SNM-1001A

Satellite Modem
Installation and Operation Manual

Part Number MN/SNM1001A.IOM Revision 1

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Revision 1
March 4, 2003

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3. Ship the product back to Comtech EF Data. (Shipping charges should be prepaid.)

For more information regarding the warranty policies, see Warranty Policy, p. xii.

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About this Manual

This manual provides installation and operation information for the Comtech EF Data SNM-1001A satellite modem. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the SNM-1001A.

Related Documents

The following documents are referenced in this manual:

- *INTELSAT Earth Station Standards 308, 309, and 310*

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Recommended Standard (RS) Designations have been superseded by the new designation of the Electronic Industries Association (EIA). References to the old designations are shown only when depicting actual text displayed on the screen of the unit (RS-232, RS-485, etc.). All other references in the manual will be shown with the EIA designations (EIA-232, EIA-485, etc.) only.

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.

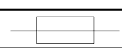
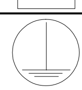
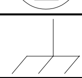
European EMC Directive

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.

Warranty Policy

This Comtech EF Data product is warranted against defects in material and workmanship for a period of two years 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 you have any questions regarding your equipment or the information in this manual, please contact the Comtech EF Data Customer Support Department.

Overview of Changes made to Revision 0:

Added 57.6 kbps through-out the manual as required.

Added Version 7.1.7 to Chapter 3.

Added FW/6535-1AH to Appendix B.

Chapter 1. INTRODUCTION

SNM-1001A
Satellite Modem

The SNM-1001A Satellite Modem is a dual function modem: it can operate in burst and continuous mode.

1.1 Standard Features

- Burst mode operation: 19.2 or 57.6 kbps, 1/2 rate QPSK (see Appendix C)
- Differential encoder/decoder
- Built-in scramblers/descramblers
- Tx and Rx frequency synthesizers
- Multi-rate FEC convolutional Viterbi and Sequential Decoder
- Fully Accessible System Topology (FAST) (see Appendix A)
- Built-in self test (see Chapter 5)
- Asymmetrical loop timing

1.1.1 Modem Functions

Modulator	Demodulator
Performs filtered BPSK, QPSK, OQPSK, and 8PSK modulation onto a variable frequency/amplitude carrier.	Performs filtered BPSK, QPSK, OQPSK, and 8PSK demodulation from carriers of variable frequencies/amplitudes.
Encodes the data for the appropriate decoder.	Decodes the data.
Scrambles the data.	Descrambles the data.
Monitors and displays the modulator status without interrupting service.	Monitors and displays the demodulator status without interrupting service
Provides send clock timing	
Performs self-test.	Performs self-test.

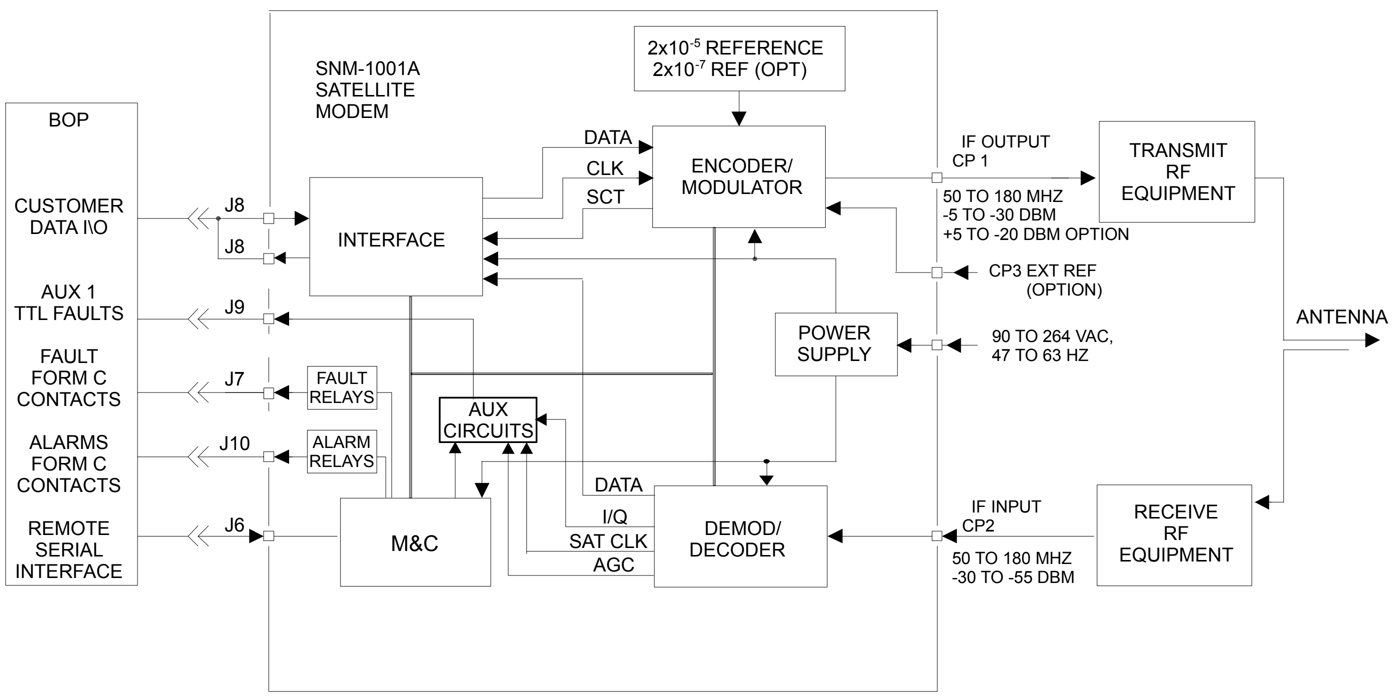


Figure 1-1. Block Diagram

1.1.2 Modes of Operation

The following modes of operation are supported:

- AUPC (*Note 1*)
- Custom (*Note 2*)
- EFD Closed Network
- SDM-100 Emulation
- SDM-6000 Emulation

Notes:

1. The AUPC option allows an additional overhead channel to be multiplexed and demultiplexed from the data carrier.
2. The Custom mode of operation enables the programming of the modem for emulating most proprietary modems.

Two mechanisms are provided for uplink power control within a closed network. One method, which requires the optional AUPC interface card, is used for control between two links to sustain sufficient transmit power to maintain a programmed Eb/N0 at both ends.

The second method is used for self-monitoring the carrier from the same uplink with the local demodulator, requires no additional hardware, and is software-selectable. This method is appropriate for applications such as paging networks, where the uplink is transmitting to receive-only devices.

The modem interfaces between the channel unit or multiplexer (MUX) and Intermediate Frequency (IF) converter equipment operating in a 50 to 180 MHz band.

The modem interfaces between Single Channel Per Carrier (SCPC) fixed-rate terminal equipment operating within the following specifications:

- Data rate of 4 Mbps with 7/8 Forward Error Correction (FEC)
- Symbol rate of 4.8 ks/s to 2500 Ms/s

1.1.3 Modem Construction

The modem is a complete, self-contained unit in a standard, one-rack unit (1 RU), 19-inch (48 cm), rack-mountable enclosure weighing approximately 11 lbs (5 kg). The unit was constructed using modular design (Figure 1-2), and consists of from two to five Printed Circuit Boards (PCBs), depending on the configuration. The modem consists of two major, replaceable assemblies as follows:

- Rear panel, main PCB, and power supply
- Upper and lower enclosures (chassis) and the front panel

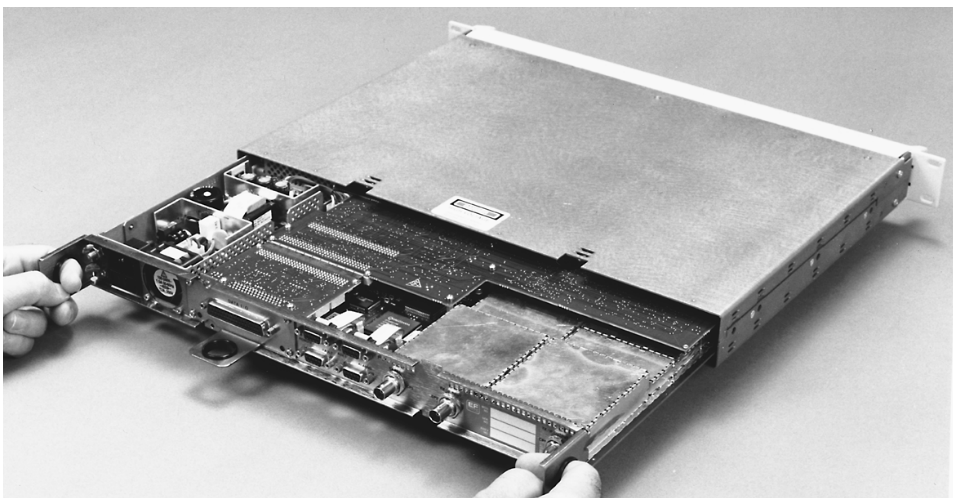
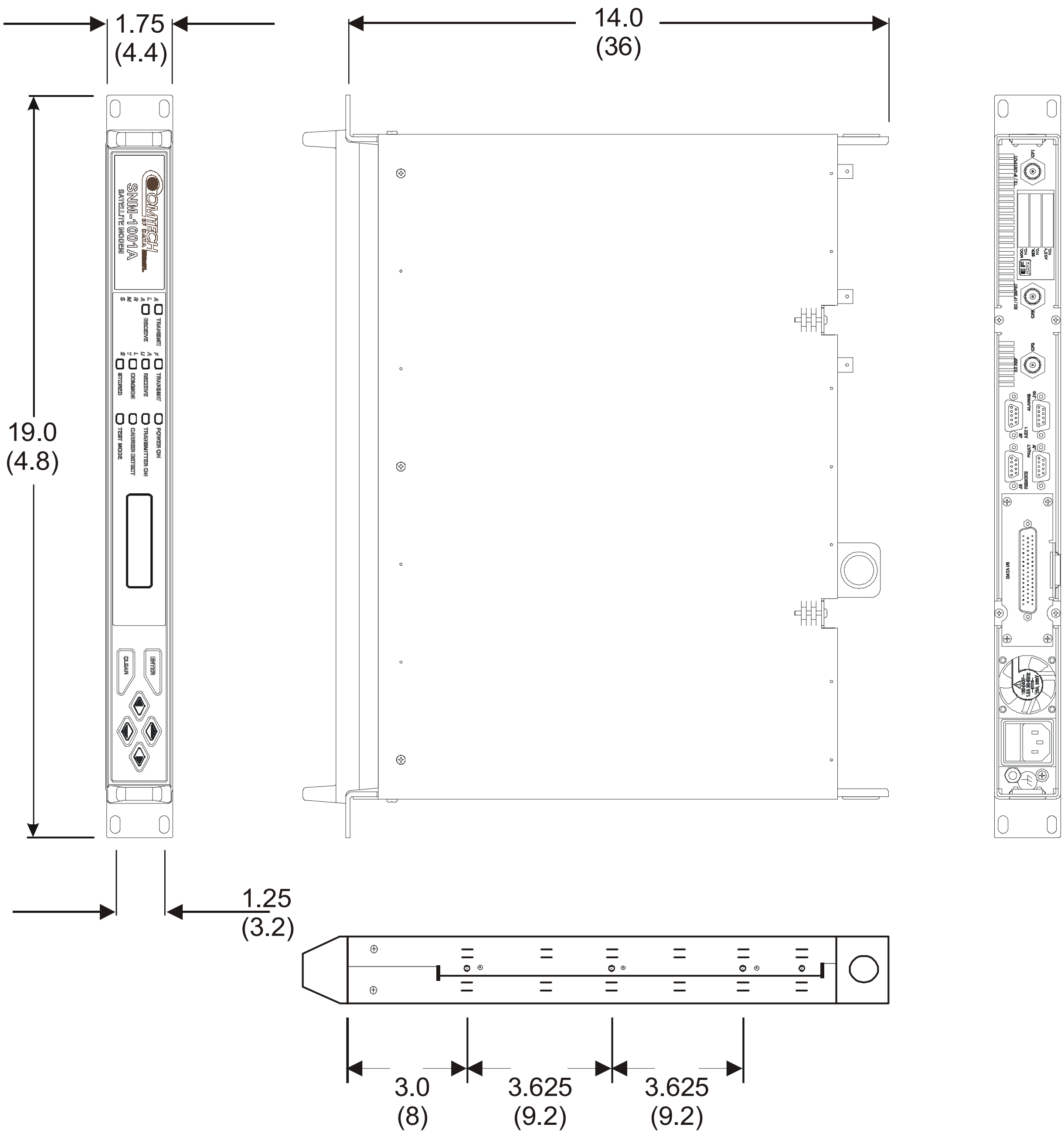


Figure 1-2. Modular Design

The front panel of the modem contains all Monitor and Control (M&C) function indicators used for operating the modem. The modem can be operated remotely via the M&C connection on the rear panel.

1.1.3.1 Dimensional Envelope Diagram

Dimensions are listed in inches with centimeters in parentheses.



1.1.4 Typical Spectral Occupancy

Figure 1-3 shows a typical spectral occupancy curve using the Comtech EF Data filter mask.

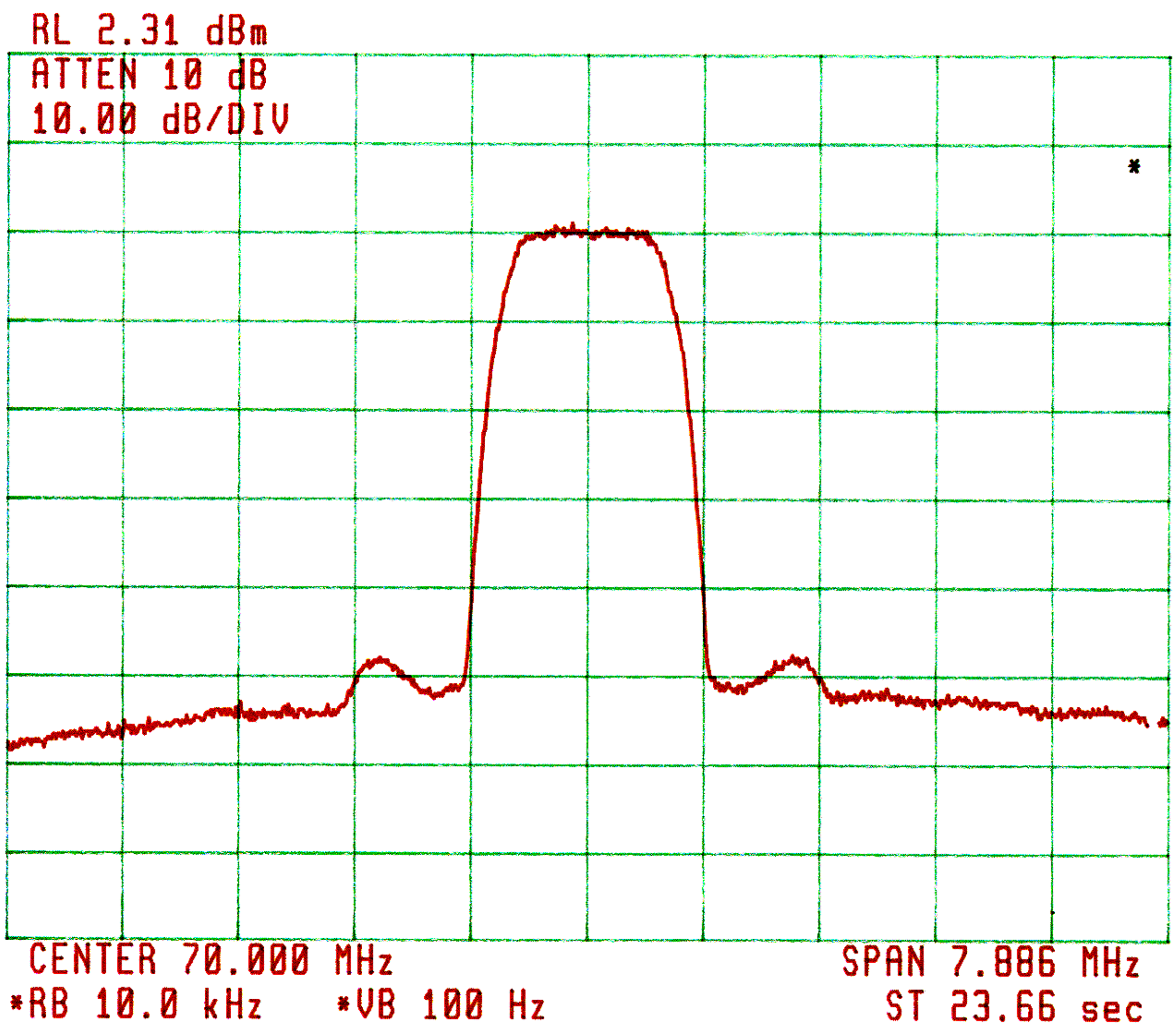


Figure 1-3. Typical Spectral Occupancy

1.2 Major Assemblies

Part Number	Description	Comments	Installation	
			Factory	User
PL/6092	Assy, Top	Chassis	x	
PL/6095-1	Module, AC -5 Output 75Ω	Optional	x	
PL/6095-2	Module, AC +5 Output 75Ω	Optional	x	
PL/6095-3	Module, AC -5 Output 50Ω	Optional	x	
PL/6095-4	Module, AC +5 Output 50Ω	Optional	x	
PL/6095-5	Module, AC -5 Output 75Ω, H/S	Optional	x	
PL/6095-6	Module, AC +5 Output 75Ω, H/S	Optional	x	
PL/6095-7	Module, AC -5 Output 50Ω, H/S	Optional	x	
PL/6095-8	Module, AC +5 Output 50Ω, H/S	Optional	x	
PL/6095-11	Module, -48 VDC, -5 output 75Ω	Optional	x	
PL/6095-12	Module, -48 VDC, +5 output 75Ω	Optional	x	
PL/6095-13	Module, -48 VDC, -5 output 50Ω	Optional	x	
PL/6095-14	Module, -48 VDC, +5 output 50Ω	Optional	x	
PL/6095-15	Module, -48 VDC, -5 output 75Ω, H/S	Optional	x	
PL/6095-16	Module, -48 VDC, +5 output 75Ω, H/S	Optional	x	
PL/6095-17	Module, -48 VDC, -5 output 50Ω, H/S	Optional	x	
PL/6095-18	Module, -48 VDC, +5 output 50Ω, H/S	Optional	x	
P/L7710-1	Assy, Front Panel	Component	x	
KT/9672-1	Turbo Product Upgrade Kit	Opt *(Note)*	x	x
PL/6284	INTELSAT/Closed Network TX Reed-Solomon	Optional	x	x
PL/6285	INTELSAT/Closed Network RX Reed-Solomon	Optional	x	x
PL/5727-1	Connector, 25-Pin D	Optional	x	x
PL/6031-1	Connector, 37-Pin D	Optional	x	x
PL/6032-1	Connector, 34-Pin Winchester	Optional	x	x
PL/6032	Connector, 34-Pin Winchester	Optional	x	x

Note: The overhead interface card and Reed-Solomon cards cannot be installed if Turbo Product Codec is installed.

1.3 Options

Option	Comment
50Ω IF Impedance	-20 dB return loss 50 to 180 MHz
-20 to +5 dBm IF output	Output 2nd Harmonics: < 45 dBc at data rates < 64 kbps < 50 dBc at data rates ≥ 64 kbps
Sequential, Viterbi or Turbo Product Codec	Modem can be supplied with any combination of: • Viterbi • Sequential • Turbo **Note**: For Turbo, Reed-Solomon is not applicable, Revision C (or later) main board is required
Reed-Solomon Codec	Concatenates with Viterbi or Sequential (Not applicable to Turbo)
OQPSK	Requires Viterbi or Turbo Product Codec
8PSK, 2/3 rate, IESS-310	Requires Viterbi and Reed-Solomon Codec
8PSK, 2/3 rate, EFD Mode	Requires Viterbi Codec
8PSK, 3/4 rate, Turbo	Requires Turbo Product Codec
AUPC	
EIA-422/EIA-449 Interface	
48 VDC Input Power	
Single Data/Code Rate	
≤ 512 kbps maximum data rate	
≤ 5.0 Mbps maximum data rate	
High Stability Reference	Internal stability = ± 0.2 PPM, with the ability to drive out the external reference connector
Asymmetrical Loop Timing (SCT)	
Transmit Only	
Receive Only	

1.3.1 FAST Options

The modem has a variety of hardware options available as shown in Table 1-1. Hardware options are available through conventional means as well as through Aaptive Broadband's FAST system. OQPSK mode is available through the FAST feature. For detailed descriptions of the FAST feature and all options, refer to Appendix A.

Note: Comtech EF Data has included a DEMO Mode in the Utility Menu. This feature will allow the operator to experience any of the FAST options. This feature has a 60-minute time limit, after which, the unit will return to its previous configuration.

Table 1-1. FAST Options and Required Configurations

Hardware	Single Data Rate	Low Variable Data Rate (up to 512 kbps)	High Variable Data Rate (up to 4.375 Mbps)	Sequential Decoder	Viterbi Decoder	Asymmetrical Loop Timing	8PSK	Reed–Solomon Codec	AUPC
Basic Platform SNM-1001A	●			● 1	● 1				
FAST Options		●	●	●	●	●	●		
FAST Options with Reed Solomon Hardware								●	●

1 The basic modem is shipped with either Sequential or Viterbi decoder.

1.3.2 Factory-Installed Options

Consult a Comtech EF Data Customer Support representative for modem options. The following options are installed at the factory:

- Output Impedance: 75Ω (50Ω Optional)
- High Stability Reference Oscillator
- High-power version (+5 to -20 dBm)
- Offset Quadrature Phase Shift Keying (OQPSK)

1.3.3 Factory- or User-Installed Options

Consult a Comtech EF Data Customer Support representative for modem options. The following options can be factory- or user-installed:

- Turbo Product Codec
- INTELSAT/Closed Network TX or RX Reed-Solomon
- AUPC

Chapter 2. INSTALLATION

This chapter provides unpacking and installation instructions, and a description of external connections and backward alarm information.

CAUTION

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 cartons containing foam spacing for maximum shipping protection.

CAUTION

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

Unpack the modem as follows:

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

The modem arrives fully assembled from the factory. After unpacking the modem, install the modem as follows:

1. If required, install the mounting bracket in equipment rack (Figure 2-1). Install and tighten the bracket bolts.

2. Loosen the screw with flat washer located on the left side of modem chassis. Mount the modem chassis into the equipment rack and slide the screw with flat washer through the slot of the mounting bracket. Tighten the screw sufficiently to allow the modem chassis to slide in the bracket.

3. Connect the cables to the proper locations on the rear panel. Refer to Section 2.3 for connector pinouts, placement, and function.

4. Connect the primary power cable to the power source. Before turning on the power switch, become familiar with the front panel operation in Chapter 3.

5. If problems exist with the installation, refer to Chapter 5 for troubleshooting information.

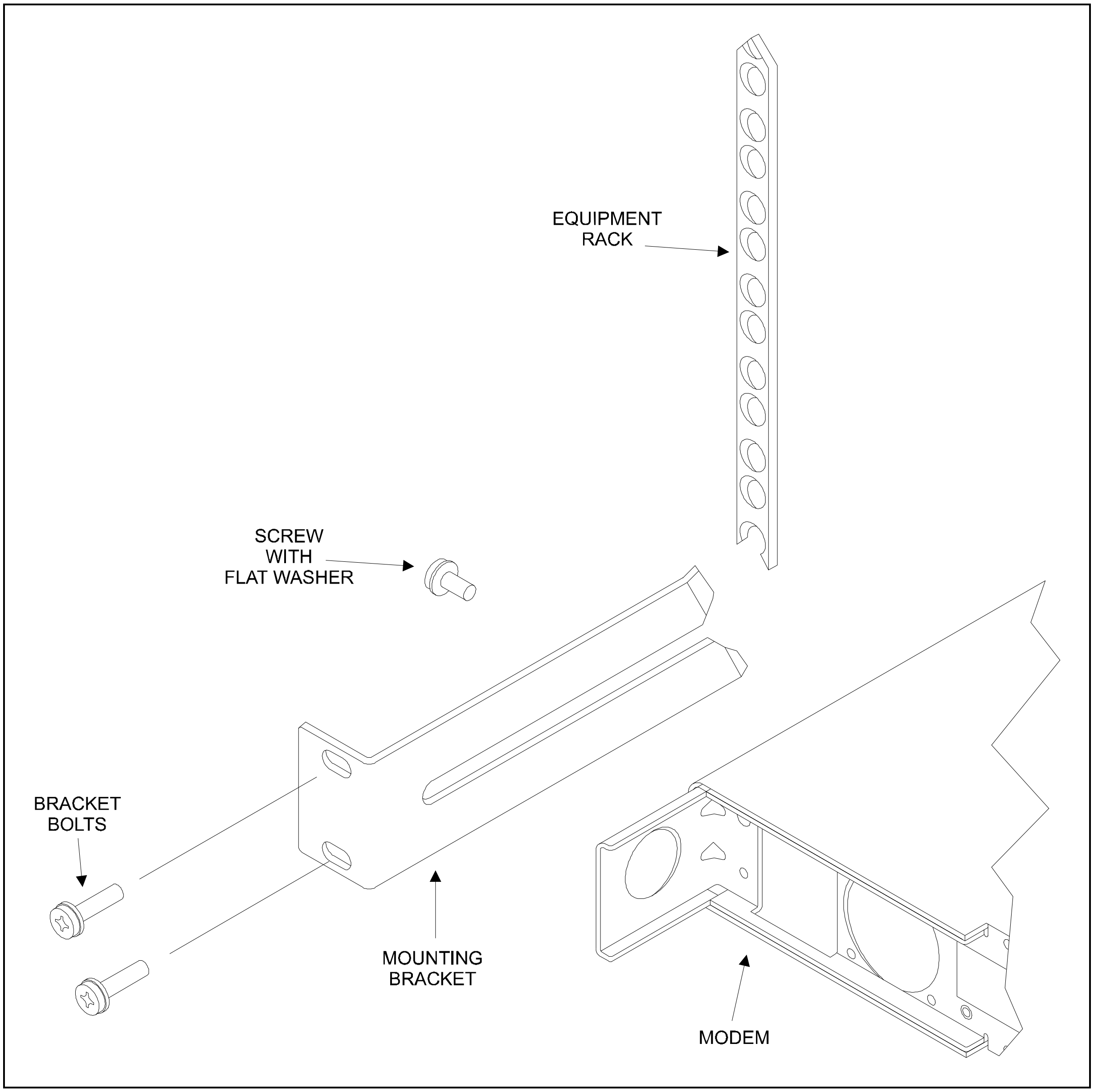


Figure 2-1. Installation of the Mounting Bracket

2.3 External Modem Connections

Rear panel connectors provide all necessary external connections between the modem and other equipment. Table 2-1 lists these connectors, and Figure 2-2 through Figure 2-4 show the locations.

Table 2-1. Modem Rear Panel Connectors

Name	Ref Des	Connector Type	Function
TX/IF OUTPUT	CP1	BNC	RF Output
RX/IF INPUT	CP2	BNC	RF Input
EXTERNAL REF	CP3	BNC	Input
DATA I/O	J1	37-pin D	Eurocomm D11
REMOTE	J6	9-pin D	Remote Interface
FAULT	J7	9-pin D	FORM C Fault Relay Contacts
DATA I/O	J8	25-pin D 34-pin 37-pin D	Data Input/Output (standard modem) V.35 EIA-422
AUX 1	J9	9-pin D	(TTL) Faults Satellite Clock Demod I/Q Automatic Gain Control (AGC) Out
ALARMS	J10	9-pin D	FORM C Alarm Relay Contacts
AC INPUT	NONE	IEC	
GROUND	NONE	10-32 Stud	

Note: The European EMC Directive (EN55022, EN50082-1) requires using properly shielded cables for DATA I/O. These cables must be double-shielded from end-to-end, ensuring a continuous ground shield.

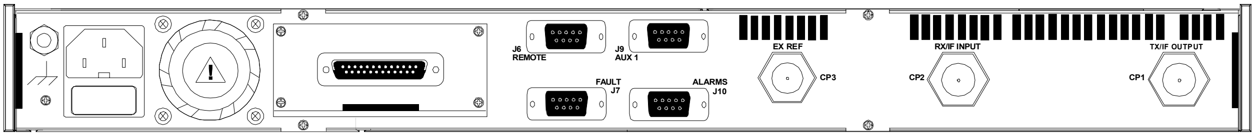


Figure 2-2. Basic Modem, 25-Pin D Connector

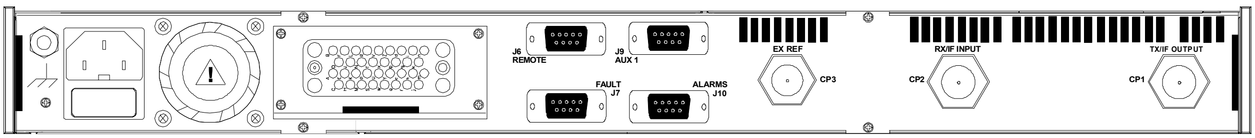


Figure 2-3. (V.35) 34-Pin Winchester Connector

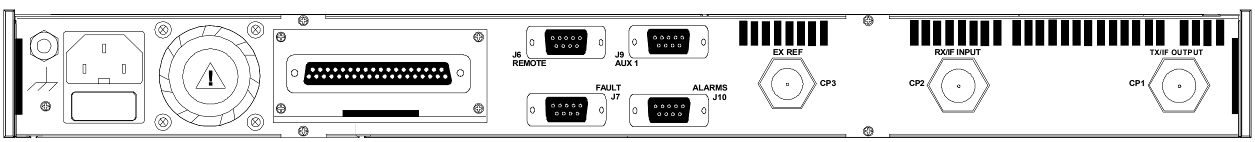


Figure 2-4. EIA-422/449, 37-Pin D Connector

2.3.1 Remote Connector and Pinouts (J6)

The remote connector is a 9-pin subminiature female D connector (J6) located on the rear panel of the modem. Screw locks are provided for mechanical security of the mating connector.

The remote connector interfaces the M&C functions to a remote location. The remote location can be an M&C computer located away from the modem, but attached via cable to the remote connector. This DCE interface is user selectable for either EIA-232 or EIA-484. Refer to Appendix B for a description of the remote interface commands.

Table 2-2. Remote Connector and Pinouts (J6)

EIA-232	
Pin #	Name
1	
2	RD (RX)
3	TD (TX)
4	
5	GND
6	DSR
7	RTS
8	CTS
9	

EIA-485		
Pin #	Name (2-Wire)	Name (4-Wire)
1	GND	
2		
3		
4*	+RX/TX	+TX
5*	-RX/TX	-TX
6		
7		
8*	+RX/TX	+RX
9*	-RX/TX	-RX

*For 2-Wire Operation:

- Only two wires are required.
- Tie pins 4 and 8 together (both +).
- Tie pins 5 and 9 together (both -).

2.3.2 Fault Connector and Pinouts (J7)

The fault connector provides Form C contact closures for fault reporting. The three Form C summary fault contacts, ratings 1A maximum at 24 VDC, 0.5A at 120 VAC, are Modulator, Demodulator, and Common Equipment.

The fault interface connection is a 9-pin subminiature female D connector (J7) located on the rear panel of the modem. Screw locks are provided for mechanical security on the mating connector.

Table 2-3. Fault Connector and Pinouts (J7)

Pin #	Signal Function	Name
1	Common equipment is not faulted	NO
2		COM
3	Common equipment is faulted	NC
4	Modulator is not faulted	NO
5		COM
6	Modulator is faulted	NC
7	Demodulator is not faulted	NO
8		COM
9	Demodulator is faulted	NC

Note: A connection between the common (COM) and normally open (NO) contacts indicates no fault.

Refer to Chapter 5 for a discussion of monitored faults. To obtain a system summary fault, connect all the Form C contacts in parallel.

2.3.3 Data I/O Interface Connector (J8)

The Data I/O interface connector conducts data input and output signals to and from the modem, and connects to the customer's terrestrial equipment, breakout panel, or protection switch. The modem is currently available with a choice of four Data I/O connectors, as follows:

- 25-pin D connector is the standard connector shipped with a base platform modem.
- 34-pin Winchester is an alternate connector available upon special request for the base platform modem.
- 37-pin D is an alternate connector available upon special request for the base platform modem.

The Data I/O pinout is different for each of the interface configurations. For pinout information, refer to the appropriate table as follows:

Connector	EIA-232	EIA-422/ EIA-449	V.35	Refer to
25-pin Connector Standard	X	X	X	Table 2-4
34-pin Connector Optional			X	Table 2-5
37-pin Connector Optional		X		Table 2-6

Table 2-4. 25-Pin D Connector Pinouts

Pin #	EIA-422	EIA-232	V.35
1	SHLD	SHLD	SHLD
2	SD-A	TXD	SD-A
3	RD-A	RXD	RD-A
4	RS-A	RTS	RTS
5	CS-A	CTS	CTS
6	DM-A	DSR	DSR
7	SIGGND	SIGGND	SIGGND
8	RR-A	DCD	RLSD
9	RT+B		SCR+B
10	RR-B		
11	TT+B		SCTE+B
12	ST+B		SCT+B
13	CS+B		
14	SD+B		SD+B
15	ST-A	ST	SCT-A
16	RD+B		RD+B
17	RT-A	RXC	SCR-A
18	LL	LL	LL
19	RS+B		
20*	MC-A	MC	MC-A
21	DF	DF	DF
22	DM+B		
23*	MC+B		MC-B
24	TT-A	TXC	SCTE-A
25	MF	MF	MF

***Note:** Use the MASTER clock for EXTERNAL clock input. This clock input should equal the data rate unless the Asymmetrical Loop Timing Option (ASLT) is available. The ASLT option allows selection of different clock rates that vary from the digital data rate. Refer to the Utility/Modem Type/Modem Options menu for the ASLT option information.

Table 2-5. 34-Pin Winchester Connector Pinouts (V.35)

Pin #	Name
A	Ground
B	Ground
C	Request to Send (RTS)
D	Clear to Send (CTS)
E	Data Set Ready (DSR)
F	Receive Line Signal Detect (RLSD)
P	Send Data A (SD-A)
R	Receive Data A (RD-A)
S	Send Data B (SD+B)
T	Receive Data B (RD+B)
U	Serial Clock Transmit External A (SCTE-A)
V	Serial Clock Receive A (SCR-A)
W	Serial Clock Transmit External B (SCTE+B)
X	Serial Clock Receive B (SCR+B)
Y	Serial Clock Transmit A (SCT-A)
c (CC)	External Reference Clock A (EXC-A)
d (DD)	External Reference Clock B (EXC-B)
m (MM)	Modulator Fault (MF)
n (NN)	Demodulator Fault (DF)
a(AA)	Serial Clock Transmit B (SCT+B)

Note: Pins H, J, K, L, M, N, Z, a (AA), b (BB), e (EE), f (FF), h (HH), j (JJ), k (KK), l (LL) have no connection.

The modem is available with a Winchester V.35 as the data I/O connector (PL/6032). There is a jumper on the unit that either opens or closes the CC line. The interface is shipped with jumpers in positions 2 and 3, because:

1. Comtech EF Data has determined that several locations use Fireberd™ test equipment and a conflict will occur if CC is connected between the modem and the Fireberd™.

2. Placing the jumper in positions 2 and 3 opens up the CC line, because the TTC/Fireberd™ test equipment interfaces use the line for DTE/DCE control.

3. Grounding pin CC at the Fireberd™ interface will change the Fireberd ™ to a DCE device.

4. Comtech EF Data uses the CC and DD for the input master clock (same as the external clock input to the modem). To input an external clock, change the jumper to positions 1 and 2 (the pin closest to the Winchester connector).

Table 2-6. 37-Pin Connector Pinouts (Optional)

Pin #	EIA-422/MIL-188-144
1, 19	Shield
3	MF
4	SD-A
5	ST-A
6	RD-A
7	RS-A
8	RT-A
9	CS-A
11	DM-A
13	RR-A
16	MC-A
17	TT-A
20, 37	SIGGND
21	DF
22	SD+B
23	ST+B
24	RD+B
25	RS+B
26	RT+B
27	CS+B
29	DM+B
31	RR+B
34	MC+B
35	TT+B

There are jumpers on the PL/6031 EIA-422 interface. Place the jumpers on the center pin and the pin towards the Master Clock (MC) to allow an external clock input on pins 16 and 34.

If desired, place the jumpers on the TR side to allow an external clock input on pins 12 and 30. Place the jumpers on the TR side for Demand Assigned Multiple Access (DAMA) applications.

2.3.3.1 Data I/O Interface Connector (J8) Removal/Installation Procedures

The following procedures outline the removal and installation of the Data I/O connector (J8). These procedures are written with the assumption that the same configured connector will be reinstalled. However, the operator does have an option to install a different configured connector.

Refer to Table 2-7 for a matrix explaining connector options.

Table 2-7. Connector (J8) Matrix

Modem Configuration	EIA-232	EIA-422/EIA449	V.35
25-pin Connector	X	X	X
34-pin Connector			X
37-pin Connector		X	

2.3.3.1.1 Removing the Data I/O Connector (J8)

1. (For Ribbon-Configured Connector PL/6031.) Remove Data I/O connector (J8) (Figure 2-5) as follows:

    a. Remove four screws securing the rear panel to the chassis.

    b. Pull out rear panel to gain access to disconnect connector (J8).

    c. Disconnect connector (J8) from the PCB.

    d. Remove the four screws securing connector (J8) to the rear panel.

    e. Remove the connector (J8).

2.3.3.1.2 Installing the Data I/O Connector (J8)

1. (For Ribbon-Configured Connector PL/6031.) Install Data I/O connector (J8) (Figure 2-5) as follows:

   a. Position connector (J8) in rear panel.

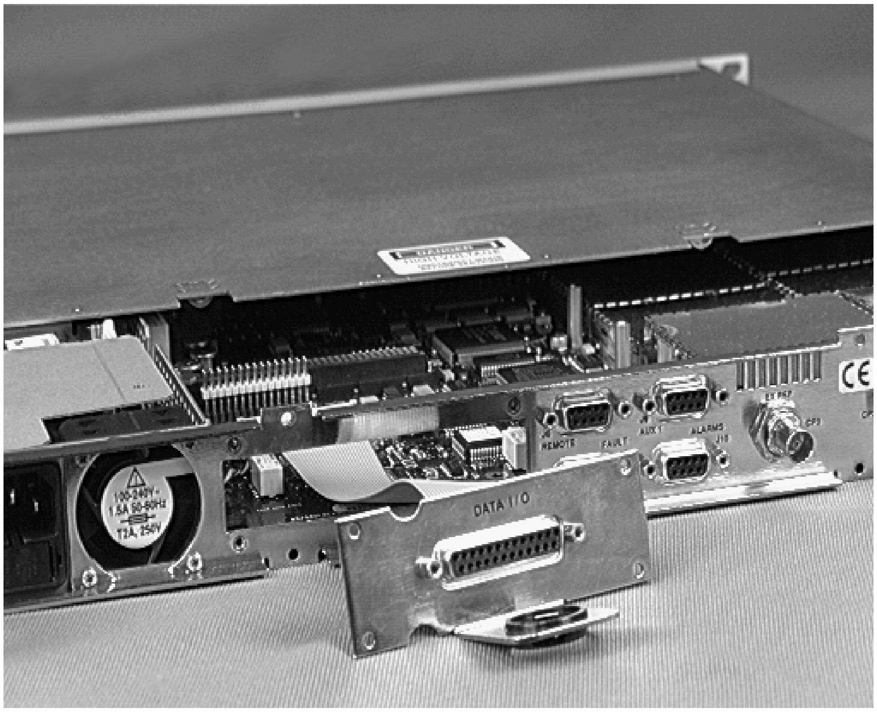
   CAUTION

   Use care when connecting the data I/O connector (J8) to the PCB. Damage to the connector pins may render the data I/O connector (J8) unserviceable. Misalignment can be the result.

   b. Connect connector (J8) to the PCB.

   c. Secure connector (J8) to the rear panel with four screws.

   d. Position the rear panel to mate with the chassis and secure with four screws.



For Ribbon-Configured Connector

Figure 2-5. Data I/O Connector (J8) Removal/Installation

2.3.4 Auxiliary 1 Connector and Pinouts (J9)

The auxiliary 1 (AUX 1) connector provides:

- MOD and DEMOD (TTL) faults
- Satellite clock
- Satellite I&Q
- Automatic Gain Control (AGC) output voltage

The faults are open collector levels that indicate a modulator or demodulator failure. A logic "1" indicates the faulted condition.

AGC_OUT is a programmable voltage, 0 to 10V, for a receive signal level between -25 and -60 dBm.

AUX 1 connection is a 9-pin female D connector (J9) located on the rear panel of the modem. Screw locks are provided for mechanical security on the mating connector. Refer to Table 2-8 for pinout information.

Table 2-8. AUX 1 Connector and Pinouts (J9)

Pin #	Signal Function	Name
1	Satellite Clock -	SAT_CLK-
2	No Connection	NC
3	Satellite Clock +	SAT_CLK+
4	MODULATOR TTL Fault	MDFLTTTL
5	Ground	GRN
6	RX_Q	RX Q Channel Eye
7	DEMODULATOR TTL Fault	
8	RX 1 Channel Eye	RX_1
9	Agc Output	AGC

2.3.5 Alarms Connector and Pinouts (J10)

The alarm connector provides Form C contact closures for alarm reporting. The two Form C summary fault contacts are Modulator and Demodulator.

The alarm connection is a 9-pin female D connector (J10) located on the rear panel of the modem. Screw locks are provided for mechanical security on the mating connector. Refer to Table 2-9 for pinout information.

Table 2-9. Alarms Connector and Pinouts (J10)

Pin #	Signal Function	Name
1	Alarm 1 is faulted	NO
2		COM
3	Alarm 1 is not faulted	NC
4	Alarm 2 is faulted	NO
5		COM
6	Alarm 2 is not faulted	NC
7	Alarm 3 is faulted	NO
8		COM
9	Alarm 3 is not faulted	NC

Alarm 1 = Not used
Alarm 2 = TX
Alarm 3 = RX

Refer to Chapter 5 for a discussion of monitored alarms. To obtain a system summary alarm, connect all the Form C contacts in parallel.

2.3.6 RF Output Connector (CP1)

CP1 is a BNC connector for the transmit IF signal. The output impedance is 75Ω (50Ω optional), and the output power level is -5 to -30 dBm, with +5 to -20 dBm optional. In normal operation, the output will be a QPSK (Optional: OQPSK) or BPSK modulated result of the Data I/O connector between 50 and 180 MHz, in 1 Hz steps.

2.3.7 RF Input Connector (CP2)

CP2 is a BNC connector for the receive IF signal. The input impedance is 75Ω (50Ω optional). For normal operation, the desired carrier signal level should be between -30 and -55 dBm. Signals between 50 and 180 MHz are selected and demodulated to produce clock and data at the Data I/O connector.

2.3.8 External Reference (CP3)

CP3 is a BNC connector for an external reference. The input impedance is 75Ω. For normal operation, the reference signal is ≥ 0 dBm.

Valid External Reference frequencies are 1, 5, 10, and 20 MHz.

2.3.9 Power Entry

2.3.9.1 AC Power Connector

A standard, detachable, non-locking, 3-prong power cord (IEC plug) supplies the Alternating Current (AC) power to the modem. Observe the following:

Input Power	55W maximum, 40W typical
Input Voltage	90 to 132 or 175 to 264 VAC Unit switches ranges automatically
Connector Type	I.E.C
Fuse Protection	1A slo-blo Line and neutral fusing 5 mm type fuses

2.3.9.2 48VDC Option

Input Power	55W maximum, 40W typical
Input Voltage	38 to 64 VDC
Connector Type	20A, 3 screw terminal block
Fuse Protection	2A slo-blo

2.3.10 Ground Connector (GND)

A #10-32 stud on the rear panel of the modem is used for connecting a common chassis ground among all equipment.

Note: The AC power connector provides the safety ground.

Chapter 3. FRONT PANEL OPERATION

This chapter describes the front panel operation of the modem, including the menus and their explanations, software configuration, clocking information, and buffering.

For information about remote control operation, refer to Appendix B.

3.1 Front Panel

The modem front panel (Figure 3-1) enables control of modem configuration parameters and displays the modem status.

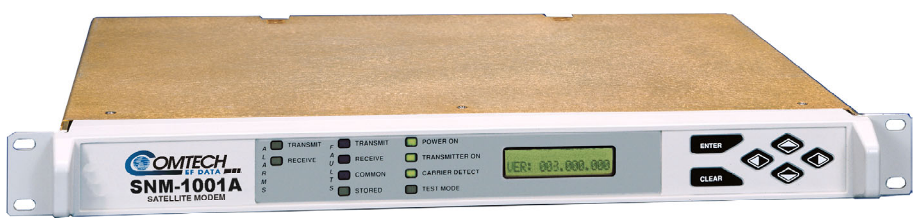


Figure 3-1. Front Panel View

The front panel features include:

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

All functions are accessible at the front panel by entering one of six pre-defined Function Select categories or levels:

- Configuration
- Monitor
- Faults/Alarms
- Stored Faults/Alarms
- AUPC
- Utility

3.1.1 LED Indicators

The 10 LEDs on the front panel indicate modem summary faults, status, and alarms. Table 3-3-1 lists the indicators.

Table 3-3-1. LED Indicators

Name	LED	Meaning
Faults		
Transmit	Red	A fault condition exists in the transmit chain.
Receive	Red	A fault condition exists in the receive chain.
Common	Red	A common equipment fault condition exists.
Stored	Yellow	A fault 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.
Alarms		
Transmit	Yellow	A transmit function is in an alarm condition.
Receive	Yellow	A receive function is in an alarm condition.

3.1.2 Front Panel Keypad

The front panel keypad permits local operation of the modem. The keypad consists of six keys (Figure 3-2).

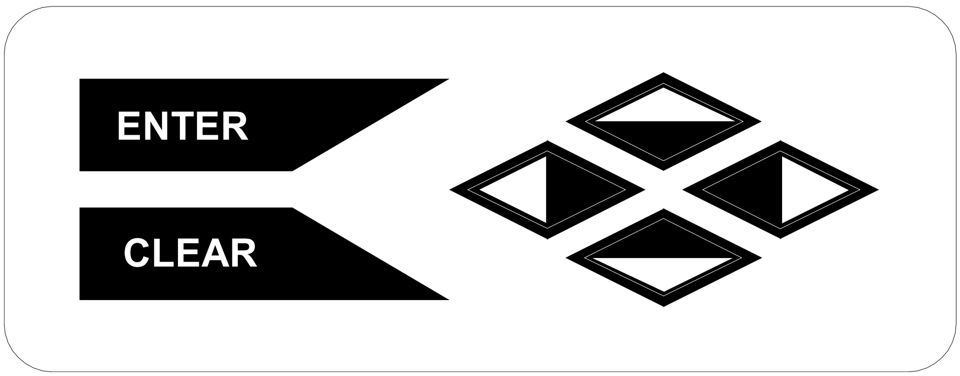


Figure 3-2. Keypad

Each key provides one or more logical functions. These functions are defined in the following table.

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.
Left and Right Diamond Keys	These keys are used to move to the next selection or to move the cursor for certain functions. **Note:** Throughout this chapter, [←] and [→] are used to indicate left and right diamond keys.
Top and Bottom Diamond Keys	These keys are used primarily to change configuration data (numbers). At times, they are also used to move from one section to another. **Note:** Throughout this chapter, [↑] and [↓] are used to indicate top and bottom diamond keys.

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.

3.2 Menu System

Use the Menu Tree (Figure 3-3) as a quick reference for accessing the modem functions.

When the modem power is applied, the base level of the menu system displays the sign-on message:

- Line 1 of the sign-on message is the modem model number and type.
- Line 2 is the version number of the firmware.

The main level of the menu system is Function Select. To access this level from the sign-on message, press the [←] or [→] keys. From the Function Select menu, select one of the functional categories:

- Configuration
- Monitor
- Faults/Alarms
- Stored Faults/Alarms
- 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.

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
- 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 [↑] or [↓] to change the parameters. After the display represents the correct parameters, press [ENTER] to complete the change. This action initiates the necessary programming by the modem.

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

Notes:

1. Menus or commands that are specific to certain modem configurations are only accessible after selecting the appropriate modem configuration. This prevents incompatible parameters from accidentally being selected.
2. All of the windows are accessible in the Custom mode. Take caution not to select incompatible parameters, as the modem does not shut out incompatible command choices in the Custom mode.

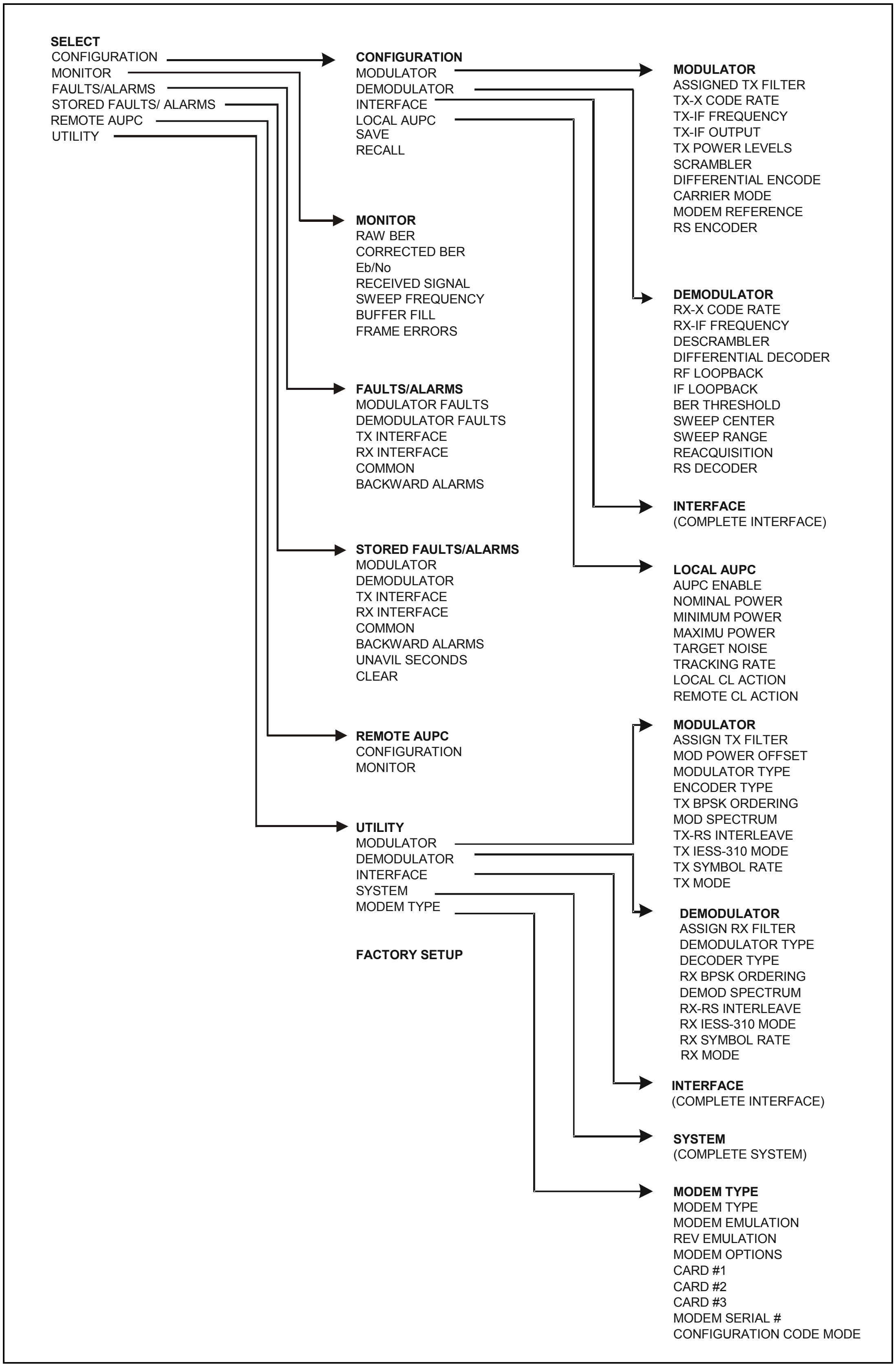


Figure 3-3. Menu Tree

3.3 Opening Screen

This screen is displayed whenever power is first applied to the unit.

```
SNM-1001A     CUSTOM
    VER: 7.1.7
```

Press [→] key to go to the any of the following FUNCTION SELECT menu screens

- CONFIGURATION
- MONITOR
- FAULTS/ALARMS
- STORED FLTS/ALMS
- UTILITY

Note: At any time, pressing CLEAR will return to a main heading.

3.3.1 FUNCTION SELECT: CONFIGURATION

```
FUNCTION SELECT
 CONFIGURATION
```

Press [→] key to go to any of the following sub-menus. Press <ENTER> to review or edit the menu.

CONFIGURATION MODULATOR	Permits the user to fully configure the modulator portion of the modem.
CONFIGURATION DEMODULATOR	Permits the user to fully configure the demodulator portion of the modem.
CONFIGURATION INTERFACE	Permits the user to fully configure the interface portion of the modem.
CONFIGURATION SAVE	Permits the user to fully configure the save portion of the modem
CONFIGURATION RECALL	Permits the user to fully configure the recall portion of the modem

3.3.1.1 CONFIGURATION: MODULATOR

```
CONFIGURATION
  MODULATOR
```

Press <ENTER > to review or edit the following commands.

3.3.1.1.1 MODULATOR:TX-X CODE RATE

```
TX-A   QPSK  1/2
  64.000 Kbps
```

```
TX-B   QPSK 1/2
 128.000 Kbps
```

```
TX-C   QPSK 1/2
 256.000 Kbps
```

```
TX-D   QPSK 1/2
 512.000 Kbps
```

```
TX-V   QPSK 1/2
  38.400 Kbps
```

Upon 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 (Table 3-2) 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 increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Notes:

1. When the TX rate has been programmed, the transmitter is automatically turned off to prevent swamping of other channels. To turn the transmitter on, use the TX-IF Output function.

2. Code Rate 3/4 not compatible with a combination of a CSC Closed Modulator Type and Sequential Encoder.

Table 3-2. Configuration Modulator Data Rates – Continuous Mode

Code Rate	Data Rate Range
BPSK 1/2	2.4 to 1250 kbps
QPSK 1/2 & OQPSK 1/2	4.8 to 2500 kbps
QPSK 3/4 & OQPSK 3/4	7.2 to 3750 kbps
QPSK 7/8 & OQPSK 7/8	8.4 to 4375 kbps
8PSK 2/3	64 to 5000 kbps
BPSK 1/1	4.8 to 2500 kbps
QPSK 1/1 & OQPSK 1/1	9.6 to 5000 kbps
BPSK 21/44	2.4 to 1193 kbps *see Note 3*
BPSK 5/16	2.4 to 781.25 kbps *see Note 3*
8PSK 3/4	384 to 5000 kbps *see Note 3*

Notes:
1. Max Symbol Rate: 2500 kbps.
2. Max Data rate for Low Var Rate: 512 kbps.
3. Turbo only.

Configuration Modulator Data Rates – Burst Mode

Code Rate	Data Rate Range
QPSK 1/2	19.2 or 57.6 kbps

3.3.1.1.2 MODULATOR:TX-IF FREQUENCY

```
TX-IF FREQUENCY
70.000000 MHz
```

Modulator Transmit Frequency Range: 50 to 180 MHz, in 1 Hz steps

Upon 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 increase or decrease the digit at the flashing cursor. Press [ENTER] to complete 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 TX-IF Output function.

3.3.1.1.3 MODULATOR:TX-IF OUTPUT

```
TX-IF OUTPUT
    OFF
```

Modulator Output: On or Off

Upon entry, the current status of the output is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.1.4 MODULATOR:TX POWER LEVEL

```
TX POWER LEVEL
  + 0.0 dBm
```

Modulator Output Power Level Ranges:

-5 to -30 dBm	**Normal Range**
+5 to -20 dBm	**High Power Option**
-129 to +104 dBm	**User Offset Adjust**

An offset can be added through the Utility menu to remove losses or gains in the system.

Note: The front panel display may be changed in the power offset utility. Using that function does not change the actual output power level.

The window displays AUPC_PWR when the AUPC is turned on in the AUPC Configuration menu.

Upon 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 complete the change.

Note: The high power oscillator option is +5 to -20 dB.

3.3.1.1.5 MODULATOR:SCRAMBLER

```
SCRAMBLER
ON
```

Scrambler: On or Off

Upon entry, the current status of the scrambler is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

Note: In Burst Mode, the differential encoder is ignored.

3.3.1.1.6 MODULATOR:DIFF. ENCODER

```
DIFF. ENCODER
ON
```

Differential Encoder: On or Off

Upon entry, the current status of the scrambler is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.1.7 MODULATOR:CARRIER MODE

```
CARRIER MODE
NORMAL-MODULATED
```

Carrier Modes: Normal-Modulated, Center-CW, Dual-CW, Offset-CW

- NORMAL-MODULATED: The Carrier mode is normally in the off position.
- CENTER-CW: (Continuous Wave) Generates a carrier at the current modulator frequency. This can be used to measure the output frequency.
- DUAL-CW: (Continuous Wave) 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-CW: (Continuous Wave) Generates a single, upper, side-band-suppressed carrier signal. The upper side-band is at one-quarter of the symbol rate from the carrier. When inverted spectrum is selected, this generates a single, lower, side-band-suppressed carrier.

Upon entry, the Center mode is displayed. To activate this test mode, press [ENTER]. Press [↑] or [↓] to select the desired mode. To return to the Configuration menu, press [CLEAR].

Note: When [CLEAR] is pressed, the modem is configured to the state before CW mode was invoked. The transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the IF Output function.

3.3.1.1.8 MODULATOR:MODEM REFERENCE

```
MODEM REFERENCE
   INTERNAL
```

Modulator References:

INTERNAL	
EXT 1 MHz	*Note*
EXT 5MHZ	*Note*
EXT 10MHZ	*Note*
EXT 20 MHZ	*Note*
OUPUT 10 MHz	**(High Stability Option only)**

Note: If any external reference is selected for the modem reference and there is no input to CP3, the modem will detect an alarm and switch to the internal clock.

Upon entry, the Internal mode is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.1.9 MODULATOR:RS ENCODER (option)

```
RS ENCODER
   OFF
```

Reed-Solomon Encoder: On or Off

Upon entry, the current status of the Reed-Solomon encoder is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

Note: Programming the Reed-Solomon encoder automatically turns off the RF transmitter (because of symbol rate changes). If none of the proper overhead types and data rates apply, the Reed-Solomon encoder program in the on state will be rejected (double beep).

3.3.1.2 CONFIGURATION: DEMODULATOR

```
CONFIGURATION
DEMODULATOR
```

Press <ENTER > to review or edit the subsequent commands.

3.3.1.2.1 DEMODULATOR:RX-X CODE RATE

```
RX-A QPSK 1/2
64.000 Kbps
```

```
RX-B   QPSK 1/2
128.000 Kbps
```

```
RX-C   QPSK 1/2
256.000 Kbps
```

```
RX-D   QPSK 1/2
512.000 Kbps
```

```
RX-V   QPSK 1/2
38.400 Kbps
```

Upon 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 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 increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Notes:

1. When the RX rate has been programmed, the transmitter is automatically turned off to prevent swamping of other channels. To turn the transmitter on, use the RX-IF Output function.
2. Code Rate 3/4 not compatible with a combination of a CSC Closed Modulator Type and Sequential Encoder.

Table 3-3. Configuration Demodulator Data Rates – Continuous Mode

Code Rate	Data Rate Range
BPSK 1/2	2.4 to 1250 kbps
QPSK 1/2 & OQPSK 1/2	4.8 to 2500 kbps
QPSK 3/4 & OQPSK 3/4	7.2 to 3750 kbps
QPSK 7/8 & OQPSK 7/8	8.4 to 4375 kbps
8PSK 2/3	64 to 5000 kbps
BPSK 1/1	4.8 to 2500 kbps
QPSK 1/1 & OQPSK 1/1	9.6 to 5000 kbps
BPSK 21/44	2.4 to 1193 kbps *Note 3*
BPSK 5/16	2.4 to 781.25 kbps *Note 3*
8PSK 3/4	384 to 5000 kbps *Note 3*

Notes:

1. Max Symbol Rate: 2500 kbps.
2. Max Data rate for Low Var Rate: 512 kbps.
3. Turbo only.

Configuration Modulator Data Rates – Burst Mode

Code Rate	Data Rate Range
QPSK 1/2	19.2 or 57.6 kbps

3.3.1.2.2 DEMODULATOR:RX-IF FREQUENCY

```
RX-IF FREQUENCY
70.000000 MHz
```

Demodulator Receive Frequency: 50 To 180 MHz, In 1 Hz Steps

Upon 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 increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.2.3 DEMODULATOR:DESCRAMBLER

```
DESCRAMBLER
    ON
```

Descrambler: On or Off

Upon entry, the current status of the descrambler is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.2.4 DEMODULATOR:DIFF. DECODER

```
DIFF. DECODER
     ON
```

Differential Decoder: On or Off

Note: In Burst Mode, the differential decoder is ignored.

3.3.1.2.5 DEMODULATOR:RF LOOP BACK

```
RF LOOP BACK
OFF
```

RF Loopback Operation: On or Off

Upon entry, the current status of the RF loopback is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

When RF loopback is turned on, the demodulator is programmed to the same frequency as the modulator. When RF loopback is turned off, the demodulator is tuned to the previous frequency. RF loopback nullifies IF loopback. Figure 3-4 shows a block diagram of RF loopback operation.

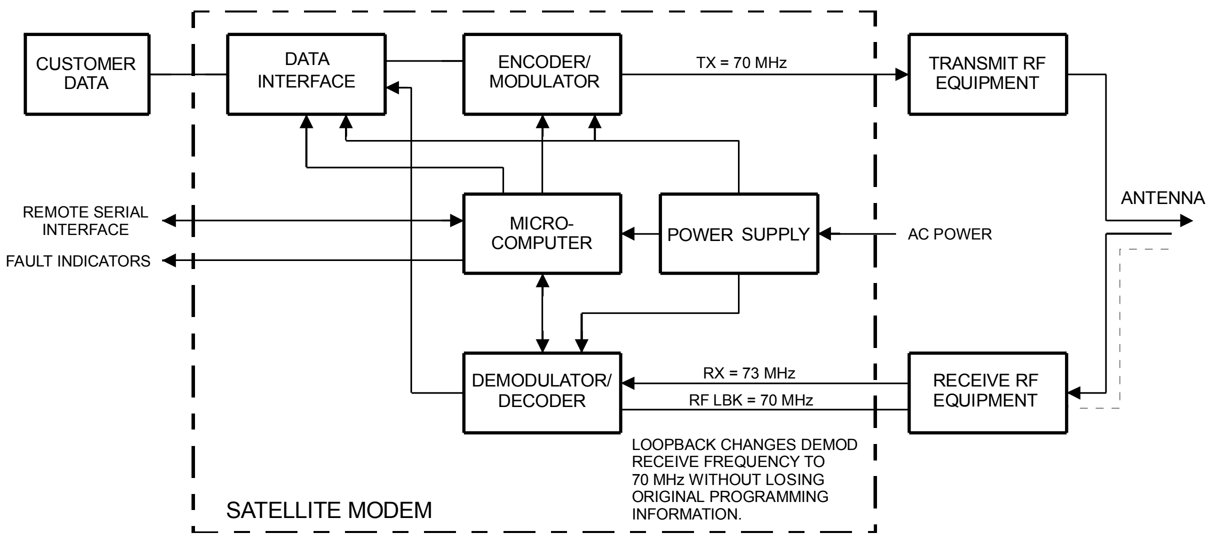


Figure 3-4. RF Loopback

Note: When RF loopback is turned on, the demodulator receive frequency is programmed to be the same frequency as the modulator transmit frequency. This test mode will verify the satellite link without changing the programmed frequency of the demodulator. When RF loopback is turned off, the demodulator is programmed back to the previous frequency.

3.3.1.2.6 DEMODULATOR:IF LOOP BACK

```
IF LOOP BACK
OFF
```

IF Loopback Operation: On or Off

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. IF loopback nullifies RF loopback.

Figure 3-5 shows a block diagram of IF loopback operation.

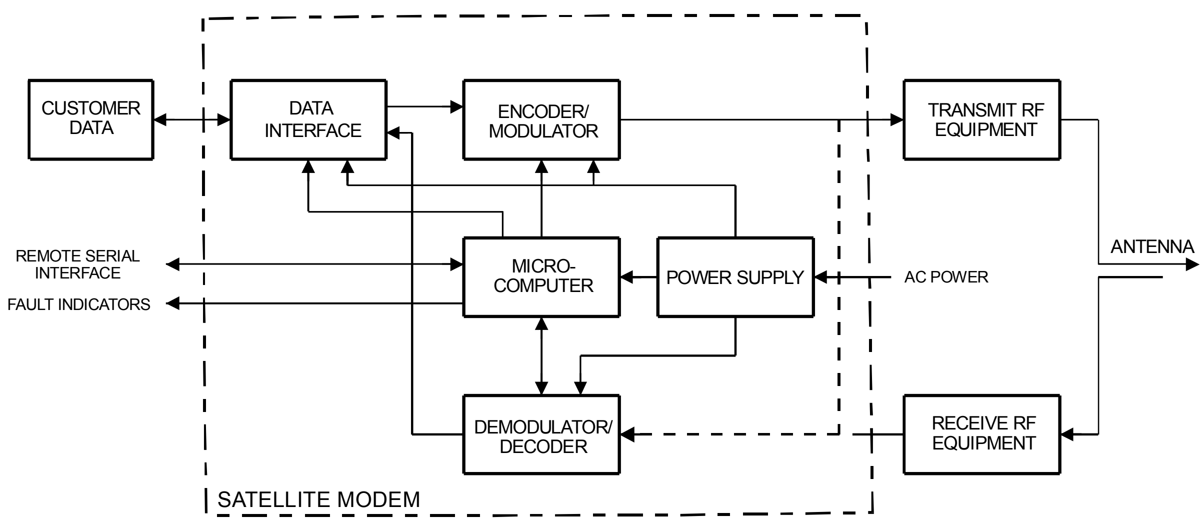


Figure 3-5. IF Loopback

Note: When IF loopback is turned on, the demodulator is looped back to the modulator inside the modem and the demodulator is programmed to the same frequency as the modulator. This test mode will verify the operation of the modem. When IF loopback is turned off, the demodulator is programmed back to the previous frequency and is reconnected to the IF input.

3.3.1.2.7 DEMODULATOR:BER THRESHOLD

```
BER THRESHOLD
    NONE
```

BER Threshold Setting: NONE, or 1.0 E-3 to 1.0 E-8

BER threshold may be set from 1.0 E-3 to 1.0 E-8, or may be disabled by specifying NONE.

Upon entry, the current setting of the BER threshold is displayed. Press [↑] or [↓] to select the desired setting. Press [ENTER] to complete the change.

If the selected BER threshold is exceeded, a receive fault will be indicated by the modem status indicators.

3.3.1.2.8 DEMODULATOR:SWEEP CENTER

```
SWEEP CENTER
 +    0 Hz
```

Sweep Center Frequency Range: -35000 to +35000 Hz

Programs the sweep center frequency for the directed sweep function. 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.

3.3.1.2.9 DEMODULATOR:SWEEP RANGE

```
SWEEP RANGE
60000  Hz
```

Sweep Width Range: 0 to 70000 Hz

Upon entry, the current programmed setting is displayed. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

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. The smaller the range, the faster the modem will lock, provided the receive carrier center frequency is within the RX IF frequency sweep range.

3.3.1.2.10 DEMODULATOR:REACQUISITION

```
REACQUISITION
  0 SECONDS
```

Sweep Reacquisition Time: 0 to 999 Seconds

Upon 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 increase or decrease the digit at the flashing cursor. Select the number of seconds desired for the reacquisition mode. Press [ENTER] to complete the change.

Programs the sweep reacquisition mode time duration. This is the time that the modem will remain in a narrow sweep 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.

3.3.1.2.11 DEMODULATOR:RS DECODER

```
RS DECODER
   OFF
```

Reed-Solomon Decoder: On, Correction Off, or Off

(Reed-Solomon Option only) Upon entry, the current status of the Reed-Solomon decoder is displayed. Use [↑] or [↓] to select one of the following modes:

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.
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.

Press [ENTER] to complete the change.

Note: If none of the proper overhead types or data rates apply, the Reed-Solomon decoder in the on state will be rejected (double beep). With the Reed-Solomon decoder turned on (not off or Correction off), the corrected BER will be reported from the outer decoder (Reed-Solomon decoder).

3.3.1.3 CONFIGURATION: INTERFACE

```
CONFIGURATION
INTERFACE
```

Press <ENTER > to review or edit the following commands.

3.3.1.3.1 INTERFACE:TX CLOCK SOURCE

```
TX CLOCK SOURCE
TX TERRESTRIAL
```

Programs the clock source for the modem transmitter clock to the following configurations:

TX TERRESTRIAL	Sets the TX clock to recover timing from the incoming clock/data.
SCT (INTERNAL)	Sets the TX clock to operate from the modem internal clock (this is also the fallback clock). Note: When loop timing is enabled, SCT (LOOP) is displayed instead of SCT (INTERNAL).
EXT. CLOCK/DATA CLOCK	Sets the TX clock to operate from the external reference clock. Ext Clock: TX Data Rate and Ext.Clock frequency shall match or ASLT option. The correct frequency must be programmed into EXT-CLK FREQ.

Upon entry, the current transmit clock setting is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.3.2 INTERFACE:TX CLOCK PHASE

```
TX CLOCK PHASE
AUTO
```

Transmit Clock Phase: AUTO, NORMAL, or INVERT

Upon entry, the current setting of the TX clock phase is displayed. Press [↑] or [↓] to make the selection. When AUTO is selected, the modem will automatically select NORMAL or INVERT to properly phase the TX clock with the TX data. Press [ENTER] to complete the change.

3.3.1.3.3 INTERFACE:EXT-CLK FREQ

```
EXT-CLK FREQ
1544.000 KHz
```

External Reference Clock Input Frequency Range: 8.000 to 10000.000 kHz

Upon entry, the current setting for the external reference is displayed. Press [←] or [→] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

This clock frequency can be any multiple of 600 Hz from 2.4 to 64 kHz, and can be any multiple of 8 kHz from 64 kHz to 4.376 MHz. This can be used for the Doppler/plesiochronous buffer reference. It can be a reference to SCT.

Use the master clock input on J8 for the external master reference. The external reference on CP3 only allows for 1, 5, 10, and 20 MHz external reference input.

Note: The clock rate must be equal to the data rate unless the asymmetrical loop timing option is present.

3.3.1.3.4 INTERFACE:BUFFER CLOCK

```
BUFFER CLOCK
RX (SATELLITE)
```

Programs the interface buffer output clock to one of the following modes:

RX (SATELLITE)	Sets the output buffer clock to the satellite clock.
SCT (INTERNAL)	Sets the buffer clock to operate from the modem internal clock. This is also the fallback clock.
EXT. CLOCK	Sets this clock source to the external clock.
TX TERRESTRIAL	Sets the buffer output clock to recover timing from the incoming TX data clock.

Upon entry, the current setting of the plesiochronous buffer clock is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.3.5 INTERFACE:BUFFER SIZE

Upon entry, the current buffer length is displayed. Press [↑] or [↓] to select the desired buffer size. Press [ENTER] to complete the change.

The buffer size is displayed in seconds or bits. (Use the Utility Interface menu to change the buffer units to seconds or bits.)

```
BUFFER SIZE
 384 BITS
```

32 To 262144 Bits (16 Bit Steps)

If selecting bits, choose from 32 to 262144 bits, in increments of 16 bits.

OR

```
   BUFFER SIZE
6 MILLI SECONDS
```

1 to 99 ms, or 0 (BYPASS)

If selecting seconds, choose from 1 to 99 ms, in increments of 1 ms or 0 (Bypass).

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.

3.3.1.3.6 INTERFACE:BUFFER CENTER

```
BUFFER CENTER
  YES / NO
```

Buffer Center: Yes or No

This command is used to center the buffer. Choose YES and press [ENTER] twice to center the buffer.

3.3.1.3.7 INTERFACE:RX CLOCK PHASE

```
RX CLOCK PHASE
    NORMAL
```

Receive Clock Phase: Normal or Invert

Upon entry, the current status of the RX Clock is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.3.8 INTERFACE:B-BAND LOOP BACK

```
B-BAND LOOP BACK
OFF
```

Baseband Loopback Operation: On or Off

When baseband loopback is turned on, the data and timing signals are switched from the demodulator to the modulator on the modem side of the interface. The DTE baseband signals are also looped back from the transmitter data and clock to receiver data and clock on the customer side of the interface. This is a bi-directional loopback of the baseband data. Refer to Figure 3-6 for a block diagram of baseband loopback operation.

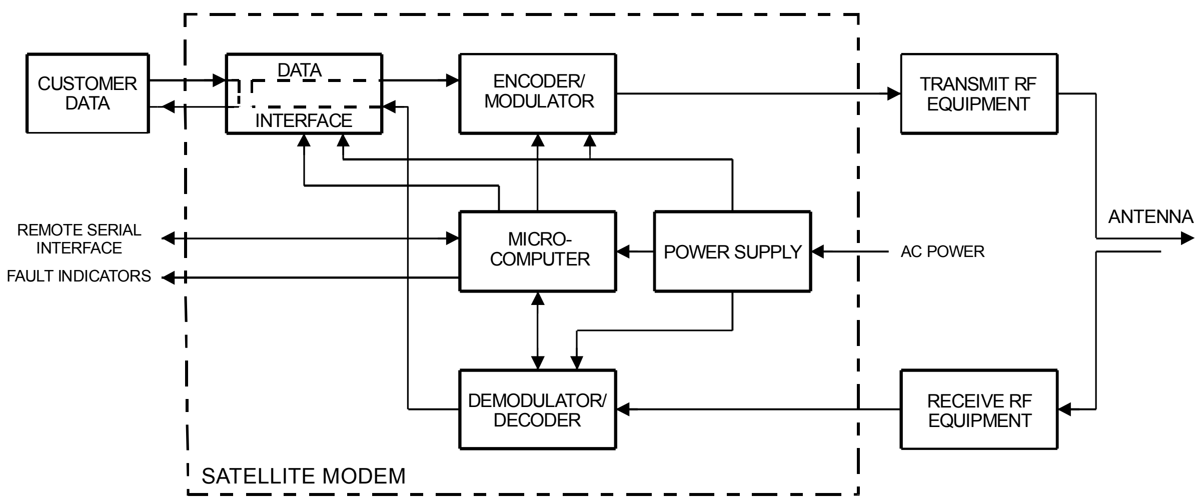


Figure 3-6. Baseband Loopback

Note: When baseband loopback is turned on, 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 verify the customer equipment and cabling between the modem and the customer equipment.

3.3.1.3.9 INTERFACE:INTRFC LOOP BACK

```
INTRFC LOOP BACK
      OFF
```

Interface Loopback Operation: On or Off

Note: This command is available only when the Reed-Solomon PCB is installed.

When INTERFACE LOOPBACK is turned on, data is looped back at the modem side of the interface. This is a bi-directional loop back of the data after the base band data has had the overhead added. Refer to Figure 3-7 for the interface loopback block diagram.

Upon entry, the current status is displayed. [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

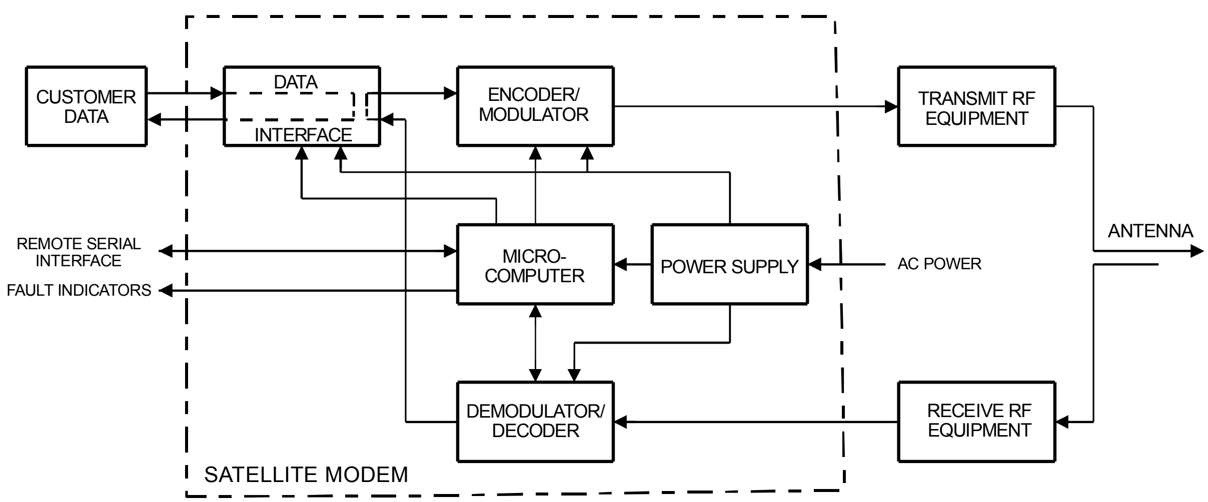


Figure 3-7. Interface Loopback

Note: When interface loopback is turned on, data is looped back on the modem side of the interface. This is a bi-directional loopback of the data after the baseband data had the 16/15 overhead added. This test mode will verify the internal channel unit interface operation.

3.3.1.3.10 INTERFACE:LOOP TIMING

```
LOOP TIMING
    OFF
```

Loop Timing: On or Off

Programs the transmit clocking to the RX satellite clock.

TX and RX data rates must be equal unless the asymmetrical loop timing option is enabled.

3.3.1.4 CONFIGURATION: LOCAL AUPC

Note: This menu is not available if Modem Type is ASYNC or AUPC and Local AUPC is ACTIVE in the Utility menu.

```
CONFIGURATION
 LOCAL AUPC
```

Press <ENTER > to review or edit the following commands.

3.3.1.4.1 LOCAL AUPC:AUPC ENABLE

```
AUPC ENABLE
    OFF
```

AUPC: ON or OFF

Upon entry, the current status is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.1.4.2 LOCAL AUPC:NOMINAL POWER

```
NOMINAL POWER
  -10.0 dBm
```

AUPC Nominal Power Value Range: -5 to -30 dBm, in 0.5 dBm steps

Programs the nominal power value of the AUPC. Upon entry, the current nominal power value is displayed. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.4.3 LOCAL AUPC:MINIMUM POWER

```
MINIMUM POWER
  -30.0 dBm
```

AUPC Minimum Power Level Range: -5 to –30 dBm, in 0.5 dBm steps

Programs the minimum power level of the AUPC. Upon entry, the current minimum power value is displayed. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.4.4 LOCAL AUPC:MAXIMUM POWER

```
MAXIMUM POWER
   -5.0 dBm
```

AUPC Maximum Power Level Range: -5 to –30 dBm, in 0.5 dBm steps

Programs the maximum power level of the AUPC. Upon entry, the current maximum power value is displayed. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.4.5 LOCAL AUPC:TARGET Eb/No

```
TARGET EB/NO
6.0 dB
```

E_b/N_0 Target Set Point Range: 3.2 to 16.0 dB, in 0.1 dB steps

Programs the E_b/N_0 target set point. Upon entry, the current value is displayed. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.4.6 LOCAL AUPC:TRACKING RATE

```
TARGET EB/NO
5.0 dB/Min
```

Maximum Tracking Rate Range: 0.5 to 6.0 dBm/minute, in 0.5 dBm/minute steps

Programs the maximum tracking rate of the AUPC. Upon entry, the current value is displayed. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.4.7 LOCAL AUPC:LOCAL CL ACTION

```
LOCAL CL ACTION
HOLD
```

Local Carrier Loss: HOLD, NOMINAL, or MAXIMUM

Upon entry, the current value is displayed. Press [↑] or [↓] to change the value at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.4.8 LOCAL AUPC:REMOTE CL ACTION

```
REMOTE CL ACTION
      HOLD
```

Remote Carrier Loss: HOLD, NOMINAL, or MAXIMUM

Upon entry, the current value is displayed. Press [↑] or [↓] to change the value at the flashing cursor. Press [ENTER] to complete the change.

3.3.1.5 CONFIGURATION:SAVE

```
CONFIGURATION
     SAVE
```

CONFIGURATION SAVE: 1, 2, 3, 4 or 5

The Configuration Save menu allows programming of 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.

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.

3.3.1.6 CONFIGURATION: RECALL

```
CONFIGURATION
RECALL
```

CONFIGURATION RECALL: 1, 2, 3, 4 or 5

The Configuration Recall menu allows the user to recall a previously saved configuration setup. Upon entry, select memory location 1 through 5 by pressing [↑] or [↓]. Press [ENTER] to execute the recall.

3.3.2 FUNCTION SELECT:MONITOR

```
FUNCTION SELECT
MONITOR
```

Press <ENTER > to review or edit the following commands.

3.3.2.1 MONITOR:RAW BER

```
RAW BER
2.4 E-3
```

Raw BER Range: < m.m E-e to > m.m E-e, or No Data

Displays the current BER or "No Data" (if carrier is not locked).

Notes:

1. Low limit is based on performance.
2. High limit is based on data/code rate.

Press[←] or [→] to move the flashing cursor, and [↑] or [↓] to increase or decrease the selected kbps. Press [ENTER] to complete the change.

3.3.2.2 MONITOR:CORRECTED BER

```
CORRECTED BER
4.0  E-3
```

Corrected BER Range: 1.0 E-3 to 1.0 E-12, or No Data

Displays the current corrected BER or “No Data” (if carrier is not locked).

Notes:

1. Low limit is based on performance.
2. High limit is 1.0 E-12.

Press[←] or [→] to move the flashing cursor, and [↑] or [↓] to increase or decrease the selected kbps. Press [ENTER] to complete the change.

3.3.2.3 MONITOR:EB/NO

```
EB/NO
16.0 dB
```

Eb/No Range: 2.0 to 16.0 dB, or No Data

Displays the current E_b/N_0 or “No Data” (if carrier is not locked).

Notes:

1. Low limit is based on the data rate.
2. High limit is 16.0 dB.

Press[←] or [→] to move the flashing cursor, and [↑] or [↓] to increase or decrease the selected kbps. Press [ENTER] to complete the change.

3.3.2.4 MONITOR:RECEIVE SIGNAL

```
RECEIVE SIGNAL
   -45.0dBm
```

Receive Signal Range: -25.0 to -60.0 dBm

Displays the current receive signal level.

Press[←] or [→] to move the flashing cursor, and [↑] or [↓] to increase or decrease the selected kbps. Press [ENTER] to complete the change.

3.3.2.5 MONITOR:SWEEP FREQUENCY

```
SWEEP FREQUENCY
   +      0 Hz
```

Sweep Frequency Range: -35,000 to +35,000 Hz, or No Data

Displays the current offset frequency or “No Data” (if carrier is not locked).

Press[←] or [→] to move the flashing cursor, and [↑] or [↓] to increase or decrease the selected kbps. Press [ENTER] to complete the change.

3.3.2.6 MONITOR:BUFFER FILL

```
BUFFER FILL
    50%
```

Buffer Fill Status: 1 to 99%.

Displays the current plesiochronous buffer fill status (percent).

3.3.2.7 MONITOR:TX-RS N/K DEPTH

```
TX-RS N/K DEPTH
n.n E-e
```

Monitors Transmit Reed-Solomon coder parameters.

3.3.2.8 MONITOR:RX-RS N/K DEPTH

```
TX-RS N/N DEPTH
n.n E-e
```

Monitors Receive Reed-Solomon coder parameters.

3.3.2.9 MONITOR:TX SCRAM

```
TX SCRAM
```

Transmit Scrambler: **OFF, IBS, SYNC, ITU V.35, INTELSAT V.35, FDC MOD V.35, EFD MOD V.35, 2^{12-1} SYNC**

Monitors selected Transmit Scrambler.

3.3.2.10 MONITOR:RX SCRAM

```
RX SCRAM
```

Receive Scrambler: **OFF, IBS, SYNC, ITU V.35, INTELSAT V.35, FDC MOD V.35, EFD MOD V.35, 2^{12-1} SYNC**

Monitors selected Receive Scrambler.

3.3.3 FUNCTION SELECT:FAULTS/ALARMS

```
FUNCTION SELECT
FAULTS/ALARMS
```

Press <ENTER > to review or edit the following sub-menus.

Line 2 of the display shows the current Faults/Alarms status 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.

Unlike faults, 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.

3.3.3.1 FAULTS/ALARMS:MODULATOR

```
   MODULATOR
---------
```

IF SYNTHESIZER	Modulator IF synthesizer fault.
DATA CLOCK SYN	Transmit clock synthesizer fault. Indicates the internal Voltage Controlled Oscillator (VCO) has not locked to the incoming data clock.
I CHANNEL	I channel data activity fault.
Q CHANNEL	Q channel data activity fault.
AGC LEVEL	TX IF AGC level fault.
MODEM REF ACT	MODEM REF activity alarm.
MODEM REF PLL	MODEM REF PLL not locked.
MODULE	Modulator module fault.
CONFIGURATION	Modulator configuration fault.

3.3.3.2 FAULTS/ALARMS:DEMODULATOR

```
   DEMODULATOR
+------
```

CARRIER DETECT	Carrier detect fault. Indicates the 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.
MODULE	Demodulator/decoder module fault.
CONFIGURATION	Demodulator/decoder configuration fault.

3.3.3.3 FAULTS/ALARMS:TX INTERFACE

```
   TX INTERFACE
---+----
```

TX DROP	Drop interface hardware fault. Typically indicates that the drop interface PLL is not locked (D&I only).
TX DATA/AIS	Data or AIS. When data fault is selected in the Interface Configuration 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 in the Interface Configuration menu, the TX Data/AIS Fault/Alarm is not activated. **Note:** AIS is an alarm, not a switching fault.
TX CLK PLL	Transmitter phase-locked loop fault. Indicates the transmitter Phase-Locked Loop (PLL) is not locked.
TX CLK ACTIVITY	Activity detector alarm of the selected interface transmit clock. The interface will fall back to the internal clock when this alarm is active.
TX AUDIO 1 CLIP	IDR TX audio for channel 1 is clipped.
TX AUDIO 2 CLIP	IDR TX audio for channel 2 is clipped.
CONFIGURATION	TX interface configuration fault. Indicates the TX interface cannot execute a programmed configuration parameter.

3.3.3.4 FAULTS/ALARMS:RX INTERFACE

```
   RX INTERFACE
---------------
```

BUFFER UNDERFLOW	Buffer underflow alarm. Indicates that a buffer underflow has occurred.
BUFFER OVERFLOW	Buffer overflow alarm. Indicates that a buffer overflow has occurred.
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 in the Configuration Interface menu, the RX Data/AIS Fault/Alarm is not activated. **Note:** AIS is an alarm, not a switching fault.
FRAME BER	Frame BER fault. Indicates that the frame BER exceeds 1^{-3}.
BACKWARD ALARM	Backward alarms.
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.
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 if RX 2047 is ON.
BUFFER FULL	Buffer full alarm. Indicates the buffer is less than 10% or greater than 90% full.
RX INSERT	Insert interface hardware fault. Typically indicates the insert interface PLL is not locked. This fault is only available when D&I is selected for modem type.
RX AUDIO 1 CLIP	IDR RX audio for channel 1 is clipped.
RX AUDIO 2 CLIP	IDR RX audio for channel 2 is clipped.
CONFIGURATION	Configuration alarm

3.3.3.5 FAULTS/ALRMS:COMMON

```
        COMMON
-------
```

BATTERY/CLOCK	Battery or clock fault.
-12V SUPPLY	-12V power supply fault.
+12V SUPPLY	+12V power supply fault.
+5V SUPPLY	+5V power supply fault.
SELF TEST	Built in self test fault.
CONTROLLER	Controller fault. Typically indicates the controller has gone through a power on/off cycle.
INTERFACE MODULE	Interface module fault. Typically indicates that the interface module is missing or will not program.

3.3.4 FUNCTION SELECT:STORED FLTS/ALMS

```
FUNCTION SELECT
STORED FLTS/ALMS
```

Press <ENTER > to review or edit the following sub-menus.

The modem stores the first 10 (Flt0 through Flt9) occurrences of fault status changes in the applicable major fault category.

Each fault status change is stored with the time and date of the occurrence of the fault. Stored faults may be viewed by entering the stored faults level from the Select menu. Refer to Faults and Alarms menus for fault explanations. UNAVAL SECONDS fault information.

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 last known 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 currently logged stored faults, 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.

3.3.4.1 STORED FLTS/ALMS:MODULATOR

```
MODULATOR  X
STORED TIME/DATE
```

Displays the stored date and time of a fault or alarm, such as:

IF SYNTHESIZER	MODEM REF ACT
DATA CLOCK SYN	MODEM REF PLL
I CHANNEL	MODULE
Q CHANNEL	CONFIGURATION
AGC LEVEL	

3.3.4.2 STORED FLTS/ALMS:DEMODULATOR

```
DEMODULATOR  X
STORED TIME/DATE
```

Displays the stored date and time of a fault or alarm, such as:

CARRIER DETECT	BER THRESHOLD
IF SYNTHESIZER	MODULE
I CHANNEL	CONFIGURATION
Q CHANNEL	

3.3.4.3 STORED FLTS/ALMS:TX INTERFACE

```
TX INTERFACE  X
STORED TIME/DATE
```

Displays the stored date and time of a fault or alarm, such as:

TX DROP	TX AUDIO 1 CLIP
TX DATA/AIS	TX ADUIO 2 CLIP
TX CLK PLL	CONFIGURATION
TC CLK ACTIVITY	

3.3.4.4 STORED FLTS/ALMS:RX INTERFACE

```
 RX INTERFACE  X
STORED TIME/DATE
```

Displays the stored date and time of a fault or alarm, such as:

BUFFER UNDERFLOW	DEMUX LOCK
BUFFER OVERFLOW	RX 2047 LOCK
RX DATA/AIS	BUFFER FULL
FRAME BER	RX INSERT
BACKWARD ALARM	RX AUDIO 1 CLIP
BUFFER CLK PLL	RX AUDIO 2 CLIP
BUFFER CLK ACT	CONFIGURATION

3.3.4.5 STORED FLTS/ALMS:COMMON

```
    COMMON  X
STORED TIME/DATE
```

Displays the stored date and time of a fault or alarm, such as:

BATTERY/CLOCK	SELF TEST
-12 VOLT SUPPLY	CONTROLLER
+12 VOLT SUPPLY	INTERFACE MODULE
+5 VOLT SUPPLY	

3.3.4.6 STORED FLTS/ALMS:UNAVAILABLE SECONDS

Note: This is available only with the Reed-Solomon option.

```
 UNAVAL SECONDS  X
STORED TIME/DATE
```

A fault is indicated if the Reed-Solomon Codec could not correct bit errors in one block of serialized data in any given second.

3.3.4.7 STORED FLTS/ALARMS:CLEAR

```
   CLEAR  ??
STORED FAULTS
```

3.3.5 FUNCTION SELECT:REMOTE AUPC

Note: This is only available with the AUPC option.

```
FUNCTION SELECT
  REMOTE AUPC
```

3.3.5.1 REMOTE AUPC:CONFIGURATION

```
 REMOTE AUPC
CONFIGURATION
```

To view or change the Remote AUPC functions, enter the Remote AUPC menu 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.

3.3.5.2 CONFIGURATION:AUPC ENABLE

Note: This command is for control or last known status.

```
AUPC ENABLE
    OFF
```

AUPC: ON or OFF

3.3.5.3 CONFIGURATION:B-BAND LOOP BACK

Note: This command is for control or last known status.

```
B-BAND LOOP BACK
      OFF
```

Remote Baseband Loopback: ON or OFF

3.3.5.4 CONFIGURATION:TX 2047 PATTERN

Note: This command is for control or last known status.

```
TX 2047 PATTERN
      OFF
```

Remote TX 2047 Pattern: ON or OFF

3.3.5.5 REMOTE AUPC:MONITOR

```
REMOTE AUPC
  MONITOR
```

3.3.5.5.1 MONITOR: 2047 ERRORS

```
2047 ERRORS
n.n E-e
```

This is a monitor point that displays the current Receive 2047 BER.

If no data is available, “No Data” is displayed.

3.3.6 FUNCTION SELECT:UTILITY

```
FUNCTION SELECT
UTILITY
```

The Function Select Utility menu contains the following command sets:

3.3.6.1 UTLITY:FIXED MODEM RATE

```
UTILITY
FIXED MODEM RATE
```

Note: Single Code/Data Rate Modems only.

3.3.6.1.1 FIXED MODEM RATE: CODE RATE/DATA RATE

```
CR: ______________

DR: ____________Kb
```

If CR/DR is blank, enter the code and data rate one time only.

If CR/DR is displayed, then the fixed code/data rate is shown

3.3.6.2 UTILITY:MODULATOR

```
UTILITY
MODULATOR
```

Select information to view using the [←] [→] arrow keys, then press ENTER.

3.3.6.2.1 MODULATOR:ASSIGN TRANSMIT FILTERS

```
TX-A   QPSK 1/2
64.000 Kbps
```

Assign Transmit Filters: **A, B, C, D or V**
If V selected, also set rate (see Table 3-4)

Upon 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.

Select one of four pre-defined transmitter code/data rate combinations (A, B, C, or D):

```
TX-A   QPSK 1/2
64.000 Kbps
```

```
TX-B   QPSK 1/2
128.000 Kbps
```

```
TX-C   QPSK 1/2
256.000 Kbps
```

```
TX-D   QPSK 1/2
512.000 Kbps
```

Or:

Select the variable rate selection (V).

```
TX-V   QPSK 1/2
38.400 Kbps
```

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 increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Table 3-4. Transmit Code/Data Rates

Code Rate	Data Rate Range
BPSK 1/2	2.4 to 1250 kbps
QPSK/OQPSK 1/2	4.8 to 2500 kbps
QPSK/OQPSK 3/4	7.2 to 3750 kbps
QPSK/OQPSK 7/8	8.4 to 4375 kbps
8PSK 2/3	64 to 5000 kbps
BPSK 1/1	4.8 to 2500 kbps
QPSK/OQPSK 1/1	9.6 to 5000 kbps
BPSK 21/44	2.4 to 1193 kbps *Note 5*
BPSK 5/16	2.4 to 781.25 kbps *Note 5*
8PSK 3/4	384 to 5000 kbps *Note 5*

Notes:

1. When the TX rate has been programmed, the transmitter is automatically turned off to prevent swamping of other channels. To turn the transmitter on, use the TX-IF Output function.
2. Code Rate 3/4 not compatible with a combination of a CSC Closed Modulator Type and Sequential Encoder.
3. Maximum Symbol Rate: 2500 kbps
4. Maximum Data Rate for Low Var Rate: 512 kbps
5. Turbo Only

3.3.6.2.2 MODULATOR:MOD POWER OFFSET

```
MOD POWER OFFSET
    + 0.0 dB
```

Modulator Power Offset Range: -99.9 To +99.9 dB, in 0.1 Db steps

This value is the offset to the modulator output power readout in the Configuration menu. This screen does not actually change the modulator power level, but displays an offset value in the monitor.

Note: Anything except 0.0 dB will cause ADJ to be displayed for the TX power level.

3.3.6.2.3 MODULATOR:MODULATOR TYPE

```
MODULATOR TYPE
INTELSAT OPEN
```

Transmit Filter Type: INTELSAT OPEN, EFD CLOSED, CSC CLOSED, FDC CLOSED, or SDM-51 COMPATIBLE

Notes:

1. Requires EFD, AUPC or CUSTOM modem type (from the Utility Modem Type menu).
2. CSC CLOSED not compatible with 3/4 Code Rate/Sequential Encoder Type combination.

3.3.6.2.4 MODULATOR:ENCODER TYPE

```
ENCODER TYPE
TURBO
```

Encoder Type: VITERBI , SEQUENTIAL or TURBO

Notes:

1. Requires EFD, AUPC or CUSTOM modem type (from the Utility Modem Type menu).
2. CSC CLOSED not compatible with 3/4 Code Rate/Sequential Encoder Type combination.

3.3.6.2.5 MODULATOR:TX BPSK ORDERING

```
TX BPSK ORDERING
STANDARD
```

TX BPSK Bit Ordering: STANDARD or NON-STANDARD

3.3.6.2.6 MODULATOR:MOD SPECTRUM

```
MOD SPECTRUM
NORMAL
```

Mod Spectrum: NORMAL or INVERT

Programmable vector rotation allows selecting NORMAL or INVERT for spectrum reversal of the I and Q baseband channels.

3.3.6.2.7 MODULATOR:TX-RS INTERLEAVE

```
TX-RS INTERLEAVE
     8  DEEP
```

Transmit Reed-Solomon Interleaving Depth: 4, 8, or 16

3.3.6.2.8 MODULATOR:TX IESS-310 MODE

Note: Only available with Reed-Solomon and 8PSK 2/3.

```
TX IESS-310 MODE
      OFF
```

Transmit IESS-310 Mode: ON or OFF

3.3.6.2.9 MODULATOR:TX MODE

```
  TX MODE
CONTINUOUS
```

Transmit Mode Selection: CONTINUOUS or BURST

3.3.6.2.10 MODULATOR:TX SYMBOL RATE

Note: Status Only.

```
TX SYMBOL RATE
 64.000 Ksps
```

Transmit Symbol Rate: 4.800 to 2500 kbps

3.3.6.3 UTILITY:DEMODULATOR

```
UTILITY
DEMODULATOR
```

Select information to view using the [←] [→] arrow keys, then press ENTER.

3.3.6.3.1 DEMODULATOR:ASSIGN RECEIVE FILTERS

```
RX-A   QPSK 1/2
 64.000 Kbps
```

```
RX-B   QPSK 1/2
128.000 Kbps
```

```
RX-C   QPSK 1/2
256.000 Kbps
```

```
RX-D   QPSK 1/2
512.000 Kbps
```

Note: OQPSK option only.

```
RX-V   QPSK 1/2
 38.400 Kbps
```

Select one of four (A, B, C, or D) pre-defined receiver code/data rate combinations or a variable rate selection (V). Receive code rates are listed in Table 3-5.

Upon entry, the current receive 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 increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Notes:

1. Code Rate 3/4 not compatible with a combination of a CSC Closed Modulator Type and Sequential Encoder.

Table 3-5. Utility Demodulator Data Rates

Code Rate	Data Rate Range
BPSK 1/2	2.4 to 1250 kbps
BPSK 21/44	2.4 to 1193 kbps *Note 3*
BPSK 5/16	2.4 to 781.25 kbps *Note 3*
BPSK 1/1	4.8 to 2500 kbps
QPSK/OQPSK 1/2	4.8 to 2500 kbps
QPSK/OQPSK 3/4	7.2 to 3750 kbps
QPSK/OQPSK 7/8	8.4 to 4375 kbps
QPSK/OQPSK 1/1	9.6 to 5000 kbps
8PSK 2/3	64 to 5000 kbps
8PSK 3/4	384 to 5000 kbps *Note 3*
Notes: 1. Max Symbol Rage 2500 kbps 2. Max Data Rate for Low Var Rate: 512 kbps 3. Turbo Only	

3.3.6.3.2 DEMODULATOR:DEMODULATOR TYPE

```
DEMODULATOR TYPE
 INTELSAT OPEN
```

Receive Filter Type: INTELSAT OPEN, EFD CLOSED, CSC CLOSED, or FDC CLOSED

Notes:

1. RX FILTER TYPE is selectable only when Custom is selected for modem type in the Utility Modem Type menu.
2. CSC CLOSED Demodulator Type is not compatible with a 3/4 Code Rate and Sequential Decoder Type combination.

3.3.6.3.3 DEMODULATOR:DECODER TYPE

```
DECODER TYPE
  VITERBI
```

Decoder Type: VITERBI, SEQUENTIAL, or TURBO

The modem must have the proper hardware enabled.

Notes:

1. This window is only available when Custom mode is selected for modem type in the Utility Modem Type menu.
2. A Sequential Decoder Type and a 3/4 Code Rate combination is not compatible with a CSC Closed Demodulator Type.

3.3.6.3.4 DEMODULATOR:RX BPSK ORDERING

```
RX BPSK OREDERING
    STANDARD
```

Receive BPSK Bit Ordering: STANDARD or NON-STANDARD

3.3.6.3.5 DEMODULATOR:DEMOD SPECTRUM

```
DEMOD SPECTRUM
    NORMAL
```

Programmable Vector Rotation: NORMAL or INVERT

This command is used for spectrum reversal of the I and Q baseband channels.

3.3.6.3.6 DEMODULATOR:RX-RS INTERLEAVE

```
RX-RS INTERLEAVE
       8  DEEP
```

Range: 4, 8, or 16 DEEP

3.3.6.3.7 DEMODULATOR:RX IESS-310 MODE

```
RX IESS-310 MODE
       OFF
```

Choose: ON or OFF

This command is used for 8PSK 2/3 with Reed-Solomon.

Note: Only available when the 8PSK option is selected.

3.3.6.3.8 DEMODULATOR:RX MODE

```
RX MODE
CONTINUOUS
```

Receive Mode Selection: CONTINUOUS or BURST

3.3.6.3.9 DEMODULATOR:RX SYMBOL RATE

```
RX SYMBOL RATE
64.000 Ksps
```

4.800 to 2500 kbps

Note: Status Only

3.3.6.3.10 DEMODULATOR:MAX PACKET SIZE

```
MAX PACKET SIZE
2048 BITS
```

Maximum Packet Size: 0 to 1048567 bits

3.3.6.4 UTILITY:INTERFACE

```
UTILITY
INTERFACE
```

Select information to view using the [←] [→] arrow keys, then press ENTER.

3.3.6.4.1 INTERFACE:TX OVERHEAD TYPE

```
TX OVERHEAD TYPE
NONE
```

None or AUPC

Note: Overhead types are selectable only when Custom is selected for modem type in the Utility Modem Type menu.

3.3.6.4.2 INTERFACE:RX OVERHEAD TYPE

```
RX OVERHEAD TYPE
      NONE
```

None or AUPC

Note: Overhead types are selectable only when Custom is selected for modem type in the Utility Modem Type menu.

3.3.6.4.3 INTERFACE:TX TERR INTERFACE

```
TX TERR INTERFACE
      RS422
```

EIA-232, EIA-422, or V.35

3.3.6.4.4 INTERFACE:RX TERR INTERFACE

```
RX TERR INTERFACE
      RS422
```

EIA-232, EIA-422, or V.35

3.3.6.4.5 INTERFACE:BUFFER PROGRAM

```
BUFFER PROGRAM
     BITS
```

BITS or MILLISECONDS

Displays the currently selected framing type and structure of the data. This function is used with the buffer program in ms for plesiochronous buffer slips.

Upon entry, the framing type (T1 or E1) is displayed on Line 1. The framing structure of each type (None or G.704) is displayed on Line 2. Press [←] or [→] and [↑] or [↓] to select framing structure and type. Press [ENTER] to complete the change .

3.3.6.4.6 INTERFACE:RTS TX-IF CNTRL

```
RTS TX-IF CNTRL
      OFF
```

ON or OFF

Programs the modem to allow a Request To Send (RTS) signal to enable the output when data is ready for transmission.

3.3.6.4.7 INTERFACE:TX DATA PHASE

```
TX DATA PHASE
   NORMAL
```

NORMAL or INVERT

TX data phase relationship. Use this option to select Normal or Invert for the TX data relationship to the selected TX clock.

3.3.6.4.8 INTERFACE:RX DATA PHASE

```
RX DATA PHASE
   NORMAL
```

NORMAL or INVERT

RX data phase relationship. Use this option to select Normal or Invert for the RX data relationship to the selected RX clock.

3.3.6.4.9 INTERFACE:CTS DELAY

```
CTS DELAY
0 SECONDS
```

Range: 0 to 60 seconds

Sets the delay in seconds for the Clear To Send (CTS) signal.

3.3.6.5 UTILITY:SYSTEM

```
UTILITY
SYSTEM
```

Select information to view using the [←] [→] arrow keys, then press ENTER.

3.3.6.5.1 SYSTEM:TIME/DATE

```
TIME:     12:00:00AM
DATE:      7/04/1976
```

Time of day and date display/set function.

The current time 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.

3.3.6.5.2 SYSTEM:REMOTE BAUD RATE

```
REMOTE BAUD RATE
9600 bps    EVEN
```

BAUD: 19200, 9600, 4800, 2400, 1200, 600, 300 or 150
PARITY: EVEN, ODD or NONE

The parity and baud rate settings of the modem are displayed.

To change the modem baud rate and/or parity, 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 baud rate and parity. The parity can be set to EVEN, ODD, or NONE. The baud rate can be set from 150 to 19200 bps.

3.3.6.5.3 SYSTEM:REMOTE ADDRESS

```
REMOTE ADDRESS
      1
```

Range: 1 to 255

The current modem address is displayed.

To change the remote address, press [ENTER]. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

Note: Address 0 is reserved has a Global Address.

3.3.6.5.4 SYSTEM:REMOTE TYPE

```
  REMOTE TYPE
RS485  (2-WIRE)
```

EIA-485(2-Wire), EIA-485(4-Wire) or EIA-232

3.3.6.5.5 SYSTEM:OPERATION MODE

```
OPERATION MODE
    DUPLEX
```

DUPLEX, TRANSMIT ONLY or RECEIVE ONLY

Programs the modem for selected type of operation.

Note: When TRANSMIT ONLY or RECEIVE ONLY are selected, the appropriate faults are masked from the Faults and Stored Faults menus.

3.3.6.5.6 SYSTEM:YEAR DISPLAY

```
YEAR DISPLAY
 2 - DIGIT
```

2 - DIGITS or 4 - DIGITS

Displays the year in 2- or 4-digit format.

To change the remote address, press [ENTER]. Press [↑] or [↓] to make the selection. Press [ENTER] to complete the change.

3.3.6.5.7 SYSTEM:TEST MODE STATUS

```
TEST MODE STATUS
 _ _ _ _ _ _ _ _
```

Test mode status indicator. The following modem test points are listed and display a "+" when a test mode is active:

- RS CORR OFF
- INTRFC LOOP BACK
- B-BAND LOOP BACK
- RF LOOP BACK
- IF LOOP BACK
- CARRIER MODE
- RX 2047 Pattern
- TX 2047 Pattern

To view the test modes, press [ENTER]. Press [↑] or [↓] to make the selection.

3.3.6.5.8 SYSTEM:LAMP TEST

```
LAMP TEST ??
PRESS ENTER
```

Lamp test function. Press <ENTER> to turn the front panel indicators on for 3 seconds.

3.3.6.5.9 SYSTEM:SELF TEST

```
SELF TEST
OFF
```

OFF, AUTO, or RUN

Select an option. After completion of the test, SELF TEST (“PASSED” or “FAILED”) is displayed.

- OFF bypasses built-in self test.
- AUTO initiates built-in self test when turning on modem.
- RUN initializes self test.

3.3.6.5.10 SYSTEM:M&C FIRMWARE

```
M&C FIRMWARE
FW/NNNNNN-DDR
```

Displays the M&C module firmware version.

3.3.6.5.10.1 M&C FIRMWARE:MONTH:DAY:YEAR

```
M&C FIRMWARE
MM/DD/YYYY
```

Press <ENTER> to display the month, day, and year.

3.3.6.5.11 SYSTEM:BOOT FIRMWARE

```
BOOT FIRMWARE
FW/NNNNNN-DDR
```

Displays the M&C module firmware version.

3.3.6.5.11.1 BOOT FIRMWARE:MONTH:DAY:YEAR

```
BOOT FIRMWARE
 MM/DD/YYYY
```

Press <ENTER> to display the month, day, and year.

3.3.6.5.11.2 BOOT FIRMWARE:VERSION NUMBER

```
BOOT FIRMWARE
    VER: x.x.x
```

Press <ENTER> to display the version number.

3.3.6.5.12 SYSTEM:FPGA FIRMWARE

```
FPGA FIRMWARE
  VFW/NNNNNN-DDR
```

Displays the FPGA module firmware version.

3.3.6.5.12.1 FPGA FIRMWARE:MONTH:DAY:YEAR

```
FPGA FIRMWARE
    MM/DD/YYYY
```

Press <ENTER> to display includes the month, day, and year.

3.3.6.5.13 SYSTEM:DISPLAY CONTRAST

```
DISPLAY CONTRAST
      LEVEL:  64
```

Range: 0 to 100

Sets the contrast setting of the Front Panel menu.

Press [ENTER] to begin. Press [↑] or [↓] to increase or decrease the number at the flashing cursor, from 0 to 100. Press [ENTER] to complete the change.

3.3.6.5.14 SYSTEM:EXT AGC: MIN PWR

```
EXT AGC:  MIN PWR
       0.0 Volts
```

Range: 0.0 to 10.0, in 0.5V steps

Sets the AGC voltage for a RX signal level of -25.0 dBm. Upon entry, the current external AGC voltage level is displayed. Press [↑] or [↓] to increase or decrease the AGC voltage level in 0.5V steps. Press [ENTER] to complete the change.

Note: For any receive signal level between -25.0 and -60.0 dBm, the software will interpolate the required AGC voltage.

3.3.6.5.15 SYSTEM:EXT AGC: MAX PWR

```
EXT AGC:  MAX PWR
      10.0 Volts
```

Range: 0.0 to 10.0, in 0.5V steps

Sets the AGC voltage for a RX signal level of -60.0 dBm. Upon entry, the current external AGC voltage level is displayed. Press [↑] or [↓] to increase or decrease the AGC voltage level in 0.5V steps. Press [ENTER] to complete the change.

Note: For any receive signal level between -25.0 and -60.0 dBm, the software will interpolate the required AGC voltage.

3.3.6.5.16 SYSTEM:MASTER RESET

```
MASTER RESET
    HARD/SOFT
```

HARD or SOFT

CAUTION

Initiating a hard reset will reset the modem and place the default configuration settings in ROM. Initiating a soft reset will reset the modem hardware, but saves the current configuration settings.

Select [ENTER] once to access HARD or SOFT.

1. Press [←] or [→] to make the selection.
2. Press [ENTER].
3. Press [→] five times to move the cursor to YES.
4. Select YES and press [ENTER] again.

Note: The following parameters do not revert to default settings after a hard reset:

- Address
- Parity
- Baud Rate
- Remote Type
- Ext AGC: Min Pwr
- Ext AGC: Max Pwr
- Display Contrast

3.3.6.6 UTILITY:MODEM TYPE

```
UTILITY
  MODEM TYPE
```

Select information to view using the [←] [→] arrow keys, then press ENTER.

3.3.6.6.1 MODEM TYPE:CODE RATE/DATA RATE

```
CR: _______________
DR: ______________Kb
```

A one-time displayed menu for entering the code/data rates for Single-Rate modems.

Code Rate: ______________________________

Data Rate: ______________________________kb

3.3.6.6.2 MODEM TYPE:MODEM TYPE

```
MODEM TYPE
  CUSTOM
```

CUSTOM, EFD or AUPC

Select from the following types of modem operation:

- CUSTOM Selections are made from the Front Panel menu
- EFD Closed Network Operation
- AUPC AUPC Option

CAUTION **Use caution when modifying the CUSTOM Type, as it accepts all changes to the modem, including incompatible parameter changes. Only experienced modem operators who are familiar with all of the controls should use CUSTOM type.**

When the modem is changed from one type of operation to another, it is reset to the default configurations of the new modem type. The RF-IF Output must be turned on to get the modem to lock.

If the type entered matches the existing modem type, parameters will not change. If the modem type is changed to Custom, parameters will not change.

If the modem type selection is not permitted, that type of operation may not be an available option. Select MODEM OPTIONS and OVERHEAD OPTIONS to see which modem operations are allowed.

3.3.6.6.3 MODEM TYPE:MODEM EMULATION

```
MODEM EMULATION
DISABLED
```

This command allows selection of the following modem emulation types:

SDM-100	15.7.1
SDM-300	6.2.2
SDM-308-4	4.03 6.05 7.03
SDM-308-5	6.08
SDM-309	6.04
SDM-650	4.12A 4.16
SDM-6000	5.1.1

3.3.6.6.4 MODEM TYPE:REV EMULATION

```
REV EMULATION
CURRENT_VERSION
```

CURRENT VERSION or FUNCTIONAL X

Programs an emulation mode of a previous functional revision.

Note: The number displayed in the CURRENT VERSION position increases with each software version change.

Upon entry, the CURRENT VERSION is displayed. Press [↑] or [↓] to select the FUNCTIONAL version. Press [ENTER] to complete the change.

Notes:

1. Programming a current version (default) allows all features and options (if installed) to operate normally.
2. Programming a FUNCTIONAL version (X) eliminates any changes that affect the later version. Only functional changes are affected by the revision emulation feature.
3. A correction change (e.g., VER 3.1.2) remains fixed in accordance with the latest version. Since the revision emulation default is the current version, program the functional version at the start of each operation.
4. The revision emulation feature does not affect some interface changes for the direct operation of the modem (Configuration save/recall, test mode screen in the Utility/System, all factory setup modes, etc.).

3.3.6.6.5 MODEM TYPE:MODEM OPTIONS

```
           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 [←] [→] arrows to move from one symbol to the next. The first line will display the option. The second line will display the status:

Option	Code	Legend
HIGH POWER	(0 or +)	0 = Not Installed, Not Upgradable
HIGH STABILITY	(0 or +)	- = Not Installed, FAST Upgradable
ASLT	(- or +)	+ = Installed
VITERBI	(- or +)	x = Not Installed, Field Upgradable
SEQUENTIAL	(- or +)	
SINGLE RATE	(- or +)	
LOW RATE VAR	(- or +)	
FULL RATE VAR	(- or +)	
CARD #1 PCB	(x or +)	
CARD #2 PCB	(x or +)	
CARD #3 PCB	(x or +)	
8PSK 2/3	(- or +)	
TX only	(0 or +)	
RX only	(0 or +)	
OQPSK	(- or +)	

IMPORTANT

The actual choices displayed in the sub-menus may vary according to which FAST options have been enabled. Where a FAST option affects a menu, this is shown in the descriptive text.

3.3.6.6.6 MODEM TYPE:CARD #1 TYPE

```
CARD #1 TYPE
OVERHEAD 01
```

Status Only: OVERHEAD 01, MUX 01, FLEX MUX 01, or NOT INSTALLED

3.3.6.6.7 MODEM TYPE:CARD #2 TYPE

```
CARD #2 TYPE
REED SOLOMON 03
```

Status Only: REED SOLOMON 02, REED SOLOMON 03, TURBO INSTALLED, or NOT INSTALLED

3.3.6.6.8 MODEM TYPE:CARD #3 TYPE

```
CARD #3 TYPE
REED SOLOMON 02
```

Status Only: REED SOLOMON 02, REED SOLOMON 03, TURBO INSTALLED, or NOT INSTALLED

3.3.6.6.9 MODEM TYPE:CARD #1 OPTIONS

```
CARD #1 OPTIONS
     +++++
```

Status Only:

OVERHEAD 01 LIST:

G.703	**(- or +)**
IBS	**(- or +)**
ASYNC/AUPC	**(- or +)**
D&I	**(- or +)**
IDR	**(- or +)**

MUX 01 LIST:

4 CHANNEL SYNC	**(- or +)**
8 CHANNEL SYNC	**(- or +)**
4 CHANNEL ASYNC	**(- or +)**
8 CHANNEL ASYNC	**(- or +)**

3.3.6.6.10 MODEM TYPE:CARD #2 OPTIONS

```
CARD #2 OPTIONS
       +
```

Status Only:

REED-SOLOMON 02 LIST:

INTELSAT	**(- or +)**
AUPC	**(- or +)**

REED-SOLOMON 03 LIST:

INTELSAT	**(- or +)**
AUPC	**(- or +)**

3.3.6.6.11 MODEM TYPE:CARD #3 OPTIONS

```
CARD #3 OPTIONS
       +
```

Status Only:

REED SOLOMON 02 LIST:	
INTELSAT	**(- or +)**
AUPC	**(- or +)**
REED SOLOMON 03 LIST:	
INTELSAT	**(- or +)**
AUPC	**(- or +)**

3.3.6.6.12 MODEM TYPE:LOCAL MODEM AUPC

```
LOCAL MODEM AUPC
      OFF
```

ON or OFF

Configures the modem for the self-monitoring Local Modem AUPC mode and for local TX power control (self-monitoring) due to severe rain fade.

Notes:
1. The self-monitoring Local Modem AUPC mode is not used when the ASYNC/AUPC interface option is installed.
2. The Modem must be configured for Duplex operation and the demod locked to the modulator signal. Refer to Section A.1.4.1.1 for additional information.

3.3.6.6.13 MODEM TYPE:MODEM SERIAL

```
MODEM SERIAL #
  012345678
```

Status Only

3.3.6.6.14 MODEM TYPE:CARD #1 SERIAL

```
CARD #1 SERIAL #
   012345678
```

Status Only, if installed.

3.3.6.6.15 MODEM TYPE:CARD #2 SERIAL

```
CARD #2 SERIAL #
   012345678
```

Status Only, if installed.

3.3.6.6.16 MODEM TYPE:CARD #3 SERIAL

```
CARD #3 SERIAL #
   012345678
```

Status Only, if installed.

3.3.6.6.17 MODEM TYPE:CONFIGURATION CODE - MODEM

```
CONFIGURATION
CODE - MODEM
```

Comtech EF Data-supplied code. Press <ENTER>

```
1)AAAAAAAAAA
2)AAAAAAAAAA
```

On entry, the current configuration code is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Entering this code enables the corresponding modem option. To purchase an option, contact an Comtech EF Data marketing representative for more information.

3.3.6.6.18 MODEM TYPE:CONFIGURATION CODE – CARD #1

Note: Applies only if Card #1 is installed.

```
CONFIGURATION
CODE - CARD #1
```

Comtech EF Data-supplied code. Press <ENTER>

```
1)AAAAAAAAAA
2)AAAAAAAAAA
```

On entry, the current configuration code is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Entering this code enables the corresponding modem option. To purchase an option, contact an Comtech EF Data marketing representative for more information.

3.3.6.6.19 MODEM TYPE:CONFIGURATION CODE – CARD #2

Note: Applies only if Card #2 is installed.

```
CONFIGURATION
CODE - CARD #2
```

Comtech EF Data-supplied code. Press <ENTER>

```
1)AAAAAAAAAA
2)AAAAAAAAAA
```

On entry, the current configuration code is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Entering this code enables the corresponding modem option. To purchase an option, contact an Comtech EF Data marketing representative for more information

3.3.6.6.20 MODEM TYPE:CONFIGURATION CODE – CARD #3

Note: Applies only if Card #3 is installed.

```
CONFIGURATION
CODE - CARD #3
```

Comtech EF Data-supplied code. Press <ENTER>

```
1)AAAAAAAAAA
2)AAAAAAAAAA
```

On entry, the current configuration code is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increase or decrease the digit at the flashing cursor. Press [ENTER] to complete the change.

Entering this code enables the corresponding modem option. To purchase an option, contact an Comtech EF Data marketing representative for more information

---

3.3.6.7 UTILITY:FACTORY SET-UP

```
UTILITY
FACTORY SET-UP
```

CAUTION

This command is used for factory configuration only. Factory setup must not be changed by unauthorized persons. Doing so will cause modem failure.

3.4 Custom Modem Defaults

Note: The following parameters do not revert to default settings after a hard reset:

- Address/Parity/Baud Rate
- Remote Type
- EXT AGC MIN Power
- EXT AGC Max Power
- Display Contrast

Modulator		Demodulator	
Data Rate	A	Date Rate	A
TX Rate A	64 kbps, QPSK 1/2	RX Rate A	64 kbps, QPSK 1/2
TX Rate B	128 kbps, QPSK 1/2	RX Rate B	128 kbps, QPSK 1/2
TX Rate C	256 kbps, QPSK 1/2	RX Rate C	256 kbps, QPSK 1/2
TX Rate D	512 kbps, QPSK 1/2	RX Rate D	512 kbps, QPSK 1/2
TX Rate V	38.4 kbps, QPSK 1/2	RX Rate V	38.4 kbps, QPSK 1/2
IF Frequency	70 MHz	IF Frequency	70 MHz
IF Output	Off	Descrambler	On
Power Output	-10 dBm	Differential Encoder	On
Scrambler	On	RF Loopback	Off
Differential Encoder	On	IF Loopback	Off
Carrier Mode	Normal-Modulated	BER Threshold	None
Modem Reference	Internal	Sweep Center	0 Hz
RS Encoder	Off	Sweep Range	60000 Hz
		Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	Channel, Level (TX/RX)	-5 dBm
TX Clock Phase	Auto	Interface Loopback	Off
EXT-CLK Frequency	1544 kHz	Loop Timing	Off
Buffer Clock	RX (Satellite)	TX Data Fault	None
Buffer Size	384 bit/s	RX Data Fault	None
RX Clock Phase	Normal	TX 2047 Pattern	Off
B-Band Loopback	Off	RX 2047 Pattern	Off
		TX Coding Format	AMI

Configuration Local AUPC			
AUPC Enabled	Off	Target E_b/N_0	0.6 dB
Nominal Power	-10.0 dB	Tracking Rate	0.5 dB/min
Minimum Power	-30.0 dBm	Local CL Action	Hold
Maximum Power	-5.0 dBm	Remote CL Action	Hold
Function Select Monitor			
RAW BER	2.4 E-3	Sweep Frequency	0 Hz
Corrected BER	4.0 E-3	Buffer Fill	50%
E_b/N_0	16.0 dB	Frame Errors	n.n E-e
Receive Signal	-45 dB		
Function Select Remote AUPC			
AUPC Enable	Off	TX 2047 Pattern	Off
B-Band Loopback	Off	2047 Errors	n.n E-e
Utility			
Modulator		**Demodulator**	
Data Rate	A	Date Rate	A
TX Rate A	64 kbps, QPSK 1/2	RX Rate A	64 kbps, QPSK 1/2
TX Rate B	128 kbps, QPSK 1/2	RX Rate B	128 kbps, QPSK 1/2
TX Rate C	256 kbps, QPSK 1/2	RX Rate C	256 kbps, QPSK 1/2
TX Rate D	512 kbps, QPSK 1/2	RX Rate D	512 kbps, QPSK 1/2
TX Rate V	38.4 kbps, QPSK 1/2	RX Rate V	38.4 kbps, QPSK 1/2
MOD Power Offset	0 dB	Demodulator Type	INTERNAL Open
Modulator Type	INTELSAT Open	Decoder Type	Viterbi
Encoder Type	Viterbi	RX BPSK Ordering	Standard
TX BPSK Ordering	Standard	DEMOD Spectrum	Normal
MOD Spectrum	Normal	RX-RS Interleave	8 deep
TX-RS Interleave	8 deep	RX-IESS-310 Mode	Off
TX-IESS-310 Mode	Off	RX Symbol Rate	64 ksps
TX Symbol Rate	64 Ksps		
Utility Interface			
TX Overhead Type	None	CTS Delay	0 seconds
RX Overhead Type	None	Buffer Program	Bits
TX Terr Interface	RS422	RTS TX-IF CNTRL	Off
RX Terr Interface	RS422	TX Data Phase	Normal
		RX Data Phase	Normal

Utility System			
Time	12:00:00 AM	Self Test	Off
Date	7/04/76	M&C Firmware	FW/NNNNNN-DDR MM/DD/YYYY
Remote Baud Rate	9600 bit/s	Boot Firmware	FW/NNNNNN-DDR MM/DD/YYYY Version:
Remote Address	1	FPGA Firmware	MM/DD/YYYY
Remote Type	RS485 (2-Wire)	Display Contrast	64
Operational Mode	Duplex	EXT AGC: Min Pwr	0 volts
Year Display	2-Digit	EXT AGC: Max Pwr	10 volts

3.5 Revision Emulation Operation

To program an emulation mode from Version 1.1.1 through the current version, use the revision emulation feature in the Utility Modem Type menu.

Software Version	Firmware	Rev	Description of Change
1.1.1	FW/6535-1	-	Original Issue.
2.1.1	FW/6535-1	A	Updated menus to reflect current application.
3.1.1	FW/6535-1	B	Added reflash capability.
4.1.1	FW/6535-1	C	To allow the flex mux to operate in a T1/E1 mode.
4.1.2	FW/6535-1	D	Loop timing and clocking in D&I mode.
5.1.1	FW/6535-1	E	Added FAST Option OQPSK 1/2, 3/4, and 7/8.
5.1.2	FW/6535-1	F	Modem external reference.
6.1.9	FW/6535-1	U	Added Turbo.
7.1.7	FW/6535-1	AH	Added 57.6 kbps

Chapter 4. FUNCTIONAL DESCRIPTION

This chapter contains the theory of operation data for the satellite modem.

4.1 Monitor and Control (M&C)

A block diagram of the M&C is shown in Figure 4-1. The M&C monitors the modem and provides configuration updates to other modems within the modem when necessary. The modem configuration parameters are maintained in battery-backed RAM, which provides total recovery after power-down situation.

The M&C functions include extensive fault and status reporting. All modem functions are accessible through a local front panel interface and a remote communications interface.

4.1.1 Theory of Operation

The M&C card comprises the following subsections:

- Microcontroller with Universal Asynchronous Receiver/Transmitter (UART)
- Digital-to-Analog Converter (DAC)
- Read Only Memory (ROM)
- Analog-to-Digital Converter (ADC)
- Read Access Memory (RAM)
- Universal ASYNC
- User Interface
- Fault and Alarm Relays

The heart of the M&C card is the Dallas 80C310 microcontroller operating at 11 MHz. This microcontroller contains 256 kbytes of internal RAM. The ROM at U8 is 29F040 (512 kbytes).

ROM access times must be equal to or greater than 150 ns. The RAM can be 8 or 32 kbytes in size. This RAM chip is internally battery-backed and contains a real time clock used by the M&C.

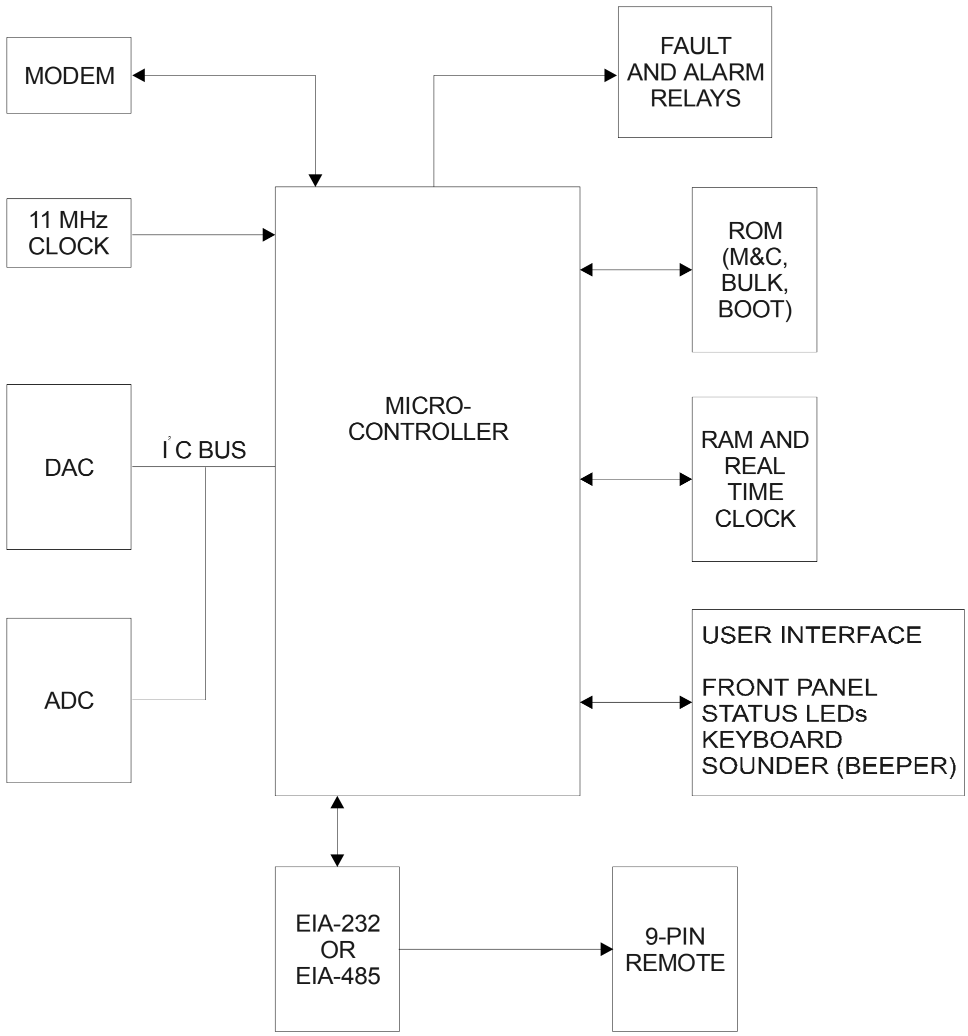


Figure 4-1. M&C Block Diagram

The non-volatile RAM on the M&C module allows the module to retain configuration information without prime power for 1 year (approximately). If the modem is powered down, the following sequence is carried out by the M&C microcontroller.

1. When power is applied to the M&C, the microcontroller checks the non-volatile memory to see if valid data has been retained. If valid data has been retained, the modem is reconfigured to the parameters maintained by the RAM.

2. If the non-volatile memory fails the valid data test, a default configuration from ROM is loaded into the system.

The UART supports serial ASYNC communications channels (remote port) with a maximum data rate of 19200 bps. The UART is a built-in peripheral of the microcontroller. The communications type can be EIA-232, EIA-485 (2-wire), EIA-485 (4-wire), software selectable.

The DAC supplies a voltage that controls the contrast of the display. The ADC monitors all the voltages from the power supply. The DAC and ADC are mapped to the microcontroller with an Integrated Circuit (IC) bus.

The user interface includes the following parts:

- Front panel
- Status LEDs
- Keyboard
- Sounder (beeper)

All functions are memory-mapped to the microcontroller.

4.1.2 Remote Baud Rate

The remote communications baud rate and parity are programmed by the front panel control in the Utility System menu (refer to Chapter 3). The programmed baud rate and parity are maintained indefinitely in RAM on the M&C module. The parity bits can be set to EVEN or ODD. The available baud rate are listed below:

- 150
- 300
- 600
- 1200
- 2400
- 4800
- 9600
- 19200

4.1.3 Remote Address

To communicate with the established remote communications protocol, configure each modem for one address between 1 and 255. Each modem on a common remote communications link (EIA-485) must have a distinct address. Use the front panel control in the Utility System menu (Chapter 3) to program the address.

An EIA-485/EIA-232 communications link remotely controls and monitors all modem functions. Use the 2- or 4-wire, half-duplex EIA-485 interface to connect between two or more modems and switches on a common communications link. Use the EIA-232 interface to communicate with a single modem.

Note: Address 0 is reserved as a global address which simultaneously addresses all devices on a given communications link.

4.2 Modulator

The modulator provides PSK modulated carriers within the 50 to 180 MHz range. The types of modulation that encode the transmitted baseband data from the interface PCB are:

- BPSK
- QPSK
- OQPSK
- 8PSK

Refer to Section 4.2.3 for a description of each modulation type.

A block diagram of the modulator is shown in Figure 4-2.

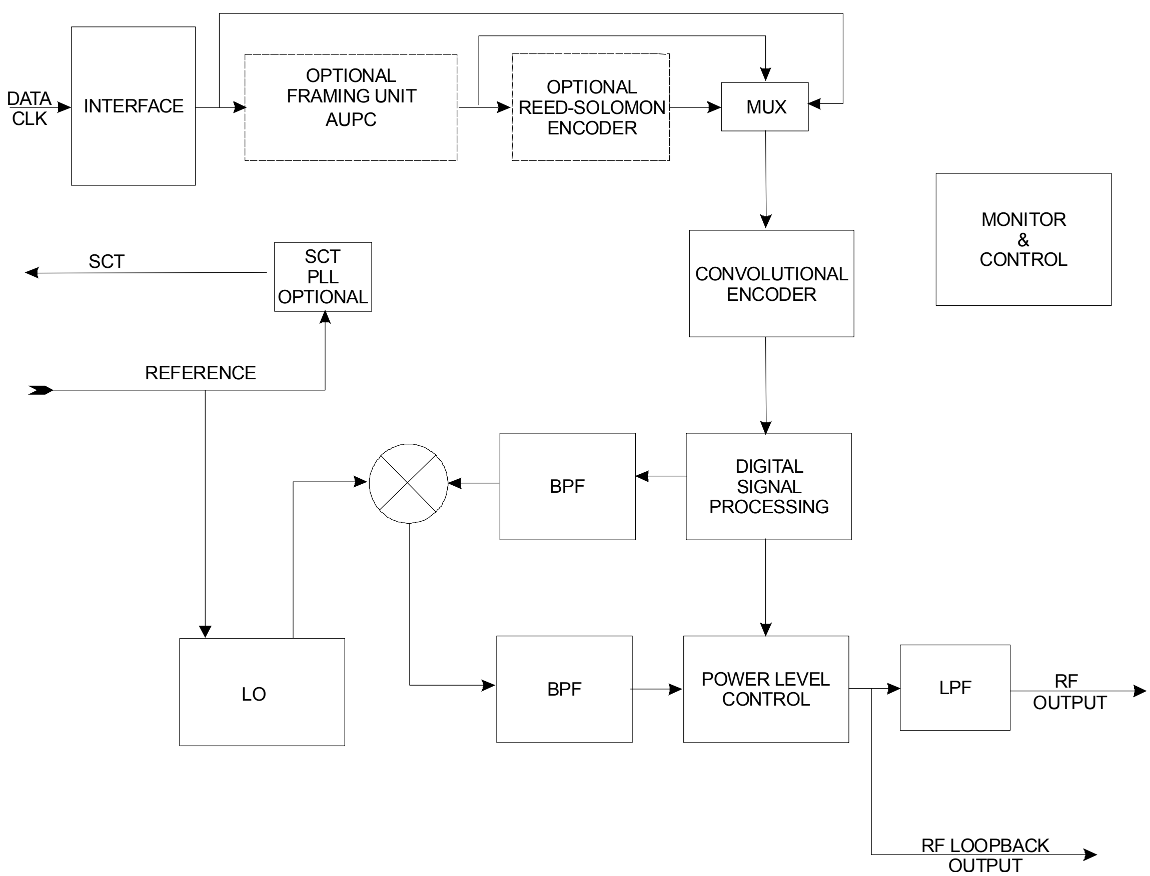


Figure 4-2. Modulator Block Diagram

4.2.1 Modulator Specifications

Refer to Appendix D for modulator specifications.

4.2.2 Theory of Operation

The modulator is composed of eight basic subsections. These subsections are divided into the baseband processing section and the RF section of the modulator. The modulator controls all programmable functions on this module. Fault information from the modulator is sent to the M&C. Refer to Chapter 5 for a list of reported faults.

The major modulator subsections are:

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

If the modem is so equipped, the data is first processed by the optional overhead or Reed-Solomon PCB. The data is then sent to the scrambler for energy dispersal, and then to the differential encoder. The differential encoder is a 2-bit encoder, which allows for resolution of two of the four ambiguity states of the QPSK or OQPSK demodulator.

The data is sent to the convolutional encoder for encoding the baseband data. The code rates 1/2, 3/4, 7/8, and 2/3 are based on the symbol rate range of 2.4 kbps to 2.5 Mbps. 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.

For Sequential codes, the convolutional encoder generates the parity bits from the input data stream, which allows for error correction at the far end of the link. The rate of the encoder may be 1/2, 3/4, 7/8, and 2/3. For example, the 7/8 rate puts out 8 symbols for every 7 bits in. In QPSK (or OQPSK) mode, the data is split into two separate data streams to drive the I and Q channels of the modulator. Refer to Section 4.2.3 for the theory of modulation types.

After the convolutional 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 Direct Digital Modulation. Symbol rates up to 2.5 Mbps can be achieved automatically.

The modulated carrier is applied to the RF 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 RF synthesizer provides the proper frequencies to convert the modulator IF to the desired output frequency in the 50 to 180 MHz range. The synthesizer has a single loop, and incorporates a Direct Digital Synthesis (DDS) chip to accommodate 1 Hz steps over a range of 130 MHz. The RF section has a frequency stability of $\pm$ 1 x 10^{-5}. An optional 2 x 10^{-7} Temperature Compensated Crystal Oscillator (TCXO) can be installed.

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. The +5 dB output option is capable of outputting +5 to -20 dBm.

4.2.3 Theory of Modulation Types

The modulation types for the modem include BPSK, QPSK, OQPSK, or 8PSK. Refer to Appendix D for encoding information.

The PSK data transmission encoding method uses the phase modulation technique. This method varies the phase angle of the carrier wave to represent a different bit value for the receiver. The higher levels of modulation are required for an operating range that has a limited bandwidth.

The order of modulation is represented by mPSK, where “m” relates to the number of discrete phase angles. Refer to the following list for a brief description of the modulation types.

- BPSK: 2 discrete phase angles represent the 2 possible states of a symbol.
- QPSK (OQPSK): 4 discrete phase angles represent the 4 possible states of a symbol.
- 8PSK: 8 discrete phase angles represent the 8 possible states of a symbol.

Note: The code rate determines the number of symbols per bit.

4.3 Demodulator

A block diagram of the demodulator is shown in Figure 4-3.

The demodulator converts PSK modulated carriers within the 50 to 180 MHz range to a demodulated baseband data stream. The converted modulation types are BPSK, QPSK, OQPSK, and 8PSK (refer to Section 4.2.3 for a description of modulation types). The demodulator then performs FEC on the data stream using Viterbi or Sequential decoding algorithms.

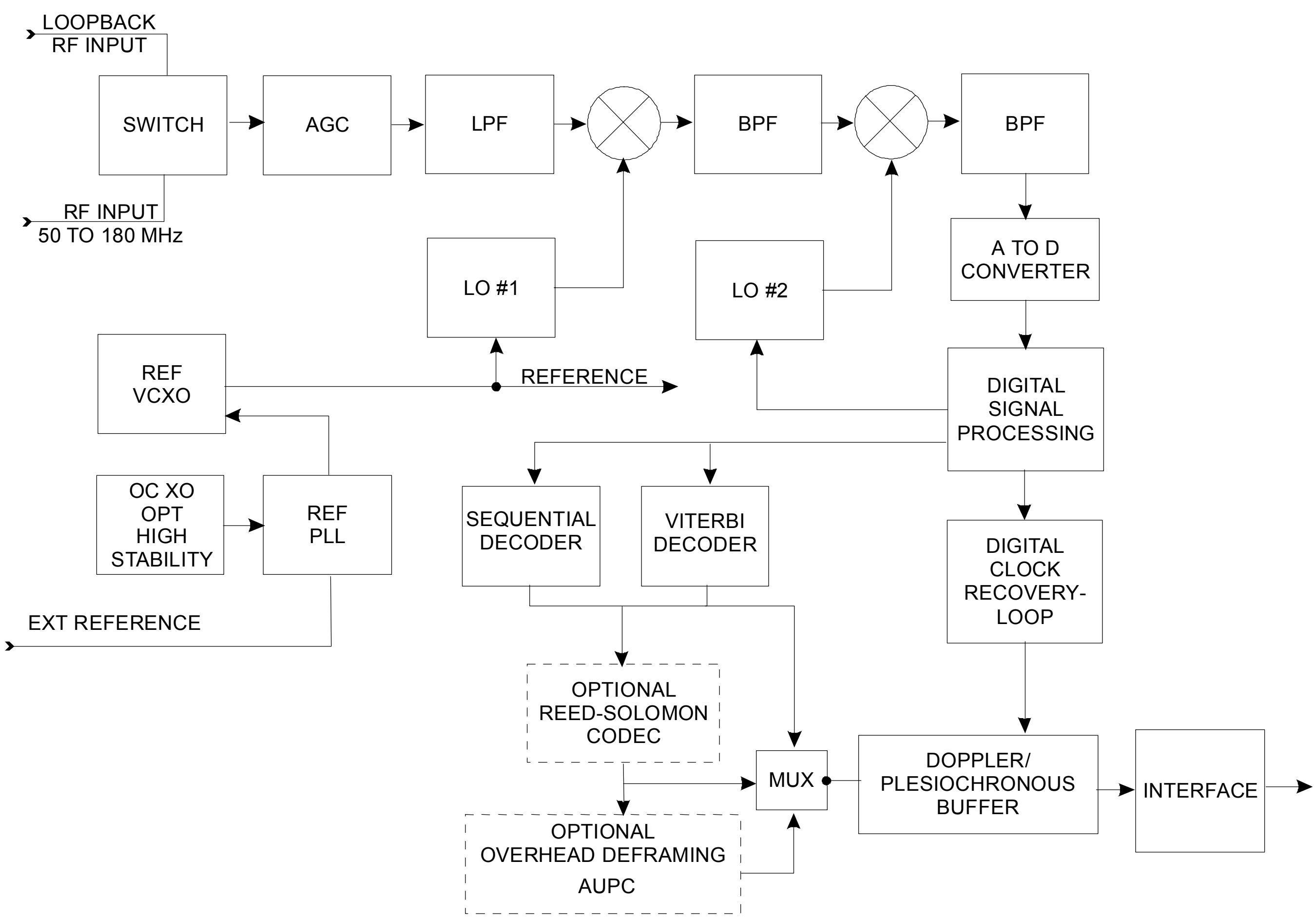


Figure 4-3. Demodulator Block Diagram

4.3.1 Demodulator Specifications

Refer to Appendix D for demodulation specifications.

4.3.2 Theory of Operation

The demodulator functions as an advanced, digital, coherent-phase-lock receiver and decoder. Demodulator faults are also reported to the front panel. The demodulator consists of the following basic subsections.

- Digital Costas Loop
- RF Section
- Automatic Gain Control
- Analog-to-Digital (A/D) Converter
- Soft Decision Mapping
- Programmable Vector Rotation
- Digital Nyquist Filters
- FEC Decoder
- Digital Clock Recovery Loop
- Decoder

The modulated IF signal at 50 to 180 MHz enters the RF module for conversion to an IF frequency. The IF is then sampled by an A to D converter and digitally demodulated. The 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 Control
- Carrier Recovery (Costas) Loop
- Clock Recovery Loop
- Soft Decision Mapping

The AGC provides a gain feedback signal to the RF section. This closed loop control ensures 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.

When the active decoder 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 Costas loop, in conjunction with a Direct Digital Synthesizer (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 RF module and provides the reference to which the local oscillator is locked. The M&C sweeps the local oscillator (via DDS programming) through the user-specified sweep range.

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. 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 Viterbi decoder and optional Sequential decoder. The output is then sent to the optional Reed-Solomon PCB.

4.4 Decoder

The SNM-1001A can be configured in any of the following configurations:

- Basic SNM-1001A (Sequential or Viterbi Decoder)
- FAST options (Sequential or Viterbi Decoder)
- FAST options with Reed-Solomon hardware (Sequential or Viterbi Decoder)

Refer to Appendix A for additional information.

4.5 Interface

The terrestrial interface functions include:

- MUX various types of ESC into the data
- Buffering the receive data
- DEMUX various types of ESC from the data
- Monitoring and displaying the interface status without interruption of service

The interface block diagram is shown in Figure 4-4.

The terrestrial interfaces for the modem are defined by data communication standards MIL-STD-188/EIA-449, EIA-232, or V.35. The interface receivers and drivers for these standards, as well as the handshake signals for MIL-STD-188 and V.35, are selectable through the front panel selection.

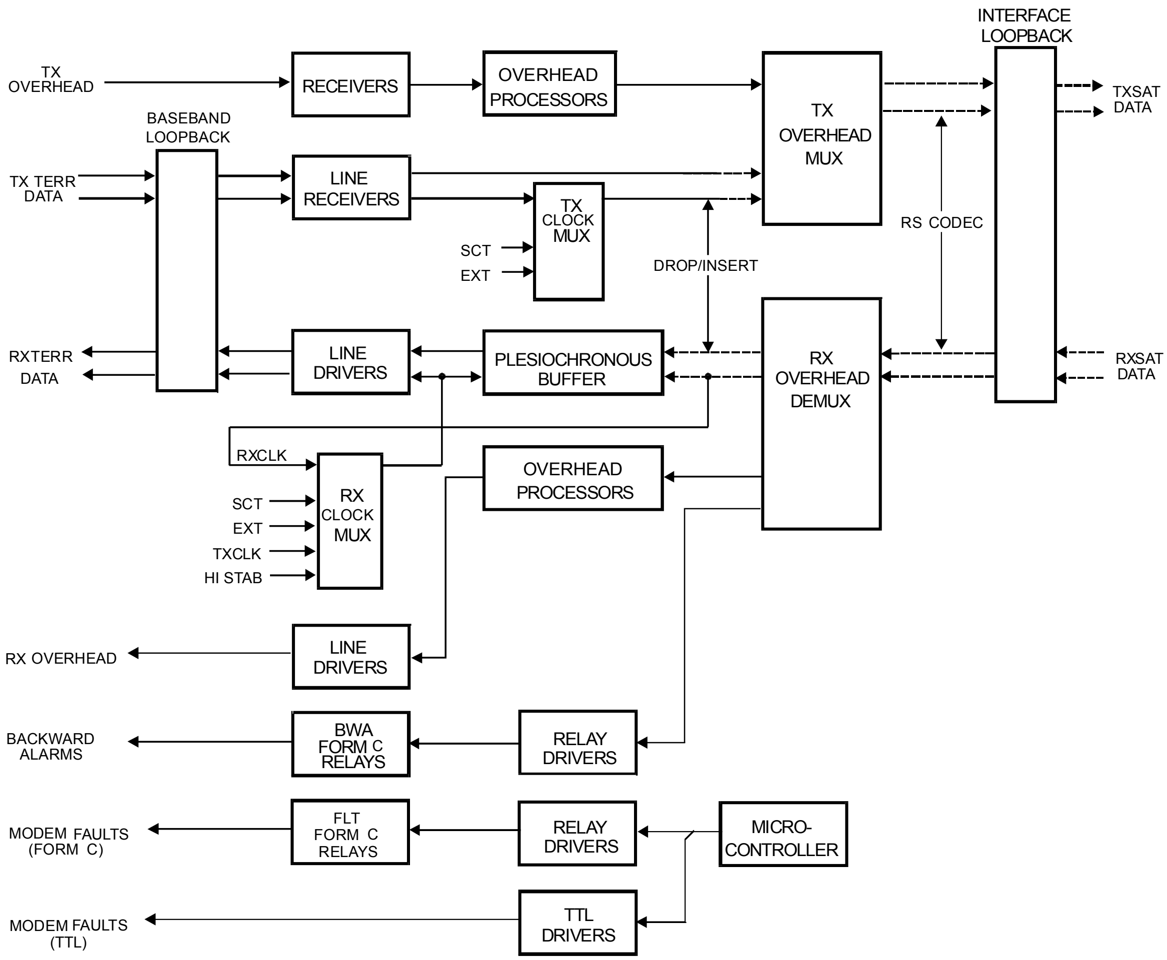


Figure 4-4. Interface Block Diagram

4.5.1 Interface Specifications

Refer to Appendix B for interface specifications.

4.5.2 Plesiochronous/Doppler/Buffer

Data from the DEMUX section is fed into a buffer. The increments range from 1 to 32 ms. Refer to the interface specifications for a list of valid entries for each of the selected formats. The buffer automatically centers on resumption of service, either from the front panel or remotely. The startup buffer will overfill when centering to match the satellite frame to the terrestrial frame with a maximum slide of 0.5 ms.

The fill status is available as a monitor and is accurate to 1%. Overflows or underflows are stored in the stored fault section of the M&C status registers, along with the date and time of the incident (which are provided by the modem internal clock). These are stored in battery-backed RAM.

A normal selection is to have the data clocked out of the buffer by an external clock. This procedure removes the Doppler from the receive satellite data.

The operator may select from four other clock sources as a backup:

- RX satellite
- Internal clock source
- TX terrestrial

Problems occurring on any of the selected clocks will cause the modem to substitute the satellite clock and a fault will be signaled.

4.5.3 Closed Network

Typically, the closed network operation does not add overhead to the terrestrial data. The closed network operation is not dictated by a specification. The terrestrial data and clock are passed through the baseband loopback relay and are translated from the selected baseband format to TTL. The data is re-synchronized by the clock and the data stream is then output to the modulator through the interface loopback device.

The receive data from the demodulator/decoder is input to the buffer. User data from the DEMUX section may be optionally input to the buffer.

The front panel interface provides four clock selections clocking the data out of the buffer:

- Internal Clock (SCT)
- RX Recovered Clock (RXCLK)
- External Clock (EXT)
- TX Clock Dejittered (TXCLK)

If either RXCLK, SCT, or EXT is selected and then fails, the interface will automatically switch to RX Sat CLK as the source. The receive data and selected clock are translated to the levels of the selected baseband interface and output through the baseband loopback relay.

Chapter 5. MAINTENANCE

This chapter provides the following information:

- System checkout
- Fault isolation
- Module replacement and identification

5.1 System Checkout

CAUTION

This equipment contains parts and assemblies sensitive to damage by ESD. Use ESD precautionary procedures when touching, removing, or inserting PCBs.

The modem comes equipped with an internal self-test feature. This feature is designed to provide the operator with maximum confidence that the modem is operational without installing external equipment.

A 2047 pattern is generated by the modem and routed through all sections. This is accomplished by placing the modem in IF and baseband loopbacks. Pseudo Gaussian noise is introduced to the modulated IF section allowing the modem to check its indicated E_b/N_0 against the known E_b/N_0 of the demodulated input.

- If this measurement falls outside of a specified window, the modem declares a failed test.

- If an overhead card and/or Reed-Solomon card are installed, the signal is routed through the card, verifying their operation.

- Faults, if any, are stored in the Stored Fault menu.

5.1.1 Interface Checkout

Use the following procedure and the test setup in Figure 5-1 to inspect the interface.

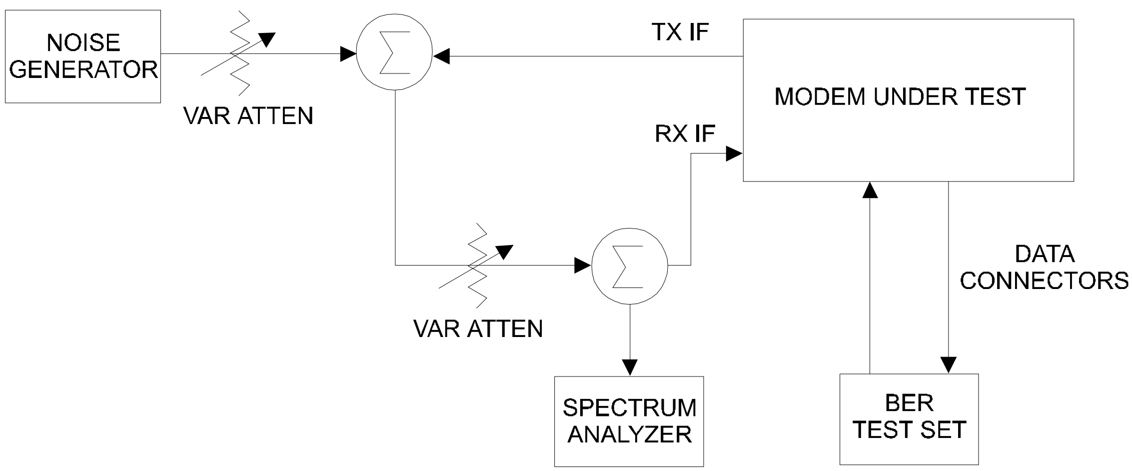


Figure 5-1. Fault Isolation Test Setup

1. Connect a BER test set to the appropriate modem data connector as shown in Figure 5-1. Refer to Chapter 2 for external modem connections.

2. Set up the modem for baseband loopback operation by using the Configuration Interface front panel menu (Chapter 3). The modem will run error free. Refer to Chapter 3 for a block diagram of the baseband loopback operation.

3. Change the modem from baseband loopback to interface loopback operation by using the Configuration Interface front panel menu (Chapter 3). The modem will run error free. Refer to Chapter 3 for a block diagram of the interface loopback operation.

5.1.2 Modulator Checkout

Use the following procedure to check out the modulator:

1. Set up the equipment as shown in Figure 5-1. Refer to Chapter 4 for modulator specifications.

2. Set up the modem for operation by using the Configuration Modulator and Demodulator front panel menus.

3. Clear all TX faults by correct use of data and clock selection (Chapter 4).

4. Measure the E_b/N_0 with a receiver that is known to be properly operating. Refer to Table 5-1 and Figure 5-2 to check for proper E_b/N_0 level. The (S+N)/N is measured by taking the average level of the noise and the average level of the modem spectrum top. Use this measurement for the first column on Table 5-1. Read across the page to find the S/N and E_b/N_0 for the specific code rate.

   Once the demodulator has locked to the incoming signal, the Monitor menu will display signal level, raw BER, corrected BER, and E_b/N_0. Refer to Chapter 1 for examples of BER performance curves.

5. Connect a spectrum analyzer to the modem as shown in Figure 5-1. Ensure the IF output meets the appropriate mask and spurious specifications. Measure the power output at different levels and frequencies.

   A typical output spectrum is shown in Figure 5-3.

6. To check the frequency and phase modulation accuracy:

   a. Set the modem to the continuous wave Normal mode by using the Carrier Mode front panel menu (Chapter 3). This sets the Carrier mode in the off condition. A pure carrier should now be present at the IF output. This should only be used for frequency measurements. In this mode, spurious and power measurements will be inaccurate.

   b. Set the modem to the continuous wave Offset mode by using the Carrier Mode front panel menu (Chapter 3). This generates a single, upper side-band-suppressed carrier signal. Ensure the carrier and side-band suppression is < -35 dBc.

Table 5-1. Conversion to S/N and E_b/N_0 Chart

(dB)	Code	Rate 1/2	Code	Rate 3/4	Code	Rate 7/8
(S+N)/N	S/N	E_b/N_0	S/N	E_b/N_0	S/N	E_b/N_0
4.0	1.8	1.8	1.8	0.0	1.8	-0.6
4.5	2.6	2.6	2.6	0.8	2.6	0.2
5.0	3.3	3.3	3.3	1.6	3.3	0.9
5.5	4.1	4.1	4.1	2.3	4.1	1.6
6.0	4.7	4.7	4.7	3.0	4.7	2.3
6.5	5.4	5.4	5.4	3.6	5.4	3.0
7.0	6.0	6.0	6.0	4.3	6.0	3.6
7.5	6.6	6.6	6.6	4.9	6.6	4.2
8.0	7.3	7.3	7.3	5.5	7.3	4.8
8.5	7.8	7.8	7.8	6.1	7.8	5.4
9.0	8.4	8.4	8.4	6.7	8.4	6.0
9.5	9.0	9.0	9.0	7.2	9.0	6.6
10.0	9.5	9.5	9.5	7.8	9.5	7.1
10.5	10.1	10.1	10.1	8.3	10.1	7.7
11.0	10.6	10.6	10.6	8.9	10.6	8.2
11.5	11.2	11.2	11.2	9.4	11.2	8.8
12.0	11.7	11.7	11.7	10.0	11.7	9.3
12.5	12.2	12.2	12.2	10.5	12.2	9.8
13.0	12.8	12.8	12.8	11.0	12.8	10.3
13.5	13.3	13.3	13.3	11.5	13.3	10.9
14.0	13.8	13.8	13.8	12.1	13.8	11.4
14.5	14.3	14.3	14.3	12.6	14.3	11.9
15.0	14.9	14.9	14.9	13.1	14.9	12.4
15.5	15.4	15.4	15.4	13.6	15.4	12.9
16.0	15.9	15.9	15.9	14.1	15.9	13.5
16.5	16.4	16.4	16.4	14.6	16.4	14.0
17.0	16.9	16.9	16.9	15.2	16.9	14.5
17.5	17.4	17.4	17.4	15.7	17.4	15.0
18.0	17.9	17.9	17.9	16.2	17.9	15.5
18.5	18.4	18.4	18.4	16.7	18.4	16.0
19.0	18.9	18.9	18.9	17.2	18.9	16.5
19.5	19.5	19.5	19.5	17.7	19.5	17.0
20.0	20.0	20.0	20.0	18.2	20.0	17.5

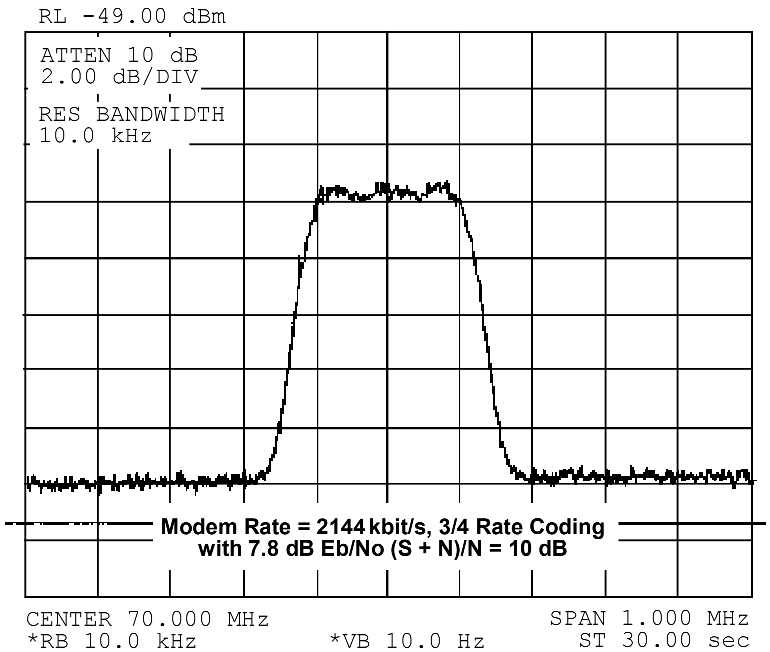


Figure 5-2. Typical Output Spectrum (with Noise)

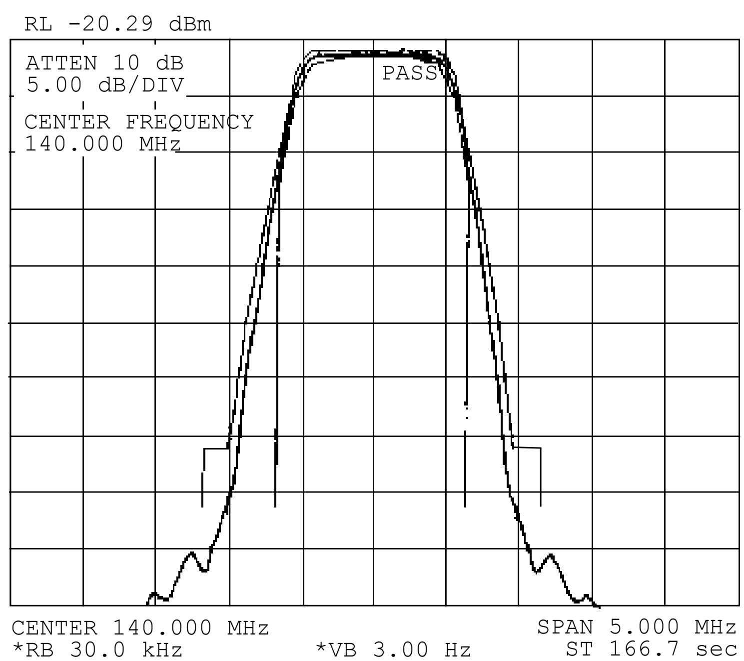


Figure 5-3. Typical Output Spectrum (without Noise)

5.1.3 Demodulator Checkout

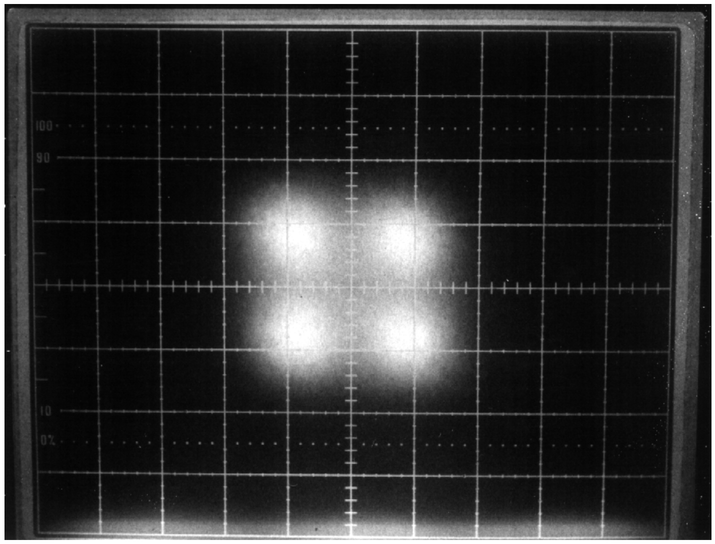
Use the following procedure to test the demodulator.

1. Set up the equipment as shown in Figure 5-1. Refer to Chapter 4 for the demodulator specifications.

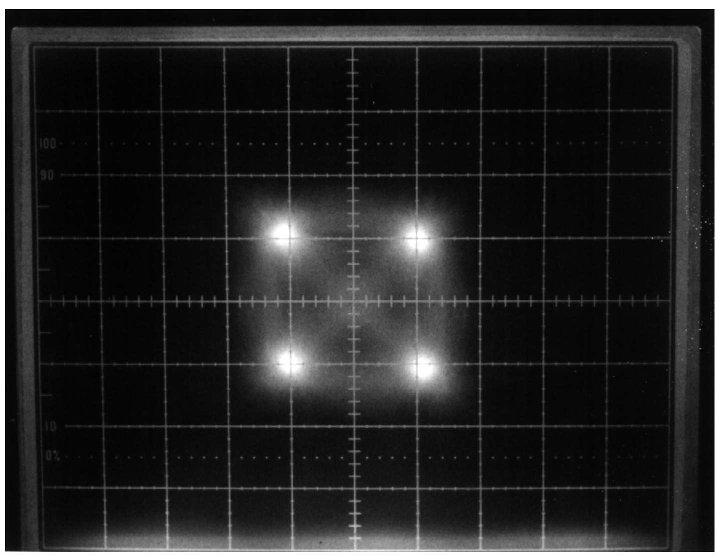
2. Set up the modem with an external IF loop and level. Use a properly operating modulator, and ensure that power levels, data rates, code rates, etc., are compatible.

3. Allow the modem to lock up. Depending on the data rate and overhead type, lock up may take several seconds. When the green carrier detect LED is on and the DEMUX lock fault has been cleared (where applicable), the modem will run at the specified error rate. Run the TX power level (input amplitude) over the full range, and offset the TX frequency from the RX frequency by 35 kHz. Ensure the modem still runs within the specified error rate.

4. Set up the modem to check the constellation patterns with an oscilloscope that is set in the X-Y mode. Typical constellation patterns with noise and without noise are shown in Figure 5-4. These test points are available on the auxiliary connector (J9, pins 6 and 8). It is not necessary to open the modem to look at these test points.



WITH NOISE



WITHOUT NOISE

Figure 5-4. Typical Eye Constellations

5.2 Fault Isolation

The modem's design allows a technician to repair a faulty modem on location.

CAUTION

This equipment contains parts and assemblies sensitive to damage by ESD. Use ESD precautionary procedures when touching, removing, or inserting PCBs.

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

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

Note: Each fault or alarm category includes possible problems and the appropriate action required to repair the modem.

If any of the troubleshooting procedures mentioned earlier in this chapter do not isolate the problem, and Comtech EF Data Customer Support assistance is necessary, have the following information available for the representative:

- Modem configuration. Modem configuration includes the modulator, demodulator, interface, or local AUPC sections.

- Faults (active or stored).

5.2.1 System Faults/Alarms

System faults are reported in the "Faults/Alarms " menu, and stored faults are reported in the "Stored Flts/Alms" menu. Refer to Chapter 3 for more information. To determine the appropriate action for repairing the modem, refer to Table 5-2 and the list of possible problems.

Table 5-2. SNM-1001A Fault Tree

	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	TX ALARM RELAY #2	RX ALARM LED	RX ALARM RELAY #3	SPARE RELAY ALARM #1	PRIMARY ALARM RELAY	SECONDARY ALARM RELAY	TX AIS	RX AIS
MODULATOR FAULTS			(1)		(2)		(3)		(4)		(5)		(6)**	(7)**	**	**
IF SYNTHESIZER	X	X	X										X		X	
DATA CLOCK SYN	X	X	X										X		X	
I CHANNEL	X	X	X										X		X	
Q CHANNEL	X	X	X										X		X	
AGC	X	X	X										X		X	
MODEM REF ACT								X	X							
MODEM REF PLL	X	X	X										X		X	
DEMODULATOR FAULTS																
CARRIER DETECT				X	X								X			X
IF SYNTHESIZER				X	X								X			X
I CHANNEL				X	X								X			X
Q CHANNEL				X	X								X			X
BER THRESHOLD										X	X			X		
MODULE				X	X								X			X

Legend		
Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
(1)	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) *
(2)	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) *
(3)	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) *
(4)	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) *
(5)	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) *
(6)	PRIMARY ALARM	Pin 43 (NO), 10 (COM), 27 (NC) *
(7)	SECONDARY ALARM	Pin 44 (NO), 11 (COM), 28 (NC) *
(8)	DEF MAINT ALARM	Pin 17 **
*	A connection between the common and N.O. contacts indicate no fault/alarm.	
**	Signal is open collector high impedance if faulted.	

Table 5-2. SNM-1001A Fault Tree (Continued)

	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	TX ALARM RELAY #2	RX ALARM LED	RX ALARM RELAY #3	SPARE RELAY ALARM #1	PRIMARY ALARM RELAY	SECONDARY ALARM RELAY	TX AIS
TX INTERFACE FAULTS			(1)		(2)		(3)		(4)		(5)		(6) **	(7) **	***
TX DATA/AIS								X	X					X	
TX CLK PLL	X	X	X										X		X
TX CLK ACTIVITY								X	X				X		X
TX AUDIO 1 CLIP								X	X						
TX AUDIO 2 CLIP								X	X						
RX INTERFACE FAULTS															
BUFFER UNDERFLOW										X	X				
BUFFER OVERFLOW										X	X				
RX DATA/AIS										X	X			X	
FRAME BER				X	X								X		
BACKWARD ALARM										X	X			X	
BUFFER CLK PLL				X	X								X		
BUFFER CLK ACT										X	X		X		
DEMUX LOCK				X	X								X		
RX 2047 LOCK										X	X				
BUFFER FULL										X	X				

Legend		
Test Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
(1)	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) *
(2)	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) *
(3)	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) *
(4)	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) *
(5)	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) *
(6)	PRIMARY ALARM	Pin 43 (NO), 10 (COM), 27 (NC) *
(7)	SECONDARY ALARM	Pin 44 (NO), 11 (COM), 28 (NC) *
(8)	DEF MAINT ALARM	Pin 17 **
*	A connection between the common and N.O. contacts indicate no fault/alarm.	
**	Signal is open collector high impedance if faulted.	

Table 5-2. SNM-1001A Fault Tree (Continued)

	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	TX ALARM RELAY #2	RX ALARM LED	RX ALARM RELAY #3	SPARE RELAY ALARM #1	PRIMARY ALARM RELAY	SECONDARY ALARM RELAY	IBS BACKWARD ALARM	TX AIS	RX AIS
COMMON EQUIP FAULTS			(1)		(2)		(3)		(4)		(5)		(6) **	(7) **	**	***	***
BATTERY/CLOCK						X								X			
-12V POWER SUPPLY						X	X						X				
+12V POWER SUPPLY						X	X						X				
+5V SUPPLY						X	X						X				
CONTROLLER						X	X						X			X	X
SELF TEST						X											
INTERFACE MODULE						X	X						X			X	X

Legend		
Test Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
(1)	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) *
(2)	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) *
(3)	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) *
(4)	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) *
(5)	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) *
(6)	PRIMARY ALARM	Pin 43 (NO), 10 (COM), 27 (NC) *
(7)	SECONDARY ALARM	Pin 44 (NO), 11 (COM), 28 (NC) *
(8)	DEF MAINT ALARM	Pin 17 **
*	A connection between the common and N.O. contacts indicate no fault/alarm.	
**	Signal is open collector high impedance if faulted.	

5.2.2 Faults/Alarms Display

General fault, status, and alarm information are indicated by 10 LEDs located on the modem's front panel.

A fault (red LED) indicates a fault that currently exists in the modem.

When a fault occurs, it is stored in the stored fault memory, and indicated by the single yellow LED.

The LED is turned off when the fault clears. If the fault clears, the occurrence is also stored.

A total of 10 occurrences of any fault can be stored. Each fault or stored fault indicated by a front panel LED could be one of many faults. To determine which fault has occurred, use the Fault or Stored Fault front panel menu. Refer to Chapter 3 for information on the Fault or Stored Fault front panel menu.

Alarms are considered minor faults, which 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 (white on black) character that appears at the display panel.

5.2.3 Faults/Alarms Analysis

This section describes the possible problems and actions to take for the following faults:

- Modulator
- Demodulator
- Transmit interface
- Receive interface
- Common equipment

5.2.3.1 Modulator Faults

Fault/Alarm	Possible Problem and Action
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 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. This is considered a major alarm, and will turn off the modulator output. 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.
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.
INTERNAL SCT SYN	Internal TX data clock synthesizer fault. The SCT has failed to lock to the internal reference.
EXT REF ACT	External reference activity fault. Indicates clock reference not detected.
MODULE	Modulator module fault. Typically indicates that the modulator module is missing or will not program.

5.2.3.2 Demodulator Faults

Fault/Alarm	Possible Problem and Action
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 RF 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. This fault is a hardware failure. Contact the Comtech EF Data Customer Support Department.
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.
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 Utility menu. This is an alarm based on the corrected BER reading on the front panel.
MODULE	Demodulator module fault. Typically indicates that the demodulator module is missing or will not program. Contact the Comtech EF Data Customer Support Department.

5.2.3.3 Transmit Interface Faults

Fault/Alarm	Possible Problem and Action
TX DROP	N/A
TX DATA/AIS	Data or incoming AIS. When the AIS is selected in the Interface Utility menu for TX data fault, the transmit interface fault TX data/AIS is monitoring a fault condition of all 1s from customer data input to the modem. When data is selected in the Interface Utility menu for TX data fault, the TX interface fault TX data/AIS is monitoring a fault condition of all 1s or 0s. This is referred to as a data-stable condition (data is not transitioning). This fault indicates there is trouble in the chain sending data to the modem. The modem passes this signal transparently, and takes no other action. This indication is a monitor function only, and aids in isolating the trouble source in a system.
TX CLOCK PLL	Transmitter phase-locked loop fault. Indicates the transmitter PLL is not locked to the reference of the interface transmit clock recovery oscillator. Contact the Comtech EF Data Customer Support Department.
TX CLOCK ACT	Activity detector alarm of the selected interface transmit clock. Indicates the selected TX clock is not being detected. Check the signal of the selected TX clock source to verify the signal is present. The interface will fall back to the internal clock when this alarm is active.

5.2.3.4 Receive Interface Faults

Fault/Alarm	Possible Problem and Action
BUFFER UNDERFLOW	Buffer underflow alarm. Indicates the plesiochronous buffer has underflowed. Buffer underflow is normally a momentary fault (there are clock problems if this alarm is continuously present). This alarm is included in this section to be consistent with the fault reporting system and to be correctly registered in the stored fault memory. The time and date of the first 10 receive buffer underflow faults are stored in battery-backed memory as an aid to troubleshooting. The interval between stored overflow/underflow events can be used to determine relative clock accuracies.
BUFFER OVERFLOW	Buffer overflow alarm. Indicates the plesiochronous buffer has overflowed. The problems and actions in the buffer underflow section apply to this alarm.
RX DATA/AIS	Data or incoming AIS. The data monitored for RX data is coming from the satellite. When the AIS is selected for RX data fault in the Interface Utility menu, the RX data/AIS is monitoring an alarm condition of all 1s from the satellite. When data is selected for RX data fault in the Interface Utility menu, the RX data/AIS is monitoring a fault condition of all 1s or 0s. This is referred to as a data-stable condition (data is not transitioning). The fault indicates trouble in receiving data from the satellite. The modem passes this signal transparently, and can close a FORM C contact. The indication is a monitor function only to help isolate the source of trouble in a system.
FRAME BER	N/A
BACKWARD ALARM	N/A
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. If the fault continues, contact the Comtech EF Data Customer Support Department.
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.
DEMUX_LOCK	Demultiplexer synchronization lock fault. This fault means that the demultiplexer is unable to maintain valid frame and multiframe alignment. The usual cause is invalid or absent receive data. This is a major (prompt) alarm. The alarm will cause insertion of receive AIS (all 1s) and the switch-over will be attempted. This fault is to be sent as a backward alarm to the distant end. This fault will occur when no carrier is present, but will probably never occur with a correct signal.
RX 2047 LOCK	RX 2047 lock alarm. Indicates the RX 2047 data test pattern is not being received by the decoder. The alarm probably indicates the transmitter is not set correctly.

Fault/Alarm	Possible Problem and Action
BUFFER FULL	Buffer full alarm. Indicates the buffer is < 10% or > 90% full.
RX INSERT	N/A

5.2.3.5 Common Equipment Faults

Fault/Alarm	Possible Problem and Action
BATTERY/CLOCK	M&C battery voltage or clock fault. Indicates a low voltage in the memory battery. Typically, this fault will be active when a modem has been hard reset or the firmware has been changed. When a hard reset has been executed or the firmware has been changed, this fault will typically be active when the modem is first turned on.
-12 VOLT SUPPLY	-12V power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the -12V line from the power supply or on any of the plug-in boards.
+12 VOLT SUPPLY	+12 VDC power supply fault. Use the same procedure as with -12V fault.
+5 VOLT SUPPLY	+5V power supply fault. Use the same procedure as with a -12V fault. The +5V supply requires a minimum load of 1A.
CONTROLLER	Controller fault. Indicates a loss of power in the M&C card. Typically indicates the controller has gone through a power on/off cycle.
INTERFACE	Interface module fault. Indicates a problem in programming the interface card.

5.2.4 Remove and Replace Power Supply

WARNING

Ensure that all power to the modem is disconnected. Make certain technicians performing the task are in compliance with all industry safety regulations. DC modems may contain power within the modem; observe safety regulations prior to performing the task.

Remove the Power Supply, as follows:

1. Disconnect all power to the modem.
2. Remove the modem from the rack and place modem on a workbench or equivalent area to perform the task.
3. Remove the hardware securing the cover to the chassis.
4. Remove the cover.
5. Remove the cover from the power supply.
6. Disconnect the multiple wire-plug-in from the Power Supply.
7. Disconnect the plug-in from the Power outlet.
8. Disconnect the GREEN Ground plug-in from the Power supply PCB.
9. Remove the four screws securing the Power Supply to the chassis.
10. Remove the Power Supply.

Install Power Supply, as follows:

1. Position new power supply in the chassis and secure with the four screws.
2. Connect the GREEN Ground wire to the Power Supply PCB.
3. Connect the Power Outlet plug-in to the Power Supply PCB.
4. Connect the multiple wires-plug-in to the Power Supply PCB.
5. Install the Power Supply cover.
6. Install the modem cover and secure with the standard hardware.
7. Reinstall the modem in the rack.

5.2.5 Remove and Replace the Fan Assembly

WARNING

Ensure that all power to the modem is disconnected. Make certain technicians performing the task are in compliance with all industry safety regulations. DC modems may contain power within the modem; observe safety regulations prior to performing the task.

Remove the Fan Assembly, as follows:

1. Disconnect all power to the modem.
2. Remove the modem from the rack and place modem on a workbench or equivalent area to perform the task.
3. Remove the hardware securing the cover to the chassis.
4. Remove the cover.
5. Remove the cover from the power supply.
6. Remove the Data I/O Interface connector, as follows:

    a. Disconnect the Data I/O interface connector from the Main PCB.
    b. Disconnect the hardware securing the Data I/O interface connector
    c. Remove the Data I/O Interface connector.

7. Disconnect fan cable to the Main PCB.
8. Remove the four screws securing the fan assembly.
9. Remove the fan assembly.

Install the Fan Assembly, as follows:

1. Place fan assembly in the chassis and secure with the four screws.
2. Connect the fan assembly cable to the Main PCB.
3. Install the Data I/O Interface Connector as follows:

    a. Insert the Data I/O Interface Connector into the chassis.
    b. Connect the cable(s) and Data I/O to the Main PCB
    c. Secure the Data I/O Interface Connector.

4. Install the Power Supply cover.
5. Install the chassis cover and secure with the hardware.

Appendix A. OPTIONS

This appendix describes the options available for the SNM-1001A. Available options include:

A.1 FAST Accessible Options	A.2 Conventional Options	A.3 Software and Hardware Upgrades
A.1.2 Implementation	A.2.1 Reed-Solomon Codec	A.3.1 Main PCB
A.1.3 AUPC		A.3.2 Turbo Product Codec
A.1.4.1 Sequential Decoder		
A.1.4.2 Viterbi Decoder		
A.1.4.3 Reed-Solomon Decoder		
A.1.5 Asymmetrical Loop Timing		
A.1.6 Variable Data Rates		

A.1 FAST Accessible Options

Comtech EF Data's FAST system allows immediate implementation of these options through the user interface keypad:

- Decoder
- Asymmetrical loop timing
- Variable data rates

Some FAST options are available through the basic platform unit, while others require that the unit be equipped with optional hardware or that the hardware be installed in the field. Refer to Table A-1 for a listing of possible configurations.

Other options are available through conventional changes such as installing daughter card PCBs. Refer to Section A.2, Conventional Options, for additional information.

Table A-1. FAST Options and Required Configurations

Hardware	Single Data Rate	Low Variable Data Rate (up to 512 kbps)	High Variable Data Rate (up to 4.375 Mbps)	Sequential Decoder	Viterbi Decoder	Asymmetrical Loop Timing	8PSK	Reed–Solomon Codec	AUPC Overhead
Basic Platform SNM-1001A	●			● 1	● 1				
FAST Options		●	●	●	●	●	●		
FAST Options with Reed Solomon Hardware								●	●

1 The basic modem is shipped with either Sequential or Viterbi decoder.

A.1.1 FAST System Theory

FAST is an enhancement feature available only in Comtech EF Data products, enabling on-location upgrade of the operating feature set—in the rack—without removing a modem from the setup. When service requirements change, the operator can upgrade the topology of the modem to meet those requirements within minutes after confirmation by Comtech EF Data. This accelerated upgrade can be accomplished only because of FAST's extensive use of programmable devices incorporating Comtech EF Data-proprietary signal processing techniques. These techniques allow the use of a unique access code to enable configuration of the available hardware. The access code can be purchased at any time from Comtech EF Data. Once obtained, the access code is loaded into the unit through the front panel keyboard or the rear remote port.

With the exclusive FAST technology, operators have maximum flexibility for enabling functions as they are required. FAST allows an operator to order a modem precisely tailored for the initial application, reducing risk and cost overruns during the application integration process.

A.1.2 Implementation

FAST is factory-implemented in the modem at the time of order. Hardware options for basic modems can be ordered and installed either at the factory or in the field. The operator can select options that can be activated easily in the field, depending on the current hardware configuration of the modem.

A.1.2.1 Activation Procedure

A.1.2.1.1 Obtain Modem Serial Number

1. Press [CLEAR] to return to the Main menu.
2. Use [←] and [→] to select Function Select menu.
3. Press [ENTER].
4. Use [←] and [→] to select Utility Modem Type menu.
5. Press [ENTER].
6. Use [←] and [→] to select Modem Serial # menu.
7. Record serial number: ______________________________

A.1.2.1.2 Select Features:

1. Use [←] and [→] to select Modem Options menu.

2. Press [ENTER].

3. Scroll through the Modem Options and check off all features that display a "+" sign as follows:

HIGH POWER	[ ]	SINGLE RATE	[ ]
HIGH STABILITY	[ ]	LOW RATE VOLTAGE	[ ]
ASLT	[ ]	FULL RATE VARIABLE	[ ]
VITERBI	[ ]	CARD #1 PCB	[ ]
SEQUENTIAL	[ ]	CARD #2 PCB	[ ]

Notes:
1. If the menu displays a "0", the unit will need to be returned to the manufacturer for the desired hardware upgrade.
2. If the unit displays an "X," the unit can be upgraded in the field.
3. If the unit displays a "+", the feature is installed.
4. If the unit displays a "-," the feature is FAST accessible.

4. Press [CLEAR].

5. Use [←] and [→] to select CARD #1 (Overhead Card) menu.

6. Record Card #1 serial number, if displayed:______________

7. Use [←] and [→] select CARD #2 (Reed-Solomon Card) menu.

8. Record Card #2 serial number, if displayed:______________

9. Press [CLEAR].

10. Contact a Comtech EF Data sales representative to order features.

11. Comtech EF Data Customer Support personnel will verify the order and provide an invoice and instructions.

A.1.2.1.3 Entering Access Codes from the Front Panel

1. Press CLEAR to return to **Main** menu.

2. Use the [←] [→] keys to go to the **Function Select:Utility** menu.

3. Press <ENTER>.

4. Go to **Utility:Modem Type** menu.

5. Press <ENTER>.

6. Go to **Configuration Code-Modem** menu.

7. Press <ENTER>.

8. Menu should display as follows:

```
    1) AAAAAAAAAA
    2) AAAAAAAAAA
```

9. To enter the code, press <ENTER> and use the [↑] [↓] keys to select an alpha numeric character. Use [→] to move to the next character or to move to the next line. Repeat this procedure until all 20 characters of the code have been entered.

10. After completing entry of the 20-character code, press <ENTER>. The unit should display **Modem Initialization** and will reboot to the factory default settings with the new option available.

11. If a wrong or invalid code is entered, the unit will display **Wrong Code Entered!** and no changes will occur. Please retry the code, verify that the code is correct, or request assistance from Comtech EF Data Customer Support.

A.1.2.1.4 Entering Access Codes from the Remote Control Port

1. Establish remote communication with the unit. Display will show **REMOTE MODE** (if applicable).

2. Enter the following commands as needed to enable the option related to each board:

<table>
<tr><td>Main Board:</td><td><x/CCMD_code</td><td rowspan="3">x = address

code = 20 digit configuration code</td></tr>
<tr><td>TX-Reed-Solomon:</td><td><x/CCTR_code</td></tr>
<tr><td>RX-Reed-Solomon:</td><td><x/CCRR_code</td></tr>
</table>

3. The modem should re-initialize and boot up to the factory default settings.

A.1.2.1.5 Verify Upgrade

1. Press [CLEAR] to return to the Main menu.

2. Use [←] and [→] to select Function Select Utility menu.

3. Press [ENTER].

4. Use [←] and [→] to select Utility Modem Type menu.

5. Press [ENTER].

6. Use [←] and [→] to select Modem Options menu.

7. Press [ENTER].

8. Use [←] and [→] to scroll through features. Visually check selected features for a "+" sign. If a "+" sign is evident, the upgrade is completed.

9 If upgrade is incorrect, the menu display will exhibit "WRONG CODE ENTERED." Repeat procedures. Contact Comtech EF Data Customer Support personnel for further instructions, if the error message remains.

A.1.3 AUPC

Note: If required, refer to Section A.3 for installation of the Reed-Solomon card.

The AUPC channel is MUXed onto the data and transmitted at an overhead rate of 16/15 of the main channel. The AUPC feature allows remote communication between a local modem and a remote modem.

Refer to Figure A-1 for a modem block diagram with the AUPC interface option.

EIA-422, or V.35 interfaces are available for terrestrial data input and output. These interfaces can be selected via the front panel.

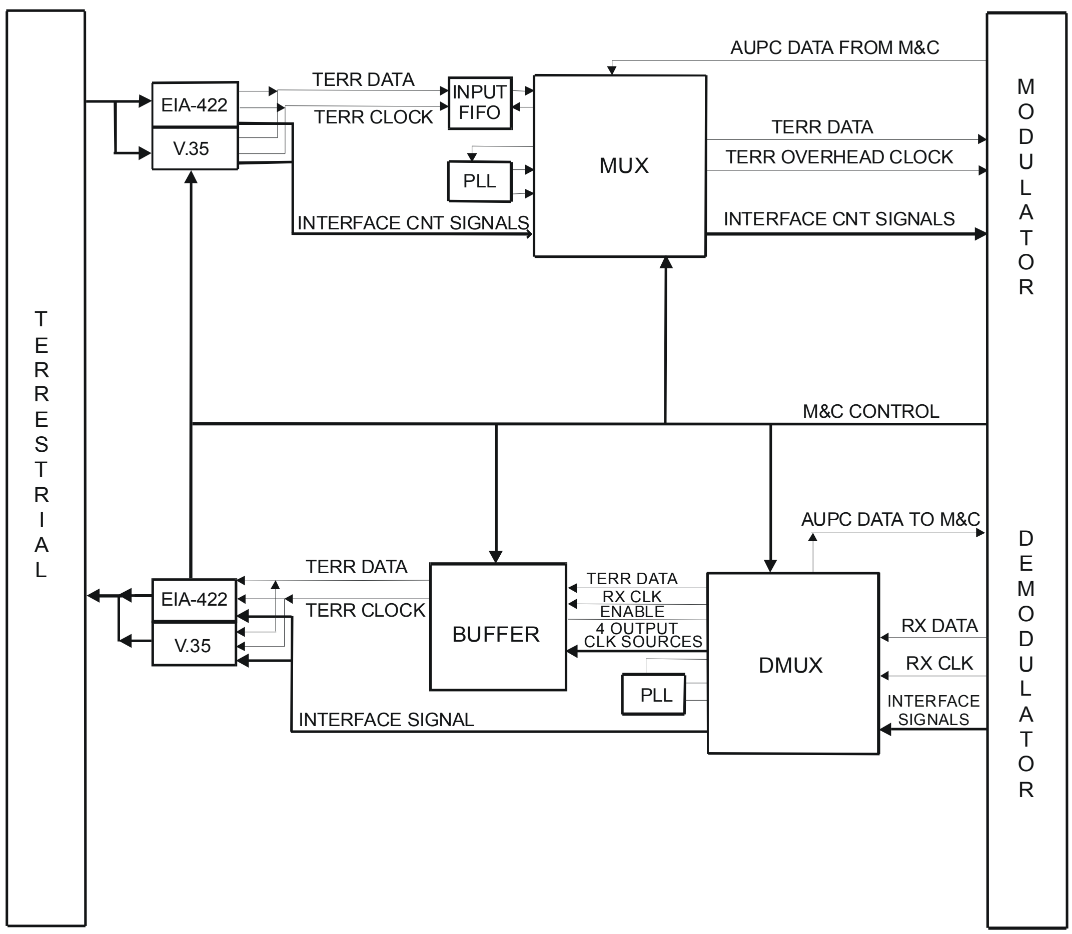
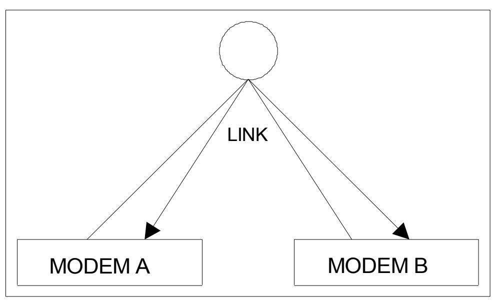


Figure A-1. AUPC Block Diagram

A.1.3.1 AUPC

The AUPC function allows each of two modems in a closed link to control the output of the other modem. Both modems must have the AUPC options enabled. These options are:

AUPC ENABLE	Enables the AUPC to function locally.
NOMINAL POWER	Output power level. Can be used for problem conditions, if chosen.
MINIMUM POWER	Sets minimum output power to be used.
MAXIMUM POWER	Sets maximum output power to be used.
TARGET NOISE	Desired E_b/N_0 of the local modem.
TRACKING RATE	Sets speed at which modems will adjust to output power.
LOCAL CL ACTION	Defines action that local modem will take if it loses carrier (Maximum, Minimum, or Hold).
REMOTE CL ACTION	Defines action that local modem will take if remote modem reports carrier loss (Maximum, Minimum, or Hold).



With AUPC enabled on both modems (A and B), if modem A loses carrier:

1. Modem A sets its output power (MAXIMUM, MINIMUM, OR HOLD) as specified by LOCAL CL ACTION.

2. Modem A then sends a "lost carrier" command to modem B.

3. Modem B sets its output power (MAXIMUM, MINIMUM, OR HOLD) as specified by REMOTE CL ACTION.

4. Once modem A has reacquired the carrier, it sends commands to modem B to achieve the desired E_b/N_0. During this time, modem B sends commands to modem A to increase or decrease power to maintain modem B's target E_b/N_0.

Notes:

1. Modem B will not make changes to modem A if the E_b/N_0 is within 0.5 dB of the target noise.
2. Modem B will not control modem A transmitting output level if the target noise for modem B is set within 15.5 to 16.0 dB and the receive signal to the modem is sufficient that the receive noise is 16 dB or better.
3. Modem A will be transmitting at the maximum output if the local carrier loss action is set to maximum.

5. Caution shall be observed when setting the target E_b/N_0 above 15.5 dB, the maximum limit is established at 16.0 dB.

Notes:

1. Local carrier loss always takes priority over remote carrier loss.
2. The RX AUPC link is dead when the carrier is lost.

A.1.3.1.1 Self-Monitoring Local Modem AUPC Control

Note: This feature is available with or without the overhead PCB installed. Self-monitoring AUPC is not used when the ASYNC/AUPC is selected as the Modem Type, because the ASYNC/AUPC feature uses the overhead channel to control the modem's output power.

The operator can allow the modulator to control its own TX power when the earth station is in the same satellite footprint. The operator should tune the demodulator to receive its own signal, similar to a satellite loop.

Note: This option can be used for half-duplex operation and for one signal transmitting to many sites. For full-duplex operation, use a separate demodulator.

This option is located in the Utility/Modem Type/Local Modem AUPC menu. Proceed as follows:

1. Locate and enable the option.

2. Set all configuration parameters.

Notes:

1. Comtech EF Data does not recommend increasing the power to the satellite without consulting with the satellite controller.
2. Be careful not to set carrier output to the high-side when there is a loss of carrier due to severe weather.
3. Do not use the distant end RX signal to compensate for local rain fade unless allowances are made for a narrow window for TX level changes.
4. Changes in local weather will attribute to cause level unbalancing in the TX signal. The TX signal is attenuated due to heavy, dense, or cloud conditions.

A.1.3.2 Remote AUPC

This feature allows the user to monitor and control a remote modem location using the front panel or serial port of the local modem. The operator can set or reset the following commands:

- Baseband loopback
- TX 2047 pattern
- AUPC enable

The user can remotely monitor the receive 2047 BER. Refer to Appendix B for a description of remote operation.

A.1.3.3 Theory of Operation

A.1.3.3.1 Terrestrial Data Interfaces

Two I/O interfaces are provided for the terrestrial data source: EIA-422 and V.35. The operator must select the terrestrial interface type from the front panel under the Utility Interface menu. Once selected, I/O data is routed to and from the appropriate drivers and receivers.

A.1.3.3.2 MUX Operation

The MUX receives terrestrial and AUPC data from the selected receivers. The terrestrial data flows into a small First In/First Out (FIFO) buffer. The FIFO buffer aids in the rate exchange between the terrestrial data rate and the overhead rate. The data can be clocked into the MUX by the terrestrial clock or an internal clock.

AUPC data is received from a serial M&C interface. The overhead clock is generated from the terrestrial data clock by a phase-locked loop. Inside the multiplexer, overhead bits (1/16) are added to create a sub-frame, frame, and multi-frame structure. The AUPC data from the M&C interface is inserted into the framing structure. The framed data is output to the modulator card on the modem at the overhead rate.

A.1.3.3.3 DEMUX Operation

The DEMUX section functions in a “reverse” manner to the MUX side. Data, including overhead, is received from the Demod card in the modem at the overhead rate.

The DEMUX locates the framing in the overhead and locks to the frame sync pattern generated by the multiplexer on the transmitting end. Once locked to the framing, the terrestrial data is clocked into the Doppler buffer with the overhead clock and an enable line.

The AUPC data is stripped from the frame structure and is sent to the M&C via a serial interface.

A.1.3.3.4 Buffer Operation

The buffer has two serial interfaces to the M&C interface. The first serial interface is used to download the desired buffer size. The second serial interface is used to provide the M&C with the information necessary to calculate the fill status of the buffer. Three discrete lines are provided:

- One line to center the buffer on command.
- Two lines to indicate either an overflow or underflow condition.

The Doppler buffer receives data clocked by the overhead clock from the Demod and an enable line from the DEMUX. The data is stored in RAM. Four options are allowed to clock the data out of the buffer:

- TX
- RX
- Internal
- External

Based on this selection, terrestrial data is clocked out of the buffer to the selected drivers and on to the end user.

A.1.3.3.5 Loop Timing Operation

The appropriate RX buffer clock choice for loop timing is RX Satellite. This will clock out the data from the modem using the recovered clock from the demodulator IF input.
The SCT clock output will be phase-locked to the RX Satellite clock when loop timing is selected. The operator can use the clock developed from the RX Satellite IF for clocking data into the user device. This would be using RX timing. The operator also can use the ST clock, which is now phased-locked to the receiver, to clock the user data (Send Data) to the modem.

A.1.3.3.6 Baseband Loopback Operation

A baseband loopback option is provided. When selected, the input terrestrial data and clock from the operator are looped back to the user as the output terrestrial data and clock.

The terrestrial data and clock output from the DEMUX are also looped to the terrestrial data and clock input at the MUX.

A.1.3.4 Front Panel Operation

For information on the additional front panel operations that are specific to the ASYNC interface, refer to Chapter 3. The following menus are affected:

- Configuration Interface
- Configuration Local AUPC
- Utility Interface
- Remote AUPC Configuration
- Remote AUPC Monitor

A.1.3.5 AUPC Modem Defaults

Modulator		Demodulator	
Data Rate	A	Data Rate	A
TX Rate A	64 kbps, QPSK 1/2	RX Rate A	64 kbps, QPSK 1/2
TX Rate B	256 kbps, QPSK 1/2	RX Rate B	256 kbps, QPSK 1/2
TX Rate C	768 kbps, QPSK 1/2	RX Rate C	768 kbps, QPSK 1/2
TX Rate D	2048 kbps, QPSK 1/2	RX Rate D	2048 kbps, QPSK 1/2
TX Rate V	128 kbps, QPSK 1/2	RX Rate V	128 kbps, QPSK 1/2
IF Frequency	70 MHz	IF Frequency	70 MHz
IF Output	OFF	Descrambler	ON
TX Power Level	-10 dBm *(see Note)*	Differential Decoder	ON
Scrambler	ON	RF Loop Back	OFF
Differential Encoder	ON	IF Loop Back	OFF
CW Mode	Normal (OFF)	BER Threshold	NONE
RS Encoder	OFF	Sweep Center Freq.	0 Hz
Modulator Type	EFD Closed	Sweep Range	60000 Hz
Encoder Type	Viterbi	Sweep Reacquisition	0 seconds
Mod Spectrum	Normal	RS Decoder	OFF
Mod Power Fixed	0 dBm	Demodulator Type	EFD Closed
		Decoder Type	Viterbi
		Demod Spectrum	Normal
Interface			
TX Clock Source	TX Terrestrial		
Buffer Clock Source	RX Satellite		
TX Clock Phase	Auto		
RX Clock Phase	Normal		
EXT-REF Frequency	1544.000 kHz		
Baseband Loopback	OFF		
Interface Loopback	OFF		
Loop Timing	OFF		
TX Data/AIS Fault	NONE		
RX Data/AIS Fault	NONE		
TX 2047 Pattern	OFF		
RX 2047 Pattern	OFF		
TX Coding Format	AMI		
RX Coding Format	AMI		
Buffer Programming	Bits		
Buffer Size	384		
Local AUPC			
AUPC ENABLE	OFF	Target Noise	6.0 dB
Nominal Power	+0.0 dBm	Tracking Rate	0.5 dB/MIN
Minimum Power	-20.0 dBm	Local CL Action	Hold
Maximum Power	+5 dBm	Remote CL Action	Hold
Note: 0 dBm if High Power option is installed.			

A.1.4 Decoder

A.1.4.1 Sequential Decoder

The sequential decoder is used in closed network applications, typically in Frequency Division Multiple Access (FDMA) satellite communications systems. The sequential decoder is a FASToption. Refer to A.2 for a block diagram of the sequential decoder.

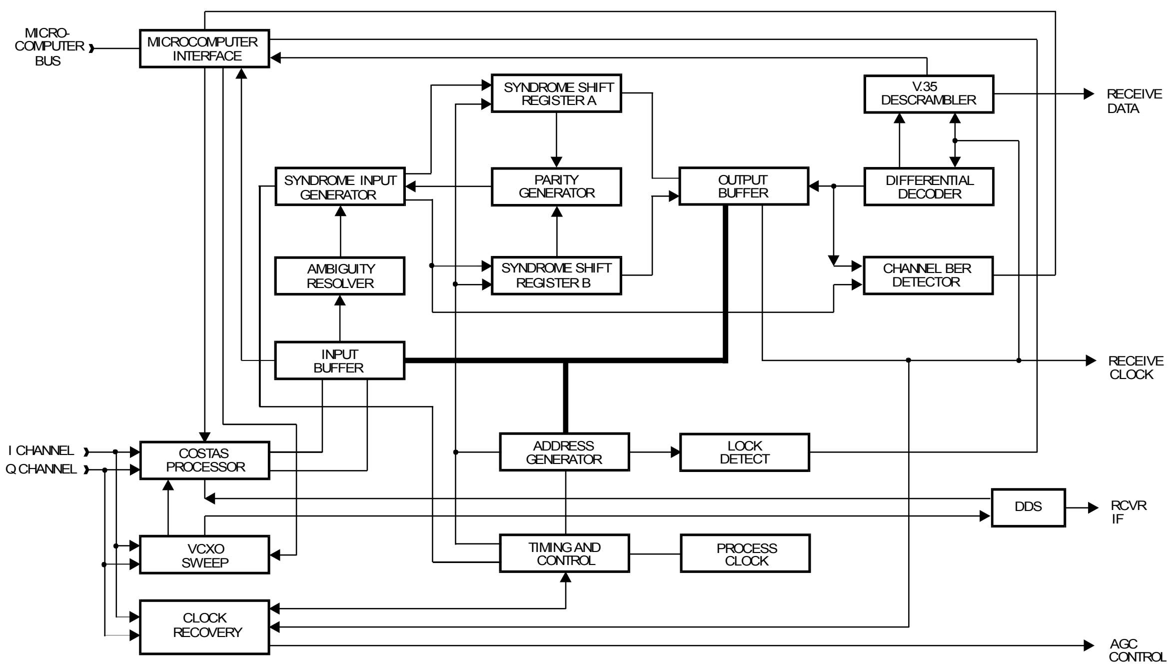


Figure A-2. Sequential Decoder Block Diagram

A.1.4.1.1 Theory of Operation

The sequential decoder also works in conjunction with the convolutional encoder at the transmitting modem to correct bit errors in the received data stream from the demodulator.

The sequential decoder processes 2-bit quantized I&Q channel data symbols from the demodulator. This data is assumed to be a representation of the data transmitted, corrupted by additive white Gaussian noise. The decoder's task is to determine which bits have been corrupted by the transmission channel, and correct as many as possible. This is accomplished by the use of parity bits added by the encoder to the data stream prior to transmission.

The possible sequences of bits, including parity output by the encoder, are listed on a code tree. The decoder uses the parity bits and knowledge of the code tree to determine the most likely correct sequence of data bits for a given received sequence.

The search proceeds from a node in the code tree by choosing the branch with the highest metric value (highest probability of a match between the received data and a possible code sequence). The branch metrics are added to form the cumulative metric. As long as the cumulative metric increases at each node, the decoder assumes it is on the correct path, and continues forward. If the decoder makes a wrong decision, the cumulative metric will decrease rapidly as the error propagates through the taps of the parity generator. In this case, the decoder tries to back up through the data to the last node where the metric was increasing, then take the other branch.

In an environment with severe errors, the decoder will continue to search backwards for a path with an increasing metric until it either finds one, runs out of buffered data, or runs out of time and must deliver the next bit to the output.

The decoder processes data at a fixed rate, which is much higher than the symbol rate of the input data. This allows it to evaluate numerous paths in its search for the most likely one during each symbol time.

Data enters the input RAM of the decoder from the demod processor in 2-bit soft decision form for both I&Q channels, as shown in the block diagram (Figure 4-3). The input RAM buffers the data to provide history for the backward searches. Data from the RAM passes through the Ambiguity Corrector, which compensates for the potential 90° phase ambiguity of the demodulator.

The syndrome input generator converts the 2-bit soft decision data into a single bit per channel, and simultaneously corrects some isolated bit errors. The data is then shifted through the syndrome shift registers, which allows the parity generator to detect bit errors. The resulting error signal provides the feedback to the timing and control circuitry to allow it to direct the data along the path of the highest cumulative metric.

The corrected data is buffered through the output RAM and re-timing circuit, which provides a data stream to the differential decoder and descrambler at the constant rate of the data clock. The data and the clock are then output from the card.

The sequential decoder also provides a lock detect signal to the M&C when the error rate has dropped below a threshold level. The M&C monitors these signals and takes appropriate action.

The raw BER count is made by comparing the input and output decoder data. Because the output data contains many fewer errors than the input, differences in the two can be counted to yield the raw BER. The raw BER is sent to the M&C for further processing.

A.1.4.2 Viterbi Decoder

The Viterbi decoder operates in conjunction with the convolutional encoder at the transmit modem. The decoder uses a decoding algorithm to provide FEC on the received data stream for errors occurring in the transmission channel.A block diagram of the Viterbi decoder is shown in Figure A-3.

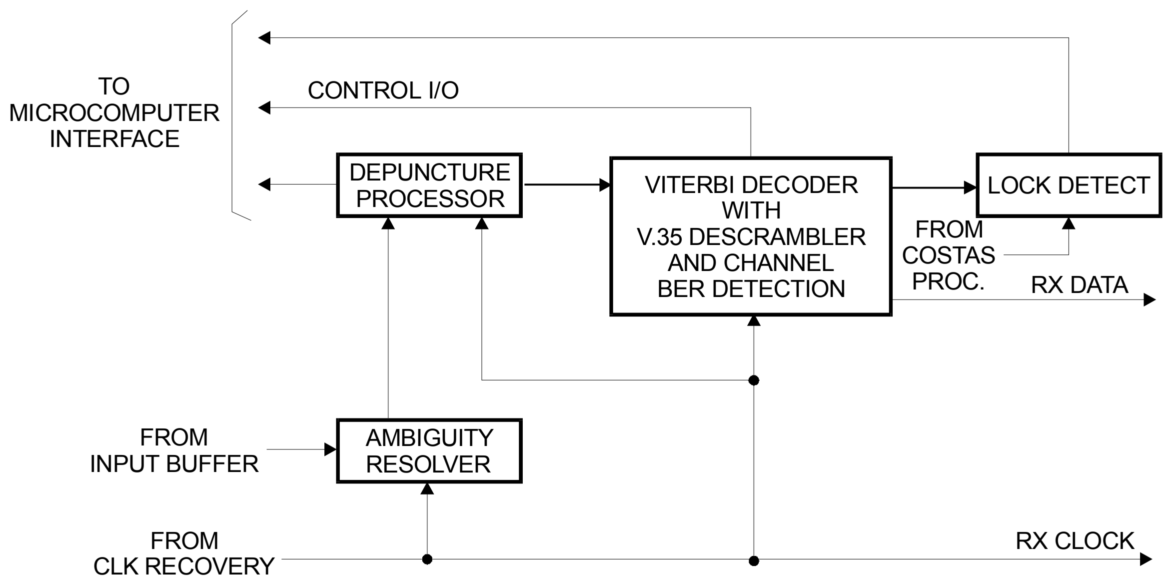


Figure A-3. Viterbi Decoder Block Diagram

A.1.4.2.1 Viterbi Specification

Parameter	Specification
BER	See Chapter 1
Maximum Data Rate	2.048 Mbps (rate 1/2) 2.048 Mbps (rate 3/4) 2.048 Mbps (rate 7/8)
Synchronization Time	8000 bits (maximum)
Output Fault Indicators	Activity detection of I and Q data sign bits
Raw BER Detection	From 0 to 255 bits out of 1024 samples
Differential Decoding	2-phase or none
Constant Length	7

A.1.4.2.2 Theory of Operation

The Viterbi decoder processes 3-bit quantized R0 and R1 parallel code bits or symbols from the demodulator. The quantization is 3-bit soft-decision in sign/magnitude format. This data is a representation of the data transmitted, corrupted by additive white Gaussian noise. The task of the decoder is to determine which symbols have been corrupted by the transmission channel and correct as many errors as possible. The code symbols produced by the encoder provide the data for this task.

The seven functions used in processing the data stream are:

- Phase compensation with an ambiguity resolver
- De-puncturing
- Computing branch metric values
- Add-Select-Compare (ASC) computer processing
- Memory storage
- Descrambling
- Differential decoding

The data is first sent through an ambiguity resolver for compensating the potential 90° phase ambiguity inherent in a QPSK demodulator. The data is then de-punctured if the decoder is operating in the 3/4 or 7/8 rates. The de-puncture pattern is the same as the puncture pattern used in the encoder.

A set of branch metric values is then computed for each of the received symbol pairs. This is related to the probability that the received symbol pair was actually transmitted as one of the four possible symbol pairs.

The branch metrics are then processed by the ASC computer. The ASC computer makes decisions about the most probable transmitted symbol stream with the state metrics computed for the previous 64 decoder inputs.

The results of the ASC computer are stored in the path memory (80 states in depth). The path with the maximum metric is designated as the survivor path, and its data is used for output. The difference between the minimum and the maximum path metrics is used as the means of determining synchronization of the decoder.

The output data is then descrambled and differentially decoded. Both of these processes are optional, and may be selected by the user locally or remotely. The data from the differential decoder is sent to the interface PCB for formatting and output. The synchronization signal is used for lock-detect and sent to the M&C.

The raw BER count is generated from the minimum and maximum metrics and sent to the M&C for further processing. Refer to Chapter 1 for Viterbi decoder BER specifications.

A.1.4.3 Reed-Solomon Decoder

Refer to Section A.2, Conventional Options, for Reed-Solomon information.

A.1.5 Asymmetrical Loop Timing

Asymmetrical Loop Timing is the same timing method that is designed into the SDM-650B TROJAN interfaces. Refer to Figure A-4 and Figure A-5 for TX and RX Asymmetrical Loop Timing block diagram. There are two advantages for using Asymmetrical Loop Timing:

- Versatility: The user can select different transmit and receive data rates, yet still clock the send data with the receive satellite clock.

- Fits easily into on site clocking schemes: The user may clock the send data with a clock that is not necessarily operating at the same rate as the data rate.

The send timing may only be referenced from an external clock source that is equal to the data rate in the basic modem.

The asymmetrical clock loop reference must be one of the following:

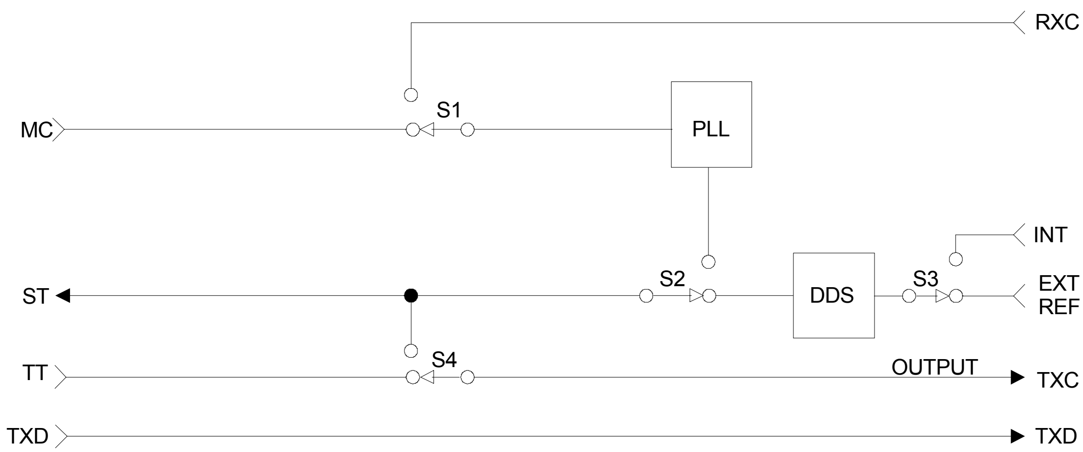
- Transmit terrestrial clock
- External clock input
- Receive clock input

Notes:

1. The clock inputs are as follows:
   a. $\geq$ 64 kHz shall be divisible by 8 kHz.
   b. $\geq$ 32 kHz but < 64 kHz shall be divisible by 600 Hz or 8 kHz.
   c. < 32 kHz shall be divisible by 600 Hz.

2. The transmit clock source can be the same at the RX digital data rate or EXT CLOCK if they are ± 100 PPM. This is provided on the basic unit, with or without the asymmetrical loop timing option.

The transmit data is normally clocked into the modem with the Terminal Timing (TT) clock in typical EIA-422 operation. The received data is clocked out with the Receive Timing (RT) clock. The asymmetrical loop timing option allows the transmit and receive data to be clocked with the same, or a multiple of the same clock. The added benefit is that the transmit and receive data rates do not have to be the same.

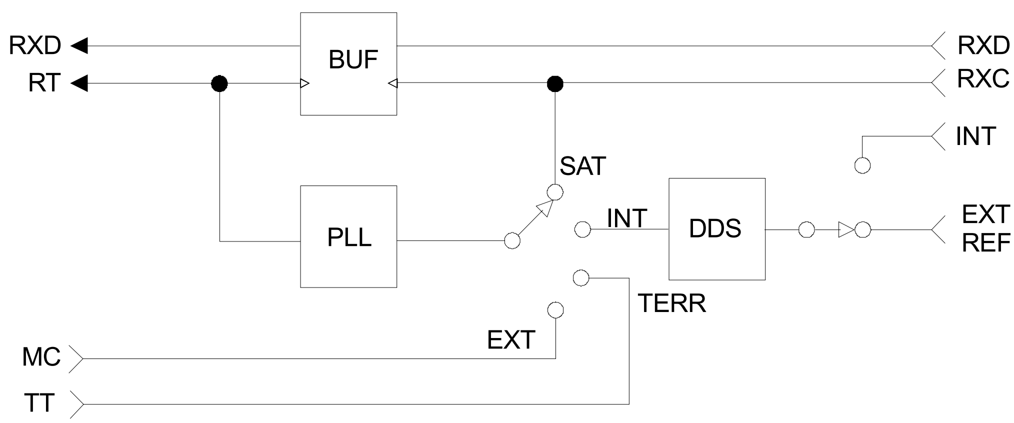


Clock Selection	S1 set to:	S2 set to:	S3 set to:	S4 set to:
TX TERR (TT)		DDS	INT	TT
INT (SCT)		DDS	INT	ST
SCT (INT)		DDS	EXT REF (See Note 2)	ST
SCT (LOOP)		DDS	EXT REF (See Note 2)	ST
INT (LOOP) (See Note 1)	RXC	PLL		ST
EXT CLOCK	MC	PLL		ST

Notes:

1. When CONFIGURATION INTERFACE → LOOP TIMING is set to ON, SCT(INT) will change to read: SCT(LOOP).
2. When CONFIGURATION MOD → MOD REF is set to EXT MOD, S3 will switch to the EXT REF position.

Figure A-4. Transmit Section of the Asymmetrical Loop Timing Block Diagram



Note: PLL will be bypassed when the RX data rate is set to the TX data rate. This will disable the Asymmetrical Mode.

Figure A-5. Receive Section of the Asymmetrical Loop Timing Block Diagram

Example:

Master/Slave Clocking Setup:

1. Master site has a 10 MHz clock that is needed as the clock source.

2. Unequal data rates: 4.096 Mbps and 2.152 Mbps (numbers divisible by 8).

Master Site Option:

1. Set Configuration/Modulator/Modem Reference to EXT 10 MHz.

2. Set Configuration/Interface/TX Clock Source to SCT (Internal).

Note: The SCT clock is slaved off the 10 MHz input. The 10 MHz reference should be placed into CP3 of the modem.

3. Set Configuration/Interface/Buffer Clock to SCT (Internal).

Slave Site:

1. Set Configuration/Interface/Loop Timing to ON.

2. Set Configuration/Interface/TX Clock Source to SCT (LOOP)
   or
   TX Terrestrial, Only if the user equipment can provide the proper slaved clock to the modem.

3. Set Configuration/Interface/Buffer Clock to RX Satellite (Buffer Bypass).

A.1.6 Variable Data Rates

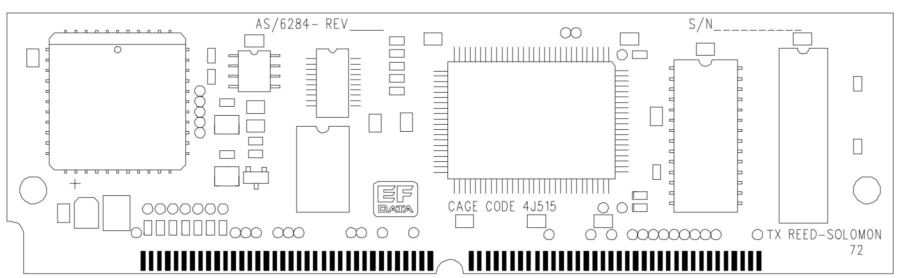
The basic platform modem comes with single data rate capabilities. At the time of purchase, the customer may add optional variable data rate capabilities. If variable rate requirements arise after the purchase of a basic platform modem, these capabilities can be added in the field using FAST technology. The variable rate options include one of the following:

- Rates up to 512 kbps
- Rates up to 4.375 Mbps

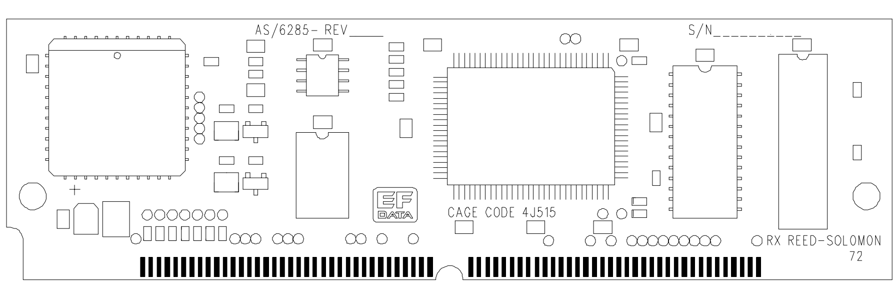
A.2 Conventional Options

A.2.1 Reed-Solomon Codec

The modem must have the Reed-Solomon PCB installed to access this feature. The Reed-Solomon Codec PCB is a 4.75” x 6.00” (12.07 x 15.24 cm) daughter card located on the main PCB (Figure A-6).



TX REED-SOLOMON



RX REED-SOLOMON

Figure A-6. Reed-Solomon PCB (AS/5304-1)

The Reed-Solomon Codec works in conjunction with the Viterbi decoder and includes additional framing, interleaving, and Codec processing to provide concatenated FEC and convolutional encoding and decoding. Refer to Figure A-7 for a block diagram of the Reed-Solomon Codec.

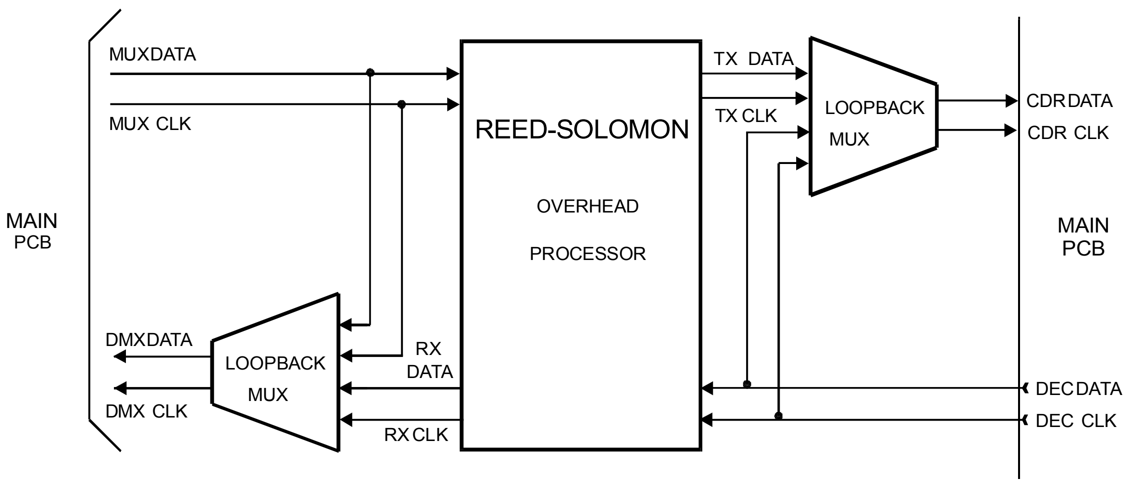


Figure A-7. Reed-Solomon Codec Block Diagram

A.2.1.1 Specifications

Refer to Table A-2 overhead types and data rates supported by the Reed-Solomon Codec option are listed below. Refer to Chapter 1 for BER specifications.

Table A-2. Specifications

Overhead Type	Data Rate
AUPC	2.4 to 2048 kbps
No Overhead	2.4 to 4.555 kbps

A.2.1.2 Theory of Operation

The Reed-Solomon Codec works in conjunction with the interface card to provide concatenated convolutional encoding and decoding.

The two main sections of the Codec are:

- Reed-Solomon encoder (Section A.2.1.3)
- Reed-Solomon decoder (Section A.2.1.4)

A.2.1.3 Reed-Solomon Encoder

A block diagram of the Reed-Solomon encoder section is shown in Figure A-8.

The Reed-Solomon encoder section includes the following circuits:

- Synchronous Scrambler
- Reed-Solomon Codec (encoder section)
- Serial/Parallel Converter
- RAM Interleaver
- Parallel/Serial Converter

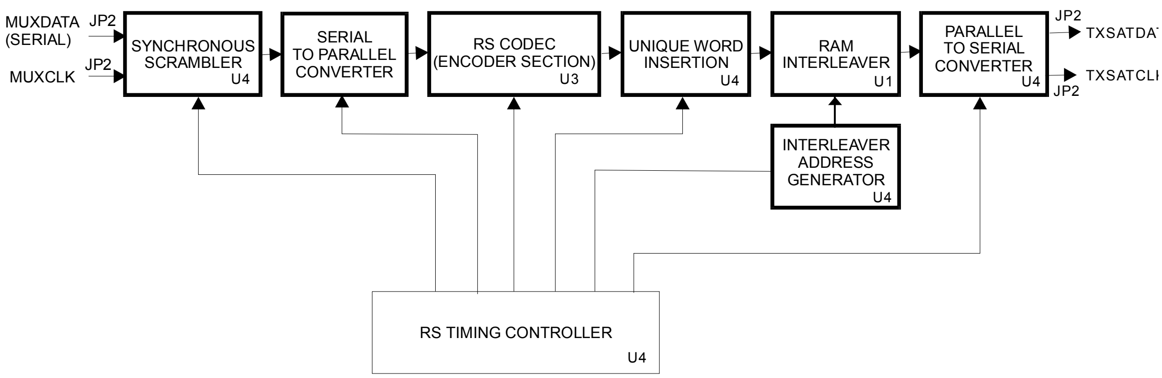


Figure A-8. Reed-Solomon Encoder Section Block Diagram

The data and clock signals (MUXDATA and MUXCLK) come from the multiplexer on the main PCB, and are sent to the Reed-Solomon encoder section. Since the data input to the Reed-Solomon encoder is serial, the data passes through a self-synchronizing serial scrambler, in accordance with INTELSAT-308 Rev. 6B specification.

The host software allows the scrambler to be turned on or off at the front panel as required by the user. If the scrambler is disabled, the data passes through the scrambler unaltered.

The data then passes through a serial/parallel converter, and on to a FIFO. The serial/parallel converter changes the data to an 8-bit word. A synchronous FIFO buffers the incoming data, because the rate is different than the encoded data rate. Once buffered by the FIFO, the data passes to the Reed-Solomon Codec.

Refer to
Figure A-8 for the Reed-Solomon code page format. The Reed-Solomon outer Codec reads the data in blocks of k bytes, and calculates and appends check bytes to the end data block. The letter n represents the total number of bytes in a given block of data out of the Codec. The letter k represents the number of data bytes in a given block.

The term, $n - k = 2t$, is the total number of check bytes appended to the end of the data. This is referred to as the "Reed-Solomon overhead." The term's ***k, n***, and ***t*** will vary, depending on the Reed-Solomon coding used. The output data is passed to a block interleaver.

Since errors from the Viterbi decoder usually occur in bursts, a block interleaver with a depth of four is used in accordance with the INTELSAT-308 Rev. 6B specification. The interleaver has the effect of spreading out the errors across blocks of data instead of concentrating the errors in a single block of data. Since there are fewer errors in any given block, there is a greater chance that the Reed-Solomon decoder can correct the errors on the receiving end of the satellite link. To allow the decoder to synchronize to the data, four unique words are inserted in the last two bytes of the last two pages at the end of each page of data.

Once the data passes through the interleaver, it is fed through a parallel/serial converter and sent back to the interface PCB. After further processing by the interface PCB, the data is sent to the modulator PCB.

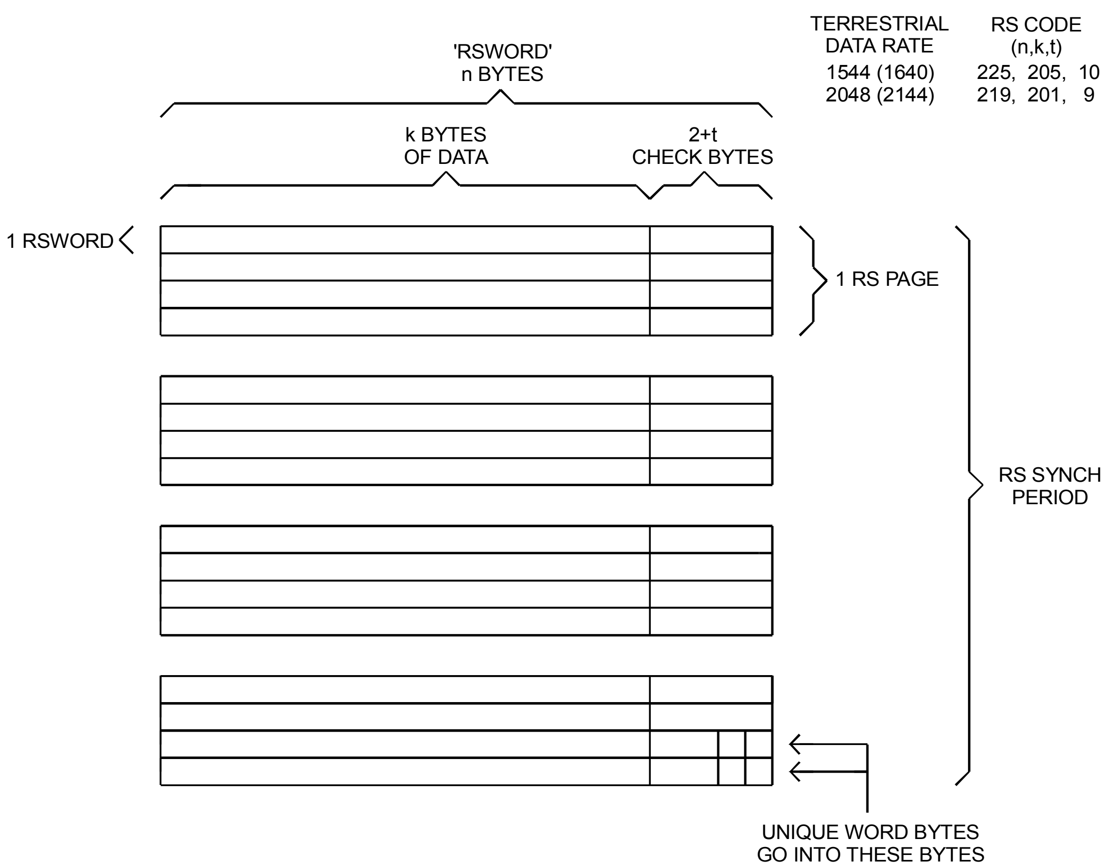


Figure A-9. Reed-Solomon Code Page Format

A.2.1.4 Reed-Solomon Decoder

Refer to Figure A-10 for a block diagram of the Reed-Solomon decoder section.

The Reed-Solomon decoder section includes the following circuits:

- Serial/Parallel Converter
- RAM Deinterleaver
- Parallel/Serial Converter
- Reed-Solomon Codec (decoder section)
- Synchronous Descrambler

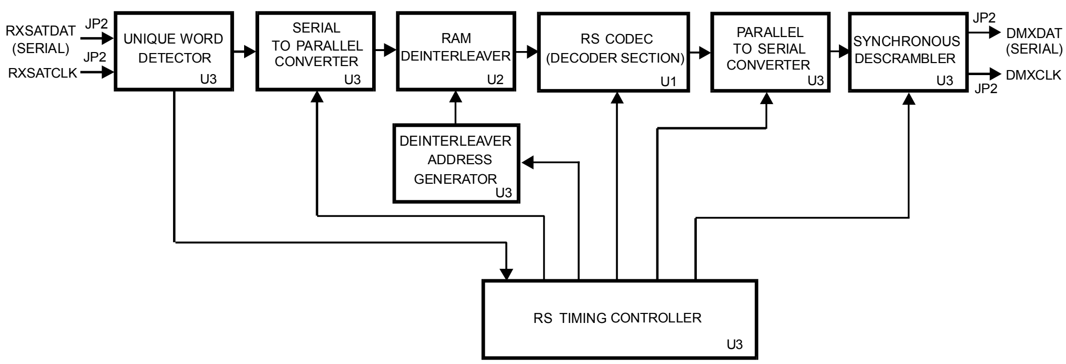


Figure A-10. Reed-Solomon Decoder Section Block Diagram

The data and clock signals come from the demultiplexer on the interface PCB, and are sent to the Reed-Solomon decoder section.

The data is sent through a serial/parallel converter. Because it was block interleaved by the encoder, the data must pass through a de-interleaver with the same depth as the interleaver used on the encoder. The de-interleaver is synchronized by the detection of the unique words, which are placed at the end of each page by the interleaver on the encoder.

Once the de-interleaver is synchronized to the incoming data, the data is reassembled into its original sequence, in accordance with the INTELSAT-308 Rev. 6B specification. The data is then sent to the Reed-Solomon outer decoder.

Refer to Figure A-9 for the Reed-Solomon code page format. The outer Codec reads the data in blocks of ***n*** bytes and recalculates the check bytes that were appended by the encoder. If the recalculated data bytes do not match the check bytes received, the Codec makes the necessary corrections to the data within the data block. The letter n represents the total number of bytes in a given block of data out of the Codec. The letter k represents the number of data bytes in a given block.

The term ***n* - *k* = 2*t*** is the total number of check bytes appended to the end of the data. The term's ***k, n,*** and ***t*** will vary depending on the Reed-Solomon coding used. The Codec then sends the corrected data to a FIFO.

Because the check bytes are not part of the real data, a synchronous FIFO is used to buffer the data and strip the check bytes out of the blocks of data. The data then passes through a parallel converter to be serialized.

The data is sent through a self-synchronizing serial descrambler in accordance with the INTELSAT-308 Rev. 6B specification. The descrambler converts the data back into the original data that the user intended to send. The synchronous descrambler is synchronized by the detection of the unique word at the end of each Reed-Solomon page. The data is then sent to the interface PCB for further processing.

A.2.1.5 Unpacking

CAUTION

This equipment contains parts and assemblies sensitive to damage by ESD. Use ESD precautionary procedures when touching, removing, or inserting PCBs.

1. Remove the Reed-Solomon PCB and mounting hardware from the cardboard caddypack and anti-static material.

2. Check the packing list to ensure the shipment is complete.

3. Inspect the Reed-Solomon PCB for any shipping damage.

A.2.1.6 Installation

The following tool is required to install the overhead interface PCB:

Description	Application
Phillips ™ Screwdriver	To remove and replace cross-point screws.

Use the following information to install the Reed-Solomon Codec PCB as a daughter card on the main PCB.

Refer Figure A-11 for installation location of the Reed-Solomon daughter card.

CAUTION

Turn the power off before installation. High current VDC is present. Failure to do so could result in damage to modem components.

1. Turn off the modem and unplug the power supply.

2. Remove the rear panel retaining screws. Using the finger pulls, slide the main modem assembly out from the rear of the modem chassis.

3. Install the Reed-Solomon PCB to the main PCB by mating the male simm connectors with the female simm connectors in the position shown in Figure A-11.

4. After completing the above installation procedure, turn on the modem. If the Reed-Solomon PCB was installed properly, the Utility Interface/Interface Module menu will display “OPT:Reed-Solomon” or “OPT:DI, Reed-Solomon” (if the D&I is also installed). Refer to Chapter 3 for more information.

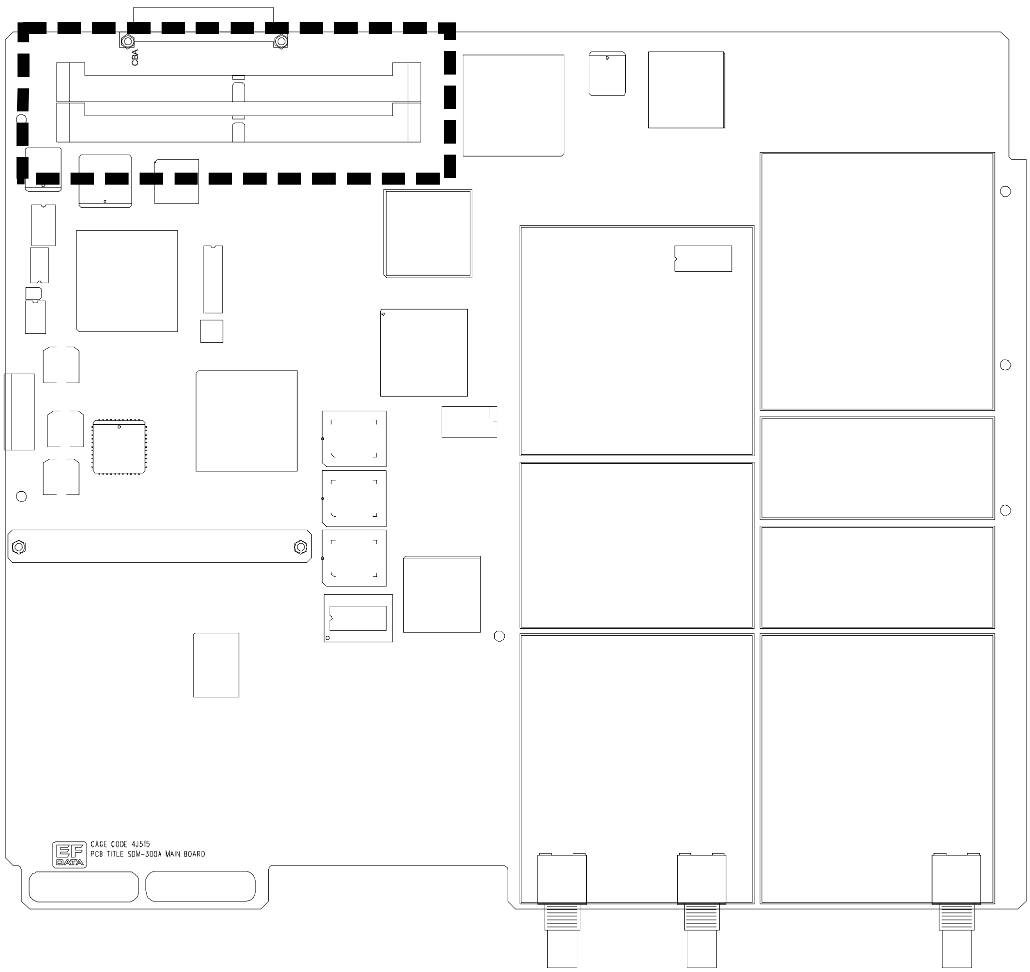


Figure A-11. Reed-Solomon Codec Installation

A.3 Software and Hardware Installation/Upgrades

A.3.1 Main PCB

The main PCB has two field-changeable firmware chips. If necessary, these chips can be removed and new chips added to allow for additional options, enhancements, or repairs. Currently, there are no foreseeable requirements for this task. See Figure A-12. for the locations of the field-changeable chips.

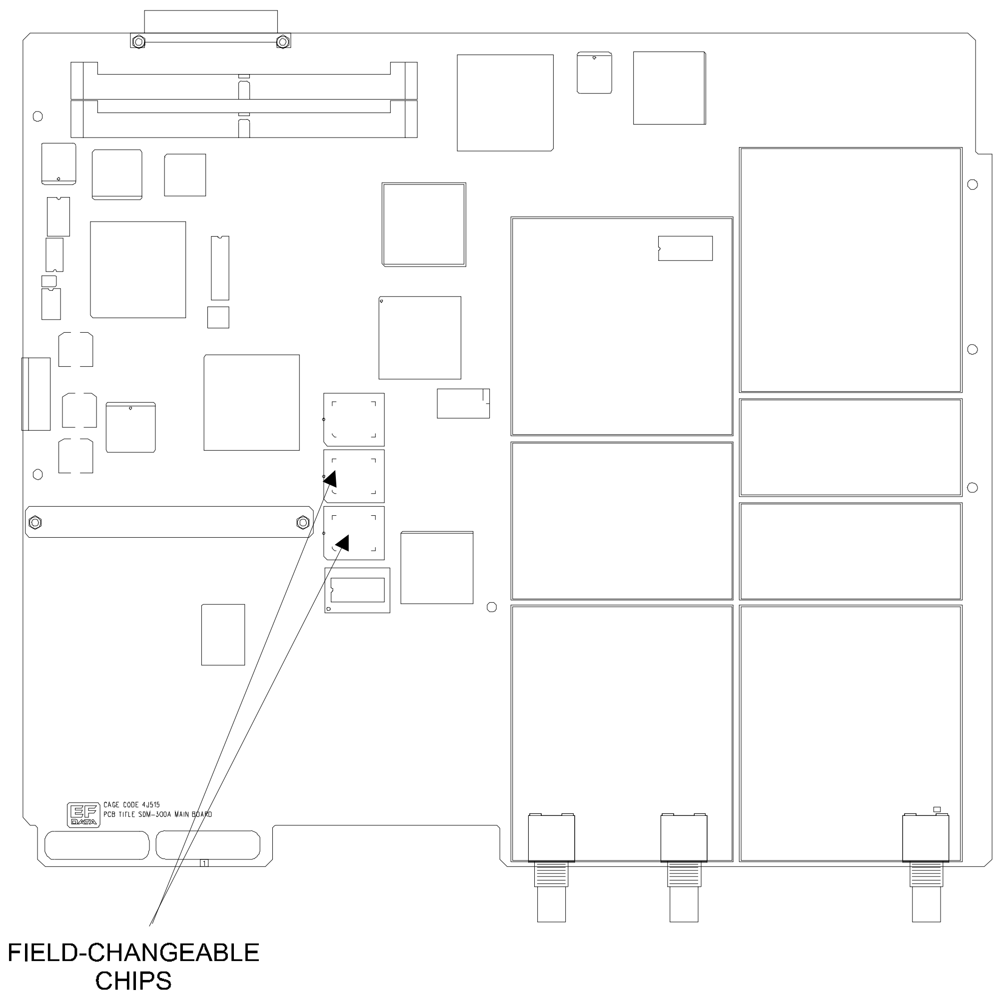


Figure A-12. Main Board Field-Changeable Chips

A.3.2 Turbo Product Codec

The SNM-1001A supports the optional Turbo Product Code Forward Error Correction (FEC) feature. A Turbo Product Codec can be installed at the factory or added as a field-installed upgrade to modems currently deployed. Seven new Turbo code rates/modulations are supported:

- BPSK 5/16
- BPSK 21/44
- QPSK 3/4
- QPSK 1/2
- 8PSK 3/4 (requires 8PSK optioned modem)
- OQPSK 3/4 (requires OQPSK optioned modem)
- OQPSK 1/2 (requires OQPSK optioned modem)

These Turbo code rates and modulations are also compatible with the equivalent functions in the CDM-550 and CDM-600 modems. Interoperability between these modems and the SNM-1001A is guaranteed.

A.3.2.1 Benefits of Turbo Product Code FEC

- **Enhanced BER Performance** – QPSK 3/4 rate Turbo provides nearly a 2 dB improvement over Viterbi 3/4 rate concatenated Reed-Solomon
- **Reduced Delay** – Significantly less processing delay (latency) than concatenated Reed-Solomon modes
- **Soft Knee Characteristic** – Traditional concatenated Reed-Solomon schemes exhibit a pronounced threshold effect where a small reduction in Eb/No results in a total loss of data. Turbo does not suffer from this problem; the decoder stays locked down to the point of unusable error rate
- **Bandwidth Efficiency** – no additional bandwidth expansion requirement (such as that associated with Reed-Solomon coding), resulting in bandwidth savings of 9% to 13%

A.3.2.2 BER Performance

E_b/N_0 (dB) Specification					
	QPSK/OQPSK		BPSK		8PSK
BER	1/2 Rate	3/4 Rate	21/44 Rate	5/16 Rate	3/4 Rate
10^{-6}	3.0	3.9	2.9	*See Note*	7.0
10^{-7}	3.2	4.1	3.1	*See Note*	7.3
10^{-8}	3.5	4.4	3.4	*See Note*	7.6
10^{-9}	3.8	4.7	3.7	4.0	8.0

Note: BPSK 5/16 rate Turbo is included for compatibility with other Comtech EF Data equipment. However, implementation limitations prohibit optimum performance at E_b/N_0 values below 4.0 dB. Performance is virtually error free above 4.0 dB E_b/N_0, and operation below this level is not recommended.

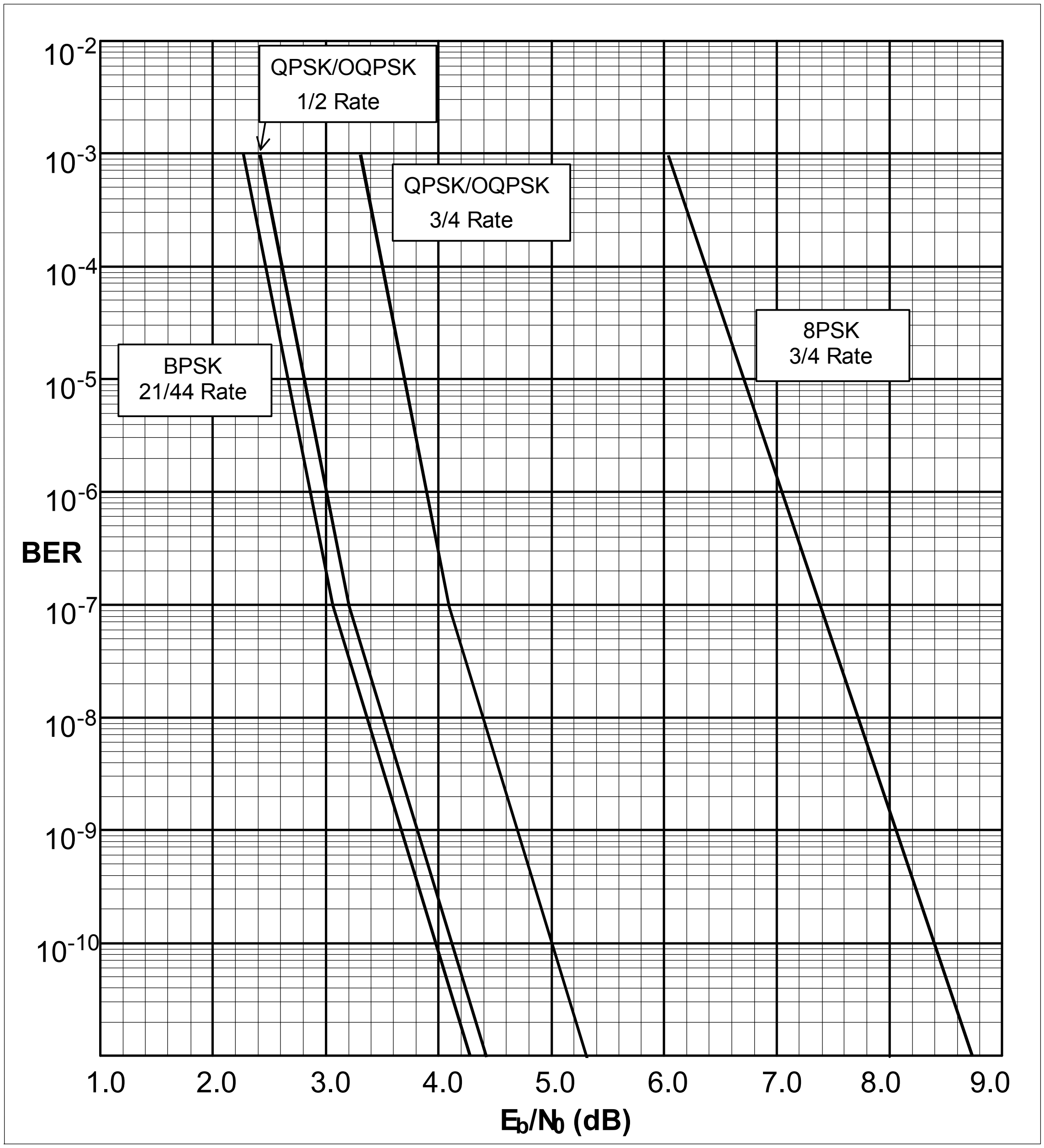


Figure A-13. SNM-1001A Turbo Codec BER Performance

A.3.2.3 Data Rates

Modulation Type	Encoding Type	Data Rate Range (Kbps)	
BPSK	5/16 Rate Turbo	2.4	781.25
BPSK	21/44 Rate Turbo	2.4	1193.0
QPSK/OQPSK	1/2 Rate Turbo	4.8	2386.0
QPSK/OQPSK	3/4 Rate Turbo	7.2	3750.0
8PSK	3/4 Rate Turbo	384.0	5000.0

Note: QPSK/OQPSK 1/2 Rate Turbo requires additional frame overhead. When computing symbol rates for QPSK/OQPSK 1/2 Rate, use an additional factor of 22/21 (e.g.: $SR = [DR * 2/1 * 22/21] / 2$)

A.3.2.4 Remote Control & Menu Structure Changes

Changes to the remote control and menu structure are minimal. The following list summarizes the changes required for the Turbo Codec option:

- **Encoder/Decoder Select –** Turbo added as selection with Viterbi and Sequential; Turbo can only be selected for a Modem Type of “Custom” or “EF Data”.
- **Data Rate** – Selection and assignments for Turbo rates available when Turbo is enabled.

A.3.2.5 Upgrading To Turbo

Upgrading requires removing any installed Reed-Solomon modules first (Turbo and Reed-Solomon cannot be populated at the same time), installation of the Turbo Codec module, installation of new M&C firmware, and installation of new Bulk firmware.

An upgrade kit includes the following items:

Upgrade Kit Part Number KT/9672-1

- AS/9394-1 (Turbo Codec Module)
- FW/6535-1U or later version (M&C firmware)
- FW/6094W or later version (Bulk firmware)
- Installation instructions

The modems must have a Revision C (or later) main board for the Turbo upgrade. There are two ways to determine the revision status:

1. Provide the serial number of the modem to Comtech EF Data for verification of the revision status.

2. Check the first two digits of the modem serial number. These digits correspond to the year of manufacture.

    a. If the first two digits of the modem serial number start with 99, 00, or 01, then the modem main board is revision C.

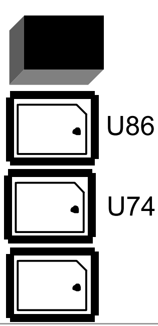
    b. If the serial number starts with 98, then it may be either revision B or C, and it is necessary to check with the factory.

    c. Serial numbers beginning with the numbers 97 or earlier are not eligible for upgrade.

CAUTION

Observe all normal precautions for handling electrostatic-sensitive devices.

A.3.2.6 Install Turbo Board and Firmware

1	Disconnect the AC power to the modem.
2	Remove the 2 side screws near the front of the modem.
3	Slide top cover back and lift it off the modem.
4	Remove incompatible boards:
4a*	Card 1 Removal: *If unit has top board (Card 1 – overhead board)*: Refer to Figure A-14. Remove the 4 rear panel screws around the 50-pin I/O switch module. Unplug the I/O module Remove the 7 mounting screws holding the overhead board Carefully lift the board off the modem.
4b	*If installed, remove all Reed-Solomon boards from the SIMM sockets:* Refer to Figure A-14. Push the spring clips outward while rocking the board vertically, then lift the board out.
5	Install Turbo board: Refer to Figure A-15. Hold the Turbo board in a near-vertical position with the components toward the rear panel. Align the Turbo board with either of the SIMM sockets. Seat the connector into the socket. Tilt the board toward the front panel until the spring clips lock the board into place.
6	*If replacement Firmware ICs were included with the Turbo board*, install them as follows: Refer to Figure A-15. Using a PLCC type IC Puller, remove existing firmware modulesU86 and U74. (If a puller is not available, use a tool similar to an ice pick to carefully pry upward at alternating, opposite corners of the IC.)
7	 Install the replacement firmware modules: Ensure that the “dot” mark is oriented **toward the beveled corner** of the socket. Carefully push the IC into the socket. U86 is located next to the lithium battery NV-RAM (large black or yellow IC, U95). U74 is located in the center socket position.
8*	*If step 4a was performed,* reinstall the overhead board with its 7 mounting screws, then replug the I/O module into the rear panel location and install its 4 mounting screws.
9	Replace the top cover, mating the forward edge under the front panel lip. While holding the cover in place, reinstall the 2 side screws.
10	Apply the AC power to the modem. The modem will re-initialize.

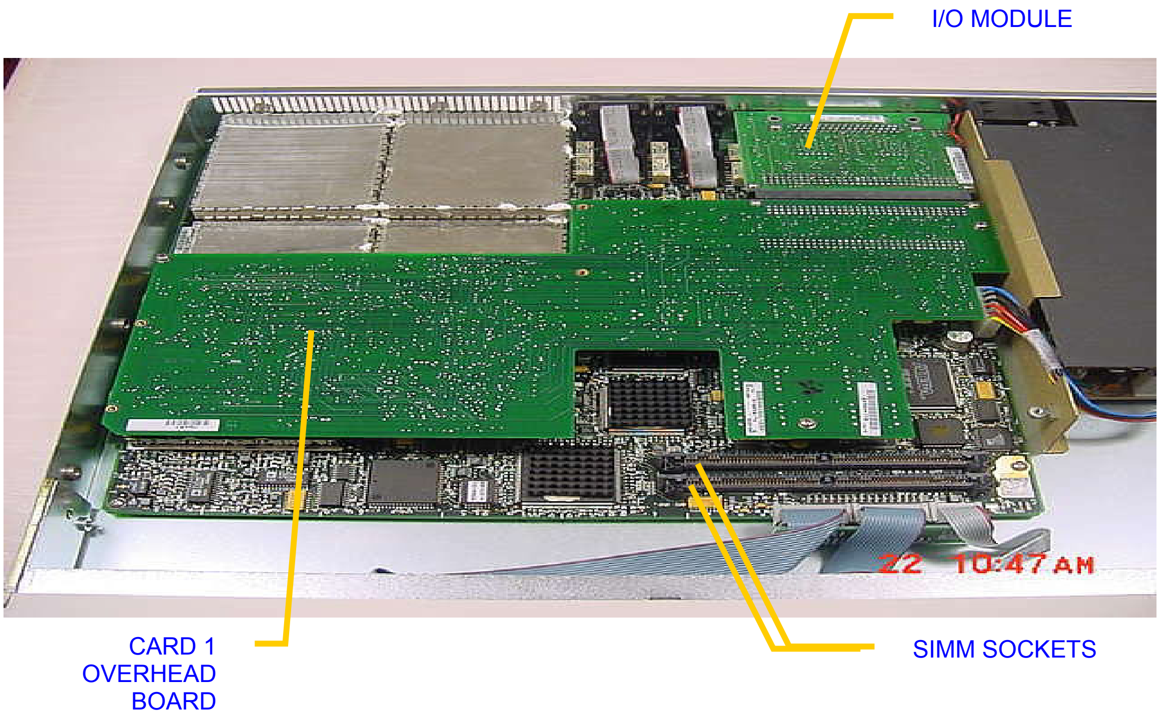


Figure A-14. Card 1 and Reed-Solomon Removal

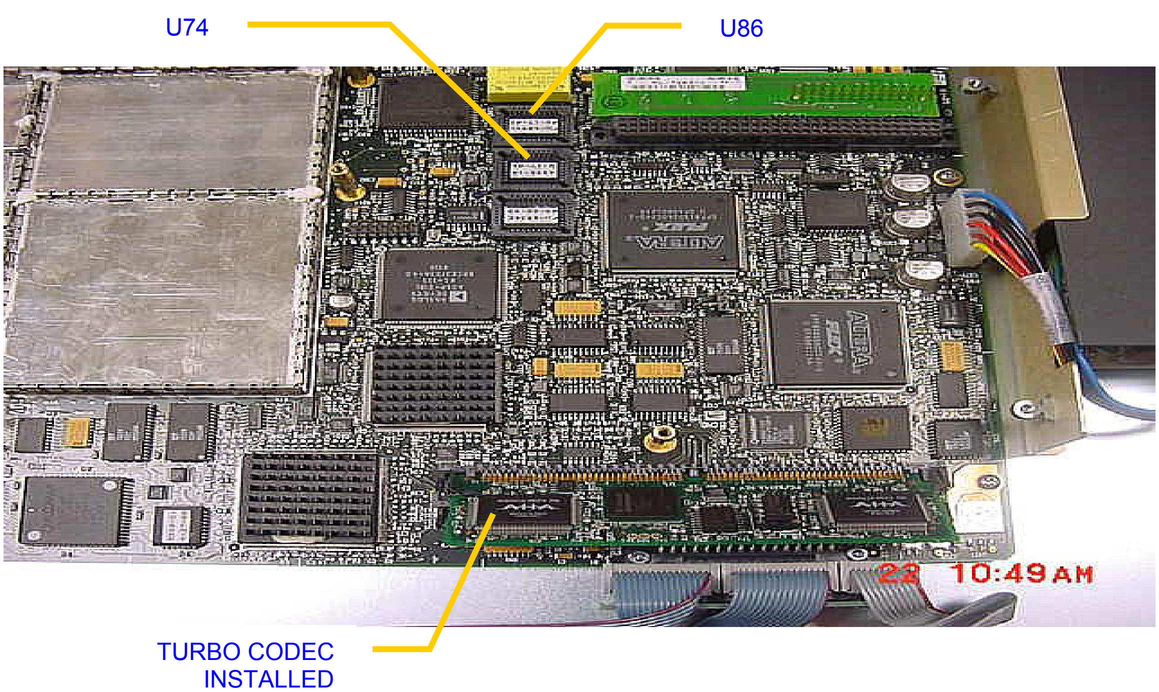


Figure A-15. Turbo and Firmware Installation

A.3.2.7 Turbo Setup

1	Press the Right-or-Left Arrow until "Function Select Utility" appears. Press Enter.
2	Press the Right Arrow until "Utility Modem Type" appears. Press Enter.
3	Press the Up or Down Arrow until "Modem Type Custom" or "Modem Type EFD" appears. Press Enter. Press Clear.
4	Press the Right Arrow until "Utility Modulator" appears. Press Enter.
5	Press the Right Arrow until "Encoder Type" appears. Press Enter.
6	Press the Up arrow until "Turbo" appears. Press Enter.
7	Press Clear. Press the Right Arrow until "Utility Demodulator" appears. Press Enter.
8	Press the Right Arrow until "Decoder Type" appears. Press Enter.
9	Press the Up Arrow until Turbo appears. Press Enter.

Note: In this configuration, the modem will allow only valid data rates and formats for Turbo. Open-network modem types cannot be selected.

Appendix B. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the SNM-1001A.

- Firmware number: FW/6535-1AH
- Software version: 7.1.7

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

B.1 General

Remote control and status information is transferred via a EIA-485 (optional EIA-232C) 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 SNM-1001A never transmits data on the link unless it is commanded to do so.

B.2 Message Structure

The ASCII character format requires 11 bits/character: 1 start bit, 7 information bits with 1 parity bit (odd/even) or 8 information bits with no parity bits, and 2 stop bits.

Messages on the remote link fall into the categories of commands and responses. Commands are messages transmitted to a satellite modem, while responses are messages returned by a satellite modem in response to a command.The general message structure is as follows:

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

B.2.1 Start Character

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

'<' for commands
'>' for responses

B.2.2 Device Address

The device address is the address of the one satellite 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 satellite modem connected to a common remote communications link must be assigned its own unique address. Addresses are software-selectable at the modem 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 and 255.

B.3 Commands/Responses Format

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

If a satellite modem receives a message addressed to it which does not match the established protocol or can not be implemented a negetive acknowledgement message is sent in response. This message is:

```
>add/?ER1_PARITY ERROR'cr''lf']
```

Error message for received parity errors.

```
>add/?ER2_INVALID PARAMETER'cr''lf'}
```

Error message for a recognized command which can not 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, use 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.

B.4 End Character

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

'cr' - Carriage return character for commands.
']' - End bracket for responses.

B.5 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 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_nnnn_mmmm.mmm'cr' >add/AMRx_nnnn_mmmm.mmm'cr''lf'] <add/AMRx_'cr' >add/AMRx_nnnn_mmmm.mmm'cr''lf']	Where: x = A, B, C, D, or V [preset designator]. nnnn = 1/2 (QPSK 1/2), [coder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), and OQ78 (OQPSK 7/8), OQSK (OQPSK 1/1), BPSK (BPSK 1/1) (QPSK (QPSK 1/1), 2144 (BPSK 21/44), B516 (BPSK 5/16), 8P34 (8PSK 3/4). mmmm.mmm = Data rate in kHz. Tx Burst mode nnnn = 1/2, mmmm.mmm = 19.2 or 57.6 kbps
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_nnnn_mmmm.mmm'cr' >add/SMRV_nnnn_mmmm.mmm'cr' RF_OFF'cr''lf'] See MR command.	Where: mmmm.mmm = Data rate in kHz. nnnn = 1/2 (QPSK 1/2), [coder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), OQ78 (OQPSK 7/8), OQSK (OQPSK 1/1), BPSK (BPSK 1/1) (QPSK (QPSK 1/1), 2144 (BPSK 21/44), B516 (BPSK 5/16), 8P34 (8PSK 3/4). Note: Setting the modulator turns off the RF transmitter. Tx Burst mode nnnn = 1/2, mmmm.mmm = 19.2 or 57.6 kbps

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 = +99.0 to –99.0, 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: 1. 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.
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. Burst Mode: xxx = OFF
Modulator Type	Command: Response: Status: Response:	<add/MT_xxxx’cr’ >add/MT_xxxx’cr’’lf’] <add/MT_xxxx’cr’ >add/MT_xxxx’cr’’lf’]	Where: xxxx = INTL (INTELSAT OPEN NETWORK), EFD (EF DATA CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), FDC (FAIRCHILD CLOSED NETWORK), SDM51 (SDM51 COMPATIBLE). Burst Mode: xxx = INTL
Modulator Encoder Type	Command: Response: Status: Response:	<add/MET_xxx’cr’ >add/MET_xxx’cr’’lf’] <add/MET_xxx’cr’ >add/MET_xxx’cr’’lf’]	Where: xxx = VIT (K-7 VITERBI ENCODER), SEQ (SEQUENTIAL ENCODER), TUR (TURBO ENCODER) Burst Mode: xxx = VIT
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), OUT10 (OUTPUT 10 MHz).

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), INV (inverted spectrum).
Reed-Solomon Encoder Enable	Command: Response: Status: Response:	<add/RSEN_xxx'cr' >add/RSEN_xxx'cr''lf'] <add/RSEN_'cr' >add/RSEN_xxx'cr''lf']	Where: xxx = ON or OFF.
Transmit BPSK Data Ordering	Command: Response: Status: Response:	<add/TDA_xxx'cr' >add/TDA_xxx'cr''lf'] <add/TDA_xxx'cr' >add/TDA_xxx'cr''lf']	Where: xxx = NRM (STANDARD), INV (NON-STANDARD).
Carrier Only Mode	Command: Response: Status: Response:	<add/COM_xxxxxx'cr' >add/COM_xxxxxx'cr''lf'] <add/COM_xxxxxx'cr' >add/COM_xxxxxx'cr''lf']	Where: xxxxxx = OFF (NORMAL-MODULATED), DUAL (DUAL-CW), OFFSET (OFFSET-CW), CENTER (CENTER-CW).
TX Reed-Solomon Interleave Value	Command: Response: Status: Response:	<add/TRSI_xx'cr' >add/TRSI_xx'cr''lf'] <add/TRSI_'cr' >add/TRSI_xx'cr''lf']	Where: xx = 4, 8, or 16.
TX 8PSK 2/3 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.

B.6 Demodulator Configuration Commands

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 180.000000 in 1 Hz steps.
Demodulator Rate Preset Assignment	Command: Response: Status: Response:	<add/ADRx_nnnn_mmmm.mmm'cr' >add/ADRx_nnnn_mmmm.mmm'cr''lf'] <add/ADRx_'cr' >add/ADRx_nnnn_mmmm.mmm'cr''lf']	Where: x = A, B, C, D, or V [preset designator]. nnnn = 1/2 (QPSK 1/2), [decoder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), OQ78 (OQPSK 7/8), OQSK (OQPSK 1/1), BPSK (BPSK 1/1) , and (QPSK (QPSK 1/1), 21/44 (BPSK 21/44), B516 (BPSK 5/16), 8P34 (8PSK 3/4). mmmm.mmm = Data rate in kHz. Burst Mode: nnnn – 1/2, mmmm.mmm = 19.2 or 57.6 kbps
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_nnnn_mmmm.mmm'cr' >add/SDRV_nnnn_mmmm.mmm'cr''lf '] See DR command.	Where: nnnn = 1/2 (QPSK 1/2), [decoder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), OQ78 (OQPSK 7/8), OQSK (OQPSK 1/1), BPSK (BPSK 1/1) , and (QPSK (QPSK 1/1), 2144 (BPSK 21/44), B516 (BPSK 5/16), 8P34 (8PSK 3/4). mmmm.mmm = Data rate in kHz Burst Mode: nnnn – 1/2, mmmm.mmm = 19.2 or 57.6 kbps
Descramble 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. Burst Mode: xxx = 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.
RF Loopback	Command: Response: Status: Response:	<add/RFL_xxx'cr' >add/RFL_xxx'cr''lf'] <add/RFL_'cr' >add/RFL_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 Reacquisi-tion	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), EFD (EF DATA CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), FDC (FAIRCHILD CLOSED NETWORK). Burst Mode: xxx = INTL.

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 (K-7 VITERBI ENCODER), SEQ (SEQUENTIAL ENCODER), TUR (TURBO DECODER). Burst Mode: xxx = VIT.
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), 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), INV (NON-STANDARD).
Reed-Solomon Interleave Value	Command: Response: Status: Response:	<add/RRSI_xx'cr' >add/RRSI_xx'cr''lf'] <add/RRSI_'cr' >add/RRSI_xx'cr''lf']	Where: xx = 4, 8, or 16.
RX 8PSK 2/3 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.

B.7 Interface Configuration Commands

Interface Transmit Overhead Type	Command: Response: Status: Response:	<add/ITOT_xxxxx'cr' >add/ITOT_xxxxx'cr''lf'] <add/ITOT_'cr' >add/ITOT_xxxxx'cr''lf']	Where: xxxxx = NONE, IDR, IBS, DI, ASYNC, or FLEX.

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, or FLEX.
TX Driver Type	Command: Response: Status: Response:	<add/TXDR_xxxxx'cr' >add/TXDR_xxxxx'cr''lf'] <add/TXDR_'cr' >add/TXDR_xxxxx'cr''lf']	Where: xxxxx = G703, V35, RS422, or RS232.
RX Driver Type	Command: Response: Status: Response:	<add/RXDR_xxxxx'cr' >add/RXDR_xxxxx'cr''lf'] <add/RXDR_'cr' >add/RXDR_xxxxx'cr''lf']	Where: xxxxx = G703, V35, RS422, or RS232.
Transmit Clock	Command: Response: Status: Response:	<add/TC_xxx'cr' >add/TC_xxx'cr''lf'] <add/TC_'cr' >add/TC_xxx'cr''lf']	Where: xxx = INT (internal SCT clock), EXT (external TX terrestrial clock), REF (external clock-reference frequency).
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 = 8.0 to 10000.0 (external clock frequency in kHz).
Transmit Clock Phase	Command: Response: Status: Response:	<add/TCP_xxxx'cr' >add/TCP_xxxx'cr''lf'] <add/TCP_'cr' >add/TCP_xxxx'cr''lf']	Where: xxxx = NRM (normal clock phasing), INV (inverted clock phasing), AUTO (automatic 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 SCT clock), EXT (external TX terrestrial clock), SAT (receive satellite clock), REF (external clock-reference frequency), 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), 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 Loopback	Command: Response: Status: Response:	<add/ILB_xxx'cr' >add/ILB_xxx'cr''lf'] <add/ILB_'cr' >add/ILB_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_).		
Interface Buffer Size (Bit Format)	Command: Response: Status: Response:	<add/IBS _nnnnnn'cr' >add/IBS _nnnnnn'cr''lf'] <add/IBS _'cr' >add/IBS _nnnnnn'cr''lf']	Where: nnnnnn = 32 to 262144, 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 99 (buffer size in milli-seconds). Note: For Drop & Insert: 1. nn = 7.5, 15, or 30 (milli-seconds) for E1CAS format. 2. nn = 6, 12, 24, or 30 (milli-seconds) for T1S/T1ESFS format. 3. nn = 1, 2, 4, 8, 16, or 32 (milli-seconds) for all other D&I formats.
Interface Buffer Center	Command: Response:	<add/IBC_'cr' >add/IBC_'cr''lf']	
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 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 = ON or OFF. Note: Transmit 2047 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 = ON or OFF. Note: Receive 2047 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_xxxx'cr' >add/TDP_xxxx'cr''lf'] <add/TDP_'cr' >add/TDP_xxxx'cr''lf']	Where: xxxx = NRM (normal data phasing), INV (inverted data phasing).
Receive Data Phase	Command: Response: Status: Response:	<add/RDP_xxxx'cr' >add/RDP_xxxx'cr''lf'] <add/RDP_'cr' >add/RDP_xxxx'cr''lf']	Where: xxxx = NRM (normal data phasing), INV (inverted data phasing).
CTS Delay Time	Command: Response: Status: Response:	<add/CTSD_xx'cr' >add/CTSD_xx'cr''lf'] <add/CTSD_'cr' >add/CTSD_xx'cr''lf']	Where: xx = 0 to 60 (number of seconds).

B.8 System Configuration Commands

Time Of Day	Command: Response: Status: Response:	<add/TIME_hh:mmxx'cr' >add/TIME_hh:mmxx'cr''lf'] <add/TIME_'cr' >add/TIME_hh:mmxx'cr''lf']	Where: hh = 1 to 12 (hours). mm = 00 to 59 (minutes). xx = AM or PM.
Date	Command: Response: Status: Response:	<add/DATE_mm/dd/yyyy'cr' >add/DATE_mm/dd/yyyy'cr''lf'] <add/DATE_'cr' >add/DATE_mm/dd/yyyy'cr''lf']	Where: mm = 1 to 12 (month). dd = 1 to 31 (day). yyyy = 00 to 99 (year) in 2 - digit year mode, and 1975 to 1999 and 2000 to 2075 in 4 - digit mode.
Remote	Command: Response:	<add/REM_'cr' >add/REM_'cr''lf']	Configures the modem for remote operation. The SDM300A will respond to any status request at any time. However, the SDM300A 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 SDM300A.
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, or DUPLEX. This command configures the modem for simplex or duplex 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_xxxxxxx'cr' >add/SMT_xxxxxxx'cr''lf'] <add/SMT_'cr' >add/SMT_xxxxxxx'cr''lf']	Where: xxxxxx = ASYNC, EFD, or CUSTOM.
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.
Local Modem AUPC Mode	Command: Response: Status: Response:	<add/LMA_xxx'cr' >add/LMA_xxx'cr''lf'] <add/LMA_'cr' >add/LMA_xxx'cr''lf']	Where: xxx = ON or OFF. This command configures the modem for the LOCAL MODEM AUPC mode. When 'ON' is selected, the AUPC configuration can be entered.
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.
RF Mode Control	Command: Response: Status: Response:	<add/RFMD_xxxx'cr' >add/RFMD_xxxx'cr''lf'] <add/RFMD_xxxx'cr' >add/RFMD_xxxx'cr''lf']	Where: xxxx = NRM (Normal Mode), PWR (Turn RF off on power up), COMM (Turn RF off on power up and loss of remote communications after 10 seconds), CD (Turn RF ON when carrier is detected, turn RF OFF when no carrier is detected. For the RF ON condition, the TX-IF must be programmed ON. Note: RTS TX-IF, when enabled over-rides CD). This command allows for the RF output to be enabled or disabled depending on the following described conditions. One application for this command will be in demand network systems.
Receive Mode Selection	Command: Response: Status: Response:	<add/RXM_xxxxx'cr' >add/RXM_xxxxx'cr''lf'] <add/RXM_xxxxx'cr' >add/RXM_xxxxx'cr''lf']	This command configures the modem receive side to operate in burst mode or continuous mode. xxxxx = BURST or CONT (Continuous)
Transmit Mode Selection	Command: Response: Status: Response:	<add/TXM_xxxxx'cr' >add/TXM_xxxxx'cr''lf'] <add/TXM_xxxxx'cr' >add/TXM_xxxxx'cr''lf']	This command configures the modem transmit side to operate in burst mode or continuous mode. xxxxx = BURST or CONT (Continuous)
Max Packet Size	Command: Response: Status: Response:	<add/BPS_xxxxxxx'cr' >add/BPS_xxxxxxx'cr''lf'] <add/BPS_xxxxxxx'cr' >add/BPS_xxxxxxx'cr''lf']	This command sets the maximum packet size. xxxxxxx = 0 to 1048576 bits

B.9 Automatic Uplink Power Control (AUPC)

B.9.1 Local Modem AUPC Commands

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.
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. The nominal power range is modified relative to the value specified by the modulator power offset (MPO_).
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. The nominal power range is modified relative to the value specified by the modulator power offset (MPO_).
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. The nominal power range is modified relative to the value specified by the modulator power offset (MPO_).
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).
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).

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).
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).
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).
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).
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.

B.10 Modulator Configuration Status

Modulator Config. Status	Command:	<add/MCS_'cr'	
	Response:	>add/MCS_'cr'	
		RF_xxx'cr'	RF Output
		MF_nnn.nnnnnnn'cr'	Modulator Frequency
		MR_nnnn_mmmm.mmm'cr'	Modulator Rate
		AMRA_nnnn_mmmm.mmm'cr'	Preset 'A' Assignment
		AMRB_nnnn_mmmm.mmm'cr'	Preset 'B' Assignment
		AMRC_nnnn_mmmm.mmm'cr'	Preset 'C' Assignment
		AMRD_nnnn_mmmm.mmm'cr'	Preset 'D' Assignment
		AMRV_nnnn_mmmm.mmm'cr'	Preset 'V' Assignment
		MPO_snn.n'cr'	Modulator Power Offset
		MOP_snn.n'cr'	Modulator Output Power
		SE_xxx'cr'	Scrambler Enable
		DENC_xxx'cr'	Differential Encoder
		MT_xxxxx'cr'	Modulator Type
		MET_xxx'cr'	Modulator Encoder Type
		COM_xxxxxx'cr'	Carrier Only Mode
		MRC_xxx'cr'	Modulator Reference Clock
		MSR_xxx'cr'	Modulator Spectrum Rotation
		RSEN_xxx'cr'	Reed-Solomon Encoder
		TDA_xxx'cr'	Transmit BPSK Data Ordering
		TRSI_xx'cr'	TX Reed-Solomon Interleave Value
		T310_xxx'cr''lf']	TX 8PSK 2/3 IESS-310 Operation
			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.

Modulator/ Coder Config. Program Status	Command:	<add/MCP_'cr'		
	Response:	>add/MCP_'cr'		
		SMT_xxxxxxx'cr'		System Modem Type
		ITOT_xxxxx'cr'		Interface Transmit Overhead Type
		MOM_xxxxxxx'cr'		Modem Operation Mode
		MT_xxxxx'cr'		Modulator Type
		MET_xxx'cr'		Modulator Encoder Type
		TCEN_1_xxxx'cr'	(Note 6)	Flex Mux TX Channel #1 Enable
		TCDR_1_xxxx.x'cr'	(Note 7)	Flex Mux TX Channel #1 Data Rate
		TCEN_2_xxx'cr'	(Note 6)	Flex Mux TX Channel #2 Enable
		TCEN_3_xxxx'cr'	(Note 6)	Flex Mux TX Channel #3 Enable
		TCDR_3_xxxx.x'cr'	(Note 8)	Flex Mux TX Channel #3 Data Rate
		TCCP_3_yyy'cr'	(Note 8)	Flex Mux TX Channel #3 Clock Phase
		TCDP_3_yyy'cr'	(Note 8)	Flex Mux TX Channel #3 Data Phase
		TCEN_4_xxxx'cr'	(Note 6)	Flex Mux TX Channel #4 Enable
		TCDR_4_xxxx.x'cr'	(Note 9)	Flex Mux TX Channel #4 Data Rate
		TCCP_4_yyy'cr'	(Note 9)	Flex Mux TX Channel #4 Clock Phase
		TCDP_4_yyy'cr'	(Note 9)	Flex Mux TX Channel #4 Data Phase
		MF_nnn.nnnnnn'cr'		Modulator Frequency
		MR_nnnn_mmmm.mmm'cr'		Modulator Rate
		MPO_snn.n'cr'		Modulator Power Offset
		LPC_xxx'cr'	(Note 10)	AUPC Local Power Enable
		MOP_snn.n'cr'	(Note 4)	Modulator Output Power
		SE_xxx'cr'		Scrambler Enable
		DENC_xxx'cr'		Differential Encoder
		ILT_xxx'cr'		Interface Loop Timing
		ERF_nnnnn.n'cr'		External Reference Frequency
		TC_xxxx'cr'		Transmit Clock (Source)
		TCP_xxxx'cr'		Transmit Clock Phase
		BBL_xxx'cr'		Baseband Loopback
		ILB_xxx'cr'		Interface Loopback
		ILT_xxx'cr'		Interface Loop Timing
		ICFT_xxxx'cr'		Interface Coding Format Transmit
		ISP_xxxxxx'cr'		Interface Substitution Pattern (TX 2047)
		ISP_xxx'cr'		Interface Substitution Pattern (TX 2047)
		TDF_xxxx'cr'		Transmit Data Fault
		ISCL_TX1_nnn'cr'		Service Channel Level TX1
		ISCL_TX2_nnn'cr'		Service Channel Level TX2
		TDP_xxxx'cr'		Transmit Data Phase
		DDF_xxxxxx'cr'	(Note 1)	Drop Data Format
		BDCA_dd;cc_dd;cc...'cr'	(Note 1)	Bulk Drop Channels Assignment
		MRC_xxx'cr'		Modulator Reference Clock
		MSR_xxx'cr'		Modulator Spectrum Rotation
		RSEN_xxx'cr'		Reed-Solomon Encoder
		BW_TX1_nnn'cr'	(Note 2)	Backward Alarm Enable TX1
		BW_TX2_nnn'cr'	(Note 2)	Backward Alarm Enable TX2
		BW_TX3_nnn'cr'	(Note 2)	Backward Alarm Enable TX3
		BW_TX4_nnn'cr'	(Note 2)	Backward Alarm Enable TX4
		TXDR_xxxxxx'cr'		TX Driver Type
		TOBR_nnnnn'cr'	(Note 3)	ASYNC Transmit Overhead Baud Rate
		TCCL_n'cr'	(Note 3)	ASYNC Transmit Channel Character Length

		TCSB_n'cr'	(Note 3)	ASYNC Transmit Channel Stop Bits
		TOCP_xxxx'cr'	(Note 3)	ASYNC Transmit Overhead Channel Parity
		TCT_xxxxx'cr'	(Note 3)	ASYNC Transmit Communications Type
		NOMP_snn.n'cr'	(Note 10)	AUPC Nominal Power Value
		MINP_snn.n'cr'	(Note 10)	AUPC Minimum Power Value
		MAXP_snn.n'cr'	(Note 10)	AUPC Maximum Power Value
		LCL_xxxx'cr'	(Note 10)	AUPC Local Carrier Loss
		RCL_xxxx'cr'	(Note 10)	AUPC Remote Carrier Loss
		CTSD_xx'cr'		CTS Delay Time
		RTSM_xxx'cr'		RTS TX-IF Control Mode
		TDA_xxx'cr'		Transmit BPSK Data Ordering
		COM_xxxxxx'cr'		Carrier Only Mode
		TET_xxxxx'cr'	(Note 2)	IDR Transmit ESC Type
		MTDR_1_yyyyyy'cr'	(Note 5)	Mux Tributary #1 Data Rate & Enable
		MTIT_1_yyyyy'cr'	(Note 5)	Mux Tributary #1 Interface Type
		MTCP_1_yyy'cr'	(Note 5)	Mux Tributary #1 Clock Phase
		MTDP_1_yyy'cr'	(Note 5)	Mux Tributary #1 Data Phase
		MTMD_1_yyyyy'cr'	(Note 5)	Mux Tributary #1 Mode
		MTAF_1_yyy'cr'	(Note 5)	Mux Tributary #1 Async Mode
		MTDR_2_yyyyyy'cr'	(Note 5)	Mux Tributary #2 Data Rate & Enable
		MTIT_2_yyyyy'cr'	(Note 5)	Mux Tributary #2 Interface Type
		MTCP_2_yyy'cr'	(Note 5)	Mux Tributary #2 Clock Phase
		MTDP_2_yyy'cr'	(Note 5)	Mux Tributary #2 Data Phase
		MTMD_2_yyyyy'cr'	(Note 5)	Mux Tributary #2 Mode
		MTAF_2_yyy'cr'	(Note 5)	Mux Tributary #2 Async Mode
		MTDR_3_yyyyyy'cr'	(Note 5)	Mux Tributary #3 Data Rate & Enable
		MTIT_3_yyyyy'cr'	(Note 5)	Mux Tributary #3 Interface Type
		MTCP_3_yyy'cr'	(Note 5)	Mux Tributary #3 Clock Phase
		MTDP_3_yyy'cr'	(Note 5)	Mux Tributary #3 Data Phase
		MTMD_3_yyyyy'cr'	(Note 5)	Mux Tributary #3 Mode
		MTAF_3_yyy'cr'	(Note 5)	Mux Tributary #3 Async Mode
		MTDR_4_yyyyyy'cr'	(Note 5)	Mux Tributary #4 Data Rate & Enable
		MTIT_4_yyyyy'cr'	(Note 5)	Mux Tributary #4 Interface Type
		MTCP_4_yyy'cr'	(Note 5)	Mux Tributary #4 Clock Phase
		MTDP_4_yyy'cr'	(Note 5)	Mux Tributary #4 Data Phase
		MTMD_4_yyyyy'cr'	(Note 5)	Mux Tributary #4 Mode
		MTAF_4_yyy'cr'	(Note 5)	Mux Tributary #4 Async Mode
		MTDR_5_yyyyyy'cr'	(Note 5)	Mux Tributary #5 Data Rate & Enable
		MTIT_5_yyyyy'cr'	(Note 5)	Mux Tributary #5 Interface Type
		MTCP_5_yyy'cr'	(Note 5)	Mux Tributary #5 Clock Phase
		MTDP_5_yyy'cr'	(Note 5)	Mux Tributary #5 Data Phase
		MTMD_5_yyyyy'cr'	(Note 5)	Mux Tributary #5 Mode
		MTAF_5_yyy'cr'	(Note 5)	Mux Tributary #5 Async Mode
		MTDR_6_yyyyyy'cr'	(Note 5)	Mux Tributary #6 Data Rate & Enable
		MTIT_6_yyyyy'cr'	(Note 5)	Mux Tributary #6 Interface Type
		MTCP_6_yyy'cr'	(Note 5)	Mux Tributary #6 Clock Phase
		MTDP_6_yyy'cr'	(Note 5)	Mux Tributary #6 Data Phase
		MTMD_6_yyyyy'cr'	(Note 5)	Mux Tributary #6 Mode
		MTAF_6_yyy'cr'	(Note 5)	Mux Tributary #6 Async Mode
		MTDR_7_yyyyyy'cr'	(Note 5)	Mux Tributary #7 Data Rate & Enable
		MTIT_7_yyyyy'cr'	(Note 5)	Mux Tributary #7 Interface Type
		MTCP_7_yyy'cr'	(Note 5)	Mux Tributary #7 Clock Phase

		MTDP_7_yyy'cr' (Note 5) MTMD_7_yyyyy'cr' (Note 5) MTAF_7_yyy'cr' (Note 5) MTDR_8_yyyyyy'cr' (Note 5) MTIT_8_yyyyy'cr' (Note 5) MTCP_8_yyy'cr' (Note 5) MTDP_8_yyy'cr' (Note 5) MTMD_8_yyyyy'cr' (Note 5) MTAF_8_yyy'cr' (Note 5) TRSI_xx'cr' T310_xxx'cr' G7LT_xxxxx'cr' (Note 11) RF_xxx'cr''lf']	Mux Tributary #7 Data Phase Mux Tributary #7 Mode Mux Tributary #7 Async Mode Mux Tributary #8 Data Rate & Enable Mux Tributary #8 Interface Type Mux Tributary #8 Clock Phase Mux Tributary #8 Data Phase Mux Tributary #8 Mode Mux Tributary #8 Async Mode TX Reed-Solomon Interleave Value TX 8PSK 2/3 IESS-310 Operation G.703 Unbalanced or Balanced RF Output (ON/OFF) Note: This command is used by the Comtech 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 Comtech 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 D&I Overhead (or Flex Mux D&I).
2. Data is only returned for TX IDR Overhead.
1. Data is only returned for TX ASYNC Overhead
2. Data not returned if Local AUPC is enabled & TX ASYNC overhead.
5. Data is only returned if MUX PCB (Card Slot #1) is installed.
6. Data is only returned if FLEX MUX PCB (Card Slot #1) is installed.
7. Data not returned if Channel #1 is disabled.
8. Data not returned if Channel #3 is disabled or set for AUPC.
9. Data not returned if Channel #4 is disabled or set for AUPC.
10 Data is only returned for TX ASYNC Overhead(or Flex Mux AUPC).
11 Data is only returned if G.703 Personality PCB is installed.

B.11 Demodulator Configuration Status

Demodulator Config. Status	Command:	<add/DCS_’cr’	
	Response:	>add/DCS_’cr’	
		DF_nnn.nnnnnnn’cr’	Demodulator Frequency
		DR_nnnn_mmmm.mmm’cr’	Demodulator Rate
		ADRA_nnnn_mmmm.mmm’cr’	Preset ‘A’ Assignment
		ADRB_nnnn_mmmm.mmm’cr’	Preset ‘B’ Assignment
		ADRC_nnnn_mmmm.mmm’cr’	Preset ‘C’ Assignment
		ADRD_nnnn_mmmm.mmm’cr’	Preset ‘D’ Assignment
		ADRV_nnnn_mmmm.mmm’cr’	Preset ‘V’ Assignment
		DE_xxx’cr’	Descrambler Enable
		DDEC_xxx’cr’	Differential Decoder
		RFL_xxx’cr’	RF Loopback
		IFL_xxx’cr’	IF Loopback
		SCF_snnnnn’cr’	Sweep Center Frequency
		SWR_nnnnn’cr’	Sweep Width Range
		SR_xxx’cr’	Sweep Reacquisition
		BERT_xxxx’cr’	BER Threshold
		DT_xxxx’cr’	Demodulator Type
		DDT_xxx’cr’	Demodulator Decoder Type
		DSR_xxx’cr’	Demodulator Spectrum Rotation
		RSDE_xxx’cr’	Reed-Solomon Decoder
		RDA_xxx’cr’	Receive BPSK Data Ordering
		RRSI_xx’cr’	RX Reed-Solomon Interleave Value
		R310_xxx’cr’’lf’]	RX 8PSK 2/3 IESS-310 Operation
			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.

Demod/ Decoder Config. Program Status	Command:	<add/DCP_'cr'	
	Response:	>add/DCP_'cr'	
		SMT_xxxxxxx'cr'	System Modem Type
		IROT_xxxxx'cr'	Interface Receive Overhead Type
		MOM_xxxxxxx'cr'	Modem Operation Mode
		BERT_xxxx'cr'	BER Threshold
		DT_xxxx'cr'	Demodulator Type
		DDT_xxx'cr'	Demodulator Decoder Type
		RCEN_1_xxxx'cr' (Note 4)	Flex Mux RX Channel #1 Enable
		RCDR_1_xxxx.x'cr' (Note 5)	Flex Mux RX Channel #1 Data Rate
		RCEN_2_xxx'cr' (Note 4)	Flex Mux RX Channel #2 Enable
		RCEN_3_xxxx'cr' (Note 4)	Flex Mux RX Channel #3 Enable
		RCDR_3_xxxx.x'cr' (Note 6)	Flex Mux RX Channel #3 Data Rate
		RCCP_3_yyy'cr' (Note 6)	Flex Mux RX Channel #3 Clock Phase
		RCDP_3_yyy'cr' (Note 6)	Flex Mux RX Channel #3 Data Phase
		RCEN_4_xxxx'cr' (Note 4)	Flex Mux RX Channel #4 Enable
		RCDR_4_xxxx.x'cr' (Note 7)	Flex Mux RX Channel #4 Data Rate
		RCCP_4_yyy'cr' (Note 7)	Flex Mux RX Channel #4 Clock Phase
		RCDP_4_yyy'cr' (Note 7)	Flex Mux RX Channel #4 Data Phase
		DF_nnn.nnnnnn'cr'	Demodulator Frequency
		DR_nnnn_mmmm.mmm'cr'	Demodulator Rate
		DE_xxx'cr'	Descrambler Enable
		DDEC_xxx'cr'	Differential Decoder
		RFL_xxx'cr'	RF Loopback
		IFL_xxx'cr'	IF Loopback
		SCF_snnnnn'cr'	Sweep Center Frequency
		SWR_nnnnn'cr'	Sweep Width Range
		SR_xxx'cr'	Sweep Reacquisition
		ILT_xxx'cr'	Interface Loop Timing
		ERF_nnnnn.n'cr'	External Reference Frequency
		BC_xxx'cr'	Buffer Clock
		RCP_xxxx'cr'	Receive Clock Phase
		BBL_xxx'cr'	Baseband Loopback
		ILB_xxx'cr'	Interface Loopback
		ICFR_xxxx'cr'	Interface Coding Format Receive
		IRFS_T1_ssss'cr'	Interface Receive T1 Frame Structure
		IRFS_E1_ssss'cr'	Interface Receive E1 Frame Structure
		IBP_xxx'cr'	Interface Buffer Programming
		IRE_xxxxxx'cr'	Interface Read Error (RX 2047)
		RDF_xxxx'cr'	Receive Data Fault
		ISCL_RX1_nnn'cr'	Service Channel Level RX1
		ISCL_RX2_nnn'cr'	Service Channel Level RX2
		RDP_xxxx'cr'	Receive Data Phase
		IDF_xxxxxx'cr' (Note 1)	Insert Data Format
		ICRC_xxx'cr' (Note 1)	Insert E1 CRC Enable
		IBS _nnnnnn'cr'	Interface Buffer Size
		BICA_dd;cc_dd;cc...'cr' (Note 1)	Bulk Insert Channels Assignment
		DSR_xxx'cr'	Demodulator Spectrum Rotation
		RSDE_xxx'cr'	Reed-Solomon Decoder
		BW_RX1_nnn'cr' (Note 2)	Backward Alarm Enable RX1
		BW_RX2_nnn'cr' (Note 2)	Backward Alarm Enable RX2

		BW_RX3_nnn'cr' (Note 2) BW_RX4_nnn'cr' (Note 2) RXDR_xxxxxx'cr' ROBR_nnnnn'cr' (Note 3) RCCL_n'cr' (Note 3) RCSB_n'cr' (Note 3) ROCP_xxxx'cr' (Note 3) RCT_xxxxx'cr' (Note 3) ENSP_nn.n'cr' (Note 8) MAXT_n.n'cr' (Note 8) RDA_xxx'cr' RET_xxxxx'cr' (Note 2) RRSI_xx'cr' R310_xxx'cr' G7LT_xxxxx'cr''lf']	Backward Alarm Enable RX3 Backward Alarm Enable RX4 RX Driver Type ASYNC Receive Overhead Baud Rate ASYNC Receive Channel Character Length ASYNC Receive Channel Stop Bits ASYNC Receive Overhead Channel Parity ASYNC Receive Communications Type AUPC EBN0 Target Set Point AUPC Max. Tracking Rate Receive BPSK Data Ordering IDR Receive ESC Type RX Reed-Solomon Interleave Value RX 8PSK 2/3 IESS-310 Operation G.703 Unbalanced or Balanced 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 D&I overhead (or Flex Mux D&I mode).is installed.
2. Data is only returned for RX IDR Overhead.
3. Data is only returned for RX ASYNC Overhead.
4. Data is only returned if Flex Mux PCB (Card Slot #1) is installed.
5. Data not returned if Channel #1 is disabled.
6. Data not returned if Channel #3 is disabled or set for AUPC.
7. Data not returned if Channel #4 is disabled or set for AUPC.
8. Data is only returned for RX ASYNC Overhead (or Flex Mux AUPC mode).
9. Data is only returned if G.703 Personality PCB is installed.

Interface Config. Status	Command:	<add/ICS_'cr'		
	Response:	>add/ICS_'cr'		
		TC_xxxx'cr'		Transmit Clock (Source)
		ERF_nnnnn.n'cr'		External Reference Frequency
		TCP_xxxx'cr'		Transmit Clock Phase
		RCP_xxxx'cr'		Receive Clock Phase
		BBL_xxx'cr'		Baseband Loopback
		ILB_xxx'cr'		Interface Loopback
		ILT_xxx'cr'		Interface Loop Timing
		ICFT_xxxx'cr'		Interface Coding Format Transmit
		ICFR_xxxx'cr'		Interface Coding Format Receive
		BC_xxx'cr'		Buffer Clock (Source)
		IRFS_T1_ssss'cr'		Interface Receive Frame Structure (T1)
		IRFS_E1_ssss'cr'		Interface Receive Frame Structure (E1)
		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'		Service Channel Level TX1
		ISCL_TX2_nnn'cr'		Service Channel Level TX2
		ISCL_RX1_nnn'cr'		Service Channel Level RX1
		ISCL_RX2_nnn'cr'		Service Channel Level RX2
		TDP_xxxx'cr'		Transmit Data Phase
		RDP_xxxx'cr'		Receive Data Phase
		DDF_xxxxxx'cr'	(Note 1)	Drop Data Format
		BDCA_dd;cc_dd;cc...'cr'	(Note 1)	Bulk Drop Channels Assignment
		ICRC_xxx'cr'	(Note 2)	Insert E1 CRC Enable
		IDF_xxxxxx'cr'	(Note 2)	Insert Data Format
		BICA_dd;cc_dd;cc...'cr'	(Note 2)	Bulk Insert Channels Assignment
		BW_TX1_nnn'cr'	(Note 3)	Backward Alarm Enable TX1
		BW_TX2_nnn'cr'	(Note 3)	Backward Alarm Enable TX2
		BW_TX3_nnn'cr'	(Note 3)	Backward Alarm Enable TX3
		BW_TX4_nnn'cr'	(Note 3)	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
		TXDR_xxxxxx'cr'		TX Driver Type
		RXDR_xxxxxx'cr'		RX Driver Type
		TOBR_nnnnn'cr'	(Note 5)	ASYNC Transmit Overhead Baud Rate
		TCCL_n'cr'	(Note 5)	ASYNC Transmit Channel Character Length
		TCSB_n'cr'	(Note 5)	ASYNC Transmit Channel Stop Bits
		TOCP_xxxx'cr'	(Note 5)	ASYNC Transmit Overhead Channel Parity
		TCT_xxxxx'cr'	(Note 5)	ASYNC Transmit Communications Type
		ROBR_nnnnn'cr'	(Note 6)	ASYNC Receive Overhead Baud Rate
		RCCL_n'cr'	(Note 6)	ASYNC Receive Channel Character Length
		RCSB_n'cr'	(Note 6)	ASYNC Receive Channel Stop Bits

		ROCP_xxxx'cr'	(Note 6)	ASYNC Receive Overhead Channel Parity
		RCT_xxxxx'cr'	(Note 6)	ASYNC Receive Communications Type
		LPC_xxx'cr'	(Note 5)	AUPC Local Power Enable
		NOMP_snn.n'cr'	(Note 5)	AUPC Nominal Power Value
		MINP_snn.n'cr'	(Note 5)	AUPC Minimum Power Value
		MAXP_snn.n'cr'	(Note 5)	AUPC Maximum Power Value
		LCL_xxxx'cr'	(Note 5)	AUPC Local Carrier Loss
		RCL_xxxx'cr'	(Note 5)	AUPC Remote Carrier Loss
		ENSP_nn.n'cr'	(Note 6)	AUPC EBN0 Target Set Point
		MAXT_n.n'cr'	(Note 6)	AUPC Max. Tracking Rate
		RTSM_xxx'cr'		RTS TX-IF Control Mode
		CTSD_xx'cr'		CTS Delay Time
		TET_xxxxx'cr'	(Note 3)	IDR Transmit ESC Type
		RET_xxxxx'cr'	(Note 4)	IDR Receive ESC Type
		MTDR_1_yyyyyy'cr'	(Note 7)	Mux Tributary #1 Data Rate & Enable
		MTIT_1_yyyyy'cr'	(Note 7)	Mux Tributary #1 Interface Type
		MTCP_1_yyy'cr'	(Note 7)	Mux Tributary #1 Clock Phase
		MTDP_1_yyy'cr'	(Note 7)	Mux Tributary #1 Data Phase
		MTMD_1_yyyyy'cr'	(Note 7)	Mux Tributary #1 Mode
		MTAF_1_yyy'cr'	(Note 7)	Mux Tributary #1 Async Mode
		MTDR_2_yyyyyy'cr'	(Note 7)	Mux Tributary #2 Data Rate & Enable
		MTIT_2_yyyyy'cr'	(Note 7)	Mux Tributary #2 Interface Type
		MTCP_2_yyy'cr'	(Note 7)	Mux Tributary #2 Clock Phase
		MTDP_2_yyy'cr'	(Note 7)	Mux Tributary #2 Data Phase
		MTMD_2_yyyyy'cr'	(Note 7)	Mux Tributary #2 Mode
		MTAF_2_yyy'cr'	(Note 7)	Mux Tributary #2 Async Mode
		MTDR_3_yyyyyy'cr'	(Note 7)	Mux Tributary #3 Data Rate & Enable
		MTIT_3_yyyyy'cr'	(Note 7)	Mux Tributary #3 Interface Type
		MTCP_3_yyy'cr'	(Note 7)	Mux Tributary #3 Clock Phase
		MTDP_3_yyy'cr'	(Note 7)	Mux Tributary #3 Data Phase
		MTMD_3_yyyyy'cr'	(Note 7)	Mux Tributary #3 Mode
		MTAF_3_yyy'cr'	(Note 7)	Mux Tributary #3 Async Mode
		MTDR_4_yyyyyy'cr'	(Note 7)	Mux Tributary #4 Data Rate & Enable
		MTIT_4_yyyyy'cr'	(Note 7)	Mux Tributary #4 Interface Type
		MTCP_4_yyy'cr'	(Note 7)	Mux Tributary #4 Clock Phase
		MTDP_4_yyy'cr'	(Note 7)	Mux Tributary #4 Data Phase
		MTMD_4_yyyyy'cr'	(Note 7)	Mux Tributary #4 Mode
		MTAF_4_yyy'cr'	(Note 7)	Mux Tributary #4 Async Mode
		MTDR_5_yyyyyy'cr'	(Note 7)	Mux Tributary #5 Data Rate & Enable
		MTIT_5_yyyyy'cr'	(Note 7)	Mux Tributary #5 Interface Type
		MTCP_5_yyy'cr'	(Note 7)	Mux Tributary #5 Clock Phase
		MTDP_5_yyy'cr'	(Note 7)	Mux Tributary #5 Data Phase
		MTMD_5_yyyyy'cr'	(Note 7)	Mux Tributary #5 Mode
		MTAF_5_yyy'cr'	(Note 7)	Mux Tributary #5 Async Mode
		MTDR_6_yyyyyy'cr'	(Note 7)	Mux Tributary #6 Data Rate & Enable
		MTIT_6_yyyyy'cr'	(Note 7)	Mux Tributary #6 Interface Type
		MTCP_6_yyy'cr'	(Note 7)	Mux Tributary #6 Clock Phase
		MTDP_6_yyy'cr'	(Note 7)	Mux Tributary #6 Data Phase
		MTMD_6_yyyyy'cr'	(Note 7)	Mux Tributary #6 Mode
		MTAF_6_yyy'cr'	(Note 7)	Mux Tributary #6 Async Mode
		MTDR_7_yyyyyy'cr'	(Note 7)	Mux Tributary #7 Data Rate & Enable
		MTIT_7_yyyyy'cr'	(Note 7)	Mux Tributary #7 Interface Type

		MTCP_7_yyy'cr' (Note 7) MTDP_7_yyy'cr' (Note 7) MTMD_7_yyyyy'cr' (Note 7) MTAF_7_yyy'cr' (Note 7) MTDR_8_yyyyyy'cr' (Note 7) MTIT_8_yyyyy'cr' (Note 7) MTCP_8_yyy'cr' (Note 7) MTDP_8_yyy'cr' (Note 7) MTMD_8_yyyyy'cr' (Note 7) MTAF_8_yyy'cr' (Note 7) TCEN_1_xxxx'cr' (Note 8) TCDR_1_xxxx.x'cr' (Note 9) TCEN_2_xxx'cr' (Note 8) TCEN_3_xxxx'cr' (Note 8) TCDR_3_xxxx.x'cr' (Note 10) TCCP_3_yyy'cr' (Note 10) TCDP_3_yyy'cr' (Note 10) TCEN_4_xxxx'cr' (Note 8) TCDR_4_xxxx.x'cr' (Note 11) TCCP_4_yyy'cr' (Note 11) TCDP_4_yyy'cr' (Note 11) RCEN_1_xxxx'cr' (Note 8) RCDR_1_xxxx.x'cr' (Note 12) RCEN_2_xxx'cr' (Note 8) RCEN_3_xxxx'cr' (Note 8) RCDR_3_xxxx.x'cr' (Note 13) RCCP_3_yyy'cr' (Note 13) RCDP_3_yyy'cr' (Note 13) RCEN_4_xxxx'cr' (Note 8) RCDR_4_xxxx.x'cr' (Note 14) RCCP_4_yyy'cr' (Note 14) RCDP_4_yyy'cr''lf'] (Note 14)	Mux Tributary #7 Clock Phase Mux Tributary #7 Data Phase Mux Tributary #7 Mode Mux Tributary #7 Async Mode Mux Tributary #8 Data Rate & Enable Mux Tributary #8 Interface Type Mux Tributary #8 Clock Phase Mux Tributary #8 Data Phase Mux Tributary #8 Mode Mux Tributary #8 Async Mode Flex Mux TX Channel #1 Enable Flex Mux TX Channel #1 Data Rate Flex Mux TX Channel #2 Enable Flex Mux TX Channel #3 Enable Flex Mux TX Channel #3 Data Rate Flex Mux TX Channel #3 Clock Phase Flex Mux TX Channel #3 Data Phase Flex Mux TX Channel #4 Enable Flex Mux TX Channel #4 Data Rate Flex Mux TX Channel #4 Clock Phase Flex Mux TX Channel #4 Data Phase Flex Mux RX Channel #1 Enable Flex Mux RX Channel #1 Data Rate Flex Mux RX Channel #2 Enable Flex Mux RX Channel #3 Enable Flex Mux RX Channel #3 Data Rate Flex Mux RX Channel #3 Clock Phase Flex Mux RX Channel #3 Data Phase Flex Mux RX Channel #4 Enable Flex Mux RX Channel #4 Data Rate Flex Mux RX Channel #4 Clock Phase Flex Mux RX Channel #4 Data Phase 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 D&I Overhead.
2. Data is only returned for RX D&I Overhead.
3. Data is only returned for TX IDR Overhead.
4. Data is only returned for RX IDR Overhead.
5. Data is only returned for TX ASYNC Overhead.
6. Data is only returned for RX ASYNC Overhead.
7. Data is only returned if MUX PCB (Card Slot #1) is installed.
8. Data is only returned if FLEX MUX PCB (Card Slot #1) is installed.
9. Data not returned if TX Channel #1 is disabled.
10. Data not returned if TX Channel #3 is disabled or set for AUPC.
11. Data not returned if TX Channel #4 is disabled or set for AUPC.
12. Data not returned if RX Channel #1 is disabled.
13. Data not returned if RX Channel #3 is disabled or set for AUPC.
14. Data not returned if RX Channel #4 is disabled or set for AUPC.

MODEM Faults Status (Summary)	Command: Response:	<add/MFS_'cr' >add/MFS_'cr' DMD_xxx'cr' MOD_xxx'cr' TX_xxx'cr' IRX_xxx'cr' CEQ_xxx'cr' 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' SCT_xxx'cr' EXT_xxx'cr' CONF_xxx'cr' SFLT_xx'cr''lf']	 RF Output (ON/OFF) actual status not config Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) AGC Level (OK/FLT) Modem Reference PLL Lock (OK/FLT) Modem Reference Activity (OK/FLT) Configuration (OK/FLT) Number of stored faults logged (0 to 10)

Demodulator 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' CONF_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) Configuration (OK/FLT) Number of stored faults logged (0 to 10)
Interface Transmit Side Status	Command: Response:	<add/ITXS_'cr' >add/ITXS_'cr' DRP_xxx'cr' TXD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr' TAC1_xxx'cr' TAC2_xxx'cr' CONF_xxx'cr' SFLT_xx'cr''lf']	 D&I Drop (OK/FLT) Transmit Data/AIS (OK/FLT) Transmit Synthesizer PLL Lock (OK/FLT) Selected Transmit Clock Activity (OK/FLT) Transmit Audio Clip Channel #1 (OK/FLT) Transmit Audio Clip Channel #2 (OK/FLT) Configuration (OK/FLT) Number of Stored Faults Logged (0 to 10)
Interface Receive Side Status	Command: Response:	<add/IRXS_'cr' >add/IRXS_'cr' UNFL_xxx'cr' OVFL_xxx'cr' RXD_xxx'cr' FBER_xxx'cr' BWA_xxx'cr' CLK_xxx'cr' PLL_xxx'cr' DMUX_xxx'cr' 2047_xxx'cr' BUFF_xxx'cr' INS_xxx'cr' RAC1_xxx'cr' RAC2_xxx'cr' CONF_xxx'cr' SFLT_xx'cr''lf']	 Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Receive Data Loss/AIS (OK/FLT) Frame BER (OK/FLT) Receive Backward Alarm (OK/FLT) Selected Buffer Clock Activity (OK/FLT) Buffer Clock PLL Lock (OK/FLT) Demux Lock (OK/FLT) 2047 Pattern Lock Detect (OK/FLT) Buffer Full (OK/FLT) D&I Insert (OK/FLT) Receive Audio Clip Channel #1 (OK/FLT) Receive Audio Clip Channel #2 (OK/FLT) Configuration (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' INT_xxx'cr' BAT_xxx'cr' +5_xxx'cr' +12_xxx'cr' -12_xxx'cr' ST_xxx'cr' MODE_xxxxxx'cr' SFLT_xx'cr''lf']	 Monitor & Control Module (OK/FLT) Data Interface/Overhead Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (OK/FLT) Self Test (OK/FLT) Mode (LOCAL or REMOTE) 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 (FLT/OK) TX Backward Alarm 2 (FLT/OK) TX Backward Alarm 3 (FLT/OK) TX Backward Alarm 4 (FLT/OK) RX Backward Alarm 1 (FLT/OK) RX Backward Alarm 2 (FLT/OK) RX Backward Alarm 3 (FLT/OK) RX Backward Alarm 4 (FLT/OK) Number of stored faults logged (0 to 10)

B.12 Error 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.

Corrected BER Log	Command: Response: Examples:	<add/CBEL_'cr' >add/CBEL_t.t;s1,s2,s3 ... sn'cr''lf'] [No new compiled data from last poll] >add/CBEL_1.0'cr''lf'] [Momentary lock in 32 time intervals: 2.0E-3, 5.2E-7, 1.0E-10, <1.0E-12] >add/CBEL_1.0;,,,,,,,2003,5207,1010,<1012, ,,,,,,,,,,,,,,,,,,,,'cr''lf']	Where: t.t = Time between corrected BER samples in seconds ('0.1' to '9.9'). ; = At least one data point has been logged. s1 to sn = Corrected BER samples in the format of (xmmee). x = The optional data modifier '<' or '>' (less than or greater than). mm = The corrected BER mantissa ('10' for 1.0 to '99 for 9.9). ee = The corrected BER negative exponent ('00' to '99'). Error data (samples) are compiled at the nominal system rate indicated by the time parameter (t.t). The samples are stored in a thirty-two-element FIFO. When the 'CBEL_' command is received, the samples in the FIFO are formatted and returned as indicated. The FIFO is then flushed. If the FIFO becomes full, the oldest sample will be lost as the current sample is written. Notes: 1. The most recent sample is represented by 'sn' while the least recent sample is represented by 's1'. 2. Data delimited by a comma (',') will be returned for all time intervals logged. 3. The optional data modifiers '>' and '<' are only present if the error rate exceeds the computational resolution of the system.

Interface Read Error Status	Command: Response:	<add/IRES_'cr' >add/IRES_tttt_xn.nE-ee'cr''lf']	Where: tttt = FRM (FRAME) or 2047 (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 frame or 2047 error rate. The 'IRE_' configuration command is used to select reading of frame or 2047 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.
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_nnnn_mmmm.mmm'cr''lf']	Where:. nnnn = 1/2 (QPSK 1/2), [coder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), (OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), OQ78 (OQPSK 7/8), OQSK (OQPSK 1/1), BPSK (BPSK 1/1), QPSK (QPSK 1/1), 2144 (BPSK 21/44), B516 (BPSK 5/16), and 8P34 (8PSK 3/4). mmmm.mmm = Data rate in kHz

Demodulator Rate Status	Command: Response:	<add/DR_'cr' >add/DR_nnnn_mmmm.mmm'cr''lf']	Where: nnnn = 1/2 (QPSK 1/2), [coder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), (OQ12 (OQPSK 1/2), OQ34 (OQPSK 3/4), OQ78 (OQPSK 7/8), OQSK (OQPSK 1/1), BPSK (BPSK 1/1), QPSK (QPSK 1/1), 2144 (BPSK 21/44), B516 (BPSK 5/16), and 8P34 (8PSK 3/4). mmmm.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]	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.

B.13 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/date status information.

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/YYYYY'cr' MOD_xxx'cr' SYN_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' AGC_xxx'cr' SCT_xxx'cr' EXT_xxx'cr' CONF_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) Modem Reference PLL Lock (OK/FLT) Modem Reference Activity (OK/FLT) Configuration (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' CONF_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) Configuration (OK/FLT)
Interface Transmit Side Stored Faults	Command: Response:	<add/ITSF_#'cr' >add/ITSF_# hh:mm:ss MM/DD/YYYY'cr' DRP_xxx'cr' TXD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr' TAC1_xxx'cr' TAC2_xxx'cr' CONF_xxx'cr''lf']	 D&I Drop (OK/FLT) Transmit Data/AIS (OK/FLT) Transmit Synthesizer PLL Lock (OK/FLT) Selected Transmit Clock Activity (OK/FLT) Transmit Audio Clip Channel #1 (OK/FLT) Transmit Audio Clip Channel #2 (OK/FLT) Configuration (OK/FLT)

Interface Receive Side Stored Faults	Command: Response:	<add/IRSF_#'cr' >add/IRSF_# hh:mm:ss MM/DD/YYYY'cr' UNFL_xxx'cr' OVFL_xxx'cr' RXD_xxx'cr' FBER_xxx'cr' BWA_xxx'cr' CLK_xxx'cr' PLL_xxx'cr' DMUX_xxx'cr' 2047_xxx'cr' BUFF_xxx'cr' INS_xxx'cr' RAC1_xxx'cr' RAC2_xxx'cr' CONF_xxx'cr''lf']	 Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Receive Data Loss/AIS (OK/FLT) Frame BER (OK/FLT) Receive Backward Alarm (OK/FLT) Selected Buffer Clock Activity (OK/FLT) Buffer Clock PLL Lock (OK/FLT) Demux Lock (OK/FLT) 2047 Pattern Lock Detect (OK/FLT) Buffer Full (OK/FLT) D&I Insert (OK/FLT) Receive Audio Clip Channel #1 (OK/FLT) Receive Audio Clip Channel #2 (OK/FLT) Configuration (OK/FLT)
Common Equipment Stored Faults	Command: Response:	<add/CSF_#'cr' >add/CSF_# hh:mm:ss MM/DD/YYYY'cr' M&C_xxx'cr' INT_xxx'cr' BAT_xxx'cr' +5_xxx'cr' +12_xxx'cr' -12_xxx'cr' ST_xxx'cr''lf']	 Monitor & Control Module (OK/FLT) Data Interface/Overhead Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (OK/FLT) Self Test (OK/FLT)
WSed- Solomon Unavailable Seconds	Command: Response:	<add/RSSF_#'cr' >add/RSSF_# hh:mm:ss MM/DD/YYYY'cr' UNA_xxx'cr''lf']	 Unavailable Seconds (FLT/OK)

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.
Note: Parameters 2 through 6 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 = nnn.nnnnnn, IF frequency in MHz.
	3	**Modulator rate** (ref. 'MR_' command).	p3 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	4	**Modulator preset 'A' assignment** (ref. 'ARMA_' command).	p4 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	5	**Modulator preset 'B' assignment** (ref. 'ARMB_' command).	p5 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	6	**Modulator preset 'C' assignment** (ref. 'ARMC_' command).	p6 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	7	**Modulator preset 'D'** (ref. 'ARMD_' command).	p7 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	8	**Modulator preset 'V' assignment** (ref. 'ARMV_' command).	p8 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	9	**Modulator power offset** (ref. 'MPO_' command).	p9 = snn.n, modulator power offset in dB.
	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), '1' (INTL), '3' (FDC), '4' (CSC), or '6' (SDM51).
	14	**Modulator encoder type** (ref. 'MET_' command).	p14 = n, where 'n' is '0' (SEQ), '1' (VIT).
	15	**Carrier only mode ON/OFF.**	p15 = n, where 'n' is '0' (off) or '1' (on).
	16	**Demodulator IF** (ref. 'DF_' command).	p16 = nnn.nnnnnn, demodulator IF frequency in MHz.
	17	**Demodulator rate** (ref. 'DR_' command).	p17 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	18	**Demodulator preset A** (ref. 'ADRA_' command).	p18 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	19	**Demodulator preset B assignment** (ref. 'ADRB_' command).	p19 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	20	**Demodulator preset C assignment** (ref. 'ADRC_' command).	p20 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	21	**Demodulator preset D assignment** (ref. 'ADRD_' command).	p21 = nnnn_mmmm.mmm, code rate/data rate in kbit/s.
	22	**Demodulator preset V assignment** (ref. 'ADRV_' command).	p22 = nnnn_mmmm.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	**RF loopback** (ref. 'RFL_' command).	p25 = n, where 'n' is '0' (off) or '1' (on).
	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), '1' (INTL), '3' (FDC), or '4' (CSC).
	32	**Demodulator decoder type** (ref. 'DDT_' command).	p32 = n, where 'n' is '0' (SEQ), '1' (VIT).
	33	**Transmit clock source** (ref. 'TC_' command).	p33 = n, where 'n' is '0' (INT), '1' (REF), '2' (EXT), or 6 (DATA).
	34	**External reference frequency** (ref. 'ERF_' command).	p34 = nnnnn.n, external reference frequency in kHz.
	35	**Transmit clock phase** (ref. 'TCP_' command).	p35 = n, where 'n' is '0' (NRM), '1' (INV), '2' (AUTO).
	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	**Interface loopback** (ref. 'ILB_' command).	p38 = n, where 'n' is '0' (off) or '1' (on).
	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), '2' (B8ZS), or '3' (HDB3).
	41	**RX Interface coding format** (ref. 'ICFR_' command).	p41 = n, where 'n' is '0' (AMI), '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), '5' (INS).
	43	**Interface RX-T1 frame structure** (ref. 'IRFS_' command).	p43 = n, where n is '0' (NONE) or '1' (G704).
	44	**reserved null field.**	
	45	**Interface RX-E1 frame structure** (ref. 'IRFS_' command).	p45 = n, where n is '0' (NONE) or '1' (G704).
	46	**reserved null field.**	
	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).
	50	**Interface receive overhead type** (ref. 'IROT_' command).	p50 = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), '4' (ASYNC).
	51	**Interface substitution pattern** (ref. 'ISP_' command).	p51 = n, where 'n' is '0' (OFF) or '1' (ON).
	52	**Interface read error** (ref. 'IRE_' command).	p52 = n, where 'n' is '0' (OFF) or '1' (ON).
	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).

	55	**Interface service channel TX1** (ref. 'ISCL_' command).	p55 = nnn, service channel level in dBm.
	56	**Interface service channel TX2** (ref. 'ISCL_' command).	p56 = nnn, service channel level in dBm.
	57	**Interface service channel RX1** (ref. 'ISCL_' command).	p57 = nnn, service channel level in dBm.
	58	**Interface service channel RX2** (ref. 'ISCL_' command).	p58 = nnn, service channel level in dBm.
	59	**System modem type** (ref. 'SMT_' command).	p59 = n, where 'n' is '0' (IDR), '1' (IBS), ''2' (EFD), 3' (CUSTOM), '4' (DI), '5' (ASYNC), or '8' (AUPC).
	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 1)	64	**Drop Data Format** (ref. 'DDF_' command).	p64 = n, where 'n' is '0' (T1), '1' (T1ESF), '2' (E1CCS), '3' (E1CAS), '6' (E131TS), '7' (T1S), and '8' (T1ESFS).
(Note 2)	65	**Insert Data Format** (ref. 'IDF_' command).	p65 = n, where 'n' is '0' (T1), '1' (T1ESF), '2' (E1CCS), '3' (E1CAS), '6' (E131TS), '7' (T1S), and '8' (T1ESFS).
(Note 1)	66	**Bulk Drop Channels Assignment.**	p66 = dd;cc_dd;cc_dd;cc_dd;cc......, as defined by the BDCA_ command.
(Note 2)	67	**Bulk Insert Channels Assignment.**	p67 = ii;cc_ii;cc_ii;cc_ii;cc......, as defined by the BICA_ command.
(Note 2)	68	**Insert E1 CRC Enable** (ref. 'ICRC_' command).	p68 = n, where 'n' is '0' (off) or '1' (on).

	69	**Modem Reference Clock** (ref. 'MRC_' command).	p69 = n, where 'n' is '0' (INT), '1' (EXT1), '2' (EXT5), '3' (EXT10), or '4' (EXT20), respectively.
	70	**Modulator Spectrum Rotation** (ref. 'MSR_' command).	p70 = n, where 'n' is '0' (NRM), '1' (INV).
	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** (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	**TX Driver Type** (ref. 'TXDR_' command).	p82 = n, where 'n' is '0' (G.703), '1' (V.35), '2' (RS422), or '3' (RS232).
	83	**RX Driver Type** (ref. 'RXDR_' command).	p83 = n, where 'n' is '0' (G.703), '1' (V.35), '2' (RS422), or '3' (RS232).

	84	**reserved null field.**	
(Note 3)	85	**ASYNC TX Overhead Baud Rate** (ref. 'TOBR_' command).	p85 = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 4)	86	**ASYNC RX Overhead Baud Rate** (ref. 'ROBR_' command).	p86 = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 3)	87	**ASYNC TX Channel Char. Length** (ref. 'TCCL_' command).	p87 = n, where 'n' is the currently programmed character length.
(Note 4)	88	**ASYNC RX Channel Char. Length** (ref. 'RCCL_' command).	p88 = n, where 'n' is the currently programmed character length.
(Note 3)	89	**ASYNC TX Channel Stop** (ref. 'TCSB_' command).	p89 = n, where 'n' is the current number of stop bits programmed.
(Note 4)	90	**ASYNC RX Channel Stop Bits** (ref. 'RCSB_' command).	p90 = n, where 'n' is the current number of stop bits programmed.
(Note 3)	91	**ASYNC TX Channel Parity** (ref. 'TOCP_' command).	p91 = xxxx, where 'xxxx' is the currently programmed parity.
(Note 4)	92	**ASYNC RX Channel Parity** (ref. 'ROCP_' command).	p92 = xxxx, where 'xxxx' is the currently programmed parity.
(Note 3)	93	**ASYNC TX Communications Type** (ref. 'TCT_' command).	p93 = n, where 'n' is '0' (RS232), '1' (RS485_4WIRE), '2' (RS485_2WIRE).
(Note 4)	94	**ASYNC RX Communications Type** (ref. 'RCT_' command).	p94 = n, where 'n' is '0' (RS232), '1' (RS485).
(Note 15)	95	**AUPC Local Power enable ON/OFF** (ref. 'LPC_' command).	p95 = n, where 'n' is '0' (off) or '1' (on).
(Note 15)	96	**AUPC Nominal Power Value** (ref. 'NOMP_' command).	p96 = snn.n, where 'snn.n' Nominal Power Value in dBm.
(Note 15)	97	**AUPC Minimum Power Value** (ref. 'MINP_' command).	p97 = snn.n, where 'snn.n' Minimum Power Value in dBm.
(Note 15)	98	**AUPC Maximum Power Value** (ref. 'MAXP_' command).	p98 = snn.n, where 'snn.n' Maximum Power Value in dBm.

(Note 16)	99	**AUPC EBN0 Target Set Point** (ref. 'ENSP_' command).	p99 = nn.n, where 'nn.n' EBN0 Target Set Point in dB.
(Note 16)	100	**AUPC Max. Tracking Rate** (ref. 'MAXT_' command).	p100 = n.n, where 'n.n' is the Max. Tracking Rate in dB/Min.
(Note 15)	101	**AUPC Local Carrier Loss** (ref. 'LCL_' command).	p101 = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
(Note 15)	102	**AUPC Remote Carrier Loss** (ref. 'RCL_' command).	p102 = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
	103	**reserved null field.**	
	104	**reserved null field.**	
	105	**Transmit BPSK Data Ordering** (ref. 'TDA_' command).	p105 = n, where 'n' is '0' (NRM), '1' (INV).
	106	**Receive BPSK Data Ordering** (ref. 'RDA_' command).	p106 = n, where 'n' is '0' (NRM), '1' (INV).
	107	**RTS TX-IF Control Mode** (ref. 'RTSM_' command).	p107 = n, where 'n' is '0' (off) or '1' (on).
	108	**CTS Delay Time** (ref. 'CTSD_' command).	p108 = nn, CTS delay time in seconds.
	109	**Carrier Only Mode** (ref. 'COM_' command).	p109 = n, where 'n' is '0' (OFF),'1' (CENTER-CW), '2' (DUAL-CW), '3' (OFFSET-CW).
(Note 5)	110	**IDR TX ESC Type** (ref. 'TET_' command).	p110 = n, where 'n' is '0' (AUDIO), '1' (DATA).
(Note 6)	111	**IDR RX ESC Type** (ref. 'RET_' command).	p111 = n, where 'n' is '0' (AUDIO), '1' (DATA).
	112	**TX Reed-Solomon Interleave Value** (ref. 'TRSI_' command).	p112 = nn, Interleave value.

	113	**RX Reed-Solomon Interleave Value** (ref. 'RRSI_' command).	p113 = nn, Interleave value.
	114	**reserved null field.**	
	115	**reserved null field.**	
	116	**reserved null field.**	
	117	**TX 8PSK 2/3 IESS-310 Operation** (ref. 'T310_' command).	p117 = n, where 'n' is '0' (off) or '1' (on).
	118	**RX 8PSK 2/3 IESS-310 Operation** (ref. 'R310_' command).	p118 = n, where 'n' is '0' (off) or '1' (on).
(Note 8)	119	**Flex Mux Channel #1 Enable** (ref. "TCEN_1" command).	p119 = n, where 'n' is '0' (Disabled), '1' (D&I), or '2' (for T1/E1) operation.
(Note 9)	120	**TX Flex Mux Channel #1 Data Rate** (ref. "TCDR_1" command).	p120 = nnnn.n, where 'nnnn.n' is the data rate in Kbps.
(Note 8)	121	**TX Flex Mux Channel #2 Enable** (ref. "TCEN_2" command).	p121 = n, where 'n' is '0' (Disabled), '1' (Enabled).
(Note 8)	122	**TX Flex Mux Channel #3 Enable** (ref. "TCEN_3" command).	p122 = n, where 'n' is '0' (Disabled), '1' (Sync RS422), '2' (Async RS422), '3' (Sync RS232), '4' (Async RS232), or '5' (AUPC operation).
(Note 10)	123	**TX Flex Mux Channel #3 Data Rate** (ref. "TCDR_3" command).	p123 = nnnn.n, where 'nnnn.n' is the data rate in Kbps.
(Note 10)	124	**TX Flex Mux Channel #3 Clock Phase** (ref. "TCCP_3" command).	p124 = n, where 'n' is '0' (Normal) or '1' (Invert).

(Note 10)	125	**TX Flex Mux Channel #3 Data Phase** (ref. "TCDP_3" command).	p125 = n, where 'n' is '0' (Normal) or '1' (Invert).
(Note 8)	126	**TX Flex Mux Channel #4 Enable** (ref. "TCEN_4" command).	p126 = n, where 'n' is '0' (Disabled), '1' (Sync RS232), '2' (Async RS232), '3' (Async RS485), or '4' (AUPC operation).
(Note 11)	127	**TX Flex Mux Channel #4 Data Rate** (ref. "TCDR_4" command).	p127 = nnnn.n, where 'nnnn.n' is the data rate in Kbps.
(Note 11)	128	**TX Flex Mux Channel #4 Clock Phase** (ref. "TCCP_4" command).	p128 = n, where 'n' is '0' (Normal) or '1' (Invert).
(Note 11)	129	**TX Flex Mux Channel #4 Data Phase** (ref. "TCDP_4" command).	p129 = n, where 'n' is '0' (Normal) or '1' (Invert).
(Note 8)	130	**RX Flex Mux Channel #1 Enable** (ref. "RCEN_1" command).	p130 = n, where 'n' is '0' (Disabled), '1' (D&I), or '2' (T1/E1 operation).
(Note 12)	131	**RX Flex Mux Channel #1 Data Rate** (ref. "RCDR_1" command).	p131 = nnnn.n, where 'nnnn.n' is the data rate in Kbps.
(Note 8)	132	**RX Flex Mux Channel #2 Enable** (ref. "RCEN_2" command).	p132 = n, where 'n' is '0' (Disabled), '1' (Enabled).
(Note 8)	133	**RX Flex Mux Channel #3 Enable** (ref. "RCEN_3" command).	p133 = n, where 'n' is '0' (Disabled), '1' (Sync RS422), '2' (Async RS422), '3' (Sync RS232), '4' (Async RS232), or '5' (AUPC operation).
(Note 13)	134	**RX Flex Mux Channel #3 Data Rate** (ref. "RCDR_3" command).	p134 = nnnn.n, where 'nnnn.n' is the data rate in Kbps.
(Note 13)	135	**RX Flex Mux Channel #3 Clock Phase** (ref. "RCCP_3" command).	p135 = n, where 'n' is '0' (Normal) or '1' (Invert).
(Note 13)	136	**RX Flex Mux Channel #3 Data Phase** (ref. "RCDP_3" command).	p136 = n, where 'n' is '0' (Normal) or '1' (Invert).
(Note 8)	137	**RX Flex Mux Channel #4 Enable** (ref. "RCEN_4" command).	p137 = n, where 'n' is '0' (Disabled), '1' (Sync RS232), '2' (Async RS232), '3' (Async RS485), or '4' (AUPC operation).
(Note 14)	138	**RX Flex Mux Channel #4 Data Rate** (ref. "RCDR_4" command).	p138 = nnnn.n, where 'nnnn.n' is the data rate in Kbps.

(Note 14)	139	**RX Flex Mux Channel #4 Clock Phase** (ref. "RCCP_4" command).	p139 = n, where 'n' is '0' (Normal) or '1' (Invert).
(Note 14)	140	**RX Flex Mux Channel #4 Data Phase** (ref. "RCDP_4" command).	p140 = n, where 'n' is '0' (Normal) or '1' (Invert).
(Note 17)	141	**G.703 Operation** (ref. "G7LT_"command)	P141 = n, where 'n' is '0' for UNBAL or '1' for BAL.

Notes:

1. Data will only be returned if TX Overhead is programmed for D&I (or TX Flex MUX D&I). Comma is always returned.
2. Data will only be returned if RX Overhead is programmed for D&I (or RX Flex MUX D&I). Comma is always returned.
3. Data will only be returned if TX Overhead is programmed for ASYNC. Comma is always returned.
4. Data will only be returned if RX Overhead is programmed for ASYNC. Comma is always returned.
5. Data will only be returned if TX Overhead is programmed for IDR. Comma is always returned.
6. Data will only be returned if RX Overhead is programmed for IDR. Comma is always returned.
7. Not Used.
8. Data is only returned if Flex MUX PCB (Card Slot #1) is installed.. Comma is always returned.
9. Data not returned if TX Channel #1 is disabled. Comma is always returned.
10. Data not returned if TX Channel #3 is disabled or set for AUPC. Comma is always returned.
11. Data not returned if TX Channel #4 is disabled or set for AUPC. Comma is always returned.
12. Data not returned if RX Channel #1 is disabled. Comma is always returned.
13. Data not returned if RX Channel #3 is disabled or set for AUPC. Comma is always returned.
14. Data not returned if RX Channel #4 is disabled or set for AUPC. Comma is always returned (except for last parameter).
15. Data will only be returned if TX Overhead is programmed for ASYNC/AUPC. (or TX Flex Mux AUPC). Comma is always returned.
16. Data will only be returned if RX Overhead is programmed for ASYNC/AUPC. (or RX Flex Mux AUPC). Comma is always returned.
17. Data will only be returned if G.703 Personality PCB is installed. Comma is always returned.

B.14 Bulk Consolidated Status Faults

Bulk Consoli-dated Status Faults	Command: Response:	<add/BCSF_'cr' >add/BCSF_abcdefghijklmnopqr'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 = Modem Reference PLL Lock. Bit 4 = reserved. Bit 3 = Configuration. Bit 2 = Modem Reference Activity. 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 = Configuration. 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 = reserved. 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 = Transmit Synthesizer PLL Lock. Bit 3 = Selected Transmit Clock Activity. Bit 2 = reserved. Bit 1 = Configuration. Bit 0 = Drop fault. Character 'i': Interface transmit side faults character 3. Bit 6 = 1 always. Bit 5 = TX Audio Channel 1 Clip. Bit 4 = TX Audio Channel 2 Clip. 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 = Insert fault. 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 Underflow. Bit 4 = Buffer Overflow. Bit 3 = Receive Data Loss/AIS. Bit 2 = Frame BER. Bit 1 = Receive Backward Alarm. Bit 0 = Selected Buffer Clock Activity. Character 'l': Interface receive side faults character 3. Bit 6 = 1 always.

			Bit 5 = Buffer Clock PLL Lock. Bit 4 = Demux Lock. Bit 3 = 2047 Pattern Lock Detect. Bit 2 = Buffer Full. Bit 1 = reserved. Bit 0 = Configuration. Character 'm': Interface receive side faults character 4. Bit 6 = 1 always. Bit 5 = RX Audio Channel 1 Clip. Bit 4 = RX Audio Channel 2 Clip. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'n': Common equipment fault status character 1. Bit 6 = 1 always. Bit 5 = Monitor & Control Module. Bit 4 = Interface Module. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of common equipment stored faults. Character 'o': Common equipment fault status character 2. Bit 6 = 1 always. Bit 5 = Battery/Clock. Bit 4 = +5V power supply. Bit 3 = reserved. Bit 2 = +12V power supply. Bit 1 = -12V power supply. 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.

			Character 'r': Interface Reed-Solomon Unavailable Seconds Bit 6 = 1 always. Bit 5 = not used. Bit 4 = not used. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of Reed-Solomon Unavailable Seconds stored faults.

B.15 Miscellaneous Status

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.
Equipment Type	Command: Response:	<add/ET_'cr' >add/ET_ttttttt_xxx.yyy.zzz'cr''lf']	Where: ttttttt = Equipment type. xxx.yyy.zzz = Software version.
Monitor & Control Firmware Information	Command: Response:	<add/MCFI_'cr' >add/MCFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddr'cr' mm/dd/yy'cr''lf']	Where: xxx.yyy.zzz = Software version number (0.0.0 to 999.999.999). nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z).
DATA ROM Firmware Information	Command: Response:	<add/DFI_'cr' >add/DFI_'cr' FW/nnnnnn-ddr'cr' mm/dd/yy'cr' TURBO: FW/nnnnnn-ddr'cr''lf']	Where: nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z). Note: If Dash number is not used, '-dd' will be reported.

Boot M&C Firmware Information	Command: Response:	<add/BFI_'cr' >add/BFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddr'cr' mm/dd/yy'cr''lf']	Where: xxx.yyy.zzz = Software version number (0.0.0 to 999.999.999). nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z).
Modem Options/ Misc. Information	Command: Response:	<add/MOI_'cr' >add/MOI_'cr' s,HGH_PWR'cr' s,HGH_STAB'cr' s,ASLT'cr' s,VIT'cr' s,SEQ'cr' s,SR'cr' s,LRV'cr' s,FRV'cr' s,CARD_1_PCB'cr' s,CARD_2_PCB'cr' s,CARD_3_PCB'cr' s,8PSK_2/3'cr' s,TX_ONLY'cr' s,RX_ONLY'cr' s,OQPSK'cr''lf']	 (0 or +) High Power (0 or +) High Stability (- or +) Asymmetrical Loop Timing (- or +) Viterbi Encoder/Decoder (- or +) Sequential Encoder/Decoder (- or +) Single Code/Data Rate (- or +) Low Rate Variable (- or +) Full Rate Variable (x or +) Card #1 Installed (x or +) Card #2 Installed (x or +) Card #3 Installed (- or +) 8PSK 2/3 Code Rate (0 or +) TX Only Operation (0 or +) RX Only Operation (O or +) OQPSK 1/2, 3/4, 7/8 Notes: 1. s = 0 (Not Installed, Not Upgradable). 2. - (Not Installed, FAST Upgradable). 3. + (Installed). 4. X (Not Installed, Field Upgradable).
Card #1 Type Information	Command: Response:	<add/C1TI_'cr' >add/C1TI_'cr' ttttt'cr''lf']	Where: ttttt = type (OH_01, MUX_01, FMUX_01, or NOT_INSTALLED).
Card #2 Type Information	Command: Response:	<add/C2TI_'cr' >add/C2TI_'cr' tttt'cr''lf']	Where: tttt = type (RS_02, RS_03, or NOT_INSTALLED).
Card #3 Type Information	Command: Response:	<add/C3TI_'cr' >add/C3TI_'cr' tttt'cr''lf']	Where: tttt = type (RS_02, RS_03, or NOT_INSTALLED).

Card #1 Options/ Misc. Information	Command: Response:	<add/C1OI_'cr' >add/C1OI_'cr' <u>OH_01 list:</u> s,G.703 'cr' s,IBS 'cr' s,ASYNC_AUPC'cr' s,D&I 'cr' s,IDR 'cr''lf'] <u>MUX_01 list:</u> s,4_CHAN_SYNC'cr' s,8_CHAN_SYNC'cr' s,4_CHAN_ASYNC'cr' s,8_CHAN_ASYNC'cr''lf']	 (- or +) (- or +) (- or +) (- or +) (- or +) (- or +) (- or +) (- or +) (- or +) Notes: 1. Card #1 Installed Only. 2. s = - (Not Installed, FAST Upgradable). 3. + (Installed).
Card #2 Options/ Misc. Information	Command: Response:	<add/C2OI_'cr' >add/C2OI_'cr' <u>RS_02 list:</u> s,INTELSAT'cr''lf'] <u>RS_03 list:</u> s,INTELSAT'cr''lf']	 (- or +) (- or +) Notes: 1. Card #2 Installed Only. 2. s = - (Not Installed, FAST Upgradable). 3. + (Installed).
Card #3 Options/ Misc. Information	Command: Response:	<add/C3OI_'cr' >add/C3OI_'cr' <u>RS_02 list:</u> s,INTELSAT'cr''lf'] <u>RS_03 list:</u> s,INTELSAT'cr''lf']	 (- or +) (- or +) Notes: 1. Card #3 Installed Only. 2. s = - (Not Installed, FAST Upgradable). 3. + (Installed).

Serial Number	Command: Response:	<add/SNUM_'cr' >add/SNUM_'cr' MODEM_xxxxxxxxx'cr' CARD_1_xxxxxxxxx'cr' (Note 1) CARD_2_xxxxxxxxx'cr' (Note 2) CARD_3_xxxxxxxxx'cr''lf'] (Note 3)	Where: xxxxxxxxx = Serial number 000000000 to 999999999. Notes: 1. Data is only returned if Card #1 is installed. 2. Data is only returned if Card #2 is installed. 3. Data is only returned if Card #3 is installed.

Built In Self Test	Command:
	Response:
	
	Status:
	Response:
		<add/BIST_xxxx'cr'
		for (OFF or AUTO):
		>add/BIST_xxxx'cr''lf']
		
		for (RUN):
		>add/BIST_xxxx'cr'
		ST_xxx'cr''lf']
		
		<add/BIST_xxxx'cr'
		>add/BIST_xxxx'cr''lf']
			Where: xxxx = OFF (self test disabled), RUN (run self test now), AUTO (run self test on power up/software restart).
			
			Self Test (OK/FLT)
			
			Note: Allow 35 Seconds for response to RUN the Self Test.

State Of Product	Command: Response:	<add/SOP_'cr' >add/SOP_'cr' add'cr' abc'cr' rrrrr bps'cr' <var-string1>'cr' <var-string2>'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"). <var-string1> = Variable length strings explaining communication hardware type "RS-485, 2 wire", "RS-485, 4 wire", "RS-232". <var_string2> = Variable length strings explaining the intention of the product. "Under normal system operation", "REFLASH of BULK firmware required", "REFLASH of M&C firmware required".

Appendix C. Burst Mode Modulator Operation

C.1 Burst Mode Modulator: Theory of Operation

The modulator is composed of two basic sections: the baseband processing section and the RF section. The modem M&C controls all programmable functions in both sections.

C.1.1 Burst Mode

From the front panel, TX Terrestrial or SCT can be selected for the modulator clock input. An activity detector monitors the selected clock, to automatically switch the clock to SCT if there is a fault.

When a transmission is to be initiated, the RTS input must be activated. When detected, the modulator will put out a pure carrier for 96 clock cycles for 19.2 kbps or 288 clock cycles for 57.6 kbps, followed by a clock training sequence for 352 clock cycles. A 31-bit unique word is then transmitted.

At this time, the CTS line will go false. The next bit of data into the modem will be the first bit transmitted.

When the last bit of the data packet has been sent to the modem, the user deactivates the RTS line.

When the modulator detects RTS going false, the modulator will flush the convolutional encoder (6 bits), then put out the unique word prime twice (62 bits). At this point, the packet is complete, and the modulator will return the CTS to true. The modulator is now ready for the next packet.

Data to be transmitted will come from the interface card via the demodulator. The format is RS-422, and includes a clock that is synchronous with the data. The data signal at this point is clean and free of jitter. The data signal goes to the scrambler, which provides energy dispersal. There is no need for a differential encoder in burst mode, as the ambiguities are resolved using the unique word. The data signal passes to the 1/2 rate Viterbi K=7 convolutional encoder.

The output of the encoder generates two separate data streams to drive the in-phase and quadrature channels of the modulator. The data signal passes through a set of variable-rate digital Nyquist filters. There are activity detectors on both the In-phase and Quadrature (I&Q) channel Nyquist filters.

The digital Nyquist filters are followed by Digital to Analog (D/A) converters and reconstruction filters. These filters provide proper spectral shaping and equalization. The filters are under control of the M&C.

The I&Q filtered data signals are applied to the RF modulator, which converts them to a modulated carrier. The spectral shape will be identical to that of the input data streams, but double-sided about the carrier frequency.

The RF synthesizer provides the proper frequencies to convert the modulator IF to the desired output frequency in the 50 to 180 MHz range. The synthesizer has multiple loops, and incorporates a DDS chip to accommodate 100 Hz steps over a range of 130 MHz. The RF section has a frequency stability of ± 1 x 10^{-5}.

The signal from the power combiner is sent to the output amplifier, which amplifies the low-level signal from the modulator section to the proper level for output from the module. The amplifier contains circuitry which provides programmable control of the output level over a range of -5.0 to -30.0 dBm, in 0.1 dB steps. Power leveling is provided at ± 1.0 dB to maintain the stability of the output level over time and temperature.

Note: The data packet must not be less than 48 bits of data. There is no maximum length for the data packet.

C.2 Burst Mode Modulator: Specifications

C.2.1 Digital Data Rate

The digital data rate is selectable at 19.2 or 57.6 kbps. The modem automatically calculates and sets the symbol rate.

Modulation Type	Encoding Type	Data Rate
QPSK 1/2	Viterbi	19.2 kbps
QPSK 1/2	Viterbi	57.6 kbps

C.2.2 Modulation and Encoding Types

QPSK modulation and 1/2 rate Viterbi forward error correction encoding is standard.

Encoder	Code Rate	Modulation
Viterbi, K7	1/2	QPSK

C.2.3 Scrambling Types

One of the following scrambling types can be selected by the operator.

- A programmable seed 2^15 -1 Synchronous Scrambler.
- None

C.2.4 Differential Encoder

The differential encoder is not needed as the data inversion ambiguity is resolved during acquisition.

C.2.5 Transmit Frequency (IF)

The range of the output IF spectrum can be selected by the operator from 50 to 180 MHz, in 1 Hz steps.

C.2.6 Frequency Reference

SCT, RX Bit Clock, and IF output are locked to the Frequency Reference.

Internal (Standard	Stability over the operating temperature range = ± 10 PPM.
Internal High Stability (Optional)	Stability over the operating temperature range = ± 0.2 PPM.
External Reference Input (Standard)	The External frequency reference connector is located on the back panel. This allows Frequency Reference to be locked to an external reference frequency standard. Impedance 75Ω Frequency 1, 5, 10 or 20 MHz Amplitude ≥ +0 dBm < +20 dBm DC offset Capacitively coupled Connector BNC
Reference Frequency Output (Optional)	The External frequency reference connector can be used as an output when the High Stability option is installed. When selected from the front panel, this output can be used to lock other equipment to the Internal High Stability Reference of the selected modem. The output is 10 MHz, the level is +10 dBm ± 5 dBm.

C.2.7 Transmit Frequency Change Time

The time between the end of a remote command and the end of the modem reply for frequency change and synthesizer lock will be < 200 mS.

C.2.8 Phase Noise

1. The phase noise of the transmit IF output carrier is no worse than:

dBc/Hz	Distance from Carrier
-66.0	100 Hz
-76.0	1 kHz
-86.0	10 kHz
-96.0	100 kHz
-96.0	1 MHz

2. Fundamental AC line spurious is -42 dBc or lower.

3. The sum of all the single sideband spurious, from 0 to 0.75 x symbol rate, is -42 dBc or lower.

C.2.9 Transmit IF Output Switch

When set to off, no signal present at the output is greater than -60 dBm, measured in a 3 kHz bandwidth from 0 to 500 MHz.

C.2.10 Transmit IF Power

The transmit IF power is operator selectable from -5 to -30 dBm, in 0.1 dB steps, with an accuracy of ± 0.5 dB. The maximum drift due to temperature change over the specified range is ± 0.5 dB.

As an option the output can be selectable from +5 to -20 dBm, in 0.1 dB steps, with an accuracy of ± 0.5 dB. The maximum drift due to temperature change over the specified range is ± 0.5 dB.

C.2.11 Modulator Power Offset

An offset to the displayed IF output power may be entered from -99.0 to +99.0 dB, in 0.1 dB steps.

C.2.12 Modulated IF Output Shape

The modem meets the following transmit output spectral mask specifications. The desired mask is selectable from the front panel or remotely.

- INTELSAT/EUTELSAT
- Closed net (Comtech EF Data)

C.2.13 Spurious Emissions

Spurious emissions are measured relative to the power of the modulated carrier. The measurement is done with the carrier on in continuous mode and modulated by the correct data/clock signal. Spurious emissions measured in a 3 kHz bandwidth at the transmit IF output are:

0 to 500 MHz (-5 to -30 dBm)	-55 dBc
0 to 500 MHz (+5 to -20 dBm > 64 kbps)	-50 dBc
0 to 500 MHz (+5 to -20 dBm < 64 kbps)	-45 dBc

C.2.14 Modulator Phase Error

The modulator will have less than 2° of phase error

C.2.15 Transmit IF Test Modes

The following transmit IF test modes are available to the operator. Spurious emissions in the following test modes will be ≤ -30 dBc.

TX IF Test Modes	Remarks
CW:	Outputs a single carrier at the defined frequency
Offset:	Dual sideband signal with lower sideband and carrier suppressed ≤ -35 dBc
Dual sideband:	Suppressed carrier ≤ -35 dBc

C.2.16 Modulator Spectrum Rotation

The operator can select normal or inverted spectrum of the Modulator Output.

C.2.17 Transmit Preamble

In burst mode, when RTS transitions from false to true, the modem shall turn on the RF carrier and generate a burst preamble with the following characteristics:

96 symbols @ 19.2 kbps or 288 symbols @ 57.6 kbps	352 symbols	31 symbols
CW	BIT TIMING	UNIQUE WORD

Channel contents:

CW:	I and Q channels contain all 1's	
Bit Timing:	I:	1010...
	Q:	1010...
Unique Word:	I:	000 0010 0011 1010 1001 0111 1001 1011
	Q:	000 0010 0011 1010 1001 0111 1001 1011

***Note:** Bit Timing and the Unique Word is BPSK and uncoded.

At the end of the preamble, the modulator shall cause CTS to transition from false to true. This signals the baseband equipment to begin sending data. The RF carrier shall remain on until RTS transitions back to false.

C.2.18 Transmit Packet

The minimum length is 48 bits. The maximum length can be infinite. Packet length is determined by the user.

C.2.19 Transmit Postamble

When RTS transitions back to false, the modulator flushes the Encoder and sends the End of Message pattern, turns off the RF carrier and resets CTS back to false. The EOM pattern is shown below.

6 symbols	31 symbols	31 symbols
Flush	Unique Word'	Unique Word'

Unique Word Prime	I:	110 1100 1111 0100 1010 1110 0010 0000
	Q:	110 1100 1111 0100 1010 1110 0010 0000

***Note:** The Unique Word Prime is BPSK and uncoded.

C.3 Burst Mode Demodulator: Theory of Operation

The demodulator card functions as an advanced, fully digital, coherent phase-lock receiver, and a Viterbi or Sequential decoder.

C.3.1.1 Burst Mode

The following subsections make up the demodulator:

- RF synthesizer
- IF amplifier
- Quadrature demodulator
- Identical anti-aliasing filters
- D/A converters
- Digital Nyquist filters
- Costas loop
- Clock loop
- Automatic Gain Control (AGC)
- Automatic Offset Control (AOC)
- Unique word detector
- Ambiguity resolver
- Soft-decision decoder
- Synchronous descrambler
- End of message detector

The modulated signal enters the RF module, where it is converted from an IF signal at 50 to 180 MHz to I&Q baseband channels. The synthesizer has multiple loops, and incorporates a DDS chip to accommodate 100 Hz steps over a range of 130 MHz. The RF section has a frequency stability of $\pm 1 \times 10^{-5}$.

The two channels are then passed through identical anti-aliasing filters, D/A converters, and digital Nyquist filters.

The result is a filtered, digital representation of the received signal. A Costas loop maintains the phase lock during the message. A phase-lock loop maintains the data clock. The soft-decision mapper converts the I&Q samples to soft-decision values. The soft-decision values are then fed to the Viterbi decoder, where error detection and correction are performed.

The I&Q channels are also used to calculate the AGC and AOC voltages. The AGC and AOC are fed back to the RF module.

Finally, the data from the output of the Viterbi decoder is descrambled with a 2^{15}-1 synchronous descrambler, and routed to the interface card. There also is a summary fault relay that provides a FORM C output located on the demodulator board.

The data clock phase can be selected from the Interface Utility menu.

Using Digital Signal Processing (DSP) techniques, the demodulator looks for carrier power in an 8 kHz bandwidth. When a carrier is detected, the DSP calculates the offset from the nominal frequency. The DSP then zeros out the offset. This occurs during the CW portion of the preamble sequence. During the second part of the preamble sequence, the clock phase is recovered. When the unique word is detected, the Demod determines the ambiguity of the received signal. It then corrects the ambiguity, if necessary, and starts feeding data to the Viterbi decoder. A delay generator determines when the first bit of the data packet comes out of the Viterbi decoder, and initiates the synchronous load of the 2^{15}-1 synchronous descrambler. After the descrambler starts the lock, the RR lines are set to true, denoting that valid data is being received. The demodulator, when locked, continually monitors the incoming data for the end-of-message marker. When the end-of-message marker is detected, a delay generator determines when the remaining data has been flushed out of the modem, and the Lock and RR line is set to false.

Note: The data packet must not be less than 48 bits of data. There is no maximum length for the data packet.

C.4 Burst Mode Demodulator: Specifications

C.4.1 Digital Data Rate

The digital data rate is fixed at 19.2. The modem automatically calculates and sets the symbol rate.

Modulation Type	Encoding Type	Data Rate
QPSK 1/2	Viterbi	19.2 kbps

C.4.2 Demodulation and FEC Decoding Types

QPSK demodulation and 1/2 rate Viterbi forward error correction decoding is standard.

Encoder	Code Rate	Modulation
Viterbi, K7	1/2	QPSK

C.4.3 Descrambling Types

One of the following descrambling types can be selected by the operator.

- 2^15 -1 Synchronous
- None

C.4.4 Differential Decoder

The differential decoder is not needed as the data inversion ambiguity is resolved during acquisition.

C.4.5 Demodulator Spectrum Rotation

The operator can select normal or inverted spectrum for the Demodulator Input.

C.4.6 Receive Frequency (IF)

The range of the input IF spectrum can be selected by the operator from 50 to 180 MHz, in 1 Hz steps.

The actual value of offset from the programmed frequency is available to the operator on the front panel as well as the remote port. The resolution of this value is 1 Hz. Monitor accuracy is ± 10 PPM.

C.4.7 Receive Input Power (Desired Carrier)

The modem can meet the specified BER and automatically adjust to a receive IF input power of -30 to -55 dBm. Monitor accuracy is ± 2.5 dB.

C.4.8 Receive Input Power (Composite)

The modem can operate to its specified performance under all the following conditions:

- The sum of all carriers is ≤ -5 dBm.
- The sum of all carriers within 10 MHz from the desired is ≤ +30 dBc.
- The sum of all carriers is ≤ +40 dBc.

C.4.9 IF Input Overload

The modem will not be damaged by a continuous receive IF input of +20 dBm.

C.4.10 Demodulator IF Input Shape

The modem can be set to match any of the following spectral mask specifications.

- INTELSAT/EUTELSAT
- Closed net (Comtech EF Data)

C.4.11 Channel Spacing/Adjacent Carrier Performance

The modem bit error performance will be degraded less than 0.5 dB with the following receive IF signal:

- Two like-modulated carriers spaced 1.3 times the symbol rate from the receive frequency, and/or 1.2 times the acquisition range, whichever is larger.
- Each adjacent carrier up to 10 dBc higher in power than the desired carrier.
- A single adjacent carrier spaced 1.4 times the symbol rate, up to +20 dBc.

C.4.12 Acquisition Time

Viterbi 6 dB E_b/N_0 with ± 4 kHz Frequency Uncertainty			
Code Rate	**Data Rate**	**T_{acq}**	**$P(t < T_{acq})$**
1/2	19.2 kbps	< 30 msec	93%

C.4.13 Acquisition Probability

Viterbi with ± 4 kHz Frequency Uncertainty			
E_b/N_0	**Data Rate**	**T_{acq}**	**$P(t < T_{acq})$**
6 dB	19.2 kbps	< 30 msec	93%
8 dB	19.2 kbps	< 30 msec	99%

C.4.14 Receive IF Carrier Acquisition Range

1. The modem will automatically lock to a correctly formatted carrier, which is within 4 kHz of the displayed receive frequency.
2. The operator can adjust the acquisition range from 0 to 4 kHz, in 1 Hz steps.
3. The operator can adjust the center of the acquisition range from 0 to 8 kHz, in 1 Hz steps.

C.4.15 Collision Recovery

A programmable packet length can be programmed from 48 bits to 1,048,576 bits in 1 bit increments. This allows for the demodulator to go back to acquisition mode when this parameter times out, in the case of a collision. This value should be set greater than the maximum packet size but less than the time slot size.

Note: this is programmed from the UTILITY DEMODULATOR menu.

C.5 Burst Mode System - Specifications

C.5.1 Loopback Modes

The operator can select one of the following interface loopback test modes.

- Baseband: Near end and far end
- Interface: Near end

C.5.1.1 Test Modes

The following receive IF test modes are available to the operator.

Test Modes	Remarks
IF loopback:	Disconnects the IF input from the receive input connector and couples it to a sample of the transmit IF output. The IF output is not affected. **Note:** The transmit and receive data rates must be the same for the modem to lock.
RF loopback:	Sets the demodulator frequency to the same value as the modulator. For the modem to lock, an external IF loop must be provided. **Note:** The transmit and receive data rates must be the same for the modem to lock.

C.5.2 Remote Control

All modem functions can be controlled remotely through the remote connector on the rear panel. See the Remote Specification for the complete command and response structures and syntax. Interface type:

- EIA-485 (4- or-2-wire) or EIA-232
- Baud Rate Range 150 to 19.2 kbit
- ASCII characters
- 11 bits per character
- 1 start bit
- Information Bps
    - 7 information bits, 1 parity bit (odd/even)
    - 8 information bits, no parity bit
- 2 stop bits
- Operation mode TX only, RX only, or Duplex

For exact remote control information, refer to the latest firmware appropriate for this piece of equipment.

C.5.3 Modem Remote Address

The modem will have the ability to be programmed for a remote address. This will range from 0 to 255. The value of zero is defined as global. All other addresses are unique, and should not have more than one modem assigned on a given EIA-485/232 bus.

C.5.4 Monitored Signals

The operator can display/read one of the following, continually updated, performance monitors.

Note: These monitors will not have valid information unless the burst is of sufficient length to accumulate the data.

- Receive signal level -25 to -60 dBm, ± 2.5 dB accuracy
- Raw BER
- Corrected BER, range 1.0 E-3 to 1.0 E-12
- E_b/N_0,.1 dB resolution, ± 0.5 dB accuracy, range 2.0 to 16.0 dB
- RX frequency offset, 1 Hz resolution, ± 10 PPM accuracy, range -4 to +4 kHz

C.5.5 Faults Monitored

Faults monitored by the modem, and the action taken at each occurrence of that fault.

MODULATOR FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	TX ALARM RELAY #2	RX ALARM LED	RX ALARM RELAY #3	SPARE RELAY ALARM #1
			(1)		(2)		(3)		(4)		(5)	
IF SYNTHESIZER	X	X	X									
DATA CLOCK SYN	X	X	X									
AGC	X	X	X									
MODEM REF ACT								X	X			
MODULE	X	X	X									
DEMODULATOR FAULTS												
IF SYNTHESIZER				X	X							
MODULE				X	X							

Legend		
Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
1	TX FAULT	JX/Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	JX/Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	JX/Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	JX/Pin 4 (NO), 5 (COM), 6 (NC) +
5	RX ALARM #3	JX/Pin 7 (NO), 8 (COM), 9 (NC) +
6	PRIMARY ALARM	JX/Pin 43 (NO), 10 (COM), 27 (NC) +
7	SECONDARY ALARM	JX/Pin 44 (NO), 11 (COM), 28 (NC) +
8	DEF MAINT ALARM	JX/Pin 17 *****
****	A connection between the common and N.C. contacts indicate fault.	
*****	Signal is open collector high impedance if faulted.	
+	A connection between the common and N.O. contacts indicate alarm.	

Figure 2. SNM-1001A Burst Mode Fault Tree

TX INTERFACE FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	TX ALARM RELAY #2	RX ALARM LED	RX ALARM RELAY #3	SPARE RELAY ALARM #1
			(1		(2		(3		(4		(5	
TX CLK PLL	X	X	X									
TX CLK ACTIVITY								X	X			

Legend		
Test Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
1	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) +
5	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) +
6	PRIMARY ALARM	Pin 43 (NO), 10 (COM), 27 (NC) +
7	SECONDARY ALARM	Pin 44 (NO), 11 (COM), 28 (NC) +
8	DEF MAINT ALARM	Pin 17 *****
****	A connection between the common and N.C. contacts indicate fault.	
*****	Signal is open collector high impedance if faulted.	
+	A connection between the common and N.O. contacts indicate alarm.	

Figure 2. SNM-1001A Burst Mode Fault Tree (Continued)

COMMON EQUIP FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	TX ALARM RELAY #2	RX ALARM LED	RX ALARM RELAY #3	SPARE RELAY ALARM #1
			(1)		(2)		(3)		(4)		(5)	
BATTERY/CLOCK						X						
-12V POWER SUPPLY						X	X					
+12V POWER SUPPLY						X	X					
+5V SUPPLY						X	X					
CONTROLLER						X	X					
INTERFACE MODULE						X	X					

Legend		
Test Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
1	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) +
5	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) +
6	PRIMARY ALARM	Pin 43 (NO), 10 (COM), 27 (NC) +
7	SECONDARY ALARM	Pin 44 (NO), 11 (COM), 28 (NC) +
8	DEF MAINT ALARM	Pin 17 *****
****	A connection between the common and N.C. contacts indicate fault.	
*****	Signal is open collector high impedance if faulted.	
+	A connection between the common and N.O. contacts indicate alarm.	

Figure 2. SNM-1001A Burst Modeode Fault Tree (Continued)

C.5.6 Stored Faults

All faults listed above will be stored in battery backed memory for up to 10 occurrences of each fault, along with the time and date of when the fault occurred, and, where applicable, when it cleared. All faults can be cleared by operator command.

C.5.7 Stored Configurations

Five memories are available for storing the current modem configuration. These are maintained through a power off cycle.

C.6 Burst Mode Specifications

General Specifications	
Operating Frequency Range	50 to 180 MHz, synthesized in 100 Hz steps
Type of Modulation	QPSK
Operating Channel Spacing	Less than 0.5 dB degradation operating with 2 adjacent-like channels, each 10 dB higher at 1.3 times the symbol rate, or a minimum of 1.2 times the specified acquisition range
Bit Error Rate	See Table 1-3
Phase Noise	In accordance with IESS-308
Digital Interface (Field Changeable Plug-in Modules) One Interface per Module)	RS-422/449 on 37-pin D MIL-STD-188 on 37-pin D V.35 on 25-pin D or 34-pin block RS-232-C on 25 pin-D
Digital Data Rate: QPSK, 1/2 Rate	 19.2 kbps or 57.6 kbps
Doppler Buffer	N/A
Forward Error Correction	Convolutional encoding with soft decision, K=7 Viterbi decoding or Sequential
Data Scrambling	Selectable or none, 2^{15}-1, synchronous
Prime Power	90 to 264 VAC auto select, 47 to 63 Hz, 50W maximum, fused at 2A, 38 to 64 VDC
Operating Temperature	0° to 50°C (32° to 122°F)
Humidity	0 to 95% noncondensing
Diagnostic Features	IF Loopback RF Loopback Baseband Loopback (bi-directional, electrical) Fault Monitoring Bit Error Rate Monitoring Remote Control via Serial Port

Additional Modulator Specifications	
Output Power	-5 to -30 dBm, adjustable in 0.1 dB steps
Output Spurious and Harmonics	-55 dBc in 4 kHz BW in-band (50 to 180 MHz) -55 dBc in 4 kHz BW out-of-band (0 to 500 MHz)
Output Impedance	75Ω standard (50Ω optional)
Output Return Loss	20 dB
Output Frequency Stability	± 10 PPM
Data Clock Source	Internal or external External clock ± 100 PPM and < 5% jitter
Internal Data Clock Stability	± 10 PPM
Additional Demodulator Specifications	
Input Power (Desired Carrier)	-30 to -55 dBm (composite) +30 dB power within 2 MHz from desired carrier +40 dB power outside of 2 MHz from desired carrier -5 dBm maximum composite
Input Impedance	75Ω standard (50Ω optional)
Input Return Loss	20 dB
Carrier Acquisition Range	± 4 kHz minimum
Clock Acquisition Range	± 100 PPM
Acquisition Time	< 30 ms
Directed Sweep	N/A
Remote Control Specifications	
Serial Interface	RS-485/449, baud rate 110 to 19,200 bit/s Protocol not necessarily compatible with SDM-650 and SDM-308
Signals Controlled/Monitored	Transmit Frequency Receive Frequency Transmit Power Transmitter ON/OFF IF Loopback RF Loopback Baseband Loopback Scrambler ON/OFF Descrambler ON/OFF Sweep Center Filter Mask Raw Error Rate Corrected Bit Error Rate Receive E_b/N_0 TX Clock Internal/External RX Clock Normal/Invert Receive Signal Level Receive Carrier Detect Power Supply Voltages Fault Status Stored Fault Status
Configuration Retention	Will maintain current configuration for at least one year without power
Addressing	Programmable to 1 of 255 possibilities Address 0 reserved for global addressing
Local control of all remote functions included via push-button entry	

Appendix D. SPECIFICATIONS

D.1 Continuous Mode Specifications

Operating Frequency Range	50 to 180 MHz Synthesized in 1 Hz steps
Modulation Types (Front panel selection)	8PSK BPSK QPSK OQPSK (FAST upgrade, front panel selection)
Operating Channel Spacing	Less than 0.5 dB degradation operating with two adjacent like channels (each 10 dB higher at 1.3 times the symbol rate) A single adjacent carrier spaced 1.4 times the symbol rate, up to +20 dBm
Baseband Interface	EIA-422/449 V.35 EIA-232
Elastic Buffer	32 to 262144 bits, selectable from front panel in bits or ms
Digital Data Rate	2.4 kbps to 5.0 Mbps in 1 bps steps (front panel selection)
Scrambling/Descrambling Types	IESS 309 (Synchronous 215) International Telephone and Telegraph Consultative Committee (CCITT) V.35 Comtech EF Data/Comstream compatible Fairchild compatible
Forward Error Correction	Viterbi K = 7: Rate 1/2, 3/4, 7/8, 2/3 Reed-Solomon: Rate 225/205, 126/112, 219/201 Turbo: Rate 5/16, 21/44, 3/4 Sequential: Rate 1/2, 3/4, 7/8 (Code rates selectable from front panel)
Monitor and Control	Front panel display (16 character by 2 rows), backlit ***(continued)***
Filter Mask Types	INTELSAT/EUTELSAT Closed net (Comtech EF Data) Closed net (Fairchild compatible), SDM-51 compatible

Loopback Modes	Baseband (near end and far end) Interface (near end and far end) IF Loopback (near end) RF Loopback (far end)
Diagnostic Features	IF Loopback RF Loopback Baseband Loopback Interface Loopback Fault monitoring (includes current and stored faults) BER monitoring Input IF power monitoring Buffer fill status monitoring Remote control via serial port
Power	Prime power 90 to 264 VAC, 47 to 63 Hz, 40W maximum, fused at 2A 38 to 64 VDC
Physical: Size Weight	 1.75H x 19.0W x 15.2D inches (1 RU) (4.4H x 48W x 37D cm) 9 lbs (4 kg)
Shipping Size, including container: Weight	 9H x 21W x 20D inches (23 H x 53 W x 51 D cm) 15.25 lbs (7 kg) (approximate)
Environmental: Temperature Humidity Operational Shock	 0° to 50°C (32° to 122°F) 0 to 95% non-condensing When any one corner of the modem is dropped from 1 cm onto a hard surface, the modem will not take any errors or faults.

D.2 Remote Control Specifications

Serial Interface	RS-232 or RS-485 (2- or 4-wire)
Baud Rate	150 to 19200 Mbps
Signals Controlled	Transmit Frequency Receive Frequency Transmit Power Transmitter On/Off Data Rate Select RF Loopback IF Loopback Baseband Loopback Interface Loopback Transmit and Receive Filter Mask Self Test Scrambler Type Scrambler On/Off Descrambler Type Descrambler On/Off Buffer Clock TX/RX/INT/INS (D&I only) Transmit Clock Internal/External Receive Clock Normal/Invert Differential Encoding and Decoding Code and Decode Rate Transmit and Receive Overhead Type Acquisition Sweep Parameters Buffer Size Reed-Solomon On/Off Mod and Demod Spectrum Norm/Invert Rev Emulation Current/Functional Local Modem AUPC On/Off Remote AUPC Enable On/Off
Signals Monitored	Raw Error Rate Corrected BER Receive E_b/N_0 Receive Signal Level Receive Carrier Detect Power Supply Voltages Fault Status Stored Fault Status
Configuration Retention	Will maintain current configuration for at least one year without power
Addressing	Programmable to 1 of 255 possibilities; address 0 is reserved for global addressing

Note: Local control of all remote functions is included by push-button entry.

D.3 Modulator Specifications

D.3.1 Digital Data Rate

The digital data rate is selctable in 1 bps steps. The modem automatically calculates and sets the symbol rate. Data rates entered that exceed the date arate or symbol rate specification are rejectred at entry. The symbol rate range is 4.8 kHz to 2.5 MHz.

Table C-1. Modulator Digital Data Rate

Modulation Type	Encoding Type	Data Rate Range	
BPSK 1/2	Viterbi	2.4 kbps	1.25 Mbps
QPSK 1/2	Viterbi	4.8 kbps	2.5 Mbps
QPSK 3/4	Viterbi	7.2 kbps	3.75 Mbps
QPSK 7/8	Viterbi	8.4 kbps	4.375 Mbps
OQPSK 1/2	Viterbi	4.8 kbps	2.5 Mbps
OQPSK 3/4	Viterbi	7.2 kbps	3.75 Mbps
OQPSK 7/8	Viterbi	8.4 kbps	4.375 Mbps
8PSK 2/3	Viterbi	512 kbps	5.0 Mbps
BPSK 1/2	Sequential	2.4 kbps	1.25 Mbps
QPSK 1/2	Sequential	4.8 kbps	2.5 Mbps
QPSK 3/4	Sequential	7.2 kbps	3.75 Mbps
QPSK 7/8	Sequential	8.4 kbps	4.375 Mbps
BPSK 5/16	Turbo	2.4 kbps	781.25 kbps
BPSK 21/44	Turbo	2.4 kbps	1193 kbps
QPSK 3/4	Turbo	7.2 kbps	3750 kbps
OQPSK 3/4	Turbo	7.2 kbps	3750 kbps
8PSK 3/4	Turbo	384 kbps	5.0 Mbps
BPSK 1/2	Viterbi and Reed-Solomon	2.4 kbps	1.138 Mbps
QPSK 1/2	Viterbi and Reed-Solomon	4.8 kbps	2.277 Mbps
QPSK 3/4	Viterbi and Reed-Solomon	7.2 kbps	3.416 Mbps
QPSK 7/8	Viterbi and Reed-Solomon	8.4 kbps	3.986 Mbps
OQPSK 1/2	Viterbi and Reed-Solomon	4.8 kbps	2.277 Mbps
OQPSK 3/4	Viterbi and Reed-Solomon	7.2 kbps	3.416 Mbps
OQPSK 7/8	Viterbi and Reed-Solomon	8.4 kbps	3.986 Mbps
8PSK 2/3	Viterbi and Reed-Solomon	512 kbps	4.555 Mbps
BPSK 1/2	Sequential and Reed-Solomon	2.4 kbps	1.138 Mbps
QPSK 1/2	Sequential and Reed-Solomon	4.8 kbps	2.277 Mbps
QPSK 3/4	Sequential and Reed-Solomon	7.2 kbps	3.416 Mbps
QPSK 7/8	Sequential and Reed-Solomon	8.4 kbps	3.986 Mbps
BPSK 1/1	None	4.8 kbps	2.5 Mbps
QPSK 1/1	None	9.6 kbps	5.0 Mbps
OQPSK 1/1	None	9.6 kbps	5.0 Mbps

D.3.2 Modulation and Encoding Types

Table D-2 shows combinations of modulation and forward error correction (FEC) encoding types.

Table D-2. Modulation and Encoding Types

Encoder	Code Rate	Modulation
Viterbi, K7	1/2	BPSK
Viterbi, K7 Reed-Solomon	1/2 225/205 Closed	BPSK
Viterbi, K7	1/2, 3/4, 7/8	QPSK, OQPSK
Viterbi, K7, TCM	2/3	8PSK
Viterbi, K7 Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed or IDR T1, 126/112 IBS and D&I, 219/201 IDR E1	QPSK, OQPSK
Viterbi, K7, TCM Reed-Solomon EFD Compatible	2/3 225/205 Closed or IDR T1, 126/112 IBS and D&I, 219/201 IDR E1	8PSK
Viterbi, K7, TCM Reed-Solomon IESS-310 Compatible	2/3 219/201 [4] No Overhead, 219/201 [4] IBS and D&I, 219/201 [8] IDR T1/E1	8PSK
Sequential	1/2	BPSK
Sequential Reed-Solomon	1/2 225/205 Closed	BPSK
Sequential	1/2, 3/4, 7/8	QPSK, OQPSK
Sequential Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK, OQPSK QPSK, OQPSK
Turbo	5/16	BPSK
Turbo	21/44	BPSK
Turbo	3/4	QPSK, OQPSK, 8PSK
Uncoded	1/1	BPSK, QPSK, OQPSK

D.3.3 Scrambling Types

Modulation Type	FEC or Framing	Scrambling
EFD Closed, CSC Closed	Sequential	ITU V.35
EFD Closed, CSC Closed, FDC Closed	Viterbi	ITU V.35 Intelsat Modified
EFD Closed	Viterbi/RS Concatenated	EFD Modified V.35
EFD Closed	Turbo	2^{12-1} Synchronous
FDC Closed	Sequential	FDC Modified V.35

D.3.4 Differential Encoder

The differential encoder (On or Off) takes care of one set of ambiguities due the error correction codes being transparent.

D.3.5 BPSK Bit Ordering

The encoder has the ability to select whether I is the first bit or Q is the first bit in the symbol word grouping for compatibility with any system. For standard operation Q is the first bit.

- Viterbi (Standard/Non-Standard)
- Sequential (Standard/Non-Standard)

D.3.6 Interleaver (Reed-Solomon Codec)

- QPSK - Depth 4 (IBS, IDR, D&I)
- 8PSK - Depth 4 (No Overhead, IBS, D&I) (IESS-310)
- Depth 8 (Closed Network, Async)
- 8PSK - Depth 8 (IDR) (IESS-310)

D.3.7 Transmit Frequency (IF)

The range of the output IF spectrum can be selected by the operator from 50 to 180 MHz, in 1 Hz steps.

D.3.8 Frequency Reference

SCT, RX Bit Clock, and IF output are locked to the Frequency Reference.

Frequency Reference	Remarks
Internal (Standard	Stability over the operating temperature range = ± 10 PPM.
Internal High Stability (Optional)	Stability over the operating temperature range = ± 0.2 PPM.
External Reference Input (Standard)	The External frequency reference connector is located on the back panel. This allows Frequency Reference to be locked to an external reference frequency standard. Impedance 75Ω Frequency 1, 5, 10 or 20 MHz Amplitude ≥ +0 dBm < +20 dBm DC offset Capacitively coupled Connector BNC
Reference Frequency Output (Optional)	The External frequency reference connector can be used as an output when the High Stability option is installed. When selected from the front panel, this output can be used to lock other equipment to the Internal High Stability Reference of the selected modem. The output is 10 MHz, the level is +10 dBm ± 5 dBm.

D.3.9 Transmit Frequency Change Time

The time between the end of a remote command and the end of the modem reply for frequency change and synthesizer lock will be < 500 mS.

D.3.10 Phase Noise

1. The phase noise of the transmit IF output carrier is no worse than:

dBc/Hz	Distance from Carrier
-66.0	100 Hz
-76.0	1 kHz
-86.0	10 kHz
-96.0	100 kHz
-96.0	1 MHz

2. Fundamental AC line spurious is -42 dBc or lower.

3. The sum of all the single sideband spurious, from 0 to 0.75 x symbol rate, is -42 dBc or lower.

D.3.11 Transmit IF Output Switch

When set to Off, no signal present at the output is greater than -60 dBm, measured in a 3 kHz bandwidth from 0 to 500 MHz.

D.3.12 Transmit IF Power

The TX IF power is operator selectable from -5 to -30 dBm, in 0.1 dB steps, with an accuracy of ± 0.5 dB. The maximum drift due to temperature change over the specified range is ± 0.5 dB.

As an option the output can be selectable from +5 to -20 dBm, in 0.1 dB steps, with an accuracy of ± 0.5 dB. The maximum drift due to temperature change over the specified range is ± 0.5 dB.

D.3.13 Modulator Power Offset

An offset to the displayed IF output power may be entered from -99.0 to +99.0 dB, in 0.1 dB steps.

D.3.14 Modulated IF Output Shape

The modem meets the following transmit output spectral mask specifications. The desired mask is selectable from the front panel or remotely.

- INTELSAT/EUTELSAT
- Closed net (Comtech EF Data and Comstream)
- Closed net (Fairchild compatible)
- Closed net (SDM-51, SDM-52)

D.3.15 Spurious Emissions

Spurious emissions are measured relative to the power of the modulated carrier. The measurement is done with the carrier on in continuous mode and modulated by the correct data/clock signal. Spurious emissions measured in a 3 kHz bandwidth at the transmit IF output are:

0 to 500 MHz (-5 to -30 dBm)	-55 dBc
0 to 500 MHz (+5 to -20 dBm > 64 kbps)	-50 dBc
0 to 500 MHz (+5 to -20 dBm < 64 kbps)	-45 dBc

D.3.16 Modulator Phase Error

The modulator has less than 2° of phase error

D.3.17 Transmit IF Test Modes

Select from the following TX IF test modes. Spurious emissions in the following test modes will be ≤ -30 dBc.

CW	Outputs a single carrier at the defined frequency
Offset	Dual sideband signal with lower sideband and carrier suppressed ≤ -35 dBc (≤ -30 dBc for 8PSK only)
Dual sideband	Suppressed carrier ≤ -35 dBc (≤ -30 dBc for 8PSK only)

D.3.18 Modulator Spectrum Rotation

Select Normal or Inverted spectrum of the of the Modulator Output.

D.3.19 Encoding

D.3.19.1 BPSK Encoding

The modulator converts transmitted baseband data into a modulated BPSK carrier. Using vector analysis of the constellation pattern, BPSK represents one symbol with the carrier phase either at 0° or 180°. The encoding characteristics for BPSK are provided in the following table.

Code Rate	Symbols/Bit	Bits/Hz
1/2	2	0.5
5/16	3.2	0.3125
21/44	2.1	0.477

D.3.19.2 QPSK Encoding

The modulator converts transmitted baseband data into a modulated QPSK carrier at the following parameters:

- 4.8 kbps to 2.5 Mbps (1/2 rate)
- 7.2 kbps to 3.75 Mbps (3/4 rate)
- 8.4 kbps to 4.375 Mbps (7/8 rate)

Using vector analysis of the constellation pattern, QPSK represents a symbol with the carrier phase angle at 45°, 135°, 225°, or 315°. The 1/2, 3/4, and 7/8 rates encoded provide the desired input/output bit rates.

Code Rate	Symbols/Bit	Bits/Hz
1/2	2	1
3/4	1.5	1.33
7/8	1.143	1.75

D.3.19.3 OQPSK Encoding

The modulator PCB converts the transmitted baseband data into a modulated OQPSK carrier within the same parameters as QPSK.

The OQPSK modulation is mainly different from QPSK by offsetting the I and Q channel modulation signals. This offset prevents the RF envelope from going through zero. Under certain conditions, this may allow less back-off in the High Power Amplifier (HPA) system. The 1/1, 1/2, 3/4, and 7/8 rates encoded provide the desired input/output bit rates.

Code Rate	Symbols/Bit	Bits/Hz
1/1	1	2
1/2	2	1
3/4	1.333	1.5
7/8	1.143	1.75

D.3.19.4 8PSK Encoding

The modulator converts transmitted baseband data into modulated 8PSK carrier at the following parameters:

Using vector analysis of the constellation pattern, 8PSK represents a symbol with carrier phase angles at 22.5°, 67.5°, 112.5°, 157.5°, 202.5°, 247.5°, 292.5°, and 337.5°. The rate encoding provides the desired input/output bit rates.

Code Rate	Symbol/Bit	Bits/Hz
2/3	1.5	2
3/4	1.333	2.25

D.4 Demodulator Specifications

D.4.1 Digital Data Rate

The digital data rate is selectable in 1 bps steps. The modem automatically calculates and sets the symbol rate. Data rates entered that exceed the data rate or symbol rate specification are rejected at entry. The symbol rate range is 4.8 kHz to 2.5 MHz.

Table C-3. Demodulator Digital Data Rated

Modulation Type	Decoding Type	Data Rate Range	
BPSK 1/2	Viterbi	2.4 kbps	1.25 Mbps
QPSK 1/2	Viterbi	4.8 kbps	2.5 Mbps
QPSK 3/4	Viterbi	7.2 kbps	3.75 Mbps
QPSK 7/8	Viterbi	8.4 kbps	4.375 Mbps
OQPSK 1/2	Viterbi	4.8 kbps	2.5 Mbps
OQPSK 3/4	Viterbi	7.2 kbps	3.75 Mbps
OQPSK 7/8	Viterbi	8.4 kbps	4.375 Mbps
8PSK 2/3	Viterbi	512 kbps	5.0 Mbps
BPSK 1/2	Sequential	2.4 kbps	1.25 Mbps
QPSK 1/2	Sequential	4.8 kbps	2.5 Mbps
QPSK 3/4	Sequential	7.2 kbps	3.75 Mbps
QPSK 7/8	Sequential	8.4 kbps	4.375 Mbps
BPSK 5/16	Turbo	2.4 kbps	781.25 kbps
BPSK 21/44	Turbo	2.4 kbps	1193 kbps
QPSK 3/4	Turbo	7.2 kbps	3750 kbps
OQPSK 3/4	Turbo	7.2 kbps	3750 kbps
8PSK 3/4	Turbo	384 kbps	5.0 Mbps
BPSK 1/2	Viterbi and Reed-Solomon	2.4 kbps	1.138 Mbps
QPSK 1/2	Viterbi and Reed-Solomon	4.8 kbps	2.277 Mbps
QPSK 3/4	Viterbi and Reed-Solomon	7.2 kbps	3.416 Mbps
QPSK 7/8	Viterbi and Reed-Solomon	8.4 kbps	3.986 Mbps
OQPSK 1/2	Viterbi and Reed-Solomon	4.8 kbps	2.277 Mbps
OQPSK 3/4	Viterbi and Reed-Solomon	7.2 kbps	3.416 Mbps
OQPSK 7/8	Viterbi and Reed-Solomon	8.4 kbps	3.986 Mbps
8PSK 2/3	Trellis and Reed-Solomon	512 kbps	4.555 Mbps
BPSK 1/2	Sequential and Reed-Solomon	2.4 kbps	1.138 Mbps
QPSK 1/2	Sequential and Reed-Solomon	4.8 kbps	2.277 Mbps
QPSK 3/4	Sequential and Reed-Solomon	7.2 kbps	3.416 Mbps
QPSK 7/8	Sequential and Reed-Solomon	8.4 kbps	3.986 Mbps
OQPSK 1/2	Sequential and Reed-Solomon	4.8 kbps	2.277 Mbps
OQPSK 3/4	Sequential and Reed-Solomon	7.2 kbps	3.416 Mbps
OQPSK 7/8	Sequential and Reed-Solomon	8.4 kbps	3.986 Mbps

D.4.2 Demodulation and FEC Decoding Types

Table D-4 shows combinations of demodulation and forward error correction decoding.

Table D-4. Demodulation FEC Decoding

Decoder	Code Rate	Modulation
Viterbi, K7	1/2	BPSK
Viterbi, K7 Reed-Solomon	1/2 225/205 Closed	BPSK
Viterbi, K7	1/2, 3/4, 7/8	QPSK, OQPSK
Viterbi, K7, TCM	2/3	8PSK
Viterbi, K7 Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed or IDR T1, 126/112 IBS and D&I, 219/201 IDR E1	QPSK, OQPSK
Viterbi, K7, TCM Reed-Solomon EFD Compatible	2/3 225/205 Closed or IDR T1, 126/112 IBS and D&I, 219/201 IDR E1	8PSK
Viterbi, K7, TCM Reed-Solomon IESS-310 Compatible	2/3 219/201 [4] No Overhead, 219/201 [4] IBS and D&I, 219/201 [8] IDR T1/E1	8PSK
Sequential	1/2	BPSK
Sequential Reed-Solomon	1/2 225/205 Closed	BPSK
Sequential	1/2, 3/4, 7/8	QPSK, OQPSK
Sequential Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK, OQPSK QPSK, OQPSK
Turbo	5/16	BPSK
Turbo	21/44	BPSK
Turbo	3/4	QPSK, OQPSK, 8PSK
Uncoded	1/1	BPSK, QPSK, OQPSK

D.4.3 Descrambling Types

The operator can select one of the following descrambling types:

Demodulator Type	FEC or Framing	Scrambling
EFD Closed, CSC Closed	Sequential	ITU V.35
EFD Closed, CSC Closed, FDC Closed	Viterbi	ITU V.35 Intelsat Modified
EFD Closed	Viterbi/RS Concatenated	EFD Modified V.35
EFD Closed	Turbo	2^{12-1} Synchronous
FDC Closed	Sequential	FDC Modified V.35

D.4.4 Differential Decoder

The differential decoder takes care of one set of ambiguities due the error correction codes being transparent.

- On or Off

D.4.5 BPSK Bit Ordering

The decoder has the ability to select whether I is the first bit or Q is the first bit in the symbol word grouping for compatibility with any system. For standard mode Q is the first bit.

- Viterbi (Standard/Non-Standard)
- Sequential (Standard/Non-Standard)

D.4.6 Decoding

D.4.6.1 BPSK Decoding

Using vector analysis of the constellation pattern, BPSK represents one symbol with the carrier phase either at 0° or 180°. The characteristics for BPSK are provided in the following table.

Code Rate	Symbols/Bit	Bits/Hz
1/2	2	0.5
5/16	3.2	0.3125
21/44	2.1	0.477

D.4.6.2 QPSK Decoding

The demodulator converts transmitted baseband data into a modulated QPSK carrier at the following parameters:

- 4.8 kbps to 2.5 Mbps (1/2 rate)
- 7.2 kbps to 3.75 Mbps (3/4 rate)
- 8.4 kbps to 4.375 Mbps (7/8 rate)

Using vector analysis of the constellation pattern, QPSK represents a symbol with the carrier phase angle at 45°, 135°, 225°, or 315°. The 1/2, 3/4, and 7/8 rates provide the desired input/output bit rates.

Code Rate	Symbols/Bit	Bits/Hz
1/2	2	1
3/4	1.5	1.33
7/8	1.143	1.75

D.4.6.3 OQPSK Decoding (Optional)

The demodulator PCB converts the transmitted baseband data into a modulated OQPSK carrier within the same parameters as QPSK.

The OQPSK modulation is mainly different from QPSK by offsetting the I and Q channel modulation signals. This offset prevents the RF envelope from going through zero. Under certain conditions, this may allow less back-off in the High Power Amplifier (HPA) system. The 1/1, 1/2, 3/4, and 7/8 rates encoded provide the desired input/output bit rates.

Code Rate	Symbols/Bit	Bits/Hz
1/1	1	2
1/2	2	1
3/4	1.333	1.5
7/8	1.143	1.75

D.4.6.4 8PSK Decoding

The demodulator converts transmitted baseband data into modulated 8PSK carrier at the following parameters:

Code Rate	Symbol/Bit	Bits/Hz
2/3	1.5	2
3/4	1.333	2.25

D.4.7 Deinterleaver (Reed-Solomon Codec)

- QPSK - Depth 4 (IBS, IDR, D&I)
- 8PSK - Depth 4 (No Overhead, IBS, D&I)
- Depth 8 (Closed Network, ASYNC)
- 8PSK - Depth 8 (IDR)

D.4.8 Demodulator Spectrum Rotation

Select Normal or Inverted spectrum for the Demodulator Input.

D.4.9 Receive Frequency (IF)

- The range of the input IF spectrum can be selected by the operator from 50 to 180 MHz, in 1 Hz steps.

- The actual value of offset from the programmed frequency is available to the operator on the front panel as well as the remote port. The resolution of this value is 1 Hz. Monitor accuracy is ± 10 PPM.

D.4.10 Receive Input Power (Desired Carrier)

The modem can meet the specified BER and automatically adjust to a RX IF input power of -30 to -55 dBm. Monitor accuracy is ± 2.5 dB.

D.4.11 Receive Input Power (Composite)

The modem can operate to its specified performance under all the following conditions:

- The sum of all carriers is ≤ -5 dBm.
- The sum of all carriers within 10 MHz from the desired is ≤ +30 dBc.
- The sum of all carriers is ≤ +40 dBc.

D.4.12 IF Input Overload

The modem will not be damaged by a continuous RX IF input of +20 dBm.

D.4.13 Demodulator IF Input Shape

The modem can be set to match any of the following spectral mask specifications.

- INTELSAT/EUTELSAT
- Closed net (Comtech EF Data and Comstream)
- Closed net (Fairchild compatible)
- Closed net (SDM-51/SDM-52)

D.4.14 Channel Spacing/Adjacent Carrier Performance

The modem bit error performance will be degraded ≤ 0.5 dB with the following receive IF signal:

- Two like-modulated carriers spaced 1.3 times the symbol rate from the receive frequency, and/or 1.2 times the acquisition range, whichever is larger.

- Each adjacent carrier up to 10 dBc higher in power than the desired carrier.

- A single adjacent carrier spaced 1.4 times the symbol rate, up to +20 dBc.

D.5 BER Performance Specifications

Table D-5 lists referenced tables that reflect the Bit Energy-to-Noise Ratio (E_b/N_0) required to achieve 10^{-3} to 10^{-10} BER.

Table D-5. BER Performance Reference Tables

Table	Option
Table D-6	Viterbi Decoder with Open Network BER Data
Table D-7	Viterbi Decoder with Closed Network BER Data
Table D-8	Viterbi Decoder with Reed-Solomon (Optional)
Table D-9	Sequential Decoder (56 kbps) (Optional)
Table D-10	Sequential Decoder (1544 kbps) (Optional)
Table D-11	Sequential Decoder with Reed-Solomon (1544 kbps) (Optional)
Table D-12	8PSK With/Without Reed-Solomon
Table D-13	Viterbi Decoder and OQPSK
Table D-14	Uncoded (1/1) BPSK, QPSK, and OQPSK

D.5.1 Performance with Noise, Viterbi Decoder, and Open Network Mode

Refer to Figure C-1 for the Viterbi BER curves.

Table D-6 lists the Viterbi specifications for the E_b/N_0 required to achieve 10^{-3} to 10^{-8} BER for different coding configurations. All values are for operating in QPSK mode. Without coding, the modem provides QPSK operation within 0.8 dB of theoretical for BER in the range 10^{-1} to 10^{-6}. Performance measurements were recorded with transmit and receive IF connected back-to-back through an additive white Gaussian noise channel.

Table D-6. Viterbi Decoder with Open Network BER Data

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
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
10^{-7}	6.7	8.2	9.2
10^{-8}	7.2	8.8	9.9

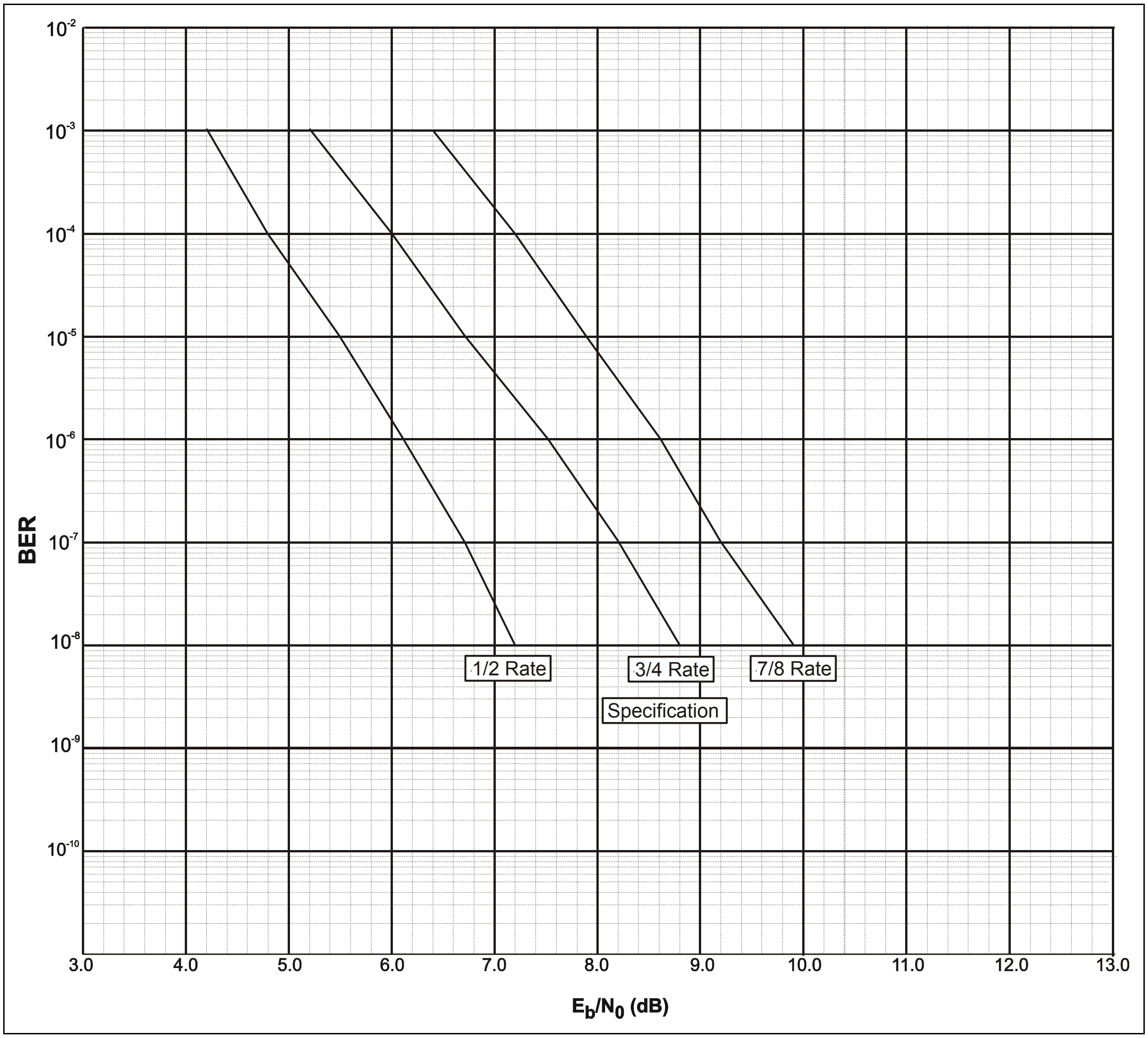


Figure C-1. Viterbi BER Performance Curves

D.5.2 Performance with Noise, Viterbi Decoder, and Closed Network

Refer to Figure D-2 for the Viterbi with Closed Network BER curves.

Table D-7 lists the Viterbi with Closed Network specifications for the E_b/N_0 required to achieve 10^{-5} to 10^{-10} BER for different configurations.

Table D-7. Viterbi Decoder with Closed Network BER Data

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-3}	3.8	4.9	6.1
10^{-4}	4.6	5.7	6.9
10^{-5}	5.3	6.4	7.6
10^{-6}	6.0	7.2	8.3
10^{-7}	6.6	7.9	8.9
10^{-8}	7.2	8.5	9.6

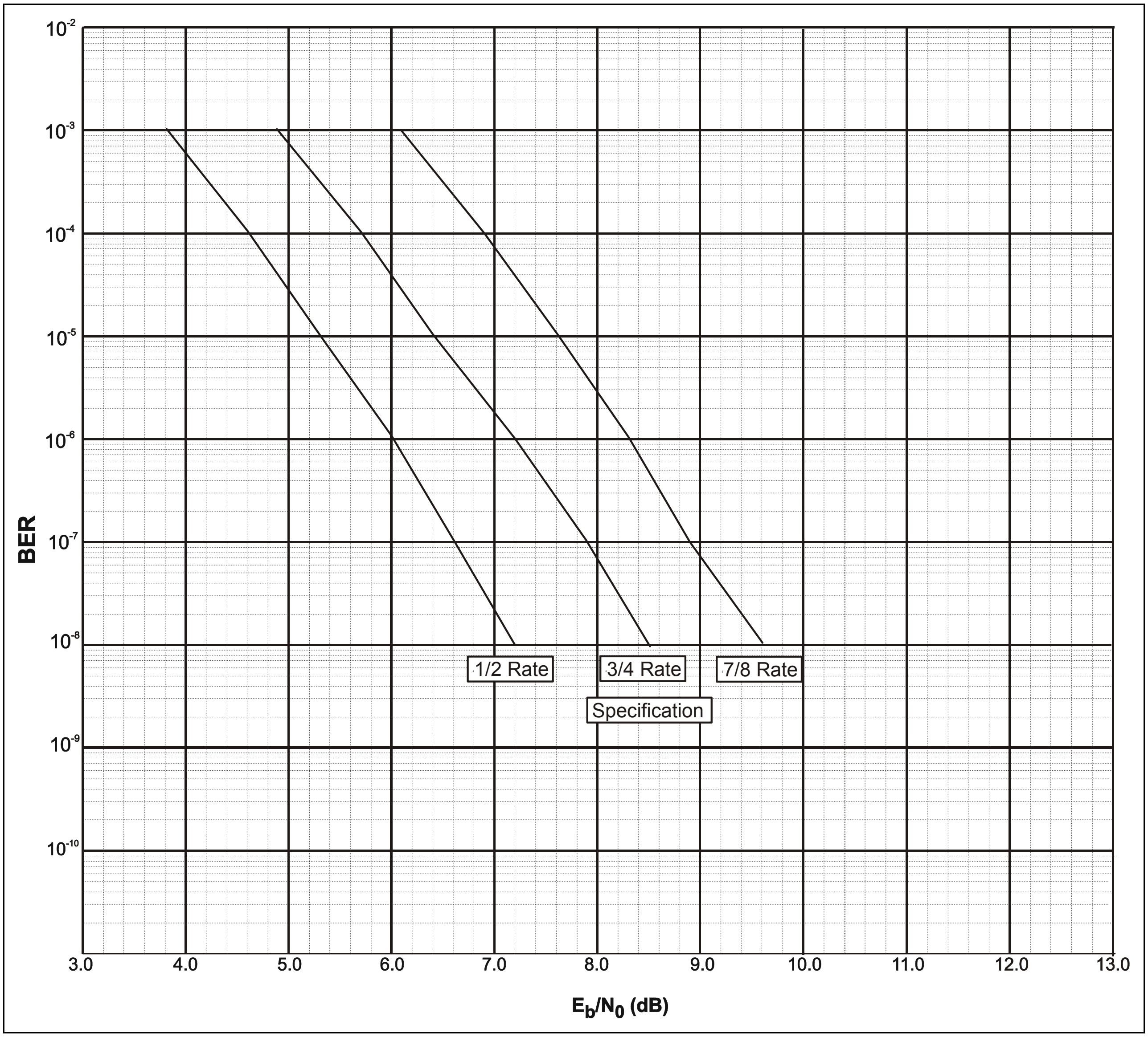


Figure D-2. Viterbi with Closed Network BER Performance Curves

D.5.3 Performance with Noise, Viterbi Decoder, and Reed-Solomon (Optional)

Refer to Figure D-3 for the Viterbi decoder with Reed-Solomon BER curves.

Table D-8 lists the Viterbi decoder with Reed-Solomon specifications for the E_b/N_0 required to achieve 10^{-6} to 10^{-10} BER for different configurations.

Table D-8. Viterbi Decoder with Reed-Solomon

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-6}	4.1	5.6	6.7
10^{-7}	4.2	5.8	6.9
10^{-8}	4.4	6.0	7.1
10^{-10}	5.0	6.3	7.5

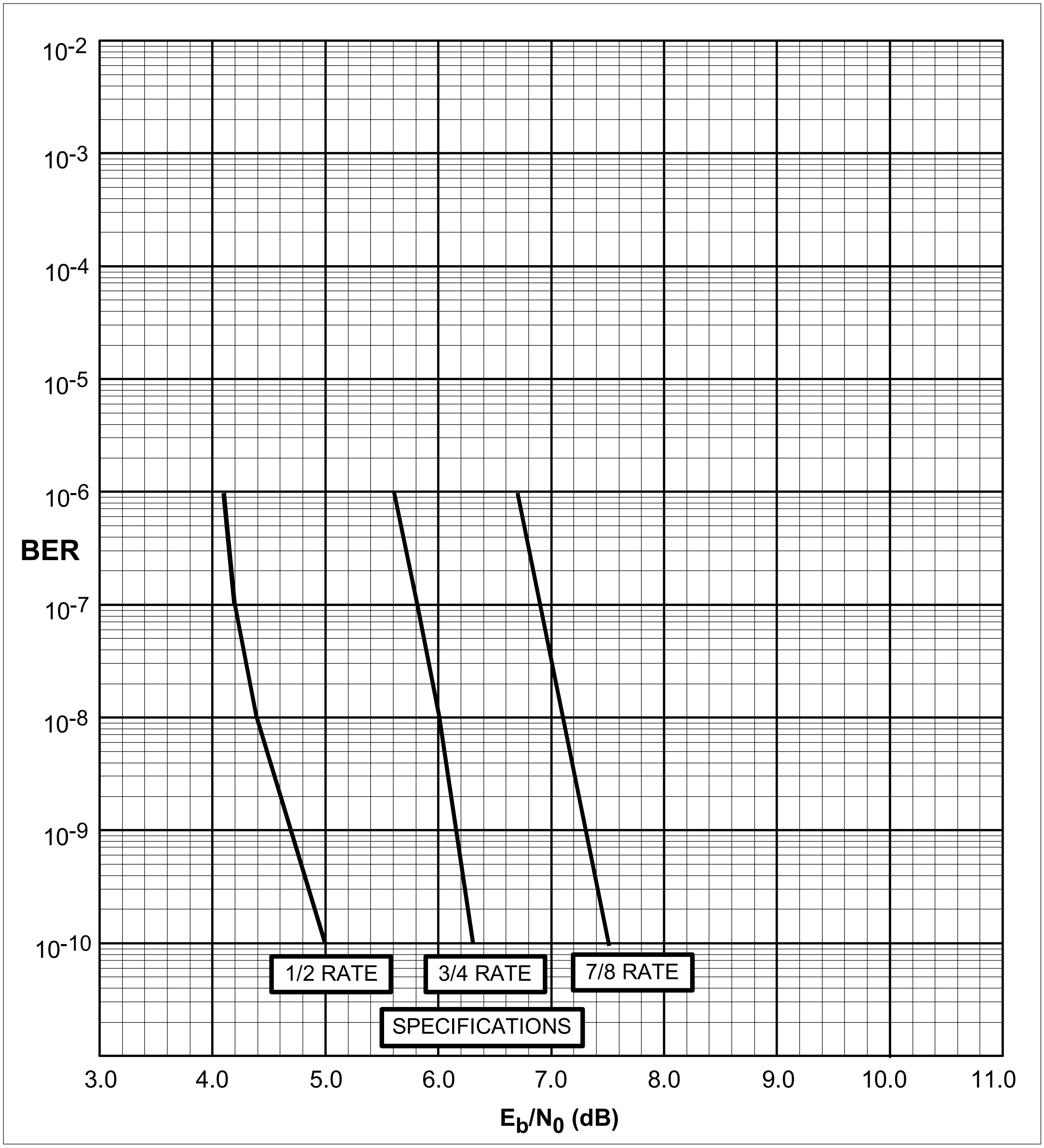


Figure D-3. Noise, Viterbi, and Reed-Solomon (Optional) BER Performance Curves

D.5.4 Performance with Noise, 56 kbps and Sequential Decoder (Optional)

Refer to Figure D-4 for the sequential BER curves.

Table D-9 lists the sequential specifications for the E_b/N_0 required to achieve 10^{-3} to 10^{-8} BER at 56 kbps. All values are for operating in BPSK and QPSK modes.

Table D-9. Sequential BER Data (56 kbps)

E_b/N_0 (dB) Specification			
BER	1/2 Rate	3/4 Rate	7/8 Rate
10^{-3}		4.6	5.5
10^{-4}	4.1	5.1	6.1
10^{-5}	4.5	5.5	6.6
10^{-6}	5.0	5.9	7.3
10^{-7}	5.4	6.4	7.8
10^{-8}	5.8	6.8	8.4

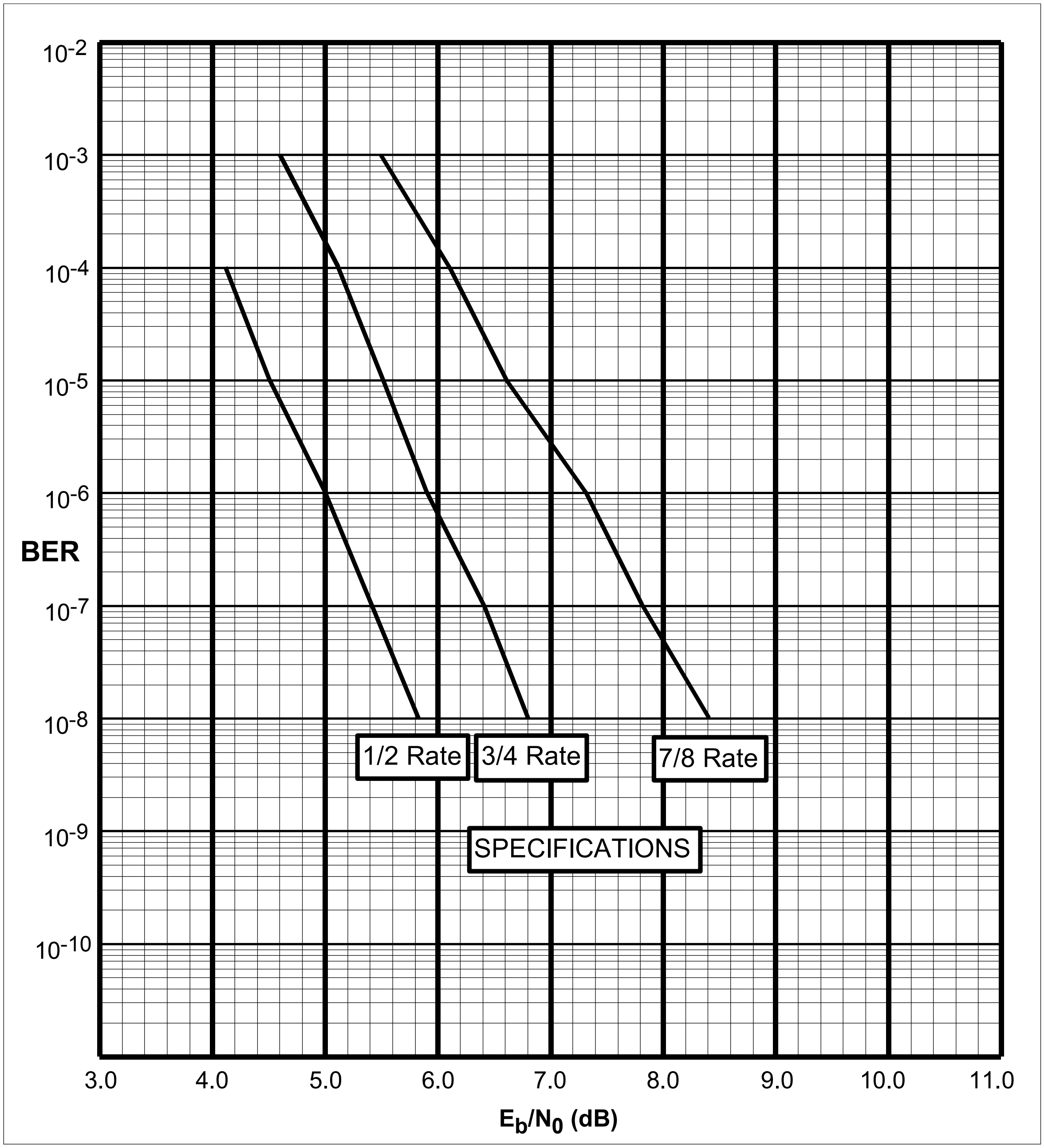


Figure D-4. Sequential BER Performance Curves (56 kbps)

D.5.5 Performance with Noise, 1544 kbps and Sequential Decoder (Optional)

Refer to Figure D-5 for the Sequential BER curves.

Table D-10 lists the sequential specifications for the E_b/N_0 required to achieve 10^{-3} to 10^{-8} BER at 1544 kbps. All values are for operating in BPSK and QPSK modes.

Table D-10. Sequential Decoder BER Data (1544 kbps)

E_b/N_0 (dB) Specification			
BER	1/2 Rate	3/4 Rate	7/8 Rate
10^{-3}	4.8	5.2	6.0
10^{-4}	5.2	5.7	6.4
10^{-5}	5.6	6.1	6.9
10^{-6}	5.9	6.5	7.4
10^{-7}	6.3	7.0	7.9
10^{-8}	6.7	7.4	8.4

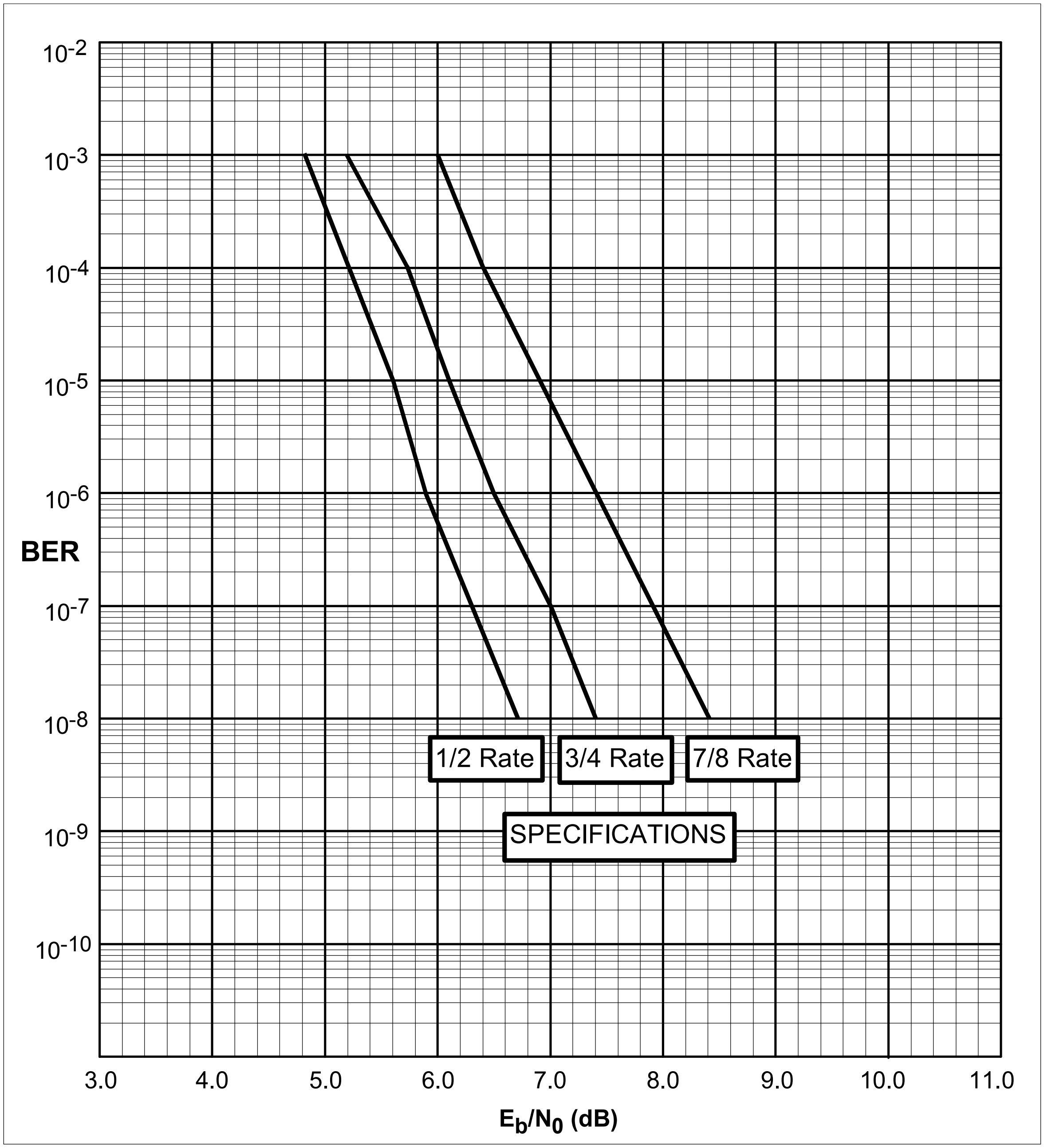


Figure D-5. Sequential Decoder BER Performance Curves (1544 kbps)

D.5.6 Performance with Noise at 1544 kbps, Sequential Decoder, and Reed-Solomon (Optional)

Refer to Figure C-6 for the Sequential BER curves.

Table D-11 lists the sequential specifications for the E_b/N_0 required to achieve 10^{-3} to 10^{-8} BER at 1544 kbps. All values are for operating in BPSK and QPSK modes.

Table D-11. Sequential Decoder BER Curves (Reed-Solomon)

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-6}	4.1	5.6	6.7
10^{-7}	4.2	5.8	6.9
10^{-8}	4.4	6.0	7.1
10^{-10}	5.0	6.3	7.5

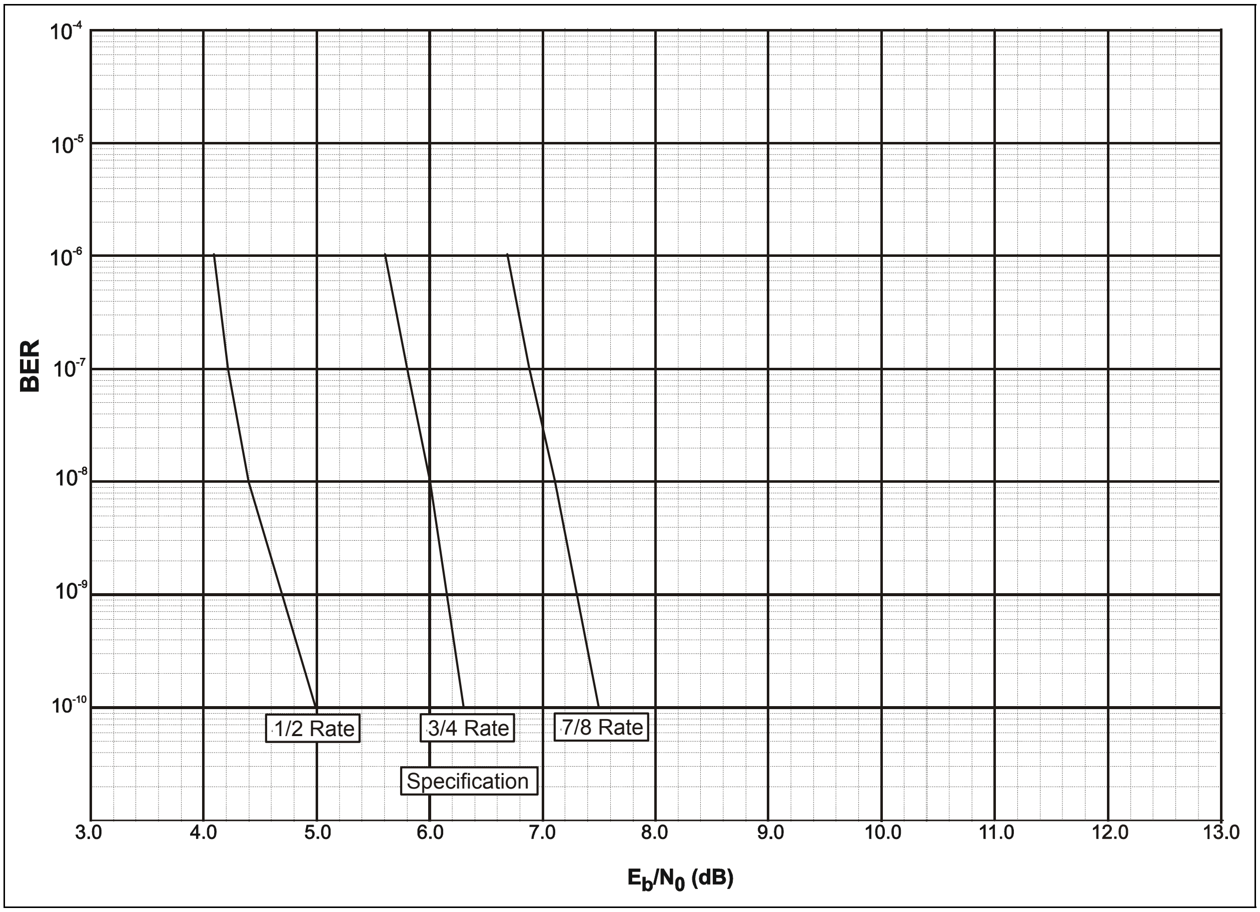


Figure D-6. Sequential BER Curves at 1544 kbps and Reed-Solomon

D.5.7 8PSK Performance with Noise and With/Without Reed-Solomon

Refer to Figure D-7 for the 8PSK curves.

Table D-12 lists the 8PSK specification for performance with noise and with/without Reed-Solomon. All values are for operating in 8PSK mode.

Table D-12. 8PSK Specification

E_b/N_0 (dB) Specification		
BER	2/3 Rate without Reed-Solomon	2/3 Rate with Reed-Solomon
10^{-6}	8.7	6.1
10^{-7}	9.5	6.4
10^{-8}	10.2	6.6
10^{-9}	11	6.9
10^{-10}	11.8	7.2

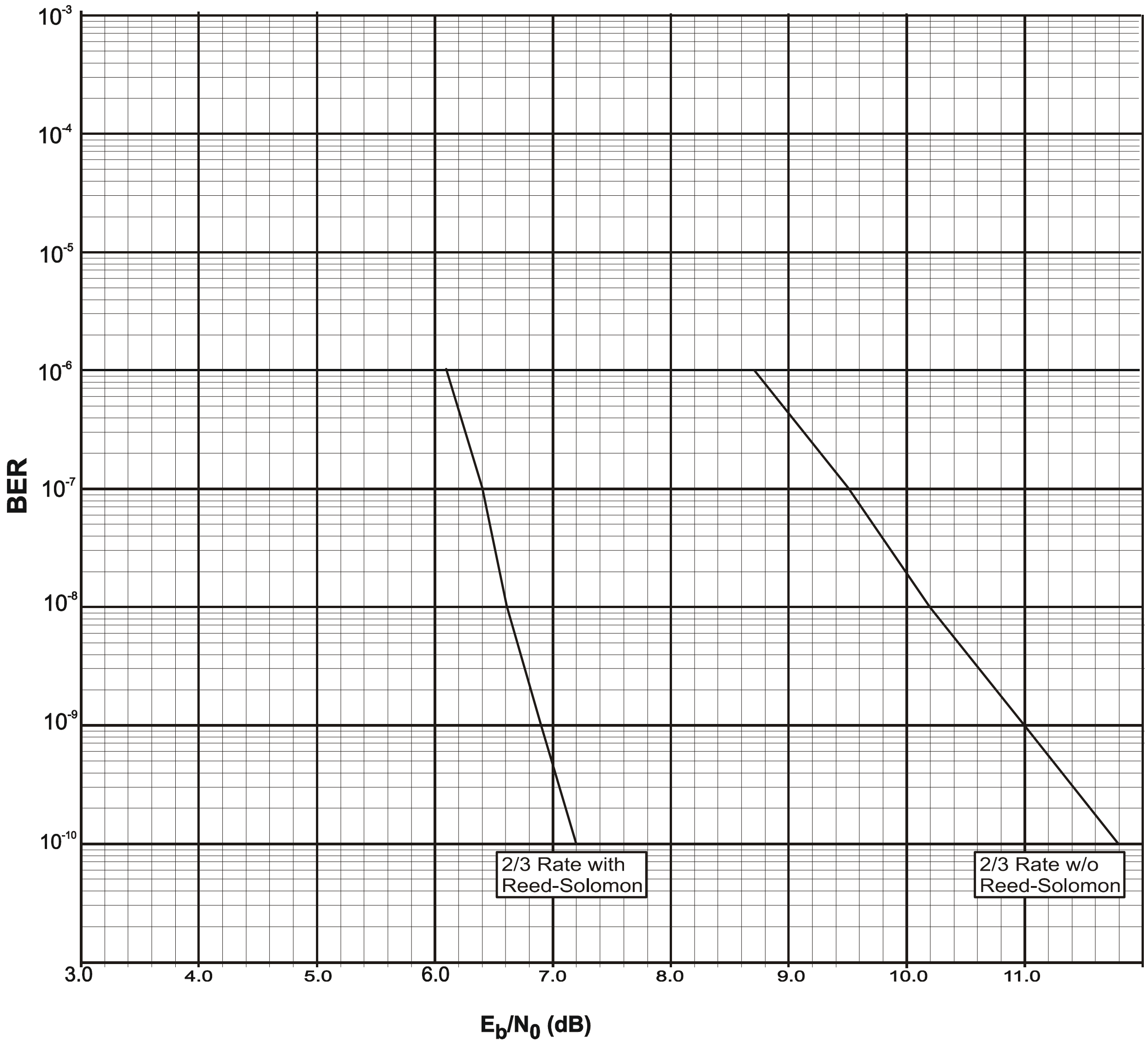


Figure D-7. 8PSK BER Specification Curves (1544 kbps)

D.5.8 Performance with Noise, Viterbi Decoder, and OQPSK

Table D-13 lists the Viterbi and OQPSK specifications for the E_b/N_0 required to achieve 10^{-3} to 10^{-8} BER for different configurations.

Table D-13. Viterbi Decoder and OQPSK

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-3}	4.1	5.2	6.4
10^{-4}	4.9	6.0	7.2
10^{-5}	5.6	6.7	7.9
10^{-6}	6.3	7.5	8.6
10^{-7}	6.9	8.2	9.2
10^{-8}	7.5	8.8	9.9

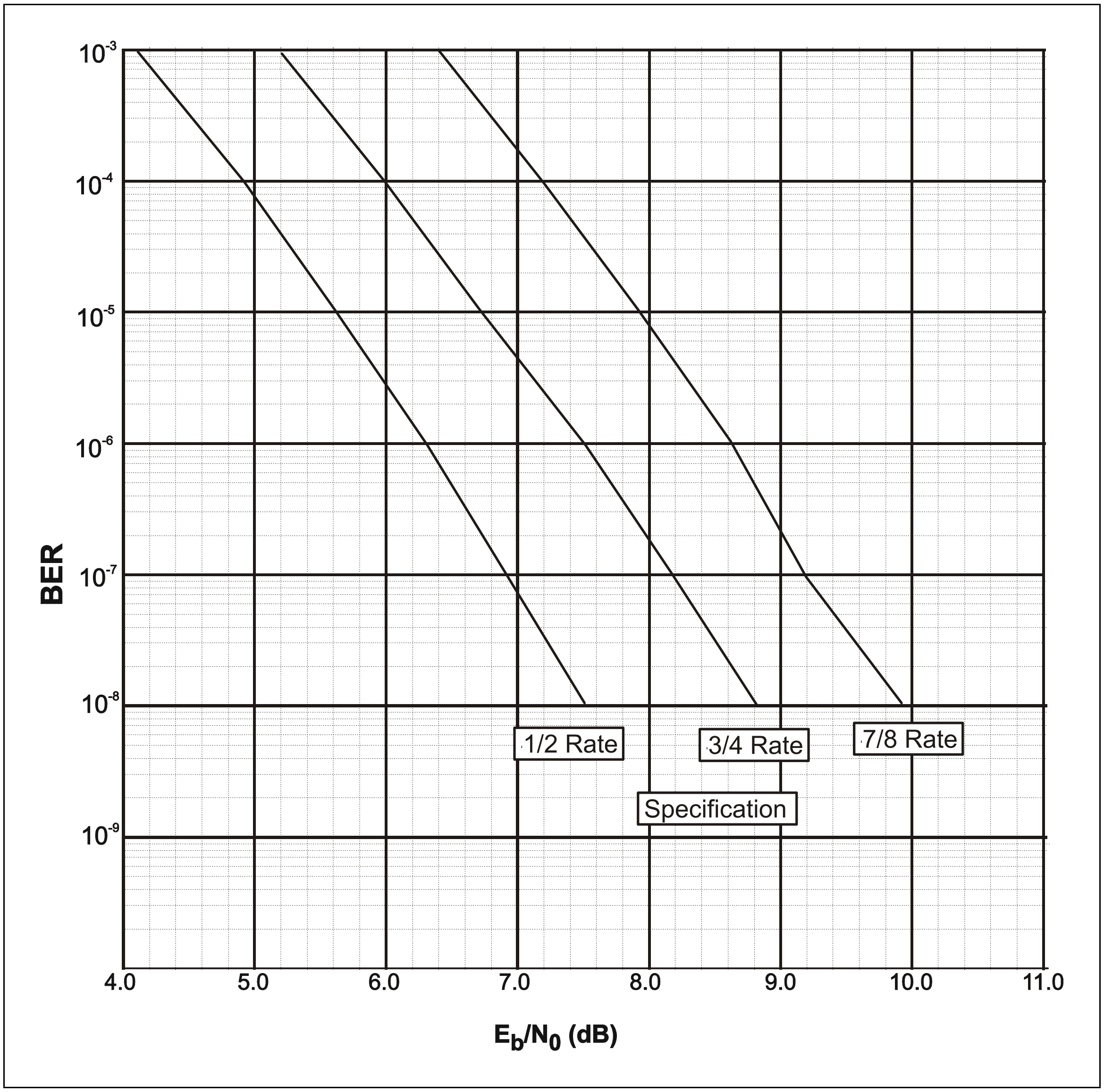


Figure D-8. Viterbi Decoder and OQPSK

D.5.9 Performance with Noise, Uncoded (1/1) BPSK, QPSK, and OQPSK

Table D-14 shows uncoded BPSK with scrambler/desrambler Off. Encoded QPSK and OQPSK with scrambler/descrambler and differential encoder/decoder Off.

Table D-14. Uncoded (1/1) BPSK, QPSK, and OQPSK

E_b/N_0 (dB) Specification	
BER	**1/1**
10^{-3}	8.0
10^{-4}	9.6
10^{-5}	10.8
10^{-6}	11.6
10^{-7}	12.4

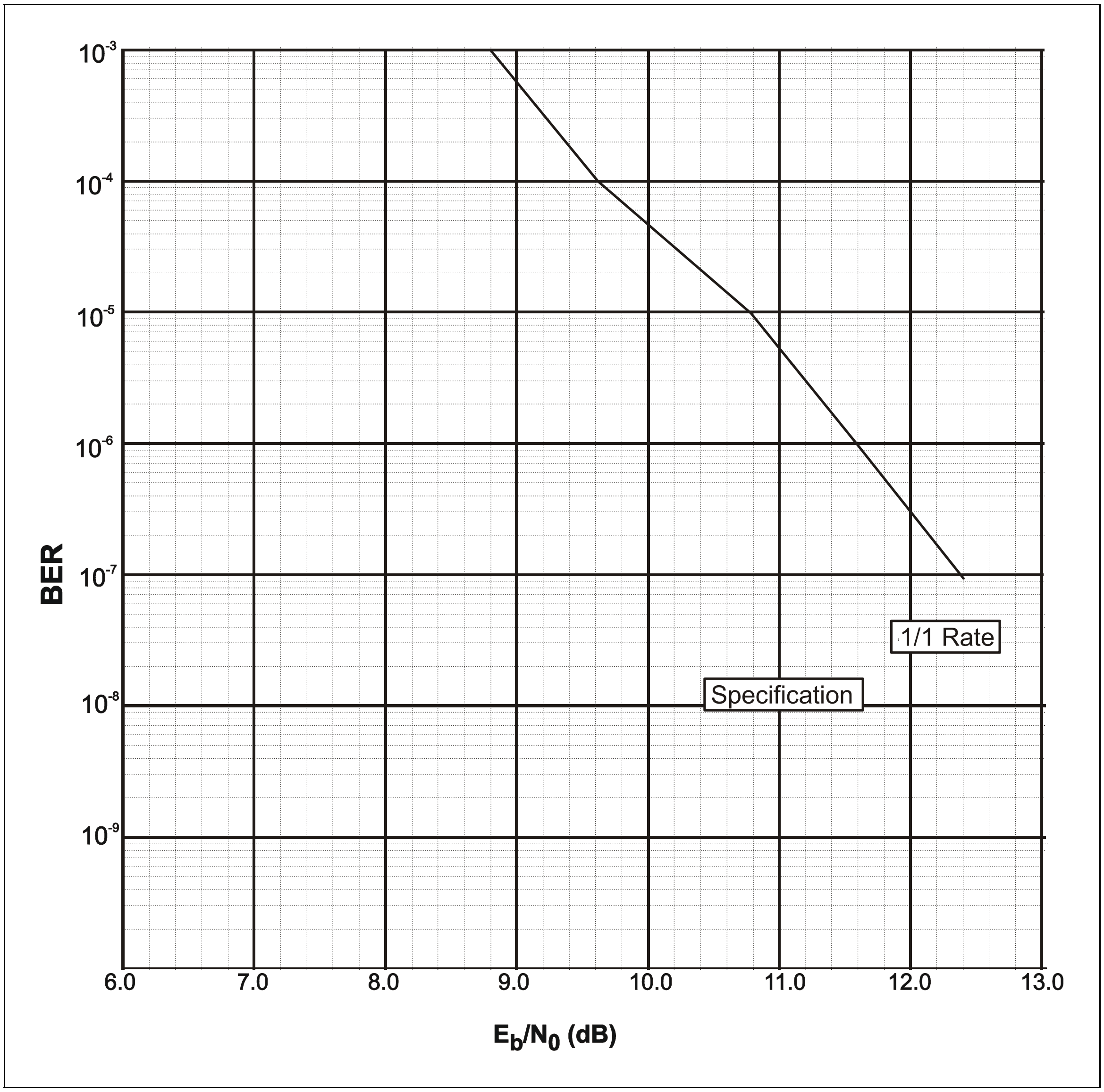


Figure D-9. Uncoded (1/1) BPSK, QPSK, and OQPSK

D.5.9.1 Performance with Noise Turbo Product Codec (Optional)

	QPSK	BPSK		8PSK
BER	3/4 Rate	21/44 Rate	5/16 Rate	3/4 rate
10^{-6}	3.9	2.8	*see Note*	7.0
10^{-7}	4.1	3.1	*see Note*	7.3
10^{-8}	4.3	3.3	*see Note*	7.6
10^{-9}	4.8	3.7	4.0	8.0

Note: 5/16 BPSK is included for compatibility with other equipment but implementation limitations prohibit optimum performance at low Eb/No. Performance is virtually error free above 4 dB Eb/No. Performance below 4dB Eb/No is not guaranteed.

D.5.9.2 Performance with Noise, 1544 kbps Sequential Decoder, and Reed-Solomon (Optional)

Eb/No (dB) Specification			
BER	1/2 Rate	3/4 Rate	7/8 Rate
10-6	4.1	5.6	6.7
10-7	4.2	5.8	6.9
10-8	4.4	6.0	7.1
10-10	5.0	6.3	7.5

D.5.9.3 BER Threshold

The modem has a programmable BER threshold function. This allows the operator to set the threshold from 1.0 E-3 to 1.0 E-8.

D.6 Acquisition Time

Refer to Table D-15 for acquisition time.

Table D-15. Acquisition Time

Viterbi 6 dB E_b/N_0 with ± 35 kHz Frequency Uncertainty			
Code Rate	**Data Rate**	**T_{acq}**	**$P(t < T_{acq})$**
1/2	< 9.6 kbps	< 10 sec	95%
1/2	≥ 9.6 < 64 kbps	< 5 sec	95%
1/2	≥ 64 < 190 kbps	< 1 sec	95%
1/2	≥ 190 < 512 kbps	< 10 sec	95%
1/2	≥ 512 < 1000 kbps	< 2.5 sec	95%
1/2	≥ 1 < 2.5 Mbps	< 1 sec	95%
Sequential 6 dB E_b/N_0 with ± 35 kHz Frequency Uncertainty			
Code Rate	**Data Rate**	**T_{acq}**	**$P(t < T_{acq})$**
1/2	2.4 < 4.8 kbps	< 20 sec	95%
1/2	≥ 4.8 < 9.6 kbps	< 10 sec	95%
1/2	≥ 9.6 < 64 kbps	< 5 sec	95%
1/2	≥ 64 < 190 kbps	< 1 sec	95%
1/2	≥ 190 < 512 kbps	< 17 sec	95%
1/2	≥ 512 < 1000 kbps	< 2.5 sec	95%
1/2	≥ 1 < 2.5 Mbps	< 1 sec	95%

D.6.1 Receive IF Carrier Acquisition Range

The modem locks automatically to a correctly formatted carrier, which is within ± 35 kHz of the displayed receive frequency. The operator can adjust the following:

Acquisition Range	0 to 70 kHz (in 1 Hz steps)
Center of the Acquisition Range	-35 to +35 kHz (in 1 Hz steps)

D.6.2 Receive IF Carrier Reacquisition

The modem is programmed to delay the acquisition process upon loss of lock. This will miniminize the acquisition time for a brief loss of the carrier. This delay can be programmed from 0 to 999 seconds in 1-second steps.

D.6.3 AGC Output

A programmable DC output, proportional to the receive signal level, is located on the rear panel at 10 mA maximum (0 to 10 volts).

Default Level	0 volts for –60 dBm 10 volts for –25 dBm
Low Level (0V)	Programmed from 0 to 10V in 0.5V increments.
High Level (10V)	Programmed from 0 to 10V in 0.5V increments.

D.7 Interface Specifications

D.7.1 Interface General

D.7.2 Transmit Clock Source

Select the TX clock from the following sources.

- Terrestrial: ± 100 PPM of the programmed rate, ≤ 5% jitter.
- SCT (internal): ± 10 PPM or SCT (with high stability option). ± 0.2 PPM.

D.7.3 Send Clock Timing Source

The send clock timing output can be generated from the Frequency Reference (either via the front panel or remotely).

- If loop timing is selected the send clock timing output can be:
    - The external clock input must be ± 100 PPM of the selected data rate.
    - The RX satellite clock, RX data rate must be ± 100 PPM of the TX data rate.
- If the Asymmetrical Loop Timing (ASLT) option is selected, either via the front panel or remotely, the send clock timing output can be referenced from:
    - The external clock input, (Master Clock), which can be any multiple of 8 kHz as long as it is ≥ 64 kHz ≤ 4.376 MHz or any multiple of 600 Hz as long as it is ≥ 2.4 kHz ≤ 64 kHz.
    - The RX clock which can be any multiple of 8 kHz as long as it is ≥ 64 kHz ≤ 4.376 MHz or any multiple of 600 Hz as long as it is ≥ 2.4 kHz ≤ 64 kHz.

D.7.3.1 Transmit Clock Switching Due to Failure of Selected Clock

The modem will automatically switch the TX clock source to SCT internal on failure of terminal timing.

D.7.3.2 Transmit Clock Phase Adjustment

The TX clock phase can be set by the operator to Normal, Inverted, or Auto mode.

D.7.3.3 Transmit Data Phase Adjustment

The TX data phase can be set by the operator to Normal or Inverted.

D.7.3.4 Transmit Data Stable Condition

Transmitted data to the Modulator will be held stable (all 1's) for the fault conditions shown in the Fault Tree, then set TX AIS.

D.7.3.5 Doppler/Plesiochronous Buffer Clock Source

The Doppler/Plesiochronous buffer clock reference can be selected by the operator from the following sources.

- The RX satellite clock (Bypass Mode).
- The TX terrestrial clock (TT). Must be within ± 100 PPM of the nominal receive data rate. Or it can be any multiple of 8 kHz as long as it is ≥ 64 kHz ≤ 4.376 MHz or any multiple of 600 Hz as long as it is ≥ 2.4 kHz ≤ 64 kHz.
- The external clock (Master Clock) input, must be within ± 100 PPM of the programmed value. Or it can be any multiple of 8 kHz as long as it is ≥ 64 kHz ≤ 4.376 MHz or any multiple of 600 Hz as long as it is ≥ 2.4 kHz ≤ 64 kHz.
- SCT/Internal, ± 10 PPM or (with high stability option), ± 0.2 PPM.

D.7.3.6 Receive Clock Switching Due to Failure of Selected Clock

The modem will automatically switch the RX clock source to RX satellite on failure of the selected clock.

D.7.3.7 Receive Clock Phase Adjustment

The RX clock phase can be set by the operator to Normal or Inverted.

D.7.3.8 Receive Clock Jitter

The RX clock will have less than 2% jitter.

D.7.3.9 Receive Data Phase Adjustment

The RX data phase can be set by the operator to Normal or Inverted.

D.7.3.10 Receive Data Stable Condition

Received data will be held stable (all 1's) at the output of the modem for the fault conditions listed in the Fault tree, then set RX AIS.

D.7.3.11 Receive Doppler/Plesiochronous Buffer Size

The RX Doppler buffer size can be set by the operator from:

- Bypass.
- 32 to 262,144 bits, in 16 bit steps.
- Selectable in ms, from 2 to 98 in 2 ms steps, based on the data rate.

D.7.3.12 Buffer Centering

The operator can set the buffer to 50% .The modem will automatically set the buffer to 50% after receive signal acquisition or a buffer overflow/underflow.

D.7.3.13 Switch Faults

Modulator Fault	Open collector output, 15V maximum, 20 mA maximum current sink, fault is open circuit.
Demodulator Fault	Open collector output, 15V maximum, 20 mA maximum current sink, fault is open circuit.

D.8 Terrestrial Interface Types

D.8.1 Universal

The following interface types are available through the EIA-530 25-pin data I/O connector.

- EIA-232
- V.35
- EIA-422, MIL-188-114A

Optional mechanical interfaces are also available. See Chapter 2 for pinout information.

- 37-pin D (EIA-449)
- 34-pin Block (V.35)

D.8.2 EIA-232 Specification

EIA-232 Specification	
Circuit Supported	TXD, TXC, ST, RXD, RXC, DSR, DCD, CTS, LL, RTS, MC
Driver Amplitude (RXD, RXC, ST, CTS, DM, DSR)	True: 10V, ± 5V False: -10V, ± 5V
Receiver Amplitude (TXD, TXC, RTS, LL, MC)	True: Minimum +1V False: Maximum -1V
Impedance	5000, ± 2000Ω < 2500 pF
Data Rate	9.6 to 120 kbps
Circuit Assignments	
TXD	Send Data
RXD	Receive Data
RTS	Request to Send
CTS	Clear to Send
DM	Data Mode
DSR	Receiver Ready
MC	Master Clock
LL	Local Loopback
ST	Send Timing
RXC	Receive Timing
TXC	Terminal Timing
MF	Mod Fault (ttl)
DF	Demod Fault (ttl)

D.8.2.1 V.35 Specification V.10, V.11 Specification, Circuit Supported

V.35 Specification V.10, V.11 Specification, Circuit Supported	
Circuit Supported	SD, SCT, SCTE, RD, SCR, DSR, RLSD, RTS, CTS, MC, DSR, LL
Driver Amplitude (RD, SCR, SCTE, CTS, RLSD, DSR, SCTE)	± 0.5V-PK, ± 20% differential, into 100Ω
Amplitude (SCT, SD, RTS, LL, MC)	± 0.2V Minimum into 100Ω
Polarity (SD, SCT, SCTE, RD, SCR)	True when B positive with respect to A False when A positive with respect to B
Polarity (RTS, CTS, DSR, RLSD)	True when < -0.2V with respect to ground False when > +0.2V with respect to ground
Phasing (SCTE, SCR)	False-to-True transition nominally in center of data bit
Symmetry (SCT, SCTE, SCR)	50%, ± 5%
Circuit Assignments	
SD-A, SD-B	Send Data
SCT-A, SCT-B	Serial Clock Transmit
RD-A, RD-B	Receive Data
SCR-A, SCR-B	Serial Clock Receive
SCTE-A, SCTE-B	Transmitter Signal Timing
MC-A, MC-B	Master Clock
RTS	Request to Send
CTS	Clear to Send
DSR	Data Set Ready
RLSD	Receive Line Signal Detect
LL	Local Loopback
MF	Mod Fault (ttl)
DF	Demod Fault (ttl)

D.8.2.2 EIA-449/EIA-422 Mil-188-114A Specification

EIA-449/EIA-422 Mil-188-114A Specification	
Circuit Supported	SD, ST, TT, RD, RT, DM, RR, RS, CS, MC
Amplitude (RD, RT, ST, DM, RR)	$\pm$ 2V differential into 100Ω
Impedance (RD, RT, ST, DM, RR)	Less than 100Ω, differential
Impedance (SD, TT, MC)	4kΩ True when B is positive with respect to A False when A is positive with respect to B
Phasing (RD, RT)	False-to-true transition of RT nominally in center of RD data bit
Symmetry (ST, TT, RT)	50%, $\pm$ 5%
Circuit Assignments	
SD-A, SD-B	Send Data
ST-A, ST-B	Send Timing
RD-A, RD-B	Receive Data
RS-A, RS-B	Request to Send
RT-A, RT-B	Receive Timing
CS-A, CS-B	Clear to Send
DM-A, DM-B	Data Mode
RR-A, RR-B	Receiver Ready
TT-A, TT-B	Terminal Timing
MC-A, MC-B	Master Clock
MF	Mod Fault (ttl)
DF	Demod Fault (ttl)

D.9 AUPC Specification

AUPC Specification	
Target Power Levels	-5 to -30 dBm (+5 to -20 dBm for high power option)
Target E_b/N_0 Level	3.2 to 16.0 dB in 0.1 dB steps
Tracking Rate	0.5 to 6.0 dB/min in 0.5 dB/min steps
Local and Remote Carrier Loss Setting (local has priority)	Maximum - go to highest power output level Nominal - go to preprogrammed output level Hold - no action
AUPC Test Modes	2047 test pattern for remote BER monitoring Remote baseband loopback test

D.9.1 Local Automatic Uplink Power Control (AUPC)

AUPC functions are only available with ASYNC overhead. Local AUPC can be Enabled or Disabled.

D.9.2 AUPC Power Levels

Select from -5 to -30 dBm (+5 to -20 dBm for high power option) in 0.5 dBm steps, for the Nominal, Minimum, and Maximum TX power levels.

D.9.3 AUPC Target Noise Level

Select the E_b/N_0 target setpoint from 3.2 to 16.0 dB in 0.1 dBm steps.

D.9.4 AUPC Tracking Rate

Select the maximum tracking rate from 0.5 to 6.0 dBm/minute in 0.5 dBm/minute steps.

D.9.5 AUPC Carrier Loss Action

Select transmit power level of Maximum, Nominal, or Hold for both local and remote carrier loss. Local carrier loss has priority over remote carrier loss.

D.9.6 Remote AUPC

Select remote AUPC to be enabled or disabled. The operator also can select a remote TX 2047 test pattern and a remote baseband loopback to be enabled or disabled. The operator can monitor the remote AUPC 2047 bit error rate.

D.10 System Specifications

D.10.1 Loopback Modes

The operator can select one of the following interface loopback test modes.

- Baseband: Near end and far end.
- Interface: Near end and far end (Reed-Solomon or Overhead only).

D.10.2 Test Modes

Table D-16 shows RX-IF test modes.

Note: The TX and RX data rates must be the same for the modem to lock.

Table D-16. Test Modes

IF Loopback:	Disconnects the IF input from the RX input connector and couples it to a sample of the TX IF output. The IF output is not affected.
RF Loopback	Sets the demodulator frequency to the same value as the modulator. For the modem to lock, an external IF loop must be provided.
BIST (Built in Self Test)	The modem has the ability to generate 2^{11-1} (2047) PN data and pass the data through the Interface, Modulator and Demodulator sections of the modem. The modem can generate noise in the IF path to simulate a satellite environment. The true BER can then be measured by the modems built in BER monitor. This feature can be invoked on power up or by the operator and the result checked against specification and a fault is flagged if the unit fails. The feature can be turned off at the front panel if so desired to minimize initialization time. The RF output is off during this self test
2047 Pattern Generator (must have overhead card installed and activated)	Inserts an Industry Standard 2047 pattern in lieu of the TX data stream.
2047 Pattern Monitor (must have overhead card installed and activated)	Monitors the RX data for 2047 pattern. If 2047 pattern is present, this test mode provides an indication of Bit Error Rate (BER). The RX data is not interrupted.

D.10.3 Remote Control

All modem functions can be controlled remotely through the remote connector on the rear panel. See Appendix B for the complete command and response.

Interface type:

- EIA-485 (4- or-2-wire) or EIA-232
- Baud Rate Range 150 to 19.2 kbps.
- ASCII characters
- 11 bits per character
- 1 start bit

- Information bits
  - 7 information bits, 1 parity bit (odd/even)
  - 8 information bits, no parity bit
- 2 stop bits
- Operation mode TX only, RX only, or Duplex

For exact remote control information, refer to the latest firmware appropriate for this piece of equipment.

D.10.4 Modem Remote Address

Note: The value of zero is defined as global.

The modem can be programmed for a remote address, ranging from 0 to 255. All other addresses are unique, and should not have more than one modem assigned per EIA-485/232 bus.

D.10.5 Monitored Signals

The operator can display/read one of the following, continually updated, performance monitors.

- Receive signal level -25 to -60 dBm, ± 2.5 dB accuracy
- Raw BER
- Corrected BER, range 1.0 E-3 to 1.0 E-12
- Eb/N0,.1 dB resolution, ± 0.5 dB accuracy, range 2.0 to 16.0 dB
- RX frequency offset, 1 Hz resolution, ± 10 PPM accuracy, range -35 to +35 kHz
- Buffer fill status, 1% resolution, 1% to 99%

D.10.6 Modem Emulation Modes

The modem has the ability to emulate the remote commands for the following modems:

SDM-100	Ver: 15.7.1
SDM-300	6.2.2
SDM-308-4	4.03
SDM-308-4	6.05
SDM-308-4	6.08
SDM-308-4	7.03
SDM-309	6.04
SDM-650	4.12A
SDM-650	4.16
SDM-6000	5.1.1

D.11 Doppler

Refer to Table C-17.

A geo-stationary satellite should be positioned directly over the Equator and orbit with a duration of 24 hours. In practice, the Earth, Moon, and Sun's gravity, as well as solar wind influence the exact inclination of the satellite (relative to the Equator). Station keeping motors are required to maintain the orbital position. When viewed from the Earth, the satellite appears to prescribe an ellipse in space, degrading to a "figure 8" as the angle of inclination increases.

The orbit of the satellite can result in a peak-to-peak altitude variation of ± 2% (85 km), while the station keeping of a newly launched satellite will typically be ± 0.1° (150 km). The total effect will be 172 km relative to the nominal 42,164 km radius.

Depending upon the location of the Earth station relative to the satellite, the variation in propagation delay will typically be 1.15 ms (up to satellite and back down), therefore a buffer depth of 2 ms is sufficient to cope with most commercial satellites.

Since station keeping involves using fuel in the motors, allowing the satellite to drift into a wider "figure 8" can extend the "lifetime" of the satellite, using the motor less often. The older satellite will be found in a more inclined orbit with the station keeping various in latitude by as much as ± 4°. The total effect of the inclined orbit may result in a typical variation inpath delay of 35 ms.

Table C-17. Minimum Doppler/Plesiochronous Buffer Capacity Requirements

Satellite Orbit Inclination	Buffer Capacity (ms) For Various Circuit Configuration	
(Degrees)	Master/Master	Master/Slave
0.1 (Nomnal)	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
4.0	12.9	25.2

Notes:

1. The above minimum buffer capacities include a factor of two to allow the buffer to start in the center and then drift in either direction. In the Master/Slave case, where the TX timing at one end of the link is derived from the demodulator and used to TX back to either the station which originated the timing signal or to a different station, another factor of two has been applied to the Doppler contribution to account for the passage of the timing signal twice through the satellite.
2. Adding the buffer requirements due to satellite delay variations (Doppler) and that due to the interfacing of different national clocks (plesiochronous) derived the above capacities.
3. Actual buffer capacity is likely to be larger due to the need to slip primary order streams on a multiframe basis.

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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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