SDM-8000

Satellite Modem
Installation and Operation Manual

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

Part Number MN/SDM8000.IOM **Revision 13**

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Satellite Modem
Installation and Operation Manual

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Revision 13
July 30, 2005

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

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

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About this Manual

This manual provides installation and operation information for the Comtech EF Data SDM-8000 Satellite Modem. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the SDM-8000.

Related Documents

The following documents are referenced in this manual:

- *American Telephone and Telegraph* (*AT&T) 43802*
- *CCITT G.703, G.704, G.721, G.732, G.733, G.823, G.824*
- *Department of Defense (DOD) MIL-STD-188-114A, "Electrical Characteristics of Digital Interface Circuits"*
- *Comtech EF Data's UB-300 Universal Breakout Panel Installation and Operation Manual*
- *Comtech EF Data's IDR Breakout Panel Installation and Operation Manual*
- *Comtech EF Data's IBS Breakout Panel Installation and Operation Manual*
- *Comtech EF Data's IB-8004 Breakout Panel Installation and Operation Manual*
- *Comtech EF Data's IB-8005 Breakout Panel Installation and Operation Manual*
- *Comtech EF Data's D&I Breakout Panel Installation and Operation Manual*
- *Comtech EF Data's ASYNC Breakout Panel Installation and Operation Manual*

Conventions and References

Cautions and Warnings

CAUTION

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

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

IMPORTANT

Indicates information critical for proper equipment function.

Overview of Changes to Previous Edition

The following changes were made for Revision 13:

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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 is equivalent to the new designation of the Electronic Industries Association (EIA). All references in the manual will be shown either has the EIA designations (EIA-232, EIA-485, etc.) or the RS designations..

Military Standards

References to "MIL-STD-188" apply to the 114A series (i.e., MIL-STD-188-114A), which provides electrical and functional characteristics of the unbalanced and balanced voltage digital interface circuits applicable to both long haul and tactical communications. Specifically, these references apply to the MIL-STD-188-114A electrical characteristics for a balanced voltage digital interface circuit, Type 1 generator, for the full range of data rates. For more information, refer to the Department of Defense (DOD) MIL-STD-188-114A, "Electrical Characteristics of Digital Interface Circuits."

Trademarks

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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 Technical Publications department: techpub@comtechefdata.com.

Electrical Safety

The SDM-8000 Satellite Modem has been shown to comply with the following safety standard:

- EN 60950: Safety of Information Technology Equipment, including electrical business machines

The equipment is rated for operation over the range 100 - 240 volts AC. It has a maximum power consumption of 290 watts, and draws a maximum of 2.9 mA.

IMPORTANT

1. Refer to Physical Description section for fuse data.
2. FOR CONTINUED OPERATOR SAFETY, ALWAYS REPLACE THE FUSES WITH THE CORRECT TYPE AND RATING.

Fuses

The SDM-8000 is fitted with two fuses - one each for line and neutral connections. These are contained within the body of the IEC power inlet connector, behind a small plastic flap.

Environmental

The SDM-8000 must not be operated in an environment where the unit is exposed to extremes of temperature outside the ambient range 0 to 50°C (32° to 122°F), precipitation, condensation, or humid atmospheres above 95% RH, altitudes (un-pressurised) greater than 2000 metres, excessive dust or vibration, flammable gases, corrosive or explosive atmospheres.

Operation in vehicles or other transportable installations that are equipped to provide a stable environment is permitted. If such vehicles do not provide a stable environment, safety of the equipment to EN60950 may not be guaranteed.

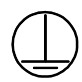
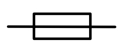
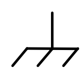
Installation

The installation and connection to the line supply must be made in compliance to local or national wiring codes and regulations.

The SDM-8000 is designed for connection to a power system that has separate ground, line and neutral conductors. The equipment is not designed for connection to power system that has no direct connection to ground.

The SDM-8000 is shipped with a line inlet cable suitable for use in the country of operation. If it is necessary to replace this cable, ensure the replacement has an equivalent specification. Examples of acceptable ratings for the cable include HAR, BASEC and HOXXX-X. Examples of acceptable connector ratings include VDE, NF-USE, UL, CSA, OVE, CEBEC, NEMKO, DEMKO, BS1636A, BSI, SETI, IMQ, KEMA-KEUR and SEV.

International Symbols:

Symbol	Definition		Symbol	Definition
~	Alternating Current			Protective Earth
	Fuse			Chassis Ground

Telecommunications Terminal Equipment Directive

In accordance with the Telecommunications Terminal Equipment Directive 91/263/EEC, this equipment should not be directly connected to the Public Telecommunications Network.

EMC (Electromagnetic Compatibility)

In accordance with European Directive 89/336/EEC, the CDM-700 Modem has been shown, by independent testing, to comply with the following standards:

Emissions: EN 55022 Class B - Limits and methods of measurement of radio interference characteristics of Information Technology Equipment.

(Also tested to FCC Part 15 Class B)

Immunity: EN 50082 Part 1 - Generic immunity standard, Part 1: Domestic, commercial and light industrial environment.

Additionally, the CDM-700 has been shown to comply with the following standards:

- EN 61000-3-2 Harmonic Currents Emission
- EN 61000-3-3 Voltage Fluctuations and Flicker
- EN 61000-4-2 ESD Immunity
- EN 61000-4-4 EFT Burst Immunity
- EN 61000-4-5 Surge Immunity
- EN 61000-4-6 RF Conducted Immunity
- EN 61000-4-8 Power Frequency Magnetic Field Immunity
- EN 61000-4-9 Pulse Magnetic Field Immunity
- EN 61000-4-11 Voltage Dips, Interruptions, and Variations Immunity
- EN 61000-4-13 Immunity to Harmonics

IMPORTANT

In order that the Modem continues to comply with these standards, observe the following instructions:

- Connections to the transmit and receive IF ports (Type N or Type F connectors) should be made using a good quality coaxial cable - for example 50 Ω or 75 Ω.

- All 'D' type connectors attached to the rear panel must have back-shells that provide continuous metallic shielding. Cable with a continuous outer shield (either foil or braid, or both) must be used, and the shield must be bonded to the backshell.

- The equipment must be operated with its cover on at all times. If it becomes necessary to remove the cover, the user should ensure that the cover is correctly re-fitted before normal operation commences.

1.

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Warranty Policy

This Comtech EF Data product is warranted against defects in material and workmanship for a period of 2 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.

Chapter 1. INTRODUCTION

This Comtech EF Data SDM-8000 Satellite Modem, referred to in this manual as "the modem" (Figure 1-1) is designed to meet the requirements of the IDR, IBS, and other specifications encountered in the satellite digital communications industry.

Figure 1-1. SDM-8000

1.1 Overview

The modem is a high performance, full-duplex, digital-vector modulator/demodulator that meets the open network requirements of the **I**NTELSAT **E**arth **S**tation **S**tandards (IESS) -308, -309, and -310 emulation specifications for **I**ntermediate **D**ata **R**ate (IDR), **I**NTELSAT **B**usiness **S**ervices (IBS), and **S**atellite **M**ultiservice **S**ystem (SMS).

The modem also can be used for any closed network and satellite communication system applications.

The modem supports the following main modes of operation:

- IDR (with Audio or 64 kbps data)
- IBS
- **D**rop **&** **I**nsert (D&I)
- Custom
- **Async**hronous overhead (ASYNC)
- Type X

The modem interfaces between **S**ingle **C**hannel **P**er **C**arrier (SCPC) fixed-rate terminal equipment operating within the following specifications:

- Data rate of 9.6 kbps to 9.312 Mbps
- Symbol rate of 19 kS/s to 6.3 MS/s
- Can be configured to add overhead/framing to the data

1.1.1 Modem Types

The modulation types include:

- Bi-Phase Shift Keying (BPSK)
- Quadrature Phase Shift Keying (QPSK)
- 8-Phase Shift Key (8-PSK)
- 16-Quadrature Amplitude Modulation (16-QAM)

The Custom mode of operation enables the modem to emulate most proprietary modems.

The modem interfaces between the channel unit or multiplexer (MUX) and **I**ntermediate **F**requency (IF) converter equipment operating in a 50 to 180 MHz band. An internal channel unit, conforming to IESS-308 and -309 emulation specifications, provides overhead designated for an **E**ngineering **S**ervice **C**ircuit (ESC).

1.1.2 Modem Construction

The modem contains:

- Built-in scramblers/descramblers
- Differential encoder/decoder
- Transmit and receive frequency synthesizers
- Multi-rate Forward Error Correction (FEC) convolutional Viterbi decoder

The modem provides:

- High performance with narrow occupied bandwidth
- Automatic signal acquisition
- High flexibility
- Extensive online monitoring circuits

The modem is a complete, self-contained unit in a standard 2-unit (2U) 19-inch (48 cm) rack-mountable enclosure weighing approximately 19 lbs (8.6 kg).

The unit was constructed using modular design (Figure 1-2), and consists of five **P**rinted **C**ircuit **B**oard (PCB) assemblies, including the front and rear panel. The backplane PCB is mounted on the chassis assembly, and contains receptacles for plug-in PCBs.

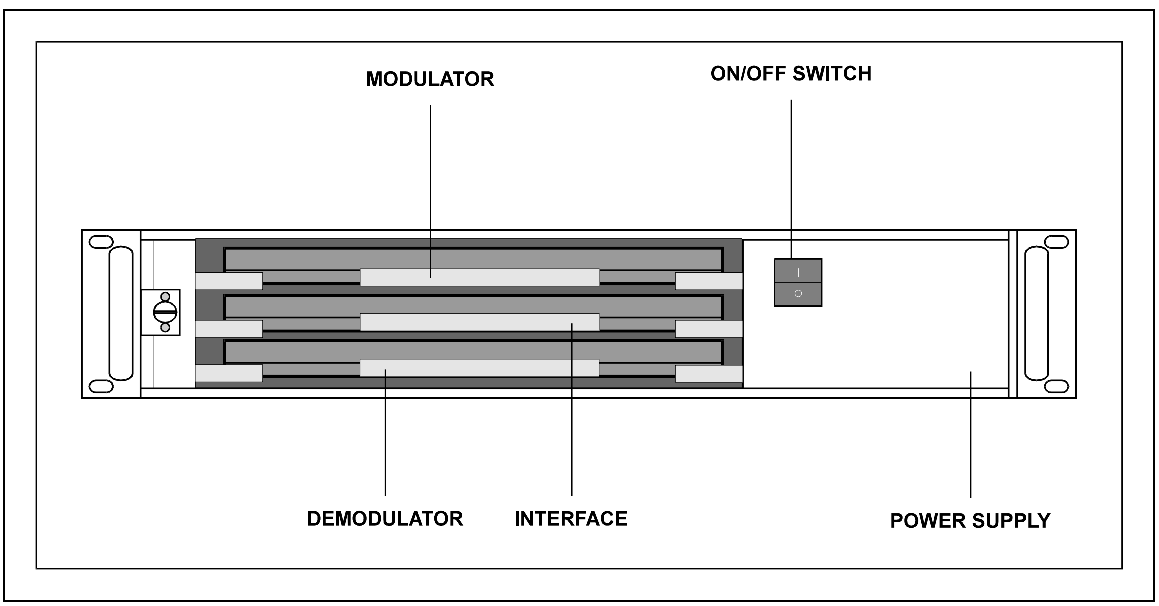


Figure 1-2. Modulator Construction

The front edge of the modulator, demodulator, and interface PCBs contains the test points.

The front panel of the modem contains all **M**onitor **&** **C**ontrol (M&C) function indicators for operating the modem. The display/M&C PCB is mounted on the front panel.

The chassis also contains a fan (on the rear panel) and a power supply.

Refer to Figure 1-3 for a system block diagram.

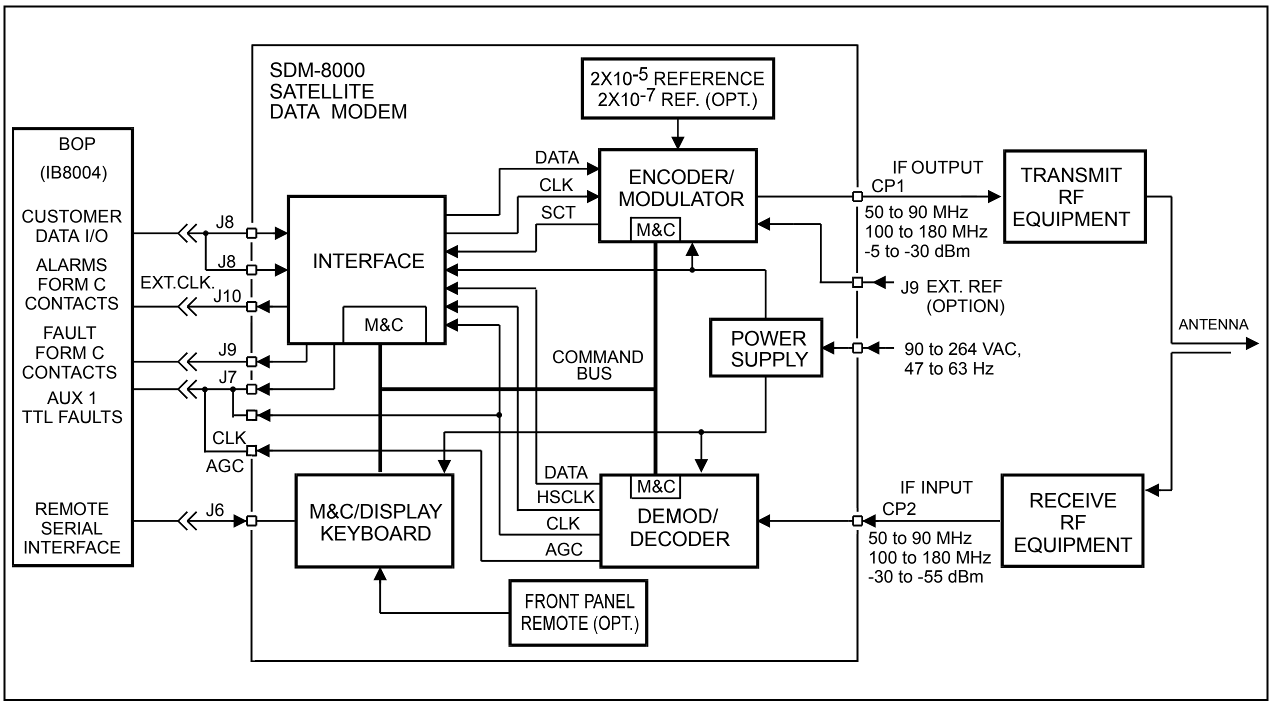


Figure 1-3. Block Diagram

1.2 Options

Refer to Table 1-1 for a description of module types that are compatible with each option.

Table 1-1. Module Types

Configuration	Interface Type	FEC Option	Options
70/140 MHz Duplex (AC)	Standard	Sequential	+5 V Output
70/140 MHz TX (AC)	Standard with Buffer	Viterbi	50Ω
70/140 MHz RX (AC)	Standard with Buffer/R-S	Trellis	Int. SW Relay
70/140 MHz Duplex (DC)	Standard with Buffer/DVB R-S	Sequential & Trellis	Int. SW Relay 50 Ω
70/140 MHz TX (DC)	IBS		+5 V Output & 50 Ω
70/140 MHz RX (DC)	IBS/IDR		H/S 10-7
	IBS/D&I with ACU		2048 Max D/R
	IBS/R-S		
	IBS/D&I/RS with ACU		
	IBS/IDR/D&I with ACU		
	IBS/IDR/R-S		
	IBS/IDR/D&I/RS with ACU		
	IBS with ACU		
	IBS with ACU/IDR		
	IBS/R-S with ACU		
	IBS/IDR/R-S with ACU		

Note: Viterbi decoder and 75Ω configuration are standard with the SDM-8000 Modem.

1.2.1 Sequential Decoder

The sequential decoder works in closed network applications which typically use the **F**requency **D**ivision **M**ultiple **A**ccess (FDMA) satellite communications system. The 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.

For more information, refer to Appendix B.

Notes:

1. D&I, and D&I with ASYNC options, can be used with the sequential decoder.
2. The Reed-Solomon option cannot be used with the sequential decoder.
3. The sequential decoder option will not function in 8-PSK and 16-QAM modes.

1.2.2 D&I with ASYNC Overhead

The D&I multiplexer with the ASYNC overhead data channel is used for earth station-to-earth station communication. The D&I multiplexer works in conjunction with the interface PCB to enable the modem to Tx or Rx fractional parts of a T1 data stream. The overhead channel is MUXed onto the data and transmitted at an overhead rate of 16/15 of the main channel.

For more information, refer to Appendix B.

Notes:
1. D&I, and D&I with ASYNC options, can be used with the sequential decoder.
2. The Reed-Solomon options cannot be used with the sequential decoder.

1.2.3 Reed-Solomon

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 Appendix B for more information.

Note: The sequential decoder cannot be used with the Reed-Solomon option.

1.2.4 8-PSK

The 8-PSK modulation type is a PSK encoding method for providing a modulated carrier at 38.4 kbps to 9.3 Mbps by pragmatic-trellis encoding at 2/3 rate.

Notes:
1. The sequential decoder option cannot be used in the 8-PSK mode.
2. The D&I and Reed-Solomon options can be used in the 8-PSK mode.

1.2.5 16-QAM

The 16-QAM is an encoding method for providing a modulated carrier at 50 kbps to 9.3 Mbps in 3/4 rate, and 68 kbps to 9.3 Mbps in 7/8 rate.

Notes:
1. The sequential decoder option cannot be used in the 16-QAM mode.
2. The Reed-Solomon option is required for 16-QAM operation.

1.2.6 Interface Relay Board

The interface relay board option provides easy method for changing the data interface. The interface relay replaces the need to physically change the interface multi-pin jumpers by enabling data interface selections from the modem front panel. For more information, refer to Appendix B.

1.3 Modem Assemblies

Refer to Table 1-2 for modem assemblies.

Table 1-2. Modem Assemblies

Drawing #	Assembly	Remarks
PL/2300-1	Assy, Top	
EIA-8000	Kit, Reed-Solomon	
PL/3606-1	Chassis, SDM-8000	AC
PL/3606-2	Chassis, SDM-8000	DC
PL/2305	Display/Monitor & Control	No FW required
PL/2487	Extender Board	
PL/2876	Interface Switch Relay Board	Optional Daughter Board
PL/5039-1	Modulator Card 50Ω	Repls PL3415-1
PL/5039-2	Modulator Card 75Ω	Repls PL3415-2
PL/5039-3	Modulator Card 50Ω, +5 dBm	Repls PL3415-3
PL/5039-4	Modulator Card 75Ω, +5 dBm	Repls PL3415-4
PL/5039-5	Modulator Card 50Ω, High Stability Option	Repls PL3415-5
PL/5039-6	Modulator Card 75Ω, High Stability Option	Repls PL3415-6
PL/5039-7	Modulator Card 50Ω, High Stability Option (+5 dBm)	Repls PL3415-7
PL/5039-8	Modulator Card 75Ω, High Stability Option (+5 dBm)	Repls PL3415-8
PL/5039-11	Modulator Card 50Ω, 8-PSK/16-QAM	Repls PL3415-11
PL/5039-12	Modulator Card 75Ω, 8-PSK,/16-QAM	Repls PL3415-12
PL/5039-13	Modulator Card 50Ω, +5 dBm 8-PSK/16-QAM	Repls PL3415-13
PL/5039-14	Modulator Card 75Ω, +5 dBm 8-PSK/16-QAM	Repls PL3415-14
PL/5039-15	Modulator Card 50Ω, High Stability Option 8-PSK/16-QAM	Repls PL3415-15
PL/5039-16	Modulator Card 75Ω, High Stability Option 8-PSK/16-QAM	Repls PL3415-16
PL/5039-17	Modulator Card 50Ω, High Stability Option (+5 dBm) 8-PSK/16-QAM	Repls PL3415-17
PL/5039-18	Modulator Card 75Ω, High Stability Option (+5 dBm) 8-PSK/16-QAM	Repls PL3415-18
PL/4895-1	Demodulator Card Viterbi 50Ω 8-PSK/QPSK	Repls PL3416-1
PL/4895-2	Demodulator Card Viterbi 75Ω 8-PSK/QPSK	Repls PL3416-2
PL/4895-3	Demodulator Card Viterbi 50Ω 8-PSK/16-QAM	Repls PL3416-3
PL/4895-4	Demodulator Card Viterbi 75Ω 8-PSK/16-QAM	Repls PL3416-4
PL/4895-5	Demodulator Card Viterbi/Sequential 50Ω 8-PSK/QPSK	Repls PL3416-1
PL/4895-6	Demodulator Card Viterbi/Sequential 75Ω 8-PSK/QPSK	Repls PL3416-2
PL/4895-7	Demodulator Card Viterbi/Sequential 50Ω 8-PSK/16-QAM	Repls PL3416-3
PL/4895-8	Demodulator Card Viterbi/Sequential 75Ω 8-PSK/16-QAM	Repls PL3416-4

Table 1-3. Modem Assemblies (Continued)

Drawing #	Assembly	Remarks
PL/3495-1	Interface Card (Standard)	
PL/3495-2	Interface Card (Standard with Buffer)	
PL/3495-3	Interface Card (IBS)	
PL/3495-4	Interface Card (IBS/IDR)	
PL/3708-1	Reed-Solomon Board (IDR Standard)	Optional Daughter Board
PL/3117	Sequential Decoder Board	Optional Daughter Board
PL/3496-1	ASYNC/AUPC Board	Optional Daughter Board
PL/3496-2	Drop & Insert with ASYNC/AUPC Board	Optional Daughter Board

Note: All the high stability modulators have the capability of having the SCT INTERNAL synthesized to the EXT CLOCK input at the data I/O connector. This is used in asymmetrical Loop Timing applications. (See Chapter 6.)

1.4 New In This Manual

The following changes were made to Revision 12 :

- Added Version 21.1.3
- Added Erratas A, B, C, D, E, F, and G
- Added Addendum A
- Added engineering changes.
- Revised manual to reorganize chapters.

Chapter 2. INSTALLATION

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. The circuit boards are packed in separate cardboard caddypacks (also packaged within the cardboard carton).

CAUTION

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

Remove 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 and caddypacks.
3. Remove the modem, caddypacks, 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 2.3 for installation instructions.

2.2 System Options

The standard modem with all PCB assemblies installed is a full-duplex QPSK satellite modem. The system can also be configured for TX-only or RX-only operation:

- For a Tx-only system, the demodulator PCB can be removed. Enter the SYSTEM UTILITY menu on the front panel and select Operation mode. Enter the menu and select Tx-only. This masks the receive faults and receive stored FAULTS in the Faults menu.

- For an Rx-only system, the modulator PCB can be removed. Enter the SYSTEM UTILITY menu on the front panel and select Operation mode. Enter the menu and select Rx-only. This will mask the transmit faults and transmit stored faults in the FAULTS menu.

2.3 Installation

Refer to the following steps to install the modem:

1. Mount the modem (Figure 2-1) in the assigned position of the equipment rack. Support the modem by either a rack-mounted shelf, or the two rear rack-mounted brackets supplied with the unit.

2. Connect the cables to the proper locations on the rear panel. Refer to Section 2.4 for connector pinouts, placement, and function.

3. Refer to Chapter 4 to verify that all interface jumper settings are in the proper position.

4. Open the front panel and install the three main PCB assemblies:

   a. Install the Modulator PCB (AS/3415-x or Alt AS/5039-x) in the top slot.
   b. Install the Interface PCB (AS/4895 or AS/3495) in the middle slot.
   c. Install the Demodulator PCB (AS/3416) in the bottom slot.

   Note: The cards are keyed and will only fit in the proper chassis slot. Verify that the PCBs are properly seated.

5. Before turning the power switch on, become familiar with front panel operation in Chapter 6.

6. Turn on the power switch located inside the front panel.

7. Check for the proper transmitter (Tx) output signal level and spectrum.

8. Check for proper receiver (Rx) input signal level and spectrum.

9. If there is any problem with the installation, refer to Chapter 9 for troubleshooting information.

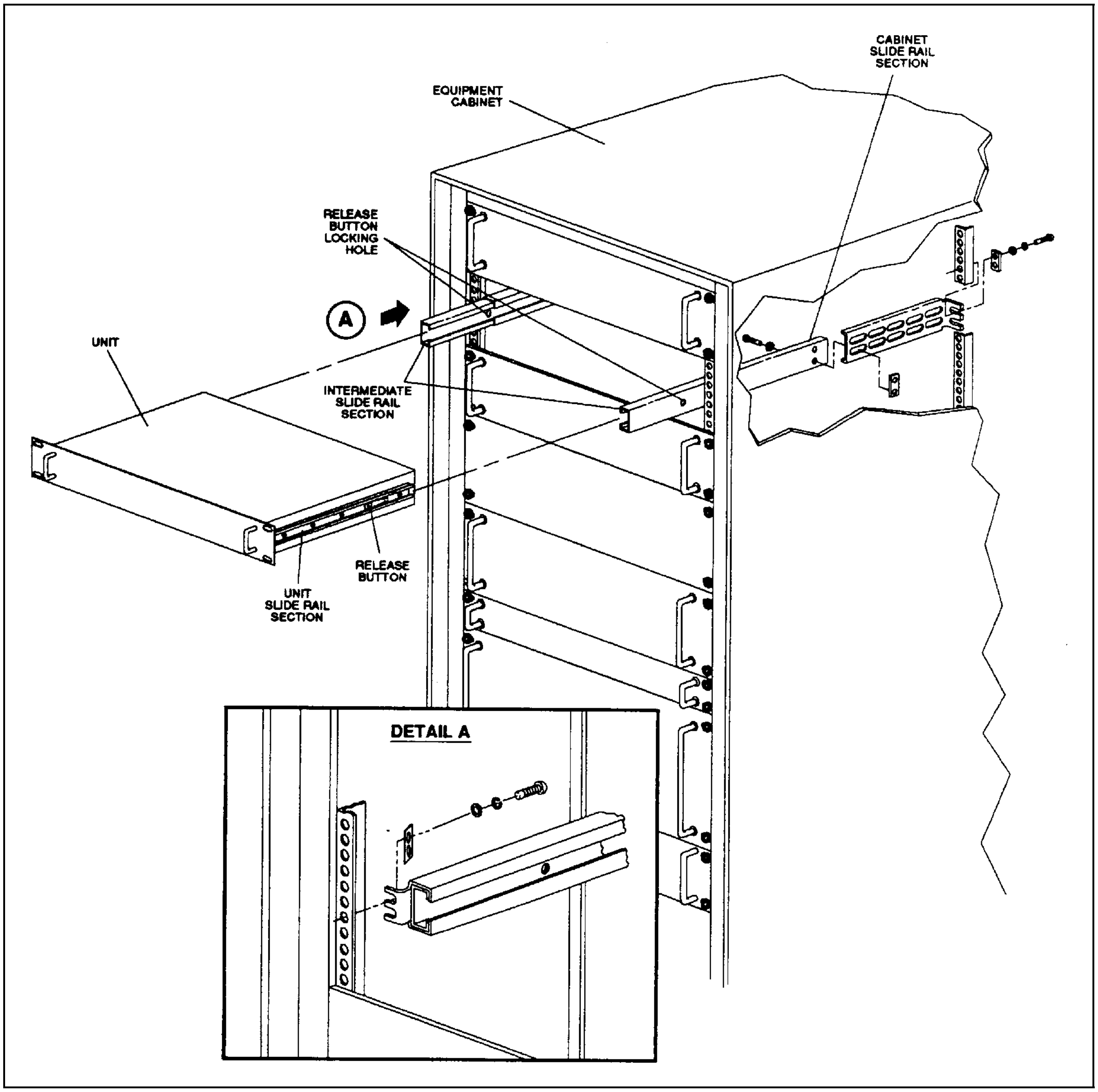


Figure 2-1. Typical Rack Installation

Chapter 3. EXTERNAL CONNECTIONS

3.1 External Connections

When a breakout panel is not required, the rear panel connectors enable the external connections between the modem and other equipment. Table 3-1lists these connectors, and Figure 3-1 shows their locations.

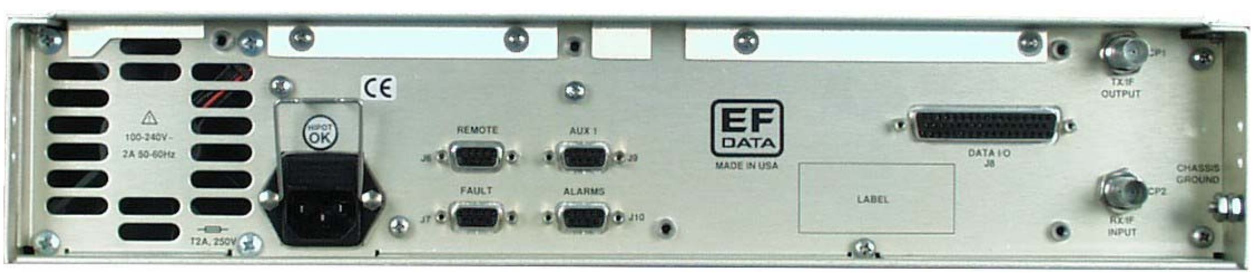


Figure 3-1. SDM-8000 Rear Panel View

Table 3-1. Modem Rear Panel Connectors

Name	Ref. Desig.	Connector Type	Function
Tx/IF OUTPUT	CP1	BNC	RF Output
Rx/IF INPUT	CP2	BNC	RF Input
REMOTE	J6	9-pin D	Remote Interface
FAULT	J7	9-pin D	Form C Fault Relay Contacts
DATA I/O	J8	50-pin D	Data Input/Output
AUX 1	J9	9-pin D	Terminal Timing Logic (TTL) Faults Satellite Clock External Reference Automatic Gain Control (AGC) Out
ALARMS	J10	9-pin D	Form C Alarm Relay Contacts

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.

3.1.1 RF Output Connector (CP1)

CP1 is a BNC connector for the TX IF signal.

The output impedance is 75Ω (50Ω optional), and the output power level is -5 to -30 dBm. In normal operation, the output will be a QPSK modulated result of the DATA I/O connector between 50 and 180 MHz.

3.1.2 RF Input Connector (CP2)

CP2 is a BNC connector for the RX IF signal.

The input impedance is 75Ω (50Ω optional). For normal operation, the desired carrier signal level must 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.

3.1.3 Remote Connector and Pinouts (J6)

The remote connector interfaces the M&C functions to a remote location. This is a DCE interface that can be either EIA-232 or EIA-485, refer to Table 3-2. Refer to Appendix A for a description of the remote commands.

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

Table 3-2. Remote Connector and Pinouts (J6)

EIA-485			EIA-232	
4-Wire Mode		2-Wire Mode		
Pin #	Name	Name	Pin #	Name
1	GND	GND	1	
2			2	RD (RX)
3			3	TD (TX)
4	+TX	+TX/RX*	4	
5	-TX	-TX/RX*	5	GND
6			6	DSR
7			7	RTS
8	+RX	+TX/RX*	8	CTS
9	-RX	-TX/RX*	9	

Notes:

1. Either pair of Pins 4 and 5 or Pins 8 and 9 can be used in EIA-485, 2-wire applications.
2. The high signals for TX and RX are tied together. Consequently, the low signals for TX and RX are tied together

3.1.4 Fault Connector and Pinouts (J7)

The fault connector provides Form C contact closures for fault reporting. The three Form C summary fault contacts are Modulator, Demodulator, and Common Equipment, refer to Table 3-3. Refer to Chapter 6 for a discussion of faults monitored. To obtain a system summary fault, connect all the Form C contacts in parallel.

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

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

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

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

3.1.5 DATA I/O Interface Connector (J8)

The DATA I/O interface connector interfaces data input and output signals to and from the modem. The DATA I/O connects to the customer terrestrial equipment through a breakout panel or protection switch. The DATA I/O can be configured (depending on options) to IDR, IBS, or D&I types of interfaces. Refer to the MODEM UTILITY functions in Chapter 6 for configuration instructions. The DATA I/O pinout is different for each of the interface configurations.

3.1.5.1 IDR Configuration Connector Pinouts (J8)

The IDR DATA I/O interface connection is a 50-pin female D connector located on the rear panel of the modem, refer to Table 3-4. Screw locks are provided for mechanical security of the mating connector. Refer to Chapter 5 for backward alarm theory and connection information.

Table 3-4. IDR Configuration Connector Pinouts (J8)

Signal Function	Name	Pin #
Ground	GND	1, 2
Send Data	SD_A SD_B	34 18
RX Data	RD_A RD_B	36 20
Reference Clock/(EIA-422) In	EXC_A EXC_B	35 19
8 kbps TX Data (EIA-422)	TXD_A TXD_B	37 38
8 kHz TX CLK (EIA-422) Out	TXC_A TXC_B	21 22
1 kHz TX Octet (EIA-422) In	TXO_A TXO_B	4 5
8 kbps RX Data (EIA-422)	RXD_A RXD_B	39 40
8 kHz RX CLK (EIA-422)	RXC_A RXC_B	23 24
1 kHz RX Octet (EIA-422)	RXO_A RXO_B	6 7
ADPCM1 Audio In or 64 kbps TX Data	A1I_A or 64TXD_A A1I_B or 64TXD_B	45 29
ADPCM1 Audio Out or 64 kHz RX Clock Out	A1O_A or 64RXXC_A A1O_B or 64RXC_B	46 30
ADPCM2 Audio In or 64 kHz TX Clock Out	A2I_A or 64TXC_A A2I_B or 64TXC_B	47 29
ADPCM2 Audio Out or 64 kbps RX Data	A2O_A or 64 RXD_A A2O_B or 64 RXD_B	48 32
Backward Alarm 1 Out	BWO1_C BWO1_NC BWO1_NO	8 *(Note 1)* 25 41
Backward Alarm 2 Out	BWO2_C BWO2_NC BWO2_NO	9 *(Note 1)* 26 42

Table 3-4. IDR Configuration Connector Pinouts (J8) (Continued)

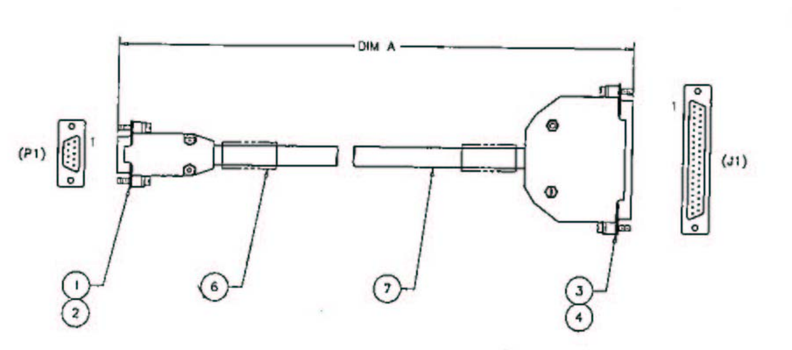
Signal Function	Name	Pin #
Backward Alarm 3 Out	BWO3_C BWO3_NC BWO3_NO	10 *(Note 1)* 27 43
Backward Alarm 4 Out	BWO4_C BWO4_NC BWO4_NO	11 *(Note 1)* 28 44
Backward Alarm 1 In	BWI1	12 *(Note 2)*
Backward Alarm 2 In	BWI2	13 *(Note 2)*
Backward Alarm 3 In	BWI3	14 *(Note 2)*
Backward Alarm 4 In	BWI4	15 *(Note 2)*
Modulator Fault	MF	49 *(Note 3)*
Demodulator Fault	DF	33 *(Note 3)*
Deferred Maintenance Alarm	DMA	17 *(Note 3)*
Demodulator Fault Relay	DF_C DF_NO	16 *(Note 4)* 50
AGC Output	AGC_OUT	3

Notes:

1. Backward alarm relay contacts are named for normal no fault conditions (BWOx-C connected to BWOx-NC if no fault).
2. Backward alarm inputs must be grounded or pulled logic low to clear the alarm.
3. Signals MF, DF, and DMA are open collector, high impedance if faulted. MF and DF are used by a backup protection switch if the modem is used in a redundant system.
4. Relay contacts DF-C and DF-NO are named for faulted condition (DF-C connected to DF-NO unless demodulator [demod] fault).

3.1.5.1.1 Cable (CA/5876) Pin Assignments

Cable (CA/5876) is used at DB9 connector for the 64K EIA-422 option. The following is a pin assignment listing to the DB37 connector.



Item No.	Item	From	To	Signal	Twisted Pair	Dim. A
1	9-Pin Conn	P1-1	J1-4	SDA	x	12.0 ± 1.0 IN
2	9-Pin Conn	P1-6	J1-22	SDB		
3	37-Pin Conn	P1-2	J1-8	RTA	x	
4	37-Pin Conn	P1-7	J1-26	RTB		
5	Heat Shrink	P1-4	J1-23	STB	x	
6	1-in Label	P1-8	J1-5	STA		
7	22-AWG Wire	P1-5	J1-24	RDB	x	
		P1-9	J1-6	RDA		
		P1-3	J1-1	SHIELD GND		
			J1-19			
			J1-20			
			J1-37			

Figure 3-2. Cable Assembly, 9-Pin to 37-Pin

3.1.5.2 IBS Interface Connector Pinouts (J8)

The IBS interface connection is a 50-pin female D connector located on the rear panel of the modem, refer to Table 3-5. Screw locks are provided for mechanical security of the mating connector. Refer to Chapter 5 for backward alarm theory and connection information.

Table 3-5. IBS Interface Connector Pinouts (J8)

Signal Function	Name	Pin #
Ground	GND	1, 2
T1/E1 Send Data	T1E1_SDA T1E1_SDB	34 18
T1/E1 Receive Data	T1E1_RDA T1E1_RDB	36 20
External Clock In	EXC_A EXC_B	35 19
EIA-422/V.35 Send Data	SD_A SD_B	37 38
EIA-422/V.35 Receive Data	RD_A RD_B	39 40
Terrestrial TX Data	TERESTXDAT	5
Engineering Service Channel	RXESCDAT	7
EIA-422/V.35 Receive Timing	SCR/RT_A SCR/RT_B	23 24
EIA-422/V.35 Transmit Timing	SCT/ST_A SCT/ST_B	21 22
EIA-422/V.35 Terminal Timing	SCTE/TT_A SCTE/TT_B	12 13
EIA-422 Transmit Octet	R422TXO_A R422TXO_A	14 15
EIA-422 Receive Octet	R422RXO_A R422RXO_B	8 9
EIA-422/V.35 Request To Send	RTS_A RTS_B	45 29
ESC Data Set Ready (EIA-232 Only)	ESC_DSR	41
EIA-422/V.35 Clear To Send	CTS_A CTS_B	47 31
EIA-422/V.35 Data Set Ready/ Data Mode	DSR/DM_A DSR/DM_B	48 32
EIA-422/V.35 Receive Line Signal Detect/Receiver Ready	RLSD/RR_A RLSD/RR_B	46 30
Primary Alarm Out	PRI_COM PRI_NO PRI_NC	10 43 27
Secondary Alarm Out	SEC_COM SEC_NO SEC_NC	11 44 28
Modulator Fault	MOD_FLT	49
Demodulator Fault	DEM_FLT	33
AGC Output	AGC_OUT	3

3.1.5.3 IDR/D&I Interface Connector Pinouts (J8)

The IDR/D&I interface connection is a 50-pin female D connector located on the rear panel of the modem, refer to Table 3-6. Screw locks are provided for mechanical security of the mating connector.

Table 3-6. IDR/D&I Interface Connector Pinouts (J8)

Signal Function	Name	Pin #
Ground	GND	1, 2
Drop Data Input	DDI_A DDI_B	34 18
Drop Data Output	DDO_A DDO_B	37 38
Insert Data Input	IDI_A IDI_B	39 40
Insert Data Output	IDO_A IDO_B	36 20
External Clock/ EIA-422 In	EXC_A EXC_B	35 19
Terrestrial TX EIA-232 Data	TERESTXDAT	5
Terrestrial RX EIA-232 Data	TERESRXDAT	7
EIA-232 Data Set Ready	DSR	48
Primary Alarm Relay	PRI_COM PRI_NC PRI_NO	10 *(Note 1)* 27 43
Secondary Alarm Relay	SEC_COM SEC_NC SEC_NO	11 *(Note 1)* 28 44
Modulator Fault	MF	49 *(Note 2)*
Demodulator Fault	DF	33 *(Note 2)*
AGC Output	AGC_OUT	3

Notes:

1. Alarm relay contacts are named for normal no fault conditions (xx-COM connected to xx-NC if no fault).
2. Signals MF, DF, and DMA are open collector, high impedance, if faulted. MF and DF are used by a backup protection switch if the modem is used in a redundant system.

3.1.5.4 EIA-422 Data with IDR Overhead

The following procedure describes a path in which data can be passed using the EIA-422 format while the unit is operating with IDR overhead. Normally, data in IDR mode is sent in G.703 format and uses different pins in the Data I/O Interface Connector (J8). The only lines common between EIA-422 and IDR overhead are :

- EXT CLK
- MOD Fault
- Demod Fault

Perform the following procedure should be used with EIA-422 data applied to an IDR format.

Step	Procedures
1	Set Utility/Modem Type to Custom.
2	Set Utility/Interface/TX Overhead Type to IDR.
3	Set Utility/Interface/RX Overhead Type to IDR. **Note:** This will place the multiplexer and demultiplexer into operation.
4	Open the front panel and remove the Interface PCB (AS/4895 or AS/3495). a. For IBS Only - Set jumpers for EIA-422 at JP2, JP3, and JP5. b. For IDR Only - Set the jumpers for EIA-422 at JP1, JP7, JP22, and JP23. **Note:** This completes the transition from regular IDR to EIA-422.
5	Install Data I/O Connector J8 to 8004 Breakout panel. **Note:** This will transition the 50-pin connector to a 37-pin connector, allowing only the necessary pins to be used.

The remaining regular IDR overhead functions are:

- The four Backward Alarms Outputs
- The Backward Alarm Input 3 and 4.

In addition, Backward Alarms 1, 3, and 4 are disabled. They share a jumper (JP2) with TT/BW11 and 2 selection, because BW1, 3, and 4 share pins with an overhead function used in IBS mode.Backward Alarms 1, 3, and 4 can be enabled, but it would be necessary to split the ganged jumper into individual shunts. Contact Comtech EF Data Customer Support for additional information.

The operator may regain both audio channels by disabling the following:

- Request To Send (RTS)
- Clear To Send (CTS)
- Receiver Ready (RR)
- Data Mode (DM)

Notes:
1. Leave JP3 in the IDR position.
2. Set JP2 and JP 5 to IBS mode.

3.1.6 Auxiliary 1 Connector and Pinouts (J9)

AUX 1 connection is a 9-pin female D connector located on the rear panel of the modem, refer to Table 3-7. Screw locks are provided for mechanical security on the mating connector.

The auxiliary 1 (AUX 1) connector provides:

- Transistor-Tranistory logic
- Satellite clock signals
- External reference input
- 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. The external reference clock input is 5, 10, or 20 MHz.

AGC_OUT is the voltage for a receive signal level between -25 and -60 dBm.

Table 3-7. Auxiliary 1 Connector and Pinouts (J9)

Signal Function	Name	Pin #
Satellite clock-	SAT_CLK-	1
External reference	EXT_REF	2 *(see Note)*
Satellite clock+	SAT_CLK+	3
Modulator fault	MDTTLFLT	4
Ground	GND	5
Ground	GND	6
Demodulator fault	DMTTLFLT	7
Ground	GND	8
AGC Out	AGC Output	9

Note: This is an unbalanced input for a high stability site reference of either 5, 10, or 20 MHz. Comtech EF Data recommends that the Modulator PCB include the high stability option (to be used in Ext Ref input) for the modem to accept the site reference of 5, 10, or 20 MHz.

3.1.7 Alarms Connector and Pinouts (J10)

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

Refer to Chapter 6 for a discussion of alarms monitored. To obtain a system summary alarm, connect all the Form C contacts in parallel.

The alarms connection is a 9-pin female D connector located on the rear panel of the modem, refer to Table 3-8. Screw locks are provided for mechanical security on the mating connector.

Table 3-8. Alarms Connector and Pinouts (J10)

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

Note: A connection between the common (COM) and normally closed (NC) contacts indicates no alarm.

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

3.1.8 AC Power Connector

A standard detachable, non-locking, 3-prong power cord (IEC plug) supplies the Alternating Current (AC) power to the modem. Normal input voltage is 90 to 264 VAC, 47 to 63 Hz. The modem automatically switches between ranges. Maximum power consumption is less than 130W.

3.1.9 Ground Connector (GND)

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

Note: The AC power connector provides the safety ground.

Chapter 4. CONFIGURATION

This chapter describes the hardware configuration of the Display/M&C, modulator, demodulator, and interface PCBs.

4.1 Display/M&C Configuration

The Display/M&C PCB is located on the front panel of the modem. Figure 4-1. shows the Display/M&C card and jumper locations. Table 4-1lists the jumper settings.

Table 4-1. Display/M&C PCB Jumper Settings

Jumper	Position	Function
JP1	1 to 2 3 to 4 5 to 6 7 to 8	EIA-485 – Remote EIA-485 – Remote EIA-232 – Remote EIA-232 – Remote
JP2 (*See Note*)	1 to 2 2 to 3	4-Wire 2-Wire
JP3 (*See Note*)	1 to 2 2 to 3	4-Wire 2-Wire
JP5	1 to 2 2 to 3	EIA-485 – Remote EIA-232 – Remote
JP9 and JP10	32K 64K 128K 256K 256K	27C256 EEPROM at U17 27C512 EEPROM at U17 27C010 EEPROM at U17 27C020 EEPROM at U17 27C040 EEPROM at U17

Note: Pins JP2 and JP3 must be in the 4-wire position for EIA-232.

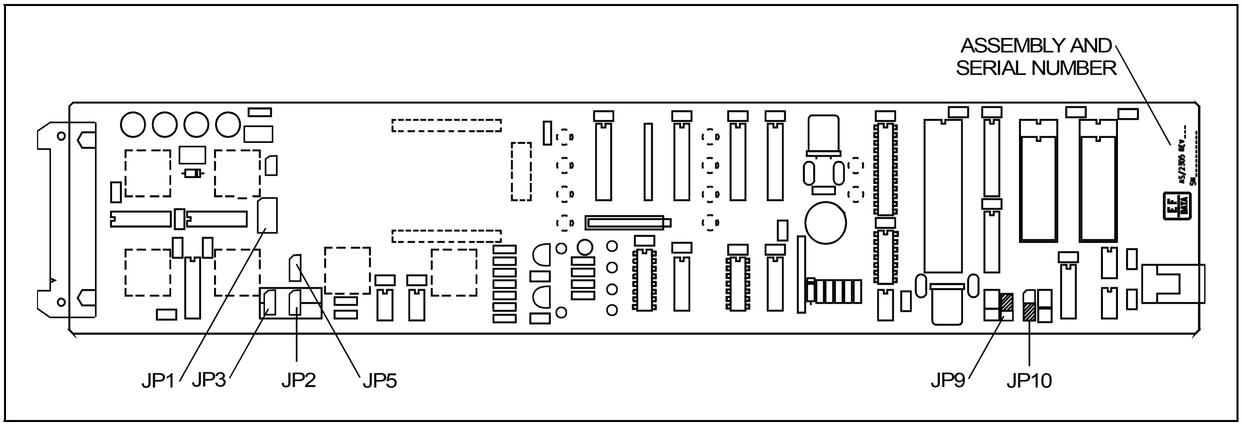


Figure 4-1. Display/M&C PCB

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 2 or more modems and switches on a common communications link. Use the EIA-232 interface to communicate with a single modem.

For EIA-485 configuration:	1. Install two jumpers (shunts) at the EIA-485 positions of JP1. 2. Install one jumper at the EIA-485 position of JP5. 3. For 2- or 4-wire operation, place jumpers JP2 and JP3 in the designated positions.
For EIA-232 configuration:	1. Install two jumpers (shunts) at the EIA-232 positions of JP1. 2. Install one jumper at the EIA-232 position of JP5. 3. Place jumpers JP2 and JP3 in the 4-wire operation positions.

4.1.1 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 6). The programmed baud rate and parity are maintained indefinitely in Random Access Memory (RAM) on the M&C module. The parity bits can be set to EVEN or ODD. The available baud rates are listed below:

- 110
- 150
- 300
- 600
- 1200
- 2400
- 4800
- 9600
- 19200

4.1.2 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 6) to program the addresses.

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

4.2 Modulator Configuration

The top slot of the modem chassis contains the Modulator PCB (AS/5039-X). Table 4-2 lists the jumper settings. Figure 4-2 shows the modulator card and jumper locations.

Table 4-2. Modulator (AS/5039) PCB Jumper Settings

Jumper	Position	Function
J3	1.2	Output Enable
J4	1.2	PROM Size Selection
JP4	2.3	Q Channel Data
JP5	2.3	I Channel Data

Note: The modulator PCB jumpers are factory set.

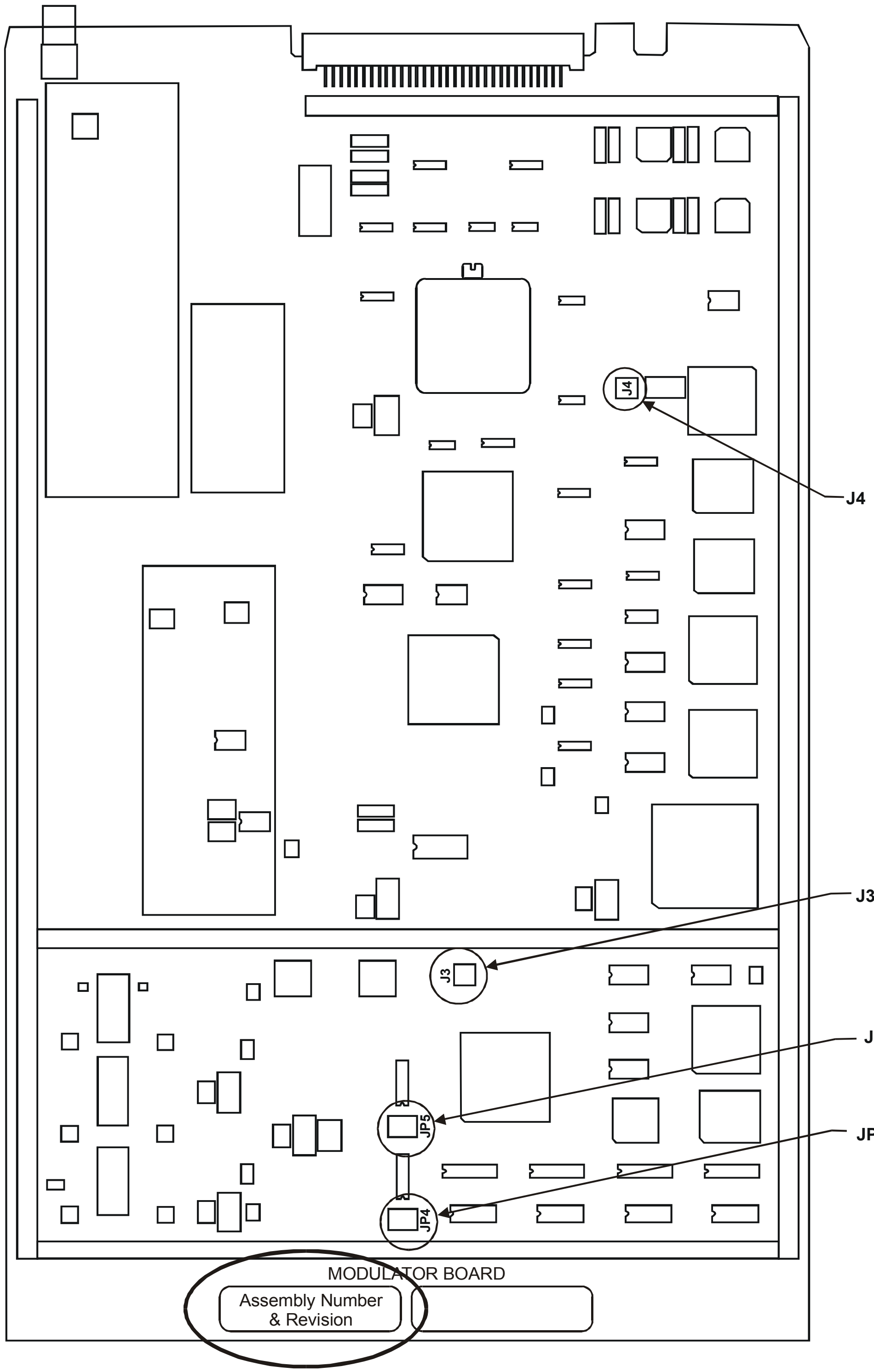


Figure 4-2. Modulator (AS/5039) PCB

4.3 Demodulator Configuration

The bottom slot of the modem chassis contains the Demodulator PCB (AS/4895-X). Table 4-3 lists the jumper settings. Figure 4-3 shows the demodulator card and jumper locations.

Table 4-3. Demodulator (AS/4895) PCB Jumper Settings

Jumper	Position	Function
JP1	2.3	Data Clock
JP2	2.3	PROM Size Selection
JP3	1.2	Q Data
JP4	1.2	I Data
TP9	1.2	RFB Test Point
TP10	1.2	RF Test Point

Note: The demodulator PCB jumpers are factory set.

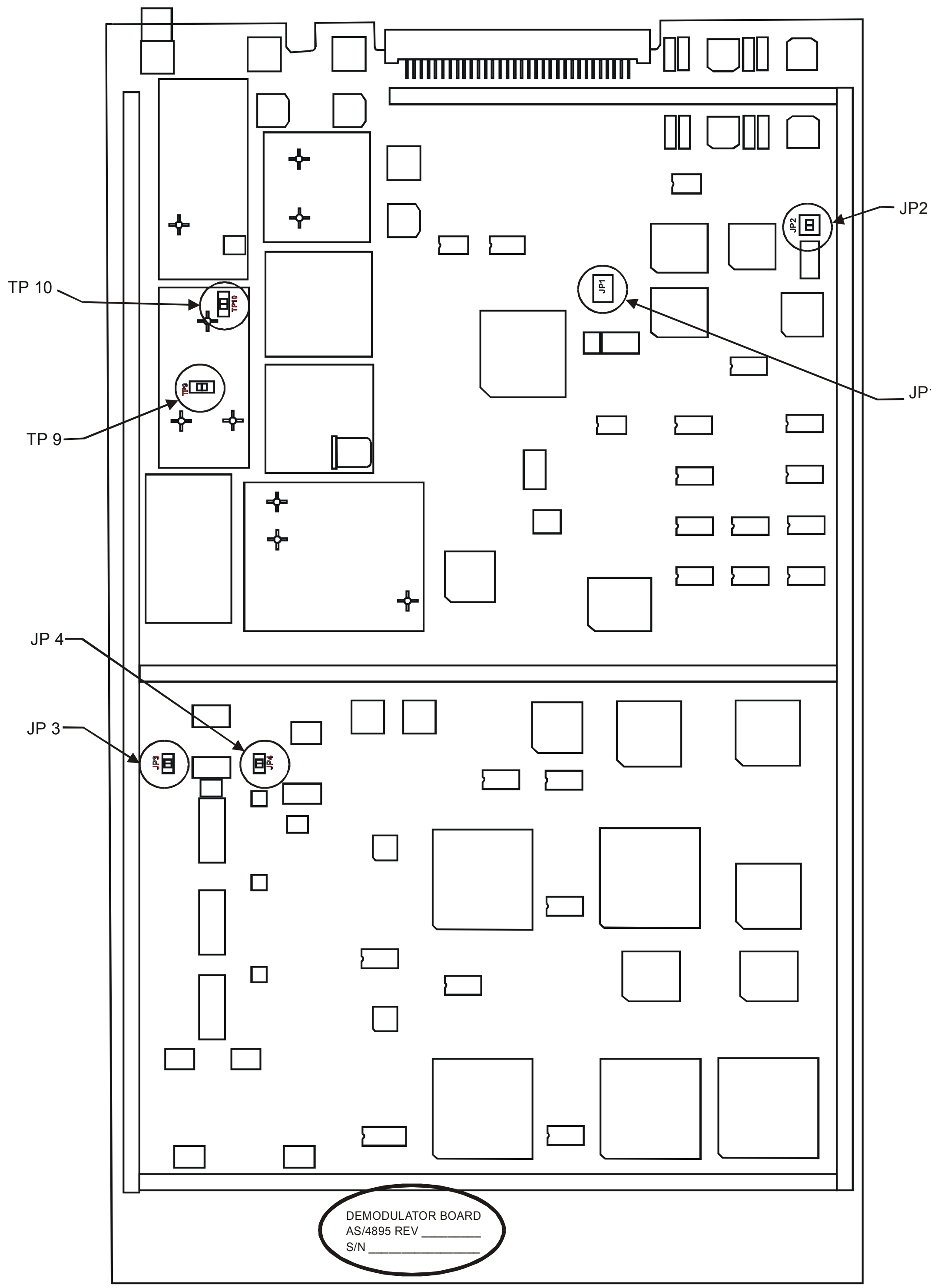


Figure 4-3. Demodulator (AS/4895) PCB

4.4 Interface Configuration

The Interface PCB (AS/3495-x) is located in the middle slot of the modem chassis.

The interface PCB has jumpers that must be set for various modes of operation. Table 4-4 lists the interface PCB jumper settings for all available options. Figure 4-4 shows the jumper locations. The silk-screen on the interface PCB includes all necessary jumper information.

Note: For proper jumper installation, position the interface PCB with the ejector end directly in front of the user. An "X" indicates a "don't care" state for a jumper.

Table 4-4. Interface Configuration Jumper Settings

	IDR		IBS			
Jumpers	**Standard**	**64K Option**	**G.703**	**V.35**	**EIA-422**	**D&I**
JP1	X	Left	X	Right	Left	X (EIA-422)
JP2	Right	Right	Left	Left	Left	IBS
JP3	Right	Left	Left	Left	Left	Left
JP4	N/A	N/A	N/A	N/A	N/A	
JP5	Right	Right	Left	Left	Left	IBS
JP7	OFF	OFF	OFF	Right	Left	OFF
JP8	N/A	N/A	N/A	N/A	N/A	
JP16 (*Note 2*)	Factory Set	Factory Set	Factory Set	Factory Set	Factory Set	
JP22	OFF	OFF	OFF	Right	Left	OFF
JP23	OFF	Left	OFF	Right	Left	OFF
G.703 Levels						
	High Drive		**Nominal Level**	**Nominal Shaped**	**Low Level**	**Low Shaped**
JP9	OFF		OFF	ON	OFF	ON
JP10	OFF		OFF	OFF	ON	ON
JP11	OFF		OFF	OFF	OFF	OFF

Notes:

1. For proper jumper installation, position the interface PCB with the ejector end directly in front of the user. An “X” indicates a “don’t care” state for a jumper.
2. An interface relay board option is available. This option provides an easy method for changing the data interface. The relay board replaces the need to physically change the multi-pin jumpers by enabling the user to select data interfaces from the modem front panel. Set VP16 in the 64K position when using the interface relay board. The firmware for the M&C must be ≥ FW/2448-1K
3. D&I 308-5 Rev. 6 specifications require all jumpers to be set to IBS.
4. In D&I mode, JP2, JP3, and JP5 may be set to IDR when not using overhead.
5. The following table lists the minimum firmware upgrade requirements needed to enable the 64 kbit feature:

Card	Location	Firmware
M&C	U17	FW/2448-1V
Interface	U109 and U110	FW/2882-M
Interface	U111	FW/2451-2V

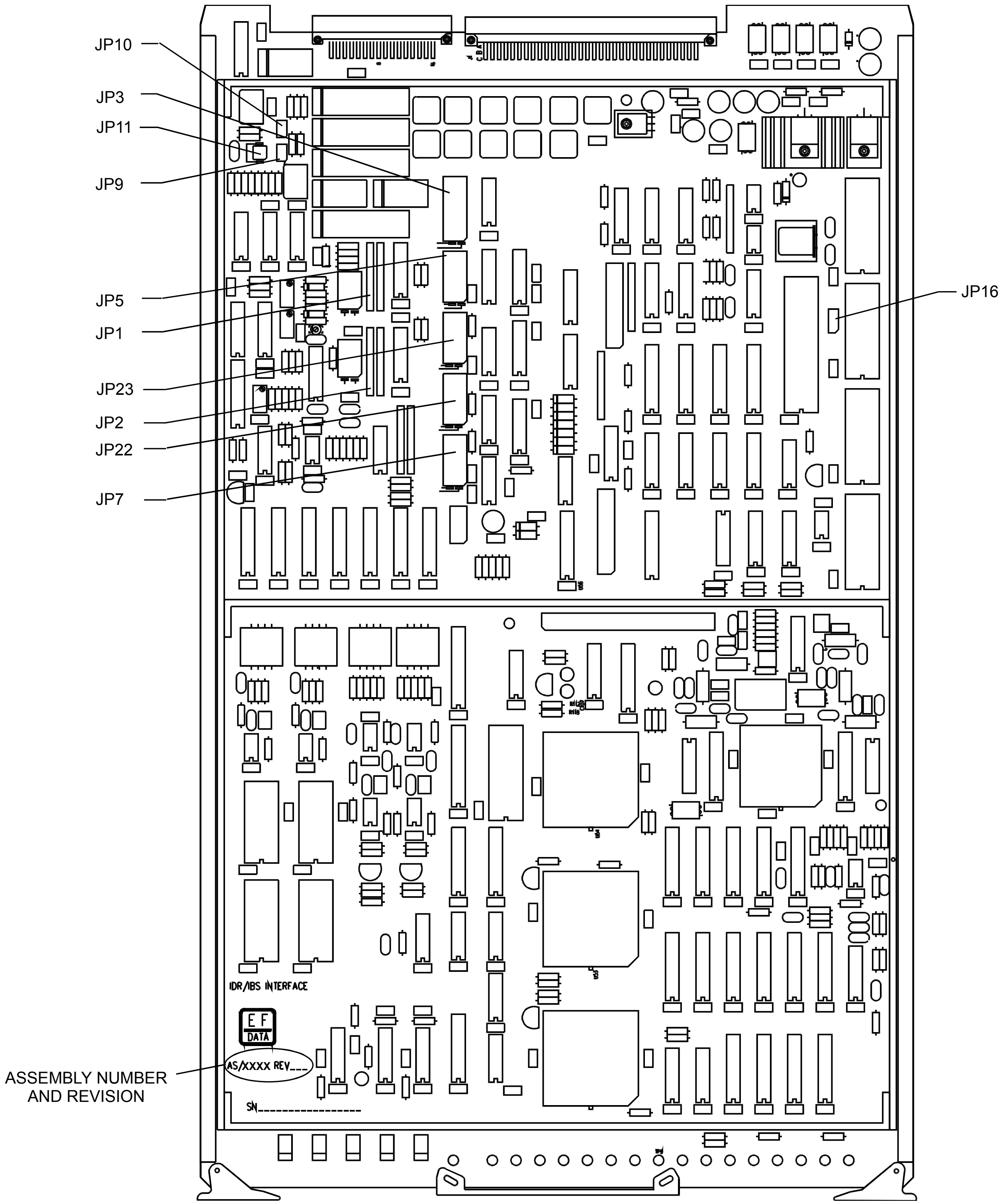


Figure 4-4. Interface PCB

Table 4-5 lists the interface configuration jumper setting for Type X operation.

Table 4-5. Type X Interface Configuration Jumper Settings

Type	Jumper Positions
1 (SDM-308-4/M1200P)	Set jumpers per IDR option.
2 (SDM-309/M1200P)	Set jumpers per IBS option.
3 (SDM-308-5)	Set jumpers per IBS option.
4 (SDM-308-4/old IDR interface)	Set jumpers per IDR option.
5 (SDM-308-4/M1200P/RS)	

Note: Refer to Table 4-4 for jumper positions.

Table 4-6 lists a description of all jumpers and functions for IDR, IBS, and D&I operations.

Table 4-6. Description of Interface Jumpers

Jumper #	Name	Function
JP1	EIA-422/V.35	Configures RTS receiver for balanced EIA-422 or unbalanced V.35.
JP2	IBS DATA/IDR BWA	Configures IBS (and all EIA-422/V.35 formats), SCTE (TT), and TX Octet (IBS only). Backward alarm input for IDR (BWA 1 to BWA 4).
JP3	IBS DATA/IDR AUDIO	Configures EIA-422 or V.35 for data signals RTS, CTS, DSR, and RLSD. See JP1 and JP22 and Adaptive Differential Pulse Code Modulation (ADPCM) Audio for IDR only.
JP5	IBS DATA/IDR 8KB	Configures for RX type data signal drivers. See JP6 and JP7 8 KB data drivers for IDR only.
JP7	RS422/V.35 (RX DRIVERS)	Configures EIA-422 or V.35 driver types for RX data signals. Do not use this jumper for G.703 interface (marked OFF).
J16	SET AT FACTORY	64K position for interface relay board option.
JP22	RS422/V.35 (HS DRIVERS)	Configures EIA-422 or V.35 driver types for CTS, DSR, and RLSD signals. Do not use this jumper for G.703 interface (marked OFF).
JP23	RS422/V.35 (TX DRIVERS)	Configures EIA-422 or V.35 for TX side SCT CLK driver.
Nonconfigurable Jumpers for G.703 Driver Types		
J3 and J4	REED-SOLOMON	Reed-Solomon option.
J5	FACTORY TEST	Factory testing and service.
J6	DROP & INSERT	D&I option.
JP9	SHAPED	Shaped or rectangular pulses (shaped only for 6.312 Mbit/s T2).
JP10	LO LEVEL	Low or normal level. Low for 6.312 Mbit/s T2. Normal for 1.544 Mbit/s T1.
JP11	HI LEVEL	High or normal level (high for 2.048 Mbit/s and 8.448 Mbit/s E1, E2).

4.5 Software Configuration

This section consists of the following software information:

- Configuration of modem types
- Revision emulation
- Modem emulation
- Remote interface specification
- Modem defaults

4.5.1 Modem Types

The modem can be configured to the types of operation specified in Table 4-7. Each mode allows the modem to operate under the requirements of the following configuration specifications.

Table 4-7. Modem Types

Configuration	Specification
IDR	IESS-308
IBS	IESS-309
D&I	IESS-308-5
Custom	Access all modes
ASYNC	AUPC and closed network overhead
Type X (1 to 5)	Access SDM-308/309 modems

Note: To program an evaluation mode of a previous functional revision, use the revision emulation feature in the Utility menu. Refer to Chapter 6 for more information.

4.5.1.1 IDR, IBS, and D&I Operation

This section describes how to enter the modes of operation for IDR, IBS, and D&I.

Step	Procedures
1	Set all hardware jumpers on the interface PCB to the proper positions. Section 3.1 lists all interface PCB jumpers that must be set for various modes of operation. Table 4-4 lists the jumper settings required for each configuration.
2	If all hardware jumpers are not properly set, the modem will not allow the modem type change. If this occurs: a. Enter the **Modem Type: Compatibility** through the **Utility: Modem Type** menu. For more information, refer to Chapter 6. b. Select the proper mode of operation. A configuration subsection will aid in finding any compatibility problem. For more information about the modem utility function, refer to Chapter 6.
3	Use the front panel keypad to select the type of modem operation at the **Modem Type** menu. When the change occurs, the modem will automatically reset all of the settings to the default conditions for that mode of operation. Refer to Section 3.6 for a list of default settings. The IF output setting in the **Configuration: Modulator** menu must be turned on.

When stepping through the front panel menu, the modem will not allow access to menus that are not functions of the selected mode. This eliminates the selection of any incompatible parameters. Refer to Chapter 6 for general front panel operation and modem configuration changes.

4.5.1.2 Custom Operation

To operate in the Custom mode, enter Modem Type and select Custom. The modem does not change the default settings when entering this mode of operation. All currently programmed parameters will remain effective.

CAUTION

Use caution when operating in the Custom mode. This mode accepts all modem settings, including incompatible parameters. Improper jumper settings will not lock out the modem mode change. Users should become familiar with the procedures prior to operating the modem.

4.5.2 Remote Interface Specification

Refer to Appendix A for the current remote interface specification. Appendix A defines the protocol and command structure for remote control and status monitoring of the modem.

4.5.3 Revision Emulation

To program an emulation mode from Version 2.1.1 through the current version, use the revision emulation feature in the Utility Modem Type menu. Refer to Table 4-8.

Notes:

1. 8-PSK is only available if the modulator M&C firmware (FW/2449-1) is Rev. E or greater and installed on the new modulator PCB (AS/3415).
2. 8-PSK is only available if the demodulator M&C firmware (FW/2450-2) is Rev. - or greater and installed on the new demodulator PCB (AS/3416).
3. Programming a functional number (2 through X) eliminates all changes (disables new features/options) for the later version numbers.
4. Programming Current Version (default) allows all features and options to operate (if installed).
5. The user must manually program the functional version on a cold-start (default is Current Version).
6. Revision emulation will not affect some user interface changes that do not affect direct operation of the modem. For example: **Configuration: Save/Recall** cosmetic changes, test mode screen in the **Utility:System** menu; all factory setup modes, etc.
7. Set revision emulation to Current Version for modem type emulation operation.
8. The newest revision modem should be placed in the backup position when the modem is placed in a protection switch system. Use revision emulation to match modems in a protection switch system if moving a modem is not feasible.

Table 4-8. SDM-8000 Revision Emulation

Functional #	S/W Version	Firmware #	Description of Change
2	2.1.1	2448-1A	Original version.
3	3.1.1	2448-1B	Addition of Viterbi BPSK 1/2.
4	4.1.1	2448-1C	Addition of modulator/demodulator high-stability internal 5 MHz/ external divider option.
5	5.1.1	2448-1E	Addition of modulator/demodulator spectrum rotation feature; a revision emulation feature; and a Reed-Solomon option.
6	6.1.1	2448-1F	Addition of IDR backward alarm control feature.
7	7.1.1	2448-1H	Addition of IDR backward alarm control feature.
8	8.1.1	2448-1I	Addition of modulator/demodulator Viterbi 8PSK 2/3.
9	9.1.1	2448-1J	Addition of modulator/demodulator Viterbi 16-QAM 3/4 and 16-QAM 7/8; Type 1 modem type. Changed to MCS/MCP/DCS/DCP/ICS remote commands.
10	10.1.1	2448-1K	Addition of interface relay board option.
11	11.1.1	2448-1L	Addition of 1/1 QPSK; ASYNC overhead option and modem emulation feature.
12	12.1.1	2448-1N	Addition of support for 8 bits, no parity; Allow IF frequencies from 90 to 100 MHz per specification.
13	13.1.1	2448-1P	Addition of support for Reed-Solomon DVB, SMS-7000.
14	14.1.1	2448-1T	Addition of support for Async EIA-485.
15	15.1.1	2448-1U	Addition of DVB for interface overhead type.
16	16.1.1	2448-1V	To provide support for IDR 64K ESC.
17	16.1.2	2448-1W	To provide support for scrambler in D&I, IBS, or Custom Mode.
18	17.1.1	2448-1Y	Addition of IESS-310 Mode.
19	18.1.1	2448-1AA	To provide support for SCT Phase Lock Loop Option. (Must have high stability modulator.)
20	19.1.1	2448-1AC	Made PLL fault action programmable and Reed-Solomon no longer automatically turns off.
21	20.1.1	2448-1AD	To support 8-PSK 5/6.

4.5.4 Modem Emulation

Table 4-9 lists the types of modem emulations this modem handles. This allows the modem to be used in place of the following pre-existing modems in a rack system. The emulation is identified by Type X, where X is the number of the emulation type (1 through 5).

Refer to the front panel menus in Chapter 6 to set up the modem for Type 1 through 5 operation. Table 4-10 list the modem emulation software and operating requirements.

Table 4-9. Modem Emulation Types

Type X	Modem Emulation	Operation
1	SDM-308-4/M1200P	IDR
2	SDM-309/M1200P	IBS
3	SDM-308-5	IBS
4	SDM-308-4 (old IDR interface)	IDR
5	SDM-308-4/M1200P/RS	

Table 4-10. Modem Emulation

Type 1			
Modem	**Firmware**	**Version**	**Description of Change**
SDM-308-4/1200P	0713-61D 0713-61C 0713-61B 0713-61A 0713-61- 0713-23I 0713-23H 0713-23G 0713-23F	6.04 6.03 6.02 6.01 6.00 3.09 3.08 3.07 3.06	1. 70/140 MHz modulator/demodulator. 2. 16.0 dB E_b/N_0. 3 Variable modulator/demodulator filters. 4. N/A not allowed for rate assignments. 5. Displays 99% instead of No Data for buffer fill status. 6. Allow transmit clock source of EXT_reference regardless of EXT REF FREQ. SDM-8000 TX data rate must match EXT REF FREQ. SDM-8000 is programmable.
Type 2			
Modem	**Firmware**	**Version**	**Description of Change**
SDM-309/1200P	0713-59C 0713-59B 0713-59A 0713-59- 0713-56A	6.03 6.02 6.01 6.00 4.01	1. 70/140 MHz modulator/demodulator. 2. 16.0 dB E_b/N_0. 3 Variable modulator/demodulator filters. 4. N/A not allowed for rate assignments. 5. Displays 99% instead of No Data for buffer fill status. 6. Allow transmit clock source of EXT_reference regardless of EXT REF FREQ. SDM-8000 TX data rate must match EXT REF FREQ. SDM-309 is programmable.
Type 3			
Modem	**Firmware**	**Version**	**Description of Change**
SDM-308-5	0713-61E 0713-61D 0713-61C 0713-61B	6.05 6.04 6.03 6.02	1. 70/140 MHz modulator/demodulator. 2. 16.0 dB E_b/N_0. 3 Variable modulator/demodulator filters. 4. N/A not allowed for rate assignments. 5. Displays 99% instead of No Data for buffer fill status.
Type 4			
Modem	**Firmware**	**Version**	**Description of Change**
SDM-308-4 (Old IDR interface	0713-62C 0713-62B 0713-62A 0713-62- 0713-10K	4.03 4.02 4.01 4.00 2.72	1. 70/140 MHz modulator/demodulator. 2. 16.0 dB E_b/N_0. 3 Variable modulator/demodulator filters. 4. N/A not allowed for rate assignments. 5. Displays 99% instead of No Data for buffer fill status.
Type 5			
Modem	**Firmware**	**Version**	**Description of Change**
SDM308-4/1200P/RS			

4.6 Modem Defaults

The M&C default settings are loaded into the modem after a hard reset (Chapter 6). These default settings are also loaded each time the modem type is changed to IDR, IBS, or D&I. When selecting Custom for the modem type, the current configuration parameters do not change. This section contains the default settings.

Note: The following system settings will not revert to the default values after a hard reset:

- Parity
- Remote Address
- Remote Baud Rate

4.6.1 IDR

Refer to Table 4-11 for IDR Defaults.

Table 4-11. IDR Defaults

Modulator Defaults		Demodulator Defaults	
Data Rate	[A (QPSK 3/4)]	Data Rate	[A (QPSK 3/4)]
TX Rate A	[1640 kbit/s]	RX Rate A	[1640 kbit/s]
TX Rate B	[2144 kbit/s]	RX Rate B	[2144 kbit/s]
TX Rate C	[6408 kbit/s]	RX Rate C	[6408 kbit/s]
TX Rate D	[8544 kbit/s]	RX Rate D	[8544 kbit/s]
TX Rate V	[1640 kbit/s]	RX Rate V	[1640 kbit/s]
IF Frequency	[70 MHz]	IF Frequency	[70 MHz]
IF Output	[OFF]	Demodulator Type	[INTELSAT Open]
Mod Power Offset	[0 dB]	V.35 Descrambler	[ON]
TX Power Level	[-10 dBm]	Differential Decoder	[ON]
V.35 Scrambler	[ON]	Decoder Type	[Viterbi]
Differential Encoder	[ON]	IF Loopback	[OFF]
		Demod Spectrum	[Normal]
Modulator Type	[INTELSAT Open Net]	RF Loopback	[OFF]
Encoder Type	[Viterbi]	Sweep Center	[0 Hz]
Carrier Mode	[Normal (OFF)]	Sweep Range	[60000 Hz]
Mod Power Fixed	[0 dB]	Reacquisition	[0 seconds]
Mod Spectrum	[Normal]	BER Threshold	[NONE]
Interface Defaults			
TX Clock Source	[TX Terrestrial]	Buffer Program	[Bits]
Buffer Clk Source	[RX Satellite]	Buffer Size	[384]
TX Clock Phase	[Auto]	T1 Framing Structure	[G.704]
RX Clock Phase	[Normal]	E1 Framing Structure	[G.704]
Ext-Ref Freq	[1544 kHz]	T2 Framing Structure	[G.743]
B-Band Loopback	[OFF]	E2 Framing Structure	[G.742]
Intrfc Loopback	[OFF]	Service Channel TX	[-5 dBm]
TX Coding Format	[AMI]	Service Channel RX	[-5 dBm]
RX Coding Format	[AMI]	Loop Timing	[OFF]
TX 2047 Pattern	[OFF]	TX Overhead Type	[IDR]
RX 2047 Pattern	[OFF]	RX Overhead Type	[IDR]
TX Data Fault	[NONE]	TX Data Phase	[Normal]
RX Data Fault	[NONE]	RX Data Phase	[Normal]
TX Terr Interface	[G.703]	IDR B/W Alarm Control	[ON]
RX Terr Interface	[G.703]		

4.6.2 IBS

Refer to Table 4-12 for IBS Defaults.

Table 4-12. IBS Defaults

Modulator Defaults		Demodulator Defaults	
Data Rate	[A (QPSK 1/2)]	Data Rate	[A (QPSK 1/2)]
TX Rate A	[64 kbit/s]	RX Rate A	[64 kbit/s]
TX Rate B	[265 kbit/s]	RX Rate B	[256 kbit/s]
TX Rate C	[768 kbit/s]	RX Rate C	[768 kbit/s]
TX Rate D	[2048 kbit/s]	RX Rate D	[2048 kbit/s]
TX Rate V	[128 kbit/s]	RX Rate V	[128 kbit/s]
IF Frequency	[70 MHz]	IF Frequency	[70 MHz]
IF Output	[OFF]	Decoder Type	[Viterbi]
Mod Power Offset	[0 dB]	Differential Decoder	[ON]
TX Power Level	[-10 dBm]	Demodulator Type	[INTELSAT Open]
Differential Encoder	[ON]	IF Loopback	[OFF]
Modulator Type	[INTELSAT Open Net]	RF Loopback	[OFF]
Encoder Type	[Viterbi]	Sweep Center	[0 Hz]
Carrier Mode	[Normal (OFF)]	Sweep Range	[60000 Hz]
Mod Power Fixed	[0 dB]	Reacquisition	[0 seconds]
Mod Spectrum	[Normal]	BER Threshold	[NONE]
		Demod Spectrum	[Normal]
Interface Defaults			
TX Clock Source	[TX Terrestrial]	Buffer Program	[bits]
Buffer Clock Source	[RX Satellite]	Buffer Size	[384 bits]
TX Clock Phase	[Auto]	IBS Scrambler	[ON]
RX Clock Phase	[Normal]	IBS Descrambler	[ON]
Ext-Ref Freq	[1544 kHz]	T1 Framing Structure	[G.704]
B-Band Loopback	[OFF]	E1 Framing Structure	[G.704]
Intrfc Loopback	[OFF]	T2 Framing Structure	[G.743]
TX Coding Format	[AMI]	E2 Framing Structure	[G.742]
RX Coding Format	[AMI]	Loop Timing	[OFF]
TX 2047 Pattern	[OFF]	TX Overhead Type	[IBS]
RX 2047 Pattern	[OFF]	RX Overhead Type	[IBS]
TX Data Fault	[NONE]	TX Terr Interface	[G.703]
RX Data Fault	[NONE]	RX Terr Interface	[G.703]
RX Data Phase	[Normal]	TX Data Phase	[Normal]

4.6.3 Drop & Insert

Refer to Table 4-13 for Drop & Insert (D&I) Defaults.

Table 4-13. D&I Defaults

Modulator Defaults		**Demodulator Defaults**	
Data Rate	[A (QPSK 1/2)]	Data Rate	[A (QPSK 1/2)]
TX Rate A	[64 kbit/s]	RX Rate A	[64 kbit/s]
TX Rate B	[256 kbit/s]	TX Rate B	[256 kbit/s]
TX Rate C	[768 kbit/s]	RX Rate C	[768 kbit/s]
TX Rate D	[2048 kbit/s]	RX Rate D	[2048 kbit/s]
TX Rate V	[128 kbit/s]	RX Rate V	[128 kbit/s]
IF Frequency	[70 MHz]	IF Frequency	[70 MHz]
IF Output	[OFF]	Differential Decoder	[ON]
TX Power Level	[-10 dBm]	RF Loopback	[OFF]
Differential Encoder	[ON]	IF Loopback	[OFF]
Carrier Mode	[Normal (OFF)]	BER Threshold	[NONE]
Modulator Ref.	[Internal]	Sweep Center	[0 Hz]
Mod Power Offset	[0 dB]	Sweep Range	[60000 Hz]
Mod Power Fixed	[0 dB]	Reacquisition	[0 seconds]
Modulator Type	[INTELSAT Open]	Demodulator Type	[INTELSAT Open]
Encoder Type	[Viterbi]	Decoder Type	[Viterbi]
Mod Spectrum	[Normal]	Demod Spectrum	[Normal]
Interface Defaults			
TX Clock Source	[TX Terrestrial]	IBS Scrambler	[ON]
TX Clock Phase	[Auto]	IBS Descrambler	[ON]
Ext-Ref Freq.	[1544 kHz]	Drop Data Format	[T1]
Buffer Clock Source	[Insert]	Insert Data Format	[T1]
Buffer Size	[1 ms]	TX Overhead Type	[D&I]
RX Clock Phase	[Normal]	RX Overhead Type	[D&I]
B-Band Loopback	[OFF]	TX Terr Interface	[G.703]
INTRFC Loopback	[OFF]	RX Terr Interface	[G.703]
Loop Timing	[OFF]	Buffer Program	[ms]
TX Coding Format	[AMI]	T1 Framing Structure	[G.704]
RX Coding Format	[AMI]	T2 Framing Structure	[G.743]
TX Data/AIS Fault	[NONE]	E1 Framing Structure	[G.704]
RX Data/AIS Fault	[NONE]	E2 Framing Structure	[G.742]
TX 2047 Pattern	[OFF]	TX Data Phase	[Normal]
RX 2047 Pattern	[OFF]	RX Data Phase	[Normal]

Note: When selecting E1_CAS or E1_CCS D&I data format, the defaults in the D&I data channels are offset by 1 from 16 and up. When programming from E1_CAS or E1_CCS to any other format, the D&I channels are defaulted to straight through.

4.6.4 Custom

Refer to Table 4-14 for Custom Defaults.

Table 4-14. Custom Defaults

Modulator Defaults		Demodulator Defaults	
Data Rate	[A (QPSK 1/2)]	Data Rate	[A (QPSK 1/2)]
TX Rate A	[64 kbit/s]	RX Rate A	[64 kbit/s]
TX Rate B	[265 kbit/s]	RX Rate B	[256 kbit/s]
TX Rate C	[768 kbit/s]	RX Rate C	[768 kbit/s]
TX Rate D	[2048 kbit/s]	RX Rate D	[2048 kbit/s]
TX Rate V	[128 kbit/s]	RX Rate V	[128 kbit/s]
IF Frequency	[70 MHz]	IF Frequency	[70 MHz]
TX-IF Output	[OFF]	Descrambler	[ON]
TX Power Level	[-10 dBm]	Differential Decoder	[ON]
Scrambler	[ON]	RF Loopback	[OFF]
Differential Encoder	[ON]	IF Loopback	[OFF]
Carrier Mode	[Normal (OFF)]	BER Threshold	[NONE]
Modulator Ref.	[Internal]	Sweep Center	[0 Hz]
Mod Power Offset	[0 dB]	Sweep Range	[60000 Hz]
Mod Power Fixed	[0 dB]	Reacquisition	[0 seconds]
Modulator Type	[INTELSAT Open]	Demodulator Type	[INTELSAT Open]
Encoder Type	[Viterbi]	Decoder Type	[Viterbi]
Mod Spectrum	[Normal]	Demod Spectrum	[Normal]
Interface Defaults			
TX Clock Source	[TX Terrestrial]	TX 2047 Pattern	[OFF]
TX Clock Phase	[Auto]	RX 2047 Pattern	[OFF]
Ext-Ref Freq.	[1544 kHz]	TX Overhead Type	[NONE]
Buffer Clock	[RX Satellite]	RX Overhead Type	[NONE]
Buffer Size	[384 bits]	TX Terr Interface	[G.703]
RX Clock Phase	[Normal]	RX Terr Interface	[G.703]
B-Band Loopback	[OFF]	Buffer Program	[bits]
INTRFC Loopback	[OFF]	T1 Framing Structure	[G.704]
Loop Timing	[OFF]	T2 Framing Structure	[G.743]
TX Coding Format	[AMI]	E1 Framing Structure	[G.704]
RX Coding Format	[AMI]	E2 Framing Structure	[G.742]
TX Data Fault	[NONE]	TX Data Phase	[Normal]
RX Data Fault	[NONE]	RX Data Phase	[Normal]

4.6.5 Type X (1 through 5)

Refer to Table 4-15 for Type X (1 through 5) Defaults.

Table 4-15. Type X (1 Through 5) Defaults

Modulator Defaults		Demodulator Defaults	
Data Rate	A (QPSK 3/4)	Data Rate	A (QPSK 3/4)
TX Rate A	1640 kbit/s	RX Rate A	1640 kbit/s
TX Rate B	2144 kbit/s	RX Rate B	2144 kbit/s
TX Rate C	6408 kbit/s	RX Rate C	6408 kbit/s
TX Rate D	8544 kbit/s	RX Rate D	8544 kbit/s
TX Rate V	1640 kbit/s	RX Rate V	1640 kbit/s
IF Frequency	70 MHz	IF Frequency	70 MHz
IF Output	OFF	Demodulator Type	INTELSAT Open
Mod Power Offset	-5 dB	V.35 Descrambler	ON
TX Power Level	-10 dBm	Differential Decoder	O]
V.35 Scrambler	ON	Decoder Type	Vterbi
Differential Encoder	ON	IF Loopback	OFF
Modulator Type	INTELSAT Open	RF Loopback	OFF
Encoder Type	Viterbi	Reacquisition	0 seconds
Carrier Mode	Normal (OFF)	BER Threshold	NONE
Interface Defaults			
TX Clock Source	TX Terrestrial	RX Data Fault	NONE
Buffer Clock Source	Auto	TX Data Fault	NONE
Ext-Ref Freq.	1544 kHz	Buffer Program	Bits
B-Band Loopback	RX Satellite	Buffer Size	9840 bits
Intrfc Loopback	9840 bits	Service Channel TX1	-5 dBm
TX Coding Format	Normal	Service Channel TX2	-5 dBm
RX Coding Format	OFF	Service Channel RX1	-5 dBm
TX 2047 Pattern	OFF	Service Channel RX2	-5 dBm
RX 2047 Pattern	AMI	TX Overhead Type	IDR
RX Terr Interface	AMI	RX Overhead Type	IDR]
TX Terr Interface	NONE	TX Clock Phase	Auto
RX Data Fault	NONE	RX Clock Phase	Normal

4.6.6 System

Refer to Table 4-16 for System Defaults.

Table 4-16. System Defaults

Time	[12:00 AM]	Operation Mode	[Duplex]
Date	[7/4/76]	Ext AGC: Min Pwr	[0.0 V]
Remote Baud Rate	[9600]	Ext AGC: Max Pwr	[0.0 V]
Parity	[EVEN]	Modem Type	[Custom]
Remote Address	[1]	Insert CRC Enable	[ON]

4.7 8-PSK 2/3 IESS Operation

Whenever IESS-310 mode is turned OFF the Reed-Solomon parameters (N/K/T/I) used are the same as usual. When IESS-310 mode is turned ON, new Reed-Solomon parameters are used (8-PSK, 2/3 only). Refer to Table 3-1 of Reed-Solomon parameters used on the SDM-8000 modem.

The user interface changes on the modem include new menus located in the Utility Modulator and Demodulator. The menus are named: “TX IESS-310 MODE” and “RX IESS-310 MODE.” They are displayed at all times to allow flexibility for the user to make mdoem changes in any order. Also, there are new remote commands and reworked commands for switch support and M&C systems (“BCS_”).

Table 4-17. 8-PSK 2/3 IESS-310 Operation Parameters

Parameter	N	K	T	I
None/ASYNC				
(IESS310 Off) or (non–8PSK 2/3)	225	205	10	8
(IESS310 On) and (CR=8PSK 2/3)	219	210	9	4
IBS/D&I				
(IESS310 Off) or (non–8PSK 2/3)	126	112	7	4
(IESS310 On) and (CR=8PSK 2/3)	219	201	9	4
IDR (T1)				
(IESS310 Off) or (non–8PSK 2/3)	225	205	10	4
(IESS310 On) and (CR=8PSK 2/3)	219	201	9	8
IDR (E1)				
(IESS310 Off) or (non–8PSK 2/3)	219	201	9	4
(IESS310 On) and (CR=8PSK 2/3)	219	201	9	8
IDR (T2)				
(IESS310 Off) or (non–8PSK 2/3)	194	178	8	4
(IESS310 On) and (CR=8PSK 2/3)	219	201	9	8
IDR (E2)				
(IESS310 Off) or (non–8PSK 2/3)	194	178	8	4
(IESS310 On) and (CR=8PSK 2/3)	219	201	9	8
Required Firmware:				
SDM-8000 Host M&C	AS/2305	U17	FW/2448-1Y	Ver: 17.1.1
Interface M&C	AS/2697 AS/3495	U111	FW/2451-2W	Ver: 9.2.1
Reed-Solomon FW	AS/3708	U8	FW/4925D	

Note: Feature is not supported on AS/3241 Reed-Solomon PCB.

Chapter 5. THEORY OF OPERATION

This chapter contains the theory of operation for the modem PCBs, and discusses modulation types.

5.1 Display/M&C

The Display/M&C PCB is located on the front panel. This card, referred to as the M&C, monitors the modem and provides configuration updates to other modules within the modem when necessary.

The modem configuration parameters are maintained in battery-backed RAM, which provides total recovery after a power-down situation.

The M&C functions include extensive fault monitoring and status reporting.

All modem functions are accessible through a local front panel interface and a remote communications interface.

Refer to Chapter 4 for a diagram of the M&C card. A block diagram of the M&C is shown in Figure 5-1.

5.1.1 Theory of Operation

The M&C card is composed of the following subsections:

- Microcontroller
- Digital to Analog Converter (DAC)
- Read Only Memory (ROM)
- Analog to Digital Converter (ADC)
- RAM
- Inter-Modem Communications
- Universal ASYNC
- User Interface
- Receiver/Transmitter (UART)

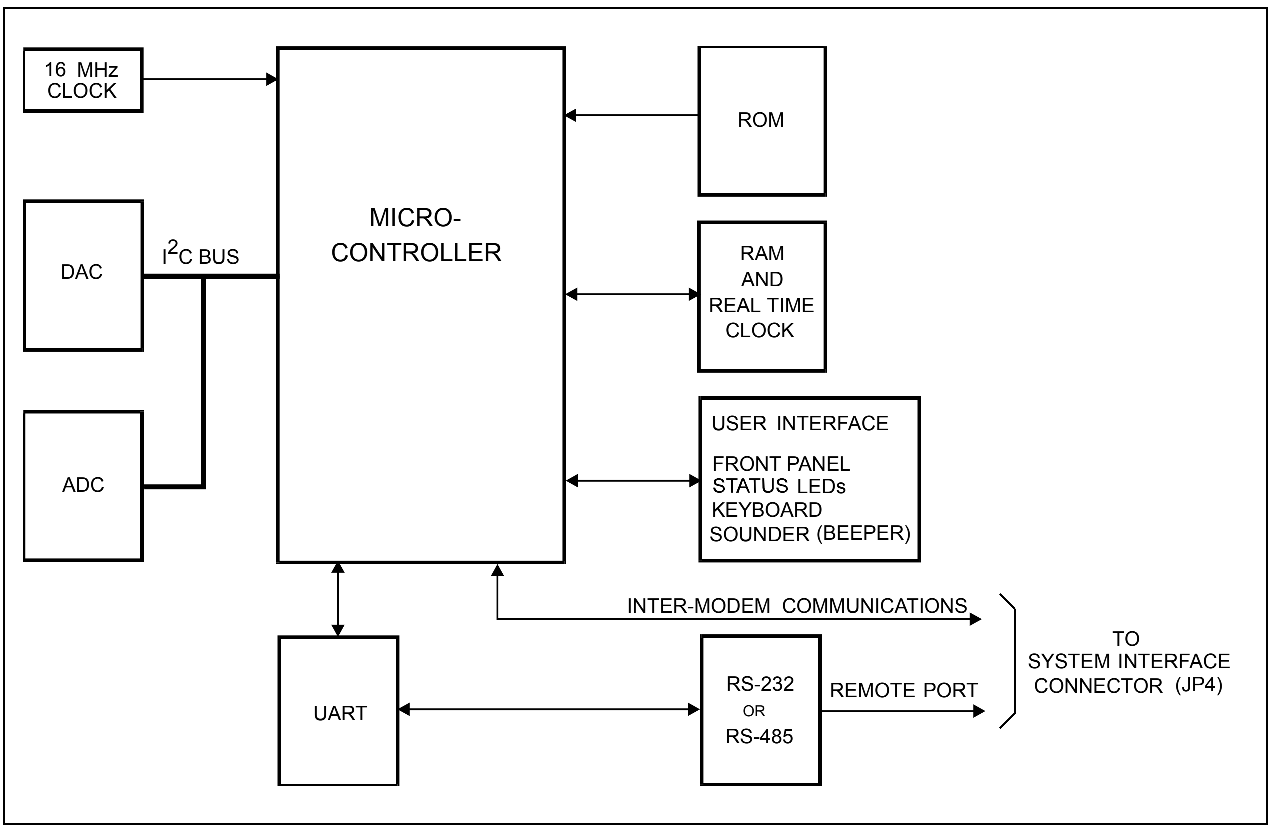


Figure 5-1. Display/M&C Block Diagram

The heart of the M&C card is the Intel 80C32 (or a compatible microcontroller) operating at 16 MHz. This microcontroller contains 256 kbps of internal RAM. A ROM at U17 can be:

- 27C010 (128 kbps)
- 27C020 (256 kbps)
- 27C040 (512 kbps)

ROM access times must be equal to or greater than 200 Ns. The correct ROM size can be set by jumpers JP9 and JP10. The RAM can be 8 kbps or 32 kbps in size. This RAM chip is internally battery-backed, and contains a real time clock used by the M&C.

The non-volatile RAM on the M&C module allows the module to retain configuration information without prime power for up to one year. 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 nonvolatile memory to see if valid data has been retained. If valid data has been retained, the modem is reconfigured to the parameters maintained in RAM.

2. If the nonvolatile 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 bit/s. The UART is memory-mapped to the microcontroller. The communications type can be EIA-232 or EIA-485 (set with M&C jumpers JP1 and JP5). For EIA-485 communications, 2- or 4-wire operation can be set by jumpers JP2 and JP3. The remote port is connected to the M&C system interface connector (JP4).

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 inter-modem communications uses the internal serial port located in the microcontroller. The inter-modem communications are connected to the M&C system interface connector (JP4) for communication between the modulator, demodulator, and interface cards.

The user interface includes the following parts:

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

All functions are memory-mapped to the microcontroller.

5.2 Modulator

The modulator PCB is a 10.25 x 17.00 inches (25 x 43 cm) assembly that fits in the top slot of the modem chassis. The modulator provides PSK and QAM 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
- 8-PSK
- 16-QAM

Refer to Section 5.2.3 for a description of each modulation type. Refer to Chapter 4 for a diagram of the modulator PCB and modulator jumper settings. A block diagram of the modulator is shown in Figure 5-2.

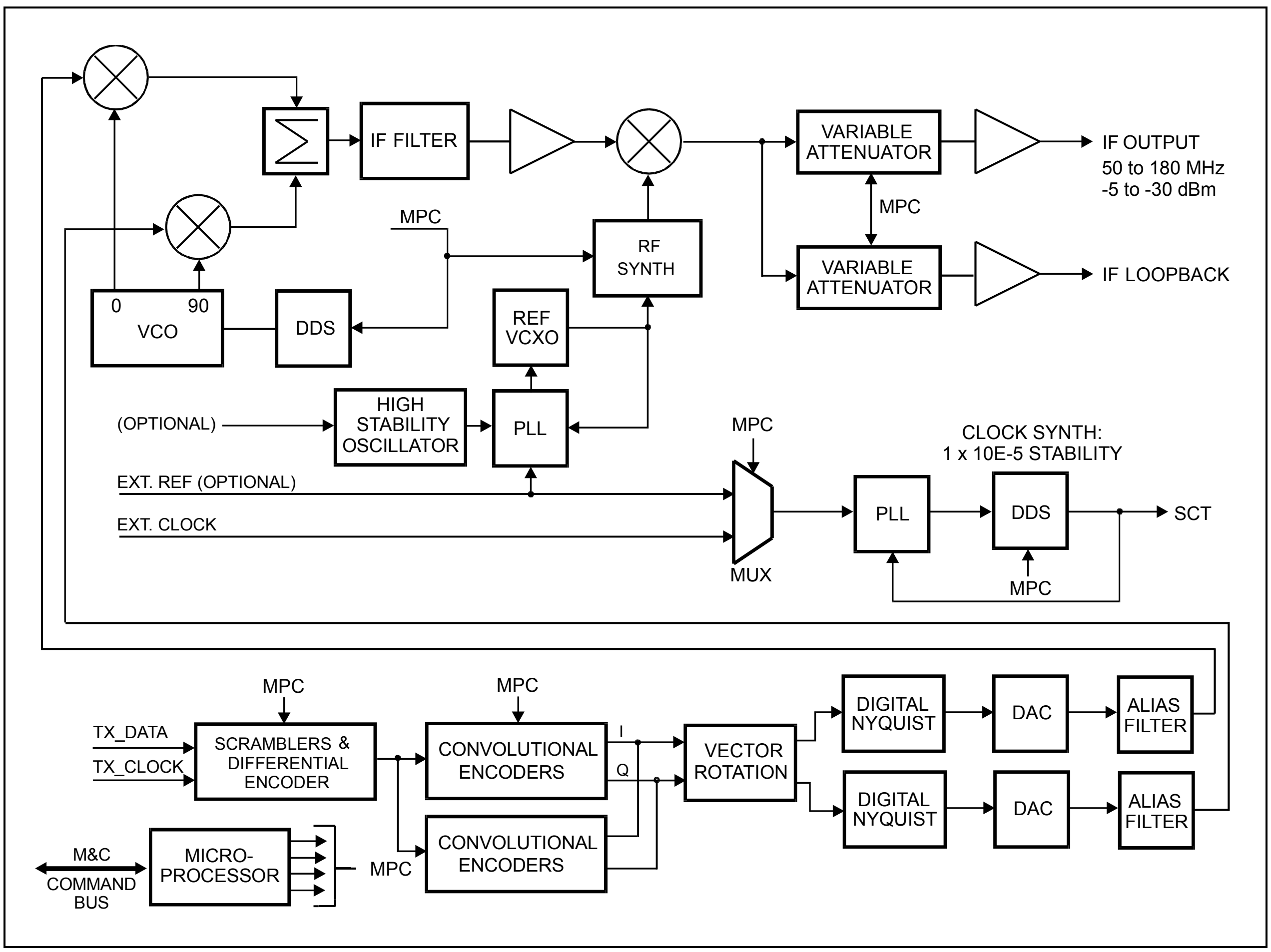


Figure 5-2. Modulator Block Diagram

5.2.1 Modulator Specifications

Refer to Appendix C for Modulator specifications.

5.2.2 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 M&C controls all programmable functions on this module. Fault information from the modulator is sent to the host M&C. Refer to Chapter 9 for a list of reported faults.

The major modulator PCB subsections are:

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

The format for the digital data stream from the interface PCB is EIA-422, and includes a clock synchronous with the data. At this point, the data is clean and free of jitter. The data is 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 demodulator.

The data is sent to the convolutional encoder for encoding the data rates of the transmitted baseband data. The code rates 1/2, 3/4, and 7/8 are based on the symbol rate range of 9.6 kbps to 6.3 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, or 7/8. For example, the 7/8 rate puts out 8 symbols for every 7 bits in. If the modulator is in the QPSK mode, the data is split into two separate data streams to drive the I and Q channels of the modulator. Refer to Section 5.6 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 Digital-to-Analog (D/A) converters and anti-aliasing filters. These filters provide proper spectral shaping, as well as proper equalization. Symbol rates up to 6.3 Mbps can be achieved by changing the filter with the M&C controls.

The I and Q filtered data is applied to the RF modulator for converting the data to a modulated carrier. Refer to Section 5.6 for the theory of modulation types. 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 Direct Digital Synthesis (DDS) chip to accommodate 2.5 kHz steps over a range of 130 MHz. The RF section has a frequency stability of $\pm 1 \times 10^{-5}$. An optional 2×10^{-7} Temperature Compensated Crystal Oscillator (TCXO) can be installed.

The serial clock transmit (SCT) is generated with a DDS as part of a fully-digital phase-locked loop (PPL) circuit. The PLL synthesizes the SCT from the modulator reference. The PPL may synthesize the SCT from the external clock source at the data I/O if the modem is equipped with a high stability modulator.

5.2.2.1 Restriction for SCT Clock

The SCT PLL can only lock at the following frequency steps:

SCT Frequency Range	Step Size	Steps in Range
4.8 ≤ SCT < 48 kbps	400 Hz	108
48.0 ≤ SCT < 256 kbps	2.0 kHz	104
256.0 ≤ SCT < 512 kbps	4.0 kHz	64
512.0 ≤ SCT < 9312 kbps	8.0 kHz	1100

If an SCT frequency is selected which does not conform to the step size constraints (such as 512 kbps), then the PLL is disabled and the SCT is synthesized open loop from the modulator reference. In this event, the frequency error does not exceed 1×10^{-5}.

The following applies to a modem equipped with high stability modulator. When synthesizing from the external clock source, any valid SCT can be generated and phase-locked to the external clock source at one of the rates listed below:

SCT Frequency Range	Step Size	Steps in Range
4.8 ≤ SCT < 48 kbps	800 Hz	54
48.0 ≤ SCT < 256 kbps	2.0 kHz	104
256.0 ≤ SCT < 512 kbps	4.0 kHz	64
512.0 ≤ SCT < 9312 kbps	8.0 kHz	1100

The lowest frequency range is composed of 800 Hz steps (as opposed to 400 Hz steps for the modulator reference mode). If an SCT frequency is selected which does not conform to the step size constraints (such as 512 kbps), then the PLL is disabled and the SCT is synthesized open loop from the modulator reference. In this event, the frequency error does not exceed 1×10^{-5}.

The signal from the power combiner 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 dBm, 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 has a high power oscillator capable of outputting +5 to -20 dBm.

5.2.3 Theory of Modulation Types

The modulation types for the modem include:

- BPSK
- QPSK
- 8-PSK
- 16-QAM

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 QAM method uses a combination of differential phase shifts and amplitudes totaling 16 different states to represent a different bit value for the receiver.

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 1 symbol
- QPSK — 4 discrete phase angles represent the 4 possible states of 2 symbols
- 8-PSK — 8 discrete phase angles represent the 8 possible states of 3 symbols
- 16-QAM — 16 discrete phase angles represent the 16 possible states of 4 symbols

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

5.2.3.1 BPSK Encoding

The modulator PCB converts transmitted baseband data into a modulated BPSK carrier at 9.6 kbps to 3.15 Mbps (1/2 rate). Using vector analysis of the constellation pattern, BPSK represents 1 symbol with the carrier phase either at 0° or 180°. The 1/2 rate encoded at the convolutional encoder provides 2 symbols output for every bit input. In BPSK 1/1 uncoded operation, 1 symbol is output for every bit input, and convolutional encoding is not performed.

Code Rate	Symbols/Bit	Bits/Hz
1/1	1	1
1/2	2	0.5

5.2.3.2 QPSK Encoding

The modulator PCB converts transmitted baseband data into a modulated QPSK carrier at the following parameters:

- 19 kbps to 6.3 Mbps (1/2 rate)
- 28.5 kbps to 9.3 Mbps (3/4 rate)
- 33.25 kbps to 9.3 Mbps (7/8 rate)
- 38.4 kbps to 9.3 Mbps uncoded (1/1 rate)

Using vector analysis of the constellation pattern, QPSK represents 2 symbols with the carrier phase angle at 45°, 135°, 225°, or 315°. The 1/1, 1/2, 3/4, and 7/8 rates encoded at the convolutional encoder provide the desired input/output bit rates.

Code Rate	Symbols/Bit	Bits/Hz
1/1	1	2
1/2	2	1
3/4	1.33	1.5
7/8	1.143	1.75

5.2.3.3 8-PSK Encoder

The modulator PCB first converts the transmit baseband data into a modulated 8-PSK carrier at 38.4 kbps to 9.3 Mbps by pragmatic trellis encoding at 2/3 rate. The 2/3 rate pragmatic trellis encoder generates 3 symbols for every 2-bit input. A phase ambiguity resolution encoder processes the 3 symbols in a manner that permits the receiver/decoder to decode the data while resolving the phase ambiguities caused by the transmission channel. A self-synchronizing scrambler and descrambler of the type specified by INTELSAT for IDR applications is provided to ensure uniform one-zero density. Using vector analysis of the constellation pattern generated by the modulator, 8 discrete phase angles (0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315°) represent the 8 possible states of the 3 symbols generated by the encoder. This results in a bandwidth efficiency of 2 bits/s/Hz (symbol_rate = data_rate ÷ 2).

Code Rate	Symbols/Bit	Bits/Hz
2/3	1.5	2

In 8-PSK operations, the hardware to perform Reed-Solomon block encoding and decoding is not required, but may be used to achieve the better performance. The Reed-Solomon encoder and decoder can be enabled or disabled in normal operation.

When enabled, the output spectrum bandwidth is increased by about 10% due to the required Reed-Solomon encoding and decoding. This results in a bandwidth efficiency of 1.8 bits/s/Hz (symbol_rate = data_rate ÷ 2).

5.2.3.4 16-QAM Encoding

The modulator PCB first converts the transmit baseband data into a modulated 16-QAM carrier at 58 kbps to 9.3 Mbps in 3/4 rate. The modulator PCB then converts the data at 68 kbps to 9.3 Mbps in 7/8 rate by encoding. Finally, the modulator PCB punctures the data by using the industry standard K= 7, 1/2 rate convolutional code and 3/4 and 7/8 punctured patterns. The 3/4 rate convolutional encoder generates 4 symbols for every 3-bits input. The 7/8 rate generates 8 symbols for every 7-bits input.

No phase ambiguity resolution encoder is required, because the Viterbi decoder processes the symbols in a manner that permits decoding of the data while resolving the phase ambiguities caused by the transmission channel.

When the Reed-Solomon encoder and decoder are not enabled, a self-synchronizing scrambler and descrambler of the type specified by INTELSAT for IDR applications is provided to ensure uniform one-zero density. Using vector analysis of the constellation pattern generated by the modulator, 16 discrete phase angle/amplitude combinations represent the 16 possible states of 4 symbols generated the encoder. This results in a bandwidth efficiency of:

- 3 bits/s/Hz in 3/4 rate (symbol_rate = data_rate ÷ 2)
- 3.5 bits/s/Hz in 7/8 rate (symbol_rate = data_rate ÷ 3.5)

Code Rate	Symbols/Bit	Bit/Hz
3/4	1.33	3
7/8	1.143	3.5

In 16-QAM operation, the hardware to perform Reed-Solomon block encoding and decoding is required to achieve the best operational characteristics and performance.

Although the Reed-Solomon encoder and decoder can be disabled for test purposes, proper operation may not be realized, thus requiring that they be enabled for normal operation. A synchronous scrambler and descrambler of the type specified by INTELSAT for Reed-Solomon outer Codec use is provided to ensure uniform one-zero density. The output spectrum bandwidth is increased by about 10% due to the required Reed-Solomon encoding and decoding. This action results in a bandwidth efficiency of:

- 2.7 bits/s/Hz in 3/4 rate (symbol_rate = data_rate ÷ 2.7)
- 3.15 bits/s/Hz in 7/8 rate (symbol_rate = data_rate ÷ 3.15)

5.3 Demodulator

The modem demodulator PCB is 10.25 x 17.00 inches (26 x 43 cm), and fits in the bottom slot of the modem chassis. The demodulator converts PSK modulated carriers within the 50 to 180 MHz range to a demodulated baseband data stream. The demodulator then performs FEC on the data stream using the Viterbi decoding algorithm. A block diagram is shown in Figure 5-3. Refer to Chapter 4 for a diagram of the demodulator PCB and demodulator jumper settings. The converted modulation types are:

- BPSK
- QPSK
- 8-PSK
- 16-QAM

Note: Viterbi decoding is not used with the uncoded operation.

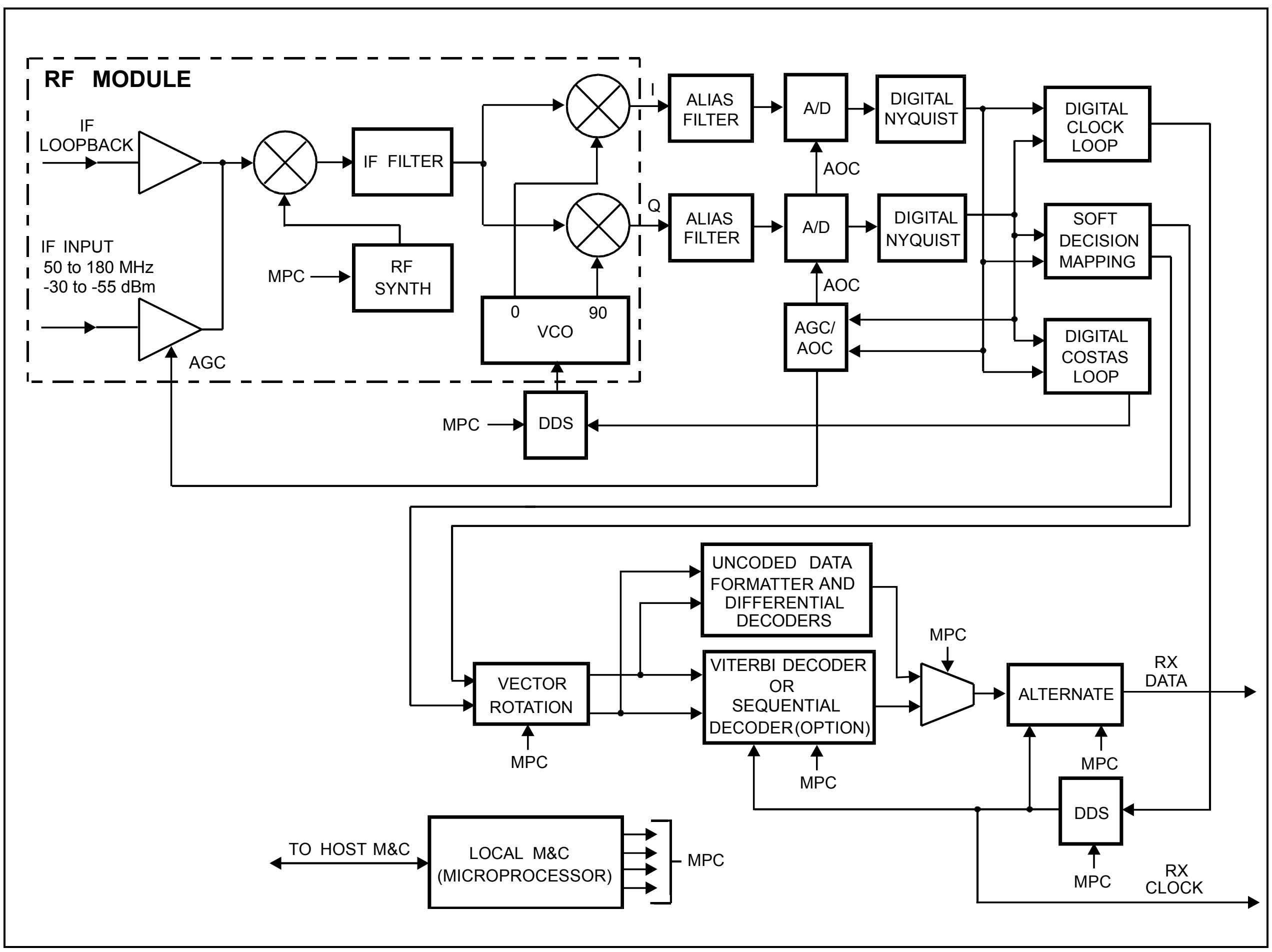


Figure 5-3. Demodulator Block Diagram

5.3.1 Demodulator Specifications

Refer to Appendix C for Demodulator specifications.

5.3.2 Theory of Operation

Note: Refer to Section 5.2.3 for modulation types.

The demodulator PCB functions as an advanced digital coherent phase-lock receiver and Viterbi decoder (or optional sequential decoder). An on-board microprocessor (local M&C) controls all programmable functions on this module via a bi-directional link with the host M&C located on the front panel assembly. Demodulator faults are also reported over this link. The demodulator card consists of the following basic subsections.

- Local M&C
- Digital Costas Loop
- RF Module
- Automatic Gain and Offset Control
- Alias Filters
- Soft Decision Mapping
- Analog-to-Digital (A/D) Converters (with offset control)
- Programmable Vector Rotation
- Digital Nyquist Filters
- Viterbi Decoder
- Digital Clock Recovery Loop
- Sequential Decoder (option)
- Uncoded Data Formatter

The modulated IF signal at 50 to 180 MHz enters the RF module for conversion to I and Q analog baseband channels. The I and Q channels are then passed through identical anti-alias filters, offset amplifiers, and A/D converters. The digitized I and Q data is then sent to the digital Nyquist filters, resulting in a filtered, digital representation of the received signal. The digital data is then sent to four separate circuits:

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

The AGC provides a gain feedback signal to the RF module, and an offset feedback signal to the offset amplifiers just prior to the A/Ds. 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.

The digital Costas loop, in conjunction with a DDS, performs the carrier recovery function. The Costas loop consists of a Costas phase detector, loop filter, and DDS, all implemented digitally. The DDS performs the function of a Voltage-Controlled Oscillator (VCO) in an analog implementation, but can be easily programmed to the desired center frequency via the local M&C. The output of the DDS is sent to the RF module and provides the reference to which the quadrature local oscillator is locked. The local M&C sweeps the local oscillator (via DDS programming) through the user specified sweep range.

When the active decoder (Viterbi or sequential) determines that the modem is locked, the local 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 local M&C resumes the sweep process.

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

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

The output of the vector rotation circuit is then sent to the Viterbi decoder, uncoded data formatter, and optional sequential decoder. The output of the Viterbi decoder or optional sequential decoder is the final output of the demodulator PCB. The output is then sent to the interface PCB.

Note: The Viterbi decoder is described in detail in Section 5.4.

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

1. Differentially encoding both the I and Q channels in the modulator.

2. Subsequently differentially decoding both the I and Q channels in the demodulator.

5.4 Viterbi Decoder

The Viterbi decoder circuitry (Figure 5-4) is located on the demodulator PCB (bottom slot of the modem chassis). 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.

Note: Viterbi decoding is not used in uncoded operation. The uncoded data formatter and differential decoder circuit bypasses the Viterbi or sequential decoder.

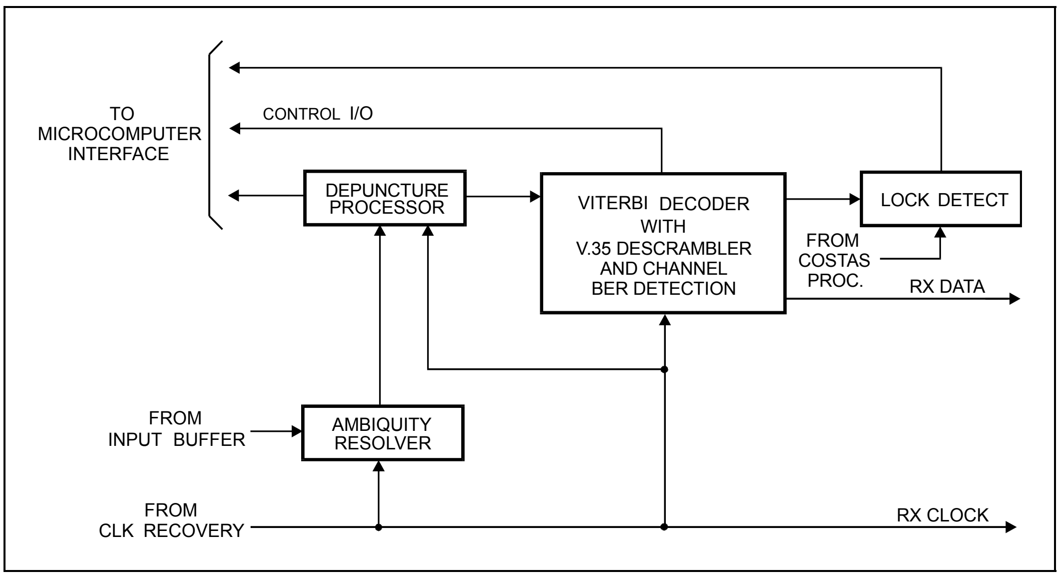


Figure 5-4. Viterbi Decoder Block Diagram

5.4.1 Specifications

Refer to Table 5-1 for Viterbi specifications.

Table 5-1. Viterbi Specification

BER	See Appendix C.
Maximum Data Rate	6.4 Mbps (Rate 1/2) 9.3 Mbps (Rate 3/4) 9.3 Mbps (Rate 7/8)
Synchronization Time	8000 bits (maximum)
Output Fault Indicators	Activity detection of I and Q data sign bits and descrambler data
Raw BER Detection	From 0 to 255 bits out of 1024 samples
Differential Decoding	2-phase or none
Constant Length	7
I/O Connector	96-pin DIN

5.4.2 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 Viterbi decoder performs seven functions for providing FEC. The 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.

5.5 Interface

The modem interface is a 10.25 x 17.00 inches (26 x 43 cm) PCB that fits in the middle slot of the modem chassis. The interface PCB provides synchronous data interfacing for terrestrial data and overhead signals and a means for modem fault reporting. Refer to Chapter 3 for a diagram of the interface PCB and interface jumper settings.

A block diagram of the interface PCB is shown in Figure 5-5.

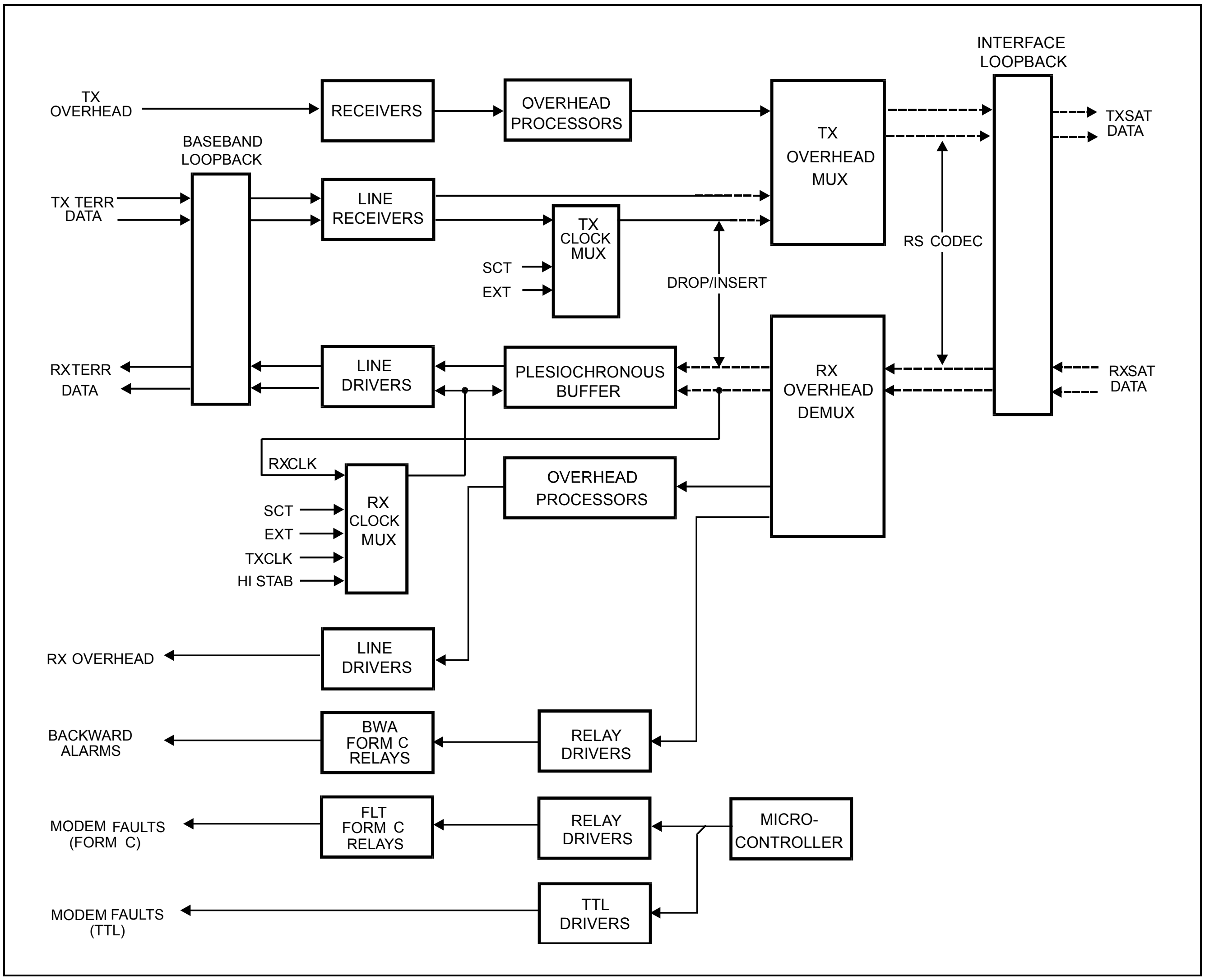


Figure 5-5. Interface Block Diagram

The terrestrial interface functions include:

- Multiplexing various types of ESC into the data
- Buffering the received data
- Demultiplexing various types of ESC from the data
- Monitoring and displaying the interface status without interruption of service

The interface PCB can be configured for the following closed and open network types of modem operation (Types 1 to 5):

Type	Description
1	Closed Network Only
2	Closed Network Only with Buffer
3	Open Network, IBS with Buffer
4	Open Network, IBS, IDR with Buffer
5	DVB

Overhead can be added to the terrestrial data for IBS and IDR modes of operation. The format of the overhead data is dependent on the mode of operation.

The interface supports terrestrial data rates from 9.6 kbps to 9.312 Mbps.

The terrestrial interfaces for the modem are defined by the data communication standards MIL-STD-188/EIA-449, V.35, and G.703. The interface receivers and drivers for these standards, as well as the handshake signals for MIL-STD-188 and V.35, are selectable through multi-pin jumpers. Positions of the jumpers are monitored by the M&C to determine if a selected configuration is valid.

The following four plug-on options can be used with the interface PCB:

- D&I multiplexer that works in conjunction with the interface PCB to enable the modem to transmit or receive fractional parts of a T1/E1 data stream (Appendix B).

- D&I with ASYNC overhead data channel which is typically used for earth station-to-earth station communication (Appendix B)

- Reed-Solomon Codec that works in conjunction with the Viterbi decoder and includes additional framing, interleaving, and Codec processing to provide concatenated FEC and convolutional encoding and decoding (Appendix B).

- Interface relay board that provides the modem user with an easy method to change the data interface. The interface relay replaces the need to physically change the multi-pin jumpers by enabling the selection of the data interfaces from the front panel.

5.5.1 Interface Specifications

Refer to Appendix C for Interface specifications.

5.5.2 Theory of Operation

This section provides the theory of operation for closed and open network.

5.5.2.1 Closed Network

Closed network operation does not add overhead to the terrestrial data. 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 resynchronized 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 through the same interface loopback device. User data from the DEMUX section may be optionally input to a plesiochronous buffer.

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

- Internal Clock (SCT)
- RX Recovered Clock (RXCLK)
- External Reference Clock (EXT)
- High Stability Clock (HI STAB)
- TX Clock Dejittered (TXCLK)

If either RXCLK or EXT is selected and then fails, the interface will automatically switch to INT (SCT) 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.

5.5.2.2 Open Network

The modem is a high-performance, full-duplex, digital-vector modulator/demodulator. The modem meets the open network requirements of the INTELSAT IESS-308, -309 and -310 specifications for IDR, IBS, and EUTELSAT SMS.

5.5.2.3 IDR

IDR operation adds 96 kbps overhead to the terrestrial data. The terrestrial data rates supported are:

- 1.544 Mbps (T1)
- 2.048 Mbps (E1)
- 6.312 Mbps (T2)
- 9.312 Mbps (E2)

The terrestrial data is passed through the baseband loopback relay and is translated from the G.703 format to TTL with a recovered clock.

Overhead framing, two ADPCM audio channels, four backward alarms, and an EIA-422 format 8 kbps synchronous data channel are multiplexed with the dejittered terrestrial data.

The interface for the audio is a 600Ω transformer-balanced input. The ADPCM audio channels are encoded according to CCITT G.721.

The backward alarms are level-translated to TTL by threshold comparators set to 2.5V. A 1K pull-up resistor to +5V is connected to each alarm input.

The multiplexed data stream is output to the modulator through the interface loopback device. The receive data from the demodulator is input through the same interface loopback device. The receive data is demultiplexed to produce:

- Receive Terrestrial Data
- 2 ADPCM Audio Channels
- 4 Backward Alarms
- 8 kbps Synchronous Data Channel

The ADPCM audio channels are decoded according to CCITT G.721, and output through a 600Ω transformer.

The backward alarms are reported to the M&C and output to FORM C relay contacts.

5.5.2.4 64 kbps Service Channel Option

The two audio channels in the ESC data stream can be replaced with a single 64 kbps service channel. The data is transmitted and received on the same connector pins which are used for audio. The data is electrically similar to the 8-channel data channel (except for the data bit rate).

As with the 8-channel, the data is changed on the falling edge of the clock and is clocked into the modem on the rising edge. Setup and hold times for the rising edge are 5 µS.

Note: If byte alignment is required, the 8 kHz clock can be used. Refer to Figure 5-6. The first bit of data is valid with the rising edge of the first 64 kHz clock following the rising edge of the 8 kHz clock. Setup and hold times for the rising edge are 5 µS.

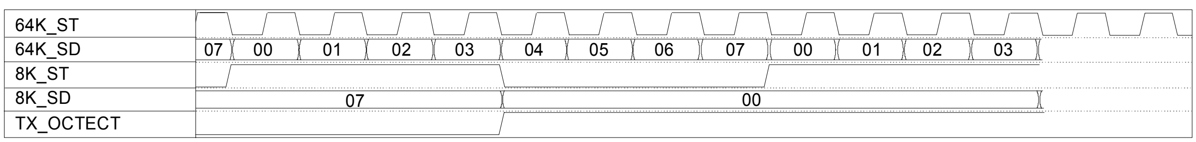


Figure 5-6. 8/64 kHz Clock

The receive timing is identical to the transmit. Data is changed by the modem on the falling edge of the clock and clocked into the user's equipment on the rising. If byte alignment is used, the rising edge of the 8 kHz marks the first bit.

Perform the following for jumper information:

1. Two jumpers must be moved in order to use the 64 kbps service channel.
2. The PCB is configured for IDR, then jumper JP3 is moved to the LEFT position.
3. Jumper JP23 is added to the LEFT position.
4. If a jumper relay board is used, then the jumpers will set automatically.

5.5.2.5 8 kbps Synchronous Data Channel

The 8 kbps synchronous data channel is formatted for EIA-422. The terrestrial data output from the demultiplexer is input to a plesiochronous buffer. The front panel interface provides four clock selections clocking the data out of the buffer:

- Internal Clock (SCT)
- RX Recovered Clock (RXCLK)
- External Reference Clock (EXT)
- High Stability Clock (HI STAB)
- TX Clock (TXCLK)

If either RXCLK or EXT is selected and then fails, the interface automatically switches to INT (SCT) recovered clock as the source.

The AIS is detected in the receive data and reported to the M&C. The M&C control inserts AIS into the TX data path. The receive data and selected clock are translated to conform to G.703 interface, and output through the baseband loopback relay.

Four sets of transmit and receive backward alarms are available to implement the structure defined in IESS-308. Backward alarms are sent to the distant side of an IDR link to signal that trouble has occurred at the receive side (which may have resulted from an improper transmission).

Implementation is straight forward in a simple, single destination link. INTELSAT specifies that any major failure of the downlink chain is to generate a backward alarm. The modem has a demodulator fault relay which de-energizes in the event of a receive fault.

The fault tree for this signal includes the appropriate overhead framing faults in order for this relay to be connected to the appropriate backward alarm input. This signal also includes faults in the downlink chain, since major problems with the antenna, Low Noise Amplifier (LNA), down converter, and other components will cause an interruption in service and fault the modem. Refer to Chapter 3 for connection information.

5.5.2.6 IBS

IBS operation adds a proportional overhead (1/15) to the terrestrial data. 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 scrambled synchronously with the multiframe sync in the multiplexer. The scrambler is enabled by the front panel.

External input and output for an ESC in EIA-232 format is provided on the interface. The ESC runs asynchronously at approximately 1/512 of the terrestrial data rate. If the ESC clock is not used, the channel runs at 1/2000 of the terrestrial data rate. The overhead containing framing, the ESC channel, and faults from the modem are multiplexed with dejittered terrestrial data. The multiplexed data stream is output to the modulator through the interface loopback device.

The receive data from the demodulator is input through the same interface loopback device. The receive data is demultiplexed and synchronously descrambled by the demultiplexer. The backward alarms are reported to the M&C and output by Form C relay contacts. The ESC is output by an EIA-232 driver. The terrestrial data output from the demultiplexer is input to a plesiochronous buffer.

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

- Internal Clock (SCT)
- RX Recovered Clock (RXCLK)
- External Reference Clock (EXT)
- High Stability Clock (HI STAB)
- TX Clock Dejittered (TXCLK)

If either RXCLK or EXT is selected and then fails, the interface automatically switches to INT (SCT) as the source. AIS is detected in the receive data and reported to the M&C. The receive data and selected clock are translated to the levels of the selected baseband interface and output through the baseband loopback relay.

5.6 Backward Alarm Theory and Connections

Four sets of transmit and receive backward alarms are available to implement the structure defined in IESS-308. Backward alarms are sent to the distant side of an IDR link to signal that trouble has occurred at the receive side (which may have resulted from an improper transmission).

Implementation is straightforward in a simple, single destination link. INTELSAT specifies that any major failure of the downlink chain will generate a backward alarm. The modem has a demodulator fault relay which de-energizes in the event of a receive fault. For this relay to be connected to the appropriate backward alarm input, the fault menu for this signal includes the appropriate overhead framing faults.

This signal also includes faults in the downlink chain, since major problems with the antenna, LNA, down converter, and other components will cause an interruption in service and fault the modem.

The outputs of the demodulator fault relay are available as follows:

- Pins DF-C and DF-NO on the 50-pin D IDR interface connector (J8)
- 9-pin D modem fault connector (J7)

The relay contacts are named for the faulted state. If a receive fault does not occur, DF-C is connected to DF-NO.

The preferred method of using a backward alarm in a single destination system is to connect the signals at the IDR data interface, either at the modem in a non-redundant system, or at the protection switch, if used.

Signal	Pin #
GND	DB50-2
BWI1	DB50-12
BWI2	DB50-13
BWI3	DB50-14
BWI4	DB50-15
DF-C	DB50-16
DF-NO	DB50-50

This method signals faults on all four alarm channels, and is compatible with a redundancy system. The method assumes that the same modem handles traffic in both directions in each single destination link.

To handle more complicated systems, connect the appropriate outputs of the demod fault relay to the appropriate backward alarm inputs. In a multidestination system, connect the relay to the particular backward alarm assigned to that link. Refer to IESS-308 for further clarification.

There are two methods for detecting a backward alarm that is being received on a particular link. Each backward alarm output drives a FORM C relay with all three contacts available on the data connector. If a modem (or switch) is integrated into a computer network through the modem (or switch) EIA-232 or EIA-485 remote interface connector, the status of all transmit and receive backward alarms may be read through that port. Refer to Appendix A for the remote interface specification.

In addition to the four backward alarms for IDR and two backward alarms (primary and secondary) for IBS, all modes support the following faults:

- MOD (modulator equipment)
- DEM (demodulator equipment)
- CEQ (common equipment)

Each fault is indicated by a FORM C relay contact and an open collector output.

Chapter 6. FRONT PANEL OPERATION

6.1 Front Panel

Figure 6-1. Front Panel View

The user can fully control and monitor the operation of the SDM-8000 from the front panel, using the keypad and display. Nested menus are used, which display all available options, and prompt the user to carry out a required action.

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 predefined Function Select categories or levels:

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

6.1.1 LED INDICATORS

The 10 LEDs on the front panel indicate:

- General modem summary fault information
- Status
- Alarms

The indicators are defined in Table 6-1 below:

Table 6-1. Front Panel LED Indicators

Name	LED	Condition
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	The transmitter is currently On. This indicator reflects the actual condition of the transmitter, as opposed to the programmed condition.
Carrier Detect	Green	The 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.

6.1.2 FRONT PANEL KEYPAD

The front panel keypad (Figure 4-2) controls the local operation of the modem. The keypad consists of six keys. Each key provides one or more logical functions.

Figure 6-2. Keypad

The function of these keys is as follows:

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, Right [◀], [▶]	These arrows are used to move to the next selection or to move the cursor functions. At times, they may also used to move from one section to another.
Up, Down [▲], [▼]	These arrows are used primarily to change configuration data (numbers). At times, they may also be used to move from one section to another.

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.

6.2 Menu System

To access and execute all functions, refer to the menu tree in Figure 4-3.

Note: Refer to Chapter 4 for the default settings for IDR, IBS, D&I, Custom, Type X, and System modes.

When the modem power is turned on, 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 base level, press any of the arrow keys. From the Function Select menu, select one of the functional categories:

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

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

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

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

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

Press an arrow key to change the parameters. After the display represents the correct parameters, press [ENTER] to execute the change. This action initiates the necessary programming by the modem.

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.

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

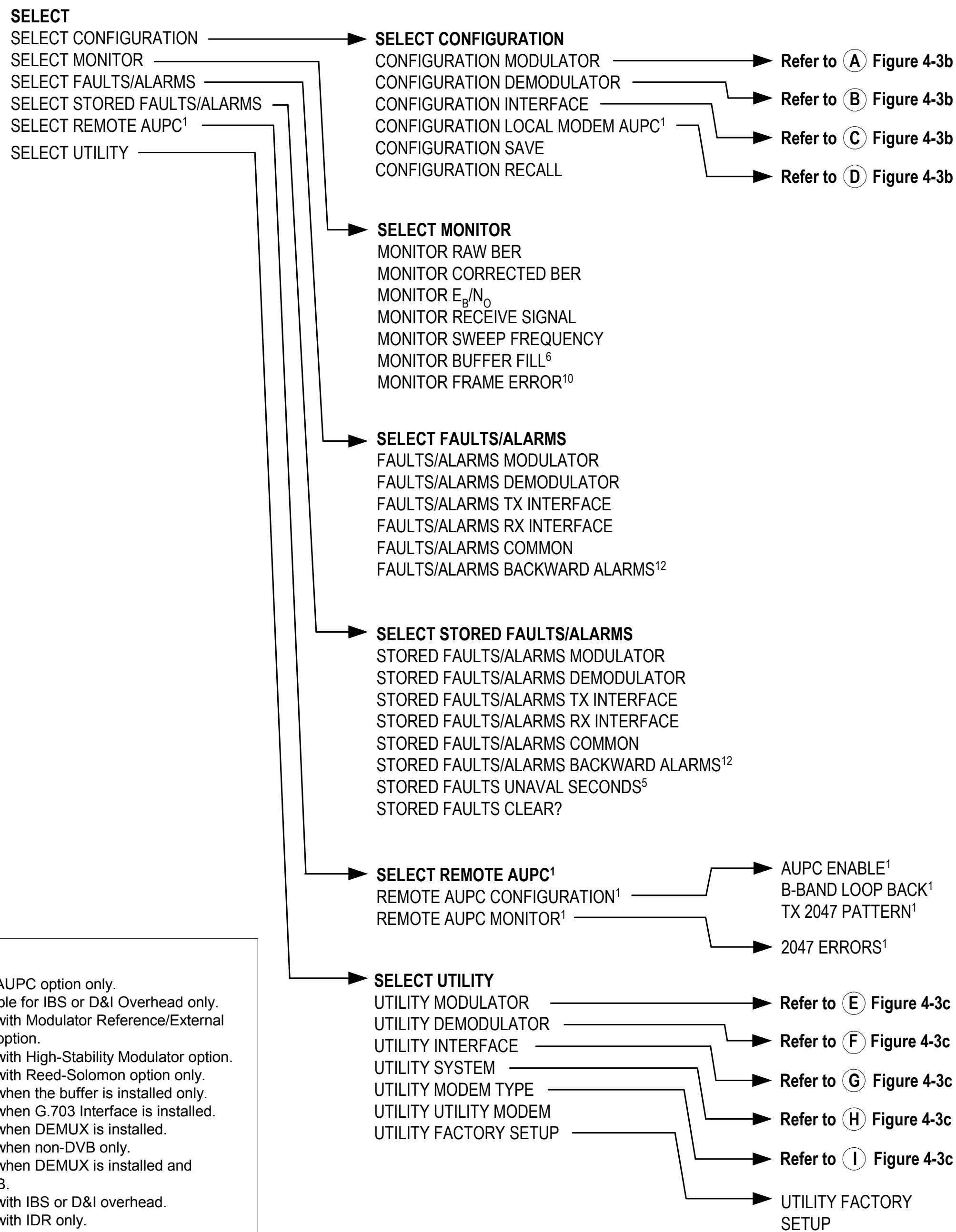
The following notes describe each configuration function in detail.

Notes:

1. Hardware configuration may change the front panel menu selection.

2. Windows that are specific to certain modem configurations are only accessible after selecting the appropriate modem configuration. This prevents incompatible parameters from accidentally being selected.

3. All of the 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.



Key:
[1] Requires AUPC option only.
[2] Not available for IBS or D&I Overhead only.
[3] Available with Modulator Reference/External Divider option.
[4] Available with High-Stability Modulator option.
[5] Available with Reed-Solomon option only.
[6] Available when the buffer is installed only.
[7] Available when G.703 Interface is installed.
[8] Available when DEMUX is installed.
[9] Available when non-DVB only.
[10] Available when DEMUX is installed and non-DVB.
[11] Available with IBS or D&I overhead.
[12] Available with IDR only.
[13] Available with D&I only.
[14] Available with ASYNC Overhead option only.
[15] Available with DVB Overhead only.
[16] Change in custom only.
[17] 8PSK 2/3 and Reed-Solomon only.
[18] Status only except with Relay option.
[19] Available with Relay option only.
[20] Status only.
[21] Change in custom or ASYNC only.
[22] Available with relay option only.

Figure 6-3. Menu Trees

(A) CONFIGURATION MODULATOR
TX-X CODE_RATE
TX-IF FREQUENCY
TX-IF OUTPUT
TX POWER LEVEL
SCRAMBLER[2]
DIFF. ENCODER
CARRIER MODE
MODULATOR REF[3]
SCT PLL REF[4]
RS ENCODER[5]

(B) CONFIGURATION DEMODULATOR
RX-X CODE_RATE
RX-IF FREQUENCY
DESCRAMBLER[2]
DIFF. DECODER
RF LOOP BACK
IF LOOP BACK
BER THRESHOLD
SWEEP CENTER
SWEEP RANGE
REACQUISITION
RS DECODER[5]

(C) CONFIGURATION INTERFACE
TX CLOCK SOURCE
TX CLOCK PHASE
EXT-REF FREQ
BUFFER CLOCK
BUFFER SIZE
BUFFER CENTER[6]
RX CLOCK PHASE
B-BAND LOOP BACK
INTRFC LOOP BACK
LOOP TIMING
TX CODING FORMAT[7]
RX CODING FORMAT[7]
TX DATA FAULT
RX DATA FAULT[8]
TX 2047 PATTERN[9]
RX 2047 PATTERN[10]
IBS SCRAMBLER[2]
IBS DESCRAMBLER[2]
SERVICE CHANNEL ADJUST[12]
DROP FORMAT[13]
INSERT FORMAT[13]
DROP CHANNEL ASSIGNMENTS[13]
INSERT CHANNEL ASSIGNMENTS[13]
ASYNC TX BAUD[14]
ASYNC RX BAUD[14]
ASYNC TX LENGTH[14]
ASYNC RX LENGTH[14]
ASYNC TX STOP[14]
ASYNC RX STOP[14]
ASYNC TX PARITY[14]
ASYNC RX PARITY[14]
TX DVB FRAMING[15]
RX DVB FRAMING[15]

(D) CONFIGURATION LOCAL MODEM AUPC[1]
AUPC ENABLE
NOMINAL POWER
MINIMUM POWER
MAXIMUM POWER
TRACKING NOISE
TRACKING RATE
LOCAL CL ACTION
REMOTE CL ACTION

Key:
1 Requires AUPC option only.
2 Not available for IBS or D&I Overhead only.
3 Available with Modulator Reference/External Divider option.
4 Available with High-Stability Modulator option.
5 Available with Reed-Solomon option only.
6 Available when the buffer is installed only.
7 Available when G.703 Interface is installed.
8 Available when DEMUX is installed.
9 Available when non-DVB only.
10 Available when DEMUX is installed and non-DVB.
11 Available with IBS or D&I overhead.
12 Available with IDR only.
13 Available with D&I only.
14 Available with ASYNC Overhead option only.
15 Available with DVB Overhead only.
16 Change in custom only.
17 8PSK 2/3 and Reed-Solomon only.
18 Status only except with Relay option.
19 Available with Relay option only.
20 Status only.
21 Change in custom or ASYNC only.
22 Available with relay option only.

Figure 6-3. Menu Trees (continued)

(E) UTILITY MODULATOR
ASSIGN TRANSMIT FILTERS
MOD OPWER OFFSET
MOD POWER FIXED OFFSET[20]
MODULATOR TYPE[16]
ENCODER TYPE
TX MODULE FW
TX FPGA FW
MOD SPECTRUM
TX IESS-310 MODE[5]

(F) UTILITY DEMODULATOR
ASSIGN RECEIVER FILTERS
DEMODULATOR TYPE[16]
DECODER TYPE[21]
RXMODULE FW
RX FPGA FIRMWARE
DEMOD SPECTRUM
RX IESS-310 MODE[17]

(G) UTILITY INTERFACE
TX OVERHEAD TYPE[16]
RX OVERHEAD TYPE[16]
TX TERR INTERFACE[18]
RX TERR INTERFACE[18]
G.703 LEVEL TYPE[22]
INTERFACE BUILD[20]
INTERFACE OPTION[20]
BUFFER PROGRAM
FRAMING STRUCTURE
INTRFC MODULE FW
INTERFACE FPGA FW
E1 INSERT CRC[13]
TX DATA PHASE
RX DATA PHASE
IDR BACKWARD ALARM CONTROL[12]
IDR ESC TYPE[12]
ASYNC TX TYPE[14]
ASYNC RX TYPE[14]
TX PLL RESPONSE

(H) UTILITY SYSTEM
TIME: HH:MM:SS AM PM
DATE: MM/DD/YY
REMOTE BAUD RATE X PARITY
REMOTE ADDRESS
OPERATION MODE
TEST MODE STATUS
LAMP TEST???
MASTER RESET
M&C MODULE FW
DISPLAY CONTRAST
EXT AGC: MIN PWR
EXT AGC: MAX PWR

(I) UTILITY MODEM TYPE
MODEM TYPE
MODEM TYPE COMPATIBILITY
REV EMULATION

Key:
[1] Requires AUPC option only.
[2] Not available for IBS or D&I Overhead only.
[3] Available with Modulator Reference/External Divider option.
[4] Available with High-Stability Modulator option.
[5] Available with Reed-Solomon option only.
[6] Available when the buffer is installed only.
[7] Available when G.703 Interface is installed.
[8] Available when DEMUX is installed.
[9] Available when non-DVB only.
[10] Available when DEMUX is installed and non-DVB.
[11] Available with IBS or D&I overhead.
[12] Available with IDR only.
[13] Available with D&I only.
[14] Available with ASYNC Overhead option only.
[15] Available with DVB Overhead only.
[16] Change in custom only.
[17] 8PSK 2/3 and Reed-Solomon only.
[18] Status only except with Relay option.
[19] Available with Relay option only.
[20] Status only.
[21] Change in custom or ASYNC only.
[22] Available with relay option only.

Figure 6-3. Menu Trees (continued)

6.3 Opening Screen

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

```
SDM-8000                      YYYYY
VER: 21.1.3
```

Where "YYYYY" may be:

- CUSTOM
- IDR
- IBS
- D&I
- ASYNC
- DVB
- TYPE X (where X = 1 to 5)

6.3.1 FUNCTION SELECT: CONFIGURATION

```
FUNCTION SELECT
 CONFIGURATION
```

Press [▶] 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 LOCAL MODEM AUPC	Permits the user to fully configure the local modem AUPC 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

6.3.1.1 FUNCTION SELECT: CONFIGURATION: MODULATOR

```
CONFIGURATION
  MODULATOR
```

Press [Enter] to review or edit the following subsequent menus.

FUNCTION SELECT: CONFIGURATION: MODULATOR: TX_X CODE RATE

Select one of four (A, B, C, or D) predefined transmitter code/data rate combinations or a variable rate selection (V).

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

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

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

```
TX-D                        QPSK 1/2
         2048.000 Kbps
```

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

Code Rate	Viterbi Data Rate Range	Sequential Code Rate
BPSK 1/2	9.6 to 3150.0 MHZ	9.6 to 1544.0 MHz
QPSK 1/2	19.0 to 6300.0 MHz	19.0 to 2185.0 MHz
QPSK 3/4	28.5 to 9312.0 MHz	28.5 to 3277.0 MHz
QPSK 7/8	33.25 to 9312.0 MHz	33.25 to 3823.0 MHz
8-PSK 2/3	38.0 to 9312.0 MHz	Not Applicable
8-PSK 5/6	47.5 to 9312.0 MHz	Not Applicable
16-QAM 3/4	57.0 to 9312.0 MHz	Not Applicable
16-QAM 7/8	64.0 to 9312.0 MHz	Not Applicable
QPSK 1/1	38.0 to 9312.0 MHz	Not Applicable

On entry, the current transmitter rate is displayed with the flashing cursor on the first character of the code rate on line 1. Line 2 displays the data rate. Press [◄] or [►] to make the selection. To select the currently defined variable data rate, select TX-V, and press [ENTER] twice.

To change the rate using the variable rate selection, press [ENTER] when TX-V is displayed. A flashing cursor is displayed on the first character of the coding type on line 1. Press [◄] or [►] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

Notes:

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

2. When using the Reed-Solomon option, the TX data program also turns off the Reed-Solomon encoder. This allows the Reed-Solomon Codec and the non-Reed-Solomon Codec modems to operate together in a switch rack system.

FUNCTION SELECT: CONFIGURATION: MODULATOR: TX_IF FREQUENCY

```
TX-IF                        FREQUENCY
              70.0000 MHz
```

Programs the modulator transmit frequency between 50 and 180 MHz, in multiples of 2.5 kHz steps.

On entry, the current transmitter frequency is displayed with the flashing cursor on the first character. Press [◄] or [►] to move the flashing cursor, and [▲] or [▼] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

Note: When the transmitter frequency is changed, the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the IF Output function. When using the Reed-Solomon option, the frequency change also turns off the Reed-Solomon encoder. This allows the Reed-Solomon Codec/non-Reed-Solomon Codec modems to operate together in a switch rack system.

FUNCTION SELECT: CONFIGURATION: MODULATOR: TX_IF OUTPUT

```
TX-IF                           OUTPUT
                   OFF
```

Programs the modulator output On or Off.

On entry, the current status of the output is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: MODULATOR: TX_POWER LEVEL

```
TX POWER LEVEL
  -10.0 dBm
```

Programs the modulator output power level from:

- -5 dBm to –30 dBm for no offset
- -109.9 dBm to –114 dBm for offset, fixed/user or total range

Notes:

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

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

On entry, the current transmitter power level is displayed with the flashing cursor on the first character. Press [↑] or [↓] to increase or decrease the output power level in 0.1 dBm steps. Press [ENTER] to execute the change.

The high power oscillator option is +5 dB to -20 dB. The window displays AUPC_PWR when the AUPC is turned on in the AUPC Configuration menu.

FUNCTION SELECT: CONFIGURATION: MODULATOR: SCRAMBLER

Note: This menu is not available for IBS or D&I, and will not appear in the front panel menu. When using the Reed-Solomon option, the TX IDR overhead program automatically controls the V.35 scrambler (if the Reed-Solomon encoder is set to Off) or the synchronous scrambler (if Reed-Solomon encoder is set to On).

```
SCRAMBLER
   ON
```

Programs the scrambler On or Off.

On entry, the current status of the V.35 scrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: MODULATOR: DIFF ENCODER

```
DIFF ENCODER
     ON
```

Programs the differential encoder On or Off.

On entry, the current status of the differential encoder is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: MODULATOR: CARRIER MODE

```
CARRIER MODE
NORMAL (OFF)
```

Programs the modem for continuous wave mode. Four modes of operation are available:

Normal (Off):	The Carrier mode is normally in the Off position. To execute any of the Carrier continuous wave modes, enter the Carrier mode and select the test mode of choice.
Center:	Generates a carrier at the current modulator frequency. This can be used to measure the output frequency.
Dual:	Generates a dual side-band suppressed carrier signal. Side-bands are at one-half of the symbol rate from the carrier. This is used to check the channel balance and carrier null.
Offset:	Generates a single upper side-band suppressed carrier signal. The upper side-band is at one-quarter of the symbol rate from the carrier. This is used to check the quadrature.

On entry, the Center mode is displayed. To activate this test mode, press [ENTER]. Press an arrow key to select the desired mode.

FUNCTION SELECT: CONFIGURATION: MODULATOR: MODULATOR REF

```
MODULATOR REF
  INTERNAL
```

Optional program for selecting the following references:

- High stability 5 MHz internal reference
- 5 MHz, 10 MHz, and 20 MHz external references

On entry, the Internal mode is displayed. Press [▲] or [▼] to make the selection. Press [ENTER] to execute the change.

Optional: High Stability Modulator

FUNCTION SELECT: CONFIGURATION: MODULATOR: SCT PLL REF

```
  SCT PLL REF
MODULATOR REF
```

Optional program for selecting the following references:

- Modulator REF
- EXT-REF frequency

On entry, the current status is displayed. Press [▲] or [▼] to make the selection.
Press [ENTER] to execute the change.

Optional: High Stability Modulator

FUNCTION SELECT: CONFIGURATION: MODULATOR: R-S ENCODER

```
R-S ENCODER
    OFF
```

Programs the Reed-Solomon encoder On or Off.

On entry, the current status of the Reed-Solomon encoder is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Notes:

1. Programming the Reed-Solomon encoder automatically turns off the RF transmitter (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).

2. Programming the TX data rate or TX frequency automatically turns off the Reed-Solomon encoder. This allows the Reed-Solomon Codec and the non-Reed-Solomon modems to operate together in a switch rack system.

6.3.1.2 FUNCTION SELECT: CONFIGURATION: DEMODULATOR

```
CONFIGURATION
DEMODULATOR
```

Press [Enter} to review or edit the subsequent menus.

FUNCTION SELECT: CONFIGURATION: DEMODULATOR: RX-X CODE RATE

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

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

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

```
RX-D                    QPSK 1/2
          2048.000 Kbps
```

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

Receiver rate selection. Select one of four (A, B, C, or D) predefined receiver decoder/data rate combinations) or a variable rate selection (V).

Code Rate	Viterbi Data Rate Range	Sequential Code Rate
BPSK 1/2	9.6 to 3150.0 MHZ	9.6 to 1544.0 MHz
QPSK 1/2	19.0 to 6300.0 MHz	19.0 to 2185.0 MHz
QPSK 3/4	28.5 to 9312.0 MHz	28.5 to 3277.0 MHz
QPSK 7/8	33.25 to 9312.0 MHz	33.25 to 3823.0 MHz
8-PSK 2/3	38.0 to 9312.0 MHz	Not Applicable
8-PSK 5/6	47.5 to 9312.0 MHz	Not Applicable
16-QAM 3/4	57.0 to 9312.0 MHz	Not Applicable
16-QAM 7/8	64.0 to 9312.0 MHz	Not Applicable
QPSK 1/1	38.0 to 9312.0 MHz	Not Applicable

On entry, the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line 1. The data rate is displayed on line 2. Press an arrow key to select one of four pre-defined rates (A, B, C, or D). To select the currently defined variable data rate, select RX-V, and press [ENTER] twice.

To change the rate using the variable rate selection, press [ENTER] when RX-V is displayed. A flashing cursor is displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

Note: When using the Reed-Solomon option, the RX data rate program automatically turns off the Reed-Solomon decoder. This allows the Reed-Solomon Codec and the non-Reed-Solomon Codec modems to operate together in a switch rack system.

FUNCTION SELECT: CONFIGURATION: DEMODULATOR: RX-IF FREQUENCY

```
RX-IF FREQUENCY
  70.0000 MHz
```

Programs the demodulator receive frequency between 50 and 180 MHz, in 2.5 kHz steps.

On entry, the current receive frequency is displayed with the flashing cursor on the first character. Press [◀] or [▶] to move the flashing cursor, and [▲] or [▼] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

Note: When using the Reed-Solomon option, the RX frequency program automatically turns off the Reed-Solomon decoder. This allows the Reed-Solomon Codec and the non-Reed-Solomon Codec modems to operate together in a switch rack system

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: DESCRAMBLER

Note: This window is not available for IBS or D&I, and will not appear in the front panel menu. When using the Reed-Solomon option, the RX IDR overhead program automatically controls the V.35 descrambler (if the Reed-Solomon decoder is set to Off or Correction Off) or the synchronous descrambler (if the Reed-Solomon decoder is set to On).

```
DESCRAMBLER
    ON
```

Programs the V.35 descrambler On or Off.

On entry, the current status of the synchronous descrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: DIFF DECODER

```
DIFF DECODER
     ON
```

Programs the differential decoder On or Off.

On entry, the current status of the differential decoder is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: RF LOOP BACK

```
RF LOOP BACK
    OFF
```

Programs the modem for RF loopback operation (On or Off).

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.

Note: RF loopback nullifies IF loopback.

On entry, the current status of the RF loopback is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

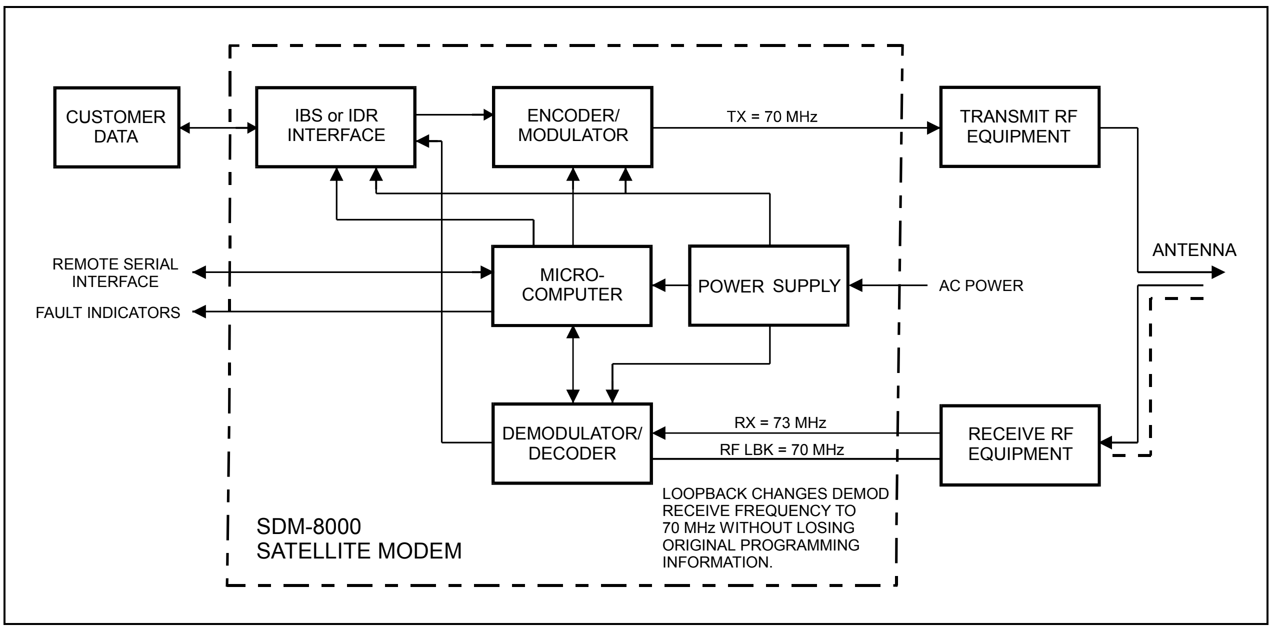


Figure 6-4. RF Loopback

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 allows the user to 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.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: IF LOOP BACK

```
IF LOOP BACK
    OFF
```

Programs the modem for 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. Refer to Figure 6-5 for a block diagram of IF loopback operation.

Note: IF loopback nullifies RF loopback.

On entry, the current status of IF loopback is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

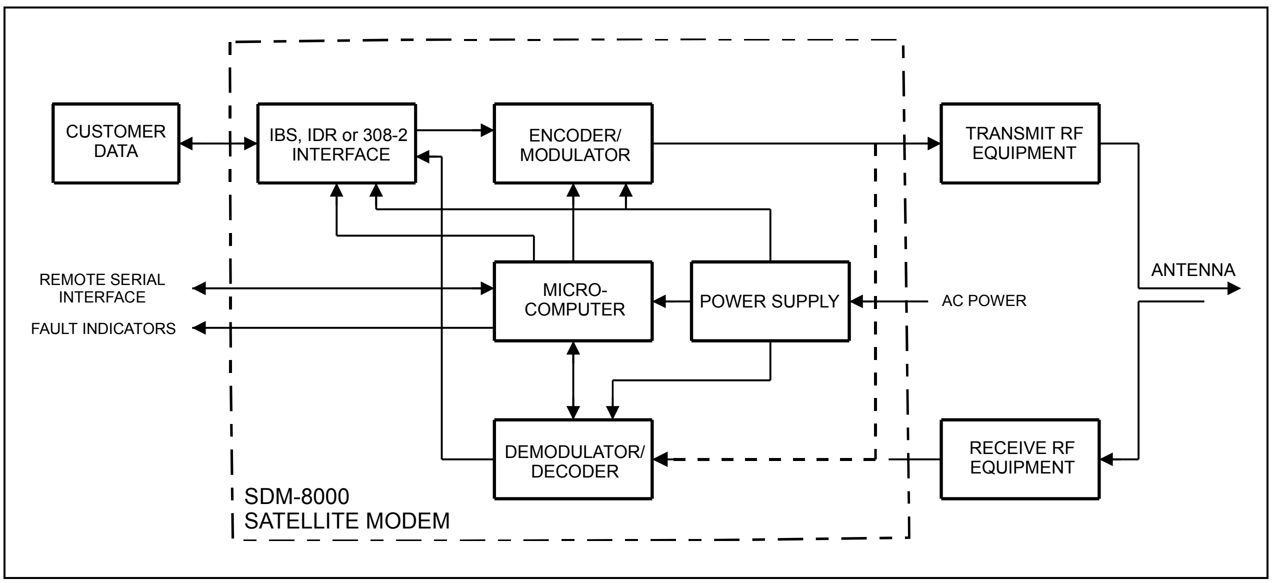


Figure 6-5. IF Loopback

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.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR:BER THRESHOLD

```
BER THRESHOLD
    NONE
```

Sets the BER threshold.

If the BER threshold set is exceeded, a receive fault will be indicated by the modem status indicators. BER threshold may be set from 1.0^{-3} to 1.0^{-8}, or may be disabled by specifying None.

On entry, the current setting of the BER threshold is displayed. Press [▲] or [▼] to select the desired setting. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: BER SWEEP CENTER

```
SWEEP CENTER
 -     0 Hz
```

Programs the sweep center frequency for the directed sweep function.

The sweep center frequency can be set in the range from –30000 Hz to +30000 Hz.

On entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [◄] or [►] to move the flashing cursor. Press [▲] or [▼] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. When in directed sweep, the value from the sweep monitor screen (when the modem was last locked) should be entered for the sweep center frequency.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: SWEEP RANGE

```
SWEEP RANGE
 60000 Hz
```

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 60000 Hz. When set at 60000 Hz, the modem is in the normal acquisition mode.

Note: The sweep range can be narrowed by tightly packed carriers to avoid the modem locking to an incorrect frequency.

On entry, the current programmed setting is displayed. Press [◄] or [►] to move the flashing cursor. Press [▲] or [▼] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. The smaller the range, the faster the modem will lock, provided the receive carrier center frequency is within the RX IF frequency sweep range.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: REACQUISITION

```
REACQUISITION
  0 SECONDS
```

Programs the sweep reacquisition mode time duration.

This is the time that the modem will remain in a narrow sweep of the selected range (± 5%) after loss of acquisition. After this timer runs out, the modem will return to the normal acquisition sweep.

The reacquisition time is 0 to 999 seconds.

On entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [◄] or [►] to move the flashing cursor. Press [▲] or [▼] to increment or decrement the digit at the flashing cursor. Select the number of seconds desired for the reacquisition mode. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION:DEMODULATOR: REED-SOLOMON DECODER

```
RS DECODER
    OFF
```

Programs the Reed-Solomon Decoder On, Correction Off, or Off.

On entry, the current status of the Reed-Solomon decoder is displayed. Use an arrow key 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 execute 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). Programming the RX data rate or RX frequency automatically turns off the Reed-Solomon decoder. This allows Reed-Solomon Codec and non-Reed-Solomon Codec modems to operate in a switch rack system.

6.3.1.3 FUNCTION SELECT: CONFIGURATION: INTERFACE

```
CONFIGURATION
  INTERFACE
```

Press [Enter] to review or edit the following subsequent menus.

FUNCTION SELECT: CONFIGURATION: INTERFACE: TX CLOCK SOURCE

```
TX CLOCK SOURCE
TX TERRESTRIAL
```

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

SCT (Internal):	Sets the TX clock to operate from the modem internal clock (this is also the fallback clock). The SCT can be locked to a high stability source depending on the setting for modulator reference.
External Reference:	Sets the TX clock to operate from the external reference clock at the Data I/O connector. Transmit Clock source must be phase/frequency locked to the data that is being transmitted.
TX Terrestrial:	Sets the TX clock to recover timing from the incoming clock/data.

On entry, the current transmit clock setting is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: TX CLOCK PHASE

```
TX CLOCK PHASE
     AUTO
```

Programs the TX clock phase to Auto, Normal, or Invert.

On 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 execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: EXT-REF FREQ

```
EXT-REF FREQ
1544.000 kHz
```

Programs the external reference clock input frequency between 8 kHz and 10 MHz. This is the EXT Clock input at the Data I/O connector.

Note: The clock rate must be an integer multiple of the data rate. The integer must be between 3 and 2^{14} -1.

This clock source is typically programmed to:

- 1544 kHz
- 5000 kHz
- 10000 kHz.

On entry, the current setting for the external reference is displayed. Press [◄] or [►] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: 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):	If the High Stability option is installed on the transmit board, the SCT becomes the High Stability mode.
External Reference:	Sets this clock source to the external reference clock at the Data I/O connector, 32 kHz to 10 MHz.
TX Terrestrial:	Sets the buffer output clock to recover timing from the incoming TX data clock.
High Stability:	This is a reference on the Demod board.

On entry, the current setting of the plesiochronous buffer clock is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: BUFFER SIZE

```
BUFFER SIZE
   384 BITS
```

```
  BUFFER SIZE
6 MILLI SECONDS
```

Sets the size of the buffer.

On entry, the current buffer length is displayed. Press [▲] or [▼] to select the desired buffer size. The buffer size is displayed in seconds or bits. Enter the Interface Utility menu to change the buffer units to seconds or bits. If selecting seconds, choose from 1 to 99 ms, in increments of 1 ms or 0 (Bypass). If selecting bits, choose from 32 to 262,144 bits, in increments of 16 bits. Press [ENTER] to execute the change.

When D&I is selected for modem type, the buffer units are automatically set to ms. The user may select from 1 to 32 ms, in 1 ms increments.

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.

FUNCTION SELECT: CONFIGURATION: INTERFACE: BUFFER CENTER

```
BUFFER CENTER
   YES/NO
```

This configuration function is used to center the buffer.

Press [ENTER] twice to center the plesiochronous buffer.

FUNCTION SELECT: CONFIGURATION: INTERFACE: RX CLOCK PHASE

```
RX CLOCK PHASE
    NORMAL
```

Programs the RX clock phase to Normal or Inverted.

On entry, the current status of the RX Clock is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: B-BAND LOOP BACK

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

Programs the modem for baseband loopback operation (On or Off).

When baseband loopback (Figure 6-6, and Figure 6-7) is turned on, the data and timing signals are hard wired (via relays) 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 bidirectional loopback of the baseband data.

On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

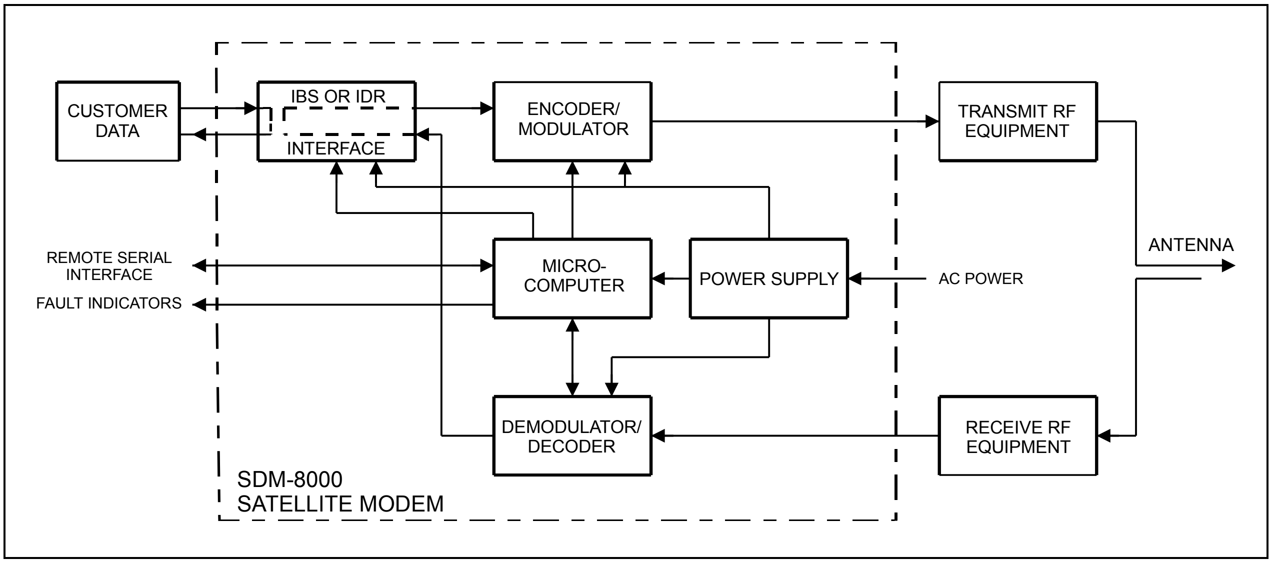


Figure 6-6. Baseband Loopback (without D&I)

Note: When baseband loopback is turned on, data is looped back on the customer side of the interface. This is a bidirectional loopback of the baseband data. This test mode will verify the customer equipment and cabling between the modem and the customer equipment. The baseband loopback is not bidirectional in Drop and Insert.

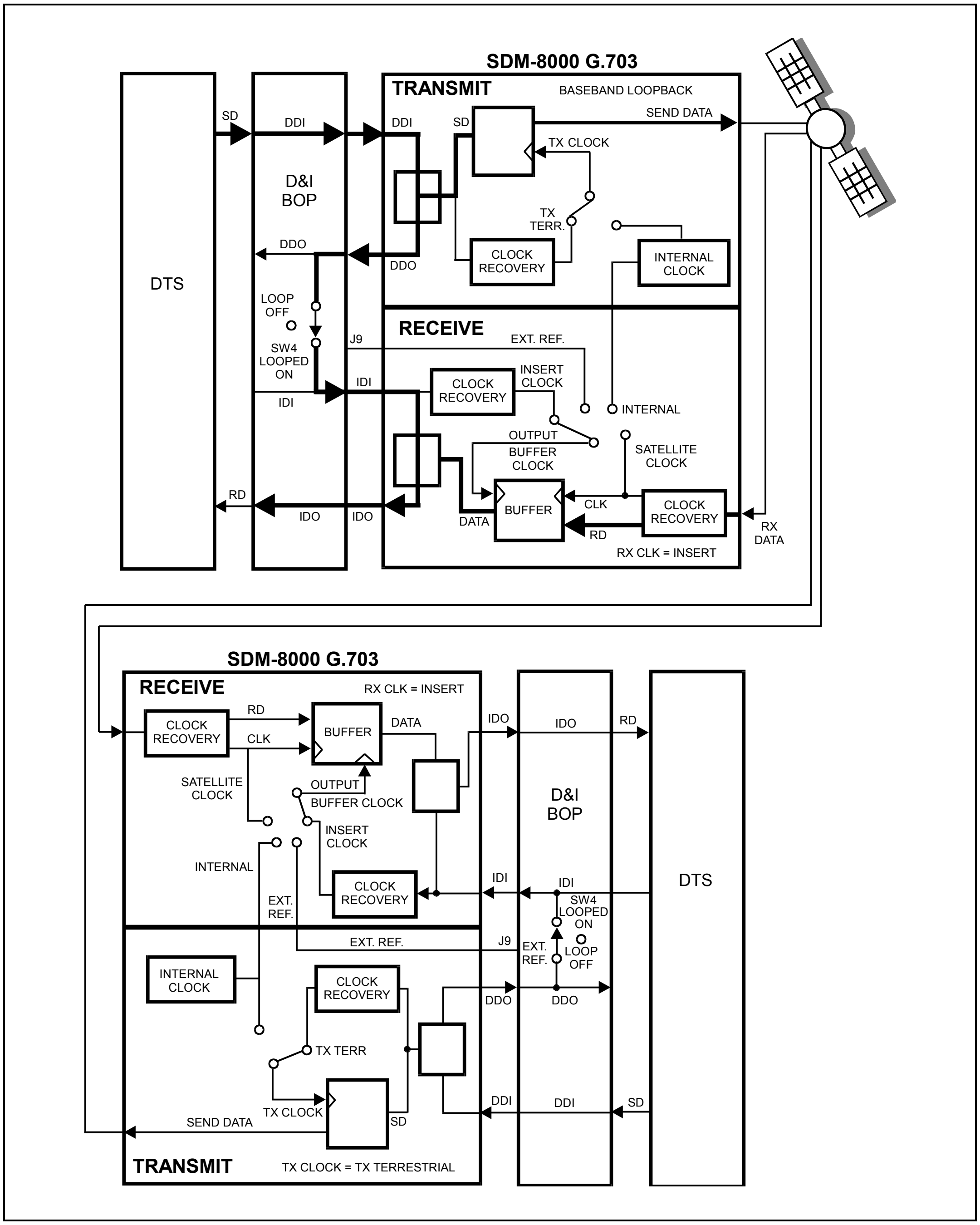


Figure 6-7. Baseband Loopback (with D&I)

Note: Baseband loopback is not bi-directional in D&I mode. The TX data will still be transmitted, but the RX data will be lost in the insert MUX.

FUNCTION SELECT: CONFIGURATION: INTERFACE: INTERFACE LOOP BACK

```
INTRFC LOOP BACK
      OFF
```

Programs the modem for interface loopback operation (On or Off).

When interface loopback (Figure 6-8) is turned on, data is looped back at the modem side of the interface. This is a bidirectional loopback of the data after the baseband data has had the overhead added.

On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

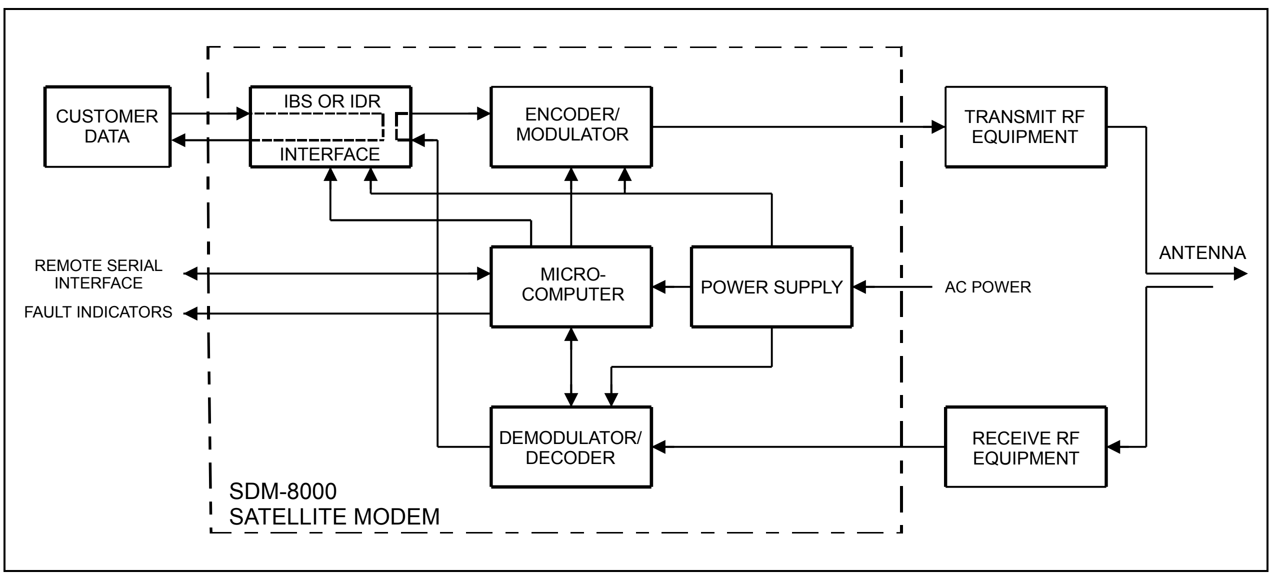


Figure 6-8. Interface Loopback

Note: When interface loopback in turned on, data is looped back on the modem side of the interface. This is a bidirectional 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.

FUNCTION SELECT: CONFIGURATION: INTERFACE:LOOP TIMING

```
LOOP TIMING
    OFF
```

Programs the modem SCT output clock to be phased locked to the RX satellite clock. The SCT (INTERNAL) will change to SCT (LOOP) when turned On.

Note: When the modem has been configured for ASLT, the SCT output will be the same rate as the modems TX data rate, but still phased locked to the unbalanced RX satellite data rate.

On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: TX CODING FORMAT

Note: This menu is only available when G.703 interface is installed.

```
TX CODING FORMAT
      AMI
```

Programs the transmitter for AMI, B6ZS, B8ZS, or HDB3 coding of the baseband data.

On entry, the current coding format is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: RX CODING FORMAT

Note: This menu is only available when G.703 interface is installed.

```
INTRFC LOOP BACK
      OFF
```

Programs the receiver for AMI, B6ZS, B8ZS, or HDB3 coding.

On entry, the current coding format is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE:TX DATA FAULT

Note: This menu is only available when the MUX is installed.

```
TX DATA FAULT
    NONE
```

Transmit data fault. Press an arrow key to select one of the following modes:

None:	The transmit interface fault Data/AIS is not activated.
Data:	Sets transmit interface fault Data/AIS to monitor a fault condition of all 1s or 0s. This is referred to as a data-stable condition, which means that the data is not transitioning.
Alarm Indication Signal (AIS):	Sets transmit interface fault Data/AIS to monitor a fault condition of all 1s from customer data input to the modem.

On entry, the current TX data fault that is being monitored is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: RX DATA FAULT

Note: This menu is only available when the DEMUX is installed.

```
RX DATA FAULT
    NONE
```

Receive data fault. Selects a receive interface fault monitor of None, AIS, or Data.

The data monitored for RX data is coming from the satellite. Refer to TX DATA FAULT for a description of function choices.

On entry, the current RX DATA FAULT that is being monitored is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: TX 2047 PATTERN

Note: This menu is only available when the MUX is installed and Non-DVB.

```
TX 2047 PATTERN
      OFF
```

Programs the transmitter to On or Off to insert a 2047 pattern in place of the normal transmit data.

On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: RX 2047 PATTERN

Note: This menu is only available when the DEMUX is installed and Non-DVB.

```
RX 2047 PATTERN
      OFF
```

Programs the modem to receive a 2047 pattern as the normal receive data and allows the BER monitor to work on that 2047 pattern.

On entry, the current status is displayed. Press an arrow key to select On or Off. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: IBS SCRAMBLER

Note: This menu is only available for IBS or D&I overhead. When using the Reed-Solomon option, this program does not turn on the synchronous scrambler. An asterisk (*) indicates Test mode configuration option.

```
IBS SCRAMBLER
     ON
```

Programs the IBS synchronous scrambler On or Off.

On entry, the current status of the scrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: IBS DESCRAMBLER

Note: This menu is only available when IBS or D&I has been selected for modem type in the Utility menu. When using the Reed-Solomon option, this program does not turn on the synchronous descrambler.

```
IBS DESCRAMBLER
      ON
```

Programs the IBS synchronous descrambler On or Off.

On entry, the current status of the descrambler is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: SERVICE CHANNEL

Note: This window is only available when IDR has been selected for modem type in the Utility menu.

```
SERVICE CHANNEL
    ADJUST
```

This configuration function is used to set service channel audio levels at TX-1, TX-2, RX-1, or RX-2.

On entry, press [◄] or [▶] to select the desired service channel. To adjust the service channel level (+10.0 to -20.0 dBm), press [ENTER]. Press [▲] or [▼] to adjust the service channel. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: SERVICE CHANNEL: TX-1

```
CHANNEL: TX-1
LEVEL = -5 dBm
```

This configuration allows Channel Tx-1 to be adjusted between +10 to –20 dBm.

FUNCTION SELECT: CONFIGURATION: INTERFACE: SERVICE CHANNEL: TX-2

```
CHANNEL: TX-2
LEVEL = -5 dBm
```

This configuration allows Channel Tx-2 to be adjusted between +10 to –20 dBm.

FUNCTION SELECT: CONFIGURATION: INTERFACE: SERVICE CHANNEL: TX-3

```
CHANNEL: TX-3
LEVEL = -5 dBm
```

This configuration allows Channel Tx-3 to be adjusted between +10 to –20 dBm.

FUNCTION SELECT: CONFIGURATION: INTERFACE: SERVICE CHANNEL: TX-4

```
CHANNEL: TX-4
LEVEL = -5 dBm
```

This configuration allows Channel Tx-4 to be adjusted between +10 to –20 dBm.

FUNCTION SELECT: CONFIGURATION: INTERFACE: DROP FORMAT

Note: This menu is only available for the D&I option.

```
DROP FORMAT
    T1
```

This configuration is used to select the desired drop data channel signaling. The choices are:

- E1_CCS (E1 Common Channel Signaling)
- E1_CAS (E1 Channel Associated Signaling)
- E1_IBS (E1 Pass Through)
- E1_31_TS (E1 No Multiframe Sync Alignment)
- T1 (T1 Data)
- T1_IBS (T1 Pass Through)
- T1_ESF (T1 Extended Super Frame)
- T1_ESF_S (Special signaling)
- T1_S (Special signaling)

On entry, the current drop data channel signal is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: INSERT FORMAT

Note: This menu is only available for the D&I option.

```
INSERT FORMAT
     T1
```

Selects the desired insert data channel signaling. The choices are:

- E1_CCS (E1 Common Channel Signaling)
- E1_CAS (E1 Channel Associated Signaling)
- E1_IBS (E1 Pass Through)
- E1_31_TS (E1 No Multiframe Sync Alignment)
- T1 (T1 Data Signal)
- T1_IBS (T1 Pass Through)
- T1_ESF (T1 Extended Super Frame)
- T1_ESF_S (Special signaling)
- T1_S (Special signaling)

On entry, the current insert data channel signal is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: DROP CHANNEL

```
DROP CHANNEL
ASSIGNMENTS
```

Programs the drop channels into the following desired time slot:

- Channels 1 to 31: E1_CCS, E1_31_TS, and E1_CAS
- Channels 1 to 24: T1, T1_ESF, T1_S, and T1_ESF_S

Note: Dropping time slot 0 is not allowed for E1_CCS, E1_CAS, or E1_31_TS. Use time slot 16 only in E1_31_TS. The number of drop channels is data rate dependent. The number of drop channels is DR/64 kbps. Thus, when the data rate is 64 kbps, there is only one drop channel. When the data rate is 1920 Kbps, there are 30 drop channels.

On entry, drop channel 1 and the current time slot are displayed. Press [↑] or [↓] to select the drop channel to be programmed.

Press [ENTER] to begin programming. Press [↑] or [↓] to select the time slot for each available drop channel by incrementing or decrementing the digit at the flashing cursor. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: DROP CHANNEL: DROP SAT CHANNEL TERR

```
DROP SAT ----->1
CHANNEL TERR-> 1
```

May be one of the following formats: T1, T1_ESF, T1_S, and T1_ESF_S.

FUNCTION SELECT: CONFIGURATION: INTERFACE: DROP CHANNEL: DROP SAT T-SLOT TERR

```
DROP SAT ----->1
T-SLOT TERR -> 1
```

May be all other formats.

FUNCTION SELECT: CONFIGURATION: INTERFACE: INSERT CHANNEL

Note: This menu is only available for the D&I option.

```
INSERT CHANNEL
 ASSIGNMENTS
```

Programs the satellite channels into the following desired terrestrial frame slot:

- Channels 1 to 31: E1_CCS, E1_31_TS, and E1_CAS
- Channels 1 to 24: T1, T1_ESF, T1_S, and T1_ESF_S

Note: The number of satellite channels is data rate dependent. The number of channels is DR/64 kbps. When the satellite data rate is 64 kbps, there is only one satellite channel. When the satellite data rate is 1920 kbps, there are 30 satellite channels.

On entry, satellite channel 1 and the current terrestrial frame slot are displayed. Press [▲] or [▼] to select the satellite channel to be programmed. Press [ENTER] to choose the satellite channel to be programmed. Press [▲] or [▼] to select the terrestrial frame slot for each available satellite channel by incrementing or decrementing the digit at the flashing cursor. If a time slot is unused, select NI (Not Inserted). Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: INSERT CHANNEL: INSERT SAT CHANNEL TERR

```
INSERT SAT --->1
CHANNEL TERR-> 1
```

May be one of the following formats: T1, T1_ESF, T1_S, and T1_ESF_S.

FUNCTION SELECT: CONFIGURATION: INTERFACE: INSERT CHANNEL: INSERT SAT T-SLOT TERR

```
INSERT SAT --->1
T-SLOT TERR -> 1
```

May be all other formats.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC TX BAUD

```
ASYNC TX BAUD
  110 bps
```

Programs the ASYNC overhead transmit baud rate.

On entry, the current status of the ASYNC TX baud rate is displayed. Press an arrow key to select one of the following baud rates (bps): 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400.

Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC RX BAUD

```
ASYNC RX BAUD
  110 bps
```

Programs the ASYNC overhead receive baud rate.

On entry, the current status of the ASYNC RX baud rate is displayed. Press an arrow key to select one of the following baud rates (bps): 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400.

Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC TX LENGTH

```
ASYNC TX LENGTH
    7 BITS
```

Programs the ASYNC overhead transmit word length for 5, 6, 7, or 8 bits.

On entry, the current status of the ASYNC TX word length is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC RX LENGTH

```
ASYNC RX LENGTH
    7 BITS
```

Programs the ASYNC overhead receive word length for 5, 6, 7, or 8 bits.

On entry, the current status of the ASYNC RX word length is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC TX STOP

```
ASYNC TX STOP
   2 BITS
```

Programs the ASYNC overhead transmit stop bits for 1 or 2.

On entry, the current status of the ASYNC TX stop bits is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC RX STOP

```
ASYNC RX STOP
   2 BITS
```

Programs the ASYNC overhead receive stop bits for 1 or 2.

On entry, the current status of the ASYNC RX stop bits make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC TX PARITY

```
ASYNC TX PARITY
     EVEN
```

Programs the ASYNC overhead transmit parity for:

- Even
- Odd
- None

On entry, the current status of the ASYNC TX transmit parity is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: ASYNC RX PARITY

```
ASYNC RX PARITY
     EVEN
```

Programs the ASYNC overhead receive parity for:

- Even
- Odd
- None

On entry, the current status of the ASYNC RX receive parity is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: TX DVB FRAMING

Note: This menu is only available for DVB overhead only.

```
TX DVB FRAMING
     188
```

Programs the TX DVB Framing mode for either:

- 188
- 204
- No framing

On entry, the current status of the transmit DVB framing is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: INTERFACE: RX DVB FRAMING

Note: This menu is only available for DVB overhead only.

```
RX DVB FRAMING
     188
```

Programs the RX DVB Framing mode for either:

- 188
- 204
- No framing

On entry, the current status of the receive DVB framing is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

6.3.1.4 FUNCTION SELECT: CONFIGURATION: LOCAL AUPC

```
CONFIGURATION
 LOCAL AUPC
```

Press [Enter] to review or edit the following subsequent menus.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: AUPC ENABLE

```
AUPC ENABLE
    OFF
```

Programs the AUPC On or Off.

On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: NOMINAL POWER

```
NOMINAL POWER
  -10.0 dBm
```

Programs the nominal power value of the AUPC. The nominal power value can range from -5 to -30 dBm, in 0.5 dBm steps.

On entry, the current nominal power value is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: MINIMUM POWER

```
MINIMUM POWER
   -30 dBm
```

Programs the minimum power level of the AUPC. The minimum power level can range from -5 to -30 dBm, in 0.5 dBm steps.

On entry, the current minimum power level is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: MAXIMUM POWER

```
MAXIMUM POWER
    -5 dBm
```

Programs the maximum power level to the AUPC. The maximum power level can range from -5 to -30 dBm, in 0.5 dBm steps.

On entry, the current maximum power level is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: TARGET NOISE

```
TARGET NOISE
   6.0 dB
```

Programs the E_b/N_o target set point. The E_b/N_o target set point ranges from 3.2 dB to 16.0 dB, in 0.1 dB steps.

On entry, the current E_b/N_o target set point is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: TRACKING RATE

```
TRACKING RATE
 0.5 dB/Min
```

Programs the maximum tracking rate of the AUPC.

Maximum tracking rate can range from 0.5 to 6.0 dBm, in 0.5 dBm/min. steps.

On entry, the current maximum tracking rate is displayed. Press an arrow key to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: LOCAL CL ACTION

```
LOCAL CL ACTION
     HOLD
```

Programs the local carrier loss for Hold, Normal, or Maximum.

On entry, the current status of the local carrier loss is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: CONFIGURATION: LOCAL AUPC: REMOTE CL ACTION

```
REMOTE CL ACTION
      HOLD
```

Programs the AUPC On or Off.

Programs the remote carrier loss for Hold, Nominal, or Maximum.

On entry, the current status of the remote carrier loss is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

6.3.1.4 FUNCTION SELECT: CONFIGURATION: CONFIGURATION SAVE

```
CONFIGURATION
SAVE
```

FUNCTION SELECT: CONFIGURATION: CONFIGURATION SAVE: SAVE

```
CONFIGURATION X
SAVE
```

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

After changing the configuration parameters to the desired settings, enter the Configuration Save menu and select memory location 1 through 5. Press [ENTER] to execute the save.

6.3.1.5 FUNCTION SELECT: CONFIGURATION: CONFIGURATION RECALL

```
CONFIGURATION
RECALL
```

FUNCTION SELECT: CONFIGURATION: CONFIGURATION RECALL: RECALL

```
CONFIGURATION X
RECALL
```

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

6.3.2 FUNCTION SELECT: MONITOR

```
FUNCTION SELECT
    MONITOR
```

When the Monitor level is entered, press [←] or [→] to select the desired monitor function. Each monitor function is displayed in real time as long as it is selected.

FUNCTION SELECT: MONITOR: RAW BER

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

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

Range: <m.m^{-e} to > m.m^{-e}.

Note: Low limit is based on performance. High limit is based on data/code rate.

FUNCTION SELECT: MONITOR: CORRECTED BER

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

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

Range: <m.m^{-e} to > m.m^{-e}.

Note: Low limit is based on performance. High limit is based on data/code rate.

FUNCTION SELECT: MONITOR: EB/NO

```
EB/NO
   16.0 dB
```

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

Range: <mm.m to >mm.m.

Note: Low limit is based on the data rate. High limit is 16.0 dB.

FUNCTION SELECT: MONITOR: RECEIVE SIGNAL

```
RECEIVE SIGNAL
     -45.0 dBm
```

Displays the current receive signal level.

Range: -25.0 to -60.0 dBm.

FUNCTION SELECT: MONITOR: SWEEP FREQUENCY

```
SWEEP FREQUENCY
  +    0 Hz
```

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

Range: -30,000 Hz to +30,000 Hz.

FUNCTION SELECT: MONITOR: BUFFER FILL

```
BUFFER FILL
    Nn%
```

Displays the current plesiochronous buffer fill status percent.

Range: nn% (1% to 99%).

Note: This menu is only available when buffer is installed.

FUNCTION SELECT: MONITOR: FRAME ERRORS

```
FRAME ERRORS
  n.n E-e
```

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

Displays the current framing pattern bit error rate or “No Data” (if carrier is not locked). Monitors the currently selected READ_ERROR function.

Range: $<$m.m^{-e} to $>$ m.m^{-e}.

Note: Low limit is based on performance. High limit is based on the data/code rate. This menu is only available when DEMUX is installed and Non-DVB.

6.3.3 FUNCTION SELECT: FAULTS/ALARMS

```
FUNCTION SELECT
 FAULTS/ALARMS
```

The Faults/Alarms level is accessible from the Function Select menu. The Faults/Alarms are similar to monitor functions, as they display the current fault status of the group being displayed.

Press [←] or [→] to move between the following Fault/Alarm groups:

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

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

- "–" indicates that no fault or alarm exists.
- "+" indicates that a fault exists, and will cause switching in a redundant system.
- Reversed contrast "+" indicates an active alarm.

Alarms do not cause switching to occur. To display labels for individual faults or alarms, press [ENTER].

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

The following sections outline the faults and alarms monitored and displayed in each group.

FUNCTION SELECT: FAULTS/ALARMS: MODULATOR FAULTS

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

The following faults may be monitored:

Note: Refer to Section 6.2 for more details of the causes of each fault.

IF SYNTHESIZER	Modulator IF synthesizer fault.
DATA CLOCK ACT	Transmit data clock activity alarm. Indicates that data clock activity was not detected.
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.
INTERNAL SCT SYN	Internal TX data clock synthesizer fault.
MODULE	Modulator module fault. Typically indicates that the modulator module is missing or will not program
ECT REF ACT	Modulator fault. Indicates modulator does not have an external reference. Use this only with the External Reference High Stability option.
PROGRAMMING	Modulator programming fault. Indicates a front panel programming error has been made.
CONFIGURATION	Modulator Configuration fault. Indicates the modulator cannot execute a programmed configuration parameter.

Note: Low limit is based on performance. High limit is based on data/code rate.

FUNCTION SELECT: FAULTS/ALARMS: DEMODULATOR FAULTS

```
DEMODULATOR
--------      --
```

The following faults may be monitored:

Note: Refer to Section 6.2 for more details of the causes of each fault.

CARRIER DETECT	Carrier detect fault. Indicated the decoder is not locked.
IF SYNTHESIZER	Modulator IF synthesizer fault.
RX CLOCK SYN	Receive data clock synthesizer fault. Indicates a loss of lock on the reference of the demodulator clock recovery oscillator.
I CHANNEL	I channel data activity fault.
Q CHANNEL	Q channel data activity fault.
DESCRAMBLER	Descrambler activity alarm. Indicates a loss of activity in the descrambler.
BER THRESHOLD	Secondary alarm result of the BER threshold set in the DEMOD Configuration menu.
MODULE	Modulator module fault. Typically indicates that the modulator module is missing or will not program
ECT REF ACT	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not perform.
PROGRAMMING	Demodulator programming fault. Indicates a front panel programming error has been made.
CONFIGURATION	Demodulator Configuration fault. Indicates the modulator cannot execute a programmed configuration parameter.

Note: Low limit is based on performance. High limit is based on data/code rate.

FUNCTION SELECT: FAULTS/ALARMS: TX INTERFACE FAULTS

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

Note: Refer to Section 6.2 for more details of the causes of each fault.

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.
PROGRAMMING	Transmit interface programming fault. Indicates a front panel programming error has been made.
CONFIGURATION	Transmit interface configuration fault. Indicates the transmit interface cannot execute a programmed configuration parameter.

FUNCTION SELECT: FAULTS/ALARMS: RX INTERFACE FAULTS

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

Note: Refer to Section 6.2 for more details of the causes of each fault.

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 Interface Configuration 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 Interface Configuration 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 when receive 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.
PROGRAMMING	Receive Interface programming fault. Indicates a front panel programming error has been made.
CONFIGURATION	Transmit Interface Configuration fault. Indicates the transmit interface cannot execute a programmed configuration parameter.

FUNCTION SELECT: FAULTS/ALARMS: COMMON EQUIPMENT FAULTS

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

Note: Refer to Section 6.2 for more details of the causes of each fault.

BATTERY/CLOCK – Battery or clock fault.
-12V SUPPLY – -12V power supply fault.
+12V SUPPLY – +12V power supply fault.
+5V SUPPLY – +5V power supply fault.
-5V SUPPLY – -5V power supply 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.

FUNCTION SELECT: FAULTS/ALARMS: BACKWARD ALARMS

```
BACKWARD ALARMS
--------
```

Note: Refer to Section 6.2 for more details of the causes of each fault.

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

Note: Only available with IDR selected.

6.3.4 FUNCTION SELECT: STORED FAULTS/ALARMS

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

The modem stores the first ten (Flt0 through Flt9) occurrences of fault status changes in each of the following major fault categories:

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

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

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

On entering the stored faults level, press [◀] or [▶] to move between the fault groups and the "Clear Stored Faults?" selections. The time and date of the first stored fault status (Flt0) for the selected group will be displayed alternately on line 2 of the display. Press [▲] or [▼] to cycle through the selected group's stored fault status (Flt0 through Flt9). To display the fault status associated with the displayed time and date, press [ENTER]. To identify the fault, press [◀] or [▶] to move the flashing cursor.

To clear the stored faults currently logged, press [ENTER] when the "Clear Stored Faults/Yes?" selection is displayed.

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

FUNCTION SELECT: FAULTS/ALARMS: MODULATOR X FAULT

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

```
 (FAULT LABEL)
---------    --
```

Faults may be any of the following:

- DATA/CLOCK ACTIVITY
- IF SYNTHESIZER
- DATA CLOCK ACT
- DATA CLOCK SYN
- I CHANNEL
- Q CHANNEL
- AGC
- INTERNAL SCT SYN
- MODULE
- EXT REF ACT
- PROGRAMMING
- CONFIGURATION

FUNCTION SELECT: FAULTS/ALARMS: DEMODULATOR X FAULT

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

```
 (FAULT LABEL)
---------    --
```

Faults may be any of the following:

- CARRIER DETECT
- IF SYNTHESIZER
- RX CLOCK SYN
- I CHANNEL
- Q CHANNEL
- DESCRAMBLER
- BER THRESHOLD
- MODULE
- PROGRAMMING
- CONFIGURATION

FUNCTION SELECT: FAULTS/ALARMS: TRANSMIT INTERFACE FAULT

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

```
 (FAULT LABEL)
 ---------    --
```

Faults may be any of the following:

- TX EXT DVB MUX <- Enhanced

- TX DROP
- TX DATA/AIS
- TX CLK PLL
- TX CLK ACTIVITY
- PROGRAMMING
- CONFIGURATION

FUNCTION SELECT: FAULTS/ALARMS: RECEIVE INTERFACE FAULT

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

```
 (FAULT LABEL)
 ---------    --
```

Faults may be any of the following:

- BUFFER UNFL
- BUFFER OVFL
- RX DATA/AIS
- FRAME BER
- BACKWARD ALARM
- BUFFER CLK PLL
- BUFFER CLK ACT
- DEMUX LOCK
- RX 2047 LOCK
- BUFFER FULL
- RX INSERT
- PROGRAMMING
- CONFIGURATION

FUNCTION SELECT: FAULTS/ALARMS: COMMON EQUIPMENT FAULT

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

```
 (FAULT LABEL)
 ---------    --
```

Faults may be any of the following:

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

FUNCTION SELECT: FAULTS/ALARMS: BACKWARD ALARMS FAULT

Note: IDR only.

```
BACKWARD ALRMS X
STORED TIME/DATE
```

```
 (FAULT LABEL)
 ---------    --
```

Faults may be any of the following:

- BW ALARM RX #4
- BW ALARM RX #3
- BW ALARM RX #2
- BW ALARM RX #1
- BW ALARM TX #4
- BW ALARM TX #3
- BW ALARM TX #2
- BW ALARM TX #1

FUNCTION SELECT: FAULTS/ALARMS: UNAVAILABLE SECONDS FAULT

```
UNAVAIL 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.

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

FUNCTION SELECT: FAULTS/ALARMS: CLEAR STORED FAULTS

```
CLEAR ??
STORED FAULTS
```

6.3.5 FUNCTION SELECT: REMOTE AUPC

```
FUNCTION SELECT
REMOTE AUPC
```

The remote functions may be viewed or changed by entering the remote level from the Select menu on the front panel. After entering the Remote 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.

Note: This is only available with the ASYNC overhead option.

FUNCTION SELECT: REMOTE AUPC: REMOTE AUPC: CONFIGURATION

```
REMOTE AUPC
CONGIGURATION
```

FUNCTION SELECT: REMOTE AUPC: REMOTE AUPC: CONFIGURATION: AUPC ENABLE

```
AUPC ENABLE
    OFF
```

Programs the AUPC enable On or Off.

On entry, the current status of the remote AUPC is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

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

FUNCTION SELECT: REMOTE AUPC: REMOTE AUPC: CONFIGURATION: B-BAND LOOP BACK

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

Programs the remote baseband loopback On or Off.

On entry, the current status of the remote baseband loopback is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

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

FUNCTION SELECT: REMOTE AUPC: REMOTE AUPC: CONFIGURATION: TX 2047 PATTERN

```
TX 2047 PATTERN
      OFF
```

TX 2047 PATTERN-Programs the remote TX 2047 pattern On or Off.

On entry, the current status of the remote TX 2047 is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

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

FUNCTION SELECT: REMOTE AUPC: REMOTE AUPC

```
REMOTE AUPC
  MONITOR
```

FUNCTION SELECT: REMOTE AUPC: REMOTE AUPC: 2047 ERRORS

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

Receive 2047 BER. This is a monitor point that displays the current RX 2047 BER. If no data is available, “No Data” is displayed.

6.3.6 FUNCTION SELECT: UTILITY

```
FUNCTION SELECT
    UTILITY
```

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

- Modulator
- Demodulator
- Interface
- System
- Modem Type
- Factory Setup

The menu information includes:

- Filter Types
- Terrestrial Interface Types
- Mod/Demod Types
- Time/Date
- Encoder/Decoder Types
- Modem Types
- Current Firmware
- Test Mode Status
- Overhead Type
- Revision Emulation
- Lamp Test

Provisions are also made for assigning data and code rates to the modulator and demodulator.

Note: Changes in the Utility menu may cause changes in other front panel menus.

After entering the Utility functions level, press [◄] or [►] to select the desired Utility menu, and press [ENTER].

6.3.6.1 FUNCTION SELECT: UTILITY: MODULATOR

```
UTILITY
MODULATOR
```

FUNCTION SELECT: UTILITY: ASSIGN TRANSMIT FILTERS

Transmit filter display/assignment utility. Used to make filter rate reassignments. The modulator has five symbol rate filter presets designated as A, B, C, D, and V.

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

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

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

```
TX-D                    QPSK 1/2
        2048.000 Kbps
```

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

Code Rate	Viterbi Data Rate Range	Sequential Code Rate
BPSK 1/2	9.6 to 3150.0 MHZ	9.6 to 1544.0 MHz
QPSK 1/2	19.0 to 6300.0 MHz	19.0 to 2185.0 MHz
QPSK 3/4	28.5 to 9312.0 MHz	28.5 to 3277.0 MHz
QPSK 7/8	33.25 to 9312.0 MHz	33.25 to 3823.0 MHz
8PSK 2/3	38.0 to 9312.0 MHz	Not Applicable
8PSK 5/6	47.5 to 9312.0 MHz	Not Applicable
16QAM 3/4	57.0 to 9312.0 MHz	Not Applicable
16QAM 7/8	64.0 to 9312.0 MHz	Not Applicable
QPSK 1/1	38.0 to 9312.0 MHz	Not Applicable

Notes:

1. Switching between modem types resets the filter presets to their factory defined values.

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

To view the current preset assignments, press [ENTER]. TX-A will be on line 1 of the display, followed by the code rate (1/2, 3/4, or 7/8). On line 2 will be the data rate assigned to preset A. Press [←] or [→] to view the assignments for presets B, C, D, and V (TX-B, TX-C, TX-D, and TX-V). To change a preset assignment, press [ENTER] when the data for that preset is displayed. Press [←] or [→] until the flashing cursor is at the parameter to be changed, then [↑] or [↓] to change that parameter. After all changes have been made, press [ENTER] to confirm the assignment. If a preset data/code rate is changed and the modem is currently using that preset, the modem will be reprogrammed to the new data/code rate.

Refer to the following page for a display of the preset assignments.

FUNCTION SELECT: UTILITY: MOD POWER OFFSET

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

Modulator power offset adjust. Offsets the modulator output power readout in the Configuration menu. This feature does not actually change the modulator power level, but displays an offset value in the monitor. The modulator power offset range is -49.9 to +49.9 dB, in 0.1 dB steps.

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

FUNCTION SELECT: UTILITY: MOD POWER FIXED

```
MOD POWER FIXED
OFFSET:  + 0.0 dB
```

Modulator power offset (status only). Indicates the power of a modulator that has been provided with extra gain (+20.0 to -20.0 dBm).

Note: This screen displays the fixed modulator power offset for Nominal High Power options.

FUNCTION SELECT: UTILITY: MODULATOR TYPE

```
MODULATOR TYPE
 INTELSAT OPEN
```

Transmit filter type select. Select INTELSAT OPEN, EFD CLOSED, CSC CLOSED, or FDC CLOSED network filtering.

Note: CSC Closed Modulator Type is not compatible with a 3/4 Code Rate and Sequential Encoder Type combination/

FUNCTION SELECT: UTILITY: ENCODER TYPE

```
ENCODER TYPE
  Viterbi
```

ENCODER TYPE-Encoder type selection. Select Viterbi or Sequential encoder type.

Note: Sequential Encoder Type and 3/4 Code rate combination is not compatible with CSC Closed Modulator Type.

FUNCTION SELECT: UTILITY: TX MODULE

```
TX MODULE  FW
 XXX.YYY.ZZZ
```

Displays the transmit module firmware version. The display includes the month, day, and year.

FUNCTION SELECT: UTILITY: TX MODULE : MONTH/DAY/YEAR

```
FW/NNNNNN-DDRR
MM/DD/YY
```

FUNCTION SELECT: UTILITY: TX FPGA FW

```
TX FPGA FW
FW/NNNNNN-DDRR
```

Displays the transmit module firmware version. The display includes the month, day, and year.

FUNCTION SELECT: UTILITY: TX FPGA FW: MM/DD/YY

```
FW/NNNNNN-DDRR
MM/DD/YY
```

FUNCTION SELECT: UTILITY: MODULATOR SPECTRUM

```
MOD SPECTRUM
NORMAL
```

MOD SPECTRUM-Programmable vector rotation. Allows the operator to select Normal or Inverted (INVERT) for spectrum reversal of the I and Q baseband channels.

FUNCTION SELECT: UTILITY: TX IESS-310 MODE

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

TX IESS-310 MODE-Programs the IESS-310 On or Off. Used for 8-PSK 2/3 and Reed-Solomon.

On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

6.3.6.2 FUNCTION SELECT: UTILITY: DEMODULATOR

```
UTILITY
DEMODULATOR
```

FUNCTION SELECT: UTILITY: DEMODULATOR: ASSIGN RECEIVE FILTERS

ASSIGN RECEIVER FILTERS-Receive filter display/assignment utility. Used to view the current filter rate assignments and to make filter rate reassignments.

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

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

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

```
RX-D                        QPSK 1/2
             2048.000 Kbps
```

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

Code Rate	Viterbi Data Rate Range	Sequential Code Rate
BPSK 1/2	9.6 to 3150.0 MHZ	9.6 to 1544.0 MHz
QPSK 1/2	19.0 to 6300.0 MHz	19.0 to 2185.0 MHz
QPSK 3/4	28.5 to 9312.0 MHz	28.5 to 3277.0 MHz
QPSK 7/8	33.25 to 9312.0 MHz	33.25 to 3823.0 MHz
8PSK 2/3	38.0 to 9312.0 MHz	Not Applicable
8PSK 5/6	47.5 to 9312.0 MHz	Not Applicable
16QAM 3/4	57.0 to 9312.0 MHz	Not Applicable
16QAM 7/8	64.0 to 9312.0 MHz	Not Applicable
QPSK 1/1	38.0 to 9312.0 MHz	Not Applicable

Notes:

1. Switching between modem types resets the filter presets to their factory defined values.
2. Code Rate 3/4 not compatible with a combination of a CSC Closed Demod Type and Sequential Decoder.

To view the current preset assignments, press [ENTER]. RX-A will be on line 1 of the display, followed by the code rate (1/2, 3/4, or 7/8). On line 2 will be the data rate assigned to preset A. Press [←] or [→] to view the assignments for presets B, C, D, and V (RX-B, RX-C, RX-D, and RX-V). To change a preset assignment, press [ENTER] when the data for that preset is displayed. Press [←] or [→] until the flashing cursor is at the parameter to be changed, then [↑] or [↓] to change that parameter. After all changes have been made, press [ENTER] to confirm the assignment. If a preset data/code rate is changed and the modem is currently using that preset, the modem will be reprogrammed to the new data/code rate.

Refer to the following page for a display of the preset assignments.

FUNCTION SELECT: UTILITY: DEMODULATOR: DEMODULATOR TYPE

```
DEMODULATOR TYPE
  INTELSAT OPEN
```

Demodulator TYPE-Receive filter type select. Select Type INTELSAT OPEN, EFD CLOSED, CSC CLOSED, or FDC CLOSED network receive filtering.

Notes:

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

FUNCTION SELECT: UTILITY: DEMODULATOR: DECODER TYPE

```
DECODER TYPE
VITERBI
```

DECODER TYPE-Decoder type selection. Select Viterbi or Sequential decoder type. The modem must have the proper hardware installed.

Notes:

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

FUNCTION SELECT: UTILITY: DEMODULATOR: RX MODULE FIRMWARE

```
RX MODULE FW
FW/NNNNNN-DDRR
```

Displays the receive module firmware version. The display includes the month, day, and year.

FUNCTION SELECT: UTILITY: DEMODULATOR: RX MODULE FIRMWARE: MONTH/DAY/YEAR

```
FW/NNNNNN-DDRR
MM/DD/YY
```

FUNCTION SELECT: UTILITY: DEMODULATOR: RX FPGA FIRMWARE

```
RX FPGA FW
FW/NNNNNN-DDRR
```

Displays the firmware installed in the RX field programmable gate array. The display includes the month, day, and year.

FUNCTION SELECT: UTILITY: DEMODULATOR: RX FPGA FIRMWARE: MONTH/DAY/YEAR

```
FW/NNNNNN-DDRR
MM/DD/YY
```

FUNCTION SELECT: UTILITY: DEMODULATOR: DEMOD SPECTRUM

```
DEMOD SPECTRUM
NORMAL
```

Programmable vector rotation. Select Normal or Inverted for spectrum reversal of the I and Q baseband channels.

FUNCTION SELECT: UTILITY: DEMODULATOR: RX IESS-310 MODE

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

Note: Used for 8-PSK 2/3 and Reed-Solomon.

RX IESS-310 MODE-Programs the IESS-310 On or Off.

On entry, the current status is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

6.3.6.3 FUNCTION SELECT: UTILITY: INTERFACE

```
UTILITY
INTERFACE
```

FUNCTION SELECT: UTILITY: INTERFACE: TX OVERHEAD TYPE

```
TX OVERHEAD TYPE
NONE
```

Select None, IDR, IBS, D&I, ASYNC, or DVB for TX overhead type.

Note: This window is only available when Custom is selected for modem type in the Utility menu.

FUNCTION SELECT: UTILITY: INTERFACE: RX OVERHEAD TYPE

```
RX OVERHEAD TYPE
NONE
```

Select IBS, IDR, D&I, ASYNC, DVB, or None for RX overhead type.

Note: This window is only available when Custom is selected for modem type in the Utility menu.

FUNCTION SELECT: UTILITY: INTERFACE: TX TERRESTRIAL INTERFACE

```
TX TERR INTRFACE
V.35
```

Displays the TX interface type V.35, G.703, or MIL188.

Note: This menu is status only except with the interface relay board option (RELAY).

FUNCTION SELECT: UTILITY: INTERFACE: RX TERRESTRIAL INTERFACE

```
RX TERR INTRFACE
      V.35
```

Displays the RX interface type V.35, G.703, or MIL188.

Note: This menu is status only except with the interface relay board option (RELAY).

FUNCTION SELECT: UTILITY: INTERFACE: G.703 LEVEL TYPE

```
G703 LEVEL TYPE
 NOMINAL LEVEL
```

Programs the G.703 level type for the following data rate and pulse-shaped configurations:

Configuration	Description
NOMINAL LEVEL	Rectangular pulse. 1544 Kbps and 2048 Kbps. This is the default.
HIGH DRIVE	Rectangular pulse. 8448 Mbps.
NOMINAL SHAPED	A non-standard pulse option for a higher amplitude than the lower shaped option. This pulse is shaped due to line loss problems.
LOW LEVEL	A non-standard pulse option for a lower amplitude than the nominal level option.
LOW SHAPED	Rectangular pulse. 6312 Kbps.

On entry, the current G.703 level type is displayed. Press an arrow key to select the configurations in the above list. Press [ENTER] to execute the change.

Note: This menu appears only with the interface relay board option (RELAY).

FUNCTION SELECT: UTILITY: INTERFACE: INTERFACE BUILD

```
INTERFACE BUILD
    TYPE 4
```

Displays the interface module type (1, 2, 3, or 4). This menu is a status-only window reporting the following types of modem operation:

Type 1 - Closed Network only.
Type 2 - Closed Network only with Doppler Buffer.
Type 3 - Closed Network, IBS with Doppler Buffer.
Type 4 - Closed Network, IBS, IDR with Doppler Buffer.

Note: The two options available with a type 4 are D&I with ASYNC overhead, and Reed-Solomon.

On entry, the current status of the E1 insert CRC is displayed. Press an arrow key to select ON or OFF. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: INTERFACE: INTERFACE OPTION

```
INTERFACE OPTION
-----
```

This menu is a status-only window, reporting the following interface options:

- Drop & Insert
- Reed-Solomon
- ASYNC
- AUPC
- RELAY

FUNCTION SELECT: UTILITY: INTERFACE: BUFFER PROGRAM

```
BUFFER PROGRAM
     BITS
```

Buffer unit program function. Select ms or bits.

Note: To have the modem calculate the plesiochronous shift, set the buffer units to ms. When a specific buffer depth is desired, the buffer unit should be set to bits.

FUNCTION SELECT: UTILITY: INTERFACE: FRAMING STRUCTURE

```
FRAMING
STRUCTURE
```

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.

Note: Under G.703 operation, when framing structure is selected, the buffer length will be restricted to multiples of the frame length.

On entry, the framing type (T1, T2, E1, or E2) is displayed on Line 1. The framing structure of each type is displayed on Line 2. Press an arrow key to select T1, T2, E1, or E2 framing type. Press [ENTER] to change the framing structure of the displayed framing type.

FUNCTION SELECT: UTILITY: INTERFACE: FRAMING STRUCTURE: T1 FRAMING

```
T1 FRAMING
STRUCTURE: G.704
```

Select either: None or G.704.

FUNCTION SELECT: UTILITY: INTERFACE: FRAMING STRUCTURE: E1 FRAMING

```
E1 FRAMING
STRUCTURE: G.704
```

Select either: None or G.704.

FUNCTION SELECT: UTILITY: INTERFACE: FRAMING STRUCTURE: T2 FRAMING

```
T2 FRAMING
STRUCTURE: G.743
```

Select either: None, G.704, G.743, or G.747

FUNCTION SELECT: UTILITY: INTERFACE: FRAMING STRUCTURE: E2 FRAMING

```
E2 FRAMING
STRUCTURE: G.742
```

Select either: None, G.704, G.742, or G.745

FUNCTION SELECT: UTILITY: INTERFACE: INTERFACE MODULE FIRMWARE

```
INTRFC MODULE FW
XXX.YYY.ZZZ
```

Interface module firmware.

Displays the current version of the interface module firmware. The display includes the month, day, and year.

FUNCTION SELECT: UTILITY: INTERFACE: INTERFACE MODULE FIRMWARE: MONTH/DAY/YEAR

```
FW/NNNNNN-DDRR
MM/DD/YY
```

FUNCTION SELECT: UTILITY: INTERFACE: INTERFACE FPGA FIRMWARE

```
INTRFACE FPGA FW
FW/NNNNNN-DDRR
```

Field programmable gate array firmware. Displays the current version of the Field Programmable Gate Array (FPGA) firmware. The display includes the month, day, and year.

FUNCTION SELECT: UTILITY: INTERFACE: INTERFACE FPGA FIRMWARE: MONTH/DAY/YEAR

```
FW/NNNNNN-DDRR
MM/DD/YY
```

FUNCTION SELECT: UTILITY: INTERFACE: E1 INSERT CRC

```
E1 INSERT CRC
     ON
```

E1 insert CRC enable function. Use this option to turn the CRC-4 on the insert side of the E1 circuits on or off. The default for this function is on. If the equipment cannot use the CRC-4 signal, disable the signal by turning it off.

Note: Only available with D&I.

FUNCTION SELECT: UTILITY: INTERFACE: TX DATA PHASE

```
TX DATA PHASE
   NORMAL
```

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

On entry, press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: INTERFACE: RX DATA PHASE

```
RX DATA PHASE
   NORMAL
```

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

On entry, press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD

```
 IDR BACKWARD
ALARM CONTROL
```

Controls IDR monitor and alarm functions when not using a communications link. Use this option to select On or Off for the RX and TX alarms.

Press an arrow key to select BW alarm RX or TX numbers 1 through 4. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM RX #4

```
BW ALARM RX #4
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM RX #3

```
BW ALARM RX #3
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM RX #2

```
BW ALARM RX #2
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM RX #1

```
BW ALARM RX #1
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM TX #4

```
BW ALARM TX #4
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM TX #3

```
BW ALARM TX #3
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM TX #2

```
BW ALARM TX #2
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR BACKWARD: BACKWARD ALARM TX #1

```
BW ALARM TX #1
      ON
```

FUNCTION SELECT: UTILITY: INTERFACE: IDR ESC TYPE

```
IDR ESC TYPE
2-32K AUDIO
```

IDR ESC TYPE-Use this option to select 64K DATA or 2-32K AUDIO. This menu is status only if IDR is selected through jumpers. It programs the IDR type if a jumper relay board is used.

On entry, the current status of the IDR ESC TYPE is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Jumper settings shall be changed according to Table 6-2. Interface Jumper Settings. Failure of this option may result.

Note: This program is only available with the IDR overhead option.

Table 6-2. Interface Jumper Settings

Summary Indicator	Interface Module
JP1, JP2, JP23	TX TERRESTRIAL INTERFACE
JP3, JP5, JP22, JP7	RX TERRESTRIAL INTERFACE
JP2	IDR TX BW ALARMS (1 through 4)
JP5	IDR TX 8KB DATA DRIVERS
JP5	IDR RX 8KB DATA DRIVERS
JP3	IDR AUDIO
MODULATOR SUMMARY INDICATOR	MODULATOR TYPE
DEMODULATOR SUMMARY INDICATOR	DEMODULATOR TYPE
MODULATOR SUMMARY INDICATORS	ENCODER TYPE
DEMODULATOR SUMMARY INDICATORS	DECODER TYPE

FUNCTION SELECT: UTILITY: INTERFACE: ASYNC TX TYPE

```
ASYNC TX TYPE
RS232
```

Programs the ASYNC overhead TX data type for EIA-232 or EIA-485 (2- or 4-Wire).

On entry, the current status of the ASYNC TX data type is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Note: This program is only available with the ASYNC overhead option.

FUNCTION SELECT: UTILITY: INTERFACE: ASYNC RX TYPE

Note: This program is only available with the ASYNC overhead option.

```
ASYNC RX TYPE
    RS232
```

Programs the ASYNC overhead RX data type for EIA-232 or EIA-485.

On entry, the current status of the ASYNC RX data type is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: INTERFACE: TX PLL RESPONSE

```
TX PLL RESPONSE
     FAULT
```

Status Window

Displays either Alarm or Fault.

6.3.6.4 FUNCTION SELECT: UTILITY: SYSTEM

```
UTILITY
SYSTEM
```

FUNCTION SELECT: UTILITY: SYSTEM: TIME/DATE

```
TIME:  12:00:00AM
DATE:     7/04/05
```

Time of day and date display/set function.

Entered in the format:

- Time: HH:MM:SS AM/PM
- Date: MM/DD/YY

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.

FUNCTION SELECT: UTILITY: SYSTEM: REMOTE BAUD RATE X PARITY

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

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 110 to 19200 bps.

FUNCTION SELECT: UTILITY: SYSTEM: REMOTE ADDRESS

```
REMOTE ADDRESS
             1
```

The current modem address is displayed (1 to 255).

To change the remote address, press [ENTER]. Press an arrow key to make the selection. Press [ENTER] to execute the change.

Note: Address 0 is reserved for global address.

FUNCTION SELECT: UTILITY: SYSTEM: OPERATION MODE

Note: When TX-only or RX-only is selected, the appropriate faults are masked from the Faults and Stored Faults menus.

```
OPERATION MODE
    DUPLEX
```

Operation mode. Programs the modem for Duplex, RX-only, or TX-only operation.

On entry, the operational status may be changed. Press an arrow key to make the selection. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: SYSTEM: TEST MODE STATUS

```
TEST MODE STATUS
       ---------
```

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

- RS DVB ENC OFF
- RS DVB DEC OFF
- REED-SOLOMON
- RX 2047 PATTERN
- TX 2047 PATTERN
- INTRFC LOOP BACK
- B-BAND LOOP BACK
- RF LOOP BACK
- IF LOOP BACK
- CARRIER MODE

To view the test modes, press [ENTER]. Press an arrow key to make the selection.

FUNCTION SELECT: UTILITY: SYSTEM: LAMP TEST

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

Lamp test function. Press [ENTER] to turn the front panel indicators on for three seconds.

FUNCTION SELECT: UTILITY: SYSTEM: MASTER RESET

```
MASTER RESET
HARD/SOFT
```

Master reset function.

CAUTION

Initiating a hard reset will result in the modem being configured to the default 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. Press [←] or [→] to make the selection. Press [ENTER]. Select Yes or No, and press [ENTER] again.

FUNCTION SELECT: UTILITY: SYSTEM: M&C MODULE FIRMWARE

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

Displays the M&C module firmware version. The display includes the month, day, and year.

FUNCTION SELECT: UTILITY: SYSTEM: M&C MODULE FIRMWARE: MONTH/DAY/YEAR

```
M&C MODULE FW
MM/DD/YY
```

FUNCTION SELECT: UTILITY: SYSTEM: DISPLAY CONTRAST

```
DISPLAY CONTRAST
  LEVEL:  64
```

Sets the contrast setting of the front panel menu.

Press [ENTER] to begin. Press [↑] or [↓] to increment or decrement the number at the flashing cursor, from 0 to 100. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: SYSTEM: EXT AGC MIN PWR

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

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

Sets the AGC voltage for a RX signal level of -60.0 dBm. The voltage range with is 0.0 to 10.0V, in 0.5V steps.

On entry, the current external AGC voltage level is displayed. Press [↑] or [↓] to increment or decrement the AGC voltage level in 0.5V steps. Press [ENTER] to execute the change.

FUNCTION SELECT: UTILITY: SYSTEM: EXT AGC MAX PWR

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

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

Sets the AGC voltage for a RX signal level of -25.0 dBm. The voltage range with is 0.0 to 10.0V, in 0.5V steps.

On entry, the current external AGC voltage level is displayed. Press [↑] or [↓] to increment or decrement the AGC voltage level in 0.5V steps. Press [ENTER] to execute the change.

Example:	EXT AGC MIN PWR = -50 dBm. EXT AGC MAX PWR = -30 dBm.

An AGC voltage reading of 4.0V would indicate a power level of 38 dBm if AS/3495 is used, or -46 dBm if AS/2697 is used.

Note: At power-up, the AGC OUT setting will be based on the previous configuration. These settings can only be changed through the front panel.

6.3.6.5 FUNCTION SELECT: UTILITY: MODEM TYPE

```
UTILITY
MODEM TYPE
```

FUNCTION SELECT: UTILITY: MODEM TYPE: MODEM TYPE

```
MODEM TYPE
CUSTOM
```

Selects the following types of modem operation:

D&I	D&I
Custom	Allows user to make all selections from the front panel menu
IBS	SDM-309 Mode of Operation
IDR	SDM-308 Mode of Operation
ASYNC	ASYNC Overhead Option
Type X	SDM-308, -309 Modem Emulation Interface Module TX TERR Interface RX TERR Interface MUX DEMUX Buffer IDR TX BW Alarms IDR TX 8 Kbps ESC/ IDR RX BW Alarms IDR RX 8 Kbps ESC IDR Audio IBS ESC Modulator Type Demodulator Type Encoder Type Decoder Type

n

When the modem is changed from one mode of operation to another, the modem will be reset to the default configurations of the new modem type. The RF-IF Output must be turned on to get the modem to lock. If the modem type is entered as the same configuration, the modem will not change any parameters. If the modem is changed to Custom mode, no parameters will be changed. If the modem will not allow the modem type selection, the jumpers may not have been set up for that type of operation. Entering the Modem Type Compatibility menu will describe what changes must be made. Once the jumpers have been properly set for a modem type, select Modem Type and press [ENTER] to execute the change.

Note: Refer to Chapter 4 for Type X modem emulation information.

FUNCTION SELECT: UTILITY: MODEM TYPE: MODEM TYPE COMPATIBILITY

```
MODEM TYPE
COMPATIBILITY
```

This menu lists the available options for each modem type, and identifies what options are active or inactive. When trying to enter a mode type in the previous menu, the modem will not allow selection of a type that does not have the proper jumpers selected. When entering any of the four mode type windows, one of the following strings of 16 characters will appear:

1 Option is installed and selected.
* Option is installed but not selected. When this occurs it must be corrected in order for the modem to allow the Modem Type to be selected.
O Option is not installed.
x Don't Care; option is installed but is not active.
X Don't Care; option is installed and active.

Press [ENTER] again and the name of the option at the cursor will be displayed. Press an arrow key to move the flashing cursor through the list of options. Jumpers marked with an "*" are older interface boards and may not be present on new revisions. Newer models have these jumpers set within the software.

Refer to Table 6-2 for proper jumper settings.

FUNCTION SELECT: UTILITY: MODEM TYPE: CUSTOM

```
CUSTOM
```

FUNCTION SELECT: UTILITY: MODEM TYPE: IDR

```
IDR
```

FUNCTION SELECT: UTILITY: MODEM TYPE: IBS

```
IBS
```

FUNCTION SELECT: UTILITY: MODEM TYPE: D&I

```
D&I
```

FUNCTION SELECT: UTILITY: MODEM TYPE: ASYNC

```
ASYNC
```

FUNCTION SELECT: UTILITY: MODEM TYPE: DVB

```
DVB
```

FUNCTION SELECT: UTILITY: MODEM TYPE: TYPE X

```
TYPE X
```

FUNCTION SELECT: UTILITY: MODEM TYPE: BACKWARD ALARM TX #1

```
BW ALARM TX #1
ON
```

FUNCTION SELECT: UTILITY: MODEM TYPE: REV EMULATION

```
REV EMULATION
CURRENT VERSION
```

Programs an emulation mode of a previous functional revision. This allows the user to select the CURRENT VERSION or FUNCTIONAL version (x).

Note: The Utility menu numbers increase with each software version change. Refer to Chapter 4 for a description of the software configuration.

On entry, the CURRENT VERSION is displayed. Press an arrow key to select the FUNCTIONAL versions. Press [ENTER] to execute the change.

Notes:

1. Programming a current version (default) allows all features and options (if installed) to operate normally.

2. Programming a function (2 through 11) 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 13.1.1) 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.

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.).

Place the most recent version of the modem in the backup position when used with Protection Switch SMS-658, SMS-758, or SMS-7000.

6.3.6.6 UTILITY FACTORY SET-UP

```
UTILITY
FACTORY SET-UP
```

This configuration is used for factory alignment. Factory setup should not be changed by unauthorized persons. To do so may cause modem failure.

6.4 Custom Modem Defaults

Table 6-3. Custom Modem Defaults

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	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	20948 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
TX-IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	Off	Descrambler	On
Power Level	-10.0 dBm	Differential Encoder	On
Scrambler	On	RF Loopback	Off
Differential Encoder	On	IF Loopback	Off
Carrier Mode	Normal (Off)	BER Threshold	None
Modem Reference	Internal	Sweep Center	0 Hz
SCT PLL REF	Modulator Reference	Sweep Range	60000 Hz
RS Encoder	Off	Reacquisition	0 seconds
		RS Decoder	Off
Interface			
TX Clock Source	TX Terrestrial	Service Channel	Adjust
TX Clock Phase	Auto	Channel, Level (TX/RX)	-5 dBm
EXT-CLK Frequency	1544 kHz	Drop Format	T1
Buffer Clock	RX (Satellite)	Insert Format	T1
Buffer Size	384 bit/s or 6 mseconds	Drop SAT	Channel Terr, others T-Slot Terr
RX Clock Phase	Normal	Insert SAT	Channel Terr, other T-Slot Terr
B-Band Loopback	Off	ASYNC TX Baud	110 kbps
Interface Loopback	Off	ASYNC RX Baud	110 kbps
Loop Timing	Off	ASYNC TX Length	7 bps
TX Coding Format	AMI	ASYNC RX Length	7 bps
RX Coding Format	AMI	ASYNC TX Stop	2 bps
TX Data Fault	None	ASYNC RX Stop	2 bps
RX Data Fault	None	ASYNC TX Parity	Even
TX 2047 Pattern	Off	ASYNC RX Parity	Even
RX 2047 Pattern	Off	TX DVB Framing	188
IBS Scrambler	On	RX DVB Framing	188

Table 6-3. Custom Modem Defaults (Continued)

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			
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	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
MOD Power Offset	0 dB	Demodulator Type	INTERNAL Open
Modulator Type	INTELSAT Open	Decoder Type	Viterbi
Encoder Type	Viterbi	DEMOD Spectrum	Normal
TX MOD Spectrum	Normal	RX-IESS-310 Mode	Off
TX-IESS-310 Mode	Off		
Utility Interface			
TX Overhead Type	None	Backward Alarm RX #4	On
RX Overhead Type	None	Backward Alarm RX #3	On
TX Terr Interface	V.35	Backward Alarm RX #2	On
RX Terr Interface	V.35	Backward Alarm RX #1	On
Interface Build	Type 4	Backward Alarm TX #4	On
Buffer Program	BITS	Backward Alarm TX #3	On
T1 Framing Structure	G.704	Backward Alarm TX #2	On
E1 Framing Structure	G.704	Backward Alarm TX #1	On
T2 Framing Structure	G.743	IDR ESC Type	2-32 Audio
E2 Framing Structure	G.742	ASYNC TX Type	RS232
E1 Insert CRC	On	ASYNC RX Type	RS232
TX Data Phase	Normal	TX PLL Response	Fault
RX Data Phase	Normal		

Table 6-3. Custom Modem Defaults (Continued)

Utility System			
Time	12:00:00 AM	Operation Mode	Duplex
Date	7/04/76	Display Contrast	64
Remote Baud Rate	9600 bit/s	EXT AGC: Min Pwr	0 volts
Remote Address	1	EXT AGC: Max Pwr	s
Utility ModemType			
Modem Type	Custom	Rev Emulation	Current version

Notes:

Chapter 7. CLOCKING OPTIONS

7.1 Clocking Options

Clocking of the data from the terrestrial equipment to the satellite (and vice versa) will depend on the application. The most common options and recommended configurations are described in the following sections.

Both Master/Master and Master/Slave applications require a certain amount of buffer due to Doppler shift caused by the apparent movement of the satellite in distance to the earth station. The Master/Master satellite set-up requires additional buffering due to mismatched station clocks.

7.1.1 IDR/IBS G.703 Master/Master

Refer to Figure 7-1 for the clocking block diagram with transmit and buffer clock options.

This application is used when both earth stations have high stability clocks, and the received data is to be clocked to the local network. The disadvantage of the master/master application is that the receive data will slip, as the clocks will not be synchronized. If the buffer is properly set up, the slips will be an exact frame length, causing minimum loss of data. By using very high stability clocks, the expected time between slips can be from 20 to 40 days, or infinite days. Loss of the buffer clock will mean the buffer will not be emptied, and data will not be available. The buffer clock will normally revert to the low stability internal reference automatically.

7.1.2 IDR/IBS G.703 Master/Slave

Refer to Figure 7-2.

This application should be used when the far end earth station does not have local access to a high stability reference clock, or when it is not required to synchronize with a local clock. The user equipment must loop the timing in G.703 applications.

7.1.3 IDR/IBS EIA-422 or V.35 Master/Master

Refer to Figure 7-3 for:

- Clocking block diagram
- Transmit clock options
- Buffer clock options
- V.35 timing signals
- EIA-422 timing signals

7.1.4 IDR/IBS EIA-422 or V.35 Master/Slave

Refer to Figure 7-4 for:

- Clocking block diagram
- Transmit clock options
- Buffer clock options
- V.35 timing signals
- EIA-422 timing signals

Modem loop timing is available in the modem. Loop timing sets the TX and RX clocks to the same clock source. In the **CONFIGURATION INTERFACE** menu , set the loop timing to ON, and select Internal mode for the TX clock. The SCT (INTERNAL) will change to SCT (LOOP) when loop timing is turned ON. The RX buffer clock should be set to satellite for this application

Notes:

1. To compensate for the Doppler shift on the outward and return paths, the length of the buffer at the master end will need to be twice the length that is normally required.
2. The use of loop timing in the modem also is an option for EIA-422 and V.35 operation.

7.1.5 D&I G.703 Master/Master

In the D&I configuration, the most typical clocking option is the master/master application. Refer to Figure 7-5 for:

- Blocking diagram
- Transmit clock options
- Buffer clock options

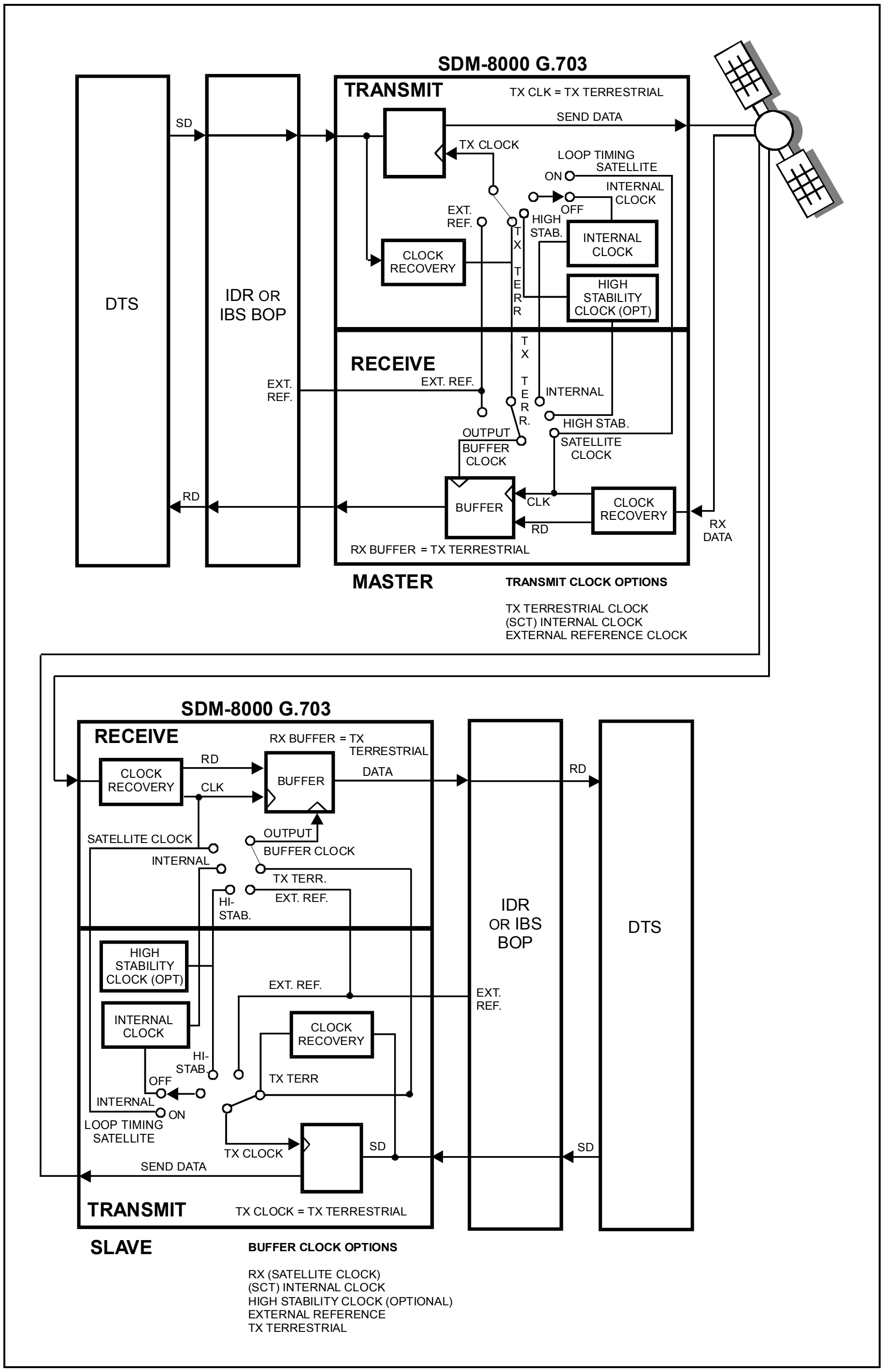


Figure 7-1. IDR/IBS G.703 Master/Master Clocking Diagram

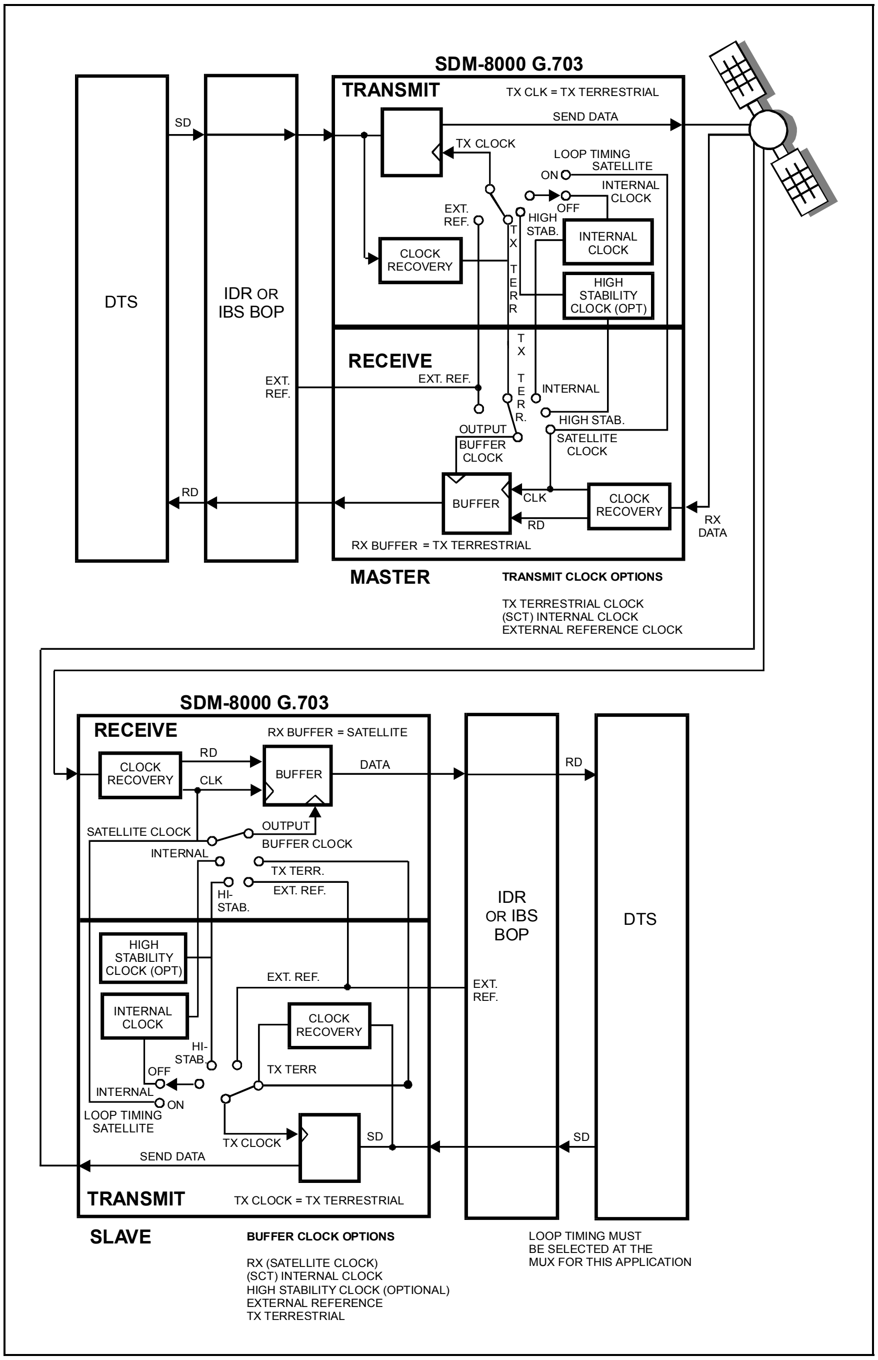


Figure 7-2. IDR/IBS G.703 Master/Slave Clocking Diagram

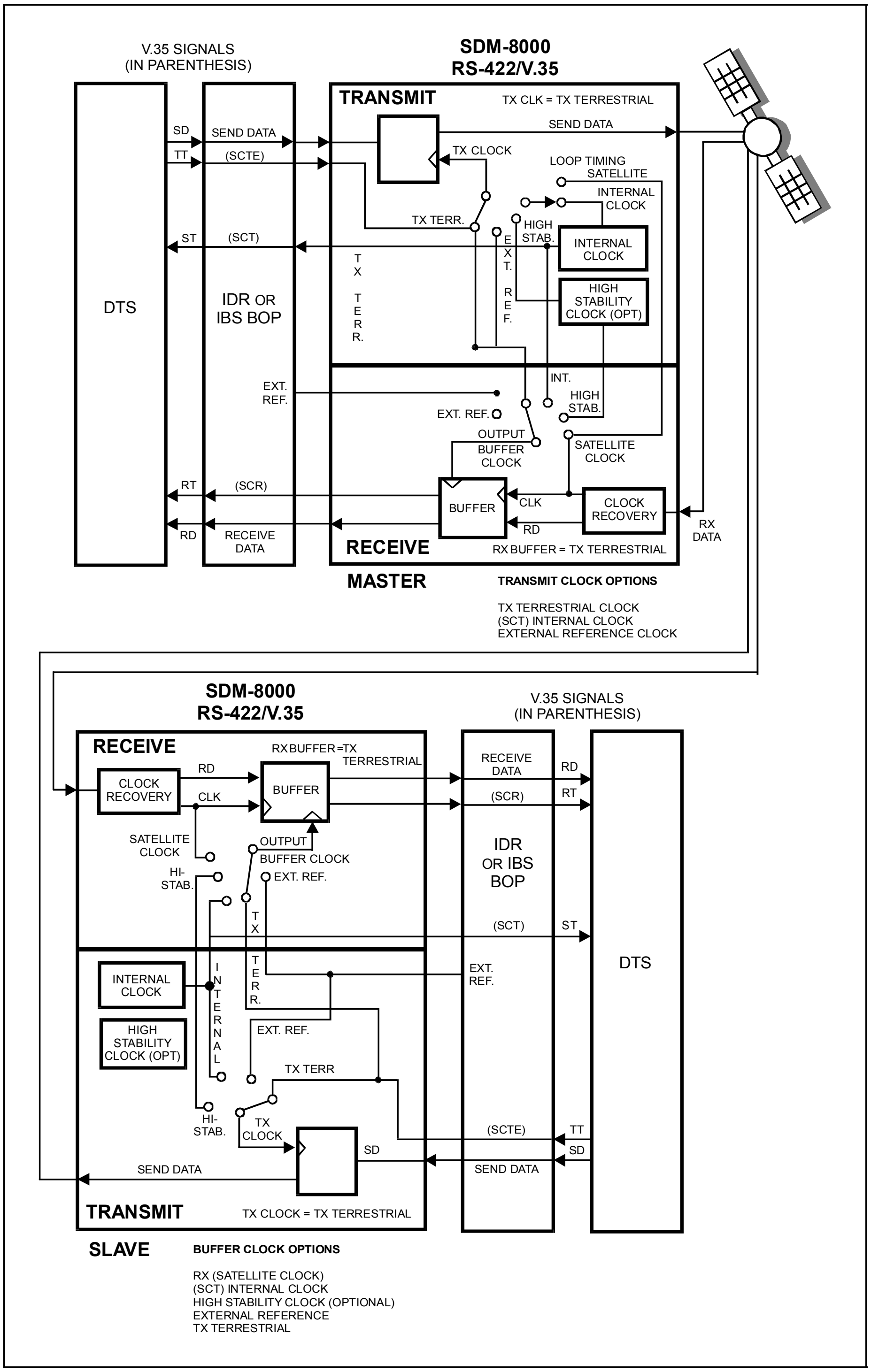


Figure 7-3. IDR/IBS EIA-422/V.35 Master/Master Clocking Diagram

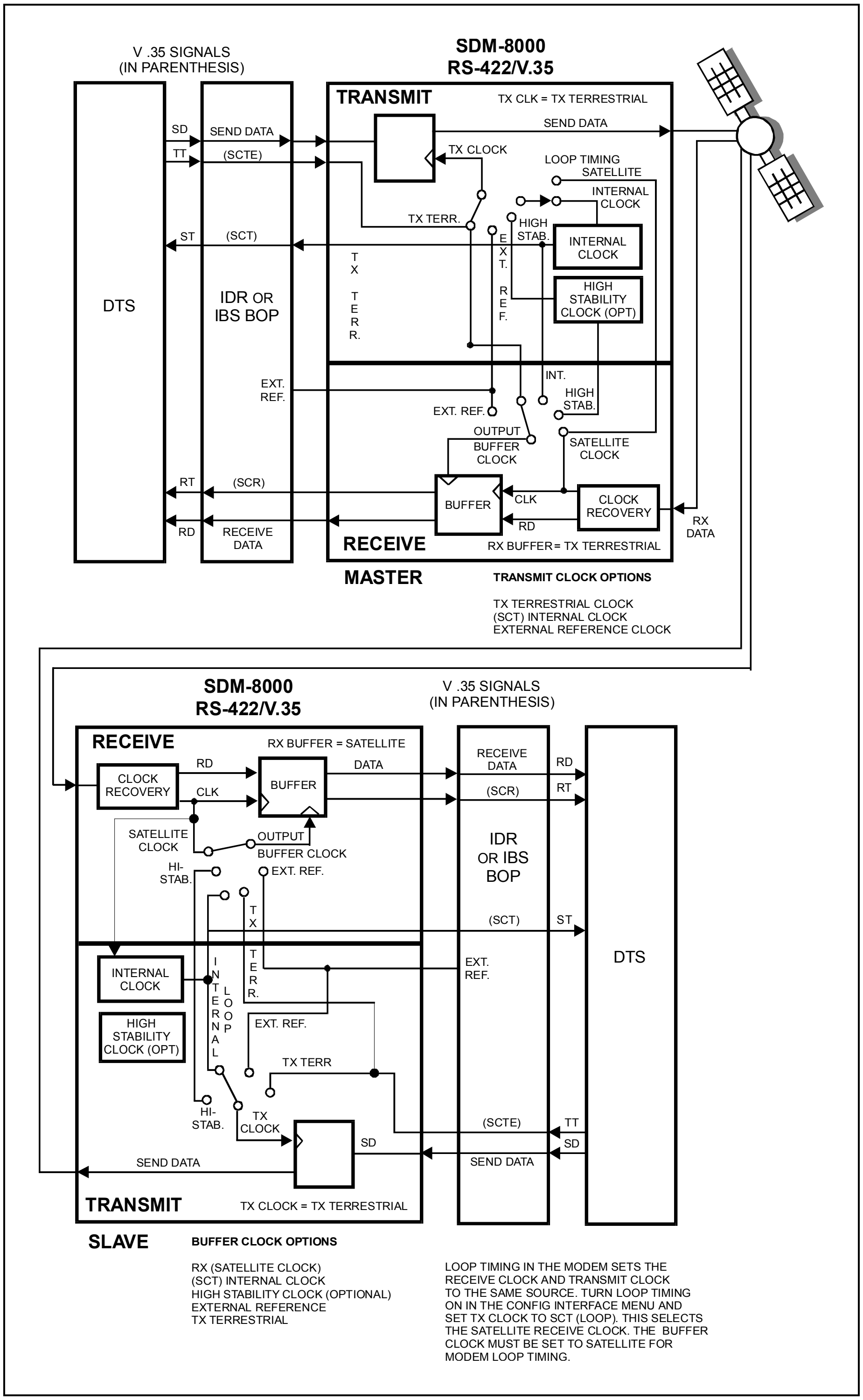


Figure 7-4. IDR/IBS EIA-422/V.35 Master/Slave Clocking Diagram

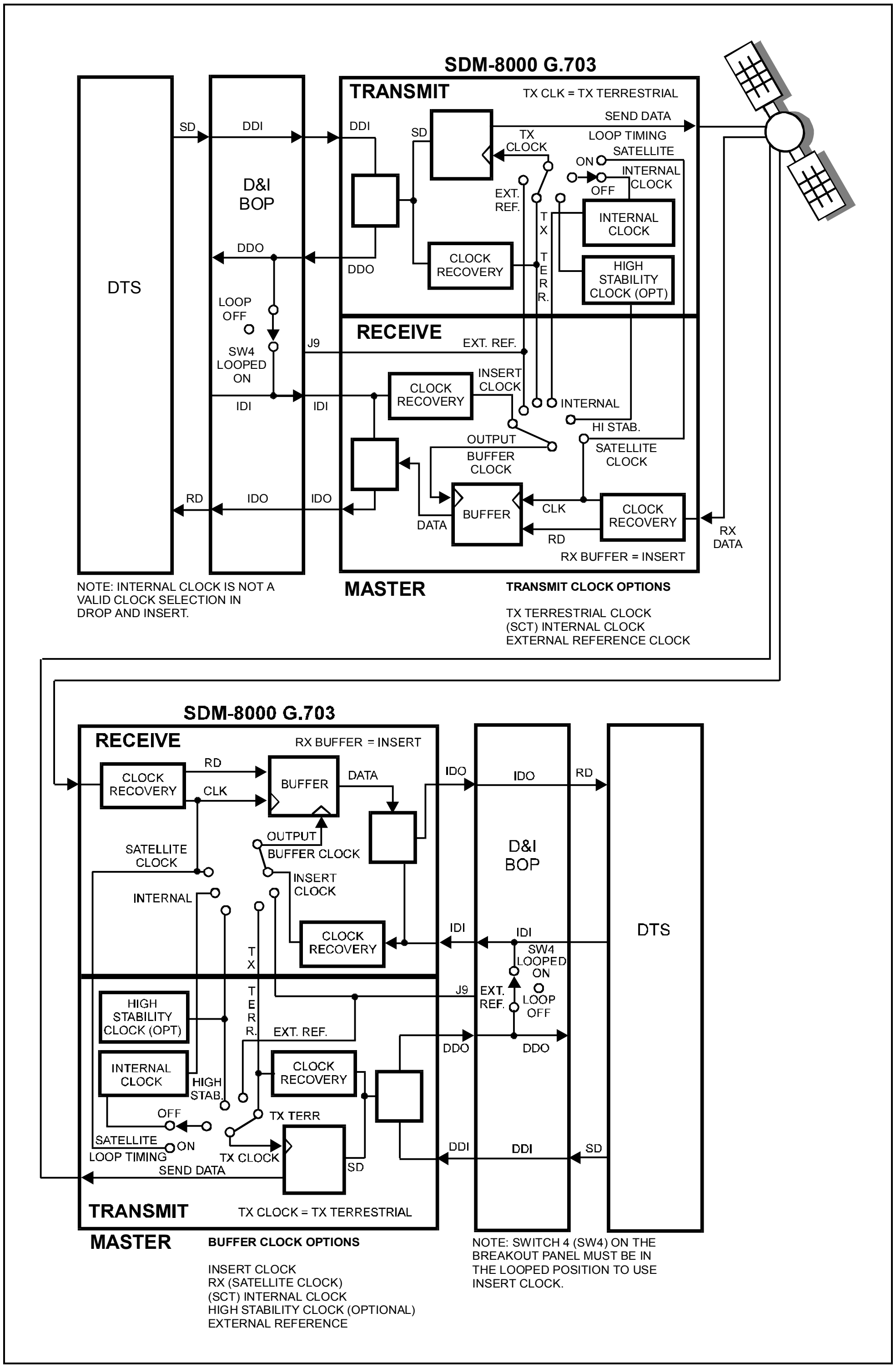


Figure 7-5. D&I G.703 Master/Master Clocking Diagram

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Chapter 8. BREAKOUT PANELS

8.1 Breakout Panels

The following Breakout Panels are applible to the satellite modem.

8.1.1 ASYNC Breakout Panel

The ASYNC breakout panel supports the use of the ASYNC interface in the modem. Connections between the breakout panel and other equipment are made through front and rear panel connectors. This breakout panel is used in 1:1 or M:N switching configurations.

For more information, refer to the *ASYNC Breakout Panel Installation and Operation Manual*.

8.1.2 D&I Breakout Panel

The D&I (B-308-5) breakout panel provides standardized interfaces for the D&I capabilities of the modem. The balanced and unbalanced interfaces for drop DATA I/O and insert DATA I/O are provided and are selectable with rear panel DIP switches. This breakout panel is used in 1:1 or M:N switching configurations.

For more information, refer to the *D&I Breakout Panel Installation and Operation Manual*.

8.1.3 IB-8004 Breakout Panel

The IB-8004 breakout panel provides convenient access to the SDM-308 Rev. 4 ESC components and access to the 1/15 IBS overhead order wire and alarms. The panel also supports T1/E1, EIA-422/449, and V.35 data interfaces. This breakout panel is used in a single modem configuration.

For more information, refer to the *IB-8004 Breakout Panel Installation and Operation Manual*.

8.1.4 IB-8005 Breakout Panel

The IB-8005 breakout panel provides convenient access to all features of the IB-8004 breakout panel, as well as D&I capabilities. The balanced and unbalanced interfaces for drop DATA I/O and insert DATA I/O are provided. Each interface is selectable with rear panel DIP switches. This breakout panel is used in single modem applications.

For more information, refer to the *IB-8005 Breakout Panel Installation and Operation Manual*.

8.1.5 IBS Breakout Panel

The IBS (B-309) breakout panel provides access to the 1/15 IBS overhead order wire and alarms. The panel also supports T1/E1, EIA-422/449, and V.35 data interfaces. T1/E1 can be configured for balanced or unbalanced DATA I/O at the front panel with toggle switches. This breakout panel is used in 1:1 or M:N switching configurations.

For more information, refer to the *IBS Breakout Panel Installation and Operation Manual*.

8.1.6 IDR Breakout Panel

The IDR (B-308-4) breakout panel provides convenient access to the SDM-308 Rev. 4 ESC components with industry standard connectors. The panel can be configured for balanced or unbalanced DATA I/O at the rear panel DIP switches. This breakout panel is used in 1:1 or M:N switching configurations.

For more information, refer to the *IDR Breakout Panel Installation and Operation Manual*.

8.2 UB-300 Universal Breakout Panel

The UB-300 universal breakout panel functions as IDR, IBS, and D&I data breakout panels in one small rack-mountable unit. This breakout panel is used in 1:1 or M:N switching configurations. The UB-300 supplies convenient access to the SDM-308 Rev. 4 ESC through a standard connector and to the 1/15 IBS overhead order wire, alarms, T1/E1, EIA-422/449, and V.35 data interfaces. The T1/E1 can be configured for balanced or unbalanced DATA I/O at the front panel through rear panel switches. The UB-300 also provides standardized interfaces for D&I data. Both balanced and unbalanced interfaces for drop DATA I/O and insert DATA I/O are provided, and are selectable through rear panel DIP switches.

For more information, refer to the *UB-300 Universal Breakout Panel Installation and Operation Manual*.

Chapter 9. MAINTENANCE

This chapter contains system checkout, fault isolation, and module replacement information.

9.1 System Checkout

This section provides instructions for checking the modem setup within the earth station.

Due to the complexity of the modem circuitry, use the checkout procedure only as a basic guideline. More complicated tests are beyond the scope of this manual.

The system checkout consists of test instructions for the modulator PCB, demodulator PCB, and interface PCB. The instructions include tables and test points for ensuring that the E_b/N_0, typical output spectrums, typical eye patterns, and constellation pictures are correct.

If a test failure occurs, refer to Section 6.2 for fault isolation procedures.

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

9.1.1 Interface Checkout

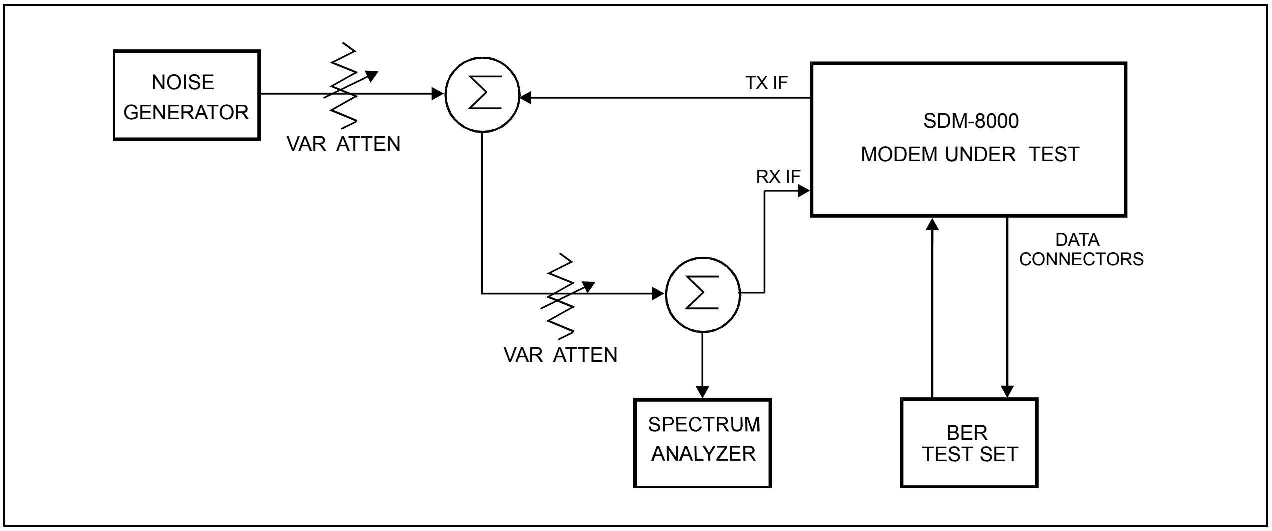


Figure 9-1. Fault Isolation Test Setup

To inspect the interface PCB:

Step	Procedures
1	Set up the equipment as shown in Figure 9-1. Refer to Appendix C for the modulator specifications. Section 9.1.4.1 lists the interface PCB test points.
2	Ensure the interface is configured for the proper mode of operation. Refer to Chapter 4 for configuration jumper settings.
3	Connect a BER test set to the appropriate modem data connector as shown in Figure 9-1. Refer to Chapter 3 for MIL-STD-188, G.703, or V.35 data connections.
4	Set up the modem for baseband loopback operation by using the **Configuration: Interface** front panel menu (Chapter 6). The modem will run error free. Refer to Chapter 6 for a block diagram of the baseband loopback operation
5	Change the modem from baseband loopback to interface loopback operation by using the **Configuration: Interface** front panel menu (Chapter 6). The modem will run error free. Refer to Chapter 6 for a block diagram of the interface loopback operation.

9.1.2 Modulator Checkout

To inspect the modulator PCB:

Step	Procedures
1	Set up the equipment as shown in Figure 9-1. Refer to Appendix C for the modulator specifications. Section 9.1.4.2 lists the modulator PCB test points and signal names.
2	Set up the modem for IF loopback operation by using the **Configuration: Demodulator** front panel menu (Chapter 6), or use an external IF loop with attenuation. Refer to Chapter 6 for a block diagram of the IF loopback operation.
3	Clear all TX faults by correct use of data and clock selection (Chapter 7).
4	Measure the E_b/N_0 with a receiver that is known to be properly operating. Refer to Table 9-1and 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 9-1. Read across the page to find the S/N and E_b/N_0 for the specific code rate. a. 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 Appendix C for examples of BER performance curves.
5	Connect a spectrum analyzer to the modem as shown Figure 9-2. 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 9-1.
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 6). This sets the Carrier mode in the off condition. A pure carrier should now be present at the IF output. Use this only for frequency measurements. Spurious and power measurements will be inaccurate b. b.Set the modem to the continuous wave Offset mode by using the Carrier Mode front panel menu (Chapter 6). This generates a single upper side-band suppressed carrier signal. Ensure the carrier and side-band suppression is < -30 dBc.

Table 9-1. 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

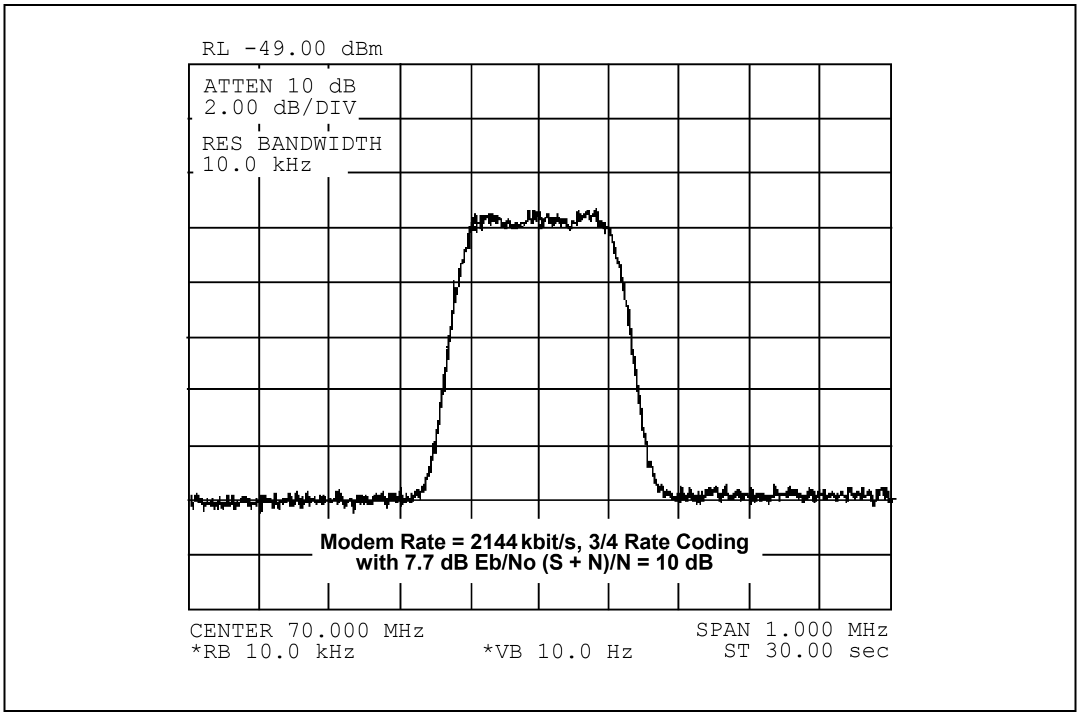


Figure 9-2. Typical Output Spectrum (with Noise)

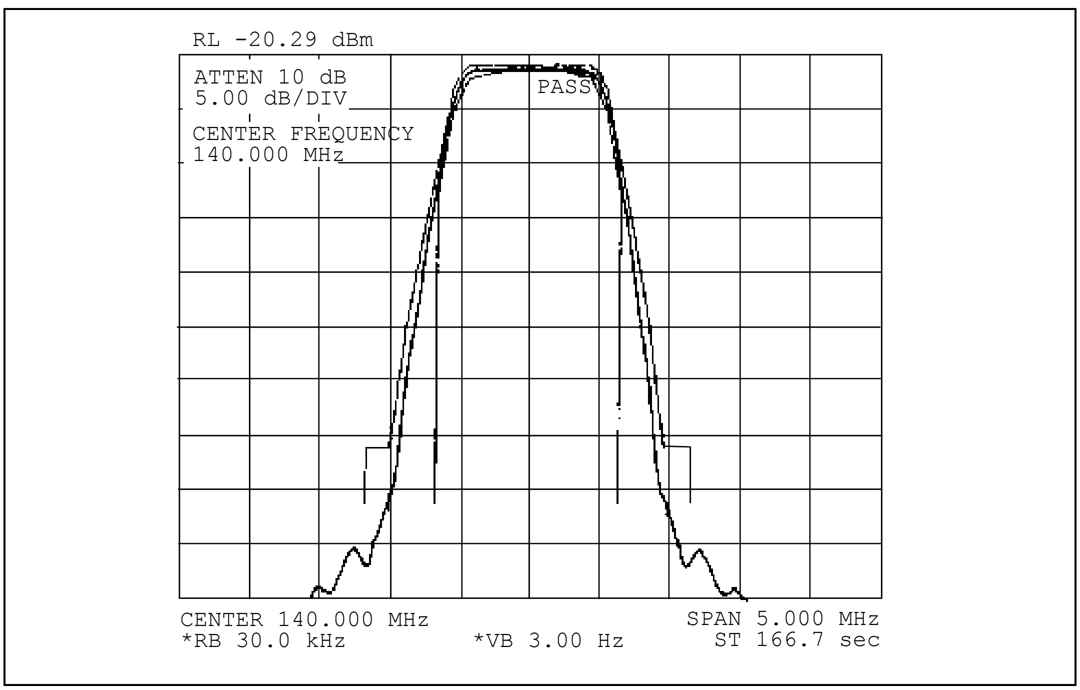
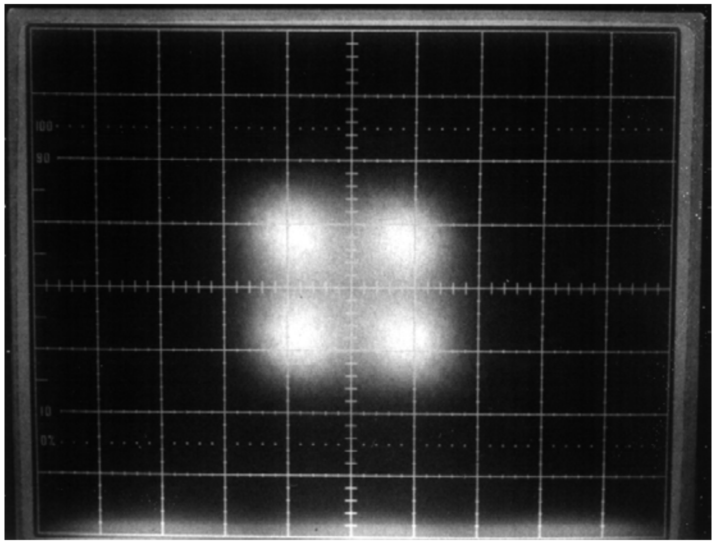


Figure 9-3. Typical Output Spectrum

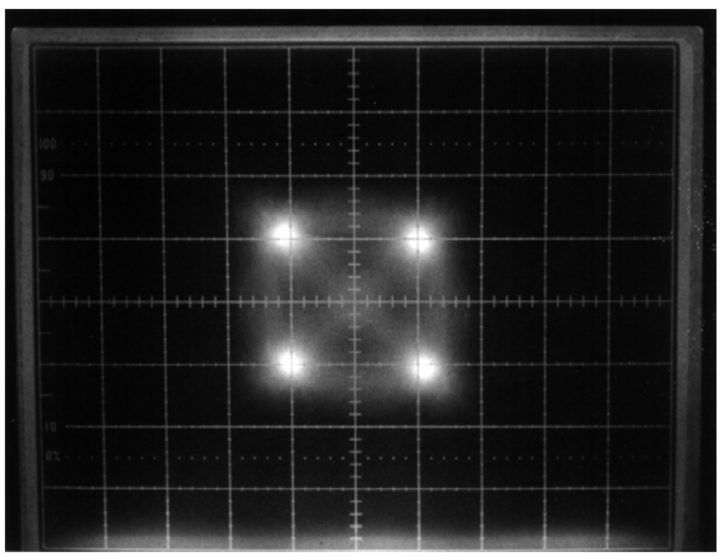
9.1.3 Demodulator Checkout

To inspect the demodulator PCB.

Step	Procedures
1	Set up the equipment as shown in Figure 9-1. Refer to Appendix C for the demodulator specifications. Section 9.1.4.3 lists the demodulator PCB test points and signal names.
2	Set up the modem with an external IF loop, and level. Using a properly operating modulator, 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, lockup may take several minutes. a. 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 b. Run the TX power level (input amplitude) over the full range, and offset the TX frequency from the RX frequency by 30 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. Figure 9-4 shows typical constellation patterns with noise and without noise.



WITH NOISE



WITHOUT NOISE

Figure 9-4. Typical Eye Constellations

9.1.4 PCB Test Points

This section lists the interface, modulator, and demodulator PCB test points that can be accessed at the front panel. The list includes a signal description under normal operating conditions.

9.1.4.1 Interface PCB Test Points

Refer to Figure 9-5 and Table 9-2.

Table 9-2. Interface PCB Test Points.

Test Point	Signal Name	Description
TP1	GND	Ground.
TP18	RX SAT CLK	Receive clock from Demod/decoder at data rate overhead (if applicable).
TP19	RX TER CLK	Plesiochronous buffer output clock (same as SAT if buffer bypassed) at data rate. Clocked to buffer clock selection.
TP4	TX MFS	Transmit Multi-Frame Sync (overhead only).
TP5	TX FS	Transmit Frame Sync (overhead only).
TP6	TX SFS	Transmit Sub Frame Sync (overhead only).
TP7	RX MFS	Receive Multi-Frame Sync (overhead only).
TP8	RX FS	Receive Frame Sync (overhead only).
TP9	RX SFS	Receive Sub Frame Sync (overhead only).
TP12	-5V	-5V power supply test point.
TP13	-12V	-12V power supply test point.
TP14	+5V	+5V power supply test point.
TP15	+12V	+12V power supply test point.
TP16	DAC PROBE1	Not used.
TP17	DAC PROBE 2	Not used.
TP20	MUX CLK	Transmit MUX clock data rate + overhead (if applicable). Same as TX TER CLK if no overhead.
TP21	TX TER CLK	Baseband input clock from TX clock source.
LED	**LED Name**	**Description**
D1	IDR AUDIO 1	IDR audio clip indication channel 1.
D4	IDR AUDIO 2	IDR audio clip indication channel 2.
D5	DEMUX LOCK	IDR and IBS only.
D6	BUFFER OVERFLOW	Buffer overflow indication.
D7	BUFFER UNDERFLOW	Buffer underflow indication.

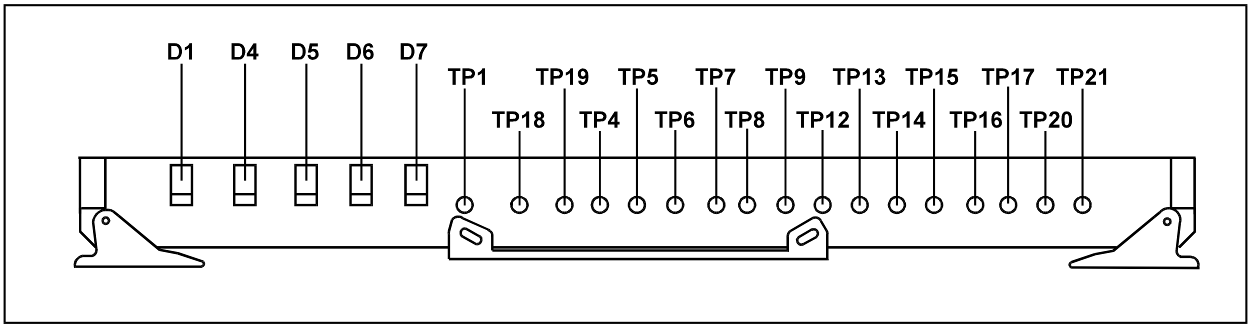


Figure 9-5. Interface PCB Test Points

9.1.4.2 Modulator PCB Test Points

Refer to Figure 9-6 and Table 9-3.

Table 9-3. Modulator PCB Test Points

Test Point	Signal Name	Description
TP8	Ground	Ground.
TP4	I channel	I channel eye pattern test point.
TP5	Q channel	Q channel eye pattern test point.
TP1	Ground	Ground.
TP2	SCT	SCT test point.
TP17	Ground	Ground.
TP6	Bit Clock	Data Clock test point.
TP7	Symbol Clock	Symbol Clock test point.

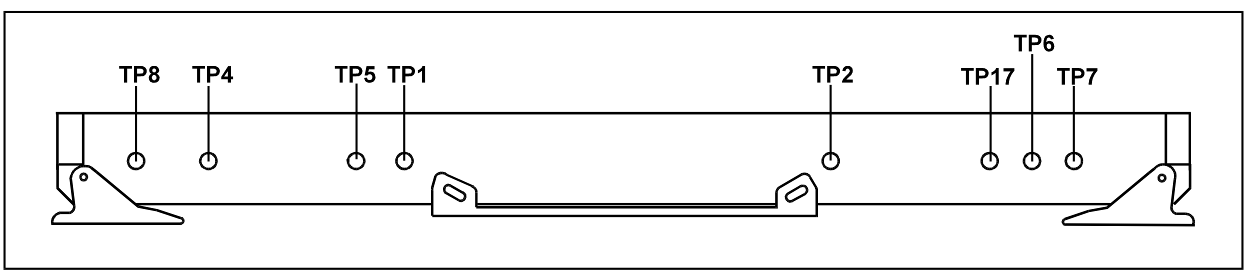


Figure 9-6. Modulator PCB Test Points

9.1.4.3 Demodulator PCB Test Points

Refer to Table 9-7 and Table 9-4.

Table 9-4. Demodulator PCB Test Points

Test Point	Signal Name	Description
TP25	SYMBOL CLK	Symbol clock.
TP21	GND	Ground test point.
TP5	Q EYE	Q channel monitor. The I and Q test points are a digital representation of the received filtered signal. To view these test points, use an oscilloscope in the X-Y mode. The display will be the constellation shown in Figure 9-4.
TP6	I EYE	I channel monitor. See Q EYE test point.
TP20	GND	Ground test point.
TP18	HS BUF CLK	High-stability buffer clock (optional feature).
TP15	DATA CLK	Data Clock.

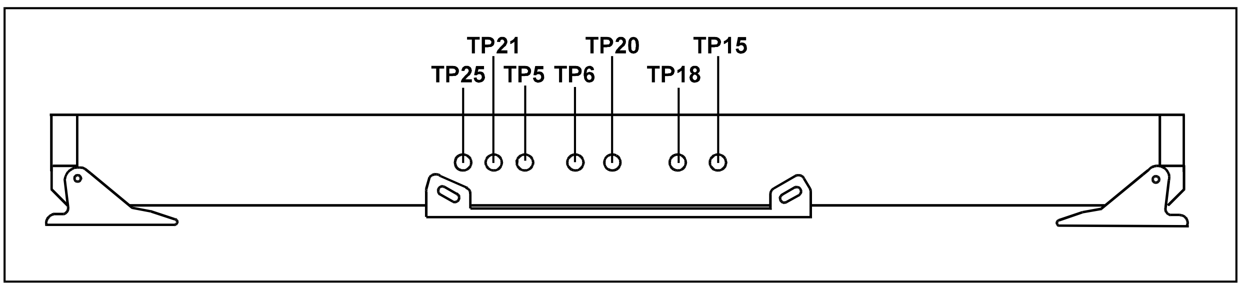


Figure 9-7. Demodulator PCB Test Points

9.2 Fault Isolation

The modem's design allows a competent technician to repair a faulty modem on location. All active circuits, except the power supply, can be removed from the modem through the front panel, without requiring special tools. The power supply can be removed through the top cover with standard tools.

CAUTION

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

The fault monitoring capability of the modem assists the operator in determining which PCB has failed. Replace the faulty PCB with a working spare. Return the faulty PCB to Comtech EF Data for repair.

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 listed in Section 9.2.3 includes possible problems and the appropriate action required to repair the modem.

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

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

- Faults (active or stored).

9.2.1 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 6 for more information. To determine the appropriate actions for repairing the modem, refer to Table 9-5 and the list of possible problems and actions in 9.2.3.

Table 9-5. SDM-8000 Fault Tree

MODULATOR FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY (1)	RX FAULT LED	RX FAULT RELAY (2)	COM EQ FAULT LED	COM EQ FAULT RELAY (3)	TX ALARM LED	TX ALARM RELAY #2 (4)	RX ALARM LED	RX ALARM RELAY #3 (5)	SPARE RELAY ALARM #1	PRIMARY ALARM RELAY (6) ** ***	SECONDARY ALARM RELAY (7) ** ***	IBS BACKWARD ALARM ** ***	DEFERRED MAIN ALARM (8) *	TX AIS * ** ***	RX AIS * ** ***	D&I TERR BWA ***
IF SYNTHESIZER	X	X	X										X				X		X
DATA CLOCK ACT								X	X				X				X		
DATA CLOCK SYN	X	X	X										X				X		X
I CHANNEL	X	X	X										X				X		X
Q CHANNEL	X	X	X										X				X		X
AGC	X	X	X										X				X		X
INTERNAL SCT SYN	X	X	X										X				X		X
EXT REF ACT								X	X				X				X		
MODULE	X	X	X										X				X		X
PROGRAMMING	X	X	X										X				X		X
CONFIGURATION	X	X	X										X				X		X
DEMODULATOR FAULTS																			
CARRIER DETECT				X	X								X		X			X	
IF SYNTHESIZER				X	X								X		X			X	
RX CLOCK SYN				X	X								X		X			X	
I CHANNEL				X	X								X		X			X	
Q CHANNEL				X	X								X		X			X	
DESCRAMBLER				X	X													X	
BER THRESHOLD										X	X			X		X			
MODULE				X	X								X		X			X	
PROGRAMMING				X	X								X		X			X	
CONFIGURATION				X	X								X		X			X	

Legend

Test Note	Fault/Alarm Relay	Test Points Connector/Pins
1	TX FAULT	J4/Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	J4/Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	J4/Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	J10/Pin 4 (NO), 5 (COM), 6 (NC) ****
5	RX ALARM #3	J10/Pin 7 (NO), 8 (COM), 9 (NC) ****
6	PROMPT ALARM	J5/Pin 43 (NO), 10 (COM), 27 (NC) ****
7	SERVICE ALARM	J5/Pin 44 (NO), 11 (COM), 28 (NC) ****
8	DEF MAINT ALARM	J5/Pin 17 *****

* IDR only
** IBS only
*** D&I only
**** A connection between the common and N.O. contacts indicates no fault/alarm.
**** Signal is open collector high impedance if faulted.

Table 9-5. SDM-8000 Fault Tree (Continued)

TX INTERFACE FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY (1)	RX FAULT LED	RX FAULT RELAY (2)	COM EQ FAULT LED	COM EQ FAULT RELAY (3)	TX ALARM LED	TX ALARM RELAY #2 (4)	RX ALARM LED	RX ALARM RELAY #3 (5)	SPARE RELAY ALARM #1	PROMPT ALARM RELAY (6) ** ***	SERVICE ALARM RELAY (7) ** ***	IBS BACKWARD ALARM ** ***	DEFERRED MAIN ALARM (8) *	TX AIS * ** ***	RX AIS * ** ***	D&I TERR BWA ***
TX DROP		X	X										X				X		X
TX DATA/AIS								X	X				X	X		X	X		
TX CLK PLL	X	X	X										X				X		
TX CLK ACTIVITY								X	X				X				X		X
PROGRAMMING	X	X	X										X				X		
CONFIGURATION	X	X	X										X				X		
RX INTERFACE FAULTS																			
BUFFER UNDERFLOW										X	X								
BUFFER OVERFLOW										X	X								
RX DATA/AIS										X	X		X		X	X		X	
FRAME BER				X	X								X		X			X	
BACKWARD ALARM										X	X			X					X
BUFFER CLK PLL				X	X								X					X	
BUFFER CLK ACT										X	X		X						
DEMUX LOCK				X	X								X		X			X	
RX 2047 LOCK										X	X								
BUFFER FULL										X	X								
RX INSERT				X	X								X					X	
PROGRAMMING				X	X								X					X	
CONFIGURATION				X	X								X					X	

Legend		
Test Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
1	TX FAULT	J4/Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	J4/Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	J4/Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	J10/Pin 4 (NO), 5 (COM), 6 (NC) ****
5	RX ALARM #3	J10/Pin 7 (NO), 8 (COM), 9 (NC) ****
6	PROMPT ALARM	J5/Pin 43 (NO), 10 (COM), 27 (NC) ****
7	SERVICE ALARM	J5/Pin 44 (NO), 11 (COM), 28 (NC) ****
8	DEF MAINT ALARM	J5/Pin 17 *****
*	IDR only	
**	IBS only	
***	D&I only	
****	A connection between the common and N.O. contacts indicates no fault/alarm.	
****	Signal is open collector high impedance if faulted.	

Table 9-5. SDM-8000 Fault Tree (Continued)

COMMON EQUIP FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY (1)	RX FAULT LED	RX FAULT RELAY (2)	COM EQ FAULT LED	COM EQ FAULT RELAY (3)	TX ALARM LED	TX ALARM RELAY #2 (4)	RX ALARM LED	RX ALARM RELAY #3 (5)	SPARE RELAY ALARM #1	PROMPT ALARM RELAY (6) ** ***	SERVICE ALARM RELAY (7) ** ***	IBS BACKWARD ALARM ** ***	DEFERRED MAIN ALARM (8) *	TX AIS * ** ***	RX AIS * ** ***	D&I TERR BWA ***
BATTERY/CLOCK						X								X		X			
-12V POWER SUPPLY						X	X						X						
+12V POWER SUPPLY						X	X						X						
+5V SUPPLY						X	X						X						
-5V SUPPLY						X	X						X						
CONTROLLER						X	X						X				X	X	
INTERFACE MODULE						X	X						X				X	X	
BACKWARD ALARMS (IDR AND CUSTOM ONLY)																			
BW ALARM RX #4										X	X					X			
BW ALARM RX #3										X	X					X			
BW ALARM RX #2										X	X					X			
BW ALARM RX #1										X	X					X			
BW ALARM TX #4								X	X										
BW ALARM TX #3								X	X										
BW ALARM TX #2								X	X										
BW ALARM TX #1								X	X										

Legend

Test Note	Fault/Alarm Relay	Test Points Connector/Pins
1	TX FAULT	J4/Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	J4/Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	J4/Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	J10/Pin 4 (NO), 5 (COM), 6 (NC) ****
5	RX ALARM #3	J10/Pin 7 (NO), 8 (COM), 9 (NC) ****
6	PROMPT ALARM	J5/Pin 43 (NO), 10 (COM), 27 (NC) ****
7	SERVICE ALARM	J5/Pin 44 (NO), 11 (COM), 28 (NC) ****
8	DEF MAINT ALARM	J5/Pin 17 *****

* IDR only
** IBS only
*** D&I only
**** A connection between the common and N.O. contacts indicates no fault/alarm.
**** Signal is open collector high impedance if faulted.

9.2.2 Fault/Alarm Display and Description

The 10 LEDs on the modem front panel indicate general fault, status, and alarm information.

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

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.

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, that 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. Use the Fault or Stored Fault front panel menu to determine which fault has occurred.

Alarms indicate minor faults that will not switch the modem offline in a redundant system. When an alarm occurs, a reversed contract “+” character (white on black) appears in the Fault or Stored Fault front panel menu.

9.2.3 Fault/Alarm Analysis

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

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

9.2.3.1 Modulator Faults

Refer Table 9-6 to for modulator faults.

Table 9-6. Modulator Faults

Fault/Alarm	Possible Problem and Action
IF SYNTHESIZER	Modulator IF synthesizer is faulted. This is a major alarm, and will turn off the modulator output. Return the modulator for repair.
DATA CLOCK ACT	Transmit data clock activity alarm. This fault is not a major alarm and will not turn off the modulator output. The problem is most likely on the interface card or external to the modem. Use the baseband loopback and interface loopback test modes for checking the interface. Ensure the incoming data clock is present at the modem DATA I/O connector. If data and clock are present at the DATA I/O, then replace the interface card to clear the fault and return the modem for repair.
DATA CLOCK SYN	Transmit data clock synthesizer fault. This fault is an indication 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 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. In the IDR type configuration, the data rate must reflect any overhead bits that are added. In the IBS type, the internal reference is changed to account for the IBS overhead of 16/15. A standard IDR type configuration operating at Rev. 2 would be programmed to the input data rate. An IBS type operating at Rev. 3 would be programmed to reflect the 96 kbps of overhead. A 1544 kbps Rev. 3 IDR is programmed to 1640 kbps. An IBS type would be programmed for the input data rate to the channel unit. The modem accounts for the overhead because of the change in internal reference. Use interface loopback for isolating the problem. Verify the frequency of the input data clock to be within the lock range of 100 PPM. If the inputs to the modem are correct, then the problem could be in one of two locations. Check the modulator first by replacing it with a spare. If the problem still exists, replace the interface card. When the fault has been isolated to a single card, send that card back for repair.
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, it indicates a loss of incoming data. If the fault is active with the scrambler turned off, check for input data at the DATA I/O connector. If data is present, replace the interface card to clear the fault and return the interface card for repair. If the fault is active with the scrambler turned on, replace the modulator card and return it for repair.

Table 9-6. Modulator Faults (Continued)

Q CHANNEL	Activity alarm for the Q channel digital filter. Use the I channel procedure above.
AGC LEVEL	Output power AGC level fault. Indicates the level of the modulator output is not at the programmed level. Replace the modulator card and return it for repair.
INTERNAL SCT SYN	Internal TX data clock synthesizer fault. The SCT has failed to lock to the internal reference. Replace the modulator board.
EXT REF ACT	External reference activity. Activity fault for the external reference clock. Indicates clock reference not detected.
MODULE	Modulator module fault. Typically indicates that the modulator module is missing or will not program. Ensure the modulator card is present and is properly seated. If the modulator card is properly seated, this could indicate a problem in the M&C card or in the interface between the modulator and the M&C card. Another possible problem is the modulator firmware may be installed incorrectly or has a pin not making contact. Ensure the modulator firmware is correctly installed. Return the defective card for repair.
PROGRAMMING	Modulator programming fault. Indicates the modulator module has failed to program a current configuration parameter. If this fault occurs, notify the factory for assistance.
CONFIGURATION	Modulator configuration fault. Indicates the modulator module does not support a programmed configuration parameter. This fault typically happens in the Custom mode when the programmed configuration does not match the module hardware. Verify the programming of the modulator hardware matches the configuration parameters. Also verify all jumpers are set correctly for currently programmed configuration parameters.

9.2.3.2 Demodulator Faults

Refer to Table 9-7 for demodulator faults.

Table 9-7. 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 (Section 9.2.3.1). Verify the frequency of the data transmitted from the modulator is within 100 PPM. Check the test points on the demodulator and decoder for the eye pattern, data, and clock to verify proper levels, activity, and phase (Section 9.1).
IF SYNTHESIZER	Demodulator IF synthesizer fault. Indicates the demodulator IF synthesizer is faulted. This fault is a hardware failure. Return the demodulator for repair.
RX CLOCK SYN	Receive data clock synthesizer fault. Indicates a loss of lock on the reference of the demodulator clock recovery oscillator. This is a hardware failure fault. Return the decoder card for repair.
I CHANNEL	Indicates a loss of activity in the I channel of the quadrature demodulator. Typically indicates a problem in the modulator side of the circuit. Check for proper RF input to the demodulator. If the input to the demodulator is correct, then the problem is in the baseband processing. Replace either the demodulator card or the decoder card to isolate the fault and return the failed card for repair.
Q CHANNEL	Indicates a loss of activity in the Q channel of the quadrature demodulator. Follow the same procedure for the I channel fault.
DESCRAMBLER	Descrambler alarm. Indicates loss of activity in the descrambler. Typically indicates a loss of decoder program. Could indicate a problem in the M&C card or a problem in the communication between the M&C and the decoder.
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.

Table 9-7. Demodulator Faults (Continued)

MODULE	Demodulator module fault. Typically indicates that the demodulator module is missing or will not program. Ensure the demodulator card is present and properly seated. If the card is properly seated this could indicate a problem in the M&C card or in the interface between the demodulator card and the M&C card. Return the defective card for repair.
PROGRAMMING	Demodulator programming fault. Indicates the demodulator module has failed to program a current configuration parameter. If this fault occurs, notify the factory for assistance.
CONFIGURATION	Demodulator configuration fault. Indicates the demodulator module does not support a programmed configuration parameter. This fault typically happens in the Custom mode when the programmed configuration does not match the module hardware. Verify the programming of the demodulator hardware matches the configuration parameters. Also verify all jumpers have been set correctly for currently programmed configuration parameters.

9.2.3.3 Transmit Interface Faults

Refer to Table 9-8 for transmit interface faults.

Table 9-8. Transmit Interface Faults

Fault/Alarm	Possible Problem and Action
TX DROP	Drop interface hardware fault (D&I only). The typical cause of this fault is the drop phase-locked loop is not locked, or some other drop interface hardware has malfunctioned. Return the D&I card to the factory for repair.
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 all 0s. This is referred to as a data stable condition (the 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. Return the interface card for repair.
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.
PROGRAMMING	Transmit interface programming fault. Indicates the TX interface module has failed to program a current configuration parameter. If this fault occurs, notify the factory for assistance.
CONFIGURATION	Transmit interface configuration fault. Indicates the TX interface module does not support a programmed configuration parameter. This fault typically happens in the Custom mode when the programmed configuration does not match the module hardware. Verify the programming of the TX interface hardware matches the configuration parameters. Also verify all jumpers have been set correctly for currently programmed configuration parameters.

9.2.3.4 Receive Interface Faults

Refer to Table 9-9 for receive interface faults.

Table 9-9. 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 is continuously present). This is included in this section to be consistent with the fault reporting system and correctly registered in the stored fault memory. The time and date of the last 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 accuracy's.
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 all 0s. This is referred to as a data stable condition (meaning the 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	The receive decoded error rate has exceeded 10E-3 over a 60-second period measured on the framing bits. This is defined as a major (prompt) receive alarm by INTELSAT specifications IESS-308. In a redundant system, a switch over will be attempted. Since some data must be correctly received to indicate this fault, receive AIS will not be substituted. This fault is to be sent as a backward alarm to the distant end. This must be wired externally as faults other than from the modem may need to enter the fault tree.
BACKWARD ALARM	Backward alarm. Modem is receiving a backward alarm indicating trouble at the distant end which may be a result of improper transmission at the near end of the link. This particular alarm is reported and recorded but the modem takes no other action. In most cases, the fault is due to some receive problem with the modem so a real fault will probably be occurring if backward alarm faults are being recorded.

Table 9-9. Receive Interface Faults (Continued)

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, return the interface card for repair.
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. It 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. This probably indicates the transmitter is not set correctly.
BUFFER FULL	Buffer full alarm. Indicates the buffer is less than 10% or greater than 90% full.
RX INSERT	Insert interface hardware fault (D&I only). The typical cause of this fault is the insert phase locked loop is not locked or some other insert interface hardware has malfunctioned. Return the D&I card to the factory for repair.
PROGRAMMING	Receive interface programming fault. Indicates the RX interface module has failed to program a current configuration parameter. If this fault occurs, contact the Comtech EF Data Customer Service Department.
CONFIGURATION	Receive interface configuration fault. Indicates the RX interface module does not support a programmed configuration parameter. This fault typically happens in the Custom mode when the programmed configuration does not match the module hardware. Ensure the programming of the RX interface hardware matches the configuration parameters. Also verify all jumpers have been set correctly for currently programmed configuration parameters.

9.2.3.5 Common Equipment Faults

Refer to Table 9-10 for common equipment faults.

Table 9-10. 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 will be active when a modem has been hard reset or the firmware has been changed. If the fault occurs without a firmware change or hard reset of the modem, replace the display/M&C card. 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	-12 VDC power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the -12 VDC line from the power supply or on any of the plug-in boards. Check TP2 on the display/M&C card to verify the proper -12 VDC monitor voltage (1.06 VDC). If this voltage is not correct, it will verify that the -12 VDC supply is not at the proper level. Try isolating the fault to a single board. If removing each of the boards does not fix the problem, then the power supply is faulted. Return the faulty plug-in board or replace the chassis power supply.
+12 VOLT SUPPLY	+12 VDC power supply fault. Use the same procedure as with -12V fault. To verify the +12 VDC power supply voltage, check TP4 on the display/M&C card. A voltage of 3.81 VDC will be monitored when the +12 VDC is at the proper level.
+5 VOLT SUPPLY	+5 VDC power supply fault. Use the same procedure as with a -12 VDC fault. The +5 VDC supply requires a minimum load of 1A. This is accomplished with the display/M&C card and one other card being plugged into the chassis. To verify the +5 VDC power supply voltage, check TP5 on the display/M&C card. A voltage of 2.5 VDC will be monitored when the +5 VDC is at the proper level.
-5 VOLT SUPPLY	-5 VDC power supply fault. To verify the -5 VDC power supply voltage, check TP3 on the display/M&C card. A voltage of 2.03 VDC will be monitored when the -5 VDC is at the proper level.
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. Ensure the interface card is present and properly seated. If the card is properly seated, this could indicate a problem in the M&C card or in the interface between the interface card and M&C card. Return the defective card for repair.

9.2.3.6 Backward Alarms

Refer to Table 9-11 for backward alarms faults.

Table 9-11. Backward Alarm Faults

Fault/Alarm	Possible Problem and Action
BW ALARM RX4	Receive backward alarm #4. The distant end of the link is sending Backward Alarm #4. This indicates trouble at the distant end which may be a result of improper transmission at the near end of the link. The modem signals this event by setting the deferred maintenance alarm (open collector). This is essentially a monitor function so the modem reports and records the event, but takes no other action. Refer to Chapter 5 for the backward alarm theory of operation. If the user does not wish to monitor the backward alarm faults, the backward alarm inputs must be grounded at the breakout panel. Refer to Chapter 8 for breakout panel pinouts.
BW ALARM RX3	Receive backward alarm #3. Refer to BW alarm RX 4 for details.
BW ALARM RX2	Receive backward alarm #2. Refer to BW alarm RX 4 for details.
BW ALARM RX1	Receive backward alarm #1. Refer to BW alarm RX 4 for details.
BW ALARM TX4	Transmit backward alarm #4. The modem is being instructed to send backward alarm #4 to the distant end of the link. This is controlled by wiring the backward alarm inputs of the modem to the demod fault relay and/or other fault outputs in the receive system (see IESS-308 for clarification). The simplest implementation for single destination service is to wire the demod fault relay between ground and the four backward alarm inputs (see Chapter 5 for clarification). This sends all four backward alarms in the event of any major (prompt) receive fault. This particular alarm is transmitted, reported and recorded, but the modem takes no other action. In most cases, the alarm is sent due to some receive problem with the modem so a real fault will probably be occurring if backward alarms are being sent. The transmit backward alarms are a symptom of trouble, not a cause.
BW ALARM TX3	Transmit backward alarm #3. Refer to BW alarm TX 4 for details.
BW ALARM TX2	Transmit backward alarm #2. Refer to BW alarm TX 4 for details.
BW ALARM TX1	Transmit backward alarm #1. Refer to BW alarm TX 4 for details.

9.3 Module Replacement

Refer to Chapter 1 for part numbers of the various modules.

The modem consists of plug-in cards that can be easily replaced. Use card ejectors for removing the modulator, demodulator, and interface PCBs.

For the display/M&C PCB on the modem front panel, remove the six mounting screws and the connector.

The power supply is attached to the modem chassis. For repair of the power supply module, remove all the plug-in cards before shipping the chassis with the power supply.

Appendix A. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the SDM-8000.

- Firmware number: FW/2448-1AG
- Software version: 20.1.3

A.1 General

Remote controls and status information are transferred via an EIA-485 (optional EIA-232) 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.

Communications on the remote link are initiated by a remote controller or terminal. The modem never transmits data on the link unless it is commanded to do so.

A.2 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- Information bits (Select one)
  - 7 information bits
  - 8 information bits
- 1 parity bit (Used with 7 information bits)
- 2 stop bits

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

Commands are messages which are 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
- Command/Response
- End of Message Character

A.2.1 Start Character

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

- “<” for commands
- “>” for responses

A.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 1 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 which is 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.

A.2.3 Command/Response

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 cannot be implemented, a negative acknowledgment 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 cannot be implemented or has parameters which are out of range.)
- >add/?ER3_unrecognizable command'cr''lf']
  (Error message for unrecognizable command or bad command syntax.)
- >add/?ER4_modem in local mode'cr''lf']
  (Modem in local error; send the REM command to go to remote mode.)
- >add/?ER5_hard coded parameter'cr''lf']
  (Error message indicating that the parameter is hardware dependent and may not be changed remotely.)

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

A.2.4 End Character

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

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

A.3 Configuration Commands/Responses

A.3.1 Modulator

Modulator Frequency	Command: Response: Status: Response:	<add/MF_nnn.nnnn'cr' >add/MF_nnn.nnnn'cr' RF_OFF'cr''lf'] <add/MF_'cr' >add/MF_nnn.nnnn'cr''lf']	Where: nnn.nnnn = Frequency in MHz, 50.0000 to 90.0000, and 100.0000 to 180.0000, in 2.5 kHz steps. Note: When the modulator frequency is programmed, the RF output is switched off.
RF Output (IF Output)	Command: Response: Status: Response:	<add/RF_xxx'cr' >add/RF_xxx'cr''lf'] <add/RF_'cr' >add/RF_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator Rate Preset Assignment	Command: Response: Status: Response:	<add/AMRx_nnnnn_mmmm.mmm'cr' >add/AMRx_nnnnn_mmmm.mmm'cr''lf'] <add/AMRx_'cr' >add/AMRx_nnnnn_mmmm.mmm'cr''lf']	Where: x = A, B, C, D, or V (Preset designator). nnnnn = one of the following Coder rates: 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8), QPSK (QPSK 1/1). mmmm.mmm = Data rate in kHz. See **Note** in MET Command
Modulator Rate Preset Selection	Command: Response: Status:	<add/SMRx_'cr' >add/SMRx_'cr' RF_OFF'cr''lf'] See MR command.	Where: x = A, B, C, D, or V (Preset designator). Note: Setting the modulator rate turns off the RF transmitter.
Modulator Rate Variable Assignment & Selection	Command: Response: Status:	<add/SMRV_nnnnn_mmmm.mmm'cr' >add/SMRV_nnnnn_mmmm.mmm'cr' RF_OFF'cr''lf'] See MR command.	Where: nnnnn = one of the following Coder rates: 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8), QPSK (QPSK 1/1). mmmm.mmm = Data rate in kHz. Note: Setting the modulator turns off the RF transmitter. See **Note** in MET Command
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 = +99.9 to -69.9, in 0.1 dB increments. Note: The modulator power offset is added to the nominal power level to adjust the transmit power range.

Set Modulator Output Power Level	Command: Response: Status: Response:	<add/MOP_snn.n'cr' >add/MOP_snn.n'cr''lf'] <add/MOP_'cr' >add/MOP_snn.n'cr''lf']	Where: snn.n = -30.0 to -5.0, in 0.1 steps (nominal range in dBm). Notes: 1. The nominal power range is modified relative to the value specified by the modulator power offset (MPO_). 2. When TX Overhead is programmed for ASYNC, AUPC is installed, and AUPC local power enable 'LPC_' is programmed 'ON'; the MOP (Modulator Output Power) command is not allowed. Only MOP status is allowed. See 'LPC_' command.
Scrambler Enable	Command: Response: Status: Response:	<add/SE_xxx'cr' >add/SE_xxx'cr''lf'] <add/SE_'cr' >add/SE_xxx'cr''lf']	Where: xxx = ON or OFF.
Differential Encoder Enable	Command: Response: Status: Response:	<add/DENC_xxx'cr' >add/DENC_xxx'cr''lf'] <add/DENC_'cr' >add/DENC_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator 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 (EFData CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), or FDC (FAIRCHILD CLOSED NETWORK). See **Note** in MET Command
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) or SEQ (SEQUENTIAL ENCODER). **Note:** The CSC mod/demod type is not compatible with the combination of a Sequential encoder or decoder type and a ¾ Code Rate.
Modulator 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, EXT5 (5 MHz), EXT10 (10 MHz), or EXT20 (20 MHz).
Modulator Spectrum Rotation	Command: Response: Status: Response:	<add/MSR_xxxx'cr' >add/MSR_xxxx'cr''lf'] <add/MSR_'cr' >add/MSR_xxxx'cr''lf']	Where: xxxx = NRM (normal spectrum) or 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.
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.
Modulator SCT PLL Reference	Command: Response: Status: Response:	<add/MSPR_xxx'cr' >add/MSPR_xxx'cr''lf'] <add/MSPR_'cr' >add/MSPR_xxx'cr''lf']	Where: xxx = MR (MODULATOR REF.) or ERF (EXT-REF FREQ).

A.3.2 Demodulator

Set Demodulator Frequency	Command: Response: Status: Response:	<add/DF_nnn.nnnn'cr' >add/DF_nnn.nnnn'cr''lf'] <add/DF_'cr' >add/DF_nn.nnnn'cr''lf']	Where: nnn.nnnn = Frequency in MHz, 50.0000 to 90.0000, and 100.0000 to 180.0000, in 2.5 kHz steps.
Demodulator Rate Preset Assignment	Command: Response: Status: Response:	<add/ADRx_nnnnn_mmmm.mmm'cr' >add/ADRx_nnnnn_mmmm.mmm'cr''lf'] <add/ADRx_'cr' >add/ADRx_nnnnn_mmmm.mmm'cr''lf']	Where: x = A, B, C, D, or V (Preset designator). nnnnn = one of the following Coder rates: 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8), QPSK (QPSK 1/1). mmmm.mmm = Data rate in kHz. See **Note** in MET Command
Demodulator Rate Preset Selection	Command: Response: Status:	<add/SDRx_'cr' >add/SDRx_'cr''lf'] See DR command.	Where: x = A, B, C, D, or V (Preset designator).
Demodulator Rate Variable Assignment & Selection	Command: Response: Status:	<add/SDRV_nnnnn_mmmm.mmm'cr' >add/SDRV_nnnnn_mmmm.mmm'cr''lf'] See DR command.	Where: nnnnn = one of the following Coder rates: 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8), QPSK (QPSK 1/1). mmmm.mmm = Data rate in kHz. See **Note** in MET Command
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.
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 = -30000 to +30000, 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 60000, in 1 Hz steps.
Sweep Reacquisition	Command: Response: Status: Response:	<add/SR_xxx'cr' >add/SR_xxx'cr''lf'] <add/SR_'cr' >add/SR_xxx'cr''lf']	Where: xxx = 0 to 999 (number of seconds).
Bit Error Rate Threshold	Command: Response: Status: Response:	<add/BERT_xxxx'cr' >add/BERT_xxxx'cr''lf'] <add/BERT_'cr' >add/BERT_xxxx'cr''lf']	Where: xxxx = NONE or 1E-n (where n = 3, 4, 5, 6, 7, or 8 [exponent of threshold]).
Demodulator Type	Command: Response: Status: Response:	<add/DT_xxxx'cr' >add/DT_xxxx'cr''lf'] <add/DT_xxxx'cr' >add/DT_xxxx'cr''lf']	Where: xxxx = INTL (INTELSAT OPEN NETWORK), EFD (EFData CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), or FDC (FAIRCHILD CLOSED NETWORK). See **Note** in MET Command
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) or SEQ (SEQUENTIAL ENCODER). **Note:** The CSC mod/demod type is not compatible with the combination of a Sequential encoder or decoder type and a ¾ Code Rate.
Demodulator Spectrum Rotation	Command: Response: Status: Response:	<add/DSR_xxxx'cr' >add/DSR_xxxx'cr''lf'] <add/DSR_'cr' >add/DSR_xxxx'cr''lf']	Where: xxxx = NRM (normal spectrum) or INV (inverted spectrum).
Reed-Solomon Decoder Enable	Command: Response: Status: Response:	<add/RSDE_xxx'cr' >add/RSDE_xxx'cr''lf'] <add/RSDE_'cr' >add/RSDE_xxx'cr''lf']	Where: xxx = ON, OFF, or CORR_OFF.
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.

A.3.3 Interface Configuration Commands

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), or REF (external reference clock).
External 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 reference 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), or AUTO (automatic clock phasing).
Receive Clock Phase	Command: Response: Status: Response:	<add/RCP_xxxx'cr' >add/RCP_xxxx'cr''lf'] <add/RCP_'cr' >add/RCP_xxxx'cr''lf']	Where: xxxx = NRM (normal clock phasing) or INV (inverted clock phasing).
Baseband Loopback	Command: Response: Status: Response:	<add/BBL_xxx'cr' >add/BBL_xxx'cr''lf'] <add/BBL_'cr' >add/BBL_xxx'cr''lf']	Where: xxx = ON or OFF.
Interface 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 Coding Format Transmit	Command: Response: Status: Response:	<add/ICFT_xxxx'cr' >add/ICFT_xxxx'cr''lf'] <add/ICFT_'cr' >add/ICFT_xxxx'cr''lf']	Where: xxxx = AMI, HDB3, B6ZS, or B8ZS.
Interface Coding Format Receive	Command: Response: Status: Response:	<add/ICFR_xxxx'cr' >add/ICFR_xxxx'cr''lf'] <add/ICFR_'cr' >add/ICFR_xxxx'cr''lf']	Where: xxxx = AMI, HDB3, B6ZS, or B8ZS.
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.
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 reference clock), HS (internal high stability clock), or INS (insert clock).
Interface Buffer Size	Buffer size programming is supported in two formats, bits or milli-seconds. The selected format must be chosen using the buffer programming command (IBP_). If the buffer is to be programmed in milli-seconds and plesiochronous slips are required, use the receive framing structure command (IRFS_) to define the proper framing format. Note: For Drop & Insert, only milli-seconds format is allowed.		
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. Note: For Drop & Insert, buffer size programming is always in milli-seconds format.
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, nn= 1, 2, 4, 8, 16, or 32 (buffer size in milli-seconds). nn= 7.5, 15, or 30 (buffer size in milli-seconds) for E1CAS_format. nn= 6, 12, 24, or 30 (buffer size in milli-seconds) for T1IBS_format.
Interface Buffer Center	Command: Response:	<add/IBC_'cr' >add/IBC_'cr''lf']	
Interface Substitute Pattern	Command: Response: Status: Response:	<add/ISP_xxx'cr' >add/ISP_xxx'cr''lf'] <add/ISP_'cr' >add/ISP_xxx'cr''lf']	Where: xxx = ON or OFF. Note: Transmit 2047 Pattern.
Interface Read Error Select	Command: Response: Status: Response:	<add/IRE_xxxx'cr' >add/IRE_xxxx'cr''lf'] <add/IRE_'cr' >add/IRE_xxxx'cr''lf']	Where: xxxx = ON or OFF. Note: Receive 2047 Pattern.
Interface Service Channel Level	Command: Response: Status: Response:	<add/ISCL_xxx_snn'cr' >add/ISCL_xxx_snn'cr''lf'] <add/ISCL_xxx'cr' >add/ISCL_xxx_snn'cr''lf']	Where: xxx = TX1, TX2, RX1, or RX2 (service channel designator). nnn = -20 to +10, in steps of 1 (service channel level in dBm).
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: xxxx = NONE, IDR, IBS, DI, DVB, or ASYNC.

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: xxxx = NONE, IDR, IBS, DI, DVB, or ASYNC.
Interface Buffer Program	Command: Response: Status: Response:	<add/IBP_xxx'cr' >add/IBP_xxx'cr''lf'] <add/IBP_'cr' >add/IBP_xxx'cr''lf']	Where: xxx = BITS or MS (milli-seconds). Note: For Drop & Insert, only milli-seconds format is allowed.
Interface Receive Framing Structure	Command: Response: Status: Response:	<add/IRFS_ff_ssss'cr' >add/IRFS_ff_ssss'cr''lf'] <add/IRFS_ff'cr' >add/IRFS_ff_ssss'cr''lf']	Where: ff = T1, T2, E1, or E2 (frame type). ssss = NONE, G704, G742, G743, G745, or G747 (framing structure). Notes: 1. Valid T1 frame structures are NONE and G704. 2. Valid T2 frame structures are NONE, G704, G743, and G747. 3. Valid E1 frame structures are NONE and G704. 4. Valid E2 frame structures are NONE, G704, G742, and G745. 5. For Drop & Insert, Interface Receive Framing Structure is ignored, but can be entered.
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) or 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) or INV (inverted data phasing).
Drop Data Format	Command: Response: Status: Response:	<add/DDF_xxxxxx'cr' >add/DDF_xxxxxx'cr''lf'] <add/DDF_'cr' >add/DDF_xxxxxx'cr''lf']	Where: xxxxx = T1, T1ESF, T1IBS, E1CCS, E1CAS, E1IBS, E131TS, T1S, or T1ESFS.
Insert Data Format	Command: Response: Status: Response:	<add/IDF_xxxxxx'cr' >add/IDF_xxxxxx'cr''lf'] <add/IDF_'cr' >add/IDF_xxxxxx'cr''lf']	Where: xxxxx = T1, T1ESF, T1IBS, E1CCS, E1CAS, E1IBS, E131TS, T1S, or T1ESFS.
Insert E1 CRC Enable	Command: Response: Status: Response:	<add/ICRC_xxx'cr' >add/ICRC_xxx'cr''lf'] <add/ICRC_'cr' >add/ICRC_xxx'cr''lf']	Where: xxx = ON or OFF.

Drop Channels Assignment	Command: Response: Status: Response:	<add/DCA_dd;cc'cr' >add/DCA_dd;cc'cr''lf'] <add/DCA_dd'cr' >add/DCA_dd;cc'cr''lf']	Where: dd = 1 to N (over the satellite drop channel) (where N = [Modulator Data Rate] divided by [64 kbps], cc = 1 to 24 [terrestrial channel number for T1 data formats], cc = 1 to 31 [terrestrial time slot number for E1 data formats]). Note: This command is not valid if the drop data format is specified to be T1IBS or E1IBS. Also, this command is not valid when the drop data format is specified as E1CAS and the modulator data rate is set to 1920.0 kbps.
Bulk Drop Channels Assignment	Command: Response: Status: Response:	<add/BDCA_dd;cc_dd;cc_dd;cc_dd;cc......'cr' >add/BDCA_dd;cc_dd;cc_dd;cc_dd;cc......'cr''lf'] <add/BDCA_'cr' >add/BDCA_dd;cc_dd;cc_dd;cc_dd;cc......'cr''lf']	Where: dd = 1 to N (over the satellite drop channel) (where N = [Modulator Data Rate] divided by [64 kbps], cc = 1 to 24 [terrestrial channel number for T1 data formats], cc = 1 to 31 [terrestrial time slot number for E1 data formats]). Notes: 1. The status response returns programming information for 1 to N drop channels. 2. This command is not valid if the drop data format is specified to be T1IBS or E1IBS. Also, this command is not valid when the drop data format is specified as E1CAS and the modulator data rate is set to 1920.0 kbps.
Insert Channels Assignment	Command: Response: Status: Response:	<add/ICA_ii;cc'cr' >add/ICA_ii;cc'cr''lf'] <add/ICA_ii'cr' >add/ICA_ii;cc'cr''lf']	Where: ii = 1 to N (over the satellite insert channel) (where N = [Demodulator Data Rate] divided by [64 kbps], cc = 1 to 24 [terrestrial channel number for T1 data formats], cc = 1 to 31 [terrestrial time slot number for E1 data formats], cc = 0 if no insert is desired for the specified insert channel). Notes: 1. Time slot 16 (cc = 16) may not be specified when the insert data format is specified to be E1CAS. 2. This command is not valid if the insert data format is specified to be T1IBS or E1IBS. Also, this command is not valid when the insert data format is specified as E1CAS and the demodulator data rate is set to 1920.0 kbps.
Bulk Insert Channels Assignment	Command: Response: Status: Response:	<add/BICA_ii;cc_ii;cc_ii;cc_ii;cc......'cr' >add/BICA_ii;cc_ii;cc_ii;cc_ii;cc......'cr''lf'] <add/BICA_'cr' >add/BICA_ii;cc_ii;cc_ii;cc_ii;cc......'cr''lf']	Where: ii = 1 to N, (over the satellite insert channel) (where N = [Modulator Data Rate] divided by [64 kbps], cc = 1 to 24 [terrestrial channel number for T1 data formats], cc = 1 to 31 [terrestrial time slot number for E1 data formats], cc = 0 if no insert is desired for the specified insert channel). Notes: 1. The status response returns programming information for 1 to N insert channels. 2. Time slot 16 (cc = 16) may not be specified when the insert data format is specified to be E1CAS. 3. This command is not valid if the insert data format is specified to be T1IBS or E1IBS. Also, this command is not valid when the insert data format is specified as E1CAS and the demodulator data rate is set to 1920.0 kbps.
IDR Backward Alarm Enable	Command: Response: Status: Response:	<add/BW_xxx_nnn'cr' >add/BW_xxx_nnn'cr''lf'] <add/BW_xxx_'cr' >add/BW_xxx_nnn'cr''lf']	Where: xxx = TX1, TX2, TX3, TX4, RX1, RX2, RX3, or RX4 (backward alarm designator). nnn = ON or OFF.

ASYNC Transmit Overhead Baud Rate	Command: Response: Status: Response:	<add/TOBR_nnnnn'cr' >add/TOBR_nnnnn'cr''lf'] <add/TOBR_'cr' >add/TOBR_nnnnn'cr''lf']	Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400.
ASYNC Receive Overhead Baud Rate	Command: Response: Status: Response:	<add/ROBR_nnnnn'cr' >add/ROBR_nnnnn'cr''lf'] <add/ROBR_'cr' >add/ROBR_nnnnn'cr''lf']	Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400.
ASYNC Transmit Channel Character Length	Command: Response: Status: Response:	<add/TCCL_n'cr' >add/TCCL_n'cr''lf'] <add/TCCL_'cr' >add/TCCL_n'cr''lf']	Where: n = 5, 6, 7, or 8 (characters).
ASYNC Receive Channel Character Length	Command: Response: Status: Response:	<add/RCCL_n'cr' >add/RCCL_n'cr''lf'] <add/RCCL_'cr' >add/RCCL_n'cr''lf']	Where: n = 5, 6, 7, or 8 (characters).
ASYNC Transmit Channel Stop Bits	Command: Response: Status: Response:	<add/TCSB_n'cr' >add/TCSB_n'cr''lf'] <add/TCSB_'cr' >add/TCSB_n'cr''lf']	Where: n = 1 or 2 (stop bits).
ASYNC Receive Channel Stop Bits	Command: Response: Status: Response:	<add/RCSB_n'cr' >add/RCSB_n'cr''lf'] <add/RCSB_'cr' >add/RCSB_n'cr''lf']	Where: n = 1 or 2 (stop bits).
ASYNC Transmit Overhead Channel Parity	Command: Response: Status: Response:	<add/TOCP_xxxx'cr' >add/TOCP_xxxx'cr''lf'] <add/TOCP_'cr' >add/TOCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE.
ASYNC Receive Overhead Channel Parity	Command: Response: Status: Response:	<add/ROCP_xxxx'cr' >add/ROCP_xxxx'cr''lf'] <add/ROCP_'cr' >add/ROCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE.
ASYNC Transmit Communica-tions Type	Command: Response: Status: Response:	<add/TCT_xxxxxxxx'cr' >add/TCT_xxxxxxxx'cr''lf'] <add/TCT_'cr' >add/TCT_xxxxxxxx'cr''lf']	Where: xxxxxxxx = RS232, RS485 (4-Wire), or RS485-2W (2-Wire).
ASYNC Receive Communica-tions Type	Command: Response: Status: Response:	<add/RCT_xxxxx'cr' >add/RCT_xxxxx'cr''lf'] <add/RCT_'cr' >add/RCT_xxxxx'cr''lf']	Where: xxxxx = RS232 or RS485.
TX Driver Type	Command: Response: Status: Response:	<add/TXDR_xxxxxx'cr' >add/TXDR_xxxxxx'cr''lf'] <add/TXDR_'cr' >add/TXDR_xxxxxx'cr''lf']	Where: xxxxxx = G703, V35, or MIL188. Note: Status only available if the optional RELAY BOARD is not installed.

RX Driver Type	Command: Response: Status: Response:	<add/RXDR_xxxxxx'cr' >add/RXDR_xxxxxx'cr''lf'] <add/RXDR_'cr' >add/RXDR_xxxxxx'cr''lf']	Where: xxxxxx = G703, V35, or MIL188. Note: Status only available if the optional RELAY BOARD is not installed.
G703 Level Select	Command: Response: Status: Response:	<add/G703_xx'cr' >add/G703_xx'cr''lf'] <add/G703_'cr' >add/G703_xx'cr''lf']	Where: xx = HD (high drive), NL (nominal level), NS (nominal shaped), LL (low level), or LS (low shaped). Note: Optional RELAY BOARD must be installed.
Transmit DVB Framing	Command: Response: Status: Response:	<add/TDVB_xxxx'cr' >add/TDVB_xxxx'cr''lf'] <add/TDVB_'cr' >add/TDVB_xxxx'cr''lf']	Where: xxxx = 188, 204, or NONE. Note: DVB Reed-Solomon board must be installed.
Receive DVB Framing	Command: Response: Status: Response:	<add/RDVB_xxxx'cr' >add/RDVB_xxxx'cr''lf'] <add/RDVB_'cr' >add/RDVB_xxxx'cr''lf']	Where: xxxx = 188, 204, or NONE. Note: DVB Reed-Solomon board must be installed.
IDR ESC Type	Command: Response: Status: Response:	<add/ESCT_xxxxx’cr’ >add/ESCT_xxxxx’cr’’lf’] <add/ESCT_’cr’ >add/ESCT_xxxxx’cr’’lf’]	Where: xxxxx = Data (64K Data) or Auto (2x32K Audio) Note: Status only available if the optional RELAY BOARD is not installed.

A.3.4 System

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/yy'cr' >add/DATE_mm/dd/yy'cr''lf'] <add/DATE_'cr' >add/DATE_mm/dd/yy'cr''lf']	Where: mm = 1 to 12 (month). dd = 1 to 31 (day). yy = 00 to 99 (year).
Remote	Command: Response:	<add/REM_'cr' >add/REM_'cr''lf']	This command configures the modem for remote operation. The modem will respond to any status request at any time. However, the modem 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 modem.
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. When receive only mode is selected, transmit faults are inhibited.
System Modem Type	Command: Response: Status: Response:	<add/SMT_xxxxxx'cr' >add/SMT_xxxxxx'cr''lf'] <add/SMT_'cr' >add/SMT_xxxxxx'cr''lf']	Where: xxxxxx = IDR, IBS, DI, ASYNC, DVB, CUSTOM, or TYPE n (n = 1 to 5).
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.
RF Mode Control	Command: Response: Status: Response:	<add/RFMD_xxxx'cr' >add/RFMD_xxxx'cr''lf'] <add/RFMD_'cr' >add/RFMD_xxxx'cr''lf']	Where xxxx = NRM (Normal Mode), PWR (Turn RF Off/On) COMM (Turn RF Off/On and Loss of Remote Communications after 10 seconds if no command is received), 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 programmed On.) This command allows for the RF output to be enabled or disabled. One application for this command is in demand network systems.

A.3.5 AUPC

AUPC Local Power 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. Note: 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). Note: 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). Note: 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). Note: The nominal power range is modified relative to the value specified by the modulator power offset (MPO_).
AUPC E_b/N_0 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 (E_b/N_0 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 (maximum 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	Note: Always wait 3 seconds between consecutive remote modem command/status polls.		
Remote AUPC Enable	Command: Response: Status: Response:	<add/RPC_xxx'cr' >add/RPC_xxx'cr''lf'] <add/RPC_'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). This command returns 2047 BER from the remote AUPC modem. If data is not valid, the message 'No_Data' is returned instead of BER data. Note: Received 2047 pattern.

A.4 Status Commands/Responses

A.4.1 Configuration

Modulator Config Status	Command:	<add/MCS_'cr'	
	Response:	>add/MCS_'cr'	
		RF_xxx'cr'	RF Output (ON/OFF)
		MF_nnn.nnnn'cr'	Modulator Frequency
		MR_nnnnn_mmmm.mmm'cr'	Modulator Rate
		AMRA_nnnnn_mmmm.mmm'cr'	Preset 'A' Assignment
		AMRB_nnnnn_mmmm.mmm'cr'	Preset 'B' Assignment
		AMRC_nnnnn_mmmm.mmm'cr'	Preset 'C' Assignment
		AMRD_nnnnn_mmmm.mmm'cr'	Preset 'D' Assignment
		AMRV_nnnnn.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 (ON/OFF)
		DENC_xxx'cr'	Differential Encoder (ON/OFF)
		MT_xxxx'cr'	Modulator Type
		MET_xxx'cr'	Modulator Encoder Type
		COM_xxx'cr'	Carrier Only Mode (ON/OFF)
		MRC_xxx'cr' (Note 1)	Modulator Reference Clock
		MSR_xxx'cr'	Modulator Spectrum Rotation
		RSEN_xxx'cr' (Note 2)	Reed-Solomon Encoder (ON/OFF)
		T310_xxx'cr' (Note 2)	TX 8PSK 2/3 IESS-310 Operation
		MSPR_xxx'cr''lf'] (Note 1)	Modulator SCT PLL Reference
			The modulator configuration status command causes a block of data to be returned by the addressed modem. The block of data reflects the current configuration status of the modulator module. Additional configuration status of new options and features will always be appended to the end.
			Notes: 1. Data will only be returned if the modulator board has the High Stability Internal 5 MHz/External Divider option. 2. Data is only returned if the Reed-Solomon option is installed on the interface board.

Modulator/ Coder Config Program Status	Command:	<add/MCP_'cr'	
	Response:	>add/MCP_'cr'	
		SMT_xxxxxx'cr'	System Modem Type
		ITOT_xxxx'cr'	Interface Transmit Overhead Type
		MOM_xxxxxxx'cr'	Modem Operation Mode
		MT_xxxx'cr'	Modulator Type
		MET_xxx'cr'	Modulator Encoder Type
		MF_nnn.nnnn'cr'	Modulator Frequency
		MR_nnnnn_mmmm.mmm'cr'	Modulator Rate
		MPO_snn.n'cr'	Modulator Power Offset
		LPC_xxx'cr' (Note 1)	AUPC Local Power Enable
		MOP_snn.n'cr' (Note 2)	Modulator Output Power
		SE_xxx'cr'	Scrambler Enable (ON/OFF)
		DENC_xxx'cr'	Differential Encoder (ON/OFF)
		ERF_nnnnn.n'cr'	External Reference Frequency
		TC_xxx'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_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 3)	Drop Data Format
		BDCA_dd;cc_dd;cc...'cr' (Note 3)	Bulk Drop Channels Assignment
		MRC_xxx'cr'	Modulator Reference Clock
		MSR_xxx'cr'	Modulator Spectrum Rotation
		RSEN_xxx'cr'	Reed-Solomon Encoder (ON/OFF)
		BW_TX1_nnn'cr' (Note 4)	Backward Alarm Enable TX1
		BW_TX2_nnn'cr' (Note 4)	Backward Alarm Enable TX2
		BW_TX3_nnn'cr' (Note 4)	Backward Alarm Enable TX3
		BW_TX4_nnn'cr' (Note 4)	Backward Alarm Enable TX4
		TXDR_xxxxxx'cr'	TX Driver Type
		TOBR_nnnnn'cr' (Note 5)	ASYNC TX Overhead Baud Rate
		TCCL_n'cr' (Note 5)	ASYNC TX Channel Character Length
		TCSB_n'cr' (Note 5)	ASYNC TX Channel Stop Bits
		TOCP_xxxx'cr' (Note 5)	ASYNC TX Overhead Channel Parity
		TCT_xxxxxxxx'cr' (Note 5)	ASYNC TX Communications Type
		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
		TDVB_xxxx'cr' (Note 6)	Transmit DVB Framing
		T310_xxx'cr'	TX 8PSK 2/3 IESS-310 Operation
		MSPR_xxx'cr'	Modulator SCT PLL Reference
		RF_xxx'cr''lf']	RF Output (ON/OFF)
			This command is used by the EFData 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 EFData, it is advisable that other commands ('MCS_' and 'ICS_', or 'BCS_') be used for M&C systems.
			Notes:

			1. Data is only returned for ASYNC TX Overhead and AUPC installed. 2. Data is only returned for ASYNC TX Overhead, AUPC installed, and Local AUPC is disabled (OFF). 3. Data is only returned for D&I TX Overhead. 4. Data is only returned for IDR TX Overhead. 5. Data is only returned for ASYNC TX Overhead. 6. DVB Reed-Solomon board must be installed.
Demodulator Config Status	Command: Response:	<add/DCS_'cr' >add/DCS_'cr' DF_nnn.nnnn'cr' DR_nnnnn_mmmm.mmm'cr' ADRA_nnnnn_mmmm.mmm'cr' ADRB_nnnnn_mmmm.mmm'cr' ADRC_nnnnn_mmmm.mmm'cr' ADRD_nnnnn_mmmm.mmm'cr' ADRV_nnnnn.mmmm.mmm'cr' DE_xxx'cr' DDEC_xxx'cr' RFL_xxx'cr' IFL_xxx'cr' SCF_snnnnn'cr' SWR_nnnnn'cr' SR_xxx'cr' BERT_xxxx'cr' DT_xxxx'cr' DDT_xxx'cr' DSR_xxx'cr' RSDE_xxx'cr' (See Note) R310_xxx'cr''lf'] (See Note)	 Demodulator Frequency Demodulator Rate Preset 'A' Assignment Preset 'B' Assignment Preset 'C' Assignment Preset 'D' Assignment Preset 'V' Assignment Descrambler Enable Differential Decoder RF Loopback IF Loopback Sweep Center Frequency Sweep Width Range Sweep Reacquisition BER Threshold Demodulator Type Demodulator Decoder Type Demodulator Spectrum Rotation Reed-Solomon Decoder 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. Note: Data is only returned if the Reed-Solomon option is installed on the interface board.

Demod/	Command:	<add/DCP_'cr'	
Decoder	Response:	>add/DCP_'cr'	
Config		SMT_xxxxxx'cr'	System Modem Type
Program		IROT_xxxx'cr'	Interface Receive Overhead Type
Status		MOM_xxxxxxx'cr'	Modem Operation Mode
		BERT_xxxx'cr'	BER Threshold
		DT_xxxx'cr'	Demodulator Type
		DDT_xxx'cr'	Demodulator Decoder Type
		DF_nnn.nnnn'cr'	Demodulator Frequency
		DR_nnnnn_mmmm.mmm'cr'	Demodulator Rate
		DE_xxx'cr'	Descrambler Enable (ON/OFF)
		DDEC_xxx'cr'	Differential Decoder (ON/OFF)
		RFL_xxx'cr'	RF Loopback (ON/OFF)
		IFL_xxx'cr'	IF Loopback (ON/OFF)
		SCF_snnnnn'cr'	Sweep Center Frequency
		SWR_nnnnn'cr'	Sweep Width Range
		SR_xxx'cr'	Sweep Reacquisition
		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
		ILT_xxx'cr'	Interface Loop Timing
		ICFR_xxxx'cr'	Interface Coding Format Receive
		IRFS_T1_ssss'cr'	Interface Receive Frame Structure (T1)
		IRFS_T2_ssss'cr'	Interface Receive Frame Structure (T2)
		IRFS_E1_ssss'cr'	Interface Receive Frame Structure (E1)
		IRFS_E2_ssss'cr'	Interface Receive Frame Structure (E2)
		IBP_xxx'cr'	Interface Buffer Programming
		IRE_xxxx'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 (ON/OFF/CORR_OFF)
		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)	Backward Alarm Enable RX3
		BW_RX4_nnn'cr' (Note 2)	Backward Alarm Enable RX4
		RXDR_xxxxxx'cr'	RX Driver Type
		G703_xx'cr'	G.703 Level Select
		ROBR_nnnnn'cr' (Note 3)	ASYNC RX Overhead Baud Rate
		RCCL_n'cr' (Note 3)	ASYNC RX Channel Character Length
		RCSB_n'cr' (Note 3)	ASYNC RX Channel Stop Bits
		ROCP_xxxx'cr' (Note 3)	ASYNC RX Overhead Channel Parity
		RCT_xxxxx'cr' (Note 3)	ASYNC RX Communications Type
		ENSP_nn.n'cr' (Note 4)	AUPC EBN0 Target Set Point
		MAXT_n.n'cr' (Note 4)	AUPC Maximum Tracking Rate
		RDVB_xxxx'cr'	Receive DVB Framing
		ESCT_xxxxx'cr' (Note 3)	IDR ESC Type
		R310_xxx'cr''lf']	RX 8PSK 2/3 IESS-310 Operation
			This command is used by the EFData 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 EFData, it is advisable that other commands ('DCS_' and 'ICS_', or 'BCS_') be used for M&C systems.
			Notes:

			1. Data is only returned for D&I RX Overhead. 2. Data is only returned for IDR RX Overhead. 3. Data is only returned for ASYNC RX Overhead. 4. Data is only returned for ASYNC RX Overhead and AUPC installed.
Interface Config Status	Command:	<add/ICS_'cr'	
	Response:	>add/ICS_'cr'	
		TC_xxx'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_T2_ssss'cr'	Interface Receive Frame Structure (T2)
		IRFS_E1_ssss'cr'	Interface Receive Frame Structure (E1)
		IRFS_E2_ssss'cr'	Interface Receive Frame Structure (E2)
		IBP_xxx'cr'	Interface Buffer Programming
		IBS_nnnnnn'cr'	Interface Buffer Size
		ITOT_xxxx'cr'	Interface Transmit Overhead Type
		IROT_xxxx'cr'	Interface Receive Overhead Type
		ISP_xxx'cr'	Interface Substitution Pattern (TX 2047)
		IRE_xxxx'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' (Note 5)	TX Driver Type
		RXDR_xxxxxx'cr' (Note 5)	RX Driver Type
		G703_xx'cr' (Note 5)	G.703 Level Select
		TOBR_nnnnn'cr' (Note 6)	ASYNC Transmit Overhead Baud Rate
		TCCL_n'cr' (Note 6)	ASYNC Transmit Channel Character Length
		TCSB_n'cr' (Note 6)	ASYNC Transmit Channel Stop Bits
		TOCP_xxxx'cr' (Note 6)	ASYNC Transmit Overhead Channel Parity
		TCT_xxxxxxxx'cr' (Note 6)	ASYNC Transmit Communications Type
		ROBR_nnnnn'cr' (Note 7)	ASYNC Receive Overhead Baud Rate
		RCCL_n'cr' (Note 7)	ASYNC Receive Channel Character Length
		RCSB_n'cr' (Note 7)	ASYNC Receive Channel Stop Bits
		ROCP_xxxx'cr' (Note 7)	ASYNC Receive Overhead Channel Parity
		RCT_xxxxx'cr' (Note 7)	ASYNC Receive Communications Type
		LPC_xxx'cr' (Note 8)	AUPC Local Power Enable
		NOMP_snn.n'cr' (Note 8)	AUPC Nominal Power Value
		MINP_snn.n'cr' (Note 8)	AUPC Minimum Power Value
		MAXP_snn.n'cr' (Note 8)	AUPC Maximum Power Value
		LCL_xxxx'cr' (Note 8)	AUPC Local Carrier Loss
		RCL_xxxx'cr' (Note 8)	AUPC Remote Carrier Loss

		ENSP_nn.n'cr' (Note 9) MAXT_n.n'cr' (Note 9) TDVB_xxxx'cr' (Note 10) RDVB_xxxx'cr' (Note 10) ESCT_xxxxx'cr''lf'] (Note 5)	AUPC E_b/N_0 Target Set Point AUPC Maximum Tracking Rate Transmit DVB Framing Receive DVB Framing IDR ESC Type 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 D&I TX Overhead. 2. Data is only returned for D&I RX Overhead. 3. Data is only returned for IDR TX Overhead. 4. Data is only returned for IDR RX Overhead. 5. Data is only returned if the relay board option is installed on the interface board. 6. Data is only returned for ASYNC TX Overhead. 7. Data is only returned for ASYNC RX Overhead. 8. Data is only returned for ASYNC TX Overhead and AUPC installed. 9. Data is only returned for ASYNC RX Overhead and AUPC installed. 10. DVB Reed-Solomon board must be installed.
MODEM Faults Status (Summary)	Command: Response:	<add/MFS_'cr' >add/MFS_'cr' DMD_xxx'cr' MOD_xxx'cr' ITX_xxx'cr' IRX_xxx'cr' CEQ_xxx'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' DCA_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' AGC_xxx'cr' SCT_xxx'cr' EXT_xxx'cr' PROG_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 Activity (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) AGC Level (OK/FLT) Internal SCT Synthesizer (OK/FLT) External Reference Activity (OK/FLT) Programming (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' RCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' DSCR_xxx'cr' BERT_xxx'cr' PROG_xxx'cr' CONF_xxx'cr' SFLT_xx'cr''lf']	 Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) Receive Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) Descrambler (OK/FLT) BER Threshold (OK/FLT) Programming (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' DDRP_xxx'cr' TXD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr' PROG_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) Programming (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' PROG_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) Programming (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' -5_xxx'cr' +12_xxx'cr' -12_xxx'cr' MODE_xxxxxx'cr' SFLT_xx'cr''lf']	 Monitor & Control Module (OK/FLT) Data Interface Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) -5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (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) 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)

A.4.2 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, 010,<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) (where: 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], and 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 32-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.

E_b/N_0 Status	Command: Response:	<add/EBN0_'cr' >add/EBN0_xnn.ndB'cr''lf']	Where: x = < or > (data modifier to indicate that the E_b/N_0 is less than or greater than the returned value). nn.n = 1.0 to 99.9 (E_b/N_0 value). Notes: 1. The 'x' (< or >) parameter is only returned if the E_b/N_0 has exceeded the computational resolution of the system. 2. 'No Data' is returned if the E_b/N_0 cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the E_b/N_0.
Modulator Rate Status	Command: Response:	<add/MR_'cr' >add/MR_nnnn_mmmm.mmm'cr''lf']	Where: nnnnn = one of the following Coder rates: 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8),QPSK (QPSK 1/1). mmmm.mmm = Data rate in kHz.
Demodulator Rate Status	Command: Response:	<add/DR_'cr' >add/DR_nnnn_mmmm.mmm'cr''lf']	Where: nnnnn = one of the following Coder rates: 1/2 (QPSK 1/2), 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 16Q34 (16QAM 3/4), 16Q78 (16QAM 7/8), QPSK (QPSK 1/1). 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, ±). 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_snnnnn'cr' CD_xxx'cr''lf']	Where: s = + or - (sweep offset from center). nnnnn = 0 to 30000. xxx = OK or FLT (decoder lock status OK or FAULT). This command returns the current sweep value and decoder lock status.

A.5 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.
- YY Year.

Modulator Stored Faults	Command: Response:	<add/MSF_#'cr' >add/MSF_# hh:mm:ss MM/DD/YY'cr' MOD_xxx'cr' SYN_xxx'cr' DCA_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' AGC_xxx'cr' SCT_xxx'cr' EXT_xxx'cr' PROG_xxx'cr' CONF_xxx'cr''lf']	Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Activity (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) AGC Level (OK/FLT) Internal SCT Synthesizer (OK/FLT) External Reference Activity (OK/FLT) Programming (OK/FLT) Configuration (OK/FLT)
Demodulator Stored Faults	Command: Response:	<add/DSF_#'cr' >add/DSF_# hh:mm:ss MM/DD/YY'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' RCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' DSCR_xxx'cr' BERT_xxx'cr' PROG_xxx'cr' CONF_xxx'cr''lf']	Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) Receive Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) Descrambler (OK/FLT) BER Threshold (OK/FLT) Programming (OK/FLT) Configuration (OK/FLT)
Interface Transmit Side Stored Faults	Command: Response:	<add/ITSF_#'cr' >add/ITSF_# hh:mm:ss MM/DD/YY'cr' DRP_xxx'cr' TXD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr' PROG_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) Programming (OK/FLT) Configuration (OK/FLT)

Interface Receive Side Stored Faults	Command: Response:	<add/IRSF_#'cr' >add/IRSF_# hh:mm:ss MM/DD/YY'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' PROG_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) Programming (OK/FLT) Configuration (OK/FLT)
Common Equipment Stored Faults	Command: Response:	<add/CSF_#'cr' >add/CSF_# hh:mm:ss MM/DD/YY'cr' M&C_xxx'cr' INT_xxx'cr' BAT_xxx'cr' +5_xxx'cr' -5_xxx'cr' +12_xxx'cr' -12_xxx'cr''lf']	Monitor & Control Module (OK/FLT) Data Interface Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) -5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (OK/FLT)
Interface Alarms Stored Faults	Command: Response:	<add/IASF_#'cr' >add/IASF_# hh:mm:ss MM/DD/YY'cr' TXBWA1_xxx'cr' TXBWA2_xxx'cr' TXBWA3_xxx'cr' TXBWA4_xxx'cr' RXBWA1_xxx'cr' RXBWA2_xxx'cr' RXBWA3_xxx'cr' RXBWA4_xxx'cr''lf']	TX Backward Alarm 1 (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)
Reed-Solomon Unavailable Seconds	Command: Response:	<add/RSSF_#'cr' >add/RSSF_# hh:mm:ss MM/DD/YY'cr' UNASEC_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 = $xm.m^{-ee}$.
3	**Corrected BER** (ref. 'CBER_' command).	p3 = $xm.m^{-ee}$.
4	**Interface Read Error Status** (ref. 'IRES_' command).	p4 = tttt_$xm.m^{-ee}$.
5	**E_b/N_0** (ref. 'EBN0_' command).	p5 = xnn.n, E_b/N_0 in dB.
6	**Buffer Fill Status** (ref. 'IBFS_' command).	p6 = nn%, buffer fill status.

Notes**:**

1. Parameters 2 through 6 are dependent on carrier acquisition, if the decoder is not locked empty data blocks are returned (,,,,,).
2. Parameter 4 will return null data for DVB RX Overhead.

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.nnnn, IF frequency in MHz.
3	**Modulator rate** (ref. 'MR_' command).	p3 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
4	**Modulator preset 'A' assignment** (ref. 'ARMA_' command).	p4 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
5	**Modulator preset 'B' assignment** (ref. 'ARMB_' command).	p5 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
6	**Modulator preset 'C' assignment** (ref. 'ARMC_' command).	p6 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
7	**Modulator preset 'D' assignment** (ref. 'ARMD_' command).	p7 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
8	**Modulator preset 'V' assignment** (ref. 'ARMV_' command).	p8 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
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), or '4' (CSC).
14	**Modulator encoder type** (ref. 'MET_' command).	p14 = n, where 'n' is '0' (SEQ) or '1' (VIT).
15	**Carrier only mode ON/OFF.**	p15 = n, where 'n' is '0' (off) or '1' (on).
16	**Demodulator IF frequency** (ref. 'DF_' command).	p16 = nnn.nnnn, demodulator IF frequency in MHz.

Bulk Consol Status (continued)

Parameter Number	Parameter Name (Command Reference)	Description
17	**Demodulator rate** (ref. 'DR_' command).	p17 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
18	**Demodulator preset A assignment** (ref. 'ADRA_' command).	p18 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
19	**Demodulator preset B assignment** (ref. 'ADRB_' command).	p19 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
20	**Demodulator preset C assignment** (ref. 'ADRC_' command).	p20 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
21	**Demodulator preset D assignment** (ref. 'ADRD_' command).	p21 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
22	**Demodulator preset V assignment** (ref. 'ADRV_' command).	p22 = nnnnn_mmmm.mmm, code rate/data rate in kbps.
23	**Descrambler enable** (ref. 'DE_' command).	p23 = n, where 'n' is '0' (off) or '1' (on).
24	**Differential decoder enable** (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 Hz.
28	**Sweep width range** (ref. 'SWR_' command).	p28 = nnnnn, sweep range in Hz.
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) or '1' (VIT).
33	**Transmit clock source** (ref. 'TC_' command).	p33 = n, where 'n' is '0' (INT), '1' (REF), or '2' (EXT).
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), or '2' (AUTO).

Bulk Consol Status (continued)

Parameter Number	Parameter Name (Command Reference)	Description
36	**Receive clock phase** (ref. 'RCP_' command).	p36 = n, where 'n' is '0' (NRM) or '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), '1' (B6ZS), '2' (B8ZS), or '3' (HDB3).
41	**RX Interface coding format** (ref. 'ICFR_' command).	p41 = n, where 'n' is '0' (AMI), '1' (B6ZS), '2' (B8ZS), or '3' (HDB3).
42	**Buffer clock source** (ref. 'BC_' command).	p42 = n, where 'n' is '0' (INT), '1' (REF), '2' (EXT), '3' (SAT), '4' (HS), or 5 (INS).
43	**Interface RX-T1 frame structure** (ref. 'IRFS_' command).	p43 = n, where n is '0' (NONE) or '1' (G704).
44	**Interface RX-T2 frame structure** (ref. 'IRFS_' command).	p44 = n, where n is '0' (NONE), '1' (G704), '3' (G743), or '5' (G747).
45	**Interface RX-E1 frame structure** (ref. 'IRFS_' command).	p45 = n, where n is '0' (NONE) or '1' (G704).
46	**Interface RX-E2 frame structure** (ref. 'IRFS_' command).	p46 = n, where n is '0' (NONE), '1' (G704), '2' (G74), or '4' (G745).
47	**Interface Buffer Programming** (ref. 'IBP_' command).	p47 = n, where 'n' is '0' (BITS) or '1' (MS).
48	**Interface buffer size** (ref 'IBS_' command).	p48 = nnnnnn, buffer size in bits or milli seconds.
49	. **Interface transmit overhead type** (ref. 'ITOT_' command).	p49 = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), '4' (ASYNC), or '5' (DVB).
50	**Interface receive overhead type** (ref. 'IROT_' command).	p50 = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), '4' (ASYNC), or '5' (DVB).
51	**Interface substitution pattern** (ref. 'ISP_' command).	p51 = n, where 'n' is '0' (off) or '1' (on).
52	**Interface read error** (ef. 'IRE_' command).	p52 = n, where 'n' is '0' (FRM/OFF) or '1' (2047/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).

Bulk Consol Status (continued)

	Parameter Number	Parameter Name (Command Reference)	Description
	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), '3' (CUSTOM), '4' (DI), '5' (ASYNC), or '6' (DVB).
	60	**Modem operation mode** (ref. 'MOM_' command).	p60 = n, where 'n' is '1' (TX_ONLY), '2' (RX_ONLY), or '3' (DUPLEX).
(Note 1)	61	**MODEM REMOTE/LOCAL mode.**	p61 = n, where 'n' is '0' (LOCAL) or '1' (REMOTE).
(Note 1)	62	**Transmit data phase** (ref. 'TDP_' command).	p62 = n, where 'n' is '0' (NRM) or '1' (INV).
(Note 2)	63	**Receive data phase** (ref. 'RDP_' command).	p63 = n, where 'n' is '0' (NRM) or '1' (INV).
(Note 2)	64	**Drop Data Format** (ref. 'DDF_' command).	p64 = n, where 'n' is '0' (T1), '1' (T1ESF), '2 (E1CCS), '3' (E1CAS), '4' (E1IBS), '5' (T1IBS), '6' (E131TS), '7' (T1S), and '8' (T1ESFS), respectively.
(Note 3)	65	**Insert Data Format** (ref. 'IDF_' command).	p65 = n, where 'n' is '0' (T1), '1' (T1ESF), '2 (E1CCS), '3' (E1CAS), '4' (E1IBS), '5' (T1IBS), '6' (E131TS), '7' (T1S), and '8' (T1ESFS), respectively.
(Note 2)	66	**Bulk Drop Channels Assignment**.	p66 = dd;cc_dd;cc_dd;cc_dd;cc......, as defined by the BDCA_ command.
(Note 3)	67	**Bulk Insert Channels Assignment.**	p67 = ii;cc_ii;cc_ii;cc_ii;cc......, as defined by the BICA_ command.
(Note 3)	68	**Insert E1 CRC Enable** (ref. 'ICRC_' command).	p68 = n, where 'n' is '0' (off) or '1' (on).
(Note 4)	69	**Modulator Reference Clock** (ref. 'MRC_' command).	p69 = n, where 'n' is '0' (INT), '1' (EXT5), '2' (EXT10), or '3' (EXT20), respectively.
	70	**Modulator Spectrum Rotation** (ref. 'MSR_' command).	p70 = n, where 'n' is '0' (NRM) or '1' (INV).
	71	**Demodulator Spectrum Rotation** (ref. 'DSR_' command).	p71 = n, where 'n' is '0' (NRM) or '1' (INV).
(Note 5)	72	**Reed-Solomon Encoder Enable** (ref. 'RSEN_' command).	p72 = n, where 'n' is '0' (off) or '1' (on).
(Note 5)	73	**Reed-Solomon Decoder Enable** (ref. 'RSDE_' command).	p73 = n, where 'n' is '0' (OFF), '1' (ON), or '2' (CORR_OFF).

Bulk Consol Status (continued)

	Parameter Number	Parameter Name (Command Reference)	Description
	74	**Backward Alarm enable TX1** (ref. 'BW_TX1_' command).	p74 = n, where 'n' is '0' (off) or '1' (on).
	75	**Backward Alarm enable TX2** (ref. 'BW_TX2_' command).	p75 = n, where 'n' is '0' (off) or '1' (on).
	76	**Backward Alarm enable TX3** (ref. 'BW_TX3_' command).	p76 = n, where 'n' is '0' (off) or '1' (on).
	77	**Backward Alarm enable TX4** (ref. 'BW_TX4_' command).	p77 = n, where 'n' is '0' (off) or '1' (on).
	78	**Backward Alarm enable RX1** (ref. 'BW_RX1_' command).	p78 = n, where 'n' is '0' (off) or '1' (on).
	79	**Backward Alarm enable RX2** (ref. 'BW_RX2_' command).	p79 = n, where 'n' is '0' (off) or '1' (on).
	80	**Backward Alarm enable RX3** (ref. 'BW_RX3_' command).	p80 = n, where 'n' is '0' (off) or '1' (on).
	81	**Backward Alarm enable RX4** (ref. 'BW_RX4_' command).	p81 = n, where 'n' is '0' (off) or '1' (on).
(Note 6)	82	**TX Driver Type.**	p82 = n, where 'n' is '0' (G.703), '1' (V.35), or '2' (MIL188/RS422).
(Note 6)	83	**RX Driver Type** (ref. 'RXDR_' command).	p83 = n, where 'n' is '0' (G.703), '1' (V.35), or '2' (MIL188/RS422).
(Note 6)	84	**G703 Level Select** (ref. 'G703_' command).	p84 = n, where 'n' is '0' (high drive), '1' (nominal), '2' (nominal shaped), '3' (low level), or '4' (low shaped).
(Note 7)	85	**ASYNC TX Overhead Baud Rate** (ref. 'TOBR_' command).	p85 = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 8)	86	**ASYNC RX Overhead Baud Rate** (ref. 'ROBR_' command).	p86 = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 7)	87	**ASYNC TX Channel Char. Length** (ref. 'TCCL_' command).	p87 = n, where 'n' is the currently programmed character length.
(Note 8)	88	**ASYNC RX Channel Char. Length** (ref. 'RCCL_' command).	p88 = n, where 'n' is the currently programmed character length.
(Note 7)	89	**ASYNC TX Channel Stop Bits** (ref. 'TCSB_' command).	p89 = n, where 'n' is the current number of stop bits programmed.
(Note 8)	90	**ASYNC RX Channel Stop Bits** (ref. 'RCSB_' command).	p90 = n, where 'n' is the current number of stop bits programmed.
(Note 7)	91	**ASYNC TX Channel Parity** (ref. 'TOCP_' command).	p91 = xxxx, where 'xxxx' is the currently programmed parity.
(Note 8)	92	**ASYNC RX Channel Parity** (ref. 'ROCP_' command).	p92 = xxxx, where 'xxxx' is the currently programmed parity.

Bulk Consol Status (continued)

	Parameter Number	Parameter Name (Command Reference)	Description
(Note 7)	93	**ASYNC TX Communications Type** (ref. 'TCT_' command).	p93 = n, where 'n' is '0' (RS232), '1' (RS485_4WIRE), or '2' (RS485_2WIRE).
(Note 8)	94	**ASYNC RX Communications Type** (ref. 'RCT_' command).	p94 = n, where 'n' is '0' (RS232) or '1' (RS485).
(Note 9)	95	**AUPC Local Power enable ON/OFF** (ref. 'LPC_' command).	p95 = n, where 'n' is '0' (off) or '1' (on).
(Note 9)	96	**AUPC Nominal Power Value** (ref. 'NOMP_' command).	p96 = sYnn.n, where 'snn.n' Nominal Power Value in dBm.
(Note 9)	97	**AUPC Minimum Power Value** (ref. 'MINP_' command).	p97 = snn.n, where 'snn.n' Minimum Power Value in dBm.
(Note 9)	98	**AUPC Maximum Power Value** (ref. 'MAXP_' command).	p98 = snn.n, where 'snn.n' Maximum Power Value in dBm.
(Note 10)	99	**AUPC EBN0 Target Set Point** (ref. 'ENSP_' command).	p99 = nn.n, where 'nn.n' EBN0 Target Set Point in dB.
(Note 10)	100	**AUPC Maximum Tracking Rate** (ref. 'MAXT_' command).	p100 = n.n, where 'n.n' is the Maximum Tracking Rate in dB/Min.
(Note 9)	101	**AUPC Local Carrier Loss** (ref. 'LCL_' command).	p101 = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
(Note 9)	102	**AUPC Remote Carrier Loss** (ref. 'RCL_' command).	p102 = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
(Note 11)	103	**Transmit DVB Framing** (ref. 'TDVB_' command).	p103 = n, where 'n' is '0' (188), '1' (204), or '2' (NONE)
(Note 11)	104	**Receive DVB Framing** (ref. 'RDVB_' command)	p104 = n, where 'n' is '0' (188), '1' (204), or '2' (NONE).
(Note 6)	105	**IDR ESC Type** (ref. "ESCT_" command).	p105 = n, where 'n' is '0' (AUDIO), '1' (DATA).
(Note 5)	106	**TX 8PSK 2/3 IESS-310 Operation** (ref. "T310_" command).	p106 = n, where 'n' is '0' (off) or '1' (on).
(Note 5)	107	**RX 8PSK 2/3 IESS-310 Operation** (ref. "R310_" command).	p107 = n, where 'n' is '0' (off) or '1' (on).
(Note 4)	108	Modulator SCT PLL Reference (ref. "MSPR_" command).	p108 = n, where 'n' is '0' (MODULATOR REF) or '1' (EXT-REF FREQ).

Notes:

1. Data will only be returned with FW/24521-2 or higher on interface board. Comma is always returned.
2. Data will only be returned if TX Overhead is programmed for Drop & Insert. Comma is always returned.
3. Data will only be returned if RX Overhead is programmed for Drop & Insert. Comma is always returned.
4. Data will only be returned if the modulator board has the High Stability Internal 5 MHz/External Divider Option. Comma is always returned.
5. Data will only be returned if the Reed-Solomon option is installed in the interface board. Comma is always returned.
6. Data is only returned if the relay board option is installed on the interface board. Comma is always returned.
7. Data will only be returned if TX Overhead is programmed for ASYNC. Comma is always returned.
8. Data will only be returned if RX Overhead is programmed for ASYNC. Comma is always returned.
9. Data will only be returned if TX Overhead is programmed for ASYNC and AUPC is installed. Comma is always returned.
10. Data will only be returned if RX Overhead is programmed for ASYNC and AUPC is installed. Comma is always returned.
11. DVB Reed-Solomon board must be installed.

Bulk Consol Status	Command: Response:	<add/BCSF_'cr' >add/BCSF_abcdefghijklmnop'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. Additional fault status of new options and features will be appended to the end or use existing reserved bits. 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 = Data Clock Activity. Bit 3 = 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 = Internal SCT Synthesizer. Bit 4 = Programming. Bit 3 = Configuration. Bit 2 = External 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 = Receive Clock Synthesizer. Bit 3 = I Channel. Bit 2 = Q Channel. Bit 1 = Descrambler. Bit 0 = BER threshold. Character 'f': Demodulator fault status character 3. Bit 6 = 1 always. Bit 5 = Programming. 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 = Programming. Bit 1 = Configuration. Bit 0 = Drop fault. Character 'i': 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 'j': 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 'k': 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 = Programming. Bit 0 = Configuration. Character 'l': 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 'm': Common equipment fault status character 2. Bit 6 = 1 always. Bit 5 = Battery/Clock. Bit 4 = +5V Power Supply. Bit 3 = -5V Power Supply. Bit 2 = +12V Power Supply. Bit 1 = -12V Power Supply. Bit 0 = reserved. Character 'n': 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 'o': 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 'p': 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.
Change Status	Command: Response:	<add/CS_'cr' >add/CS_x'cr''lf']	Where: The 'x' character is defined as follows: 'at' = 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. This command returns the equipment type and the software version of the addressed device.
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).
Modulator Firmware Information	Command: Response:	<add/MFI_'cr' >add/MFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddrr'cr' mm/dd/yy'cr' FPGA_FW/nnnnnn-ddrr'cr' FPGA_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). rr = Firmware revision (-, or A to Z).

Demodulator Firmware Information	Command: Response:	<add/DFI_'cr' >add/DFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddrr'cr' mm/dd/yy'cr' FPGA_FW/nnnnnn-ddrr'cr' FPGA_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). rr = Firmware revision (-, or A to Z).
Interface Firmware Information	Command: Response:	<add/IFI_'cr' >add/IFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddrr'cr' mm/dd/yy'cr' FPGA_FW/nnnnnn-ddrr'cr' FPGA_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). rr = Firmware revision (-, or A to Z).
Modem Type Compatibility Status	Command: Response:	<add/MTCS_tttttt'cr' >add/MTCS_tttttt'cr' s,INT_MODULE'cr' s,TX_TERR_INT'cr' s,RX_TERR_INT'cr' s,MUX'cr' s,DEMUX'cr' s,BUFFER'cr' s,IDR_TX_BWA'cr' s,IDR_TX_ESC'cr' s,IDR_RX_BWA'cr' s,IDR_RX_ESC'cr' s,IDR AUDIO'cr' s,IBS_ESC'cr' s,MOD_TYPE'cr' s,DEMOD_TYPE'cr' s,ENCODER_TYPE'cr' s,DECODER_TYPE'cr''lf']	Where: tttttt = IDR, IBS, DI, ASYNC, DVB, CUSTOM, or TYPE n (modem type compatibility status desired). s = 0 (Required function is not supported), 1 (Required function is supported), x (Non required function is supported), X (Non required function is not supported.), or * (Required function is supported with hardware reconfiguration [function requirement status]).

Appendix B. OPTIONS

This appendix describes the various options available for the SDM-8000, including:

- Sequential Decoder
- D&I with Asynchronous Overhead
- Reed-Solomon Codec
- Interface Relay Board
- Digital Video Broadcast (DVB)
- Asymmetrical Loop Timing with High Stability Modulator

Note: Refer to Chapter 1 for 8-PSK and 16-QAM information.

B.1 Sequential Decoder

The sequential decoder PCB is a 5.0” x 7.0” (13cm x 18cm) daughter card that is located on the demodulator PCB. The demodulator PCB fits in the bottom slot of the modem chassis. The sequential decoder, referred to in this manual as the “decoder,” is used in closed network applications which typically use the FDMA satellite communications systems. The 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.

Refer to Figure B-1 for the decoder block diagram.

B.1.1 Specifications

Refer to Table B-1 for Sequential Decoder specification.

Table B-1. Sequential Decoder Specification

BER	BER (54 kbps): See Chapter 1. BER (1544 kbps): See Chapter 1.
Maximum Data Rate	2.1 Mbps (Rate 1/2). 3.2 Mbps (Rate 3/4 and 7/8).
Synchronization Time	19000 bits (Maximum).
Output Fault Indicators	Activity detection of I and Q data. Sign bits and descrambler data.
Raw BER Detection	From 0 to 255 bits out of 1024 samples.
Descrambling	V.35 or none.
Differential Decoding	2-phase.
I/O Connectors	2 x 24-pin headers.

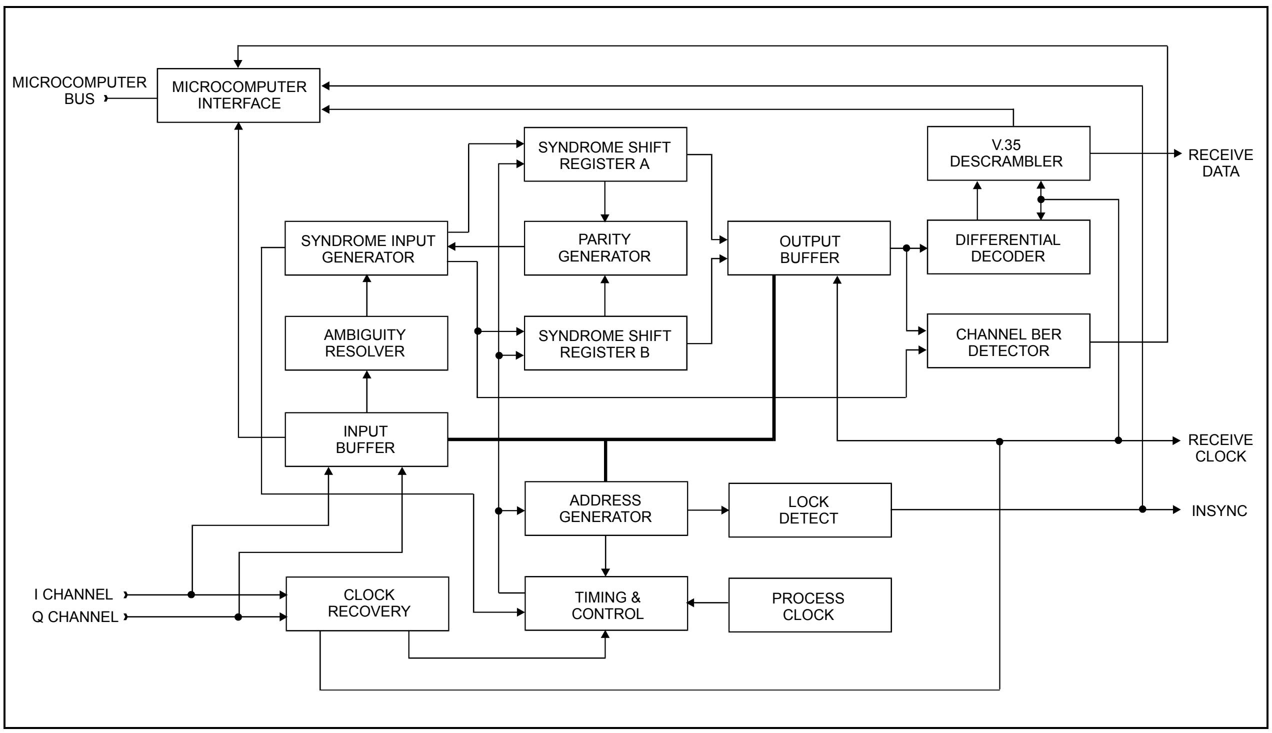


Figure B-1. Sequential Decoder Block Diagram

B.1.2 Theory of Operation

The decoder provides:

- FEC
- Differential decoding
- Descrambling function

The decoder processes 2-bit quantized I and Q channel data symbols from the demodulator. This data is assumed to be a representation of the data transmitted and corrupted by the additive white Gaussian noise. The decoder determines which bits have been corrupted by the transmission channel and corrects as many as possible. This is made possible by the parity bits the encoder adds to the input data stream prior to transmission.

The possible sequences of bits (including parity output by the encoder) is called 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. This is the 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 rapidly decreases 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 takes 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 the decoder to evaluate numerous paths in its search for the most likely one during each symbol time.

Data enters the decoder input buffer from the Demod processor in 2-bit soft decision form for both I and Q channels. The input buffer is used to buffer the data to provide history for the backwards searches. Data from the buffer passes through the ambiguity resolver 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 (A and B) which allows the parity generator to detect bit errors. The resulting error signal provides the feedback of the timing and control circuitry to direct the data along the path of the highest cumulative metric. The corrected data is buffered through the output buffer and retiming circuit, which provides a data stream at the constant rate of the data clock to the differential decoder and descrambler. The data and clock are then output from the PCB.

The decoder also provides a lock detect signal (INSYNC) 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 results from the comparison of the input and output decoder data. Because the input data contains many more errors than the output data, differences in the two can be counted to yield the raw BER. The raw BER is sent to the M&C for further processing.

B.1.3 Unpacking

CAUTION

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

1. Remove the sequential decoder PCB and mounting hardware from the cardboard caddypack and anti-static material.
2. Check the packing list to ensure shipment is complete.
3. Inspect the parts for any shipping damage.

B.1.4 Installation

A Phillips™ screwdriver is the only tool required.

CAUTION

Turn OFF power before installation. High current VDC is present. Failure can result in damage to the modem components.

Note: Refer to Figure B-2 for an illustration of the decoder board.

To install the sequential decoder option:

1. Open the modem front door and turn off the power.

2. Remove the demodulator PCB (bottom board) from the modem.

3. Install the decoder PCB to the demodulator PCB by the mating the male header connectors JP2 and JP1 with the female header connectors J7 and J8.

4. Align the decoder PCB standoffs with the demodulator PCB mounting holes. Install the four mounting screws and washers.

CAUTION

The mounting hardware must be installed to provide proper grounding between the decoder PCB and the demodulator PCB.

5. After completing the above installation procedure, turn on the modem. If the decoder PCB was installed properly, the interface module screen on the Utility Demodulator subsection will display “sequential” when selected. Refer to Chapter 6 for more information.

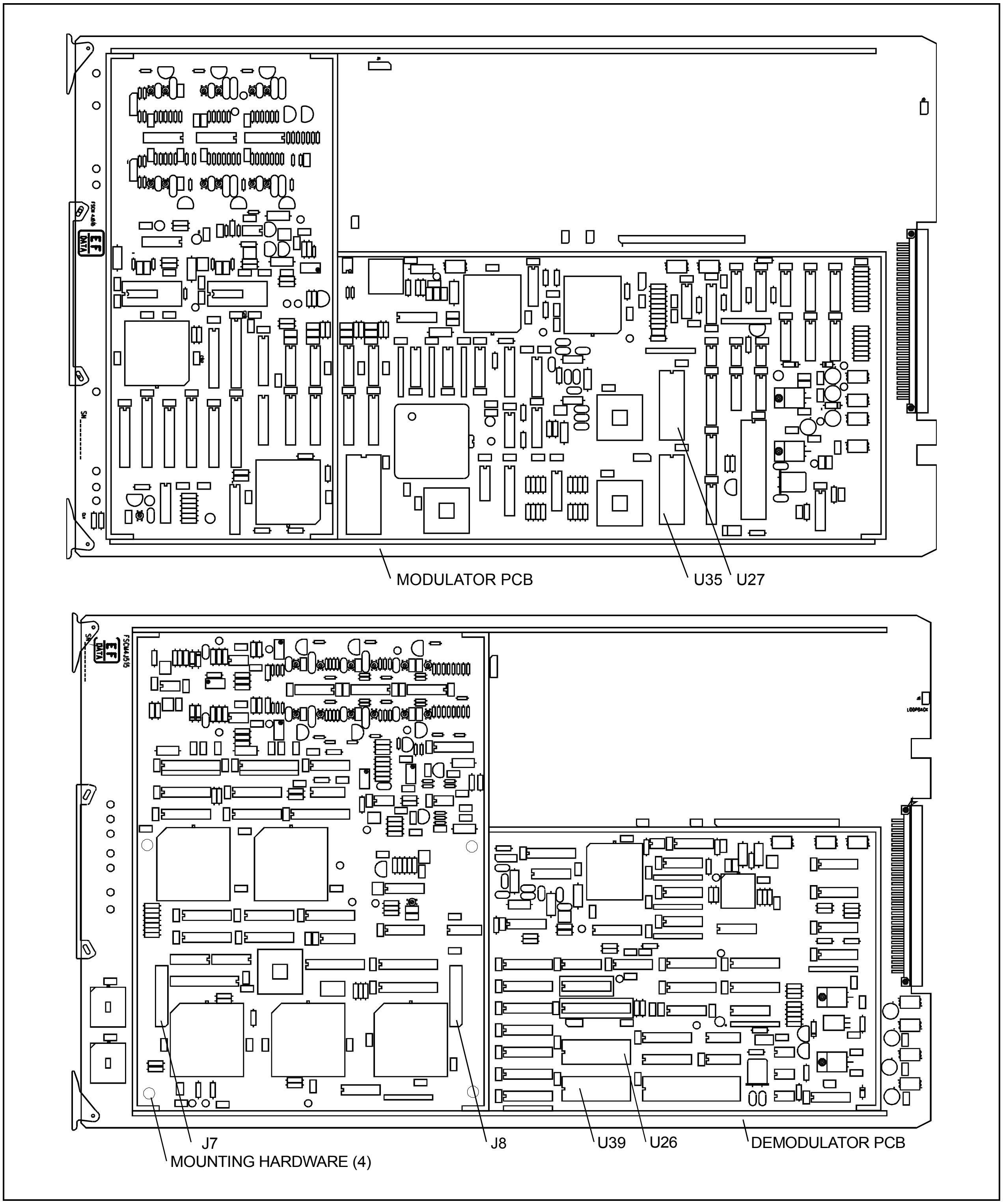


Figure B-2. Sequential Decoder Installation

B.2 D&I with Asynchronous Overhead

The D&I with asynchronous overhead PCB (AS/3496-2) is a 5.90” x 6.40” daughter card that plugs into the interface PCB. The interface card fits in the middle slot of the modem chassis. The D&I multiplexer works in conjunction with the interface card to enable the modem to transmit or receive fractional parts of a T1 data stream.

The asynchronous overhead data channel is typically used for earth station-to-earth station communication. The overhead channel is MUXed onto the data and transmitted at an overhead rate of 16/15 of the main channel.

Note: The asynchronous overhead option (AS/3496-1) also works in conjunction with the interface PCB, but does not include the D&I option. Refer to this section for theory and installation information. Chapter 1 includes modem compatibility requirements.

B.2.1 Specifications

Refer to Appendix C for specification information.

B.2.2 Asynchronous Overhead Operation

The asynchronous overhead PCB (AS/3496-1) is a 5.90” x 6.40” daughter card that plugs into the interface PCB.

The asynchronous overhead data channel is typically used for earth station-to-earth station communication in a closed network application. The overhead channel is MUXed onto the data and transmitted at an overhead rate of 16/15 of the main channel.

The asynchronous overhead option (AS/3496-1) works in conjunction with the interface PCB but does not include the D&I option.

B.2.3 Theory of Operation

Refer to Figure B-3 for a block diagram of the D&I with asynchronous overhead. The main sections of the PCB that will be discussed in the theory of operation include:

- Data Interface
- Transmit Multiplexer
- Receive Demultiplexer
- Asynchronous Overhead
- Plesiochronous Buffer
- ESC
- Automatic Uplink Power Control
- Modem-to-Modem Channel for Remote
- Backward Alarm

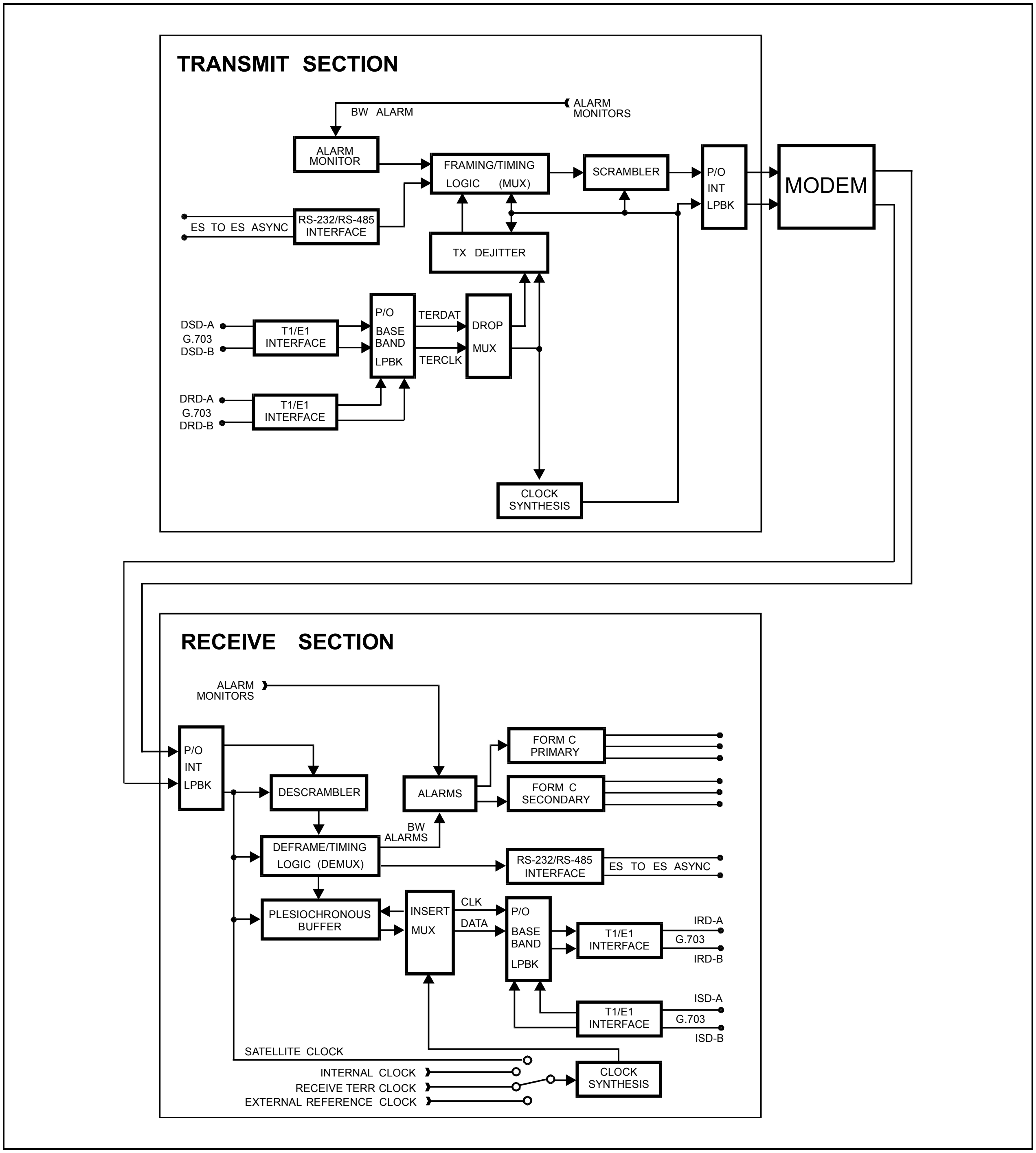


Figure B-3. D&I with Asynchronous Overhead Block Diagram

B.2.3.1 Data Interface

The module contains transformer-balanced data interfaces that support CCITT G.703 parameters and dejitter. This is compatible with AT&T Digital Speech Interpolation (DSI) service. Data inputs and outputs named are listed below:

Data Inputs	Drop send data input A and B (DSD–A and DSD–B) Insert send data input A and B (ISD–A and ISD–B)
Data Outputs	Drop receive data output A and B (DRD–A and DRD–B) Insert receive data output A and B (IRD–A and IRD–B)

The system is frequently used with the drop receive data output signal (DRD–A, –B) looped to feed the insert send data input signal (ISD–A, –B). This is done at the far end of any redundancy switching in order to allow transmit and receive chains to be switched independently. The zero substitution codes AMI, B8ZS, and HDB3 are user-selectable during configuration.

A data loopback function on the insert data is available in this section. This enables the user to determine that the T1 or E1 data parameters correctly match those of this interface. The drop data is always hard-wired into loopback.

B.2.3.2 Transmit Multiplexer

The data stream is multiplexed with a 1/15 overhead channel, and the resultant information rates are interfaced to the Mod/Demod/Coder sections of the modem. A phase-locked loop generates the output clock (with overhead), using the input clock as a reference. The input clock is normally the recovered clock from the data interface. If a valid input signal is not present, the interface falls back to a 10^{-5} accuracy reference clock generated in the modem, and will transmit a valid IESS-308 framing pattern. If this happens, the link will remain open at the far end and a fault will be signaled.

The transmit data will be replaced with an all 1s pattern (AIS) in the event of certain failures, in accordance to IESS-308.

As a test mode, the transmit data can be replaced with a 2047 pattern. This selection overrides the AIS. Only user data bits are replaced with the pattern, while the ESC, including framing and alarms, will operate normally.

The composite multiplexed data stream is normally fed to the modem for further processing (scrambling and K=7 Viterbi encoding). The composite data stream may be looped back at this point as a test function, called interface loopback, when the transmit data rate matches the receive data rate. This allows the customer to test the entire interface as the ESC is looped to itself through the demultiplexer (DEMUX). The plesiochronous buffer may also be checked, since user data passes through this circuit.

B.2.3.3 Receive Demultiplexer

The receive data with overhead is processed in the demultiplexer. This circuit checks and synchronizes to the frame pattern, and separates the user data from the ESC channel. If the DEMUX is receiving a correct and synchronized signal, it will signal the modem that the multiplex system is locked (MUXlock) and passing data. This is indicated by interrogating the modem, a green LED on the interface, and sending the signal into the receive fault tree in accordance with IESS-308. Under certain fault conditions defined by IESS-308, the receive user data will be replaced by a pattern with all 1s, and a fault will be signaled.

B.2.3.4 Asynchronous Overhead

Asynchronous overhead is a 1/15 rate overhead channel that is composed of the following:

- Framing information
- EIA-232 or EIA-485 data
- AUPC information (if installed)
- Valid data flags
- Parity bits

The rate of asynchronous data transfers may be selected by the user with the maximum rate available limited to 1.875% of the synchronous data rate. The asynchronous overhead structure is an Comtech EFData standard and is not compatible with IBS or IDR overhead formats.

B.2.3.5 Plesiochronous Buffer

User data from the DEMUX section is fed into a plesiochronous buffer. The buffer size is user selectable in bit increments that correspond to the length of an IESS-308 satellite superframe. The increments range from 1 to 32 ms. See the specifications for a list of valid entries for each of the selected formats. The buffer automatically centers on resumption of service after an outage or may be commanded to center in the interface configuration section 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. In general, manual centering will not be plesiochronous.

The fill status is available as a monitor function and accurate to 1%. Red LEDs on the module momentarily indicate overflow or underflow incidents. These are stored in the stored fault section of the M&C status registers, along with the date and time of the incident 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 the recovered clock from the receive data input in order to synchronize the receive data output with the satellite data. The user may select from two other clock sources as a backup: either a user supplied external reference clock or the internal clock source.

Problems occurring on either the recovered receive data input clock or the external clock (if selected) will substitute the satellite clock and a fault will be signaled.

B.2.3.6 Engineering Service Channel (ESC)

The ESC uses certain bits of the satellite overhead to implement an EIA-232 data channel. The two types of available data channels are asynchronous and synchronous. The asynchronous channel works by over sampling input and output EIA-232 data so that a clock signal is not required. Data rates up to 1/2000 of the satellite rate may be used. Synchronous data channels are also allowed at a rate of 1/512 of the data rate of the modem. The synchronous channel requires use of the TX clock provided by the modem for operation.

B.2.3.7 Automatic Uplink Power Control (AUPC)

The AUPC feature is designed for remote communications between a local modem (A) and a remote modem (B). It allows the local modem to maintain a constant (± 0.5 dB) E_b/N_0 by requesting changes in transmit power levels from the remote modem. Refer to Chapter 6 for complete details of AUPC configuration functions. The user has the ability to set the following parameters:

- AUPC Enable (turns the AUPC on or off)
- Remote Carrier Loss Action (Maximum, Nominal, Hold)
- Carrier Loss Action (Maximum, Nominal, Hold)
- Set Nominal Power
- Set Maximum Power
- Set Minimum Power Limit
- Set Target E_b/N_0
- Set Maximum Tracking Rate

When the AUPC is turned on in the local modem, it can receive commands from the remote interface. The AUPC then increments or decrements the power in 0.5 dB steps, and allows power to be changed for remote or local Carrier Loss. When the AUPC is turned off in the local modem, the commands are still sent, but the local modem will not respond to the commands.

When Remote AUPC in enabled from the menu of a local modem, that modem becomes the controller for the distant modem. As the controller for the distant modem, it monitors it's own target E_b/N_0 and issues appropriate commands to change the distant modem's power level to meet that target level.

When Local AUPC is enabled from the menu of a local modem, it is allowing the distant modem to control the local modem's TX power level.

If, for example, modem A has Remote AUPC enabled, modem B will automatically have Local AUPC enabled. If modem B loses carrier detect, it's TX power level will match whatever setting is selected in the Configuration/Local AUPC/ Local CL Action menu. If modem A loses carrier detect, modem B's TX power level will match whatever setting is selected in the Configuration/Local AUPC/ Local CL Action menu.

The loss of lock action is as follows (Modem A loses carrier detect):

1. Modem A sets power to Maximum, Nominal, or Hold as specified by Carrier Loss Action.

2. Modem A sends Carrier Loss command to Modem B.

3. Modem B sets power to Maximum, Nominal, or Hold as specified by Remote Carrier Loss Action.

   Note: Local carrier loss has priority over remote carrier loss.

B.2.3.8 Modem to Modem Channel for Remote

This feature allows the user to monitor and control a remote modem location using the front panel or serial port of the local modem. Refer to Chapter 6 and for complete details of AUPC remote configurations. The user can set or reset the following commands:

- Baseband Loopback
- TX 2047 Pattern
- AUPC Enable

The user can remotely monitor the receive 2047 BER.

B.2.3.9 Backward Alarm

Backward alarm signals are included in the overhead. The signals are sent to the distant side of a satellite link to indicate trouble with the receive side which may be a result of improper transmission. The M&C computer monitors the receive side of the link. In the event of trouble, the M&C sends an alarm over the transmit side to the distant end. This alarm signal indirectly includes faults in the downlink chain, since major problems with the antenna, LNA, or down converter, etc. will cause an interruption in service and fault the modem. Reception of a backward alarm is indicated as one of the events that causes a secondary alarm. The modem may be interrogated from the front panel or by using the EIA-485 or EIA-232 interface in order to identify the cause of the alarm.

B.2.4 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 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 PCB for any shipping damage.

B.2.5 Installation

A Phillips™ screwdriver is the only tool required.

Use the following information to install the D&I with asynchronous overhead PCB, called the "D&I/asynchronous PCB," as a daughter card on the interface PCB.

Refer to Figure B-4 for an illustration of the board.

CAUTION

Turn OFF power before installation. High current VDC is present. Failure can result in damage to the modem components.

To install the D&I asynchronous overhead PCB:

1. Open the modem front door and turn off the power.

2. Remove the interface PCB (middle board) from the modem.

3. Install the D&I/asynchronous PCB to the interface PCB by mating the female connector JP1 on the D&I ribbon cable, with the male connector J6 on the interface PCB.

4. Align the D&I/asynchronous PCB standoffs with the interface PCB mounting holes. Install the four mounting screws and washers.

CAUTION

The mounting hardware must be installed to provide proper grounding between the D&I/Asynchronous PCB and the interface PCB.

5. After completing the above installation procedure, turn on the modem. If the D&I/asynchronous PCB was installed properly, the interface module screen on the Utility-Interface subsection will display “OPT:DI” when selected. Refer to Chapter 6 for more information.

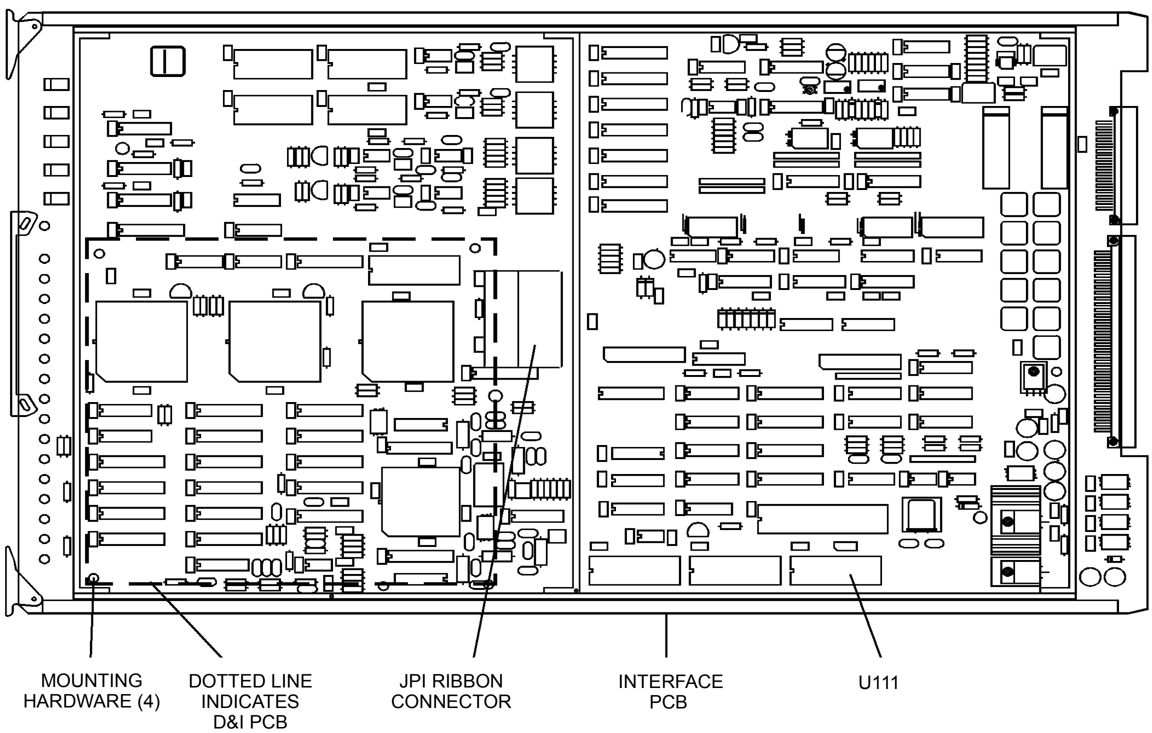


Figure B-4. D&I Multiplexer Installation

B.3 Reed-Solomon Codec

The Reed-Solomon Codec PCB is a 4.75” x 6.00” (12cm x 15cm) daughter card that is located on the interface PCB.

The interface card fits in the middle slot of the modem chassis.

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 B-5 for a block diagram of the Reed-Solomon Codec.

B.3.1 Specifications

The overhead types and data rates supported by the Reed-Solomon Codec option are listed below.

Overhead Type	Data Rate
IDR	1640 (T1)
IDR	2144 (E1)
IDR	6408 (T2)
IDR	8544 (E1)
D&I/IBS	64
D&I/IBS	128
D&I/IBS	256
D&I/IBS	384
D&I/IBS	512
D&I/IBS	1024

Refer to Appendix C for BER specifications.

B.3.2 Theory of Operation

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

Refer to Figure B-5 for a block diagram of the Reed-Solomon Codec.

The two main sections of the Codec that will be included in the theory of operation are the Reed-Solomon encoder (Section B.3.2.1) and the Reed-Solomon decoder (Section B.3.2.2).

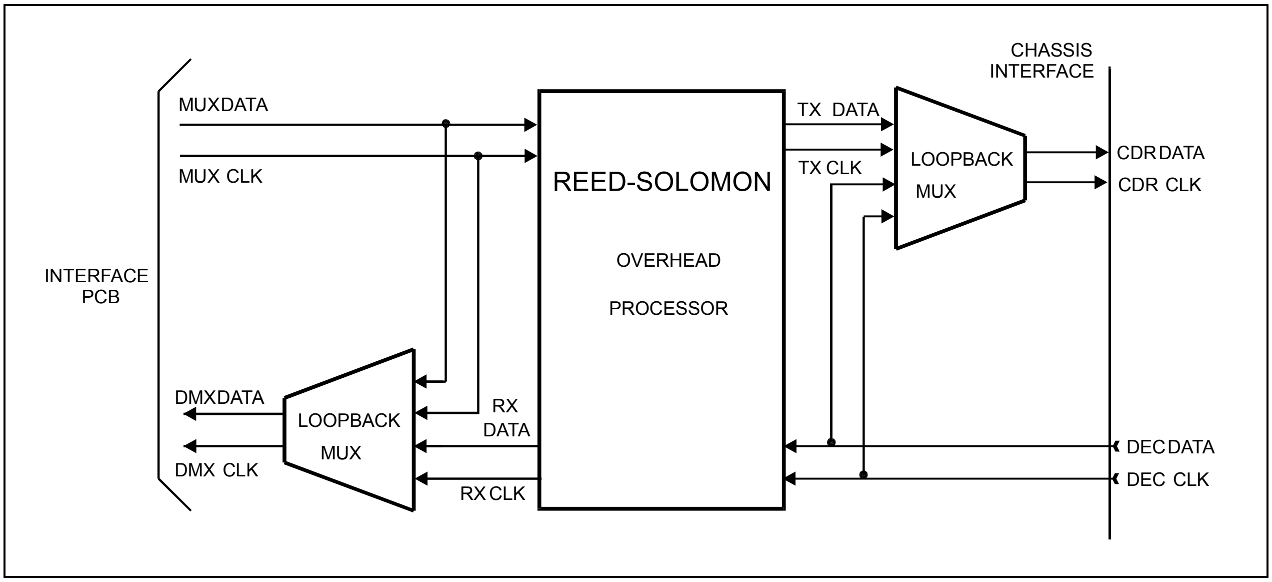


Figure B-5. Reed-Solomon Codec Block Diagram

B.3.2.1 Reed-Solomon Encoder

A block diagram of the Reed-Solomon encoder section is shown in Figure B-6.

The Reed-Solomon encoder section includes the following circuits:

- Synchronous Scrambler
- Reed-Solomon Codec
- Synchronous First In/First Out
- Serial/Parallel Converter
- Parallel/Serial Converter
- Interleaver

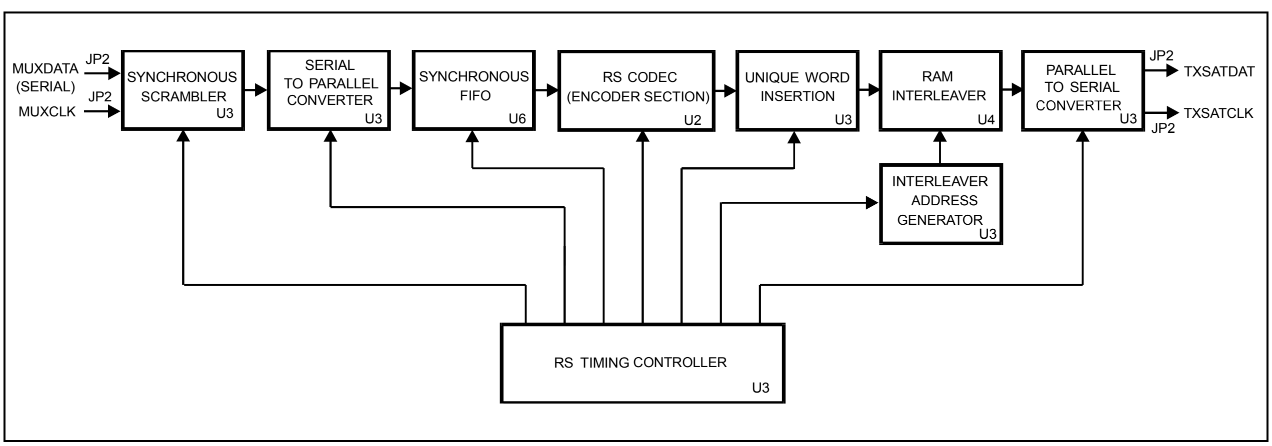


Figure B-6. Reed-Solomon Encoder Section Block Diagram

The data and clock signals (MUXDATA and MUXCLK) come from the multiplexer on the interface PCB, and are sent to the Reed-Solomon encoder section through connector JP2. Since the data input to the Reed-Solomon encoder is serial, the data passes through a self-synchronizing serial scrambler, in accordance with specification INTELSAT-308, Rev. 6B.

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, which changes the data to an 8-bit word. The word then passes to a synchronous First In/First Out (FIFO) buffer, 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 B-7 for the Reed-Solomon code page format. The Reed-Solomon outer Codec reads the data in blocks of ***n*** bytes, and calculates and appends check bytes to the end data block. The letter ***k*** represents the total number of bytes in a given block of data out of the Codec. The letter ***n*** represents the number of data bytes in a given block.

The term, ***k - n = 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 terms ***k, n***, and ***t*** will vary, depending on the data rate 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 4 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 (Figure B-7).

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.

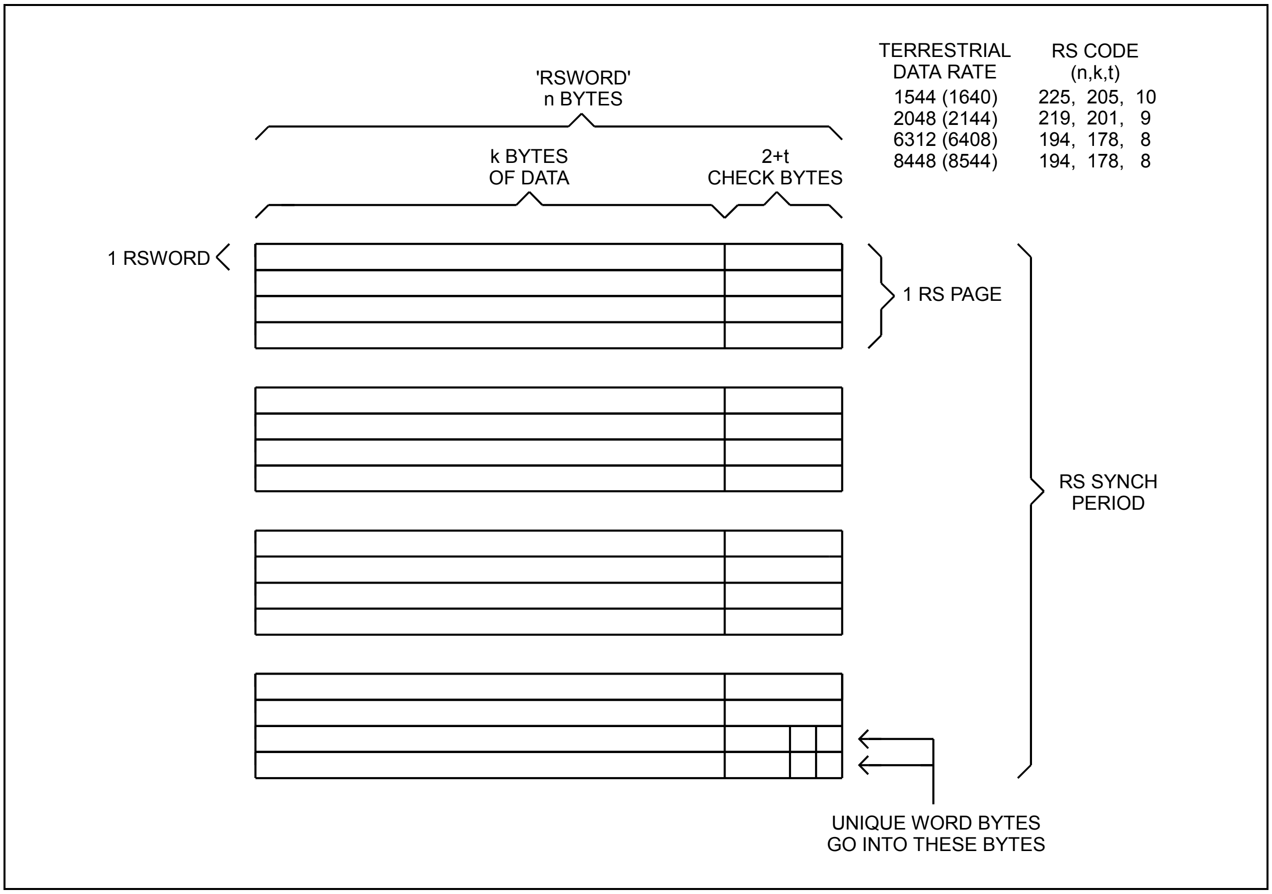


Figure B-7. Reed-Solomon Code Page Format

B.3.2.2 Reed-Solomon Decoder

Refer to Figure B-8 for a block diagram of the Reed-Solomon decoder section.

The Reed-Solomon decoder section includes the following circuits:

- Serial/Parallel Converter
- Synchronous FIFO
- RAM Interleaver
- Parallel/Serial Converter
- Reed-Solomon Encoder/Decoder
- Synchronous Descrambler

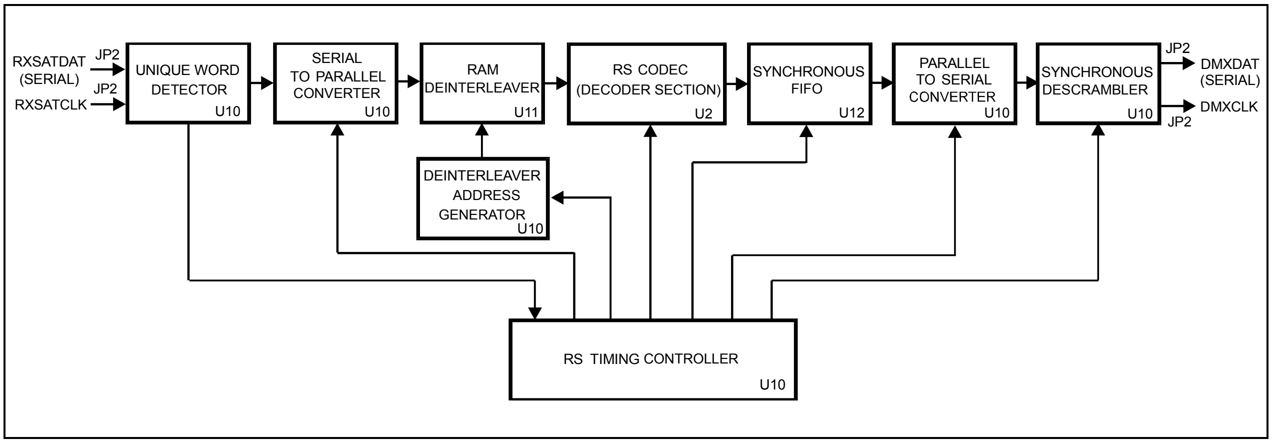


Figure B-8. Reed-Solomon Decoder Section Block Diagram

The data and the clock signals come from the demultiplexer on the interface PCB, and are sent to the Reed-Solomon decoder section through connector JP2.

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 B-7 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 ***k*** represents the total number of bytes in a given block of data out of the Codec. The letter ***n*** represents the number of data bytes in a given block.

The term, ***k - n = 2t***, is the total number of check bytes appended to the end of the data. The terms ***k, n,*** and ***t*** will vary depending on the data rate being 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.

B.3.3 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.

B.3.4 Installation

A Phillips™ screwdriver is the only tool required.

Refer to Figure B-9 for an illustration of the board.

CAUTION

Turn OFF power before installation. High current VDC is present. Failure can result in damage to the modem components.

To install the Reed-Solomon Codec PCB:

1. Open the modem front door and turn off the power.

2. Remove the interface PCB (middle board) from the modem.

3. Install the Reed-Solomon PCB to interface PCB by mating the male header connectors JP1 and JP2 with the female header connectors J3 and J4.

4. Align the Reed-Solomon PCB standoffs with the interface PCB mounting holes. Install the four mounting screws and washers.

CAUTION

The mounting hardware must be installed to provide proper grounding between the Reed-Solomon PCB and the interface PCB.

5. After completing the above installation procedure, turn on the modem. If the Reed-Solomon PCB was installed properly, the interface module screen on the Utility Interface subsection will display “OPT:Reed-Solomon” or “OPT:DI, Reed-Solomon” (if the D&I is also installed). Refer to Chapter 6 for more information.

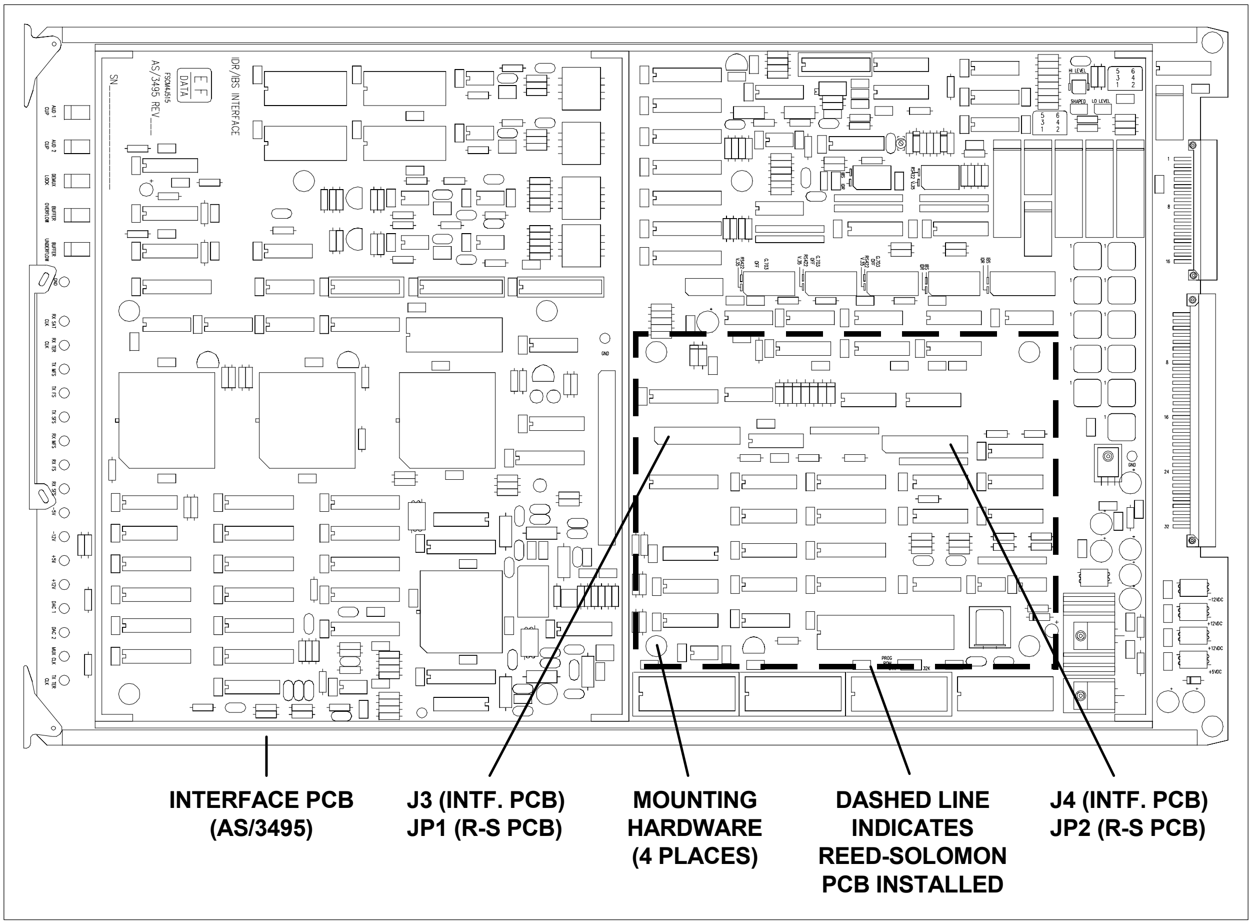


Figure B-9. Reed-Solomon Codec Installation

B.4 Interface Relay Board

The interface relay board is a 3.50” x 6.50” (9cm x 17cm) daughter card (Figure B-10) that is located on the interface PCB. This option provides the modem user with an easy method to change the data interface. The interface relay replaces the need to physically change the interface multi-pin jumpers.

The user can select the following data interfaces from the modem front panel:

Data Interface	Modem Circuitry Affected
MIL-STD-188	Receiver, driver, and handshake signals
V.35	Receiver, driver, and handshake signals
G.703	Receiver and driver

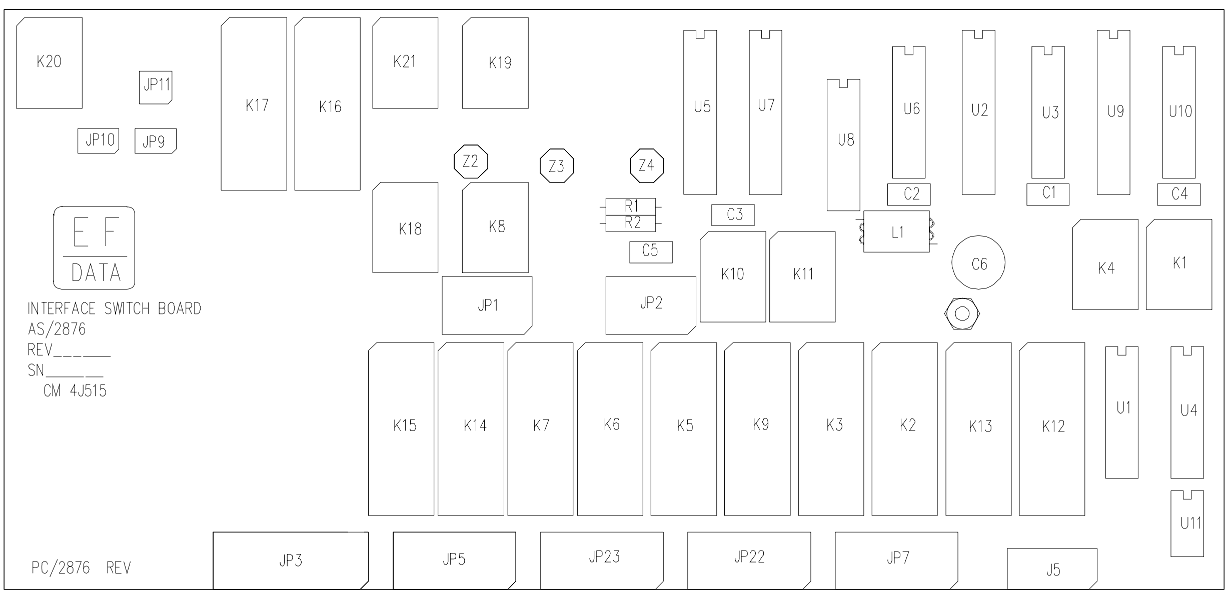


Figure B-10. Interface Relay Board

B.4.1 Theory of Operation

The interface relay board works in conjunction with the host firmware on the display/M&C PCB and the M&C firmware on the interface PCB. The option provides front panel selection for the MIL-STD-188, V.35, and G.703 data interface configurations by using Type 2 FORM C and Type 4 FORM C relays.

B.4.2 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 interface relay board and firmware from the cardboard caddypack and anti-static material.

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

3. Inspect the interface relay board for any shipping damage.

B.4.3 Installation

An IC tool is required.

Use the following procedure to install the interface relay board as a daughter card on the interface PCB. The two firmware ICs are installed on the interface PCB and the display/M&C PCB.

Refer to Figure B-11 for illustrations of the interface PCB, display/M&C PCB, and jumper and firmware locations.

CAUTION

Turn OFF the power before installation. High Current VDC is present. Failure can result in damage to the modem components.

To install the interface relay board:

1. Open the modem front door and turn off the power.

2. Remove the interface PCB (middle board) from the modem.

3. Remove the following jumpers from the interface PCB:

JP1	JP9
JP2	JP10
JP3	JP11
JP5	JP22
JP7	JP23

4. Change JP16 on the interface PCB to the 64K position.

5. Install the interface relay board by carefully mating the male and female header connectors listed in Step 3 (also include J5). Note that both sets of connectors have the same connector number.

Ensure the connectors are properly aligned to prevent pin damage.

When the connectors are properly aligned, carefully install the daughter card fully on the interface card.

6. After completing the above installation procedure, turn on the modem. Refer to Section B.4.4.1 for an operational check.

7. Re-install the interface PCB to the modem.

8. Remove the EEPROM marked FW/2448 from U17 on the display/M&C PCB (located on the front panel). Install the Host M&C firmware marked 2448-1N (or newer).

9. After completing the above procedures, turn on the modem and refer to Section B.4.4.1 for an operational check.

B.4.4 Operation

This section includes an operational check and the Front Panel menu for the interface relay option. If required, refer to Chapter 6 for more information.

B.4.4.1 Operational Check

Use the following procedure to check the interface relay board option:

1. Enter the Function Select Utility and Utility Interface menus.

2. Select “Relay” at the Interface Option menu. If the interface relay option was installed properly, the modem display should show a “+” at the right side of the window.

   Note: A “+” is shown on the display for each installed option.

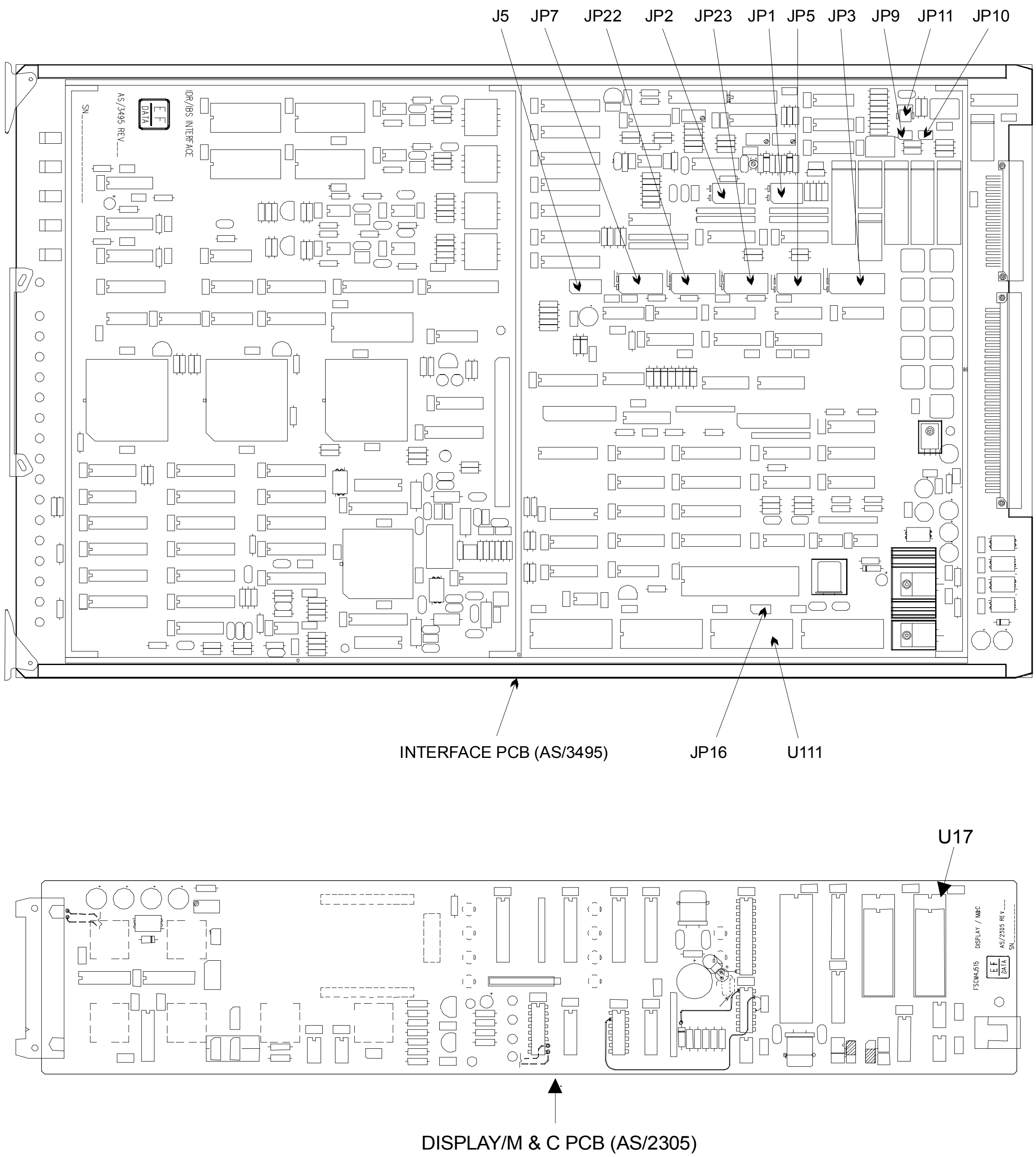


Figure B-11. Interface Relay Board Installation

B.4.4.2 Interface Option Menu

This menu enables the user to select the following options:

- D&I
- Reed-Solomon
- ASYNC overhead
- AUPC
- Relay (Interface Relay Board)

Note: A "+" is shown on the display window for each installed option.

B.4.4.3 Interface Build Menu

This menu displays the type of modem operation (Types 1 through 4).

B.4.4.4 G.703 Menu

The G.703 Level Type menu has the following options for selecting data rates and pulse shapes. Refer to Chapter 9 for diagrams of a typical output spectrum.

Configuration	Description
HIGH DRIVE	Rectangular pulse. 8448 Mbps.
LOW SHAPED	Rectangular pulse. 6312 kbps.
LOW LEVEL	A non-standard pulse option for a lower amplitude than the nominal level option.
NOMINAL SHAPED	A non-standard pulse option for a higher amplitude than the low shaped option. This is pulse shaped due to line loss problems.
NOMINAL LEVEL (DEFAULT)	Rectangular pulse. 1544 kbps and 2048 kbps.

B.5 Digital Video Broadcast (DVB)

The DVB mode of the SDM-8000 sets the Viterbi Forward Error Correction (FEC). Reed-Solomon and framing to be compatible with the European Telecommunications Standard ETS 300 421 (DVB)

The DVB mode will support data rates up to 8.448 Mbps.

The DVB mode employs the following features:

- Special framing
- Scrambling
- Reed-Solomon coding
- Code rate puncturing

Applicable specifications include:

- European Telecommunications Standard ETS 300 421
- ISO/IEC 13818-1

Figure B-12 shows the conceptual block diagrams for the transmit and receive processes of the SDM-8000 when configured for DVB operation.

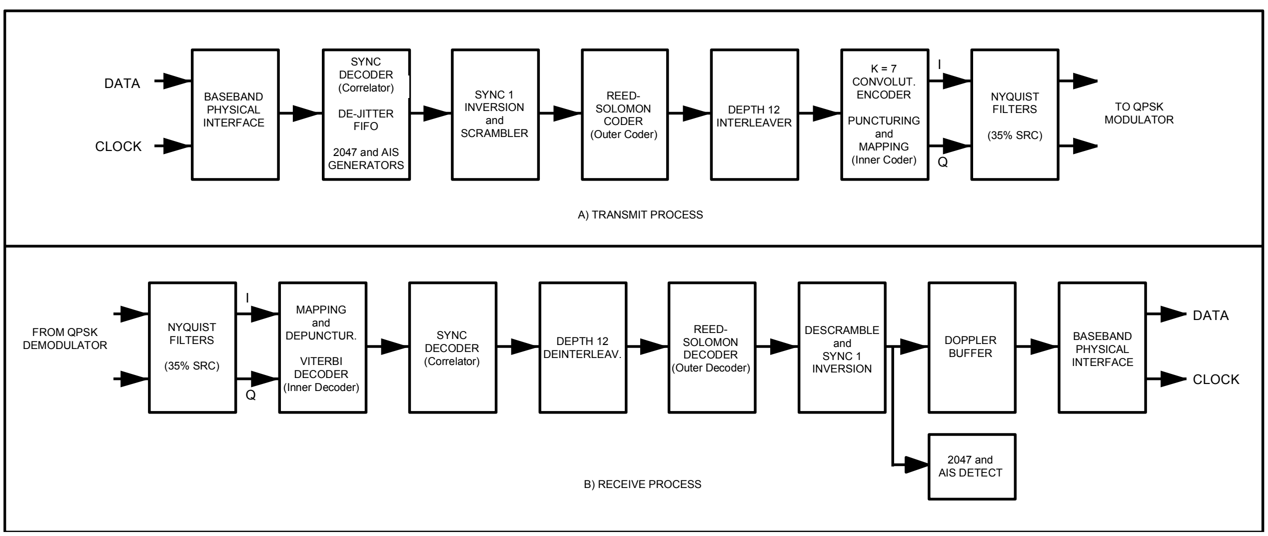


Figure B-12. Block Diagram of SDM-8000 Configured for DVB Operation

Note: The Intermediate Frequency (IF) physical interfaces and Quadrature Phase Shift Keying (QPSK) modulator are functionally equivalent to those used during INTELSAT operation, and will not be described here.

The blocks shown in Figure B-12 have special functionality when operating in DVB mode. Each block is described in the following sections.

B.5.1 Option Requirements

This section covers the module types that are compatible with each option, and the minimum software requirements for the modem PCBs. The following options list the interface type and PCB assembly numbers.

B.5.1.1 DVB Option

The DVB option works in conjunction with the Viterbi decoder, and includes additional framing, interleaving, and Codec processing to provide:

- Concatenated FEC
- Convolutional encoding/decoding

This option can be factory or user installed.

Refer to Table B-2 for minimum modem compatibility requirements.

Table B-2. Modem Compatibility Requirements

Assembly	Assembly #	Firmware	
Interface PCB	AS/3495-5	FW/6218-B FW/2451-2P	U109, U110 U111
Display/M&C PCB	AS/2305 Rev. C6	FW/2448-1P	U17
Modulator PCB	AS/3415	FW.2449-1J FW/2621-L	U27 U35
Demodulator PCB	AS/3416	FW/2450-2G FW/3461-L	U26 U39
DVB Reed-Solomon PCB	AS/4980-3 Rev. A	FW/5134-1	U19

B.5.1.2 Display/M&C

See Figure B-13.

The SDM-8000 modem with the DVB option has two additions to the front panel selections. These additions are the selection of the transmit and receive framing configuration. The terrestrial framing selections of 188 Framing, 204 Framing, or No Framing can each be found in the Configuration Interface menu.

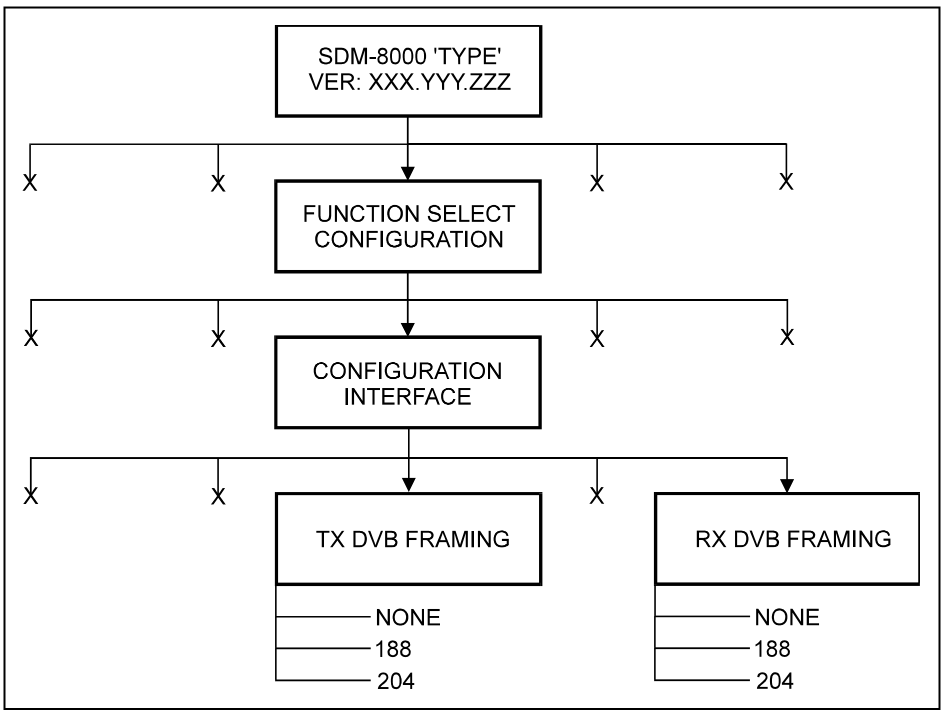


Figure B-13. Configuration Interface Menu

B.5.2 Baseband Interface

The SDM-8000 with the DVB option supports three terrestrial framing formats, allowing the advantage of DVB Reed-Solomon FEC to be used with framing formats other than MPEG-2 Transport Packet Framing. The three framing formats supported are:

- Terrestrial 188 Byte Framing Format (MPEG-2 Transport Packet)
- Terrestrial 204 Byte Framing Format
- Terrestrial No-Framing Format

In the No-Framing format, no special framing is associated with the data. Straight data is received at the baseband interface.

Framing formats are selectable via the front panel interface. Independent of the framing selection, the DVB Reed-Solomon Codec operates with a RS (204,188,8) code. A frame formatter located in the Transmit Sync Decoder (Figure B-14) re-formats the input data stream, as required, into a DVB Reed-Solomon RS(204,188,8) Error Protected Packet format. The scrambler, RS Codec, and interleaver are synchronized to the framing provided by the frame formatter. The frame formatter also incorporates a de-jitter FIFO and rate exchange PLL to hand-off data to a stable system clock.

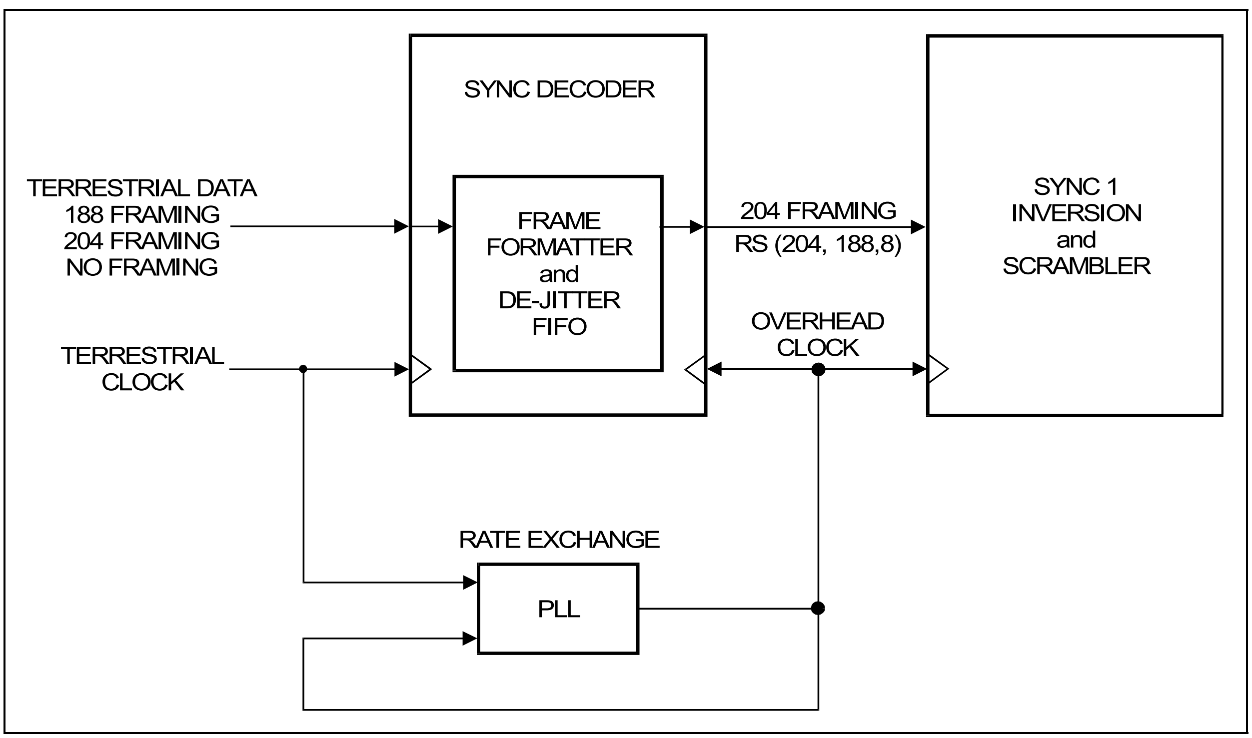


Figure B-14. Baseband Terrestrial Framing Block Diagram

B.5.2.1 Terrestrial 188 Byte Frame Format (MPEG-2 Transport Data Packet)

B.5.2.1.1 Transmit Terrestrial 188 Byte Frame Format

In DVB 188 byte frame format mode, the transmit baseband interface accepts 188-byte MPEG-2 transport packets in bit serial format. Figure B-15 shows the packet arrangement.

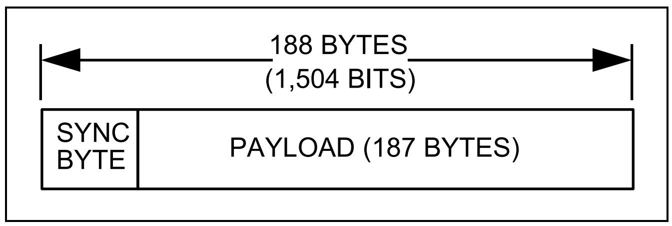


Figure B-15. MPEG-2 Transport Packet

The frame formatter re-formats the packet into a 204 byte RS error protected format, de-jitters the data, then passes it to the Sync 1 inversion and scrambler block.

B.5.2.1.2 Receive Terrestrial 188 Byte Frame Format

Refer to Figure B-15.

The receive DVB baseband interface takes data from the Sync decoder logic and provides bit serial data to the outside world in 188-byte packets (1,504 bits).

B.5.2.2 Terrestrial No Framing Format

B.5.2.2.1 Transmit Terrestrial No Framing Format

In DVB no framing format mode, the transmit DVB baseband interface accepts data in bit serial format. Figure B-16 shows the packet arrangement.

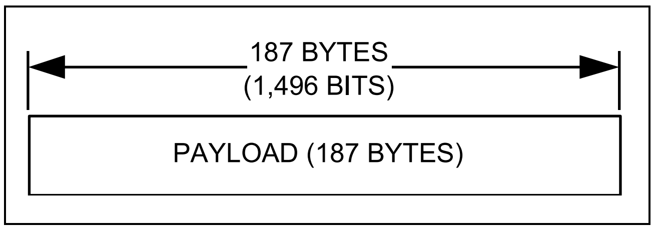


Figure B-16. (No Framing) DVB Baseband Packet

The formatter takes blocks of 187 bytes, re-formats the block into a 204 byte RS protected format, de-jitters the data, then passes it to the Sync 1 inversion and scrambler block.

B.5.2.2.2 Receive Terrestrial No Framing Format

See Figure B-16.

The receive DVB baseband interface takes data from the Sync decoder logic, and strips off the frame sync and RS check bytes, providing only the 187 byte payload in bit serial format (1,496 bits).

B.5.2.3 Terrestrial 204 Byte Framing Format

B.5.2.3.1 Transmit Terrestrial 204 Byte Framing Format

In the DVB 204 byte frame format mode the transmit baseband interface accepts data in 204-byte packets in bit serial format that are composed of 188-byte MPEG-2 packets. In addition, 16 null bytes are included as place holders for Reed-Solomon overhead. Figure B-17 shows the packet arrangement.

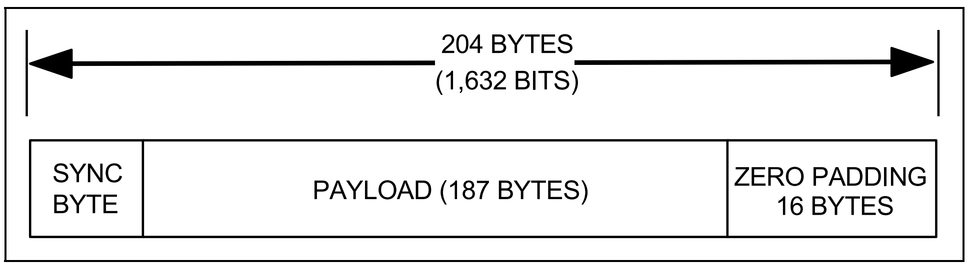


Figure B-17. 204-byte Mode Baseband Packet

The data is de-jittered and passed to the Sync 1 inversion and scrambler block.

B.5.2.3.2 Receive Terrestrial 204 Byte Framing Format

See Figure B-17.

The receive 204 byte baseband interface takes data from the Sync decoder logic, and provides bit serial data in 204 byte packets (1,632 bits) to the outside world.

B.5.3 Sync Decoder (Correlator)

See Figure B-13.

Through the front panel interface, a framing selection is chosen to match that of the terrestrial data framing.

Sync Decoder circuitry will attempt to "lock" to the framing structure selected through the front panel. Once the Sync Decoder is "locked" and the framing structure is known to the Sync Decoder, the data packet is said to be *correlated*. The resulting frame structure is now in a known relationship to the scrambler, the Reed-Solomon Codec, and the interleaver.

B.5.3.1 Transmit/Receive Contingencies

In the case when the Sync Decode logic cannot lock to the framing pattern selected on the front panel, an internal Alarm Indication Signal (AIS) generator fills the payload data with all 1s. Frame sync bytes are inserted into the data stream according to the framing selected on the front panel. Every eighth frame sync byte shall be inverted for descrambler synchronization.

Note: In No Framing mode, the input data stream will always be framed and transmitted.

B.5.3.2 Transport Error Indicator

The transport error indicator is a one bit flag. When set to "1", it indicates that at least one uncorrectable bit error exists in the associated transport packet. This bit is the first bit of the first byte following the frame sync byte. Refer to ISO/IEC DIS 13818-1 Section 2.4.3.3.

Note: In No Framing mode, the transport error indicator bit flag is not implemented.

B.5.4 Sync 1 Inversion and Scrambler/Descrambler

In compliance with the DVB specifications, and to ensure adequate binary transitions, the payload data (187-bytes) in the transport packet is scrambled using a Pseudo Random Binary Sequence (PRBS) generator. The polynomial used for the PRBS is:

$$1 + X^{14} + X^{15}$$

The basic scrambler/descrambler is shown in Figure B-18.

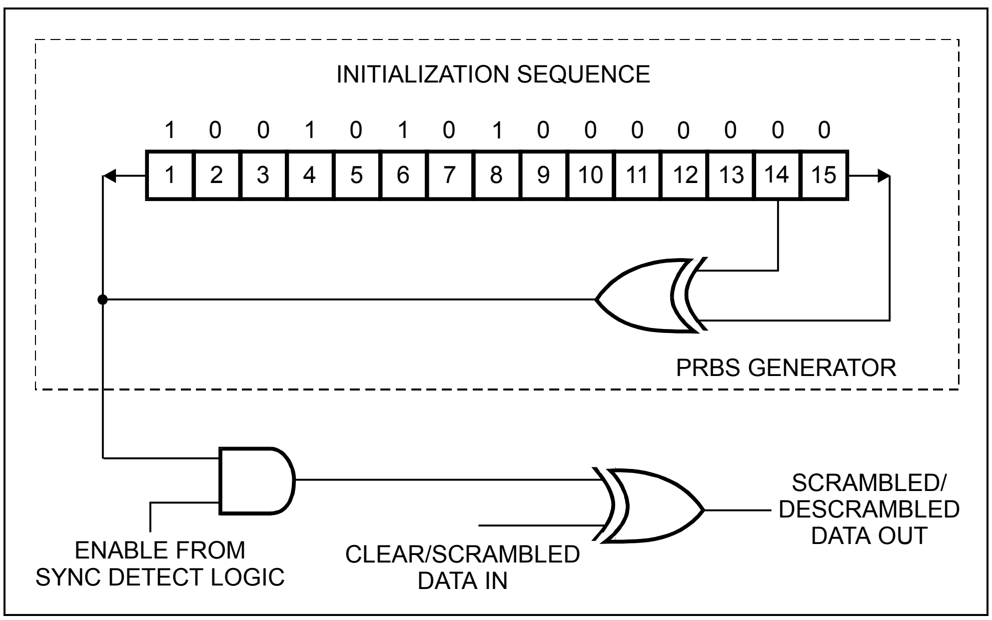


Figure B-18. Scrambler/Descrambler

At every eighth transport packet, the sequence “100101010000000” is loaded into the PRBS registers. The inverted sync byte is used to initialize the PRBS generator.

B.5.4.1 DVB (De)Scrambler

The DVB specifications require that the inverted sync byte detection be used to load the PRBS generator every eight sync bytes, and that the PRBS generator run continuously until the next load (eight packet period).

The first bit at the output of the PRBS generator is applied to the first bit of the first byte following the inverted MPEG-2 sync byte (i.e., 0xB8). To aid other synchronization functions during the MPEG-2 sync bytes of the subsequent seven transport packets, the PRBS generation continues, but its output is gated off, leaving these bytes unscrambled.

There is an additional 16 bytes of padding at the end of each transport packet. The padding is reserved for Reed-Solomon (RS) overhead. (To be compatible with the DVB specification, the PRBS generator must be halted and the scrambler disabled during these 16 padding bytes.) The period of the PRBS generator for DVB mode is:

$$\boxed{\text{PERIOD} = 8 \text{ PACKETS}* \frac{204 \text{ BYTES}}{\text{PACKET}} - \frac{16 \text{ PAD BYTES}}{\text{PACKET}} - 1 \text{ INVERTED SYNC BYTE} = 1503 \text{ BYTES}}$$

Figure B-19 shows the relationship.

Note: The scrambler and the descrambler work in the same way, except that scrambled data is input and descrambled data is output.

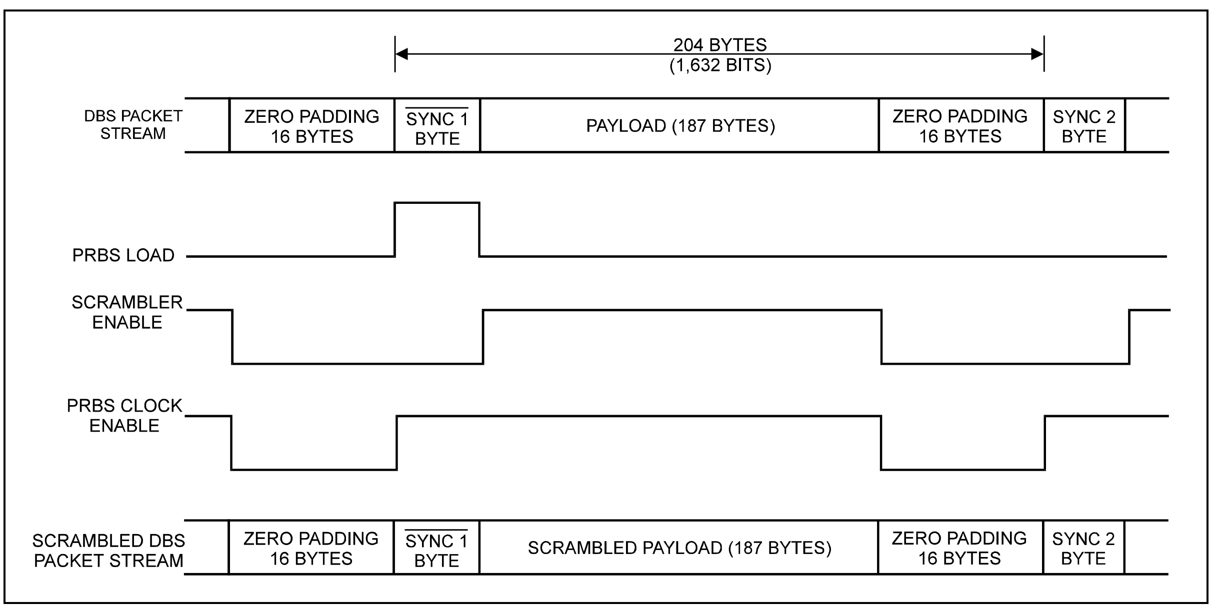


Figure B-19. DVB Scrambler Sequence

B.5.5 Reed-Solomon Coder/Decoder

The Reed-Solomon coder receives scrambled data packets in byte serial format.

RS (204,188,8) shortened code, from the original RS (255,239,8) code, is applied to each scrambled transport packet (188-bytes) to generate an error-protected packet. See Figure B-20 for the packet arrangement.

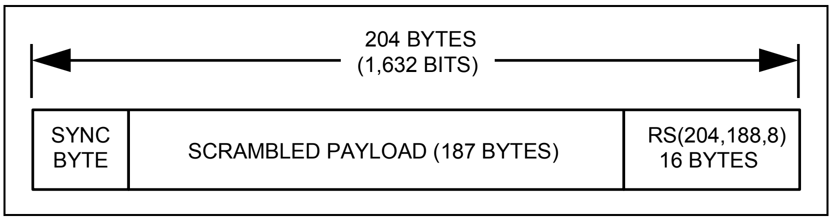


Figure B-20. Reed-Solomon RS(204,188,8) Error-Protected Packet

Note: RS coding is also applied to the non-inverted or inverted packet sync byte.

The shortened Reed-Solomon code is implemented by adding 51 bytes, all set to zero, to the information bytes at the input of a (255,239) encoder. These bytes are discarded after the encoding procedure. The code and field generator polynomials are shown below.

Code Generator Polynomial:

$$g(x) = (x + \alpha^0)(x + \alpha^1)(x + \alpha^2) \dots (x + \alpha^{15})$$

Field Generator Polynomial:

$$p(x) = x8 + x4 + x3 + x2 + 1$$

B.5.6 Depth 12 Interleaver/De-interleaver

Conceptually, the interleaver is composed of I = 12 branches, cyclically connected to the input byte stream by the input switch. Each branch is a FIFO shift register, with depth = 17 x branch index. The cells of the FIFO contain 1 byte, and the input and output branches are synchronized. For synchronization purposes, the sync bytes and inverted sync bytes are always routed in branch 0 of the interleaver, corresponding to a null delay.

The de-interleaver is similar in principle to the interleaver, but the branch indexes are reversed (i.e., branch 0 corresponds to the longest delay). De-interleaver synchronization is accomplished by routing the first recognized sync byte to branch 0.

Figure B-21 shows the interleaver/de-interleaver block diagram.

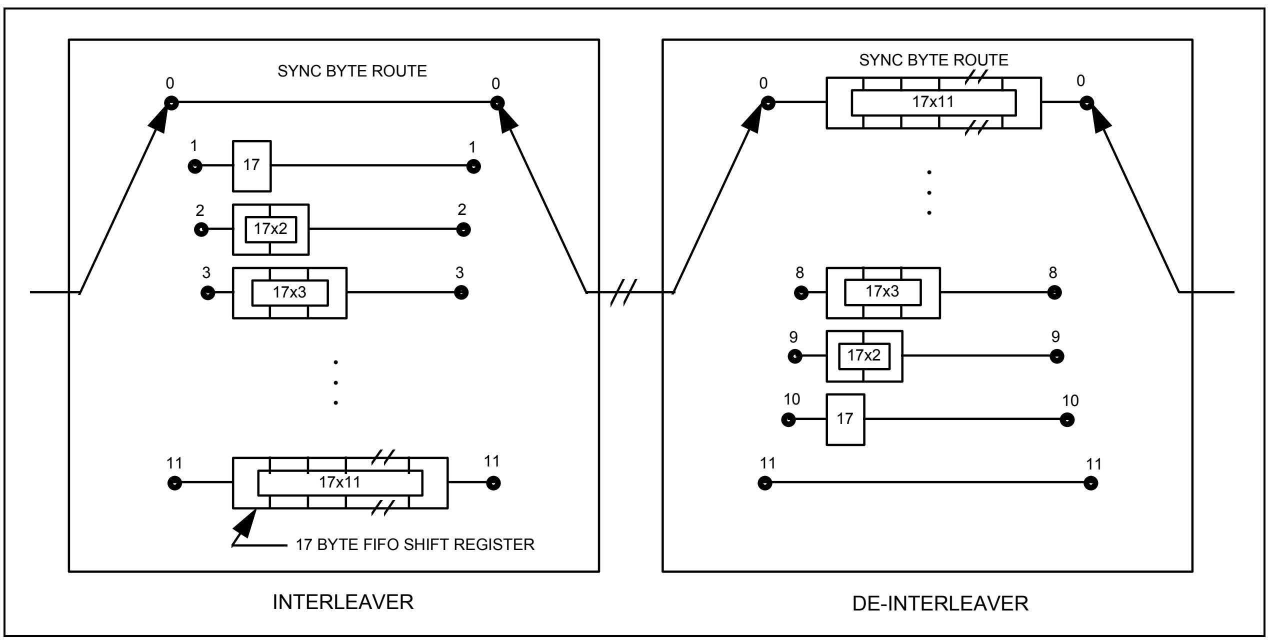


Figure B-21. Interleaver/De-interleaver

An interleaved frame is generated by applying convolutional interleaving (with depth I = 12) to the error-corrected packets.

Figure B-22 shows the interleaved frame structure.

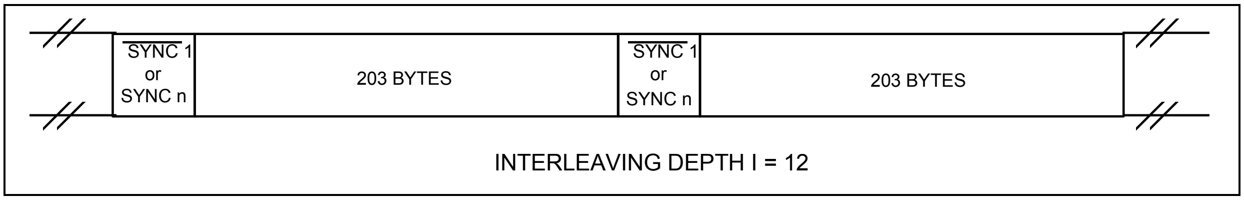


Figure B-22. Interleaved Frame Structure

The interleaved frame is composed of overlapping error-protected packets delimited by inverted or non-inverted MPEG-2 sync bytes, preserving the periodicity of 204-bytes.

B.5.7 Inner Coder/Decoder

The transmit convolutional coder is a standard k = 7, rate 1/2 (G1 = 171, G2 = 133), followed by a programmable puncturing unit. The code rates supported are 1/2, 3/4, and 7/8.

B.5.7.1 Punctured Operation

The DVB puncturing scheme differs from that specified by IESS-308 (INTELSAT), and is shown in Figure B-23.

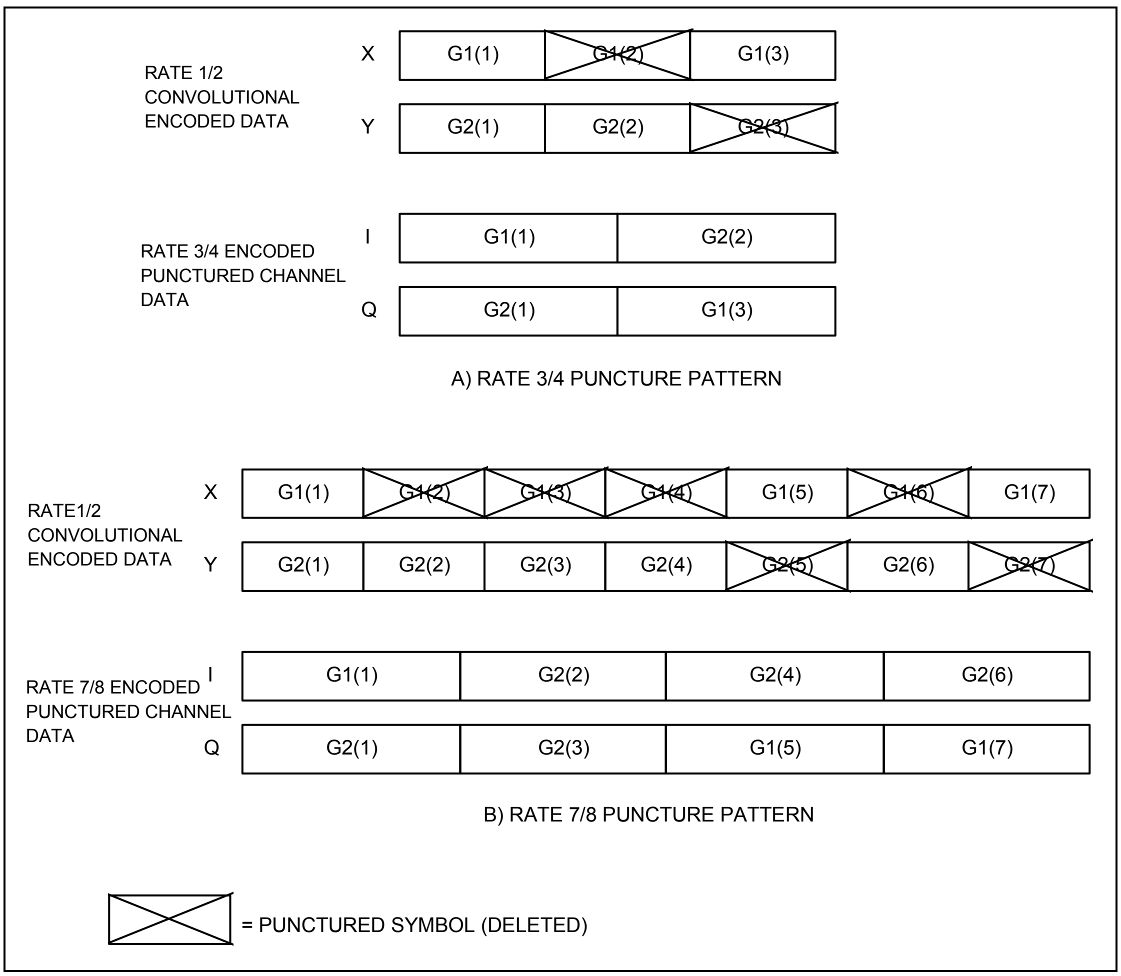


Figure B-23. DVB Puncturing

In punctured operation (rates 3/4 and 7/8), a rate exchange is required between the rate 1/2 convolutional encoded data and the encoded punctured channel data.

Note: The DVB specification also describes rate 2/3 and rate 5/6 puncturing, but the SDM-8000 does not support these code rates at this time.

Table B-3 shows the ratios between the convolutional encoder's clock and the symbol clock for each exchange rate.

Table B-3. Rate Exchange Ratios for DVB Puncturing

Rate	Ratio	Comment
7/8	7:4	
3/4	3:2	
1/2	1:1	No symbols are punctured, therefore no rate exchange is required.

The reception process works by shuffling the encoded punctured channel data to the appropriate positions for the rate 1/2 Viterbi decoder. Null symbol indicators are inserted into the punctured symbol positions in the rate 1/2 data stream.

Again, for rates 3/4 and 7/8, a rate exchange is required for the symbol clock to Viterbi clock hand-off. For rate 1/2, no symbols are punctured, and therefore, no rate exchange is required.

B.5.7.2 Signal Space Mapping

DVB operation employs conventional Gray-coded QPSK modulation with absolute mapping (no differential coding). Bit mapping in the signal space is shown in Figure B-24.

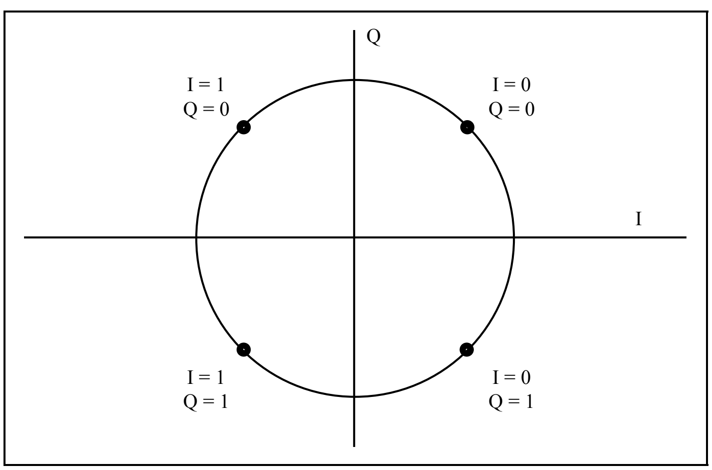


Figure B-24. QPSK Constellation

B.5.8 Nyquist Filters

Prior to modulation, the I and Q baseband signals are passed through Nyquist filters exhibiting a square-root, raised-cosine transfer function with a 35% rolloff factor. The theoretical transfer function is defined by the following expression:

$$H(f) = 1 \quad \text{for} \quad |f| < f_N(1-\alpha)$$

$$H(f) = \sqrt{\frac{1}{2} + \frac{1}{2}\sin\frac{\pi}{2f_N}\left[\frac{f_N - |f|}{\alpha}\right]} \quad \text{for} \quad f_N(1-\alpha) \le |f_N| \le f_N(1+\alpha)$$

$$H(f) = 0 \quad \text{for} \quad |f| > f_N(1+\alpha)$$

where:

$$\alpha = .35$$

$$f_N = \frac{1}{2T_S} = \frac{R_S}{2} \quad \text{is the Nyquist frequency}$$

The reception process uses Nyquist filters exhibiting the same transfer function as the transmission process (matched filters). The receiving Nyquist filters are incorporated directly after the QPSK demodulator. The I and Q outputs of these filters are digitized and mapped to 3-bit, soft-decision symbols for subsequent de-puncturing (if required) and Viterbi decoding.

B.5.9 DVB with Reed-Solomon BER (QPSK)

Table B-4 shows the DVB Reed-Solomon specifications for the E_b/N_0 required to achieve 10^{-6} to 10^{-10} BER for different configurations.

Table B-4. Reed-Solomon BER Data

Specification				Typical			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**	**BER**	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-6}	3.7 dB	4.7 dB	5.4 dB	10^{-6}	3.1 dB	4.0 dB	5.0 dB
10^{-7}	3.9 dB	4.9 dB	5.6 dB	10^{-7}	3.2 dB	4.1 dB	5.2 dB
10^{-8}	4.0 dB	5.1 dB	5.8 dB	10^{-8}	3.3 dB	4.2 dB	5.3 dB
10^{-10}	4.3 dB	5.4 dB	6.2 dB	10^{-10}	3.6 dB	4.5 dB	5.5 dB

All values are for QPSK mode operation. See Figure B-25 for the DVB Reed-Solomon BER Curves.

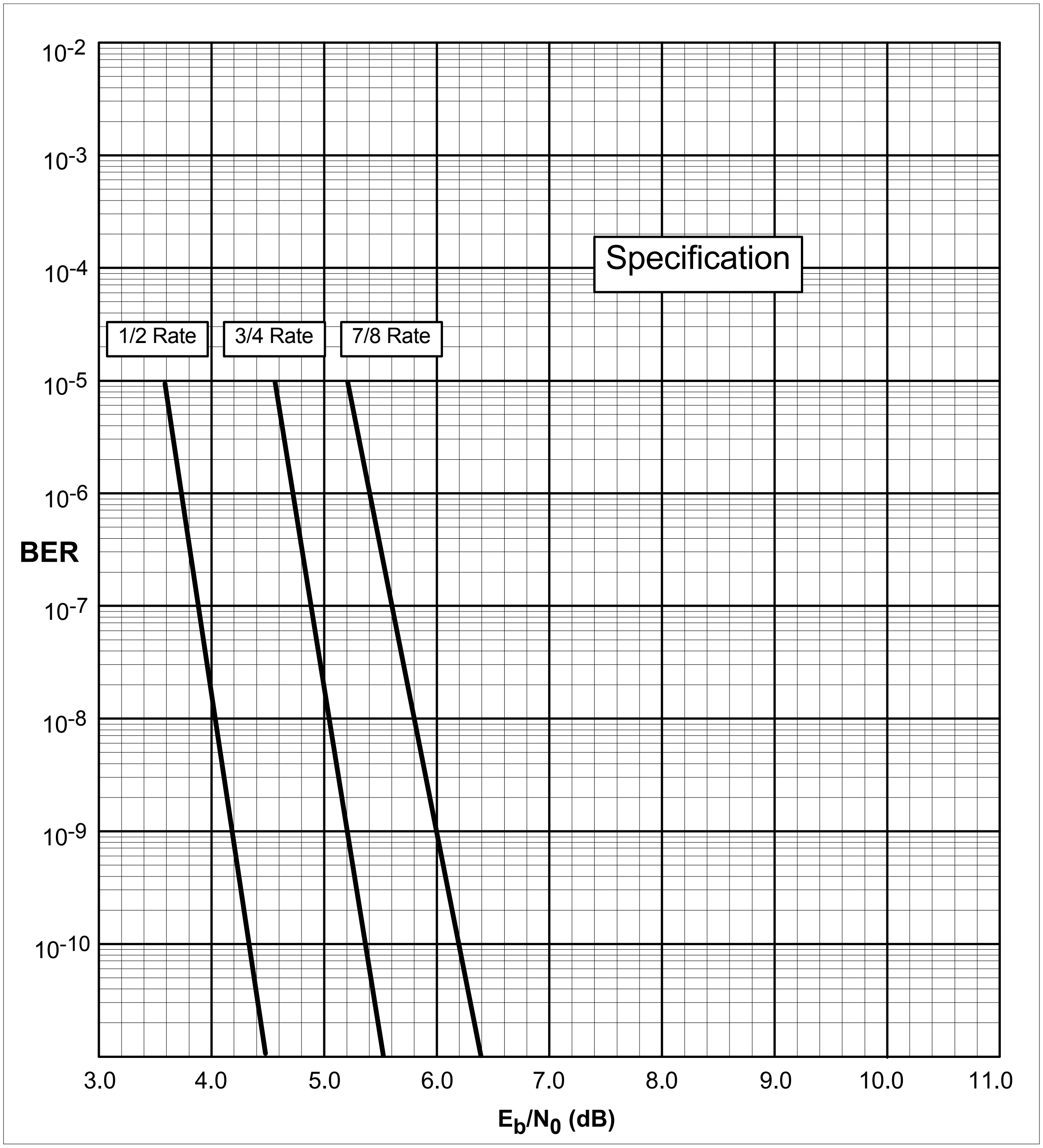


Figure B-25. QPSK (1/2, 3/4, 7/8) with Reed-Solomon (DVB)

B.6 Asymmetrical Loop Timing

B.6.1 Description

Note: The SDM-8000 Satellite Modem can be supplied with the Asymmetrical Loop Timing (ASLT) option, providing the operator has a high stability modulator and firmware for the modem. The firmware of the modulator shall be greater than FW/2449-1K.

Data links that can facilitate the Internet do not need to TX and RX at the same data rate. A main hub station may TX at 1.544 Mbps to several terminals, while smaller terminals TX less data at a smaller date rate of 128 kbps.

The preference is to clock the data links using Master/Slave timing relationship. The hub is the master site and the small terminals are slaved to the hub. The slave sites RX and TX clocks are slaved to the master site clock even through the data rates are different.

Asymmetrical Loop Timing (ASLT) is the same timing method that is designed into many other Comtech EFData satellite modems.

B.6.2 Optional Clocking Options

Refer to the following for optional clocking options.

Option	Description
1	Use a High Stability clock reference for the modem of 5, 10, or 20 MHz.
2	Use an external clock source that is not equal to the TX data rate or for the modem clock.
3	Use RX timing output to clock the TX data into the modem even if the data rates are not equal. (This is a variation of Option 2.) The RX timing is routed into the operator's equipment and to the external clock input of the modem. This is accomplished with wiring at the data I/O connector.
4	Use the internal High Stability clock.

The purpose of these options is to expand the clocking options of the modem.

The difference between the modem reference and the external clock is that the modem reference must be one of three clocks; 5, 10, or 20 MHz and this signal is placed into the modem at AUX 1, pin 2. It is an unbalanced signal at 1 volt peak-to-peak minimum. The signal can be square or sine wave.

The external clock input is usually equal to the TX data rate, but can be different if using the high stability modulator. This is a differential balance pair that is placed into the modem at the data I/O connector

Many ASYNC sateillite links can use this modulator PCB. The TX data rate can be different from the RX data, but the link can be clocked from one clock source.

B.6.3 Internal SCT Clock

Refer to Figure B-26 for an example of the PLL synthesizing the SCT clock from the available input sources.

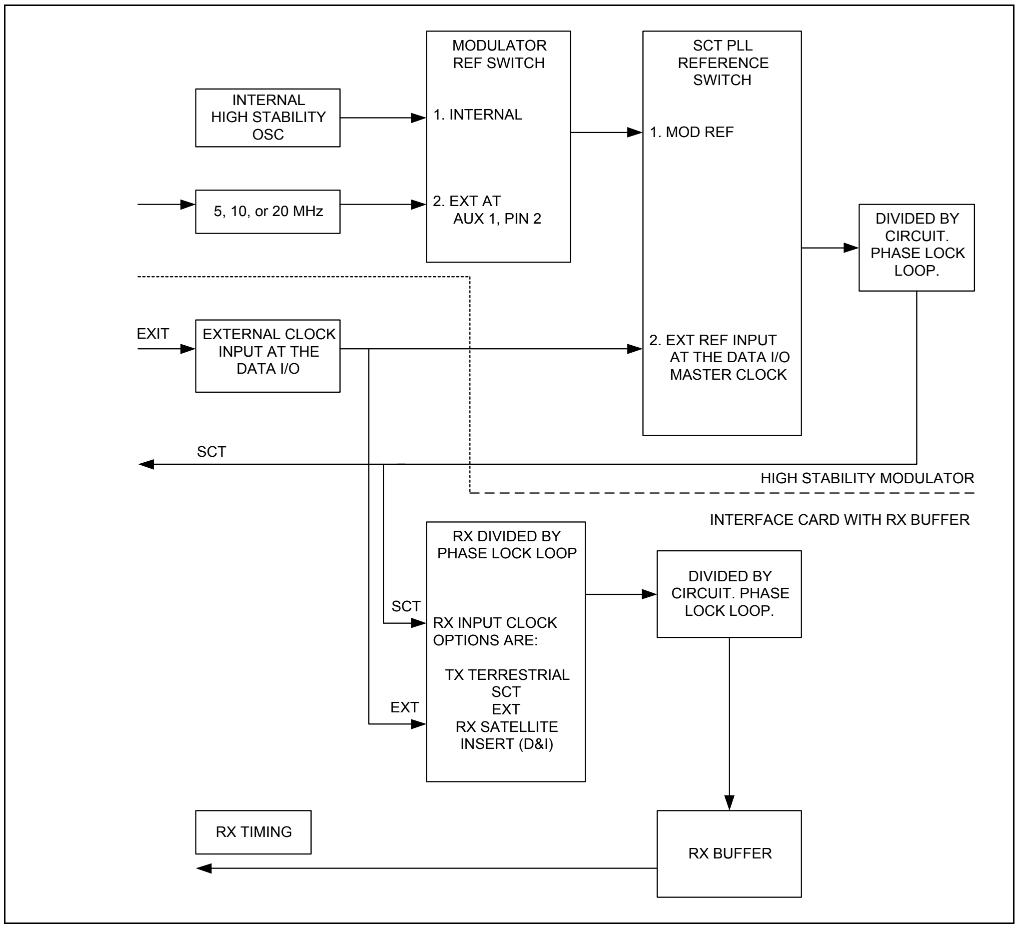


Figure B-26. Internal SCT Clock

Examples:

1. 10 MHz Site Clock is used as the modem reference.

Command	Response
Set	CONFIG/MOD/SCT PLL to MODULATOR REF
Set	CONFIG/MOD/MODULATOR REF to 10 MHz
Set	CONFIG/INTERFACE/TX CLOCK to TX TERRESTRIAL. (SCT internal also is valid, but TX terrrestrial is preferred, because of the phase changes that occur due to the cables used and their lengths.)
Set	CONFIG/INTERFACE/BUFFER CLK to SCT INTERNAL
Set	CONFIG/INTERFACE/BUFFER SIZE to 4 to 6 Milliseconds
Input	The 10 MHz clock at AUX 1 (P9), pin 2. (Use pin 5, 6, or 8 for GND. EXT REF is an unbalanced input and should be at least 1 volt peak-to-peak.)

The operator may have equipment that has different data rates, but want to utilize the clock from the modem. RX timing will clock the data going into the operator's equipment and Send timing, which is phase locked to the modem RX timing, will clock the data out of the operator's equipment. This is called Asymmetrical Loop Timing.

2. The following represents a slave modem that is using the clock from a distant end modem.

Command	Response
Set	CONFIG/MOD/SCT PLL REF to EXT REF FREQ.
Set	CONFIG/INTERFACE/EXT REF FREQ to RX DATA RATE.
Set	CONFIG/INTERFACE/TCX CLOCK to TX TERRESTRIAL (The operator may use SCT Internal because the internal SCT clock is phase locked to the clock coming in at the EXT/MASTER Clock input. TX Terrestrial is preferred because of phase changes that occur due to cables utilized and their lengths.)
Set	CONFIG/INTERFACE/BUFFER CLOCK to RX SATELLITE.
Buffer Size	Not Applicable (Because the buffer is in BYPASS when set to RX SATELLITE.)

Tie RT to EXT/MASTER Clock input at the cable or at the breakout panel (BOP) data connectors. If using the UB-300 BOP, the RT and EXT/MASTER CLOCK appears on all the data connectors. The same can be done with the SMS-700 Switch, as follows:

UB-300	J3, Pins 17 to 23 and Pins 19 to 22
SMS-7000	J1, Pins 17 to 20 and Pins 9 to 23

3. The operator has a clock at the T1 or E1 rate but the TX data rate is different.

Command	Response
Set	CONFIG/MOD/SCT PLL REF to EXT REF FREQ
Set	CONFIG/INTERFACE/EXT REF FREQ to the T1 or E1 rate.
Set	TX CLOCK SOURCE nad the RX BUFFER as desired.
Input	T1 or E1 Clock at the EXT/MASTER CLOCK pins of the data connector.

Appendix C. SPECIFICATIONS

C.1 Specifications

C.1.1 General Specification

Table C-1 lists the general specifications of the modem.

Note: Local control of all remote functions are included by push-button entry.

Table C-1. General Specifications

General Specifications		
Operating Frequency Range	50 to 180 MHz Synthesized in 2.5 kHz steps	
Transmit Frequency Stability	± 10 PPM ± 0.1 PPM (Optional)	
Modulation Types	QPSK BPSK 8-PSK 16-QAM (Front panel selection)	
Phase Noise	dBm/Hz -66.0 -76.0 -86.0 -96.0 -96.0	Distance from Carrier 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz
Transmit IF Output Switch	0 to 500 MHz Measured in 3.0 MHz bandwidth	

Table C-1. General Specifications (Continued)

General Specifications	
Baseband Interface	EIA-422/EIA-449 MIL-STD-188 V.35 G.703 — 1.544 Mbps G.703 — 2.048 Mbps G.703 — 6.312 Mbps G.703 — 8.448 Mbps (Field selectable in ± 100 bit/s)
Elastic Buffer	32 to 262144 bits or 1 to 32 ms Selectable from front panel in bits or ms
Digital Data Rate	9.6 kbps to 9.312 Mbps 1 bit steps (Front panel selection)
Symbol Data Rate	19 kS/s to 6.3 MS/s
Scrambling/Descrambling Types	IESS-309 (Synchronous 2^{15}) (CCITT) V.35 (EFData, Comstream Fairchild , Linkabit , and Hughes compatible)
Forward Error Correction	Viterbi K=7: Rate 1/2, 3/4, 7/8 Sequential: Rate 1/2, 3/4, 7/8 Pragmatic Trellis: Rate 2/3 or 5/6 (8-PSK only) Uncoded: Rate 1/1 Reed-Solomon: Concantinated)
M&C	Front panel display (16 character by 2 rows)
Modulated IF Output Shape Filter Mask Types:	 INTELSAT/EUTELSAT Closed net (Comtech EFDataa) Closed net (Fairchild compatible) Closed net (Hughes compatible)
ESC	IDR IBS None (Field selectable)
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, 130W maximum fused at 2A
Physical: Size Weight	 3.5” H x 19.0” W x 21.5” D (2RU) (9 cm x 48cm x 55 cm) 19 lbs. (8.6 kg)
Environmental: Temperature Humidity	 0 to 50°C (+32° to 122°F) 0 to 95%, non-condensing

Table C-1. General Specifications (Continued)

Additional Modulator Specifications		
Transmit IF Power	-5 to -30 dBm, adjustable in 0.1 dB steps +5 to -20 dBm high power output (optional)	
Modulator Power Offset	0 to ± 99 dB Measured in 0.1 dB steps	
Spurious Emmissions	-5 to –30 dBm TX output option: (0 to 500 MHz) +5 to –20 dBm TX output option: 0 to 500 MHz , Symbol Rates ≥ 64 kbps 0 to 500 MHz, Symbol Rates ≤ 64 kbps	-55 dBm -55 dBm -50 dBm
Output Impedance	50 or 75Ω	
Output Return Loss	≤ -17 dB (for 50Ω); ≤ -20 dB (for 75Ω)	
Output Frequency Stability	± 10 PPM	
Transmit IF Test Modes	CW – Outputs a single carrier at the defined frequency. Offset – Dual sideband signal with upper sideband and carrier suppressed –30 dBc.	
Data Clock Source	Internal, ± 1 x 10^{-5} stability Internal High-Stability ± 2 x 10^{-7} (optional) External (optional)	
Additional Demodulator Specifications		
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	
Receive Input Power (Desired Carrier)	-30 to –50 dBm -30 to –45 dBm	< 2 Mbps Symbol Rate > 2 Mbps Symbol Rate
Receive Input Power (Composite)	1. The sum of all carriers is ≤ -5 dBm. 2. The sum of all carriers within 10 MHz from the desired is ≤ +30 dBc. 3. The sum of all carriers is ≤ +40 dBc.	
IF Input Overload	The unit can be damaged by continous RX IF input of 0 dBm.	
Input Impedance	75Ω (50Ω Optional)	
Input Return Loss	≤ -17 dB (for 50Ω); ≤ -20 dB (for 75Ω)	
Carrier Acquisition Range	± 30 kHz minimum	
Clock Acquisition Range	± 100 PPM	

Table C-1. General Specifications (Continued)

Remote Control Specifications	
Serial Interface	EIA-232 or EIA-485
Baud Rate	110 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 Scrambler Type Scrambler ON/OFF Descrambler Type Descrambler ON/OFF Buffer Clock TX/RX/INT/HS/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 Type IDR Backward Alarm Control On/Off Reed-Solomon ON/OFF Mod and Demod Spectrum Norm/Invert Rev Emulation Current/Functional
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 up to one year without power
Addressing	Programmable to 1 of 255 possibilities Address 0 reserved for global addressing

C.1.2 BER Performance

Table C-2 list the Bit Energy-to-Noise Ratio (E_b/N_0) required to achieve 10^{-3} to 10^{-10} Bit Error Rates (BER).

Table C-2. BER Performance

Table	Description
C-3	Noise, Viterbi Decoder, and IDR Mode
C-4	Noise, Viterbi Decoder, IBS, and D&I Mode
C-5	Noise, Sequential Decoder, BPSK, QPSK, and 56 kbps
C-6	Noise, Sequential Decoder, BPSK, QPSK, and 1544 kbps
C-7	Noise, and Reed-Solomon
C-8	Noise, Viterbi Decoder, and 8-PSK 2/3
C-9	Noise, Viterbi Decoder, and 8-PSK 5/6
C-10	Noise, ViterbiDecoder, and 16-QAM

C.1.2.1 Performance with Noise, Viterbi Decoder, IBS, and D&I Mode

The modem BER performance (Table C-3)will be degraded ≤ 0.5 dB with two like-modulated carriers spaced ± 1.4 times the symbol rate from the RX frequency, and each adjacent carrier up to 7 dB higher in power.

Refer to Figure C-1 for the Viterbi BER curves.

Table C-3. Viterbi Decoder BER Data

E_b/N_0 (dB) Specification			
BER	**1/2**	**3/4**	**7/8**
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

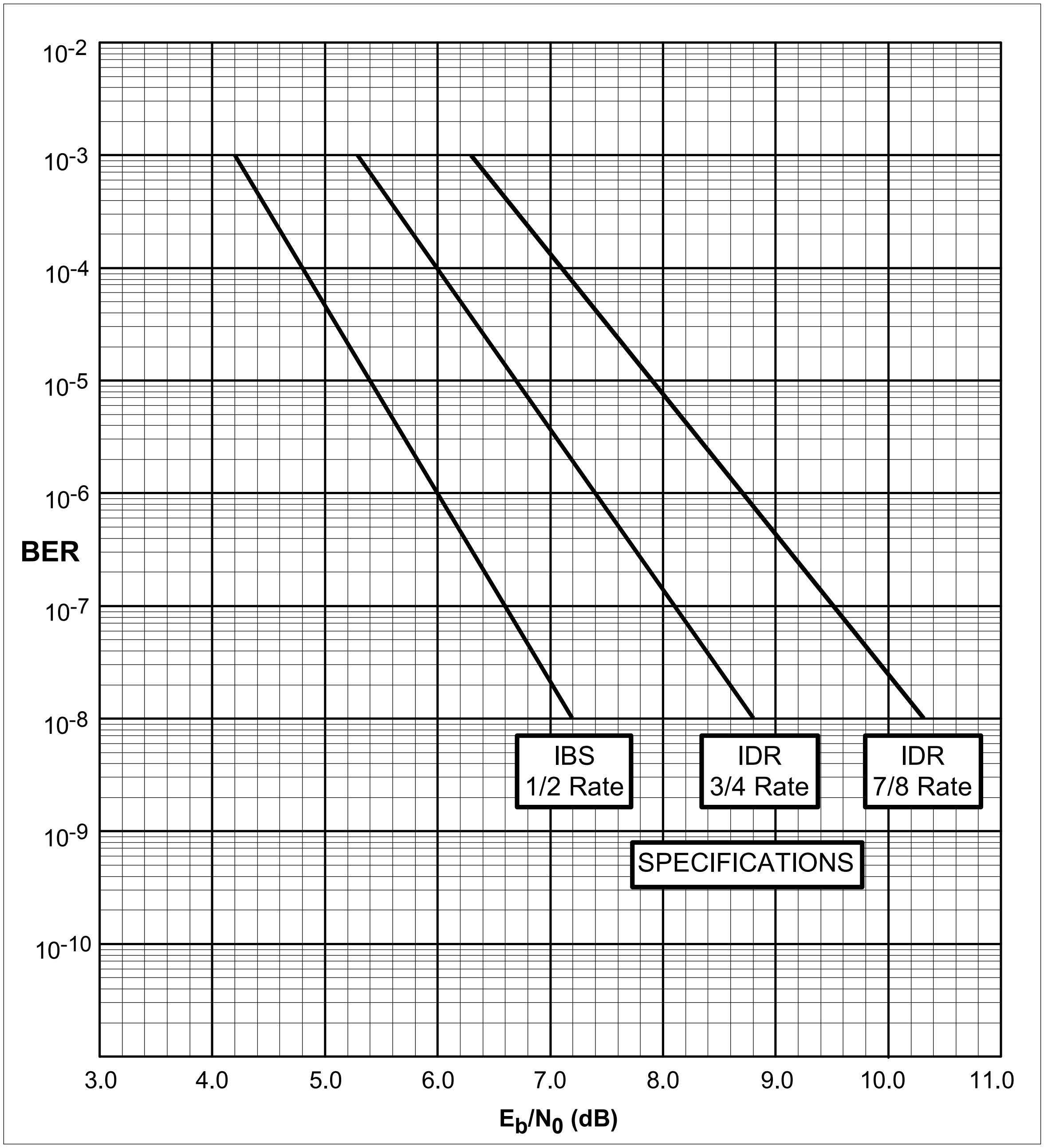


Figure C-1. Viterbi BER , IBS, and D&I Mode Performance Curves

C.1.2.2 Performance with Noise, Sequential Decoder, BPSK, QPSK, and 56 kbps

The modem BER performance (Table C-4)will be degraded ≤ 0.5 dB with two like-modulated carriers spaced ± 1.3 times the symbol rate from the RX frequency, and each adjacent carrier up to 10 dB higher in power.

Refer to Figure C-2 for the Viterbi BER curves.

Table C-4. Sequential Decoder 56 kbps

E_b/N_0 Specifications			
BER	**1/2**	**3/4**	**7/8**
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	7.9
10^{-8}	5.8	6.8	8.4

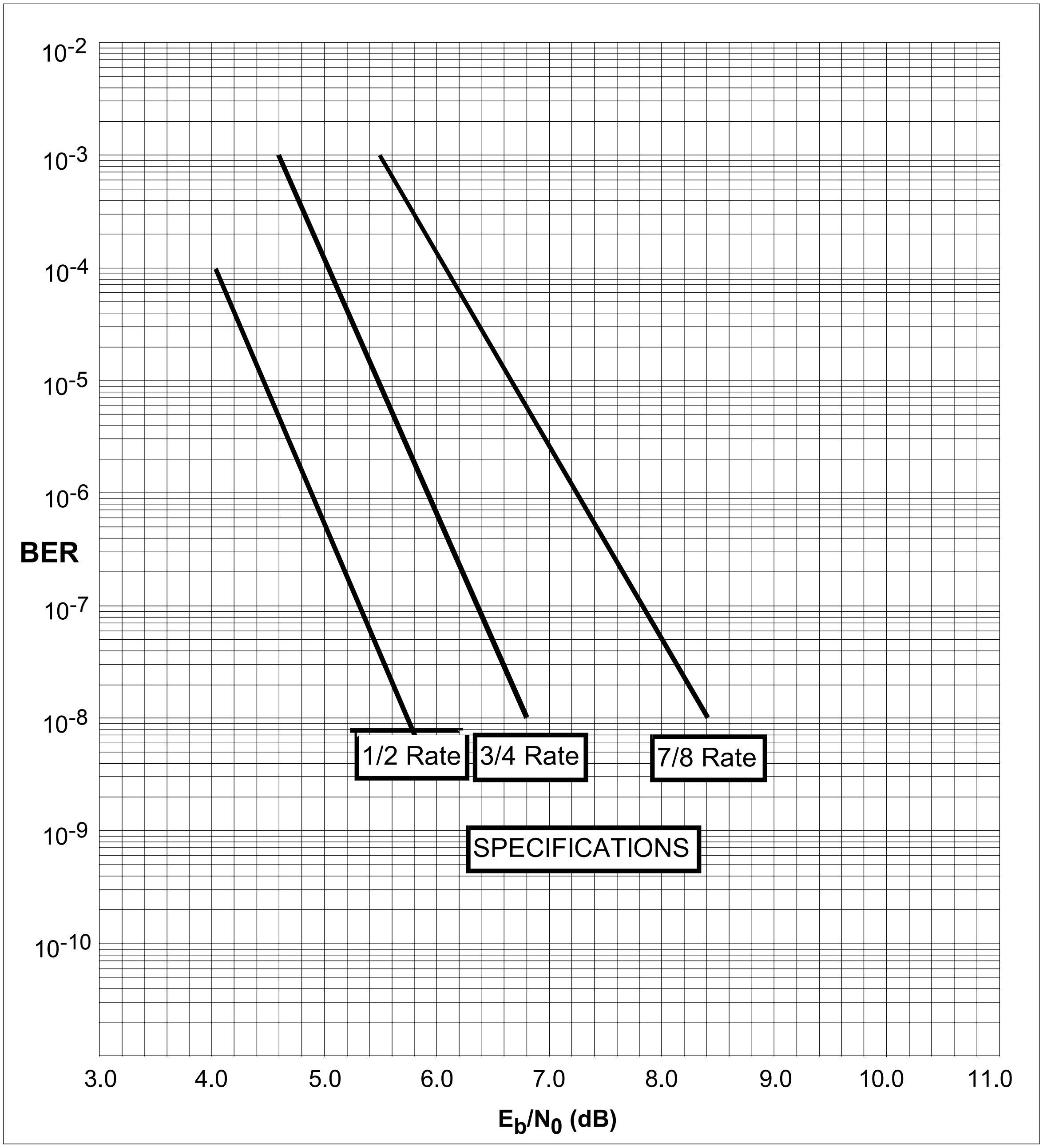


Figure C-2. Sequential Decoder 56 kbps BER Performance Curves

C.1.2.3 Performance with Noise, Sequential Decoder, BPSK, QPSK, and 1544 kbps

The modem BER performance (Table C-5)will be degraded ≤ 0.5 dB with two like-modulated carriers spaced ± 1.3 times the symbol rate from the RX frequency, and each adjacent carrier up to 10 dB higher in power.

Refer to Figure C-3 for Sequential BER Data.

Table C-5. Sequential Decoder, 1544 kbps

	E_b/N_0 Specifications		
BER	**1/2**	**3/4**	**7/8**
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

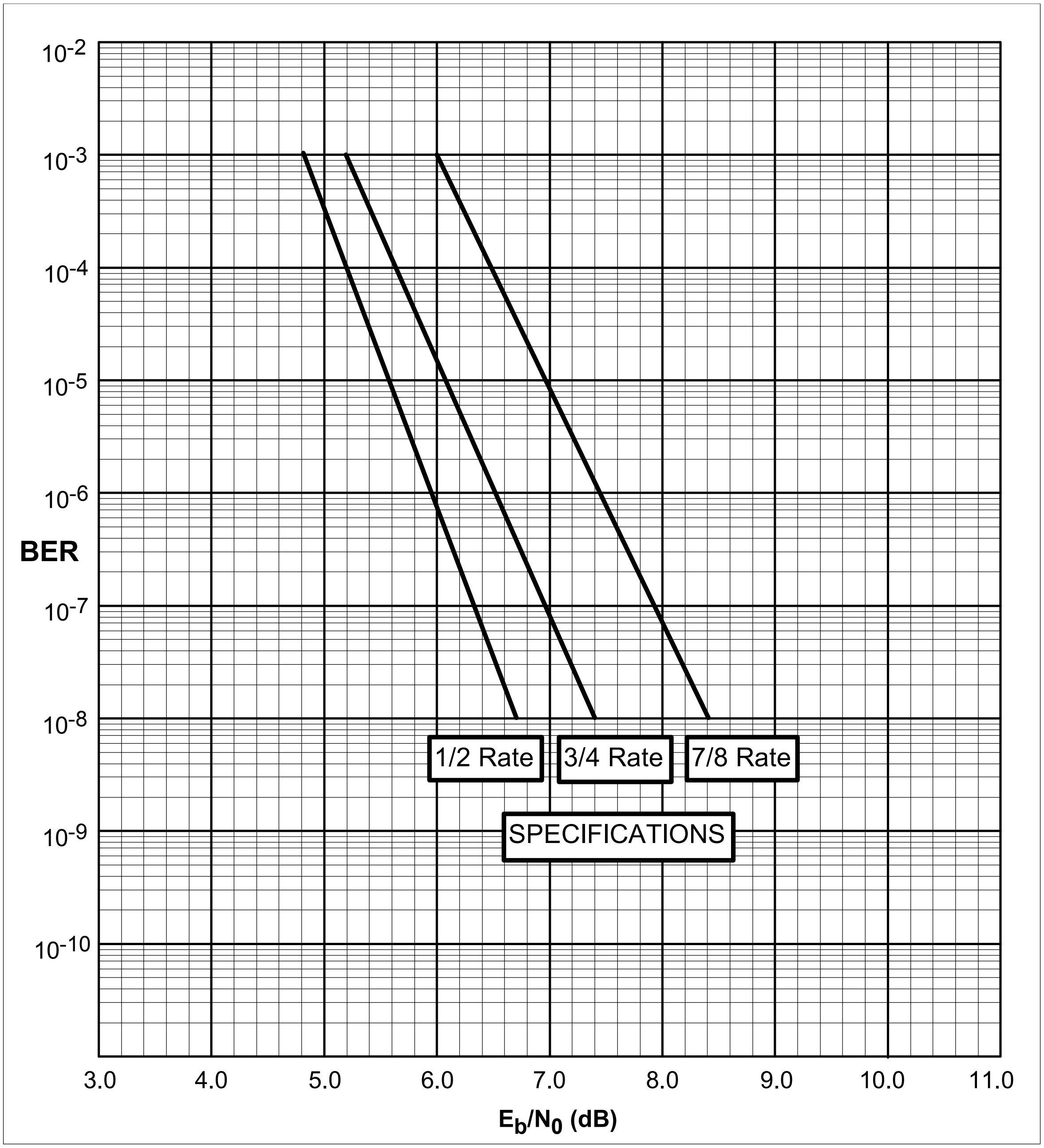


Figure C-3. Sequential Decoder, 1544 kbps BER Performance Curves

C.1.2.4 Performance with Noise and Reed-Solomon

The Reed-Solomon specification for the bit energy-to-noise (E_b/N_0) required to achieve 10^{-5} to 10^{-10} BER for different configurations are shown in Table C-6.

Refer to Figure C-4 for Sequential BER data.

Table C-6. Noise and Reed-Solomon

	E_b/N_0 Specifications	
BER	**1/2**	**3/4**
10^{-6}	4.1	5.6
10^{-7}	4.2	5.8
10^{-8}	4.4	6.0
10^{-10}	5.0	6.3

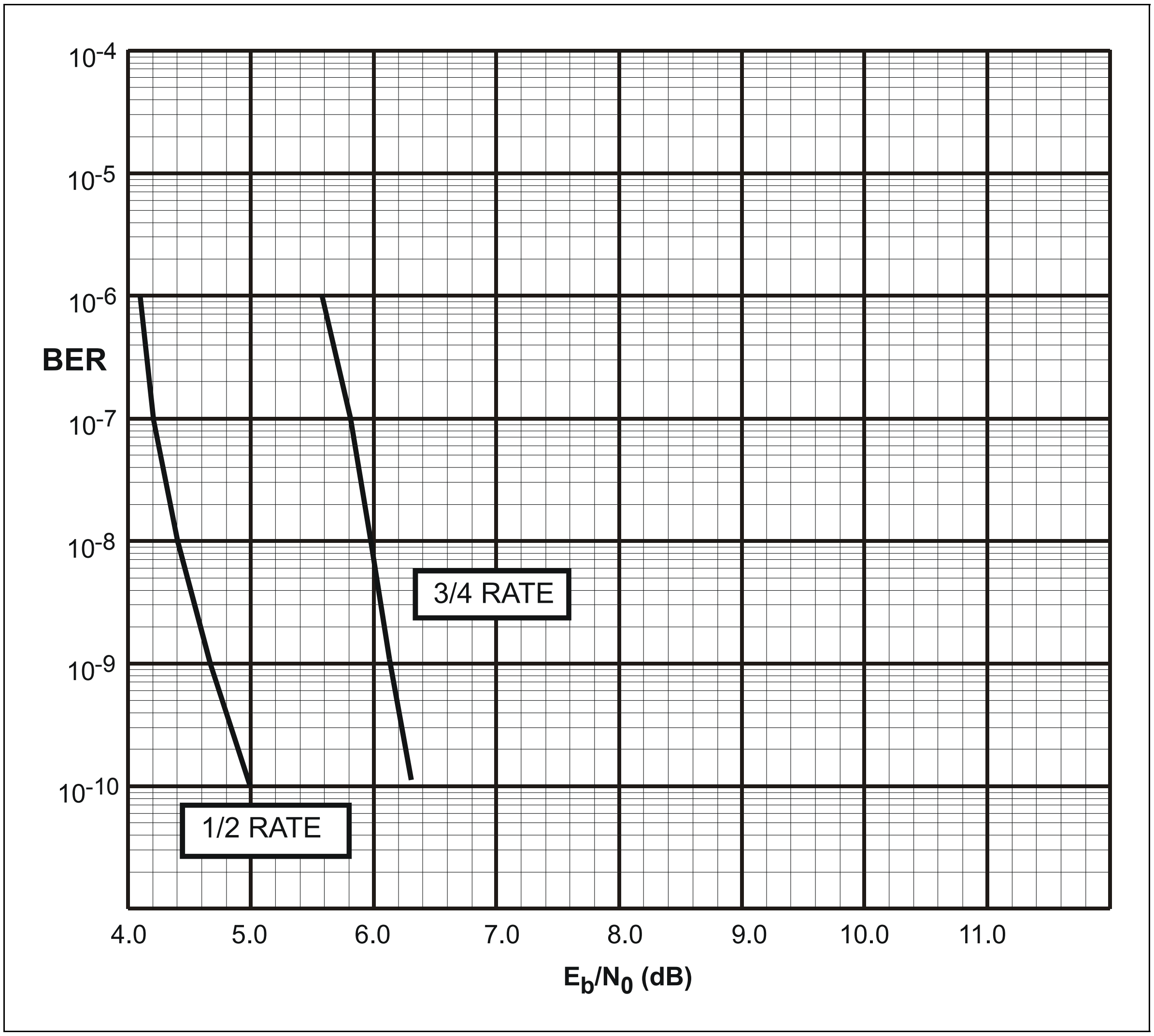


Figure C-4. Noise and Reed-Solomon

C.1.2.5 Performance with Noise, Viterbi Decoder, and 8-PSK 2/3

The specification for the E_b/N_0 required to achieve 10^{-4} to 10^{-9} BER for different configurations are shown in Table C-7.

Refer to Figure C-5 for Noise, ViterbiDecoder, and 8-PSK 2/3.

Table C-7. Viterbi Decoder and 8-PSK 2/3

E_b/N_0 (dB) Specifications		
BER	**Reed-Solomon**	**Without Reed-Solomon**
10^{-4}	5.5	7.0
10^{-5}	5.8	7.8
10^{-6}	6.2	8.7
10^{-7}	6.5	9.5
10^{-8}	6.7	10.2
10^{-9}	6.9	

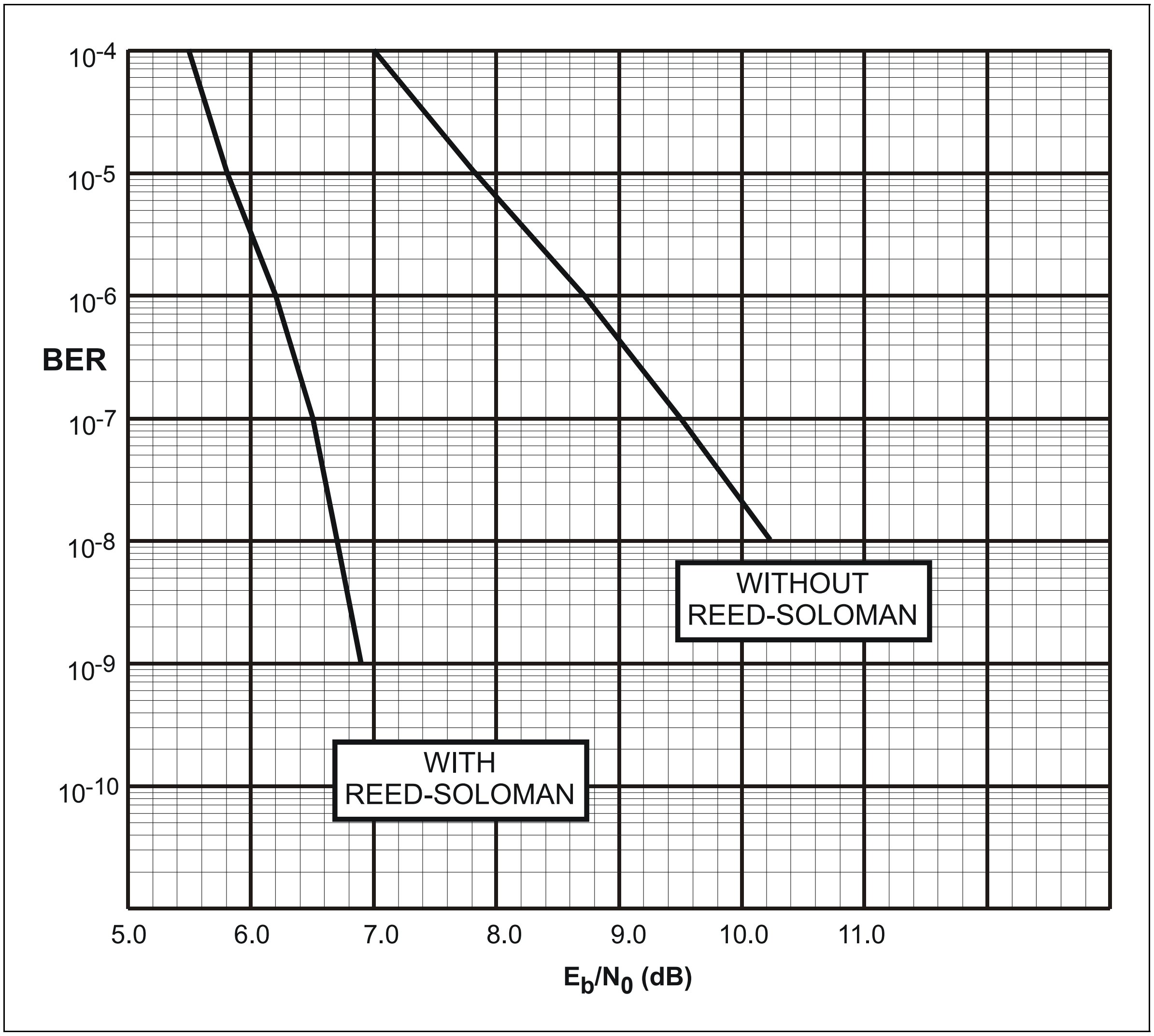


Figure C-5. Noise, Viterbi Decoder, and 8-PSK 2/3 BER Performance Curves

C.1.2.6 Performance with Noise, Viterbi Decoder, and 8-PSK 5/6

The specification for the E_b/N_0 required to achieve 10-4 to 10-9 BER for different configurations are shown in Table C-8.

Refer to Figure C-6 for Viterbi Decoder and 8-PSK.5/6 BER.

Table C-8. Viterbi Decoder and 8-PSK 5/6 BER Data

E_b/N_0 (dB) Specifications			
Reed-Solomon		**Without Reed-Solomon**	
BER	**E_b/N_0**	**BER**	**E_b/N_0**
10-4	7.5	10-4	9.0
10-5	7.8	10-5	10.0
10-6	8.2	10-6	10.8
10-7	8.6	10-7	11.5
10-8	8.8	10-8	12.3
10-9	9.3	10-9	13.1

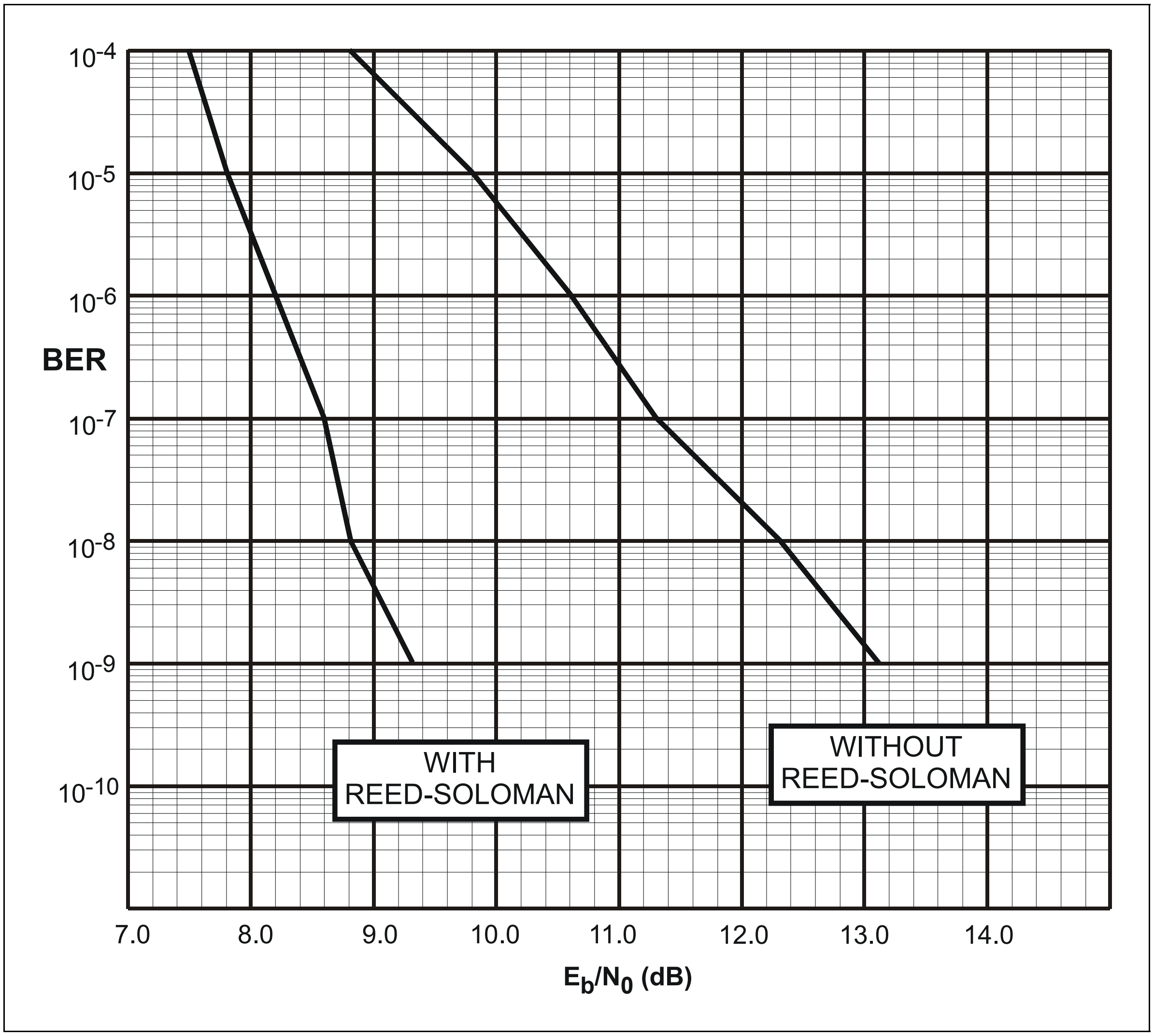


Figure C-6. Viterbi Decoder, 8-PSK 5/6 BER Performance Curves

C.1.2.7 Performance with Noise, Viterbi Decoder, and 16-QAM

The specifications for the E_b/N_0 requiredd to achieve 10^{-4} to 10^{-9} BER for different configurations are shown in Table C-9.

Refer to Figure C-7 for Viterbi Decoder and 16-QAM data.

Table C-9. Viterbi Decoder and 16-QAM

E_b/N_0 (dB) Specifications				
	Reed-Solomon		Without Reed-Solomon	
BER	3/4	7/8	3/4	7/8
10-4	7.9	9.3	9.1	10.4
10-5	8.1	9.6	10.0	11.2
10-6	8.4	9.8	10.8	12.0
10-7	8.6	10.0	11.7	12.8
10-8	8.8	10.3	12.6	13.6
10-9	9.2	10.5		

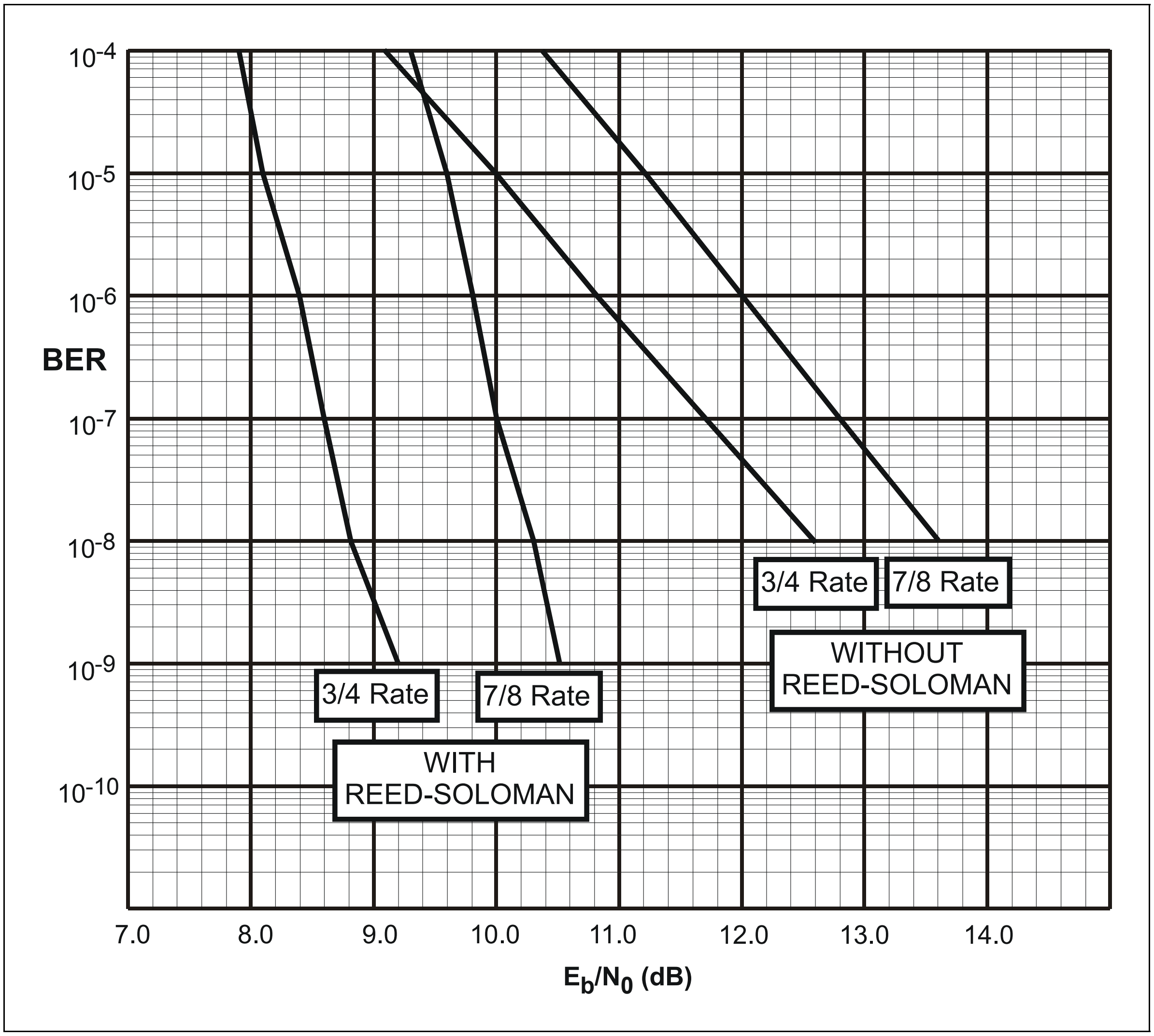


Figure C-7. Viterbi Decoder and 16-QAM

C.1.3 Acquisition Time

Time to Lock After Recovery	
Loss of carrier at 7 E_b/N_0 (BPSK, QPSK, 8-PSK)	20 sec maximum at 64 kbps 2 sec maximum ar 2 Mbps
Loss of carrier at 9 E_b/N_0 (16-QAM)	200 sec maximum at 64 kbps (16-QAM 3/4) 20 sec maximum at 2 Mbps

C.1.4 Receive IF Test Modes

The following RX IF test modes are selectable by the operator:

IF Loopback	Disconnects the IF input from the connector and couples it to a sample of the TX IF output. The IF output is not affectred.
RF Loopback	Sets the demoidualtor frequency to the same value as the modulator. For the modem to lock, an external IF loop must be provided.

Note: The TX and RX data rates must be the same for the modem to lock.

C.1.5 Receive IF Carrier Acquisition Range

The modem will automatically lock to a correctley formatted carrier which is within ± 30 kHz of the displayed RX frequency. The operator can adjust the following:

- The acquisition range from 0 to 60 kHz, in 1 Hz steps.
- The center of the acquisition range from 0 to ± 30 kHz, in 1 Hz steps.
- The time from loss of carrier to the start of the acquisition sweep from 2.0 to 99 seconds, in 1 second steps.

C.1.6 AGC Output

An (DC) output, proportional to the RX signal level, is located at the rear panel at 10 mA maximum, 0 to 10V.

C.2 Modulator Specification

Refer to Table C-10 for Modulator Specification.

Table C-10. Modulator Specification

Modulation Types	BPSK, QPSK, 8-PSK, and 16-QAM
Data Rate Range	9.6 kbps to 3.15 Mbps 1/2 Rate BPSK 19.0 kbps to 6.3 Mbps 1/2 Rate QPSK 28.5 kbps to 9.3 Mbps 3/4 Rate QPSK 33.25 kbps to 9.3 Mbps 7/8 Rate QPSK 38.0 kbps to 9.3 Mbps 2/3 Rate 8-PSK 47.5 kbps to 9.3 Mbps 5/6 Rate 8-PSK 57.0 kbps to 9.3 Mbps 3/4 Rate 16-QAM 64.0 kbps to 9.3 Mbps 7/8 Rate 16-QAM **Uncoded Operation:** 38.4 kbps to 9.3 Mbps 1/1 Rate QPSK
Symbol Rate Range	9.6 ks/s to 6.3 Ms/s
Test Modes	Carrier Null and Quadrature (Dual and Offset)
Frequency Range	50 to 180 MHz
Frequency Select Method	Synthesized
Frequency Step Size	2.5 kHz
Frequency Stability (RF)	**Internal Reference:** ± 10 PPM oscillator Optional high stability oscillator (2 x 10^{-7}) **External Reference:** Will lock to external 5, 10, or 20 MHz reference
Frequency Stability (SCT)	**Internal Reference:** ± 10 PPM oscillator Optional high stability oscillator (2 x 10^{-7}) **External Reference:** Will lock to external 5, 10, or 20 MHz reference
Phase Error	2.5° maximum
Filtering Type	Nyquist, pre-equalized
Spectral Occupancy	Spectral density is -30 dB at ± 0.75 symbol rate
Spurious and Harmonics	-55 dBc, 0 to 500 MHz
Output Power Level Range	-5 to -30 dBm ± 0.5 dB (+5 to -20 dBm High-Power option)
Output Stability	± 0.5 dB
Output Power Adjustment	0.1 dB step size
Output Impedance	75Ω (50Ω optional)
Output Return Loss	20 dB minimum
Scrambler Types	V.35 or Custom
Differential Encoding FEC Convolutional Encoding	2-phase or None
Viterbi	Rate 1/2, 3/4, 7/8, or None (uncoded 1/1)
I/O Connector	96-pin DIN, 75Ω (TX IF)
Reported Faults	• AGC Level • IF Synthesizer • I Channel Filter Activity • Q Channel Filter Activity • Data Clock Activity • External Reference Activity • Data Clock Syn • Internal SCT Syn • Module • Programming • Configuration

C.3 Demodulator Specifications

Refer to Table C-11 for demodulator specifications.

Table C-11. Demodulator Specification

Modulation Types	BPSK, QPSK, 8-PSK, and 16-QAM	
Data Rate Range	9.6 kbps to 3.15 Mbps 19.0 kbps to 6.3 Mbps 28.5 kbps to 9.3 Mbps 33.25 kbps to 9.3 Mbps 38.0 kbps to 9.3 Mbps 47.5 kbps to 9.3 Mbps 57.0 kbps to 9.3 Mbps 64.0 kbps to 9.3 Mbps **Uncoded Operation:** 38.4 kbps to 9.3 Mbps	1/2 Rate BPSK 1/2 Rate QPSK 3/4 Rate QPSK 7/8 Rate QPSK 2/3 Rate 8-PSK 5/6 Rate 8-PSK 3/4 Rate 16-QAM 7/8 Rate 16-QAM 1/1 Rate QPSK
Symbol Rate Range	9.6 ks/s to 6.3 Ms/s	
IF Frequency	50 to 180 MHz, in 2.5 kHz steps	
Input Level	-30 to -55 dBm	
Decoding Type	Viterbi – 1/2, 3/4, 7/8 Sequential – 1/2, 3/4, 7/8 Uncoded – 1/1 Field changeable Code rates selectable from front panel	
Filter Masks	Open net (INTELSAT or EUTELSAT) EFD Closed net Custom	
Descrambler Types	V.35 or Custom	
Reported Faults	Carrier Detect Descrambler IF Synthesizer BER Threshold RX Clock Syn Module I Channel Q Channel Programming Configuration	

C.4 Interface-Related Specifications

C.4.1 Digital Interface Specifications

Refer to Table C-12 for Digital Interface specifications.

Table C-12. Digital Interface Specification

Main Channel	
Physical Interfaces	MIL-STD-188/EIA-449 V.35 G.703
Data Rates	9.6 kbps to 9.312 Mbps, in 1 Hz steps
External Clock Frequency Range	32 kHz to 10 MHz
External Clock Amplitude	Differential 0.5 to 5 Vp-p Common Mode 0 to 5 VDC
External Clock Impedance	100Ω
External Clock Input Type	Sine or square wave Duty cycle 50% ± 10%
TX Clock Reference	Normal (derived from SD for G.703 interface, SCTE, TT) Internal (10^{-5}) External
Plesiochronous Buffer	Included in receive path
Buffer Clock Reference	TX satellite (dejitter with overhead if applicable)
RX Satellite (bypass)	External (balanced input) Internal (1 x 10^{-5} accuracy)
Buffer Depth	384 to 262,144 bits selectable in 16 bit increments or 2 ms format
Depth Status	Monitored accurate to 1% displayed on front panel
Buffer Centering	Automatic (start of service, overflow, or underflow) and manual
Overflows/Underflows	Logged as stored fault loopback
Loopback	Baseband loopback Interface loopback

Reported Faults		
TX Faults	RX Faults	
TX Drop	Buffer Underflow	Buffer Clock Act
TX Data/AIS	Buffer Overflow	Demux Lock
TX Clock PLL	RX Data/AIS	RX 2047 Lock
TX Clock Activity	Frame BER	Buffer Full
Programming	Backward Alarm	RX Insert
Configuration	Buffer Clock PLL	Programming

C.4.1.1 G.703 Specifications

Refer to Table C-13 for G.703 specifications.

Table C-13. G.703 Specifications

Primary Data Circuits Supported	T1 SD, RD E1 SD, RD	T2 SD, RD E2 SD, RD
Interface Type	Transformer coupled symmetrical pair	
Data Rates	T1 1.544 kbps ± 100 bit/s E1 2.048 kbps ± 130 bit/s	T2 6.312 kbps ± 30 PPM E2 8.448 kbps ± 30 PPM
Pulse Width	T1 324 ± 50 Ns E1 244 ± 25 Ns	T2 79 Ns ± 63/-8 Ns E2 59 ± 10 Ns
SD Amplitude	T1 3V +0.3/-1.5V-pk into 100Ω E1 3V +0.3/-1.5V-pk into 120Ω E2 24V ± 0.3V-pk into 75Ω	
RD Amplitude	T1 3V +0.3/-1.5V-pk into 100Ω E1 3V +0.3/-1.5V-pk into 120Ω E2 2.4V ± 0.3V-pk into 75Ω	
Pulse Mask	T1 G.703.2 E1 G.703.6	T2 G.703.3 E2 G.703.7
Jitter Attenuation	T1 G.824 E1 G.823	T2 G.824 E2 G.823
Line Code	AMI, B8ZS, B6ZS, HDB3	

C.4.1.2 MIL-STD-188/449 Specifications

Refer to Table C-14 for MIL-STD-188/449 specifications.

Table C-14. MIL-STD-188/449 Specifications

Circuit Supported	SD, ST, TT, RT, DM, RR, RS, and MC
Amplitude (RD, RT, ST, DM, RR)	4 ± 2V differential into 100Ω
Impedance (RD, RT, ST, DM, RR)	Less than 100Ω, differential
Impedance (SD, TT, MC)	100 ± 20Ω, differential polarity True when B positive with respect to A False when A 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% ± 5%
Frequency Stability (ST)	± 100 PPM

C.4.1.3 V.35 Specifications

Refer to Table C-15 for V.35 specifications.

Table C-15. V.35 Specifications

Circuit Supported	SD, SCT, SCTE, RD, SCR, DSR, RLSD, RTS, CTS, and MC
Amplitude (RD, SCR, SCT, SD, SCTE)	± 55V-pk ± 20% differential, into 100Ω
Amplitude (CTS, DSR, RLSD)	±10 ± 5V into ± 5000 ± 2000Ω
Impedance (RD, SCR, SCT)	100 ± 255 > 20Ω, differential
Impedance (SD, SCTE)	100 ± 10Ω, differential
Impedance (RTS)	5000 ± 2000Ω, < 2500 PF
DC Offset (RD, SCR, SCT)	± 0.6V max, 1000Ω termination to ground
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 < -3V with respect to ground False when > +3V with respect to ground
Phasing (SCTE, SCR)	False-to-True transition nominally in center of data bit
Symmetry (SCT, SCTE, SCR)	50% ± 5%

C.4.1.4 IDR Interface Specifications

Refer to Table C-16 for IDR Interface specifications.

Table C-16. IDR Interface Specifications

Composite Data Rates Supported		
IDR	1.640 Mbps 2.144 Mbps	6.408 Mbps 8.544 Mbps
Primary Data Rates Supported		
G.703	1.544 kbps 2.048 kbps	6.312 kbps 8.448 kbps
Engineering Service Channel		
ESC Audio	2 duplex ADPCM channels	
Audio Encoding	CCITT G.721	
Audio Interface Type	600Ω transformer-balanced 4-wire	
Audio Input Level	-20 to +10 dBm for 0 dBm, 1 dB steps	
Audio Output Level	-20 to +10 dBm for 0 dBm, 1 dB steps	
Auto Filtering	Internal 300 to 3400 Hz input and output	
ESC Data Interface Type	EIA-422	
ESC Data Rate	8 kbps	
ESC Data Circuits Supported	SD, ST, RD, RT, Octet In, and Octet Out	
Ocetet Timing	Octet high in with every 8th bit, aligns with frame bit d8	
64 kbps Data Interface Type	EIA-422	
64 kbps Data Rate	64 kbps	
64 kbps Data Circuits Supported	SD, ST, RD, and RT	
64 kbps Data Signal Phasing	Per EIA-449, Data changes on the rising clock transition, is sampled on the falling clock edge	
64 kbps Octet Timing	Octet aligned with rising edge of ESC clock.	

Faults and Alarms	
Backward Alarms Supported	4 input, 4 output
Backward Alarm Inputs	1kΩ pull up to +5V, set below 2V to clear
Backward Alarm Outputs	FORM C Relay, NO, NC, C
Demodulator Fault Relay	NO, C contacts available for backward alarm inputs
Deferred Maintenance Alarm	Open collector, high impedance IF fault, 15V max, 20 mA maximum

C.4.1.5 IBS Interface Specification

Refer to Table C-17 for IBS Interface specifications.

Table C-17. IBS Interface Specifications

Composite Data Rates Supported	N x 64 kbps from 64 kbps to 2048 kbps with 1/15 overhead
Primary Data Circuits Supported G.703 Format	G.703 1.544 Mbps ± 100 bit/s SD, RD G.703 2.048 Mbps ± 130 bit/s SD, RD
Primary Data Circuits Supported MIL-STD-188/449 and V.35 Format	N x 64 kbps to 2.048 Mbps and 1/544 Mbps
Engineering Service Channel	
Earth Station-to-Earth Station Channel	EIA-232 TD, RD, DSR, RTS Asynchronously sampled at 1/512 of the primary channel data rate for a usable data rate equal to 1/2000 of the primary channel data rate
EIA-232 Specification	
Circuit Supported	RD, TD, DSR, RTS, CTS
Amplitude (RD, RTS)	True: 14V ± 11V False: -14 V ± 11V
Amplitude (TD, DSR, CTS)	True: 11V ± 2V False: -11V ± 2V
Impedance	5000 ±2000Ω < 2500 pF
Baud Rate	Max: 1/2000 times the data rate (refer to Chapter 4 for details)
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

C.4.1.6 D&I Interface Specifications

Refer to Table C-18 for D&I Interface specifications.

Table C-18. D&I Interface Specifications

Primary Data Circuits Supported	T1 DSD, DRD, ISD, IRD E1 DSD, DRD, ISD, IRD
Primary Data Rates Supported	1544 kbps per G.703 2048 kbps per G.703
Satellite Data Rates Supported	N x 64 kbps N = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, or 24 (T1) N = 1, 2, 3*, 4, 5*, 6, 8, 10*, 12, 15*, 16, 20*, 24, or 30 (E1) 2048 kbps (E1_IBS) 1544 kbps + (T1_IBS) * = No CAS allowed
Terrestrial Framing Supported	G.732/G.733, G.704
Satellite Overhead Rate	1/16 of data rate per IESS-308 Rev. 6 and IESS-309 Rev. 3
Drop Time Slot Selection	1 to 24 (T1)
(Time Slot 0 not Allowed)	1 to 31 (E1) Arbitrary order
Insert Time Slot Selection	1 to 24 (T1)
(Time Slot 0 not Allowed)	1 to 31 (E1) Arbitrary order
Interface Type	Transformer-coupled symmetrical pair
Terrestrial Input Data Rate	T1 1544 kbps ±100 bit/s E1 2048 kbps ±130 bit/s
Pulse Width	T1 324 ± 50 Ns E1 244 ± 25 Ns
SD Amplitude	T1 3.0 +0.3/-1.5V-pk into 100Ω E1 3.0 +0.3/-1.5V-pk into 120Ω
RD Amplitude	T1 3.0 ± 0.3V-pk into 100Ω E1 3.0 ± 0.3V-pk into 120Ω
Pulse Mask	T1 G.703.2 E1 G.703.6
Line Code	Selectable AMI, B8ZS, HDB3
Jitter Attenuation	T1, per AT&T 43802 T1, per CCITT G.824 E1, per CCITT G.823
Transmit Clock Reference	Normal (derived from drop SD) Internal (10^{-5} accuracy) External (EIA-422 input)
Plesiochronous Buffer	Included in receive path
Buffer Clock Reference	Derived from insert input External (EIA-422) Internal
Buffer Depth	
T1, T1_ESF, E1_CCS, E1_IBS, E1_31_TS	1, 2, 4, 6, 8, 12, 24, or 32 ms
E1_CAS	7.5, 15, or 30 ms
T1_IBS	6, 12, 18, 24, or 30 ms
Depth Status	Monitored accurate to 1%
Buffer Centering	Automatic (start of service), manual
Overflows/Underflows	Logged as stored fault

Engineering Service Channel	
ESC Data Interface Type	EIA-232C
ESC Data Rate	1/512 of satellite data rate, maximum (over sampled)
ESC Data Circuits Supported	SD, RD, DSR
Faults and Alarms	
Backward Alarms Supported	1 (looped per IESS-309)
Backward Alarm Output	Sums into secondary alarm
Modulator Fault	Open collector, 15V maximum, 20 mA maximum, used by protection switch, if in system
Demodulator Fault	Open collector, 15V maximum, 20 mA maximum, used by protection switch, if in system

C.4.1.7 Asynchronous Interface Specifications

Refer to Table C-19 for Asynchronous Interface specifications.

Table C-19. Asynchronous Interface Specifications

Main Channel	
Physical Interface	MIL-STD-188
(Factory Option)	EIA-422/449 V.35 G.703
Data Rates	9.6K, 19.2K, 32 kbps to 8.448 Mbps
G.703 Data Rates (Jumper Selectable)	1.544 Mbps 2.048 Mbps 6.312 Mbps 8.448 Mbps
G.703 Line Code	AMI, B8ZS, B6ZS, HDB3
Transmit Clock Reference	Internal modem reference or external transmit clock (SCT or TT)
Jitter Attenuation	Per G.703
Pulse Mask	Per G.703
Overhead Channel	
Overhead Rate	16/15 of main channel
ASYNC Channel Rate (maximum)	< 1.875% of main channel
ASYNC Channel Interface	EIA-232C 2-wire EIA-485 half-duplex 4-wire EIA-485 full-duplex
Connector	25-pin D on breakout panel
Baud Rates, ASYNC	110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 bit/s
ASYNC Format	5, 6, 7, or 8 data bits Even, odd, or no parity 1 or 2 stop bits (1 or 1.5 for 5 bit)
Buffer Specifications (Plesiochronous/Buffer Operation)	
Buffer Size	384 to 262144 bits, in 16-bit steps
Buffer Fill Status	Monitored accurate to ± 1%
Buffer Centering	Automatic or Manual
Buffer Clock Reference	Transmit Internal (10^{-5} Stability) External Receive (Buffer Bypass)
External Clock Amplitude	Differential 0.5 to 5 Vp-p Unbalanced Mode 0 to 5 VDC.
External Clock Frequency	256 to 2048 kHz, in 64 kHz steps
External Clock Impedance	100W
External Clock Input Type	Sine or Square wave 50% ± 10%

C.4.1.8 Reed-Solomon Specifications (Optional)

Refer to Table C-20 for Reed-Solomon specifications.

Table C-20. Reed-Solomon Specifications

Primary Data Rates Supported (IDR)	1640 kbps (T1) 2144 kbps (E1) 6408 kbps (T2) 8544 kbps (E2)
Satellite Data Rates Supported	N x 64 kbps
(IBS/D&I)	N = 1, 2, 3, 4, 6, 8, or 16

C.5 Interface General

C.5.1 Transmit Clock Source

The TX clock is selectable by the operator from the following sources:

- SCT (Internal) ± 10 PPM (from Modulator).
- Terrestrial: Must be ± 130 PPM.
- External: Must be ± 100 PPM (must be locked to data).
- RX satellite clock (Loop Timing). RX data rate must be the same as the TX data rate. Must be ± 100 PPM.

Transmit Clock Source Specifications	
External Clock Frequency Range	32 kHz to 10 MHz
External Clock Amplitude	Balanced Mode: 1.0 to 5.0 volts peak-to-peak Unbalanced Mode: 0.5 to volt peak-to-peak 0 VDC Offset
External Clock Impedance	100Ω Balanced 75 Ω Unbalanced
External Clock Input Type	Sine or Square Wave Duty Cycle: 50 ± 10%
Transmit Clock Switching Due to Failure of Selected Clock	The modem will automatically switch the TX Xloxk source to SCT on failure of the selected clock.
Data Test Pattern Substitutions	The operator can substitute the TX data with 2047. **Note**: This pattern is only available with IDR/IBS framing.
Transmit Data Substitution Due to Fault	The operator can select either NONE or AIS TX data substitution codes.
Faults WhichGenerate Data Substitution	Refer to Fault Tree, Section C.7.

C.5.2 Buffer Clock

Refer to the following for buffer specifications.

Buffer Clock Source	Select from the following: • TX Terrestrial Clock • RX Satellite Clock • External Clock • SCT, Internal • High Stability
Buffer Clock Source Specification	Clocks must be ± 100 PPM.
RX Clock Switching Due to Failure of Selected Clock	Modem will automatically switch the RX clock source to internal on failure of the selected clock.
RX Clock Adjustment Phase	Selectable from either Normal or Inverted.
RX Doppler Buffer	RX Doppler buffer can be set from 64 to 65,536 bit/s in 16 bit steps (also selectable in milliseconds).
Buffer Centering	Selectable to 50% by the operator.
Loopback Modes	Selectable from one of the following: • Baseband – Near-end and far-end • Interface – Near-end and far-end • D&I Baseband – Insert data into drop data out.

C.5.3 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.

C.5.4 Data Phase

TX and/or RX data can be set by the operator to Normal or Inverted by jumper setting on the Interface PCB.

C.6 System-Related Specifications

C.6.1 Monitored Signals

The operator can display or read one of the following, continually updated, performance monitors.

Receive signal level	-30 to –60 dBm ± 5 dB
Raw Data	$1E^{-3}$ to $1E^{-6}$
Corrected BER	$1E^{-3}$ to $1E^{-12}$
E_b/N_0	3 to 16 E_b/N_0
RX FREQ Offset (sweep frequency)	± 30000 Hz
Current buffer depth Error Rate of 2047 test pattern	1 to 99%

C.7 Typical Spectral Occupancy

Refer to Figure C-8 for a typical spectral occupancy curve using the Comtech EFData filter mask.

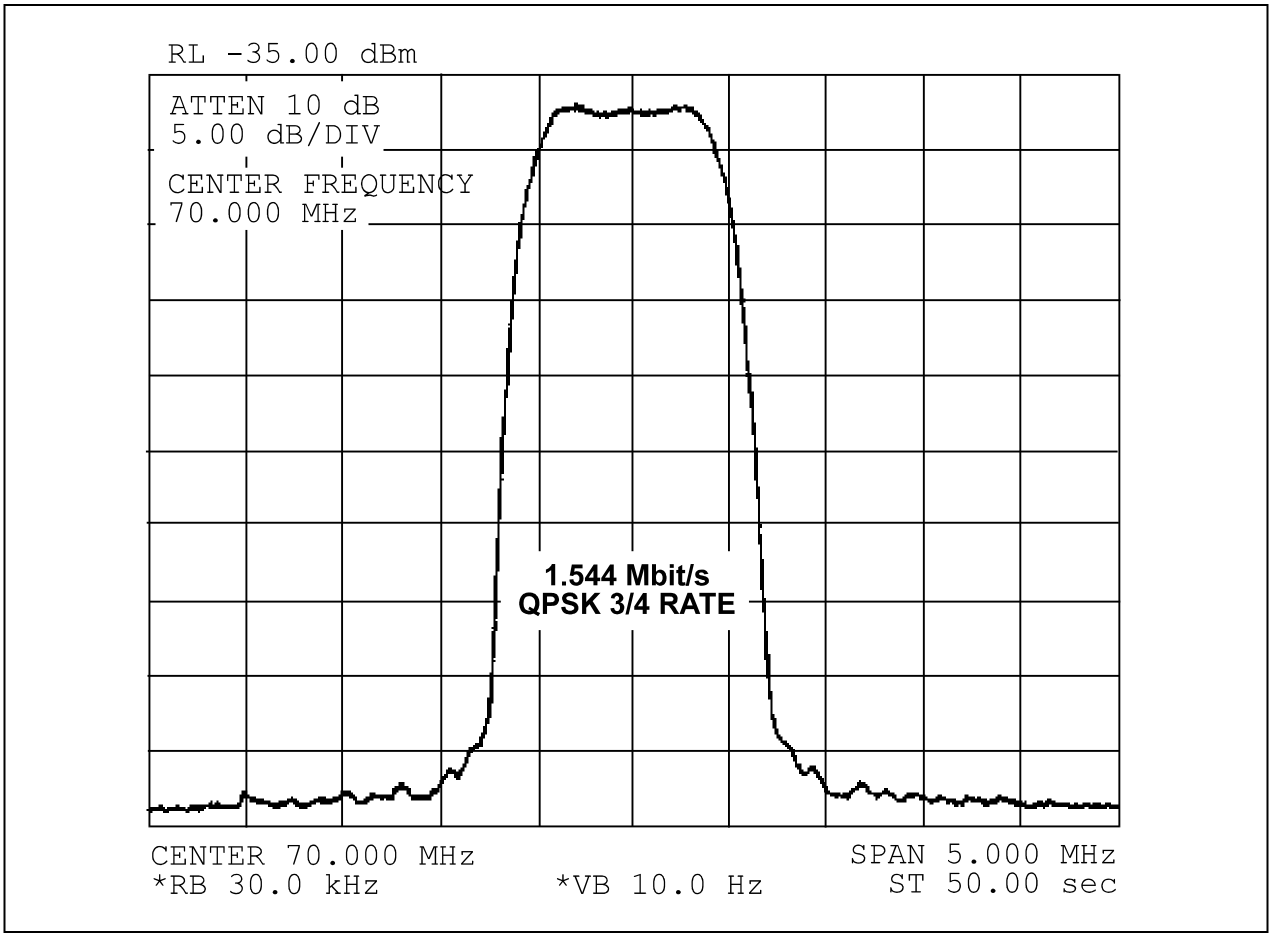


Figure C-8. SDM-8000 Typical Spectral Occupancy

C.8 Dimensional Envelope

Note: All dimensions are listed in inches, centimeters are listed in parenthesis.

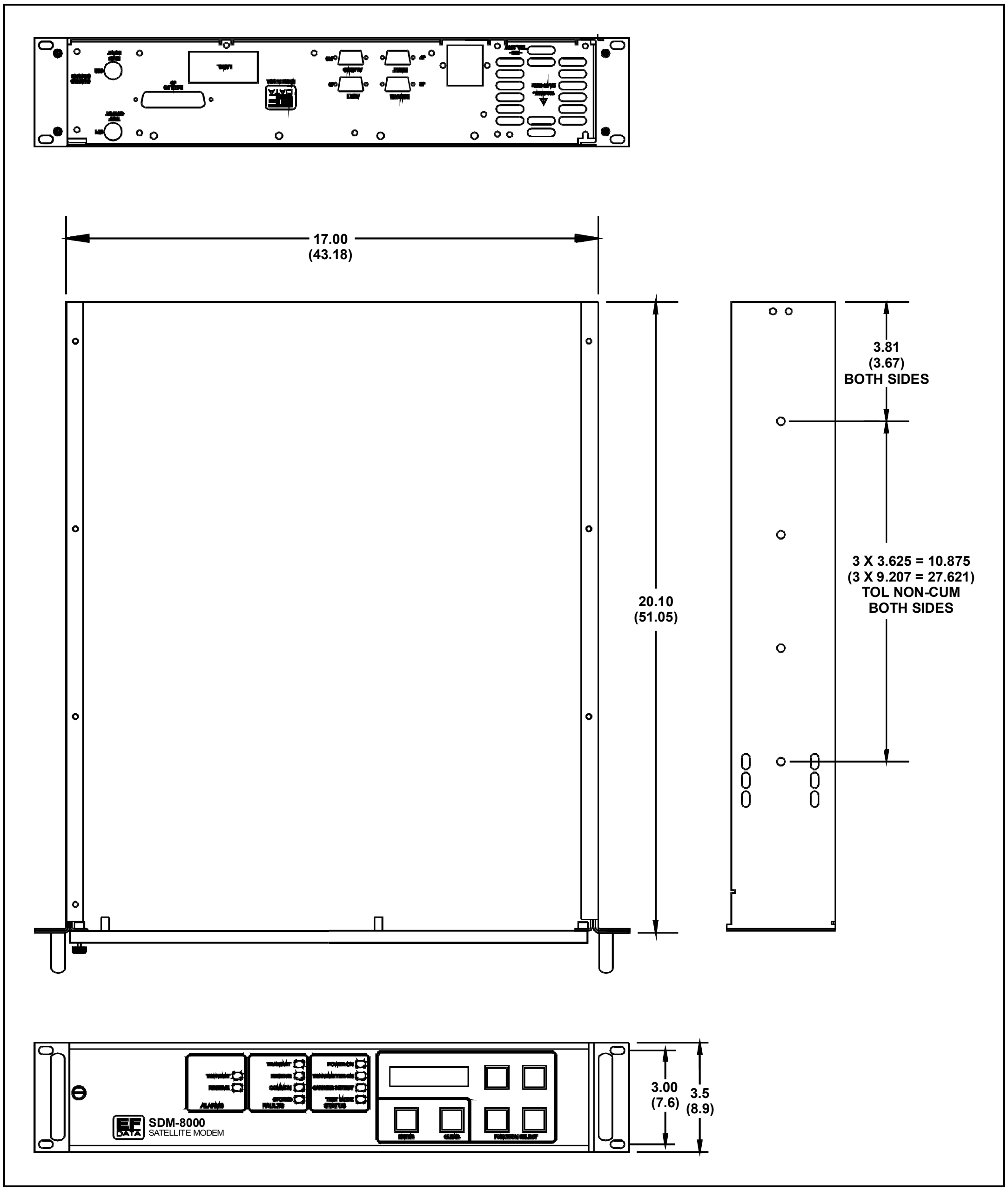


Figure C-9. Dimensional Envelope

Glossary

The following is a list of acronyms and abbreviations that may be found in this manual.

Acronym/ Abbreviation	Definition
Ω	Ohms
16-QAM	16 Quadrature Amplitude Modulation
8-PSK	8 Phase Shift Keying
A	Ampere
A/D	Analog to Digital
AC	Alternating Current
ADC	Analog to Digital Converter
ADJ	Adjust
ADMA	Amplitude Domain Multiple Access
ADPCM	Adaptive Differential Pulse Code Modulation
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
AM	Amplitude Modulation
AMI	Alternate Mark Inversion
AOC	Automatic Offset Control
APM	Amplitude Phase Modulation
ASC	Add-Select-Compare
ASCII	American Standard Code for Information Interchange
ASK	Amplitude Shift Keying
ASYNC	Asynchronous
AUPC	Automatic Uplink Power Control
AUX 1	Auxiliary 1
AVC	Automatic Volume Control
BB	Baseband
BCD	Binary Coded Decimal
BER	Bit Error Rate
BER CONT	BIT Error Rate Continuous
bit/s	bits per second
BPSK	Bi-Phase Shift Keying

BTU	British Thermal Unit
BW	Backward Alarm or Bandwidth
BWR	Bandwidth Ratio
C	Celsius
C/N	Carrier-to-Noise Ratio
C/No	Carrier-to-Noise Density Ratio
CCITT	International Telephone and Telegraph Consultative Committee
CDMA	Code Division Multiple Access
CH	Channel
CHNL	Channel
CIC	Common Interface Circuit
CL	Carrier Loss
CLK	Clock
CLNA	C-band LNA
CLR	Clear
CMOS	Complementary Metal Oxide Semiconductor
Coax	Coaxial
Codec	Coder/Decoder
COM	Common
CPFSK	Continuous-Phase Frequency Shift Keying
CPSK	Coherent Phase Shift Keying
CPU	Central Processing Unit
cr	Carriage Return
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CS	Clear to Send
CSC	Comstream Compatible
CSMA	Carrier Sense Multiple Access
CTS	Clear to Send
CU	Channel Unit
CW	Continuous Wave
D&I	Drop and Insert
D/A	Digital-to-Analog
D/C	Down Converter
DAC	Digital-to-Analog Converter
DAMA	Demand Assignment Multiple Access
dB	Decibels
dB/Hz	Decibels/Hertz (unit of carrier-to-noise density ratio)
dBc	Decibels referred to carrier
dBm	Decibels referred to 1.0 milliwatt
dBm0	The signal magnitude in dBm referenced to the nominal level at that point
dBW	Decibels referred to 1.0 watt
DC	Direct Current
DCE	Data Circuit Terminating Equipment
DCPSK	Differentially Coherent Phase Shift Keying
DDO	Drop Data Output
DDS	Direct Digital Synthesis
Demod	Demodulator
DEMUX	Demultiplexer
DET	Detector
DM	Data Mode
DPCM	Differential Pulse Code Modulation
DPSK	Differential Phase Shift Keying
DSP	Digital Signal Processing
DSR	Data Signal Rate

DTE	Data Terminal Equipment
DVB	Digital Video Broadcast
E&M	Ear and Mouth
E_b/N_0	Bit Energy-to-Noise Ratio
ECL	Emitter Coupled Logic
EDP	Electronic Data Processing
EEPROM	Electrically-Erasable Programmable Read-Only Memory
EFD	EFData Compatible
EIA	Electronic Industries Association
EMC	Electro-Magnetic Compatibility
EMF	Electromotive Force
EPROM	Erasable Read-Only Memory
ESC	Engineering Service Circuit or Engineering Service Channel
ESD	Electrostatic Discharge
EXC	External Clock
EXT	External Reference Clock
FDC	Fairchild Data Compatible
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FET	Field Effect Transistor
FFSK	Fast Frequency Shift Keying
FIFO	First in/First Out
Flt	Fault
FM	Frequency Modulation
FPGA	Field Programmable Gate Array
FS	Frame Sync
FSK	Frequency Shift Keying
FW	Firmware
GHz	Gigahertz (10^9 hertz)
GND	Ground
HI STAB	High Stability
HPA	High Power Amplifier
Hz	Hertz (cycle per second)
I&Q	In-Phase and Quadrature
I/O	Input/Output
IBS	INTELSAT Business Services
IC	Integrated Circuit
IDI	Insert Data Input
IDR	Intermediate Data Rate
IESS	INTELSAT Earth Station Standards
IF	Intermediate Frequency
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
ISD	Insert Send Data
k	kilo (10^3)
KΩ	kilo-ohms
kbit/s	Kilobits per second (10^3 bits per second)
kHz	Kilohertz (10^3 Hertz)
ks/s	Kilosymbols Per Second (10^3 symbols per second)
kW	Kilowatt (10^3 Watts)
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
lf	Line Feed
LNA	Low Noise Amplifier

LO	Local Oscillator
LSB	Least Significant Bit
LSI	Large Scale Integration (semiconductors)
m	mille (10^{-3})
M&C	Monitor and Control
mA	Milliamperes
Max	Maximum
Mbit/s	Megabits per second
MC	Monitor and Control
MFS	Multiframe Sync
MHz	Megahertz (10^{6} Hertz)
Min	Minimum or Minute
Mod	Modulator
MOP	Modulated Output Power
MPC	Microprocessor Controller
ms	Millisecond (10^{-3} second)
Ms/s	Megasymbols per second
MSB	Most Significant Bit
MUX	Multiplexer
n	nano (10^{-9})
N/A	Not Applicable
NACK	Negative Acknowledgment
NC	No Connection or Normally Closed
NO	Normally Open
NRZ	Non-Return to Zero (code)
ns	Nanosecond (10^{-9} second)
OQPSK	Offset Quadrature Phase Shift Keying
OSC	Oscillator
p	pico (10^{-12})
P-P	Peak-to-Peak
P/AR	Peak to Average Ratio
PAL	Programmable Array Logic
PC	Printed Circuit
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PECL	Positive Emitter Coupled Logic
pF	PicoFarads (10^{-12} Farads)
PK	Peak
PLL	Phase-Locked Loop
PN	Pseudo-Noise
PPM	Parts Per Million
PS	Power Supply
PSK	Phase Shift Keying
PWB	Printed Wiring Board
PWR	Power
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RD	Receive Data
REF	Reference
REPLS	Replaces
RF	Radio Frequency
RLSD	Receive Line Signal Detect
RMA	Return Material Authorization
ROM	Read-Only Memory

RR	Receiver Ready
RS	Ready to Send
RT	Receive Timing
RTS	Request to Send
RX	Receive (Receiver)
RXCLK	Receive Clock
RXD	Receive Data
RZ	Return-to-Zero
s	Second
S/N	Signal-to-Noise Ratio
SCPC	Single Channel Per Carrier
SCR	Serial Clock Receive
SCT	Serial Clock Transmit
SCTE	Serial Clock Transmit External
SD	Send Data
SFS	Subframe Sync
SMS	Satellite Multiservice System
SN	Signal-to-Noise Ratio
SSB	Single-sideband
SSPA	Solid State Power Amplifier
ST	Send Timing
SW	Switch
SYNC	Synchronize
TB	Terminal Block
TCXO	Temperature-Compensated Crystal Oscillator
TDMA	Time Division Multiple Access
TEMP	Temperature
TERR	Terrestrial
TP	Test Point
TT	Terminal Timing
TTL	Transistor-Transistor Logic
TX	Transmit (Transmitter)
TXCLK	Transmit Clock
TXD	Transmit Data
TXO	TX Octet
U/C	Up converter
UART	Universal Asynchronous Receiver/Transmitter
UHF	Ultra-high Frequency
UNK	Unknown
US	United States
UW	Unique Word
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage-Controlled Oscillator
VCXO	Voltage-Controlled Crystal Oscillator
VDC	Volts, Direct Current
VSWR	Voltage Standing Wave Ratio
W	Watt
WG	Waveguide

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Index

Notes:

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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