Comtech EF Data is an ISO 9001 Registered Company

SDM-309B

Satellite Modem
Installation and Operation Manual

Part Number MN/SDM309B.IOM
Edition 2
February 29, 1992

Comtech EF Data is an ISO 9001 Registered Company

SDM-309B

Satellite Modem
Installation and Operation Manual

Part Number MN/SDM309B.IOM
Edition 2
February 29, 1992

Special Instructions:

This is the second edition of the manual.

Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, (480) 333-2200, FAX: (480) 333-2161.

Warranty Policy

This Adaptive Broadband product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Adaptive Broadband will, at its option, repair or replace products that prove to be defective.

For equipment under warranty, the customer is responsible for freight to Adaptive Broadband and all related custom, taxes, tariffs, insurance, etc. Adaptive Broadband is responsible for the freight charges **only** for return of the equipment from the factory to the customer. Adaptive Broadband will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Adaptive Broadband.

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 Adaptive Broadband.

No other warranty is expressed or implied. Adaptive Broadband 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. Adaptive Broadband shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Disclaimer

Adaptive Broadband 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, Adaptive Broadband 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 Adaptive Broadband Customer Support Department. (For more information, refer to the preface.)

Preface

About this Manual

Effective April 29, 1999, California Microwave EFData has changed its name to **Adaptive Broadband Corporation** to reflect its focus as a leading architect of the wireless broadband evolution.

This manual provides installation and operation information for the Adaptive Broadband SDM-309B satellite modem. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the SDM-309B.

Conventions and References Used in this Manual

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.

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.

Trademarks

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

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Adaptive Broadband Customer Support Department according to the following information.

Customer Support

Contact the Adaptive Broadband Customer Support Department for:

- Product support
- Information on returning a product
- Information on upgrading a product
- Product training
- Reporting comments or suggestions concerning manuals

An Adaptive Broadband Customer Support representative may be reached at:

Adaptive Broadband
Attention: Customer Support Department
2114 West 7th Street
Tempe, Arizona 85281 USA

(480) 333-2200 (Main Adaptive Broadband Number)
(480) 333-4357 (Customer Support Desk)
(480) 333-2161 FAX

or, E-Mail can be sent to the Customer Support Department at:

service@adaptivebroadband.com

To return an Adaptive Broadband product (in-warranty and out-of-warranty) for repair or replacement:

1. Request a Return Material Authorization (RMA) number from the Adaptive Broadband Customer Support Department.

   Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.

2. To ensure that the product is not damaged during shipping, pack the product in its original shipping carton/packaging.

3. Ship the product back to Adaptive Broadband. (Shipping charges should be prepaid.)

For more information regarding the warranty policies, refer to the disclaimer page located behind the title page.

This page is intentionally blank.

Table of Contents

CHAPTER 1. INTRODUCTION 1–1

1.1 Scope 1–1

1.2 Purpose And Function 1–1

1.3 Description 1–1

1.4 System Specification 1–7

CHAPTER 2. INSTALLATION 2–1

2.1 Unpacking 2–1

2.2 External Connections 2–1
2.2.1 Data I/O 2–4
2.2.2 Remote (J6) 2–4
2.2.2.1 Connector Pinout (J6) 2–4
2.2.3 Fault (J7) 2–4
2.2.3.1 Connector Pinout (J7) 2–4
2.2.4 IF Output (CP1) 2–5
2.2.5 IF Input (CP2) 2–5
2.2.6 AC Power 2–5
2.2.7 GND 2–5

2.3 System Requirements 2–5

2.4 System Installation 2–6

CHAPTER 3. OPERATION 3–1

3.1 SDM 309/M1200P Front Panel 3–1
3.1.1 General 3–1
3.1.2 LED Indicators 3–1
3.1.3 Front Panel Controls 3–2
3.1.4 Configuration 3–4

3.1.4.1 MOD Configuration ... 3–4
3.1.4.2 DEMOD Configuration ... 3–5
3.1.4.3 Interface Configuration ... 3–8
3.1.5 Monitor ... 3–10
3.1.6 Faults ... 3–10
3.1.6.1 Mod_Flts - Modulator Faults ... 3–11
3.1.6.2 Dmd_Flts - Demodulator/Decoder Faults ... 3–11
3.1.6.3 CEQ_Flts - Common Equipment Faults ... 3–11
3.1.6.4 TX_INTF - Transmit Interface Faults ... 3–11
3.1.6.5 RX_INTF - Receive Interface Faults ... 3–11
3.1.7 Stored Faults ... 3–12
3.1.8 Utility ... 3–12

3.2 Drop And Insert Front Panel Operation ... 3–26
3.2.1 General ... 3–26
3.2.2 Configuration ... 3–26
3.2.2.1 MOD Configuration ... 3–27
3.2.2.2 DEMOD Configuration ... 3–28
3.2.2.3 Interface Configuration ... 3–30
3.2.3 Monitor ... 3–34
3.2.4 Faults ... 3–35
3.2.4.1 Mod_Flts - Modulator Faults ... 3–35
3.2.4.2 Dmd_Flts - Demodulator/Decoder Faults ... 3–36
3.2.4.3 CEQ_Flts - Common Equipment Faults ... 3–36
3.2.4.4 TX_INTF - Transmit Interface Faults ... 3–36
3.2.4.5 RX_INTF - Receive Interface Faults ... 3–36
3.2.5 Stored Faults ... 3–36
3.2.6 Utility ... 3–37

CHAPTER 4. M&C AND INTERFACES ... 4–1

4.1 Monitor And Control ... 4–1
4.1.1 General ... 4–1
4.1.2 Description of Options ... 4–1
4.1.2.1 Remote Interface ... 4–1
4.1.2.2 Remote Baud Rate ... 4–4
4.1.2.3 Remote Address ... 4–4
4.1.2.4 Battery ... 4–4
4.1.2.5 Modulator/Coder Defaults ... 4–5
4.1.2.6 Demodulator/Decoder Defaults ... 4–5
4.1.2.7 Interface Configuration Defaults ... 4–5
4.1.2.8 Utility Defaults ... 4–6
4.1.3 Remote Interface Specification ... 4–6
4.1.4 Monitor and Control Theory of Operation ... 4–6

4.2 Digital Interfaces ... 4–6
4.2.1 IBS/M1200P Interface ... 4–7
4.2.1.1 Functional Description ... 4–7
4.2.1.2 Data Interface ... 4–7
4.2.1.3 Transmit Multiplexer ... 4–7
4.2.1.4 Receive Multiplexer ... 4–13
4.2.1.5 Plesiochronous Buffer ... 4–13
4.2.1.6 Engineering Service Channel (ESC) ... 4–14
4.2.1.7 IBS Interface Connector Pinouts ... 4–14

4.2.1.8 IBS Interface Specification 4–15
4.2.1.9 IBS Interface Breakout Panel 4–17
4.2.1.9.1 IBS Terrestrial Interface (J1) 4–19
4.2.1.9.2 RS422 Interface (J2) 4–19
4.2.1.9.3 V.35 Interface (J3) 4–20
4.2.1.9.4 Engineering Service Channel 4–20
4.2.1.9.5 G.703 Interface (J5) 4–21
4.2.1.9.6 External Reference Clock (J6) 4–21
4.2.1.9.7 Send Data (J7) 4–21
4.2.1.9.8 Receive Data (J8) 4–22
4.2.1.9.9 Alarm Outputs (TB1) 4–22
4.2.2 Drop & Insert Interface 4–24
4.2.2.1 Functional Description 4–24
4.2.2.2 Data Interface 4–25
4.2.2.3 Transmit Multiplexer 4–25
4.2.2.4 Receive Demultiplexer 4–25
4.2.2.5 Plesiochronous Buffer 4–26
4.2.2.6 Engineering Service Channel (ESC) 4–26
4.2.2.7 Backward Alarm 4–26
4.2.2.8 Drop & Insert Interface Connector Pinouts 4–32
4.2.2.9 Drop & Insert Interface Specification 4–32
4.2.2.10 Drop & Insert Breakout Panel 4–34
4.2.2.10.1 Drop Data Input, Insert Data Output, and Ext. Ref Clk (J1) 4–36
4.2.2.10.2 Drop Data Output (J2) 4–36
4.2.2.10.3 Insert Data Input (J3) 4–36
4.2.2.10.4 Insert Data Output (J4) 4–37
4.2.2.10.5 Drop Data Input (J5) 4–37
4.2.2.10.6 Drop Data Output (J6) 4–37
4.2.2.10.7 Insert Data Input (J7) 4–37
4.2.2.10.8 Insert Data Output (J8) 4–37
4.2.2.10.9 External Reference Clock (J9) 4–37
4.2.2.10.10 ESC Channel (J10) 4–38
4.2.2.10.11 Faults (J11) 4–38
4.2.2.10.12 Data Interface (J12) 4–38
4.2.2.11 Rear Panel Switches 4–39
4.2.2.11.1 Drop Data Input 4–39
4.2.2.11.2 Drop Data Output 4–39
4.2.2.11.3 Insert Data Input 4–39
4.2.2.11.4 Insert Data Output 4–40
4.2.2.11.5 External Reference Clock 4–40
4.2.2.11.6 Drop Output/Insert Input (SW4) 4–40
4.2.2.11.7 Drop Data Output DCE/DTE Select (SW5) 4–40
4.2.3 External Channel Unit Interface 4–45

4.3 Interface Clocking Options 4–45
4.3.1 Master/Slave 4–45
4.3.1.1 Master/Slave RS422 or V.35 4–45
4.3.1.2 Master/Slave G.703 4–46
4.3.1.3 Master/Slave X.21 4–46
4.3.1.4 Master/Slave External Station Clock 4–46
4.3.2 Master/Master 4–46
4.3.2.1 Master/Master (Customer Clock) 4–47
4.3.2.2 Master/Master (Station Clock) 4–47

CHAPTER 5. THEORY OF OPERATION 5–1

5.1 Modulator 5–1
5.1.1 General description 5–1
5.1.2 Specifications 5–1
5.1.3 Theory of Operation 5–6

5.2 Viterbi Decoder / Demodulator Processor 5–7
5.2.1 General Description 5–7
5.2.2 Viterbi Decoder/Demod Processor Specification 5–7
5.2.2.1 Demod Processor Specification 5–7
5.2.2.2 Viterbi Decoder Specifications 5–8
5.2.3 Theory Of Operation 5–14
5.2.3.1 Demod Processor 5–14
5.2.3.2 Viterbi Decoder 5–14

5.3 Demodulator 5–15
5.3.1 General Description 5–15
5.3.2 Specifications 5–16
5.3.3 Theory of Operation 5–19

5.4 Reacquisition, Fast Acquisition And Directed Sweep 5–19
5.4.1 General 5–19
5.4.2 Reacquisition 5–20
5.4.3 Fast Acquisition 5–21
5.4.4 Directed Sweep 5–21

CHAPTER 6. MAINTENANCE 6–1

6.1 System Checkout 6–1
6.1.1 General 6–1
6.1.2 Modulator Checkout 6–1
6.1.3 Demodulator Checkout 6–1
6.1.4 Test Points 6–8
6.1.4.1 Modulator (Figure 6-5) 6–8
6.1.4.2 Demodulator (Figure 6-6) 6–9
6.1.4.3 Viterbi Decoder/demod Card AS/0701 (Figure 6-7) 6–10
6.1.4.4 Viterbi Decoder/Demod Card AS/0949 (Figure 6-8) 6–11
6.1.4.5 Viterbi Decoder/Demod Card AS/2133 (Figure 6-9) 6–12

6.2 Fault Isolation 6–13
6.2.1 Modulator Faults 6–13
6.2.2 Demodulator Faults 6–14
6.2.3 Common Equipment Faults 6–15

6.3 Interface Fault Isolation 6–15
6.3.1 Transmit Overhead Framing Unit Faults 6–16
6.3.2 Receive Overhead Framing Unit Faults 6–16

6.4 Module Replacement 6–22

6.5 Module Identification 6–22

6.6 Repacking For Shipment **6–22**

APPENDIX A. DATA RATES AND FILTERS **A–1**

APPENDIX B. SATELLITE MODEM REMOTE CONTROL **B–1**

APPENDIX C. EXTERNAL CHANNEL UNIT **C–1**

APPENDIX D. SOFTWARE CHANGE SPECIFICATIONS **D–1**

This page is intentionally blank.

Chapter 1. INTRODUCTION

1.1 Scope

This manual describes the SDM-309B Satellite Modem, hereinafter referred to as the modem (Figure 1-1). It includes installation, operation, and maintenance instructions. A description of the equipment is contained in Section 1. Section 2 provides the installation instructions. The use of controls, indicators, and operation is described in Section 3. Maintenance instructions are in Section 4.

1.2 Purpose And Function

The modem is a high performance, full-duplex, QPSK digital modulator-demodulator for Intelsat Business Services (IBS) satellite communication systems. This modem and internal channel unit complies with the requirements of IESS 309. The internal channel unit interfaces between SCPC fixed-rate terminal equipment having a data rate of 64 Kbps to 2.048 Mbps and adds overhead/framing to the data. The modem interfaces between the channel unit and IF converter equipment operating in a 50 to 90 MHz or 100 to 180 MHz band (Figure 1-2). This modem can be used with an external channel unit (Multipoint/M1200 or equivalent). Refer to Appendix C for more information. The modem contains built-in scrambler/ descrambler, differential encoder/decoder, transmit and receive frequency synthesizers, and a multi-rate Forward Error Correction (FEC) convolutional encoder-viterbi decoder. The modem provides high performance with narrow occupied bandwidth, automatic signal acquisition, high flexibility, and extensive on-line monitoring circuits.

1.3 Description

The modem is a complete, self-contained unit in a standard 19-inch rack mountable enclosure weighing approximately 25 pounds. It is of modular construction (Figure 1-3). The chassis assembly (with the front and rear panel) encloses seven printed circuit board assemblies (PCB). The backplane PCB is mounted on the chassis assembly and contains receptacles for five plug-in PCB’s. Test points are located on the front board edge of the modulator, demodulator, and decoder PCB. All controls and indicators for operation of

the modem are located on the front panel. The chassis also contains the power supply, and a fan is on the rear panel. A system block diagram is shown in Figure 1-4.

Figure 1-1 SDM-309B Modem

Figure 1-2 Satellite Communications System With SDM-309B Modem

Figure 1-3 Modular Construction

Figure 1-4 SDM-309B Block Diagram

The modem consists of the following assemblies:

Assembly	Drawing No.
Chassis with Power Supply	AS/1100-3
PCB, Monitor and Control	AS/0356
PCB, Modulator	AS/0773-X
PCB, Demodulator	AS/0778-X
PCB, Viterbi Decoder	AS/2133*
PCB, Front Panel Control Board	AS/0361
PCB, Mother Board	AS/0979-1
PCB, Internal Channel Unit (IBS) (D&I)	AS/1010 & AS/1011 or AS/1455
(External Channel Unit)	See Appendix C
PCB, Mod Daughter Variable Rate	AS/0930-2 or
PCB, Mod Daughter Fixed Rate	AS/0715
PCB, Demod Daughter Variable Rate	AS/0929-2 or
PCB, Demod Daughter Fixed Rate	AS/0698

Note: X= various options available on the modulator and demodulator boards. Refer to Table 6-3 for more information on the options available for each board.

*Older versions of the Viterbi Decoder board can also be used in the SDM-309B modem. Refer to Chapter 5, Section 5.2 for more information on the available revisions and compatibility information.

1.4 System Specification

Table 1-1 lists the operating specifications of the modem. The bit energy-to-noise ratio (Eb/N0) required to achieve 10-5 and 10-7 bit error rates is listed in Table 1-2. The typical bit error rate performance of the modem is shown in Figure 1-5, and a typical output spectrum of the modem is shown in Figure 1-6.

Table 1-1 SDM-309B Satellite Modem Specification

System Specifications	
Operating Frequency Range	50 to 90 MHz, or 100 to 180 Mhz Synthesized in 2.5 KHz Steps
Type of Modulation	Quadrature Phase Shift Keying
Operating Channel Spacing	Less Than .5 dB degradation operating with 2 adjacent like channels each 10 dB higher at 1.3 times the symbol rate or 75 KHz minimum
Bit Error Rate	See Table 1-2
Digital Interface IBS/M1200P D&I/M1200P External Channel Unit (See Appendix C)	 V.35, RS/422, & G.703 G.703 - T1 & E1 RS422/449, DS1, V.35, G.703
Digital Data Rate	64 to 2048 Kb/s Configurable Choice of up to Four pre-defined fixed Rates or Variable Rate Option

Forward Error Correction	Convolutional Encoding with Soft Decision K7 Viterbi Decoding
Data Scrambling	Selectable, Synchronous (Per IESS-309 Rev 3 Section 4.4.5) or None
Diagnostic Features	RF Loopback Digital Data Loopback Fault Monitoring Bit Error Rate Monitoring Remote Control via Serial Port
Prime Power	90-132 VAC or 180 to 264 VAC, 47-63 Hz 75 W Max. Fused at 2 A
Size	5.25" H by 19.0" W by 18.0" D (3RU)
Weight	30 pounds Maximum
Additional Modulator Specifications	
Output Power Optional	-5 to -25 dBm, Adjustable in 0.5 dB Steps +5 to -20 dBm
Output Spurious and Harmonics	-50 dBc in Band (50 to 90 Mhz or 100 to 180 Mhz) -40 dBc out of band (spurious measured in 4 KHz BW)
Output Impedance	75 Ω
Output Return Loss	20 dB
Output Frequency Stability	± 10 ppm
Data Clock Source	Internal or External
Internal Data Clock Stability	± 50 ppm
Additional Demodulator Specifications	
Input Power (Desired Carrier) (Maximum Total)	-30 to -55 dBm +30 dB power within 20 Mhz from desired carrier +40 dB power outside of 20 Mhz from desired carrier 0 dBm
Input Impedance	75 Ω
Input Return Loss	20 dB
Carrier Acquisition Range	± 25 KHz minimum
Clock Acquisition Range	± 100 ppm
Remote Control Specifications	
Serial Interface	RS-232 or RS-485/449
Baud Rate	300 to 9600 BPS
Signals Controlled/Monitored	Transmit Frequency Receive Frequency Transmit Power Transmitter On/Off Data Rate Select RF Loopback Data Loopback Scrambler On/Off Descrambler On/Off Raw Error Rate Corrected Bit Error Rate Receive Eb/N0 TX Clock Internal/External RX Clock Normal/Invert Receive Signal Level Receive Carrier Detect Power Supply Voltages Fault Status Stored Fault Status

Configuration Retention	Will Maintain Current Configuration for 30 days Minimum Without Power
Addressing	Programmable to 1 of 256 Possibilities Address 0 Reserved for Global Addressing
Local Control of All Remote Functions Included Via Pushbutton Entry.	

Table 1-2 BER Performance Specification

Note:

The bit energy-to-noise ratio (Eb/N0) required to achieve 10^{-3} to 10^{-8} bit error rates at various data rates for different coding configurations is shown below. All values are for operation in QPSK mode. The modem alone, without coding, provides operation within 0.5 dB of theoretical for BPSK and within 0.8 dB for QPSK, for BER's in the range 10-1 to 10-6. Performance measurements are with Transmit and Receive IF connected back to back through an additive white gaussian noise channel.

Viterbi K=7		
	1/2 Rate	3/4 rate
BER		
10-3	4.2 dB	5.3 dB
10-4	4.7 dB	6.0 dB
10-6	6.1 dB	7.6 dB
10-8	7.2 dB	8.8 dB

Figure 1-5 Typical Bit Error Rate Performance

Figure 1-6 SDM-309B Modem Typical Output Spectrum

Chapter 2. INSTALLATION

2.1 Unpacking

The modem and manuals are packaged in pre-formed reusable foam inside a cardboard carton. To remove the modem proceed as follows:

CAUTION

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

a. Cut the tape at the top of the carton.

b. Lift off the foam containing the modem.

c. Save the packing material for reshipment either back to the factory or to another site.

d. Inspect the equipment for damage incurred during shipment.

e. Check the equipment against the packing list shipped with the equipment to ensure that the shipment is complete.

2.2 External Connections

Connections between the modem and other equipment are made through six connectors. These connectors are listed in Table 2-1 and their locations are shown in Figure 2-1. The use of each of these connectors is described in the following paragraphs.

Table 2-1 Rear Panel Connectors

Name	Ref Design	Connector Type	Section	Function
DATA I/O	NONE	VARIOUS	4.2.1 4.2.2 4.2.3	IBS/M1200P I/O D&I/M1200P I/O External Channel Unit
REMOTE	J6	9 PIN "D"	2.2.2	INTERFACE

FAULT	J7	9 PIN "D"	2.2.3	FORM C FAULT RELAY CONTACTS
IF OUTPUT	CP1	BNC	2.2.4	TX IF OUTPUT
IF INPUT	CP2	BNC	2.2.5	RX IF INPUT
AC POWER	NONE	STANDARD	2.2.6	AC POWER INPUT
GND	NONE	#10-32 STUD	2.2.7	CHASSIS GROUND

Figure 2-1 Rear Panel View

2.2.1 Data I/O

For information and pinouts on the data connectors, please refer to the appropriate subSection in Section 4.2 and Appendix C.

2.2.2 Remote (J6)

The remote connector on the modem is used to interface the Monitor and Control functions to a remote location. This interface can be either RS232 or RS485. For a complete discussion on the remote interface, refer to Sections 4.1.2 and 4.1.3.

2.2.2.1 Connector Pinout (J6)

The remote interface is provided on a 9 pin female "D" connector. Screw locks and latching blocks are provided for mechanical security of the mating connector. The remote connector is a DCE interface.

RS485		RS232	
Pin#	**Name**	**Pin#**	**Name**
1.	GND	1.	
2.		2.	RD (RX)
3.		3.	TD (TX)
4.	+RX/TX	4.	
5.	-RX/TX	5.	GND
6.		6.	DSR
7.		7.	RTS
8.	+RX/TX	8.	CTS
9.	-RX/TX	9.	

2.2.3 Fault (J7)

The fault connector on the modem is used to provide FORM C contact closures for the purpose of fault reporting. There are three (3) FORM C summary fault contacts, modulator, demodulator, and common equipment. For a complete discussion on what faults are monitored refer to Section 3.1.5. To get a system summary alarm connect all the FORM C contacts in parallel.

2.2.3.1 Connector Pinout (J7)

The fault interface is provided on a 9 pin female "D" connector. Screw locks and latching blocks are provided for mechanical security on the mating connector.

Pin #	Name	
1.	NO	COMMON EQUIPMENT IS OK
2.	COM	

3.	NC	COMMON EQUIPMENT IS FAULTED
4.	NO	MODULATOR IS OK
5.	COM	
6.	NC	MODULATOR IS FAULTED
7.	NO	DEMODULATOR IS OK
8.	COM	
9.	NC	DEMODULATOR IS FAULTED

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

2.2.4 IF Output (CP1)

This is the transmit IF connector. The output impedance is 75 Ω and the output power level is -5 to -15dBm. In normal operation, the output will be a QPSK modulated result of the DATA I/O connector between 50 and 90 Mhz.

2.2.5 IF Input (CP2)

This is the receive IF connector. The input impedance is 75 Ω. For normal operation the signal level needs to be between -30 and -55 dBm with a maximum composite level of 0 dBm. Signals between 50 and 90 Mhz are selected and demodulated to produce clock and data at the DATA I/O connector.

2.2.6 AC Power

The AC power is supplied to the modem by a standard detachable, non locking, 3-prong power cord. Normal input voltage is 90-132 VAC or 180-264 VAC, 47-63 Hz. Maximum power consumption is less than 75 W.

Note: Damage may result if the incorrect input voltage is applied to this connector. If there is any question of the compatibility, DO NOT connect up the unit until EFDATA has been contacted.

2.2.7 GND

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

2.3 System Requirements

The standard modem with all the cards installed (Figure 1-3), is full duplex QPSK satellite modem. The system can also be configured for TX only or RX only.

For a TX only system, the demodulator (0778-X) and decoder (2133, 0949, or 0701) are removed. You also must enter the Utility Menu on the front panel and select OP MODE

(Operation Mode). Enter the menu and select TX only. This will mask the receive faults and receive stored faults in the faults menu.

For a RX only system, the modulator (0773-X) is removed. Enter the Utility Menu on the front panel and select OP MODE). Enter the menu and select RX only. This will mask the transmit faults and transmit stored faults in the faults menu.

The modem interface is configured by the selection of the data interface card. Refer to Section 4.2 for discussion on the data interfaces.

The modem data/code rate is configured by the installation of a daughter card (0715 or 0930) on the modulator and a daughter card (0698 or 0929-X) on the demodulator. The UTILITIES function must be set up to be compatible with the daughter cards. Refer to Section 3.1.8 for information on the UTILITIES function. The modem will be set up to match the daughter cards when it is shipped from the factory.

2.4 System Installation

After unpacking the modem per Section 2.1, installation of the modem can be done as follows:

a. Mount the modem chassis in the assigned position in the equipment rack.

b. Connect the cables on the rear panel to the appropriate location. Refer to Section 2.2 for connector pinouts, placement, and function.

c. Open the front panel and verify the three (3) main cards and the M&C and Data Interface cards are properly seated. Refer to Figure 1-3 for position of the cards. When the cards are installed correctly, the color of the card guides on the chassis will match the color of the card ejectors on the cards.

d. Before turning on the power switch, read and become familiar with Section 3.1, the Front Panel Operation.

e. Turn on the power switch that is located inside the front panel.

f. Check for proper TX signal level and spectrum.

g. Check for proper RX signal level and spectrum.

h. If there is any problem on installation refer to Section 6.0 for trouble shooting the system.

Chapter 3. OPERATION

3.1 SDM 309/M1200P Front Panel

3.1.1 General

The following is a Step by Step explanation and procedure for operating the SDM 309B modem, hereafter referred to as the modem, with an internal IBS channel unit. The complete front panel operation is described below.

The Modem front panel (Figure 3-1) provides the local user interface which is necessary to configure and monitor status of the satellite modem. The front panel features a sixteen character, two line LCD display and six key key-pad which provides for sophisticated functions, yet is easy to use. Eight LED indicators are also present on the front panel to provide overall status at a glance. All functions are accessible at the front panel by entering one of five predefined 'sELECT" categories or levels: Configuration (CONFIG), Monitor, Faults, Stored Faults (StFaults), and Utility.

3.1.2 LED Indicators

General modem status and summary fault information is indicated by eight LED's on the front panel. The indicators are defined as follows:

Faults	
Transmit (Red LED)	Indicates that a Modulator fault or a Transmit Interface fault condition exists.
Receive (Red LED)	Indicates that a Demodulator/Decoder fault or a Receive Interface fault condition exists.
Common (Red LED)	Indicates that a common equipment fault condition exists.
Stored (Red LED)	Indicates that a fault has been logged and stored. The fault may or may not be active.
Status	
Power On (Green LED)	Indicates power is applied to the modem.
Transmitter On (Green LED)	Indicates that the transmitter is currently on. This indicator reflects the actual condition of the transmitter, as opposed to the programmed condition.
Carrier Detect (Green LED)	Indicates that the decoder is locked.

Test Mode (Yellow LED)	Flashes when the modem is in a test configuration.

3.1.3 Front Panel Controls

The Modem is locally operated by using the front panel key-pad (Figure 3-1). The key-pad consists of six keys: Enter, Clear, Right Arrow, Left Arrow, Up Arrow, and Down Arrow. Each key has it's own logical function or functions:

Enter Key	The "Enter" key is used to select a displayed function or to execute a change to the Modem's configuration.
Clear Key	The "Clear" key is used to back out of a selection or to cancel a configuration change which has not been executed using the "Enter" key. Pressing the "Clear" key generally returns the display to the previous selection.
Left & Right Arrow Keys	These keys are used to move to the next selection or to move the cursor for certain functions.
Up & Down Arrow Keys	These keys are used primarily to change configuration data (numbers) but are also used at times to move from one Section to another.

The Modem responds by beeping whenever a key is pressed. A single beep indicates that the key pressed was a valid entry and the appropriate action was taken. However, a double beep when a key is pressed indicates that the key pressed was an invalid entry.

The Modem front panel control uses a tree structured menu system (Figures 3-2 to 3-7) to access and execute all functions. The base level of this structure is the sign-on message which is displayed at the front panel upon modem power up. Line one of the sign-on message is the modem model number (SDM309) and line two is the version number of the firmware implemented in your modem. The main level of the menu system is the 'sELECT" menu which may be accessed from the base level by pressing any of the arrow keys. From the 'sELECT" menu you may select any one of five functional categories: configuration functions, monitor functions, fault functions, stored fault functions or utility functions. Use the right and left arrow keys to move from one selection to another, when the desired function is displayed on line two you can enter that level by pressing the "Enter" key. Once you have entered the functional level of your choice, move to the desired function by using the right and left arrow keys. Refer to the following text for information on individual functional categories and there functions.

Figure 3-1 Front Panel View

3.1.4 Configuration

Modem configuration may be viewed or changed by entering the “CONFIG” level from the ‘sELECT” menu on the front panel. After entering the “CONFIG” menu, use the right and left arrow keys to select “MOD”, “DEMOD”, or “INTERFACE” configuration. Enter the selected configuration menu by pressing the “ENTER” key. Use the right and left arrow keys to view the selected configuration parameters. If it is desired to change a configuration parameter press the “Enter” key to begin the change process at which point you can use the arrow keys to make the changes. After the changes are made and the display represents the correct parameters execute the change by pressing the “Enter” key. When the “Enter” key is pressed the necessary programming is initiated by the modem. If you decide not to change the parameter prior to executing the change simply press the “Clear” key. The following notes describe each configuration function in detail.

3.1.4.1 MOD Configuration

TXA	Transmitter rate selection. Select one of four predefined transmitter coder/data rate combinations or a variable rate selection. On entry the current transmitter rate is displayed with the flashing cursor on the first character of the code rate on line one. The data rate is displayed on line two. Use the arrow keys to select one of four predefined rates. Filters that are not present may display as “N/A” (not assigned) and can not be programmed. If your modem is equipped with the variable rate option you can also select TXV and enter the desired data rate. To change the rate using the variable rate selection, press the “ENTER” key when “TXV is displayed. A flashing cursor will be displayed on the first character of the coding type on line one. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key to execute the change. **Note:** 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 “RF_Out” function.
TX_Freq	Programs the modulator transmit frequency between 50mhz and 90MHz or 100MHz and 180MHz in 2.5 KHz Steps. On entry the current transmitter frequency is displayed with the flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key to execute the change. **Note:** The transmitter frequency is programmable within the specified range (50 - 90 MHz or 100 - 180 MHz) in 2.5 KHz Steps. 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 “RF_OUT” function.
RF_Out	Programs the modulator output to On or Off. On entry the current status of the output is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.

TX_Power	Programs the modulator output power level from -5 dB to -30 dBm in .5 dB Steps. On entry the current transmitter power level is displayed with the flashing cursor on the first character. The up and down keys are used to increase or decrease the output power level in .5 dBm Steps. Press the “ENTER” key to execute the change. **Note:** If your modem has the high power Mod option installed (-11 modulator), you must change the output power range on the front panel. Enter the Utility menu and find Pow Adj. Press the “ENTER” key and adjust the maximum output power to read +5.0 dB using the up arrow. This will make the TX power read +5.0 to -20.0 dB, the output range of a high power mod.
DifEncdr	Programs the differential encoder On or Off. On entry the current status of the DifEncdr is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
CW_Mode	*Programs the modem for continuous wave mode. Three modes of operation are available: center, dual, and offset modes. Center Mode: Generates a carrier at the current modulator frequency. This can be used to measure the output power and output frequency. Dual Mode: Generates a dual side-band suppressed carrier signal. Side-bands are at one half (1/2) the symbol rate from the carrier. This is used to check the channel balance and carrier null. Offset Mode: Generates a single upper side-band suppressed carrier signal. The upper side-band is at one quarter (1/4) 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 the “ENTER” key. Use the arrow keys to select the “DUAL or the “OFFSET” modes. To return to the “CONFIG” menu press the “CLEAR” key. **Note:** When the “CLEAR” key is pressed, the modem is configured to the state it was in before “CWMode” was invoked and the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on use the “RF_OUT” function.

3.1.4.2 DEMOD Configuration

RXA	Receiver rate selection. Select one of four predefined receiver decoder/data rate combinations or a variable rate selection. On entry the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line one. The data rate is displayed on line two. Use the arrow keys to select one of four predefined rates. Filters that are not present may display as “N/A” (not assigned) and can not be programmed. If your modem is equipped with the variable rate option you can also select TXV and enter the desired data rate. To change the rate using the variable rate selection, press the “ENTER” key when “RXV” is displayed. A flashing cursor will be displayed on the first character of the coding type on line one. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key to execute the change.
RX_freq	Programs the demodulator receive frequency between 50 MHz and 90 MHz or 100 MHz and 180 MHz in 2.5 KHz Steps. On entry the current receive frequency is displayed with the flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key execute the change. **Note:** The receiver frequency is programmable within the specified range (50 - 90 MHz or 100 - 180 MHz) in 2.5 KHz Steps.
DifDecdr	Programs the differential decoder On or Off. On entry the current status of the differential decoder is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
IFLoopBk	*Programs the modem for IF loopback operation. When the IF loop-back is turned on the demodulator input is connected to the modulator output through an attenuator and 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 turned to it’s previous frequency and is reconnected to the IF input. See Figure 3-8 for a block diagram of IF loopback operation. On entry the current status of the IF loopback is displayed with a flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
RFLoopBk	*Programs the modem for RF loopback operation. 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 it’s previous frequency. See Figure 3-9 for a block diagram of RF loopback operation. On entry the current status of the RF Loopback is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.

SWP-RACQ	Programs the sweep reacquisition mode time duration. The time selected with this parameter is the time that the modem will remain in a narrow sweep (± 10%) after acquisition has been accomplished. After this timer runs out the modem will return to the normal sweep. On entry the current programmed setting is displayed with a flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment and decrement the digit at the flashing cursor. Select the number of seconds for the reacquisition mode from 0 to 999 seconds. Press the “ENTER” key to execute the change.
**SWP_CNTR	Programs the sweep center frequency for the directed sweep function. The sweep center frequency may be set in the range from +25000Hz to -25000Hz. On entry the current programmed setting is displayed with a flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment and decrement the digit at the flashing cursor. Select the sweepcenter frequency from -25000Hz to +25000Hz. Press the “ENTER” key 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.
**SWP_RNGE	Programs the overall travel of the sweep width range during acquisition in the directed sweep mode. The sweep width may be set from 0 Hz to 50000 Hz. (When set at 50000 Hz, the modem is in the fast acquisition mode). On entry the current programmed setting is displayed with a flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment and decrement the digit at the flashing cursor. Select a sweep range from 0 Hz to 50000 Hz. Press the “ENTER” key to execute the change. When in directed sweep, the smaller the range is, the faster the modem will lock, provided the sweep center frequency is close.
**SWP_DIR	Programs the direction of the sweep travel in the directed sweep mode. On entry the current programmed setting is displayed with the flashing cursor on the first character. Use the arrow keys to select Forward (+) or Reverse (-). Press the “ENTER” key to execute the change.
BERT_set	This function is used to set 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 1E-3 to 1E-8 or may be disabled by specifying NONE. On entry the current setting of the BER threshold is dis played. Use the up and down arrow keys to select the desired setting. Press the “ENTER” key to execute the change. * Indicates Test Mode configuration option. **These windows only show up when the Fast Acquisition has been turned on in the “Utility” menu.

3.1.4.3 Interface Configuration

TX_clock	Programs the clock source for the modem transmitter clock. “Internal” sets the TX clock to operate from the modem internal clock, this is also the fallback clock. “External” sets the TX clock to operate from the external reference clock. This clock must be frequency locked to the data that is being transmitted. “TX Terrestrial” sets the TX clock to recover timing from the incoming data. On entry the current transmit clock setting is displayed with the flashing cursor on the first character. Use the arrow keys to select “Internal”, “External Reference”, or TX Terrestrial” clock. Press the “ENTER” key to execute the change.
BUF_Clk	Programs the interface plesiochronous buffer output clock. “TX Terrestrial” sets the buffer output clock to recover timing from the incoming TX data clock. “External” sets this clock source to the external reference clock. ‘satellite” sets the output buffer clock to the satellite clock, this is also the fallback clock. If ‘satellite” is selected, the doppler shift caused by the satellite will not be removed. “Internal” set the buffer clock to operate from the modem internal clock. On entry the current setting of the plesiochronous buffer clock is displayed with the flashing cursor on the first character. Use the arrow keys to select ‘satellite”, “Internal”, “Ext Ref”, or “TX_Terr” for the buffer clock. Press the “ENTER” key to execute the change.
RX_Clock	Programs the RX clock to “Normal” or “Inverted”. On entry the current status of the RX Clock is displayed with the flashing cursor on the first character. Use the arrow keys to select “Normal” or “Inverted”. Press the “ENTER” key to execute the change.
Ext_REF	Program the external reference clock input frequency between 8 KHz and 10 MHz in 8 KHz Steps. On entry the current setting for the external reference is displayed with the flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key to execute the change.
BBLoopBk	*Programs the modem for baseband loopback operation. 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. See Figure 3-10 for a block diagram of baseband loopback operation. On entry the current status is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
INTF_LBk	*Programs the modem for interface loopback operation. When interface loop-back is 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 has had the 16/15 overhead added. See Figure 3-11 for a block diagram of interface loopback operation. On entry the current status is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.

CODING	Programs the modem for “AMI”, “B8ZS”, “B6ZS”, or “HDB3” coding of the baseband data. On entry the current coding format is displayed. Use the arrow keys to select the desired coding format. Press the “ENTER” key to execute the change.
TX_2047	*Programs the modem to insert a 2047 pattern in lieu of the normal transmit data. On entry the current status is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
TXD_FLT	Transmit Data Fault. This configuration function is used to select a Transmit Interface fault monitor of AIS, Data, or None. When AIS (Alarm Indication Signal) is selected the TX_INTF (Transmit Interface) fault “Data/AIS” is monitoring a fault condition of all 1’s from customer data input to the modem. When Data_Flt is selected, the TX_INTF fault “Data/AIS” is monitoring a fault condition of all 1’s or all 0’s. This is referred to as a data stable condition which means that the data is not transitioning. When None is selected, the TX_INTF fault “Data/AIS” is not activated. On entry the current TX Data fault that is being monitored is displayed with the flashing cursor on the first character. Use the arrow keys to select Data, AIS, or None. Press the “ENTER” key to execute the change.
RXD_FLT	Receive Data Fault. This configuration function is used to select a Receive Interface fault monitor of AIS, Data, or None. The data monitored for Receive Data is coming from the Satellite. Refer to TXD_FLT for a description of the function choices. On entry the current RX Data fault that is being monitored is displayed with the flashing cursor on the first character. Use the arrow keys to select Data, AIS, or None. Press the “ENTER” key to execute the change.
BUF_SIZE	This configuration function is used to set the size of the plesiochronous buffer. On entry the current plesiochronous buffer length is displayed. Use the up and down arrow keys to select the desired buffer size. You may select from 384 to 262,144 bits in increments of sixteen. Press the “ENTER” key to execute the change.
BUF_CNTR	This configuration function is used to center the plesiochronous buffer. Press the “ENTER” key twice to center the plesiochronous buffer.
READ_ERR	This configuration is used to select the read error function mode. Frame or 2047 errors may be selected. On entry the current read error mode is displayed. Use the arrow keys to select “2047” errors or “FRAME” errors as desired. Press the “ENTER” key to display and monitor the selected errors. To exit the read error mode press the “CLEAR” key.
Dscrmblr	Programs the demod/decoder for descrambler On or Off. On entry the current status of the descrambler is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
Scramblr	Programs the modulator for scrambler On or Off. On entry the current status of the scrambler is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change. * Indicates Test Mode configuration option.

3.1.5 Monitor

When the “MONITOR” level is entered use the right and left arrow keys to select the desired monitor function. Each monitor function is displayed in real time as long as it is selected.

Raw_BER - Raw bit error rate.
* Range: <1.0E-4 to >2550E-4

Cor_BER - Corrected bit error rate.
* Range: <1.0E-8 to >1E-3

Eb/N0 - Energy(bit)/noise ratio.
* Range: <3.2 dB to >16.0 dB

Swp_Freq - Sweep Monitor**
*Range: -25,000 Hz to +25,000 Hz

RxSignal - Receive signal level.
* Range: <-60 dBm to >-30 dBm

FIL_STAT - Plesiochronous buffer fill status in percent.
* Range: 1% to 99%

FRM_ERR/2047_ERR - Framing pattern bit error rate. Monitors the currently selected READ_ERR function.
* Range: <8.0E-4 to >1.4E-3

* When the decoder loses lock no data is available and is so indicated.

** Sweep Frequency only shows up in the “Monitor” menu if the Fast Acquisition has been turned on in the “Utility” menu.

3.1.6 Faults

The “FAULTS” level is accessible from the ‘sELECT” menu. Faults are similar to monitor functions as they display the current fault status of the group being displayed. Use the right and left arrow keys to move between the fault groups: Mod_Flts (modulator faults), Dmd_Flts (demodulator faults), CEQ_Flts (common equipment faults), TX_INTF (transmitter interface faults), and RX_INTF (receiver interface faults). The current faults status is displayed on line two of the display in real time. Faults status is display as “+” (plus) or “-” (minus) for each parameter monitored, “+” indicates that a fault exists and “-” indicates that no fault exists. To display labels for individual faults press the “Enter” key. Use the left and right arrow keys to move the flashing cursor to the fault you wish to identify. The label for that fault is immediately displayed on line one of the display. The “Clear” key can be used to exit this level of operation and return to the previous level. The following lists outline the faults monitored and displayed in each group.

3.1.6.1 Mod_Flts - Modulator Faults

RF_Syn	Modulator RF synthesizer fault.
Data_Clk	Transmit data clock activity indicator.
TClk_Syn	Transmit clock synthesizer fault.
I-Channl	I channel activity fault.
Q-Channl	Q channel activity fault.
AGC_level	Automatic gain control level fault.
Module	Modulator module fault. Typically indicates that the modulator module is missing or will not program.

3.1.6.2 Dmd_Flts - Demodulator/Decoder Faults

C_Detect	Carrier detect fault. Indicates that the decoder is not locked.
RF_Syn	Demodulator RF synthesizer fault.
Data_Clk	Receive data clock activity fault.
I-Channl	I channel activity fault.
Q-Channl	Q channel activity fault.
BERthrsh	Secondary alarm result of BERT_set in the DEMOD configuration menu.
Module	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not program.

3.1.6.3 CEQ_Flts - Common Equipment Faults

Battery	Battery fault.
-12 volt	Negative 12 volt power supply fault.
+12 volt	Plus 12 volt power supply fault.
+5 volt	Plus 5 volt power supply fault.
Intrface	Interface module fault. Typically indicates that the interface module is missing or will not program.

3.1.6.4 TX_INTF - Transmit Interface Faults

Data/AIS	Data or Alarm indication Signal. When Data_FLT is selected in the Interface Configuration menu the fault indicates a Data stable condition. When AIS is selected, fault indicates data is all 1's. Refer to Section 1.2.3 (Interface Configuration) for a detailed description of these faults.
TX_PLL	Transmitter phase locked loop fault. Indicates that the transmitter PLL is not locked.
CLK_ACT	Activity detector alarm of the selected interface transmit clock. The interface will fall back to the internal clock when this fault is active.

3.1.6.5 RX_INTF - Receive Interface Faults

BUF_UNFL	Buffer underflow fault. Indicates that a plesiochronous buffer underflow has occurred.
BUF_OVFL	Buffer overflow fault. Indicates that a plesiochronous buffer overflow has occurred.

Data/AIS	Data or Alarm Indication Signal. When Data_FLT is selected in the Interface Configuration menu the fault indicates a Data stable condition. When AIS is selected, the fault indicates data is all 1's. Refer to Section 4.3 (Interface Configuration for a detailed description of these faults.
FRM_BER	Frame BER fault. Indicates that the frame BER exceeds 1E-3.
BW_ALM	Backward Alarm Fault.
RX_PLL	Receive Phase Locked Loop Fault.
Buff_Clk	Activity detector alarm of the selected interface receive clock. The interface will fall back to the satellite clock when this fault is active.
MUX_lock	MUX lock fault. Indicates that the MUX is not locked.

3.1.7 Stored Faults

The Modem stores the first ten (Flt0 - Flt9) occurrences of fault status changes in each of the six major fault categories. Each stored fault status change is stored with the time and date of the occurrence. Stored faults may be viewed by entering the 'stFaults" level from the 'sELECT" menu. All stored faults may be cleared by executing the "CLEAR ?? StFaults" command from the 'stFaults" level.

Stored faults are not maintained through a controller power on reset cycle. However, the last known time is maintained in non volatile RAM and upon power up a common equipment fault is logged (Flt0) with that time and date. On power up an additional common equipment fault is also logged (Flt1) to indicate the power up time and date. So on power up the power down and power up times are logged as common equipment fault 0 and common equipment fault 1.

Upon entering the 'stFaults" level use the left and right arrow keys to move between the six fault groups and the "CLEAR ?? StFaults" selections. The time and date of the first stored faults status (Flt0) for the selected group will be displayed alternately on line two of the display. Use the up and down arrow keys to cycle through the selected group's stored faults status (Flt0 - Flt9). To display the faults status associated with the displayed time and date press the "Enter" key, at this time you can use the right and left arrow keys to move the flashing cursor to the fault you wish to identify.

To clear the stored faults currently logged simply press the "ENTER" key when the "CLEAR ?? StFaults" selection is displayed.

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

3.1.8 Utility

The utility functions provide a means to set the time and date of the modem real time clock circuit. Provisions are also made for assigning data and code rates to the modulator and demodulator. A lamp test function is provided for testing of the front panel optical indicators.

After entering the “UTILITY” functions level use the right and left arrow keys to select the utility function of interest. The current time and date can be displayed and changed as required. Access to the transmitter and receiver Data/Code Rate assignment and the lamp test functions are also available from within the utility functions level.

Note: The selection of data/code rates in the “UTILITY” program must match the hardware filters installed on the modulator and demodulator modules.

The utility functions are as follows:

Time	Time of day set/display function. The current time that the modem is set for is displayed when selected. To set the modem time press the “ENTER” key and use the right and left arrow keys to position the flashing cursor over the parameter to be changed. Use the up and down arrow keys to change the parameter to the desired value. Once the parameters are displayed as desired press the “ENTER” key to set the time.
Date	Date set/display. Follow the same procedure as outlined for the time function to view and set the date.
LAMP TEST ??	Lamp test function used to illuminate all the front panel indicators for three seconds. Press the “ENTER” key to turn on all of the front panel indicators for three seconds.
Address/Parity/Baud Rate	The current modem address, parity selection and selected baud rate of the modem is displayed. This in only a monitor function. No changes can be made from this menu. On entry the currently set address of the modem will be displayed (0 to 255) on the first line. The currently set parity, even or odd, will be displayed on the second line. The currently set baud rate from 110 to 9600 will also be displayed on the second line.
POW ADJ.	Modulator Power Adjust Offset. Allows the operator to offset the modulator output power readout in the configuration menu. This will be the highest modulator power that will be displayed and programmed. This feature does not actually change the modulator power level. The function is to change the actual reading to display an offset value in the monitor. The modulator Power Offset can be set between +20.0 to -20.0 dB in 0.5 dB increments. **Note:** The maximum output power adjust, set in this window, must match the maximum output power of the modulator installed in the modem. In a switching system the backup modem must be set the same as the prime modem or a fault will occur.

OP MODE	Operation Mode. Programs the modem operation for TX only, RX only, or Duplex operation. On entry the flashing cursor is on the first character of the display. Use the arrow keys to select TX only, RX only, or Duplex. Press the “ENTER” key to execute the change. When TX only or RX only is selected, the appropriate faults are masked from the Faults and Stored Faults menu.
Fast ACQ	Fast Acquisition function. Turns the fast acquisition and directed sweep function ON or OFF. When the fast acquisition has been turned OFF, the Swp_Cntr, SWP_Rnge and SWP_DIR windows in the configuration menu are disabled and do not appear. Also, in the “Monitor” menu, Swp_Freq will not appear. When turned “OFF” fast acquisition does not occur.
INTRFACE	This is a monitor function that displays the interface that has been selected on the M&C card. No changes are accepted from the front panel.
Filter Adjust	Variable Rate Filters K factor settings. This is a factory setting and the operator is not allowed to enter this parameter without authorization from EFData service department. Failure to comply will result in a modem failure.
Assign TX_Fltrs	Transmit filter display/assignment utility. Used to view current filter rate assignments and to make filter rate reassignments. The modulator has four symbol rate filters. Each filter is for a specific symbol rate. The data rate and code rate for each filter must be established upon initial modulator installation and when circumstances indicate the need to do so. Filters are designated as A, B, C, and D. To view the current filter assignments press the “ENTER” key when the “Assign TX_Fltrs” selection is displayed from the utility functions menu. On line one of the display will be TXA” which indicates transmitter filter A. Following “TXA” on line one will be the code rate (1/2 or 3/4) or “N/A” which indicates that the filter is not assigned. On line two will be the data rate assigned to filter “A”. Use the right and left arrow keys to see the assignments for filters B, C, and D (TXB, TXC, and TXD). If it is desired to change a filter assignment press the “ENTER” key when the data for that filter is displayed. Use the right and left arrow keys until the flashing cursor is at the parameter to be changed. Then use the up and down arrow keys to change that parameter. When all changes are made press the “Enter” key to confirm the assignment. Some filters may have parameters preprogrammed in the filter board hardware. If the filter parameters are preprogrammed the previously described programming techniques will be disabled. **Note:** These assignments are used for the selection of “TXR” (Transmitter Rate) in the configuration functions menu. The parameter “N/A” is used to indicate that the specific filter is not present.

Assign RX_Fltrs	Receive filter display/assignment utility. Used to view current filter rate assignments and to make filter rate reassignments. Refer to the previous text under “Assign TX_Fltrs”. The receive filters assignments are basically identical.

Figure 3-2 Menu Tree

Figure 3-3 Menu Tree

Figure 3-4 Menu Tree

Figure 3-5 Menu Tree

Figure 3-6 Menu Tree

Figure 3-7 Menu Tree

Figure 3-8 IF Loopback

Figure 3-9 RF Loopback

Figure 3-10 Interface Loopback

Figure 3-11 Baseband Loopback

3.2 Drop And Insert Front Panel Operation

3.2.1 General

The following is a Step by Step explanation and procedure for operating the SDM 309B modem, hereafter referred to as the modem, with an internal drop and insert channel unit. The operation of the front panel is the same “look and feel” as the SDM 309 modem without the drop and insert channel unit, except there are additional commands for the drop and insert channel unit. The complete front panel operation is described below.

The Modem front panel control uses a tree structured menu system (Figure 3-12 to 3-17) to access and execute all functions. The base level of this structure is the sign-on message which is displayed at the front panel upon modem power up. Line one of the sign-on message is the modem model number (SDM308-5) and line two is the version number of the firmware implemented in your modem. The main level of the menu system is the ‘sELECT” menu which may be accessed from the base level by pressing any of the arrow keys. From the ‘sELECT” menu you may select any one of five functional categories: configuration functions, monitor functions, fault functions, stored fault functions or utility functions. Use the right and left arrow keys to move from one selection to another, when the desired function is displayed on line two you can enter that level by pressing the “Enter” key. Once you have entered the functional level of your choice, move to the desired function by using the right and left arrow keys. Refer to the following text for information on individual functional categories and there functions.

3.2.2 Configuration

Modem configuration may be viewed or changed by entering the “CONFIG” level from the ‘sELECT” menu on the front panel. After entering the “CONFIG” menu, use the right and left arrow keys to select “MOD”, “DEMOD”, or “INTERFACE” configuration. Enter the selected configuration menu by pressing the “ENTER” key. Use the right and left arrow keys to view the selected configuration parameters. If it is desired to change a configuration parameter press the “Enter” key to begin the change process at which point you can use the arrow keys to make the changes. After the changes are made and the display represents the correct parameters execute the change by pressing the “Enter” key. When the “Enter” key is pressed the necessary programming is initiated by the modem. If you decide not to change the parameter prior to executing the change simply press the “Clear” key. The following notes describe each configuration function in detail.

3.2.2.1 MOD Configuration

TXA	Transmitter rate selection. Select one of four predefined transmitter coder/data rate combinations or a variable rate selection. On entry the current transmitter rate is displayed with the flashing cursor on the first character of the code rate on line one. The data rate is displayed on line two. Use the arrow keys to select one of four predefined rates. Filters that are not present may display as “N/A” (not assigned) and can not be programmed. If your modem is equipped with the variable rate option you can also select TXV and enter the desired data rate.
TX_Freq	Programs the modulator transmit frequency between 50 and 90 MHz or 110 and 180 MHz in 2.5 KHz Steps. On entry the current transmitter frequency is displayed with the flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key to execute the change. To change the rate using the variable rate selection, press the “ENTER” key when “TXV is displayed. A flashing cursor will be displayed on the first character of the coding type on line one. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key to execute the change. **Note:** The transmitter frequency is programmable within the specified range (50 - 90 MHz or 110 - 180 MHz) in 2.5 KHz Steps. 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 “RF_OUT” function.
RF_Out	Programs the modulator output to On or Off. On entry the current status of the output is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
TX_Power	Programs the modulator output power level from -5 dB to -30 dBm in 0.5 dB Steps. On entry the current transmitter power level is displayed with the flashing cursor on the first character. The up and own keys are used to increase or decrease the output power level in 0.5 dBm Steps. Press the “ENTER” key to execute the change. **Note:** If your modem has the high power Mod option installed (-11 modulator), you must change the output power range on the front panel. Enter the Utility menu and find Pow Adj. Press the “ENTER” key and adjust the maximum output power to read +5.0 dB using the up arrow. This will make the TX power read +5.0 to -20.0 dB, the output range of a high power mod.
DifEncdr	Programs the differential encoder On or Off. On entry the current status of the DifEncdr is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.

CW_Mode	*Programs the modem for continuous wave mode. Three modes of operation are available: center, dual, and offset modes. Center Mode: Generates a carrier at the current modulator frequency. This can be used to measure the output power and output frequency. Dual Mode: Generates a dual side-band suppressed carrier signal. Side-bands are at one half (1/2) the symbol rate from the carrier. This is used to check the channel balance and carrier null. Offset Mode: Generates a single upper side-band suppressed carrier signal. The upper side-band is at one quarter (1/4) 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 the “ENTER” key. Use the arrow keys to select the “DUAL or the “OFFSET” modes. To return to the “CONFIG” menu press the “CLEAR” key. **Note:** When the “CLEAR” key is pressed, the modem is configured to the state it was in before “CWMode” was invoked and the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on use the “RF_OUT” function.

3.2.2.2 DEMOD Configuration

RXA	Receiver rate selection. Select one of four predefined receiver decoder/data rate combinations or a variable rate selection. On entry the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line one. The data rate is displayed on line two. Use the arrow keys to select one of four predefined rates. Filters that are not present may display as “N/A” (not assigned) and can not be programmed. If your modem is equipped with the variable rate option you can also select TXV and enter the desired data rate.
RX_freq	Programs the demodulator receive frequency between 50 and 90 MHz or 110 and 180 MHz in 2.5 KHz Steps. On entry the current receive frequency is displayed with the flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “ENTER” key execute the change. **Note:** The receiver frequency is programmable within the specified range (50 - 90 MHz or 110 - 180 MHz) in 2.5 KHz Steps.
DifDecdr	Programs the differential decoder On or Off. On entry the current status of the differential decoder is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.

IFLoopBk	*Programs the modem for IF loopback operation. When the IF loopback is turned on the demodulator input is connected to the modulator output through an attenuator and 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 turned to it's previous frequency and is reconnected to the IF input. See Figure 3-8 for a block diagram of IF loopback operation. On entry the current status of the IF loopback is displayed with a flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the "ENTER" key to execute the change.
RFLoopBk	*Programs the modem for RF loopback operation. When RF loopback is turned on the demodulator is programmed to the same frequency as the modulator. When RF loop-back is turned off the demodulator is tuned to it's previous frequency. See Figure 3-9 for a block diagram of RF loopback operation. On entry the current status of the RF Loopback is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the "ENTER" key to execute the change.
SWP_RACQ	This function sets the sweep reacquisition rate from 0 to 999 seconds. The time selected with this parameter is the time that the modem will remain in a narrow sweep (± 10%) after acquisition has been accomplished. After this timer runs out the modem will return to the normal sweep. On entry the current programmed setting is displayed with a flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment and decrement the digit at the flashing cursor. Select the number of seconds for the reacquisition mode form 0 to 999 seconds. Press the "ENTER" key to execute the change.
**SWP_CNTR	Programs the sweep center frequency for the directed sweep function. The sweep center frequency may be set in the range from +25000Hz to -25000Hz. On entry the current programmed setting is displayed with a flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment and decrement the digit at the flashing cursor. Select the sweepcenter frequency from -25000Hz to +25000Hz. Press the "ENTER" key 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.
**SWP_RNGE	Programs the overall travel of the sweep width range during acquisition in the directed sweep mode. The sweep width may be set from 0 Hz to 50000 Hz. (When set at 50000 Hz, the modem is in the fast acquisition mode). On entry the current programmed setting is displayed with a flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment and decrement the digit at the flashing cursor. Select a sweep range from 0 Hz to 50000 Hz. Press the "ENTER" key to execute the change. When in directed sweep, the smaller the range is, the faster the modem will lock, provided the sweep center frequency is close.

**SWP_DIR	Programs the direction of the sweep travel in the directed sweep mode. On entry the current programmed setting is displayed with the flashing cursor on the first character. Use the arrow keys to select Forward (+) or Reverse (-). Press the “ENTER” key to execute the change.
BERT_set	This function is used to set 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 1E-3 to 1E-8 or may be disabled by specifying NONE. On entry the current setting of the BER threshold is displayed. Use the up and down arrow keys to select the desired setting. Press the “ENTER” key to execute the change. * Indicates Test Mode configuration option. **These windows only show up when the Fast Acquisition has been turned on in the “Utility” menu.

3.2.2.3 Interface Configuration

INS_Clk	Programs the interface plesiochronous buffer clock for Satellite, internal, external reference, or Insert clock. On entry the current setting of the plesiochronous buffer clock is displayed with the flashing cursor on the first character. Use the arrow keys to select ‘satellite”, “Internal”, “External Reference” or “Insert” for the buffer clock. Press the “ENTER” key to execute the change.
Ext_REF	Programs the data rate of external reference. Select either 1544 or 2048 Kbps. On entry the current setting for the external reference is displayed with the flashing cursor on the first character. Use the arrow keys to enter the external data rate desired. Press the “ENTER” key to execute the change.

BBLoopBk	*Programs the modem for baseband loopback operation. When baseband loopback is turned on insert data is looped back on the customer side of the interface. **Note:** The drop data is hard wired into loopback causing the BBLoopBk function to affect only the insert data. See Figure 3-10 for a block diagram of Baseband loopback operation. On entry the current status is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
INTF_LBk	*Programs the modem for interface loopback operation. When interface loopback is turned on data is looped back on the modem side of the interface. See Figure 3-11 for a block diagram of Interface loopback operation. On entry the current status is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change. **Note:** Interface loopback only works when the TX data rate matches the RX data rate.
TX CODE	Programs the transmitter for “AMI”, “HDB3”, or “B8ZS” data. On entry the current coding format is displayed. Use the arrow keys to select the desired coding format. Press the “ENTER” key to execute the change.
RX CODE	Programs the receiver for “AMI”, “HDB3”, or “B8ZS” data. On entry the current coding format is displayed. Use the arrow keys to select the desired coding format. Press the “ENTER” key to execute the change.
TX_2047	*Programs the modem to insert a 2047 pattern in place of the normal transmit data. On entry the current status is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.

TXD_FLT	Transmit Data Fault. This configuration function is used to select a Transmit Interface fault monitor of AIS, Data, or none. When AIS (Alarm Indication Signal) is selected the TX_INTF (Transmit Interface) fault “Data/AIS” is monitoring a fault condition of all 1’s from customer data input to the modem. When Data_Flt is selected, the TX_INTF fault “Data/AIS” is monitoring a fault condition of all 1’s or all 0’s. This is referred to as a data stable condition which means that the data is not transitioning. When None is selected, the TX_INTF fault “Data/AIS” is not activated. On entry the current TX Data fault that is being monitored is displayed with the flashing cursor on the first character. Use the arrow keys to select Data, AIS, or None. Press the “ENTER” key to execute the change.
RXD_FLT	Receive Data Fault. This configuration function is used to select a Receive Interface fault monitor of AIS, Data, or None. The data monitored for Receive Data is coming from the Satellite. Refer to TXD_FLT for a description of the function choices. On entry the current RX Data fault that is being monitored is displayed with the flashing cursor on the first character. Use the arrow keys to select Data, AIS, or None. Press the “ENTER” key to execute the change.
BUF_SIZE	This configuration function is used to set the size of the plesiochronous buffer. On entry the current plesiochronous buffer length is displayed. Use the up and down arrow keys to select the desired buffer size. You may select from 1 to 32 seconds. Press the “ENTER” key to execute the change.
BUF_CNTR	This configuration function is used to center the plesiochronous buffer. Press the “ENTER” key twice to center the plesiochronous buffer.
READ_ERR	This configuration is used to select the read error function mode. Frame or 2047 errors may be selected. On entry the current read error mode is displayed. Use the arrow keys to select “2047” errors or “FRAME” errors as desired. Press the “ENTER” key to display and monitor the selected errors. To exit the read error mode press the “CLEAR” key.

DRP_DATA	This configuration is used to select the desired drop data channel signaling. The choices are E1CCS (E1 Common Channel Signaling), E1CAS (E1 Channel Associated Signaling), E1_IBS, T1_IBS, E1_31_TS, T1 (T1 data signal), and T1ESF (T1 Extended Super Frame). On entry the current drop data channel signal is displayed with the flashing cursor on the first character. Use the arrow keys to select E1CCS, E1CAS, E1_IBS, T1_IBS, E1_31_TS, T1, or T1ESF. Press the “ENTER” key to execute the change.
INS_DATA	This configuration is used to select the desired insert data channel signaling. The choices are E1CCS (E1 Common Channel Signaling), E1CAS (E1 Channel Associated Signaling), E1_IBS, T1_IBS, E1_31_TS, T1 (T1 data signal), and T1ESF (T1 Extended Super Frame). On entry the current insert data channel signal is displayed with the flashing cursor on the first character. Use the arrow keys to select E1CCS, E1CAS, E1_IBS, T1_IBS, E1_31_TS, T1, or T1ESF. Press the “ENTER” key to execute the change.
DROP CHANNELS	Programs the drop channels into the desired time slot from 1 to 31 for E1CCS, E1_31_TS, and E1CAS (dropping time slot 0 is not allowed) and from channels 1 to 24 for T1 and T1ESF. **Note:** The number of drop channels is data rate dependent. The number of Drop Channels = DR/64KBPS. 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 one and the current time slot is displayed with the flashing cursor on drop channel one. Use the up and down arrow keys to select the drop channel to be programmed. Use the right and left arrow keys to choose between drop channels and time slots. Use the up and down arrow keys to select the time slot for each available drop channel by incrementing or decrementing the digit at the flashing cursor. Press the “Enter” key to execute the change.

INSERT CHANNELS	Programs the Satellite bearer channels into the desired Terrestrial frame slot from 1 to 31 for E1CCS, E1_31_TS, and E1CAS and from channels 1 to 24 for T1 and T1ESF. **Note:** The number of Satellite bearer channels is data rate dependent. The number of Channels = DR/64KBPS. When the Satellite data rate is 64 KBPS there is only one Satellite bearer channel. When the Satellite data rate is 1920 KBPS there are 30 Satellite bearer channels. On entry Satellite bearer channel one and the current Terrestrial frame slot is displayed with the flashing cursor on Satellite bearer channel one. Use the up and down arrow keys to select the Satellite bearer channel to be programmed. Use the right and left arrow keys to choose between Satellite bearer channel and Terrestrial frame slot. Use the up and down arrow keys to select the Terrestrial frame slot for each available Satellite bearer channel by incrementing or decrementing the digit at the flashing cursor. Press the “ENTER” key to execute the change.
Scramblr	Programs the modulator for scrambler On or Off. On entry the current status of the scrambler is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change.
Dscrmblr	Programs the demod/decoder for descrambler On or Off. On entry the current status of the descrambler is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “ENTER” key to execute the change. * Indicates Test Mode configuration option.

3.2.3 Monitor

When the “MONITOR” level is entered use the right and left arrow keys to select the desired monitor function. Each monitor function is displayed in real time as long as it is selected.

Raw_BER - Raw bit error rate.
* Range: <1.0E-4 to 2550E-4

Cor_BER - Corrected bit error rate.

* Range: <1.0E-8 to >1E-3

Swp_Freq - Sweep Monitor**
*Range: -25,000 Hz to +25,000 Hz

Eb/N0 - Energy(bit)/noise ratio.
* Range: <3.2dB to >16.0 dB

RxSignal - Receive signal level.
* Range: <-60 dBm to >-30 dBm

FIL_STAT - Plesiochronous buffer fill status in percent.

FRM_ERR/2047_ERR - Framing pattern bit error rate. Monitors the currently selected READ_ERR function.

* When the decoder loses lock no data is available and is so indicated.

** Sweep Frequency only shows up in the “Monitor” menu if the Fast Acquisition has been turned on in the “Utility” menu.

3.2.4 Faults

The “FAULTS” level is accessible from the ‘sELECT” menu. Faults are similar to monitor functions as they display the current fault status of the group being displayed. Use the right and left arrow keys to move between the fault groups: Mod_Flts (modulator faults), Dmd_Flts (demodulator faults), CEQ_Flts (common equipment faults), TX_INTF (transmitter interface faults), RX_INTF (receiver interface faults), and ALARMS (backward alarm indicators). The current faults status is displayed on line two of the display in real time. Faults status is display as “+” (plus) or “-” (minus) for each parameter monitored, “+” indicates that a fault exists and “-” indicates that no fault exists. To display labels for individual faults press the “Enter” key. Use the left and right arrow keys to move the flashing cursor to the fault you wish to identify. The label for that fault is immediately displayed on line one of the display. The “Clear” key can be used to exit this level of operation and return to the previous level. The following lists outline the faults monitored and displayed in each group.

3.2.4.1 Mod_Flts - Modulator Faults

RF_Syn	Modulator RF synthesizer fault.
Data_Clk	Transmit data clock activity indicator.
TClk_Syn	Transmit clock synthesizer fault.
I-Channl	I channel activity fault.
Q-Channl	Q channel activity fault.
AGC_level	Automatic gain control level fault.
Module	Modulator module fault. Typically indicates that the modulator module is missing or will not program.

3.2.4.2 Dmd_Flts - Demodulator/Decoder Faults

C_Detect	Carrier detect fault. Indicates that the decoder is not locked.
RF_Syn	Demodulator RF synthesizer fault.
Data_Clk	Receive data clock activity fault.
I-Channl	I channel activity fault.
Q-Channl	Q channel activity fault.
BER Threshold	Indicates the set BER threshold has been exceeded.
Module	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not program.

3.2.4.3 CEQ_Flts - Common Equipment Faults

Battery	Battery fault.
-12 volt	Negative 12 volt power supply fault.
+12 volt	Plus 12 volt power supply fault.
+5 volt	Plus 5 volt power supply fault.
Controlr	Controller fault. Typically indicates that the controller has gone through a power on-off cycle.
Intrface	Interface module fault. Typically indicates that the interface module is missing or will not program.

3.2.4.4 TX_INTF - Transmit Interface Faults

Data/AIS	Data or Alarm indication Signal. When Data_FLT is selected in the Interface Configuration menu the fault indicates a Data stable condition. When AIS is selected, fault indicates data is all 1's. Refer to Section 3.2.2.3 (Interface Configuration) for a detailed description of these faults.
DROP	Drop Interface Hardware Fault. Typically indicates that the drop interface PLL is not locked.
CLK_ACT	Clock Activity fault. Indicates there is no clock activity on the TX interface.

3.2.4.5 RX_INTF - Receive Interface Faults

BUF_UNFL	Buffer underflow fault. Indicates that a plesiochronous buffer underflow has occurred.
BUF_OVFL	Buffer overflow fault. Indicates that a plesiochronous buffer overflow has occurred.
Data/AIS	Data or Alarm Indication Signal. When Data_FLT is selected in the Interface Configuration menu the fault indicates a Data stable condition. When AIS is selected, the fault indicates data is all 1's. Refer to Section 3.2.2.3 (Interface Configuration for a detailed description of these faults.
FRM_BER	Frame BER fault. Indicates that the frame BER exceeds 1E-3.
BW_ALM	Backward Alarm Fault.
INSERT	Insert Interface Hardware Fault. Typically indicates the insert interface PLL is not locked.
INS_clk	Insert Clock fault. Indicates no insert clock activity.
MUX_lock	MUX lock fault. Indicates that the MUX is not locked.

3.2.5 Stored Faults

The Modem stores the first ten (Flt0 - Flt9) occurrences of fault status changes in each of the six major fault categories. Each stored fault status change is stored with the time and date of the occurrence. Stored faults may be viewed by entering the ‘stFaults” level from the ‘sELECT” menu. All stored faults may be cleared by executing the “CLEAR ?? StFaults” command from the ‘stFaults” level.

Stored faults are not maintained through a controller power on reset cycle. However, the last known time is maintained in non volatile RAM and upon power up a common equipment fault is logged (Flt0) with that time and date. On power up an additional common equipment fault is also logged (Flt1) to indicate the power up time and date. So on power up the power down and power up times are logged as common equipment fault 0 and common equipment fault 1.

Upon entering the ‘stFaults” level use the left and right arrow keys to move between the six fault groups and the “CLEAR ?? StFaults” selections. The time and date of the first stored faults status (Flt0) for the selected group will be displayed alternately on line two of the display. Use the up and down arrow keys to cycle through the selected group’s stored faults status (Flt0 - Flt9). To display the faults status associated with the displayed time and date press the “Enter” key, at this time you can use the right and left arrow keys to move the flashing cursor to the fault you wish to identify.

To clear the stored faults currently logged simply press the “Enter” key when the “CLEAR ?? StFaults” selection is displayed.

Note: Faults are stored in time sequence with the oldest faults status change stored in Flt0 and the most recent in Flt9. Only the first ten faults status changes are stored and all stored faults which have not been used indicate “No Fault” on the display.

3.2.6 Utility

The utility functions provide a means to set the time and date of the modem real time clock circuit. Provisions are also made for assigning data and code rates to the modulator and demodulator. A lamp test function is provided for testing of the front panel optical indicators.

After entering the “UTILITY” functions level use the right and left arrow keys to select the utility function of interest. The current time and date can be displayed and changed as required. Access to the transmitter and receiver Data/Code Rate assignment and the lamp test functions are also available from within the utility functions level.

Note: The selection of data/code rates in the “UTILITY” program must match the hardware filters installed on the modulator and demodulator modules.

The utility functions are as follows:

Time	Time of day set/display function. The current time that the modem is set for is displayed when selected. To set the modem time press the “ENTER” key and use the right and left arrow keys to position the flashing cursor over the parameter to be changed. Use the up and down arrow keys to change the parameter to the desired value. Once the parameters are displayed as desired press the “ENTER” key to set the time.
Date	Date set/display. Follow the same procedure as outlined for the time function to view and set the date.
LAMP TEST ??	Lamp test function used to illuminate all the front panel indicators for three seconds. Press the “ENTER” key to turn on all of the front panel indicators for three seconds.
Address/Parity/Baud Rate	The current modem address, parity selection and selected baud rate of the modem is displayed. This in only a monitor function. No changes can be made from this menu. On entry the currently set address of the modem will be displayed (0 to 255) on the first line. The currently set parity, even or odd, will be displayed on the second line. The currently set baud rate from 110 to 9600 will also be displayed on the second line.
POW ADJ.	Modulator Power Adjust Offset. Allows the operator to offset the modulator output power readout in the configuration menu. This will be the highest modulator power that will be displayed and programmed. This feature does not actually change the modulator power level. The function is to change the actual reading to display an offset value in the monitor. The modulator Power Offset can be set between +20.0 to -20.0 dB in 0.5 dB increments. **Note:** The maximum output power adjust, set in this window, must match the maximum output power of the modulator installed in the modem. In a switching system the backup modem must be set the same as the prime modem or a fault will occur.
OP MODE	Operation Mode. Programs the modem operation for TX only, RX only, or Duplex operation. On entry the flashing cursor is on the first character of the display. Use the arrow keys to select TX only, RX only, or Duplex. Press the “ENTER” key to execute the change. When TX only or RX only is selected, the appropriate faults are masked from the Faults and Stored Faults menu.
Fast ACQ	Fast Acquisition function. Turns the fast acquisition and directed sweep function ON or OFF. When the fast acquisition has been turned OFF, the Swp_Cntr, SWP_Rnge and SWP_DIR windows in the configuration menu are disabled and do not appear. Also, in the “Monitor” menu, Swp_Freq will not appear. When turned “OFF” fast acquisition does not occur.

Filter Adjust	This is a factory setting and the operator is not allowed to enter this parameter without authorization from EFData service department. Failure to comply will result in a modem failure.
Assign TX_Fltrs	Transmit filter display/assignment utility. Used to view current filter rate assignments and to make filter rate reassignments. The modulator has four symbol rate filters. Each filter is for a specific symbol rate. The data rate and code rate for each filter must be established upon initial modulator installation and when circumstances indicate the need to do so. Filters are designated as A, B, C, and D. To view the current filter assignments press the “Enter” key when the “Assign TX_Fltrs” selection is displayed from the utility functions menu. On line one of the display will be TXA” which indicates transmitter filter A. Following “TXA” on line one will be the code rate (1/2 or 3/4) or “N/A” which indicates that the filter is not assigned. On line two will be the data rate assigned to filter “A”. Use the right and left arrow keys to see the assignments for filters B, C, and D (TXB, TXC, and TXD). If it is desired to change a filter assignment press the “Enter” key when the data for that filter is displayed. Use the right and left arrow keys until the flashing cursor is at the parameter to be changed. Then use the up and down arrow keys to change that parameter. When all changes are made press the “ENTER” key to confirm the assignment. Some filters may have parameters preprogrammed in the filter board hardware. If the filter parameters are preprogrammed the previously described programming techniques will be disabled. **Note:** These assignments are used for the selection of “TXR” (Transmitter Rate) in the configuration functions menu. The parameter “N/A” is used to indicate that the specific filter is not present.
Assign RX_Fltrs	Receive filter display/assignment utility. Used to view current filter rate assignments and to make filter rate reassignments. Refer to the previous text under “Assign TX_Fltrs”. The receive filters assignments are basically identical.

Figure 3-12 Menu Tree

Figure 3-13 Menu Tree

Figure 3-14 Menu Tree

Figure 3-15 Menu Tree

Figure 3-16 Menu Tree

Figure 3-17 Menu Tree

Chapter 4.
M&C AND INTERFACES

4.1 Monitor And Control

4.1.1 General

The Modem uses a sophisticated microcontroller module to perform the monitor and control functions of the modem. This module is referred to as the Monitor & Control (M&C) (Figure 4-1). The M&C monitors the modem and provides configuration updates to other modules within the modem when necessary. Modem configuration parameters are maintained in battery backed RAM which provides for total recovery after a power down situation. Extensive fault monitoring and status gathering is provided. All modem functions are accessible through a local front panel interface and a remote communications interface.

4.1.2 Description of Options

4.1.2.1 Remote Interface

All modem functions can be remotely controlled and monitored via a RS-485 (optional RS-232C) communications link. The two wire, half duplex RS-485 interface makes it possible to operate 255 modems on a common communications link. While the RS-232C interface is used to communicate with a single Modem. The M&C module must be hardware configured to one of the two interfaces.

RS-485 Configuration: To configure the M&C for RS-485 operation.
Install jumpers JP1, JP2, and JP3.
Remove jumpers JP4, JP5 and JPX.
Connect JP7 to RS485

RS-232C Configuration: To configure the M&C for RS-232C operation.

Install jumpers JP4, JP5 and JPX.

Remove jumpers JP1, JP2, and JP3.

Connect JP7 to RS232

Figure 4-1 Monitor & Control Card

4.1.2.2 Remote Baud Rate

The remote communications baud rate and parity is programmed by a switch pack (SP1) on the M&C module. Programming the baud rate and parity is accomplished by setting the switches. The switches are individually set in the OFF or ON positions. A switch is programmed “OFF” by placing it in the position furthest away from the PCB (open). “ON” is programmed by placing the switch in the position nearer the PCB.

Switch position #1 sets the parity as follows:			
Even Parity-		SP1-1 OFF	
Odd Parity-		SP1-1 ON	
Switch positions #2, #3, and #4 set the baud rate as follows:			
BAUD	SP1-2	SP1-3	SP1-4
110	ON	ON	ON
150	ON	ON	OFF
300	ON	OFF	ON
600	ON	OFF	OFF
1200	OFF	ON	ON
2400	OFF	ON	OFF
4800	OFF	OFF	ON
9600	OFF	OFF	OFF

Note: SP1 on the M&C modules have four additional switches, (SP1-5 through SP1-8). These four switch locations are not currently assigned or used.

4.1.2.3 Remote Address

Each modem must be configured for one address between 1 and 255 to communicate using the established remote communications protocol. Each modem on a common remote communications link (RS-485) must have a distinct address. Addresses are programmed by a switch pack (SP2) on the M&C module. Addresses are binary coded numbers set at SP2 with switch #1 (SP2-1) being the most significant bit and switch #8 (SP2-8) the least significant bit.

4.1.2.4 Battery

A rechargeable battery on the M&C module allows it to retain configuration information without prime power for up to 30 days. A jumper JP6 is supplied on the M&C module to disconnect battery power from the backup RAM. During normal operation this jumper should be in the ON position. Should the Modem be 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 battery backed up RAM to see if valid data has been retained. If valid data has been retained the Modem is reconfigured to the configuration maintained in RAM.

2. If the battery backed RAM failed the valid data test the modulator, demodulator, and interface modules would be tested to determine if valid configuration information was retained by them. If valid configuration information was retained by a module, that module's configuration will be stored in the battery backed RAM and maintained from that point on.

3. If battery backed RAM failed the valid data test and a module fails the valid data test a default configuration for the module is stored in battery backed RAM and maintained.

4.1.2.5 Modulator/Coder Defaults

TXA	Transmit Filter A [1/2 (code rate), 64Kbps]
TXB	Transmit Filter B [1/2 (code rate), 256Kbps]
TXC	Transmit Filter C [1/2 (code rate), 768Kbps]
TXD	Transmit Filter D [1/2 (code rate), 2048Kbps]
TXR	Transmit rate selected "A" [1/2, 128Kbps]
TX_Freq	Transmitter frequency [70MHz]
RF_Out	RF Output [OFF]
TX_Power	Transmit Power Level [-10dBm]
DifEncdr	Differential Encoder [ON]
CW_Mode	Continuous Wave Mode [OFF]

4.1.2.6 Demodulator/Decoder Defaults

RXA	Receive Filter A [1/2 (decode rate), 64Kbps]
RXB	Receive Filter B [1/2 (decode rate), 256Kbps]
RXC	Receive Filter C [1/2 (decode rate), 768Kbps]
RXD	Receive Filter D [1/2 (decode rate), 2048Kbps]
RXR	Receive rate selected "A" [1/2, 128Kbps]
RX_Freq	Receiver frequency [70MHz]
DifDecdr	Differential Decoder [ON]
RFLoopBk	RF Loop Back [OFF]
IFLoopBk	IF loop back [OFF]
SWP_RACQ	Sweep Reacquisition [0 Sec]
*SWP_CNTR	Sweep Center [0 Hz]
*SWP_RNGE	Sweep Range [50000Hz]
*SWP_DIR	Sweep Direction [Forward]
BERTset	BER Threshold [None]

*These windows only show up when Fast_ACQ (Fast Acquisition) has been turned "ON" in the Utility menu.

4.1.2.7 Interface Configuration Defaults

TX_clock	Transmit Clock [Internal]
Buf_Clk	Buffer Clock [Satelite]
RX_clock	Receive Clock [Normal]
Ext_Ref	External Reference [1544KHz]
BBLoopBk	Base Band Loop Back [OFF]

INTF_LBk	Interface Loop Back [OFF]
Coding	[AMI]
TX_2047	[OFF]
TXD_Flt	[NONE]
RXD_Flt	[NONE]
Buf_Size	[384]
Read_ERR	[FRAME]
Dscrmblr	Descrambler [ON]
Scramblr	Scrambler [ON]

4.1.2.8 Utility Defaults

POW ADJ	Power Adjust [-5.0 dBm]
OP MODE	Operation Mode [Duplex]
Fast_ACQ	Fast Acquisition [OFF]

Note: If Battery backed RAM fails the valid data test time and date are set as follows:

Date 7/4/76
Time 12:00AM

4.1.3 Remote Interface Specification

Refer to Appendix B for the remote interface specification.

4.1.4 Monitor and Control Theory of Operation

The Monitor and Control module is built around the Intel 80C31 microcontroller operating at 5.5295 MHz. The microsystem is designed to support 64K bytes of read only code memory and 64K bytes of random access data memory. Of the 64K bytes data memory only 4K is used for RAM, the remaining address is used for memory mapped I/O. Memory mapped I/O includes real time clock/memory, a eight channel analog to digital converter and external buffered bus structure for overall modem control and status gathering. The 80C31 microcontroller supports a serial asynchronous communications channel with a maximum baud rate of 9600bps using the 5.5295 MHz reference. A rechargeable battery is employed to maintain the system real time clock and modem configuration through power out situations.

4.2 Digital Interfaces

4.2.1 IBS/M1200P Interface

4.2.1.1 Functional Description

The IBS Interface module (Figure 4-2) consists of two PWB's that are married together. The two assembly numbers are AS/1010 and AS/1011. Figure 4-3 is a block diagram of the IBS/M1200P Channel Unit. Figure 4-4 is a fault and alarm tree designed to explain the fault and alarm reporting matrix that is designed in the IBS/M1200P Channel Unit. Refer to Section 3.1.6 (Faults) and Section 3.1.2 (LED Indicators) for a detailed description of the faults and alarms.

The IBS Interface module provides fully compliant baseband processing in accordance with Intelsat IESS-309 for serial data rates of 64, 128, 256, 384, 512, 768, 1536, 1544, 1920, and 2048 kb/s. IESS-309 framed operation is not supported by this interface. Control parameters including data rate may be set by the customer in the interface configuration menu either from the front panel or remotely through the RS-485 or RS-232 interface (see Section 4.1, M&C of the modem manual).

4.2.1.2 Data Interface

The module provides three field selectable data interfaces: V.35, RS422, and G.703. The G.703 interface supports only the 1544 and 2048 data rate selections, while all data rates are supported by both the V.35 and RS422 interfaces.

Data rate selection is done by installing a header on the interface card and connecting to the proper connector on the IBS subpanel. Figure 4-5 (Jumper Table) describes the different interface header connections and shows the location of JP1, JP2, and JP3 on the IBS Terrestrial Interface.

A bidirectional data loop back function, "Baseband Loopback" is provided in this Section so that the user may determine that his baseband data is reaching the interface. Refer to Figure 3-2 (Front Panel Menu Tree) for the location of the baseband loopback function.

4.2.1.3 Transmit Multiplexer

The customer data stream is multiplexed with the Engineering Service Channel (ESC) and the resultant information (16/15 times the data rate) is interfaced to the Mod/Demod/Coder Sections of the modem. A phase locked loop generates the output clock from a user selectable reference. Normally this reference will be the recovered clock from the data interface, but in certain circumstances it may be desirable to use an external reference clock. An RS-422 input is provided for this purpose (EXC-A and EXC-B) and may be selected during configuration. Also available is a 10-5 accuracy

reference clock generated in the modem. The interface will automatically select the internal clock if it detects a problem with the customer selected clock. A fault will be signaled if this happens.

Figure 4-2 IBS Interface Module

Figure 4-3 IBS Interface Block Diagram

Figure 4-4 IBS Fault Tree

Figure 4-5 Jumper Table

The transmit data will be replaced with an all ones pattern (Alarm Indication Signal or AIS) in the event of certain failures, per IESS-309. The modem will transparently pass an incoming AIS signal but can signal that this is happening if interrogated from the front panel or remotely through the M&C Interface.

As a test mode the transmit data can be replaced with a 2047 pattern. Selecting this overrides AIS. Only user data bits are replaced with the pattern, the Engineering Service Channel including framing and alarms will operate normally.

The composite multiplexed data stream is normally fed to the modem for further processing (K7 Viterbi encoding and modulation), but maybe looped back at this point as a test function called "Interface Loopback". This allows the customer to test virtually the entire interface as the ESC is looped to itself through the Demultiplexer (Demux). User data also passes through the a Plesiochronous buffer in this mode, so this may also be checked. The interface loopback function is bidirectional so that received modem data is returned to the modulator for transmission. Figure I-2 (Front Panel Menu Tree) shows the location of the Interface Loopback function.

4.2.1.4 Receive Multiplexer

Receive data including overhead is fed into the demultiplexer for processing (except in interface loopback). 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 signal and synchronized, it will signal the modem that the multiplex system is locked ("Muxlock") and passing data . This is indicated by interrogating the modem and by a green Light Emitting Diode (LED) on the Interface, and is fed into the receive fault tree per IESS-309. Under certain fault conditions defined by IESS-309 the receive user data will be replaced by an all ones pattern. A fault will be signaled when this occurs.

4.2.1.5 Plesiochronous Buffer

User data from the Demux Section is fed into a Plesiochronous buffer. The buffer size is user selectable in 16 bit increments from 384 to 262144 bits. The buffer is automatically centered on resumption of service after an outage or may be commanded to center in the interface configuration Section, from the front panel or remotely. Manual centering will generally not be Plesiochronous for obvious reasons.

The fill status is available as a monitor function and is accurate to 1%. Overflow or underflow incidents will be momentarily indicated by red LED’s on the module and are stored in the ‘stored Fault" Section of the Monitor & Control status registers, along with the date and time of the incident, provided by the modem internal clock. These are stored in battery backed RAM.

The user may select to have the data clocked out of the buffer from 4 clock sources; the recovered "TX Terrestrial" clock from user terrestrial input data, a user supplied "External" reference clock, the ‘satellite" clock which is the modem receive clock, or the "Internal" clock source. Satellite clock selection is similar to buffer bypass. Lack of

activity on either the TX Terrestrial clock or the external clock (if selected) will substitute Satellite clock and a fault will be signaled.

4.2.1.6 Engineering Service Channel (ESC)

The engineering service channel (ESC) is fully compliant with IESS 309 Rev. 2 for serial Data Rates as defined in Section 2.1. It generates overhead at a rate of 1/15 times the data rate which is multiplexed with the customer data to achieve the output data rates. Circuits included consist of a backward alarm channel and an Earth Station to Earth Station communication channel.

The backward alarm channel is transmitted by the "near end" to inform the "far end" that data is not being properly received. It is generated per IESS 309. Receipt of the backward alarm is reported by closure of the secondary alarm relay.

The Earth Station to Earth Station (ES to ES) channel asynchronously samples the Transmit Data (TD) signal of the RS-232 channel at a sample rate of 1/512 times the customer data rate. A minimum of 3 (preferably 4) samples of each bit of the TD signal are required to reliably reproduce the signal at the far end (RD). Therefore the maximum RS-232 data rate which will provide for asynchronous communications is approximately 1/2000 times the customer data rate.

For example, if the modem data rate is 64 KBPS, the TD signal would be sampled at a rate of 64000/512 which is equal to 125 BPS. The minimum of 4 samples of the TD signal per sample rate of 125 BPS would make a maximum RS-232 data rate of 125 BPS/4 which is equal to 31.25 BPS.

If the modem data rate is 2048 KBPS, the TD signal would be sampled at 2048000/512 which is 4000 BPS. 4000 BPS/ 4 samples would require a maximum RS-232 data rate of 1000 BPS.

4.2.1.7 IBS Interface Connector Pinouts

The IBS interface is the Data Common Equipment (DCE), which receives incoming data, and is provided on a 50 pin female "D" connector accessible from the rear panel of the modem. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
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
RS-422/V.35 SEND DATA	SD_A SD_B	37 38
RS-422/V.35 RECEIVE DATA	RDA RDB	39 40

TERRESTRIAL TX DATA	TERESTXDAT	5
ENGINEERING SERVICE CHANNEL	RXESCDAT	7
RS-422/V.35 RECEIVE TIMING	SCR/RTA SCR/RTB	23 24
RS-422/V.35 TRANSMIT TIMING	SCT/STA SCT/STB	21 22
RS422/V.35 TERMINAL TIMING	SCTE/TTA SCTE/TTB	12 13
RS422 TRANSMIT OCTET	R422TXOA R422TXOA	14 15
RS422 RECEIVE OCTET	R422RXOA R422RXOB	8 9
RS422/V.35 REQUEST TO SEND	RTSA RTSB	45 29
V.35 DATA SET READY	V.35_DSR	41
RS422/V.35 CLEAR TO SEND	CTSA CTSB	47 31
RS422/V.35 DATA SET READY	DSR/DMA DSR/DMB	48 32
RS422/V.35 RECEIVER READY	RRA/RLSD RRB/RLSD	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

4.2.1.8 IBS Interface Specification

Common Interface Specifications	
Transmit Clock Reference	TX_Terrestrial (derived from TT, SCTE, or SD) Internal (10^{-5} accuracy) External Reference (differential receiver)
Buffer Clock Reference	TX_Terrestrial (derived from TT, SCTE, or SD) Satellite (bypass) External Reference (differential receiver) Internal (10^{-5} accuracy)
Modulator Fault	Open collector output 15 V max 20 mA max current sink Fault is open circuit
Demodulator Fault	Open collector output 15 V max 20 mA max current sink Fault is open circuit
External Clock Characteristics	Amplitude: Differential .5 - 5 V p-p Common Mode 0 - 2.5 VDC Frequency: 8 KHz to 10 MHz, in 8 KHz Steps Impedance: 100 Ω Waveshape: Sine or Square Duty Cycle: 50 ± 10%
Earth Station to Earth Station Channel	RS-232 TD, RD, DSR, RTS, CTS 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.

RS-232 Specification	
Circuit Supported	RD, TD, DSR, RTS, CTS
Amplitude (RD, RTS)	True: 14 V ± 11 V False: -14 V ± 11 V
Amplitude (TD, DSR, CTS)	True: 11 V ± 2 V False: -11 V ± 2 V
Impedance	5000 ± 2000 Ω <2500pF
Baud Rate	Max: 1/2000 times the data rate (Refer to Section 2.1.5 for details)
RS422 Specification	
Circuit Supported	SD, ST, TT, RD, RT, DM, RR, MC
Amplitude (RD,RT,ST,DM,RR)	4 ± 2 V differential into 100 Ω
Impedance (RD,RT,ST,DM,RR)	Less than 100 Ω, differential
Impedance (SD,TT,MC)	100 ± 20 Ω, differential Polarity True when B positive wrt A False when A positive wrt 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
V.35 Specification	
Circuit Supported	SD, SCT, SCTE, RD, SCR, DSR, RLSD, MC
Amplitude (RD,SCR,SCT,SD,SCTE)	.55 V pk ± 20% differential, into 100 Ω
Amplitude (CTS,DSR,RLSD)	10 ± 5 V into 5000 ± 2000 Ω
Impedance (RD,SCR,SCT)	100 ± 20 Ω, differential
Impedance (SD,SCTE)	100 ± 10 Ω, differential
Impedance (RTS)	5000 ± 2000 Ω, <2500 pf
DC Offset (RD,SCR,SCT)	± .6 V max, 1000 ohm termination to ground
Polarity (SD,SCT,SCTE,RD,SCR)	True when B positive wrt A False when A positive wrt B
Polarity (RTS,CTS,DSR,RLSD)	True when <-3V wrt ground False when >+3V wrt ground
Phasing (SCTE,SCR)	False to True transition nominally in center of data bit.
Symmetry (SCT,SCTE,SCR)	50% ± 5%
Frequency Stability (SCT)	± 100 ppm
G.703 Specification	
Composite Data Rates Supported	1544 Kb/s 2048 Kb/s
Primary Data Circuits Supported	T1 - SD,RD E1 - SD,RD
Interface Type	Transformer Coupled Symmetrical Pair
Data Rate	T1 - 1544 Kb/s ± 100 b/s E1 - 2048 Kb/s ± 130 b/s
Pulse Width	T1 - 324 ± 50 nsec E1 - 244 ± 25 nsec
SD Amplitude	T1 - 3 +.3/- 1.5 V pk into 100 Ω E1 - 3 +.3/- 1.5 V pk into 120 Ω
RD Amplitude	T1 - 3 ± .3 V pk into 100 Ω E1 - 3 ± .3 V pk into 120 Ω
Pulse Mask	T1 - G.703.2 E1 - G.703.6
Line Code	Selectable AMI, B6ZS, B8ZS, or HDB3
Jitter Attenuation	T1 - per AT&T 43802 T1 - per CCITT G.824 E1 - per CCITT G.823

4.2.1.9 IBS Interface Breakout Panel

The IBS Breakout Panel supports the use of the SDM-309 modem with an IBS/M1200P Channel Unit. Connections between the breakout panel and other equipment are made through front and rear panel connectors. These connectors are listed in Table 4-1. The location of these connectors are shown in Figure 4-6. Figure 4-7 shows the schematic diagram for the IBS Interface Breakout panel. The assembly number for the breakout panel is AS/1030.

Table 4-1

Ref Desig.	Connector Type	Name	Pinout Section
J1	50 PIN “D”	IBS TERR. INTERFACE	4.2.1.9.1
J2	37 PIN “D”	RS422 INTERFACE	4.2.1.9.2
J3	CNV 35 PIN	V.35 INTERFACE	4.2.1.9.3
J4	25 PIN “D”	ENGINEERING SERVICE CHANNEL	4.2.1.9.4
J5	15 PIN “D”	G.703 INTERFACE	4.2.1.9.5
J6	BNC	EXT REF CLOCK	4.2.1.9.6
J7	BNC	SEND DATA	4.2.1.9.7
J8	BNC	RECEIVE DATA	4.2.1.9.8
TB1	TERMINAL BLOCK	ALARMS OUTPUT	4.2.1.9.9

Figure 4-6 IBS Break-Out Panel

4.2.1.9.1 IBS Terrestrial Interface (J1)

The IBS terrestrial interface is provided on a 50 pin female "D" connector accessible from the rear of the breakout panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	1,2
T1E1 SEND DATA	T1E1_SD-A T1E1_SD-B	34 18
EXTERNAL CLOCK	EXC-A EXC-B	35 19
T1E1 RECEIVE DATA	T1E1_RD-A T1E1_RD-B	36 20
TERRESTRIAL TX DATA	TXD	5
SEND DATA	SD-A SD-B	37 38
SERIAL CLOCK TX/SEND TIMING	SCT/ST-A SCT/ST-B	21 22
TERRESTRIAL RX DATA	RXD	7
RECEIVE DATA	RD-A RD-B	39 40
SERIAL CLOCK RX/RECEIVER TIMING	SCR/RT-A SCR/RT-B	23 24
RS422 RX OCTET	RS422RXO-A RS422RXO-B	8 9
SERIAL CLOCK TX EXT./TERMINAL TIMING	SCTE/TT-A SCTE/TT-B	12 13
REQUEST TO SEND	RTS-A RTS-B	45 29
RECEIVE LINE SIGNAL DETECT/RECEIVER READY	RLSD/RR-A RR-B	46 30
RS422 TX OCTET	RS422TXO-A RS422TXO-B	14 15
CLEAR TO SEND	CTS-A CTS-B	47 31
DATA SET READY/DATA MODE	DSR/DM-A DM-B	48 32
TERRESTRIAL ESC DATA SET READY	TER_ESC_DSR	41
PRIMARY ALARM	PRI_COM PRI_NO PRI_NC	10 43 27
SECONDARY ALARM	SEC_COM SEC_NO SEC_NC	11 44 28

4.2.1.9.2 RS422 Interface (J2)

The RS422 interface is provided on a 37 pin female “D” connector accessible from the front of the break-out panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number

GROUND	GND	1, 19, 20, 37
TX OCTET	TXO-A TXO-B	3 21
SEND DATA	SD-A SD-B	4 22
SEND TIMING	ST-A ST-B	5 23
RECEIVE DATA	RD-A RD-B	6 24
RECEIVER TIMING	RT-A RT-B	8 26
EXTERNAL CLOCK	EXC-A EXC-B	15 33
REQUEST TO SEND	RTS-A RST-B	7 25
CLEAR TO SEND	CTS-A CTS-B	9 27
TERMINAL TIMING	TT-A TT-B	17 35
RX OCTET	RXO-A RXO-B	16 34
RECEIVER READY	RR-A RR-B	13 31
DATA MODE	DM-A DM-B	11 29

4.2.1.9.3 V.35 Interface (J3)

The V.35 interface is provided of a 35 pin CNV connector accessible from the front of the breakout panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	A, B
REQUEST TO SEND	RST	C
CLEAR TO SEND	CTS	D
DATA SET READY	DSR	E
RECEIVE LINE SIGNAL DETECT	RLSD	F
SEND DATA	SD-A SD-B	P S
RECEIVE DATA	RD-A RD-B	R T
SERIAL CLOCK TRANSMIT EXTERNAL	SCTE-A SCTE-B	U W
SERIAL CLOCK RECEIVE	SCR-A SCR-B	V X
SERIAL CLOCK TRANSMIT	SCT-A SCT-B	Y AA
EXTERNAL CLOCK	EXC-A EXC-B	CC DD

4.2.1.9.4 Engineering Service Channel

The engineering service channel is provided on a 25 pin “D” female connector assessable from the front panel of the breakout panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	1, 7
TRANSMIT DATA	TXD	2
RECEIVE DATA	RXD	3
REQUEST TO SEND/CLEAR TO SEND	RTS/CTS	4 5
TERRESTRIAL ESC DATA SET READY	TER_ESC_DSR	6

Note: RTS and CTS are looped together on the connector.

4.2.1.9.5 G.703 Interface (J5)

The G.703 interface is provided on a 15 pin female "D" connector and is located on the front of the break-out panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	2, 4
RECEIVE DATA	T1E1_RD-A T1E1_RD-B	3 11
SEND DATA	T1E1_SD-A T1E1_SD-B	1 9
EXTERNAL CLOCK	EXC-A EXC-B	7 8

4.2.1.9.6 External Reference Clock (J6)

This connector is the interface for the unbalanced external reference clock input. To activate this connector, SW1 must be in the UNBAL position. If the balanced external reference clock input is to be used SW1, must be in the BAL position. Switch 1 is located on the front panel to the right of the external reference clock input.

4.2.1.9.7 Send Data (J7)

This connector is the interface for the unbalanced Send Data input. To activate this connector SW2 must be in the UNBAL position. If the balanced Send Data input is to be used, SW2 must be in the BAL position. Switch 2 is located on the front panel to the right of the send data input.

4.2.1.9.8 Receive Data (J8)

This connector is the interface for the unbalanced Receive Data input. To activate this connector SW3 must be in the UNBAL position. If the balanced Send Data input is to be used, SW3 must be in the BAL position. Switch 3 is located on the front panel to the right of the receive data input.

4.2.1.9.9 Alarm Outputs (TB1)

The alarm outputs are provided on a 8 position terminal block located on the front panel of the breakout panel.

Signal Function	Name	Pin Number
GROUND	GND	1, 5
PRIMARY ALARM	PRI_COM PRI_NO PRI_NC	2 3 4
SECONDARY ALARM	SEC_COM SEC_NO SEC_NC	66 7 8

Figure 4-7 IBS Interface Breakout Panel Schematic Diagram

4.2.2 Drop & Insert Interface

4.2.2.1 Functional Description

The IDR Drop & Insert Interface module (Figure 4-8) consists of two PWBs that are married together. The two assembly numbers are AS/1010 and AS/1455. Figure 4-9 is a block diagram of the Drop & Insert Channel Unit. Figure 4-10 is a fault and alarm tree designed to explain the fault and alarm reporting matrix that is designed in the IDR/M1200P Channel Unit. Refer to Section 3.1.6 (Faults) and Section 3.1.2 (LED Indicators) for a detailed description of the faults and alarms.

The IDR Drop & Insert Interface module provides fully compliant baseband processing in accordance with Intelsat IESS-308 rev. 6 for the Terrestrial information rate of 2048 kbits/s (E1) allowing N X 64 Kbit data rates (see the specifications for N=X) over the satellite link. The interface also supports IESS-308 rev. 6 transmission and reception parameters with a G.703 1544 kbits/s (T1) Terrestrial Interface. The interface module provides interface to transmission level framing compliant to IESS-309 Section 4.6.2, data type 2. Control parameters including T1 or E1 may be set by the customer in the interface configuration menu either from the front panel or remotely through the RS-485 or RS-232 interface (see Section 4.1, M&C of the modem manual). Selection is made by choosing the appropriate Terrestrial Interface under interface configuration. Also, there are jumpers on the 1455 PWB that must be selected to determine T1 or E1 operation. Refer to Figure 4-11 for jumper selection.

Selection of the Transmit and Receive data rates may be made in 64 Kbit/s increments and may be independent of each other. The actual satellite rates is 16/15 of the transmit or receive data rate to include overhead per IESS-308 rev. 6 but this is transparent to the user.

The user must select the actual terrestrial time slots to be transmitted or received under the interface config menu either from the front panel or through the RS-485 or RS-232 interface. Any time slots from 1 to 31 for E1 or channels from 1 to 24 for T1 may be selected. Note that E1 access to time slot 0 is not allowed.

Time slots may be selected in arbitrary order. The user should be aware that some of the time slots generally contain framing information instead of data, but this allows greater flexibility in use. The configuration menu will allow time slots to be selected for transmission or reception up to the maximum permitted by the particular transmit or receive data rate.

The satellite overhead includes an Engineering Service Data Channel. Use of this channel is not specified by IESS-308/309. EFData uses it to implement an oversampled RS-232 data link which will work at data rates up to 1/2000 of the satellite rate.

4.2.2.2 Data Interface

The module contains transformer balanced data interfaces supporting CCITT G.703 parameters, (compatible with AT&T DSI service) and de-jitter. Data inputs are named Drop Send Data Input A and B (DSD-A and DSD-B) and Insert Send Data Input A and B (ISD-A and ISD-B). Outputs are Drop Receive Data Output A and B (DRD-A and DRD-B) and Insert Receive Data Output A and B (IRD-A and IRD-B). Frequently the system will be used with the Drop Receive Data Output signal looped to feed the Insert Send Data Input. This is to be done at the far end of any redundancy switching as this will allow Transmit and Receive chains to be switched independently. Zero substitution codes are AMI, B8ZS, and HDB3 are user selectable during configuration.

A data loop back function on the "Insert" data is available in this Section so that the user may determine that his T1, or E1 data parameters correctly match those of this interface. The "Drop" data is always hard wired into loopback.

4.2.2.3 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 no valid input signal is present the interface will fall back to a 10-5 accuracy reference clock generated in the modem and transmit a valid IESS-308 framing pattern. This will keep the link open to the far end. A fault will be signaled if this happens.

The transmit data will be replaced with an all ones pattern (Alarm Indication Signal or AIS) in the event of certain failures, per IESS-308.

As a test mode the transmit data can be replaced with a 2047 pattern. Selecting this overrides AIS. Only user data bits are replaced with the pattern, the Engineering Service Channel including framing and alarms will operate normally.

The composite multiplexed data stream is normally fed to the modem for further processing (scrambling and K7 Viterbi encoding). The composite data stream may be looped back at this point as a test function called "Interface Loopback" provided that the transmit data rate matches the receive data rate. This allows the customer to test virtually the entire interface as the ESC is looped to itself through the Demultiplexer (Demux). User data also passes through the a Plesiochronous buffer in this mode, so this may also be checked.

4.2.2.4 Receive Demultiplexer

Receive data including overhead is fed into the demultiplexer for processing. 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 signal and synchronized, it will signal the modem that the multiplex system is locked ("Muxlock") and passing data . This is

indicated by interrogating the modem and by a green Light Emitting Diode (LED) on the Interface, and is fed into the receive fault tree per IESS-308. Under certain fault conditions defined by IESS-308 the receive user data will be replaced by an all ones pattern. A fault will be signaled when this occurs.

4.2.2.5 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. These increments turn out to be in 1, 2, 4, 6, 8, 12, 24, and 32 msec. The buffer is automatically centered 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 start up buffer will overfill upon centering to match the satellite frame to the terrestrial frame with a maximum slide of 0.5 msec. Manual centering will generally not be Plesiochronous for obvious reasons.

The fill status is available as a monitor function and is accurate to 1%. Overflow or underflow incidents will be momentarily indicated by red LED’s on the module and are stored in the ‘stored Fault" Section of the Monitor & Control status registers, along with the date and time of the incident, provided by the modem internal clock. These are stored in battery backed RAM.

The user will normally select 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 2 other clock sources as a backup, either a user supplied "External" reference clock, or the internal" clock source. Problems on either the Recovered Receive data input clock or the external clock (if selected) will substitute Satellite clock and a fault will be signaled.

4.2.2.6 Engineering Service Channel (ESC)

The engineering service channel (ESC) uses certain of the satellite overhead bits to implement an asynchronous RS-232 data channel. This channel works by oversampling input and output RS-232 data so that no clock signal is required. Data rates up to 1/2000 of the satellite rate may be used.

4.2.2.7 Backward Alarm

A backward alarm is included in the overhead. Basically, backward alarms are sent to the distant side of an satellite link to signal that there is trouble with the receive side which may be as a result of improper transmission. The M&C computer monitors the receive side of the link and in the event of trouble sends an alarm over the transmit side to the distant end. This alarm signal also indirectly includes faults in the downlink chain since major problems with the antenna, LNA, or downconverter, etc. will cause an interruption in service which will fault the modem. Reception of a backward alarm is indicated as one

of the events which cause a secondary alarm. The modem may be interrogated from the front panel or using the RS-485 or RS-232 interface to identify the cause of the alarm.

Figure 4-8 Drop and Insert Channel Unit

Figure 4-9 Drop and Insert Block Diagram

Figure 4-10 Drop & Insert Fault Tree

Figure 4-11 Drop & Insert Jumper Table

4.2.2.8 Drop & Insert Interface Connector Pinouts

The D&I interface is provided on a 50 pin female "D" connector accessible from the rear panel of the modem. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	1,2
DROP DATA INPUT	DSD-A DSD-B	34 18
DROP DATA OUTPUT	DRD-A DRD-B	37 38
INSERT DATA INPUT	ISD-A ISD-B	39 40
INSERT DATA OUTPUT	IRD-A IRD-B	36 20
REFERENCE CLOCK (RS-422) IN	EXC-A EXC-B	35 19
TX RS-232 DATA RX RS-232 DATA	TERESTXDAT TERESRXDAT	5 7
RS-232 DATA SET READY	DSR	48
PRIMARY FAULT RELAY	PRI-COM PRI-NC PRI-NO	10 (Note 1) 27 43
SECONDARY FAULT RELAY	SEC-COM SEC-NC SEC-NO	11 (Note 1) 28 44
MODULATOR FAULT	MF	49 (Note 2)
DEMODULATOR FAULT	DF	33 (Note 2)
RESERVED		3

Notes:

1. ALARM Relay contacts named for normal No Fault condition (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 SMS-658 M/N backup switch if used in redundant system.

4.2.2.9 Drop & Insert Interface Specification

Terrestrial Data Rates Supported	1544 Kb/s per G.703 2048 Kb/s per G.703
Terrestrial Framing Supported	G.732/G.733, G.704
Primary Data Circuits Supported	T1 DSD,DRD,ISD,IRD E1 DSD,DRD,ISD,IRD

Satellite Data Rates Supported	N x 64 Kb/s, N = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20 r 24 (T1) N = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, or 30 (E1) N = 32 (E1_IBS) N = 24+ (T1_IBS)
Satellite Overhead Rate	1/16 of Data Rate per IESS-308 Rev. 6 and IESS-309 Rev. 3
Drop Time Slot Selection (Time Slot 0 not allowed)	1 to 24 (T1) 1 to 31 (E1) Arbitrary Order
Insert Time Slot Selection (Time Slot 0 not allowed)	1 to 24 (T1) 1 to 31 (E1) Arbitrary Order
Interface Type	Transformer Coupled Symmetrical Pair
Data Rate	T1 1544 Kb/s ± 100 b/s E1 2048 Kb/s ± 130 b/6s
Pulse Width	T1 324 ± 50 nsec E1 244 ± 25 nsec
SD Amplitude	T1 3.0 + 0.3/- 1.5 V pk into 100 Ω E1 3.0 + 0.3/- 1.5 V pk into 120 Ω
RD Amplitude	T1 3.0 ± 0.3 V pk into 100 Ω E1 3.0 ± 0.3 V pk into 120 Ω
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 (RS-422 Input)
Plesiochronous Buffer	Included in receive path
Buffer Clock Reference	Derived from Insert Input External (RS-422) Internal
Buffer Depth T1, T1_ESF, E1_CCS, E1_IBS, E1_31_TS	1, 2, 4, 6, 8, 12, 24, or 32 msec
E1_CAS	7.5, 15, 30 msec
T1_IBS	6, 12, 18, 24 or 30 msec
Depth Status	Monitored accurate to 1 %
Buffer Centering	Automatic (start of service) Manual
Overflows/Underflows	Logged as stored fault
ESC Data Interface Type	RS-232
ESC Data Rate	1/2000 of Satellite Data Rate, Maximum (Oversampled)
ESC Data Circuits Supported	SD, RD, DSR
Backward Alarms Supported	1, looped per IESS-309
Backward Alarm Output	Sums into Secondary Alarm
Modulator Fault	Open collector, 15 V max, 20 ma max. Used by Protection switch if in System
Demodulator Fault	Open collector, 15 V max, 20 ma max. Used by Protection switch if in System

4.2.2.10 Drop & Insert Breakout Panel

The Drop and Insert Breakout Panel supports the use of the drop and insert channel unit in the SDM-309 modem. Connections between the breakout panel and other equipment are made through front and rear panel connectors. These connectors are listed in Table 4-2. The location of these connectors are shown in Figure 4-12.

Table 4-2 Breakout Panel Connectors

Ref Desig.	Connector Type	Name	Pinout Section
J1	15 PIN “D”	DROP DATA INPUT	4.2.2.10.1
J2	15 PIN “D”	DROP DATA OUTPUT	4.2.2.10.2
J3	15 PIN “D”	INSERT DATA INPUT	4.2.2.10.3
J4	15 PIN “D”	INSERT DATA OUTPUT	4.2.2.10.4
J5	BNC	DROP DATA INPUT	4.2.2.10.5
J6	BNC	DROP DATA OUTPUT	4.2.2.10.6
J7	BNC	INSERT DATA INPUT	4.2.2.10.7
J8	BNC	INSERT DATA OUTPUT	4.2.2.10.8
J9	BNC	EXT REF CLOCK	4.2.2.10.9
J10	25 PIN “D”	ESC CHANNEL	4.2.2.10.10
J11	TERM. BLOCK	FAULTS	4.2.2.10.11
J12	50 PIN “D”	DATA INTERFACE	4.2.2.10.12

Figure 4-12 Drop and Insert Break-Out Panel

4.2.2.10.1 Drop Data Input, Insert Data Output, and Ext. Ref Clk (J1)

The Drop Data Input, Insert Data Output, and External Reference Clock balanced signals are provided on a 15 pin “D” female connector accessible from the front of the break-out panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	2, 4
INSERT DATA OUT	IDO-A IDO-B	3 11
EXTERNAL CLOCK	EXC-A EXC-B	7 8
DROP DATA INPUT	DDI-A DDI-B	1 9

Note: The balanced insert data output signals on J1 are selected by SW2. The balanced drop data input signals on J1 are selected by SW1. The balanced External Clock signals on J1 are selected by SW3. Refer to Section 4.2.2.11 for further rear panel switch information.

4.2.2.10.2 Drop Data Output (J2)

The balanced Drop Data Output signals are provided on a 15 pin “D” female connector accessible from the front of the breakout panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	2, 4
DROP DATA OUTPUT	DDO-A DDO-B	1 9
DROP DATA OUTPUT	DDO-A DDO-B	3 11

Note: The drop data output signals are connected to SW5 which selects DTE or DCE operation. Refer to Section 4.2.2.11.7 for further information on SW5. The balanced drop data output signals on J2 are selected by SW1. Refer to Section 4.2.2.11.2 for further balanced drop data output selection.

4.2.2.10.3 Insert Data Input (J3)

The balanced Insert Data Input is provided on a 15 pin “D” female connector assessable from the front panel of the breakout panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	2, 4
INSERT DATA INPUT	IDI-A IDI-B	3 11

Note: The balanced insert data input signals on J3 are selected by SW2. Refer to Section 4.2.2.11.3 for further balanced insert data signal selection information.

4.2.2.10.4 Insert Data Output (J4)

The balanced Insert Data Output is provided on a 15 pin female "D" connector and is located on the front of the break-out panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	2, 4
INSERT DATA OUTPUT	IDO-A IDO-B	3 11

Note: The balanced insert data output signals on J4 are selected by SW2. Refer to Section 4.2.2.11.4 for further balanced insert data output signal selection information.

4.2.2.10.5 Drop Data Input (J5)

This connector is the interface for the unbalanced drop data input. The unbalanced drop data input signal on J5 is selected by SW1. Refer to Section 4.2.2.11.1 for further information on selecting the balanced or unbalanced drop data input signal.

4.2.2.10.6 Drop Data Output (J6)

This connector is the interface for the unbalanced drop data output. The unbalanced drop data output signal on J6 is selected by SW1. Refer to Section 4.2.2.11.2 for further information on selection of the balanced or unbalanced drop data output signal.

4.2.2.10.7 Insert Data Input (J7)

This connector is the interface for the unbalanced insert data input. The unbalanced insert data input signal on J7 is selected by SW2. Refer to Section 4.2.2.11.3 for further information on selection of the balanced or unbalanced insert data input signal.

4.2.2.10.8 Insert Data Output (J8)

This connector is the interface for the unbalanced insert data output. The unbalanced insert data output signal on J8 is selected by SW2. Refer to Section 4.2.2.11.4 for further information on selection of the balanced or unbalanced insert data output signal.

4.2.2.10.9 External Reference Clock (J9)

This connector is the interface for the unbalanced external reference clock input. The unbalanced external reference clock signal on J9 is selected by SW3. Refer to Section 4.2.2.11.5 for further information on selection of the balanced or unbalanced external reference clock signal.

4.2.2.10.10 ESC Channel (J10)

The ESC channel interface is provided on a 25 pin “D” female connector and is located on the front of the breakout panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	1, 7
TERRESTRIAL TX DATA	TERTXDAT	2
TERRESTRIAL RX DATA	TERRXDAT	3
REQUEST TO SEND	RTS	4
CLEAR TO SEND	CTS	5
DATA SET READY	DSR	6

Note: RTS and CTS are looped together on the connector.

4.2.2.10.11 Faults (J11)

The faults are provided on an eight position terminal block located on the front of the breakout panel.

Signal Function	Name	Pin Number
GROUND	GND	J11-1, J11-5
PRIMARY COMMON	PRI_COM	J11-2
PRIMARY NORM/OPEN	PRI_NO	J11-3
PRIMARY NORM/CLOSED	PRI_NC	J11-4
SECONDARY COMMON	SEC_COM	J11-6
SECONDARY NORMALLY OPEN	SEC_NO	J11-7
SECONDARY NORMALLY CLOSED	SEC_NC	J11-8

4.2.2.10.12 Data Interface (J12)

The Data interface is provided on a 50 pin female "D" connector accessible from the rear of the breakout panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
GROUND	GND	1, 2
DROP DATA INPUT	DDI-A DDI-B	34 18
EXTERNAL CLOCK	EXC-A EXC-B	35 19
INSERT DATA OUTPUT	IDO-A IDO-B	36 20

DROP DATA OUTPUT	DDO-A DDO-B	37 38
TERRESTRIAL TX DATA	TER_TXDAT	5
TERRESTRIAL RX DATA	TER_RXDAT	7
INSERT DATA INPUT	IDI-A IDI-B	39 40
PRIMARY COMMON	PRI_COM	10
PRIMARY NORMALLY OPEN	PRI_NO	43
PRIMARY NORMALLY CLOSED	PRI_NC	27
SECONDARY COMMON	SEC_COM	11
SECONDARY NORMALLY OPEN	SEC_NO	44
SECONDARY NORMALLY CLOSED	SEC_NC	28
DATA SET READY	DSR	48

4.2.2.11 Rear Panel Switches

Switch 1 through switch 3 are used to select signals through the BNC connectors or the DB15 connectors. Switch 4 is used to select normal or loopback conditions. Switch 5 is used to select DCE or DTE Drop Data Output pin selection. Figure 4-13 shows the layout of the rear panel switches. Table 4-3 describes their function. Figure 4-14 and Figure 4-15 is the schematic diagram for the breakout panel.

4.2.2.11.1 Drop Data Input

The drop data input signal has two input sources. The BNC connector has the unbalanced input signal and the DB15 connector has the balanced input signal. To use the BNC connector input, SW1 position 1 & 2 must be closed (close to PCB) and SW1 position 3 & 4 must be open (away from PCB). To use the DB15 connector input, SW1 position 1 & 2 must be open and SW1 position 3 & 4 must be closed. The switch pack is located on the rear of the breakout panel.

4.2.2.11.2 Drop Data Output

The drop data output signal has two outputs. The BNC connector has the unbalanced output signal and the DB15 connector has the balanced output signal. To use the BNC connector output, SW1 position 5 & 6 must be closed (close to PCB) and SW1 position 7 & 8 must be open (away from PCB). To use the DB15 connector output, SW1 position 5 & 6 must be open and SW1 position 7 & 8 must be closed.

4.2.2.11.3 Insert Data Input

The insert data input signal has two input sources. The BNC connector has the unbalanced input signal and the DB15 connector has the balanced input signal. To use the BNC connector input, SW2 position 1 & 2 must be closed (close to PCB) and SW2 position 3 & 4 must be open (away from PCB). To use the DB15 connector input, SW2 position 1 & 2 must be open and SW2 position 3 & 4 must be closed.

4.2.2.11.4 Insert Data Output

The insert data output signal has two outputs. The BNC connector has the unbalanced output signal and the DB15 connector has the balanced output signal. To use the BNC connector output, SW2 position 5 & 6 must be closed (close to PCB) and SW2 position 7 & 8 must be open (away from PCB). To use the DB15 connector output, SW2 position 5 & 6 must be open and SW2 position 7 & 8 must be closed.

4.2.2.11.5 External Reference Clock

The external reference clock signal has two input sources. The BNC connector has the unbalanced input signal and the DB15 connector has the balanced input signal. To use the BNC connector input, SW3 position 1 & 3 must be closed (close to PCB) and SW3 position 2 & 4 must be open (away from PCB). To use the DB15 connector input, SW3 position 1 & 3 must be open and SW3 position 2 & 4 must be closed.

4.2.2.11.6 Drop Output/Insert Input (SW4)

When the Drop Data Output is to be connected directly to the Insert Data Input on a single breakout panel the loop function may be used. Switch 4 in the UP position eliminates the need for an external cable from the Drop Data Output to the Insert Data Input. When the Drop Data Output is not to be connected to the Insert Data Input on the same breakout panel, the Normal function must be used. Switch 4 in the DOWN position allows normal operation.

4.2.2.11.7 Drop Data Output DCE/DTE Select (SW5)

When the Drop Data Output is to be connected to another Drop Data Input the DTE position (DOWN) must be selected for SW5. This puts the Drop Data Output on pins 1 and 9 on J2. When the Drop Data Output is to be connected to an Insert Data Input, the DCE position (UP) must be selected for SW5. This puts the Drop Data Output on pins 3 and 11 of J2.

Figure 4-13 Rear Panel Switch Diagram

Table 4-3

Switch 1				
Switch Position				
-1-	**-2-**	**-3-**	**-4-**	
UNBALANCED DDI	CLOSED	CLOSED	OPEN	OPEN
BALANCED DDI	OPEN	OPEN	CLOSED	CLOSED
Switch Position				
-5-	**-6-**	**-7-**	**-8-**	
UNBALANCED DDO	CLOSED	CLOSED	OPEN	OPEN
BALANCED DDO	OPEN	OPEN	CLOSED	CLOSED
Switch 2				
Switch Position				
-1-	**-2-**	**-3-**	**-4-**	
UNBALANCED IDI	CLOSED	CLOSED	OPEN	OPEN
BALANCED IDI	OPEN	OPEN	CLOSED	CLOSED
Switch Position				
-5-	**-6-**	**-7-**	**-8-**	
UNBALANCED IDO	CLOSED	CLOSED	OPEN	OPEN
BALANCED IDO	OPEN	OPEN	CLOSED	CLOSED
Switch 3				
Switch Position				
-1-	**-2-**	**-3-**	**-4-**	
UNBALANCED EXC	CLOSED	OPEN	CLOSED	OPEN
BALANCED EXC	OPEN	CLOSED	OPEN	CLOSED
Switch 4				
Drop Data Output/Insert Input				
LOOPBACK	SWITCH POSITION - UP			
NORMAL	SWITCH POSITION - DOWN			
Switch 5				
Drop Data Output Dce/Dte Select				
DCE	SWITCH POSITION - UP			
DTE	SWITCH POSITION - DOWN			

Figure 4-14 Drop and Insert Schematic Diagram

Figure 4-15 Drop & Insert Daughter Board Schematic Diagram

4.2.3 External Channel Unit Interface

Refer to Appendix C for a complete description of the External Channel Unit Interface and system integration. This is an optional mode of operation, making the SDM-309B modem compatible with a variety of stand alone channel unit equipment for IBS service. Please refer to Appendix C for full details.

4.3 Interface Clocking Options

Clocking of the data from the terrestrial circuits to the satellite and visa versa will depend upon the application. The most common options and recommended configurations are described in the following Section.

4.3.1 Master/Slave

This application is used where the far end earth station does not have local access to a high stability reference clock, or where it is not required to synchronize with a local clock.

The disadvantage of the master/slave application is that the signal received at the slave station is subject to doppler shift.

Note: The length of the buffer at the master end will need to be twice the length that is normally required since it will be compensating for the doppler shift on the outward and return paths.

4.3.1.1 Master/Slave RS422 or V.35

* Clock must be looped externally at slave end.

RS422 Clock Loopback	V.35 Clock Loopback
Join RT-A to TT-A	Join SCR-A to SCTE-A
(pin 8 to pin 17)	(pin V to pin U)
Join RT-B to TT-B	Join SCR-B to SCTE-B
(pin 26 to pin 35)	(pin X to pin Y)

Note: By wiring the interface for clock turnaround, the impedance will be reduced. This generally will cause no problem providing the cable length to the final terminal equipment is not excessive. Selecting no loading at the terminal equipment will ensure correct line matching.

Modem Settings (Master)	
TX_CLOCK	TX_TERR
BUF_CLK	TX_TERR
RX_CLOCK	NORMAL

Modem Settings (Slave)	
TX_CLOCK	TX_TERR
BUF_CLK	SATELITE
RX_CLOCK	NORMAL

4.3.1.2 Master/Slave G.703

* There is no loop timing selection on board for G.703. It is assumed that any G.703 termination equipment will extract the clock from the satellite signal and turn it around for retransmitting. The settings for the Master and Slave modems are the same as listed above.

4.3.1.3 Master/Slave X.21

* Clock must be looped externally at slave end.

Modem Settings (Master)	
TX_CLOCK	INT
BUF_CLK	INT
RX_CLOCK	NORMAL
Modem Settings (Slave)	
TX_CLOCK	TX_TERR
BUFF_CLK	SATELITE
RX_CLOCK	NORMAL

4.3.1.4 Master/Slave External Station Clock

* Clock must be looped externally at slave end (For RS422 and V.35 see notes in previous example).

Modem Settings (Master)	
RX_CLOCK	NORMAL
TX_CLOCK	EXT_REF
BUFF_CLOCK	EXT_REF
EXT_REF	SET TO FREQUENCY OF STATION CLOCK
Modem Settings (Slave)	
TX_CLOCK	TX_TERR
BUFF_CLK	SATELITE
RX_CLK	NORMAL
EXT_REF	N/A

4.3.2 Master/Master

This application is used where both earth stations have high stability clocks available and the received data is to be clocked onto the local network.

The disadvantage of the master/master application is that the receive data will slip as the clock will not be synchronized. The buffer if properly set up will ensure that the slips are

an exact frame length, causing minimum loss of data. By using very high stability clocks, the expected time between slips can be many days.

Loss of the buffer clock will mean the buffer will not be emptied and no data will be available. The buffer clock will normally revert to the low stability internal reference automatically.

4.3.2.1 Master/Master (Customer Clock)

Modem Settings (Master)	
TX_CLOCK	TX_TERR
BUFF_CLK	TX_TERR
RX_CLK	NORMAL
EXT_REF	N/A

4.3.2.2 Master/Master (Station Clock)

Care should be taken when using this mode. Make sure that the station clock is also used to synchronize the transmit data. Phasing problems may also occur between the transmit data and the station clock input and for this reason, it is better to use the TERR clock on transmit.

Modem Settings (Master)	
SDM-309B	
TX_CLOCK	EXT_REF OR TX_TERR
BUFF_CLK	EXT_REF OR TX_TERR
RX_CLOCK	NORMAL
EXT_REF	SET TO FREQUENCY OF STATION CLOCK.

Chapter 5.
THEORY OF OPERATION

5.1 Modulator

5.1.1 General description

The modem Modulator card is a 10.25" x 14" card (Figure 5-1) that fits in the top left slot of the modem chassis. Its function is to create a QPSK modulated carrier within the 50 - 90 MHz or 100 - 180 MHz range from the digital data stream that is provided by the Interface card. Several subSections make up the card. These include:

1) The Digital Interface
2) The Scrambler/Differential Encoder
3) The Convolutional Encoder
4) The I/Q Nyquist Filters
5) The Modulator
6) The Output Amplifier
7) The RF Synthesizer
8) The Clock Synthesizer

A block diagram of the modulator is shown in Figure 5-2. A detailed description of the subSections appears in Section 5.1.3.

5.1.2 Specifications

Modulation type	QPSK (BPSK optional)
Frequency Range	50 to 90 MHz or 100 to 180 MHz
Frequency Select Method	Synthesized
Frequency Step Size	2.5 KHz
Frequency Stability	10 ppm
Channel Spacing	.7 Times the Data Rate Divided by the Encoding Rate.
Phase Error	2.5 ° max.
Filtering Type	Nyquist, Pre-equalized
Spectral Occupancy	See Figure 5-3 dB at ± .75 Symbol Rate

Spurious and Harmonics	-50 dBc minimum in band, 40 dBc minimum out of band
Output Power Level Range	-5 to-30 dBm
Output Power Adjustment	0.5 dB Step Size
Output Stability	± .5 dB over -5 to -25 dBm ±1 dB over -25 to -30 dBm
Output Impedance	75 Ω (50 Optional)
Output Return Loss	20 dB Minimum
Differential Encoding	2 Phase or None
FEC Encoding	Convolutional - Rate 7/8, 3/4, or 1/2
I/O Connector	DIN - 96 pin

Figure 5-1 Modulator Card

Figure 5-2 Modulator Block Diagram

Figure 5-3 Modulator Output Spectral Occupancy

5.1.3 Theory of Operation

As mentioned in Section 5.1.1, the modulator is composed of eight basic subSections. SubSections 1-4 and 8 make up the baseband processing portion of the modulator while subSections 5-7 form the RF portion of the modulator.

Data that is to be transmitted is input to the Digital Interface (1) of the modulator. The format is RS-422 and includes a clock synchronous with the data. The data at this point is clean and dejittered. A data rate clock provided by the Clock Synthesizer (8) and buffered by the Digital Interface is output from the card. The frequency of this clock is programmable. The use of this clock as the source timing signal for the link is optional. In addition to these functions the Digital Interface provides buffering of M & C signals to the microcomputer data bus. The data for all programmable functions pass across this interface as well as module fault information from the Modulator back to the M & C. Faults reported include, synthesizers out of lock, RF output leveled, input data clock activity, and digital filter activity.

The Data is delivered from the Data Interface to the Differential Encoder then the Scrambler (2). The Differential Encoder is a two bit encoder which allows for resolution of two of the four ambiguity states of the QPSK demodulator or of both states of a BPSK demodulator. It is programmable on or off. The Scrambler is according to CCITT V.35. It provides a pseudo-random characteristic to the data stream for dispersal of the transmitted energy, independent of the data pattern. It is programmable on or off.

The Data passes to the Convolutional Encoder (3). The Convolutional Encoder generates the parity bits from the input data stream that allows for error correction at the far end of the link. The rate of the encoder may be 7/8, 3/4, or 1/2. This means, for instance that for 7/8 rate, 8 bits are output for every 7 bits input. If the modulator is in the QPSK mode, the Data is split into two separate data streams, to drive the in-phase and quadrature channels of the modulator.

From the Encoder, the Data passes to the Nyquist Filters (4). There are two identical Nyquist filters, one for the in-phase channel and one for the quadrature channel. They are each implemented as an FIR digital filter and provide the proper spectral shaping as well as proper equalization.

The I and Q filtered data is applied to the Modulator (5) which converts them to a QPSK modulated carrier. The spectral shape will be identical to that of the input data streams but double sided about the carrier frequency.

The RF Synthesizer (7) provides the proper frequencies to convert the Modulator IF to the desired output frequency in the 50 to 90 MHz range. The frequencies generated are locked to a single, high stability, crystal oscillator which results in an output frequency of high stability.

The final subSection of the Modulator is the Output Amplifier (6). It take the low level signal from the Modulator Section and amplifies it to the proper level for output from the

module. It contains circuitry which provides programmable control of the output level over a 10 dB range in .5 dB Steps and power leveling to maintain the stability of the output level over time and temperature.

5.2 Viterbi Decoder / Demodulator Processor

5.2.1 General Description

The modem Viterbi Decoder/Demod Processor is a 10.25" x 14" card (Figure 5-4 through Figure 5-6) that fits in the middle left slot of the modem chassis. The card performs four separate functions. It contains the Digital Costas Processor which provides signals to the Demodulator board for carrier recovery and automatic gain control, it performs clock recovery of both the symbol clock and the data clock, it provides the forward error correction function utilizing a Viterbi decoder, and it provides differential decoding. There are three Viterbi decoder options available in the field.

The 0701 board is the oldest model used in the old SDM-309 modems. The original IBS modems were used with the external channel units and could operate at data rates of 64 kbs to 2048 kbs. The M&C firmware used with the 0701 board is version 2.XX. If a customer needs to replace a 0701 decoder board, they will receive the 2133 Viterbi board and must upgrade the M&C firmware.

The 0949 board and the 2133 board can operate from 9.6 kbs (BPSK) to 8 Mbs. Firmware is backward compatible between the 0949 and the 2133 boards, but older firmware will not operate in the newer boards. An example would be a 2133 board that has 6.XX firmware in the M&C could be replaced with an 0949 board. But an 0949 board that has 4.XX firmware in the M&C could not be replaced with a 2133 board without upgrading the M&C firmware. All new SDM-309B modems will be shipped with the new 2133 Viterbi decoder boards.

A block diagram of the board is found in Figure 5-7. A detailed description of the module appears in Section 5.2.3

5.2.2 Viterbi Decoder/Demod Processor Specification

5.2.2.1 Demod Processor Specification

Operating Symbol Rate Range	19.2 Kb/s to 2048 Kb/s
Operating Code Rate Range	7/8, 3/4, 1/2
Input Signal	11 Level Quantized I and Q
Output Signals	VCXO Drive, AGC Drive, I sign, I mag, Q sign, Q mag, Symbol Clock, Data Clock
Carrier Phase Error	± 3 ° Max
Carrier Loop Bandwidth	Software Controlled

Clock Phase Error	± 5%
Clock Loop Bandwidth	Software Controlled
Clock Jitter	5% p to p Max

5.2.2.2 Viterbi Decoder Specifications

Bit Error Rate	See Figure 5-8
Maximum Data Rate	6.4 Mb/s (Rate 1/2) 9.5 Mb/s (Rate 3/4)
Synchronization Time	8000 Bits, max
Output Fault Indicators	Activity Detection of I & 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	DIN - 96 pin

Figure 5-4 Viterbi Decoder (AS/0701)

Figure 5-5 Viterbi Decoder (AS/0949)

Figure 5-6 Viterbi Decoder (AS/2133)

Figure 5-7 Viterbi Decoder Block Diagram

Figure 5-8 Typical Decoder BER Performance

5.2.3 Theory Of Operation

5.2.3.1 Demod Processor

The Demod Processor, in conjunction with the Demodulator, reconstructs the digital data stream that was transmitted but corrupted by transmission channel impairments. The Demod Processor accepts 11 bit quantized signals from the Demodulator for both the I and Q channels.

Two of the levels are mainly used for Clock Recovery while the other 9 are used by the Costas Calculator and in generation of the 2 bit soft decision symbols required by the Viterbi Decoder.

The Costas Calculator generates a phase error term from the I and Q channel quantized data. This error term is scaled by input from the M & C, then is output to the analog portion of the loop. The sweep voltage, which is also controlled by the M & C, is summed with the integrated error term and is output from the board to drive the VCXO on the Demodulator.

The Clock Loop is contained on this card. It consists of a phase locked loop with a VCXO for a reference. The phase locked loop generates a clock, four times the desired data rate. From this clock Dividers generate the Data Rate Clock and the Symbol Rate Clock. The Symbol Rate Clock is compared with the Quantized I and Q channel data to generate a phase error term. The error term is scaled and integrated before it drives the VCXO on the phase locked loop thus closing the outer loop and driving the Symbol Rate Clock to synchronize to the incoming Symbols.

The I and Q channel data is sampled and converted to 3 bit quantized R0 and R1 parallel code bits for use by the Viterbi Decoder.

5.2.3.2 Viterbi Decoder

The Viterbi decoder operates, in conjunction with the convolutional encoder in the transmit modem, to correct errors in the received data stream from the demodulator due to the transmission channel. The Viterbi decoder processes three bit quantized R0 and R1 parallel code bits or symbols from the demodulator. The quantization is three bit soft decision in sign/magnitude format. This data is a representation of the data transmitted, corrupted by Additive White Gaussian Noise. The decoder’s task is to determine which symbols have been corrupted by the transmission channel and correct as many as possible. The code symbols produced by the encoder provide a means of doing just that.

The Viterbi decoder performs seven functions. The data passes through a ambiguity resolver which compensates for the potential 90 degree phase ambiguity inherent in a QPSK demodulator. The data is then "de-punctured" if the decoder is operating in 3/4 or

7/8 rate. 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, 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 add-select-compare (ASC) computer. The ASC computer makes decisions about the most probable transmitted symbol stream by processing the current branch metrics with the state metrics computed for the sixty-four previous decoder inputs. The results of the ASC computer are stored in memory called path memory. The path memory is 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 metric's is used as the means of determining synchronization of the decoder. The output data may then be descrambled and differentially decoded. Both of these processes are optional and may be selected by the user locally or remotely. The data out of the differential decoder is sent to the interface card 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 metric's and sent to the M & C for further processing

5.3 Demodulator

5.3.1 General Description

The modem Demodulator card is a 10.25" x 14" card (Figure 5-9) that fits in the lower left slot of the modem chassis. Its function is to accept a desired QPSK modulated signal in the 50 to 90 MHz or 100 to 180 MHz range and convert it to filtered baseband in-phase and quadrature signals which are then quantized and output from the card.

Several subSections make up the card. These include:

1) The AGC Amplifier
2) The Quadrature Demodulator
3) The RF Synthesizer
4) The Nyquist Filter
5) The Baseband Amplifier
6) The Soft Decision Interface

A block diagram of the Demodulator is shown in Figure 5-10. A detailed description of the subSections appears in Section 5.3.3

5.3.2 Specifications

Demodulation Type	QPSK
Frequency Range	50 to 90 MHz or 100 to 180 MHz
Frequency Select Method	Synthesized
Frequency Step Size	2.5 KHz
Channel Spacing	.7 Times the Data Rate Divided by the Encoding Rate.
Input Level Desired Carrier	-55 to -30 dBm
Input Overload	0 dBm max
Input Impedance	75 W (50 Optional)
Input Return Loss	20 dB minimum
Filtering	Nyquist, 8 pole, 1 of 4 selectable
Image Rejection	40 dB minimum
Symbol Rate Range	9.1 to 3152 Kb/s
I/O Connector	DIN - 96 pin

Figure 5-9 Demodulator Card

Figure 5-10 Demodulator Block Diagram

5.3.3 Theory of Operation

As mentioned in Section 5.3.1, the Demodulator is composed of six basic subSections. The first three make up the RF portions of the board while the last three handle the baseband processing. A Costas Loop is used for carrier recovery, however the Demodulator board provides only the I and Q channel signals and has a VCXO input. It does not do the costas processing.

The incoming modulated carrier enter the Demodulator in the AGC Amplifier (1) where it is filtered and amplified. The AGC circuit, which is controlled off card, provides variable gain to maintain the signal level into the IF converter at a constant level over the entire input dynamic range. The signal is converted to the fixed IF by the Frequency Synthesizer (3). The Synthesizer is programmable externally, to allow for acquisitions of carriers in the 50 to 90 MHz or 100 to 180 MHz range.

The IF is split into two channels in the Quadrature Demodulator (2). Using an in-phase and a quadrature carrier from a VCXO controlled externally, the quadrature demodulator produces the I and Q channel baseband signals. These two signals are amplified and filtered in the Nyquist Filters (4). These filters are matched filters to those of the transmitter resulting in optimal detection of the transmitted data. In addition, they effectively remove adjacent channels which could corrupt the detection process.

The signal is amplified to the final level in the Baseband Amplifier (5). At this point the signal looks like the classic "Eye Pattern". It is then quantized in the Soft Decision Interface (6) and output to the card I/O connector.

5.4 Reacquisition, Fast Acquisition And Directed Sweep

5.4.1 General

The fast acquisition algorithm has been permanently installed in the 4.XX and 6.XX versions of the modem software. The carrier should be acquired within 30 seconds regardless of the symbol rate. The upper limit on the symbol rate for fast acquisition is 128 Kbps. The lower limit is 64 Kbps. Fast acquisition will work in conjunction with the sweep reacquisition function. However, fast acquisition will not work concurrently with the directed sweep function. The sweep range parameter must be set at 50000 Hz to enable fast acquisition. If the sweep range is set at any frequency less than 50000 Hz, the modem is in the directed sweep mode. Turning on the directed sweep function automatically disables the fast acquisition function.

5.4.2 Reacquisition

Normally the modem sweeps full range of plus/minus 30 KHz during acquisition. The time it takes to complete one full sweep cycle depends upon the symbol rate of the demod as follows:

1. If the demod symbol rate is less than or equal to 112 KBPS the sweep time is: sweep time (in seconds) = 8400/SR (symbol rate in KBPS)

2. If the demod symbol rate is greater that 112 KBPS but less than 257 KBPS the sweep time is: sweep time (in seconds) = 4200/SR (symbol rate in KBPS)

3. If the demod symbol rate is greater than 256 KBPS the sweep time is: sweep time (in seconds) = 2100/SR (symbol rate in KBPS)

After initial acquisition (decoder locked for at least three seconds), if the carrier is lost (decoder becomes unlocked) the modem enters the reacquisition mode. During reacquisition the sweep is limited to 10% of the nominal sweep range, around the last known lock point. If reacquisition does not take place during the time set for reacquisition (0 - 999 seconds) the modem will terminate the reacquisition mode and begin sweeping the full range of plus/minus 30 KHz.

The reacquisition mode is intended to reduce the time for reacquisition at lower symbol rates. The following guidelines should be applied when using the re-acquisition mode:

1. The time specified for re-acquisition must be multiples of 10% of the total nominal sweep time. This will insure that the modem has time to sweep across the lock point at least once prior to termination of the re-acquisition mode.

2. Add a little to the re-acquisition time to account for the anticipated outage.

EXAMPLE: Demod operating at 64 Kbps, an anticipated outage of 2 seconds. What should be the minimum re-acquisition setting?

Sweep time = 8400/64 = 132 second (round fractions up). Ten percent of the total sweep time is 13.2 seconds. Add 2 seconds to the minimum re-acquisition time for the anticipated outage.

ANSWER = 15.2 seconds, round up for 16 seconds minimum.

The additional function for sweep reacquisition can be found in the Configuration menu of the front panel. SWP_RACQ is the parameter used to set the minimum reacquisition time as described above.

5.4.3 Fast Acquisition

When Fast Acquisition is enabled the fast acquisition algorithm is used for acquisition of receive symbol rates of 128 Kbps or lower. If the sweep range is set to less than 50KHz, acquisition will be dictated by the directed sweep specifications and the fast acquisition algorithm will not be used.

5.4.4 Directed Sweep

The directed sweep mode was designed to rapidly acquire a carrier of known frequency offset. If the customer knows where the carrier is going to be, the Directed Sweep Mode can be much faster than the Fast Acquisition Mode. Due to the reduced speed of the lower data rates, (up to 30 seconds in fast acquisition) the customer has the option of controlling the sweep functions. There are four additional functions in the front panel menu that are directly related to the directed sweep mode. There is a monitor function, SWP_FREQ, that detects the current sweep frequency and there are three functions in the configuration menu that are specifically for the directed sweep mode. They are, Sweep Center, Sweep Range, and Sweep Direction. These functions only show up in the front panel menu when the Fast Acquisition function has been turned ON in the “Utility” menu. Refer to the Front Panel Operation instructions for further details of the directed sweep functions.

Chapter 6. MAINTENANCE

6.1 System Checkout

6.1.1 General

The system checkout Section is to be used as an aid in setting up a modem within the earth station. There are tables for use in checking to see if the Eb/N0 is correct, typical output spectrum, and typical eye pattern and constellation pictures.

6.1.2 Modulator Checkout

The modem supplies a QPSK modulated result of the DATA I/O connector to the IF output connector (CP1). A typical output spectrum is shown in Figure 6-1. If the output does not resemble this picture refer to the fault isolation in Section 6.2.1 to locate the problem.

The first Step in turning up a carrier is to set the output frequency. This is done in the “CONFIG” menu on the front panel (Sections 3.1.4. and 3.2.1). The “CONFIG” menu also allows the operator to set the output level, turn the output ON or OFF, set the scrambler, differential encoder, clock source, and gives access to the test modes for system check out. Available test modes are RF loopback, BB loopback, and CW mode. After the output frequency and level is set the output is to be turned ON.

6.1.3 Demodulator Checkout

The demodulator supplies baseband data to the DATA I/O connector that is a result of the QPSK modulated signal input at the IF input connector (CP2). Clock and data are recovered, decoded, and descrambled from the input RF signal by the demodulator and decoder cards.

The input to the demodulator card must be set within the proper frequency and power level for the demodulator to lock to the signal. Refer to Figure 6-2 and Table 6-1 to check for proper Eb/N0 level. Figure 6-2 is an example of a 3/4 rate carrier operating at

an Eb/N0 of 7.5 dB. (S+N)/N is measured by taking the average level of the noise and the average level of the top of the modem spectrum as shown. Use this measurement for the first column on Table 6-1. Read across the page to find the S/N and Eb/N0 for the specific code rate. Once the demodulator has locked to the incoming signal the “MONITOR” menu will display signal level, raw BER, corrected BER, and Eb/N0 (Sections 3.1.5. and 3.2.4). These functions are not displayed until the demodulator is locked to a carrier. A typical eye pattern with noise and without noise is shown in Figure 6-3 and a typical constellation with noise and without noise is shown in Figure 6-4. If the demodulator does not lock up refer to the fault isolation in Section 6.2.2 to help find the problem.

Figure 6-1 Typical Output Spectrum

Figure 6-2 Output Spectrum With Noise

Table 6-1

EFDATA Corporation						
Conversion Of (S+N)/N TO S/N And Eb/N0 For Various Code Rates						
(dB)	Code Rate 1/2		Code Rate 3/4		Code Rate 7/8	
(S+N)/N	S/N	Eb/N0	S/N	Eb/N0	S/N	Eb/N0
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 6-3 Typical Eye Patterns

Figure 6-4 Typical Eye Constellations

6.1.4 Test Points

The following is a list of front panel test points and a description or the signal that is to be present under normal operation.

6.1.4.1 Modulator (Figure 6-5)

TPG1	Ground
TP2	Q EYE Pattern Level is 2 V P-P. The DC offset is 0 V. This signal is the Q input to the QPSK modulator. The eye pattern at this point is not equalized.
TP3	I EYE Pattern Level is 2 V P-P. The DC offset is 0 V. This signal is the I input to the QPSK modulator. The eye pattern at this point is not equalized.
TP4	Q - Analog Data Eye Pattern Approximately 1.4 V P-P between eye sample points.
TPG2	Ground
TP6	I - Analog Data Eye Pattern Approximately 1.4 V P-P between eye sample points.
TP17	I channel data TTL level data that is output from the last register in the digital filter. The I channel activity fault is monitoring the line.
TP18	Q channel data TTL level data that is output from the last register in the digital filter. The Q channel activity fault is monitoring the line.
TP19	Symbol rate clock TTL level clock that is locked to the incoming data to the interface card. This clock is at the symbol frequency and not at the data rate. the frequency is equal to: QPSK-(DATA RATE/CODE RATE)/2 BPSK-(DATA RATE/CODE RATE)
TPG6	Ground

Figure 6-5

6.1.4.2 Demodulator (Figure 6-6)

TP10	VCXO Control Voltage Approximately 0 to +2.5V sweep range.
TP23	Discriminator Voltage. Nominally +2.5V with 6 dB noise at 128 Kbs.
TPG	Ground test point
TP1	Q EYE pattern. Level is 1V P-P at the center of the eye crossing. The DC offset is about +2.4V.
TP2	Q THRS - Q channel threshold voltage. +2.9V DC.
TP3	I THRS - I channel threshold voltage. +2.9V DC.
TP4	I EYE pattern. Level is 1V P-P at the center of the eye crossing. The DC offset is about +2.4V.
TP5	Q CLK THRS + Q channel + clock threshold. +2 to +3V DC.
TP6	Q CLK THRS - Q channel - clock threshold. +2 to +3V DC.
TP7	I CLK THRS - I channel + clock threshold. +2 to +3V DC.
TP8	I CLK THRS +I channel - clock thr eshold. +2 to +3V DC.

Figure 6-6

6.1.4.3 Viterbi Decoder/demod Card AS/0701 (Figure 6-7)

TP1	Data Clock. Result of the data clock recovery loop in the demod processor Section.
TP2	R0C Sign Bit. Result of the hard decision interface. 50% duty cycle random TTL data.
TP3	R1C Sign Bit. Result of the hard decision interface. 50% duty cycle random TTL data.
TP4	Symbol Clock. Result of the symbol clock recovery loop in the demod processor Section.
TP5	Not used at this time.
TP6	Not used at this time.
TPG	Ground Test Point.
TP7	Sync Change out. Result of Viterbi decoder initiating ambiguity resolution change.
TP8	Decoder Synchronization. Result of the Viterbi decoder achieving synchronization.
TP9	Decoder Data. Data out of the decoder.
TP10	Decoder Clock. Clock out of the decoder.
TP11	Decoder Lock. Result of the decoder and clock synchronization and AGC leveling.

Figure 6-7

6.1.4.4 Viterbi Decoder/Demod Card AS/0949 (Figure 6-8)

TPG	Ground Test Point.
TP1	Decoder Data. Data out of the decoder.
TP2	Decoder Clock. Clock out of the decoder.
TP3	Sync Error. Approximate raw error rate. Random TTL pulses. One pulse for every I channel or Q channel error.
TPG	Ground Test Point.
TP4	I Channel Data. Result of the hard decision interface. 50% duty cycle random TTL data.
TP5	Symbol Clock. Result of the symbol clock recovery loop in the demod processor Section.
TP6	Q Channel Data. Result of the hard decision interface. 50% duty cycle random TTL data.
TP7	Data Clock VCO. 8 MHz to 18 MHz TTL master clock for data clock generation.
TPG	Ground Test Point.

Figure 6-8

6.1.4.5 Viterbi Decoder/Demod Card AS/2133 (Figure 6-9)

TP2	GND Ground Test Point.
TP3	VIT LOCK Viterbi lock Result of the decoder and clock synchronization and AGC leveling.
TP4	DATA CLK Data Clock. Result of the data clock recovery loop in the demod processor Section.
TP8	SYM CLK Symbol Clock. Result of the symbol clock recovery loop in the demod processor Section.

Figure 6-9

6.2 Fault Isolation

System faults are reported in the “FAULT” menu (Figure 3-3). Stored faults are reported in the ‘sTFAULTS” menu (Figures 3-4 through 3-6). The following list is to be used in isolating the problem and deciding the appropriate action to be taken.

6.2.1 Modulator Faults

Refer to Sections 3.1.6.1, 3.2.5.1, and Figures 3-3 and 3-4 of the O&I manual.

Fault	Possible Problem And Action
RF_SYN	Modulator synthesizer is faulted. This is considered a major alarm and will turn off the modulator output. Return the modulator module for repair.
DATA_CLK	Incoming data clock activity fault. This fault is not considered a major alarm and will not turn off the modulator output. Problem is most likely on the interface card or external to the modem. Check to see that 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 for repair.
TCLK_SYN	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 considered a major alarm and will turn off the modulator output. Check to see that the proper data rate has been set up and selected. Verify the incoming data rate to match what has been selected in the modem. Refer to Table 6.2 for available data rates for the SDM 309. Or refer to Intelsat document IESS 309 for available data rates for the SDM 309 modem In the SDM 309 the internal reference is changed to account for the IBS overhead of 16/15. An SDM 309 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. Verify the frequency of the input data clock to be within the lock range of 100PPM. If the inputs to the modem are all 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_CHANNL	Activity alarm for the I channel digital filter. This alarm is considered a major alarm and will turn off the modulator 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 to see that there is 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.
Q_CHANNL	Activity alarm for the Q channel digital filter. Follow the same procedure as for the I channel.
AGC_LEVL	Output power level fault. Indicates that the level at the modulator output is not the level that is programmed. Replace the modulator card and return it for repair.

MODULE	Modulator module fault. Indicates a problem in programming the modulator card. Check to see that the modulator card is present and is properly seated. If the modulator card is properly seated this could indicate a problem in the Monitor and Control (M&C) card or in the interface between the modulator and M&C card. Return the defective card for repair.

6.2.2 Demodulator Faults

Refer to Sections 3.1.6.2, 3.2.5.2, and Figures 3-3 and 3-5 in the O&I manual.

Fault	Possible Problem And Action
C_DETECT	Indicates loss of decoder lock. 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. Check first of all to see that the demodulator has an RF input at the proper frequency and power level. Check to see that the demodulator data rate is properly programmed. Refer to the fault isolation procedure for TCLK_SYN in the modulator Section 6.2.1. Verify the frequency of the data transmitted from the modulator is within 100PPM. Look at the test points on the demodulator and decoder for the eye pattern, data, and clock per Section 6.1. to verify proper levels, activity, and phase.
RF_SYN	Demodulator synthesizer is faulted. Return the demodulator for repair.
DATA_CLK	Indicates a loss of lock on the reference of the demodulator clock recovery oscillator. Return the decoder card for repair.
I_CHANNL	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 filter on the daughter card on the demodulator, in the soft decision circuitry on the demodulator, or it is in the decoder costas processor. Replace either the demodulator card or the decoder card to isolate the fault and return the failed card for repair.
Q_CHANNL	Indicates a loss of activity in the Q channel of the quadrature demodulator. Follow the same procedure as with the I channel fault.
BERTHRSH	Indication that the preset BER threshold has been exceeded. Setting of this alarm is done in the “UTILITY” menu. This is an alarm based on the corrected BER reading on the front panel.
MODULE	Demodulator module fault. Indicates a problem in programming the demodulator card. Check to see that the demodulator card and the decoder card are present and are properly seated. If the cards are properly seated this could indicate a problem in the Monitor and Control (M&C) card or in the interface between the decoder card and M&C card. Return the defective card for repair.

6.2.3 Common Equipment Faults

Refer to Section 3.1.6.3, 3.2.5.3, and Figures 3-3 and 3-6 in the O&I manual.

Fault	Possible Problem And Action
BATTERY	M&C battery voltage fault. Indicates a low voltage in the memory battery. Typically will be active when a modem is first turned on. Allow the modem to charge up the battery before any other action is taken. Charge time is 5 to 8 hours depending on how long the modem has been powered down.
-12 VOLT	-12 volt power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the -12 volt line on the mother board or a short on the -12 volt line of any or the plug-in boards. To gain access to the rear side of the mother board, remove the rear panel cover. Refer to Figure 6-10 for location of the -12 V on the mother board. Return the faulty plug-in board or replace the chassis power supply.
+12 VOLT	+12 volt power supply fault. Use the same procedure as with -12 volt fault.
+5 VOLT	+5 volt power supply fault. Use the same procedure as with -12 volt fault. The +5 volt supply requires a minimum load of 1A. This is accomplished with the M&C card and one other card being plugged into the chassis.
CONTROLR	Controller fault. Indicates a loss of power in the M & C card. This fault is shown only in the stored fault menu.
INTRFACE	Interface module fault. Indicates a problem in programming the interface card. Check to see that the interface card is present and is properly seated. If the card is properly seated this could indicate a problem in the Monitor and Control (M&C) card or in the interface between the interface card and M&C card. Return the defective card for repair.

6.3 Interface Fault Isolation

Stored faults for the interface are reported in the ‘sTFAULTS” menu (Section 3.1.6) of O&I manual. The following is a list of the interface faults listed in Section 3.1.6.4, 3.1.6.5, 3.2.4.4 and 3.2.4.5. All faults are discussed in the manual for the IBS/M1200P and the D&I/M1200P interfaces. When a fault is unique to a given interface, it will be designated as so.

6.3.1 Transmit Overhead Framing Unit Faults

Fault	Possible Problem And Action
DATA/AIS	Data or Incoming Alarm Indication Signal. When AIS (Alarm Indication Signal) is selected the TX_INTF (Transmit Interface) fault “Data/AIS is monitoring a fault condition of all 1’s from customer data input to the modem. When Data_Flt is selected, the TX_INTF fault “Data/AIS is monitoring a fault condition of all 1’s or all 0’s. This is referred to as a data stable condition which means 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, to help isolate the source of the trouble in a system.
TX_PLL	(IBS/M1200P Only) Indicates a loss of lock on the reference of the interface transmit clock recovery oscillator. Return the interface card for repair.
DROP	(D&I/M1200P Only) Drop Interface Hardware Fault. The typical cause of this fault is the drop phase locked loop is not locked or some other drop interface hard- ware has malfunctioned. Return the drop and insert channel unit to the factory for repair.
Clk_Act	Loss of activity on the selected transmit clock source. The modem will fallback to the internal SCT clock source with an accuracy of 10-5.

6.3.2 Receive Overhead Framing Unit Faults

Fault	Possible Problem And Action
BUF_UNFL	Buffer Underflow, the plesiochronous buffer has underflowed. As 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 be correctly registered in the ‘stored Fault" memory. The time and date of the last 10 Receive "OFU" faults are stored in battery backed memory as an aid to trouble shooting. The interval between stored Over-flow/Underflow events can be used to determine relative clock accuracies.
BUF_OVFL	Buffer Overflow, the plesiochronous buffer has overflowed. See the "BUF_UNFL" Section for problems and actions as the same comments apply.
Data/AIS	Data or incoming Alarm Indication Signal. The data monitored for Receive Data is coming from the Satellite. When AIS (Alarm Indication Signal) is selected the RX_INTF (Receive Interface) fault “Data/AIS is monitoring a fault condition of all 1’s from customer the satellite. When Data_Flt is selected, the RX_INTF fault “Data/AIS is monitoring a fault condition of all 1’s or all 0’s. This is referred to as a data stable condition which means the data is not transitioning. This indicates there is trouble in receiving data from the satellite. The modem passes this signal transparently and takes no other action. This indication is a monitor function only, to help isolate the source of trouble in a system.

FRM_BER	Frame Bit Error Rate. 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 Specification IESS-308. In a redundant system a switchover 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.
BW_ALARM	Backward Alarm Fault. 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 however, this 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.
Insert	(D&I Only) Insert Interface Hardware Fault. 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 Drop and insert channel unit to the factory for repair.
Ins_Clk	(D&I Only) Insert Clock Fault. This fault occurs when no data is present on the Terrestrial side of the interface usually caused by the wrong clock selection such as the insert clock source is selected as “External” and no external clock is present. Check the selected clock source and verify the clock is present. If the fault is modem related, other faults will also occur. If the Satellite clock is selected a demod fault, “Data Clk_Syn” fault will probably occur. If the Insert clock is selected a mod fault, “TX_Clk_Syn” fault will probably occur.
RX_PLL	(IBS/M1200P Only) Indicates a loss of lock on the reference of the interface receive clock recovery oscillator. Return the interface card for repair.
BUFF_CLK	Loss of activity on the selected buffer clock source. The modem will fallback to the satellite clock.
MUX_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 Alarm Indication Signal (all ones) and switchover 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.

Table 6-2

Programmable Data Rates For The EFData									
Variable Rate SDM-309B Modem									
64.0									
64.5	65.0	65.5	66.0	66.5	67.0	67.5	68.0	68.5	69.0
69.5	70.0	70.5	71.0	71.5	72.0	72.5	73.0	73.5	74.0
74.5	75.0	75.5	76.0	76.5	77.0	77.5	78.0	78.5	79.0
79.5	80.0	80.5	81.0	81.5	82.0	82.5	83.0	83.5	84.0
84.5	85.0	85.5	86.0	86.5	87.0	87.5	88.0	88.5	89.0
89.5	90.0	90.5	91.0	91.5	92.0	92.5	93.0	93.5	94.0
94.5	95.0	95.5	96.0	96.5	97.0	97.5	98.0	98.5	99.0
99.5	100.0	100.5	101.0	101.5	102.0	102.5	103.0	103.5	104.0
104.5	105.0	105.5	106.0	106.5	107.0	107.5	108.0	108.5	109.0
109.5	110.0	110.5	111.0	111.5	112.0	112.5	113.0	113.5	114.0
114.5	115.0	115.5	116.0	116.5	117.0	117.5	118.0	118.5	119.0
119.5	120.0	120.5	121.0	121.5	122.0	122.5	123.0	123.5	124.0
124.5	125.0	125.5	126.0	126.5	127.0	127.5	128.0	128.5	129.0
129.5	130.0	130.5	131.0	131.5	132.0	132.5	133.0	133.5	134.0
134.5	135.0	135.5	136.0	136.5	137.0	137.5	138.0	138.5	139.0
139.5	140.0	140.5	141.0	141.5	142.0	142.5	143.0	143.5	144.0

144.5	145.0	145.5	146.0	146.5	147.0	147.5	148.0	148.5	149.0
149.5	150.0	150.5	151.0	151.5	152.0	152.5	153.0	153.5	154.0
154.5	155.0	155.5	156.0	156.5	157.0	157.5	158.0	158.5	159.0
159.5	160.0	160.5	161.0	161.5	162.0	162.5	163.0	163.5	164.0
164.5	165.0	165.5	166.0	166.5	167.0	167.5	168.0	168.5	169.0
169.5	170.0	170.5	171.0	171.5	172.0	172.5	173.0	173.5	174.0
174.5	175.0	175.5	176.0	176.5	177.0	177.5	178.0	178.5	179.0
179.5	180.0	180.5	181.0	181.5	182.0	182.5	183.0	183.5	184.0
184.5	185.0	185.5	186.0	186.5	187.0	187.5	188.0	188.5	189.0
189.5	190.0	190.5	191.0	191.5	192.0	192.5	193.0	193.5	194.0
194.5	195.0	195.5	196.0	196.5	197.0	197.5	198.0	198.5	199.0
199.5	200.0	200.5	201.0	201.5	202.0	202.5	203.0	203.5	204.0
204.5	204.8	205.0	205.5	206.0	206.4	206.5	207.0	207.5	208.0
208.5	209.0	209.5	209.6	210.0	210.5	211.0	211.2	211.5	212.0
212.5	212.8	213.0	213.5	214.0	214.4	214.5	215.0	215.5	216.0
216.5	217.0	217.5	217.6	218.0	218.5	219.0	219.2	219.5	220.0
220.5	220.8	221.0	221.5	222.0	222.4	222.5	223.0	223.5	224.0
224.5	225.0	225.5	225.6	226.0	226.5	227.0	227.2	227.5	228.0
228.5	228.8	229.0	229.5	230.0	230.4	230.5	231.0	231.5	232.0
232.5	233.0	233.5	233.6	234.0	234.5	235.0	235.2	235.5	236.0
236.5	236.8	237.0	237.5	238.0	238.4	238.5	239.0	239.5	240.0
240.5	241.0	241.5	241.6	242.0	242.5	243.0	243.2	243.5	244.0
244.5	244.8	245.0	245.5	246.0	246.4	246.5	247.0	247.5	248.0
248.5	249.0	249.5	249.6	250.0	250.5	251.0	251.2	251.5	252.0
252.5	252.8	253.0	253.5	254.0	254.4	254.5	255.0	255.5	256.0
257.0	257.6	258.0	259.0	259.2	260.0	260.8	261.0	262.0	262.4
263.0	264.0	265.0	265.6	266.0	267.0	267.2	268.0	268.8	269.0
270.0	270.4	271.0	272.0	273.0	273.6	274.0	275.0	275.2	276.0
276.8	277.0	278.0	278.4	279.0	280.0	281.0	281.6	282.0	283.0
283.2	284.0	284.8	285.0	286.0	286.4	287.0	288.0	289.0	289.6
290.0	291.0	291.2	292.0	292.8	293.0	294.0	294.4	295.0	296.0
297.0	297.6	298.0	299.0	299.2	300.0	300.8	301.0	302.0	302.4
303.0	304.0	305.0	305.6	306.0	307.0	307.2	308.0	308.8	309.0
310.0	310.4	311.0	312.0	313.0	313.6	314.0	315.0	315.2	316.0
316.8	317.0	318.0	318.4	319.0	320.0	321.0	321.6	322.0	323.0
323.2	324.0	324.8	325.0	326.0	326.4	327.0	328.0	329.0	329.6
330.0	331.0	331.2	332.0	332.8	333.0	334.0	334.4	335.0	336.0
337.0	337.6	338.0	339.0	339.2	340.0	340.8	341.0	342.0	342.4
343.0	344.0	345.0	345.6	346.0	347.0	347.2	348.0	348.8	349.0
350.0	350.4	351.0	352.0	353.0	353.6	354.0	355.0	355.2	356.0
356.8	357.0	358.0	358.4	359.0	360.0	361.0	361.6	362.0	363.0
363.2	364.0	364.8	365.0	366.0	366.4	367.0	368.0	369.0	369.6
370.0	371.0	371.2	372.0	372.8	373.0	374.0	374.4	375.0	376.0
377.0	377.6	378.0	379.0	379.2	380.0	380.8	381.0	382.0	382.4
383.0	384.0	385.0	385.6	386.0	387.0	387.2	388.0	388.8	389.0
390.0	390.4	391.0	392.0	393.0	393.6	394.0	395.0	395.2	396.0
396.8	397.0	398.0	398.4	399.0	400.0	401.0	401.6	402.0	403.0
403.2	404.0	404.8	405.0	406.0	406.4	407.0	408.0	409.0	409.6
410.0	411.0	411.2	412.0	412.8	413.0	414.0	414.4	415.0	416.0
417.0	417.6	418.0	419.0	419.2	420.0	420.8	421.0	422.0	422.4
423.0	424.0	425.0	425.6	426.0	427.0	427.2	428.0	428.8	429.0
430.0	430.4	431.0	432.0	433.0	433.6	434.0	435.0	435.2	436.0
436.8	437.0	438.0	438.4	439.0	440.0	441.0	441.6	442.0	443.0
443.2	444.0	444.8	445.0	446.0	446.4	447.0	448.0	449.0	449.6
450.0	451.0	451.2	452.0	452.8	453.0	454.0	454.4	455.0	456.0
457.0	457.6	458.0	459.0	459.2	460.0	460.8	461.0	462.0	462.4
463.0	464.0	465.0	465.6	466.0	467.0	467.2	468.0	468.8	469.0
470.0	470.4	471.0	472.0	473.0	473.6	474.0	475.0	475.2	476.0
476.8	477.0	478.0	478.4	479.0	480.0	481.0	481.6	482.0	483.0
483.2	484.0	484.8	485.0	486.0	486.4	487.0	488.0	489.0	489.6
490.0	491.0	491.2	492.0	492.8	493.0	494.0	494.4	495.0	496.0
497.0	497.6	498.0	499.0	499.2	500.0	500.8	501.0	502.0	502.4
503.0	504.0	505.0	505.6	506.0	507.0	507.2	508.0	508.8	509.0

510.0	510.4	511.0	512.0	513.6	514.0	515.2	516.0	516.8	518.0
518.4	520.0	521.6	522.0	523.2	524.0	524.8	526.0	526.4	528.0
529.6	530.0	531.2	532.0	532.8	534.0	534.4	536.0	537.6	538.0
539.2	540.0	540.8	542.0	542.4	544.0	545.6	546.0	547.2	548.0
548.8	550.0	550.4	552.0	553.6	554.0	555.2	556.0	556.8	558.0
558.4	560.0	561.6	562.0	563.2	564.0	564.8	566.0	566.4	568.0
569.6	570.0	571.2	572.0	572.8	574.0	574.4	576.0	577.6	578.0
579.2	580.0	580.8	582.0	582.4	584.0	585.6	586.0	587.2	588.0
588.8	590.0	590.4	592.0	593.6	594.0	595.2	596.0	596.8	598.0
598.4	600.0	601.6	602.0	603.2	604.0	604.8	606.0	606.4	608.0
609.6	610.0	611.2	612.0	612.8	614.0	614.4	616.0	617.6	618.0
619.2	620.0	620.8	622.0	622.4	624.0	625.6	626.0	627.2	628.0
628.8	630.0	630.4	632.0	633.6	634.0	635.2	636.0	636.8	638.0
638.4	640.0	641.6	642.0	643.2	644.0	644.8	646.0	646.4	648.0
649.6	650.0	651.2	652.0	652.8	654.0	654.4	656.0	657.6	658.0
659.2	660.0	660.8	662.0	662.4	664.0	665.6	666.0	667.2	668.0
668.8	670.0	670.4	672.0	673.6	674.0	675.2	676.0	676.8	678.0
678.4	680.0	681.6	682.0	683.2	684.0	684.8	686.0	686.4	688.0
689.6	690.0	691.2	692.0	692.8	694.0	694.4	696.0	697.6	698.0
699.2	700.0	700.8	702.0	702.4	704.0	705.6	706.0	707.2	708.0
708.8	710.0	710.4	712.0	713.6	714.0	715.2	716.0	716.8	718.0
718.4	720.0	721.6	722.0	723.2	724.0	724.8	726.0	726.4	728.0
729.6	730.0	731.2	732.0	732.8	734.0	734.4	736.0	737.6	738.0
739.2	740.0	740.8	742.0	742.4	744.0	745.6	746.0	747.2	748.0
748.8	750.0	750.4	752.0	753.6	754.0	755.2	756.0	756.8	758.0
758.4	760.0	761.6	762.0	763.2	764.0	764.8	766.0	766.4	768.0
769.6	770.0	771.2	772.0	772.8	774.0	774.4	776.0	777.6	778.0
779.2	780.0	780.8	782.0	782.4	784.0	785.6	786.0	787.2	788.0
788.8	790.0	790.4	792.0	793.6	794.0	795.2	796.0	796.8	798.0
798.4	800.0	801.6	802.0	803.2	804.0	804.8	806.0	806.4	808.0
809.6	810.0	811.2	812.0	812.8	814.0	814.4	816.0	817.6	818.0
820.0	822.0	824.0	826.0	828.0	830.0	832.0	834.0	836.0	838.0
840.0	842.0	844.0	846.0	848.0	850.0	852.0	854.0	856.0	858.0
860.0	862.0	864.0	866.0	868.0	870.0	872.0	874.0	876.0	878.0
880.0	882.0	884.0	886.0	888.0	890.0	892.0	894.0	896.0	898.0
900.0	902.0	904.0	906.0	908.0	910.0	912.0	914.0	916.0	918.0
920.0	922.0	924.0	926.0	928.0	930.0	932.0	934.0	936.0	938.0
940.0	942.0	944.0	946.0	948.0	950.0	952.0	954.0	956.0	958.0
960.0	962.0	964.0	966.0	968.0	970.0	972.0	974.0	976.0	978.0
980.0	982.0	984.0	986.0	988.0	990.0	992.0	994.0	996.0	998.0
1000.0	1002.0	1004.0	1006.0	1008.0	1010.0	1012.0	1014.0	1016.0	1018.0
1020.0	1022.0	1024.0	1028.0	1032.0	1036.0	1040.0	1044.0	1048.0	1052.0
1056.0	1060.0	1064.0	1068.0	1072.0	1076.0	1080.0	1084.0	1088.0	1092.0
1096.0	1100.0	1104.0	1108.0	1112.0	1116.0	1120.0	1124.0	1128.0	1132.0
1136.0	1140.0	1144.0	1148.0	1152.0	1156.0	1160.0	1164.0	1168.0	1172.0
1176.0	1180.0	1184.0	1188.0	1192.0	1196.0	1200.0	1204.0	1208.0	1212.0
1216.0	1220.0	1224.0	1228.0	1232.0	1236.0	1240.0	1244.0	1248.0	1252.0
1256.0	1260.0	1264.0	1268.0	1272.0	1276.0	1280.0	1284.0	1288.0	1292.0
1296.0	1300.0	1304.0	1308.0	1312.0	1316.0	1320.0	1324.0	1328.0	1332.0
1336.0	1340.0	1344.0	1348.0	1352.0	1356.0	1360.0	1364.0	1368.0	1372.0
1376.0	1380.0	1384.0	1388.0	1392.0	1396.0	1400.0	1404.0	1408.0	1412.0
1416.0	1420.0	1424.0	1428.0	1432.0	1436.0	1440.0	1444.0	1448.0	1452.0
1456.0	1460.0	1464.0	1468.0	1472.0	1476.0	1480.0	1484.0	1488.0	1492.0
1496.0	1500.0	1504.0	1508.0	1512.0	1516.0	1520.0	1524.0	1528.0	1532.0
1536.0	1540.0	1544.0	1548.0	1552.0	1556.0	1560.0	1564.0	1568.0	1572.0
1576.0	1580.0	1584.0	1588.0	1592.0	1596.0	1600.0	1604.0	1608.0	1612.0
1616.0	1620.0	1624.0	1628.0	1632.0	1636.0	1640.0	1644.0	1648.0	1652.0
1656.0	1660.0	1664.0	1668.0	1672.0	1676.0	1680.0	1684.0	1688.0	1692.0
1696.0	1700.0	1704.0	1708.0	1712.0	1716.0	1720.0	1724.0	1728.0	1732.0
1736.0	1740.0	1744.0	1748.0	1752.0	1756.0	1760.0	1764.0	1768.0	1772.0
1776.0	1780.0	1784.0	1788.0	1792.0	1796.0	1800.0	1804.0	1808.0	1812.0
1816.0	1820.0	1824.0	1828.0	1832.0	1836.0	1840.0	1844.0	1848.0	1852.0
1856.0	1860.0	1864.0	1868.0	1872.0	1876.0	1880.0	1884.0	1888.0	1892.0

1896.0	1900.0	1904.0	1908.0	1912.0	1916.0	1920.0	1924.0	1928.0	1932.0
1936.0	1940.0	1944.0	1948.0	1952.0	1956.0	1960.0	1964.0	1968.0	1972.0
1976.0	1980.0	1984.0	1988.0	1992.0	1996.0	2000.0	2004.0	2008.0	2012.0
2016.0	2020.0	2024.0	2028.0	2032.0	2036.0	2040.0	2044.0	2048.0	

Notes:

1. Programmed variable rates are listed above from 64 Kb/s to 2.048 Mb/s or Single Data Rate option is available.

2. Maximum 1/2 rate is 2048 Kb/s.

3 Maximum 3/4 rate is 2048 Kb/s.

Figure 6-10 Rear View Without Cover

6.4 Module Replacement

The modem cards are plug-in cards that can be replaced by removing the defective card and reinserting the replacement. There are card ejectors for use in removing the cards. On the interface card there are additional screws on the rear panel that need to be removed before the interface card is removed (refer to Figure 6-10). These screws must be reinstalled after the replacement card is inserted to hold the card in place while the data connector is being installed. The power supply in the modem is attached to the modem chassis. For repair of the power supply module it is recommended that all the plug-in cards be removed and send the chassis with the power supply back for repair.

For instructions on changing the data rate cards refer to Appendix A. For instructions on software upgrades refer to Appendix D.

6.5 Module Identification

The modem cards each have an assembly number that is marked on the board. The latest revision is stamped on the board as is the serial number. EFData tracks the hardware by the assembly revision and serial number. Data rate dependent hardware is labeled with the associated symbol rate on a label on the board. When replacing a plug-in module, care must be taken to assure that the proper daughter card is used. Refer to the individual Sections on each module for location of the configuration identification. Refer to Table 6-3 for a list of Part Numbers and descriptions of various modules used in the SDM-309B Modem.

6.6 Repacking For Shipment

The modem and modem cards are to be shipped in the factory packaging. The three main cards can be shipped in the caddy pack boxes that they were received in. The M&C and interface cards can also be shipped in the caddy pack boxes when they are being shipped without the modem chassis.

When a modem is being transported it is required that the three main cards be removed and sent with the modem packed in the caddy pack boxes. The M&C and interface cards are to be installed in the modem chassis with the two screws installed on the rear panel to hold the interface card in place.

Note: Failure to comply with the repacking procedure will void the warranty.

Table 6-3

EFData Part Numbers For Various Modules

Modulators Base Part Number - AS/0773 OR AS/0773X	
Dash #	**Description**
2	SDM-308/9, Open network filtering
11	SDM-308/9, Open network filtering, +5 dBm output
Demodulators Base Part Number - AS/0778 OR AS/0778X	
Dash #	**Description**
1	SDM-650, 308, 309, 70/140MHZ, 75 ohm
Viterbi Decoders Base Part Number - AS/0701	
Dash #	**Description**
1	SDM-308 (IDR)
2	SDM-309 (IBS)
Viterbi Decoder Base Part Number - AS/0949	
NO DASH NUMBERS	
Viterbi Decoder Base Part Number - AS/2133	
NO DASH NUMBERS	
Interfaces & Filter Cards	
Part #	**Description**
AS/1010 & 1011	IBS/M1200P Channel Unit Interface
AS/1010 & 1455	Drop & Insert Channel Unit Interface
AS/0930-2	Modulator Daughter Filter Card (Variable Rate)
AS/0715-X	Modulator Daughter Filter Card (Fixed Rate)
AS/0929-2	Demodulator Daughter Filter Card (Variable Rate)
AS/0698-X	Demodulator Daughter Filter Card (Fixed Rate)
X = 1 to 4, the number of filters installed on a fixed rate filter card.	

Appendix A.
DATA RATES AND FILTERS

The SDM-309B modem will operate at data rates from 64 Kbps to 2.048 Mbps with variable rate filters or fixed rate filters.

This appendix covers data rate change instructions for fixed rate and variable rate filters in Section 1. It also covers the differences between a fixed rate filter in Section 2, and a variable rate filter in Section 3, and describes the modem configuration for each filter type.

1.0 Data Rate Change Instructions

1.1 Fixed Rate Filters

1. Turn off modem power switch.

2. Remove the modulator card (0773) (Black card ejectors).

3. With a phillips screwdriver, remove the two (2) screws holding the daughter board in place. See Figure A-1 for location of the hardware.

4. Remove the daughter card (0715) from the modulator. Figure A-3 and Figure A-4 are fixed rate filter cards.

5. Install the replacement daughter card (0715) so that both screw holes line up. See Figure A-1.

   CAUTION

   If the filter is installed in the wrong position, damage will result on the daughter card.

6. Reinstall the daughter board hold down screws (Figure A-1) and reinsert the modulator into the chassis.

7. Remove the demodulator card (0778) (white card ejectors).

8. With a phillips screwdriver, remove the four (4) screws holding down the daughter card. See Figure A-2 for location of the hardware.

9. Remove the daughter card (0698) from the demodulator.

10. Install the replacement daughter card (0698) so that J1 on the daughter card lines up with J2 on the demodulator card and J2 on the daughter card lines up with J3 on the demodulator card and all four hold down screws line up. See Figure A-2.

CAUTION

If the filter is installed in the wrong position, damage will result on the daughter card.

11. Reinstall the daughter board hold down screws (Figure A-2) and reinsert the demodulator into the modem chassis.

12. Remove the M&C board and remove JP6 (Battery ON/OFF) for at least 10 seconds. Replace the battery jumper to the ON position and reinsert the M&C card into the modem.

13. Turn on the power switch.

14. Go to the “Utility” menu on the front panel and program the time and day. **Note:** The data/code rate assignment of a fixed rate filter in the “Utility” menu is automatically read by the M&C when power is turned on. Also each daughter card is labeled with the filter assignment (A, B, C, and D) and the associated symbol rate. Example - the label for a 64KBPS, 7/8 rate, QPSK filter is 36.57.

15. Go to the “Config” menu on the front panel and select the TX and RX rate that is desired and turn ON the RF output. The hardware change is complete.

1.2 Variable Rate Filters

1. Turn on the power switch.

2. Go to the “Utility” menu on the front panel and program the TXA, TXB, TXC, TXD, RXA, RXB, RXC, and/or RXD to the new desired data/code rates. Refer to the “Utility” menu of the Front Panel Operation in Chapter 3 for complete programming details.

3. Go to the “Config” menu on the front panel and select the TX and RX rate that is desired or select TXV and RXV and enter new desired data/code rates into the menu and Press “Enter” to execute the change. Remember that you can only select data rates up to and including 2048 Kpbs with a variable rate filter. Refer to Table 6-2 for a list of the programmable data rates of the variable rate filters. Enter the “Config MOD” menu and turn ON the RF output. The software change is complete.

Figure A-1 Modulator Filter Card Change

Figure A-2 Demodulator Filter Card Change

Figure A-3 Fixed Rate Modulator Filter

Figure A-4 Fixed Rate Demodulator Filter

Figure A-5 Variable Rate Modulator Filter

Figure A-6 Variable Rate Demodulator Filter

Appendix B. SATELLITE MODEM REMOTE CONTROL

1.0 Scope

This document defines the protocol and command structure for remote control and status monitoring of the EFData SDM308-5 satellite modem. Firmware FW/0713-60E, version 6.05.

2.0 General

Remote control and status information is transferred via a RS-485 (optional RS-232C) serial communications link. Commands and data are transfered on the remote control communications link as US ASCII encoded character strings. The remote communications link is operated in a half duplex mode. Communcations on the remote link are initiated by a remote controller or terminal. The SDM308-5 never transmits data on the link unless it is commanded to do so.

3.0 Message Structure

The ASCII character format used requires 10 or 11 bits/character: 1 start bit, 7 information bits, 1 parity bit (odd/even), and 1 or 2 stop bits.

Messages on the remote link fall into the catagories of commands and responses. Commands are messages which are transmit to a satellite modem, while responses are messages returned by a satellite modem in response to a command.

The general message structure is as follows:

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

3.1 Start Character

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

- “<“ for commands and
- “>“ for responses.

3.2 Device Address

The device address is the address of the one satellite modem which is designated to receive a transmitted command, or which is responding to a command. Valid device addresses are 1 to 3 characters long and in the range of 0 to 255. Address 0 is reserved as a global address which simultaneously addresses all devices on a given communications link. Devices do not acknowledge global commands.

Each satellite modem which is connected to a common remote communications link must be assigned its own unique address. Addresses are hardware (dipswitch) selectable at the modem and must be in the range of 1 to 255.

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

3.3 Command/Responses

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

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

`>add/?ER1_PARITY ERROR”cr””lf”]`
(error message for parity errors)

`>add/?ER2_INVALID PARAMETER”cr””lf”]`
(error message for a recognized command which can not be implemented or has parameters which are out of range)

`>add/?ER3_UNRECOGNIZABLE COMMAND”cr””lf”]`
(error message for unrecognizable command or bad command syntax)

`>add/?ER4_MODEM IN LOCAL MODE”cr””lf”]`
(MODEM in local error, use the REM command to go to remote mode)

`>add/?ER5_HARD CODED PARAMETER”cr””lf”]`
(error message indicating that the parameter is hardware dependent and may not be changed remotely)

3.4 End Character

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

- “cr” (carriage return character) for commands.
- “]” (end bracket) for responses.

4.0 Configuration Commands/Responses

4.1 Modulator Configuration Commands

4.1.1 Set Modulator Frequency (to nnn.nnnn MHZ, nnn.nnnn = 50.0000-90.0000)

Command: `<add/MF_nnn.nnnn”cr”`
Response: `>add/MF_nnn.nnnn”cr” RF_OFF”cr””lf”]`

Note: When modulator frequency is changed the RF output is switched off. nnn.nnnn = 50.0000 to 90.0000 and 100.0000 to 180.0000 for the 140MHz modulator.

Status Only: `<add/MF_”cr”`
Response: `>add/MF_nnn.nnnn”cr””lf”]`

4.1.2 Set RF Output ON/OFF

Command: `<add/RF_xxx”cr”` (xxx = ON or OFF)
Response: `>add/RF_xxx”cr””lf”]`

Status Only: `<add/RF_”cr”`
Response: `>add/RF_xxx”cr””lf”]`

4.1.3 Modulator Rate

The modulator has four symbol rate filters. Each filter is for a specific symbol rate. The data rate and coder rate for each filter must be established upon initial modulator installation and when circumstances indicate the need to do so. Filters are designated as A, B, C, and D. If a filter is not physically present in the system it may be assigned N/A (not assigned). Additionally filters which are factory programmed may not be remotely programmed and will return the "error 5" message when a programming command is issued.

VARIABLE RATE MODULATOR OPTION
Modulators with the variable rate option installed may have four preprogrammed rates available by using the filter rate assignment commands. These rates are selected using

the standard ‘sMRx_" commands. Modems that have the variable rate option installed will also respond to the special ‘sMRV_" command.

4.1.3.1 Modulator Filter Rate Assignment

Command: `<add/AMRx_nnn_mmmm.m”cr”` (x = A,B,C, or D Filter designator)
(nnn = 1/2,3/4, or 7/8 Coder rate)
(mmmm.m = 48.0 to 4080.0 (Data rate)

Response: `>add/AMRx_nnn_mmmm.m”cr””lf”]`

Status Only: `<add/AMRx_”cr”`
Response: `>add/AMRx_nnn_mmmm.m”cr””lf”]`

Note: The parameters nnn_mmmm.m may be replaced by N/A to indicate no assignment.

Example:
Command: `<add/AMRx_N/A”cr”`
Response: >add/AMRx_N/A”cr””lf”]

4.1.3.2 Select Modulator Rate

Command: `<add/SMRx_”cr”` (x = A,B,C, or D Filter designator)
Response: `>add/SMRx_”cr”RF_OFF”cr””lf”]`

Setting the modulator turns off the RF transmitter.

Status Only: see MR command.

Note: If the MODEM is commanded to a filter (rate) which is not assigned (N/A) the error 2 message will be returned.

4.1.3.3 Select Modulator Rate Variable *Variable Rate Option Only*

Command: `<add/SMRV_nnn_mmmm.m”cr”` (nnn = 1/2,3/4, or 7/8 Coder rate)
(mmmm.m = 48.0 to 4080.0 Data rate)

Response: `>add/SMRV_nnn_mmmm.m”cr””lf”] RF_OFF”cr””lf”]`

*Setting the modulator turns off the RF transmitter.

Status Only: see MR command.

4.1.4 Set Modulator Power Offset

Command: `<add/MPO_snn.n"cr"`
Response: `>add/MPO_snn.n"cr""lf"]`

snn.n = +20.0 to -20.0 in 0.5dB increments.

Note: This will be the highet modulator power that will be displayed and programmed. Use the MOP_ command to actually change the modulator output power.

Status Only: `<add/MPO_"cr"`
Response: `>add/MPO_snn.n"cr""lf"]`

4.1.5 Set Modulator Output Power Level

Command: `<add/MOP_snn.n"cr"`
Response: `>add/MOP_snn.n"cr""lf"]`

snn.n = +20.0 to -45.0 in 0.5dB increments for 140MHz modulator.
snn.n = +20.0 to -30.0 in 0.5dB increments for 70MHz modulator.

Note: Must be within 25.0dB of the modulator power offset value (see MPO_) for the 140MHz modulator and within 10.0dB of the modulator power offset for the 70MHz modulator.

Status Only: `<add/MOP_"cr"`
Response: `>add/MOP_snn.n"cr""lf"]`

4.1.6 Differential Encoder Enable

Command: `<add/DENC_xxx"cr"` (xxx = ON or OFF)
Response: `>add/DENC_xxx"cr"lf"]`

Status Only: `<add/DENC_"cr"`
Response: `>add/DENC_xxx"cr"lf"]`

4.2 Demodulator Configuration Commands

4.2.1 Set Demodulator Frequency (to nnn.nnnn MHZ, nnn.nnnn = 50.0000-90.0000)

Command: `<add/DF_nnn.nnnn"cr"`
Response: `>add/DF_nnn.nnnn"cr""lf"]`

Note: nnn.nnnn = 50.0000 to 90.0000 and 100.0000 to 180.0000 for the 140MHz demodulator.

Status Only: `<add/DF_”cr”`
Response: `>add/DF_nn.nnnn”cr””lf”]`

4.2.2 Demodulator Rate

The demodulator has four symbol rate filters. Each filter is for a specific symbol rate. The data rate and decoder rate for each filter must be established upon initial demodulator installation and when circumstances indicate the need to do so. Filters are designated as A, B, C, and D. If a filter is not physically present in the system it may be assigned N/A (not assigned). Additionally filters which are factory programmed may not be remotely programmed and will return the "error 5" message when a programming command is issued.

VARIABLE RATE DEMODULATOR OPTION
Demodulators with the variable rate option installed may have four preprogrammed rates available by using the filter rate assignment commands. These rates are selected using the standard ‘sDRx_" commands. Modems that have the variable rate option installed will also respond to the special ‘sDRV_" command. This allows for truly variable rate control while maintaining compatibility with previous systems.

4.2.2.1 Demodulator Filter Rate Assignment

Command: `<add/ADRx_nnn_mmmm.m”cr”` (x = A,B,C, or D Filter designator)
(nnn = 1/2,3/4, or 7/8 Decoder rate)
(mmmm.m = 48.0 to 4080.0 Data rate)

Response: `>add/ADRx_nnn_mmmm.m”cr””lf”]`

Status Only: `<add/ADRx_”cr”`
Response: `>add/ADRx_nnn_mmmm.m”cr””lf”]`

Note: The parameters nnn_mmmm.m may be replaced by N/A to indicate no assignment.

Example:
Command: `<add/ADRx_N/A”cr”`
Response: `>add/ADRx_N/A”cr””lf”]`

4.2.2.2 Select Demodulator Rate

Command: `<add/SDRx_”cr”` (x = A,B,C, or D Filter designator)
Response: `>add/SDRx_”cr””lf”]`

Status Only: see DR command.

Note: If the MODEM is commanded to a filter (rate) which is not assigned (N/A) the error 2 message will be returned.

4.2.2.3 Select Demodulator Rate Variable *Variable Rate Option Only*

Command: `<add/SDRV_nnn_mmmm.m"cr"` (nnn = 1/2,3/4, or 7/8 Coder rate)
(mmmm.m = 48.0 to 4080.0 Data rate)

Response: `>add/SDRV_nnn_mmmm.m"cr""lf"]`

Status Only: see DR command.

4.2.3 Differential Decoder Enable

Command: `<add/DDEC_xxx"cr"` (xxx = ON or OFF)
Response: `>add/DDEC_xxx"cr"lf"]`

Status Only: `<add/DDEC_"cr"`
Response: `>add/DDEC_xxx"cr"lf"]`

4.2.4 RF Loop-back (ON/OFF)

Command: `<add/RFL_xxx"cr"` (xxx = ON or OFF)
Response: `>add/RFL_xxx"cr""lf"]`

Status Only: `<add/RFL_"cr"`
Response: `>add/RFL_xxx"cr""lf"]`

4.2.5 IF Loop-back (ON/OFF)

Command: `<add/IFL_xxx"cr"` (xxx = ON or OFF)
Response: `>add/IFL_xxx"cr""lf"]`

Status Only: `<add/IFL_"cr"`
Response: `>add/IFL_xxx"cr""lf"]`

4.2.6 Bit Error Rate Threshold

Command: `<add/BERT_xxxx"cr"` (xxxx = NONE, or 1E-n.)
Response: `>add/BERT_xxxx"cr""lf"]`

Where n = 3,4,5,6,7 or 8 (exponent of threshold).

Status Only: `<add/BERT_"cr"`
Response: `>add/BERT_xxxx"cr""lf"]`

4.2.7 Sweep Reacquisition

This command is used to specify time duration of the reacquisition mode. The sweep is reduced to plus/minus 2500Hz of the last known lock point. Use of this function may reduce reacquisition times at low data rates. To inhibit the sweep reacquisition mode set ‘sR" to 0 seconds.

Command: `<add/SR_xxx”cr”` (xxx = 0 to 999 number of seconds)
Response: `>add/SR_xxx”cr””lf”]`

Status Only: `<add/SR_”cr”`
Response: `>add/SR_xxx”cr””lf”]`

4.2.8 Fast Acquisition Mode

This command is used to enable or disable fast acquisition and directed sweep modes of operation.

When fast acquisition is enabled the fast acquisition algorithm (requires hardware calibration) is used for acquisition of receive symbol rates of 128Ksps or lower. However, if the sweep range is set to less than 50khz, acquisition will be dictated by the directed sweep specifications and the fast acquisition algorithm will not be used.

The directed sweep functions are also available when fast acquisition is enabled. Directed sweep provides three commands for manipulating the acquisition process. These commands are ‘sCF_" (sweep center frequency), ‘sWR_" (sweep range), and ‘sD_" (sweep direction).

Command: `<add/FAM_xxx”cr”`
Response: `>add/FAM_xxx”cr””lf”]`

xxx = ON or OFF (OFF disables fast aquisition and directed sweep modes).

Status Only: `<add/FAM_”cr”`
Response: `>add/FAM_xxx”cr””lf”]`

4.2.9 Sweep Center Frequency

This command sets the sweep center frequency. During carrier acquisition the sweep starts at a offset which is one half the currently programmed sweep range (SWR_) from the sweep center frequency. The direction of the offset is determined by the currently programmed sweep direction (SD_).

The sweep center frequency may be set in the range of +25000Hz to -25000Hz.

Command: `<add/SCF_xnnnnn”cr””lf”`
Response: `>add/SCF_xnnnnn”cr””lf”]`

Status Only: `<add/SCF_"cr""lf"`
Response: `>add/SCF_xnnnnn"cr""lf"]` (x = + or - sweep offset direction).
(nnnnn = 0 to 25000.

*__Note:__ This command is only valid when fast acquisition is enabled. See the "FAM_" command definition.

4.2.10 Sweep Width Range

This command sets the overall travel of the sweep during acquisition. The sweep width may be set in the range of 0Hz to 50000Hz.

Command: `<add/SWR_nnnnn"cr""lf"`
Response: `>add/SWR_nnnnn"cr""lf"]`

Status Only: `<add/SWR_"cr""lf"`
Response: `>add/SWR_nnnnn"cr""lf"]` (nnnnn = 0 to 50000.)

*__Note:__ This command is only valid when fast acquisition is enabled. See the "FAM_" command definition.

4.2.11 Sweep Direction

This command sets the direction of the sweep travel. "+" sets incremental sweep while "-" sets decremental sweep.

Command: `<add/SD_s"cr""lf"`
Response: `>add/SD_s"cr""lf"]`

Status Only: `<add/SD_"cr""lf"`
Response: `>add/SD_s"cr""lf"]`

s = + or - (direction of sweep travel during acquisition).

*__Note:__ This command is only valid when fast acquisition is enabled. See the "FAM_" command definition.

4.3 Interface Configuration Commands (Drop & Insert Interface)

4.3.1 Insert Clock (Internal/Reference/Insert/Satellite)

Command: `<add/IC_xxx"cr"` (xxx = INT, REF, INS, or SAT)
Response: >add/IC_xxx"cr""lf"]

Status Only: `<add/IC_"cr"`
Response: `>add/IC_xxx"cr""lf"]`

4.3.2 External Reference Frequency

Command: `<add/ERF_nnnnn"cr"`
Response: `>add/ERF_nnnnn"cr""lf"]`

nnnnn = 8 to 99992 (external reference frequency in KHz, must be a a multiple of 8KHz).

Status Only: `<add/ERF_"cr"`
Response: `>add/ERF_nnnnn"cr""lf"]`

4.3.3 Interface Loop-back (ON/OFF)

Command: `<add/ILB_xxx"cr"` (xxx = ON or OFF)
Response: `>add/ILB_xxx"cr""lf"]`

Status Only: `<add/ILB_"cr"`
Response: >add/ILB_xxx"cr""lf"]

4.3.4 Base Band Loop-back (ON/OFF)

Command: `<add/BBL_xxx"cr"` (xxx = ON or OFF)
Response: `>add/BBL_xxx"cr""lf"]`

Status Only: `<add/BBL_"cr"`
Response: >add/BBL_xxx"cr""lf"]

4.3.5 Interface Coding Format Transmit (AMI/HDB3/B8ZS)

Command: `<add/ICFT_xxxx"cr"` (xxxx = AMI,HDB3 or B8ZS)
Response: `>add/ICFT_xxxx"cr""lf"]`

Status Only: `<add/ICFT_"cr"`
Response: `>add/ICFT_xxxx"cr""lf"]`

4.3.6 Interface Coding Format Receive (AMI/HDB3/B8ZS)

Command: `<add/ICFR_xxxx"cr"` (xxxx = AMI,HDB3 or B8ZS)
Response: `>add/ICFR_xxxx"cr""lf"]`

Status Only: `<add/ICFR_"cr"`
Response: `>add/ICFR_xxxx"cr""lf"]`

4.3.7 Scrambler Enable (ON/OFF)

Command: `<add/SE_xxx"cr"` (xxx = ON or OFF)
Response: `>add/SE_xxx"cr""lf"]`

Status Only: `<add/SE_"cr"`
Response: `>add/SE_xxx"cr""lf"]`

4.3.8 Descramble Enable (ON/OFF)

Command: `<add/DE_xxx″cr″` (xxx = ON or OFF)
Response: `>add/DE_xxx″cr″″lf″]`

Status Only: `<add/DE_″cr″`
Response: `>add/DE_xxx″cr″″lf″]`

4.3.9 Interface Substitute Pattern (Transmit 2047 Pattern)

Command: `<add/ISP_xxx″cr″` (xxx = ON or OFF)
Response: `>add/ISP_xxx″cr″″lf″]`

Status Only: `<add/ISP_″cr″`
Response: `>add/ISP_xxx″cr″″lf″]`

4.3.10 Interface Read Error Select (FRAME/2047)

This command is used to select the reading of frame error data or 2047 pattern error data.

Command: `<add/IRE_xxxx″cr″` (xxxx = FRM (FRAME) or 2047)
Response: `>add/IRE_xxxx″cr″″lf″]`

Status Only: `<add/IRE_″cr″`
Response: `>add/IRE_xxxx″cr″″lf″]`

4.3.11 Interface Buffer Center

This command centers the interface buffer.

Command: `<add/IBC_″cr″`
Response: `>add/IBC_″cr″″lf″]`

4.3.12 Interface Buffer Size

Command: `<add/IBS_nn″cr″`
Response: `>add/IBS_nn″cr″″lf″]`

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.

Status Only: `<add/IBS_″cr″`
Response: `>add/IBS_nn″cr″″lf″]`

4.3.13 Transmit Data Fault

Command: `<add/TDF_xxxx"cr"`
Response: `>add/TDF_xxxx"cr""lf"]`

xxxx = NONE, DATA, or AIS (transmit data fault flagged on transmit data loss, AIS from terrestrial interface or none flagged).

Status Only: `<add/TDF_"cr"`
Response: `>add/TDF_xxxx"cr""lf"]`

4.3.14 Receive Data Fault

Command: `<add/RDF_xxxx"cr"`
Response: `>add/RDF_xxxx"cr""lf"]`

xxxx = NONE, DATA, or AIS (receive data fault flagged on satellite receive data loss, AIS from satellite or none flagged).

Status Only: `<add/RDF_"cr"`
Response: `>add/RDF_xxxx"cr""lf"]`

4.3.15 Drop Data Format

Command: `<add/DDF_xxxxxx"cr"`
Response: `>add/DDF_xxxxxx"cr""lf"]`

xxxxx = T1, T1ESF, T1IBS, E1CCS, E1CAS, E1IBS, or E131TS.

Status Only: `<add/DDF_"cr"`
Response: `>add/DDF_xxxxxx"cr""lf"]`

4.3.16 Insert Data Format

Command: `<add/IDF_xxxxxx"cr"`
Response: `>add/IDF_xxxxxx"cr""lf"]`

xxxxx = T1, T1ESF, T1IBS, E1CCS, E1CAS, E1IBS, or E131TS.

Status Only: `<add/IDF_"cr"`
Response: `>add/IDF_xxxxxx"cr""lf"]`

4.3.17 Drop Channels Assignment

Command: `<add/DCA_dd;cc"cr"`
Response: `>add/DCA_dd;cc"cr""lf"]`

dd = 1 to N, (over the satellite drop channel)
where N = (Modulator Data Rate) divided by (64Kbps).
cc = 1 to 24 (terrestrial channel number for T1 data formats).

cc = 1 to 31 (terrestrial time slot number for E1 data formats).

Status Only: `<add/DCA_dd”cr”`
Response: `>add/DCA_dd;cc”cr””lf”]`

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 1920.0Kbps.

4.3.18 Bulk Drop Channels Assignment

Command: `<add/BDCA_dd;cc_dd;cc_dd;cc_dd;cc.....”cr”`
Response: `>add/BDCA_dd;cc_dd;cc_dd;cc_dd;cc.....”cr””lf”]`

dd = 1 to N, (over the satellite drop channel)
where N = (Modulator Data Rate) divided by (64Kbps).
cc = 1 to 24 (terrestrial channel number for T1 data formats).
cc = 1 to 31 (terrestrial time slot number for E1 data formats).

Status Only: `<add/BDCA_”cr”`
Response: `>add/BDCA_dd;cc_dd;cc_dd;cc_dd;cc.....”cr””lf”]`

Notes: The status response returns progamming information for 1 to N drop channels. 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 1920.0Kbps.

4.3.19 Insert Channels Assignment

Command: `<add/ICA_ii;cc”cr”`
Response: `>add/ICA_ii;cc”cr””lf”]`

ii = 1 to N, (over the satellite insert channel)
where N = (Demodulator Data Rate) divided by (64Kbps).
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.

Status Only: `<add/ICA_ii”cr”`
Response: `>add/ICA_ii;cc”cr””lf”]`

Notes: Time slot 16 (cc = 16) may not be specified when the insert data format is specified to be E1CAS. 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 1920.0Kbps.

4.3.20 Bulk Insert Channels Assignment

Command: `<add/BICA_ii;cc_ii;cc_ii;cc_ii;cc.....”cr”`
Response: `>add/BICA_ii;cc_ii;cc_ii;cc_ii;cc.....”cr””lf”]`

ii = 1 to N, (over the satellite insert channel)
where N = (Modulator Data Rate) divided by (64Kbps).
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.

Status Only: `<add/BICA_”cr”`
Response: `>add/BICA_ii;cc_ii;cc_ii;cc_ii;cc.....”cr””lf”]`

Notes: The status response returns progamming information for 1 to N insert channels. Time slot 16 (cc = 16) may not be specified when the insert data format is specified to be E1CAS. 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 1920.0Kbps.

4.4 System Configuration Commands

4.4.1 Time Of Day

Command: `<add/TIME_hh:mmxx”cr”` (hh = hours, mm = minutes,
Response: `>add/TIME_hh:mmxx”cr””lf”]` xx = AM or PM)

Status Only: `<add/TIME_”cr”`
Response: `>add/TIME_hh:mmxx”cr””lf”]`

Example: Set modem 67 time to 10:45PM.

Command: `<67/TIME_10:45PM”cr”`
Response: `>67/TIME_10:45PM”cr””lf”]`

4.4.2 Date

Command: `<add/DATE_mm/dd/yy”cr”` (mm = month, dd = day, and
Response: `>add/DATE_mm/dd/yy”cr””lf”]` yy = year)

Status Only: `<add/DATE_”cr”`
Response: `>add/DATE_mm/dd/yy”cr””lf”]`

Example: Set modem 235 date to 11/30/87.

Command: `<235/DATE_11/30/87”cr”`
Response: `>235/DATE_11/30/87”cr””lf”]`

4.4.3 Remote Configures the MODEM for remote operation.

The SDM308-5 will respond to any status request at any time. However, the SDM308-5 must be in “Remote Mode” to change configuration parameters.

Command: `<add/REM_”cr”`
Response: `>add/REM_”cr””lf”]`

4.4.4 Clear Stored Faults

This command is used to clear all stored faults logged by the SDM308-5.

Command: `<add/CLSF_”cr”`
Response: `>add/CLSF_”cr””lf”]`

4.4.5 Modem Operation Mode

This command configures the modem for simplex or duplex operation modes. When transmit only mode is selected receive faults are inhibited and when receive only mode is selected transmit faults are inhibited.

Command: `<add/MOM_xxxxxxx”cr”`
Response: `>add/MOM_xxxxxxx”cr””lf”]`

xxxxxxx = TX_ONLY, RX_ONLY, or DUPLEX.

Status Only: `<add/MOM_”cr”`
Response: `>add/MOM_xxxxxxx”cr””lf”]`

5.0 Status Commands/Responses

5.1 Configuration Status

5.1.1 Modulator/Coder Configuration Status

The Modulator/Coder 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/Coder.

Command: `<add/MCS_”cr”`
Response: `>add/MCS_”cr”`

`RF_xxx”cr”`	RF output (ON/OFF)
`MF_nnn.nnnn”cr”`	Modulator Frequency
`MPO_snn.n”cr”`	Modulator Power Offset
`MOP_snn.n”cr”`	Modulator Output Power
`MR_nnn_mmmm.m”cr”`	Modulator Rate

AMRA_nnn_mmmm.m″cr″	filter “A” assignment
AMRB_nnn_mmmm.m″cr″	filter “B” assignment
AMRC_nnn_mmmm.m″cr″	filter “C” assignment
AMRD_nnn_mmmm.m″cr″	filter “D” assignment
COM_xxx″cr″	Carrier Only Mode (ON/OFF)
DENC_xxx″cr″	Differential Encoder (ON/OFF)
AMRV_nnn.mmmm.m″cr″″lf″]	modulator variable rate assignment *(variable rate option only)*

5.1.2 Modulator/Coder Configuration Program Status

This command is used by the SMS658 M:N protection switch to collect information that is necessary to configure back-up modems.

Command: <add/MCP_″cr″
Response: >add/MCP_″cr″

MF_nnn.nnnn″cr″	Modulator Frequency
MPO_snn.n″cr″	Modulator Power Offset
MOP_snn.n″cr″	Modulator Output Power
MR_nnn_mmmm.m″cr″	Modulator Rate
DENC_xxx″cr″	Differential Encoder (ON/OFF)
SE_xxx″cr″	Scrambler Enable (ON/OFF)
ERF_nnnnn″cr″	External Reference Frequency
BBL_xxx″cr″	Base Band Loop-back (ON/OFF)
ILB_xxx″cr″	Interface Loop-back (ON/OFF)
ICFT_xxxx″cr″	Coding Format Transmit (AMI/HDB3/B8ZS)
ISP_xxx″cr″	Substitution Pattern (ON/OFF)
TDF_xxxx″cr″	Transmit Data Fault (NONE/DATA/AIS)
DDF_xxxxxx″cr″	Drop Data Format
BDCA_dd;cc_dd;cc...″cr″	Bulk Drop Channels Assignment
RF_xxx″cr″″lf″]	RF output (ON/OFF)

5.1.3 Demodulator/Decoder Configuration Status

The Demodulator/Decoder 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.

Command: <add/DCS_″cr″
Response: >add/DCS_″cr″

DF_nnn.nnnn″cr″	Demodulator Frequency
DR_nnn_mmmm.m″cr″	Demodulator Rate
ADRA_nnn_mmmm.m″cr″	filter “A” assignment
ADRB_nnn_mmmm.m″cr″	filter “B” assignment
ADRC_nnn_mmmm.m″cr″	filter “C” assignment
ADRD_nnn_mmmm.m″cr″	filter “D” assignment
RFL_xxx″cr″	RF Loop-back (ON/OFF)
DDEC_xxx″cr″	Differential Decoder (ON/OFF)
BERT_xxxx″cr″	BER Threshold
SR_xxx″cr″	Sweep Reacqisition (seconds)
IFL_xxx″cr″	IF loop-back (ON/OFF)
SCF_snnnnn″cr″	*Sweep Center Frequency
SWR_nnnnn″cr″	*Sweep Width

SD_s″cr″	*Sweep Direction
FAM_xxx″cr″	Fast Acquisition Mode
ADRV_nnn.mmmm.m″cr″″lf″]	demodulator variable rate assignment (variable rate option only)*

***Note:** ‘sCF_", ‘sWR_", and ‘sD_" responses are returned only when fast acquisition is enabled. See the "FAM_" command definition.

5.1.4 Demodulator/Decoder Configuration Program Status

This command is used by the SMS658 M:N protection switch to collect information that is necessary to configure back-up modems.

Command: <add/DCP_″cr″
Response: >add/DCP_″cr″

DF_nnn.nnnn″cr″	Demodulator Frequency
DR_nnn_mmmm.m″cr″	Demodulator Rate
DDEC_xxx″cr″	Differential Decoder (ON/OFF)
BERT_xxxx″cr″	BER Threshold
SR_xxx″cr″	Sweep Reacqisition (seconds)
IFL_xxx″cr″	IF Loop-back (ON/OFF)
DE_xxx″cr″	Descrambler Enable (ON/OFF)
IC_xxx″cr″	Insert Clock (INT/INS/SAT/REF)
ERF_nnnnn″cr″	External Reference Frequency
BBL_xxx″cr″	Base Band Loop-back (ON/OFF)
ILB_xxx″cr″	Interface Loop-back (ON/OFF)
ICFR_xxxx″cr″	Coding Format Receive (AMI/HDB3/B8ZS)
RDF_xxxx″cr″	Receive Data Fault (NONE/DATA/AIS)
IRE_xxxx″cr″	Interface Read Error Select (FRM/2047)
IDF_xxxxxx″cr″	Insert Data Format
IBS_nnnnnn″cr″	Interface Buffer Size
BICA_dd;cc_dd;cc...″cr″	Bulk Insert Channels Assignment
FAM_xxx″cr″	Fast Acquisition Mode
SCF_snnnnn″cr″	*Sweep Center Frequency
SWR_nnnnn″cr″	*Sweep Width
SD_s″cr″″lf″]	*Sweep Direction

***Note:** ‘sCF_", ‘sWR_", and ‘sD_" responses are returned only when fast acquisition is enabled. See the "FAM_" command definition.

5.1.5 Interface Configuration Status

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.

Command: <add/ICS_″cr″
Response: >add/ICS_″cr″

IC_xxx″cr″	Insert Clock (INT,INS,REF,SAT)
ERF_nnnnn″cr″	External Reference Frequency
BBL_xxx″cr″	Base Band Loop-back (ON/OFF)
ILB_xxx″cr″	Interface Loop-back (ON/OFF)
ICFT_xxxx″cr″	Coding Format Transmit (AMI/HDB3/B8ZS)

ICFR_xxxx"cr"	Coding Format Receive (AMI/HDB3/B8ZS)
ISP_xxx"cr"	Substitution Pattern (ON/OFF)
TDF_xxxx"cr"	Transmit Data Fault (NONE/DATA/AIS)
RDF_xxxx"cr"	Receive Data Fault (NONE/DATA/AIS)
IBS_nnnnnn"cr"	Interface Buffer Size
IRE_xxxx"cr"	Interface Read Error Select (FRM/2047)
DE_xxx"cr"	Descrambler Enable (ON/OFF)
SE_xxx"cr"	Scrambler Enable (ON/OFF)
DDF_xxxxxx"cr"	Drop Data Format
BDCA_dd;cc_dd;cc..."cr"	Bulk Drop Channels Assignment
IDF_xxxxxx"cr"	Insert Data Format
BICA_dd;cc_dd;cc..."cr""lf"]	Bulk Insert Channels Assignment

5.2 MODEM Faults Status (Summary)

This command returns the current overall fault conditions of the MODEM.

Command: <add/MFS_"cr"
Response: >add/MFS_"cr"

DMD_xxx"cr"	Demodulator (FLT/OK)
MOD_xxx"cr"	Modulator (FLT/OK)
CEQ_xxx"cr"	Common Equipment (FLT/OK)
ITX_xxx"cr"	Interface Transmit Side (OK/FLT)
IRX_xxx"cr""lf"]	Interface Receive Side (OK/FLT)

5.3 Modulator Status

The modulator status is returned as a block of data which indicates general status information.

Command: <add/MS_"cr"
Response: >add/MS_"cr"

RF_xxx"cr"	RF output (ON/OFF) actual status not config
MOD_xxx"cr"	Module missing or won't program (OK/FLT)
AGC_xxx"cr"	AGC leveled (OK/FLT)
SYN_xxx"cr"	Carrier synthesizer (OK/FLT)
BCLK_xxx"cr"	Bit clock (OK/FLT)
TCLK_xxx"cr"	Transmit clock (OK/FLT)
ICH_xxx"cr"	I-channel (OK/FLT)
QCH_xxx"cr"	Q-channel (OK/FLT)
SFLT_xx"cr""lf"]	Number of stored faults logged (0 to 10)

5.4 Demodulator Status

The demodulator status is returned as a block of data which provides general status information.

Command: <add/DS_"cr"
Response: >add/DS_"cr"

DMD_xxx"cr"	Demod module (OK/FLT)
CD_xxx"cr"	Carrier detect (OK/FLT)

SYN_xxx″cr″	Synthesizer lock (OK/FLT)
ICH_xxx″cr″	I-channel (OK/FLT)
QCH_xxx″cr″	Q-channel (OK/FLT)
BCLK_xxx″cr″	bit clock (OK/FLT)
BERT_xxx″cr″	BER threshold (OK/FLT)
RSL_-nn.ndBm″cr″	Receive Signal Level (level or No Data)
CSV_snnnnn″cr″	Current Sweep Value
SFLT_xx″cr″″lf″]	Number of stored faults logged (0 to 10)

5.5 Common Equipment Status

The common equipment status command causes a block of data to be returned which indicates the status of the common equipment.

Command: <add/CES_″cr″
Response: >add/CES_″cr″

M&C_xxx″cr	Monitor & Control Module (OK/FLT)
INT_xxx″cr″	Data Interface Module (OK/FLT)
BAT_xxx″cr″	battery (OK/FLT)
PS1_xxx″cr″	+5 volt power supply (OK/FLT)
PS2_xxx″cr″	+12 volt power supply (OK/FLT)
PS3_xxx″cr″	-12 volt power supply (OK/FLT)
MODE_xxxxxx″cr″	Mode (LOCAL or REMOTE)
SW_x.xxx″cr″	Software Version
SFLT_xx″cr″″lf″]	Number of stored faults logged (0 to 10)

5.6 Interface Transmit Side Status

Command: <add/ITXS_″cr″
Response: >add/ITXS_″cr″

CLK_xxx″cr″	Selected Transmit Clock Activity (OK/FLT)
DRP_xxx″cr″	Drop (OK/FLT)
TXD_xxx″cr″	Transmit Data (OK/FLT)
SFLT_xx″cr″″lf″]	Number of Stored Faults Logged (0 to 10)

5.7 Interface Receive Side Status

Command: <add/IRXS_″cr″
Response: add/IRXS_″cr″

MUX_xxx″cr″	MUX Lock (OK/FLT)
CLK_xxx″cr″	Selected Insert Clock Activity (OK/FLT)
INS_xxx″cr″	Insert (OK/FLT)
BWA_xxx″cr″	Receive Backward Alarm (OK/FLT)
BER_xxx″cr″	Frame BER (OK/FLT)
RXD_xxx″cr″	Receive Data Loss/AIS (OK/FLT)
OVFL_xxx″cr″	Buffer Overflow (OK/FLT)
UNFL_xxx″cr″	Buffer Underflow (OK/FLT)
IRES_xxxx_n.nE-e″cr″	Read Error Status
IBFS_nn%″cr″	Interface Buffer Fill Status
SFLT_xx″cr″″lf″]	Number of Stored Faults Logged (0 to 10)

5.8 Bit Error Rate Status

5.8.1 Raw BER

Command: `<add/RBER_"cr"`
Response: `>add/RBER_nnnnE-4"cr""lf"]` nnnn = RBER or nnnn = <1.0 (lower limit)

Example: Request Raw BER from modem 123.

Command: `<123/RBER_"cr"`
Response: `>123/RBER_152E-4"cr""lf"]` RBER = .0152 errors/bit

*__Note:__ "No Data" is returned if no carrier is detected (decoder not locked).

5.8.2 Corrected BER

Command: `<add/CBER_"cr"`
Response: `>add/CBER_nE-m"cr""lf"]`

Example: Request Corrected BER from modem 19.

Command: `<19/CBER_"cr"`
Response: `>19/CBER_3E-5"cr""lf"]` CBER = .00003 errors/bit

*__Note:__ Corrected BER limits are; lower <1E-8, upper >1E-3. "No Data" is returned if no carrier is detected (decoder not locked).

5.8.3 Corrected BER Log

Error data (samples) are compiled at the nominal system rate indicated by the time parameter (t.t). The samples are stored in a thirty-two-element FIFO. When the "CBEL_" command is received the samples in the FIFO are formatted and returned as indicated. The FIFO is then flushed. If the FIFO becomes full the oldest sample will be lost as the current sample is written.

Command: `<add/CBEL_"cr"`
Response: `>add/CBEL_t.t;s1,s2,s3 ... sn"cr""lf"]`

t.t = Time between corrected BER samples in seconds ("0.1" to "9.9").
; = At least one data point has been logged.
s1 to sn = Corrected BER samples in the format of (xmmee):
x - The optional data modifier "<" or ">" (less than or greater than).
mm - The corrected BER mantissa ("01" to "99").
ee - The corrected BER negative exponent ("00" to "99").

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.

Examples:
No Data - `>add/CBEL_1.0”cr””lf”]`
Momentary lock in 32 time intervals -
```
>add/CBEL_1.0;,,,,,,,0203,<0108,<0108,<0108,,,,,,,,,,,,,,,,,,,,,”cr””lf
”]
```

5.9 Eb/N0 Status

The Eb/N0 status command causes the Eb/N0 ratio to be returned. Eb/N0 is returned in dB.

Command: `<add/EBN0_”cr”`
Response: `>add/EBN0_nn.ndB”cr””lf”]`

Example: Request Eb/N0 ratio from modem 2.

Command: `<2/EBN0_”cr”`
Response: `>2/EBN0_4.2dB”cr””lf”]` Nb/N0 = 4.2dB

Note: EB/N0 limits are; lower <3.2dB, upper >9.7dB (the upper limit is >16.0dB for the 949 decoder). "No Data" is returned if no carrier is detected (decoder not locked).

5.10 Modulator Rate Status

Command: `<add/MR_”cr”`
Response: `>add/MR_nnn_mmmm.m”cr””lf”]`

nnn = 1/2,3/4,7/8 (Coder rate).
mmmm.m = 56.0 to 4080.0 (Data rate)

Note: The parameters nnn_mmmm.m may be replaced by N/A to indicate no assignment.

5.11 Demodulator Rate Status

Command: `<add/DR_”cr”`
Response: `>add/DR_nnn_mmmm.m”cr””lf”]`

nnn = 1/2,3/4, or 7/8 (Decoder rate).
mmmm.m = 56.0 to 4080.0 (Data rate)

Note: The parameters nnn_mmmm.m may be replaced by N/A to indicate no assignment.

5.12 Receive Signal Level Status

Command: `<add/RSL_”cr”`
Response: `>add/RSL_-nn.ndBm”cr””lf”]`

5.13 Current Sweep Value

This command returns the current sweep value, and the decoder lock status.

Command: `<add/CSV_”cr””lf”`
Response: `>add/CSV_snnnnn”cr”CD_xxx”cr””lf”]`

s = + or - (sweep offset direction).
nnnnn = 0 to 25000.
xxx = OK or FLT (decoder lock status OK or FAULT).

5.14 Interface Read Error Status

This command returns frame or 2047 error rate. If data is not valid the message "No_Data" is returned in lieu of error rate data. The IRE configuration command is used to select reading of frame or 2047 errors.

Command: `<add/IRES_”cr”`
Response: `>add/IRES_xxxx_n.nE-e”cr””lf”]`

xxxx = FRM (FRAME) or 2047 (indicates type of error being read).
n.n = 1.0 to 9.9 (error rate number).
e = 2 to 6 (exponent).

Example:
Command: `<add/IRES_”cr”`
Response: `>add/IRES_FRM_2.3E-6”cr””lf”]`

5.15 Interface Buffer Fill Status

Command: `<add/IBFS_”cr”`
Response: `>add/IBFS_nn%”cr””lf”]`

nn = 1 to 99 (Relative to buffer depth).

5.16 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 in leu of the normal time/date status information.

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

“#”	Fault number (0 - 9), “0” is the first fault stored.
hh	Hours in twenty four hour format.
mm	Minutes.
ss	Seconds.
MM	Month.
DD	Day
YY	Year.

5.16.1 Modulator Stored Faults

Command: `<add/MSF_#"cr"`
Response: `>add/MSF_# hh:mm:ss MM/DD/YY"cr"`

`MOD_xxx"cr"`	Module missing or won"t program (OK/FLT)
`AGC_xxx"cr"`	AGC leveled (OK/FLT)
`SYN_xxx"cr"`	Carrier synthesizer (OK/FLT)
`BCLK_xxx"cr"`	Bit clock (OK/FLT)
`TCLK_xxx"cr"`	Transmit clock (OK/FLT)
`ICH_xxx"cr"`	I-channel (OK/FLT)
`QCH_xxx"cr""lf"]`	Q-channel (OK/FLT)

5.16.2 Demodulator Stored Faults

Command: `<add/DSF_#"cr"`
Response: `>add/DSF_# hh:mm:ss MM/DD/YY"cr"`

`DMD_xxx"cr"`	Demod module (OK/FLT)
`CD_xxx"cr"`	Carrier detect (OK/FLT)
`SYN_xxx"cr"`	Synthesizer lock (OK/FLT)
`ICH_xxx"cr"`	I-channel (OK/FLT)
`QCH_xxx"cr"`	Q-channel (OK/FLT)
`BCLK_xxx"cr"`	bit clock (OK/FLT)
`BERT_xxx"cr""lf"]`	BER threshold (OK/FLT)

5.16.3 Common Equipment Stored Faults

Command: `<add/CSF_#"cr"`
Response: `>add/CSF_# hh:mm:ss MM/DD/YY"cr"`

`M&C_xxx"cr`	Monitor & Control Module (OK/FLT)
`INT_xxx"cr"`	Data Interface Module (OK/FLT)
`BAT_xxx"cr"`	battery (OK/FLT)
`PS1_xxx"cr"`	+5 volt power supply (OK/FLT)
`PS2_xxx"cr"`	+12 volt power supply (OK/FLT)
`PS3_xxx"cr""lf"]`	-12 volt power supply (OK/FLT)

5.16.4 Interface Transmit Side Status

Command: `<add/ITSF_#"cr"`
Response: `>add/ITSF_# hh:mm:ss MM/DD/YY"cr"`

`CLK_xxx"cr"`	Selected Transmit Clock Activity (OK/FLT)
`DRP_xxx"cr"`	Drop (OK/FLT)
`TXD_xxx"cr""lf"]`	Transmit Data (OK/FLT)

5.16.5 Interface Receive Side Status

Command: `<add/IRSF_#"cr"`
Response: `>add/IRSF_# hh:mm:ss MM/DD/YY"cr"`

`MUX_xxx"cr"`	MUX Lock (OK/FLT)
`CLK_xxx"cr"`	Selected Insert Clock Activity (OK/FLT)

`INS_xxx"cr"`	Insert (OK/FLT)
`BWA_xxx"cr"`	Receive Backward Alarm (OK/FLT)
`BER_xxx"cr"`	Frame BER (OK/FLT)
`RXD_xxx"cr"`	Receive Data Loss/AIS (OK/FLT)
`OVFL_xxx"cr"`	Buffer Overflow (OK/FLT)
`UNFL_xxx"cr""lf"]`	Buffer Underflow (OK/FLT)

5.17 Bulk Consolidated Status

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"]). The maximum number of characters returned is approxamately 230. Most of the data returned is formated the same way as the single command status request (refer to the appropriate portions of this document in preceeding Sections).

Command: `<add/BCS_"cr"`
Response: `>add/BCS_p1,p2,p3, . . . pn"cr""lf"]`

Where "pn" is the last parameter returned.

Parameter 1 (p1): Modulator RF output ON/OFF.
p1 = n, where "n" is "0" to indicate off or "1" to indicate on.
Parameter 2 (p2): Modulator IF frequency.
p2 = nnn.nnnn, where "nnn.nnnn" is the modulator IF frequency in MHz.
Parameter 3 (p3): Modulator output power level.
p3 = snn.n, where 'snn.n" transmitter power output power level in dBm.
Parameter 4 (p4): Modulator rate currently programmed.
p4 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 5 (p5): Modulator filter A assignment.
p5 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 6 (p6): Modulator filter B assignment.
p6 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 7 (p7): Modulator filter C assignment.
p7 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 8 (p8): Modulator filter D assignment.
p8 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 9 (p9): Carrier only mode ON/OFF.
p9 = n, where "n" is "0" to indicate off or "1" to indicate on.
Parameter 10 (p10): Differential encoder enable ON/OFF.
p10 = n, where "n" is "0" to indicate off or "1" to indicate on.
Parameter 11 (p11): Demodulator IF frequency.
p11 = nnn.nnnn, where "nnn.nnnn" is the demodulator IF frequency in MHz.
Parameter 12 (p12): Demodulator rate currently programmed.
p12 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 13 (p13): Demodulator filter A assignment.
p13 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 14 (p14): Demodulator filter B assignment.
p14 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 15 (p15): Demodulator filter C assignment.
p15 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.
Parameter 16 (p16): Demodulator filter D assignment.
p16 = nnn_mmmm.m, where "nnn" is the code rate and "mmmm.m" is the data rate in Kbps.

Parameter 17 (p17): RF loop-back ON/OFF.
p17 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 18 (p18): Differential decoder enable ON/OFF.
p18 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 19 (p19): BER threshold.
p19 = nnnn, where “nnnn” is the currently programmed BER threshold in the same format as the single command “BERT_”.
Parameter 20 (p20): Sweep Reacquisition.
p20 = nn, where “nn” is the reacquisition parameter in seconds.
Parameter 21 (p21): IF loop-back ON/OFF.
p21 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 22 (p22): Insert clock source (Internal/Reference/Insert/Satellite).
p22 = n, where “n” is “0”, “1”, “2”, or “3” (“0” = INT, “1” = REF, “2” = INS, “3” = SAT).
Parameter 23 (p23): Extrernal Reference Frequency.
p23 = nnnnn, where “nnnnn, is the assigned frequency in KHz.
Parameter 24 (p24): Base band loop-back ON/OFF.
p24 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 25 (p25): Interface loop-back ON/OFF.
p25 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 26 (p26): TX Interface coding format (AMI/B8ZS/HDB3).
p26 = n, where “n” is “0”, “1”, “2”, or “3” (“0” = AMI, “1” = B8ZS, “3” = HDB3).
Parameter 27 (p27): RX Interface coding format (AMI/B8ZS/HDB3).
p28 = n, where “n” is “0”, “1”, “2”, or “3” (“0” = AMI, “1” = B8ZS, “3” = HDB3).
Parameter 28 (p28): Interface substitution pattern 2047 (ON/Off).
p28 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 29 (p29): Transmit Data Fault
p29 = n, where “n” is “0”, “1”, or “2” (“0” = NONE, “1” = AIS, “2” = DATA).
Parameter 30 (p30): Receive Data Fault
p30 = n, where “n” is “0”, “1”, or “2” (“0” = NONE, “1” = AIS, “2” = DATA).
Parameter 31 (p31): Interface buffer size.
p31 = nn, where “nn” is the currently programmed buffer size in milli-seconds.
Parameter 32 (p32): Interface read error select (FRAME/2047).
p32 = n, where “n” is “1” or “2” (“1” = FRAME, “2” = 2047).
Parameter 33 (p33): Descrambler enable ON/OFF.
p33 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 34 (p34): Scrambler enable ON/OFF.
p34 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 35 (p35): Drop Data Format
p35 = n, where “n” is “0”, “1”, “2”, “3”, “4”, “5” or “6” for T1, T1ESF, E1CCS, E1CAS, E1IBS, T1IBS, and E131TS respectively.
Parameter 36 (p36): Insert Data Format
p36 = n, where “n” is “0”, “1”, “2”, “3”, “4”, “5” or “6” for T1, T1ESF, E1CCS, E1CAS, E1IBS, T1IBS, and E131TS respectively.
Parameter 37 (p37): Bulk Drop Channels Assignment.
p37 = dd;cc_dd;cc_dd;cc_dd;cc....., as defined by the BDCA_ command.
Parameter 38 (p38): Bulk Insert Channels Assignment.
p37 = ii;cc_ii;cc_ii;cc_ii;cc....., as defined by the BICA_ command.
Parameter 39 (p39): MODEM REMOTE/LOCAL mode.
p39 = n, (“n” is “0” to indicate local or “1” to indicate remote).
*Parameter 40 (p40): Sweep center programmed.
p40 = snnnnn, where ‘s” is “+” or “-” and “nnnnn” is the sweep center currently programmed.
*Parameter 41 (p41): Sweep width range.
p41 = nnnnn, where “nnnnn” is in the range of 0Hz to 50000 Hz.
*Parameter 42 (p42): Sweep direction.
p42 = n, where “n” is “+” for positive or “-” for negative sweep direction.

*__Note:__ Parameters 40, 41, and 42 are only returned when fast acquisiton is enabled. See the "FAM_" command definition.

5.18 Bulk Consolidated Status Faults

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.

Command: `<add/BCSF_”cr”`
Response: `>add/BCSF_abcdefghij”cr””lf”]`

Character “a”: Modulator fault status character 1.
Bit 6 = 1 always.
Bit 5 = Modulator fault.
Bit 4 = RF output status, actual not programmed status (1 = on, 0 = off).
Bit 3 through Bit 0 = Binary representation (0 - 10) of the number of modulator stored faults.

Character “b”: Modulator fault status character 2.
Bit 6 = 1 always.
Bit 5 = AGC fault.
Bit 4 = Modulator RF synthesizer fault.
Bit 3 = Bit clock fault.
Bit 2 = Transmit clock fault.
Bit 1 = I-channel fault.
Bit 0 = Q-channel fault.

Character “c”: Demodulator fault status character 1.
Bit 6 = 1 always.
Bit 5 = Demodulator fault.
Bit 4 = Carrier detect status (0 for decoder lock).
Bit 3 through Bit 0 = Binary representation (0 - 10) of the number of demodulator stored faults.

Character “d”: Demodulator fault status character 2.
Bit 6 = 1 always.
Bit 5 = Demodulator RF synthesizer fault.
Bit 4 = not used.
Bit 3 = I-channel fault.
Bit 2 = Q-channel fault.
Bit 1 = Bit clock fault.
Bit 0 = BER threshold fault.

Character “e”: Common equipment fault status character 1.
Bit 6 = 1 always.
Bit 5 = M&C fault.
Bit 4 = Interface fault.

Bit 3 through Bit 0 = Binary representation (0 - 10) of the number of common equipment stored faults.

Character “f”: Common equipment fault status character 2.
Bit 6 = 1 always.
Bit 5 = Battery fault.
Bit 4 = +5 volt fault.
Bit 3 = +12 volt fault.
Bit 2 = -12 volt fault.
Bit 1 = not used.
Bit 0 = not used.

Character “g”: Interface transmit side faults character 1.
Bit 6 = 1 always.
Bit 5 = not used.
Bit 4 = not used.
Bit 3 through Bit 0 = Binary representation (0 - 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 clock activity fault.
Bit 4 = Drop fault.
Bit 3 = Transmit DATA/AIS fault.
Bit 2 = not used.
Bit 1 = not used.
Bit 0 = not used.

Character “i”: Interface receive side faults character 1.
Bit 6 = 1 always.
Bit 5 = MUX lock fault.
Bit 4 = Insert clock activity fault.
Bit 3 through Bit 0 = Binary representation (0 - 10) of the number of interface receive side stored faults.

Character “j”: Interface receive side faults character 2.
Bit 6 = 1 always.
Bit 5 = Insert fault.
Bit 4 = Receive backward alarm fault.
Bit 3 = Frame BER fault.
Bit 2 = Receive DATA/AIS fault.
Bit 1 = Buffer overflow fault.
Bit 0 = Buffer underflow fault.

5.19 Bulk Consolidated Anolog Status

This command is similar to the “BCS_” command but, returns MODEM anolog parameters.

Command: `<add/BCAS_”cr”`
Response: `>add/BCAS_p1,p2,p3, . . . pn”cr””lf”]`

Where “pn” is the last parameter returned.

Parameter 1 (p1): Receive signal level.
p1 = -nn, where “nn” is the value of the receive signal level in dBm.
Parameter 2 (p2): Raw BER.
p2 = nnnnE-4, where “nnnn” is the raw bit errors in 10000 bits.
Parameter 3 (p3): Corrected BER.
p3 = nE-e, where “n” is the mantissa and “e” is exponent (power of 10).
Parameter 4 (p4): EB/N0.
p4 = n.n, where “n.n” is EB/N0 in dB.
Parameter 5 (p5): Interface Read Error Status.
p5 = xxxx_n.nE-e, where “xxxx_n.nE-e” is the read error status as defined in this document.
Parameter 6 (p6): Buffer Fill Status.
p6 = nn%, where “nn%” is the buffer fill status.

*__Note:__ Parameters 1 through 6 are dependent on carrier acquisition, if the decoder is not locked empty data blocks are returned (,,,,,).

5.20 Change Status

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.

Command: `<add/CS_”cr”`
Response: `>add/CS_x”cr””lf”]`

The “x” character is defined as follows:
“at” = no change since last CS_ poll
“A” = BCS_ response has changed since last CS_ poll
“B” = BCSF_ response has changed since last CS_ poll
“C” = Both responses have changed since last CS_ poll

5.21 Equipment Type

This command returns the equipment model number and M&C firmware version number.

Command: `<add/ET_”cr”`
Response: `>add/ET_SDM308-5_x.xx”cr””lf”]`

Where x.xx is the software version number.

Appendix C.
EXTERNAL CHANNEL UNIT

1.1 General

The following Appendix is an aide in interconnecting the SDM-309B modem with the Multipoint M1200 channel unit for IBS service. The interface options are described in Section 2. Figure C-1 is a block diagram of a satellite communications system using an external channel unit with the SDM-309B modem.

1.2 System Integration

Connecting the channel unit to the modem as shown in this appendix will allow the modem and channel unit to be automatically backed up in a M:N or 1:1 System. The use of the special cables shown in this appendix is required to pass the fault lines to the switch and to connect the DTE connectors of the channel unit to the DTE connectors of the M:N or 1:1 switch.

The modem to channel unit interface options are:

RS422/449	Use cable AS/0741 as the interconnect cable
V.35	Use cable AS/0479 as the interconnect cable

The interconnect between the switch and the channel unit requires a special DTE to DCE adapter cable to connect the two DTE connectors. The channel unit to switch interface options are:

DS1/G.703	Use cable AS/0752 as the interconnect cable
V.35	Use cable AS/0750 as the interconnect cable
RS422/449	Use cable AS/0751 as the interconnect cable

Note: Verify the switch settings in the M1200 are set for the proper interface selection.

The Alarm cable AS/0753 is used to sum the modem and channel unit alarms together for fault reporting to the switch. The female molex connector (connector B) is to be connected to the male molex connector on the cable between the switch and the channel unit. Likewise, the male molex connector (connector C) is to be connected to the female

molex connector on the cable between the modem and the channel unit. The following drawings (Figure C-2 through C-8) are attached for reference.

Figure C-1 Satellite Communications System With External Channel Unit

Figure C-2 System Interconnect Diagram

Figure C-3 Adapter Cable AS/0749 (V.35)

Figure C-4 Adapter Cable AS/0750 (V.35)

Figure C-5 Adapter Cable AS/0751 (RS449)

Figure C-6 Adapter Cable AS/0752 (15 Pin “D”)

Figure C-7 Adapter Cable AS/0741 (RS449)

Figure C-8 Adapter Cable AS/0753 (15 Pin “D”)

2.0 Digital Interfaces

2.1 RS422 & MIL-STD-188-114 Interface

2.1.1 Functional Description

The RS422 and MIL-STD-188-114 digital interface (Figure C-9) provides the level translation, buffering and termination between the internal modem signals and the RS422 or MIL-STD-188-114 interface on the rear panel. Electrical characteristics of the RS422 interface signals are defined in EIA STD RS422. Electrical characteristics of the MIL-STD-188-114 interface signals are defined in MIL-STD-188-114 in conjunction with MIL-STD-188-100. MIL-STD-188-114 defines signal levels, offsets, termination resistors, etc., while MIL-STD-188-100 specifies such characteristics as signal quality, and clock/data phase relationships and EIA STD RS449 provides details of the mechanical interface. Both the electrical and mechanical specifications are summarized in Sections 2.1.2 and 2.1.3. A functional block diagram of the interface is shown in Figure C-10.

The RS422 and MIL-STD-188-114 interface provides a Send Timing (ST) clock signal at the modem data rate. In the INTERNAL clock mode, the data to be transmitted, Send Data (SD) must be synchronized to ST. In the EXTERNAL clock mode, clock is accepted on the Terminal Timing (TT) input to clock in the data to be transmitted. In either case, the phase relationship between the clock and data is not important as long as it meets the jitter specifications of RS422 or MIL-STD-188-100 because a clock phase correction circuit is provided which shifts the clock away from the data transition times. The clock phasing is jumper selectable at JP1. When there is no jitter on the clock source, the AUTO setting is used. The NORMAL setting is used when standard specifications on clock and data relationships exist. The INVERT mode is used when the incoming clock is inverted from the standard clock and data relationship.

Data received by the modem is output on the Received Data (RD) lines while the recovered clock is output on the Receive Timing (RT) lines. For applications that require the rising edge of the clock to occur in the middle of the data bit time, Receive Clock NORMAL mode should be selected. INVERT mode puts the falling edge of RT in the middle of the data bit. This selection can be made from the front panel in the configuration menu.

The Request to Send (RS) lines are hardwired to the Clear to Send (CS) lines, since the modem does not support polled operation. Data Mode (DM) indicates that the modem is powered up. Receiver Ready (RR) indicates that an RF carrier is being received and demodulated with a sufficiently low error rate for the decoder to remain locked.

The RS422 and MIL-STD-188-114 interface also provides bi-directional relay loopback of both the clock and data at the DCE interface. In LOOPBACK, from the DTE side, SD is connected to RD, and either ST or TT (in INTERNAL or EXTERNAL mode) is looped back to RT. From the modem side, the received data and recovered clock are routed back to the modulator input for retransmission.

Loop timing is supported by the selection of jumper JP10. When in the ON position the transmit clock (ST) is replaced by the clock recovered from the satellite (RT). Active loop timing is indicated by a yellow light on the front edge of the card. The JP10 REM setting is for future options.

Three fault outputs are provided on dry contact Form C relays. These are the COMMON EQUIPMENT, MODULATOR, and DEMODULATOR faults. They are available on the FAULT connector on the modem rear panel. Generation of these fault conditions is described in Section 3.1.5. Fault indicators are also provided on TTL open collector drivers on the RS422 or MIL-STD-188-114 connector. The TTL MOD fault indicates a MODULATOR fault or COMMON EQUIPMENT fault, while the TTL DEMOD fault indicates a DEMOD or COMMON EQUIPMENT fault.

The printed circuit board for the RS422/MIL188-114 interface is used for a number of different interface types. The differences will be jumper settings on the board as well as hardware configuration. There will be different parts installed for the various different configurations. Changing to a different interface can be done by replacing the board. Table C-1 will describe the jumper settings for a Rev E board and Table C-2 describes the jumper settings for a Rev C board. These jumpers are factory set for each given configuration. You should not have to change them. This list is supplied for troubleshooting purposes only.

Figure C-9 RS422 & MIL-STD-188-114 Interface

Figure C-10 RS422 & MIL-STD-188-114 Block Diagram

Table C-1 AS/0627-3 Rev E Board Jumper Selection

JP1	TX Clock Select	Normal Invert Auto*
JP2	Interface Select	V.35 (-2) Mil-188/RS232 (-3)*
JP3	RX Data	Normal* Buffer
JP8	RX Clock	Normal* Buffer
JP4	Address Set	0*
JP5	Address Set	0*
JP6	Address Set	1*
JP7	Address Set	1* MIL (-3)
JP9	CTS to RTS	V.35 (Processor controller for V.35 & RS232) Mil 188/RS422* (Hard loops CTS to RTS)
JP10	Loop Timing	REM On Off*
JP11	Asyn Clk Syn (-5)	Cut Shorts
JP12	SCT	1 to 2 Invert 2 to 3 Normal*
JP13	RD	1 to 2 Invert 2 to 3 Normal*
JP14	RR	1 to 2 Invert 2 to 3 Normal*
JP15	DM	1 to 2 Invert 2 to 3 Normal*
JP16	SD	1 to 2 Invert 2 to 3 Normal*
*Indicates Factory jumper settings for MIL-188/RS422 interface type.		

Table C-2 AS/0627-3 Rev C Board Jumper Selection

JP1	Clock Select	Normal Invert Auto*
JP2	Interface Select	V.35 (-2) Mil-188/RS232 (-3)*
JP3	RX Data	Normal* Buffer
JP8	RX Clock	Normal* Buffer
JP4	Address Set	1*
JP5	Address Set	1*
JP6	Address Set	0*
JP7	Address Set	0* MIL (-3)

2.1.2 Connector Pinouts

The RS422 and MIL-STD-188-114 interface is provided on a 37 pin female "D" connector accessible from the rear panel of the modem. Screw locks and latching blocks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
SIGNAL GROUND	SG	1, 19, 20, 37
SEND DATA	SD-A SD-B	4 22
SEND TIMING	ST-A ST-B	5 23
RECEIVE DATA	RD-A RD-B	6 24
REQUEST TO SEND	RS-A RS-B	7 25
RECEIVER TIMING	RT-A RT-B	8 26
CLEAR TO SEND	CS-A CS-B	9 27
DATA MODE	DM-A DM-B	11 29
RECEIVER READY	RR-A RR-B	13 31
TERMINAL TIMING	TT-A TT-B	17 35
MOD FAULT	_	3
DEMOD FAULT	_	21
MASTER CLOCK (INPUT)	MC-A MC-B	16 34

2.1.3 Specification

Circuit Supported	SD, ST, TT, RD, RT, DM, RR, MOD FAULT, DEMOD FAULT, MC
Amplitude (RD,RT,ST,DM,RR)	4 ± 2 V differential into 100 Ω
DC Offset (RD, RT, ST, DM, RR)	0 ±.4 V
Impedance (RD,RT,ST,DM,RR)	Less than 100 Ω, differential
Impedance (SD,TT,MC)	100 ± 20 Ω, differential
Polarity	True when B positive wrt A False when A positive wrt 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
Modulator Fault	Open collector output 15 V max 20 mA max current sink Fault is open circuit
Demodulator Fault	Open collector output 15 V max 20 mA max current sink Fault is open circuit

2.2 V.35 Interface

2.2.1 Functional Description

The V.35 digital interface (Figure C-11) provides level translation, buffering and termination between the internal modem signals and the V.35 DCE interface on the rear panel. Electrical characteristics of the interface signals are defined in CCITT Recommendation V.35. The electrical and mechanical specifications are summarized in Sections 2.2.2 and 2.2.3. A functional block diagram of the interface is shown in Figure C-12.

The V.35 interface provides a Serial Clock Transmit (SCT) clock signal at the modem data rate. In the INTERNAL clock mode, the data to be transmitted, Send Data (SD) must be synchronized to SCT. In the EXTERNAL clock mode, clock is accepted on the Serial Clock Transmit External (SCTE) input to clock in the data to be transmitted. In either case, the phase relationship between the clock and data is not important as long as it meets the jitter specification because a clock phase correction circuit is provided which shifts the clock away from the data transition times. The clock selection is jumper selectable at JP1 on the front edge of the board. When there is no jitter on the clock source, the AUTO setting is used. The NORMAL setting is used when standard specifications on clock and data relationships exist. The INVERT mode is used when the incoming clock is inverted from the standard clock and data relationship.

Data received by the modem is output on the Received Data (RD) lines while the recovered clock is output on the Serial Clock Receive (SCR) lines. For applications that require the rising edge of the clock to occur in the middle of the data bit time, Receive Clock NORMAL mode should be selected. INVERT mode puts the falling edge of SCR in the middle of the data bit. This selection can be made from the front panel in the configuration menu.

The Request to Send (RTS) lines are jumpered to the Clear to Send (CTS) lines, since the modem does not support polled operation. Data Set Ready (DSR) indicates that the modem is powered up. Receive Line Signal Detect (RLSD) indicates that an RF carrier is being received and demodulated with a sufficiently low error rate for the decoder to remain locked.

The V.35 interface also provides bi-directional relay loopback of both the clock and data at the DCE interface. In LOOPBACK, from the DTE side, SD is connected to RD, and either SCT or SCTE (in INTERNAL or EXTERNAL mode) is looped back to SCR. From the modem side, the received data and recovered clock are routed back to the modulator input for retransmission.

Loop timing is supported by the selection of jumper JP10 on the front edge of the card. When in the ON position the internal clock (SCT) is replaced by the clock recovered from the receive (IF) data (RD). Active loop timing is indicated by a yellow light on the

front edge of the card. The JP10 REM setting is used when loop timing is supported by software on the M&C and will be included in the front panel menu.

Three fault outputs are provided on dry contact Form C relays. These are the COMMON EQUIPMENT, MODULATOR, and DEMODULATOR faults. They are available on the FAULT connector on the modem rear panel. Generation of these fault conditions is described in Section 3.1.5. Fault indicators are also provided on TTL open collector drivers on the V.35 connector. The TTL MOD fault indicates a MODULATOR fault or COMMON EQUIPMENT fault, while the TTL DEMOD fault indicates a DEMOD or COMMON EQUIPMENT fault.

Table C-3 lists the jumper settings for the V.35 interface. These jumpers are factory set for a specific configuration. Clock selections, signal selections and loop timing can be changed upon individual needs.

Table C-3 AS/0627-2 Rev E Board Jumper Selection

JP1	TX Clock Select	Normal Invert Auto*
JP2	Interface Select	V.35 (-2)*
JP3	RX Data	Normal* Buffer
JP8	RX Clock	Normal* Buffer
JP4	Address Set	1*
JP5	Address Set	0*
JP6	Address Set	1*
JP7	Address Set	1* V.35 (-2)
JP9	CTS to RTS	V.35* (Processor controller for V.35 & RS232)
JP10	Loop Timing	Auto On Off*
JP11	Asyn Clk Syn (-5)	Cut Shorts
JP12	SCT	1 to 2 Invert 2 to 3 Normal*
JP13	RD	1 to 2 Invert 2 to 3 Normal*
JP14	RR	1 to 2 Invert 2 to 3 Normal*
JP15	DM	1 to 2 Invert 2 to 3 Normal*
JP16	SD	1 to 2 Invert 2 to 3 Normal*
*Indicates Factory jumper settings for V.35 interface type.		

Figure C-11 V.35 Interface Card

Figure C-12 V.35 Interface Block Diagram

2.2.2 Connector Pinouts

The V.35 interface is provided on the industry standard 34 pin block connector accessible from the rear panel of the modem. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin Number
SIGNAL GROUND	SG	A,B
SEND DATA	SD-A SD-B	P S
SERIAL CLOCK TRANSMIT	SCT-A SCT-B	Y (AA)
RECEIVE DATA	RD-A RD-B	R T
REQUEST TO SEND	RTS	C
SERIAL CLOCK RECEIVE	SCR-A SCR-B	V X
CLEAR TO SEND	CTS	D
DATA SET READY	DSR	E
RECEIVE LINE SIGNAL DETECT	RLSD	F
SERIAL CLOCK TRANSMIT EXT.	SCTE-A SCTE-B	U W
MODULATOR FAULT	---	(MM) m
DEMODULATOR FAULT	---	(NN) n
MASTER CLOCK (INPUT)	MC-A MC-B	(CC) c (DD) d

2.2.3 Specification

Circuit Supported	SD, SCT, SCTE, RD, SCR, DSR, RLSD, MOD, FAULT, DEMOD FAULT, MC
Amplitude (RD,SCR,SCT,SD,SCTE)	.55 V pk ± 20% differential, into 100 Ω
Amplitude (CTS,DSR,RLSD)	10 ± 5 V into 5000 ± 2000 Ω
Impedance (RD,SCR,SCT)	100 ± 20 Ω, differential
Impedance (SD,SCTE)	100 ± 10 Ω, differential
Impedance (RTS)	5000 ± 2000 Ω, <2500 pf
DC Offset (RD,SCR,SCT)	± .6 V max, 1000 ohm termination to ground
Polarity (SD,SCT,SCTE,RD,SCR)	True when B positive wrt A False when A positive wrt B
Polarity (RTS,CTS,DSR,RLSD)	True when <-3V wrt ground False when >+3V wrt ground
Phasing (SCTE,SCR)	False to True transition nominally in center of data bit.
Symmetry (SCT,SCTE,SCR)	50% ± 5%
Frequency Stability (SCT)	± 100 ppm
Modulator Fault	Open collector output 15 V max 20 mA current sink max Fault is open circuit
Demodulator Fault	Open collector output 15 V max 20 mA current sink max Fault is open circuit

3.0 Front Panel Operation

3.1 Configuration

Modem configuration may be viewed or changed by entering the “CONFIG” level from the ‘sELECT” menu on the front panel. Figures C-13 through C-15 show the structure of the front panel menu tree. The definitions of configurable functions follow:

TXR	Transmitter rate selection. Select one of four predefined transmitter coder/data rate combinations. On entry the current transmitter rate is displayed with the flashing cursor on the first character of the code rate on line one and the data rate on line two. Use the arrow keys to select one of four predefined rates. **Note:** 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 “RF_Out” function.
RXR	Receiver rate selection. Select one of four predefined receiver decoder/data rate combinations. On entry the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line one and the data rate on line two. Use the arrow keys to select one of four predefined rates.
TX_Freq	Programs the modulator transmit frequency between 50 - 90 MHz or 100 - 180 MHz in 2.5 KHz Steps. On entry, the current transmitter frequency is displayed with the flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “Enter” key 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 “RF_OUT” function.
RX_Freq	Programs the demodulator receive frequency between 50 - 90 MHz or 100 - 180 MHz in 2.5 KHz Steps. On entry, the current receive frequency is displayed with the flashing cursor on the first character. Use the right and left arrow keys to move the flashing cursor and the up and down arrow keys to increment or decrement the digit at the flashing cursor. Press the “Enter” key execute the change.
RF_Out	Programs the modulator output to On or Off. On entry, the current status of the output is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.

TX_Power	Programs the modulator output power level from -5 dBm to -15 dBm in 0.5 dB Steps. On entry the current transmitter power level is displayed with the flashing cursor on the first character. The up and down keys are used to increase or decrease the output power level in 0.5 dBm Steps. Press the “Enter” key to execute the change.
RFLoopBk	*Programs the modem for RF loop-back operation. When RF loop-back is turned on the demodulator is programmed to the same frequency as the modulator. When RF loop-back is turned off the demodulator is tuned to it’s previous frequency. The modulator out-put must be externally connected to the demodulator input for the modem to operate normally. On entry, the current status of the RFLoop is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.
IFLoopBk	*Programs the modem for interface loopback operation. When interface loopback is turned on the demodulator input is connected to the modulator output through an attenuator and 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 turned to it’s previous frequency and is reconnected to the IF input. On entry, the current status of the IFLoopback is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.
BBLoopBk	*Programs the modem for baseband loopback operation. When baseband loopback is turned on the data and timing signals are hard wired (relays) from the demodulator to the modulator. The DTE base band signals are also looped back from transmitter data and clock to receiver data and clock. On entry, the current status of the BBLoop is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.
Scramblr	Programs the modulator for scrambler On or Off. On entry, the current status of the scrambler is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.
Dscrmblr	Programs the demod/decoder for descrambler On or Off. On entry, the current status of the descrambler is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.
DifEncdr	Programs the differential encoder On or Off. On entry, the current status of the Differential Encoder is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.
DifDecdr	Programs the differential decoder On or Off. On entry, the current status of the Differential Decoder is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press the “Enter” key to execute the change.

TX_Clock	Programs the modem for internal or external transmitter clock. On entry, the current status of the Transmit Clock is displayed with the flashing cursor on the first character. Use the arrow keys to select “Internal” or “External” transmit clock. Press the “Enter” key to execute the change.
RX_Clock	Programs the modem for inverted or normal receive clock. On entry, the current status of the Receive Clock is displayed with the flashing cursor on the first character. Use the arrow keys to select “Inverted” or “Normal” receive clock. Press the “Enter” key to execute the change.
Swp_Racq	Programs the sweep reacquisition time from 0 to 999 seconds. On entry, the current status of the sweep reacquisition is displayed with the flashing cursor on the first character. Use the arrow keys to increment or decrement the digit at the flashing cursor. Press the “Enter” key to execute the change.
CW_Mode	*Programs the modem for continuous wave mode. Three modes of operation are available: center, dual, and offset modes. On entry, the “CENTER” mode is displayed. To activate this test mode press the “ENTER” key. Use the arrow keys to select the “DUAL or the “OFFSET” modes. To return to the “CONFIG” menu press the “CLEAR” key. **Note:** When the “CLEAR” key is pressed, the modem is configured to the state it was in before “CWMode” was invoked and the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the “RF_OUT” function. Center Mode: Generates carrier at the current modulator frequency. This can be used to measure the output power and output frequency. Dual Mode: Generates a dual side-band suppressed carrier signal. Side-bands are at one half (1/2) the symbol rate from the carrier. This is used to check the channel balance and carrier null. Offset Mode: Generates a single upper side-band suppressed carrier signal. The upper side-band is at one quarter (1/4) the symbol rate from the carrier. This is used to check the quadrature. * Indicates Test Mode configuration option.

3.2 Monitor

The “MONITOR” level is accessible from the ‘sELECT” menu. The following modem parameters are displayed in real time when selected.

Raw_BER	Raw bit error rate. * Range: <1.0E-4 to 2550E-4
Corr_BER	Corrected bit error rate. * Range: <1.0E-8 to>1E-3
Eb/N0	Energy(bit)/noise ratio. * Range: <3.2dB to>9.7dB
RxSignal	Receive signal level. * Range: <-60dBm to>-30dBm
* When the decoder loses lock no data is available and is so indicated.	

3.3 Faults

Faults are grouped into the categories of modulator faults, demodulator faults, and common equipment faults. The “FAULTS” level is accessible from the ‘sELECT” menu. The following lists outline the faults monitored and displayed in each group.

Mod_Flts - Modulator Faults	
RF_Syn	Modulator RF synthesizer fault.
Data_Clk	Transmit data clock activity fault.
TClk_Syn	Transmit clock synthesizer fault.
I-Channl	I channel activity fault.
Q-Channl	Q channel activity fault.
AGC_level	Automatic gain control level fault.
Module	Modulator module fault. Typically indicates that the modulator module is missing or will not program.
Dmd_Flts - Demodulator/Decoder Faults	
C_Detect	Carrier detect fault. Indicates that the decoder is not locked.
RF_Syn	Demodulator RF synthesizer fault.
Data_Clk	Receive data clock activity fault.
I-Channl	I channel activity fault.
Q-Channl	Q channel activity fault.
Dscrambl	Descrambler activity fault.
BER Thrshld	BER Threshold fault. Indicates that the corrected BER Threshold that is set in the “Utility” menu has been exceeded.
Module	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not program.
CEQ_Flts - Common Equipment Faults	
Battery	Battery fault.
-12 volt	Negative 12 volt power supply fault.
+12 volt	Plus 12 volt power supply fault.
+5 volt	Plus 5 volt power supply fault.
Controlr	Controller fault. Typically indicates that the controller has gone through a power on-off cycle.
Intrface	Interface module fault. Typically indicates that the interface module is missing or will not program.

3.4 Stored Faults

The Modem stores the first ten (Flt0 - Flt9) occurrences of fault status changes in each of the three major fault categories. Each stored fault status change is also stored with the time and date of the occurrence. Stored faults may be viewed by entering the ‘stFaults” level from the ‘sELECT” menu. All stored faults may be cleared by executing the “CLEAR ?? StFaults” command from the ‘stFaults” level.

Stored faults are not maintained through a controller power on reset cycle. However, the last known time is maintained in non volatile RAM and upon power up a common equipment fault is logged (Flt0) with that time and date. On power up an additional common equipment fault is also logged (Flt1) to indicate the power up time and date. So on power up the power down and power up times are logged as common equipment fault 0 and common equipment fault 1.

3.5 Utility

Utility functions provide a means to set the time and date of the Modem real time clock circuit. Also provisions are made for setting a BER Threshold level alarm assigning data and code rates to the modulator and demodulator. A lamp test is available to test the front panel indicators.

Note: The selection of data/code rates in the “UTILITY” program must match the hardware filters installed on the modulator and demodulator modules.

Time: Set Real Clock Time	The current time that the modem is set for is displayed when selected. To set the modem time press the “ENTER” key and use the right and left arrow keys to position the flashing cursor over the parameter to be changed. Use the up and down arrow keys to change the parameter to the desired value. Once the parameters are displayed as desired press the “ENTER” key to set the time.
Date: Set Real Clock Date	Follow the same procedure as outlined for the time function to view and set the date.
Lamp Test:	The lamp test function can be used to verify the operation of all front panel indicators. Press the “ENTER” key to energize all front panel indicators for three seconds; after three seconds current modem status will be indicated.
BERT_Set: BER Threshold Set	A corrected BER Threshold may be set to indicate a demodulator fault if the threshold is exceeded. The current BER Threshold is displayed when selected. Press the “ENTER” key and use the arrow keys to select the desired BER Threshold. When the desired Threshold is displayed at the flashing cursor press the “ENTER” key to select it.

Assign TX_Fltrs: Modulator Symbol Rate Assignment	The modulator has four symbol rate filters. Each filter is for a specific symbol rate. The data rate and coder rate for each filter must be established upon initial modulator installation and when circumstances indicate the need to do so. Filters are designated as A, B, C, and D. To view the current filter assignments press the “ENTER” key when the “Assign TX_Fltrs” selection is displayed from the utility functions menu. On line one of the display will be TXA” which indicates transmitter filter A. Following “TXA” on line one will be the coder rate (1/2, 3/4, or 7/8) and on line two will be the data rate assigned to filter “A”. Use the right and left arrow keys to see the assignments for filters “B”, “C”, and “D” (TXB, TXC, and TXD). If it is desired to change a filter assignment press the “ENTER” key when the data for that filter is displayed. Use the right and left arrow keys until the flashing cursor is at the parameter to be changed. Then use the up and down arrow keys to change that parameter. When all changes are made press the “ENTER” key to confirm the assignment. * Note: These assignments are used for the selection of “TXR” (Transmitter Rate) in the configuration functions menu.
Assign RX_Fltrs - Demodulator Symbol Rate Assignment	Refer to the previous text under “Assign TX_Fltrs”. The receive filters assignments are basically identical.

Figure C-13 Menu Tree

Figure C-14 Menu Tree

Figure C-15 Menu Tree

Appendix D. SOFTWARE CHANGE SPECIFICATIONS

Steps 1 through 5 are instructions for changing software on the Monitor and Control card. Steps 6 through 9 are instructions for changing software on the Viterbi Decoder card. If you do not need to change Viterbi Decoder software, skip to Step 10 and continue.

1. Remove the monitor and control card (0356) (black card ejector on vertical card).

2. Remove the proms in location U7 and U9 (28 Pin - .6" wide).

3. Install the new firmware, FW0713-XX into U7 position and FW0714-XX into U9 position making sure that pin 1 is installed properly.

   Note: See Table D-1 for the definition of the various firmware that is available.

4. Remove the battery jumper JP6, for about 20 seconds and reinstall in the ON position.

5. Reinstall the monitor and control card into the modem chassis.

6. Remove the Viterbi Decoder card (0701, 0949, or 2133) from the modem chassis. The Decoder card is the horizontal card with grey card ejectors.

7. Remove the PROM in proper location on the Viterbi decoder (28 pin - .6" wide). Refer to the decoder firmware Table D.1 for location and description of the various Viterbi decoder boards.

8. Install the new firmware FWXXXX in UX position on the Viterbi Decoder. See Table D.1 for the definition of the various firmware that is available.

9. Reinstall the Decoder into the modem chassis.

10. Turn on the power switch.

11. Go to the “Utility” menu on the front panel and program the time, day, TXA, TXB, TXC, TXD, RXA, RXB, RXC, and RXD to the new data/code rates.

    Note: The data/code rate assignment in the “Utility” menu MUST match the filter assignment on the daughter card. Each daughter card is labeled with the filter assignment (A, B, C, and D) and the associated symbol rate. Example - the label for a 64KBPS, 7/8 rate, QPSK filter is 36.57.

12. Go to the “Config” menu on the front panel and select the TX and RX rate that is desired and turn ON the RF output. The software change is complete.

Table D.1

The firmware for the M&C cards is contained in three (3) EPROMs. Two EPROM’s (U7 & U8) contain the various modem program codes and the other (U9) contains the data information for the various plug-in modules. The firmware for the Viterbi Decoder card is contained in one EPROM. Refer to the decoder firmware table below for location.

M&C U#	Firmware Number	Description
U7	FW/0713-11D	SDM309 Variable Rate Standard (Version 2.66)
U7 & U8	FW/0713-19X	SDM309/M1200P Variable Rate (Version 3.XX)
U7 & U8	FW/0713-56X	SDM309/M1200P Variable Rate, Fast acquisition, Directed Sweep (Version 4.XX)
U7 & U8	FW/0713-57X	SDM308-5 Drop & Insert, Fast Acquisition, Directed Sweep (Version 6.XX)
U9	FW/0714-7X	SDM309 70/140 MHz
U1	FW/0760-1X	AS/0701 SDM309 Viterbi Decoder
U17	FW/1910X	AS/0949 SDM309 Viterbi Decoder
U42	FW/2355X	AS/2133 SDM309 Viterbi Decoder
Note: The X following each of the firmware numbers stand for the revision release information of that firmware number.		