USER MANUAL

MTT-14B/ RXT-2140

SHDSL Module for MTT and RXT Platforms

Please direct all questions to your local VeEX Sales Office, Representative, or Distributor. Or, contact VeEX technical support at www.veexinc.com.

WARNING

Using the supplied equipment in a manner not specified by VeEX Inc. may impair the protection provided by the equipment.

CAUTIONS!

- Do not remove or insert the module while the test set is on. Inserting or removing a module with the power on may damage the module.
- Do not remove or insert the software cartridge while the test set is on. Otherwise, damage could occur to the cartridge.

End of Life Recycling and Disposal Information

DO NOT dispose of Waste Electrical and Electronic Equipment (WEEE) as unsorted municipal waste. For proper disposal return the product to VeEX Inc.. Please contact our local offices or service centers for information on how to arrange the return and recycling of any of our products.

Phone: +1 510 651 0500

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Website: www.veexinc.com

EC Directive on Waste Electrical and Electronic Equipment (WEEE)

The Waste Electrical and Electronic Equipment Directive aims to minimize the impact of the disposal of electrical and electronic equipment on the environment. It encourages and sets criteria for the collection, treatment, recycling, recovery, and disposal of waste electrical and electronic equipment.

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The SHDSL module provides SHDSL modem emulation. Modem emulation includes STU-R, STU-C, STUC E1, STUR E1, and E1 emulation to verify link turn-up, read performance data, and system loopbacks for troubleshooting.

1.1 Connector Panel

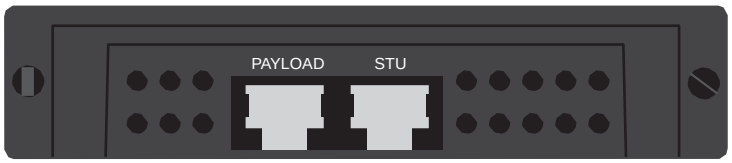


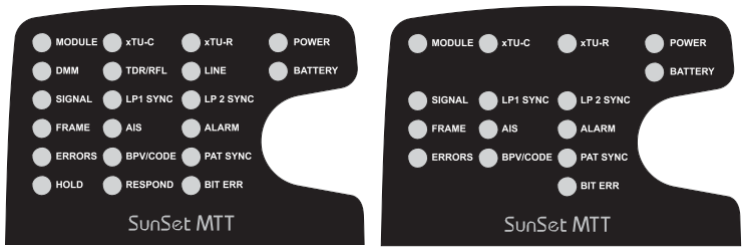
Figure 1 Connector Panel

The module panel contains:

PAYLOAD: RJ-45 port for E1 testing.

STU: RJ-45 port (for SHDSL testing) Pin out for the STU port: pair one is 4 and 5, pair two is 7 and 8.

1.2 LEDs



SSMTT-ACM, -ACM+, -EX SSMTT-B, -C

Figure 2 Test Set LED Panels

The module uses the following test set LEDs:

MODULE
- Green: Indicates that the test set is using the module.

xTU-C
- Green: Indicates that the module is linked up as STU-C.
- Blinking Red: Indicates that the module is attempting to link up.

xTU-R
- Green: Indicates that the module is linked up as STU-R.
- Blinking Red: Indicates that the module is attempting to link up.

LP1 SYNC
- Green: When link is established with far end device.
- Red: When link is not established with far end device.

ALARM
- Red: Indicates that the module has detected an alarm.

2 SHDSL Menus

The following figure shows the location of major menu items.

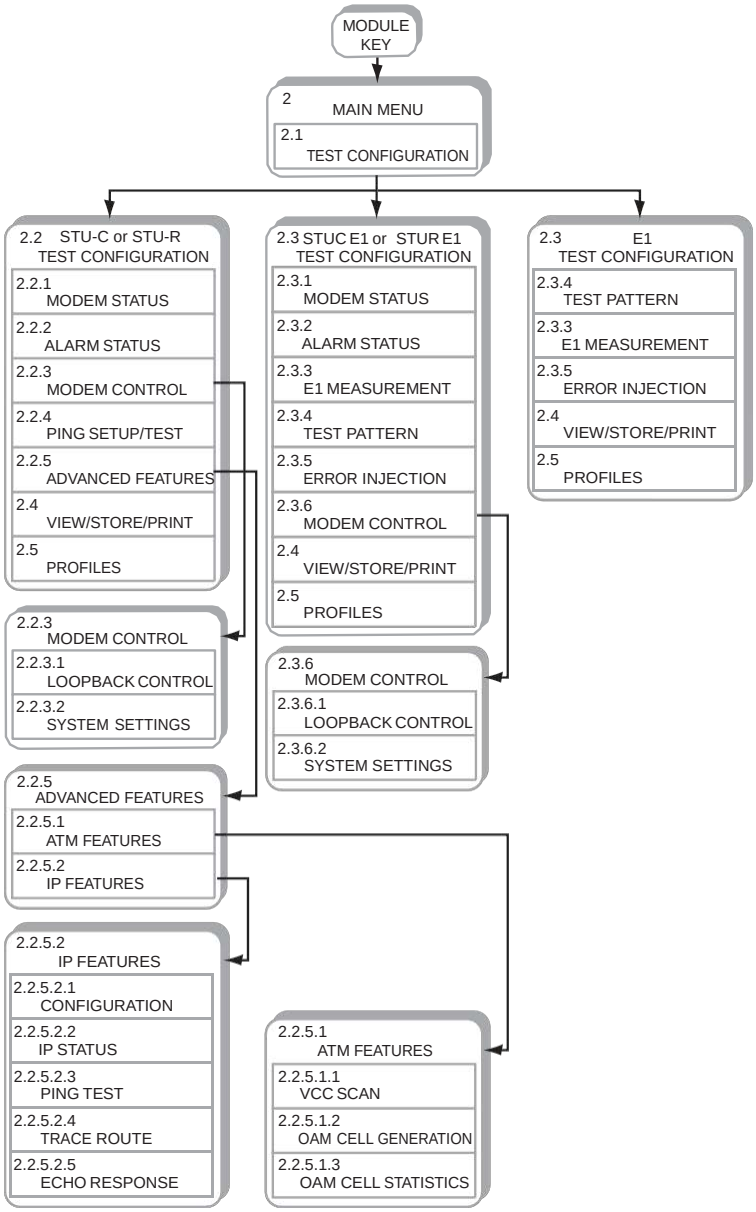


Figure 3 Module Menu Tree

2.1 Test Configuration

MODE determines the displayed configuration screen:

MODE

Options: STU-C (F1), STU-R (F2), STUC E1 (F3), STUR E1 (more, F1), E1 (more, F2)

Select the proper operating mode for the circuit to be tested.

2.2 STU-C and STU-R Configuration

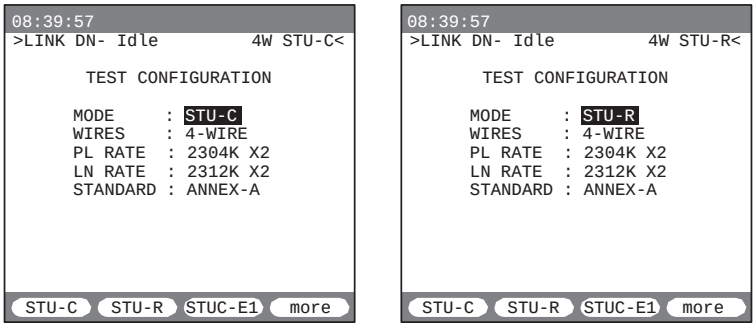


Figure 4 STU-x Configuration Screens

Configure the following:

WIRES

Options: 2-WIRE (F1), 4-WIRE (F2)

Select the type of line that the test set will be connected to.

PL RATE (Payload Rate)

Options: AUTO (F1), 128K (F2), 192K (F3), 256K (more, F1), 320K (more, F2), 384K (more, F3), 512K (more, F1), 768K (more, F2), 1024K (more, F3), 1152K (more, F1), 1280K (more, F2), 1536K (more, F3), 2048K (more, F1), 2304K (more, F2)

Manually choose the Payload Rate or press F1 to let the test set automatically select the correct rate.

LN RATE (Line Rate)

Options: AUTO (F1), 136K (F2), 200K (F3), 264K (more, F1), 328K (more, F2), 392K (more, F3), 520K (more, F1), 776K (more, F2), 1032K (more, F3), 1160K (more, F1), 1288K (more, F2), 1544K (more, F3), 2056K (more, F1), 2312K (more, F2)

Manually choose the Line Rate or press F1 to let the test set automatically select the correct rate.

Notes for Payload and Line Rates:

- PL Rate and LN Rate are related. Line Rate is inclusive of overhead. The difference between the two are 8K. Whenever one configuration is modified, the other one will also be modified.

- For single ended applications, i.e., STU-R emulation testing with a DSLAM, use a fixed rate that matches the expected commercial service rate.

STANDARD (per ITU G.991.2)
Options: ANNEX-A (F1), ANNEX-B (F2)

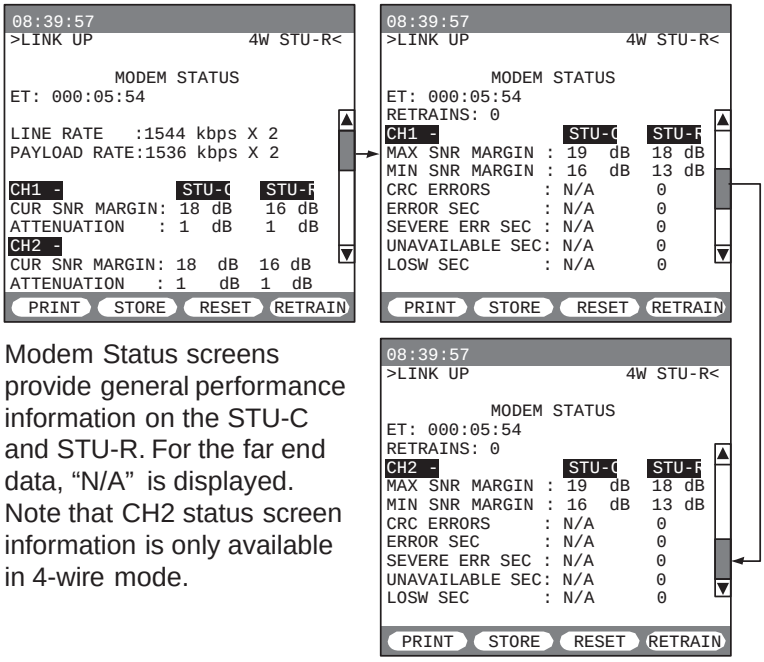
Select an operating standard.

- ANNEX-A: Describes specifications for G.SHDSL systems operating under North American network conditions.
- ANNEX-B: Describes specifications for G.SHDSL systems operating under European network conditions.

Press ESC to return to the main menu.

2.2.1 Modem Status

Use these screens to view real time link parameters. Press ▲ , ▼ to view the available screens.



Modem Status screens provide general performance information on the STU-C and STU-R. For the far end data, “N/A” is displayed. Note that CH2 status screen information is only available in 4-wire mode.

Figure 5 Modem Status Screens

ET: Elapsed Time since RESET (F3), RETRAIN (F4), or ESC is pressed.

LINE RATE reported in kbps, see *Section 2.2-Notes for Payload and Line Rates*.

PAYLOAD RATE reported in kbps, see *Section 2.2-Notes for Payload and Line Rates*.

CUR SNR MARGIN: Current signal-to-noise margin (in dB) is the maximum dB increase in equalized noise or the maximum dB decrease in equalized signal that a system can tolerate and maintain a BER of 10^{-7}.

ATTENUATION: This displays the loop attenuation (in dB).

MAX SNR MARGIN: Maximum signal-to-noise margin (in dB) measured during ET. When either RETRAIN (F4) or ESC is pressed, MAX SNR is reset.

MIN SNR MARGIN: Minimum signal-to-noise margin (in dB) that is measured during ET. When either RETRAIN (F4) or ESC is pressed, MIN SNR is reset.

CRC ERRORS: Count of CRC errors and is reset when ET is reset.

ERROR SEC: Count of 1 second intervals during which one or more CRC errors are declared and/or one or more LOSW defects are declared. Reset when ET is reset.

SEVERE ERR SEC: Count of 1 second intervals during which at least 50 CRC errors are declared or 1 or more LOSW defects are declared. 50 CRC errors during a 1 second interval is equivalent to a 30% error frame rate for a normal frame length. Reset when ET is reset.

UNAVAILABLE SEC: Count of 1 second intervals for which the SHDSL line is unavailable. The SHDSL line becomes unavailable at the onset of 10 contiguous SESs. The 10 SESs are included in the unavailable time. Once unavailable, the SHDSL line becomes available at the onset of 10 contiguous seconds with no SESs. The 10 seconds with no SES are excluded from unavailable time. Reset when ET is reset.

LOSW SEC: Loss of synchronization word second is a count of 1 second intervals during which one or more SHDSL LOSW defects are declared. Reset when ET is reset.

The following F-keys are common to these screens:

PRINT (F1): Send the status screens to the serial port.

STORE (F2): Press to store the status screen.

RESTART (F3): Restarts polling and resets ET to zero.

RETRAIN (F4): Retrains the modem and resets ET to zero.

2.2.2 Alarm Status

This screen provides general alarm status (current and history for local and remote).

Note CH2 is reported only in 4-wire mode.

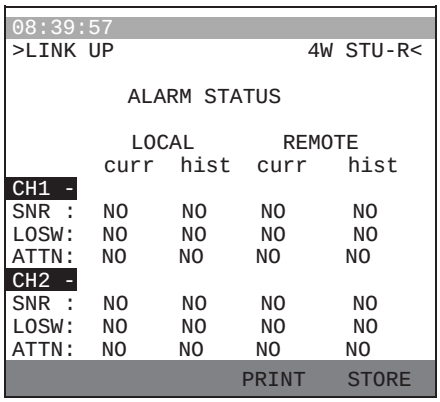


Figure 6 Alarm Status Screen

This screen reports the following:

SNR: Triggered when the local current SNR margin value is below the user threshold setting. This is set in MODEM CONTROL > SYSTEM SETTINGS, on the SNR MARGIN THRESHOLD line.

LOSW: Loss of Sync defect alarm, a loss of synchronization word defect is declared when at least 3 consecutive received frames contain 1 or more errors. An LOSW defect is cleared when at least 2 consecutive received frames contain no errors.

ATTN: Triggered when the local attenuation value is greater than the user threshold value. This is set in MODEM CONTROL > SYSTEM SETTINGS, on the LOOP ATTN THRESHOLD line.

These alarm conditions are displayed as current and history. These are defined as:

curr YES: The alarm condition is currently detected.

curr NO: The alarm condition is not currently detected.

hist YES: The alarm condition has been detected, but it is no longer present.

hist NO: The alarm condition has never been detected since the start of the test or since pressing HISTORY.

The following F-keys are available:

PRINT (F3): Send the alarm screen to the serial port.

STORE (F4): Press to store the status screen.

2.2.3 Modem Control

This menu contains the following:

- LOOPBACK CONTROL
- SYSTEM SETTINGS

2.2.3.1 SHDSL System Loopback Control

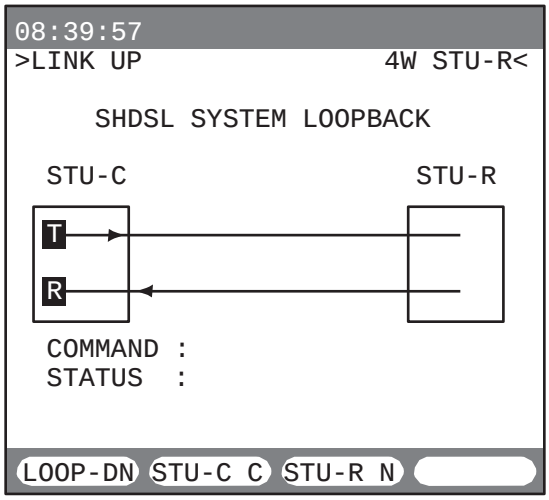


Figure 7 SHDSL System Loopback Screen

This screen displays a loopback graphic. It includes a COMMAND line used to enter different types of loopback messages sent via the EOC. They are:

LOOP-DN (F1): This will cause the COMMAND line to change to LOOP-DN and the appropriate EOC message will be sent. The STATUS line will report either SUCCESS or FAIL.

STU-C C (F2): Use this to loopback the STU-C, facing the customer. This will cause the COMMAND line to change to STU-C C and the appropriate EOC message will be sent. The STATUS line will report either WAITING, FAILED, SUCCESS, or ILLEGAL ACTION.

STU-R N (F3): Use this to loopback the STU-R, facing the network. This will cause the COMMAND line to change to STU-R N and the appropriate EOC message will be sent. The STATUS line will report either WAITING, FAILED, SUCCESS, or ILLEGAL ACTION.

2.2.3.2 System Settings

Use this screen to adjust the defaults for:

DISPLAY ALL EOC MESSAGES

- ON: will display far end values for CRC, SES, ES, UAS, and LOSW (if available). At this time, the module does not support this mode.
- OFF: is the default.

SNR MARGIN THRESHOLD

Adjust by using +1 (F1) or -1 (F2). The threshold can be OFF, or adjusted between -15 through +15 dB. If the SNR margin is less than this setting, then the ALARM LED will be on.

LOOP ATTEN THRESHOLD

Adjust by using +1 (F1) or -1 (F2). The threshold can be OFF, or adjusted from 1–127. The default setting is OFF. If this setting is exceeded, then the ALARM LED will be on.

RECEIVE EOC SNR OFFSET

For reporting via the EOC (for STU-C/R only).

- ON: for far end sending SNR raw values to near end.
- OFF: for far end sending SNR margin values to near end. OFF is the default.

SEND EOC SNR OFFSET

For reporting via the EOC (for STU-C/R only).

- ON: for near end sending SNR margin values to far end. ON is the default.
- OFF: for near end sending SNR raw values to far end.

TRANSFORMER RATIO

- ON: the transformer ratio is set to 5:4:1. ON is the default.
- OFF: the transformer ratio is set to 4:1.

CAUTION: If the reported loop attenuation is significantly different between the STU-R and STU-C, ensure that the transformer ratio used is the same.

When finished press ENTER to update and save the changes.

2.2.4 PING Setup/Test

Link turn-up verifies connectivity to a DSLAM. PING testing takes the turn-up procedure one step further and verifies connectivity to the far end network. PING is a common method to discover whether two remote LAN segments using TCP-IP protocol are connected. When receiving a PING message, Internet devices acknowledge it by sending an echo message back.

After turning up the link, enter PING SETUP/TEST from the module main menu. The first screen contains configuration items for the PING test. Enter the proper protocol used by the circuit, as well as the necessary IP addresses. The first setting is MODE.

Notes:

- Before performing a PING test, confirm that the link is established.
- To enter numbers, press SHIFT and use the numeric keypad. If available, use <-,-> to move the cursor.

MODE

Options: PROFILE (F1), LLC-BRG (F2), LLC-RTE (more, F1), CLIPoA (more, F2), PPPoE (more, F1), PPPoA (F2, more)

Select the protocol mode for the PING test.

- PROFILE: Use to store and retrieve PING configurations, see *Section 2.2.4.4*.
- LLC-BRG: LLC-Bridge protocol. This follows RFC 1483 bridge encapsulation. It supports both static and dynamic IP management.
- LLC-RTE: LLC-Routed protocol. It supports only static IP addressing.
- CLIPoA: This refers to Classical IP over ATM according to RFC 2225. Used only in STATIC mode.
- PPPoE: PPP over Ethernet, according to standard RFC 2516 PPP over Ethernet. PPPoE supports dynamic IP addressing.
- PPPoA: PPP over ATM, according to standard RFC 2364, PPP over AAL5. PPPoA supports dynamic IP addressing.

The actual configuration settings depend on the selected mode, hence the following subsections describe setup and PING results for each mode.

2.2.4.1 LLC-Bridge and Routed Mode Setup

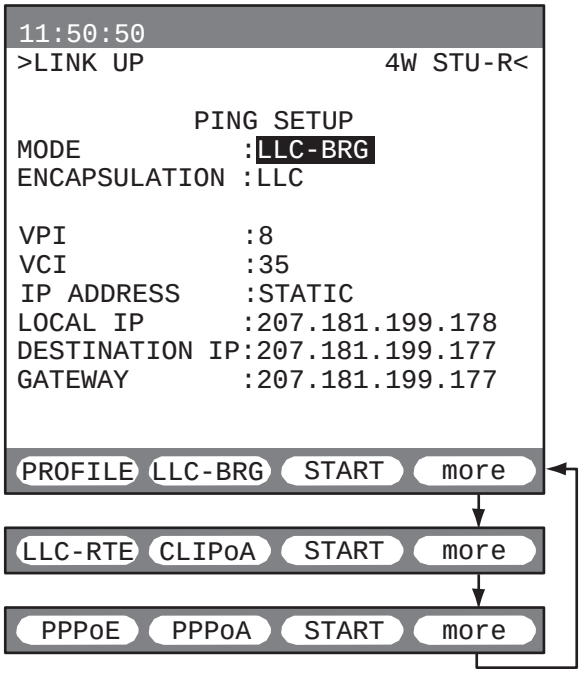


Figure 8 LLC-BRG PING Setup Screen

Configure these settings for LLC-BRG and LLC-RTE modes:

ENCAPSULATION
Options: LLC (F1), VC MUX (F2), AUTO (F3)

Choose the encapsulation method for carrying traffic over AAL Type 5 over ATM.

- LLC: Logical Link Control based on IEEE standard 802.2. LLC encapsulation is used when multiple protocol are encapsulated over a single ATM Virtual Connection.
- VC MUX: This is used when only one protocol is carried over a single ATM Virtual Connection.
- AUTO: Automatically detect the setting.

VPI
Range: 0 through 255

The default is 8, which is a typical Ethernet assignment. Along with VCI, VPI identifies the next destination of a cell as it moves through a series of ATM switches on the way to its destination. The service provider typically assigns VPI.

VCI
Range: 0 through 65535

The default is 35, which is a typical Ethernet assignment. Along with VPI, VCI identifies the next destination of a cell as it moves through a series of ATM switches on the way to its destination. The service provider typically assigns VCI.

IP ADDRESS
Options: STATIC (F1), DHCP (F2)

- STATIC: This type of IP management means that the user has a permanent IP address. For STATIC, enter the LOCAL IP; this will be the value used during the test.
- DHCP: This refers to dynamic IP management. If selected, enter the IP address for the destination.

  Dynamic management provides a way for computers to obtain protocol configuration parameters (like the local IP address) dynamically from the network. In this case, the IP address is not permanent to the terminal; instead, the terminal requests an address from the server on the network. When selecting DYNAMIC for IP ADDRESS, the module sends a request to the server; the server responds and provides an IP address. Upon selecting DYNAMIC, the LOCAL IP line disappears; the network dynamically assigns an IP address.

LOCAL IP
Enter a local IP address of the circuit under test. For LLC-BRG static mode and LLC-RTE, this is the local IP address used. For LLC-BRG DHCP mode, there is no LOCAL IP mode since a dynamically assigned local IP address is used.

DESTINATION IP
Enter the destination address of the device to be pinged. If pinging a gateway, enter the gateway's address for the Destination IP. Pinging the gateway verifies connectivity to the ISP.

GATEWAY
If required, enter a gateway address. A gateway is a device that connects dissimilar networks and passes information between them. In TCP/IP, the default gateway address is the address where the Internet Protocol sends packets destined for remote networks, unless a different route is configured. Since LLC-RTE is a pure routed mode, there is no gateway setting. This setting applies only to LLC-BRG mode.

2.2.4.2 CLIPoA Setup

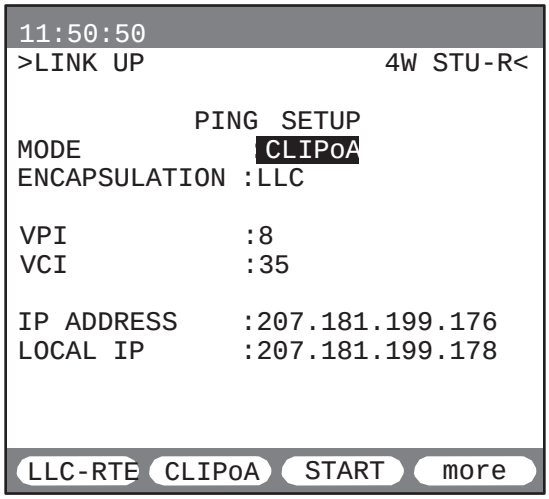


Figure 9 CLIPoA Configuration Screen

Configure theses settings for Classical IP over ATM:

ENCAPSULATION
Options: LLC

LLC is the only encapsulation method available.

VPI
Range: 1 to 255

The default is 8, which is a typical Ethernet assignment. Along with VCI, VPI identifies the next destination of a cell as it moves through a series of ATM switches on the way to its destination. The service provider typically assigns VPI.

VCI
Range: 1 to 65535

The default is 35, which is a typical Ethernet assignment. Along with VPI, VCI identifies the next destination of a cell as it moves through a series of ATM switches on the way to its destination. The service provider typically assigns VCI.

LOCAL IP
Enter the Local IP address of the circuit to be tested.

DESTINATION IP
Enter the Destination IP address to be pinged.

2.2.4.2.1 LLC-BRG, LLC-RTE, and CLIP Mode PING Results

After configuring, press F3 to start the test. As the test proceeds, the test set displays an 'IN PROGRESS' message.

- The module will send 10 PINGs at one-second intervals. One or more responses from the destination is considered a pass. Refer to the following figure for a pass sample.

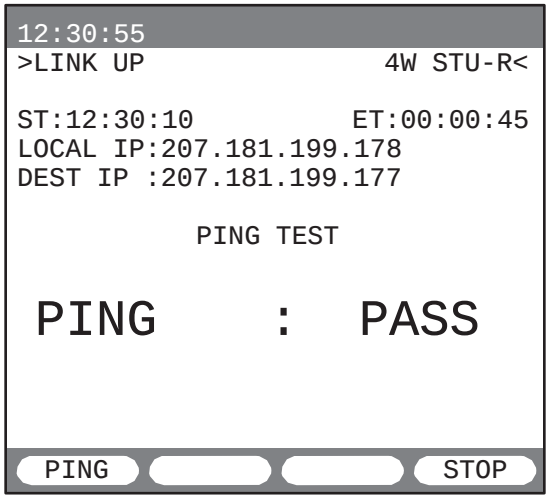


Figure 10 LLC PING Test Passed

- 'PING PASS' means the destination has received the PING message and properly responded to the module. This indicates that the module can connect to the Internet.
- If the test set receives no response, it will display 'PING FAIL'. This indicates that either the destination did not receive the PING message or it did not reply.
- Press F4 to stop the test, press it again to restart testing.
- Press F1 to PING the DEST IP again after PING: PASS is displayed.

In addition to the test results, the screen also reports:

ET: Elapsed Time since the test was started or restarted.

ST: Start Time of the test.

LOCAL IP: Provides the local IP address for the module. For LLC-BRG static and LLC-RTE, this is the exact LOCAL IP address entered in the configuration screen. For LLC-BRG DHCP, LOCAL IP shows all zeros until the DHCP server assigns an IP address. When assigned, the LOCAL IP line will display this address.

DEST IP: Provides the destination IP address for the PING messages. This is determined in the configuration screen.

If selecting LLC-BRG, DHCP IP ADDRESS, the PING results screen differs slightly from Figure 10. For DHCP, the network must assign the local IP address. There are two steps for the results:

1. When the test first begins, the LOCAL IP address line shows all zeros. As soon as the DHCP server provides an IP address, it updates and DHCP displays 'PASS' as in the following figure:

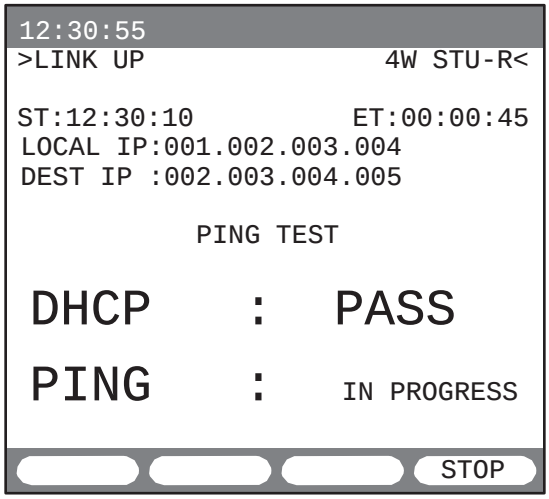


Figure 11 DHCP: IP Address Assigned

2. After receiving an IP address, the test set begins transmitting PING messages using the local IP address. When a reply is received, 'PING PASS' is displayed as in the following figure:

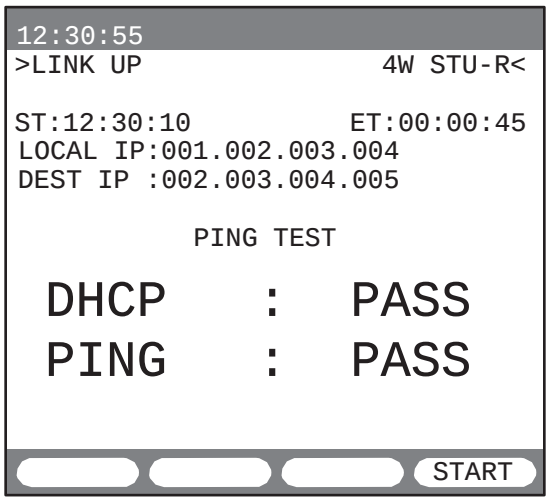


Figure 12 DHCP: PING Passed

2.2.4.3 PPPoA and PPPoE Mode Setup

PPP (Point-to-Point Protocol) allows one or more user sessions to tunnel across the link. This includes provisions for security and protocol negotiations. The module supports two versions of PPP: PPPoE (PPP over Ethernet) and PPPoA (PPP over ATM). Refer to *Section 4.1* for details on these protocols.

When selecting PPP, the network security and authentication requires negotiation. Refer to the following figure:

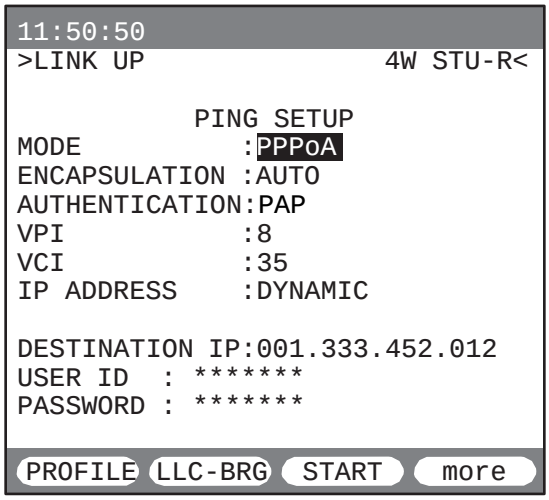


Figure 13 PPPoA PING Setup Screen

Configure these settings for PPPoA and PPPoE modes:

ENCAPSULATION
Options: LLC (F1), VC MUX (F2), AUTO (F3)

This refers to the Encapsulation method for carrying traffic over AAL Type 5 over ATM.

- LLC: Logical Link Control based on IEEE standard 802.2. LLC encapsulation is used when multiple protocol are encapsulated over a single ATM Virtual Connection.
- VC MUX: This is used when only one protocol is carried over a single ATM Virtual Connection.
- AUTO: Automatically detect the setting.

Note: When MODE is set for PPPoE, LLC is the only available encapsulation method.

AUTHENTICATION
Options: PAP (F1), CHAP (F2), AUTO (F3)

The authentication layer ensures that only a valid device establishes a connection with the network. Choose the following:

- PAP: Password Authentication Protocol as defined in RFC 1334. PAP is the simplest method for authentication. It involves a two-way handshake where one peer sends a user name and ID to another peer element in the network. The second peer returns an authentication-acknowledge message either accepting or rejecting the user name and password. When selecting PAP, enter the password and ID at the bottom of the configuration screen.
- CHAP: Challenge Handshake Authentication Protocol as defined in RFC 1994. It involves a three-way handshake, in which the test set sends a challenge containing its user name. The server responses with a specific identifier expected for this transaction. The test set then accepts or rejects this response, when accepted the test set starts sending data.
- AUTO: Use this recommended setting to automatically detect the authentication.

VPI

Range: 0 through 255

The default is 8, which is a typical Ethernet customer assignment. Along with VCI, VPI identifies the next destination of a cell as it moves through a series of ATM switches on the way to its destination. The service provider typically assigns VPI.

VCI

Range: 0 through 65535

The default is 35, which is a typical Ethernet customer assignment. Along with VPI, VCI identifies the next destination of a cell as it moves through a series of ATM switches on the way to its destination. The service provider typically assigns VCI.

IP ADDRESS

Options: STATIC (F1), DYNAMIC (F2)

- STATIC: This type of IP management means that the user has a permanent IP address. For STATIC, enter the LOCAL IP; this will be the value used during the test.
- DYNAMIC: This refers to dynamic IP management. If selected, enter the IP address for the destination. Dynamic management provides a way for computers to obtain protocol configuration parameters (like the local IP address) dynamically from the network. In this case, the IP address is not permanent to the terminal; instead, the terminal requests an address from the server on the network. When selecting DYNAMIC for IP ADDRESS, the module sends a request to the server; the server responds and provides an IP address. Upon selecting DYNAMIC, the LOCAL IP line disappears; the network dynamically assigns an IP address.

LOCAL IP
Enter a local IP address of the circuit under test. For LLC-BRG and LLC-RTE STATIC, this is the local IP address used. For LLC-BRG DYNAMIC mode, there is no LOCAL IP mode since a dynamically assigned local IP address is used.

DESTINATION IP
Enter the destination address of the device to be pinged. If pinging a gateway, enter the gateway's address for the Destination IP. Pinging the gateway verifies connectivity to the ISP.

USER ID
For authentication (PAP and CHAP), enter a user ID prior to receiving an IP address from the ISP. Refer to *Section 2.2.4.3.1*.

PASSWORD
For authentication (PAP and CHAP), enter a password prior to receiving an IP address from the ISP. Refer to *Section 2.2.4.3.1*.

2.2.4.3.1 Entering a User ID/Password

Follow this procedure to enter a USER ID or PASSWORD for PAP and CHAP authentication.

1. Place the cursor on USER ID.
2. Press EDIT (F1) and a character screen is displayed.
3. Press INPUT (F3) to enter the character grid. Notice a cursor appears in the grid and INPUT changes to STOP.
4. Use ◄, ▲, ▼, ► to move the cursor to the desired character. Press ENTER to select that character. The character will appear on the USER ID line.
5. Continue selecting characters until done. Press STOP (F3) to exit the character grid.

- If you make a mistake; press STOP (F3). Use ◄,► to select the incorrect character.
  - Press DELETE (F2) to delete the character.
  - Press INSERT (F1) to add a character to the left of the selected character.
  - Press OVER (F1) to replace the selected character with a new character.

6. Select HIDE USER ID (or PASSWORD) and choose whether to hide the ID code by pressing YES (F1) or NO (F2). Figure 13 shows the USER ID and PASSWORD hidden.
7. Press F4 to save the ID and return to the setup screen.
8. Select PASSWORD and follow the previous procedure from step 2 to enter the password.

2.2.4.3.2 PPPoA and PPPoE Mode PING Results

After configuring, press F3 to start the test. As the test proceeds, the test set displays an 'IN PROGRESS' message.

For PPP PING results there are three stages to the test:

- ROUTER: This stage identifies the connection to the Broadband Remote Access Server or ISP.
- PPP: Identifies the account with the ISP and ensures that account verification (with authentication enabled) is established.
- PING represents the connection/response to the destination IP address.

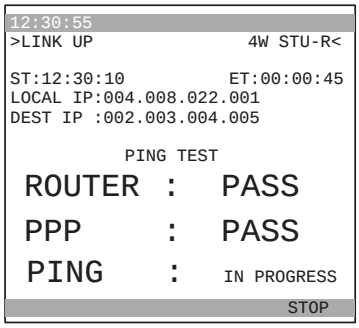


Figure 14
PPP PING Results Screen

Reflected in Figure 14 are these three stages:

- ROUTER
  - "PASS" means that the module has connected to the router/broadband access server (ISP). The next step will be to verify authentication.
  - "FAIL" means that no connection to the ISP is available.
- PPP
  - "PPP: in progress" means that the handshaking procedure is currently in progress. A local IP address is not yet assigned, as indicated by all zeros for the LOCAL IP. If static IP management were selected, the LOCAL IP entered in the configuration screen would be used.
  - "PPP: PASS" means that the authentication handshaking was successful and a local IP address has been assigned, as displayed on the LOCAL IP line.
- PING
  - "PING:—" This stage has not begun yet. PING will begin as soon as the PPP stage is completed.
  - "PING: in progress" means that the PING test is currently in process. As soon as the module receives a response from the destination, it will display 'PASS'. If the test set receives no response from the destination, it will display 'FAIL'.

2.2.4.4 Profile

The PING setup screens feature a PROFILE (F1) key. This allows saving and retrieving various configurations. To save a configuration, use this procedure:

1. From any PING configuration screen, select MODE and press PROFILE (F1) and a PING Profile list screen is displayed.

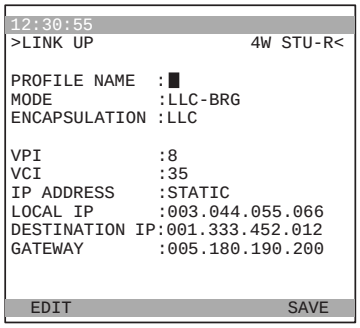


Figure 15 Profile Configuration Screen

2. Use ▲ , ▼ to select a blank line and press EDIT (F1) to display the configuration screen shown in Figure 15.
3. With the cursor on the PROFILE NAME line, give the Profile a name by pressing EDIT (F1). A character entry screen is displayed.
4. Press INPUT (F3) to select the character grid and use ◄ , ▲ , ▼ , ► to move the cursor to the desired character. Press ENTER to select the character and the selected character appears on the PROFILE NAME line. Repeat until finished.

- If a mistake is made; press STOP (F3), use ◄ , ► to select the incorrect character and then press:
  - DELETE (F2) to delete the character.
  - INSERT (F1) to add a character left of the selected character.
  - OVER (F1) to replace a character with another character.

5. When finished, press STOP (F3) to exit the character grid.
6. Press F4 to save the PROFILE NAME and return to the PING configuration screen.
7. Select MODE, choose the mode for the PING and configure the remainder of the screen as in the previous PING configuration sections. When finished, press F4 to save the profile.

Invoking a Profile

1. From MODE, press PROFILE (F1) and in the PING Profile list screen use ▲ , ▼ to select a saved profile.
2. Press SELECT (F4) then F3 to start the PING test.

Editing a Saved Profile

1. From MODE, press PROFILE (F1) and in the PING Profile list screen use ▲ , ▼ to select a saved profile.
3. Press EDIT (F1) and the Profile Configuration screen is displayed as in Figure 15.
4. Make any required changes by using the procedures in the first part of this section.
5. When finished, press F4 to save the altered Profile.

2.2.5 Advanced Features

This menu screen contains the following optional features:

- ATM FEATURES
- IP FEATURES

2.2.5.1 ATM Features

This menu screen contains:

- VCC SCAN
- OAM CELL GENERATION
- OAM CELL STATISTICS

2.2.5.1.1 VCC Scan

This feature can scan up to 4 VCCs. ATM/IP traffic must be transmitted from the network end while in VCC Scan. For each detected VCC, the test set displays the VPI (3 digits), VCI (5 digits), PTI (3 digits), and CLP (3 digits). A scanning bar is displayed when scanning. When full it resets and starts again.

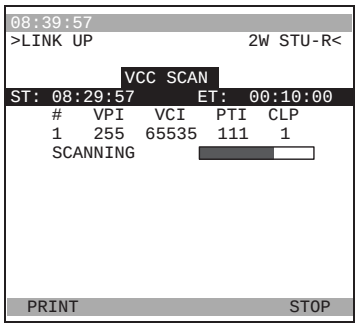


Figure 16 VCC Scan Screen

This feature is used to verify what PVC is active at the customer location. Very often VCCs are directed toward the wrong destination and they create overflow of the customer line. Also, the assigned VP/VC value may not be known.

The following is reported:

ST: Start Time indicates when the scan was started.

ET: Elapsed time indicates how long the scan has lasted.

#: Number of the VCC

VPI: Virtual Path Identifier address number containing one or more VCIs. In UNI, the VPI is 8 bits. In NNI, the VPI is 12 bits.

VCI: Virtual Channel Identifier address number which facilitates the physical cell transmission within the switch fabric path. The VCI is 16 bits.

UNI/NNI VPI and VCI values are given in the next two tables:

Use	VPI	VCI
Unassigned cell	00000000	00000000 00000000
Invalid	Any value other than 0	00000000 00000000
Meta-signaling	XXXXXXXX	00000000 00000001
General broadcast	XXXXXXXX	00000000 00000010
Point-to-Point signaling	XXXXXXXX	00000000 00000101
Segment OAM F4 cell	Any value	00000000 00000011
End-to-end OAM F4 cell	Any value	00000000 00000100
VP resource management	Any value	00000000 00000110
Reserved for future VP functions	Any value	00000000 00000111
Reserved for future functions	Any value	00000000 000SSSSS[1]
Reserved for future functions	Any value	00000000 000TTTTT[2]
Segment OAM F5 cell	Any value	Any value other than 00000000 00000000, 00000000 00000011, 00000000 00000110, 00000000 00000111
End-to-end OAM F5 cell	Any value	Any value other than 00000000 00000000, 00000000 00000011, 00000000 00000100, 00000000 00000110, 00000000 00000111
Notes		
[1] any value from 01000 to 01111		
[2] any value from 10000 to 11111		

Table 1 UNI VPI and VCI Values

Use	VPI	VCI
Unassigned cell	00000000	00000000 00000000
Invalid	Any value other than 0	00000000 00000000
NNI signaling	Any value	00000000 00000101
Segment OAM F4 cell	Any value	00000000 00000011
End-to-end OAM F4 cell	Any value	00000000 00000100
VP resource management	Any value	00000000 00000110
Reserved for future VP functions	Any value	00000000 00000111
Reserved for future VP functions	Any value	00000000 000SSSSS[1]
Reserved for future VP functions	Any value	00000000 000TTTTT[2]
Segment OAM F5 cell	Any value	Any value other than 00000000 00000000
End-to-end OAM F5 cell	Any value	Any value other than 00000000 00000000
VC resource management	Any value	Any value other than 0000000 00000000, 0000000 00000110
Reserved for future VC functions	Any value	Any value other than 00000000 00000000
Notes		
[1] any value from 01000 to 01111		
[2] any value from 10000 to 11111		

Table 2 NNI VPI and VCI Values

PTI: Payload Type Identifier is a 3–bit field used to indicate whether the cell contains user information or Connection Associated Layer Management information (F5 flow). The PTI bit may be modified by any network element if there is congestion in the system to notify other elements of the congestion. The values are given in the following table:

PTI Coding Bits 432	Interpretation
000	User data cell, congestion not experienced. ATM user-to-user indication = 0
001	User data cell, congestion not experienced. ATM user-to-user indication = 1
010	User data cell, congestion experienced. ATM user-to-user indication = 0
011	User data cell, congestion experienced. ATM user-to-user indication = 1
100	OAM F5 segment associated cell
101	OAM F5 end-to-end associated Cell
110	UNI - Resource management cell NNI - VC resource management cell
111	Reserved for future VC functions.
after Rec. I.361, Sec. 2.2.4 and 2.3.3	

Table 3 PTI Decode Values

CLP: Cell Loss Priority is one bit that may be set by the user or the service provider to indicate lower priority cells (usually, CLP=1); they are subject to discard before other cells.

The following F-keys are available.

PRINT (F1): Press to print the scan results.

STORE (F3): Press to store the scan results, available after STOP is pressed.

STOP/START (F4): Press to stop scanning, press again to start.Once a scan is started, a SCANNING progress bar is displayed.

2.2.5.1.2 OAM Cell Generation

This screen contains configuration items for OAM cell generation.

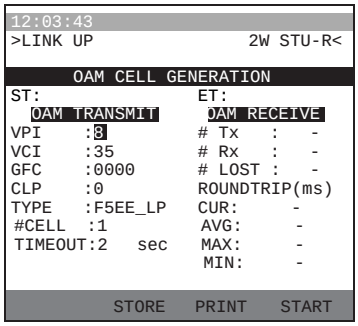


Figure 17 OAM Cell Generation Screen

Configure the items in the left column under OAM TRANSMIT:

VPI

Options: 0–255

Enter the Virtual Path Identifier by using SHIFT and the number keypad. See *Section 2.2.5.1.1* for more information.

VCI

Options: 0–65535

Enter the Virtual Channel Identifier by using SHIFT and the number keypad. See *Section 2.2.5.1.1* for more information.

GFC

Options: 0000–1111 (binary only), default 0000

Enter a value using SHIFT and the numeric keypad. Generic Flow Control assists in the control of the flow of traffic. Used only for UNI interfaces. It is primarily used to ease short-term overload conditions (too many cells). As indicated in Figure 17, it contains 4 bits. It is an ATM layer function. In real-life it is not widely utilized, as the CLP (Cell Loss Priority indicator) does the flow management job.

CLP

Options: 0 or 1

Enter a value for Cell Loss Priority by using SHIFT and the numeric keypad. See *Section 2.2.5.1.1* for more information.

TYPE

Options: F4SGAIS (F1), F4SGRDI (F2), F4SG_LP (F3), F4EEAIS (more, F1), F4EERDI (more, F2), F4EE_LP (more, F3), F5SGAIS (more, F1), F5SGRDI (more, F2), F5SG_LP (more, F3), F5EEAIS (more, F1), F5EERDI (more, F2), F5EE_LP (more, F3)

Choose the type of OAM cell to transmit. Refer to *Section 2.2.5.1.3* for definitions of OAM cell types.

#CELL
Options: 1–9999

Enter the number of OAM cells to transmit by using SHIFT and the number keypad.

TIMEOUT
Options: 1–10 seconds

Enter a value in seconds by using SHIFT and the number keypad. This is only used for loopback (F4 or F5) cells. If no response is received after the timeout has expired, the cells are declared lost. This field is set to N/A for AIS and RDI (F4 or F5) since no response is expected.

The items in the right column under OAM RECEIVE are the results of the OAM ATM PING.

 # Tx: Number of OAM cells transmitted.

Note: The following items will display N/A, unless loopback (F4 or F5) cells are received.

 # Rx: Number of OAM loopback cells received.

 # LOST: Number of transmitted OAM cells not received; considered lost due to the timeout.

The following items are under ROUNDTRIP (ms).

CUR: Current cell roundtrip in milliseconds.

AVG: Average cell roundtrip in milliseconds.

MAX: Maximum cell roundtrip in milliseconds.

MIN: Minimum cell roundtrip in milliseconds.

The following F-keys are available:

STORE (F2): Press to store the OAM ATM PING results.

PRINT (F3): Press to print the OAM ATM PING results.

2.2.5.1.3 OAM Cell Statistics

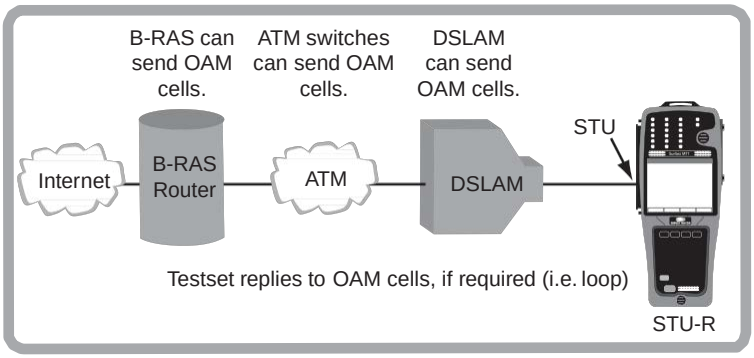


Figure 18 OAM Connection

This feature automatically responds to any ATM OAM requests. The screen does not need to be displayed for results to be compiled as long as the link is up. Statistics are not recorded while in ADVANCED FEATURES > IP FEATURES menu.

Each time that an OAM request is received and answered, the counters in the screen to the right get updated. The test set will reply to F4/F5 (segment/path) OAM loop commands. It also counts received AIS and RDI F4/F5 OAM cells.

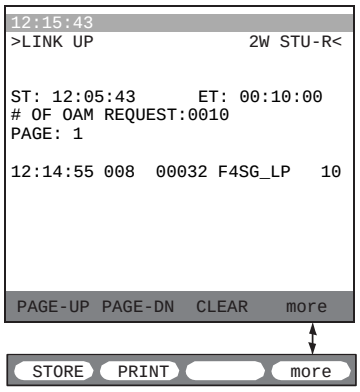


Figure 19 OAM Cell Statistics Screen

The following is reported:

ST: Indicates when the measurement was started or when CLEAR (F3) was last pressed.

ET: Elapsed time since the measurement was started or when CLEAR (F3) was last pressed.

 # OF OAM REQUEST: Indicates the total number of OAM's received during the capture time.

PAGE: Indicates the current page number.

TIME: Indicates the capture time of the first request for the OAM VPI/VCI pair

VPI: Indicates the Virtual Path Identifier; 000–999

VCI: Indicates the Virtual Channel Identifier; 00000–65535

OAM: The following Operations Administration Messages:

F4SGAIS: AIS F4 (path) on the segment

F4SGRDI: RDI F4 (path) on the segment

F4SG_LP: loopback request F4 (path) on the segment

F5SGAIS: AIS F5 (channel) on the segment

F5SGRDI: RDI F5 (channel) on the segment

F5SG_LP: loopback request F5 (channel) on the segment

F4EEAIS: AIS F4 (path) end-to-end

F4EERDI: RDI F4 (path) end-to-end

F4EE_LP: loopback request F4 (path) end-to-end

F5EEAIS: AIS F5 (channel) end-to-end

F5EERDI: RDI F5 (channel) end-to-end

F5EE_LP: loopback request F5 (channel) end-to-end

TOTAL: Indicates the total number of a specific OAM cell received.

The following F-keys are available:

PAGE-UP (F1) and **PAGE DN** (F2): Press to scroll through the screens.

CLEAR (F3): Press to clear the counters and restart the test.

STORE (more, F1): Press to store the results.

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

2.2.5.2 IP Features

These optional features provide advanced Internet connectivity troubleshooting through detailed connection status, PING statistics, and trace route. The menu screen contains the following:

- CONFIGURATION
- IP STATUS
- PING TEST
- TRACE ROUTE
- ECHO RESPONSE

2.2.5.2.1 Configuration

After turning up the link, select IP FEATURES > CONFIGURATION from the main menu. This screen contains configuration items for the IP connection. Enter the proper protocol used by the circuit, as well as the necessary IP addresses.

CONNECT/DISC appears at either F3 or F4 depending on the setting selected. Press CONNECT to start the connection procedure to the ISP. Press DISC to release the connection. Once CONNECT is pressed; the connection will stay UP, if successful, or DOWN if unsuccessful. In either case, press DISC to change any of the configuration items.

MODE

Options: PROFILE (F1), LLC-BRG (F2), LLC-RTE (more, F1), CLIPoA (more, F2), PPPoE (more, F1), PPPoA (more, F2)

Select the protocol mode for the PING test.

- PROFILE allows storing and retrieving of IP configurations, see the subsection entitled *Profile Setup*.
- LLC-BRG refers to LLC-Bridge protocol. This follows RFC 1483 bridge encapsulation. It supports both static and dynamic (DHCP) IP management.
- LLC-RTE refers to LLC-Routed protocol. It supports only static IP addressing.
- CLIPoA refers to Classical IP over ATM according to RFC2225. It only supports Static IP addressing.
- PPPoE refers to PPP over Ethernet, according to standard RFC 2516 PPP over Ethernet. PPPoE supports both static and dynamic IP addressing.
- PPPoA refers to PPP over ATM, according to standard RFC 2364, PPP over AAL5. PPPoA supports both static and dynamic IP addressing.

Note: The actual configuration settings displayed depend on the selected MODE as seen in Figure 20:

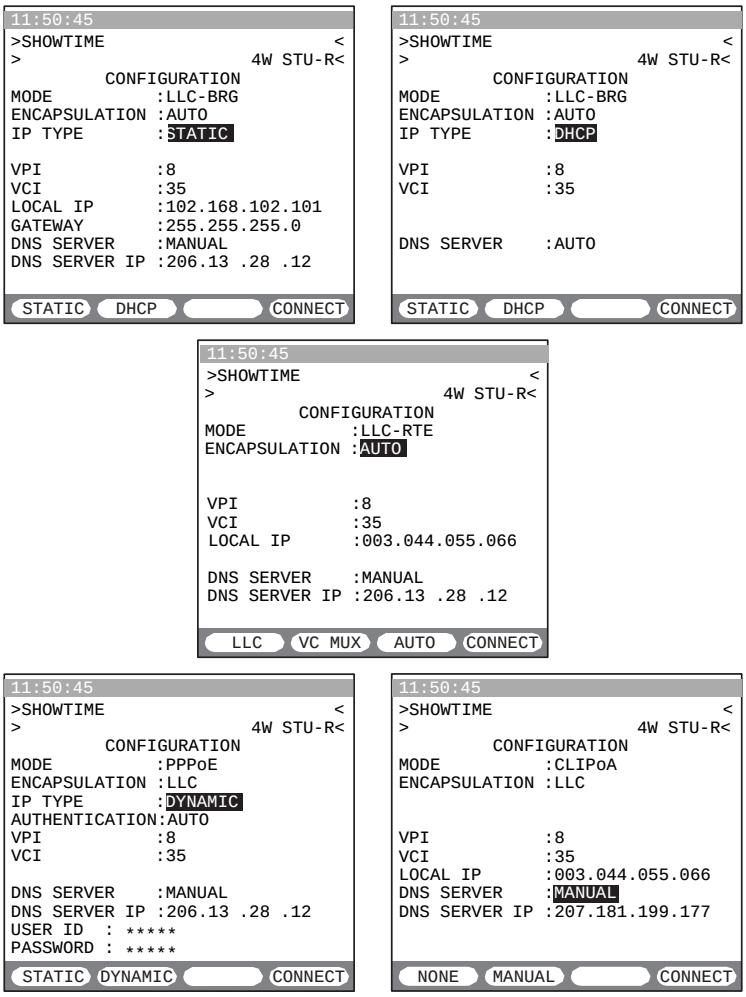


Figure 20 IP Configuration Screens

Notes

- PPPoE STATIC is shown, PPPoA STATIC has the same setup features, except MODE is PPPoA
- PPPoE-DYNAMIC is shown, PPPoA DYNAMIC has the same setup features, except MODE is PPPoA.

Common F-keys and Procedures

The number entry fields in the IP Configuration screens have common navigation F-keys. They are:

<- (F2): Moves the insertion point one place to the left.
-> (F3**)**: Moves the insertion point one place to the right.
To enter numbers, press SHIFT and use the numeric keypad.

Configure the following:

ENCAPSULATION
Options: LLC (F1), VC MUX (F2), AUTO (F3)

Choose the encapsulation method for carrying traffic over AAL Type 5 over ATM as described in RFC 2684.

- LLC: Logical Link Control based on IEEE standard 802.2. It is used when multiple protocols are encapsulated over a single ATM virtual connection.
- VC MUX: (not in CLIPoA or PPPoE modes) Used when only one protocol is carried over a single ATM virtual connection.
- AUTO: (not in CLIPoA or PPPoE modes) Use this to automatically detect the encapsulation.

IP TYPE (not in LLC-RTE or CLIPoA)
Options: STATIC (F1), DHCP (F2, only in LLC-BRG MODE), DYNAMIC (F2, only in PPP mode)

- STATIC: The IP address is statically assigned to the user. Enter the known IP address in the LOCAL IP field.
- DHCP: Dynamic Host Configuration Protocol provides a way for devices to obtain protocol configuration parameters (local IP address) dynamically from the network. In this, the IP address is not fixed to the device; instead the device requests an address from a network DHCP server. When selected for IP ADDRESS, the test set sends a DHCP request to the server; the server responds and provides an IP address. Note that upon selecting DHCP, the LOCAL IP setting disappears.
- DYNAMIC: Dynamic management provides a way for devices to obtain protocol configuration parameters (local IP address) dynamically from the network. In this case, the IP address is not fixed to the device; instead, the terminal requests an address from the network server. When selected for IP ADDRESS, the test set sends a request to the server; the server responds and provides an IP address to use. Note that upon selecting DYNAMIC the LOCAL IP setting disappears.

AUTHENTICATION (not in LLC-BRG, LLC-RTE, CLIPoA)
Options: PAP (F1), CHAP (F2), AUTO (more F1), NONE (more, F2, only in PPPoA MODE)

This ensures that only a valid device establishes a connection with the network.

- PAP: Password Authentication Protocol as in RFC 1334. This is the simplest method for authentication. It involves a two-way handshake where one peer sends a user name and ID to another peer network element. The receiving peer sends back an authentication-acknowledge message either accepting or rejecting the user name and password. Note that when selected, a password and ID will need to be entered.

- CHAP: Challenge Handshake Authentication Protocol as in RFC 1994. It involves a three-way handshake. In this, the test set sends a challenge containing its user name. The server sends a response with a specific identifier expected for this transaction. The test set then accepts or rejects this response. Once done, the handshake is complete and data may be sent.
- AUTO: Use this recommended setting to automatically detect the authentication type requested by the ISP.
- NONE: Available for PPPoA, no authentication is required.

VPI
Range: 1 to 255 (default 8)
Along with the VCI, this identifies the next destination of a cell as it moves through a series of ATM switches to its destination. It is typically assigned by the service provider.

VCI
Range: 1 to 65535 (default is 35)
Along with the VPI, this identifies the next destination of a cell as it moves through a series of ATM switches to its destination. It is typically assigned by the service provider.

LOCAL IP (not in DHCP or DYNAMIC IP)
Specify the IP address of the circuit to be tested.

GATEWAY (LLC-BRG only)
Specify the gateway address. A gateway is a device that connects dissimilar networks and passes information between them. In TCP/IP, the default gateway address is the address where the Internet Protocol sends packets destined for remote networks, unless a different route is configured.

DNS SERVER
Options: NONE (F1), MANUAL (F2), AUTO, only for LLC-BRG DHCP and PPPoE, PPPoA modes (F3)

The Domain Name System Server translates IP addresses into domain names and vice versa. DNS allows you to reference domain names instead of their actual numerical IP address. I.e., www.VeEXtelecom.com translates to 216.102.182.

- NONE: No domain name server, is used. The PING trace route, and web access tests will only use an IP address.
- MANUAL: Manually enter the IP address of the DNS server. Note that at the time of connection the test set will verify the validity of the DNS server IP address.
- AUTO: This will automatically obtain the DNS server IP address upon connection to the ISP.

USER ID (not in LLC-BRG, LLC-RTE, or CLIPoA modes)
For authentication (PAP and CHAP), enter a user ID prior to receiving an IP address from the ISP. See the following subsection entitled *Entering a User ID/Password.*

PASSWORD (not in LLC-BRG, LLC-RTE, or CLIPoA modes)
For authentication (PAP and CHAP), enter a password prior to receiving an IP address from the ISP. See the following subsection entitled *Entering a User ID/Password.*

When finished configuring the IP CONFIGURATION screen, press F3 to connect.

Entering a User ID/Password

1. Place the cursor on USER ID.
2. Press EDIT (F1) and the character entry screen is displayed.
3. Press INPUT (F3) and a cursor appears in the grid.
4. Use ◄, ▲, ▼, ► to move the cursor to the desired character. Press ENTER to select that character. The character will appear in the USER ID line.
5. Continue selecting characters until done. Press STOP (F3) to exit the character grid. If a mistake is made; press STOP (F3) and use ◄, ► to select the incorrect character.
   - Press DELETE (F2) to delete the character.
   - Press INSERT (F1) to add a character to the left of a selected character.
   - Press OVER (F1) to replace the selected character.
6. At HIDE USER ID, choose whether to hide the ID code by pressing YES (F1) or NO (F2). In the bottom left screen shown in Figure 20 the USER ID and PASSWORD are hidden.
7. Press SAVE (F4) to save the ID and return to the Setup screen.
8. Select PASSWORD and follow the previous procedure.

Profile Setup

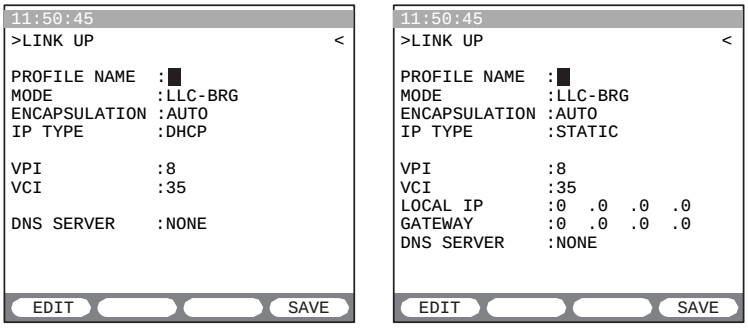


Figure 21 Profile Configuration Screens

IP CONFIGURATION features a PROFILE (F1) F-key that allows for saving and retrieving complete IP configurations:

Creating and Saving a Profile

1. From the IP CONFIGURATION, select MODE and press F1.
2. In the PROFILE screen, select a blank line and press EDIT (F1) and the last configured IP CONFIGURATION screen is displayed.
3. In either screen, when the cursor is on PROFILE NAME give the profile a name by pressing EDIT (F1).
4. In the displayed character entry screen, press INPUT (F3) and a cursor appears in the character grid. Use ◄, ▲, ▼, ► to move that cursor to a desired character. When it is selected, press ENTER and the character will appear after PROFILE NAME.

   If a mistake is made, press F3 and use ◄,► to select the incorrect character. Press one of the following:
   - DELETE (F2) to delete the character.
   - INSERT (F1) to insert a character.
   - OVER (F1) to replace the selected character.

   When finished, press F3 to exit the character grid.
5. Press F4 to save the name and return to one of the screens in Figure 21. Configure the rest as discussed in the previous configuration sections.
6. When finished, press F4 to save the profile.

Editing a Saved Profile

1. From the IP configuration screen, press F1.
2. In the PROFILE listing screen, select a profile and press F1.
3 In the configuration screen, make any required changes and when finished, press F4 to save the changes.

Invoking a Profile

1. From the IP configuration screen, press F1.
2. In the PROFILE listing screen, select a profile and press F4.
3. Press F3 to connect and start the procedure.

2.2.5.2.2 IP Status

These screens are displayed after pressing CONNECT in IP CONFIGURATION (except LLC-RTE and CLIPoA). They report important information on the status of the connection to the ISP.

- LLC-RTE and CLIPoA: 'UP' is displayed when the link is up.
- LLC-BRG: Information about the ARP request in STATIC or about the DHCP session in dynamic mode is reported.
- PPPoE and PPPoA STATIC or DYNAMIC: Information about the PPP session is reported.

LLC-BRG/DHCP IP Status

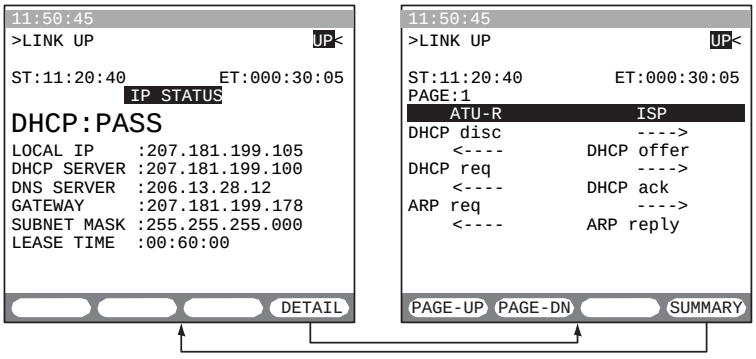


Figure 22 DHCP IP Screens

In this configuration, the test set sends a DHCP discovery message to start DHCP negotiation with the ISP and obtain an IP address. During this process, the following is reported:

ST: Start time indicates when CONNECT was pressed.

ET: Elapsed time since CONNECT was pressed.

The status of the connection to the ISP is displayed on the right side of the screens. It can be DHCP UP, if it has passed, or it can be DHCP DOWN, if it has failed. The status is also displayed under the IP STATUS line in the left screen of Figure 22. It can be:

DHCP: in progress: Connection is not yet completed.

DHCP: PASS: A successful connection.

DHCP: FAIL: Connection was not successful as indicated by one of the following messages:

- LINK DOWN: Link is closed.
- DHCP DISCOVERY FAILED: There is no response to the DHCP discovery message sent by the STU-R. The reason could be an incorrect VP/VC or an incorrect protocol.
- DHCP REQUEST FAILED: A DHCP NACK or DHCP DECLINE message has been sent by the DHCP server.

If DHCP: PASS is displayed, the following is reported:

- LOCAL IP: STU-R IP address assigned by the DHCP server.

- DHCP SERVER: DHCP server IP address. If this reports FAIL, then the ISP did not return a DNS server IP address or it was invalid.
- GATEWAY: Gateway IP address.
- SUBNET MASK: Netmask.
- LEASE TIME: Duration shown in HH:MM:SS of the IP address allocation.

The screen contains this F-Key:

DETAIL (F4): Press to display the right screen shown in Figure 22. It reports the details of the handshake messages exchanged between the STU-R and the DHCP server. The screen also provides the protocol decode of the messages exchanged between the STU-R and the ISP. It contains the following F-keys:

PAGE-UP (F1) and **PAGE-DN** (F2): Page through any additional screens.

SUMMARY (F4): Press to return to the IP STATUS screen.

LLC-BRG Static IP Status

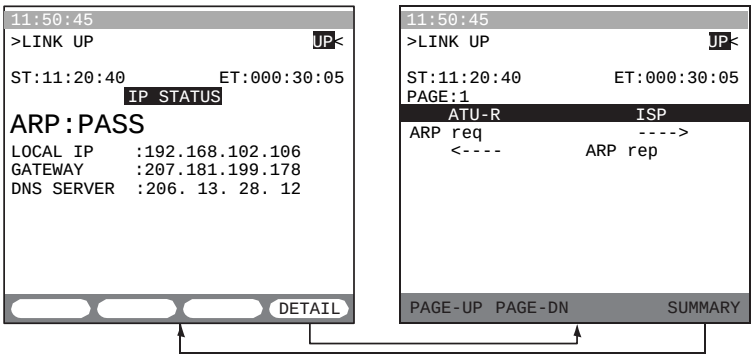


Figure 23 ARP IP Screens

After pressing CONNECT in IP CONFIGURATION, the test set will send an ARP (Address Resolution Protocol) request to the ISP in order to verify the IP configuration. The following is reported:

ST: Indicates when the CONNECT key was pressed.

ET: Elapsed time since the CONNECT key was pressed.

The status of the connection to the ISP is displayed on the right side of the screens. It can be 'ARP UP', if it has passed, or it can be 'ARP DOWN', if it has failed. The status is also displayed under the IP STATUS line in the left screen of Figure 23. It can be:

ARP: in progress: Connection is not yet competed.

ARP: PASS: A successful connection.

ARP: FAIL: Connection was not successful; indicated by one of the following messages:

- LINK DOWN: Link is closed.
- WRONG CONFIGURATION: Wrong VP/VC, protocol, local address or gateway IP address.

If ARP: PASS, the following is reported:

- LOCAL IP: STU-R IP address assigned by the DHCP server.
- GATEWAY: Gateway IP address.
- DHCP SERVER: DHCP server IP address. If reports FAIL, the ISP did not return a DNS server IP address or it was invalid.

The screen contains this F-Key:

DETAIL (F4): Press to display the right screen shown in Figure 23. It reports the details of the handshake messages exchanged between the STU-R and the gateway. It also provides the protocol decode of the messages exchanged between the STU-R and the ISP. It contains the following F-keys:

PAGE-UP (F1) and **PAGE-DN** (F2): Page through any additional screens.

SUMMARY (F4): Press to return to the IP STATUS screen.

PPP Static or Dynamic IP Status

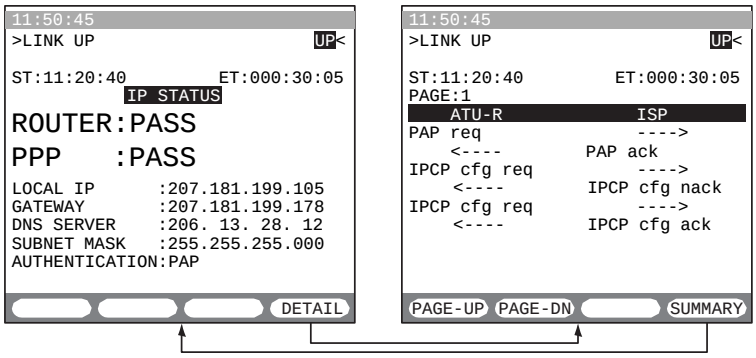


Figure 24 PPP IP Screens

After pressing CONNECT in IP CONFIGURATION, the test set will start the PPP negotiation with the ISP. The following is reported:

ST: Indicates when CONNECT was pressed.

ET: Elapsed time since CONNECT was pressed.

The status of the connection to the ISP is displayed on the right side of the screens. It can be 'PPP UP', if it has passed, or it can be 'PPP DOWN', if it has failed. The status is also displayed under the IP STATUS line in the left screen of Figure 24. It can be:

ROUTER: in progress: Connection is not yet opened.

ROUTER: PASS: The ISP has responded and the connection parameters have been successfully negotiated.

ROUTER: FAIL: The ISP has not responded or the negotiation of the connection parameters has failed.

PPP: in progress: Connection is not yet opened.

PPP: PASS: The authentication and IP parameters of the connection have been successfully negotiated and the connection is UP. If successful, the following is displayed:

- LOCAL IP: STU-R IP address.
- GATEWAY: Gateway IP address.
- SUBNET MASK: Netmask.
- DHCP SERVER: DHCP server IP address. If FAIL, the ISP did not return a DNS server IP address, or it was invalid.
- AUTHENTICATION: Authentication mode PAP, CHAP or NONE (only in PPPoA).

PPP: FAIL: Indicates that the authentication or the IP parameters of the connection haven't been successfully negotiated and that the connection is down. A messages can be displayed:

- LINK DOWN: Link is closed.
- PPP-RESPONSE TIMEOUT (PPPoA only): There is no response to the messages sent by the STU-R. The reasons could be an incorrect VP/VC or an incorrect protocol.
- PPPoE DISCOVERY FAILED (PPPoE only): There is no response to the discovery messages sent by the STU-R. The reasons could be an incorrect VP/VC or an incorrect protocol.
- WRONG AUTHENTICATION: The authentication mode (PAP, CHAP, or NONE-PPPoA only) is not the one expected by the ISP.
- WRONG USER ID or PASSWORD: The STU-R has not been authorized by the ISP.
- WRONG CONFIGURATION: The negotiation of the IP parameters of the connection has failed. The reason could be an incorrect local IP address for PPPoE or PPPoA configurations.

The screen contains this F-Key:

DETAIL (F4): Press to display the right screen shown in Figure 24. It reports the details of the handshake messages exchanged between the STU-R and the PPP server. It also provides the protocol decode of the messages exchanged between the STU-R and the ISP. Note that in a PPPoA handshake, the messages exclude the PPPoE discovery stage. It contains the following F-keys:

PAGE-UP (F1) and **PAGE-DN** (F2): Page through any additional screens.

SUMMARY (F4): Press to return to the IP STATUS screen.

2.2.5.2.3 PING Test

Before running this test, the connection must be UP as indicated at the top right of the screen.

This screen is the same for all the encapsulation types. Press F4 after configuration to start the test. Press again to stop the test.

The following is displayed:

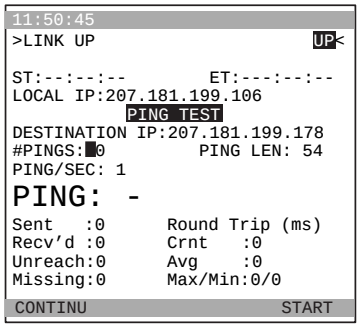


Figure 25 PING Test Screen

ST: Indicates when the START key was pressed.

ET: Elapsed time since the START key was pressed.

LOCAL IP: Displays the LOCAL IP entered in the CONFIGURATION screen, if static IP TYPE has been selected. It displays the dynamically assigned address if DHCP or DYNAMIC IP TYPE has been selected in the CONFIGURATION screen.

Configure the following for PING testing:

DESTINATION IP

Options: GATEWAY (F1), URL/IP ADDR (F2), LIST (F3)

Enter the Destination IP address.

- GATEWAY: Use to automatically PING the Gateway. IP address not available in LLC-RTE and CLIPoA modes.
- IP ADDR: Use to enter a destination address. Use SHIFT and number keypad along with ◄,►, or press F3 and select a saved IP address from the list.
- URL: Uniform Resource Locator is used to enter a destination domain name if a DNS server is available. To enter, press URL (F1) for a character entry screen or LIST (F2) for the DESTINATION IP list.

To save a URL or IP address, use this procedure:

1. Press F2 and the in the DESTINATION IP list select a blank line and press EDIT (F1).
2. In the character entry screen select the type of address by pressing URL (F1) or IP ADDR (F2). If IP ADDR is selected, this screen is replaced by a numeric entry screen.
   A. Press ▼ to select DESTINATION IP and use SHIFT, the numeric key pad, <-- (F2) and --> (F3) to enter.
   B. When finished, press F4 to save.
3. In the PING configuration screen, press ▼ to select URL.
4. Press F3 to select the character grid with a cursor.
5. Use ◄, ▲, ▼, ► to move the cursor to the desired character.

Press ENTER to select that character. The character will appear in the URL line. Repeat this until done then press STOP (F3) to exit the character grid.

- If a mistake is made, press STOP (F3) and use ◄,► to select the incorrect character.
  - Press DELETE (F2) to delete the character.
  - Press INSERT (F1) to add a character to the left of the selected character.
  - Press OVER (F1) to replace the selected character.

6. Press F4 to save and return to PING configuration.

#PINGS

Options: 1-999999; default is 10.

Select the number of PINGS to send. Use SHIFT, the number keypad and ◄,► to enter a number, or press F1 for continuous.

PING LEN

Options: 64-1500 bytes; default is 64.

Select the PING length to send. Use SHIFT, the number keypad and ◄,► to enter a value.

PING/SEC

Options: 1-10; default is 1.

Select the number of PINGS to send per second from. Use SHIFT, the number keypad and ◄,► to enter a value.

When ready, press F4 to begin. Press again to stop. The following is reported:

PING: result will indicate:

PING: –: The test hasn't been started.
PING: IN PROGRESS: The test is in process.
PING: PASS: At least 1 echo response has been received.
PING: FAIL: An echo response has not been received.
PING: NO DNS SERVER: The DNS server is unavailable.
PING: DNS LOOKUP FAILED: The IP address could not be associated with the host name.

The bottom of the screen reports the statistics of the test:

Sent: Number of PINGS sent to the network.

Recv'd: Number of correct echo responses received.

Unreach: Number of echo responses with an unreach flag.

Missing: Number of echo responses missing.

Round Trip: Measure of the round trip delay in milli seconds.Crnt (Current), Avg (Average) and Max/Min (Maximum and Minimum) is reported.

2.2.5.2.4 Trace Route

Before running the test, UP must be displayed as indicated at the top right of the screen.

Use this screen to send PING messages to a destination address and trace the messages across the routers through which they travel. The result screen is the same for all encapsulation types.

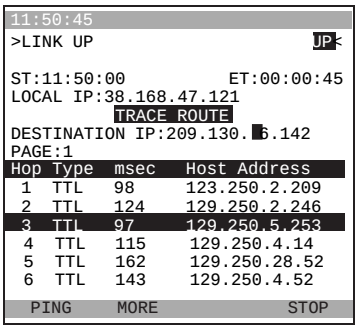


Figure 26 Trace Route Screen

After entering a destination IP address (see *Section 2.2.5.2.3*), press F4 to start. Press again to stop it, resetting ET to zero. Scroll through the results using ▲ , ▼ . PAGE displays the currently displayed page number. Configure the following:

LOCAL IP: If STATIC IP TYPE, enter LOCAL IP in IP FEATURES > CONFIGURATION. If DHCP/DYNAMIC, this is network assigned.

DESTINATION IP

Options: GATEWAY (F1), URL/IP ADDR (F2), LIST (F3)

- GATEWAY: Use to automatically PING the Gateway. IP address not available in LLC-RTE and CLIPoA modes.
- IP ADDR: Use to enter a destination address. Use SHIFT, the numeric keypad and ◄ , ►, or press F3 and select from the list.
- URL: Uniform Resource Locator is used to enter a destination domain name if a DNS server is available. To enter, press URL (F1) for a character entry screen or LIST (F2) for the DESTINATION IP list. To save, see *Section 2.2.5.2.3.*

The following is reported after pressing F4:

ST: Indicates when START was pressed.

ET: Elapsed time since START was pressed

Hop: Displays up to 32 router hops.

Type: Describes the type of hop. It can be the following types:

ECHO: The destination IP has responded.

MISS: A router or destination IP has not responded.

TTL: Time To Live field of the PING message has been decremented, and successfully passed a router.

msec: Duration of a hop (roundtrip).

Host Address: Responding router's IP address.

Host Name: Press MORE (F2) or use ◄ , ► to see the Host Name (if DNS server is enabled).

Use ▲ , ▼ to select a hop and press F1 to PING it, or press MORE (F2) to display the host name (if available).

2.2.5.2.5 Echo Response

Before running the test, UP must be displayed as indicated at the top right of the screen.

This screen runs in the background, updating continuously. Use PAGE-UP (F1) and PAGE-DN (F2) to scroll any available screens.

The following is reported:

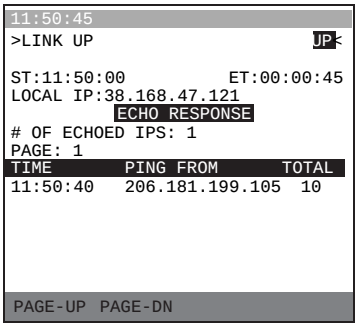


Figure 27 Echo Response Screen

ST: Indicates when CONNECT was pressed in IP FEATURES > CONFIGURATION.

ET: Elapsed Time since CONNECT was pressed in IP FEATURES > CONFIGURATION.

LOCAL IP: If STATIC IP TYPE, enter LOCAL IP in IP FEATURES > CONFIGURATION. If DHCP/DYNAMIC, this is network assigned.

 # OF ECHOED IPS: Number of different IP addresses which sent PINGs to the module.

PAGE: Current page number.

TIME: Timestamp of the last PING received from the associated IP address.

PING FROM: IP address that sent the PING.

TOTAL: Number of PINGs received from the associated IP address.

2.3 STUC E1, STUR E1, and E1 Configuration

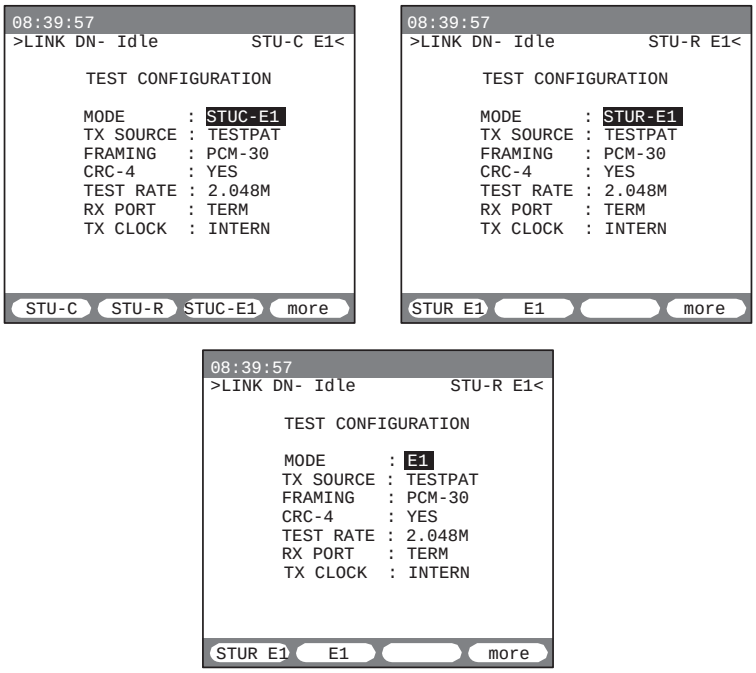


Figure 28 STUx E1 and E1 Configuration Screens

Configure the following:

TX SOURCE

Options: TESTPAT (F1), LOOP (F2)

- TESTPAT: Use for out-of-service bit error rate testing. In this case, a test pattern will be transmitted on the selected Transmit jack. During Nx64K testing, an idle code will be inserted on the unused channels.
- LOOP: Use for full duplex drop and insert testing on an in-service line. In this case, the signal received on the Rx jack will be transmitted out the Tx jack.

FRAMING

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

Choose the appropriate framing for the circuit under test.

- PCM-30: The test set will synchronize on both FAS (Frame Alignment Signal) and MFAS (MultiFrame Alignment Signal).
- PCM-31: The test set will synchronize only on FAS.
- UNFRAME: Framing is not used.

Notes:

- If unsure of the framing, press AUTO. Use the combination which synchronizes properly and/or allows error free measurements.

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

CRC-4

Select yes to measure CRC-4 errors on the incoming signal and also to transmit the CRC-4 bits on the outgoing signal. CRC-4 works with PCM-31 and PCM-30 framing only. If UNFRAME has been selected, the CRC-4 configuration is NO.

TEST RATE

Options: 2.048M (F1), Nx64K (F2)

Select an appropriate rate for the circuit under test.

- 2.048M: Configure the test set for full rate testing. If uncertain about which one to choose, select this for full rate testing.
- Nx64: Configure the test set for fractional testing. Upon pressing, the SELECT TIME SLOT screen is displayed as in the screen shown to the right. In it, select each time slot to test, these can be selected automatically or manually using the following procedures:

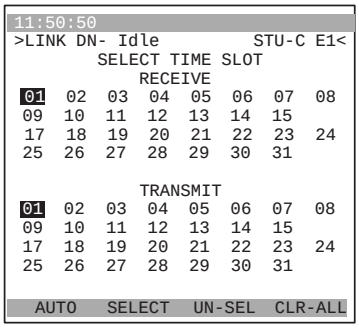


Figure 29 Select Time Slot Screen

Manually Selecting Time Slots

1. Use ◄, ▲, ▼, ► to choose the time slot and press SELECT (F2). Repeat until finished. Selected time slots remain highlighted, as shown in Figure 29.

- Press UN-SEL (F3) to deselect a time slot.
- Press CLR-ALL (F4) to clear all selections and to start over.

Automatically Selecting Time Slots

1. Press AUTO (F1) if receiving a signal which is already formatted in the Nx64 kbit/s fractional E1 format.

   In AUTO, the test set automatically configures time slots by looking for active data. It will configure the transmit side to be the same as the active time slots on the receive side. The test set determines which time slots are active by first determining which time slots are idle. Any time slot that is not idle is assumed to be active.

   In PCM-31 framing, time slots 1-31 correspond to channels 1-31. In PCM-30 framing, time slots 1-15 correspond to channels

1-15, and time slots 17-31 correspond to channels 16-30. In PCM-30, time slot 16 is used for the multiframe alignment signal. Fractional E1 is not offered with unframed signals, because framing is required to determine the location of time slots.

The time slots specified for transmit and receive need not be the same. The test set will assume that all incoming data is received byte by byte in ascending channel order.

2. When finished, press ENTER to validate the settings and return to TEST CONFIGURATION.

RX PORT

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

Configures the 2.048 Mbit/s receiver.

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

CAUTION! If uncertain, select BRIDGE, this will protect the 2.048 Mbit/s signal.

- TERM: Terminate the received signal with a 75 or 120Ω impedance termination. The tested signal has been transmitted over real cable at a level between approximately +6 and -43 dB. Using TERM mode will disrupt the circuit.
- BRIDGE: Applies high-impedance isolation resistors to the circuit. This isolation circuit will protect the signal from any possible disruption. The tested signal has been transmitted over regular cable at a level of approximately +6 and -43 dB.
- MONITOR: Used when a measurement is made at a protected monitoring point, at a level between -15 and -30 dB.

  If a 0 dB signal is received, the BPV/CODE LED will be red. This happens when the test set is plugged into an OUT jack. In this case, select TERM. If uncertain if a jack is bridged or protected, try BRIDGE first.

TX CLOCK

Options: Rx (F1), INTERN (F2)

- Rx: The test set uses the timing from the received signal as the clock source.
- INTERN: Use the internal timing of the test set. This timing is not synchronized to the network. Use when loopback testing where synchronization is not required.

2.3.1 Modem Status

Use these screens to view realtime link parameters. Press ▲ , ▼ to view the available screens

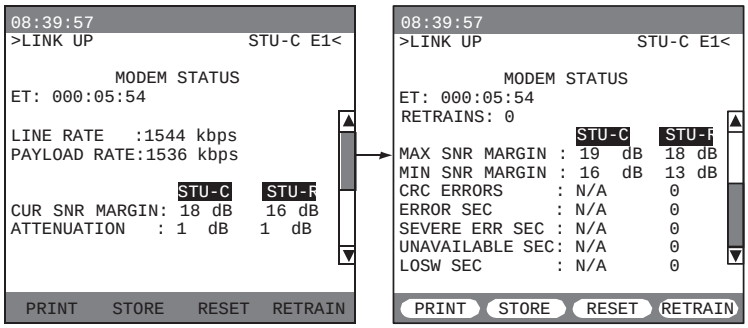


Figure 30 STUx E1 Modem Status Screens

Modem Status screens provide general performance information on the STU-C and STU-R. For the far end data, “N/A” is displayed. The following is reported:

ET: Elapsed Time since RESET (F3), RETRAIN (F4), or ESC was pressed.

LINE RATE reported in kbps, see *Section 2.2-Notes for Payload and Line Rates*.

PAYLOAD RATE reported in kbps, see *Section 2.2-Notes for Payload and Line Rates*.

CUR SNR MARGIN: Current signal-to-noise margin (in dB) is the maximum dB increase in equalized noise or the maximum dB decrease in equalized signal that a system can tolerate and maintain a BER of 10^{-7}.

ATTENUATION: Displays the loop attenuation (in dB).

MAX SNR MARGIN: Maximum signal-to-noise margin (in dB) measured during ET. When either RETRAIN (F4) or ESC is pressed, MAX SNR is reset.

MIN SNR MARGIN: Minimum signal-to-noise margin (in dB) that is measured during ET. When either RETRAIN (F4) or ESC is pressed, MIN SNR is reset.

CRC ERRORS: Count of CRC errors. Reset when ET is reset.

ERROR SEC: Count of 1 second intervals during which one or more CRC errors are declared and/or one or more LOSW defects are declared. Reset when ET is reset.

SEVERE ERR SEC: Count of 1 second intervals during which at least 50 CRC errors or 1 or more LOSW defects are declared. 50 CRC errors during a 1 second interval is equivalent to a 30% error frame rate for a normal frame length. Reset when ET is reset.

UNAVAILABLE SEC: Count of 1 second intervals for which the SHDSL line is unavailable. The SHDSL line becomes unavailable at the onset of 10 contiguous SESs. The 10 SESs are included in the unavailable time. Once unavailable, the SHDSL line becomes available at the onset of 10 contiguous seconds with no SESs. The 10 seconds with no SESs are excluded from unavailable time. Reset when ET is reset.

LOSW SEC: Loss of synchronization word second is a count of 1 second intervals during which one or more SHDSL LOSW defects are declared. This parameter is reset when ET is reset.

The following F-keys are common to these screens:

PRINT (F1): Send the status screens to the serial port.

STORE (F2): Press to store the status screen.

RESTART (F3): Restarts polling and resets ET to zero.

RETRAIN (F4): Retrains the modem and resets ET to zero.

2.3.2 Alarm Status

This screen provides general alarm status (current and history for local and remote). The following is reported:

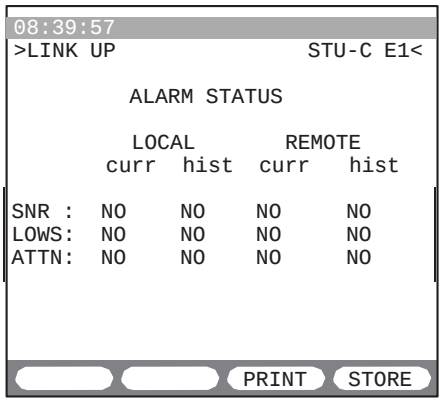


Figure 31 STUx E1 Alarm Status Screen

SNR: Triggered when the local current SNR margin value is below the user threshold setting. This is set in MODEM CONTROL > SYSTEM SETTINGS, on the SNR MARGIN THRESHOLD line.

LOSW: Loss of Sync defect alarm, a loss of synchronization word defect is declared when at least 3 consecutive received frames contain 1 or more errors. An LOSW defect is cleared when at least 2 consecutive received frames contain no errors.

ATTN: Triggered when the local attenuation value is greater than the user threshold value. This is set in MODEM CONTROL > SYSTEM SETTINGS, on the LOOP ATTN THRESHOLD line.

These alarm conditions are displayed as current and history. These are defined as:

curr YES: The alarm condition is currently detected.

curr NO: The alarm condition is not currently detected.

hist YES: The alarm condition has been detected, but it is no longer present.

hist NO: The alarm condition has never been detected since the start of the test or since pressing HISTORY.

The following F-keys are available:

PRINT (F3): Send the alarm screen to the serial port.

STORE (F4): Press to store the status screen.

2.3.3 E1 Measurement

The test set continuously performs measurements on a received signal. While a measurement is being made, "Meas" is displayed. When stopped, the indicator is no longer displayed.

Results are compiled while in any E1 mode. Measurements are automatically restarted anytime the configuration is changed.

Measurements often have a count number displayed on the left hand side and the corresponding rate or percentage displayed on the right hand side of the same line. For example, in Figure 33, CODE appears on the left and RATE on the right.

A key concept is circuit availability. It is available only when the bit error rate is low enough for an understandable signal. It is unavailable at the beginning of 10 consecutive SES (Severely Errored Seconds). Errors, ES (Errored Seconds), and SES are not accumulated when unavailable. Therefore, if errors are injected from the test set at a $2x10^{-3}$ error rate, increasing bit errors, ES, and SES for the first 9 seconds will be seen. At the tenth second, all the counts will return to the values before the error injection was started and the unavailable counter will increase by 10.

Once unavailable, it becomes available only after 10 consecutive seconds without severe errors. To continue the previous example, if severe error injection is turned off and then 1 or 2 errors are inserted in the next 5 seconds, the unavailable second counter continues to increase for the first 9 seconds while the error counter does not change. Then at the 10th second, the unavailable second counter decreases by 10 and the error counter increases by the 1 or 2 inserted errors.

The following F-keys are shared by all E1 result screens:

PAGE-UP (F1) and **PAGE-DN** (F2): Page through the screens.

STOP/START (F3): Press to stop the measurement and record the results, press again to restart.

HOLDSCR/CONTINU (MORE, F1): Press to freeze the display so it can easily observed. The measurements are still proceeding, but are updated in memory. When finished, press again to continue.

LOCK/UNLOCK (MORE, F2): Press to lock the keypad. This is useful if running a long-term test and wish to have the test undisturbed. Press again to unlock the keypad.

The following is displayed except in the STATUS screen:

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

RT: Remaining Time is always CONTINU for continuous.

FRM: Transmitted framing.

TxCK: Transmit clock source.

PATT: Transmitted test pattern.

RATE: Test rate

2.3.3.1 Measurement Definitions

The following measurements are displayed within the results screens. The definitions are listed in alphabetical order. Each measurement is proprietary to its screen; i.e., 'error' refers to E-Bit errors in the E-BIT screen, and to all Summary errors in the SUMMARY screen.

AISS: Count of the number of Alarm Indication Signal Seconds.

AS: Count of Available Seconds since the start of the test. It equals the length of the total test time minus any Unavailable Seconds.

%AS: Percentage of Available Seconds since the start of the test.

BIT: Count of Bit errors since the start of the test. Bit errors are not counted during unavailable time.

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

CLK SLIP: Number of Clock Slips since the start of the test.

CODE: Count of the number of line Code errors (Bipolar Violations that violate the coding rules) since the start of the test. This is measured only in E1 mode. In HDB3 coding, a Code Error is a bipolar violation that is not part of a valid HDB3 substitution. CODE RATE is the Average Bipolar Violation error rate since the start of the test.

CRC: Count of the number of CRC-4 block errors since the start of the test. N/A is displayed when the test set is not synchronized on a received CRC-4 check sequence. CRC RATE is the average CRC-4 block error rate since the start of the test. N/A is displayed when the test set is not synchronized on a received FAS or MFAS signal.

DGRM: Count of Degraded Minutes since the start of the test. This occurs when there is a 10^{-6} bit error rate during 60 available, non-severely bit errored seconds.

%DGRM: Percentage of summary Degraded Minutes since the start of the test.

EBIT: Number of E-bit errors since the start of the test.

EBER: Average E-bit error rate since the start of the test.

EFS: Number of Error Free Seconds since the start of the test.

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

ES: Count of the number of Errored Seconds since the start of the test. An ES is any second with at least one BPV, bit error, FBE, errored block, or CRC-4 error. An ES is not counted during a UAS.

%ES: Percentage of errored seconds since the start of the test.

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

FE: Count of the number of Frame bit Errors since the start of the test. N/A is displayed when the test set has not synchronized on a known framing pattern within the received signal.

Hz/PPM: The Hertz/Part Per Million count records any variance from 2.048 Mbit/s in the received frequency.

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

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

+LVL, -LVL: Positive and Negative Level is the level of positive and Negative pulses received by the test set displayed in decibels variance from G.703 specified level (dB).

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

MAX Hz, MIN Hz: Maximum and Minimum frequencies since the start of the test.

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

RxCLK: Received clocking frequency.

+/- RxLVL: Positive or negative level of pulses received.

RCV Hz: Frequency measured during the last second.

SES: Count of Severely Errored Seconds since the start of the test. A severely errored second has an error rate of $>10^{-3}$. SES is not counted during unavailable time.

%SES: Percentage of seconds since the start of the test that are Severely Errored Seconds.

SLIP: Count of Bit Slips that occur when the synchronized pattern either loses a bit or has an extra bit stuffed into it.

UAS: Count of Unavailable Seconds that have occurred since the start of the test. This begins at the onset of 10 consecutive SES. The displayed value of UAS updates after the tenth consecutive severely errored second occurs. It also begins at LOS or LOF.

%UAS: Percentage of Unavailable Seconds since the start of the test.

2.3.3.2 E1 Measurement Screens

These screens are available for STUC E1, STUR E1, and E1 configurations.

E1 Status Screen

This screen displays the status of the E1 Line. In large type, a status message is displayed for the line. These messages can be NO ERRORS, FRM LOSS, SIG LOSS or ERROR DET. They represent the condition of the line during testing.

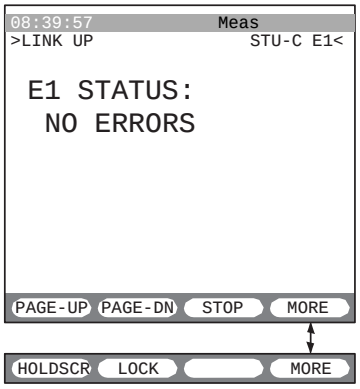


Figure 32 E1 Status Screen

E1 Summary Screen

This screen contains summary results for the E1 Line. It presents the most significant measurement results. It contains data related to the specific types of impairments, like code errors, CRC-4 block errors, framing, and multiframe bit errors. See *Section 2.3.3.1* for measurement definitions.

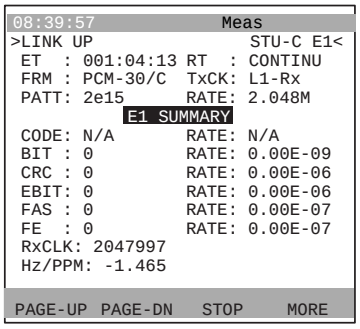


Figure 33 E1 Summary Screen

E1 Frequency Screen

This screen shows relevant frequency information. When no reference clock signal is present, the test set will default to its internal clock, for the measurement of MAX, MIN, and current RCV bit rates of the signal. See *Section 2.3.3.1* for measurement definitions.

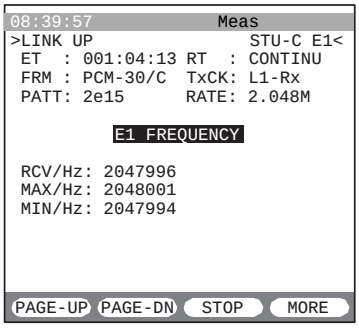


Figure 34 E1 Frequency Screen

E1 G.821 Screen

This screen presents the measurement parameters specified in ITU G.821. See *Section 2.3.3.1* for measurement definitions.

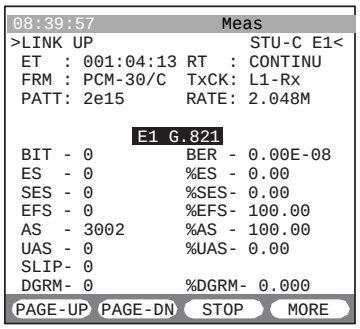


Figure 35 E1 G.821 Screen

E1 Alarm/Signal Screen

This screen presents alarm and measurement parameters relating to the E1 signal. See *Section 2.3.3.1* for measurement definitions.

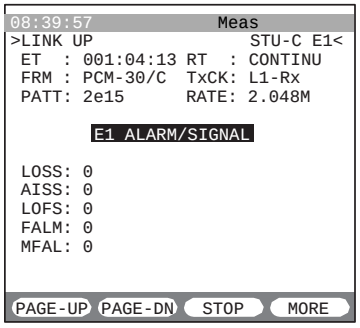


Figure 36 E1 Alarm/Signal Screen

E1 M.2100/550 Screen

This screen provides pass/fail measurements in accordance with ITU M.2100/550. This is used where a 2.048 Mbit/s circuit passes through international boundaries. It allocates a certain allowable error rate to each nation that carries the circuit.

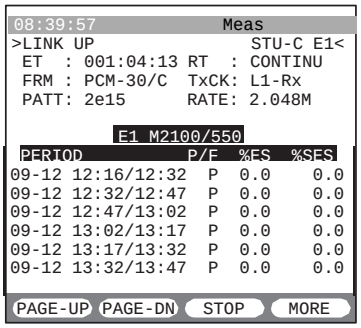


Figure 37 E1 M.2100/550 Screen

The following definitions pertain to this screen:

PERIOD: Identifies the date and time interval of each of the reported pass or fail results.

P/F: Indicates whether the test result Passed or Failed.

%ES: Percentage of M.2100 Errored Seconds since the start of the test. An errored second is any second with a Code, Bit, Frame, Multiframe or CRC errors.

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

For other screen items, See *Section 2.3.3.1*.

E1 G.826 Screen

The ITU standard, specifies required performance characteristics of 2.048 Mbit/s lines. The parameter definitions given in G.826 are block-based. This allows for convenient in-service measurement.

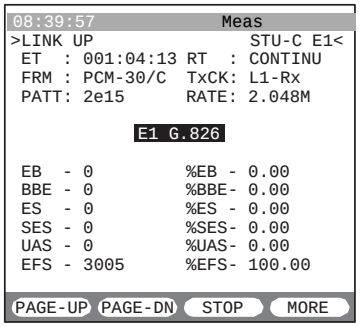


Figure 38 E1 G.826 Screen

The following definitions pertain to this screen:

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

%BBE: Percentage of Background Block Errors since the start of the test, excluding all blocks during SES and unavailable time.

EB: Errored Block is a block containing 1 or more bit errors.

%EB: Percentage of Errored Blocks since the start of the test.

SES: Severely Errored Second is a 1 second period which contains greater or equal to 30% errored blocks.

%SES: Percentage of Severely Errored Seconds since the start of the test.

For other screen items, See *Section 2.3.3.1*.

2.3.4 Test Pattern

To transmit one of the standard patterns:

1. In the screen on the right, use ◄, ▲, ▼, ► to select a desired pattern. As a pattern is highlighted, the test set transmits that pattern.
2. Press INVERT (F2) to send the pattern with an inverted polarity (1s and 0s reversed). Press NORMAL (F2) to send it with a normal polarity.

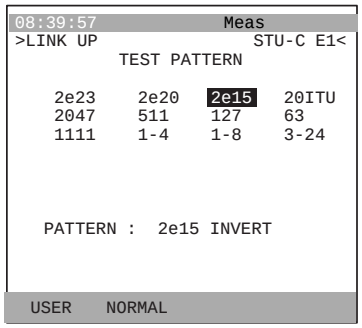


Figure 39 Test Pattern Screen

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

The following standard test patterns are available:

2e23: Industry-standard $2e23^{-1}$ pseudo random bit sequence formed from a 23 stage shift register. It contains up to 22 zeros in a row and violates standards for consecutive zeros in AMI transmission.

2e20: Industry-standard $2e20^{-1}$ pseudo random bit sequence. It is formed from a 20 stage shift register. This pattern contains up to 19 zeros in a row and violates standards for consecutive zeros in AMI transmission.

2e15: Industry-standard $2e15^{-1}$ pseudo random bit sequence. It is formed from a 15 stage shift register. It contains up to 14 zeros in a row and does not violate standards for consecutive zeros in AMI-coded transmission.

20ITU: This is a $2e20^{-1}$ pseudo random bit sequence. It is formed from a 20 stage shift register. It conforms to the ITU O.153 technical standard. It is not identical to 2e20, because different feedback mechanisms are used when the patterns are produced by means of shift registers. 20ITU suppresses consecutive sequences of more than 18 zeros, as opposed to 14 zeros in 2e20.

2047, 511, **127**, **63**: Industry-standard bit codes used for DDS.

1111: Industry-standard all ones pattern is used for stress testing E1 AMI and B8ZS lines. If sent unframed, it will be interpreted as an AIS (Alarm Indication Signal).

1010: Industry-standard alternating ones and zeros pattern. It is frame aligned with 'f' showing the location of the framing bit.

0000: Industry-standard all zeros pattern. It 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.

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

QRSS: Industry-standard Quasi Random Signal 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.

1-4: Used to stress test circuits. The frame aligned pattern is 0100.

1-8: Industry-standard pattern used for stress testing AMI and B8ZS lines. It is frame aligned ('f' is the framing bit) as shown in its binary form: f 0100 0000.

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

2.3.4.1 Custom Patterns

In addition to the standard patterns, a pattern can be created.

Creating a Pattern

1. In the TEST PATTERN screen, press USER (F1).
2. Select a blank position on the list and press CREATE (F1). The cursor appears at LABEL.
3. Press TOGGLE (F3) and the letter A will be highlighted.
4. Use ◄, ▲, ▼, ► to select the desired character.
5. Press SELECT (F4) and the character appears next to LABEL. Repeat until the label is done.
6. Press TOGGLE (F3) to move out of the character grid and back to LABEL.
7. Press ▼ to move to 'No' and press SHIFT and use the numeric keypad to enter the pattern. Enter up to 24 bits.

   Use INSERT (F1) and DELETE (F2) to make corrections.
8. When finished, press SHIFT followed by ENTER to store the pattern and to return to TEST PATTERN. The new pattern label will now be displayed in the list.

Sending a Custom Pattern

1. In the TEST PATTERN screen, press USER (F1).
2. In the USER TEST PATTERN list screen, use ▲, ▼ to select a desired pattern and press ENTER to send the pattern.

Viewing a Custom Pattern

1. In USER TEST PATTERN list screen, use ▲, ▼ to select a desired pattern and press F1 to view it.

Deleting a Custom Pattern

1. In the TEST PATTERN screen, press USER (F1).
2. Select an entry to delete and press F3.

2.3.5 Error Injection

To start error injection, press ERR INJ. The test set will insert errors as specified in the screen to the right. If the error injection is set to RATE mode, an ERR-INJ indicator will be displayed.

Note: Error Injection works in STU-C E1, STU-R E1, or E1 modes, but not in STU-C or STU-R modes.

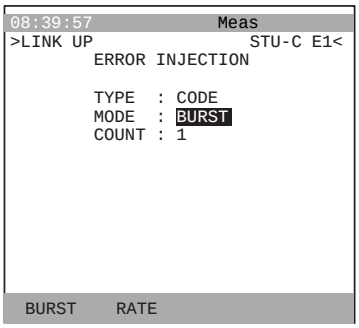


Figure 40 Error Injection Screen

Configure the following:

TYPE

Options: CODE (F1), BIT (F2), BIT + COD (F3), CRC-4 (MORE, F2), FRAME (MORE, F2), E-BIT (MORE, F3)

Specify the type of errors to be inserted.

MODE

Options: BURST (F1), RATE (F2)

Specify the mode of error injection.

- RATE: Applies only to CODE and BIT errors. Errors are injected at a constant rate.
- Other types of errors may be inserted one at a time under BURST mode, which injects a set number of errors.

COUNT

Options: 1 to 9999 or 1e-9 to 2e-3

For BURST, choose the COUNT of errors to be inserted.

For RATE, choose the error RATE number and exponent.

- For BURST, press SHIFT, then use the numeric keypad to enter any number between 1 and 9999. The errors will be inserted in approximately 1 second or less, and will cause from 1 to 3 errored seconds.
- Applies only to BIT and CODE errors. All other errors will be injected singly.
- For RATE, the errors will be inserted at a continuous rate as specified in this entry. An on screen ERR-INJ indicator will be displayed while this is active.

Programming a Burst of 10 Errors

1. Select ERROR INJECTION.
2. At TYPE, press CODE (F1) to select the error type.
3. At MODE, press BURST (F1).
4. At COUNT. Press SHIFT and enter 10 using the numeric keypad. Press SHIFT when finished.
5. Press ENTER and the test set is set inject 10 CODE errors each time ERR INJ is pressed.

Programming a 10-6 Bit Error Rate

1. Select ERROR INJECTION.
2. At TYPE, press BIT (F2) to select the error type.
3. At MODE, press RATE (F2).
4. At COUNT. Press SHIFT and use the numeric keypad to press 1. The multiplier position shows 1. The cursor moves to the exponent position. Now press 6. When finished, press SHIFT.
5. Press ENTER and the test set is set to inject Bit errors at $1x10^{-6}$ rate each time ERR INJ is pressed. To turn off the error rate injection, press ERR INJ once then verify that the on screen ERR INJ indicator is off.

2.4 View/Store/Print

Use this screen to store different results to view or print at a later time. To store results, use the procedure in *Section 2.4.1*.

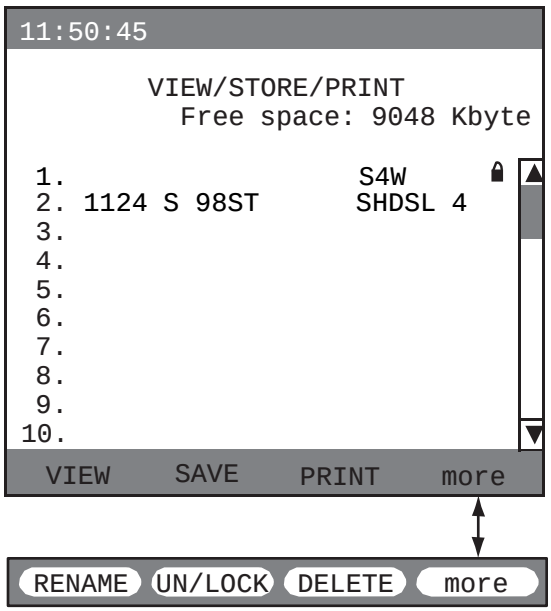


Figure 41 View/Store/Print List Screen

The following F-keys are available:

VIEW (F1): Allows viewing of a selected file. See *Section 2.4.2*.

SAVE (F2): Select a blank line and press this key to save your results. See *Section 2.4.1*.

PRINT (F3): Print a selected file. See *Section 2.4.3*.

RENAME (more, F1): Rename a file, unless locked. See *Section 2.4.6*.

DELETE (more, F2): Delete a file, unless locked. See *Section 2.4.4*.

UN/LOCK (more, F3): Protect a file from changes or deleting. See *Section 2.4.5*.

2.4.1 Saving a Test

1. From any screen with a STORE F-key, press it and the test is saved with a generic filename as a CSV file that can be opened with most spreadsheet programs. These files are stored in the MMC card under RESULT > CSV.

2.4.2 Viewing a Stored Test

1. From the module main menu, select VIEW/STORE/PRINT.
2. Select the desired file with ▲ , ▼ and press F1 to view the stored result.
3. Use ▲ , ▼ to scroll through the available screens.
4. When finished, press ESC.

2.4.3 Printing a Stored Test

1. Connect a SunSet printer to the serial port of the test set.

- For other types of printers or for more information, refer to the Storing and Printing chapter in the test set chassis User's Manual.

2. From the module main menu, select VIEW/STORE/PRINT.
3. Select the desired file with ▲ , ▼ and press F3 and the file will begin printing.
4. When finished, press ESC.

2.4.4 Deleting a Stored Test

1. From the module main menu, select VIEW/STORE/PRINT.
2. Select the desired file with ▲ , ▼ and press DELETE (more, F3) and the file is deleted if unlocked.
3. When finished, press ESC.

2.4.5 Locking and Unlocking a Stored Test

1. From the module main menu, select VIEW/STORE/PRINT.
2. Select the desired file with ▲ , ▼ and press UN/LOCK (more, F2) and the file is locked or unlocked as indicated to the right of the file name. Refer to the lock icon shown in Figure 41.
3. When finished, press ESC.

2.4.6 Renaming a Stored Test

1. From the module's main menu, select VIEW/STORE/PRINT.
2. Select the desired file with ▲ , ▼.

- Press UN/LOCK (more, F2) if the file is locked as indicated by the lock icon as in Figure 41.

3. Press RENAME (F1) and a character entry screen like the one shown in Figure 42 is displayed.

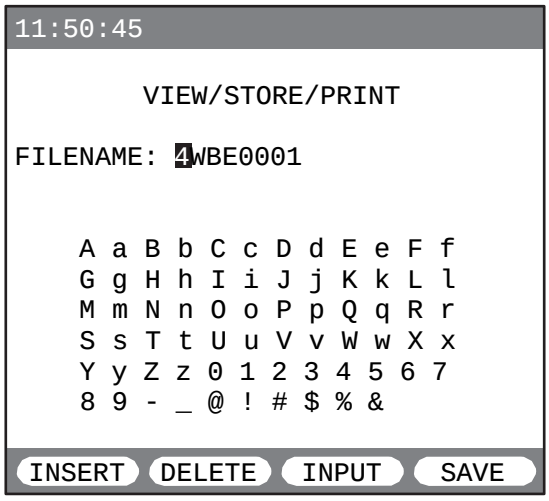


Figure 42 Filename Character Screen

4. Press INPUT (F3). Note that the 'A' character is highlighted and the INPUT F-key has changed to STOP.
5. Use ◄, ▲, ▼, to select the desired character.
6. Press ENTER to place the desired character in the label. Continue this process until the FILENAME label is complete. You may enter up to 15 characters. If a mistake is made in the entry:
   A. Press F3 to stop.
   B. Move the FILENAME cursor to the incorrect character.
   C. Press F2 to delete the character or, press F1 to insert a character.
   D. Press INPUT (F3) to select a character. Press ENTER to insert the new character to the left of the cursor.
7. Press SAVE (F4) to escape the character entry screen and return to the VIEW/STORE/PRINT screen.

2.5 Profiles

Use the Profile function to store commonly used module configuration settings.

The following screen contains a DEFAULT profile. This profile is based on the factory standard configuration of this module. To create other profiles, change the configuration settings in any available screens. Once all configuration screens are changed as desired, select PROFILES from the modules main menu and select a blank line. Press F2 and the settings are saved with a generic filename. Use this screen to manage profiles. The screen and its functions are as follows:

Note: The DEFAULT file can't be deleted or unlocked.

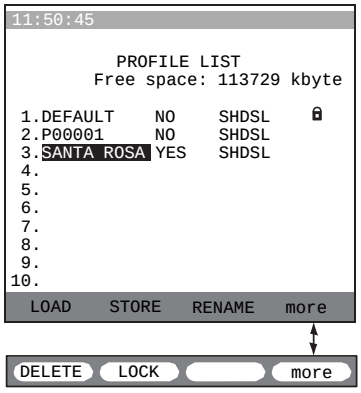


Figure 43 Profile List Screen

The following F-keys are available:

LOAD (F1): Press to change all configuration settings of the module to match the selected profile. The LOADED column changes from NO to YES.

STORE (F2): Press to save all current configuration screens with a generic filename. Currently 10 profiles can be saved. The type of module is indicated in the MODULE column.

RENAME (F3): Select a filename and press F3 to change its name. A character entry screen is displayed. Use the procedure in *Section 2.4.6* to edit the name from step 4.

DELETE (more, F1): Press to delete a selected unlocked profile.

LOCK/UNLOCK (more, F2): Press to lock or unlock a selected file. Lock a profile to prevent changes. The files status is indicated by a lock icon in the LOCK column. In Figure 43, DEFAULT is locked.

3 Applications

3.1 Loop Prequalification

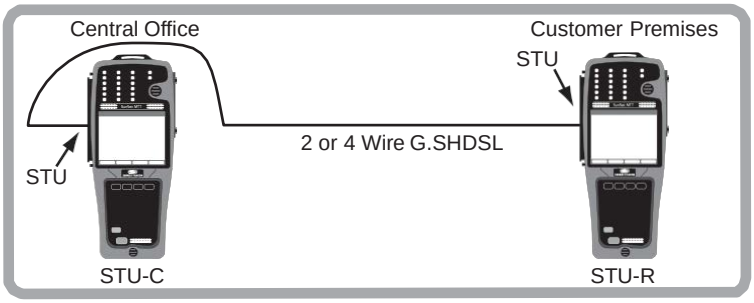


Figure 44 Dual-ended Modem Emulation

Use this dual-ended test during the prequalification phase, before the DSLAM is setup and running in a particular location. It is also used by contract groups who need to prequalify circuits, but do not have direct access to the DSLAM. The application for this mode is:

- STU-C and STU-R modem emulation; link turn-up utilizing proper G.SHDSL line coding in 2 or 4 wire mode.

3.2 STU-R Emulation-ISP Service

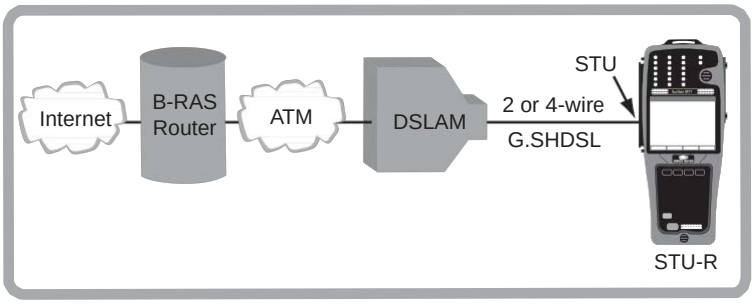


Figure 45 STU-R Emulation

Use STU-R modem emulation during installation and service verification procedures. Connect the test set to the cable pair, using the STU port on the module and turn up the link with the CO. This verifies the link can be established, the bit rate can be supported, and no errors occur. Applications in this mode are:

- Achieve synchronization with DSLAM.
- Link measurements like rate, noise margin, and attenuation.
- PING to ISP.

3.3 STU-R Emulation-Private Network Service

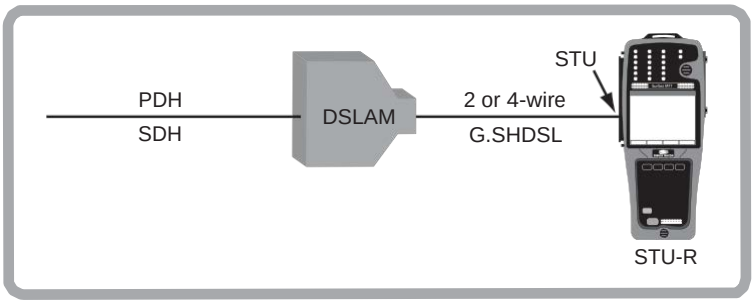


Figure 46 STU-R Emulation-Private Network Service

Common applications in this mode include:

- Achieve synchronization with DSLAM.
- Link measurement like rate, noise margin, and attenuation.

3.4 STU-C Emulation

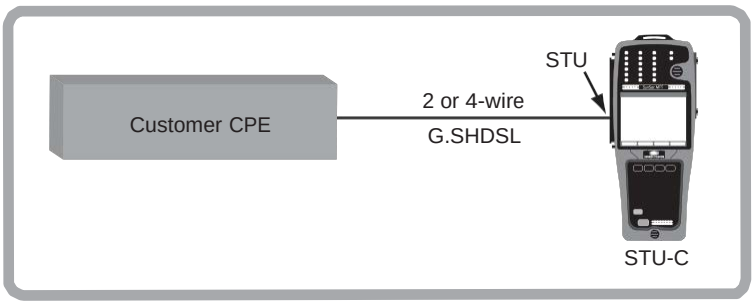


Figure 47 STU-C Emulation

This mode is used to prequalify circuits before the STU-C is installed and to troubleshoot faulty circuits. Connect to the CPE and turn up the link.

3.5 Accept a New E1 Circuit

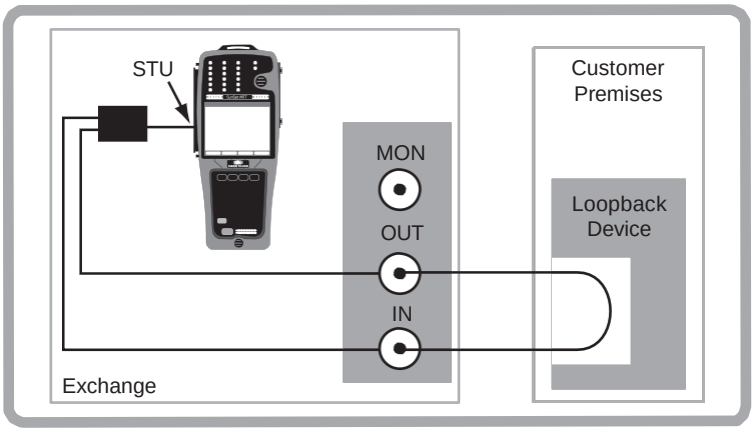


Figure 48 Accept a New E1 Span

1. Verify that the span is not in service. This acceptance test will disrupt service. There must be a loopback device at the far end.
2. From the module main menu, select TEST CONFIGURATION and configure as follows:

   MODE: STUC E1, STUR E1, or E1
   Tx SOURCE: TESTPAT
   FRAMING: As specified by the circuit design.
   CRC-4: As specified by the circuit design.
   TEST RATE: 2.048M
   Rx PORT: TERM
   TX CLOCK: INTERN

   When finished, press ENTER.
3. From the module main menu, select TEST PATTERN and select the desired test pattern. When finished, press ENTER.
4. Connect the test set to the circuit as shown in Figure 48 and press HISTORY to acknowledge any blinking LEDs. Verify that the PAT SYNC LED is green.
5. From the module main menu, select E1 MEASUREMENT, press START (F3) and verify that the circuit performs to your company's requirements for the service delivered. Use PAGE-UP (F1) and PAGE-DN (F2) to access each of the individual measurement screens.
6. When finished, press ESC to return to the module main menu and remove the loop at the far end of the circuit.

3.6 In-Service E1 Circuit Monitoring

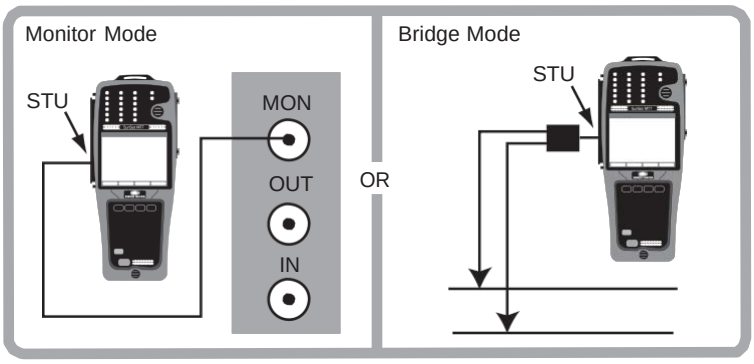


Figure 49 In-Service E1 Circuit Monitoring

1. This test may be performed while the span is in-service.
2. From the module main menu, select TEST CONFIGURATION and configure as follows:

   MODE: STUC E1, STUR E1, or E1
   Tx SOURCE: TESTPAT
   FRAMING: As specified by the circuit design.
   CRC-4: As specified by the circuit design.
   TEST RATE: 2.048M
   Rx PORT: MONITOR or BRIDGE
   TX CLOCK: INTERN

   When finished, press ENTER.

   Note: If unsure of what Rx PORT level to use, then use BRIDGE. MONITOR should be used when you have a PMP (Protected Monitoring Point) access.
3. Connect the test set to the circuit as shown in Figure 49 and press HISTORY to acknowledge any blinking LEDs.
4. Examine the LEDs for information about the circuit:
   - SIGNAL should be green, red indicates no signal.
   - A valid framing type should be indicated.
   - A steady ERROR or CODE LED indicates that the circuit is working but is experiencing trouble.
   - ALARM indicates a problem on the far end of the circuit.
   - AIS may indicate a trouble condition where a network element transmitting to the test set has lost its incoming signal and has replaced it with the AIS signal.
6. From the module main menu, select E1 MEASUREMENT. Press START (F3) and verify that the span performs to your company's requirements for the service delivered.

3.7 Measuring E1 Signal Level

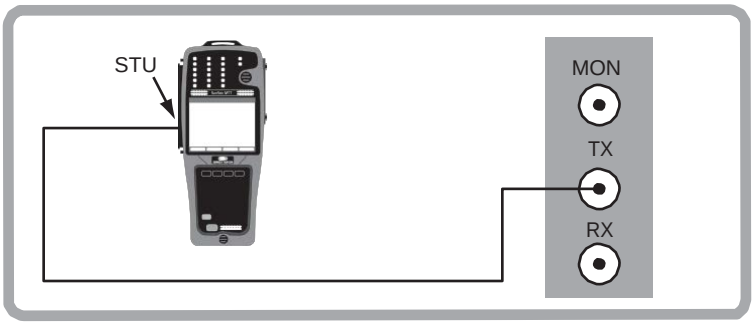


Figure 50 Measuring E1 Signal Level

A signal level measurement can be performed by itself or in conjunction with one of the other tests.

1. Select the Rx PORT level to use. The measurement can be performed using TERM, MONITOR, or BRIDGE. A 1111 pattern in Rx PORT TERM or BRIDGE provides the most accurate results. MONITOR generally shows a result of about -20 or -30 dB. TERM will disrupt service. BRIDGE: Measurement may be degraded by a low-quality termination at the network element terminating the E1 line.
2. The rest of this procedure will use the TERM mode for illustrative purposes. Verify that the span is not in service.
3. From the module main menu, select TEST CONFIGURATION and configure as follows:

   MODE: STUC E1, STUR E1, or E1
   Tx SOURCE: TESTPAT
   FRAMING: As specified by the circuit design.
   CRC-4: As specified by the circuit design.
   TEST RATE: 2.048M
   Rx PORT: TERM
   TX CLOCK : INTERN

   When finished, press ENTER.
4. Connect the test set into the circuit as shown in Figure 50 and press HISTORY to acknowledge any blinking LEDs.
5. From the module MAIN MENU, select E1 MEASUREMENT and press START (F3).
6. Press PAGE-DN (F2) until the E1 ALARM/SIGNAL screen is displayed and read the signal level. Note that separate readings are given for the positive and negative signals so that you can get more accurate information on a faulty regenerator.

3.8 V.54 Channel Loopback Test

1. From the module main menu, select TEST CONFIGURATION and configure as follows:

   MODE: STUC E1, STUR E1, or E1
   Tx SOURCE: TESTPAT
   TEST RATE: Nx64/2.048M (as required)

   When finished, press ENTER.

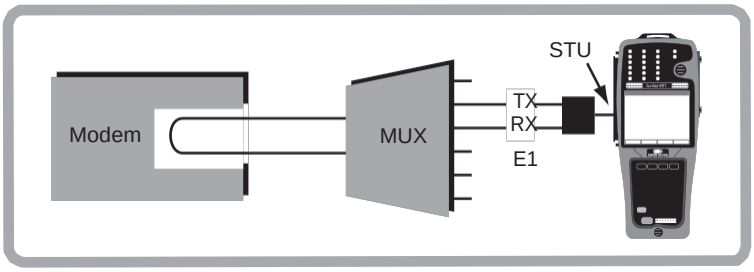


Figure 51 V.54 Channel Loopback Test

2. Connect the test set into the circuit as shown in Figure 51 and press HISTORY to acknowledge any blinking LEDs.
3. From the module main menu, select MODEM CONTROL > LOOPBACK CONTROL and press the F-key that will loop up the far end device. The STATUS line will indicate either success or error.
4. From the module main menu, select E1 MEASUREMENT and run a BERT by pressing ERR INJ
5. Stop the test.
6. From the module main menu, select MODEM CONTROL > LOOPBACK CONTROL and press LOOP-DN (F1) to loop down the far end device. The STATUS line will indicate either success or error.

3.9 Nx64 kbit/s Testing

Fractional E1 circuits are circuits of data rate Nx64 kbit/s, where N can be anywhere from 1 to 31 channels. N channels of the E1 line are dedicated to the fractional E1 circuit, and the remaining channels of the E1 line are either filled with an idle code, other revenue traffic or framing information.

Use the following procedure:

1. Verify that the fractional circuit is not in service. This test will disrupt service.
2. From the module main menu, select TEST CONFIGURATION and configure as follows:

   MODE: STUC E1, STUR E1, or E1
   Tx SOURCE: TESTPAT
   FRAMING: As specified by the circuit design.
   CRC-4: As specified by the circuit design.
   TEST RATE: Nx64K, the fractional SELECT TIME SLOT screen is displayed. Manually configure the timeslots or press AUTO. If needed, see *Section 2.3.3*.
   Rx PORT: TERM
   TX CLOCK: INTERN

   Press ENTER when configured.

   Note: AUTO configuration may not yield proper channels if any of the active channels are transmitting an idle code.
3. Connect the test set to the circuit as shown in Figure 48.
4. Ensure that a loop is in place at the far end of the circuit.
5. Press HISTORY to acknowledge any blinking LEDs.
6. Select MEASUREMENT RESULTS and press START (F3) to perform the acceptance test and verify the fractional service performs to your company's requirements for the service delivered.

4 Reference

4.1 PING Technology

The name PING is derived from the SONAR world where one pings an object in the water and listens for its echo. This concept applies to the Internet world, where one pings an address and waits for its echo (reply). This verifies that the end device is present and that the connection is active.

The PING message is an ICMP (Internet Control Message Protocol) message. Both devices must be using TCP/IP protocol. However, IP can be encapsulated onto the ADSL physical layer in several ways. The following figure provides a summary of the different implementation schemes for IP over ADSL.

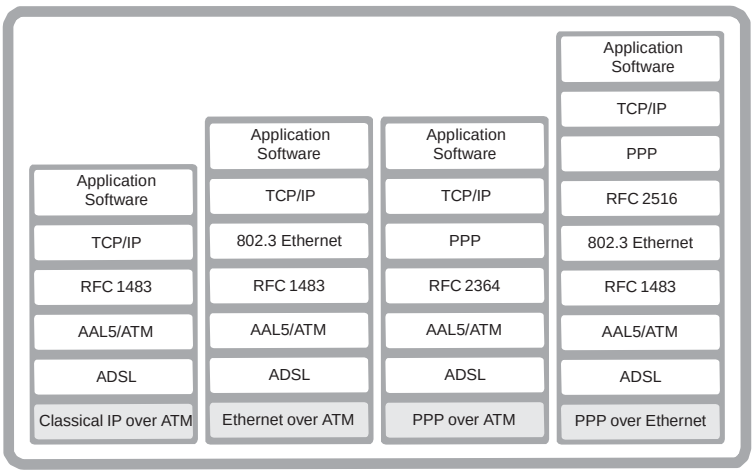


Figure 52 Encapsulation Technologies for IP over ADSL

4.1.1 Classical IP over ATM (CLIPoA)

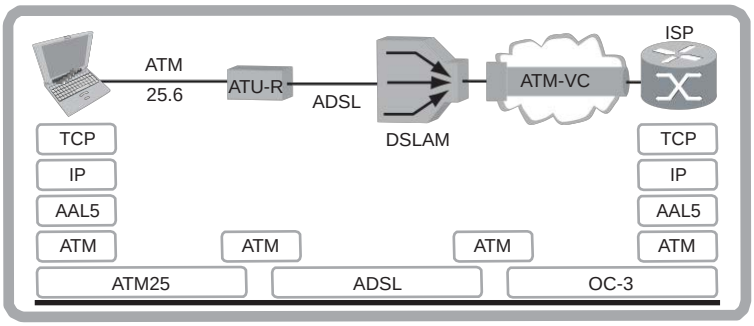


Figure 53 Classical IP over ATM

Classical IP over ATM is an IETF protocol which uses ATM's high speed ability in the Local Area Network. It uses ATMF (ATM25.6) physical interface over Twisted Pair Cable (per ATM Forum) to interconnect in the LAN at the speed of 25.6 Mbps.

Classical IP over ATM reduces overhead by having IP and ARP datagrams encapsulated in AAL5 using IETF RFC 1483 LLC/ SNAP encapsulation.

4.1.2 Ethernet Frames over ATM (EoA)

In this case, the Ethernet frames are encapsulated into the ATM Adaptation Layer 5 (AAL5) using RFC 1483. The encapsulation supports both routing and bridged. This is based on the standard RFC 1483 'Multi protocol Encapsulation over AAL 5'.

Figure 54 shows a sample configuration of Ethernet over ATM used in the field. In this case, IP address management can be static with RFC 1483 Bridge encapsulation, dynamic with the use of DHCP session management or it can use RFC 1483 Routed.

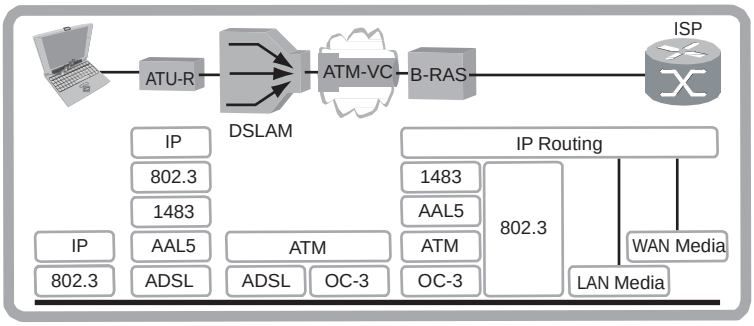


Figure 54 Ethernet over ATM

4.1.3 PPP over Ethernet (PPPoE) over ATM

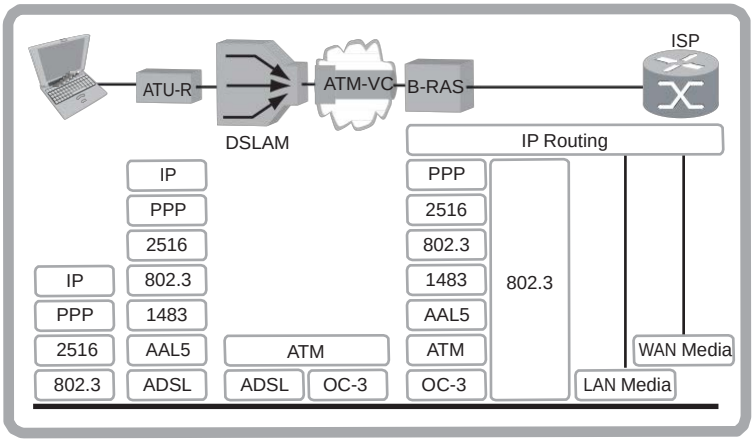


Figure 55 PPP over Ethernet (PPPoE)

PPPoE uses Ethernet networking with PPP in an encapsulation scheme designed for multi-PC homes and small businesses. PPPoE enables multiple PCs to connect to multiple destinations through a single, shared CPE using one PVC. This is based on the standard RFC 2516 'PPP over Ethernet'.

4.1.4 PPP over ATM (PPPoA)

PPPoA has a great advantage in reducing the overhead required in PPPoE. It is based on the standard RFC 2364 'PPP over AAL 5'.

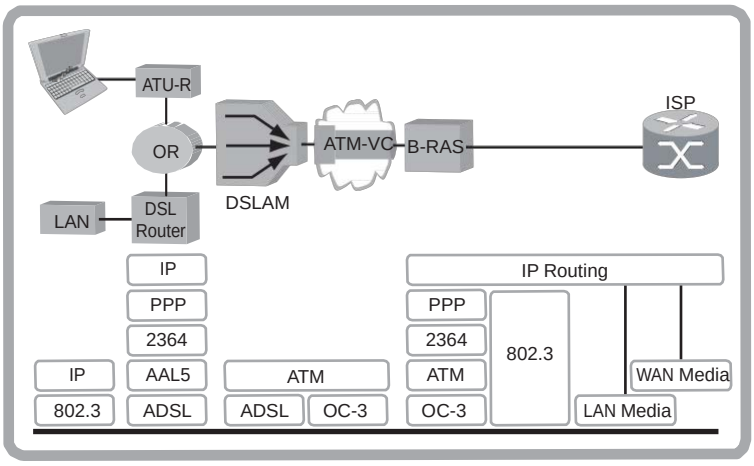


Figure 56 PPP over ATM (PPPoA)

For PPP (PPPoE and PPPoA), IP address management will most likely be dynamic. However, static IP address management can exist. PPPoA has the following implementations of IP management:

- Static IP address management over PPP.
- Dynamic IP address management over PPP. In this case, the IP address is requested and assigned at the time of the connection.

Authentication is commonly used since it provides security for the connection. In the case of PPP, identification is controlled with a user name and password. These will be required in order to open a link with the ISP. Identification can use either the PAP or the CHAP authentication mechanisms. The PPP session is opened with the Broadband-Remote Access Server (B-RAS). The LCP session is handled between the B-RAS and the PC (CPE) to manage the authentication of the user name and password.

4.1.5 PING Acronyms

Here are some of the acronyms and abbreviations you will commonly encounter.

CHAP: Challenge Handshake Authentication Protocol

CLIPoA: Classical IP over ATM

DHCP: Dynamic Host Configuration Protocol

LCP: Link Control Protocol

LLC: Logical Link Control

PAP: Password Authentication Protocol

PPP: Point-to-Point Protocol **PPPoA**:

Point-to-Point over ATM **PPPoE**:

Point-to-Point over Ethernet **PVC**:

Permanent Virtual Circuit

VCI: Virtual Channel Identifier

VPI: Virtual Path Identifier

4.2 E1 Technology Overview

This section covers the fundamental concepts in 2.048 Mbit/s technology; sampling a signal, converting this information into a bitstream, and dividing the bitstream into segments (channels). This section also touches upon the basics of signalling technologies like MFR2 and CAS.

4.2.1 Technical Standards

E1 transmission technology is defined by a number of technology standards. Such standards allow equipment designers and service providers to ensure that various pieces of equipment are compatible and that networks operate in a predictable, reliable manner. The following standards cover many of the important aspects of E1 transmission technology:

- ITU G.703: Physical/electrical characteristics of interfaces.
- ITU G.704: Synchronous frame structures.
- ITU G.706: Frame alignment and CRC.
- ITU G.821: Error performance of a international connection.
- ITU G.826: Error performance and transmission quality control.
- ITU M.550/M.2100 Getting an international connection into service.
- Q.140: Concerns redundant copies from subrate channels.
- Q.400: Concerns CAS (Channel Associated Signaling).

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

4.2.2 Basic Definitions

Binary Data: A signal which has been converted into a format of zeros and ones.

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

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

4.2.3 Converting a Voice Signal

To transmit voice over a digital medium, like a 2.048 Mbit/s line. The analog voice signal must be converted into a binary format. Then it must be converted to a bit stream suitable for digital transmission. This conversion can be accomplished through Pulse Code Modulation as shown in Figure 57.

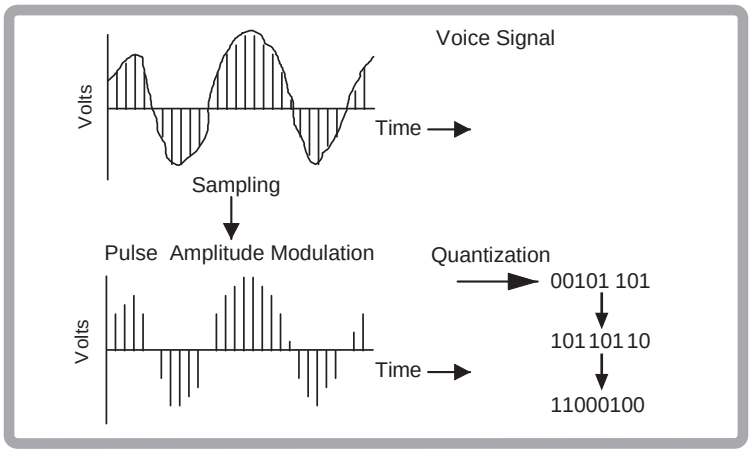


Figure 57 Converting a Voice Signal

The Nyquist theorem requires that the signal be sampled at twice the signal's maximum frequency in order for the signal to be reproduced without a loss of information. For voice signals, the maximum frequency is approximately 4000 Hz. This provides adequate clarity for voice transmission bandwidth. Thus, we must sample our 4000 Hz voice signal at a frequency of 8000 Hz (8000 samples/second).

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

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

4.2.4 2.048 Mbit/s Data Rate

The E1 signal (bitstream) is transmitted at a rate of 2.048 Mbit/s (2 048 000 bits per second). This transmission rate is achieved by combining 32 individual 64 kbit/s bitstreams:

64 (kbit/s /Channel) x 32 (Channels) = 2048 kbit/s = 2.048 Mbit/s

This 2.048 Mbit/s signal is the overall E1 transmission rate.

4.2.5 Line Coding

Two common E1 line coding types are shown in Figure 58:

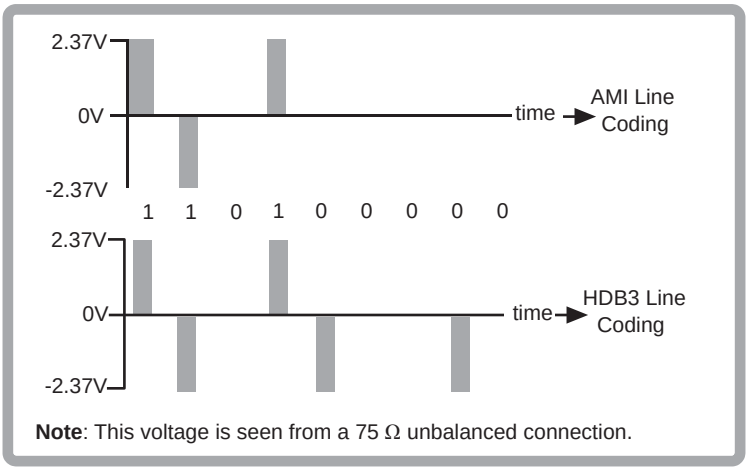


Figure 58 AMI & HDB3 Line Coding

AMI: Alternate Mark Inversion is the simplest of the two line coding formats. AMI is used to represent successive 1 values in a bitstream with alternating positive and negative pulses. Figure 58 depicts these alternating pulses. AMI is not used in most 2.048 Mbit/s transmission because synchronization loss occurs during long strings of data zeros.

HDB3: This line coding format was adopted in order to eliminate synchronization problems occurring with AMI. With HDB3 coding, a string of four consecutive zeros is replaced with a substitute string of pulses containing an intentional bipolar violation. As the far end equipment receives the E1 signal, it examines the bit stream for these intentional bipolar code violations. It then extracts the code and reconstruct the original data. The HDB3 code substitutions provide high pulse density so that the receiving equipment is always able to maintain synchronization with the received signal. For example, in the code 1000 0000, HDB3 coding substitutes bipolar violations for the string of zeros.

General rules apply to the substitutions. The particular substitution made is governed by the polarity of the last inserted bit, as well as the number of pulses following the previous violation bit. If there is an odd number of pulses, 000V is substituted; the polarity of V is the same as that of the bit immediately preceding it. If there is an even number of pulses, B00V is inserted; the polarity of B is opposite to that of the bit immediately preceding it and the polarity of V is the same as that of B. Refer to Figure 59 to see the types of HDB3 zero substitution codes.

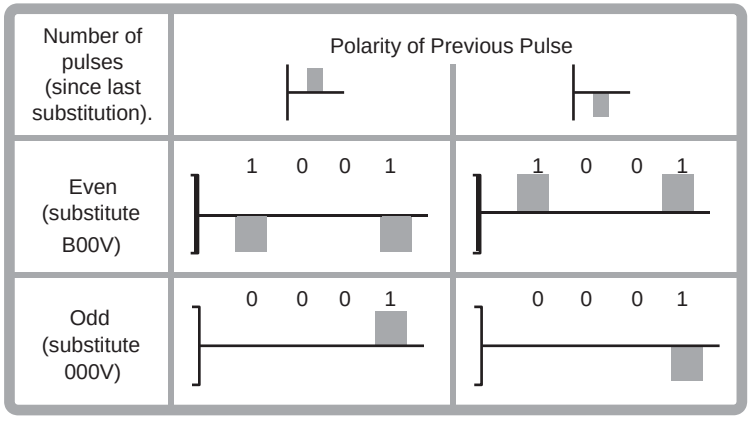


Figure 59 HDB3 Encoding

The E1 module can be configured to detect the one of the two types of HDB3 substitution codes, even if they are not matched to the proper number of pulses since the last substitution.

4.2.6 Signal Levels

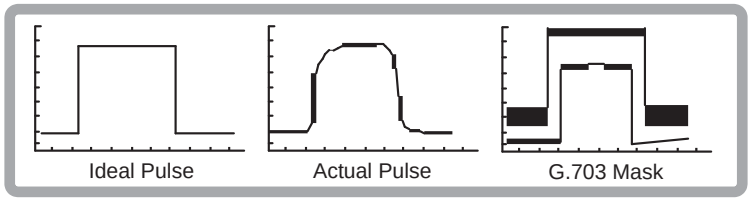


Figure 60 Pulse Shape

Once a signal has been encoded into a binary format and assembled into a bit stream, the pulses in the bit stream are then converted to actual voltage levels suitable for E1 transmission. In Figure 59, a typical signal level for an E1 pulse with 75W impedance is either ± 2.37 volts (for a binary 1 value) or 0 volts (for a binary 0 value). Real-world values are typically ± 10%. Ideally, each pulse transmitted would be perfectly symmetrical. However, in the real-world, each pulse is slightly distorted when generated and more so when it travels down the line. In Figure 60, the shape of an ideal pulse is compared to an actual pulse.

An E1 pulse might need to conform to a standardized pulse shape. This is often determined by comparing it to a specified 'mask'. A commonly used pulse mask is defined by ITU-T G.703, it is shown in the G.703 Mask illustration in Figure 60.

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

4.2.7 2.048 Mbit/s Framing

E1 transmission utilizes two types of framing: FAS (Frame Alignment Signal) and MFAS (MultiFrame Alignment Signal). Framing is necessary so that the equipment receiving the E1 signal is able to identify and extract the individual channels. PCM-31 uses FAS framing and PCM-30 uses MFAS with FAS framing.

FAS (Frame Alignment Signal)

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

In the FAS format, time slot 0 of every other frame is reserved for the FAS pattern. Alternate frames contain the FAS Distant Alarm indication bit and other bits reserved for National and International use. Hence, there are 31 time slots into which data can be placed as in Figure 61.

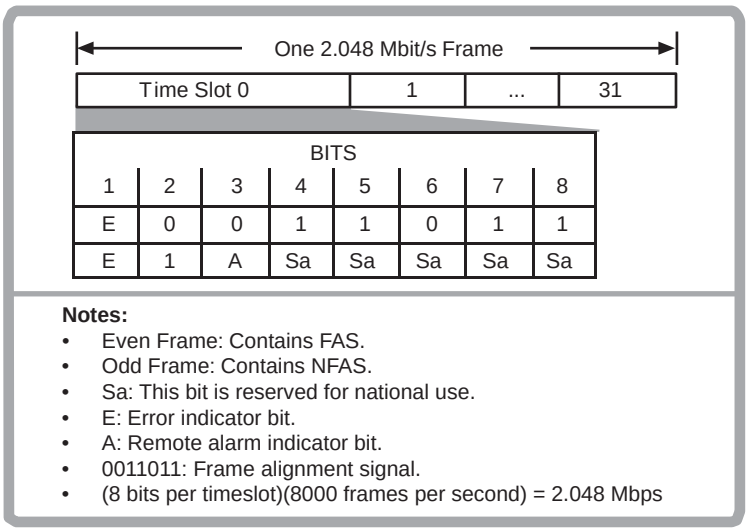


Figure 61 FAS Framing Format

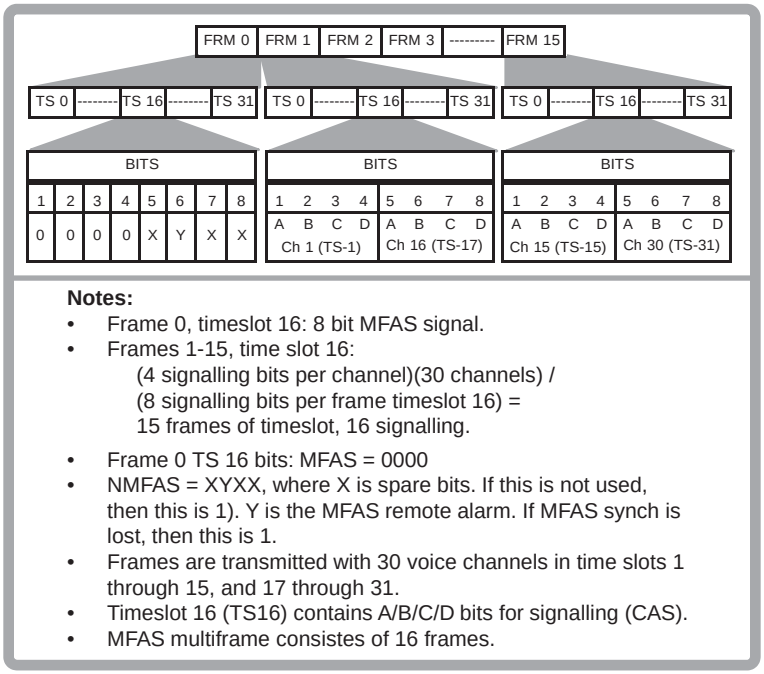
FAS does not accommodate voice channel signalling. The first bit (c or Si) of these frames is reserved for international use. It can be used for the CRC-4, Cyclic Redundancy Check-4, when enhanced performance monitoring is required. Therefore, when CRC is enabled in TEST CONFIGURATION, these bits depend upon the CRC calculation and should continually change between 0 and 1. When CRC-4 is not enabled, these bits are set to 1.

In FAS framing, the odd frames do not contain the frame alignment signal. The bits are defined as follows:

- When CRC is enabled, bit 1 is used for the Cyclic Redundancy Check-4 performance monitoring. When CRC is enabled, this bit may only be changed when CRC is disabled.
- The second bit is set to 1 to avoid FAS signal confusion.
- Bit A is used for the Remote (FAS) Distant Alarm. This bit is set to 1 to indicate an alarm. It is set to 0 for no alarm.
- Spare bits (4-8): Are set to 1 for crossing an international border. When unused, their settings are defined by ITU-T G.704.

The first bits of frames 13 and 15 transmit the two E-bits, which are used to indicate CRC-4 errors. A 0 in this bit denotes received errored sub-multiframes; a 1 represents errorless received frames.

MFAS (MultiFrame Alignment Signal)



Notes:

- Frame 0, timeslot 16: 8 bit MFAS signal.
- Frames 1-15, time slot 16:
  (4 signalling bits per channel)(30 channels) /
  (8 signalling bits per frame timeslot 16) =
  15 frames of timeslot, 16 signalling.
- Frame 0 TS 16 bits: MFAS = 0000
- NMFAS = XYXX, where X is spare bits. If this is not used, then this is 1). Y is the MFAS remote alarm. If MFAS synch is lost, then this is 1.
- Frames are transmitted with 30 voice channels in time slots 1 through 15, and 17 through 31.
- Timeslot 16 (TS16) contains A/B/C/D bits for signalling (CAS).
- MFAS multiframe consistes of 16 frames.

Figure 62 MFAS Framing Format

MFAS framing provides CAS (Channel-Associated Signalling) to transmit A/B/C/D bit supervision information for each channel. This method uses the 32 timeslot frame format including timeslot 0 for the FAS. This method also uses timeslot 16 for the MFAS and the CAS. It takes 16 frames to make up a MultiFrame. When the MFAS frame is transmitted, all of the individual FAS frames and framing information intact is left intact. The 16 FAS frames are assembled together, dedicating timeslot 16 of the first frame to MFAS framing information, then dedicating timeslot 16 of the remaining 15 frames to A/B/C/D bits as in Figure 62.

CRC-4 Error Checking in a MultiFrame Format

M-FRM	SM-FRM	FRM	TIME SLOT 0 Bits Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8
	1	0	c1	0	0	1	1	0	1	1
		1	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		2	c2	0	0	1	1	0	1	1
		3	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		4	c3	0	0	1	1	0	1	1
		5	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		6	c4	0	0	1	1	0	1	1
		7	0	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
	2	8	c1	0	0	1	1	0	1	1
		9	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		10	c2	0	0	1	1	0	1	1
		11	1	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		12	c3	0	0	1	1	0	1	1
		13	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8
		14	c4	0	0	1	1	0	1	1
		15	E	1	A	Sa4	Sa5	Sa6	Sa7	Sa8

Notes:

- SMF-FRM+1: Sub-Multiframe #1.
- Sa: Spare bit reserved for national use.
- A: Remote Alarm (FAS: Remote Alarm Indication).
- Frame Alignment Signal Pattern: 0011011
- CRC-4 Frame Alignment Signal: 001011
- CRC multiframe is not aligned with MFAS timeslot 16 multiframe.
- SM-FRM 2: Sub-Multiframe 2
- E: E-bit Errors.
- c1, c2, c3, c4: CRC bits

Figure 63 CRC-4 Multiframe Format

A CRC-4 (Cyclic Redundancy Check-4) is often used in E1 transmission to identify possible bit errors. CRC-4 allows the detection of errors within the 2.048 Mbit/s signal while it is in service. CRC-4 is based on a mathematical calculation performed on each sub-multiframe of data. The equipment which originates the E1 data calculates the CRC-4 bits for one sub-multiframe. Next it inserts the CRC-4 bits in the CRC-4 positions in the next sub-multiframe. Receiving equipment performs the reverse mathematical computation on the sub-multiframe. It examines the CRC-4 bits which were transmitted in the next sub-multiframe. Next it compares the transmitted CRC-4 bits to the calculated value. Discrepancies in the two values indicate a CRC-4 error.

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

CRC-4 error checking is a convenient method of identifying bit errors within an in-service system. On an in-service system, it is generally not possible to measure the actual bit errors because there is no pattern synch. Bit error measurement is used on an out-of-service system because the results are more precise.

CRC-4 uses a multiframe structure consisting of 16 frames, as shown in Figure 63. However, the CRC-4 multiframe is not necessarily aligned with the MFAS multiframe. Each CRC-4 multiframe can be divided into 2 sub multiframes (SMFRM). These are labeled SMFRM1 and SMFRM2 and consist of 8 frames apiece. Four bits of CRC information are associated with each sub-multiframe.

The CRC-4 bits are calculated for each sub-multiframe, buffered, and inserted into the following sub-multiframe to be transmitted across the E1 span.

When the terminating equipment calculates an error using CRC-4, it should transmit an E-bit to the far end, thus informing the far end equipment of the error.

E-bit Performance Monitoring

When the terminal equipment of a 2.048 circuit is optioned for CRC-4 transmission, E-bit transmission may also be enabled. E-bit performance monitoring of the circuit is now possible. The terminating equipment transmits an E-bit error on the 2.048 Mbit/s line, when it receives a CRC-4 error. However, E-bit error transmission is a relatively new feature in 2.048 transmission. Therefore, it is likely that the embedded equipment does not transmit the E-bit error information correctly. Check the specifications of the network to see if this is available.

When this type of terminal equipment detects an incoming CRC-4 error, it will respond by transmitting an E-bit error toward the other terminal. Test set 2, shown in Figure 64, will be able to see the E-bit errors by plugging into a protected monitoring point. Note that the test set can not see the actual code errors, framing bit errors and CRC errors introduced at the trouble point. The test set can see only the E-bit errors transmitted by Terminal B. Thus, E-bit error transmission allows a 2.048 Mbit/s in-service circuit to be reliably monitored for transmission performance from any point on the circuit.

Without E-bit error transmission, only a complete circuit failure can be reliably determined at any point on the circuit. With a complete circuit failure, the test set will see either loss of signal, alarm indication signal, or remote alarm indication.

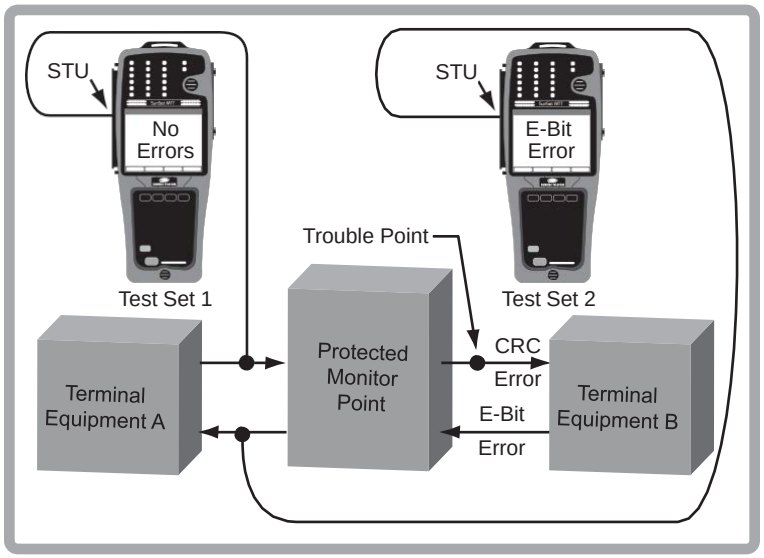


Figure 64 In-service E-bit Performance Monitoring

5 General Information

5.1 Testing and Calibration Statement

VeEX Inc. certifies that this product was manufactured, tested and verified according to the applicable VeEX Inc. Inc. manufacturing and test procedure(s). These formal procedures are designed to assure that the product meets its required specifications.

This product has no user-adjustable settings. During normal usage, periodic calibration is not a requirement. However, if the product fails during the self-verification test, during power up, the product can be returned to the manufacturer for evaluation and repair.

5.2 Express Limited Warranty

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

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

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

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

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

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