COMTECH EF DATA™

A SUBSIDIARY OF COMTECH TELECOMMUNICATIONS CORP.

SLM-7650

Satellite Modem
Installation and Operation Manual

Part Number MN/SLM7650.IOM

Revision 4

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September 10, 2005

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Registered Company.

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About this Manual

This manual describes the installation and operation for the Comtech EF Data SLM-7650 Satellite Modem. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the SLM-7650.

Related Documents

Standards (Military)

MIL-STD-188-165	Interoperability and Performance Standards for SHF Communications PSK Modems (FDMA Operation)
MIL-STD-810F	Environmental Test Method and Engineering Guidelines
MIL-STD-1686C	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiates Explosive Devices) Metric

Standards (Federal)

FED-STD-313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

Standards (General)

EIA-422	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA-485	Standard for Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-point Systems
EIA/TIA-530	High Speed 24-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment
IESS-308	Performance Characteristics for Intermediate Data Rate (IDR) Digital Carriers
IESS-309	QPSK/FDMA Performance Characteristics for Intelsat Business Service (IBS)
IESS-310	Performance Characteristics for Intermediate Data Rate using 8PSK 2/3
	(Standard A, B, C, E and F Earth Stations)
ANSI/J-STD-001A	Joint Industry Standard Requirements for Soldered Electrical and Electronic Assemblies
ANSI/VITA, 3-1995	American National Standard for Board Level Live Insertion for VME.
ISO 9001	Quality System

Comtech EF Data Specifications

SP/9710	Comtech EF Data Specification, *SLM-7650 Satellite Modem*
SP/9710-1	Comtech EF Data Specification, *SLM-7650 Remote Control Protocol Specification*

Conventions and References

Cautions and Warnings

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.

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

IMPORTANT indicates a statement that is associated with the task being performed.

Metric Conversion

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing English to Metric conversions.

Recommended Standard Designations

Recommended Standard (RS) Designations are equivalent to the Electronic Industries Association (EIA). Either reference is satisfactory, except manuafacturer only will reference one of the designators thru-out the manual.

Trademarks

Product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Customer Support Department.

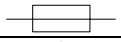
European EMC Directive

In order to meet the European Electro-Magnetic Compatibility (EMC) Directive (EN55022, EN50082-1), properly shielded cables for DATA I/O are required. More specifically, these cables must be shielded from end-to-end, ensuring a continuous ground shield.

The following information is applicable for the European Low Voltage Directive (EN60950):

<HAR>	Type of power cord required for use in the European Community.
	CAUTION: Double-pole/Neutral Fusing ACHTUNG: Zweipolige bzw. Neutralleiter-Sicherung

International Symbols:

	Alternating Current.
	Fuse.
	Safety Ground.
	Chassis Ground.

NOTE: For additional symbols, refer to “Cautions and Warnings” listed earlier in this preface.

Warranty Policy

This Comtech EF Data product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective.
For equipment under warranty, the customer is responsible for freight to Comtech EF Data and all related custom, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges **only** for return of the equipment from the factory to the customer. 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.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from improper installation or maintenance, abuse, unauthorized modification, or operation outside of environmental specifications for the product, or, for damages that occur due to improper repackaging of equipment for return to Comtech EF Data.

No other warranty is expressed or implied. Comtech EF Data specifically disclaims the implied warranties of merchantability and fitness for particular purpose.

Exclusive Remedies

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.

Disclaimer

Comtech EF Data has reviewed this manual thoroughly in order that it will be an easy-to-use guide to your equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EF Data reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.
If there are any questions regarding your equipment or the information in this manual, please contact the Comtech EF Data Customer Support Department.

Chapter 1. INTRODUCTION

This chapter provides an overview of the SLM-7650 satellite modem, referred to in this manual as “the modem.”

1.1 Overview

The SLM-7650 (Figure 1-1) interfaces between terrestrial fixed-rate data terminal equipment, with data rates between 9.6 kbps and 20 Mbps, and RF converter equipment that interfaces at 50 to 90 MHz and 100 to 180 MHz on the IF ports.

Figure 1-1. SLM-7650 Satellite Modem

1.2 Description

The modem is a high performance, full-duplex, digital-vector, modulator/demodulator that meets the requirements of most systems encountered in the commercial and government Satellite Communications industry including:

- Government/Defense
  - DSCS II
  - DSCS III
  - NATO III

- Commercial
  - INTELSAT
  - EUTELSAT
  - PANAMSAT
  - NEW SKIES
  - SES Americom
  - Others

The modem is ideal for tri-band terminals requiring both commercial and government access methods. Additionally, the modem can be used for virtually any closed network satellite communication system. The modem is compliant with MIL-STD-188-165 over the data rate range specified within this specification. The modem is also compliant to the **I**NTELSAT **E**arth **S**tation **S**tandards (IESS) -308, -309, and –310 specifications for the following:

- **I**ntermediate **D**ata **R**ate (IDR)
- **I**NTELSAT **B**usiness **S**ervices (IBS)

The modem is compatible with the following modems within the operating parameters defined in this manual:

- OM-73(V)
- MD-1340
- MD-1352(P)/U (BEM-7650)
- SLM-8650
- SLM-3650
- SLM-6650
- SLM-4650
- LM-46/4046
- MD-945 (OM-73 interoperability mode only; orderwire not supported)

1.2.1 Definition of Modulator Functions

The modulator section accepts data and clock from a digital signal source and after appropriate processing modulates the information on an IF carrier. The modulator provides the following functions:

1. Interface that receives digital signals, including data, clock, frequency reference, and control from a digital signal source.
2. A function that scrambles the data.
3. A differential encoder.
4. **F**orward **E**rror **C**orrection (FEC) encoding.
5. Perform BPSK, QPSK, OQPSK, 8-PSK, and 16-QAM modulation.
6. An output IF signal.
7. Setup, control, monitoring, and upgrade of the modulator.
8. **B**uilt-**i**n **T**est (BIT) function that detects fault conditions and allows faults to be isolated to the modulator. This includes provision for an IF loopback and a transmit interface test data pattern.

1.2.2 Definition of Demodulator Functions

The demodulator section accepts a signal from an **I**ntermediate **F**requency (IF) carrier, demodulate the IF carrier, and after appropriate processing, outputs the data and clock to the user. The demodulator provides the following functions:

1. An input for the IF signal.
2. Acquisition functions and a function to demodulate BPSK, QPSK, OQPSK, 8-PSK, and 16-QAM carriers.
3. **F**orward **E**rror **C**orrection (FEC) decoding.
4. A differential decoder.
5. Descrambles the received data.
6. Digital interface to output digital signals, including data, and associated clock.
7. Setup, control, monitoring, and upgrade of the demodulator.
8. **B**uilt-**i**n **T**est (BIT) function that detects fault conditions and allow faults to be isolated to the demodulator. This includes provision for an IF loopback and a way to measure the error using a test data pattern.

1.2.3 Definition of Interface/M&C Functions

The interface/M&C section consists of a device having the following identifiable functions:

1. Terrestrial Interface, defined by EIA-422 (balanced circuits) [MIL-STD-188-114A Type II and III compatible].
2. Multiplex/Demultiplex an asynchronous data channel onto the primary data channel.
3. Provide Intelsat compatible Overhead Framing for Open Network interoperability.
4. Provide a buffer that can be clocked by the Tx, terrestrial source, an external reference, internal clock, or from the recovered clock from the satellite link.
5. Monitor the modem status without interrupting service
6. Provide an interface for control of the modem parameters via the front panel or serial remote control interface

1.2.4 Additional Features

The modem contains the following additional features:

- **F**ully **A**ccessible **S**ystem **T**opology (FAST)
- **B**uilt-**i**n **s**elf **t**est (BIST)
- **A**symmetrical **l**oop **t**iming (ASLT)
- Selectable near or far end, baseband loopback with ASYNC overhead option enabled
- Intelsat compliant Reed-Solomon Codec
- **ASYNC**hronous Channel Unit Overhead (ASYNC)
- **A**utomatic **U**plink **P**ower **C**ontrol (AUPC)
- **T**urbo **P**roduct **C**ode (TPC) **F**orward **E**rror **C**orrection (FEC) (Hardware Option)
- G.703 Optional Interface with Overhead Card (AS/10175), 50-pin interface and access to IESS ESC

1.3 Operating Modes

Table 1-1 Operating Modes

Modes	Description
7650-00	This is the basic OM-73 compatibility mode.
7650-02	This mode is compatible with the SLM8650-02 modem up to the 8.448 Mbps data rate limit of the SLM-8650. Operation in this mode requires the optional ASYNC option to be activated.
EFD	This is the basic closed network non-OM73 operating mode compatible with legacy-closed network Comtech EF Data modems.
ASYNC	This mode allows for an asynchronous overhead channel to be multiplexed and demultiplexed onto the primary data channel. **A**utomatic **U**plink **P**ower **C**ontrol (AUPC) is available to maintain the link margin of a duplex link during the normal fades that occur with a satellite communication network.
IDR, IBS, IBS-309, and VSAT-IBS	These modes of operation are typical open network operating modes used within the INTELSAT and EUTELSAT satellite networks.
Custom	This mode of operation enables the programming of the modem for emulating most proprietary modems.

1.4 Options

Table 1-2 SLM-7650 Options

Option	Part No.	Description	Remarks
Chassis Configuration	PL/9709-1	90 – 264 VAC TNC	Standard
	PL/9709-2	90 – 264 VAC BNC	Option
System Configuration	SS/SLM7650-0009 SS/SLM7650-0010	Tx and Rx	Standard
	SS/SLM7650-0010	Rx Only	Option
	SS/SLM7650-0009	Tx Only	Option
Baseband Interface	PL/9685-1	37-pin EIA-449	Standard
	PL/9685-2	25-pin EIA-530	Option
Modulation Type		BPSK, QPSK, OQPSK	Standard
	SS/SLM7650-0004	BPSK, QPSK, OQPSK, 8-PSK	Option
	SS/SLM7650-0004 SS/SLM7650-0005	BPSK, QPSK, OQPSK, 8-PSK, 16-QAM	Option
Variable Data Rate		9.6 kbps to 10 Mbps	Standard
	SS/SLM7650-0003	9.6 kbps to 20 Mbps	Option
Overhead Framing	SS/SLM7650-0006	IDR/IBS	Option
	SS/SLM7650-0007	ASYNC/AUPC	Option
	SS/SLM7650-0006 SS/SLM7650-0007	IDR/IBS/ASYNC/AUPC	Option
Reed-Solomon (IESS Fixed)	SS/SLM7650-0008	Tx and Rx	Option
Turbo FEC	PL/9652-1	Tx and Rx	Option
G.703 Option Overhead Interface	PL/10175-1 PL/10175-2	G.703, 50 pin, access to IESS ESC	Option

1.5 System Specifications Summary

Table 1-3. System Specifications Summary

Characteristic	Specification	
System		
Operating Frequency Range	50 to 90, 100 to 180 MHz, in 1 Hz steps	
Modulation Types	Non-Turbo Modulation Types BPSK: 1/1 and 1/2 (CEVD) QPSK: 1/1, 1/2, 3/4, and 7/8 (CEVD) OQPSK: 1/1, 1/2, 3/4, and 7/8 (CEVD) 8-PSK: 2/3 and 5/6 (TCM) 16-QAM: 3/4, 7/8 (CEVD)	Turbo Modulation Types BPSK: 5/16 and 21/44 QPSK: 3/4, 7/8, 17/18, and 21/44 OQPSK: 3/4, 7/8, 17/18, and 21/44 8-PSK: 3/4, 7/8, and 17/18 16-QAM: 3/4 and 7/8
Digital Data Rate	9.6 kbps to 20.0 Mbps, in 1 bps steps	
Symbol Rate	9.6 ks/s to 10 Ms/s	
External Reference In	1, 5, 10, or 20 MHz, selectable	
Internal Reference Stability	$\pm$ 2 x 10^{-7}	
Scrambling	V.35 scrambler variations to meet MIL-STD-188-165 and IESS-308, -309, -310.	
IDR/IBS Framing Compatibility	Support for IDR and IBS framing. Allows basic IDR/IBS open network operation.	
Built-in Test (BIT)	Fault and status reporting, BER performance monitoring, IF loopback, programmable test modes, Tx/Rx 2047 pattern provides and estimated BER.	
Summary Faults	Reported via 15-pin D sub, FORM C relay contacts for Tx, Rx, Common equipment faults, and Tx and Rx Alarms.	
Modulation		
Output Power	+5 to –30 dBm, adjustable in 0.1 dB steps	
Output Return Loss	17 dB	
Output Impedance	50Ω	
Spurious	0 to 500 MHz (-5 to –30 dBm) –5 dBc 0 to 500 MHz (+5 tp –20 dBm) –50 dBc > 64 kbps o to 500 MHz (+5 to –20 dBm) _45 dBc < 64 kbps	
Tx Clock Source	INT, Tx Terrestrial, and Data Source Sync	
Output Connector	TNC	
Demodulation		
Input Power: Desired Carrier Maximum Composite	 -15 to –55 dBm 0 dBm or +40 dBc	
Input Impedance	50Ω	
Input Connector	TNC	
Carrier Acquisition Range	$\pm$ 35 kHz, selectable	
Input Return Loss	17 dB minimum	
Buffer Clock	INT, EXTERNAL, Tx Terrestrial, Rx Satellite	
Elastic Buffer	32 to 1,048,576 bits selectable	

Table 1-3. System Specifications Summary (continued)

Characteristic	Specification
Coding Options	
Uncoded	1/1
Viterbi	K=7
Viterbi and Reed-Solomon	Concatenated
Trellis	Per IESS-310
Trellis and Reed-Solomon	Concatenated
Turbo	Tutbo product Code (TPC)
Open Network Option	
IDR	INTELSAT IESS-308 (framing only)
IDR	INTELSAT IESS-310 (framing only)
IBS	INTELSAT IESS-309 (framing only)
Environmental and Physical Speciufication	
Prime Power	90 to 264 VAC, 47 to 63 Hz (DC optional)
Mounting	1 RU
Size	19W x 19D x 1.71H inches (1 RU) (48W x 48D x 4.3H cm)
Weight	< 15 lbs. (< 6.8 kg)
Temperature: Operating Storage (Non-operational)	 0 to 50°C (32 to 122°F) -40 to +70°C (-40 to 158°F)
Humidity	0 to 95%, non-condensing

1.5.1 Bit Error Rate Performance With Noise

Refer to the following tables for BER performance over the specified data rate ranges. The table values reflect specified guaranteed performance of the demodulator when operating with the associated modulator and noise. Typically the performance shall be 0.5 dB better than specified for adequate production margin.

1.5.1.1 Vfiterbi Decoding BER Performance

Table 1-4. Viterbi Decoder BER

Eb/No Performance Viterbi Decoder, QPSK							
	Viterbi			Reed-Solomon		Turbo	
BER	1/2	3/4	7/8	1/2	3/4	3/4	7/8
10^{-3}	4.2	5.2	6.4				
10^{-4}	4.8	6.0	7.2				
10^{-5}	5.5	6.7	7.9				
10^{-6}	6.1	7.5	8.6	4.1	5.6	4.1	4.5
10^{-7}	6.7	8.2	9.2	4.2	5.8	4.3	4.6
10^{-8}	7.2	8.8	9.9	4.4	6.0	5.5	4.7
10^{-10}				5.0	6.3	5.5	4.8

1.5.1.2 Viterbi Decoder and Reed-Solomon BER Performance,

Table 1-5. High Order Modulation Option

Eb/No Performance, Viterbi Decoder and Reed-Solomon								
	Non-Turbo				Turbo			
	8-PSK		16-QAM		8-PSK		16-QAM	
BER	2/3	5/6	3/4	7/8	3/4	7/8	3/4	7/8
10^{-6}	6.2	8.2	8.4	9.8	6.5	7.1	7.6	8.2
10^{-7}	6.5	8.5	8.6	10.0	6.9	7.2	7.95	8.35
10^{-8}	6.7	8.9	8.8	10.3	7.2	7.3	8.3	8.5
10^{-9}	6.9	9.3	9.0	10.5	7.5	7.4	8.65	8.65
10^{-10}	7.2	9.7	9.2	10.8	7.8	7.5	9.0	8.8

1.5.2 Dimensional Envelope

Note: Dimensions are given in both inches and millimeters.

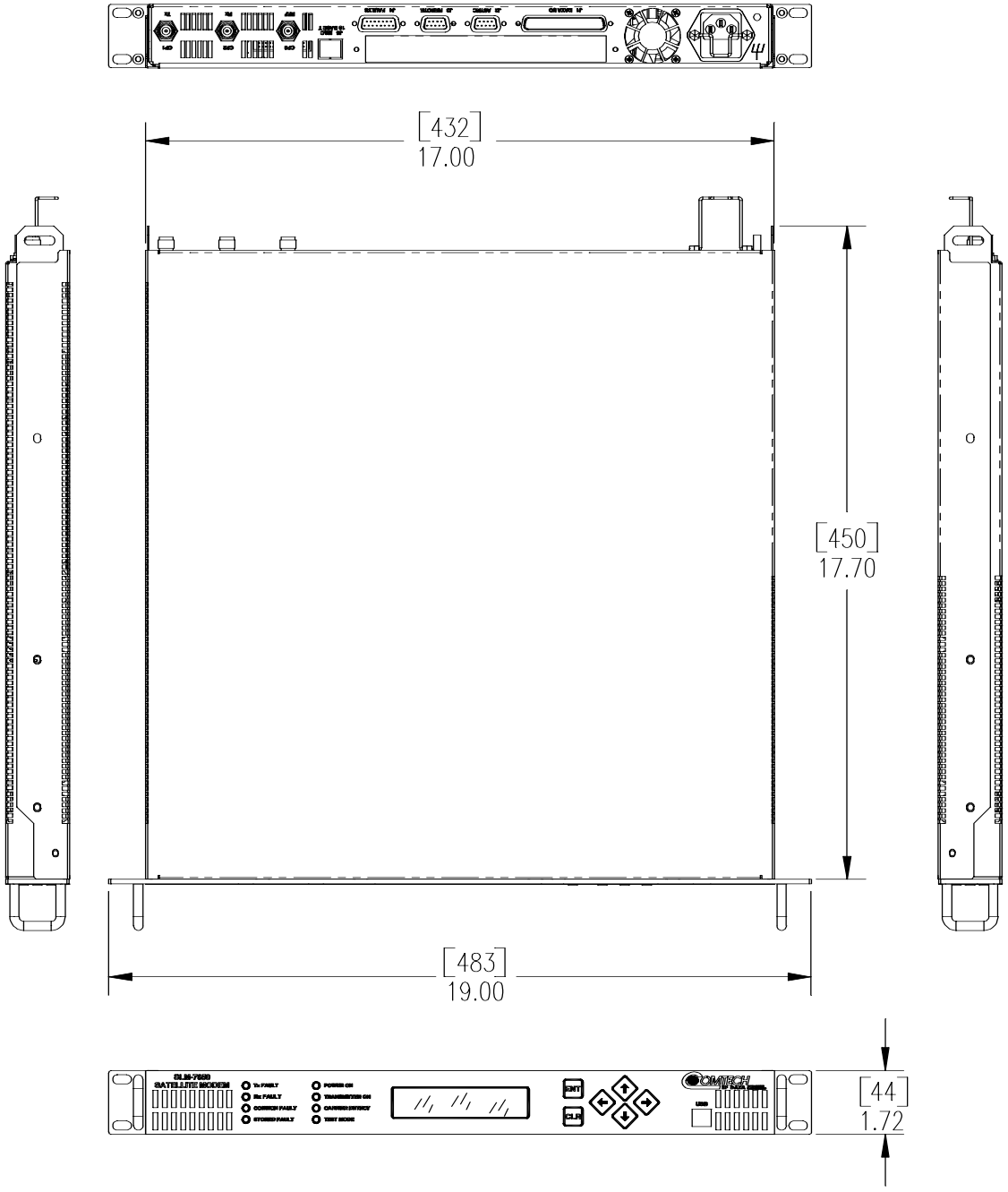


Figure 1-2. Dimensional Envelope

Chapter 2. INSTALLATION

This chapter provides unpacking and installation instructions, system options, and a description of external connections.

The equipment contains parts and assemblies sensitive to damage by Electrostatic Discharge (ESD). Use ESD precautionary procedures when touching, removing, or inserting PCBs.

2.1 Unpacking

The modem and manual are packaged in pre-formed, reusable, cardboard carton containing foam spacing for maximum shipping protection.

Do not use any cutting tool that will extend more than 1 inch into the container and cause damage to the modem.

To remove the modem:

1. Cut the tape at the top of the carton indicated by OPEN THIS END.
2. Remove the cardboard/foam space covering the modem.
3. Remove the modem, manual, and power cord from the carton.
4. Save the packing material for storage or reshipment purposes.
5. Inspect the equipment for any possible damage incurred during shipment.
6. Check the equipment against the packing list to ensure the shipment is correct.
7. Refer to Section 2.2 for installation instructions.

2.2 Installation

2.2.1 Installation Procedure

Install the SLM-7650 into the equipment rack as follows:

1. Carefully lift the modem into the selected position in the equipment rack. Refer Figure 1-2 for unit dimensional envelope.
2. Connect the cables to the proper locations on the rear panel.

Notes:

1. To allow proper cooling of the unit, the modem shall be positioned in a manner to allow an uninterrupted airflow around the unit, including no blockages in front of the fan assembly.
2. If there is any problem with the installation, contact Comtech EF Data's Customer Support Department.

2.2.2 External Modem Connections

Figure 2-1. Rear Panel

2.2.2.1 Power Entry

Table 2-1. Modem Rear Panel Connectors

AC Option	
Input Power	60W maximum, 50W typical
Input Voltage	90 to 132, or 175 to 264 VAC Unit switches range automatically
Connector Type	I.E.C.
Fuse Protection	2A slo-blo Line and neutral fusing 5 mm type fuses

2.2.2.2 IF Connection: Transmit and Receive

Table 2-2. IF Interface

Connector Name		Connector Type
Tx IF	CP1	TNC 50Ω (optional BNC 50 Ω)
Rx IF	CP2	TNC 50Ω (optional BNC 50 Ω)

2.2.2.3 External Reference Input

Table 2-3 Modem External Reference Input

Connector Name	Designation	Connector Type
REF	CP3	TNC 50Ω (optional BNC 50 Ω)

2.2.2.4 Terrestrial Data Interfaces

Table 2-4. Terrestrial Data Interface
37-Pin D Female

Pin #	Signal Name	Pin #	Signal Name
1	GND		
2	N/C	20	GND
3	MOD_FLT	21	DEMOD_FLT
4	SDA	22	SDB
5	STA	23	STB
6	RDA	24	RDB
7	RTSA	25	RTSB
8	RTA	26	RTB
9	CTSA	27	CTSB
10	N/C	28	N/C
11	DMA	29	DMB
12	N/C	30	N/C
13	RRA	31	RRB
14	N/C	32	N/C
15	N/C	33	N/C
16	EXC/MCA	34	EXC/MCB
17	TTA	35	TTB
18	N/C	36	N/C
19	GND	37	GND

Table 2-5. Terrestrial Data Interface 25-Pin D Female (Optional)

Pin #	Signal Name	Pin #	Signal Name
1	GND		
2	SDA	14	SDB
3	RDA	15	STA
4	RTSA	16	RDB
5	CTSA	17	RTA
6	DMA	18	N/C
7	GND	19	RTSB
8	RRA	20	EXC/MCA
9	RTB	21	DF
10	RRB	22	DMB
11	TTB	23	EXC/MCB
12	STB	24	TTA
13	CTSB	25	MF

2.2.2.5 Remote Control Interface (M&C)

Table 2-6. Remote Control Interface (M&C)

Remote Control Interface, 9 Pin D Female, DCE								
EIA-485 4 Wire			EIA-485 2 Wire			EIA-232		
Pin #	Signal Name	I/O	Pin #	Signal Name	I/O	Pin #	Signal Name	I/O
1	GND		1	GND		1	GND	
2			2			2	RD	O
3			3			3	TD	I
4	+TX	I	4	+TX/+RX	I/O	4		
5	-TX	I	5	-TX/-RX	I/O	5	GND	
6			6			6	DSR	O
7			7			7	RTS	I
8	+RX	O	8	+TX/+RX	I/O	8	CTS	O
9	-RX	O	9	-TX/-RX	I/O	9		

2.2.2.6 Asynchronous Data Interface

Table-2-7. Asynchronous Data Interface

Asynchronous Interface, 9-Pin D Female, DCE								
EIA-485 (4-Wire)			EIA-485 (2-Wire)			EIA-232		
Pin #	Signal Name	I/O	Pin #	Signal Name	I/O	Pin #	Signal Name	I/O
1	GND		1	GND		1	GND	
2			2			2	RD	O
3			3			3	TD	I
4	+TX	I	4	+TX/+RX	I/O	4		
5	-TX	I	5	-TX/-RX	I/O	5	GND	
6			6			6	DSR	O
7			7			7	RTS	I
8	+RX	O	8	+TX/+RX	I/O	8	CTS	O
9	-RX	O	9	-TX/-RX	I/O	9		

2.2.2.7 Faults Status

Table 2-8. Fault/Alarm Status Interface

Specifications					
Connector Type = 15-pin D subminiature, female					
Form C Contact Ratings = 1A maximum at 24 VDC, 0.5A at 120 VAC					
Pinout					
Pin #	Name	Function	Pin #	Name	Function
1	COM		10	COM	
2	NO	COMMON EQUIPMENT OK	11	NO	TRANSMIT IS ALARMED
3	NC	COMMON EQ IS FAULTED	12	NC	TRANSMIT IS OK
4	COM		13	COM	
5	NO	RECEIVE IS OK	14	NO	RECEIVE IS ALARMED
6	NC	RECEIVE IS FAULTED	15	NC	RECEIVE IS OK
7	COM				
8	NO	TRANSMIT IS OK			
9	NC	TRANSMIT IS FAULTED			

2.2.2.8 G.703 Overhead Option Card Connections

2.2.2.8.1 50-Pin Interface Connector

Table 2-9. 50-Pin Sub-D Female Interface Connector

50-Pin Sub-D Female				
Pin #	**IDR**	**IBS**	**ASYNC / Normal**	**D&I**
1, 2	GND	GND	GND	GND
3	AGC (O)	AGC (O)	AGC (O)	AGC (O)
33	DF (O)	DF (O)	DF (O)	DF (O)
49	MF (O)	MF (O)	MF (O)	MF (O)
34	SDA G.703 (I)	SDA G.703 (I)	SDA G.703 (I)	DDI_A G.703 (I)
18	SDB G.703 (I)	SDB G.703 (I)	SDB G.703 (I)	DDI_B G.703 (I)
36	RDA G.703 (O)	RDA G.703 (O)	RDA G.703 (O)	IDO_A G.703 (O)
20	RDB G.703 (O)	RDB G.703 (O)	RDB G.703 (O)	IDO_B G.703 (O)
37	TXDA EIA422 8k (I)	SD-A EIA422 (I)	SD-A EIA422 (I)	DDO-A G.703 (O)
38	TXDB EIA422 8k (I)	SD+B EIA422 (I)	SD+B EIA422 (I)	DDO-B G.703 (O)
12	BWAI_1 (I)	TT-A EIA422 (I)	TT-A EIA422 (I)	
13	BWAI_2 (I)	TT+B EIA422 (I)	TT+B EIA422 (I)	
21	TXC-A EIA422 8k (O)	ST-A EIA422 (O)	ST-A EIA422 (O)	
22	TXC+B EIA422 8k (O)	ST+B EIA422 (O)	ST+B EIA422 (O)	
45	Aud1-Ain / 64SDA (I)	RTS-A EIA422 (I)	RTS-A EIA422 (I)	
29	Aud1-Bin / 64SDB (I)	RTS+B EIA422 (I)	RTS+B EIA422 (I)	
47	Aud2-Ain / 64STA (O)	CTS-A EIA422 (O)	CTS-A EIA422 (O)	
31	Aud2-Bin / 64STB (O)	CTS+B EIA422 (O)	CTS+B EIA422 (O)	
39	RXDA EIA422 8k (O)	RD-A EIA422 (O)	RD-A EIA422 (O)	IDI-A G.703 (I)
40	RXDB EIA422 8k (O)	RD+B EIA422 (O)	RD+B EIA422 (O)	IDI-B G.703 (I)
23	RXC-A EIA422 8k (O)	RT-A EIA422 (O)	RT-A EIA422 (O)	
24	RXC+B EIA422 8k (O)	RT+B EIA422 (O)	RT+B EIA422 (O)	
46	Aud1-Aout / 64RTA (O)	RR-A EIA422 (O)	RR-A EIA422 (O)	
30	Aud1-Bout / 64RTB (O)	RR+B EIA422 (O)	RR+B EIA422 (O)	
48	Aud2-Aout / 64RDA (O)	DSR-A EIA422 (O)	DSR-A EIA422 (O)	DSR_ESC EIA232 (O)
32	Aud2-Bout / 64RDB (O)	DSR+B EIA422 (O)	DSR+B EIA422 (O)	
35	EXC-A EIA422 (I)	EXC-A EIA422 (I)	EXC-A EIA422 (I)	EXC-A EIA422 (I)
19	EXC+B EIA422 (I)	EXC+B EIA422 (I)	EXC+B EIA422 (I)	EXC+B EIA422 (I)
5	TXOctBin EIA422 (I)	TXD_ESC EIA232 (I)	TXDA_ESC EIA485/232 (I)	TXD_ESC EIA232 (I)
4	TXOctAin EIA422 (I)		TXDB_ESC EIA485 (I)	
7	RXOctBout EIA422 (O)	RXD_ESC EIA232 (O)	RXDA_ESC EIA485/232 (O)	RXD_ESC EIA232 (O)
6	RXOctAout EIA422 (O)		RXDB_ESC EIA485 (O)	
14	BWAI_3 (I)	TXAOct EIA422 (I)		
15	BWAI_4 (I)	TXBOct EIA422 (I)		
8	BWO1_C	RXAOct EIA422 (O)		
9	BWO2_C	RXBOct EIA422 (O)		
10	BWO3_C	PROMPT_C		PROMPT_C
11	BWO4_C	SERVICE_C		SERVICE_C
25	BWO1_NC	TCLK_ESC EIA232 (O)	CTS_ESC EIA232 (O)	TCLK_ESC EIA232 (O)
26	BWO2_NC	RCLK_ESC EIA232 (O)		RCLK_ESC EIA232 (O)
27	BWO3_NC	PROMPT_NC		PROMPT_NC
28	BWO4_NC	SERVICE_NC		SERVICE_NC
41	BWO1_NO	DSR_ESC EIA232 (O)	DSR_ESC EIA232 (O)	DSR_ESC EIA232 (O)
42	BWO2_NO			
43	BWO3_NO	PROMPT_NO		PROMPT_NO
44	BWO4_NO	SERVICE_NO		SERVICE_NO
16	Demod_Fault_C			
50	Demod_Fault_NO			
17	Def_Maint_Alrm (O)			

2.2.2.8.2 15-Pin Connector (G.703 Balanced)

Table 2-10. 15-Pin Sub-D Female (G.703 Balanced)

15 Pin Sub-D Female		
Pin #	**G.703 (Non-D&I)**	**D&I**
1	SD_A G.703 (I)	DDI_A G.703 (I)
9	SD_B G.703 (I)	DDI_B G.703 (I)
12		DDO_A G.703 (O)
5		DDO_B G.703 (O)
13		IDI_A G.703 (I)
6		IDI_B G.703 (I)
3	RD_A G.703 (O)	IDO_A G.703 (O)
11	RD_B G.703 (O)	IDO_B G.703 (O)
7	EXC_A EIA-422 (I)	EXC_A EIA-422 (I)
8	EXC_B EIA-422 (I)	EXC_B EIA-422 (I)
2, 4	Ground	Ground

2.2.2.8.3 BNC Connectors (G.703 Unbalanced)

Table 2-11. 75 Ω BNC Connectors (G.703 Unbalanced)

Connector	Characteristics
Tx Data G.703 (Input)	BNC 75 Ω, Female
Rx Data G.703 (Output)	BNC 75 Ω, Female

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Chapter 3. OPERATION

This chapter describes the front panel operation of the modem, including the menus and their explanations, and clocking information. For information about remote control operation, refer to Appendix B.

3.1 Front Panel

The modem front panel (Figure 3-1) enables the user to control modem configuration parameters and display the modem status.

Figure 3-1. **SLM-7650 Front Panel**

The front panel features include:

- 24-character, 2-line LCD display
- 6-button keypad for local control
- 8 LEDs to provide overall status at a glance

Note: All functions are accessible at the front panel by scrolling through a multilevel menu using the front panel keypad and display.

3.1.1 LED Indicators

The 8 LEDs on the front panel indicate general modem summary fault information and status. The indicators are defined as follows in Table 3-1:

Table 3-1. Front Panel Indicators

Name	LED	Meaning
Faults		
Transmit	Red/Yellow	A fault (red) or alarm (yellow) condition exists in the transmit chain.
Receive	Red/Yellow	A fault (red) or alarm (yellow) condition exists in the receive chain.
Common	Red	A common equipment fault condition exists.
Stored	Yellow	A fault or alarm has been logged and stored. The fault may or may not be active.
Status		
Power On	Green	Power is applied to the modem.
Transmitter On	Green	Transmitter is currently on. This indicator reflects the actual condition of the transmitter, as opposed to the programmed condition.
Carrier Detect	Green	Decoder is locked.
Test Mode	Yellow	Flashes when the modem is in a test configuration.

3.1.2 Front Panel Keypad

The front panel keypad (Figure 3-2) controls the local operation of the modem. The keypad consists of six keys. Each key provides one or more logical functions (Table 3-2). The modem responds by beeping whenever a key is pressed:

- A single-beep indicates a valid entry and the appropriate action was taken.
- A double-beep indicates an invalid entry or a parameter is not available for operation.

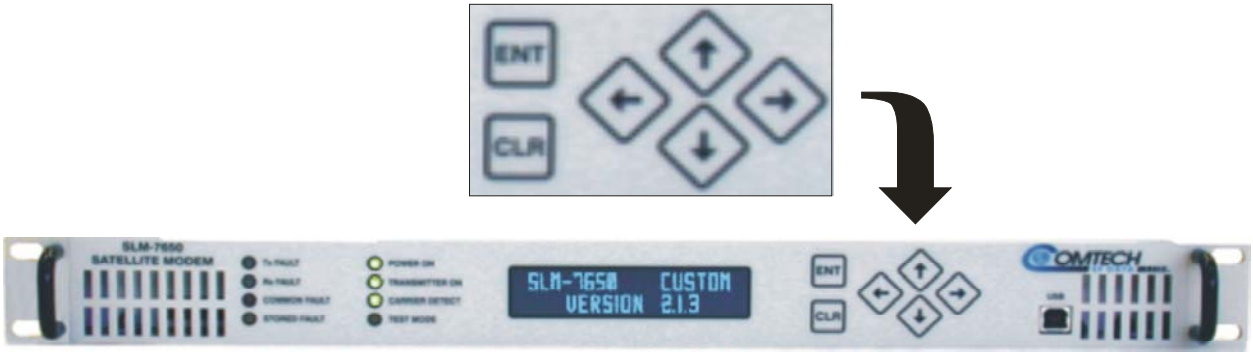

Figure 3-2. Keypad

Table 3-2. Keypad Functions

Key	Function
[ENTER]	This key is used to select a displayed function, or to execute a modem configuration change.
[CLEAR]	This key is used to back out of a selection, or to cancel a configuration change, which has not been executed using [ENTER]. Pressing [CLEAR] generally returns the display to the previous selection.
[←] and [→]	These keys are used to move to the next selection, or to move the cursor for certain functions.
[↑] and [↓]	These keys are used primarily to change configuration data (numbers), but are also used at times to move from one section to another.

3.2 Front Panel Operation

3.2.1 Front Panel Menu Operation

When the modem is first powered ON, the sign-on message for the menu system displays. This sign-on message is also displayed when the [CLEAR] key is pressed repeatedly from anywhere within the menu system. The sign-on message displays the following information:

- Line 1 is the modem model number and type.
- Line 2 is the version number of the M&C firmware.

An overview of the first three layers in modem menu system is shown in Figure 3-3.

Function Select is the main level of the menu system. To access this level from the sign-on message, press any of the arrow keys. The modem control and monitor parameters are accessed from the following Function Select menus:

- Configuration
- Monitor
- Faults/Alarms
- Stored Faults/Alarms
- Remote Automatic Uplink Power Control (AUPC)
- Utility

Press [←] or [→] to move from one selection to another. When line 2 displays the desired function, select that level by pressing [ENTER]. After entering the appropriate functional level, press [←] or [→] to move to the desired function.

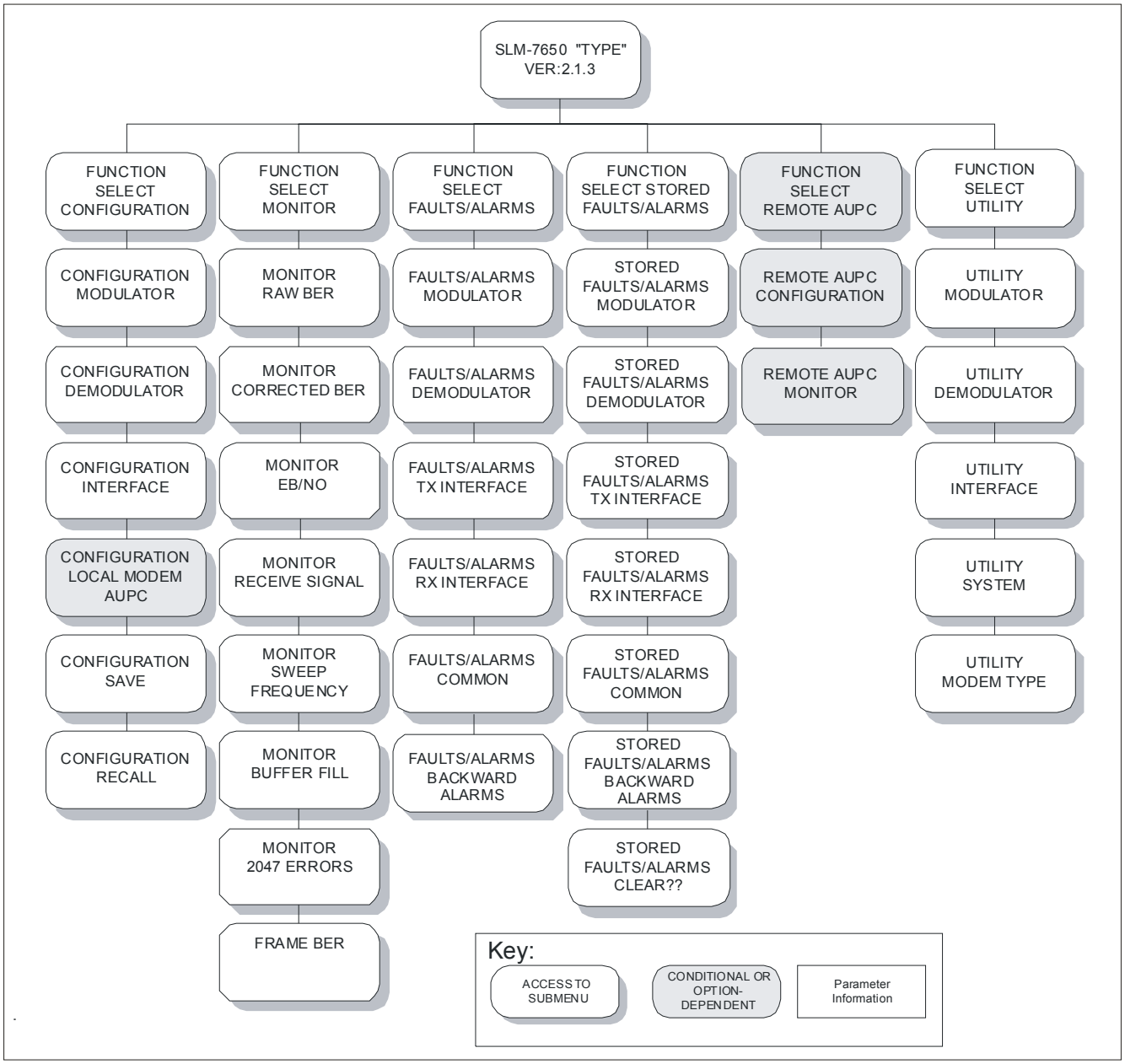

Figure 3-3. Main Menu

Notes:

1. Operating mode selections and hardware configuration may change the front panel menu selection.
2. Parameters that are specific to certain modem configurations are only accessible after selecting the appropriate modem configuration. This prevents incompatible parameters from accidentally being selected.
3. All of the parameters are accessible in the Custom mode. Take caution not to select incompatible parameters, as the modem does not block out incompatible command choices in the Custom mode.

3.2.2 Configuration

To view or change the modem's configuration, enter the Configuration level from the Function Select menu. Once in the Configuration menu, press [←] or [→] to scroll through the Configuration menu selection:

- Modulator
- Demodulator
- Interface
- Local AUPC
- Save
- Recall

Press [ENTER] to select the desired Configuration menu option. To view the options for the selected configuration parameters, press [←] or [→]. To change a configuration parameter, press [ENTER] to begin the change process.

Press an arrow key to change the parameters. When the correct parameters are displayed, press [ENTER] to execute the change. This action initiates the necessary programming by the modem.

To undo a parameter change prior to execution, press [CLEAR].

3.3 Digital Data Rate and Symbol Rate

The digital data rate is selectable in 1 bit/s increments, from 9.6 kbps to 20.0 Mbps depending on modulation type, code rate, and overhead. The symbol rate range is 9.6 kS/s to 10.0 MS/s, and is a limiting factor to data rate. See for Table 3-3 details.

Table 3-3. Data Rate Ranges

Operating Mode	Modulation/Coding	FEC/Overhead Type	Min DR (kbps)	Max DR (Mbps)
7650-00, CEFD Clsd	BPSK, Uncoded	None	9.60	10.000
7650-00, CEFD Clsd	QPSK, OQPSK Uncoded	None	19.20	20.000
7650-00, CEFD Clsd	BPSK 1/2	Viterbi	9.60	5.000
7650-00, CEFD Clsd	QPSK, OQPSK 1/2	Viterbi	9.60	10.000
7650-00, CEFD Clsd	QPSK, OQPSK 3/4	Viterbi	14.40	15.000
7650-00, CEFD Clsd	QPSK, OQPSK 7/8	Viterbi	16.80	17.500
7650-00, CEFD Clsd	8-PSK 2/3	Trellis	64.00	20.000
7650-00, CEFD Clsd	8-PSK 5/6	Trellis	80.00	20.000
7650-00, CEFD Clsd	BPSK 1/2	Viterbi and R-S	9.60	4.555
7650-00, CEFD Clsd	QPSK, OQPSK 1/2	Viterbi and R-S	9.60	9.111
7650-00, CEFD Clsd	QPSK, OQPSK 3/4	Viterbi and R-S	13.12	13.666
7650-00, CEFD Clsd	QPSK, OQPSK 7/8	Viterbi and R-S	15.31	15.944
7650-00, CEFD Clsd	8-PSK 2/3	Trellis and R-S	64.00	18.222
7650-00, CEFD Clsd	8-PSK 5/6	Trellis and R-S	80.00	20.000
7650-00, CEFD Clsd	16-QAM 3/4	Viterbi and R-S	256.00	20.000
7650-00, CEFD Clsd	16-QAM 7/8	Viterbi and R-S	256.00	20.000
CEFD Clsd	BPSK 21/44	TPC	9.60	4.772
CEFD Clsd	BPSK 5/16	TPC	9.60	3.125
CEFD Clsd	QPSK, OQPSK 21/44	TPC	9.60	9.545
CEFD Clsd	QPSK, OQPSK 3/4	TPC	14.40	15.000
CEFD Clsd	QPSK, OQPSK 7/8	TPC	16.80	17.500
CEFD Clsd	QPSK, OQPSK 17/18	TPC	18.13	18.888
CEFD Clsd	8-PSK 3/4	TPC	72.00	20.000
CEFD Clsd	8-PSK 7/8	TPC	84.00	20.000
CEFD Clsd	8-PSK 17/18	TPC	90.60	20.000
CEFD Clsd	16-QAM 3/4	TPC	256.00	20.000
CEFD Clsd	16-QAM 7/8	TPC	256.00	20.000
7650-02, Async	BPSK, Uncoded	Async	9.60	8.448
7650-02, Async	QPSK, OQPSK Uncoded	Async	18.00	8.448
7650-02, Async	BPSK 1/2	Viterbi, Async	9.60	4.687
7650-02, Async	QPSK, OQPSK 1/2	Viterbi, Async	9.60	8.448
7650-02, Async	QPSK, OQPSK 3/4	Viterbi, Async	13.50	8.448
7650-02, Async	QPSK, OQPSK 7/8	Viterbi, Async	15.75	8.448
7650-02, Async	8-PSK 2/3	Trellis, Async	64.00	8.448
7650-02, Async	8-PSK 5/6	Trellis, Async	80.00	8.448
7650-02, Async	BPSK 1/2	Viterbi and R-S, Async	9.60	8.448

Operating Mode	Modulation/Coding	FEC/Overhead Type	Min DR (kbps)	Max DR (Mbps)
7650-02, Async	QPSK, OQPSK 1/2	Viterbi and R-S, Async	9.60	8.448
7650-02, Async	QPSK, OQPSK 3/4	Viterbi and R-S, Async	12.30	8.448
7650-02, Async	QPSK, OQPSK 7/8	Viterbi and R-S, Async	14.35	8.448
7650-02, Async	8-PSK 2/3	Trellis and R-S, Async	64.00	8.448
7650-02, Async	8-PSK 5/6	Trellis and R-S, Async	80.00	8.448
7650-02, Async	16-QAM 3/4	Viterbi and R-S, Async	256.00	8.448
7650-02, Async	16-QAM 7/8	Viterbi and R-S, Async	256.00	8.448
IDR	QPSK 1/2	Viterbi, IDR, 1544	1544.00	1.544
IDR	QPSK 3/4	Viterbi, IDR, 1544	1544.00	1.544
IDR	QPSK 1/2	Viterbi, IDR, 2048	2048.00	2.048
IDR	QPSK 3/4	Viterbi, IDR, 2048	2048.00	2.048
IDR	QPSK 1/2	Viterbi, IDR, 6312 & 8448	6312.00	8.448
IDR	QPSK 3/4	Viterbi, IDR, 6312 & 8448	6312.00	8.448
IDR	QPSK 1/2	Viterbi and R-S, IDR, 1544	1544.00	1.544
IDR	QPSK 3/4	Viterbi and R-S, IDR, 1544	1544.00	1.544
IDR	QPSK 1/2	Viterbi and R-S, IDR, 2048	2048.00	2.048
IDR	QPSK 3/4	Viterbi and R-S, IDR, 2048	2048.00	2.048
IDR	QPSK 1/2	Viterbi and R-S, IDR, 6312 & 8448	6312.00	8.448
IDR	QPSK 3/4	Viterbi and R-S, IDR, 6312 & 8448	6312.00	8.448
IDR/IESS310 = ON	8-PSK 2/3	Trellis and R-S, IDR	1544.00	8.448
IBS	QPSK 1/2	Viterbi, IBS	64.00	8.448
IBS	QPSK 3/4	Viterbi, IBS	64.00	8.448
IBS	QPSK 1/2	Viterbi and R-S, IBS	64.00	8.333
IBS	QPSK 3/4	Viterbi and R-S, IBS	64.00	8.448
IBS/IESS310 = ON	8-PSK 2/3	Trellis and R-S, IBS	64.00	1.536
IBS-309	QPSK 1/2	Viterbi and R-S, IBS	64.00	8.448
IBS-309	QPSK 3/4	Viterbi and R-S, IBS	64.00	8.448
VSAT-IBS	BPSK 1/2	Viterbi and R-S	64.00	4.589
VSAT-IBS	QPSK 1/2	Viterbi and R-S	64.00	8.448
VSAT-IBS	QPSK 3/4	Viterbi and R-S	64.00	8.448
VSAT-IBS/ IESS310 = ON	8-PSK 2/3	Trellis and R-S	64.00	1.536

3.4 Menus

3.4.1 Configuration Menu

3.4.1.1 Modulator Menu

Menu Item	Specifications/usage
TX-DR Data Rate, Code Rate, and Modulation Type	Filter: A, B, C, D, or V Data rates are referenced in Paragraph 3.3 On entry, the current transmitter rate is displayed with the flashing cursor on the first character of the code rate on line 1. Line 2 displays the data rate. Press [←] or [→] to make the selection. To select the currently defined variable data rate, select TX-V, and press [ENTER] twice. To change the rate using the variable rate selection, press [ENTER] when TX-V is displayed. A flashing cursor is displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
TX-IF FREQUENCY	Programs the modulator transmit frequency between 50 and 90 or 100 to 180 MHz, in 1.0 Hz steps. On entry, the current transmitter frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** When the transmitter frequency is changed, the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the IF Output function.
TX-IF OUTPUT	Programs the modulator output On or Off. On entry, the current status of the output is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
TX POWER LEVEL	Programs the modulator output power level from: +5 to -30 dBm for no offset. An offset can be added through the Utility menu to remove losses or gains in the system. On entry, the current transmitter power level is displayed with the flashing cursor on the first character. Press [↑] or [↓] to increase or decrease the output power level in 0.1 dBm steps. Press [ENTER] to execute the change.
SCRAMBLER TYPE	Programs the scrambler IESS, OM73, or TURBO. On entry, the current status of the scrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Menu Item	Specifications/usage
SCRAMBLER	Programs the scrambler On or Off. On entry, the current status of the scrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
DIFF. ENCODER	Programs the differential encoder On or Off. On entry, the current status of the differential encoder is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
CARRIER MODE *(Test Mode Configuration)*	Programs the modem for continuous wave mode. Four modes of operation are available: Normal (Off): The Carrier mode is normally in the OFF position. To execute any of the Carrier continuous wave modes, enter the Carrier mode and select the test mode of choice. Center: Generates a carrier at the current modulator frequency. This can be used to measure the output frequency. Dual: Generates a dual side-band suppressed carrier signal. Side bands are at one-half of the symbol rate from the carrier. This is used to check the channel balance and carrier null. Offset: Generates a single upper side-band suppressed carrier signal. The upper side band is at one-quarter of the symbol rate from the carrier. This is used to check the quadrature. On entry, the Center mode is displayed. To activate this test mode, press [ENTER]. Press an arrow key to select the desired mode. To return to the Configuration menu, press [CLEAR].
RS ENCODER	Programs the Reed-Solomon encoder On or Off. On entry, the current status of the Reed-Solomon encoder is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change. **Notes:** 1. Programming the Reed-Solomon encoder automatically turns off the RF transmitter. 2. A double beep will occur when attempting to turn on Reed-Solomon if the data rate and overhead type are invalid.

3.4.1.2 Demodulator Menu

Menu Item	Specifications/usage
RX-DR Data Rate, Code Rate, and Modulation Type	Filter: A, B, C, D, or V Data rates are referenced in paragraph 3.3. On entry, the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line 1. The data rate is displayed on line 2. Press an arrow key to select one of four pre-defined rate (A, B, C, or D). To select the currently defined variable data rate, select RX-V, and press [ENTER] twice. To change the rate using the variable rate selection, press [ENTER] when RX-V is displayed. A flashing cursor is displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
RX-IF FREQUENCY	Programs the demodulator receive frequency between 50 and 90 MHz or 100 to 180 MHz, in 1.0 Hz steps. On entry, the current receive frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
DESCRAMBLER TYPE	Programs the descrambler IESS, OM73, or TURBO. On entry, the current status of the synchronous descrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
DESCRAMBLER	Programs the descrambler On or Off. On entry, the current status of the synchronous descrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
DIFF. DECODER	Programs the differential decoder on or off. On entry, the current status of the differential decoder is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
IF LOOP BACK *(Test Mode Configuration)*	Programs the modem for IF loopback operation. When IF loopback is turned on, the demodulator input is connected to the modulator output through an internal attenuator. The demodulator is programmed to the same frequency as the modulator. An attenuator within the modem connects the IF Out to the IF In. When IF loopback is turned off, the demodulator is tuned to the previous frequency and is reconnected to the IF input. Refer to Figure 5-9 for a block diagram of IF loopback operation. On entry, the current status of IF loopback is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
BER THRESHOLD	Sets the BER threshold. If the BER threshold set is exceeded, a receive fault will be indicated by the modem status indicators. BER threshold may be set from 1.0 E-3 to 1.0 E-8, or may be disabled by specifying None. On entry, the current setting of the BER threshold is displayed. Press [↑] or [↓] to select the desired setting. Press [ENTER] to execute the change.

Menu Item	Specifications/usage
SWEEP CENTER	Programs the sweep center frequency for the directed sweep function. The sweep center frequency can be set in the range from -35000 to +35000 Hz. On entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. When in directed sweep, the value from the sweep monitor screen (when the modem was last locked) should be entered for the sweep center frequency.
SWEEP RANGE	Programs the overall travel of the sweep width range during acquisition in the directed sweep mode. The sweep width may be set from 0 to 70000 Hz. When set at 70000 Hz, the modem is in the normal acquisition mode. Keep the sweep range narrow for low data rates. On entry, the current programmed setting is displayed. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. The smaller the range, the faster the modem will lock, provided the receive carrier center frequency is within the RX IF frequency sweep range.
SWEEP REACQUISITION	Programs the sweep reacquisition mode time duration. This is the time that the modem will remain in a narrow sweep of the selected range (± 500 Hz) after loss of acquisition. After this timer runs out, the modem will return to the normal acquisition sweep. The reacquisition time is 0 to 999 seconds. On entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Select the number of seconds desired for the reacquisition mode. Press [ENTER] to execute the change.
RS DECODER *(Correction OFF is a Test Mode Configuration)*	Programs the Reed-Solomon decoder On, Correction Off, or Off. ON: Enables the Reed-Solomon decoder to provide data error corrections. CORRECTION_OFF: Turns off the Reed-Solomon decoder data error correction circuitry. Data flow is then routed through normal data paths without error corrections. Only Viterbi error correction will be On. OFF: The RS decoder is normally disabled (Off position). To execute any of the Reed-Solomon decoder modes, enter the desired Reed-Solomon decoder and select the desired mode. On entry, the current status of the Reed-Solomon decoder is displayed. Use an arrow key to select the desired mode. Press [ENTER] to execute the change.

3.4.1.3 Interface Menu

Menu Item	Specifications/usage
TX CLOCK SOURCE	Programs the clock source for the modem transmitter clock to the following configurations: TX Terrestrial: Selecting TX Terrestrial will clock the data to the encoder using the customer terrestrial clock. Another term for this clock is terminal timing. SCT (Internal): Setting SCT as the TX clock source will clock the data to the encoder using the internal clock of the modem. This indication will change to SCT (Loop) when loop timing is turned on. Data Source Sync: The Clock for the modem input data will be recovered from the transitions of the input data. This clock is then used to phase lock the internal SCT clock and to clock the transmit data to the encoder. The SCT PLL REF will display Data Source Sync and can only be changed by selecting either SCT (Internal) or TX Terrestrial in this menu. On entry, the current transmit clock setting is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
TX CLOCK PHASE	Programs the TX clock phase to Normal or Invert. On entry, the current setting of the TX clock phase is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
SCT PLL REF	Programs the timing source for the **S**erial **C**lock **T**ransmit (SCT) **P**hase **L**ock **L**oop (PLL). MODEM REF Source (Uses the timing standard that is programmed in the Modem Reference menu.) EXT MASTER CLOCK (The MC input is on the baseband data interface. The frequency must be programmed in the Ext Master Clock Frequency menu screen.) DATA SOURCE SYNC (appears only when DATA is selected as the Tx Clock source) RX Loop (appears only when Loop Timing is ON) De-selecting DATA or Rx Loop is accomplished at the CONFIG / INTERFACE MENU On entry, the current timing source is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

Menu Item	Specifications/usage
EXT MASTER CLOCK FREQUENCY	Programs the external master clock input frequency between 9.6 kHz and 20 MHz. The data rate of the external master clock input will need to be entered by the user to match the expected rate at the input to the modem at the data I/O connector. **Notes:** 1. If the EXT MC is selected as the timing source for the SCT PLL the frequency of the MC must meet one of the three following: a. The MC frequency is equal to the transmit data rate. b. The transmit data rate and the MC freq. are both integer multiples of 600 Hz. c. The transmit data rate and the MC freq. are both integer multiples of 1 kHz. 2. If the EXT MC is selected as the timing source for the Buffer Clock the frequency of the MC must meet one of the three following: a. The MC frequency is equal to the receive data rate. b. The receive data rate and the MC freq. are both integer multiples of 600 Hz. c. The receive data rate and the MC freq. are both integer multiples of 1 kHz. On entry, the current setting for the external reference is displayed. Press [←] or [→] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
BUFFER CLOCK	Programs the interface buffer output clock to one of the following modes: RX (Satellite): Turns off the buffer. This will clock the data in and out of the buffer with the same receive satellite clock. This is the fall back when either TX Terrestrial or the External Master Clock is missing. SCT (Internal): Clocks the data to the user with the internal clock of the modem. This is also the fallback clock. External Master Clock: Clocks the data to the user with the external master clock input. (The MC input is on the baseband data interface. The frequency must be programmed in the Ext Master Clock Frequency menu screen.) TX Terrestrial: Clocks the data to the user with the customers Tx Terrestrial clock input. Insert: Drop and Insert applications only. Overhead must be installed. On entry, the current setting of the plesiochronous buffer clock is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
BUFFER SIZE	Sets the size of the buffer. On entry, the current buffer length is displayed. Press [↑] or [↓] to select the desired buffer size. The buffer size is displayed in seconds or bits. Enter the Interface Utility menu to change the buffer units to seconds or bits. If selecting seconds, choose from 1 to 48 ms, in increments of 1 ms or 0 (Bypass). If selecting bits, choose from 32 to 1,048,576 bits, in increments of 16 bits. Press [ENTER] to execute the change. Setting the RX buffer to RX Satellite will turn off the buffer. **Note:** To have the modem calculate the plesiochronous shift, set the buffer units to ms. When a specific buffer depth is desired, set the buffer units to bits. Select bits or ms from the Utility Interface menu.
BUFFER CENTER	This configuration function is used to center the buffer. Press [ENTER] twice to center the buffer.
RX CLOCK PHASE	Programs the RX clock phase to Normal or Inverted. On entry, the current status of the RX Clock is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Menu Item	Specifications/usage
B-BAND LOOPBACK *(Test Mode Configuration)*	Programs the modem for baseband loopback operation. Baseband loop back will turn around the data and clock to the user at the terrestrial interface of the modem. This is a bi-directional loop so the data and clock over the satellite is also turned around. Refer to Figure **5-10** for a block diagram of baseband loopback operation. On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
LOOP TIMING	Loop timing ON will phase lock the SCT internal clock to the recovered satellite clock of the decoder. This is used at the Slave end of a Satellite link to clock the data in and out of the modem using the clock from the distant end of the link. Selecting Loop timing ON will cause the SCT (INT) to change to SCT (Loop) and the SCT PLL REF to display RX Loop. Turn loop timing OFF to make another choice at the SCT PLL REF menu. On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
TX CODING FORMAT AMI, B6ZS, B8ZS, or HDB3	Programs the transmitter for AMI, B6ZS, B8ZS, or HDB3 coding of the baseband data. On entry, the current coding format is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when G.703 interface is installed.
RX CODING FORMAT AMI, B6ZS, B8ZS, or HDB3	Programs the receiver for AMI, B6ZS, B8ZS, or HDB3 coding. On entry, the current coding format is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when G.703 interface is installed.
TX DATA Alarm	Transmit data fault. Press an arrow key to select one of the following modes: None: The transmit interface fault Data/AIS is not activated. Alarm Indication Signal (AIS): This is also commonly referred to as All Ones. The M&C will produce an alarm if the customer is inputting data that is all ones. Data: The M&C will produce an alarm if the Customer input data is missing (all zeros or all ones). On entry, the current TX data fault that is being monitored is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
RX DATA ALARM	Receive data Alarm. Selects a receive interface alarm monitor of None, AIS, or Data. The data monitored for RX data is coming from the satellite. Refer to TX DATA ALARM for a description of function choices. On entry, the current RX DATA ALARM that is being monitored is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
TX 2047 PATTERN *(Test Mode Configuration)*	Programs the modem to transmit a test pattern instead of the incoming data stream. Selections are as follows: NONE 2047 (compatible with a Fireberd BERT) MIL-188 This is a modified 2047 pattern that is used to test the Data Source Sync function of the modem. It has the maximum number of consecutive zeros that the modem can handle when recovering the clock from the data transitions. On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Menu Item	Specifications/usage
RX 2047 PATTERN *(Test Mode Configuration)*	Programs the modem to monitor a test pattern. Selections are as follows: See the options for TX 2047 Pattern. The 2047 Errors menu choice under the Monitor menu will report Bit Error Rate if a 2047 pattern is being received by the demod and this option is set to 2047. On entry, the current status is displayed. Press an arrow key to select on or off. Press [ENTER] to execute the change.
SERVICE CHANNEL ADJUST	This configuration function is used to set service channel audio gain at TX-1, TX-2, RX-1, or RX-2. On entry, press [←] or [→] to select the desired service channel. To adjust the service channel gain (+8.0 to -6.0 dBm), press [ENTER]. Press [↑] or [↓] to adjust the service channel. Press [ENTER] to execute the change. **Note:** This window is only available when IDR has been selected for modem type in the Utility menu and option card (PL/10175-2) is installed.
DROP FORMAT	This configuration is used to select the desired drop data channel signaling. The choices are: • E1_CCS (E1 Common Channel Signaling) • E1_CAS (E1 Channel Associated Signaling) • T1 (T1 Data, D4 framing) • T1_ESF (T1 Extended Super Frame) **Note:** This menu is only available for the D&I option. On entry, the current drop data channel signal is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
INSERT FORMAT	Selects the desired insert data channel signaling. The choices are: • E1_CCS (E1 Common Channel Signaling) • E1_CAS (E1 Channel Associated Signaling) • T1 (T1 Data, D4 framing) • T1_ESF (T1 Extended Super Frame) **Note:** This menu is only available for the D&I option. On entry, the current insert data channel signal is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Menu Item	Specifications/usage
DROP CHANNEL ASSIGNMENTS	Drop Channel Assignments: Maps terrestrial time slots to transmit satellite channels. Terrestrial time slots: T1 = 1 to 24 E1 (CCS) = 1 to 31 E1 (CAS) = 1 to 15 and 17 to 31 Channels: 1 to N (N = Satellite Data Rate ÷ 64 kbps) N = 30 (1920.0 kbps) is a transparent mode which disables time slot to channel mapping. On entry, drop channel 1 and the current time slot are displayed. Press [↑] or [↓] to select the drop channel to be programmed. Press [ENTER] to begin programming. Press [↑] or [↓] to select the time slot for each available drop channel by incrementing or decrementing the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** This menu is only available for the D&I option.
INSERT CHANNEL ASSIGNMENTS	Insert Channel Assignments: Maps received satellite channels to terrestrial time slots. Terrestrial time slots: T1 = 1 to 24 E1 (CCS) = 1 to 31 E1 (CAS) = 1 to 15 and 17 to 31 Channels: 1 to N (N = Satellite Data Rate ÷ 64 kbps) N = 30 (1920.0 kbps) is a transparent mode which disables time slot to channel mapping. On entry, satellite channel 1 and the current terrestrial time slot are displayed. Press [↑] or [↓] to select the satellite channel to be programmed. Press [ENTER] to choose the satellite channel to be programmed. Press [↑] or [↓] to select the terrestrial time slot for each available satellite channel by incrementing or decrementing the digit at the flashing cursor. If a time slot is unused, select NI (Not Inserted). Press [ENTER] to execute the change. **Note:** This menu is only available for the D&I option.
DDO/INI LOOP	Selects Drop Data Output to Insert Data Input Loop. This provides an internal path so an external cable connection does not have to be connected. Selection is ON or OFF. **Note:** This menu is only available for the D&I option.

Menu Item	Specifications/usage
ASYNC TX	Programs the baud rate settings and interface format of ASYNC overhead in the modem. To change the ASYNC overhead baud rate (110 to 38400 bps), press [ENTER]. Press [←] or [→] to position the cursor over the baud rate parameter. Press [↑] or [↓] to select one of the following baud rates (bps): 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400. Once the desired baud rate is displayed, press [ENTER] to set the baud rate. To change the ASYNC overhead interface format of the modem is displayed press [ENTER]. Press [←] or [→] to position the cursor over the interface format parameter. Press [↑] or [↓] to scroll through the available interface formats. Once the desired format is displayed, press [ENTER] to set the baud rate. The number of data bits, parity, and stop bits is selectable. Available formats are: 7 data bits, Even parity, and 1 stop bits (7E1); 7 data bits, Odd parity, and 1 stop bits (7O1), 7 data bits, No parity, and 1 stop bit (7N1), 7 data bits, Even parity, and 2 stop bits (7E2); 7 data bits, Odd parity, and 2 stop bits (7O2); 7 data bits, No parity, and 2 stop bit (7N2), 8 data bits, Even parity, and 1 stop bits (8E1); 8 data bits, Odd parity, and 1 stop bits (8O1); 8 data bits, No parity, and 1 stop bit (8N1), 8 data bits, Even parity, and 2 stop bits (8E2); 8 data bits, Odd parity, and 2 stop bits (8O2);8 data bits, or No parity, and 2 stop bit (8N2)
ASYNC RX	Programs the baud rate settings and interface format of RX ASYNC overhead in the modem. To change the RX ASYNC overhead baud rate (110 to 38400 bps), press [ENTER]. Press [←] or [→] to position the cursor over the baud rate parameter. Press [↑] or [↓] to select one of the following baud rates (bps): 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400. Once the desired baud rate is displayed, press [ENTER] to set the baud rate. To change the RX ASYNC overhead interface format of the modem is displayed press [ENTER]. Press [←] or [→] to position the cursor over the interface format parameter. Press [↑] or [↓] to scroll through the available interface formats. Once the desired format is displayed, press [ENTER] to set the baud rate. The number of data bits, parity, and stop bits is selectable. Available formats are: 7 data bits, Even parity, and 1 stop bits (7E1); 7 data bits, Odd parity, and 1 stop bits (7O1), 7 data bits, No parity, and 1 stop bit (7N1), 7 data bits, Even parity, and 2 stop bits (7E2); 7 data bits, Odd parity, and 2 stop bits (7O2); 7 data bits, No parity, and 2 stop bit (7N2), 8 data bits, Even parity, and 1 stop bits (8E1); 8 data bits, Odd parity, and 1 stop bits (8O1); 8 data bits, No parity, and 1 stop bit (8N1), 8 data bits, Even parity, and 2 stop bits (8E2); 8 data bits, Odd parity, and 2 stop bits (8O2);8 data bits, or No parity, and 2 stop bit (8N2).
ASYNC COMM TYPE	Programs the ASYNC COMM type as EIA-232, EIA-485 (2-Wire), or EIA-485 (4-wire). On entry, press an arrow key to make the selection. Press [ENTER] to execute the change.
ASYNC CONNECTOR	Selects interface connector to use for ASYNC Channel, J2 (9 pin) or J6 (50 pin).

3.4.1.4 Local AUPC Menu

The Local AUPC menu is used to configure the Automatic Uplink Power Control parameters for a Duplex or Simplex (Broadcast) link. This menu will only be displayed if the modem is programmed to a mode that requires AUPC functionality. Within the **Utility: Modem Type** menu, selection of Modem Types 7650-02 or ASYNC or programming the Local Modem AUPC to ON will activate this display.

Menu Item	Specifications/usage
AUPC ENABLE	Programs the Automatic Uplink Power Control On or Off. On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
NOMINAL POWER	Programs the nominal power value of the AUPC. The nominal power value can range from +5 to -30 dBm, in 0.1 dBm steps. On entry, the current nominal power value is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
MINIMUM POWER	Programs the minimum power level of the AUPC. The minimum power level can range from +5 to -30 dBm, in 0.1 dBm steps. On entry, the current minimum power level is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
MAXIMUM POWER	Programs the maximum power level to the AUPC. The maximum power level can range from +5 to -30 dBm, in 0.1 dBm steps. On entry, the current maximum power level is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
TARGET E_b/N_0	Programs the E_b/N_0 target set point. The E_b/N_0 target set point ranges from 3.2 to 16.0 dB, in 0.1 dB steps. On entry, the current E_b/N_0 target set point is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
TRACKING RATE	Programs the maximum tracking rate of the AUPC. Maximum tracking rate can range from 0.5 to 6.0 dBm per minute, in 0.5 dB steps. On entry, the current maximum tracking rate is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
LOCAL CL ACTION	Choices are: HOLD, NOMINAL, MAXIMUM If the local demodulator loses lock then the modulator output level will change depending on the selected choice. The choices are: HOLD to the current level Return to the selected NOMINAL level To shoot to the selected MAXIMUM power level On entry, the current status of the local carrier loss is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.
REMOTE CL ACTION	Choices are HOLD, NOMINAL, MAXIMUM This will cause the local modulator output level to change depending on the distant ends loss of demodulator lock. On entry, the current status of the remote carrier loss is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

3.4.1.5 Save Menu

The Configuration Save menu allows the user to program configuration parameters into memory on the M&C. There are five memory locations that may be used to store specific configuration setups that are used frequently. This feature speeds up the configuration process by allowing faster configuration changes.

After changing the configuration parameters to the desired settings, enter the Configuration Save menu and select memory location 1 through 5. Press [ENTER] to execute the save. A hard reset of the modem will clear out the saved parameters.

3.4.1.6 Recall Menu

The Configuration Recall menu allows the user to recall a previously saved configuration setup. On entry, select memory location 1 through 5 by pressing an arrow key. Press [ENTER] to execute the recall.

3.4.2 Monitor Menu

The Monitor level is accessible from the Function Select menu. The Monitor menu provides information on the link performance of the demodulator. When the Monitor level is entered, press [←] or [→] to select the desired monitor function. Each monitor function is displayed in real time as long as it is selected.

Menu Item	Specifications/usage
RAW BER	Displays the current BER or "No Data" (if carrier is not locked). Range: <m.m E-e to >m.m E-e. **Note:** Low limit is based on performance. High limit is based on data/code rate.
CORRECTED BER	Displays the current corrected BER or "No Data" (if carrier is not locked). Range: <m.m E-e to >m.m E-e. **Note:** Low limit is based on performance. High limit is 1.0 E-12.
Eb/No	Displays the current E_b/N_0 or "No Data" (if carrier is not locked). Range: <mm.m to >mm.m. **Note:** Low limit is based on the data rate. High limit is 16.0 dB.
RECEIVE SIGNAL	Displays the current receive signal level. Range: -15.0 to -55.0 dBm.
SWEEP FREQUENCY	Displays the current sweep frequency offset from the configured demodulator center frequency. Range: -35,000 to +35,000 Hz.
BUFFER FILL	Displays the current plesiochronous buffer fill status percent. Range: nn% (1% to 99%). **Note:** Press [ENTER] twice to reenter the buffer.
2047 ERRORS	Displays the 2047 data pattern error rate or "No Data" if the 2047 data pattern is not detected. Range: <nun E-e to >nun E-e. **Note:** Low limit is based on performance. High limit is based on the data/code rate.
FRAME BER	Displays the IDS/IBR frame error rate in the same format as 2047 errors.

3.4.3 Faults/Alarms Menu

The Faults/Alarms level is accessible from the Function Select menu. The Faults/Alarms are similar to monitor functions, as they display the current fault status of the group being displayed. Press [←] or [→] to move between the following Fault/Alarm groups:

- Modulator
- Demodulator
- Transmit Interface
- Receive Interface
- Common Equipment
- Backward Alarms (IDR ESC only)

The current Faults/Alarms status is displayed on line 2 of the display in real time. For each parameter monitored, fault status is displayed as one of the following:

"–" Indicates that no fault or alarm exists.
"+" Indicates that a fault exists, and will cause switching in a redundant system.
Reversed contrast "+" indicates an active alarm. Alarms do not cause switching to occur.

To display labels for individual faults or alarms, press [ENTER].
Press [←] or [→] to move the flashing cursor to make the selection. The label for that Fault/Alarm is then displayed on line 1 of the display. Press [CLEAR] to exit this level of operation and return to the previous level.

3.4.3.1 Modulator Faults

Menu Item	Specifications/usage
MODULE	Modulator section fault. Typically indicates that the modulator section will not program.
IF SYNTHESIZER	Modulator IF synthesizer fault.
DATA CLOCK SYNTH	Transmit symbol clock lock detect. Indicates that the symbol clock is not locked.
I CHANNEL	I channel data activity fault.
Q CHANNEL	Q channel data activity fault.
AGC LEVEL	TX IF AGC level fault.

3.4.3.2 Demodulator Faults

Menu Item	Specifications/usage
MODULE	Demodulator/decoder section fault. Typically indicates that the Demod/decoder section will not program.
CARRIER DETECT	Carrier detect fault. Indicates the demodulator/decoder is not locked.
IF SYNTHESIZER	Demodulator IF synthesizer fault. Indicates the IF synthesizer is not locked.
I CHANNEL	I channel activity fault. Indicates a loss of activity in the I channel of the quadrature demodulator.
Q CHANNEL	Q channel activity fault. Indicates a loss of activity in the Q channel of the quadrature demodulator.
BER THRESHOLD	Secondary alarm result of the BER threshold set in the DEMOD Configuration menu.

3.4.3.3 Transmit Interface Faults

Menu Item	Specifications/usage
MODULE	TX Interface section fault. Typically indicates that the TX Interface section will not program.
TX DATA/AIS	Data or AIS. When DATA fault is selected in the Configuration Interface menu, the fault indicates a data stable condition. This indicates the data is all 1s or 0s (i.e., data is not transitioning). When AIS is selected, the alarm indicates the data is all 1s from customer data input to the modem. When NONE is selected, the TX Data/AIS Fault/Alarm is not activated. **Note:** AIS is an alarm, not a switching fault.
TX CLK ACTIVITY	Activity detector alarm of the selected interface transmit clock. The interface will fall back to the internal clock (SCT) when this alarm is active.
TX CLK PLL	Indicates TX input clock is out of range.
SCT PLL	SCT phase-locked loop (PLL) fault. Indicates the internal transmit clock oscillator PLL is not locked to the selected reference.
SCT REFERENCE ACT	Activity detector alarm at the input of the selected source for SCT Reference. Indicates the selected clock is not being detected.
TX DROP	Drop interface fault. Typically indicates that terrestrial data stream is not synchronized (D&I only)

3.4.3.4 Receive Interface Faults

Menu Item	Specifications
MODULE	RX Interface section fault. Typically indicates that the RX Interface section will not program.
BUFFER CLK PLL	Buffer clock phase-locked loop fault. Indicates the buffer clock PLL is not locked.
BUFFER CLK ACT	Activity detector alarm of the selected interface receive clock. The interface will fall back to the satellite clock when this fault is active.
RX DATA/AIS	Data or AIS. When DATA fault is selected in the Configuration Interface menu, the fault indicates a data stable condition. This indicates the data coming from the satellite is all 1s or 0s (i.e., data is not transitioning). When AIS is selected, the alarm indicates the data is all 1s from the satellite. When NONE is selected the RX Data/AIS Fault/Alarm is not activated. **Note:** AIS is an alarm, not a switching fault.
DEMUX LOCK	DEMUX lock fault. Indicates that the Demux is not locked.
RX 2047 LOCK	RX 2047 lock alarm. Indicates the RX 2047 data pattern is not locked. **Note:** This alarm is only active when receive 2047 is on.
BUFFER OVERFLOW	Buffer overflow alarm. Indicates that a buffer overflow has occurred.
BUFFER UNDERFLOW	Buffer underflow alarm. Indicates that a buffer underflow has occurred.
BUFFER FULL	Buffer full alarm. Indicates the buffer is less than 10%, or greater than 90% full.
BACKWARD ALARM	Indicate reception of IBS backward alarms.
RX INSERT	D&I Insert fault. Typically indicates that terrestrial data stream is not synchronized (D&I only)
FRAME BER	Fault if Frame BER exceeds 1E-3 (option card PL/10175-2 only).

3.4.3.5 Common Equipment Faults

Fault	Cause
MODULE	Interface/M&C section summary fault. Typically indicates that the interface section will not program or the M&C has failed
BATTERY/CLOCK	Battery or clock fault.
-12V SUPPLY	-12V power supply fault.
+12V SUPPLY	+12V power supply fault.
+5V SUPPLY	+5V power supply fault.
+3.3V SUPPLY	+3.3 V power supply fault.
+2.5V SUPPLY	+2.5V power supply fault.
+1.8V SUPPLY	+1.8V power supply fault.
TEMPERATURE	Over/Under Temperature Fault. Indicates that the internal temperature of the modem has exceeded +75°C or is below -10°C.
MODEM REF ACT	Activity detector alarm at the input of the selected source for the Modem Reference. Indicates that a signal is not being detected at the Modem Reference connector (CP3). The Modem Reference will fall back to the internal reference if this fault is active.
MODEM REF PLL	Reference Phase Lock loop is Not Locked.

3.4.3.6 IDR Backward Alarms

BW Alarm RX #4	Receive backward alarm #4 indicator.
BW Alarm RX #3	Receive backward alarm #3 indicator.
BW Alarm RX #2	Receive backward alarm #2 indicator.
BW Alarm RX #1	Receive backward alarm #1 indicator.
BW Alarm TX #4	Transmit backward alarm #4 indicator.
BW Alarm TX #3	Transmit backward alarm #3 indicator.
BW Alarm TX #2	Transmit backward alarm #2 indicator.
BW Alarm TX #1	Transmit backward alarm #1 indicator.

Note: Only available with IDR selected and with IDR ESC.

3.4.4 Stored Faults/Alarms Menu

The Stored Faults/Alarms level is accessible from the Function Select menu. The modem stores the first 10 (Flt0 through Flt9) occurrences of fault status changes in each of the following major fault categories:

- Modulator
- Demodulator
- Transmit Interface
- Receive Interface
- Common Equipment

Each fault status change is stored with the time and date of the occurrence (i.e., when a fault occurs). Stored faults may be viewed by entering the stored faults level from the Select menu.

Stored faults are not maintained through controller power-on reset cycle. However, the last known time is maintained in nonvolatile Random Access Memory (RAM). On power-up, a common equipment fault is logged (Flt0) with that time and date. Also on power-up, an additional common equipment fault is logged (Flt1) to indicate the power-up time and date. The power-down and power-up times are logged as common equipment fault 0 and common equipment fault 1, respectively.

On entering the stored faults level, press [←] or [→] to move between the fault groups and the "Clear Stored Faults?" selections. The time and date of the first stored fault status (Flt0) for the selected group will be displayed alternately on line 2 of the display. Press [↑] or [↓] to cycle through the selected group's stored fault status (Flt0 through Flt9). To display the fault status associated with the displayed time and date, press [ENTER]. To identify the fault, press [←] or [→] to move the flashing cursor. To clear the stored faults currently logged, press [ENTER] when the "Clear Stored Faults/Yes?" selection is displayed.

Note: Faults are stored in time sequence, with the oldest fault status change stored in Flt0, and the most recent in Flt9. Only the first 10 fault status changes are stored. All stored faults, which have not been used, indicate "No Fault" on the display.

3.4.5 Remote AUPC Menu

This menu will only be displayed if the modem is programmed to a mode that allows AUPC functionality. Within the Utility Modem Type menu, selection of Modem Types 7650-02 or ASYNC will activate this display.

Note: These are extra configuration commands that can modify the distant end modem. These configuration or monitor functions can only be accomplished if the modems are locked under the configuration of 7650-02 or ASYNC as a modem type.

The remote functions may be viewed or changed by entering the Remote AUPC level from the Function select menu on the front panel After entering the Remote AUPC menu, press [←] or [→] to select the Configuration or Monitor menu. Enter the selected menu by pressing [ENTER]. Press [←] or [→] to view the selected configuration parameters.

3.4.5.1 Remote AUPC Configuration

Menu Item	Specifications/usage
AUPC ENABLE	Programs the AUPC enable On or Off. On entry, the current status of the remote AUPC is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change. **Note:** This program is for control or last known status.
B-BAND LOOP BACK	Programs the remote baseband loopback On or Off. On entry, the current status of the remote baseband loopback is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change. **Note:** This program is for control or last known status.
TX 2047 PATTERN	Programs the remote TX 2047 pattern On or Off. On entry, the current status of the remote TX 2047 is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change. **Note:** This program is for control or last known status.

3.4.5.2 Remote AUPC Monitor

Menu Item	Specifications/usage
2047 ERRORS	Receive 2047 BER. This is a monitor point that displays the current distant end RX 2047 BER. If no data is available, “No Data” is displayed.

3.4.6 Utility Menu

The Function Select Utility menu is divided into the following categories:

- Modulator
- Demodulator
- Interface
- System
- Modem Type

Provisions also are made for assigning data and code rates to the modulator and demodulator. These are the setting for TX or RX code Rate /Type A, B, C, and D.

Changes in the Utility menu may cause changes in other front panel menus. After entering the Utility functions level, press [←] or [→] to select the desired Utility menu, and press [ENTER]. The Factory Setup Utility menu is for Comtech EF Data service personnel only. Entering this menu without authorization may cause the modem to operate incorrectly.

3.4.6.1 Utility Modulator Menu

Menu Item	Specifications/usage
ASSIGN TRANSMIT FILTERS	Filter: A, B, C, D, or V Data rates are referenced in paragraph 3.3. **Note:** These assignments are used for the selection of the TX rate in the Configuration Modulator menu.
MOD POWER OFFSET	Modulator power offset adjust. Offsets the modulator output power readout in the Configuration menu. This feature does not actually change the modulator power level, but displays an offset value in the monitor. The modulator power offset range is -69.9 to +94.9 dB, in 0.1 dB steps. **Note:** Anything except 0.0 dB will cause ADJ to be displayed in the TX power level screen.
MODULATOR TYPE	Transmit filter type select. Select INTELSAT OPEN or EFD CLOSED network filtering. **Note:** This window is only available when CUSTOM is selected for modem type in the Utility menu.
ENCODER TYPE	FEC type select. Select VITERBI or TURBO. **Note:** This window is only available when CUSTOM or EFD is selected for modem type in the Utility Menu.
TX BPSK ORDERING	Transmit BPSK bit ordering selection. Select STANDARD or NON-STANDARD. Press an arrow key to make the selection. Press [ENTER] to execute the change.
MOD SPECTRUM	Programmable vector rotation. Allows the operator to select Normal or Inverted (INVERT) for spectrum reversal of the I and Q baseband channels. Press an arrow key to make the selection. Press [ENTER] to execute the change.
TX IESS-310 MODE	Select IESS-310 mode on or off. IESS-310 mode is for 8 PSK 2/3 modulation with Reed-Solomon only. Press an arrow key to make the selection. Press [ENTER] to execute the change.
TX R-S CODE WORD	Displays or selects the current N, K, T, and Interleave values for the Reed-Solomon FEC. The standard code word can only be changed when CUSTOM is the selected modem type in the Utility Menu.
TX SYMBOL RATE	Status Only. Displays the current TX Symbol Data Rate within 9.6 ksym/s to 10 Msym/s.

3.4.6.2 Utility Demodulator Menu

Menu Item	Specifications/usage
ASSIGN RECEIVER FILTERS	Filter: A, B, C, D, or V Data rates are referenced in paragraph 3.3. **Note:** These assignments are used for the selection of the Rx rate in the Configuration Functions menu.
DEMODULATOR TYPE	Receive filter type select. Select Type INTELSAT OPEN or EFD CLOSED network receive filtering. **Note:** This window is only available when CUSTOM is selected for modem type in the Utility menu.
DECODER TYPE	FEC type select. Select VITERBI or TURBO. **Note:** This window is only available when CUSTOM or EFD is selected for modem type in the Utility Menu.
RX BPSK ORDERING	Receive BPSK bit ordering selection. Select STANDARD or NON-STANDARD. Press an arrow key to make the selection. Press [ENTER] to execute the change.
DEMOD SPECTRUM	Programmable vector rotation. Select NORMAL or INVERT for spectrum reversal of the I and Q baseband channels. Press an arrow key to make the selection. Press [ENTER] to execute the change.
RX IESS-310 MODE	Select IESS-310 mode on or off. IESS-310 mode is for 8-PSK 2/3 modulation with Reed-Solomon only. Press an arrow key to make the selection. Press [ENTER] to execute the change.
RX R-S CODE WORD	Displays or selects the current N, K, T, and Interleave values for the Reed-Solomon FEC. The standard code word can only be changed when CUSTOM is the selected modem type in the Utility Menu.
RX SYMBOL RATE	Status Only. Displays the current RX Symbol Rate within 9.6 ksym/s to 10 Msym/s.

3.4.6.3 Utility Interface Menu

Menu Item	Specifications/usage
TX OVERHEAD TYPE	Select None, IDR, IBS, VSAT-IBS, IBS-309, or ASYNC for TX overhead type. **Note:** This parameter is only programmable when Custom is selected for modem type in the Utility menu.
RX OVERHEAD TYPE	Select None, IDR, IBS, VSAT-IBS, IBS-309, or ASYNC for RX overhead type. **Note:** This parameter is only programmable when Custom is selected for modem type in the Utility menu.
TERRESTRIAL INTERFACE	Selects the data interface to be used: J1 RS422, J6 RS422, G.703 Balanced, G.703 Unbalanced. **Note:** Optional interface only.
RTS TX-IF CNTRL	Programs the modem to allow a Request-to-Send (RTS) signal to enable the modulator output when data is ready for transmission. Press an arrow key to make the selection. Press [ENTER] to execute the change.
BUFFER PROGRAM	Buffer unit program function. Select MILLI-SECONDS or BITS. Press an arrow key to make the selection. Press [ENTER] to execute the change.
FRAMING STRUCTURE	Select the Terrestrial interface frame structure. This function is used with the BUFFER SIZE program to allow plesiochronous slips in the buffer. Available selections are: T1 - NONE or *G.704 E1 - NONE or *G.704 T2 - NONE or G.704, *G.743, or G.747 E2 - NONE or G.704, *G.742, or G.745 (* default parameters)
TX DATA PHASE	TX data phase relationship. Use this option to select Normal or Invert for the TX data relationship to the selected TX clock. On entry, press an arrow key to make the selection. Press [ENTER] to execute the change.
RX DATA PHASE	RX data phase relationship. Use this option to select Normal or Invert for the TX data relationship to the selected RX clock. On entry, press an arrow key to make the selection. Press [ENTER] to execute the change.
IDR BACKWARD ALARM CONTROL	Controls IDR monitor and alarm functions reporting. Use this option to select on or off for the RX and TX alarms. On entry, the BW ALARM RX or BW ALARM TX is displayed on line 1.Press an arrow key to select BW alarm RX or TX numbers 1 through 4 on line 2. Press [ENTER] to execute the change.
IDR ESC TYPE	Selects the IDR ESC: 2 – 32 kbps ADPCM Audio or 64 kbps data channel.

3.4.6.4 Utility System Menu

Menu Item	Specifications/usage
TIME: HH:MM:SS DATE: MM/DD/YYYY	Time of day and date display/set function. The current time (24 hour clock) and date in the modem's memory are displayed when selected. To change the modem time and/or date, press [ENTER]. Press [←] or [→] to position the cursor over the parameter to be changed. Press [↑] or [↓] to change the parameter. Once the parameters are displayed as desired, press [ENTER] to set the time and date.
REMOTE SERIAL PORT	Programs the baud rate settings and interface format in the modem. To change the baud rate(110 to 38400 bps), press [ENTER]. Press [←] or [→] to position the cursor over the baud rate parameter. Press [↑] or [↓] to select one of the following baud rates (bps): 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400. Once the desired baud rate is displayed, press [ENTER] to set the baud rate. To change the remote interface format of the modem is displayed press [ENTER]. Press [←] or [→] to position the cursor over the interface format parameter. Press [↑] or [↓] to scroll through the available interface formats. Once the desired format is displayed, press [ENTER] to set the baud rate. The number of data bits, parity, and stop bits is selectable. Available formats are: 7 data bits, Even parity, and 1 stop bits (7E1); 7 data bits, Odd parity, and 1 stop bits (7O1); 7 data bits, Even parity, and 2 stop bits (7E2); 7 data bits, Odd parity, and 2 stop bits (7O2); or 8 data bits, no parity, and 1 stop bit (8N1).
REMOTE ADDRESS	The current modem address is displayed (1 to 255). To change the remote address, press [ENTER]. Press an arrow key to make the selection. Press [ENTER] to execute the change.
REMOTE TYPE	Select EIA-232, EIA-485 (2-wire) or EIA-485 (4-wire). To change the remote type, press [ENTER]. Press an arrow key to make the selection. Press [ENTER] to execute the change.
MODEM REF	Programs the Modem Reference timing standard: Internal reference. External 1, 5, 10, and 20 MHz (Input is REF (CP3) on the rear panel) On entry, the current timing source is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
OPERATION MODE	Operation mode. Programs the modem for Duplex, TX-only, or RX-only operation. On entry, the operational status may be changed. Press an arrow key to make the selection. Press [ENTER] to execute the change. **Note:** When TX-only or RX-only are selected, the appropriate faults are masked from the Faults and Stored Faults menus.
TEST MODE STATUS	Test mode status indicator. The following modem test points are listed in this window and display a "+" when a test mode is active: REED-SOLOMON-CORR OFF B-BAND LOOPBACK IF LOOPBACK CARRIER MODE RX 2047 PATTERN TX 2047 PATTERN To view the test modes, press [ENTER]. Press an arrow key to make the selection.
LAMP TEST	Lamp test function. Press [ENTER] to turn the front panel indicators on for 3 seconds.

Menu Item	Specifications/usage
M&C FIRMWARE	Displays the M&C module firmware version. The display includes the month, day, and year.
BOOT FIRMWARE	Displays the BOOT module firmware version. The display includes the month, day, and year.
BULK FIRMWARE	Displays the BULK module firmware version. The display includes the month, day, and year.
DISPLAY BRIGHTNESS	Sets the brightness setting of the front panel menu. Press [ENTER] to begin. Press [↑] or [↓] to increment or decrement the number at the flashing cursor, from 25 to 100%. Press [ENTER] to execute the change.
EXT AGC: MIN PWR	Sets the AGC voltage for receive signal level of -60.0 dBm.
EXT AGC: MAX PWR	Sets the AGC voltage for receive signal level of -15.0 dBm
USB REFLASH	Configures the modem for upgrade via the USB connector on the front panel.
MASTER RESET	Master reset function.  ***Initiating a hard reset will reset the modem and set the default configuration settings. Initiating a soft reset will reset the modem hardware, but saves the current configuration settings.*** Select [ENTER] once to access HARD or SOFT. Press [←] or [→] to make the selection. Press [ENTER]. Select Yes or No, and press [ENTER] again. **Note:** The following system settings will not revert to the default values upon a hard reset: Remote Format Remote Address Remote Baud Rate

3.4.6.5 Utility Modem Type Menu

Menu Item	Specifications/usage
MODEM TYPE	Selects the following types of modem operation: 7650-00 7650-02 IDR IBS VSAT-IBS IBS-309 EFD ASYNC CUSTOM When the modem is changed from one mode of operation to another, the modem will be reset to the default configurations of the new modem type. Note that the RF-IF output must be turned on to get the modem to lock. If the modem type is entered as the same configuration, the modem will not change any parameters. If the modem is changed to custom, no parameters will be changed.  ***Use caution when modifying the Custom Mode Type. The user has the capability to change all of the modem settings, including incompatible parameters. It is recommended that qualified personnel use the "Custom Mode" only, as the Custom Mode was designed for special case configurations.***
MODEM OPTIONS	Status Only. Displays the installed modem options. If the option is installed a "+" symbol is displayed. To view the available options, press {ENTER}. Observe for the flashing cursor. Press the directional arrow to move from one symbol to the next. The first line will display the option. The second line will display the status. A "+" symbol indicates the option is installed. A"–" symbol indicates the option is Not Installed or FAST Upgradeable. A "0" symbol indicates the option is Not Installed or Not Upgradeable. OPTIONS: FULL RATE VAR 8PSK 2/3 & 5/6 IBS/IDR FRAMING ASYNC OVERHEAD REED-SOLOMON 16QAM 3/4 & 7/8 MOD ENABLED DEMOD ENABLED TURBO OPTION G.703/50 PIN OPTION D&I/ESC
MODEM SERIAL #	Status Only. Displays the modem serial number.
CONFIGURATION CODE – MODEM	Comtech EF Data-supplied code.

3.5 Modes of Operation

The modem has multiple modes of operation that are selectable from any of the control interfaces. These modes simplify the configuration of the modem by setting up default values that are consistent with network requirements. The modes of operation are selected in the Utility: Modem Type menu (Paragraph 3.4.6.5).

When a mode of operation is selected, the modem will be configured for a particular set of default operating parameters. Certain menus will be displayed, blanked, or disabled based on the requirements for that particular operating mode.

The following paragraphs will detail each of the modes of operation and provide a table with the default parameters.

3.5.1 7650-00 Operation

The 7650-00 mode of operation is the basic OM-73 interoperability mode. This mode is compatible with MIL-STD-188-165 Rev. – and Rev. A with some extended capability. The additional capability includes 8-PSK and 16-QAM. This mode is similar to, and compatible with, the 8650-00 mode in the Comtech EF Data SLM-8650 satellite modem.

Table 3-4. 7650-00 Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	OM73
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	OM73	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	B-Band Loopback	Off
TX Clock Phase	Normal	Loop Timing	Off
SCT PLL REF	Modem Reference	TX Data Fault	None
EXT REF Frequency	1544 kHz	RX Data Fault	None
Buffer Clock	RX (Satellite)	TX 2047 Pattern	Off
Buffer Size	384 bits	RX 2047 Pattern	Off
RX Clock Phase	Normal		
Utility			
Modulator		**Demodulator**	
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX-B	256 Kbps QPSK 1/2	RX-B	256 Kbps QPSK 1/2
TX-C	768 kbps QPSK 1/2	RX-C	768 kbps QPSK 1/2
TX-D	2048 kbps QPSK 1/2	RX-D	2048 kbps QPSK 1/2
TX-V	128 kbps QPSK 1/2	RX-V	128 kbps QPSK 1/2
Modulator Power Offset	0.0 dB	Demodulator Type	EFD Closed
Modulator Type	EFD Closed	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off		
Encoder Type	Viterbi	Decoder Type	Viterbi
Interface			
TX Overhead Type	None	TX Data Phase	Normal
RX Overhead Type	None	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.2 7650-02 Operation

The 7650-02 mode of operation is compatible with the 8650-02 operating mode of the SLM-8650 modem up to the 9.3 Mbps data rate limit of the SLM-8650. Operation in this mode requires the ASYNC framing option to be activated.

Table 3-5. 7650-02 Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	OM73
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	OM73	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	Loop Timing	Off
TX Clock Phase	Normal	TX Data Fault	None
SCT PLL REF	Modem Reference	RX Data Fault	None
EXT REF Frequency	1544 kHz	TX 2047 Pattern	Off
Buffer Clock	RX (Satellite)	RX 2047 Pattern	Off
RX Clock Phase	Normal	ASYNC TX	Baud=1200 Format=7E2
B-Band Loopback	Off	ASYNC RX	Baud=1200 Format=7E2
Buffer Size	384 bits	ASYNC COMM TYPE	EIA-232
Local AUPC			
AUPC Enable	Off	Target E_b/N_0	6.0 dB
Nominal Power	–10 dBm	Tracking Rate	1.0 dB/min
Minimum Power	–30 dBm	Local CL Action	Hold
Maximum Power	–5 dBm	Remote CL Action	Hold
Function Select Remote AUPC			
AUPC Enable	Off	TX 2047 Pattern	Off
B-Band Loopback	Off		
Utility			
Modulator		**Demodulator**	
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX-B	256 Kbps QPSK 1/2	RX-B	256 Kbps QPSK 1/2
TX-C	768 kbps QPSK 1/2	RX-C	768 kbps QPSK 1/2
TX-D	2048 kbps QPSK 1/2	RX-D	2048 kbps QPSK 1/2
TX-V	128 kbps QPSK 1/2	RX-V	128 kbps QPSK 1/2
Modulator Power Offset	0.0 dB	Demodulator Type	EFD Closed
Modulator Type	EFD Closed	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off		
Encoder Type	Viterbi	Decoder Type	Viterbi
Interface			
TX Overhead Type	ASYNC	TX Data Phase	Normal
RX Overhead Type	ASYNC	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.3 IDR Operation

The IDR mode of operation configures the modem for basic IDR operation without the addition of the overhead card. The IDR mode is used for open network applications operating in compliance with the IESS-308 (IDR) and IESS-310 (TCM-IDR) Intelsat standards. When the IDR mode is active, a fixed overhead of 96 kbps will be added to the selected data rates. Within the data rate range of the modem, there are four IDR operating rates, 1.544, 2.048, 6.312, and 8.448 Mbps.

Optional Reed-Solomon (R-S) concatenated outer coding compatible with the IESS-308 and IESS-310 standards is supported in this mode. Refer to the modem specification for the specific R-S parameters that apply to each data rate.

Operation in this mode requires the IDR framing option to be activated. The data type will be MIL-188 (RS-422) and there will not be any access to the Intelsat defined ESC overhead data. An optional overhead card is required for G.703 or any other baseband interface and to gain access to the ESC overhead data.

Table 3-6. IDR Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	1544 kbps QPSK 3/4	RX-A	1544 kbps QPSK 3/4
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	IESS
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	IESS	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	B-Band Loopback	Off
TX Clock Phase	Normal	Loop Timing	Off
SCT PLL REF	Modem Reference	TX Data Fault	None
EXT REF Frequency	1544 kHz	RX Data Fault	None
Buffer Clock	RX (Satellite)	TX 2047 Pattern	Off
Buffer Size	9840 bits	RX 2047 Pattern	Off
RX Clock Phase	Normal		
Utility			
Modulator		**Demodulator**	
TX-A	1544 kbps QPSK 3/4	RX-A	1544 kbps QPSK 3/4
TX-B	2048 Kbps QPSK 3/4	RX-B	2048 Kbps QPSK 3/4
TX-C	6312 kbps QPSK 3/4	RX-C	6312 kbps QPSK 3/4
TX-D	8448 kbps QPSK 3/4	RX-D	8448 kbps QPSK 3/4
TX-V	1544 kbps QPSK 3/4	RX-V	1544 kbps QPSK 3/4
Modulator Power Offset	0.0 dB	Demodulator Type	INTELSAT Open
Modulator Type	INTELSAT Open	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off		
Encoder Type	Viterbi	Decoder Type	Viterbi
Interface			
TX Overhead Type	IDR	TX Data Phase	Normal
RX Overhead Type	IDR	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.4 IBS Operation

The IBS mode of operation configures the modem for basic IBS operation without the addition of the overhead card. The IBS mode is used for open network applications operating in compliance with the IESS-309 Intelsat standard. When the IBS mode is active, an overhead of 6.667% will be added to the selected data rates. The available IBS data rates are n x 64 kbps from 64 kbps to 2.048 Mbps.

Optional Reed-Solomon (R-S) concatenated outer coding compatible with the IESS-308 (IDR-small carrier) standard is supported in this mode. The R-S parameters that are selected for this mode of operation are n=126, k=112, t=7 with an interleaver depth of 4.

Operation in this mode requires the IBS framing option to be activated. The data type will be MIL-188 (RS-422) and there will not be any access to the Intelsat defined ESC overhead data. An optional overhead card is required for G.703 or any other baseband interface and to gain access to the ESC overhead data.

Table 3-7. IBS Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	IESS
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	IESS	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	B-Band Loopback	Off
TX Clock Phase	Normal	Loop Timing	Off
SCT PLL REF	Modem Reference	TX Data Fault	None
EXT REF Frequency	1544 kHz	RX Data Fault	None
Buffer Clock	RX (Satellite)	TX 2047 Pattern	Off
Buffer Size	384 bits	RX 2047 Pattern	Off
RX Clock Phase	Normal		
Utility			
Modulator		**Demodulator**	
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX-B	256 Kbps QPSK 1/2	RX-B	256 Kbps QPSK 1/2
TX-C	768 kbps QPSK 1/2	RX-C	768 kbps QPSK 1/2
TX-D	2048 kbps QPSK 1/2	RX-D	2048 kbps QPSK 1/2
TX-V	128 kbps QPSK 1/2	RX-V	128 kbps QPSK 1/2
Modulator Power Offset	0.0 dB	Demodulator Type	INTELSAT Open
Modulator Type	INTELSAT Open	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off	Decoder Type	Viterbi
Encoder Type	Viterbi		
Interface			
TX Overhead Type	IBS	TX Data Phase	Normal
RX Overhead Type	IBS	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.5 VSAT-IBS Operation

The VSAT-IBS mode of operation configures the modem for open and closed network applications operating in compliance with Appendix K of the IESS-309 Intelsat standard. The VSAT-IBS mode does not allow any overhead to be added to the selected data rates but requires Reed-Solomon concatenated outer coding. The R-S parameters that are required for this mode of operation are n=219, k=201, t=9 with an interleaver depth of 4. The available IBS data rates are n x 64 kbps from 64 kbps to 8.448 Mbps.

The data type will be MIL-188 (RS-422) and an optional overhead card is required for G.703 or any other baseband interface.

Table 3-8. VSAT-IBS Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	IESS
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	IESS	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	B-Band Loopback	Off
TX Clock Phase	Normal	Loop Timing	Off
SCT PLL REF	Modem Reference	TX Data Fault	None
EXT REF Frequency	1544 kHz	RX Data Fault	None
Buffer Clock	RX (Satellite)	TX 2047 Pattern	Off
Buffer Size	384 bits	RX 2047 Pattern	Off
RX Clock Phase	Normal		
Utility			
Modulator		**Demodulator**	
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX-B	256 Kbps QPSK 1/2	RX-B	256 Kbps QPSK 1/2
TX-C	768 kbps QPSK 1/2	RX-C	768 kbps QPSK 1/2
TX-D	2048 kbps QPSK 1/2	RX-D	2048 kbps QPSK 1/2
TX-V	128 kbps QPSK 1/2	RX-V	128 kbps QPSK 1/2
Modulator Power Offset	0.0 dB	Demodulator Type	INTELSAT Open
Modulator Type	INTELSAT Open	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off	Decoder Type	Viterbi
Encoder Type	Viterbi		
Interface			
TX Overhead Type	VSAT-IBS	TX Data Phase	Normal
RX Overhead Type	VSAT-IBS	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.6 IBS-309 Operation

The IBS-309 mode of operation configures the modem for basic IBS operation without the addition of the overhead card. The IBS-309 mode is used for open network applications operating in compliance with TN309.5 of the IESS-309 Intelsat standard. When the IBS-309 mode is active, an overhead of 6.667% will be added to the selected data rates. The available IBS data rates are n x 64 kbps from 64 kbps to 2.048 Mbps.

Optional Reed-Solomon (R-S) concatenated outer coding compatible with TN309.5 of the IESS-309 (IBS) standard is supported in this mode. The R-S parameters that are selected for this mode of operation are n=219, k=201, t=9 with an interleaver depth of 4.

Operation in this mode requires the IBS framing option to be activated. The data type will be MIL-188 (RS-422) and there will not be any access to the Intelsat defined ESC overhead data. An optional overhead card is required for G.703 or any other baseband interface and to gain access to the ESC overhead data.

Table 3-9. IBS-309 Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	IESS
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	IESS	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	B-Band Loopback	Off
TX Clock Phase	Normal	Loop Timing	Off
SCT PLL REF	Modem Reference	TX Data Fault	None
EXT REF Frequency	1544 kHz	RX Data Fault	None
Buffer Clock	RX (Satellite)	TX 2047 Pattern	Off
Buffer Size	384 bits	RX 2047 Pattern	Off
RX Clock Phase	Normal		
Utility			
Modulator		**Demodulator**	
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX-B	256 Kbps QPSK 1/2	RX-B	256 Kbps QPSK 1/2
TX-C	768 kbps QPSK 1/2	RX-C	768 kbps QPSK 1/2
TX-D	2048 kbps QPSK 1/2	RX-D	2048 kbps QPSK 1/2
TX-V	128 kbps QPSK 1/2	RX-V	128 kbps QPSK 1/2
Modulator Power Offset	0.0 dB	Demodulator Type	INTELSAT Open
Modulator Type	INTELSAT Open	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off		
Encoder Type	Viterbi	Decoder Type	Viterbi
Interface			
TX Overhead Type	IBS-309	TX Data Phase	Normal
RX Overhead Type	IBS-309	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.7 ASYNC/AUPC Operation

Asynchronous Overhead (ASYNC) with AUPC is a closed network application that gives the user the ability to communicate from the hub site to the remote site through the added overhead. The user can use the AUPC feature that remotely controls the remote modem's power level, according to parameters programmed by the user. The user can also remotely monitor and control the remote modem by sending remote commands over the link via the overhead. This can be done by a local terminal or Monitor and Control system. The interface for the selectable EIA/TIA-232/485 ASYNC data channel is on the rear panel 9-pin ASYNC connector J2.

The ASYNC mode of operation is compatible with the ASYNC operating mode of any Comtech EF Data satellite modem. Operation in this mode requires the ASYNC framing option to be activated.

Table 3-10. ASYNC/AUPC Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	IESS
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	IESS	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	Loop Timing	Off
TX Clock Phase	Normal	TX Data Fault	None
SCT PLL REF	Modem Reference	RX Data Fault	None
EXT REF Frequency	1544 kHz	TX 2047 Pattern	Off
Buffer Clock	RX (Satellite)	RX 2047 Pattern	Off
RX Clock Phase	Normal	ASYNC TX	Baud=1200 Format=7E2
B-Band Loopback	Off	ASYNC RX	Baud=1200 Format=7E2
Buffer Size	384 bits	ASYNC COMM TYPE	EIA-232
Local AUPC			
AUPC Enable	Off	Target E_b/N_0	6.0 dB
Nominal Power	–10 dBm	Tracking Rate	1.0 dB/min
Minimum Power	–30 dBm	Local CL Action	Hold
Maximum Power	–5 dBm	Remote CL Action	Hold

Function Select Remote AUPC			
AUPC Enable	Off	TX 2047 Pattern	Off
B-Band Loopback	Off		
Utility			
Modulator		**Demodulator**	
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX-B	256 Kbps QPSK 1/2	RX-B	256 Kbps QPSK 1/2
TX-C	768 kbps QPSK 1/2	RX-C	768 kbps QPSK 1/2
TX-D	2048 kbps QPSK 1/2	RX-D	2048 kbps QPSK 1/2
TX-V	128 kbps QPSK 1/2	RX-V	128 kbps QPSK 1/2
Modulator Power Offset	0.0 dB	Demodulator Type	EFD Closed
Modulator Type	EFD Closed	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off		
Encoder Type	Viterbi	Decoder Type	Viterbi
Interface			
TX Overhead Type	ASYNC	TX Data Phase	Normal
RX Overhead Type	ASYNC	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.8 EFD Operation

The EFD mode of operation is the basic closed network, non-OM-73 operating mode of the modem compatible with the EFD mode in any Comtech EF Data legacy satellite modem. The modem does not require any additional hardware installed to operate in EFD mode. The EFD mode does not allow any overhead to be added to the selected data rates but the full range of data rate, code rate, FEC options, and modulation types are available.

The data type will be MIL-188 (RS-422). An optional overhead card is required for G.703 or any other baseband interface

Table 3-11. EFD Default Parameters

Function Configuration			
Modulator		**Demodulator**	
Data Rate	A	Data Rate	A
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler Type	IESS
TX Power Level	-20 dBm	Descrambler	On
Scrambler Type	IESS	Diff Decoder	On
Scrambler	On	IF Loopback	Off
Diff. Encoder	On	BER Threshold	None
Carrier Mode	Normal-Modulated	Sweep Center	0 Hz
RS Decoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	B-Band Loopback	Off
TX Clock Phase	Normal	Loop Timing	Off
SCT PLL REF	Modem Reference	TX Data Fault	None
EXT REF Frequency	1544 kHz	RX Data Fault	None
Buffer Clock	RX (Satellite)	TX 2047 Pattern	Off
Buffer Size	384 bits	RX 2047 Pattern	Off
RX Clock Phase	Normal		
Utility			
Modulator		**Demodulator**	
TX-A	64 kbps QPSK 1/2	RX-A	64 kbps QPSK 1/2
TX-B	256 Kbps QPSK 1/2	RX-B	256 Kbps QPSK 1/2
TX-C	768 kbps QPSK 1/2	RX-C	768 kbps QPSK 1/2
TX-D	2048 kbps QPSK 1/2	RX-D	2048 kbps QPSK 1/2
TX-V	128 kbps QPSK 1/2	RX-V	128 kbps QPSK 1/2
Modulator Power Offset	0.0 dB	Demodulator Type	EFD Closed
Modulator Type	EFD Closed	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX IESS-310 Mode	Off
TX IESS-310 Mode	Off		
Encoder Type	Viterbi	Decoder Type	Viterbi
Interface			
TX Overhead Type	NONE	TX Data Phase	Normal
RX Overhead Type	NONE	RX Data Phase	Normal
RTS TX-IF CNTRL	Off	FRAMING	See 3.2.7.3
Buffer Program	Bits		
System			
Modem Reference	Internal	USB Re-Flash	Disabled
Operation Mode	Duplex		

3.5.9 Custom Operation

The CUSTOM mode of operation allows access to all front panels menus, including the Utility menus. When selecting this mode of operation the modem does not change the settings when from the previous operating mode. All currently programmed parameters will remain as they were. The CUSTOM operation mode is used when the modem must function in a non-standard operating mode. For example, to use the modem in an IBS closed network application (per IESS-309), the following steps are taken:

1. Select the IBS modem type, so that the modem loads the IBS default parameter.
2. Select the Custom modem type, which allows Access to the Tx and Rx overhead type.
3. Select NONE for the Tx and Rx overhead types.

Use caution when operating in the Custom mode. This mode accepts all modem settings, including incompatible parameters. Users should become familiar with the procedures prior to operating the modem.

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Chapter 4. THEORY OF OPERATION

This chapter describes theory of operation for the SLM-7650.

4.1 Overview

The SLM-7650 is a duplex modem in a 1 RU chassis. The modem consists of three basic sub-sections. The modulator section, the demodulator section , and the baseband interface and monitor and control section.

The modem operates on 110/220 VAC (auto-selecting) and provides 50 to 90 MHz and 100 to 180 MHz transmit and receive intermediate frequency interfaces. The primary baseband interface to the modem is MIL-STD-188-114 type II and III. An optional interface card is available as a baseband interface for special applications. (Refer to Figure 4-1 for the system operation.)

4.2 Built in Test

Hardware provisions are included for built in test. This built in test means that the modem is constantly monitored for fault or alarm conditions. The fault and alarm status of the modem is reported in the FAULT/ALARM menu. Summary faults are reported on the front panel LED display. The Fault connector on the back of the interface will also reports these summary faults through dry contact closures. The fault tree (Chapter 5, Table 5-1) in the maintenance section is a guide for fault and alarm reporting.

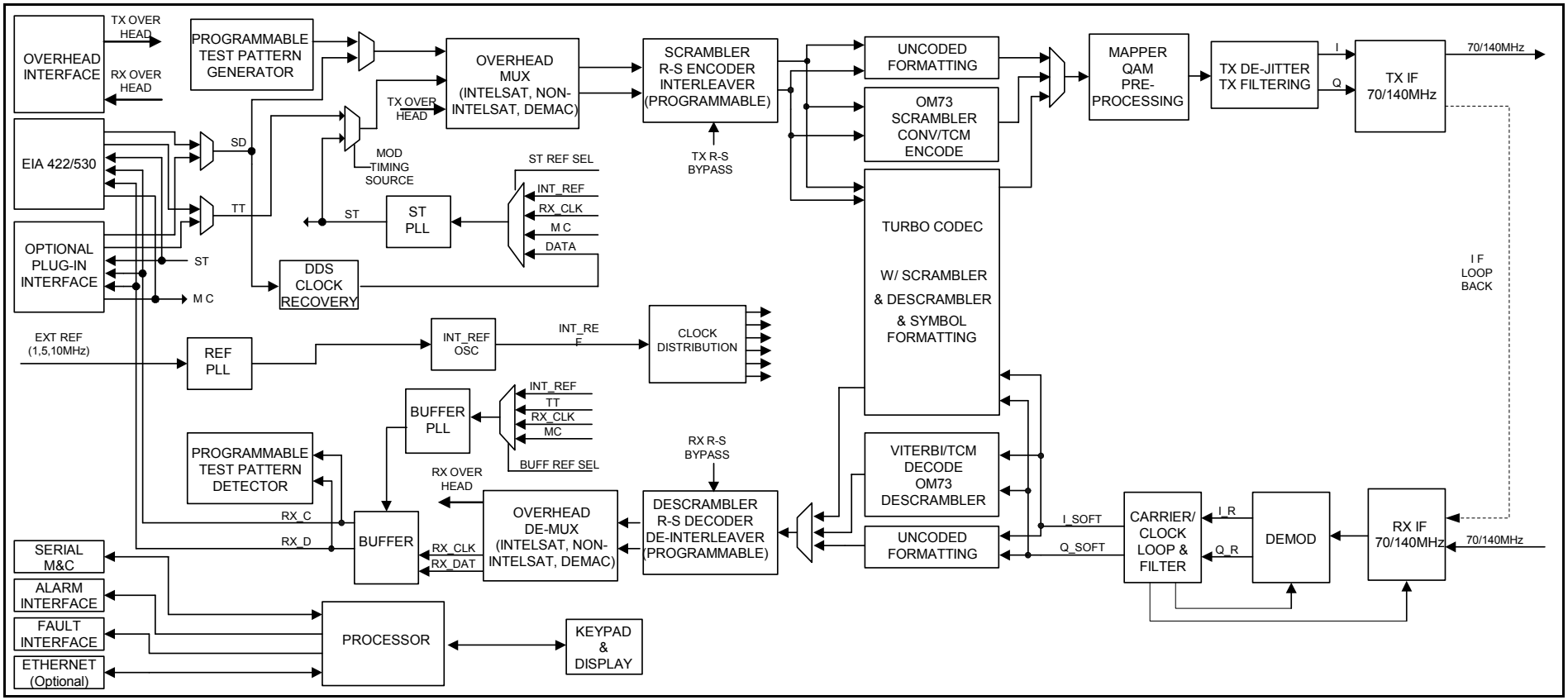


Figure 4-1. System Block Diagram

4.3 Definitions

4.3.1 Differential Encoding/Decoding

A process of manipulating the data in order to maintain bit integrity. There is a possibility that the demodulator may lock to one of the two-quadrature positions for QPSK modulation. If the demod locks to the wrong quadrature state then the data output will not be correct. The use of differential encoding/decoding will ensure the data bits will be correct whether the quadrature locks to the wrong state or not.

4.3.2 Scrambler/Descrambler

Scrambling will ensure that there will not be an excessive amount of consecutive 1s and 0s in the data stream. It is not an encryption method. It serves to give the IF signal a consistent and uniform shape. The output IF signal will not look correct if the scrambler is Off and no data is applied. Scrambling is often referred to as Energy dispersal. There are generally two types of scramblers in satellite modems:

- The self-synchronizing scrambler
- The synchronous scrambler

The descrambler simply works in the reverse direction as a scrambler to provide the proper data output from the modem.

4.3.2.1 Self-Synchronizing Scrambler/Descrambler

The Self-Synchronizing Scrambler uses the input data stream to assist in the scrambling method. This will result in three output data errors for every single error out of the descrambler. There are many variations in the design of the V.35 scramblers. The ITU-RS.524-4 is the source document for this scrambler. Selecting one of the following scrambling methods does not guarantee compatibility with other manufacturers scrambling methods. The self-synchronizing scrambler is used in the following:

- EF Data closed network
- Open network IDR IESS-308
- OM73
- MD 1002

4.3.2.2 Synchronous Scrambler/Descrambler

The Synchronous Scrambler does not multiply errors and is very suited for framed data applications. The initial sequence of the frame may be used to start the scrambler. Because there is no error multiplication, there is a 0.2 dB BER gain for the synchronous scrambler. The synchronous scrambler is used in the following applications:

- IDR/Small carrier IESS-308
- IDR IESS-308 with Reed-Solomon
- IBS-309 Intelsat Business Service
- IESS-310, 8PSK 2/3 with Reed-Solomon
- Comtech CDM-550 framed operation

Note: Compatibility issues do come up when dealing with scrambling. The scramblers may be turned off if the modems are not compatible. An IF spectral inversion also can be tried. Realize that the output IF signal will not look correct if the scrambler is Off and no data is applied.

4.3.3 Encoding/Decoding

Various FEC methods are available in the modem to enable operation in the noisy satellite environment. These multiple FEC rates in combination with the various modulation types enables the satellite operator to balance the power and bandwidth availability of each transponder. These include convolutional encoding with Viterbi decoding (CEVD) and Trellis encoding/decoding for 8PSK operation, and concatenation of these with Reed-Solomon outer coding. Turbo Product Coding (TPC) is also available as an option.

4.3.3.1 Convolutional/Viterbi (CEVD)

The combination of convolutional coding and Viterbi decoding has become an almost universal standard for satellite communications. The modem complies with the Intelsat IESS-308/309 standards for Viterbi decoding with a constraint length of seven. This is a *de facto* standard, even in a closed network environment, which means almost guaranteed inter-operability with other manufacturer's equipment. It provides very useful levels of coding gain, and its short decoding delay and error-burst characteristics make it particularly suitable for low data rate coded voice applications. It has a short constraint length, fixed at 7, for all code rates. (The constraint length is defined as the number of output symbols from the encoder that are affected by a single input bit.) By choosing various coding rates (Rate 1/2, 3/4 or 7/8) the user can trade off coding gain for bandwidth expansion. Rate 1/2 coding gives the best improvement in error rate, but doubles the transmitted data rate, and hence doubles the occupied bandwidth of the signal. Rate 7/8 coding, at the other extreme, provides the most modest improvement in performance, but only expands the transmitted bandwidth by 14 %. A major advantage of the Viterbi decoding method is that the performance is independent of data rate, and does not display a pronounced threshold effect (i.e., does not fail rapidly below a certain value of Eb/No). Because the method of convolutional coding used with Viterbi, the encoder does not preserve the original data intact, and is called *non-systematic*.

The available CEVD rates offered are:

- Rate 1/2 is offered for BPSK
- Rates 1/2, 3/4, and 7/8 for QPSK and OQPSK
- Rates 3/4 and 7/8 are offered for 16-QAM.

Table 4-1. Viterbi Decoding Summary

FOR	AGAINST
Good BER performance - very useful coding gain.	Higher coding gain possible with other methods
Almost universally used, with *de facto* standards for constraint length and coding polynomials	
Shortest decoding delay (~100 bits) of any FEC scheme - good for coded voice, VOIP, etc	
Short constraint length produce small error bursts - good for coded voice.	
No pronounced threshold effect - fails gracefully.	
Coding gain independent of data rate.	

4.3.3.2 Reed-Solomon

Reed-Solomon is an added coding method to convolutional encoding and Viterbi decoding. This is called *Concatenated Code* when more than one error correction methods is used at the same time.

The concatenation of an outer Reed-Solomon Codec with Viterbi decoder first became popular when it was introduced by Intelsat in the early 1990's. It permits significant improvements in error performance without significant bandwidth expansion. The coding overhead added by the RS outer Codec is typically around 10%, which translates to a 0.4 dB power penalty for a given link. Reed-Solomon codes are block codes (as opposed to Viterbi which is convolutional), and in order to be processed correctly the data must be framed and de-framed. Additionally, Reed-Solomon codes are limited in how well they can correct errors that occur in bursts. This, unfortunately, is the nature of the uncorrected errors from the Viterbi decoder, which produce clusters of errors that are multiples of half the constraint length. For this reason, the data must be interleaved following R-S encoding, and is then de-interleaved prior to R-S decoding. This ensures that a single burst of errors leaving the Viterbi decoder is spread out over a number of interleaving frames, so errors entering the R-S decoder do not exceed its capacity to correct those errors.

In the case of the modulator, different RS code rates are used, according to the mode of operation. Refer to the modulator specification in Appendix C for details on the code rates and interleave depth for each operating mode.

A characteristic of concatenated RS coding is the very pronounced threshold effect. For any given modem design, there will be a threshold value of Eb/No below which the demodulator cannot stay synchronized. This may be due to the carrier-recovery circuits, or the synchronization threshold of the primary FEC device, or both. In the SLM-7650, and Rate 1/2 operation, this threshold is around 4 dB Eb/No. Below this value, operation is not possible, but above this value, the error performance of the concatenated RS system produces exceptionally low error rates for a very small increase in Eb/No.

Care should be taken not to operate the demodulator near its sync threshold. Small fluctuations in Eb/No may cause total loss of the link, with the subsequent need for the demodulator to re-acquire the signal.

It cannot be emphasized strongly enough that the purpose of the concatenated Reed-Solomon is to dramatically improve the BER performance of a link under given noise conditions. It should NOT be considered as a method to reduce the link EIRP requirement to produce a given BER. Factors such as rain-fade margin, particularly at Ku-band, are extremely important, and reducing link Effective Isotropic Radiated Power (EIRP) can seriously degrade the availability of such a link.

Table 4-2. Concatenated RS Coding Summary

FOR	AGAINST
Exceptionally good BER performance - several orders of magnitude improvement in link BER under given link conditions.	Very pronounced threshold effect - does not fail gracefully in poor Eb/No conditions. Additional coding overhead actually degrades sync threshold, and reduces link fade margin.
Very small additional bandwidth expansion	Significant processing delay (~25 kbit/s) - not good for voice, or IP applications
	Adds to demod acquisition time.

4.3.3.3 Trellis Coding

In the other FEC methods described here, the processes of coding and modulation are independent - the FEC codec has no knowledge of, or interaction with the modulator. However, there are schemes in which the coding and modulation are combined together, where the encoder places FEC symbols in a precise manner into the signal constellation. This can yield an overall improvement in performance, and is used in higher-order modulation schemes, such as 8PSK, 16-PSK, 16QAM, etc. When convolution coding is used, the overall *coded modulation* approach is referred to as Trellis Coded Modulation (TCM). Ungerboeck was an early pioneer, and developed optimum mapping and decoding schemes. However, the decoding scheme was seen as complex, and expensive, and Qualcomm Inc. developed a variation on the theme, which uses a Viterbi decoder at the core, surrounded by adjunct processing. The scheme is able to achieve performance very close to the optimum Ungerboeck method, but with far less complexity, and is called *pragmatic Trellis Coded Modulation*.

Intelsat recognized that as more and more high power transponders are put in to service, the transponders are no longer *power limited*, but *bandwidth limited.* In order to maximize transponder capacity, they looked at 8PSK as a method of reducing the occupied bandwidth of a carrier, and adopted Qualcomm's pragmatic TCM, at Rate 2/3.

A Rate 2/3 8PSK/TCM carrier occupies only 50% of the bandwidth of a Rate 1/2 QPSK carrier. However, the overall coding gain of the scheme is not adequate by itself, and so Intelsat's IESS-310 specification requires that the scheme be concatenated with an outer R-S codec. When combined, there is a threshold value of Eb/No of around 6 dB, and above approximately 7 dB, the bit error rate is better than 1×10^{-8}.

The detractions of the concatenated R-S approach apply here also, along with more stringent requirements for phase noise and group delay distortion – the natural consequences of the higher-order modulation.

Table 4-3. 8PSK/TCM Coding Summary

FOR	AGAINST
Exceptionally bandwidth efficient compared to QPSK	Needs concatenated RS outer codec to give acceptable coding gain performance
	Demod acquisition threshold much higher than for QPSK
	8PSK is more sensitive to phase noise and group delay distortion than QPSK

4.3.3.4 Turbo Product Codec (Hardware Option)

4.3.3.4.1 Introduction

Turbo coding is an FEC technique developed within the last few years, which delivers significant performance improvements compared to more traditional techniques. Two general classes of Turbo Codes have been developed, Turbo Convolutional Codes (TCC), and Turbo Product Codes (TPC, a block coding technique). Comtech EF Data has chosen to implement an FEC codec based on TPC. A Turbo Product Code is a 2 or 3 dimensional array of block codes. Encoding is relatively straightforward, but decoding is a very complex process requiring multiple iterations of processing for maximum performance to be achieved.

Unlike the popular method of concatenating a Reed Solomon codec with a primary FEC codec, Turbo Product Coding is an entirely stand-alone method. It does not require the complex interleaving/de-interleaving of the R-S approach, and consequently, decoding delays are significantly reduced. Furthermore, the traditional concatenated R-S schemes exhibit a very pronounced threshold effect – a small reduction in Eb/No can result in total loss of demod and decoder synchronization. TPC does not suffer from this problem – the demod and decoder remain synchronized down to the point where the output error rate becomes unusable. This is considered to be a particularly advantageous characteristic in a fading environment. Typically, in QPSK, 8-PSK and 16-QAM TPC modes the demod and decoder can remain synchronized 2 – 3 dB below the CEVD/R-S or TCM cases.

Comtech EF Data now offers a very broad range of TPC code rates, combined with the entire range of modulation types, from BPSK to 16-QAM.

Table 4-4 is a listing of all the available TPC modes and rates in the modulator.

Table 4-4. Available TPC Modes

Code Rate/Modulation	Data Rate Range
Rate 21/44 BPSK	9.6 kbps to 4.772 Mbps
Rate 5/16 BPSK	9.6 kbps to 3.125 Mbps
Rate 1/2 QPSK/OQPSK	9.6 kbps to 9.54 Mbps
Rate 3/4 QPSK/OQPSK	14.4 kbps to 15.0 Mbps
Rate 7/8 QPSK/OQPSK	16.8 kbps to 17.5 Mbps
Rate 17/18 QPSK/OQPSK	18.13 kbps to 18.88 Mbps
Rate 3/4 8PSK	72.0 kbps to 20 Mbps
Rate 7/8 8PSK	84.0 kbps to 20 Mbps
Rate 17/18 8PSK	90.6 kbps to 20 Mbps
Rate 3/4 16QAM	256.0 kbps to 20 Mbps
Rate 7/8 16QAM	256.0 kbps to 20 Mbps

4.3.3.4.2 End-to-End Processing Delay

In many cases, FEC methods that provide increased coding gain do so at the expense of increased processing delay. However, with TPC, this increase in delay is very modest. Table 4-5 below shows the processing delays for the major FEC types, including three TPC modes. Note that in all cases, the delay is inversely proportional to data rate, so for 128 kbps, the delay values would be half of those shown above. It can be clearly seen that the concatenated Reed-Solomon cases increase the delay very significantly, due mainly to interleaving/de-interleaving.

Table 4-5. Turbo Product Coding processing delay comparison

FEC Mode (64 kbps data rate)	End-to-end delay, ms
Viterbi, Rate 1/2	12
Viterbi Rate 1/2 + Reed Solomon	266
Turbo Product Coding, Rate 3/4, QPSK/OQPSK	79
Turbo Product Coding, Rate 21/44, BPSK	64
Turbo Product Coding, Rate 5/16, BPSK	48

4.3.3.5 Uncoded Operation (No FEC)

There are occasions where a user may wish to operate a satellite link with no forward error correction of any kind. For this reason, the modulator offers this uncoded mode for three modulation types - BPSK, QPSK and OQPSK. However, the user should be aware of some of the implications of using this approach.

PSK demodulators have two inherent undesirable features. The first of these is known as 'phase ambiguity', and is due to the fact the demodulator does not have any absolute phase reference, and in the process of carrier recovery, the demodulator can lock up in any of K phase states, where K = 2 for BPSK, K = 4 for QPSK/OQPSK. Without the ability to resolve these ambiguous states there would be a 1-in-2 chance that the data at the output of the demodulator would be wrong, in the case of BPSK. For QPSK, the probability would be 3 in 4.

The problem is solved in the case of BPSK by differentially encoding the data prior to transmission, and then performing the inverse decoding process. This is a very simple process, but has the disadvantage that it doubles the receive BER. For every bit error the demodulator produces, the differential decoder produces two.

The problem for QPSK is more complex, as there are 4 possible lock states, leading to 4 ambiguities. When FEC is employed, the lock state of the FEC decoder can be used to resolve two of the four ambiguities, and the remaining two can be resolved using serial differential encoding/decoding. However, when no FEC is being used, an entirely different scheme must be used. Therefore, in QPSK, a parallel differential encoding/decoding technique is used, but has the disadvantage that it again doubles the receive BER.

OQPSK is a different situation again, where the ambiguities result not only from not having an absolute phase reference, but also not knowing which of the two parallel paths in the demod, I or Q, contains the half-symbol delay. Another type of differential encoding is used, but yet again the error rate is doubled, compared to ideal.

The second problem inherent in PSK demodulators is that of 'data false locking'.

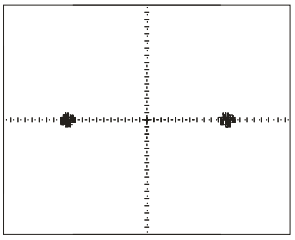
When data at a certain symbol rate is used to modulate the carrier, the demodulator can lock at incorrect frequencies, spaced at intervals of one-quarter of the symbol rate away from the carrier. Fortunately, when FEC decoding is used, the decoder synchronization state can be used to verify the correct lock point has been achieved, and to reject the false locks. However, if uncoded operation is used, there is no way to recognize a data false lock. The demodulator will indicate that it is correctly locked, but the data out will not be correct.

Comtech EF Data strongly cautions users when using uncoded operation. If the acquisition sweep width exceeds one quarter of the symbol rate, there is a very high probability that the demodulator will false lock.

As an example, if 64 kbps QPSK uncoded is used, the symbol rate will be half of this rate, or 32 ksymbols/second. One quarter of this equals 8 kHz. Therefore, the absolute maximum acquisition sweep range, which should be considered, is +/- 8 kHz. If there is any frequency uncertainty on the incoming carrier, this should be subtracted from the sweep width. The problem becomes progressively better with increasing symbol rate.

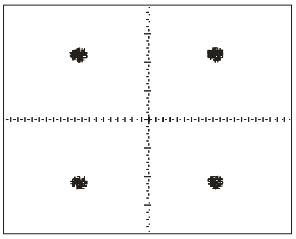
4.3.4 Modulation Types

4.3.4.1 BPSK



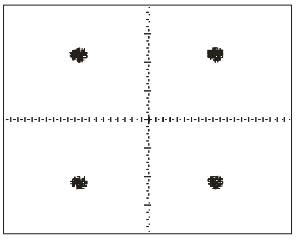
Binary Phase Shift Keying uses vector analysis of the constellation pattern to represent one symbol per carrier phase at either 0 or 180 degrees. The rate 1/2 provides 2 symbol outputs for every input bit. The symbol rate is two times the data rate for BPSK 1/2. Decoder lock is achieved very quickly

4.3.4.2 QPSK



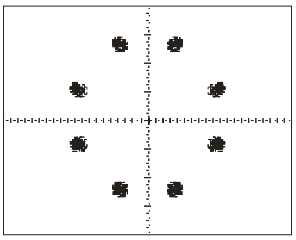
Quaternary Phase Shift Keying differs from BPSK by representing two symbols in one of four phase angle positions; 45, 135, 225, or 315 degrees. Uncoded 1/1, 1/2, 3/4, and 7/8 FEC rates are used for QPSK. The symbol rate for QPSK with an FEC of 1/2 is the same as the data rate. The symbol rate is 2/3 of the data rate for 3/4.

4.3.4.3 Offset QPSK



Offset Quaternary Phase Shift Keying is a variation of QPSK. The offset prevents any succession of symbols going through the zero point of the quadrature. The RF envelope will not collapse when the modulation format is set to OQPSK. It is possible to operate high power amplifiers with less then recommended back off when using this type of modulation.

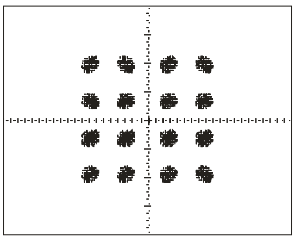
4.3.4.4 8-PSK



8-Phase Shift Keying Pragmatic trellis coded modulation encoding is used to transmit baseband data for 8 phase shift keying. Eight discrete phase angles represent the 8 possible symbol combinations of three bits. The symbol rate for 2/3 rate 8PSK is 1/2 of the data rate. The symbol rate for 5/6 FEC 8PSK is 3/5 of the data rate.

Reed Solomon is recommended to achieve acceptable performance.

4.3.4.5 16-QAM



16-phase Quaternary Amplitude Modulation The modulator generates a constellation with 16 discrete phase angle/amplitude states for 16-QAM. There is a large reduction of the symbol rate when using 16-QAM. The symbol rate for 3/4 FEC is 1/3 of the data rate. This severe reduction in symbol rate requires more power on the satellite transponder. Reed Solomon encoding is absolutely necessary.

Phase noise and non-linear links will have a detrimental effect on 16-QAM.

4.3.5 Bit Error Rate

The Bit Error Rate of any digital circuit is the number of bit errors, divided by the bit rate, divided by the total time of the test.

BE/Rate/time

Example: What is the bit error rate when 2 errors occurred in 10 minutes with a data rate of 256 kHz?

$2/256k/(10x60) = 1.3 \times 10^{-8}$

A communications link that is free of errors is always desired, but most links will operate with a certain number of uncorrectable errors over a period of time. Forward Error Correction is necessary to reduce the errors to an acceptable level.

The BER performance curves are an important reference for modem performance. The slope of the BER curve is an indication of the speed at which the BER performance can degrade under link impaired conditions. There is a point that the modems will not operate any more. This point is referred to as the BER Threshold point. Once the BER Threshold point is reached then the modem will lose lock. The performance of a modem at or near threshold is dependent on the type of FEC that is in operation. The Turbo Product Codec will have the least pronounced threshold effect. The modem will stay locked at very low EbNo values where the bit error correction is as low as 1×10^{-2}. Data is, of course, unusable at that point, but the error correction will regain substantial error correction for very small increases in signal input.

4.3.6 Symbol Rate

Symbol rate is the rate that the modulated output signal changes from one phase or amplitude state to another. It is represented by the actual bandwidth of the transmitted carrier at the 3 dB down points from the top of the spectral waveform. It is useful for determining the frequency allocation of the satellite transponder. It is also used to calculate the frequency separation for each carrier on the satellite.

4.3.7 Symbol Rate Calculations

SR = (DR + OH) * 1/FEC * MF * RSF

SR	Symbol Rate
DR	Data Rate
OH	Overhead Rate
FEC	Forward Error Correction
MF	Modulation Format
RSF	Reed-Solomon Factor

Overhead for IDR	96 kbps (Data rates are 1544, 2048, 6312, and 8448 Mbit/s)
Overhead for IBS/ASYNC	DR * 1/15 (IBS Data rates are n x 64 kbit/s to 2.048 Mbit/s)
FEC	1/2 3/4 7/8 2/3 5/6 21/44 5/16 17/18
MF	BPSK = 1, QPSK = 1/2, OQPSK = 1/2, 8PSK = 1/3, 16QAM = 1/4

Reed-Solomon Factor: RSF = 1.0 if Reed-Solomon is disabled, else refer to Table 4-6: For the N/K values listed the Overhead varies from 8.96% to 12.5%

Table 4-6. Reed-Solomon Factor

Mode	Overhead Type	RSF	N	K	T	I
IESS-310 Compliant (8PSK 2/3 only)	None/ASYNC	1.0896	219	201	9	4
	IBS (TCM/IDR Small Carrier)	1.0896	219	201	9	4
	IDR (TCM/IDR at T1, E1,T2, E2)	1.0896	219	201	9	8
Non-IESS-310 Compliant 8PSK 2/3 and all other modulation types and code rates.	None	1.0976	225	205	10	8
	VSAT-IBS	1.0896	219	201	9	4
	IBS-309	1.0896	219	201	9	4
	IBS (IDR Small Carrier)	1.1250	126	112	7	4
	IDR, T1	1.0976	225	205	10	4
	IDR, E1	1.0896	219	201	9	4
	IDR, T2	1.0899	194	178	8	4
	IDR, E2	1.0899	194	178	8	4

4.4 Theory of Operation

4.4.1 Modulator

The modulator converts the input data and clock to a modulated Intermediate Frequency (IF) output in the frequency range of 70 +/- 20 MHz or 140 +/- 40 MHz. The modulator is controlled by commands from the M&C/Interface CCA and fault information from the modulator is sent to the M&C/Interface. The modulator is composed of eight basic subsections.

The major modulator subsections are:

- Scrambler/Differential Encoder
- Convolutional Encoder
- Programmable Vector Rotation
- I/Q Nyquist Filters
- Modulator
- IF Synthesizer
- Output Amplifier
- Output Level Control

The data from the baseband interface section is first processed through the scrambler for energy dispersal, and then to the differential encoder. The differential encodes the data in a way that the demodulator will be able to resolve the various ambiguities that result from the different modulation types. After the differential encoder, the data is passed to the FEC encoding section.

If Reed-Solomon outer coding is selected, the data will be processed first by the R-S encoder before being passed to the convolutional or trellis encoder. The available convolutional code rates are 1/2, 3/4, and 7/8, and the trellis code rates are 5/6, and 2/3 are based on the symbol rate range of 9.6 kbit/s to 10 Mbit/s. For Viterbi codes, the convolutional encoder encodes the data at 1/2 rate. If the selected code rate is 3/4, then 2 of every 6 symbols are punctured. For 3 bits in, there are 4 symbols out. When TPC is selected, the data bypasses the R-S encoder and enters the Turbo encoder block. This block contains all the necessary functions required for Turbo code operation including scrambling, unique word insertion, and formatting.

After the FEC encoder, the data is sent to a programmable vector rotation circuit. This feature provides the user with data communications compatibility for spectrum reversal of the I and Q channels before and after satellite transmission. The I and Q channel data then pass through a set of variable rate digital Nyquist filters. The two identical digital Nyquist filters are followed by the modulator function. Symbol rates up to 10 Msym/s can be achieved automatically.

The modulated carrier is applied to the IF section for conversion to the correct output frequency. The spectral shape will be identical to that of the input data streams, but double-sided about the carrier frequency.

The IF synthesizer provides the proper frequencies to convert the modulator IF to the desired output frequency in the 70 or 140 MHz range. The synthesizer incorporates a Direct Digital Synthesis (DDS) chip to accommodate 1 Hz steps over the full IF range. The frequency stability of the IF signal will match the stability of the modem reference.

The signal is sent to the output amplifier. The amplifier takes the low level signal from the modulator section and amplifies the signal to the proper level for output from the module. The amplifier circuitry provides programmable control of the output level over a range of +5 to -30 dB, in 0.1 dB steps. The amplifier has power leveling of ± 0.5 dB to maintain the stability of the output level over time and temperature.

4.4.2 Demodulator

The demodulator will provide baseband data and clock to the customer by processing the down-converted RF signal from the satellite. The frequency of the input IF signal for the demodulator is 70 ± 20 MHz or 140 ± 40 MHz. The input level is between -15 dBm and -55 dBm. The demodulator uses Viterbi or trellis decoding with or without concatenated Reed Solomon decoding (optional Turbo Product Code). A large receive buffer is available to compensate for any frequency changes caused by the satellite link.

The demodulator functions as an advanced digital coherent phase-lock receiver with selectable FEC decoders. The demodulator is controlled by commands from the M&C and fault information from the demodulator is sent to the M&C. The demodulator is composed of eight basic subsections.

The major demodulator subsections are:

- Input Amplifier
- Input AGC
- IF Synthesizer
- Demodulator
- I/Q Nyquist Filters
- FEC Decoding
- Descrambler/Differential Decoder
- Buffer

The modulated IF signal at 70 ± 20 MHz or 140 ± 40 MHz enters the IF section for conversion to I and Q analog baseband channels. The I and Q channels are then passed through identical anti-alias filters, offset amplifiers, and DAC. The digitized I and Q data is then sent to the digital Nyquist filters, resulting in a filtered, digital representation of the received signal. The digital data is then sent to four separate circuits:

- Automatic Gain/Offset Control
- Carrier Recovery (Costas) Loop
- Clock Recovery Loop
- Soft Decision Mapping

The AGC provides a gain feedback signal to the IF section to ensure that the digital representation of the I and Q channels is optimized for the Costas and Clock loops, as well as the soft decision mapping circuitry.

The digital Costas loop, in conjunction with a DDS, performs the carrier recovery function. The Costas loop consists of a Costas phase detector, loop filter, and DDS, all implemented digitally.

The DDS performs the function of a Voltage-Controlled Oscillator (VCO) in an analog implementation, but can be easily programmed to the desired center frequency via the M&C.

The output of the DDS is sent to the IF section, providing the reference to which the quadrature local oscillator is locked. The M&C sweeps the local oscillator (via DDS programming) through the user specified sweep range.

When the active decoder (Viterbi, trellis, TPC, or uncoded) determines that the modem is locked, the M&C stops the sweep and begins the de-stress process. This involves fine-tuning the DDS based on the phase error in the Costas loop. The de-stress process continues as long as the modem is locked. If the carrier is interrupted, the M&C resumes the sweep process.

The digital clock loop, in conjunction with another DDS, performs the clock recovery function. The clock loop consists of a phase detector, loop filter, and DDS, all implemented digitally. The DDS performs the function of a VCO in an analog implementation, but can be easily programmed to the desired center frequency via the M&C. The recovered data and symbol clocks are then used throughout the demodulator.

The soft decision mapper converts the digital I and Q data to 3-bit soft decision values. These values are then fed to the programmable vector rotation circuit, providing compatibility with spectrum reversal of the I and Q channels.

The output of the vector rotation circuit is then sent to the FEC decoder or uncoded data formatter. The output of the FEC decoder is the final output of the demodulator section.

The uncoded data formatter is used in uncoded operation only and bypasses the FEC decoder entirely. Since in uncoded operation there is no FEC information to use for determining lock, ambiguity resolution, and lock detect are performed differently than when Viterbi or TPC FEC is used. Inversion ambiguity is resolved by:

1. Differentially encoding both the I and Q channels in the modulator.
2. Subsequently differentially decoding both the I and Q channels in the demodulator.

In Offset QPSK modulation, the bit ordering ambiguity is resolved since the ordering is inherent in the modulated carrier. By inserting the 1/2 symbol period delay in the I channel data path and using the Q channel symbol interval as the reference, I occurs before Q. Thus, the data is ordered I then Q into a single bit stream.

Carrier lock is determined by sensing the "quality" of the eye pattern. In OQPSK, both eyes should be as wide as possible. In BPSK, the I channel eye should be wide open and the Q channel eye should be closed. Special circuitry determines when the eye pattern on either channel is not within a valid range, and declares lock accordingly.

The alternate descrambler provides OM-73 compatible descrambling of the decoded data stream. The descrambler is the non-recursive counterpart to the OM-73 scrambler. The scrambled data enters an 11-bit shift register, where taps 9 and 11 are exclusive ORed to provide a synchronous reset to an 8-bit counter (adverse state detector). The following are all exclusive NORed to form the descrambled output:

- Terminal count of this counter
- Inverse of the input data
- Taps 9 and 11 of the shift register

This function may be turned ON or OFF by the M&C. The output of the alternate descrambler is the final output of the demodulator and is then sent to the baseband interface section.

Carrier acquisition in the demodulator is a function symbol rate and modulation type. Lower data rates and higher modulation types will require a longer acquisition time. For very small carrier (<25 ksym/s), there is also the possibility that the demodulator will lock to the wrong carrier if the sweep range encompasses like carriers within the sweep range. The demodulator has available functionality that can shorten the acquisition time. These are: Sweep Range, Sweep Center Frequency, and Reacquisition.

The Sweep Range sets limits of the carrier loop during acquisition. The Sweep Center Frequency function allows the operator to target the demod center frequency to be offset from the assigned demodulator center frequency. The Reacquisition function is used to reduce the amount of time that is required to relock the demod in the event of a short outage or fade. For the time specified in the Reacquisition function, the demodulator will reduce the sweep range of the carrier loop to +/-500 Hz from the demodulator center frequency prior to the outage.

4.4.3 Baseband Interface

The baseband section of the modem consists of the Monitor and Control (M&C), the transmit and receive baseband interface section, and the reference and clock distribution section.

4.4.3.1 Monitor and Control

The remote serial monitor and control port is selectable as RS-232 or RS-485. The remote control port is used to retrieve status or provide user control of the modem from a remote location and is also used to upgrade the firmware on each CCA.

A fault connector provides Form C contacts for reporting faults on each CCA.

4.4.3.2 Transmit and Receive Baseband

The primary data channel is available on a TIA/EIA-449, 37 pin or an optional TIA/EIA-530, 25 pin subminiature D-shell connector. The data and clock signals conform to MIL-188-114 type II and III, and TIA/EIA-422 balanced data and clock signal levels.

The digital data baseband loopback occurs between the transmit and receive sections of the modem. This baseband loopback is a bi-directional loop at the input and output of the interface drivers and receivers. This will allow the operator to verify a valid baseband connection to the modem.

An overhead channel is available for Asynchronous (ASYNC) serial communications between the two ends of the satellite link and Automatic Uplink Power Control (AUPC). This overhead channel increases the symbol rate by 6.7%. This overhead function is a closed network application that is compatible with an SLM-8650 operating in 8650-02 mode. The interface for the overhead data is available on a 9 Pin 'D' connector at the rear panel of the modem. The electrical interface is selectable TIA/EIA-232 or TIA/EIA-485 (2 or 4 wire).

Intelsat specifies an overhead framing structure for every open network carrier. The specifications from Intelsat are IESS-308, IESS-309, and IESS-310. The modem can be configured to provide IDR and IBS framing of the data stream per the Intelsat specifications. The type of overhead framing over Intelsat is dependent on the data rate, modulation type, and service that are in operation. Refer to the IESS documents for complete details on these operating modes and framing format.

The IESS documents define the content of the bits within the overhead frame commonly referred to as Engineering Service Channel (ESC) data. The modem does not provide access to ESC data but sets all of the bits in a 'non-inserted' state so there is no problem interfacing into an open network earth station. An optional interface card is available to provide the interface to the IESS defined ESC data.

The modem is able to provide a bit error rate if the demodulator receives a 2047 pattern and the demodulator test mode of 2047 is turned ON. The modulator is also capable of substituting the 2047 test pattern in lieu of the incoming data stream. The 2047 test pattern is a standard test pattern compatible with the FIREBERD 6000 and similar commercial BER testers. In additional to the 2047 test pattern, a special MIL test pattern is available. This MIL pattern is a modified 2047 pattern that pads the eleven 0s in a 2047 pattern to 50 (2086) once every five, 2047 patterns. This creates a 10274-bit test pattern. This MIL test pattern must be turned on in the modulator for and BER results to be displayed.

The receive baseband section contains a configurable FIFO buffer large enough to handle the link variations caused by an inclined orbit geosynchronous satellite. Generally, the buffer size may be set to 4 ms to take care of the periodic, 24-hour, link variations of the satellite. Refer to paragraph 4.4.3.3.5 for a more complete discussion on the buffer function within the modem.

4.4.3.2.1 Option Interface G.703, Overhead (AS/10175)

This interface is provided as a plug-in option card for the SLM7650 with user accessible connectors at the rear of the modem as follows:

- Two BNC type female connectors for G.703 un-balanced interface
- One 15-pin D-sub female connector for balanced G.703 interface
- One 50-pin D-sub female connector for legacy equipment interfacing

The interface provides the following features:

- G.703 data interface (balanced/un-balanced)
- EIA422/MIL188 interface (50 pin connector)
- ASYNC overhead data interface (50 pin connector)
- Access to IDR/IBS Engineering Service Channels (ESC)
- Drop & Insert

Additionally the option card is designed to support two build options as follows:

- Build Option 1 (AS/10175-1) – G.703 data interface, EIA422/MIL188 interface, ASYNC overhead data interface
- Build Option 2 (AS/10175-2) – Includes all features of build option 1 with the addition of Drop & Insert overhead and access to IDR/IBS ESC

The option interface card when installed is integrated into the SLM7650 Monitor & Control system with access to configuration and status monitoring. Details of the option interface are included in the following sections.

4.4.3.2.1.1 Terrestrial Data Interface Selection

When the option interface card is installed terrestrial data interfacing is selectable as defined in the following Table.

Selected Interface	Interface Connector(s)	Comments
EIA422 Modem	25/37 pin	Standard modem interface
EIA422 Option Card	50 pin	Provided by option card
G.703 Balanced	15 pin / 50 pin	Provided by option card
G.703 Un-balanced	BNC	Provided by option card

4.4.3.2.1.2 Terrestrial Data Interface, MIL-STD-188-114A/EIA-422 (50 pin)

The MIL-STD-188-114A/EIA-422 (RS422) option card interface is provided on a 50 pin connector. See 50 pin connector pin-out for circuit definitions.

4.4.3.2.1.3 G.703 Data Interface

The G.703 data interface is compatible with the requirements set forth within CCITT Recommendation G.703. Specific definitions for the G.703 interface implementation are summarized in the following table.

Characteristic	Definitions
Data Rates	1544.0 kbps (T1), 2048.0 kbps (E1), 6312.0 kbps (T2), and 8448.0 kbps (E2)
Line Coding	AMI, HDB3, B6ZS, and B8ZS
Balanced Data Interface	Supported on the 50 pin and 15 pin connector interfaces. Simultaneous connections to both connectors is not supported.
Un-balanced Data Interface	Supported on BNC 75 ohm connector interface.

4.4.3.2.1.4 Asynchronous Data Channel (50 pin)

An asynchronous data interface accessible through the 50 pin connector is provided. The asynchronous data interface is selectable between the interface at the 50 pin connector or the interface at the modem 9 pin ASYNC data connector.

4.4.3.2.1.5 Open Collector Fault Outputs (50 pin)

Open collector outputs for modulator fault (MF) and demodulator fault (DF) are provided at the 50 pin connector. The open collector outputs source ground to indicate that the associated fault does not exist. These fault indicators are used for interface to CEFD redundancy systems.

4.4.3.2.1.6 AGC Output

A programmable DC output proportional to the receive signal level is provided on the 50 pin connector.

Characteristic	Definitions
Output Voltage Range	0 to 10 Vdc
Output Current	10 mA maximum
Min power (-60 dBm) output voltage	Programmable from 0 to 10 Vdc in .5 volt increments. Default value of 0 Vdc
Max power (-15 dBm) output voltage	Programmable from 0 to 10 Vdc in .5 volt increments Default value of 10 Vdc
Receive Signal Level Output Indication	The output voltage should be linear between the maximum and minimum power settings with respect to the receive signal level. The voltage output limits at the programmed min/max voltages for out of range receive signal levels.

4.4.3.2.1.7 IBS Overhead ESC

The interface option card provides access to the IBS engineering service channels at the 50 pin connector. IBS ESC requirements are defined within IESS-309 and IESS-403.

Characteristic	Definitions
IBS Octet Signaling	Provides support for octet (byte) alignment signaling for the primary data channel. The octet signal is active for one clock period, framing bit 0 of an 8 bit data sequence. The receive side octet signal is provided as an output every eighth bit. The transmit side octet signal is an input that is used to synchronize the octet to the IBS multi-frame.
IBS Backward Alarm	IESS-309 compatible
Prompt Alarm Indication	Form C Relay, contacts accessible through the 50 pin connector
Service Alarm Indication	Form C Relay, contacts accessible through the 50 pin connector
ESC Data Channel	EIA-232 interface accessible through the 50 pin connector. Refer to IESS-309 and IESS-403.
ESC TX Data Channel	ESC TX data is sampled on the rising edge of the ESC TX clock sourced from the overhead card. The ESC TX clock will have a period of 1/480 of the transmit terrestrial data rate and a duty cycle of approximately 50%.
ESC RX Data Channel	ESC RX data and clock is sourced from the overhead card. Data transitions occur on the falling edge of the clock. The clock period will be 1/480 of the receive terrestrial data rate and have a duty cycle of approximately 50%

4.4.3.2.1.8 IDR Overhead ESC

The interface option card provides access to the IDR engineering service channels at the 50 pin connector. IDR ESC requirements are defined within IESS-308 and IESS-403.

Characteristic	Requirement
ESC Audio	2 duplex 32 kbps ADPCM channels
	Audio encoding per CCITT G.721
	Interface – 600Ω transformer balanced 4-wire
	Audio output gain – programmable from -6.0 to +8.0 in 2.0 dB steps
	Audio input gain – programmable from -6.0 to +8.0 in 2.0 dB steps
ESC 64 kbps Data	Replaces 32 kbps audio channels when enabled
	Interface type – EIA422
	ESC TX data is sampled on the rising edge of the ESC TX clock sourced from the overhead card. The ESC TX clock will have a period of 64 kHz and a duty cycle of approximately 50%.
	ESC RX data and clock is sourced from the overhead card. Data transitions occur on the falling edge of the clock. The clock period will be 64 kHz and have a duty cycle of approximately 50%.
ESC 8 kbps Data	Interface type – EIA422
	ESC TX data is sampled on the rising edge of the ESC TX clock sourced from the overhead card. The ESC TX clock will have a period of 8 kHz and a duty cycle of approximately 50%. In addition the transmit interface provides an octet signal at 1 kHz for byte alignment purposes.
	ESC RX data and clock is sourced from the overhead card. Data transitions occur on the falling edge of the clock. The clock period will be 8 kHz and have a duty cycle of approximately 50%. In addition the receive interface provides an octet signal at 1 kHz for byte alignment purposes.
ESC Backward Alarms	4 alarm inputs with 1 k Ω pull-ups to +5 Vdc. Pull input to ground to clear alarm.
	4 alarm outputs with Form C relays (NO, NC, and C contacts). The alarm condition is indicated by a connection between the NO and C contacts.
Demodulator Fault Relay	Form C relay with NO and C contacts available for backward alarm inputs. Contacts NO and C are connected when no demodulator fault is present.
IDR Deferred Maintenance Alarm	Open collector output. Sources ground when alarm is not asserted. Output rated 15 Vdc (max), 20 mA (max)

4.4.3.2.1.9 Drop & Insert

The interface option card provides Drop & Insert (D&I) functional support. The following table provides definitions for D&I.

Characteristic	Definitions
Terrestrial Data Rates	1544.0 kbps (T1), 2048.0 kbps (E1)
Terrestrial Framing	G.732/G.733, G.704
D&I Formats	T1 (D4 framing), T1 (Extended Super Frame "ESF"), E1 (Common Channel Signaling "CCS"), and E1 (Channel Associated Signaling "CAS")
Satellite Data Rates	N x 64.0 kbps ("N" is the number of 64.0 kbps channels) N = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24 (T1 and E1_CCS) N = 1, 2, 4, 6, 8, 12, 16, 24, 30 (E1_CAS)
Satellite Overhead	1/15 of satellite data rate, per IESS-309
D&I Time Slot to Channel Mapping	Terrestrial time slots: T1 = 1 to 24 E1 (CCS) = 1 to 31 E1 (CAS) = 1 to 15 and 17 to 31 Channels: 1 to N (N = Satellite Data Rate ÷ 64 kbps) **Note:** N = 30 (1920.0 kbps) is a transparent mode which disables time slot to channel mapping.
	Drop Channel Assignments: Maps terrestrial time slots to transmit satellite channels.
	Insert Channel Assignments: Maps received satellite channels to terrestrial time slots.
Terrestrial Data Interface	G.703
	Signals Supported: DDI (Drop Data Input) DDO (Drop Data Output) IDI (Insert Data Input) IDO (Insert Data Output) **Note:** Only DDI and IDO are supported on the G.703 un-balanced interface. DDO to IDI internal loop is supported, when enabled the drop data output is internally routed to the insert data input.
Transmit Clock Source (Drop)	Transmit clock will reference the terrestrial input data source only.
Receive Buffer Clock Source (Insert)	In addition to the normal buffer clock sources, "Insert Clock" is added as a selection. If "Insert" is selected as the clock source, inserts will be applied to the terrestrial data input at IDI and output to IDO. Any other clock selection will cause inserts to be applied to an internally generated terrestrial data stream referenced to the selected clock source and output to IDO.
ESC	D&I operates with the IBS Overhead ESC.

4.4.3.3 Reference and Clock Distribution

4.4.3.3.1 Modem Frequency Reference

A modem frequency reference is distributed within the modem enclosure. This frequency reference is the frequency standard for all frequencies generated within the modem. This reference is a phase lock loop circuit that is driven by either an internal high stability oven-controlled oscillator or an external modem reference signal. The external modem reference input on the rear panel of the modem is user selectable as 1, 5, 10 or 20 MHz.

4.4.3.3.2 Modem Clocking

Clocking the data in and out of the modem is extremely important. Loss of synchronization will occur if the selections are not correct. The operator must understand the clock settings at the user equipment before any selections are made at the modem. The modem clock selection is designed to accommodate most system timing requirements that are encountered in a satellite communication link. Clock selections on the transmit baseband section will define the timing standard for the carrier sent toward the satellite. Clock selections on the receive baseband section will define the timing standard for the data sent toward the terrestrial side of the satellite link.

The basic system timing modes discussed here fall variations of three basic timing configurations Master/Slave, Master/Master, and Asymmetrical Master/Slave.

Transmit Clock choices:

1. Internal (ST)
2. TX Terrestrial (Terminal Timing (TT) TIA/EIA-449 pins 17 and 35)
3. Data Source SYNC (Recovers Clock from the Data)

Receive Buffer Clock Choices:

1. Internal (ST)
2. TX Terrestrial Clock (Terminal Timing (TT) TIA/EIA-449 pins 17 and 35)
3. External Master Clock, (MC) pins 16 and 34
4. RX Satellite (Buffer is OFF)

Note: The highlighted denotes Master Clock and the doted box denotes the clock schematic.

4.4.3.3.2.1 Timing Configuration #1: User Provides Clock

Modem Reference clock is either INT, 1, 5, 10, or 20 MHz

TX clock source = TX Terrestrial

Buffer clock also is using TX Terrestrial

This user is ignoring the internal modem clock and providing timing to the modem (Figure 4-2).

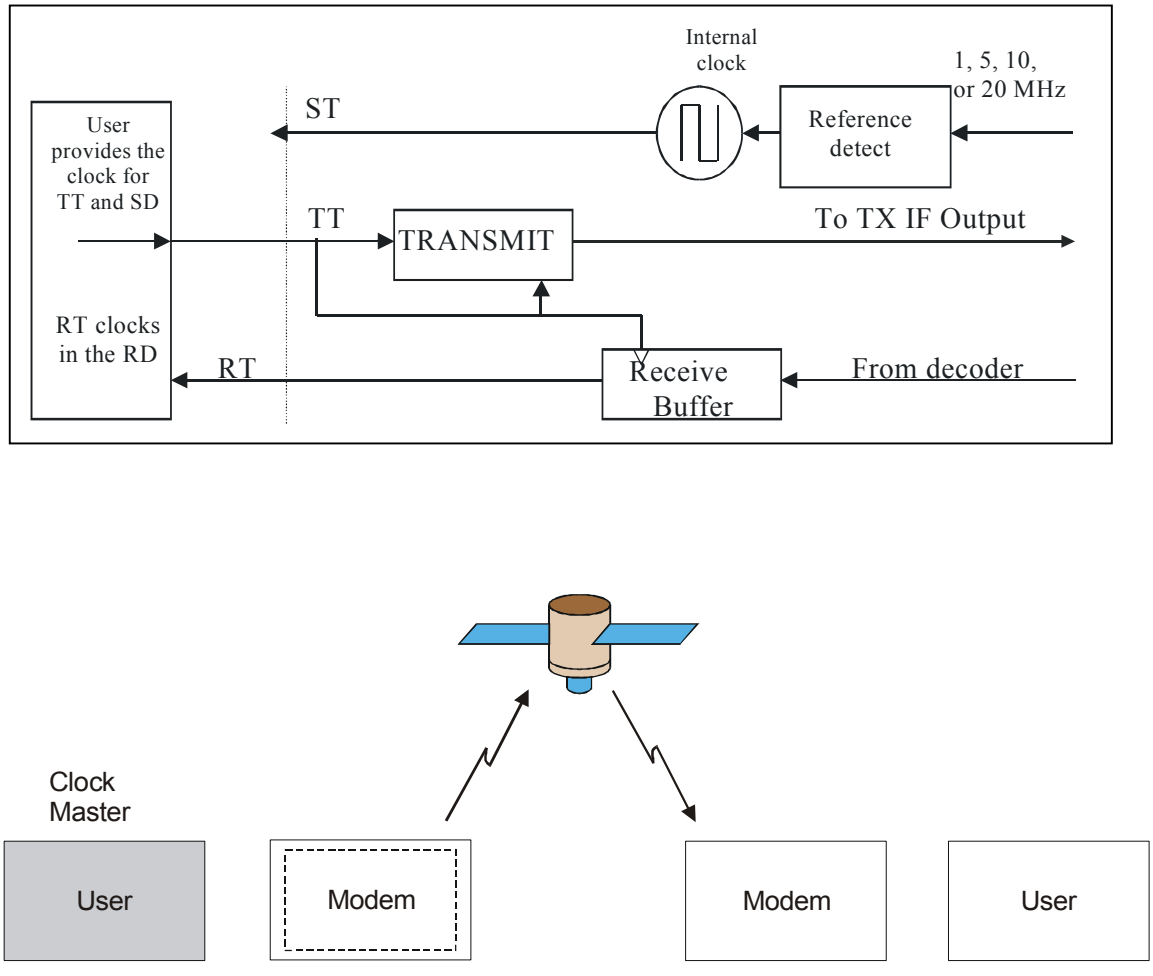


Figure 4-2. User Provides Clock

4.4.3.3.2.2 Timing Configuration #2: Modem Provides Clock

Modem Reference clock is either INT, 1,5, 10, or 20 MHz

TX clock source = TX terrestrial

Buffer clock also is using TX Terrestrial

This user is using the internal modem clock (ST) as the system clock (Figure 4-3).

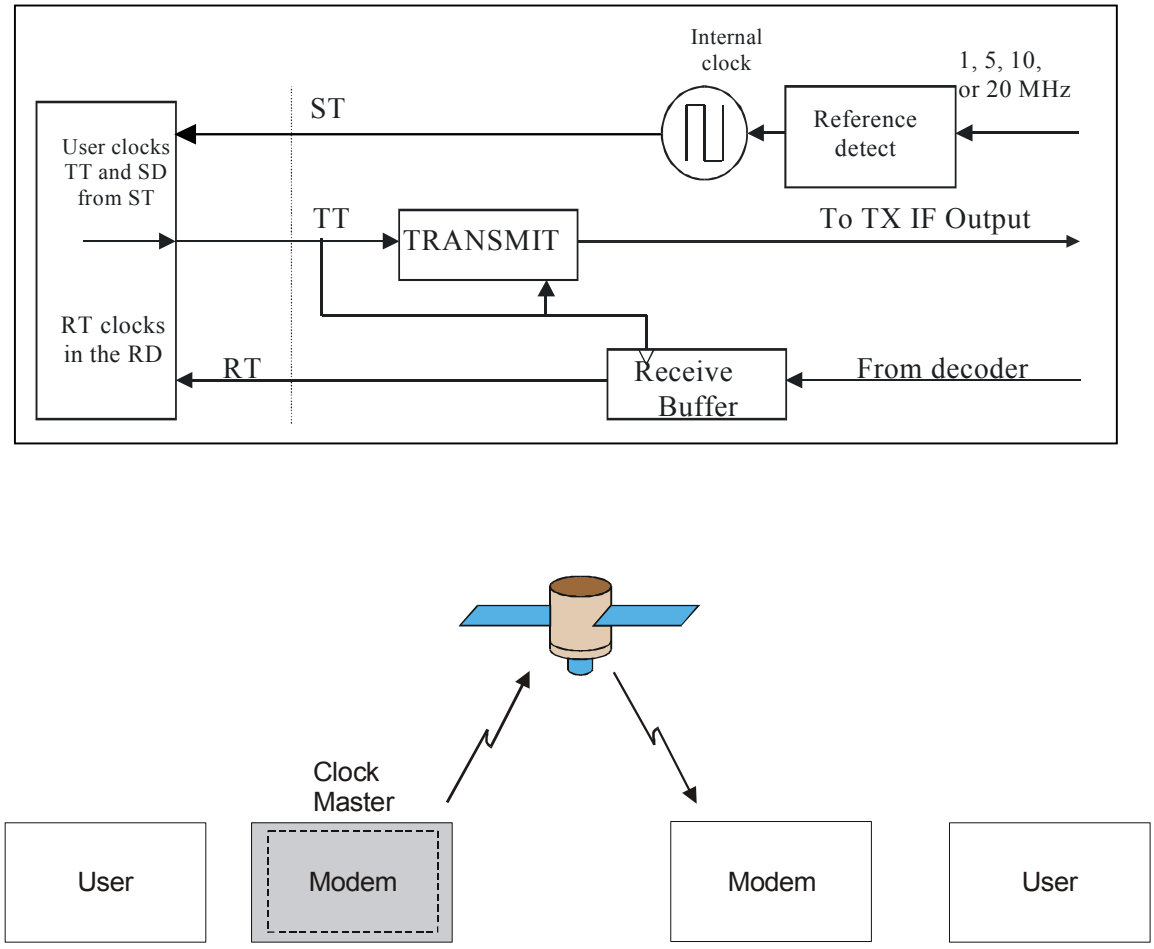


Figure 4-3. Modem Provides Clock

4.4.3.3.2.3 Timing Configuration #3: Modem Clocks Internally

Modem Reference clock is either INT, 1, 5, 10, or 20 MHz

TX Clock source = INT

Buffer clock also is using INT

This user is using the internal modem clock (ST) as the system clock (Figure 4-4).

WARNING: This mode is not recommended for operation at higher data rates. The modulator will be clocking the send data, for transmission to the satellite, with the same internal oscillator that is providing the timing to the DTE equipment. Installation variations can cause varying delay between the internal SCT and the incoming send data. There will be data rate verses cable length combinations that will not operate with the normal transmit clock phase setting. There are setup options to overcome these situations.

1) If Transmit Element Timing from the DTE (TT) is available, use the TX-TERR selection for the TX Clock source.
2) If TT is not available, use the TX Clock Phase selection to operate in Normal or Invert mode. One of these phases will operate properly.

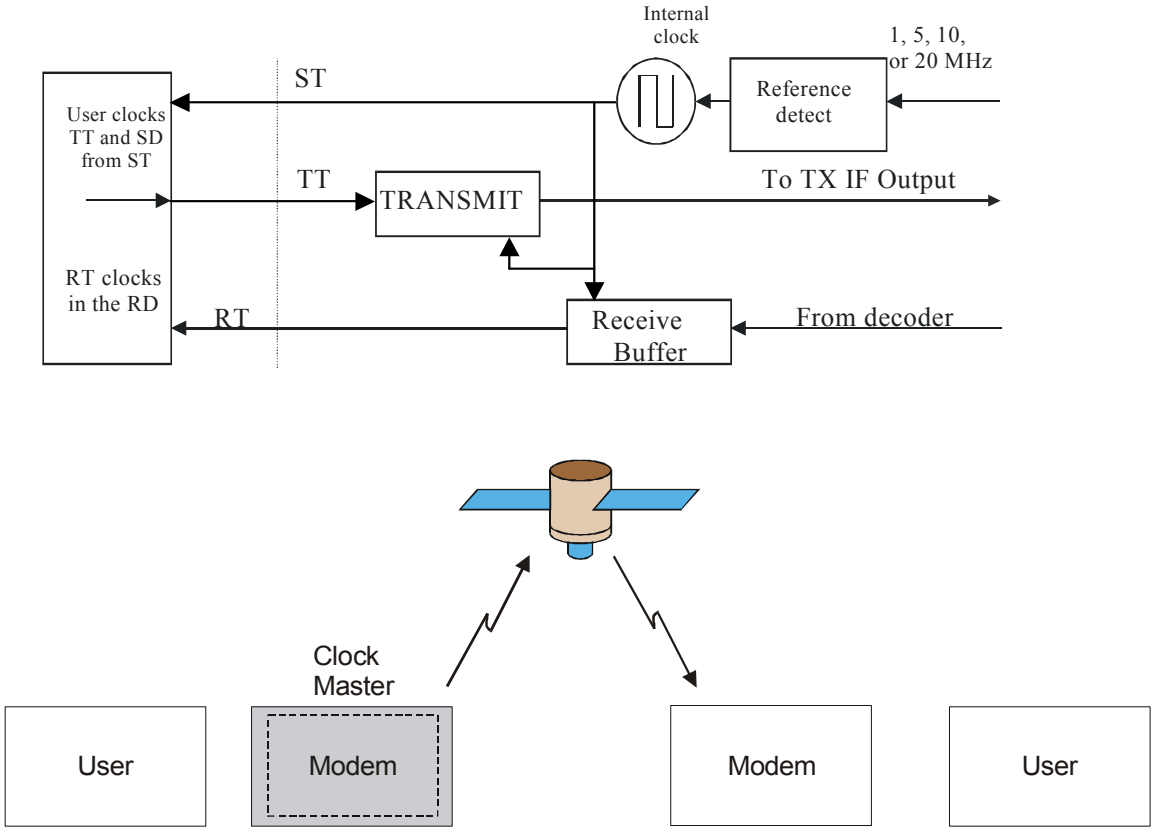


Figure 4-4. Modem Clocks Internally

4.4.3.3.2.4 Timing Configuration #4: Slave Modem-Loop Timed

Master clock is at the distant end of the link.

TX Clock Source = TX Terrestrial

Selecting RX satellite turns Off the buffer.

The user desires to clock the SD to the modem with the satellite clock.

User configured Loop Timing. The TX and RX data rates must be equal. The user must tie RT and ST at their equipment (Figure 4-5).

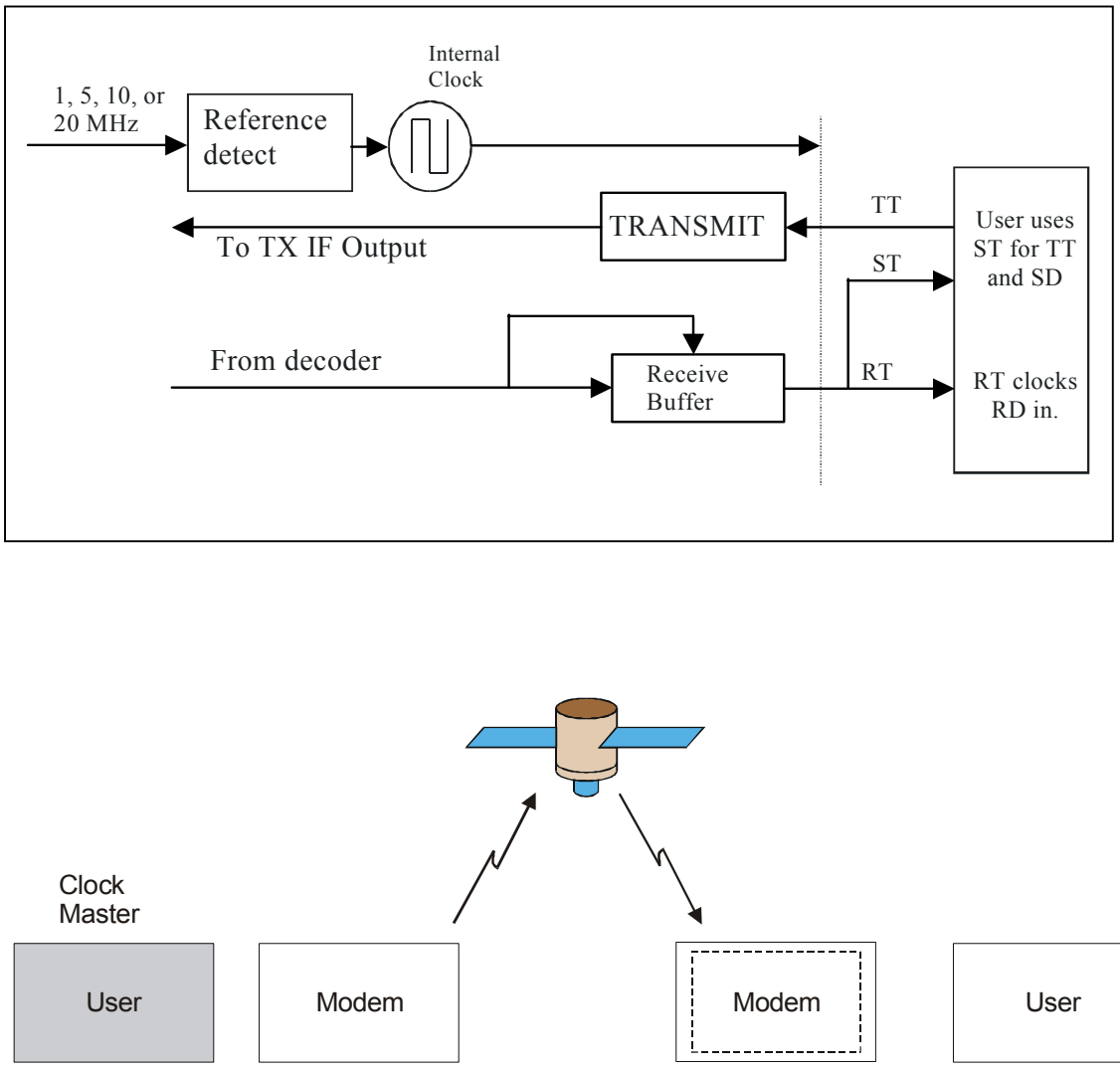


Figure 4-5. Slave Modem-Loop Timed

4.4.3.3.2.5 Timing Configuration #5: EXT Master Clock as Source

This example illustrates the buffer using the EXT Master clock source (Figure 4-6).

The External Master clock frequency must be set in the configuration menu.

Modem Reference clock is either INT, 1, 5, 10, or 20 MHz

TX clock Source = TX Terrestrial

RX Buffer = EXT Master Clock

The External Master clock, inputs on pins 16 and 34. Observe the follows rules:

If "Transmit Terrestrial" or "External" is selected as the buffer output reference source one of the following constraints must be satisfied:

a. Reference frequency is equal to RX data rate.

b. Receive data rate and REF frequency are both integer multiples of 600 Hz.

c. Receive data rate and REF frequency are both integer multiples of 1 kHz.

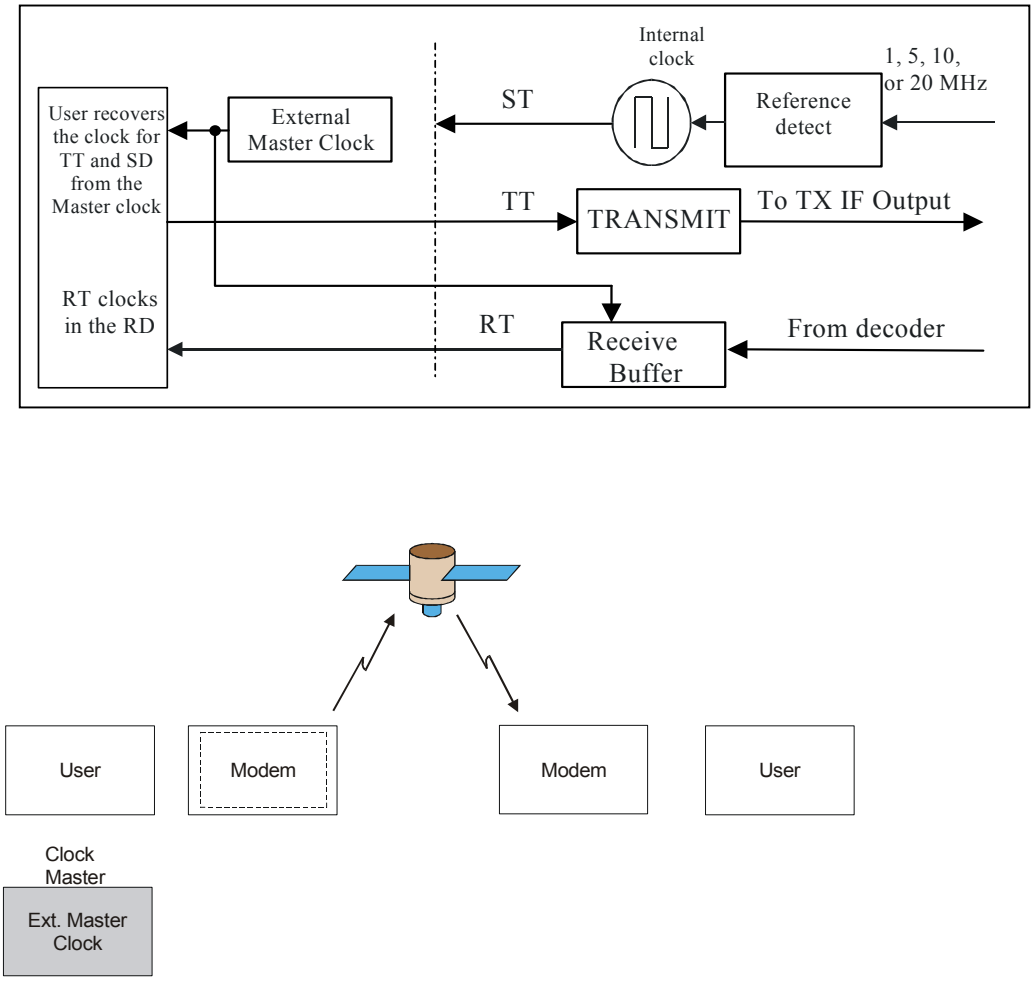


Figure 4-6. EXT Master Clock as Source

4.4.3.3.2.6 Timing Configuration #6: User Provides Data Only

Modem Reference clock is either INT 1, 5, 10, or 20 MHz

TX Clock Source = Data Source Sync

(X.21 operation will not have a TX terrestrial clock to the modem.)

Buffer clock is set to RX satellite (OFF or Bypass)

This user is generating the transmit clock from the send data (SD) (Figure 4-7).

The User must not use ST to generate SD.

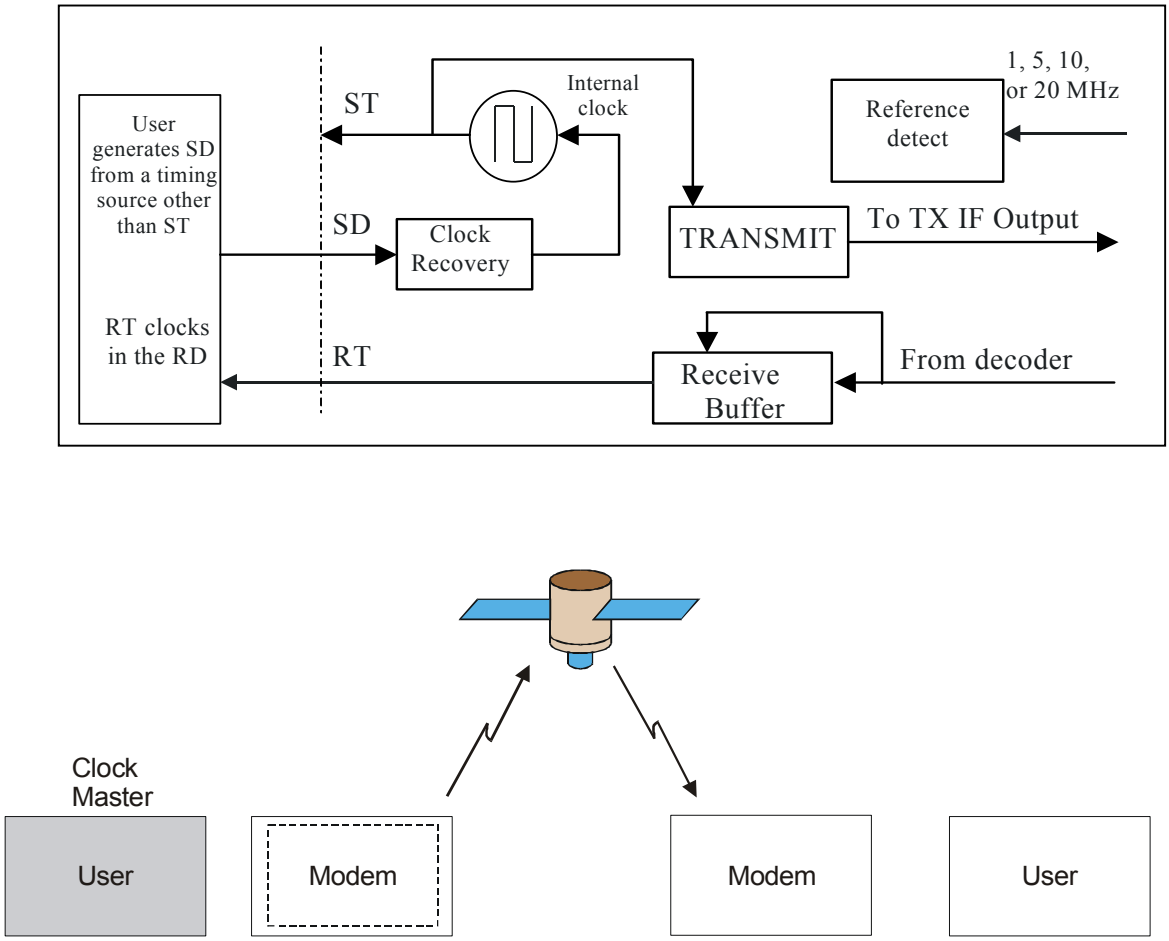


Figure 4-7. User Provides Data Only

4.4.3.3.3 Internal Clock

The Internal clock of the modem is referred to as Send Timing (ST). This clock is available as an output clock from the modem. It can use as a clock source for the data equipment if the user wants to clock the data equipment from the modem. The user equipment will output the send data and transmit terrestrial clock by slaving to the modem ST clock. The internal ST clock is also the fallback clock for all conditions where the selected clock source is removed.

The frequency standard of this clock is typically tied to that of the modem reference. However, the modem offers flexibility in the selection of the timing source for the internal ST clock. The SCT PLL REF is the internal ST clock Phase Lock Loop Reference source. The choices for this reference are Modem Reference, External Master Clock, Rx Satellite, or Data Source Sync (Figure 4-8).

The Modem Reference has a number of choices. The default is Internal that selects the high stability oscillator on the monitor and control card. The other choices have to do with accepting either 1, 5, 10, or 20 MHz from the user site clock. Figure 4-8 is a sketch of these clock choices relating to the internal SCT clock of the modem.

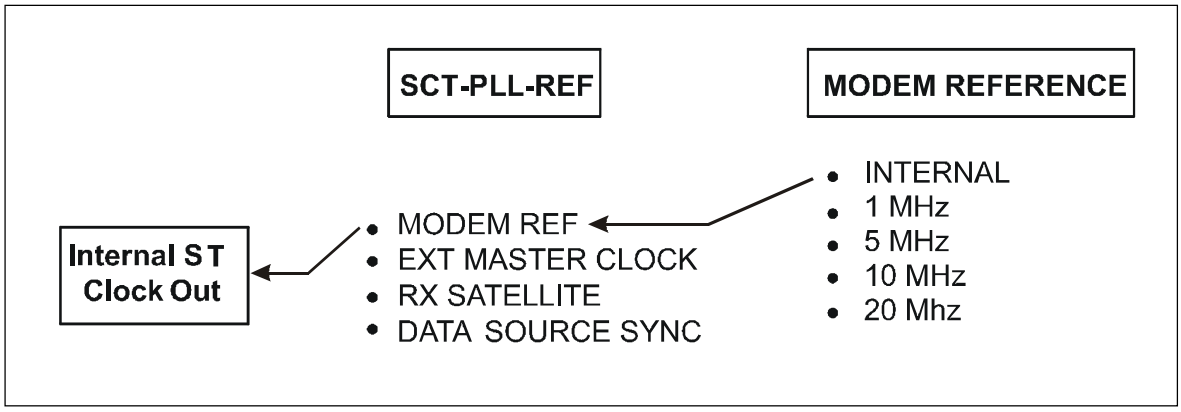


Figure 4-8. Internal SCT Clock Selection

Notes:

EXT MASTER CLOCK - This choice for SCT-PLL-REF is a user clock input at the data connector. A balanced differential pair may be used to clock the internal clock of the modem.

Rx SATELLITE - This choice is only invoked when Loop Timing is turned on. This will only appear in the SCT-PLL-REF menu when loop timing is turned on and cannot be changed until loop timing is turned off.

DATA SOURCE SYNC – This will only appear when DATA SOURCE SYNC is selected as the transmit clock source. The selection cannot be changed until the Transmit Clock Source is changed to either Tx Terrestrial or SCT (internal).

4.4.3.3.4 Asymmetrical Loop Timing (ASLT)

There are operational satellite links that have specific clocking requirements that include the use of unequal data rates for transmit and receive. Asymmetrical loop timing (ASLT) is an optional loop-timing mode that will allow for one timing standard in the circuit even though the data rates are not equal. Compare the difference in clocking for the following diagrams shown in Figure 4-9.

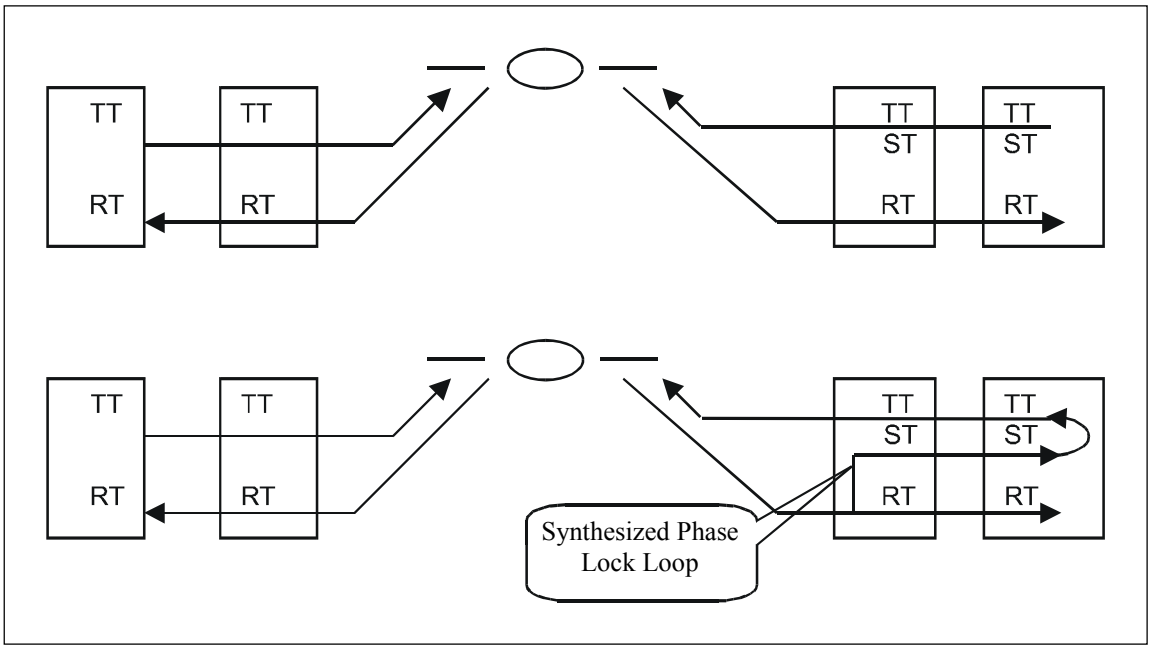


Figure 4-9. Separate Links vs Asymmetrical Loop Timing

The top example shows how most users would configure the clock as two separate transmission links if the clock rates are not equal. No buffers are required and the setup is very straightforward.

The bottom example shows how the ASLT allows for loop timing the transmission link as if the data rates were equal. The timing standard at the master station is used for the complete duplex asymmetrical satellite link. The synthesized phase lock loop circuit is used at the slave end of the link to ensure that the ST output clock is phase locked to the receive recovered satellite clock.

If ASLT is selected to be ON, the 'RX_Sat' clock is configured as the SCT-PLL-REF source. There are, however, data rate restrictions and one of the following constraints must be satisfied:

- The receive data rate is equal to the transmit data rate.
- The transmit data rate and the receive data rate are both integer multiples of 600 Hz.
- The transmit data rate and the receive data rate are both integer multiples of 1 kHz.

4.4.3.3.5 Buffering

There are two primary purposes for a receive FIFO buffer in a satellite modem. One is to compensate for periodic changes in the receive data rate caused by the satellite movement (Doppler shift) and the other is to provide a controlled reset to compensate for small differences in master timing standards at two ends of the satellite link (Plesiochronous timing). The same receive buffer is used to compensate for the Doppler shift and for plesiochronous timing.

The receive buffer can be clocked by a number of sources. The internal system clock (INT), the recovered clock from the satellite (RX_Sat), the TX terrestrial clock from the modulator (TX_Terr), or the External Master Clock (MC) from the Data I/O.

When the receive data is clocked out of the modem using the receive recovered satellite clock (RX_Sat) the buffer is not active. The receive data is being clocked in and out of the buffer with the same clock. When the buffer clock selection is anything other than RX_Sat the buffer is active and must be properly configured. Also, anytime that the receive buffer is active in the modem, that end of the satellite link is considered the source of a master clock.

In a satellite link with one master clock, the operator will typically clock the data in and out of the modem with the transmit clock source (TX_Terr). If there are two master clocks in the link then the receive buffer must operate as a Plesiochronous/Doppler buffer. The buffer must be sized to compensate for the Doppler shift plus the additional size required to extend the time between inevitable slips caused by the Plesiochronous timing. Plesiochronous operation is typical in international Public Switched Telecommunications/Telephone Network (PSTN). The PSTN users will inevitably suffer SYNC losses or periodic pattern slips because of the two master clocks are being used in the network.

The receive buffer will periodically fill and empty as the received signal changes in frequency. The buffer size must be set large enough to avoid an over or under fill. An overly large buffer will unnecessarily increase the data delay. The buffer size should be large enough to allow the buffer to start at any time, as the satellite is moving in the inclined orbit. The receive buffer size is determined by how many days are desired between the clock slips and the amount of Doppler that must be considered.

The amount of Doppler shift that will be present in the link will vary based on the particular satellite that is in the link. Communication satellites in geosynchronous earth orbit (GEO) appear to float in a repeated figure eight pattern every 24 hours. The size of the figure eight is controlled through the use of station keeping propulsion. As these the satellites reach the end of their operational life, station-keeping fuel is used up and the satellites will be removed from orbit. In a move to extend the useful life of some satellite, operators are using an operating technique called inclined orbit. This procedure allows the satellite to drift in a 'north/south' direction while maintaining a strict 'east/west' position. However, the side affects of this operating mode are increased Doppler shift and required antenna tracking systems on large antennas.

As the satellite distance decreases, the frequency of the signal being received at the earth station will be at a slightly higher rate. If the satellite distance increases, then the receive frequency at the earth station will be at a lower rate. The effects of the rate changes can be nullified by the receive buffer. The buffer will fill up and overflow if the buffer clock is slower than the recovered clock from the satellite. The buffer will empty if the buffer clock is faster than the recovered clock from the satellite. The buffer will recenter when the buffer overflows or underflows. An overflow or underflow of the receive buffer will cause a loss of the data that is in the buffer. Proper configuration of the buffer will minimize the adverse affects on the overall communication network. A loss of bit count integrity (BCI) will not cause the buffer to recenter. The buffer will recenter if the decoder looses lock.

The time between clock slips can be calculated as follows:

$T = B/2/\Delta$

Where:

- B = Total Buffer size
- Δ = Difference in frequency
- T = Time in seconds

The buffer size is divided in half because the buffer starts at the 50% fill state.

The following tables are used to determine buffer size.

- Table 4-7 will provide the delay variations expected for an inclined orbit satellite.
- Table 4-8 gives some recommended buffer sizes based on the examples that follow.

Table 4-7. Delay Variations for Inclined Orbit Satellites

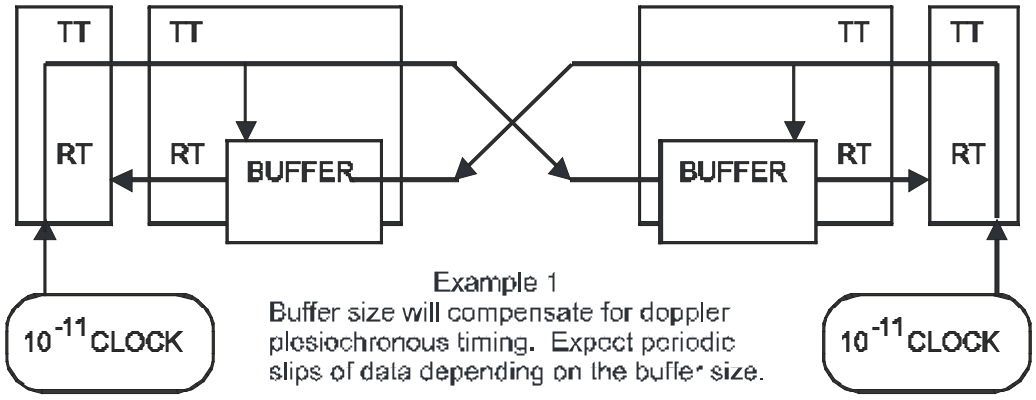
Inclination in Degrees							
Parameter	0.5	1.0	1.5	2.0	2.5	3.0	Units
Maximum variations	1.1	1.8	2.6	3.3	4.1	4.8	milliseconds
Maximum rate of variations	40	67	94	121	148	175	nsec/sec

Note: The maximum variations are based on the peak-to-peak uplink plus downlink delay and the maximum rate of variations include the uplink and downlink.

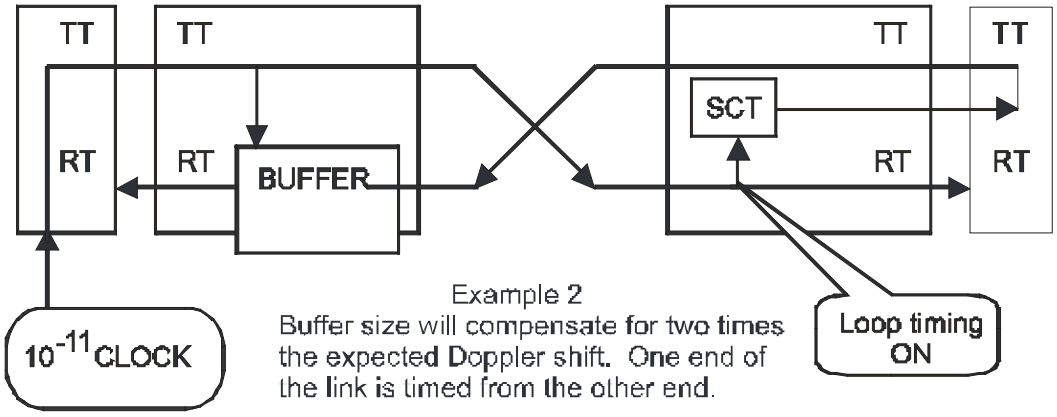
Table 4-8. Recommended Buffer Size

Satellite Orbit Inclination (Nominal)	Buffer size in milliseconds	
	Example 1 Doppler + Plesiochronous	Example 2 Doppler only
0.1	1.5	2.4
0.5	2.5	4.4
1.0	3.9	7.4
1.5	5.5	10.4
2.0	6.9	13.2
2.5	8.5	16.4
3.0	9.9	19.2

EXAMPLE 1 - includes a factor of two to allow the buffer to start in the center and then drift in either direction. This will allow the buffer to start at any time and at any satellite position in the figure eight pattern. The buffer size must be increased to lengthen the number of days between slips.



EXAMPLE 2 - shows a MASTER/SLAVE link and will include a factor of two to allow the buffer to start in the center plus an additional factor of two to account for the passage of the timing signal twice through the satellite. The actual buffer size may be larger for primary framed data like T1, T2, E1, or E2. Framed signals require the buffer size to be an integer multiple of the frame length of the data. Setting the buffer size to a multiple of the frame length will decrease the need for the user equipment to re-acquire frame synchronization. If a complete frame or group of frames is missing because of a buffer slip then the user equipment will, most likely, maintain synchronization.



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Chapter 5. MAINTENANCE

The SLM-7650 is designed for operation without the need for periodic maintenance. This chapter will provide information on modem firmware upgrades, fault isolation, and modem performance verification procedures.

5.1 Modem Firmware Upgrade

The use of flash memory has alleviated the necessity to remove and replace individual ICs that contain the firmware when an upgrade is required. A reflash of the modem will take less than 4 minutes. Reflash of the modem will completely reconfigure the modem to the default parameters. Scheduled equipment downtime will be required otherwise the network will be adversely affected.

Comtech EF Data will provide the program and the files required for the reflash of the modem. The procedure for a USB reflash upgrade is located on the Comtech EF Data web site and will also be sent with the new upgrade files. Care is required to assure the use of the proper files when upgrading the modem. Using old reflash files may result in the modem being out-of-service until the proper files are used to make the upgrade.

A standard personal computer with USB capability is used for the flash upgrade.

The typical upgrade will be provided on a CD ROM. The CD-ROM will contain a single executable ZIP file that contains all the files and the program needed to upgrade the modem. The operator will copy the ZIP file to the desired directory and run the executable file. The required files will be copied to the user hard drive.

The following is a basic overview of the steps involved in an upgrade. This is not intended to be the complete procedure. Refer to the procedure provided with the upgrade for the complete and detailed instructions.

- Run the Reflash program (Figure 5-1)
- Enable the USB Reflash in the Utility - System menu.
- Connect the USB cable to the USB port on the front panel of the modem.
- The modem will go into Reflash mode.
- Select the new upgrade file.
- Upload the Application.
- When the upgrade is complete, remove the USB cable.
- The modem will re-boot and configure to the default parameters.

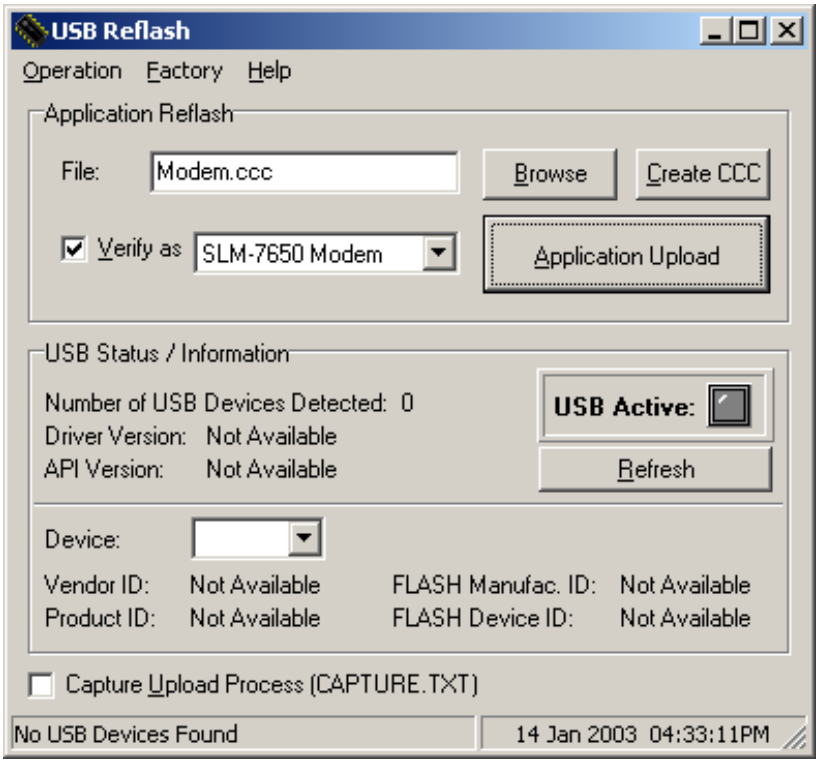

Figure 5-1. Reflash Program Window

The program and upgrade files should be in one directory. An example of what would be contained on an upgrade CD-ROM is show in figures Figure 5-2 through Figure 5-4.

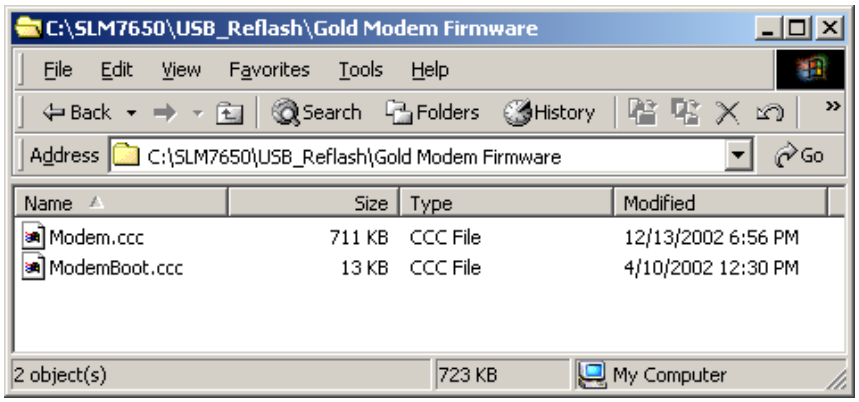

Figure 5-2. Example of Upgrade File Location

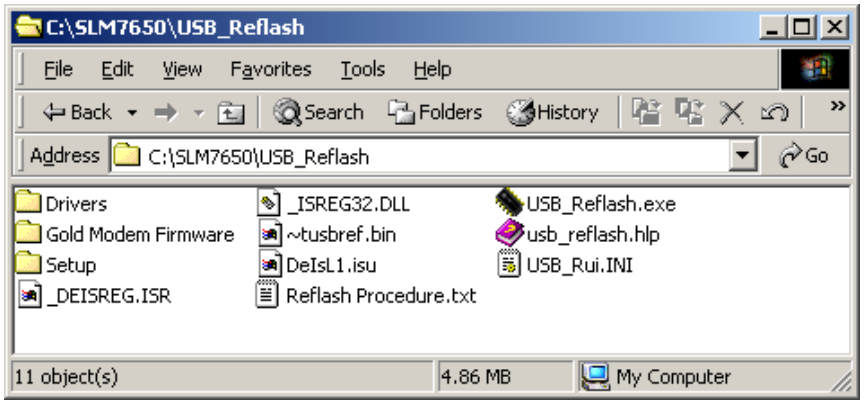

Figure 5-3. Example of Reflash Program File Location

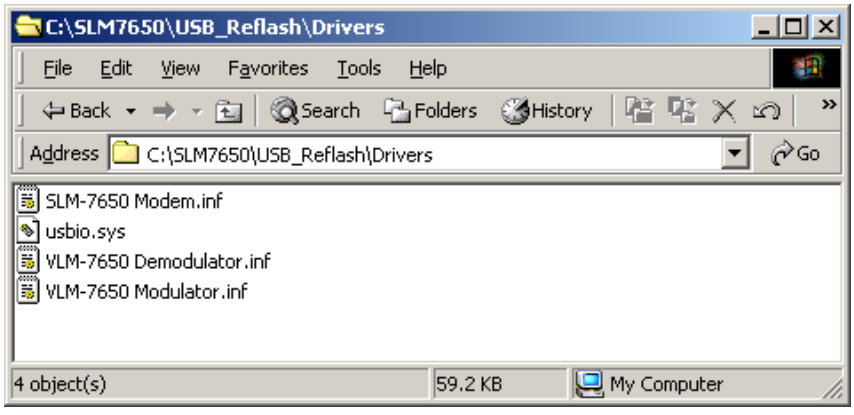

Figure 5-4. Example of USB Drivers File Location

5.2 Fault Isolation

The fault monitoring and internal test modes of the modem assists the operator in determining if the link problem is the result of a faulty modem. The maintenance philosophy of the SLM-7650 identifies the modem is the LRU. If the modem is found to be faulty, remove the modem from the rack and return to the depot for repair.

The fault isolation procedure lists the following categories of faults or alarms.

- Modulator
- Demodulator
- Transmit Interface
- Receive Interface
- Common Equipment

5.2.1 Fan

A six-month fan inspection is suggested. Listen for uncommon fan noise and check that air is flowing out of the back of the modem.

5.2.2 M & C Battery

There is a small battery in the monitor and control section that may need to be replaced every 5 years. Schedule periodic replacement every four years or if a battery low alarm occurs while the modem has been plugged in. The battery part number is BTM4T28-BR12SH. The Comtech EF Data part number is HW/M4T28.

The battery fits on a surface mount integrated chip that functions as a timekeeper and memory device. The battery voltage is checked upon power up and, automatically, every 24 hours as long as the device is powered up. A battery low alarm will be generated if the voltage falls below 2.5 Vdc. The modem configuration should be checked if the battery low alarm occurs on power up because the data integrity may be compromised if the battery voltage falls below 2.5 Vdc.

A fresh battery should be installed if the battery alarm is generated during the 24-hour interval check. This indicates that the battery is near end of life. The modem configuration has not been compromised, since the modem has been constantly powered up.

5.2.3 Faults/Alarms

System faults are reported in the “Faults/Alarms” menu, and stored faults are reported in the “Stored Flts/Alms” menu. To determine the appropriate action for repairing the modem, refer to Table 5-1 and the list of possible problems.

Table 5-1. SLM-7650 Fault Tree

PARAMETER	TX IF OUTPUT OFF	TX FAULT LED "RED" (FAULT)	TX FAULT RELAY	RX FAULT LED "RED" (FAULT)	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX FAULT LED "YELLOW" (ALARM)	TX ALARM RELAY	RX FAULT LED "YELLOW" (ALARM)	RX ALARM RELAY	TX AIS	RX AIS	IBS PROMPT ALARM RELAY (1)	IBS SERVICE ALARM RELAY (1)	IBS BACKWARD ALARM (1)	IDR DEF. MAINT. ALARM (2)	D&I TERRESTRIAL BWA (3)
Modulator Faults																		
Module	X	X	X									X		X				X
IF Synthesizer	X	X	X									X		X				X
Data Clock Syn	X	X	X									X		X				X
I Channel	X	X	X									X		X				X
Q Channel	X	X	X									X		X				X
AGC Level	X	X	X									X		X				X
Demodulator Faults																		
Module				X	X								X	X		X		
Carrier Detect				X	X								X	X		X		
IF Synthesizer				X	X								X	X		X		
I Channel				X	X								X	X		X		
Q Channel				X	X								X	X		X		
BER Threshold										X	X				X		X	
TX Interface Faults																		
Module		X	X									X		X				
TX Data/AIS								X	X						X		X	
TX Clock Activity								X	X			X		X				X
TX Clock PLL								X	X			X		X				X
SCT PLL		X	X									X		X				
SCT Reference Activity								X	X			X		X				
TX Drop		X	X									X		X				X

Table 5-1. SLM-7650 Fault Tree (Cont.)

PARAMETER	TX IF OUTPUT OFF	TX FAULT LED "RED" (FAULT)	TX FAULT RELAY	RX FAULT LED "RED" (FAULT)	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX FAULT LED "YELLOW" (ALARM)	TX ALARM RELAY	RX FAULT LED "YELLOW" (ALARM)	RX ALARM RELAY	TX AIS	RX AIS	IBS PROMPT ALARM RELAY (1)	IBS SERVICE ALARM RELAY (1)	IBS BACKWARD ALARM (1)	IDR DEF. MAINT. ALARM (2)	D&I TERRESTRIAL BWA (3)
RX Interface Faults																		
Module				X	X								X	X				
Buffer Clock PLL				X	X								X	X				
Buffer Clock Activity										X	X			X				
RX Data/AIS										X	X				X	X	X	
Demux Lock				X	X								X	X		X		
RX 2047										X	X							
Buffer Overflow										X	X							
Buffer Underflow										X	X							
Buffer Full										X	X							
RX Insert				X	X								X	X				
IBS Backward Alarm										X	X				X			X
Frame BER				X	X									X		X		
Common Equipment Faults																		
Module						X	X							X				
Battery Clock						X									X		X	
-12 Volt						X	X							X				
+12 Volt						X	X							X				
+5 Volt						X	X							X				
+3.3 Volt						X	X							X				
+2.5 Volt						X	X							X				
+1.8 Volt						X	X							X				
Temperature						X								X				
Modem Reference PLL	X					X	X					X	X	X				
Modem Reference Activity						X								X				

Table 5-1. SLM7650 Fault Tree (Cont.)

PARAMETER	TX IF OUTPUT OFF	TX FAULT LED "RED" (FAULT)	TX FAULT RELAY	RX FAULT LED "RED" (FAULT)	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX FAULT LED "YELLOW" (ALARM)	TX ALARM RELAY	RX FAULT LED "YELLOW" (ALARM)	RX ALARM RELAY	TX AIS	RX AIS	IBS PROMPT ALARM RELAY (1)	IBS SERVICE ALARM RELAY (1)	IBS BACKWARD ALARM (1)	IDR DEF. MAINT. ALARM (2)	D&I TERRESTRIAL BWA (3)
Backward Alarms (IDR with option card)																		
Backward Alarm RX #1										X	X						X	
Backward Alarm RX #2										X	X						X	
Backward Alarm RX #3										X	X						X	
Backward Alarm RX #4										X	X						X	
Backward Alarm TX #1								X	X									
Backward Alarm TX #2								X	X									
Backward Alarm TX #3								X	X									
Backward Alarm TX #4								X	X									

Note #	Description
1	IBS alarms are available with IBS/D&I operation and with the option card installed.
2	IDR Deferred Maintenance Alarm is available with IDR operation and option card installed.
3	D&I Terrestrial Backward Alarm is available with D&I operation and with option card installed.

5.2.4 Fault/Alarm Display and Description

General fault, status, and alarm information is indicated by 8 LEDs located on the modem's front panel.

The TX and RX fault LEDs are dual purpose. A lit red LED indicates a fault currently exists in the modem. A lit yellow fault LED indicates an alarm currently exists in the modem.

The Fault LED will turn OFF when the fault and alarm clears.

All faults and alarms are logged in the stored fault memory and are indicated by the yellow Stored Fault LED.

A total of 10 fault or alarm status changes will be stored in the Stored Faults menu. Each fault/alarm or stored fault/alarm indicated by a front panel LED could be one of many faults. Use the Fault or Stored Fault front panel menu to determine which fault or alarm has occurred.

Alarms will not switch the modem offline in a redundant system. Alarms are shown in the Fault or Stored Fault front panel menu by a reversed-contrast "+" that appears at the display panel (white on black).

5.2.5 Fault/Alarm Analysis

This section describes the possible problems and trouble shooting actions for the each of the faults listed in the Fault Tree (Table 5-1).

Note: Have the modem configuration and fault information available when contacting Comtech EF Data Customer Support if on-site troubleshooting efforts fail to determine the problem with the modem.

5.2.5.1 Modulator Faults

Table 5-2. Modulator Fault Information

Fault/Alarm	Possible Problem and Action
MODULE	Modulator section fault. Typically indicates that the modulator will not program. Return the modem for repair.
IF SYNTHESIZER	Modulator IF synthesizer fault. This is considered a major alarm, and will turn off the modulator output. Return the modem for repair.
DATA CLOCK SYN	Transmit data clock synthesizer fault. This is considered a major alarm, and will turn off the modulator output. This fault indicates that the internal clock VCO has not locked to the incoming data clock, or the internal clock synthesizer has not locked to the internal reference. Ensure the proper data rate has been set up and selected, and the incoming data rate matches the modem selections.
I CHANNEL	Activity alarm for the I channel digital filter. This alarm is considered a major alarm, and will turn off the modulator IF output. An alarm in this position indicates either a fault in the scrambler, or if the scrambler is disabled, the alarm indicates a loss of incoming data. If the fault is active with the scrambler turned off, check for input data at the DATA I/O connector. If data is present return the modem for repair.
Q CHANNEL	Activity alarm for the Q channel digital filter. Use the I channel procedure.
AGC LEVEL	Output power AGC level fault. Indicates the level at the modulator output is not the programmed level. Return the modem for repair.

5.2.5.2 Demodulator Faults

Table 5-3. Demodulator Fault Information

Fault/Alarm	Possible Problem and Action
MODULE	Demodulator section fault. Typically indicates that the demodulator will not program. Return the modem for repair.
CARRIER DETECT	Carrier detect fault. Indicates the decoder is not locked. This is the most common fault displayed in the modem. Any problem from the input data on the modulator end of the circuit to the output of the decoder can cause this alarm. First, ensure the demodulator has an IF input at the proper frequency and power level. Ensure the demodulator data rate is properly programmed. Refer to the fault isolation procedure for Data Clock Syn in the modulator section. Verify the frequency of the data transmitted from the modulator is within 100 PPM.
IF SYNTHESIZER	Demodulator IF synthesizer fault. Indicates the demodulator IF synthesizer is faulted. Return the modem for repair.
I CHANNEL	Indicates a loss of activity in the I channel of the quadrature demodulator. Typically indicates a problem in the modulator side of the circuit. Check for proper RF input to the demodulator. If the input to the demodulator is correct, then the problem is in the baseband processing. Return the modem for repair.
Q CHANNEL	Indicates a loss of activity in the Q channel of the quadrature demodulator. Follow the same procedure for the I channel fault.
BER THRESHOLD	Indicates the preset BER threshold has been exceeded. Setting of this alarm is done in the Configuration - Demodulator menu. This is an alarm based on the corrected BER reading on the front panel.

5.2.5.3 Transmit Interface Faults

Table 5-4. Transmit Interface Fault Information

Fault/Alarm	Possible Problem and Action
MODULE	TX Interface section fault. Typically indicates that the TX Interface will not program. Return the modem for repair.
TX DATA/AIS	Data or incoming AIS. UTILITY / INTERFACE / TX DATA FAULT = AIS Will indicate a fault condition if the user data is all 1s. UTILITY / INTERFACE / TX DATA FAULT = DATA Will indicate a fault condition if the user data is all 1s or all 0s. This is referred to as a data-stable condition (data is not transitioning).
TX CLOCK ACT	Activity detector alarm of the selected transmit clock. Indicates the selected TX clock is not being detected. Check the signal of the selected TX clock source.
TX CLOCK PLL	Indicates TX input clock is out of range.
SCT PLL	Internal ST Clock loop fault. Indicates the internal ST clock is not locked to the selected reference. Return the modem for repair.
SCT REFERENCE ACTIVITY	Activity detector alarm at the input of the selected source for SCT Reference. Indicates the selected clock is not being detected. Check the signal of the selected clock.
TX DROP	Indicates that the Drop mux has a fault. D&I only.

5.2.5.4 Receive Interface Faults

Table 5-5. Receive Interface Fault Information

Fault/Alarm	Possible Problem and Action
MODULE	RX Interface section fault. Typically indicates that the RX Interface will not program. Return the modem for repair.
BUFFER CLK PLL	Buffer clock phase-locked loop fault. The buffer synthesizer is the wrong frequency or will not lock. Ensure the selected buffer clock source is at the proper frequency and level.
BUFFER CLK ACT	Activity detector alarm of the selected clock source for the receive buffer. The interface will fall back to the internal clock when this fault is active. Verify that the proper signal is present at the desired clock input.
RX DATA/AIS	Receive Data or AIS alarm UTILITY / INTERFACE / RX DATA FAULT = AIS Will indicate a fault condition if the recovered satellite data is all 1s. UTILITY / INTERFACE / RX DATA FAULT = DATA Will indicate a fault condition if the recovered satellite data is all 1s or all 0s. This is referred to as a data-stable condition (data is not transitioning).
DEMUX LOCK or R-S FEC LOCK	Overhead demux or R-S framing lock fault. Indicates that the overhead framing or the R-S FEC framing is not locked to the recovered frame from the satellite. Verify that the proper overhead frame is configured.
RX 2047 LOCK	RX 2047 lock alarm. Indicates the decoder is not receiving the RX 2047 data test pattern. The alarm probably indicates the transmit data is not set to the proper test pattern. Verify that the proper differential decoder and descramblers are configured.
BUFFER OVERFLOW	Buffer overflow alarm. Buffer overflow is normally a momentary fault. Indicates the receive buffer has overflowed. The data is being clocked out of the buffer slower than what is being clocked into the buffer from the decoder. Verify the system timing.
BUFFER UNDERFLOW	Buffer underflow alarm. Buffer underflow is normally a momentary fault. Indicates the receive buffer has emptied. The data is being clocked out of the buffer faster than what is being clocked into the buffer from the decoder. Verify the system timing.
BUFFER FULL	Buffer full alarm. Indicates the buffer is < 10% or > 90% full.
RX INSERT	Indicates that the Insert demux has a fault. D&I only.
IBS BACKWARD ALARM	IBS Backward Alarm indication.
FRAME BER	Indicates IBS/IDR Frame BER has exceeded 1E-3

5.2.5.5 Common Equipment Faults

Table 5-6. Common Equipment Fault Information

Fault/Alarm	Possible Problem and Action
MODULE	M&C/Interface section summary fault. Typically indicates that the interface module will not program or the M&C has failed. Return the modem for repair.
BATTERY	M&C battery voltage fault. Indicates a low voltage in the memory battery. Check the modem configurations if the modem was just powered because the modem configuration may not have been retained in the memory chip. Let the modem run for 24 hours to see if the alarm clears. Replace the battery (HW/M4T28) if the alarm does not clear. Refer to paragraph 5.2.2.
-12 Vdc SUPPLY	-12 Vdc ± 5% power supply fault. Indicates a high or low voltage condition for the -12 Vdc power supply. Return to modem for repair.
+12 Vdc SUPPLY	+12 Vdc ± 5% power supply fault. Indicates a high or low voltage condition for the +12 Vdc power supply. Return to modem for repair.
+5 Vdc SUPPLY	+5 Vdc ± 5% power supply fault. Indicates a high or low voltage condition for the +5 Vdc power supply. Return to modem for repair.
+3.3 Vdc SUPPLY	+3.3 Vdc ± 5% power supply fault. Indicates a high or low voltage condition for the +3.3 Vdc power supply. Return to modem for repair.
+2.5 Vdc SUPPLY	+2.5 Vdc ± 5% power supply fault. Indicates a high or low voltage condition for the +2.5 Vdc t power supply. Return to modem for repair.
+1.8 Vdc SUPPLY	+1.8 Vdc ± 5% power supply fault. Indicates a high or low voltage condition for the +1.8 Vdc power supply. Return to modem for repair.
TEMPERATURE	Over/Under Temperature Fault. Indicates that the internal temperature of the modem has exceeded +75 degrees C or is below -10 degrees C. Could indicate that the fan is not operating properly. Also assure the proper operating temperature environment for the modem.
Modem Reference PLL	Modem Reference lock fault. The internal modem reference has failed to lock to the selected reference. Return the modem for repair.
Modem Reference Activity	External modem reference activity fault. Indicates the external modem reference signal is not detected at CP3 on the rear panel.

5.3 Modem Performance Verification Tests

However, if more detailed verification is required, Table 5-7 lists common test equipment that is generally used for modem verification. Refer to the test set up in Figure 5-5 for all of the modem verification tests.

Table 5-7. Test Equipment Required

Item Type	Quantity	Description and Usage
Spectrum Analyser	1	HP 8560E Spectrum Analyser, or equivalent
RF frequency counter	1	Up to 200 MHZ capability, with high stability time base
Power Meter	1	Minimum requirement is +10 dBm to -40 dBm
Bit Error Rate Tester	1	Fireberd 6000 Bit Error Rate Tester, or equivalent. Used for BER measurements under various Eb/No conditions **Note**: The BER tester should be equipped with the appropriate Data Interface (RS422, V.35, etc), and the necessary data interface cables.
Noise Test Set	1	NoiseCom or equivalent.
Oscilloscope	1	General-purpose 2-channel oscilloscope with X, Y capability.

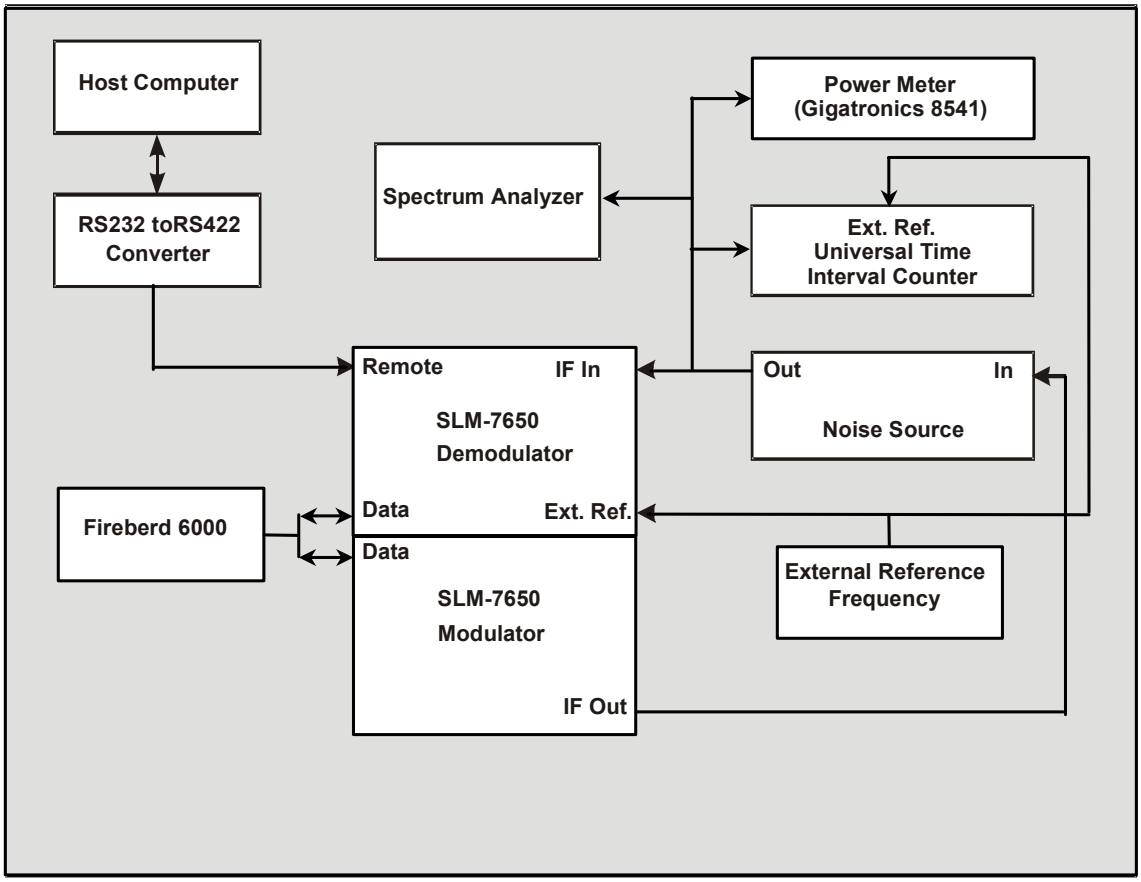

Figure 5-5. Modem Verification Test Setup

5.3.1 Modulator Tests

The tests listed will give reasonable assurance that the modulator section is performing to specification. The test equipment used in these test is listed in Table 5-7.

5.3.1.1 Spectral Shape of the IF Output

1. In the Utility - Modem Type menu, configure the modem for modem type 7650-00.
2. In the Configuration - Modulator menu turn the modulator TX IF Output ON.
3. Connect the modulator output to a Spectrum Analyzer.
4. Set the Spectrum Analyzer to a center frequency of 70MHz, frequency span of 100 KHz, and resolution bandwidth to 3 kHz. Set the reference level to see the modulated spectrum on the spectrum analyzer screen.
5. Verify that the output spectral density mask meets MIL-STD-188-165 Section 5.1.6.4.1 and its associated Figure 4

5.3.1.2 Carrier Null

1. Continue from the previous step and in the Configuration -Modulator menu, set the Carrier Mode to DUAL (Figure 5-6).
2. On the Spectrum Analyzer, verify that the center carrier null is greater than 35 dB.
3. Change the Carrier Mode to OFFSET(Figure 5-7).
4. On the Spectrum Analyzer, verify that the offset carrier null is greater than 30 dB.
5. Set the Carrier Mode to Normal-Modulated.
6. Turn the TX-IF Output ON.

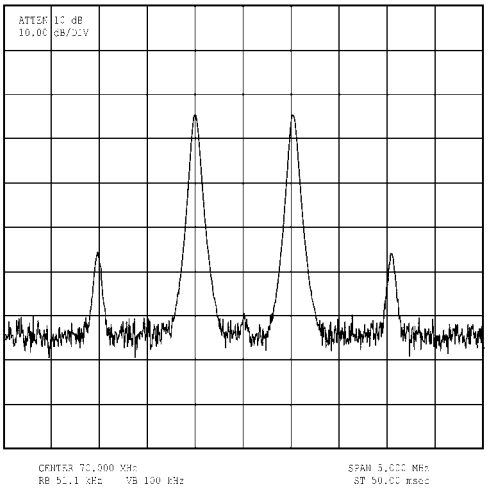

Figure 5-6. DUAL Test Mode

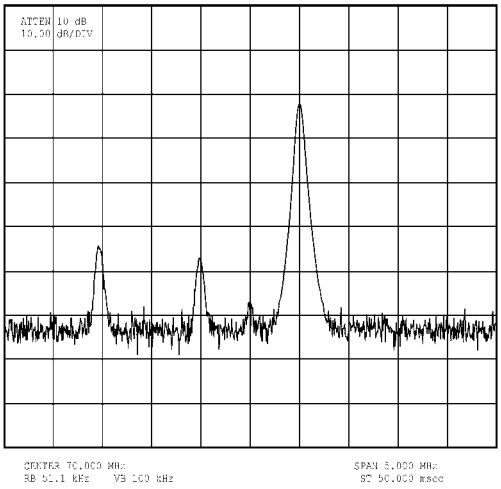

Figure 5-7. OFFSET Test Mode

5.3.1.3 Spurious using a Spectrum Analyzer

1. Continue from the previous step and change the Spectrum Analyzer frequency span to cover the frequency range of 0 to 500 MHz.
2. Verify there are no spurious signals above the specified level.

5.3.1.4 Output Frequency

1. Continue from the previous step and in the Configuration -Modulator menu, set the Carrier Mode to CENTER (Figure 5-8).
2. Connect the IF output to a Frequency Counter that is referenced to the same frequency reference that is connected to the modulator.
3. Verify that the output frequency of the modulator is within the tolerance listed in the specification.
4. Set the Carrier Mode to Normal-Modulated.
5. Turn the TX-IF Output ON.

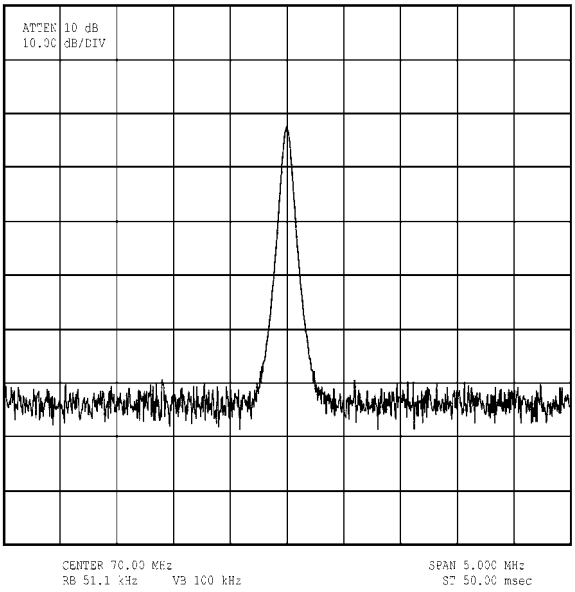

Figure 5-8. CENTER Test Mode

5.3.1.5 Power Level

1. Continue from the previous step and connect the IF output to a Power Meter.
2. In the Configuration -Modulator menu, set the TX Power Level to -10 dBm
3. Verify that the Power Meter indicates an output power between -9.5 and -10.5 dBm.
4. Change the TX Power Level to -25 dBm.
5. Verify that the Power Meter indicates an output power between -24.5 and -25.5 dBm.
6. Change the TX Power Level to +5 dBm.
7. Verify that the Power Meter indicates an output power between +4.5 and +5.5 dBm.

5.3.2 Demodulator Tests

The tests listed will give reasonable assurance that the demodulator section is performing to specification. The test equipment used in these test is listed in Table 5-7. All demodulator tests require connection to a known good modulator that is capable of being configured to the same operating modes as the demodulator under test. These tests can be run without a Noise test set, but the confidence level of the test is reduced.

5.3.2.1 Dynamic Range

1. In the Utility - Modem Type menu, configure the modem for modem type 7650-00.
2. Set the level into the demodulator for -15 dBm and an Eb/No of 5.0 dB.
3. Verify that the demod locks and the Fireberd syncs.
4. Set the level into the demodulator for -55 dBm and an Eb/No of 5.0 dB
5. Verify that the demod locks and the Fireberd syncs.

5.3.2.2 Acquisition Range.

1. Continue from the previous step and set the level into the demodulator for -40 dBm and an Eb/No of 5.0 dB.
2. Verify that the demodulator locks and the Fireberd syncs.
3. In the Monitor menu, observe the frequency the demodulator Sweep Frequency
4. Set the IF frequency of the test modulator 70.025 MHz.
5. Turn on transmit power on the test modulator.
6. Verify that the demodulator locks and the Fireberd syncs.
7. In the Monitor menu, observe the frequency the demodulator Sweep Frequency
8. Set the IF frequency of the test modulator to 69.975 MHz.
9. Turn on transmit power on the test modulator.
10. Verify that the demodulator locks and the Fireberd syncs.
11. In the Monitor menu, observe the frequency the demodulator Sweep Frequency

5.3.3 System BER Test

1. Continue from the previous step but change the modulator and the demodulator data rate to 1544 kbps, 1/2 rate CEVD.
2. Connect the demodulator input to the output of a Noise test set that is connected to the modulator and a BER tester.
3. Verify that the demodulator operates within the specified Eb/No performance.
4. Additional data rates can be done to verify operation over the full data rate range. BER testing can become very time consuming at low data rates.

Note: Accumulation of 20 error events (error seconds) is the generally considered a valid BER test. For Reed-Solomon testing this can become extremely time consuming.

5.3.4 Modem Test Modes

The modem has built in capability to assist the operator in performance verification.

5.3.4.1 IF Loopback

When IF loopback is turned ON (Configuration-Demodulator menu), the demodulator input is internally connected to a sampled output from the modulator. Also the demodulator is programmed to the same IF frequency as the modulator. This test mode is a quick way to verify the operation of the modem without the need to disconnect any cables. When IF loopback is turned off, the demodulator is programmed back to the previous frequency and is reconnected to the IF input.

NOTE: The data rate of the mod and demod must match for IF Loopback to operate properly. The modulator channel is not affected by this test mode and will continue to operate normally.

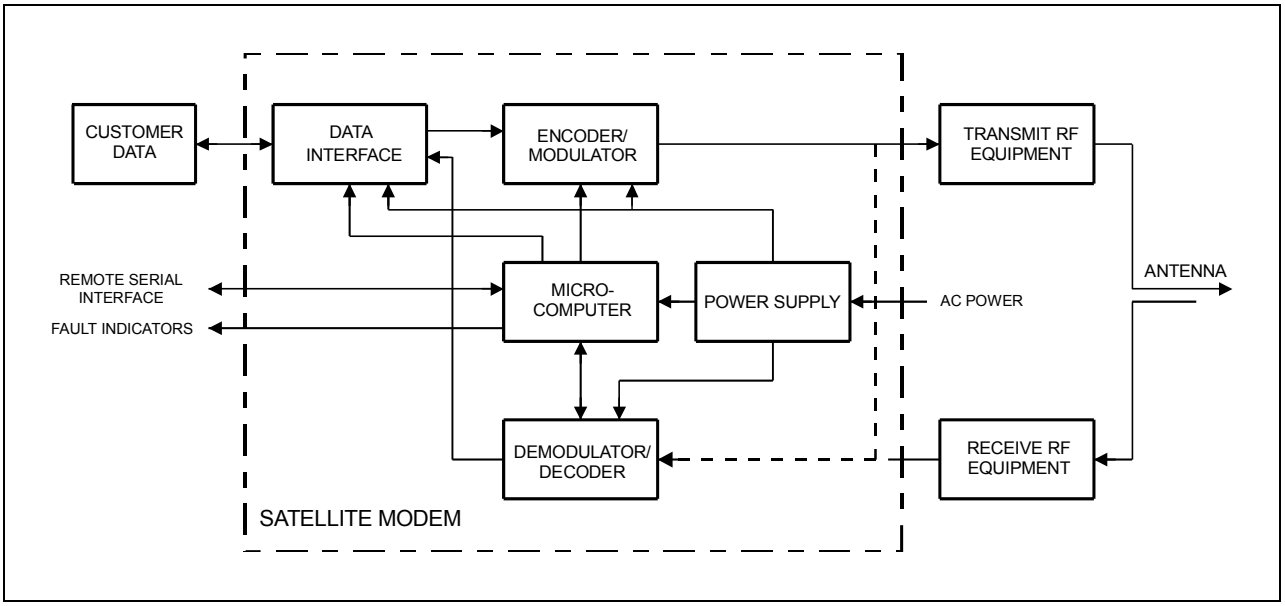

Figure 5-9. IF Loopback

5.3.4.2 Base Band Loopback

When baseband loopback is turned on (Configuration-Interface menu), data is looped back on the customer side of the interface. This is a bi-directional loopback of the baseband data. This test mode will verity the customer equipment and cabling between the modem and the customer equipment.

NOTE: The data rate of the mod and demod must match for IF Loopback to operate properly. Both the modulator and demodulator sections of the modem are affected by activating this test mode.

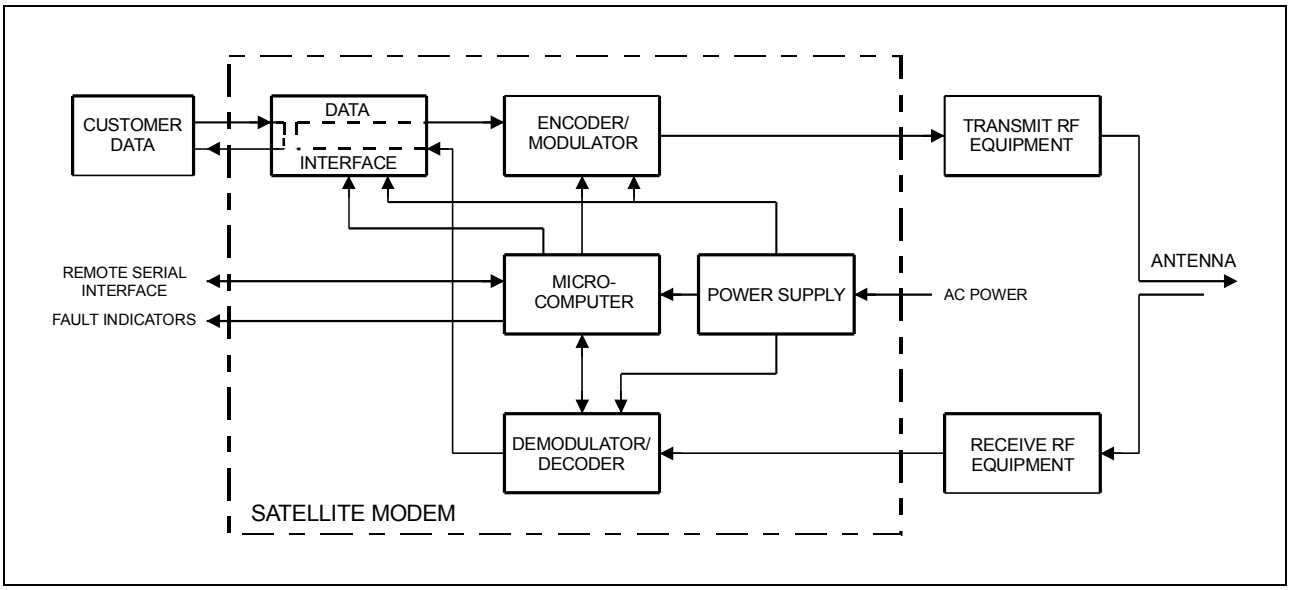

Figure 5-10. Baseband Loopback

5.3.4.3 Carrier Modes

There are three carrier test modes available in the Configuration - Modulator menu. The normal setting is Carrier mode OFF. Exiting any of the carrier test modes will turn the IF Output OFF and the operator will be required to manually turn it back ON.

5.3.4.3.1 Center Carrier Wave

Center Carrier Wave (Figure 5-8) will turn off the modulation on the IF carrier. A center frequency will be transmitted at the output of the modulator. This is useful for checking the frequency accuracy and phase noise of the modulator.

5.3.4.3.2 Offset Carrier Wave

Offset Carrier Wave (Figure 5-7) will present two sine waves, 90 degrees apart to the IF carrier. This will cause the carrier waveform to have a peak at the high end of the IF band-pass and a lower peak to the left of center. The center carrier will be present but at a low level. This test mode is useful for checking the quadrature balance and carrier null. The center carrier should be at or below 35 dBc from the carrier peak.

5.3.4.3.3 Dual Carrier Wave

Dual Carrier Wave (Figure 5-6) will generate a dual side-band suppressed carrier signal. This is useful for checking carrier null and quadrature balance. The two peaks should be at the same output level. The modulator is presented with alternating ones and zeroes.

5.3.4.4 Reed-Solomon Correction OFF

The Reed-Solomon (R-S) decoder data error correction circuitry can be disabled without removing the overhead associated with the R-S FEC. When R-S Correction is set to OFF (Configuration-Demodulator menu) the data flow is then routed through normal data paths without R-S error corrections. Only Viterbi error correction will be active. This test mode will allow a more timely verification of link performance.

5.3.4.5 2047 and MIL-188 Test Patterns

The operator is capable of substituting a test pattern on the transmit side and monitoring on the receive side of the modem. These test pattern can be used as a quick BER performance test to verify that the link performance is operating at a reasonable error rate. The BER performance is read in the Monitor-2047 error menu. If the carrier is not locked, the Monitor menu will display 'No Data'. The normal setting for both the TX 2047 Pattern and the RX 2047 Pattern is NONE.

The '2047' setting is a standard pattern compatible with a Fireberd BERT.

The 'MIL-188' setting is a modified 2047 pattern that is used to test the Data Source Sync function of the modem. It has the maximum number of consecutive zeros that the modem can handle when recovering the clock from the data transitions.

This test mode will affect the transmit side of the modem by switching from the incoming data stream to the internal pattern generator. The receive side of the modem is not affected and is only a monitor of the recovered satellite data steam.

Table 5-8. Conversion to S/N and E_b/N_0 Chart

		BPSK		Q/OQPSK				8PSK		16QAM	
		1/1	1/2	1/1	1/2	3/4	7/8	2/3	5/6	3/4	7/8
(C+N)/N	C/N	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No
3.0	0.0	0.0	3.0	-3.0	0.0	-1.8	-2.5	-3.0	-4.0	-4.8	-5.5
3.5	0.9	0.9	3.9	-2.1	0.9	-0.8	-1.5	-2.1	-3.0	-3.8	-4.5
4.0	1.8	1.8	4.8	-1.2	1.8	0.0	-0.6	-1.2	-2.2	-3.0	-3.6
4.5	2.6	2.6	5.6	-0.4	2.6	0.8	0.2	-0.4	-1.4	-2.2	-2.8
5.0	3.3	3.3	6.4	0.3	3.3	1.6	0.9	0.3	-0.6	-1.4	-2.1
5.5	4.1	4.1	7.1	1.1	4.1	2.3	1.6	1.1	0.1	-0.7	-1.4
6.0	4.7	4.7	7.8	1.7	4.7	3.0	2.3	1.7	0.8	0.0	-0.7
6.5	5.4	5.4	8.4	2.4	5.4	3.6	3.0	2.4	1.4	0.6	0.0
7.0	6.0	6.0	9.0	3.0	6.0	4.3	3.6	3.0	2.1	1.3	0.6
7.5	6.6	6.6	9.7	3.6	6.6	4.9	4.2	3.6	2.7	1.9	1.2
8.0	7.3	7.3	10.3	4.2	7.3	5.5	4.8	4.2	3.3	2.5	1.8
8.5	7.8	7.8	10.8	4.8	7.8	6.1	5.4	4.8	3.9	3.1	2.4
9.0	8.4	8.4	11.4	5.4	8.4	6.7	6.0	5.4	4.4	3.6	3.0
9.5	9.0	9.0	12.0	6.0	9.0	7.2	6.6	6.0	5.0	4.2	3.5
10.0	9.5	9.5	12.6	6.5	9.5	7.8	7.1	6.5	5.6	4.8	4.1
10.5	10.1	10.1	13.1	7.1	10.1	8.3	7.7	7.1	6.1	5.3	4.7
11.0	10.6	10.6	13.7	7.6	10.6	8.9	8.2	7.6	6.7	5.9	5.2
11.5	11.2	11.2	14.2	8.2	11.2	9.4	8.8	8.2	7.2	6.4	5.7
12.0	11.7	11.7	14.7	8.7	11.7	10.0	9.3	8.7	7.7	6.9	6.3
12.5	12.2	12.2	15.3	9.2	12.2	10.5	9.8	9.2	8.3	7.5	6.8
13.0	12.8	12.8	15.8	9.8	12.8	11.0	10.3	9.8	8.8	8.0	7.3
13.5	13.3	13.3	16.3	10.3	13.3	11.5	10.9	10.3	9.3	8.5	7.9
14.0	13.8	13.8	16.8	10.8	13.8	12.1	11.4	10.8	9.8	9.1	8.4
14.5	14.3	14.3	17.4	11.3	14.3	12.6	11.9	11.3	10.4	9.6	8.9
15.0	14.9	14.9	17.9	11.9	14.9	13.1	12.4	11.9	10.9	10.1	9.4
15.5	15.4	15.4	18.4	12.4	15.4	13.6	12.9	12.4	11.4	10.6	9.9
16.0	15.9	15.9	18.9	12.9	15.9	14.1	13.5	12.9	11.9	11.1	10.4
16.5	16.4	16.4	19.4	13.4	16.4	14.6	14.0	13.4	12.4	11.6	11.0
17.0	16.9	16.9	19.9	13.9	16.9	15.2	14.5	13.9	12.9	12.1	11.5
17.5	17.4	17.4	20.4	14.4	17.4	15.7	15.0	14.4	13.4	12.7	12.0
18.0	17.9	17.9	20.9	14.9	17.9	16.2	15.5	14.9	14.0	13.2	12.5
18.5	18.4	18.4	21.4	15.4	18.4	16.7	16.0	15.4	14.5	13.7	13.0
19.0	18.9	18.9	22.0	15.9	18.9	17.2	16.5	15.9	15.0	14.2	13.5
19.5	19.5	19.5	22.5	16.4	19.5	17.7	17.0	16.4	15.5	14.7	14.0
20.0	20.0	20.0	23.0	16.9	20.0	18.2	17.5	16.9	16.0	15.2	14.5

Table 5-9. Reed-Solomon Overhead Correction Factor

Reed-Solomon Overhead effect on Eb/No					
R-S Code	225/205	219/201	204/188	126/112	194/178
Eb/No Adjustment (increase)	0.40	0.37	0.35	0.51	0.37

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Appendix A. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the SLM-7650.

Firmware number:	FW/9875-2B
Software version:	2.1.3

A.1 Disclaimer – Remote Commands

Comtech EF Data reserves the right to make changes in the remote control commands of the product described in this manual at any time without notice and without obligation to notify any person of such changes. If there are any questions regarding your equipment or the information in this manual, please contact the Comtech EF Data Customer Support Department.

NOTE: The firmware referenced in this manual may be an earlier version of the actual firmware supplied with the unit.

A.2 About Remote Commands

This document defines the protocol and command structure for remote control and status monitoring of the SLM7650 Satellite Modem.

Remote controls and status information are transferred via an asynchronous serial communications link.

Commands and data are transferred on the remote control communications link as US ASCII-encoded character strings.

The remote communications link is operated in a half-duplex mode.

A remote controller or terminal initiates communications on the remote link. The modem never transmits data on the link unless it is commanded to do so.

A.3 Message Structure

Messages on the remote link fall into the categories of commands and responses.

Commands are messages that are transmitted to the modem, while responses are messages returned by the modem in response to a command.

The general message structure is as follows:

- Start Character
- Device Address "add"
- Command/Response
- End of Message Character

A.4 Start Character

A single character precedes all messages transmitted on the remote link. This character flags the start of a message. This character is:

- "<" for commands
- ">" for responses

A.5 Device Address

The device address is the address of the one modem which is designated to receive a transmitted command, or which is responding to a command.

Valid device addresses are 1 to 3 characters long, and in the range of 0 to 255. Address 0 is reserved as a global address which simultaneously addresses all devices on a given communications link. Devices do not acknowledge global commands.

Each modem that is connected to a common remote communications link must be assigned its own unique address. Addresses are selectable from the modem front panel user interface, and must be in the range of 1 to 255.

Note: "add" is used to indicate a valid 1 to 3 character device address in the range between 0 to 255.

A.6 Command/Response

The command/response portion of the message contains a variable-length character sequence that conveys command and response data.

If the modem receives a properly formatted message (command), which is addressed to it with valid parameters, the message will be echoed back in the response as defined by the protocol.

If the modem receives a message addressed to it, which does not match the established protocol or cannot be implemented, a negative acknowledgment message is sent in response. This message is:

```
>add/?ER2_invalid parameter'cr''lf']
```

(Error message for a recognized command, which cannot be implemented or has parameters, which are out of range.)

```
>ADD/?ER3_UNRECOGNIZABLE COMMAND'CR''LF']
```

(Error message for unrecognizable command or bad command syntax.)

```
>ADD/?ER4_MODEM IN LOCAL MODE'CR''LF']
```

(Modem in local error; send the REM command to go to remote mode.)

```
>ADD/?ER5_HARD CODED PARAMETER'CR''LF']
```

(Error message indicating that the parameter is hardware dependent and may not be changed remotely.)

A.7 End Character

Each message is ended with a single character, which signals the end of the message:

- "cr" Carriage return character for commands
- "]" End bracket for responses

A.8 Configuration Commands/Responses

A.8.1 Modulator Configuration Commands

Modulator Frequency	Command: Response: Status: Response:	<add/MF_nnn.nnnnnn'cr' >add/MF_nnn.nnnnnn'cr' RF_OFF'cr''lf'] <add/MF_'cr' >add/MF_nnn.nnnnnn'cr''lf']	Where: nnn.nnnnnn = Frequency in MHz, 50.000000 to 90.000000 and 100.000000 to 180.000000 in 1 Hz steps. Note: When the modulator frequency is programmed, the RF output is switched off.
RF Output (IF Output)	Command: Response: Status: Response:	<add/RF_xxx'cr' >add/RF_xxx'cr''lf'] <add/RF_'cr' >add/RF_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator Rate Preset Assignment	Command: Response: Status: Response:	<add/AMRx_nnnnn_mmmmm.mmm'cr' >add/AMRx_nnnnn_mmmmm.mmm'cr''lf'] <add/AMRx_'cr' >add/AMRx_nnnnn_mmmmm.mmm 'cr''lf']	Where: x = A, B, C, D, or V [preset designator]. For CEVD FEC: nnnnn = 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), and OQP78 (OQPSK 7/8), BPSK (BPSK 1/1), QPSK (QPSK 1/1), OQSK (OQPSK 1/1), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8) For TCM FEC: nnnnn = 8P23 (8PSK 2/3), 8P56 (8PSK 5/6) For TPC FEC: nnnnn = B2144 (BPSK 21/44), B516 (BPSK 5/16), 21/44 (QPSK 21/44), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), 17/18 (QPSK 17/18), OQ2144 (OQPSK 21/44), OQ34 (OQPSK 3/4), and OQ78 (OQPSK 7/8), OQ1718 (OQPSK 17/18), 8P34 (8PSK 3/4), 8P78 (8PSK 7/8), 8P1718 (8PSK 17/18), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8). mmmmm.mmm = Data rate in kHz.
Modulator Rate Preset Selection	Command: Response: Status:	<add/SMRx_'cr' >add/SMRx_'cr' RF_OFF'cr''lf'] See MR command.	Where: x = A, B, C, D, or V (preset designator). Note: Setting the modulator rate turns off the RF transmitter.

Modulator Rate Variable Assignment & Selection	Command: Response: Status:	<add/SMRV_nnnnn_mmmmm.mmm'cr' >add/SMRV_nnnnn_mmmmm.mmm'cr' RF_OFF'cr''lf'] See MR command.	Where: mmmmm.mmm = Data rate in kHz. For CEVD FEC: nnnnn = 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), and OQP78 (OQPSK 7/8), BPSK (BPSK 1/1), QPSK (QPSK 1/1), OQSK (OQPSK 1/1), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8) For TCM FEC: nnnnn = 8P23 (8PSK 2/3), 8P56 (8PSK 5/6) For TPC FEC: nnnnn = B2144 (BPSK 21/44), B516 (BPSK 5/16), 21/44 (QPSK 21/44), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), 17/18 (QPSK 17/18), OQ2144 (OQPSK 21/44), OQ34 (OQPSK 3/4), and OQ78 (OQPSK 7/8), OQ1718 (OQPSK 17/18), 8P34 (8PSK 3/4), 8P78 (8PSK 7/8), 8P1718 (8PSK 17/18), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8). Note: Setting the modulator turns off the RF transmitter.
Modulator Type	Command: Response: Status: Response:	<add/MT_xxxx'cr' >add/MT_xxxx'cr''lf'] <add/MT_'cr' >add/MT_xxxx'cr''lf']	Where: xxxx = INTL (INTELSAT OPEN NETWORK) or EFD (EF DATA CLOSED NETWORK). Note: Invalid Parameter Error Response is returned if command is sent while in any modem type other than Custom. Status can always be sent.
Set Modulator Power Offset	Command: Response: Status: Response:	<add/MPO_snn.n'cr' >add/MPO_snn.n'cr''lf'] <add/MPO_'cr' >add/MPO_snn.n'cr''lf']	Where: snn.n = +94.9 to –69.9, in 0.1 dB increments. Note: The modulator power offset is added to the nominal power level to adjust the transmit power range.
Set Modulator Output Power Level	Command: Response: Status: Response:	<add/MOP_snn.n'cr' >add/MOP_snn.n'cr''lf'] <add/MOP_'cr' >add/MOP_snn.n'cr''lf']	Where: snn.n = -30.0 to +5.0, in 0.1 steps (nominal range in dBm). Notes: 2. The nominal power range is modified relative to the value specified by the modulator power offset (MPO_). 2. The MOP_ command will return status only when local AUPC is enabled.
Modulator Scrambler Type	Command: Response: Status: Response	<add/SCRT_xxxx'cr' >add/SCRT_xxxx'cr''lf'] <add/SCRT_'cr' >add/SCRT_xxxx'cr''lf']	Where: xxxx = IESS, OM73, or TURBO.
Scrambler Enable	Command: Response: Status: Response:	<add/SE_xxx'cr' >add/SE_xxx'cr''lf'] <add/SE_'cr' >add/SE_xxx'cr''lf']	Where: xxx = ON or OFF.
Differential Encoder Enable	Command: Response: Status: Response:	<add/DENC_xxx'cr' >add/DENC_xxx'cr''lf'] <add/DENC_'cr' >add/DENC_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator Spectrum Rotation	Command: Response: Status: Response:	<add/MSR_xxx'cr' >add/MSR_xxx'cr''lf'] <add/MSR_'cr' >add/MSR_xxx'cr''lf']	Where: xxx = NRM (normal spectrum) or INV (inverted spectrum).

Reed-	Command:	<add/RSEN_xxx'cr'	Where: xxx = ON or OFF.

Solomon Encoder Enable	Response: Status: Response:	>add/RSEN_xxx'cr' RF_OFF'cr''lf'] <add/RSEN_'cr' >add/RSEN_xxx'cr''lf']	
Transmit BPSK Data Ordering	Command: Response: Status: Response:	<add/TDA_xxx'cr' >add/TDA_xxx'cr''lf'] <add/TDA_'cr' >add/TDA_xxx'cr''lf']	Where: xxx = NRM (STANDARD) or INV (NON-STANDARD).
Carrier Only Mode	Command: Response: Status: Response:	<add/COM_xxxxxx'cr' >add/COM_xxxxxx'cr''lf'] <add/COM_'cr' >add/COM_xxxxxx'cr''lf']	Where: xxxxxx = OFF (NORMAL-MODULATED), DUAL (DUAL-CW), OFFSET (OFFSET-CW), CENTER (CENTER-CW).
TX 8PSK IESS-310 Operation	Command: Response: Status: Response:	<add/T310_xxx'cr' >add/T310_xxx'cr''lf'] <add/T310_'cr' >add/T310_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator Encoder Type	Command: Response: Status: Response:	<add/MET_xxx'cr' >add/MET_xxx'cr''lf'] <add/MET_'cr' >add/MET_xxx'cr''lf']	Where xxx = VIT (Viterbi) or TUR (Turbo).
Modulator Reed-Solomon Codeword	Command: Response: Status: Response:	<add/MRSC_nnn_kkk_i'cr' >add/MRSC_nnn_kkk_i'cr''lf'] <add/MRSC_'cr' >add/MRSC_nnn_kkk_i'cr''lf']	Where nnn_kkk_i = 225_205_8, 225_205_4, 219_201_8, 219_201_4, 194_178_4, or 126_112_4. Note: This command is valid only in modem type "CUSTOM" when overhead type is "NONE" or "ASYNC". Status is available at all times.
Bulk Configur-ation	Command: Response: Status: Response:	<add/BMC_p1,p2, . . . pn'cr' >add/BMC_p1,p2, . . . pn'cr"lf'] <add/BMC_'cr' >add/BMC_p1,p2, . . .pn'cr"lf']	This command causes the modulator to be programmed with supplied parameters. All parameters are separated by a ',' (comma) except for the last parameter which has the standard command termination character ('cr'). Parameters that do not need to be changed can be nulled (no data between comma's).
		Parameter 1:	**Modulator RF output (ref. "RF_" command).** P1 = n, where 'n' is '0' to indicate off or '1' to indicate on..
		Parameter 2:	**Modulator output power level (ref. "MOP_" command).** P2 = snn.n, transmitter output power level in dBm.
		Parameter 3:	**Modulator IF frequency (ref. "MF_" command).** P3 = nnn.nnnnnn, IF frequency in MHz.
		Parameter 4:	**Modulator Rate Variable Assign & Selection (ref. "MR_")** P4 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
		Parameter 5:	**Reed Solomon Encoder Enable (ref. "RSEN_" command).** P5 = n, where 'n' is '0' to indicate off or '1' to indicate on.
		Parameter 6:	**Interface transmit overhead type (ref. "ITOT_" command).** P6 = n, where 'n' is '0' (NONE), '1' (IDR), or '2' (IBS), '3' (DI), '4' (ASYNC), '5' (IBS309), '6' (VSAT-IBS).
		Parameter 7:	**Modulator type (ref. "MT_" command).** P7 = n, where 'n' is '0' or '1'(0=EFD,1=INTL)
		Parameter 8:	**Scrambler enable (ref. "SE_" command).** P8 = n, where 'n' is '0' to indicate off or '1' to indicate on.
		Parameter 9:	**Differential encoder enable (ref. "DENC_" command).** P9 = n, where 'n' is '0' to indicate off or '1' to indicate on.

		Parameter 10:	**Modulator Spectrum Rotation (ref. "MSR_" command).** P10 = n, where 'n' is '0', '1' (0 = NRM, 1 = INV).
		Parameter 11:	**TX IESS-310 Operation (ref. "T310_" command).** P11 = n, where ,n, is '0' or '1' (0 = OFF, 1 = ON).
		Parameter 12:	**Transmit clock source (ref. "TC_" command).** P12 = n, where 'n' is (0= INT,2=EXT,6=DATA).
		Parameter 13:	**Transmit clock phase (ref. "TCP_" command).** P13 = n, where 'n' is '0', '1', '2' (0 = NRM, 1 = INV, 2 = AUTO).
		Parameter 14:	**Transmit data phase (ref. "TDP_" command).** P14 = n, where 'n' is '0', '1' (0 = NRM, 1 = INV).
		Parameter 15:	**Transmit BPSK Data Ordering (ref. "TDA_" command).** P15 = n, where 'n' is '0', '1' (0 = NRM, 1 = INV).
		Parameter 16:	**Carrier Only Mode (ref. "COM_" command).** P16 = n, where 'n' is '0' (OFF),'1'(CENTER-CW), '2' (DUAL-CW), or '3' (OFFSET-CW).
		Parameter 17:	**RTS TX-IF Control Mode (ref. "RTSM_" command).** P17 = n, where ,n, is '0' or '1' (0 = OFF, 1 = ON).
		Parameter 18:	**Interface substitution pattern (ref. "ISP_" command).** P18 = n, where 'n' is '0' to '2' (0=OFF,1=2047/ON,2=MIL188).
		Parameter 19:	**Transmit data fault (ref. "TDF_" command).** P19 = n, where 'n' is '0', '1' to '2' (0=NONE,1=DATA,2=AIS).
		Parameter 20:	**Modulator Power Offset (ref. "MPO_" command).** P20 = snn.n, transmitter output power offset in dBm.
		Parameter 21:	**Scrambler Type (ref. "SCRT_" command).** P21 = n where n = '0' (IESS), '1' (OM73), or '2' (TURBO).
		Parameter 22:	**SCT PLL Reference (ref. "MSPR_" command).** P22 = n, where 'n' is '0' or '1' (0=MR, 1=ERF)
		Parameter 23:	**ASYNC TX Baud Rate (ref. "TOBR_" command).** P23 = n, where: 'n' is '0' = 110 baud, '1' = 150 baud, '2' = 300 baud, '3' = 600 baud, '4' = 1200 baud, '5' = 2400 baud, '6' = 4800 baud, '7' = 9600 baud, '8' = 19200 baud, '9' = 38400 baud
		Parameter 24:	**ASYNC TX Character Length (ref. "TCCL_" command).** P24 = n, where: 'n' is '7' or '8' bits.
		Parameter 25:	**ASYNC TX Stop Bits (ref. "TCSB_" command).** P25 = n, where: 'n' is '1' or '2' bits.
		Parameter 26:	**ASYNC TX Parity (ref. "TOCP_" command).** P26 = n, where: 'n' is '0' = NONE, '1' = EVEN, '2' = ODD
		Parameter 27:	**Reserved.**
		Parameter 28:	**Mod RS Codeword (ref. "MRSC_" command).** P28 = n, where: 'n' is '0' = RS(225,205,10) depth 8, '1' = RS(225,205,10) depth 4, '2' = RS(219,201,9) depth 8, '3' = RS(219,201,9) depth 4, '4' = RS(194,178,8) depth 4, '5' = RS(126,112,7) depth 4
		Parameter 29:	**Interface Coding Format Transmit (ref. "ICFT_" command).** P29 = n, where 'n' is '0' (AMI), '1' (B6ZS), '2' (B8ZS), or '3' (HDB3).

		Parameter 30:	**Interface Service Channel Level TX1 (ref. "ISCL_TX1_" command).** P30 = snn.n, where 'snn.n' is -6.0 to +8.0 in steps of 2 dB.
		Parameter 31:	**Interface Service Channel Level TX2 (ref. "ISCL_TX2_" command).** P31 = snn.n, where 'snn.n' is -6.0 to +8.0 in steps of 2 dB.
		Parameter 32:	**Drop Data Format (ref. "DDF_" command).** P32 = n, where 'n' is '0' (T1), '1' (T1ESF), '2' (E1CCS), or '3' (E1CAS).
		Parameter 33:	**Bulk Drop Channel Assignment (ref. "BDCA_" command).** P33 = dd;cc_dd;cc_dd;cc_dd;cc…, as defined by the 'BDCA_' command.
		Parameter 34:	**IDR Backward Alarm TX1 (ref. "BW_TX1_" command).** P34 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 35:	**IDR Backward Alarm TX2 (ref. "BW_TX2_" command).** P35 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 36:	**IDR Backward Alarm TX3 (ref. "BW_TX3_" command).** P36 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 37:	**IDR Backward Alarm TX4 (ref. "BW_TX4_" command).** P37 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 38:	**IDR Transmit ESC Type (ref. "TET_" command).** P38 = 0, where 'n' is '0' (2x32Kbit/s Audio) or '1' (64Kbit/s Data).

A.9 Demodulator Configuration

Set Demodulator Frequency	Command: Response: Status: Response:	<add/DF_nnn.nnnnnn'cr' >add/DF_nnn.nnnnnn'cr''lf'] <add/DF_'cr' >add/DF_nnn.nnnnnn'cr''lf']	Where: nnn.nnnnnn = Frequency in MHz, 50.000000 to 90.000000 and 100.000000 to 180.000000 in 1 Hz steps.
Demodulator Rate Preset Assignment	Command: Response: Status: Response:	<add/ADRx_nnnnn_mmmmm.mmm'cr' >add/ADRx_nnnnn_mmmmm.mmm 'cr''lf'] <add/ADRx_'cr' >add/ADRx_nnnnn_mmmmm.mmm 'cr''lf']	Where: x = A, B, C, D, or V [preset designator]. For CEVD FEC: nnnnn = 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), and OQP78 (OQPSK 7/8), BPSK (BPSK 1/1), QPSK (QPSK 1/1), OQSK (OQPSK 1/1), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8) For TCM FEC: nnnnn = 8P23 (8PSK 2/3), 8P56 (8PSK 5/6) For TPC FEC: nnnnn = B2144 (BPSK 21/44), B516 (BPSK 5/16), 21/44 (QPSK 21/44), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), 17/18 (QPSK 17/18), OQ2144 (OQPSK 21/44), OQ34 (OQPSK 3/4), and OQ78 (OQPSK 7/8), OQ1718 (OQPSK 17/18), 8P34 (8PSK 3/4), 8P78 (8PSK 7/8), 8P1718 (8PSK 17/18), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8). mmmmm.mmm = Data rate in kHz.
Demodulator Rate Preset Selection	Command: Response: Status:	<add/SDRx_'cr' >add/SDRx_'cr''lf'] See DR command.	Where: x = A, B, C, D, or V (preset designator).
Demodulator Rate Variable Assignment & Selection	Command: Response: Status:	<add/SDRV_nnnnn_mmmmm.mmm'cr' >add/SDRV_nnnnn_mmmmm.mmm 'cr''lf'] See DR command.	Where: For CEVD FEC: nnnnn = 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), and OQP78 (OQPSK 7/8), BPSK (BPSK 1/1), QPSK (QPSK 1/1), OQSK (OQPSK 1/1), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8) For TCM FEC: nnnnn = 8P23 (8PSK 2/3), 8P56 (8PSK 5/6) For TPC FEC: nnnnn = B2144 (BPSK 21/44), B516 (BPSK 5/16), 21/44 (QPSK 21/44), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), 17/18 (QPSK 17/18), OQ2144 (OQPSK 21/44), OQ34 (OQPSK 3/4), and OQ78 (OQPSK 7/8), OQ1718 (OQPSK 17/18), 8P34 (8PSK 3/4), 8P78 (8PSK 7/8), 8P1718 (8PSK 17/18), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8). mmmmm.mmm = Data rate in kHz

Demodulator Scrambler Type	Command: Response: Status: Response	<add/DCRT_xxxx'cr' >add/DCRT_xxxx'cr''lf'] <add/DCRT_'cr' >add/DCRT_xxxx'cr''lf']	Where: xxxx = IESS, OM73, or TURBO.
Descrambler Enable	Command: Response: Status: Response:	<add/DE_xxx'cr' >add/DE_xxx'cr"lf'] <add/DE_'cr' >add/DE_xxx'cr"lf']	Where: xxx = ON or OFF.
Differential Decoder Enable	Command: Response: Status: Response:	<add/DDEC_xxx'cr' >add/DDEC_xxx'cr"lf'] <add/DDEC_'cr' >add/DDEC_xxx'cr"lf']	Where: xxx = ON or OFF.
IF Loopback	Command: Response: Status: Response:	<add/IFL_xxx'cr' >add/IFL_xxx'cr"lf'] <add/IFL_'cr' >add/IFL_xxx'cr"lf']	Where: xxx = ON or OFF.
Sweep Center Frequency	Command: Response: Status: Response:	<add/SCF_snnnnn'cr' >add/SCF_snnnnn'cr"lf'] <add/SCF_'cr' >add/SCF_snnnnn'cr"lf']	Where: snnnnn = -35000 to +35000, in 1 Hz steps.
Sweep Width Range	Command: Response: Status: Response:	<add/SWR_nnnnn'cr' >add/SWR_nnnnn'cr"lf'] <add/SWR_'cr' >add/SWR_nnnnn'cr"lf']	Where: nnnnn = 0 to 70000, in 1 Hz steps.
Sweep Reacquisition	Command: Response: Status: Response:	<add/SR_xxx'cr' >add/SR_xxx'cr"lf'] <add/SR_'cr' >add/SR_xxx'cr"lf']	Where: xxx = 0 to 999 (number of seconds).
Bit Error Rate Threshold	Command: Response: Status: Response:	<add/BERT_xxxx'cr' >add/BERT_xxxx'cr"lf'] <add/BERT_'cr' >add/BERT_xxxx'cr"lf']	Where: xxxx = NONE, or 1E-n, where n = 3, 4, 5, 6, 7, or 8 (exponent of threshold).
Demodulator Type	Command: Response: Status: Response:	<add/DT_xxxx'cr' >add/DT_xxxx'cr"lf'] <add/DT_xxxx'cr' >add/DT_xxxx'cr"lf']	Where: xxxx = INTL (INTELSAT OPEN NETWORK) or EFD (EF DATA CLOSED NETWORK). Note: Invalid Parameter Error Response is returned if command is sent while in any modem type other than Custom. Status can always be sent.
Demodulator Decoder Type	Command: Response: Status: Response:	<add/DDT_xxx'cr' >add/DDT_xxx'cr"lf'] <add/DDT_xxx'cr' >add/DDT_xxx'cr"lf']	Where: xxx = VIT (Viterbi) or TUR (Turbo).

Demodulator Spectrum Rotation	Command: Response: Status: Response:	<add/DSR_xxx'cr' >add/DSR_xxx'cr"lf'] <add/DSR_'cr' >add/DSR_xxx'cr"lf']	Where: xxx = NRM (normal spectrum) or INV (inverted spectrum).
Reed-Solomon Decoder Enable	Command: Response: Status: Response:	<add/RSDE_xxx'cr' >add/RSDE_xxx'cr'lf'] <add/RSDE_'cr' >add/RSDE_xxx'cr'lf']	Where: xxx = ON, OFF, or CORR_OFF.
Receive BPSK Data Ordering	Command: Response: Status: Response:	<add/RDA_xxx'cr' >add/RDA_xxx'cr"lf'] <add/RDA_xxx'cr' >add/RDA_xxx'cr"lf']	Where: xxx = NRM (STANDARD) or INV (NON-STANDARD).
RX 8PSK IESS-310 Operation	Command: Response: Status: Response:	<add/R310_xxx'cr' >add/R310_xxx'cr"lf'] <add/R310_'cr' >add/R310_xxx'cr"lf']	Where: xxx = ON or OFF.
Demodulator Reed-Solomon Codeword	Command: Response: Status: Response:	<add/DRSC_nnn_kkk_i'cr' >add/DRSC_nnn_kkk_i'cr''lf'] <add/DRSC_'cr' >add/DRSC_nnn_kkk_i'cr''lf']	Where nnn_kkk_i = 225_205_8, 225_205_4, 219_201_8, 219_201_4, 194_178_4, or 126_112_4. Note: This command is valid only in modem type "CUSTOM" when overhead type is "NONE" or "ASYNC". Status is available at all times.
Bulk Configuration	Command: Response: Status: Response:	<add/BDC_p1,p2, . . . pn'cr' >add/BDC_p1,p2, . . . pn'cr"lf'] <add/BDC_'cr' >add/BDC_p1,p2, . . .pn'cr"lf']	This command causes the modulator to be programmed with supplied parameters. All parameters are separated by a ',' (comma) except for the last parameter which has the standard command termination character ('cr'). Parameters that do not need to be changed can be nulled (no data between comma's).
		Parameter 1:	**Sweep Width Range (ref. "SWR_" command).** P1 = nnnnn, where 'nnnnn' is the sweep range in Hz.
		Parameter 2:	**Bit Error Rate Threshold (ref. "BERT_" command).** P2 = n, where 'n' = '0' for NONE or '3' to '8'.
		Parameter 3:	**Demodulator IF frequency (ref. "DF_" command).** P3 = nnn.nnnnnn, IF frequency in MHz.
		Parameter 4:	**Demodulator Rate Variable Assign & Select (ref. "DR_"** P4 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
		Parameter 5:	**Reed Solomon Decoder Enable (ref. "RSDE_" command).** P5 = n, where 'n' is '0' (OFF), '1'(ON), or '2' (CORR_OFF).
		Parameter 6:	**Interface receive overhead type (ref. "IROT_" command).** P6 = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), '4' (ASYNC), '5'(IBS309), '6' (VSAT-IBS)
		Parameter 7:	**Demodulator type (ref. "DT_" command).** P7 = n, where 'n' is '0' or '1'(0=EFD,1=INTL)
		Parameter 8:	**Descrambler enable (ref. "DE_" command).** P8 = n, where 'n' is '0' to indicate off or '1' to indicate on.
		Parameter 9:	**Differential decoder enable (ref. "DDEC_" command).** P9 = n, where 'n' is '0' to indicate off or '1' to indicate on**.**
		Parameter 10:	**Demodulator Spectrum Rotation (ref. "DSR_" command).** P10 = n, where 'n' is '0', '1' (0 = NRM, 1 = INV).
		Parameter 11:	**RX IESS-310 Operation (ref. "R310_" command).** P11 = n, where ,n, is '0' or '1' (0 = OFF, 1 = ON).
		Parameter 12:	**Buffer Clock Source (ref. "BC_" command).** P12 = n, where: '0' = internal clock, '1' External Ref, '2' = TX Terrestrial, '3' = RX satellite clock, or '5' (INS).

		Parameter 13:	**Receive clock phase (ref. "RCP_" command).** P13 = n, where 'n' is '0' or '1' (0 = NRM or 1 = INV).
		Parameter 14:	**Receive data phase (ref. "RDP_" command).** P14 = n, where 'n' is '0', '1' (0 = NRM, 1 = INV).
		Parameter 15:	**Receive BPSK Data Ordering (ref. "RDA_" command).** P15 = n, where 'n' is '0', '1' (0 = NRM, 1 = INV).
		Parameter 16:	**Buffer Programming Mode** P16 = n, where 'n' is '0', '1' (0 = BITS, 1 = MILLISECONDS)
		Parameter 17:	**Buffer Size (ref. "IBS_" command).** P17 = nnnnnn, where 'nnnnnn' = 32 to 1048576 bits (p16=0) = 1 to 48 ms (p16=1)
		Parameter 18:	**Sweep Reacquisition (ref. "SR_" command).** P18 = nnn, where: 'nnn' = 0 to 999 seconds.
		Parameter 19:	**Interface Read Error Select (ref. "IRE_" command).** P19 = n, where 'n' is '0' to '2' (0=OFF,1=2047/ON,2=MIL188).
		Parameter 20:	**Receive data fault (ref. "RDF_" command).** P20 = n, where 'n' is '0', '1' to '2' (0=NONE,1=DATA,2=AIS).
		Parameter 21:	**Descrambler Type (ref. "DCRT_" command).** P21 = n where n = '0' (IESS), '1' (OM73), or '2' (TURBO).
		Parameter 22:	**Sweep Center Frequency (ref. "SCF_" command).** P22 = snnnnn, where: snnnnn is the sweep center frequency in Hz.
		Parameter 23:	**IF Loopback (ref. "IFL_" command).** P23 = n, where: 'n' is '0' to indicate off or '1' to indicate on.
		Parameter 24:	**ASYNC RX Baud Rate (ref. "ROBR_" command).** P24 = n, where: 'n' is '0' = 110 baud, '1' = 150 baud, '2' = 300 baud, '3' = 600 baud, '4' = 1200 baud, '5' = 2400 baud, '6' = 4800 baud, '7' = 9600 baud, '8' = 19200 baud, '9' = 38400 baud
		Parameter 25:	**ASYNC RX Character Length (ref. "RCCL_" command).** P25 = n, where: 'n' is '7' or '8' bits.
		Parameter 26:	**ASYNC RX Stop Bits (ref. "RCSB_" command).** P26 = n, where: 'n' is '1' or '2' bits.
		Parameter 27:	**ASYNC RX Parity (ref. "ROCP_" command).** P27 = n, where: 'n' is '0' = NONE, '1' = EVEN, '2' = ODD
		Parameter 28:	**Reserved.**
		Parameter 29:	**T1 Frame Structure (ref. "IRFS_" command).** P29 = n, where: 'n' is '0' = NONE or '1' = G.704
		Parameter 30:	**E1 Frame Structure (ref. "IRFS_" command).** P30 = n, where: 'n' is '0' = NONE or '1' = G.704
		Parameter 31:	**T2 Frame Structure (ref. "IRFS_" command).** P31 = n, where: 'n' is '0' = NONE, '1' = G.704, '3' = G.743, '5' = G.747
		Parameter 32:	**E2 Frame Structure (ref. "IRFS_" command).** P32 = n, where: 'n' is '0' = NONE, '1' = G.704, '2' = G.742, '4' = G.745

		Parameter 33:	**Demod RS Codeword (ref. "DRSC_" command).** P33 = n, where: 'n' is '0' = RS(225,205,10) depth 8, '1' = RS(225,205,10) depth 4, '2' = RS(219,201,9) depth 8, '3' = RS(219,201,9) depth 4, '4' = RS(194,178,8) depth 4, '5' = RS(126,112,7) depth 4
		Parameter 34:	**Interface Coding Format Receive (ref. "ICFR_" command).** P34 = n, where 'n' is '0' (AMI), '1' (B6ZS), '2' (B8ZS), or '3' (HDB3).
		Parameter 35:	**Interface Service Channel Level RX1 (ref. "ISCL_RX1_" command).** P35 = snn.n, where 'snn.n' is -6.0 to +8.0 in steps of 2 dB.
		Parameter 36:	**Interface Service Channel Level RX2 (ref. "ISCL_RX2_" command).** P36 = snn.n, where 'snn.n' is -6.0 to +8.0 in steps of 2 dB.
		Parameter 37:	**Insert Data Format (ref. "IDF_" command).** P37 = n, where 'n' is '0' (T1), '1' (T1ESF), '2' (E1CCS), or '3' (E1CAS).
		Parameter 38:	**Bulk Insert Channel Assignment (ref. "BICA_" command).** P38 = dd;cc_dd;cc_dd;cc_dd;cc…, as defined by the 'BICA_' command.
		Parameter 39:	**IDR Backward Alarm RX1 (ref. "BW_RX1_" command).** P39 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 40:	**IDR Backward Alarm RX2 (ref. "BW_RX2_" command).** P40 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 41:	**IDR Backward Alarm RX3 (ref. "BW_RX3_" command).** P41 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 42:	**IDR Backward Alarm RX4 (ref. "BW_RX4_" command).** P42 = n, where 'n' is '0' (OFF) or '1' (ON).
		Parameter 43:	**IDR Receive ESC Type (ref. "RET_" command).** P43 = 0, where 'n' is '0' (2x32Kbit/s Audio) or '1' (64Kbit/s Data).

A.10 Interface Configuration Commands

Interface Transmit Overhead Type	Command: Response: Status: Response:	<add/ITOT_xxxxx'cr' >add/ITOT_xxxxx'cr' RF_OFF 'cr''lf'] <add/ITOT_'cr' >add/ITOT_xxxxx'cr''lf']	Where: xxxxx = NONE, IDR, IBS, DI, ASYNC, IBS-309, or VSAT-IBS
Interface Receive Overhead Type	Command: Response: Status: Response:	<add/IROT_xxxxx'cr' >add/IROT_xxxxx'cr''lf'] <add/IROT_'cr' >add/IROT_xxxxx'cr''lf']	Where: xxxxx = NONE, IDR, IBS, DI, ASYNC, IBS-309, or VSAT-IBS
Transmit Clock	Command: Response: Status: Response:	<add/TC_xxxx'cr' >add/TC_xxxx'cr''lf'] <add/TC_'cr' >add/TC_xxxx'cr''lf']	Where: xxxx = INT (internal SCT clock), EXT (external TX terrestrial clock) or DATA (data clock sync).
SCT PLL Reference	Command: Response: Status: Response:	<add/MSPR_xxx'cr' >add/MSPR_xxx'cr''lf'] <add/MSPR_'cr' >add/MSPR_xxx'cr''lf']	Where: XXX = MR (modem reference), ERF (external clock, "MC/EXC") Default is MR. When transmit clock source is selected as "DATA" the ST Reference Clock Source defaults to "DATA" no matter what MSPR_ parameter is selected. See TC_ command.
External Clock-Reference Frequency	Command: Response: Status: Response:	<add/ERF_nnnnn.n'cr' >add/ERF_nnnnn.n'cr''lf'] <add/ERF_'cr' >add/ERF_nnnnn.n'cr''lf']	Where: nnnnn.n = 9.6 to 20000.0 (external clock frequency in kHz). *Note: Specifies the frequency of External Master Clock input.
Transmit Clock Phase	Command: Response: Status: Response:	<add/TCP_xxx'cr' >add/TCP_xxx'cr''lf'] <add/TCP_'cr' >add/TCP_xxx'cr''lf']	Where: xxx = NRM (normal clock phasing) or INV (inverted clock phasing).
Buffer Clock	Command: Response: Status: Response:	<add/BC_xxx'cr' >add/BC_xxx'cr''lf'] <add/BC_'cr' >add/BC_xxx'cr''lf']	Where: xxx = INT (internal clock), EXT (external TX terrestrial clock), SAT (receive satellite clock), REF (external clock-reference frequency), or INS (insert clock).
Receive Clock Phase	Command: Response: Status: Response:	<add/RCP_xxx'cr' >add/RCP_xxx'cr''lf'] <add/RCP_'cr' >add/RCP_xxx'cr''lf']	Where: xxx = NRM (normal clock phasing) or INV (inverted clock phasing).
Baseband Loopback	Command: Response: Status: Response:	<add/BBL_xxx'cr' >add/BBL_xxx'cr''lf'] <add/BBL_'cr' >add/BBL_xxx'cr''lf']	Where: xxx = ON or OFF.

Interface Loop Timing	Command: Response: Status: Response:	<add/ILT_xxx'cr' >add/ILT_xxx'cr"lf'] <add/ILT_'cr' >add/ILT_xxx'cr"lf']	Where: xxx = ON or OFF.
Interface Buffer Size			Buffer size programming is supported in two formats; bits, or milli-seconds. The selected format must be chosen using the buffer programming command (IBP_). If the buffer is to be programmed in milli-seconds and plesiochronous slips are required use the receive framing structure command (IRFS_) to define the proper framing format.
Interface Buffer Size (Bit Format)	Command: Response: Status: Response:	<add/IBS_nnnnnnn'cr' >add/IBS_nnnnnnn'cr"lf'] <add/IBS_'cr' >add/IBS_nnnnnnn'cr"lf']	Where: nnnnnnn = 32 to 1048576, in 16 bit increments.
Interface Buffer Size (Milli-second Format)	Command: Response: Status: Response:	<add/IBS_nn'cr' >add/IBS_nn'cr"lf'] <add/IBS_'cr' >add/IBS_nn'cr"lf']	Where: nn = 0 to 48 milli-seconds in 1 milli-second increments (buffer size in milli-seconds). The maximum buffer size, in milli-seconds, is data rate dependant. Maximum buffer size cannot exceed 48 milli-seconds or 1048576/(Data Rate) seconds, whichever is lower.
Interface Buffer Center	Command: Response:	<add/IBC_'cr' >add/IBC_'cr"lf']	Centers the buffer.
Interface Buffer Programming	Command: Response: Status: Response:	<add/IBP_xxxx'cr' >add/IBP_xxxx'cr"lf'] <add/IBP_'cr' >add/IBP_xxxx'cr"lf']	Where: xxxx = BITS or MS (milli-seconds).
Interface Receive Framing Structure	Command: Response: Status: Response:	<add/IRFS_ff_ssss'cr' >add/IRFS_ff_ssss'cr"lf'] <add/IRFS_ff'cr' >add/IRFS_ff_ssss'cr"lf']	Where: ff = T1, T2, E1, or E2 (frame type). ssss = NONE, G704, G742, G743, G745, or G747 (framing structure). Notes:1. Valid T1 frame structures are NONE, and G704. 2. Valid T2 frame structures are NONE, G704, G743, and G747. 3. Valid E1 frame structures are NONE, and G704 4. Valid E2 frame structures are NONE, G704, G742, and G745.
Interface Substitute Pattern	Command: Response: Status: Response:	<add/ISP_xxxxxx'cr' >add/ISP_xxxxxx'cr"lf'] <add/ISP_'cr' >add/ISP_xxxxxx'cr"lf']	Where: xxxxxx = 2047, MIL188 or OFF. Note: Transmit 2047 or MIL188 Pattern.
Interface Read Error Select	Command: Response: Status: Response:	<add/IRE_xxxxxx'cr' >add/IRE_xxxxxx'cr"lf'] <add/IRE_'cr' >add/IRE_xxxxxx'cr"lf']	Where: xxxxxx = 2047, MIL188 or OFF. Note: Receive 2047 or MIL188 Pattern.

Transmit Data Fault	Command: Response: Status: Response:	<add/TDF_xxxx'cr' >add/TDF_xxxx'cr"lf'] <add/TDF_'cr' >add/TDF_xxxx'cr"lf']	Where: xxxx = NONE, DATA, or AIS.
Receive Data Fault	Command: Response: Status: Response:	<add/RDF_xxxx'cr' >add/RDF_xxxx'cr"lf'] <add/RDF_'cr' >add/RDF_xxxx'cr"lf']	Where: xxxx = NONE, DATA, or AIS.
Transmit Data Phase	Command: Response: Status: Response:	<add/TDP_xxx'cr' >add/TDP_xxx'cr"lf'] <add/TDP_'cr' >add/TDP_xxx'cr"lf']	Where: xxxx = NRM (normal data phasing) or INV (inverted data phasing).
Receive Data Phase	Command: Response: Status: Response:	<add/RDP_xxx'cr' >add/RDP_xxx'cr"lf'] <add/RDP_'cr' >add/RDP_xxx'cr"lf']	Where: xxx = NRM (normal data phasing) or INV (inverted data phasing).
RTS TX-IF Control Mode	Command: Response: Status: Response:	<add/RTSM_xxx'cr' >add/RTSM_xxx'cr"lf'] <add/RTSM_'cr' >add/RTSM_xxx'cr"lf']	Where: xxx = ON or OFF. This command configures the modem for the RTS TX-IF control mode. If 'ON' is selected, the TX-IF output will only be turned on if the incoming RTS signal is asserted (also the TX-IF output has to be programmed ON and no major modulator faults are present). If 'OFF' is selected, the TX-IF output will operate normal ignoring the RTS signal.
Interface Coding Format Transmit	Command: Response: Status: Response:	<add/ICFT_xxxx'cr' >add/ICFT_xxxx'cr"lf'] <add/ICFT_'cr' >add/ICFT_xxxx'cr"lf']	Where: xxxx = AMI, HDB3, B6ZS, or B8ZS.
Interface Coding Format Receive	Command: Response: Status: Response:	<add/ICFR_xxxx'cr' >add/ICFR_xxxx'cr"lf'] <add/ICFR_'cr' >add/ICFR_xxxx'cr"lf']	Where: xxxx = AMI, HDB3, B6ZS, or B8ZS.
Interface Service Channel Level	Command: Response: Status: Response:	<add/ISCL_xxx_nnn'cr' >add/ISCL_xxx_nnn'cr"lf'] <add/ISCL_xxx'cr' >add/ISCL_xxx_nnn'cr"lf']	Where: xxx = TX1, TX2, RX1, or RX2 (service channel designator). nnn = -6 to +8, in steps of 2 (service channel level in dB).
Drop Data Format	Command: Response: Status: Response:	<add/DDF_xxxxx'cr' >add/DDF_xxxxx'cr"lf'] <add/DDF_'cr' >add/DDF_xxxxx'cr"lf']	Where: xxxxx = T1, T1ESF, E1CCS, or E1CAS.
Insert Data Format	Command: Response: Status: Response:	<add/IDF_xxxxx'cr' >add/IDF_xxxxx'cr"lf'] <add/IDF_'cr' >add/IDF_xxxxx'cr"lf']	Where: xxxxx = T1, T1ESF, E1CCS, or E1CAS.

DDO/IDI Loopback	Command: Response: Status: Response:	<add/DIL_xxx'cr' >add/DIL_xxx'cr''lf'] <add/DIL_'cr' >add/DIL_xxx'cr''lf']	Where: xxx = ON or OFF.
Drop Channels Assignment	Command: Response: Status: Response:	<add/DCA_dd;cc'cr' >add/DCA_dd;cc'cr''lf'] <add/DCA_dd'cr' >add/DCA_dd;cc'cr''lf']	Where: dd = 1 to n (over the satellite drop channel), where n = modulator data rate divided by 64 kbit/s. cc = 1 to 24 (terrestrial channel number for T1 data formats). cc = 1 to 31 (terrestrial channel number for E1 data formats). Notes: 1. This command is not valid when the drop data format is specified as E1CAS, and the modulator data rate is set to 1920.0 kbit/s
Bulk Drop Channels Assignment	Command: Response: Status: Response:	<add/BDCA_dd;cc_dd;cc_dd;cc… 'cr' >add/BDCA_dd;cc_dd;cc_dd;cc…'cr''lf'] <add/BDCA_'cr' >add/BDCA_dd;cc_dd;cc_dd;cc…'cr''lf']	Where: dd = 1 to n (over the satellite drop channel), where n = modulator data rate divided by 64 kbit/s. cc = 1 to 24 (terrestrial channel number for T1 data formats). cc = 1 to 31 (terrestrial channel number for E1 data formats). Notes: 1. The status response returns programming information for 1 to n drop channels. 2. This command is not valid when the drop data format is specified as E1CAS, and the modulator data rate is set to 1920.0 kbit/s
Insert Channels Assignment	Command: Response: Status: Response:	<add/ICA_ii;cc'cr' >add/ICA_ii;cc'cr''lf'] <add/ICA_ii'cr' >add/ICA_ii;cc'cr''lf']	Where: ii = 1 to n (over the satellite insert channel), where n = demodulator data rate divided by 64 kbit/s. cc = 1 to 24 (terrestrial channel number for T1 data formats). cc = 1 to 31 (terrestrial channel number for E1 data formats). cc = 0 (if no insert is desired for the specified insert channel). Notes: 1. This command is not valid when the insert data format is specified as E1CAS, and the demodulator data rate is set to 1920.0 kbit/s

Bulk Insert Channels Assignment	Command: Response: Status: Response:	<add/BICA_ii;cc_ii;cc_ii;cc… 'cr' >add/BICA_ii;cc_ii;cc_ii;cc…'cr''lf'] <add/BICA_'cr' >add/BICA_ii;cc_ii;cc_ii;cc…'cr''lf']	Where: ii = 1 to n (over the satellite insert channel), where n = demodulator data rate divided by 64 kbit/s. cc = 1 to 24 (terrestrial channel number for T1 data formats). cc = 1 to 31 (terrestrial channel number for E1 data formats). cc = 0 (if no insert is desired for the specified insert channel). Notes: 1. The status response returns programming information for 1 to n insert channels. 2. Time slot 16 (cc=16) may not be specified when the insert data format is specified to be E1CAS 3. This command is not valid when the insert data format is specified as E1CAS, and the demodulator data rate is set to 1920.0 kbit/s.
IDR Backward Alarm Enable	Command: Response: Status: Response:	<add/BW_xxx_nnn'cr' >add/BW_xxx_nnn'cr''lf'] <add/BW_xxx'cr' >add/BW_xxx_nnn'cr''lf']	Where: xxx =TX1, TX2, TX3, TX4, RX1, RX2, RX3, or RX4 (backward alarm designator). nnn = ON or OFF.
IDR Transmit ESC Type	Command: Response: Status: Response:	<add/TET_xxxxx'cr' >add/TET_xxxxx'cr''lf'] <add/TET_'cr' >add/TET_xxxxx'cr''lf']	Where: xxxxx = DATA (64K Data) or AUDIO (2x32K Audio). Note: TX IDR Overhead only.
IDR Receive ESC Type	Command: Response: Status: Response:	<add/RET_xxxxx'cr' >add/RET_xxxxx'cr''lf'] <add/RET_'cr' >add/RET_xxxxx'cr''lf']	Where: xxxxx = DATA (64K Data) or AUDIO (2x32K Audio). Note: RX IDR Overhead only.
Terrestrial Interface Format	Command: Response: Status: Response:	<add/TIF_xxxxx'cr' >add/TIF_xxxxx'cr''lf'] <add/TIF_'cr' >add/TIF_xxxxx'cr''lf']	Where: xxxxx = J1(RS422), J6 (RS422), G703B (Balanced G.703), G703U (Unbalanced G.703).
Terrestrial Async Source	Command: Response: Status: Response:	<add/TAS_xx'cr' >add/TAS_xx'cr''lf'] <add/TAS_'cr' >add/TAS_xx'cr''lf']	Where: xx = J2 or J6.

A.10.1 Asynchronous Interface Commands

ASYNC Transmit Overhead Baud Rate	Command: Response: Status: Response:	<add/TOBR_nnnnn'cr' >add/TOBR_nnnnn'cr''lf'] <add/TOBR_'cr' >add/TOBR_nnnnn'cr''lf']	Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400. Note: TX ASYNC Overhead only.
ASYNC Receive Overhead Baud Rate	Command: Response: Status: Response:	<add/ROBR_nnnnn'cr' >add/ROBR_nnnnn'cr''lf'] <add/ROBR_'cr' >add/ROBR_nnnnn'cr''lf']	Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400. Note: RX ASYNC Overhead only.
ASYNC Transmit Channel Character Length	Command: Response: Status: Response:	<add/TCCL_n'cr' >add/TCCL_n'cr''lf'] <add/TCCL_'cr' >add/TCCL_n'cr''lf']	Where: n = 7 or 8 bits. Note: TX ASYNC Overhead only.
ASYNC Transmit Channel Stop Bits	Command: Response: Status: Response:	<add/TCSB_n'cr' >add/TCSB_n'cr''lf'] <add/TCSB_'cr' >add/TCSB_n'cr''lf']	Where: n = 1 or 2 (Stop bits). Note: TX ASYNC Overhead only.
ASYNC Transmit Channel Parity	Command: Response: Status: Response:	<add/TOCP_xxxx'cr' >add/TOCP_xxxx'cr''lf'] <add/TOCP_'cr' >add/TOCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE. Note: TX ASYNC Overhead only.
ASYNC Receive Channel Character Length	Command: Response: Status: Response:	<add/RCCL_n'cr' >add/RCCL_n'cr''lf'] <add/RCCL_'cr' >add/RCCL_n'cr''lf']	Where: n = 7 or 8 bits. Note: RX ASYNC Overhead only.
ASYNC Receive Channel Stop Bits	Command: Response: Status: Response:	<add/RCSB_n'cr' >add/RCSB_n'cr''lf'] <add/RCSB_'cr' >add/RCSB_n'cr''lf']	Where: n = 1 or 2 (Stop bits). Note: RX ASYNC Overhead only.
ASYNC Receive Channel Parity	Command: Response: Status: Response:	<add/ROCP_xxxx'cr' >add/ROCP_xxxx'cr''lf'] <add/ROCP_'cr' >add/ROCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE. Note: RX ASYNC Overhead only.
ASYNC Communications Type	Command: Response: Status: Response:	<add/ACT_xxxxxxxx'cr' >add/ACT_xxxxxxxx'cr''lf'] <add/ACT_'cr' >add/ACT_xxxxxxxx'cr''lf']	Where: xxxxxxxx = RS232, RS485 (4- Wire) or RS485_2W (2-Wire). Note: ASYNC Overhead only.

A.11 System Configuration Commands

Time Of Day	Command: Response: Status: Response:	<add/TIME_hh:mm:ss'cr' >add/TIME_hh:mm:ss'cr''lf'] <add/TIME_'cr' >add/TIME_hh:mm:ss'cr''lf']	Where: hh = 0 to 23 (hours). mm = 00 to 59 (minutes). ss = 00 to 59 (seconds).
Date	Command: Response: Status: Response:	<add/DATE_mm/dd/yyyy'cr' >add/DATE_mm/dd/ttyy'cr''lf'] <add/DATE_'cr' >add/DATE_mm/dd/yyyy'cr''lf']	Where: mm = 1 to 12 (month). dd = 1 to 31 (day). yyyy = 2000 to 2099 (year).
Remote	Command: Response:	<add/REM_'cr' >add/REM_'cr''lf']	Configures the modem for remote operation. The SLM7650 will respond to any status request at any time. However, the SLM7650 must be in 'Remote Mode' to change configuration parameters.
Clear Stored Faults	Command: Response:	<add/CLSF_'cr' >add/CLSF_'cr''lf']	This command is used to clear all stored faults logged by the SLM7650.
Modem Reference Clock	Command: Response: Status: Response:	<add/MRC_xxxxx'cr' >add/MRC_xxxxx'cr''lf'] <add/MRC_'cr' >add/MRC_xxxxx'cr''lf']	Where: xxxxx = INT (INTERNAL), EXT1 (EXTERNAL 1 MHz), EXT5 (EXTERNAL 5 MHz), EXT10 (EXTERNAL 10 MHz), EXT20 (EXTERNAL 20 MHz).
Modem Operation Mode	Command: Response: Status: Response:	<add/MOM_xxxxxxx'cr' >add/MOM_xxxxxxx'cr''lf'] <add/MOM_'cr' >add/MOM_xxxxxxx'cr''lf']	Where: xxxxxxx = TX_ONLY, RX_ONLY, DUPLEX mode. This command configures the modem for simplex, duplex or standby operation modes. When transmit only mode is selected, receive faults are inhibited and when receive only mode is selected, transmit faults are inhibited.
System Modem Type	Command: Response: Status: Response:	<add/SMT_xxxxxx'cr' >add/SMT_xxxxxx'cr' RF_OFF'cr''lf'] <add/SMT_'cr' >add/SMT_xxxxxx'cr''lf']	Where: xxxxxx = IDR, IBS, DI, ASYNC, EFD, CUSTOM, IBS-309, VSAT-IBS, 7650.00 or 7650.02.
Save Modem Config.	Command: Response:	<add/SMC_n'cr' >add/SMC_n'cr''lf']	Where: n = 1, 2, 3, 4, or 5 (stored configuration number). This command saves the current modem configuration for recall at a later time using the 'RMC_' command. Up to five different modem configurations can be saved.
Recall Modem Config.	Command: Response:	<add/RMC_n'cr' >add/RMC_n'cr''lf']	Where: n = 1, 2, 3, 4, or 5 (stored configuration number). This command causes the modem to be reprogrammed with configuration parameters previously saved using the 'SMC_' command. One of five saved configurations can be specified.

System Reset	Command: Response:	<add/SYSR!_xxxx'cr' >add/SYSR!_xxxx'cr''lf'	Where: xxxx = HARD or SOFT Note: HARD reset initializes and reprograms all modules to system default configuration values while SOFT reset initializes and reprograms all modules to currently programmed configuration values

A.12 Automatic Uplink Power Control (AUPC)

AUPC Local Enable	Command: Response: Status: Response:	<add/LPC_xxx'cr' >add/LPC_xxx'cr''lf'] <add/LPC_'cr' >add/LPC_xxx'cr''lf']	Where: xxx = ON or OFF. Notes: 1. When programmed ON, the MOP (Modulator Output Power) command is not allowed, only MOP status is allowed. 2. ASYNC Overhead only.
AUPC Nominal Power Level	Command: Response: Status: Response:	<add/NOMP_snn.n'cr' >add/NOMP_snn.n'cr''lf'] <add/NOMP_'cr' >add/NOMP_snn.n'cr''lf']	Where: snn.n = -30.0 to +5.0, in 0.1 steps (nominal range in dBm). Notes: 1. ASYNC Overhead only.
AUPC Maximum Power Limit	Command: Response: Status: Response:	<add/MAXP_snn.n'cr' >add/MAXP_snn.n'cr''lf'] <add/MAXP_'cr' >add/MAXP_snn.n'cr''lf']	Where: snn.n = -30.0 to +5.0, in 0.1 steps (nominal range in dBm). Notes: 1. ASYNC Overhead only.
AUPC Minimum Power Limit	Command: Response: Status: Response:	<add/MINP_snn.n'cr' >add/MINP_snn.n'cr''lf'] <add/MINP_'cr' >add/MINP_snn.n'cr''lf']	Where: snn.n = -30.0 to +5.0, in 0.1 steps (nominal range in dBm). Notes: 1. ASYNC Overhead only.
AUPC Eb/N0 Target Set Point	Command: Response: Status: Response:	<add/ENSP_nn.n'cr' >add/ENSP_nn.n'cr''lf'] <add/ENSP_'cr' >add/ENSP_nn.n'cr''lf']	Where: nn.n = 3.2 to 16.0, in 0.1 increments (Eb/N0 in dB). Note: ASYNC Overhead only.
AUPC Maximum Tracking Rate	Command: Response: Status: Response:	<add/MAXT_n.n'cr' >add/MAXT_n.n'cr''lf'] <add/MAXT_'cr' >add/MAXT_n.n'cr''lf']	Where: n.n = 0.5 to 6.0, in 0.5 increments (max tracking rate in dBm/minute). Note: ASYNC Overhead only.
AUPC Local Carrier Loss Action	Command: Response: Status: Response:	<add/LCL_xxxx'cr' >add/LCL_xxxx'cr''lf'] <add/LCL_'cr' >add/LCL_xxxx'cr''lf']	Where: xxxx = HOLD, NOM, or MAX (power level setting when local carrier loss). Note: ASYNC Overhead only.
AUPC Remote Carrier Loss Action	Command: Response: Status: Response:	<add/RCL_xxxx'cr' >add/RCL_xxxx'cr''lf'] <add/RCL_'cr' >add/RCL_xxxx'cr''lf']	Where: xxxx = HOLD, NOM, or MAX (power level setting when remote carrier loss). Note: ASYNC Overhead only.

Remote Modem AUPC Commands	Notes: 1. Always wait 3 seconds between consecutive remote modem command/status polls. 2. If Local AUPC is not enabled, status commands will return last known condition. They will also request status from the remote modem. This allows a second request to return proper status.		
Remote AUPC Enable	Command: Response:	<add/RPC_xxx'cr' >add/RPC_xxx'cr''lf']	Where: xxx = ON or OFF (remote AUPC enable). Note: ASYNC Overhead only.
Remote Interface Substitution Pattern	Command: Response: Status: Response:	<add/RISP_xxx'cr' >add/RISP_xxx'cr''lf'] <add/RISP_'cr' >add/RISP_xxx'cr''lf']	Where: xxx = ON or OFF (remote transmit 2047 pattern enable). Note: Transmit 2047 Pattern.
Remote Interface Baseband Loopback	Command: Response: Status: Response:	<add/RBBL_xxx'cr' >add/RBBL_xxx'cr''lf'] <add/RBBL_'cr' >add/RBBL_xxx'cr''lf']	Where: xxx = ON or OFF (remote baseband loopback enable). Note: ASYNC Overhead only.
Remote Interface Read Error Status	Command: Response: Example: Command: Response:	<add/RRES_'cr' >add/RRES_nE-e'cr''lf'] <add/RRES_'cr' >add/RRES_2E-6'cr''lf']	Where: n = 1 to 9 (error rate number). e = 2 to 6 (exponent). Note: Received 2047 Pattern. This command returns 2047 BER from the remote AUPC modem. If data is not valid, the message 'No_Data' is returned in lieu of BER data.

A.13 Status Commands/Responses

A.13.1 Modulator Configuration Status

Modulator Config. Status	Command: Response:	<add/MCS_'cr' >add/MCS_'cr' RF_xxx'cr' MF_nn.nnnnnnn'cr' MR_nnnn_mmmmm.mmm'cr' AMRA_nnnn_mmmmm.mmm'cr' AMRB_nnnn_mmmmm.mmm'cr' AMRC_nnnn_mmmmm.mmm'cr' AMRD_nnnn_mmmmm.mmm'cr' AMRV_nnnn_mmmmm.mmm'cr' MPO_snn.n'cr' MOP_snn.n'cr' SE_xxx'cr' DENC_xxx'cr' MT_xxxxx'cr' MET_xxx'cr' COM_xxxxxx'cr' MRC_xxx'cr' MSR_xxx'cr' RSEN_xxx'cr' MSPR_xxx'cr' TDA_xxx'cr' SCRT_xxxx'cr' T310_xxx'cr' MRSC_nnn_kkk_i'cr''lf'] (Note 1)	RF Output Modulator Frequency Modulator Rate Preset 'A' Assignment Preset 'B' Assignment Preset 'C' Assignment Preset 'D' Assignment Preset 'V' Assignment Modulator Power Offset Modulator Output Power Scrambler Enable Differential Encoder Modulator Type Modulator Encoder Type Carrier Only Mode Modem Reference Clock Modulator Spectrum Rotation Reed-Solomon Encoder SCT PLL Reference Transmit BPSK Data Ordering Scrambler Type TX 8PSK IESS-310 Operation Reed-Solomon Codeword The modulator configuration status command causes a block of data to be returned by the addressed modem. The block of data reflects the current configuration status of the modulator module. Additional configuration status of new options and features will always be appended to the end.
			Notes: 1. Data is only returned when the modem type is set to CUSTOM and TX Overhead is either NONE or ASYNC.

Modulator / Coder Config. Program Status	Command:	<add/MCP_'cr'		
	Response:	>add/MCP_'cr'		
		SMT_xxxxxxx'cr'		System Modem Type
		RMR_'cr'		Reset Mod Rate (reserved for Comtech switch)
		MET_xxx'cr'		Modulator Encoder Type
		ITOT_xxxxx'cr'		Interface Transmit Overhead Type
		MOM_xxxxxxx'cr'		Modem Operation Mode
		MT_xxxxx'cr'		Modulator Type
		MF_nn.nnnnnn'cr'		Modulator Frequency
		MR_nnnn_mmmmm.mmm'cr'		Modulator Rate
		MPO_snn.n'cr'		Modulator Power Offset
		LPC_xxx'cr'	(Note 3)	AUPC Local Power Enable
		MOP_snn.n'cr'	(Note 2)	Modulator Output Power
		SE_xxx'cr'		Scrambler Enable
		DENC_xxx'cr'		Differential Encoder
		ERF_nnnnnn.n'cr'		External Reference Frequency
		TC_xxxx'cr'		Transmit Clock (Source)
		TCP_xxxx'cr'		Transmit Clock Phase
		BBL_xxx'cr'		Baseband Loopback
		ILT_xxx'cr'		Interface Loop Timing
		TIF_xxxxx'cr'	(Note 7)	Terrestrial Interface Format
		ICFT_xxxxx'cr'	(Note 7)	Interface Coding Format Transmit
		ISP_xxx'cr'		Interface Substitution Pattern (TX 2047)
		TDF_xxxx'cr'		Transmit Data Fault
		TET_xxxxx'cr'	(Note 5)	IDR Transmit ESC Type
		ISCL_TX1_nnn'cr'	(Note 5)	Service Channel Level TX1
		ISCL_TX2_nnn'cr'	(Note 5)	Service Channel Level TX2
		TDP_xxxx'cr'		Transmit Data Phase
		DDF_xxxxxx'cr'	(Note 6)	Drop Data Format
		BDCA_dd;cc_dd;cc…'cr'	(Note 6)	Bulk Drop Channels Assignment
		DIL_xx'cr'	(Note 6)	DDO/IDI Loopback
		MRC_xxx'cr'		Modem Reference Clock
		MSR_xxx'cr'		Modulator Spectrum Rotation
		RSEN_xxx'cr'		Reed-Solomon Encoder
		BW_TX1_nnn'cr'	(Note 5)	Backward Alarm Enable TX1
		BW_TX2_nnn'cr'	(Note 5)	Backward Alarm Enable TX2
		BW_TX3_nnn'cr'	(Note 5)	Backward Alarm Enable TX3
		BW_TX4_nnn'cr'	(Note 5)	Backward Alarm Enable TX4
		MSPR_xxxx'cr'		SCT PLL Reference
		TAS_xx'cr'	(Note 8)	Terrestrial ASYNC Source
		TOBR_nnnnn'cr'	(Note 1)	ASYNC Transmit Overhead Baud Rate
		TCCL_nnn'cr'	(Note1)	ASYNC Transmit Channel Character Length
		TCSB_nnn'cr'	(Note1)	ASYNC Transmit Channel Stop Bits
		TOCP_nnn'cr'	(Note1)	ASYNC Transmit Channel Parity
		ACT_xxxxx'cr'	(Note 1)	ASYNC Communications Type
		NOMP_snn.n'cr'	(Note 3)	AUPC Nominal Power Value
		MINP_snn.n'cr'	(Note 3)	AUPC Minimum Power Value
		MAXP_snn.n'cr'	(Note 3)	AUPC Maximum Power Value
		LCL_xxxx'cr'	(Note 3)	AUPC Local Carrier Loss
		RCL_xxxx'cr'	(Note 3)	AUPC Remote Carrier Loss
		RTSM_xxx'cr'		RTS TX-IF Control Mode
		TDA_xxx'cr'		Transmit BPSK Data Ordering
		COM_xxxxxx'cr'		Carrier Only Mode
		SCRT_xxxx'cr'		Scrambler Type
		T310_xxx'cr'		TX 8PSK IESS-310 Operation
		MRSC_nnn_kkk_i'cr'	(Note 4)	Reed-Solomon Codeword
		RF_xxx'cr"lf']		RF Output (ON/OFF)
				Note: This command is used by the EF Data M:N protection switch to collect information that is necessary to configure back-up modems. Because this command (content and/or order) can be changed at any time by EF Data, it is advisable that other commands ('MCS_' and 'ICS_', or 'BCS_') be used for M&C systems.

			Notes: 1. Data is only returned for TX ASYNC Overhead 2. Data not returned if Local AUPC is enabled & TX ASYNC overhead. 3. Data is only returned for TX ASYNC Overhead Mux. 4. Data is only returned when the modem type is set to CUSTOM and TX Overhead is either NONE or ASYNC. 5. Data is only returned when the option card is installed and TX Overhead is IDR. 6. Data is only returned when the option card is installed and TX Overhead is DI. 7. Data is only returned when the option card is installed. 8. Data is only returned when the option card is installed and TX Overhead is ASYNC.

A.14 Demodulator Configuration Status

Demodulator Config. Status	Command: Response:	<add/DCS_'cr' >add/DCS_'cr' DF_nn.nnnnnnn'cr' DR_nnnn_mmmmm.mmm'cr' ADRA_nnnn_mmmmm.mmm'cr' ADRB_nnnn_mmmmm.mmm'cr' ADRC_nnnn_mmmmm.mmm'cr' ADRD_nnnn_mmmmm.mmm'cr' ADRV_nnnn_mmmmm.mmm'cr' DE_xxx'cr' DDEC_xxx'cr' IFL_xxx'cr' SCF_snnnnn'cr' SWR_nnnnn'cr' SR_xxx'cr' BERT_xxxx'cr' DT_xxxx'cr' DDT_xxx'cr' DSR_xxx'cr' RSDE_xxx'cr' RDA_xxx'cr' DCRT_xxxx'cr' R310_xxx'cr' DRSC_nnn_kkk_l'cr''lf'] (Note 1)	Demodulator Frequency Demodulator Rate Preset 'A' Assignment Preset 'B' Assignment Preset 'C' Assignment Preset 'D' Assignment Preset 'V' Assignment Descrambler Enable Differential Decoder IF Loopback Sweep Center Frequency Sweep Width Range Sweep Reacquisition BER Threshold Demodulator Type Demodulator Decoder Type Demodulator Spectrum Rotation Reed-Solomon Decoder Receive BPSK Data Ordering Descrambler Type RX 8PSK IESS-310 Operation Reed-Solomon Codeword The demodulator configuration status command causes a block of data to be returned by the addressed modem. The block of data reflects the current configuration of the demod. Additional configuration status of new options and features will always be appended to the end.
			Notes: 1. Data is only returned when the modem type is set to CUSTOM and RX Overhead is either NONE or ASYNC.

Demod/ Decoder Config. Program Status	Command: Resp onse:	<add/DCP_'cr' >add/DCP_'cr' SMT_xxxxxxx'cr' RDR_'cr' DDT_xxx'cr' IROT_xxxxx'cr' MOM_xxxxxxx'cr' BERT_xxxx'cr' DT_xxxx'cr' DF_nn.nnnnnn'cr' DR_nnnn_mmmmm.mmm'cr' DCRT_xxxx'cr' DE_xxx'cr' DDEC_xxx'cr' IFL_xxx'cr' SCF_snnnnn'cr' SWR_nnnnn'cr' SR_xxx'cr' ERF_nnnnnn.n'cr' BC_xxx'cr' RCP_xxxx'cr' BBL_xxx'cr' ILT_xxx'cr' TIF_xxxxx'cr' (Note 6) ICFR_xxxx'cr' (Note 6) IBP_xxx'cr' IRE_xxxxxx'cr' RDF_xxxx'cr' RET_xxxxx'cr' (Note 4) ISCL_RX1_nnn'cr' (Note 4) ISCL_RX2_nnn'cr' (Note 4) RDP_xxxx'cr' IDF_xxxxxx'cr' (Note 5) BICA_dd;cc_dd;cc…'cr' (Note 5) DIL_xx'cr' (Note 5) IBS _nnnnnn'cr' DSR_xxx'cr' RSDE_xxx'cr' BW_RX1_nnn'cr' (Note 4) BW_RX2_nnn'cr' (Note 4) BW_RX3_nnn'cr' (Note 4) BW_RX4_nnn'cr' (Note 4) TAS_xx'cr' (Note 7) ROBR_nnnnn'cr' (Note 1) RCCL_nnnnn'cr' (Note 1) RCSB_nnnnn'cr' (Note 1) ROCP_nnnnn'cr' (Note 1) ACT_xxxxx'cr' (Note 1) ENSP_nn.n'cr' (Note 2) MAXT_n.n'cr' (Note 2) RDA_xxx'cr' R310_xxx'cr' DRSC_nnn_kkk_i'cr''lf'] (Note 3)	System Modem Type Reset Demod Rate (reserved for Comtech switch) Demodulator Decoder Type Interface Receive Overhead Type Modem Operation Mode BER Threshold Demodulator Type Demodulator Frequency Demodulator Rate Descrambler Type Descrambler Enable Differential Decoder IF Loopback Sweep Center Frequency Sweep Width Range Sweep Reacquisition External Reference Frequency Buffer Clock Receive Clock Phase Baseband Loopback Interface Loop Timing Terrestrial Interface Format Interface Coding Format Receive Interface Buffer Programming Interface Read Error (RX 2047) Receive Data Fault IDR Receive ESC Type Service Channel Level RX1 Service Channel Level RX2 Receive Data Phase Insert Data Format Bulk Insert Channels Assignment DDO/IDI Loopback Interface Buffer Size Demodulator Spectrum Rotation Reed-Solomon Decoder Backward Alarm Enable RX1 Backward Alarm Enable RX2 Backward Alarm Enable RX3 Backward Alarm Enable RX4 Terrestrial ASYNC Source ASYNC Receive Overhead Baud Rate ASYNC Receive Channel Character Length ASYNC Receive Channel Stop Bits ASYNC Receive Channel Parity ASYNC Communications Type AUPC EBN0 Target Set Point AUPC Max. Tracking Rate Receive BPSK Data Ordering RX 8PSK IESS-310 Operation Reed-Solomon Codeword This command is used by the EF Data M:N protection switch to collect information that is necessary to configure back-up modems. Because this command (content and/or order) can be changed at any time by EF Data, it is advisable that other commands ('DCS_' and 'ICS_', or 'BCS_') be used for M&C systems. Notes: 1. Data is only returned for RX ASYNC Overhead. 2. Data is only returned for RX ASYNC Overhead. 3. Data is only returned when the modem type is set to CUSTOM and RX Overhead is either NONE or ASYNC.

			4. Data is only returned when the option card is installed and RX Overhead is IDR. 5. Data is only returned when the option card is installed and RX Overhead is DI. 6. Data is only returned when the option card is installed. 7. Data is only returned when the option card is installed and RX Overhead is ASYNC.

A.15 Interface Configuration Status

Interface Config. Status	Command:	<add/ICS_'cr'		
	Response:	>add/ICS_'cr'		
		TC_xxxx'cr'		Transmit Clock (Source)
		ERF_nnnnnn.n'cr'		External Reference Frequency
		TCP_xxxx'cr'		Transmit Clock Phase
		RCP_xxxx'cr'		Receive Clock Phase
		BBL_xxx'cr'		Baseband Loopback
		ILT_xxx'cr'		Interface Loop Timing
		ICFT_xxxx'cr'	(Note 8)	Interface Coding Format Transmit
		ICFR_xxxx'cr'	(Note 8)	Interface Coding Format Receive
		BC_xxx'cr'		Buffer Clock (Source)
		IRFS_T1_xxx'cr'		T1 Frame Structure
		IRFS_T2_xxx'cr'		T2 Frame Structure
		IRFS_E1_xxx'cr'		E1 Frame Structure
		IRFS_E2_xxx'cr'		E2 Frame Structure
		IBP_xxx'cr'		Interface Buffer Programming
		IBS _nnnnnn'cr'		Interface Buffer Size
		ITOT_xxxxx'cr'		Interface Transmit Overhead Type
		IROT_xxxxx'cr'		Interface Receive Overhead Type
		ISP_xxxxxx'cr'		Interface Substitution Pattern (TX 2047)
		IRE_xxxxxx'cr'		Interface Read Error (RX 2047)
		TDF_xxxx'cr'		Transmit Data Fault
		RDF_xxxx'cr'		Receive Data Fault
		ISCL_TX1_nnn'cr'	(Note 5)	Service Channel Level TX1
		ISCL_TX2_nnn'cr'	(Note 5)	Service Channel Level TX2
		ISCL_RX1_nnn'cr'	(Note 4)	Service Channel Level RX1
		ISCL_RX2_nnn'cr'	(Note 4)	Service Channel Level RX2
		TET_xxxxx'cr'	(Note 5)	IDR Transmit ESC Type
		RET_xxxxx'cr'	(Note 4)	IDR Receive ESC Type
		TDP_xxxx'cr'		Transmit Data Phase
		RDP_xxxx'cr'		Receive Data Phase
		DDF_xxxxxx'cr'	(Note 7)	Drop Data Format
		BDCA_dd;cc_dd;cc… 'cr'	(Note 7)	Bulk Drop Channels Assignment
		IDF_xxxxxx'cr'	(Note 6)	Insert Data Format
		BICA_dd;cc_dd;cc… 'cr'	(Note 6)	Bulk Insert Channels Assignment
		BW_TX1_nnn'cr'	(Note 5)	Backward Alarm Enable TX1
		BW_TX2_nnn'cr'	(Note 5)	Backward Alarm Enable TX2
		BW_TX3_nnn'cr'	(Note 5)	Backward Alarm Enable TX3
		BW_TX4_nnn'cr'	(Note 5)	Backward Alarm Enable TX4
		BW_RX1_nnn'cr'	(Note 4)	Backward Alarm Enable RX1
		BW_RX2_nnn'cr'	(Note 4)	Backward Alarm Enable RX2
		BW_RX3_nnn'cr'	(Note 4)	Backward Alarm Enable RX3
		BW_RX4_nnn'cr'	(Note 4)	Backward Alarm Enable RX4
		TIF_xxxxx'cr'	(Note 8)	Terrestrial Interface Format
		TOBR_nnnnn'cr'	(Note 1)	ASYNC Transmit Overhead Baud Rate
		TCCL_nnn'cr'	(Note 1)	ASYNC Transmit Channel Character Length
		TCSB_nnn'cr'	(Note 1)	ASYNC Transmit Channel Stop Bits
		TOCP_nnn'cr'	(Note 1)	ASYNC Transmit Channel Parity
		ACT_xxxxx'cr'	(Note 3)	ASYNC Communications Type
		ROBR_nnnnn'cr'	(Note 2)	ASYNC Receive Overhead Baud Rate
		RCCL_nnnnn'cr'	(Note 2)	ASYNC Receive Channel Character Length
		RCSB_nnnnn'cr'	(Note 2)	ASYNC Receive Channel Stop Bits
		ROCP_nnnnn'cr'	(Note 2)	ASYNC Receive Channel Parity
		LPC_xxx'cr'	(Note 1)	AUPC Local Power Enable
		NOMP_snn.n'cr'	(Note 1)	AUPC Nominal Power Value
		MINP_snn.n'cr'	(Note 1)	AUPC Minimum Power Value
		MAXP_snn.n'cr'	(Note 1)	AUPC Maximum Power Value
		LCL_xxxx'cr'	(Note 1)	AUPC Local Carrier Loss
		RCL_xxxx'cr'	(Note 1)	AUPC Remote Carrier Loss
		ENSP_nn.n'cr'	(Note 2)	AUPC EBN0 Target Set Point

		MAXT_n.n'cr' (Note 2) RTSM_xxx'cr' TAS_xx'cr' (Note 9) DIL_xxx'cr''lf'] (Note 10)	AUPC Max. Tracking Rate RTS TX-IF Control Mode Terrestrial ASYNC Source DDO/IDI Loopback The Interface configuration status command causes a block of data to be returned by the addressed MODEM. The block reflects the current configuration of the interface. Additional configuration status of new options and features will always be appended to the end. Notes: 1. Data is only returned for TX ASYNC Overhead. 2. Data is only returned for RX ASYNC Overhead. 3. Data is only returned for TX or RX ASYNC Overhead. 4. Data is only returned when the option card is installed and RX overhead is IDR. 5. Data is only returned when the option card is installed and TX overhead is IDR. 6. Data is only returned when the option card is installed and RX overhead is DI. 7. Data is only returned when the option card is installed and TX overhead is DI. 8. Data is only returned when the option card is installed. 9. Data is only returned when the option card is installed and TX or RX Overhead is ASYNC. 10. Data is only returned when the option card is installed and TX or RX Overhead is DI.

A.16 Fault Status

MODEM Faults Status (Summary)	Command: Response:	<add/MFS_'cr' >add/MFS_'cr' DMD_xxx'cr' MOD_xxx'cr' ITX_xxx'cr' IRX_xxx'cr' CEQ_xxx BWAL_xxx'cr''lf']	 Demodulator (FLT/OK) Modulator (FLT/OK) Interface Transmit Side (FLT/OK) Interface Receive Side (FLT/OK) Common Equipment (FLT/OK) Backward Alarms (FLT/OK)
Modulator Status	Command: Response:	<add/MS_'cr' >add/MS_'cr' RF_xxx'cr' MOD_xxx'cr' SYN_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' AGC_xxx'cr' SFLT_xx'cr''lf']	 RF Output (ON/OFF) actual status not configuration Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) AGC Level (OK/FLT) Number of stored faults logged (0 to 10)
Demod Status	Command: Response:	<add/DS_'cr' >add/DS_'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' BERT_xxx'cr' SFLT_xx'cr''lf']	 Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) BER Threshold (OK/FLT) Number of stored faults logged (0 to 10)
Interface Transmit Side Status	Command: Response:	<add/ITXS_'cr' >add/ITXS_'cr' MOD_xxx'cr' TXD_xxx'cr' CLK_xxx'cr' TXCPLL_xxx'cr' PLL_xxx'cr' SCT_xxx'cr' DRP_xxx'cr' SFLT_xx'cr''lf']	 Interface Transmit Module (OK/FLT) Transmit Data/AIS (OK/FLT) Selected Transmit Clock Activity (OK/FLT) Transmit Clock PLL Fault (OK/FLT) SCT PLL Lock (OK/FLT) SCT Reference Clock Activity (OK/FLT) D&I Drop (OK/FLT) Number of Stored Faults Logged (0 to 10)
Interface Receive Side Status	Command: Response:	<add/IRXS_'cr' >add/IRXS_'cr' MOD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr' RXD_xxx'cr' DMUX_xxx'cr' 2047_xxx'cr' OVFL_xxx'cr' UNFL_xxx'cr' BUFF_xxx'cr' INS_xxx'cr' BWA_xxx'cr' FBER_xxx'cr' SFLT_xx'cr''lf']	 Interface Receive Module (OK/FLT) Buffer Clock PLL Lock (OK/FLT) Selected Buffer Clock Activity (OK/FLT) Receive Data Loss/AIS (OK/FLT) Demux/Reed-Solomon Lock (OK/FLT) 2047 Pattern Lock Detect (OK/FLT) Buffer Overflow (OK/FLT) Buffer Underflow (OK/FLT) Buffer Full (OK/FLT) D&I Insert (OK/FLT) Receive Backward Alarm (OK/FLT) Frame BER (OK/FLT) Number of stored faults logged (0 to 10)

Common Equipment Status	Command: Response:	<add/CES_'cr' >add/CES_'cr' M&C_xxx'cr' BAT_xxx'cr' -12V_xxx'cr' +12V_xxx'cr' +5V_xxx'cr' +3.3V_xxx'cr' +2.5V_xxx'cr' +1.8V_xxx'cr' TEMP_xxx'cr' PLL_xxx'cr' ACT_xxx'cr' SFLT_xx'cr''lf']	 Controller Module (OK/FLT) Battery/Clock (OK/FLT) -12 Volt Level (OK/FLT) +12 Volt Level (OK/FLT) +5 Volt Level (OK/FLT) +3.3 Volt Level (OK/FLT) +2.5 Volt Level (OK/FLT) +1.8 Volt Level (OK/FLT) Temperature (OK/FLT) Modem Reference PLL (OK/FLT) Modem Reference Activity (OK/FLT) Number of stored faults logged (0 to 10) The common equipment status command causes a block of data to be returned which indicates the status of the common equipment.
Interface Alarms (Backward Alarm) Status	Command: Response:	<add/IAS_'cr' >add/IAS_'cr' TXBWA1_xxx'cr' TXBWA2_xxx'cr' TXBWA3_xxx'cr' TXBWA4_xxx'cr' RXBWA1_xxx'cr' RXBWA2_xxx'cr' RXBWA3_xxx'cr' RXBWA4_xxx'cr' SFLT_xx'cr''lf']	 TX Backward Alarm 1 (OK/FLT) TX Backward Alarm 2 (OK/FLT) TX Backward Alarm 3 (OK/FLT) TX Backward Alarm 4 (OK/FLT) RX Backward Alarm 1 (OK/FLT) RX Backward Alarm 2 (OK/FLT) RX Backward Alarm 3 (OK/FLT) RX Backward Alarm 4 (OK/FLT) Number of stored faults logged (0 to 10)

A.17 General Status, Performance

Raw BER	Command: Response:	<add/RBER_'cr' >add/RBER_xm.mE-ee'cr''lf']	Where: x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. 'No Data' is returned if the error rate cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the error rate.
Corrected BER	Command: Response:	<add/CBER_'cr' >add/CBER_xm.mE-ee'cr''lf']	Where: x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. 'No Data' is returned if the error rate cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the error rate.
Interface Read Error Status	Command: Response:	<add/IRES_'cr' >add/IRES_tttt_xn.nE-ee'cr''lf']	Where: ttttt = 2047 or MIL188 (indicates type of error being read). x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). This command returns 2047 or MIL188 error rate. The 'IRE_' configuration command is used to select reading of 2047 or MIL188 errors. Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. 'No Data' is returned if the error rate cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the error rate.

Frame Error Status	Command: Response:	<add/FBER_'cr' >add/FBER_xn.nE-ee'cr''lf']	Where: x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. 'No Data' is returned if the error rate cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the error rate.
Eb/N0 Status	Command: Response:	<add/EBN0_'cr' >add/EBN0_xnn.ndB'cr''lf']	Where: x = < or > (data modifier to indicate that the Eb/N0 is less than or greater than the returned value). nn.n = 1.0 to 99.9 (Eb/N0 value). Notes: 1. The 'x' (< or >) parameter is only returned if the Eb/N0 has exceeded the computational resolution of the system. 2. 'No Data' is returned if the Eb/N0 cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the Eb/N0.
Modulator Rate Status	Command: Response:	<add/MR_'cr' >add/MR_nnnnn_mmmmm.mmm'cr''lf']	Where:. nnnnn = 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), and OQ78 (OQPSK 7/8), BPSK (BPSK 1/1), QPSK (QPSK 1/1), OQSK (OQPSK 1/1), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8), B2144(BPSK 21/44), B516 (BPSK 5/16), 21/44 (QPSK 21/44), 17/18 (QPSK 17/18), OQ2144 (OQPSK 21/44), OQ1718 (OQPSK 17/18), 8P34 (8PSK 3/4), 8P78 (8PSK 7/8), 8P1718 (8PSK 17/18). mmmmm.mmm = Data rate in kHz
Demod Rate Status	Command: Response:	<add/DR_'cr' >add/DR_nnnnn_mmmmm.mmm'cr''lf']	Where: nnnnn = 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), and OQ78 (OQPSK 7/8), BPSK (BPSK 1/1), QPSK (QPSK 1/1), OQSK (OQPSK 1/1), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8), B2144(BPSK 21/44), B516 (BPSK 5/16), 21/44 (QPSK 21/44), 17/18 (QPSK 17/18), OQ2144 (OQPSK 21/44), OQ1718 (OQPSK 17/18), 8P34 (8PSK 3/4), 8P78 (8PSK 7/8), 8P1718 (8PSK 17/18). mmmmm.mmm = Data rate in kHz.

Receive Signal Level Status	Command: Response:	<add/RSL_'cr' >add/RSL_xsnn.ndBm'cr''lf']	Where: x = < or > (data modifier to indicate that the receive signal level is less than or greater than the returned value). s = + or - (receive signal level sign, plus or minus). nn.n = 0.0 to 99.9 (receive signal level magnitude). Notes: 1. The 'x' (< or >) parameter is only returned if the level has exceeded the computational resolution of the system. 2. 'No Data' is returned if the level cannot be calculated. 3. Sampling' is returned if not enough data is currently available to calculate the level.
Interface Buffer Fill Status	Command: Response:	<add/IBFS_'cr' >add/IBFS_nn%'cr''lf']	Where: nn = 1 to 99 (relative to buffer depth).
Current Sweep Value	Command: Response:	<add/CSV_'cr' >add/CSV_xsnnnnn'cr''lf] CD_yyy'cr''lf']	Where: x = < or > (data modifier to indicate that the sweep offset value is less than or greater than the returned value). s = + or - (sweep offset from center). nnnnn = 0 to 35000. yyy = OK or FLT (decoder lock status OK or FAULT). Notes: 1. The 'x' (< or >) parameter is only returned if the level has exceeded the computational resolution of the system. 2. 'No Data' is returned if the level cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the level.

A.18 Bulk Status

Bulk Consol. Analog Status	Command: Response:	<add/BCAS_'cr' >add/BCAS_p1,p2,p3, . . . pn'cr''lf']	This command is similar to the 'BCS_' command, but returns modem analog parameters. Additional status of new options and features will always be appended to the end.

Where 'pn' is the last parameter returned.

Parameter Number	Parameter Name (Command Reference)	Description
1	**Receive Signal Level** (ref. 'RSL_' command).	p1 = xsnn.n, receive signal level in dBm.
2	**Raw BER** (ref. 'RBER_' command).	p2 = xm.mE-ee.
3	**Corrected BER** (ref. 'CBER_' command).	p3 = xm.mE-ee.
4	**Interface Read Error Status** (ref. 'IRES_' command).	p4 = tttt_xm.mE-ee.
5	**EB/N0** (ref. 'EBN0_' command).	p5 = xnn.n, EB/N0 in dB.
6	**Buffer Fill Status** (ref. 'IBFS_' command).	p6 = nn%, buffer fill status.
7	**Frame BER Status** (ref. 'FBER_' command).	p7 = xm.mE-ee.

Note: Parameters 2 through 7 are dependent on carrier acquisition, if the decoder is not locked empty data blocks are returned (,,,,,).

Bulk Consol. Status	Command : Response:	<add/BCS_'cr' >add/BCS_p1,p2,p3, . . . pn'cr''lf']	This command causes bulk modem status to be returned. To reduce the length of the response, message parameter data are returned without identifiers. However, parameter identification can be determined by order of return. Each status parameter is terminated with a ',' (comma) except for the last parameter which has the standard message termination sequence ('cr''lf']). Most of the data returned is formatted the same way as the single command status request (refer to the appropriate portions of this document in preceding sections). Additional configuration status of new options and features will always be appended to the end.

Where 'pn' is the last parameter returned.

Parameter Number	Parameter Name (Command Reference)	Description
1	**Modulator RF output** (ref. 'RF_' command).	**p1** = n, where 'n' is '0' (off) or '1' (on).
2	**Modulator IF frequency** (ref. 'MF_' command).	**p2** = nn.nnnnnn, IF frequency in MHz.
3	**Modulator rate** (ref. 'MR_' command).	**p3** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
4	**Modulator preset 'A' assignment** (ref. 'ARMA_' command).	**p4** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
5	**Modulator preset 'B' assignment** (ref. 'ARMB_' command).	**p5** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
6	**Modulator preset 'C' assignment** (ref. 'ARMC_' command).	**p6** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
7	**Modulator preset 'D' assignment** (ref. 'ARMD_' command).	**p7** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
8	**Modulator preset 'V' assignment** (ref. 'ARMV_' command).	**p8** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
9	**Modulator power offset** (ref. 'MPO_' command).	**p9** = snn.n, transmitter power offset level in dBm.
10	**Modulator output power level** (ref. 'MOP_' command).	**p10** = snn.n, transmitter output power level in dBm.
11	**Scrambler enable** (ref. 'SE_' command).	**p11** = n, where 'n' is '0' (off) or '1' (on).
12	**Differential encoder enable** (ref. 'DENC_' command).	**p12** = n, where 'n' is '0' (off) or '1' (on).
13	**Modulator type** (ref. 'MT_' command).	**p13** = n, where 'n' is '0' (EFD) or '1' (INTL).
14	**Modulator Encoder Type** (ref. 'MET_' command).	**p14** = n, where 'n' is '1' (Viterbi) or '2' (TURBO).
15	**Carrier only mode**	**p15** = n, where 'n' is '0' (Normal), '1' (Center), '2' (Dual), or 3 (Offset).
16	**Demodulator IF** (ref. 'DF_' command).	**p16** = nn.nnnnnn, demodulator IF frequency in MHz.

Bulk Consol. Status (continued)

Parameter Number	Parameter Name (Command Reference)	Description
17	**Demodulator rate** (ref. 'DR_' command).	**p17** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
18	**Demodulator preset A assignment** (ref. 'ADRA_' command).	**p18** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
19	**Demodulator preset B assignment** (ref. 'ADRB_' command).	**p19** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
20	**Demodulator preset C assignment** (ref. 'ADRC_' command).	**p20** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
21	**Demodulator preset D assignment** (ref. 'ADRD_' command).	**p21** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
22	**Demodulator preset V assignment** (ref. 'ADRV_' command).	**p22** = nnnn_mmmmm.mmm, code rate/data rate in kbit/s.
23	**Descrambler enable** (ref. 'DE_' command).	**p23** = n, where 'n' is '0' (off) or '1' (on).
24	**Differential decoder** (ref. 'DDEC_' command).	**p24** = n, where 'n' is '0' (off) or '1' (on).
25	**reserved null field.**	
26	**IF loopback** (ref. 'IFL_' command).	**p26** = n, where 'n' is '0' (off) or '1' (on).
27	**Sweep center frequency** (ref. 'SCF_' command).	**p27** = snnnnn, sweep center frequency in Hertz.
28	**Sweep width range** (ref. 'SWR_' command).	**p28** = nnnnn, sweep range in Hertz.
29	**Sweep reacquisition** (ref. 'SR_' command).	**p29** = nnn, reacquisition time in seconds.
30	**BER threshold** (ref. 'BERT_' command).	**p30** = xxxx, BER threshold.
31	**Demodulator type** (ref. 'DT_' command).	**p31** = n, where 'n' is '0' (EFD) or '1' (INTL).
32	**Demodulator Decoder Type** (ref. 'DDT_' command).	**p32** = n, where 'n' is '1' (Viterbi) or '2' (Turbo).
33	**Transmit clock source** (ref. 'TC_' command).	**p33** = n, where 'n' is '0' (INT), "2' (EXT), 6 (DATA).
34	**External reference frequency** (ref. 'ERF_' command).	**p34** = nnnnnn.n, external reference frequency in kHz.

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(continued)

Parameter Number	Parameter Name (Command Reference)	Description
35	**Transmit clock phase** (ref. 'TCP_' command).	**p35** = n, where 'n' is '0' (NRM) or '1' (INV).
36	**Receive clock phase** (ref. 'RCP_' command).	**p36** = n, where 'n' is '0' (NRM), '1' (INV).
37	**Baseband loopback** ref. 'BBL_' command).	**p37** = n, where 'n' is '0' (OFF) or '1' (ON).
38	**reserved null field.**	
39	**Interface loop timing** (ref. 'ILT_' command).	**p39** = n, where 'n' is '0' (OFF) or '1' (ON).
40	**TX Interface coding format** (ref. 'ICFT_' command).	**P40** = n, where 'n' is '0' (AMI), '1' (B6ZS), '2' (B8ZS), or '3' (HDB3).
41	**RX Interface coding format** (ref. 'ICFR_' command).	**P41** = n, where 'n' is '0' (AMI), '1' (B6ZS), '2' (B8ZS), or '3' (HDB3).
42	**Buffer clock source** (ref. 'BC_' command).	**p42** = n, where 'n' is '0' (INT), '1' (REF), '2' (EXT), '3' (SAT), or '5' (INS).
43	**Interface RX-T1 frame structure** (ref. 'IRFS_' command).	**p43** = n, where n is '0' (NONE) or '1' (G704).
44	**Interface RX-T2 frame structure** (ref. 'IRFS_' command).	**p44** = n, where n is '0' (NONE), '1' (G704), '3' (G743), or '5' (G747).
45	**Interface RX-E1 frame structure** (ref. 'IRFS_' command).	**p45** = n, where n is '0' (NONE) or '1' (G704).
46	**Interface RX-E2 frame structure** (ref. 'IRFS_' command).	**p46** = n, where n is '0' (NONE), '1' (G704), '2' (G742), or '4' (G745).
47	**Interface Buffer Programming** (ref. 'IBP_' command).	**p47** = n, where 'n' is '0' (BITS) or '1' (MS).
48	**Interface buffer size** (ref. 'IBS _' command).	**p48** = nnnnnn, buffer size in bits or milli seconds.
49	**Interface transmit overhead type** (ref. 'ITOT_' command).	**p49** = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), '4' (ASYNC), 5 (IBS-309), or 6 (VSAT-IBS).
50	**Interface receive overhead type** (ref. 'IROT_' command).	**p50** = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), '4' (ASYNC), 5 (IBS-309), or 6 (VSAT-IBS).
51	**Interface substitution pattern** (ref. 'ISP_' command).	**p51** = n, where 'n' is '0' (OFF), '1' (2047), or '2' (MIL188).
52	**Interface read error** (ref. 'IRE_' command).	**p52** = n, where 'n' is '0' (OFF), '1' (2047), or '2' (MIL188).

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(continued)

	Parameter Number	Parameter Name (Command Reference)	Description
	53	**Transmit data fault** (ref. 'TDF_' command).	**p53** = n, where 'n' is '0' (NONE), '1' (DATA), or '2' (AIS).
	54	**Receive data fault** (ref. 'RDF_' command).	**p54** = n, where 'n' is '0' (NONE), '1' (DATA), or '2' (AIS).
(Note 5)	**55**	**Interface Service Channel TX1** (ref. 'ISCL_' command).	**p55** = nnn, service channel level in dB.
(Note 5)	**56**	**Interface Service Channel TX2** (ref. 'ISCL_' command).	**p56** = nnn, service channel level in dB.
(Note 6)	**57**	**Interface Service Channel RX1** (ref. 'ISCL_' command).	**p57** = nnn, service channel level in dB.
(Note 6)	**58**	**Interface Service Channel RX2** (ref. 'ISCL_' command).	**p58** = nnn, service channel level in dB.
	59	**System modem type** (ref. 'SMT_' command).	**p59** = n, where 'n' is '0' (IDR), '1' (IBS), '2' (EFD), '3' (CUSTOM), '4' (DI), '7' (ASYNC), '8' (7650-00), '9' (7650-02), '10' (IBS-309), or '11' (VSAT-IBS).
	60	**Modem operation mode** (ref. 'MOM_' command).	**p60** = n, where 'n' is '1' (TX_ONLY), '2' (RX_ONLY), '3' (DUPLEX).
	61	**MODEM REMOTE/LOCAL mode.**	**p61** = n, where 'n' is '0' (LOCAL), '1' (REMOTE).
	62	**Transmit data phase** (ref. 'TDP_' command).	**p62** = n, where 'n' is '0' (NRM), '1' (INV).
	63	**Receive data phase** (ref. 'RDP_' command).	**p63** = n, where 'n' is '0' (NRM), '1' (INV).
(Note 3)	**64**	**Drop Data Format** (ref. 'DDF_' command).	**p64** = n, where 'n' is '0' (T1), '1' (T1ESF), '2' (E1CCS), or '3' (E1CAS).
(Note 4)	**65**	**Insert Data Format** (ref. 'IDF_' command).	**p65** = n, where 'n' is '0' (T1), '1' (T1ESF), '2' (E1CCS), or '3' (E1CAS).
(Note 3)	**66**	**Bulk Drop Channels Assignment** (ref. 'BDCA_' command).	**p66** = dd;cc_dd;cc_dd;cc_dd;cc…, as defined by the 'BDCA_' command.
(Note 4)	**67**	**Bulk Insert Channels Assignment** (ref. 'BICA_' command).	**p67** = dd;cc_dd;cc_dd;cc_dd;cc…, as defined by the 'BICA_' command.
	68	**reserved null field.**	
	69	**Modem Reference Clock** (ref. 'MRC_' command).	**p69** = n, where 'n' is '0' (INT), '4' (EXT1), '1' (EXT5), '2' (EXT10), or '3' (EXT20) respectively.
	70	**Modulator Spectrum Rotation** (ref. 'MSR_' command).	**p70** = n, where 'n' is '0' (NRM), '1' (INV).

Bulk Consol. Status (continued)

	Parameter Number	Parameter Name (Command Reference)	Description
	71	**Demodulator Spectrum Rotation** (ref. 'DSR_' command).	**p71** = n, where 'n' is '0' (NRM), '1' (INV).
	72	**Reed-Solomon Encoder Enable** (ref. 'RSEN_' command).	**p72** = n, where 'n' is '0' (off) or '1' (on).
	73	**Reed-Solomon Decoder Enable** (ref. 'RSDE_' command).	**p73** = n, where 'n' is '0'(OFF), '1' (ON), '2' (CORR_OFF).
(Note 5)	**74**	**Backward Alarm enable TX1** (ref. 'BW_TX1_' command).	**p74** = n, where 'n' is '0'(OFF), or '1' (ON).
(Note 5)	**75**	**Backward Alarm enable TX2** (ref. 'BW_TX2_' command).	**p75** = n, where 'n' is '0'(OFF), or '1' (ON).
(Note 5)	**76**	**Backward Alarm enable TX3** (ref. 'BW_TX3_' command).	**p76** = n, where 'n' is '0'(OFF), or '1' (ON).
(Note 5)	**77**	**Backward Alarm enable TX4** (ref. 'BW_TX4_' command).	**p77** = n, where 'n' is '0'(OFF), or '1' (ON).
(Note 6)	**78**	**Backward Alarm enable RX1** (ref. 'BW_RX1_' command).	**p78** = n, where 'n' is '0'(OFF), or '1' (ON).
(Note 6)	**79**	**Backward Alarm enable RX2** (ref. 'BW_RX2_' command).	**p79** = n, where 'n' is '0'(OFF), or '1' (ON).
(Note 6)	**80**	**Backward Alarm enable RX3** (ref. 'BW_RX3_' command).	**p80** = n, where 'n' is '0'(OFF), or '1' (ON).
(Note 6)	**81**	**Backward Alarm enable RX4** (ref. 'BW_RX4_' command).	**p81** = n, where 'n' is '0'(OFF), or '1' (ON).
	82	**SCT Reference Clock** (ref. 'MSPR_' command).	**p82** = n, where 'n' is '0' (MR), '1' (ERF).
(Note 1)	**83**	**ASYNC TX Overhead Baud Rate** (ref. 'TOBR_' command).	**p83** = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 2)	**84**	**ASYNC RX Overhead Baud Rate** (ref. 'ROBR_' command).	**P84** = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 1)	**85**	**ASYNC TX Channel Char. Length** (ref. 'TCCL_' command).	**p85** = n, where 'n' is the currently programmed character length (7 or 8 bits).
(Note 2)	**86**	**ASYNC RX Channel Char. Length** (ref. 'RCCL_' command).	**p86** = n, where 'n' is the currently programmed character length (7 or 8 bits).
(Note 1)	**87**	**ASYNC TX Channel Stop Bits** (ref. 'TCSB_' command).	**p87** = n, where 'n' is the currently programmed number of stop bits (1 or 2).
(Note 2)	**88**	**ASYNC RX Channel Stop Bits** (ref. 'RCSB_' command).	**p88** = n, where 'n' is the currently programmed number of stop bits (1 or 2).

Bulk Consol. Status (continued)

	Parameter Number	Parameter Name (Command Reference)	Description
(Note 1)	**89**	**ASYNC TX Channel Parity** (ref. 'TOCP_' command).	**p89** = xxxx, where ‘xxxx’ is the currently programmed parity.
(Note 2)	**90**	**ASYNC RX Channel Parity** (ref. 'ROCP_' command).	**p90** = xxxx, where ‘xxxx’ is the currently programmed parity.
(Note 1)	**91**	**ASYNC Communications Type** (ref. 'ACT_' command).	**p91** = n, where ‘n’ is ‘0’ (RS232), ‘1’ (RS485-4Wire), or ‘2’ (RS485-2Wire).
(Note 2)	**92**	**ASYNC Communications Type** (ref. 'ACT_' command).	**p92** = n, where ‘n’ is ‘0’ (RS232), ‘1’ (RS485_4WIRE), or ‘2’ (RS485_2WIRE).
(Note 1)	**93**	**AUPC Local Power Enable** (ref. 'LPC_' command).	**p93** = n, where 'n' is '0' (off), '1' (on).
(Note 1)	**94**	**AUPC Nominal Power Value** (ref. 'NOMP_' command).	**p94** = snn.n, where 'snn.n' Nominal Power Value in dBm.
(Note 1)	**95**	**AUPC Minimum Power Value** (ref. 'MINP_' command).	**p95** = snn.n, where 'snn.n' Minimum Power Value in dBm.
(Note 1)	**96**	**AUPC Maximum Power Value** (ref. 'MAXP_' command).	**p96** = snn.n, where 'snn.n' Maximum Power Value in dBm.
(Note 2)	**97**	**AUPC EBN0 Target Set Point** (ref. 'ENSP_' command).	**p97** = nn.n, where 'nn.n' EBN0 Target Set Point in dB.
(Note 2)	**98**	**AUPC Max. Tracking Rate** (ref. 'MAXT_' command).	**p98** = n.n, where 'n.n' Max. Tracking Rate in dB/Min.
(Note 1)	**99**	**AUPC Local Carrier Loss** (ref. 'LCL_' command).	**p99** = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
(Note 1)	**100**	**AUPC Remote Carrier Loss** (ref. 'RCL_' command).	**p100** = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
(Note 7)	**101**	**Terrestrial Interface Format** (ref. ‘TIF_’ command).	**p101** = n, where 'n' is '0' (Balanced G.703), ‘1’ (UnBalanced G.703), ‘2’ (RS-422 J1), or ‘3’ (RS-422 J6).
	102	**reserved null field.**	
	103	**reserved null field.**	
	104	**reserved null field.**	
	105	**reserved null field.**	
	106	**Transmit IESS-310 Mode** (ref. 'T310_' command).	**p106** = n, where 'n' is '0' (off), '1' (on).

Bulk Consol. Status (continued)

	Parameter Number	Parameter Name (Command Reference)	Description
	107	**Receive IESS-310 Mode** (ref. 'R310_' command).	**p107** = n, where 'n' is '0' (off) or '1' (on).
	108	**Transmit BPSK Data Ordering** (ref. 'TDA_' command).	**p108** = n, where 'n' is '0' (NRM), '1' (INV).
	109	**Receive BPSK Data Ordering** (ref. 'RDA_' command).	**p109** = n, where 'n' is '0' (NRM),'1' (INV).
	110	**RTS TX-IF Control Mode** (ref. 'RTSM_' command).	**p110** = n, where 'n' is '0' (off) or '1' (on).
	111	**Scrambler Type** (ref. 'SCRT_' command).	**p111** = n, where 'n' is '0' (IESS), '1' (OM73), or '2' (TURBO).
	112	**Descrambler Type** (ref. 'DCRT_' command).	**p112** = n, where 'n' is '0' (IESS), '1' (OM73), or '2' (TURBO).
	113	**Modulator RS Codeword** (ref. 'MRSC_' command).	**p113** = n, where 'n' is '0' RS(225,205,10) depth 8, '1' RS(225,205,10) depth 4, '2' RS(219,201,9) depth 8, '3' RS(219,201,9) depth 4, '4' RS(194,178,8) depth 4, or '5' RS(126,112,7) depth 4.
	114	**Demodulator RS Codeword** (ref. 'DRSC_' command).	**p114** = n, where 'n' is '0' RS(225,205,10) depth 8, '1' RS(225,205,10) depth 4, '2' RS(219,201,9) depth 8, '3' RS(219,201,9) depth 4, '4' RS(194,178,8) depth 4, or '5' RS(126,112,7) depth 4.
(Note 5)	**115**	**IDR TX ESC Type** (ref. 'TET_' command).	**p115** = n, where 'n' is '0' (2x32Kbits/s Audio) or '1' (64Kbit/s Data).
(Note 6)	**116**	**IDR RX ESC Type** (ref. 'RET_' command).	**p116** = n, where 'n' is '0' (2x32Kbits/s Audio) or '1' (64Kbit/s Data).
(Note 6)	**117**	**Terrestrial ASYNC Source** (ref. 'TAS_' command).	**p117** = n, where 'n' is '0' (J2) or '1' (J6).
(Note 9)	**118**	**DDO/IDI Loopback** (ref. 'DIL_' command).	**p118** = n, where 'n' is '0' (OFF) or '1' (ON).

Notes:
1. Data will only be returned if TX Overhead is programmed for ASYNC. Comma is always returned.
2. Data will only be returned if RX Overhead is programmed for ASYNC. Comma is always returned.
3. Data will only be returned if the option card is installed and the TX Overhead is programmed for DI. Comma is always returned.
4. Data will only be returned if the option card is installed and the RX Overhead is programmed for DI. Comma is always returned.
5. Data will only be returned if the option card is installed and the TX Overhead is programmed for IDR. Comma is always returned.
6. Data will only be returned if the option card is installed and the RX Overhead is programmed for IDR. Comma is always returned.
7. Data will only be returned if the option card is installed. Comma is always returned.
8. Data will only be returned if the option card is installed and either TX or RX Overhead is programmed for ASYNC. Comma is always returned.
9. Data will only be returned if the option card is installed and TX or RX Overhead is programmed for DI. Comma is always returned.

Bulk Consoli-dated Status Faults	Command: Response:	<add/BCSF_'cr' >add/BCSF_abcdefghijklmnopq'cr"lf']	This command causes all modem fault status to be returned. To reduce the length of the response, fault status is embedded into the bit structure of the characters that are returned. Faults are indicated by a binary 1 in the designated bit position. Character 'a': Modulator fault status character 1. Bit 6 = 1 always. Bit 5 = Modulator module fault. Bit 4 = RF output status, actual not programmed status (1 = on, 0 = off). Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of modulator stored faults. Character 'b': Modulator fault status character 2. Bit 6 = 1 always. Bit 5 = IF Synthesizer. Bit 4 = reserved. Bit 5 = Data Clock Synthesizer. Bit 2 = I Channel. Bit 1 = Q Channel. Bit 0 = AGC Level. Character 'c': Modulator fault status character 3. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'd': Demodulator fault status character 1. Bit 6 = 1 always. Bit 5 = Demod module fault. Bit 4 = Carrier detect status (0 for decoder lock). Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of demodulator stored faults. Character 'e': Demodulator fault status character 2. Bit 6 = 1 always. Bit 5 = IF Synthesizer Lock. Bit 4 = reserved. Bit 3 = I Channel. Bit 2 = Q Channel. Bit 1 = reserved. Bit 0 = BER threshold. Character 'f': Demodulator fault status character 3. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'g': Interface transmit side faults character 1. Bit 6 = 1 always. Bit 5 = TX Interface Module. Bit 4 = reserved. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of interface transmit side stored faults. Character 'h': Interface transmit side faults character 2. Bit 6 = 1 always. Bit 5 = Transmit Data/AIS.

			Bit 4 = Selected Transmit Clock Activity. Bit 3 = SCT Synthesizer PLL Lock. Bit 2 = SCT Reference Clock Activity. Bit 1 = Transmit Clock PLL Fault. Bit 0 = drop fault. Character 'i': Interface transmit side faults character 3. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'j': Interface receive side faults character 1. Bit 6 = 1 always. Bit 5 = RX Interface Module. Bit 4 = reserved. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of interface receive side stored faults. Character 'k': Interface receive side faults character 2. Bit 6 = 1 always. Bit 5 = Buffer clock PLL lock. Bit 4 = Buffer clock activity. Bit 3 = Receive Data Loss/AIS. Bit 2 = Demux lock. Bit 1 = RX 2047 Pattern lock. Bit 0 = reserved. Character 'l': Interface receive side faults character 3. Bit 6 = 1 always. Bit 5 = Buffer underflow. Bit 4 = Buffer overflow. Bit 3 = Buffer full. Bit 2 = insert fault. Bit 1 = receive backward alarm. Bit 0 = Frame BER. Character 'm': Common equipment fault status character 1. Bit 6 = 1 always. Bit 5 = Monitor & Control Module. Bit 4 = reserved. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of common equipment stored faults. Character 'n': Common equipment fault status character 2. Bit 6 = 1 always. Bit 5 = Battery/Clock. Bit 4 = -12V power supply. Bit 3 = +12V power supply. Bit 2 = +5V power supply. Bit 1 = +3.3V power supply. Bit 0 = +2.5V power supply. Character 'o': Common equipment fault status character 3. Bit 6 = 1 always. Bit 5 = +1.8V power supply. Bit 4 = Temperature. Bit 3 = Modem reference PLL. Bit 2 = Modem reference activity. Bit 1 = reserved. Bit 0 = reserved. Character 'p': Interface Backward Alarm status character 1.

			Bit 6 = 1 always. Bit 5 = TX backward alarm 1. Bit 4 = TX backward alarm 2. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of backward alarm stored faults. Character 'q': Interface Backward Alarm status character 2. Bit 6 = 1 always. Bit 5 = TX backward alarm 3. Bit 4 = TX backward alarm 4. Bit 3 = RX backward alarm 1. Bit 2 = RX backward alarm 2. Bit 1 = RX backward alarm 3. Bit 0 = RX backward alarm 4.
Change Status	Command: Response:	<add/CS_'cr' >add/CS_x'cr''lf']	Where: The 'x' character is defined as follows: '@' = no change since last BCS_ and BCSF_ polls. 'A' = BCS_ response has changed since last BCS_ poll. 'B' = BCSF_ response has changed since last BCSF_ poll. 'C' = Both responses have changed since last BCS_ and BCSF_ polls. This command indicates that a change has or has not occurred on either the BCS_ or the BCSF_ response since the last BCS_ or BCSF_ poll.

A.19 System Information

Equipment Type	Command: Response:	<add/ET_'cr' >add/ET_tttttttt_xxx.yyy.zzz'cr''lf']	Where: tttttttt = SLM7650 xxx.yyy.zzz = Software version.
Boot M&C Firmware Information	Command: Response:	<add/BFI_'cr' >add/BFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddr'cr' mm/dd/yyyy'cr' hh:mm:ss'cr''lf']	Where: xxx.yyy.zzz = Software version number (1.1.1 to 999.999.999). nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). rr = Firmware revision (-, or A to ZZ).
Host M&C Firmware Information	Command: Response:	<add/MCFI_'cr' >add/MCFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddrr'cr' mm/dd/yyyy'cr''lf']	Where: xxx.yyy.zzz = Software version number (1.1.1 to 999.999.999). nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). rr = Firmware revision (-, or A to ZZ).
Data (Bulk) Firmware Information	Command: Response:	<add/DFI_'cr' >add/DFI_'cr' FW/nnnnnnrr'cr' mm/dd/yyyy'cr' hh:mm:ss'cr''lf']	Where: nnnnnn = Firmware number (0 to 999999). rr = Firmware revision (-, or A to ZZ).
Modem Options / Misc. Information	Command: Response:	<add/MOI_'cr' >add/MOI_'cr' s,8PSK'cr' s,IBS_IDR'cr' s,ASYNC'cr' s,HRV'cr' s,RS'cr' s,16QAM'cr' s,TURBO'cr' s,MOD'cr' s,DEMOD'cr' s,G703'cr' s,DI'cr''lf']	(- or +) 8PSK (- or +) IBS/IDR Overhead (- or +) ASYNC Overhead (- or +) High Data Rate (- or +) Reed-Solomon (- or +) 16QAM (x or +) Turbo CODEC (- or +) Modulator Functionality is enabled (- or +) Demodulator Functionality is enabled (x or +) Option G.703/50Pin (x or +) Option D&I/ESC s = 0 (Not Installed, Not Upgradable), - (Not Installed, Fast Upgradable), + (Installed), x (Not Installed, Field Upgradable)
Serial Number	Command: Response:	<add/SNUM_'cr' >add/SNUM_'cr' xxxxxxxxx'cr''lf']	Where: xxxxxxxxx = Serial number 000000000 to 999999999.

State Of Product	Command: Response:	<add/SOP_'cr' >add/SOP_'cr' add'cr' abc'cr' rrrrr bps'cr' <var-string1>'cr' ……..…… <var-stringx>'cr''lf']	Product Address Data Format Baud Rate Comm Type Where: abc = Explained below. a = Number of data bits (7). b = Parity type (O, E, N). c = Number of stop bits (2). rrrrr = baud rate ("150", "300", "600", "1200", "2400", "4800", "9600", "14.4K", "19.2K, "38.4K""). <var-string1> = Variable length strings explaining communication hardware type "RS-485, 2 wire", "RS-485, 4 wire", "RS-232". <var-stringx> = Variable length strings explaining the intention of the product. Examples: "Under normal system operation"

A.20 Stored Faults

Information on stored faults is returned when requested. If no stored fault exists for a given fault number, the words “NO FAULT” will be returned instead of the normal time/data status.

The following symbols are commonly used to define the stored faults status commands:

- # Fault number (0 to 9). “0” is the first fault stored.
- hh Hours in 24-hr. format.
- mm Minutes.
- ss Seconds.
- MM Month.
- DD Day.
- YYYY Year.

Modulator Stored Faults	Command: Response:	<add/MSF_#'cr' >add/MSF_# hh:mm:ss MM/DD/YYYY'cr' MOD_xxx'cr' SYN_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' AGC_xxx'cr''lf']	 Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) AGC Level (OK/FLT)
Demodulator Stored Faults	Command: Response:	<add/DSF_#'cr' >add/DSF_# hh:mm:ss MM/DD/YYYY'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' BERT_xxx'cr''lf']	 Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) BER Threshold (OK/FLT)
Interface Transmit Side Stored Faults	Command: Response:	<add/ITSF_#'cr' >add/ITSF_# hh:mm:ss MM/DD/YYYY'cr' MOD_xxx’cr' TXD_xxx'cr' CLK_xxx'cr' TXCPLL_xxx’cr’ PLL_xxx'cr' SCT_xxx’cr’ DRP_xxx’cr’’lf']	 Module (OK/FLT) Transmit Data/AIS (OK/FLT) Selected Transmit Clock Activity (OK/FLT) Transmit Clock PLL Fault (OK/FLT) SCT Synthesizer PLL Lock (OK/FLT) SCT Reference Clock Activity (OK/FLT) D&I Drop (OK/FLT)

Interface Receive Side Stored Faults	Command: Response:	<add/IRSF_#'cr' >add/IRSF_# hh:mm:ss MM/DD/YYYY'cr' MOD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr' RXD_xxx'cr' DMUX_xxx'cr' 2047_xxx'cr' OVFL_xxx'cr' UNFL_xxx'cr' BUFF_xxx'cr' INS_xxx'cr' BWA_xxx'cr' FBER_xxx'cr''lf']	 Module (OK/FLT) Buffer Clock PLL Lock (OK/FLT) Selected Buffer Clock Activity (OK/FLT) Receive Data Loss/AIS (OK/FLT) Demux/Reed-Solomon Lock (OK/FLT) 2047 Pattern Lock Detect (OK/FLT) Buffer Overflow (OK/FLT) Buffer Underflow (OK/FLT) Buffer Full (OK/FLT) D&I Insert (OK/FLT) Receive Backward Alarm (OK/FLT) Frame BER (OK/FLT)
Common Equipment Stored Faults	Command: Response:	<add/CSF_#'cr' >add/CSF_# hh:mm:ss MM/DD/YYYY'cr' M&C_xxx'cr' BAT_xxx'cr' –12V_xxx'cr' +12V_xxx'cr' +5V_xxx'cr' +3.3V_xxx'cr' +2.5V_xxx'cr' +1.8V_xxx'cr' TEMP_xxx'cr' PLL_xxx'cr' ACT_xxx'cr''lf']	 M&C (OK/FLT) Battery/Clock (OK/FLT) -12 Volt Level (OK/FLT) +12 Volt Level (OK/FLT) +5 Volt Level (OK/FLT) +3.3 Volt Level (OK/FLT) +2.5 Volt Level (OK/FLT) +1.8 Volt Level (OK/FLT) Temperature (OK/FLT) Modem Reference PLL (OK/FLT) Modem Reference Activity (OK/FLT)
Interface Backward Alarms Stored Faults	Command: Response:	<add/IASF_#'cr' >add/IASF_# hh:mm:ss MM/DD/YYYY'cr' TXBWA1_xxx'cr' TXBWA2_xxx'cr' TXBWA3_xxx'cr' TXBWA4_xxx'cr' RXBWA1_xxx'cr' RXBWA2_xxx'cr' RXBWA3_xxx'cr' RXBWA4_xxx'cr''lf']	 TX Backward Alarm 1 (OK/FLT) TX Backward Alarm 2 (OK/FLT) TX Backward Alarm 3 (OK/FLT) TX Backward Alarm 4 (OK/FLT) RX Backward Alarm 1 (OK/FLT) RX Backward Alarm 2 (OK/FLT) RX Backward Alarm 3 (OK/FLT) RX Backward Alarm 4 (OK/FLT)

METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	—	1.609×10^{3}	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

Formulas
C = (F - 32) * 0.555
F = (C * 1.8) + 32

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^{3}	35.27	32.15	2.205	2.679	—

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