DS1 Network Interface Unit with Performance Monitoring Model 3115-60 Issue C

Part of the Westell PROACT ™ Family

CLEI* Code: T1S1ECVAAA

CONTENTS PAGE #

1. GENERAL 1
2. APPLICATIONS 2
3. TRANSMISSION FEATURES AND OPTIONS 3
4. LOOPBACK FEATURES AND OPTIONS 5
5. SECTIONALIZATION ALARM FEATURES 7
6. PERFORMANCE MONITORING & REPORTING . 8
7. HARDWARE OPTIONS & FEATURES 11
8. INSTALLATION 12
9. SET-UP AND OPERATION 13
10. TESTING & TROUBLESHOOTING 22
11. CUSTOMER & TECHNICAL SERVICES 22
12. WARRANTY & REPAIRS 22
13. SPECIFICATIONS 23

1. GENERAL

1.1 Document Purpose

This document describes the Westell 3115-60 DS1 Network Interface Unit (NIU) with Performance Monitoring, shown in Figure 1.

1.2 Document Status

The Issue C equipment provides improved power-up capability. The Issue B equipment updated the default LBO setting and the real time PM provisioning. Whenever this practice is updated, the reason will be stated in this paragraph.

- NOTE -
Hereafter, the 3115-60 DS1 Network Interface Unit with Performance Monitoring may be referred to as the "NIU," the "unit," or "3115-60."

1.3 Product Purpose and Description

The Westell 3115-60 Issue C T1 Network Interface Unit with real-time Performance Monitoring serves as an interface between a T1 metallic span, or a customer premises-based fiber multiplexer, and the intra-building Customer Premises Equipment (CPE). The 3115-60 Issue C is a member of the Westell PROACT family of T1 NIUs that provide standard maintenance loopback plus collection and reporting of DS1 performance statistics. These performance monitoring capabilities allow service providers to *"PROACTively"* respond to facility performance degradation, thereby improving the availability of Hi-Cap T1 circuits.

1.4 Product Mounting

The 3115-60 is a 200 MECHANICS® NIU and makes electrical connections to the Facility and CPE sides of the circuit through a 56-pin card-edge connector of a 200- or 400-mechanics type

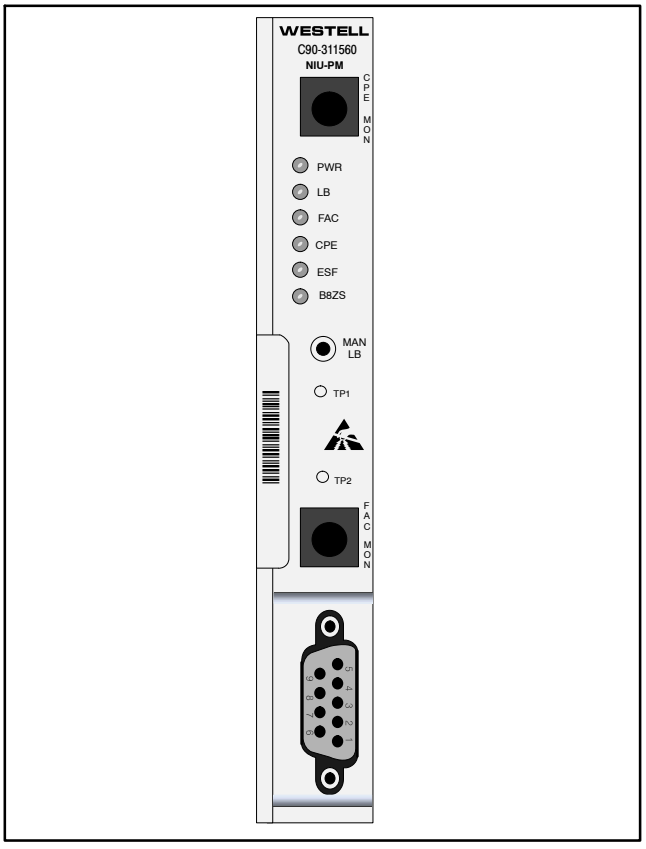


Figure 1. 3115-60 NIU with Performance Monitoring

mounting, using industry-standard pin assignments. The mounting assembly is usually mounted on an equipment backboard at the customer location, after the building entrance terminal and primary protection. Westell offers a wide range of single and multiple slot mountings available in both backboard (wall) and rack mount versions for NIUs. In some applications it may be desirable to situate the NIU in outside plant cabinets or enclosures. The NIU is fully qualified for operating over the temperature range of -40 to +65°C (temperature hardened).

1.5 Product Features

The 3115-60 offers the following features.

- Loopback activation and deactivation using inband (unframed or SF/ESF framed) or ESF Data Link codes
- Full-featured T1 NIU loopback device plus detailed T1 performance monitoring and reporting at the customer facility interface

- Addressed loopback control with 16-bit pattern for TER (T1 Extension Repeater) applications
- CPE-to-Facility LBO provisionable from 0 to 22.5dB in 7.5 dB increments
- Alternate self-aligning CPE-to-Facility LBO that automatically protects the network from a mis-optioned customer LBO
- Enhanced sectionalization capabilities via AIS-CI and RAI-CI alarm signals as defined by T1.403-1998
- Derives and maintains DS1 performance statistics independently for each direction of transmission
- Supports both 30-day stored as well as real-time performance reporting modes
- Flexible DS1 performance reporting options:
  - Local, non-intrusive access to PM parameters via a front-panel local craft interface port
  - Remote, intrusive access during loopback to PM parameters via TL1 commands and responses in the ESF Data Link
  - Remote, non-intrusive access to PM parameters via TL1 commands and responses in the Data Link, by use of a Test Head, without affecting customer payload
  - Remote, non-intrusive real-time reporting of PM parameters via 1-second NPRM and/or SPRM reports in the Data Link per ANSI T1.403-1998
- On board test pattern generator
- Notepad craft screen for documenting information about the circuit
- User-configurable alarm threshold craft screen
- Integral real-time clock provides time stamping of all performance information
- Selectable powering option (via jumper option) for span, local or span-thru power
- Front-panel test points for measuring span current
- Monitor-type bantam jacks on FAC IN and FAC OUT ports for transmission path monitoring
- Front-panel craft interface port (serial RS-232, VT-100) for local, non-intrusive PM extraction, unit set up, test code generation and circuit maintenance
- Remote provisioning and query of options (TL1 non-intrusive or 16-bit intrusive)
- Front-panel LEDs indicate status of:
  - □ PWR (Power)
  - □ FAC (Facility Signal Status)
  - □ CPE (CPE Signal Status)
  - □ LB (Loopback)
  - □ ESF (ESF Framing detected from the facility)
  - □ B8ZS (B8ZS detected from the facility)
- Internal per-circuit local power fusing
- Operates over the -40 to +65°C temperature range allowing deployment in outside plant (OSP) enclosures and cabinets; Temperature Hardened

2. APPLICATIONS

The NIU can be used to terminate a T1 metallic span facility or as an adjunct to a lightwave multiplexer when DS1 circuits are extended to a customer location on fiber facilities. The CPE connections are intra-building.

The unit is situated at the customer's premises and functions as a maintenance interface between the T1 metallic span or fiber multiplexer facility and the CPE. In addition to conventional NIU functions such as loopback, the NIU collects performance data for both directions of the facility, stores the information and reports it to the remote test center either on demand via TL1 commands or on a real-time basis via NPRMs. This performance information can also be locally accessed via the front-panel RS-232 craft interface port.

- NOTE -
Real-time Performance Monitoring retrieval will initially require that the test head be updated to monitor the Facility Data Link non-intrusively for performance information.

2.1 Transmission Design

2.1.1 T1 Span - Copper Applications

2.1.1.1 Normal T1 span design allows from 0 to 15dB of loss from the last repeater in the span to the customer interface and a maximum loss of 7.5dB for inside wiring to the CPE (see Figure 2). This represents a total loss of 22.5dB. This mode provides a receive transmission path that can be configured to pass the signal from the span to the CPE with either no net regeneration or with the optional regenerator to 0dB DSX. The optional regenerator in this path can be used in applications where the maximum loss of 22.5dB to the CPE cannot be achieved otherwise, or in special situations where the customer requires a 0dB DSX handoff.

2.1.1.2 The unit's transmit path from the CPE to the Network provides a selectable 0 to 22.5 dB LBO as well as an automatic, self-aligning LBO (Line Build Out) circuit to meet route junction and end section design requirements in T1 span applications.

2.1.2 T1 Fiber Applications

When T1 service to a customer is provided via fiber, the unit can be configured to serve as a maintenance interface between the fiber mux and the CPE. The unit can be located up to 220 feet from the mux. See Figure 3. In this mode, the unit can be provisioned for CPE-to-FAC regeneration which will regenerate CPE input levels that have been attenuated from 0 to 30dB to a normal 0dB DSX. This is useful due to the fact that the DS1 low-speed tributary ports of most multiplexers are designed to accommodate input levels that have been attenuated no more than 3dB from 0dB DSX. This feature allows for greater section losses to be accommodated. The CPE-to-FAC regeneration feature allows the unit to be used in applications

that previously required a T1 Extension Repeater. *Note: For fiber applications, the CPE-to-FAC LBO must be set to disabled (0 dB).*

2.2 Power

2.2.1 Local Power

The NIU can be powered either from the T1 span or from a local external supply. When locally powered, the supply should be 22 to 56Vdc and can be either a positive or negative ground reference. This allows the NIU to operate from +24Vdc supplies at certain wireless and PCS (Personal Communication Service) sites. In the local power mode, the NIU completes the T1 span simplex power loop and drops negligible span voltage.

2.2.2 Span Power - Loop Mode

When optioned for Span Power - Loop Mode, the unit is powered remotely from the last serving office via the transmission simplex leads. The unit will operate with a simplex current ranging from 57 to 63 mA and will drop 24 Volts nominal at 60mA. In addition, in the Span Power - Loop Mode, the unit will serve as a termination device for span power by looping the simplex current back on the FAC OUT simplex lead.

2.2.3 Span Power - Thru Mode

2.2.3.1 When optioned for Span Power - Thru Mode, the unit is powered remotely from the last serving office via the transmission simplex leads. The unit will operate with a simplex current ranging from 57 to 63 mA and will drop 27 Volts nominal plus the CPE load (maximum of 75 Volts). In addition, in the Span Power - Thru Mode, the unit will pass the simplex current through to the CPE OUT simplex lead, while also shorting the CPE IN simplex lead to the FAC OUT simplex lead, thus providing a path for simplex current returned by the CPE equipment.

2.2.3.2 Under normal operation, the downstream span powered equipment (e.g. CSU) will terminate the span power and will provide the simplex power loop. If the equipment is removed, the simplex loop would be opened and the span would lose power. To protect against this scenario, the NIU provides a current loop sense to detect when the CPE simplex loop is opened, and provide a simplex termination to prevent the span from losing power. This circuit also detects restoration of the CPE simplex loop termination and the NIU would restore power to the CPE equipment. With CPE termination open, span drop increases by 4V.

3. TRANSMISSION FEATURES & OPTIONS

The NIU can be configured to operate in multiple applications. The specific transmission provisioning is dependent on the application. To facilitate this discussion, refer to Figure 4 for a simplified diagram of the NIU transmission path during normal operation.

3.1 RCV Path: Facility to CPE (A to Z Direction)

3.1.1 The incoming DS1 bit stream from the facility enters the NIU on the FAC IN port and is transformer coupled into the receive path circuitry. To facilitate circuit testing, a front-panel bantam jack (FAC MON) provides monitor access to the receive path.

3.1.2 The FAC-to-CPE path is continuously monitored for loss of signal, control codes and performance statistics by various detectors that operate over an input signal range of 0 to -30dB DSX, and are unaffected by cable length or terminations on any port or signal state of the CPE. If the FAC IN signal level goes below -30dBDSX for more than 150ms, a FAC-to-CPE path Loss-Of-Signal condition is declared, the front-panel FAC LED lights solid red and an Alarm Indication Signal (AIS) is sent to the CPE.

3.1.3 FAC-to-CPE Regen

With FAC-to-CPE Regen enabled, the NIU will regenerate input levels that have been attenuated from 0 to 30dB to a nominal 0dB DSX to the customer interface. The FAC-to-CPE

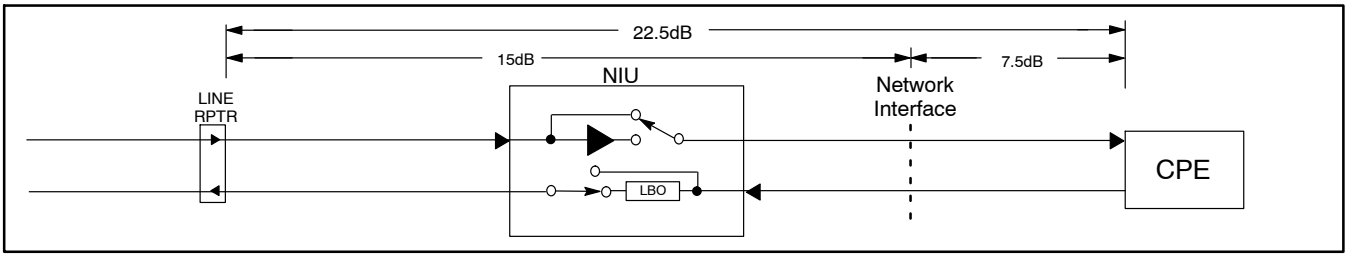


Figure 2. Metallic T1 Span Applications

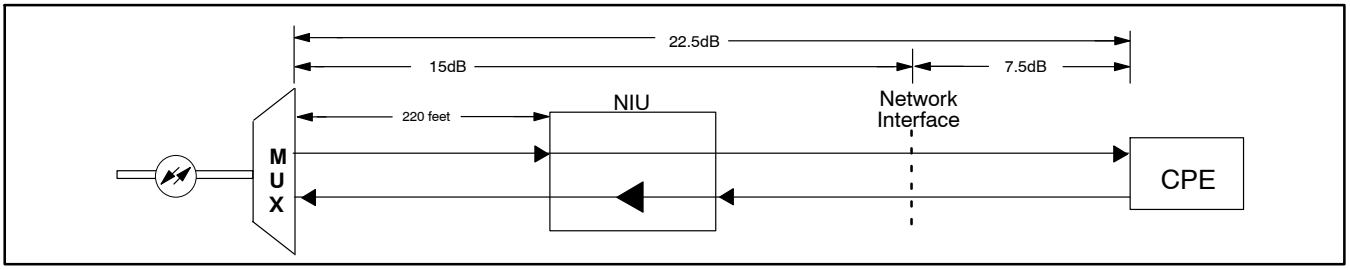


Figure 3. Lightwave/Mux Fiber Applications

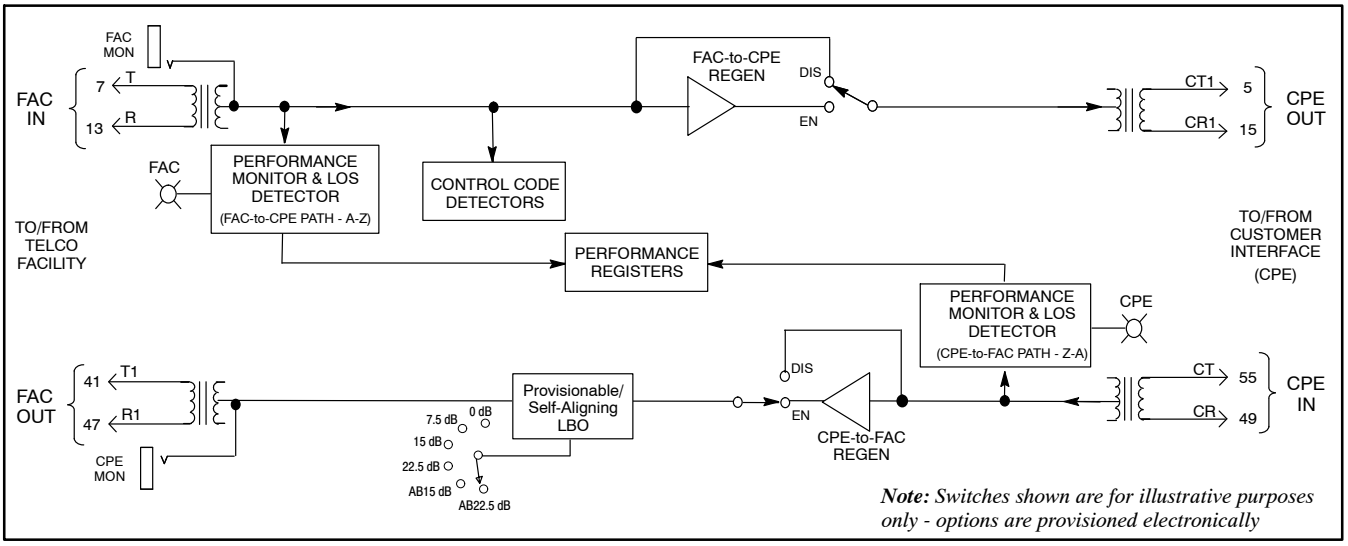


Figure 4. 3115-60 Block Diagram Overview

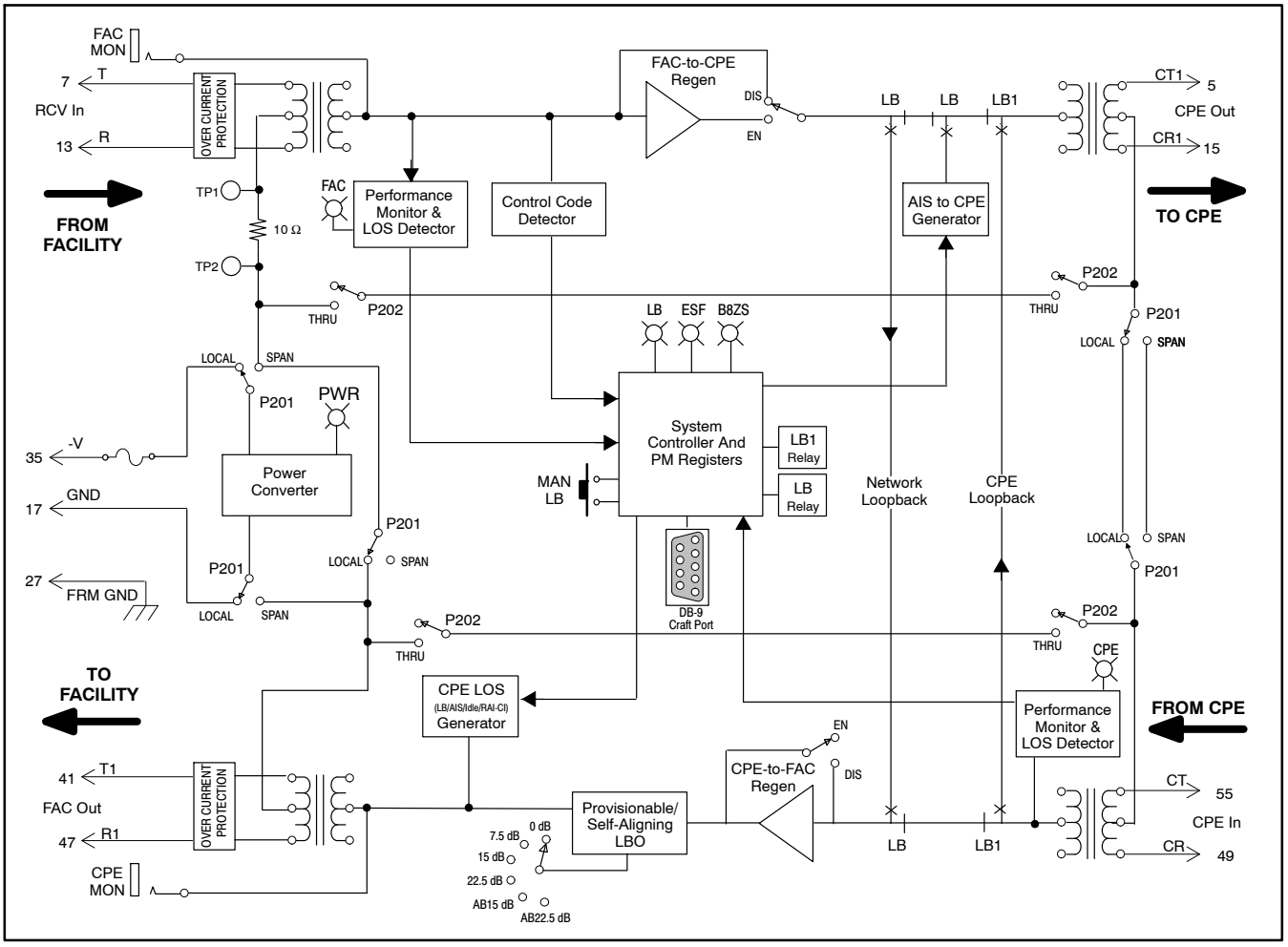


Figure 5. 3115-60 Detailed Block Diagram

Regen is a selectable option that can be set remotely via TL1 or 16-bit commands or locally via the craft terminal interface port. With the FAC-to-CPE Regen disabled, the receive transmission path provides no net regeneration form input to output. In this case, the NIU has a nominal insertion loss of 1.5dB.

3.2 XMT Path: CPE-to-FAC (Z to A Direction)

The DS1 signal from the CPE enters the NIU via the CPE IN port and is transformer coupled into the transmit path circuitry. The transmit path is continuously monitored for loss of signal and DS1 performance from the customer. If the CPE IN signals goes below -30dBDSX for more than 150ms, a CPE-to-FAC path Loss-Of-Signal condition is declared and the front-panel CPE LED lights solid red.

3.2.1 CPE-to-FAC Regen

When placed behind a multiplexer (i.e., fiber applications), the unit functions as a T1 Extension Repeater and requires the CPE-to-FAC Regen to be enabled. With FAC Regen enabled, the NIU will regenerate input levels that have been attenuated from 0 to 30dB to a nominal 0dB DSX to the facility interface. The CPE-to-FAC Regen is a selectable option that can be set remotely via TL1 or 16-bit commands or locally via the craft terminal interface port. With the CPE-to-FAC Regen disabled, the receive transmission path provides no net regeneration form input to output. In this case, the signal is connected directly to the CPE-to-FAC LBO circuit.

3.2.2 CPE-to-FAC LBO

3.2.2.1 LBO (Line Build Out) is an artificial line used to meet T1 span and end-section design requirements. The 3115-60 provides a fixed LBO circuit as well as a self aligning LBO circuit.

3.2.2.2 The fixed LBO circuit provides from 0 to 22.5dB of signal attenuation in 7.5dB increments. The CPE-to-FAC LBO is a selectable option that can be set remotely via TL1 or 16-bit commands or locally via the craft terminal interface port.

3.2.2.3 As an alternative to the fixed LBO settings, the "Auto-Binder" feature can be selected (AB15 and AB22.5). The auto-binder option only introduces loss when necessary, automatically protecting the network from mis-optioned customer equipment - specifically, mis-optioned customer LBO settings.

3.2.2.4 At installation, the NIU/PM will have it's "Auto-Binder Level" circuitry optioned to match the circuit's binder level requirement .... e.g. -22.5 dB (AB22.5). The "Auto-binder Level" circuitry measures the signal level arriving from the facility as well as the signal level arriving from the customer. Based on these levels, the NIU/PM's "Auto-Binder Level" circuitry will automatically insert the appropriate amount of additional loss required to ensure the customer's signal arrives at the binder group's common termination point at the correct level. For a setting of "AB22.5", a level of -22.5 dB is maintained. The "Auto-binder Level" circuitry constantly monitors the input levels from the network and customer and adjusts how much additional LBO is required to keep the binder level at the necessary level.

- NOTE -

The "Auto-Binder Level" circuitry only introduces additional loss when the customer "fails" to meet the signal level requirements set forth by the RBOC. The additional loss is only inserted when the customer's signal threatens to interfere with other, adjacent T1 service by introducing cross-talk problems. Additionally, sufficient hysteresis is provided to prevent the "Auto-Binder" circuitry from oscillating in and out.

Examples:

If FAC IN level is 0dB and CPE IN level is 22.5dB, and Binder Level selection is set for 22.5dB, the LBO circuit would adjust itself to 0dB.

If FAC IN level is 0dB and CPE IN level is 15dB, and the Binder Level selection is set for 22.5dB, the LBO circuit would adjust itself to 7.5dB.

3.2.2.5 The resulting signal is then output over the FAC OUT port toward the Telco Facility. To facilitate circuit testing, a front-panel bantam jack (CPE MON) provides monitor access to the path.

3.3 Monitored Line Coding - AMI/B8ZS

The Monitored Line Code option determines if B8ZS octets and 8 consecutive 0's are reflected in the Line Errored Seconds and B8ZS Errored Second performance parameters. This option does not effect the unit's transmission path. When the Monitored Line Coding is set for AMI, occurrences of 16 consecutive 0's will be disregarded and occurrences of B8ZS octets will be reflected in the B8ZS Errored Count. When the Monitored Line Coding is set for B8ZS, occurrences of B8ZS octets will be disregarded and occurrences of 8 consecutive 0's will be reflected in the Line Errored Seconds.

3.4 Monitored Framing - ESF/SF

The Monitored Framing option determines the framing reference that the performance monitoring (PM) section of the NIU will use in it's PM calculations. If the option is set for "ESF", valid ESF-framing bits and CRC-bits are expected. Note, the setting of this option does not affect the unit's ability to pass signal. That is, if this option is set to "SF", the NIU shall still have the ability to pass ESF framed signals AND inject NPRM's into the ESF data-link - despite the fact that the PM section will be reporting Severe Errored Frame events due to the framing mismatch (i.e. Monitored Framing = SF, Actual FACILITY Framing = ESF). This option can be set remotely via TL1 or 16-bit commands or locally via the craft interface.

4. LOOPBACK FEATURES AND OPTIONS

Loopback can be used during maintenance and circuit troubleshooting to verify the integrity of the Telco DS1 facility up to, and including, the NIU. Loopback, when activated, loops the entire DS1 payload from the receive facility back towards the transmit facility. Also, when the unit is in loopback the front-panel Loopback LED (LB) will be on, and a loopback timeout circuit, if enabled, is activated. Figure 6 shows a simplified view of the circuit during loopback .

4.1 Facility Loopback

During Facility Loopback, the LB LED is solid green, the FAC LED is flashing green, and the receive T1 bit stream from the facility enters the NIU on the FAC IN port. The signal is then routed through the loopback path to the opposite path and is passed back to the network via the FAC OUT port. During Network-side Loopback, AIS is sent toward the CPE.

4.2 CPE Loopback

CPE Loopback is available via the NIU craft port STATUS menu. By using the <Ctrl> and <C> keys simultaneously, the NIU can activate the CPE loopback. During CPE Loopback, the signal from the CPE is routed through the loopback path back to the CPE. When CPE Loopback is activated, the LB LED is solid green and the CPE LED is flashing green.

4.3 Dual Loopback

Dual Loopback is available to simultaneously loop back signals to the facility and then back to the CPE. Dual Loopback can be activated via inband codes, via the MLB front panel switch, and via the NIU craft port STATUS menu. When Dual Loopback is activated, the LB LED is solid green and the FAC and CPE LEDs are flashing green.

4.4 Loopback Activation/Deactivation

Loopback can be activated/deactivated by one of four ways:

1. Remotely, on-demand, via control codes (inband or ESF Data Link) in the DS1 signal from a network test location,
2. Locally, on demand, via the front-panel MAN LB push button switch,
3. Locally, on demand, via the front-panel RS-232 craft terminal interface port, or
4. Automatically, when the NIU detects a loss of signal from the CPE and CPE LOS is optioned for LB (see Part 5).

4.5 Remote Loopback Activation/Deactivation

Loopback activation/deactivation is done from a remote test center, such as a Hi-Cap Center or Central Office, by sending inband or ESF Data Link loopback control codes toward the NIU for the proper duration. These control code sequences are listed in Table 1.

Function	Code	Type
DS1/T1 Activate (Loop Up)	11000	Unframed, SF or ESF
	0001 0010 1111 1111	ESF DATA LINK[1]
DS1/T1 Deactivate (Loop Down)	11100	Unframed, SF or ESF
	0010 0100 1111 1111 or 0011 1000 1111 1111	ESF DATA LINK[1]

Note 1: Right-most bit sent first.

Table 1. Loopback Control Codes

4.5.1 Inband Codes

Inband codes are repetitive patterns at the 1.544Mb rate and may be unframed, SF framed or ESF framed. The Inband code pattern must be sent for a minimum of five seconds. The unit will reject the pattern if it is less than five seconds in duration or if the error rate is greater than 10^{-3}.

4.5.2 ESF Codes

ESF codes are bit-oriented messages sent in the ESF Data Link and must be sent for a minimum of four consecutive repetitions (approximately 16ms). The unit will reject the pattern if it is less than four consecutive repetitions in duration or if the error rate is greater than 10^{-3}.

4.6 Addressed Loopback Mode

4.6.1 When installed in SONET/Mux applications, the NIU can be configured for addressed loopbacks. This allows the craft to test locations at the service interface (SI) then subsequently loop the NIU adjacent to the SONET or Mux Interface. The addressed loopback mode is an option that can be set remotely via TL1 or 16-bit commands or locally via the craft interface port.

4.6.2 To loop back the unit when it is configured for addressed loopback operation, the test person first sends the inband or ESF Data Link Loop-Up command (see Table 1) for the proper duration. This will loop up the distant NIU and serve as an arming code for the 3115-60. When the unit is armed, the LB LED will flash yellow.

4.6.3 The test person then sends the 16-bit repeating pattern 1101 0011 1101 0011 for five seconds minimum. Upon receiving

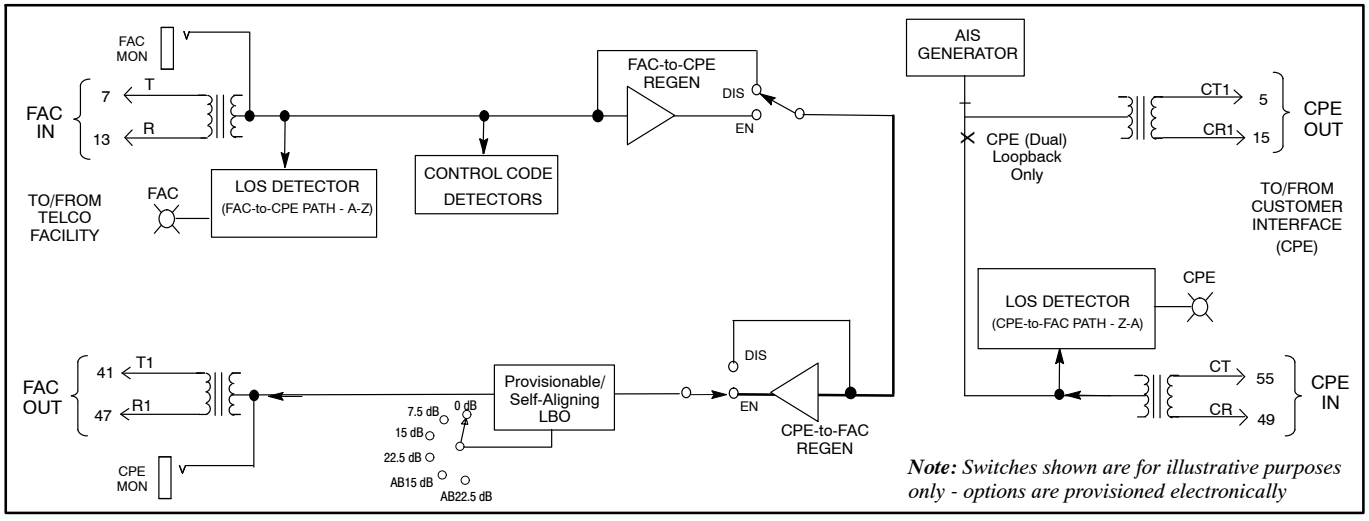


Figure 6. Transmission Path During Loopback Operation

the code, the unit enters loopback and 15 seconds later returns an acknowledgement of 232 bit errors indicating the NIU is looped.

4.7 Manual Loopback

The NIU loopback state can be controlled by pressing the front-panel MAN LB push button. Depression of the MAN LB push button will cycle through the loopback states.

- If depressed for 3 to 5 seconds, the LB LED will be on solid (Green). If released in this interval, the Network Loopback will be activated.
- If depressed for greater than 5 seconds, the LB LED will begin flashing (Green). If released after 5 seconds, the Dual Loopback will be activated.
- When first depressed, the LB LED will go off and remain off during the first 3 seconds that the MAN LB is depressed. If released during this 3 second period, all existing loopback conditions will be deactivated.

4.8 Loopback Timeout

4.8.1 The unit provides a timeout feature that can be configured to release a code-activated loopback condition either 20, 60, 120 or 1440 minutes (24 hours) after initial activation.

4.8.2 The loopback condition can be released before the timeout expiration period by: 1) sending loop-down code to the NIU from the network test location, 2) through the craft interface port, or 3) by pressing the front-panel MAN LB switch for less than 3 seconds. Loopback timeout can be permanently disabled via an option provisioned locally from the craft interface port or remotely from the network test location.

4.9 CPE (Dual) Loopback Activation

4.9.1 To activate CPE loopback, the unit must first be in network-side loopback from the remote test location. At this point, re-application of loop-up code will operate CPE loopback allowing the customer or craft personnel to evaluate the integrity of the circuitry on the CPE-side of the demarcation point. The unit can be placed in CPE loopback via the front-panel MAN LB push button (see Paragraph 4.7). CPE Loopback can also be activated and deactivated from the Circuit Status Menu via the craft interface port.

4.9.2 When CPE loopback is activated, it will remain activated until:

1. the NIU detects a loop-down command from the Network-side,
2. when the timeout release feature expires,
3. when released via the craft interface port, or
4. when the MAN LB switch is pressed.

5. SECTIONALIZATION ALARM FEATURES

The NIU is equipped with features that allow a network monitoring location to differentiate between fault conditions that are beyond the NIU (i.e., CPE or inside wiring) and those that are legitimate network problems.

5.1 CPE LOS Modes

5.1.1 LB Upon CPE LOS

In this mode, the unit continuously monitors the DS1 signal from the CPE for customer loss of signal, and upon detecting a loss will change the CPE LED from green to red and cause the unit to enter Loopback toward the network. When the signal from the CPE is restored the unit will return to normal operation. LB upon CPE LOS is an option that can be set remotely via TL1 or 16-bit commands or locally via the craft interface port. When set to enter loopback upon detecting a loss of signal from the CPE, the NIU will assume the transmission path as shown in Figure 6.

5.1.2 AIS Upon CPE LOS

In this mode, the unit continuously monitors the DS1 signal from the CPE for customer loss of signal, and upon detecting a loss will change the CPE LED from green to red and send an unframed, all-ones Alarm Indication Signal (AIS) to the network. When the signal from the CPE is restored the unit will return to normal operation. The AIS upon CPE LOS mode is an option that can be set remotely via TL1 or 16-bit commands or locally via the craft interface port.

5.1.3 Idle Code Upon CPE LOS

In this mode, the unit continuously monitors the DS1 signal from the CPE for customer loss of signal and upon detecting a loss will change the CPE LED from green to red and send an Idle code toward the network. When signal from the customer is restored, the NIU returns to normal operation. The specific format in which the Idle signal is sent toward the network facility is dependent on the format of the DS1 signal received from the network facility:

1. If the received signal is SF, the Idle signal will be SF and will provide a 0001 0111 repeating pattern in each of the 24 DS0 time slots,
2. If the received signal is ESF, the Idle signal will be ESF and provide a 0001 0111 repeating pattern in each of the 24 DS0 time slots. In addition, the ESF Data Link will contain the ESF yellow alarm signal 1111 1111 0000 0000, interrupted each second with a 100ms burst of LAPD idle code 0111 1110,
3. If no signal is received from the network or if the DS1 signal is unframed, the NIU will default to the SF Idle mode.

The Idle Code upon CPE LOS mode is an option that can be set remotely or locally via TL1 or 16-bit commands or via the craft interface port.

5.2 CPE Loss Of Signal Override

5.2.1 When the NIU detects a loss of signal from the CPE and if the CPE Loss of Signal option is enabled, the NIU will respond in accordance to the setting of the CPE LOS option. These options are as follows:

- enter loopback upon loss of signal from the CPE
- send AIS to the network upon loss of signal
- send Idle to the network upon loss of signal
- send AIS-CI to the network upon loss of signal

5.2.2 No matter what action the NIU takes upon detecting a loss of signal from the CPE, that mode can be remotely overridden by sending a loop-down command to the NIU. Hence, CPE LOS Override.

5.2.3 Upon detecting the loop-down command, the NIU will disable the CPE LOS function and operate as if the CPE LOS function is actually set for disable. During this mode, the NIU will respond to normal loop-up and loop-down commands. The CPE LOS Override feature will time out in 20 minutes. At the end of 20 minutes, the NIU will re-enable the CPE LOS function and respond accordingly. That is, if a loss-of-signal condition from the CPE still exists, the NIU will, again, respond according to how the CPE LOS option is set (LB/AIS/Idle/AIS-CI).

5.3 RAI-CI and AIS-CI Alarms

In this mode, the unit continuously monitors both the signal from the customer and from the network facility in order to determine what type of alarm signal to send back toward the network monitoring location. This capability, along with the uniquely-identifiable Remote Alarm Indication - Customer Interface (RAI-CI) and Alarm Indication Signal - Customer Interface (AIS-CI) signals, allows test personnel to accurately sectionalize network facility problems versus CPE problems.

5.3.1 RAI-CI

If the unit sees a Remote Alarm Indication signal coming from the customer equipment (SF or ESF framed), and does not detect an Alarm Indication Signal (AIS), Loss of Frame (LOF) or Loss of Signal (LOS) on the network, the unit will send a Remote Alarm Indication (RAI-CI) toward the network if the network is ESF.

5.3.2 AIS-CI

5.3.2.1 If the unit sees an Alarm Indication Signal coming from the customer equipment (AIS-CI), and does not detect a Loss of Frame (LOF), or Loss of Signal (LOS) on the network, the unit will send a unique Alarm Indication Signal (AIS-CI) toward the network.

5.3.2.2 Both AIS-CI and RAI-CI are backwards compatible with existing network devices and will appear as normal AIS or RAI.

5.3.2.3 Upon detecting a loss of signal on the network side of the unit, the unit will send an Alarm Indication Signal (AIS) toward the customer equipment. The customer equipment, in turn, will send a Remote AIarm Indication (RAI) signal back towards the network.

6. PERFORMANCE MONITORING/REPORTING

The unit continuously monitors the DS1 bit stream in both the Network-to-CPE (A-Z) and CPE-to-Network (Z-A) direction for performance statistics, and maintains these statistics independently for each direction. Performance primitives are collected and stored as performance parameters which are available for remote retrieval or local retrieval via the front-panel craft terminal interface port.

6.1 Performance Primitives

Performance primitives are basic error events, or other performance-related occurrences, monitored by the unit and stored as performance parameters.

Line Performance Primitives

Bipolar Violation	BPV
Excessive Zeros	EXZ
Loss of Signal	LOS

Path Performance Primitives

CRC Error (ESF)	CRC6
Frame Bit Error (SF)	FE
Out of Frame	OOF
Severely Errored Frame	SEF
Alarm Indication Signal	AIS

6.2 Performance Parameters

The unit monitors, processes and stores the span's performance primitives as Line, Path and Miscellaneous parameters.

Line Performance Parameters

Coding Violation Line	CVL
Errored Seconds Line	ESL
Severely Errored Seconds Line	SESL
Loss of Signal Seconds Line	LOSS-L

Path Performance Parameters

Coding Violation Path	CVP
Errored Seconds Path	ESP
Severely Errored Seconds Path	SESP
Unavailable Seconds-Path	UASP

Miscellaneous Parameters

Pulse Density Violation Seconds	PDV-SEC
B8ZS Violation Seconds	B8ZS-SEC
Monitored Seconds	MSEC

6.3 Status Register (STAT)

The unit provides a Status Register for both directions of transmission indicating various events that have occurred during a particular monitoring window. The Status Register consists of an 8-bit word with a "1" indicating an occurrence of a particular event.

Event	Bit
Loopback	1
Data incomplete	2
Loss of Signal	3
Reserved	4
Power Loss	5
AIS	6
RAI (alarm yellow)	7
Out of Frame	8

6.4 Event/Alarm Log

The NIU features an Event/Alarm Log that registers various events occurring during the monitoring period. The log provides time-stamped entries for the most important types of events such as loss of signal, power outages, PM registers cleared, alarm detection, and more. Several different types of events are possible in the log as listed in the examples of Table 2. The Event/Alarm Log will retain the 100 most recent

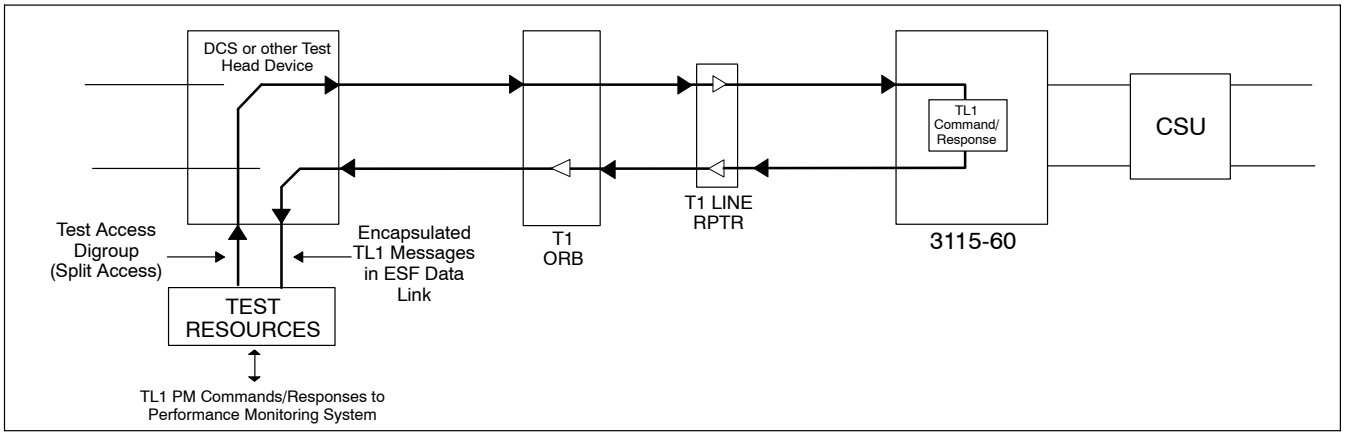


Figure 7. TL1 PM Retrieval Diagram - Intrusive Mode Shown

events in non-volatile memory. The Event/Alarm Log can be viewed locally via the craft interface port or can be retrieved remotely via TL1 commands.

Message Type	Event/Alarm Log Message
SIGNAL STATE	LOS FROM CPE
	LOS FROM CPE CLEARED
	LOS FROM FAC
	LOS FROM FAC CLEARED
	AIS FROM FAC
	AIS FROM FAC CLEARED
	AIS FROM CPE
	AIS FROM CPE CLEARED
	RAI FROM CPE
	RAI FROM CPE CLEARED
LOOPBACK ACTIVITIES	REMOTE LOOP UP
	MANUAL LOOP UP
	REMOTE LOOP DOWN
	MANUAL LOOP DOWN
	TIMEOUT LOOP DOWN
	ANY LOOP UP
	ANY LOOP DOWN
NIU POWER STATUS	LOSS OF POWER
	POWER UP
MAINT. RESET ACTIVITIES	RESET PM REGISTERS
	RESET EVENT/ALARM LOG
	CHANGE CIRCUIT ID
	PROVISIONING OPTION CHANGE
PROVISIONING ANOMALIES	SF FRAMING SET
	ESF FRAMING SET
	FRAMING LOSS

Table 2. Samples of Event/Alarm Log Messages

6.5 Performance Storage Registers

The unit maintains performance parameters, Status Register events and PIRs for both directions of transmission in 15 minute, hourly, and daily registers as shown in Table 3.

15 Minutes	1 Hour	1 Day
Current	Current	Current
Previous	Previous	Previous
95 Additional	22 Additional	6 Additional
24 Hours Total	24 Hours Total	30 Days Total

Table 3. PM Data Storage Periods

6.6 Historical Performance Monitoring & Retrieval

Historical (30 day) PM data is provided by the unit. In the idle or non-looped state, the DS1 bit stream (SF or ESF circuits), in both directions of transmission, is monitored for performance statistics. The unit records and time stamps these performance statistics in non-volatile memory for retrieval at a later time. These performance statistics can be retrieved on demand from the NIU in two ways: 1) locally, and on a non-intrusive basis, via the front-panel craft interface port or 2) remotely, via TL1 commands and responses in the ESF Data Link.

6.7 PM Retrieval, SF/ESF Circuits (Craft Port)

The 3115-60 provides a front-panel RS-232 connector for local access of performance statistics data without placing the unit into loopback. See Paragraph 7.1.2 and Figure 11.

6.8 PM Retrieval, SF/ESF Circuits (Intrusive)

6.8.1 To access historical performance information, the test center (Hi-Cap or CO) first accesses the circuit on a split basis, and places the NIU in loopback. If the circuit is SF, the test controller must then reconfigure for ESF framing for the duration of the session to allow commands and responses to be exchanged with the NIU in the ESF Data Link of the intervening facility.

6.8.2 The procedure for customer ESF circuits is identical to SF, except the test controller does not need to change the framing format during the test session.

6.9 Real Time Performance Reporting

Real-time PM reporting from both the facility and CPE can be provided using one of two methods, SPRM (Supplemental Performance Report Messages) or NPRM (Network Performance Report Messages). Both methods are similar in structure but differ in content. Both methods also conform to ANSI Specifications described in T1.403-1998. These message formats are

similar to ANSI T1.403-like PRMs (Performance Report Messages) that are sent toward the network at 1-second intervals via the ESF Data Link by the CPE CSU. The NPRM or SPRM messages allow network equipment to determine if the T1 signal was in error before being sent to the customer. It also indicates if the T1 signal from the CPE contained errors before it enters the network.

6.9.1 Network Performance Report Message (NPRM)

6.9.1.1 The NPRM mode operates by sending an NPRM message toward the network once every second. This message contains performance information that covers the last four seconds of operation. This NPRM is inserted into the Data Link by the NIU "after" the 1-second PRM from the customer CSU that is passed through the NIU. Note that the CSU may not generate PRMs or may be operating in the PUB 54016 mode that does not use PRMs. The 3115-60 always generates an NPRM whether CSU PRMs are generated or not. In order to allow network monitoring equipment to differentiate between CSU PRMs and NPRMs, the NPRM is assigned a SAPI address of 16, allowing easy differentiation from a CSU PRM that has an assigned SAPI address of 14. A generalized network diagram of NPRM reporting and collection is illustrated in Figure 8.

6.9.1.2 NPRM is generally preferred to SPRM since it provides more detailed information, and does not modify the customer CSU PRMs thereby guaranteeing compatibility with all T1.403-1995 compliant CSUs.

6.9.2 Supplemental Performance Report Message

The Supplemental Performance Report Message (SPRM) mode, like the NPRM mode, consists of a performance report message that is sent toward the network at 1-second intervals.

6.9.2.1 SPRM Mode - ESF Circuits

When installed on ESF circuits and the CSU is generating PRMs, the 3115-60 actually modifies bits in the customer-generated PRM in order to provide performance information on the circuit at the point of the network interface. This modified PRM is known as the Supplemental Performance Report Message (SPRM). Typically, the "R", "U1" and "U2" bits of the customer PRM are the modified bits. The R bit channel is used to flag whether or not SPRM information had been added to the PRMs and, if so, what mode of SPRM is in use. The U1 and U2 bits are used to multiplex the additional performance information into the PRMs.

6.9.2.2 SPRM Mode - SF Circuits

When installed on SF circuits and frame format conversion is enabled (i.e., network is ESF framed), the 3115-60 generates its own SPRM in order to provide performance information on the T1 circuit at the point of the network interface. The "R", "U1" and "U2" bits of the 3115-60-generated PRM provide the additional performance information into the PRMs. The use of each bit is given in the following paragraphs.

6.9.2.3 R Bit

Data is written to the R bit at a rate of 1 bit per PRM, or 1 bit per second. Each new bit is written into the R bit associated with the message for second "t = T0". The R bit then shifts, second-by-second, along with the other bits in the PRM until it is last seen in the R-bit position for second "t = T0 + 3". The 1 bit per second patterns sent in the R-bit channel have the following meanings:

000000000... No SPRM present or SPRM is disabled. This is the status of the R bit when a CSU generates a PRM.

111111111... SPRM added at point of generation of PRM. This only applies when the NIU is generating its own PRM, while in Frame Conversion mode.

10101010... Internal hardware fault detected at point of insertion of SPRM.

10001000... SPRM added to PRM at intermediate point. This mode applies when the customer equipment is generating PRMs and the 3115-60 is modifying it with additional information or when the 3115-60 is generating a PRM in Normal mode (frame conversion disabled).

6.9.2.4 U1 Bit

This bit carries performance information in the DS1 signal received from the network back to the network. This bit is a logic 1, if a condition is detected in the signal which would normally result in conversion of any bit in a PRM from 0 to 1. Each U1 bit carries information for the same period as the 1-second message in which it is embedded with such offset as is provided by the transmission delay between the point of generation of the PRM and the point of insertion of the SPRM.

- NOTE -
This bit defaults to zero for self-generated SPRMS.

6.9.2.5 U2 Bit

This bit carries performance information in the DS1 signal received from the customer back to the network. This bit is a logic 1, if a condition is detected in the signal which would normally result in conversion of any bit in a PRM from 0 to 1. Each U2 bit carries information for the same period as the 1-second message in which it is embedded with such offset as is provided by the transmission delay between the point of generation of the PRM and the point of insertion of the SPRM. As a result of modifying a customer-generated PRM, a new Frame Check Sequence (FCS) for the SPRM is calculated and inserted by the 3115-60.

6.9.3 SPRM/NPRM Mode

The SPRM/NPRM mode consists of both SPRM and NPRM Performance Report Messages sent toward the network at 1-second intervals. Detailed descriptions of SPRMs and NPRMs can be found in Paragraphs 6.9 through 6.9.2.5.

6.9.4 Framing Format Conversion

Both real-time reporting techniques, NPRM and SPRM, require that the DS1 facility from the NIU to the network operate in the ESF mode since the PRMs are carried in the ESF Data Link. If the customer's circuit and CSU is ESF framed, conversion by the NIU is not required. If the circuit and CSU are SF, the NIU can be configured to convert SF framing to ESF prior to insertion of SPRM or NPRM messages. Bipolar Violations (BPVs), frame errors and yellow alarms are all correctly mapped through the unit. Additionally, unframed signals are passed through unframed.

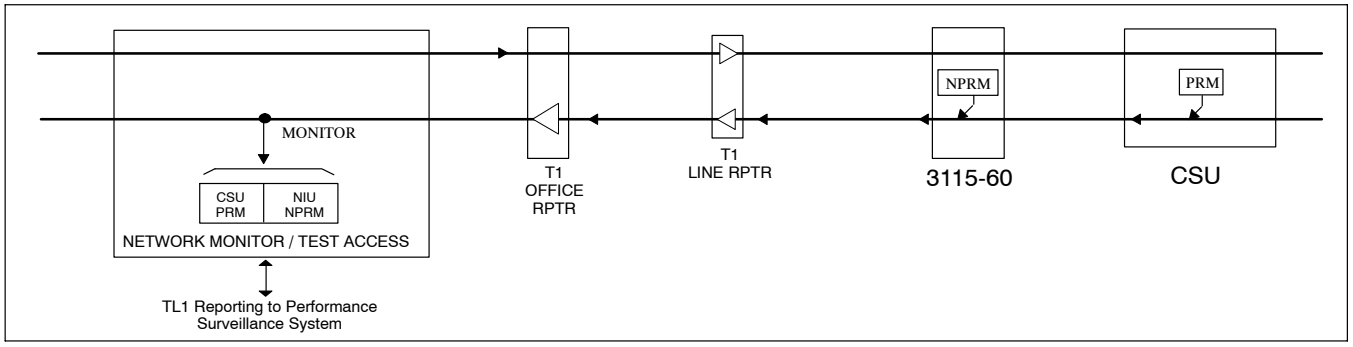


Figure 8. NPRM Application Diagram

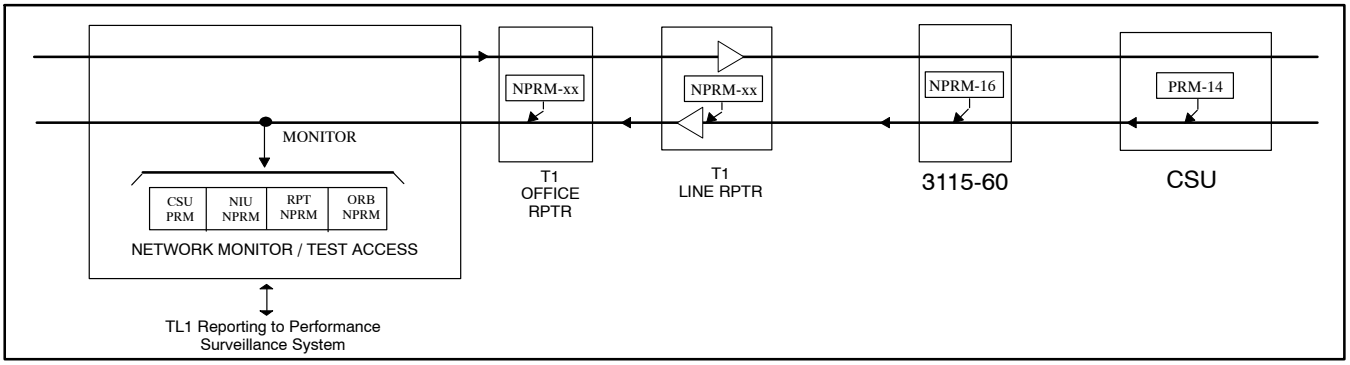


Figure 9. NPRM Application Diagram - Extended Capabilities

- NOTE -
A Warning message is displayed whenever the Frame Conversion option in the Provisioning table is enabled and the user attempts to save the changes. It warns that "Frame Conversion can be service affecting. Are you sure you want to save ?"

7. HARDWARE OPTIONS & FEATURES

The 3115-60 contains features and options located on the front and side (PCB) panels, as described in the paragraphs below.

- NOTE -
Set any/all manual option switches prior to installing the unit.

- WARNING -
Before making *any* connections, verify power is off (including removing the fuse at the fuse and alarm panel) and that any and all plug-in units are removed from the shelf. Do not install plug-in units until *all* shelf wiring is complete.

7.1 Front Panel Features

The unit contains six LEDs for a quick visual indication to the status of the circuit, two bantam-type monitor jacks for transmission path testing, a DB-9 connector with a female RS-232 interface for craft terminal access, and test points for measuring span current. A description of each is provided below.

7.1.1 Monitoring Bantam Jacks

The 3115-60 contains two bantam jacks which monitor the T1 signal. These jacks are labelled FAC MON and CPE MON, as shown in Figure 10.

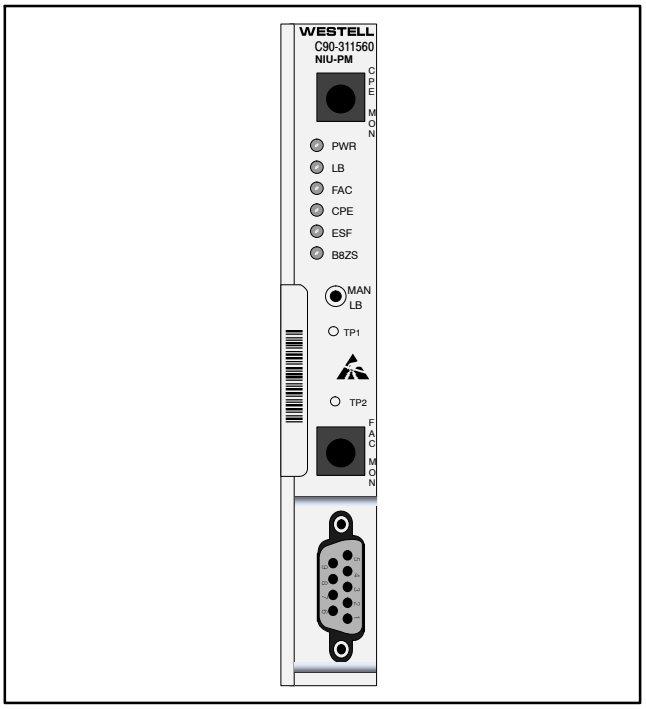
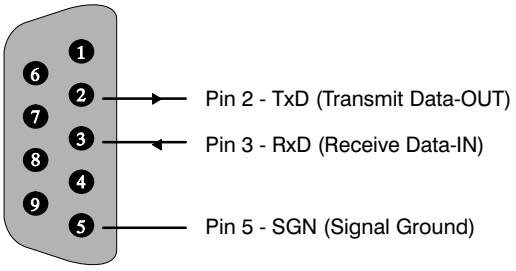


Figure 10. 3115-60 Front Panel

FAC MON — Allows monitoring of the T1 signal being received from the network



CAUTION

When disconnecting test equipment from the bantam jacks or the Craft Interface port, apply pressure on the unit front panel to hold the unit in the assembly. Failure to do so may cause the unit to be removed from service while disconnecting test equipment.

Figure 11. Front Panel RS-232 (DB-9) Pin Assignments

CPE MON Allows monitoring of the T1 signal being sent to the network

7.1.2 RS-232 DB-9 Connector

The 3115-60 contains a front panel, 9-pin, female, RS-232 DB-9 hardware connector which allows access to stored performance data for retrieval purposes, and allows maintenance, circuit troubleshooting and set up procedures.

7.1.3 Test Points

The 3115-60 contains two test point jacks for measuring the span current.

TP1 & TP2 Allows for measuring span current using a DC voltmeter. TP1 will read positive with respect to TP2. A voltmeter reading of 0.6VDC equates to a 60mA span.

7.1.4 Push Button Switch, MAN LB

The NIU loopback state can be controlled by pressing the front-panel MAN LB push button. Depression of the MAN LB push button will cycle through the loopback states.

- When first depressed, the LB LED will go off and remain off during the first 3 seconds that the MAN LB is depressed. If released during this 3 second period, all existing loopback conditions will be deactivated.
- If depressed for 3 to 5 seconds, the LB LED will be on solid (Green). If released in this interval, the Network Loopback will be activated.
- If depressed for greater than 5 seconds, the LB LED will begin flashing (Green). If released after 5 seconds, the Dual Loopback will be activated.

7.1.5 Status LEDs

The multi-function status LEDs on the front panel provide a visual indication of various maintenance and alarm conditions. The LED colors, states, and conditions are listed in Table 4.

7.2 PCB Power Options (Side Panel)

The unit has a powering option capability (pin headers on the PCB, making connection via a push-on pin jumper) to configure the unit for the proper powering operation. A jumper is provided to allow the installer to select either Span, Local or Thru powering. If Span power is desired, mount the jumper over the left two rows of pins on header P201. If Local power is desired, mount the jumper over the right two columns of pins on header P201. If Thru power is desired, mount the jumper over header P202. The location of these options is shown in Figure 12.

LED	LED Color	LED State	STATUS LED Description
PWR	Green	On	Power is applied and present to the unit.
		Off	Power not applied.
LB	Green	On	Unit is in Loopback.
	Yellow	Flashing	Unit is armed and ready to detect the addressable LB code.
	Off		Unit is not in any loopback condition.
FAC	Green	On	Signal is detected from the network.
		Flashing	Facility loopback active.
	Yellow	On	Signal from the network has exceeded the BER threshold.
		Flashing	Signal from the network has fallen below the threshold of -30dB DSX.
	Red	On	Signal from the network to the unit is lost.
CPE	Green	On	Signal is detected from the customer.
		Flashing	CPE loopback active.
	Yellow	On	Signal from the customer has exceeded the BER threshold.
		Flashing	Customer to the unit has fallen below the threshold of -30dB DSX.
	Red	On	Signal from the customer is lost.
ESF	Green	On	Unit has detected ESF framing from the network.
		Off	Unit is detecting SF/unframed signals from the network.
B8ZS	Green	On	Unit is configured for B8ZS line coding.
		Off	Unit is configured for AMI line coding.

Table 4. Front Panel LED Conditions and States

8. INSTALLATION

Installation consists of inspecting the equipment for damages, following proper safety precautions, mounting the unit in the proper slot of the mounting assembly, and verifying the presence of power and signalling as indicated by the status LEDs. The following paragraphs provide detailed instructions for performing these procedures.

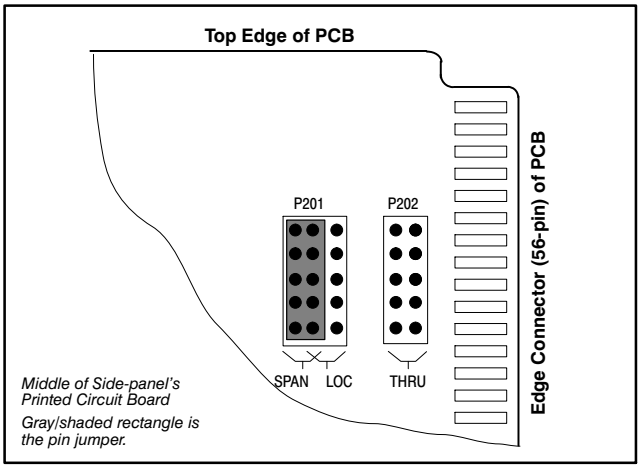


Figure 12. NIU Powering Option Location

8.1 Following Safety Precautions

Before installing the NIU, observe the following safety notes.

- INSPECTION NOTE -

Visually inspect the unit for damages prior to installation. If the equipment has been damaged in transit, immediately report the extent of the damage to the transportation company and to Westell (see Part 11 for telephone number).

CAUTION - STATIC-SENSITIVE

This product contains static-sensitive components! Follow proper electrostatic discharge procedures to maintain personal and equipment safety. Do not store units near magnetic, electromagnetic or electrostatic fields. Always store or ship units in the original static-protective packaging from Westell. Use anti-static mats when working on units.

- PRECAUTIONARY STATEMENT -

- **Never install telephone wiring during a lightning storm.**
- **Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.**
- **Never touch uninsulated telephone wires or terminals unless the phone line has been disconnected at the network interface.**
- **Use caution when installing or modifying telephone lines.**
- **This equipment is intended to be used behind devices that provide primary lightning protection.**
- **This installation should conform to Local Codes and NEC requirements.**
- **This equipment is to be installed in a restricted access location.**

- CAUTION -

Never apply power until all installer connections are made.

CAUTION

Risk of electric shock. Voltages up to 140 VDC (with reference to ground) may be present on telecommunications circuits.

- CAUTION -

Use care when installing and removing modules - *do not force into place*. If a module resists insertion, remove it and check for obstructions in/near the connectors and mounting slots, then carefully re-align and gently re-insert the module.

8.2 Mounting the Module

The 3115-60 is a 200 MECHANICS®-type plug-in module that mounts in a 200- or 400-mechanics-type mounting assembly (or equivalent mounting which matches the pin-out plan of the module). Before installing the module, set any options in the desired position(s). Align the module with the mounting or assembly card guides above and below the unit and insert as far as it will go into the slot connector.

8.3 Making Installer Connections

No installer connections are required other than inserting the module into the card-edge connector in the shelf or assembly. The unit makes electrical connections to external equipment when installed and properly seated in the 56-pin card-edge connector in the mounting assembly. The pin-outs used by the NIU are listed in Table 5.

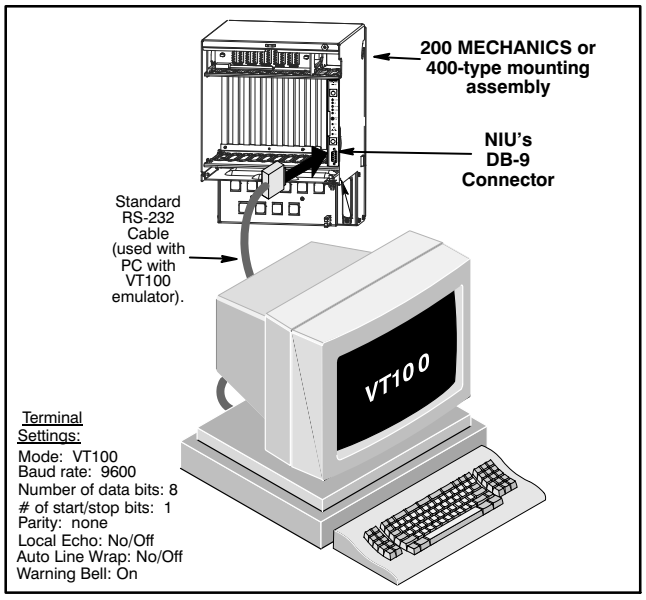


Figure 13. Preparing for Provisioning Via DB-9 Port

Function	Designation	Pin Number
FAC IN	T	7
	R	13
CPE OUT	CT1	5
	CR1	15
CPE IN	CT	55
	CR	49
FAC OUT	T1	41
	R1	47
LOCAL POWER	-Local Power	35
	Ground	17
Frame Ground	FRM GND	27

Table 5. 3115-60 Pin Designations

9. SET-UP AND OPERATION

9.1 Craft Terminal Setup and Operation

9.1.1 The front-panel craft interface port allows the craft to configure the unit for a particular application, view the stored T1 performance statistics, as well as graphically view circuit status and perform various test routines. Each menu provides an associated HELP screen that explains the function and use of the menu. HELP screens are accessed by pressing (?).

9.1.2 The craft interface port is a DB-9 connector with an electrical RS-232 female interface in a DCE configuration. The craft device can be a terminal operating in the VT-100 protocol or a PC running a VT-100 terminal emulator program. If a VT-100 terminal is used a "null-modem" cable may be required between the terminal and the NIU. If a PC with VT-100 emulator program is used, a standard RS-232 cable can be used. The RS-232 port should be set up for 9600 baud, no parity, and one stop bit (NP,1S). The electrical connections to the craft port are shown in Figure 11.

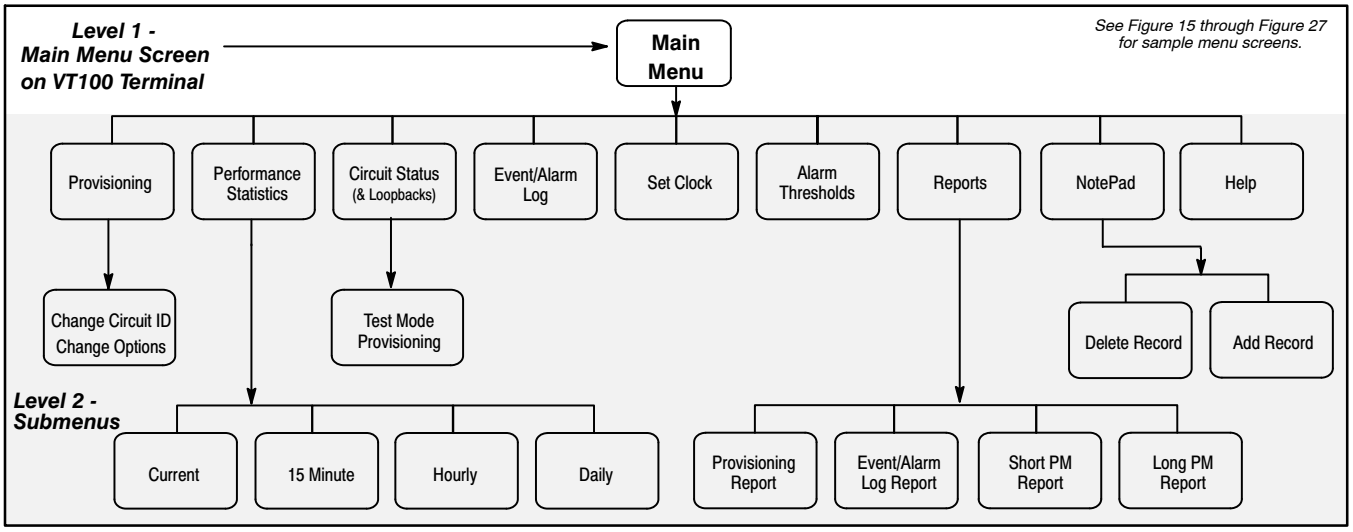


Figure 14. A Directory Tree/Path of Software Menus Accessed Via the Craft Interface & VT100 Terminal

Westell C90-311560 CLEI: T1S1ECVAAA

MAIN MENU

PROACT
T1 PERFORMANCE MONITORING NIU

WESTELL TECHNOLOGIES, INC.
AURORA, IL.
1-800-323-6883

SELECTIONS

O) PROVISIONING
P) PERFORMANCE STATISTICS
S) CIRCUIT STATUS
L) EVENT/ALARM LOG
C) SET CLOCK
T) ALARM THRESHOLDS
R) REPORTS
N) NOTEPAD
?) HELP

Enter letter of selection

Figure 15. Main Menu Screen

9.2 Menus and Screens

9.2.1 MAIN Menu Screen

Once the terminal or PC is connected to the craft interface port, the MAIN menu should appear. The MAIN menu provides the NIU model number, CLEI code, Technical Service contact telephone number, as well as navigation buttons to other screens. The Model Number and CLEI Code are set at the factory and cannot be changed. The MAIN menu is illustrated in Figure 15. To return to the MAIN menu screen from any other screen enter <Esc>.

9.2.2 SET CLOCK Menu Screen

9.2.2.1 The SET CLOCK screen, Figure 16, is used to set the unit's internal clock. To reach this screen from the MAIN menu, type <C>. The unit is shipped from the factory with its clock set to Central Standard Time.

9.2.2.2 To set the date or time, use the <tab> to select the field, then type the new parameter in the highlighted box. To save the changes, press <Enter>.

9.2.2.3 To return to the MAIN menu from this screen, press the <Esc> key. The clock can be remotely set via TL1 commands, using the SET-DAT command.

9.2.3 PROVISIONING Menu Screen

The PROVISIONING screen (Figure 17) is used to configure the unit's options. To reach this screen from the MAIN menu, type <O>. The NIU is set from the factory to a standard configuration. All options in the menu can be set and queried remotely. For each option, the display shows the "CURRENT"

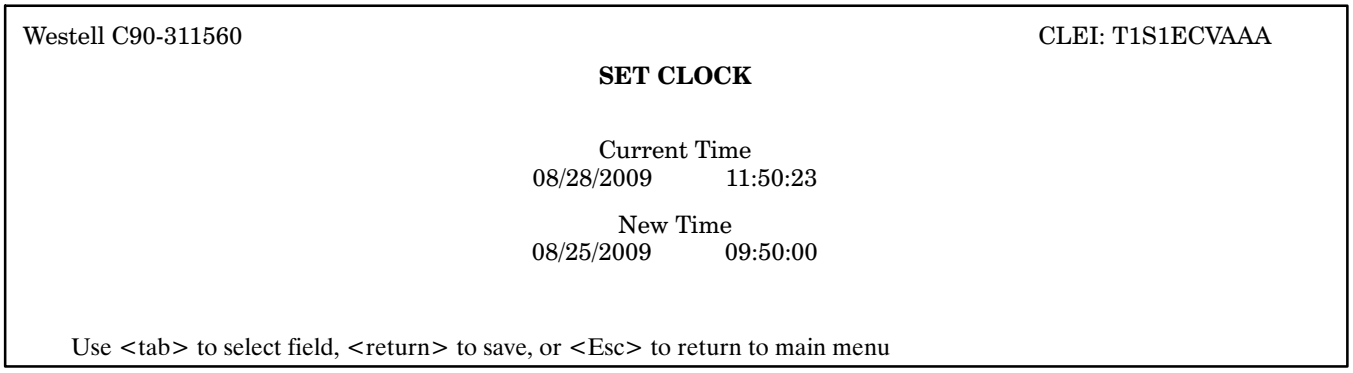


Figure 16. Set Clock Menu Screen (Typical)

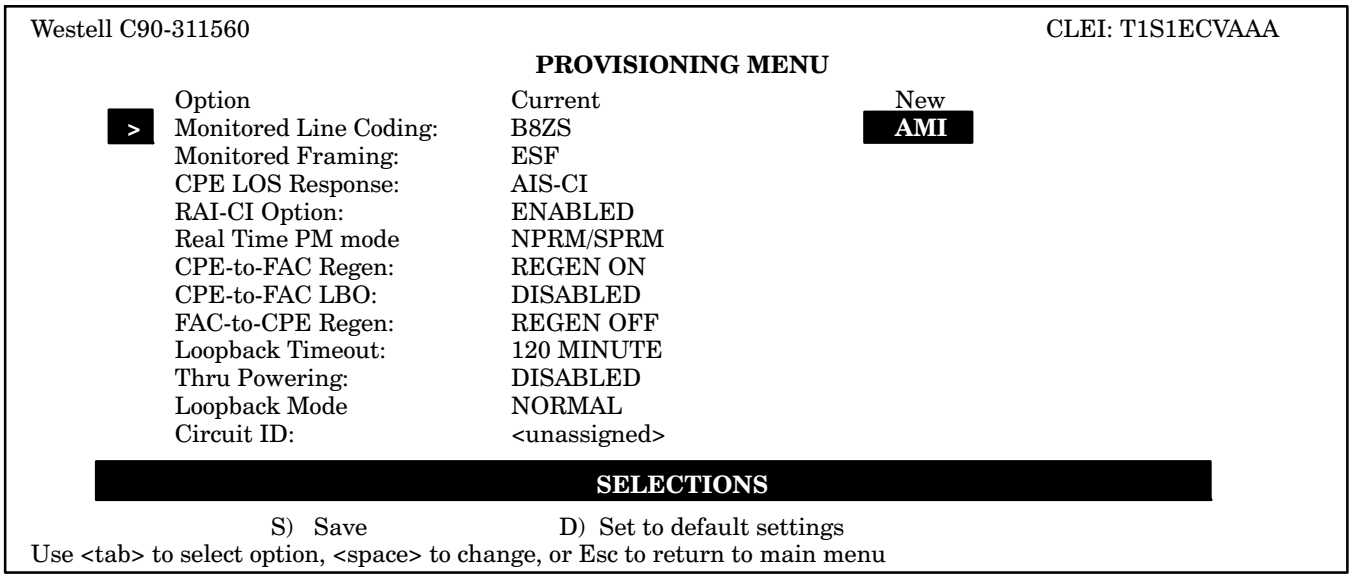


Figure 17. Provisioning Menu Screen

configuration as well as a "NEW" field that shows what the option can be changed to. Use <tab> or the arrow keys to advance to an option field. Use the <space> bar to change the available options under the "NEW" field.

9.2.3.1 Saving The Changed Options

After configuring the options, press <S> to save the new settings. ***Note:*** *If you enter <Esc> without saving, the system will give a message asking if you want to save the new settings.*

- WARNING -

Always save changes before disconnecting to activate the changes. If the craft terminal is disconnected without saving the changes, the changes will be lost (unit does not save changes automatically).

9.2.4 PERFORMANCE STATISTICS Menu Screens

The Performance Statistics screens are used to view the stored T1 performance statistics. To reach this screen from the MAIN menu, type <P>. The example screen below (Figure 18), shows various performance parameters for both the NET-to-CPE (A to Z) and CPE-to-NET (Z to A) directions as well as a status register describing abnormal circuit conditions during the period. By using the selection keys at the bottom of the screen, all Historical time registers can be examined. Type the appropriate command to view the 15-minute, Hourly, and Daily screens or the <N> for Next and <P> for Previous page commands. The parameters on these screens are automatically updated at 5-second intervals. To return to the MAIN menu from this screen, press the <Esc> key.

9.2.4.1 Updates

To stop the automatic updating, type <U>. To resume automatic updating, type <U> again.

9.2.4.2 Clearing Status Registers

To clear all stored historical data, type <C>. The system will give a confirmation message prompting if all data is to be cleared. Type <Y> for Yes or <N> for No.

- WARNING -

The clear command <C> affects all performance monitoring screens. The clear command will clear all data screens regardless of the activating time interval screen.

Field/Option	Parameter	Default*	Description
Monitored Line Coding *(Note 1)*	AMI		Configures unit for AMI line coding.
	B8ZS	✓	Configures unit for B8ZS line coding.
CPE LOS Response	None		No response to customer LOS.
	LB		Enters loopback toward Network upon detecting a Customer LOS.
	Idle		Send Idle toward Network upon detecting a customer LOS.
	AIS		Send AIS toward Network upon detecting a Customer LOS.
	AIS-CI	✓	Send AIS-CI toward Network upon detecting a Customer LOS.
RAI-CI Option	Enabled	✓	Converts customer RAI to RAI-CI if also receiving a valid network signal.
	Disabled		RAI from CPE is always passed unchanged.
Monitored Framing	SF		Monitors SF parameters for PM.
	ESF	✓	Monitors ESF parameters for PM.
Real-Time Mode	None		Disables real-time reporting.
	NPRM		Configures the unit to send NPRM messages.
	SPRM		Configures the unit to send SPRM messages.
	SPRM / NPRM	✓	Configures the unit to send both SPRM and NPRM messages.
FAC-to-CPE REGEN	Regen Off	✓	No regeneration in the FAC-to-CPE (A-Z, RCV) path.
	Regen On		Regeneration in the FAC-to-CPE path.
CPE-to-FAC REGEN	Regen Off		No regeneration in the CPE-to-FAC (Z-A, XMT) path.
	Regen On	✓	Regeneration in the CPE-to-FAC path.
CPE-to-FAC LBO **Note: For fiber applications, set CPE-to-FAC LBO to "Disabled."*	Disabled*	✓	Select this option to disable the CPE-to-FAC LBO.
	7.5 dB		Select this option to select 7.5 dB of LBO.
	15 dB		Select this option to select 15 dB of LBO.
	22.5 dB		Select this option select 22.5 dB of LBO.
	AB15 dB		Select this option if the Auto Binder level of the cable is 15 dB.
	AB22.5 dB		Select this option if the Auto Binder level of the cable is 22.5 dB.
Loopback Mode	Normal	✓	Unit loops up to normal inband/Data Link loopback codes.
	Addressed		Unit loops up to unique 16-bit addressed loopback code.
Loopback Time-out	Disabled		Loopback will not time-out.
	20 Minute		Loopback will automatically time-out 20 minutes after initial activation.
	60 Minute		Loopback will automatically time-out 60 minutes after initial activation.
	120 Minute	✓	Loopback will automatically time-out 120 minutes after initial activation.
	24 Hour		Loopback will automatically time-out 1440 minutes after initial activation.
Thru Powering	Enabled		With option P202 = THRU, the NIU provides THRU span powering.
	Disabled	✓	THRU span powering is disabled.
Circuit ID	<user defined>		This field can be up to 20 alphanumeric characters (user defined).

Table 6. Options and Parameters

9.2.5 Event/Alarm Log Screen

9.2.5.1 The Event/Alarm Log screen is used to view various events that occurred on the span during the monitoring period. The log provides time-stamped entries for the most important types of events such as alarm signal detection, loopback, PM Registers cleared, Event/Alarm Log cleared, Clock setting, loss of signal, power outages, and more. The Event/Alarm Log will retain the 100 most recent events in non-volatile memory. The Event/Alarm Log can be viewed locally via the craft interface port. An example of a typical Event/Alarm Log screen is shown in Figure 19. The Event/Alarm Log can also be retrieved remotely via TL1 commands.

9.2.5.2 To gain access to the Event/Alarm Log screen, type <L> while in the Main Menu. The Event/Alarm Log appears. To advance through the log, type <N> (next page), or <P> (previous page), or <Esc>(to return to the MAIN Menu).

9.2.5.3 To clear all stored data in the Event/Alarm Log, type <C>. The system will give a confirmation message prompting if all data is to be cleared. Type <Y> for Yes or <N> for No.

9.2.6 CIRCUIT STATUS Menu Screen

9.2.6.1 The Circuit Status screen is used to view the circuit status of the NIU, as well as perform various test routines such as loopback. To reach this screen from the MAIN menu, type <S>. The Circuit Status screen, shown in Figure 20, provides a graphical representation of the NIU and its ports to the T1 facility and customer interface.

9.2.6.2 For each port, the screen shows:

Westell C90-311560 CLEI: T1S1ECVAAA
02/28/2009 09:02:48

15 MINUTE PM STATISTICS

(CURRENT)

	FAC-to-CPE	CPE to FAC
CVL	0	0
ESL	0	0
SESL	0	0
LOSS-L	0	99
CVP	0	0
ESP	0	0
SESP	0	0
UASP	0	99
PDV-SEC	102	2
B8ZS_SEC	0	0
MSEC	102	102
STAT	.2..5.78	.2..5678

Date: 02/28/2009
Time: 08:00:00

Stat Register Key	
1	Loopback
2	Data Incomplete
3	Loss of Signal
4	Unused
5	Power Loss
6	AIS
7	Yellow Alarm
8	Out of Frame

SELECTIONS

Q) 15 Minute H) Hourly D) Daily N) Next P) Previous
U) Disable auto updating C) Clear stored data

Enter selection or <Esc> to go back to main menu

Figure 18. 15-Minute PM Status Screen (Typical)

Westell C90-311560 CLEI: T1S1ECVAAA

EVENT/ALARM LOG Events 1 - 15 of 100

No.	Date	Time	Event
1	2/28/00	13 : 00 : 00	MANUAL LOOP DOWN
2	2/28/00	12 : 50 : 00	MANUAL LOOP UP
3	2/28/00	12 : 60 : 15	REMOTE LOOP DOWN
4	2/28/00	12 : 05 : 00	REMOTE LOOP UP
5	2/28/00	12 : 02 : 30	MANUAL LOOP UP
6	2/28/00	12 : 02 : 00	CHANGED CPE REGEN OPTION
7	2/28/00	12 : 01 : 20	MANUAL LOOP DOWN
8	2/28/00	12 : 00 : 30	CHANGED FAC REGEN OPTION
9	2/28/00	11 : 02 : 50	CHANGED FAC REGEN OPTION
10	2/28/00	11 : 02 : 00	MANUAL LOOP UP
11	2/28/00	11 : 00 : 00	AIS FROM CPE CLEARED
12	2/28/00	10 : 02 : 15	AIS FROM CPE
13	2/28/00	10 : 02 : 00	LOS FROM CPE CLEARED
14	2/28/00	10 : 00 : 05	LOS FROM CPE
15	2/28/00	10 : 00 : 00	POWER UP

SELECTIONS

N) Next page P) Previous page C) Clear log ?) Help

Enter selection or <Esc> to go back to main menu

Figure 19. Event/Alarm Log Screen (Typical - Sample Only)

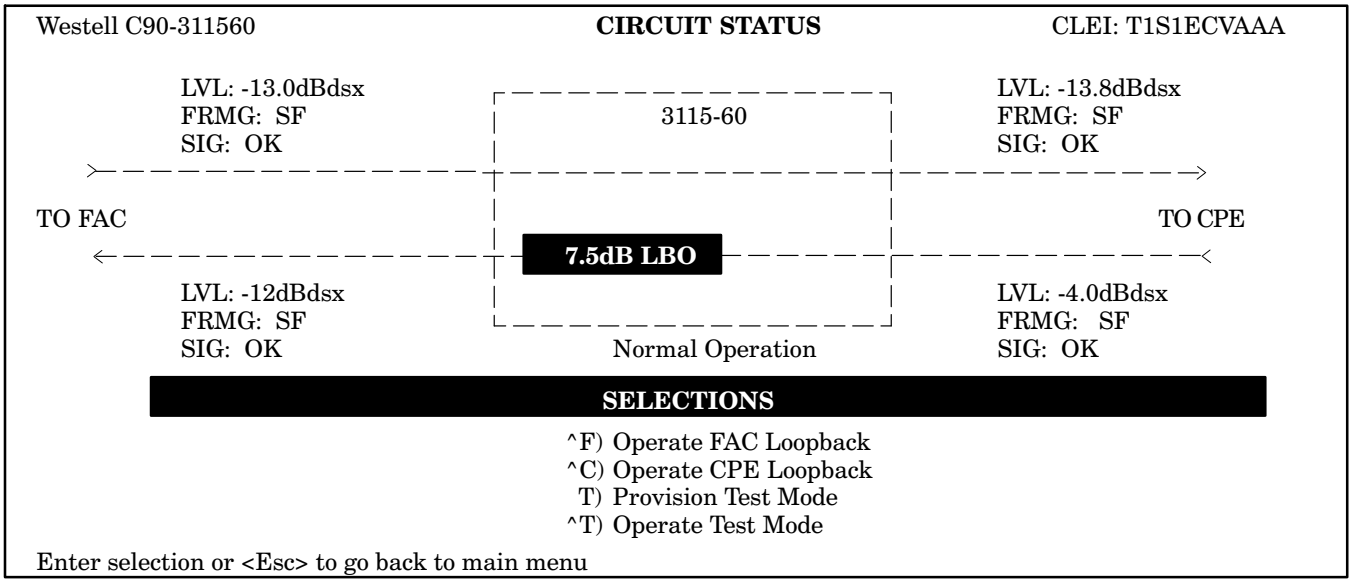


Figure 20. Typical Circuit Status Screen - Normal Operation

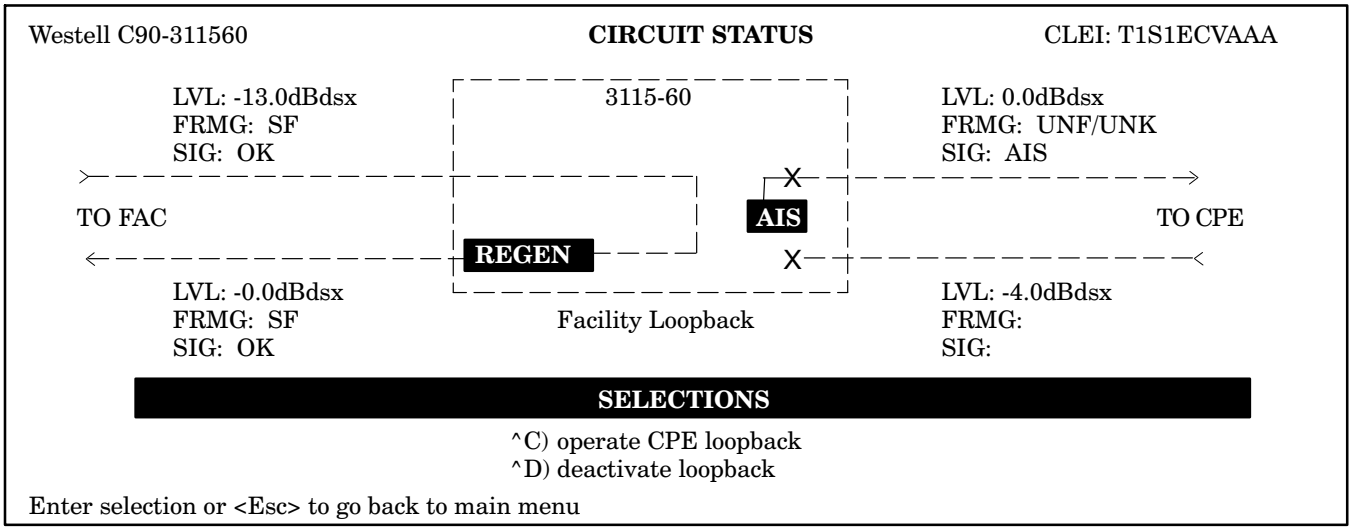


Figure 21. Typical Circuit Status Screen - Facility Loopback

1. Level (LVL) of the signal in dB. Possible values in this field are:
   - 0 0dB level detected
   - -1 -1dB level detected
   - -2 -2dB level detected ••• up to
   - -30 -30dB level detected
   - LOW Too low to measure
2. Framing (FRMG) that is present at the port. Possible values in this field are:
   - SF SF framing present
   - ESF ESF framing present
   - UNF unframed
   - UNK unknown
3. Signal (SIG) status at the port. Possible values here are:
   - OK Normal signal condition
   - LOS Loss Of Signal
   - AIS Alarm Indication Signal (all ones)
   - RAI Remote Alarm Indication (yellow alarm)
   - Idle Customer Disconnect Indication signal
   - RAI-CI Remote Alarm Indication - Customer Interface
   - AIS-CI Alarm Indication Signal - Customer Interface

9.2.6.3 The Circuit Status screen also shows a graphical representation of the internal transmission paths of the NIU, with the specific regeneration or LBO parameters that have been provisioned. When different parameters are provisioned, remotely or via the provisioning menu, they will be reflected here.

9.2.6.4 ***Facility Loopback.*** By using the <Ctrl><F>keys simultaneously, the NIU can be placed into a loopback toward the Facility (see Figure 21).

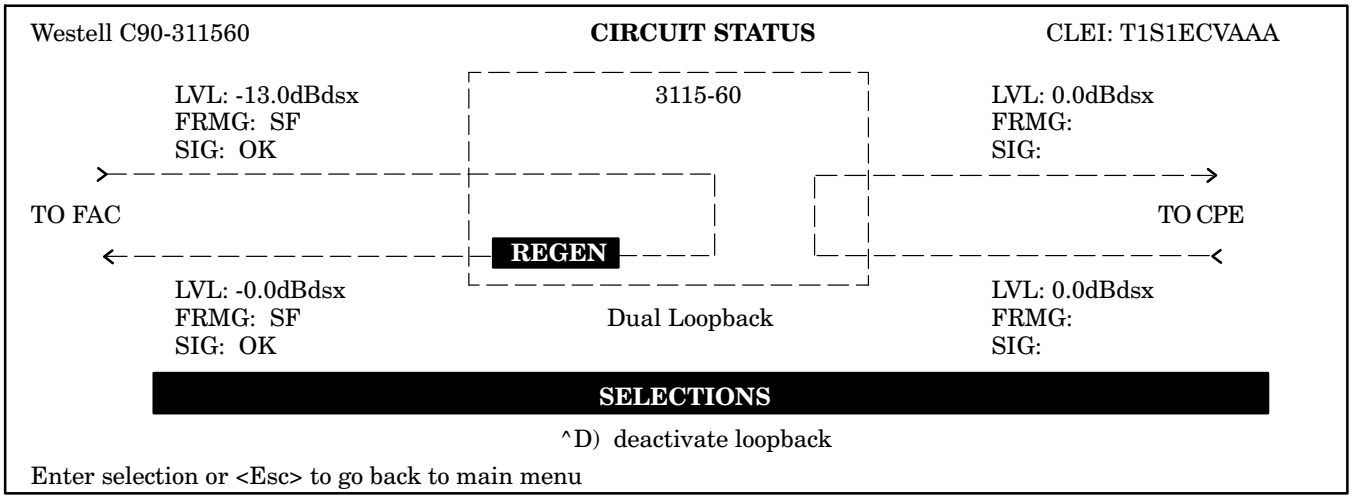


Figure 22. Typical Circuit Status Screen - Dual Loopback

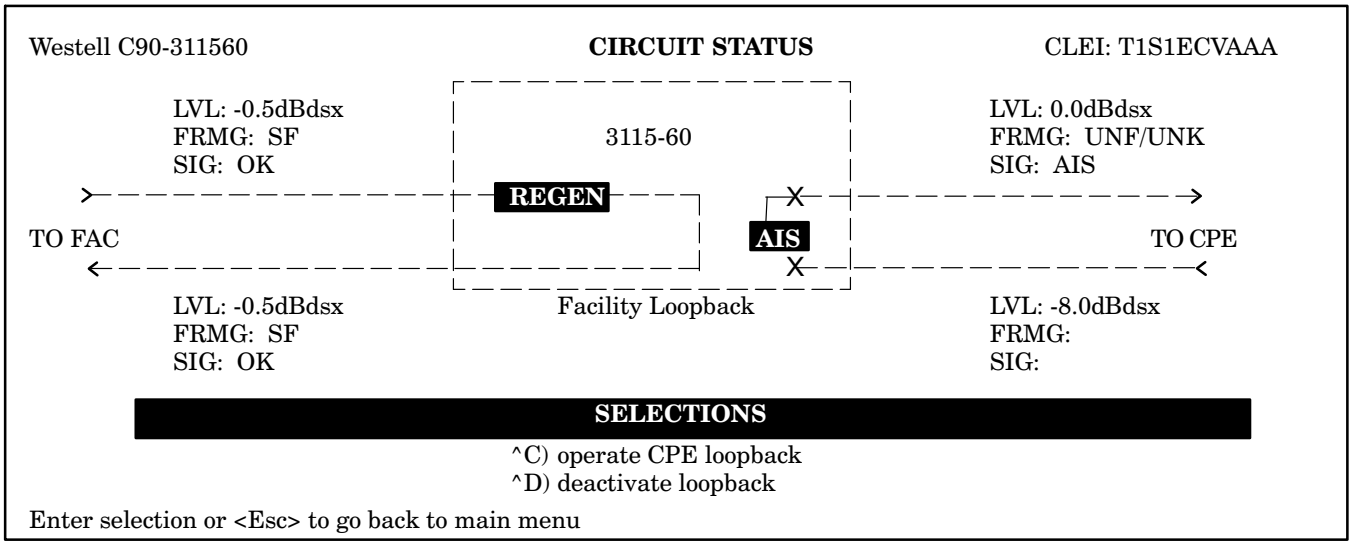


Figure 23. Typical Circuit Status Screen - Facility Loopback with FAC-to-CPE REGEN Enabled

9.2.6.5 ***CPE Loopback.*** By using the <Ctrl><C> keys simultaneously, the NIU can be placed into a loopback toward the CPE only. The graphical representation on the Status Screen will change appropriately to show the CPE loopback and AIS being transmitted toward the facility.

9.2.6.6 ***Dual Loopback.*** Dual loopback is achieved by using both <Ctrl><F> and <Ctrl><C> (see Figure 22). The graphical representation will change appropriately to show the loopback state as well as the configuration of transmission parameters and options in the loopback path. Figure 23 shows the NIU in a single loopback mode when FAC-to-CPE Regeneration is Enabled.

9.2.6.7 Finally, using the <Ctrl><D> keys simultaneously, will cause the NIU to deactivate loopback and return the circuit to normal operation. Also, the Loopback Timeout circuit will also reset to the pre-selected setting.

9.2.7 TEST MODE PROVISIONING Menu Screen

The TEST MODE PROVISIONING screen (Figure 24) is used to configure the unit's options for the test mode. To reach this screen from the MAIN menu, type <S> to get into the STATUS Screen and then type <T>. For each option, the display shows the "CURRENT" configuration as well as a "NEW" field that shows what the option can be changed to. Use <tab> or the arrow keys to advance to an option field. Use the <space> bar to change the available options under the "NEW" field.

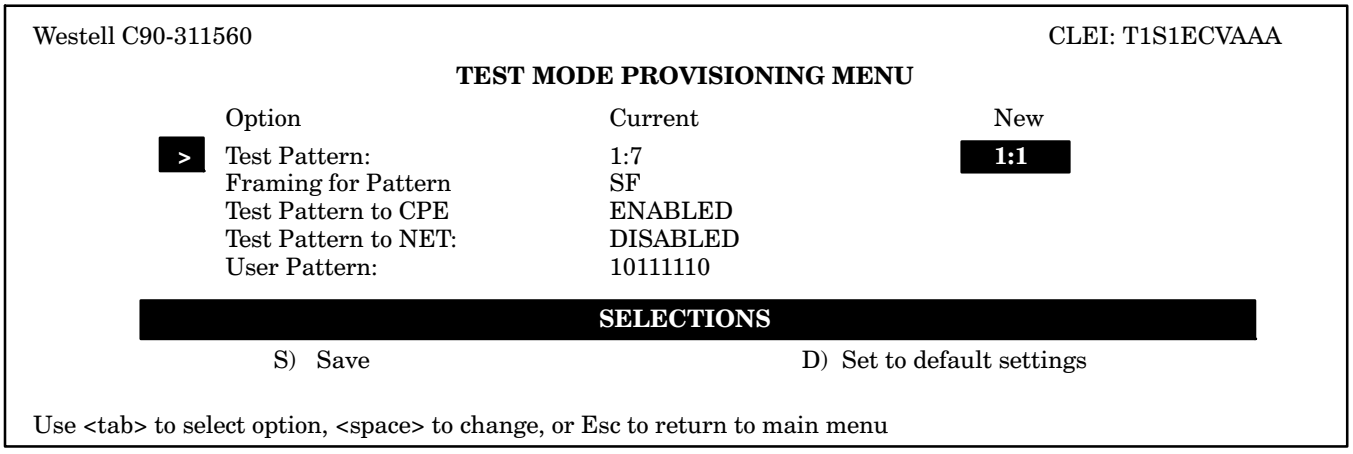


Figure 24. Test Mode Provisioning Menu Screen

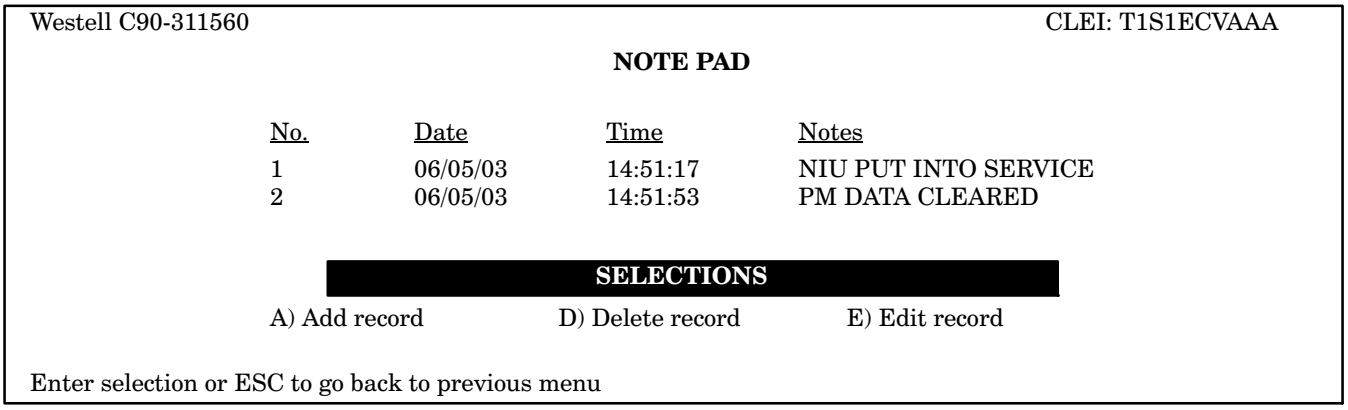


Figure 25. NOTE PAD Screen

9.2.7.1 Saving The Changed Options

After configuring the options, press <S> to save the new settings. ***Note:*** *If you enter <Esc> without saving, the system will give a message asking if you want to save the new settings.*

- WARNING -
If the craft terminal is disconnected without saving the changes, the changes will be lost (unit does not save changes automatically).

Field	Parameter	Default
TEST PATTERN	1:1	
	1:7	✓
	ALL ONES	
	USER (4-16 BITS)	
FRAMING FOR PATTERN	UNFRAMED	
	SF	
	ESF	✓
TEST PATTERN TO CPE	ENABLED	✓
	DISABLED	
TEST PATTERN TO NET	ENABLED	
	DISABLED	✓

Table 7. 3115-60 Test Mode Parameters

9.2.7.2 The test mode is activated while in the STATUS screen by using the <Ctrl><T> keys simultaneously. Additional applications of <Ctrl><T> will toggle the state of the test mode.

9.2.8 NOTE PAD Screen

The Note Pad screen provides a means for Craft personnel to log notes about the circuit. See Figure 25. Each entry is date and time stamped for future reference. Up to 15 notes can be entered, with each note limited to 50 characters. Add, delete, and edit selections allow the user to manage entries.

9.2.9 ALARM THRESHOLDS Screen

The ALARM THRESHOLDS screen allows the user to set various performance monitoring thresholds for the different parameters, illustrated above in Figure 26. An event will be recorded in the Event/Alarm log when any parameter threshold is exceeded. A threshold setting of "0" will disable it.

9.2.10 REPORTS screen

The CRAFT port provides a means for downloading various reports to a PC running HyperTerminal software. The menu option for performing this function will be labeled "REPORTS", and will appear as part of the MAIN menu. Once selected, the "REPORTS" screen, Figure 27, will allow the user to select from one of four options, labeled as follows:

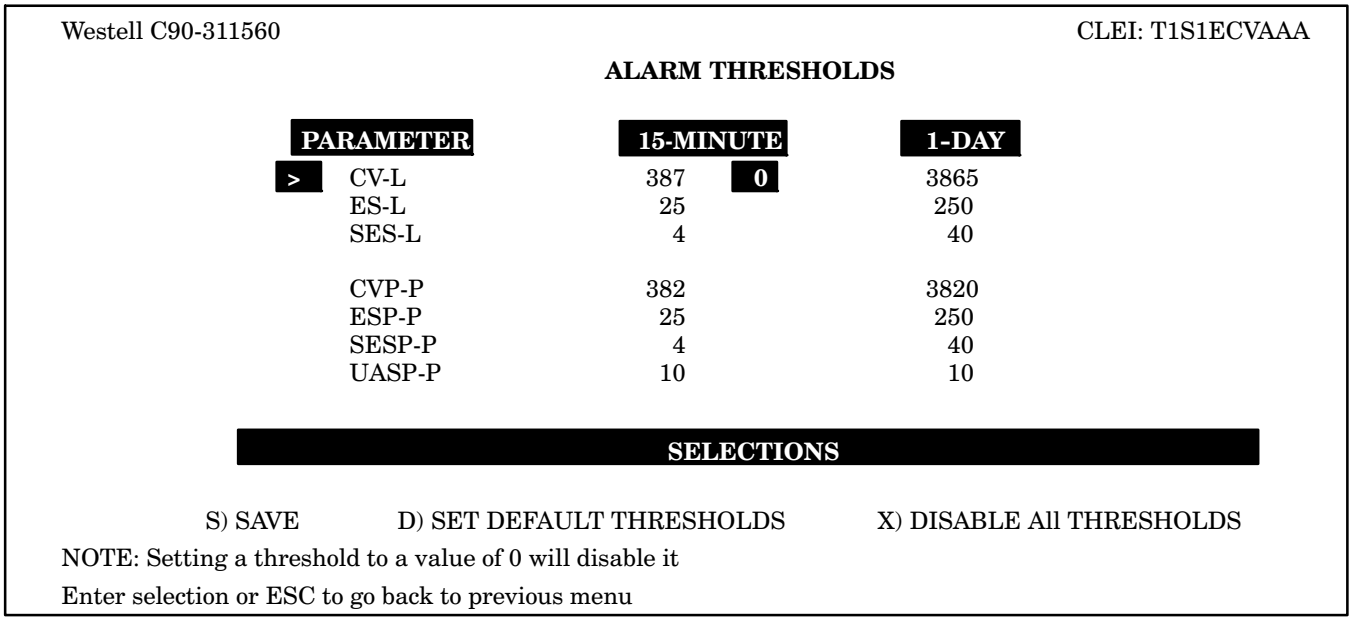


Figure 26. ALARM THRESHOLDS Screen

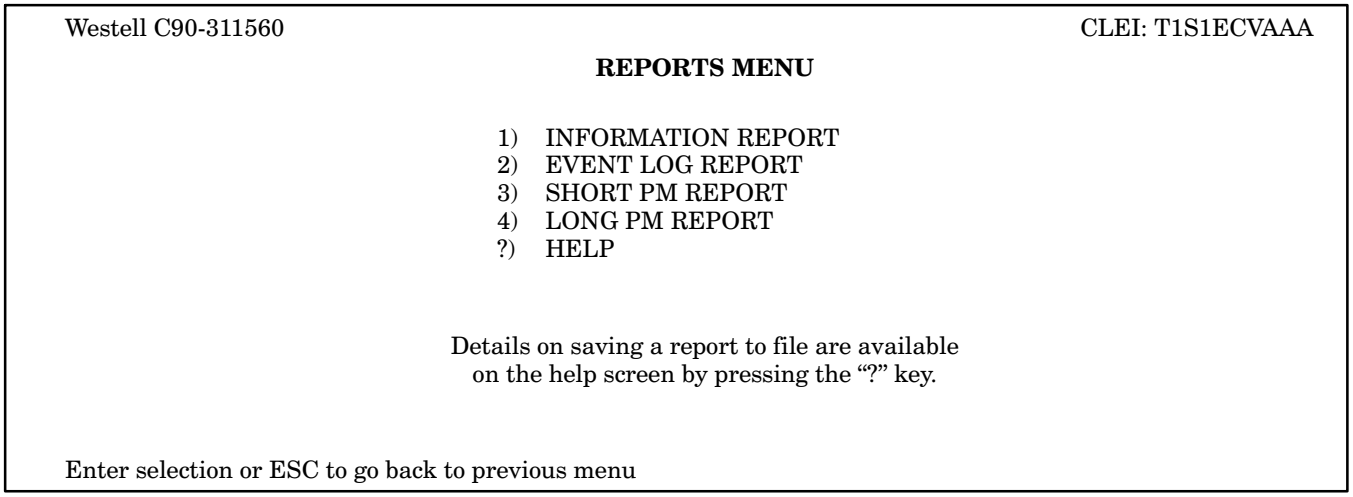


Figure 27. REPORTS Screen

1. Information Report - Provides all provisioning (including Alarm Threshold) information about the unit.
2. Event Log Report - Provides all provisioning information and a complete listing of all stored Event/Alarm Log events.
3. Short PM Report - Provides all provisioning information, and detailed PM information for the current 15-minute, current hour and current day.
4. Long PM Report - Provides all provisioning information, and a complete listing of all PM information stored in the unit.

Reports Screen Download Procedure

1. Select "Transfer," "Capture Text" from the Hyper Terminal drop down menu.
2. Enter a file name then select "Start."
3. Select a report number "1," "2," "3," or "4" to capture data from the "SEND DATA TO LOG FILE" menu.
4. After download is complete, select "Transfer," "Capture Text," and "Stop" from HyperTerminal.

9.3 Remote Provisioning and Query via TL1

The NIU is capable of being provisioned and queried via TL1 commands. These TL1 commands and responses are transported via the Facility Data Link and do not require that the unit be put in loopback. The TL1 instruction sequence is outlined in Appendix C of this document.

9.3.1 Remote Provisioning via 16-Bit Commands

To initiate a remote provisioning session, the NIU is first put into loopback. While in loopback, the test person sends the appropriate provisioning code to the NIU. Each code consists of a 16-bit pattern and can be unframed, SF or ESF framed. All codes must be sent to the unit for minimum of five seconds. In order to see a bit-error response from the unit, the code must be present for a minimum of 20 seconds. The unit will respond to the code with bit errors after the 20-second time frame. Provisioning codes and responses shown in Appendix A.

9.3.2 Remote Query of Provisioned Parameters via 16-Bit Commands

The NIU also allows the test person to query the NIU and determine its provisioned options. To initiate a remote query session, the NIU is first put into loopback. Once in loopback, the test person sends the appropriate 16-bit query code to the NIU. All query codes must be sent to the unit for minimum of five seconds. In order to see a bit-error response from the unit, the query code must be present for a minimum of 20 seconds. Query codes and responses are shown in Appendix B.

9.4 Power

9.4.1 Local Power Input Lead Fusing

The NIU offers a flexible powering option which will allow the unit to operate directly from T1 metallic spans, or from a locally-provided 22 to 56Vdc source. The NIU is fused on its local power input lead, pin 35, to prevent the failure of an individual NIU from affecting other units on the same local power supply. This fuse is not field replaceable since failure is an indication of an internal fault of the unit.

- NOTE -

The 3115-60 is equipped with an on-board 3V Lithium battery. If power is removed from the circuit for whatever reason, the battery circuit is enabled to maintain the real-time clock circuit. If the battery ever needs replacement, the unit must be returned to Westell.

9.4.2 PCB Powering Option Switch

The unit contains an option to configure the unit for either span, local or thru powering. The option must be set at the time of installation. Figure 12 shows the location of this option. Select either SPAN, LOCAL, or THRU as required by the application. If optioned for THRU powering, via P202, the THRU power function can be enabled & disabled via the craft port Provisioning Screen or via 16-bit or TL1 Remote Provisioning.

10. TESTING & TROUBLESHOOTING

10.1 Testing and Field Repairs

This equipment should not be field repaired. If the equipment is suspected of being faulty, replace it with another unit, optioned identically, and retest. If the replacement unit appears to operate correctly, the original unit may be faulty and should be returned to Westell for repair or replacement (Paragraph 12.2).

10.2 Troubleshooting

If trouble is encountered, verify all installer connections to the assembly and check that the CO power fuse is not blown. Also verify all module connections and option switch settings, and verify the modules are making a positive connection with the shelf connector. If trouble persists, replace the suspect unit and repeat procedures outlined. These procedures are not designed to effect repairs or modifications. Any tests beyond those outlined herein, or repairs made beyond replacing a faulty unit, are not recommended and may void the warranty.

11. CUSTOMER & TECHNICAL SERVICES

11.1 Customer Service & Technical Assistance

If technical or customer assistance is required, contact Westell by calling or using one of the following options:

Voice: (800) 377-8766
email: *global_support@westell.com*

For additional information about Westell, visit the Westell World Wide Web site at http://**www.Westell.com.**

11.2 Part Numbers

This equipment is identified by a product number (C90-311560), which consists of three parts: the issue letter of the equipment (B), the assembly type (90), and the specific model number (311560). When a change is made to the product which changes the form, fit, or function of the product, the issue letter is incremented by one. Please indicate the issue level as well as the model number when making equipment inquiries.

12. WARRANTY & REPAIRS

12.1 Warranty

Westell warrants this product to be free of defects at the time of shipment. Westell also warrants this product to be fully functional for the time period specified by the terms and conditions governing the sale of the product. Any attempt to repair or modify the equipment by anyone other than an authorized Westell representative will void the warranty.

12.2 Repair and Return

Westell will repair or replace any defective Westell equipment without cost during the warranty period if the unit is defective for any reason other than abuse, improper use, or improper installation. To return defective equipment, first request a Return Material Authorization (RMA) number from Westell by calling or using one of the options shown below. Once an RMA number is obtained, return the defective unit (freight prepaid), along with a brief problem description, to the address we will provide to you when you contact us.

Voice: (630) 375-4457
email: rgmdept@westell.com

Replacements will be shipped in the fastest manner consistent with the urgency of the situation. Westell will continue to repair or replace faulty equipment beyond the warranty period for a nominal charge. Contact Westell for details.

13. SPECIFICATIONS

13.1 Ordering Specifications

To order units, call the telephone number shown in Paragraph 11.1 and please specify a specific model number shown in Table 8.

Model #	Part #	Description
3115-60	C90-311560	DS1 Network Interface Unit (NIU) with Performance Monitoring. *CLEI* Code: T1S1ECVAAA. Barcode/ECI: 174118. CPR: 070XWL.*

**CLEI is a trademark of Telcordia Technologies.*

Table 8. Ordering and Option Information

13.2 Electrical and Physical Specifications

The electrical and signalling specifications are listed below, and the physical specifications are shown in Table 9.

Transmission

A. Insertion Loss (Regen OFF): 1.5 dB, max.

B. Regen Range: -30 to 0 dBDSX

C. Port Impedance: 100 Ohms (±22%) at 772 kHz

Detectors

D. FAC and CPE LOS Detector Thresholds: ≤ -30 dB @ 150 ms

E. Code Detector Range: -30 to 0 dBDSX

F. Code Detector Maximum Error Rate: 10^{-3}

Power

G. Span Power Voltage Drop: 24V (nom.) at 60 mA

H. Span Power Operating Current: 57 to 63 mA

I. Local Power: -22 to -56 Vdc, ± reference to ground

J. Local Power Current Consumption: 19 mA, typ. at -48 Vdc

K. Heat Release (SPAN PWR): 1.44 Watts, typ.

L. Heat Release (THRU PWR): 1.70 Watts, typ.

M. Heat Release (LOCAL PWR): 0.91 Watts, typ.

N. Equipped with a 3 V Lithium battery to maintain the real-time clock. If battery needs replacement, the unit must be returned to Westell.

Physical Feature	U.S.	Metric
Height	5.6 inches	14.2 cm
Width	0.7 inches	1.8 cm
Depth	6.0 inches	15.2 cm
Weight (approx.)	6 ounces	170 g
Operating Temp.	-40° to 149°F	-40° to 65°C
Humidity	0 to 95% (non-condensing)	

Table 9. Physical Specifications

Appendix A - Remote Provisioning Codes						
Field	**Parameter**	**Default**	**TL1 Command & Response (See Note 1)**	**16-Bit Code (See Note 2)**	**Hex Code**	**Bit Error Response**
Monitored Line Coding	AMI		WSTMONLC=AMI	1100 0101 1011 0001	C5B1	
	B8ZS	✓	WSTMONLC=B8ZS	1100 0101 1011 0010	C5B2	
Monitored Framing	SF		WSTMONFRMG=SF	1100 0100 1101 0001	C4D1	
	ESF	✓	WSTMONFRMG=ESF	1100 0100 1101 0010	C4D2	
CPE LOS Response	None		WSTCLOSRSP=NONE	1100 0101 1010 0001	C5A1	
	LB		WSTCLOSRSP=LB	1100 0101 1010 0010	C5A2	
	AIS		WSTCLOSRSP=AIS	1100 0101 1010 0011	C5A3	
	Idle		WSTCLOSRSP=Idle	1100 0101 1010 0100	C5A4	
	AIS-CI	✓	WSTCLOSRSP=AIS-CI	1100 0101 1010 0101	C5A5	
RAI-CI Operation	Disabled		WSTRAICI=DIS	1100 0101 1010 0110	C5A6	
	Enabled	✓	WSTRAICI=ENA	1100 0101 1010 0111	C5A7	
Real-Time PM Mode	None		WSTRTPM=NONE	1100 0101 1101 0001	C5D1	
	NPRM		WSTRTPM=NPRM	1100 0101 1101 0010	C5D2	
	SPRM		WSTRTPM=SPRM	1100 0101 1101 0011	C5D3	
	NPRM/SPRM	✓	WSTRTPM=BOTH	1100 0101 1101 0100	C5D4	
CPE REGEN (FAC-to-CPE)	Regen Off	✓	WSTRCVRGN=DIS	1100 0100 1010 0001	C4A1	100
	Regen On		WSTRCVRGN=ENA	1100 0100 1010 0010	C4A2	
FAC REGEN (CPE-to-FAC)	Regen Off		WSTTRMTRGN=DIS	1100 0100 1011 0001	C4B1	
	Regen On	✓	WSTTRMTRGN=ENA	1100 0100 1011 0010	C4B2	
XMT LBO (CPE-to-FAC) **Note: For fiber applications, set CPE-to-FAC LBO to "0 dB" (Disabled).*	0 dB (Disabled)*	✓	WSTTRMTLBO=0	1100 0100 1011 0011	C4B3	
	7.5 dB		WSTTRMTLBO=7.5	1100 0100 1011 0100	C4B4	
	15 dB		WSTTRMTLBO=15	1100 0100 1011 0101	C4B5	
	22.5 dB		WSTTRMTLBO=22.5	1100 0100 1011 0110	C4B6	
	AB15 dB		WSTTRMTLBO=AB15	1100 0100 1011 0111	C4B7	
	AB22.5 dB		WSTTRMTLBO=AB22.5	1100 0100 1011 1000	C4B8	
Loopback Mode	Normal	✓	WSTLBMODE=NORM	1100 0101 1111 0011	C5F3	
	Addressed		WSTLBMODE=ADDR	1100 0101 1111 0100	C5F4	
Loopback Time-out	Enable 20		WSTLBTO=20	1101 0101 1101 0001	D5D1	
	Enable 60		WSTLBTO=60	1101 0101 1101 0010	D5D2	
	Enable 120	✓	WSTLBTO=120	1101 0101 1101 0011	D5D3	
	Enable 1440		WSTLBTO=24HR	1101 0101 1101 0100	D5D4	
	Disable		WSTLBTO=DIS	1101 0101 1101 0110	D5D6	
Thru Powering	Disable	✓	WSTSPNPWR=DIS	1100 0110 1101 0001	C6D1	
	Enable		WSTSPNPWR=ENA	1100 0110 1101 0010	C6D2	
Reset to Default	Reset		WSTSDEF=	1100 0101 0111 0110	C576	
Circuit ID	ASCII string up to 20 char.		WSTCKTID=<ASCIIstring>	N/A		N/A

Note 1: *TL1 commands are transmitted in the Facility Data Link (FDL) using the command SND-CMD-FDL via the LAPB protocol. The command used to provision the unit is: ED-T1:::<CTAG>:::<OPTNM>-<OPTSTG>;. Example of the TL1 command to change the XMT LBO of the unit is: ED-T1::::::WSTTXLBO=7.5; The unit then will respond to the command with TL1 command in this example 7.5.*

Note 2: *All 16-bit command codes must be sent to the unit for minimum of five seconds in order to provision the unit. In order to see a bit-error response from the unit, the command code must be present for a minimum of 20 seconds. The unit will respond to the command with bit errors after the 20-second time frame.*

Table 10. Remote Provisioning Codes

Appendix B (Table 11) - Remote Query and Response Codes						
Query Function	**TL1 Command (See Note 1)**	**TL1 Command Response**	**16-Bit Command Code & [Hex] (See Note 2)**	**Bit Error Response**	**Setting/Parameter**	**De-fault**
Line Coding	WSTMONLC	AMI	1100 0101 1011 0000 [C5B0]	200	AMI	
		B8ZS		300	B8ZS	✓
Monitored Framing	WSTMONFRMG	SF	1100 0100 1101 0000 [C4D0]	2000	SF Framing	
		ESF		1000	ESF Framing	✓
CPE LOS Response	WSTCLOSRSP	None	1100 0101 1010 0000 [C5A0]	1000	RAI-CI OFF; TLOS OFF	
		LB		1100	RAI-CI OFF; LB on TLOS	
		AIS		1200	RAI-CI OFF; AIS on TLOS	
		Idle		1300	RAI-CI OFF; IDLE on TLOS	
		AIS-CI		1400	RAI-CI OFF; AIS-CI on TLOS	
RAI-CI Operation	WSTRAICI	DIS		2000	RAI-CI ON; TLOS OFF	
				2100	RAI-CI ON; LPBK on TLOS	
		ENA		2200	RAI-CI ON; AIS on TLOS	
				2300	RAI-CI ON; Idle on TLOS	
				2400	RAI-CI ON; AIS-CI on TLOS	✓
Real-Time Mode	WSTRTPM	None	1100 0101 1101 0000 [C5D0]	1000	None	
		NPRM		2000	NPRM Enabled	
		SPRM		3000	SPRM Enabled	
		NPRM/SPRM		2500	NPRM/SPRM Enabled	✓
Loopback Time-out	WSTLBTO	DIS	1101 0101 1101 0000 [D5D0]	1000	Disabled	
		20		200	20 Minutes	
		60		600	60 Minutes	
		120		1200	120 Minutes	✓
		24 HR		1600	24 Hr.	
Circuit ID	WSTCKTID	<ASCII string>	N/A	N/A	User Defined	
RCV Level (from Facility)	WSTRCVLVL	<nn.n>dB, or LOS	See below for 16-bit codes		TL1 Returns actual level	
XMT Level (from CPE)	WSTTRMTLVL	<nn.n>dB, or LOS	See below for 16-bit codes		TL1 Returns actual level	
CPE-to-FAC LBO (Auto Binder)	WSTBNDRLVL	<nn.n>dB			TL1 Returns actual LBO setting	
FAC-to-CPE Path	WSTRCVRGN	DIS	1100 0100 1010 0000 [C4A0]	1000	Regen OFF	✓
		ENA		2000	Regen ON	
Sectionalization Alarm Query	WSTCLOSRSP	NONE	1100 0101 1010 0000 [C5A0]	1000	RAI-CI OFF; No CPE LOS Response	
		LB		1110	RAI-CI OFF; LB on CPE LOS	
		AIS		1200	RAI-CI OFF; AIS on CPE LOS	
		IDLE		1300	RAI-CI OFF; IDLE on CPE LOS	
	WSTCLOSRSP	NONE		2000	RAI-CI ON; No CPE LOS Response	
		LB		2100	RAI-CI ON; LB on CPE LOS	
		AIS		2200	RAI-CI ON; AIS on CPE LOS	
		IDLE		2300	RAI-CI ON; IDLE on CPE LOS	
		AIS-CI		2400	RAI-CI ON; AIS-CI on CPE LOS	✓
Product I.D.	WSTPNUM	C90-311560	1101 0101 1101 1010 [D5DA]	560	WESTELL 3115-60	

Table 11 — Continued on Next Page...

Table 11 - Continued. **Appendix B - Remote Query and Response Codes**

Query Function	TL1 Command (See Note 1)	TL1 Command Response	16-Bit Command Code (See Note 2)	Bit Error Response	Setting/Parameter	De-fault
CPE-to-FAC Path Query	WSTTRMTLBO	0	1100 0100 1011 0000 [C4B0]	1000	REGEN OFF; LBO 0dB	
		7.5		1070	REGEN OFF; LBO 7.5dB	
		15		1150	REGEN OFF; LBO 15dB	
		22.5		1220	REGEN OFF; LBO 22.5dB	
		AB15		1500	REGEN OFF; AB15	
		AB22.5		1700	REGEN OFF; AB22.5	
	WSTTRMTLBO	0		2000	REGEN ON; LBO 0dB	✓
		7.5		2070	REGEN ON; LBO 7.5dB	
		15		2150	REGEN ON; LBO 15dB	
		22.5		2220	REGEN ON; LBO 22.5dB	
		AB15		2500	REGEN ON; AB15	
		AB22.5		2700	REGEN ON; AB22.5	
Loopback Mode Query	WSTLBMODE	NORM	1100 0101 1111 0000 [C5F0]	1100	Normal Mode	✓
		ADDR		2100	Addressed Mode	
Through Power Query	WSTSPNPWR	ENA	1100 0110 1101 0000 [C6D0]	2000	Through Power Enabled	
		DIS		1000	Through Power Disabled	✓

Function	Code Sequence	Hex Code	Bit Error Responses and dB Levels							
			BER	Level	BER	Level	BER	Level	BER	Level
CPE Level Query	1100 0101 0110 1110 [C56E] Unframed, SF or ESF	C56E	6 10 20 40 30 50	0 dB -1 dB -2 dB -4 dB -3 dB -5 dB	60 70 80 90 100 110	-6 dB -7 dB -8dB -9dB -10 dB -11 dB	120 130 140 160 150 170	-12 dB -13 dB -14 dB -16 dB -15 dB -17 dB	180 190 200 400 410	-18 dB -19 dB -20 dB -21 dB Loss of signal
Facility Level Query	1100 0101 0110 1111 [C56F] Unframed, SF or ESF	C56F								

Note 1: *TL1 commands are transmitted in the Facility Data Link (FDL) using the command SND-CMD-FDL via the LAPB protocol. The command used to provision the unit is: RTRV-T1:::<CTAG>:::OPTNM>-<OPTSTG>;. Example of the TL1 command to change the Application Mode of the unit is: RTRV-T1::::::WSTTXLBO=7.5; The unit then will respond to the command with TL1 command in this example 7.5.*

Note 2: *All 16-bit command codes must be sent to the unit for minimum of five seconds in order to provision the unit. In order to see a bit-error response from the unit, the command code must be present for a minimum of 20 seconds. The unit will respond to the command with bit errors after the 20-second time frame.*

Table 11. Remote Query and Response Codes

APPENDIX C

NIU QUERY AND RESPONSES VIA TL1 COMMANDS

1. TL1 Commands

TL1 Command and responses are transmitted in the Facility Data Link using the command SND−CMD−FDL via the modified LAPB protocol. Below is a short glossary of characters used in the TL1 Command:

<cr>Carriage Return

<lf>Line Feed

^Space

<ctag> Correlation tag. This is an optional field and may be left blank

ED-T1 Command

This command is used to provision the PROACT unit

Command:

```
ED−T1:::<ctag>:::<optnm>=<optstg>;
```

Example: Set Transmit LBO=7.5 dB

```
ED−T1::::::WSTTXLBO=7.5;
```

RTRV-T1 Command

This command is used to query the provision settings on the PROACT unit

Command:

```
RTRV−T1:::<ctag>:::<optnm>;
```

Example: Query Transmit LBO setting

```
RTRV−T1::::::WSTTXLBO;
```

Valid Response:

```
<cr><lf>
<lf>
^^^SJPM^YY−MM−DD^HH:MM:SS<cr><lf>
M^^<ctag>^COMPLD<cr><lf>
^^^<optnm>=<optstg><cr><lf>
;
```

List of Options

This is a comprehensive list of command line options. Simply use the codes identified in the columns below when configuring command lines.

OPTION	OPTNM	OPTSTG
Monitored Line Coding	WSTLMONLC	B8ZS, AMI
CLOS Response	WSTCLOSRSP	NONE, LB, Idle, AIS, AIS-CI
RAI-CI Option	WSTRAICI	DIS, ENA
Real Time PM Mode	WSTRTPM	NONE, NPRM, SPRM, BOTH
CPE-to-FAC Regen	WSTTRMTRGN	DIS, ENA
FAC-to-CPE Regen	WSTRCVRGN	DIS, ENA
Loopback Timeout	WSTLBTO	DIS, 20, 60, 120, 1440
Addressable Loopback Mode	WSTLBMODE	NORM, ADDR
Circuit ID	WSTCKTID	*<ASCII string up to 20 characters>*
Reset All Options to Default	WSTSDEF	(*NA*)
FAC-to-CPE Level (RTRV Only)	WSTRCVLVL	<*nn.n*>dBdsx
CPE-to-FAC Level (RTRV Only)	WSTTRMTLVL	<*nn.n*>dBdsx
Transmit Path LBO	WSTTRMTLBO	0, 7.5, 15, 22.5, AB15, AB22.5
CPE-to-FAC Auto Binder LBO	WSTBNDRLVL	<nn.n>dB

Figure 28. Appendix C — NIU Query and Responses Via TL1 Commands