SUNRISE TELECOM
INCORPORATED

SA-901 MAN-10870-001 Rev. D

SunSet® OCx
User's Manual

Sunrise Telecom®... a step ahead

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

Welcome

Thank you for purchasing the SunSet OCx. This manual will take you through setting up and using your test set, helping you make full use of its extensive and flexible testing capabilities. Please note that this manual applied to both the black and white and the color version of the SunSet. Because the user interface differs slightly between the versions, there may be subtle differences between what is shown on your SunSet OCx and what is shown in this manual. Additional manuals are available for specific options.

1.0 Important Safety Information

Please read and follow these safety recommendations, to avoid injury and to prevent damage to the unit. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

⚠ **WARNING:** This is a Class 1 LASER Product. Avoid looking directly at the Transmitter source. For added safety, turn off the laser when not in use. See also Section 1.1.1.

Removable Software Cards: Insert and remove software cartridges ONLY with the power switched OFF. Otherwise, software cartridges may become damaged.

Power: Use the SS138D AC adaptor only for charging and AC powered operation. It is marked with the Sunrise Telecom Incorporated logo.

Fuses: This unit is equipped with an internal resettable fuse, which is rated to trip at 3.7 amps. Do not attempt to replace this fuse. Return the unit to Sunrise Telecom Incorporated, or its authorized service centers, for repair.

Operating Environment: This instrument is intended for operation in partly weather protected and temperature controlled locations, as per IEC 721-3-7, Class 7K2. DO NOT operate this unit in rain, or in a direct water splash environment.

Operating temperature: 0 to 40° C
Storage temperature: -20 to 70° C
Humidity: 5% to 90% non-condensing

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

- No operator serviceable parts inside this instrument. Refer to qualified personnel.
- Do not operate the unit with the cover removed.
- Always use the provided power cord.
- To avoid electric shock, the power cord protective grounding must be connected to ground. The unit is grounded through its provided power cord.
- Provide good ventilation.
- The unit can operate at max. altitude of 2000m.
- Do not position the unit in a way that makes it difficult to disconnect it from other equipment or from the power supply.
- Overvoltage protection: category II
- Pollution degree II, per IEC 664

1.1.1 Laser Safety

This is a Class 1 laser product per IEC 825-1:1993 and CDRH, 21 CFR 1040.

⚠ **WARNING**: Use of controls and procedures other than those specified in this manual may result in exposure to hazardous laser radiation.

Unterminated optical connectors may emit laser radiation. **Do not view with optical instruments.**

The LED on the optical panel and an indicator on the LCD indicates the status of the laser (ON/OFF). **Make sure to turn off the laser before connecting or disconnecting optical cables or before removing the protective plug**.

1.2 Unpacking the SunSet

Use the following procedure for unpacking your new SunSet:

1) Remove the packing list from the shipping container.

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

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

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

5) Complete the Warranty Registration Card and return it immediately to Sunrise Telecom or your national distributor.

   Note: Sunrise Telecom Incorporated must receive your warranty registration card in order to provide you with updated software releases.

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

7) Verify the plug is inserted in the optical Tx and Rx jacks, if the jacks are not in use, in order to keep the jacks clean.

8) Plug the AC Battery Charger, SS138D, into an appropriate AC wall outlet: 120 VAC - 240 VAC

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

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

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

12) Use the Calibration Procedure in the Reference chapter for a check-out procedure.

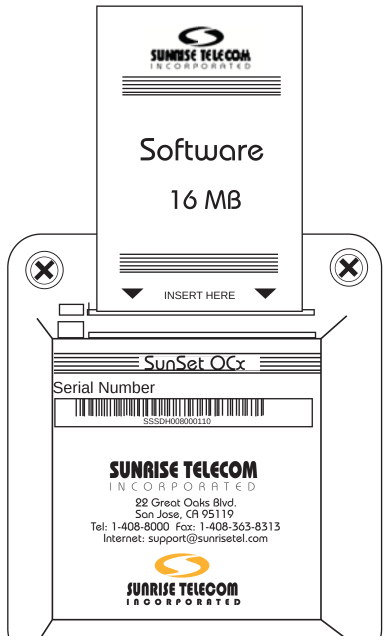


Figure 1
Cartridge Installation

Note: Each software cartridge is mated to a single SunSet. If your SunSet does not start properly, verify that the serial number printed on the software cartridge matches the serial number on the back of your SunSet. Also verify that the 'S/N Card' and 'unit' numbers in the SYSTEM CONFIG>VERSION/OPTION screen match.

When ordering software upgrades, be sure to specify the serial number of the SunSet into which the new cartridge will be installed. Please note your SunSet OCx features a second slot, which may hold an optional memory card.

1.3 Service Information

In general, handle fiber patch cords and connectors carefully. Always replace dust covers. Keep the optical connectors clean, and make a practice of not looking into fiber ends. The following sections give more specifics.

1.3.1 Handling Optical Fiber

1.3.1.1 Introduction

- An optical fiber is a strand of glass about the same diameter as a human hair, yet are remarkably durable.
- Careful handling will ensure continued high performance and long life.
- Do not pull or kink patch cords, as the glass strand in the middle might become damaged or broken.
- A sharp bend will cause excessive signal loss.
- Keep patch cord bend radiuses no sharper than an inch.
- Use specialized optical cable raceways and plenums whenever they are available.
- Don't use tie wraps as you would with electrical cables. Tie wraps will put strain on the fiber.

1.3.1.2 Fiber Optic Connectors

There are several types of optical connectors in use today. Figure 2 shows the two most popular, SC and FC. In this example, a SC to FC bulkhead adapter will be used to connect the two fibers together. In Figure 3, a schematic of the connector cross section demonstrates the details of the connection mechanism.

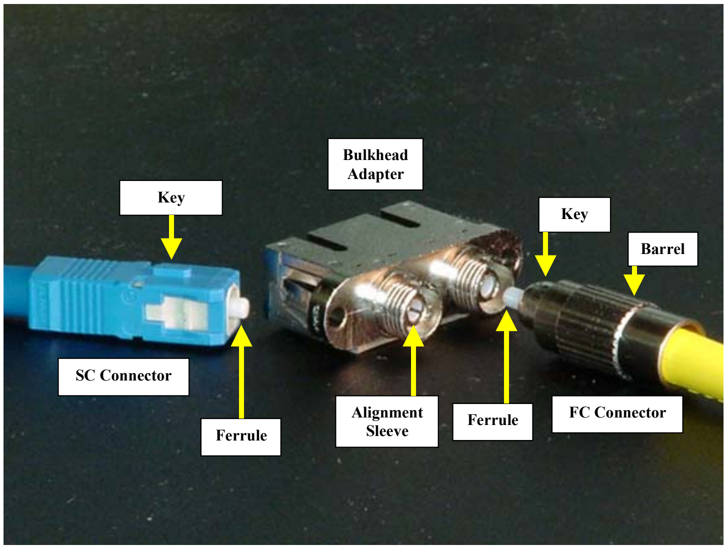


Figure 2 SC and FC Connectors

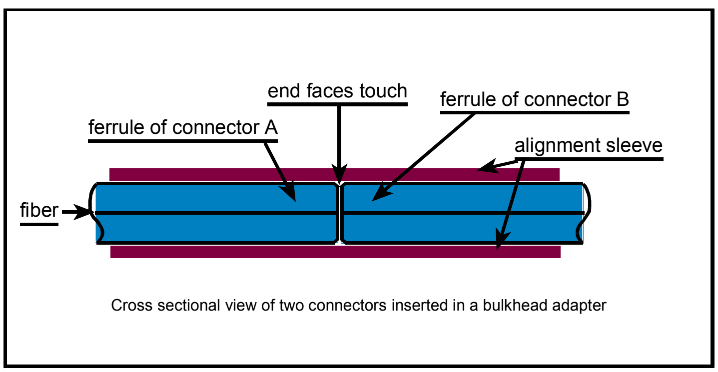


Figure 3 Cross Section of Connectors

- When using optical connectors, insert or remove the ferrule straight into the sleeve.
- Minimize wiggling the connector as this may loosen the tight fit that is required for the ferrule and sleeve.
- For SC connectors, orient the prominent key on the connector body (Figure 2) with the slot in bulkhead adapter. Push the connector in until it clicks. To remove, pinch the connector body between your thumb and finger, and gently pull straight out.

- FC connectors require more care. Find the small key and orient it with the equally small slot in the threaded section of the bulkhead adapter. Even in Figure 2, this key is not very visible. Thread the outer barrel only lightly finger tight. Never use pliers!
- Over tightening the barrel will not improve signal transmission, and could cause permanent damage. To remove, unthread the barrel, and gently pull straight out.
- Most problems with FC connectors are due to key misalignment. This is difficult to detect because even when the key is misaligned, the barrel can be threaded, which then hides the misaligned key. A hint is when the barrel only catches the first one or two threads. The connector will not be completely seated in the bulkhead adapter.
- A properly connected FC connector should seat completely and the barrel will thread several turns.

1.3.1.3 Cleaning

Fiber optic connectors must be kept clean to ensure long life of the connectors and to minimize transmission loss at the connection point. Sunrise Telecom recommends cleaning at least once a month, and more often when required.

Precautions

- When not in use, always replace dust covers and caps to prevent deposits and films from airborne particles. A single dust particle caught between two connectors will cause significant signal loss. Dust particles can scratch the polished fiber end, resulting in permanent damage.
- Do not touch the connector end or the ferrules, since this will leave an oily deposit from your fingers.
- Do not allow uncapped connectors to drop on the floor.

How to Clean

- Should a fiber connector become dirty or exhibit high loss, carefully clean the entire ferrule and end face.
- Special lint-free pads should be used with isopropyl alcohol.
- Even though not easily accessible, the end face in a bulkhead adapter on test equipment can be cleaned by using a special lint-free swab, again with isopropyl alcohol.
- In extreme cases, a test set may require more thorough cleaning at the factory.
- Cotton, paper, or solvents should never be used for cleaning since they may leave behind particles or residue.

- Use a fiber optic cleaning kit especially made for cleaning optical connectors, and follow the directions.
- Canned air can do more harm than good if not used properly. Again, follow the directions that come with the kit.

1.3.2 Customer Service

Please contact your local distributor or Sunrise Telecom's Customer Service if you need technical assistance:

Customer Service
Sunrise Telecom Incorporated
302 Enzo Dr.
San Jose, CA 95138
U.S.A.

Tel : 1-800-701-5208, 1-408-360-2200—option 1
Fax : 1-408-363-8313
Internet: http://www.sunrisetelecom.com
E-Mail: support@sunrisetelecom.com

1.4 Replacing the Battery Pack

1) To remove the battery cover, push down on the cover on the back panel, in the direction indicated by the arrow. Refer to Figure 4.

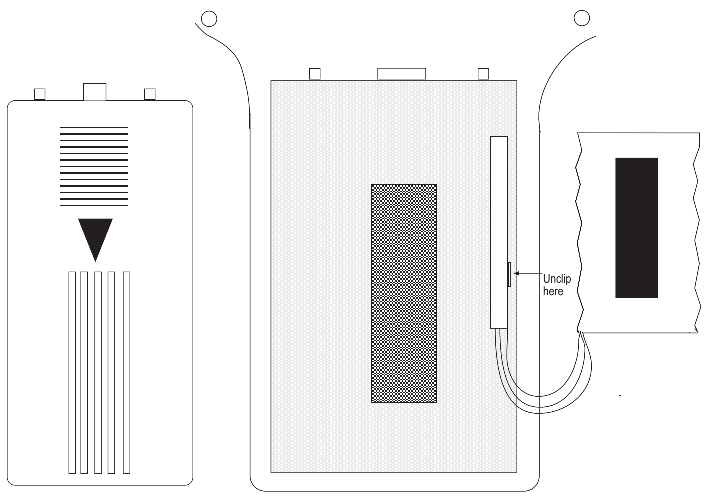


Figure 4 Replacing the Battery Pack

2) Pull the SS140 NiMH battery pack off its hook and loop backing, and out of the set. Unclip the battery pack, as indicated on Figure 4.

3) Clip in your new battery pack, replace it against the hook and loop inside the unit, and slide the battery cover back on, hooking the cover clips into the provided slots.

Note: Please dispose of expired batteries safely.

Chapter 2 Test Set Description

2.1 Front View Description

Refer to Figure 5 for the front view of the SunSet OCx black and white platform. Figure 6 shows the color SunSet OCx platform.

Figure 5 SunSet OCx Black and White, Front View

Figure 6 SSOCx Color, Front View

2.1.1 Keys

See Figure 7 for the SunSet OCx keypad. Most SunSet keys perform two distinct operations. The white label on the key indicates what function will be performed if the key is pressed by itself. The orange label above the key shows what function will be performed if the SHIFT key is pressed first. A SHFT indicator will be displayed in the upper left-hand corner of the screen.

The SHIFT key should not be pressed simultaneously with another key. Instead, the SHIFT key should be pressed and then released. At this point the SHFT indicator will appear. Any other key can now be pressed and released, and the SunSet will perform the function indicated by the orange label.

If the keys are not operating as expected, check the SHFT indicator. If the 'SHFT' indicator (upper left-hand corner of the screen) indicates the wrong shift status, simply press the SHIFT key again.

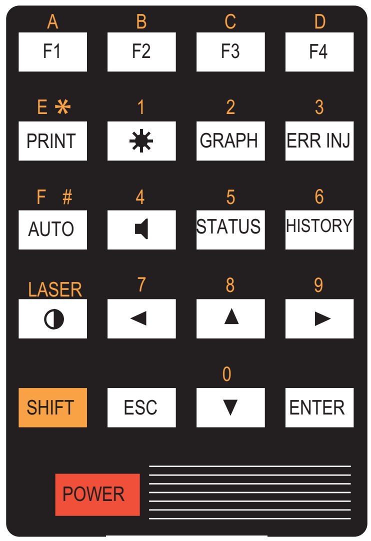


Figure 7 Keypad

White Labels

F-keys (F1, F2, F3, F4): These keys are used to select choices F1 through F4 at the bottom of the LCD display.

When you configure a setup screen, a number of options are typically available for each setup item. The available choices appear on the bottom of the screen. The desired option may be selected by pressing the corresponding F-key directly below. Refer to Figure 8.

In Figure 8, the Line Build Out Level is set to is set to 0 dB by pressing the F1 key.

Notes:

1) In most instances, when the desired F-key is pressed, the cursor will advance to the next line of the display automatically. To change the settings of a previous line, press the Up Arrow key, then re-select the option using the appropriate F-key.

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

3) If more than four F-key options are available to the user, a 'MORE' indicator will appear in the F4 position. Pressing the F4 key will display the other options.

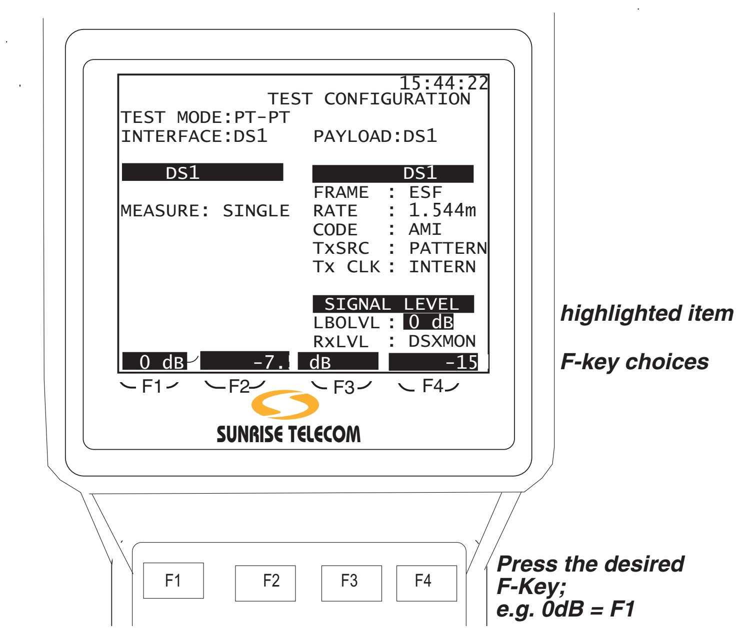


Figure 8 F-Keys

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

☀ : 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 SunSet to maintain its battery charge approximately 15% longer.

GRAPH: The GRAPHic key displays a graphic of the current circuit configuration and status. Here are some sample OC1-DS1 screens:

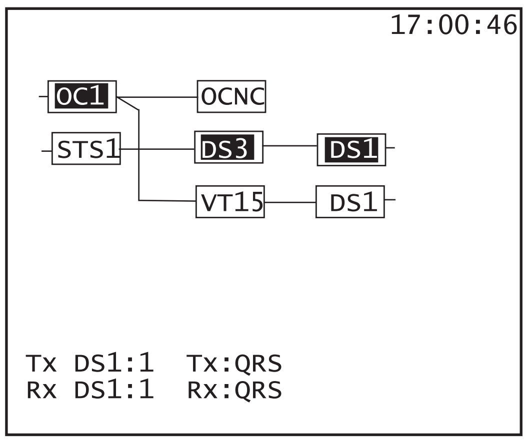


Figure 9 Point-to-Point Graphic Screen

In this figure, you can trace the path of the OC-1 to DS1 point-to-point setup. The highlighted boxes tell you which rates are in use. In Figure 9, a DS1 is mapped onto an OC-1 via a DS3.

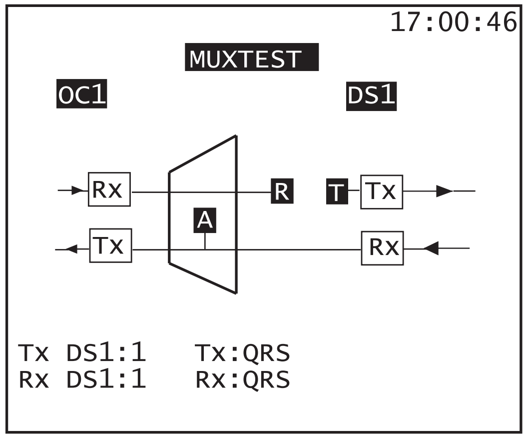


Figure 10 Muxtest Graphic Screen

In this MUXTEST setup sample, the mux is represented by the trapezoid. The rates/ports are highlighted at the top of the screen. At the bottom of the screen, see a text description of the rate under test and the test pattern being transmitted (Tx) and received (Rx).

- The highlighted R represents where Results are being taken.
- The highlighted T represents the SunSet OCx's Transmitter.
- The highlighted A is where the OCx is inserting AIS on the unused channels.

Figure 11 is a sample MUXMODE configuration. Note that the T and R are in different places than they were in the MUXTEST (Figure 10). Otherwise, the same description applies.

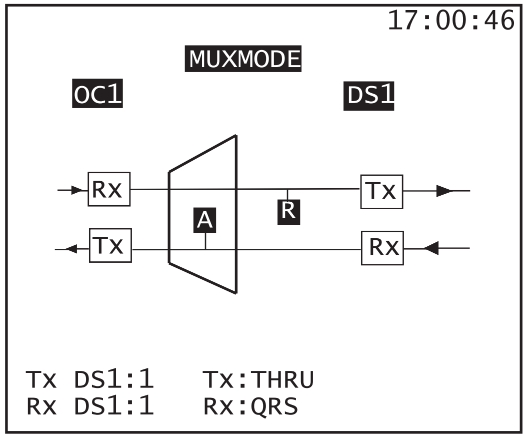


Figure 11   Muxmode Graphic Screen

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

AUTO: The AUTO key has three functions:

1) AUTO lets the test set auto-synch on the received signal, framing, mapping, and pattern.
2) Pressing the AUTO key will restart the measurements.
3) A screen appears which reports on the unit's progress in establishing synchronization. See Figure 12.

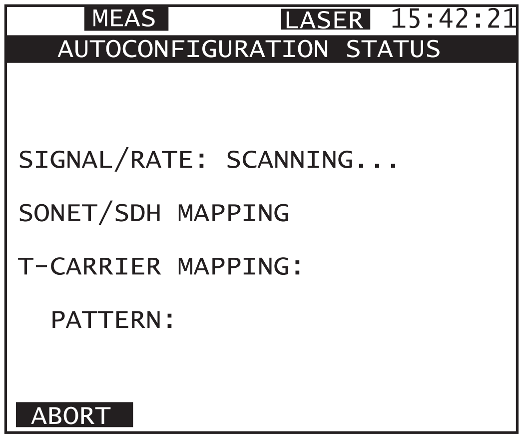


Figure 12 Auto Config Screen

The SunSet OCx will determine the rates and mapping in use, starting with the higher rates and working down. However, if the unit already has proper framing, it will not look for signal in other interfaces and will immediately look for pattern, saving you time.

: The volume key turns the speaker volume higher or lower via Up and Down F-keys or with the cursor keys on a graphical screen. Press EXIT (F3), or the ESC or ENTER when finished.

STATUS: Press this key to access the EVENT STATUS screen.
Press the STATUS key to see a screen showing any current events. See the Figure 13 for a sample screen:

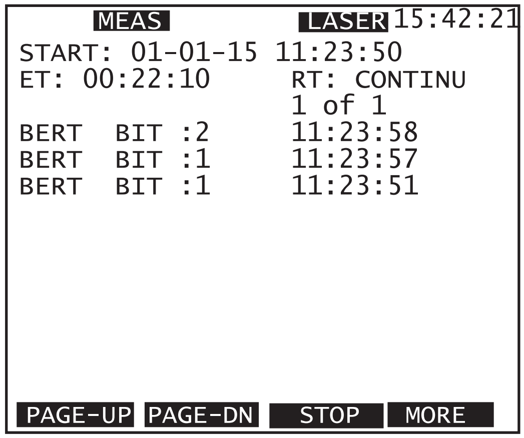


Figure 13 Status Screen

Use the PAGE-UP (F1) and PAGE-DN (F2) keys to scroll through the available screens. Use the START/STOP (F3) key to restart or halt measurements. Press PRINT (MORE, F1) to send the record data to the serial port for printing. If you have an ATA Storage card, press SAVE (MORE, F2) to save the information as an Event record. See *Chapter 3, Section 3.11.3*, for information on View/Print Records.

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.

◐: The CONTRAST key adjusts the contrast of the LCD screen. Press the key repeatedly until the contrast is as you wish.

▲, ▼, ▶, ◀ (Cursor or Arrow Up/Down/Left/Right): The arrow keys are used to move the cursor in the indicated direction.

ESC: The ESC key moves you back toward the main menu. To return to the main menu, keep pressing ESC until the main menu is displayed.

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, such as in Error Injection, pressing the ENTER key is required after the user finishes entering data in a given screen. In these cases, the SunSet will execute the inputs only after the ENTER key has been pressed. In most of the high usage functions, it is not necessary to press ENTER to invoke the operation. If the operation you are trying to perform will not begin, try pressing the ENTER key. When the ENTER key is used to invoke the operation, you may need to press ESCAPE to return to the previous menu.

Black Labels

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

POWER: The power key controls the on/off function of the SunSet OCx. It is the red key located in the lower left-hand corner of the test set's keypad.

Orange Labels

LASER: This key toggles the 'LASER' on and off. The laser automatically turns on when the test configuration is set to an optical rate. The laser cannot be turned on unless the test configuration is set to an optical rate.

A, B, C, D, E*, F#: These keys are used to enter DTMF tones, as well as hexadecimal numbers. They can also be used to provide labels for user-defined information.

0, 1, 2, 3, 4, 5, 6, 7, 8, 9: These keys are used to enter user test patterns and telephone numbers. They can also be used to provide labels for user-defined information.

2.1.2 LEDs

The bicolor Light Emitting Diodes (LEDs) provide a visual indication for the condition of the received signal. The LEDs provide enough diagnostic information at a glance that additional testing may not be required by some users. A LED will be lit green continuously when the particular condition for that LED is detected. For example, a continuous green light for T1-1 FRAME indicates that the test set has detected T1 framing for Line 1. A continuous red light denotes an alarm condition for the item. For example, the ERRORS LEDs light red if an error has been observed on the indicated signal.

Blinking lights provide historical information for the circuit condition. This is quite helpful if the user happened to be away from the set when the error or alarm condition occurred. Pressing the HISTORY key stops the blinking. Even after pressing HISTORY, defects will be recorded in the Event Status and Measurement Results screens.

2.1.2.1 Common LEDs

PAT SYNC: Lights green if the unit has synchronized on the test pattern in the received signal. The received pattern must match the transmitted pattern. The pattern may be observed in MEASUREMENT RESULTS. When the SunSet is taking measurements, it will automatically attempt to synchronize on the selected Rx pattern, unless the user has turned off BERT mode in SYSTEM CONFIG. If synchronization is lost, the PATtern SYNChronization LED lights red.

No light indicates the set is receiving live data. If measurements are started, and the unit is detecting pulses and framing but cannot achieve pattern synchronization, it will indicate LIVE data.

BIT ERR: Lights red if a bit error has been detected. In ATM mode, the BIT ERR LED also indicates the presence of a HEC error.

POWER: Lights green when the SunSet is switched on and has an adequate power source.

BATTERY: Lights green when the battery is being charged. The LED lights red when the SunSet's power supply voltage has dropped to a low level.

Note: Connecting the AC Battery Charger will allow you to use the SunSet indefinitely. However, if you plan to use the SunSet for an extended period of time, it is best to plug the AC Battery Charger in first.

2.1.2.2 SONET LEDs

(LASER) ON: This LED is located on the left side panel. It indicates the power status of the LASER.
Amber: LASER is on.
No light: LASER is off.

PULSES
Green: Indicates that the test set is receiving valid SONET pulses.
Red: Indicates the test set is not receiving the expected SONET pulses, based on the Test Configuration.
No light: Indicates that SONET pulses are not expected with your particular TEST CONFIGURATION.

FRAME
Green: Indicates that there is valid framing on the received SONET signal.
Red: Indicates the received framing is invalid.
No light: Indicates that SONET framing is not expected with your particular TEST CONFIGURATION.

ALARM
Red: Indicates that an alarm condition is detected on the received SONET signal.
No light: Indicates that no alarm condition appears on the received SONET signal.

ERRORS
Red: Indicates that some kind of error is detected on the received SONET signal.
No light: Indicates that there are no errors detected on the received SONET signal.

ATM CELL

No light: The LED is inactive and remains off until the user enters the ATM Functions menu or selects ATM test mode.

Green: The test set detects ATM cells, whether or not they have error or pass the receive filters.

Red: The test set does not detect ATM cells.

POINTER

Red: Indicates that the received OCx/STS signal has an invalid SPE pointer or 8 consecutive New Data Flags (NDFs).

No light: Indicates that the received SONET signal has a valid SPE pointer.

2.1.2.3 T3/T1-2 LEDs

These LEDs may apply to either a DS3 signal (received at the DS3 Rx jack, or embedded inside a SONET signal), or a second DS1 signal (T1DUAL mode), depending on your configuration.

PULSES

Green: Indicates that the test set is receiving valid T3 or T1 Line 2 pulses from the selected source. The source could be the DS3 or T1-2 Rx jack, or a DS3 payload within a SONET signal.

Red: Indicates that the test set is not receiving the expected T3 or T1 pulses. The test set expects to receive these pulses based on your TEST CONFIGURATION.

No light: Indicates that T3 or T1 pulses are not expected with your particular TEST CONFIGURATION.

FRAME

Green: Indicates valid framing on the received DS3 or DS1 signal from the selected source. This will depend upon how the DS3 FRAME item has been configured in the TEST CONFIGURATION menu. The LED will light green only if the test set's framing configuration matches the framing found on the received DS3 or DS1 signal.

Red: Indicates that framing is specified in the TEST CONFIGURATION menu, but is not present on the received signal.

No light: Indicates that the received DS3 signal is specified as UNFRAMED in the TEST CONFIGURATION menu.

Note: If the OCx is configured for M13 framing yet receives C-bit parity framing, the FRAME LED will light green.

ALARM

Red: Indicates that an alarm condition is appearing on the received DS3 or DS1 signal from the selected source.

ERRORS

DS3

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

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

T1-2

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

No light: Indicates no errors are appearing on the RX DS1 signal.

2.1.2.4 T1-1 LEDs

These LEDS apply to either a DS1 signal plugged in at the T1-1 Rx port, or a DS1/VT1.5 payload within a higher rate signal.

PULSES

Green: Indicates that the test set is receiving valid T1 pulses from the selected source.

Red: Indicates that the test set expects to receive valid T1 pulses from the selected source, but that none are appearing. The SunSet expects to receive these pulses based on your TEST CONFIGURATION.

No light: Indicates that T1 pulses are not expected with your particular TEST CONFIGURATION.

FRAME

Green: Indicates that valid SF, ESF, or SLC-96 framing has been observed on the received DS1 signal from the selected source. This will depend upon how the DS1 FRAME item has been configured in the TEST CONFIGURATION menu. The LED will light green only 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 present on the received signal from the selected source.

No light: Indicates that the specified DS1 signal framing is UN-FRAMED, or that no DS1 signal is expected.

Note: If the OCx is configured for SF-D4 framing yet receives SCL-96, the FRAME LED will light green.

ERRORS

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

No light: Indicates that no errors are appearing on the received DS1 signal.

ALARM

Red: Indicates that an alarm condition is appearing on the received DS1 signal from the selected source.

No light: Indicates no alarm received on the DS1 signal.

B8ZS

Green: Indicates the set detects B8ZS line coding substitution on the received T1 signal from the selected source. B8ZS line coding will not appear on a DS1 signal which has been dropped out of a DS3 or STS-1.

No light: Indicates that B8ZS line coding is not present on the received T1 signal from the selected source.

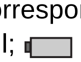
Note: The B8ZS LED lights green only when B8ZS code substitution is detected (8 or more consecutive zeroes). An idle signal or other high ones-density signal does not cause B8ZS substitutions. In such cases, the B8ZS LED will not light green.

POINTER (VT Loss Of Pointer)

Red: Indicates a VT frame with an invalid VT pointer or 8 consecutive NDFs.

No light: Indicates no VT pointer problems.

2.1.2.3 Banner Notes

The color SunSet OCx units feature icons on the main menu. See *Chapter 3, Section 1* for the icon/function correspondences. The color screen features a power icon as well;  indicates power status. The color of the battery changes from green to red when power is running low. Plug in the charger when you see the icon turn red.

For dual wavelength units, the 'LASER' banner will report the wavelength in use (1310 nm or 1510 nm) rather than the word LASER. An 'OH TX' banner appears when the unit is sending non-default SONET overhead bytes.

'INJ' or 'INJECT' indicates you are inserting errors at a rate. 'ALM' or 'ALARM' indicates you are transmitting an alarm.

2.2 Connector Panels

The SunSet OCx has two side connector panels, as shown in the following figures. The right side panel is the same for both the standard and OC-48 versions of the unit. See Figure 14.

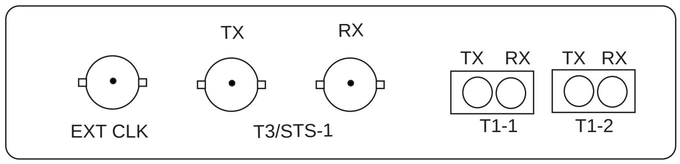


Figure 14 Right Side Connectors

EXT CLK: BNC connector used for external clock input from a frequency generator.

T3/STS-1 TX and RX: BNC connectors used for either a T3 or a STS-1 transmit and receive signal.

T1-1 TX and RX: Bantam connectors used for the Line 1 DS1 transmit and receive signal.

T1-2 TX and RX: Bantam connectors used for the Line 2 DS1 transmit and receive signal. T1-2 RX may also receive a BITS signal to use as an external clock.

Here is the left side panel, for both the standard and OC-48 platforms:

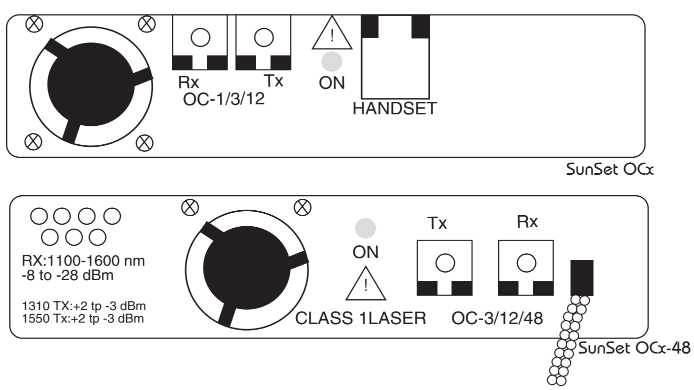


Figure 15 Left Side Connectors and LED

OC-1/3/12 or OC-3/12-/48 TX and RX: Optical connectors used to transmit and receive an OC-1, OC-3, OC-12, or OC-48 signal. Only one rate may be used at a time.

Caution

The optical transmitter in the SunSet OCx may overdrive the receiver of some network elements. The SunSet OCx optical transmit power is shown on the label next to the transmitter connector.

- Always check the maximum receive optical power level allowable before connecting the SunSet to the circuit.
- Insert optical attenuators if required.
- Attenuators are available from Sunrise Telecom or from other sources.

WARNING : DO NOT STARE DIRECTLY INTO THE OC1/3/12/48 PORTS.

ON LED: This indicates the power status of the laser. It lights amber when the laser is on. It does not light when the laser is off. Note that the laser automatically turns on when an optical rate is selected.

SunSet OCx OC-48 Notes

- For dual wavelength units, select the wavelength to Tx in either the SETUP SONET PORT screen under the Setup icon, choose between 1310 nm and 1550 nm. Both wavelengths use the same Tx port.
- The handset port is not available.

HANDSET: You may connect a handset here for VF talk and listen functions.

The top of the SunSet OCx also contains connectors. See Figure 16.

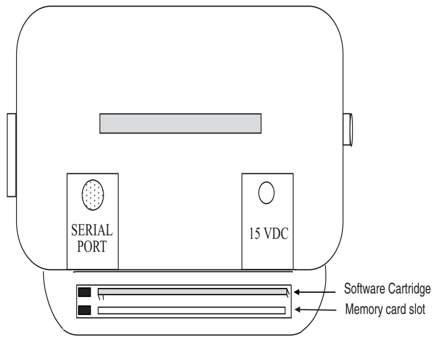


Figure 16 Top Panel

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

15 VDC: The SunSet charger, SS138D, is plugged in here. The SunSet may be operated with a discharged battery, provided the charger is connected. The battery will charge while the SunSet is being operated, if the charger remains connected.

2.3 ATA Storage Card

The ATA storage card allows you to store a substantial number of test results. Here are some hints on card usage:

- Do not remove the card while the unit is still writing (saving) records. It is best to stop taking measurement results before removing the card in order to ensure this. It is also a good idea to carry out the STOP ATA CARD function in the PROTOCOL FUNCTIONS menu *before* removing the card.

Viewing ATA card Stored Records in a PC:

1) Stop taking measurement results.
2) STOP ATA CARD (in Protocol functions).
3) Remove the card by pressing down on the outer card release button on the back of the SunSet OCx (See *ch. 1,* Figure 1).
4) Place the card into the PC card slot on your PC.
5) If this is the first time you have used an ATA card on your computer, a Windows hardware install screen will pop up. The card will appear as a hard drive under "My Computer." Follow the instructions to install the card.
6) Open the desired file. Note that the events and records will be available in two formats, binary (e.g. rbin) and text (e.g. records). Erasing the binary files will prevent the SunSet OCx from reading the results off the card.

Replacing the ATA Card

1) Turn the unit off.
2) Place the card back into its slot, and press it all the way down, until the button pops up as usual.
3) Turn the unit's power back on.

Saving Records

- Use the SYSTEM CONFIGURATION > MEASUREMENT TIMING > SAVE RESULTS and PRINT RESULTS (*ch. 3*) items to determine how measurements are saved in the MEASUREMENT RESULTS screens. Note however that individual events are not captured via this saving method.
- To save and view Event records, press RECORD (MORE, F3) in a MEASUREMENT RESULTS screen, then press VIEW EVENTS on the screen which appears.

Erasing Records

- To permanently erase all of the stored records, reformat the storage card while it is in your PC.
- Using the Delete function in the VIEW/PRINT RECORDS will not delete the text files associated with the record.

Chapter 3 Menus

3.1 Introduction

The SunSet OCx 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 surrounding area is darkened while the writing is light-colored. After highlighting the item, you may execute the selection by pressing the ENTER key, or the appropriate F-key when you are selecting an option. In a few specific cases, the simple action of highlighting an item will execute the selection. The SETUP TEST PATTERN menu works in this way.

The following menu tree shows the location of each menu item. Section numbers refer to sections within this chapter.

Setup sec. 3.2 Test Configuration

- Configurations 3.2.1
- Test Config Screen 2 3.2.2
  - OC-48c Settings 3.2.2.1
  - OC-48 Settings 3.2.2.2
  - OC-12c Settings 3.2.2.3
  - OC-12 Setting 3.2.2.4
  - OC-3c Settings 3.2.2.5
  - OC-3 Settings 3.2.2.6
  - OC-1 Settings 3.2.2.7
  - STS-1 Settings 3.2.2.8
  - DS3 Settings 3.2.2.9
  - VT1.5 Settings 3.2.2.10
  - DS1 Settings 3.2.2.11

Setup sec. 3.3 Loopback Control

- DS1 Loopback 3.3.1
- CSU/NIU Emulation 3.3.2
- DS1 Repeater 3.3.3
- HDSL Loopback 3.3.4
  - Network Loopback 3.3.4.1
- DS3/DS1 Stuff Bit 3.3.5
- DS3/DS1 C-bit 3.3.6
- DS3 C-Bit FEAC 3.3.7

SetupTest Pattern sec 3.4

- User Test Patterns 3.4.1

Setup SONET Port sec 3.5

Measurement Results sec. 3.6

- SONET Measurements 3.6.1
- VT1.5 Measurements 3.6.2
- DS3 Measurements 3.6.3
- DS2 Measurements 3.6.4
- DS1 Measurements 3.6.5

SONET Features sec.3.7

- SOH Monitor 3.7.1
- OH Byte Send 3.7.2
- Send K1, K2 Bytes 3.7.3
- Send S1 byte 3.7.4
- J0 Trace Generation 3.7.5
- POH Monitor 3.7.6
- Path OH Send 3.7.7
  - J1 Path Trace Generation 3.7.7.1
  - Edit C2 Signal Label Byte 3.7.7.2
  - Send Z4/K3 Byte 3.7.7.3
  - Send V5 Byte 3.7.7.4
  - Send Z4/K4 Byte 3.7.7.5
  - J2 Path Trace Generation 3.7.7.6
- SONET APS Meas. 3.7.8
- Transmit SS Bits 3.7.9
- OC48 Pointer Control 3.7.10
  - Pointer Send/Monitor 3.7.10.1
  - Pointer Test Seq. 3.7.10.2
- APS Byte Capture 3.7.11
  - Start a New Trace 3.7.11.1
  - Load a Saved Trace 3.7.11.2

DS3 Features *sec. 3.8*

- View Received Data 3.8.1
- C-bit Monitor 3.8.2
- Monitor DS3 FEAC 3.8.3
- Send DS3 FEAC 3.8.4
- Propagation Delay 3.8.5

Continued on next page

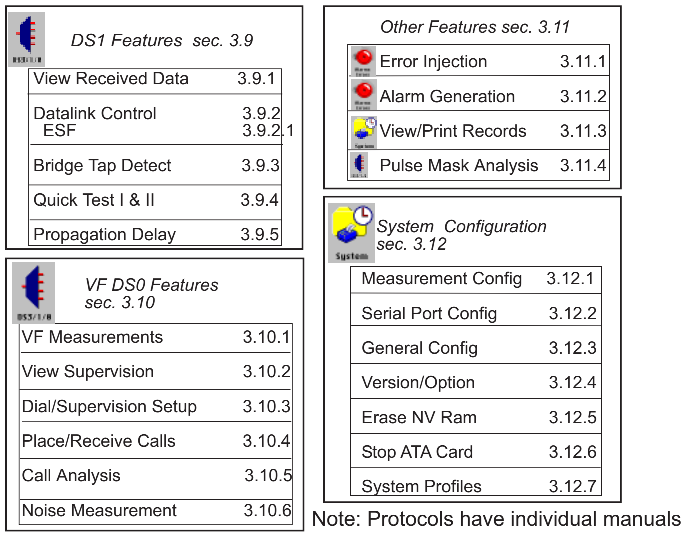


Figure 17 Menu Tree

See Figures 18 and 19 for sample main menu screens.The protocols (ISDN, GR-303, SS7, Frame Relay, and ATM) each have their own manual.

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

Color LCD Notes

The units featuring a color LCD present an icon-based main menu. See Figure 18 for the menu. Note that the possible messages, such as the Shift and LASER indicators, are now shown in different colors. The time of day has moved to the left side of the screen. F-keys are located at the base of the screen as usual. The F4 key shows 'HELP' in the main menu; press this key to access use definitions of the keys and LEDs.

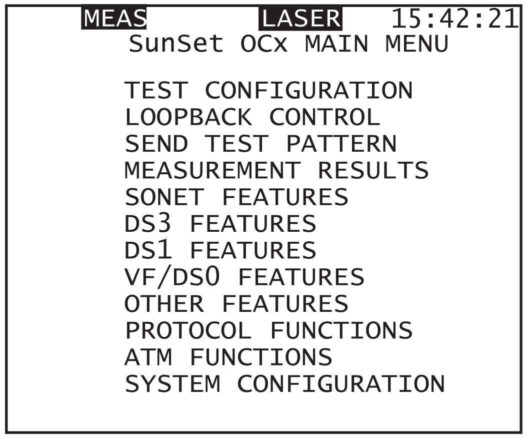


Figure 18 Black and White LCD Main Menu

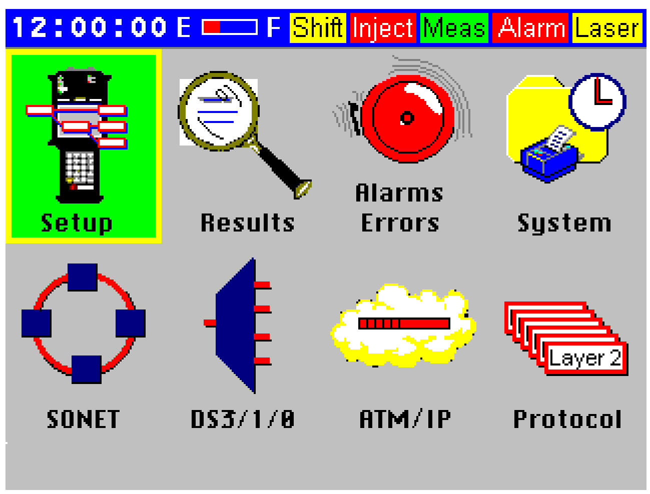


Figure 19 Color Main LCD Menu Screen

Use the keypad arrow keys to select the menu you want to access. Setup is highlighted in the sample figure. Here is a list of what is available under each menu icon:

Setup: (1) TEST CONFIGURATION, (2) LOOPBACK CONTROL, (3) SETUP TEST PATTERN, (4) SETUP SONET PORT

Results: MEASUREMENT RESULTS

Alarms Errors: (1) ERROR INJECTION, (2) ALARM GENERATION

System: (1) VIEW/PRINT RECORDS, (2) MEASUREMENT TIMING, (3) SERIAL PORT CONFIG, (4) GENERAL CONFIG, (5) VERSION/OPTION, (6) ERASE NV RAM, (7) STOP ATA CARD, (8) SYSTEM PROFILES

SONET: (1) SECTION OVERHEAD MONITOR, (2) OVERHEAD BYTE SEND, (3) SEND K1, K2 BYTES, (4) SEND S1 BYTE, (5) JO/J1 SECTION TRACE GENERATION, (6) PATH OVERHEAD MONITOR, (7) PATH OVERHEAD SEND, (8) POINTER CONTROL, (9) SONET APS MEASUREMENT

DS3/1/0: (1) DS3 FEATURES, (2) DS1 FEATURES, (3) VF/DSO FEATURES

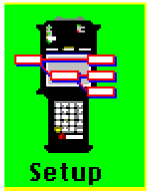
ATM/IP: ATM FUNCTIONS

PROTOCOLS: (1) ISDN PRIMARY RATE, (2) GR-303 MONITOR, (3) SS7 ANALYSIS, (4) FRAME RELAY, (5) STOP ATA CARD

See the corresponding chapters in the this manual for each selection; the appropriate icon will head each section. Note that the DS3 and DS1 PULSE MASK features are not available on the SSOCx OC-48, nor is Frame Relay. Additionally, the handset jack is not available. The built-in microphone and speaker are available for VF testing.

Getting Started

Turn the unit by pressing the POWER key. The unit will perform a Self Test If you see an error message, please contact Sunrise Telecom Incorporated's Customer Service department at 1-800-701-5208 (option 1).



3.2 Test Configuration

Before connecting the SunSet to your circuit, you must configure the TEST CONFIGURATION items properly. To access the TEST CONFIGURATION screen, press ESC until you return to the main menu. Move the cursor to the TEST CONFIGURATION selection, and press ENTER. Access the TEST CONFIGURATION item via the Setup icon if you have a color unit.

Setting up the TEST CONFIGURATION is the most important step in the entire test procedure. If the TEST CONFIGURATION items are configured improperly, all measurement results will be meaningless. Note that there are two TEST CONFIGURATION screens.

If you have an OC-48 unit, and are testing at SONET, make sure to also configure the SETUP SONET PORT settings.

The F-keys show the available options for each setup parameter in the display. As the F-key is pressed in this screen, the SunSet immediately alters its configuration to reflect the new setting. The cursor will automatically move down to the next line. In the first TEST CONFIGURATION screen, you configure the Test Mode and higher-order settings such as the high and low rates and the test payload. Note that not all rates defined in this chapter are available on all units (for example, OC-1 is not available on the OC-48 unit).

The first selection in the TEST CONFIGURATION screen is TEST MODE. Select between point-to-point testing, MUXTest where you test a multiplexer/demultiplexer, and MUXMode, which emulates a mux. After completing these selections, press ENTER to access the second TEST CONFIGURATION screen.

In the second TEST CONFIGURATION screen, you configure the individual rates. The TEST CONFIGURATION menu differs for each mode selected. Additionally, more than one payload rate is available for most of the test modes (such as OC-3 and STS-1). Hence, there are a variety of testing setups available. Not all settings or options listed for a particular Test Interface or Payload will necessarily be available; it all depends on the requirements for a particular test.

Often times, an intermediary rate must also be configured; for example, select OC-1 as your TEST CONFIGURATION, and DS1 as the PAYLOAD, and you will also have to configure the intermediary DS3 rate. The following table shows the rates and their payloads:

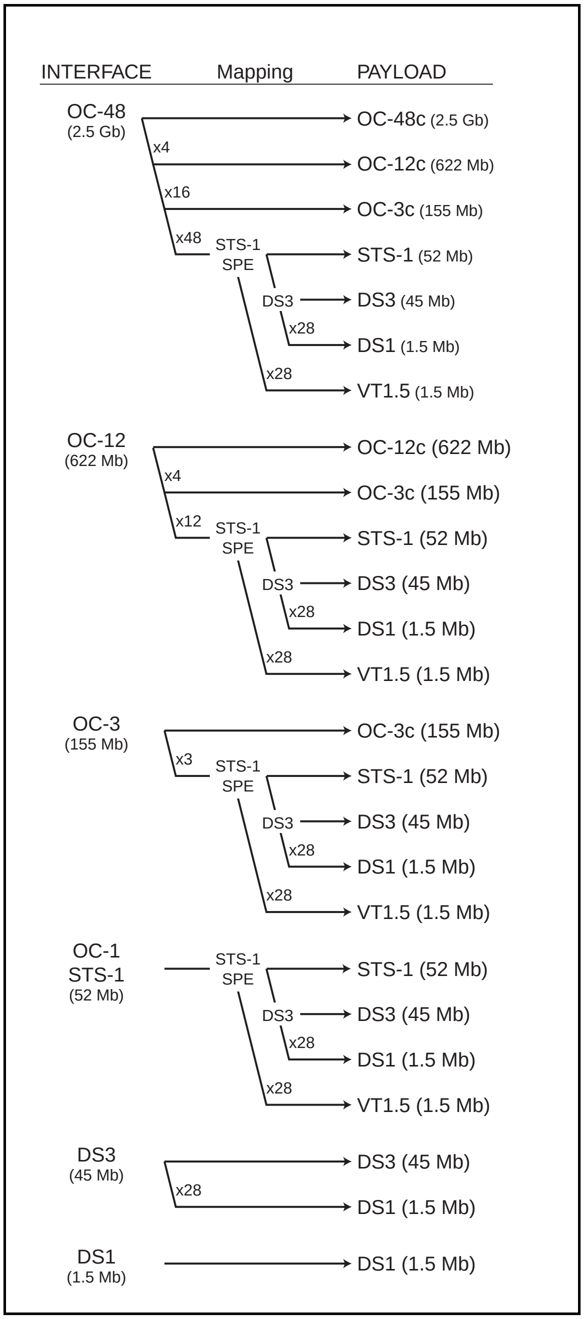


Figure 20   Rates and Payloads

3.2.1 Configurations

Here is the TEST CONFIGURATION screen, accessed via the Setup icon or the MAIN MENU:

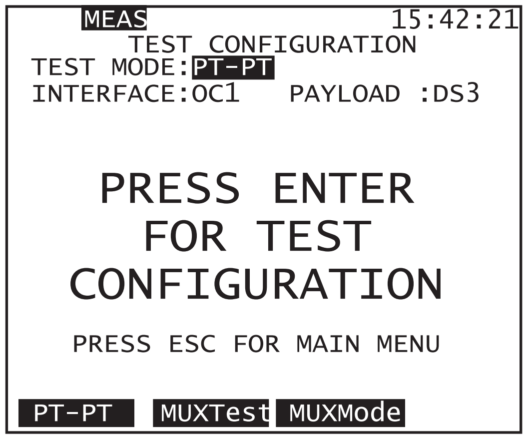


Figure 21 Test Configuration, Screen 1

In this screen, configure the test mode and higher-order settings such as the high and low rates and the test payload.

TEST MODE

Options: PT-PT (F1), MUXTest (F2), MUXMode (F3), ATM (F4)

Choose the type of test to perform.

- PT-PT configures the unit for basic point-to-point testing.
- MUXTest configures the unit to test through a multiplexer or demultiplexer. The set generates a test pattern for the transmit source.
- MUXMode configures the unit to emulate a multiplexer/demultiplexer. The set passes the payload between the received and transmitted rate, for a THRU transmit source.

The TEST MODE selection determines which configuration items next appear. Remember that the options presented will depend on the unit's platform (OC-48 color, OC-3 black and white, etc.).

For Point-to-Point:
INTERFACE
Options: OC48, OC12, OC3, OC1, STS1, DS3, DS1
Determine the high rate side of your test.

PAYLOAD
Options: STS48c, STS12c, STS3c, STS1, DS3, DS1, VT1.5;
Note that the options available will depend on your INTERFACE selection.
Determine the low rate side of your test.

NOTE: For OC-3c testing, select OC3 as your INTERFACE and STS3c as your PAYLOAD. When you enter the second TEST CONFIGURATION screen, the rate heading will appear as OC-3c. The same setup applies to configuring for OC-12c and OC-48c.

The following graphics show different ways point-to-point testing may work, depending on the TxSRC selection:

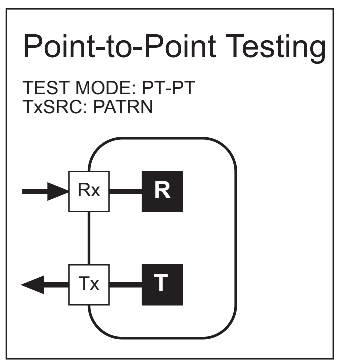


Figure 22 Point-to-Point: TxSRC - PATRN

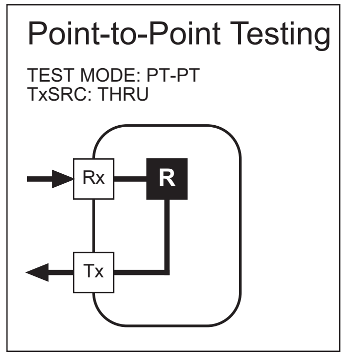


Figure 23   Point-to-Point: TxSRC - THRU

Figures 24 and 25 show the TEST CONFIGURATION for MUXTest and MUXMode:

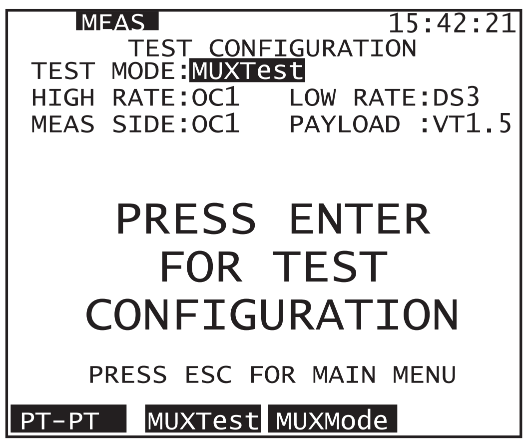


Figure 24   MUXTest Configuration

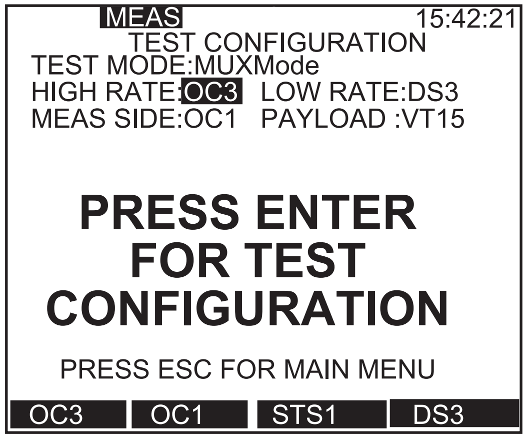


Figure 25 MUXMode Configuration

- ATM is available for OC-48 units. See the ATM User's Manual for details. For ATM testing on OC-12, OC-3 and DS3 units, use point-to-point testing.

HIGH RATE

Options: OC48, OC12, OC3, OC1, STS1, DS3

Determine the high rate side of your test.

LOW RATE

Options: DS3, DS1; Note that the options available will depend on your HIGH RATE selection.

Determine the low rate side of your test.

MEAS SIDE

Options: OC48, OC12, OC3, OC1, STS1, DS3, DS1; Note that the options available will be the same as your HIGH and LOW RATE selections.

Determine on which side the unit will take measurements.

- Select the same rate as your HIGH RATE side, and the unit will test (MUXTest) a multiplexer or emulate (MUXMode) a demultiplexer.
- Select the same rate as your LOW RATE side, and the unit will test (MUXTest) a demultiplexer or emulate (MUXMode) a multiplexer.

The following graphics show the differences in how MUXTest and MUXMode work. Note that both the TEST MODE and MEAS SIDE choices determine how the test functions.

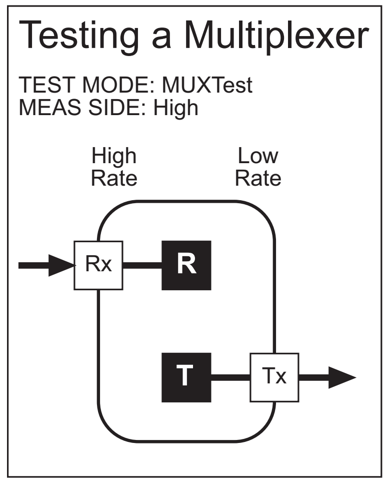


Figure 26 Test a Multiplexer: MUXTest, MEAS SIDE—High

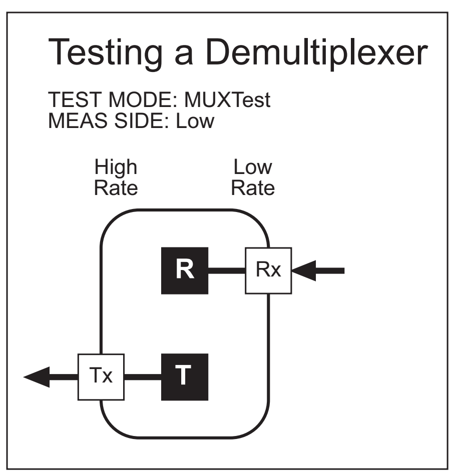


Figure 27 Test a Demultiplexer: MUXTest, MEAS SIDE—Low

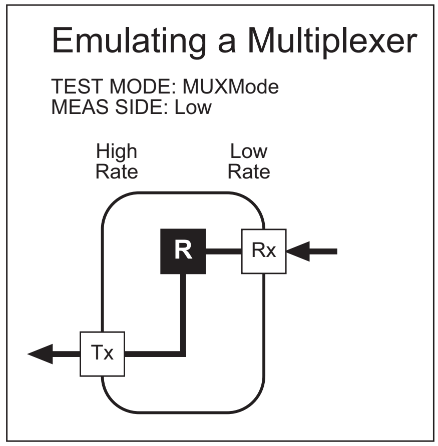


Figure 28 Emulate a Multiplexer: MUXMode, MEAS SIDE—Low

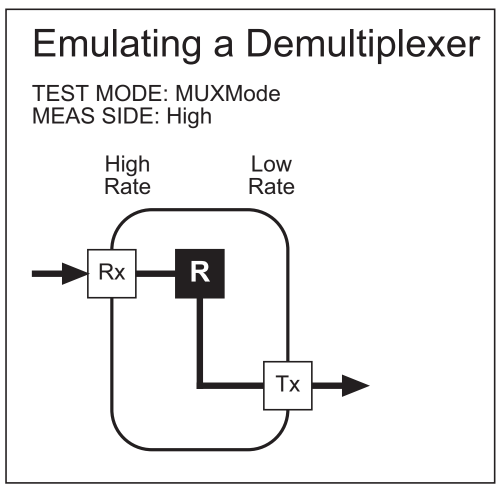


Figure 29 Emulate a Demultiplexer MUXMode, MEAS SIDE—High

PAYLOAD

Options: OC12C, OC3c, DS3, VT1.5, DS1; Note that the options available will depend on your platform and LOW RATE selection.

The payload may be the same rate as the LOW side, or a signal within that LOW RATE.

Note: When you have completed this stage of the Test Configuration, press ENTER, which brings you to the second TEST CONFIGURATION screen. Press ESC if you do not want to keep the changes you have configured.

3.2.2 Test Configuration—Screen 2

Here you will configure the individual rates.

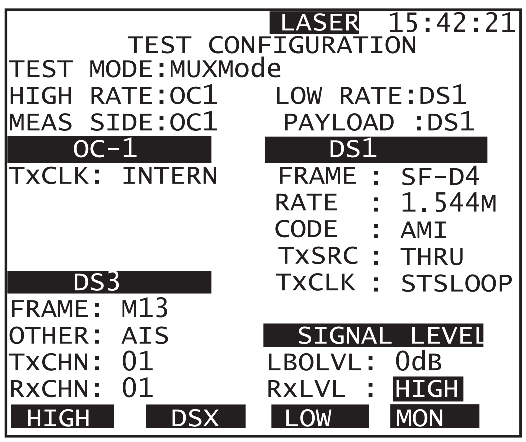


Figure 30 MUXMode Configuration, Screen 2

In Figure 30, the following items are presented in the header. All of the items were configured in the previous screen. Refer to *3.2.1* for details.

This section contains the setup choices for the different rates. Note that not all settings are available under all test setups. Here are a few sample screens. In Figure 31, the user is testing a DS1 within an OC-3 signal.

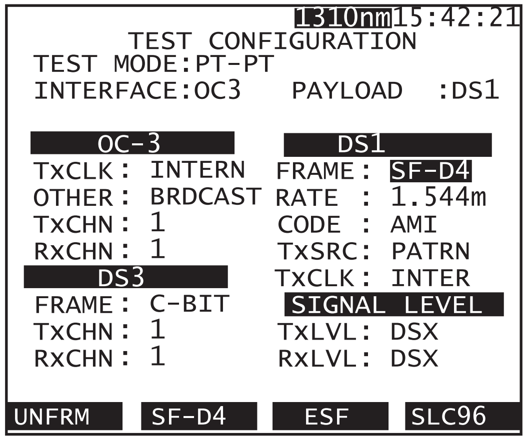


Figure 31 OC-3/DS1 Config

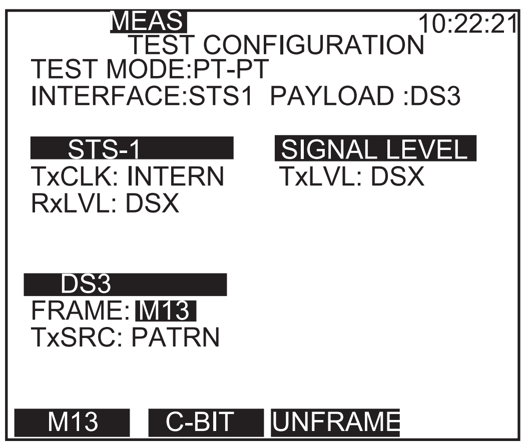


Figure 32 STS-1/DS3 Configuration Screen

In Figure 32, the user is testing a DS3 within an STS-1.

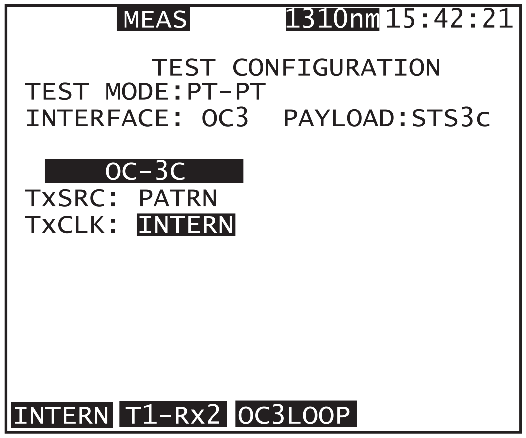


Figure 33   OC-3c Configuration Screen

In Figure 33, the user is testing an OC-3c.

SIGNAL LEVEL Settings

The SIGNAL LEVEL section is presented under most rates. Configure as follows. Notes for the individual rates appear in their sections.

TxLVL (may also be LBOLVL, if DS1 LOW RATE or INTERFACE)
Options:
DS1: 0 dB (F1), -7.5 dB (F2), -15 dB (F3), -22.5 dB (F4)
Other rates: HIGH, DSX, LOW

Determine the transmitted signal level.

- In the first TEST CONFIGURATION screen, MEAS SIDE is set to either the HIGH RATE or LOW RATE side. The TxLVL setting here applies to whichever of those two (HIGH or LOW) settings was NOT chosen for the MEAS side. See the following example:

HIGH RATE: OC1	LOW RATE: DS3
MEAS SIDE: OC1	PAYLOAD: DS1

- Since OC1 has been selected as the MEAS SIDE, the TxLVL setting applies to the DS3 signal

RxLVL

Options: HIGH (F1), DSX (F2), LOW (F3), MON (F4) or
TERM (F1), BRIDGE (F2), DSXMON (F3)
Determine the received signal level

- This level applies to the receive/measure side.
- The options depend on your settings.

3.2.2.1 OC-48c Settings

Select OC-48 as your INTERFACE and STS48c as your PAYLOAD to configure an OC-48c rate.

TxSRC

Options: PATRN
Determine the source of the STS-48c signal.

- Set at PATRN.

SunSet OCx OC-48 Notes: SONET Port Configuration

After you have completed your rate configurations, enter the SETUP SONET PORT menu item to finish the setup process. This is where the TxSRC option is set, not on the TEST CONFIGURATION screen.

TxCLK

Options: INTERN (F1), T1-Rx2 (F2), LOOP (F3)
Determine the clock source for the signal transmitted out the OC jack.

- Select INTERN to use the internal timing of the test set.
- Select T1-Rx2 when a Building Integrated Timing Source is available. Plug the BITS in at the T1 Line 2 Rx port.
- Select LOOP to have the set use the timing signal received on OC-48 Rx as the clock source for its OC-48 transmit signal.

3.2.2.2 OC-48 Settings

TxCLK

Options: INTERN (F1), T1-Rx2 (F2), LOOP (F3)

Determine the clock source for the signal transmitted out the OC-48 jack.

- Select INTERN to use the internal timing of the test set.
- Select T1-Rx2 when a Building Integrated Timing Source is available. Plug the BITS in at the T1 Line 2 Rx port.
- Select LOOP to have the set use the timing signal received on OC-48 Rx as the clock source for the OC-48 transmit signal.

TxCHN, RxCHN

Options: 1—48

Determine which STS inside the OC-48 will be used for transmitting and receiving.

- Use the NEXT (F2) and PREVious (F2) keys to make your selection.

OTHER

Options: UNEQ, BRDCST (F2)

Determine what will be transmitted on the other/unused rates

- Choose UNEQ, and the unequipped path signal will be sent.
- Choose BRDCST, and the selected test pattern will be transmitted on all timeslots simultaneously.

3.2.2.3 OC-12c Settings

Select OC-12 as your INTERFACE and STS12c as your PAYLOAD to configure an OC-12c rate.

TxSRC

Options: PATRN (F1), THRU (F2) (N/A OC-48 units)

Determine the source of the STS-12c signal.

- Select PATRN to transmit a STS-12c test pattern in each time slot. This test pattern is configured in the SEND TEST PATTERN menu.
- Select THRU to loop the incoming STS-12c signal from the OC-12 Rx to Tx.

TxCLK

Options: INTERN (F1), T1-Rx2 (F2), LOOP (F3)

Determine the clock source for the signal transmitted out the OC3 jack.

- Select INTERN to use the internal timing of the test set.
- Select T1-Rx2 when a Building Integrated Timing Source is available. Plug the BITS in at the T1 Line 2 Rx port.
- Select LOOP to have the set to use the timing signal received on OC12 Rx as the clock source for its OC-12 transmit signal.

3.2.1.4 OC-12 Settings

TxCLK

Options: INTERN (F1), T1-Rx2 (F2), LOOP (F3)

Determine the clock source for the signal transmitted out the OC12 jack.

- Select INTERN to use the internal timing of the test set.
- Select T1-Rx2 when a Building Integrated Timing Source is available. Plug the BITS in at the T1 Line 2 Rx port.
- Select LOOP to have the set to use the timing signal received on OC12 Rx as the clock source for its OC-12 transmit signal.

OTHER

Options: AIS or UNEQ (F1), BRDCAST (F2)

Determine what will be transmitted on the other/unused rates

- Choose AIS/UNEQ to insert an AIS or UNEQ (OC-48 unit) signal on the line.
- Choose BRDCAST to transmit your selected test pattern on all timeslots simultaneously. This is for out-of-service testing.

TxCHN, RxCHN

Options: 1—12

Determine which STS inside the OC-12 will be used for transmitting and receiving.

- Use the NEXT (F2) and PREVious (F2) keys to make your selection.

3.2.2.5 OC-3c Settings

TxSRC
Options: PATRN (F1), THRU (F2) (N/A OC-48 unit)
Determine the source of the OC-3c signal.

- Select PATRN to transmit an STS-3c test pattern in each time slot. This test pattern is configured in the SEND TEST PATTERN menu.
- Select THRU to loop the incoming STS-3c signal from the OC3 Rx to Tx.

TxCLK
Options: INTERN (F1), T1-RX2 (F2), OC3LOOP (F3)
Determine the clock source for the signal transmitted out the OC3 jack.

- Select INTERN to use the internal timing of the test set.
- Select T1-RX2 when a Building Integrated Timing Source is available. Plug the BITS in at the T1 Line 2 Rx port.
- Select LOOP to have the set to use the timing signal received on OC3 Rx as the clock source for its OC-3 transmit signal.

3.2.2.6 OC-3 Settings

TxCLK
Options: INTERN (F1), T1-RX2 (F2), OC3LOOP (F3)
Determine the clock source for the signal transmitted out the OC3 jack.

- Select INTERN to use the internal timing of the test set.
- Select T1-RX2 when a Building Integrated Timing Source is available. Plug the BITS in at the T1 Line 2 Rx port.
- Select OC3LOOP to have the set to use the timing signal received on OC3 Rx as the clock source for its OC-3 transmit signal.

OTHER
Options: UNEQ or AIS (F1), BRDCAST (F2)
Determine what will be transmitted on the other/unused rates

- Choose UNEQ (OC-48 units) to insert an unequipped signal on the line; choose AIS (OC-3/12 units) to insert an AIS.

- Choose BRDCAST to transmit your selected test pattern on all timeslots simultaneously. This is for out-of-service testing.

TxCHN

Options: 1 (F1), 2 (F2), 3 (F3)

Determine which STS inside the OC-3 will be used for transmitting.

RxCHN

Options: 1 (F1), 2 (F2), 3 (F3)

Determine which STS inside the OC-3 will be used for receiving.

- As you change the TxCHN, the RxCHN will also correspondingly change, and should usually be the same. You may however set them to different numbers.

3.2.2.7 OC-1 Settings

TxCLK

Options: INTERN (F1), T1-Rx2 (F2), OC1LOOP (F3)

- Select INTERN to use the unit's internal timing.
- Select T1-Rx2 to use a Building Integrated Timing Source, plugged in at the T1-2 Rx port.
- Select OC1LOOP to use the timing received from the OC1 Rx port as the clocking source.

OTHER

Options: AIS (F1), BRDCAST (F2)

Determine what will be transmitted on the other/unused rates

- Choose AIS to insert an AIS signal on the line.
- Choose BRDCAST to transmit your selected test pattern on all timeslots simultaneously.

TxCHN

Options: any number from 1—28

Determines which DS1/VT1.5 to transmit on.

- Press NEXT (F1) and/or PREVIUS (F2) to select the desired DS1

RxCHN
Options: any number from 1—28
Determine which DS1/VT1.5 to receive on.

3.2.2.8 STS-1 Settings

TxCLK
Options: INTERN (F1), STSLOOP (F2)
Determine the transmit clock for the signal transmitted out the STS-1 jack.

- Choose INTERN to use the unit's internal timing; when the 5 ppm accuracy of the internal clock is sufficient.
- Select STSLOOP to have the SunSet loop the timing received on the STS-1 Rx jack to the STS-1 Tx jack.

OTHER
Options: UNEQ (F1), BRDCAST (F2), THRU (F2)
Determine what will be transmitted on the other/unused rates

- Choose UNEQ to insert an unequipped signal on the line.
- Choose BRDCAST to transmit your selected test pattern on all timeslots simultaneously. This is for out-of-service testing.
- Choose THRU to loop the received signal to the transmit port.

TxCHN
Options: any number from 1—28
Determines which DS1/VT1.5 inside the STS-1 to transmit on.

- Press NEXT (F1) and/or PREV (F2) to select the desired DS1/VT1.5.

RxCHN
Options: any number from 1—28
Determine which DS1/VT1.5 inside the STS-1 to receive on.

- As you change the TxCH, the RxCH will also correspondingly change. To select a different receive channel, cursor to RxCH, and use the NEXT (F1) or PREV (F2) to select the DS1.

- The Tx and Rx channel should 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.

SIGNAL LEVEL Notes

TxLVL

Options: HIGH (F1), DSX (F2), LOW (F3)

TxLVL sets the transmit signal level.

- HIGH gives you the highest level pulse, typically .9V base to peak nominal voltage.
- DSX adheres to the GR-253-CORE standard for base to peak at a STSX-1, typically between .36V and .85V.
- LOW sets a pulse of typically .15V base to peak nominal voltage.

RxLVL

Options: HIGH (F1), DSX (F2), LOW (F3), MON (F4)

Determine the received signal level.

- RxLVL does not necessarily have to be set at the same value as the TxLVL.
- Choose DSX when you are plugged into an STSX-1 OUT jack.
- Select MON when you are plugged into an STSX-1 MON jack.
- Use HIGH or LOW when expecting a high or low signal, respectively.

3.2.2.9 DS3 Settings

TxCLOCK

Options: INTERN (F1), DS3LOOP (F2)

Determine the clock source for the signal transmitted out the DS3 jack.

- Select INTERN to use the internal timing of the test set.
- Pressing DS3LOOP uses the timing signal received on DS3 Rx as the clock source for the DS3 transmit signal.

FRAME

Options: M13 (F1), C-BIT (F2), UNFRAME

Configure the DS3 signal framing.

TxSRC

Options: PATRN (F1), THRU (F2)

Determine the source of the DS3 signal.

- Select PATRN to transmit a DS3 test pattern. This test pattern is configured in the SEND TEST PATTERN menu.
- Select THRU to loop the incoming DS3 signal from the DS3 Rx to Tx.
- Select UNFRAME (F3) to send an unframed signal.

OTHER

Options: AIS (F1), BRDCAST (F2)

Determine what you will transmit on the 27 unused DS1s.

- Choose AIS to insert an AIS signal on the DS3 line. This might be used if the DS3 is out-of-service.
- Choose BRDCAST to transmit your selected test pattern on all 28 DS1s simultaneously. This is for out-of-service testing only.

TxCHN

Options: any number from 1—28

Determines which DS1 inside the DS3 to transmit on.

- Press NEXT (F1) and/or PREV (F2) to select the desired DS1

RxCHN

Options: any number from 1—28

Determine which DS1 inside the DS3 to receive on.

- As you change the TxCH, the RxCH will also correspondingly change. To select a different receive channel, cursor to RxCH, and use the NEXT (F1) and/or PREV (F2) to select the desired DS1.
- The Tx and Rx channel should 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.

SIGNAL LEVEL Notes

TxLVL

Options: HIGH (F1), DSX (F2), LOW (F3)

TxLVL sets the transmit signal level.

- HIGH (F1) gives you the highest pulse, typically .9V base to peak nominal voltage.
- DSX (F2) adheres to the GR-499-CORE standard for use at a DSX-3, in between .36V and .85V.
- LOW (F3) sets a typical pulse of .15V base to peak nominal voltage.

RxLVL

Options: HIGH (F1), DSX (F2), LOW (F3), MON (F4)

Determine the received signal level.

- RxLVL does not necessarily have to be set at the same value as TxLVL.
- You should choose DSX when you are plugged into a DSX-3 OUT jack.
- Select MON when you are plugged into a DSX-3 MON jack.
- Use HIGH or LOW when expecting a high or low signal, respectively.

3.2.2.10 VT1.5 Settings

VT1.5 is the lowest rate virtual tributary; a signal designed for transport and switching of sub-STS-1 payloads. One VT1.5 may transport one DS1 signal. Hence the settings are the same as the DS1 settings.

FRAME

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

- Select UNFRM for no framing
- Select SF-D4 for SF-D4 (Super Frame) framing
- Select ESF for ESF (Extended Super Frame) framing
- Select SLC-96 for SLC-96 framing

RATE

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

Set the desired test rate for your test signals.

- Choose 1.544M for full rate 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, refer to Figure 36 and the description that follows for instructions on selecting timeslots.

CODE

Options: AMI (F1) , B8ZS (F2)

Determine the line code which is to be transmitted on the test set's DS1 signal.

- B8ZS (Bipolar 8 Zero Substitution) uses intentional BPVs to encode strings of eight consecutive zeros.
- AMI (Alternate Mark Inversion) uses alternating positive and negative pulses to represent successive 1 values. In AMI, there is a risk of synchronization loss during long strings of zeros.

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.

Be sure you choose this setting correctly. An incorrect AMI/ B8ZS setting is the most common problem in setting up the test set to transmit to switches, channel banks, multiplexers, and digital cross connect systems. The test set's code setting must be the same as that of the equipment at the other end of a DS1 line.

TxSRC

Options: PATTERN (F1), THRU (F2)

Determine the source of your DS1 test signal.

- Select PATTERN (F1) to transmit the DS1 test pattern. This test pattern is configured in the SEND TEST PATTERN screen.
- Select THRU (F2) to loop each of the incoming channels from the DS1-Rx to Tx without placing any test pattern onto the line. When you select THRU, the test set automatically adjusts the TX CLK for DS1-Rx.

TxCLK

Options: INTERN (F1), Rx-1 (F2), Rx-2 (F3), EXTERN (F4), STSLOOP (F4)

This item determines the source of the transmit clock.

- See TxCLK under DS1 Settings for further explanation.

3.2.2.11 DS1 Settings

T1 may be either a payload, a single line under test, or two lines under test. Select SINGLE in the MEASURE field to configure to test a single line. Choose DUAL to test two DS1 lines. Refer to Figure 34 for a sample T1 Single screen, and Figure 35 for the T1 Dual screen.

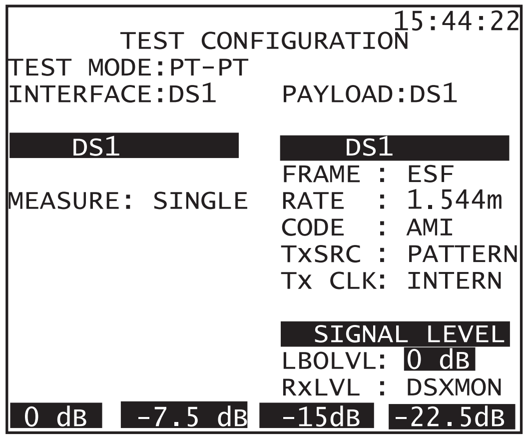


Figure 34 DS1 Single Mode Configuration

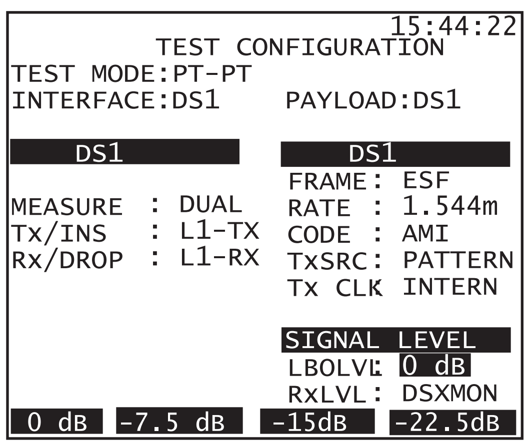


Figure 35 DS1 Dual Mode Configuration

The following items are available for configuration in the T1 modes. Note that a few items specific to only the DS1 DUAL screen are included at the end of this section.

MEASURE

Options: SINGLE (F1), DUAL (F2)

Determine whether one or two lines will be under test.

- Select SINGLE to test one DS1 line; use the T1-1 ports and LEDs.
- Select DUAL to test two DS1 lines; use the T1-1 ports and LEDs for line 1, and the T1-2 ports and LEDs for line 2.

FRAME

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

- Select UNFRAME for no framing
- Select SF-D4 for SF-D4 (Super Frame) framing
- Select ESFfor ESF (Extended Super Frame) framing
- Select SCL-96 for SLC-96 framing

RATE

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

Set the desired test rate for your test signals.

- Choose 1.544M for full rate 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 36:

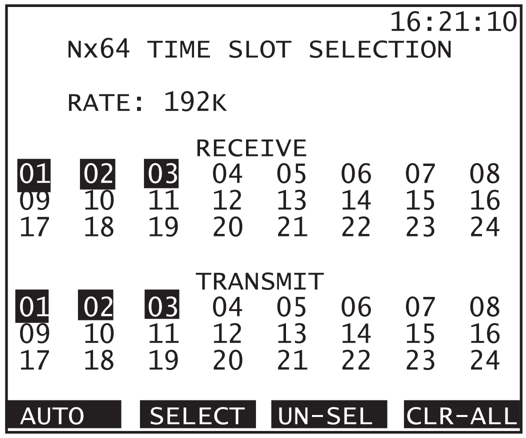


Figure 36 Fractional T1 Screen

To select the channels:

- To have the set automatically configure itself to the fractional T1 channel, press (F1) for AUTO. The test set performs this auto configuration by looking for the 7F or FF idle code, eliminating the unused channels.
- To select the T1 channels manually, move the cursor to the desired channel using the arrow keys.
  1) Press SELECT (F2). The reported rate will change as you make or clear selections.
  2) Repeat this procedure until all the desired channels have been selected.
  3) As you configure the RECEIVE timeslots, the set will automatically simultaneously choose the corresponding TRANSMIT channels. To configure the TRANSMIT timeslots differently, cursor down and select the timeslots manually.
  4) If you inadvertently select an undesired channel, simply press the UN-SEL key (F3).
  5) Press CLR-ALL (F4) to deselect everything and start over.

Note: Pressing the ENTER key will save your timeslot selections.

CODE

Options: B8ZS (F1), AMI (F2)

Determine the line code which is to be transmitted on the test set's DS1 signal.

1) B8ZS (Bipolar 8 Zero Substitution) uses intentional BPVs to encode strings of eight consecutive zeros.
2) AMI (Alternate Mark Inversion) uses alternating positive and negative pulses to represent successive 1 values. In AMI, there is a risk of synchronization loss during long strings of zeros.

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.

Be sure you choose this setting correctly. An incorrect AMI/B8ZS setting is the most common problem in setting up the test set to transmit to switches, channel banks, multiplexers, and digital cross connect systems. The test set's code setting must be the same as that of the equipment at the other end of a DS1 line.

TxSRC

Options: PATTERN (F1), THRU (F2)

Determine the source of your DS1 test signal.

- Select PATTERN to transmit the DS1 test pattern. This test pattern is configured in the SEND TEST PATTERN screen.
- Select THRU to loop each of the incoming channels from the DS1-Rx to Tx without placing any test pattern onto the line. When you select THRU, the test set automatically adjusts the XMT CLK for DS1-Rx.

TxCLK

Options: INTERN (F1), Rx-1 (F2), Rx-2 (F3), EXTERN (F4), LOOP (F4)

This item determines the source of the transmit clock.

Internal timing (F1) should be used when:

- An external frequency source is not available
- The test set will not be transmitting towards synchronized network equipment
- 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

- The 5 ppm accuracy of the INTERNal clock is sufficient
- Most kinds of loopback testing is performed

DS1 received timing, received from a DS1 source plugged in at Line 1 (Rx-1, F2) or at Line 2 (Rx-2, F2) should be used when:

- The set should be synchronous to the network
- The set is performing FT1 Nx64 measurements towards a switch or DCS

External timing, plugged in at the EXT CLK port should be used when

- Precise frequency measurements are required
- An external frequency source such as the central office clock is plugged in

Loop timing:

- Select STS/LOOP or DS3/LOOP to drop the timing from the received signal and loop it
- should be used when the set should be synchronous with the network
- not available in T1 SINGLE or T1 DUAL mode

Notes on the SIGNAL LEVEL
Rx LVL
Options: TERM (F1), DSXMON (F2), BRIDGE (F3)
Configure the DS1 receiver(s).

- Note that the level applies to both lines, if in DUAL mode.
- The TERM mode should be 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.

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

This mode is useful 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.

- 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.

TxLBO (applies to both lines in DUAL Mode)
Options: 0 dB (F1), -7.5 dB (F2), -15 dB (F3), -22.5 dB (F4)

This item determines the Line Build Out (TxLBO) appearing on your transmitted T1 signal. Line Build Out is used to stress test a line by attenuating the dB to a certain level.

0 dB should be used when:

- The set is plugged in at the front panel jack of a DSX, CSU equipment direction, NI equipment direction, channel bank, or other 3V test point.
- Under most conditions.

-7.5 dB , -15 dB, or -22.5 dB should be used when:

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

Items Specific to DS1 Dual

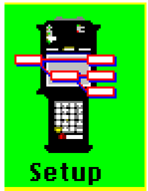
Tx/INS
Options: L1-Tx (F1), L2-Tx (F2)

The selected line is designated the primary line. The specified test pattern, injected errors, and generated alarms are transmitted out each line.

Rx/DROP
Options: L1-Rx (F1), L2-Rx (F2)

The selected line is designated the primary line. The test set will measure all alarms and errors on each line, but only perform bit error rate testing on the primary line.

- Select F1 to test at the line 1 port.
- Select F2 to test at the line 2 port.



3.3 Loopback Control

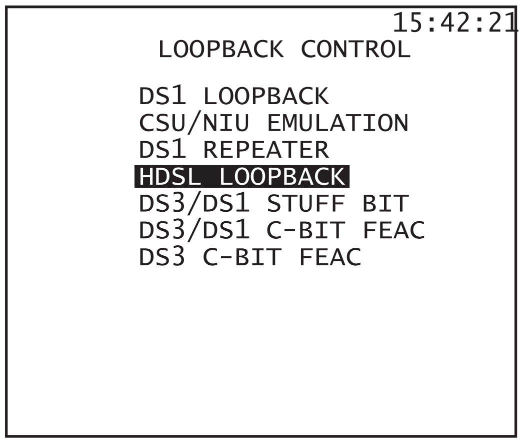


Figure 37 Loopback Control Menu

LOOPBACK CONTROL may be entered from the MAIN MENU or via the Setup icon.

- With the circuit looped back, you can measure performance on the transmission path between the tester and the loopback device.
- Before proceeding, find out if the line has loopback devices installed, and, if so, what type of loopback is available, and how it is intended to work.

3.3.1 DS1 Loopback

- You must have a DS1 PAYLOAD.
- See the following figure.

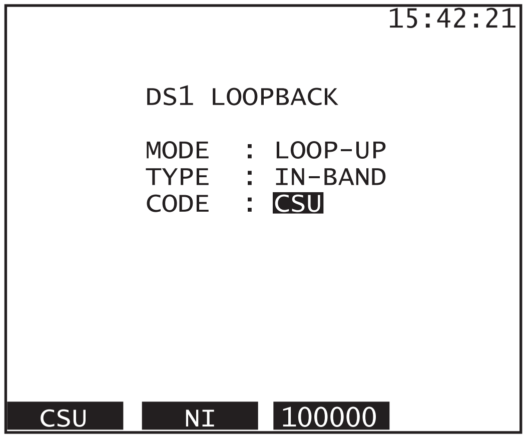


Figure 38 DS1 Loopback Screen

Basic Loopback Procedure

1) From the LOOPBACK CONTROL menu, 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 settings. This should be selected last.

2) Access the loopback TYPE.

- Choose either an IN-BAND (F1) or ESF-DL (F2) loopback when you have ESF framing. IN-BAND is the default for SF-D4 and SLC96.

- 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.

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. ESF-DL loopbacks will have a code of either LINE, PAYLOAD, or NETWORK.
- IN-BAND: 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: 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; left to right):
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 LOOP-UP (F1) to loop the circuit up before testing.
- Choose LOOP-DN (F2) 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.

3.3.2 CSU/NIU Emulation

- Requires CSU/NIU Emulation option SWOCx-P

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 OCx 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 39.

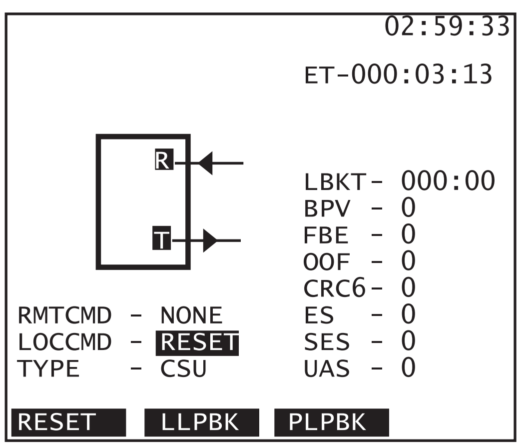


Figure 39 CSU/NI Emulation

Use this procedure:

1) Configure the TEST CONFIGURATION menu as:

   TEST MODE: PT-PT
   INTERFACE: DS1 single or dual
   FRAME: as appropriate
   RATE: 1.544M
   CODE: as appropriate
   TxSRC: PATTERN
   TxCLK: TERM

   TxLBO: as appropriate
   RxLVL: N/A

- Press ENTER when your settings are correct.

2) ENTER LOOPBACK CONTROL.

- Enter the CSU/NI EMULATION menu.

3) Plug the cords into the test set and the circuit under test.

4) Set the test set 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 TEST CONFIGURATION menu.

6) If desired, operate any of the local commands (LOCCMD) 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 re-frame 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 re-frames and re-codes 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 ESC and you will return to the main menu. All loopbacks will be dropped as you exit the emulation screen.

3.3.3 DS1 Repeater

- Requires Intelligent Span Control software option SWOCx-N
- Figure 40 shows the line repeater loopback.

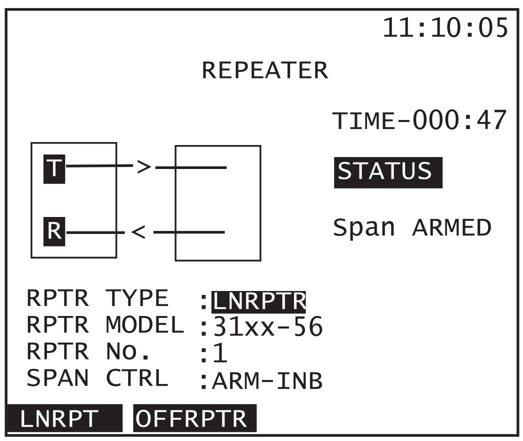


Figure 40 DS1 Repeater Screen

This diagram shows several aspects of the repeater control session.

The **TIME** (timeout) timer shows how much time is remaining until the repeater will automatically drop its loopback.

The **STATUS** bar shows the current looping status of the span (Span Armed in the sample figure).

RPTR TYPE shows the type of repeater under loopback control.

RPTR MODEL tells the specific repeater model in use.

RPTR No. tellswhich repeater in the line is under test (1 in the sample figure).

SPAN CTRL line shows which 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 Westell central office repeater and line repeater (1xx-56, 31xx-80) F-key menus include a sequential loopback (SEQLPBK) item. It allows you to quickly step through the loopbacks on a line. To use this feature, arm the span and then press the SEQLPBK F-key and observe which repeater loops up. You don't have to enter the repeater address. This feature is useful for tracking down misaddressed repeaters.

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

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

Here are the configurations.

1) Choose the type of repeater at the RPTR TYPE line. The choices are line repeater, LNRPTR (F1), and office repeater, OFFRPTR (F2).

2) Enter the repeater model at the RPTR MODEL line: 31xx-56 (F1), 31xx-80 (F2) or TELTRND (F3). Use the SHIFT and number keys to enter your two-digit number.

3) SPAN CTRL when RPTR TYPE is 31xx-56 or 31xx-80 (Westell):
ARM-DLK (ARM-INB when framing is SF) (F1), UNARMDL (DIS-ARM when framing is SF) (F2), LOOP-UP (F3), LOOP-DN (more, F1), SEQLPBK (more, F3) LPBKQRY (more, F3), PWR-QRY (more, F1), UNIVLDN when framing is SF (blank in ESF) (more, F3), TOUTDIS (more, F2),

4) SPAN CONTROL when RPTR MODEL is TELTRND
ARM-DLK (ARM-INB when framing is SF) (F1), UNARMDL (DIS-ARM when framing is SF) (F2), LOOP-UP (F3), LOOP-DN (more, F1), LPBKQRY (more, F2), PWLPQRY (more, F3), PWCUTTH (more, F1), (more, F1), TOUTDIS (more, F2)

Line Repeater Procedures

To control a 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) Pressing 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.

4) Pressing 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.

5) Pressing PWCUTTH will tell the looping repeater to attempt to cut power through to the other repeaters on the span.

6) Pressing the UNIVLDN key will cause the set to transmit universal loopdown code to loop down any looped repeaters.

Office Repeater Procedures

There are few differences between controlling a line and an office repeater. The differences are in the SPAN CONTROL functions.

- When the RPTR TYPE is 31xx-56 or 31xx-80, POWR-DN replaces PWR-QRY for (more, F2).
- When the RPTR TYPE is TELTREND, POWR-DN replaces PWLPQRY for (more, F2), UNIVLDN replaces PWCUTTH for (more, F3), and DUAL-LB replaces UNIVLDN for (more, F3).
- When the RPTR TYPE is TELTREND, these additional choices are available: UNBLOCK (more, F1), CLR-FT1 (more, F2), and ARM-INB (more, F3)

Here are some definitions:

- Pressing LPBKQRY will query all the repeaters on the span to see which one is actually looped back.
- Pressing POWR-UP will tell the office repeater to power the span. This is used only after you have powered down the span.
- Pressing 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.
- Pressing UNIVLDN will send the NIU in-band loop down code to drop one Teltrend or NIU loopback at a time.
- Pressing the LOOP-UP 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.
- 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.
- 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.
- Selecting the DUAL-LB key will loop back 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.
- 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. Next, you can send the UNBLOCK code, which will temporarily inhibit the NIU blocking feature of the office repeater. Then send the NIU loop up (ARM-INB) code again and the far end NIU will loop up.

- CLR-FT1 (F2) is used to temporarily reconfigure the E-type office repeater from fractional mode 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) Next, press CLR-FT1. You will 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.

3.3.4 HDSL Loopback

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

1. From the main menu or Setup icon, enter LOOPBACK CONTROL.
2. Select HDSL LOOPBACK.
3. The following screen appears, in which you will choose the type of loopback you wish to do.

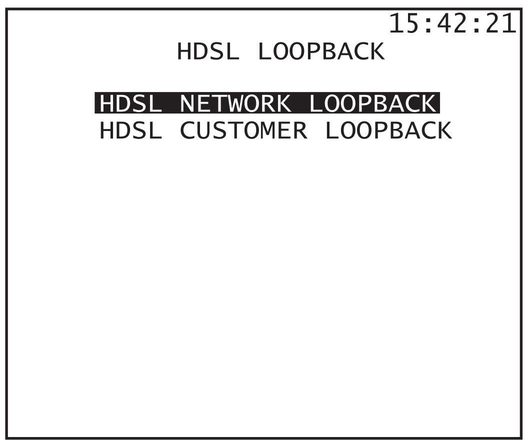


Figure 41   HDSL Loopback Menu

3.3.4.1 Network Loopback

The Network Loopback enables the user to send out loopback code from the Central Office towards the customer premises direction, to effect loopback of the High bit-rate Terminal Unit—Central office (HTU-C) and the High bit-rate Terminal Unit—Remote Distribution (HTU-R) towards the network.

After sending the arming code, the span is assumed to be armed and ready to receive loopback commands. The loop up of the NIU as a result of the arming is verified by BERT and error injection before the graphic shows the NIU in loop. If no loop is detected, then the NIU remains in through mode. Failure to detect a loopback may signify that an NIU is not actually in the circuit.

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

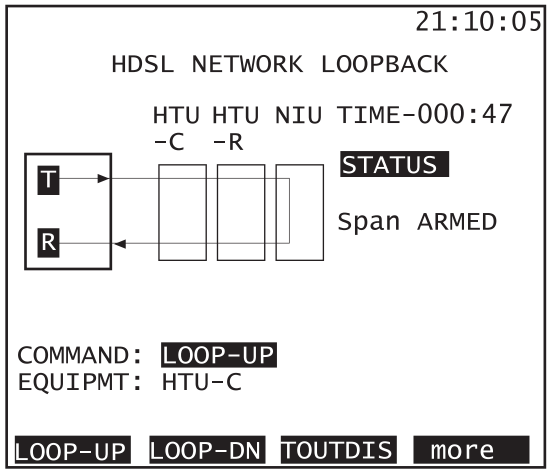


Figure 42 HDSL NIU Loopback

- The box at the far left represents the SunSet OCx. The “T” indicates the L1-Tx signal; “R” indicates L1-Rx signal.
- The network boxes are labelled: HTU-C, HTU-R, NIU. When you successfully loop up a network element, the graphic updates. For example, Figure 41 shows a loopback at the NIU.

TIME indicates the amount of time that has elapsed since arming the span.

STATUS: indicates the span’s status. This reports either “Span Idle” or “Span Armed.”

COMMAND

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

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

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

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

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

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

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

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

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

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

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

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

Notes:
- Sending a loopback command loops the DS1 signal toward the network.

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

Loopback Codes

- ARM-INB: Arming code In-band 11000 11000…
- UNARM: Disarming code In-band 11100 11100…
- ARM-DL: Arming code ESF-DL 1111111 01001000
- UNARMDL: Disarming code ESF-DL 11111111 00100100
- HTU-C Loop up In-band: 11010011 11010011
- HTU-R Loop up In-band: 11000111 01000010
- Loop down HTU-C or HTU-R: In-band 10010011 10010011
- TOUTDIS Loopback timeout override: In-band 11010101 11010110

2.3.4.2 Customer Loopback

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

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

Loopback Codes

- ARM-INB: Arming code In-band 11000 11000…
- UNARM: Disarming code In-band 11100 11100…
- ARM-DL: Arming code ESF-DL 1111111 01001000
- UNARMDL: Disarming code ESF-DL 11111111 00100100
- HTU-C Loop up In-band: 11010011 11010011
- HTU-R Loop up In-band: 11000111 01000010
- Loop down HTU-C or HTU-R: In-band 10010011 10010011
- TOUTDIS: Loopback timeout override In-band 11010101 11010110

3.3.5 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 appropriate only if a DS3/DS1 test mode has been selected from within the TEST CONFIGURATION.

Use the following procedure:

1) Enter the LOOPBACK CONTROL item menu and select the DS3/DS1 STUFF-BIT option.

2) Select the CHNL you want to use. In order to activate the loopback, both the TxCH and the RxCH must be the same.

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.

3.3.6 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) Enter the LOOP BACK CONTROL menu and select the DS3/DS1 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 CHNL you want to loop. Use the NEXT (F1) and PREVious (F2) keys to make the selection, or press DS1-ALL (F3) to loop all of the DS1s.

4) 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.

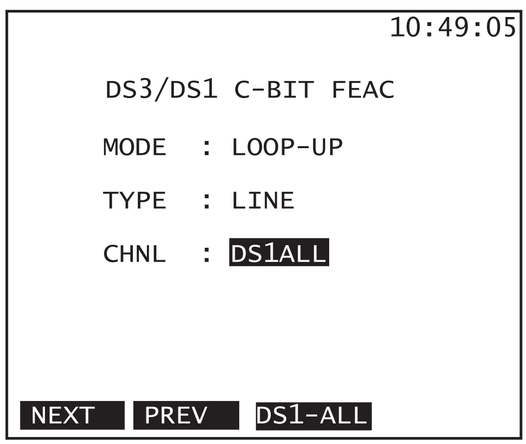


Figure 43 DS3/DS1 C-bit FEAC Screen

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

6) After this message has been displayed, press ESC as necessary to return to the main menU.

3.3.7 DS3 C-BIT FEAC

The DS3 C-bit FEAC option also utilizes the Far-End Alarm and Control Channel (FEAC). It requires a DS3 point-to-point setup.

For C-bit parity, a line loopback feature is provided. With the DS3 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:

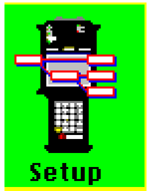
1) Enter the Loop Back Control menu, and select the DS3 C-BIT FEAC option.

2) Press the Down Arrow key to access the TYPE. Two looping options are available: NETWORK (F1) and LINE (F2).
- Note that CHNL is set to DS3.

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 Setup Test Pattern

The SEND TEST PATTERN menu may be accessed through the MAIN MENU or the Setup icon. This screen and the available test patterns vary depending on the mode selected in TEST CONFIGURATION. When a payload of DS1 or VT1.5 has been chosen, the screen appears as in Figure 44. See Figure 45 for the DS3 payload test patterns.

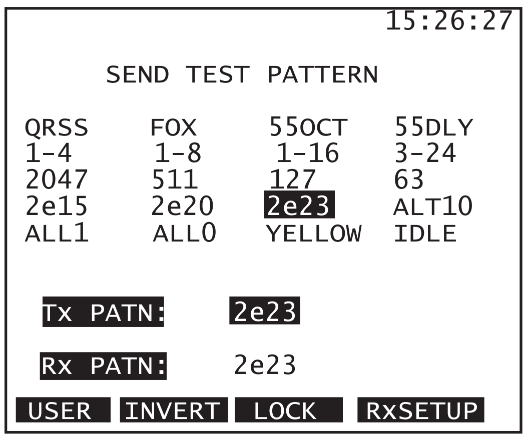


Figure 44 DS1 *S*end Test Pattern

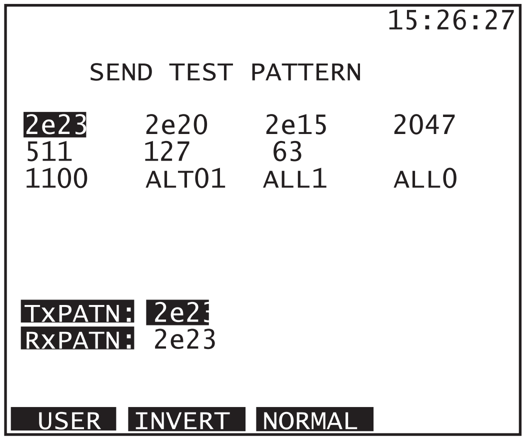


Figure 45 DS3 Test Patterns

Note that the some of the function keys (such as INVERT/NORMAL) may appear at different locations, depending on your configuration.

Tx PATN
Highlight the pattern you want to transmit, as usual. It will appear at the Tx PATN line.

Additional Tx F-key
LOCK/UNLOCK: When pressed, LOCK will match the Rx pattern to the highlighted Tx PATN, and then change them together, should you change the pattern. When LOCKED, pressing the AUTO key will change the Tx and Rx pattern. The default setting is LOCK.

Rx PATN
View the pattern you expect to receive. If UNLOCKed, you may highlight a pattern different from the Tx PATN which you expect to receive. It will appear at the Rx PATN line.

Additional UNLOCK condition F-keys
Rx->Tx: Changes the Rx PATN to match the Tx PATN.
Tx->Rx: Changes the Tx PATN to match the Rx PATN.
TxSETUP/RxSETUP (F4): Allows access to the Tx PATN/Rx

PATN setting, when you are in the opposite side, in the UNLOCK configuration.

Available Patterns:

DS1/VT1.5 payload: QRSS, FOX, 55OCT, 55DLY, 1-4, 1-8, 1-16, 3-24, 2047, 511, 127, 63, 2e23, 2e20, 2e15, ALT10, ALL1, ALL0, YELLOW, IDLE

STS-1, DS3, payload: 2e23, 2e20, 2e15, 1100, ALT10, ALL1, ALL0

STS-3c payload: 2e23, 2e20, 2e15, 2047, 1100, ALT10, ALL1, ALL0

STS-12c payload: 2e23, 2e20, 2e15, 2047
Additional patterns, OC-48 units: 1100, ALT10, ALL1, ALL0

STS-48c payload (OC-48 units only): 2e31, 2e23, 1100, ALT10, ALL1, ALL0

- Use the arrow keys to move the cursor to the test pattern of interest.
- Note that the Tx/Rx PATN message changes as each new pattern is highlighted.
- As each pattern is highlighted, the SunSet immediately begins transmitting that pattern.
- Press INVERT (F2) to send the selected pattern in an inverted form (1s and 0s reversed). Press NORMAL (F3) to return to normal .
- When a test pattern is being sent inverted, you will see an 'INVERT' message after the pattern name in the Tx/Rx PATN fields.
- When finished, press ENTER or ESC to return to the main menu.
- See the *Ch. 5, Reference* for definitions of standard patterns.

3.4.1 User Test Patterns

In addition to these standard patterns, you may create, edit, view, send and delete a user pattern.

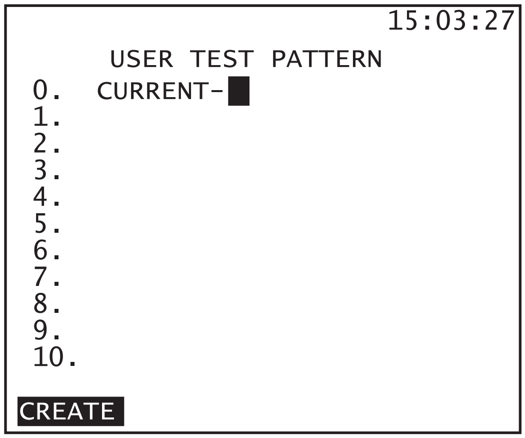


Figure 46 User Test Pattern

Sending a User Test Pattern

1) In the SEND TEST PATTERN screen (Figure 45), press USER (F1).

2) The test set will present a list of stored User patterns.

- Use the Up/Down arrow keys to cursor to the desired pattern.

3) Press ENTER.

Viewing a User Test Pattern

1) From the USER TEST PATTERN screen, move your cursor down to the desired test pattern.

2) Press VIEW (F1).

3) You will see your selected pattern on the screen (in binary, hex, and ASCII, as applicable).

- When you are finished viewing, press ESC to return to the USER TEST PATTERN screen.

Creating User-Defined Patterns

To program a user test pattern, follow this procedure:

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

2) Cursor down to a blank position on the user pattern list.

3) Choose CREATE (F1). The cursor appears at the LABEL position on the USER TEST PATTERN label screen, as in Figure 47.

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

5) Use the arrow keys to move the flashing indicator to the desired letter.

a) Choose SELECT (F4). The letter appears next to the label.

b) Repeat until you have the label as desired.

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

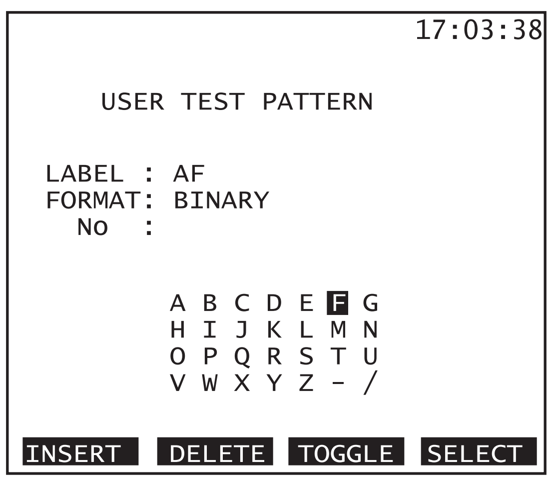


Figure 47 User Test Pattern Label Screen

7) Cursor down to the FORMAT line. Select BINARY (F1) or HEX (F2) for the pattern format.

8) Press the Down Arrow key to move to the pattern entry (‘No.’) area.

a) Press the SHIFT key.
   - Enter the bits to make up the desired pattern; up to 32 for DS1, up to 24 for DS3, up to 16 for SONET.
   - Use the INSERT (F1) and DELETE (F2) keys if you need to make corrections to the pattern.

b) Press the SHIFT key again when you are finished.
   - Verify that the ‘SHFT’ indicator no longer appears in the upper left corner of the screen.

9) Press the ENTER key to store the pattern and to return to the USER TEST PATTERN screen.

- Your new code will now be displayed for you in the menu.
- Move the cursor to the pattern and press ENTER. Your new pattern is now being transmitted.

10) Press STORE (F4) to save the current pattern.

Editing a User Test Pattern Label

Use this procedure to edit a test pattern label you have created:

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

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

3) When the cursor is placed on the LABEL code, press TOGGLE (F3). The letter A within the alphabet grid will be highlighted.

a) To replace a particular letter, cursor to it, press INSERT (F1), arrow to the desired replacement letter, then press TYPOVR (F1).

b) Press DELETE (F2) to remove a letter.

c) To add letters to the label, choose TOGGLE (F3) to return to the alphabet grid. Cursor over to the desired letter and press SELECT (F4). Repeat this until the LABEL is complete.

4) Choose TOGGLE (F3) to move out of the alphabet grid and back to the LABEL item.
a) If the LABEL is now correct, press ENTER and you are done.
b) Arrow down to edit the pattern itself.

Correcting a Mistake in the Pattern

Use the following procedure to correct any mistakes made while entering the pattern. This procedure assumes you are starting from step 8 of the Creating User-Defined Patterns procedure.

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

2) Enter the correct digit.
a) Press the SHIFT key to remove the 'SHFT' indicator.
b) Cursor to the end of the line.
c) Press the SHIFT key again to display the 'SHFT' indicator.
d) Enter in the rest of the digits.

3.5 Setup SONET Port (OC-48 platform only)

When you are in a SONET configuration, enter this function via the Setup icon in order to configure the OC ports.

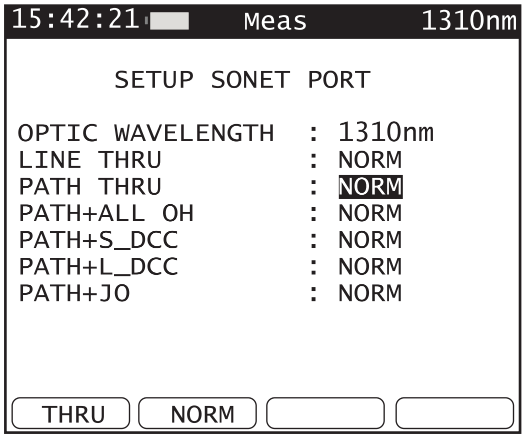


Figure 48 Setup SONET Port

OPTIC WAVELENGTH

Options: 1310nm (F1), 1510nm (F2)

On dual wavelength units, choose the optical wavelength.

- When a wavelength is selected, the banner in the upper-right corner of the screen will indicate 1310 nm or 1550 nm, as appropriate.

The following items all have THRU and NORM as the options. Here is a description of those choices.

THRU Mode

SONET Thru modes are only available on the OC-48 platform. There are two Thru Modes: Line Thru and Path Thru.

- When one is selected (set to THRU**),** the other is deselected (set to NORM**).**
- For normal, point-to-point operation, both set both modes to NORM.
- Enabling THRU Mode will disable some functions, depending on which mode is selected. For example, pointer adjustments do not function in any THRU Mode.

- When a THRU Mode is activated, a ‘Thru’ banner appears at the top the screen next to the battery icon.

Here are the line items. Select THRU (F1) or NORM (F2) for each item:

LINE THRU

The SunSet OCx OC-48 unit passes through all overhead bytes. Furthermore, the SunSet cannot change overhead bytes, inject errors, nor generate alarms. This mode is also called “monitor thru” and not generally recommended—use a splitter instead.

PATH THRU

The OCx passes through all path overhead and pointer bytes plus others in the section and line based on the following settings. In PATH THRU mode, you can only inject some errors (REI-L, B1, B2) and generate some alarms (LOP, AIS-L, AIS-P). This mode is particularly useful when no splitter point is available or when injecting defects to trigger APS events.

While in PATH THRU, you can choose to send no overhead through, all overhead through, or a combination of the Section DCC, Line DCC, and Section Trace through.

PATH+ALL OH: All section and line overhead is passed through except parity and framing. You cannot change any overhead bytes.

PATH+S_DCC: Section DCC (D1—D3)

PATH+L_DCC: Line DCC (D4—D12)

PATH+J0: Section Trace (J0)

When all PATH+ fields are set to NORM, only the Path overhead is passed through. You can change any Section or Line overhead bytes.

3.6 Measurement Results

- The SunSet OCx continuously performs measurements on its received signal.
- You need not access the Measurement Results menu in order for measurement results to be compiled.
- Measurements are automatically restarted every time the configuration is significantly changed, such as changing framing, mapping or test pattern.
- The Measurement Results screen allows you to view the accumulated measurements and restart the measurement process.
- MEAS is shown at the top left of the screen whenever measurements are in progress.
- The screens available will depend on your configuration; each rate will have its own results screens. Refer to the type of signal in the following sections to find the corresponding results available.

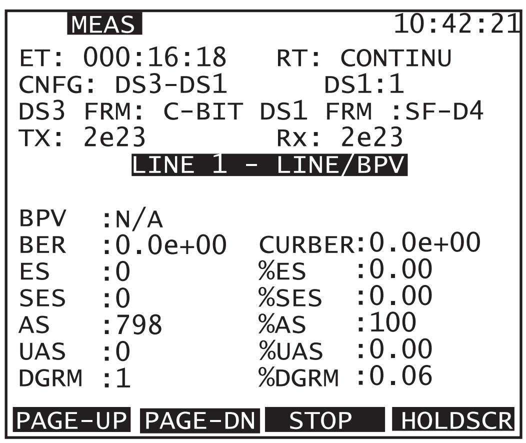


Figure 49 Measurement Results

The actual measurement results screen and the values displayed depend upon the setup chosen in TEST CONFIGURATION. There are, however, some common features in all the Measurement Results screens. Figure 48 displays a sample Measurement Results screen.

• Measurements may have a count number displayed on the left side of the screen, and the corresponding rate or percentage displayed on the same line on the right side. For example, ES, the count of errored seconds, is displayed on the left column, while %ES, the percentage of errored seconds, is displayed on the right column, as shown in Figure 49.

• Here are the function keys common to each of the 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. Note that the MEAS indicator appears or disappears when you STOP or START measurements.

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

PRINT (MORE, F2): Press to send all of the results to the serial port for printing. Nothing happens if a printer is not attached.

RECORD (MORE, F3): This is a shortcut to the VIEW/PRINT RECORDS function.

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

Current Time: The current time of day is displayed in the upper right-hand corner of the screen on black and white units, and on the upper left-hand corner of color units.

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

1) since the SunSet was switched on.
2) since the SunSet was reconfigured using the TEST CONFIGURATION menu.
3) since the measurement was restarted using the (F3) START/STOP key.

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. If the test is timed, the time remaining will count down.

CNFG: This is your test configuration, as determined by your TEST CONFIGURATION settings. If there are a multiple payloads, there will often be bracketed numbers, indicating the number of each of the rates; for example, an OC3/ DS1 point-to-point configuration might list STS[DS1]: 1[1], indicating the first DS1 within the first STS within the OC1 is under test.

Tx: This is the test pattern the unit is transmitting.

Rx: This is the test pattern the unit is receiving. Note that if Pattern Sync cannot be achieved, the unit will report 'Notsync' here. If the test set loses pattern sync, it will say 'Notsync'. If it starts measurements without synchronization, it will say 'LIVE'.

Summary Screen

The first screen presented in MEASUREMENT RESULTS is the SUMMARY screen. It gives you an overview of the status of the line. 'NO ERRORS' will be reported in bold letters if the line is error-free. The type of error received will be shown if errors are being received. This screen will update throughout the test.

```
          MEAS    LASER15:42:21
ET: 08:22:10  RT: CONTINU
CONFIG: OC12-DS1  STS :2[1]
TX: QRSS  Rx: QRSS
        SUMMARY
     SONET LOSS    : 3
     SONET P-RDI   : 3
     SONET LINE-UAS:10




PWR: 0.00DbM  FREQ: 622080000

PAGE-UP  PAGE-DN STOP  MORE
```

Figure 50 SONET Summary Screen

- **PWR** or **Vpk**: Strength of the signal received at the appropriate port.

- **FREQ**: Current frequency during the second.

Other Defects Screen

This screen summarizes important data on the rates under test. The signals and measurements presented will depend on the configuration.

Bit Performance Screen

This screen is a special case. It appears for the payload rate. It reports on any bit errors in the payload, or the G.821 specifications on a DS1 line. The final subsection covers these results.

Common Definitions

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 available second with at least one of the errors on the screen. An errored second is not counted during an unavailable second (UAS).

%ES is the percentage of Errored Seconds since the beginning of the test.

EFS: This is a count of seconds containing none of the errors on this screen on the line.

%EFS is the percentage of seconds containing no errors since the beginning of the test.

FC: A Failure Count is a defect (AIS, RDI, etc.) that persists for 2.5 ± 0.5 seconds. Failure Counts are not counted for Section.

Failures can help distinguish between isolated events and a single persistent event. For example, an AIS-L that last 15 seconds would be 1 failure, but 3 AIS-L occurrences that lasted 5 seconds each would be 3 failures. In both cases, 15 unavailable seconds (UAS) would be recorded.

Failure counts are counted for Line, Path and VT Path, both near and far end.

FC-L: Line near end
FC-LFE: Line far end
FC-P: Path near end
FC-PFE: Path far end

FC-V: VT near end
FC-FVE: VT far end

SES: This is a count of the number of Severely Errored Seconds that have occurred since the beginning of the test. A bit severely errored second is a second with a 10^{-3} error rate, of any of the errors on this screen; otherwise the SES threshold depends on the type of error and test configuration. A severely errored second is not counted during an unavailable second.

When the tenth SES is counted, the test set will transfer those 10 seconds to UAS, and the SES count will switch back to 0. The UAS counter starts at 10 (0...0...10...11...etc.).

%SES is the percentage of severely errored seconds since the beginning of the test.

UAS: This is a count of all the UnAvailable Seconds since the beginning of the test. 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..

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

3.6.1 SONET Measurements

You must be in a SONET configuration to view these results. NO ERRORS will be reported in large type if there are no errors in the signal. Here is a sample Summary screen:

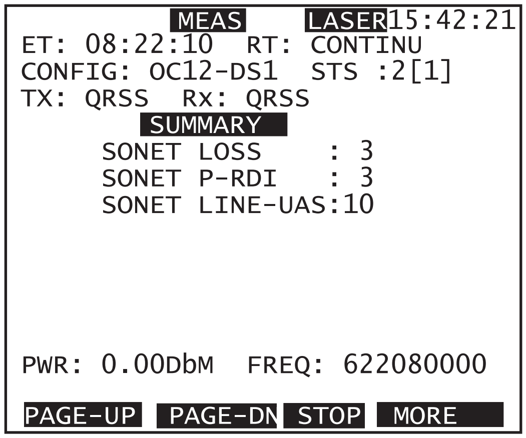


Figure 51 OC12/DS1 Summary Screen

SONET Defects Results Screen

This screen presents an overview of possible errors.

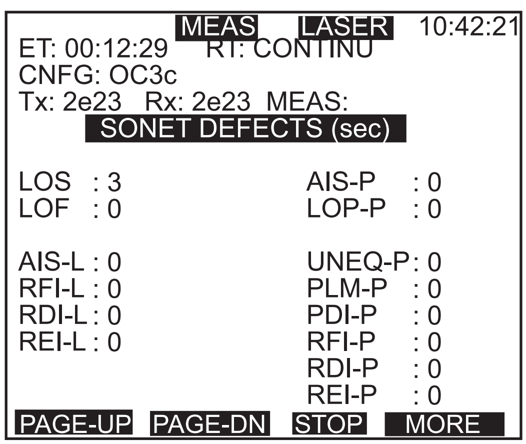


Figure 52 OC3c SONET—Defects

LOS: This is the count of the number of seconds in which the signal has been lost during the test. For SONET, a loss of signal will be detected when 20 μsec of all zeros occurs.

Usage: A loss of signal usually indicates that the input optical power is either too low or too high. Verify that the optical power of the signal source is within the range specified for the unit. If the power is too high, use an attenuator.

LOF: This is the count of the Loss of Frame seconds since the beginning of the test. A loss of frame occurs at 24 consecutive frames with invalid framing. LOFs are counted until the onset of 8 consecutive frames with valid framing.

Usage: As with LOS, LOF can indicate an optical power level that is too high for the receiver. LOF will also occur when the received data rate does not match the test configuration of the test set. For example, the test set is configured for OC-3 and the fiber is carrying OC-12. Once the power level has been verified, press the AUTO key to have the test set configure to the proper interface rate.

AIS-P: Path Alarm Indication Signal seconds is a count of the number of seconds in which Path AIS is detected. Path AIS is detected when the test set receives 3 consecutive frames of all ones in the H1, H2 bytes. AIS is counted until the onset of NDF with valid pointer or three successive frames with valid pointer.

Usage: An AIS-P is sent when a network element receives an AIS-L which itself is sent to indicate a LOS or LOF.

LOP-P/V: This is the count of the number of seconds in which there was a loss of pointer or NDF (New Data Flag) in the Path or VT. A LOP occurs for 8 consecutive frames of invalid pointer or NDF. LOPs are counted until the onset of 3 consecutive frames of valid pointer.

Usage: LOP defects are relatively rare and usually indicate a gross timing mismatch between a network element and the rest of the network.

AIS-L: Line Alarm Indication Signal is a count of the number of seconds in which Line AIS was detected. Line AIS is detected when the test set receives 5 consecutive frames of 111 in the bits 2, 1, 0 (6,7,8, transmission standard) of the K2 byte. AIS-L is counted until the set receives 5 consecutive frames of patterns other than 111 in the bits 2, 1, 0 of the K2 byte.

Usage: When a network element receives a LOF or LOS, it sends an AIS-L downstream

RFI-L: Line Remote Failure Indication is declared after 2.5 seconds of RDI-L and cleared after 10 consecutive seconds without an REI-L.

Usage: After approximately 2.5 seconds of RDI, an RFI is declared. Thus, the presence of an RFI represents the persistent presence of a LOS or LOF occurring on the other direction of the network.

RDI-L: Line Remote Defect Indication was formally known as a FERF (Far End Remote Failure) and is the SONET equivalent to a yellow alarm over the SONET line. An RDI-L is counted when bits 6-8 of the K2 byte are “110” for 5-10 consecutive frames.

Usage: When a network element receives an AIS-L, LOS, or LOF, it responds upstream with an RDI-L. Thus, the presence of an RDI-L ultimately indicates the presence of a LOS or LOF in the network, as shown in the diagram on the next page.

REI-L: Line Remote Error Indicator was formally known as a FEBE (Far End Block Error) and indicates the number of B2 errors detected by the downstream network equipment. This information is conveyed through bits 5-8 of the M0 byte or the entire M1 byte.

Usage: Parity errors, such as B2, indicate bit errors in the network. An REI-L is transmitted in response to B2 errors and thus is also an indication of bit errors.

UNEQ-P/V: A Path or VT Unequipped defect is declared when the C2 byte is set to 0 for 5 consecutive frames.

Usage: An unequipped SONET path is one that is active but not carrying any data, such as a backup path not in use. Unequipped serves much the same usage as an idle signal in a T-carrier network.

PLM-P/V: A Path or VT Payload Label Mismatch is declared when the C2 setting does not match the current configuration.

Usage: The presence of an PLM defect is usually indicative that the test set configuration does not match the network. For example, the network may have a VT1.5 payload when the test set is configured for DS3/DS1. In some cases of a concatenated payload, a PLM can be essentially ignored. The default C2 value for a concatenated payload is 01 (hex). If the payload is ATM or other specific type of data transmission, the C2 may be some other value, such as 13 (hex) for ATM.

RFI-P/V: Path or VT Remote Failure Indication is declared after 2.5 seconds of RDI-P/V and cleared after 10 consecutive seconds without an RDI-P/V.

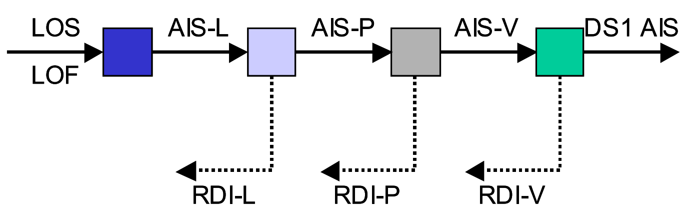
Usage: After approximately 2.5 seconds of RDI, an RFI is declared. Thus, the presence of an RFI represents the persistent presence of a LOS or LOF occurring on the other direction of the network.

RDI-P/V: Path or VT Remote Defect Indication was formally known as a FERF (Far End Remote Failure) and is the SONET equivalent to a yellow alarm over the SONET path. An RDI-P/V is counted when bit 5 of the G1 byte is set to 1.

Usage: When a network element receives an AIS-P/V, it responds upstream with an RDI-L. Thus, the presence of an RDI-P/V ultimately indicates the presence of a LOS or LOF in the network, as shown in the diagram, below.

REI-P/V: Path or VT Remote Error Indicator was formally known as a FEBE (Far End Block Error) and indicates the number of B3 errors detected by the downstream network equipment. This information is conveyed through bits 1—4 of the G1 byte.

Usage: Parity errors, such as B3 or BIP-2, indicate bit errors in the network. An REI-P/V is transmitted in response to B3/BIP-2 errors and thus is also an indication of bit errors



SONET Section Layer Results

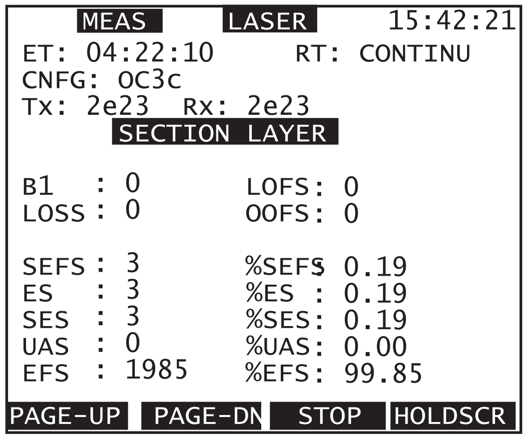


Figure 53 SONET Section Layer Results

B1: This is a count of the incoming BIP-8 parity errors in the SONET signal. The B1 byte is contained in the Section Overhead. This byte provides Section error monitoring by means of bit-interleaved parity 8 code using even parity. It is also called a Section Code Violation (CV-S).

LOSS: This is the count of the number of seconds in which the signal has been lost during the test. For SONET, a loss of signal will be detected when 20 µsec of all zeros occurs.

LOFS: This is the count of the Loss of Frame Seconds since the beginning of the test. A loss of frame occurs at 24 consecutive frames with invalid framing. LOFs are counted until the onset of 8 consecutive frames with valid framing.

OOF: This is the count of the Out-Of-Frame seconds that have occurred since the beginning of the test. An OOF signifies the failure to acquire a valid framing pattern for 4 consecutive frames. OOF is counted until the onset of a valid framing pattern exactly 6480 bits apart.

SEFS: Severely Errored Frame Seconds is the number of seconds during which four consecutive errored framing patterns are detected.

SONET Line Layer – Near End Results

This screen reports on the near end Line.

```
          MEAS    LASER 15:42:21
ET: 04:22:10     RT: CONTINU
CNFG: OC3c
Tx: 2e23    Rx: 2e23
     LINE LAYER - NEAR END

B2  : 0           AIS-L: 0

ES  : 3           %ES  : 100
SES : 3           %SES : 0.00
UAS : 0           %UAS : 0.00
EFS : 20          %EFS : 100
FC-L: 0

PAGE-UP  PAGE-DN STOP  MORE
```

Figure 54 SONET—Line Near End Line Results

Here is the addition to the screen:

B2: This is a count of the incoming Line parity errors. The B2 byte is contained in the Line Overhead and provides Line error monitoring. It is also called a Line Code Violation (CV-L).

SONET Line Layer – Far End Results

This screen reports on the far end Line.

```
           MEAS    LASER    15:42:21
ET: 04:22:10     RT: CONTINU
CNFG: OC3c
Tx: 2e23  Rx: 2e23  MEAS:
      LINE LAYER - FAR END

REI-L   :0
RDI-L   :0             RFI-L  :0

ES      :0             %ES   :100
SES     :0             %SES :0.00
UAS     :0             %UAS :0.00
EFS     :2544          %EFS :100.00
FC-LFE:0
PAGE-UP  PAGE-DN STOP   MORE
```

Figure 55 SONET—Line Far End Line Results

SONET Path Layer – Near End Results

This screen reports on the near end Path.

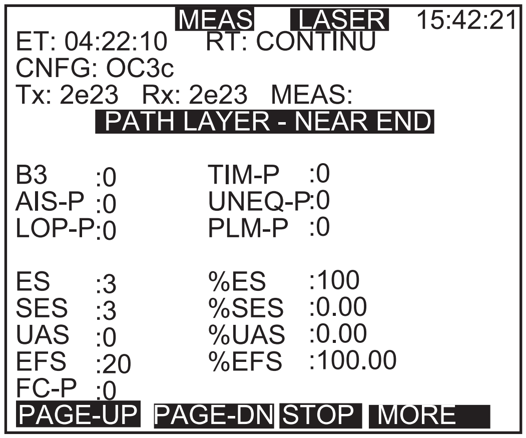


Figure 56 SONET—Path Near End

Here is the additional definition:

B3: This is a count of the incoming B3 BIP-8 parity errors. The B3 byte is contained in the Path Overhead and thus, provides a Path error monitoring function. It is also called a Path Code Violation (CV-P).

SONET Path Layer – Far End Path Results

This screen reports on the far end Path.

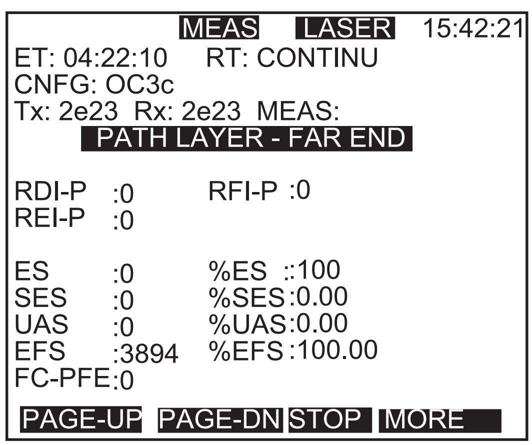


Figure 57 SONET—Path Far End Results

SONET Pointer Measurements

This screen reports on the overhead pointers. The pointers available will depend on your configuration. In the sample OC3c figure, results are available for the SONET Path and the VT1.5. The OC-48 platform reports some results the black and white platform does not.

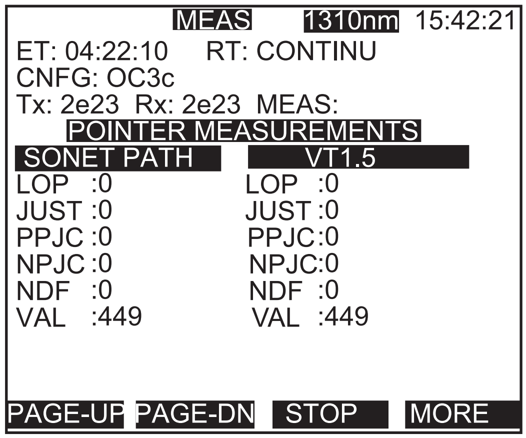


Figure 58 SONET—Pointer Measurements

LOP: This is the count of the number of seconds in which there was a Loss Of Pointer or New Data Flag (NDF). A LOP occurs for 8 consecutive frames of invalid pointer or NDF. LOPs are counted until the onset of 3 consecutive frames of valid pointer.

JUST (Pointer Justification): This is the count of total incoming pointer adjustments.

PPJC (Positive Pointer Justification Counts): Count of pointer increases.

NPJC (Negative Pointer Justification Counts): This is the count of pointer decreases.

NDF: This is the number of frames with a New Data Flag.

VAL (Value): This is the actual pointer value.

SONET Optical Signal Measurements

This screen reports on the signal. The following figure is a SONET example.

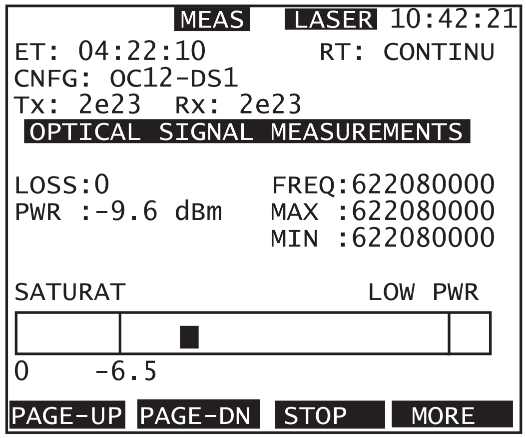


Figure 59 SONET—Optical Measurements

LOSS: This is the count of the number of seconds in which the signal has been lost during the test. For SONET, a loss of signal will be detected when 20 µsec of all zeros occurs.

FREQ: This is the current frequency measured during the second.

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

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

PWR: This is the strength of the signal received at the OC port. It is reported in dBm.

The measurement bar gives you a visual clue as to the state of the optical power. If the signal is oversaturated, the black box, which represents the current power state, will be towards the left end of the bar. In this case, place a -10 dB attenuator before the SunSet's optical receiver. If you do not have enough power, the black box will be toward the right end of the bar (Loss of Signal).

STS-1 Signal Measurements

The next figure is a sample STS (electrical) screen:

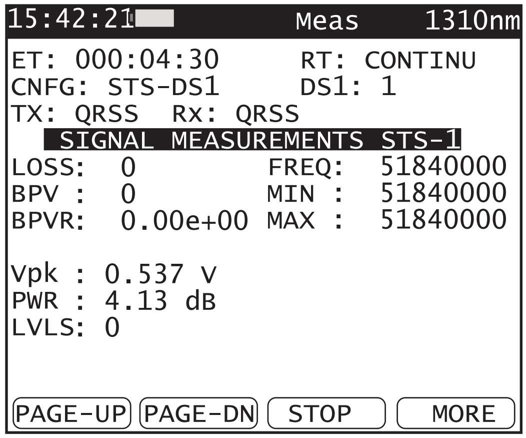


Figure 60 STS-1 Signal Measurements

Here are the differences:
BPV: This is a count of the number of Bipolar Violations which have occurred since the beginning of the test.

BPVR: This is the rate at which bipolar violations have been received.

Vpk: This is the peak to peak level of negative and positive pulses received by the test set, displayed in volts.

PWR: This is the power received at the STS port, in dB.

3.6.2 VT1.5 Measurements

VT1.5 measurements are in two primary screens. They follow the format of the SONET measurements.

VT Path Layer—Near End Results

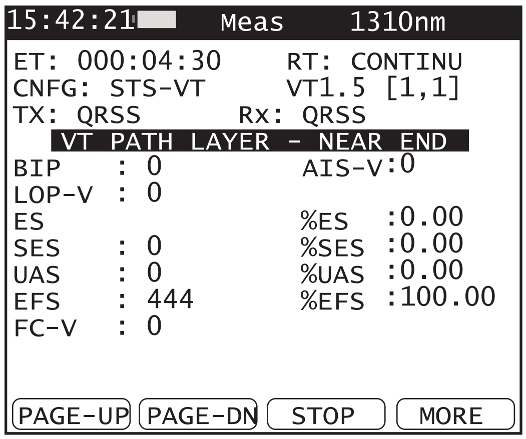


Figure 61 VT Near End Path Measurements

BIP: This is the count of incoming bit-interleaved parity errors; an error occurs when the calculated transmitted number does not match the received calculated number. This measurement is also called CV-V.

Path Layer—Far End Results

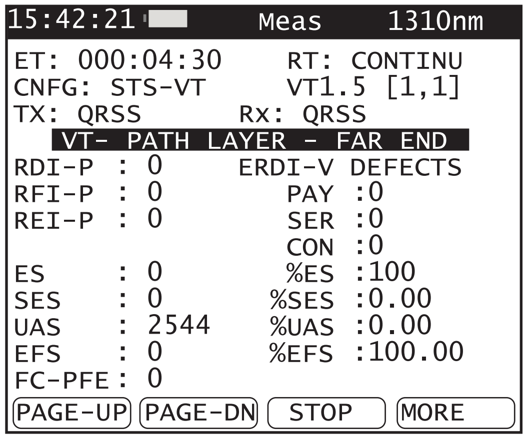


Figure 62 VT Far End Path Measurements

The VT far end results reports the same measurements as the near end results screen, only for the far end.

Enhanced RDI Defects

	Z7 Bits 5-7	V5 Bit 8	ERDI-P Priority	Trigger	Interpretation
RDI-V	y x x	0	n/a	No defects	No RDI-V defect
	y x x	1	n/a	AIS-V, LOP-V	one-bit RDI-V defect
ERDI-V	1 0 1	0	1	AIS-V, LOP-V	ERDI-V Server defect
	1 1 0	0	2	UNEQ-V, TIM-V	ERDI-V Connectivity defect
	0 1 0	1	3	PLM-V	ERDI-V Payload defect
	0 0 1	1	4	No defects	No RDI-V defect

If ERDI-V is not supported, the value of "x" should be 0.

Figure 63 ERDI Defects

3.6.3 DS3 Measurements

The following screens appear in a DS3 configuration.

DS3 Path Results

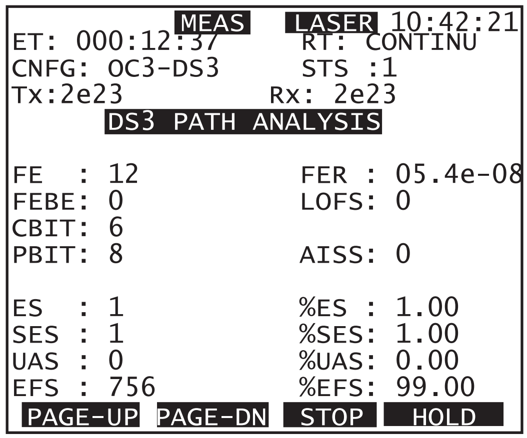


Figure 64 OC3/DS3 DS3 Path Results

FE: 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.

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

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

FEBE: This is a 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.

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 OOFSs. LOFS are counted until the onset of 10 consecutive non-OOFs.

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

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.

P-BIT: This is the P-bit Parity Error count.

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.

ES: Usage: Errored seconds are a key tariff parameter for T3 services. This 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: 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 1% end to end. Some customers expect performance at less than 0.5%.

SES: A Severely Errored Second is a second with a 10^{-3} error rate, where error rate is measured off of bit errors, BPV errors, and framing bit errors. An out of frame will also generate a SES.

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

%EFS: Usage: Data customers typically expect this number to be 99% or higher. %EFS and %AS are probably the two most significant parameters in gauging the quality of T3 service delivered to the end user.

T3 Signal Measurements

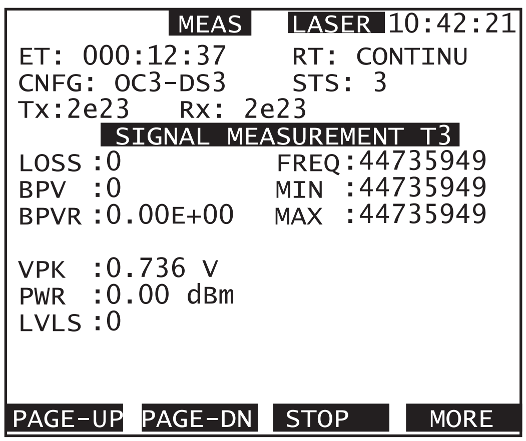


Figure 65 OC3/DS3 T3 Signal Results

Here are the additions to the screen:

BPV: This is a count of the number of BiPolar Violations that have occurred since the beginning of the test. Note that this measurement only applies to a DS3 signal, not a DS3 payload.

Usage: This measurement detects problems with the line in the local office to which the set is attached. The problem is a local one, because DS3 electrical signals are only transmitted intra-office. This measurement is also useful where the framing or data being transmitted is unknown and helps to separate local troubles from remote troubles.

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

Usage: The rate is sometimes used instead of a count when the measurement is conducted for a longer period.

FREQ: This is the current frequency measured during the last second.

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

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

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

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). The OCx uses a reference voltage of 0.85V.

LVLS: This is the number of Level Seconds; seconds where the received level has gone below the user-defined limit.

DS3 Other Defects Screen

The following defects may be listed in an OTHER DEFECTS screen.

AIS: This is the number of seconds containing Alarm Indication Signal. DS3 AIS is a signal with valid M-frame alignment channel, M-subframe alignment pattern, 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 natures of an out-of-service condition. For instance, a break in the line will cause a loss of signal for the 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 AIS.

IDLE: This is the number of seconds containing DS3 IDLE code.

LOF: This is the count of Loss of Frame occurrences since the beginning of the test. LOF occurs at the onset of 3 OOFs. LOFs are counted until the onset of 10 consecutive non-OOFs.

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

YEL: This is the count of the number of occurrences of YELlow Alarm (also known as Remote Alarm Indication) 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.

3.6.4 DS2 Measurements

This screen gives results for the DS2 rate.

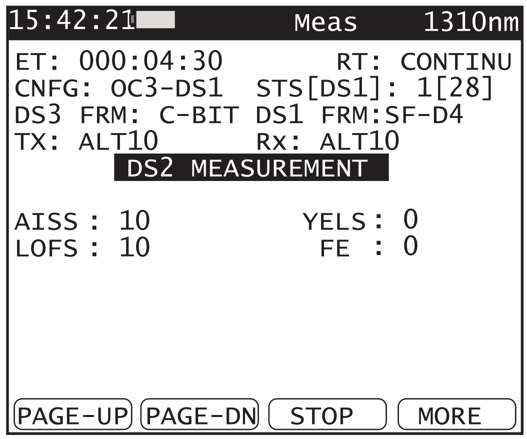


Figure 66 OC3/DS1 DS2 Results

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

LOFS: This is the count of Loss Of Frame Seconds since the beginning of the test. LOFS are triggered when an OOF condition occurs. LOFS stop counting as soon as the OOF condition ends.

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

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.

FE: 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.

3.6.5 DS1 Measurements

The DS1 results screens follow. In DS1 Dual Mode, Line 1 or Line 2 will show in the title, so you know which line you are looking at results for. Note that the order of the screens may vary. See Figure 67 for a color sample.

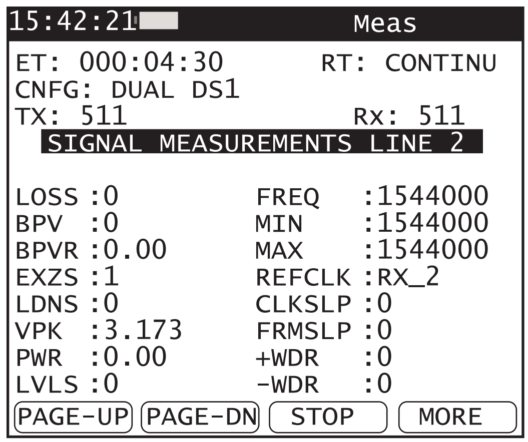


Figure 67 DS1 Line Measurements

Here is a sample black and white Summary screen for DS1 Dual Mode:

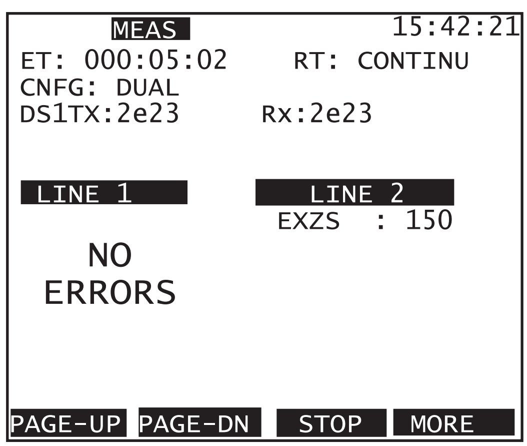


Figure 68 DS1 Dual Summary Screen

DS1 Defects

This screen reports on any defects (alarms) received on the DS1 line.

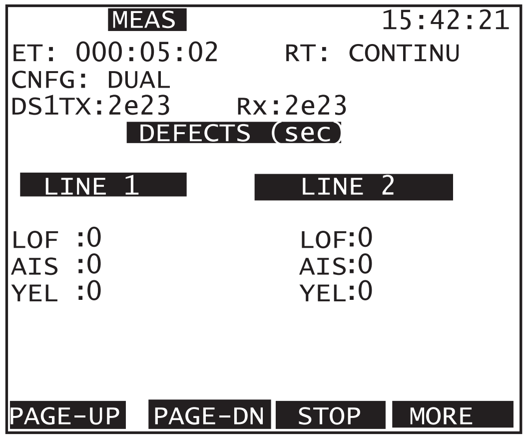


Figure 69 Dual DS1 Defects Screen

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

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

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

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

YEL: 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, and called RAI.

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.

DS1 Signal Line Measurements

This screen reports on the DS1 signal.

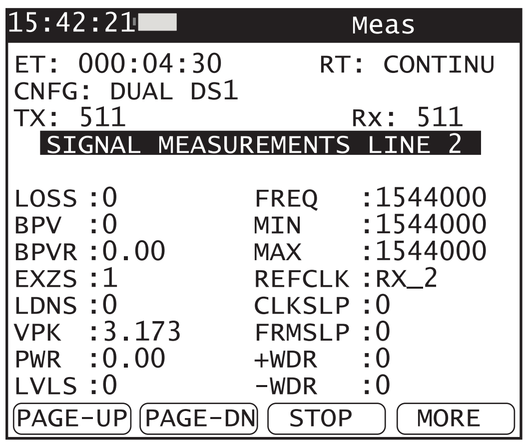


Figure 70 OC3/DS1 DS1 Results

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

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

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

BPVR is the rate at which BPVs are received.

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

Usage: Refer to the usage of LDNS.

LDNS: Low Density Seconds is a count of the number of seconds when the n(n-1) rule is broken.

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

Vpk: This is the DS1 voltage peak. The level at a DSX should be approximately 3 volts.

PWR: This is a measure of the power of the received DS1 signal. The measurement is given in dBdsx, and represents the area of a single DS1 pulse. Since the power of a signal is affected by the signal's height, this measurement is related to the height of the DS1 pulse (Vpk).

FREQ: Frequency of the signal as measured against the frequency of the reference clock. The set's internal clock is used to measure frequency when no external clock source is plugged in.

MAX, MIN: These are the maximum and minimum frequencies measured since the beginning of the test, shown in Hz.

REFCLK: The reference clock is the clock the frequency is compared against. The Reference Clock is the internal clock at this time. The INTERN reference clock of the set has stratum 3 accuracy. The test set will automatically use the T1-2 Rx or the EXT CLK port as the reference clock if it detects a signal on the port.

CLKSLIP: A clock slip occurs when the measured frequency deviates from the reference frequency by one unit interval. A unit interval is the amount of time it takes to transmit one T1 pulse.

FRMSLP: 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: FRMSLPs are useful for finding frequency synchronization problems in the network.

+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.

Note on Wander and Jitter: The SunSet OCx will average out jitter over a sampling period. It is possible, though unlikely, that jitter will be recorded as wander in a given sample period. If the phenomenon is jitter rather than wander, then the next sampling period should 'wander' in the other direction. If the circuit under test has jitter, the two wander measurements would cancel each out for a total 0 cumulative wander.

DS1 Path Results

This screen reports on the DS1 line, including frame and CRC-6 errors.

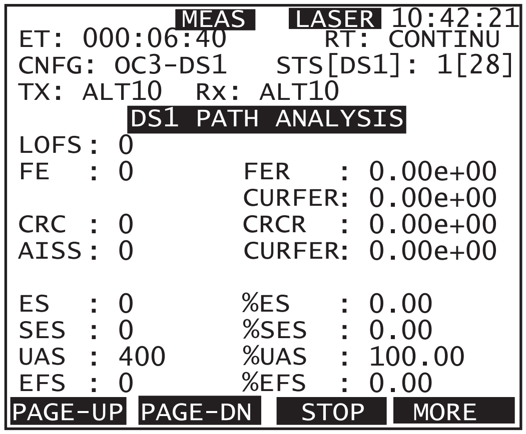


Figure 71 OC3/DS1 Path Analysis Results

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

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

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

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

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

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

CRCR: The CRC-6 (Cyclic Redundancy Check code - 6) block Error Rate, is the rate at which CRC-6 block errors occurred during the previous one second.

Note that a block error rate is not the same thing as a bit error rate. The two measures are roughly related to each other. For instance, a bit error rate of 1×10^{-9} would correspond roughly to a block error rate of 2×10^{-6}, assuming a burstiness average of 2 errors per error burst. When monitoring a live T1 signal, it will not be possible to directly measure the bit error rate, so CER is used as a substitute measurement.

Note: The ESF CRC-6 measurements shows the results that are derived from the CRC-6 bits within the ESF signal. These results are only reported with an ESF signal.

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

CURFER: Current Framing bit Error Rate during the previous second.

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

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

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

CURCER: This is the Current CRC-6 Error Rate since the beginning of the test.

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, FE or CRC-6 error. An errored second is not counted during an unavailable second.

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

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

%ES: This is a percentage of Errored Seconds (as defined above) since the beginning of the test.

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

When the tenth SES is counted, the test set will transfer those 10 seconds to UAS, and the SES count will switch back to 0. The UAS counter starts at 10 (0...0...10...11...etc.).

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 a count of the percentage of Severely Errored Seconds that have occurred since the beginning of the test. A severely errored second is a second with a 10^{-3} error rate, where error rate is a measurement of bit errors.

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 UAS 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 around 3 hours maximum outage time per year on a T1 service.

%UAS: This is the percentage of UASs since the beginning of the test.

EFS: This is a count of Error Free Seconds since the beginning of the test . An EFS is a one-second period in the AS during which no bit errors and no pattern slips have been detected.

%EFS: This is the percentage of Error Free Seconds since the beginning of the test which have not contained errors.

DS1 Bit Performance

This screen reports on the G.821 parameters if on a DS1 line, or on any bit errors in a payload (regardless of rate).

```
    MEAS          1310nm 10:42:21
ET: 000:16:18    RT: CONTINU
CNFG: OC3-DS1  STS[DS1]: 1[28]
TX: QRSS  Rx: QRSS  MEAS:

     BIT PERFORMANCE
BIT    :0     BER     :0.0E+00
EFS    :978   %EFS    :100.00
ES     :0     %ES     :0.00
SES    :0     %SES    :0.00
AS     :978   %AS     :100.00
UAS    :0     %UAS    :0.00
PATLS  :0     %PATLS  :0.00

PAGE-UP  PAGE-DN  STOP  MORE
```

Figure 72 OC3/DS1 Bit Performance Results

BIT: This is a count of the number of bit errors which have occurred since the beginning of the test. A bit error is a difference between the pattern of the incoming signal and the reference pattern detected after pattern synchronization.

Usage: The test set is measuring a known pattern, so the measurement covers transmission performance over the entire service, not just a local section. This is the preferred measurement for out-of-service testing, and service acceptance tests. The measurement is often performed in conjunction with a loop-back device at the far end.

BER: This is the average Bit Error Rate, since the beginning of the test. This measurement is reported as N/A when the test set is not synchronized on a known received pattern.

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

ES: This is a count of the number of Errored Seconds which have occurred since the beginning of the test.

- An ES is a one-second period in the AS during which one or more bit errors are detected.
- An ES is not counted during an unavailable second.

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

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

SES: This is a count of the number of Severely Errored Seconds that have occurred since the beginning of the test. An SES is a one-second period in the AS during which either one or more of the followings occur:

- BER is equal to or worse than 1×10^{-3}.
- Alarm indication signal
- Loss of signal
- Loss of frame alignment
- Loss of pattern synchronization
- Uncontrolled pattern slip

The SES is a subset of ES, therefore a SES will also cause an ES count. 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: The %SES is the ratio of SES to the AS expressed as a percentage, 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. The UAS register displays the unavailable time in seconds in the total observation time.

A period of unavailable time begins at the onset of a period of ten consecutive SES. The unavailable time ends when the first second of a period of ten consecutive non-SES seconds.

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

PATLS: This is a count of the number of occurrence of pattern loss since the beginning of the test.

SunSet OCx OC-48 Notes

The SunSet OCx OC-48 features SERVICE DISRUPTION measurements, when a pseudorandom test pattern is in use (such as 2e31, 127, and QRSS). Measurements are presented in milliseconds (ms). This is a very precise disruption measurement. If you are running a fixed pattern (such as 1-8), a long pattern (such as 55 Octet) or a User pattern, you will get a 'N/A' result.

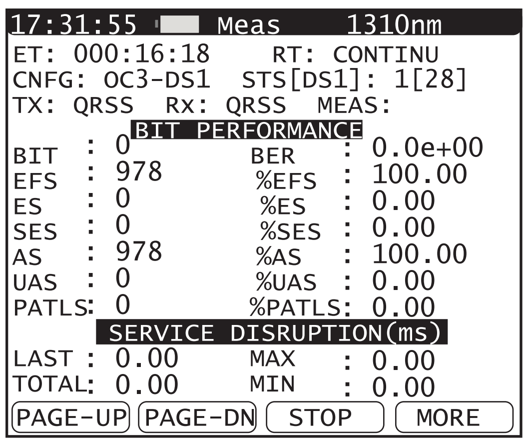


Figure 73 OCx OC-48 Bit Performance Results

SERVICE DISRUPTION

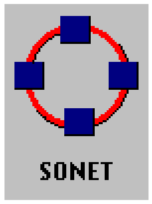
LAST: Length of the latest service disruption.

TOTAL: Total length of time during which service has been disrupted in this test.

MAX: Longest period for which service was disrupted.

MIN: Shortest period for which service was disrupted.

> **Note**: When there has been only one disruption, the MAX will equal the MIN.



3.7 Sonet Features

This menu gives you access to the SunSet OCx's SONET capacities. You may monitor and program section and path overhead bytes, as well as display and program pointer operations.

Note: the SSOCx OC-12 and lower units feature Tx SS BITS TYPE SELECTION instead of POINTER CONTROL (which is found on the SSOCx OC-48), and does not include the J0 SECTION TRACE GENERATION screen.

Enter SONET FEATURES from the MAIN MENU, via the SONET icon if you have a color unit. You will see this screen:

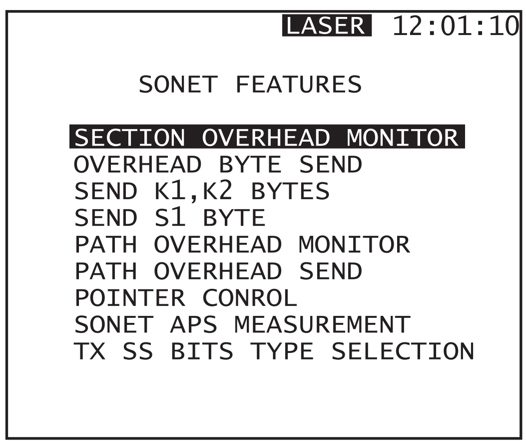


Figure 74 SONET Features Menu

Overhead bytes are transmitted within the OC/STS signal; therefore in order to access the SONET FEATURES menu, in the TEST CONFIGURATION menu, the INTERFACE field must be set to STS-1, OC-1/3/12/48.

The SONET system has embedded overhead capabilities within the STS signal; this makes the high level of network management possible for SONET.

There are three defined overhead areas in the STS-1 signal: Path, Line, and Section:

- Path-level overhead is carried from end-to-end.
- Line-level overhead travels between STS-n multiplexers.
- Section overhead is used for communications between adjacent network elements, such as regenerators.

Within these overhead areas, there are transmission error detection and report features, communication channels, pointers, and frame content codes. The following sections will discuss the SONET FEATURES in detail.

3.7.1 Section Overhead Monitor

Enter the SECTION OVERHEAD MONITOR feature from SONET FEATURES menu i to view the overhead bytes, as shown in the following screen:

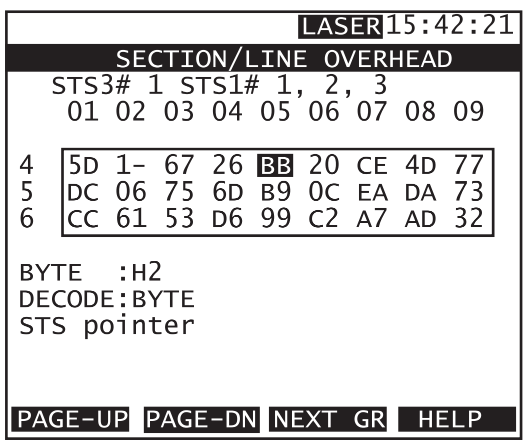


Figure 75 Receive Overhead Bytes

- For most rates, the screen is formatted in 9 columns by 9 rows, as the Section overhead is. For OC-1 and STS-1, the screen is 3 columns by 3 rows (refer to Figure 76).
- Use the PAGE-UP (F1) and PAGE-DN (F2) keys to scroll

through the different rows (1–3, 4–6, 7–9).

- Press the NEXT GRoup (F3) key to view overhead for the next group of STS-1s. See the STS3# and STS1# fields for this information.
- Use the cursor keys to highlight the byte you want information on.
- The following information is automatically presented for a highlighted byte:

BYTE: H2, in the sample figure
DECODE: the decode format, shown in ASCII
info: byte definition; STS pointer byte in the sample screen

- Press the HELP (F4) key to bring up a screen showing the layout of the bytes. Press ESCAPE (F1 or F4) or the ESC key to return to the OVERHEAD screen. Here is a sample screen:

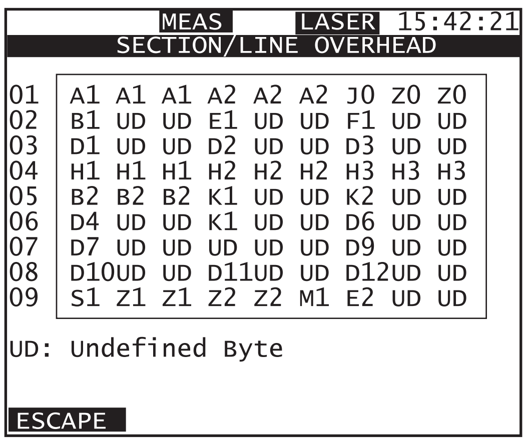


Figure 76 Overhead Help Screen

The nine bytes of the section overhead are used as follows:

A1, A2 - Frame alignment pattern, F6 28 (1111 0110 0010 1000)

J0/Z0 - STS-1 identification; a binary number corresponding to its appearance in an interleaved STS-N. Here, 01 (0000 0001) signifies the first signal, J0. 2 through N signifies the rest of the signals, in Z0.

B1 - Parity check

E1 - Local orderwire channel for voice communication between regenerators

F1 - User defined

D1, D2, D3 - Data communications channel

The 18 bytes of the STS-1 Line Overhead are used as follows:

H1, H2 - Payload pointers

H3- Pointer Action, used for negative byte stuffing

B2 - Parity check

K1, K2 - APS (Automatic Switching Protection) between line terminating equipment

D4-D12 - Data communications channel

S1/Z1 - Synchronization messages; S1 is in the first STS-1 of an STS-N signal. Z1 is in signals 2 through N

M0 - REI, provides a count of the far end B2 errors in STS-OC-1 signals

M1 - REI, provides a count of the far end B2 errors in STS/OC-n signals.

E2 - Express orderwire channel for voice communication

Here is a sample OC-1 screen:

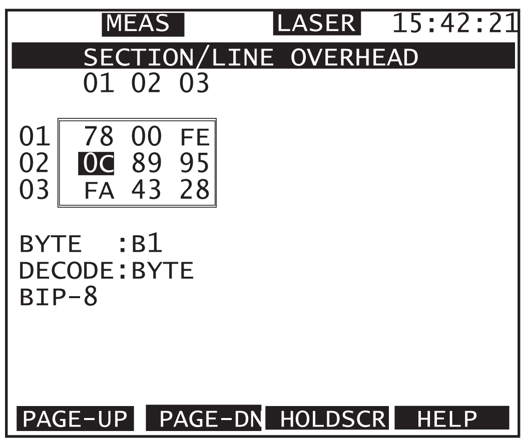


Figure 77 OC-1 Overhead Monitor Screen

Additional information, such as the exact bits and particular decode information is available for the K1, K2, and S1 bytes. See Figure 78 for a K1 sample.

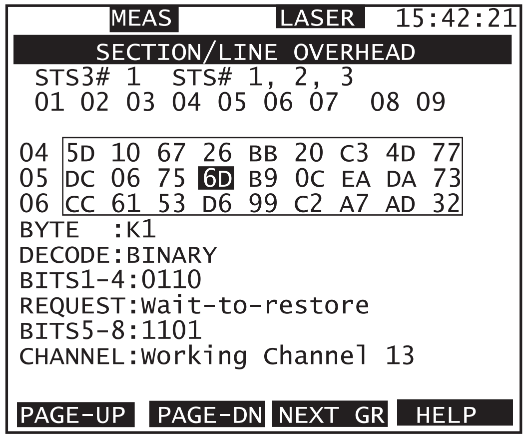


Figure 78 K1 Byte Sample Screen

Table A.1/G.783 Bits 1–4 of the K1 Byte

Bits 1234	**Condition, state or external request**	**Order**
1111	Lockout of protection (Note 1)	Highest
1110	Forced switch	|
1101	Signal fail high priority	|
1100	Signal fail low priority	|
1011	Signal degrade high priority	|
1010	Signal degrade low priority	|
1001	Unused (Note 2)	|
1000	Manual switch	|
0111	Unused (Note 2)	|
0110	Wait-to restore	|
0101	Unused (Note 2)	|
0100	Exercise	|
0011	Unused (Note 2)	|
0010	Reverse request	|
0001	Do not revert	|
000	No request	Lowest

Notes

1. Only channel number 0 is allowed with a Lockout of Protection request.
2. Some network operators may use these codes for network specific purposes. The receiver is capable of ignoring these

codes.

3 Requests are selected from the table, depending on the protection switching arrangements; in any particular case, only a subset of the requests may be required.

TABLE A.2/G.783
K1 channel number

Channel #	Requesting switch action
0	Null channel (no working channel or extra traffic channel). Conditions and associated priority (fixed high) apply to the protection section.
1—14	Working channel (1—14) Conditions and associated priority (high or low) apply to the corresponding working sections. For 1 + 1, only working channel 1 is applicable with fixed high priority.
15	Extra traffic channel. Conditions are not applicable. Exists only when provisioned in a 1 : n architecture.

TABLE A.3/G.783
K2 channel number

Channel #	Indication
0	Null channel
1—14	Working channel (1–14) For 1 + 1, only working channel 1 is applicable.
15	Extra traffic channel Exists only when provisioned in a 1 : n architecture.

3.7.2 Overhead Byte Send

This feature allows you to control the user's overhead bytes of the transmitted SONET signal. As seen, this function separates the OH bytes into Section, Line, J1 Path, and Path bytes.

If necessary, please refer to *Section 3.7.1, Section Overhead Monitor*, to learn how these bytes are used.

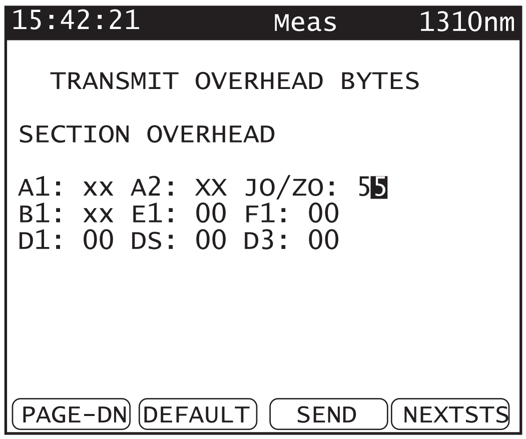


Figure 79 Transmit SOH Bytes

- Bytes marked in green (00) are available to change. Any bytes labeled XX (in black on color units) may not be changed.
- For OC-3 or higher rates, press NEXTSTS (F4) to scroll through the overhead available for all three STS-1s. The STS-1 No. line in the header will show the selected STS-1.
- Use the PAGE-DN (F1 or F2) key to scroll through all of the available byte transmit screens.

DEFAULT (F2) resets the bytes to default values and sends automatically (N/A OC-48 units).

SEND (F3) sends the overhead bytes. An 'OH TX' banner appears in the header when the unit is sending non-default bytes.

Here is a sample transmit Line overhead screen.

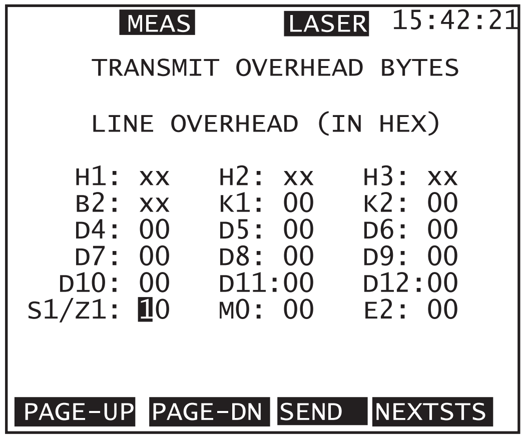


Figure 80   Transmit Line OH

To change bytes:

1. Use the arrow keys to move the cursor.
2. Use the SHIFT key and keypad letters/numbers to enter in the desired hexadecimal code, ranging from 00 to FF.

When you have finished, press SEND (F3) to send this byte.

Scroll down to the Path Overhead Bytes screen, in order to control the Path Overhead Bytes. See the next figure for a sample screen.

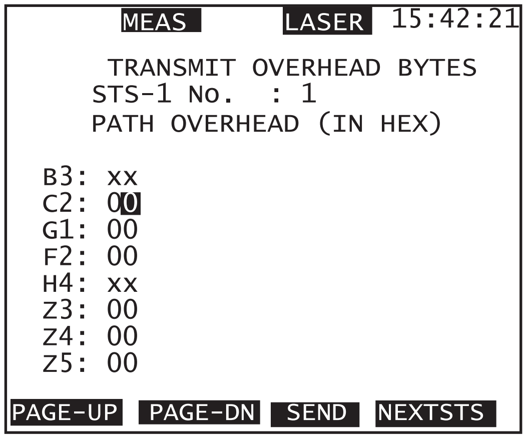


Figure 81 Transmit Path OH

As in the other transmit byte screens, any byte labeled xx may not be changed. In the Path OH screen, you may manually control bytes C2, G1 (last 4 bits), F2, Z3, Z4, and Z5.

To change these bytes:

1. Use the arrow keys to move the cursor to the desired byte.
2. Activate the SHIFT key
3. Press the keypad letters/numbers to enter in the desired hexadecimal code, ranging from 00 to FF.
4. When you have finished, press SEND (F3) to send this byte.

3.7.3 Send K1, K2 Bytes

Enter this screen to configure the K1 and K2 bytes.

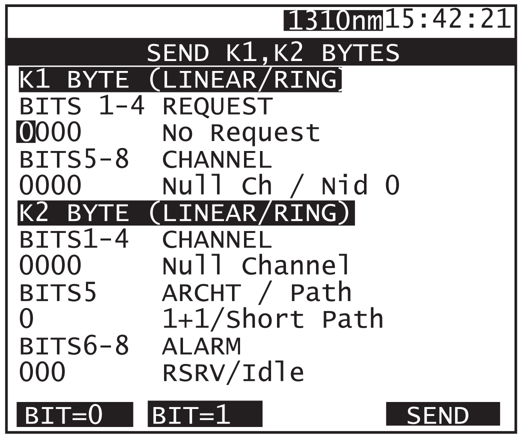


Figure 82 Send K1, K2 Bytes

Use the BIT=0 (F1) and BIT=1 (F2) keys to determine each bit within the two bytes. Each time a bit is changed, the label will change automatically. When they are configured correctly, press SEND (F4).

There are two ways to build a SONET network: in a line and in a ring. They have slightly different protection switching schemes; therefore the decodes for the K1/K2 bytes change slightly depending on which scheme you are using. Both decodes are shown on the screen—see Figure 82.

3.7.4 Send S1 Bytes

Enter this screen to configure the S1 byte for transmission.

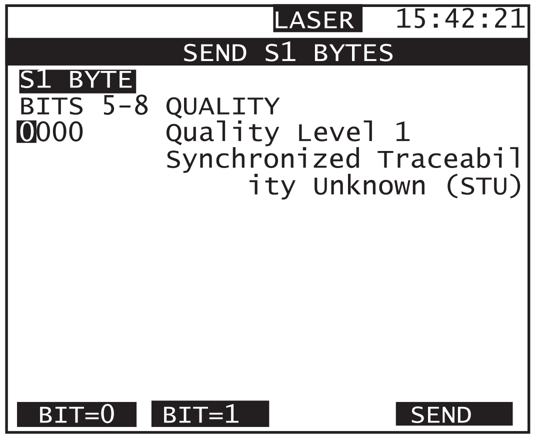


Figure 83 Send S1 Bytes

Use the BIT=0 (F1) and BIT=1 (F2) keys to determine each available bit. Each time a bit is changed, the label will change automatically. When they are configured properly, press SEND (F4).

3.7.5 J0 Section Trace Generation

This feature is only available on the SunSet OCx OC-48 unit. Enter this feature to configure the J0 section trace.

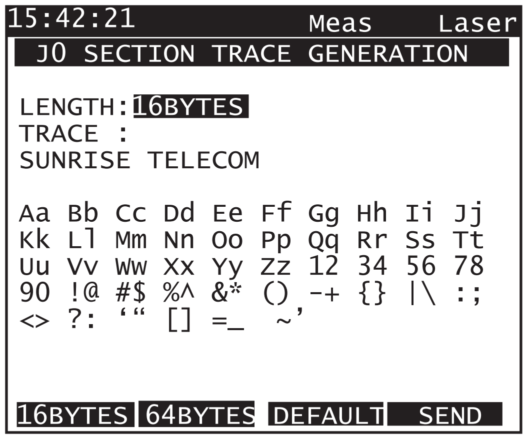


Figure 84 J0 Path Generation

For the LENGTH of the trace, select 16BYTES (F1) or 64BYTES (F2). DEFAULT (F3) transmits the Sunrise Telecom message: SUNRISE TELECOM A STEP AHEAD! for 16 bytes, SUNRISE TELECOM OCx A STEP AHEAD! OC3/OC12/OC48 HANDHELD UNIT! for 64 bytes.

To send USER data, follow the procedure below.

Enter Your Own Message

Here are the F-keys:

- Press INSERT (F1) to add an extra space.
- Press DELETE (F2) to remove a character.
- Press TOGGLE (F3) to access the ASCII characters. Use the cursor keys to move among the characters.
- Press SELECT (F4) to place the highlighted character into the label. When you have completed the label, press TOGGLE again to exit the label.
- Press SEND (F4) to transmit your message.

3.7.6 POH Monitor

The appearance of the Path Overhead Monitor screen will vary depending on whether or not you are monitoring a VT1.5 mapped SONET signal.

See the next figure for a sample screen.

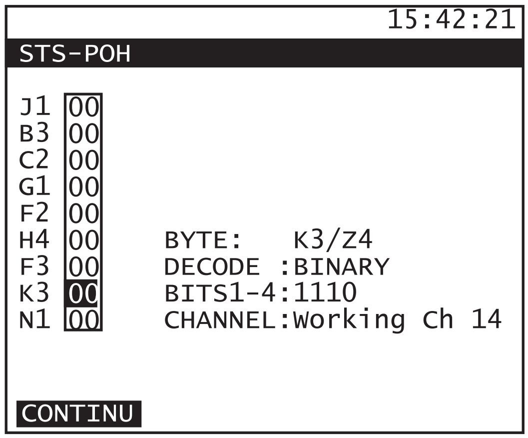


Figure 85 POH Monitoring Screen

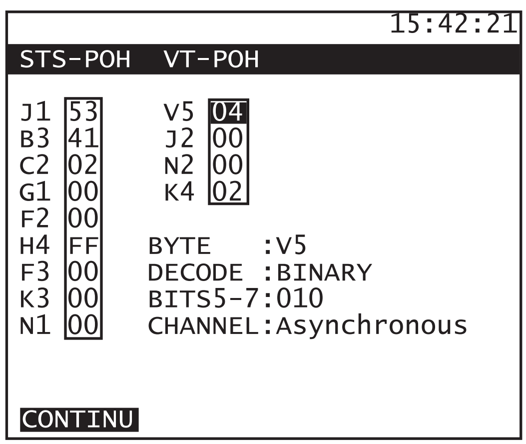


Figure 86 VT POH Monitoring

Use the cursor keys to select a byte. Any additional information will appear to the right of the column of bytes. The HOLDSCR/ CONTINU (F1) key allows you to halt and restart the presentation of data.

The 8 bytes of the Path Overhead are used as follows:

B3 - Parity check

C2 - Indicates the construction and content of the STS SPE. In Figure 86, C2 has a value of 02, which signifies Floating VT Mode. Here are the most common codes:

00	Unequipped
01	Equipped - Nonspecific
02	VT - Structured STS-1 SPE (Floating VT Mode)
03	Locked VT Mode
04	Asynchronous mapping for DS3
12	Asynchronous mapping for DS4NA
13	Mapping for ATM
14	Mapping for DQDB
15	Asynchronous mapping for FDDI

G1 - Conveys the path terminating status and performance. Bits 1 through 4 of the G1 byte carry a REI code to convey the count of interleaved- bit blocks which have been detected by the Path BIP-8 code. This count can have 9 values, 0 to 8 errors. In Figure 86, the G1 byte, 00, indicates 0 errors.

F2 - User defined

H4 - The Floating VT Mode uses the H4 byte to indicate the V1 through V4 bytes in a 500- ms (4-frame) Superframe. The correspondence of the H4 code and the V1 through V4 bytes is as follows:

H4 Byte	VT Byte
11111100	V1
11111101	V2
11111110	V3
11111111	V4

F3 (Z3), K3 (Z4) - Reserved for future use

N1 (Z5) - Tandem Path Performance; conveys information, like incoming error count and a tandem data link, about the tandem connection. This function is still under study for SONET systems.

3.7.7 Path Overhead Send

Enter this item from the SONET FEATURES menu to access the Send POH menu, as shown next. The selections available will depend upon your TEST CONFIGURATION.

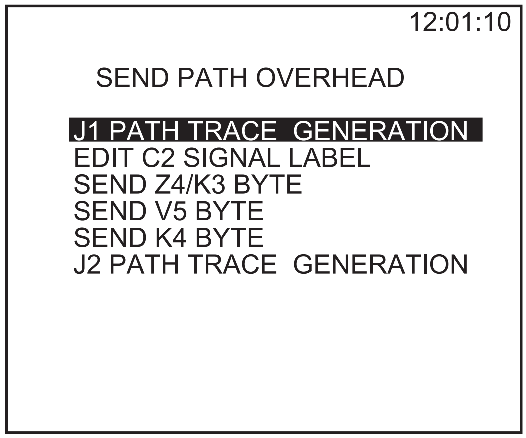


Figure 87 Send POH Bytes Menu

3.7.7.1 J1 Path Trace Generation

This feature accesses J1 of the path overhead, and allows you to repetitively transmit a selectable 16 or 64 byte ASCII text sequence. The J1 byte is the Path trace message. Any receiving terminal along the path can verify the continued connection of the signal.

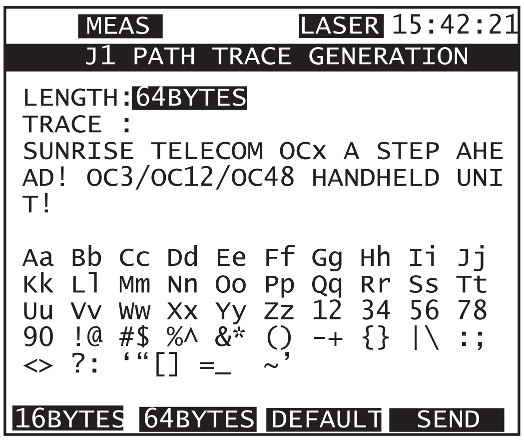


Figure 88 J1 Path Trace Generation

For the LENGTH of the trace, select 16BYTES (F1) or 64BYTES (F2). To enter the default Sunrise Telecom message, press DEFAULT (F3).

Enter Your Own Trace

Cursor down to enter the trace line if you want to enter your own message. Here are the F-keys:

- Press INSERT (F1) to add an extra space.
- Press DELETE (F2) to remove a character.
- Press TOGGLE (F3) to access the ASCII characters. Use the cursor keys to move among the characters.
- Press SELECT (F4) to place the highlighted character into the label. When you have completed the label, press TOGGLE again to exit the label.

3.7.7.2 Edit C2 Signal Label Byte

The C2 POH byte indicates the contents of the SPE.

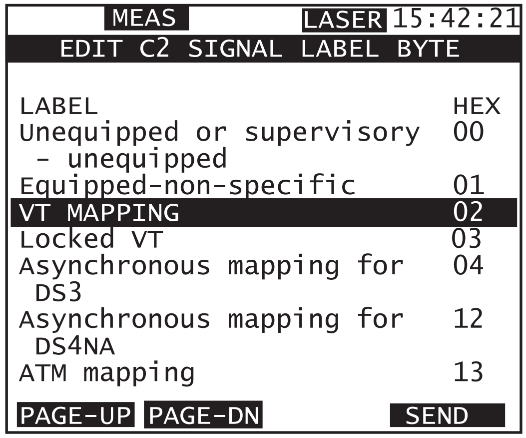


Figure 89 Edit C2 Label Byte

Use the cursor keys to move among the labels. Use the PAGE-UP (F1) and PAGE-DN (F2) keys to scroll between pages of labels. When the byte/label you want to send is highlighted, press SEND (F4).

3.7.7.3 Send Z4/K3 Byte

Here is the SEND Z4/K3 BYTES screen:

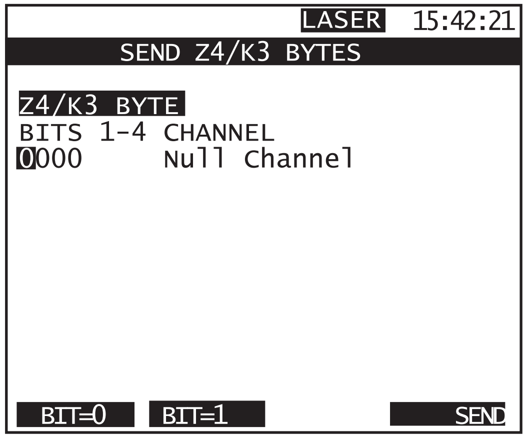


Figure 90 Send Z4/K3 Bytes Screen

Use the BIT=0 (F1) and BIT=1 (F2) keys to determine each available bit. Each time a bit is changed, the label will change automatically. When they are configured properly, press SEND (F4).

3.7.7.4 Send V5 Bytes

The V5 byte is a virtual tributary overhead byte. Here is the SEND V5 BYTES screen:

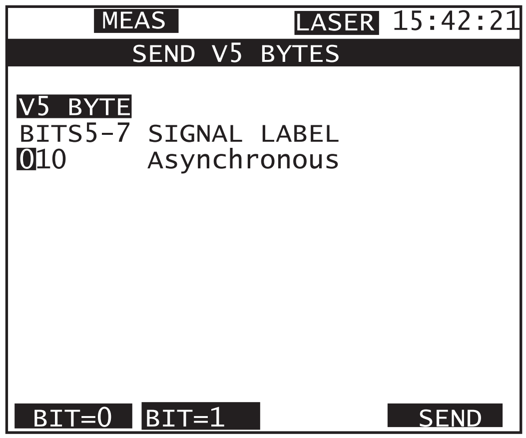


Figure 91 Send V5 Bytes Screen

Use the BIT=0 (F1) and BIT=1 (F2) keys to determine each available bit. Each time a bit is changed, the label will change automatically. When they are configured properly, press SEND (F4).

3.7.7.5 Send Z4/K4 Byte

K4 is used for virtual tributary protection switching and enhanced RDI-V. Here is the SEND K4 BYTE Screen:

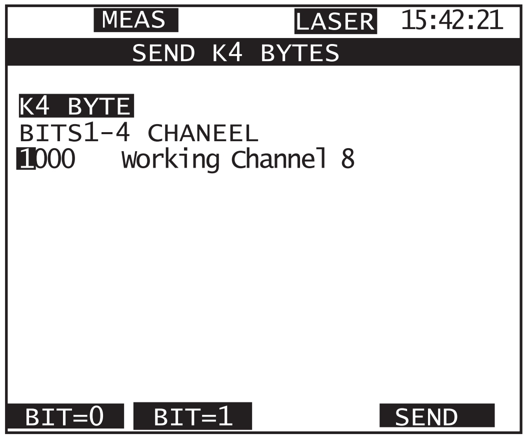


Figure 92   Send K4 Bytes Screen

Use the BIT=0 (F1) and BIT=1 (F2) keys to determine each available bit. Each time a bit is changed, the label will change automatically. When they are configured properly, press SEND (F4).

3.7.7.6 J2 Path Trace Generation

This feature accesses J2 of the VT1.5 overhead, and allows you to repetitively transmit a selectable 16 or 64 byte ASCII text sequence. The J2 PATH TRACE GENERATION screen is identical to the J1 PATH TRACE GENERATION screen. See *3.7.7.1 J1 Path Trace Generation* for details on using this function.

3.7.8 SONET APS Measurement

- Requires APS Timing software option SWOCx-U

Automatic Protection Switching (APS) keeps the network working even if a network element or link fails. When a failure is detected by one or more network elements, the network proceeds through a coordinated predefined sequence of steps to transfer (or switchover) live traffic to the backup facility (also called "protection" facility.)

This is done very quickly to minimize lost traffic, typically within 50 ms. Traffic remains on the protection facility until the primary facility (also called "working" facility) fault is cleared, at which time the traffic reverts to the working facility.

In a SONET or SDH network, the K1 and K2 line overhead bytes (also called the "APS channel") are used by the NEs to exchange request and acknowledgments for protection switch actions.

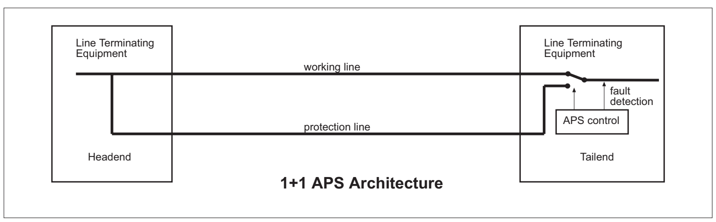


Figure 93 1+1 APS Architecture

What causes the network to initiate an automatic protection switchover? The three most common causes are: detection of AIS, detection of excessive B2 errors, and initiation through a network management terminal. According to GR-253 and G.841, a network element is required to detect AIS and initiate an APS within 10ms. B2 errors should be detected according to a defined algorithm, and more than 10 ms is allowed. This means that the entire time for both failure detection and traffic restoration may be 60 ms or more (10 ms or more detect time plus 50 ms switch time.)

To take an APS measurement, connect the test set to the location of concern within the network. For many applications, this will be a drop point of an ADM. For other applications, it will be a monitoring point in the ring. Examples of both are shown in Figure 94.

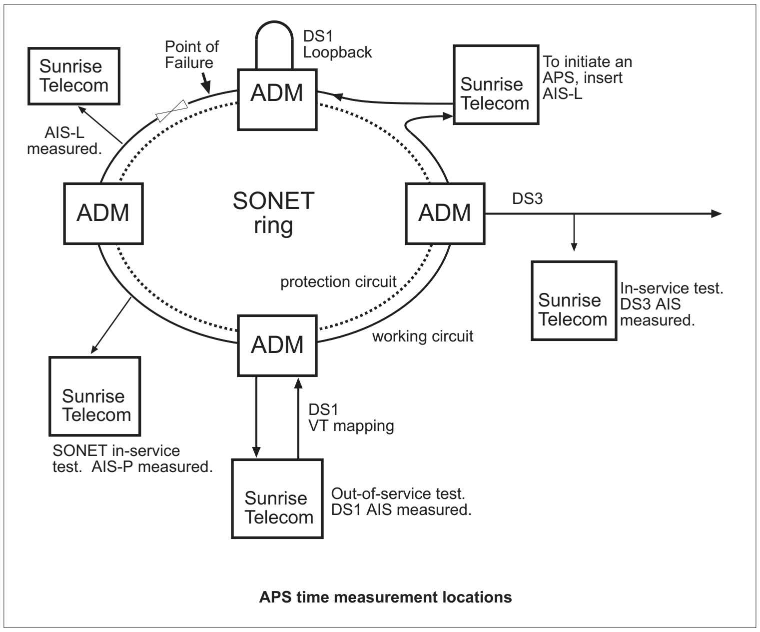


Figure 94   APS Measurement Points

You will also need to decide whether to connect the test set in-service or out-of-service. For most applications, traffic cannot be interrupted, so the testing will be done in-service. If a network is being installed or a new service provisioned, then testing can be done out-of-service. The Service Disruption measurement is appropriate for out-of-service APS testing. See *Chapter 3, Section 6*.

Enter SONET FEATURES > SONET APS MEASUREMENT, then configure the following items. See Figure 95.

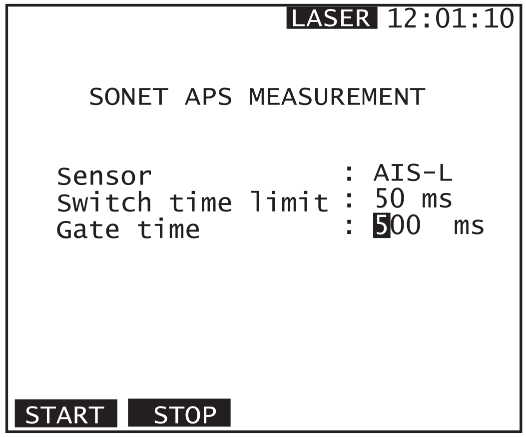


Figure 95 APS Screen

Note that you may press START (F1) at any time to begin an APS measurement. Press STOP (F2) to halt a measurement already underway.

Sensor

Options BIT, AIS-L, B2, AIS-P
DS3 payload: DS3FE, P-BIT, C-BIT

- For an out-of-service test, make sure that pattern synchronization is established before beginning the test.
- Select BIT to look for a bit error. Use of bit errors as a sensor is not recommended. Use the Service Disruption measurement instead.
- Select AIS-L to look for a Line AIS signal.
- Select AIS-P to look for a Path AIS signal.
- Select B2 to look for B2 errors.
- Select DS3FE to look for DS3 framing errors.
- Select P-BIT to look for P-bit errors.
- Select C-BIT to look for C-bit errors.
- Generally, AIS is used.

Note—SunSet OCx OC-48: Use the service disruption function for readings more accurate than those from the bit sensor.

Switch Time Limit

Options: 15—200 ms

Set criteria for the maximum APS time allowed for the network to pass APS testing.

- After the APS time is measured, a “PASS” or “FAIL” will be displayed along with the measured time.
- In general, this value should be set to 50 ms.

Gate Time

Options: 51—5000 ms

During an automatic protection switchover, AIS may come and go as the NEs progress through their algorithm to switch traffic to the protection circuit. The Gate time allows you to set a time limit on how long to wait. Gate time must be longer than Switch time limit, but should not be so long that other network events are mistakenly combined with the APS time measurement.

Here is another way to think of Gate Time and Switch Time Limit: (Gate Time) – (Switch Time Limit) = the minimum interval required for the circuit to be AIS free. A good value for Gate Time is 100 ms for a 50 ms switch time.

Starting the Measurement

Once the three parameters are set, start the measurement. The test set is now armed and waiting for an APS event to be detected. Initiate the APS using a network management terminal, inserting AIS with test equipment, or by breaking the working circuit. The APS time is measured and displayed, as well as a Pass/Fail message based on the specified switch time.

3.7.9 Transmit SS Bits Type Selection

Determine how to set the SS bits. This function is available on the OC-3 and OC-12 units.

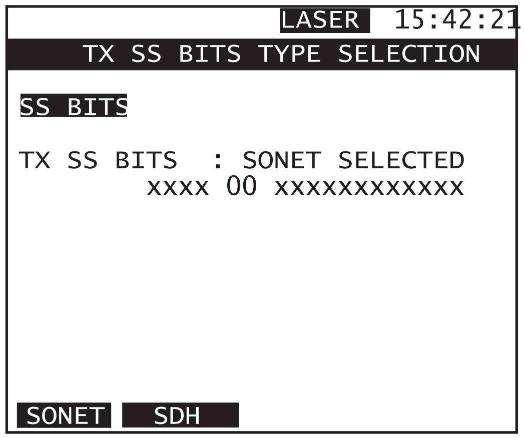


Figure 96 SS Bits Selection

SS BITS

- These bits sit between the NDF and the pointer value.
- Default value should be set to 00; the label is SONET.
- Press F2 to select SDH. The bits are set to 10.
- Press the ENTER key to make the new settings effective.

3.7.10 SSOCx OC-48 Pointer Control

If your unit is an SSOCx OC-48, you may perform various pointer monitoring and adjusting actions.

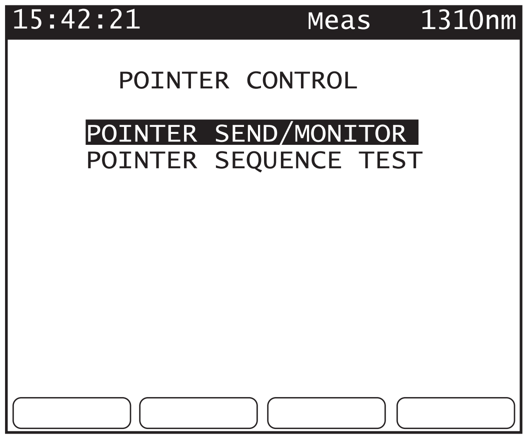


Figure 97 Pointer Control Menu

3.7.10.1 Pointer Send/Monitor

Use this function to observe and change pointer values.

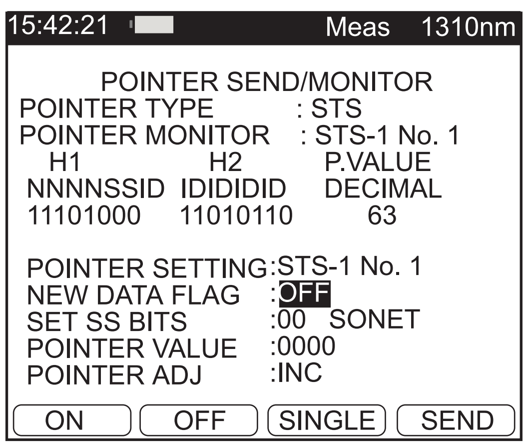


Figure 98 Pointer Control

POINTER TYPE

View or select the type of pointer being monitored.

- If you are using a VT1.5 payload, use the STS (F1) or VT (F2) key to select the pointer type. Otherwise, TYPE will be set at STS.

Notes

- Each monitored byte is displayed in binary.
- The pointer value is displayed in decimal.

POINTER MONITOR

Options: STS 1—3/12/48 (depending on the OC rate)

Select which STS-1 within the OC-3/12/48 to affect.

- Use the NEXTSTS (F1) and PREVSTS (F2) keys to make your selection.
- This setting applies only to optical configurations.

The remaining settings configure the pointer you are going to control. Press SEND (F4) to put the new settings into effect. You may see the effects of any adjustments at the monitor lines above.

POINTER SETTING

Options: STS 1—3/12/48 (depending on the OC rate)

Select which STS-1 within the OC-3/12/48 to affect.

- Use the NEXTSTS (F1) key to make your selection.
- This setting applies only to optical configurations.

NEW DATA FLAG (NDF) :

F1: ON. Select ON, and the unit will transmit the enabled code (1001) in the NDF bits of the H1 byte.

F2: OFF. The unit transmits a disabled code (0110).

F3: SINGLE. The unit transmits a NDF for a single frame. This causes a loss of pointer (LOP) condition.

SET SS BITS

- These bits sit between the NDF and the pointer value.
- Default value should be set to 00; the label is SONET.
- Use the cursor keys to move from one bit to another. Use F1

(BIT=0) to set the bit to 0, and F2 (BIT=1) to set it to 1. If the SS bits are set to 10, the label in front of them should display SDH. When set to 11 or 01, UNKNOWN will display.

- Press SEND (F4) to make the new settings effective.

POINTER VALUE

Use the keypad to enter any decimal value from 0 to 782. Any value greater than 782 should be displayed as INVALID. Press SEND (F4) to enter this new value.

The OCx does allow you to send invalid pointer values between 783 and 1023, inclusive. Doing so will cause a loss of pointer condition. A warning message appears on the screen in these cases.

POINTER ADJ

Changing the Pointer Adjustment will stress the network. Note that you do not have to press SEND (F4) in order to adjust the pointer.

INC (F1) : Pressing this key will increase the pointer value by one.

DEC (F2): Pressing this key will decrease the pointer value by one.

3.7.10.2 Pointer Test Sequences

- Requires Pointer Test Sequence software option SWOCx-X.

Pointer test sequences are an important tool for qualifying and installing optical networks. This OC-48 unit feature allows an engineer to stress test the robustness and jitter tolerance of the network. You will need a unit at the far end to take the measurements, or the network element output connected to the OCx sending the test sequences. Here is the first setup screen:

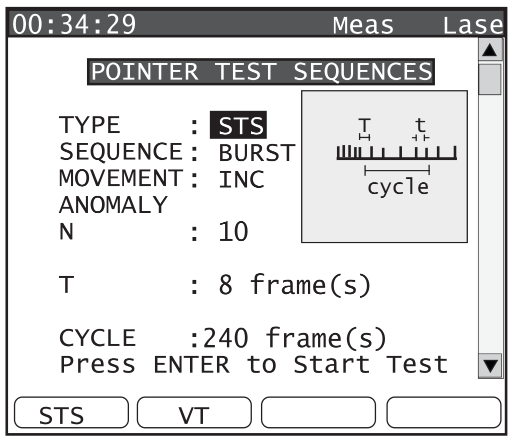


Figure 99 Pointer Test Sequences Setup 1

In this screen, items that do not apply to your setup as you have configured it appeared grayed out. Simply skip those items and move on to the next black line.

TYPE

Options: STS (F1), VT (F2)

Decide the type of pointer to be affected by the test sequence.

SEQUENCE

Options: OPPOS (F1), SINGLE (F2), BURST (F3), TRANS (MORE, F1), PERIOD (MORE, F2), 87-3 (MORE, F3), 26-1 (MORE, F1), CUSTOM (MORE, F2)

Decide how to affect the pointer sequence.

- Choose OPPOS to increase/decrease the pointer value in alternating sequence.

- Choose SINGLE to increase or decrease the pointer value.
- Choose BURST to generate a sequence of changes in the pointer value in one direction only (increase or decrease).
- Choose TRANS to generate changes in the phase of the pointer adjustment.
- Choose PERIOD to generate periodic changes in the pointer value.
- Choose 87-3 to generate an 87-3 pattern (87 consecutive pointer adjustments, followed by 3 time periods with in change in pointer value).
- Choose 26-1 to generate an 26-1 pattern (26 consecutive pointer adjustments, followed by time period with no change in pointer value).

Note: 87-3 is intended for STS pointers and 26-1 is intended for VT pointers.

- Choose CUSTOM to customize your pointer sequence.

MOVEMENT

Specify whether the pointer is increasing or decreasing.

- Use the INC key to increase the pointer value.
- Use the DEC key to decrease the pointer value.
- Use INC/DEC to alternate the pointer value (increase/decrease); applies only to the OPPOS SEQUENCE.

ANOMALY

Options: NONE (F1), ADDED (F2), CANCEL (F3)

Specify the type of anomaly, if any.

- Select ADDED to insert additional pointer adjustment into the sequence.
- Select CANCEL to skip one of the adjustments in the sequence.

N

Options: 1—9999 (default=6)

Specify the number of pointer adjustments in a row.

- Use the keypad to enter the number.

n
Options: 1—9999 (default=4)
Specify the position of the pointer anomaly from the start of the sequence.

- Use the keypad to enter the number.
- This only applies to Custom test sequences, ADDED or CANCEL ANOMALY.
- Note that the value of n can never be higher than N.

T
Options: 1—9999 (default=6) frames
Specify the average pointer spacing in time.

- Use the keypad to enter the number.
- T is known as T2 or T5 in G.783.

t
Options: 1—9999 (default=6) frames
Specify the average added pointer spacing in time; it only applies when ANOMALY is ADDED.

- Use the keypad to enter the number.
- t is known as T3 or T4 in G.783.

CYCLE
Options: 1—9999 frames
Specify the duration of the sequence. The cycle must be greater than or equal to Tx(N+1).

- Use the keypad to enter the number.

When you have finished configuring the setup screen, arrow down to the next screen (shown in the following figure).

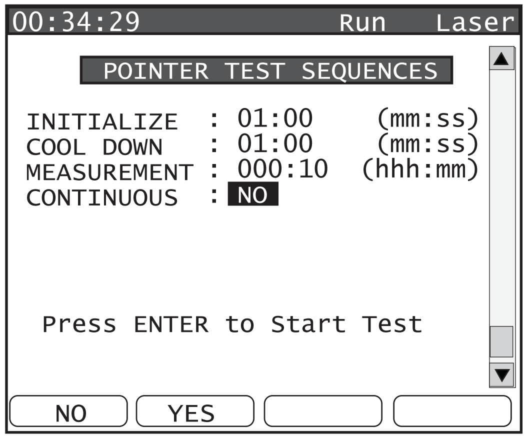


Figure 100 Pointer Test Sequence, Setup 2

INITIALIZE

Options: 0—99:59 minutes:seconds (default 1:00)

Specify the initialization period.

- Use the keypad to enter the time.
- During the initialization period, the unit sends pointer increase/ decreases (as set in the MOVEMENT field). Anomalies are not sent during initialization.

COOL DOWN

Options: 0—99:59 minutes:seconds (default: 30 sec.)

Specify the cool down period.

- Use the keypad to enter the time.
- During the cool down period, the unit sends the normal periodic sequence (87-3 sequence), or no pointer adjustments at all (all other sequences).

MEASUREMENT

Options: 0—99:59 minutes:seconds (default: 15 sec.)

Specify the initialization period.

- Use the keypad to enter the time.

- Measurements should not be taken during the initialization or cool down periods. In the measurement period, the sequence continues as the unit compiles standard measurements.

CONTINUOUS

Options: NO (F1), YES (F2)

Determine if the test will run continuously.

- If you select NO, enter the measurement time above.

Press ENTER when you are ready to start the test. You will see the following screen:

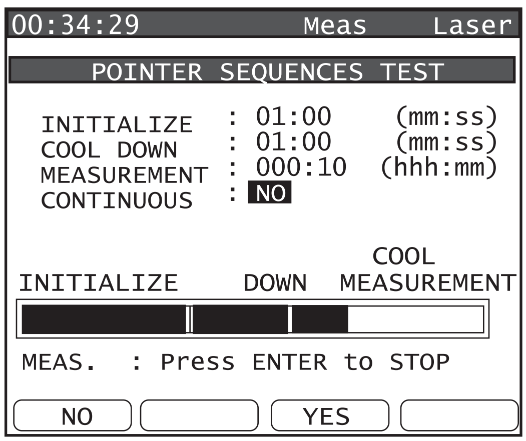


Figure 101 Test Sequence Test in Progress

- The bar graph at the bottom shows the progress of each phase of the test.

3.7.11 APS Byte Capture

- Requires APS Timing software option SWOCx-U.

3.7.11.1 Start a New Trace

Use this feature to monitor the K1 and K2 overhead bytes of a SONET or SDH signal and record the changes, in a non-OC-48 unit. From the APS BYTE CAPTURE menu, select START A NEW TRACE, as shown in the next figure.

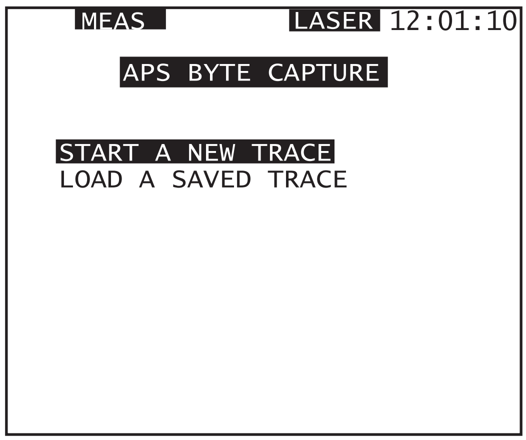


Figure 102 APS BYTE CAPTURE Menu

- The resolution is down to one frame or 125 ms.
- Start the test manually or have the test set trigger on a specific K1/K2 value. View the decoded K1/K2 bytes according to ring or linear protocols.
- A single test set monitors one side of the APS signaling.
- Connect the unit to the circuit via a splitter, or in THRU mode.
- Figure 103 shows the APS measurement points.

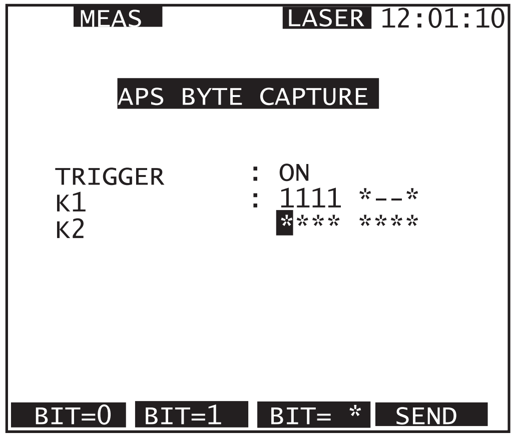


Figure 103 APS Byte Capture Configuration

Manual Start

1. Set TRIGGER to OFF.
2. Press START (F4). The unit will begin looking for and recording all K1/K2 bytes.

Trigger Start

1. Set TRIGGER to ON.
2. Set the K1 and K2 bits as required, using the BIT=0 (F1), BIT=1 (F2) and BIT=* (F3) keys.
   * indicates a wild card; the trigger will act on a 1 or a 0.
3. Press START (F4).
4. The unit will start looking and recording K1/K2 bytes after the trigger (as defined above) is met. It will then display all received K1/K2 bytes.

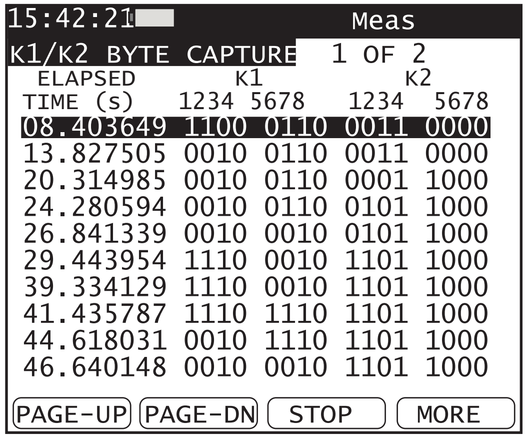


Figure 104 K1/K2 Byte Capture Screen

Figure 104 shows the captured bytes with the time elapsed in seconds since each change. The ‘1 of 2’ note in the second line of the header indicates a second screen of captured bytes is available to scroll to.

At the start of the test, the initial K1/K2 values are displayed in the first row. The screen then lists each new transition in a new line. Once ten changes have been recorded, the eleventh change starts a new screen.

F-keys

- Use PAGE-UP (F1) and PAGE-DN (F2) to scroll through the available screens of bytes.
- Press STOP (F3) to stop capturing bytes. The key will become RESTART so you can begin a new test; remember that if you have set a TRIGGER, that condition must be met before bytes will be captured.
- Press FRAMES (MORE, F1) to see the number of frames containing these bytes in the indicated time (instead of the number of seconds). Press TIME (MORE, F1) to return to the seconds display.
- Press DUR (MORE, F2) to see the length of time in seconds or frames each byte was unchanged. F2 becomes TIME; press to return to viewing the elapsed time since the initial last event (in seconds or frames).

Figure 105 shows the received frames and their duration.

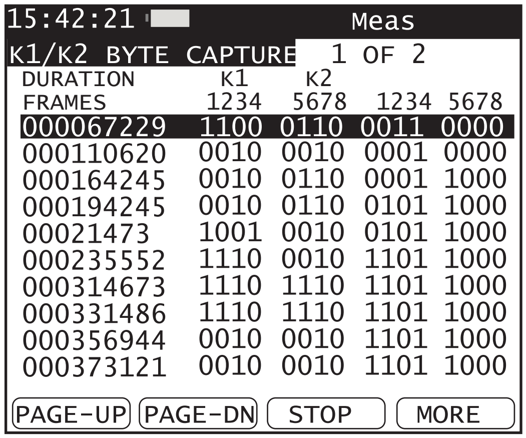


Figure 105 K1/K2 Frame Duration Sample

- Press the DECODE (MORE, F3) key to see the bytes decoded. The screen will show the LINEAR decode, as in the next sample figure.

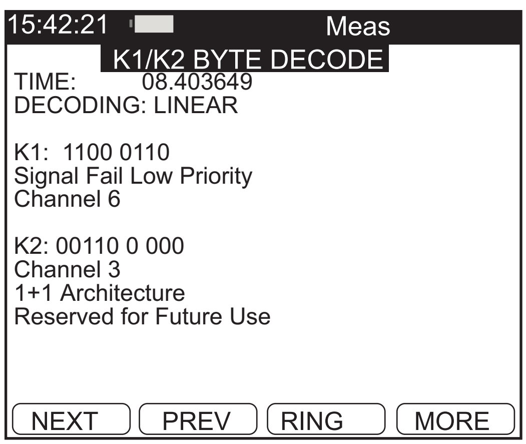


Figure 106 Linear K1/K2 Decode

Use the SUMMARY (F1) key in decode screen to return to the summary view of the results.

PRINT (F2) sends the decode information to the serial port for printing.

- In the LINEAR decode screen, press RING (MORE, F3) to view a screen with the bytes decoded for a RING topography. In the RING screen, F3 becomes LINEAR. Use the NEXT (F1) and PREV (F2) keys to view the available bytes.

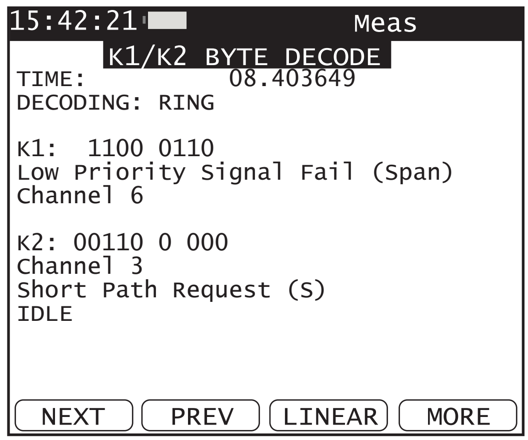


Figure 107 K1/D2 Ring Decode

- Press PRINT (MORE, F1) to send the results to the serial port for printing; from the SUMMARY screen, the summary results will print.
- Press SAVE (MORE, F2) to save the results; this function requires an ATA memory card. You will enter a standard Save screen; use the INPUT (F3) key to access the alphanumeric grid, then press SAVE (F3) when you are through to save the trace under your newly entered LABEL.

3.7.11.2 Load a Saved Trace

Use this feature to look at a save K1 and K2 trace.

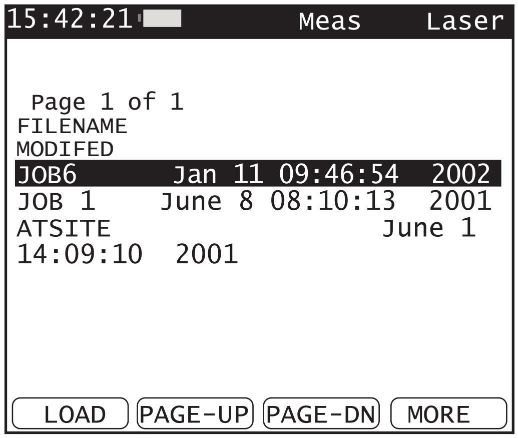
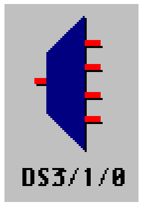


Figure 108 Load a Byte Capture Trace

Use the cursor keys to highlight the trace you want to affect.

F-keys

- Press LOAD (F1) to view the highlighted trace. The trace screens will appear. They work the same as in the START A NEW TRACE screens.
- Press PAGE-UP (F2) or PAGE-DN (F3) to scroll through the available screens of traces.
- Press RENAME (more, F1) to enter the trace saving LABEL screen to rename the trace.
- Press DELETE (more, F2) to delete the highlighted trace.
- Press DEL-ALL (more, F3) to delete all of the saved traces.



3.8 DS3 Features

Enter DS3 FEATURES from the MAIN MENU if your unit is black and white, or via the DS3/1/0 icon if you have a color unit, in order to access DS3 functions. The menu features four choices, as shown in the next figure.

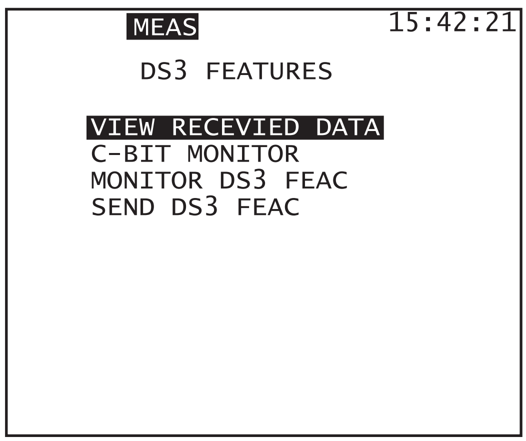


Figure 109 DS3 Features Menu

3.8.1 View Received Data

Refer to Figure 110 for a typical screen display. This display refers to the received DS3 payload. View the DS3 data, sans overhead bits, 1 byte at a time. Note that in an OC-3 or higher multirate test, you may choose which DS3 to view by pressing the NEXT (F1) and PREV (F2) keys.

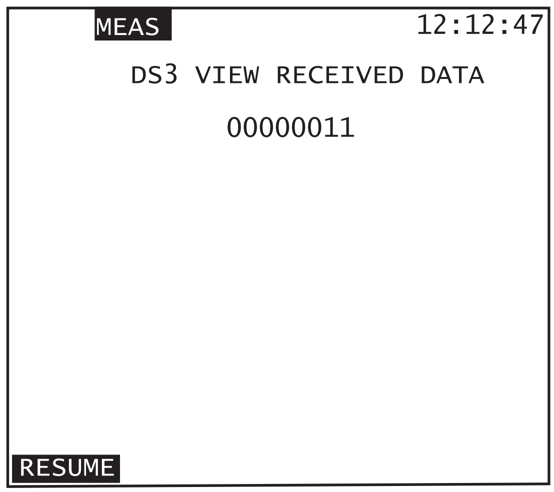


Figure 110 View Received DS3 Data

3.8.2 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 111. Press the PAUSE (F1) key to halt the live presentation of data; press RESUME (F1) to restart it. Note that in an OC-3 or higher test you may choose which DS3 to view by pressing the NEXT (F1) and PREV (F2) keys.

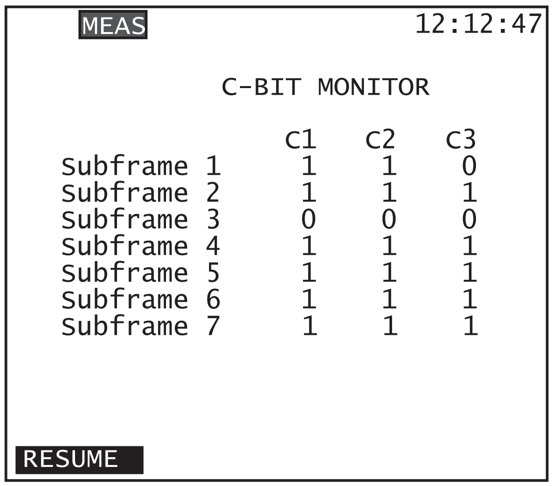


Figure 111 C-bit Monitor

3.8.3 Monitor DS3 FEAC

In the MONITOR DS3 FEAC screen, as shown in the next figure, you can observe the current and past messages appearing on the DS3 Far End Alarm and Control (FEAC) datalink. C-bit framing is required. The third C-bit in M-subframe 1 provides the 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.

Press the PAUSE (F1) key to halt the live presentation of data; press RESUME (F1) to restart it. Note that in a multirate test you may choose which DS3 to view by pressing the F-key corresponding to the DS3 you want.

```
    MEAS                       15:42:21
          MONITOR DS3 FEAC


RECEIVE STATUS: MESSAGE

RECEIVED MESSAGES:
  CURRENT: 1111111001100000
  1st LAST: 1111110001110000
  2nd LAST: 1111111101101000
  3rd LAST:
  4th LAST:

(left most bit received first)
PAUSE
```

Figure 112 Monitor DS3 FEAC

An STS-1 No. line item will be available if required. Select the STS-1 to monitor for DS3 information. In black and white units, press the appropriate F-key: F1 for STS-1 #1, F2 for #2, F3 for #3 (PAUSE moves to F4). In OC-12 and OC-48 configurations, use the NEXT (F1) and PREV (F2) keys to make the selection.

3.8.4 Send DS3 FEAC

- Requires DS3 FEAC software option SWOCx-D.

The SEND DS3 FEAC allows you to transmit messages across the DS3 FEAC datalink, when you are using C-bit framing.

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.

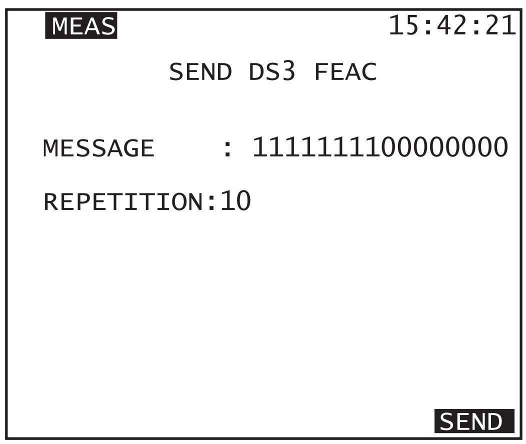


Figure 113 Send DS3 FEAC

STS-1 No. (if available)

Options:

Select the STS-1 to monitor for DS3 information

- For an OC-3 configuration, use the appropriate F-key to make your choice: #1 (F1), #2 (F2), #3 (F3)
- In OC-12 and OC-48 configurations, use the NEXT (F1) and PREV (F2) keys to make the selection.

MESSAGE
Options: any 16 digit message.
Configure the transmitted code word.

- Use the SHIFT and number keys to enter the 1s and 0s.
- Note that you may press SEND (F4) at any time to transmit the code word.

REPETITION
Options: 1—99, CONTINU
Determine how many times the code word message will be sent. Ten is usually the recommended minimum number.

- To send the message a specific number of time, use the SHIFT and number keys to enter a count.
- To send the message continuously, press CONTINU (F1).

Press SEND (F4) to send the message.

Here is a list of the FEAC codewords.

FEAC Code	**Codeword**	
Alarm/Status Condition		
DS3 EquipmentFailure (SA)	11111111	00110010
DS3 LOS	11111111	00011100
DS3 OOF	11111111	00000000
DS3 AIS Received	11111111	00101100
DS3 Idle Received	11111111	00110100
DS3 EquipmentFailure (NSA)	11111111	00011110
Common EquipmentFailure(NSA)	11111111	00111010
Multiple DS1 LOS	11111111	00101010
DS1 EquipmentFailure (SA)	11111111	00001010
Single DS1 LOS	11111111	00111100
DS1 EquipmentFailure (NSA)	11111111	00000110
Loopback Control		
Line LoopbackActivate	11111111	00001110
Line LoopbackDeactivate	11111111	00111000
DS3 Line	11111111	00110110
DS1 Line #1	11111111	01000010
DS1 Line #2	11111111	01000100
DS1 Line #3	11111111	01000110

DS1 Line #4	11111111	01001000
DS1 Line #5	11111111	01001010
DS1 Line #6	11111111	01001100
DS1 Line #7	11111111	1001110
DS1 Line #8	11111111	01010000
DS1 Line #9	11111111	01010010
DS1 Line #10	11111111	01010100
DS1 Line #11	11111111	01010110
DS1 Line #12	11111111	01011000
DS1 Line #13	11111111	01011010
DS1 Line #14	11111111	01011100
DS1 Line #15	11111111	01011110
DS1 Line #16	11111111	01100000
DS1 Line #17	11111111	01100010
DS1 Line #18	11111111	01100100
DS1 Line #19	11111111	01100110
DS1 Line #20	11111111	01101000
DS1 Line #21	11111111	01101010
DS1 Line #22	11111111	01101100
DS1 Line #23	11111111	01101110
DS1 Line #24	11111111	01110000
DS1 Line #25	11111111	01110010
DS1 Line #26	11111111	01110100
DS1 Line #27	11111111	01110110
DS1 Line #28	11111111	01111000
DS1 Line All	11111111	00100110
Network Use(Loopback Activate)	00010010	11111111
Network Use(Loopback Deactivate)	00100100	11111111

Reserved for Future Use or Undefined

Maintenance Use	01111010	11111111
Maintenance Use	00111110	11111111
Undefined	All others	11111111

SA: Service Affecting   NSA: Non-Service Affecting

Line Loopback Deactivate: There is a discrepancy in the proper codeword as specified in T1.107a versus T1.404. This specification uses the T1.107a version as this seems to be the correct one and the codeword from T1.404 (01110000) appears to be a typo. 0111000 is also the codeword for DS1 Line #24.

3.8.5 Propagation Delay

You must be in a DS3 point-to-point configuration with a loopback in place in order to use this feature.

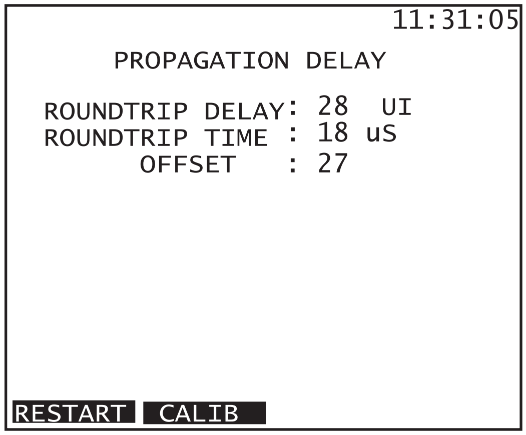
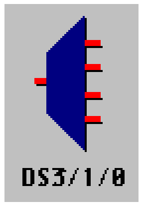


Figure 114 Propagation Delay

The test set measures the number of unit intervals required for the signal to travel down the line and then return. This number is converted into microseconds of round trip delay. One T1 UI (Unit Interval) equals 488 µS.

- Press RESTART (F1) in order to begin the test anew.
- Press CALIB (F2) if you have more than one piece of looped equipment on the line, and want to recalibrate the measurement to see the propagation delay between two devices, not including the SunSet OCx. Continue pressing CALIB as necessary to take measurements further down the line.



3.9 DS1 Features

Enter DS1 FEATURES from the MAIN MENU in order to access DS1 functions.

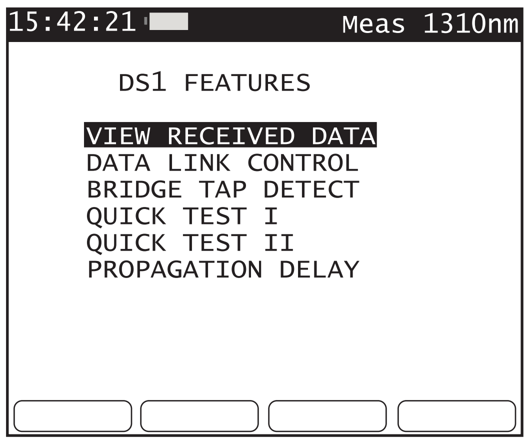


Figure 115 DS1 Features Menu

3.9.1 View Received Data

Refer to Figure 116 for a typical screen display. This display refers to the received DS1 payload.

MEAS 12:12:47

VIEW RECEIVED DATA

STS-1 No.: 00 DS1 No.:02
PAGE:01

T/S	BINARY	HEX	ASCII
00	00011011	1B	( )
01	10001110	8E	(q)
02	01000100	44	D ( )
03	11011010	DA	([)
04	01100101	65	(e)
05	00100010	22	(D)
06	10100001	A1	( )
07	00110000	30	0 ( )
08	00110000	30	0 ( )

PAGE-UP PAGE-DN PAUSE PRINT

Figure 116 DS1 View Received Data

To view this screen, use the following procedure:

1) Cursor to the DS1 FEATURES item in the main menu, via the DS3/1/0 Features icon if required, and press ENTER.

2) At the VIEW RECEIVED DATA line, press ENTER.

3) View the live presentation of the data.

4) Choose PAUSE (F3) to trap the current data on the T1 line. Press RESUME (F3) to return to the live presentation of data.

- Press PRINT (F4) to send the data to the serial port for printing.
- At the DS1 and STS-1 items, use the PREV (F1) and NEXT (F2) keys to select the DS1 and STS-1 to view.

5) Choose PAGE-UP (F1) or PAGE-DN (F2) to view more data.

- Note the PAGE number in the upper left-hand portion of the screen.

- 60 pages of data are available; which is equal to 20 frames.

6) When you have finished, press the ESCAPE key twice to return to the main menu.

The following display definitions are used in this screen:

PAGE: Indicates which of the available 60 pages of data is currently being displayed.

DS1 No.: Shows which DS1 data is currently on display.

STS-1 No.: Shows which STS-1 the DS1 is residing in.

T/S: Specifies the Time Slot being viewed.

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

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

ASCII: This column displays the ASCII representation of the 8-bit binary framing word which has been received.

The character displayed to the left of the parentheses represents the 8-bit framing words translated in their present order.

The character displayed within the parentheses represents the 8 bits translated in reverse order.

3.9.2 Data Link Control

- Requires DS1 Datalink software option SWOCx-O.

3.9.2.1 ESF Data Link

ESF DATA LINK CONTROL is provided when you have chosen a DS1 setup with ESF framing in the TEST INTERFACE menu. See the next figure.

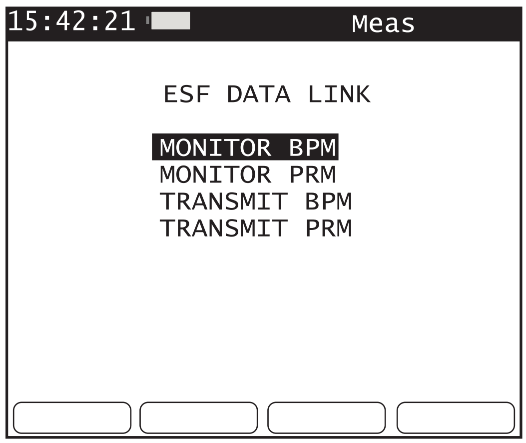


Figure 117 ESF Datalink Menu

Monitor BPM

Monitor BPM allows you to monitor the Bit Report Messages present on the datalink. Note that the messages are bumped down the list as new ones arrive. BPMs indicate alarms and other conditions. See the next figure for a sample of monitored BPM.

```
MEAS                        06:44:12

   MONITOR ESF DATA LINK BPM

  DATA LINK
0: 11111111 00100000

1: 11111100 01111110

2: 11111111 0010000

3:

4:
CLEAR   DECODE
```

Figure 118   Monitor ESF BPM Screen

Press DECODE (F2) to see a plain-language translation of the received messages:

```
MEAS                        06:44:12

   MONITOR ESF DATA LINK BPM

  DATA LINK
0: Stratum 1 Traceable

1: IDLE

2: Stratum 1 Traceable

3:

4:
CLEAR   BINARY
```

Figure 119   Monitored BPM Messages, Decoded

Press BINARY (F2) to return to the binary presentation of data. Note that message 0 is always the most current message. Messages count backwards from 0.

Monitor PRM

MONITOR PRM allows you to monitor the Performance Report Messages received on the ESF datalink. It gives you real-time end-to-end performance information, such as CRC and frame errors, even when the circuit is in service.

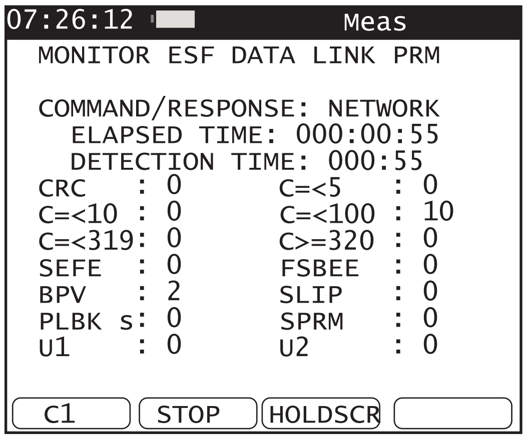


Figure 120 Monitor ESF PRM

Here are the screen definitions:

COMMAND/RESPONSE: Reports on which piece of equipment sent the message; Network in the sample screen. Note that you may change the side you are monitoring by pressing the F1 key; it alternates between CI and Network.

ELAPSED TIME: This is the total amount of time which has passed since the data link began to be monitored.

DETECTION TIME: This is the total amount of time the 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. A SEFE occurs when two or more framing-bit-pattern errors occur within a 3 ms period.

FSBEE: This is the number of frame synchronization bit error events reported.

BPV: This is the number of seconds in which at least one line code violation occurred.

SLIP: This is the number of seconds during which at least one frame slip occurred.

PLBK s: This is the number of seconds in which the device is looped back.

SPRM: This is the number of supplementary performance report messages received.

U1: This is the number of seconds in which the U1 bit was not set to zero. U bits are under further study for synchronization.

U2: This is the number of seconds in which the U2 bit was not set to zero. U bits are under further study for synchronization.

F-keys

- Press STOP (F2) to stop monitoring the datalink. To begin monitoring anew, press START (F2).
- HOLDSCR (F3) stops the screen from updating while you look at it. The measurement continues the background in the back-

ground. You can let the screen update again by pressing the CONTINU (F3) key.

Transmit BPM

Use this screen to transmit BPM. This is an out-of-service test. You may press SEND (F4) at any time to transmit the codeword as programed. You may press STOP (F4) to halt transmission. The STATUS line reports on the transmission status: SENDING or IDLE.

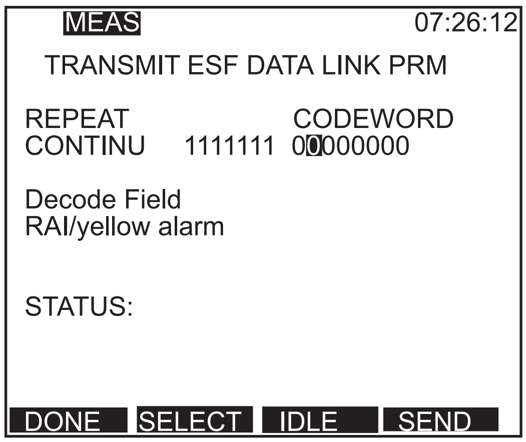


Figure 121 Transmit ESF BPM

Here are the settings:

REPEAT

Options: CONTINU (F1), TIMED (F2), NUMBER (F3)

- Select F1 and the datalink is sent continuously until you press STOP (F4). Escaping from this screen will also stop transmission.
- Select F2 and 000:00 will appear. Enter the number of minutes and seconds you would like the transmission to last, using the SHIFT and number keys.

  When you press SEND (F4), the sending message in the STATUS field will show the Remaining Time counting down.

- Select F3, and you may enter a number between 3 and 99; this is the number of repetitions the codeword will be transmitted.

- Use the Up and Down arrow cursor keys to move from the REPEAT field to the CODEWORD field.

CODEWORD

Options: SELECT (F1), IDLE (F3), SEND (F4)
View the last selected codeword.

- The meaning of the codeword is presented for you in the Decode Field (RAI/yellow alarm in the sample figure).
- Use the SHIFT and number keys to enter a codeword or press F2 to SELECT a particular message from the pre-programmed list of BPMs. See the next figure.

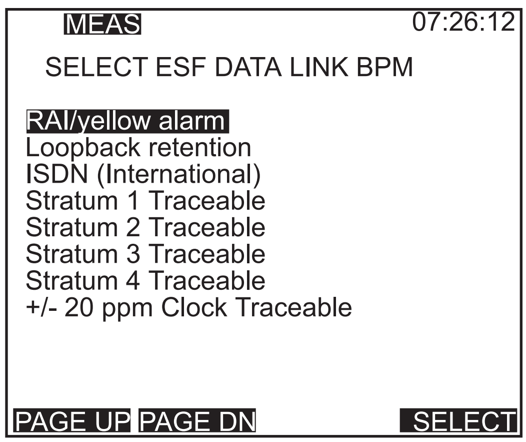


Figure 122   Select a BPM

In this screen, use the PAGE-UP (F1) and PAGE-DN (F2) keys to scroll through the available screens of messages. Use the arrow keys to move among the messages on a screen. Press SELECT (F4) and the highlighted message will be chosen. It will appear in the TRANSMIT ESF DATA LINK BPM screen when you return to it by pressing ENTER.

- Select IDLE (F3) to send the T1.403 idle code (01111110).

Transmit PRM

In this screen, you may view the PRM messages the unit is transmitting. You may not select a message to transmit. The unit compiles performance statistics from the line and puts them into a PRM message. The values are calculated automatically.

PRM transmission starts as soon as you enter this screen. This is an out-of-service test.

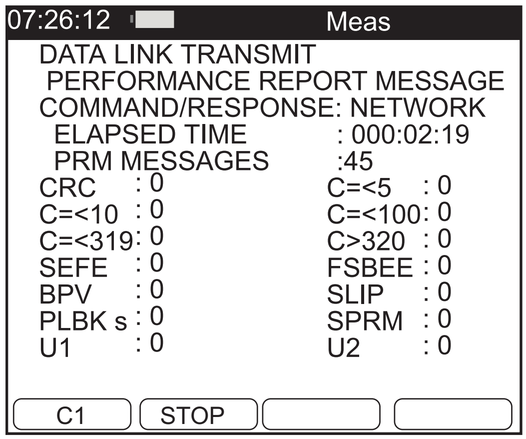


Figure 123 Transmit ESF PRM

Here are the settings:

COMMAND/RESPONSE: Use the F1 key to toggle between the NETWORK (C/R=1) and CI (C/R=0) selections.

ELAPSED TIME: This is the amount of time which has passed since the start of PRM transmission.

PRM MESSAGES: This is the number of PRM messages sent by the test set.

See the MONITOR PRM section for definitions of the results.

3.9.3 Bridge Tap Detect

The bridge tap test 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
CNFG: DS1
Tx: 1-8      Rx: 1-8

      BIT PERFORMANCE

BIT   : 0              BER  : 0.0e08
EFS   : 21             %EFS : 100
ES    : 0              %ES  : 00.000
SES   : 0              %SES : 00.000
AS    : 21             %AS  : 100.00
UAS   : 0              %UAS : 0
PATLS : 0              DGRM : 0.00

PAGE-UP PAGE-DN
```

Figure 124 Bridge Tap G.821 Results

```
                                  09:27:44

     BRIDGE TAP DETECT
PAGE: 1
  PATRN     BIT ERRS     ES    AS

1  ALL1     12           2     30
2  ALT10    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
```

Figure 125 Bridge Tap Results—Summary Screen

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 TEST CONFIGURATION items have been properly configured.

2) You can observe the test in progress by looking at the Bit Performance results screen (Figure 124). You can PAGE-DN (F2) and see the summary results (Figure 125). 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.

   On OC-48 units, Service Disruptions are provided at the bottom of the BIT PERFORMANCE screen. It provides a very precise disruption measurement.

3) 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 current ANSI and Bellcore standards, an errored second is not counted during an unavailable second.

3.9.4 Quick Test- I and - II

The quick test can save 30 minutes 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.

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, and is used for B8ZS lines.

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

1) Before using the quick test, set your line interface in the TEST CONFIGURATION menu to the following DS1 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, via the DS3/1/0 if applicable, enter DS1 FEATURES.

- Move the cursor down to QUICK TEST I/II 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 126 for the ticket entry menu.

a) Choose INPUT (F3) to enter the alphabet grid. The letter A will be highlighted.
b) Cursor over to the first letter in your ticket name, then press the ENTER key. Repeat this step until you have selected all the letters.
c) Press STOP (F3) to get out of the alphabet grid.

d) Press SAVE (F4) to save the test label.

```
                                  21:10:05

           QUICK TEST - I
   TICKET         : A
   LOOPBACK       : CSU
   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   STOP    SAVE
```

Figure 126 Ticket Entry

- Use the INSERT/TYPEOVR (F1) and DELETE (F2) keys to correct any mistakes you may make in the label.

5) Cursor down to the LOOPBACK menu item.

```
                                  21:10:05
            QUICK TEST - I

     TICKET   : AMI
     LOOPBACK : NONE
     PRINT    : NONE

  TEST PATTERN            DURATION
     1.3-24                 5  min
     2.ALL 1                5  min
     3.QRSS                 15 min
     4.QRSS                 15 min
     5.NONE                 0 min

 NONE   CSU-INB   NIU-INB   MORE
```

Figure 127 Other Entries

- Choose the loopback location as appropriate: NONE (F1). CSU-INBand (F1), NIU-INBand (F2), NIU-DataLink (more, F1), LINE-DataLink (more, F2), or Payload-DataLink (more, F3).

6) Cursor down to the PRINT menu item. Choose YES (F1) or NONE (F2) as appropriate.

7) Cursor down to the first pattern.
a) Scroll through the F-key options to observe all of the different patterns you can send.
b) Change the pattern if necessary.

8) Cursor over to the time for the first pattern.
- If necessary, change the time. First press the SHIFT 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.

Note: If you wish to PRINT your results, enter YES at the PRINT line before beginning the quick test.

10) When your quick test is configured properly, press ENTER, and the quick test will begin. The QUICK TEST RESULTS screen will appear. The XMT and RCV fields show you the test pattern currently under test.

Note: Press ESC to stop and abort the test.

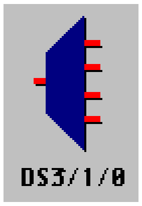
11) When the quick test is finished, you will see summary results. You can see if the loopback operations were successful.
a) Press the PAGE-UP (F1) and PAGE-DN (F2) keys to view the test results from each pattern which was transmitted.
b) Press the ESC key when you are finished.

3.9.5 Propagation Delay

You must be in a DS1 PT-PT mode to use this feature. The circuit must be looped back at the far end in order for the test set to perform this measurement.

This 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 T1 UI equals 488 uS. Use the following procedure:

1) Establish a loopback.
2) From the DS1 Features menu, enter PROPAGATION DELAY.
3) The measurement will be performed automatically.
4) Use the RESTART (F1) key to perform another measurement if desired.



3.10 VF/DS0 Features

- Sections 3.10.3—3.10.5 require Voice Frequency Dialing and Analysis software option SWOCx-D.

In order to access the VF/DS0 FUNCTIONS menu, the DS1 signal under test must have valid framing. Channels can only be identified in a framed signal. See the next figure.

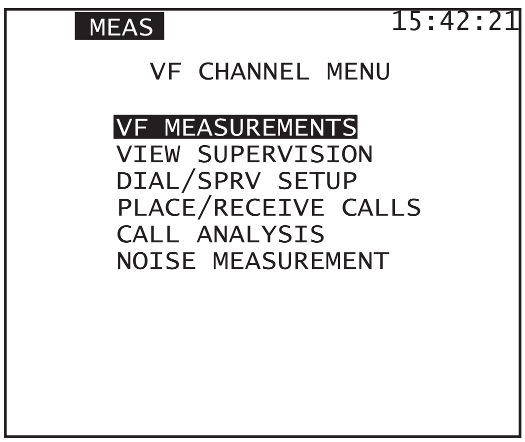


Figure 128 VF Channel Menu

3.10.1 VF Measurements

From the VF CHANNEL MENU, enter VF MEASUREMENTS. You will see the following screen:

```
      MEAS          LASER 15:42:21
           VF MEASUREMENTS

DS1     Tx[Rx]: 05[05]

TxCHAN  : 01      Rx/DROP: Rx-1
TxMODE  : TALK    Rx1CHAN: 01
TxFREQ  : 404 hZ  Rx2CHAN: N/A
Tx LVL  : 0 dBm   Rx1LSTN: SPKR
TxABCD  : 00      Rx2LSTN: N/A

Rx1ABCD:11        Rx2ABCD: 11
Rx1FREQ:0         Rx1 LVL: 2.3
Rx1DATA:00000000
 NEXT   PREV
```

Figure 129 VF Measurements, Single/Payload Mode

```
      MEAS          LASER 15:42:21
           VF MEASUREMENTS

Tx/INSERTL:       Tx-2

TxCHAN  : 01      Rx/DROP : Rx-1
TxMODE  : TALK    Rx1CHAN : 01
TxFREQ  : 404 hZ  Rx2CHAN : N/A
Tx LVL  : 0 dBm   Rx1LSTN : SPKR
TxABCD  : 00      Rx2LSTN :

Rx1ABCD: 11       Rx2ABCD : 01
Rx1FREQ: 0        Rx1 LVL : 2.3
Rx1DATA: 00000000

 OFF    SPEAKER
```

Figure 130 VF Measurements, T1 Dual Mode

Note that the first line in the T1 Single/Payload Mode screen lists the Transmit and Receive channels in brackets (05, 05 in the sample screen). An STS-1 line indicator may also be present in OC rate setups. The first line of the T1 Dual Mode tells you the line you are transmitting/inserting on (Line 2 in the sample screen). You may select between Tx-1 (F1) and Tx-2 (F2).

Here are the settings:

TxCHAN

Options: 1—24

Configure the transmit channel.

- Use the NEXT (F1) and PREV (F2) keys to select a channel.

TxMODE

Options: TALK (F1), TONE (F2) , QUIET (F3)

Select the insert type.

- Select TALK to talk on the transmit channel; you can talk into the microphone located on the bottom of the test set.
- Select TONE to insert a tone on the transmit channel. If you select TONE, configure the next two settings.
- Select QUIET to place a quiet termination on the signal; the unit's microphone will not operate.

TxFREQ

Options: 404 (F1), 1004 (F2), 1804 (F3), 2713 (MORE, F1), 2804 (MORE, F2)

Select the transmit frequency of your inserted tone, in Hz.

- You may also manually enter a specific frequency, from 50—3950 Hz, using the keypad.

Tx LVL

Options: +/- (F1), 0 (F2), -13 (F3)

Determine the transmit level for your inserted tone, in dBm.

- Select 0 to send the tone at the selected frequency level. This is the default setting.
- Select -13 to use a standard -13 dBm level.
- To select your own level, press the SHIFT and required number keys, then use the +/- (F1) key to determine if the level will be positive or negative.

TxABCD

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

Determine the supervision to send on the transmit channel.

The values are determined by trunk and equipment type.

As you select one of these choice, the supervision will immediately be sent.

If you wish, you may enter the A/B/(C/D) supervision state manually:

a) Press the SHIFT key to display the SHFT indicator in the upper left portion of the LCD screen.
b) Press the 1 and/or 0 key as appropriate. If you make a mistake, press the SHIFT key again to turn off the indicator, cursor back to the digit to be changed, press the SHIFT key again, then enter the correct number.
c) When the digits are correct, press SHIFT again. Make sure the 'SHFT' indicator has vanished.

Rx/DROP

Options: Rx-1 (F1), Rx-2 (F2)

Select the line to receive on.

- Select Rx-1 to receive on Line 1.
- Select Rx-2 to receive on Line 2.
- In T1 SINGLE or DS1 payload setup, this is set at Rx-1.

Rx1CHAN and **Rx2CHAN** (if DUAL Mode)

Options: 01—24

Select the receive channel.

- Use the NEXT (F1) and PREV keys to select the channel.

Rx1LSTN

Options OFF (F1), SPEAKER (F2), HANDSET (F3)

Determine how you will listen to line 1.

- Select OFF to not listen on line 1.
- Select SPEAKER to use the unit's speaker.
- Select HANDSET to plug a handset into the unit's handset port.

Rx2LSTN (if DUAL Mode)

Options: OFF (F1), SPEAKER (F2)

- Select OFF to not listen on line 2.

- Select SPEAKER to use the unit's speaker.

Measurements

The following measurements are only for observation. In the T1 Dual Mode, measurements are shown for the line selected as Rx/DROP in the section above. The RxABCD for the line not selected will show N/A. In all other modes, T1-1 is the receive line.

Rx1ABCD and Rx2ABCD

Observe the signalling bits for the indicated receive channel (Line 1 or Line 2)

Rx1/2FREQ

View the received channel's frequency.

Rx1/2DATA

View the received channel's data.

Rx1/2 LVL

View the received channel's level, in dBm.

3.10.2 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 the next figure.

Use the following procedure:

1) Enter the VF/DS0 FUNCTIONS item.

2) Select the VIEW SUPERVISION menu item.

Observe the signalling bits of all channels simultaneously. Note that SF-D4 and SLC96 framed signals will show A/B bit signalling information, and ESF framed signals will show A/B/C/D signaling bit information.

- Channels 1 through 4 are shown on the first line, 5—8 on the second, and so on.
- Line 2 is shown when you are in T1DUAL mode.

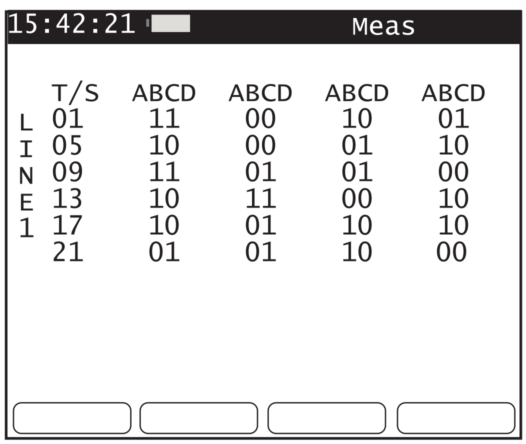


Figure 131 View Supervision Screen

3.10.3 Dial/Supervision 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 FXO or FXS line cards. The set will use this conditioning in VF MEASUREMENTS, Tx A/B/C/D. Refer to Figure 132 and use this procedure:

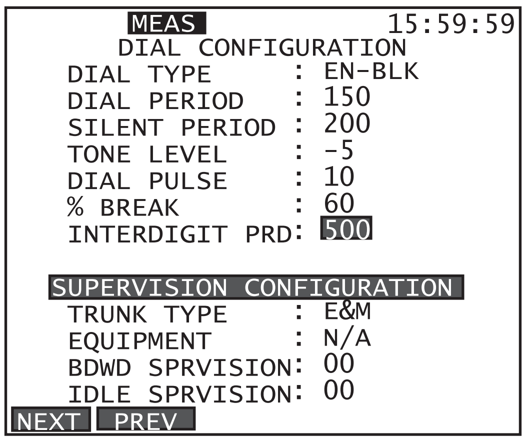


Figure 132 Dial/SPRV Setup Screen

From the VF CHANNEL menu, cursor down to the DIAL/ SPRVS SETUP item and press ENTER.

DIAL TYPE

Options: EN-BLK (F1), OVR-LP (F2)

Determine which type of dialing to use.

- Choose F1 to use en-block dialing, where all of the digits are sent in succession when the call is placed.
- Choose F2 to use overlap dialing, where the digits are sent as they are entered.

DIAL PERIOD

Options: 30 —999 ms

Set the dial period, in milliseconds.

- The dial period is used in DTMF and MF dialing.
- The factory default is 100 ms.

a) Press and release the SHIFT key so the 'SHFT' 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 key so that the 'SHIFT' indicator is no longer displayed in the screen. Then 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 mode.

SILENT PERIOD
Options: 30 ms to 999 ms
Specify the silent period in milliseconds used for MFR2, DTMF and MF dialing. The factory default value is 100 ms.

- Use the SHIFT and number keys to enter a value.

TONE LEVEL
Options: -25 to -5 dBm

Use the NEXT (F1) or PREV (F2) keys to set the tone level in dBm.

DIAL PULSE

- Dial Pulse is set to 10 pps. This item is for viewing only.

%BREAK
Options: 40%, 50%, 60%
Set the %Break.

- Use the NEXT (F1) and PREV (F2) keys to select the percentage.
- Applies to DP dialing only.

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

- Use the NEXT (F1) and PREV (F2) keys to select the interdigit period.
- Applies to DP dialing only.

SUPERVISION CONFIGURATION

TRUNK TYPE
OPTIONS: E&M (F1), G-START (F2), L-START (F3), USER (F4)

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

EQUIPMENT
Options: FXS (F1), FXO (F2)

- If you have selected G-Start or L-Start trunk type above, you must choose your equipment type.

BKWD SPRVISN

- Use the SHIFT and keypad numbers (1/0) to enter the four idle supervision bits.
- These bits are the backward ABCD bits sent on the opposite line from the one placing the call.

IDLE SPRVISN

- Use the SHIFT and keypad numbers (1/0) to enter the four idle supervision bits.
- These bits will be transmitted by the test set on the 23 idle timeslots.

3.10.4 Place/Receive Calls

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

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

MF Dialing is useful in inter-switch addressing applications. DTMF dialing 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. Refer to Figure 133.

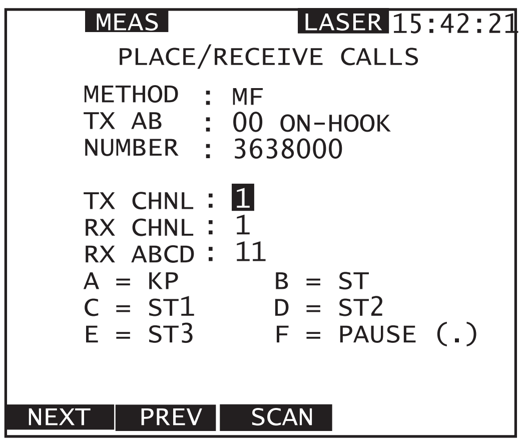


Figure 133 Place/Receive Calls

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

- MF, 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—9, as well as many other control codes. These control codes appear at the bottom of the screen when

MF is selected.

- DTMF, 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—9, #, *, and A-D.
- DP, Dial Pulse, is the oldest addressing technique. With pulse dialing, the phone goes on-hook 10 times per second in order to dial a given number. For example, to dial the number 7, the set starts in the off-hook condition, then goes on-hook/off-hook seven times. This type of addressing is now commonly used in switched 56 services.

TX AB(CD)

Options: ON-HOOK (F1), OFF-HOOK (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 send a 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.

NUMBER

Options: USER (F1), DTMF or MF (F2), DP (F3)

Enter the digits to be dialed.

Basic Dialing Procedure

This is the simplest dialing procedure:

1) Press and release the SHIFT key to display the 'SHFT' indicator at the top of the screen.

2) 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 key to get rid of the SHFT indicator in the display. Press the cursor key to cursor over to the digit that needs to be changed. Next, press DELETE (F2) key to delete a number, or enter the number over again using the process described in the previous paragraph. Note that if the DIAL TYPE is OVERLAP, numbers are dialed immediately, and cannot be edited. Start over instead.

3) 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 in one of these formats, press the appropriate F-key, then use the shift and numeric keys are usual. Your original choice will be 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.

4) 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.
- Press DELETE (F3) while the cursor is highlighting a pattern you want to eliminate, and it will be deleted.

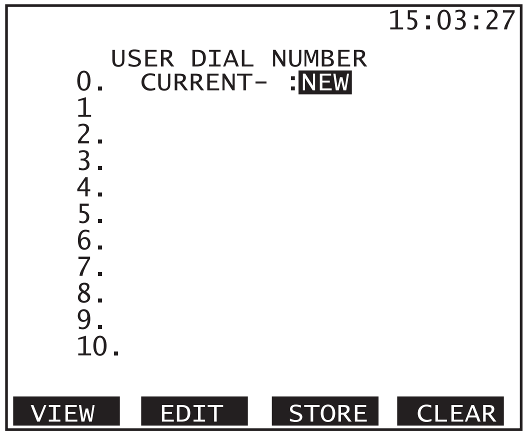


Figure 134 User Dial Number Screen

- 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 highlighted letter in the alphabet grid). Cursor down to the number, then edit the number. When it is correct, 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, cursor to the CURRENT - NEW line (number 0 in the list), or any blank line.
a) Press EDIT (F2) from the CURRENT line, or press CREATE (F1) from any other blank line.
b) Alternately, you may press STORE (F3) in the PLACE/RECEIVE CALLS screen.

2) Enter the LABEL first. See Figure 135. You may enter up to 10 digits for the LABEL.

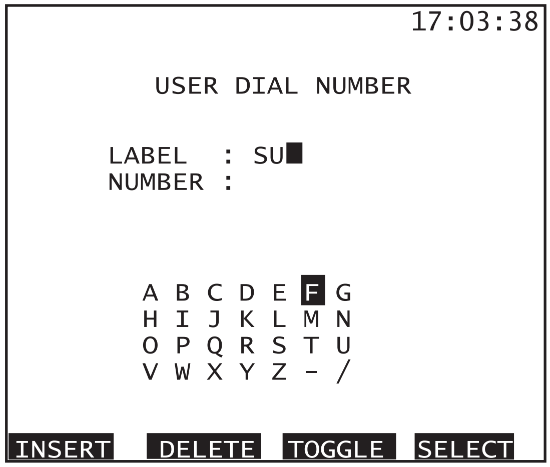


Figure 135 User Number Toggle Screen

a) With the cursor placed on the LABEL item, 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 (F4). Continue with this as necessary.
d) When you are finished with the alphabet grid, press TOGGLE (F3) to return to the LABEL entry.

3) Cursor down to the NUMBER line.
a) Press the SHIFT key to enter the letters A-F or numbers 0—9. Note that you may vary the type of digits used by pressing the DTMF, DP, and MF F-keys, as available. See the next figure for a sample screen.

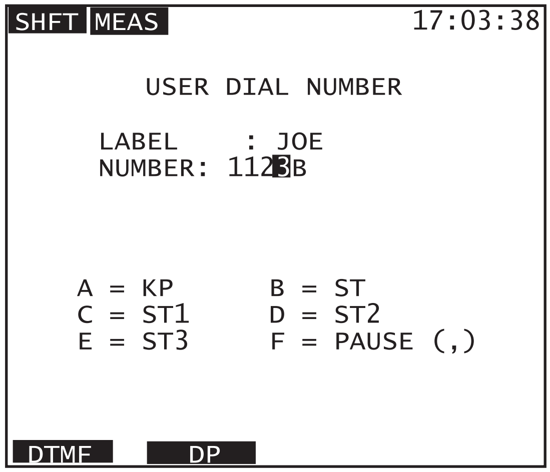


Figure 136 Enter the User Dial Number

b) Cursor backwards to delete any unwanted digits.
c) When you have finished, press the ENTER key. This stores your new number under the label you gave it, and returns you to the USER DIAL NUMBER menu.

Tx CHNL

Select the transmit channel.

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

a) Use the NEXT (F1) and PREV (F2) keys to select the transmit timeslot for the T1 line.

- The test set does not immediately begin inserting on a timeslot. The test set will not begin transmitting on a timeslot for about one second. This allows you to move through the timeslots without interrupting them.

- In SCAN (F3) mode, the SunSet OCx is in a receive only mode. The test set searches all timeslots for an on-hook to off-hook transition. When it finds this transmission, it locks on that timeslot and waits for the digits. The SunSet will notify you with the message ‘Incoming call on Channel 01 (as appropriate)’. You may then accept or reject this call.

If you are in SCAN mode, 1CHNL will appear as the F3 key. Press this key to select an individual channel.

Rx CHNL

Select the receive channel.

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

a) Use the NEXT (F1) and PREV (F2) keys to select the transmit timeslot for the T1 line.
b) Use the SCAN (F3) key to have the unit scan for the first channel to go active. See TxCHNL notes.

RxAB(CD)

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

3.10.5 Call Analysis

Use CALL ANALYSIS to decode and analyze MF, DTMF and DP tones. In the VF CHANNEL MENU, cursor down to the CALL ANALYSIS item and press ENTER. See Figure 137. You may press ENTER again at any time to start an analysis, or you may continue with the setup.

```
                                        07:20:34
                CALL ANALYSIS

          TEST MODE  : TX1/RX1
          DIAL TYPE  : DTMF
          AUTO SCAN  : NO
          TX SPRVS   : ON/OFF
          RX-1 CH    : 01
          RX-2 CH    : N/A
          TX-1       : 1
           press ENTER to start



ANALYZE  SCAN
```

Figure 137 Call Analysis

Configure the following items:

TEST MODE

Set the test mode.

DUAL Options: TX1/RX1 (F1), RX1/RX2 (F2)

- Select TX1/RX1 to send and receive on Line 1. Note that this may be TX2/RX1 if you are configured to transmit on Line 2 and receive on Line 1.
- Select RX1/RX2 to analyze calls on both lines.

DIAL TYPE

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

Designate the type of dialing the unit will scan for. Selecting the incorrect DIAL TYPE will result in incorrect Digit Analysis.

AUTO SCAN

Options: YES (F1), NO (F2)

- Enable AUTO SCAN by choosing YES (F1). When in scan mode, the SunSet OCx will rapidly scan all 24 receive channels for any-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.
- Select NO (F2), and you must enter the transmit and receive timeslots below. In this mode, the SunSet OCx will analyze only on the selected receive channel.

TxSPRVS

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 state. The test set will display the received supervision and channel number.

RX-1 CH, RX-2 CH

Select the receive channel(s).

- Use the NEXT (F1) and PREV (F2) keys to make the selection.
- These items are reported as N/A in a DS1 Single mode.
- In a DS1 DUAL mode, select the channel to receive on for each line.
- RX-2 is N/A when the test mode is TX1/RX1

TX-1

Select the line 1 transmit channel.

- Use the NEXT (F1) and PREV (F2) keys to make the selection.

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.

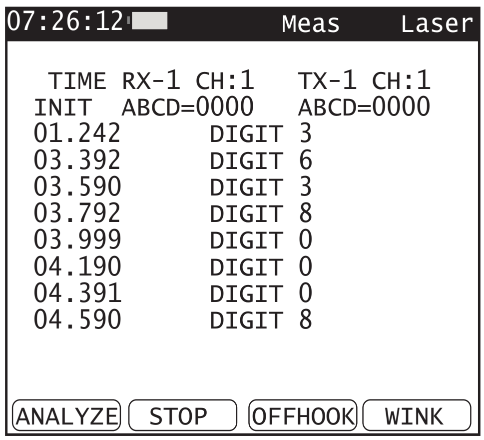


Figure 138 Digit Capture

F-keys

- Press ANALYZE (F1) your results. See below.
- Press STOP (F2) to halt the digit capture process. RESTART (F2) begins the process anew.
- Press OFFHOOK (F3) to transmit an offhook.
- Press WINK/FLASH (F4) to transmit a wink or flash (invert the bits).

Digit Analysis

Press F1 to ANALYZE 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 139 for a sample screen.

```
                         07:20:34
       DTMF ANALYSIS
DIGIT-1 : 4     INTD:---ms
H/L Hz 1209/0767  PERD:101ms
    dBm-6.4/-4/6  TWST:+1.8

DIGIT-2 : 0       INTD:99ms
H/L Hz 1336/0944  PERD:101ms
    dBm-6.4/-4.5  TWST:+1.9

DIGIT-3 : 8       INTD:99ms
H/L Hz 1336/0852  PERD:0101ms
    dBm-6.4/-4.6  TWST: +1.8


PAGE-UP  PAGE-DN
```

Figure 139 Call Analysis/Digit Analysis (DTMF)

• Use the PAGE-UP (F1) and PAGE-DN (F2) keys to view the results.

The following information will be 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.

To begin a new Decode and Analysis session, escape and then reenter the CALL ANALYSIS menu item. Use PRINT to print the test results if desired.

Press ESCAPE to return to the VF CHANNEL MENU.

3.10.6 Noise Measurement

Refer to Figure 140 and use this procedure:

1) In the VF/DS0 FUNCTIONS menu, cursor down to the NOISE MEASUREMENT menu item and press ENTER.

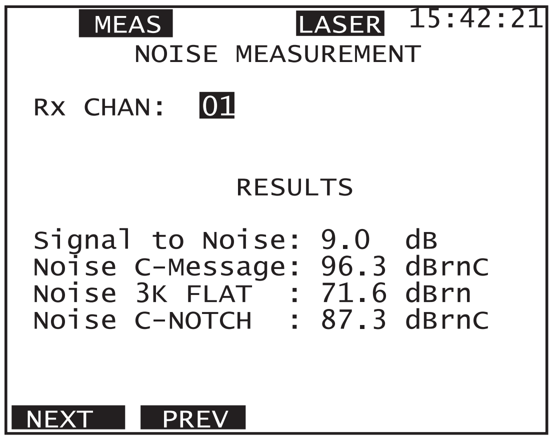


Figure 140 Noise Measurement

2) RX CHNL
Select the channel you wish to perform measurements on.

- Use the NEXT (F1) and PREV (F2) keys to change the channel.

3) Observe the noise measurement RESULTS. Results are taken from the line designated as Rx/DROP in the VF MEASUREMENTS screen.

Signal to Noise
C-Message
3kHz flat (3-K FLAT)
C-Notch

4) After your desired measurement results are complete, press ESCAPE to return to the VF/DS0 FUNCTIONS menu.

3.11 Other Features

Refer to the following figure for the Other Features menu, which appears in black and white units. This menu is not available in the color units, though the functions are; use the section icon to know where to find each function.

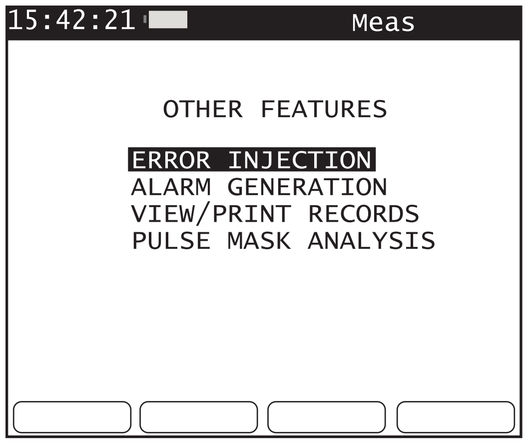
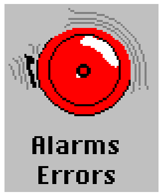


Figure 141 Other Features Menu



3.11.1 Error Injection

You can select a particular payload to inject errors on. Some configurations do not have a separate payload to configure, as shown in Figure 142. See Figure 143 for a multirate setup.

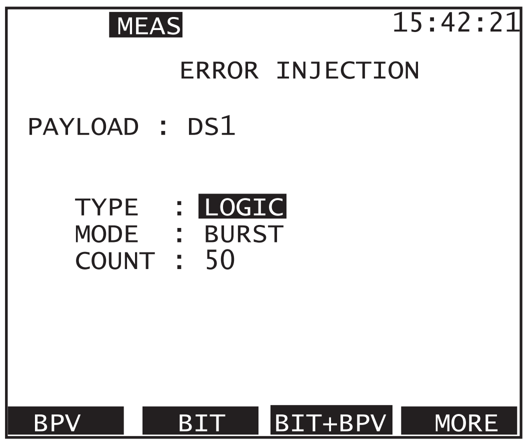


Figure 142 Error Injection, Single Rate (DS1)

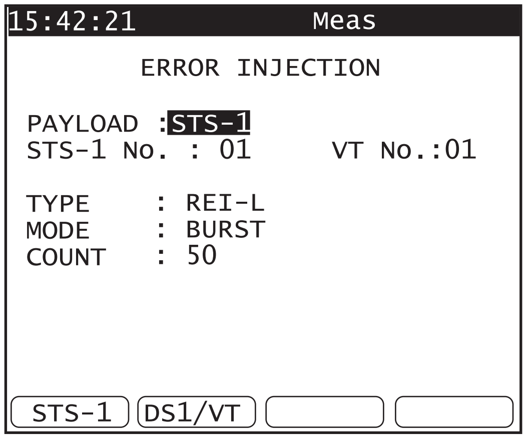


Figure 143 Optical Error Injection—Multirate

PAYLOAD

Options: Depends on the test interface. For example, in Figure 143, STS-1 (F1) and DS1/VT (F2) are both available. VT number 1 within the first STS-1 has been selected.

TYPE

Select the type of errors you wish to insert.

Options: See the table for errors available for each TEST CONFIGURATION.

Payload	Errors Available	Burst/Rate
SONET or STS-1	Bit	B, R
	REI-L	B, R
	REI-P	B, R
	B1, B2, B3	B, R
STS-1	BPV	B, R
	REI-L	B, R
	REI-P	B, R
	B1, B2, B3	B, R
DS3	Bit	B, R
	BPV	B, R
	Frame	B
	P-Bit	B (1)
	C-Bit	B (1)
	FEBE	B (1)
DS1/ VT1.5	Bit	B, R
	Frame	B
	BPV	B, R
	CRC	B, R
	REI-V	B
	BIP-2	B

OC-3 Platform:N/A
OC-12 Platform: B only
OC-48 Platform: B, R

Figure 144 Error Injection Options

- Select BPV for Bipolar Violations.
- Select BIT for bit errors.
- Select BIT+BPV to generate bit errors and bipolar violations simultaneously.
- Select FRAME to generate a framing bit error.
- Select CRC to generate a CRC-6 error.
- Select P-Bit to send a P-bit parity error.
- Select C-bit to send a C-bit error.
- Select FEBE to send a Far End Block Error.
- Select REI to send Remote Error Indication on the Virtual Tributary, Line or Path, as appropriate
- Select B1, B2, B3 or BIP-2 to send that parity error.

Additional Information

- Not all errors are available for all rates or all configurations.
- Items in italics are only available under some configurations for the indicated payload.
- BPV errors are available for only electrical line rates (e.g. DS1, DS3, STS-1) only.
- To select BIT errors, set the PAYLOAD field to match the Test Configuration and Payload settings. For STS-1 and concat-

enated payloads, set the PAYLOAD to SONET.

MODE

Select the error injection method.

Options: RATE (F1), BURST (F2)

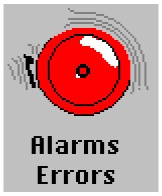
- BURST mode allows a set number of errors to be injected with each press of the ERR INJ key.
  1) Cursor down to COUNT.
  2) Press the SHIFT key and observe the 'SHFT' indicator in the upper left-hand corner of the screen.
  3) Using the keypad, enter the number of errors you wish to inject each time the ERR INJ key is pressed. The SunSet will accept values between 1 and 999.
  4) Note that many errors are set at a Burst Count of 1 (examples include FRAME for DS1 and FEBE for DS3).

- RATE mode allows errors to be injected continuously at a specified rate.
  1) Select RATE at the MODE item. The cursor automatically moves down to the next item, RATE.
  2) Press the SHIFT key and observe the 'SHFT' indicator in the upper left-hand corner of the screen.
  3) Enter the constant rate at which you wish to inject errors when the ERR INJ key is pressed. The SunSet will accept values between 1e-3 and 9e-9.
  4) Note that RATE is not available to all errors.

When the settings are complete, press ENTER.

Error injection is usually performed to verify presence of a loopback. 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.

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. A 'INJ' indicator will appear on the top line of the screen if you are injecting errors at a particular rate. When you press the ERR INJ key again to stop injecting errors, the 'INJ' indicator will vanish.



3.11.2 Alarm Generation

This function gives the user an option to choose from AIS, YELLOW, or IDLE alarms for low rate signals, and between other alarms for higher rate signals. When any of these are selected, an 'ALM' indication is displayed on the top of the screen. See the next figure:

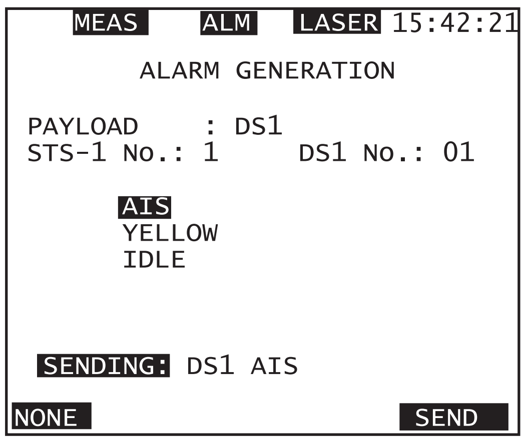


Figure 145 Alarm Generation

PAYLOAD

Options: SONET, STS-1, DS3/DS2, DS1, VT1.5

Select the test rate. Note that payloads available depend on your TEST CONFIGURATION. In some configurations, the payload is set at a particular rate.

STS-1, DS1 or VT No.

Options: STS-1: 1—12

DS1, VT1.5: 1—28

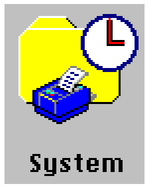
Select which STS-1, DS1 or VT1.5 to send the alarms on.

Alarms

Options: NONE (F1) SEND (F4) and as indicated:
DS3/DS2/DS1: AIS, YELLOW, IDLE
DS1/VT1.5: AIS, YELLOW, IDLE, VT AIS, VT RFI, VT RDI-VSD, VT-RDI-VCD, VT RDI-VPD
SONET: LOF, LINE AIS, LINE RDI, PATH AIS, PATH RDI, PATH LOP

Select the desired alarm, if any. Note that the alarms available will vary, depending on the test rate.

- Alarms apply to the indicated rate.
- The default setting is NONE. Press F1 to select NONE.
- To send an alarm, highlight your choice, then press SEND. The set will transmit the alarm as soon as you press SEND. You can transmit alarms while making measurements, viewing data, performing talk/listen and so on. Make sure to disable all alarms (by pressing NONE) when you are through.



3.11.3 View/Print Records

The OTHER FEATURES menu or System icon contains the VIEW/PRINT RECORDS feature. TEST and EVENT RECORDS are also available in the Measurement Results screens, via the RECORD (MORE/F3) key. An ATA storage card (SA720 or SA721) is required in order to use this feature. You will see the following screen after entering:

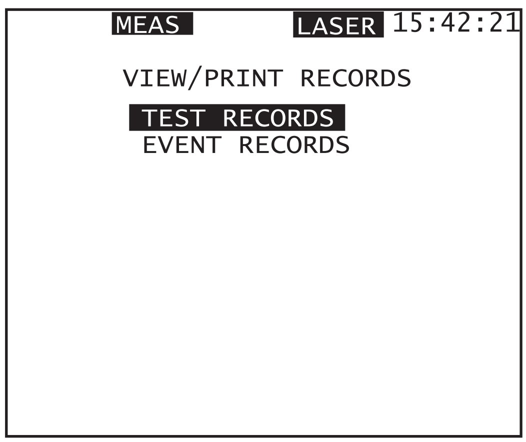


Figure 146 View/Print Records

Saving Records

Test records are saved according to the new SAVE RESULTS configuration in the SYSTEM CONFIGURATION screen (see *Section 3.12.1*). When a TIMED entry is made, results are saved after the entered time. When LAST is chosen, results are saved each time you press STOP in the Measurement Results screens.

Event records are saved by entering the EVENT STATUS screen and pressing SAVE (more, F2).

Viewing Records

Press VIEW (F3) in the TEST or EVENT RECORDS screen to see the record. Figure 147 shows a sample TEST RECORDS screen.

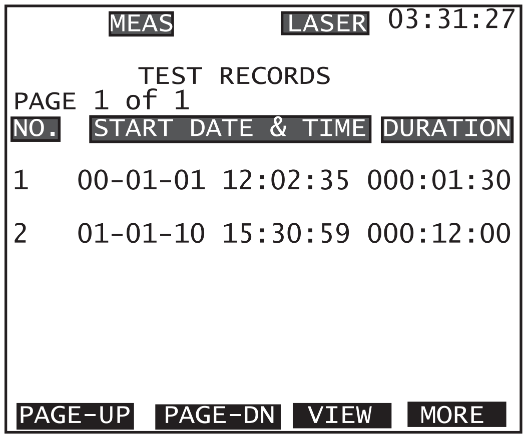


Figure 147 Test Records Screen

F-keys

In addition to the VIEW (F3) key, the following F-keys are available in both the TEST and EVENT RECORDS screens.

- Use the PAGE-UP (F1), PAGE-DN (F2) keys to scroll through the available screens of records or events.
- Press PRINT (MORE, F1) to send the highlighted record to the serial port for printing.
- Press DELETE (MORE, F2) to delete the highlighted record.
- Press DEL ALL (MORE, F3) to delete all of the records.

Records are saved both as a binary file and a text file using an automated file naming system. The binary file is used by the test set for viewing and printing records. The text files allow you easy portability to a PC.

Move the cursor until the record you want to see is highlighted. Press VIEW (F3) to enter the saved measurement results (see *Section 3.6 Measurement Results* for definitions and sample screens).

3.11.4 Pulse Mask Analysis (N/A SSOCx OC-48)

- Requires Pulse Mask software option SWOCx-E.
- Measure and view the quality of a DS1 or DS3 pulse.
- You must be connected to the physical DS1 or DS3 line to do a Pulse Mask Analysis.
- Pulse Mask Analysis is not available on the OC-48 unit.
- Pulse Mask Analysis is recommenced for out-of-service testing.
- The vertical scale is normalized to the peak voltage of the pulse.
- The power level will be about 1 dB lower than the PWR field in the Signal Measurement screen.
- See the following figures for samples of a DS1 and a DS3 pulse.

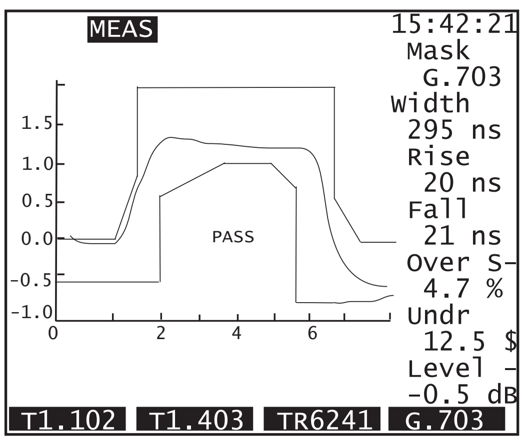


Figure 148 DS1 Pulse Mask

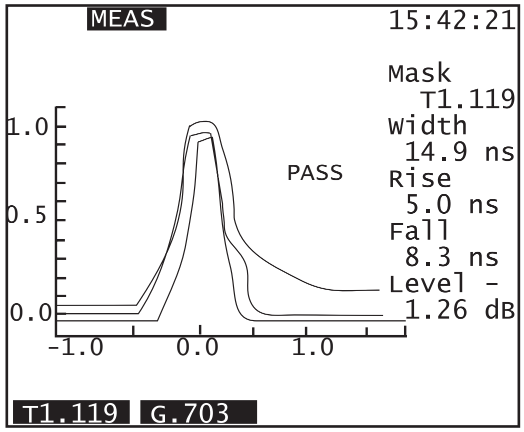


Figure 149 DS3 Pulse Mask

Use this procedure:

1) Configure the unit for DS1 or DS3 point-to-point testing.

2) Connect to the line.

3) From the MAIN MENU, enter OTHER FEATURES.

4) Enter PULSE MASK ANALYSIS.
a) You will see a ‘Preparing Data’ message.
b) After several seconds, the pulse shape will be displayed.

Screen Definitions:

- The center line is the actual captured pulse.
- The inner and outer lines are the specified pulse mask upper and lower limits.
- As long as the captured pulse falls within the inner and outer lines, it passes for quality. PASS or FAIL is shown on the screen.

Width: Pulse Width, in ns
Rise Time: Rise Time, in ns
Fall: Fall Time, in ns
Ovr Shoot: Over Shoot, percentage
Und Shoot: Undershoot, percentage
Level: Signal level, in dB

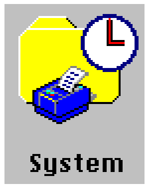
As long as the captured pulse falls within the inner and outer lines, it passes for quality. The standard used for the DS1 pulse is ANSI T1.403. The ANSI T1.404 standard is applied to the DS3 pulse.

To apply a different mask to the pulse, press the F-key corresponding to the mask specification you want to apply. Here are the choices:

DS3: T1.119 (F1), G.703 (F2)

DS1: T1.102 (F1), T1.403 (F2), TR6241 (F3), G.703 (F4)

Note: The PROTOCOL FUNCTIONS (ISDN, GR-303, SS7, and Frame Relay) and ATM FUNCTIONS each have their own manual.



3.12. System Configuration

The SYSTEM CONFIGURATION menu can be accessed from the MAIN MENU in black and white units, or via the System icon in color units. See the next figure.

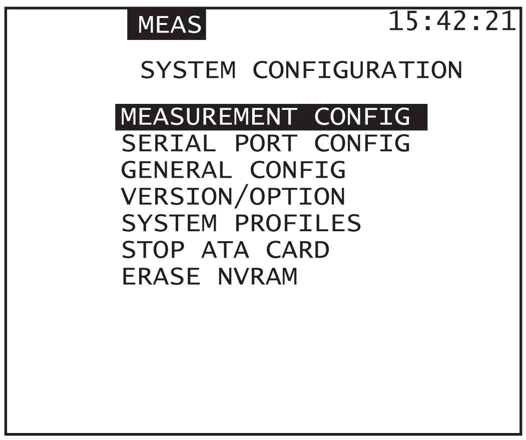


Figure 150 System Configuration Menu

3.12.1 Measurement Configuration

The SunSet allows the user to customize various measurement parameters. If you need to change the test parameter settings, refer to Figure 151 and use the following procedure:

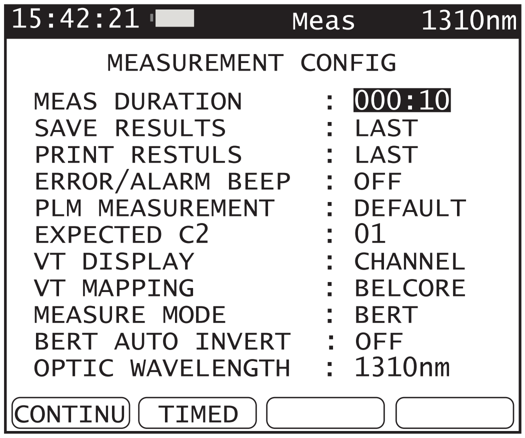


Figure 151 Measurement Timing

MEAS DURATION

Options: CONTINU (F1), TIMED (F2)

Set the measurement duration.

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

SAVE RESULTS
Options: TIMED (F1), LAST (F2), EVENT (F3)

- An ATA storage card (SA720) is required in order to use this feature.
- Select TIMED to have the test results saved every 1 to 99 minutes. Press the SHIFT key, then enter the number of minutes (between 1 and 99 minutes).
- In LAST mode, the test results are saved only at the end of a timed test, or a continuous test that has ended due to a RESTART.
- Do not use EVENT (F3).
- Press SAVE in the EVENT/STATUS screen (accessed via the STATUS key) to save events (see Section 2.1.1 of this manual). An event is defined as the occurrence of one or more errors or the start or end of an alarm condition.

PRINT RESULTS
Options: TIMED (F1), LAST (F2), EVENT (F3)

- Select TIMED to have the test results printed every 1 to 99 minutes. Press the SHIFT key, then enter the number of minutes (between 1 and 99 minutes).
- In LAST mode, the test results are printed only at the end of a timed test, or a continuous test that has ended due to a RESTART.
- Select EVENT to have the unit print results every time an event occurs. An event is defined as the occurrence of one or more errors.

ERROR/ALARM BEEP
Options: ON (F1), OFF (F2)

- Select ON and the SSOCx will sound a beep when it is receiving alarms or errors. Note that the number of audible beeps is not equal to the number of received errors.
- Select OFF and the SunSet OCx will not beep when receiving errors or alarms.

PLM MEASUREMENT
Options: DEFAULT (F1), CUSTOM (F2), DISABLE (F3)

- Path Payload Mismatch is declared when the received C2 setting does not match the configuration set in the next line.
- Select DEFAULT to have the test set base the expected C2 value on the test configuration.
- Select CUSTOM to enter the bits yourself. The cursor will move automatically to the next line, EXPECTED C2.
- Select DISABLE to have the test set ignore the C2 bits. PLM will be N/A in the measurement screens.

EXPECTED C2
Enter the C2 bits.

- Use the SHIFT and number keys to enter the bits, if you have selected CUSTOM above.

VT DISPLAY
Determine how the virtual tributaries will be counted and displayed.
Options: CHANNEL (F1), GROUP (F2)

- Select CHANNEL to display VTs as individual channel numbers, 1—28.
- Select GROUP to display them in the group/VT number format. See the next figure. The first digit is the VT Group number, the second is the VT number.

Standard

1-1	1	1-2	8	1-3	15	1-4	22
2-1	2	2-2	9	2-3	16	2-4	23
3-1	3	3-2	10	3-3	17	3-4	24
4-1	4	4-2	11	4-3	18	4-4	25
5-1	5	5-2	12	5-3	19	5-4	26
6-1	6	6-2	13	6-3	20	6-4	27
7-1	7	7-2	14	7-3	21	7-4	28

Sequential

1-1	1	1-2	2	1-3	3	1-4	4
2-1	5	2-2	6	2-3	7	2-4	8
3-1	9	3-2	10	3-3	11	3-4	12
4-1	13	4-2	14	4-3	15	4-4	16
5-1	17	5-2	18	5-3	19	5-4	20
6-1	21	6-2	22	6-3	23	6-4	24
7-1	25	7-2	26	7-3	27	7-4	28

Figure 152 VT Group Numbering Table

VT MAPPING

Determine the VT mapping system to use.

Options: BELCORE (F1), M13ANSI (F2)

- Bellcore refers to the Standard mapping above.
- M13ANSI refers to the Sequential mapping above.

MEASURE MODE

Determine the VT mapping system to use.

Options: BERT (F1), LIVE (F2)

- Select BERT to search for the test pattern, and take bit error measurements with all other measurements.
- Choose LIVE to ignore the test pattern and take all measurements, except for the bit error measurement.
- Most people leave the unit set in BERT mode, even when monitoring live, in-service circuits. in this case, they expect the PAT SYNC LED to remain red, as there is no pattern synchronization. The bit error measurement will show 100% UAS.
- If the LIVE mode is selected, the PAT SYNC LED is turned OFF, and the bit error measurement screen is not displayed in Results.

BERT AUTO INVERT

Determine if the test pattern will be automatically resynchronize if a pattern inverts.

Options: OFF (F1), ON (F2)

- When Auto Invert is on, the SSOCx will automatically resync if a pattern inverts. There will be a few pattern loss seconds, then the unit will get pattern sync on the new, inverted pattern. This is useful mainly for alternating 01 patterns.
- By turning BERT AUTO INVERT off, the SSOCx will completely lose pattern sync until the original pattern reappears. Example: Suppose you are sending 2e20-inverted to an OCx and have pattern sync. If you change the pattern to 2e20-normal, the SSOCx will lose pattern sync until you return to 2e20-inverted.
- The default is OFF.

OPTIC WAVELENGTH

Options: 1310nm (F1), 1510nm (F2)

On dual wavelength units, choose the optical wavelength.

- When a wavelength is selected, the banner in the upper-right corner of the screen will indicate ‘1310 nm’ or ‘1550 nm’, as appropriate.
- This setting has the same effect as changing the wavelength in the SETUP SONET PORT screen (OC-48 units).

3.12.2 Serial Port Configuration

This menu lets you determine the serial port settings for printing and remote control. The factory default settings work with the printer supplied by the factory. However, you can alter these settings if you want to use the SunSet OCx with another printer. Figure 153 shows the pin-to-pin assignments of the DIN to EIA 232-C cable supplied by Sunrise Telecom Incorporated.

You are free to use this information to attempt to set the SunSet OCx up with another printer. However, Sunrise Telecom Incorporated does not warrant the operation of the test set with any printer other than the one supplied by Sunrise Telecom.

------ PIN-TO-PIN CONNECTIONS -----

DIN 8-PIN PIN#	DESCRIPTION	EIA-232-C D-SUB PIN#	DESCRIPTION
2	DSR	6	DSR
3	TX	3	TXD
4	RX	2	RXD
5	GND	5	GND
6	CTS	8	CTS
7	GND	7	GND
8	DTR	4	DTR

Figure 153 Printer Cable SS115B Pin Assignments

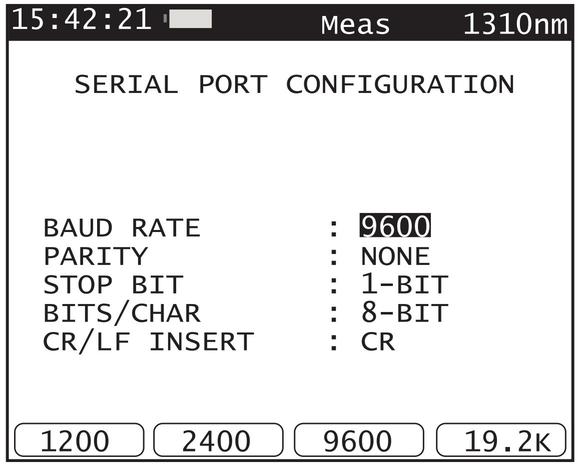


Figure 154 Serial Port Configuration

BAUD RATE

Options: 1200 (F1), 2400 (F2), 9600 (F3), 19.2K (F4)

The Baud rate determines the number of shortest signalling elements per second on a transmission medium.

- The default setting is 9600; 9600 or 19.2k are recommended for remote control operations.
- 1200 and 2400 will not support remote control features.

PARITY

Options: NONE (F1), ODD (F2), EVEN (F3)

An extra bit, known as a parity bit, is added to the data as an accuracy check.

- In ODD parity, the total number of ones (including the added parity bit) is odd.
- In EVEN parity, the total number of ones (including the added parity bit) is even.
- The receiving element checks the parity bit, and indicates an error if the total number of ones does not add up to the correct total.
- NONE, the factory default setting, signifies no parity checking.

STOP BIT

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

In asynchronous transmission, the stop bit is the last transmitted character which permits the receiver to come into an idle condition before accepting another character.

- Select 1-BIT or 2-BIT.
- The factory default setting is 1-BIT.

BITS/CHAR

Options: 7-BIT (F1), 8-BIT (F2)

BITS/CHAR determines the number of bits per character.

- Press (F1) to select 7 bits per character.
- Press (F2) to select 8 bits per character.

CR/LF INSRT

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

- Press CR (F1) to select carriage return.
- Press CR+LF (F2) for carriage return and line feed.
- In carriage return and line feed, an extra line space is inserted after every line.

3.12.3 General Configuration

- Set the time, date, and backlight duration.
- Press ENTER after configuring each item in order to save the setting.

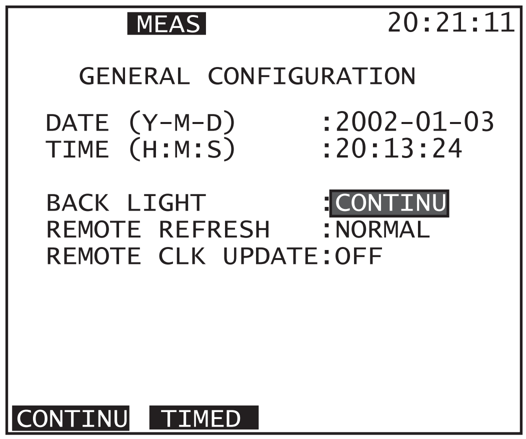


Figure 155 General Configuration Screen

DATE

Set the current date in the year-month-day format.

a) Press SHIFT to display the SHFT 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 to remove the SHFT indicator from the display.

TIME

Set the current time of day in the hour–minute–second format.

a) Press SHIFT to display the ‘SHFT’ 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 to remove the ‘SHFT’ indicator from the display.

BACK LIGHT

Set up the backlight timer.

- This timer controls how long the backlight will stay lit when you press the ✱ key.
- Choose CONTINU (F1) if you want the backlight to stay on continuously until you press the ✱ key again.
- Choose TIMED (F2) if you want the backlight to automatically turn itself off after the indicated number of minutes.
  a) After you choose TIMED, press the SHIFT 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 'SHFT' indicator from the display.

REMOTE REFRESH

Options: NORMAL (F1), TOGGLE (F2)

Determine how often the VT100 display will refresh while using the Remote Control feature.

- Normal: refreshes the VT100 display once per second
- Toggle: hitting the 'x'/ refresh key on your VT100 toggles between refreshing normally (once per second) and not refreshing the screen at all.

REMOTE CLK UPDATE

Options: ON (F1), OFF (F2)

Determine if the Clock Display on the VT100 terminal will refresh during Remote Control operations.

- On: The clock display will refresh once a second.
- Off: The clock display will not refresh.

3.12.4 Version/Option

This screen displays the software version, type, software and unit serial numbers, and options installed in your OCx. PAGE-UP (F1) and PAGE-DN (F2) as necessary. Figure 156 depicts a sample Version/Option screen.

The two serial numbers should match. If they do not, a 'Security Violation' warning message will appear. Contact Sunrise Telecom for information.

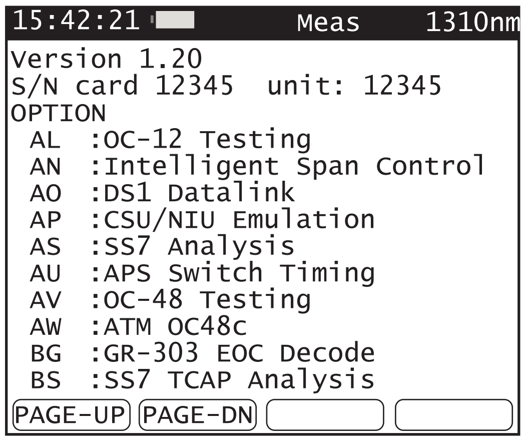


Figure 156 Version/Option Screen

Note that the second letter of the option label corresponds to the software option. For example, "AN: Intelligent Span Control" corresponds to SWOCx-N, Intelligent Span Control.

- Option AV comes standard with the SSOCx-E.
- Option AL comes standard with the SSOCx-E and SSOCx-D.
- Option AB comes standard with SSOCx-E/D/C.
- Option AA comes standard with SSOCx-E/D/C/B.

PAGE-DN (F2) to the Hardware Info screen (Figure 160), which shows the revision of each hardware circuit board:

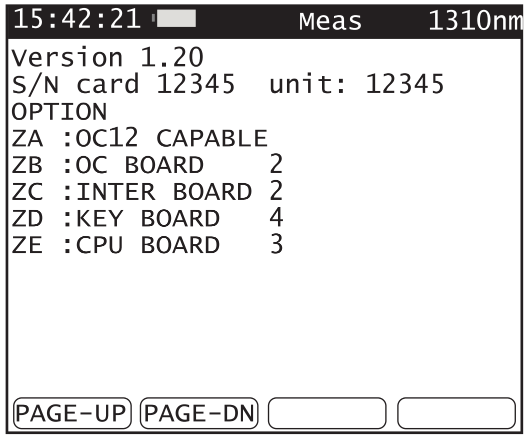


Figure 157   Hardware Info Screen

3.12.5 Erase NVRAM

- Erase NV (Non Volatile) RAM erases all the user-storable information entered into the test set.
- This operation should always be performed when inserting a new software cartridge.
- Erase NVRAM has no effect on the storage card.

This operation can also be tried as a last resort if the set is not performing properly. If this is the case, you should initiate ERASE NV RAM, only after attempting to correct the problem by:
1) Making sure that the test set is properly configured for the application being attempted.
2) Turning the power switch off and on.
3) Performing a self test and turning the power off and on again.

WARNING: Performing the ERASE NVRAM operation will erase all the user-storable information the user has entered into the test set. All user transmit patterns, telephone numbers, and settings will be erased.

Use the following procedure to perform ERASE NVRAM :
1) From the MAIN MENU or the System icon, enter the SYSTEM CONFIGURATION menu, then enter the ERASE NV RAM menu item.
2) Press ENTER again after the warning message is displayed. A 'Restarting the System' message will be displayed.
3) Reconfigure the set for the operations you need to perform. TEST CONFIGURATION, TEST PATTERNS, and all other areas of the set will be restored to the factory defaults.

3.12.6 Stop ATA Card

Perform the STOP ATA CARD function before removing the storage card for use in your PC. It ensures you will not lose any data. Before reinserting the card, turn the unit power off. See C*hapter 2, Section 2.3*, for details on this function.

3.12.7 System Profiles

You may save up to 10 System Profiles in the test set. These profiles can save you time in configuring the test set for your applications. The test set can store the current configuration as a system profile. You provide a name for the profile so that it may be conveniently recalled at a later time.

Items that are stored in the profile are: TEST CONFIGURATION, TEST PATTERN, GENERAL CONFIG (except for date and time), and SEND OVERHEAD BYTES. See Figure 158.

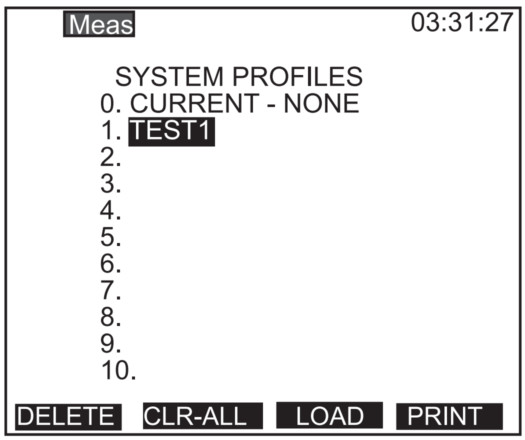


Figure 158 System Profiles List

Enter a New System Profile

1) Cursor down to a blank line.

2) Press the STORE (F1) key. You will enter the LABEL screen, as in Figure 159.

3) Type in the label you wish to give the profile. Do this by pressing TOGGLE (F3) to toggle to the alphabet grid with the highlighted A.

a) Cursor to the desired letter and press SELECT (F4).
b) Repeat this as necessary until the desired label is spelled.
c) Press TOGGLE (F3) to leave the alphabet grid.

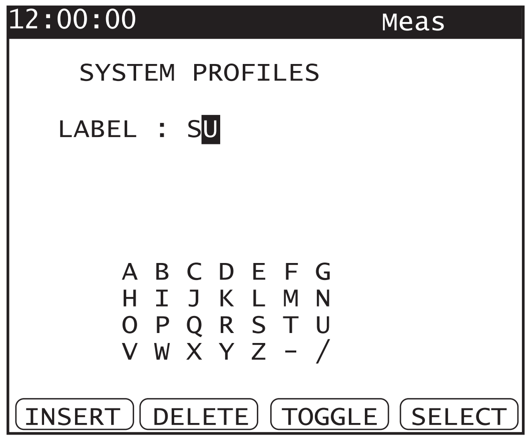


Figure 159   System Profiles Label

5) Press ENTER to store the SYSTEM PROFILE.

Invoke a Stored System Profile

1) Enter the SYSTEM PROFILES menu.

2) Cursor down to the desired system profile.

3) Press the LOAD (F3) key.

Activate the Default Profile

This is a way to return all the OCx's settings to the factory defaults.

1) Enter the SYSTEM PROFILES menu.

2) Select the DEFAULT (F3) key. The test set configuration will be set to the factory default.

Delete a Profile

1) Enter the SYSTEM PROFILES menu.

2) Cursor down to the desired profile.

3) Press the DELETE (F1) key.

- Press the CLEAR-ALL (F2) key to delete all of the stored system profiles.

Modify an Existing Profile

Note: The SYSTEM PROFILES menu does not operate like the user pattern menus. You may not edit an existing system profile in the SYSTEM PROFILES menu. If you wish to modify an existing profile, you must change the settings in the original menus and then restore the profile. Refer to the following modification procedure:

1) Enter the SYSTEM PROFILES menu.

2) Cursor down to the desired system profile

3) Press the LOAD (F3) key to invoke this profile. This will also exit you from the screen.

4) Move to the other menus within the test set where you will change the setup items.

5) Enter the SYSTEM PROFILES menu.

6) Press the STORE (F2) key.

7) Give the profile a new name. If you want, you can give this modified profile the same name as the original, but pay close attention to which file number it is stored under so that you will be able to tell which profile is old, which is new.

8) Press ENTER to return to the SYSTEM PROFILES menu.

9) Cursor down to the old version of the profile which you no longer need.

10) Press the DELETE (F1) key.

Additional F-keys

- Press PRINT (more, F1) to send the highlighted profile to the serial port for printing.
- Press EXPORT (more, F2) to save the profile (in a file called ‘profiles.dat’) to the storage card, where you may copy it to your PC and then to another unit.
- Press IMPORT (more, F3) to import a saved profiles.dat file into your unit from the storage card.

Chapter 4 Applications

4.1 Accept a New Circuit

Here is a procedure for accepting a new DS1 circuit, at any rate. The setup is illustrated in Figure 160.

1) Verify that the span is not in service. This acceptance test will disrupt service. Ensure that there is a loopback device at the far end of the span.

2) From the MAIN MENU or Setup icon, enter the TEST CONFIGURATION menu; press ENTER.

a) Configure the first screen as follows:

TEST MODE: PT-PT
INTERFACE: DS1 (or select other specific rate)
PAYLOAD: DS1 (or select other specific rate)

b) Press ENTER.
c) Configure the second screen as follows:

DS1
MEASURE: SINGLE

DS1
FRAME: as specified
RATE: 1.544M
CODE: B8ZS (or as specified)
TxSRC: PATTERN
TxCLK: INTERN

SIGNAL LEVEL
LBOLVL: 0 dB
RxLVL: TERM

Note: If using another rate, configure it as per the circuit design.

d) Press ENTER.

3) Connect the SunSet to the circuit as shown in Figure 160.

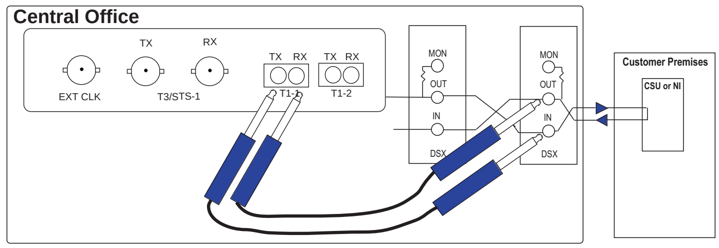


Figure 160 Accept a New Circuit

a) Press the HISTORY key to acknowledge any blinking history lights and turn them off.
b) Verify that the PULSES, FRAME and PAT SYNC LEDs are lit green.
c) Verify that there are no alarms or errors (no red ALARM or ERROR LEDs).

4) From the MAIN MENU move to the MEASUREMENT RESULTS menu item, via the Results icon if you have a color unit.
a) Press the ENTER key.
b) Verify that the span performs to your company's requirements for the service delivered. If necessary, refer to Measurement Definitions (*Ch. 3, Section 3.6*) for an explanation of the MEASUREMENT RESULTS parameters.
b) Use the PAGE-UP (F1) and PAGE-DN (F2) to access each of the individual measurement screens.

5) When your results have been completed, press the ESCAPE key to return to the MAIN MENU.

6) Remove the loop at the far end of the circuit.

4.2 Monitor an In-Service Circuit

Here is a procedure for monitoring a span that is in-service. The setup is illustrated in Figures 161 and 162.

1) This test may be performed while the span is carrying live customer traffic.

2) Press the ESCAPE key until you arrive at the MAIN MENU or Setup icon. Move your cursor to the TEST CONFIGURATION menu item and press ENTER. Use the following configuration:

   TEST MODE: PT-PT
   INTERFACE: DS1 (or select other specific rate)
   PAYLOAD: DS1 (or select other specific rate)

a) Press ENTER.
b) Configure the second screen as follows:

   DS1
   MEASURE: SINGLE

   DS1
   FRAME: as specified
   RATE: 1.544M
   CODE: B8ZS (or as specified)
   TxSRC: PATTERN
   TxCLK: INTERN

   SIGNAL LEVEL
   LBOLVL: 0 dB
   RxLVL: MONITOR or BRIDGE

   Notes
   1) If you are not sure what Rx LEVEL to use, then use BRIDGE. This will protect the circuit from disruption. MONITOR may cause a disruption if the test set is not plugged in to a protected MONITOR point.

   2) If using another rate, configure it as per the circuit design.

c) Press the ENTER key when all of the settings are correct.

3) Connect the SunSet OCx to the circuit. See Figure 161 for a sample DS1 connection. Figure 162 shows the general setup for a monitoring at any rate.
- Press the HISTORY key to acknowledge any blinking history lights and turn them off.

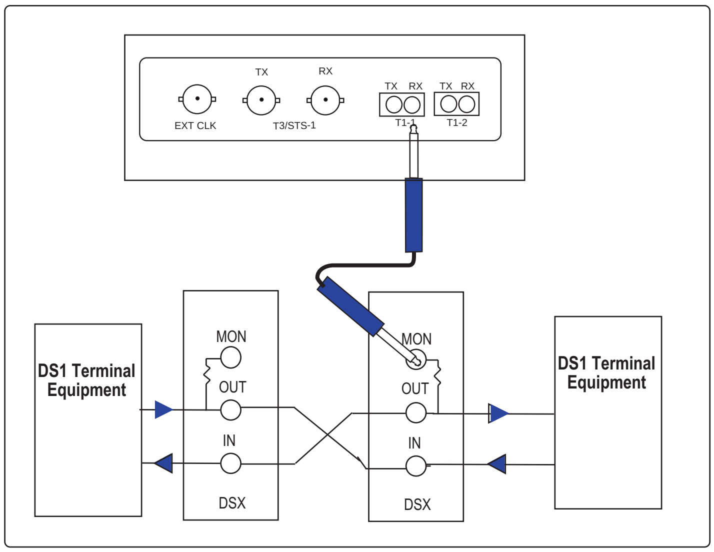


Figure 161 Monitoring an In-Service DS1 Circuit

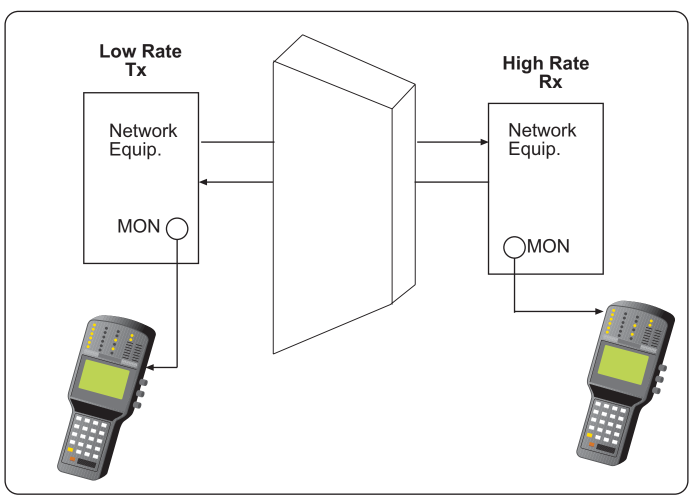


Figure 162 General Monitoring Setup

4) Examine the LEDs for information about the circuit under test.

- The PULSES and FRAME LEDs should be lit green.
- A steady red ERRORS or ALARM light will tell you that the circuit is working but is experiencing trouble.
- A red PULSES LED is an indication of no signal.
- An ALARM indication will show a problem on the other side of the circuit.

5) To make a basic measurement:
a) From the MAIN MENU move to the MEASUREMENT RESULTS menu item, via the Results icon if you have a color unit.
b) Press the ENTER key.
c) Verify that the span performs to your company's requirements for the service delivered.

The Measurement Results screen also shows you what kind of pattern, if any, is being received by the test set.

4.2.1 Viewing the SONET Overhead Bytes

The following application procedure may be used to view the overhead bytes embedded within the STS-1 signal. You may look at the overhead bytes of any STS/OC signal.

1) Enter the TEST CONFIGURATION.
a) Select STS-1 as the INTERFACE.
b) Select the appropriate PAYLOAD.
c) Configure the unit settings as desired:

TEST MODE: PT—PT
INTERFACE: STS-1
PAYLOAD: AS APPROPRIATE
RxLVL: DSX or MON, as appropriate

2) Connect the SunSet OCx Rx jack to the OUT jack of a Maintenance Port, as depicted in Figure 163, or to the MON jack of an STX-1, as shown in Figure 164.
a) Verify the PULSES and FRAME LEDs are lit green.
b) Press the HISTORY key to acknowledge any blinking lights and turn them off.

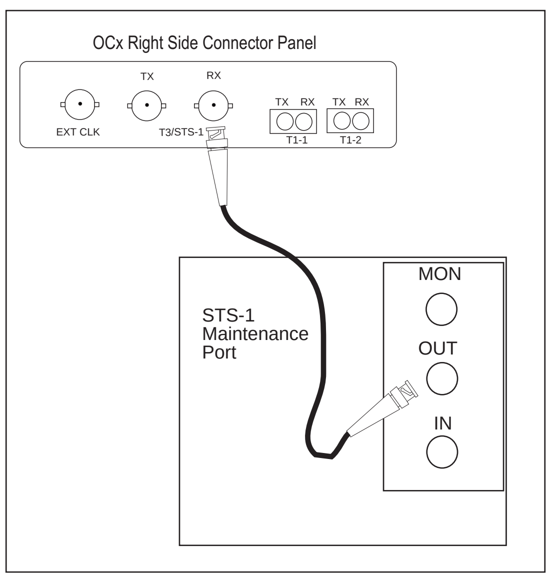


Figure 163 Plugging into the Out Jack

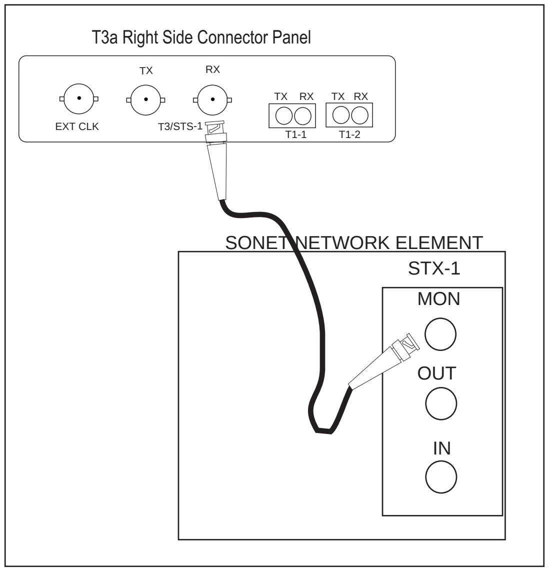


Figure 164 Plugging into STX-MON

3) Press ESCAPE until you reach the main menu.
a) Enter SONET FEATURES > SECTION OVERHEAD MONITOR, via the SONET icon if you have a color unit.
   - Figure 165 shows a sample SECTION OVERHEAD screen.

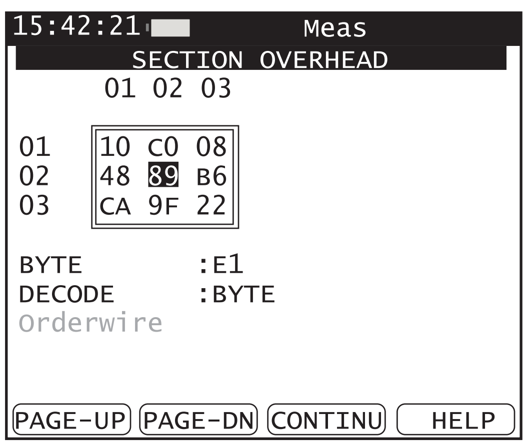


Figure 165 Section Overhead Screen

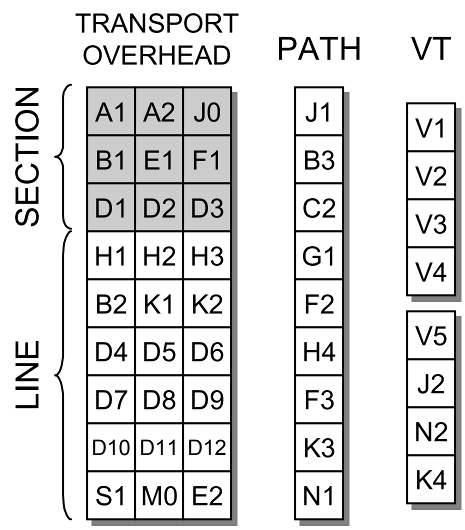


Figure 166 SONET Overhead Layout

Monitor Section Overhead

1. Verify the following:
   a. Frame alignment pattern A1 = F6 and A2 = 28
   b. Section bit interleaved parity code byte B1 is continuously changing
   c. SunSet OCx can detect other incoming Section Overhead bytes (J0, E1,F1,D1-D3)

Monitor Line Overhead

1. Verify the following:
   a. STS Payload Pointer (H1 and H2) and the Pointer Action (H3) bytes remain constant when there are no pointer adjustments.
   b. The APS K1 and K2 bytes along with the M0/M1 bytes are equal to zero when the signal is error free.
   c. Line bit interleaved parity code byte B2 is continuously changing
   d. The OCx can detect other incoming Overhead bytes (D4-D12,S1/Z1, and E2)

Monitor Path Overhead

1. Press ESCAPE and move the cursor down to the PATH OVERHEAD MONITOR using the arrow keys and press ENTER. Verify the following:

a. The SunSet OCx can detect all 64 kbps channels of the STS path trace byte, J1, used to identify the start of the signal path.

b. The Path bit interleaved parity code byte B3 is continuously changing.

- The OCx can detect other incoming Path Overhead bytes (C2,G1,F2,H4,Z3-Z5)

Monitor VT Overhead

1. Select VT1.5 as the Payload in the TEST CONFIGURATION.
2. Enter SONET FEATURES > PATH OVERHEAD MONITOR, then move the cursor to the VT-POH side to access data on the VT bits.

a. The V5 byte does signal label and error monitoring functions, including a BIP-2 parity calculation in bits 6-7, and Path Yellow (also known as Remote Alarm Indication) in Bit 8. Bit 4 is used for RFI-V indication.

- The other bytes include:
  V3: Pointer Action, Analogous to H3
  J2: VT Signal Trace (16 ASCII characters)
  N2 (Z6): Tandem connection monitoring
  K4 (Z7): Protection Switching and Enhanced RDI-V

4.3 Transmitting Overhead Bytes

Use this procedure to manipulate the transmitted overhead bytes.

1) Configure the SunSet OCx to match the network configuration. Here is a sample setup:
- TEST MODE: PT-PT, INTERFACE: OC3, and PAYLOAD: VT1.5
- Laser On.
- Transmitting clock set to OC3LOOP (this will prevent clocking difference between the test set and the network which can result in pointer movements).

2) Connect the optical patch cords (yellow cables) from a unit to the network element. Tx on one unit goes to Rx on the other unit and vice versa.

3) Enter SONET FEATURES, via the SONET icon if you have a color unit.

4) Move the cursor over to OVERHEAD BYTE SEND by using the arrow keys, then press ENTER. When you first enter this screen you will be looking at the Section Overhead bytes. The ones labeled XX cannot be manipulated. All other overhead bytes can be changed.

   To change the overhead bytes that you will be sending, simply move the cursor over to the desired location, press the SHIFT key, change the numbers to your liking, press the SHIFT key once more.

5) Notice the ‘OH Tx’ flag that indicates you are transmitted user-selected overhead bytes. To send the default overhead values, select DEFAULT (F4).

6) Press SEND. Press PAGE-DN to change the Line and Path overhead.

Send K1/K2 bytes

From the SONET FEATURES menu, press ESCAPE, move the cursor over to SEND K1, K2 BYTES, and press ENTER. These bytes are used for the APS (Automatic Protection Switching). They relay APS messages in binary code. Remember that each byte is eight bits and each individual bit can be changed in the two K bytes.

To change the K bytes, move the cursor over to the bit you wish to change and press the F1 or F2 key for a 0 or 1. Once you are satisfied with your changes, press SEND.

J0 Section Trace (OC-48 units only)

From the SONET FEATURES menu, cursor to J0 SECTION TRACE GENERATION by using the arrow keys, then press ENTER. J0 is a section trace byte used to identify the Section. Its length can be changed from 16 Bytes to 64 Bytes by using the F1 or F2 key. Once the proper length has been chosen, move the cursor over to the current message being displayed.

To change this message press TOGGLE (F3), then cursor across the various letters, numbers, and symbols you can select. Once you are satisfied with the message as written, press TOGGLE again, move the cursor over to the LENGTH option, and press SEND (F4).

To send only a single J0 byte, and not a 16- or 64-byte message, use the OVERHEAD BYTE SEND screen function.

J1 Path Trace

Move the cursor over to PATH OVERHEAD SEND by using the arrow keys, and press ENTER. The J1 PATH TRACE GENERATION option works just like the J0 SECTION TRACE GENERATION, except for this one is for the path and not the section. The receiving Path Terminating Element (PTE) collects 64 repeating J1 bytes to verify the connectivity with the transmitting PTE.

C2 Byte Send

Move the cursor over to EDIT C2 SIGNAL LABEL by using the arrow keys, and press ENTER. C2 is the signal label byte indicating the construction of the Synchronous Payload Envelope (SPE), that is, asynchronous mapping, ATM, etc. Using the arrow keys, select a C2 signal label byte and press SEND (F4). Verify the new C2 byte has been received by the other test set.

Z4 / K3 Byte Send

The Z4 byte is designated for future growth. In the DQDB mapping, the Z3 byte is used to carry DQDB Layer Management information. In some systems, it is renamed as K3 and is designated for High-Order Path APS signalling. The K3 byte is still under study.

Move the cursor over to SEND Z4/K3 BYTE by using the arrow keys, and press ENTER. To change this byte, move the cursor over to the byte you wish to change and use the F1 and F2 keys to choose between a zero and a one. Once you are satisfied with your choice, press SEND (F4).

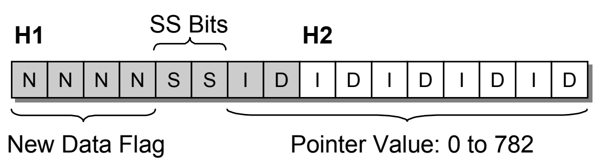
V5 Byte Send

The V5 byte is the VT1.5 path overhead byte. It includes a BIP-2 parity calculation in bits 6-7, and Path Yellow (also known as Remote Alarm Indication) in Bit 8. Bit 4 is spare for future use.

With VT1.5 selected as your payload, cursor to SEND V5 BYTE within the SEND PATH OVERHEAD menu, then press ENTER. To change this byte, move the cursor over to the byte you wish to change and use the F1 and F2 keys to choose between a zero and a one. Notice that the byte definition appears next to the bits. Once you are satisfied with your choice, press SEND (F4).

Pointer Control (OC-48 units only)

Cursor to POINTER CONTROL using the arrow keys, and press ENTER. Pointers are very important within the SONET overhead because they help find where the next synchronous payload envelop (SPE) starts. The Pointers utilize the H1-H3 bytes in the Line Overhead. See the next figure.



New Data Flag: 0110 = Normal, 1001 = New Data Flag (NDF)
Other values use "3 of 4" rule.
SS Bits: 00=SONET, 10=SDH, 01 and 11 are Undefined
Concatenation: In STS-Nc signal, the first H1/H2 bytes set normally. Subsequent H1/H2 bytes set to 1001ss1111111111 to indicate Concatenation.

Figure 167 H1/H2 Pointers

Within the POINTER SEND/MONITOR menu you can select which Synchronous Transport Signal (STS) you wish to look at. You may also change the POINTER SETTING, NEW DATA FLAG, SS BITS, POINTER VALUE, and POINTER ADJ by moving the cursor over to the desired variable and using the F-keys.

7) When you are finished viewing and/or manipulating these bytes, disconnect your test set from the circuit.

4.4 Point-to-Point Facilities Verification

Use these tests to look at each side of a structured signal.

4.4.1 End-to-End Test

In this out-of-service test, a test set transmits towards to network, and on to another test set. This test verifies error-free transmission and troubleshoots problems (through the mux/demux process).

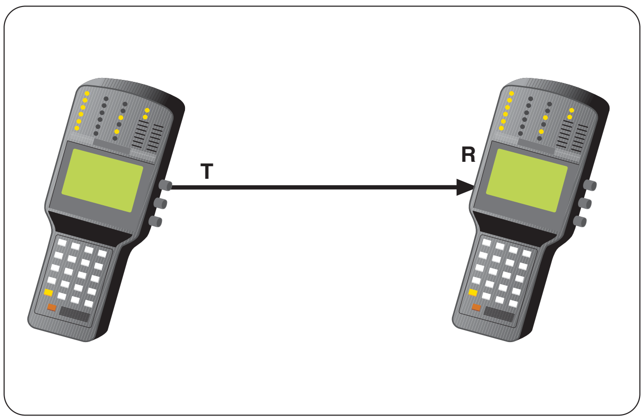


Figure 168 End-to-End Testing

Here is a sample TEST CONFIGURATION. Configure your setup as specified by your circuit.

TEST MODE: PT-PT

INTERFACE: OC3 (or select other specific rate)

PAYLOAD: DS1 (or select other specific rate)

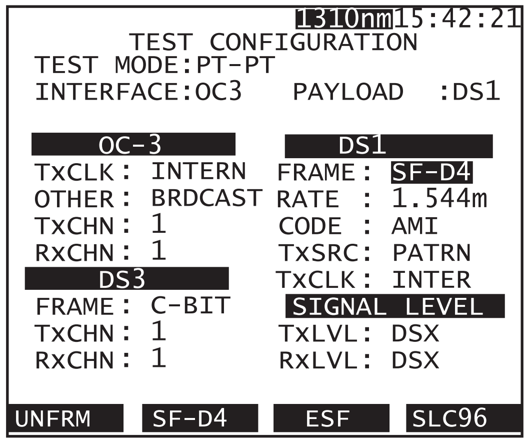


Figure 169   OC3/DS1 Configuration

4.4.2 End-to-Loopback Test

This is an out-of-service test. The test set transmits to a piece of network equipment, which has a loop in place, allowing you to send a structured signal and test the multiplexer/demultiplexer which is involved.

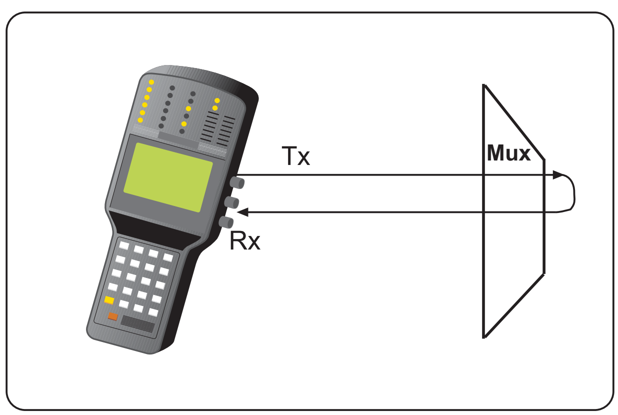


Figure 170   End-to-Loopback Test

4.4.3 Testing a Multiplexer

The SunSet OCx can perform an out-of-service through multiplex test. For multiplexing testing, the SunSet transmits a test pattern at a low rate and receives it back in a structured high rate, after it has been multiplexed, and compares it for measurement.

For demultiplexing testing, the set transmits a test pattern within a channel at a high rate (structured) and receives it at its low rate port. The set compares the signals for measurement.

1) Here are some sample setups:

TEST MODE: MUXTEST
HIGH RATE: OC3 LOW RATE: DS1
MEAS SIDE: OC3 PAYLOAD: DS1

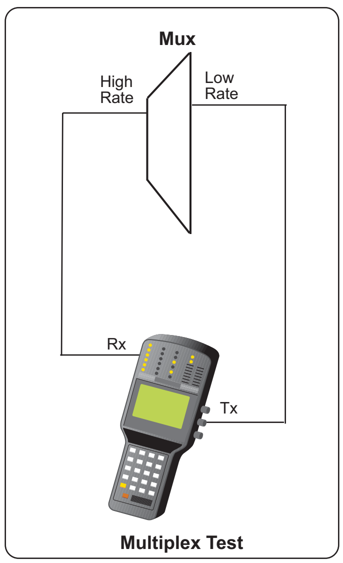


Figure 171 Muxtest Setup

- Connect the test set's DS1 Rx jack to the DS1 output on the multiplexer.

TEST MODE: MUXTEST
HIGH RATE: OC3 LOW RATE: DS1
MEAS SIDE: DS1 PAYLOAD: DS1

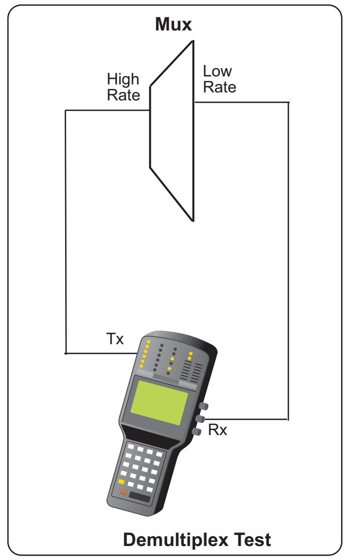


Figure 172 Demux Test Setup

- Connect the test set's optical Rx jack to the OC-3 input connector on the multiplexer.

2) Enter the SETUP TEST PATTERN item
- Select the stress pattern you wish to transmit into the MUX.

3) Examine the LEDs on the test set closely.
- If you are unable to synch on your selected pattern, the low rate connectors on your MUX may be mislabelled or miswired.

4) From the MAIN MENU (Results icon), enter the MEASUREMENT RESULTS feature.
- Verify the proper operation of your OC MUX.

5) You may wish to inject a bit error into your OC-3 and verify that they have passed through the OC/STS MUX, and was detected by the test set.
a) Enter OTHER FEATURES/ERROR INJECTION to do so; use the Errors/Alarms icon if you have a color unit.
b) Send bit errors (TYPE=BIT) on a DS1 PAYLOAD, in either a burst or at a rate.

c) Press the ERR INJ key to send the errors.
d) Check the BIT PERFORMANCE screen in Measurement Results (under the Results icon if you have a color unit) screen for the errors. You have verified the multiplexing operation of the OC-3 multiplex for the DS1 signal.

4.4.4 Emulating a OC/SONET Multiplexer

The following application allows you to use the SunSet as a OC-3/DS1 mux, mapping the DS1 into SONET via VT1.5.

Figure 173 shows the signal path of the multiplexing operation.

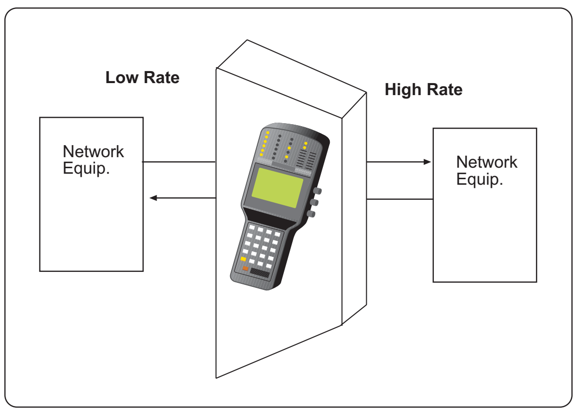


Figure 173 STS Multiplex Operation

1) From the MAIN MENU (Results icon), enter TEST CONFIGURATION.

2) Configure the other settings as follows:

TEST MODE: MUXMODE
HIGH RATE: OC3 LOW RATE: DS1
MEAS SIDE: DS1 PAYLOAD: VT1.5

a) Configure the details according to your lines. The next figure shows a sample setup. In color units, you will see a 'Thru' marker in the header. The UU indication in the mux shows you that Unequipped is being transmitted on the unused STS-1s and VT1.5s.

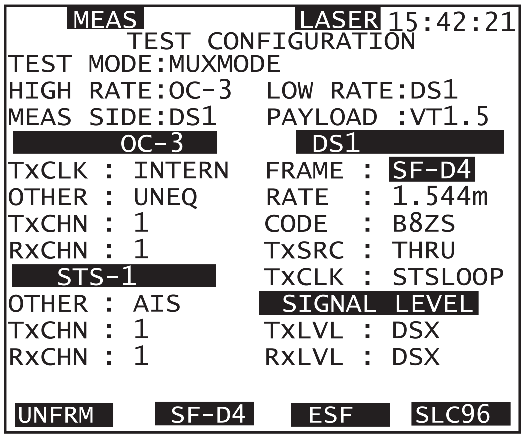


Figure 174 Muxmode Configuration, Screen 2

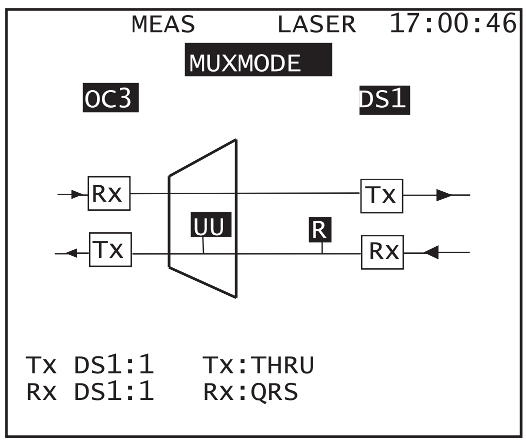


Figure 175 Muxmode Graphic Screen

3) Press ENTER when your settings are correct.

4) Connect the OCx with a bidirectional setup.
a) Connect the optical Tx/Rx ports to their opposites.
b) Connect the DS1Tx/Rx ports to their opposites.

5) From the MAIN MENU (Results icon), enter the MEASUREMENT RESULTS feature.

4.5 Automatic Protection Switching

Verify APS functionality with this application. Refer to *section 4.2.1* for the setup. Figure 176 shows the APS byte frame and functions; Figure 177 shows the APS architecture.

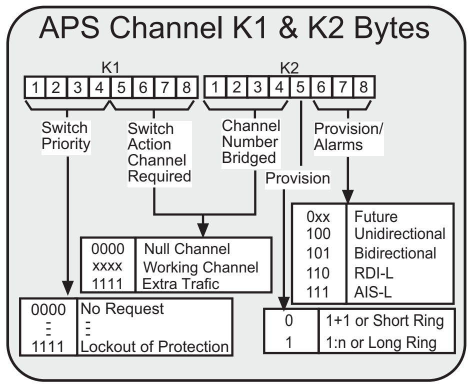


Figure 176 APS Bytes

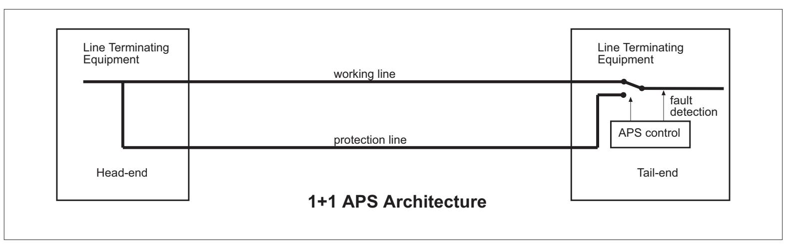


Figure 177 APS Architecture

APS Measurements

1. Once all of the connectors are properly attached and nothing but green LED's are visible, you are ready to enter the APS menu.
2. From the main menu, enter SONET FEATURES, via the SONET icon if you have a color unit.

3. Scroll to SONET APS MEASUREMENT and press ENTER. You will see three variables that can be manipulated: **Sensor**, **Switch time limit**, and **Gate time**.

4. Move the cursor to **Sensor** by using the arrow keys. The **Sensor** is what the test set will be looking for to trigger the APS event. For example, if the **Sensor** is set to AIS-L then it will be looking for an Alarm Indication Signal coming from the Line overhead. Once the AIS is received the APS event will launch.

   To change the sensor, press the F3 key.

5. Cursor over to the **Switch time limit**. The **Switch time limit** is measured in milliseconds and represents the amount of time you allow for the switch to occur and still pass the test.

   For example, if the **Switch time limit** is set to 20 ms, then the APS must switch between the working line and the protection line (see diagram in previous page) in less than 20 milliseconds or else the test has failed.

   To change the **Switch time limit,** press the yellow SHIFT key followed by the numbers you wish to change the Switch time to. Remember, the SHIFT key must be pressed a second time when you are finished making the desired changes.

6. Cursor to the **Gate time**. The **Gate time** is also measured in milliseconds, and is the amount of time the test set will continue to monitor the APS event regardless if it has passed or failed the **Switch time limit**. The **Gate time** is larger than the Switch time limit and is used as a reference guide to the event.

   To change the **Gate time** press the yellow SHIFT key followed by the numbers you wish to change the Gate time to. Remember, the SHIFT key must be pressed a second time when you are finished making the desired changes.

7. Now you are ready to measure APS events. Press start (F1) and you should see a message saying “waiting for APS event”. This means that the unit is ready to measure the amount of time it will take for the ADM to switch from the working line over to the protection line once AIS has occurred.

Acronyms

APS = Automatic Protection Switching
AIS-P = Alarm Indication Signal in the Path overhead
DS3FEAC = DS3 Far End Alarm Control
P-BIT = Bit error in the Path overhead
C-BIT = Parity error

AIS-L = Alarm Indication Signal in the Line overhead
B2 = B2 error
BIT = Bit error
ADM = Add / Drop Multiplexer

4.5.1 Service Disruption

This feature is an out-of-service test of automatic protection switch times. Whereas the APS Timing feature can be used to monitor and measure an in-service network, the Service Disruption requires either another test set to send a PRBS pattern or a loopback in the network.

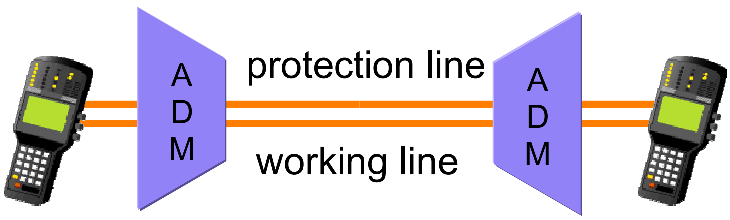


Figure 178 Service Disruption

1) Configure the test set for PT-PT wit the appropriate interface and payload.

2) Select a PRBS test pattern, such as 2e20 or 2e31.

3) Verify that the PAT SYNC led is green and that there are no errors on the circuit.

4) The service disruption measurement takes place automatically and requires no further user action. When the test set detects a loss pattern, such as from a loss of signal, loss of frame, or AIS, the test set will measure the duration of the disruption automatically.

5) To view the time and duration of the disruption, press STATUS to enter the Event Status screen. A typical result may appear like this, with the most recent event/time at the top.

BERT -END- NOT SYNC 13:01:05

SONET –END- AIS-L 13:01:05
SER DIS: 128.19 ms 13:01:04
BERT START NOT SYNC 13:01:04
SONET START AIS-L 13:01:04

In this example, the service disruption lasted 128.19 ms. The Event Status screen can record an unlimited number of service disruptions while the measurement is running.

6) Service Disruption statistics are shown in the BIT Performance Screen as follows:

SERVICE DISRUPTION (ms)
LAST : 128.19 MAX : 130.47
TOTAL:2453.28 MIN : 115.41

In this example, the sum total time of all service disruptions since the start of the test was 2453.23 ms. The most recent one was 128.19 ms. The longest was 130.47 ms and the shortest was 115.41 ms. To see when each occurred and the total number of disruptions, go to the Event Status screen.

Chapter 5 Reference

This chapter provides miscellaneous useful information. Included are common abbreviations and definitions, troubleshooting, procedures and the Express Limited Warranty. Specifications are also featured.

5.1 Abbreviations

A
AC - Alternating Current
ACK - Acknowledge
ADM - Add/Drop Multiplex
AFBER - Average Framing Bit Error Rate
AIS - Alarm Indication Signal
AISS - Alarm Indication Signal Seconds
ALM - Alarm
AMI - Alternate Mark Inversion
APS - Automatic Switching Protection
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
B1 - B1 BIP-8 Parity Errors
B2 - B2 BIP-8 Parity Errors
B3 - B3 BIP-8 Parity Errors
B8ZS - Bipolar 8-Zero Substitution
BATT - Battery
BER - Bit Error Rate
BPV - Bipolar Violation
BPVR - Bipolar Violation Rate
BTSLP - Bit Slip
BUFF - Buffer
C
Cbit - C-bit Parity Error Count
CER - CRC-6 Error Rate
CLK - Clock

CLKSLIP - Clock Slip
CLR - Clear
CNFG - Configuration
COD - Code
COFA - Change of Frame Alignment
CONFIG - Configuration
CRC - Cyclic Redundancy Check
CRC-6 - Cyclic Redundancy Check Code - 6
CSU - Customer Service Unit
CTL- Control

D

dB - decibel
dBm - dB reference to one milliwat; 0 dBm=1 mW
dBdsx - decibel referenced to dsx power level
DC - Direct Current
DCS - Digital Cross-connect System
DENS - Density
DGRM - Degraded Minute
DIG - Digital
DLC - Digital Loop Carrier
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
DTMF - Dual-Tone Multi Frequency

E

E - Equipment
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 Zeros Seconds

F

F - Facility
F1 - Function 1
FAC - Facility

FBE - Framing Bit Error
FBER - Framing Bit Error Rate
FDL - Facility Data Link
FEAC - Far End Alarm and Control Channel
FEBE - Far end Block Error
FELP - Far End Loop
FERF - Far End Receive Failure
FERFS - Far End Receive Failure Seconds
FREQ - Frequency
FRM - Frame
FSBEE - Frame Synchronization Bit Error Event
FSLIP - Frame Slip
ft - feet
FT1 - Fractional T1

H

HEX - hexadecimal
HOLDSCRN - Hold Screen
Hz - Hertz

I

INTERN - Internal
INV - Inverted
ISDN - Integrated Services Digital Network

L

LAISS - Line Alarm Indication Signal Seconds
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
LOCS- Loss of Clock Seconds
LOF - Loss of Frame
LOFS - Loss of Frame Second
LOG - Logical
LOP - Loss of Pointer
LOPS - Loss of Pointer Seconds
LOS - Loss of Signal
LOSS - Loss of Signal Second
LPBK - Loopback
LPBKQRY - Loopback Query
Lpp - Level peak-to-peak
LVL - Level

M
MAX - Maximum
mbps - megabits per second
MF - Multi-Frequency
MIN - Minimum
MON - Monitor
Mux - Multiplex
mW - milliwatt
N
NDF - New Data Flag;
NI - Network Interface
NIU - Network Interface Unit
NOTE - Network Office Terminating Equipment
NV RAM - Non Volatile Random Access Memory
O
OC - Optical Carrier
OH - Overhead
OOF - Out Of Frame
OOFS - Out Of Frame Seconds
P
PAISS - Path Alarm Indication Signal Seconds
PAT - Pattern
PAT SYNC - Pattern Synchronization
PCM - Pulse Code Modulation
PJ - Pointer Justification
PLPBK - Payload Loopback
PNTR - Pointer
ppm - parts per million
PRBS - Pseudo Random Bit Sequence
PRNT - Print
PRNTR - Printer
PWR - Power
PWRLPQRY - Power Loop Query
PWCUTTH - Power Cut Through
PYELS - Path Yellow Alarm Seconds
Q
QRS - Quasi Random Signal
R
R - Receive
RAI - Remote Alarm Indicator
RCV - Receive
RDI - Remote Defect Indicator

REF - Reference
RFI - Remote Failure Indicator
RT - Remaining Time
RX - Receive

S

S/N - Serial Number, also Signal to Noise Ratio
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
SONET - Synchronous Optical Network
SPE - Synchronous Payload Envelope
SPLT - Split
SS - SunSet
STS - Synchronous Transport Signal
SW - Software, also Switch
SYLS - Synchronization Lost Seconds
SYNC - Synchronized

T

T - Transmit
T1DM - T1 Data Multiplexer
T/S - Time Slot
TE - Terminal Equipment
TERM - Terminated
TM - Terminal Multiplexer
TOH - Transport Overhead
TOUT - Time Out
TOUTDIS - Timeout Disable
TSTSIG - Test Signal
TX - Transmit
TxClk - Transmit Clock

U

UAS - Unavailable Second
UI - Unit Interval
UNIVLDN - Universal Loopdown
uS - microsecond

V

V - Volts

VAC - Volts AC
VF - Voice Frequency
VT - Virtual Tributary
W
WDR - Wander
Y
YEL - Yellow (Alarm)
YEL ALM - Yellow Alarm
YELS - Yellow Alarm Second

5.2 Standard Test Patterns

Pattern Definitions

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

2e23: 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 zeros in a row and violates standards for consecutive zeros in AMI-coded transmission.

2e20: The $2e^{20}$-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 zeros in a row and violates standards for consecutive zeros in AMI-coded transmission. QRS is derived from this pattern.

2e15: The $2e^{15}$-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 zeros in a row and does not violate standards for consecutive zeros in AMI-coded transmission.

2047: The 2047 bit code used for DDS applications.

511: The 511-bit code used for DDS applications.

127: The 127-bit code used for DDS applications.

63: The 63-bit code used for DDS applications.

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

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.

ALT10: The alternating ones and zeros 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.

ALL1: The 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`

ALL0: The All 0s 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`

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

1-8: The 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 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 3 in 24 pattern is used for stress testing AMI lines. It is the 12.5% minimum 1s density pattern. The pattern is frame aligned ("f" is the framing bit) as shown in its binary form:

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

FOX: The industry-standard FOX pattern is used in data communications applications. The ASCII translation of the pattern is the " Quick brown fox jumped over the lazy dogs 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
```

55OCT: This is the original 55-octet pattern. It is used for stress testing T1 circuits and network elements. If transmitted in a framed signal with AMI coding, it will violate the 15-zero constraint. It does not violate the zeros 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
```

55DLY: The Daly 55 Octet pattern is a special stress pattern that obeys industry standards for pulse density and maximum consecutive zeros in both AMI and B8ZS coded circuits. 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 zeros constraint in an unframed signal. If framed, the framing bit is inserted at octet boundaries. Note that the Daly 55 octet pattern replaced the original 55 octet pattern. 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
```

IDLE: This is the industry-standard 7F IDLE pattern. Here is the pattern:

```
f 0001 0111
```

YELLOW: This is the industry-standard YELLOW alarm pattern, used for SF framing. Here is the pattern:

```
f 1011 1111
```

Technology Overview

The following section gives you an overview of SONET, T3, and T1 technology. It also shows you the basics of troubleshooting and performance maintenance for these three circuits.

5.3 SONET Technology

This section is an introductory guide to the Synchronous Optical Network (SONET) standards, and presents an overview of the associated technology and applications.

5.3.1 Introduction

SONET is the American standard for high capacity optical telecommunications network, as formulated by the ECSA (Exchange Carriers Standards Association) for ANSI. Internationally, this technology is known as Synchronous Digital Hierarchy (SDH), designed to transport CEPT asynchronous transmission rates.

Telecordia Technologies (formerly Bellcore) maintains FR-SONET-17-Broadband and Transport Network Generic Requirements: SONET and ATM Transmport Technologies. The most relevant portion is GR-253-CORE-Synchronous Optical Netowrk (SONET) Transport Systems: Common Generic Criteria.

Briefly, SONET and SDH define optical carrier (OC) levels and electrically equivalent synchronous transport signals (STS) for the fiber-optic based transmission hierarchy. This synchronous transport system provides a simple, common, and flexible telecommunications infrastructure.

SONET and SDH employ a system called “Direct Synchronous Multiplexing.” It is no longer necessary to demultiplex tributary channels before switching—a requirement with the existing DS1/DS3 asynchronous networks.

With SONET , the low-speed signals may be extracted without demultiplexing the entire signal through multiple stages.

5.3.2 The SONET Network: Architecture & Devices

The lowest level SONET is termed the Synchronous Transport Signal Level 1 (STS-1); this signal has a rate of 51.84 Mbps. Its optical equivalent, as obtained by a direct electrical conversion of the STS-1 signal, is the OC-1, Optical Carrier Level 1. The higher level signals are obtained by the byte-interleaved mapping of lower level signals. Basically, the bytes are interleaved in such a format where the low-speed signals are still visible.

There is no additional signal processing except the direct conversion from electrical (STS) to optical (OC) form. These higher signal levels are denoted by STS-N and OC-N. According to SONET standards, n can equal 1,3,12, 48, and 192, etc. Figure 179 displays some SONET line rates and the SDH equivalent formats.

Line Rate	SONET	SDH	SONET Capacity	SDH Capacity
51.840 Mb/s	OC-1 STS-1	STM-0	28 DS1s 1 DS3	
155.520 Mb/s	OC-3	STM-1	84 DS1s 3 DS3s	63 E1s 1 E4
622.080 Mb/s	OC-12	STM-4	336 DS1s 12 DS3s	252 E1s 4 E4s
2.488 Gb/s	OC-48	STM-16	1344 DS1s 48 DS3s	1008 E1s 16 E4s
9.952 Gb/s	OC-192	STM-64	5376 DS1s 192 DS3s	4032 E1s 64 E4s

Figure 179 Synchronous Technology Signal Line Rates

The OC-3 (Optical Carrier 3) rate is where the various rate systems meet; STS-3 it is equivalent to the STM-1 (Synchronous Transport Mode), in the SDH standard. The rate is 155.52 Mbps. OC-12 is sequivalent to STS-4, at 622.08 Mbps, etc.

STS-N frames consist of a number of STS frames multiplexed together. The high rate frame is made by interleaving the STS-n's byte by byte (for example, by multiplexing three STS-1s together to make a STS-3). By multiplexing in this manner, the columns of each lower rate STS are also interleaved. As each of the first three columns of each STS are overhead, the resulting STS-3's first nine columns are overhead. Since error checking is usually only done once for the entire frame, only the overhead in the first STS is usually actually used. The remaining overhead is left as undefined. The STS-1s are still accessible in a higher STS-n rate.

Concatenated payloads, designated STS-Nc or OC-Nc, are not divided into individual STS-1 channels. Rather, the entire SPE is used for a single payload. For example, an OC-3 is usually divided into three 52 Mb STS-1 channels, each with its own pointer and path overhead. An OC-3c is a single 155 Mb channel with a single pointer and path overhead. Concatenation is used for data-based networks such as ATM and Packet Over SONET.
OC-3cs are often used for transporting ATM cells.

Figure 180 depicts the multiplexing process. In this figure, three STS-1s are multiplexed to form one STS-3. A1, A2, A3, B1, B2, etc., represent the overhead bytes for each STS-1 signal. Overhead bytes will be discussed in Section 3.4 of this chapter. SPE A, B, C represent the synchronized payload envelopes for the 3 STS-1 signals.

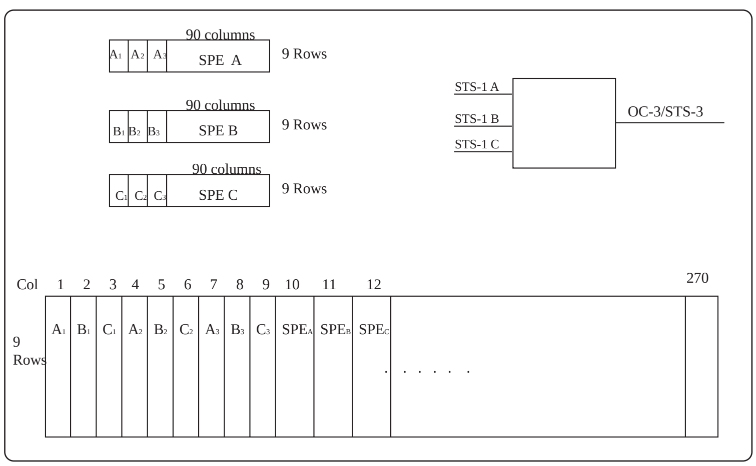


Figure 180 Bit-Interleaving Multiplexing

Virtual Tributaries

SONET also defines synchronous formats at sub-STS-1 levels. The STS-1 payload is subdivided into virtual tributaries (VTs)-synchronous signals used to transport lower-speed transmissions.

- STS-1 SPE has a channel capacity of 50.11 Mbps; designed to transport a DS3 tributary signal.
- The VT frame structure transports a lower rate signal, such as the DS1 signal.

There are three common sizes of VTs; VT 1.5, VT-2, and VT-6.

- Each VT 1.5 frame consists of 27 bytes (3 columns of 9 bytes). These bytes provide a transport capacity of 1.728 Mbps, and thus, can accommodate the transport of a DS1 signal. 28 VT 1.5s may be multiplexed into the STS-1 SPE.
- Each VT-2 frame consists of 36 bytes (4 columns of 9 bytes). These bytes provide a transport capacity of 2.304 Mbps, and can accommodate the transport 1 E1 signal. 21 VT-2s may be multiplexed into the STS-1 SPE.
- Each VT-6 frame consists of 108 bytes (12 columns of 9 bytes). These bytes provide a transport capacity of 6.912 Mbps and will accommodate the mapping of a DS2 signal. Seven VT-6s may be multiplexed into the STS-1 SPE.
- Different types of VT groups may be mixed into one STS-1 SPE. However, the most

The next figure shows the overall SONET multiplexing structure:

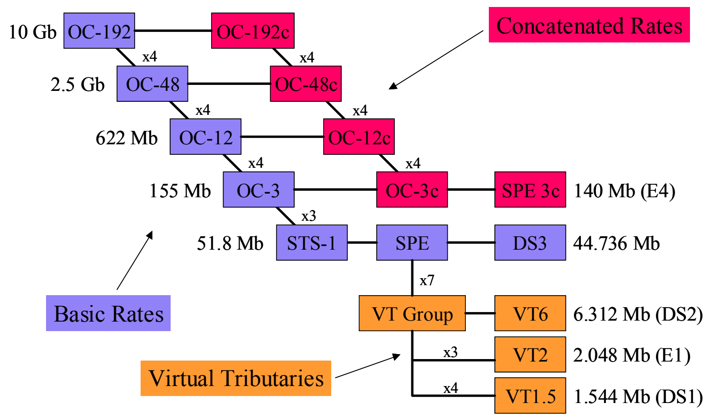


Figure 181 SONET Multiplexing Heirarchy

SONET Network

The basic devices are defined as follows:

1) Digital Loop Carrier systems (DLC): specialized SONET back-to-back mux systems providing circuit concentration in the local loop market. These elements are similar to the Terminal Mux, but transmission speed is normally limited to 155 Mbps.

2) Terminal Mux: performs the simple multiplexing of SONET and standards DS1/DS3 channels onto a single SONET bearer.

3) Add/Drop Mux: a terminal multiplexer with the ability to operate in through mode (ADM) and add and drop channels to the through signal. This may be used to add, drop, or cross-connect tributary channels. They may operate at any SONET rate.

   At an add/drop site, only those signals that need to be accessed are dropped and inserted. The remaining traffic continues through the network element without requiring signal processing.

4) SONET DCS (Cross Connect): A SONET cross-connect accepts various SONET rates, accesses the STS-1 signals, and switches at this level. The major difference between a cross-connect and an add/drop multiplex is that a cross-connect may

be used to interconnect a much larger number of STS-1s. It is ideally used at a SONET hub.

5) Regenerator: required for SONET and transmission over 35 miles. These are not just simple signal reconstituters, but have alarm and error checking capability.

Figure 182 provides an illustration of SONET architecture and devices.

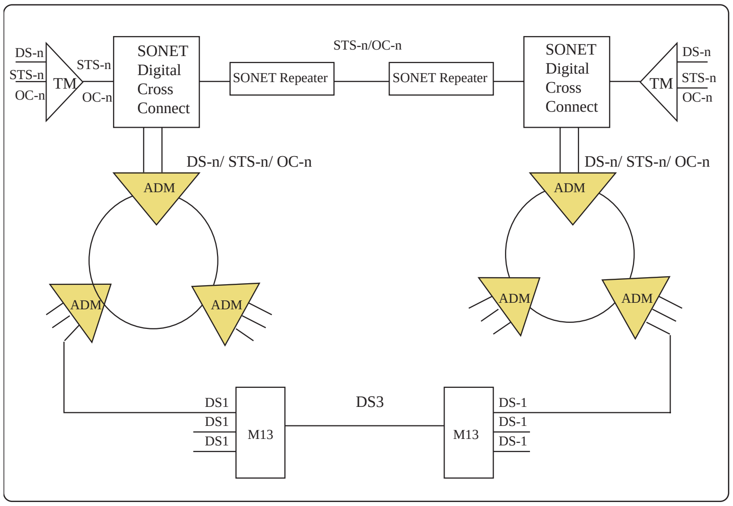


Figure 182 SONET Archintecture & Devices

5.3.3 Frame Formats

Figure 183 displays the frame format of the STS-1 signal. The STS-1 frame format is usually depicted as a matrix of 9 rows of 90 bytes. The signal bits are transmitted starting with those on the top left hand byte in row 1, until all the bits in the 90th (last) byte in row 2 are transmitted. This process continues until the 90th byte of the 9th row is transmitted. The entire frames is transmitted in 125 microseconds.

The frame is comprised of two main areas: transport overhead (TOH) and the synchronous payload envelope (SPE). The TOH and SPE are two distinct and readily accessible parts within the frame structure. The Path overhead (POH) is contained in the SPE.

The SPE is the defined area within he STS-N which carries the data for customer services. The SPE is designed to traverse the network from end to end. Once the payload is multiplexed into the SPE, it can be transported and switched without having to be examined or demultiplexed at intermediate nodes. For this reason, SONET is called service-independent and transparent. See the next figure for the SPE format:

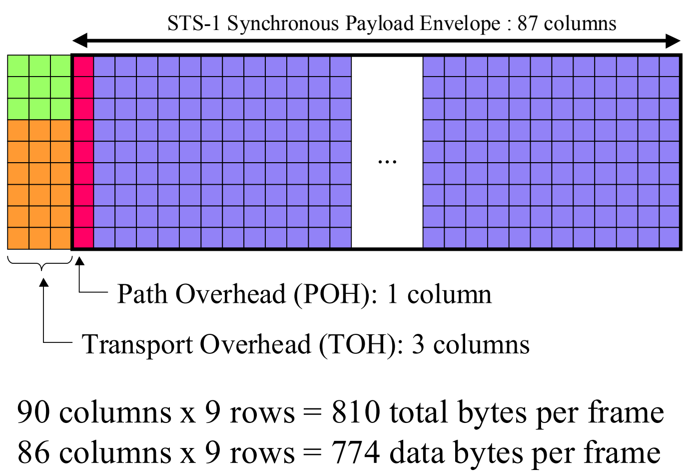


Figure 183 SPE Format

The TOH provides the facilities required to support and maintain the SPE between nodes in a synchronous network (i.e. alarm monitoring, bit-error monitoring, and data communications channels). The STS-1 payload has the ability to transport up to 28 DS1s or 1 DS3.

The next two figures show different ways of looking at the STS-n frames. The first gives an overview, the second shows the specifics of the overhead and the interleaved payload.

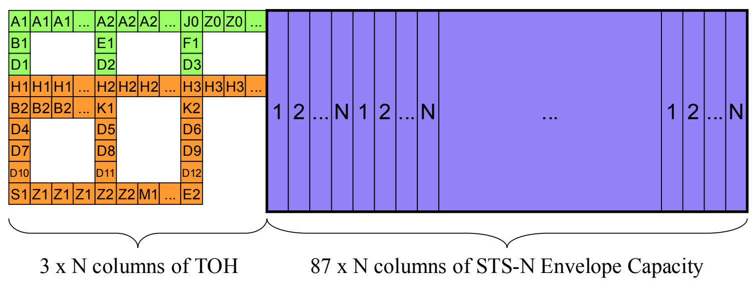


Figure 184 STS-n Frame

- N STS-1 frames are interleaved to create an STS-N signal.
  - Typical values for N are 3, 12, 48, 192, etc.
- Transport overhead bytes are frame-aligned
- Individual SPEs are completely independent
  - Each STS-1 has own pointer
- Gaps indicate undefined TOH bytes

5.3.4 STS-1 Overhead

The SONET network may be described in terms of three different network spans. These spans allows for fault sectionalization.

- PATH: allows network performance to be maintained from a customer service end-to-end perspective
- LINE: allows network performance to be maintained between transport nodes. This provides the majority of network management reporting.
- SECTION: allows network performance to be maintained between line regenerators (repeaters) or between a line regenerator and a SONET network element.

Figure 185 displays a representation of these network spans.

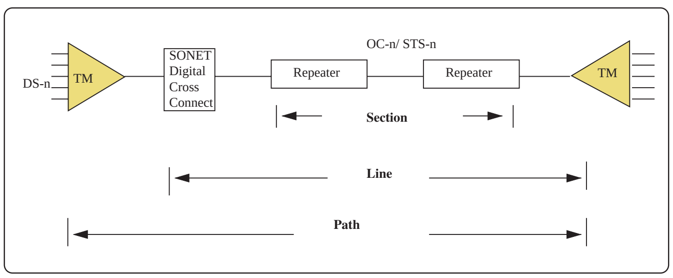


Figure 185 Network Spans

The embedded overhead in the SONET signal supports network maintenance at each level of these network spans. Thus, the Path, Line, and Section Overhead are distinct. Figure 186 shows the location of these three overheads within the STS-1 framing.

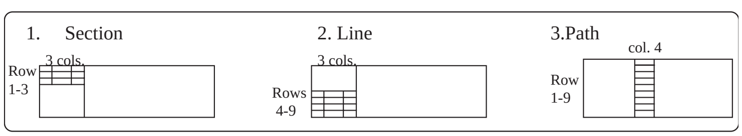


Figure 186 STS-1 Overhead Bytes

Each overhead consists of:

Section Overhead

- framing
- performance monitoring
- local orderwire
- data communicatiosn channel (132 kb)

Line Overhead

- pointer to the start of the synchronous payload envelope
- performance monitoring of the individual STS-1s
- express orderwire
- protection switching information
- line alarm indication signals (AIS)
- line Remote Defect Indication (RDI-L) indication

STS Path Overhead

- performance monitoring of the STS SPE
- signal label
- path trace

The high level of network management possible with the SONET depends on the information provided by the overheads within the STS frame. Basically, the Path Overhead provides the facilities needed to support and maintain the transportation of the SPE between path terminating locations where the SPE is assembled and disassembled. The Line and Section Overhead provide the facilities to support and maintain the transportation of the SPE between the adjacent nodes in the SONET network.

In higher OC rates, generally only the Section and Line overhead in the first STS is utilized. The rest is ignored. Each SPE within the OC-N signal has independent Path overhead. This figure shows the labels of the overhead, which will be gone into in more detail in the following sections.

Notes:

Bytes after slash apply to 2nd through Nth byte of STS-N signal. Alternative, newer labels are listed in parenthesis.

A: Framing
B: Bit Interleaved Parity (BIP-8)
D: Data Communications Channel (DCC)
E: Orderwire
F: User
G: Status
H: Pointer
J: Trace
K: Protection Switching
Z: Growth

Figure 187 Overhead Bytes

Further Section Overhead Definition

- The framing bytes, A1 and A2, provide a frame alignment pattern (11110110 00101000, binary, F6 28 hex).
- The B1, parity check, byte, provides section error monitoring. It uses a bit-interleaved parity 8 code (BIP-8), with even parity.
- The E1, section orderwire, byte provides for voice communications among regenerators, hubs, and remote terminal locations.
- The F1 byte is the Section User Channel, for user's purposes. It is terminated at all section level equipment.
- The last three section OH bytes, D1-D3, proved a data communications channel for Operations, Administration, Mainentance and Provisioning (OAM&P).

Line Overhead

The three bytes H1-H3 facilitate the operation of the STS-1 payload pointer. The payload pointer is involved with synchronization of SONET. Ideally, all synchronous network elements should derive their timing signal from the same master network clock. However, current synchronized network timing schemes allow for the existence of more than one master clock.

SONET uses pointers to compensate for frequency phase variations caused by multiple timing sources. Pointers enable the transparent transport of synchronous payload envelopes across pleiochronous boundaries (between nodes with separate network clocks having almost the same timing). This means the SPE can be switched and transported though SONET without having to be examined an de-multiplexed at intermediate nodes.

The use of pointers avoids the delays and loss of data associated with the use of large (125 µs frame) slip buffers for synchronization. This permits the ease of dropping, inserting, and cross-connecting these payloads in the network. The pointer is simply an offset value that points to where the SPE begins.

Here are the H bytes:

H1-H2: Pointer; values range from 0 to 782

H3: Pointer Activity (Byte stuffing)

- The B2 byte provides a BIP-8 line error monitoring function.
- The two bytes K1 and K2 provide Automatic Switching Protection (APS) signalling between line terminating equipment.
- The nine bytes D4-D12 provide a data communications channel at 576K for message-based administrative, monitor, main-

tenance, alarm, and other communications needs.

- The S1 byte provides synchronization status, reporting on the signal clock source and quality.
- The E2 byte provides an express orderwire channel for voice communications between line terminating equipment.
- M0 is used for Remote Error Indication (REI-L). This provides a count of the far end line B2 errors. In STS-3 and higher signals, M0 is replaced by M1, which serves the same purpose. See Figure 181 for the position of M1.

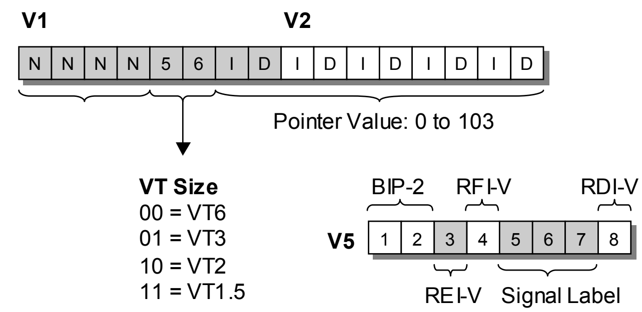
Path Overhead

Figure 187 shows the Path Overhead bytes.

- The J1 byte makes up a 64-byte fixed-length string, which is transmitted one byte per SPE frame. It can contain any alphanumeric message. The continuity of connection to the source of the path can be verified at any receiving terminal by checking this message string.
- The B3 byte provides a BIP-8 “path” error monitoring function.
- The C2 byte indicates the construction of the STS SPE.
- The G1 byte provides alarm and performance information. It conveys this information back to the originating STS Path Termination equipment. This byte allows the monitoring of a two-way path at either end, or at any point along the way.
- The F2 byte is the path user’s channel; it is provided for proprietary network operator communications between Path Termination equipment.
- The H4 byte is the VT multiframe indicator. Currently, it is used only for VT multiframe carried by that particular SPE.
- Bytes Z3 and Z4 are reserved for future use.
- Byte Z5 provides tandem path connection monitoring information. This is an important feature for customers with multiple service providers.

VT Overhead

The first byte in the VT SPE is the V5 VT Overhead byte. See Figure 188.



V1-V2 VT Payload Pointer (Analogous to H1-H2)
V3 Pointer Action (Analogous to H3)
V4 Undefined
V5 Signal label and error monitoring (Analogous to B3, C2, and G1)

Signal Label
000 = Unequipped
001 = Equipped -- Nonspecific Payload
010 = Asynchronous Mapping
011 = Bit-synchronous Mapping (obsolete)
100 = Byte-synchronous Mapping

J2 VT Signal Trace (16 ASCII characters)
N2 Tandem connection monitoring
K4 Protection Switching and Enhanced RDI-V

Figure 188 VT Overhead Details

5.3.5 Performance Monitoring

Some overhead bytes contain special functions, like Path Overhead byte G1's alarm and performance information. These bytes make effective "in-service" testing possible within a SONET network. Loss of Signal (LOS), Loss of Frame (LOF), and Loss of Pointer (LOP) cause Alarm Indication Signal (AIS) to be transmitted downstream.

These AIS signals vary depending on the level of maintenance hierarchy affected. Maintenance signals, in response to AIS, are sent upstream to warn of the trouble downstream.

Nomenclature

Defects are identified by their location in the network: section, line, path, or virtual tributary path. The abbreviations -S, -L, -P, and -V are used to distinguish between these. Sometimes you will see AIS-P written as P-AIS, but they mean the same—a path-level AIS defect. See Figure 183.

There are two classes of defects: near-end and far-end. Near-End defects are any defects detected on the line being tested. Far-End defects are always a response to a near-end defect. In SONET, far-end defects always have "remote" somewhere in the name, like Remote Defect Indication (RDI), which is a far-end response to an AIS defect.

5.3.5.1 Defects

Loss of Signal: LOS

LOS occurs when the data is all zeros for 2.3 to 100 microseconds (less than a frame).

Loss of Framing: LOF

LOF occurs when there is no valid framing pattern for 3 ms (24 frames).

LOS and LOF defects can be caused by optical power that is either too low or too high. In many cases when a LOF occurs, it is due to the optical receiver being saturated. Inserting an attenuator clears up the problem. This is common when interfacing between singlemode and multimode equipment.

Both LOS and LOF are cleared with 2 consecutive valid frames.

Loss of Pointer: LOP

LOP occurs for path or virtual tributaries when there is no valid pointer for 8 to 10 frames. The LOP is cleared when a valid pointer appears for 3 consecutive frames.

Payload Label Mismatch: PLM

PLM occurs when the value of the C2 byte does not mach the expected value, indicating that two network elements are not configured for the same payload.

Unequipped: UNEQ

Unequipped is used for paths and virtual tributaries that have not been provisioned. It serves the same role as an idle code.

Trace Identifier Mismatch: TIM

TIM occurs when the expected path or virtual tributary trace (J1 or J2 byte, respectively) does not match the expected value, alerting to a potential provisioning problem. The TIM measurement is optional.

Alarm Indication Signal: AIS

SONET AIS comes in three varieties depending on whether the originating defect occurred in the Line, Path, or Virtual Tributary Path. There is no Section AIS.

Line AIS is triggered on a Loss of Signal (LOS) or Loss of Frame (LOF). The AIS signal is given valid section overhead (framing), but the remainder of the signal an all-ones (scrambled). AIS-L is detected when bits 6-8 of the K2 byte are "111" for five consecutive frames.

Path AIS is triggered by a Line AIS or a Loss of Pointer (LOP). The AIS-P sets the H1-H3 bytes to all ones. AIS-P is detected when H1-H2 are all ones for three consecutive frames.

VT AIS is triggered by a AIS-P, LOP-P, UNEQ-P, TIM-P, PLM-P, or LOP-V. AIS-V are also triggered by a DS1 LOS, OOF, or AIS. The AIS-V sets the entire VT to all-ones, including the VT overhead. AIS-V is detected when V1-V2 are all ones for three consecutive frames.

Remote Defect Indicator: RDI

RDI is a far-end response to a major fault, such as a LOS or AIS. The network element that detects the defect generates an RDI in the overhead of the signal heading toward the origin of the problem.

SONET RDI, like AIS, comes in three varieties. Older specifications use FERF instead instead of RDI. An RDI that lasts for 2.5 ± 0.5 seconds becomes an RFI "Remote Failure Indication."

Line RDI is triggered by AIS-L, LOS, or LOF. RDI-L is indicated by setting bits 6-8 of the K2 byte to "110." RDI-L is detected when this code is seen for 5 to 10 consecutive frames. Path RDI is indicated by bit 5 of the G1 byte. RDI-P is detected if this bit is set to 1 for 10 consecutive frames.

VT RDI is indicated by bit 8 of the V5 byte. RDI-V is detected if this bit is set to 1 for 10 consecutive sub-frames (the V5 byte is only sent once every four SONET frames).

Path RDI and VT RDI has changed considerably over the years. The RDI-P/V mentioned above are called "one-bit" RDI defects. The current specifications include an enhanced RDI, called ERDI-P/V. These indicate the presence of more types of defects besides AIS. The details on ERDI-P/V follow.

5.3.5.2 Enhanced RDI: ERDI

Traditional RDIs do not indicate Unequipped, Payload Label Mismatch, and other serious defects. These are covered by ERDI. ERDIs allow for more specific designation of what caused the defect: server, connectivity, or payload defects. Payload defects would not trigger an RDI in older systems, since these systems do not include PLM or LCD (Loss of Cell Delineation—an ATM defect) in their definitions.

	G1 Bits 5-7	ERDI-P Priority	Trigger	Interpretation
RDI-P	0 x x	n/a	No defects	No RDI-P defect
RDI-P	1 x x	n/a	AIS-P, LOP-P	one-bit RDI-P defect
ERDI-P	1 0 1	1	AIS-P, LOP-P	ERDI-P Server defect
ERDI-P	1 1 0	2	UNEQ-P, TIM-P	ERDI-P Connectivity defect
ERDI-P	0 1 0	3	PLM-P, LCD-P	ERDI-P Payload defect
ERDI-P	0 0 1	4	No defects	No RDI-P defect

Figure 189 Path ERDI

	Z7 Bits 5-7	V5 Bit 8	ERDI-P Priority	Trigger	Interpretation
RDI-V	y x x	0	n/a	No defects	No RDI-V defect
	y x x	1	n/a	AIS-V, LOP-V	one-bit RDI-V defect
ERDI-V	1 0 1	1	1	AIS-V, LOP-V	ERDI-V Server defect
	1 1 0	1	2	UNEQ-V, TIM-V	ERDI-V Connectivity defect
	0 1 0	0	3	PLM-V	ERDI-V Payload defect
	0 0 1	0	4	No defects	No RDI-V defect

Figure 190 VT ERDI

Backwards compatibility is ensured by the tables above. If ERDI-P is not supported, the equipment only looks at G1 bit 5, ignoring bits 6 and 7. If ERDI-V is not supported, the equipment only looks at V5 bit 8, ignoring Z7.

ERDI-P and ERDI-V are detected if the appropriate bit code persists for 5 to 10 consecutive frames. The ERDI-V specification has gone through many revisions and may behave very differently on different network equipment and test sets.

Parity

Parity is a means to detect bit errors on live data. Parity is calculated after scrambling, and placed into the parity byte of the next frame (before scrambling). For example, the B1 byte of a given frame is based on the previous frame. Because the parity is calculated over 8 bits, this is called BIP-8. VT1.5 uses BIP-2 since it only looks at even/odd numbered bits.

Section parity (B1) is calculated once over the entire SONET frame. For OC-N signals, there is still only a single B1 byte.

Line parity (B2) is calculated over the entire frame, except the section overhead. An OC-N signal has N B2 bytes. Essentially, each STS-1 within the OC-N is calculated separately. For concatenated signals, the parity just pretends the payload is split into N STS-1 signals. Line parity is sometimes called BIP-Nx8 parity, so that an OC-12 would use BIP-96.

Path parity (B3) is calculated once over the payload (SPE). For OC-N signals, there are N B3 bytes—one for each STS-1 payload. For concatenated signals, there is only one B3 byte.

By calculating parity separately for section, line, path, and virtual tributaries, the source of the errors can be isolated quickly.

For example, if the test set detects a B2 (Line) error, but not a B1 (Section) error, the problem originates before the last regenerator. If multiple types of parity errors occur simultaneously, they are probably caused by the same fault and the technician should focus on the closest one. For example, if both a B2 (Line) and B3 (Path) error are detected, there is a problem between the test set and the last line network element; the B3 error can be ignored until the B2 error is resolved.

Parity errors are also called Code Violations (not to be confused with bipolar violations) and designated CV-S, CV-L, CV-P, and CV-V.

Remote Error Indicator: REI

REI is a far-end response to parity errors. When a network element detects one or more parity errors, it sends an REI in the overhead of the signal back in the direction the parity error originated. The REI provides an indication of the number of parity errors detected. There is no REI for the section layer.

REI-L appears in the M0 and M1 bytes. The value of the byte indicates the number of B2 errors: 0-8 for M0 (STS/OC-1 signals) and 0-255 for M1 (STS/OC-3 and higher signals).

REI-P appears in bits 1-4 of the G1 byte, giving a number from 0-8 B3 errors.

REI-V appears in bit 3 of the V5 byte and only gives a simple indication whether BIP-2 errors were present, not a number.

5.3.5.3 Performance Monitoring Parameters

The following parameters are calculated separately over section, line, path, and virtual tributary path for both the near end and far end (except section).

SEFS: Severely Errored Frame Second (Section only)

A SEFS occurs when the framing pattern has an error for four or more consecutive frames.

CV: Code Violations

CV is a count of B1/B2/B3/BIP-2 errors (near end) or REI-L/P/V errors (far end).

ES: Errored Seconds

ES is any second with one or more errors. For example, if there are 5 B1 errors within one second, there would be 5 CV-S and 1

ES-S. If there is 1 B1 errors a second for five seconds, there would be 5 CV-S and 5 ES-S.

SES: Severely Errored Seconds

SES is any second that exceed a specified threshold of errors or AIS/RDI. SES-S will also be counted for Loss of Signal (LOS) and Severely Errored Frame (SEF)

The threshold depends on the line rate and type of error. For example, SES-L triggers on 615 B2 errors at OC-12 but 2,459 at OC-48. An AIS-L triggers a SES-L at any rate.

UAS: Unavailable Seconds

UAS starts after 10 seconds of SES and clears after 10 seconds without an SES.

FC: Failure Counts

A failure is a defect (AIS, RDI, etc.) that persists for 2.5 ± 0.5 seconds. Failure Counts are not counted for Section.

Failures can help distinguish between isolated events and a single persistent event. For example, an AIS-L that last 15 seconds would be 1 failure, but 3 AIS-L occurrences that lasted 5 seconds each would be 3 failures. In both cases, 15 unavailable seconds (UAS) would be recorded.

AS: Available Seconds

The elapsed time minus UAS. This is a non-standard PM parameter, but is included here as some users used to DS1 and DS3 testing may expect to see it.

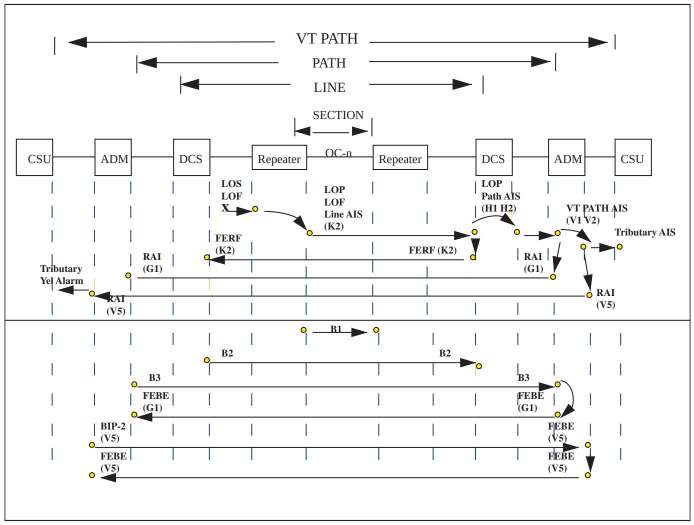


Figure 191   Alarm Signal Flow

SONET Defects to ANSI T1.105 and BELLCORE GR-253

Current Abbrev.	**Meaning**
Section	
LOS	Loss of Signal
OOF	Out Of Frame
LOF	Loss Of Frame
B1 (8 bits)	Section error monitoring
Line (L)	
B2 (n x 8 bits)	Line error monitoring
AIS-L	Line AIS
RDI-L	Line Remote Defect Indication (formerly known as LINE FERF)
REI-L	Line Remote Error Indication (formerly known as LINE FEBE)

STS Path (SP)

LOP-P	Path Loss of Pointer
NDF-P	Path New Data Flag
AIS-P	Path AIS
B3 (8 bits)	Path error monitoring
UNEQ-P	Path UNEQuipped
RDI-P	Path Remote Defect Indication (formerly known as STS Path FERF)
ERDI-P PAY	Path RDI Payload Defect
ERDI-P SER	Path RDI Server Defect
ERDI-P CON	Path RDI Connectivity Defect
REI-P	SP Remote Error Indication (formerly known as STS Path FEBE)
PDI-P	Path Payload Defect Indication
TIM-P	Path Trace Identifier Mismatch
PLM-P	Path Path Label Mismatch

Virtual Tributary (VT)

LOP-V	Loss of Pointer
NDF-V	VP New Data Flag
AIS-V	VP AIS
LOM	Loss of Multiframe
BIP-V	VT error monitoring
UNEQ-V	VT UNEQuipped (formerly known as VT Uneq.)
RDI-V	VT Remote Defect Indication
ERDI-V PAY	VT RDI Payload Defect
ERDI-V SER	VT RDI Server Defect
ERDI-V CON	VT RDI Connectivity Defect
REI-V	VT Remote Error Indication (formerly known as VT Path FEBE)
RFI-V	VT Remote Failure Indication
PDI-V	VT Payload Defect Indication
TIM-V	VT Trace Identifier Mismatch
PLM-V	VT Path Label Mismatch

5.4 DS3 Transmission

5.4.1 Introduction

DS3 Usage

DS3s 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.

DS3 Services

Telephone companies are 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.

5.4.2 DS3 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 192 for a simple example of typical equipment in a DS3 circuit.

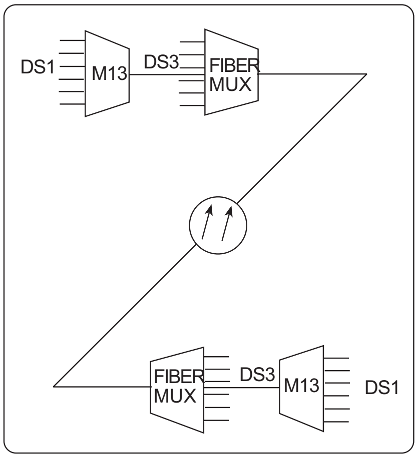


Figure 192 Typical DS3 Circuit

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 193 for an example of how data is translated into the electrical signal.

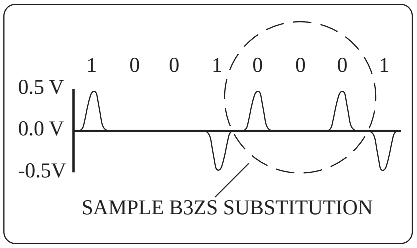


Figure 193 DS3 Data Transmission

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 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 zeros with a special bipolar violation code; see Figure 186. 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.

5.4.3 Framing and Alarms

Framing on a DS3 signal allows the two terminals of a DS3 line to synchronize on the signal and demultiplex subchannels in a predetermined order. It also allows a variety of maintenance and operational benefits.

M13 and C-bit parity framing

There are two common types of DS3 framing: the original M13 (often called M23) framing and the newer C-bit parity framing.

The original scheme for mapping DS1 into DS3 signals involved a two-stage process. First, 4 DS1s were multiplexed into a DS2 (6.312 Mb/s) signal. Then, 7 DS2s were multiplexed into a DS3 signal. These two steps are referred to as M12 and M23 multiplexing, respectively. Combined, they form what is known as M13. The M13 multiplexer is a common element found at the edges of a DS3 network.

In the traditional M13 scheme, stuff bits were added at each step to accommodate the asynchronous signals. The creation of the DS2 signal is a wasteful step. C-Bit parity framing eliminates the step by creating “pseudo-DS2” signals that do not require extra bit stuffing. This frees up bits that are then used for parity checking (C-bits), Far End Alarm and Control (FEAC), and Far End Block Error (FEBE) indication.

The next figure shows the basic DS3 framing format used by both the M13 and C-bit parity framing methods.

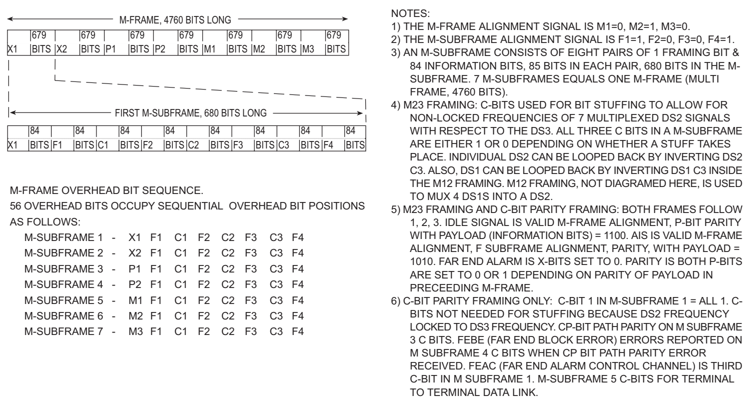


Figure 194   DS3 Framing: C-bit Parity & M23

Idle Signal

The DS3 idle signal allows DS3 circuits to stay out of service as desired without triggering network alarms.

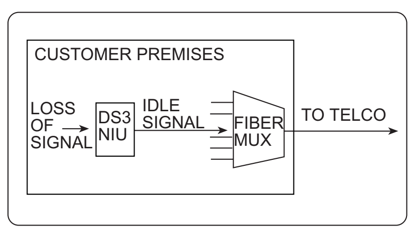


Figure 195 DS3 Idle Signal

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 195 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.

The DS3 idle signal is a validly framed DS3 signal with a payload consisting of a repeated 1100 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 196 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.

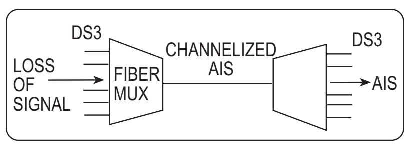


Figure 196 Generation of DS3 AIS

Remote Alarm Indication (RAI)

RAI, also known as a yellow 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 197. The RAI lets the M13 multiplex at the other end know that there is a service outage on the circuit. The RAI is transmitted by setting the X bits to 0.

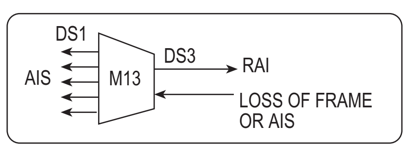


Figure 197 Generation of DS3 RAI

5.4.4 DS3 Performance

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 and in some DS3/1 multiplexers. In the multiplexers, DS1s can be looped back by inverting the third C bit in M13 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 198 shows a new service being tested from the central office using a test set and DS3 NIU.

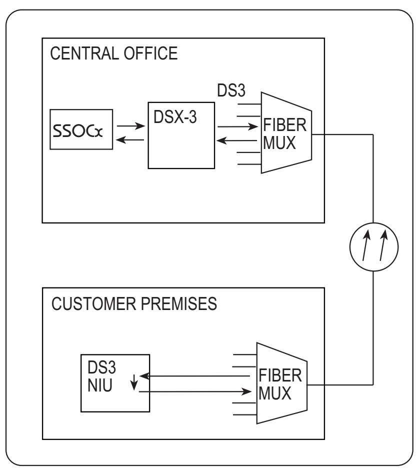


Figure 198 DS3 Loopback Testing

DS3 Performance Monitoring

C-bit parity framing enables end-to-end performance monitoring of DS3 circuits, while they are 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 199 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.

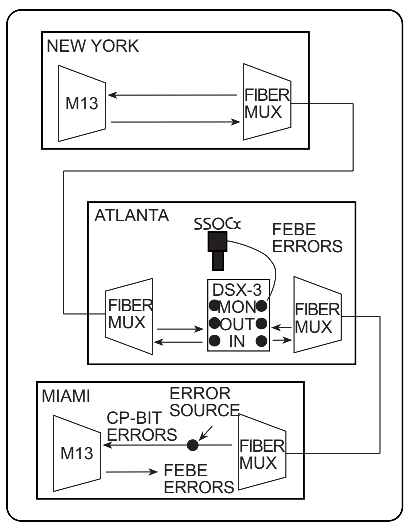


Figure 1979 DS3 End to End Performance Monitoring

5.5 DS1 Transmission

5.5.1 Introduction

DS1 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.

DS1 Services

Telephone companies are 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.

5.5.2 DS1 Network Elements

As shown in the next figure, a rich variety of equipment is available for T1 circuits.

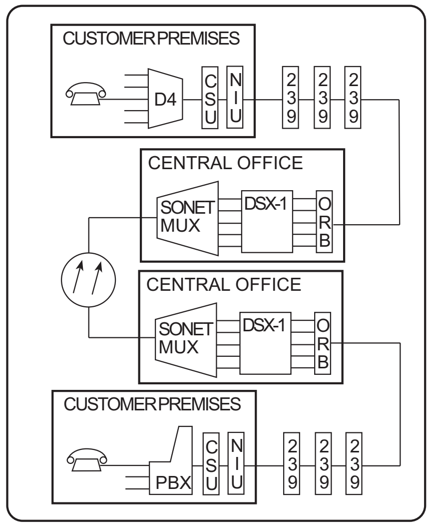


Figure 200 DS1 Network Elements

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 are located up to 6000 feet apart on a twisted pair span, 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. 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 variety of channel plug-ins to handle DDS-style circuits, private line circuits, and 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.

DS1 Signal

The DS1 signal is a 1.544 Mbps 3.0 Volt signal. Like the DS3 signal, it uses a bipolar format. Unlike DS3, there are two line codes used in transmission, Alternate Mark Inversion (AMI) and Bipolar 8-Zero Substitution (B8ZS).

AMI was the original line code used when DS1 was first introduced. However, its use is suboptimal in today's networks, which mix data transmission with voice transmission and which require near error-free quality.

The problem with AMI line coding is that it requires the terminal transmitting data to have at least a 12.5% average 1s density and a maximum of 15 consecutive zeros. This data content is impossible to guarantee when computer data is being transmitted, so transmission quality can suffer.

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

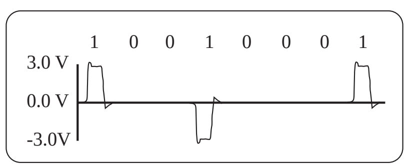


Figure 201 DS1 Pulse Transmission

5.5.3 T1 Framing

T1 framing is simpler than DS3 framing. In T1, there are 192 data bits and one framing bit. With framing, you can tell where the first bit of the frame is.

Most T1s are arranged with 24 channels of data, with one byte (8 bits) transmitted per channel per frame. Channel 1 is the first 8 bits after the frame bit, channel 2 is the second 8 bits after the framing bit and so on. 8000 frames are transmitted per second. Each channel provides 64 kbps bandwidth. See Figure 202.

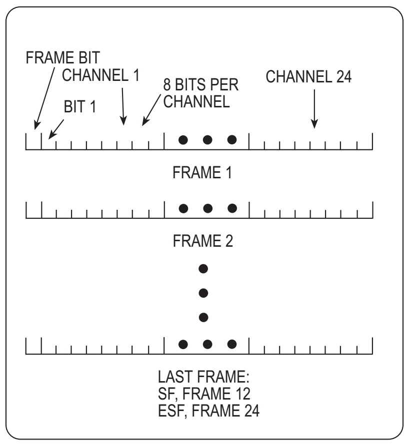


Figure 202 DS1 Frame Structure

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, which groups 24 frames together. Of the 24 framing bits, only 6 are used to establish the frame position, i.e. which frame is number 1, which frame is number 2, and so on. Another 6 are used for a CRC-6 (Cyclic Redundancy Check code - 6), and 12 are used for the ESF Data Link (DL).

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 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 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 which is transmitted through the network.

Through the Nyquist theorem, 8000 samples per second must be taken in order to achieve the 4000 Hz bandwidth requirement. As shown in Figure 203, the analog signal is sampled at 125 micro second intervals, 8000 times per second. Each sample is a measurement of the voltage of the analog signal. The voltage level is then converted to an 8-bit binary word. An 8-bit word provides 256 different levels, which is not very many.

To produce a higher quality sound, a µ-law transformation is used which puts a constant dB level in between each voltage step. This creates a nonlinear relationship between the pulse amplitude and the level number, but it is more pleasing to the ear because it provides a more constant signal to noise ratio at a wide range of volumes.

Each 8-bit word occupies one channel in one frame. Because there are 24 channels available, up to 24 conversations can be carried on the T1 signal.

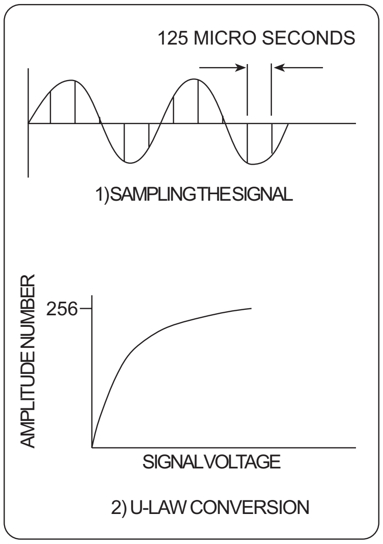


Figure 203   PCM Sampling and μ-Law Encoding

5.5.4 DS1 Performance

Switching

A basic understanding of switching is helpful when troubleshooting T1 problems. The DS3 transmission section pointed out that DS1, DS2, and DS3 signals are plesiochronous, that is, they are not frequency-locked with respect to each other.

The DS2 and DS3 signals have stuff bits built into the framing, so that all signals can be slipping with respect to each other and not cause any transmission errors 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 (also 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, which 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.

Next, it assembles all the bytes for each transmit DS1, inserts any idle code on timeslots that are not actively in the middle of a call, and inserts an appropriate framing bit for the frame type being used. It then transmits each DS1 frame during 1/8000 of a second. There may be several 125 µsec periods of delay for a byte as it moves through the switch.

Not all the DS1s will have the frames ending at exactly the same moment in time.Therefore, 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 moment required.

All the DS1s must be received and transmitted at exactly the same frequency, the frequency 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 empties, the switch must insert extra data in each of the timeslots that are transmitted on the cross-connected channels. An error has now occurred, because what is transmitted is not the same as what is received.

Likewise, if any received DS1's frequency is higher than the switch, sooner or later the receive buffer will overflow because bits are coming in faster than they are being taken out. Once the buffer overflows, some bits which are received will not be transmitted on the cross-connected channel. An error has again occurred, this time because data has been lost.

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

Synchronization

DS1 circuits should be synchronized to avoid the switching problems described above. 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 slip by more than 100 to 300 bps, a digital switch may even put the DS1 out of service, creating 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 the next figure.

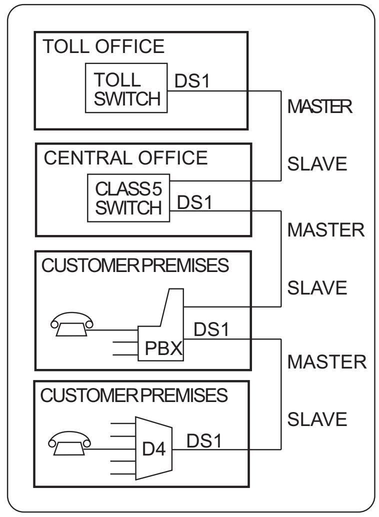


Figure 204 Timing Distribution

A network element which is slave timed to another network element may also be the master to other network elements attached to it. 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 way to be timed is to be internally timed. The advantage of this is that the element will always be able to generate a signal, so no clock signal is required.

Test sets doing acceptance testing are usually set to internal timing. Note that internal timing is not acceptable when the test set will be transmitting toward a switch for nx64 kbps testing, when the switch is drawing its timing from something other than the test set. In this case the test set should be loop timed.

AIS and Yellow Alarms

In DS1, AIS and yellow alarms work just like they do in DS3. An intermediate network element such as an M13 multiplex, 1x1 DCS, or SONET mux, is supposed 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 which is attached. See Figure 205 for diagrams of how the AIS and yellow alarms are transmitted.

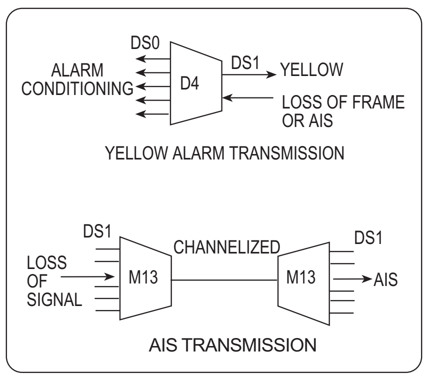


Figure 205 AIS & Yellow Alarms

Loopbacks

Loopback testing lets you quickly verify the performance of a new DS1 circuit. It can greatly speed the fault sectionalization process on a circuit that is not working properly.

Loopback capabilities are provided in a variety of equipment - new central office repeaters, new regenerative line repeaters, NIUs, CSUs, and M13 multiplexes. The general characteristics of this equipment have been discussed in the DS1 equipment section. The next figure shows the variety of loopback points available from the central office during a fault sectionalization process.

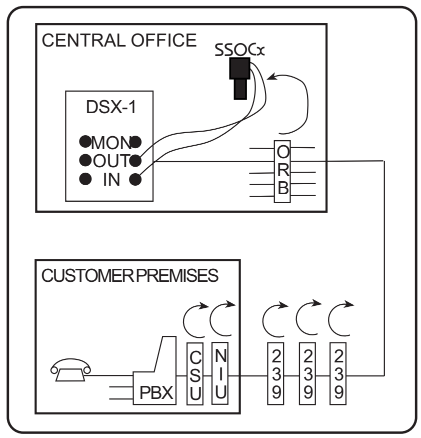


Figure 206   DS1 Loopback Testing

5.6 Troubleshooting

Here are some helpful suggestions for when your test set is not performing as expected.

Problem: PULSES, FRAME, ERRORS and other LEDs are red, but there should be no problem.

Suggestions:

1) Test Configuration may be incorrect. When the receiver has been connected, press the AUTO key.
2) Check the cords; they may be loose or dirty.
3) Verify the RxLevel.
4) Try reversing the cords.
5) Verify the TxCHN and RxCHN match the channels to be tested.

Problem: Keys do not work properly.

Suggestion:

1) Verify SHIFT status by pressing and releasing the SHIFT key until it shows the appropriate staus (lit to allow you to enter the indicated letters or digits).

Problem: Test set will not power up properly.

Suggestion:

1) Make sure the power cord is plugged in.
2) Make sure the Software cartridge is inserted firmly and seated correctly. A flickering screen usually indicates that the Software 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) Press the contrast control key to make sure you have good contrast.
2) Try switching on the screen backlight with the backlight key.

Problem: Test set shows Security Violation when switched on.

Suggestion:

1) Make sure the serial number on the back of the software cartridge matches the serial number on the back of the test set.

Each software cartridge is programmed for a specific test set. If software cartridges are swapped between test sets, your test set will not work properly.
2) Call Customer Service.

Problem: Test set performs improperly.
Suggestion:
1) Try changing the Test Configuration settings, then changing them back.
2) Try switching the test set off, then switching it on again.
3) Try the ERASE NV RAM item in the SYSTEM CONFIGmenu.

CAUTION: 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: Test Patterns will not synch (DS3, DS1).
Suggestions:
1) Verify that you are transmitting the desired pattern in the SETUP TEST PATTERN menu.
2) Verify RxPattern is correct.
3) Enter the SETUP TEST PATTERN screen, and make sure the PATTERN is NORMAL.

Problem: Test patterns will not synch with other test equipment.
Suggestions:
1) Verify that the test set is configured for the same framing, line coding and test pattern as the other test equipment. If you are unsure of the framing and coding, use the AUTO key.
2) Fpr DS1 patterns, use VIEW RECEIVED DATA to examine the pattern being received. The pattern being received may not be a standard test pattern.
3) Some ANSI and ITU-T patterns (2e31, 2e23, 2e15) are inverses of each other. Invert the pattern in the Setup Test Pattern screen.

5.7 Calibration

The SunSet OCx is a self-calibrating test set. It does not require you to perform any adjustments and does not need to be returned to Sunrise Telecom for calibration.

Sunrise Telecom recommends that this procedure be performed once per year to verify proper calibration of the unit. If you encounter any errors or problems during this procedure, contact Sunrise Telecom Customer Service.

Boot-up Procedure

1) Switch the test set on.

2) Verify that all LED's blink and that each LED lights properly. The POWER LED should always light as green and the BATTERY LED should light only when the battery is nearly fully discharged.

3) Verify that there are no errors listed on the screen at the completion of the boot-up process.

T1 Procedure

4) Connect a single bantam to single bantam cord from T1-1 Tx to T1-1 Rx.

5) Enter TEST CONFIGURATION and configure the test set for:

TEST MODE: PT-PT	
INTERFACE: DS1	PAYLOAD: DS1
	FRAME: ESF
MEASURE: SINGLE	RATE: 1.544M
	CODE: B8ZS
	TxSRC: PATTERN
	TxCLK: INTERN
	LBOLVL: 0 dB
	RxLVL: TERM

7) If necessary, press the HISTORY key to acknowledge the flashing history LEDs and stop them from flashing. Verify that the green T1-1 PULSES, FRAME, and PAT SYNC LEDs are on. The B8ZS LED may also be on, depending on the test pattern that you are transmitting.

8) Return to the MAIN MENU and go to MEASUREMENT RESULTS. STOP (F3) the current measurement then press START (F3) to restart the measurement.

9) Press PAGE-UP (F1) twice to view the SIGNAL MEASUREMENTS LINE 1 screen. Verify that the Vpk is between 2.700 and 3.300 V. Verify that the FREQ is 1544000.

10) Return to the MAIN MENU and go to TEST CONFIGURATION.

11) Connect a single bantam to single bantam cord from T1-2 Tx to T1-1 Rx. Yes, T1-1 Rx.

12) Configure the set for:

TEST MODE: PT-PT	
INTERFACE: DS1	PAYLOAD: DS1
	FRAME: ESF
	RATE: 1.544M
	CODE: B8ZS
	TxSRC: PATTERN
	TxCLK: INTERN
MEASURE: DUAL	
	LBOLVL: 0 dB
	RxLVL: TERM

13) If necessary, press the HISTORY key to acknowledge the flashing history LEDs and stop them from flashing. Verify that the green T1-1 PULSES, FRAME, and PAT SYNC LEDs are on. The B8ZS LED may also be on, depending on the test pattern that you are transmitting.

14) Return to the MAIN MENU and go to MEASUREMENT RESULTS. STOP (F3) the current measurement then press START (F3) to restart the measurement.

15) Press PAGE-UP (F1) three times to view the SIGNAL MEASUREMENTS LINE 1 screen. Verify that the Vpk is between 2.700 and 3.300 V. Verify that the FREQ is 1544000.

T3 Procedure

16) Connect a single BNC to single BNC cord from T3 Tx to T3 Rx.

17) Enter TEST CONFIGURATION and configure the test set for:

TEST MODE: PT-PT
INTERFACE: DS3 PAYLOAD: DS3

FRAME: C-BIT TxLVL: DSX
TxSRC: PATTERN RxLVL: DSX
TxCLK: INTERN

18) If necessary, press the HISTORY key to acknowledge the flashing history LEDs and stop them from flashing. Verify that the green T3 PULSES, FRAME, and PAT SYNC LEDs are on.

19) Return to the MAIN MENU and go to MEASUREMENT RESULTS. STOP (F3) the current measurement then press START (F3) to restart the measurement.

20) Press PAGE-UP (F1) twice to view the SIGNAL MEASUREMENTS T3 screen. Verify that the Vpk is between 0.650 and 0.800 V. Verify that the FREQ is 44736000.

STS-1 Procedure

The following only applies to units that support SONET testing.

21) Connect a single BNC to single BNC cord from STS-1 Tx to STS-1 Rx.

22) Enter TEST CONFIGURATION and configure the test set for:

TEST MODE: PT-PT
INTERFACE: STS-1 PAYLOAD: STS-1

TxCLK: INTERN TxLVL: DSX
RxLVL: DSX

23) If necessary, press the HISTORY key to acknowledge the flashing history LEDs and stop them from flashing. Verify that the green SONET PULSES, FRAME, and PAT SYNC LEDs are on.

24) Return to the MAIN MENU and go to MEASUREMENT RESULTS. STOP (F3) the current measurement then press START (F3) to restart the measurement.

25) Press PAGE-UP (F1) twice to view the SIGNAL MEASUREMENTS STS-1 screen. Verify that the Vpk is between 0. 650 and 0.800 V. Verify that the FREQ is 51840000.

Optical Procedure

The following only applies to units that support OC-3 and higher rates.

26) Connect an optical patch cord from OC Tx to OC Rx.

Warning: If the unit has been configured with a high-powered laser, an attenuator may be required. Consult the optical ranges listed on the left side the unit. When in doubt, add a -10 dB attenuator.

27) For units configured for dual wavelengths, go to the SETUP SONET PORT screen and set the Optic Wavelength to 1310 nm.

28) Enter TEST CONFIGURATION and configure the test set for:

TEST MODE: PT-PT
INTERFACE: OC-3 PAYLOAD: STS3c

TxSRC: PATTERN
TxCLK: INTERN

29) If necessary, press the HISTORY key to acknowledge the flashing history LEDs and stop them from flashing. Verify that the green SONET PULSES, FRAME, and PAT SYNC LEDs are on.

30) Return to the MAIN MENU and go to MEASUREMENT RESULTS. STOP (F3) the current measurement then press START (F3) to restart the measurement.

31) Press PAGE-UP (F1) twice to view the OPTICAL MEASUREMENTS STS-1 screen. Verify that the FREQ is 155520000.

32) Note the optical PWR reading. Using an independent, calibrated optical power meter, confirm that the optical power is within 2 dBm of the PWR reading.

33) Verify that the transmitted power of the SunSet OCx is within the range specified on the side of the unit.

34) Repeat steps 27 through 32 for each of the following rates, as applicable:

INTERFACE: OC-12 PAYLOAD: STS12c
Expected Frequency: 622080000

INTERFACE: OC-48 PAYLOAD: STS48c
Expected Frequency: 2488320000

35) If you have a dual wavelength unit, repeat steps 27 through 34 for 1550 nm. A 10 dB attenuator is required

36) The calibration procedure is now complete.

5.8 Customer Service

Sunrise Telecom Customer Service is available 24 hours a day.

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 OCx is 3 years from the date of shipment, with one-year coverage of the battery and accessories. A Return Merchandise Authorization (RMA) Number is required before any product may be shipped to Sunrise Telecom Incorporated for repair. Out-of-warranty repairs require both an RMA and a Purchase Order before the unit is returned. All repairs are warranted for 90 days.

Please contact Customer Service if you need additional assistance:

Customer Service
Sunrise Telecom Incorporated
302 Enzo Dr.
San Jose, CA 95138
U.S.A.
Tel: 1 408 363 8000 or
1-800-701-5208 (24 hr.)
Fax: 1 408 363 8313
Internet: http://www.sunrisetelecom.com
Email: support@sunrisetelecom.com

5.9 Express Limited Warranty

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

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

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

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

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

F. No Guaranty, Nonapplication of Warranty. COMPANY does not guaranty or warrant that the operation of hardware, software, or firmware will be uninterrupted or error-free. Further, the warranty shall not apply to defects resulting from:

(1) Improper or inadequate maintenance by CUSTOMER;
(2) CUSTOMER-supplied software or interfacing;
(3) Unauthorized modification or misuse;
(4) Operation outside of the environmental specifications for the product;
(5) Improper site preparation or maintenance; or
(6) Improper installation by CUSTOMER.

5.10 Specs & Configs

5.10.1 Specifications

OC-12/3 CONNECTORS

OC-1/3/12: SCPC SM-F (default) or FCPC SM-F (SSOCx-FC)
STS-1 and DS3: BNC
DS1: Bantam, Line 1 and 2
External Clock: BNC
Handset Port: 4-pin modular plug
Serial Port: 8-pin Mini DIN RS232C (V.24), DTE
DC Power

OC-48 CONNECTORS

OC-3/12/48: Universal field interchangeable connector Adapters include:

- SCPC SM-F (default),FCPC SM-F (SSOCx-FC-48), STPC SM-F (SSOCx-ST-48)
- Dual wavelength configureations OC-3/12/48 LCPC

STS-1 and DS3: BNC
DS1/E1: Bantam, Line 1 and 2
External Clock: BNC
Serial Port: 8-pin Mini DIN RS232C (V.24), DTE
DC Power

OC-12/3 STATUS/ALARM INDICATORS

Power and low battery LED indicators
Logic: Pattern Sync and Bit Error
SONET: Pulses, Alarm, Frame, Errors, Pointer, and ATM Cell
DS3: Pulses, Alarm, Frame, and Errors
DS1: Pulses, Alarm, Frame, Errors, B8ZS, and VT Pointer

OC-48 INDICATORS

OC-3/12/48: Universal field interchangeable connector Adapters include:

- SCPC SM-F (default),FCPC SM-F (SSOCx-FC-48), STPC SM-F (SSOCx-ST-48)
- Dual wavelength configureations OC-3/12/48 LCPC

STS-1 and DS3: BNC
DS1/E1: Bantam, Line 1 and 2
External Clock: BNC
Serial Port: 8-pin Mini DIN RS232C (V.24), DTE
DC Power

OC-12/3 SONET

Rates: STS-1, OC-1, OC-3, OC-12

Payloads: OC-12c, OC-3c, DS3, DS3/DS1, VT1.5 Asynchronous

Clock Source
- Internal: 19.44 MHz, ±5 ppm
- Loop: Recovered, ±300 ppm
- BITS: ±5 ppm

Framing: Conforms to ANSI T1.105 and Bellcore TR-253

Line Coding: B3ZS (STS-1), NRZ (Optical)

Optical Transmitter
- Wavelength: 1310 nm (standard) or 1550 nm (SSOCx-15)
- Power Output: -15 to -8 dBm (1310), -5 to 0 dBm (1550)
- Laser Safety: IEC825-1, Class 1, 21 CFR 1040.10 & 1040.11

Optical Receiver
- Wavelength: 1100-1600 nm
- Input Sensitivity: -31 dBm (1310), -36 dBm (1550)
- Max. Input power: 0 dBm typical

STS-1 Transmitter
- High, DSX, Low. DSX conforms to ANSI T1.102 and Bellcore TR-NWT-000253

STS-1 Receiver
- Input Impedance: 75 ohm
- Input Sensitivity: +3 dB to –26 dB resistive loss or 450 ft cable loss from STSX-1

OC-3c/12c Test Patterns
- 2^{23}-1, 2^{20}-1, 2^{15}-1, 2047, 1100, 0101, 1111, 0000
- 10 user patterns defined up to 16 bits. Pattern names up to 10 characters
- Test pattern inversion

Other Test Patterns based on DS3, DS1, or VT1.5 payload

Error Injection
- Frame, Line FEBE, Path FEBE, VT FEBE, VT BIP, Bit, plus payload errors, B1, B2, B3

Alarm Generation
- AIS, Line AIS, Line RDI, Line LOP, Path AIS, Path RDI, Path LOP, VT AIS, VT RDI, VT LOP, LOF

OC-48 SONET

Rates: STS-1, OC-3, OC-12, OC-48

Payloads: STS-48c, STS-12c, STS-3c, STS-1, DS3, DS3/DS1, VT1.5 Asynchronous, Nx64k, Nx56k

Clock Source
- Internal: 19.44 MHz, ± 5 ppm

Loop: Recovered, ± 300 ppm
BITS: ± 5 ppm
Framing: Conforms to ANSI T1.105 and Telcordia GR-253
Line Coding: B3ZS (STS-1), NRZ (Optical)

Standard Chassis (SSOCx-E)
Transmitter
– Wavelength: 1310 nm typical
– Power: -10 dBm to -8 dBm
Receiver
– Wavelength: 1100 nm to 1600 nm
– Range[1]: -27 dBm to -7 dBm
– Typical low sensitivity[1]: -31 dBm
– Maximum: -5 dBm

Multimode Single Wavelength Option (SSOCx-MM-48)
Transmitter
– Wavelength: 1310 nm typical
– Power: -6 dBm to 0 dBm
Receiver
– Wavelength: 1100 nm to 1600 nm
– Range[1]: -17 dBm to +1 dBm
– Typical low sensitivity[1]: -19 dBm
– Maximum: +1 dBm
– Multimode fiber compatible

Long Reach 1310 Option (SSOCx-LR-48)
Transmitter
– Wavelength: 1310 nm typical
– Power: -3 dBm to +3 dBm
Receiver
– Wavelength: 1100 nm to 1600 nm
– Range[1]: -27 dBm to -7 dBm
– Typical low sensitivity[1]: -31 dBm
– Maximum: -5 dBm

Long Reach 1550 Option (SSOCx-1550-48)
Transmitter
– Wavelength: 1550 nm typical
– Power: -3 dBm to +3 dBm
Receiver
– Wavelength: 1100 nm to 1600 nm
– Range[1]: -27 dBm to -7 dBm
– Typical low sensitivity[1]: -31 dBm
– Maximum: -5 dBm

Long/Short Dual Wavelength Option (SSOCx-DW-48-1)
Connectors: 3 each LCPC
Transmitter 1
– Wavelength: 1310 nm typical
– Power: -10 dBm to -8 dBm

Transmitter 2
– Wavelength: 1550 nm typical
– Power: -3 dBm to +3 dBm
Receiver
– Wavelength: 1100 nm to 1600 nm
– Range[1]: -26 dBm to -7 dBm
– Typical low sensitivity[1]: -30 dBm

Multimode Dual Wavelength Option (SSOCx-DW-48-2)

Connectors: 3 each LCPC
Transmitter 1
– Wavelength: 1310 nm typical
– Power: -6 dBm to 0 dBm
Transmitter 2
– Wavelength: 1550 nm typical
– Power: -3 dBm to +3 dBm
Receiver
– Wavelength: 1100 nm to 1600 nm
– Range[1]: -17 dBm to +1 dBm
– Typical low sensitivity[1]: -19 dBm
– Maximum: +1 dBm
– Multimode fiber compatible

Long/Long Dual Wavelength Option (SSOCx-DW-48-3)

Connectors: 3 each LCPC
Transmitter 1
– Wavelength: 1310 nm typical
– Power: -3 dBm to +3 dBm
Transmitter 2
– Wavelength: 1550 nm typical
– Power: -3 dBm to +3 dBm
Receiver
– Wavelength: 1100 nm to 1600 nm
– Range[1]: -26 dBm to -7 dBm
– Typical low sensitivity[1]: -30 dBm
– Maximum: -5 dBm

Laser Safety: IEC825-1, Class 1, 21 CFR 1040.10 & 1040.11
Jitter Tolerance: Per Telcordia GR-253 Section 7
STS-1 Transmitter: High, DSX, Low. DSX conforms to ANSI T1.102 and Telcordia TR-NWT-000253
STS-1 Receiver
Input Impedance: 75Ω
Input Sensitivity: +3 dB to -26 dB resistive loss or 450 ft cable loss from STSX-1
OC-3c/12c Test Patterns
2^{23}-1, 2^{20}-1, 2^{15}-1, 2047, All 1s, All 0s, Alt 1010
10 user patterns defined up to 16 bits. Pattern names up to 10 characters
Test pattern inversion

OC-48c Test Patterns

2^{31}-1, 2^{23}-1, 2^{15}-1, All 1s, All 0s, Alt 1010

10 user patterns defined up to 16 bits. Pattern names up to 10 characters

Test pattern inversion

Other Test Patterns based on DS3, DS1, or VT1.5 payload

Error Injection: Frame, Line FEBE, Path FEBE, VT FEBE, B1, B2, B3, VT BIP, Bit, plus other payload errors

Alarm Generation: AIS, Line AIS, Line RDI, Path AIS, Path RDI, Path LOP, VT AIS, VT RDI, VT LOP, LOM, LOF

OC-12/3 DS3

Clock Source

Internal: 44.736 MHz, ±5 ppm

Loop: Recovered, ±300 ppm

Framing

Unframed, M13, and C-BIT

Conforms to ANSI T1.102, 107, 107A, 403, and 404 as well as Bellcore TR-TSY-000009 and TR-TSY-000191

Coding: B3ZS

Transmitter

High, DSX, Low

Pulse Shape: Conforms to CCITT G.703, Bellcore TR-TSY-000499

Receiver

Input Impedance: 75 ohm

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

Test Patterns

2^{23}-1, 2^{20}-1, 2^{15}-1, 2047, 511, 127, 63, All 1s, All 0s, Alt 1010

10 user patterns defined up to 24 bits. Pattern names up to 10 characters

Test pattern inversion

Error Injection

BPV, Logic, Logic+BPV, Frame, C-Bit, P-Bit, FEBE

Programmable error burst 1 to 9999 count, or error rate 2 x 10^{3} to 1 x 10^{-9}

Alarm Generation

AIS, Yellow, Idle, DS2 AIS, DS2 Yellow

OC-48 DS3

Clock Source

Internal: 44.736 MHz, ± 5 ppm

Loop: Recovered, ± 300 ppm

Framing
  Unframed, M13, and C-bit
  Conforms to ANSI T1.102, 107, 107A, 403, & 404, and Telcordia TR-TSY-000009 & TR-TSY-000191
Coding: B3ZS
Transmitter
  High, DSX, Low
  Pulse Shape: Conforms to ITU-T G.703, Telcordia TR-TSY-000499
Receiver
  Input Impedance: 75Ω
  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 Telcordia TR-TSY-000009
Test Patterns
  2^{23}-1, 2^{20}-1, 2^{15}-1, 2047, 511, 127, 63, All 1s, All 0s, Alt 1010
  10 user patterns defined up to 24 bits. Pattern names up to 10 characters
  Test pattern inversion
Error Injection
  BPV, Logic, Logic+BPV, Frame, C-bit, P-bit, FEBE
  Programmable error burst 1 to 9999 count, or error rate 2 x 10^{-3} to 1 x 10^{-9}
Alarm Generation: AIS, Yellow, Idle, DS2 AIS, DS2 Yellow
Framing: Unframed, PCM-30, PCM-31, with or without CRC-4, conforms to ITU-T G.704
Programmable send frame words: Manual/auto E-bits, MFAS word bit 5, bit 6 (MFAS RAI), bit 7, bit 8, MFAS ABCD, FAS RAI, display and print & send and receive FAS/NFAS and MFAS/NMFAS words, auto CRC-4 generation, freely settable Sa4, Sa5, Sa6, Sa7, Sa8, bits to 1 or 0 for 8 frames
Set idle channel code and ABCD bits (PCM-30)

OC-12/3 DUAL DS1

Clock Source
  Internal: 1.544 MHz, ±5 ppm
  External: ±300 ppm, TTL, 0 to -30 dB resistive
  Loop: Recovered, ±300 ppm
Framing
  Unframed, 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
Coding: AMI, B8ZS
Transmitter
  Line Build Out (LBO): 0, -7.5, -15, -22.5 dB
  Pulse shape conforms to Telecordia TR-TSY-000499; reference: G.703, CB113, CB119, CB132, CB143, PUB62508, PUB62411

Receiver

- Terminate: +6 to -36 dB cable loss, 100 ohm, ±1%
- Bridge: +6 to -36 dB cable loss, >1000 ohm
- DSX Monitor: -15 to -25 dB, resistive; 100 ohm, ±1%

Test Patterns

- 2^{23}-1, 2^{20}-1, 2^{15}-1, 2047, 511, 127, 63, QRSS, All 1s, All 0s, Alt 1010, 1-8, 1-16, 3-24, 1-4, 55-DALY, 55-Octet, FOX, Yellow, Idle
- 10 user patterns defined up to 32 bits. Pattern names up to 10 characters
- Test pattern inversion

Error Injection

- BPV, Logic, Logic+BPV, CRC-6, Frame
- Programmable error burst 1 to 9999 count, or error rate 2 x 10^{3} to 1 x 10^{-9}

Alarm Generation: AIS, Yellow, Idle

Fractional T1

- Error measurements, channel configuration verification
- Nx64 kbps, Nx56 kbps, N=1 to 24

OC-48 DUAL DS1

Clock Source

- Internal: 1.544 MHz, ± 5 ppm
- External: ± 300 ppm, TTL, 0 to -30 dB resistive
- Loop: Recovered, ± 300 ppm

Framing: Unframed, SF-D4, ESF, SLC-96*. Conforms to ANSI T1.102, 107, 107A, 403, and 404. Also Telcordia TR-TSY-000009 and TR-TSY-000191. *SLC is a registered trademark of AT&T.

Coding: AMI, B8ZS

Transmitter

- Line Build Out (LBO): 0, -7.5, -15, -22.5 dB
- Pulse shape conforms to Telcordia TR-TSY-000499; reference: ITU-T G.703, CB113, CB119, CB132, CB143, PUB62508, PUB62411

Receiver

- Terminate: +6 to -36 dB cable loss, 100Ω, ± 1%
- Bridge: 1000Ω
- DSX Monitor: -15 to -25 dB, resistive; 100Ω, ± 1%

Test Patterns

- 2^{23}-1, 2^{20}-1, 2^{15}-1, 2047, 511, 127, 63, QRSS, All 1s, All 0s, Alt 1010, 1-8, 1-16, 3-24, 1-4, FOX, Yellow, Idle
- 10 user patterns defined up to 32 bits. Pattern names up to 10 characters
- Test pattern inversion

Error Injection

- BPV, Logic, Logic+BPV, CRC-6, Frame

Programmable error burst 1 to 9999 count, or error rate 2 x 10^{-3} to 1 x 10^{-9}
Alarm Generation: AIS, Yellow, Idle
Fractional T1
Error measurements, channel configuration verification
Nx64 kbps, Nx56 kbps, N=1 to 24

OC-12/3 MEASUREMENTS

G.821 and general errors: Bit error, bit error rate, errored seconds, %errored seconds, severely errored seconds, %severely errored seconds, error-free seconds, %error-free seconds, available seconds, unavailable seconds, sync loss seconds, degraded minutes

SONET Signal loss second, frame loss second, loss of clock second, out of frame, loss of pointer second, path AIS second, line AIS second, path RDI, REI second, section CV B1, line CV B2, path CV B3, BPV, Positive/Negative pointer adjustments, Path REI, frequency, STS-1 peak voltage (V), STS-1 power (dBm)

VT1.5: VT LOP seconds, FEBE, VT RDI seconds, VT AIS seconds, BIP-2 error, VT pointer Positive/Negative adjustment

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, %errorfree 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, Yellow alarm seconds

DS2 Defects: LOF, AIS, Yellow, FE

DS1 Defects: LOF, AIS, Yellow, FE, FE Rate, Current FER, Frame Slips, CRC, CRC Rate, Current CRC, ES, %ES, SES, %SES, UAS, %UAS, EFS, %EFS

DS1 BPV, BPV rate, F-bit error, bit error, CRC-6 block error, CRC-6 block error rate, BPV, out of frame 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 0s seconds

Signal Measurements

Signal available seconds count and percent, loss of signal seconds count and percent, low density seconds count, excess 0s seconds count, AIS seconds count

Receive bit rate: 1542 to 1546 kbps, ±1 bps, external or internal clock

Receive level (volts and dBdsx): Vpk

Frequency Measurements

Moving bar graph of slip count, max frequency, min frequency, clock slips,frame slips, max positive wander, max negative wander

General

Continuous measurement

Elapsed time, remaining time

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 timeslots as test pattern, 10 patterns

OC-48 MEASUREMENTS

SONET defects: LOS, LOF, OOFS, AIS-L RFI-L, RDI-L, REI-L, AIS-P, LOP-P, UNEQ-P, PLM-P, PDI-P, RFI-P, RDI-P, REI-P, AIS-V, LOP-V, TIM-V, UNEQ-V, PLM-V, PDI-V, RFI-V, RDI-V, ERDI-V, REI-V, B1, B2, B3, BIP-2, severely errored frame seconds, %severely errored frame seconds, errored seconds, %errored seconds, severely errored seconds, %severely errored seconds, unavailable seconds, %unavailable seconds, error free seconds, %error free seconds, failure counts

SONET Pointer: Justification, Increase, Decrease

SONET Signal: BPV*, BPV Rate*, Vpk*, Power, Frequency, Min/Max Frequency (*STS-1 only)

DS3 Defects: LOF, AIS, Yellow, Idle, FE (frame errors), FE Rate, FEBE, C-bit, P-bit, errored seconds, %errored seconds, severely errored seconds, %severely errored seconds, unavailable seconds, %unavailable seconds, error free seconds, %error free seconds

DS3 Signal: BPV, BPV Rate, Vpk, Power, Frequency, Min/Max Frequency

DS2 Defects: LOF, AIS, Yellow, FE

DS1 Defects: LOF, AIS, Yellow, FE, FE Rate, Current FER, Frame Slips, CRC, CRC Rate, Current CRC, errored seconds, %errored seconds, severely errored seconds, %severely errored seconds, unavailable seconds, %unavailable seconds, error free seconds, %error free seconds

DS1 Signal: BPV, BPV Rate, EXZS, LDNS, Vpk, Power, Frequency, Min/Max Frequency, Clock Slips, +Wander, -Wander
Bit Performance (G.821): Bit errors, BER, errored seconds, %errored seconds, severely errored seconds, %severely errored seconds, unavailable seconds, %unavailable seconds, error free seconds, %error free seconds, available seconds, %available seconds, pattern loss, %pattern loss

OC-12/3 Loopback and Span Control

Inband, ESF datalink, and user programmable 24 bits
M13 C-bit loopbacks per TR-TSY-000009
DS3 FEAC loopbacks per ANSI T1.404

OC-48 Loopback and Span Control

DS1 Inband, ESF data link, and 10000
M13 C-bit loopbacks per Telcordia TR-TSY-000009
DS3 FEAC loopbacks per ANSI T1.404

OC-12/3 SONET Overhead Control

Monitor Section, Line, and Path overhead bytes
 View hex value of all bytes
 Decode bytes per Telcordia GR-253
Transmit Section, Line, and Path overhead bytes by hex value
 Select K1/K2, S1, C2, Z4 decodes
J1 Path Trace: Send/Receive 64- or 16-byte ASCII Trace
SS Bit Manipulation

OC-48 SONET OVERHEAD CONTROL

Monitor and Transmit Path, Line, and Section overhead bytes
ASCII decode of 60-byte Path Trace (J1)
VT1.5 overhead control

OC-12/3 Voice Frequency Functions

Monitor speaker with volume control for Line 1 & 2
Built-in microphone/speaker or optional handset
View all 24 channel A, B (C, D) bits for Line 1 & 2
Control A, B (C, D) bits (on/off-hook, wink)
Supervision types: E&M, loop start, ground start, FXO, FXS, User
Companding law - µ Law
VF Level and Frequency Measurement
 Level: +3 to -60 dBm, resolution 0.1 dBm
 Frequency: 50 to 3950 Hz, resolution 1 Hz
VF tone generation
 Variable tone: 50 to 3950 Hz @ 1 Hz step; +3 to -60 dBm @ 1 dBm
 Fixed tones: 404, 1004, 1804, 2713, 2804 Hz @ 0 dBm and -13 dBm

Signal-to-Noise (S/N)
Noise with filters: 3-kHz flat, C-message, C-notch

OC-48 Voice Frequency Functions

Monitor speaker with volume control for Line 1 & 2
Built-in microphone/speaker or optional handset
View all 24 channel A,B (C,D) bits for Line 1 & 2
Control A,B (C,D) bits (E&M, on/off hook, wink)
Companding law - u Law
VF Level and Frequency Measurement
  Level: +3 to -60 dBm, resolution 0.1 dBm
  Frequency: 50 to 3950 Hz, resolution 1 Hz
VF tone generation
  Variable tone: 50 to 3950 H @ 1 Hz step. +3 to -60 dBm @ 1 dBm
  Fixed tones: 404, 1004, 1804, 2713, 2804 Hz @ 0 dBm and -13 dBm
Signal to Noise (S/N)
Available at DS1 demapped from any rate

Note: See individual Protocol manuals for specifications.

OC-12/3 SOFTWARE OPTIONS

VF MEASUREMENT AND DIALING (SWOCx-C)

MF/DTMF/DP dialing up to 32 digits, 10 user programmable quick dial number for each tone type
MFR1 digits, 0 - 9, KP, ST, ST1-3, Pause
DTMF digits, 0 - 9, *, #, A, B, C, D, Pause
DP digits, 0 - 9, Pause
Programmable interdigital period, tone period, and tone level (MF, DTMF)
Programmable %break and interdigital period @ 10 pps (DP)
MF/DTMF decode up to 40 received digits. Analyze number, high/low frequencies, high/low levels, twist, tone period, interdigital time.
Analyzer dynamic range: 0 to -25 dBm
DP decode up to 40 digits. Analyze number, %break, PPS, interdigital time

DS3 FEAC (SWOCx-D)

Provides analysis, control and loop back of the DS3 FEAC data link in C-bit parity framing format

PULSE MASK ANALYSIS (SWOCx-E)

DS1 and DS3 Pulse Mask

Measurements: Pass/Fail, rise time, fall time, pulse width, % overshoot, % undershoot

DS1 Resolution: 1 ns

DS3 Resolution: 1.65 ns

DS1 Masks: ANSI T1.102, T1.403. AT&T CB119, Pub 62411

DS1 Scan Period: 800 ns

DS3 Masks: T1.404

Pulse/Mask Display: Test set screen and printer

Intelligent Span Control (SWOCx-N)

Automated looping of Westell & Teltrend line & central office repeaters

In-band and ESF-DL codes: Arming, loop up/down, loopback query, sequential loopback, power loop query, span power down/up, unblocking

ESF Data Link (SWOCx-O)

Monitor and send T1.403 PRM and BPM on Data Link

Supports automatic HDLC protocol handling

Generate Yellow alarm, Line loopback activate, Line loopback deactivate, Payload loopback activate, Payload loopback deactivate codes

CSU/NIU Emulation (SWOCx-P)

Responds to loopback commands, in-band and ESF-DL

Graphic indication of incoming signal status

Automatic generation of AIS alarms

APS Timing Measurement (SWOCx-U)

Resolution: 1 ms

Sensors: L-AIS, P-AIS, B2, Bit Errors

Pass/Fail Indicator

User selectable Switch and Gate Time

OC-48 SOFTWARE OPTIONS

VF Measurement and Dialing (SWOCx-C)

MF/DTMF/DP dialing up to 32 digits, 10 user programmable quick dial numbers for each tone type

MFR1 digits, 0 - 9, KP, ST, ST1-3, Pause

DTMF digits, 0 - 9, *, #, A, B, C, D, Pause
DP digits, 0 - 9, Pause
Programmable interdigital period, tone period, & tone level (MF, DTMF)
Programmable %break and interdigital period @ 10 pps (DP)
MF/DTMF decode up to 40 received digits. Analyze number, high/low frequencies, high/low levels, twist, tone period, interdigital time.
– Analyzer dynamic range: 0 to -25 dBm
DP decode up to 40 digits. Analyze number, %break, PPS, interdigital time
1.544 Mbps payloads

APS Timing Measurement (SWOCx-U)
Resolution: 1 ms
Sensors: L-AIS, P-AIS, B2, and DS3 Errors
Pass/Fail Indicator
User selectable Switch and Gate Time

OC 12/3 GENERAL
Upgrades: SW options upgradeable via software in-field cartridge replacement
Display: Backlit 32 characters by 16 lines
Printer: Print Screen
Operating temperature: 32°F to 122°F (0°C to 45°C)
Operating humidity: 5% to 90%, noncondensing
Storage temperature: -4°F to 158°F (-20°C to 70°C)
Size: 4 x 2.8 x 10.5 in (10.5 x 7 x 27 cm)
Weight: 3 lb (1.3 kg)
Battery
Built-in NiMH rechargeable battery pack
Operation time: 1.5 to 3 hours
AC operation: 100 to 240 VAC, 50/60 Hz universal charger
3 year warranty on chassis, 1 year warranty on accessories & battery

OC-48 GENERAL
Upgrades: SW options upgradeable via software in-field cartridge replacement
Display: Backlit 320 x 240 pixel color display; indoor and direct sunlight viewable
Printer: Print Screen + Test Results
Operating temperature: 32°F to 104°F (0°C to 40°C)
Operating humidity: 5% to 90%, noncondensing

Storage temperature: -4°F to 158°F (-20°C to 70°C)
Size: 4 x 2.8 x 10.5 in (10.5 x 7 x 27 cm)
Weight: 3 lb (1.3 kg)
Battery
Built-in NiMH rechargeable battery pack
Operation time: .75 to 3 hours
AC operation: 100 to 240 VAC, 50/60 Hz universal charger
3 year warranty on chassis, 1 year warranty on accessories & battery

5.10.2 Configurations

5.10.2.1 SSOCx

TEST SET

SSOCx-L	SunSet OCx Lite: DS1 to DS3 Requires factory upgrade for optical and SONET Testing CLEI: TBD/CPR: TBD
SSOCx-A	SunSet OCx: DS1 to DS3 CLEI: TEDQADFWAA CPR: 774326
SSOCx-B	SunSet OCx: DS1 to STS-1 CLEI: TEDQADGWAA CPR: 774327
SSOCx-C	SunSet OCx: DS1 to OC-3c CLEI: TEDQADHWAA CPR: 774328
SSOCx-D	SunSet OCx: DS1 to OC-12c CLEI: TEDQADJWAA CPR: 774349
SSOCx-E	SunSet OCx: DS1 to OC-48c CLEI: TBD/CPR: TBD Refer to SunSet OCx (OC-48 version) specification sheet.

Each configuration includes:

Dual DS1 Testing, DS3 Testing, DS0 Drop/Insert, Fractional T1, SunSet Rubber Holster (SS143B), Software Cartridge (SA708), Data Storage Card (SA720), Internal NiMH battery (SS140), AC Adapter (SS138D), Power Cord (SS145A), Cable (SS115-OCx; except for SSOCx-D & SSOCx-E), Standard SC Connectors, User's Manual (SA901), 3 year warranty on chassis; 1 year warranty on accessories & battery.

HARDWARE OPTIONS

SSOCx-FC-3 FC optical connector for SSOCx-A, SSOCx-B, SSOCx-C. Replaces standard SC connectors

SSOCx-FC-12 FC optical connector for SSOCx-D Replaces standard SC connectors

SSOCx-ST ST optical connectors - Replaces standard SC connectors. Requires SSOCx-E.

SSOCx-1550 Long range 1550 nm optics - Replaces standard intermediate range 1310 nm optics.

SSOCx-LR Long range 1310 nm optics - Replaces standard intermediate range 1310 nm optics.

SSOCx-CC Certificate of Calibration

SSOCx-CCM Certificate of Calibration

SOFTWARE OPTIONS

SWOCx-C VF Dialing and Analysis

SWOCx-D DS3 FEAC

SWOCx-E Pulse Mask Analysis (DS1 and DS3 pulse masks)
Not available for SSOCx-E

SWOCx-F ISDN PRI Call Set Up & Monitor
Includes Supplemental Manual SA901-03

SWOCx-G1 GR-3031
Includes Supplemental Manual SA901-02

SWOCx-G2 GR-303 eoc Decode1 - Requires SWOCx-G1

SWOCx-H ATM Analysis at DS12 (Q2 2001)
Includes Supplemental Manual SA901-01

SWOCx-I ATM Analysis at DS32
Includes Supplemental Manual SA901-01

SWOCx-J ATM Analysis at OC-3c2. Requires SSOCx-C or higher
Includes Supplemental Manual SA901-01

SWOCx-K ATM Analysis at OC-12c2.
Requires SSOCx-D or SSOCx-E
Includes Supplemental Manual SA901-01

SWOCx-M1 Remote Control, VT-100. Includes printer cable (SS115D) and null modem adapter (SS122B)

SWOCx-M2 Remote Control, Windows-based. Includes printer cable (SS115D) and null modem adapter (SS122B)

SWOCx-N Intelligent Span Control

SWOCx-O DS1 Data link

SWOCx-P CSU/NIU Emulation

SWOCx-R1 Frame Relay3 (Q2 2001)

SWOCx-R2 Frame Relay NNI3 (Q2 2001). Requires SWOCx-R1.
SWOCx-S1 SS7 Protocol Analysis1
SWOCx-S2 SS7 TCAP Analysis1 (Q2 2001). Requires SWOCx-S1.
SWOCx-U APS Timing

Note 1: Refer to Signaling option specification sheet.
Note 2: Refer to ATM option specification sheet.
Note 3: Refer to Frame Relay option specification sheet.

OPTICAL ACCESSORIES

SA501 Optical Cable; FC to FC, 2m
SA502 Optical Cable; FC to SC, 2m
SA503 Optical Cable; FC to ST, 2m
SA511 Optical Cable; SC to SC, 2m
SA512 Optical Cable; SC to ST, 2m
SA521 Optical Attenuator; FC, -10 dB
SA531 Optical Attenuator; SC, -10 dB
SA541 Optical Splitter; FC, 90/10
SA545 Optical Splitter; FC, 50/50
SA551 Optical Splitter; SC, 90/10
SA555 Optical Splitter; SC, 50/50
SA591 FCPC Universal Connector4
SA593 ST Universal Connector4

OTHER ACCESSORIES

SS101 Carrying case
SS104C NimH cigarette lighter Battery
SS105 Repeater Extender
SS106 Cable, single bantam to single bantam, 6’
SS108 Cable, single bantam to single 310, 6’
SS109 Cable, single bantam to probe clip, 6’
SS110 Cable, dual bantam to 15-pin D connector (m), 6’
SS111 Cable, dual bantam to 15-pin D connector (f), 6’
SS112 Cable, 2 single bantams to RJ-48 8-position modular plug, 6’.
SS115C DIN-8 to 6-pin RJ-11 Printer Cable. Compatible with the STAR DP-8340 printer.
SS115D DIN-8 to DB-9 Printer Cable. Included when either SWOCx-M1/Ms or SS118B/C is ordered.

SS117 Printer Paper, 5 rolls, for SS118B/C

SS118B High Capacity Thermal Printer. With internal recharge able battery. Includes cable (SS115D) for connection to SunSet and 110 VAC charger.

SS118C High Capacity Thermal Printer. With internal recharge able battery. Includes cable (SS115D) for connection to SunSet & 220 VAC charger.

SS122B Null Modem Adapter. DCE to DCE, DB9 conversion. Included when SWOCx-M1/M2 is ordered.

SS211 Cable; BNC (m) 75W to BNC (m) 75. 2 m

SS303 Cable; WECO 440A to BNC, 6'

SS427 Handset

SS430-WT Sunrise Cable Kit
Includes Cable Kit Carrying Case, 2 Bantam to Bantam, 2 Bantam to 310, 2 Bantam to Test Clip, 1 RJ45 to "Y" Bantam, 2 BNC to BNC, plus the following adapters: 4 BNC to 440A, 2 BNC to 358A, 2 TAD 3 adapters. 1 Multiuse Tool, 1 Small Mini Maglite, 1 Banjo adapter.

Replacement

SS115-OCx Din-8 to DB-9 (m) with ferrite for Sunset OCx, OC-3 Hardware.

SS138D SunSet AC Adapter, 100-240 VAC, 50/60 Hz input, output 15 VDC @ 2.6A. Only for use with SunSets equipped w/NiMH battery pack.

SS140 High Capacity NiMH Battery Pack
9-Cell, 10.8 VDC, 1.8 Ahr

SS143B SunSet Rubber Holster

SS145A Power Cord, 2-prong for SS138D and SS142
For use in North America and Asia

SS145B Power Cord, 2-pin Euro-style for SS138D and SS142

SA708 8 MB Software Card
Replacement Software card for SunSet OCx

SA720 Permanent Memory Card
16 MB additional storage space

SA901 SunSet OCx User's Manual

5.10.2.2 SSOCx-e OC-48 Configurations

SSOCx-E SunSet OCx: DS1 to OC-48c
CLEI: TBD/CPR: TBD

Configuration includes:

Dual DS1 Testing, DS3 Testing, DS0 Drop/Insert, Fractional T1, SunSet Rubber Holster (SS143B), Software Cartridge (SA708), Data Storage Card (SA720), Internal NiMH battery (SS140), AC Adapter (SS138D), Power Cord (SS145A), Cable (SS115-OCx; except for SSOCx-D & SSOCx-E), Standard SC Connectors, User's Manual (SA901), 3 year warranty on chassis; 1 year warranty on accessories & battery.

Hardware Options

SSOCx-FC-48	FC optical connectors - Replaces standard SC con-nectors. Requires SSOCx-E (Single wavelength only).
SSOCx-ST-48	ST optical connectors - Replaces standard SC connectors. Requires SSOCx-E (Single wavelength only).
SSOCx-CC	Certificate of Calibration
SSOCx-CCM	Certificate of Calibration. Includes measurement data
SSOCx-MM-48	Multimode Single Wavelength Option
SSOCx-LR-48	Long Reach 1310 Option
SSOCx-1550-48	Long Reach 1550 Option
SSOCx-DW-48-1	Long/Short Dual Wavelength Option
SSOCx-DW-48-2	Multimode Dual Wavelength Option
SSOCx-DW-48-3	Long/Long Dual Wavelength Option

Software Options

SWOCx-C	VF Dialing and Analysis
SWOCx-D	DS3 FEAC
SWOCx-F	ISDN PRI Call Set Up & Monitor Includes Supplemental Manual SA901-03
SWOCx-G1	GR-303[1] Includes Supplemental Manual SA901-02
SWOCx-G2	GR-303 eoc Decode[1] - Requires SWOCx-G1
SWOCx-H	ATM Analysis at DS1[2] (Q2 2001) Includes Supplemental Manual SA901-01
SWOCx-I	ATM Analysis at DS3[2] Includes Supplemental Manual SA901-01
SWOCx-J	ATM Analysis at OC-3c[2]. Requires SSOCx-C or higher

	Includes Supplemental Manual SA901-01
SWOCx-K	ATM Analysis at OC-12c[2].
	Requires SSOCx-D or SSOCx-E.
	Includes Supplemental Manual SA901-01
SWOCx-N	Intelligent Span Control
SWOCx-O	DS1 Data link
SWOCx-P	CSU/NIU Emulation
SWOCx-S1	SS7 Protocol Analysis[1]
SWOCx-S2	SS7 TCAP Analysis[1].
	Requires SWOCx-S1.
SWOCx-U	APS Timing
SWOCx-W	ATM Analysis at OC-48c[2]

Note 1: Refer to Signaling option specification sheet.
Note 2: Refer to ATM option specification sheet.

Optical Accessories

SA501	Optical Cable; FC to FC, 2 m
SA502	Optical Cable; FC to SC, 2 m
SA503	Optical Cable; FC to ST, 2 m
SA511	Optical Cable; SC to SC, 2 m
SA512	Optical Cable; SC to ST, 2 m
SA521	Optical Attenuator; FC, -10 dB
SA531	Optical Attenuator; SC, -10 dB
SA541	Optical Splitter; FC, 90/10
SA545	Optical Splitter; FC, 50/50
SA551	Optical Splitter; SC, 90/10
SA555	Optical Splitter; SC, 50/50
SA591	FCPC Universal Connector[3]
SA593	ST and SC Universal Connector[3]

Note 3: Requires SSOCx-E

Other Accessories

SS101 Carrying case
SS104D NiMH cigarette lighter Battery Charger, Output 15.5 VDC @ 2.5A. To be used with SunSets equipped with NiMH batteries only.
SS105 Repeater Extender
SS106 Cable, single bantam to single bantam, 6'
SS108 Cable, single bantam to single 310, 6'
SS109 Cable, single bantam to probe clip, 6'
SS110 Cable, dual bantam to 15-pin D connector (m), 6'

SS111	Cable, dual bantam to 15-pin D connector (f), 6'
SS112	Cable, 2 single bantams to RJ-48 8-position modular plug, 6'
SS115C	DIN-8 to 6-pin RJ-11 Printer Cable. Compatible with the STAR DP-8340 printer interface.
SS115D	DIN-8 to DB-9 Printer Cable. Included when either SWOCx-M1/M2 or SS118B/C is ordered.
SS117	Printer Paper, 5 rolls, for SS118B/C
SS118B	High Capacity Thermal Printer. With internal rechargeable battery. Includes cable (SS115D) for connection to SunSet and 110 VAC charger.
SS118C	High Capacity Thermal Printer. With internal rechargeable battery. Includes cable (SS115D) for connection to SunSet & 220 VAC charger.
SS122B	Null Modem Adapter. DCE to DCE, DB9 conversion. Included when SWOCx-M1/M2 is ordered.
SS211	Cable; BNC (m) 75W to BNC (m) 75W 2 m
SS303	Cable; WECO 440A to BNC, 6'
SS427	Handset
SS430-WT	Sunrise Cable Kit Includes Cable Kit Carrying Case, 2 Bantam to Bantam, 2 Bantam to 310, 2 Bantam to Test Clip, 1 RJ45 to 'Y' Bantam, 2 BNC to BNC, plus the follow ing adapters: 4 BNC to 440A, 2 BNC to 358A, 2 TAD 3 adapters. 1 Multiuse Tool, 1 Small Mini Maglite, 1 Banjo adapter.

Replacement

SS138D	SunSet AC Adapter, 100-240 VAC, 50/60 Hz input, output 15 VDC @ 2.6A. Only for use with SunSets equipped w/NiMH battery pack.
SS140	High Capacity NiMH Battery Pack 9-Cell, 10.8 VDC, 1.8 Ahr
SS143B	SunSet Rubber Holster
SS145A	Power Cord, 2-prong for SS138D and SS142 For use in North America and Asia
SS145B	Power Cord, 2-pin Euro-style for SS138D and SS142
SA716	16 MB Software Card Replacement Software card for SunSet OCx
SA720	Permanent Memory Card 16 MB additional storage space
SA901	SunSet OCx User's Manual

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