SLM-5650C

Satellite Modem
Installation and Operation Manual

Part Number MN-SLM-5650C
Revision 0

IMPORTANT NOTE: The information contained in this document supersedes all previously published information regarding this product. Product specifications are subject to change without prior notice.

Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, 480.333.2200, FAX: 480.333.2161

Revision History

Rev	Date	Description
0	Mar 2019	Initial Release.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Acronym List

Acronym	Description	First Use Page Number
AGC	Automatic Gain Control	3-2
AO	Assignment Operator	7-5
AUPC	Automatic Uplink Power Control	6-14
BER	Bit Error Rate	1-9
BIT	Built In Test	1-9
BUC	Block Up Converter	1-4
CEFD	Comtech EF Data	1-1
CLI	Command Line Interface	Preface ii
CRC	Cyclic Redundancy Check	6-32
CW	Code Word	6-14
DC	Direct Current	2-1
DoD	Department of Defense	Preface i
DSSS	Direct Sequence Spread Spectrum	1-1
EIA	Electronic Industries Association	Preface ii
EVM	Error Vector Magnitude	A-7
FCS	Frame Check Sequence	6-32
FDMA	Frequency Division Multiple Access	1-1
FEC	Forward Error Correction	1-1
FIFO	First In First Out	6-32
FPGA	Field Programmable Gate Array	6-32
FTP	File Transfer Protocol	4-1
GbE	Gigabit Ethernet	1-7
HP	High Performance	B-15
HDLC	High-level Data Link Control	1-7
HTTP	Hypertext Transfer Protocol	1-2
HTTPS	Hypertext Transfer Protocol Secured	1-2
IBS	Intelsat Business Service	6-15
IF	Intermediate Frequency	1-4
LAN	Local Area Network	1-7
LDPC	Low Density Parity Check	1-1
LED	Light Emitting Diode	3-1
LL	Low Latency	B-15

Acronym	Description	First Use Page Number
LNB	Low Noise Block Down Converter	1-4
LVDS	Low Voltage Differential Signaling	6-14
M&C	Monitor and Control	5-1
MAC	Media Access Control	6-32
MIB	Management Information Base	5-1
NMS	Network Management System	5-1
OID	Object Identifier	5-3
PC	Personal Computer	1-1
PEM	Privancy-enhanced Electronic Mail	6-5
QO	Query Operator	7-5
RF	Radio Frequency	1-8
SLL	Secure Socket Layer	5-2
SNMP	Simple Network Management Protocol	5-1
SWaP	Size, Weight, and Power	1-1
TRANSEC	Transmission Security	B-1
TPC	Turbo Product Coding	1-4
UART	Universal Asynchronous Receiver Transmitter	7-1
ULL	Ultra Low Latency	B-14
URL	Uniform Resource Locator	6-5
WAN	Wide Area Network	1-7

Units of Measurement

Unit / Symbol	Definition
Ω	Ohm
A	Ampere
bps	bits per second
˚C	Celsius (degrees)
Hz	Hertz
kHz	kilo Hertz
dB	decibel
dBc	Decibels relative to the carrier
dBm	Decibel-milliwatts
˚F	Fahrenheit (degrees)
Kbps	Kilobit per second
kg	kilogram
ksps	Kilo symbols per second
lbs.	pounds
mA	Milli-amp
Mbps	Megabit per second
MHz	Megahertz
mm	millimeter
ms	millisecond
Msps	Mega symbols per second
mW	milliwatt
in.	inch
µF	micro-farads
W	Watt
V	Volt

BLANK PAGE

PREFACE

About this Manual

This manual describes the installation and operation procedures for the Comtech EF Data SLM-5650C Satellite Modem. This document is intended for the persons responsible for the operation and maintenance of the SLM-5650C.

Conventions and References

Patents and Trademarks

See all of Comtech EF Data's Patents and Patents Pending at http://patents.comtechefdata.com.

Comtech EF Data acknowledges that all trademarks are the property of the trademark owners.

Related Documents

The following documents are referenced in this manual:

- Department of Defense (DOD) MIL-STD-188-165A, Interoperability and Performance Standards for SHF Satellite Communications PSK Modems (FDMA Operation) (dated November 2005)

Warnings, Cautions, Notes, and References

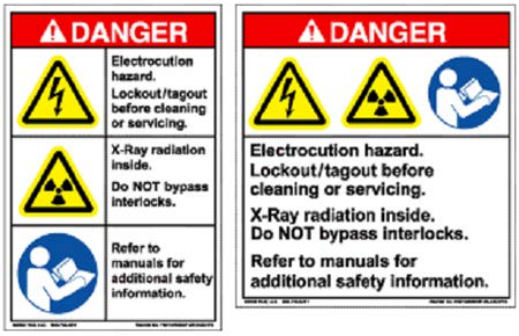
A **WARNING** indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

A **CAUTION** indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. **CAUTION** may also be used to indicate other unsafe practices or risks of property damage.

A **NOTE:** gives you important information about a task or the equipment.

A **REFERENCE** directs you to important operational information or details furnished elsewhere, either in the manual or in adjunct Comtech EF Data publications.

Examples of Multi-Hazard Notices



Recommended Standard Designations

The Electronic Industries Association (EIA) designations supersede the Recommended Standard (RS) designations. References to the old designations may be shown when depicting actual text (e.g., RS-232) displayed on front panel menus, Web Server pages, serial remote interfaces, Telnet Command Line Interfaces (CLIs), or unit rear panels. All other references in the manual refer to EIA designations.

Carefully review the following information.

Safety and Compliance

Electrical Safety and Compliance

The unit complies with the **EN 60950 Safety of Information Technology Equipment (Including Electrical Business Machines)** safety standard.

Electrical Installation

Connect the unit to a power system that has separate ground, line and neutral conductors. Do not connect the unit without a direct connection to ground.

Class I Pluggable Equipment Type A-Protective Earthing

The cable distribution system/telecommunication network of this product relies on protective earthing and the integrity of the protective earthing must be ensured

In Finland:

"Laite on liitettävä suojakoskettimilla varustettuun pistorasiaan"

In Norway:

“Apparatet må tilkoples jordet stikkontakt”

In Sweden:

“Apparaten skall anslutas till jordat uttag”

Galvanic Isolator Use

Utrustning som är kopplad till skyddsjord via jordat vägguttag och/eller via annan utrustning och samtidigt är kopplad till kabel-TV nät kan i visa fall medföra risk för brand. För att undvika detta skall vid anslutning av utrustningen till kabel-TV nät galvanisk isolator finnas mellan utrustningen och kabel-TV nätet.

Restricted Access Location

In Nordic Countries, equipotential bonding should be applied using the permanently connected ground stud by a qualified service person.

Battery Warning

Risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to the instructions.

Operating Environment

DO NOT OPERATE THE UNIT IN ANY OF THESE EXTREME OPERATING CONDITIONS:

- **AMBIENT TEMPERATURES LESS THAN -10° C (14° F) OR MORE THAN 50° C (122° F) FOR THE INDOOR UNIT AND LESS THAN -40° C (-40° F) OR MORE THAN 65°C (149° F) FOR THE OUTDOOR UNIT**
- **PRECIPITATION, CONDENSATION, OR HUMID ATMOSPHERES OF MORE THAN 95% RELATIVE HUMIDITY FOR THE INDOOR UNIT**
- **UNPRESSURIZED ALTITUDES OF MORE THAN 3000 METRES (9842 FEET)**
- **EXCESSIVE DUST FOR INDOOR UNIT**
- **FLAMMABLE GASES**
- **CORROSIVE OR EXPLOSIVE ATMOSPHERES**

Product Support

For all product support, please call:

+1.240.243.1880

+1.866.472.3963 (toll free USA)

By email:

esc@comtechefdata.com

Comtech EF Data Headquarters

http://www.comtechefdata.com

Comtech EF Data Corp.

2114 West 7th Street

Tempe, Arizona USA 85281

+1.480.333.2200

Warranty Policy

Comtech EF Data products are warranted against defects in material and workmanship for a specific period from the date of shipment, and this period varies by product. In most cases, the warranty period is two years. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective. Repairs are warranted for the remainder of the original warranty or a 90-day extended warranty, whichever is longer. Contact Comtech EF Data for the warranty period specific to the product purchased.

For equipment under warranty, the owner is responsible for freight to Comtech EF Data and all related customs, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges only for return of the equipment from the factory to the owner. Comtech EF Data will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EF Data.

All equipment returned for warranty repair must have a valid Return Material Authorization (RMA) number issued prior to return and be marked clearly on the return packaging. Comtech EF Data strongly recommends all equipment be returned in its original packaging.

Comtech EF Data Corporation's obligations under this warranty are limited to repair or replacement of failed parts, and the return shipment to the buyer of the repaired or replaced parts.

Limitations of Warranty

The warranty does not apply to any part of a product that has been installed, altered, repaired, or misused in any way that, in the opinion of Comtech EF Data Corporation, would affect the reliability or detracts from the performance of any part of the product, or is damaged as the result of use in a way or with equipment that had not been previously approved by Comtech EF Data Corporation.

The warranty does not apply to any product or parts thereof where the serial number or the serial number of any of its parts has been altered, defaced, or removed.

The warranty does not cover damage or loss incurred in transportation of the product. The warranty does not cover replacement or repair necessitated by loss or damage from any cause beyond the control of Comtech EF Data Corporation, such as lightning or other natural and weather related events or wartime environments.

The warranty does not cover any labor involved in the removal and or reinstallation of warranted equipment or parts on site, or any labor required to diagnose the necessity for repair or replacement.

The warranty excludes any responsibility by Comtech EF Data Corporation for incidental or consequential damages arising from the use of the equipment or products, or for any inability to use them either separate from or in combination with any other equipment or products.

A fixed charge established for each product will be imposed for all equipment returned for warranty repair where Comtech EF Data Corporation cannot identify the cause of the reported failure.

Exclusive Remedies

Comtech EF Data Corporation's warranty, as stated is in lieu of all other warranties, expressed, implied, or statutory, including those of merchantability and fitness for a particular purpose. The buyer shall pass on to any purchaser, lessee, or other user of Comtech EF Data Corporation's products, the aforementioned warranty, and shall indemnify and hold harmless Comtech EF Data Corporation from any claims or liability of such purchaser, lessee, or user based upon allegations that the buyer, its agents, or employees have made additional warranties or representations as to product preference or use.

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EF Data shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Chapter 1. INTRODUCTION

1.1 Overview

Figure 1-1. SLM-5650C Satellite Modem Indoor Unit

Outdoor Unit with Caps | **Outdoor Unit without Caps**

Figure 1-2. SLM-5650C Satellite Modem Outdoor Unit

The SLM-5650C Satellite Modem is offer in two unique packages. The indoor unit, shown in Figure 1-1, uses conductive cooling and provides for mounting in any orientation via either the thermal mounting rails or directly to the top or bottom surface. The outdoor unit, shown in Figure 1-2, incorporates either conductive or convection cooling. The outdoor unit is IP67 rated.

The SLM-5650C satisfies the requirements for government and military communications system applications that require state-of-the-art modulation and coding techniques to optimize satellite transponder bandwidth usage, while retaining backward compatibility.

The table below provide some of the key physical characteristic of both units.

Table 1-1. SLM-5650C Physical Characteristics

Description	SLM-5650C	SLM-5650C ODU
Dimensions	5.7” x 5.2” x 1.5”	7.7” x 5.9” x 2.8”
Volume	44.6 cubic inches	127 cubic inches
Maximum Power Consumption	27W	30W
Prime Input Power	5 VDC, 5.4 Amps	11 VDC to 33 VDC, 2.2 Amps to 0.9 Amps
Cooling	Conduction	Convection/Conduction
Weight	2.7 lbs. (1.2 kg)	5.5 lbs. (2.5 kg)

The SLM-5650C:

- Meets requirements for SWaP (Size, Weight, and Power) constrained applications in a high performance but low acoustic signature package.
- Supports Direct Sequence Spread Spectrum (DSSS) waveform and Comtech EF Data (CEFD) proprietary Low Density Parity Check (LDPC) Forward Error Correction (FEC) in three block sizes (ULL, LL, HP) and TPC FEC (3/4, 5/16, 21/44, 17/18, and 7/8 code rates).
- Is compliant with the provisions of Department of Defense (DoD) Standard MIL-STD-188-165A, *Interoperability of SHF Satellite Communications PSK Modems (Frequency Division Multiple Access [FDMA] Operation*). **NOT YET CERTIFIED.**
- Can be controlled and monitored from a Personal Computer (PC) using serial remote, Simple Network Management Protocol (SNMP), Hypertext Transfer Protocol (HTTP), Hypertext Transfer Protocol Secured (HTTPS), and telnet.

1.2 Functional Description

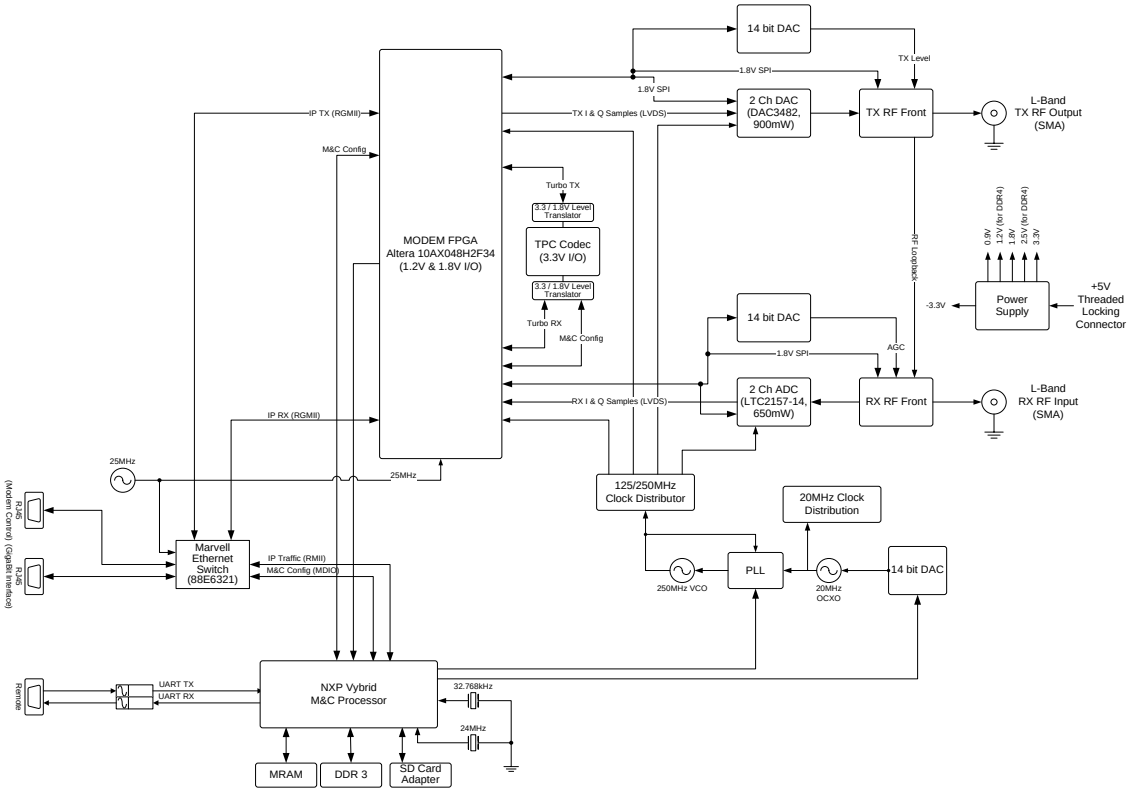


Figure 1-3. SLM-5650C Block Diagram

Figure 1-3 depicts the functional block diagram for the SLM-5650C. The modem has been designed to accommodate a wide range of currently required features, and to support both near- and long-term advances in software-defined radio technology as well as advances in FEC technology.

The user has the ability to:

- Utilize an extensive array of built-in test capabilities
- Easily upgrade the modem's operational capabilities in the field
- Easily update the modem's firmware in the field
- Use a wide range of flexible remote control options

As shown in Figure 1-3, the modem accepts Ethernet data to modulate an L-Band carrier. The demodulator receives and demodulates the L-Band carrier. Recovered data is then output on the Ethernet interface.

The Tx and Rx functions are independent with respect to modulation and coding. The modem can operate in simplex (Tx only or Rx only) or duplex mode.

1.3 SLM-5650C Features

The SLM-5650C incorporates the following features:

- SWaP optimized form factor
- Low weight and low power dissipation
- L-Band (950 to 2000 MHz) Intermediate Frequency (IF) interface
- Ethernet Interface for remote control using Telnet, SNMP, HTTP, and HTTPS
- On board Gigabit Ethernet Bridge
- Full-featured, built-in BER test-set
- Adaptive Equalizer for high order modulation types
- 8 kbps to 155.52 Mbps (Modulation-, code rate-, and interface-dependent)
- BPSK, QPSK, OQPSK, 8PSK, 8QAM, and 16QAM
- FEC Rates: 5/16, 1/3, 1/2, 2/3, 3/4, 5/6, 7/8, 21/44, 7/8, 17/18, .378, .451, .541
- Uncoded, Viterbi, Viterbi + Reed Solomon, and Sequential coding
- Turbo Product Coding (TPC) codec
- LDPC coding in three block sizes: ULL, LL, and HP
- DSSS with LDPC
- TRANSEC Encryption
- Firmware updating capability
- 10 MHz Block Up Converter (BUC) and Low Noise Block Down Converter (LNB) references

1.3.1 Physical Description

1.3.1.1 Dimensional Envelopes

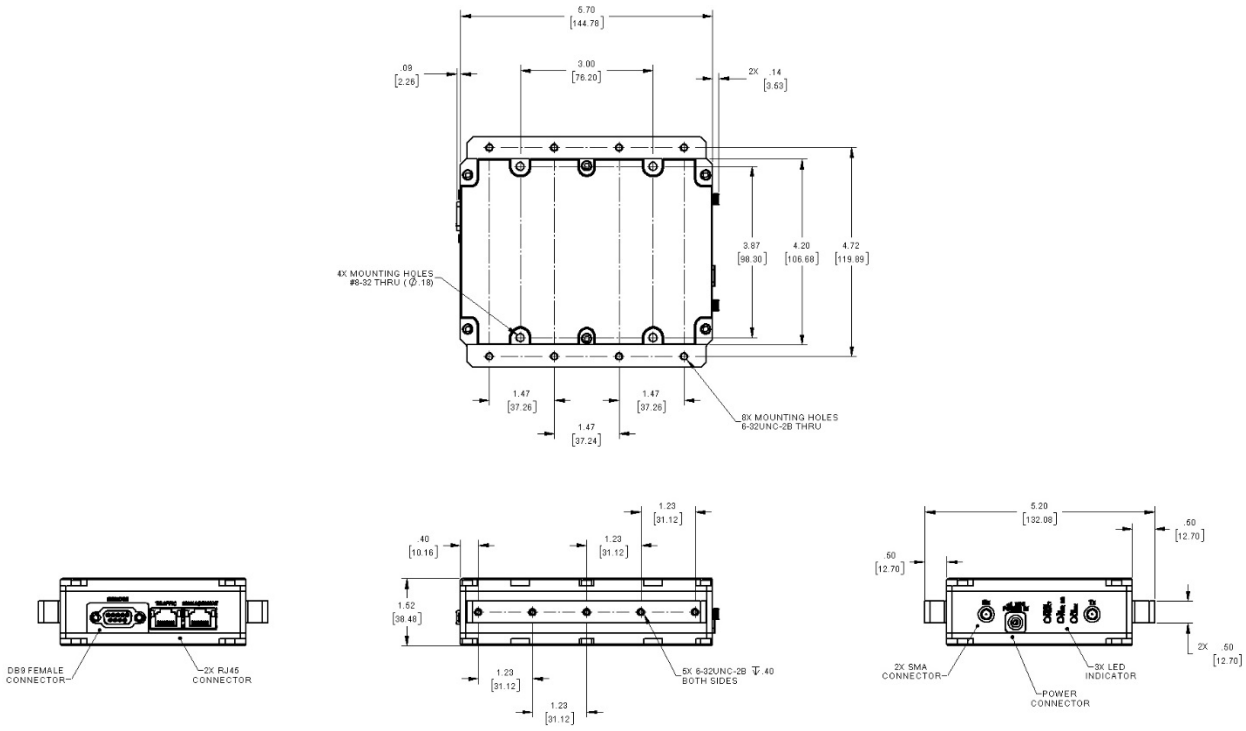


Figure 1-4. SLM-5650C Indoor Unit Dimensional Envelope

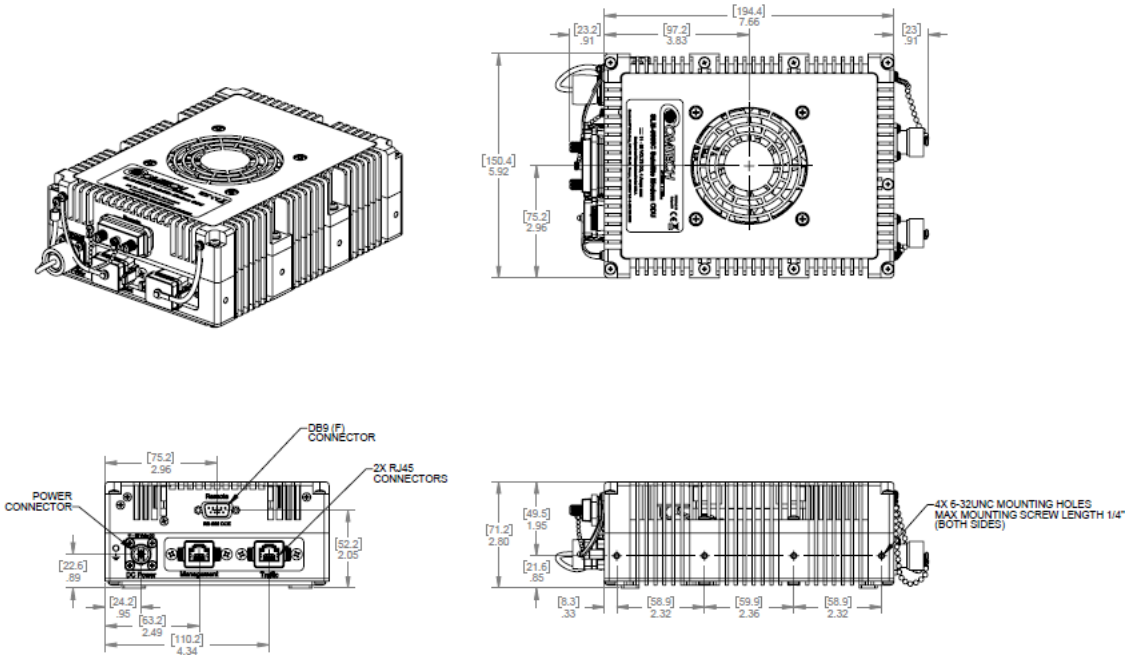


Figure 1-5. SLM-5650C Outdoor Unit Dimensional Envelope

1.3.2 Operational Features

1.3.2.1 Operating Modes

The SLM-5650C supports Uncoded, Viterbi, Viterbi+Reed Solomon, Sequential, TPC, and LDPC modes of operation. (STANAG 4486 (EBEM) in fall 2019)

1.3.2.2 Secure Management Interfaces

Chapter 6. MODEM CONFIGURATION

The SLM-5650C supports secure management interfaces, as part of its Management Security option.

Detailed information about these configurations and modes, and their functional association with the Modem, is provided in the following chapters in this manual.

1.3.2.3 Data Interfaces

The SLM-5650C supports only an Ethernet data interface in GigE Bridge mode.

1.3.2.3.1 10/100/1000BASE-T (Gigabit Ethernet)

Chapter 8. 10/100/1000BASE-T (GbE) INTERFACE

The 10/100/1000BASE-T (Gigabit Ethernet, or GbE) interface performs a simple bridge function and passes IP packets, unaltered, in each direction between the Local Area Network (LAN) (10/100/1000BASE-T interface) and Wide Area Network (WAN) (modulator / demodulator).

IP packet traffic is framed via High-level Data Link Control (HDLC) encapsulation by the modem logic, and the modem is both the origination and termination point for HDLC encapsulation. HDLC CRC-16 verification is performed on all received (from WAN) HDLC frames.

1.3.2.4 Independent Tx and Rx Function

The Tx (modulator) and Rx (demodulator) sides of the modem are functionally independent and separately controllable. The baseband Tx and Rx sides of a communication channel passing through the modem are independently configurable, including the ability to select different parameters (to include data rate, coding, modulation, and spreading) in support of asymmetrical operation.

1.3.2.5 Verification

The SLM-5650C includes test modes and loopbacks for rapid verification of the correct functioning of the modem. Of particular note is the IF loopback, which permits the user to perform a quick diagnostic test without having to disturb external cabling. During the loopback, the receive frequency configuration parameter is temporarily changed to match that of the Tx side, and an internal Radio Frequency (RF) switch connects the modulator output to the demodulator input. When normal operation is again selected, all of the previous receive frequency is restored.

1.3.2.6 Updating Modem Firmware

Chapter 4. UPDATE FIRMWARE

The SLM-5650C stores its firmware in flash memory, which allows the modem to upload firmware downloads from an external PC once Ethernet connectivity has been established. Firmware updates may be obtained free from CEFD via e-mail from CEFD Customer Support during normal business hours.

1.3.3 Interoperability

1.3.3.1 Legacy Modems

The SLM-5650C is compatible and interoperable with all specified SLM-5650C modes of operation of the following legacy modems:

- SLM-5650A
- SLM-5650B

The remote control protocol is not backwards compatible.

1.4 Summary of Specifications

Table 1-2. Summary of General Specifications

General Specifications	
Parameter	Specifications
Operating Frequency Range	950 to 2000 MHz (in 1000 Hz steps)
Modulation Types	BPSK, QPSK, OQPSK, 8PSK, 8QAM, and 16QAM
Digital Data Rates	8 kbps with LDPC Spreading ON 32 kbps with LDPC Spreading OFF 64 kbps for all other modes * Maximum data rates are modulation and FEC dependent. Refer to Appendix B.
Symbol Rate Range	14.795 ksps with Spreading ON 32 kbps for all other modes * Maximum symbol rates are modulation and FEC dependent. Refer to Appendix B.
INT REF Stability	6×10^{-8}
Scrambling	V.35 and Synchronous
Built-in Test (BIT)	Fault and status reporting, Bit Error Rate (BER) performance monitoring, IF Loop-back, programmable test modes, built-in Fireberd emulation with all comprehensive BER measurements.
Monitor and Control	EIA-232, 10/100/1000BASE-T Ethernet with HTTP, HTTPS, Telnet, and SNMP

Table 1-3. Summary of Modulator Specifications

Modulator Specifications	
Parameter	Specifications
Output Power	+10 to -40 dBm, adjustable in 0.1 dB steps.
Output Return Loss	-9 dB (L-Band)
Output Impedance	50 Ω
Spurious	From Carrier ± Tx SR TO 500 MHz –51 dBc (measured in a 10 kHz bandwidth).
Harmonics	From Carrier (CW) to the greater of the 12th harmonic or 4000 MHz –60 dBc
Output Connections	Indoor – SMA, Outdoor – “N”-Type
Modulator Spectral Inversion	Modem can invert the modulated spectrum.

Table 1-4. Summary of Demodulator Specifications

Demodulator Specifications		
Parameter		Specifications
Input Power	Desired Carrier	+10 to -55 dBm (SR>3.2 Msps) +10 to $10 \cdot \log_{10}(SR/32000)$ -75 dBM (SR≤3.2 Msps) where SR is in symbols per second
	Maximum Composite	+20 dBm or +40 dBc
Input Impedance		50 Ω
Input Connectors		Indoor – SMA, Outdoor – "N"-Type
Carrier Acquisition Range		± 30 kHz, selectable
Input Return Loss		-9 dB (L-Band)

Table 1-5. Summary of Coding Options

Coding Options	
Parameter	Specifications
Uncoded, Viterbi, Viterbi+RS	Per MIL-STD-188-165A
Sequential	Closed Network
Turbo	TPC
LDPC: ULL, LL, and HP	Closed Network

1.5 Performance

1.5.1 Acquisition and Timing Performance Requirements

The following reference Eb/No is defined as the required Eb/No corresponding to a BER of 1×10^{-3} with Reed-Solomon FEC not enabled.

Table 1-6. Acquisition and Timing Performance Requirements

Parameter	Specification
Initial Acquisition	The modem achieves initial acquisition within the times as specified within ± 30 kHz at the reference Eb/No. • For baseband data rates between 64 kbps and ≤ 128 kbps, the maximum initial acquisition time is 500 seconds. • For baseband data rates between 128kbps and ≤ 1544 kbps, the maximum initial acquisition time is 30 seconds. • For baseband data rates > 1544 kbps, the maximum initial acquisition time is 1.5 seconds.
Reacquisition	Reacquisition is achieved, as follows, after a period of up to 15 minutes of the absence of signal when the carrier returns to within 500 Hz of its original frequency. • For baseband data rates between 64 kbps and 128 kbps, the maximum reacquisition time shall be 45 seconds. • For baseband data rates between 128 kbps and 1544 kbps, the maximum reacquisition time shall be 20 seconds. • For baseband data rates greater than 1544 kbps, the maximum reacquisition time shall be 1 second.
BCI	With Tx and Rx random data, the mean time to loss of BCI due to falsely adding or deleting bits is at least 3 days at the reference Eb/No. In addition, the modem maintains BCI over 50 consecutive bits of all ones or zeros, which occur no more than once in 10,000 bits, without employing data scrambling.
System Retention	Synchronization and BCI are maintained for all Eb/No above the reference Eb/No (BPSK/QPSK/OQPSK/8PSK) for signal loss of up to 50 modulation symbol periods, with a probability of at least 90 percent.
Receive Timing Jitter	The Rx output clock peak timing jitter cannot exceed ± 5 percent at the reference Eb/No when the modulated signal meets the modulation timing jitter requirement.
Doppler	The modem meets the requirements with a Doppler shift, rate of change, and acceleration for satellite inclination up to ± 7° as presented in Table 1-7, and an additional 0.5 dB added to the reference Eb/No.

Table 1-7. Doppler Requirements

Parameter	C-Band	X-Band	Ku-Band	Ka-Band
Doppler Shift in Hz	± 2475	± 3535	± 6045	± 11,810
Doppler Rate of Change in Hz/sec	± 226	± 270	± 490	± 1046
Doppler Acceleration in Hz/sec^2	± 243	± 290	± 526	± 1124

1.5.2 Data Quality Performance

OM-73 Compatible Mode Performance

Operating in the OM-73-compatible mode, the SLM-5650C vs. Eb/No performance with differential encoding and data scrambling enabled does not exceed values shown in Table 1-8 through Table 1-14.

MIL-STD-188-165A Compatible Mode Performance

Operating with BPSK, QPSK, or OQPSK modulation in the MIL-STD-188-165A compatible mode, the SLM-5650C BER vs. Eb/No performance with differential encoding and data scrambling enabled will not exceed values shown in Table 1-8 (without Reed-Solomon) or Table 1-9 (with Reed-Solomon) tested in an IF back-to-back configuration over the BER range 5×10^{-3} to 1×10^{-7}.

Operating with 8PSK modulation and rate 2/3 pragmatic Trellis coding (without Reed-Solomon outer coding), the SLM-5650C vs. Eb/No performance is less than or equal to the values shown in Table 1-10 when tested in an IF back-to-back configuration.

Operating with 8PSK modulation, rate 2/3 pragmatic Trellis coding, and Reed-Solomon (219,201) outer coding, the SLM-5650C vs. Eb/No performance is better than or equal to the values shown in Table 1-11 when tested in an IF back-to-back configuration.

IESS-308 Compatible Mode Performance

When operating in the IESS-308 Compatible Mode, the SLM-5650C BER vs. Eb/No performance is as specified in IESS-308.

IESS-309 Compatible Mode Performance

When operating in the IESS-309 Compatible Mode, the SLM-5650C BER vs. Eb/No performance is as specified in IESS-309.

IESS-310 Compatible Mode Performance

When operating in the IESS-310 Compatible Mode, the SLM-5650C BER vs. Eb/No performance is as specified in IESS-310.

16QAM Coding Mode Performance

The SLM-5650C operating in the 16QAM mode provides back-to-back BER vs. Eb/No performance better than or equal to the values shown in Table 1-12 when using the modulation formats indicated.

Turbo Coding Mode Performance

The SLM-5650C operating in the Turbo Code Mode provides back-to-back BER vs. Eb/No performance better than or equal to the values shown in Table 1-13 when using the modulation formats indicated.

Sequential Mode Performance

The SLM-5650C operating in the Sequential Mode provides back-to-back BER vs. Eb/No performance better than or equal to the values shown in Table 1-14 when using the modulation formats indicated.

LDPC Coding Mode Performance

The SLM-5650C operating in an LDPC Mode provides back-to-back BER vs Eb/No performance better than or equal to the values shown in Table 1-11 through 1-13 when using the indicated block size and modulation formats.

1.6 BER Performance

BPSK/QPSK/Offset QPSK, Viterbi Decoding

Table 1-8. Viterbi Decoder BER

E_b/N_o (dB) Specifications Viterbi Decoder				
BER	1/2	3/4	7/8	Uncoded
10^{-3}	3.8	5.0	6.3	
10^{-4}	4.7	5.9	7.1	
10^{-5}	5.3	6.6	7.8	10.8
10^{-6}	5.9	7.2	8.4	11.6
10^{-7}	6.5	7.8	9.0	12.4
10^{-8}	7.1	8.3	9.5	13.0

BPSK/QPSK/Offset QPSK, Viterbi Decoding and Reed-Solomon

Table 1-9. BSPK/QPSK/OQPSK Viterbi with Reed-Solomon Decoder BER Performance

E_b/N_o (dB) Specifications Viterbi Decoder with Reed-Solomon			
BER	1/2	3/4	7/8
10^{-6}	4.1	5.6	6.7
10^{-7}	4.4	6.0	7.1
10^{-8}	5.0	6.3	7.5

8PSK, Trellis Decoder

Table 1-10. 8PSK, Trellis Decoder BER Performance

E_b/N_o (dB) Specifications Trellis Decoder		
BER	2/3	5/6
10^{-3}	6.5	8.7
10^{-4}	7.3	9.4
10^{-5}	8.1	10.1
10^{-6}	8.9	10.8
10^{-7}	9.6	11.6
10^{-8}	10.2	12.3

8PSK, Trellis Decoder and Reed-Solomon

Table 1-11. 8PSK, Trellis Decoder with Reed-Solomon BER Performance

E_b/N_o (dB) Specifications Trellis Decoder with Reed-Solomon		
BER	2/3	5/6
10^{-6}	6.2	8.2
10^{-7}	6.5	8.5
10^{-8}	6.7	8.9
10^{-9}	6.9	9.3
10^{-10}	7.2	9.7

16QAM, Viterbi Decoder and Reed-Solomon

Table 1-12. 16QAM, Viterbi Decoder with Reed-Solomon BER Performance

E_b/N_o (dB) Specifications Viterbi Decoder with Reed-Solomon		
BER	3/4	7/8
10^{-6}	8.2	9.5
10^{-7}	8.4	9.8
10^{-8}	8.6	10.1
10^{-9}	8.8	10.3
10^{-10}	9.0	10.6

Turbo Product Code (TPC) Decoding

Table 1-13. TPC Decoder BER Performance

E_b/N_o (dB) Specifications Turbo Product Code Decoder											
BER	BPSK		QPSK/OQPSK				8PSK			16QAM	
	21/44	5/16	21/44	3/4	7/8	17/18	3/4	7/8	17/18	3/4	7/8
10^{-6}	3.3	2.5	3.3	3.9	4.3	6.8	6.5	7.1	10.0	7.6	8.2
10^{-7}	3.4	2.8	3.4	4.1	4.4	7.1	6.9	7.2	10.6	8.0	8.4
10^{-8}	3.5	3.1	3.5	4.3	4.5	7.4	7.2	7.3	11.2	8.4	8.5

Sequential Decoding with / without Reed-Solomon

Table 1-14. Sequential Decoding with / without Reed-Solomon BER Performance

E_b/N_o (dB) Specifications Sequential Decoder with / without Reed-Solomon					
DESCRIPTION	BER	BPSK	QPSK/OQPSK		
		1/2	1/2	3/4	7/8
Sequential – 64 kbps	10^{-5}	4.8	4.8	5.8	7.0
	10^{-6}	5.2	5.2	6.4	7.5
	10^{-7}	5.6	5.6	6.9	8.0
Sequential – 1544 kbps	10^{-5}	5.2	5.2	5.9	7.2
	10^{-6}	5.7	5.7	6.5	7.7
	10^{-7}	6.1	6.1	7.0	8.3
Sequential+RS (225,205)	10^{-6}	4.4	4.4	5.0	5.6
	10^{-7}	4.6	4.6	5.3	6.0
	10^{-8}	4.8	4.8	5.6	6.4

LDPC ULL Decoding

Table 1-15. LDPC ULL Decoder BER Performance

E_b/N_o (dB) Specification				
BER	BPSK	QPSK		
	1/2	1/2	2/3	3/4
10^{-5}	3.1	3.1	3.6	4.1
10^{-6}	3.3	3.3	3.8	4.3
10^{-7}	3.5	3.5	4.0	4.5
10^{-8}	3.7	3.7	4.2	4.7

LDPC LL Decoding

Table 1-16. LDPC LL Decoder BER Performance

E_b/N_o (dB) Specification													
BER	BPSK			QPSK				8QAM			16QAM		
	.378	.451	.541	1/2	2/3	3/4	7/8	2/3	3/4	7/8	2/3	3/4	7/8
10^{-5}	1.8	2.0	2.2	2.4	3.0	3.6	4.4	5.0	5.6	6.6	6.1	6.8	8.0
10^{-6}	1.9	2.1	2.3	2.5	3.1	3.7	4.5	5.1	5.7	6.7	6.2	6.9	8.1
10^{-7}	2.0	2.2	2.4	2.6	3.2	3.8	4.7	5.2	5.8	6.8	6.3	7.0	8.2
10^{-8}	2.1	2.3	2.5	2.7	3.3	3.9	4.9	5.3	5.9	7.0	6.4	7.1	8.3

LDPC HP Decoding

Table 1-17. LDPC HP Decoder BER Performance

E_b/N_o (dB) Specification								
BER	BPSK		(O)QPSK			8QAM		16QAM
	1/3	1/2	1/2	2/3	3/4	2/3	3/4	3/4
10^{-5}	2.0	2.0	2.0	2.4	3.0	4.7	5.7	6.8
10^{-6}	2.1	2.1	2.1	2.5	3.1	4.8	5.8	6.9
10^{-7}	2.2	2.2	2.2	2.6	3.2	4.9	5.9	7.0
10^{-8}	2.3	2.3	2.3	2.7	3.3	5.0	6.0	7.1

BER Performance with Adjacent Carriers

The SLM-5650C modem performance when operating with adjacent carriers complies with MIL-STD-188-165A interface standard, Interoperability of SHF Satellite Communications PSK Modems (FDMA Operation)

BLANK PAGE

Chapter 2. INSTALLATION

2.1 Installation

PROPER HEAT SINKING IS REQUIRED.

For the indoor unit, make sure there is adequate heat sinking to the modem enclosure.

Temperature at the modem enclosure should never exceed 50°C (122°F).

Installation of the SLM-5650C indoor unit depends heavily on its use scenario. The modem may be installed in any orientation. There are mounting ears on both sides of the modem enclosure, with four threaded holes on the top/bottom and five on the side of each ear. There are also four through-holes in the body of the enclosure. See Figure 1-4 for mounting hole locations.

The threaded mounting holes are #6-32. At least 0.25 inches of thread should be engaged for mounting. The through-holes are sized for #8 hardware.

Critical items to consider when designing the installation are:

- Drawing heat away from the modem. This can be done by providing airflow across the modem or by mounting the modem to a cooler metal surface, or both.
- The mounting method should be designed considering the expected shock and vibration environment.

2.2 Connect External Cables

Chapter 3. EXTERNAL CONNECTORS AND PINOUTS

Connect the cables to the proper connectors on the modem housing.

2.3 Connect Power Supply

Chapter 3. EXTERNAL CONNECTORS AND PINOUTS

Connect the direct current (DC) power cable to the proper location on the modem by inserting the jack and threading the sleeve into the housing. A non-threaded connector may also be used.

2.4 Configuration

If there is any problem with installation or initial operation, read Appendix A. TROUBLESHOOTING for possible solutions.

Chapter 1. INTRODUCTION

All configurations are implemented locally via the unit's loaded firmware.

Step	Task
1	Read Chapter 1. INTRODUCTION before continuing.
2	Connect the power cable.
3	Turn power ON.
4	Do a check for the correct transmitter (Tx) and receiver (Rx) output signal levels and spectrums.
5	Use the modem web page to configure the unit.

2.5 Determine the Modem IP Address

Step	Task
1	Connect the serial port of the modem to the serial port of a computer. The minimum pins needed are 1, 2, & 3.
2	Open up a terminal session using an application like Putty or Tera Term.
3	Modify the following parameters: a. Emulation: VT100 b. Tx: CR+LF c. Local Echo: yes d. Baud rate: 115200 The modem is hard coded for this rate. e. Data: 8 bit f. Parity: None g. Stop: 1 h. Flow Control: None
4	Change the modems IP address. Enter the following commands: a. What is the IP Address?: • Input: <0/IPA? Displays: >0000/IPA=192.168.001.011.24 b. Change the IP address: • Input the new IP address: <0/IPA=192.168.001.021.24 c. Confirm IP address: • Input: <0/IPA? Displays: >0000/IPA=192.168.001.021.24
5	Verify high security setting for SNMP V3 is turned OFF. Enter the following commands: a. What is the current setting for Modem Interface Security Mode? • Input: <0/MIS? Displays: >0000/MIS=0 - or - Displays: >0000/MIS=1 b. If set to '1' (security mode ON), change the >0000/MIS= to '0' (security mode OFF).

BLANK PAGE

Chapter 3. EXTERNAL CONNECTORS AND PINOUTS

3.1 Overview

The SLM-5650C Indoor Unit connectors (Figure 3-1) provide all necessary external connections between the modem and other equipment. Table 3-1 summarizes the connectors, grouped according to service function. Note that the indoor unit does not support an On/Off switch.

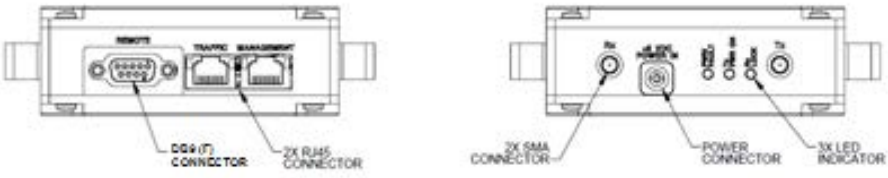


Figure 3-1. SLM-5650C Indoor Unit Connectors

The SLM-5650C Outdoor Unit connectors (Figure 3-2) provide all necessary external connections between the modem and other equipment. Table 3-1 summarizes the connectors, grouped according to service function. The outdoor unit is equiped with an On/Off switch with built-in Status Light Emmitting Diode (LED).

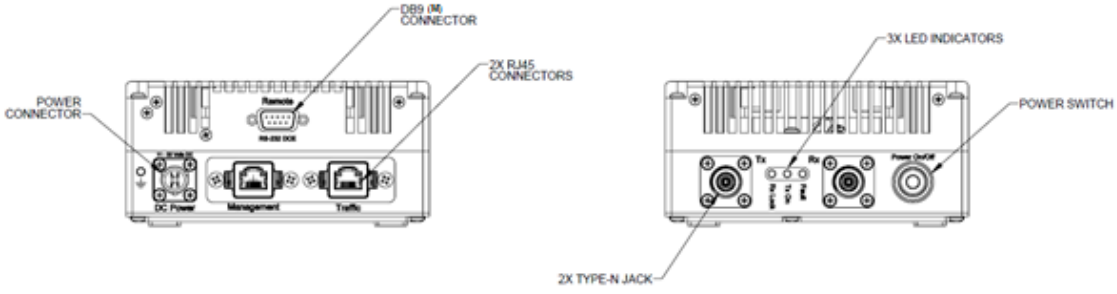


Figure 3-2. SLM-5650C Outdoor Unit Connectors

Table 3-1. SLM-5650C Indoor Unit Connectors

Connector Group	Name	Connector Type	Function
IF (Sect. 3.2)	Tx	Type 'SMA' female (L-Band)	IF Output
	Rx	Type 'SMA' female (L-Band)	IF Input
Terrestrial Data (Sect. 3.3)	MANAGEMENT	RJ-45 female	10/100Base-T, Remote Control
	TRAFFIC	RJ-45 female	10/100/1000Base-T
Utility (Sect 3.4)	REMOTE	9-pin Type 'D' female[2]	Serial Remote Interface (RS232), Analog AGC Voltage, and Constellation Monitor
Power/Ground (Sect. 3.5)	+5 VDC POWER IN	Coaxial 5.5mm/2.5mm DC Power Jack	Modem Power

The DB9 connector provided on the rear panel features threaded nuts to ensure the mechanical integrity of the mated connections.

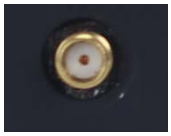
Table 3-2. SLM-5650C Outdoor Unit Connectors

Connector Group	Name	Connector Type	Function
IF (Sect. 3.2)	Tx	"N"-Type female (L-Band)	IF Output
	Rx	"N"-Type female (L-Band)	IF Input
Terrestrial Data (Sect. 3.3)	MANAGEMENT	RJ-45 female	10/100Base-T, Remote Control
	TRAFFIC	RJ-45 female	10/100/1000Base-T
Utility (Sect 3.4)	REMOTE	9-pin Type 'D' male	Serial Remote Interface (RS232), Analog Automatic Gain Control (AGC) Voltage, Summary Alarm, External Mute and Constellation Monitor
Power/Ground (Sect. 3.5)	+11 VDC to +33 VDC POWER IN	4-pin Mil-circular	Modem Power

The DB9 connector provided on the rear panel features threaded nuts to ensure the mechanical integrity of the mated connections.

3.2 IF Connectors

3.2.1 Indoor Unit Tx, Rx L-Band IF Interface Connectors



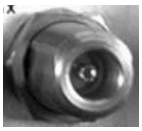
The L-Band IF Interfaces use standard 50 Ω Type ‘SMA’ female connectors:

Table 3-3. Indoor Unit L-Band IF Interface Connectors

L-Band IF Connector	Description	Direction
Tx	950-2000 MHz Transmit	Output
Rx	950-2000 MHz Receive	Input

Note: The RF spectrum must fit within the L-Band range.

3.2.2 Outdoor Unit Tx, Rx L-Band IF Interface Connectors



The L-Band IF Interfaces use standard 50 Ω “N”-Type female connectors:

Table 3-4. Outdoor Unit L-Band IF Interface Connectors

L-Band IF Connector	Description	Direction
Tx	950-2000 MHz Transmit	Output
Rx	950-2000 MHz Receive	Input

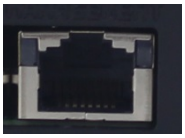
Note: The RF spectrum must fit within the L-Band range.

3.3 Terrestrial Data Connectors

3.3.1 Ethernet Traffic Connector (RJ-45)

The Traffic Ethernet connection is an 8-pin type ‘RJ-45’ 10/100/1000Base-T connector and functions as an Ethernet bridge for data traffic. Auto Negotiate only.

3.3.2 Ethernet Management Connector (RJ-45)



The Management Ethernet connection is an 8-pin type 'RJ-45' 10/100/1000Base-T connector. Remote control of the modem is provided using SNMP, HTTP/HTTPS or Telnet with this port. Auto Negotiate only.

3.4 Utility Connectors

Note that the pinout for the DB9 utility connector is NOT the same for the indoor and outdoor units.

3.4.1 Indoor Unit Remote Connector (DB9)

This is a female Type 'D' 9-pin subminiature (DB9) connector that serves multi-purpose roles. It provides RS-232 communications for a remote terminal, it provides a means to monitor the real time I and Q samples from the demodulator (constellation monitor), and it provides a receive signal strength indicator that can be used to aid in peaking an antenna.

The DB9 connector is not a standard RS-232 serial port pinout.

Table 3-5. Indoor Unit Remote Connector (DB-9F) Pinout

Pin #	Signal Function	Name
7	Not Connected	NC
3	Receive Data (RS232 input)	RD
8	Receive I Channel Constellation Monitor	RXI_MON
1	GROUND	GND
6	Not Connected	NC
2	Transmit Data (RS232 output)	TD
4	Receive Q Channel Constellation Monitor	RXQ_MON
9	Not Connected	NC
5	AGC Monitor (0 to 5V)	AGC_MON_OUT

3.4.2 Outdoor Unit Remote Connector (DB9)

This is a male Type 'D' 9-pin subminiature (DB9) connector that serves multi-purpose roles. It provides RS-232 communications for a remote terminal, it provides a means to monitor the real time I and Q samples from the demodulator (constellation monitor), and it provides a receive signal strength indicator that can be used to aid in peaking an antenna.

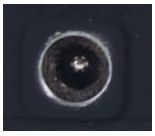
The DB9 connector is not a standard RS-232 serial port pinout.

Table 3-6. Outdoor Unit Remote Connector (DB-9F) Pinout

Pin #	Signal Function	Name
7	Receive I Channel Constellation Monitor	RXI_MON
3	Receive Data (RS232 input)	RD
8	Summary Fault (NO FAULT – Normally Closed)	SUMMARY FAULT - NC
1	AGC Monitor (0 to 5V)	AGC
6	External Mute	EXT MUTE
2	Transmit Data (RS232 output)	TD
4	Receive Q Channel Constellation Monitor	RXQ_MON
9	Summary Fault (FAULT – Normally Open)	SUMMARY FAULT - NO
5	GROUND	AGC_MON_OUT

3.5 Power/Ground Connector

3.5.1 Indoor Unit DC Power Connector



A standard coaxial connector supplies DC power to the modem. The enclosure is threaded to accept a threaded connector sleeve for retention purposes. An non-threaded installation may also be used. See Table 3-7 for specifications.

Table 3-7. Indoor Unit Power Connector

DC Voltage	5V Nominal, 6V maximum
Input Current	6A maximum
Connector Type	Coaxial 5.5mm/2.5mm DC Power Jack (CUI Inc. PP3-002BH), enclosure threaded for retention

3.5.2 Outdoor Unit DC Power Connector

A MIL-C-26482 series circular poer receptacle, Male, 4 Pin connector provide the input for the +11 VDC to +33 VDC input voltage. See Table 3-8 for specifications.

Table 3-8. Outdoor Unit Power Connector

DC Voltage	11 VDC to 33 VDC
Input Current	2.7A maximum
Connector Type	Outdoor Mil-C-26482 series circular poer receptacle, Male, 4 Pin

Table 3-9. Outdoor Unit Power Connector Pinout

Pin #	Signal Function	Range
A	DC Voltage Psostive	+11 VDC to +33 VDC
B	DC Voltage Psostive	+11 VDC to +33 VDC
C	Ground	
D	Ground	

BLANK PAGE

Chapter 4. UPDATE FIRMWARE

4.1 Updating Firmware

To ensure optimal performance, it is important to operate the SLM-5650C with its latest available firmware.

The modem must be in the Low Security mode (SNMP Type = SNMPV1V2c) in order to update firmware.

The SLM-5650C stores its firmware internally in flash memory, which simplifies the firmware updating process. The firmware update, once acquired, can be transferred from an external user PC once Ethernet connectivity has been established with the modem.

This chapter outlines the complete firmware updating process as follows:

- Perform the update, without opening the SLM-5650C, by connecting the unit to the Ethernet port of the user PC.
- Obtain the firmware update via email from customer support and extract it to the user PC.
- Transfer the firmware update, via File Transfer Protocol (FTP), from the user PC to the SLM-5650C.

4.1.1 About Firmware Files, Naming, and Versions

The SLM-5650C is factory-shipped with the latest version of operating firmware. If a firmware update is needed, it can be acquired from CEFD Customer Support during normal business hours via e-mail or on CD by standard mail delivery.

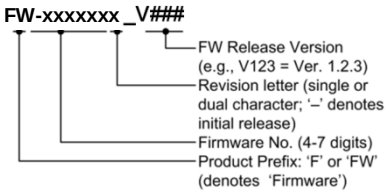


Figure 4-1. Firmware Naming Format

4.2 Obtain Modem IP Address

Chapter 7. REMOTE CONTROL

If the SLM-5650C IP Address is known, continue to Section 4.3. Otherwise, do the following:

1. Connect the user PC to the SLM-5650C serial remote port using the appropriate adapter.
2. Open a terminal emulator application such as Putty or TeraTerm.
3. Establish a connection to the modem using the appropriate RS232 port configured for 115200 baud, 8 data bits, no parity, and 1 stop bit.
4. Issue the IPA remote command, see **Chapter 7. REMOTE CONTROL** for command syntax.
5. Open a DOS command window on the user PC and “ping” the modem using the IP Address returned in step 4. Syntax is “ping xxx.xxx.xxx.xxx”.
6. Issue the MIS remote command, see **Chapter 7. REMOTE CONTROL** for command syntax.
7. If Secure mode is ON, turn it OFF using the MIS command, and reboot the modem.
8. Establish an HTTP connection to the modem using the IP Address returned in step 4.

4.3 Bulk Firmware Update – Ethernet FTP Upload Procedure

Chapter 6. MODEM CONFIGURATION

Refer to **Chapter 6. MODEM CONFIGURATION, Section 6.4.2.3 Admin | Upgrade** for instructions on how to upgrade the bulk firmware.

Chapter 5. ETHERNET-BASED MANAGEMENT

5.1 Introduction

The SLM-5650C Satellite Modem features an RJ-45 10/100/1000Base-T Ethernet management interface for the purpose of remote monitor and control (M&C) of the modem. This port operates in the Auto-Negotiation and Auto-Crossover mode.

5.2 Ethernet Management Interfaces & Protocols

A Windows-based user PC facilitates Ethernet-based remote M&C of the SLM-5650C through the following management protocols:

- **Web Server (HTTP or HTTPS) Interface.** The non-secure (HTTP) or secure (HTTPS) interface requires a compatible user-supplied web browser such as Internet Explorer, FireFox, or Google Chrome.
- **Simple Network Management Protocol (SNMP) with Public and Private Management Information Base (MIB).** The non-secure (SNMPv1/v2c) or secure (SNMPv3) interface requires a user-supplied Network Management System (NMS) or a user-supplied Management Information Base (MIB) File Browser.
- **Telnet Interface.** This non-secure Modem interface requires use of the user PC's Command-line interface, or a user-supplied terminal emulation program such as Tera Term.

5.2.1 Secure Ethernet Management Interfaces

The varying degrees of Ethernet Management are dependent on the modem configuration.

- When Management Security is **disabled** (i.e., **SNMPv1/v2c** is selected).
  - HTTP may be used.
  - Telnet protocol may be used.
  - FTP protocol may be used for firmware upgrade or Secure Socket Layer (SSL) certificate upload.
  - SNMP v1/v2c protocol may be used.
- When Management Security is **enabled** (i.e., **SNMPv3** is selected).
  - HTTPS protocol may be used.
  - Telnet protocol is disabled.
  - FTP protocol is disabled.
  - SNMP v3 protocol may be used.

5.3 HTTP/HTTPS (Web Server) Interfaces

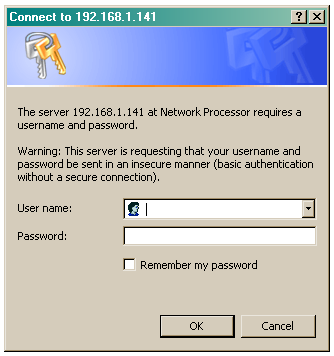
Chapter 6. MODEM CONFIGURATION

Chapter 4. UPDATE FIRMWARE

The SLM-5650C embedded Web Server application provides the user with an easy to use interface to configure and monitor all aspects of the modem. The SLM-5650C modem HTTP/HTTPS Interface requires Microsoft's Internet Explorer 7.0 (or higher) and Mozilla Firefox 2.0 (or higher), via HTTP or HTTPS (depending on the modem's security level setting). See **Chapter 6. MODEM CONFIGURATION.**

All Web Server Interfaces are accessible by typing (depending on the interface and/or management mode) "*http://xxx.xxx.xxx.xxx*" or "*https://xxx.xxx.xxx.xxx*" into the browser's **Address** box (where "*xxx.xxx.xxx.xxx*" is the IP address of the modem or optional installed interface). See **Chapter 4. UPDATE FIRMWARE, Sect. 4.2** for instructions on how to obtain the IP address.

For all interfaces, the user is prompted to type in a valid **User name** and **Password**, whether via an integrated Web page or a dialog box similar to the one shown to the right. For all interfaces, the default for both is **comtech**.



5.4 SNMP Interface

The SNMP is an Internet-standard protocol for managing devices on IP networks. An SNMP-managed network consists of three key components:

- **The managed device.** This includes the SLM-5650C Satellite Modem.
- **The SNMP Agent.** The software that runs on the SLM-5650C. The SLM-5650C SNMP Agent supports **SNMPv1**, **SNMPv2c**, and **SNMPv3**.
- **The user-supplied Network Management System (NMS).** The software that runs on the manager.

5.4.1 Management Information Base (MIB) Files

MIB files are used for SNMP remote management of a unique device. A MIB file consists of a tree of nodes called Object Identifiers (OIDs). Each OID provides remote management of a particular function. These MIB files should be compiled in a user-supplied MIB Browser or SNMP Network Monitoring System server.

The following MIB files are associated with the SLM-5650C:

MIB File/Name ('x' indicates revision letter)	Description
Fwxxxxx-xx.mib ComtechEFData MIB file	CEFD MIB file gives the root tree for ALL CEFD products and consists of only the following OID: Name: comtechEFData Type: MODULE-IDENTITY OID: 1.3.6.1.4.1.xxxx Full path: iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).comtechEFData(xxxx) Module: ComtechEFData
FW-xxxxxxxx_vYYY.MIB SLM-5650C OID MIB File	MIB file consists of all of the OID's for management of the modem functions.
FW-xxxxxxxx_vYYY.MIB SLM-5650C Traps MIB file	Trap MIB file is provided for SNMPv1 traps common for base modems.

5.4.2 SNMP Community Strings

In SNMP v1/v2c, the SNMP Community String is sent unencrypted in the SNMP packets. Caution must be taken by the network administrator to ensure that SNMP packets travel only over a secure and private network if security is a concern.

The SLM-5650C uses Community Strings as a password scheme that provides authentication before gaining access to the modem agent's MIBs. They are used to authenticate users and determine access privileges to the SNMP agent.

Type the SNMP Community String into the user-supplied MIB Browser or Network Node Management software.

The user defines three Community Strings for SNMP access:

- Read Community default = public
- Write Community default = private
- Trap Community default = comtech

Note: Maximum number of characters for community strings shall not exceed 20. All printable ASCII characters, except '\' and '~' are allowed. No trailing spaces for community strings.

For proper SNMP operation, the SLM-5650C MIB files must be used with the associated version of the SLM-5650C modem firmware.

5.4.3 SNMP Traps

These include unit faults, TX faults, and RX faults. A trap is sent both when a fault occurs and is cleared.

The "**Traps"** file only needs to be compiled if **SNMPv1** traps are to be used. Which style of traps the modem sends can be configured by the user using the SLM5650CSNMPTrapVersion OID.

The modem supports the following MIB2 SNMPv1traps / SNMPv2 notifications:

MIB2 SNMPv1 trap: Authentication Failure	5
MIB2 SNMPv2 notifications: Authentication Failure	1.3.6.1.6.3.1.1.5.5

The modem supports the following Alarms and Faults SNMPv1 traps / SNMPv2 notifications:

Table 5-1. Alarms and Faults SNMPv1 Traps

slm5650UnitAlarmV1	62471211
slm5650TxTrafficAlarmV1	62471212
slm5650RxTrafficAlarmV1	62471213

Table 5-2. Alarms and Faults SNMPv2c/SNMPv3 Notification

slm5650UnitAlarmV2	1.3.6.1.4.1.6247.121.2.1.1
slm5650TxTrafficAlarmV2	1.3.6.1.4.1.6247.121.2.1.2
slm5650RxTrafficAlarmV2	1.3.6.1.4.1.6247.121.2.1.3

5.5 Telnet Interface

Chapter 7. REMOTE CONTROL

A Telnet interface is provided for the purpose of Equipment M&C via the standard Remote Control protocol. The Telnet interface requires login at the ***Administrator*** and ***Read/Write*** User Access Levels.

An example of the login process is shown below.

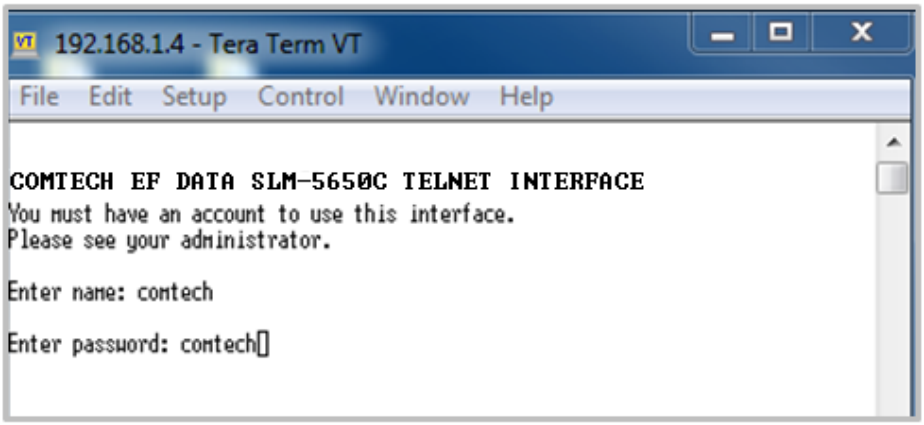


Figure 5-1. Telnet Login Screen

Once logged into the Telnet interface, the standard remote control interface (as defined in **Chapter 7. REMOTE CONTROL**) is accessible as shown in this next example:

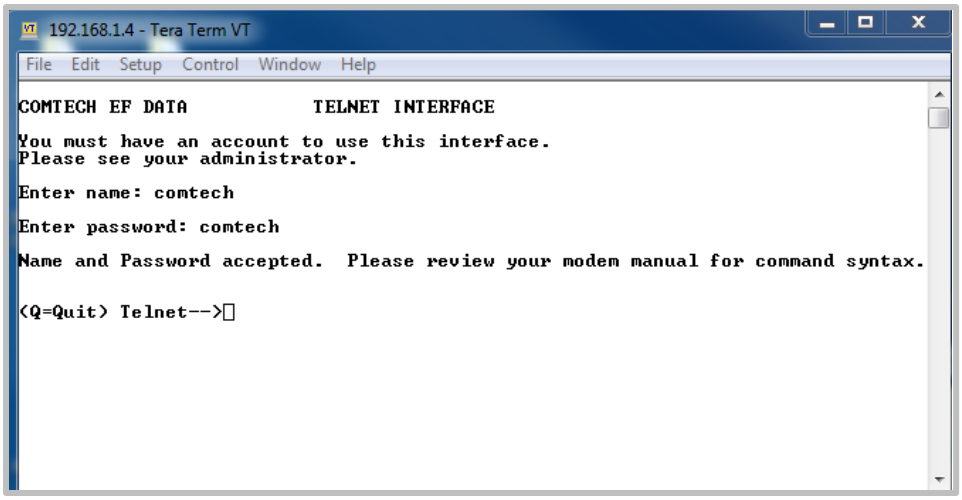


Figure 5-2. Telnet Remote Control Interface

Chapter 6. MODEM CONFIGURATION

6.1 HTTP/HTTPS Interface

This chapter describes the functionality of the SLM-5650C Modem's HTTP/HTTPS Interface. The operational parameters are available from these web pages.

6.2 Modem Web Page Access

Chapter 7. REMOTE CONTROL

A user-supplied web browser allows the full M&C of the SLM-5650C from its Modem Web Interface. The SLM-5650C embedded web applications are designed for, and work best with, Microsoft's Internet Explorer Version 7.0 or higher.

See the Remote Commands Specifications tables found in **Chapter 7. REMOTE CONTROL** for detailed descriptions of the configuration parameters featured on the individual web pages shown in this chapter.

6.2.1 User Login

Chapter 2. INSTALLATION

All Web Server Interfaces are accessible by typing (depending on the interface and/or management mode) "*http://xxx.xxx.xxx.xxx*" or "*https://xxx.xxx.xxx.xxx*" into the browser's **Address** box (where "*xxx.xxx.xxx.xxx*" is the IP address of the modem. See **Chapter 2. INSTALLATION, Sect. 2.5** for instructions on how to obtain the IP address.

Figure 6-1. Browser Address Box

For all interfaces, the Windows Security screen appears and the user is prompted to type in a valid **User name** and **Password**, whether via an integrated Web page or a dialog box like the one shown to the right. For all interfaces, the default for both is **comtech**.

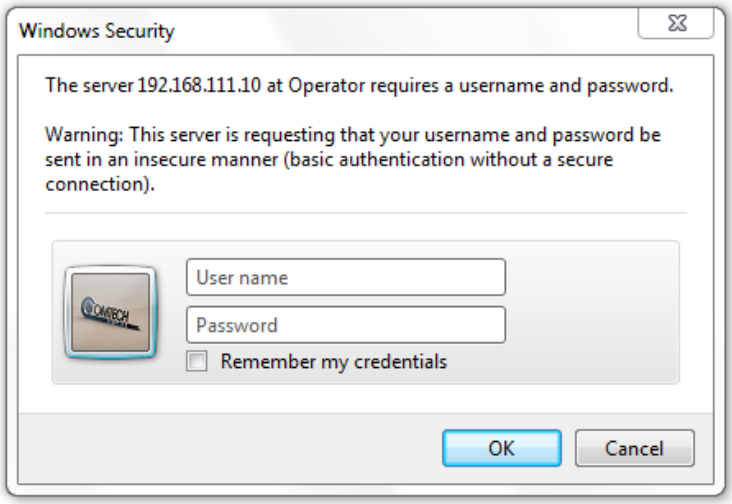


Figure 6-2. Windows Security Screen

Once the valid **User name** and **Password** is accepted, the browser window displays the SLM-5650C Base Modem Web Interface Home page:

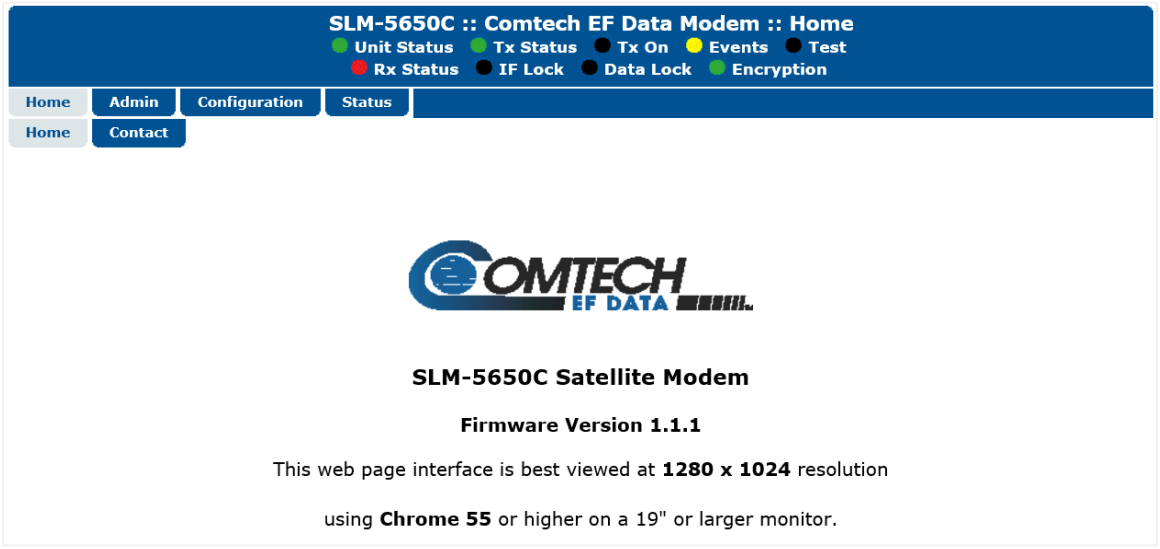


Figure 6-3. Web Interface Home Page

6.2.2 Web Interface – Operational Features

6.2.2.1 Navigation

This manual uses a naming format for all web pages to indicate the depth of navigation needed to view the referenced page: "**Top Level Tab | 2nd Level Tab**."

For example: "**Admin | Access**" is interpreted to mean first click the top-level '**Admin**' navigation tab; and then click the '**Access**' Page tab.

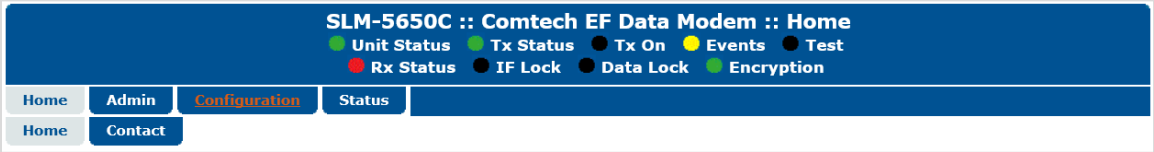


Figure 6-4. Navigation Tab Examples

6.2.2.2 Web Page Tabs

Chapter 7. REMOTE CONTROL

Each page is divided into one or more operational content tabs.

This manual explains the purpose and operation for each web page on a per-page basis. For detailed information. **See Chapter 7. REMOTE CONTROL.**

6.2.2.3 Execution Buttons

Configuration changes generally do not take effect until a selection has been saved to non-volatile memory. There may be one execution button per page or multiple execution buttons within a page section. The label for each of these buttons is generally self-explanatory, e.g., **[Submit]**, **[Clear]**, **[Refresh**], etc.

All execution buttons serve the same purpose – to save the configuration changes to non-volatile memory, or to execute an update of the active page display.

Always make sure to click the execution button before selecting another web page. Any changes made on that previous page will not be saved if the execution button for those functions is not clicked.

6.2.2.4 Feature Selection

Drop-down menus provide access to multiple setting selections, where available, for a specific function. Move the cursor to the drop-down tab, and then left-click the tab. The drop-down will open and list the available selections. Move the cursor to the desired choice and then left-click once again to select that choice.

6.2.2.5 Text or Data Entry

Text boxes are provided any time an alphanumeric entry is required for access or configuration.

Move the cursor to the text box, and then left-click anywhere inside the box. Then, use the keyboard to type in the desired alphanumeric string. Press **Enter** when done.

6.2.3 Web Interface Menu Tree

The following menu tree illustrates the options available via the Modem Web Interface:

Home	Admin	Configuration	Status
Home	Access	Modem	Status
Contact	SNMP	Utils	Info
	Upgrade	LoadStore	EventLog
		Spreading	ModemStatistics
		AUPC	PortStatistics
		ODU	ConfigLog
		TRANSEC	Firmware

This interface provides access to four navigation tabs (shown in blue):

- Home
- Admin
- Configuration
- Status

Beyond this top-level row of navigation tabs, the diagram illustrates the available 2nd level tabs (shown in grey) that afford more specific user functionality.

Click any tab to continue.

6.3 HTTPS Certificate

The SLM-5650C Firmware has a default HTTPS Certificate installed. The default certificate is a self-signed certificate built with the modem's default IP Address of 192.168.1.1 with a one-year expiration date. Since most modern web browsers will flag certificate errors and may not even allow secure connections when errors exist, most users will want to load their own certificate. An X509 private key and certificate in Privacy-enhanced Electronic Mail (PEM) format may be loaded as follows:

1. Make sure that the modem is in Non-Secure Mode (SNMPv1/v2c is selected).
2. Open a "My Computer" (Windows Explorer, not Internet Explorer) window on the PC.
3. Open a web browser and browse to the modem's **Admin | Upgrade** web page.
4. Copy the Uniform Resource Locator (URL) shown under paragraph 2. on that page into the address bar of the "My Computer" (Windows Explorer, not Internet Explorer) window and press **Enter**.
5. Windows Explorer will open an FTP connection the the modem and display a directory list with a single entry that says "README.TXT".
6. Open another "My Computer" (Windows Explorer, not Internet Explorer) window and navigate to the directory that includes the ".PEM" file. The first eight characters of the ".PEM" file must contain the letters "**5650C"**.
7. Click on the file and drag it to the "My Computer" (Windows Explorer, not Internet Explorer) window that displays the "README.TXT" and drop it in.
8. The modem will extract the key and certificate information and delete the ".PEM" file from the directory.
9. Browser to the **Status | Info** web page and check the 20 byte SSL Certificate Fingerprint (sometimes called the Thumbprint) shown there with the user certificate's fingerprint.

The user may now enable Secure Mode (SNMPv3 is selected), and reboot the modem.

Should a bad certificate get installed and HTTPS access is lost, do the following:

1. Connect a user PC to the modem's serial remote interface.
2. Open a terminal program (such as PUTTY or TeraTerm) and establish a connection to the SLM-5650C. RS232 settings are 115200 baud, 8 data bits, no parity, 1 stop bit.
3. Change the modem from Secure mode to Non-Secure mode using the MIS serial command. See **Chapter 7. REMOTE CONTROL** for command syntax.
4. Reboot the modem.
5. Follow the procedure above to load another certificate.

6.4 Modem Web Interface Page Descriptions

6.4.1 Home Page

Select the **Home** tab to continue.

6.4.1.1 Home | Home

From any location within the SLM-5650C Modem Web Interface, click the **Home** top navigation tab to return back to this top-level page. Use this page to identify the product and its current operating firmware version.

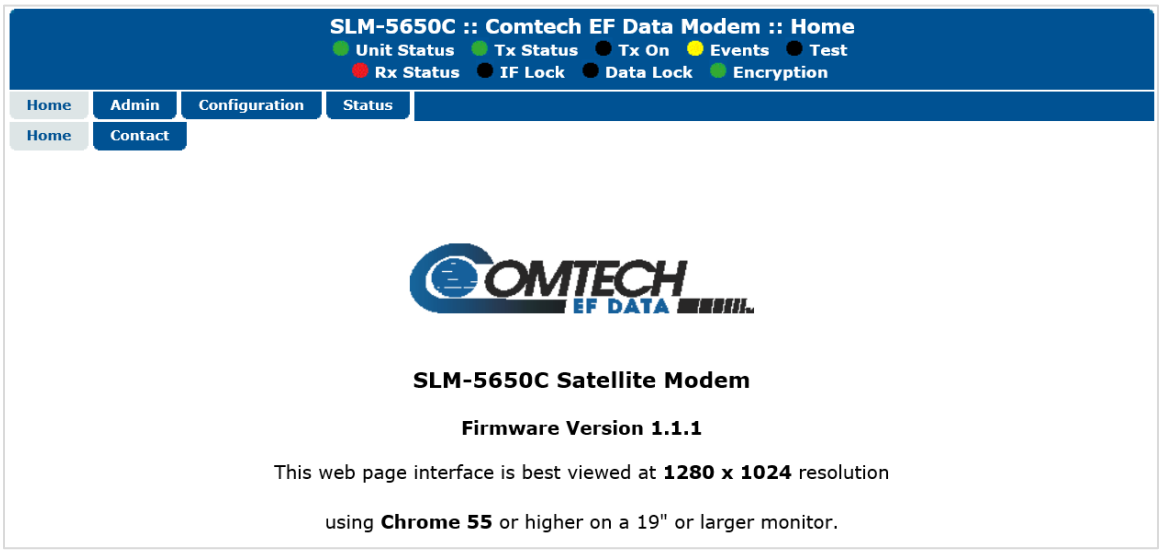


Figure 6-5. Home | Home Page

6.4.1.2 Home | Contact

The Contact page provides information on how to contact CEFD for sales or service support.

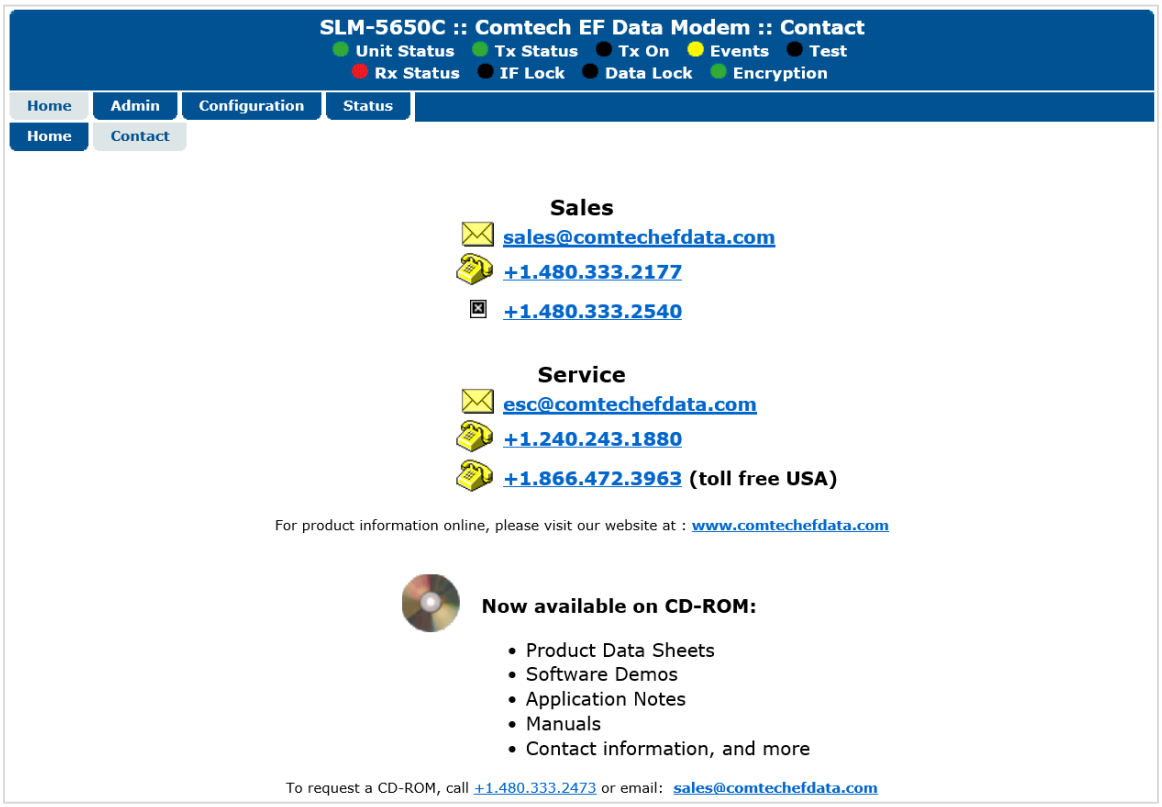


Figure 6-6. Home | Contact Page

6.4.2 Admin Pages

The Administrator may use these pages to: Set up user names, passwords, and the host IP Addresses, as required, to communicate with the SLM-5650C Modem Web Interface.

The Admin pages are available only to users who have logged in using the Administrator Name and Password.

Click the **Access** or **Remote** hyperlink to continue.

6.4.2.1 Admin | Access

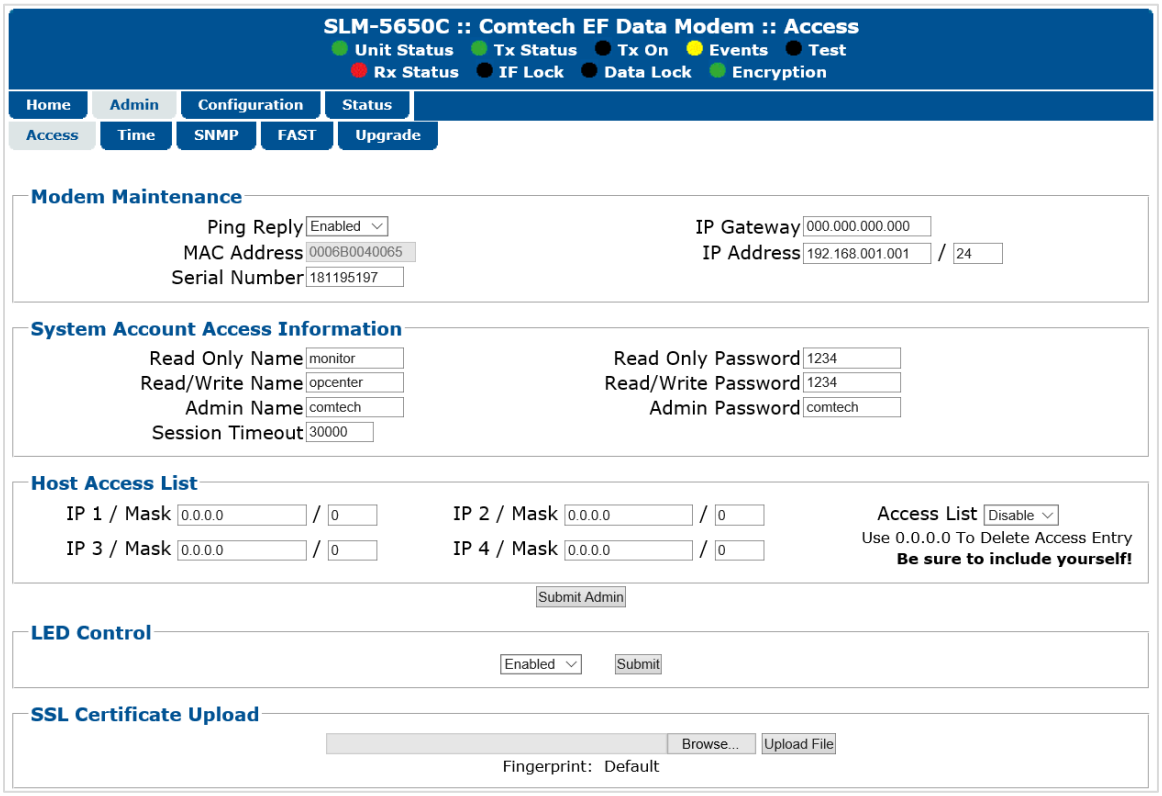


Figure 6-7. Admin | Access Page

Click **[Submit Admin]** once the desired configuration settings have been made on this page.

The Host IP is the Network Interface IP and mask of the configuration computer.

6.4.2.2 Admin | SNMP

Chapter 5. ETHERNET-BASED MANAGEMENT

Use this page to set and return administration information for the SLM-5650C SNMP feature.

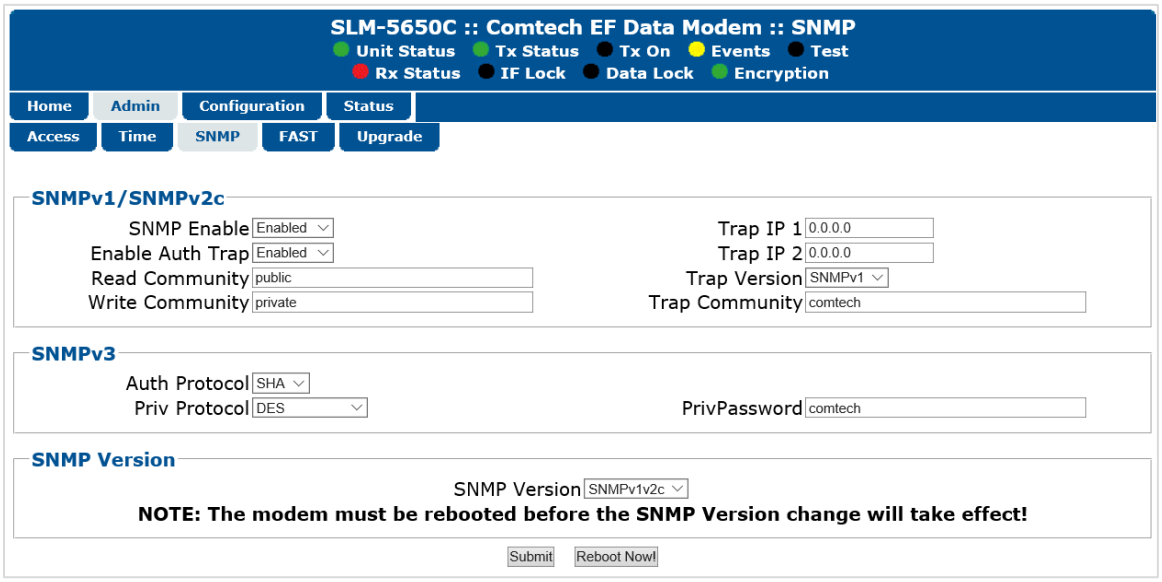


Figure 6-8. Admin | SNMP Page

Click **[Submit]** to save any changes made on this page.

Click **[Reboot Now]** to reboot the modem to apply any SNMP Version change.

6.4.2.3 Admin | Time

Use this page to set the SNTP Server Address, local time, and modem time and date.

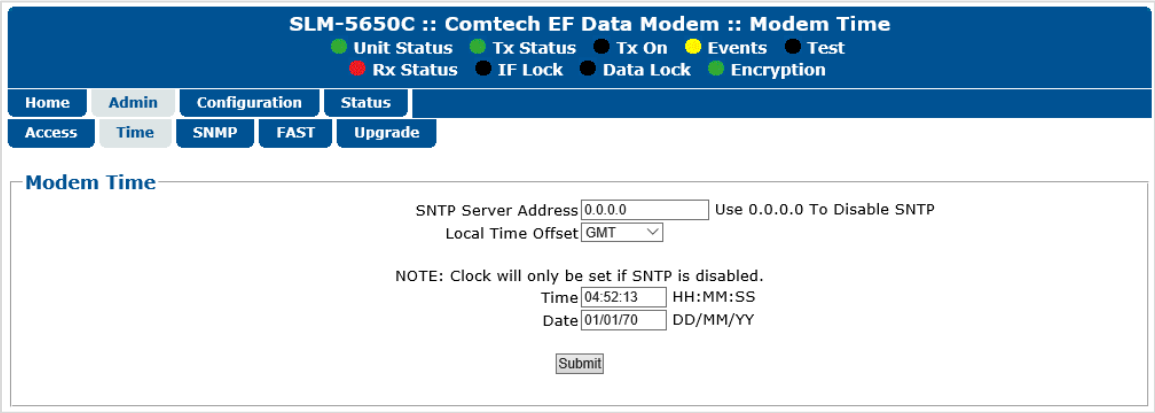


Figure 6-9. Admin | Time Page

Click **[Submit]** to save any changes made on this page.

6.4.2.4 Admin | FAST

Use this page to upgrade FAST options and turn ON/OFF the Demo Mode.

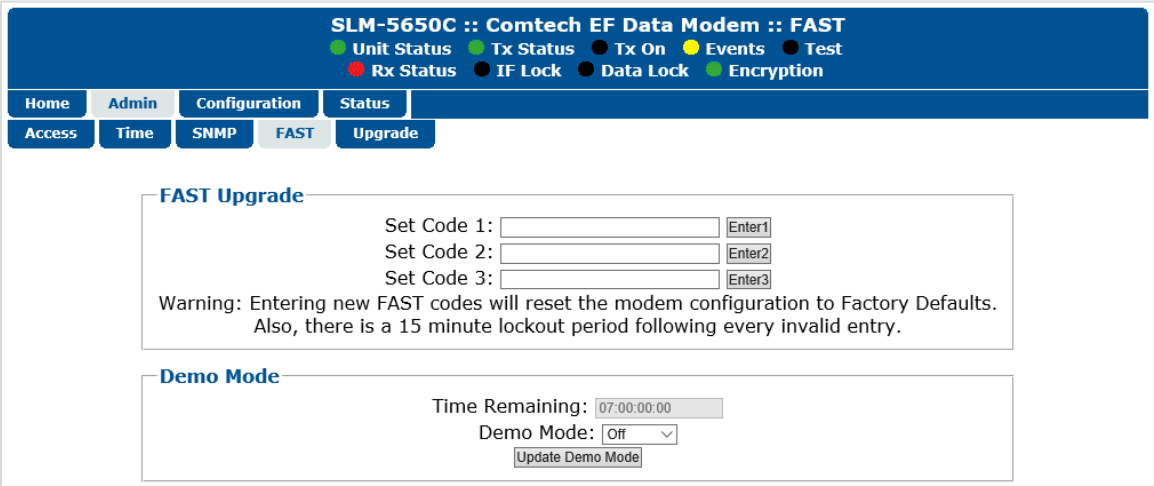


Figure 6-10. Admin | FAST Page

Description	Parameters
FAST Upgrade	When you obtain a FAST access code from CEFD, it will be for a specific option register. *Carefully* enter each register-specific 20-character FAST access code in sequence, and then click [Enter] when done. Up to three FAST Codes can be entered simultaneously. A message will display at the top of this section that states whether or not the codes are accepted or if the upgrade is successful.
Demo Time Remaining	FAST Options Demo-Mode allows access to all SLM-5650C options* for 30 calendar days. This section displays the remaining time in days, hours, and minutes. Use the drop-down list to set Demo-Mode as OFF or ON, and then click [Submit] to execute the selection.

6.4.2.5 Admin | Upgrade

Use this page to REFLASH the SLM-5650C and change the active firmware image.

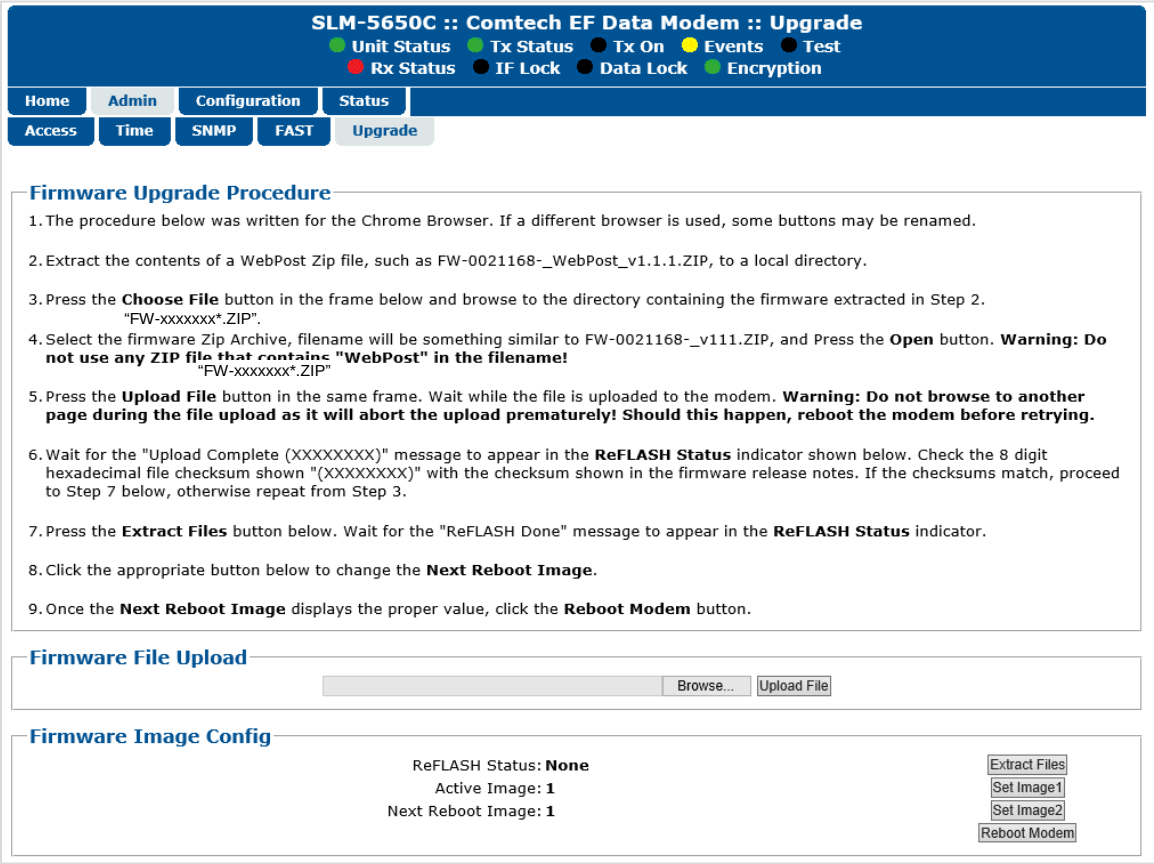


Figure 6-11. Admin | Upgrade Page

There are two firmware slots in the modem. One is operational and the other is for the older firmware.

To upgrade the firmware, follow the procedures shown in Figure 6-11.

Configuration (Modem Configuration) Pages

The '**Configuration**' pages are used to configure the Modulator, Demodulator, and Ethernet Bridge interface.

Select the **Modem**, **Utils**, **LoadStore**, **Spreading**, **AUPC**, **ODU**, or **TRANSEC** tabs to continue.

6.4.2.6 Configuration | Modem

Use this page to configure modem configuration parameters including Modem Frequency Band; Transmit/Receive; and Tx Power Level.

The Configuration Pages may change slightly, depending on the modem type selected. Not all modem parameters are valid, and could be hidden, when certain modem types are selected.

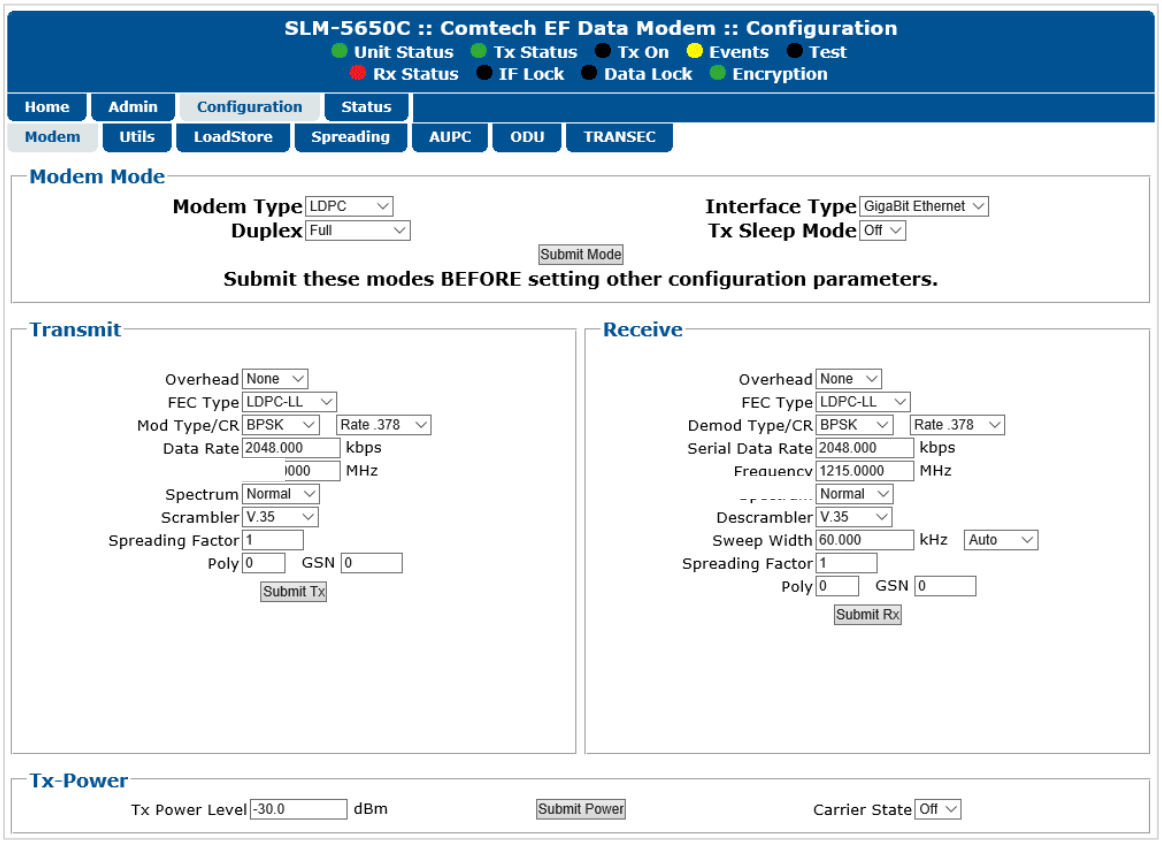


Figure 6-12. Configuration | Modem Page

Click **[Submit]** as needed in each section to save any changes.

There are four sections to configure:

- Modem Type
- Tx
- Rx
- Tx-Power

Description	Parameters
Modem Type	Modem Type is a major change for the modem and will set the configuration to defaults for the selected modem type. The Tx power will be turned off. The modem types are: • OM-73 • MIL-165A • IESS-308 • IESS-309 • IESS-310 • TURBO • 16QAM • AUPC • LDPC The modem will use less power when using either duplex set to Mod Only, Demod Only, or Tx Sleep mode. The power can be reduced by 5 Watts. The Interface Type should only be set for Gigabit Ethernet. Low Voltage Differential Signaling (LVDS) is only used at the factory during development. As an example, Reed Solomon is available when Mil-165A is selected as the Modem Type.
Transmit / Receive	The following options configure Tx and Rx, depending on the Modem Type. Overhead: Adding overhead will add a small percentage of data to the symbol rate of the modem. Automatic Uplink Power Control (AUPC) is used to manage the modem Tx power level when the System is impaired by adverse weather conditions. FEC Type: The FEC Type selection is dependant on the Modem Type. Selecting Turbo as a Modem Type will change the FEC Type to Turbo. Reed Solomon Encoder: Reed Solomon Is available depending on the Modem Type of the modem. • CW: Code Word, Depth: The Reed Solomon Code Word and Depth is selectable using the drop-down box. Differential Encoder / Decoder: The Differential Encoder is available depending on the Modem Type of the modem. Modulation Type: The Modulation Type can be set to BPSK, QPSK, OQPSK, 8PSK, 8QAM, or 16QAM. This is dependent on the Modem Type and the FEC Type. Code Rate: The Code Rate can be set to 1/1, 1/2, 1/3, 2/3, 3/4, 7/8, .378, .451, .541, 5/16, 21/44, and 17/18. These selections vary, depending on the Modem Type, FEC Type, and Modulation Type. Data Rate: The data rate range is detailed in Appendix B.

Description	Parameters
	Frequency: The L-Band frequency range is from 950 to 2000 MHz. Spectrum: Select Normal or Invert. Spectral inversion is used for modem compatibility between modem manufactures. Scrambler: Scramblers can be set to Off, V.35, Modified-V.35, Synch (Reed Solomon), Intelsat Business Service (IBS), Turbo, or OM73. These settings are dependent on Modem Type. Spreading Factor: The Spread Factor distributes the user information over a larger frequency bandwidth. The symbol rate is multiplied by the Spreading Factor number and is then called the Chip Rate. Polyn: • Polynomial 1 is compatible with the SLM-5650B. • It is not backwards compatible with the SLM-5650A. • Polynomial 0 is backwards compatible with the SLM-5650A and SLM-5650B. GSN: The GSN sets or returns the Tx Spreading Equation in the form abbbb, where: a = 0 (for Polynomial 0) or 1 (for Polynomial 1): • For Polyn 0, the GSN can be any number between 0-9999. • For Polyn 1, the GSN can be any number between 0-4095. Rx Sweep Width: The Sweep Width is only set on the Rx. This value is normally set to 60 KHz. Reduce the value when using DSSS spreading at low data rates. Adjust the Receive sweep bandwidth to the minimum of either 60 kHz or 0.6 times the symbol rate when using Spreading Factors greater than 1 at low data rates.
Tx Power	Adjust and turn on Tx power. Rolloff: The rolloff is fixed at 1.2 times the Chip Rate.

6.4.2.7 Configuration | Utils

Use this page to configure modem operating parameters, including Real Time Clock; Test Modes; Tx Miscellaneous, Rx Miscellaneous, Circuit ID, Built-in BERT, 20 MHz Reference Adjust, and AGC Monitor.

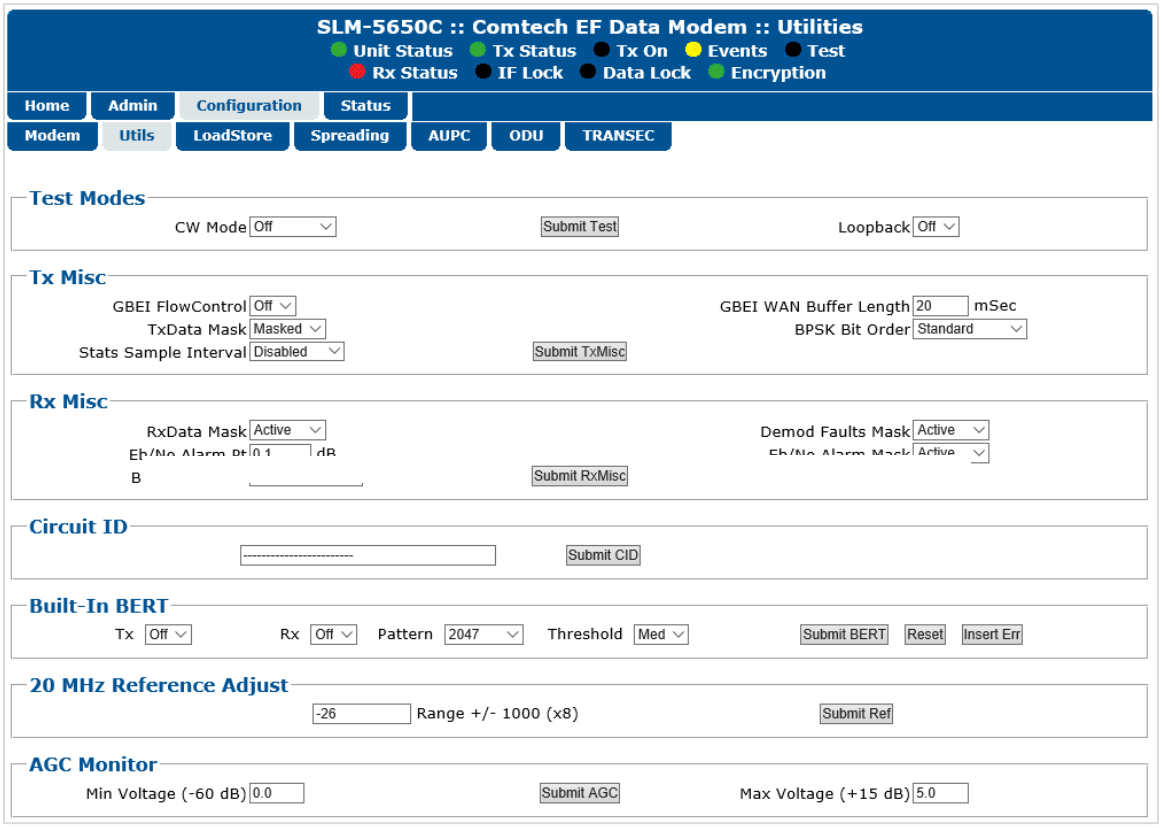
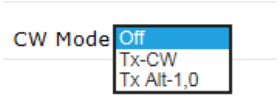
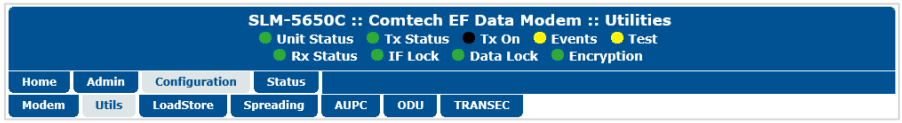
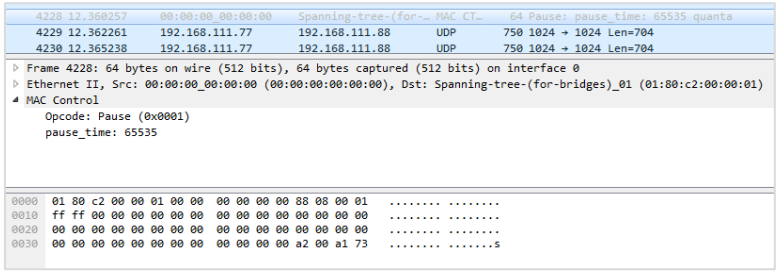


Figure 6-13. Configuration | Utils Page

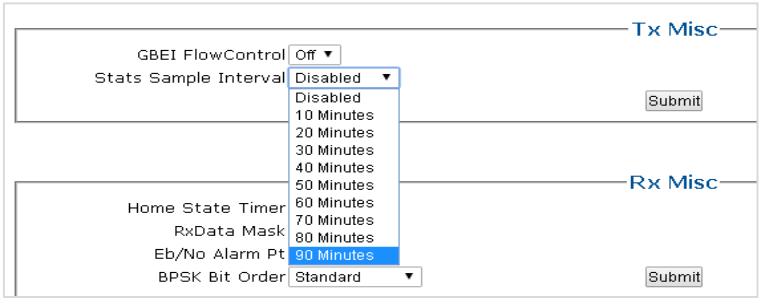
Click **[Submit]** as needed in each section to save any changes.

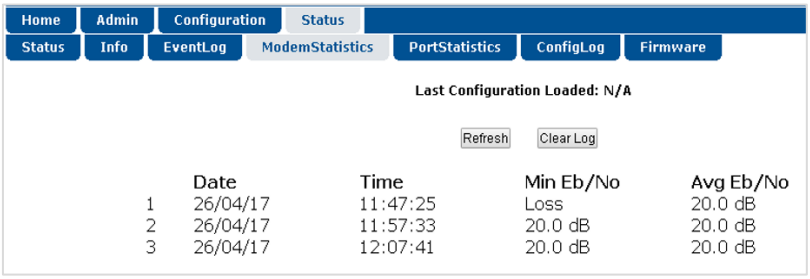
Description	Parameters
Real Time Clock	Set to get accurate stored event times.
Test Modes	CW Mode: Tx-CW, Carrier Wave at the center frequency. Tx Alt-1,0: Use to confirm carrier null and offset suppression during test.  IF loopback: Internal IF loop. (Turn loopback off before changing the Modem Type)  An amber TEST indicator on the far right of the Web page will turn on and off to indicate that a test test mode is on. The BERT functions are included in Test Modes. Turn all test modes off during normal operation. 
Tx Misc	GBEI Flow Control: GBEI Flow Control manages Ethernet Flow by sending out pause frames when the Ethernet stream becomes congested. The directly attached Network device must have Flow Control on to make this work properly. The modem interface will send out pause frames to pause the Ethernet traffic periodically. The pause frame is shown below: 

Description	Parameters

Stats Sample Interval:

Modem Statistics will only report when the Stats Sample Interval is set to a periodic value.

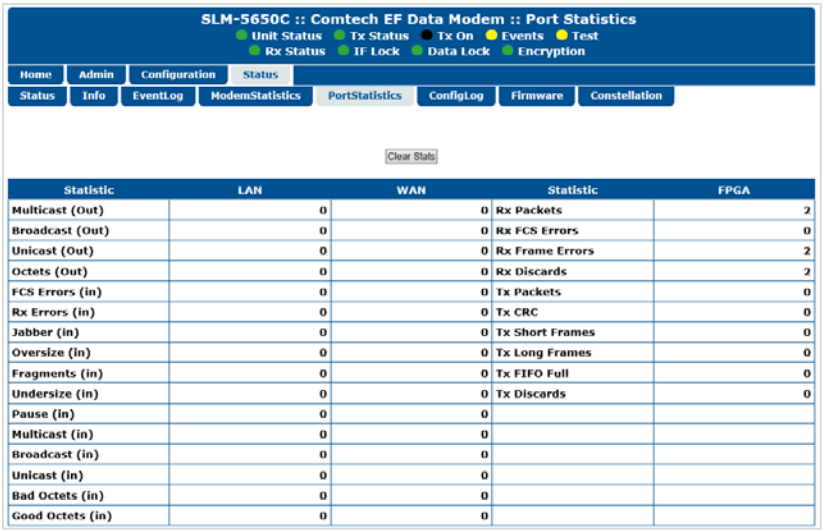




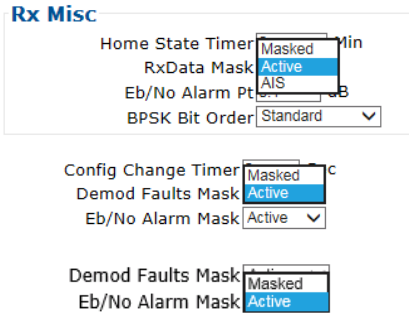
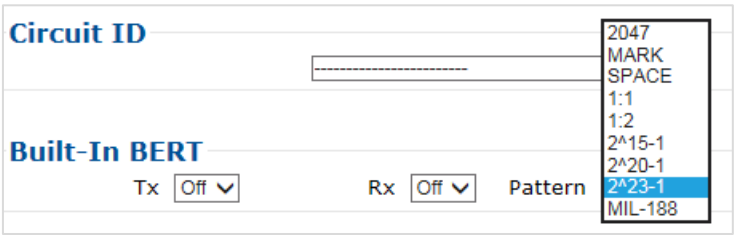
GBEI WAN Buffer Length:

The GBEI WAN Buffer Length is the setting for the Tx Buffer for Ethernet data. It does not directly add to the processing delay for the Tx Ethernet data. However, setting this too small will cause packet drops.

View the Status \ Port Statistics \ Tx FIFO Full to determine if the buffer needs to be larger. The Tx FIFO will overflow and count packet drops if the GBEI WAN buffer is too small.



Statistic	LAN	WAN	Statistic	FPGA
Multicast (Out)	0	0	Rx Packets	2
Broadcast (Out)	0	0	Rx FCS Errors	0
Unicast (Out)	0	0	Rx Frame Errors	2
Octets (Out)	0	0	Rx Discards	2
FCS Errors (in)	0	0	Tx Packets	0
Rx Errors (in)	0	0	Tx CRC	0
Jabber (in)	0	0	Tx Short Frames	0
Oversize (in)	0	0	Tx Long Frames	0
Fragments (in)	0	0	Tx FIFO Full	0
Undersize (in)	0	0	Tx Discards	0
Pause (in)	0	0		
Multicast (in)	0	0		
Broadcast (in)	0	0		
Unicast (in)	0	0		
Bad Octets (in)	0	0		
Good Octets (in)	0	0		

Description	Parameters
	BPSK Bit Order: Match the BPSK Bit Order for the Tx and Rx. This is used for modem to modem compatibility.
Rx Misc	RxData Mask / Demod Faults Mask / Eb/No Alarms Mask: Events for RxData, Demod Faults, and Eb/No Alarms can either be active or masked. The events are not reported if masked. RxData events can also be set to report all ones for no data.  Eb/No Alarm Point: The Eb/No Alarm point can be set to a specific value to report an event if the Eb/No falls below a desired value. Modem Events are reported under the Status \ Event Log Tab. Click on the Code value to read the event. 
Circuit ID	The modem operator can designate a Circuit ID for the modem. Use only numbers and capital letters. Delete the dash characters before entering the Circuit ID.
Built-in BERT	The Tx or Rx can be turned on separately. The data pattern must match on the Tx and Rx modems. The Patterns are: 

Description	Parameters
	Threshold: The threshold setting was developed to match the setting on the Fireberd Test set. Match the threshold setting to the Fireberd when testing with that test set. Setting the threshold to high will allow the BERT to stay in sync at lower Eb/No values. The BERT results can be reset and the operator can insert 1 error to confirm BERT operation.
20 MHz Reference Adjust	This adjustment affects the Carrier frequency, BUC reference, and the LNB reference. The demodulator may not lock if the 20 MHz Reference is not adjusted properly when the modem has DSSS spreading turned on. Make sure the Frequency Counter reference is extremely accurate before adjusting. Oscillator stability: 6×10^{-8}
AGC Monitor	The AGC voltage is relative to the receive signal level of the modem. The minimum is 0 and the max is 5 VDC. These settings are for the AGC DC voltage on the serial connector pin 5 with signal ground on pin 1.

6.4.2.8 Configuration | LoadStore

Use this page to load or store modem configurations.

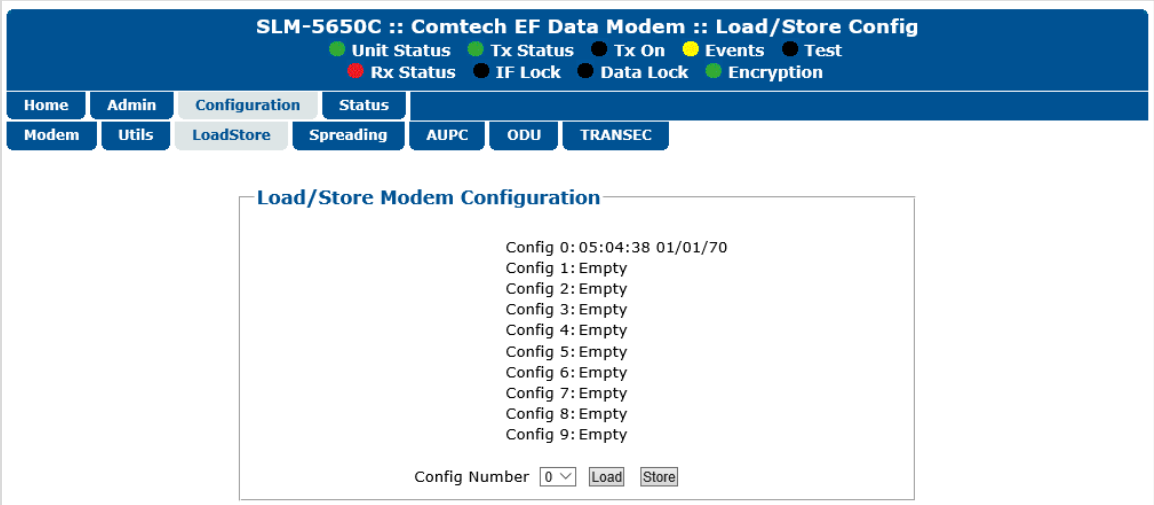


Figure 6-14. Configuration | LoadStore Page

Click **[Submit]** to save any changes made on this page.

Description	Parameters
Load/Store Modem Configuration	There are 10 slots for saved configurations. They are used when there is a need to recall many modem configurations.

6.4.2.9 Configuration | Spreading

Use this page to allow configuration of the DSSS applications.

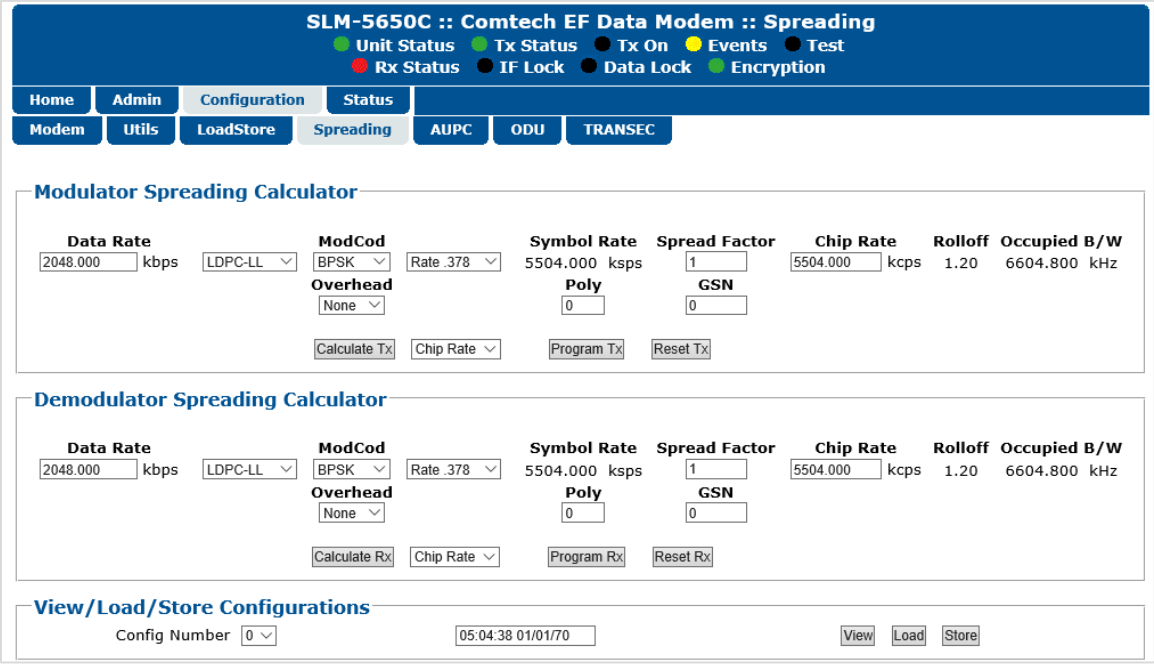


Figure 6-15. Configuration | Spreading Page

Description	Parameters
Spreading Calculator	The calculator is used to determine the Chip Rate and Occupied bandwidth when DSSS spreading is used. It can be used to calculate or configure the Tx or Rx of the modem. Spreading is used in LDPC mode, BPSK.
View/Load/Store Configuration	This is used to confirm that there is a stored modem configuration in one of the ten slots and to load and store a configuration. To view, Change the Configure Number and select view to see if the slot is either empty or when it was stored.

6.4.2.11 Configuration | AUPC

Use this page to set the AUPC parameters.

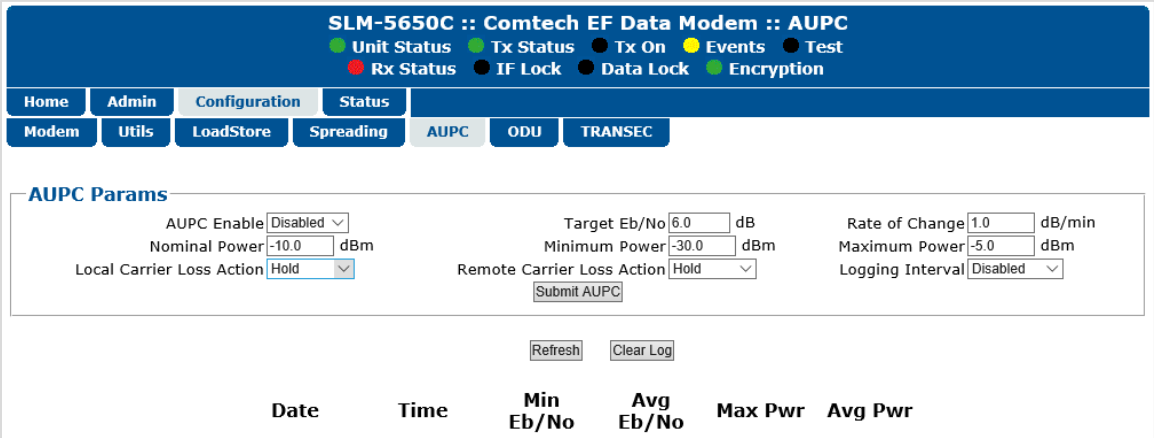


Figure 6-16. Configuration | AUPC Page

Description	Parameters
AUPC Params	This can be used by selecting overhead type as AUPC when the Modem type is set at either AUPC or LDPC. AUPC overhead adds 6.6665% to the symbol rate.

6.4.2.12 Configuration | ODU

Use this page to view the ODU Control and to view the LNB Staus.

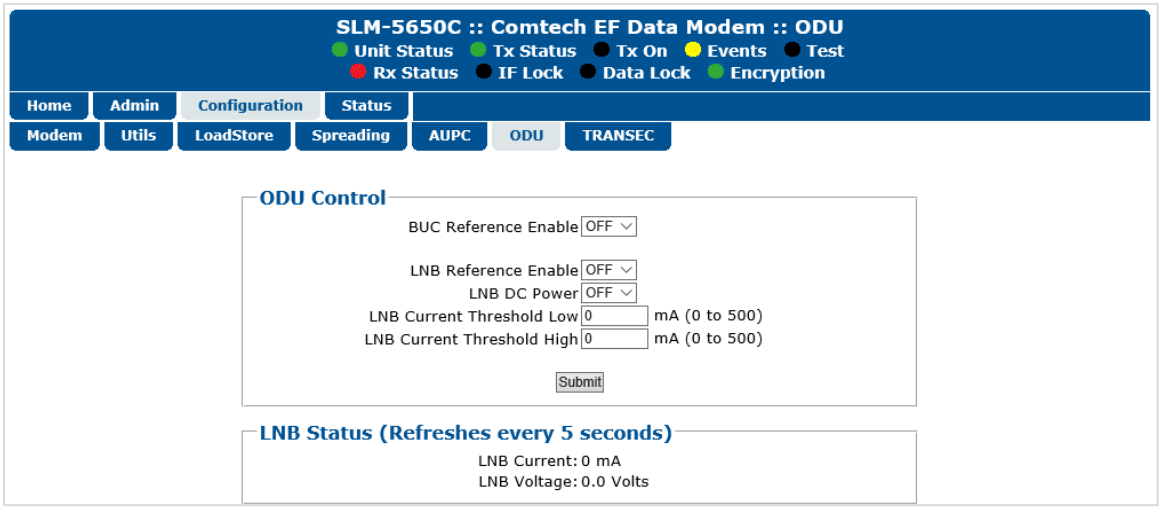


Figure 6-17. Configuration | ODU Page

Description	Parameters
ODU Control	The LNB DC voltage is selectable at +13 VDC or +18 VDC. LNB DC Power: Only turn on when connected to an LNB, otherwise leave it off to avoid damage to other modems or test equipment. LNB Current Threshold: Set to a low and high value limits to report modem events when the LNB current is out of range.
LNB Status	The LNB Status reports the LNB current and voltage of the LNB.

6.4.2.13 Configuration | TRANSEC

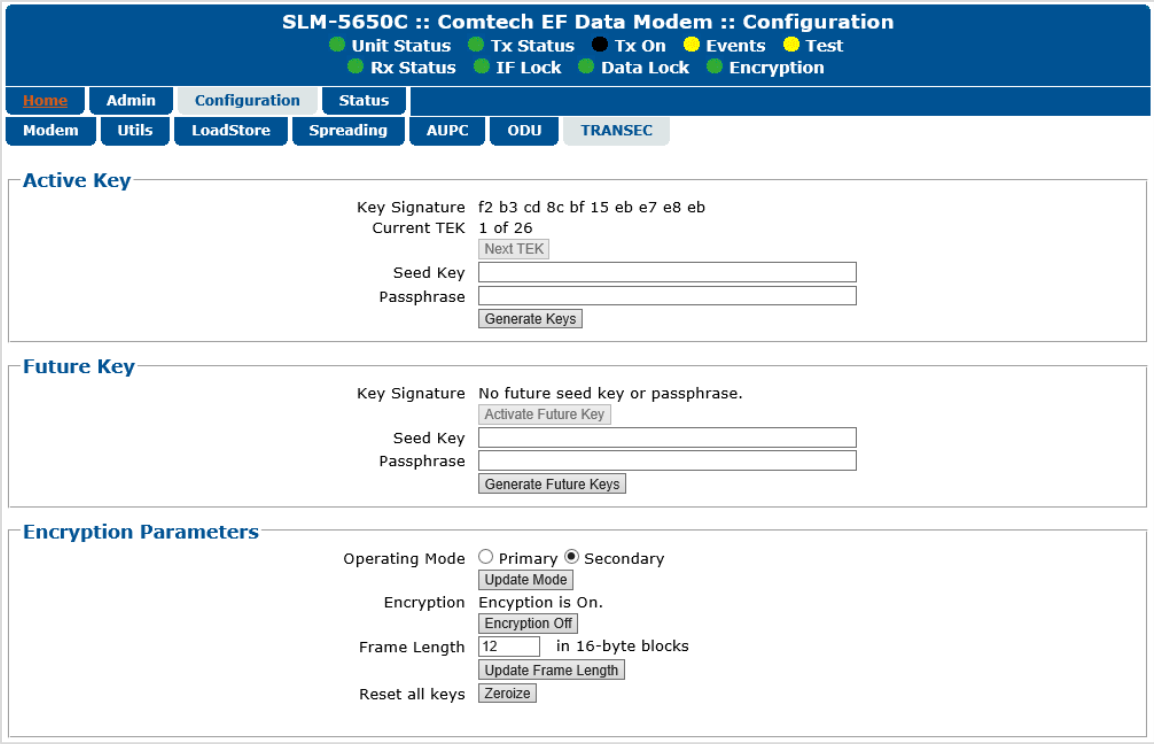


Figure 6-18. Configuration | TRANSEC Page

Description	Parameters
Active Key	Do the following steps to set the Active Key: 1. Enter Active seed key and passphrase. • The Seed Key is 32 characters, upper and lower case, and some special characters. • The Passphrase is 10 to 32 characters, upper and lower case only. • Set the Frame Length. The frame length can be set to any integer number between 1 and 16. *The frame length must match. The frame length can be changed when on or off-line.* 2. Click on Generate keys. 3. Confirm the key signatures match. 4. Select Operating Mode in Encryption Parameters. a. Primary, or b. Secondary • *The Current TEK encrement is initiated by the operator at the Primary TRANSEC modem.* • *The secondary TRANSEC TEK encrement will follow automatically.* 5. Turn encryption ON in Encryption Parameters. 6. Confirm Ethernet traffic.

Description	Parameters
Future Key	Activate Future Key: • Activate the Future Key, or • Load and activate a new key  *The Future Key can be activated after using all the 26 TEK numbers. Then, another set of TEK loads are available.* TRANSEC Encryption Overhead:  • *Overhead will increase when encryption is on.* • *TRANSEC Overhead Calculation:* *(3+16 *N) / (16 * N) where N=Frame length* Next TEK: • TEK loads can be updated periodically up to number 26. • The operator at the Primary modem will load the Next TEK. Do the following steps to set the Future Key: 1. Enter the Future Key seed key and passphrase. 2. Generate the Future Key.  *The key signature must match on both modems.*
Encryption Parameters	Frame Length: • Large frame sizes use less overhead and are more efficient. However, a greater number of information bits in the packet are impacted in noisy operating conditions. • Small frame sizes use more overhead but fewer bits are impacted when losing a packet. Small frame sizes are useful when the information bits are distributed over a wide spectral bandwidth using DSSS spreading. Reset All Keys: Zerioze. • Make sure to reboot the modem after zeroizing the TRANSEC. • Use the Admin \ Update tab. • Impacts the Next TEK increment if a reboot is not done. • The encryption state, On or Off, is maintained after zeroizing and rebooting the modem.

6.4.3 Status Pages

The **Status** pages provide *read-only* status windows: General operating and configuration information about the modem; Info about installed options; Event Log; Modem Statistics; Ethernet Port Statistics; Network Processor Statistucs, Configuration Log; and Firmware Information.

Select the **Status**, **Info**, **EventLog**, **ModemStatistics**, **PortStatistics**, **ConfigLog**, or **Firmware** tabs to continue.

6.4.3.1 Status | Status

Use this *read-only* page to view the modem's current configuration and operation parameters:

- Alarms
- Rx Parameters
- Symbol Rates
- BERT
- Chip Rates
- General Status
- Internal Temperatures

SLM-5650C :: Comtech EF Data Modem :: Status

Unit Status | Tx Status | Tx On | Events | Test
Rx Status | IF Lock | Data Lock | Encryption

Home | Admin | Configuration | Status

Status | Info | EventLog | ModemStatistics | PortStatistics | ConfigLog | Firmware | Constellation

Alarms		RX Parameters	
Unit:	00000000	Eb/No:	>20.0 dB
Tx:	00000000	EVM:	34.3 dB
Rx:	00000000	Receive Signal Level:	-16.0 dBm
		Composite Pwr:	-39.3 dBm
		Freq Offset:	-0000076 Hz
Symbol Rates		**BERT**	
Tx:	5870.933 ksps	BER:	N/A
Rx:	5870.933 ksps	Errors Received:	N/A
Chip Rates		**General Status**	
Tx:	5870.933 kcps	EventLog Length:	3
Rx:	5870.933 kcps	Fan State:	Off
Internal Temperatures			
RF:	53 °C	M&C:	53 °C
FPGA:	58 °C		

Figure 6-19. Status | Status Page

6.4.3.2 Status | Info

Use this *read-only* page to view general information about the modem and installed options.

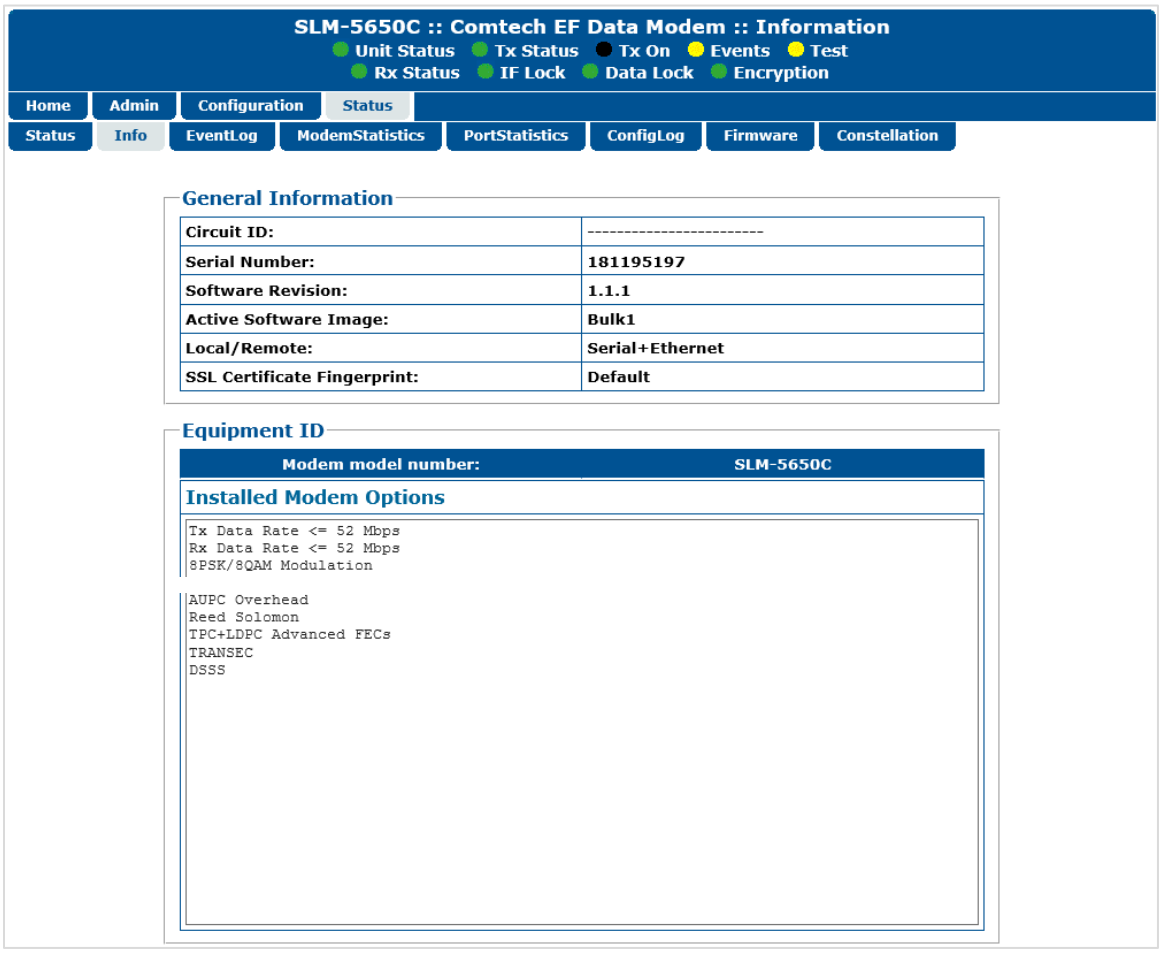


Figure 6-20. Status | Info Page

6.4.3.3 Status | Event Log

Use this *read-only* page to view a scrollable display of recorded modem events.

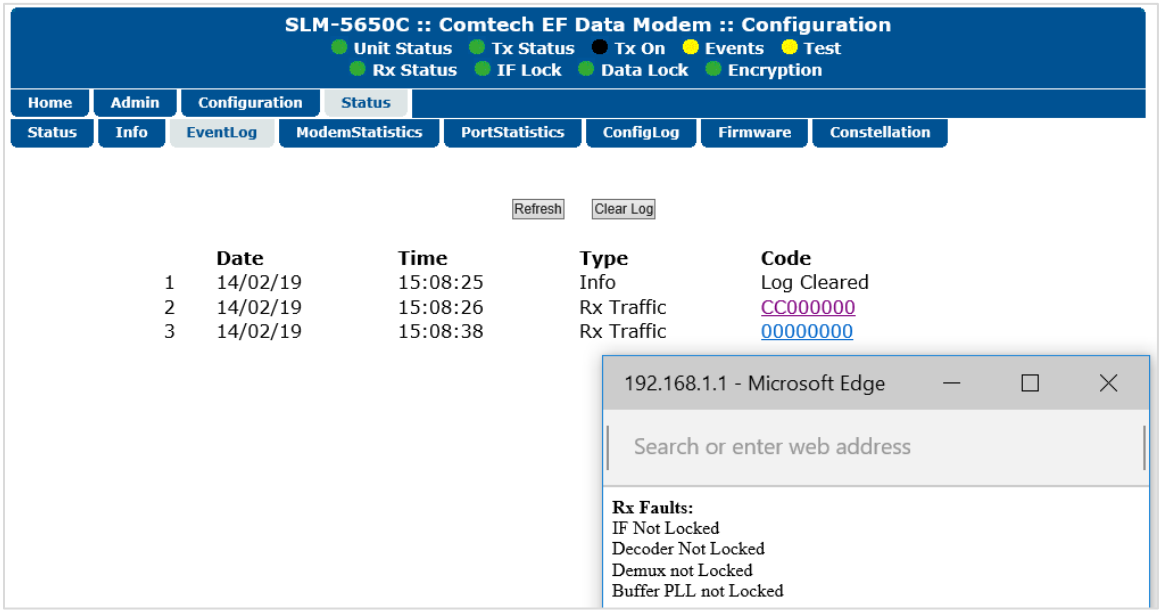


Figure 6-21. Status | Event Log Page

Click **[Refresh]** to update the display with the most recently logged events.

Click [**Clear Log]** to clear the log. Once the log is cleared, the next time **[Refresh]** is clicked any new events are logged and numbered beginning with '1'.

Description	Parameters
Event Log	(Event #) Date / Time: The first three columns display the event by the order in which it was logged, along with the date and time the event was recorded. Type: The event is identified by its type in this column. Four event types are classified: • Info • Unit • Tx Traffc • Rx Traffic Code: Click on a hyperlinked fault code to display a page that describes the error code bit positions.

6.4.3.4 Status | Modem Statistics

Use this *read-only* page view a scrollable display of recorded modem statistics.

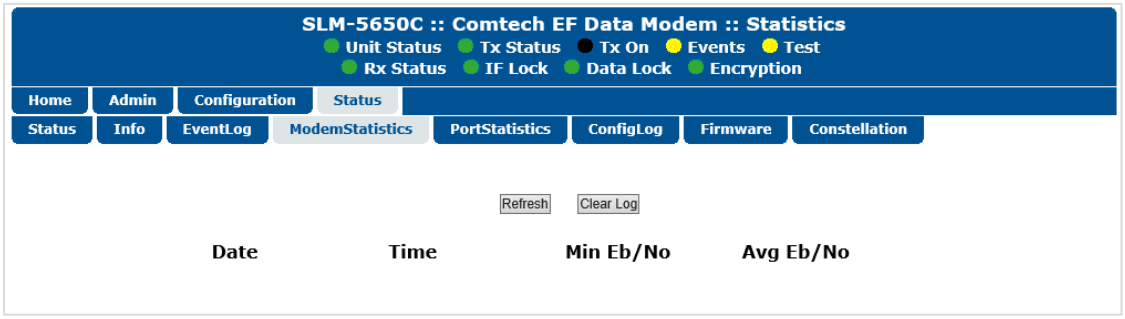


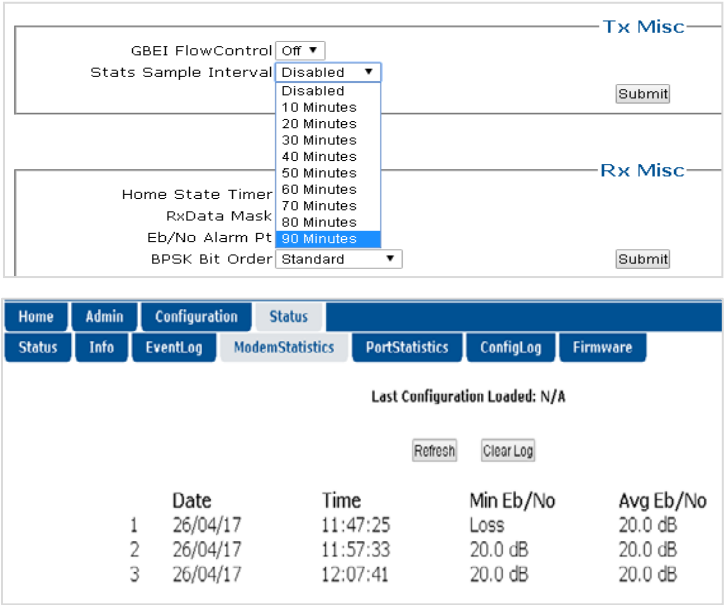
Figure 6-22. Status | Modem Statistics Page

Description	Parameters
Statistics Log	(Statistic #) Date / Time: The first three columns display the statistic by the order in which it was logged, along with the date and time the event was recorded. Min Eb/No: Avg Eb/No:

Click **[Refresh]** to update the display with the most recently logged statistics.

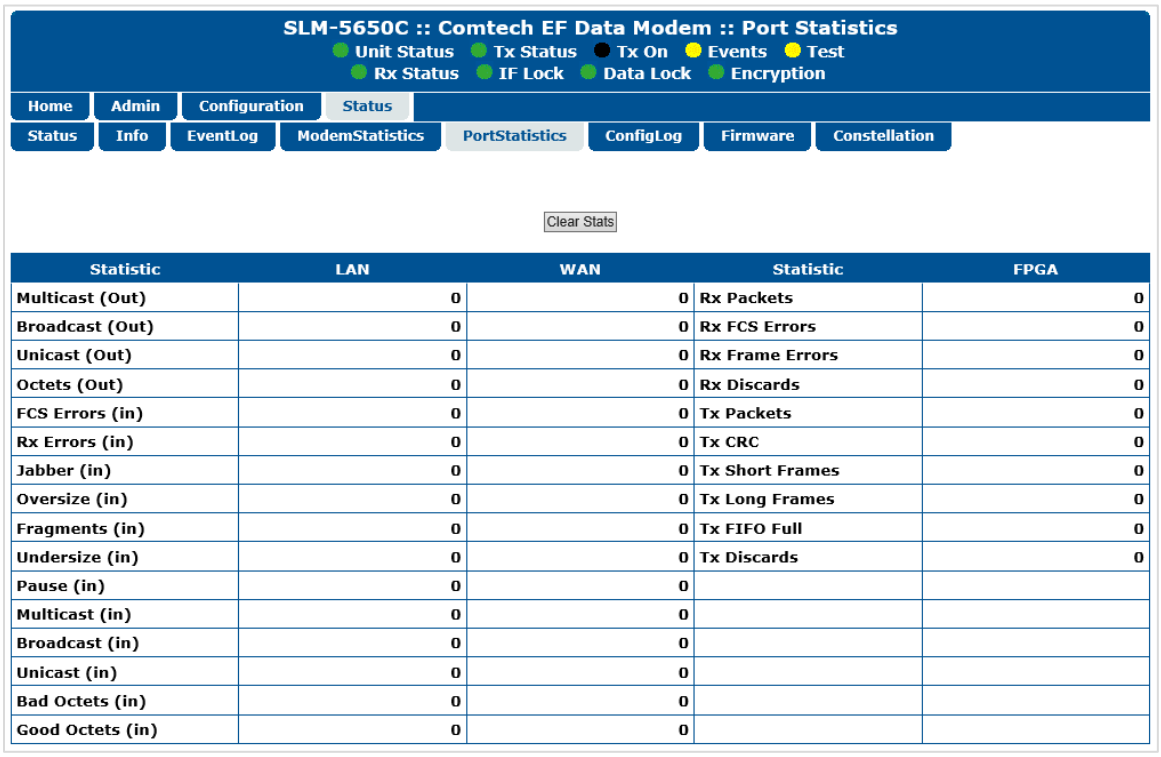
Click [**Clear Log]** to clear the log of all visible statistics. Once the log is cleared, the next time **[Refresh]** is clicked any new statistics will be logged beginning with the number '1'.

Modem Statistics logs are collected when there is a periodic setting on the Config \ Utilities WEB page, Stas Sample Interval.



6.4.3.5 Status | Port Statistics

Use this *read-only* page to view Ethernet Port Statistics. Available Ports are LAN, WAN, and Field Programmable Gate Array (FPGA).



Statistic	LAN	WAN	Statistic	FPGA
Multicast (Out)	0	0	Rx Packets	0
Broadcast (Out)	0	0	Rx FCS Errors	0
Unicast (Out)	0	0	Rx Frame Errors	0
Octets (Out)	0	0	Rx Discards	0
FCS Errors (in)	0	0	Tx Packets	0
Rx Errors (in)	0	0	Tx CRC	0
Jabber (in)	0	0	Tx Short Frames	0
Oversize (in)	0	0	Tx Long Frames	0
Fragments (in)	0	0	Tx FIFO Full	0
Undersize (in)	0	0	Tx Discards	0
Pause (in)	0	0		
Multicast (in)	0	0		
Broadcast (in)	0	0		
Unicast (in)	0	0		
Bad Octets (in)	0	0		
Good Octets (in)	0	0		

Figure 6-23. Status | Port Statistics Page

Description	Parameters
Port Statistics	The Port Statistics page consists of a table of 64-bit counters. Table 6-1 defines the individual counters. *RX Frame Errors and Rx discards are normal when the Internal BERT is turned on. The errors occur as the internal BERT is overwriting the normal Ethernet Frame.*

Table 6-1. Summary of Counters for Port Statistics Pages

Port		Attribute	Description
FPGA		Rx Packets	Total Number of received packets.
		Rx FCS Errors	Total Number of received packets with Frame Check Sequence (FCS) Errors.
		Rx Frame Errors	Total number of received packets with Frame Errors.
		Rx Discards	Total number of dropped packets.
		TX Packets	Total Number of transmitted packets.
		TX CRC	Total Number of packets with Cyclic Redundancy Check (CRC) errors.
		TX Short Frames	Total Number of packets with short frames.
		TX Long Frames	Total Number of packets with long frames.
		TX FIFO Full	Total Number of packets dropped because WAN First In First Out (FIFO) was full.
		TX Discards	Total Number of dropped packets.
(Ethernet)	LAN (Traffic port connected to J12 RJ-45) WAN (Traffic port connected to satellite interface)	Multicast (Out)	The number of packets sent that have a Multicast destination Medium Access Control (MAC) address.
		Broadcast (out)	The number of packets sent that have a Broadcast destination MAC address.
		Unicast (Out)	The number of packets sent that have a Unicast destination MAC address.
		Octets (Out)	The number of bytes sent.
		FCS Errors (in)	Total packets received with a CRC error not counted in Fragments (In), Jabber (In) or Rx Errors (In).
		Rx Errors (in)	Total packets received with Rx Error signal.
		Jabber (in)	Total packets received with length of more than Maxsize (2048 bytes) but with invalid FCS.
		Pause (in)	The number of good Flow Control packets received.
		Multicast (in)	The number of good packets that have multicast destination MAC address. Note: this address not included 802.3 Flow Control messages counted in Pause (In) or does it included Broadcast packets counted in Broadcast (in).
		Broadcast (in)	The number of good packets received that have a broadcast destination MAC address.
		Unicast (in)	The number of good packets received that have a Unicast destination MAC address.
		Bad Octets (in)	Total bytes received in bad Ethernet packets.
		Good Octets (in)	Total good Ethernet bytes received.

6.4.3.6 Status | Config Log

Use this *read-only* page to view a scrollable display the configuration change log.

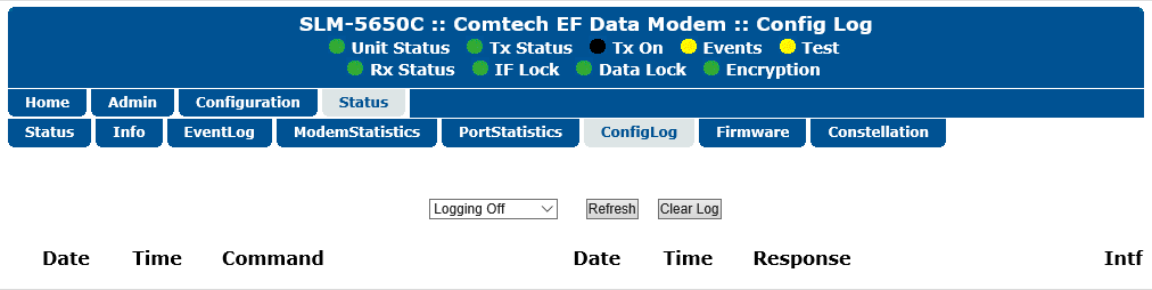
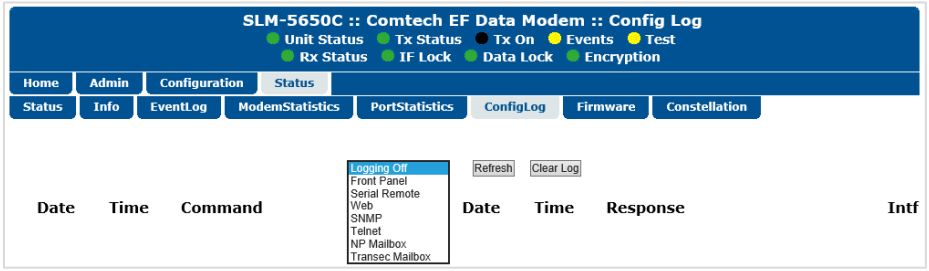
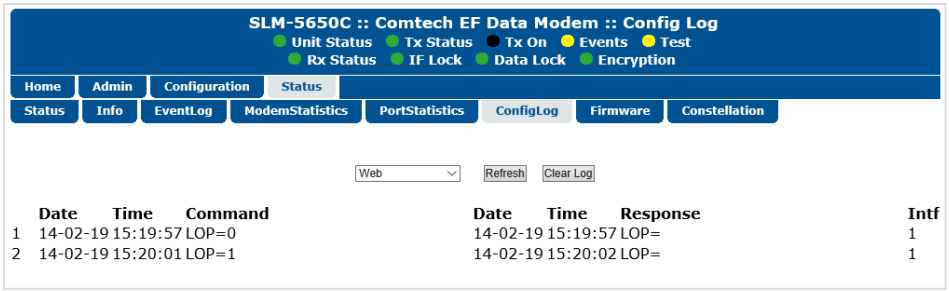


Figure 6-24. Status | Config Log Page

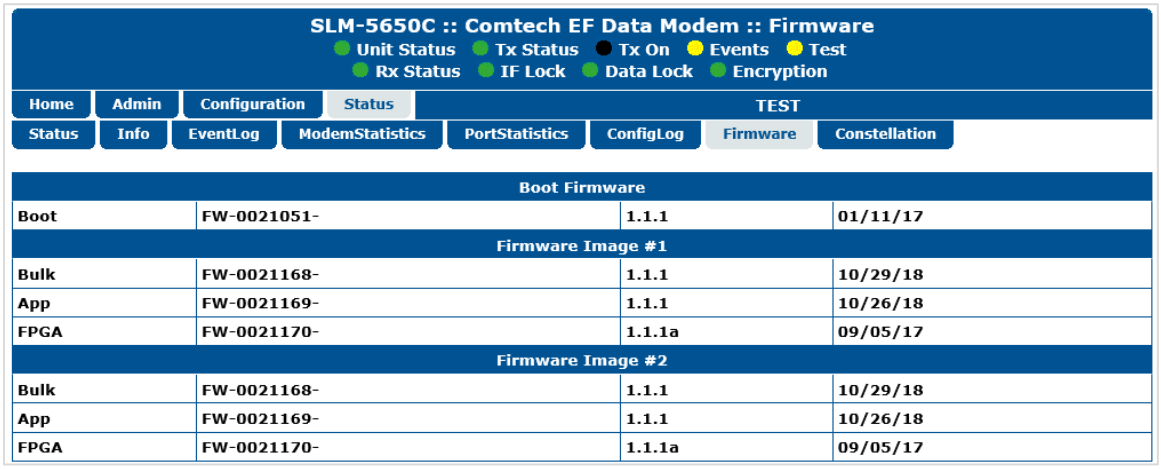
Description	Parameters
Configuration Log	Select a logging level from the drop-down menu, and then click [Refresh] to begin logging or to update the page. The selections are: • Logging Off • Front Panel (n/a, No Front panel) • Serial Remote • Web • SNMP • Telnet • NP Mailbox (n/a, No Network Processor plug in card) • TransecMailbox (n/a, Transec is not a plug-in card) When selecting the logging level, the modem will log changes from the current level and all prior levels. For example, selecting "Web" will enable logging for the WEB pages, and Serial Remote. The visible display provides the selected configuration change log information: • Date / Time / Command • Date / Time / Response • Intf Click [Clear Log] to clear the visible display. Example: Select Web 

Description	Parameters
	Change the Loopback to OFF and then back ON. These are the commands initiated for that change:



6.4.3.7 Status | Firmware

Use this *read-only* page to view information about the boot firmware and bulk firmwares programmed into the modem.



Boot Firmware			
Boot	FW-0021051-	1.1.1	01/11/17
Firmware Image #1			
Bulk	FW-0021168-	1.1.1	10/29/18
App	FW-0021169-	1.1.1	10/26/18
FPGA	FW-0021170-	1.1.1a	09/05/17
Firmware Image #2			
Bulk	FW-0021168-	1.1.1	10/29/18
App	FW-0021169-	1.1.1	10/26/18
FPGA	FW-0021170-	1.1.1a	09/05/17

6.4.3.8 Status | Constellation

Use this *read-only* page to view information about the boot firmware and bulk firmwares programmed into the modem.

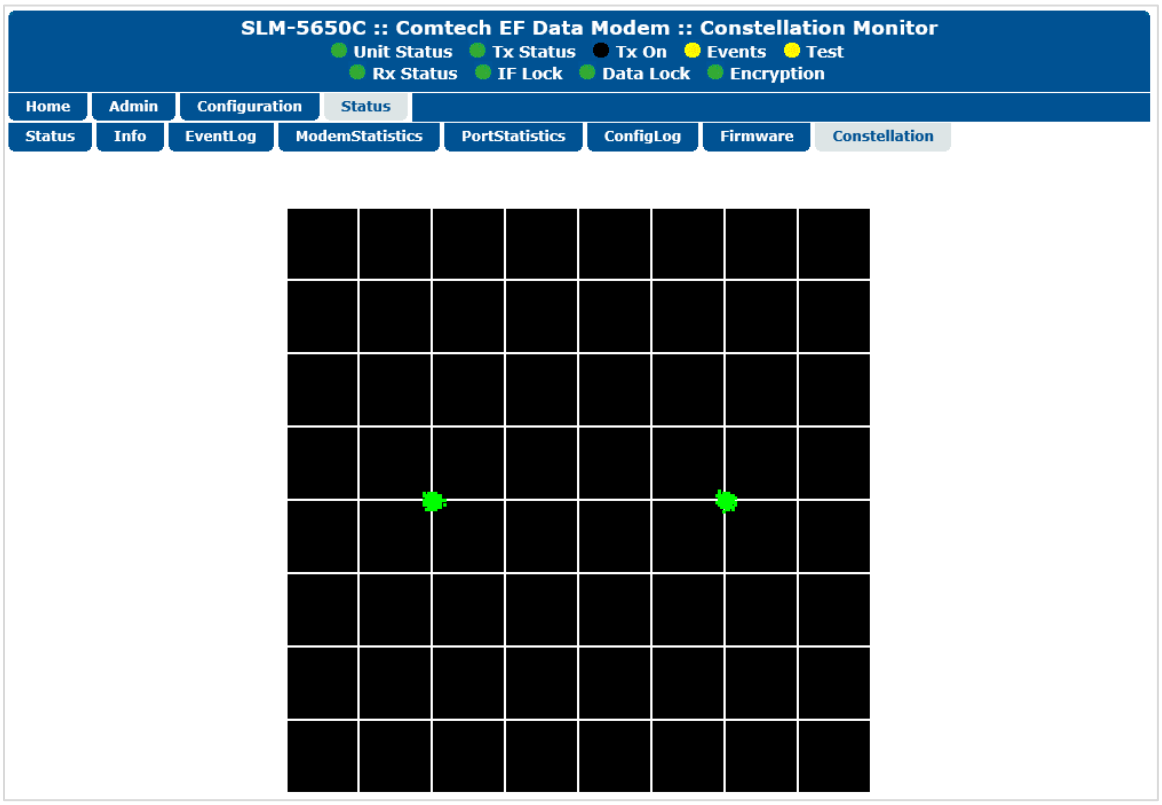


Figure 6-25. Status | Constellation Page

Chapter 7. REMOTE CONTROL

7.1 Overview

This chapter describes the protocol and message command set for remote monitor and control of the SLM-5650C Satellite Modem.

The electrical interface is an EIA-232 connection (for the control of a single device), and data is transmitted in asynchronous serial form using ASCII characters. Control and status information is transmitted in packets of variable length in accordance with the structure and protocol defined in later sections.

7.2 EIA-232

This is a much simpler configuration in which the Controller device is connected directly to the Target via a two-wire-plus-ground connection. Controller-to-Target data is carried via EIA-232 electrical levels on one conductor, and Target -to-Controller data is carried in the other direction on the other conductor.

7.3 Basic Protocol

All data is transmitted as asynchronous serial characters suitable for transmission and reception by a Universal Asynchronous Receiver Transmitter (UART). In this case, the asynchronous character format supported is 8N1. The baud rate is fixed at 115,200 baud.

All data is transmitted in framed packets. The Controller is assumed to be a PC or ASCII dumb terminal, which is in charge of the process of monitor and control. The Controller is the only device which is permitted to initiate, at will, the transmission of data. Targets are only permitted to transmit when they have been specifically instructed to do so by the Controller.

All bytes within a packet are printable ASCII characters less than ASCII code 127. In this context, the Carriage Return and Line Feed characters are considered printable.

All messages from Controller-to-Target require a response. This will be either to return data, which has been requested by the Controller, or to acknowledge reception of an instruction to change the configuration of the Target.

7.4 Packet Structure

Controller-to-Target						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code 60 (1 character)	(4 characters)	/ ASCII code 47 (1 character)	(3 characters)	= or ? ASCII codes 61 or 63 (1 character)	(n characters)	Carriage Return ASCII code 13 (1 character)

Example: <0135/TFQ=70.2345{CR}

Target-to-Controller						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII code 62 (1 character)	(4 characters)	/ ASCII code 47 (1 character)	(3 characters)	=, ?, !, or * ASCII codes 61, 63, 33, or 42 (1 character)	(From 0 to n characters)	Carriage Return, Line Feed ASCII codes 13,10 (2 characters)

Example: >0654/RSW=32{CR}{LF}

7.4.1 Start of Packet

- **Controller-to-Target:** This is the character '<' (ASCII code 60).
- **Target-to-Controller:** This is the character '>' (ASCII code 62).

The '**<**' and '**>**' characters indicate the start of packet. They may not appear anywhere else within the body of the message.

7.4.2 Target Address

This value is fixed to 0.

The Controller sends a packet with the address of a Target – the destination of the packet. When the Target responds, the address used is the same address, to indicate to the Controller the source of the packet. The Controller does not have its own address.

7.4.3 Address Delimiter

This is the “forward slash” character '***/*** ' (ASCII code 47).

7.4.4 Instruction Code

This is a three-character alphabetic sequence, which identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance – e.g., **TFQ** for transmit frequency, **RMD** for receive modulation type, etc. This aids in the readability of the message, should it be displayed in its raw ASCII form. Only upper case alphabetic characters may be used (A to Z, ASCII codes 65 to 90).

7.4.5 Instruction Code Qualifier

1. ***From Controller-to-Target***, the only permitted values are:

Symbol	Definition
= (ASCII code 61)	The '=' code is used as the Assignment Operator (AO) and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument (s) which follow it. EXAMPLE: In a message from Controller-to-Target, TFQ=0950.0000 would mean "set the transmit frequency to 950 MHz."
? (ASCII code 63)	The '?' code is used as the Query Operator (QO) and is used to indicate that the Target should return the current value of the parameters defined by the preceding byte. EXAMPLE: In a message from Controller-to-Target, TFQ? Would mean "return the current value of the transmit frequency."

2. ***From Target-to-Controller***, the only permitted values are:

Symbol	Definition
= (ASCII code 61)	The '=' code is used in two ways: a. If the Controller has sent a query code to a Target. (EXAMPLE: TFQ? (meaning 'what's the Transmit frequency?'), the Target would respond with TFQ=xxxx.xxxx, where xxxx.xxxx represents the frequency in question. b. If the Controller sends an instruction to set a parameter to a particular value, then, providing the value sent is valid, the Target will acknowledge the message by replying with TFQ=(with no message arguments).
? (ASCII code 63)	If the Controller sends an instruction to set a parameter to a particular value, then, if the value sent is not valid, the Target will acknowledge the message by replying (for example) with TFQ? (with no message arguments). This indicates that there was an error in the message sent by the Controller.
! (ASCII code 33)	If the Controller sends an instruction code which the Target does not recognize, the Target will acknowledge the message by echoing the invalid instruction, followed by the ! character. EXAMPLE: XYZ!
* (ASCII code 42)	If the Controller sends an instruction to set a parameter to a particular value, then, if the value sent is valid BUT the modulator will not permit that particular parameter to be changed at this time, the Target will acknowledge the message by replying, for example, with TFQ* (with message arguments).
# (ASCI code 35)	If the Controller sends a correctly formatted command BUT the modem is in local mode, it will not allow reconfiguration and will respond with TFQ#
~ (ASCI code 126)	If a message was sent via a local modem to a distant end device or ODU, the message was transmitted transparently through the local modem. In the event of the distant-end device not responding, the local modem would generate a response.

Symbol	Definition
	EXAMPLE: 0001/RET~ (indicating that it had finished waiting for a response and was now ready for further comms).
^ (ASCI code 94)	If the Controller sends a correctly formatted command BUT the modem is in Ethernet Remote mode, it will not allow reconfiguration, and will respond with TFQ^.

7.4.6 Optional Message Arguments

Arguments are not required for all messages. Arguments are ASCII codes for the characters 0 to 9 (ASCII codes 48 to 57), period (ASCII code 46) and comma (ASCII code 44).

7.4.7 End Of Packet

- **Controller-to-Target:** This is the 'Carriage Return' character (ASCII code 13).
- **Target-to-Controller:** This is the two-character sequence 'Carriage Return', 'Line Feed' (ASCII codes 13 and 10). Both indicate the valid termination of a packet.

7.5 Remote Commands / Queries

7.5.1 Table Indexes

Index Notes: Where **Column 'C'** = Command and **Column 'Q'** = Query, columns marked '**X**' designate instruction code as *Command only*, *Query only*, or *Command/Query*. Under **CODE, XXX** indicates a priority command; XXX^{A} indicates a command/query valid only when the SLM-5650C modem type has been set to **AUPC;** XXX^{O} indicates a command/query that is valid only when an optional interface module has been installed in the SLM-5650C.

Sect. 7.5.2 Initial Setup – Priority Commands / Queries

CODE	C	Q	PAGE
ITF	X	X	7–11

CODE	C	Q	PAGE
MOM	X	X	7–11

CODE	C	Q	PAGE
RFB	-	X	7–11

Sect. 7.5.3 Modulator (Tx) Commands / Queries

CODE	C	Q	PAGE
BEI	X	X	7–13
BTX	X	X	7–13
TBO	X	X	7–13
TCI	X	X	7–14
TCR	X	X	7–13

CODE	C	Q	PAGE
TCW	X	X	7–14
TDE	X	X	7–14
TDF	X	X	7–14
TDI	X	X	7–14
TDR	X	X	7–13

CODE	C	Q	PAGE
TFM	X	X	7–12
TFQ	X	X	7–14
TFT	X	X	7–12
TMD	X	X	7–12
TPL	X	X	7–15

CODE	C	Q	PAGE
TRD	X	X	7–15
TRS	X	X	7–15
TSC	X	X	7–15
TSE	X	X	7–15
TSF	X	X	7–16

CODE	C	Q	PAGE
TSI	X	X	7–16
TXF	-	X	7–16
TXO	X	X	7–16

Sect. 7.5.4 Demodulator (Rx) Commands / Queries

CODE	C	Q	PAGE
BBR	-	X	7–18
BRS	X	-	7–18
BRX	X	X	7–18
BTH	X	X	7–19
EBN	-	X	7–19
ERR	-	X	7–19

CODE	C	Q	PAGE
RBO	X	X	7–19
RCI	X	X	7–19
RCR	X	X	7–18
RCW	X	X	7–19
RDD	X	X	7–20
RDF	X	X	7–20

CODE	C	Q	PAGE
RDI	X	X	7–20
RDR	X	X	7–18
RDS	X	X	7–20
RFM	X	X	7–17
RFO	-	X	7–20
RFQ	X	X	7–20

CODE	C	Q	PAGE
RFT	X	X	7–17
RMD	X	X	7–17
RRD	X	X	7–21
RRS	X	X	7–21
RSE	X	X	7–21
RSF	X	X	7–21

CODE	C	Q	PAGE
RSI	X	X	7–21
RSL	-	X	7–21
RSW	X	X	7–22
RXF	-	X	7–22

Sect. 7.5.5 Modem, Unit Commands / Queries

CODE	C	Q	PAGE
AFO	-	X	7–24
AGN	X	X	7–30
AGX	X	X	7–30
CAE	X	-	7–23
CAS	X	-	7–23

CODE	C	Q	PAGE
CFO	-	X	7–23
CID	X	X	7–24
COM	X	X	7–24
DAY	X	X	7–24
EBA	X	X	7–24
EID	-	X	7–25
FRB	X	-	7–26

CODE	C	Q	PAGE
IEP	X	-	7–26
IMG	X	X	7–26
IPA	X	X	7–26
ISP	X	-	7–27
LOP	X	X	7–27
LRS	-	X	7–27
LUF	-	X	7–27
MIS	X	X	7–30

CODE	C	Q	PAGE
MSK	X	X	7–27
NUE	-	X	7–28
NUS	-	X	7–28
PAT	X	X	7–28
RNE	-	X	7–29
RNS	-	X	7–29
SNO	-	X	7–29
SSI	X	X	7–30

CODE	C	Q	PAGE
SWR	-	X	7–30
TIM	X	X	7–30
TMP	-	X	7–30

Sect. 7.5.6 Bulk Configuration Commands / Queries

CODE	C	Q	PAGE
CLD	X-		7–31

CODE	C	Q	PAGE
CST	X	-	7–31

CODE	C	Q	PAGE
MGC	X	X	7–31

Sect. 7.5.7 Automatic Uplink Power Control (AUPC) Commands / Queries

CODE	C	Q	PAGE
AET	X	X	7–32
AMN	X	X	7–32
AMT	X	X	7–32
AMX	X	X	7–32

CODE	C	Q	PAGE
ANP	X	X	7–32
ASI	X	X	7–33
CAA	X	-	7–33
IAP	X	-	7–33

CODE	C	Q	PAGE
LCL	X	X	7–33
LPC	X	X	7–33
NUA	-	X	7–33
RCL	X	X	7–34

CODE	C	Q	PAGE
RNA	-	X	7–34
RPB	X	X	7–34
RPC	X	X	7–34
RPE	-	X	7–34

CODE	C	Q	PAGE
RPL	X	X	7–35

Sect. 7.5.8 Gigabit Ethernet Interface Commands / Queries

CODE	C	Q	PAGE
GFC	X	X	7–36

CODE	C	Q	PAGE
WBL	X	X	7–36

Sect. 7.5.9 ODU Commands / Queries

CODE	C	Q	PAGE
BFR	X	X	7–37
LNC	-	X	7–38

CODE	C	Q	PAGE
LNH	X	X	7–37
LNL	X	X	7–37

CODE	C	Q	PAGE
LNR	X	X	7–37
LPS	X	X	7–37

CODE	C	Q	PAGE
LVO	-	X	7–37

NOTE – Instruction Code Qualifiers, as defined in the following sections, are used as follows in the command/query tables' 'Response to Command' columns:

=	Message ok	*	Message ok, but not permitted in current mode
?	Received ok, but invalid arguments found	#	Message ok, but unit is not in Remote mode

BLANK PAGE

7.5.2 Initial Setup – Priority Commands / Queries

Before executing *any* Modem, Unit, Bulk/Global, AUPC, or Optional Interface commands/queries, initial setup should be accomplished with these three commands, prioritized as follows: (Highest Priority) MOM, RFB, ITF (Lowest Priority). Priority commands are indicated by **shading** throughout these sections. Any change to a higher priority parameter can override any of the parameters of lower priority.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Modem Operating Mode	MOM=	1 byte	Command or Query. Modem Operating Mode, where: 0=OM-73 1=Mil-165A 2=IESS-308 3=IESS-309 4=IESS-310 5=TURBO 6=16QAM 7=AUPC 8=RXBURST 9=TXBURST A=TURBO-FA B=RXBRSTFA C=LDPC Example: MOM=0 (sets OM-73 operating mode)	MOM= MOM? MOM* MOM#	MOM?	MOM=x (see Description of Arguments)
Modem RF Band	N/A	1 byte	Query Only. Modem RF Band, where: 0=Reserved 1=L-Band (950 MHz – 2000 MHz)		RFB?	RFB =x (see Description of Arguments)
Interface Type	ITF=	1 byte	Command or Query. Interface Type, where: 4=GigaBit Ethernet Interface 7=LVDS Test Interface Example: ITF=4 (sets GigaBit Ethernet interface type)	ITF= ITF? ITF* ITF#	ITF?	ITF=x (see Description of Arguments)

7.5.3 Modulator (Tx) Commands / Queries

Tx Priority System = (Highest priority) TFM, TFT, TMD, TCR, and TDR (Lowest Priority). Priority commands indicated by **shading**. Any change to a higher priority parameter can override any of the parameters of lower priority.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Tx Overhead Type	TFM=	1 byte	Command or Query. Tx Overhead Type, where: 0=None (Unframed) 1=IBS 2=IDR 4=AUPC Depending on Modem mode, not all selections will be valid. Example: TFM=0 (selects Unframed mode)	TFM= TFM? TFM* TFM#	TFM?	TFM=x (see Description of Arguments)
Tx FEC Type	TFT=	1 byte	Command or Query. Tx FEC coding type, where: 0=None (Uncoded) 1=Viterbi 2=Turbo 3=Sequential 4=LDPC ULL (Ultra Low Latency) 5=LDPC LL (Low Latency) 6=LDPC HP (High Performance) Example: TFT=2 (selects Turbo coding)	TFT= TFT? TFT* TFT#	TFT?	TFT=x (see Description of Arguments)
Tx Modulation Type	TMD=	1 byte	Command or Query. Tx Modulation type, where: 0=BPSK 1=QPSK 2=OQPSK 3=8PSK 4=16QAM 5=8QAM Depending on FEC type, not all selections will be valid. Example: TMD=1 (selects QPSK)	TMD= TMD? TMD* TMD#	TMD?	TMD=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Tx Code Rate	TCR=	1 byte	Command or Query Tx Code Rate, where: 0 = 1/1 (Uncoded) 1 = 1/2 2 = 3/4 3 = 7/8 4 = 2/3 5 = 5/6 6 = 21/44 7 = 5/16 8 = 17/18 9 = Reserved A = 1/3 B = .541 C = .451 D = .378 Depending on FEC type, not all selections will be valid. Example: TCR=1 (selects Rate 1/2)	TCR= TCR? TCR* TCR#	TCR?	TCR=x (see Description of Arguments)
Tx Data Rate	TDR=	10 bytes	Command or Query. Tx Data rate, in kbps, in the form xxxxxx.xxx. Resolution=1 bps. Example: TDR=002047.999 (selects 2047.999 kbps)	TDR= TDR? TDR* TDR#	TDR?	TDR=xxxxxx.xxx (see Description of Arguments)
Insert Tx BERT Error	BEI=	None	Command only. Insert single bit error in Tx BERT Example: BEI=	BEI= BEI? BEI* BEI#	N/A	N/A
Tx BERT State	BTX=	1 byte	Command or Query. Tx BERT State, where: 0=Off 1=On Example: BTX=1 (Tx BERT On)	BTX= BTX? BTX* BTX#	BTX?	BTX=x (see Description of Arguments)
Tx BPSK Data Ordering	TBO=	1 byte	Command or Query. Invert Transmit BPSK Data Ordering, where:: 0=Standard 1=Non-Standard Example: TBO=1 (selects Inverted BPSK Ordering)	TBO = TBO? TBO* TBO#	TBO?	TBO=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Tx Clock Invert	TCI=	1 byte	Command or Query. Invert Transmit Clock, where: 0=Normal 1=Inverted Example: TCI=1 (selects Inverted TX Clock)	TCI = TCI? TCI* TCI#	TCI?	TCI=x (see Description of Arguments)
Tx Reed-Solomon Code Word	TCW=	1 byte	Command or Query. Tx RS encoding, where: 0 = RS(225,205,10) 1 = RS(219,201,9) 2 = RS(208,192,8) 3 = RS(194,178,8) 4 = RS(126,112,7) 5 = RS(220,200,10) Depending on Modem mode, overhead type, and data rate, not all selections will be valid. Example: TCW=0 (This is a 'don't care' if RS is Off under TRS)	TCW= TCW? TCW* TCW#	TCW?	TCW=x (see Description of Arguments)
Tx Differential Encoding	TDE=	1 byte	Command or Query. Tx Differential Encoding, where: x=Tx Differential Encoding: 0=Off 1=On Depending on FEC type or Modulation Type, not all selections will be valid. Example: TDE=1 (selects Tx Differential Encoding On)	TDE= TDE? TDE* TDE#	TDE?	TDE=x (see Description of Arguments)
Tx Data Fault	TDF=	1 byte	Command or Query. Transmit Data Fault, where: 0=None 1=DATA 2=AIS Example: TDF=0 (selects Data Fault = None)	TDF = TDF? TDF* TDF#	TDF?	TDF=x (see Description of Arguments)
Tx Data Invert	TDI=	1 byte	Command or Query. Invert Transmit Data, where: 0=Normal 1=Inverted Example: TDI=1 (selects Inverted TX Data)	TDI = TDI? TDI* TDI#	TDI?	TDI=x (see Description of Arguments)
Tx Frequency	TFQ=	8 bytes	Command or Query. Tx Frequency, 52 to 88 MHz, 104 to 176 MHz, and 950 to 2000 MHz Resolution = 1000Hz. Example: TFQ=0140.987	TFQ= TFQ? TFQ* TFQ#	TFQ?	TFQ=xxxx.xxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Tx Power Level	TPL=	5 bytes	Command or Query. Tx Output power level, where: s=sign (+ / -) xx.x = Tx Output power level, +10.0 and –40.0 dBm. Example: TPL=-13.4	TPL= TPL? TPL* TPL#	TPL?	TPL=sxx.x (see Description of Arguments)
Tx Reed-Solomon Interleaver Depth	TRD=	1 byte	Command or Query. Tx RS encoding, where: 0 = Interleaver Depth 4 1 = Interleaver Depth 8 2 = Interleaver Depth 16 Depending on Modem mode, overhead type, and data rate, not all selections will be valid. Example: TRD=0 (This is a 'don't care' if RS is Off under TRS)	TRD = TRD? TRD * TRD #	TRD?	TRD =x (see Description of Arguments)
Tx Reed-Solomon Encoding	TRS=	1 byte	Command or Query. Tx RS encoding, where: 0=Off 1=On Depending on Modem mode, not all selections will be valid. Example: TRS=0 (RS encoding is Off)	TRS= TRS? TRS* TRS#	TRS?	TRS=x (see Description of Arguments)
Tx Scrambler	TSC=	1 byte	Command or Query. Tx Scrambler state, where: 0 = Off 1 = OM-73 Scrambler 2 = V.35 Scrambler 3 = Modified V.35 (Comtech EF Data Closed Network) 4 = Reed-Solomon Synchronous Scrambler 5 = IBS Overhead Synchronous Scrambler 6 = TURBO Scrambler Depending on Modem mode, FEC type, overhead type, and RS state, not all selections will be valid. Example: TSC=1 (OM-73 Scrambler On)	TSC= TSC? TSC* TSC#	TSC?	TSC=x (see Description of Arguments)
Tx Spreading Equation	TSE=	5 bytes	Command or Query. Tx Spreading Equation, where: a = Equation 0 or 1: bbbb = GSN 0-9999(eq=0) or GSN 0-4095(eq=1) Example: TSE=00000 (Tx Equation 0 GSN 0000)	TSE= TSE? TSE* TSE#	TSE?	TSE=abbbb (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Tx Spreading Factor	TSF=	4 bytes	Command or Query. Tx Spreading Factor, where xxxx is value from 1 to 512. Values other than 1 are only valid when Modem Type = LDPC. Example: TSF=0001 (Tx Spreading Off)	TSF= TSF? TSF* TSF#	TSF?	TSF=xxxx (see Description of Arguments)
Tx Spectrum Invert	TSI=	1 byte	Command or Query. Tx Spectrum Invert selection, where: 0=Normal, 1=Tx Spectrum Inverted Example: TSI=0 (selects normal)	TSI= TSI? TSI* TSI#	TSI?	TSI=x (see Description of Arguments)
Live Tx Faults	N/A	8 bytes	Query only. Live Tx Faults are returned as a 32 bit Hexadecimal value. Bit values are defined as follows: 80000000 = Modulator Symbol Clock not locked 40000000 = Modulator RF Synthesizer not locked 20000000 = Modulator No IQ Activity 10000000 = Modulator Nyquist Filter Clipping 08000000 = Interface data clock PLLs not locked 04000000 = Interface SCT PLL not locked 02000000 = Interface No Data Activity Example: TXF=00000000 indicates No Tx Faults	N/A	TXF?	TXF=xxxxxxxx (see Description of Arguments)
Tx Carrier State	TXO=	1 byte	Command or Query. Tx Carrier State, where: 0=OFF due to front panel or remote control command 1=ON Example: TXO=1 (Tx Carrier ON)	TXO= TXO? TXO* TXO#	TXO?	TXO=x (see Description of Arguments)

7.5.4 Demodulator (Rx) Commands / Queries

Rx Priority System = (Highest priority) RFM, RFT, RMD, RCR, and RDR (Lowest Priority). Priority commands are indicated by **shading**. Any change to a higher priority parameter can override any of the parameters of lower priority.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Rx Framing Mode	RFM=	1 byte	Command or Query. Rx Overhead Type, where: 0=None (Unframed) 1=IBS 2=IDR 4=AUPC Depending on Modem mode, not all selections will be valid. Example: RFM=0 (selects Unframed mode)	RFM= RFM? RFM* RFM#	RFM?	RFM=x (see Description of Arguments)
Rx FEC Type	RFT=	1 byte	Command or Query. Rx FEC coding type, where: 0=None (Uncoded) 1=Viterbi 2=Turbo 3=Sequential 4=LDPC ULL (Ultra Low Latency) 5=LDPC LL (Low Latency) 6=LDPC HP (High Performance) Example: RFT=2 (selects Turbo coding)	RFT= RFT? RFT* RFT#	RFT?	RFT=x (same format as command argument)
Rx Demod type	RMD=	1 byte	Command or Query. Rx Modulation type, where: 0=BPSK 1=QPSK 2=OQPSK 3=8PSK 4=16QAM 5=8QAM Depending on FEC type, not all selections will be valid. Example: RMD=1 (selects QPSK)	RMD= RMD? RMD* RMD#	RMD?	RMD=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Rx FEC Code Rate	RCR=	1 byte	Command or Query. Rx FEC Code Rate, where: 0 = 1/1 (Uncoded) 1 = 1/2 2 = 3/4 3 = 7/8 4 = 2/3 5 = 5/6 6 = 21/44 7 = 5/16 8 = 17/18 9 = Reserved A = 1/3 B = .541 C = .451 D = .378 Depending on FEC type, not all selections will be valid. Example: RCR=1 (selects Rate 1/2)	RCR= RCR? RCR* RCR#	RCR?	RCR=x (see Description of Arguments)
Rx Data Rate	RDR=	10 bytes	Command or Query. Rx Data rate, in kbps, in the form xxxxxx.xxx. Resolution = 1 bps. Example: RDR=002047.999 (selects 2047.999 kbps)	N/A	RDR?	RDR=xxxxxx.xxx (see Description of Arguments)
Rx BERT BER	N/A	6 bytes	Query only. Unit returns the value of the BERT BER in the form a.b x 10^{-c}, where: First three bytes are the value; Last two bytes are the exponent. Returns 0.0E00 if the BERT is not synchronized to a pattern. Example: BBR=4.9E12	N/A	BBR?	BBR=a.bEcc (see Description of Arguments)
Rx BERT Reset	BRS=	None	Command only. Reset Rx BERT. Example: BRS=	BRS= BRS? BRS* BRS#	N/A	N/A
Rx BERT State	BRX=	1 byte	Command or Query. Rx BERT State, where: 0=Off 1=On Example: BRX=1 (Rx BERT On)	BRX= BRX? BRX* BRX#	BRX?	BRX=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Rx BERT Sync Loss Threshold	BTH=	1 byte	Command or Query. Rx BERT Sync Loss Threshold, where: 0=Low 1=Medium 2=High Example: BTH=1 (Medium)	BTH= BTH? BTH* BTH#	BTH?	BTH=x (see Description of Arguments)
Rx Eb/No	N/A	4 bytes	Query only. Returns the value of Eb/No, between 0 and 20 dB, resolution = 0.1 dB. Returns 99.9 if demod is unlocked. Example: EBN=12.3 (selects Eb/No = 12.3 dB) For values greater than 20.0 dB, the reply will be: EBN=+020	N/A	EBN?	EBN=xxxx (see Description of Arguments)
Rx BERT Errors	N/A	7 bytes	Query only. Read the total number of Bit Errors. Example: ERR=9999999	N/A	ERR?	N/A
Rx BPSK Data Ordering	RBO=	1 byte	Command or Query. Invert Receive BPSK Data Ordering in the form x, where: 0=Standard 1=Non-Standard Example: RBO=1 (selects Inverted BPSK Ordering)	RBO = RBO? RBO* RBO#	RBO?	RBO=x (see Description of Arguments)
Rx Clock Invert	RCI=	1 byte	Command or Query. Invert Receive Clock in the form x, where: 0=Normal 1=Inverted Example: RCI=1 (selects Inverted RX Clock)	RCI = RCI? RCI* RCI#	RCI?	RCI=x (see Description of Arguments)
Rx Reed-Solomon Code Word	RCW=	1 byte	Command or Query. Rx RS encoding in the form x, where: 0 = RS(225,205,10) 1 = RS(219,201,9) 2 = RS(208,192,8) 3 = RS(194,178,8) 4 = RS(126,112,7) 5 = RS(220,200,10) Depending on Modem mode, overhead type, and data rate, not all selections will be valid. Example: RCW=0 (This is a 'don't care' if RS is Off under TRS)	RCW = RCW? RCW * RCW #	RCW?	RCW=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Rx Differential Decoding	RDD=	1 byte	Command or Query. Rx Differential Decoding in the form x, where: 0=Off 1=On Depending on FEC type or Modulation Type, not all selections will be valid. Example: RDD=1 (selects Rx Differential Decoding On)	RDD= RDD? RDD* RDD#	RDD?	RDD=x (see Description of Arguments)
Rx Data Fault	RDF=	1 byte	Command or Query. Receive Data Fault, where: 0=None 1=DATA 2=AIS Example: RDF=0 (selects Data Fault = None)	RDF = RDF? RDF* RDF#	RDF?	RDF=x (see Description of Arguments)
Rx Data Invert	RDI=	1 byte	Command or Query. Invert Receive Data, where: 0=Normal 1=Inverted Example: RDI=1 (selects Inverted RX Data)	RDI = RDI? RDI* RDI#	RDI?	RDI=x (see Description of Arguments)
Rx Descrambler	RDS=	1 byte	Command or Query. Rx Scrambler state, where: 0 = Off 1 = OM-73 Scrambler 2 = IESS-V.35 Scrambler 3 = Modified V.35 (Comtech EF Data Closed Network) 4 = Reed-Solomon Synchronous Scrambler 5 = IBS Overhead Synchronous Scrambler 6 = TURBO Scrambler Depending on Modem mode, FEC type, overhead type, and RS state, not all selections will be valid. Example: RDS=1 (OM-73 Scrambler On)	RDS= RDS? RDS* RDS#	RDS?	RDS=x (see Description of Arguments)
Rx Frequency Offset	N/A	5 bytes	Query only. Unit returns the value of the measured frequency offset of the carrier being demodulated. Values range from ± 0 to ± 30 kHz, 100 Hz resolution. Returns 99999 if the demodulator is unlocked. Example: RFO=+02.3 (selects + 2.3 kHz)	N/A	RFO?	RFO=xxxxx (see Description of Arguments)
Rx Frequency	RFQ=	8 bytes	Command or Query. Rx Frequency, 52 to 88 MHz, 104 to 176 MHz, and 950 to 2000 MHz. Resolution = 1000Hz. Example: RFQ=0140.987	RFQ= RFQ? RFQ* RFQ#	RFQ?	RFQ=xxxx.xxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Rx Reed-Solomon Interleaver Depth	RRD=	1 byte	Command or Query. Rx RS encoding, where: 0 = Interleaver Depth 4 1 = Interleaver Depth 8 2 = Interleaver Depth 16 Depending on Modem mode, overhead type, and data rate, not all selections will be valid. Example: RRD=0 (This is a 'don't care' if RS is Off under RRS)	RRD = RRD? RRD * RRD #	RRD?	RRD =x (see Description of Arguments)
Rx Reed-Solomon Decoding	RRS=	1 byte	Command or Query. Rx RS encoding, where: 0=Off 1=On Depending on Modem mode, not all selections will be valid. Example: RRS=0 (RS encoding is Off)	RRS= RRS? RRS* RRS#	RRS?	RRS=x (see Description of Arguments)
Rx Spreading Equation	RSE=	5 bytes	Command or Query. Rx Spreading Equation, where: a = Equation 0 or 1: bbbb = GSN 0-9999(eq=0) or GSN 0-4095(eq=1) Example: RSE=00000 (Rx Equation 0 GSN 0000)	RSE= RSE? RSE* RSE#	RSE?	RSE=abbbb (See Description of Arguments)
Rx Spreading Factor	RSF=	4 bytes	Command or Query. Rx Spreading Factor, where xxxx is value from 1 to 512. Values other than 1 are only valid when Modem Type = LDPC. Example: RSF=0001 (Rx Spreading Off)	RSF= RSF? RSF* RSF#	RSF?	RSF=xxxx (See Description of Arguments)
Rx Spectrum Invert	RSI=	1 byte	Command or Query. Rx Spectrum Invert, where: 0=Normal 1=Rx Spectrum Invert Example: RSI=0 (selects Normal)	RSI= RSI? RSI* RSI#	RSI?	RSI=x (see Description of Arguments)
Rx Signal Level	N/A	5 bytes	Query only. Unit returns the value of the Rx signal level in the form sxx.x, where: s = + (positive) or – (negative) sign xx.x – Rx signal level value in dBm, between +15.0 and –60.0 dBm Examples: RSL = +99.9 (RSL > +15.0 dBm) RSL = +15.0 RSL = -60.0 RSL = -99.9 (RSL < -60.0 dBm)	N/A	RSL?	RSL=sxx.x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Rx Demod Acquisition Sweep Range	RSW=	8 bytes	Command or Query. Rx acquisition sweep range of demodulator, in kHz, ranging from 0 to 60 kHz. Example: RSW=0060.000 (selects 60 kHz)	RSW= RSW? RSW* RSW#	RSW?	RSW=xxxx.xxx (see Description of Arguments)
Live Rx Faults	N/A	8 bytes	Query only. Live Rx Faults are returned as a 32 bit Hexadecimal value. Bit values are defined as follows: 80000000 = Demodulator IF not locked 40000000 = Demodulator Data Decoder not locked 20000000 = Demodulator RF Synthesizer not locked 10000000 = Demodulator No IQ Activity 08000000 = Interface De-Multiplexers not locked 04000000 = Interface Buffer Clock PLL not locked 02000000 = Interface Data/AIS 01000000 = Eb/No Threshold exceeded 00800000 = Composite Power > 20 dBm 00400000 = Composite Power > 40 dBc 00200000 = BERT Sync Loss 00100000 = LNB Voltage out of range 00080000 = LNB Current out of range Example: RXF=00000000 indicates No Rx Faults	N/A	RXF?	RXF=xxxxxxxx (see Description of Arguments)

7.5.5 Modem, Unit Commands / Queries

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Clear All Stored Events	CAE=	None	Command only. Forces the software to clear the software events log. Note: This command takes no arguments Example: CAE=	CAE= CAE? CAE* CAE#	N/A	N/A
Clear All Stored Statistics	CAS=	None	Command only. Forces the software to clear the software statistics log. Note: This command takes no arguments Example: CAS=	CAS= CAS? CAS* CAS#	N/A	N/A
Configured FAST Options	N/A	16 bytes	Query only. Unit returns information concerning the Configured FAST Options, and the option field, in the form abcdefghxxxxxxxx, where: a = QOS: 0 = Not Installed 1 = Installed b = Reserved c = Spectrum Spreading d = Management Security: 0 = Not Installed 1 = Installed e = Vipersat Compatibility: 0 = Not Installed 1 = Installed f = Reserved g = Transec Data Rate Option: 0 = Base (5,000 kbps), 1 = 10,000 kbps 2 = 20,000 kbps 3 = 51,840 kbps 4 = 155,520 kbps 5 = 2,500 kbps	N/A	CFO?	CFO=abcdefghijxxxxxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Configured FAST Options (Continued)			h = Vipersat Data Rate Option: 0 = Base (5,000 kbps), 1 = 10,000 kbps 2 = 20,000 kbps 3 = 51,840 kbps, 4 = 155,520 kbps 5 = 2,500 kbps i = Bridged Point to Multipoint: 0 = Not Installed 1 = Installed j = Customer Defined Options: 0-3 x = spare			
Advanced FAST Options	N/A	16 bytes	Query only. Unit returns information concerning the Advanced FAST Options, and the option field, in the form xxxxxxxxxxxxxxx, where: x = spare	N/A	AFO?	AFO=xxxxxxxxxxxxxxx (see Description of Arguments)
Circuit ID String	CID=	24 bytes	Command or Query. Sets or queries the user-defined Circuit ID string, which is a fixed length of 24 characters. Valid characters include: Space ( ) * + – , . / 0 9 and A thru Z	CID= CID? CID* CID#	CID?	CID=x (see Description of Arguments)
Carrier Only Test Modes	COM=	1 byte	Command or Query. Test Mode, where: 0= Normal Mode (no test) 1=Tx CW 2=Tx Alternating 1,0 Pattern Example: COM=1 (CW Mode)	COM= COM? COM* COM#	COM?	COM=x (see Description of Arguments)
RTC Date	DAY=	6 bytes	Command or Query. A date in the form ddmmyy, where: dd = day of the month (01 to 31) mm = month (01 to 12) yy = year (00 to 99) Example: DAY=240457 (April 24, 2057)	DAY= DAY? DAY* DAY#	DAY?	DAY=ddmmyy (see Description of Arguments)
Eb/No Alarm Point	EBA=	4 bytes	Command or Query. Eb/No alarm point in dB, with a range between 0.1 and 20 dB. Resolution = 0.1 dB. Example: EBA=12.3	EBA= EBA? EBA* EBA#	EBA?	EBA=xx.x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Equipment ID	N/A	17 bytes	Query only. Unit returns information concerning the equipment identification, and the option field, in the form aaaabcdefghijklmx where: aaaa = defines the modem model number (565C) b = Advanced FEC: 0 = None 1 = TPC 2 = TPC + LDPC c = Advanced FEC Data Rate: 0 = Base (5,000 kbps) 1 = 10,000 kbps 2 = 20,000 kbps 3 = 51,840 kbps 4 = 155,520 kbps 5 = 2,500 kbps d = Data Interface: 2 = GigaBit Ethernet e = Data Rate (Asymmetric Tx) Option: 0 = Base (5,000 kbps), 1 = 10,000 kbps 2 = 20,000 kbps 3 = 51,840 kbps 4 = 155,520 kbps 5 = 2,500 kbps f = Higher-order modulation: 0 = None 1 = 8PSK 2 = 8PSK and 16QAM g = Reed-Solomon Codec Option: 0 = None 1 = Installed	N/A	EID?	EID=aaaabcdefghijklmx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Equipment ID (Continued)			h = Transec: 0 = None 1 = Transec Installed i = AUPC Option: 0 = None 1 = Installed j = Reserved k = Demod Only l = CnC Data Rate: 0 = None m = Sequential Encoding/Decoding Option: 0 = None 1 = Installed x = Asymmetric Rx Data Rate 0 = None 1 = 10,000 kbps 2 = 20,000 kbps, 3 = 51,840 kbps 4 = 155,520 kbps 5 = 2,500 kbps **Example:** EID=565C00000000000000 indicates SLM-5650C with no options installed			
Force Modem Reboot	FRB=	None	Command only. Reboot the modem. **Example:** FRB=	FRB= FRB#	N/A	N/A
Initialize Events Pointer	IEP=	None	Command only. Resets internal pointer to allow RNE? queries to start at the beginning of the stored events log.	IEP= IEP#	N/A	N/A
Software Image	IMG=	1 bytes	Command or Query. Next Reboot Image, where: 1 = Bulk Image #1 2 = Bulk Image #2 **Example:** IMG=1 (Image #1 will be active after next reboot)	IMG= IMG? IMG* IMG#	IMG?	IMG=x (see Description of Arguments)
IP Address	IPA=	18 bytes	Command or Query. Used to set the IP address and network prefix for the 10/100 BaseTx Ethernet management port, in the format xxx.xxx.xxx.xxx.yy, where: xxx.xxx.xxx.xxx is the IP address, and yy is the network prefix (0-31) **Example:** 010.006.030.001.24	IPA= IPA? IPA* IPA#	IPA?	IPA= xx.xxx.xxx.xxx.yy (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Initialize Statistics Pointer	ISP=	None	Command only. Resets internal pointer to allow RNS? queries to start at the beginning of the stored statistics log.	ISP= ISP#	N/A	N/A
LoopBack Test Modes	LOP=	1 byte	Command or Query. Loopback Test Modes, where: 0=Normal Mode (no test) 1=IF Loopback Example: LOP=1 (IF Loopback)	LOP= LOP? LOP* LOP#	LOP?	LOP=x (see Description of Arguments)
Local/Remote Status	N/A	1 byte	Query Only. Local/Remote status, where: 3=Serial + Ethernet Remote Control		LRS?	LRS=x (see Description of Arguments)
Modem Alarm Mask	MSK=	6 bytes	Command or Query. Alarm mask conditions, in the form abcdef, where: a=spare (must be set to 0) b=spare (must be set to 0) c=spare (must be set to 0) d=spare (must be set to 0) e=Demod Faults 0 = unmasked 1 = masked f=Eb/No Threshold Alarm 0 = unmasked 1 = masked Example: MSK=000001	MSK= MSK? MSK* MSK#	MSK?	MSK=abcdef (see Description of Arguments)
Live Unit Faults	N/A	8 bytes	Query only. Live Unit Faults are returned as a 32 bit Hexadecimal value. Bit values are defined as follows: 80000000 = Internal Power Fault 40000000 = 20 MHz Ref Clock not locked 20000000 = 250 MHz Clock not locked 10000000 = FPGA not loaded 08000000 = TRANSEC not ready 04000000 = Modem over temperature Example: LUF=00000000 indicates No Unit Faults	N/A	LUF?	LUF=xxxxxxxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Number of Unread stored Events	N/A	3 bytes	Query only. Unit returns the Number of stored Events, which remain Unread, in the form xxx. Note: This means unread over the remote control. Example: NUE=126	N/A	NUE?	NUE=xxx (see Description of Arguments)
Number of Unread stored Statistics	N/A	3 bytes	Query only. Unit returns the Number of stored Statistics, which remain Unread, in the form xxx. Note: This means unread over the remote control. Example: NUS=126	N/A	NUS?	NUS=xxx (see Description of Arguments)
BERT Pattern	PAT=	1 byte	Command or Query. BERT Pattern, where: 0=2047 1=Mark 2=Space 3=1:1 4=1:2 5=2^15-1 6=2^20-1 7=2^23-1 8=MIL-188 Example: PAT=0 (2047 Pattern)	PAT= PAT? PAT* PAT#	PAT?	PAT=x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Retrieve next 5 unread Stored Events	N/A	110 bytes	Query only. Unit returns the oldest 5 Stored Events which have not yet been read over the remote control. Reply format: {CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body, where Sub-body= Axxxxxxxxddmmyyhhmmss, A being the fault type where: 1=Unit 2=Rx Traffic 3=Tx Traffic 4=Info xxxxxxxx is the Fault Code number, as in LUF?, TXF?, RXF?, or Info Code, which is: 00000000=Power Off 00000001=Power On 00000002=Log Cleared 00000004=Global Config Change 00000007=Transec Boot Timeout If there are less than 5 events to be retrieved, the remaining positions are padded with zeros. If there are no new events, the response is RNE*.	N/A	RNE?	RNE={CR}Axxxxxxxxddmmyyhhmmss {CR}Axxxxxxxxddmmyyhhmmss {CR}Axxxxxxxxddmmyyhhmmss {CR}Axxxxxxxxddmmyyhhmmss {CR}Axxxxxxxxddmmyyhhmmss (see Description of Arguments)
Retrieve next 5 unread Stored Statistics	N/A	105 bytes	Query only. Unit returns the oldest 5 Stored Statistics which have not yet been read over the remote control. Reply format: {CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body, where Sub-body= AA.ABB.Bddmmyyhhmmss, AA.A = Minimum Eb/No during sample period. “Loss” is displayed if carrier was lost during the sample period. BB.B = Average Eb/No during sample period. “Loss” is displayed if carrier was lost during the entire sample period. If there are less than 5 events to be retrieved, the remaining positions are padded with zeros. If there are no new events, the response is RNS*.	N/A	RNS?	RNS={CR}AA.ABB.Bddmmyyhhmmss {CR}AA.ABB.Bddmmyyhhmmss {CR}AA.ABB.Bddmmyyhhmmss {CR}AA.ABB.Bddmmyyhhmmss {CR}AA.ABB.Bddmmyyhhmmss (see Description for Arguments)
Serial Number	N/A	9 bytes	Query only. Used to query the unit 9-digit serial number. Unit returns its S/N in the form xxxxxxxxx. Example: SNO=176500143	N/A	SNO?	SNO=xxxxxxxxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Statistics Sample Interval	SSI=	1 byte	Command or Query. Used to set the sample interval for the Statistics Logging Function. SSI=x, where x = 0 to 9 in 10 minute steps. Note: Setting this parameter to 0 disables the statistics logging function. Example: SSI=3 sets the logging inverval to 30 minutes.	SSI= SSI? SSI* SSI#	SSI?	SSI=x (see Description of Arguments)
Software Revision	N/A	43 bytes	Query only. Unit returns the value of the internal software revision installed in the unit, in the form: Boot:xx.yy.zz Bulk1:xx.yy.zz Bulk2:xx.yy.zz Example: SWR=Boot:01.01.01 Bulk1:01.01.01 Bulk2:01.01.01	N/A	SWR?	SWR=Boot:xx.yy.zz Bulk1:xx.yy.zz Bulk2:xx.yy.zz (see Description of Arguments)
RTC Time	TIM=	6 bytes	Command or Query. A time in the form hhmmss, indicating the time from midnight, where: hh = hours (00 to 23) mm = minutes (00 to 59) ss = seconds (00 to 59) Example: TIM=231259 (23 hours:12 minutes:59 seconds)	TIM= TIM? TIM* TIM#	TIM?	TIM=hhmmss (see Description of Arguments)
Temperature	N/A	3 bytes	Query only. Unit returns the value of the internal temperature, in the form of xxx (degrees C). Example: TMP=+26	N/A	TMP?	TMP=xxx (see Description of Arguments)
AGC Monitor Min Voltage	AGN=	3 bytes	Command or Query. Used to set the AGC Monitor Min Voltage to x.x (0 to 5 Volts), i.e. -60 dBm Example: AGN=1.0	AGN= AGN? AGN* AGN#	AGN?	AGN=x.x (see Description of Arguments)
AGC Monitor Max Voltage	AGX=	3 bytes	Command or Query. Used to set the AGC Monitor Max Voltage to x.x (0 to 5 Volts), i.e. +15 dBm Example: AGX=5.0	AGX= AGX? AGX* AGX#	AGX?	AGX=x.x (see Description of Arguments)
Modem IP Interface Security Mode	MIS=	1 byte	Command or Query. Used to set the modem IP Interface security level where: 0 = Normal or Low Level Security (SNMP v1/v2c) 1 = High Level Security (SNMP v3) Example: MIS=0	MIS= MIS? MIS* MIS#	MIS?	MIS=x (see Description of Arguments)

7.5.6 Bulk Configuration Commands / Queries

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Configuration Load	CLD=	1 byte	Command only. Causes the modem to retrieve a previously stored configuration from Configuration Memory location defined by the one-byte argument (0 to 9). Example: CLD=4 (retrieve modem configuration from location 4)	CLD= CLD? CLD* CLD#	N/A	N/A
Configuration Save	CST=	1 byte	Command only. Command causes the modem to store the current configuration in Configuration Memory location defined by the one-byte argument (0 to 9). Example: CST=4 (store the current configuration in location 4)	CST= CST? CST* CST#	N/A	N/A
Global Configuration	MGC=	217 bytes	Command or Query.	MGC= MGC? MGC* MGC#	MGC?	(see Description of Arguments)

7.5.7 Automatic Uplink Power Control (AUPC) Commands / Queries

The instruction codes that follow are valid only when the SLM-5650C Satellite Modem type has been set to **AUPC**.

Note: Always wait three (3) seconds between consecutive remote modem command/query polls. If Local AUPC is not enabled, queries will return the last known condition. A request for status from the remote modem will then be transmitted, ensuring that the next query will return current status.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
AUPC Eb/No Target Set Point	AET=	4 bytes	Command or Query. AUPC Eb/No Target, where: xx.x = AUPC Eb/No Target, 3.2 to 16.0 dB. Example: AET=13.4	AET= AET? AET* AET#	AET?	AET=xx.x (see Description of Arguments)
AUPC Minimum Power Level	AMN=	5 bytes	Command or Query. Minimum Tx Output power level, where: s=sign (+ / –) xx.x = Tx Output power level, +10.0 and –40.0 dBm. Example: AMN = –13.4	AMN= AMN? AMN* AMN#	AMN?	AMN=sxx.x (see Description of Arguments)
AUPC Maximum Tracking Rate	AMT=	3 bytes	Command or Query. AUPC Maximum Tracking Rate, where: x.x = Maximum Tracking Rate, 0.5 to 6.0 dBm/minute in increments of .5. Example: AMT=0.5	AMT= AMT? AMT* AMT#	AMT?	AMT=x.x (see Description of Arguments)
AUPC Maximum Power Level	AMX=	5 bytes	Command or Query. Maximum Tx Output power level, where: s=sign (+ / -) xx.x = Tx Output power level, +10.0 and –40.0 dBm. Example: AMX=-13.4	AMX= AMX? AMX* AMX#	AMX?	AMX=sxx.x (see Description of Arguments)
AUPC Nominal Power Level	ANP=	5 bytes	Command or Query. Nominal Tx Output power level, where: s=sign (+ / -) xx.x = Tx Output power level, +10.0 and –40.0 dBm. Example: ANP=-13.4	ANP= ANP? ANP* ANP#	ANP?	ANP=sxx.x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
AUPC Log Sample Interval	ASI=	1 byte	Command or Query. Used to set the sample interval for the AUPC Logging Function in the form x, where: x = 0 to 9 in 10 minute steps. Note: Setting this parameter to 0 disables the logging function. Example: ASI=3 (sets the logging inverval to 30 minutes)	ASI= ASI? ASI* ASI#	ASI?	ASI=x (see Description of Arguments)
Clear All AUPC Log Entries	CAA=	None	Command only. Forces the software to clear the software AUPC log. Note: This command takes no arguments. Example: AAS=	CAA= CAA? CAA* CAA#	N/A	N/A
Initialize AUPC Log Pointer	IAP=	None	Command only. Resets internal pointer to allow RNA? queries to start at the beginning of the stored statistics log.	IAP= IAP#	N/A	N/A
AUPC Local Carrier Loss Action	LCL=	1 byte	Command or Query. Tx Output Power level setting when local carrier is lost, where: 0=Hold current output power level 1=Goto Nominal output power level 2=Goto Maximum output power level Example: LCL=0	LCL= LCL? LCL* LCL#	LCL?	LCL=x (see Description of Arguments)
AUPC Local Enable	LPC=	1 byte	Command or Query. Local AUPC Control, where: 0=Off 1=On Note: When Local AUPC Control is enabled, modulator output power is automatically controlled by the modem. Power output commands via TPL are not allowed during this mode; although, queries will function as normal. Example: LPC=1 (Turn on Local AUPC Control)	LPC= LPC? LPC* LPC#	LPC?	LPC=x (see Description of Arguments)
Number of Unread AUPC Log Entries	N/A	3 bytes	Query only. Unit returns the Number of AUPC Log Entries, which remain Unread, in the form xxx. Note: This means unread over the remote control. Example: NUS=126	N/A	NUA?	NUA=xxx (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Retrieve next 5 unread AUPC Log Entries	N/A	155 bytes	Query only. Unit returns the oldest 5 AUPC Log Entries which have not yet been read over the remote control. Reply format: {CR}Sub-body{CR}Sub-body{CR}Sub-body{CR} Sub-body{CR}Sub-body, where Sub-body= AA.ABB.BCCC.CEEE.Eddmmyyhhmmss: AA.A = Minimum Eb/No during sample period. BB.B = Average Eb/No during sample period. CCC.C = Max Output Power during sample period. EEE.E = Average Output Power during sample period. If there are less than 5 events to be retrieved, the remaining positions are padded with zeros. If there are no new events, the response is RNA*.	N/A	RNA?	RNA= {CR}AA.ABB.BCCC.CEEE.Eddmmyyhhmmss{CR}AA.ABB.BCCC.CEEE.Eddmmyyhhmmss{CR}AA.ABB.BCCC.CEEE.Eddmmyyhhmmss{CR}AA.ABB.BCCC.CEEE.Eddmmyyhhmmss{CR}AA.ABB.BCCC.CEEE.Eddmmyyhhmmss (see Description of Arguments)
AUPC Remote Carrier Loss Action	RCL=	1 byte	Command or Query. Tx Output Power level setting when remote carrier is lost, where: 0=Hold current output power level 1=Goto Nominal output power level 2=Goto Maximum output power level Example: RCL=0	RCL= RCL? RCL* RCL#	RCL?	RCL=x (see Description of Arguments)
Remote Modem Pattern Substitution	RPB=	1 byte	Command or Query. Remote Modem Tx Pattern Substitution, where: 0=Off 1=On Note: For compatibility reasons, only the 2047 Tx pattern can be turned On or Off at the remote modem. Example: RPB=1 (Turn on remote modem AUPC Control)	RPB= RPB? RPB* RPB#	RPB?	RPB=x (see Description of Arguments)
Remote Modem AUPC Enable	RPC=	1 byte	Command or Query. Remote Modem AUPC Control, where: 0=Off 1=On Example: RPC=1 (Turn on remote modem AUPC Control)	RPC= RPC? RPC* RPC#	RPC?	RPC=x (see Description of Arguments)
Remote Modem BERT BER	N/A	6 bytes	Query only. Unit returns the value of the remote modem's BERT BER in the form a.b x 10^{-c}. First three bytes are the value. Last two bytes are the exponent. Returns 0.0E00 if the BERT is not synchronized to a pattern. Example: RPE=4.0E06	N/A	RPE?	RPE=a.bEcc (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
Remote Modem I/O Loopback	RPL=	1 byte	Command or Query. Remote Modem I/O Loopback Mode, where: 0=Off 1=On Example: RPL=1 (Turn on remote modem AUPC Control)	RPL= RPL? RPL* RPL#	RPL?	RPL=x (see Description of Arguments)

7.5.8 Gigabit Ethernet Interface Commands / Queries

The instruction codes that follow are valid only when the internal 10/100/1000 BaseT Gigabit Ethernet Interface is installed in the SLM-5650C Satellite Modem.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
GBEI Flow Control	GFC=	1 byte	Command or Query. Used to Enable/Disable Pause Frame flow control on the internal GBEI Interface, where x is: 0 = Disabled 1 = Enabled Example: GFC=0	GFC= GFC? GFC* GFC#	GFC?	GFC=x (see Description of Arguments)
GBEI Wan Buffer Length	WBL=	3 bytes	Command or Query. Used to set the WAN Buffer (transmit) Length, where xxx is in range from 020 mSec to 240 mSec Example: WBL=020	WBL= WBL? WBL* WBL#	WBL?	WBL=xxx (see Description of Arguments)

7.5.9 ODU Commands / Queries

The instruction codes that follow control 10 MHz references and power for Outdoor Units.

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
BUC 10 MHz Reference	BFR=	1 byte	Command or Query. Used to Enable/Disable the BUC 10 MHz Reference, where: 0 = Disable 1 = Enable Example: BFR=0	BFR= BFR? BFR* BFR#	BFR?	BFR=x (see Description of Arguments)
LNB 10 MHz Reference	LNR=	1 byte	Command or Query. Used to Enable/Disable the LNB 10 MHz Reference, where: 0 = Disable 1 = Enable Example: LNR=0	LNR= LNR? LNR* LNR#	LNR?	LNR=x (see Description of Arguments)
LNB Power Control	LPS=	1 byte	Command or Query. Used to set the LNB Power, where: 0 = Off (0V) 1 = 13V 2 = 18V 3 = 19V 4 = 24V Example: LPS=0	LPS= LPS? LPS* LPS#	LPS?	LPS=x (see Description of Arguments)
LNB Lower Current Limit	LNL=	3 bytes	Command or Query. Used to set the LNB Current Monitor lower limit, where xxx is in the range from 0 mA to 500 mA. Must be less than the currently set Upper Current Limit. Example: LNL=000	LNL= LNL? LNL* LNL#	LNL?	LNL=xxx (see Description of Arguments)
LNB Upper Current Limit	LNH=	3 bytes	Command or Query. Used to set the LNB Current Monitor upper limit, where xxx is in the range from 0 mA to 500 mA. Must be greater than the currently set Lower Current Limit. Example: LNH=500	LNH= LNH? LNH* LNH#	LNH?	LNH=xxx (see Description of Arguments)
LNB Voltage Monitor	N/A	4 bytes	Query only. Used to monitor the LNB Voltage, where xx.x is in V. Example: LVO=24.0	N/A	LVO?	LVO=xx.x (see Description of Arguments)

Parameter Type	Command (Instruction Code and Qualifier)	Arguments for Command or Response to Query	Description of Arguments	Response to Command	Query (Instruction Code and Qualifier)	Response to Query
LNB Current Monitor	N/A	3 bytes	Query only. Used to monitor the LNB current, where xxx is in mA. Example: LNC=250	N/A	LNC?	LNC=xxx (see Description of Arguments)

Chapter 8. 10/100/1000BASE-T (GbE) INTERFACE

8.1 Introduction

The 10/100/1000BASE-T Ethernet – or Gigabit Ethernet (GbE) – Interface acts as an Ethernet bridge for data traffic. IP traffic entering the GbE Interface is encapsulated in HDLC protocol for transmission over the satellite link. HDLC CRC-16 verification is performed on all received (from WAN) HDLC frames. The GbE user interface is a single IEEE 802.3ab 1000BASE-T copper compliant female RJ-45 connector, wired as described in Table 8-1. The interface is set to Auto-Negotiate only.

8.2 Physical Description

The SLM-5650C LAN interface consists of an RJ-45 connector with link status and link activity LED indicators.

8.2.1 Connector Pinout

The GbE Interface is comprised of one IEEE 802.3ab 1000Base-T copper interface via a single 'RJ-45' type female connector. The LAN interface supports 10/100/1000BASE-T operation.

Table 8-1. Connector Pinout

Pin #	Description	Direction
1	BI_DA+	bidirectional
2	BI_DA-	bidirectional
3	BI_DB+	bidirectional
4	BI_DC+	bidirectional
5	BI_DC-	bidirectional
6	BI_DB-	bidirectional
7	BI_DD+	bidirectional
8	BI_DD-	bidirectional

8.3 General Specifications

Table 8-2. GbE Interface General Specifications

General Specifications	
Data Framing	10/100/1000BASE-T Interface: RFC-894 "Ethernet"
Data Framing Format (WAN)	HDLC (Standard Single Channel)
Connector	RJ-45 female, 100Ω
Electrical Properties	Per IEEE 802.3ab
Packet Types	Burst, distributed, or IPV4
Signal Types	Serial data
Voltage Level	Per IEEE- 802.3ab
Packet Latency	50 ms maximum
Flow Control	None
Cable Length, Maximum	100 meters CAT 5 cable, patch cords and connecting hardware, per ISO/IEC 11801:1995 and ANSI/EIA/TIA-568-A (1995)
Hot Pluggable Cable	Yes
LEDs	Link Status, link activity

Appendix A. TROUBLESHOOTING

A.1 Overview

This appendix provides information pertaining to the SLM-5650C Satellite Modem's system checkout and fault isolation and identification.

A.2 Common Setup Issues

Check the following items if you encounter setup issues:

- Physical setup
- Test Mode left on
- TRANSEC encryption left on
- Modem type
- Modulator off

A.3 System Check

Chapter 6. MODEM CONFIGURATION

Use **Chapter 6. MODEM CONFIGURATION** to perform the system checks located in this section.

A.3.1 Initial System Check

Use the Modem Status page to check the modem's operational link. Current fault events are displayed along with the receive signal level, Eb/No, Rx Frequency Offset, etc.

The modem status LEDs provide a visual indication for the status of the modem.

- Tx PWR ON: The middle LED
- Rx Lock: The LED next to the Tx SMA connector
- PWR\FAULT: The LED next to the power connector

There are LEDs on the Ethernet connectors indicating Ethernet connection status.

Figure A-1. Indoor SLM-5650C LED Status

Table A-1. Indoor Unit Connectors and indicators

Item Number	Description
1	Remote
2	Traffic
3	Management
4	Rx
5	+5 VDC
6	PWR / FAULT
7	Tx PWR ON
8	Rx LOCK
9	Tx

The following table describes the LED conditions:

Table A-2. Indoor SLM-5650C LED Conditions

Comment	LED RxLOCK	LED TxPWR ON	LED PWR/ FAULT
No faults Rx signal in Tx on	Green	Green	Green blinking
No Receive	Off, occasional blink*	Green	Red Blinking
Tx off	Green with demod lock	Off	Green blinking
Tx off No receive	Off, occasional blink*	Off	Red Blinking

* Momentary demodulator false lock

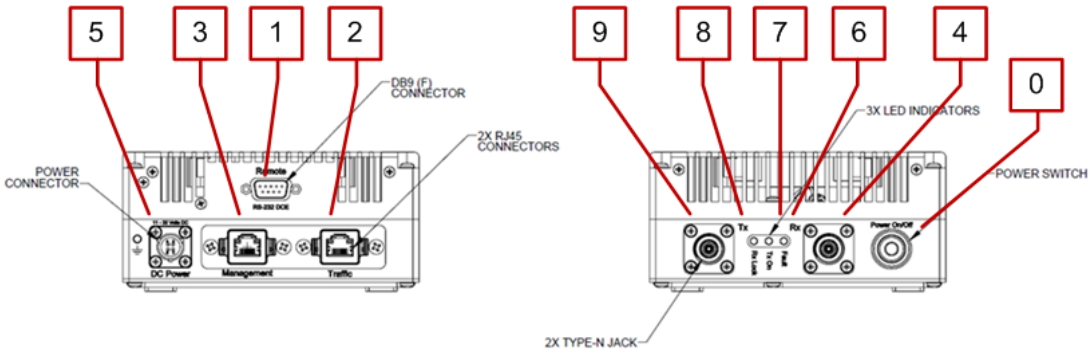


Figure A-2. Outdoor SLM-5650C LED Status

Table A-3. Outdoor Unit Connectors and indicators

Item Number	Description
0	Power Switch and Indicator
1	Remote
2	Traffic
3	Management
4	Rx
5	+5 VDC
6	PWR / FAULT
7	Tx PWR ON
8	Rx LOCK
9	Tx

The following table describes the LED conditions:

Table A-4. Outdoor SLM-5650C LED Conditions

Comment	LED RxLOCK	LED TxPWR ON	LED FAULT
No faults Rx signal in Tx on	Green	Green	Green blinking
No Receive	Off, occasional blink*	Green	Red Blinking
Tx off	Green with demod lock	Off	Green blinking
Tx off No receive	Off, occasional blink*	Off	Red Blinking

* Momentary demodulator false lock

A.3.1.1 System Check using IF Loopback and Internal BERT

The SLM-5650C modem can be tested independently using IF loopback and the Internal BERT.

Step	Task
1	Turn off IF loopback before changing Modem Types.
2	Reset the modem configuration to Modem Type defaults. a. Change the Modem Type to a selection other than your desired test selection. b. Change the Modem Type to your desired test selection.
3	Turn on IF loopback and the internal BERT.
4	Go to the Status | Status Page (Figure A-3) and check for Eb/No and the Internal BERT. BERT BER: 0.0E-05 Errors Received: 0000000 Note: The internal BERT data overwrites the Ethernet stream so there will be faults when viewing the Status \ Port Statistics WEB page.

SLM-5650C :: Comtech EF Data Modem :: Status

Unit Status · Tx Status · Tx On · Events · Test
Rx Status · IF Lock · Data Lock · Encryption

Home | Admin | Configuration | Status

Status | Info | EventLog | ModemStatistics | PortStatistics | ConfigLog | Firmware | Constellation

Alarms		RX Parameters	
Unit:	00000000	Eb/No:	>20.0 dB
Tx:	00000000	EVM:	34.3 dB
Rx:	00000000	Receive Signal Level:	-16.0 dBm
		Composite Pwr:	-39.3 dBm
		Freq Offset:	-0000076 Hz
Symbol Rates		**BERT**	
Tx:	5870.933 ksps	BER:	N/A
Rx:	5870.933 ksps	Errors Received:	N/A
Chip Rates		**General Status**	
Tx:	5870.933 kcps	EventLog Length:	3
Rx:	5870.933 kcps	Fan State:	Off
Internal Temperatures			
RF:	53 °C	M&C:	53 °C
FPGA:	58 °C		

Figure A-3. Status | Status Page

A.3.1.2 Tx Waveform Check

Step	Task
1	Use a spectrum analyzer to check the Tx modulated waveform.
2	Figure A-4 shows proper waveform output of the Tx RF path for block up converters, splitters, or high-powered amplifiers. a. The top of the waveform should not be distorted or have any slope in the operating frequency band. Any distortion after the modem can be caused by overdriven system components or impedance mismatching in coupling equipment. b. BPSK will have a slight notch at the center frequency of the carrier.

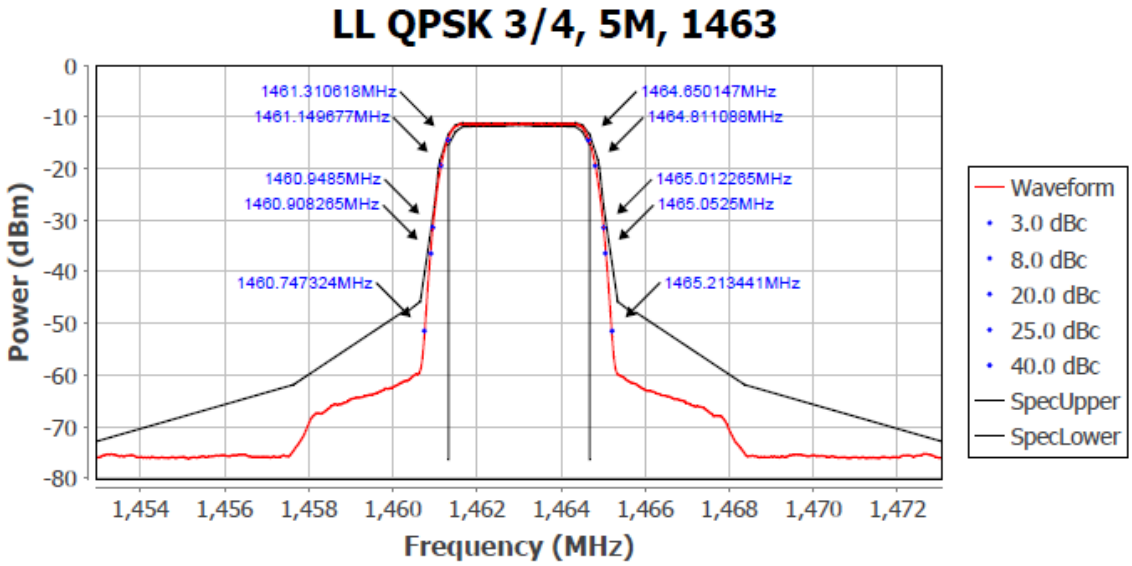


Figure A-4. Tx Waveform

A.3.1.3 Rx Waveform Check

Step	Task
1	Use a spectrum analyzer to check the Rx modulated waveform.
2	The Rx waveform displays the following when receiving a signal from a satellite system: a. A raised noise floor that obscures the low shoulders, similar to Figure A-4. b. A flat top without any slope or distortion. Distortion can be caused by overdriven equipment, impedance mismatches, or faulty equipment.
3	Check all Rx system equipment, including the splitters, if any slope or distortion is present.

A.3.1.4 Modem Demodulator Constellations

View the modem demodulator constellations by using the IQ Mon application on the user computer. The IQ Mon uses the modem ethernet management connection to retrieve the constellation information. Typical constellation patterns are shown in Figure A-5 through Figure A-10. Error Vector Magnitude (EVM) is a measure of how far the points are from the ideal quadrature locations. The smaller the dot, the bigger the number.

Extremely high composite power will add to the noise received by the modem. Frequency separation and balanced carriers are essential to satellite system operation.

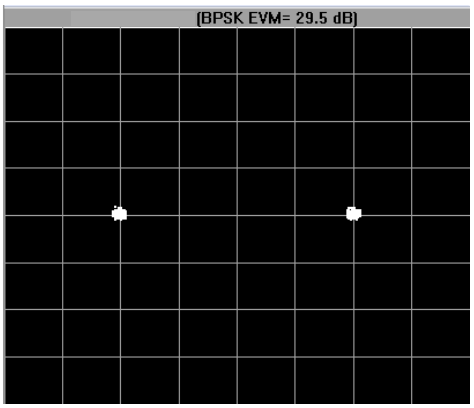


Figure A-5. BPSK Constellation

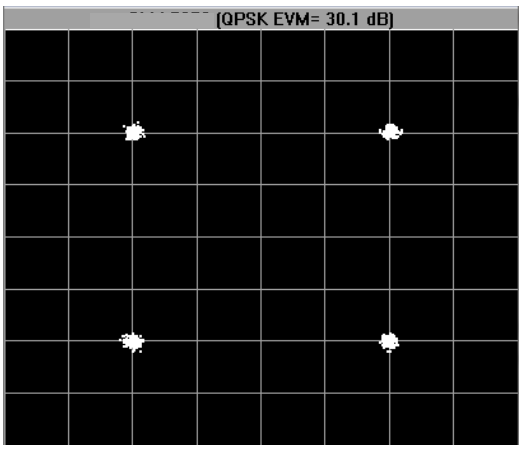


Figure A-6. QPSK Constellation

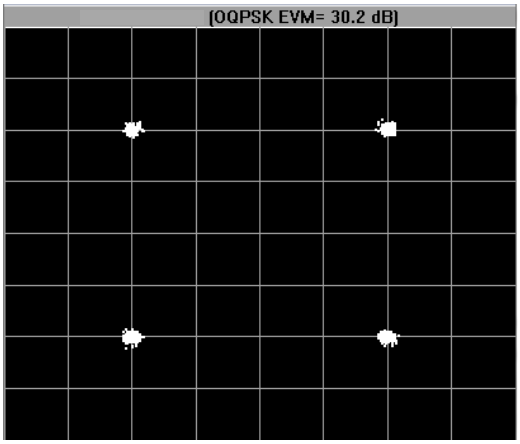


Figure A-7. OQPSK Constellation

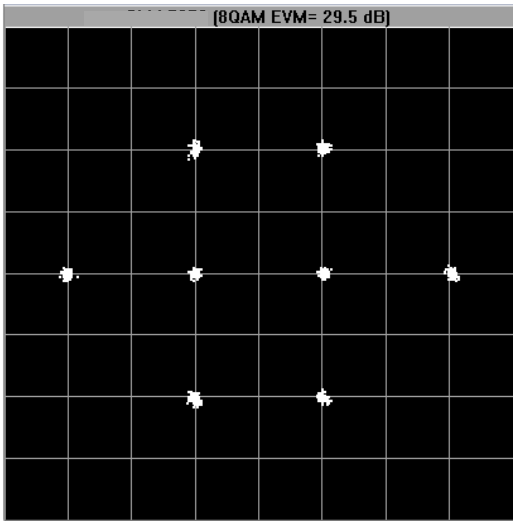


Figure A-8. 8QAM Constellation

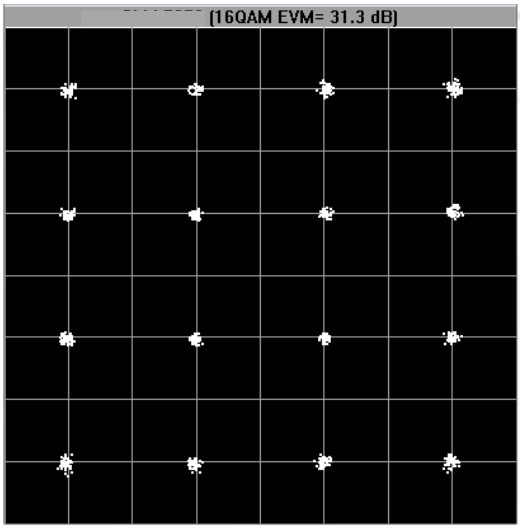


Figure A-9. 16QAM Constellation

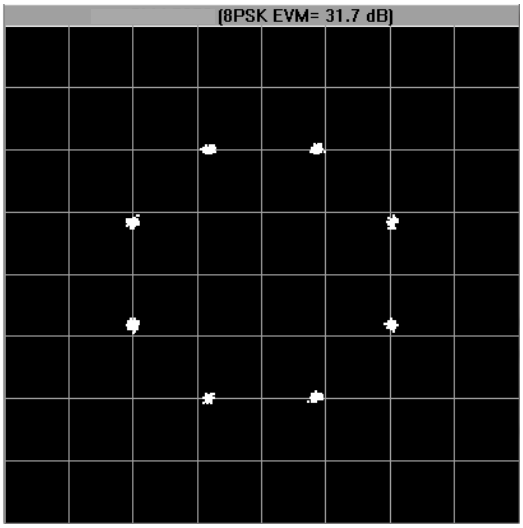


Figure A-10. 8PSK Constellation

A.4 Fault Isolation

Faults are displayed on the Modem Status page and the Modem Event Log page. They are in Hexadecimal format and are hyperlinked to a description. Click on the fault code and a pop up will show the fault condition.

- The Modem Status Tab displays the current faults.
- The Event Log records the fault events over time.

BLANK PAGE

Appendix B. OPERATIONS REFERENCE

B.1 Overview

This appendix provides the end user with reference guides for the DSSS and non-DSSS LDPC modes.

The Data Rates and Symbol Rates shown in the following tables all assume that Transmission Security (TRANSEC) is turned **OFF**. To calculate the max data rate with TRANSEC **ON**, the max data rate shown in the table becomes a max aggregate data rate. The real data rate can be calculated by dividing the TRANSEC overhead rate from the aggregate data rate. The TRANSEC overhead rate can be calculated for any TRANSEC Frame Length (N) as follows:

```
TRANSEC Overhead Rate = (3 + 16 * N) / (16 * N) where N=8
```

B.1.1 OM-73 Mode

Modulation Type	Data Rate (kbps)		Symbol Rate (ksps)	
	Min	Max	Min	Max
BPSK 1/1	64	8472	64	10000
BPSK 1/2	64	15000	128	30000
BPSK 3/4	64	22500	85.333	29999.999
BPSK 7/8	64	26250	73.142	30000
QPSK 1/1	64	20000	32	10000
QPSK 1/2	64	30000	64	30000
QPSK 3/4	64	45000	42.666	30000
QPSK 7/8	64	51840	36.571	29622.857
OQPSK 1/1	64	20000	32	10000
OQPSK 1/2	64	30000	64	30000
OQPSK 3/4	64	45000	42.666	30000
OQPSK 7/8	64	51840	36.571	29622.857

B.1.2 MIL-STD-188-165A Mode

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
BPSK 1/1	Off	N/A	64	8472	64	10000
BPSK 1/2	Off	N/A	64	15000	128	30000
BPSK 3/4	Off	N/A	64	22500	85.333	29999.999
BPSK 7/8	Off	N/A	64	26250	73.142	30000
QPSK 1/1	Off	N/A	64	20000	32	10000
QPSK 1/2	Off	N/A	64	30000	64	30000
QPSK 3/4	Off	N/A	64	45000	42.666	30000
QPSK 7/8	Off	N/A	64	51840	36.571	29622.857
OQPSK 1/1	Off	N/A	64	20000	32	10000
OQPSK 1/2	Off	N/A	64	30000	64	30000
OQPSK 3/4	Off	N/A	64	45000	42.666	30000
OQPSK 7/8	Off	N/A	64	51840	36.571	29622.857
8-PSK 2/3	Off	N/A	256	51840	128	25920
8-PSK 5/6	Off	N/A	256	51840	102.4	20736
BPSK 1/2	126,112	4, 8	64	13333.333	144	29999.999
BPSK 1/2	219,201	4, 8	64	13767.123	139.462	29999.999
BPSK 1/2	225,205	4, 8	64	13666.666	140.487	29999.998

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
BPSK 1/2	220,200	4, 8	64	13636.363	140.8	30000
BPSK 3/4	126,112	4, 8	64	20000	96	29999.999
BPSK 3/4	219,201	4, 8	64	20650.684	92.975	29999.998
BPSK 3/4	225,205	4, 8	64	20500	93.658	29999.999
BPSK 3/4	220,200	4, 8	64	20454.545	93.867	29999.999
BPSK 7/8	126,112	4, 8	64	23333.333	82.826	30000
BPSK 7/8	219,201	4, 8	64	24092.465	79.692	29999.999
BPSK 7/8	225,205	4, 8	64	23916.666	80.278	29999.999
BPSK 7/8	220,200	4, 8	64	23863.636	80.457	30000
QPSK 1/2	126,112	4, 8	64	26666.666	72	29999.999
QPSK 1/2	219,201	4, 8	64	27534.246	69.371	29999.999
QPSK 1/2	225,205	4, 8	64	27333.333	70.243	29999.999
QPSK 1/2	220,200	4, 8	64	27272.727	70.4	30000
QPSK 3/4	126,112	4, 8	64	40000	48	30000
QPSK 3/4	219,201	4, 8	64	41301.369	46.487	29999.999
QPSK 3/4	225,205	4, 8	64	41000	46.829	30000
QPSK 3/4	220,200	4, 8	64	40909.090	46.933	30000
QPSK 7/8	126,112	4, 8	64	46666.666	41.143	30000
QPSK 7/8	219,201	4, 8	64	48184.931	39.846	29999.999
QPSK 7/8	225,205	4, 8	64	47833.333	40.139	29999.999
QPSK 7/8	220,200	4, 8	64	47727.272	40.229	30000
OQPSK 1/2	126,112	4, 8	64	26666.666	72	29999.999
OQPSK 1/2	219,201	4, 8	64	27534.246	69.371	29999.999
OQPSK 1/2	225,205	4, 8	64	27333.333	70.243	29999.999
OQPSK 1/2	220,200	4, 8	64	27272.727	70.4	30000
OQPSK 3/4	126,112	4, 8	64	40000	48	30000
OQPSK 3/4	219,201	4, 8	64	41301.369	46.487	29999.999
OQPSK 3/4	225,205	4, 8	64	41000	46.829	30000
OQPSK 3/4	220,200	4, 8	64	40909.090	46.933	30000
OQPSK 7/8	126,112	4, 8	64	46666.666	41.143	30000
OQPSK 7/8	219,201	4, 8	64	48184.931	39.846	29999.999
OQPSK 7/8	225,205	4, 8	64	47833.333	40.139	29999.999
OQPSK 7/8	220,200	4, 8	64	47727.272	40.229	30000
8-PSK 2/3	126,112	4, 8	256	51840	144	29160
8-PSK 2/3	219,201	4, 8	256	51840	139.462	28241.194
8-PSK 2/3	225,205	4, 8	256	51840	140.487	28448.78
8-PSK 2/3	220,200	4, 8	256	51840	140.8	28512

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
8-PSK 5/6	126,112	4, 8	256	51840	115.2	23328
8-PSK 5/6	219,201	4, 8	256	51840	111.57	22592.955
8-PSK 5/6	225,205	4, 8	256	51840	112.39	22759.024
8-PSK 5/6	220,200	4, 8	256	51840	112.64	22809.6

B.1.3 MIL-STD-188-165A Mode – Sequential

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
BPSK 1/2	OFF	N/A	64	1067	128	2134
BPSK 1/2	126/112	4/8	64	1171	144	2634.750
BPSK 1/2	219,201	4/8	64	1171	139.463	2551.731
BPSK 1/2	225,205	4/8	64	1171	140.488	2570.488
BPSK 1/2	220,200	4/8	64	1171	140.800	2576.200
QPSK 1/2	OFF	N/A	64	2500	64	2500
QPSK 1/2	126/112	4/8	64	2222.222	72	2500
QPSK 1/2	219,201	4/8	64	2294.520	69.731	2500
QPSK 1/2	225,205	4/8	64	2277.777	70.243	2500
QPSK 1/2	220,200	4/8	64	2272.727	70.400	2500
QPSK 3/4	OFF	N/A	64	3750	42.667	2500
QPSK 3/4	126/112	4/8	64	3333.333	48	2500
QPSK 3/4	219,201	4/8	64	3441.780	46.487	2500
QPSK 3/4	225,205	4/8	64	3416.666	46.829	2500
QPSK 3/4	220,200	4/8	64	3409.090	46.933	2500
QPSK 7/8	OFF	N/A	64	4375	36.571	2500
QPSK 7/8	126/112	4/8	64	3888.888	41.142	2500
QPSK 7/8	219,201	4/8	64	4015.410	39.846	2500
QPSK 7/8	225,205	4/8	64	3986.111	40.139	2500
QPSK 7/8	220,200	4/8	64	3977.272	40.228	2500
OQPSK 1/2	OFF	N/A	64	2500	64	2500
OQPSK 1/2	126/112	4/8	64	2222.222	72	2500
OQPSK 1/2	219,201	4/8	64	2294.520	69.731	2500
OQPSK 1/2	225,205	4/8	64	2277.777	70.243	2500
OQPSK 1/2	220,200	4/8	64	2272.727	70.400	2500
OQPSK 3/4	OFF	N/A	64	3750	42.667	2500
OQPSK 3/4	126/112	4/8	64	3333.333	48	2500
OQPSK 3/4	219,201	4/8	64	3441.780	46.487	2500
OQPSK 3/4	225,205	4/8	64	3416.666	46.829	2500

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
OQPSK 3/4	220,200	4/8	64	3409.090	46.933	2500
OQPSK 7/8	OFF	N/A	64	4375	36.571	2500
OQPSK 7/8	126/112	4/8	64	3888.888	41.142	2500
OQPSK 7/8	219,201	4/8	64	4015.410	39.846	2500
OQPSK 7/8	225,205	4/8	64	3986.111	40.139	2500
OQPSK 7/8	220,200	4/8	64	3977.272	40.228	2500

B.1.4 IESS-308 Mode – Standard Higher Rates

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)	Symbol Rate (ksps)
QPSK 1/2	IESS-308	Off	N/A	1544	1640
QPSK 1/2	IESS-308	Off	N/A	2048	2144
QPSK 1/2	IESS-308	Off	N/A	6312	6408
QPSK 1/2	IESS-308	Off	N/A	8448	8544
QPSK 1/2	IESS-308	194,178	4, 8, 16	1544	1778.787
QPSK 1/2	IESS-308	194,178	4, 8, 16	2048	2328.09
QPSK 1/2	IESS-308	194,178	4, 8, 16	6312	6975.371
QPSK 1/2	IESS-308	194,178	4, 8, 16	8448	9303.371
QPSK 1/2	IESS-308	219,201	4, 8, 16	1544	1778.269
QPSK 1/2	IESS-308	219,201	4, 8, 16	2048	2327.403
QPSK 1/2	IESS-308	219,201	4, 8, 16	6312	6973.254
QPSK 1/2	IESS-308	219,201	4, 8, 16	8448	9300.537
QPSK 1/2	IESS-308	225,205	4, 8, 16	1544	1790.634
QPSK 1/2	IESS-308	225,205	4, 8, 16	2048	2343.805
QPSK 1/2	IESS-308	225,205	4, 8, 16	6312	7023.805
QPSK 1/2	IESS-308	225,205	4, 8, 16	8448	9368.195
QPSK 1/2	IESS-308	126,112	4, 8, 16	1544	1833
QPSK 1/2	IESS-308	126,112	4, 8, 16	2048	2400
QPSK 1/2	IESS-308	126,112	4, 8, 16	6312	7197
QPSK 1/2	IESS-308	126,112	4, 8, 16	8448	9600
QPSK 1/2	IESS-308	208,192	4, 8, 16	1544	1776.708
QPSK 1/2	IESS-308	208,192	4, 8, 16	2048	2325.333
QPSK 1/2	IESS-308	208,192	4, 8, 16	6312	6966.875
QPSK 1/2	IESS-308	208,192	4, 8, 16	8448	9292
QPSK 3/4	IESS-308	Off	N/A	1544	1029.333
QPSK 3/4	IESS-308	Off	N/A	2048	1365.333
QPSK 3/4	IESS-308	Off	N/A	6312	4208

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)	Symbol Rate (ksps)
QPSK 3/4	IESS-308	Off	N/A	8448	5632
QPSK 3/4	IESS-308	Off	N/A	32064	21376
QPSK 3/4	IESS-308	Off	N/A	34368	22912
QPSK 3/4	IESS-308	Off	N/A	44736	29824
QPSK 3/4	IESS-308	194,178	4, 8, 16	1544	1217.858
QPSK 3/4	IESS-308	194,178	4, 8, 16	2048	1584.06
QPSK 3/4	IESS-308	194,178	4, 8, 16	6312	4682.247
QPSK 3/4	IESS-308	194,178	4, 8, 16	8448	6324.247
QPSK 3/4	IESS-308	194,178	4, 8, 16	32064	23393.438
QPSK 3/4	IESS-308	194,178	4, 8, 16	34368	25067.506
QPSK 3/4	IESS-308	219,201	4, 8, 16	1544	1217.512
QPSK 3/4	IESS-308	219,201	4, 8, 16	2048	1583.602
QPSK 3/4	IESS-308	219,201	4, 8, 16	6312	4680.836
QPSK 3/4	IESS-308	219,201	4, 8, 16	8448	6232.358
QPSK 3/4	IESS-308	219,201	4, 8, 16	32064	23386.269
QPSK 3/4	IESS-308	219,201	4, 8, 16	34368	25059.821
QPSK 3/4	IESS-308	225,205	4, 8, 16	1544	1225.756
QPSK 3/4	IESS-308	225,205	4, 8, 16	2048	1594.537
QPSK 3/4	IESS-308	225,205	4, 8, 16	6312	4714.537
QPSK 3/4	IESS-308	225,205	4, 8, 16	8448	6277.463
QPSK 3/4	IESS-308	225,205	4, 8, 16	32064	23557.463
QPSK 3/4	IESS-308	225,205	4, 8, 16	34368	25243.317
QPSK 3/4	IESS-308	126,112	4, 8, 1	1544	1254
QPSK 3/4	IESS-308	126,112	4, 8, 1	2048	1632
QPSK 3/4	IESS-308	126,112	4, 8, 1	6312	4830
QPSK 3/4	IESS-308	126,112	4, 8, 1	8448	6432
QPSK 3/4	IESS-308	126,112	4, 8, 1	32064	24144
QPSK 3/4	IESS-308	126,112	4, 8, 1	34368	25872
QPSK 3/4	IESS-308	208,192	4, 8, 16	1544	1216.472
QPSK 3/4	IESS-308	208,192	4, 8, 16	2048	1582.222
QPSK 3/4	IESS-308	208,192	4, 8, 16	6312	4676.583
QPSK 3/4	IESS-308	208,192	4, 8, 16	8448	626.667
QPSK 3/4	IESS-308	208,192	4, 8, 16	32064	23364.667
QPSK 3/4	IESS-308	208,192	4, 8, 16	34368	25036.667
QPSK 7/8	IESS-308	Off	N/A	1544	882.286
QPSK 7/8	IESS-308	Off	N/A	2048	1170.286
QPSK 7/8	IESS-308	Off	N/A	6312	3606.857

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)	Symbol Rate (ksps)
QPSK 7/8	IESS-308	Off	N/A	8448	4827.428
QPSK 7/8	IESS-308	Off	N/A	32064	20040.571
QPSK 7/8	IESS-308	Off	N/A	34368	21473.714
QPSK 7/8	IESS-308	Off	N/A	44736	27922.857
QPSK 7/8	IESS-308	194,178	4, 8, 16	1544	1057.592
QPSK 7/8	IESS-308	194,178	4, 8, 16	2048	1371.48
QPSK 7/8	IESS-308	194,178	4, 8, 16	6312	4027.069
QPSK 7/8	IESS-308	194,178	4, 8, 16	8448	5357.355
QPSK 7/8	IESS-308	194,178	4, 8, 16	32064	20065.233
QPSK 7/8	IESS-308	194,178	4, 8, 16	34368	21500.148
QPSK 7/8	IESS-308	194,178	4, 8, 16	44736	27957.265
QPSK 7/8	IESS-308	219,201	4, 8, 16	1544	1057.296
QPSK 7/8	IESS-308	219,201	4, 8, 16	2048	1371.087
QPSK 7/8	IESS-308	219,201	4, 8, 16	6312	4025.859
QPSK 7/8	IESS-308	219,201	4, 8, 16	8448	5355.736
QPSK 7/8	IESS-308	219,201	4, 8, 16	32064	20059.087
QPSK 7/8	IESS-308	219,201	4, 8, 16	34368	21493.561
QPSK 7/8	IESS-308	219,201	4, 8, 16	44736	27948.691
QPSK 7/8	IESS-308	225,205	4, 8, 16	1544	1064.362
QPSK 7/8	IESS-308	225,205	4, 8, 16	2048	1380.46
QPSK 7/8	IESS-308	225,205	4, 8, 16	6312	4054.743
QPSK 7/8	IESS-308	225,205	4, 8, 16	8448	5394.397
QPSK 7/8	IESS-308	225,205	4, 8, 16	32064	20205.826
QPSK 7/8	IESS-308	225,205	4, 8, 16	34368	26150.843
QPSK 7/8	IESS-308	225,205	4, 8, 16	44736	28153.422
QPSK 7/8	IESS-308	126,112	4, 8, 16	1544	1088.571
QPSK 7/8	IESS-308	126,112	4, 8, 16	2048	1412.571
QPSK 7/8	IESS-308	126,112	4, 8, 16	6312	4153.714
QPSK 7/8	IESS-308	126,112	4, 8, 16	8448	5526.857
QPSK 7/8	IESS-308	126,112	4, 8, 16	32064	20708.571
QPSK 7/8	IESS-308	126,112	4, 8, 16	34368	22189.714
QPSK 7/8	IESS-308	126,112	4, 8, 16	44736	28854.857
QPSK 7/8	IESS-308	208,192	4, 8, 16	1544	1056.405
QPSK 7/8	IESS-308	208,192	4, 8, 16	2048	1369.905
QPSK 7/8	IESS-308	208,192	4, 8, 16	6312	4022.214
QPSK 7/8	IESS-308	208,192	4, 8, 16	8448	5350.857
QPSK 7/8	IESS-308	208,192	4, 8, 16	32064	20040.571

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)	Symbol Rate (ksps)
QPSK 7/8	IESS-308	208,192	4, 8, 16	34368	21473.714
QPSK 7/8	IESS-308	208,192	4, 8, 16	44736	27922.857

B.1.5 IESS-308 Mode – Extended

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
				Min	Max	Min	Max
QPSK 1/2	None	Off	N/A	64	30000	64	30000
QPSK 1/2	None	126,112	4, 8, 16	64	26666.666	72	29999.999
QPSK 1/2	None	219,201	4, 8, 16	64	27534.246	69.371	29999.999
QPSK 1/2	None	194,178	4, 8, 16	64	27525.773	69.573	30000
QPSK 1/2	None	225,205	4, 8, 16	64	27333.333	70.243	29999.999
QPSK 1/2	None	208,192	4, 8, 16	64	27559.809	69.667	30000
QPSK 1/2	IESS-309	Off	N/A	64	8448	68.267	9011.2
QPSK 1/2	IESS-309	126,112	4, 8, 16	64	8448	76.8	10137.6
QPSK 1/2	IESS-309	194,178	4, 8, 16	64	8448	74.403	9821.196
QPSK 1/2	IESS-309	225,205	4, 8, 16	64	8448	74.927	9890.341
QPSK 1/2	IESS-309	208,192	4, 8, 16	64	8448	74.311	9809.067
QPSK 3/4	None	Off	N/A	64	45000	42.666	30000
QPSK 3/4	None	126,112	4, 8, 16	64	40000	48	30000
QPSK 3/4	None	219,201	4, 8, 16	64	41301.369	46.487	29999.999
QPSK 3/4	None	194,178	4, 8, 16	64	41288.65	46.502	30000
QPSK 3/4	None	225,205	4, 8, 16	64	41000	46.829	30000
QPSK 3/4	None	208,192	4, 8, 16	64	41339.713	46.444	30000
QPSK 3/4	IESS-309	Off	N/A	64	8448	45.511	6007.467
QPSK 3/4	IESS-309	126,112	4, 8, 16	64	8448	51.2	6758.4
QPSK 3/4	IESS-309	219,201	4, 8, 16	64	8448	49.587	6545.449
QPSK 3/4	IESS-309	194,178	4, 8, 16	64	8448	49.602	6547.464
QPSK 3/4	IESS-309	225,205	4, 8, 16	64	8448	49.951	6593.561
QPSK 3/4	IESS-309	208,192	4, 8, 16	64	8448	49.541	6539.378
QPSK 7/8	None	Off	N/A	64	51840	36.571	29622.857
QPSK 7/8	None	126,112	4, 8, 16	64	46666.666	41.143	30000
QPSK 7/8	None	219,201	4, 8, 16	64	48184.931	39.846	29999.999
QPSK 7/8	None	194,178	4, 8, 16	64	48170.103	38.859	30000
QPSK 7/8	None	225,205	4, 8, 16	64	47833.333	40.139	29999.999
QPSK 7/8	None	208,192	4, 8, 16	64	48229.665	39.81	29999.999
QPSK 7/8	IESS-309	Off	N/A	64	8448	39.01	4827.428

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
				Min	Max	Min	Max
QPSK 7/8	IESS-309	126,112	4, 8, 16	64	8448	43.886	5792.914
QPSK 7/8	IESS-309	219,201	4, 8, 16	64	8448	42.503	5610.385
QPSK 7/8	IESS-309	194,178	4, 8, 16	64	8448	42.516	5612.112
QPSK 7/8	IESS-309	225,205	4, 8, 16	64	8448	42.818	5561.624
QPSK 7/8	IESS-309	208,192	4, 8, 16	64	8448	42.463	5604.181
OQPSK 1/2	None	Off	N/A	64	30000	64	30000
OQPSK 1/2	None	126,112	4, 8, 16	64	26666.666	72	29999.999
OQPSK 1/2	None	219,201	4, 8, 16	64	27534.246	69.371	29999.999
OQPSK 1/2	None	194,178	4, 8, 16	64	27525.773	69.573	30000
OQPSK 1/2	None	225,205	4, 8, 16	64	27333.333	70.243	29999.999
OQPSK 1/2	None	208,192	4, 8, 16	64	27559.809	69.667	30000
OQPSK 1/2	IESS-309	Off	N/A	64	8448	68.267	901.2
OQPSK 1/2	IESS-309	126,112	4, 8, 16	64	8448	76.8	10137.6
OQPSK 1/2	IESS-309	219,201	4, 8, 16	64	8448	74.38	9818.173
OQPSK 1/2	IESS-309	194,178	4, 8, 16	64	8448	74.403	9821.196
OQPSK 1/2	IESS-309	225,205	4, 8, 16	64	8448	74.927	9890.341
OQPSK 1/2	IESS-309	208,192	4, 8, 16	64	8448	74.311	9809.067
OQPSK 3/4	None	Off	N/A	64	20000	42.666	30000
OQPSK 3/4	None	126,112	4, 8, 16	64	40000	48	30000
OQPSK 3/4	None	219,201	4, 8, 16	64	41301.369	46.487	29999.999
OQPSK 3/4	None	194,178	4, 8, 16	64	41288.65	46.502	30000
OQPSK 3/4	None	225,205	4, 8, 16	64	41000	46.829	30000
OQPSK 3/4	None	208,192	4, 8, 16	64	41339.713	46.444	30000
OQPSK 3/4	IESS-309	Off	N/A	64	8448	45.511	6007.467
OQPSK 3/4	IESS-309	126,112	4, 8, 16	64	8448	51.2	6758.4
OQPSK 3/4	IESS-309	219,201	4, 8, 16	64	8448	49.587	6545.449
OQPSK 3/4	IESS-309	194,178	4, 8, 16	64	8448	49.602	6547.464
OQPSK 3/4	IESS-309	225,205	4, 8, 16	64	8448	49.951	6593.561
OQPSK 3/4	IESS-309	208,192	4, 8, 16	64	8448	49.541	6539.378
OQPSK 7/8	None	Off	N/A	64	20000	36.571	29622.857
OQPSK 7/8	None	126,112	4, 8, 16	64	46666.666	41.143	30000
OQPSK 7/8	None	219,201	4, 8, 16	64	48184.931	39.846	29999.999
OQPSK 7/8	None	194,178	4, 8, 16	64	48170.103	38.859	30000
OQPSK 7/8	None	225,205	4, 8, 16	64	47833.333	40.139	29999.999
OQPSK 7/8	None	208,192	4, 8, 16	64	48229.665	39.81	29999.999
OQPSK 7/8	IESS-309	Off	N/A	64	8448	39.01	4827.428
OQPSK 7/8	IESS-309	126,112	4, 8, 16	64	8448	43.886	5792.914

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
				Min	Max	Min	Max
OQPSK 7/8	IESS-309	219,201	4, 8, 16	64	8448	42.503	5610.385
OQPSK 7/8	IESS-309	194,178	4, 8, 16	64	8448	42.516	5612.112
OQPSK 7/8	IESS-309	225,205	4, 8, 16	64	8448	42.818	5561.624
OQPSK 7/8	IESS-309	208,192	4, 8, 16	64	8448	42.463	5604.181

B.1.6 IESS-309 Mode – Extended (Closed Network)

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
				Min	Max	Min	Max
BPSK 1/2	None	Off	N/A	64	15000	128	30000
BPSK 1/2	None	219,201	4, 8, 16	64	13767.123	139.462	29999.999
BPSK 1/2	IESS-309	Off	N/A	64	8448	136.533	18022.4
BPSK 1/2	IESS-309	219,201	4, 8, 16	64	8448	148.76	19636.346
BPSK 3/4	None	Off	N/A	64	22500	85.333	29999.999
BPSK 3/4	None	219,201	4, 8, 16	64	20650.684	92.975	29999.999
BPSK 3/4	IESS-309	Off	N/A	64	8448	91.022	12014.933
BPSK 3/4	IESS-309	219,201	4, 8, 16	64	8448	99.173	13090.898
QPSK 1/2	None	Off	N/A	64	30000	64	30000
QPSK 1/2	None	219,201	4, 8, 16	64	27534.246	69.371	29999.999
QPSK 1/2	IESS-309	Off	N/A	64	8448	68.267	9011.2
QPSK 1/2	IESS-309	219,201	4, 8, 16	64	8448	74.38	9818.173
QPSK 3/4	None	Off	N/A	64	20000	42.666	30000
QPSK 3/4	None	219,201	4, 8, 16	64	41301.369	46.487	29999.999
QPSK 3/4	IESS-309	Off	N/A	64	8448	45.511	6007.467
QPSK 3/4	IESS-309	219,201	4,8, 16	64	8448	49.587	6545.449
OQPSK 1/2	None	Off	N/A	64	30000	64	30000
OQPSK 1/2	None	219,201	4, 8, 16	64	27534.246	69.371	29999.999
OQPSK 1/2	IESS-309	Off	N/A	64	8448	68.267	9011.2
OQPSK 1/2	IESS-309	219,201	4, 8, 16	64	8448	74.38	9818.173
OQPSK 3/4	None	Off	N/A	64	20000	42.666	30000
OQPSK 3/4	None	219,201	4, 8, 16	64	41301.369	46.487	29999.999
OQPSK 3/4	IESS-309	Off	N/A	64	8448	45.511	6007.467
OQPSK 3/4	IESS-309	219,201	4, 8, 16	64	8448	49.587	6545.449

B.1.7 IESS-310 Mode – Extended Rates

Modulation Type	Overhead	R-S Code Word	R-S Depth	Data Rate (kbps)	Symbol Rate (ksps)
8-PSK 2/3	None	219,201	4, 8, 16	256	139.463
8-PSK 2/3	None	219,201	4, 8, 16	51840	28241.194
8-PSK 2/3	IESS-309	219,201	4, 8, 16	256	148.76
8-PSK 2/3	IESS-309	219,201	4, 8, 16	8448	4909.087
8-PSK 2/3	IESS-309	219,201	4, 8, 16	1544	937.134
8-PSK 2/3	IESS-309	219,201	4, 8, 16	2048	1211.701
8-PSK 2/3	IESS-309	219,201	4, 8, 16	6312	3534.627
8-PSK 2/3	IESS-309	219,201	4, 8, 16	8448	4698.269
8-PSK 2/3	IESS-309	219,201	4, 8, 16	32064	17563.701
8-PSK 2/3	IESS-309	219,201	4, 8, 16	34368	18818.866
8-PSK 2/3	IESS-309	219,201	4, 8, 16	44736	24467.104

B.1.8 Turbo Code Mode

Modulation Type	Data Rate (kbps)		Symbol Rate (ksps)	
	Min	Max	Min	Max
BPSK 21/44	64	30545.454	134.095	63999.999
BPSK 5/16	64	20000	204.8	64000
QPSK 17/18	64	120888.888	33.882	63999.999
QPSK 21/44	64	61090.909	67.047	63999.999
QPSK 3/4	64	96000	42.666	64000
QPSK 7/8	64	112000	36.571	64000
OQPSK 17/18	64	120888.888	33.882	63999.999
OQPSK 21/44	64	61090.909	67.047	63999.999
OQPSK 3/4	64	96000	42.666	64000
OQPSK 7/8	64	112000	36.571	64000
8-PSK 17/18	256	155520	90.352	54889.411
8-PSK 3/4	256	144000	113.777	64000
8-PSK 7/8	256	155520	97.523	59245.714
16-QAM 3/4	256	155520	85.333	51840
16-QAM 7/8	256	155520	73.143	44434.285

B.1.9 16-QAM Mode

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
16-QAM 3/4	None	None	256	51840	85.333	17280
16-QAM 3/4	219,201	4, 8, 16	256	51840	92.975	18827.462
16-QAM 3/4	208,192	4, 8, 16	256	51840	92.889	18810
16-QAM 7/8	None	None	256	51840	73.143	14811.428
16-QAM 7/8	219,201	4, 8, 16	256	51840	79.692	16137.825
16-QAM 7/8	208,192	4, 8, 16	256	51840	79.619	16122.857

16-QAM 3/4 requires Reed-Solomon to be ON to automatically resolve data ambiguities.

B.1.10 AUPC Mode

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
BPSK 1/1	OFF	N/A	64	7942.500	68.266	8472
BPSK 1/2	OFF	N/A	64	14062.500	136.533	30000
BPSK 3/4	OFF	N/A	64	21093.750	91.022	30000
BPSK 7/8	OFF	N/A	64	24609.375	78.019	30000
QPSK 1/1	OFF	N/A	64	18750	34.133	10000
QPSK 1/2	OFF	N/A	64	28125	68.266	30000
QPSK 3/4	OFF	N/A	64	42187.500	45.511	30000
QPSK 7/8	OFF	N/A	64	49218.750	39.009	30000
OQPSK 1/1	OFF	N/A	64	18750	34.133	10000
OQPSK 1/2	OFF	N/A	64	28125	68.266	30000
OQPSK 3/4	OFF	N/A	64	42187.500	45.511	30000
OQPSK 7/8	OFF	N/A	64	49218.750	39.009	30000
8PSK 2/3	OFF	N/A	64	51840	136.533	27648
8PSK 5/6	OFF	N/A	64	51840	109.226	22118.400
16QAM 3/4	OFF	N/A	64	51840	91.022	18432
16QAM 7/8	OFF	N/A	64	51840	78.019	15798.857
BPSK 1/2	225,205	8	256	12812.500	149.853	30000
BPSK 3/4	225,205	8	256	19218.750	99.902	30000
BPSK 7/8	225,205	8	256	22421.875	85.630	30000
QPSK 1/2	225,205	8	256	25625	74.926	30000
QPSK 3/4	225,205	8	256	38437.500	49.951	30000
QPSK 7/8	225,205	8	256	44843.750	42.815	30000

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
OQPSK 1/2	225,205	8	256	25625	74.926	30000
OQPSK 3/4	225,205	8	256	38437.500	49.951	30000
OQPSK 7/8	225,205	8	256	44843.750	42.815	30000
8PSK 2/3	225,205	8	256	51250	149.853	30000
8PSK 5/6	225,205	8	256	51840	119.882	24276.292
16QAM 3/4	225,205	8	256	51840	99.902	20230.243
16QAM 7/8	225,205	8	256	51840	85.630	17340.209

B.1.11 AUPC Mode – Sequential

Modulation Type	R-S Code Word	R-S Depth	Data Rate (kbps)		Symbol Rate (ksps)	
			Min	Max	Min	Max
BPSK 1/2	OFF	N/A	64	1171	136.533	2498.133
QPSK 1/2	OFF	N/A	64	2048	68.266	2184.533
QPSK 3/4	OFF	N/A	64	2048	45.511	1456.355
QPSK 7/8	OFF	N/A	64	2048	39.009	1248.304
OQPSK 1/2	OFF	N/A	64	2048	68.266	2184.533
OQPSK 3/4	OFF	N/A	64	2048	45.511	1456.355
OQPSK 7/8	OFF	N/A	64	2048	39.009	1248.304
BPSK 1/2	225,205	8	64	1067	149.853	2498.341
QPSK 1/2	225,205	8	64	2048	74.926	2397.658
QPSK 3/4	225,205	8	64	2048	49.951	1598.439
QPSK 7/8	225,205	8	64	2048	42.815	1370.09
OQPSK 1/2	225,205	8	64	2048	74.926	2397.658
OQPSK 3/4	225,205	8	64	2048	49.951	1598.439
OQPSK 7/8	225,205	8	64	2048	42.815	1370.09

B.1.12 AUPC Mode – Turbo

Modulation Type	Data Rate (kbps)		Symbol Rate (ksps)	
	Min	Max	Min	Max
BPSK 21/44	64	13423.295	143.034	29999.998
BPSK 5/16	64	8789.062	218.453	29999.998
QPSK 17/18	64	51840	36.141	29274.352
QPSK 21/44	64	26846.590	71.517	29999.998
QPSK 3/4	64	42187.500	45.511	30000
QPSK 7/8	64	49218.750	39.009	30000
OQPSK 17/18	64	51840	36.141	29274.352
OQPSK 21/44	64	26846.590	71.517	29999.998
OQPSK 3/4	64	42187.500	45.511	30000
OQPSK 7/8	64	49218.750	39.009	30000
8PSK 17/18	256	51840	96.376	19516.235
8PSK 3/4	256	51840	121.362	24576
8PSK 7/8	256	51840	104.025	21065.142
16QAM 3/4	256	51840	91.022	18432
16QAM 7/8	256	51840	78.019	15798.857

B.1.13 NON-SPREAD LDPC Mode – Ultra Low Latency (ULL)

Modulation Type	Data Rate (kbps)		Symbol Rate (ksps)		DR to SR Multiplier
	Min	Max	Min	Max	
BPSK 1/2	32*	2000	64.868	4054.263	2092/1032
QPSK 1/2	32	2000	32.434	2027.131	2092/2064
QPSK 2/3	41.851	2000	32	1529.239	2092/5448
QPSK 3/4	46.991	2000	32	1361.979	2092/3072

B.1.14 NON-SPREAD LDPC Mode – Low Latency (LL)

Modulation Type	Data Rate (kbps)		Symbol Rate (ksps)		DR to SR Multiplier
	Min	Max	Min	Max	
BPSK .378	32.000	5000	84.676	13230.769	4128/1560
BPSK .451	32.000	5000	71.019	11096.774	4128/1860
BPSK .541	32.000	5000	59.182	9247.311	4128/2232
QPSK ½	32.000	5000	32.188	5029.411	4104/4080
QPSK 2/3	42.480	5000	32.000	3766.519	4104/5448
QPSK ¾	47.720	5000	32.000	3352.941	4104/6120
QPSK 7/8	55.767	5000	32.000	2869.127	4104/7152
8QAM 2/3	256.000	5000	128.313	2506.118	4096/8172
8QAM ¾	256.000	5000	114.223	2230.936	4096/9180
8QAM 7/8	256.000	5000	97.741	1909.023	4096/10728
16QAM 2/3	256.000	5000	96.140	1877.753	4092/10896
16QAM ¾	256.000	5000	85.584	1671.568	4092/12240
16QAM 7/8	256.000	5000	73.234	1430.369	4092/14304

B.1.15 NON-SPREAD LDPC Mode – High Performance (HP)

Modulation Type	Data Rate (kbps)		Symbol Rate (ksps)		DR to SR Multiplier
	Min	Max	Min	Max	
BPSK 1/3	32.000	15000	96.000	45000	16416/5472
BPSK ½	32.000	22500	64.000	45000	16416/8208
QPSK ½	32.000	45000	32.000	45000	8208/8208
QPSK 2/3	42.667	60000	32.000	45000	8208/10944
QPSK ¾	48.000	67500	32.000	45000	8256/12384
OQPSK ½	32.000	45000	32.000	45000	8208/8208
OQPSK 2/3	42.667	60000	32.000	45000	8208/10944
OQPSK ¾	48.000	67500	32.000	45000	8256/12384
8QAM 2/3	256.000	60000	128.000	30000	5472/10944
8QAM ¾	256.000	67500	113.778	30000	5504/12384
16QAM ¾	256.000	69000	85.333	23000	4128/12384

BLANK PAGE

Appendix C. OVERHEAD and SYMBOL RATE CALCULATIONS

C.1 Overview

The SLM-5650C Satellite Modem has several optional features and functions that can add overhead. This appendix describes:

- The processing flow where overhead can be added;
- The amount of overhead added by each feature when enabled;
- The calculation of modem symbol rate and modem chip rate (when optional spreading is enabled), given the programmed modem bit rate.

C.2 SLM-5650C Processing Flow and Symbol Rate Calculation

The SLM-5650C supports Ethernet interface and provides options for framing, modulation and spreading.

Figure C-1 shows the processing flow for these functions.

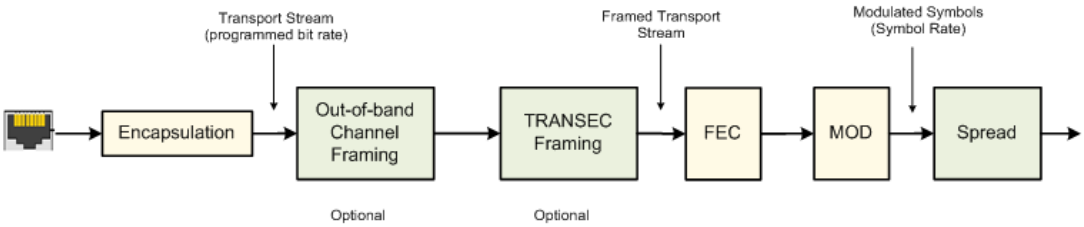


Figure C-1. SLM-5650C – Feature Block Diagram

The symbol rate S_R (Carrier 3dB Bandwidth) is a function of the programmed data bit rate B_R with FEC encoding, modulation, and transport overhead factors as shown in the equation **"**$S_R=B_R/M_OC_RF_{RS}F_TF_C$**"** (referred to hereafter as "Equation 1"), containing the following Operands:

- **Operand 1** – M_O = Modulation Order
  '1' if BPSK
  '2' if QPSK
  '3' if 8PSK
  '4' if 16QAM
- **Operand 2** – C_R = Code Rate of the FEC (e.g., CR = 0.75 if stated FEC code rate = "3/4")
- **Operand 3** – F_C = AUPC Mode Framing Factor, where:
  - F_C = 15/16 if AUPC Mode is enabled;
  - F_C = 1 if neither feature is enabled.

Only one of these two features (AUPC Mode or ACPC Mode) may be enabled at any given time.

- **Operand 4** – F_T = TRANSEC Framing Factor, where:
  - F_T = N*16/[N*16+3], where 'N' is the selected Frame Length in AES blocks per frame, in the range of 1 to 16.
  - F_T = 1 if the TRANSEC encryption is disabled.

If the DSSS feature is enabled, then the simple equation for Chip Rate (SC) equivalent to (Bw) of the spread signal is: "SC=K*SR" where 'K' is the programmed spreading factor (e.g. 2, 4, 8, 16, 32, 64, up to 512)

C.3 Sources of Overhead

C.3.1 Framing Overhead

Several modes of operation add framing overhead to the satellite channel.

C.3.1.1 AUPC Framing

AUPC overhead channel is referred to as **"Operand 3"** in Section C.2:

- The **AUPC** communications channel also supports modem-to-modem receiver signal Eb/No status used to automatically adjust the Tx uplink power when (AUPC Power Control) is enabled. If the AUPC framing mode is enabled, 16 framed output bits are created for every 15 input bits of the transport stream regardless if the features are being used. The AUPC overhead factor is a function of the programmed Data Rate.

C.3.1.2 TRANSEC Framing

When the TRANSEC encryption is enabled the transport Frame size is user selectable as (N * AES block). The parameter "N" is programmable from 1 to 16; each AES block is 16 bytes in length; each frame has a 3-byte header. This leads to the F_T factor, identified as **"Operand 5"** in Section C.2. Larger values of "N" create lower overhead, at the expense of slightly longer TRANSEC frame acquisition times.

C.3.2 Total Framing Overhead

There may be times where the framing overhead is of interest, expressed as a percentage of framing overhead bits within the framed transport stream. Identified as "**Operand 4**" in Section H.2, this value can be expressed as:

$$\text{Framing Overhead}[\%]=[1-F_T F_C]*100$$

As per "Equation 1" (see Section C.2), since the factors F_T and F_C are less than unity, the Framing Overhead (when framing is present) increases the symbol rate. Framing overhead has no effect on the programmed modem bit rate, which is equivalent to the input bit rate.

C.3.3 IP Traffic Encapsulation Overhead

With Ethernet traffic, a framed transport overhead is necessary to encapsulate the packets into the transport stream. With the SLM-5650C operating in (Static) Bridge Mode, Ethernet packets received from the interface are encapsulated using a form of HDLC. A start flag byte (0x7E) is added to each packet and a 2-byte CRC is appended to the end. In addition, in order to enable the receiver to recognize the start flag within the data stream, a "0" is inserted wherever five "1"s occur in a row in the transport data stream. Assuming random bits, the probability of bit stuffing using this technique is 1/62.

See RFC 4814 "Hash and Stuffing: Overlooked Factors in Network Device Benchmarking" for a derivation of this probability.

Considering both sources of HDLC Overhead means that, for a packet length "L", the ratio of input bits to encapsulated output bits is expressed as "Equation 2":

$$F_H=L/[L+3+L/62] = L/[(63/62)L+3]$$

Unlike framing overhead, HDLC Overhead reduces the effective throughput of packet bits relative to the programmed modem data rate. Packet Throughput, in packet bits/second, is expressed as "Equation 3":

$$\text{Packet Throughput}=(\text{Programmed Modem Data Rate})*F_H$$

HDLC Overhead – referred to as "Equation 4" – is expressed as a percent overhead of the modem date rate:

$$\text{HDLC OH}[\%]=(1-F_H)*100 =([(1/62)L+3]/[(63/62)L+3])*100$$

The HDLC Overhead ranges from approximately 6% for $L=64$ to approximately 1.8% for $L=1518$.

C.4 Product Support

For further information about the SLM-5650C overhead support of interfaces and framing options, please call **CEFD Product Support** using the information shown in the Preface.

2114 WEST 7TH STREET TEMPE ARIZONA 85281 USA
480 • 333 • 2200 PHONE
480 • 333 • 2161 FAX