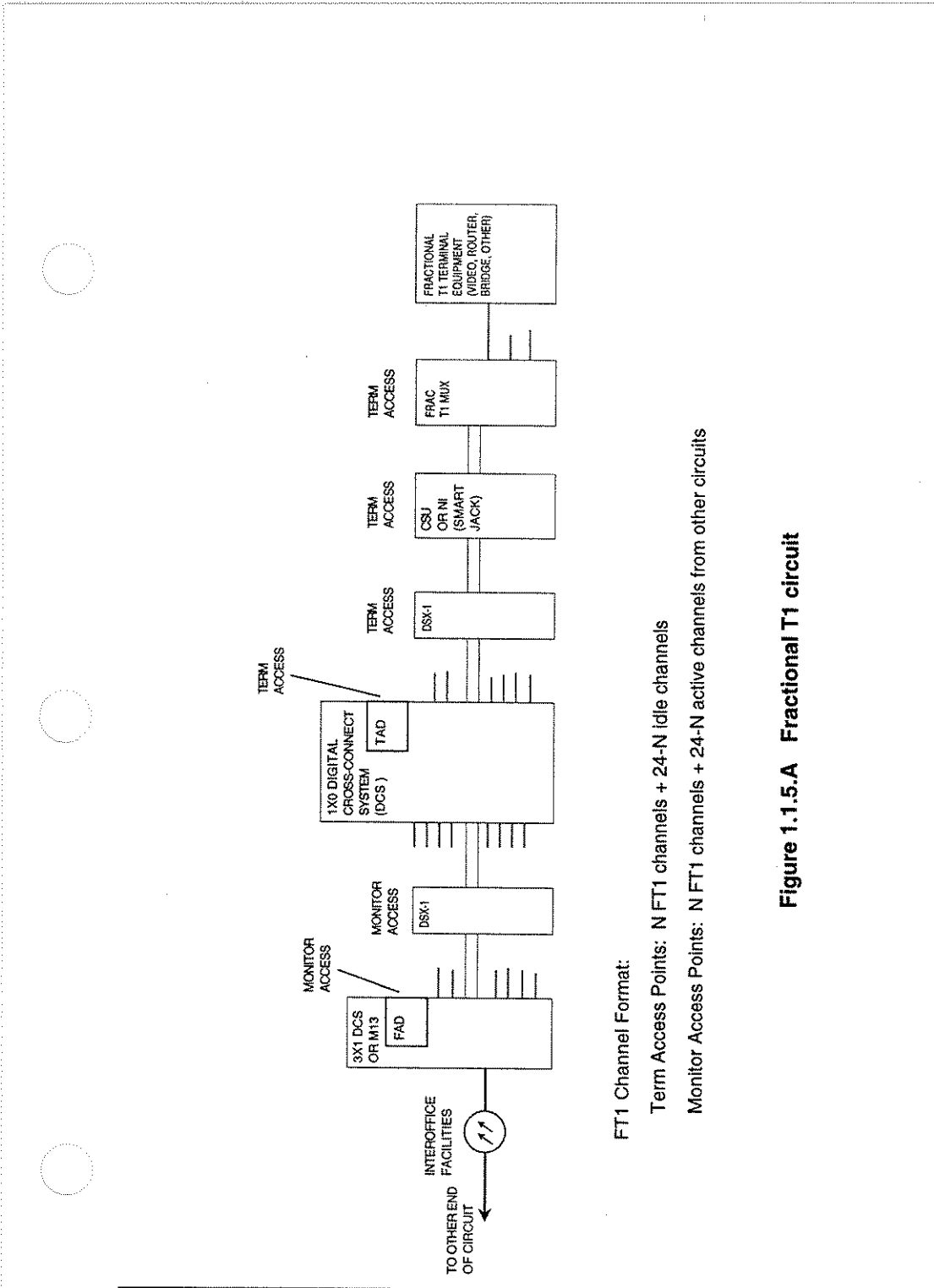
FT1 Channel Format:

Term Access Points: N FT1 channels + 24-N idle channels

Monitor Access Points: N FT1 channels + 24-N active channels from other circuits

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3) Enter the SET UP INTERFACE menu. Select DS1 (F1) for the TEST MODE.

Set the screen settings to:

FRAME: as specified by your design
TSTSG: PATRN
RATE: nx56 or nx64, set up the desired channels for transmit and receive
RECVR: TERM
CODE: as specified by your design
TxLBO: 0 dB (or as required)
TxCLK: INTERN if facing the Fractional CSU, otherwise DS1-Rx if facing the 1x0 DCS

When you press nx56 or nx64, the screen will switch to the FT1 TIME SLOT screen. Manually set up the timeslots to the configuration indicated in the circuit record. If the timeslot configuration is not known, AUTO (F1) configure to the active channels.

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 up in the OTHER FEATURES, TEST PARAMETERS, DS1 IDLE CHNL menu item, is not the same as the idle code on the circuit being tested. (7F = 01111111, FF = 11111111).

One good way to observe the idle and active channels is to plug the set in using the 1.544 Mbps test rate, and then go to the OTHER MEASURE-MENTS, VIEW RECEIVED DATA menu. This will allow you to double check what the test set comes up with in its AUTO configuration.

Press ENTER when the timeslot settings are as desired. This will return you to the SET UP INTERFACE menu. When the SET UP INTERFACE menu settings are as desired, press the ENTER key.

4) Connect the test set to the circuit at one of the term access points shown in Figure 1.15.A. Make sure you know which end of the circuit you are facing.

5) Loop up the circuit toward the near end CSU. A standard CSU loopback code may be used.

You may need to reconfigure your test set back to 1.544M RATE in the SET UP INTERFACE menu, in order to loop up the CSU.
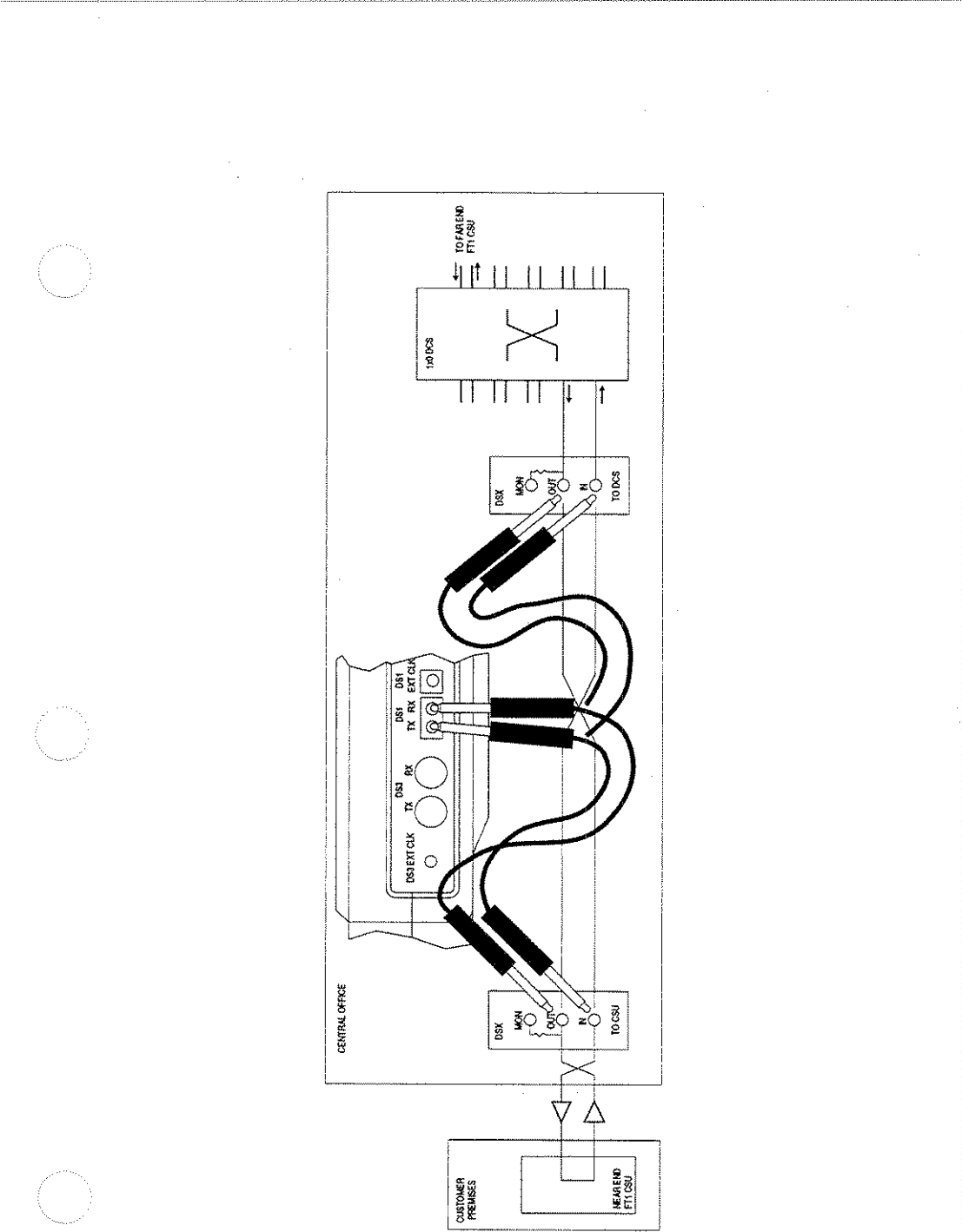
Figure 1.1.5.B   Plugging into the FT1 circuit

6) Enter the MEASUREMENT RESULTS menu, and perform the acceptance test.   Verify the fractional T1 service performs to your company's requirements for the service delivered.   If necessary, see the user's manual section which describes the MEASUREMENT RESULTS menu.

7) Change your test cords in order to look toward the far end CSU.

8) Loop back the far end FT1 CSU. You will need to find out what kind of loop code will activate the far end FT1 CSU. This may possibly require assistance at the far end.

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.   If necessary, see the user's manual section which describes the MEASUREMENT RESULTS menu.

1.16 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 also 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 only be used where the SLC-96 maintenance features are not available.

WARNING
SLC-96 systems carry up to 96 channels of customer traffic. Do not use the test setups shown in Figures 1.16.B and C unless you have been properly trained. Use the setups shown in Figures 1.16.B and C 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 1.16.A as a guide for each of these applications.

SunSet T3   Version 2.64

Some general information about SLC-96 systems is useful 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 interface to the switch. Conversely, newer switches may be built with a TR-TSY-000008 interface (SLC-96 interface standard) so 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, and 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, and the SLC-96 system keeps track of which channels are allocated to which customers, through the C bits in the SLC data link. Mode III is where the system only serves special service lines. In this mode, it 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 only used 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.

1.16.1 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) Enter the SET UP INTERFACE menu. Select DS1 (F1) for the TEST MODE.
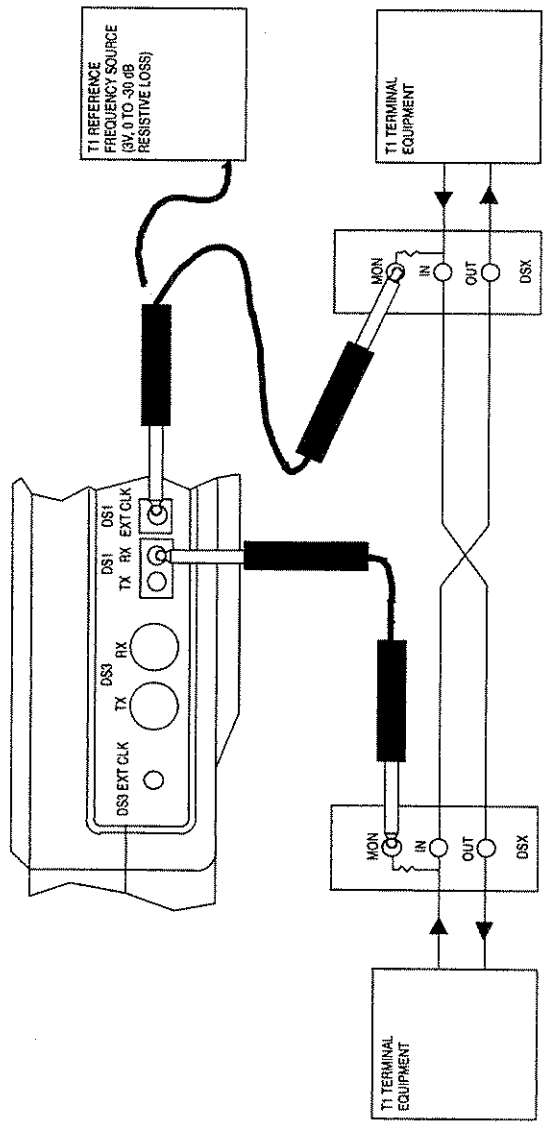
Figure 1.16.A Typical SLC-96 system configuration

SunSet T3 Version 2.64

Set your screen settings to:

    FRAME: SLC96
    TSTSG: PATRN
    RATE: 1.544M
    RECVR: DSXMON
    CODE: AMI (or as provisioned)
    TxLBO: 0 dB (or as required)
    TxCLK: INTERN

    a) When your settings are correct, press ENTER.

3) Connect the test set to the circuit as shown in Figure 1.16.B.

4) Perform a 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 menu.

    a) Enter the MONITOR DATA LINK item. Observe if a protection switch is in place. If there is one, note which digroup and which 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,
    • if there is a far end loop in place.

7) Take appropriate maintenance action. Unplug the test set from the circuit.
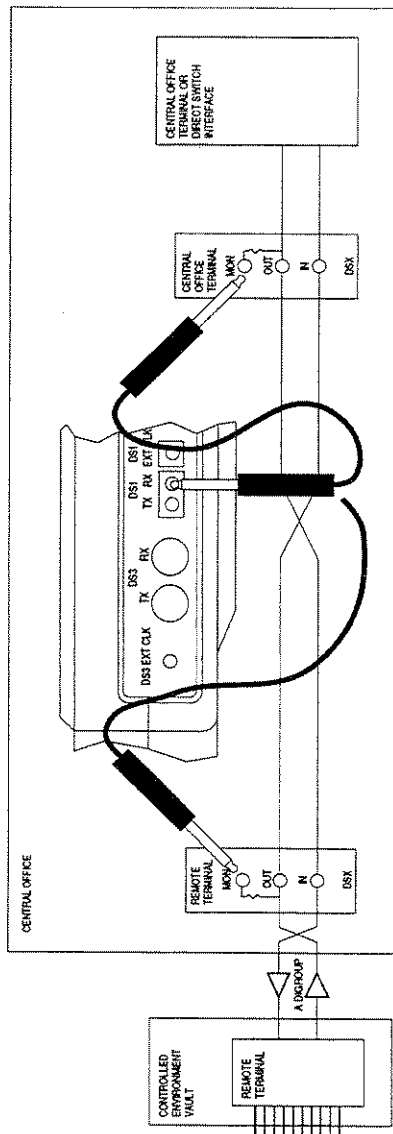
Figure 1.1.6.B Monitioring the SLC-96 Data link

SunSet T3   Version 2.64

1.16.2 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) Enter the SET UP INTERFACE menu. Select DS1 (F1) for the TEST MODE. Set the screen settings to:

FRAME: SLC96
TSTSG: PATRN
RATE: 1.544M
RECVR: TERM
CODE: AMI (or as provisioned)
TxLBO: 0 dB (or as required)
TxCLK: INTERN

    a) When your settings are correct, press ENTER.

3) Connect the test set to the circuit as required for the testing you wish to perform. Refer to Figures 1.16.A, C and 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.
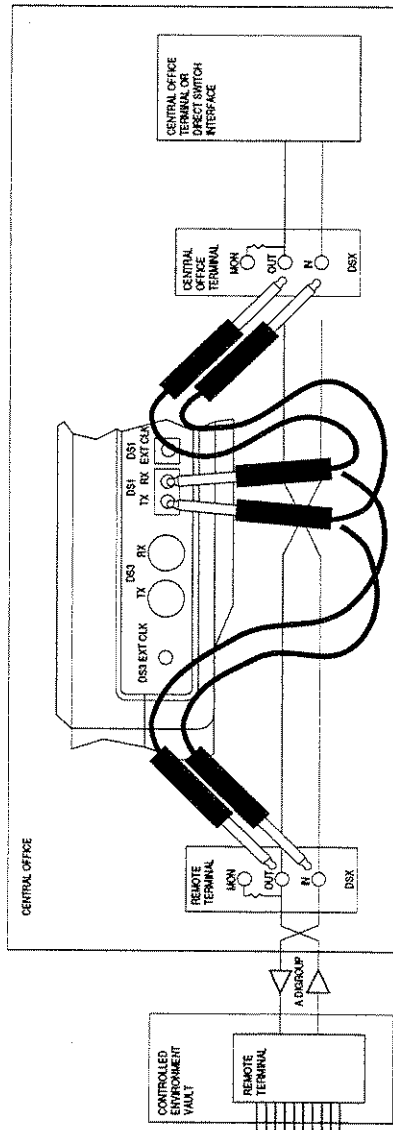
Figure 1.16.C   SLC-96 out-of-service testing

SunSet T3 Version 2.64

- Verify that A digroup can do a half-switch when half of the A-digroup and half of the protection digroup is not working.
- Verify fast and transparent protection switching so that users do not notice a problem.
- Verify proper assignment of channels during mode II operation.

4) When you are finished, disconnect the test set from the circuit.

1.16.3 Testing a Digroup on a Working SLC-96 System

Here are some application notes for looping back and troubleshooting a digroup on a working SLC-96 system. Note that this is not a complete discussion of in-service SLC-96 intrusive testing, and that you should not perform this testing without additional maintenance and procedural information, and training beyond what is presented here. Further, you should double-check the information presented here against the maintenance procedures of your particular system.

A key requirement of in-service SLC-96 testing is that you not accidentally drop service to the people who are using the SLC-96 system. One inadvertent mistake may affect many customers.

Where possible, you should use the built-in maintenance features of your SLC-96 system to effect a protection switch and far-end loopback. The procedure presented here should only be used when the built-in features of your system are not available for some reason.

1) Verify that the protection digroup is available. Do this by using the procedure described in 1.16.1.

  a) Verify in the MONITOR DATA LINK menu that PROTECT LINE SW says IDLE on both directions of transmission on the A digroup. If either direction does not say idle, then the protection line is already in use and can't be used for additional switching.

  b) Verify that the protection digroup is transmitting the same bit stream as the A digroup. You can do this by simultaneously using two test sets to monitor the SLC-96 data links on each digroup and by viewing the received data on each digroup.

Notes:

1) Plug the cords in in the order shown: First #1, then #2 and so on.

2) Two sets are required for this set-up.

3) A termination plug may be needed in each OUT jack. Otherwise, the MON signal may be unreadable. For this reason, for steps #5 and #10, plug in a TERM jack into each OUT jack. Have the termination plug ready in your hand so that you can instantly insert it after the previous step.

Figure 1.1.6.D   SLC-96 A Digroup data link tranmission

2) Obtain three test sets for general system testing. Configure the SET UP INTERFACE items of two of the sets to be DS1/SLC96/THRU/1.544M/ TERM/AMI/0dB/INTERN.

   a) Once these settings have been entered by pressing the ENTER key, plug the two sets in series with the two directions of transmission on the A digroup, as illustrated in figure 7.16D. Be sure to plug in the cords in the sequence shown in the diagram to minimize the amount of downtime for the A digroup. Before plugging the set in, obtain two termination plugs to put in the two OUT jacks shown in steps 5) and 10).

3) After making sure the protection line is idle, also make sure the protection line is in service. Do this by taking the set that is transmitting toward the remote terminal, and requesting a far end loop for the protection line.

   a) Enter the SEND MESSAGE menu, choosing WP1 or WP1B, as appropriate for the MODE, and then selecting ALM for P-FELP. Press the ENTER or SEND key to actually send the message.

   b) Take your third test set and plug into the protection line towards the remote terminal, and verify that you can send and receive error-free towards the remote terminal.

   c) After verifying that the transmission is error free, go back to the first test set, and drop the protection line far end loop by changing P-FELP to CLR and pressing the SEND or ENTER key.
      Repeat the procedure for the other test set towards the central office terminal. This will allow you to check the entire length of the protection line from your midpoint of test access. Note that your central office terminal may or may not support the loopback feature.
      If your protection line has tested OK, then you may proceed to switch the desired live digroup to the protection line as described in step 4).

4) If you wish to switch the B, C, or D digroups, use this procedure. If you wish to switch the A digroup, then move directly to step 8).

   a) Request a switch to protection by entering the SWITCH

PROTECT LINE menu item on both test sets.
b) Select SWITCH as the desired ACTION and LINE-B, C, or D as the LINE.
c) When the menus on both sets are properly set up, press the two ENTER keys simultaneously to get both terminals to switch to the protection line at the same time.
d) Move to the MONITOR DATA LINK menu in each set, to verify that each terminal is transmitting back that it has switched the desired line to the protection digroup. If PROTECT LINE SW says IDLE, then that terminal did not switch the desired digroup to the protection line and you may not proceed with your testing.
    Note the test sets must continue transmitting the protection line switch command for the entire time you want to perform your loopback test.

5) Move to the SEND MESSAGE menu, and send a far end loop message to the appropriate digroup B, C, D, or P (if you are testing the protection switch digroup). Do this by setting B-, C-, D, or P-FELP to ALM. Move to the MONITOR DATA LINK and verify that you are receiving ALM from the terminal in the appropriate B-, C-, D-, or P-FELP message. This will verify that the far end loop has been performed.

6) Plug your third test set into the digroup B, C, D, or P to be tested.
a) Transmit and receive QRS or other test patterns to verify transmission performance.
b) Perform standard transmission tests. Test towards the remote terminal and the central office terminal if you were able to establish loopbacks in each direction.

7) When you have finished testing, unplug the third test set, and test cords from the B, C, D, or P digroup.
a) Enter the SEND MESSAGE menu in the two A digroup test sets and change the B-, C-, D-, or P-FELP to CLR and press ENTER or SEND.
b) Move to the MONITOR DATA LINK menu in both sets, and verify that the terminals are sending CLR in the B, C, D, or P FELPs. This will indicate that the loops have been dropped at each end.
c) Move to the SWITCH PROTECT LINE menu in both sets, and select RELEASE. Press the ENTER or SEND key in both sets simultaneously. This will release the protection switch at both ends at the same time. Verify that you get a SWITCH succeeded

response in both sets. You have now restored the SLC-96 to a normal operating condition.

d) Unplug both A-digroup test sets in the exact reverse order of the way you plugged them in. Be careful to unplug the TERM plug in the OUT jack and the test cord in the IN jack at the same exact time. In other words, steps 9) & 10) happen simultaneously, and steps 4) & 5) happen simultaneously.

You are now finished with your maintenance procedure.

8) Follow a different procedure for looping back and testing the A digroup.

a) Instead of plugging your two test sets in the A digroup as described in step 2) and as shown in figure 1.16.D, plug them into the P digroup in the same fashion. The P-digroup will become the control digroup while you are testing the A digroup.

b) Set up both test sets in the SWITCH PROTECT LINE menu to request a LINE-A SWITCH. Press the ENTER or SEND keys of both sets to send this message. This message will keep the SLC-96 system on the protection line once you actually get it switched to the protection line as described in the next step.

9) Initiate a switch to the protection line by simultaneously inserting unattached test cords into the IN and OUT jacks of the A digroup facing the remote terminal. This will cause a loss of received signal on the A digroup at both terminals. Each one should switch to the protection digroup within a few milliseconds. The quick switch is possible because an idle protection digroup carries the A digroup bit stream.

10) Request and verify an A-FELP in the SLC-96 SEND MESSAGE menu as described in step 5).

11) Use a third test set to test the A digroup as described in step 6).

12) Unplug the third test set, and restore the SLC-96 system to operational condition as described in step 7). You are now finished with the procedure.

1.17 Using a T-BERD Power Lid

Using the T-Berd Power Lid is simple with the SunSet T3. Use this procedure:

1) First read your T-Berd Power Lid manual for general operation and safety instructions.

2) At the point where you would plug in a T-Berd test set, instead plug in the SunSet T3. You may use the SS111 Dual Bantam to 15-pin D-subminiature Connector Cable, Female.
   a) Plug the cable's bantam side into the test set. The arrows should point into the DS1 RX jack and out of the DS1 TX jack.
   b) Plug the cable's 15-pin female connector into the 15-pin male connector attached to the spiral cord coming out of the power lid.

3) You can now test the powered span with your test set.

1.18 Inserting a DS1 Test Signal into an In-service DS3 Circuit

Use this procedure to insert a DS1 test signal into a DS3 circuit. Refer to Figure 1.18.A. You will need another SunSet T3 or other piece of test equipment to receive the DS1 signal at the far end of your circuit.

1) Switch on the test set.

2) From the MAIN MENU, enter the SET UP INTERFACE item. Select ChanDS3 (F3) for the TEST MODE.

3) Select 3Rx/3Tx for the DS3/1 CNFG. For the DS3 side, configure these screen settings:

   Tx/27: THRU
   TxLVL: DSX (or as required)
   RxLVL: LOW (or as required)
   TxCH: as specified by your design
   RxCH: as specified by your design

Figure 1.18.A   Insert a DS1 into a DS3 - In Service

For the DS1 side, configure these settings:

TSTSG: PATRN
RATE: 1.544M

a) Press ENTER when your settings are correct.

4) Connect the test cable to the test set's DS3 RX jack. Connect the other end of this cable to the DSX-3 MON jack of your circuit. The sequence of connections is illustrated in Figure 1.18.A.

5) Press the AUTO key to allow the test set to configure itself for your circuit's framing, line coding and any possible stress pattern. Make sure that the DS3 and DS1 framing LEDs light up green. Do not proceed until the test set has synchronized on a valid framing type and the circuit seems to be operating correctly.

6) Enter the SEND TEST PATTERN menu and select your desired DS1 stress pattern. Note that this pattern will be transmitted on a single DS1 while the remaining 27 DS1s will be looped "THRU" the test set undisturbed.

7) Connect a test cable to the DS3 TX jack on the test set. Connect the other end of this cable to the IN jack of your circuit. This step will place a momentary hit on the circuit.

8) You are now inserting your selected DS1 test pattern on a single DS1. Each of the other 27 DS1 signals are being looped through the test set unaffected.

9) When you are finished, disconnect your test set from the circuit in exactly the reverse order in which it was connected. Failure to observe the exact order may result in the circuit being brought down. Refer to figure 1.18.A for the correct sequence.

1.19 Checking for Proper M13 MUX Operation

Check the operation of your M13 MUX by using the following procedure and referring to Figure 1.19.A.

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1) Switch on the test set.

2) From the MAIN MENU, enter the SET UP INTERFACE item. Select ChanDS3 (F3) for the TEST MODE.

3) Begin by testing the multiplexing operation of the M13. The signal path is given in Figure 1.19.A. To do this, select 3Rx/1Tx for the DS3/1 CNFG. Refer to Figures 1.19.B and C.
   For the DS3 side, configure the screen settings for:
       FRAME: as specified by your design
       Tx/27: AIS
       TxLVL: DSX (or, as required)
       RxLVL: DSX (or, as required)
       TxCH: 01
       RxCH: 01

   For the DS1 side, use the following settings:
       FRAME: as specified by your design
       TSTSG: PATRN
       RATE: 1.544M
       RECVR: TERM
       CODE: as specified by your design
       TxLBO: 0 dB
       TxCLK: INTERN
       PortTx: DS3drp

   a) Press ENTER when your settings are correct.
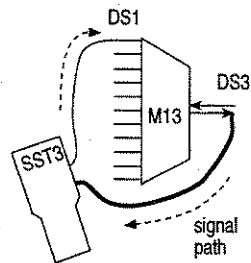
Figure 1.19.A Check Multiplexing Operation

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4) Enter the SEND TEST PATTERN menu, and select the DS1 stress pattern you wish to transmit into the MUX. This pattern will appear on the first DS1, given by the TxCH selection above.

```
                                 04:10:32

                 SET UP INTERFACE
        TEST MODE : ChanDS3
        DS3/1 CNFG:[ 3Rx/1Tx ]
          - DS3 -            - DS1 -
        FRAME: M13       FRAME : SF-D4
        Tx/27: AIS       TSTSG : PATRN
        TxLVL: DSX       RATE  : 1.544
        RxLVL: DSX       RECVR : TERM
        TxCH : 01        CODE  : B8ZS
        RxCH : 01        TxLBO : 0 dB
                         TxCLK : INTERN
                         PortTx: DS3drp

        3Rx/3Tx 1Rx/3Tx 3Rx/1Tx   more
```

Figure 1.19.B   Set Up Interface

5) Connect the test set's DS1 TX jack to the DS1 #1 input on the M13.

SunSet T3   Version 2.64
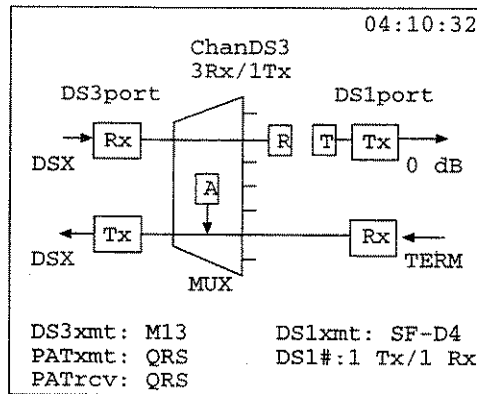
Figure 1.19.C   Graphic

6) Connect the test set's DS3 RX jack to the DS3 output connector on the M13. You are now transmitting your test pattern on DS1 #1 and then examining the same DS1 after it has been multiplexed by the M13.

7) Examine the LEDs on the test set closely. If you are unable to synch onto your selected pattern, then the DS1 connections on your MUX may be mislabeled or miswired.

   If this appears to be the problem, investigate further by cursoring down to the RxCH in the SET UP INTERFACE menu, then changing this number until you obtain pattern synch. Once pattern synch has been obtained, compare the RxCH number to the label for the DS1 connector on the side of your MUX. These should be numbered the same.
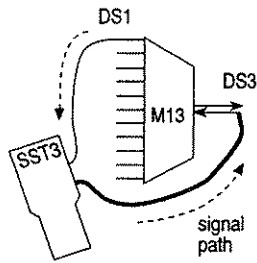
Figure 1.19.D   Check Demultiplex Operation

8) From the MAIN MENU, enter the MEASUREMENT RESULTS item. Verify the proper operation of your M13 MUX. You may wish to inject errors into your DS1 and verify that they are passed through the M13 MUX. You have now verified the multiplexing operation of the M13 for DS1 #1.

9) Enter the SET UP INTERFACE menu and configure both the TxCH and RxCH for 02. Disconnect the DS1 TX jack on the M13 and reconnect it to the DS1 #2 input. Repeat steps 7 and 8 for each of the remaining DS1s.

10) When you have verified that the multiplexing operation of the M13 is acceptable, repeat the procedure for a 1Rx/3Tx configuration. Make sure you specify the correct TxCH for your testing, and that the test set's DS3 TX jack is connected to the DS3 input of the MUX, with the DS1 RX jack connected to the DS1 output of the MUX. This will test the M13's demultiplexing operation. Refer to Figures 1.19.D, E and F.

```
                                      04:10:32

              SET UP INTERFACE
TEST MODE : ChanDS3
DS3/1 CNFG: 1Rx/3Tx
   - DS3 -          - DS1 -
FRAME: M13        FRAME : SF-D4
Tx/27: AIS        TSTSG : PATRN
TxLVL: DSX        RATE  : 1.544
RxLVL: DSX        RECVR : TERM
TxCH : 01         CODE  : B8ZS
RxCH : 01         TxLBO : 0 dB
                  TxCLK : INTERN
                  PortTx: DS3drp

3Rx/3Tx 1Rx/3Tx 3Rx/1Tx    more
```

Figure 1.19.E   Set Up Interface

Figure 1.19.F   Graphic

11) When you have verified that the M13 is operating correctly in both directions, you are finished.

1.20 Looping Back a DS1 Device within a DS3

Use this procedure for looping back a DS1 device from a DS3 access point, when the circuit is out-of-service.   Refer to Figure 1.20.A.

1) Switch on the test set.

2) Enter the SET UP INTERFACE menu. Select ChanDS3 (F3) for the TEST MODE. Select 3Rx/3Tx for the DS3/1 CNFG.

   Use these screen settings for the DS3 side:
    FRAME: as specified by your circuit design
    Tx/27: AIS
    TxLVL: DSX
    RxLVL: DSX
    TxCH: as specified by your design
    RxCH: as specified by your design

   Use these settings for the DS1 side:
    FRAME: as specified by your design
    TSTSIG: PATRN
    RATE: 1.544M
    RECVR: TERM
    CODE: as specified by your design
    TxLBO: 0 dB (or, as needed)
    TxCLK: INTERN
    PortTx: DS1Rx

   a) Press ENTER when your settings are correct.

3) Enter the LOOP BACK CONTROL menu.
   a) Select the DS1 LOOPBACK item.

   For SF-D4 framing, use these settings:
    MODE: LOOP-UP (select this last)
    TYPE: IN-BAND
    CODE: as required

   For ESF framing, use these settings:
    MODE: LOOP-UP (select this last)
    TYPE: ESF-DL

SunSet T3 Version 2.64
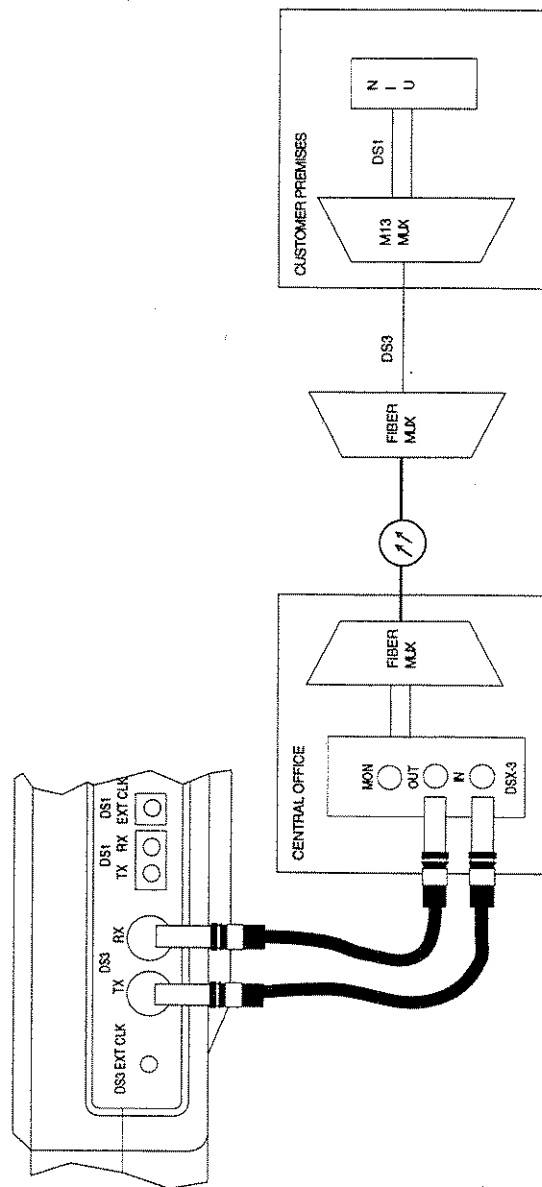
Figure 1.20.A   DS2 Loopback within a DS3 Signal

CODE: as required

4) You will receive an indication the loopback has completed. Press ESCAPE to return to the MAIN MENU. You may now perform your testing on the DS1 looped back device. The DS1 device which has been looped back is the one which is attached to the TxCH/RxCH selected above.

5) When your testing is complete, drop the DS1 loopback and disconnect your test set from the circuit.

1.21 Protect Switch Timing

Protect Switch Timing measures the time it takes a switch or multiplexer to change trunks when necessary. You may force a switch to use an alternative trunk by using the switch's software commands, or by physically disconnecting an active trunk. See Figure 1.21.A

1) Enter PROTECT SWITCH TIMING from the OTHER MEASUREMENTS menu.

2) Observe the Events, and the Time at which they occurred.
  • You may observe when Frame or Signal loss began, and when Frame or Signal loss ended.
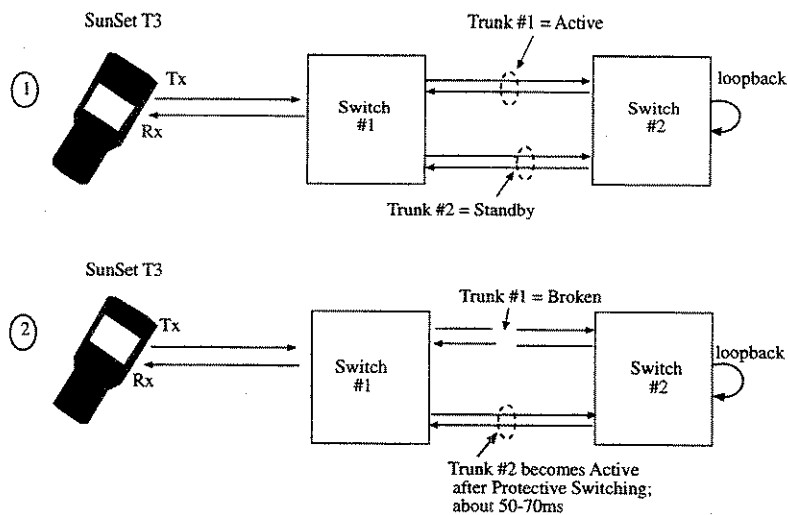
Figure 1.21.A Protect Switch Timing

2.0 E1 Applications

2.1 Accept a New 2.048 Mbps Circuit

Here is a procedure for accepting a new circuit. The setup is illustrated in Figure 2.1.A.

1) Verify that the circuit is not in service. This acceptance test will disrupt service. Ensure that there is a loopback device at the far end of the circuit.

2) Switch on the test set. Wait for the circuit graphic to be displayed. Press the ENTER key to move to the MAIN MENU.

3) Highlight the SET UP INTERFACE menu item; press ENTER. Select E1 as your test mode.

Use the following configuration:

FRAME: as specified by the circuit design (not AUTO)
CRC-4: as specified by the circuit design
RxLVL: TERM
CODE: HDB3
TSTSG: PATRN

   a) Press ENTER when all of the settings are correct.

4) Cursor to the SEND TEST PATTERN menu item and press ENTER.
   a) Highlight the pattern you want to send. Press ENTER.

5) Connect the SunSet to the circuit as shown in Figure 2.1.A. Press the HISTORY key to acknowledge any blinking history lights and turn them off.
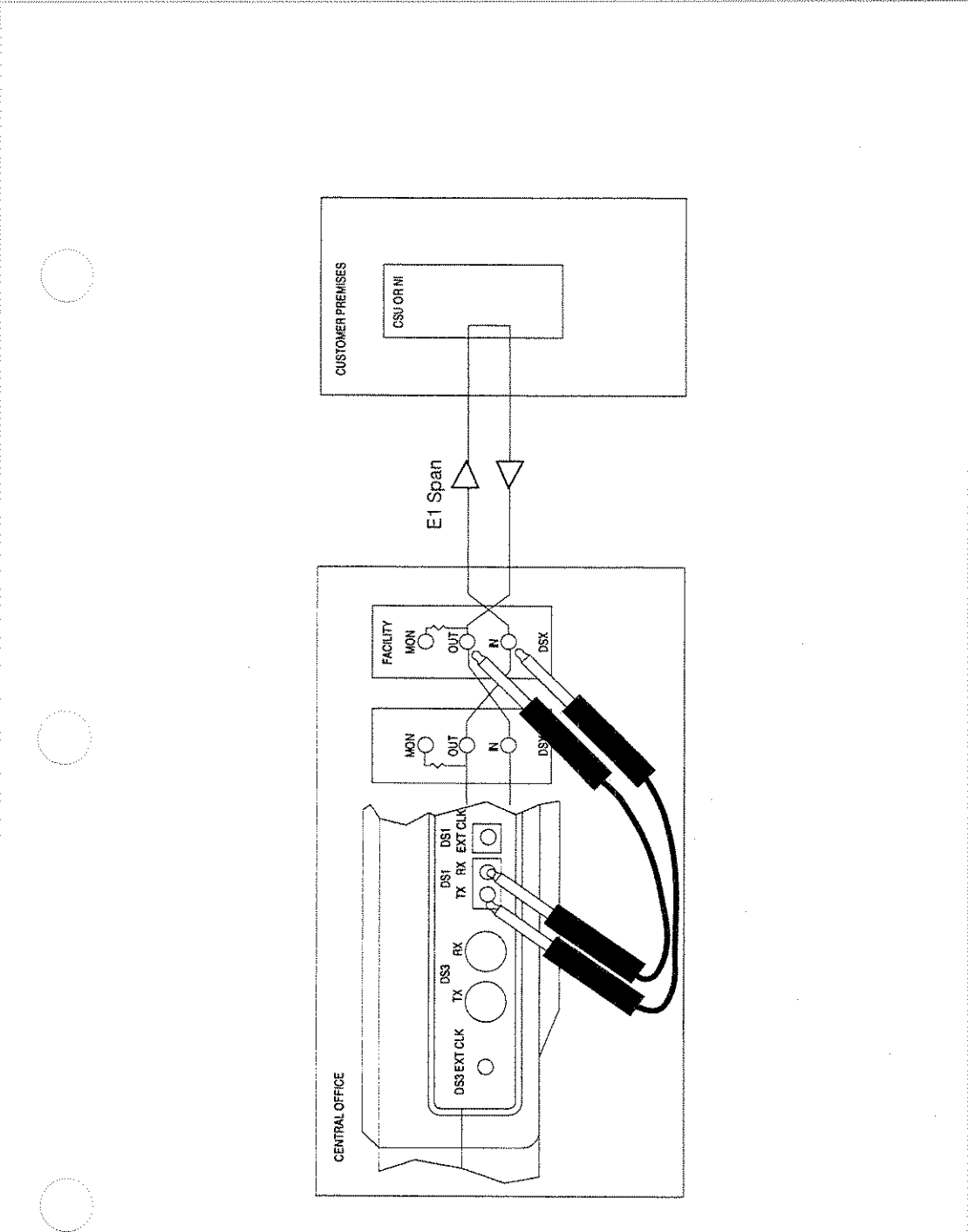
Figure 2.1.A   Accept an E1 Circuit

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6) Enter the MEASUREMENT RESULTS menu item. Verify that the circuit performs to your company's requirements for the service delivered. If necessary, refer to the Measurement Definitions section for an explanation of the BASIC MEASUREMENTS parameters. Use the PAGE-UP (F1) and PAGE-DN (F2) to access each of the individual measurement screens.

7) When your BASIC MEASUREMENTS have been completed, press the ESCAPE key to return to the MAIN MENU.

8) Remove the loop at the far end of the circuit.

9) Unplug the test set, turn it off, and put it away.

2.2 Monitor an In-Service Circuit

Here is a procedure for monitoring a circuit that is in-service. The setup is illustrated in Figures 2.2.A.

1) This test may be performed while the circuit is carrying live customer traffic.

.2) Press the ESCAPE key until you arrive at the MAIN MENU. Move your cursor to the SET UP INTERFACE item, and Select E1 as the Test Mode. Press ENTER.

Use the following configuration:

FRAME: as specified
CRC-4: as specified
RxLVL : DSXMON
CODE: AMI or HDB3
TSTSG: PATRN

a) Press the ENTER key when all of the settings are correct.

3) Connect the test set to the circuit as shown in Figure 2.2.A. Press the HISTORY key to acknowledge any blinking history lights and turn them off.
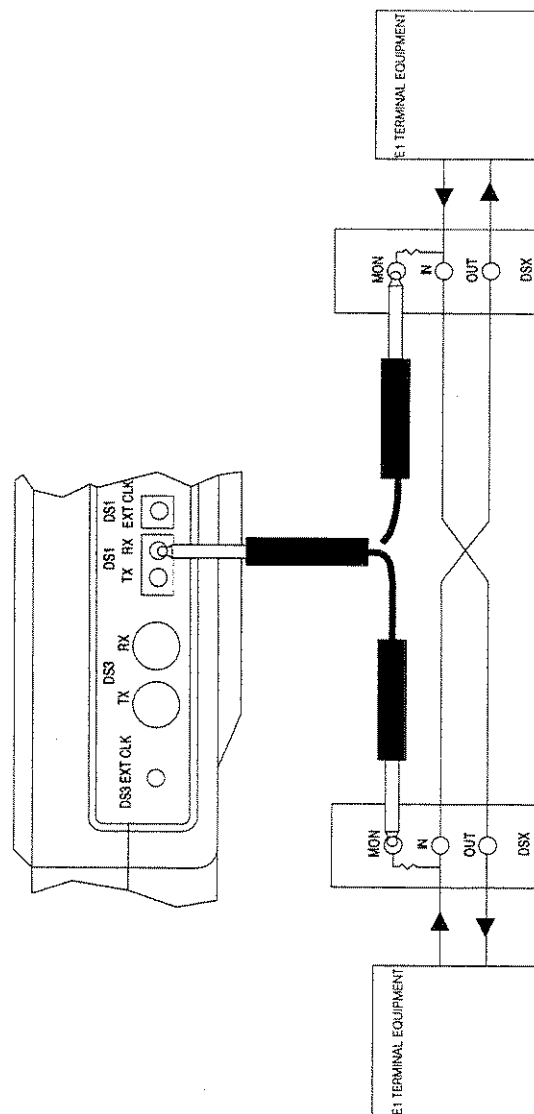
Figure 2.2.A Monitoring an In-Service Circuit

4) Examine the LEDs and the GRAPHIC screen for information about the circuit under test.

The PULSES light should be lit and a valid framing type should be indicated. A steady ERROR or CODE ERR light will tell you that the circuit is working but that it is experiencing trouble. SIG LOSS and FRM LOSS are indications of severe problems. AIS may indicate a trouble condition where a network element transmitting to the test set has lost its incoming signal and has replaced it with the AIS signal.

The GRAPHIC screen will show what kind of pattern, if any, is being received by the test set.

5) To make a basic measurement:
   a) Press ESCAPE as necessary until you arrive at the MAIN MENU.
   b) Move your cursor to the BASIC MEASUREMENTS menu item. Press the ENTER key. Verify that the circuit performs to your company's requirements for the service delivered.

6) Unplug the test set from the circuit.

2.3 Monitor a Voice Frequency Channel

Here is a procedure for monitoring a voice frequency channel within an E1 circuit. The setup is illustrated in Figure 2.2.A.

1) This test may be performed while the circuit is carrying live customer traffic.

2) Switch on the test set.

3) Enter the SET UP INTERFACE menu. Use the following settings:

    FRAME: as determined, or press AUTO
    CRC-4: as determined
    RxLVL: DSXMON
    CODE: AMI or HDB3
    TSTSG: PATRN

    a) Press ENTER when your settings are correct.

4) Connect the test set to the circuit as shown in Figure 2.2.A. Press the HISTORY key to acknowledge the blinking history lights and turn them off. Verify that the PCM-31 or PCM-30 LED is lit.

5) From the MAIN MENU, move your cursor to the VOICE FREQ FUNC-TIONS item and press ENTER. Enter VF MEASUREMENTS. Select your desired receive (RCV) timeslot. The channel number will bypass any timeslots containing the E1 framing information. In PCM-31 framing, no access is granted to timeslot 00, while in PCM-30 framing, access to timeslots 00 and 16 is denied.

   Adjust the volume to the desired level by using the VOL UP and VOL DN keys.

NOTE: If you are not able to monitor the channel, verify that the AUTO framing of the test set was able to synch on a recognized framing type. The test set will not perform the monitor function if framing is unavailable. Press the RESYNCH key to restart the auto framer if a valid frame type is not shown. If this doesn't work, try unplugging and re-plugging the receive cord. This will verify that there is no recognizable framing at this moment.

6) When you are finished, disconnect the test set from the circuit.

3.0 Using the Battery & AC Charger

The T3 is powered by an internal nickel-hydride battery pack, and has a ninety minute nominal operating time. The battery pack is designed to provide adequate power for portable testing. It is charged by a custom-designed charger to provide optimum performance. This charger is powerful enough to run the test set continuously while keeping the battery charged. The SunSet T3 requires the SS138 charger.

The chargers features a special fast-charge feature which recharges your discharged battery quickly, so 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, which completes the charging process for maximum battery output. The trickle-charging mode is also non-damaging to the battery, even 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. The test set may run over 1 hour with a fully-charged battery when the backlight is off. However, it may run for about 10% less time when the backlight is left on continuously. Refer to Chapter 4, Section 7.4, to see how you can set your backLIGHT to turn off automatically.

2) Switch off the test set when it is not in use.

3) Use the Cigarette Lighter Battery Charger when you are driving your vehicle 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 test set will run indefinitely. If you wait until the battery is low during the middle of the test, when you plug the charger in, the set's processor may reset and drop the current test as you are plugging in the charger.

5) Recharge the battery 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 overnight.

6) Do not use any other charger with this test set. Using another charger will void your warranty. Other 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

4.0 Using the Serial Port

The test set is equipped with a standard Serial Port, for both printing and remote control operations.

4.1 Serial Port Settings

The Serial Port is configurable for: baud rate, parity, stop bit, and bits/ character. These settings are configured in OTHER FEATURES, GENERAL CONFIG, from the MAIN MENU. In general, the test set's serial port settings will need to match the settings of your printer or remote control. Configuring the test set's serial port is described in detail in the procedures that follow.

4.1.1 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 (i.e. it has no ink cartridge or ribbon which needs to be replaced). Many other serial printers are available to the user; however, not all of these printers will operate correctly with the test set. 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.

Refer to Figure 4.1.B for a diagram of the pin-to-pin assignments of the DIN to EIA-232-C cable supplied by Sunrise Telecom.

If you wish to connect to a modem or other brand of printer, you may find the SS122 Null Modem Adapter useful. Refer to Figure 4.1.A.

```
    ------ PIN-TO-PIN CONNECTIONS -----

      DB-25 FEMALE           DB-25 MALE
    PIN#  DESCRIPTION      PIN#  DESCRIPTION
      7   SG  ─────────────  7   SG
      5   CTS ─────────────  20  DTR
      3   RD  ─────────────  2   TD
      2   TD  ─────────────  3   RD
```
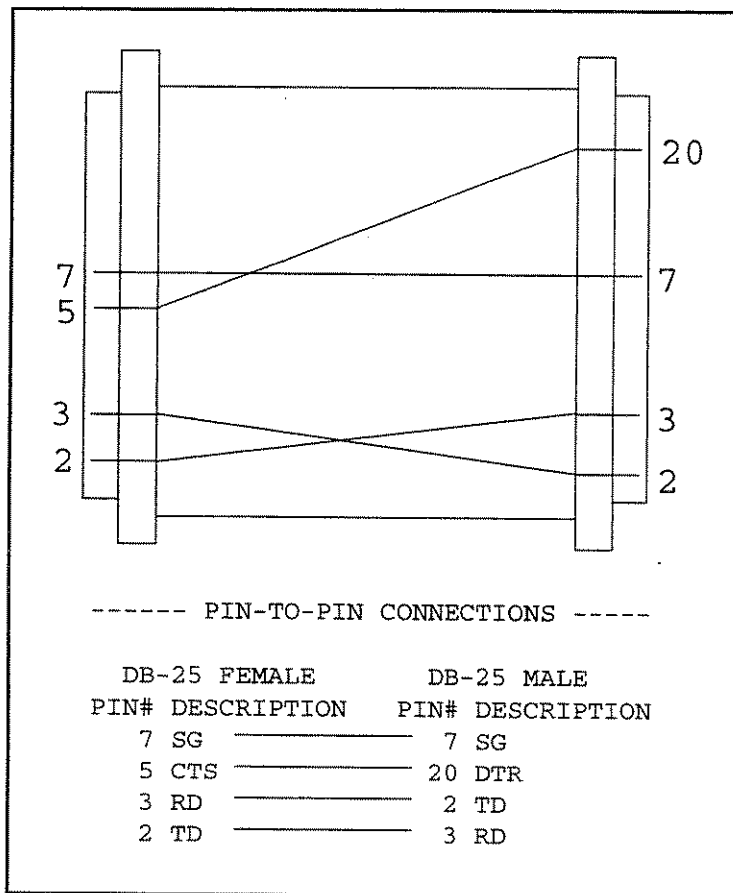
Figure 4.1.A   Null Modem pin assignments

To begin printing, follow this procedure:

1) Connect the Sunrise Telecom DIN-8 to RS232C Printer Cable (SS115) to the test set.
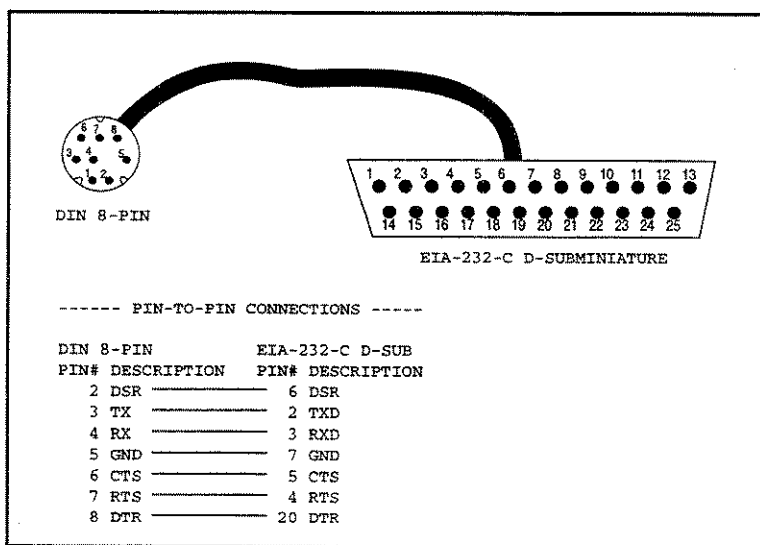
Figure 4.1.B   Printer Cable Pin Assignments

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 the test set'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 4.1.C for the correct switch settings.

The test set's factory default serial port settings are:
BAUD RATE: 9600
PARITY: NONE
STOP BIT: 1-BIT
BITS/CHAR: 8-BIT
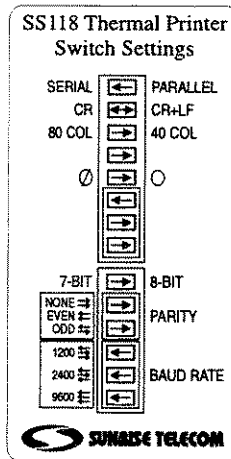
Figure 4.1.C Printer Switch Settings

If you need to reconfigure the test set's serial port settings to match the settings of your printer, use the following procedure:

a) From the MAIN MENU, select OTHER FEATURES.

b) Select the GENERAL CONFIG item.

c) Use the Down Arrow key to access the BAUD RATE setting. Four selections are available: 1200 (F1), 2400 (F2), 9600 (F3) and 19.2K (F4). These settings determine the rate at which the test set transmits data (characters) to the printer. This setting must match the setting on your printer, otherwise random characters will appear on your printout.

d) Access the PARITY setting. Three options are available here: NONE (F1), EVEN (F2), and ODD (F3). This setting must match with the configuration of your printer.

e) Access the STOP BIT setting. Two options are available: 1-BIT (F1) and 2-BIT (F2). This setting must match with the configuration of your printer. Normally this is configured as 1-BIT.

f) Access the BITS/CHAR setting. Two options are available: 7-BIT (F1) and 8-BIT (F2). This setting must match with the configuration of your printer. Normally this is configured as 8-BIT.

4) Set up printer's printing instructions by accessing the PRNT PERIOD item. Use one of these settings:

TIMED: Choose TIMED (F1) if you would like to have the printer print out results at regular intervals. The default time is 1 minute. You may enter any interval between 1 minute and 99 minutes.

To change the interval, press the SHIFT-lock key to display the SHIFT indicator. Then enter the desired numbers from the keypad. Press SHIFT-lock again to remove the SHIFT indicator.

EVENT: Choose EVENT (F2) if you would like the printer to print out a time- and date-stamped result every time an error or alarm condition is detected.

LAST: Choose LAST (F3) if you would like the printer to print out your results only at the conclusion of your test.

If you are running a continuous test (i.e. the Remaining Time indicator in the MEASUREMENT RESULTS screen indicates CONTINU), then you must manually press the PRINT (F2) key in order to send the results to the print buffer.

Note that each result can only be printed once, as the printer buffer is then emptied.

5) Confirm that the DIP switch settings (or other switch settings) on your printer correspond to those of the test set's serial port above. If you have changed the DIP switch settings, switch the printer off and then on before continuing.

6) Ensure that the printer is powered up and "on-line".

7) Ensure that the test set is not displaying its GRAPHIC screen. This screen is non-printable.

8) Press the PRN SCRN (print screen) key on the test set's keypad.

9) The test set's current screen should now print. If it doesn't, check the connections, configuration and switch settings.

4.1.2 Using Remote Control

The SunSet T3 comes with an optional remote control feature. Controlling the test set through the remote control is similar to controlling the test set directly.

The remote control allows a remote user, and a local user, to use the test set together at the same time. This simultaneous-usage feature can help a team of people fix a problem faster.

Refer to Figure 4.1.B for a diagram of the pin-to-pin assignments of the DIN to EIA-232-C cable supplied by Sunrise Telecom. Refer to Figure 4.1.A for the pin-to-pin assignments of the Sunrise Telecom Null Modem Adapter.

You may need a break-out box, null modem, patch-box and other RS-232C communications tools if you wish to set up your own serial communications. Here are some helpful hints. The test set is configured as a DTE. You will need a modified null modem cable if you wish to connect directly to a terminal.

It often is successful if pin 20 (DTR) of the modem or terminal is connected to pin 5 (CTS) of the test set DB25 connector. Pin 5 of the test set DB25 connector must show green on a breakout box in order for the test set to print. See Figure 4.1.D for a typical setup.

To begin remote operation, follow this procedure:
1) Connect the Sunrise Telecom DIN-8 to RS232C Printer Cable (SS115) to the SunSet T3.

2) If you are plugging directly into a terminal, 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.

   a) Connect the Null Modem Adapter to a "gender changer". Normally this will be a female-to-female conversion.
   b) Connect the gender changer to the cable which connects to your computer or terminal.
   c) Skip steps 3, 4, 5, 6, 7.

3) Connect the printer cable's RS232 end into a modem. A 9600 baud error-correcting modem is highly recommended. Some functions such as VF MEASUREMENTS will only work properly if a

9600 baud modem is used. Refer to Figures 2.12.A & 2.12.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.

4) If not already connected to an analog phone line, plug the modem into the telephone network (usually done with an RJ-4 cable).

5) Confirm that the SunSet's serial port settings correspond to those of your communications software or terminal. The SunSet's factory default settings are:

BAUD RATE: 9600
PARITY: NONE
STOP BIT: 1-BIT
BITS/CHAR: 8-BIT
CR/LF INSRT: CR+LF

If you need to reconfigure the SunSet's serial port settings, use the following procedure:

a) From the MAIN MENU, select SYSTEM PARAMETERS
b) Select the GENERAL CONFIG item.
c) Use the Down Arrow key to access the BAUD RATE setting. Three selections are available: 1200 (F1), 2400 (F2), and 9600 (F3). These settings determine the rate at which the SunSet transmits data (characters) to the computer or terminal. This setting must match the setting on your computer or terminal, otherwise random characters will appear on your remote screen.
d) Access the PARITY setting. Three options are available here: NONE (F1), EVEN (F2), and ODD (F3). This setting must match with the configuration of your remote control.
e) Access the STOP BIT setting. Two options are available: 1-BIT (F1) and 2-BIT (F2). This setting must match with the configuration of your remote control. Normally this is configured as 1-BIT.
f) Access the BITS/CHAR setting. Two options are available: 7-BIT (F1) and 8-BIT (F2). This setting must match with the configuration of your remote control. Normally this is configured as 8-BIT.

6) Set up a terminal to dial up the far modem and commence communications. Any terminal or personal computer with VT100 terminal emulation

software should work.
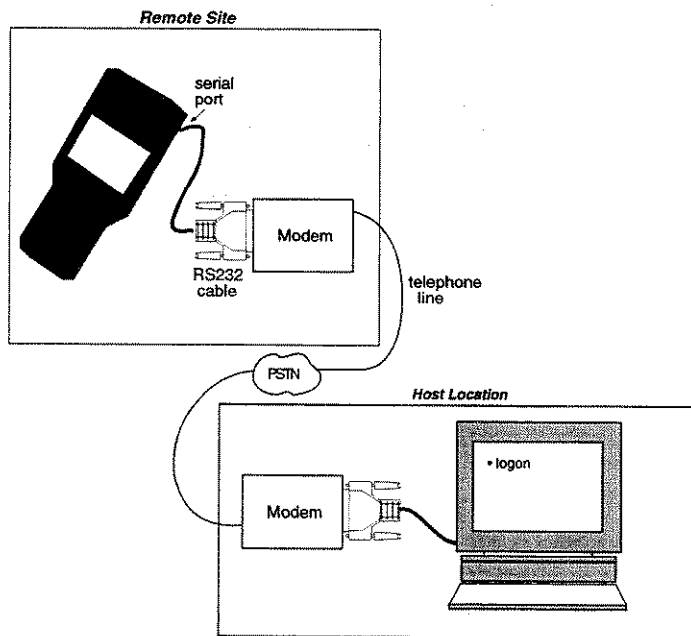
Figure 4.1.D Typical Setup

7) Call up the far modem with your terminal.

8) Once communication has been established with the far modem, log on to the SunSet T3 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.

9) Use the SunSet T3 just like you would use it locally. The same menus will be presented to you. The key options are listed under the Status Panel heading. The letter presented in bold is the key you push to initiate the command.

The cursor commands are: U p, dow n, lefT and R ight. In addition, you may find that the arrow keys on your computer/terminal will work.

Refres h repaints the screen.

Press Q uit functions as the ESCAPE key.

Other key functions are Inj err, H istory, and resY nch.

Pressing the Return key on your computer/terminal is the same as pressing the ENTER key on your test set.

F-key functions are provided by the - (F1), = (F2), [(F3), and] (F4) keys.

When you wish to enter letters or numbers in a setup screen, instead of using the SHIFT key and the orange test set key labels, just type in the numbers or letters directly from your computer/ terminal keyboard.

In remote control, you have access to most of the test set's capability. However, you will notice a few differences, such as the following:

• You will not have access to the GRAPHIC screen or the AUTO key.
• The MEASUREMENT RESULTS screen will be updated about once every 5 seconds instead of once each second.
• Local usage of print commands is not recommended during a remote control session because both the printer and the remote control use the same printer port. For instance, if a remote user is logged on, pressing the PRNTR key will log the user off.
• Talk/listen is not supported remotely.

10) When you are finished with the SunSet T3, type in:
        logoff
11) 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.

Using Remote Control from Windows 95

Here's a brief rundown on how to get your SunSet to work by remote control, when you are operating out of Windows 95.

1) From Accessories, start HyperTerminal
   a. Click to open the Hyper Terminal window

2) Double click on Hypertrm

3) At New Connection, enter "Sunrise Remote"
   a. Select an icon
   b. Click on Ok

4) In the Phone Number screen, click on the down arrow of the "Connect using:" box
   a. Select the modem or com port number you are using (note: if you are connected directly to a com port, you will need to use a Null Modem Adaptor)
   b. Click Ok

5) At the Port Settings, configure the settings as follows (matching those of your SunSet as set in the General Config screen):
   Bits per second: 9600 or 19200
   Data (or Char) bits: 8
   Parity: none
   Stop bits: 1
   Flow Control: none
   a. Click Ok when done. In the HyperTerminal screen, click on VIEW (IMPORTANT!)

7) Highlight and click on FONT

8) Highlight Terminal
   a. Set the Style and Size as you wish

9) Type "LOG-ON"

10) Remote control should work!

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Chapter 6
Troubleshooting
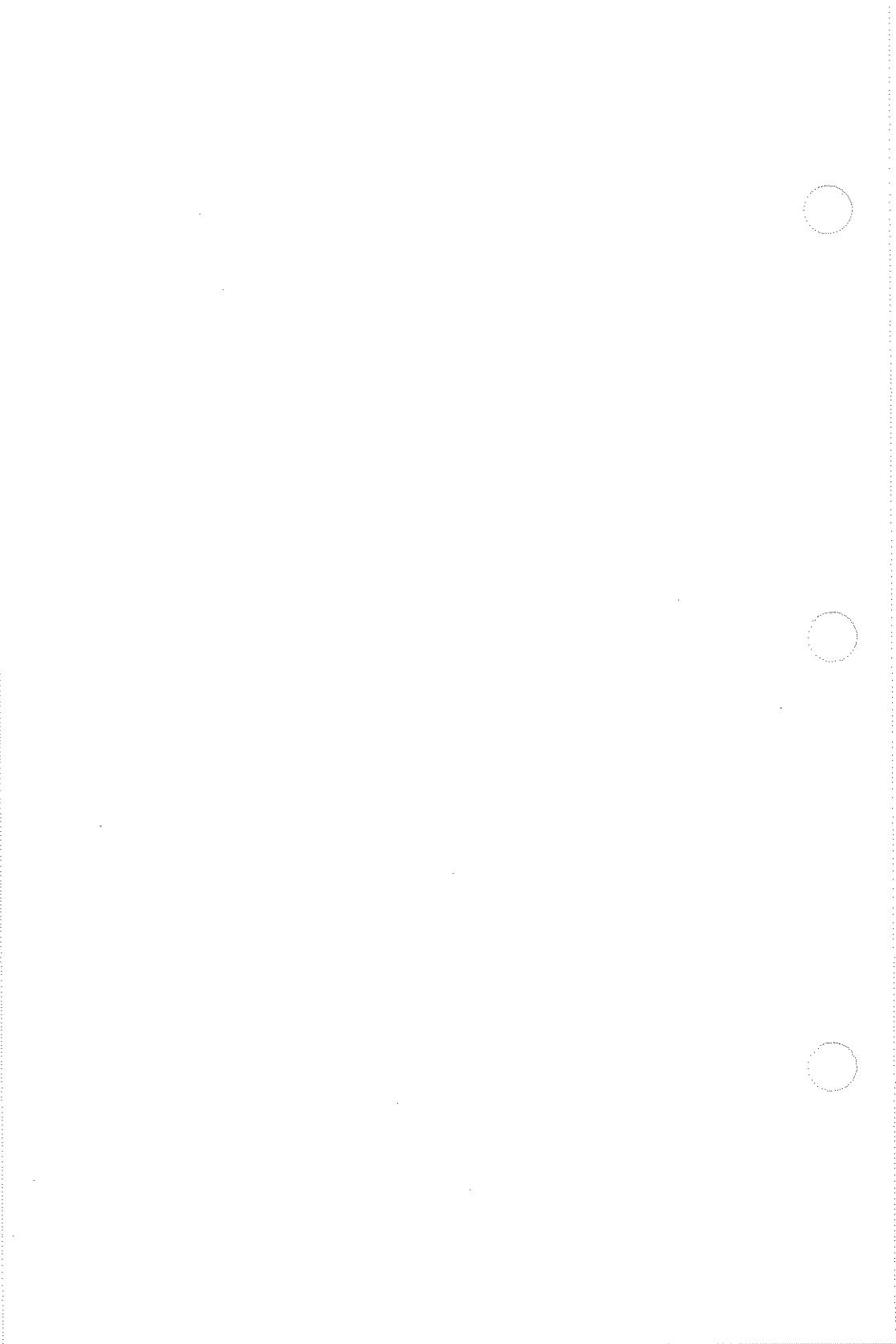
1.0 Troubleshooting

Here are some helpful suggestions for when your test set is not performing as expected.

Problem: ERRORS light, framing light, and other lights are red, but there should be no problem.
Suggestion:
1) SET UP INTERFACE configuration may be wrong. Try, TERM, MONITOR, BRIDGE for the DS1 side or HIGH, DSX, LOW for the DS3 side.

2) Check the cords; they may be loose or dirty.

3) Try reversing the DS1 TX, RX cords or the DS3 TX, RX cords.

Problem: Keys do not work properly.
Suggestion:
1) Verify SHIFT status by pressing and releasing the SHIFT-lock key until the SHIFT status indicator in the upper left-hand corner of the screen achieves the desired condition.

2) Do not press the SHIFT-lock key at the same time you press another key.

3) Press the SHIFT-lock key again. The test set may not have registered it the first time.

Problem: Test set will not power up properly.
Suggestion:
1) Make sure the battery is charged or the charger is plugged in. The test set's battery charger is powerful enough to power the test set and recharge the battery simultaneously.

2) Plug in the battery charger with the test set switched off. Verify that the LED on the battery charger is lit continuously. Let the test set charge for 5 minutes before switching it on.

3) 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 powers up, but screen is blank or unreadable.
Suggestion:
1) Adjust the contrast control knob (left side of the test set).

2) Try switching on the screen backlight with the LIGHT key.

Problem: Test set shows Security Violation when switched on.
Suggestion:
1) Make sure the serial number on the back 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, your test set will not work properly.

Problem: Test set performs improperly.
Suggestion:
1) Try switching the test set off, then switching it on again.

2) Try the ERASE NV RAM menu item.
   WARNING : this operation will erase all user-programmed information and history buffers within the test set. When the ERASE NV RAM has completed, switch the test set off for 5 seconds, then switch it on.

Problem: Measurements are not working properly (Loss of Signal, no Pattern Synch).
Suggestion:
1) Verify that the RECVR (DS1 side) or RxLVL (DS3 side) settings in the SET UP INTERFACE menu are correct.

2) Verify that all jacks are connected properly, according to the circuit graphic.

3) Ensure that the OUT and IN connections are not reversed.

4) Twist the plugs inside of the jacks and ensure that all plugs are inserted fully.

Problem: Test Patterns will not synch.

Suggestions:

    1) Press RESYNC to force the test set to resynchronize on the test pattern.

    2) Verify that you are transmitting the desired pattern in the SEND TEST PATTERN menu. Confirm this by checking the PATxmt reading on the GRAPHIC screen.

    3) Enter the OTHER FEATURES, TEST PARAMETERS menu, and make sure the PATTERN LOCK has been DISABLEd.

Problem: Test patterns will not synch with other test equipment.

Suggestions:

    1) Verify that the test set is configured for the same Framing and line Coding as the other test equipment. If you are unsure of the Framing and Coding, use the AUTO key.

    2) Verify that PATTERN INVERT is DISABLED in the OTHER FEATURES, TEST PARAMETERS menu.

    3) Use VIEW RECEIVED DATA to examine the pattern being received. The pattern being received may not be a standard test pattern.

    4) If the pattern being received is not a standard test pattern, then:

        a) Examine the received pattern using VIEW RECEIVED DATA.

        b) Use the STORE (F4) key in the VIEW RECEIVED DATA menu to store the received test pattern.

        c) The stored pattern will appear as a USER test pattern in the SEND TEST PATTERN menu.

        d) The test set may now be able to synchronize on the pattern when you press the RESYNC key.

2.0 Calibration Procedure

The SunSet T3 may be returned to Sunrise Telecom yearly for a full calibration procedure. Please contact Customer Service at 1-408-363-8000.

The following procedure may be used as a verification procedure you may perform on your own.

2.1 Verification Procedure

1) Switch the test set on.

2) Verify that all LEDs blink in sequence and that each LED lights properly. With the exception of the BATTERY and POWER lights, each LED should light in green and then red.

3) Verify that NO ERRORS is displayed at the completion of the Self Test.

4) Connect a single bantam to single bantam cord from DS1 TX to RX.

5) Connect a WECO 440A to WECO 440A cord from DS3 TX to RX.

6) Enter the SET UP INTERFACE item from the MAIN MENU.

7) At the TEST MODE item, press F1 to select DS1. Configure the set for:

FRAME: ESF
TSTSG: PATRN
RATE: 1.544M
RECVR: TERM
CODE: B8ZS
TxLBO: 0 dB
TxCLK: INTERN

a) Press ENTER when the settings are complete.
8) From the MAIN MENU enter MEASUREMENT RESULTS.

9) Using the PAGE-UP (F1) and PAGE-DN (F2) keys, access the DS1

MEASUREMENT screen where the DS1 signal levels are displayed. Verify that the +LVL is 3.00V +/- 10% and that the -LVL is 3.00V +/- 10%.

10) Verify that the FREQ is 1544000 +/- 1 Hz.

11) Press ESCAPE to return to the MAIN MENU.

12) Enter the SET UP INTERFACE item.

13) At the TEST MODE item, press F2 to select DS3. Configure the set for:

FRAME: M13
TSTSG: PATRN
TxLVL: DSX
RxLVL: DSX

a) Press ENTER when the settings are complete.

14) From the MAIN MENU enter MEASUREMENT RESULTS.

15) Verify that the Vpk is 0.76V +/- 10%.

16) Verify that the FREQ is 44736000 +/- 300 Hz.

17) Press ESCAPE to return to the MAIN MENU.

18) Enter the SET UP INTERFACE

19) If you have the SS300e option, Select E1 (more, F2) as the TEST MODE. Configure the set for:

FRAME: PCM-30
CRC-4: YES
RxLVL: TERM
CODE: HDB3
TSTSG: PATRN
a) Press ENTER when the settings are complete.

20) From the MAIN MENU, enter MEASUREMENT RESULTS.

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21) Press ERR INJ three times. Verify three errors were received in the G.821 screen.

22) Verify FREQ is 2048000 +/- 600 Hz.

23) Verify Lpp is 0dB +/- 0.5dB.

23) The verification procedure is now complete.

3.0 Customer Service

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

Customer Service performs the following functions:
• Answers customer questions over the phone on such topics as product operation and repair
• Repairs malfunctioning SunSets promptly
• Provides information about product upgrades

The warranty period covering the SunSet T3 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   Tel: 1 408 363 8000
Sunrise Telecom Inc.   Fax: 1 408 363 8313
22 Great Oaks Blvd.
San Jose, CA   95119
U.S.A.

Technical Support: (24hrs) 1 800 701 5208
Internet: http://www.sunrisetelecom.com
Email: support@sunrisetelecom.com

Chapter 7
Product Specs & Configs
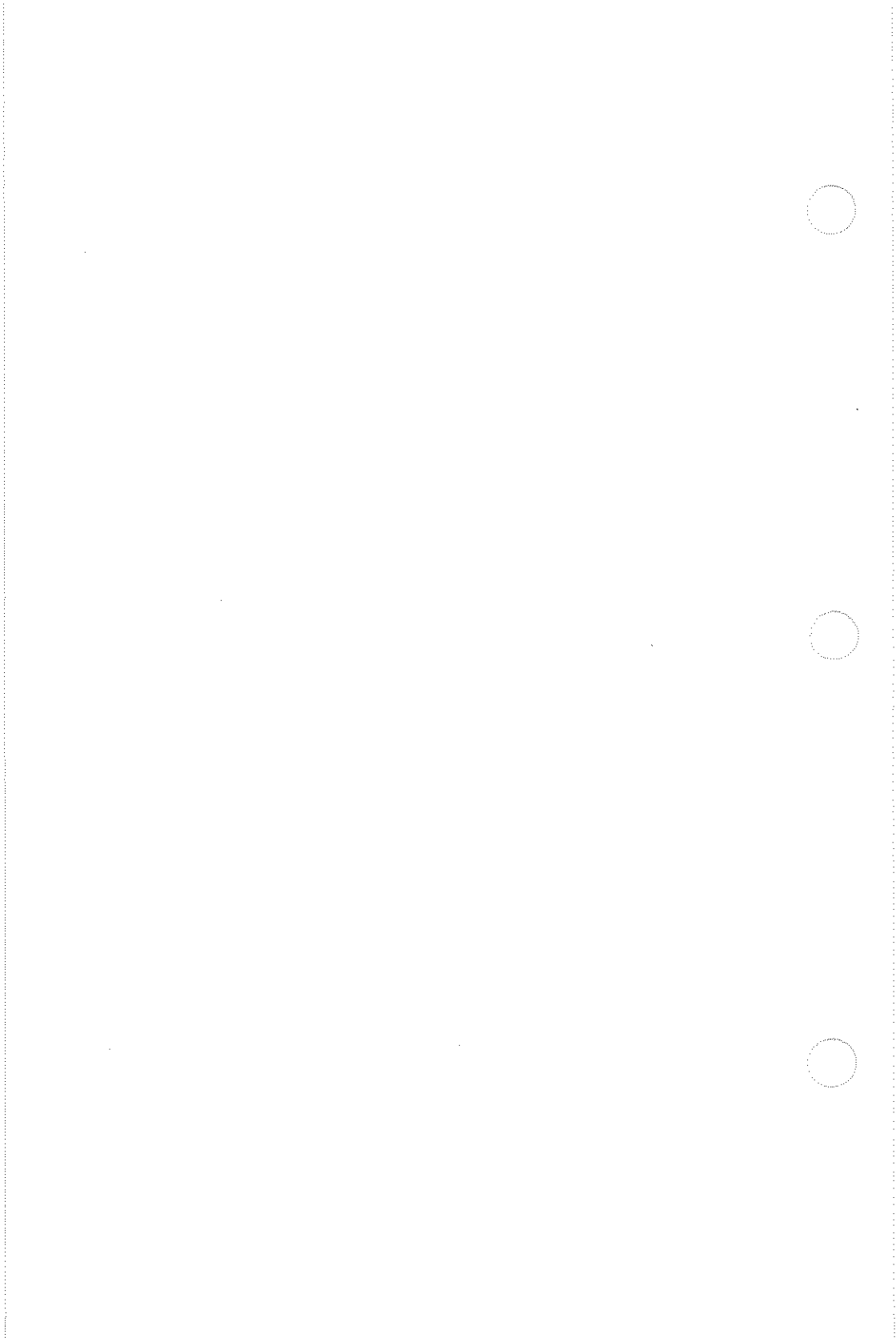
1.0 Specifications

CONNECTORS
DS3 Receive/Transmit: WECO 560
DS3 External Clock Input: coax SMC, TTL
DS1/E1 Receive/Transmit: Bantam
DS1/E1 External Clock Input: Bantam, AMI, 0 to -30 dB
Serial Port: 8 pin Mini DIN RS232C (V.24), DTE

STATUS AND ALARM INDICATORS
DS3: Pulses (green = pulses, red = loss of signal), Idle, Errors, M13 Frm (green = frm sync, red = loss of frame), C-Bit Frm (green = frm sync, red = loss of frame), AIS, Yel Alm (X-bit), FEBE

DS2: Frame (green = frm sync, red = loss of frame)

DS1: Pulses (green = pulses, red = loss of signal), B8ZS, Errors, SF (green = frm sync, red = loss of frame), ESF (green = frm sync, red = loss of frame), SLC-96 (green = frm sync, red = loss of frame), Yel Alm, AIS

E1: Pulses (green = pulses, red = loss of signal), HDB3, Errors, PCM-30 (green = frm sync, red = loss of frame), PCM-31 (green = frm sync, red = loss of frame), CRC det, Alarm, AIS

General: Pat Sync, Power, Battery

DS3 GENERAL
Framing: Unframed, M13, C-Bit parity. Conforms to ANSI T1.102, 107, 107A, 403, and 404. Also Bellcore TR-TSY-000009 and TR-TSY-000191

Line Coding: B3ZS

Clock Source: 44.736 MHz, External (+/- 300 ppm, TTL, 50% +/- 1% duty cycle), Internal (+/- 5 ppm), Loop (+/- 300 ppm)

Standard Test Patterns: 1111, 1100, 1010, 2^{15}-1, 2^{20}-1, 2^{23}-1

User Programmed Patterns: 10 programmable 24-bit patterns with alpha-numeric names

Error Injection Type: Logic, BPV, Logic+BPV simultaneously, C-bit, P-bit parity, FEBE, frame

Error Injection Mode: Burst or fixed-rate

Alarm Generation: AIS, Yellow, Idle

Loopback per ANSI FEAC proposal

FEAC transmit/receive per ANSI, requires SW301

DS3 Transmitter
Transmit Signal Source: DS3 Test pattern, DS1 Test pattern broadcast,

DS1 AIS broadcast, loop received DS3 signal

Pulse Shape: Conforms to CCITT G.703, Bellcore TR-TSY-000499. High, DSX, Low

Generate Yellow Alarm (X-bits alarm), AIS, IDLE

DS1 Insert: Insert DS1 on desired channel. Other channels have DS1 test pattern copies, AIS, or are looped through from DS3 receiver. DS1 generated internally or from DS1 RX connector

E1 Insert: Insert E1 on desired channel. Other channels have AIS. E1 generated internally

DS3 Receiver

Input Impedance: 75 ohms

Input Sensitivity:

  DSX: up to 26 dB resistive or 6 dB cable loss from DSX

  High/low: +6 dB to -26 dB resistive loss

Jitter tolerance: Conforms to TR-TSY-000009

Auto Configure to received signal:

  DS3 Framing: M13, C-Bit, Unframed

  DS1 Framing: SF-D4, ESF, SLC-96, Unframed

  E1 Framing: PCM-30, PCM-31, Unframed

  Test Pattern: Standard Test patterns, Standard Test patterns inverted, User Programmed patterns, User Programmed patterns inverted

DS1 Drop: Drop to internal receiver or drop to DS1 TX connector

E1 Drop: Drop to internal receiver or drop to DS1 TX connector

DS1 General (Requires SW310)

Signal Directions: multiplexed to DS3 jacks or to DS1 jacks

Clock Source: Internal (+/- 5 ppm), Loop (recovered, +/- 300 ppm), External (+/- 300 ppm, 0 to -30 dB resistive)

Framing: Unframed, Superframe (SF-D4), ESF, SLC-96*. Conforms to ANSI T1.102, 107, 107A, 403, and 404. Also Bellcore TR-TSY-000009 and TR-TSY-000191. *SLC is a reg. trademark of AT&T

Line Coding: AMI, B8ZS

Standard Test Patterns: All ones, all zeroes, alternate 10, 1-in-8 (1:7), 1-in-16, 3-in-24, Quasi-Random Signal (QRS), 2^6-1, 2^7-1, 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1, 55 Oct, T1-1 through T1-6, DDS-1 through DDS-6

User Programmed Patterns: 10 programmable 2048-bit patterns with alpha-numeric names

Test Pattern Inversion: all Standard Test Patterns and User Programmed Patterns

Error Injection Type: Logic, BPV, simultaneous Logic+BPV, frame
Error Injection Mode: Burst or fixed-rate
Alarm Generation: AIS, Yellow, Idle
Fractional T1: Any arbitrary combination of 1 to 24 channels. Nx56 or Nx64 format. Autoconfigure to active channels. Requires SW311
Loopbacks: CSU/NIU loop up/down, Inband, ESF datalink, programmable 32-bit control. M13 C-bit loopbacks per TR-TSY-000009
DS3 based FEAC loopbacks per ANSI T1.404
CSU/NIU Emulation: Responds to in-band and ESF datalink loopbacks by looping up/down. Line and Payload style loopbacks. Manual loopback control. Simultaneous line measurements. Requires SW313.
Other intelligent NIUs: Support for Westell and Teltrend looping line repeaters, central office repeaters, performance monitoring NIUs, maintenance switches. Requires SW303.
ANSI T1.403 ESF data link send and receive. Bit oriented messages, performance report message. Requires SW312.
TR-TSY-000008 SLC-96 data link send and receive. Modes I and III. Requires SW312

DS1 Transmitter

Pulse Shape: Conforms to CCITT G.703, Bellcore TR-TSY-000499
Output Levels: 0, -7.5, -15, -20 dB

DS1 Receiver

Input Frequency: 1.544 Mbps, +/- 300 ppm
Input Impedance: 100 ohm
Input Sensitivity: +6 dB to -36 dB
External Clock Input: 1.544 Mbps, +/- 300 ppm, 0 to -30 dB resistive with ALBO
Auto Configure to received signal:
    DS1 Framing: SF-D4, ESF, SLC-96, Unframed
    DS1 Line Coding: AMI, B8ZS
    Test Pattern: Standard Test patterns, Standard Test patterns inverted, User Programmed patterns, User Programmed patterns inverted. Enable/disable separate and independent transmit/receive patterns

E1 (2.048 Mbps, Requires SW324)

Drop and insert one E1 channel to/from a DS3
Transmit and receive at E1 interface
Transmit

Pulse Shape: Conforms to CCITT G.703, 3.0V +/- 10%
Clock: De-jittered from DS3, Internal 2.048Mbps +/- 5ppm
Line coding: AMI, HDB3
Receive
Impedance: 120 ohm, +6 to -20 dB
Line coding: AMI, HDB3
Framing: PCM-30 and PCM-31 with or w/o CRC, unframed
Test Patterns
Standard Patterns: All ones, all zeroes, alternate 10, 1-in-8 (1:7), 1-in-16, 3-in-24, QRS, 2^6-1, 2^7-1, 2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1, 55 Oct, T1-1 through T1-6, DDS-1 through DDS-6
User Programmed Patterns: 10 ea patterns up to 2048 bits long, alpha numeric name up to 10 characters for each pattern.
Test Pattern Inversion
Auto Configure to received signal, line coding, test pattern

Measurements

G.821 and general errors: Bit error, bit err rate, errored seconds, % errored seconds, severely errored seconds, % severely errored seconds, error-free seconds, % error-free seconds, available seconds, unavailable seconds, synch loss seconds, degraded minutes

DS3: Frame loss seconds, loss of signal seconds, BPV, BPV rate, F-bit error, F-bit error rate, P-bit error, C-bit error, FEBE, available seconds, errored seconds, % errored seconds, severely errored seconds, % severely errored seconds, error-free seconds, % error-free seconds, unavailable seconds, degraded minutes, AIS seconds, yellow alarm seconds, frequency, maximum frequency, minimum frequency, peak voltage (V), power (dBm)

DS2: F-bit error, frame loss seconds, AIS seconds, yel alm seconds

DS1: BPV, BPV rate, F-bit error, bit error, CRC-6 block error, CRC-6 block error rate, BPV, out of frame count, change of frame alignment count, errored seconds, % errored seconds, severely errored seconds, % severely errored seconds, error-free seconds, available seconds, degraded minutes, unavailable seconds, frequency, AIS seconds, loss of frame seconds, loss of signal seconds, yellow alarm seconds, low density seconds, excess zeroes seconds

E1: Code violation (BPV), code violation rate, FAS error, FAS error rate, MFAS error, MFAS error rate, CRC error, CRC error rate, errored seconds, % errored seconds, severely errored seconds, % severely errored seconds, error-free seconds, available seconds, degraded minutes, unavailable seconds, AIS seconds, loss of frame seconds,

loss of signal seconds, FAS alarm seconds, MFAS alarm seconds, peak voltage (V), frequency, maximum frequency, minimum frequency, + wander, - wander, peak level (dB), clockslip

Other Measurements
View Received Data
View T1 data in binary, hex, ASCII formats
Displays data in bytes by time slot
Displays 8 time slots per display page
Capture and store 256 consecutive time slots as test pattern, 10 patterns

Propagation Delay
Measure round trip propagation delay in unit intervals +/- 1 UI, with translation to microseconds and one way distance over cable

Bridge Tap
Automated transmission and measurement of 21 different patterns to identify possible bridge taps at some point on a T1 line

Quick Test I and II
2 programmable automated loopback tests that save time when performing standardized acceptance tests
10 character alpha-numeric ticket name
Automatically loopback a CSU or NIU device; automatically drop the loopback at conclusion of test
Automatically print results at conclusion of test
Specify 5 independent test patterns, run each pattern for 1 to 999 min
Operate in single-run or continuous-run mode

Loopbacks
Loopback Control, In-band
NIU loop up 11000
NIU loop down 11100
CSU loop up 10000
CSU loop down 100
Non-standard loop up 100000
10 programmable user codes, 1 to 32 bits each

Loopback Control, ESF-Facility Datalink
Payload CSU loop up 111111110 010100 0

Payload CSU loop down 111111110 100110 0
Line CSU loop up 111111110 111000 0
Line CSU loop down 111111110 001110 0
Network (NIU) loop up 111111110 100100 0
Network (NIU) loop down 111111110 010010 0
10 programmable user codes, 1 to 32 bits each

Remote Control (SW302)

VT100 emulation
Status table provides current and historical information on test sets' LEDs
Uses test set's serial port, 8 pin MINI DIN connector, RS232C
Serial port cannot be connected to printer during remote control operation

Westell PM NIU and MSS (SW303)

Supports Westell performance monitoring network interface unit and main-
    tenance switch system with ramp
Set/query NIU time and date
Query performance data by hour or for all accumulated data
Reset performance registers
Read data over ramp line
Perform maintenance switch function for Westell and Teltrend
Automated looping of Westell and Teltrend line and central office repeaters:
    SF and ESF modes supported
    Arm, loop up/down, loopback query, sequential loopback, power loop
    query, span power up/down, unblocking
Requires SW310

Fractional T1 (SW311)

Error measurements, channel configuration verification
Nx64 kbps, Nx56 kbps, N=1 to 24
Sequential, alternating, or random channels
Set Tx and Rx channels independently
Auto scan and auto configure to any FT1 order for active channels
Selectable idle channel code, 7F or FF hex
Requires SW310

ESF and SLC-96 Datalink send and Receive (SW312)

ESF Datalink
    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
T1.403 24 hour PRM collection per 15 min interval
SLC-96 Datalink
  Send and receive message
  WP1, WP1B, NOTE formats
  Alarms, switch-to-protect, far end loop
  To TR-TSY-000008 specifications, modes I and III
  SLC-96 FEND loop
Requires SW310

CSU/NI Emulation (SW313)
Graphical indication of signal status
Simultaneous display of T1 line measurements
Automatic generation of AIS
Loopbacks:
  Responds to remote loopback commands, in-band and out-of-band
  (ESF datalink T1.403)
  Establish Line and payload loopback from keypad
Requires SW310

Voice Frequency Capability (SW320)
General: Talk/listen with volume control, 24 channel signaling bit display,
  control signaling bits, view channel data, u/A law to DS3 or DS1/E1 ports
Specify trunk type: E&M, G-start (FSX/FXO), L-start (FXS/FXO), user-
  defined
Specify supervision on idle channels
Basic Transmission Impairment Measurements: Level, frequency, C-
  message noise, C-notched noise, 3 kHz flat filter noise, signal to noise
  with 1004 Hz tone. Generate 50 to 3950 Hz +/- 1 Hz, 1 Hz steps, +3 to
  -60 dBm, 1 dB steps. Requires SW321
Addressing
  DTMF/MF/DP dialing, programmable dial number up to 32 digits, 10
    stored numbers, programmable transmit level -5 to -25 dBm
  MF/DTMF dialing: specify dial period, silent period from 50 ms to 999
    ms
  DP dialing: specify % break from 40 to 60, interdigit period from 200 ms
    to 900 ms
  Measure MF/DTMF high/low frequency, level, twist, digital time, interdigital
    time
  Measure DP pulses per second, % break
  Requires SW322

ISDN PRI Call Set Up and Analysis (SW323)

D-channel message monitor

    Filter type: Call reference, caller number, called number

Voice and data call setup and receive

    Talk/listen for voice calls

    56k, 64k data rates

    Data patterns: 2047, 511, 127, 63, 1111, 0000, or 8-bit user pattern

Programmable called and caller numbers, B channel number, NSF code, NSF type

NT, TE emulation

Programmable D channel number

AT&T 5ESS and Northern Telecom DMS-100 compatible

On-screen table for optional call feature programming

Requires SW310

General

SW options upgradeable via SunWare™ in-field cartridge replacement

Printer: Print every 2 to 99 minutes, print at end of measurement, print on error/alarm events, print screen alpha-numerics

Size: 10.5 x 6 x 27 cm (4 x 2.4 x 10.5")

Weight: 1.3 Kg (2.8 lb)

SS300 and SS300e chassis:

    Built-in NimH rechargeable battery pack. Battery operating time: 90 min nominal. AC operation with 100 to 240 VAC, 50/60 Hz universal charger.

Environmental

Operating temperature: 0 to 50 °C (32 to 122 °F)

Storage temperature: -20 to 70 °C (-4 to 158 °F)

Humidity: 5% to 90% noncondensing

2.0 Configurations

Here are the various items which can be ordered in addition to the basic SunSet T3 SS300 or SS300e. The following packages give you everything you need in one convenient order number. If you prefer, you may order most items individually.

Model   Name and Description

SS300   SunSet T3 Chassis
Includes SunSet T3 Chassis, 120 VAC 1.2A Battery Charger, SunSet T3 User's Manual, SunWare Cartridge, Instrument Stand. SunWare Cartridge includes basic T3 testing operations. This model does not support option SW324.
CLEI: T3TEMPLDAA
CPR: 674737

SS300e   SunSet T3 Chassis compatible with option SW324
Includes SunSet T3 Chassis, 100 VAC to 240 VAC Universal Battery Charger, 6-cell NiMH battery, SunSet T3 User's Manual, SunWare Cartridge, Instrument Stand. SunWare Cartridge in cludes basic T3 testing operations.

SW301   DS3 FEAC
Provides control and analysis of the DS3 FEAC data link in C-bit parity framing format.

SW302   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.

SW303   Maintenance Switch, Performance Monitoring NIU, RAMP, Looping Repeaters
Provides menu-driven support for the Westell and Teltrend loop ing repeaters, Maintenance Switch, and Performance Monitoring NIU, including the RAMP feature. Requires SW310.

SW310 DS1 Testing

Provides DS1 test capability through the bantam jacks on the set. Also provides DS1 drop and insert test capability through the WECO 560-style jacks on the set. DS1 capabilities include a broad variety of test patterns, DS1 NIU and CSU loopback operations, basic DS1 measurements, view received data, quick test, bridge tap test.

SW311 Fractional T1

Provides fractional T1 test capability. Any arbitrary combination of receive and transmit DS0 channels. 56 and 64 kbps modes supported. Requires SW310.

SW312 ESF and SLC-96 Datalink Send and Receive

Provides T1.403 and ESF data link send and receive capabilities. Also includes SLC-96 data link send and receive. Requires SW310.

SW313 CSU/NIU Emulation

Provides T1 CSU and NIU emulation. Requires SW310.

SW320 DS0 Drop/Insert

Provides voice frequency talk/listen/tone. Requires SW310.

SW321 VF Level, Freq, & Noise Measurement

Includes level, frequency, and noise measurements: S/N, C-Message, C-Message Notched, and 3 kHz flat filters. Sends tones at 50 to 3950 Hz at +3 to -60 dBm. Requires SW310 and SW320.

SW322 MF/DTMF/DP Dialing, Decoding, and Analysis

Requires SW310 and SW320.

SW323 ISDN PRI Call setup & analysis

Set up and receive voice/data calls. BERT test on data calls, talk/listen on voice calls. 23B+D, Nx56K, Nx64K BERT. AT&T and Northern Telecom compatible. Requires SW310.

SW324 E1 Test Capability

From a DS3, drop and insert an E1 signal through the test sets' DS1 bantam jacks, or test an E1 signal directly through the DS1 bantam jacks. Requires the SS300e chassis.

SunSet T3 Version 2.64

SW2501 1 Mb SunWare Replacement Cartridge
> For SunSet T1, T3, TE1, E1e, STS-1, ISDN. Specify model and serial number.

Note: SunWare cartridges may be upgraded to include additional options. Simply send in a purchase order with your test set serial number and the desired new option(s). We will mail you a new cartridge with all of your original options plus the new one(s). We will also enclose a stamped, pre-addressed padded envelope for you to return the old cartridge. There is a $150 charge for replacing each lost or unreturned cartridge.

SS101   Carrying Case

SS104   Cigarette Lighter Battery Charger

SS105   Repeater Extender

SS106   Single Bantam to Single Bantam Cable, 6'

SS108   Single Bantam to Single 310 Cable, 6'

SS109   Single Bantam to Probe Clip Cable, 6'

SS110   Dual Bantam to 15-pin D Connector Cable, Male, 6'

SS111   Dual Bantam to 15-pin D Connector Cable, Female, 6'

SS112   Dual Bantam 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
> Replacement printer cable for earlier serial printers such as SS118.

SS115B DIN-8 to DB-9 Printer Cable
> Included when either SW302 or SS118B/C is ordered.

SS115C DIN-8 to 6-pin RJ-11 Printer Cable
> Compatible with the STAR DP-8340 printer interface.

SS116   Instrument Stand

SS117A Printer Paper, 5 rolls, for SS118B/C

SS118B High Capacity Thermal Printer
With internal rechargeable battery. Includes cable (SS115B) for connection to SunSet and 110 VAC charger.

SS118C High Capacity Thermal Printer
With internal rechargeable battery. Includes cable (SS115B) for connection to SunSet and 220 VAC charger.

SS121B SunSet AC Charger, 220 VAC, 50/60 Cycle.
Provides continuous operation from 220 VAC source. Provides 0.6A output at 12 VDC. Charges battery. 2-stage operation for fast recharge then slow trickle charge. 3-prong IEC connector. For SS300 chassis only.

SS122   Null Modem Adapter
Replacement null modem adapter for earlier serial printers such as SS118.

SS122A Null Modem Adapter
DTE to DCE conversion. Included with SW302.

SS123   SunSet Jacket
Provides additional weather protection for SunSets. Rugged padded synthetic fabric.

SS130A 19"/23" SunSet Rack Mount - Removable
Unit is strapped into rack mount panel.

SS130B 19"/23" SunSet Rack Mount - Permanent
Unit is screwed down to panel 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.

SS138   SunSet AC Charger, 100 to 240 VAC, 50/60 Hz input, 15 VDC @ 2A output.

SS139 **6-cell NiMH Battery Pack**
7.2 VDC, 1.8 Ahr. Requires factory installation.

SS212 **Conversion cable, BNC (m) 75Ω to bantam 120Ω, 6'**

SS300W SunSet T3 Extended Warranty
Extends the standard 1 year domestic factory warranty to 3 years.
Includes SunSet chassis but excludes battery and accessories,
which are warranted for 1 year.

SS302 **WECO 440A to WECO 440A (miniature style) Coaxial Cable**
6', fits in 560A jack

SS303 **WECO 440A to BNC Coaxial Cable, 6'**

SS304 **WECO 440A (mini) to 358A (large) Coaxial Cable, 6'**

SS305 **SunSet T3 User's Manual**

SS309 **SunSet T3 Training Tape, English**
(Specify SS309K for Korean) Available at no extra charge with
purchase of a SunSet T3.
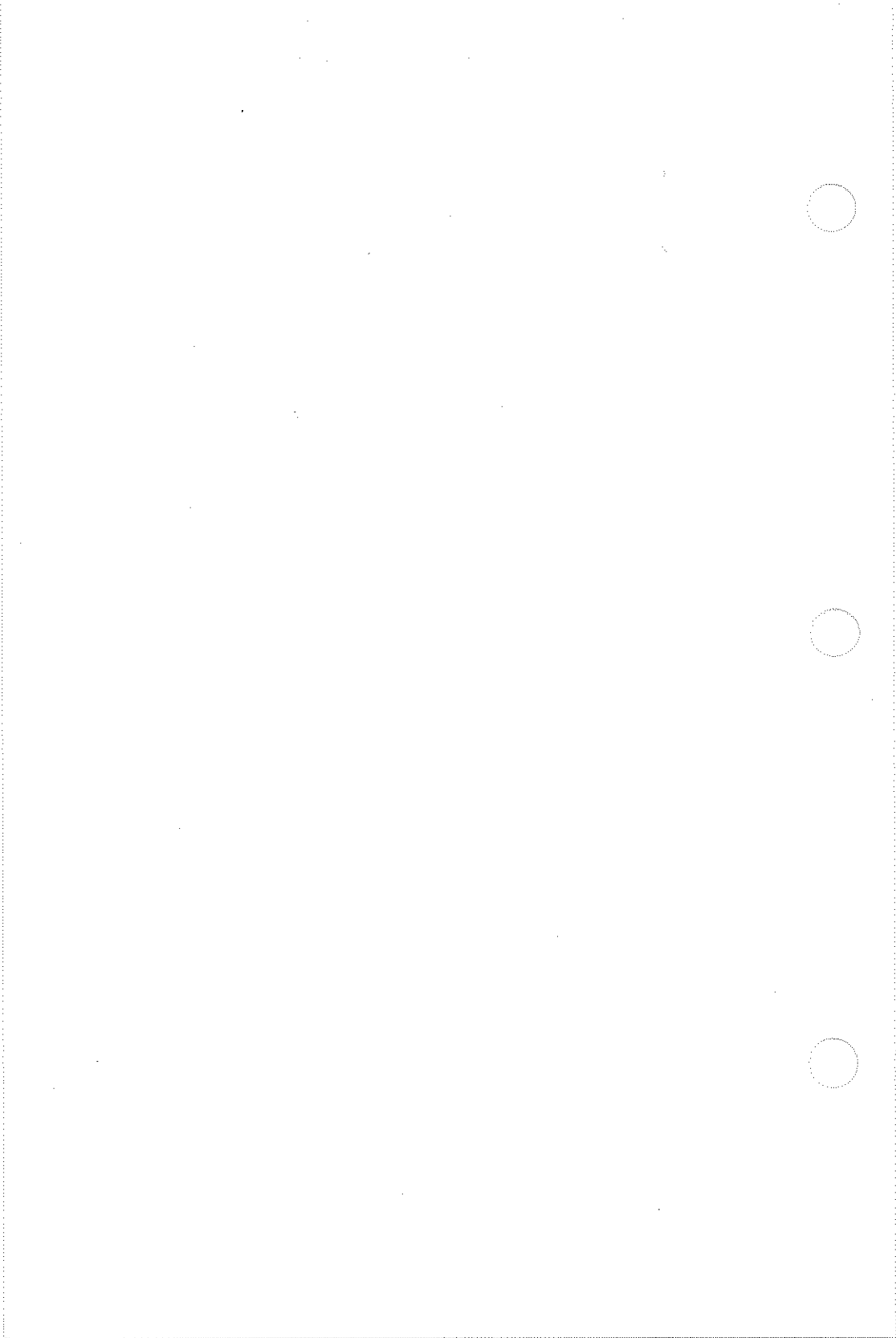
Chapter 8
Abbreviations
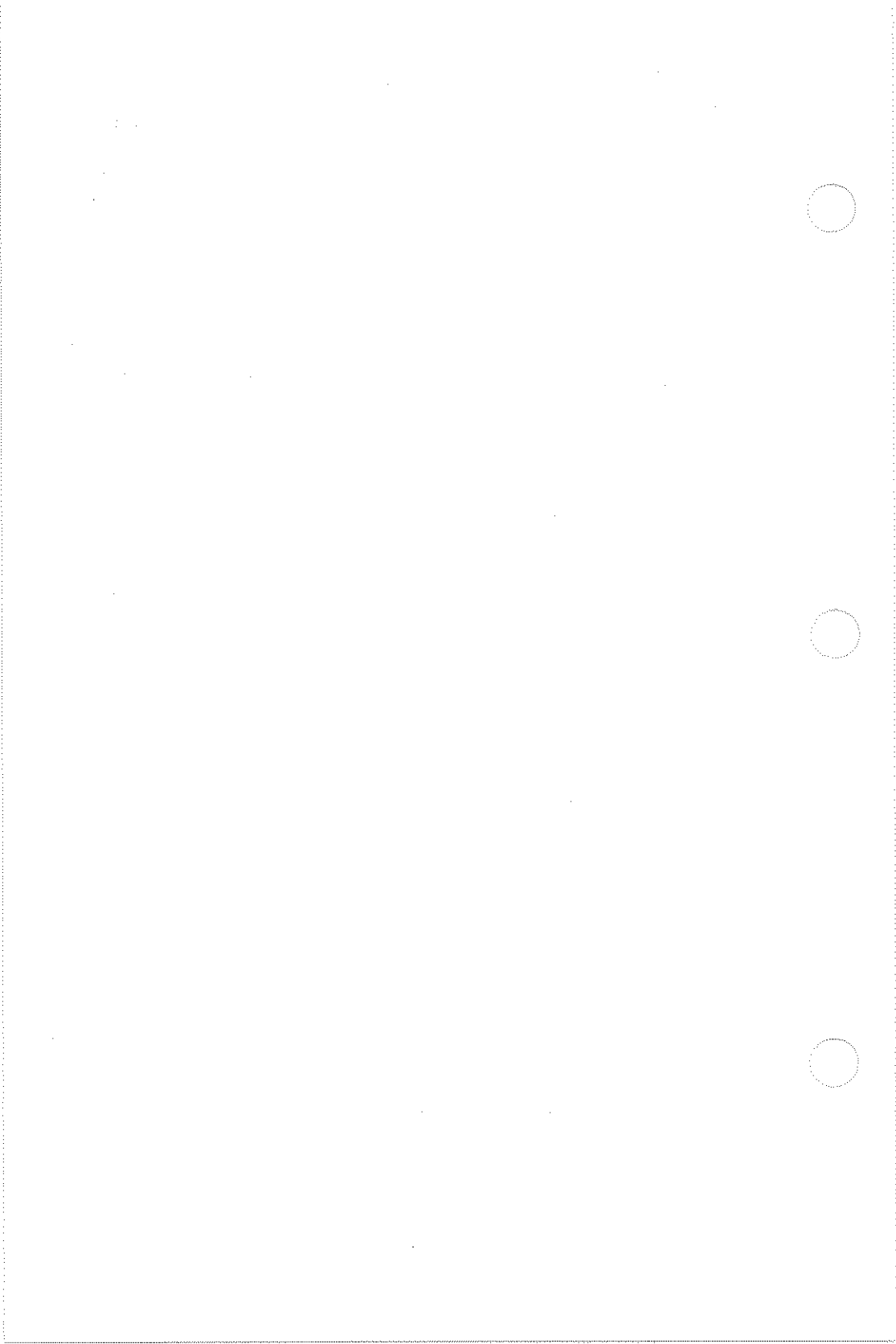
Chapter 8 Abbreviations

A

AC - Alternating Current
ACK - Acknowledge
AFBER - Average Framing Bit Error Rate
AGC - Auto Gain Control
AIS - Alarm Indication Signal
AISS - Alarm Indication Signal Seconds
ALM - Alarm
AMI - Alternate Mark Inversion
ARM-INB - Arm Inband
ARQ - Automatic Repeat Request
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

B8ZS - Bipolar 8-Zero Substitution
BATT - Battery
BIT - Bit Error
BPV - Bipolar Violation
BPVR - Bipolar Violation Rate
BRI - Basic Rate Interface
BTSLP - Bit Slip
BUFF - Buffer

C

Cbit - C-bit Parity Error Count
CER - CRC-6 (4, in E1) Error Rate
CLK - Clock
CLKSLIP - Clock Slip
CLR - Clear
COD - Code
COFA - Change of Frame Alignment
CONFIG - Configuration
CR - Carriage Return

CRC - Cyclic Redundancy Check
CRC-6 - Cyclic Redundancy Check Code - 6
CSU - Customer Service Unit
CTL- Control

D

dB - decibel
dBdsx - decibel referenced to dsx power level
DC - Direct Current
DCS - Digital Cross-connect System
DDS - Dataphone Digital Service
DENS - Density
DGRM - Degraded Minute
DIG - Digital
DLCI - Data Link Connection Identifier
DLF - Data Link Frame
DN - Down
DP - Dial Pulse
DS1 - Digital Signal 1
DSX - Digital Signal Cross-connect
DSXMON - DSX Monitor signal
DTE - Data Terminal Equipment
DTMF - Dual-Tone Multi Frequency

E

E - Equipment
E1 - 2.048 Mbps signal
EQP - Equipment
ERR INJ - Error Injection
ES - Errored Second
ESF - Extended Super Frame
ET - Elapsed Time
EXT - External
EXTERN - External
EXT CLK - External Clock
EXZS - Excess Zeroes Seconds

F

F - Facility

F1 - Function 1
FAC - Facility
FAER - Frame Alarm Error Rate
FALM - Frame Alarm Seconds
FAS - Frame Alignment Signal
FBE - Framing Bit Error
FBER - Framing Bit Error Rate
FDL - Facility Data Link
FEAC - Far End Alarm and Control Channel
FELP - Far End Loop
FREQ - Frequency
FRM - Frame
FSBEE - Frame Synchronization Bit Error Event
FSLIP - Frame Slip
ft - feet
FT1 - Fractional T1

H

HDB3 - High Density Bipolar Three
HEX - hexadecimal
HOLDSCRN - Hold Screen
Hz - Hertz

I

INTERN - Internal
INV - Inverted
ISDN - Integrated Services Digital Network

K

kFt - kilo Feet

L

LAP-B - Link Access Protocol - Balanced
LBO - Line Build Out
LDNS - Low Density Seconds
LED - Light Emitting Diode
LCD - Liquid Crystal Display

LLPBK - Line Loopback
LOFS - Loss of Frame Second
LOG - Logical
LOS - Loss of Signal
LOSS - Loss of Signal Second
LPBK - Loopback
LPBKQRY - Loopback Query
Lpp - Level peak-to-peak
LVL - Level

M

mA - miliAmpere
MAX - Maximum
mbps - megabits per second
MF - Multi-Frequency
MFAL - Multiframe Alarm second
MFAS - Multiframe Alignment Signal
MFER - Multiframe Bit Error Rate
MIN - Minimum
MON - Monitor
mW - milliwatt

N

NI - Network Interface
NIU - Network Interface Unit
NOTE - Network Office Terminating Equipment
NV RAM - Non Volatile Random Access Memory

O

OOF - Out Of Frame
OOFS - Out Of Frame Seconds

P

PAT - Pattern
PAT SYNC - Pattern Synchronization
PBX - Private Branch Exchange
PCM - Pulse Code Modulation
PLPBK - Payload Loopback

ppm - parts per million
PRA - Primary Rate Access
PRBS - Pseudo Random Bit Sequence
PRI - Primary Rate Interface
PRN SCR - Print Screen
PRNT - Print
PRNTR - Printer
PWR - Power
PWRLPQRY - Power Loop Query
PWCUTTH - Power Cut Through

Q

QRS - Quasi Random Signal

R

R - Receive
RCV - Receive
REF - Reference
RT - Remaining Time
RX - Receive

S

S/N - Serial Number, also Signal to Noise Ratio
SAPI - Service Access Point Identifier
SCRN - Screen
SEFE - Severely Errored Framing Event
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

T

T - Transmit
T1DM - T1 Data Multiplexer
T/S - Time Slot
TE - Terminal Equipment
TEI - Terminal Endpoint Identifier
TERM - Terminated
TOUT - Time Out
TOUTDIS - Timeout Disable
TX - Transmit

U

UAS - Unavailable Second
UI - Unit Interval
UNIVLDN - Universal Loopdown
uS - microsecond

V

V - Volts
VAC - Volts AC
VF - Voice Frequency

W

WDR - Wander

X

XMT - Transmit

Y

YEL - Yellow
YEL ALM - Yellow Alarm
YELS - Yellow Alarm Second

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Y

EXPRESS LIMITED WARRANTY

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

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

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(6) Improper installation by CUSTOMER.

Warranty