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SDM-650B

Satellite Modem
Installation and Operation Manual

Part Number MN/SDM650B.IOM
Revision 5

EFData Corporation is an ISO 9001 Registered Company

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Revision 5
May 28, 1996

Special Instructions:

This is the sixth edition of the manual.

Change bars were not utilized.

This revision supersedes part number MN/SDM650 Rev. 4 dated May 5, 1995.

EFData Corporation, 2105 West 5th Place, Tempe, Arizona 85281 USA, (602) 968-0447, FAX: (602) 921-9012.

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Preface

About this Manual

This manual provides installation and operation information for the EFData SDM-650B satellite modem.

This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the SDM-650B satellite modem.

Organization

This manual includes the following chapters and appendixes:

- Chapter 1 — describes the unit's purpose, function, description, options, and system specification.
- Chapter 2 — describes the unit's installation process, external connectors, and system requirements.
- Chapter 3 — describes the unit's configuration.
- Chapter 4 — provides front panel operation information.
- Chapter 5 — describes the unit's theory of operation.
- Chapter 6 — describes the maintenance of the unit, and provides troubleshooting assistance.
- Appendix A — provides data rate change instructions and the differences for fixed and variable rate filters.

- Appendix B — describes the unit's remote control operation protocol and command structure.
- Appendix C — provides field compatibility specifications.
- Appendix D — provides software change instructions.
- Appendix E — describes the unit's Automatic Gain Control (AGC) interface option.
- Appendix F — describes the asynchronous overhead channel unit option.
- Appendix G — describes the Trojan interface option.
- Glossary.

Conventions Used in this Manual

Cautions and Warnings

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

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

References Used in this Manual

Military Standards

References to “MIL-STD-188” apply to the 114A series (i.e., MIL-STD-188-114A), which provides electrical and functional characteristics of the unbalanced and balanced voltage digital interface circuits applicable to both long haul and tactical communications. Specifically, these references apply to the MIL-STD-188-114A electrical characteristics for a balanced voltage digital interface circuit, Type 1 generator, for the full range of data rates.

For more information, refer to the following document:

- Department of Defense (DOD) MIL-STD-188-114A, “Electrical Characteristics of Digital Interface Circuits.”

Trademarks

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

Related Documents

The following documents are referenced in this manual:

- *EFData Specification SP/1100*
- *CCITT Recommendation V.35*
- *CCITT Volume III Red Book*
- *INTELSAT Document 308*
- *INTELSAT Document 309*
- *Bell System Publication 62411*
- *AT&T Publication 62411*
- *EFData ASYNC Breakout Panel Installation and Operation Manual*

European EMC Directive

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

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

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

International Symbols:

~	Alternating Current.
	Fuse.
	Safety Ground.
	Chassis Ground.

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

Reporting Comments or Suggestions Concerning this Manual

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

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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 EFData. (Shipping charges should be prepaid.)

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

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Figures

Tables

Chapter 1. INTRODUCTION

This manual describes the SDM-650B satellite modem, referred to in this document as "the modem" (Figure 1-1).

Figure 1-1. SDM-650B

1.1 Purpose and Function

The modem is a high performance, full-duplex, Bi-Phase Shift Keying/Quadrature Phase Shift Keying (BPSK/QPSK), digital modulator/demodulator (modem), for Frequency Division Multiple Access (FDMA) satellite communication systems.

The modem provides an interface between Single Channel Per Carrier (SCPC) fixed-rate terminal equipment, having a data rate of 19.2 kbit/s to 3.584 Mbit/s.

The modem also provides an interface between IF converter equipment operating in a 50 to 90 MHz band, or 100 to 180 MHz band (Figure 1-2).

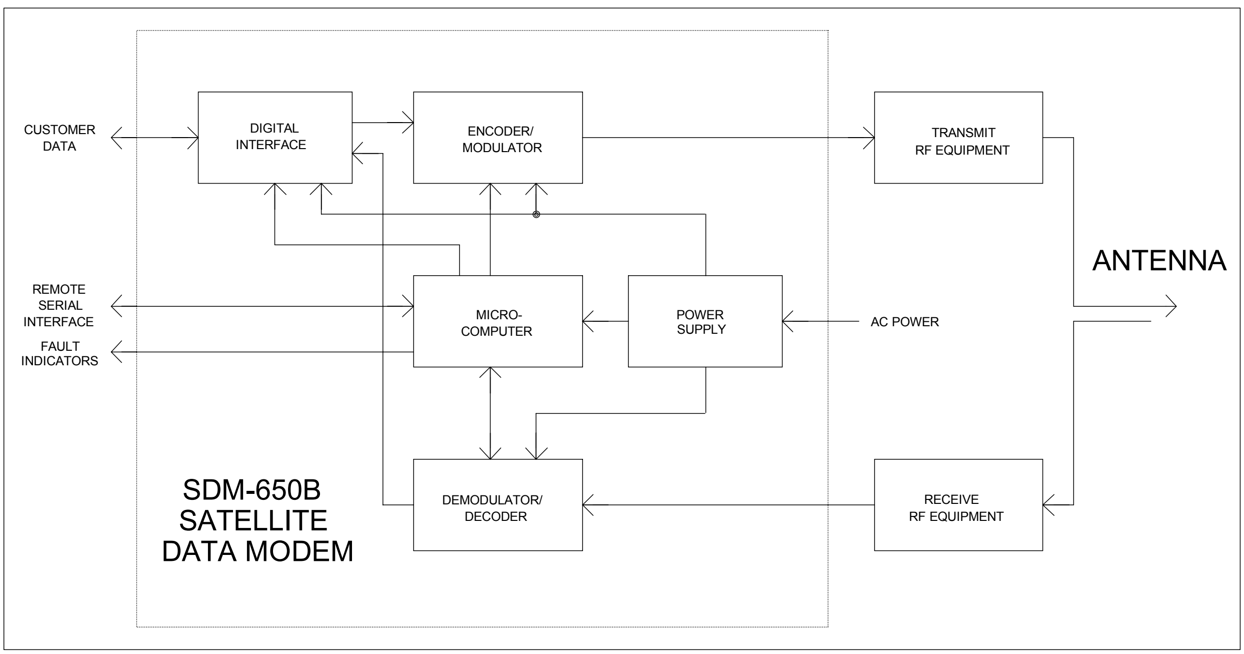


Figure 1-2. Satellite Communications System with an SDM-650B

The modem contains:

- Built-in scrambler/descrambler
- Differential encoder/decoder
- Transmit and receive frequency synthesizers
- Multi-rate Forward Error Correction (FEC) convolutional encoder-sequential decoder (Viterbi K=7 is optional)

The modem provides high performance with:

- Narrow occupied bandwidth
- Automatic signal acquisition
- High flexibility
- Extensive online monitoring circuits

1.2 Description

The modem is a complete, self-contained unit in a standard 19” rack-mountable enclosure weighing approximately 25 lbs.

The modem is of modular construction (Figure 1-3).

The chassis assembly (with the front and rear panel) encloses several Printed Circuit Boards (PCBs). The backplane PCB is mounted on the chassis assembly, and contains receptacles for five plug-in PCBs.

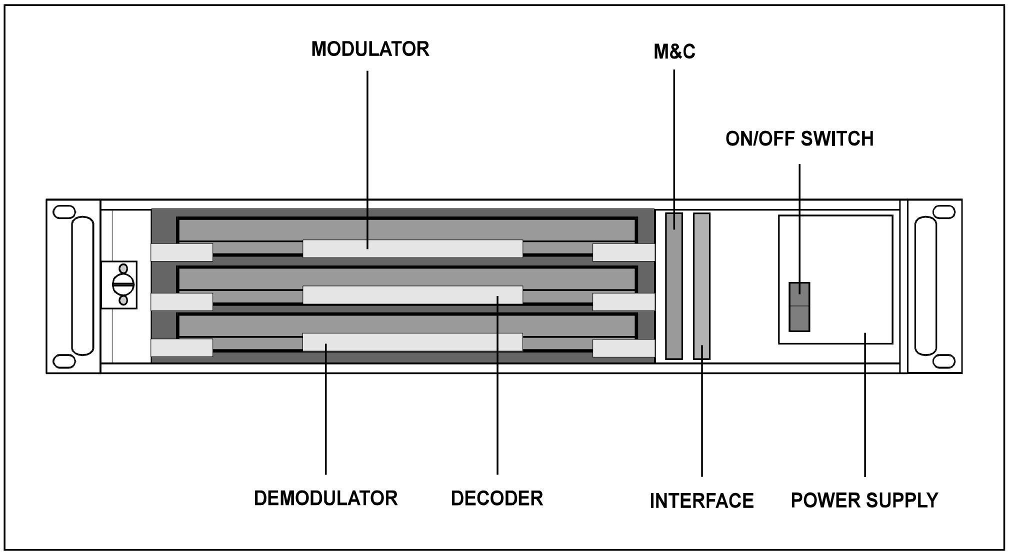


Figure 1-3. Modular Construction

Test points are located on the front board edge of the modulator, demodulator, and decoder PCBs. Refer to Section 6.1.4 for listings and diagrams of the test points.

All controls and indicators for operation of the modem are located on the front panel. For more information, refer to Chapter 4.

The chassis also contains the power supply; a fan is located on the rear panel.

The modem consists of the following assemblies:

Assembly	Drawing #
Chassis with Power Supply	AS/1099
PCB, M&C	AS/0356
PCB, Modulator	AS/0773-X
PCB, Demodulator	AS/0778-X
PCB, Sequential Decoder	AS/0365-X
PCB, Front Panel Control Board	AS/0361
PCB, Mother Board	AS/0979-1
PCB, Digital Interface V.35	AS/0627-2 (Optional)
PCB, Digital Interface DS1	AS/0569 (Optional)
PCB, Digital Interface MIL-STD-188-114	AS/0627-3 (Optional)
PCB, Doppler Buffer	AS/3812 (Optional)
PCB, Asynchronous Overhead Channel Unit	AS/1311-X (Optional)

Note: X = various options available on the modulator, demodulator, and decoder boards.

1.3 System Specification

Table 1-1 lists the operating specifications of the modem.

Table 1-1. Operating Specifications

System Specifications	
Operating Frequency Range	50 to 90 MHz, or 100 to 180 MHz. Synthesized in 2.5 kHz steps.
Type of Modulation	QPSK. BPSK.
Operating Channel Spacing	Less than 0.5 dB degradation operating with 2 adjacent like channels each 10 dB higher at 1.3 times the symbol rate or 75 kHz minimum.
BER	See Table 1-2.
Digital Interface	RS-422/-449. V.35. DS-1 STD. G.703. Others optional.
Digital Data Rate: Variable Rate Single Rate	19.2 to 3584 kbit/s configurable. Choice of up to four pre-defined rates, or variable rate option. 19.2 to 48 kbit/s, 1/2 rate BPSK only. 19.2 to 2048 kbit/s. 19.2 to 3584 kbit/s. 2048 kbit/s maximum for 1/2 rate. 3072 kbit/s maximum for 3/4 rate. 3584 kbit/s maximum for 7/8 rate.
Forward Error Correction	Convolutional encoding with soft decision, sequential, or K=7 Viterbi decoding.
Data Scrambling	Selectable. CCITT V.35. None.
Diagnostic Features	RF Loopback. IF Loopback. Digital Data Loopback. Fault Monitoring. BER Monitoring. Remote Control via Serial Port.
Prime Power	90 to 132 VAC, or 180 to 264 VAC, 47 to 63 Hz. 75W maximum, fused at 2A. -48 VDC optional.
Size	5.25” x 19.0” x 18.0” (3RU).

Additional Modulator Specifications	
Output Power	-5 to -30 dBm, adjustable in 0.5 dB steps. +5 to -15 dBm with high power option.
Output Spurious and Harmonics	-50 dBc in-band (50 to 90 MHz, or 100 to 180 MHz). -40 dBc out-of-band.
Output Impedance	75Ω.
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 Composite	 -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 maximum composite.
Input Impedance	75Ω.
Input Return Loss	20 dB.
Carrier Acquisition Range	± 25 kHz minimum.
Clock Acquisition Range	± 100 PPM.

Remote Control Specifications	
Serial Interface	RS-232-C, or RS-485.
Baud Rate	300 to 9600 bit/s.
Signals Controlled/Monitored	Transmit Frequency. Receive Frequency Transmit Power. Transmitter ON/OFF. Data Rate Select. RF Loopback. IF Loopback. Data Loopback. Scrambler ON/OFF. Descrambler ON/OFF. Raw Error Rate. Corrected BER. Receive E_b/N_0. TX Clock Internal/External. RX Clock Normal/Invert. Receive Signal Level. Receive Carrier Detect. Power Supply Voltages. Stored Fault Status.
Configuration Retention	Will maintain current configuration for 30 days minimum without power.
Addressing	Programmable to 1 of 255 possibilities. Address 0 reserved for global addressing.
Local control of all remote functions included via push-button entry.	

The specifications for the Bit Energy-to-Noise Ratio (E_b/N_0) required to achieve 10^{-5} and 10^{-7} BER for different coding configurations is listed in Table 1-2. All values are for operation in QPSK mode.

Table 1-2. BER Performance Specifications

Data Rate	Sequential			Viterbi K=7
	1/2 Rate	3/4 rate	7/8 Rate	1/2 Rate
100 kbit/s				
BER 10^{-5}	4.8 dB	5.8 dB	6.7 dB	5.5 dB
BER 10^{-7}	5.8 dB	6.6 dB	8.0 dB	6.7 dB
1544 kbit/s				
BER 10^{-5}	5.8 dB	6.3 dB	6.9 dB	5.5 dB
BER 10^{-7}	6.6 dB	7.1 dB	8.0 dB	6.7 dB

Without coding, the modem provides operation within 0.5 dB of theoretical for BPSK, and within 0.8 dB for QPSK.

Performance measurements are with transmit, and receive IF connected back-to-back through an additive white Gaussian noise channel.

BER performances of the modem are shown in Figures 1-4 through 1-7.

A typical output spectrum of the modem is shown in Figure 1-8.

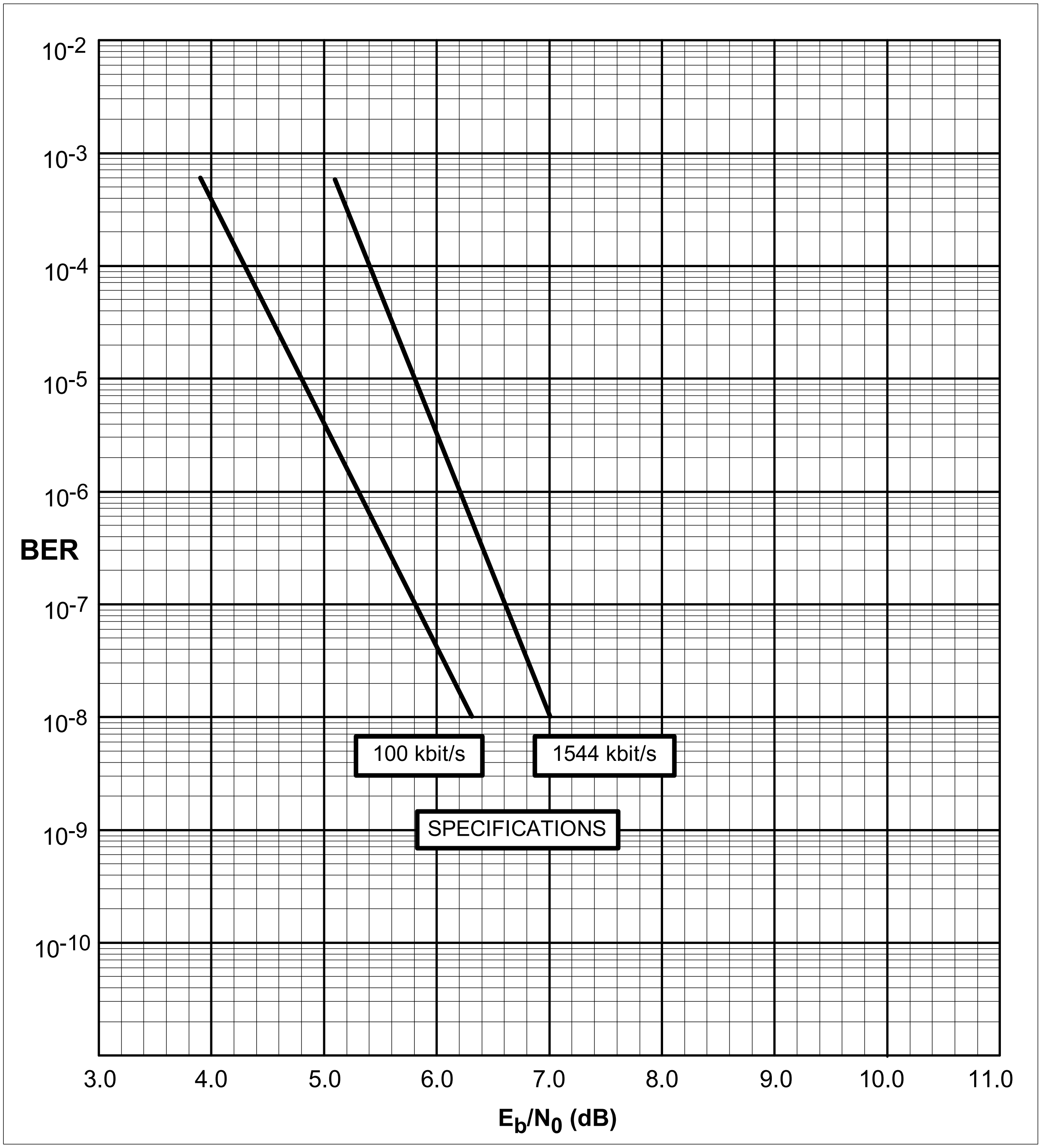


Figure 1-4. Sequential Decoder BER Performance Curves (1/2 Rate)

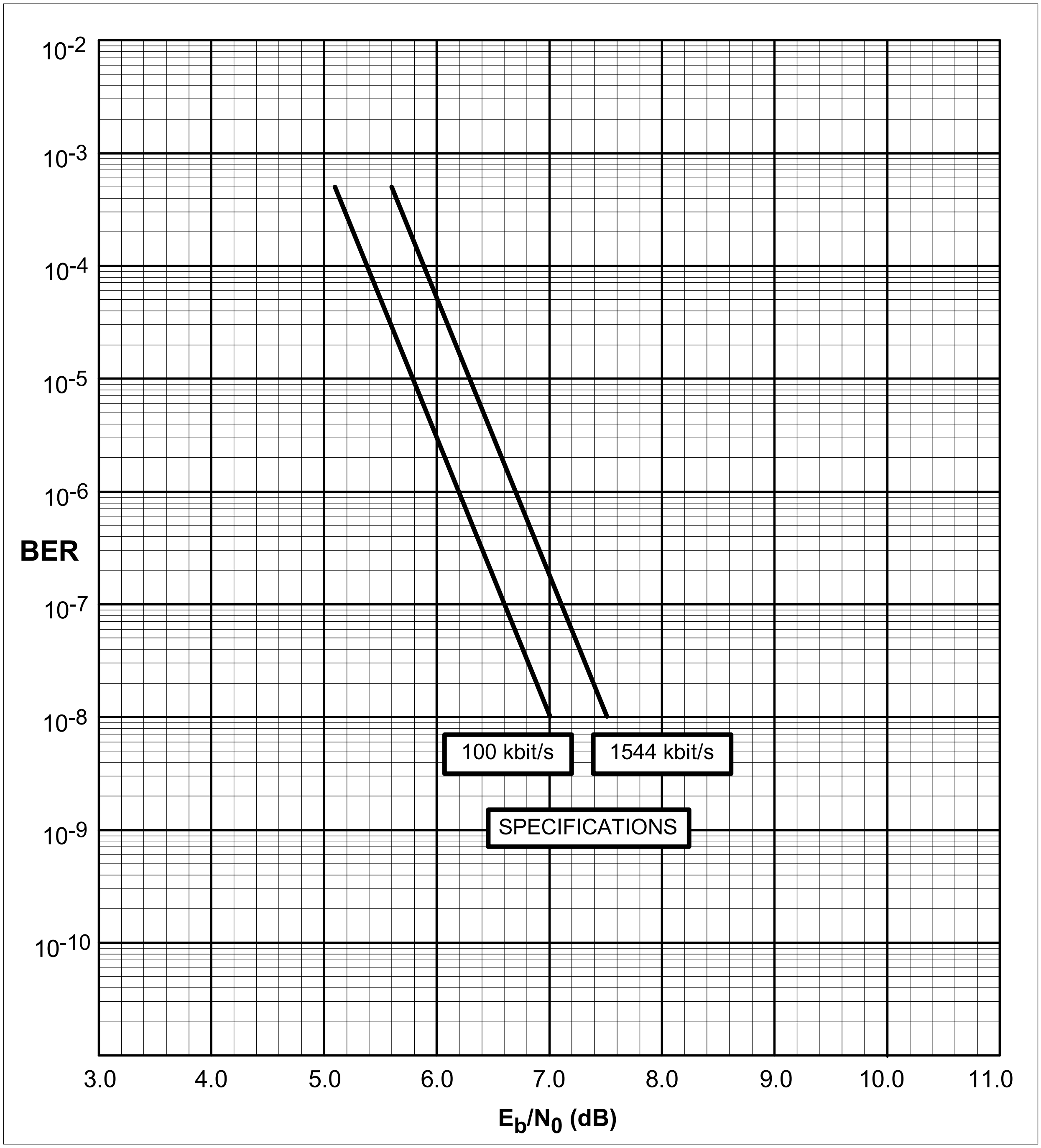


Figure 1-5. Sequential Decoder BER Performance Curves (3/4 Rate)

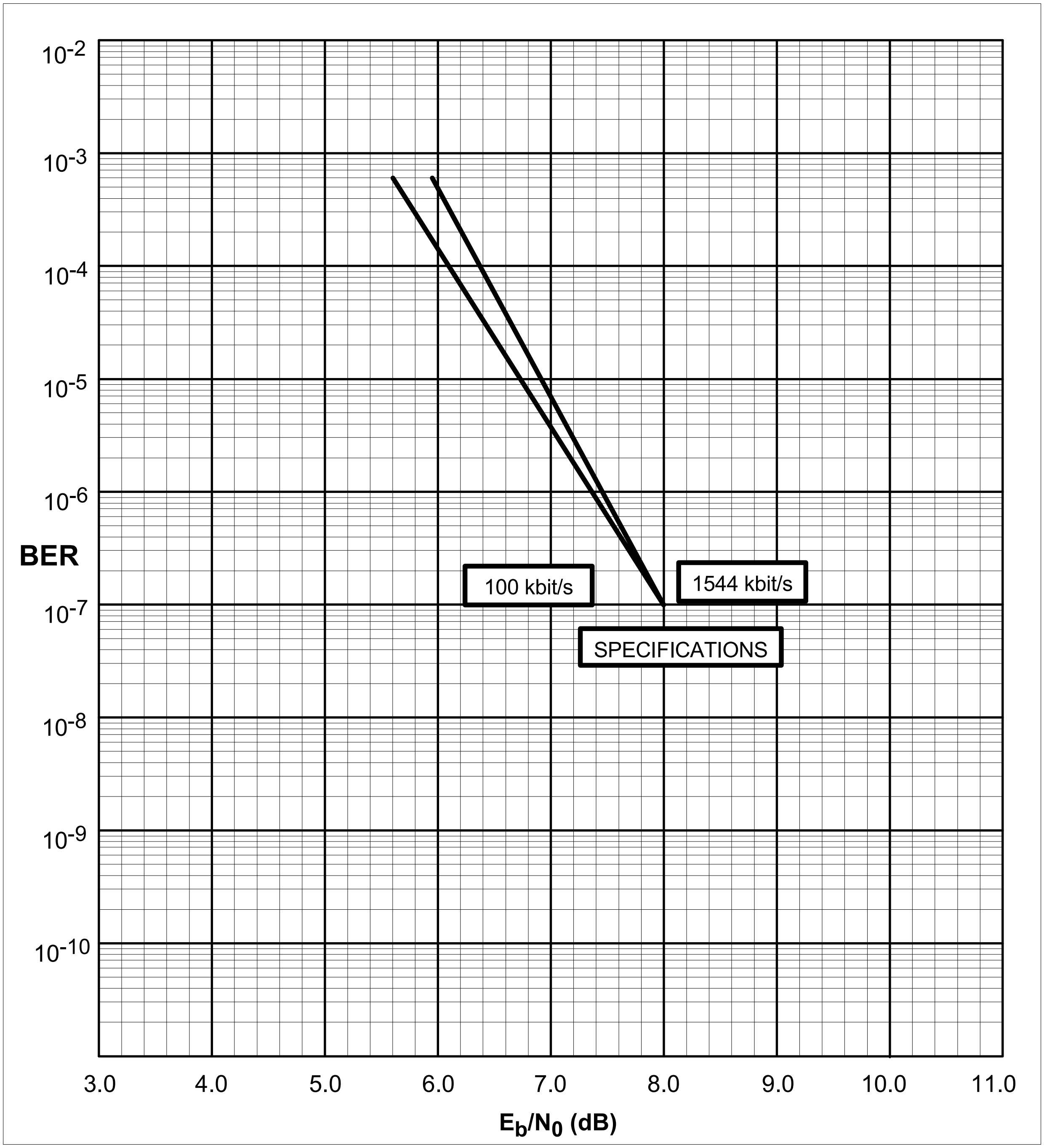


Figure 1-6. Sequential Decoder BER Performance Curves (7/8 Rate)

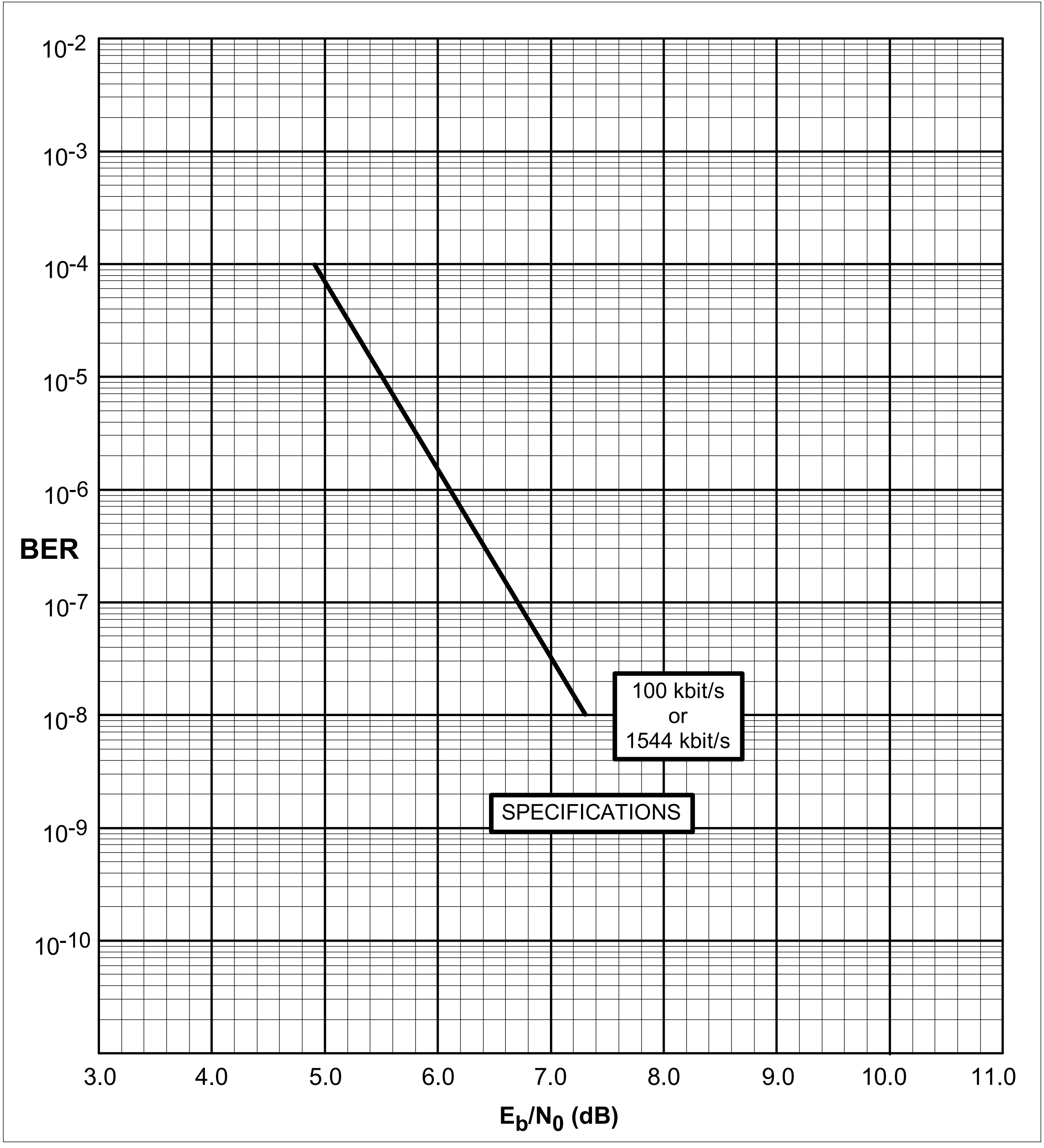


Figure 1-7. Viterbi Decoder BER Performance Curves (1/2 Rate)

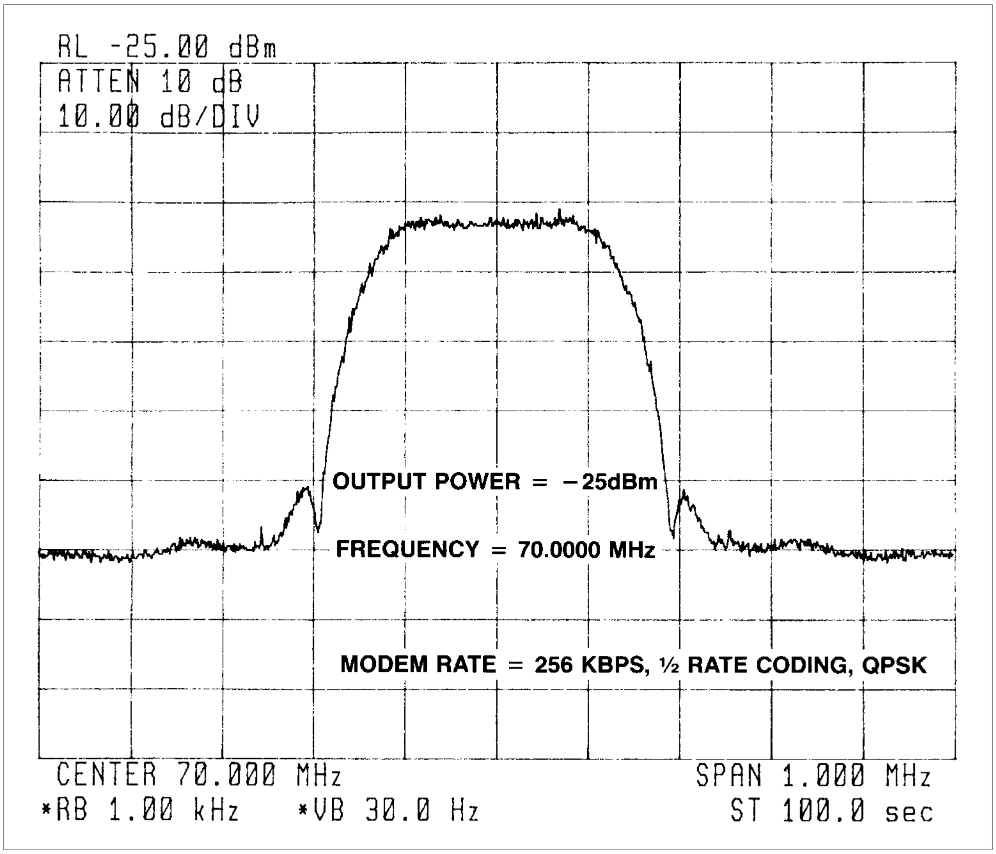


Figure 1-8. SDM-650B Typical Output Spectrum

Chapter 2. INSTALLATION

This chapter provides the following information:

- Unpacking instructions
- External connections
- System requirements
- System installation

2.1 Unpacking

The modem and manual are packaged in pre-formed, reusable, cardboard cartons containing foam spacing for maximum shipping protection. The three main circuit boards are packed in separate cardboard caddypacks (included within the cardboard carton).

To remove the modem:

CAUTION

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

Parts and assemblies may be damaged by Electrostatic Discharge (ESD). ESD safety precautions should always be observed when handling parts.

1. Cut the tape at the top of the carton (indicated by OPEN THIS END).

2. Remove the cardboard/foam space covering the modem and caddypacks.

3. Remove the modem, caddypacks, manual, and power cord from the carton.

4. Save the packing material for storage or reshipment purposes.
5. Inspect the equipment for any possible damage incurred during shipment.
6. Check the equipment against the packing list to ensure the shipment is complete.
7. Refer to Section 2.4 for further system installation instructions.

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.

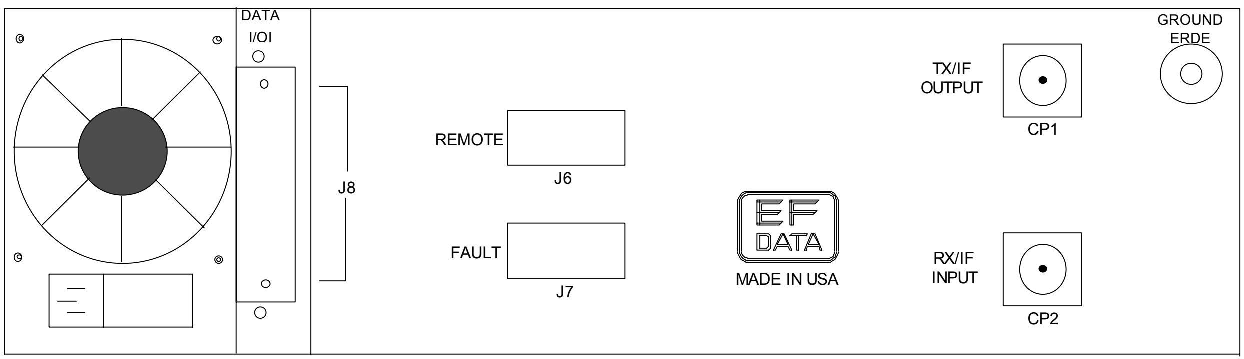


Figure 2-1. SDM-650B Rear Panel View

Table 2-1. Rear Panel Connectors

Name	Ref. Design.	Connector Type	Function
DATA I/O	J8	Various	RS-422/MIL-STD-188 I/O V.35 DATA I/O DS1 DATA I/O G.703 DATA I/O Asynchronous Overhead Channel Unit
REMOTE	J6	9-Pin D	Interface
FAULT	J7	9-Pin D	FORM C Fault Relay Contacts
IF OUTPUT	CP1	BNC	TX IF Output
IF INPUT	CP2	BNC	RX IF Input
AC POWER	None	Standard	AC Power Input
GROUND	GROUND	#10-32 Stud	Chassis Ground

The use of each connector is described in the following paragraphs.

2.2.1 DATA I/O

For information and pinouts on the data connectors, refer to Chapter 3.

2.2.2 Remote (J6)

The remote connector on the modem is used to interface the Monitor and Control (M&C) functions to a remote location. This interface can be either RS-232-C or RS-485. For a complete discussion on the remote interface, refer to Chapter 3.

The remote interface is provided on a 9-pin female D connector. Screw locks are provided for mechanical security of the mating connector. The remote connector is a Data Circuit Terminating Equipment (DCE) interface.

RS-485		RS-232-C	
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 FORM C summary fault contacts:

- Modulator
- Demodulator
- Common equipment

Refer to Chapter 4 for a complete discussion on monitored faults.

To obtain a system summary alarm, connect all FORM C contacts in parallel.

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

Pin #	Name	Function
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 75Ω, and the output power level is -5 to -30 dBm.

In normal operation, the output will be a QPSK-modulated result of the DATA I/O connector, with a frequency between 50 and 90 MHz, or 100 and 180 MHz.

2.2.5 IF Input (CP2)

This is the receive IF connector. The input impedance is 75Ω.

For normal operation, the signal level needs to be between -30 dBm and -55 dBm, with a maximum composite level of 0 dBm. Signals between 50 and 90 MHz, or 100 and 180 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 to 132 VAC, or 180 to 264 VAC, 47 to 63 Hz. Maximum power consumption is less than 75W.

Damage may result if the incorrect input voltage is applied to this connector. If there is any question of voltage compatibility, do not connect the unit until EFData has been contacted.

2.2.7 GROUND

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

2.3 System Requirements

The standard modem with all cards installed (as listed in Chapter 1) is a full-duplex QPSK satellite modem.

The system can also be configured for TX-only or RX-only operation:

- For a TX-only system, the demodulator (AS/0778-X) and decoder (AS/0365-X) are removed. The Utility menu on the front panel must be entered and Operation mode selected. Enter the menu and select TX-only. This will mask the receive faults and receive stored faults in the Faults menu.

- For an RX-only system, the modulator (AS/0773-X) is removed. Enter the Utility menu on the front panel and select Operation mode. Enter the menu and select RX-only. This will mask the transmit faults and transmit stored faults in the Faults menu.

The modem interface is configured by the selection of the data interface card. Refer to Chapter 3 for discussion on the data interface cards.

The modem data/code rate is configured by the installation of a daughter card (AS/0363, AS/0715, or AS/0930-1) on the modulator, and a daughter card (AS/0362, or AS/0929-X) on the demodulator. The Utilities function must be set up to be compatible with the daughter cards. Refer to Chapter 4 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, install the modem as follows:

1. Mount the modem chassis in its assigned position in the equipment rack.

2. Connect the cables to the rear panel in the appropriate locations. Refer to Section 2.2 for connector pinouts, placement, and functions.

3. Open the front panel and verify the three main cards, the M&C, and data interface cards are properly seated.

   Refer to Figure 1-3 for proper positioning 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.

4. Before turning ON the power switch, read and become familiar with the information in Chapter 4.

5. Turn ON the power switch (located inside the front panel).

6. Check for proper TX signal level and spectrum.

7. Check for proper RX signal level and spectrum.

8. If there is any problem with the installation, refer to Chapter 6 for troubleshooting information.

Chapter 3. CONFIGURATION

This chapter provides the following information:

- Monitor and control
- Digital interfaces
- Doppler buffer assembly
- Doppler buffer specification
- I/O connectors
- Interface clocking options

3.1 Monitor and Control

The modem uses a sophisticated microcontroller module to perform the M&C functions of the modem (refer to Figure 3-1).

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 are provided.

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

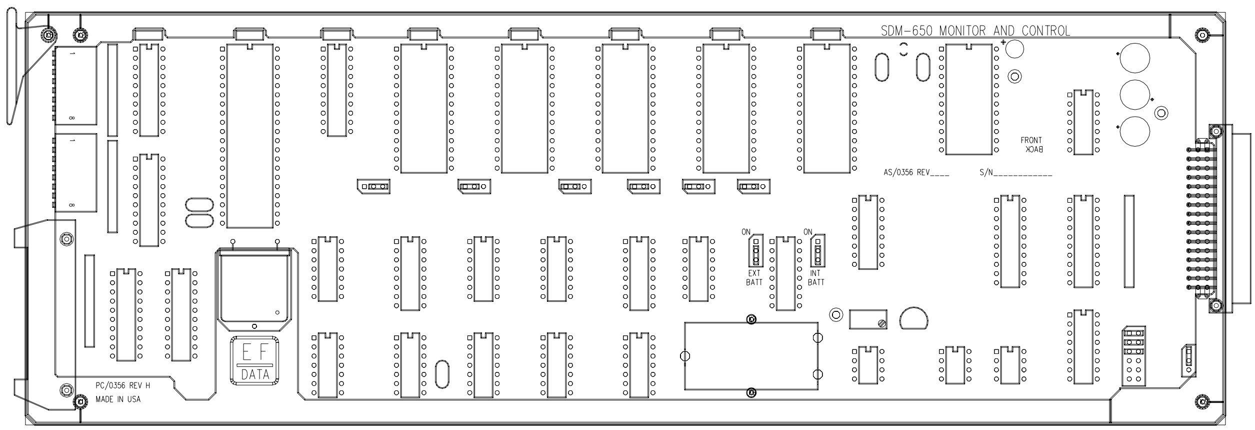


Figure 3-1. M&C Card

3.1.1 Description of Options

3.1.1.1 Remote Interface

All modem functions can be remotely controlled and monitored via an RS-485 (optional RS-232-C) communications link.

- The 2-wire, half-duplex RS-485 interface makes it possible to operate 255 modems on a common communications link.
- The RS-232-C interface is used to communicate with a single modem.

The M&C module must be hardware configured to one of the two interfaces.

Perform the following steps to configure the M&C for RS-485 operation:

1. Remove jumpers JP4, JP5, and JPX.
2. Install jumpers JP1, JP2, and JP3.
3. Connect JP7 to RS-485.

Perform the following steps to configure the M&C for RS-232-C operation:

1. Remove jumpers JP1, JP2, and JP3.
2. Install jumpers JP4, JP5, and JPX.
3. Connect JP7 to RS-232-C.

3.1.1.2 Remote Baud Rate

The remote communications baud rate and parity are programmed by a switch pack (SP1) on the M&C module.

Programming the baud rate and parity is accomplished by setting the appropriate switches in the OFF or ON positions:

- A switch is programmed OFF by placing it in the position furthest away from the PCB (open).
- A switch is programmed ON by placing it in the position nearest 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 has four additional switches (SP1-5 through SP1-8). These four switch locations are not currently assigned or used.

3.1.1.3 Remote Address

Each modem must be configured for a distinct address between 1 and 255 to communicate using the established remote communications protocol.

Addresses are programmed by a switch pack (SP2) on the M&C module.

Addresses are binary coded numbers set at SP2. Switch #1 (SP2-1) is the most significant bit, and switch #8 (SP2-8) is the least significant bit.

3.1.1.4 Battery

A rechargeable battery on the M&C module allows the modem 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 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.

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

To erase the configuration stored in RAM, capacitor C12 must be shorted while JP6 is OFF.

3.1.1.5 Modulator/Coder Defaults

TXA	Transmit Filter A — 7/8 code rate, 56 kbit/s
TXB	Transmit Filter B — 3/4 code rate, 56 kbit/s
TXC	Transmit Filter C — 1/2 code rate, 56 kbit/s
TXD	Transmit Filter D — 1/2 code rate, 64 kbit/s
TXR	Transmit Rate Selected — A 7/8, 56 kbit/s
TX-FREQ	Transmitter Frequency — 70 MHz
RF-OUT	RF Output — OFF
TX-POWER	Transmit Power Level — -10 dBm
RFLOOPBK	RF Loopback — OFF
IFLOOPBK	IF Loopback — OFF
BBLOOPBK	Baseband Loopback — OFF
SCRAMBLR	Scrambler — ON
DIFENCDR	Differential Encoder — ON
TX-CLOCK	Transmit Clock — Internal
SWP-RACQ	Sweep Re-acquisition — 0 Sec
SWP-CNTR	Sweep Center — Hz *(See Note Below)*
SWP-RNGE	Sweep Range — 5000 Hz *(See Note Below)*
SWP-DIR	Sweep Direction — Forward *(See Note Below)*
CW-MODE	Continuous Wave Mode — OFF

Note: These windows will only be displayed when FAST-ACQ (Fast Acquisition) has been turned ON in the Utility menu.

3.1.1.6 Demodulator/Decoder Defaults

RXA	Receive Filter A — 7/8 decode rate, 56 kbit/s
RXB	Receive Filter B — 3/4 decode rate, 56 kbit/s
RXC	Receive Filter C — 1/2 decode rate, 56 kbit/s
RXD	Receive Filter D — 1/2 decode rate, 64 kbit/s
RXR	Receive Rate Selected — A 7/8, 56 kbit/s
RX-FREQ	Receiver Frequency — 70 MHz
RFLOOPBK	RF Loopback — OFF
BBLOOPBK	Base Band Loopback — OFF
DSCRMBLR	Descrambler — ON
RX-CLOCK	Receive Clock — Normal
BERTHSLD	BER Threshold [None]

3.1.1.7 Utility Defaults

DATE	7/4/76
TIME	12:00 AM
POW-ADJ	-5 dB
OP-MODE	Duplex
FAST-ACQ	OFF

3.1.2 Remote Interface Specification

Refer to Appendix B for remote control operation information.

3.1.3 M&C Theory of Operation

The M&C 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
- 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
- 8-channel analog-to-digital converter
- 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 9600 bit/s 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.

3.2 Digital Interfaces

3.2.1 RS-422 and MIL-STD-188-114 Interface

3.2.1.1 Functional Description

The RS-422 and MIL-STD-188-114 digital interface (Figure 3-2) provides the level translation, buffering, and termination between the internal modem signals and the RS-422 or MIL-STD-188-114 interface connector on the rear panel. A functional block diagram of the interface is shown in Figure 3-3.

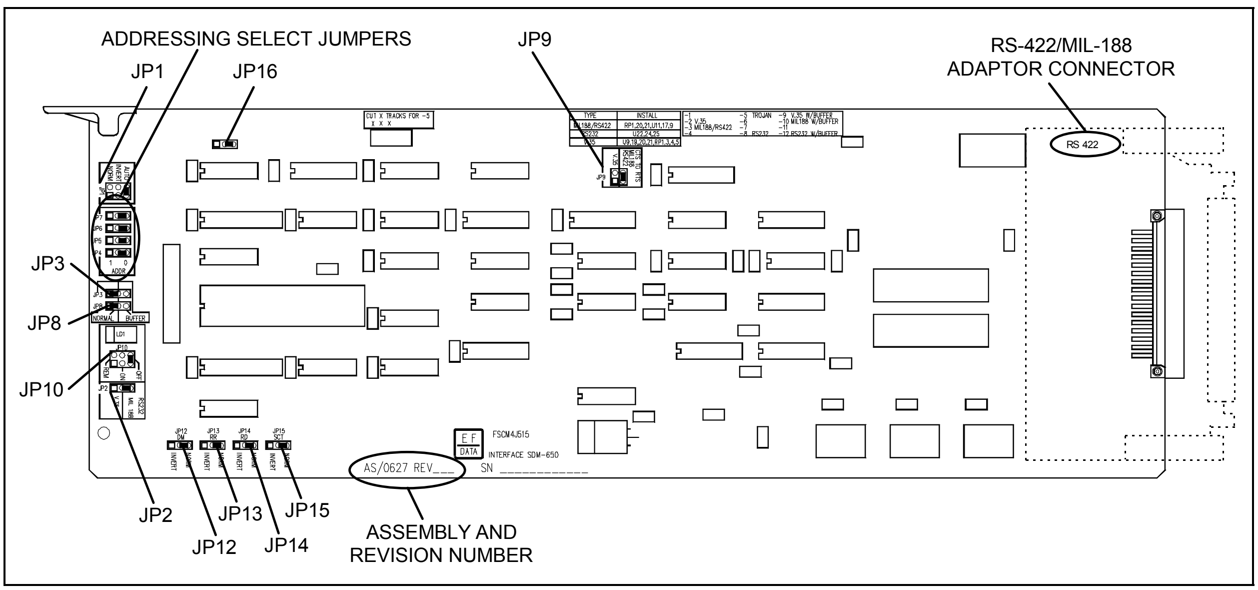


Figure 3-2. RS-422 and MIL-STD-188-114 Interface Board

Electrical characteristics of the RS-422 interface signals are defined in EIA-STD-RS-422.

Electrical characteristics of the MIL-STD-188-114 interface signals are defined in MIL-STD-188-114 and MIL-STD-188-100.

- EIA-STD-RS-449 provides details of the mechanical interface.
- MIL-STD-188-114 defines signal levels, offsets, termination resistors, etc.
- MIL-STD-188-100 specifies such characteristics as signal quality and clock/data phase relationships.

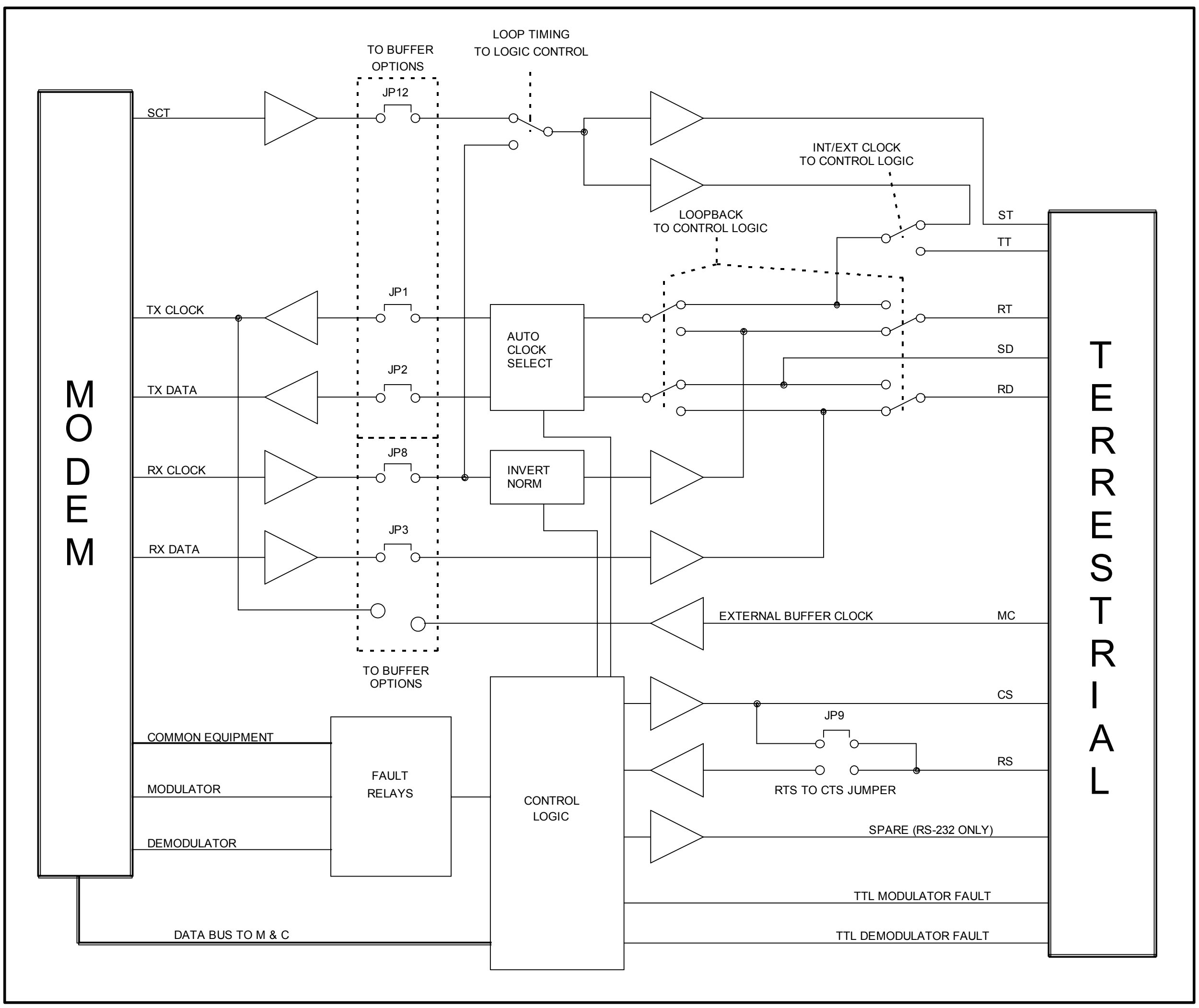


Figure 3-3. RS-422 and MIL-STD-188-114 Block Diagram

The RS-422 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, the 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 relationship meets the jitter specifications of RS-422 or MIL-STD-188-100.

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 Receive Data (RD) lines.

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 (RTS) lines are hard-wired to the Clear to Send (CTS) lines, since the modem does not support polled operation.

Data Mode (DM) indicates that the modem is powered-up.

Receive 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 RS-422 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 re-transmission.

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:

- Common Equipment
- Modulator
- Demodulator

The faults are available on the fault connector on the modem rear panel. Generation of these fault conditions is described in Chapter 4. Fault indicators are also provided on TTL open collector drivers on the RS-422 or MIL-STD-188-114 connector.

The TTL MOD fault indicates a Modulator fault or Common Equipment fault.

The TTL DEMOD fault indicates a Demodulator or Common Equipment fault.

The PCB for the RS-422/MIL-STD-188-114 interface is used for a number of different interface types. The differences are jumper settings on the board, and hardware configuration. Different parts will be installed for the various configurations. Changing to a different interface can be done by replacing the board.

Table 3-1 describes the jumper settings for a Rev. E board.

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

JP1	TX Clock Select	Normal Invert Auto	
JP2	Interface Select	V.35 (-2) MIL-STD-188/RS-232-C (-3)	*(See Note Below)*
JP3	RX Data	Normal Buffer	*(See Note Below)*
JP8	RX Clock	Normal Buffer	*(See Note Below)*
JP4	Address Set	0	*(See Note Below)*
JP5	Address Set	0	*(See Note Below)*
JP6	Address Set	1	*(See Note Below)*
JP7	Address Set	1 MIL (-3)	*(See Note Below)*
JP9	CTS to RTS	V.35 (Processor controller for V.35 and RS-232-C) MIL-STD-188/RS-422 (Hard loops CTS to RTS)	*(See Note Below)*
JP10	Loop Timing	REM ON OFF	*(See Note Below)*
JP11	ASYNC Clk Syn (-5)	Cut Shorts	
JP12	SCT	1 to 2 Invert 2 to 3 Normal	*(See Note Below)*
JP13	RD	1 to 2 Invert 2 to 3 Normal	*(See Note Below)*
JP14	RR	1 to 2 Invert 2 to 3 Normal	*(See Note Below)*
JP15	DM	1 to 2 Invert 2 to 3 Normal	*(See Note Below)*
JP16	SD	1 to 2 Invert 2 to 3 Normal	*(See Note Below)*

Note: Factory jumper settings for MIL-STD-188/RS-422 interface type.

These jumpers are factory set for each given configuration, and should not be changed. This list is supplied for troubleshooting purposes only.

3.2.1.2 Connector Pinouts

The RS-422 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 are provided for mechanical security of the mating connector.

Signal Function	Name	Pin #
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

3.2.1.3 Specification

Circuit Supported	SD, ST, TT, RD, RT, DM, RR, MOD, FAULT, DEMOD FAULT, MC.
Amplitude (RD, RT, ST, DM, RR)	4, ± 2V differential into 100Ω.
DC Offset (RD, RT, ST, DM, RR)	0, ± 0.4V.
Impedance (RD, RT, ST, DM, RR)	Less than 100Ω, differential.
Impedance (SD, TT, MC)	100, ± 20Ω, 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. 15V max. 20 mA max. current sink. Fault is open circuit.
Demodulator Fault	Open collector output. 15V max. 20 mA max. current sink. Fault is open circuit.

3.2.2 V.35 Interface

3.2.2.1 Functional Description

The V.35 digital interface (Figure 3-4) provides level translation, buffering, and termination between the internal modem signals and the V.35 DCE interface connector 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 Section 3.2.2.2 and Section 3.2.2.3, respectively.

A functional block diagram of the V.35 interface is shown in Figure 3-5.

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, SD, must be synchronized to SCT.

In the External clock mode, the clock is accepted on the Serial Clock Transmit External (SCTE) input to clock in the data to be transmitted.

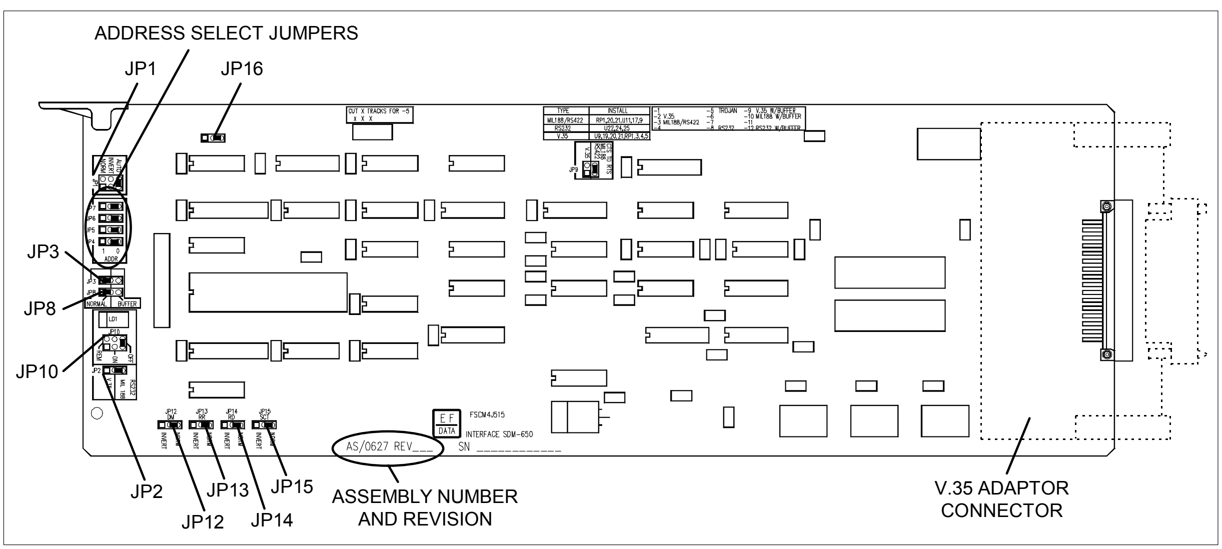


Figure 3-4. V.35 Interface Card

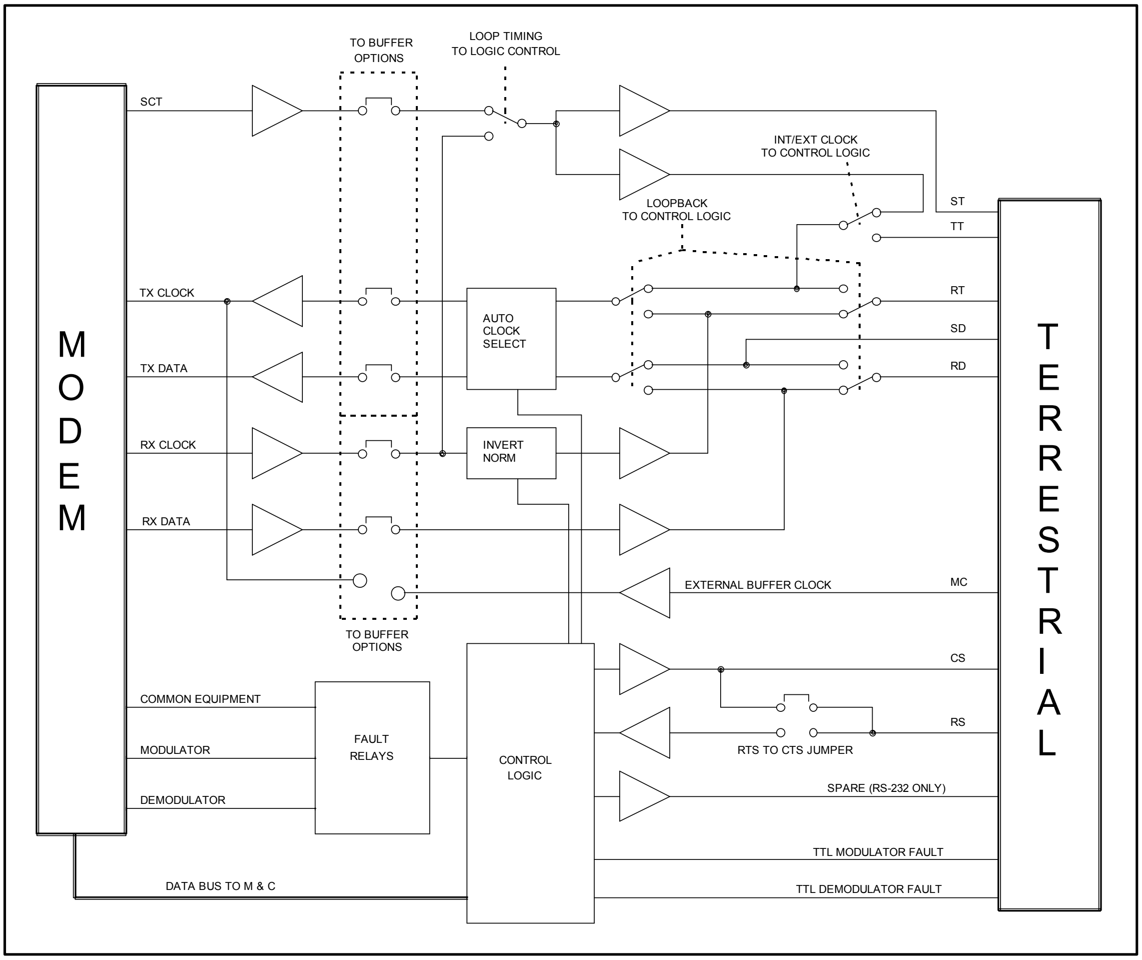


Figure 3-5. V.35 Interface Block Diagram

In either case, the phase relationship between the clock and data is not important as long as the relationship meets the jitter specification. This is 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 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 RTS lines are jumpered to the 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.

In loopback from the modem side, the received data and recovered clock are routed back to the modulator input for re-transmission.

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:

- Common Equipment
- Modulator
- Demodulator

The faults are available on the Fault connector on the modem rear panel. Generation of these fault conditions is described in Chapter 4. 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.
- The TTL DEMOD fault indicates a Demodulator or Common Equipment fault.

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

JP1	TX Clock Select	Normal Invert Auto *(See Note Below)*
JP2	Interface Select	V.35 (-2) *(See Note Below)*
JP3	RX Data	Normal *(See Note Below)* Buffer
JP8	RX Clock	Normal *(See Note Below)* Buffer
JP4	Address Set	1 *(See Note Below)*
JP5	Address Set	0 *(See Note Below)*
JP6	Address Set	1 *(See Note Below)*
JP7	Address Set	1 *(See Note Below)* V.35 (-2)
JP9	CTS to RTS	V.35 *(See Note Below)* (Processor controller for V.35 and RS-232-C)
JP10	Loop Timing	Auto ON OFF *(See Note Below)*
JP11	ASYNC Clk Syn (-5)	Cut Shorts
JP12	SCT	1 to 2 Invert 2 to 3 Normal *(See Note Below)*
JP13	RD	1 to 2 Invert 2 to 3 Normal *(See Note Below)*
JP14	RR	1 to 2 Invert 2 to 3 Normal *(See Note Below)*
JP15	DM	1 to 2 Invert 2 to 3 Normal *(See Note Below)*
JP16	SD	1 to 2 Invert 2 to 3 Normal *(See Note Below)*

Note: Factory jumper settings for V.35 interface type.

3.2.2.2 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 #
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

3.2.2.3 Specification

Circuit Supported	SD, SCT, SCTE, RD, SCR, DSR, RLSD, MOD, FAULT, DEMOD FAULT, MC.
Amplitude (RD, SCR, SCT, SD, SCTE)	0.55V pk, ± 20% differential, into 100Ω.
Amplitude (CTS, DSR, RLSD)	10, ± 5V into 5000, ± 2000Ω.
Impedance (RD, SCR, SCT)	100, ± 20Ω, differential.
Impedance (SD, SCTE)	100, ± 10Ω, differential.
Impedance (RTS)	5000, ± 2000Ω, < 2500 pF.
DC Offset (RD, SCR, SCT)	± 0.6V max., 1000Ω termination to ground.
Polarity (SD, SCT, SCTE, RD, SCR)	True when B positive 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. 15V max. 20 mA current sink max. Fault is open circuit.
Demodulator Fault	Open collector output. 15V max. 20 mA current sink max. Fault is open circuit.

3.2.3 DS-1 Interface

3.2.3.1 Functional Description

The DS-1 digital interface (Figure 3-6) provides level translation, buffering, and termination between the internal modem signals and the DS-1 DTE interface on the rear panel.

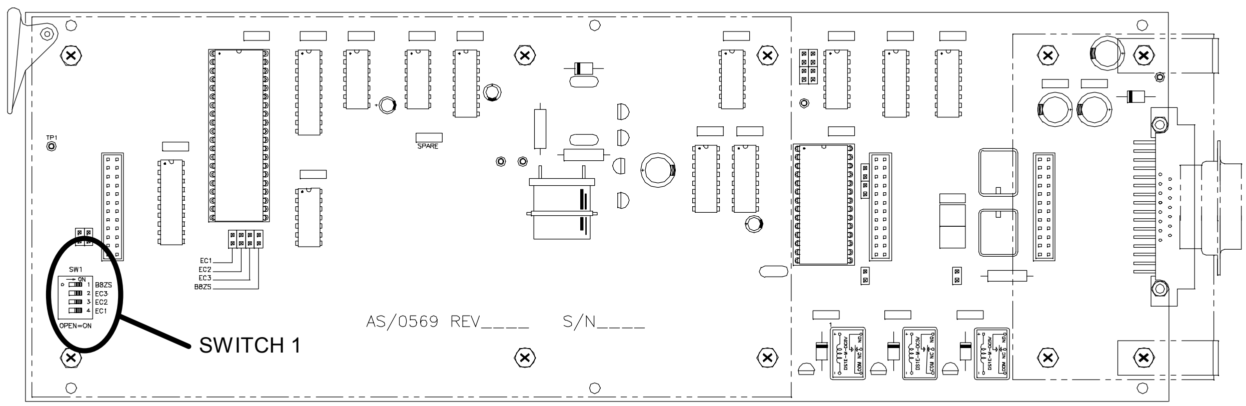


Figure 3-6. DS-1 Interface Card

The DS-1 standard is defined in *Bell System Publication 62411*.

Refer to Figure 3-7 for a functional block diagram of the DS-1 interface.

The DS-1 is a single data rate interface. The interface operates at 1.544 Mbit/s, normally referred to as the "T1" rate. This interface is also unique in that no clock signals are provided.

The clock information is provided in the data signal through the data encoding method used, Alternate Mark Invert (AMI). In this method, a mark is transmitted as a positive or negative pulse, one-half the width of the data-bit time. Each consecutive mark has the opposite sign of its predecessor. Spaces are transmitted as an all-zero voltage.

In order to provide a clear channel (i.e., a channel in which an indefinite number of 0s can be transmitted), B8ZS encoding and decoding are provided. This allows the modem to interface with DTE utilizing B8ZS coding. B8ZS coding is enabled by an on-board jumper (SW1-1). SW1-1 in the open position enables the B8ZS encoder and decoder. SW-1 in the closed position disables the B8ZS encoder and decoder, and the DS1 interface will operate in AMI.

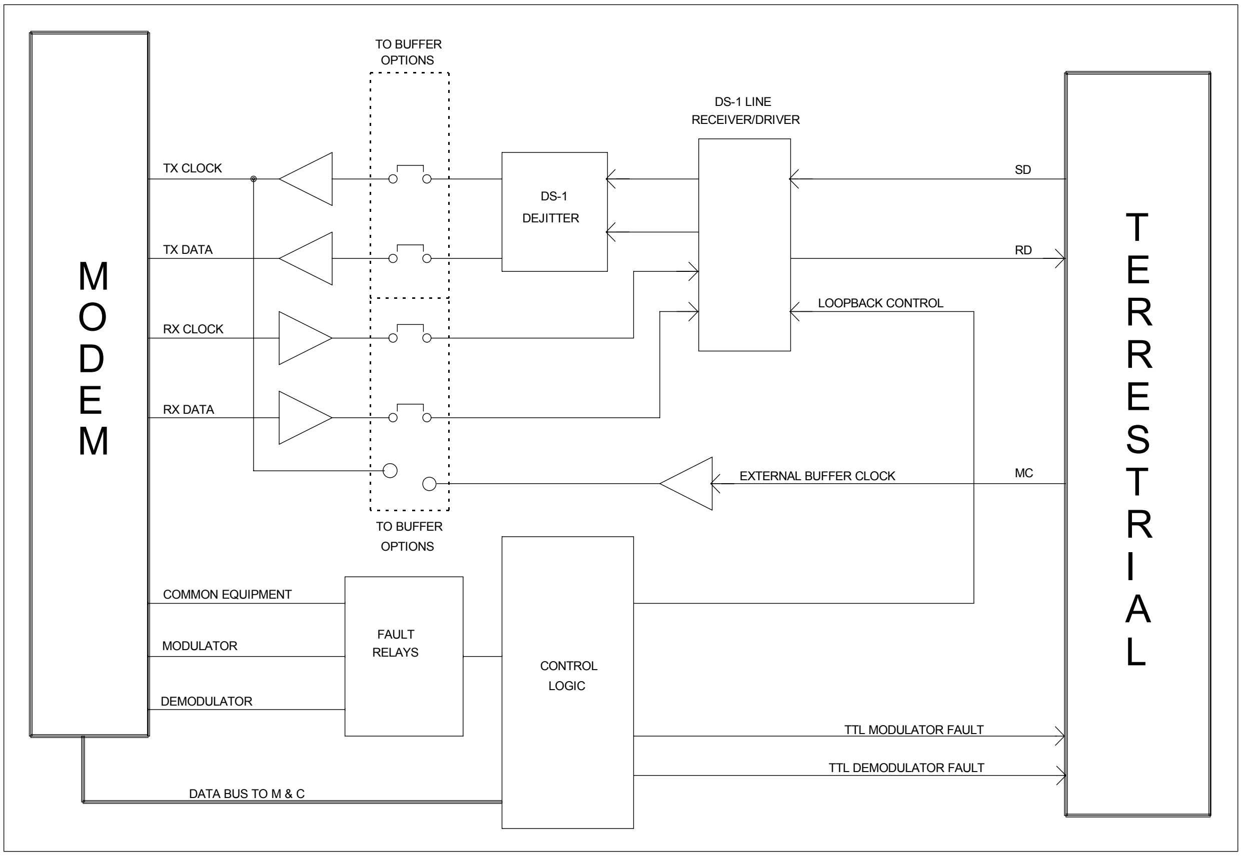


Figure 3-7. DS-1 Interface Block Diagram

The data to be transmitted by the modem is input on the SD lines. Jitter on the SD is removed by a FIFO and clock recovery phase-locked loop. Data received and demodulated by the modem is output on the RD lines.

The RD is driven from a pulse-shaper circuit which pre-equalizes the RD output to drive up to 655 feet of ABAM cable. Refer to Table 3-3.

The DS-1 interface provides bi-directional loopback of the data at the DCE interface.

In loopback from the DTE side, SD is connected to RD.

In loopback from the modem side, the received demodulated data is routed back to the modulator input for re-transmission.

Table 3-3. Equalizer Control

Distance to DSX (Ft) ***(See Note 1)*** **(applies only to 22–GA. PIC [ABAM] Cable)**	**Maximum Cable Loss (dB at 772 kHz)**	**SW1** ***(See Note 2)***		
		4	**3**	**2**
		EC1	**EC2**	**EC3**
0 to 133	0.6	C	C	C
133 to 267	1.2	C	C	O
167 to 400	1.8	C	O	C
400 to 533	2.4	C	O	O
533 to 655	3.0	O	C	C
Test Clear	---	O	C	O

Notes:

1. Other bit combinations represent test modes and are not used for normal operation.
2. Use maximum loss figures for other cable types.

Three fault outputs are provided on dry contact FORM C relays:

- Common Equipment
- Modulator
- Demodulator

The faults are available on the fault connector on the modem rear panel. Generation of these fault conditions is described in Chapter 4.

Fault indicators are also provided on TTL open collector drivers on the DS-1 connector.

- The TTL MOD fault indicates a Modulator fault or Common Equipment fault.
- The TTL DEMOD fault indicates a Demodulator or Common Equipment fault.

In order to facilitate testing of the modem when a DS-1 signal is not available, the output of the clock recovery circuitry is replaced by a 1.544 MHz clock whenever loss of the SD signal is detected. This allows the modem to generate its test signals at the proper data rate.

A TXC-LOSS fault will occur in the Common Equipment fault menu whenever the incoming data is missing.

3.2.3.2 Connector Pinouts

The DS-1 interface is provided on a 15-pin female D connector accessible from the modem rear panel. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	Pin #
SEND DATA	SD-A SD-B	1 9
RECEIVE DATA	RD-A RD-B	3 11
MASTER CLOCK	MC-A MC-B	7 8
MODULATOR FAULT	----	14
DEMODULATOR FAULT	----	15
GROUND	GND	2, 4

3.2.3.3 Specification

Circuits Supported	SD, RD, MOD FAULT, DEMOD FAULT
Data Rate	1.544 Mbit/s ± 100 bit/s
Pulse Width (RD)	324, ± 50 ns
Line Code	AMI or B8ZS (selectable)
RD Amplitude	2.75, ± 0.25V pk into a 100Ω termination
SD Amplitude	3, ± 1.5V pk into a 100Ω termination
Jitter Attenuation (SD)	Meets *AT&T Publication 62411* specification
Modulator Fault	Open collector output 15V max 20 mA current sink Fault is open circuit
Demodulator Fault	Open collector output 15V max 20 mA current sink Fault is open circuit

3.2.4 G.703, 2048 kbit/s Interface

3.2.4.1 Functional Description

The G.703 2048 kbit/s digital interface (Figure 3-8) provides level translation, buffering, and termination between the internal modem signals and the G.703 DTE interface on the rear panel.

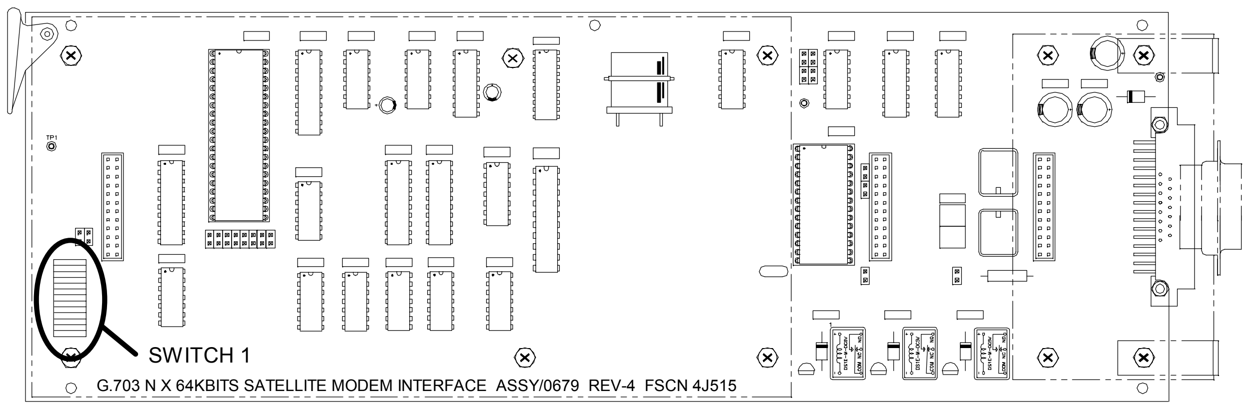


Figure 3-8. G.703 2048 kbit/s Interface Card

The G.703 standard is defined in *CCITT Volume III (red book)*.

Refer to Figure 3-9 for a functional block diagram of the G.703 2048 interface.

This interface meets G.703 specifications at 2.048 Mbit/s, normally referred to as the “E1” rate. This interface is also unique in that no clock signals are provided.

The clock information is provided in the data signal through the data encoding method used, AMI. In this method, a mark is transmitted as a positive or negative pulse, one-half the width of the data-bit time. Each consecutive mark has the opposite sign of its predecessor. Spaces are transmitted as an all-zero voltage.

Refer to Table 3-4 for line code selection and switch settings for the G.703 2048 kbit/s interface.

In order to provide a clear channel (i.e., a channel in which an indefinite number of 0s can be transmitted), HDB3 encoding and decoding is provided. This allows the modem to interface with DTE utilizing HDB3 coding. HDB3 coding is enabled by an on-board jumper (SW1-7).

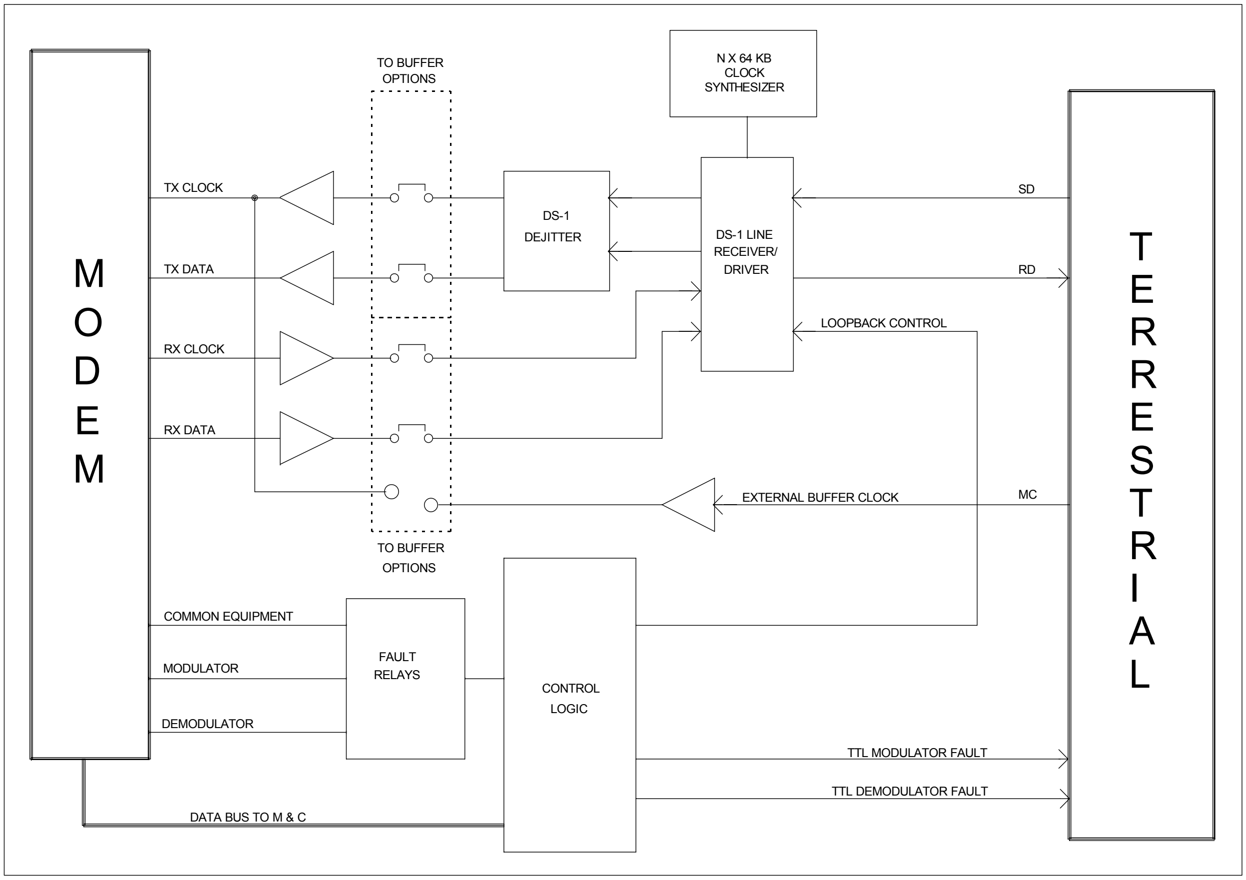


Figure 3-9. G.703 2048 Interface Block Diagram

The G.703 2048 kbit/s interface will operate in AMI, enabled by SW1-8.

The data to be transmitted by the modem is input on the SD lines. Jitter on the SD is removed by a FIFO and clock recovery phase-locked loop. Data received and demodulated by the modem is output on the RD lines.

The G.703 2048 kbit/s interface provides bi-directional loopback of the data at the DCE interface. In loopback from the DTE side, SD is connected to RD. From the modem side, the received demodulated data is routed back to the modulator input for re-transmission.

Three fault outputs are provided on dry contact FORM C relays:

- Common Equipment
- Modulator
- Demodulator

They are available on the FAULT connector on the modem rear panel. Generation of these fault conditions is described in Chapter 4.

Table 3-4. G.703, 2048 kbit/s Interface Switch Configurations

SW1 Positions								Function Selected
1	2	3	4	5	6	7	8	
X	X	X	X	X	X	0	0	AMI CODE
X	X	X	X	X	X	1	0	HDB3
0	0	0	0	0	1	X	X	2048 kbit/s

Switch Positions	
0	CLOSED
1	OPEN
X	DON'T CARE

Fault indicators are also provided on TTL open-collector drivers on the G.703 2048 kbit/s connector.

- The TTL MOD fault indicates a Modulator fault or Common Equipment fault.
- The TTL DEMOD fault indicates a Demod or Common Equipment fault.

In order to facilitate testing of the modem when a G.703 signal is not available, the output of the clock recovery circuitry is replaced by a 2.048 MHz clock whenever loss of the SD signal is detected. This allows the modem to generate test signals at the proper data rate.

3.2.4.2 Optional EXT CLK

This option is used with the Doppler buffer.

The external clock can be used as an optional source of output clock for the optional Doppler buffer. The two inputs, EXT CLK and /EXT CLK, are capacitively coupled to a RS–422 receiver and 470Ω resistors to ground. The EXT CLK is normally grounded by jumper JP17, but may be removed to use RS-422.

In the normal mode, an unbalanced signal should be fed to EXT CLK. The signal may be sine wave, square wave, or TTL. The signal should be at least 2 Vp-p and have a 40 to 60% duty cycle. Jumpers on the Doppler buffer should be set to select external clock when this feature is used.

3.2.4.3 Switch Configuration for G.703 2048 kbit/s Interface

Switch 1 is an 8-position dip switch located at the end of the G.703 interface board.

Table 3-4 lists the switch settings for data rates and available coding for the G.703 2048 kbit/s interface.

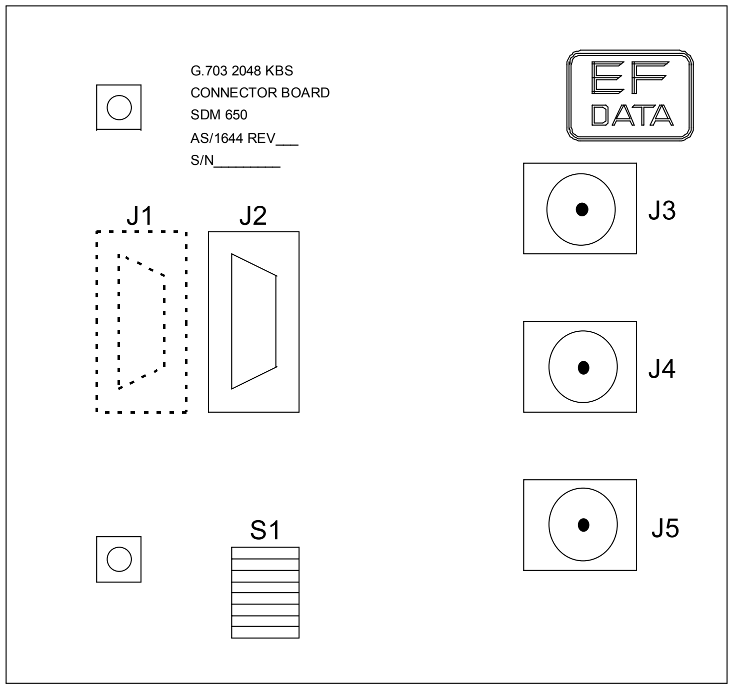
3.2.4.4 Connector Pinouts

The G.703 2048 kbit/s interface is provided on a 15-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 #
SEND DATA	SD-A SD-B	1 9
RECEIVE DATA	RD-A RD-B	3 11
MASTER CLOCK	MC-A MC-B	7 8
MODULATOR FAULT	----	14
DEMODULATOR FAULT	----	15
GROUND	GND	2, 4

3.2.4.5 G.703 2048 kbit/s Connector Board Option

The G.703 2048 kbit/s interface has a connector board option that is configured with a 15-pin D and three BNCs for unbalanced signals for SD, RD, and MC (Figure 3-10). Refer to Table 3-5 for jumper connections.



Notes:
1. Balanced signals are on the 15-pin D connector.
2. Unbalanced signals are on the BNC connectors.

Figure 3-10. G.703 2048 kbit/s Interface Connector Board (Optional)

Table 3-5. G.703 2048 kbit/s Interface Connector Jumpers

Switch	J3 (EXT REF)		J4 (SEND DATA)		J5 (RECEIVE DATA)	
	BAL	UNBAL	BAL	UNBAL	BAL	UNBAL
SW1-1	ON	ON	X	X	X	X
SW1-2	OFF	OFF	X	X	X	X
SW1-3	X	X	ON	ON	X	X
SW1-4	X	X	OFF	OFF	X	X
SW1-5	X	X	X	X	ON	ON
SW1-6	X	X	X	X	OFF	OFF

Switch Positions	
0	CLOSED
1	OPEN
X	DON'T CARE

The interface connects to the rear of the modem, directly onto the G.703 interface connector. Refer to Figure 3-11 for a schematic diagram of the optional G.703 2048 kbit/s connector board.

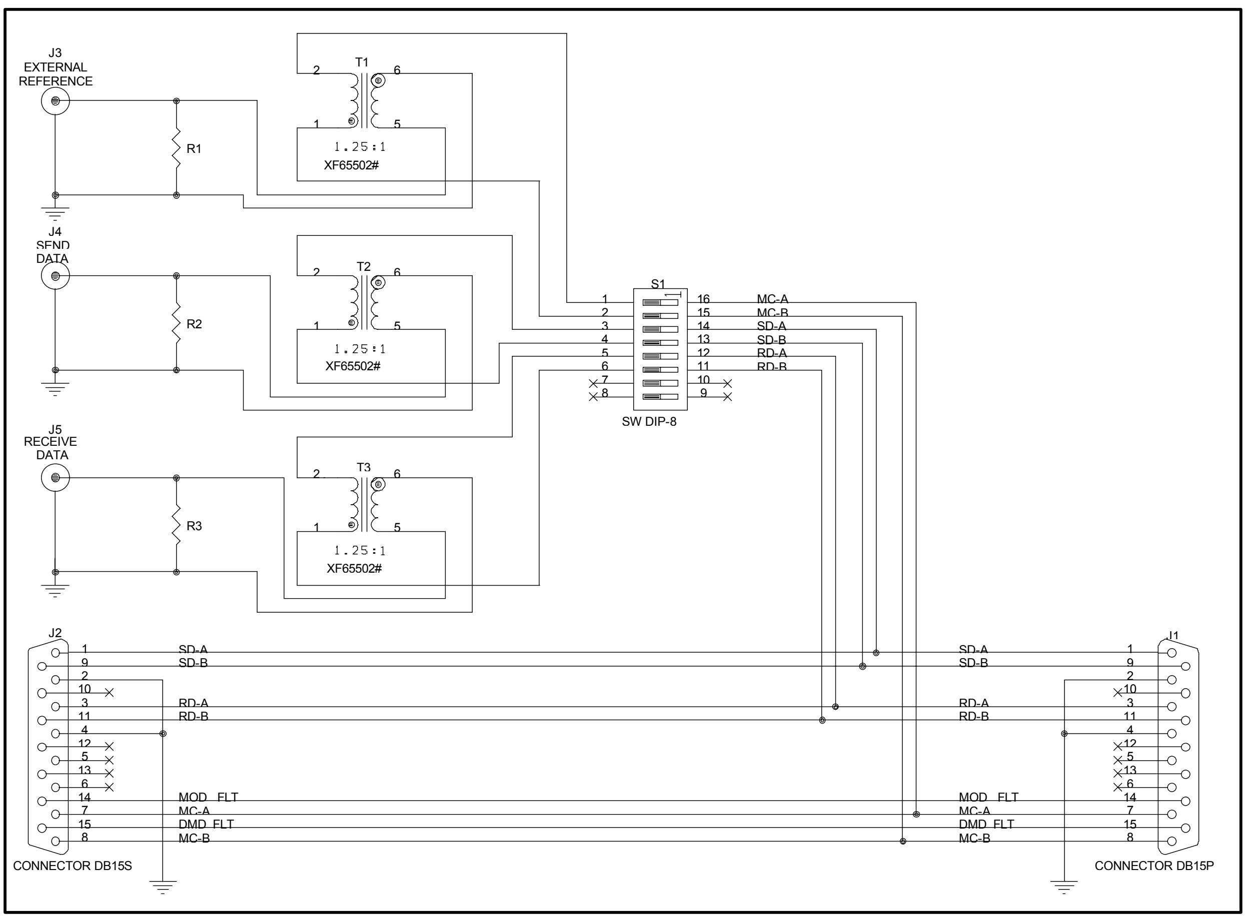


Figure 3-11. G.703 2048 kbit/s Connector Board Schematic Diagram

The G.703 2048 kbit/s optional connector board provides the balanced signals on a 15-pin female D connector. These signals are the same as the G.703 interface connector. Refer to Section 3.2.4.4 for the connector pinouts.

The unbalanced signals are accessible from J3, J4, and J5. A description of available unbalanced signals and directions is described in the following paragraphs.

3.2.4.6 External Reference (J3)

The external reference input signal has two inputs. The BNC connector, J3, has the unbalanced input signal, and the DB15 connector has the balanced input signal.

To use the unbalanced input on the BNC connector, SW1 positions 1 and 2 must be closed (close to PCB).

To use the balanced input on the DB15 connector, SW1 positions 1 and 2 must be open (away from PCB).

The switch pack is located on the optional G.703 2048 kbit/s connector board.

3.2.4.7 Send Data (J4)

The send data output signal has two outputs. The BNC connector, J4, has the unbalanced output signal, and the DB15 connector has the balanced output signal.

To use the unbalanced output on the BNC connector, SW1 positions 3 and 4 must be closed (close to PCB).

To use the balanced output on the DB15 connector, SW1 positions 3 and 4 must be open (away from PCB).

The switch pack is located on the optional G.703 2048 kbit/s connector board.

3.2.4.8 Receive Data (J5)

The receive data input signal has two inputs. The BNC connector, J5, has the unbalanced input signal, and the DB15 connector has the balanced input signal.

To use the unbalanced input on the BNC connector, SW1 positions 5 and 6 must be closed (close to PCB).

To use the balanced input on the DB15 connector, SW1 positions 5 and 6 must be open (away from PCB).

The switch pack is located on the optional G.703 2048 kbit/s connector board.

3.2.4.9 Specification

Pairs	Symmetrical pair, coaxial pair optional.
Circuits Supported	SD, RD, MOD FAULT, DEMOD FAULT.
Data Rate	2.048 Mbit/s, ± 50 PPM.
Pulse Width (RD)	244, ± 25 ns.
Line Code	AMI or HDB3 (selectable).
RD Amplitude	3.00, ± 0.3V pk into a 120Ω termination.
SD Amplitude	3, ± 1.5V pk into a 100Ω termination.
Jitter Attenuation (SD)	Exceeds CCITT G.823, specification for 2048 kbit/s.
Modulator Fault	Open collector output. 15V max. 20 mA current sink. Fault is open circuit.
Demodulator Fault	Open collector output. 15V max. 20 mA current sink. Fault is open circuit.

3.2.5 Asynchronous Overhead Interface

3.2.5.1 Functional Description

The asynchronous overhead interface module consists of three subassemblies:

- Connector board is AS/1328.
- Data processor board is AS/1289.
- Terrestrial interface is AS/1311.

Dash #	Interface	With AUPC
1311-1	RS-422	1311-4
1311-2	V.35	1311-5
1311-3	G.703	1311-6

The connector board provides the physical interface using a 50-pin D connector.

The terrestrial interface contains all circuitry required for G.703, RS-422, MIL-STD-188, and V.35 type interfaces for synchronous data, and RS-232-C and RS-485 type interfaces for asynchronous data.

The data processor contains all circuitry required for multiplexing the synchronous and asynchronous data streams, as well as data rate synthesizers and the optional plesiochronous buffer.

Refer to Figure 3-12 for a block diagram of the asynchronous overhead interface.

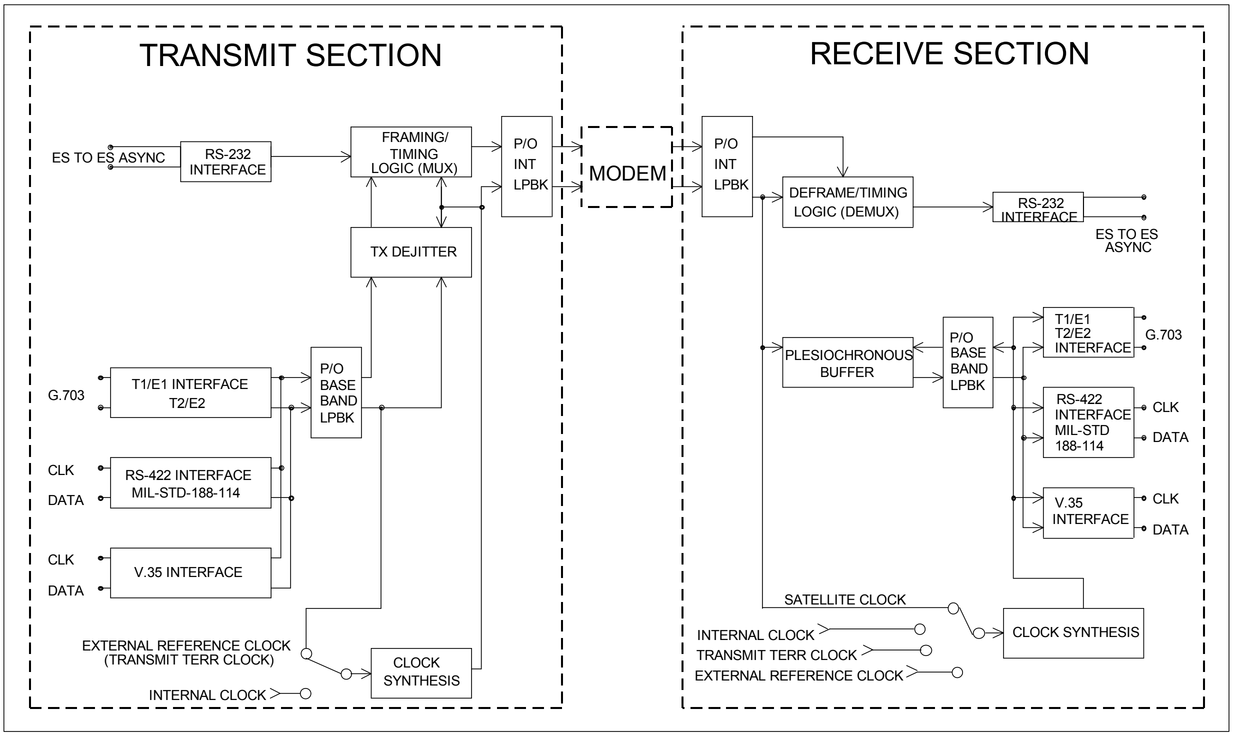


Figure 3-12. Asynchronous Overhead Interface Block Diagram

3.2.5.2 Terrestrial Interface

The terrestrial interface, AS/1311, forms the top (when mated with the connector board) of the 2-board module. The interface contains all balanced pair drivers and receivers for RS-422, MIL-STD-188, and V.35.

Data inputs are SD and transmit clock (TT or SCTE).

Data outputs are:

- Modem reference clock (SCT or ST)
- Receive data (RD)
- Receive clock (RT or SCR)

The "handshake" asynchronous signals are:

- RTS
- CTS
- DM
- DSR
- RR
- RLSD

This board may otherwise contain the circuitry for transformer balanced data interfaces supporting CCITT G.703 parameters. Data inputs are SD, and outputs are RD. Data rates of 1.544, 2.048, 6.312, and 8.448 Mbit/s are supported.

Note: 6 and 8 Mbit/s are not supported by the modem.

Line codes for zero substitution are B6ZS, B8ZS, and HDB3. AMI is also supported. The configuration of this section is determined during production and is not user selectable in the field.

The asynchronous data channel has three interface options. The RS-232-C electrical interface allows full-duplex operation. The RS-485 4-wire option also allows full-duplex, and RS-485 2-wire allows half-duplex operation. These options are jumper selectable.

Tables 3-6 and 3-7 describe the configuration of the jumpers for the various options and data rates. Figure 3-13 shows the jumper locations.

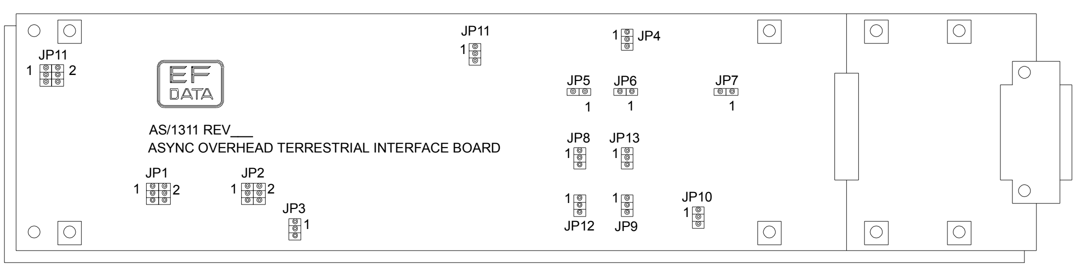


Figure 3-13. Asynchronous Overhead Jumpers

Table 3-6. Asynchronous Overhead Jumper Table

JP #	Pin #	Function
JP1	1 to 3, and 2 to 4 3 to 5, and 4 to 6	V.35, RS-422, MIL-STD-188 G.703
JP2	1 to 2 3 to 4 5 to 6	Auto TX CLK Phase Select Fixed Phase, Normal Fixed Phase, Inverted
JP3	1 to 2 2 to 3	G.703 data activity detect TX Terr CLK activity detect
JP10	1 to 2 2 to 3	V.35 operation RS-422, MIL-STD-188 operation
JP11	1 to 2 3 to 4	Normal SCT output TX CLK chained to SCT output
JP12	1 to 2 2 to 3	2-wire operation 4-wire operation
Asynchronous		
JP8, JP9, JP13	1 to 2 2 to 3	RS-485 RS-232-C

Table 3-7. Data Rate Jumper Table

Data Rate	Impedance	JP4	JP5	JP6	JP7	Voltage
1.544 Mbit/s	BAL−100	OFF	ON	ON	OFF	5.8 Vp-p
2.048 Mbit/s	BAL−120	OFF	ON	ON	OFF	5.8 Vp-p
2.048 Mbit/s	UNBAL−75	OFF	ON	ON	OFF	4.6 Vp-p
6.312 Mbit/s	BAL−110	1 to 2	OFF	OFF	OFF	1.8 Vp-p
6.312 Mbit/s	UNBAL−75	OFF	OFF	OFF	OFF	3.3 Vp-p
8.448 Mbit/s	UNBAL−75	OFF	ON	ON	OFF	4.8 Vp-p

3.2.5.3 Multiplexer

The data processor, AS/1289, forms the bottom of the 2-board module. This board contains the data multiplexer and demultiplexer.

The synchronous data stream is multiplexed with a 1/15 overhead channel, and the resultant information is interfaced to the modulator/coder section of the modem.

The input clock is normally the recovered clock from the terrestrial interface board (SCTE), but the modem reference clock can be used by selecting INT Clock.

The 1/15 overhead channel is composed of:

- Framing signals
- Flags
- Spare bit positions
- Asynchronous data stream

The maximum asynchronous data rate is limited to 1.875% of the synchronous data rate.

3.2.5.4 Demultiplexer

Receive data and clock from the demodulator/decoder is input to the demultiplexer. The demultiplexer synchronizes to the frame pattern and separates the synchronous and asynchronous data. Synchronization is indicated by the DEMUX lock LED on the front edge of the board.

The synchronous data is dejittered and interfaced either to the optional plesiochronous buffer or to the terrestrial interface board.

3.2.5.5 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). For obvious reasons, manual centering will generally not be plesiochronous.

The fill status is available as a monitor function and is accurate to 1%. Overflow or underflow incidents will be momentarily indicated by red LEDs on the module. They are stored in the Stored Faults (StFaults) section of the M&C status registers, along with the date and time of the incident, provided by the modem internal clock. They are stored in battery-backed RAM.

The user may select to have the data clocked out of the buffer from four clock sources:

- Recovered EXT clock from user terrestrial input data
- User-supplied EXT-REF reference clock
- Satellite clock which is phase-locked to the demultiplexer
- Internal clock source

Satellite clock selection is similar to buffer bypass. Problems on either the TX terrestrial clock or the external clock (if selected) will substitute satellite clock, and a fault will be signaled.

3.2.5.6 Remote Interface Specification

Refer to Appendix B, Section B.2, for the remote interface specifications for the asynchronous overhead channel unit.

3.2.5.7 Interface Connector Pinouts

The asynchronous 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 #
GROUND	GND	1, 2
T1E1 SEND DATA A	T1E1-SDA	34
T1E1 SEND DATA B	T1E1-SDB	18
EXTERNAL CLOCK A	EXCA	35
EXTERNAL CLOCK B	EXCB	19
T1E1 RECEIVE DATA A	T1E1-RDA	36
T1E1 RECEIVE DATA B	T1E1-RDB	20
TX DATA B (ASYNC)	TXD-B	4
SEND DATA A	SDA	37
SCT SIGNAL A	SCT/STA	21
TX DATA A (ASYNC)	TXD-A	5
SEND DATA B	SDB	38
SCT SIGNAL B	SCT/STB	22
RX DATA B (ASYNC)	RXD-B	6
RECEIVE DATA A	RDA	39
RECEIVE CLOCK A	SCR/RTA	23
RX DATA A (ASYNC)	RXD-A	7
RECEIVE DATA B	RD-B	40
RECEIVE CLOCK B	SCR/RTB	24
TRANSMIT TIMING A	SCTE/TTA	12
REQUEST TO SEND A	RTSA	45
REQUEST TO SEND B	RTSB	29
TRANSMIT TIMING B	SCTE/TTB	13
RECEIVER READY A	RLSD/RRA	46
RECEIVER READY B	RRB	30
RS-422 TX DATA A	R422TXDA	14
CLEAR TO SEND B	CTSB	31
DATA SET READY A	DSR/DMA	48
DATA SET READY B	DMB	32
CTS A	CTSA	47

3.2.5.8 Asynchronous Interface Specifications

Main Channel	
Physical Interface	MIL-STD-188-114.
(Factory Option)	RS-422/-449. V.35. G.703.
Data Rates	9.6K, 19.2K, 32 kbit/s to 8.448 Mbit/s.
G.703 Data Rates	1.544 Mbit/s.
(Jumper Selectable)	2.048 Mbit/s. 6.312 Mbit/s. 8.448 Mbit/s.
G.703 Line Code	AMI, B8ZS, B6ZS, HDB3.
Transmit Clock Reference	Internal modem reference or external transmit clock (SCT or TT).
Jitter Attenuation	Per G.703.
Pulse Mask	Per G.703.
Overhead Channel	
Overhead Rate	16/15 of main channel.
ASYNC Channel Rate (max.)	< 1.875% of main channel.
ASYNC Channel Interface	RS-232-C. 2-wire RS-485 half-duplex. 4-wire RS-485 full-duplex.
Connector	25-pin D on breakout panel.
Baud Rates, Asynchronous	110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 bit/s.
Asynchronous Format	5, 6, 7, or 8 data bits. Even, Odd, or No Parity. 1 or 2 stop bits (1 or 1.5 for 5 bit).
Buffer Specifications (Pleisiochronous/Buffer Operation)	
Buffer Size	384 to 262144 bits, in 16-bit steps.
Buffer Fill Status	Monitored accurate to ± 1%.
Buffer Centering	Automatic or Manual.
Buffer Clock Reference	Transmit. Internal (10^{-5} Stability). External. Receive (Buffer Bypass).
External Clock Amplitude	Differential 0.5 to 5 Vp-p. Unbalanced Mode 0 to 5 VDC.
External Clock Frequency	256 to 2048 kHz, in 64 kHz steps.
External Clock Impedance	100Ω.
External Clock Input Type	Sine or Square wave. 50%, ± 10%.

3.2.6 Asynchronous Breakout Panel

The asynchronous breakout panel supports the use of the asynchronous interface in the modem.

For more information, refer to the *ASYNC Breakout Panel Installation and Operation Manual*.

3.3 Doppler Buffer

The Doppler buffer assembly is an option that plugs on to the modem interfaces, that provides elastic buffering to the receive data channel. The Doppler buffer compensates for the effect of satellite movement or disparity between transmit and receive clocks, and can be used at data rates of 9.6 kbit/s to 2.5 Mbit/s.

Note: 120Ω impedance-matching resistors are required on the AS/0627, AS/0569, and AS/0679 PCBs.

The Doppler buffer attaches into the receive data path on the interface assembly at TTL signal levels. The buffer should be attached before the signals are configured to the specific interface type.

The buffer assembly is compatible with many different interface types.

The clock source for the buffer output can be selected from one of three sources:

- Receive channel (effective bypass mode)
- Modem transmit clock
- External customer supplied reference clock

If the transmit clock source is selected, the buffer output is used after being recovered and dejittered (if necessary). Any signal with which the transmit side is designed to work can supply a valid buffer output clock.

Jumpers on the buffer determine local clock source control, or the M&C system control.

The modem software must be configured for buffer support in order to use M&C functions from the front panel.

To select the required buffer depth for the system, the maximum peak-to-peak transmission delay variation has to be known.

Refer to Table 3-8 for jumper settings.

Refer to Table 3-9 for the delay variation of an INTELSAT satellite.

Table 3-8. Jumper Selections

Function	Install	Remove
Clock Source Control By M&C	JP8, JP9	JP10, JP11
Clock Source Receive (Bypass)	JP11	JP8, JP8, JP10
Clock Source Transmit CLK	JP10, JP11	JP8, JP9
Clock Source External	JP10	JP8, JP9, JP11
Center Control By M&C	JP1	
Center Control Local		JP1
Clear Flags Control By M&C	JP2	
Clear Flags Local		JP2
Buffer Depth Control By M&C	JP3, JP4, JP5, JP14	SW3-1, 2, 3, and 4 — Open
Buffer Depth 512 Bits	SW1-Closed SW2-Closed SW3-Closed SW4-Closed	JP3, JP4, JP5, JP14
Buffer Depth 1024 Bits	SW1-Open SW2-Closed SW3-Closed SW4-Closed	JP3, JP4, JP5, JP14
Buffer Depth 2048 Bits	SW1-Closed SW2-Open SW3-Closed SW4-Closed	JP3, JP4, JP5, JP14
Buffer Depth 4096 Bits	SW1-Open SW2-Open SW3-Closed SW4-Closed	JP3, JP4, JP5, JP14
Buffer Depth 8192 Bits	SW1-Closed SW2-Closed SW3-Open SW4-Closed	JP3, JP4, JP5, JP14
Buffer Depth 16384 Bits	SW1-Open SW2-Closed SW3-Open SW4-Closed	JP3, JP4, JP5, JP14
Buffer Depth 32768 Bits	SW1-Closed SW2-Open SW3-Open SW4-Closed	JP3, JP4, JP5, JP14
Buffer Depth 65536 Bits	SW1-Open SW2-Open SW3-Open SW4-Closed	JP3, JP4, JP5, JP14

Table 3-9. INTELSAT Delay Variations

Parameter	Inclination (Degrees)						
	0.5	1.0	1.5	2.0	2.5	3.0	Units
Maximum Variations	1.1	1.8	2.6	3.3	4.1	4.8	ms
Maximum Rate of Variations	40	67	94	121	148	175	ns/sec

The formula for calculating the buffer depth is:

Buffer Depth (bits) = Bit Rate (bit/s) x Max. Delay Variation

Contact the satellite company to determine the delay variation of a particular domestic satellite.

The buffer depth capacity can be set either through the M&C or manually with a DIP switch on the buffer. Jumpers and optional modem software determine if the control is local or through the M&C.

When an overflow or underflow occurs, the buffer will automatically reset itself to the center, and set the respective indicator.

The buffer is not plesiochronous.

Data framing is not required for proper operation.

The buffer is centered at power-up, and may be re-centered manually or through the M&C, depending on jumper settings on the assembly.

Refer to Figure 3-14 for the Doppler buffer daughter card and jumper selections.

Refer to Table 3-8 to determine settings.

CAUTION

A problem can result in the switch system when using the buffer with the source clock set to TX CLK. When the TX section switches over to the back-up modem, the source clock is no longer present at the prime mode. The internal oscillator in the prime modem will free-run at the frequency ± 50 PPM from the center. The prime modem running free will eventually cause the Doppler buffer in the prime modem to overflow or underflow. Two lines are provided on the connector called the Master Clock (MC-A and MC-B) that prevent the modem from overflowing or underflowing.

The pinouts on the 15-pin connector are:

- Pin 7 for MC-A
- Pin 8 for MC-B

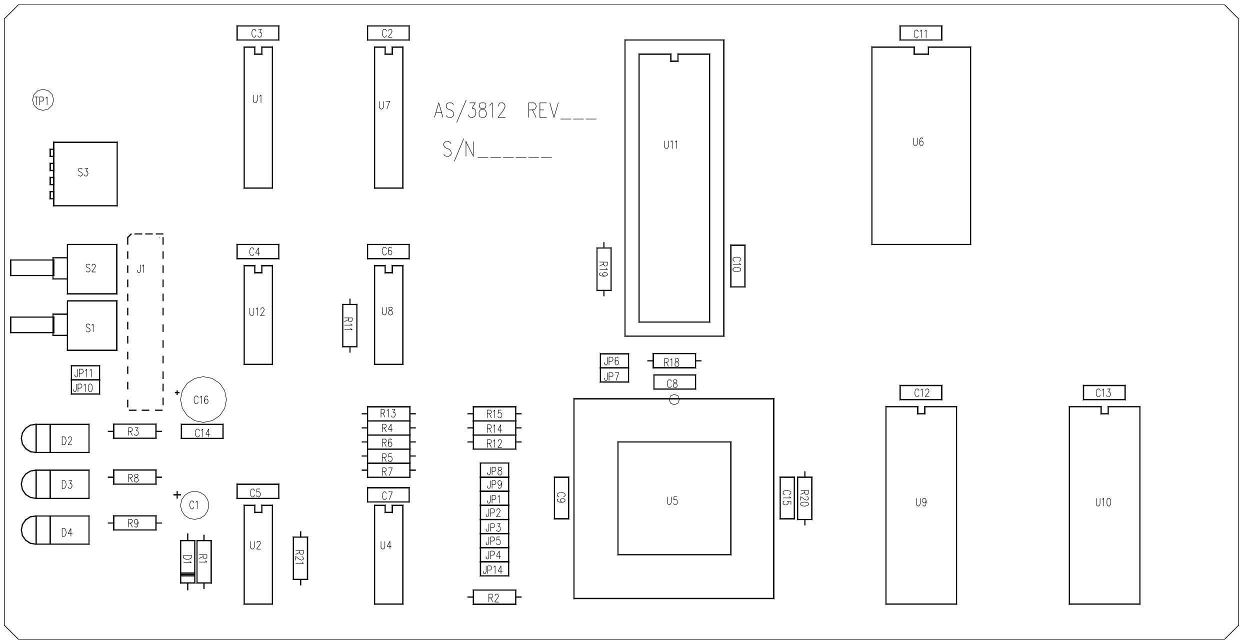


Figure 3-14. AS/3812 Doppler Buffer Daughter Card

Pinouts on the 34-pin V.35 are:

- "c" for MC-A
- "d" for MC-B

The pinouts on the 37-pin connector are:

- Pin 16 for MC-A
- Pin 34 for MC-B

The electrical configuration of these lines is the RS-422.

The jumper selection must be set to external clock in order to use the external reference.

The asynchronous channel unit has a plesiochronous buffer and is selectable in 16-bit increments, from 384 to 262144 bits.

Notes:

1. Maximum variations = peak-to-peak uplink plus downlink.
2. Maximum rate of variations = uplink plus downlink.

3.3.1 Buffer Setup

The receive buffer allows for:

- Plesiochronous buffering of two dissimilar clock frequencies: the far end transmit clock and the local network clock frequency. The clocks may be very close in frequency to each other and will normally slip at a constant rate. Figure 3-15 shows plesiochronous operation of dissimilar clocks. If incoming traffic is too fast, an occasional bit will be lost. If incoming traffic is too slow, an occasional bit will be repeated.

- Doppler buffering of the signal from the satellite. A Doppler shift results from the satellite's figure 8 shaped orbit over a period of one day. A Doppler shift should not result in a clock slip; the buffer constantly fills and empties.

If two earth stations are configured as a master/slave unit, then the buffer need only be configured for Doppler operation. The buffer has sufficient capacity for the Doppler shift on the outward and return paths.

A buffer setup for the Doppler operation will typically require less depth than one intended for both Doppler and plesiochronous operations.

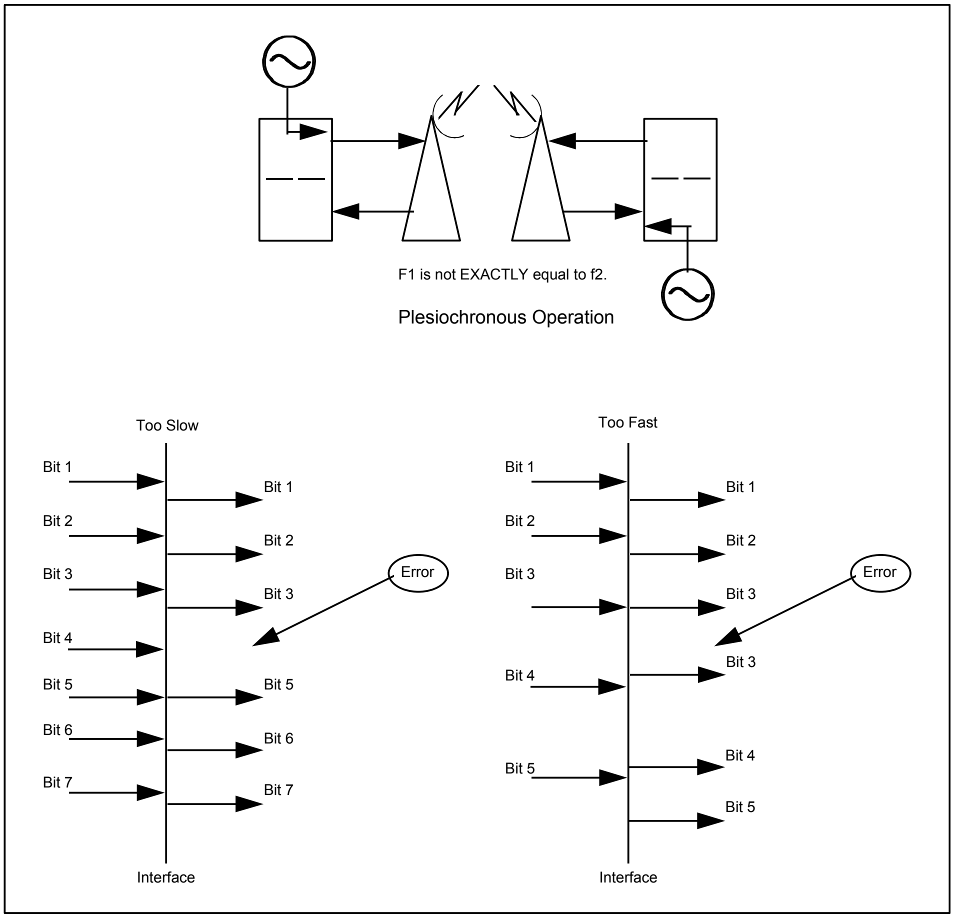


Figure 3-15. Clock Slip Diagram

3.3.1.1 Buffer Size

The depth of the receive buffer will depend upon four parameters:

- Doppler shift caused by satellite
- Stability of each clock (plesiochronous/Doppler operation only)
- Frame/multiframe length of multiplexed data format
- Allowable time between clock slips

3.3.1.2 Doppler

A geostationary satellite with a 24-hour orbit should be positioned directly over the equator. The exact inclination of the satellite (relative to the equator) is influenced by the gravity of the earth, moon, and sun. Solar wind and station keeping motors are required to maintain the satellite's orbital position.

When viewed from the earth, the satellite's orbit appears to be an ellipse around the planet. However, the orbit changes to a figure 8 shape as the angle of inclination increases.

The satellite's orbit can result in a peak-to-peak altitude variation of 0.2% (85 km). A newly launched satellite's orbit will be typically ± 0.1° (150 km). The total effect will be 172 km relative to the nominal 42,164 km radius.

The variation in propagation delay will typically be 1.15 ms (up to the satellite and back down), depending upon the location of the earth station to the satellite. The 2 ms delay is used for most commercial satellites.

Since station keeping involves using fuel in the motors, the lifetime of the satellite can be extended. The satellite's age can be prolonged by allowing the satellite to drift into a wider figure 8 orbit and using the motors less.

The older satellites will be found to be in a more inclined orbit with the station keeping varying in latitude by as much as ± 4.0°. The total effect of the inclined orbit may result in a typical variation in path delay of 35 ms.

3.3.1.3 Plesiochronous

The stability of station reference clocks is normally 10^{-11} that is derived from a cesium standard. When the stability is exceptionally high, the two clocks are not in sync with each other. Eventually, the two reference clocks will pass by each other.

The clock used for the transmit signal passes over the satellite, but will not be used at the receive earth station where a national network derives its timing locally. A buffer will fill up with data using the clock from the satellite, and will empty using the local clock. The buffer ensures that the buffer overflows or underflows at regular determinable intervals. The intervals typically occur every 40 days.

The buffer depth required, from center to end, will be calculated as follows:

Buffer Depth = Minimum Slip Period (sec) x Stability of Far End (Transmit) Clock + Stability of Local Clock

The following is an example on how to calculate a buffer depth:

Far end (transmit) clock stability	1 E-9
Local (buffer) clock stability	1E-11
Minimum clock slip	40 days

Buffer Depth = (40 x 24 x 60 x 60) x (1E-9 + 1E-11) = 3.49 ms

The buffer will either be filled or empty, depending upon the frequency relationship of the two clocks. The total buffer depth will be 2 x 3.49 ms = 6.98 ms.

3.3.1.4 Frame/Multiframe Length

The depth of the receive buffer required has been discussed above and is applicable to all unframed data.

Framed data (i.e., 2048 kbit/s G732 or 1544 kbit/s G733) is desirable to provide slips in pre-defined locations. There are two advantages of organized slip locations:

- In relation to the frame, multiplexing equipment does not lose sync.
- Outages on any channel are kept to a minimum.

A 2048 kbit/s frame structure commonly used is G732. The frame structure has a length of 256 bits, with 16 frames per multiframe (4096 bits total or 2 ms).

3.3.1.5 Total Buffer Length

The size of the buffer will be determined by the Doppler, plesiochronous, and the frame and multiframe length (the last three sections). Using the three examples given in the last three sections, the total buffer depth (end to end) will be:

Doppler + Plesiochronous ms (rounded up to the nearest multiframe)
(e.g., 1.15 + 6.98 = 8.13 ms)

If the multiframe length is 2 ms, then the nearest multiframe will be 10 ms, or 20480 bits.

3.3.1.6 Converting

To convert bits to seconds:

1/Data Rate times Bits = Seconds

To convert seconds to bits:

Data Rate times Seconds = Bits

3.4 Doppler Buffer Specification

Buffer Size (bits)	512, 1024, 2048, 4096, 8192, 16384, 32768, 65536
Clock Source	Receive, transmit, and external clock
Data Rate	9.6 kbit/s to 2.4 Mbit/s
Indicators	Buffer overflow (latched) Buffer underflow (latched)
Controls	Reset buffer to center Reset underflow and overflow indicators Buffer depth Output clock source Control functions jumper Selectable local or M&C system (optional)
Miscellaneous	Buffer automatically recenters on underflow and overflow

3.5 I/O Connectors

J1 25-pin, 0.1” spaced, dual-row header.

Pin #	Description
1	/BUFBDS
2	GND
3	TCLK
4	NC (/TCLK)
5	DB0
6	DB1
7	DB2
8	DB3
9	DB4
10	DB5
11	DB6
12	DB7
13	RCLK-SND
14	RDATA-SND
15	RCLK-RTN
16	RDATA-RTN
17	/BUFALE
18	BUFWR
19	BUFRD
20	EXTCLK
21	VCC
22	VCC
23	SPARE
24	GND

3.6 Interface Clocking Options

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

3.6.1 Master/Slave

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

3.6.1.1 Master/Slave RS-422 or V.35

Refer to Figure 3-16 for the RS-422 or V.35 master/slave configuration.

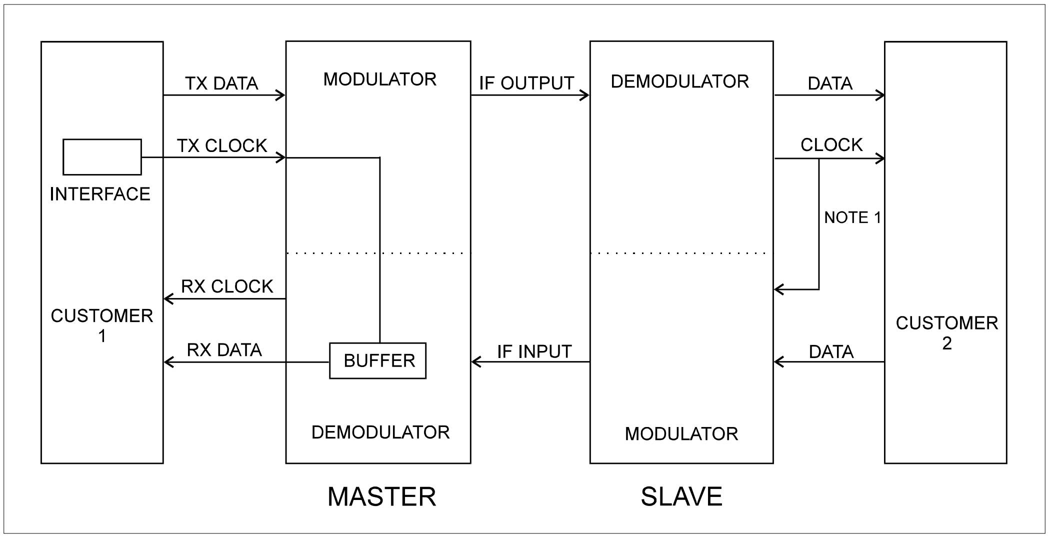


Figure 3-16. RS-422 or V.35 Master Slave Configuration

Notes:

1. The clock may be looped back by using JP10 on the interface board.
2. Refer to Tables 3-1 or 3-2 for more information.

RS-422 Clock Loopback	V.35 Clock Loopback
Join RT-A to TT-A	Join SCR-A to SCTE-A
Join pin 8 to pin 17	Join pin V to pin U
Join RT-B to TT-B	Join SCR-B to SCTE-B
Join pin 26 to pin 35	Join 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.

3.6.1.1.1 Modem Settings (Master)

1. TX-CLOCK: EXT.
2. Install JP10 and JP11 on buffer card (AS/3812).
3. Set S3 as required. Refer to Table 3-9.

3.6.1.1.2 Modem Settings (Slave)

1. TX-CLOCK: EXT.

2. Set S3 to minimum size, and install JP11 on buffer card (AS/3812). Refer to Table 3-9.

3.6.1.2 Master/Slave G.703

Refer to Figure 3-17 for the G.703 master/slave configuration.

Note: 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 re-transmitting. The settings for the master and slave modems are the same as listed in previous sections.

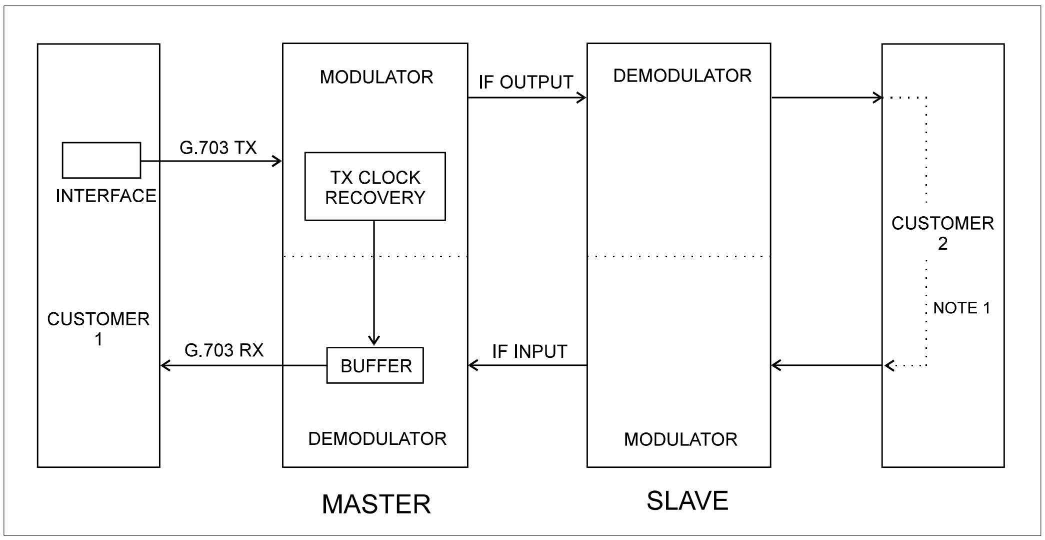


Figure 3-17. G.703 Master Slave Configuration

3.6.1.3 Master/Slave X.21

Refer to Figure 3-18 for the X.21 master/slave configuration.

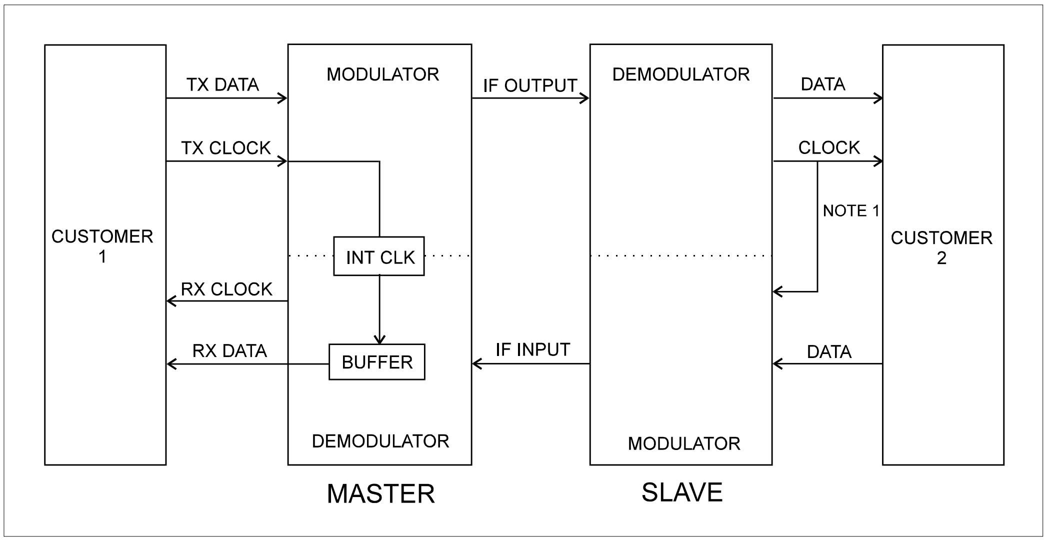


Figure 3-18. X.21 Master/Slave Configuration

Note: On Rev. E boards, there are on-board jumpers to loop back the clock. Refer to Table 3-1 (see the note in the previous example).

3.6.1.3.1 Modem Settings (Master)

- TX-CLOCK: INT.
- Install JP10 and JP11 on buffer card (AS/3812).
- Set S3 as required. Refer to Table 3-9.

3.6.1.3.2 Modem Settings (Slave)

- TX-CLOCK: EXT.
- Install JP11 on buffer card (AS/3812).
- Set S3 as required. Refer to Table 3-9.

3.6.1.4 Master/Slave External Station Clock

Figure 3-19 shows the master/slave external station clock configuration diagram.

Note: Clock must be looped externally at slave end. (For RS-422 and V.35, see the note in the previous example.)

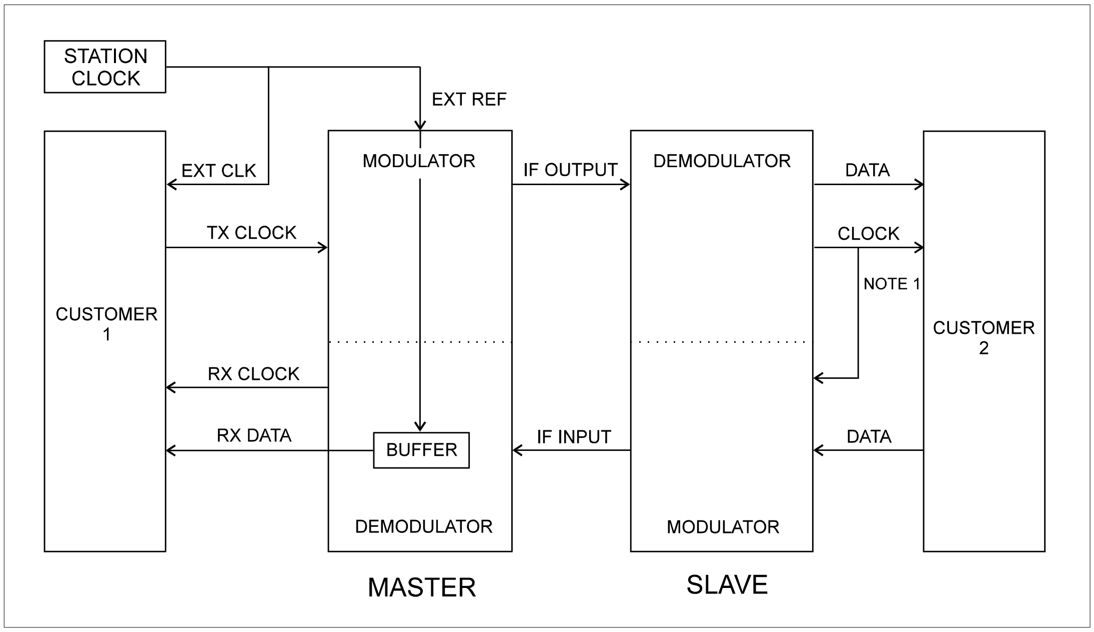


Figure 3-19. G.703 Master Slave Configuration

3.6.1.4.1 Modem Settings (Master)

- TX-CLOCK: EXT.
- Install JP10 on buffer card (AS/3812), and set S3 as required.
- Refer to Table 3-9.

3.6.1.4.2 Modem Settings (Slave)

- TX-CLOCK: EXT.
- Set S3, and install JP11 on buffer card (AS/3812).

3.6.2 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 clocks will not be synchronized. By using very high stability clocks, the expected time between slips can be many days.

The buffer clock will normally automatically revert to the low stability internal reference.

3.6.2.1 Master/Master (Customer Clock)

Refer to Figure 3-20 for the master/master customer clock configuration.

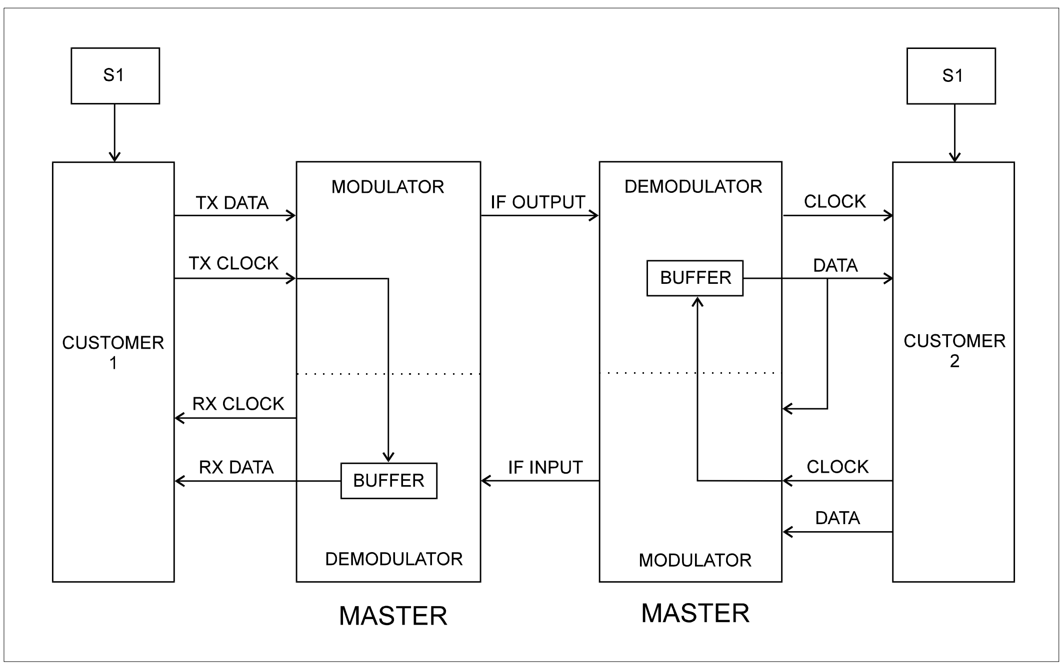


Figure 3-20. Master/Master Customer Clock Configuration

3.6.2.1.1 Modem Settings (Master)

- TX-CLOCK: EXT.
- Install JP10 and JP11 on buffer card (AS/3812).
- Set S3 as required. Refer to Table 3-9.

3.6.2.2 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. For this reason, it is better to use the TERR clock on transmit.

Refer to Figure 3-21 for a diagram of the master/master station clock configuration.

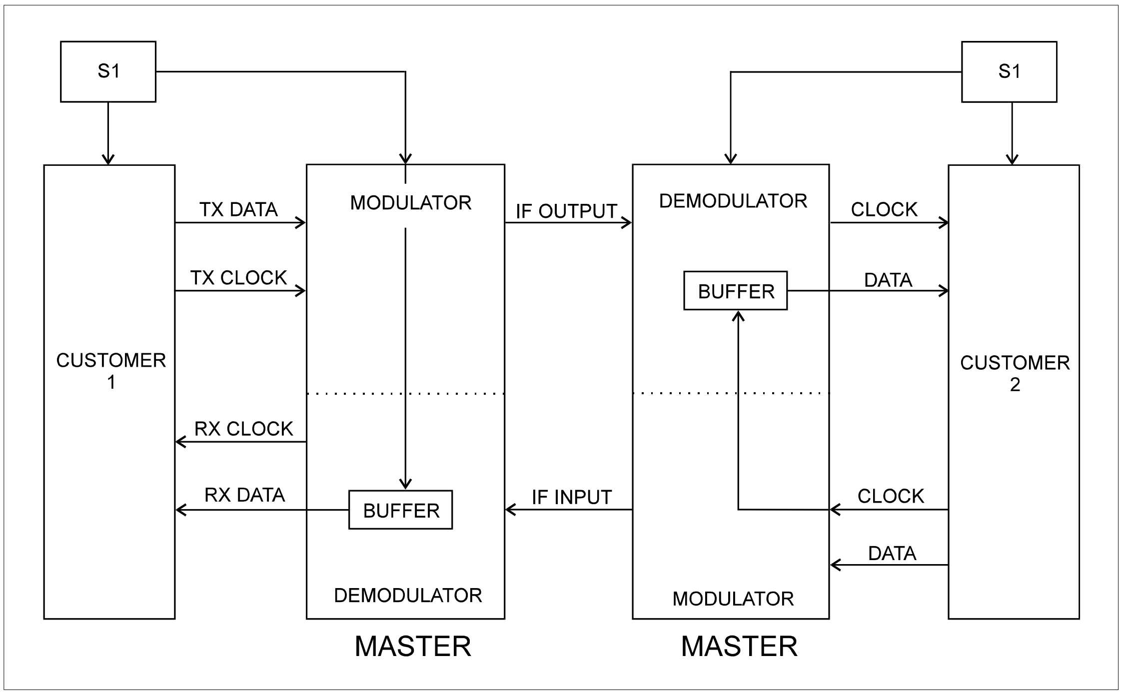


Figure 3-21. Master/Master Station Clock Configuration Diagram

3.6.2.2.1 Modem Settings (Master)

- TX-CLOCK: EXT.
- Install JP1 and JP10 on buffer card (AS/3812).
- Set S3 as required:
    - If using the G.703 2048 kbit/s interface (AS/0679), set SW1-6 and SW1-7 to open, and the remainder to closed.
    - If using the T1/DS1 1544 kbit/s interface (AS/0569), set SW1-1 to closed for AMI line coding, and open for B8ZS line coding.
- SW1-2 through SW1-4 should be set as required.

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Chapter 4. OPERATION

This chapter provides front panel operation information for the standard SDM-650B modem. The following firmware version is described:

- Firmware number: FW/0713-35R
- Software version: 4.16

Notes:

1. For front panel operation information for the modem with the asynchronous overhead channel unit installed, refer to Appendix F.
2. For front panel and remote control operation information for the modem with the Trojan interface installed, refer to Appendix G.
3. For remote control operation information for the modem, refer to Appendix B.

4.1 Front Panel

The modem front panel (Figure 4-1) provides the local user interface, which is necessary to configure and monitor the modem status.

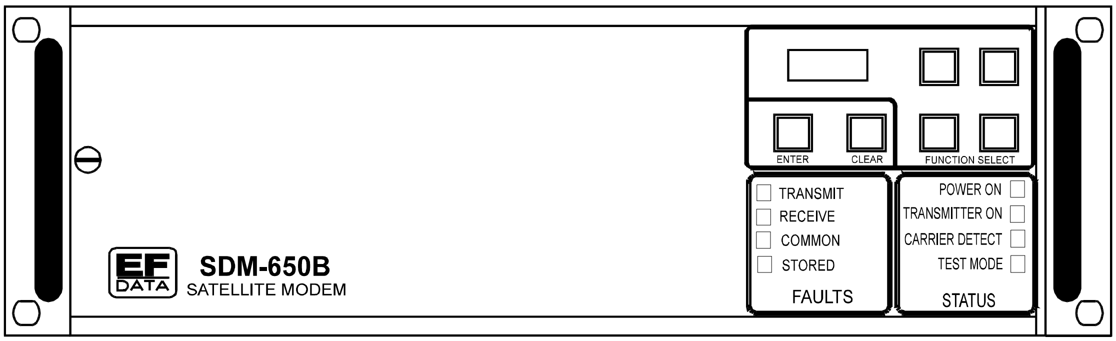

Figure 4-1. SDM-650B Front Panel View

The front panel features a 16-character, 2-line LCD display, and 6-key keypad that provides 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 pre-defined Select categories or levels:

- Configuration (Config)
- Monitor
- Faults
- Stored Faults (StFaults)
- Utility

4.1.1 LED Indicators

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

Faults	Color	Description
Transmit	Red LED	Indicates that a modulator fault condition exists.
Receive	Red LED	Indicates that a demodulator/decoder 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.
Power On	Green LED	Indicates that 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.

4.1.2 Controls

The modem is locally operated by using the following six keys:

Key	Function
[ENTER]	[ENTER] is used to select a display function, or to execute a change to the modem's configuration.
[CLEAR]	[CLEAR] is used to back out of a selection, or to cancel a configuration change which has not been executed. Pressing [CLEAR] generally returns the display to the previous selection.
[←] and [→]	These keys are used to move to the next selection or to move the cursor for certain functions.
[↑] and [↓]	These keys are used primarily to change configuration data (numbers). The keys 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.
- A double beep when a key is pressed indicates an invalid entry.

The modem front panel control uses a tree structured menu system (Tables 4-1 through 4-6) 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 1 of the sign-on message is the modem model number.
- Line 2 is the version number of the firmware implemented in the 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, any one of five functional categories can be chosen:

- Configuration
- Monitor
- Faults
- Stored faults (StFaults)
- Utility

Use [←] and [→] to move from one selection to another. When the desired function is displayed on line 2, enter that level by pressing [ENTER]. Once the desired the functional level is entered, move to the desired function by using [←] and [→].

4.1.3 Menus and Options Overview

Refer to Section 4.1.4 for menu and option explanations.

Table 4-1. Main Front Panel Menu (Standard)

Screen	Submenus/Options	Comments
SDM-650 SW_4.16		This is an information-only screen.
SELECT	CONFIG MONITOR FAULTS StFAULTS UTILITY	Go to Table 4-2. Go to Table 4-3. Go to Table 4-4. Go to Table 4-5. Go to Table 4-6.

Table 4-2. Select Configuration Menu

Menus	Submenus/Options	Comments
TX-x Code Rate	x = A, B, C, D, or V	
RX-x Code Rate	x = A, B, C, D, or V	
TX_Freq	50.0000 to 90.0000 MHz or 100.000 to 180.000 MHz	In 2.5 kHz steps.
RX_Freq	50.000 to 90.0000 MHz or 100.000 to 180.000 MHz	In 2.5 kHz steps.
RF_Out	ON OFF	
TX_Power	-5.0 dBm to -30 dBm	In 0.5 dBm steps.
RFLoopBk	ON OFF	
IFLoopBk	ON OFF	
BBLoopBk	ON OFF	
Scramblr	ON OFF	
Dscrmblr	ON OFF	
DifEncdr	ON OFF	
TX_Clock	Internal External	
RX_Clock	Normal Inverted	
SWP_RACQ	0 to 999 Seconds	
SWP_CNTR	-25000 to +25000 Hz	Displays information when fast acquisition has been turned ON in the Utility menu.
SWP_RNGE	0 to 50000 Hz	Displays information when fast acquisition has been turned ON in the Utility menu.
SWP_DIR	FORWARD + REVERSE -	Displays information when fast acquisition has been turned ON in the Utility menu.
CW_Mode	Center Dual Offset	
BUF_clk	Transmit Receive External	
BUF_CNTR	YES/NO?	
BUF_SIZE	0 to 999	

Table 4-3. Select Monitor Menu

Menus	Submenus/Options	Comments
Raw_BER	Range: < 1.0E-4 to 2549E-4	
Corr_BER	Range: > 1E-8 to > 1E-3	
Eb/N0	Range: < 3.2 dB to > 9.7 dB	
SWP_FREQ	Range: -25000 to +25000 Hz	Displays information when fast acquisition has been turned ON in the Utility menu.
RXSignal	Range: < -60 dBm to > -30 dBm	

Note: Data is not available or displayed when the decoder loses lock.

Table 4-4. Select Faults Menu

Menus	Submenus/Options	Comments
Mod_Flts	RF_Syn Data Clk TClk Syn I-Channl Q-Channl AGC levl Module	
Dmd_Flts	C_Detect RF_Syn Data_Clk I-Channl Q-Channl Dscramblr BERthrsh Module	
CEq_Flts	Battery -12 volt +12 volt +5 volt Controlr Intrface	

Note: Fault conditions are displayed as a “+” on the screen.

Table 4-5. Select Stored Faults (StFaults) Menu

Menus	Submenus/Options	Comments
Mod_Flt0 through Mod_Flt9 MM/DD/YY HH/MM/SS	RF_Syn Data_Clk TClk_Syn I-Channl Q-Channl AGC_levl Module	
Dmd_Flt0 through Dmd_Flt9 MM/DD/YY HH/MM/SS	C_Detect RF_Syn Data_Clk I-Channl Q-Channl Dscrambl BERthrsh Module	
CEq_Flt0 through CEq_Flt9 MM/DD/YY HH/MM/SS	Battery -12 volt +12 volt +5 volt Controlr Intrface	
CLEAR ?? StFaults	YES/NO	

Table 4-6. Select Utility Menu

Menus	Submenus/Options	Comments
Time	SS HH:MM AM/PM	Seconds (SS) reset at [ENTER].
Date	MM/DD/YY	
LAMP TEST??	YES	Press [ENTER] to illuminate all front panel LEDs for three seconds.
Add xxxxyyyy	Address = 0 to 255 xxxx = Parity Odd Even yyyy = 110 to 9600 Baud Rate	
POW ADJ	+20 dBm to -20 dBm	In 0.5 dBm steps.
OP MODE	TX ONLY RX ONLY DUPLEX	
FAST ACQ	ON OFF	
BERT_set	1E-3 1E-4 1E-5 1E-6 1E-7 1E-8 NONE	
BUF_CNTL	ON OFF	
FILTERS ADJUST	MOD ADJ. DMD ADJ.	This is a factory setting, and should not be changed by unauthorized persons.
Assign TX_Fltrs	Filters = A, B, C, D, or V	
Assign RX_Fltrs	Filters = A, B, C, D, or V	

4.1.4 Menu Explanations

Modem configuration may be viewed or changed by entering the Config level from the Select menu on the front panel.

4.1.4.1 Select Configuration

Refer to Table 4-2.

Once the Config menu is entered, the configuration status of all parameters can be viewed by using [←] and [→]. To change a configuration parameter, press [ENTER] to begin the change process. Then, 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 [ENTER]. When [ENTER] is pressed, the necessary programming is initiated by the modem. [CLEAR] allows the user nullify a change prior to execution.

The following table describes each configuration function in detail.

Configuration	Description
TX-x Code Rate	Transmitter rate selection. Select one of four pre-defined transmitter coder/data rate combinations (A, B, C, or D), or a variable rate selection (V). On entry, the current transmitter rate is displayed with the flashing cursor on the first character of the code rate on line 1, and the data rate on line 2. Use the arrow keys to select one of four pre-defined rates. Filters that are not present may display as N/A (not assigned) and cannot be programmed. If the modem is equipped with the variable rate option, TXV can also be selected and the desired data rate can be entered. The BPSK TX code rate operation will be selectable from this window. If one of the pre-defined filters are BPSK, the selection will show up in the appropriate TX filter. If the modem has the variable rate option, the variable rate filter may be entered and BP12 selected. Enter the desired data rate.
RX-x Code Rate	Receiver rate selection. Select one of four pre-defined receiver decoder/data rate combinations (A, B, C, or D), or a variable rate selection (V). On entry, the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line 1, and the data rate on line 2. Use the arrow keys to select one of four pre-defined rates. Filters that are not present may display as N/A (not assigned), and cannot be programmed. If the modem is equipped with the variable rate option, TXV can also be selected and the desired data rated entered. The BPSK RX code rate operation will be selectable from this window. If one of the pre-defined filters are BPSK, the selection will show up in the appropriate RX filter. If the modem has the variable rate option, the variable rate filter may be entered and BP12 selected. Enter the desired data rate.

TX_Freq	Programs the modulator transmit frequency between 50 and 90 MHz, or between 100 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 [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** The transmitter frequency is programmable within the specified range (50 to 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.
RX_Freq	Programs the demodulator receive frequency between 50 and 90 MHz, or between 100 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 [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to 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 [ENTER] to execute the change.
TX_Power	Programs the modulator output power level from -5 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. Use [↑] and [↓] to increase or decrease the output power level, in 0.5 dBm steps. Press [ENTER] to execute the change.
RFLoopBk *(Test Mode Configuration Option)*	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 its previous frequency. 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 [ENTER] to execute the change.
IFLoopBk *(Test Mode Configuration Option)*	Programs the modem for IF loopback operation. When IF loopback is turned ON, the demodulator is connected to the modulator output through an attenuator. The demodulator is programmed to the same frequency as the modulator. An attenuator within the modem connects the IF out to the IF in. When the IF loopback is turned OFF, the demodulator is tuned to its previous frequency, and is reconnected to the IF input. On entry, the current status of the IF loopback is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press [ENTER] to execute the change.

BBLoopBk *(Test Mode Configuration Option)*	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 baseband signals are also looped back from transmitter data and clock, to receiver data and clock. On entry, the current status of the baseband loopback is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press [ENTER] 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 [ENTER] 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 [ENTER] to execute the change.
DifEncdr	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 [ENTER] to execute the change.
TX_Clock	Programs the modem for internal or external transmitter clock. On entry, the current status of the TX clock is displayed with the flashing cursor on the first character. Use the arrow keys to select Internal or External transmit clock. Press [ENTER] to execute the change.
RX_Clock	Programs the modem for inverted or normal receive clock. 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 Inverted or Normal receive clock. Press [ENTER] to execute the change.
SWP_RACQ	Programs the sweep re-acquisition mode time duration. The time that is 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 [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment and decrement the digit at the flashing cursor. Select the number of seconds for the re-acquisition mode from 0 to 999 seconds. Press [ENTER] to execute the change.

SWP_CNTR	**Note:** This window is only displayed when Fast Acquisition has been turned ON in the Utility menu. Programs the sweep center frequency for the directed sweep function. The sweep center frequency may be set in the range from +25000 to -25000 Hz. On entry, the current programmed setting is displayed with a flashing cursor on the first character. Use [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment and decrement the digit at the flashing cursor. Select the sweep center frequency from -25000 to +25000 Hz. Press [ENTER] to execute the change. When in directed sweep, the value from the sweep monitor screen (when the modem was last locked) should be entered for the sweep center frequency.
SWP_RNGE	**Note:** This window is only displayed when Fast Acquisition has been turned ON in the Utility menu. Programs the overall travel of the sweep width range during acquisition in the directed sweep mode. The sweep width may be set from 0 to 50000 Hz. (When set at 50000 Hz, the modem is in fast acquisition mode.) On entry, the current programmed setting is displayed with a flashing cursor on the first character. Use [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment and decrement the digit at the flashing cursor. Select a sweep range from 0 to 50000 Hz. Press [ENTER] to execute the change. When in directed sweep, the smaller the range, the faster the modem will lock. This previous statement is true provided the sweep center frequency is close.
SWP_DIR	**Note:** This window is only displayed when Fast Acquisition has been turned ON in the Utility menu. 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 [ENTER] to execute the change.

<table>
<tr>
<td>CW_Mode

(Test Mode Configuration Option)</td>
<td>Programs the modem for continuous wave mode. Three modes of operation are available:

Center
Dual
Offset

Center Mode:
Generates carrier at the current modulator frequency. This can be used to measure the output frequency.

Dual Mode:
Generates a dual side-band suppressed carrier signal. Side-bands are at one-half 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 the symbol rate from the carrier. This is used to check the quadrature.

On entry, the Center mode is displayed. To activate this test mode, press [ENTER]. Use the arrow keys to select Dual or Offset mode. To return to the Config menu, press [CLEAR].

Note: When [CLEAR] is pressed, the modem is configured to the state it was in before CW_Mode was invoked. The transmitter is automatically turned OFF to prevent the possible swamping of other channels. To turn the transmitter ON, use the RF_Out function.</td>
</tr>
</table>

BUF_clk	Programs the plesiochronous buffer output clock for: • External • Satellite • Internal • Ext_Ref **External Mode:** When this mode is selected and no clock is present at the rear of the modem, the clock will fallback to the satellite clock. The Satellite mode sets the output buffer clock to the satellite clock, which is also the fallback clock. **Satellite Mode:** When selected, the doppler shift caused by the satellite will not be removed. **Internal Mode:** This mode sets the buffer clock to operate from the modem internal clock. **Ext_Ref Mode:** When this mode is selected and a clock is not present, a fault will occur. The output buffer clock will not fall back to the satellite clock.
BUF_CNTR	This configuration function is used to center the buffer. Press [ENTER] twice to center the plesiochronous buffer.
BUF_SIZE	This configuration function is used to set the size of the buffer. On entry, the current buffer length is displayed. Use [↑] and [↓] to select the desired buffer size. The size will be displayed in bits or milliseconds. Use the Utility menu to select bits or milliseconds. The buffer size ranges from 32 to 262144 bits, in steps of 16 bits, or 6 to 96 ms, in steps of 1 ms. Press [ENTER] to execute the change.

4.1.4.2 Select Monitor

Refer to Table 4-3.

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

Function	Description
Raw_BER	Raw bit error rate. Range: < 1.0E-4 to 2550E-4 *(See Note 1)*
Cor_BER	Corrected bit error rate. Range: < 1.0E-8 to > 1E-3 *(See Note 1)*
Eb/N0	Energy(bit)/noise ratio. Range: < 3.2 to > 9.7 dB *(See Note 1)*
Swp_Freq	Sweep Monitor. Range: -25,000 to +25,000 Hz *(See Note 1)* *(See Note 2)*
RXSignal	Receive signal level. Range: < -60 to -30 dBm *(See Note 1)*

Notes:

1. When the decoder loses lock, no data is available, and is so indicated.
2. Sweep frequency is only displayed in the Monitor menu if Fast Acquisition has been turned ON in the Utility menu.

4.1.4.3 Select Faults

Refer to Table 4-4.

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

Use [←] and [→] to move between the fault groups:

- Mod_Flts (modulator faults)
- Dmd_Flts (demodulator faults)
- Ceq_Flts (common equipment faults)

The current fault status is displayed on line 2 of the display in real time. Fault status is displayed as a "+" or a "-" for each parameter monitored.

- "+" indicates that a fault exists.
- "-" indicates that no fault exists.

To display labels for individual faults, press [ENTER]. Use [←] and [→] to move the flashing cursor to the fault to be identified. The label for that fault is immediately displayed on line 1 of the display.

[CLEAR] can be used to exit this level of operation and return to the previous level.

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

4.1.4.3.1 Modulator Faults (Mod_Flts)

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_levl	Automatic gain control level fault.
Module	Modulator module fault. Typically indicates that the modulator module is missing or will not program.

Refer to Section 6.2 for option explanations.

4.1.4.3.2 Demodulator/Decoder Faults (Dmd_Flts)

C_Detect	Carrier detect fault. Typically 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.
BERthrsh	Bit Error Rate threshold fault.
Module	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not program.

Refer to Section 6.2 for option explanations.

4.1.4.3.3 Common Equipment Faults (CEq_Flts)

Battery	Battery fault.
-12 volt	-12V power supply fault.
+12 volt	+12V power supply fault.
+5 volt	+5V 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. If using an RS-422 interface module, this fault could indicate the address jumper settings of JP4 through JP7 are not properly set. Refer to Chapter 3 for more information.

Refer to Section 6.2 for option explanations.

4.1.4.4 Select Stored Faults (StFaults)

Refer to Table 4-5.

The modem stores the first 10 (Flt0 to 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. Upon power-up, a common equipment fault is logged (Flt0) with that time and date. Also on power-up, an additional common equipment fault is logged (Flt1) to indicate the power-up time and date. Therefore, on power-up, the power-down and power-up times are logged as common equipment fault 0 and common equipment fault 1, respectively.

Upon entering the StFaults level, use [←] and [→] to move between the three fault groups and the “CLEAR ?? StFaults” selections.

The time and date of the first stored fault status (Flt0) for the selected group will be displayed alternately on line 2 of the display.

Use [↑] and [↓] to cycle through the selected group’s stored faults status (Flt0 to Flt9). To display the fault status associated with the displayed time and date, press [ENTER]. At this time, [←] and [→] can be used to move the flashing cursor to the individual desired fault.

To clear the stored faults currently logged, press [ENTER] when the “CLEAR ?? StFaults” selection is displayed.

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

4.1.4.5 Select Utility

Refer to Table 4-6. For additional information, refer to Section A.2.

Utility functions allows the user to:

- Set the time and date of the modem real time clock
- Perform a front panel lamp test
- Monitor the modem address, parity, and baud rates
- Offset the modulator output power
- Set operational mode for TX-only, RX-only, or duplex mode
- Turn Fast Acquisition ON or OFF
- Set BER threshold
- Assign data and code rates to the modulator and demodulator

After entering the Utility functions level, use [←] and [→] to select the desired utility function.

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. When selected, the current time in the modem's memory is displayed. To set the modem time, press [ENTER]. Use [←] and [→] to position the flashing cursor over the parameter to be changed. Use [↑] and [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the time.
Date	Set real clock date. When selected, the current date in the modem's memory is displayed. To set the modem date, press [ENTER]. Use [←] and [→] to position the flashing cursor over the parameter to be changed. Use [↑] and [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the date.
LAMP TEST ??	Lamp test function is used to illuminate the front panel indicators for three seconds. Press [ENTER] to turn ON all 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 is 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 user to offset the modulator output power readout in the Config 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 used 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 dBm, in 0.5 dBm increments.
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 [ENTER] to execute the change. When TX-only or RX-only is selected, the appropriate faults are masked from the Faults and StFaults 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.
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. BER threshold may be disabled by specifying None. On entry, the current setting of the BER threshold is displayed. Use [↑] and [↓] to select the desired setting. Press [ENTER] to execute the change.
BUF_CNTL	ON/OFF.
FILTERS ADJUST	This is a factory setting. The operator is not allowed to enter this parameter without authorization from EFData Customer Support Department. Failure to comply will result in a modem failure.

Assign TX_Fltrs	Modulator symbol rate assignment. This function is used to view current filter rate assignments, and to make filter rate re-assignments. The modulator has four symbol rate filters. Filters are designated as A, B, C, and D. 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. To view the current filter assignments, press [ENTER] when the Assign TX_FLTRS selection is displayed from the Utility Functions menu. On line 1 of the display will be TXA, which indicates transmitter filter A. Following TXA on line 1 will be the coder rate (1/2, 3/4, 7/8, or BP12). On line 2 will be the data rate assigned to filter A. Use [←] and [→] to see the assignments for filters B, C, and D (TXB, TXC, and TXD). To change a filter assignment, press [ENTER] when the data for that filter is displayed. Use [←] and [→] until the flashing cursor is at the parameter to be changed. Then use [↑] and [↓] to change that parameter. When all changes are made, press [ENTER] to confirm the assignment. Variable rate filters can only be programmed up to 2048 kbit/s. If a higher data rate is needed, use a fixed rate filter card. Refer to Appendix A for more information on data rate changes and variable rate filters. Fixed rate filter cards can have from one to four pre-defined fixed code and data rates installed on the filter card. If NA appears in the first line after the transmit filter assignment, then the filter card on the modulator does not have a filter present for that designated filter. These assignments in the Utility menu must match the data rate on the filter card, and cannot be changed unless the filter card is changed. **Note:** These assignments are used for the selection of TXR in the Configuration Functions menu.

Assign RX_Fltrs	Demodulator symbol rate assignment. This function is used to view current filter rate assignments, and to make filter rate re-assignments. The demodulator has four symbol rate filters. Filters are designated as A, B, C, and D. Each filter is for a specific symbol rate. The data rate and code rate for each filter must be established upon initial demodulator installation, and when circumstances indicate the need to do so. To view the current filter assignments, press [ENTER] when the Assign RX_FLTRS selection is displayed from the Utility Functions menu. On line 1 of the display will be RXA which indicates transmitter filter A. Following RXA on line 1 will be the coder rate (1/2, 3/4, 7/8, or BP12). On line 2 will be the data rate assigned to filter A. Use [←] and [→] to see the assignments for filters B, C, and D (RXB, RXC, and RXD). To change a filter assignment, press [ENTER] when the data for that filter is displayed. Use [←] and [→] until the flashing cursor is at the parameter to be changed. Then use [↑] and [↓] to change that parameter. When all changes are made, press [ENTER] to confirm the assignment. Variable rate filters can only be programmed up to 2048 kbit/s. If a higher data rate is needed, use a fixed rate filter card. Refer to Appendix A for more information on data rate changes and variable rate filters. Fixed rate filter cards can have from one to four pre-defined, fixed code rates and data rates installed on the filter card. If NA appears in the first line after the transmit filter assignment, then the filter card on the demodulator does not have a filter present for that designated filter. These assignments in the Utility menu must match the data rate on the filter card, and cannot be changed unless the filter card is changed. **Note:** These assignments are used for the selection of RXR in the Configuration Functions menu.

Chapter 5. THEORY OF OPERATION

This chapter contains information on the following cards:

- Modulator
- Sequential decoder/demodulator processor
- Demodulator

In addition, information is provided on reacquisition, fast acquisition, and the directed sweep mode.

5.1 Modulator

The modem modulator card is a 10.25” x 14” card that fits in the top-left slot of the modem chassis.

The modulator creates a QPSK or BPSK modulated carrier within the 50 to 90 MHz, or 100 to 180 MHz range, from the digital data stream provided by the interface card.

Several subsections make up the card:

- Digital interface
- Scrambler/differential encoder
- Convolutional encoder
- I/Q Nyquist filters
- Modulator
- Output amplifier
- RF synthesizer
- Clock synthesizer

A block diagram of the modulator is shown in Figure 5-1.

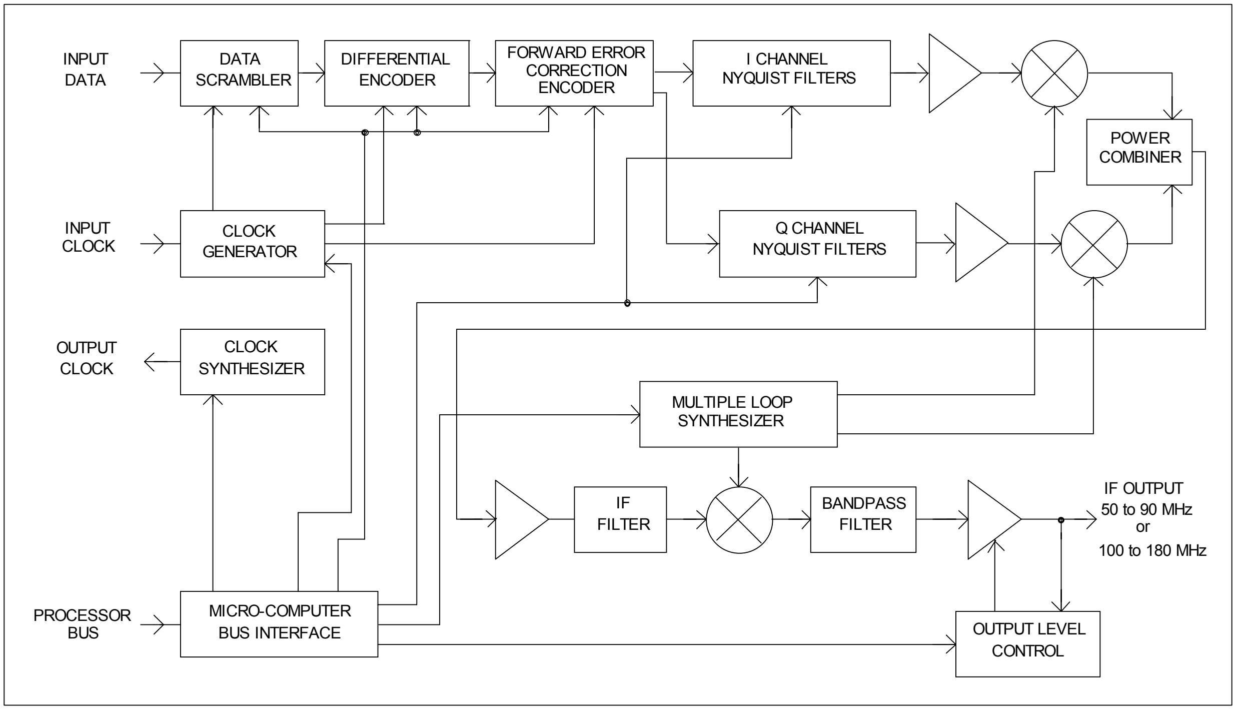

Figure 5-1. Modulator Block Diagram

Refer to Section 5.1.2 for a detailed description of the modulator.

5.1.1 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	0.7 times the data rate divided by the encoding rate
Phase Error	2.5° max
Filtering Type	Nyquist, re-equalized
Spectral Occupancy	See Figure 5-2 dB at ± 0.75 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	± 0.5 dB over -5 to -25 dBm ± 1 dB over -25 to -30 dBm
Output Impedance	75Ω (50Ω optional)
Output Return Loss	20 dB minimum
Scrambling	V.35 or none
Differential Encoding	2 Phase or none
FEC Encoding	Convolutional, Rate 7/8, 3/4, or 1/2
I/O Connector	DIN, 96-pin.

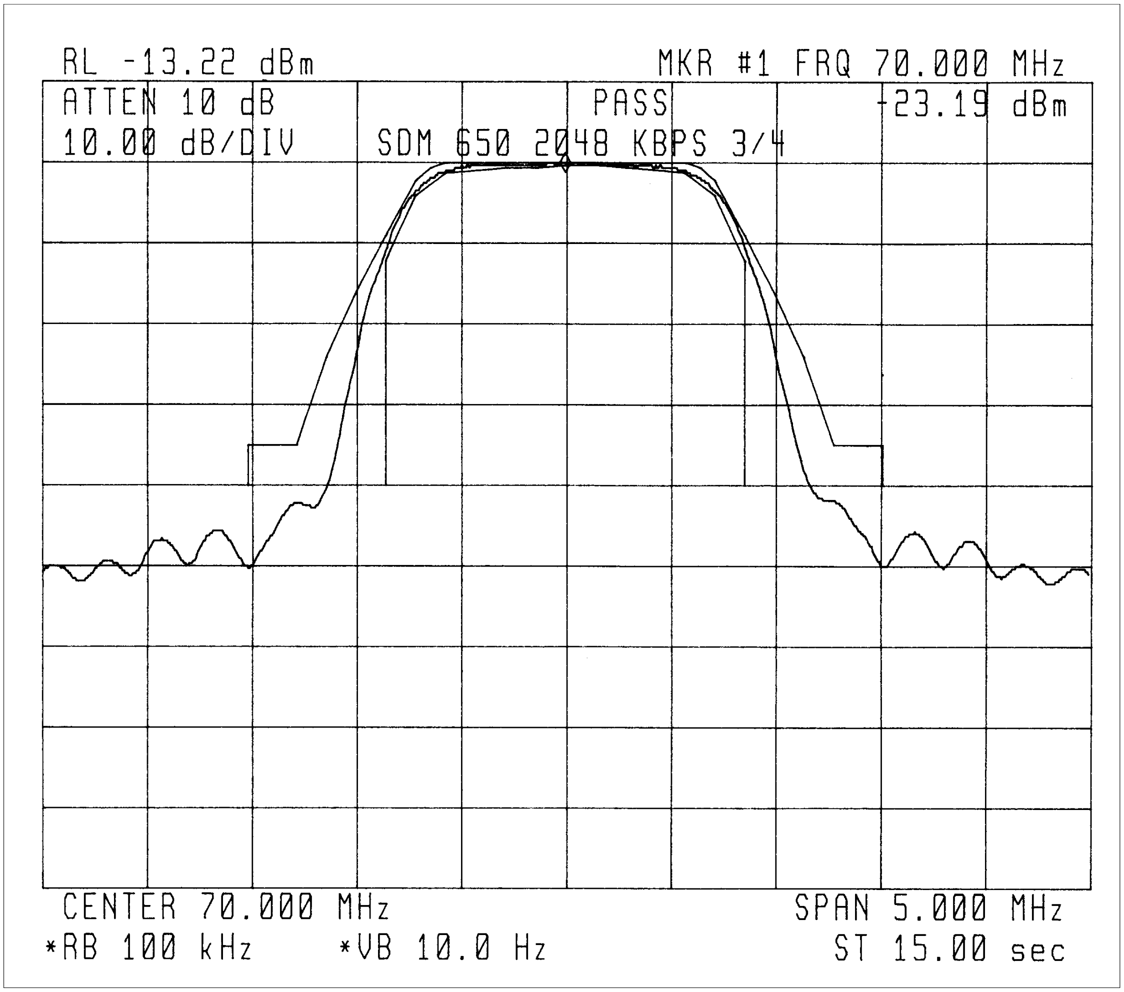

Figure 5-2. Modulator Output Spectral Occupancy

5.1.2 Theory of Operation

Data that is to be transmitted is input to the digital interface 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 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 passes across this interface, as well as module fault information from the modulator back to the M&C.

Faults reported include:

- Synthesizers out-of-lock
- AGC level
- Input data clock activity
- Digital I and Q channel fault

The data is delivered from the data interface to the differential encoder, and then to the scrambler. The differential encoder is a 2-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.

The differential encoder is programmable to ON or OFF.

The scrambler is designed according to CCITT V.35. The scrambler provides a pseudo-random characteristic to the data stream for dispersal of the transmitted energy, independent of the data pattern.

The scrambler is programmable ON or OFF.

The data then passes to the convolutional encoder. 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
- 1/2

For example, the rate of the encoder at 7/8 rate means 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. There are two identical Nyquist filters, one for the in-phase channel and one for the quadrature channel. Each filter is implemented as an FIR digital filter, and provides spectral shaping and equalization.

The I and Q filtered data is applied to the modulator, which converts the data 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 provides the proper frequencies to convert the modulator IF to the desired output frequency in the 50 to 90 MHz, or 100 to 180 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. The output amplifier takes the low level signal from the modulator and amplifies the signal to the proper level for output from the module.

The output amplifier contains circuitry which provides programmable control of the output level over a 25 dB range, in 0.5 dB steps. The output amplifier also provides power leveling to maintain the stability of the output level over time and temperature.

5.2 Sequential Decoder/Demodulator Processor

The modem sequential decoder/demodulator processor is a 10.25” x 14” card that fits in the middle-left slot of the modem chassis.

The card performs five separate functions:

- Contains the digital Costas processor which provides signals to the demodulator board for carrier recovery and Automatic Gain Control (AGC)
- Performs clock recovery of both the symbol clock and data clock
- Provides the FEC function utilizing a sequential decoder
- Provides differential decoding
- Provides V.35 descrambling

Refer to Figure 5-3 for a block diagram of the board. Refer to Section 5.2.2 for a detailed description of the module.

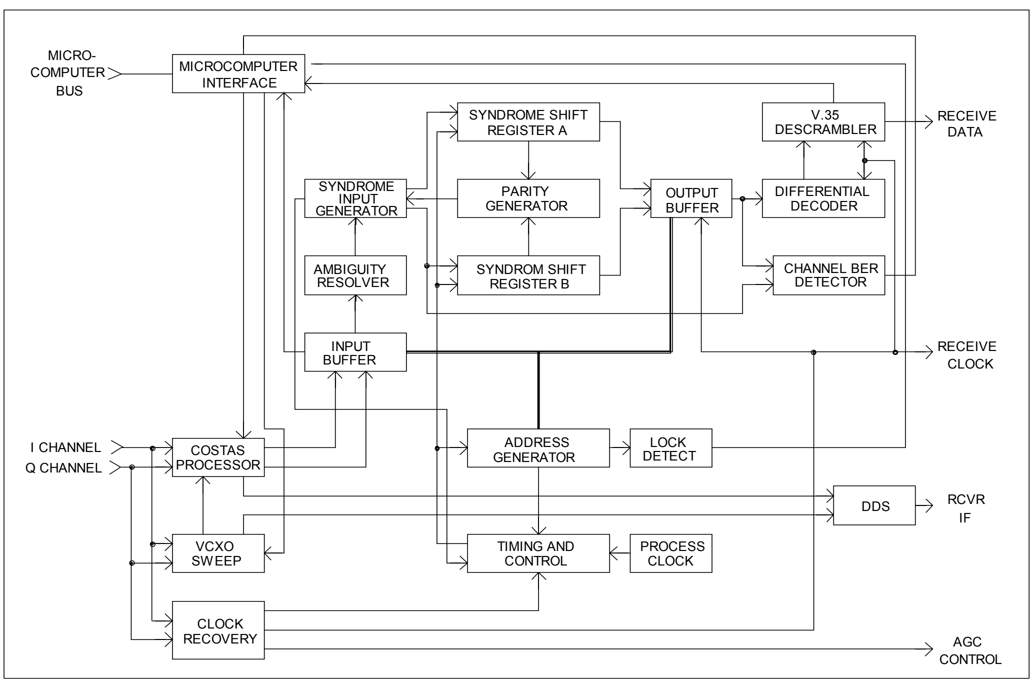

Figure 5-3. Decoder Block Diagram

5.2.1 Specification

Demodulator Processor	
Operating Symbol Rate Range	32 Ks/s to 2048 Ks/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-P max.

Sequential Decoder	
Bit Error Rate	See Chapter 1
Maximum Data Rate	2.1 Mbit/s (Rate 1/2) 3.2 Mbit/s (Rate 3/4 and 7/8)
Synchronization Time	19000 bits, max.
Output Fault Indicators	Activity detection of I and Q data Sign bits and descrambler data
Raw BER Detection	From 0 to 255 bits out of 1024 samples
Descrambling	V.35 or none
Differential Decoding	2 phase
I/O Connector	DIN, -96-pin

5.2.2 Theory of Operation

5.2.2.1 Demodulator Processor

The demodulator processor, in conjunction with the demodulator, reconstructs the digital data stream that was transmitted but corrupted by transmission channel impairments.

The demodulator 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. The other nine channels are used by the Costas calculator, and in generation of the 2-bit soft decision symbols required by the sequential 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. The clock loop 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 2-bit sign-magnitude form for use by the sequential decoder.

5.2.2.2 Sequential Decoder

The sequential decoder works in conjunction with the convolutional encoder at the transmitting modem to correct bit errors in the received data stream from the demodulator. The sequential decoder processes 2-bit quantized, I and Q channel data symbols from the demodulator. This data is assumed to be a representation of the data transmitted, corrupted by additive white Gaussian noise.

The decoder's task is to determine which bits have been corrupted by the transmission channel, and correct as many as possible. The means to do this is provided by the parity bits that the encoder adds to the input data stream prior to transmission.

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

The search proceeds from a node in the code tree by choosing the branch with the highest metric value. The highest metric value is determined by the highest probability of a match between the received data and a possible code sequence. The branch metrics are added to form the cumulative metric.

As long as the cumulative metric increases at each node, the decoder assumes it is on the correct path and continues forward.

If the decoder makes a wrong decision, the cumulative metric will decrease rapidly as the error propagates through the taps of the parity generator. In this case, the decoder tries to back up through the data to the last node where the metric was increasing, then take the other branch.

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

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

Data enters the input RAM of the decoder from the demodulator processor in 2-bit soft decision form for both I and Q channels, as shown in the block diagram (Figure 5-7).

The input RAM buffers the data to provide history for the backwards searches. Data from the RAM passes through the ambiguity corrector, which compensates for the potential 90° phase ambiguity of the demodulator.

The syndrome input generator converts the 2-bit soft decision data into a single bit per channel, and simultaneously corrects some isolated bit errors. The data is then shifted through the syndrome shift registers, which allows the parity generator to detect bit errors.

The resulting error signal provides the feedback to the timing and control circuitry to allow it to direct the data along the path of the highest cumulative metric. The corrected data is buffered through the output RAM and retiming circuit, which provides a data stream at the constant rate of the data clock to the differential decoder and descrambler.

The data and the clock are then output from the card.

The sequential decoder provides the following built-in-test functions:

- Activity detect on I and Q sign inputs
- Activity detect of descrambler data
- Raw BER detection

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

The raw BER count is made by comparing the input and output decoder data. The output data contains fewer errors than the input data.

Differences in the two data can be counted to yield the raw BER. The raw BER is sent to the M&C for further processing.

5.2.2.2.1 Sequential Decoder BER Performance Specifications

The guaranteed BER performance curves for the sequential decoder are shown in Figures 1-4 through 1-6. The specifications are based on 1/2, 3/4, and 7/8 rates at 100 and 1544 kbit/s.

The theoretical BER performance curves for the sequential decoder are shown in Figures 5-4 through 5-6. The specifications are based on 1/2, 3/4, and 7/8 rates at 56 and 1544 kbit/s.

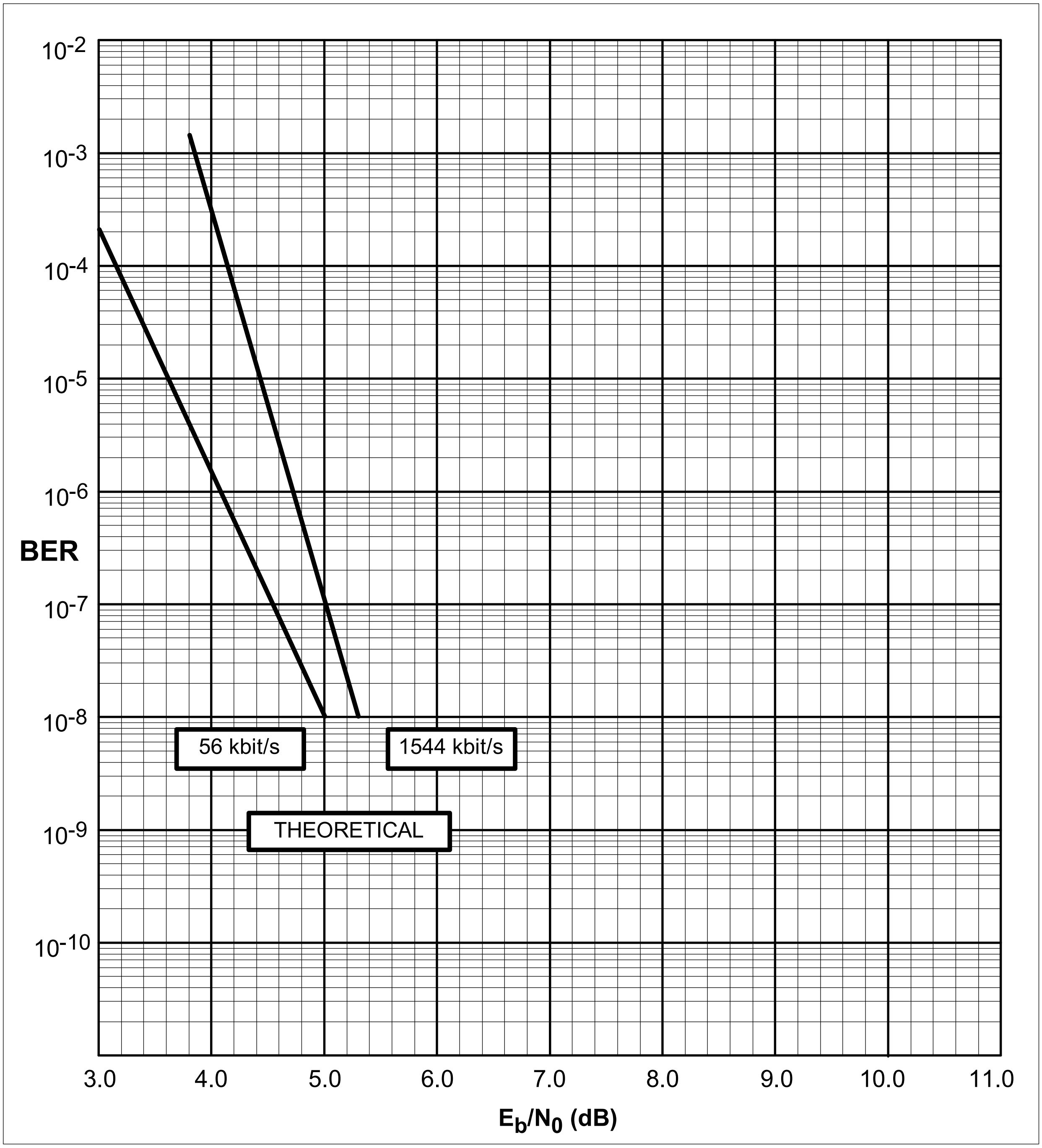

Figure 5-4. Sequential Decoder BER Performance Curves (1/2 Rate)

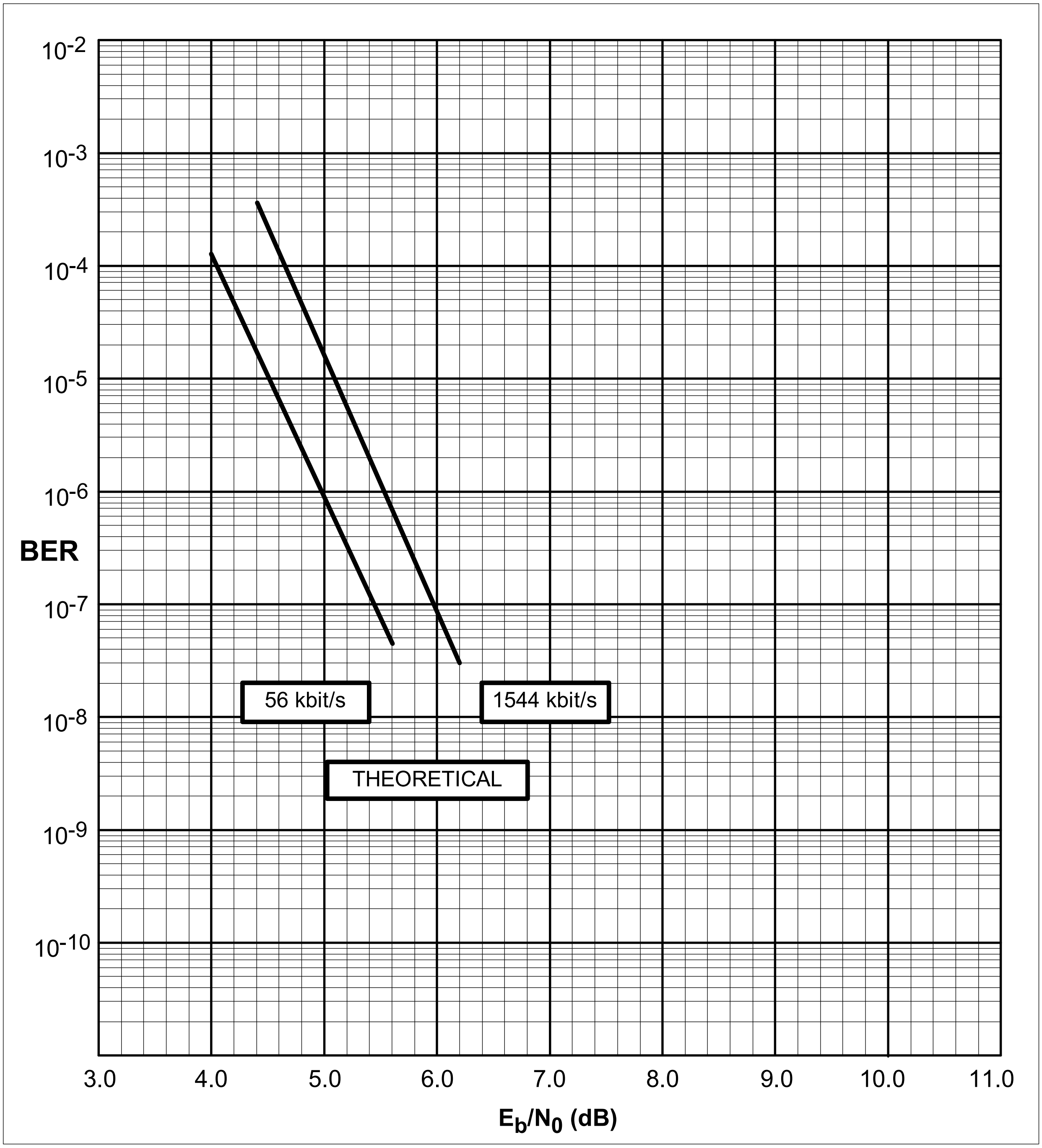

Figure 5-5. Sequential Decoder BER Performance Curves (3/4 Rate)

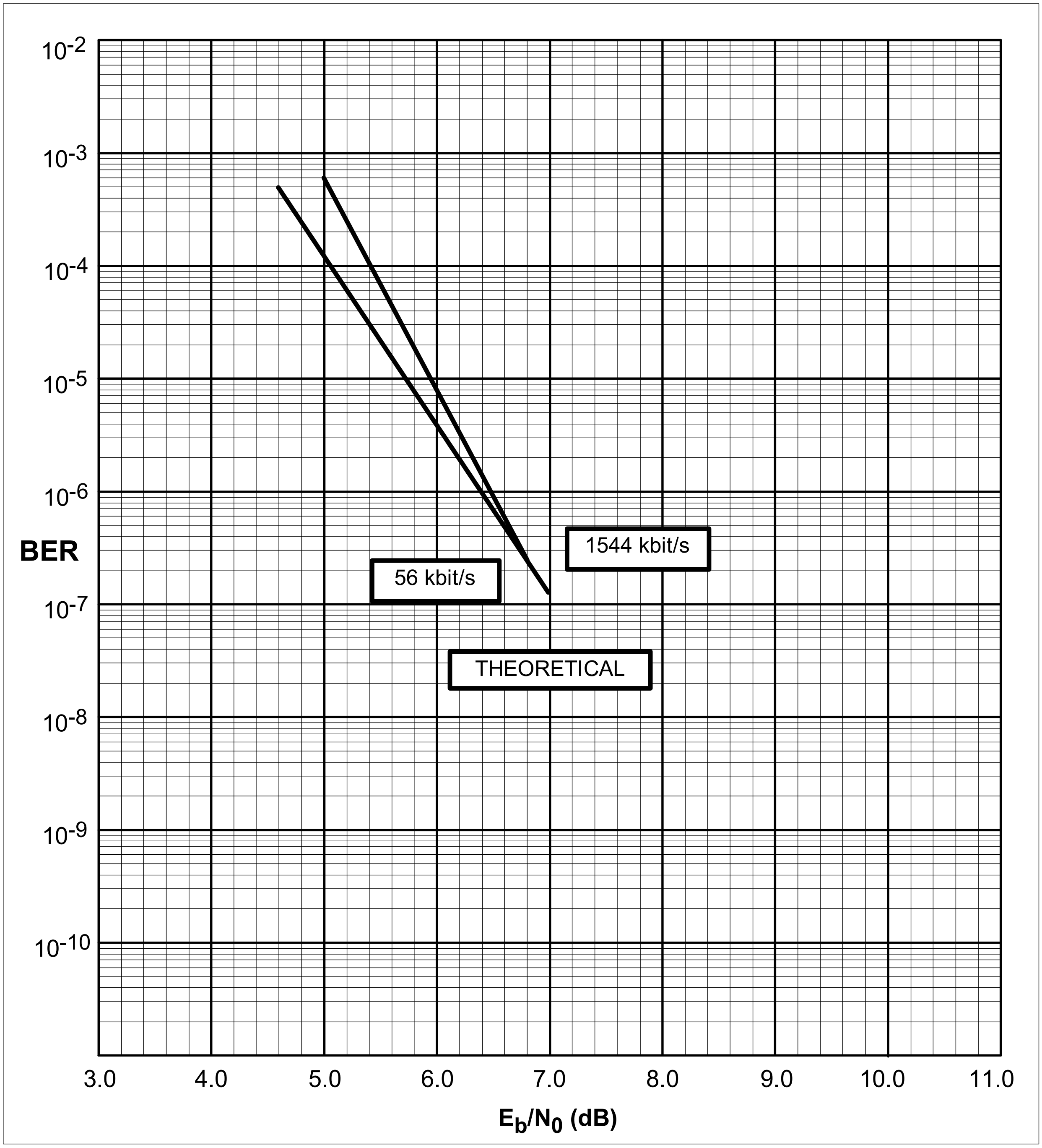

Figure 5-6. Sequential Decoder BER Performance Curves (7/8 Rate)

5.3 Demodulator

The modem demodulator card is a 10.25” x 14” card that fits in the lower-left slot of the modem chassis.

The demodulator’s function is to accept a desired QPSK or BPSK modulated signal in the 50 to 90 MHz, or 100 to 180 MHz range. The card converts the signal to filtered baseband in-phase and quadrature signals, which are then quantized and output from the card.

Several subsections make up the card:

- AGC amplifier
- Quadrature demodulator
- IF synthesizer
- Nyquist filter
- Baseband amplifier
- Soft decision interface

Refer to Figure 5-7 for a block diagram of the demodulator. Refer to Section 5.3.2 for a detailed description of the subsections.

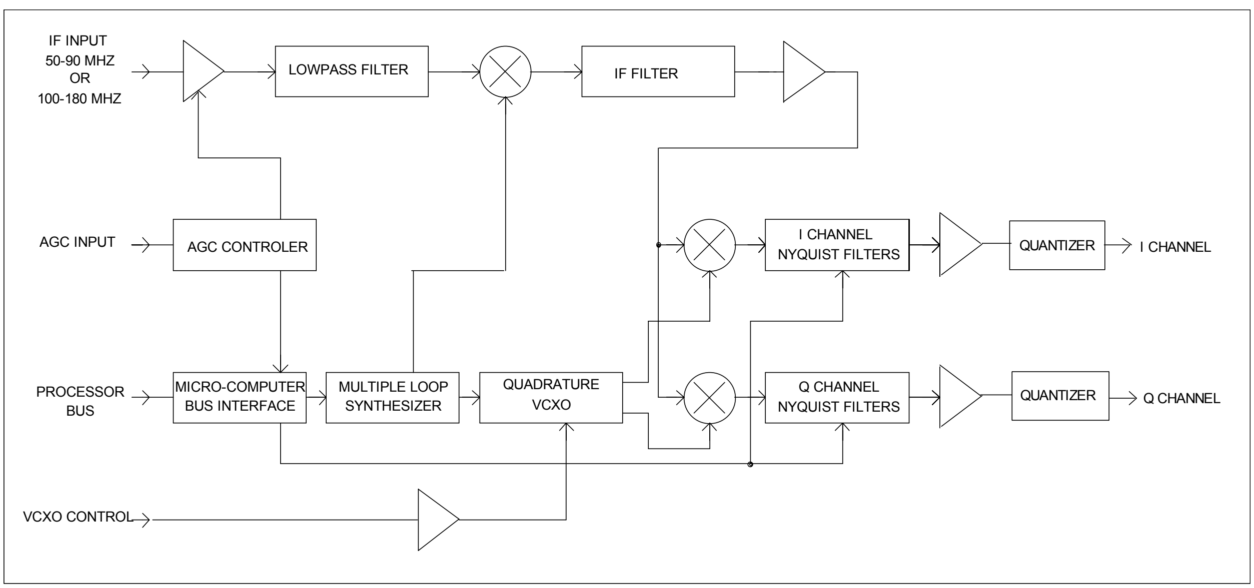

Figure 5-7. Demodulator Block Diagram

5.3.1 Specifications

Demodulation 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
Channel Spacing	0.7 times the data rate divided by the encoding rate
Input Level Desired Carrier	-55 to -30 dBm
Input Overload	0 dBm max
Input Impedance	75Ω (50Ω 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 Ks/s
I/O Connector	DIN, 96-pin

5.3.2 Theory of Operation

A Costas Loop on the decoder board is used for carrier recovery.

The demodulator board provides only the I and Q channel signals, and has a VCXO input.

The incoming modulated carrier enters the demodulator in the AGC amplifier, where the carrier is filtered and amplified. The AGC circuit, controlled from 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 carrier signal is converted to the fixed IF by the frequency synthesizer. 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. Using an in-phase and a quadrature carrier from a VCXO controlled externally, the quadrature demodulator produces the I and Q channel baseband signals.

The I and Q channel baseband signals are amplified and filtered in the Nyquist filters. 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. At this point, the signal looks like the classic “eye” pattern. The signal is then quantized in the soft decision interface and output to the card I/O connector.

5.4 Reacquisition, Fast Acquisition, and Directed Sweep

The fast acquisition algorithm has been permanently installed in the current version 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 kbit/s. There is no lower limit. Fast acquisition will work in conjunction with the sweep reacquisition function. 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.

5.4.1 Reacquisition

Normally the modem sweeps full range of ± 25 kHz during acquisition. The time it takes to complete one full sweep cycle depends upon the symbol rate of the demodulator as follows:

- If the demodulator symbol rate is less than or equal to 112 kbit/s, the sweep time is:

  Sweep Time (in Seconds) = 8400/SR (symbol rate in kbit/s)

- If the demodulator symbol rate is greater that 112 kbit/s but less than 257 kbit/s, the sweep time is:

  Sweep Time (in Seconds) = 4200/SR (symbol rate in kbit/s)

- If the demodulator symbol rate is greater than 256 kbit/s, the sweep time is:

  Sweep Time (in Seconds) = 2100/SR (symbol rate in kbit/s)

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 to 999 seconds), the modem will terminate the reacquisition mode and begin sweeping the full range of ± 25 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 reacquisition mode:

- The time specified for reacquisition must be multiples of 10% of the total nominal sweep time. This will ensure that the modem has time to sweep across the lock point at least once prior to termination of the reacquisition mode.
- Add a little to the reacquisition time to account for the anticipated outage.

Example: Demodulator operating at 64 kbit/s, an anticipated outage of 2 seconds. What should be the minimum reacquisition setting?

> Sweep time = 8400/64 = 132 second (round fractions up). 10% of the total sweep time is 13.2 seconds. Add 2 seconds to the minimum reacquisition 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 Config menu of the front panel. SWP_RACQ is the parameter used to set the minimum reacquisition time, as described above.

5.4.2 Fast Acquisition

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

5.4.3 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:

- Monitor function, SWP_FREQ, that detects the current sweep frequency.

- Three functions in the Config menu that are specifically for the directed sweep mode:

  - Sweep Center
  - Sweep Range
  - Sweep Direction

These functions will only be displayed in the front panel menu when the fast acquisition function has been turned ON in the Utility menu. Refer to Chapter 4 for further details of the directed sweep functions.

Chapter 6. MAINTENANCE

This chapter provides information on the following:

- System checkout
- Fault isolation
- Interface fault isolation
- Module replacement
- Module identification

6.1 System Checkout

This section should be used as an aid in setting up a modem within an earth station.

6.1.1 Modulator

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 to help find 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 (refer to Chapter 4). 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
- Gives access to the test modes for system checkout

Available test modes are:

- RF loopback
- Baseband loopback
- CW

After the output frequency and level are set, the output is ready to be turned ON.

6.1.2 Demodulator

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 the proper E_b/N_0 level.

Refer to Figure 6-2 for an example of a 1/2 rate carrier operating at an E_b/N_0 of 9.5 dB. The (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 of Table 6-1. Read across the page to find the S/N and E_b/N_0 for the specific code rate.

Once the demodulator has locked to the incoming signal, the Monitor menu will display:

- Signal level
- Raw BER
- Corrected BER
- E_b/N_0

These functions are not displayed until the demodulator is locked to a carrier.

Refer to Figure 6-3 for a typical eye pattern with noise, and Figure 6-4 for a typical eye pattern without noise.

Refer to Figure 6-5 for a typical eye constellation with noise, and Figure 6-6 for a typical eye constellation without noise.

If the demodulator does not lock up, refer to the fault isolation in Section 6.2.2 to help find the problem.

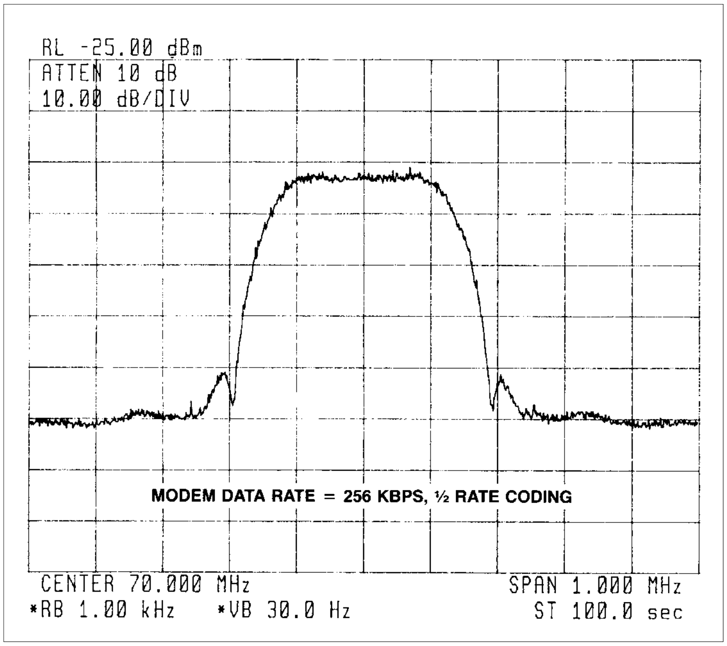

Figure 6-1. Typical Output Spectrum

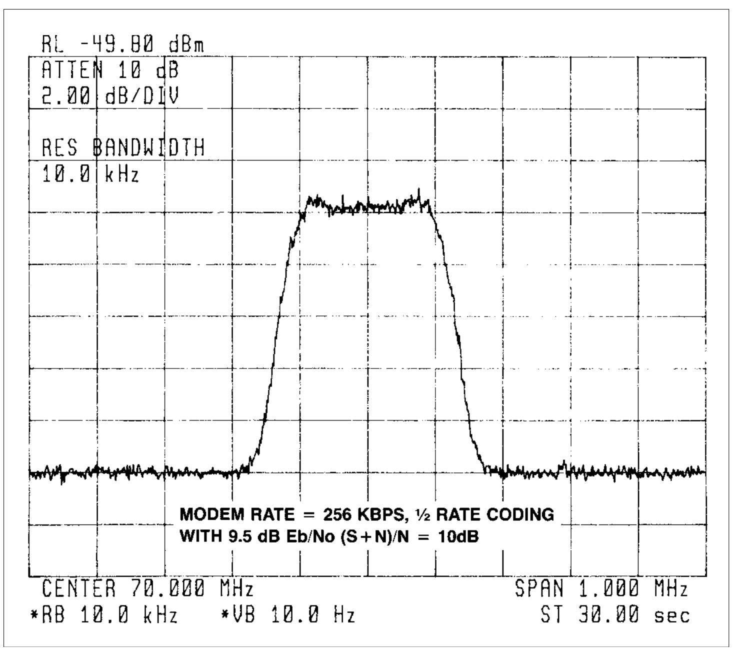

Figure 6-2. Typical Output Spectrum

Table 6-1. EFData Conversion of (S+N)/N to S/N and E_b/N_0 for Various Code Rates

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

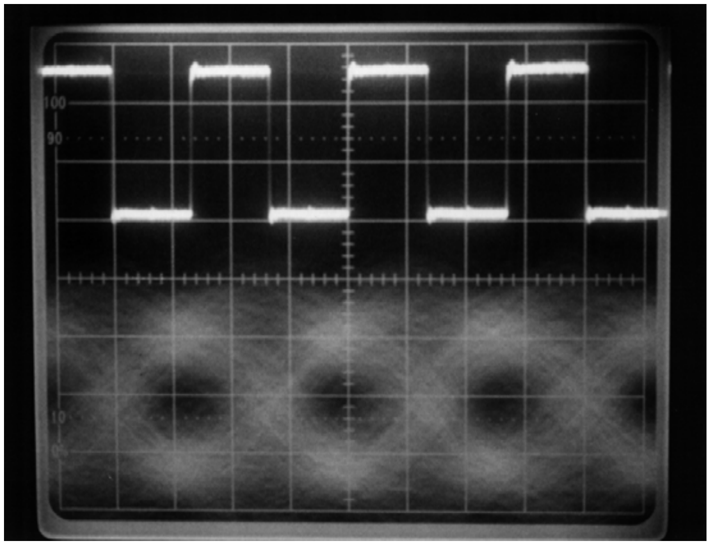

Figure 6-3. Typical Eye Pattern with Noise
(Approximately 7.5 dB E_b/N_0)

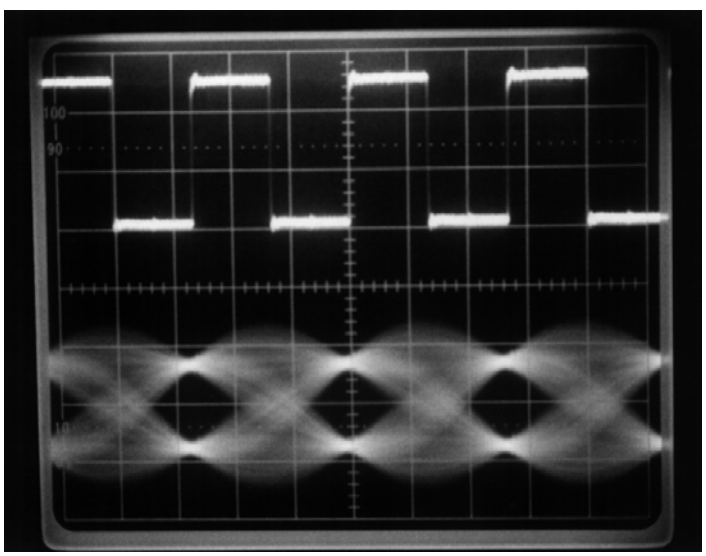

Figure 6-4. Typical Eye Pattern without Noise

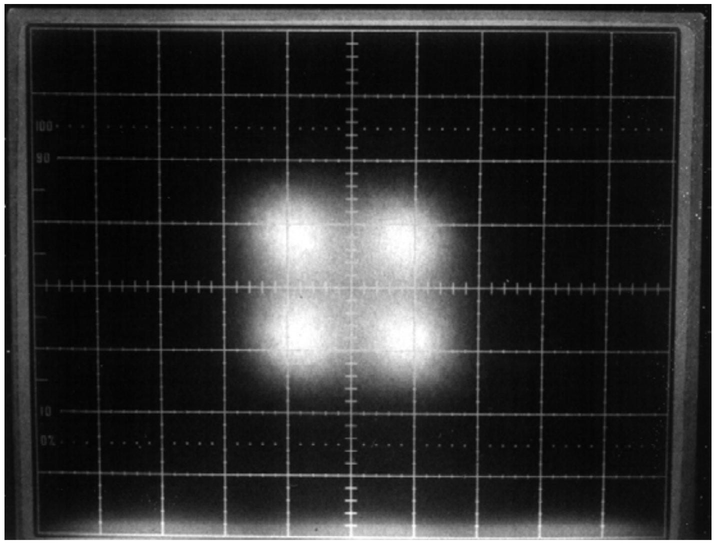

Figure 6-5. Typical Eye Constellation with Noise (Approximately 7.5 dB E_b/N_0)

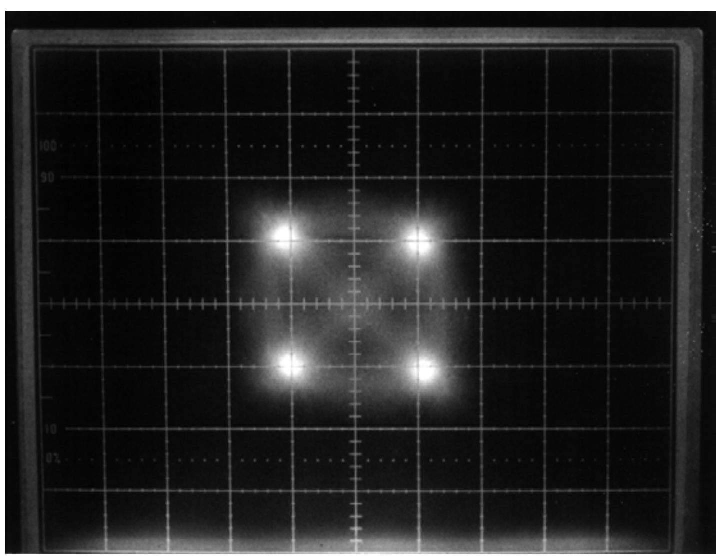

Figure 6-6. Typical Eye Constellation without Noise

6.1.3 Test Points

The following sections detail front panel test points, with a description of the signal that is to be present under normal operation.

6.1.3.1 Modulator

Refer to Figure 6-7.

TPG1	Ground.
TP2	Q EYE Pattern. Level is 2 Vp-p. The DC offset is 0V. 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 Vp-p. The DC offset is 0V. 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 Vp-p between eye sample points.
TPG2	Ground.
TP6	I — Analog Data Eye Pattern. Approximately 1.4 Vp-p between eye sample points.
TP17	I Channel Data. TL 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.

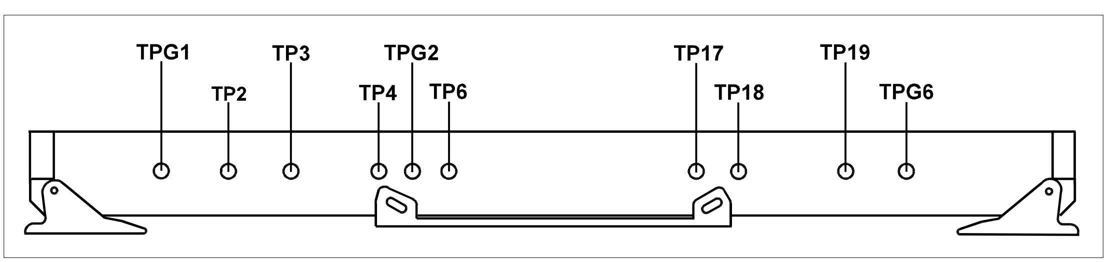

Figure 6-7. Modulator Test Points

6.1.3.2 Demodulator

Refer to Figure 6-8.

TP10	VCXO Control Voltage. Approximately 0 to +2.5V sweep range.
TP23	Discriminator Voltage. Nominally +2.5V with 6 dB noise at 128 kbit/s.
TPG1	Ground.
TP1	Q EYE Pattern. Level is 1 Vp-p at the center of the eye crossing. The DC offset is about +2.4V.
TP2	Q THRS — Q channel threshold voltage, +2.9 VDC.
TP3	I THRS — I channel threshold voltage, +2.9 VDC.
TP4	I EYE Pattern. Level is 1 Vp-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 +3 VDC.
TP6	Q CLK THRS -. Q channel - clock threshold, +2 to +3 VDC.
TP7	I CLK THRS -. I channel + clock threshold, +2 to +3 VDC.
TP8	I CLK THRS +. I channel — clock threshold. +2 to +3 VDC.

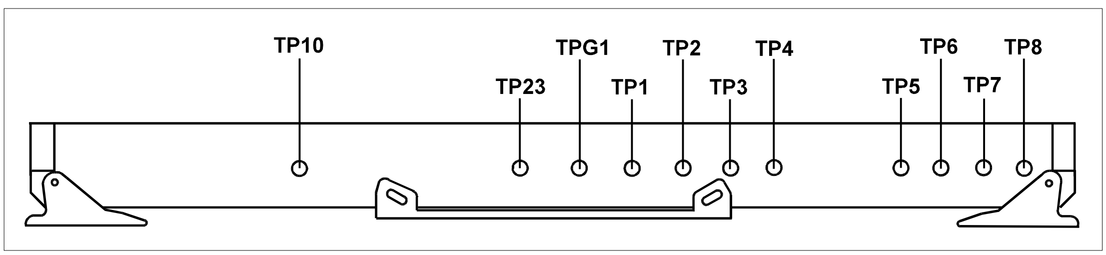

Figure 6-8. Demodulator Test Points

6.1.3.3 Sequential Decoder/Demod Card

Refer to Figure 6-9.

TPG1	Ground.
TP8	VCXO Control Voltage. Sweeps from -2.5V to +2.5 VDC.
TP1	IMAG — I Channel Magnitude Bit. Result of the soft bits from the soft decision interface. Transitions will occur in the presence of noise in the RF signal.
TP2	QSGN — Q Channel Sign Bit. Result of the hard bits from the soft decision interface. 50% duty cycle random data is displayed.
TP3	ISGN — I Channel Sign Bit. Result of the hard bits from the soft decision interface. 50% duty cycle random data is displayed.
TP4	QMAG — Q Channel Magnitude Bit. Result of the soft bits from the soft decision interface. Transitions will occur in the presence of noise in the RF signal.
TP5	SYMBOL CLOCK. Result of the data clock recovery loop in the demod processor section.
TP9	DECODER LOCK. TTL levels. TTL high indicates a locked condition. A TTL low indicates an unlocked condition.
TPG2	Ground.

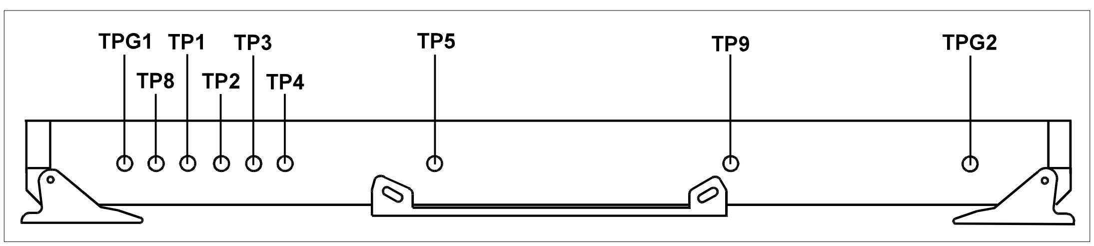

Figure 6-9. Sequential Decoder/Demod Card Test Points

6.2 Fault Isolation

System faults are reported in the Faults menu. Stored faults are reported in the StFaults menu. Refer to Chapter 4 for more information.

The following sections list the system faults outlined in Chapter 4. Use the following information to isolate a problem, and help in deciding the appropriate action to be taken.

6.2.1 Modulator Faults (Mod_Flts Menu)

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 matches what has been selected in the modem. Refer to Table 6-2 for available data rates for the modem. Refer to *INTELSAT document IESS-308* for available data rates for the SDM-308B. Refer to *INTELSAT document IESS-309* for data rates for the SDM-309B. In the modem and SDM-308B, the data rate must reflect any overhead bit that are added. In the SDM-309B, the internal reference is changed to account for the IBS overhead of 16/15. Example for the modem: 1544 kbit/s with 16 kbit/s overhead channel would be programmed to operate at 1568 kbit/s (1544K + 16K + 8K for framing). A standard modem, or a SDM-308B operating at rev. 2, would be programmed to the input data rate. An SDM-308B operating at rev. 3 would be programmed to reflect the 96 kbit/s of overhead. A 1544 kbit/s rev. 3 IDR is programmed to 1640 kbit/s. An SDM-309B 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 100 PPM. 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. 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.
AGC-LEVL	Output power level fault. Typically 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. Typically 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 M&C card, or in the interface between the modulator and M&C card. Return the defective card for repair.

6.2.2 Demodulator/Decoder Faults (Dmd_Flts Menu)

Fault	Possible Problem and Action
C_DETECT	Typically 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 that the demodulator has an RF input at the proper frequency and power level. Check that the demodulator data rate is properly programmed. Refer to the fault isolation procedure for TCLK_SYN in Section 6.2.1. Verify the frequency of the data transmitted from the modulator is within 100 PPM. Look at the test points on the demodulator and decoder for the eye pattern, data, and clock per Sections 6.1.3.2 and 6.1.3.3 to verify proper levels, activity, and phase.
RF_SYN	Demodulator synthesizer is faulted. Return the demodulator for repair.
DATA_CLK	Typically 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 in the decoder Costas processor. Replace either the demodulator card or the decoder card to isolate the fault. Return the failed card for repair.
Q-CHANNL	Indicates a loss of activity in the Q 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 in the decoder Costas processor. Replace either the demodulator card or the decoder card to isolate the fault. Return the failed card for repair.
DSCRAMBL	Indicates loss of activity in the descrambler. Typically indicates a loss of decoder program. Could indicate a problem in the M&C card, or a problem in the communication between the M&C and decoder.
BERTHRSH	Indication that the preset BER threshold has been exceeded. Setting of this alarm is done in the Utility menu. This alarm is a function of 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 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 (CEq_Flts Menu)

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	-12V power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the -12V line on the motherboard, or a short on the -12V line of any of the plug-in boards. To gain access to the rear of the motherboard, remove the rear panel cover. Refer to Figure 6-10 for location of the -12V on the motherboard. Return the faulty plug-in board or replace the chassis power supply.
+12 Volt	+12V power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the +12V line on the motherboard, or a short on the +12V line of any of the plug-in boards. To gain access to the rear side of the motherboard, remove the rear panel cover. Refer to Figure 6-10 for location of the +12V on the motherboard. Return the faulty plug-in board or replace the chassis power supply.
+5V Volt	+5V power supply fault. Use the same procedure as with -12V fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the +5V line on the motherboard, or a short on the +5V line of any of the plug-in boards. To gain access to the rear of the motherboard, remove the rear panel cover. Refer to Figure 6-10 for location of the +5V on the motherboard. Return the faulty plug-in board or replace the chassis power supply. The +5V supply requires a minimum load of 1A. This is accomplished with the M&C card and one other card being plugged into the chassis.
TXC-LOSS	This is an indicator for reporting the loss of incoming DS1 data. This alarm is active only when the DS1 interface is installed.
CONTROLR	Controller fault. Indicates a loss of power in the M&C card. This fault is shown only in the StFaults 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 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 (refer to Chapter 4).

The following sections list the interface faults. All other faults are discussed in Section 6.2.

6.3.1 Transmit Faults (TX_INTF)

The faults listed below are only displayed when the ASYNC overhead channel unit is installed.

Fault	Possible Problem and Action
TX_PLL	Indicates a loss of lock on the reference of the interface transmit clock recovery oscillator. Return the interface card 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 Faults (RX_INTF)

The faults listed below are only displayed when the ASYNC overhead channel unit is installed.

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 troubleshooting. The interval between stored overflow/underflow events can be used to determine the accuracy of the relative clock.
BUF_OVFL	Buffer Overflow. The plesiochronous buffer has overflowed. As buffer overflow is normally a momentary fault, there will be 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 troubleshooting. The interval between stored overflow/underflow events can be used to determine the accuracy of the relative clock.
RX_PLL	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 1s) 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 Variable Rate SDM-650B Modem

			19.2	19.4	19.5	19.6	19.8	20.0	20.2
20.4	20.5	20.6	20.8	21.0	21.2	21.4	21.5	21.6	21.8
22.0	22.2	22.4	22.5	22.6	22.8	23.0	23.2	23.4	23.5
23.6	23.8	24.0	24.2	24.4	24.5	24.6	24.8	25.0	25.2
25.4	25.5	25.6	25.8	26.0	26.2	26.4	26.5	26.6	26.7
26.8	26.9	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7
27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7
28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7
29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7
30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7
31.8	31.9	32.0	32.1	32.2	32.3	32.4	32.5	32.6	32.7
32.8	32.9	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7
33.8	33.9	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7
34.8	34.9	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7
35.8	35.9	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.7
36.8	36.9	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7
37.8	37.9	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7
38.8	38.9	39.0	39.1	39.2	39.3	39.4	39.5	39.6	39.7
39.8	39.9	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.7
40.8	40.9	41.0	41.1	41.2	41.3	41.4	41.5	41.6	41.7
41.8	41.9	42.0	42.1	42.2	42.3	42.4	42.5	42.6	42.7
42.8	42.9	43.0	43.1	43.2	43.3	43.4	43.5	43.6	43.7
43.8	43.9	44.0	44.1	44.2	44.3	44.4	44.5	44.6	44.7
44.8	44.9	45.0	45.1	45.2	45.3	45.4	45.5	45.6	45.7
45.8	45.9	46.0	46.1	46.2	46.3	46.4	46.5	46.6	46.7
46.8	46.9	47.0	47.1	47.2	47.3	47.4	47.5	47.6	47.7
47.8	47.9	48.0	48.1	48.2	48.3	48.4	48.5	48.6	48.7
48.8	48.9	49.0	49.1	49.2	49.3	49.4	49.5	49.6	49.7
49.8	49.9	50.0	50.1	50.2	50.3	50.4	50.5	50.6	50.7
50.8	50.9	51.0	51.1	51.5	52.0	52.5	53.0	53.5	54.0
54.5	55.0	55.5	56.0	56.5	57.0	57.5	58.0	58.5	59.0
59.5	60.0	60.5	61.0	61.5	62.0	62.5	63.0	63.5	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	2056.0
2064.0	2072.0	2080.0	2088.0	2096.0	2104.0	2112.0	2120.0	2128.0	2136.0
2144.0	2152.0	2160.0	2168.0	2176.0	2184.0	2192.0	2200.0	2208.0	2216.0
2224.0	2232.0	2240.0	2248.0	2256.0	2264.0	2272.0	2280.0	2288.0	2296.0
2304.0	2312.0	2320.0	2328.0	2336.0	2344.0	2352.0	2360.0	2368.0	2376.0

2384.0	2392.0	2400.0	2408.0	2416.0	2424.0	2432.0	2440.0	2448.0	2456.0
2464.0	2472.0	2480.0	2488.0	2496.0	2504.0	2512.0	2520.0	2528.0	2536.0
2544.0	2552.0	2560.0	2568.0	2576.0	2584.0	2592.0	2600.0	2608.0	2616.0
2624.0	2632.0	2640.0	2648.0	2656.0	2664.0	2672.0	2680.0	2688.0	2696.0
2704.0	2712.0	2720.0	2728.0	2736.0	2744.0	2752.0	2760.0	2768.0	2776.0
2784.0	2792.0	2800.0	2808.0	2816.0	2824.0	2832.0	2840.0	2848.0	2856.0
2864.0	2872.0	2880.0	2888.0	2896.0	2904.0	2912.0	2920.0	2928.0	2936.0
2944.0	2952.0	2960.0	2968.0	2976.0	2984.0	2992.0	3000.0	3008.0	3016.0
3024.0	3032.0	3040.0	3048.0	3056.0	3064.0	3072.0	3080.0	3088.0	3096.0
3104.0	3112.0	3120.0	3128.0	3136.0	3144.0	3152.0	3160.0	3168.0	3176.0
3184.0	3192.0	3200.0	3208.0	3216.0	3224.0	3232.0	3240.0	3248.0	3256.0
3264.0	3272.0	3280.0	3288.0	3296.0	3304.0	3312.0	3320.0	3328.0	3336.0
3344.0	3352.0	3360.0	3368.0	3376.0	3384.0	3392.0	3400.0	3408.0	3416.0
3424.0	3432.0	3440.0	3448.0	3456.0	3464.0	3472.0	3480.0	3488.0	3496.0
3504.0	3512.0	3520.0	3528.0	3536.0	3544.0	3552.0	3560.0	3568.0	3576.0
3584.0									

Notes:

1. Rates below 48 kbit/s are BPSK only.
2. Rates above 2.048 Mbit/s available in single rate modem only.
3. Maximum 1/2 rate is 2048 kbit/s.
4. Maximum 3/4 rate is 3072 kbit/s.
5. Maximum 7/8 rate is 3584 kbit/s.

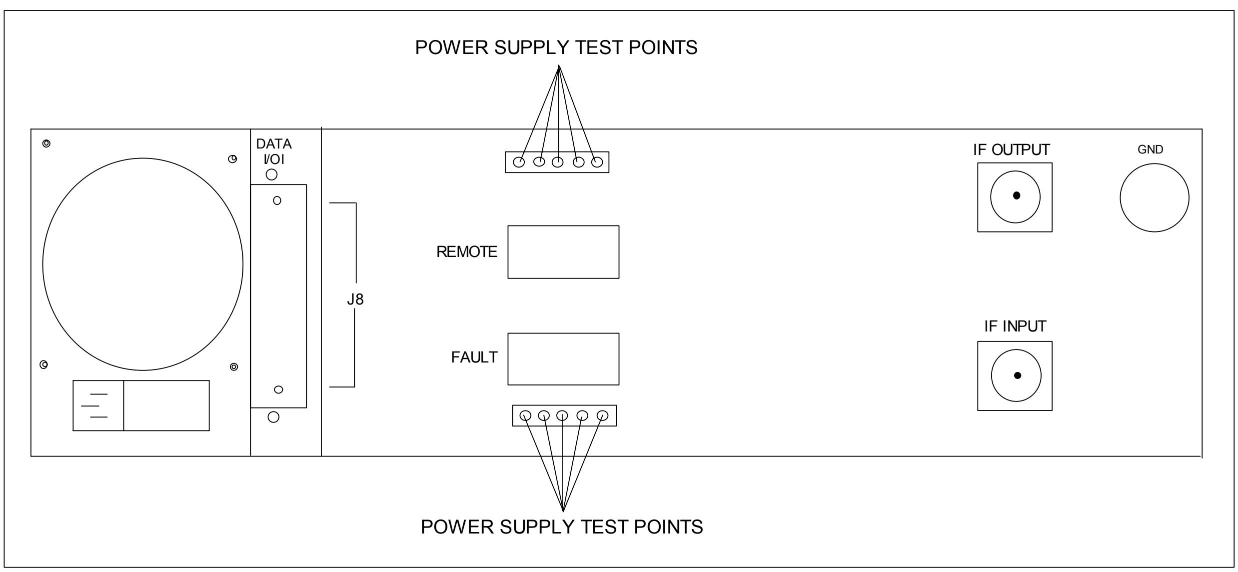

Figure 6-10. Rear View Without Cover

6.4 Module Replacement

The modem cards are plug-in cards that can be replaced by removing the defective card, and reinserting the replacement. Card ejectors are available for use in removing the cards.

Note: On the interface card, there are additional screws on the rear panel that need to be removed before the interface card is removed. These screws must be reinstalled after the replacement card is inserted.

The power supply in the modem is attached to the modem chassis. For repair of the power supply module, it is recommended that all plug-in cards be removed, and the chassis (with the power supply installed) be sent back to the factory for repair.

For instructions on changing data rate cards or software upgrades, refer to Appendix A.

6.5 Module Identification

The modem cards each have an assembly number marked on the board. The latest revision and serial number are stamped on the board. EFData tracks hardware by 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 ensure 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 modem.

Table 6-3. EFData Part Numbers for SDM-650B Modules

Modulators Base Part Number — AS/0773	
Dash #	**Description**
1	SDM-650B, EFData Filtering
3	SDM-650F, FDC Comp Filtering
5	SDM-650B, STM Filtering
9	SDM-650F, FDC Filtering, with $1X10^{-7}$ Reference
12	SDM-650F, FDC Filtering, Aydin Data Rate Crystal
14	SDM-650B, EFData Filtering, 50Ω Output
Demodulators Base Part Number — AS/0778	
Dash #	**Description**
1	SDM-650B, 70/140 MHz, 75Ω
6	SDM-650B, 70/140 MHz, 50Ω
Decoders Base Part Number — AS/0365	
Dash #	**Description**
1	SDM-650B (Std, F, C), 70/140 MHz (with GND rails)
2	SDM-650B (Std, F, C), 70 MHz (without GND rails)
3	SDM-650B w/ASYNC Interface (offset crystal)
4	SDM-650F, Aydin Data Rate Crystal
Interface and Filter Cards	
Part #	**Description**
AS/0627-2	V.35 Interface
AS/0627-3	RS-422/RS-449, and MIL-STD-188-114
AS/0627-8	RS-232 Interface
AS/0569	DS1 Interface
AS/0679	G.703 Balanced Interface
AS/1289-1	Asynchronous Overhead Channel Unit without AUPC (RS-422, and MIL-STD-188-114)
AS/1289-2	V.35 Asynchronous Overhead Channel Unit without AUPC
AS/1289-3	G.703 Asynchronous Overhead Channel Unit without AUPC
AS/0930-1	Modulator Daughter Filter Card (Variable Rate)
AS/0715-X *(See note)*	Modulator Daughter Filter Card (Fixed Rate)
AS/0929-1	Demodulator Daughter Filter Card (Variable Rate)
AS/0929-3	Fairchild Compatible Demod Daughter Filter Card
AS/0362-X *(See note)*	Demodulator Daughter Filter Card (Fixed Rate)
AS/0698-X *(See note)*	Demodulator Daughter Filter Card (Fixed Rate)

Note: X = 1 to 4, the number of filters installed on a fixed rate filter card.

Appendix A. DATA RATES AND FILTERS

The modem will operate at data rates from 19.2 kbit/s to 3.584 Mbit/s. Data rates from 19.2 to 48 kbit/s are 1/2 rate BPSK only.

Variable rate filters can operate from 19.2 to 2048 kbit/s. Fixed rate filters allow operation from 19.2 to 3584 kbit/s.

This appendix covers:

- Data rate change instructions for fixed rate and variable rate filters
- Differences between a fixed rate filter and a variable rate filter
- Modem configuration for each filter type

A.1 Fixed Rate Filters

A.1.1 Data Rate Change Instructions

1. Turn OFF modem power switch.

2. Remove the modulator card (AS/0773) by using the black card ejectors.

3. Remove the two screws securing the daughter card (AS/0715) with a Phillips screwdriver. See Figure A-1 for location of the hardware.

4. Remove the daughter card from the modulator.

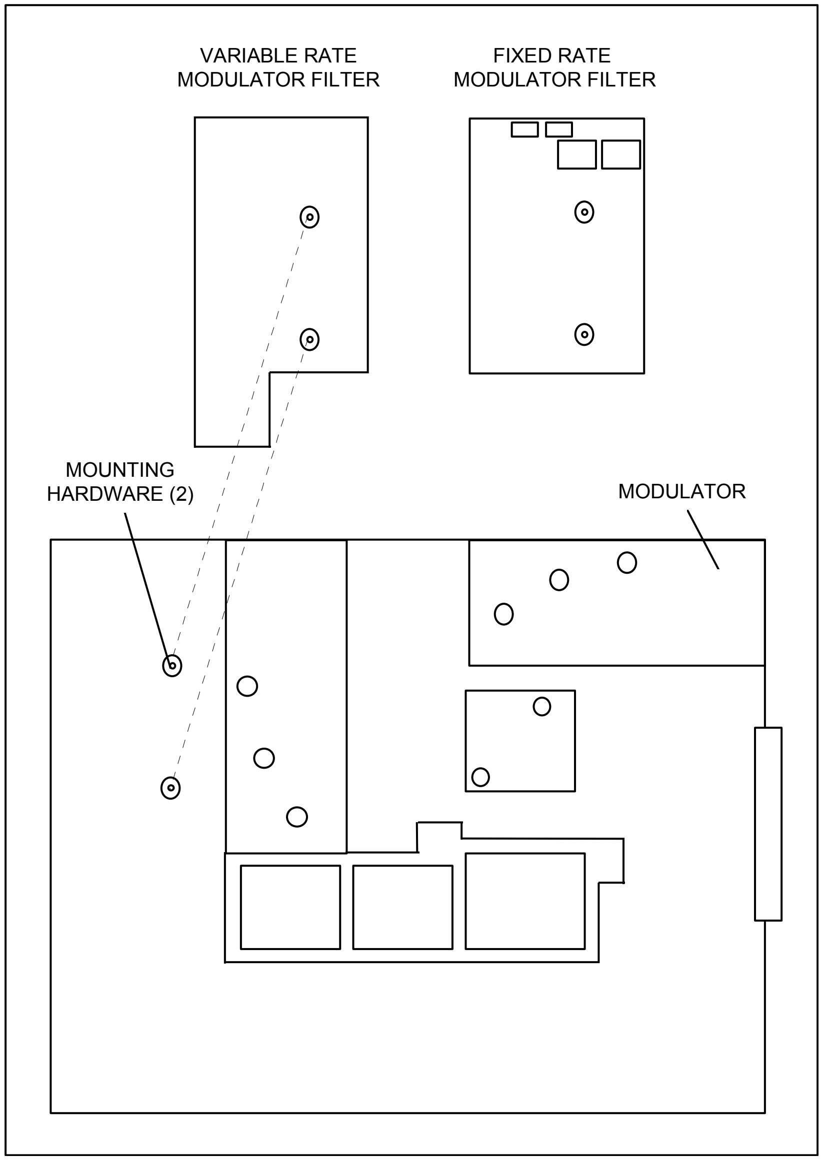

Figure A-1. Modulator Filter Card Change

5. Install the replacement daughter card, and ensure both screw holes line up with the mounting hardware. See Figure A-1.

CAUTION

If the filter is installed in the wrong position, the daughter card will be damaged.

6. Re-install the daughter board hold-down screws (Figure A-1). Re-insert the modulator into the chassis.

7. Remove the demodulator card (AS/0778) using the white card ejectors.

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

9. Remove the daughter card (AS/0362) from the demodulator.

10. Install the replacement daughter card (AS/0362) so that:

    a. J1 on the daughter card lines up with J2 on the demodulator card.
    b. J2 on the daughter card lines up with J3 on the demodulator card.
    c. All four hold-down screws line up.

    See Figure A-2.

    CAUTION

    If the filter is installed in the wrong position, the daughter card will be damaged.

11. Re-install the daughter board hold-down screws (Figure A-2), and re-insert the demodulator into the modem chassis.

12. Remove the M&C board, and remove JP6 (battery ON/OFF). Short the leads of capacitor C12. Replace the battery jumper to the ON position, and re-insert 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, 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 associated symbol rate. Example: The label for a 64 kbit/s, 7/8 rate, QPSK filter is 36.57.

15. Go to the Config menu on the front panel and select the desired TX and RX rate. Turn ON the RF output.

    The hardware change is complete.

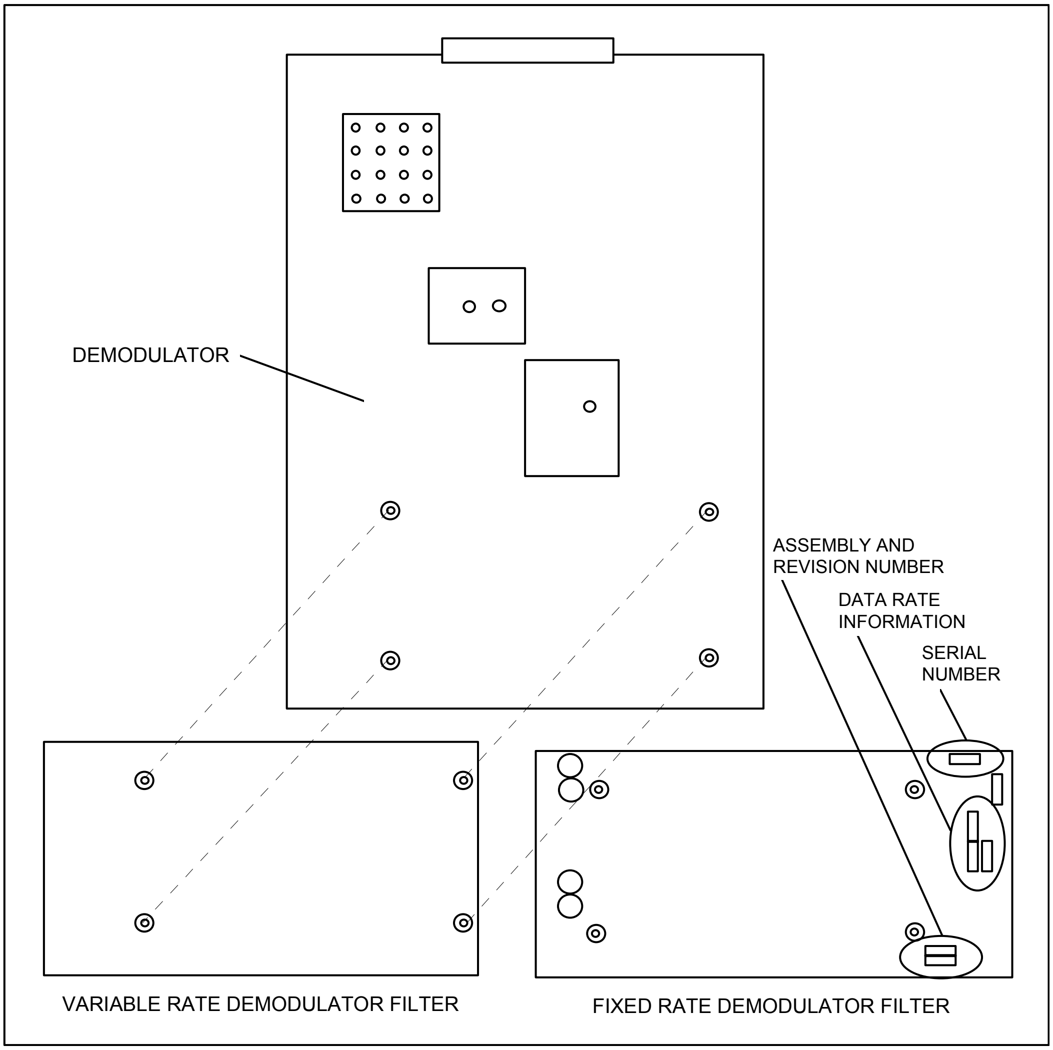

Figure A-2. Demodulator Filter Card Change

A.1.2 Hardware Configuration

This section lists the hardware configuration of a standard modem with a fixed rate filter installed.

Hardware Requirements	
Assembly #	**Description**
AS/1099-X REV-	Modem Chassis X = 1 — SDM-650B Chassis
AS/0356 Rev. F or higher	Monitor and Control M&C Software Requirements SDM-650B Ver. 2.66 or higher
AS/0773-X -	Modulator X = 1 — SDM-650B X = 3 — SDM-650F
AS/0715-X -	Modulator Daughter X = 1 — Fixed Rate Closed Network
AS/0778-X -	Demodulator X = 1 — SDM-70/140 MHz 75Ω X = 6 — SDM-70/140 MHz 50Ω
AS/0362-X -	Demodulator Daughter X = 1 — Single Rate Filter Closed Network X = 2 — Two Rate Filter Closed Network X = 3 — Three Rate Filter Closed Network X = 4 — Four Rate Filter Closed Network
AS/0365-X -	Sequential Decoder Option X = 1 — Sequential Decoder with Rail

A.2 Variable Rate Filters

A.2.1 Data Rate Change Instructions

1. Turn OFF modem power switch.

2. Remove the modulator card (AS/0773) using the black card ejectors. Verify the daughter card is a variable rate filter (AS/0930). If not, refer to Section A.1.

3. Re-install the modulator card into the modem chassis.

4. Remove the demodulator card (AS/0778) using white card ejectors. Verify the daughter card is a variable rate filter (AS/0929). Re-install the demodulator card into the modem chassis.

5. Remove the M&C board and JP6 (battery ON/OFF). Short the leads of capacitor C12. Replace the battery jumper to the ON position, and re-insert the M&C card into the modem.

6. Turn ON the power switch.

7. 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.

8. Go to the Config menu on the front panel, and select either the desired TX and RX rate, or TXV and RXV. Enter the desired data/code rates into the menu and press [ENTER]. Only data rates up to and including 2048 kbit/s with a variable rate filter can be selected. Refer to Table 6-2 for a list of the programmable data rates of the variable rate filters. Enter the Config menu, and turn ON the RF output.

   The software change is complete.

A.2.2 Hardware Configuration

This section lists the differences between a standard modem and a modem with the variable rate filter installed.

A variable rate modem is end-to-end compatible with a non-variable rate modem of the same model number. In most cases, the modem can be used as a prime or backup modem in the same protection switch with a non-variable rate modem. In order for the existing switch to operate with a variable rate modem, a software upgrade to the switch and non-variable rate modems may be required. Contact the EFData Customer Support Department for any questions regarding this matter.

Hardware Requirements	
Assembly #	**Description**
AS/1099-X Rev. -	Modem Chassis X = 1 — SDM-650B Chassis
AS/0356 Rev. F or higher	Monitor and Control M&C Software Requirements SDM-650B Ver. 2.66 or higher
AS/0773-X -	Modulator X = 1 — SDM-650B X = 3 — SDM-650F
AS/0929-X -	Modulator Daughter X = 1 — Variable Rate Closed Network EFData Filtering X = 3 — Variable Rate Closed Network Fairchild Compatible
AS/0778-X -	Demodulator X = 1 — SDM-70/140 MHz 75Ω X = 6 — SDM-70/140 MHz 50Ω
AS/0930-X -	Demodulator Daughter X = 1 — Variable Rate Closed Network
AS/0365-X -	Sequential Decoder Option X = 1 — Sequential Decoder with Rail

The following functions are found in the Select Config menu. Refer to Chapter 4 for more information.

TXR	Transmitter Rate. On entry, the current transmitter rate is displayed with the flashing cursor on the first character of the coding type on line 1, and the data rate on line 2. Use the arrow keys to select one of four pre-defined rates or variable. Press [ENTER] when TXV is displayed to change the rate using the variable rate selection. A flashing cursor will be displayed on the first character of the coding type on line 1. Use [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** When the TX rate has been programmed, the transmitter is automatically turned OFF to prevent swamping of other channels. Use the RF_Out function to turn ON the transmitter.
RXR	Receiver Rate. On entry, the current receiver rate is displayed with the flashing cursor on the first character of the coding type on line 1, and the data rate on line 2. Use the arrow keys to select one of four pre-defined rates or variable. Press [ENTER] when RXV is displayed to change the rate using the variable rate selection. A flashing cursor will be displayed on the first character of the coding type on line 1. Use [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

A.2.3 Utility

The following functions are found in the Utility menu. Refer to Chapter 4 for the functions not mentioned below.

FILTERS ADJUST	Variable Rate Filters K Factor Settings. These are factory set parameters. The operator is not allowed to view or change these parameters without authorization from an EFData Customer Support Department representative. CAUTION ***Do not try to enter this mode. An incorrect parameter change will result in unit failure.***
ASSIGN TX_FLTRS	Modulator Symbol Rate Assignment. The modulator has four symbol rate filter assignments. Each filter is for a specific symbol rate. The data rate and coder rate for each filter is 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 [ENTER] when the ASSIGN TX_FLTRS selection is displayed from the Utility menu. On line 1 of the display will be TXA, which indicates transmitter filter A. Following TXA on line 1 will be the code rate (1/2, 3/4, or 7/8). On line 2 will be the data rate assigned to filter A. Use [←] and [→] to see the assignments for filters B, C, and D (TXB, TXC, and TXD). To change a filter assignment, press [ENTER] when the data for that filter is displayed. Use [←] and [→] until the flashing cursor is at the parameter to be changed. Then use [↑] and [↓] to change that parameter. When all changes are made, press [ENTER] to confirm the assignment. **Note:** These assignments are used for the selection of TXR in the Config menu.

ASSIGN RX_FLTRS	Demodulator Symbol Rate Assignment. The demodulator has four symbol rate filter assignments. Each filter is for a specific symbol rate. The data rate and coder rate for each filter is 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 [ENTER] when the ASSIGN RX-FLTRS selection is displayed from the Utility Functions menu. On line 1 of the display will be RXA, which indicates receive filter A. Following RXA on line 1 will be the code rate (1/2, 3/4, or 7/8). On line 2 will be the data rate assigned to filter A. Use [←] and [→] to see the assignments for filters B, C, and D (RXB, RXC, and RXD). To change a filter assignment, press [ENTER] when the data for that filter is displayed. Use [←] and [→] until the flashing cursor is at the parameter to be changed. Then use [↑] and [↓] to change that parameter. When all changes are made, press [ENTER] to confirm the assignment. **Note:** These assignments are used for the selection of RXR in the Config menu.

Appendix B. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the SDM-650B:

- Section B.1 describes the *standard* version.

- Section B.2 describes the modem with the *asynchronous overhead channel unit* option installed.

Note: For remote control operation information on the modem with the Trojan interface option installed, refer to Appendix G.

B.1 Standard Version

This section describes the remote control operation of the standard SDM-650B:

- Firmware number: FW/0713-35R
- Software version: 4.16

B.1.1 General

Remote controls and status information are transferred via an RS-485 (optional RS-232-C) serial communications link.

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

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

Communications on the remote link are initiated by a remote controller or terminal. The modem never transmits data on the link unless it is commanded to do so.

B.1.2 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- 7 information bits
- 1 parity bit (odd/even)
- 2 stop bits

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

The general message structure is as follows:

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

B.1.2.1 Start Character

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

- “<” for commands
- “>” for responses

B.1.2.2 Device Address

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

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

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

B.1.2.3 Command/Response

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

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

- `>add/?ER1_PARITY ERROR"cr""lf"]`
  (Error message for received parity errors.)
- `>add/?ER2_INVALID PARAMETER"cr""lf"]`
  (Error message for a recognized command which cannot be implemented or has parameters which are out of range.)
- `>add/?ER3_UNRECOGNIZABLE COMMAND"cr""lf"]`
  (Error message for unrecognizable command or bad command syntax.)
- `>add/?ER4_MODEM IN LOCAL MODE"cr""lf"]`
  (Modem in local error; 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.)

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

B.1.2.4 End Character

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

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

B.1.3 Configuration Commands/Responses

B.1.3.1 Remote

This command configures the modem for remote operation. The modem will respond to any status request at any time. However, the modem must be in “Remote Mode” to change configuration parameters.

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

B.1.3.2 Set Modulator Frequency

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

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

Where: nnn.nnnn = 50.0000 to 90.0000, and 100.0000 to 180.0000 for the 140 MHz modulator.

Note: When modulator frequency is changed, the RF output is switched OFF.

B.1.3.3 Set RF Output

Command: <add/RF_xxx”cr”
Response: >add/RF_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.1.3.4 Set Demodulator Frequency

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

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

Where: nnn.nnnn = 50.0000 to 90.0000, and 100.0000 to 180.0000 for the 140 MHz modulator.

B.1.3.5 Set Modulator Power Offset

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

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

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

Notes:

1. This will be the highest modulator power that will be displayed and programmed.
2. Use the MOP_ command to actually change the modulator output power.

B.1.3.6 Set Modulator Output Power Level

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

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

Where:
snn.n = +20.0 to -45.0, in 0.5 dB increments for 140 MHz modulators.
snn.n = +20.0 to -30.0, in 0.5 dB increments for 70 MHz modulators.

Notes:

1. Power levels may be programmed for a maximum value specified by the modulator power offset with a range of 25 dB and 10 dB below the maximum value for the 140 MHz modulator and the 70 MHz modulator, respectively.
2. See the MPO_ command specification for more information.

B.1.3.7 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.

Notes: For the variable rate modulator option:

1. 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.
2. Modems that have the variable rate option installed will also respond to the special “SMRV_” command.

B.1.3.7.1 Modulator Filter Rate Assignment

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

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

Where:
x = A, B, C, or D (Filter designator).
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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”]`

B.1.3.7.2 Select Modulator Rate

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

Status Only: *(See MR command.)*

Where: x = A, B, C, or D (Filter designator).

Notes:

1. Setting the modulator turns OFF the RF transmitter.
2. If the modem is commanded to a filter (rate) which is not assigned (N/A), the “error 2” message will be returned.

B.1.3.7.3 Select Modulator Rate Variable

Note: This command is only applicable for the variable rate option.

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

Status Only: *(See MR command.)*

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

Note: Setting the modulator turns OFF the RF transmitter.

B.1.3.8 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.

Notes: For variable rate demodulator option:

1. 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.
2. 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.

B.1.3.8.1 Demodulator Filter Rate Assignment

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

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

Where:
x = A, B, C, or D (Filter designator).
nnn = 1/2, 3/4, 7/8, or BP12 (Decoder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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”]`

B.1.3.8.2 Select Demodulator Rate

Command: <add/SDRx_”cr”
Response: >add/SDRx_”cr””lf”]

Status Only: *(See DR command.)*

Where: x = A, B, C, or D (Filter designator).

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

B.1.3.8.3 Select Demodulator Rate Variable

Note: This command is only applicable for the variable rate option.

Command: <add/SDRV_nnn_mmmm.m”cr”
Response: >add/SDRV_nnn_mmmm.m”cr””lf”]

Status Only: *(See DR command.)*

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

B.1.3.9 Scrambler Enable

Command: <add/SE_xxx”cr”
Response: >add/SE_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.1.3.10 Descrambler Enable

Command: <add/DE_xxx”cr”
Response: >add/DE_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.1.3.11 Differential Encoder Enable

Command: <add/DENC_xxx”cr”
Response: >add/DENC_xxx”cr”lf”]

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

Where: xxx = ON or OFF.

B.1.3.12 Transmit Clock

Command: <add/TC_xxx”cr”
Response: >add/TC_xxx”cr””lf”]

Status Only: <add/TC_”cr”
Response: >add/TC_xxx”cr””lf”]

Where: xxx = INT or EXT.

B.1.3.13 Receive Clock

Command: <add/RC_xxx”cr”
Response: >add/RC_xxx”cr””lf”]

Status Only: <add/RC_”cr”
Response: >add/RC_xxx”cr””lf”]

Where: xxx = NRM or INV.

B.1.3.14 Baseband Loopback

Command: <add/BBL_xxx”cr”
Response: >add/BBL_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.1.3.15 RF Loopback

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

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

Where: xxx = ON or OFF.

B.1.3.16 IF Loopback

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

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

Where: xxx = ON or OFF.

B.1.3.17 Time of Day

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

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

Where:
hh = hours.
mm = minutes.
xx = AM or PM.

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

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

B.1.3.18 Date

Command: `<add/DATE_mm/dd/yy”cr”`
Response: `>add/DATE_mm/dd/yy”cr””lf”]`

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

Where:
mm = month.
dd = day.
yy = year.

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

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

B.1.3.19 Clear Stored Faults

This command is used to clear all stored faults logged by the modem.

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

B.1.3.20 BER Threshold

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

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

Where: xxxx = NONE or 1E-n (n = 3, 4, 5, 6, 7, or 8 [exponent of threshold]).

B.1.3.21 Sweep Reacquisition

This command is used to specify time duration of the reacquisition mode. The sweep is reduced to ± 2500 Hz 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”`
Response: `>add/SR_xxx”cr””lf”]`

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

Where: xxx = 0 to 999 (number of seconds).

B.1.3.22 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 (which requires hardware calibration) is used for acquisition of receive symbol rates of 128 kbit/s or lower.

However, if the sweep range is set to less than 50 kHz, 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)
- SD_ (Sweep Direction)

Note: These commands will be discussed in later sections.

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

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

Where: xxx = ON or OFF (OFF disables fast acquisition and directed sweep modes).

B.1.3.22.1 Sweep Center Frequency

This command sets the sweep center frequency. During carrier acquisition, the sweep starts at an 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 +25000 to -25000 Hz.

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

Status Only: `<add/SCF_"cr""lf"]`
Response: `>add/SCF_xnnnnn"cr""lf"]`

Where:
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.

B.1.3.22.2 Sweep Width Range

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

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

Status Only: `<add/SWR_"cr""lf"]`
Response: `>add/SWR_nnnnn"cr""lf"]`

Where: nnnnn = 0 to 50000.

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

B.1.3.22.3 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”]

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

Note: This command is only valid when fast acquisition is enabled. See the “FAM_” command definition.

B.1.3.23 Modem Operation Mode

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

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

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

Where: xxxxxxx = TX_ONLY, RX_ONLY, or DUPLEX.

B.1.3.24 Buffer Control Mode

This command is used to enable or disable M&C buffer control.

Command: <add/BUFF_xxx”cr”
Response: >add/BUFF_xxx”cr””lf”]

Status Only: <add/BUFF_”cr”
Response: >add/BUFF_xxx”cr””lf”]

Where: xxx = ON or OFF (OFF disables Buffer Clock, Buffer Center, and Buffer Size).

Note: For optional Doppler buffer only.

B.1.3.24.1 Buffer Clock

Command: <add/BC_xxx”cr”
Response: >add/BC_xxx”cr””lf”]

Status Only: <add/BC_”cr”
Response: >add/BC_xxx”cr””lf”]

Where: xxx = TXC, RXC, or EXT.

Note: This command is only valid when Buffer Control is enabled. See the “BUFF_” command definition.

B.1.3.24.2 Interface Buffer Center

This command centers the Doppler buffer.

Command: <add/IBC_”cr”
Response: >add/IBC_”cr””lf”]

Note: This command is only valid when Buffer Control is enabled. See the “BUFF_” command definition.

B.1.3.24.3 Interface Buffer Size

This command sets the Doppler buffer depth in bits.

Command: <add/IBS_nnnnn”cr”
Response: >add/IBS_nnnnn”cr””lf”]

Status Only: <add/IBS_”cr”
Response: >add/IBS_nnnnn”cr””lf”]

Notes:

1. Valid buffer depths are 512, 1024, 2048, 4096, 8192, 16384, and 32768.
2. This command is only valid when Buffer Control is enabled. See the “BUFF_” command definition.

B.1.4. Status Commands/Responses

B.1.4.1 Configuration

B.1.4.1.1 Modulator/Coder 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
	SE_xxx”cr”	Scrambler Enable (ON/OFF)
	COM_xxx”cr”	Carrier Only Mode (ON/OFF)
	DENC_xxx”cr”	Differential Encoder (ON/OFF)
	TC_xxx”cr”	Transmit Clock (INT/EXT)
	AMRV_nnn.mmmm.m”cr””lf”]	Modulator Variable Rate Assignment *(Variable Rate Option Only)*

B.1.4.1.2 Modulator/Coder Program

This command is used by the SMS-658 M:N protection switch to collect information that is necessary to configure backup 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
	SE_xxx”cr”	Scrambler Enable (ON/OFF)
	DENC_xxx”cr”	Differential Encoder (ON/OFF)
	TC_xxx”cr”	Transmit Clock (INT/EXT)
	RF_xxx”cr””lf”]	RF Output (ON/OFF)

B.1.4.1.3 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 Data 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
	`DE_xxx”cr”`	Descrambler Enable (ON/OFF)
	`RC_xxx”cr”`	Receive Clock (NRM/INV)
	`BBL_xxx”cr”`	Baseband Loopback (ON/OFF)
	`RFL_xxx”cr”`	RF Loopback (ON/OFF)
	`BERT_xxxx”cr”`	BER Threshold
	`SR_xxx”cr”`	Sweep Reacquisition (seconds)
	`IFL_xxx”cr”`	IF Loopback (ON/OFF)
(See Note 1)	`SCF_snnnnn”cr”`	Sweep Center Frequency
(See Note 1)	`SWR_nnnnn”cr”`	Sweep Width
(See Note 1)	`SD_s”cr”`	Sweep Direction
	`FAM_xxx”cr”`	Fast Acquisition Mode
(See Note 2)	`BC_xxx”cr”`	Buffer Clock Source
(See Note 2)	`IBS_nnnnn”cr”`	Interface Buffer Size
	`ADRV_nnn.mmmm.m”cr””lf”]`	Demodulator Variable Rate Assignment *(Variable Rate Option Only)*

Notes:

1. “SCF_”, “SWR_”, and “SD_” responses are returned only when fast acquisition is enabled. See the “FAM_” command definition.
2. “BC_” and “IBS_” responses are returned only when Buffer Control is enabled. See the “BUFF_” command definition.

B.1.4.1.4 Demodulator/Decoder Configuration Program

This command is used by the SMS-658 M:N protection switch to collect information that is necessary to configure backup modems.

Command:	`<add/DCP_”cr”`	
Response:	`>add/DCP_”cr”`	
	`BBL_xxx”cr”`	Baseband Loopback (ON/OFF)
	`IFL_xxx”cr”`	IF Loopback (ON/OFF)
	`RFL_xxx”cr”`	RF Loopback (ON/OFF)
	`DF_nnn.nnnn”cr”`	Demodulator Frequency
	`DR_nnn_mmmm.m”cr”`	Demodulator Data Rate
	`DE_xxx”cr”`	Descrambler Enable (ON/OFF)
	`RC_xxx”cr”`	Receive Clock (NRM/INV)
	`BERT_xxxx”cr”`	BER Threshold
	`SR_xxx”cr”`	Sweep Reacquisition (seconds)
	`FAM_xxx”cr”`	Fast Acquisition Mode
(See Note 1)	`SCF_snnnnn”cr”`	Sweep Center Frequency
(See Note 1)	`SWR_nnnnn”cr”`	Sweep Width
(See Note 1)	`SD_s”cr”`	Sweep Direction
(See Note 2)	`BC_xxx”cr”`	Buffer Clock Source
(See Note 2)	`IBS_nnnnn”cr””lf”]`	Interface Buffer Size

Notes:

1. “SCF_”, “SWR_”, and “SD_” responses are returned only when fast acquisition is enabled. See the “FAM_” command definition.
2. “BC_” and “IBS_” responses are returned only when Buffer Control is enabled. See the “BUFF_” command definition.

B.1.4.2 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)
(See Note)	`IRX_xxx”cr””lf”]`	Interface Receive Side (FLT/OK)

Note: “IRX_” response is returned only when Buffer Control is enabled. See the “BUFF_” command definition.

B.1.4.3 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 configured
	`MOD_xxx"cr"`	Module missing or will not 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)

B.1.4.4 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)
	`DSCR_xxx"cr"`	Descrambler (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)

B.1.4.5 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 and Control Module (OK/FLT)
	`INT_xxx"cr"`	Data Interface Module (OK/FLT)
	`TXC_xxx"cr"`	Transmit Clock Loss (DS-1 only)
	`BAT_xxx"cr"`	Battery (OK/FLT)
	`PS1_xxx"cr"`	+5V Power Supply (OK/FLT)
	`PS2_xxx"cr"`	+12V Power Supply (OK/FLT)
	`PS3_xxx"cr"`	-12V 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)

B.1.4.6 Interface Receive Side Status

Command:	`<add/IRXS_"cr"`	
Response:	`>add/IRXS_"cr"`	
	`OVFL_xxx"cr"`	Buffer Overflow (OK/FLT)
	`UNFL_xxx"cr"`	Buffer Underflow (OK/FLT)
	`SFLT_xx"cr""lf"]`	Number of Stored Faults Logged (0 to 10)

Note: This command is only valid when Buffer Control is enabled. See the "BUFF_" command definition.

B.1.4.7 BER Status

B.1.4.7.1 Raw BER

Command: <add/RBER_”cr”
Response: >add/RBER_nnnnE-4”cr””lf”]

Where: nnnn = RBER or < 1.0 (lower limit).

Example: Request raw BER from modem 123.

Command: <123/RBER_”cr”
Response: >123/RBER_152E-4”cr””lf”]

Where: RBER = .0152 errors/bit.

Note: “No Data” is returned if no carrier is detected (decoder not locked).

B.1.4.7.2 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_2E-5”cr””lf”]

Where: CBER = .00002 errors/bit.

Notes:
1. Corrected BER limits are lower < 1E-8, upper > 1E-3.
2. “No Data” is returned if no carrier is detected (decoder not locked).

B.1.4.8 E_b/N_0 Status

The E_b/N_0 status command causes the E_b/N_0 ratio to be returned. E_b/N_0 is returned in dB.

Command: <add/EBN0_”cr”
Response: >add/EBN0_n.ndB”cr””lf”]

Example: Request E_b/N_0 ratio from modem 2.

Command: <2/EBN0_”cr”
Response: >2/EBN0_6.2dB”cr””lf”]

Where: E_b/N_0 = 6.2 dB.

Notes:

1. E_b/N_0 limits are lower < 3 2 dB, upper > 9.7 dB.
2. “No Data” is returned if no carrier is detected (decoder not locked).

B.1.4.9 Modulator Rate Status

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

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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

B.1.4.10 Demodulator Rate Status

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

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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

B.1.4.11 Receive Signal Level Status

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

B.1.4.12 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”]`

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

B.1.4.13 Stored Faults

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

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

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

B.1.4.13.1 Modulator Stored Faults

Command:	<add/MSF_#”cr”	
Response:	>add/MSF_# hh:mm:ss MM/DD/YY”cr”	
	MOD_xxx”cr”	Module missing or will not 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)

B.1.4.13.2 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)
	DSCR_xxx”cr”	Descrambler (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)

B.1.4.13.3 Common Equipment Stored Faults

Command:	<add/CSF_#”cr”	
Response:	>add/CSF_# hh:mm:ss MM/DD/YY”cr”	
	M&C_xxx”cr”	Monitor and Control Module (OK/FLT)
	INT_xxx”cr”	Data Interface Module (OK/FLT)
	TXC_xxx”cr”	Transmit Clock Loss (DS1 only)
	BAT_xxx”cr”	Battery (OK/FLT)
	PS1_xxx”cr”	+5V Power Supply (OK/FLT)
	PS2_xxx”cr”	+12V Power Supply (OK/FLT)
	PS3_xxx”cr””lf”]	-12V Power Supply (OK/FLT)

B.1.4.13.4 Interface Receive Side Status Stored Faults

Command:	<add/IRSF_#”cr”	
Response:	>add/IRSF_# hh:mm:ss MM/DD/YY”cr”	
	OVFL_xxx”cr”	Buffer Overflow (OK/FLT)
	UNFL_xxx”cr””lf”]	Buffer Underflow (OK/FLT)

Note: This command is only valid when Buffer Control is enabled. See the “BUFF_” command definition.

B.1.4.14 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″]).

For standardization reasons, some parameters may not be implemented, but will retain the terminating "," (comma). Most of the data returned is formatted the same way as the single command status request (refer to the appropriate portions of this document in preceding sections).

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 = nnnn.nnnn, where "nnnn.nnnn" is the modulator IF frequency in MHz.
Parameter 3 (p3): Modulator output power level.
p3 = snn.n, where "snn.n" is the transmitter 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 kbit/s.
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 kbit/s.
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 kbit/s.
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 kbit/s.
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 kbit/s.
Parameter 9 (p9): Scrambler enable ON/OFF.
p9 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 10 (p10): Carrier only mode ON/OFF.
p10 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 11 (p11): Differential encoder enable ON/OFF.
p11 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 12 (p12): Transmit clock source (Internal/External).
p12 = n, where "n" is "0" or "1" ("0" = INT, "1" = EXT).
Parameter 13 (p13): Demodulator IF frequency.
p13 = nnnn.nnnn, where "nnnn.nnnn" is the demodulator IF frequency in MHz.

Parameter 14 (p14): Demodulator rate currently programmed.
p14 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.
Parameter 15 (p15): Demodulator filter A assignment.
p15 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.
Parameter 16 (p16): Demodulator filter B assignment.
p16 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.
Parameter 17 (p17): Demodulator filter C assignment.
p17 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.
Parameter 18 (p18): Demodulator filter D assignment.
p18 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.
Parameter 19 (p19): Descrambler enable ON/OFF.
p19 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 20 (p20): Receive clock (Invert/Normal).
p20 = n, where "n" is "0" or "1" ("0" = NRM, "1" = INV).
Parameter 21 (p21): Baseband loopback ON/OFF.
p21 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 22 (p22): RF loopback ON/OFF.
p22 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 23 (p23): Not implemented.
p23 = ",".
Parameter 24 (p24): BER threshold.
p24 = nnnn, where "nnnn" is the currently programmed BER threshold in the same format as the single command "BERT_".
Parameter 25 (p25): Sweep Reacquisition.
p25 = nnn, where "nnn" is the reacquisition parameter in seconds.
Parameter 26 (p26): IF loopback ON/OFF.
p26 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 27 (p27): MODEM REMOTE/LOCAL mode.
p27 = n, where "n" is "0" to indicate local, or "1" to indicate remote.
(See Note 1) Parameter 28 (p28): Sweep center programmed.
p28 = snnnnn, where "s" is "+" or "-", and "nnnnn" is the sweep center currently programmed.
(See Note 1) Parameter 29 (p29): Sweep width range.
p29 = nnnnn, where "nnnnn" is in the range of 0 to 50000 Hz.
(See Note 1) Parameter 30 (p30): Sweep direction.
p30 = n, where "n" is "+" for positive or "-" for negative sweep direction.
(See Note 2) Parameter 31 (p31): Buffer Clock.
p31 = n, where "n" is "0" to indicate transmit, "1" to indicate receive, or "2" to indicate external.
(See Note 2) Parameter 32 (p32): Interface Buffer Size.
p32 = nnnnn, where "nnnnn" is the buffer size in bits.

Notes:

1. Parameters 28, 29, and 30 are only returned when fast acquisition is enabled. See the "FAM_" command definition. Commas are always returned.
2. Parameters 31 and 32 are only returned when Buffer Control is enabled. See the "BUFF_" command definition. Commas are always returned.

B.1.4.15 Bulk Consolidated Analog Status

This command is similar to the "BCS_" command, but returns modem analog 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): E_b/N_0.
p4 = n.n, where "n.n" is E_b/N_0 in dB.

Note: Parameters 1 through 4 are dependent on carrier acquisition. If the decoder is not locked, empty data blocks are returned (,,,).

B.1.4.16 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_abcdef"cr""lf"]`

Where: 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 to 10) of the number of modulator stored faults.

Where: 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.

Where: 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 to 10) of the number of demodulator stored faults.

Where: Character “d”: Demodulator fault status character 2.
Bit 6 = 1 always.
Bit 5 = Demodulator RF synthesizer fault.
Bit 4 = Descrambler fault.
Bit 3 = I channel fault.
Bit 2 = Q channel fault.
Bit 1 = Bit clock fault.
Bit 0 = BER threshold fault.

Where: 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 to 10) of the number of common equipment stored faults.

Where: Character “f”: Common equipment fault status character 2.
Bit 6 = 1 always.
Bit 5 = Battery fault.
Bit 4 = +5V fault.
Bit 3 = +12V fault.
Bit 2 = -12V fault.
Bit 1 = Transmit clock loss fault (DS-1 only).
Bit 0 = not used.

Where: Character “g”: Interface receive side faults character 1.
Bit 6 = 1 always.
Bit 5 = Buffer underflow.
Bit 4 = Buffer overflow.
Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of interface receive side stored faults.

B.1.4.17 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”]`

Where: x =
“@” = 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.

B.1.4.18 Equipment Type

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

Command: `<add/ET_”cr”`
Response: `>add/ET_SDM650_x.xxx”cr””lf”]`

Where: x.xxx = M&C firmware version.

B.2 Asynchronous Overhead Interface Support Option

This section describes the remote control operation of the SDM-650B with the asynchronous overhead channel unit option installed:

- Firmware number: FW/0713-34L
- Software version: 4.12A

B.2.1 General

Remote controls and status information are transferred via an RS-485 (optional RS-232-C) serial communications link.

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

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

Communications on the remote link are initiated by a remote controller or terminal. The modem never transmits data on the link unless it is commanded to do so.

B.2.2 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- 7 information bits
- 1 parity bit (odd/even)
- 2 stop bits

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

The general message structure is as follows:

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

B.2.2.1 Start Character

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

- “<” for commands
- “>” for responses

B.2.2.2 Device Address

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

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

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

B.2.2.3 Command/Response

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

If a satellite modem receives a message addressed to it which does not match the established protocol or can not be implemented, a negative acknowledgment 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.)

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

B.2.2.4 End Character

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

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

B.2.3 Modulator Configuration Commands

B.2.3.1 Set Modulator Frequency

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

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

Where: nnn.nnnn = 50.0000 to 90.0000, and 100.0000 to 180.0000 for the 140 MHz modulator.

Note: When modulator frequency is changed, the RF output is switched OFF.

B.2.3.2 Set RF Output

Command: <add/RF_xxx”cr”
Response: >add/RF_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.2.3.3 Set Modulator Power Offset

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

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

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

Notes:

1. This will be the highest modulator power that will be displayed and programmed.
2. Use the MOP_ command to change the modulator output power.

B.2.3.4 Set Modulator Output Power Level

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

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

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

Notes:

1. Must be within 25.0 dB of the modulator power offset value (see MPO_) for the 140 MHz modulator, and within 10.0 dB of the modulator power offset for the 70 MHz modulator.
2. When local AUPC enable is programmed ON, the (MOP) Modulator Output Power command is not allowed; only MOP status is allowed. See “LPC_” command.

B.2.3.5 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.

Note: Variable rate modulator option:

1. 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.
2. Modems that have the variable rate option installed will also respond to the special “SMRV_” command.

B.2.3.5.1 Modulator Filter Rate Assignment

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

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

Where:
x = A, B, C, or D (Filter designator).
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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”]`

B.2.3.5.2 Select Modulator Rate

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

Status Only: *(See MR command.)*

Where: x = A, B, C, or D (Filter designator).

Notes:

1. Setting the modulator turns OFF the RF transmitter.
2. If the modem is commanded to a filter (rate) which is not assigned (N/A), the "error 2" message will be returned.

B.2.3.5.3 Select Modulator Rate Variable

Note: This command is only applicable for the variable rate option.

Command: `<add/SMRV_nnn_mmmm.m"cr"`
Response: `>add/SMRV_nnn_mmmm.m"cr""lf"]`
`RF_OFF"cr""lf"]`

Status Only: *(See MR command.)*

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

Note: Setting the modulator turns OFF the RF transmitter.

B.2.3.6 Scrambler Enable

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

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

Where: xxx = ON or OFF.

B.2.3.7 Differential Encoder Enable

Command: <add/DENC_xxx”cr”
Response: >add/DENC_xxx”cr”lf”]

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

Where: xxx = ON or OFF.

B.2.4 Demodulator Configuration Commands

B.2.4.1 Set Demodulator Frequency

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

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

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

B.2.4.2 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.

Note: For variable rate demodulator option:

1. 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.
2. 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.

B.2.4.2.1 Demodulator Filter Rate Assignment

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

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

Where:
x = A, B, C, or D (Filter designator).
nnn = 1/2, 3/4, 7/8, or BP12 (Decoder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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”]`

B.2.4.2.2 Select Demodulator Rate

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

Status Only: *(See DR command.)*

Where: x = A, B, C, or D (Filter designator).

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

B.2.4.2.3 Select Demodulator Rate Variable

Note: This command is only applicable for the variable rate option.

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

Status Only: *(See DR command.)*

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

B.2.4.3 Descramble Enable

Command: <add/DE_xxx”cr”
Response: >add/DE_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.2.4.4 RF Loopback

Command: <add/RFL_xxx”cr”
Response: >add/RFL_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.2.4.5 IF Loopback

Command: <add/IFL_xxx”cr”
Response: >add/IFL_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.2.4.6 BER Threshold

Command: <add/BERT_xxxx”cr”
Response: >add/BERT_xxxx”cr””lf”]

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

Where: xxxx = NONE or 1E-n (n = 3, 4, 5, 6, 7, or 8 exponent of threshold).

B.2.4.7 Sweep Reacquisition

This command is used to specify time duration of the reacquisition mode.

The sweep is reduced to ± 2500 Hz 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”`
Response: `>add/SR_xxx”cr””lf”]`

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

Where: xxx = 0 to 999 (number of seconds).

B.2.4.8 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 (which requires hardware calibration) is used for acquisition of receive symbol rates of 128 kbit/s or lower.

However, if the sweep range is set to less than 50 kHz, 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)
- “SD_” (sweep direction)

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

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

Where: xxx = ON or OFF (OFF disables fast acquisition and directed sweep modes).

B.2.4.8.1 Sweep Center Frequency

This command sets the sweep center frequency. During carrier acquisition, the sweep starts at an 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 +25000 to -25000 Hz.

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

Status Only: `<add/SCF_”cr”`
Response: `>add/SCF_xnnnnn”cr””lf”]`

Where:
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.

B.2.4.8.2 Sweep Width Range

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

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

Status Only: `<add/SWR_”cr””lf”`
Response: `>add/SWR_nnnnn”cr””lf”]`

Where: nnnnn = 0 to 50000.

Note: This command is only valid when fast acquisition is enabled. See the “FAM_” command definition.

B.2.4.8.3 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”]

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

Note: This command is only valid when fast acquisition is enabled. See the “FAM_” command definition.

B.2.5 Interface Configuration Commands

B.2.5.1 Transmit Clock

Command: <add/TC_xxx”cr”
Response: >add/TC_xxx”cr””lf”]

Status Only: <add/TC_”cr”
Response: >add/TC_xxx”cr””lf”]

Where: xxx = INT or EXT.

B.2.5.2 Buffer Clock

Command: <add/BC_xxx”cr”
Response: >add/BC_xxx”cr””lf”]

Status Only: <add/BC_”cr”
Response: >add/BC_xxx”cr””lf”]

Where: xxx = SAT, INT, EXT, or REF.

Note: Available with buffer support hardware only.

B.2.5.3 Receive Clock

Command: <add/RC_xxx”cr”
Response: >add/RC_xxx”cr””lf”]

Status Only: <add/RC_”cr”
Response: >add/RC_xxx”cr””lf”]

Where: xxx = NRM or INV.

B.2.5.4 External Reference Frequency

Command: <add/ERF_nnnnn”cr”
Response: >add/ERF_nnnnn”cr””lf”]

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

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

Note: Available with buffer support hardware only.

B.2.5.5 Interface Loopback

Command: <add/ILB_xxx”cr”
Response: >add/ILB_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.2.5.6 Baseband Loopback

Command: <add/BBL_xxx”cr”
Response: >add/BBL_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

B.2.5.7 Interface Coding Format Transmit

Command: <add/ICFT_xxxx”cr”
Response: >add/ICFT_xxxx”cr””lf”]

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

Where: xxxx = AMI, HDB3, B6ZS, or B8ZS.

B.2.5.8 Interface Coding Format Receive

Command: <add/ICFR_xxxx”cr”
Response: >add/ICFR_xxxx”cr””lf”]

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

Where: xxxx = AMI, HDB3, B6ZS, or B8ZS.

B.2.5.9 Interface Buffer Center

This command centers the interface buffer.

Command: <add/IBC_”cr”
Response: >add/IBC_”cr””lf”]

Note: Available with buffer support hardware only.

B.2.5.10 Interface Buffer Size

Command: <add/IBS_nnnnnn”cr”
Response: >add/IBS_nnnnnn”cr””lf”]

Status Only: <add/IBS_”cr”
Response: >add/IBS_nnnnnn”cr””lf”]

Where: nnnnnn = 32 to 262144, in 16-bit increments.

Note: Available with buffer support hardware only.

B.2.5.11 Transmit Overhead Baud Rate

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

Status Only: `<add/TOBR_”cr”`
Response: `>add/TOBR_nnnnn”cr””lf”]`

Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400.

B.2.5.12 Receive Overhead Baud Rate

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

Status Only: `<add/ROBR_”cr”`
Response: `>add/ROBR_nnnnn”cr””lf”]`

Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400.

B.2.5.13 Overhead Channels Character Length

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

Status Only: `<add/OCCL_”cr”`
Response: `>add/OCCL_n”cr””lf”]`

Where: n = 5, 6, 7, or 8 (characters).

B.2.5.14 Overhead Channels Stop Bits

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

Status Only: `<add/OCSB_”cr”`
Response: `>add/OCSB_n”cr””lf”]`

Where: n = 1 or 2 (stop bits).

B.2.5.15 Overhead Channels Parity

Command: <add/OCP_xxxx”cr”
Response: >add/OCP_xxxx”cr””lf”]

Status Only: <add/OCP_”cr”
Response: >add/OCP_xxxx”cr””lf”]

Where: xxxx = ODD, EVEN, or NONE.

B.2.5.16 Interface Substitution Pattern (Transmit 2047 Pattern)

Command: <add/ISP_xxx”cr”
Response: >add/ISP_xxx”cr””lf”]

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

Where: xxx = ON or OFF (transmit 2047 pattern generation).

B.2.6 System Commands/Responses

B.2.6.1 Time of Day

Command: <add/TIME_hh:mmxx”cr”
Response: >add/TIME_hh:mmxx”cr””lf”]

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

Where:
hh = hours.
mm = minutes.
xx = AM or PM.

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

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

B.2.6.2 Date

Command: `<add/DATE_mm/dd/yy”cr”`
Response: `>add/DATE_mm/dd/yy”cr””lf”]`

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

Where:
mm = month.
dd = day.
yy = year.

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

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

B.2.6.3 Remote

This command configures the modem for remote operation.

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

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

B.2.6.4 Clear Stored Faults

This command is used to clear all stored faults logged by the modem.

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

B.2.6.5 Modem Operation Mode

This command configures the modem for simplex or duplex operation modes.

When transmit-only mode is selected, receive faults are inhibited. When receive-only mode is selected, transmit faults are inhibited.

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

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

Where: xxxxxxx = TX_ONLY, RX_ONLY, or DUPLEX.

B.2.7 Automatic Uplink Power Control (AUPC) Configuration Commands

B.2.7.1 Local Modem AUPC Commands

B.2.7.1.1 Local AUPC Enable

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

Status Only: `<add/LPC_"cr"`
Response: `>add/LPC_xxx"cr""lf"]`

Where: xxx = ON or OFF (local AUPC enable).

Note: When programmed ON, the MOP command is not allowed; only MOP status is allowed.

B.2.7.1.2 Nominal AUPC Power Level

Command: `<add/NOMP_-nn.n"cr"`
Response: `>add/NOMP_-nn.n"cr""lf"]`

Status Only: `<add/NOMP_"cr"`
Response: `>add/NOMP_-nn.n"cr""lf"]`

Where: nn.n = 5.0 to 30.0, in 0.5 increments (power in dBm).

B.2.7.1.3 Maximum AUPC Power Limit

Command: <add/MAXP_-nn.n”cr”
Response: >add/MAXP_-nn.n”cr””lf”]

Status Only: <add/MAXP_”cr”
Response: >add/MAXP_-nn.n”cr””lf”]

Where: nn.n = 5.0 to 30.0, in 0.5 increments (power in dBm).

B.2.7.1.4 Minimum AUPC Power Limit

Command: <add/MINP_-nn.n”cr”
Response: >add/MINP_-nn.n”cr””lf”]

Status Only: <add/MINP_”cr”
Response: >add/MINP_-nn.n”cr””lf”]

Where: nn.n = 5.0 to 30.0, in 0.5 increments (power in dBm).

B.2.7.1.5 E_b/N_0 Target AUPC Set Point

Command: <add/ENSP_n.n”cr”
Response: >add/ENSP_n.n”cr””lf”]

Status Only: <add/ENSP_”cr”
Response: >add/ENSP_n.n”cr””lf”]

Where: n.n = 3.2 to 9.7, in 0.1 increments (E_b/N_0 in dB).

B.2.7.1.6 Maximum AUPC Tracking Rate

Command: <add/MAXT_n.n”cr”
Response: >add/MAXT_n.n”cr””lf”]

Status Only: <add/MAXT_”cr”
Response: >add/MAXT_n.n”cr””lf”]

Where: n.n = 0.5 to 6.0, in 0.5 increments (max. tracking rate in dBm/minute).

B.2.7.1.7 AUPC Local Carrier Loss Action

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

Status Only: `<add/LCL_”cr”`
Response: `>add/LCL_xxxx”cr””lf”]`

Where: xxxx = HOLD, NOM, or MAX (power level setting when local carrier loss).

B.2.7.1.8 AUPC Remote Carrier Loss Action

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

Status Only: `<add/RCL_”cr”`
Response: `>add/RCL_xxxx”cr””lf”]`

Where: xxxx = HOLD, NOM, or MAX (power level setting when remote carrier loss).

B.2.7.2 Remote Modem AUPC Commands

Notes:

1. Always wait three seconds between consecutive remote modem command/status polls.
2. On status-only commands, the first time polled will cause a “???” instead of the regular data being returned. Retrying a second time (Note 1, in effect), will return a valid status response.
3. A status poll always returns the data from the last poll.

B.2.7.2.1 Remote AUPC Enable

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

Status Only: `<add/RPC_”cr”`
Response: `>add/RPC_xxx”cr””lf”]`

Where: xxx = ON or OFF (remote AUPC enable).

B.2.7.2.2 Remote Interface Substitution Pattern (Transmit 2047 Pattern)

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

Status Only: `<add/RISP_"cr"`
Response: `>add/RISP_xxx"cr""lf"]`

Where: xxx = ON or OFF (remote transmit 2047 pattern enable).

B.2.7.2.3 Remote Interface Baseband Loopback

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

Status Only: `<add/RBBL_"cr"`
Response: `>add/RBBL_xxx"cr""lf"]`

Where: xxx = ON or OFF (remote baseband loopback enable).

B.2.7.2.4 Remote Interface Read Error Status (Received 2047 Pattern)

This command returns 2047 BER from the remote AUPC modem. If data is not valid, the message "No_Data" is returned instead of BER data.

Command: `<add/RRES_"cr"`
Response: `>add/RRES_nE-e"cr""lf"]`

Where:
n = 1 to 9 (error rate number).
e = 2 to 6 (exponent).

Example:

Command: `<add/RRES_"cr"`
Response: `>add/RRES_2E-6"cr""lf"]`

B.2.8 Status Commands/Responses

B.2.8.1 Configuration Status

B.2.8.1.1 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
	`SE_xxx”cr”`	Scrambler Enable (ON/OFF)
	`COM_xxx”cr”`	Carrier Only Mode (ON/OFF)
	`DENC_xxx”cr”`	Differential Encoder (ON/OFF)
	`TC_xxx”cr”`	Transmit Clock (INT/EXT)
	`AMRV_nnn.mmmm.m”cr””lf”]`	Modulator Variable Rate Assignment *(Variable Rate Option Only)*

B.2.8.1.2 Modulator/Coder Configuration Program

This command is used by the SMS-658 M:N protection switch to collect information that is necessary to configure backup modems.

Command:	<add/MCP_”cr”	
Response:	>add/MCP_”cr”	
	MF_nnn.nnnn”cr”	Modulator Frequency
	MPO_snn.n”cr”	Modulator Power Offset
(See Note 1)	LPC_xxx”cr”	Local AUPC Enable (ON/OFF)
(See Note 2)	MOP_snn.n”cr”	Modulator Output Power
	MR_nnn_mmmm.m”cr”	Modulator Rate
	SE_xxx”cr”	Scrambler Enable (ON/OFF)
	DENC_xxx”cr”	Differential Encoder (ON/OFF)
	TC_xxx”cr”	Transmit Clock (INT/EXT)
	BBL_xxx”cr”	Baseband Loopback (ON/OFF)
	ILB_xxx”cr”	Interface Loopback (ON/OFF)
	ICFT_xxxx”cr”	Coding Format Transmit (AMI/HDB3/B6ZS/B8ZS)
	TOBR_nnnnn”cr”	Transmit Overhead Baud Rate
	OCCL_n”cr”	Overhead Channel Character Length
	OCSB_n”cr”	Overhead Channel Stop Bits
	OCP_xxxx”cr”	Overhead Channel Parity
(See Note 1)	ISP_xxx”cr”	Interface Substitution Pattern 2047 (ON/OFF)
(See Note 1)	LPC_xxx”cr”	Local AUPC Enable (ON/OFF)
(See Note 1)	NOMP_-nn.n”cr”	Nominal Power Value (-5.0 to -30.0)
(See Note 1)	MINP_-nn.n”cr”	Minimum Power Limit (-5.0 to -30.0)
(See Note 1)	MAXP_-nn.n”cr”	Maximum Power Value (-5.0 to -30.0)
(See Note 1)	LCL_xxxx”cr”	Local Carrier Loss (HOLD, NOM, MAX)
(See Note 1)	RCL_xxxx”cr”	Remote Carrier Loss (HOLD, NOM, MAX)
	RF_xxx”cr””lf”]	RF Output (ON/OFF)

Notes:

1. Available with AUPC support hardware only.
2. Only returned if local AUPC is disabled (OFF).

B.2.8.1.3 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 Data 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
	`DE_xxx”cr”`	Descrambler Enable (ON/OFF)
	`RFL_xxx”cr”`	RF Loopback (ON/OFF)
	`BERT_xxxx”cr”`	BER Threshold
	`SR_xxx”cr”`	Sweep Reacquisition (seconds)
	`IFL_xxx”cr”`	IF Loopback (ON/OFF)
(See Note)	`SCF_snnnnn”cr”`	Sweep Center Frequency
(See Note)	`SWR_nnnnn”cr”`	Sweep Width
(See Note)	`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.

B.2.8.1.4 Demodulator/Decoder Configuration Program

This command is used by the SMS-658 M:N protection switch to collect information that is necessary to configure backup modems.

Command:	<add/DCP_”cr”	
Response:	>add/DCP_”cr”	
	IFL_xxx”cr”	IF Loopback (ON/OFF)
	RFL_xxx”cr”	RF Loopback (ON/OFF)
	DF_nnn.nnnn”cr”	Demodulator Frequency
	DR_nnn_mmmm.m”cr”	Demodulator Data Rate
	DE_xxx”cr”	Descrambler Enable (ON/OFF)
	BERT_xxxx”cr”	BER Threshold
	SR_xxx”cr”	Sweep Reacquisition (seconds)
	FAM_xxx”cr”	Fast Acquisition Mode
(See Note 2)	SCF_snnnnn”cr”	Sweep Center Frequency
(See Note 2)	SWR_nnnnn”cr”	Sweep Width
(See Note 2)	SD_s”cr”	Sweep Direction
	RC_xxx”cr”	Receive Clock (NRM/INV)
	BBL_xxx”cr”	Baseband Loopback (ON/OFF)
	ILB_xxx”cr”	Interface Loopback (ON/OFF)
	ICFR_xxxx”cr”	Coding Format Receive (AMI/HDB3/B6ZS/B8ZS)
	ROBR_nnnnn”cr”	Receive Overhead Baud Rate
	OCCL_n”cr”	Overhead Channel Character Length
	OCSB_n”cr”	Overhead Channel Stop Bits
	OCP_xxxx”cr”	Overhead Channel Parity
(See Note 1)	ERF_nnnnn”cr”	External Reference Frequency
(See Note 1)	BC_xxx”cr”	Buffer Clock (INT/EXT/SAT/REF)
(See Note 1)	IBS_nnnnnn”cr”	Interface Buffer Size
(See Note 3)	ENSP_n.n”cr”	E_b/N_0 Target Set Point (3.2 to 9.7)
(See Note 3)	MAXT_n.n”cr””lf”]	Max. Tracking Rate (0.5 to 6.0)

Notes:

1. Available with buffer support hardware only.
2. “SCF_”, “SWR_”, and “SD_” responses are returned only when fast acquisition is enabled. See the “FAM_” command definition.
3. Available with AUPC support hardware only.

B.2.8.1.5 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”`	
	`TC_xxx”cr”`	Transmit Clock (INT/EXT)
	`RC_xxx”cr”`	Receive Clock (NRM/INV)
	`BBL_xxx”cr”`	Baseband Loopback (ON/OFF)
	`ILB_xxx”cr”`	Interface Loopback (ON/OFF)
	`ICFT_xxxx”cr”`	Coding Format Transmit (AMI/HDB3/B6ZS/B8ZS)
	`ICFR_xxxx”cr”`	Coding Format Receive (AMI/HDB3/B6ZS/B8ZS)
	`TOBR_nnnnn”cr”`	Transmit Overhead Baud Rate
	`ROBR_nnnnn”cr”`	Receive Overhead Baud Rate
	`OCCL_n”cr”`	Overhead Channel Character Length
	`OCSB_n”cr”`	Overhead Channel Stop Bits
	`OCP_xxxx”cr”`	Overhead Channel Parity
(See Note 2)	`ISP_xxx”cr”`	Interface Substitution Pattern 2047 (ON/OFF)
(See Note 1)	`ERF_nnnnn”cr”`	External Reference Frequency
(See Note 1)	`BC_xxx”cr”`	Buffer Clock (INT, EXT, REF, SAT)
(See Note 1)	`IBS_nnnnnn”cr””lf”]`	Interface Buffer Size

Notes:

1. Available with buffer support hardware only.
2. Available with AUPC support hardware only.

B.2.8.1.6 AUPC Configuration Status

The AUPC 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/ACS_”cr”`	
Response:	`>add/ACS_”cr”`	
	`LPC_xxx”cr”`	Local AUPC Enable (ON/OFF)
	`NOMP_-nn.n”cr”`	Nominal Power Value (-5.0 to -30.0)
	`MINP_-nn.n”cr”`	Minimum Power Limit (-5.0 to -30.0)
	`MAXP_-nn.n”cr”`	Maximum Power Value (-5.0 to -30.0)
	`ENSP_n.n”cr”`	E_b/N_0 Target Set Point (3.2 to 9.7)
	`MAXT_n.n”cr”`	Max. Tracking Rate (0.5 to 6.0)
	`LCL_xxxx”cr”`	Local Carrier Loss (HOLD, NOM, MAX)
	`RCL_xxxx”cr”`	Remote Carrier Loss (HOLD, NOM, MAX)
	`ISP_xxx”cr””lf”]`	Interface Substitution Pattern 2047 (ON/OFF)

B.2.8.2 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)

B.2.8.3 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 configured
	MOD_xxx”cr”	Module missing or will not 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)

B.2.8.4 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)
	DSCR_xxx”cr”	Descrambler (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)

B.2.8.5 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 and Control Module (OK/FLT)
	INT_xxx”cr”	Data Interface Module (OK/FLT)
	BAT_xxx”cr”	Battery (OK/FLT)
	PS1_xxx”cr”	+5V Power Supply (OK/FLT)
	PS2_xxx”cr”	+12V Power Supply (OK/FLT)
	PS3_xxx”cr”	-12V 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)

B.2.8.6 Interface Transmit Side Status

Command:	<add/ITXS_”cr”	
Response:	>add/ITXS_”cr”	
	CLK_xxx”cr”	Selected Transmit Clock Activity (OK/FLT)
	PLL_xxx”cr”	Transmit Synthesizer PLL Lock (OK/FLT)
	SFLT_xx”cr””lf”]	Number of Stored Faults Logged (0 to 10)

B.2.8.7 Interface Receive Side Status

Command:	<add/IRXS_”cr”	
Response:	>add/IRXS_”cr”	
	MUX_xxx”cr”	MUX Lock (OK/FLT)
	CLK_xxx”cr”	Selected Buffer Clock Activity (OK/FLT)
	PLL_xxx”cr”	Receive Synthesizer PLL Lock (OK/FLT)
(See Note)	OVFL_xxx”cr”	Buffer Overflow (OK/FLT)
(See Note)	UNFL_xxx”cr”	Buffer Underflow (OK/FLT)
(See Note)	IBFS_nn%”cr”	Interface Buffer Fill Status
	SFLT_xx”cr””lf”]	Number of Stored Faults Logged (0 to 10)

Note: Available with buffer support hardware only.

B.2.8.8 Bit Error Rate Status

B.2.8.8.1 Raw BER

Command: `<add/RBER_”cr”`
Response: `>add/RBER_nnnnE-4”cr””lf”]`

Where:
nnnn = RBER.
nnnn = < 1.0 (lower limit).

Example: Request raw BER from modem 123.

Command: `<123/RBER_”cr”`
Response: `>123/RBER_152E-4”cr””lf”]`

Where: RBER = 0.0152 errors/bit.

Note: “No Data” is returned if no carrier is detected (decoder not locked).

B.2.8.8.2 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_2E-5”cr””lf”]`

Where: CBER = 0.00002 errors/bit.

Notes:
1. Corrected BER limits are lower < 1E-8, upper > 1E-3.
2. “No Data” is returned if no carrier is detected (decoder not locked).

B.2.8.9 E_b/N_0

The E_b/N_0 status command causes the E_b/N_0 ratio to be returned. E_b/N_0 is returned in dB.

Command: `<add/EBN0_”cr”`
Response: `>add/EBN0_n.ndB”cr””lf”]`

Example: Request E_b/N_0 ratio from modem 2.

Command: `<2/EBN0_”cr”`
Response: `>2/EBN0_6.2dB”cr””lf”]`

Where: E_b/N_0 = 6.2 dB.

Notes:

1. E_b/N_0 limits are lower < 3.2 dB, upper > 9.7 dB.
2. “No Data” is returned if no carrier is detected (decoder not locked).

B.2.8.10 Modulator Rate

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

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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

B.2.8.11 Demodulator Rate

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

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Decoder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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

B.2.8.12 Receive Signal Level

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

B.2.8.13 Current Sweep Value

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

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

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

B.2.8.14 Interface Buffer Fill Status

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

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

Note: Available with buffer support hardware only.

B.2.8.15 Interface Read Error Status

This command returns 2047 BER. If data is not valid, the message “No_Data” is returned instead of BER data.

Command: <add/IRES_”cr”
Response: >add/IRES_nE-e”cr””lf”]

Where:
n = 1 to 9 (error rate number).
e = 2 to 6 (exponent).

Example:

Command: <add/IRES_”cr”
Response: >add/IRES_2E-6”cr””lf”]

B.2.8.16 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 instead of the normal time/date status information.

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

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

B.2.8.16.1 Modulator Stored Faults

Command:	<add/MSF_#”cr”	
Response:	>add/MSF_# hh:mm:ss MM/DD/YY”cr”	
	MOD_xxx”cr”	Module missing or will not 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)

B.2.8.16.2 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)
	DSCR_xxx”cr”	Descrambler (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)

B.2.8.16.3 Common Equipment Stored Faults

<table>
<tr><td>Command:</td><td><code><add/CSF_#”cr”</code></td><td></td></tr>
<tr><td>Response:</td><td><code>>add/CSF_# hh:mm:ss MM/DD/YY”cr”</code></td><td></td></tr>
<tr><td></td><td><code>M&C_xxx”cr”</code></td><td>Monitor and Control Module (OK/FLT)</td></tr>
<tr><td></td><td><code>INT_xxx”cr”</code></td><td>Data Interface Module (OK/FLT)</td></tr>
<tr><td></td><td><code>BAT_xxx”cr”</code></td><td>Battery (OK/FLT)</td></tr>
<tr><td></td><td><code>PS1_xxx”cr”</code></td><td>+5V Power Supply (OK/FLT)</td></tr>
<tr><td></td><td><code>PS2_xxx”cr”</code></td><td>+12V Power Supply (OK/FLT)</td></tr>
<tr><td></td><td><code>PS3_xxx”cr””lf”]</code></td><td>-12V Power Supply (OK/FLT)</td></tr>
</table>

B.2.8.16.4 Interface Transmit Side Stored Faults

<table>
<tr><td>Command:</td><td><code><add/ITSF_#”cr”</code></td><td></td></tr>
<tr><td>Response:</td><td><code>>add/ITSF_# hh:mm:ss MM/DD/YY”cr”</code></td><td></td></tr>
<tr><td></td><td><code>CLK_xxx”cr”</code></td><td>Selected Transmit Clock Activity (OK/FLT)</td></tr>
<tr><td></td><td><code>PLL_xxx”cr””lf”]</code></td><td>Transmit Synthesizer PLL Lock (OK/FLT)</td></tr>
</table>

B.2.8.16.5 Interface Receive Side Stored Faults

<table>
<tr><td>Command:</td><td><code><add/IRSF_#”cr”</code></td><td></td></tr>
<tr><td>Response:</td><td><code>>add/IRSF_# hh:mm:ss MM/DD/YY”cr”</code></td><td></td></tr>
<tr><td></td><td><code>MUX_xxx”cr”</code></td><td>MUX Lock (OK/FLT)</td></tr>
<tr><td></td><td><code>CLK_xxx”cr”</code></td><td>Selected Buffer Clock Activity (OK/FLT)</td></tr>
<tr><td></td><td><code>PLL_xxx”cr”</code></td><td>Receive Synthesizer PLL Lock (OK/FLT)</td></tr>
<tr><td>(See Note)</td><td><code>OVFL_xxx”cr”</code></td><td>Buffer Overflow (OK/FLT)</td></tr>
<tr><td>(See Note)</td><td><code>UNFL_xxx”cr””lf”]</code></td><td>Buffer Underflow (OK/FLT)</td></tr>
</table>

Note: Available with buffer support hardware only.

B.2.8.17 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″]).

For standardization reasons, some parameters may not be implemented, but will retain the terminating "," (comma). Most of the data returned is formatted the same way as the single command status request (refer to preceding 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 kbit/s.
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 kbit/s.
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 kbit/s.
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 kbit/s.
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 kbit/s.
Parameter 9 (p9): Scrambler enable ON/OFF.
p9 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 10 (p10): Carrier only mode ON/OFF.
p10 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 11 (p11): Differential encoder enable ON/OFF.
p11 = n, where "n" is "0" to indicate OFF, or "1" to indicate ON.
Parameter 12 (p12): Demodulator IF frequency.
p12 = nnn.nnnn, where "nnn.nnnn" is the demodulator IF frequency in MHz.
Parameter 13 (p13): Demodulator rate currently programmed.
p13 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.
Parameter 14 (p14): Demodulator filter A assignment.
p14 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.

Parameter 15 (p15): Demodulator filter B assignment.
p15 = nnn_mmmm.m, where “nnn” is the code rate, and “mmmm.m” is the data rate in kbit/s.
Parameter 16 (p16): Demodulator filter C assignment.
p16 = nnn_mmmm.m, where “nnn” is the code rate, and “mmmm.m” is the data rate in kbit/s.
Parameter 17 (p17): Demodulator filter D assignment.
p17 = nnn_mmmm.m, where “nnn” is the code rate, and “mmmm.m” is the data rate in kbit/s.
Parameter 18 (p18): Descrambler enable ON/OFF.
p18 = n, where “n” is “0” to indicate OFF, or “1” to indicate ON.
Parameter 19 (p19): RF loopback ON/OFF.
p19 = n, where “n” is “0” to indicate OFF, or “1” to indicate ON.
Parameter 20 (p20): BER threshold.
p20 = nnnn, where “nnnn” is the currently programmed BER threshold in the same format as the single command “BERT_”.
Parameter 21 (p21): Sweep Reacquisition.
p21 = nn, where “nn” is the reacquisition parameter in seconds.
Parameter 22 (p22): IF loopback ON/OFF.
p22 = n, where “n” is “0” to indicate OFF, or “1” to indicate ON.
(See Note 2) Parameter 23 (p23): Sweep center programmed.
p23 = snnnnn, where “s” is “+” or “-”, and “nnnnn” is the sweep center currently programmed.
(See Note 2) Parameter 24 (p24): Sweep width range.
p24 = nnnnn, where “nnnnn” is in the range of 0 to 50000 Hz.
(See Note 2) Parameter 25 (p25): Sweep direction.
p25 = n, where “n” is “+” for positive, or “-” for negative sweep direction.
Parameter 26 (p26): MODEM REMOTE/LOCAL mode.
p26 = n, where “n” is “0” to indicate local, or “1” to indicate remote.
Parameter 27 (p27): Transmit clock source (Internal/External).
p27 = n, where “n” is “0” or “1” (“0” = INT,” “1” = EXT).
Parameter 28 (p28): Receive clock (Invert/Normal).
p28 = n, where “n” is “0” or “1” (“0” = NRM, “1” = INV).
Parameter 29 (p29): Baseband loopback ON/OFF.
p29 = n, where “n” is “0” to indicate OFF, or “1” to indicate ON.
Parameter 30 (p30): Interface loopback ON/OFF.
p30 = n, where “n” is “0” to indicate OFF, or “1” to indicate ON.
Parameter 31 (p31): TX Interface coding format (AMI/B8ZS/B6ZS/HDB3).
p31 = n, where “n” is “0”, “1”, “2”, or “3” (“0” = AMI, “1” = B6ZS, “2” = B8ZS, “3” = HDB3).
Parameter 32 (p32): RX Interface coding format (AMI/B8ZS/B6ZS/HDB3).
p32 = n, where “n” is “0”, “1”, “2”, or “3” (“0” = AMI, “1” = B6ZS, “2” = B8ZS, “3” = HDB3).
Parameter 33 (p33): Transmit Overhead Baud Rate.
p33 = nnnnn, where “nnnnn” is the currently programmed baud rate.
Parameter 34 (p34): Receive Overhead Baud Rate.
p34 = nnnnn, where “nnnnn” is the currently programmed baud rate.
Parameter 35 (p35): Overhead Channels Character Length.
p35 = n, where “n” is the currently programmed character length.
Parameter 36 (p36): Overhead Channels Stop Bits.
p36 = n, where “n” is the current number of stop bits programmed.
Parameter 37 (p37): Overhead Channels Parity.
p37 = xxxx, where “xxxx” is the currently programmed parity.
(See Note 1) Parameter 38 (p38): External Reference Frequency.
p38 = nnnnn, where “nnnnn” is the assigned frequency in kHz.
(See Note 1) Parameter 39 (p39): Buffer clock source (Internal/Reference/External/Satellite).
p39 = n, where “n” is “0”, “1”, “2”, or “3” (“0” = INT, “1” = REF, “2” = EXT, “3” = SAT).

(See Note 1) Parameter 40 (p40): Interface buffer size.
p40 = nnnnnn, where "nnnnnn" is the currently programmed buffer size in bits.

Notes:

1. Available with buffer support hardware only.
2. Parameters 23, 24, and 25 are only returned when fast acquisition is enabled. See the "FAM_" command definition.

B.2.8.18 Bulk Consolidated Analog Status

This command is similar to the "BCS_" command, but returns modem analog 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): E_b/N_0.
p4 = n.n, where "n.n" is E_b/N_0 in dB.
(See Notes) Parameter 5 (p5): Interface Buffer Fill Status.
p5 = nn, where "nn" is the fill status in percent.

Notes:

1. Parameters 1 through 5 are dependent on carrier acquisition. If the decoder is not locked, empty data blocks are returned (,,,,,).
2. Available with buffer support hardware only.

B.2.8.19 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"]`

Where: 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 to 10) of the number of modulator stored faults.

Where: 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.

Where: 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 to 10) of the number of demodulator stored faults.

Where: 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.

Where: 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 to 10) of the number of common equipment stored faults.

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

Where: 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 to 10) of the number of interface transmit side stored faults.

Where: Character “h”: Interface transmit side faults character 2.
Bit 6 = 1 always.
Bit 5 = Transmit clock activity fault.
Bit 4 = Transmit synthesizer PLL fault.
Bit 3 = not used.
Bit 2 = not used.
Bit 1 = not used.
Bit 0 = not used.

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

Where: Character “j”: Interface receive side faults character 2.
Bit 6 = 1 always.
Bit 5 = Receive synthesizer PLL fault.
Bit 4 = not used.
Bit 3 = not used.
Bit 2 = not used.
(See Note) Bit 1 = Buffer overflow fault.
(See Note) Bit 0 = Buffer underflow fault.

Note: Available with buffer support hardware only.

B.2.8.20 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”]`

Where: x =
“@” = 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.

B.2.8.21 Equipment Type

This command returns the equipment type polled and the software version.

Command: `<add/ET_”cr”`
Response: `>add/ET_SDM650_x.xxx”cr””lf”]`

Where: x.xxx = M&C firmware version.

B.2.8.22 Bulk Consolidated Status AUPC

Command: `<add/BCSA_”cr”`
Response: `>add/BCSA_p1,p2,p3, . . . pn”cr””lf”]`

Where: “pn” is the last parameter returned.

Parameter 1 (p1): Local AUPC enable ON/OFF.
p1 = n, where “n” is “0” to indicate OFF, or “1” to indicate ON.
Parameter 2 (p2): Nominal Power Value.
p2 = snn.n, where “snn.n” is the Nominal Power Value in dBm.
Parameter 3 (p3): Minimum Power Value.
p3 = snn.n, where “snn.n” is the Minimum Power Value in dBm.
Parameter 4 (p4): Maximum Power Value.
p4 = snn.n, where “snn.n” is the Maximum Power Value in dBm.
Parameter 5 (p5): E_b/N_0 Target Set Point.
p5 = n.n, where “n.n” is the E_b/N_0 Target Set Point in dB.
Parameter 6 (p6): Max. Tracking Rate.
p6 = n.n, where “n.n” is the Max. Tracking Rate in dB/Min.
Parameter 7 (p7): Local Carrier Loss.
p7 = n, where “n” is “0” to indicate HOLD, “1” to indicate NOMINAL, or “2” to indicate MAXIMUM.
Parameter 8 (p8): Remote Carrier Loss.
p8 = n, where “n” is “0” to indicate HOLD, “1” to indicate NOMINAL, or “2” to indicate MAXIMUM.
Parameter 9 (p9): Interface Substitution Pattern 2047 (ON/OFF).
p9 = n, where “n” is “0” to indicate OFF, or “1” to indicate ON.

Appendix C. FIELD COMPATIBILITY

EFDdata modems can be configured to be compatible with other modems in the field:

- Fairchild
- Comstream
- Fairchild Aydin data rate

This appendix allows the user to configure and/or identify compatible modems.

C.1 SDM-650B Standard Modem

The standard modem has the following assembly hardware configuration:

SDM-650B Chassis	AS/1099-1		
M&C Card	AS/0356		
M&C Software			
Standard	Fast Acquisition	ASYNC Standard	ASYNC with Fast Acq.
U7 FW/0713-13X	FW/0713-35X	FW/0713-27X	FW/0713-34X
U8 FW/0713-13X	FW/0713-35X	FW/0713-27X	FW/0713-34X
U9 FW/0714-5X	FW/0714-5X	FW/0714-5X	FW/0714-5X
Modulator Card	AS/0773-1		
Modulator Daughter Card	AS/0930-1 — Variable Rate AS/0715-1 — Fixed Rate		
Demodulator Card	AS/0778-1		
Demodulator Daughter Card	AS/0698-X — Fixed Rate AS/0929-1 — Variable Rate		
Decoder Card	AS/0365-1		
Decoder Software U8	FW/0562-1		

C.2 SDM-650B Fairchild-Compatible Modem

To change the standard modem to a Fairchild-compatible modem, the following changes must be made:

M&C Software	U9 FW/0714-6X
Modulator Card	AS/0773-3 (Resistor Pack Changes)
Demodulator Daughter Card	AS/0929-3 — Variable Rate AS/0698-X FDC COMP — Fixed Rate
Decoder Software U8	FW/0562-2

C.3 SDM-650B Aydin Data Rate Modem

To change the Fairchild-compatible modem to an Aydin compatible data rate, additional changes must be made to the Fairchild-compatible configuration:

Modulator Card	AS/0773	12 (Aydin Data Rate, crystal = 4.117333 MHz)
Decoder Card	AS/0365	4 (Aydin Data Rate, crystal = 4.117333 MHz)

C.4 SDM-650B Comstream Modem

To change the modem to a Comstream-compatible modem, the following changes must be made:

M&C Software	U9 FW/0714-9X
Decoder Card Software	U8 FW/0562-3X
Interface Board	AS/0627-2 V.35 Interface with Engineering Waiver #212 Modifies Carrier ON/OFF Control Using RTS (RS)

Appendix D. SOFTWARE CHANGE INSTRUCTIONS

Steps 1 through 5 are instructions for changing software on the M&C card.

Steps 6 through 9 are instructions for changing software on the Viterbi decoder card. If the Viterbi decoder software does not need to be changed, skip to Step 10 and continue.

To change the software:

1. Remove the M&C card (AS/0356) using the black card ejector on vertical card.

2. Remove the proms in location U7 and U9 (28 Pin — 0.6” 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. Short out the leads on capacitor C12, and re-install JP6 in the ON position.

5. Re-install the M&C card into the modem chassis.

6. Remove the Viterbi decoder card (AS/0701, AS/0949, or AS/2133) from the modem chassis. The decoder card is the horizontal card with gray card ejectors.

7. Remove the prom in proper location on the Viterbi decoder (28 pin — 0.6” wide). Refer to the decoder firmware in Table D-1 for location and description of the various Viterbi decoder boards.

8. Install the new firmware FW/XXXX in UX position on the Viterbi decoder. See Table D-1 for the definition of the various firmware that is available.

9. Re-install 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 associated symbol rate. Example: The label for a 64 kbit/s, 7/8 rate, QPSK filter is 36.57.

12. Go to the Config menu on the front panel and select the desired TX and RX rates. Turn ON the RF output.

    The software change is complete.

The firmware for the M&C cards is contained in three EPROMs:

- EPROMs U7 and U8 contain the various modem program codes.
- EPROM 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 Table D-1 for the location.

Table D-1. EFData M&C Viterbi Decoder Firmware

M&C EEPROM#	Firmware #	Description
U7	FW/0713-11D	Variable Rate Standard (Version 2.66)
U7, U8	FW/0713-19X	Variable Rate (Version 3.XX)
U7, U8	FW/0713-56X	Variable Rate, Fast acquisition, Directed Sweep (Version 4.XX)
U7, U8	FW/0713-57X	Drop and Insert, Fast Acquisition, Directed Sweep (Version 6.XX)
U9	FW/0714-7X	70/140 MHz
Decoder EEPROM#	**Firmware #**	**Description**
U1	FW/0760-1X	AS/0701 Viterbi Decoder
U17	FW/1910X	AS/0949 Viterbi Decoder
U42	FW/2355X	AS/2133 Viterbi Decoder

Note: The "X" following each of the firmware numbers stands for the revision release information of that firmware number.

Appendix E. AGC INTERFACE

The AGC interface option has been designed for external monitoring of the dynamic range of a modem.

The AGC interface output will be 0V out for minimum modem power, and +10V out for maximum modem power.

Rear panel gain and offset adjustments allow fine tuning of these voltages.

The AGC interface output is approximately linear, making it easy to determine the input power to the modem.

The demodulator fault relay closure can be used as an indication of the validity of the AGC voltage. If a fault is indicated, the AGC voltage is not valid.

Refer to Figure E-1 for a diagram of the rear panel showing the location of the AGC connector.

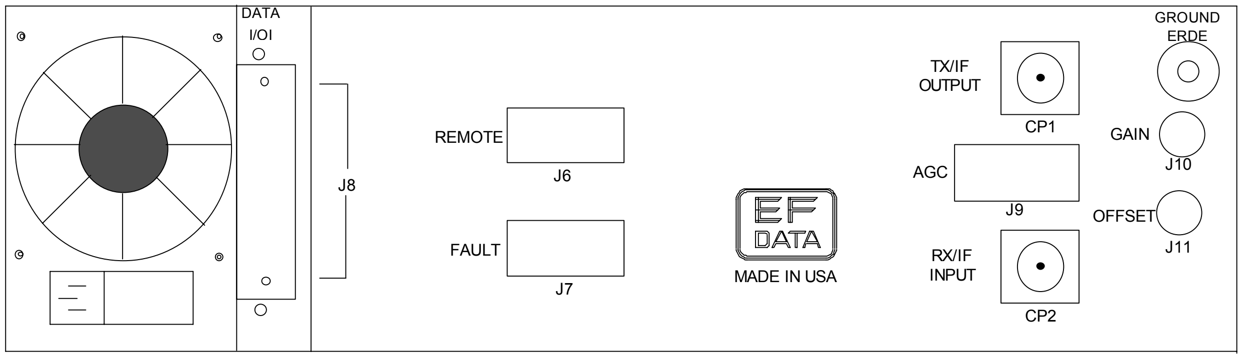

Figure E-1. Rear Panel View

E.1 Connector Pinouts

The AGC interface is supplied on a 9-pin female D connector that is accessible from the rear panel. Screw locks are provided for mechanical security of the mating connector.

Function	Name	Pin #
GROUND	GND	9
AGC OUTPUT	AGC-OUT	1
NO CONNECTION	NC	2, 3, 4, 5, 6, 7, 8

E.2 Installation Instructions

CAUTION

Parts and assemblies may be damaged by Electrostatic Discharge (ESD). ESD safety precautions should always be observed when handling parts.

E.2.1 Parts Required

Qty.	Part #	Description
1	PC/0769	AGC Interface
1	FP/1873	Back Panel for the AGC

E.2.2 Installation Procedure

Refer to Figure E-2 as needed. To install the AGC interface option:

1. Remove the rear panel of the modem.

2. Using the hardware provided, install the AS/0769 board to the modem motherboard between CP1 and CP2 (IF OUT and IF IN). (Refer to Figure E-1.)

3. Attach the following wires to the motherboard:

   a. E1 ⇒ GND
   b. E2 ⇒ +12V
   c. E3 ⇒ AGC J3, B4
   d. E4 ⇒ -12V

   Refer to Figure E-2.

4. Adjust R4 to achieve a reading of approximately 4.33KΩ between U1 pin 1 and pin 2 (refer to Figure E-3).

5. Power up the modem.

6. Adjust R5 to achieve a reading of approximately +5.75V at the right side of R2.

7. Measure the voltage at pin 1 of the 9-pin connector:

   a. To achieve the minimum AGC voltage output at pin 1, set the modem input to -55 dBm and verify the reading is 0V.

   b. To achieve the maximum AGC voltage output at pin 1, set the modem input to -30 dBm and verify the reading is 10V.

   If minor adjustments are necessary, adjust the GAIN and OFFSET potentiometers until both readings are correct.

8. Install the new back panel (refer to Figure E-1).

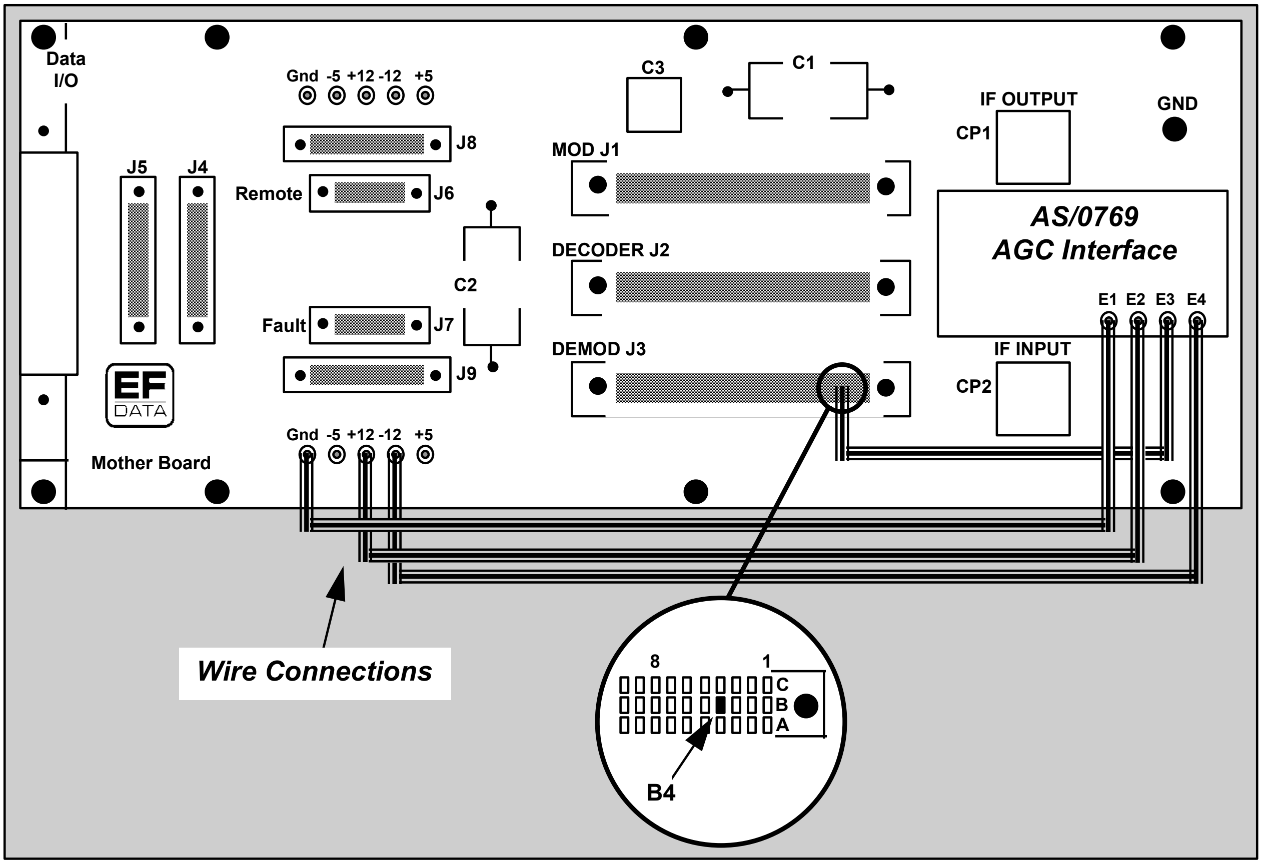

Figure E-2. Wiring Diagram

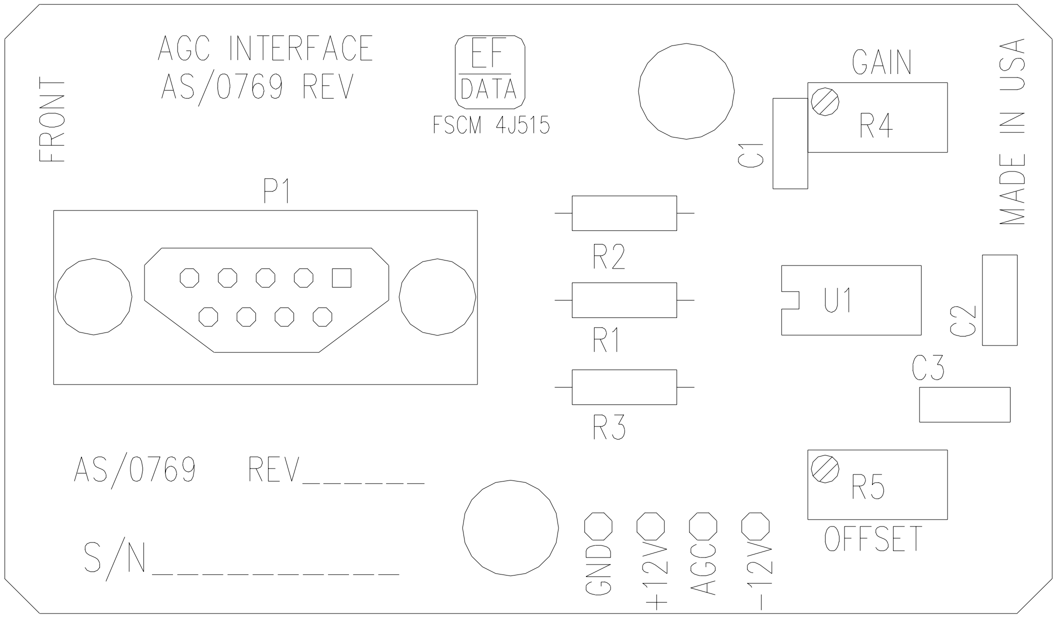

Figure E-3. AGC Adapter Board

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Appendix F. ASYNCHRONOUS OVERHEAD CHANNEL UNIT

This appendix provides information on operating the modem from the front panel with the asynchronous overhead channel unit option installed. The following version is described:

- Firmware number: FW/0713-34L
- Software version: 4.12A

Notes:

1. The same version of firmware (listed above) is used for the asynchronous overhead channel unit, whether or not the AUPC option is installed. However, if the modem hardware does not support AUPC, the AUPC-related menus and options (e.g., SELECT REMOTE; SELECT CONFIG, AUPC) will not be displayed in the front panel menus.
2. The ASYNC breakout panel is required with the asynchronous overhead channel unit. For information on the ASYNC breakout panel, refer to the *ASYNC Breakout Panel Installation and Operation Manual*.
3. For remote control operation information on the modem with the asynchronous overhead channel unit installed, refer to Appendix B.

This appendix includes:

- Functional description of ASYNC overhead channel unit
- ASYNC interface connector pinouts
- ASYNC interface specifications
- Functional description of ASYNC overhead channel unit with AUPC
- Front panel operation information

F.1 Functional Description of ASYNC Overhead Channel Unit

The ASYNC overhead interface module consists of three subassemblies:

- Connector board (AS/1328)
- Terrestrial interface (AS/1311)
- Data processor board (AS/1289)

The connector board provides the physical interface utilizing a 50-pin D connector. The terrestrial interface contains all circuitry required for G.703, RS-422, MIL-STD-188, and V.35 type interfaces for synchronous data. The terrestrial interface also contains circuitry for RS-232-C and RS-485 type interfaces for ASYNC data.

The data processor contains all circuitry required for:

- Multiplexing the synchronous and ASYNC data streams
- Data rate synthesizers
- Optional plesiochronous buffer

Refer to Figure F-1 for a block diagram of the ASYNC overhead interface.

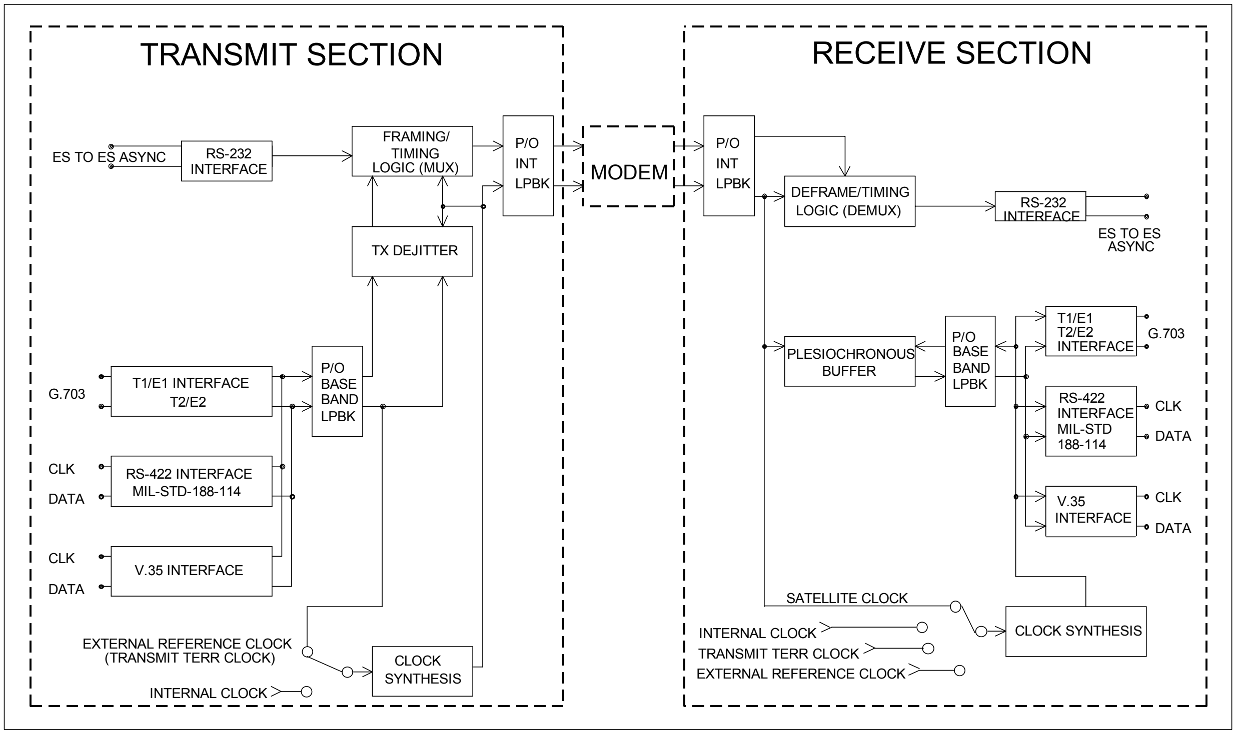

Figure F-1. Asynchronous Overhead Interface Block Diagram

F.1.1 Terrestrial Interface

The terrestrial interface (AS/1311) forms the top, when mated with the connector board, of the 2-board module. The terrestrial interface contains all balanced pair drivers and receivers for:

- RS-422
- MIL-STD-188
- V.35

Data inputs are send data (SD) and transmit clock (TT or SCTE).

Data outputs are modem reference clock (SCT or ST), receive data (RD), and receive clock (RT or SCR).

The “handshake” ASYNC signals are:

- Request to Send (RTS)
- Clear to Send (CTS)
- Data Mode
- Data Set Ready
- Receiver Ready
- Receive Line Signal Select

This board may otherwise contain circuitry for transformer balanced data interfaces supporting CCITT G.703 parameters.

Data inputs are Send Data (SD), and outputs are Receive Data (RD).

Data rates of 1.544, 2.048, 6.312, and 8.448 bits/s are supported.

Line codes for zero substitution are B6ZS, B8ZS, AMI, and HDB3. The configuration of this section is determined at the factory, and is not user selectable in the field.

The ASYNC data channel has three interface options:

- RS-232-C electrical interface allows full-duplex operation.
- RS-485 4-wire also allows full-duplex operation.
- RS-485 2-wire allows half-duplex operation.

These options are jumper selectable. Refer to Figure F-2 for jumper locations on the interface board. Refer to Tables F-1 and F-2 for jumper configuration information for the various options and data rates.

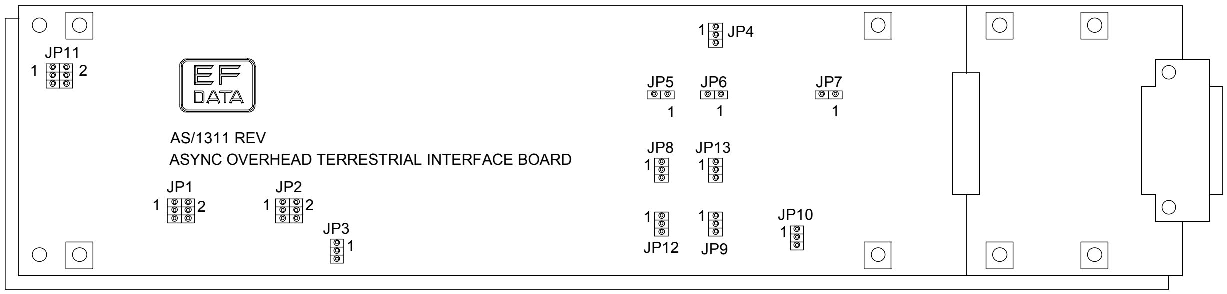

Figure F-2. Asynchronous Overhead Interface Board

Table F-1. Asynchronous Overhead Jumpers

JP #	Pin #	Function
JP1	1 to 3, and 2 to 4 3 to 5, and 4 to 6	V.35, RS-422, MIL-STD-188 G.703
JP2	1 to 2 3 to 4 5 to 6	Auto TX CLK Phase Select Fixed Phase, Normal Fixed Phase, Inverted
JP3	1 to 2 2 to 3	G.703 data activity detect TX Terr CLK activity detect
JP10	1 to 2 2 to 3	V.35 operation RS-422, MIL-STD-188 operation
JP11	1 to 2 3 to 4	Normal SCT output TX CLK “chained” to SCT output
JP12	1 to 2 2 to 3	2-wire operation 4-wire operation
Asynchronous		
JP8, JP9, JP13	1 to 2 2 to 3	RS-485 RS-232-C

Table F-2. Data Rate Jumpers

Data Rate	Impedance	JP4	JP5	JP6	JP7	Voltage
1.544 Mbit/s	BAL–100	OFF	ON	ON	OFF	5.8 Vp-p
2.048 Mbit/s	BAL–120	OFF	ON	ON	OFF	5.8 Vp-p
2.048 Mbit/s	UNBAL–75	OFF	ON	ON	OFF	4.6 Vp-p
6.312 Mbit/s	BAL–110	1 to 2	OFF	OFF	OFF	1.8 Vp-p
6.312 Mbit/s	UNBAL–75	OFF	OFF	OFF	OFF	3.3 Vp-p
8.448 Mbit/s	UNBAL–75	OFF	ON	ON	OFF	4.8 Vp-p

F.1.2 Multiplexer

The data processor (AS/1289) forms the bottom of the 2-board module. This board contains the data multiplexer and demultiplexer.

The synchronous data stream is multiplexed with a 1/15 overhead channel, and the resultant information is interfaced to the modulator/coder section of the modem.

The input clock is normally the recovered clock from the terrestrial interface board (SCTE), but the modem reference clock can be used by selecting the internal clock.

The 1/15 overhead channel is composed of:

- Framing signals
- Flags
- Spare bit positions
- ASYNC data stream

The maximum ASYNC data rate is limited to 1.875% of the synchronous data rate.

F.1.3 Demultiplexer

Receive data and clock from the demodulator/decoder are input to the DEMUX. The DEMUX synchronizes to the frame pattern, and separates the synchronous and ASYNC data. Synchronization is indicated by the demux lock LED on the front edge of the board.

The synchronous data is dejittered, and interfaced either to the optional plesiochronous buffer or to the terrestrial interface board.

F.1.4 Plesiochronous Buffer

Where the option is installed, data from the DEMUX section is fed into a plesiochronous buffer. The buffer size is selectable in increments of 1, 2, 4, 6, 8, 12, 24, and 32 ms. The buffer is automatically centered on resumption of service after an outage. The buffer can also be commanded to center from the Config Interface menu of 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 ms. For obvious reasons, manual centering will generally not be plesiochronous.

The fill status is available as a monitor function, and is accurate to 1%. Overflow or underflow incidents will be momentarily indicated by red LEDs on the module, and are stored in the “StFaults” section of the M&C status registers, along with the date and time of the incident. These are stored in battery-backed RAM.

To synchronize the receive data output with the satellite data, the user will normally select Receive Clock. The data will then be clocked out of the buffer by the clock recovered from the receive data input. The user may select from two other clock sources as a backup:

- User-supplied external reference clock
- Internal clock source

Problems on either the recovered receive data input clock or the external clock (if selected) will cause satellite clock to be substituted, and a fault will be signaled.

F.2 ASYNC Interface Connector Pinouts

The ASYNC 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 #
GROUND	GND	1, 2
T1E1 SEND DATA A	T1E1-SDA	34
T1E1 SEND DATA B	T1E1-SDB	18
EXTERNAL CLOCK A	EXCA	35
EXTERNAL CLOCK B	EXCB	19
T1E1 RECEIVE DATA A	T1E1-RDA	36
T1E1 RECEIVE DATA B	T1E1-RDB	20
TX DATA B (ASYNC)	TXD-B	4
SEND DATA A	SDA	37
SCT SIGNAL A	SCT/STA	21
TX DATA A (ASYNC)	TXD-A	5
SEND DATA B	SDB	38
SCT SIGNAL B	SCT/STB	22
RX DATA B (ASYNC)	RXD-B	6
RECEIVE DATA A	RDA	39
RECEIVE CLOCK A	SCR/RTA	23
RX DATA A (ASYNC)	RXD-A	7
RECEIVE DATA B	RD-B	40
RECEIVE CLOCK B	SCR/RTB	24
TRANSMIT TIMING A	SCTE/TTA	12
REQUEST TO SEND A	RTSA	45
REQUEST TO SEND B	RTSB	29
TRANSMIT TIMING B	SCTE/TTB	13
RECEIVER READY A	RLSD/RRA	46
RECEIVER READY B	RRB	30
RS422 TX DATA A	R422TXDA	14
CLEAR TO SEND B	CTSB	31
DATA SET READY A	DSR/DMA	48
DATA SET READY B	DMB	32
CTS A	CTSA	47

F.3 ASYNC Interface Specifications

Main Channel	
Physical Interface	MIL-STD-188-144
Factory Option	RS-422/-449 V.35 G.703
Data Rates	9.6K, 19.2K, 32 k/bits to 8.448 Mbit/s, in 32 k/bits steps
G.703 Data Rates	1.544 Mbit/s
Jumper Selectable	2.048 Mbit/s 6.312 Mbit/s 8.448 Mbit/s
G.703 Line Code	AMI, B8ZS, B6ZS, HDB3
Transmit Clock Reference	Internal modem reference or external transmit clock (SCT or TT)
Jitter Attenuation	Per G.703
Pulse Mask	Per G.703
Overhead Channel	
Overhead Rate	16/15 of main channel
ASYNC Channel Rate (max.)	< 1.875% of main channel
ASYNC Channel Interface	RS-232-C 2-wire RS-485 half-duplex 4-wire RS-485 full-duplex
Connector	25-pin D on breakout panel
Baud Rates, Asynchronous	110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 bit/s
Asynchronous Format	5, 6, 7, or 8 data bits Even, Odd, or no parity 1 or 2 stop bits (1 or 1.5 for 5 bit)
Pleisiochronous Buffer Specifications	
Buffer Size	384 to 262144 bits, in 16-bit steps
Buffer Fill Status	Monitored accurate to ± 1%
Buffer Centering	Automatic or Manual
Buffer Clock Reference	Transmit Internal (10^{-5} Stability) External Receive (Buffer Bypass)
External Clock Amplitude	Differential, 0.5 to 5 Vp-p Common Mode, 0 to 5 VDC
External Clock Frequency	256 to 2048 kHz, in 64 kHz steps
External Clock Impedance	100Ω
External Clock Input Type	Sine or square wave 50%, ± 10%

F.4 Functional Description of ASYNC Overhead Channel Unit with AUPC

The ASYNC overhead channel unit with the AUPC option functions very much the same as the original ASYNC overhead channel unit, except for some added features.

The connector pinouts and specifications apply to both versions of the ASYNC overhead channel unit.

There are two added features in the AUPC version:

- Automatic Uplink Power Control
- Modem-to-Modem Channel for Remote M&C

These features are outlined in the following sections.

F.4.1 AUPC

This feature is designed for remote communication between a local modem (A) and a remote modem (B). This feature allows the local modem to maintain a constant (± 0.5 dB) E_b/N_0 by requesting changes in transmit power level from the remote modem.

The user has the ability to set the following parameters:

- AUPC Enable (turns the AUPC ON or OFF)
- Remote Carrier Loss Action (Nominal, Maximum, Hold)
- Carrier Loss Action (Nominal, Maximum, Hold)
- Set Nominal Power Limit
- Set Maximum Power Limit
- Set Minimum Power Limit
- Set Target E_b/N_0
- Set Maximum Tracking Rate

When AUPC is turned ON in the local modem, it allows commands from the remote end to increment or decrement the power in 0.5 dB steps. This feature also allows power to be changed for remote or local carrier loss.

When AUPC is turned OFF in the local modem, the commands are still sent, but the local modem will not respond to the commands.

The action at loss of lock is as follows (modem A loses carrier detect):

1. Modem A sets its power to Nominal, Hold, or Maximum, as specified by Carrier Loss action.

2. Modem A sends Carrier Lost command to modem B.

3. Modem B sets its power to Nominal, Hold, or Maximum, as specified by Remote Carrier Loss action.

   Note: Local Carrier Loss has priority over Remote Carrier Loss.

F.4.2 Modem-to-Modem Channel for Remote M&C

This feature allows the user to monitor and control a remote modem location using the front panel or serial port of the local modem.

The user has the ability to set or reset the following commands:

- Baseband Loopback
- TX 2047 Pattern
- AUPC Enable

The user has the ability to remotely monitor the Receive 2047 BER.

F.5 Front Panel Operation

Note: The same version of firmware (FW/0713-34L, 4.12A) is used for the asynchronous overhead channel unit, whether or not the AUPC option is installed. However, if the modem hardware does not support AUPC, the AUPC-related menus and options (e.g., SELECT REMOTE; SELECT CONFIG, AUPC) will not be displayed in the front panel menus.

The modem front panel control uses a tree-structured menu system (Tables F-3 through F-12) to access and execute all functions.

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, any one of six functional categories can be chosen:

- Configuration
- Monitor
- Faults
- Stored faults (StFaults)
- Remote
- Utility

Note: For general information on front panel operation, refer to Chapter 4.

F.5.1 Menus and Options Overview

Refer to Section F.5.2 for menu and option explanations.

Note: The “A” after the software version designates “Asynchronous.”

Table F-3. Main Front Panel Menu with Asynchronous Overhead (with AUPC)

Screen	Submenus/Options	Comments
SDM650 “TYPE” SW_4.12A		This is an information-only screen. The “A” on line 2 means the asynchronous option is installed.
SELECT CONFIG	MOD DEMOD INTRFACE AUPC	Go to Table F-4. Go to Table F-5. Go to Table F-6. Go to Table F-7.
SELECT MONITOR		Go to Table F-8.
SELECT FAULTS		Go to Table F-9.
SELECT StFAULTS		Go to Table F-10.
SELECT REMOTE		Go to Table F-11.
SELECT UTILITY		Go to Table F-12.

Table F-4. Select Configuration Modulator Menu (with AUPC)

Menus	Submenus/Options	Comments
TX-x Code_Rate	x = A, B, C, D, or V	
TX_Freq	50.000 to 90.000 MHz or 100.000 to 180.000 MHz	In 2.5 kHz steps.
RF_Out	ON OFF	
TX_Power *or* AUPC_PWR	-5.0 dBm to -30 dBm	In 0.5 dBm steps. When AUPC is turned ON in the AUPC configuration menu, this window will display AUPC_PWR.
DifEncdr	ON OFF	
Scramblr	ON OFF	
CW_Mode	Center Dual Offset	

Table F-5. Select Configuration Demodulator Menu (with AUPC)

Menus	Submenus/Options	Comments
RX-x Code_Rate	x = A, B, C, D, or V	
RX_Freq	50.000 to 90.000 MHz, or 100.000 to 180.000 MHz	In 2.5 kHz steps.
Dscrmblr	ON OFF	
IFLoopBk	ON OFF	
RFLoopBk	ON OFF	
SWP_RACQ	0 to 999 sec	
SWP_CNTR	0 to 50000 Hz	Appear only when fast acquisition is turned ON.
SWP_RNGE	-25000 to +25000 Hz	Appear only when fast acquisition is turned ON.
SWP_DIR	FORWARD REVERSE	Appear only when fast acquisition is turned ON.
BERT_set	1E-3 1E-4 1E-5 1E-6 1E-7 1E-8 NONE	

Table F-6. Select Configuration Interface Menu (with AUPC)

Menus	Submenus/Options	Comments
TX_clock	External Internal	
Buf_clk	Satellite Internal Ext_Ref External	
RX_clock	Normal Inverted	
EXT_REF	Typical: 1.544 MHz 5 MHz 10 MHz	
BBLoopBk	ON OFF	
INTF_LBk	ON OFF	
TX CODE	AMI B8ZS B6ZS HDB3	
RX CODE	AMI B8ZS B6ZS HDB3	
TX 2047	ON OFF	AUPC option only.
BUF_SIZE	BITS = 32 to 262144, in 16 bit steps, or MILLI-SECONDS = 6 ms to 96 ms, in 1 ms steps	
BUF_CNTR	YES/NO	
TX BAUD	110 150 300 600 1200 2400 4800 9600 19200 38400	In bits per second.
RX BAUD	110 150 300 600 1200 2400 4800 9600 19200 38400	In bits per second.

CH LENTH	5 bits 6 bits 7 bits 8 bits	
STOP BIT	1 bit 2 bits	
PARITY	EVEN ODD NONE	

Table F-7. Select Configuration AUPC Menu (with AUPC)

Menus	Submenus/Options	Comments
AUPC	ON OFF	
NOM PWR	-30 to -5 dBm	
MIN PWR	-30 to -5 dBm	
MAX PWR	-30 to -5 dBm	
Eb/N0 SP	3.2 to 9.7 dB, in 0.1 dB steps	
MAX TR	0.5 to 6 dBm/minutes	
LOCAL CL	MAXIMUM NOMINAL HOLD	
REMOTECL	MAXIMUM NOMINAL HOLD	

Table F-8. Select Monitor Menu (with AUPC)

Menus	Submenus/Options	Comments
Raw_BER	Range: < 1.0E-4 to 2550E-4	
Corr_BER	Range: < 1E-8 to > 1E-3	
Eb/N0	Range: < 3.2 to > 9.7 dB	
SWP FREQ	Range: -30000 to +30000 Hz	Displays information when fast acquisition has been turned ON in the Utility menu.
Fil_Stat	Range: 1% to 99%	
RXSignal	Range: < -60 to > -30 dBm	
RX 2047	Range: < 1.0E-3 to > 1E-6, or No Data	

Note: Data is not available or displayed when the decoder loses lock.

Table F-9. Select Faults Menu (with AUPC)

Menus	Submenus/Options	Comments
Mod Flts – – – – – – –	RF_Syn Data_Clk TClk_Syn I-Channl Q-Channl AGC levl Module	
Dmd Flts + – + + + + – –	C_Detect RF_Syn Data Clk I-Channl Q-Channl Dscrambl BERthrsh Module	
CEq Flts – – – – –	Battery -12 volt +12 volt +5 volt Intrface	
TX_INTF – –	TX_PLL Clk_Act	
RX_INTF – – + – +	BUF_UNFL BUF_OVFL RX_PLL Buff_Clk MUX_lock	

Table F-10. Select Stored Faults (StFaults) Menu (with AUPC)

Menus	Submenus/Options	Comments
Mod Fltx MM/DD/YY HH/MM/SS	RF_Syn Data_Clk TClk_Syn I-Channl Q-Channl AGC_levl Module	Mod Flt0 through Mod Flt9.
Dmd Fltx MM/DD/YY HH/MM/SS	C_Detect RF_Syn Data_Clk I-Channl Q-Channl Dscrambl BERthrsh Module	Dmd Flt0 through Dmd Flt9.
CEQ Fltx MM/DD/YY HH/MM/SS	Battery -12 volt +12 volt +5 volt Controlr Intrface	CEQ Flt0 through CEQ Flt9.
TX_INTFx MM/DD/YY HH/MM/SS	TX_PLL Clk_Act	TX_INTF0 through TX_INTF9.
RX_INTFx MM/DD/YY HH/MM/SS	BUF_UNFL BUF_OVFL RX_PLL Buff_Clk MUX_lock	RX_INTF0 through RX_INTF9.
CLEAR ?? StFaults	YES/NO	

Table F-11. Select Remote Menu (with AUPC)

Menus	Submenus/Options	Comments
REMOTE CONFIG	AUPC ON OFF	
	BBLoopBK ON OFF	
	TX 2047 ON OFF	
REMOTE MONITOR	RX 2047 BER (1E-X) NO DATA	

Table F-12. Select Utility Menu (with AUPC)

Menus	Submenus/Options	Comments
Time	SS HH:MM AM/PM	Seconds (SS). Reset at [ENTER].
Date	MM/DD/YY	
LAMP TEST?	YES	
Add: 1 xxxxyyyy	Address = 1 to 255 Parity: Even Odd Baud Rate = 110 to 9600	Status only.
POW ADJ	+20 to -20.0 dB	
OP MODE	TX only RX only DUPLEX	
FAST ACQ	ON OFF	
INT_TYPE	RS422 V.35	
FILTERS ADJUST	MOD ADJ. DEMOD ADJ.	This is a factory setting and should not be changed by unauthorized persons.
Assign TX_Fltrs	Filters = A, B, C, D, or V	
Assign RX_Fltrs	Filters = A, B, C, D, or V	

F.5.2 Menu Explanations

F.5.2.1 Select Configuration

Refer to Table F-3.

Modem configuration may be viewed or changed by entering the Config menu from the Select menu on the front panel. After entering the Config menu, use [←] and [→] to select one of the following configurations:

- MOD
- DEMOD
- INTERFACE
- AUPC

Enter the selected Config menu by pressing [ENTER]. Use [←] and [→] to view the selected configuration parameters. Press [ENTER] to begin the configuration process. Then, 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 [ENTER]. When [ENTER] is pressed, the necessary programming is initiated by the modem. Press [CLEAR] to interrupt the process.

The following sections describe each configuration function in detail.

F.5.2.1.1 Configuration Modulator

Refer to Table F-4.

TX-x	Transmitter Rate Selection. Select one of four pre-defined 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 1. The data rate is displayed on line 2. Use the arrow keys to select one of four pre-defined rates. Filters that are not present may display N/A (not assigned). They cannot be programmed. If the modem is equipped with the variable rate option, TXV can also be selected. Enter the desired data rate.
TX_Freq	Programs the modulator transmit frequency between 50 and 90 MHz, or 100 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 [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** The transmitter frequency is programmable within the specified range (50 to 90 MHz, or 100 to 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. Use the RF_Out function to turn the transmitter ON.
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 [ENTER] 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. [↑] and [↓] are used to increase or decrease the output power level in 0.5 dBm steps. Press [ENTER] to execute the change.
AUPC_PWR	AUPC status window. When AUPC is turned ON in the AUPC Config menu, this window replaces the TX_POWER window. This is a monitor point only, and cannot be programmed from this menu.
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 [ENTER] 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 [ENTER] to execute the change.

<table>
<tr><td>CW_Mode

(Test Mode Configuration Option)</td><td>Programs the modem for continuous wave mode.

Three modes of operation are available:
Center
Dual
Offset
Center Mode:
Generates a carrier at the current modulator frequency. This can be used to measure the output frequency.

Dual Mode:
Generates a dual side-band suppressed carrier signal. Side-bands are at one-half 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 the symbol rate from the carrier. This is used to check the quadrature.

On entry, the Center mode is displayed. To activate this test mode, press [ENTER]. Use the arrow keys to select the Dual or Offset modes. Press [CLEAR] to return to the Config menu.

Note: When [CLEAR] is pressed, the modem is configured to the state it was in before CW_Mode was invoked. The transmitter is automatically turned OFF to prevent the possible swamping of other channels. Use the RF_Out function to turn the transmitter ON.</td></tr>
</table>

F.5.2.1.2 Configuration Demodulator

Refer to Table F-5.

RX-x	Receiver Rate Selection. Select one of four pre-defined 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 1. The data rate is displayed on line 2. Use the arrow keys to select one of four pre-defined rates. Filters that are not present may display N/A (not assigned). They cannot be programmed. If the modem is equipped with the variable rate option, TXV can also be selected. Enter the desired data rate.
RX_Freq	Programs the demodulator receive frequency between 50 and 90 MHz, or 100 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 [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
Dscrmblr	Programs the demodulator/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 [ENTER] to execute the change.
IFLoopBk *(Test Mode Configuration Option)*	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 internal attenuator. The demodulator is programmed to the same frequency as the modulator. An attenuator within the modem connects the IF Out to the IF In. When IF loopback is turned OFF, the demodulator is tuned to its previous frequency, and is reconnected to the IF input. 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 [ENTER] to execute the change.
RFLoopBk *(Test Mode Configuration Option)*	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 its previous frequency. 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 [ENTER] to execute the change.

SWP_RACQ	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 [←] and [→] to move the flashing cursor. Use [↑] and [↓] 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 [ENTER] to execute the change.
SWP_CNTR	**Note:** This window is only displayed when Fast Acquisition has been turned ON in the Utility menu. Programs the sweep center frequency for the directed sweep function. The sweep center frequency may be set in the range from +25000 to -25000 Hz. On entry, the current programmed setting is displayed with the flashing cursor on the first character. Use [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment and decrement the digit at the flashing cursor. Select the sweep center frequency from -25000 to +25000 Hz. Press [ENTER] to execute the change. When in directed sweep, the value from the sweep monitor screen (when the modem was last locked) should be entered for the sweep center frequency.
SWP_RNGE	**Note:** This window is only displayed when Fast Acquisition has been turned ON in the Utility menu. Programs the overall travel of the sweep width range during acquisition in the directed sweep mode. The sweep width may be set from 0 to 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 [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment and decrement the digit at the flashing cursor. Select a sweep range from 0 to 50000 Hz. Press [ENTER] to execute the change. When in directed sweep, the smaller the range, the faster the modem will lock, provided the sweep center frequency is close.
SWP_DIR	**Note:** This window is only displayed when Fast Acquisition has been turned ON in the Utility menu. 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 [ENTER] 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 [↑] and [↓] to select the desired setting. Press [ENTER] to execute the change.

F.5.2.1.3 Configuration Interface

Refer to Table F-6.

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 [ENTER] to execute the change.
Buf_clk	Programs the interface plesiochronous buffer output clock. External sets this clock source to the external reference clock. When External is selected and there is no clock present at the rear of the modem, the clock will fall back to the satellite 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 sets the buffer clock to operate from the modem internal clock. When EXT_REF clock is selected and there is no clock present, a fault will occur. The output buffer clock will not fall back to satellite clock. On entry, the current output buffer clock is displayed with the flashing cursor on the first character. Use the arrow keys to select the desired clock source. Press [ENTER] to execute the change.
RX_clock	Programs the modem for inverted or normal receiver 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 [ENTER] to execute the change.
EXT_REF	Programs the data rate of the external reference clock. Typically, this clock source is programmed to 1.544, 5, or 10 MHz. On entry, the current setting for the external reference is displayed with the flashing cursor on the first character. Use [←] and [→] to move the flashing cursor. Use [↑] and [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

BBLoopBk *(Test Mode Configuration Option)*	Programs the modem for baseband loopback operation. When baseband loopback is turned ON, baseband terrestrial data is looped back on the customer side of the interface. **Note:** Asynchronous data is not looped back in the 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 [ENTER] to execute the change.
INTF_LBk *(Test Mode Configuration Option)*	Programs the modem for interface loopback operation. When interface loopback is turned ON, data is looped back on the modem side of the interface. 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 [ENTER] 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, B8ZS, B6ZS, or HDB3 data. On entry, the current coding format is displayed. Use the arrow keys to select the desired coding format. Press [ENTER] to execute the change.
RX CODE	Programs the receiver for AMI, B8ZS, B6ZS, or HDB3 data. On entry, the current coding format is displayed. Use the arrow keys to select the desired coding format. Press [ENTER] to execute the change.
TX 2047	Programs the TX 2047 pattern ON or OFF. This test mode is only available when AUPC is turned ON in the Utility menu. 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 [ENTER] to execute the change.
BUF_SIZE	This configuration function is used to set the size of the buffer. On entry, the current buffer length is displayed. Use [↑] and [↓] to select the desired buffer size. The buffer size will be displayed in ms or bits. Enter the Utility menu to change the buffer units to milli-seconds or bits. 32 to 262144 bits, in increments of 16, can be selected. If ms is selected, 6 to 96 ms, in increments of 1 ms, can be selected. Press [ENTER] to execute the change.
BUF_CNTR	This configuration function is used to center the buffer. Press [ENTER] twice to center the plesiochronous buffer.
TX BAUD	Programs the transmitter baud rate. On entry, the current transmitter baud rate is displayed with the flashing cursor on the first character. Use [↑] and [↓] to select the desired rate. The baud rate may be programmed from 110 to 38,400 bit/s. Press [ENTER] to execute the change.

RX BAUD	Programs the receiver baud rate. On entry, the current receiver baud rate is displayed with the flashing cursor on the first character. Use [↑] and [↓] to select the desired rate. The baud rate may be programmed from 110 to 38,400 bit/s. Press [ENTER] to execute the change.
CH LENTH	Programs the character length for the ASYNC format. On entry, the current character length is displayed with the flashing cursor on the first character. Use [↑] and [↓] to select 5, 6, 7, or 8 bits. Press [ENTER] to execute the change.
Stop BIT	Programs the number of stop bits to 1 or 2. On entry, the current status of the stop bits is displayed with the flashing cursor on the first character. Use [↑] and [↓] to select 1 or 2 stop bits. Press [ENTER] to execute the change.
PARITY	Programs the parity check to even, odd, or none. On entry, the current status of the parity check is displayed with the flashing cursor on the first character. Use the arrow keys to select Even, Odd, or None. Press [ENTER] to execute the change.

F.5.2.1.4 Configuration AUPC

Refer to Table F-7.

AUPC	Programs the AUPC ON or OFF. 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 [ENTER] to execute the change.
NOM PWR	Programs the nominal power value of the AUPC. On entry, the current nominal power value is displayed with the flashing cursor on the first character. Use the arrow keys to increment or decrement the digit at the flashing cursor. The nominal power value can range from -30 to -5 dBm. Press [ENTER] to execute the change.
MIN PWR	Programs the minimum power level of the AUPC. On entry, the current minimum power level is displayed with the flashing cursor on the first character. Use the arrow keys to increment or decrement the digit at the flashing cursor. The minimum power level can range from -30 to -5 dBm. Press [ENTER] to execute the change.
MAX PWR	Programs the maximum power level of the AUPC. On entry, the current maximum power level is displayed with the flashing cursor on the first character. Use the arrow keys to increment or decrement the digit at the flashing cursor. The maximum power level can range from -30 to -5 dBm. Press [ENTER] to execute the change.
Eb/N0 SP	Programs the E_b/N_0 target setpoint. On entry, the current E_b/N_0 target setpoint is displayed with the flashing cursor on the first character. Use the arrow keys to increment or decrement the digit at the flashing cursor. The E_b/N_0 target setpoint can range from 3.2 to 9.7 dB, in 0.1 dB increments. Press [ENTER] to execute the change.
MAX TR	Programs the maximum tracking rate of the AUPC. On entry, the current maximum tracking rate is displayed with the flashing cursor on the first character. Use the arrow keys to increment or decrement the digit at the flashing cursor. The maximum tracking rate can range from 0.5 to 6 dBm/minute. Press [ENTER] to execute the change.
LOCAL CL	Programs the local carrier loss for maximum, nominal, or hold. On entry, the current status of the local carrier loss is displayed with the flashing cursor on the first character. Use the arrow keys to select maximum, nominal, or hold. Press [ENTER] to execute the change.
REMOTECL	Programs the remote carrier loss for maximum, nominal, or hold. On entry, the current status of the remote carrier loss is displayed with the flashing cursor on the first character. Use the arrow keys to select maximum, nominal, or hold. Press [ENTER] to execute the change.

F.5.2.2 Select Monitor

Refer to Table F-8.

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

Function	Description
Raw_BER	Raw bit error rate. Range: < 1.0E-4 to 2550E-4 *(See Note)*
Cor_BER	Corrected bit error rate. Range: < 1.0E-8 to > 1E-3 *(See Note)*
Eb/N0	Energy(bit)/noise ratio. Range: < 3.2 to > 9.7 dB *(See Note)*
SWP Freq	Sweep monitor. Range: -30,000 to +30,000 Hz
Fil_Stat	Plesiochronous buffer fill status in percent. Range: 1% to 99% *(See Note)*
RXSignal	Receive signal level. Range: < -60 to -30 dBm *(See Note)*
RX 2047	Receive 2047 BER. Range: < 1.0E-3 to > 1E-6, < 1E-6, or no data

Note: When the decoder loses lock, no data is available, and is so indicated.

F.5.2.3 Select Faults

Refer to Table F-9.

The Faults level is accessible from the Select menu. Faults are similar to monitor functions, they display the current fault status of the group being displayed. Use [←] and [→] to move between the following 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)

The current fault status is displayed on line 2 of the display in real time. Fault status is displayed as "+" or "-" for each parameter monitored.

- "+" indicates that a fault exists.
- "-" indicates that no fault exists.

Press [ENTER] to display labels for individual faults.

Use [←] and [→] to move the flashing cursor to the fault that is to be identified. The label for that fault is immediately displayed on line 1 of the display. Use [CLEAR] to exit this level of operation and return to the previous level.

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

F.5.2.3.1 Modulator Faults (Mod_FLTS)

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_levl	Automatic gain control level fault.
Module	Modulator module fault. Typically indicates that the modulator module is missing or will not program.

Refer to Section 6.2 for option explanations.

F.5.2.3.2 Demodulator/Decoder Faults (Dmd_Flts)

C_Detect	Carrier detect fault. Typically 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.
BERthrsh	Bit Error Rate threshold fault.
Module	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not program.

Refer to Section 6.2 for option explanations.

F.5.2.3.3 Common Equipment Faults (CEq_Flts)

Battery	Battery fault.
-12 volt	-12V power supply fault.
+12 volt	+12V power supply fault.
+5 volt	+5V 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. If using an RS-422 interface module, this fault could indicate the address jumper settings of JP4 through JP7 are not properly set. Refer to Chapter 3 for more information.

Refer to Section 6.2 for option explanations.

F.5.2.3.4 Transmit Faults (TX_INTF)

The faults listed below are only displayed when the ASYNC overhead channel unit is installed.

Refer to Section 6.2 for option explanations.

TX_PLL	Interface transmit clock phase locked loop fault.
Clk_Act	Clock activity fault. Activity detector alarm of the selected interface clock. The interface will fall back to the internal clock when this fault is active.

F.5.2.3.5 Receive Faults (RX_INTF)

The faults listed below are only displayed when the ASYNC overhead channel unit is installed.

Refer to Section 6.2 for option explanations.

BUF_UNFL	Buffer underflow fault. Typically indicates that a buffer underflow has occurred.
BUF_OVFL	Buffer overflow fault. Typically indicates that a buffer overflow has occurred.
RX_PLL	Interface receive clock phase locked loop fault.
Buff_Clk	Buffer clock activity fault. Activity detector alarm of the selected interface receive clock.
MUX_lock	MUX lock fault. Typically indicates that the MUX is not locked.

F.5.2.4 Select Stored Faults (StFaults)

Refer to Table F-10.

The modem stores the first 10 (Flt0 to 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. Upon power-up, a common equipment fault is logged (Flt0) with that time and date. Also upon power-up, an additional common equipment fault is also logged (Flt1) to indicate the power-up time and date.

On power-up, the power-down and power-up times are logged as common equipment fault 0 and common equipment fault 1, respectively.

Upon entering the StFaults level, use [←] and [→] to move between the six fault groups and the “CLEAR ?? StFaults” selections. The time and date of the first stored fault status (Flt0) for the selected group will be displayed alternately on line 2 of the display. Use [↑] and [↓] to cycle through the selected group’s stored fault status (Flt0 to Flt9). Press [ENTER] to display the fault status associated with the displayed time and date. At this time, use [←] and [→] to move the flashing cursor to the fault to be identified.

To clear the stored faults currently logged, press [ENTER] when the “CLEAR ?? StFaults” selection is displayed.

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

F.5.2.5 Select Remote

Refer to Table F-11.

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

The following sections contain information on individual functional categories and their respective functions.

F.5.2.5.1 Remote Configuration

AUPC	Remote AUPC enable. On entry, the current status of the remote AUPC is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press [ENTER] to execute the change.
BBLOOPBK	Programs the remote baseband loopback or ON or OFF. On entry, the current status of the remote baseband loopback is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press [ENTER] to execute the change.
TX 2047	Programs the remote TX 2047 pattern ON or OFF. On entry, the current status of the remote TX 2047 is displayed with the flashing cursor on the first character. Use the arrow keys to select ON or OFF. Press [ENTER] to execute the change.

F.5.2.5.2 Remote Monitor

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

F.5.2.6 Select Utility

Refer to Table F-12.

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. Access to the transmitter and receiver data/code rate assignments are also available from within the Utility menu.

After entering the Utility menu, use [←] and [→] to select the Utility function of interest. The current time and date can be displayed and changed as required.

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 in the modem's memory is displayed when selected. To change the time, press [ENTER]. Use [←] and [→] to position the flashing cursor over the parameter to be changed. Use [↑] and [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the time.
Date	Date set/display. The current date in the modem's memory is displayed when selected. To set the date, press [ENTER]. Use [←] and [→] to position the flashing cursor over the parameter to be changed. Use [↑] and [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the date.
LAMP TEST ??	Lamp test function illuminates all the front panel indicators for three seconds. Press [ENTER] to turn ON all of the front panel indicators for three seconds.
Address/Parity/Baud Rate	The current buffer address, parity selection, and the selected baud rate of the buffer are displayed. This is only a monitor function. No changes can be made from this menu.

POW ADJ	Modulator power adjust offset. Allows the operator to offset the modulator output power readout in the Config 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 +20.00 to -20 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 [ENTER] to execute the change. When TX-only or RX-only is selected, the appropriate faults are masked from the Faults and Stored Faults (StFaults) menu.
FAST ACQ	Fast Acquisition function. Turns the fast acquisition and directed sweep function ON or OFF. When Fast Acquisition has been turned OFF, the Swp_Cntr, SWP_Rnge, and SWP_DIR windows in the Config 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. **Note:** Fast acquisition only applies to data rates of 256 kbit/s and below. If the sweep range is set to less than 50 kHz, acquisition will be dictated by the directed sweep specifications. The fast acquisition algorithm will not be used.
FILTERS ADJUST INT-TYPE RS-422, V.35	This is a factory setting, and the operator is not allowed to enter this parameter without authorization from the EFData Customer Support 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. Press [ENTER] when the Assign TX-Fltrs selection is displayed in the Utility Functions menu to view the current filter assignments. On line 1 of the display will be TXA, which indicates transmitter filter A. Following TXA on line 1 will be the code rate (1/2, 3/4, or 7/8) or N/A (not assigned). On line 2 will be the data rate assigned to filter A. Use [←] and [→] to see the assignments for filters B, C, and D (TXB, TXC, and TXD). To change a filter assignment, press [ENTER] when the data for that filter is displayed. Use [←] and [→] until the flashing cursor is at the parameter to be changed. Use [↑] and [↓] to change that parameter. When all changes are made, press [ENTER] 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 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. 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. Press [ENTER] when the Assign RX-Fltrs selection is displayed in the Utility Functions menu to view the current filter assignments. On line 1 of the display will be RXA, which indicates transmitter filter A. Following RXA on line 1 will be the code rate (1/2, 3/4, or 7/8) or N/A (not assigned). On line 2 will be the data rate assigned to filter A. Use [←] and [→] to see the assignments for filters B, C, and D (RXB, RXC, and RXD). To change a filter assignment, press [ENTER] when the data for that filter is displayed. Use [←] and [→] until the flashing cursor is at the parameter to be changed. Use [↑] and [↓] to change that parameter. When all changes are made, press [ENTER] 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.

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Appendix G. TROJAN INTERFACE

This appendix provides information on the Trojan interface option for the SDM-650B, including:

- Functional description
- Connector pinouts
- Specifications
- Configuration guidelines
- Front panel operation information
- Remote control operation information

G.1 Functional Description

The Asynchronous Dejittered MIL-STD-188-114 digital interface provides level translation, buffering, jitter reduction, and termination between the modem internal signals and the MIL-STD-188-114 DCE interface on the rear panel. This interface also has the capability to handle different rates of transmit and receive data, using an internal synthesizer to generate the respective clocks. Also included in the receive chain is a selectable depth Doppler buffer to handle satellite delay variation.

Refer to Figure G-1 for a block diagram of this interface.

Control of interface parameters is accomplished from the front panel (refer to Chapter 4) through the Config Interface menu. Remote control may be accomplished through the RS-232-C/-485 port (refer to Section G.6).

The data rate synthesizer may take its input reference clock (REF_CLK) from one of four different sources:

- Transmit clock
- Receive clock
- External Station Clock (MC)
- Internal clock (SCT)

The phase-lock loop which locks to the reference has a very narrow bandwidth, effectively dejittering the reference. The phase-lock loop can handle data rates from 32 kbit/s to 2.048 Mbit/s, in steps of 8 kHz. Transmit and receive data rates do not need to be the same. If used, External Station Clock may range from 32 kHz to 10 MHz, in steps of 8 kHz.

The Doppler buffer depth ranges from 512 to 32768 bits, in powers of 2. The buffer is centered on power-up, start of service (when the modem receive section locks), or in case of underflow or overflow. The buffer may also be centered manually. Buffer overflow and underflow are logged as stored faults so that clock offset information may be obtained.

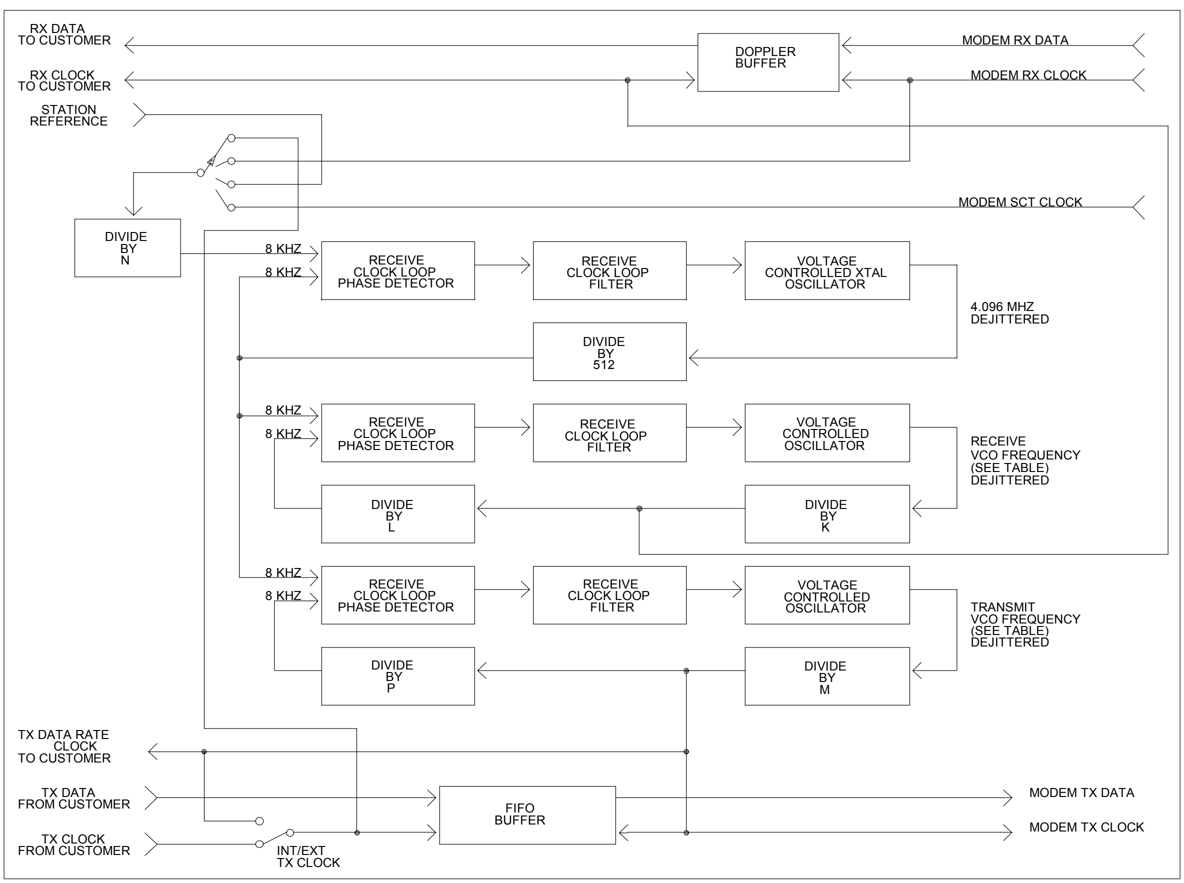

Figure G-1. Trojan Interface Block Diagram

Receive Data Rate (kbit/s)	N	K	L	Receive VCO Frequency (kHz)
56	7	64	7	3584
64	8	64	8	4096
128	16	32	16	4096
256	32	16	32	4096
512	64	8	64	4096
1024	128	4	128	4096
1544	193	2	193	3088
2048	256	2	256	4096

Receive Data Rate (kbit/s)	K	L	Receive VCO Frequency (kHz)
56	64	7	3584
64	64	8	4096
128	32	16	4096
256	16	32	4096
512	8	64	4096
1024	4	128	4096
1544	2	193	3088
2048	2	256	4096

The MIL-STD-188-114 interface provides a Send Timing (ST) clock signal at the modem transmit 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 input (TT) to clock in the data to be transmitted. In either case, the phase relationship between the clock and data is not important, so long as it meets the jitter specifications of MIL-STD-188-100, because a clock phase correction circuit is provided, which shifts the clock away from the data transition times. If EXTERNAL clock mode is used, the clock must be long-term synchronous with the synthesizer reference, unless it is selected to “Transmit” clock.

Data received by the modem is output on the Receive 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.

The Request to Send (RS) lines are hard-wired 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 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. During loopback, the synthesizer clock source is automatically set to Receive Clock for reasons of stability.

Three fault outputs are provided on dry contact Form C relays:

- Common Equipment
- Modulator
- Demodulator

They are available on the FAULT connector on the modem rear panel.

Fault indicators are also provided on TTL open collector drivers on the 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.

G.2 Connector Pinouts

The Asynchronous dejittered MIL-STD-188-114 interface is provided on a 37-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 #
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
STATION REF TIMING	MC-A MC-B	16 34
MODULATOR FAULT	MF	3
DEMODULATOR FAULT	DF	21

G.3 Specification

G.3.1 MIL-STD-188-114 Parameters

Circuit Supported	SD, ST, TT, RD, RT, DM, RR, MC, MOD FAULT, DEMOD FAULT.
Amplitude (RD, RT, ST, DM, RR)	4, ± 2V differential into 100Ω.
DC Offset (RD, RT, ST, DM, RR)	± 0.4V.
Impedance (RD, RT, ST, DM, RR)	Less than 100Ω, differential.
Impedance (SD, TT, MC)	100, ± 20Ω, differential.
Polarity	True when B positive with respect to A. False when A positive with respect to B.
Phasing (TT, RT)	False-to-true transition nominally in center of data bit.
Symmetry (ST, TT, RT)	50%, ± 5%.
Frequency Stability (ST)	± 100 ppm.
Modulator Fault	Open collector output, 15V max, 20 mA max current sink. Fault is open circuit.
Demodulator Fault	Open collector output, 15V max, 20 mA max current sink. Fault is open circuit.

G.3.2 Clock Synthesizer/Dejitter Circuit

Reference Clk Sources	Transmit Clk Receive Data Clk External Reference Clk (MC) Modem Internal Clk (SCT)
Reference Clk Input	32 kHz to 10 MHz, in 8 kHz steps
Synthesized TX Clock	56 to 2048 kHz, in 8 kHz steps
Synthesized RX Clock	56 to 2048 kHz, in 8 kHz steps
Jitter Gain	Synth Clk Freq/Ref Clk Freq, modified by a 1-pole (20 dB/decade) low-pass response corner at 0.4 Hz

G.3.3 Doppler Buffer Parameters

Buffer Size (bits)	512, 1024, 2048, 4096, 8192, 16384, 32768
Clock Source	Synthesized RX Clock
Data Rate	56 to 2048 kbit/s
Indicators	Buffer Overflow (stored fault) Buffer Underflow (stored fault)
Controls	Reset Buffer to Center Buffer Depth
Misc.	Buffer automatically recenters on Over/Underflow, power-on, or start of service

G.4 Configuration Guide

Menu Selection	Options
BBLoopBk (Baseband Loopback)	OFF/ON
EXT_REF (Station Clock Freq)	n kHz (must be evenly divisible by 8 kHz)
REF_CLK (Ref Clock Source)	Transmit Receive External (MC) Internal (SCT)
TX_clock	External (TT) Internal (Synthesizer)
RX_clock	Normal/Inverted
BUF_CNTR (Center Doppler Buffer)	YES/NO
BUF_DPTH (Buffer Depth, bits)	512 bit 1024 bit 2048 bit 4096 bit 8192 bit 16384 bit 32768 bit

Notes:

1. Reference clock source is temporarily set to Receive clock during baseband loopback.
2. Do not set TX_clock to REF_CLK when REF_CLK source is TX_clock, as this makes an unstable loop.
3. Send Data (SD) must be long-term synchronous with Send Timing (ST), unless REF_CLK source is Transmit and TX_clock is External (this is the recommended dejitter configuration).
4. EXT_REF frequency selection is a “don’t care” unless REF_CLK is selected to External. The M&C processor automatically sets the proper division rate for the clock synthesizer in the other cases.

G.4.1 Modulator/Coder Defaults

TXA	Transmit Filter A	7/8 code rate, 56 kbit/s
TXB	Transmit Filter B	3/4 code rate, 56 kbit/s
TXC	Transmit Filter C	1/2 code rate, 56 kbit/s
TXD	Transmit Filter D	1/2 code rate, 64 kbit/s
TXR	Transmit Rate Selected	“A” 7/8, 56 kbit/s
TX_Freq	Transmitter Frequency	70 MHz
RF_Out	RF Output	OFF
TX_Power	Transmit Power Level	-10 dBm
Scramblr	Scrambler	ON
DifEncdr	Differential Encoder	ON
CW_Mode	Continuous Wave Mode	OFF

G.4.2 Demodulator/Decoder Defaults (Dmd_Flts)

RXA	Receive Filter A	7/8 decode rate, 56 kbit/s
RXB	Receive Filter B	3/4 decode rate, 56 kbit/s
RXC	Receive Filter C	1/2 decode rate, 56 kbit/s
RXD	Receive Filter D	1/2 decode rate, 64 kbit/s
RXR	Receive Rate Selected	"A" 7/8, 56 kbit/s
RX-Freq	Receiver Frequency	70 MHz
Dscrmblr	Descrambler	ON
IFLoopBK	IF Loopback	OFF
RFLoopBK	RF Loopback	OFF
SWP-RACQ	Sweep Re-acquisition	0 Sec
SWP-CNTR	Sweep Center	0 Hz
SWP-RNGE	Sweep Range	5000 Hz
SWP-DIR	Sweep Direction	Forward
BERThsld	BER Threshold	None

G.4.3 Interface Defaults

BBLOOPBK	Baseband Loopback	OFF
REF_CLK	Reference Clock	Transmit
TX_CLOCK	Transmit Clock	REF_clk
RX_CLOCK	Receive Clock	Normal
BUF_DPTH	Buffer Depth	512 bits

G.5 Front Panel Operation

The operation of the front panel has the same "look and feel" as the standard modem, except there are a few additional commands for the Trojan interface.

Note: For general information on front panel operation, refer to Chapter 4.

Refer to Tables G-1 through G-8 for front panel menus and options for the SDM-650B with the Trojan interface option installed.

G.5.1 Menus and Options Overview

Refer to Section G.5.2 for menu and option explanations.

The "T" after the software version designates "Trojan."

Table G-1. Main Front Panel Menu (Trojan Interface)

Menus	Submenus/Options	Comments
SDM-650S SW_4.13T		This is an information-only screen.
SELECT CONFIG	MOD DEMOD INTRFACE	Go to Table G-2. Go to Table G-3. Go to Table G-4.
SELECT MONITOR	Raw_BER Corr_ BER Eb/NO SWP_FREQ RXSignal	Go to Table G-5. Go to Table G-5. Go to Table G-5. Go to Table G-5. Go to Table G-5.
SELECT FAULTS	MOD Flts DMD Flts Ceq Flts	Go to Table G-6. Go to Table G-6. Go to Table G-6.
SELECT StFAULTS	MOD DMD Flts Ceq Flts CLEAR??	Go to Table G-7. Go to Table G-7. Go to Table G-7. Go to Table G-7.
SELECT UTILITY	Time Date LAMP TEST?? ADD/PARITY/BAUD RATE POW ADJ OP MODE FAST ACQ FILTERS ADJUST Assign TX_Fltrs Assign RX_Fltrs	Go to Table G-8. Go to Table G-8. Go to Table G-8. Go to Table G-8. Go to Table G-8. Go to Table G-8. Go to Table G-8. Go to Table G-8. Go to Table G-8. Go to Table G-8.

Table G-2. Select Configuration Modulator Menu

Menus	Submenus/Options	Comments
TX-x Code_Rate	x = A, B, C, D, or V	
TX_Freq	50.0000 to 90.0000 MHz or 100.000 to 180.000 MHz	In 2.5 kHz steps.
RF_Out	ON OFF	
TX_Power	-5.0 dBm to -25 dBm	In 0.5 dBm steps.
Scramblr	ON OFF	
DifEncdr	ON OFF	
CW_Mode	Center Dual Offset	

Table G-3. Select Configuration Demodulator Menu

Menus	Submenus/Options	Comments
RX-x Code Rate	x = A, B, C, D, or V	
RX_Freq	50.000 to 90.0000 MHz or 100.000 to 180.000 MHz	In 2.5 kHz steps.
Dscrmblr	ON OFF	
IFLoopBk	ON OFF	
RFLoopBk	ON OFF	
SWP_RACQ	0 to 999 Seconds	
SWP_CNTR	-25000 to +25000 Hz	Displays information when fast acquisition has been turned ON in the Utility menu.
SWP_RNGE	0 to 50000 Hz	Displays information when fast acquisition has been turned ON in the Utility menu.
SWP_DIR	FORWARD + REVERSE -	Displays information when fast acquisition has been turned ON in the Utility menu.
BERT_set	1E-3 1E-4 1E-5 1E-6 1E-7 1E-8 NONE	

Table G-4. Select Configuration Interface Menu

Menus	Submenus/Options	Comments
TX_Clock	REF_CLK External	
RX_Clock	Normal Inverted	
BUF_CNTR	YES/NO?	
BUF_DPTH	512 to 32768 bits	
BBLoopBk	ON OFF	
EXT_REF	8 kHz to 10 MHz	In 8 kHz steps.
Ref_Clk	Transmit Receive External Internal	

Table G-5. Select Monitor Menu

Menus	Submenus/Options	Comments
Raw_BER	Range: < 1.0E-4 to 2550E-4	
Corr_BER	Range: > 1E-8 to > 1E-3	
Eb/N0	Range: < 3.2 dB to > 9.7 dB	
SWP FREQ	Range: -25000 to +25000 Hz	Displays information when fast acquisition has been turned ON in the Utility menu.
RXSignal	Range: < -60 dBm to > -30 dBm	

Note: Data is not available or displayed when the decoder loses lock.

Table G-6. Select Faults (StFaults) Menu

Menus	Submenus/Options	Comments
Mod Flts	RF_Syn Data_Clk TClk_Syn I-Channl Q-Channl AGC_levl Module	
Dmd Flts	C_Detect RF_Syn Data_Clk I-Channl Q-Channl Dscramblr BERthrsh Module	
CEq Flts	Battery -12 volt +12 volt +5 volt BUF_UNFL BUF_OVFL Controlr Intrface	

Note: Fault conditions are displayed as a "+" on the screen.

Table G-7. Select StFaults Menu

Menus	Submenus/Options	Comments
Mod Fltx MM/DD/YY HH/MM/SS	RF_Syn Data_Clk TClk_Syn I-Channl Q-Channl AGC_levl Module	Mod Flt0 through Mod Flt9.
Dmd Fltx MM/DD/YY HH/MM/SS	C_Detect RF_Syn Data_Clk I-Channl Q-Channl Dscrambl BERthrsh Module	Dmd Flt0 through Dmd Flt9.
CEq Fltx MM/DD/YY HH/MM/SS	Battery -12 volt +12 volt +5 volt BUF_UNFL BUF_OVFL Controlr Intrface	CEq Flt0 through CEq Flt9.
CLEAR ?? StFaults	YES/NO	

Table G-8. Select Utility Menu

Menus	Submenus/Options	Comments
Time	SS HH:MM AM/PM	Seconds (SS). Reset at [ENTER].
Date	MM/DD/YY	
LAMP TEST??	YES	Press [ENTER] to illuminate all front panel LEDs for three seconds.
Add: 1 xxxxyyyy	Address = 0 to 255 xxxx = Parity Odd Even yyyy = 110 to 9600 Baud Rate	
POW ADJ	+20 dBm to -20 dBm	In 0.5 dBm steps.
OP MODE	TX ONLY RX ONLY DUPLEX	
FAST ACQ	ON OFF	
FILTERS ADJUST	MOD ADJ. DMD ADJ.	This is a factory setting and should not be changed by unauthorized persons.
Assign TX_Fltrs	Filters = A, B, C, D, or V	
Assign RX_Fltrs	Filters = A, B, C, D, or V	

G.5.2 Menu Explanations

Note: Only the differences between the standard front panel menus and the Trojan interface menus are discussed in this section.

G.5.2.1 Select Configuration

Refer to Chapter 4 for explanations of menus and options.

G.5.2.2 Select Monitor

Refer to Chapter 4 for explanations of menus and options.

G.5.2.3 Select Faults

Refer to Chapter 4 for explanations of menus and options.

G.5.2.3.1 Modulator Faults (Mod_Flts)

Refer to Chapter 4 for explanations of menus and options.

G.5.2.3.2 Demodulator/Decoder Faults (Dmd_Flts)

Refer to Chapter 4 for explanations of menus and options.

G.5.2.3.3 Common Equipment Faults (CEq_Flts)

Refer to Table H-6. (Refer to Chapter 4 for explanations of menus and options that are not provided in this section.)

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.

G.5.2.4 Select Stored Faults (StFaults)

Refer to Chapter 4 for explanations of menus and options.

G.5.2.5 Select Utility

Refer to Chapter 4 for explanations of menus and options.

G.6 Remote Control Operation

This section describes the remote control operation of the SDM-650B with the Trojan interface installed.

- Firmware number: FW/0713-70A
- Software version: 4.13T

G.6.1 General

Remote controls and status information are transferred via an RS-485 (optional RS-232-C) serial communications link.

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

The remote communications link is operated in a half-duplex mode. Communications on the remote link are initiated by a remote controller or terminal.

The modem never transmits data on the link unless it is commanded to do so.

G.6.1.1 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- 7 information bits
- 1 parity bit (odd/even)
- 2 stop bits

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

The general message structure is as follows:

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

G.6.1.1.1 Start Character

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

- “<” for commands
- “>” for responses

G.6.1.1.2 Device Address

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

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

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

G.6.2 Command/Response

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

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

- `>add/?ER1_PARITY ERROR”cr””lf”]`
  (Error message for received parity errors.)

- `>add/?ER2_INVALID PARAMETER”cr””lf”]`
  (Error message for a recognized command which cannot be implemented or has parameters which are out of range.)
- `>add/?ER3_UNRECOGNIZABLE COMMAND”cr””lf”]`
  (Error message for unrecognizable command or bad command syntax.)

- `>add/?ER4_MODEM IN LOCAL MODE”cr””lf”]`
  (Modem in local error; 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.)

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

G.6.3 End Character

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

- “cr” Carriage return character for commands
- “]” End bracket for responses

G.6.4 Configuration Commands/Responses

G.6.4.1 Modulator

G.6.4.1.1 Set Modulator Frequency

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

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

Where:

nnn.nnnn = 50.0000 to 90.0000 MHz.

For the 140 MHz modulator, nnn.nnnn = 50.0000 to 90.0000, and 100.0000 to 180.0000 MHz.

Note: When modulator frequency is changed, the RF output is switched OFF.

G.6.4.1.2 Set RF Output

Command: <add/RF_xxx”cr”
Response: >add/RF_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

G.6.4.1.3 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.

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.

G.6.4.1.3.1 Modulator Filter Rate Assignment

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

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

Where:
x = A, B, C, or D (Filter designator).
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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”]

G.6.4.1.3.2 Select Modulator Rate

Command: <add/SMRx_”cr”
Response: >add/SMRx_”cr”
RF_OFF”cr””lf”]

Status Only: *(See the MR command.)*

Where: x = A, B, C, or D (Filter designator).

Notes:

1. Setting the modulator turns OFF the RF transmitter.
2. If the modem is commanded to a filter (rate) which is not assigned (N/A), the error 2 message will be returned.

G.6.4.1.3.3 Select Modulator Rate Variable

Note: This command is only applicable for the variable rate option.

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

Status Only: *(See the MR command.)*

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

Note: Setting the modulator turns OFF the RF transmitter.

G.6.4.1.3.4 Set Modulator Power Offset

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

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

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

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

G.6.4.1.3.5 Set Modulator Output Power Level

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

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

Where:
For the 140 MHz modulator, snn.n = +20.0 to -45.0, in 0.5 dB increments.
For the 70 MHz modulator, snn.n = +20.0 to -30.0, in 0.5 dB increments.

Notes:

1. Power levels may be programmed for a maximum value specified by the modulator power, offset with a range of 25 and 10 dB below the maximum value for the 140 MHz modulator and the 70 MHz modulator, respectively.
2. See the “MPO_” command specification for more information.

G.6.4.1.3.6 Scrambler Enable

Command: <add/SE_xxx”cr”
Response: >add/SE_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

G.6.4.1.3.7 Differential Encoder Enable

Command: <add/DENC_xxx”cr”
Response: >add/DENC_xxx”cr”lf”]

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

Where: xxx = ON or OFF.

G.6.4.2 Demodulator

G.6.4.2.1 Set Demodulator Frequency

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

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

Where: For the 140 MGz modulator, nnn.nnnn = 50.0000 to 90.0000, and 100.0000 to 180.0000.

G.6.4.2.2 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.

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.

G.6.4.2.2.1 Demodulator Filter Rate Assignment

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

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

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Decoder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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”]`

G.6.4.2.2.2 Select Demodulator Rate

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

Status Only: *(See the DR command.)*

Where: x = A, B, C, or D (Filter designator).

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

G.6.4.2.2.3 Select Demodulator Rate Variable

Note: This command is only applicable for the variable rate option.

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

Status Only: *(See the DR command.)*

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

G.6.4.2.3 Descramble Enable

Command: <add/DE_xxx”cr”
Response: >add/DE_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

G.6.4.2.4 IF Loopback

Command: <add/IFL_xxx”cr”
Response: >add/IFL_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

G.6.4.2.5 RF Loopback

Command: <add/RFL_xxx”cr”
Response: >add/RFL_xxx”cr””lf”]

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

Where: xxx = ON or OFF.

G.6.4.2.6 Sweep Reacquisition

This command is used to specify time duration of the reacquisition mode. The sweep is reduced to ± 2500 Hz 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”
Response: >add/SR_xxx”cr””lf”]

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

Where: xxx = 0 to 999 (number of seconds).

G.6.4.2.7 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 128 kbit/s or lower. However, if the sweep range is set to less than 50 kHz, 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”]`

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

Where: xxx = ON or OFF (OFF disables fast acquisition and directed sweep modes).

G.6.4.2.8 Sweep Center Frequency

This command sets the sweep center frequency. During carrier acquisition, the sweep starts at an 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 +25000 to -25000 Hz.

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

Status Only: `<add/SCF_”cr”`
Response: `>add/SCF_xnnnnn”cr””lf”]`

Where:
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.

G.6.4.2.9 Sweep Width Range

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

Command: <add/SWR_nnnnn”cr”
Response: >add/SWR_nnnnn”cr””lf”]

Status Only: <add/SWR_”cr”
Response: >add/SWR_nnnnn”cr””lf”]

Where: nnnnn = 0 to 50000.

Note: This command is only valid when Fast Acquisition is enabled. See the “FAM_” command definition.

G.6.4.2.10 Sweep Direction

This command sets the direction of the sweep travel. “+” sets incremental sweep, while “-” sets decremental sweep.

Command: <add/SD_s”cr”
Response: >add/SD_s”cr””lf”]

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

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

Note: This command is only valid when Fast Acquisition is enabled. See the “FAM_” command definition.

G.6.4.2.11 Bit Error Rate Threshold

Command: <add/BERT_xxxx”cr”
Response: >add/BERT_xxxx”cr””lf”]

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

Where: xxxx = NONE or 1E-n (n = 3, 4, 5, 6, 7, or 8 [exponent of threshold]).

G.6.4.3 Interface/Doppler Buffer

G.6.4.3.1 Baseband Loopback

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

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

Where: xxx = ON or OFF.

G.6.4.3.2 Transmit Clock

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

Status Only: `<add/TC_”cr”`
Response: `>add/TC_xxx”cr””lf”]`

Where: xxx = REF (Reference) or EXT (External).

G.6.4.3.3 Receive Clock

Command: `<add/RC_xxx”cr”`
Response: `add/RC_xxx”cr””lf”]`

Status Only: `<add/RC_”cr”`
Response: `>add/RC_xxx”cr””lf”]`

Where: xxx = NRM (Normal) or INV (Invert).

G.6.4.3.4 External Reference Frequency

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

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

Where: nnnnn = 8 to 10000 kHz, in 8 kHz steps.

G.6.4.3.5 Interface Reference Clock

Command: <add/IRC_xxx”cr”
Response: >add/IRC_xxx”cr””lf”]

Status Only: <add/IRC_”cr”
Response: >add/IRC_xxx”cr””lf”]

Where: xxx = TXC (Transmit), RXC (Receive), EXT (External), or INT (Internal).

G.6.4.3.6 Interface Buffer Center

This command centers the Doppler buffer.

Command: <add/IBC_”cr”
Response: >add/IBC_”cr””lf”]

G.6.4.3.7 Interface Buffer Depth

This command sets the Doppler buffer depth in bits.

Command: <add/IBD_nnnnn”cr”
Response: >add/IBD_nnnnn”cr””lf”]

Status Only: <add/IBD_”cr”
Response: >add/IBD_nnnnn”cr””lf”]

Valid buffer depths are 512, 1024, 2048, 4096, 8192, 16384, and 32768.

G.6.4.4 System Commands/Responses

G.6.4.4.1 Time of Day

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

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

Where:
hh = hours.
mm = minutes.
xx = AM or PM.

Example:

Set modem 67 time to 10:45PM.

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

G.6.4.4.2 Date

Command: `<add/DATE_mm/dd/yy”cr”`
Response: `>add/DATE_mm/dd/yy”cr””lf”]`

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

Where:
mm = month.
dd = day.
yy = year.

Example:

Set modem 235 date to 11/30/87.

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

G.6.4.4.3 Remote

Configures the modem for remote operation. The modem will respond to any status request at any time. However, the modem must be in “Remote Mode” to change configuration parameters.

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

G.6.4.4.4 Clear Stored Faults

This command is used to clear all stored faults logged by the modem.

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

G.6.4.4.5 Modem Operation Mode

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

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

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

Where: xxxxxxx = TX_ONLY, RX_ONLY, or DUPLEX.

G.6.4.5 Status Commands/Responses

G.6.4.5.1 Configuration

G.6.4.5.1.1 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
	SE_xxx”cr”	Scrambler enable (ON/OFF)
	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)*

G.6.4.5.1.2 Modulator/Coder Configuration Program

This command is used by the SMS-658 or SMS-758 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
	SE_xxx”cr”	Scrambler enable (ON/OFF)
	DENC_xxx”cr”	Differential encoder (ON/OFF)
	BBL_xxx”cr”	Baseband Loopback
	TC_xxx”cr”	Transmit Clock (REF/EXT)
	ERF_nnnnn”cr”	External Reference Frequency (kHz)
	IRC_xxx”cr”	Interface Reference Clock source (TXC/RXC/EXT/INT)
	RF_xx”cr””lf”]	RF output

G.6.4.5.1.3 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 data 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
	DE_xxx”cr”	Descrambler enable (ON/OFF)
	RC_xxx”cr”	Receive clock (NRM/INV)
	BBL_xxx”cr”	Baseband loopback (ON/OFF)
	RFL_xxx”cr”	RF loopback (ON/OFF)
	BERT_xxxx”cr”	BER Threshold
	SR_xxx”cr”	Sweep Reacquisition (seconds)
	IFL_xxx”cr”	IF loopback (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.

G.6.4.5.1.4 Demodulator/Decoder Configuration Program

This command is used by the SMS-658 or SMS-758 M:N protection switch to collect information that is necessary to configure back-up modems.

Command:	<add/DCP_”cr”	
Response:	>add/DCP_”cr”	
	IFL_xxx”cr”	IF loopback (ON/OFF)
	RFL_xxx”cr”	RF loopback (ON/OFF)
	DF_nnn.nnnn”cr”	Demodulator frequency
	DR_nnn_mmmm.m”cr”	Demodulator data rate
	DE_xxx”cr”	Descrambler enable (ON/OFF)
	BERT_xxxx”cr”	BER Threshold
	SR_xxx”cr”	Sweep Reacquisition (seconds)
	BBL_xxx”cr”	Baseband Loopback
	RC_xxx”cr”	Receive Clock (INV/NRM)
	ERF_nnnnn”cr”	External Reference Frequency (kHz)
	IRC_xxx”cr”	Interface Reference Clock source (TXC/RXC/EXT/INT)
	IBD_nnnnn”cr”	Interface Buffer Depth (in bits)
	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.

G.6.4.5.1.5 Interface Configuration Status

This 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”	
	BBL_xxx”cr”	Base Band Loopback (ON/OFF)
	TC_xxx”cr”	Transmit Clock (REF/EXT)
	RC_xxx”cr”	Receive Clock (INV/NRM)
	ERF_nnnnn”cr”	External Reference Frequency (kHz)
	IRC_xxx”cr”	Interface Reference Clock source (TXC/RXC/EXT/INT)
	IBD_nnnnn”cr””lf”]	Interface Buffer Depth (in bits)

G.6.4.5.2 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””lf”]`	Common Equipment (FLT/OK)

G.6.4.5.3 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 will not 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)

G.6.4.5.4 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)
	`DSCR_xxx”cr”`	descrambler (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)

G.6.4.5.5 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)
	`REF_xxx”cr”`	Interface Reference Clock (OK/FLT)
	`OVFL_xxx”cr”`	Doppler Buffer overflow (OK/FLT)
	`UNFL_xxx”cr”`	Doppler Buffer underflow (OK/FLT)
	`BAT_xxx”cr”`	battery (OK/FLT)
	`PS1_xxx”cr”`	+5V power supply (OK/FLT)
	`PS2_xxx”cr”`	+12V power supply (OK/FLT)
	`PS3_xxx”cr”`	-12V 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)

G.6.4.5.6 Bit Error Rate Status

G.6.4.5.6.1 Raw BER

Command: `<add/RBER_”cr”`
Response: `>add/RBER_nnnnE-4”cr””lf”]`

Where: nnnn = RBER or < 1.0 (lower limit).

Example:

Request Raw BER from modem 123.

Command:	`<123/RBER_”cr”`	
Response:	`>123/RBER_152E-4”cr””lf”]`	RBER = 0.0152 errors/bit

Note: “No Data” is returned if no carrier is detected (decoder not locked).

G.6.4.5.6.2 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_2E-5”cr””lf”] CBER = 0.00002 errors/bit

Notes:

1. Corrected BER limits are lower < 1E-8, upper > 01E-3.
2. “No Data” is returned if no carrier is detected (decoder not locked).

G.6.4.5.7 E_b/N_0

The E_b/N_0 status command causes the E_b/N_0 ratio to be returned. E_b/N_0 is returned in dB.

Command: <add/EBN0_”cr”
Response: >add/EBN0_n.ndB”cr””lf”]

Example:

Request E_b/N_0 ratio from modem 2.

Command: <2/EBN0_”cr”
Response: >2/EBN0_6.2dB”cr””lf”] Eb/N0 = 6.2 dB

Notes:

1. E_b/N_0 limits are lower < 3.2 dB, upper > 9.7dB.
2. “No Data” is returned if no carrier is detected (decoder not locked).

G.6.4.5.8 Modulator Rate

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

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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

G.6.4.5.9 Demodulator Rate

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

Where:
nnn = 1/2, 3/4, 7/8, or BP12 (Coder rate).
mmmm.m = 9.6 to 4080.0 (Data rate).

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

G.6.4.5.10 Receive Signal Level

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

G.6.4.5.11 Current Sweep Value

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

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

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

G.6.4.5.12 Stored Faults

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

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

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

G.6.4.5.12.1 Modulator Stored Faults

Command:	<add/MSF_#”cr”	
Response:	>add/MSF_# hh:mm:ss MM/DD/YY”cr”	
	MOD_xxx”cr”	Module missing or wont 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)

G.6.4.5.12.2 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)
	DSCR_xxx”cr”	descrambler (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)

G.6.4.5.12.3 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)
	REF_xxx”cr”	Interface Reference Clock (OK/FLT)
	OVFL_xxx”cr”	Doppler Buffer overflow (OK/FLT)
	UNFL_xxx”cr”	Doppler Buffer underflow (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)

G.6.4.5.13 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″]). For standardization reasons, some parameters may not be implemented but will retain the terminating "," (comma). Most of the data returned is formatted the same way as the single command status request (refer to the appropriate portions of this document in preceding sections).

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

Where: pn =

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 = nnnn.nnnn, where "nnnn.nnnn" is the modulator IF frequency in MHz.
Parameter 3 (p3): Modulator output power level.
p3 = snn.n, where "snn.n" is the transmitter 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 kbit/s.
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 kbit/s.
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 kbit/s.
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 kbit/s.
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 kbit/s.
Parameter 9 (p9): Scrambler enable ON/OFF.
p9 = n, where "n" is "0" to indicate off or "1" to indicate on.
Parameter 10 (p10): Carrier only mode ON/OFF.
p10 = n, where "n" is "0" to indicate off or "1" to indicate on.
Parameter 11 (p11): Differential encoder enable ON/OFF.
p11 = n, where "n" is "0" to indicate off or "1" to indicate on.
Parameter 12 (p12): Transmit clock source (Reference/External).
p12 = n, where "n" is "0" or "1" ("0" = REF, "1" = EXT).
Parameter 13 (p13): Demodulator IF frequency.
p13 = nnnn.nnnn, where "nnnn.nnnn" is the demodulator IF frequency in MHz.
Parameter 14 (p14): Demodulator rate currently programmed.
p14 = nnn_mmmm.m, where "nnn" is the code rate, and "mmmm.m" is the data rate in kbit/s.

Parameter 15 (p15): Demodulator filter A assignment.
p15 = nnn_mmmm.m, where “nnn” is the code rate, and “mmmm.m” is the data rate in kbit/s.
Parameter 16 (p16): Demodulator filter B assignment.
p16 = nnn_mmmm.m, where “nnn” is the code rate, and “mmmm.m” is the data rate in kbit/s.
Parameter 17 (p17): Demodulator filter C assignment.
p17 = nnn_mmmm.m, where “nnn” is the code rate, and “mmmm.m” is the data rate in kbit/s.
Parameter 18 (p18): Demodulator filter D assignment.
p18 = nnn_mmmm.m, where “nnn” is the code rate, and “mmmm.m” is the data rate in kbit/s.
Parameter 19 (p19): Descrambler enable ON/OFF.
p19 = n, where “n” is “0” to indicate off or “1” to indicate on.
Parameter 20 (p20): Receive clock (Invert/Normal).
p20 = n, where “n” is “0” or “1” (“0” = NRM, “1” = INV).
Parameter 21 (p21): Baseband loopback ON/OFF.
p21 = n, where “n” is “0” to indicate off, or “1” to indicate on.
Parameter 22 (p22): RF loopback ON/OFF.
p22 = n, where “n” is “0” to indicate off, or “1” to indicate on.
Parameter 23 (p23): Not implemented.
p23 = “,”.
Parameter 24 (p24): BER threshold.
p24 = nnnn, where “nnnn” is the currently programmed BER threshold in the same format as the single command “BERT_”.
Parameter 25 (p25): Sweep Reacquisition.
p25 = nnn, where “nnn” is the reacquisition parameter in seconds.
Parameter 26 (p26): IF loopback ON/OFF.
p26 = n, where “n” is “0” to indicate off, or “1” to indicate on.
Parameter 27 (p27): MODEM REMOTE/LOCAL mode.
p27 = n, where “n” is “0” to indicate local or “1” to indicate remote.
(See Note) Parameter 28 (p28): Sweep center programmed.
p28 = snnnnn, where “s” is “+” or “-”, and “nnnnn” is the sweep center currently programmed.
(See Note) Parameter 29 (p29): Sweep width range.
p29 = nnnnn, where “nnnnn” is in the range of 0 to 50000 Hz.
(See Note) Parameter 30 (p30): Sweep direction.
p30 = n, where “n” is “+” for positive or “-” for negative sweep direction.
Parameter 31 (p31): External Reference Frequency.
p31 = nnnnn, where “nnnnn” is the external reference frequency in kHz.
Parameter 32 (p32): Interface Reference Clock.
p31 = n, where “n” is “0”, “1”, “2”, or “3” (“0” = TXC, “1” = RXC, “2” = EXT, “3” = INT).
Parameter 33 (p33): Interface Buffer Depth.
p33 = nnnnn, where “nnnnn” is “512”, ”1024”, ”2048”, ”4096”, ”8192”, ”16384”, or ”32768”.

Note: Parameters 28, 29, and 30 are only returned when fast acquisition is enabled. See the “FAM_” command definition.

G.6.4.5.14 Bulk Consolidated Analog Status

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

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

Where: pn =

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 E_b/N_0 in dB.

Note: Parameters 1 through 4 are dependent on carrier acquisition. If the decoder is not locked, empty data blocks are returned (,,,).

G.6.4.5.15 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_abcdef”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 to 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 to 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 = Descrambler fault.
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 = Reference fault.
Bit 3 through Bit 0 = Binary representation (0 to 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 = Overflow fault.
Bit 0 = Underflow fault.

G.6.4.5.16 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”]`

Where: x =
“@” = 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.

G.6.4.5.17 Equipment Type

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

Command: `<add/ET_”cr”`
Response: `>add/ET_SDM650S_x.xxx”cr””lf”]`

Where: x.xxx = M&C firmware version.

Glossary

The following is a list of acronyms and abbreviations that may be found in this manual.

Acronym/ Abbreviation	Definition
Ω	Ohms
16QAM	16 Quadrature Amplitude Modulation
8PSK	8 Phase Shift Keying
A	Ampere
A/D	Analog to Digital
AC	Alternating Current
ADC	Analog to Digital Converter
ADJ	Adjust
ADMA	Amplitude Domain Multiple Access
ADPCM	Adaptive Differential Pulse Code Modulation
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
AM	Amplitude Modulation
AMI	Alternate Mark Inversion
AOC	Automatic Offset Control
APM	Amplitude Phase Modulation
ASC	Add-Select-Compare
ASCII	American Standard Code for Information Interchange
ASK	Amplitude Shift Keying
ASYNC	Asynchronous
AUPC	Automatic Uplink Power Control
AUX 1	Auxiliary 1
AVC	Automatic Volume Control
BB	Baseband
BCD	Binary Coded Decimal
BER	Bit Error Rate
BER CONT	BIT Error Rate Continuous
bit/s	Bits per second
BPSK	Bi-Phase Shift Keying

BTU	British Thermal Unit
BW	Backward Alarm or Bandwidth
BWR	Bandwidth Ratio
C	Celsius
C/N	Carrier-to-Noise Ratio
C/No	Carrier-to-Noise Density Ratio
CCITT	International Telephone and Telegraph Consultative Committee
CDMA	Code Division Multiple Access
CH	Channel
CHNL	Channel
CIC	Common Interface Circuit
CL	Carrier Loss
CLK	Clock
CLNA	C-band LNA
CLR	Clear
CMOS	Complementary Metal Oxide Semiconductor
Coax	Coaxial
Codec	Coder/Decoder
COM	Common
CPFSK	Continuous-Phase Frequency Shift Keying
CPSK	Coherent Phase Shift Keying
CPU	Central Processing Unit
cr	Carriage Return
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CS	Clear to Send
CSC	Comstream Compatible
CSMA	Carrier Sense Multiple Access
CTS	Clear to Send
CU	Channel Unit
CW	Continuous Wave
D&I	Drop and Insert
D/A	Digital-to-Analog
D/C	Down Converter
DAC	Digital-to-Analog Converter
DAMA	Demand Assignment Multiple Access
dB	Decibels
dB/Hz	Decibels/Hertz (unit of carrier-to-noise density ratio)
dBc	Decibels referred to carrier
dBm	Decibels referred to 1.0 milliwatt
dBm0	The signal magnitude in dBm referenced to the nominal level at that point
dBW	Decibels referred to 1.0 watt
DC	Direct Current
DCE	Data Circuit Terminating Equipment
DCPSK	Differentially Coherent Phase Shift Keying
DDO	Drop Data Output
DDS	Direct Digital Synthesis
Demod	Demodulator
DEMUX	Demultiplexer
DET	Detector
DM	Data Mode
DPCM	Differential Pulse Code Modulation
DPSK	Differential Phase Shift Keying
DSP	Digital Signal Processing
DSR	Data Signal Rate

DTE	Data Terminal Equipment
E&M	Ear and Mouth
E_b/N_0	Bit Energy-to-Noise Ratio
ECL	Emitter Coupled Logic
EDP	Electronic Data Processing
EEPROM	Electrically-Erasable Programmable Read-Only Memory
EFD	EFData Compatible
EIA	Electronic Industries Association
EMC	Electro-Magnetic Compatibility
EMF	Electromotive Force
EPROM	Erasable Read-Only Memory
ESC	Engineering Service Circuit or Engineering Service Channel
ESD	Electrostatic Discharge
EXC	External Clock
EXT	External Reference Clock
FDC	Fairchild Data Compatible
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FET	Field Effect Transistor
FFSK	Fast Frequency Shift Keying
FIFO	First in/First Out
Flt	Fault
FM	Frequency Modulation
FPGA	Field Programmable Gate Array
FS	Frame Sync
FSK	Frequency Shift Keying
FW	Firmware
GHz	Gigahertz (10^9 hertz)
GND	Ground
HI STAB	High Stability
HPA	High Power Amplifier
Hz	Hertz (cycle per second)
I&Q	In-Phase and Quadrature
I/O	Input/Output
IBS	INTELSAT Business Services
IC	Integrated Circuit
IDI	Insert Data Input
IDR	Intermediate Data Rate
IESS	INTELSAT Earth Station Standards
IF	Intermediate Frequency
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
ISD	Insert Send Data
k	Kilo (10^3)
KΩ	Kilo-ohms
kbit/s	Kilobits per second (10^3 bits per second)
kHz	Kilohertz (10^3 Hertz)
ks/s	Kilosymbols Per Second (10^3 symbols per second)
kW	Kilowatt (10^3 Watts)
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
lf	Line Feed
LNA	Low Noise Amplifier
LO	Local Oscillator
LSB	Least Significant Bit

LSI	Large Scale Integration (semiconductors)
m	Mille (10^{-3})
M&C	Monitor and Control
mA	Milliamperes
Max	Maximum
Mbit/s	Megabits per second
MC	Monitor and Control
MFS	Multiframe Sync
MHz	Megahertz (10^{6} Hertz)
Min	Minimum or Minute
Mod	Modulator
MOP	Modulated Output Power
MPC	Microprocessor Controller
ms	Millisecond (10^{-3} second)
Ms/s	Megasymbols per second
MSB	Most Significant Bit
MUX	Multiplexer
n	Nano (10^{-9})
N/A	Not Applicable
NACK	Negative Acknowledgment
NC	No Connection or Normally Closed
NO	Normally Open
NRZ	Non-Return to Zero (code)
ns	Nanosecond (10^{-9} second)
OQPSK	Offset Quadrature Phase Shift Keying
OSC	Oscillator
p	Pico (10^{-12})
P-P	Peak-to-Peak
P/AR	Peak to Average Ratio
PAL	Programmable Array Logic
PC	Printed Circuit
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PECL	Positive Emitter Coupled Logic
pF	PicoFarads (10^{-12} Farads)
PK	Peak
PLL	Phase-Locked Loop
PN	Pseudo-Noise
PPM	Parts Per Million
PS	Power Supply
PSK	Phase Shift Keying
PWB	Printed Wiring Board
PWR	Power
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RD	Receive Data
REF	Reference
RF	Radio Frequency
RLSD	Receive Line Signal Detect
RMA	Return Material Authorization
ROM	Read-Only Memory
RR	Receiver Ready
RS	Ready to Send
RT	Receive Timing
RTS	Request to Send

RX	Receive (Receiver)
RXCLK	Receive Clock
RXD	Receive Data
RZ	Return-to-Zero
s	Second
S/N	Signal-to-Noise Ratio
SCPC	Single Channel Per Carrier
SCR	Serial Clock Receive
SCT	Serial Clock Transmit
SCTE	Serial Clock Transmit External
SD	Send Data
SFS	Subframe Sync
SMS	Satellite Multiservice System
SN	Signal-to-Noise Ratio
SSB	Single-sideband
SSPA	Solid State Power Amplifier
ST	Send Timing
SW	Switch
SYNC	Synchronize
TB	Terminal Block
TCXO	Temperature-Compensated Crystal Oscillator
TDMA	Time Division Multiple Access
TEMP	Temperature
TERR	Terrestrial
TP	Test Point
TT	Terminal Timing
TTL	Transistor-Transistor Logic
TX	Transmit (Transmitter)
TXCLK	Transmit Clock
TXD	Transmit Data
TXO	TX Octet
U/C	Up converter
UART	Universal Asynchronous Receiver/Transmitter
UHF	Ultra-high Frequency
UNK	Unknown
US	United States
UW	Unique Word
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage-Controlled Oscillator
VCXO	Voltage-Controlled Crystal Oscillator
VDC	Volts, Direct Current
VSWR	Voltage Standing Wave Ratio
W	Watt
WG	Waveguide

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METRIC CONVERSIONS

Units of Length

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

Temperature Conversions

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

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

Units of Weight

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

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