SDM-100A

Satellite Modem
Installation and Operation Manual

Part Number MN/SDM100A.IOM
Revision 0

EFData Corporation is an ISO 9001 Registered Company

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November 27, 1996

Special Instructions:

This is the first edition of the manual.

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-100A satellite modem. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the SDM-100A.

Conventions and References 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.

Military Standards

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

Trademarks

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:

- Department of Defense (DOD) MIL-STD-188-114A, *"Electrical Characteristics of Digital Interface Circuits"*
- *EIA-STD-RS-422/449*
- *EIA-STD-RS-232-C*
- *CCITT Recommendation V.35*
- *INTELSAT Document IESS-308*
- *INTELSAT Document IESS-309*
- *EFData Specification SP/2515*

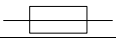
European EMC Directive

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

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

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- Information on returning a product
- Information on upgrading a product
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EFData Corporation
Attention: Customer Support Department
2105 West 5th Place
Tempe, Arizona 85281 USA

(602) 968-0447 (Main EFData Number)
(602) 517-2444 (Customer Support Desk)
(602) 921-9012 FAX

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

service@efdata.com

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

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

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

3. Ship the product back to 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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Chapter 1. INTRODUCTION

This chapter provides the description, options, and specifications for the SDM-100A satellite modem, referred to in this manual as "the modem" (Figure 1-1).

Figure 1-1. SDM-100A

1.1 Purpose and Function

The modem is ideally suited for networks implemented with digitized voice compressors. These types of circuits require the minimum processing delay provided by the modem's Viterbi decoder. A system block diagram is shown in Figure 1-2.

The modem is also employed in transportable applications, where small size and low power consumption are important.

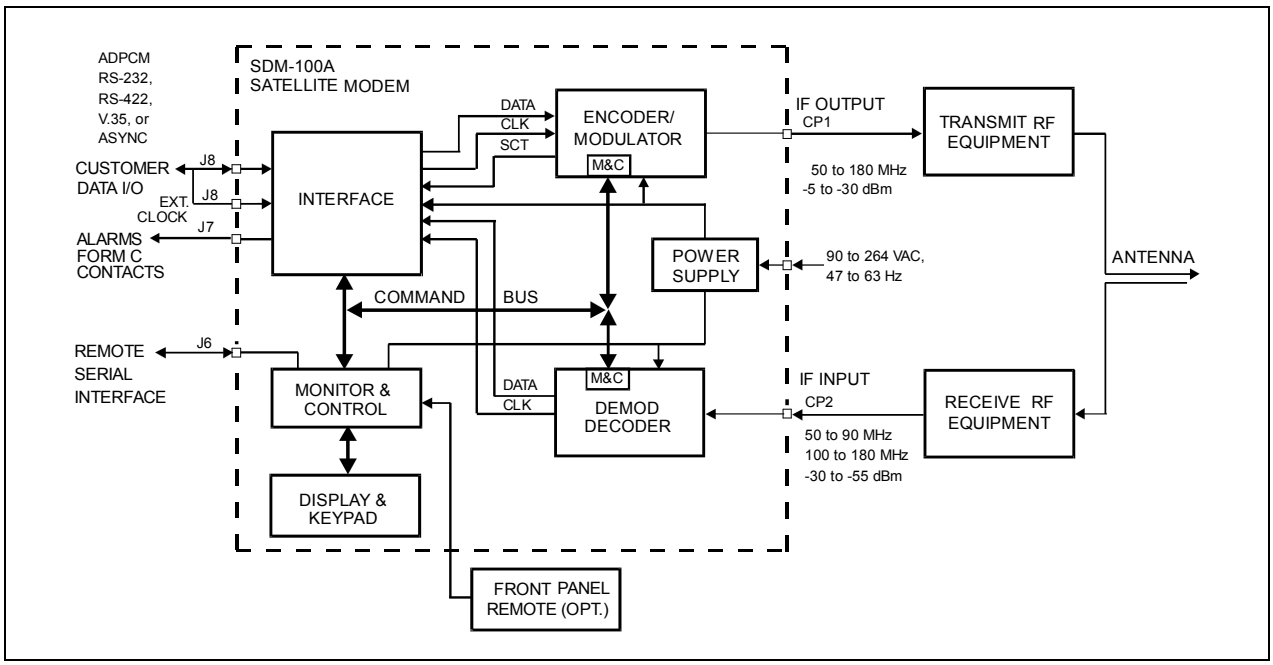

Figure 1-2. SDM-100A Block Diagram

The modem provides total flexibility in selection of the following data rates:

19.2 to 128 kbit/s	1/2 rate
28.8 to 192 kbit/s	3/4 rate
33.6 to 224 kbit/s	7/8 rate QPSK
9.6 to 64 kbit/s	1/2 rate BPSK

These parameters, as well as selection of elastic buffer, scrambler, differential encoder, power levels, and carrier frequencies, can be selected from the front panel, or by remote control via a serial interface.

Since the modem is software defined, it can be programmed to be end-to-end compatible with other manufacturer's modems at similar rates.

The modem interfaces with IF converter equipment operating in a 50 to 180 MHz band. The data interface options consist of RS-449/422, V.35, RS-232-C, ASYNC, and Adaptive Differential Pulse Code Modulation (ADPCM) voice. Changes in connectors for the various interfaces are accomplished by small, field-changeable connector modules.

Recent advances in Digital Signal Processing (DSP) have been incorporated into the modem's design. Examples of high density components employed in the modem are:

- Embedded microprocessor
- Viterbi Large Scale Integration (LSI) processors
- Direct Digital Synthesis (DDS)
- Field programmable gate arrays for logic processing

Utilization of these state-of-the-art components and surface mount technology provides maximum modem processing power in a minimum amount of space.

1.2 Description

The modem is a complete, self-contained unit in a standard 1 Unit (1U) 19" rack-mountable enclosure weighing approximately 10 lbs. A dimensional drawing of the modem is shown in Figure 1-3.

All monitor and control functions and indicators for operation of the modem are located on the front panel. The display Printed Circuit Board (PCB) is mounted on the front panel.

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/5281-X
PCB, Demod/M&C	AS/4973
PCB, Interface Daughter (RS-422)	AS/2524 *(See note below)*
PCB, Interface Daughter (V.35)	AS/2532 or AS/4326 *(See note below)*
PCB, Interface Daughter (RS232)	AS/2533 *(See note below)*
PCB, Interface Daughter (ASYNC)	AS/4089 *(See note below)*
PCB, Interface Daughter (ADPCM)	AS/3916 *(See note below)*
PCB, Modulator	AS/2522
ASIC, Sequential Decoder	IC/EFD 8858 (optional)
PCB, Mod RF	AS/3995-X
PCB, Demod RF	AS/4401-X
PCB, Reed-Solomon (SDM-100)	AS/3708-2

Where X = various options available on the modulator and demodulator boards. Refer to Table 5-2 for more information on the options available for each board.

Note: Only one interface option is shipped per modem.

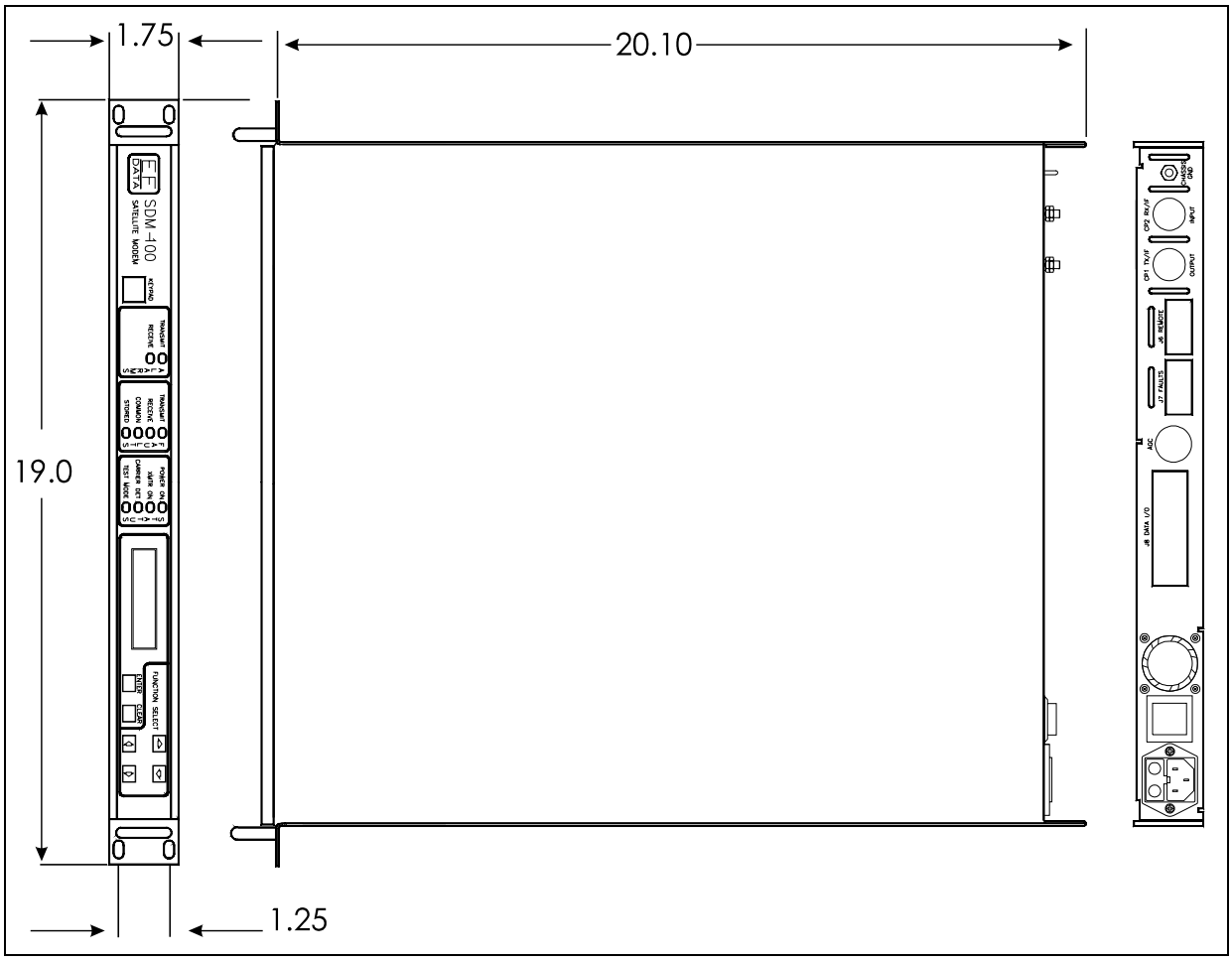

Figure 1-3. Dimensional Drawing

1.3 Options

For more information on the following options, refer to Appendix B.

1.3.1 ASYNC/AUPC Interface

The ASYNC interface board provides the interface for terrestrial data and a single ASYNC overhead channel, along with an AUPC feature.

1.3.2 ADPCM Voice

The ADPCM voice interface is capable of providing a single, duplex voice channel and Ear and Mouth (E&M) signaling data transmission.

1.4 Modem Specifications

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

Table 1-1. SDM-100A Specifications

Modem Specifications	
Operating Frequency Range	50 to 180 MHz, synthesized in 2.5 kHz steps.
Type of Modulation	Quadrature Phase Shift Keying (QPSK), or Bi-Phase Shift Keying (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 a minimum of 1.2 times the specified acquisition range.
Bit Error Rate	See Table 1-2.
Phase Noise	In accordance with IESS-308.
Digital Interface (Field Changeable Plug-in modules) (One interface per module.)	RS-422/449 on 37-pin D. MIL-STD-188 on 37-pin D. V.35 on 25-pin DIN. RS-232-C on 25-pin D. Asynchronous. ADPCM.
Digital Data Rate BPSK, 1/2 Rate QPSK, 1/2 Rate QPSK, 3/4 Rate QPSK, 7/8 Rate	 9.6 to 64 kbit/s. 19.2 to 128 kbit/s. 28.8 to 192 kbit/s. 33.6 to 224 kbit/s.
Doppler Buffer	Programmable from 64 to 65536 bits, or from 1 to 50 ms total depth.
Buffer Output Clock	Transmit, Receive, Internal, or External. Transmit and external clocks must be to data rate.
Forward Error Correction	Convolutional Encoding with Soft Decision. K=7 Viterbi Decoding, or Sequential.
Data Scrambling	Selectable (International Telephone and Telegraph Consultative Committee) CCITT V.35, or None.
Prime Power	90 to 264 VAC Auto Select, 47 to 63 Hz, 50W Max., Fused at 2A. (48 VDC optional.)
Size	1.75” H x 19.0” W x 20.0” D. Refer to Figure 1-3.
Operating Temperature	0° to 50°C.
Storage Temperature	-20° to +70°C.
Humidity	0 to 95% noncondensing.
Diagnostic Features	IF Loopback. RF Loopback. Baseband Loopback (Bi-directional, electrical). Fault Monitoring. Bit Error Rate Monitoring. Remote Control via Serial Port.

Additional Modulator Specifications	
Output Power	-5 to -30 dBm, adjustable in 0.1 dB steps.
Output Spurious and Harmonics	-55 dBc in 4 kHz BW in-band (50 to 180 MHz). -55 dBc in 4 kHz BW out-of-band (0 to 500 MHz).
Output Impedance	75Ω standard, or 50Ω optional.
Output Return Loss	20 dB.
Output Frequency Stability	± 10 PPM.
Data Clock Source	Internal or external. External clock, ± 100 PPM and < 5% jitter.
Internal Data Clock Stability	± 10 PPM.
Additional Demodulator Specifications	
Input Power (Desired Carrier)	-30 to -55 dBm (composite). +30 dB power within 2 MHz from desired carrier. +40 dB power outside of 2 MHz from desired carrier. -5 dBm maximum composite.
Input Impedance	75Ω standard, or 50Ω optional.
Input Return Loss	20 dB.
Carrier Acquisition Range	± 25 kHz minimum.
Clock Acquisition Range	± 100 PPM.
Acquisition Time	< 1 second typical at 64 kbit/s.
Directed Sweep: Sweep Range Sweep Center	 0 to 70000 Hz. -35000 to +35000 Hz.
Remote Control Specifications	
Serial Interface	RS-232-C or RS-485, Baud Rate 110 to 19,200 bit/s. Protocol not necessarily compatible with SDM-650B or SDM-308B.
Signals Controlled/Monitored	Transmit Frequency. Receive Frequency. Transmit Power. Transmitter On/Off. Data Rate Select. IF Loopback. RF Loopback. Baseband Loopback. Scrambler On/Off. Descrambler On/Off. Sweep Range. Sweep Center. Filter Mask. Raw Error Rate. Corrected Bit Error Rate. Receive E_b/N_0. TX Clock Internal/External. RX Clock Normal/Invert. Receive Signal Level. Receive Carrier Detect. Power Supply Voltages. Fault Status. Stored Fault Status.
Configuration Retention	Will maintain current configuration for up to one year 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.	

1.5 BER Performance

The bit energy-to-noise ratio (E_b/N_0) required to achieve 10^{-5} to 10^{-7} bit error rates is listed in Table 1-2.

Table 1-2. BER Performance Specification

Viterbi K = 7			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-5}	5.5 dB	6.8 dB	8.1 dB
10^{-7}	6.7 dB	8.3 dB	9.4 dB

The Bit Error Rate (BER) performance of the modem with a Viterbi decoder is shown in Figure 1-4.

The BER performance of the modem with a sequential decoder is shown in Figure 1-5.

A typical output spectrum of the modem is shown in Figure 1-6.

Notes:

1. The modem alone, without coding, provides operation within 0.5 dB of theoretical for BPSK, and within 0.8 dB for QPSK, for BERs in the range 10^{-1} to 10^{-6}.

2. Performance measurements are made with Transmit and Receive IF connected back-to-back through an additive white Gaussian noise channel.

3. The BER performance is in accordance with IESS-308 specifications.

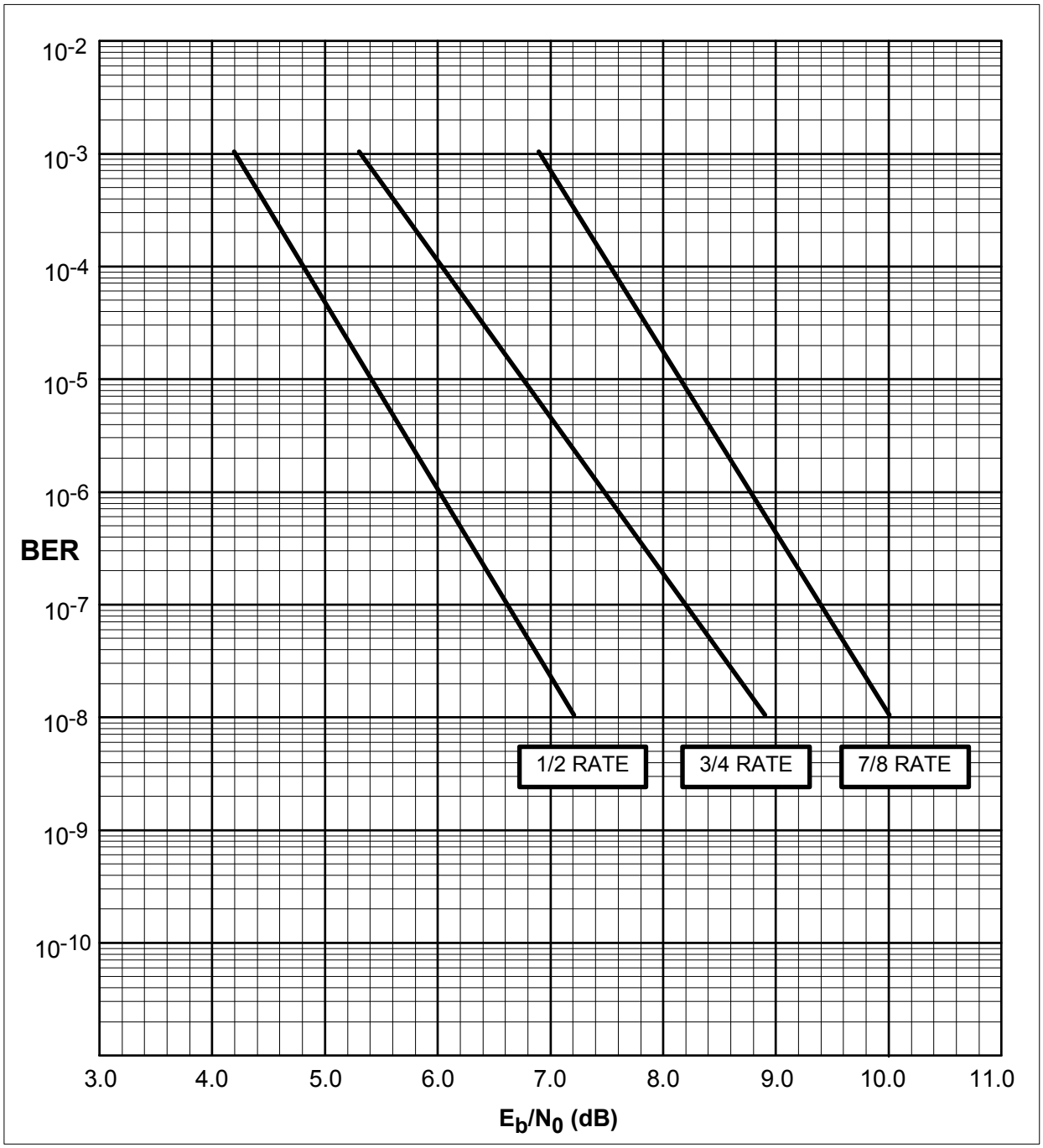

Figure 1-4. Viterbi Bit Error Rate Performance

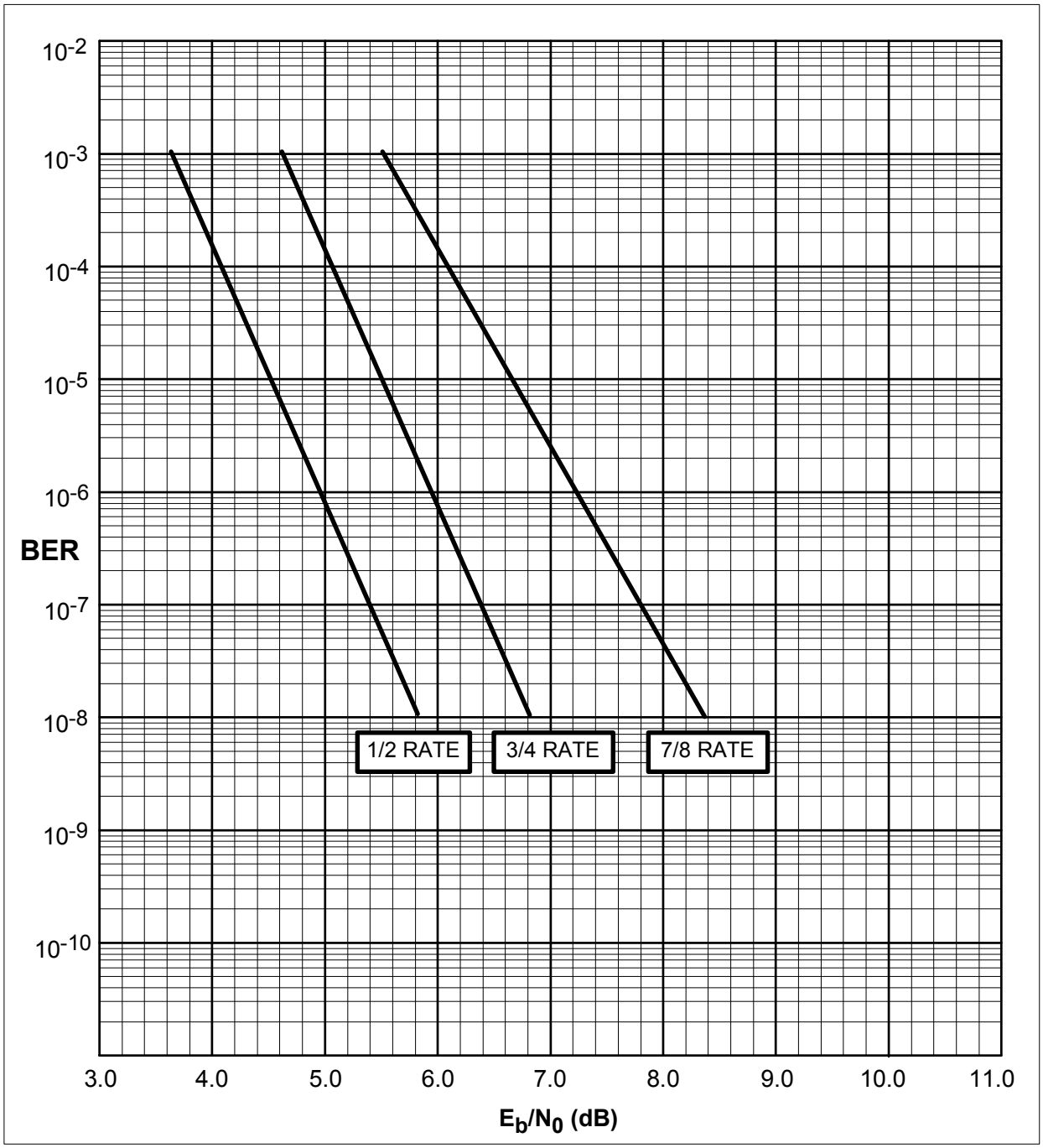

Figure 1-5. Sequential Bit Error Rate Performance

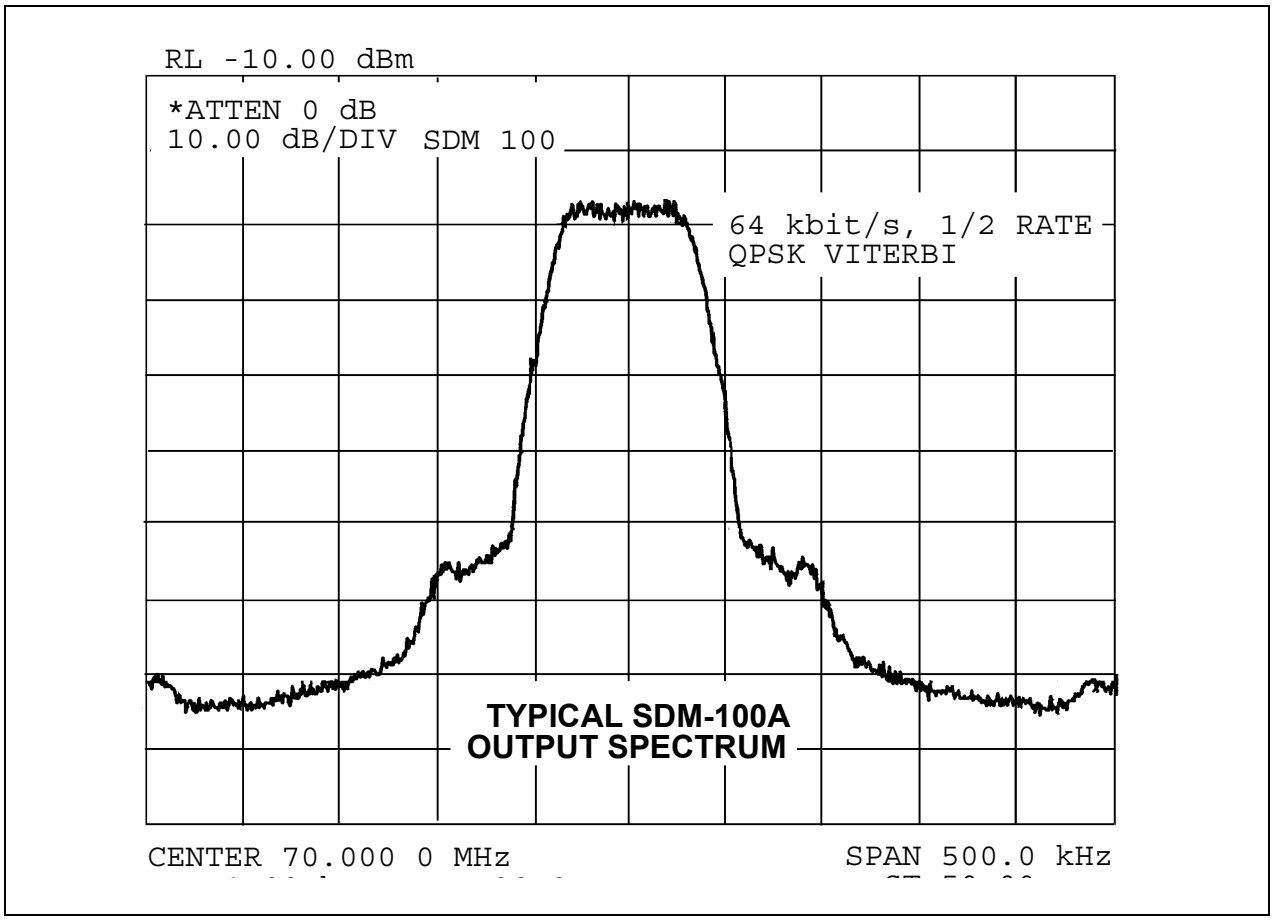

Figure 1-6. Typical Output Spectrum

Chapter 2. INSTALLATION

This chapter provides unpacking instructions, system requirements, and external connections for the modem.

2.1 Unpacking

The modem and manual are packaged in pre-formed, reusable cardboard cartons that contain foam spacing for maximum shipping protection. The circuit cards are contained in the modem chassis.

To remove the modem:

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

1. Cut the tape at the top of the carton where it is indicated "OPEN THIS END."
2. Lift out the cardboard/foam spacer covering the modem.
3. Remove the modem, manual, and power cord from carton.
4. Save the packing material for reshipment back to the factory or to another site.
5. Inspect the equipment for damage incurred during shipment.

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

7. Refer to Section 2.2 for further system installation instructions.

2.2 System Installation

Install the modem as follows:

1. Mount the modem chassis in the assigned position in the equipment rack. Refer to Figure 2-1 for an illustration of a typical rack elevation for an M:N system.

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

3. Before applying power, read and become familiar with Chapter 3.

   Verify all jumper settings are correctly set for remote operation. Refer to Chapter 4 for jumper settings.

4. Turn on the power switch (located on the rear panel).

5. Check for proper TX output signal level and spectrum.

6. Check for proper RX input signal level and spectrum.

7. If there are any problems with the installation, refer to Chapter 5 for troubleshooting the system.

2.3 System Requirements

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

- For a TX-only system, enter the UTILITY SYSTEM menu under FUNCTION SELECT UTILITY on the front panel. Select OPERATION MODE.

  Enter the menu and select Transmit Only. This will mask all receive faults and receive stored faults in the Faults menu.

- For an RX-only system, enter the UTILITY SYSTEM menu under FUNCTION SELECT UTILITY on the front panel. Select OPERATION MODE.

  Enter the menu and select Receive Only. This will mask the transmit faults and transmit stored faults in the Faults menu.

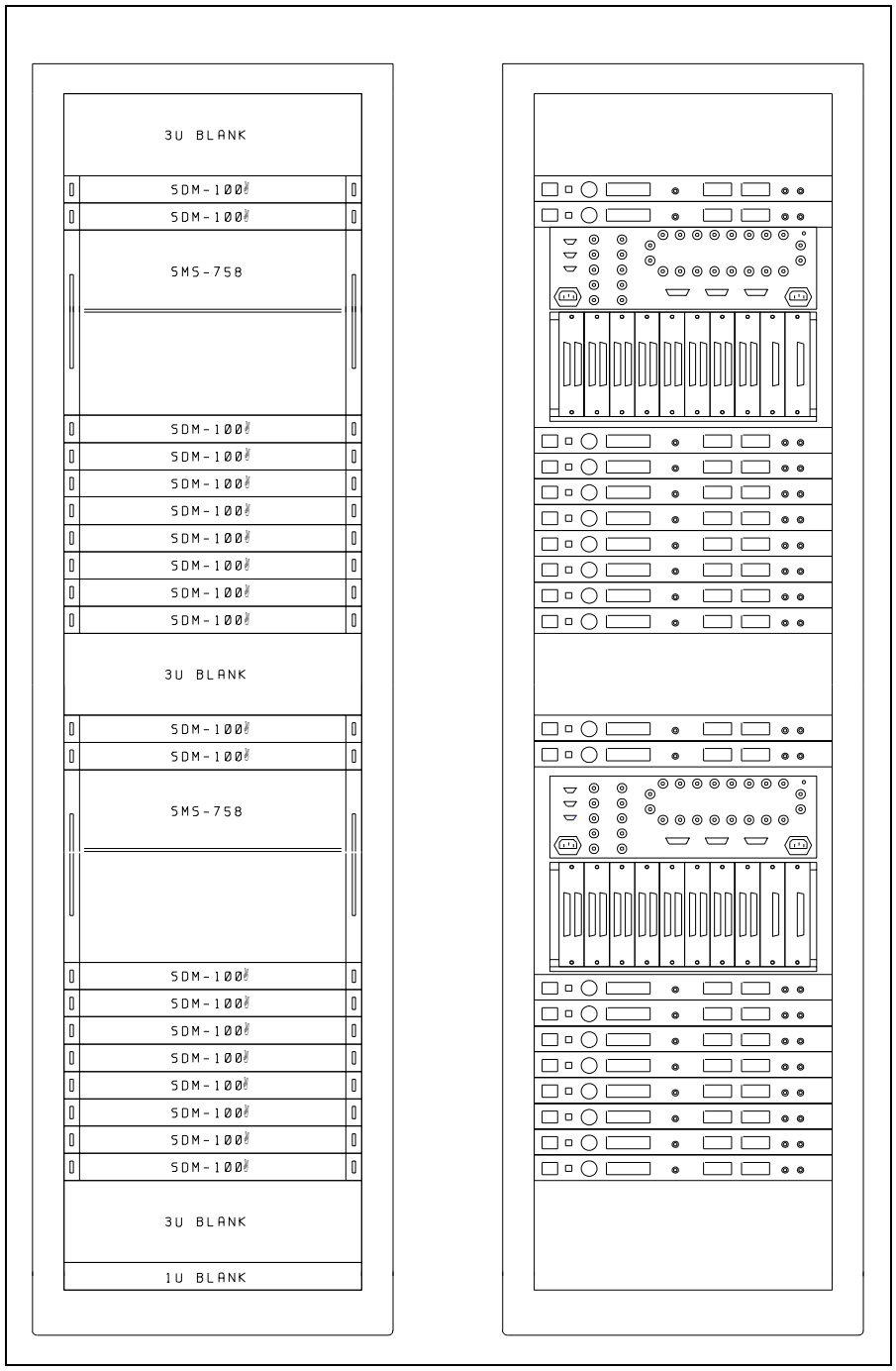

Figure 2-1. Typical Rack Elevation

2.4 External Connections

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

Table 2-1. Rear Panel Connectors

Name	Ref. Desig.	Connector Type	Function
DATA I/O	J8	Various: 37-pin D 34-pin block or 25-pin D 25-pin D 50-pin D 50-pin D	Data Input/Output: RS-422/449 V.35 RS-232 ASYNC ADPCM Voice
REMOTE	J6	9-pin D	Remote Interface
FAULTS	J7	9-pin D	FORM-C Fault Relay Contacts
TX/IF OUTPUT	CP1	BNC	TX IF Output
RX/IF INPUT	CP2	BNC	RX IF Input
AC POWER	None	Standard	Alternating Current (AC) Power Input
DC POWER	None	Terminal block	Direct Current (DC) Power Input
CHASSIS GND	GND	#10-32 stud	Chassis Ground
AGC	AGC	Test point	Automatic Gain Control (AGC) Test Point

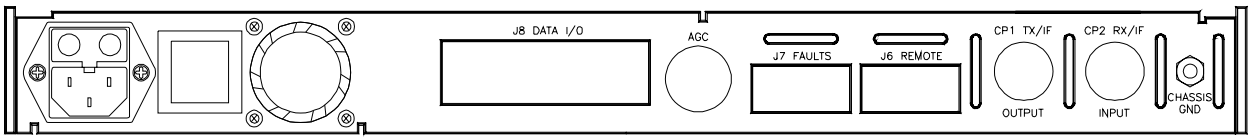

Figure 2-2. Rear Panel View

2.4.1 DATA I/O Interface (J8)

The DATA I/O interface connector is used to interface data input and output signals to and from the modem. The DATA I/O connects to the customer terrestrial equipment directly or through a protection switch.

The DATA I/O interface can be MIL-STD-188, RS-422/449, V.35, or RS-232-C.

The interface module of the modem is mounted directly on the modulator board. The modem operates with a single interface configuration. Field changes are easily done by changing the interface module (refer to Chapter 4).

2.4.2 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 more information on the remote interface, refer to Chapter 4.

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.

There are jumpers on the demodulator board that must be set to select either RS-485 or RS-232-C remote interface.

Refer to Chapter 4 for configuration information.

RS-485			RS-232-C	
	4-Wire Mode	2-Wire Mode	4- and 2-Wire Mode	
Pin	Name		Pin	Name
1	GND	GND	1	
2			2	RD (RX)
3			3	TD (TX)
4	+ TX	+ RX/TX	4	
5	- TX	- RX/TX	5	GND
6			6	Data Signal Rate (DSR)
7			7	Request to Send (RTS)
8	+RX	+ RX/TX	8	Clear to Send (CTS)
9	- RX	- RX/TX	9	

2.4.3 Faults (J7)

The Fault connector on the modem is used to interface FORM-C contact closures for the purpose of fault reporting. There are three FORM-C summary fault contacts:

- Modulator
- Demodulator
- Common equipment

For further discussion on the monitored faults, refer to Chapter 3.

To obtain a system summary fault, 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.

2.4.4 TX IF Output (CP1)

This is the transmit IF connector. The output impedance is 75Ω (50Ω optional), and the output power level is -5 to -30 dBm, in 0.1 dB steps.

For normal operation, the output will be a QPSK modulated result of the DATA I/O connector, between 50 and 180 MHz.

2.4.5 RX IF Input (CP2)

This is the receive IF connector. The input impedance is 75Ω (50Ω optional).

For normal operation, the desired carrier signal level should be between -30 and -55 dBm. Signals between 50 and 180 MHz are selected and demodulated to produce clock and data at the DATA I/O connector.

2.4.6 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 264 VAC, 47 to 63 Hz. The modem will automatically switch between ranges.

Maximum power consumption is less than 40W.

2.4.7 DC Power

DC power is available as an option. The DC power is supplied to the modem by a 3-position terminal block.

Normal input voltage is 48 VDC, ± 10%.

Maximum power consumption is less than 40W.

2.4.8 GND

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

Note: The safety ground is provided through the AC power connector.

2.4.9 AGC Test Point

The Automatic Gain Control (AGC) test point is a BNC connector on the rear panel of the modem chassis. This feature allows the user to monitor the AGC.

3 Chapter 3. OPERATION

This chapter describes the front panel operation and clocking configurations of the modem.

For remote control operation information, refer to Appendix A.

3.1 Front Panel

The front panel of the modem (Figure 3-1) provides the local user interface, which is necessary to configure and monitor status of the modem.

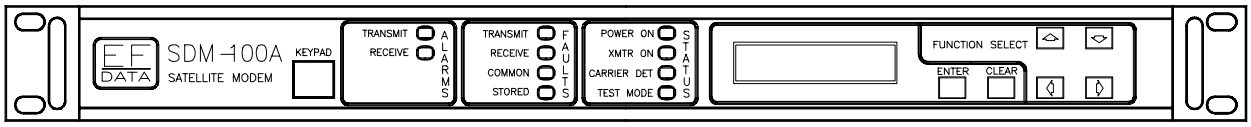

Figure 3-1. Front Panel View

The front panel features a 32-character, 2-line, Liquid Crystal Display (LCD), and a 6-button keypad, which provides for sophisticated functions, yet is easy to use.

Ten Light-Emitting Diodes (LEDs) on the front panel provide overall status at a glance.

3.1.1 Front Panel Keypad Option

This feature is a future option which will allow the user to plug in a hand-held keypad, and will allow access to all programming capabilities.

3.1.2 LED Indicators

General modem status and summary faults are indicated by 10 LEDs on the front panel. The indicators are defined as follows:

Faults		
Name	**LED Color**	**Meaning**
Transmit	Red	Indicates that a fault condition exists in the transmit chain.
Receive	Red	Indicates that a fault condition exists in the receive chain.
Common fault	Red	Indicates that a common equipment fault condition exists.
Stored	Yellow	Indicates that a fault has been logged and stored. The fault may or may not be active.
Status		
Power On	Green	Indicates that power is applied to the modem.
Transmitter On	Green	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	Indicates that the decoder is locked.
Test Mode	Yellow	Flashes when the modem is in a test configuration.
Alarms		
Transmit	Yellow	Indicates that a transmit function is in an alarm condition.
Receive	Yellow	Indicates that a receive function is in an alarm condition.

3.1.3 Front Panel Controls

The modem is locally operated by using the front panel keypad (Figure 3-1), which consists of the following keys:

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

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.

3.2 Menu System

In order to access and execute all functions, refer to the menus in Figures 3-2 through 3-25. Use the main menu in Figure 3-2 as a quick reference for accessing all modem functions. For further configuration details, refer to Section 3.3.

The base level of this structure is the sign-on message, which is displayed on the front panel upon modem power up. Line 1 of the sign-on message shows the modem type (SDM-100 or Type 1), and line 2 shows the version number of the firmware implemented in the modem.

The main level of the menu system is the "FUNCTION SELECT" menu, which may be accessed from the base level by pressing any of the arrow keys.

From the "FUNCTION SELECT" menu, any one of six functional categories may be selected:

- Configuration functions
- Monitor functions
- Fault functions
- Stored fault functions
- Remote AUPC functions
- Utility functions

Press [←] or [→] to move from one selection to another. When the desired function is displayed on line 2, select that level by pressing [ENTER].

Once the desired functional level has been entered, move to the desired function by pressing [←] or [→].

3.2.1 Standard SDM-100 Menus

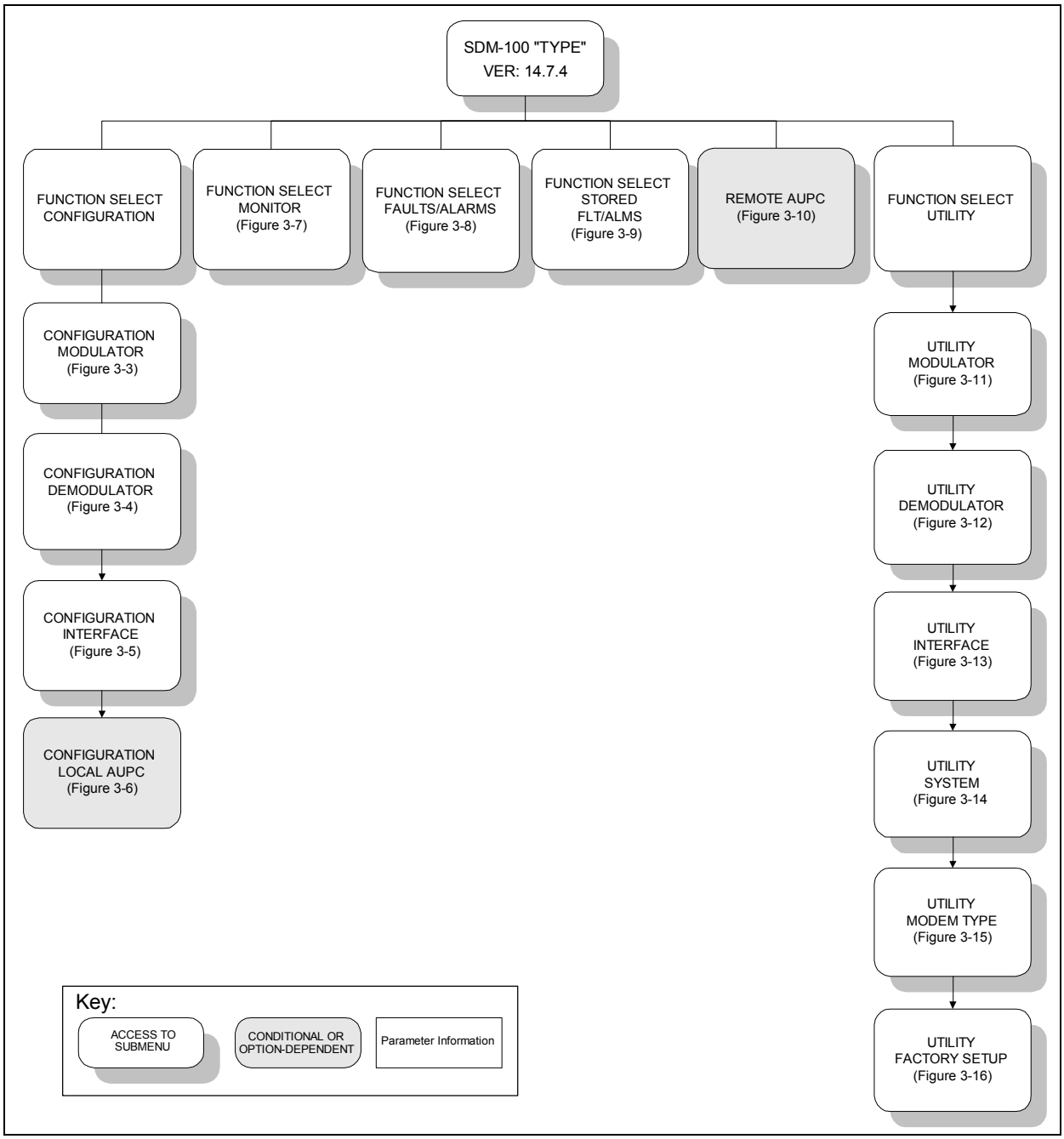

Figure 3-2. Main Menu (SDM-100 Operation)

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3.2.1.1 Configuration

Modem configuration may be viewed or changed by entering the “CONFIGURATION” level from the “FUNCTION SELECT” menu on the front panel.

After entering the “CONFIGURATION” menu, press [←] or [→] to select “MODULATOR,” “DEMODULATOR,” “INTERFACE,” or “LOCAL AUPC” (if that option is installed).

Enter the selected configuration menu by pressing [ENTER].

Press [←] or [→] to view the selected configuration parameters.

To change a configuration parameter, press [ENTER] to begin the change process. Press [↑] or [↓] to make the changes.

After the changes are made and the display represents the correct parameters, execute the changes by pressing [ENTER]. After [ENTER] is pressed, the necessary programming is initiated by the modem. To undo a parameter change prior to executing it, simply press [CLEAR].

The modem configuration functions are outlined in the following paragraphs.

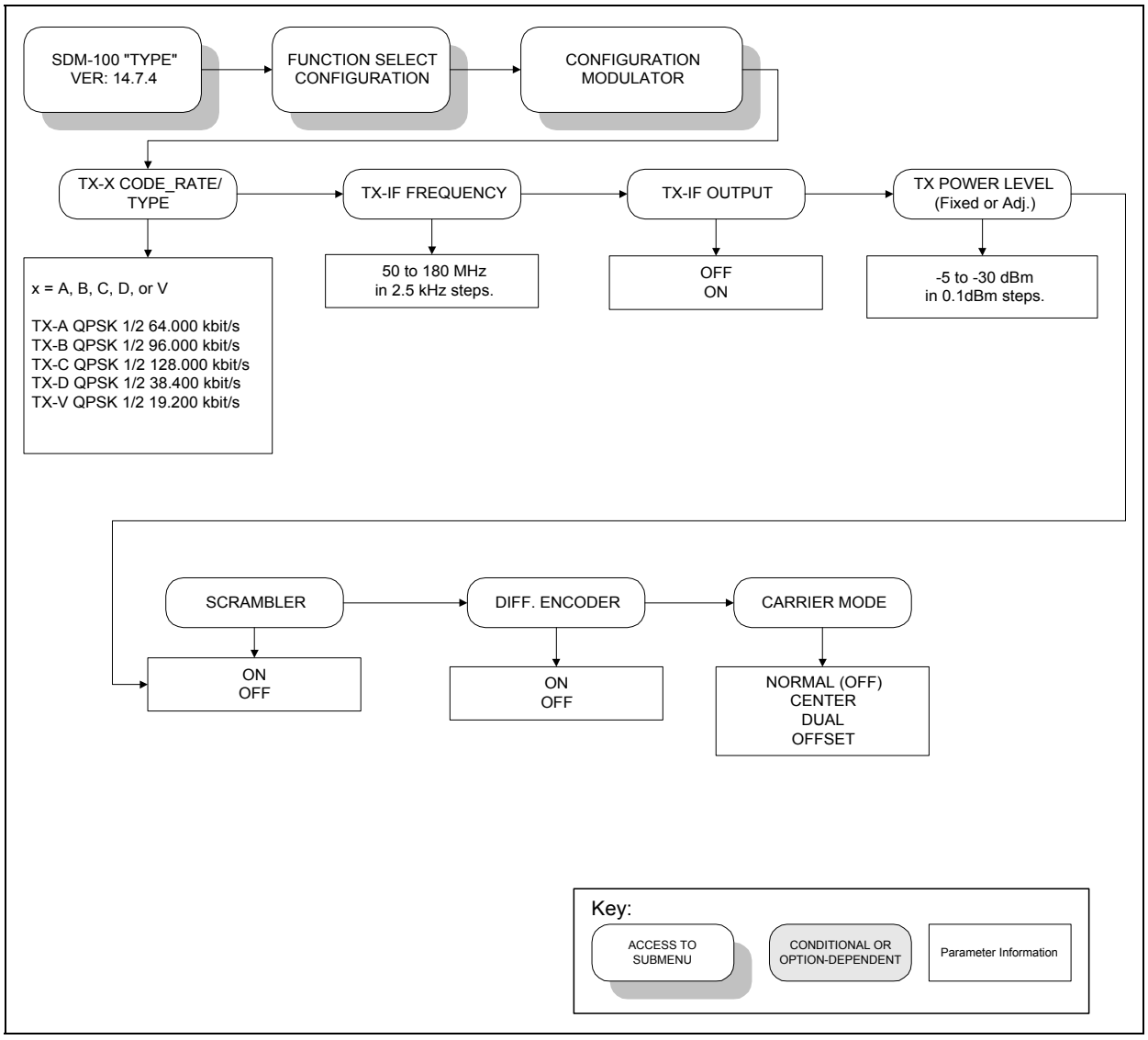

Figure 3-3. Configuration Modulator (SDM-100 Operation)

3.2.1.1.1 Configuration Modulator

TX-X Code_Rate/Type	Transmitter Rate selection. One of four predefined transmitter code/data rate combinations may be selected: A, B, C, or D, or a variable rate selection (V). These selections must first be set up in the Utility menu. 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. Press [↑] or [↓] to select one of four predefined rates (A, B, C, or D). To select the variable data rate, select "TX-V" and press [ENTER] twice. To change the rate in the variable rate selection, press [ENTER] when "TX-V" is displayed. A flashing cursor will be displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. To operate BPSK, select "TX-V" and select BPSK 1/2 for the code rate, then enter the data rate from 9.6 to 64 kbit/s. Press [ENTER] to execute the change. **Note:** When the TX Rate has been changed, the transmitter is automatically turned off to prevent swamping of other channels. To turn the transmitter on, use the "IF Output" function.
TX-IF Frequency	Programs the modulator transmit frequency between 50 and 180 MHz, in 2.5 kHz steps. On entry, the current transmitter frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** When the transmitter frequency is changed, the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the "IF Output" function.
TX-IF Output	Programs the modulator output to ON or OFF. On entry, the current status of the output is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.

TX Power Level	Programs the modulator output power level from -5 to -30 dBm, in 0.1 dBm steps. The high power option operates from + 5 to -20 dBm. On entry, the current transmitter power level is displayed with the flashing cursor on the first character. Press [↑] or [↓] to increase or decrease the output power level in 0.1 dB steps. Press [ENTER] to execute the change. **Note:** The actual front panel display may be changed in the Power Offset Utility function (Section 3.2.1.6.1). Using this function does not change the actual output power level. When the offset feature is being used, (ADJ) will be displayed on line 2.
Scrambler	Programs the scrambler ON or OFF. On entry, the current status of the V.35 Scrambler is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
Diff. Encoder	Programs the differential encoder ON or OFF. On entry, the current status of the Differential Encoder is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
Carrier Mode	Programs the modem for continuous wave mode. Four modes of operation are available: Normal (OFF), Center, Dual, and Offset modes. The Carrier mode is normally in the OFF position. To change to Center, Dual, or Offset mode, enter the Carrier Mode Menu and select the desired test mode. **Center Mode:** A test mode that generates a carrier at the current modulator frequency. This can be used to measure the output frequency. **Dual Mode:** A test mode that generates a dual side-band suppressed carrier signal. Side-bands are one-half the symbol rate from the carrier. This is used to check the channel balance and carrier null. **Offset Mode:** A test mode that generates a single upper side-band suppressed carrier signal. The upper side-band is 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]. Press [↑] or [↓] to select the “DUAL” or “OFFSET” mode. To return to the “CONFIGURATION” 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 “IF Output” function.

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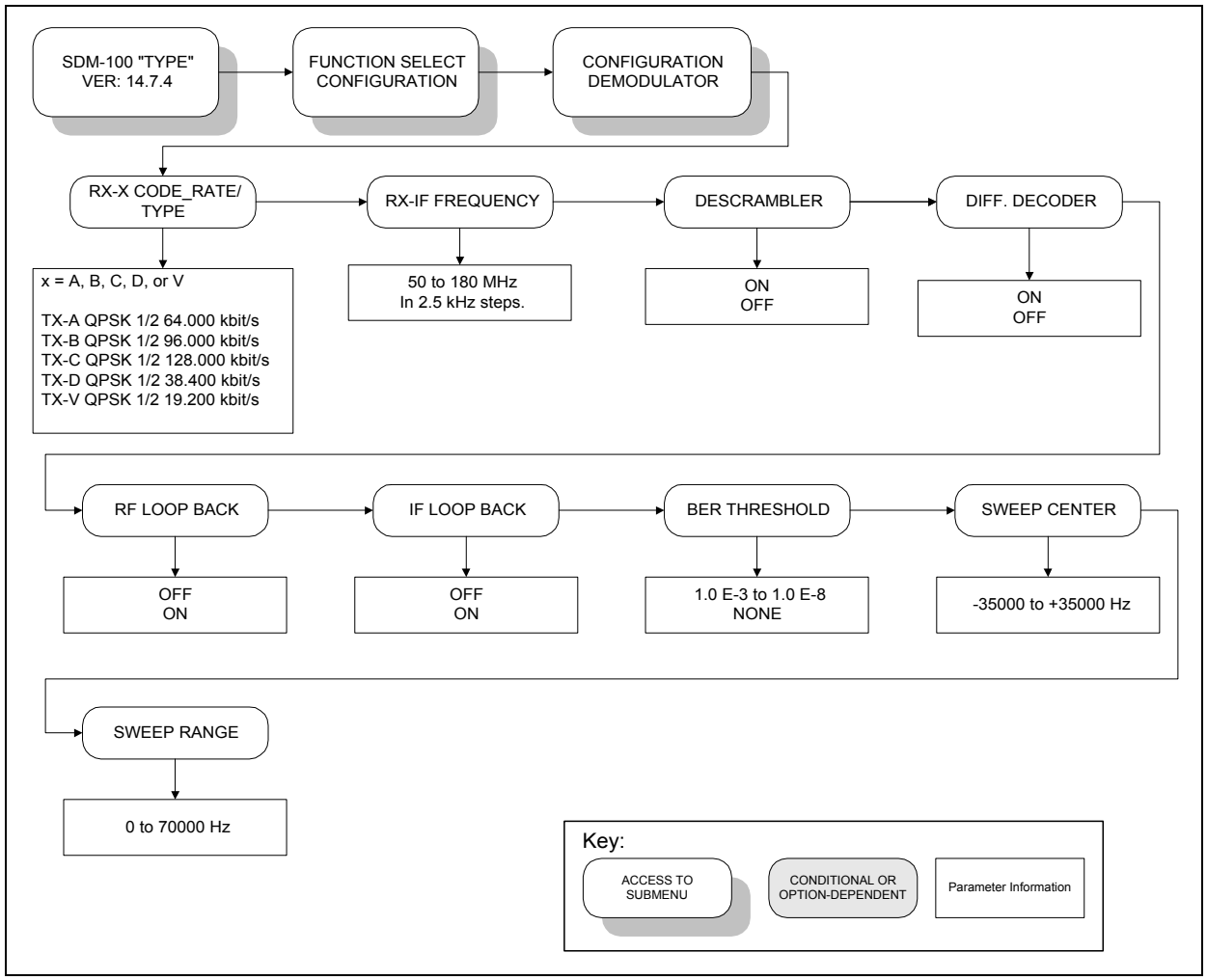

Figure 3-4. Configuration Demodulator (SDM-100 Operation)

3.2.1.1.2 Configuration Demodulator

RX-X Code_Rate/Type	Receiver rate selection. One of four predefined receiver decoder/data rate combinations (A, B, C, or D) or a variable rate selection (V) may be selected. These selections must first be set up in the Utility menu. On entry, the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line 1. The data rate is displayed on line 2. Press [↑] or [↓] to select one of four predefined rates (A, B, C, or D). To select the variable data rate, select "RX-V" and press [ENTER] twice to select the currently defined data rate. To change the rate in the variable rate selection, press [ENTER] when "RX-V" is displayed. A flashing cursor will be displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
RX-IF Frequency	Programs the receive frequency between 50 and 180 MHz, in 2.5 kHz steps. On entry, the current receive frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
Descrambler	Programs the V.35 descrambler ON or OFF. On entry, the current status of the descrambler is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
Diff. Decoder	Programs the differential decoder ON or OFF. On entry, the current status of the differential decoder is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
RF Loop Back	Programs the modem for RF loopback operation (test mode). 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. Refer to Figure 3-26 for a block diagram of RF loopback operation. **Note:** RF loopback nullifies IF loopback. On entry, the current status of RF loopback is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.

IF Loop Back	Programs the modem for IF loopback operation (test mode). When IF loopback is turned on, the demodulator input is connected to the modulator output through an internal attenuator, and the demodulator is programmed to the same frequency as the modulator. An attenuator within the modem connects the IF out to the IF in. When IF loopback is turned off, the demodulator is tuned to its previous frequency, and is reconnected to the IF input. Refer to Figure 3-27 for a block diagram of IF loopback operation. **Note:** IF loopback nullifies RF loopback. On entry, the current status of IF loopback is displayed. Press [⇑] or [⇓] to select ON or OFF. Press [ENTER] to execute the change.
BER Threshold	This function is used to set the BER threshold. If the set BER threshold 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. Press [⇑] or [⇓] to select the desired setting. Press [ENTER] to execute the change.
Sweep Center	Programs the sweep center frequency for the directed sweep function. The sweep center frequency may be set in the range from -35000 to +35000 Hz. On entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [⇑] or [⇓] to increment and decrement the digit at the flashing cursor. Select the sweep center frequency from -35000 to +35000 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.
Sweep Range	Programs the overall travel of the sweep width range during acquisition in the directed sweep mode. The sweep width may be set from 0 to 70000 Hz. (When set at 70000 Hz, the modem is in the normal acquisition mode.) On entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [⇑] or [⇓] to increment and decrement the digit at the flashing cursor. Select a sweep range from 0 to 70000 Hz. Press [ENTER] to execute the change. **Note:** The smaller the range is, the faster the modem will lock, provided the receive carrier center frequency is within the RX IF frequency sweep range.

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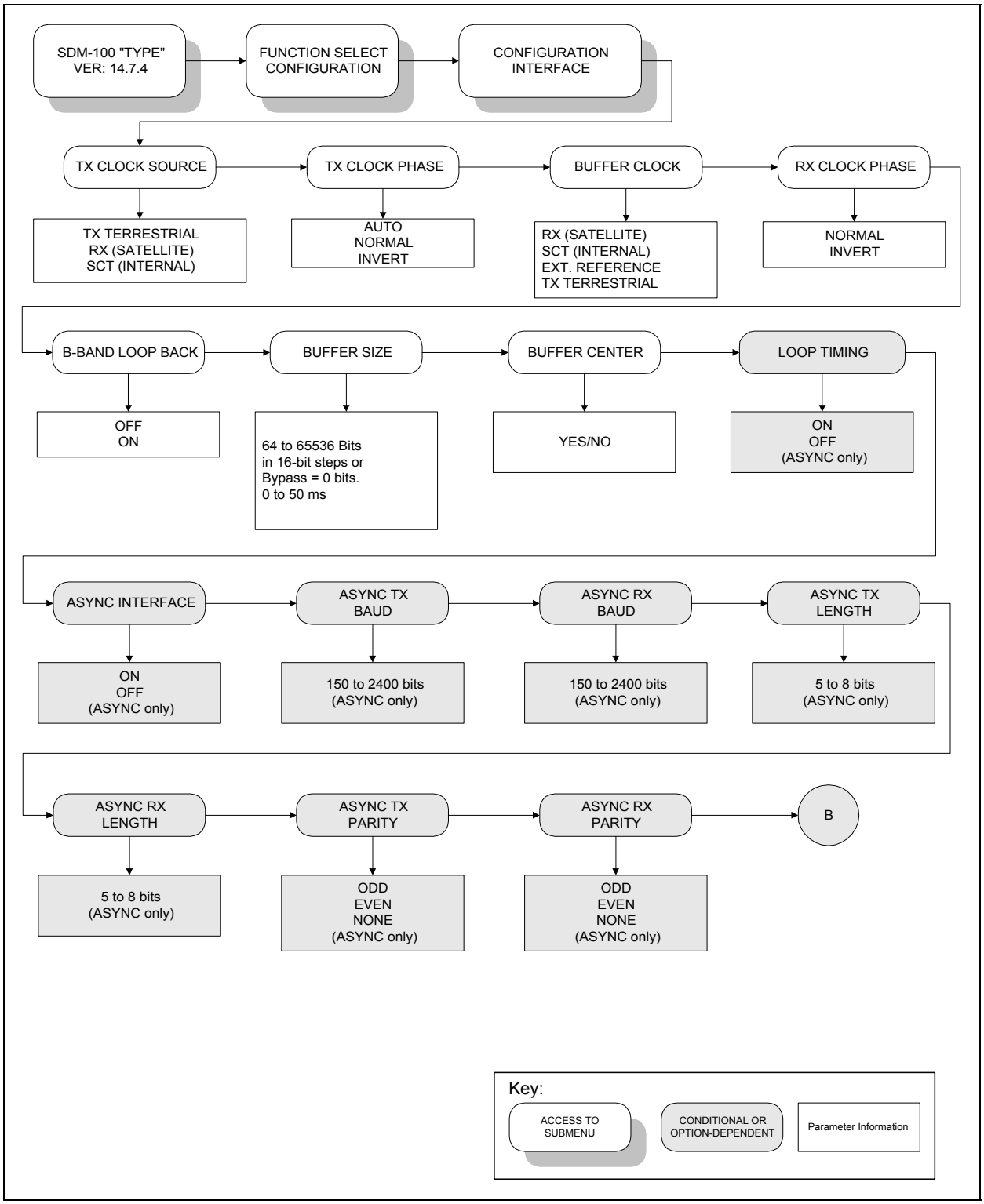

Figure 3-5. Configuration Interface (SDM-100 Operation)

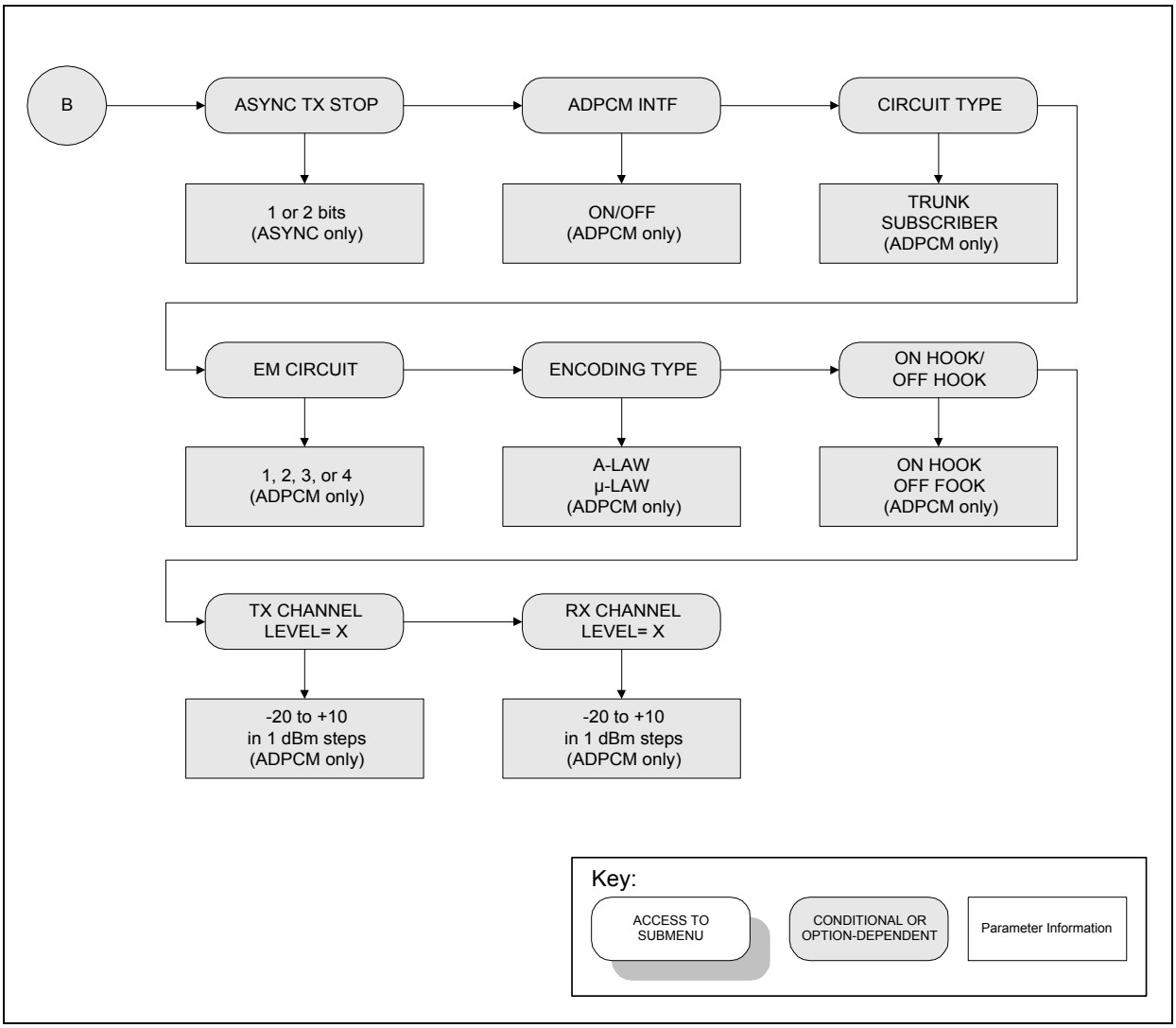

Figure 3-5. Configuration Interface Continued (SDM-100 Operation)

3.2.1.1.3 Configuration Interface

TX Clock Source	Programs the clock source for the modem transmitter clock. “TX Terrestrial” sets the TX clock to recover timing from the incoming clock/data. “RX (Satellite)” sets the TX clock to operate from the satellite clock. “SCT (Internal)” sets the TX clock to operate from the modem internal clock. This is also the fallback clock. On entry, the current transmit clock setting is displayed. Press [⇑] or [⇓] to select “SCT,” “TX Terrestrial,” or “RX (Satellite)” clock. Press [ENTER] to execute the change.
TX Clock Phase	Programs Transmit Clock phase to “Auto,” “Normal,” or “Invert.” On entry, the current setting for the TX clock phase is displayed. Press [⇑] or [⇓] to select “Auto,” “Normal,” or “Invert.” When “Auto” is selected, the modem will automatically select normal or invert to properly phase the transmit clock with the transmit data. Press [ENTER] to execute the change.
Buffer Clock	Programs interface buffer output clock. “RX (SATELLITE)” sets the output buffer clock to the satellite clock. “SCT (INTERNAL)” sets the buffer clock to operate from the modem internal clock. This is also the fallback clock. “EXT. REFERENCE” sets this clock source to the Master Clock (or Terminal Timing) external reference, which is received on the DATA I/O connector on the rear of the modem. “TX TERRESTRIAL” sets the buffer output clock to recover timing from the incoming TX data clock. On entry, the current setting of the interface buffer clock is displayed. Press [⇑] or [⇓] to select “RX (SATELLITE),” “SCT (INTERNAL),” “EXT. REFERENCE,” or “TX TERRESTRIAL” for the buffer clock. Press [ENTER] to execute the change.
RX Clock Phase	Programs the RX clock phase to “Normal” or “Inverted.” On entry, the current status of the RX Clock is displayed. Press [⇑] or [⇓] to select “Normal” or “Invert.” Press [ENTER] to execute the change.

B-Band Loop Back	Programs the modem for baseband loopback operation (test mode). When baseband loopback is turned on, the data and timing signals are hard-wired (via relays) from the demodulator to the modulator on the modem side of the interface. The Data Terminal Equipment (DTE) baseband signals are also looped back from the transmitter data and clock to the receiver data and clock on the customer side of the interface. This is a bi-directional loopback of the baseband data. Refer to Figure 3-28 for a block diagram of baseband loopback operation. On entry, the current status is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
Buffer Size	This configuration function is used to set the size of the buffer. On entry, the current buffer length is displayed. Press [↑] or [↓] to select the desired buffer size. The buffer size will be displayed in milliseconds or bits. (To change the buffer units to milliseconds or bits, enter the “Function Select Utility” menu, select the “Interface Utility” menu, and select Buffer Program.) The range which may be selected is 64 to 65,536 bits, in increments of 16, or Bypass, which equals 0 bits. If milliseconds are selected, 0 to 50 ms, in increments of 1 ms may be chosen. Press [ENTER] to execute the change. **Note:** To have the modem calculate the buffer depth, set the buffer units to milliseconds. When a specific buffer depth is desired, set the buffer units to bits. To select bits or milliseconds, enter the “Utility Interface” menu, and make the change.
Buffer Center	Configuration function used to center the buffer. On entry, the current status is displayed. Press [↑] or [↓] to select YES or NO. Press [ENTER] to execute the change.
Loop Timing	This puts the modem in a loop timing configuration. The buffer clock and the ST pin on the interface are forced to the RX clock. Available only with the ASYNC option installed. On entry, the current status is displayed. Press [↑] or [↓] to select YES or NO. Press [ENTER] to execute the change.
ASYNC Interface	This turns the ASYNC overhead ON or OFF.
TX Baud	This programs the TX UART to the desired baud rate for the ASYNC channel. Available only with the ASYNC option installed.
RX Baud	This programs the RX UART to the desired baud rate for the ASYNC channel. Available only with the ASYNC option installed.
TX Length	This programs the TX UART to the desired number of data bits. Available only with the ASYNC option installed.
RX Length	This programs the RX UART to the desired number of data bits. Available only with the ASYNC option installed.
TX Parity	This programs the TX UART for the desired parity. Available only with the ASYNC option installed.
RX Parity	This programs the RX UART for the desired parity. Available only with the ASYNC option installed.
TX Stop	This programs the TX UART to output the desired number of stop bits. Available only with the ASYNC option installed.

ADPCM Intf	ADPCM interface ON/OFF selection. If ADPCM is set ON, the ADPCM operation is selected. If ADPCM is set OFF, then the standard RS-422 interface option is selected. Available only with the ADPCM option installed.
Circuit Type	This refers to the emulation mode of the modem ADPCM interface. When the subscriber is selected, the modem interface is configured as a subscriber circuit. When the trunk is selected, the modem interface is configured as a trunk. Available only with the ADPCM option installed.
E&M Circuit	This allows the user to chose which E&M signaling type is selected. Types 1 to 4 are supported. Available only with the ADPCM option installed.
Encoding Type	This configures the audio channel to support either A-law or μ-law encoding. Available only with the ADPCM option installed.
On Hook/Off Hook	Selects between ON HOOK and OFF HOOK operation. Available only with the ADPCM option installed.
TX Channel Level	This allows the user to set the input level for the transmit audio from -20 to +10 dBm, in 1 dBm steps. Available only with the ADPCM option installed.
RX Channel Level	This allows the user to set the input level for the receive audio from -20 to +10 dBm, in 1 dBm steps. Available only with the ADPCM option installed.

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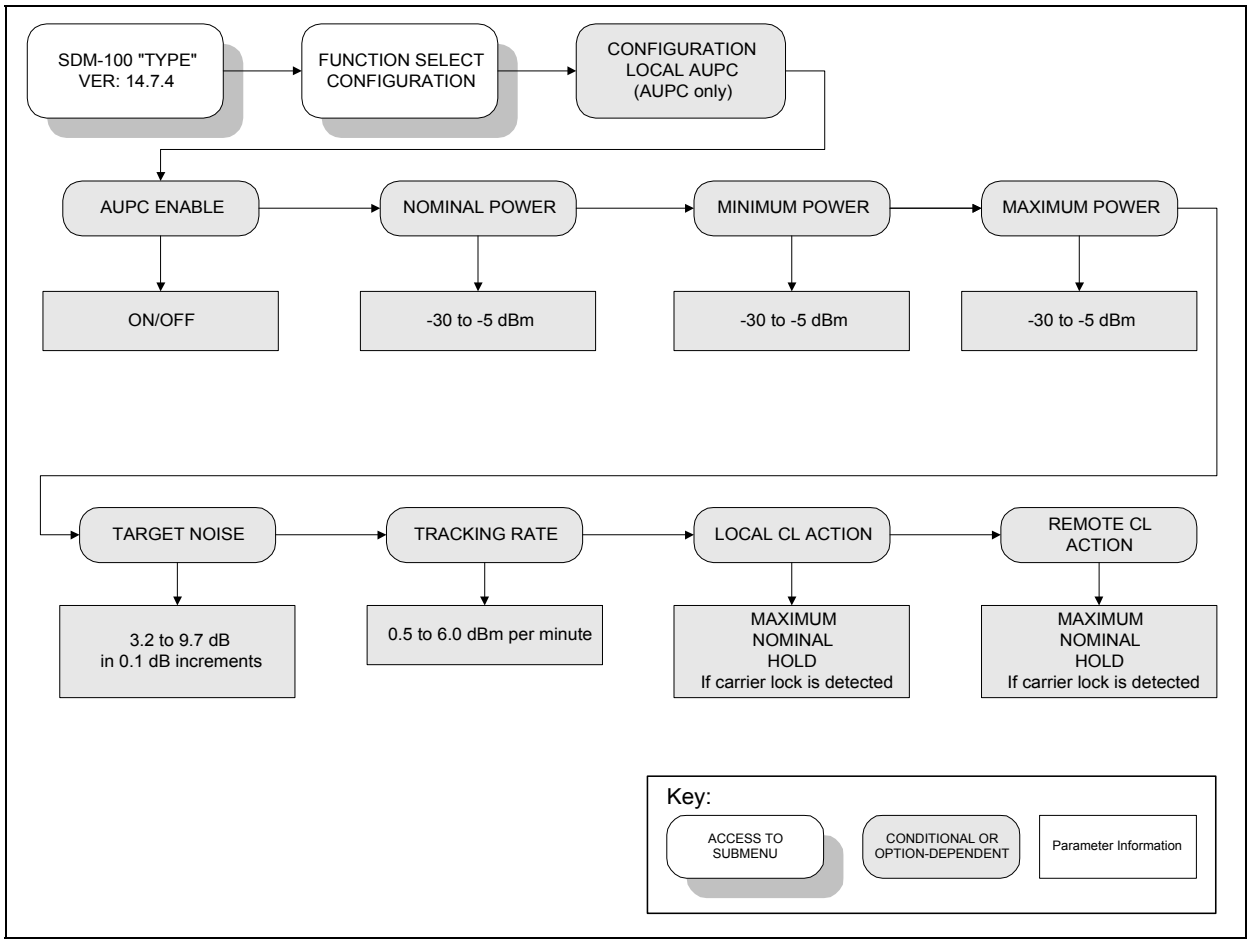

Figure 3-6. Configuration Local AUPC (SDM-100 Operation)

3.2.1.1.4 Configuration Local AUPC

AUPC Enable	This option turns the local modem's AUPC ON or OFF.
Nominal Power	This option programs the nominal power set point for AUPC from -30 to -5 dBm.
Minimum Power	This option programs the minimum power set point for AUPC from -30 to -5 dBm.
Maximum Power	This option programs the maximum power set point for AUPC from -30 to -5 dBm.
Target Noise	This option programs the target E_b/N_0 setpoint. The E_b/N_0 setpoint can range from 3.2 to 9.7 dB, in 0.1 dB increments.
Tracking Rate	This option programs the maximum tracking rate. The maximum tracking rate can range from 0.5 to 6.0 dBm per minute.
Local CL Action	This option programs the action taken by the local modem if Carrier Loss is detected. The local CL can be programmed to Maximum, Nominal, or Hold.
Remote CL Action	This option programs the action taken by the remote modem if Carrier Loss is detected. The remote CL can be programmed to Maximum, Nominal, or Hold.

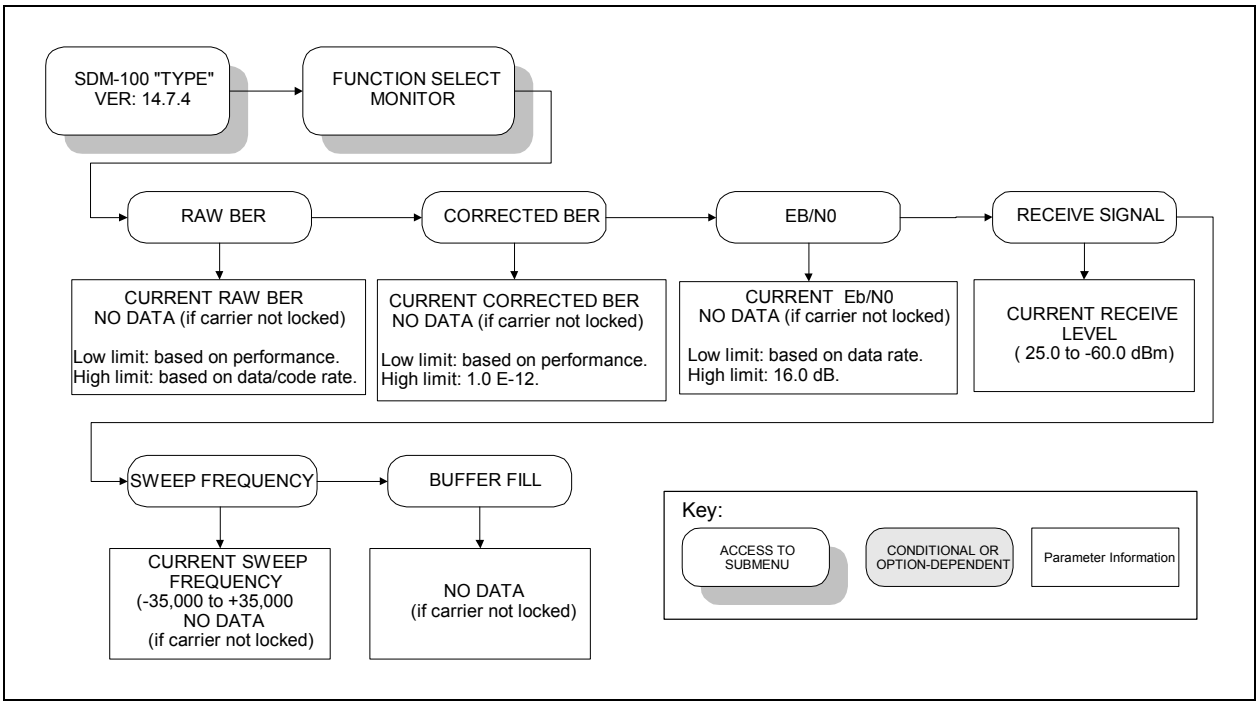

Figure 3-7. Monitor (SDM-100 Operation)

3.2.1.2 Monitor

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

Raw BER	Raw Bit Error Rate	Range: <m.m E^{-e} to >m.m E^{-e} *(See Note below)*
Corrected BER	Corrected Bit Error Rate	Range: <m.m E^{-e} to >m.m E^{-e} *(See Note below)*
E_b/N_0	Energy bit/Noise Ratio	Range: <mm.m to >mm.m *(See Note below)*
Receive Signal	Receive Signal Level	Range: <-mm.m to >-mm.m
Sweep Frequency	Sweep Monitor Range	-35,000 Hz to +35,000 Hz
Buffer Fill	Current Buffer Fill Status	1 to 99%

Note: When the decoder loses lock, no data is available, and is so indicated.

If data is under range, "<" (less than) will be indicated. If data is over range, ">" (greater than) will be indicated.

3.2.1.3 Faults/Alarms

The "FAULTS/ALARMS" level is accessible from the "FUNCTION SELECT" menu. These are similar to monitor functions, as the current status is displayed.

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

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

The current Faults/Alarms status is displayed on line 2 of the display in real time.

Fault status is displayed as a "+" (plus) or "-" (minus) for each parameter monitored:

- "-" indicates that no fault or alarm exists.
- "+" indicates that a fault exists, and will cause switching in a redundant system.
- A reversed-contrast "+" sign appearing on the display indicates an alarm is active.

Note: Alarms do not cause switching to occur.

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

The following paragraphs list the faults and alarms monitored and displayed in each group. This information can be used to isolate a problem and help the user decide on the appropriate action to be taken.

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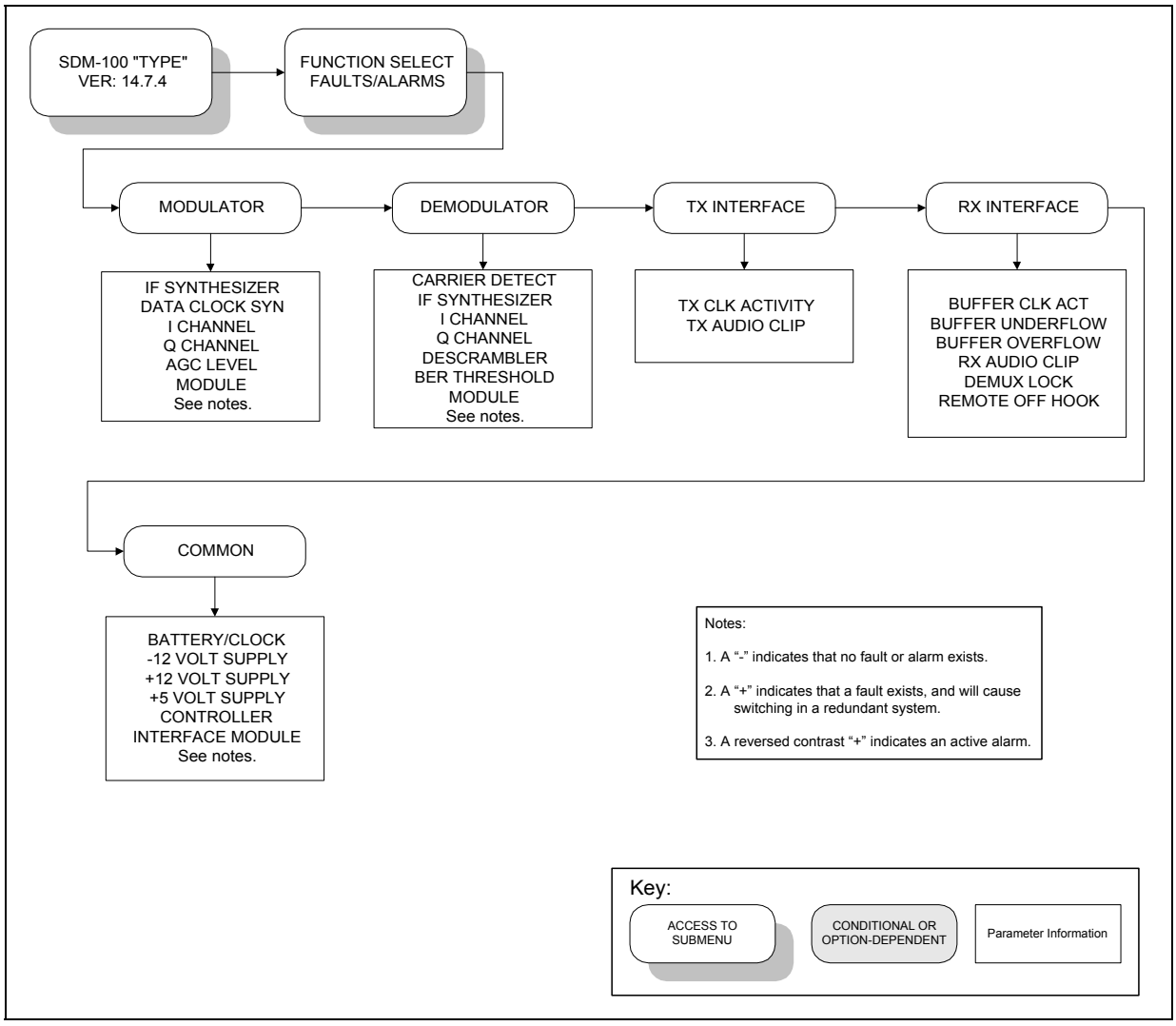

Figure 3-8. Faults/Alarms (SDM-100 Operation)

3.2.1.3.1 Modulator Faults

Fault/Alarm	Possible Problem and Action
IF Synthesizer	Modulator IF synthesizer is faulted. This is considered a major alarm and will turn off the modulator output. Return the modem for repair.
Data Clock Syn	Transmit data clock synthesizer fault. This fault 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 that the incoming data rate matches what has been selected in the modem. 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 and the problem still exists, replace the modem and return it for repair.
I Channel	Activity alarm for the I channel digital filter. This alarm is considered a major alarm, and will turn off the modulator IF output. An alarm in this position indicates either a fault in the scrambler, or if the scrambler is disabled, it indicates a loss of incoming data. If the fault is active with the scrambler turned off, check to see that there is input data at the DATA I/O connector. If data is present, the problem could be in the interface section. If the fault is active with the scrambler turned on, the problem could be in the modulator section. Return the modem for repair.
Q Channel	Activity alarm for the Q channel digital filter. Follow the same procedure as for the I channel.
AGC Level	Output power automatic gain control level fault. Indicates that the level at the modulator output is not the level that is programmed. Replace the modem and return it for repair.
Module	Modulator module fault. Typically indicates the modulator module is missing or will not program. This could indicate a problem in the interface between the modulator and M&C due to modulator firmware being installed incorrectly or a pin not making contact. Verify the modulator firmware is correctly installed. If the problem still exists, return the modem for repair.

3.2.1.3.2 Demodulator Faults

Fault/Alarm	Possible Problem and Action
Carrier Detect	Carrier detect fault. Indicates the decoder is not locked. This is the most common fault displayed in the modem. Any problem from the input data on the modulator end of the circuit to the output of the decoder can cause this alarm. First, check to see that the demodulator has an RF input at the proper frequency and power level. Check to see that the demodulator data rate is properly programmed. Verify the frequency of the data transmitted from the modulator is within 100 PPM. Use IF Loopback to verify the modem will lock.
IF Synthesizer	Demodulator IF synthesizer fault. Indicates the demodulator IF synthesizer is not locked. This fault is a hardware failure. Return the modem for repair.
I Channel	Indicates loss of activity in the I channel of the quadrature demodulator. Typically indicates a problem in the modulator side of the circuit. Check for proper RF input to the demodulator. If the input to the demodulator is correct, then the problem is in the baseband processing.
Q Channel	Q channel activity fault. Indicates a loss of activity in the Q channel of the quadrature demodulator. Follow the same procedure as with the I channel fault.
Descrambler	Descrambler Alarm. Indicates loss of activity in the descrambler. Typically indicates a loss of decoder program.
BER Threshold	Indication that the preset BER threshold has been exceeded. Setting of this alarm is done in the Utility menu. This alarm is based on the corrected BER reading on the front panel.
Module	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not program. This could indicate a problem in the M&C or in the interface between the demodulator and M&C. Return the modem for repair.

3.2.1.3.3 TX Interface Faults

Fault/Alarm	Possible Problem and Action
TX Clock Activity	Activity detector alarm of selected interface transmit clock. Indicates the selected TX clock is not being detected. Check the signal of the selected TX clock source to verify the signal is present. The interface will fall back to the internal clock when this alarm is active.
TX Audio Clip	With ADPCM option on, excessive input sensed on TX+ and TX- interface lines.

3.2.1.3.4 RX Interface Faults

Fault/Alarm	Possible Problem and Action
Buffer Clk Act	Activity detector alarm of the selected interface receive clock. The interface will fall back to the satellite clock when this fault is active.
Buffer Underflow	Buffer Underflow Alarm. 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 “Buf Underflow” faults are stored in battery-backed memory as an aid to troubleshooting. The interval between stored Overflow/Underflow events can be used to determine relative clock accuracy.
Buffer Overflow	Buffer Overflow Alarm. The plesiochronous buffer has overflowed. Refer to the “Buffer Underflow” row above for problems and actions, as the same comments apply.
RX Audio Clip	With ADPCM option on, excessive input received by DEMUX.
DEMUX Lock	Indicates loss of DEMUX lock. (ASYNC/ADPCM option.)
Remote Off Hook	Indicates that the remote handset has signaled off hook.

3.2.1.3.5 Common Equipment Faults

Fault/Alarm	Possible Problem and Action
Battery/Clock	M&C battery voltage or clock fault. Indicates a low voltage in the memory battery. Typically will be active when a modem has been Hard Reset, or the firmware has been changed. When a Hard Reset has been executed or the firmware has been changed, this fault will typically be active when the modem is first turned on. It should clear automatically as the battery charges up.
-12 Volt Supply	-12V power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the -12V line from the power supply or on the board. Check TP2 on the M&C section to verify the proper -12V monitor voltage (1.06V). If this voltage is not correct, it will verify that the -12V supply is not at the proper level. This would indicate the power supply is faulted. Return modem for repair.
+12 Volt Supply	+12V power supply fault. Use the same procedure as with -12V fault. To verify the +12V power supply voltage, check TP4 on the M&C. A voltage of 3.81V will be monitored when the +12V is at the proper level.
+5 Volt Supply	+5V power supply fault. Use the same procedure as with -12V fault. To verify the +5V power supply voltage, check TP5 on the M&C section. A voltage of 2.5V will be monitored when the +5V is at the proper level.
Controller	Controller fault. Indicates loss of power in the M&C card. Typically indicates the controller has gone through a power on-off cycle.
Interface Module	Interface module fault. Indicates a problem in programming the interface. This could indicate a problem in the M&C or in the interface between the interface section and M&C. Return the modem for repair.

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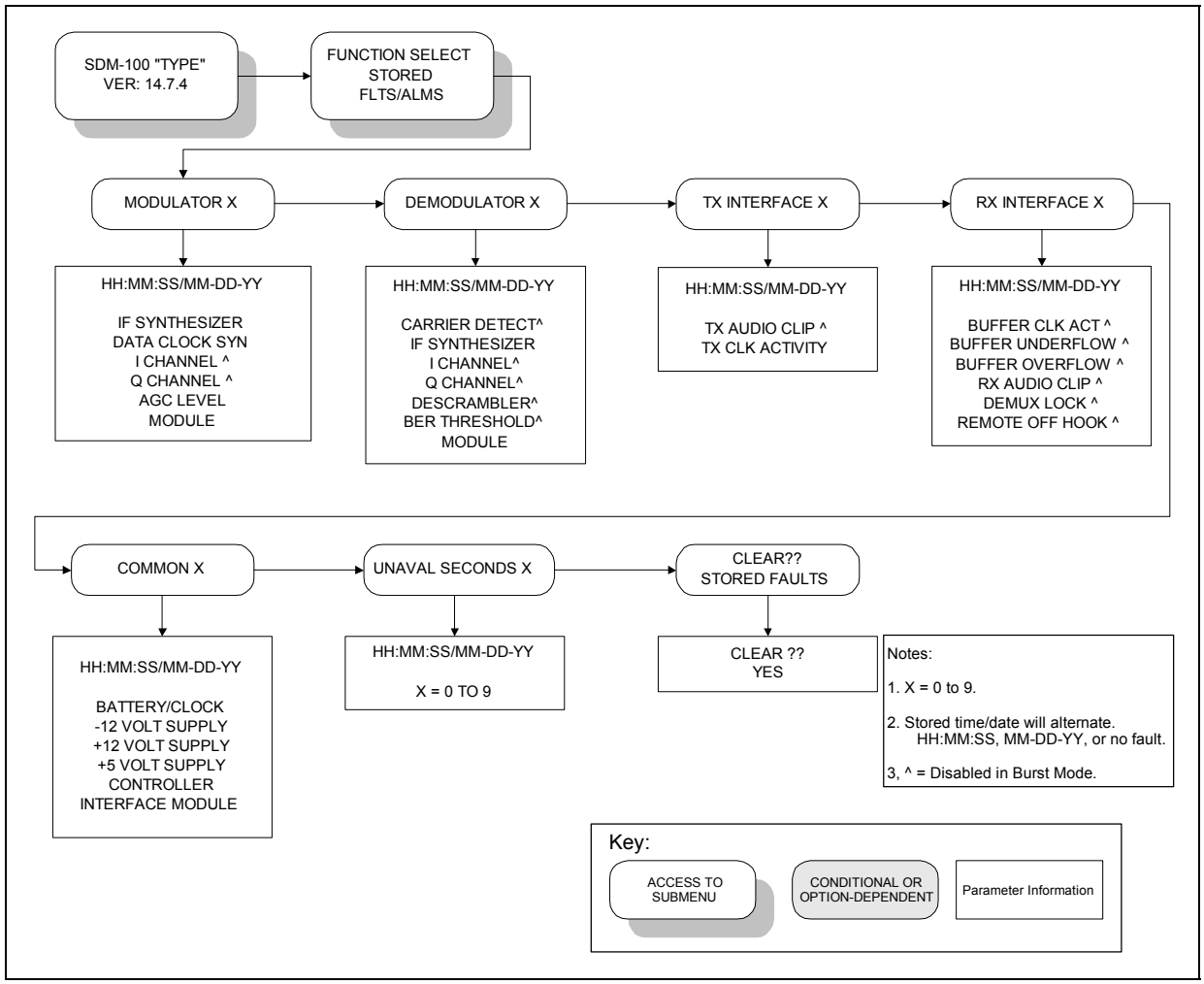

Figure 3-9. Stored FLTS/ALMS (SDM-100 Operation)

3.2.1.4 Stored Faults/Alarms

The modem stores the first 10 (Flt0 through Flt9) occurrences of fault status changes in each of the seven major fault categories. Each fault status change is stored with the time and date of the occurrence. Stored faults may be viewed by entering the "Stored Faults" level from the "FUNCTION SELECT" menu.

All stored faults may be cleared by executing the "CLEAR Stored Faults?" command from the "Stored Faults" level.

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

Upon entering the "Stored Faults" level, press [←] or [→] to move between the fault groups and the "CLEAR Stored Faults??" selections. The time and date of the first stored fault status (Flt0) for the selected group will be displayed alternately on line 2 of the display.

Press [↑] or [↓] to cycle through the selected group's stored fault status (Flt0 through Flt9). To display the fault status associated with the displayed time and date, press [ENTER]. At this time, press [←] or [→] to move the flashing cursor to the fault to be identified.

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

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

An Unavailable Seconds Fault will occur if the Reed-Solomon code could not correct bit errors in one block of serialized data in any given second. (Reed-Solomon only.)

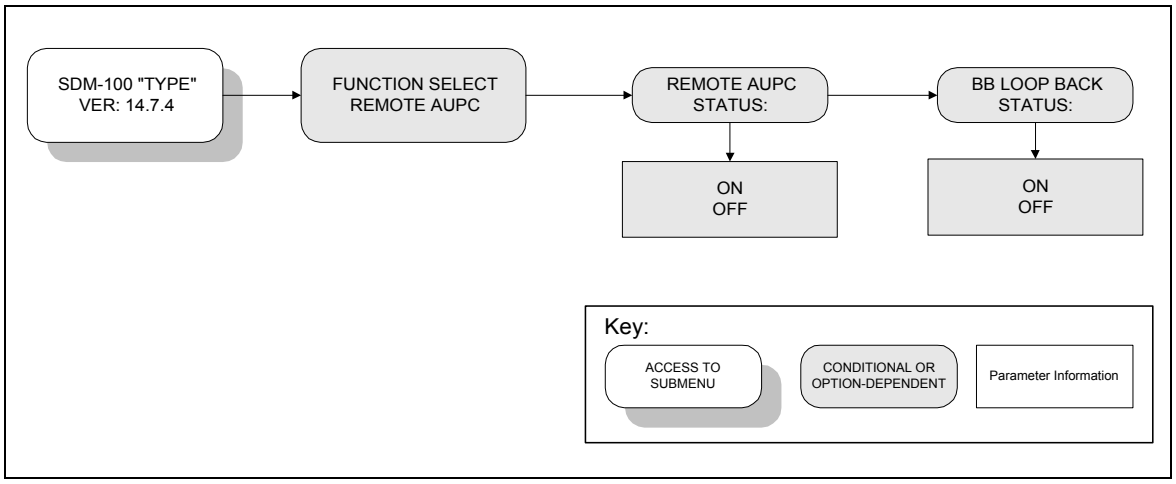

Figure 3-10. Remote AUPC (SDM-100 Operation)

3.2.1.5 Remote AUPC

Remote AUPC Status:	Programs the modem for remote AUPC. On entry, the current status is displayed. Press [⇑] or [⇓] to select ON or OFF. Press [ENTER] to execute the change.
BB Loop Back Status:	Programs the modem for baseband loopback operation (test mode). When baseband loopback is turned on, the data and timing signals are hard-wired (via relays) from the demodulator to the modulator on the modem side of the interface. The DTE baseband signals are also looped back from the transmitter data and clock to the receiver data and clock on the customer side of the interface. This is a bi-directional loopback of the baseband data. Refer to Figure 3-28 for a block diagram of baseband loopback operation. On entry, the current status is displayed. Press [⇑] or [⇓] to select ON or OFF. Press [ENTER] to execute the change.

3.2.1.6 Utility

The utility functions are divided into five user categories, and provide access to the following Utility menus:

- MODULATOR
- DEMODULATOR
- INTERFACE
- SYSTEM
- MODEM TYPE

These menus provide a means to:

- Set the time and date of the modem real time clock.
- Test the front panel optical indicators.
- Choose filtering types, code rates, decoder types, TX and RX fault enables, modem type, and overhead type.

After entering the "UTILITY" functions level, press [←] or [→] to select the "UTILITY" menu desired, and press [ENTER]. Press [←] or [→] to select the utility function of interest.

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

The UTILITY "FACTORY SET-UP" menu is for EFData service personnel only. Unauthorized access may cause the modem to operate incorrectly.

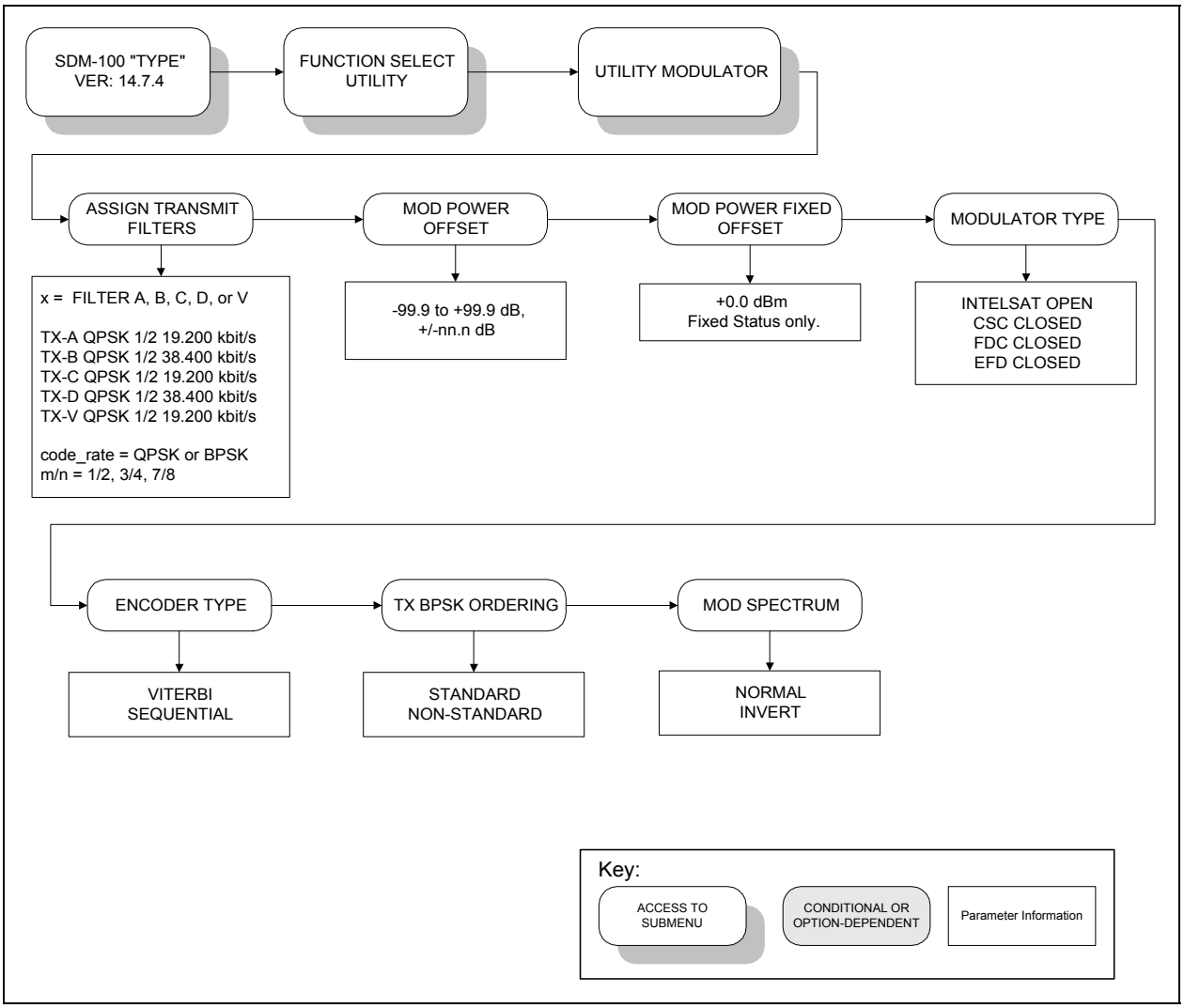

Figure 3-11. Utility Modulator (SDM-100 Operation)

3.2.1.6.1 Utility Modulator

Assign Transmit Filters	Transmit filter display/assignment utility. Used to make filter rate reassignments. The modulator has five symbol rate filter presets. Filters are designated as A, B, C, D, and V. **Note:** Switching between Modem types will reset the Filter presets to their factory-defined values. To view the current preset assignments, press [ENTER] when the "Assign Transmit Fltrs" selection is displayed from the "UTILITY FUNCTIONS" menu. On line 1 of the display will be "TX-A," which indicates transmitter filter A. Following "TX-A" 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 preset "A." Press [←] or [→] to see the assignments for presets B, C, D, and V (TX-B, TX-C, TX-D, and TX-V). To change a preset assignment, press [ENTER] when the data for that preset is displayed. Press [←] or [→] until the flashing cursor is at the parameter to be changed, then press [↑] or [↓] to change that parameter. When all changes are made, press [ENTER] to confirm the assignment. If a preset data/code rate is changed and the modem is currently using that preset, the modem will be reprogrammed to the new data/code rate. **Note:** These assignments are used for the selection of "TX-R" (Transmitter Rate) in the configuration functions menu.
Mod Power Offset	Modulator Power Adjust Offset. Allows the operator to offset the modulator output power readout in the configuration menu. 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 from 0 to ± 99.9 dB, in 0.1 dB increments. Anything except 0.0 dB causes (ADJ) to be displayed in the TX Power Level screen.
Mod Power Fixed Offset	Displays 0.0 dB for a fixed modulator, and +5.0 dB for a high power option modulator. When ADJ is displayed in this menu, the Modulator Power Offset has been set to some value other than the actual modulator output power.

Modulator Type	Transmit Filter Type Select. Allows operator to select INTELSAT Open, CSC Closed, FDC Closed, or EFD Closed network filtering.
Encoder Type	Select Viterbi or Sequential encoder type. If the Sequential encoder firmware is not installed, the modem will double beep, and not allow the selection change.
TX BPSK Ordering	Select Standard or Non-standard TX BPSK ordering. The normal operation is Standard TX BPSK ordering. If the Receiver will not lock, selecting non-standard will invert the TX BPSK ordering. In BPSK operation, this feature determines the order of MUXing of the I and Q data.
Mod Spectrum	Select Normal or Invert. Programmable vector rotation. Allows the operator to select Normal or Inverted (INVERT) for spectrum reversal of the I and Q baseband channels.

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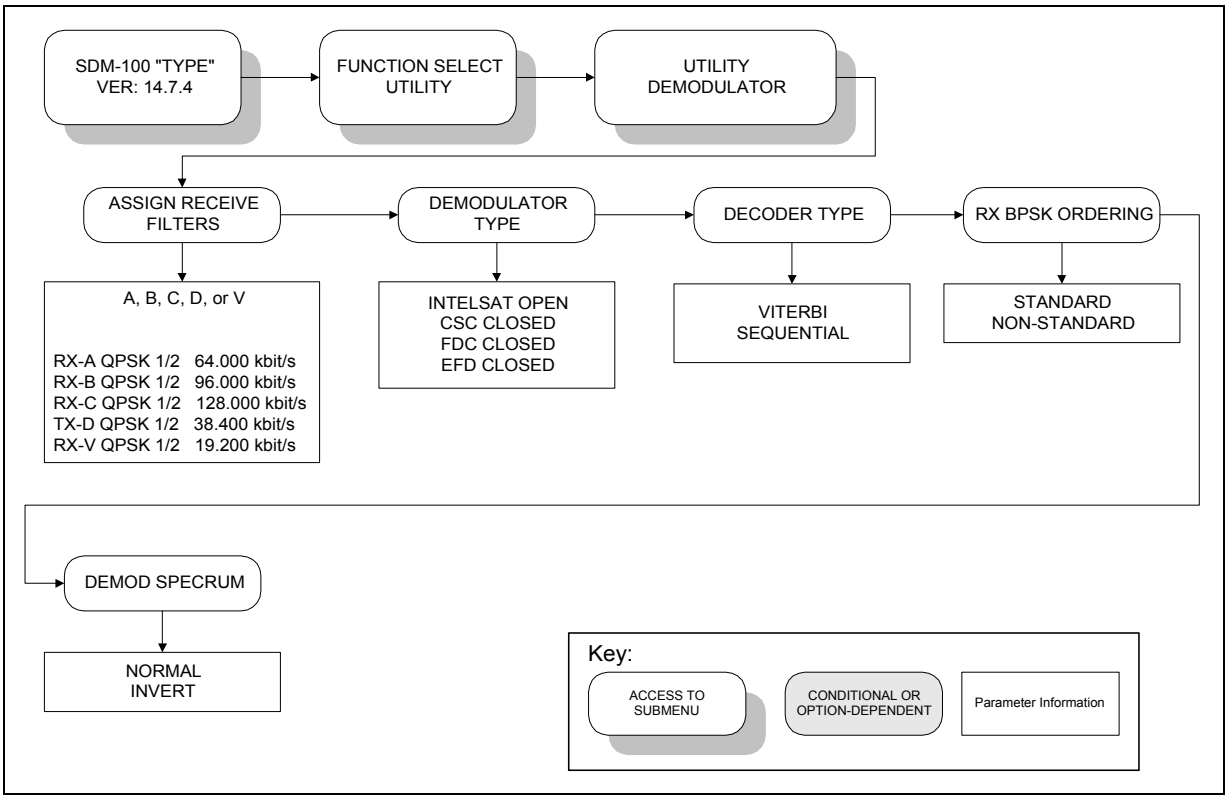

Figure 3-12. Utility Demodulator

3.2.1.6.2 Utility Demodulator

Assign Receive Filters	Receive filter display/assignment utility. Used to view current filter rate assignments and to make filter rate reassignments. Refer to the previous text under “Assign TX_Filters.” The receive filters assignments are basically identical.
Demodulator Type	Receive Filter Type Select. Allows the operator to select Open, Closed, or Comstream compatible network receive filtering.
Decoder Type	Select Viterbi or Sequential decoder type. If the sequential encoder firmware is not installed, the modem will double beep, and not allow the selection change.
RX BPSK Ordering	Select Standard or Non-standard RX BPSK ordering. The normal operation is Standard RX BPSK ordering. If the receiver will not lock, selecting non-standard will invert the RX BPSK ordering. In BPSK operation, this feature determines the order of MUXing of the I and Q data.
Demod Spectrum	Select Normal or Inverted. Programmable vector rotation. Allows the operator to select Normal or Inverted (INVERT) for spectrum reversal of the I and Q baseband channels.

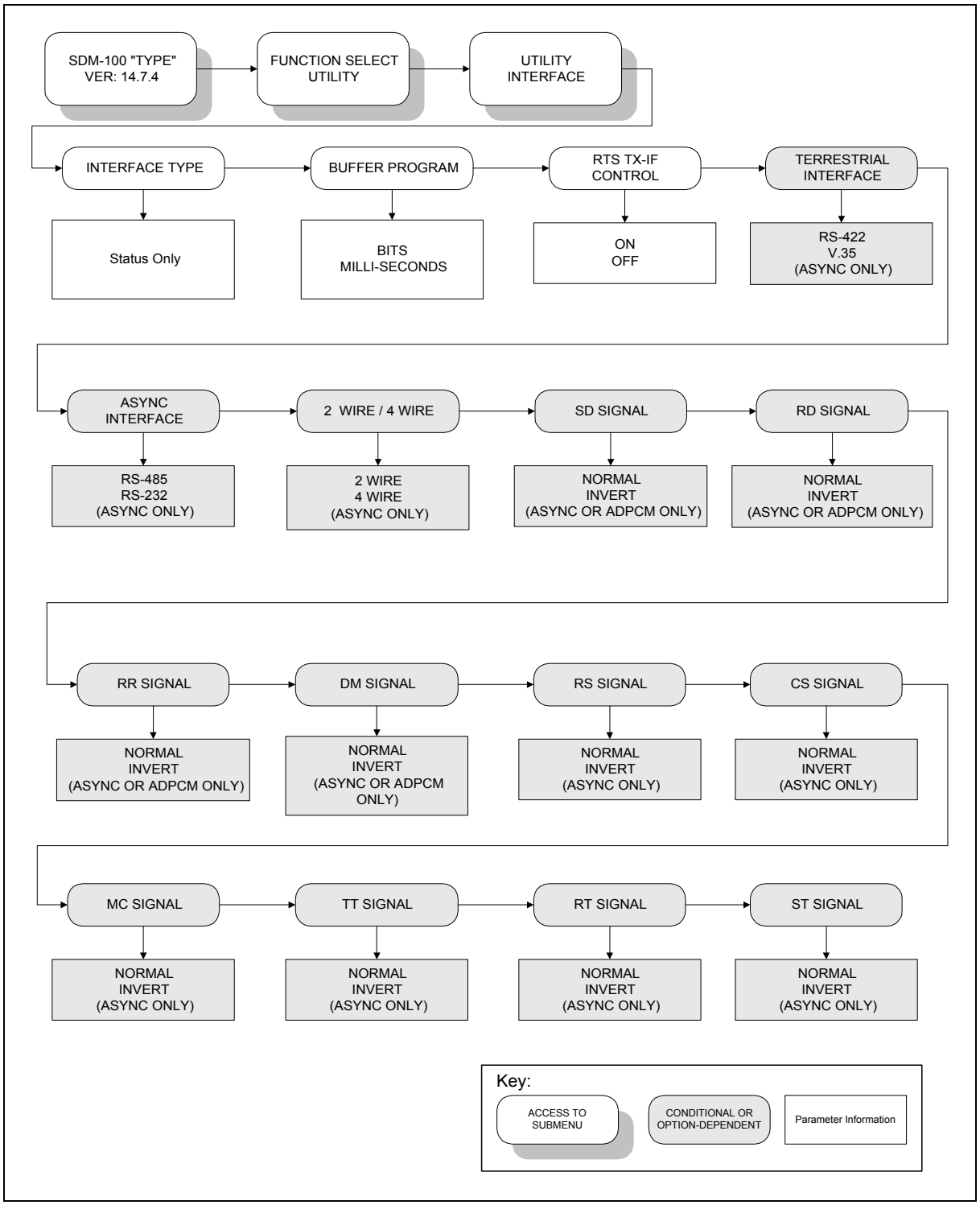

Figure 3-13. Utility Interface (SDM-100 Operation)

3.2.1.6.3 Utility Interface

Interface Type	Displays the interface type installed in modem (RS-422, V.35, RS-232-C, ASYNC, or ADPCM). This is a status window only, and no changes can be made from this menu.
Buffer Program	Sets the size of the buffer. On entry, the current buffer length is displayed. Press [⇑] or [⇓] to select the desired buffer size. The buffer size is displayed in seconds or bits. Enter the Interface Utility menu to change the buffer units to seconds or bits. If selecting seconds, choose from 1 to 99 ms, in increments of 1 ms or 0 (Bypass). If selecting bits, choose from 32 to 262,144 bits, in increments of 16 bits. Press [ENTER] to execute the change. **Note:** To have the modem calculate the plesiochronous shift, set the buffer units to ms. When a specific buffer depth is desired, set the buffer units to bits.
RTS TX-IF Cntrl	Programs the modem to allow a Request To Send (RTS) signal to enable the output when data is ready for transmission.
Terrestrial Interface	This selects the interface type for the terrestrial data. Available only with the ASYNC option.
ASYNC Interface	Programs the ASYNC data type for RS-232C or RS-485. On entry, the current status of the ASYNC data type is displayed. Press an arrow key to make the selection. Press [ENTER] to execute the change. Available only with the ASYNC option.
2- OR 4-Wire	This programs the ASYNC interface for either a 2- or 4-wire interface. Available only with the ASYNC option.
SD Signal	Inverts the polarity of the SD signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC or ADPCM options.
RD Signal	Inverts the polarity of the RD signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC or ADPCM options.
RR Signal	Inverts the polarity of the RR signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNCor ADPCM options.

DM Signal	Inverts the polarity of the DM signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC or ADPCM options.
RS Signal	Inverts the polarity of the RS signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC option.
CS Signal	Inverts the polarity of the CS signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC option.
MC Signal	Inverts the polarity of the MC signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC option.
TT Signal	Inverts the polarity of the TT signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC option.
RT Signal	Inverts the polarity of the RT signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC option.
ST Signal	Inverts the polarity of the ST signal. Select either NORMAL or INVERT (inverted) signal poarity. Available only with the ASYNC option.

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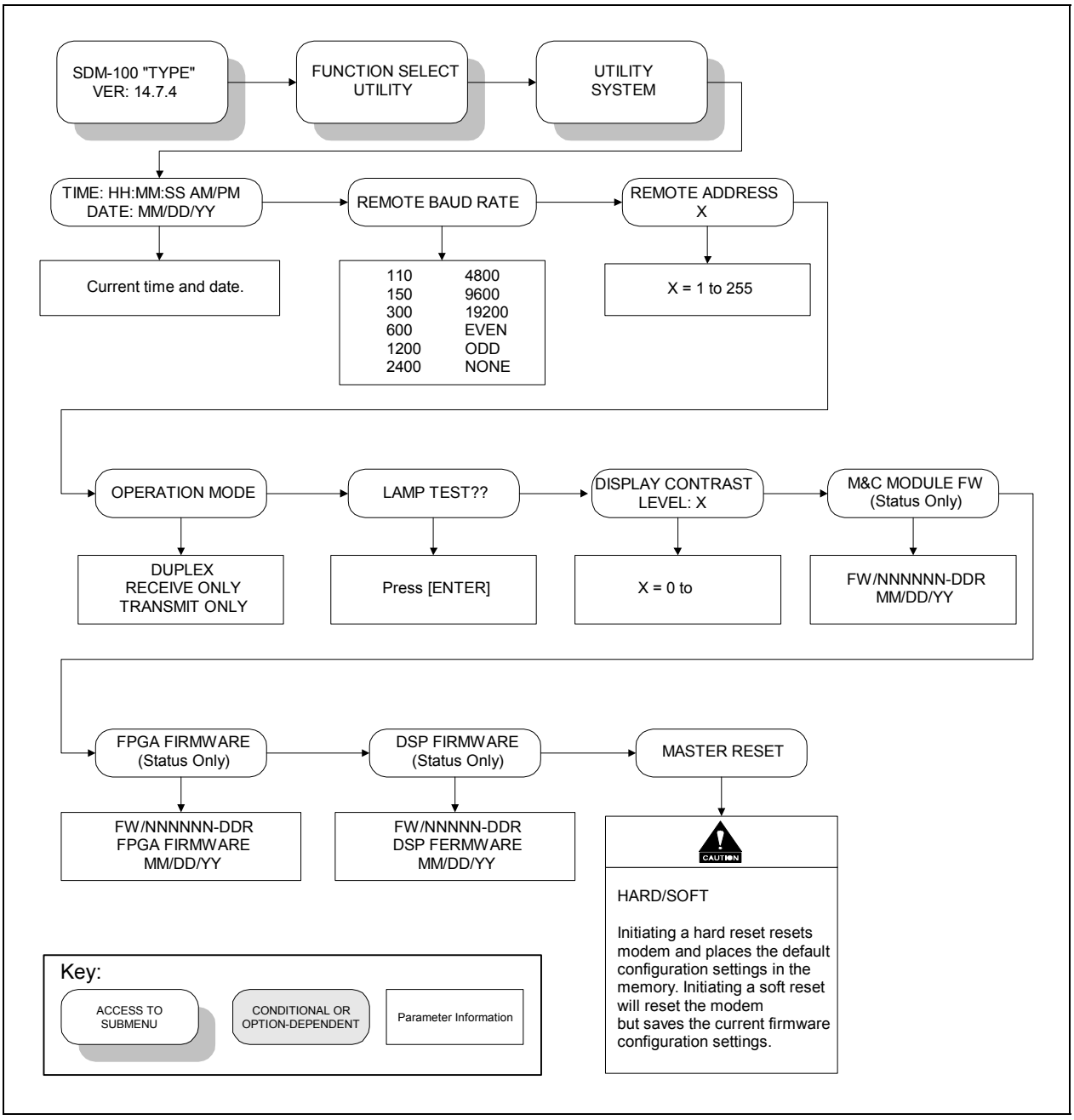

Figure 3-14. Utility System (SDM-100 Operation)

3.2.1.6.4 Utility System

Time/Date	Time of day and Date set/display function. The current time and date in the modem memory are displayed when selected. To set the modem time and/or date, press [ENTER]. Press [←] or [→] to position the flashing cursor over the parameter to be changed. Press [↑] or [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the time and date.
Remote Baud Rate	The current baud rate and parity selection of the modem are displayed. To set the modem baud rate and/or parity, press [ENTER]. Press [←] or [→] to position the flashing cursor over the parameter to be changed. Press [↑] or [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the baud rate and parity. The baud rate can be set from 110 to 19200 bits/s. The parity can be set to even, odd, or none.
Remote Address	The current modem address is displayed (1 to 255). To set the remote address, press [ENTER]. Press [↑] or [↓] to change the parameter to the desired value. Press [ENTER] to execute the change.
Operation Mode	Programs the modem operation for Duplex, RX-only, or TX-only operation. On entry, the current status is displayed. Press [↑] or [↓] to select Duple, RX-only, or TX-only. Press [ENTER] to execute the change. When TX-only or RX-only are selected, the appropriate faults are masked from the Faults and Stored Faults menu.
Lamp Test ??	Lamp test function to verify the front panel indicators. Press [ENTER] to turn on all of the front panel indicators for three seconds.
Display Contrast Level:	Set the contrast setting of the front panel display. Press [ENTER] in order to change the contrast of the front panel display. Press [↑] or [↓] to increment or decrement the number at the flashing cursor from 0 to 100. Press [ENTER] to execute the change.

M&C Module Firmware	Displays M&C module firmware version. Upon entry, the date of release of this firmware will be displayed. This is a status window only.
FPGA Firmware	Displays firmware version of the Field Programmable Gate Array. Upon entry, the date of release of this firmware will be displayed. This is a status window only.
DSP Firmware	Displays the firmware version installed in the Digital Signal Processor (DSP). Upon entry, the date of release of this firmware will be displayed. This is a status window only.
Master Reset	Master reset function.  ***When a hard reset is initiated, the modem hardware is reset, and all default configuration settings will be installed. When a soft reset is initialized, the modem hardware will be reset, but the initial firmware configuration settings will be saved.*** Press [ENTER] once to access Soft. Press [↑] or [↓] to alternate between Hard and Soft until the desired type is visible. Press [ENTER]. If Soft has been selected, press [ENTER] again to reset the modem. If Hard is selected, press [→] until the cursor is on YES, and press [ENTER].

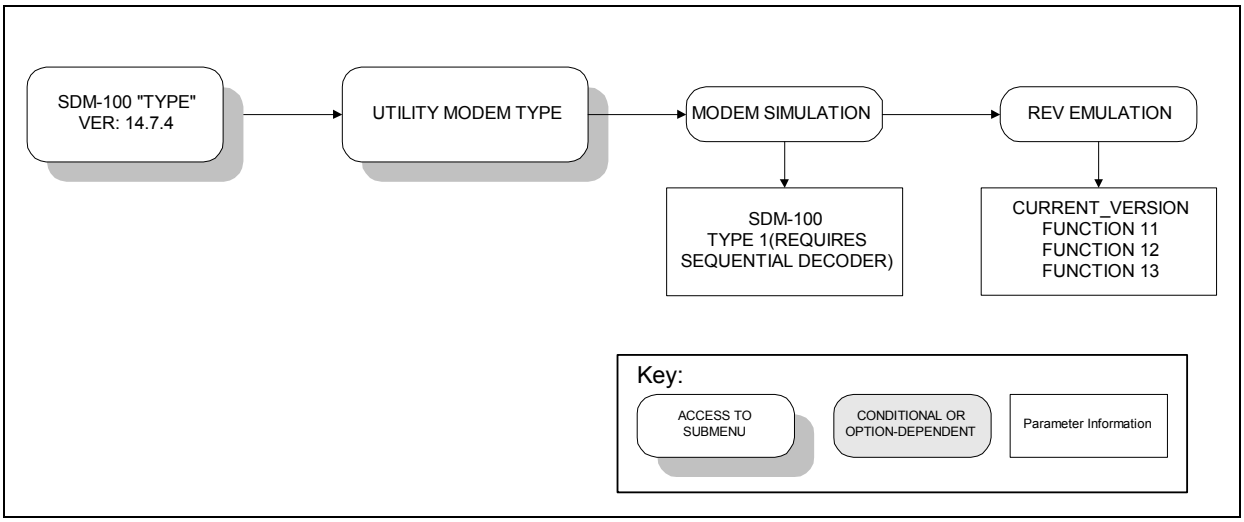

Figure 3-15. Utility Modem Type (SDM-100 and Type 1 Operation)

3.2.1.6.5 Utility Modem Type

This configuration allows the user to select normal SDM-100A operation, or to direct the modem to simulate an SDM-650B by selecting Type 1 operation. The modem will then simulate an SDM-650B that contains v.274 firmware. The Configuration Menu changes dramatically, and is shown in Figure 3-17.

Note: The modem must contain a sequential decoder.

Enter the window, and press [↑] or [↓] to change the Modem Type. Press [ENTER] to execute the change.

Rev Emulation programs an emulation mode of a previous functional revision. This allows the user to select the CURRENT VERSION or FUNCTIONAL version (xx).

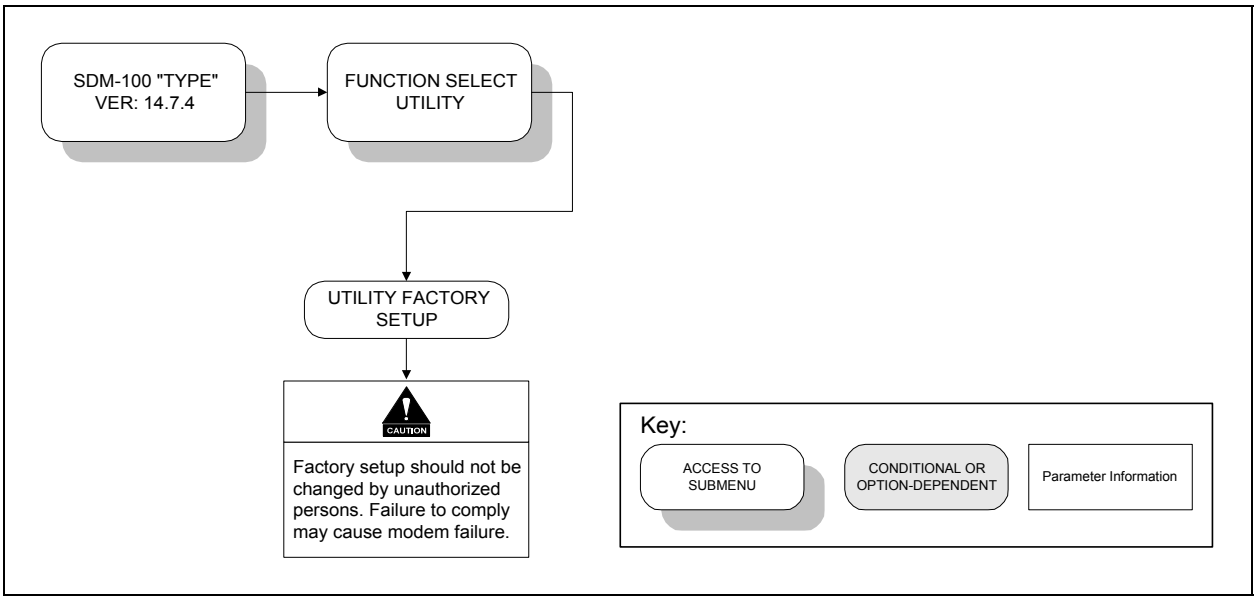

Figure 3-16. Utility Factory Setup (SDM-100 and Type 1 Operation)

3.2.1.6.6 Utility Factory Set-Up

This configuration is used for factory alignment and filter setup parameters. To avoid modem failure, Factory Setup should not be changed by unauthorized persons.

3.2.2 Type 1 Operation Menus

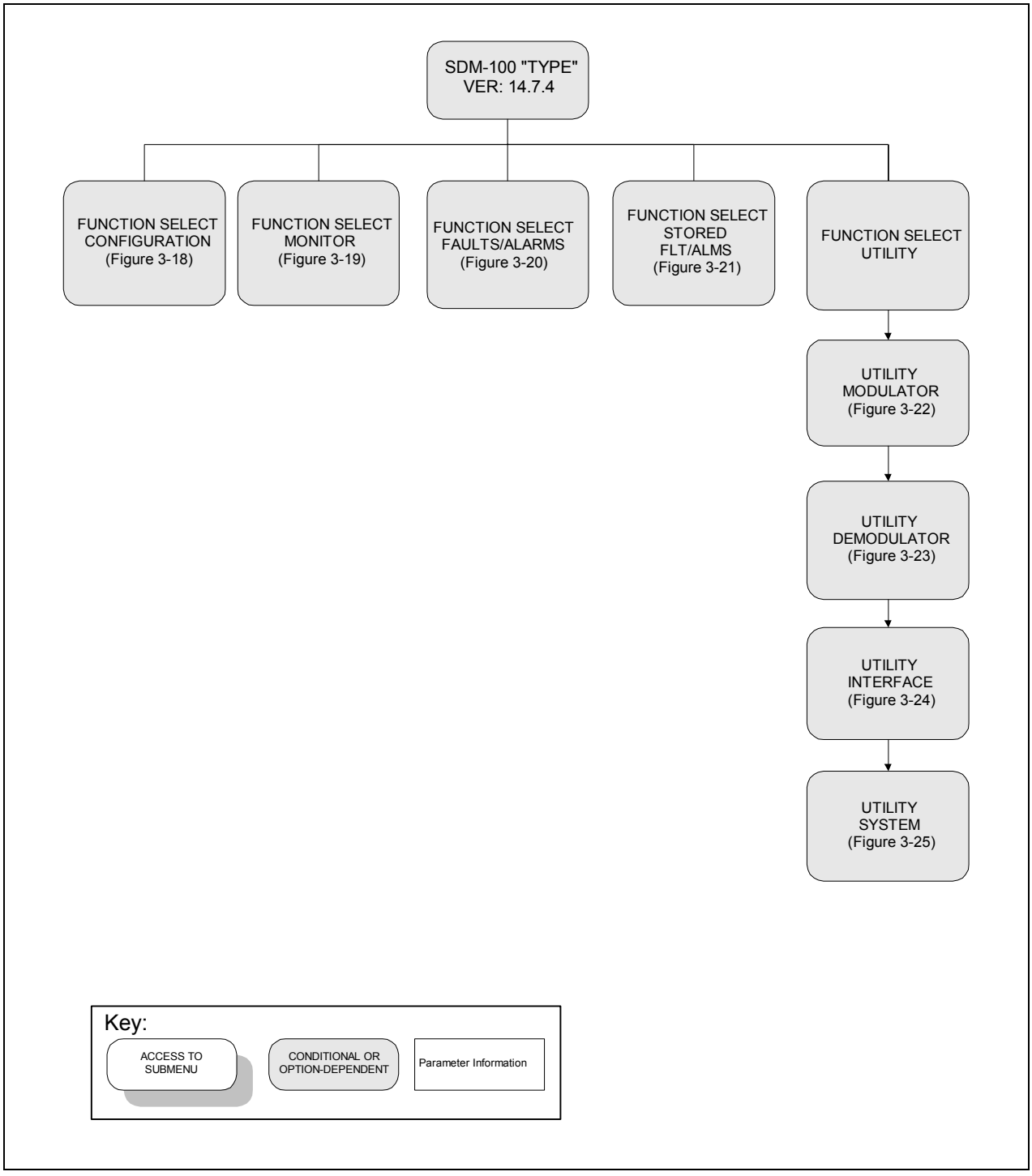

Figure 3-17. Main Menu (Type 1 Operation)

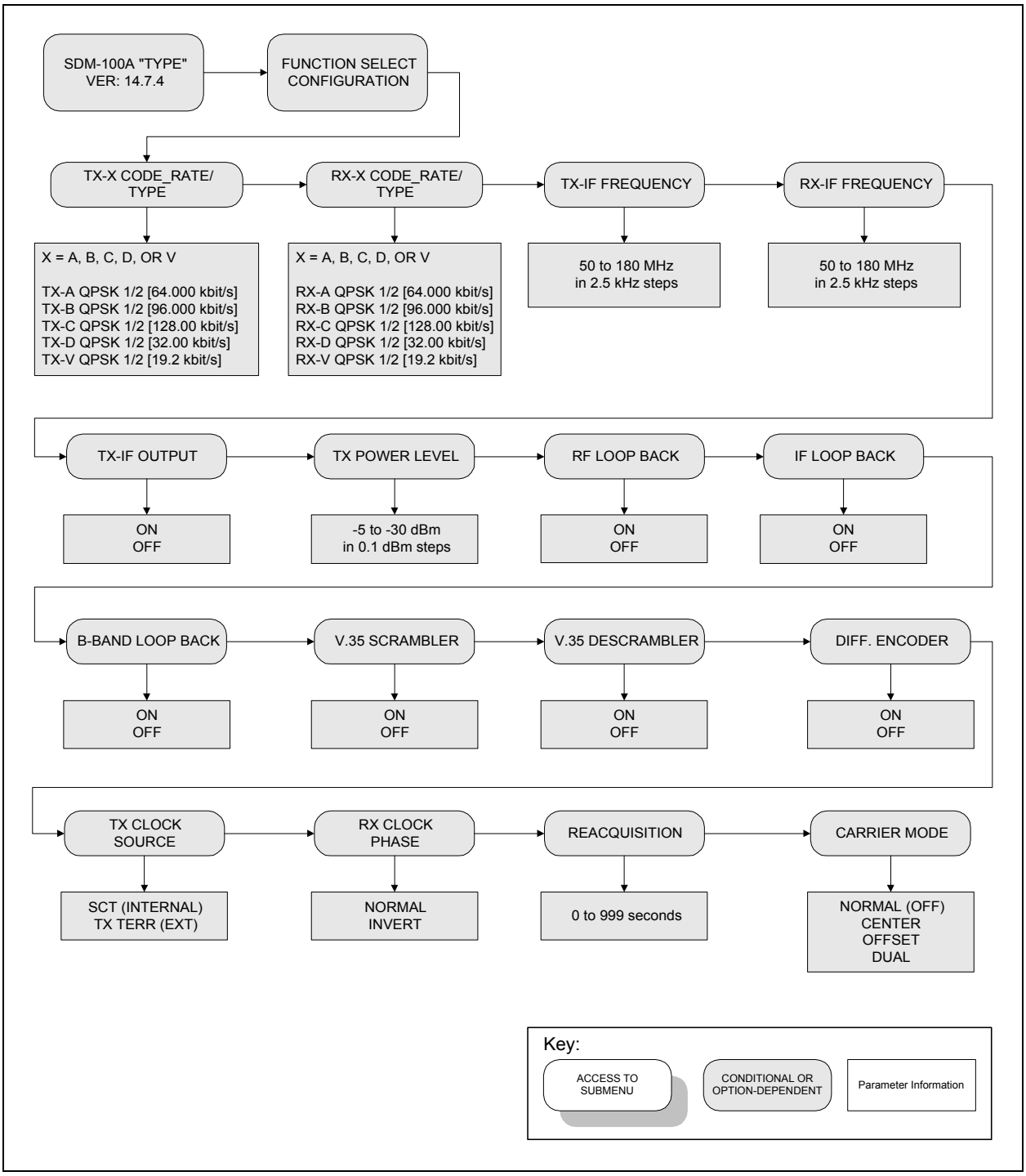

Figure 3-18. Configuration (Type 1 Operation)

3.2.2.1 Configuration: Type 1 Operation

TX-X Code_Rate/Type	Transmitter rate selection. One of four predefined transmitter code/data rate combinations may be selected: • A • B • C • D A variable rate selection (V) can also be selected. These settings must first be set up in the Utility menu. On entry, the current transmitter rate is displayed with the flashing cursor on the code rate on line 1. The data rate is displayed on line 2. Press [←] or [→] to select one of four predefined rates. To select the variable data rate, select TX-V and press [ENTER] twice to select the currently defined data rate. To change the rate using the variable rate selection, press [ENTER] when TX-V is displayed. A flashing cursor will be displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. To operate BPSK, select TX-V and select BPSK 1/2 for the code rate. Enter a data rate from 9.6 to 64 kbit/s. Press [ENTER] to execute the change. **Note:** When the TX rate has been changed, the transmitter is automatically turned off to prevent swamping of other channels. To turn on the transmitter, use the IF output function.

RX-X Code_Rate/Type	Receiver rate selection. Four predefined receiver decoder/data rate combinations are available: • A • B • C • D A variable rate selection (V) may also be selected. These settings must first be set up in the Utility menu. On entry, the current receiver rate is displayed with the flashing cursor on the code rate on line 1. The data rate is displayed on line 2. Press [↑] or [↓] to select one of four predefined rates. To select the variable data rate, select RX-V and press [ENTER] twice to select the currently defined data rate.
TX-IF Frequency	Programs the modulator transmit frequency between 50 and 180 MHz, in 2.5 kHz steps. On entry, the current transmitter frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** When the transmitter frequency is changed, the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the IF output function.
RX-IF Frequency	Programs the demodulator receive frequency between 50 and 180 MHz, in 2.5 kHz steps. On entry, the current receive frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
TX-IF Output	Programs the modulator output to ON or OFF. On entry, the current status of the output is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.

TX Power Level	Programs the modulator output power level from -5 to -30 dBm, in 0.1 dB steps. The high-power option operates from +5 to -20 dBm. On entry, the current transmitter power level is displayed with the flashing cursor on the first character. Press [↑] or [↓] to increase or decrease the output power level, in 0.1 dB steps. Press [ENTER] to execute the change. **Note:** The actual front panel display may be changed in the power offset utility function. Using this function does not change the actual output power level. When the offset feature is being used, ADJ will be displayed on the second line.
RF Loop Back	Programs the modem for RF loopback operation (test mode). 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. Refer to Figure 3-26 for a block diagram of RF loopback operation. **Note:** RF loopback nullifies IF loopback. On entry, the current status of RF loopback is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
IF Loop Back	Programs the modem for IF loopback operation (test mode). 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. The demodulator is reconnected to the IF input. See Figure 3-27 for a block diagram of IF loopback operation. **Note:** IF loopback nullifies RF loopback. On entry, the current status of IF loopback is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.

B-Band Loop Back	Programs the modem for baseband loopback operation (test mode). When baseband loopback is turned on, the data and timing signals are hard-wired (via relays) from the demodulator to the modulator on the modem side of the interface. The DTE baseband signals are also looped back from the transmitter data and clock to the receiver data and clock on the customer side of the interface. This is a bi-directional loopback of the baseband data. Refer to Figure 3-28 for a block diagram of baseband loopback operation. On entry, the current status is displayed. Press [⇑] or [⇓] to select ON or OFF. Press [ENTER] to execute the change.
V.35 Scrambler	Programs the scrambler ON or OFF. On entry, the current status of the V.35 scrambler is displayed. Press [⇑] or [⇓] to select ON or OFF. Press [ENTER] to execute the change.
V.35 Descrambler	Programs the descrambler ON or OFF. On entry, the current status of the V.35 descrambler is displayed. Press [⇑] or [⇓] to select ON or OFF. Press [ENTER] to execute the change.
Diff. Encoder	Programs the differential encoder ON or OFF. On entry, the current status of the Differential Encoder is displayed. Press [⇑] or [⇓] to select ON or OFF. Press [ENTER] to execute the change.
TX Clock Source	Programs the clock source for the modem transmitter clock. “SCT (Internal)” sets the TX clock to operate from the modem internal clock. This is also the fallback clock. “TX Terrestrial” sets the TX clock to recover timing from the incoming clock/data. On entry, the current transmit clock setting is displayed. Press [⇑] or [⇓] to select “SCT” or “TX Terrestrial,” clock. Press [ENTER] to execute the change.
RX Clock Phase	Programs the RX clock phase to “Normal” or “Inverted.” On entry, the current status of the RX Clock is displayed. Press [⇑] or [⇓] to select “Normal” or “Invert.” Press [ENTER] to execute the change.

Reacquisition	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.
Carrier Mode	Programs the modem for continuous wave mode. Four modes of operation are available: Normal (OFF), Center, Offset, and Dual modes. The Carrier mode is normally in the OFF position. To change to Center, Offset, or Dual mode, enter the Carrier Mode Menu and select the desired test mode. **Center Mode:** A test mode that generates a carrier at the current modulator frequency. This can be used to measure the output frequency. **Offset Mode:** A test mode that generates a single upper side-band suppressed carrier signal. The upper side-band is one-quarter the symbol rate from the carrier. This is used to check the quadrature. **Dual Mode:** A test mode that generates a dual side-band suppressed carrier signal. Side-bands are one-half the symbol rate from the carrier. This is used to check the channel balance and carrier null. On entry, the “CENTER” mode is displayed. To activate this test mode, press [ENTER]. Press [↑] or [↓] to select the “DUAL” or “OFFSET” mode. To return to the “CONFIGURATION” 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 “IF Output” function.

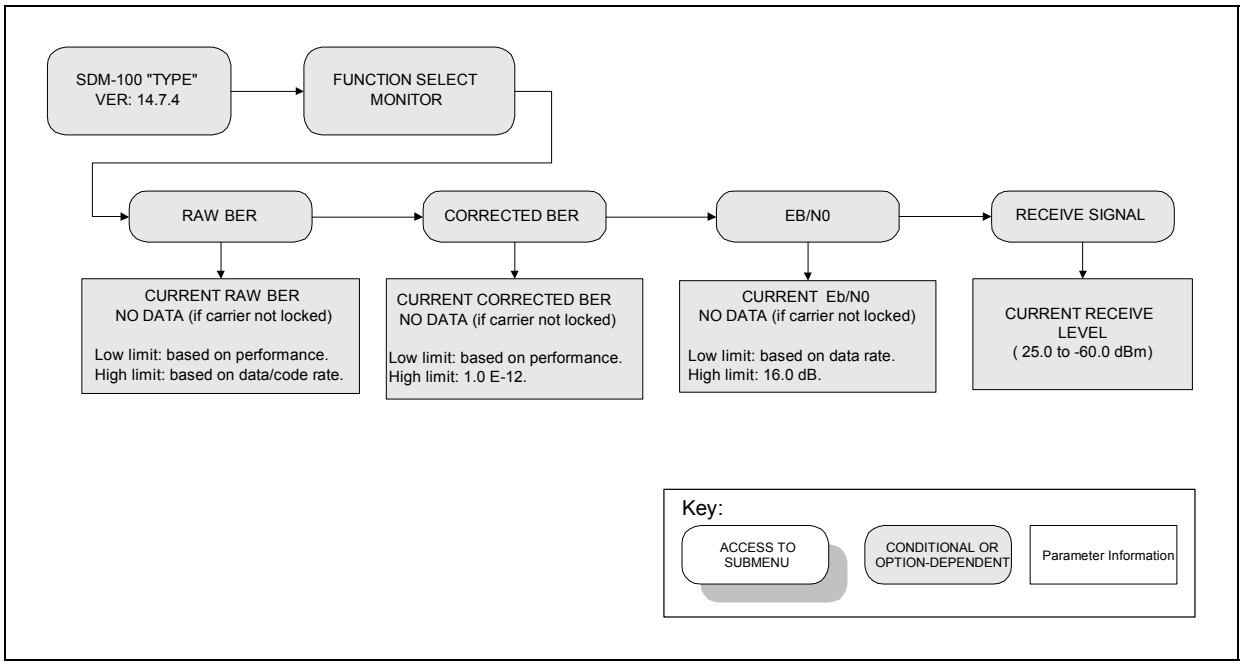

Figure 3-19. Monitor (Type 1 Operation)

3.2.2.2 Monitor: Type 1 Operation

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

RAW BER	Raw bit error rate	Range: <m.m E^{-e} to >m.m E^{-e}	*(See Note)*
CORRECTED BER	Corrected bit error rate	Range: <m.m E^{-e} to >m.m E^{-e}	*(See Note)*
E_b/N_0	Energy (bit)/noise ratio	Range: <mm.m to >mm.m	*(See Note)*
RECEIVE SIGNAL	Receive signal level	Range: <-mm.m to >-mm.m	*(See Note)*

Note: When the decoder loses lock, no data is available, and is so indicated. If data is over or under range, "<" or ">" will be indicated.

3.2.2.3 Faults/Alarms: Type 1 Operation

The Faults/Alarms level is accessible from the Function Select menu. Faults/Alarms are similar to Monitor functions. The Faults/Alarms level displays the current fault status of the group being displayed. Press [←] or [→] to move between the Faults/Alarm groups:

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

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

- "-" indicates that no fault or alarm exists.
- "+" indicates that a fault exists, and will cause switching in a redundant system.
- A reversed contrast "+" indicates an alarm is active, but will not cause switching to occur.

To display labels for individual faults or alarms, press [ENTER]. Press [←] or [→] to move the flashing cursor to the fault or alarm to be identified. The label for that fault/alarm is immediately displayed on line one of the display. [CLEAR] can be used to exit this level of operation and return to the previous level.

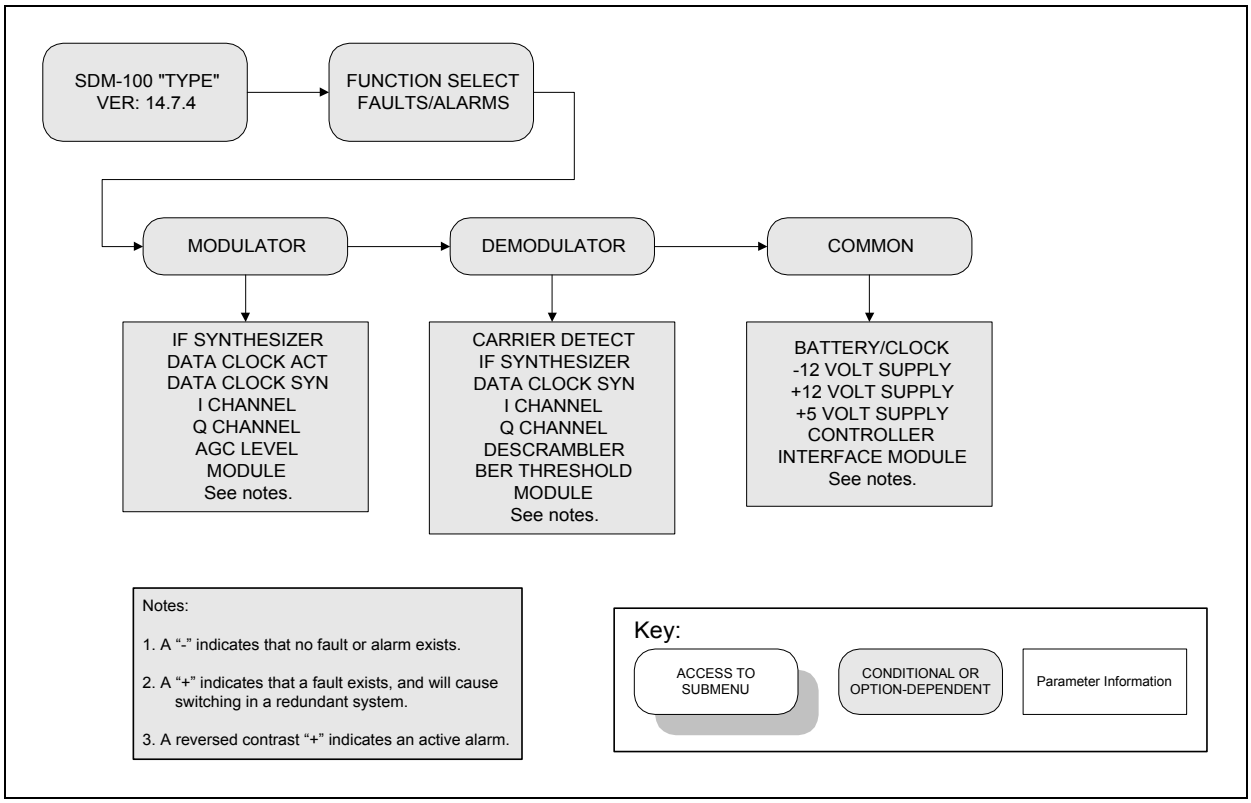

Figure 3-20. Faults/Alarms (Type 1 Operation)

3.2.2.3.1 Modulator Faults: Type 1 Operation

Fault	Description
IF Synthesizer	Modulator IF synthesizer fault.
Data Clock Act	Activity detector alarm of the selected interface receive clock. The interface will fall back to the satellite clock when this fault is active.
Data Clock Syn	Transmit clock synthesizer fault. Indicates the internal VCO has not locked to the incoming data clock.
I Channel	I channel data activity fault.
Q Channel	Q channel data activity fault.
AGC Level	TX-IF AGC level fault.
Module	Modulator module fault. Typically indicates the modulator module is missing or will not program.

3.2.2.3.2 Demodulator Faults: Type 1 Operation

Fault	Description
Carrier Detect	Carrier detect fault. Indicates the decoder is not locked.
IF Synthesizer	Demodulator IF synthesizer fault. Indicates that the IF synthesizer is not locked.
Data Clock Syn	Receive clock synthesizer fault. Indicates the internal VCO has not locked to the incoming data clock.
I Channel	I channel activity fault. Indicates a loss of activity in the I channel of the quadrature demodulator.
Q Channel	Q channel activity fault. Indicates a loss of activity in the Q channel of the quadrature demodulator.
Descrambler	Descrambler activity alarm. Indicates a loss of activity in the descrambler.
BER Threshold	Secondary alarm result of the BER threshold set in the Demod Configuration menu.
Module	Demodulator/decoder module fault. Typically indicates that the Demod/decoder module is missing or will not program.

3.2.2.3.3 Common Equipment Faults: Type 1 Operation

Fault	Description
Battery/Clock	Battery or clock fault.
-12V Supply	-12V power supply fault.
+12V Supply	+12V power supply fault.
+5V Supply	+5V power supply fault.
Controller	Controller fault. Typically indicates the controller has gone through a power on-off cycle.
Interface Module	Interface module fault. Typically indicates that the interface module is missing or will not program.

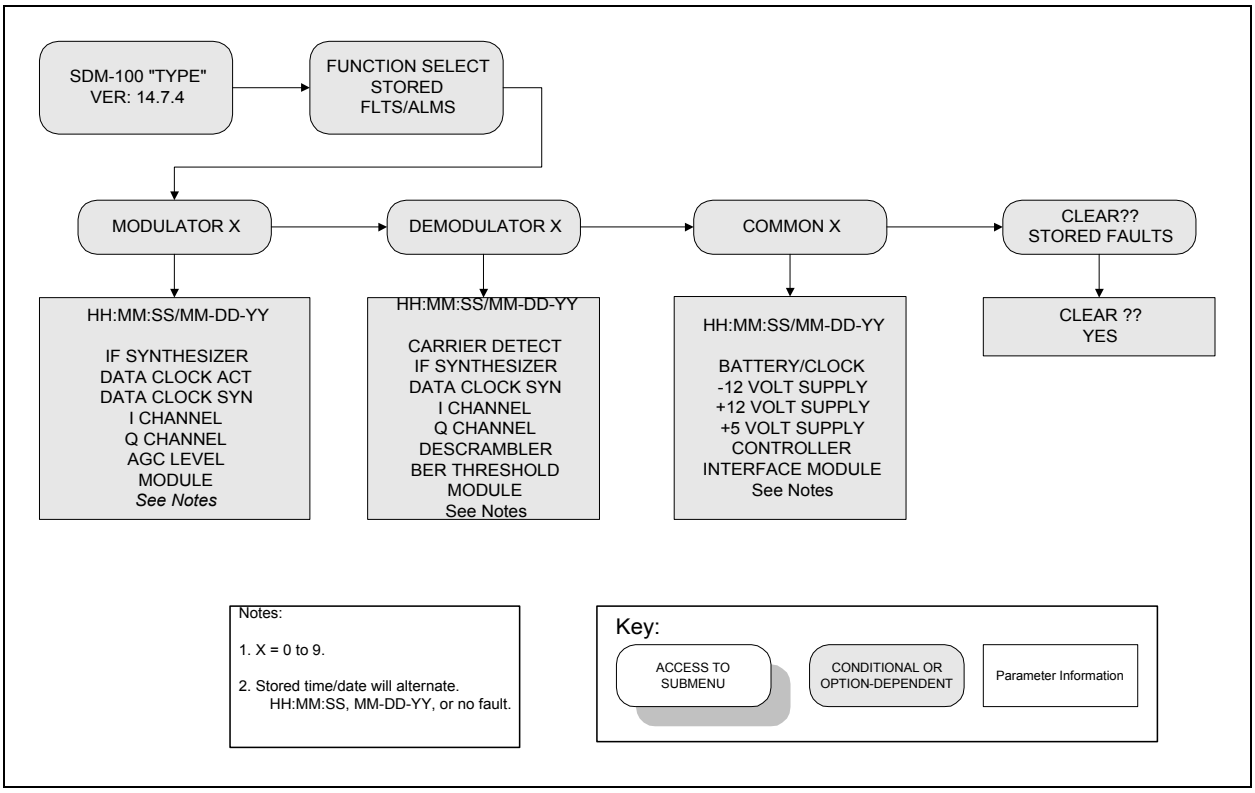

Figure 3-21. Stored FLT/ALMS (Type 1 Operation)

3.2.2.4 Stored Faults/Alarms: Type 1 Operation

The modem stores the first 10 (Flt0 through Flt9) occurrences of fault status changes in each of the seven major fault categories. Each fault status change is stored with the time and date of the occurrence (i.e., when a fault occurs and when it clears). Stored faults may be viewed by entering the stored faults level from the Function Select menu. All stored faults may be cleared by executing the CLEAR STORED FAULTS?? command from the Stored Faults menu.

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-down, a common equipment fault is logged (Flt0) with that time and date. On power-up, an additional common equipment fault is also logged (Flt1) to indicate the power-up time and date. On power-up, the power-down and power-up times are logged as common equipment fault 0 and common equipment fault 1.

Upon entering the Stored Faults menu, press [←] or [→] to move between the six fault groups and the CLEAR STORED FAULTS?? selections. The time and date of the first stored fault status (Flt0) for the selected group will be displayed alternately on line 2 of the display. Press [↑] or [↓] to cycle through the selected group's stored fault status (Flt0 through Flt9).

To display the fault status associated with the displayed time and date, press [ENTER]. At this time, [←] or [→] may be used to move the flashing cursor to the fault to be identified.

To clear the stored faults currently logged, simply press [ENTER] when the CLEAR STORED FAULTS/YES?? selection is displayed.

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

3.2.2.5 Utility Functions

The utility functions are divided into five categories:

- Modulator
- Demodulator
- Interface
- System
- Modem type utility

These menus allow the user to:

- Set the time and date of the modem real time clock
- Choose filtering types
- Select decoder types
- Choose TX and RX fault enables
- Select modem type
- Choose overhead type
- Assign data rates
- Assign code rates
- Test the front panel optical indicators

After entering the Utility functions level, press [←] or [→] to select the Utility menu desired, and press [ENTER]. Press [←] or [→] to select the utility function of interest.

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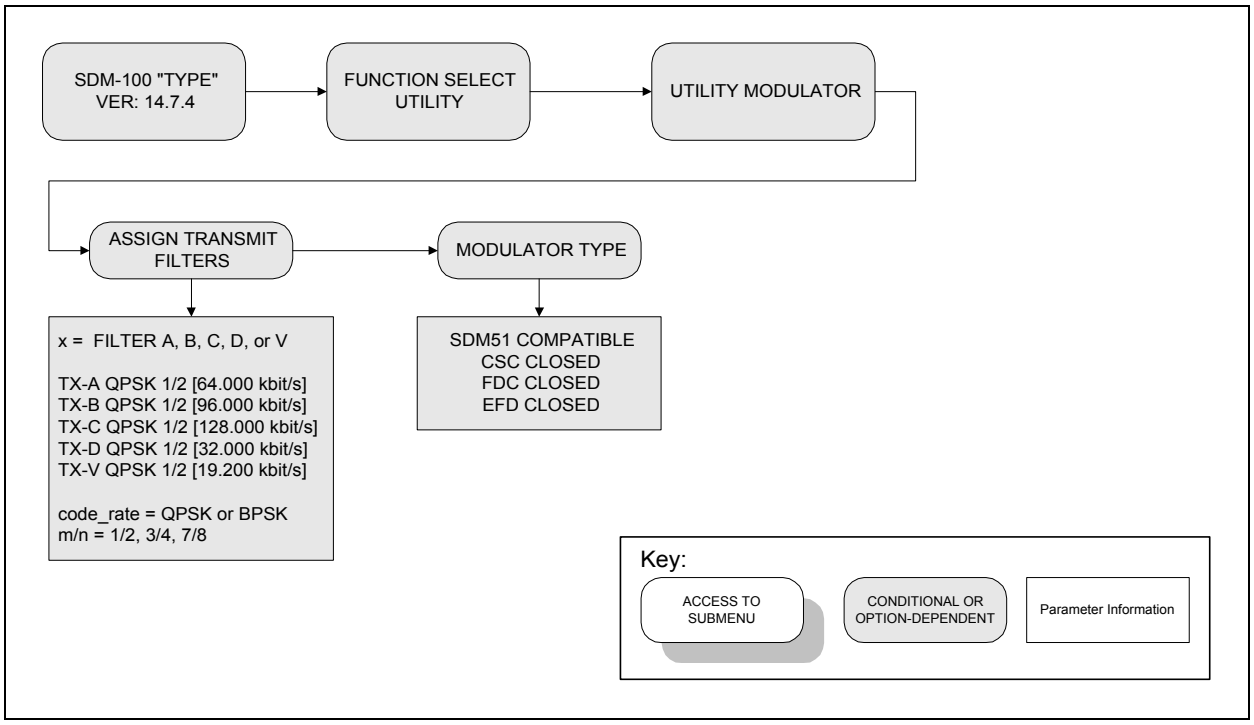

Figure 3-22. Utility Modulator (Type 1 Operation)

3.2.2.5.1 Utility Modulator: Type 1 Operation

Assign Transmit Filters	Transmit filter display/assignment utility. Used to make filter rate reassignments. The modulator has five symbol rate filter presets. Filters are designated as A, B, C, D, and V. **Note:** Switching between Modem types will reset the Filter presets to their factory-defined values. To view the current preset assignments, press [ENTER] when the "Assign Transmit Fltrs" selection is displayed from the "UTILITY FUNCTIONS" menu. On line 1 of the display will be "TX-A," which indicates transmitter filter A. Following "TX-A" 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 preset "A." Press [←] or [→] to see the assignments for presets B, C, D, and V (TX-B, TX-C, TX-D, and TX-V). To change a preset assignment, press [ENTER] when the data for that preset is displayed. Press [←] or [→] until the flashing cursor is at the parameter to be changed, then press [↑] or [↓] to change that parameter. When all changes are made, press [ENTER] to confirm the assignment. If a preset data/code rate is changed and the modem is currently using that preset, the modem will be reprogrammed to the new data/code rate. **Note:** These assignments are used for the selection of "TX-R" (Transmitter Rate) in the configuration functions menu.
Modulator Type	Transmit Filter Type Select. Allows operator to select SDM-51 compatible, CSC Closed, FDC closed, or EFD Closed network filtering.

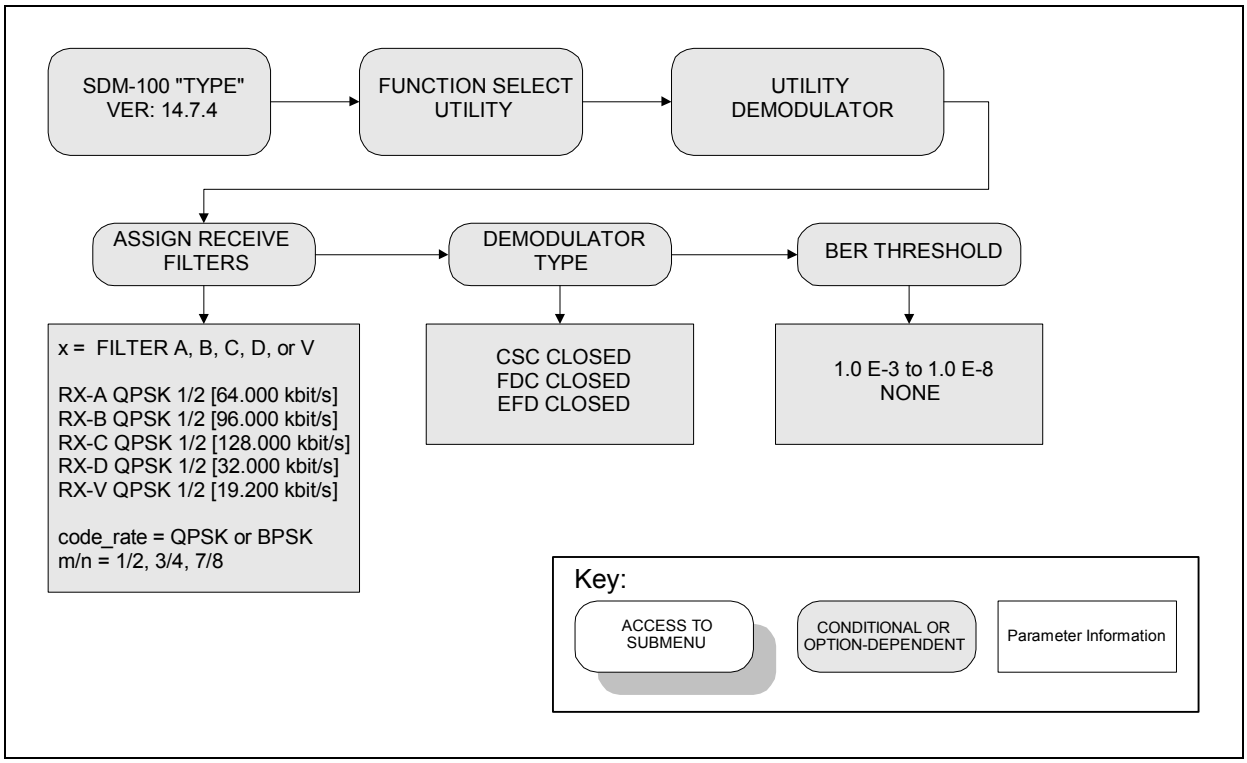

Figure 3-23. Utility Demodulator (Type 1 Operation)

3.2.2.5.2 Utility Demodulator Functions: Type 1 Operation

Assign Receive Filters	Receive filter display/assignment utility. Used to view and change current filter rate assignments. Refer to the previous text under assign transmit filters. The receive filters assignments are basically identical.
Demodulator Type	Receive filter type select. Allows the operator to select CSC Closed, FDC Closed, or EFD Closed network receive filtering.
BER Threshold	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.

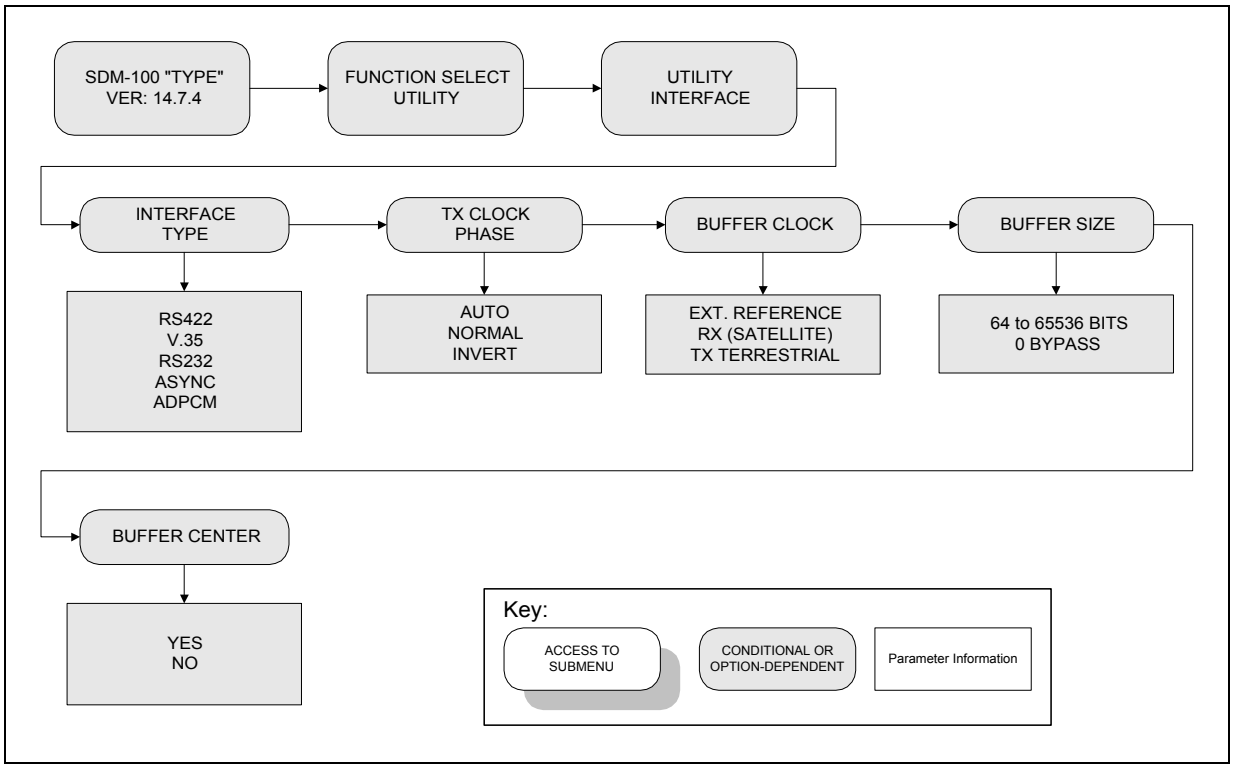

Figure 3-24. Utility Interface (Type 1 Operation)

3.2.2.5.3 Utility Interface Functions: Type 1 Operation

Interface Type	Displays the interface type (RS-422, V.35, RS-232-C, ASYNC, or ADPCM) installed in the modem. This is a status window only, and no changes can be made from this menu.
TX Clock Phase	Programs transmit clock phase to Auto, Normal or Invert. On entry, the current setting for the TX clock phase is displayed. Press [↑] or [↓] to select Normal or Invert. Press [ENTER] to execute the change.
Buffer Clock	Programs interface buffer output clock. EXT. REFERENCE sets this clock source to the master clock (or terminal timing) external reference, which is received on the DATA I/O connector on the rear of the modem. RX SATELLITE sets the output buffer clock to the satellite clock. TX TERRESTRIAL sets the buffer output clock to recover timing from the incoming TX data clock. On entry, the current setting of the interface buffer clock is displayed. Press [↑] or [↓] to select EXT. REFERENCE, RX SATELLITE, or TX TERRESTRIAL for the buffer clock. Press [ENTER] to execute the change.
Buffer Size	This configuration function is used to set the size of the buffer. On entry, the current buffer length is displayed. Press [↑] or [↓] to select the desired buffer size. The buffer size will be displayed in Milliseconds or Bits. The Interface Utility menu under the Function Select Utility menu must be entered to change the buffer units to Milliseconds or Bits. The range which may be selected is 64 to 65,536 bits, in increments of 16, or bypass, which equals 0 bits. If milliseconds are selected, 0 to 50 ms in increments of 1 ms may be chosen. Press [ENTER] to execute the change. **Note:** To have the modem calculate the buffer depth, set the buffer units to Milliseconds. When a specific buffer depth is desired, set the buffer units to bits. To select Bits or Milliseconds, enter the Utility Interface menu and make the change.
Buffer Center	Configuration function used to center the buffer. On entry, the current status is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change

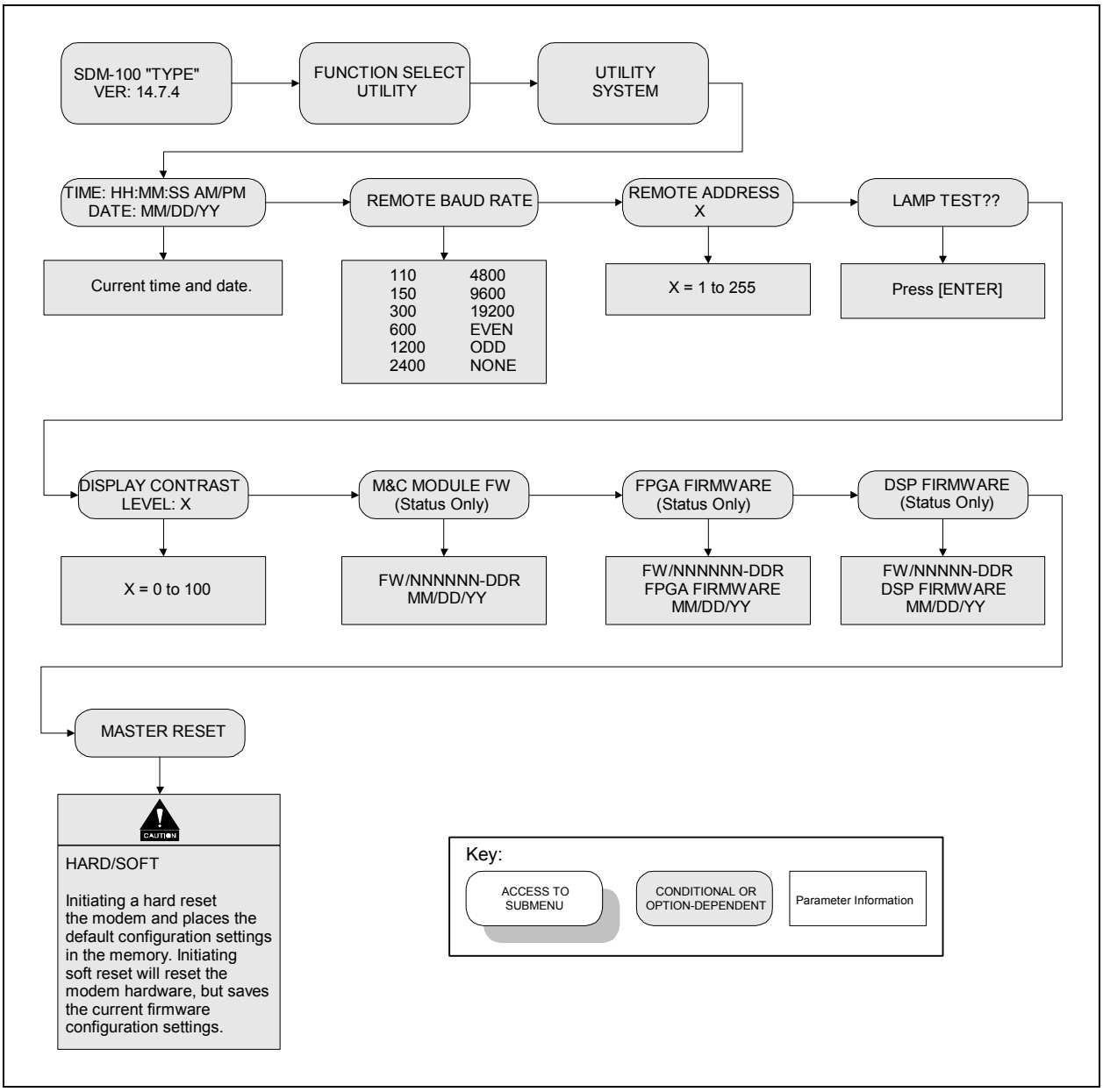

Figure 3-25. Utility System (Type 1 Operation)

3.2.2.5.4 Utility System Functions: Type 1 Operation

Time/Date	Time of day and date set/display function. The current time and date in the modem memory are displayed when selected. To set the modem time and/or date, press [ENTER]. Press [←] or [→] to position the flashing cursor over the parameter to be changed. Press [↑] or [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the time and date.
Remote Baud Rate	The current baud rate and the parity selection of the modem are displayed. To set the modem baud rate and/or parity, press [ENTER], and use [←] or [→] to position the flashing cursor over the parameter to be changed. Press [↑] or [↓] to change the parameter to the desired value. Once the parameters are displayed as desired, press [ENTER] to set the baud rate and parity. The baud rate can be set from 110 to 19200. The parity can be set to even, odd, or none.
Remote Address	The current modem address is displayed (1 to 255). To set the remote address, press [ENTER]. Press [↑] or [↓] to change the parameter to the desired value. Press [ENTER] to execute the change.
Lamp Test??	Lamp test function verifies the function of all front panel indicators. Press [ENTER] to turn on all of the front panel indicators for three seconds.
Display Contrast Level	Set the contrast setting of the front panel display. Press [ENTER] in order to change the contrast of the front panel display. Press [↑] or [↓] to increment or decrement the number at the flashing cursor from 0 to 100. Press [ENTER] to execute the change.

M&C Module FW	Displays M&C module firmware version. Upon entry, the date of release of this firmware will be displayed. This is a status window only.
FPGA Firmware	Displays firmware version of the Field Programmable Gate Array (FPGA). Upon entry, the date of release of this firmware will be displayed. This is a status window only.
DSP Firmware	Displays the firmware version installed in the Digital Signal Processor (DSP). Upon entry, the date of release of this firmware will be displayed. This is a status window only.
Master Reset	Master reset function.  ***When a hard reset is initiated, the modem hardware is reset, and default configuration settings will be installed. When a soft reset is initialized, the modem hardware will be reset, but the initial firmware configuration settings will be saved.*** Press [ENTER] once to access soft. Press [⇑] or [⇓] to alternate between hard and soft until the desired type is visible. Press [ENTER] to select. If soft has been selected, press [ENTER] again to reset the modem. If hard is selected, press [→] until the cursor is on yes, and press [ENTER].

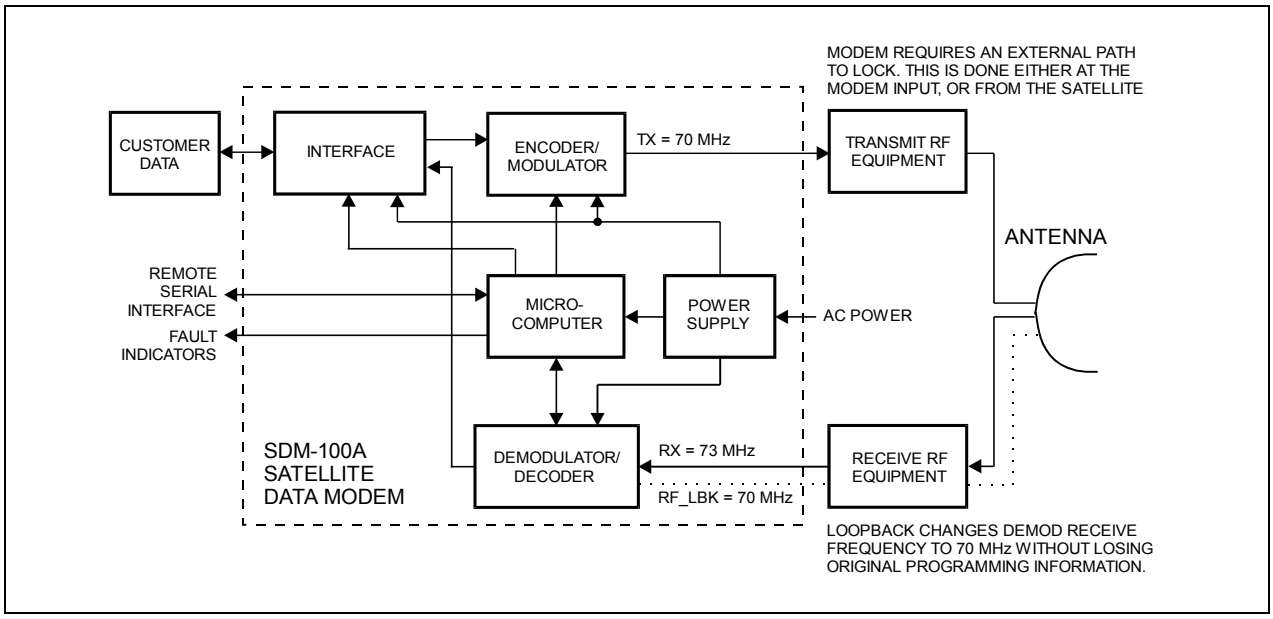

Figure 3-26. RF Loopback

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

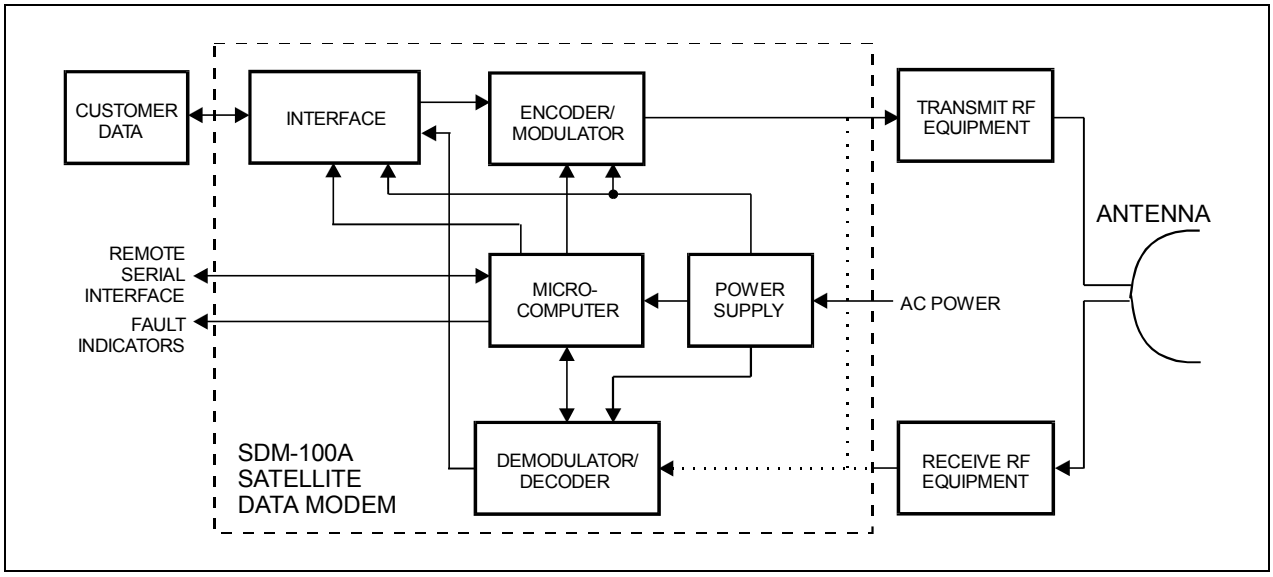

Figure 3-27. IF Loopback

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

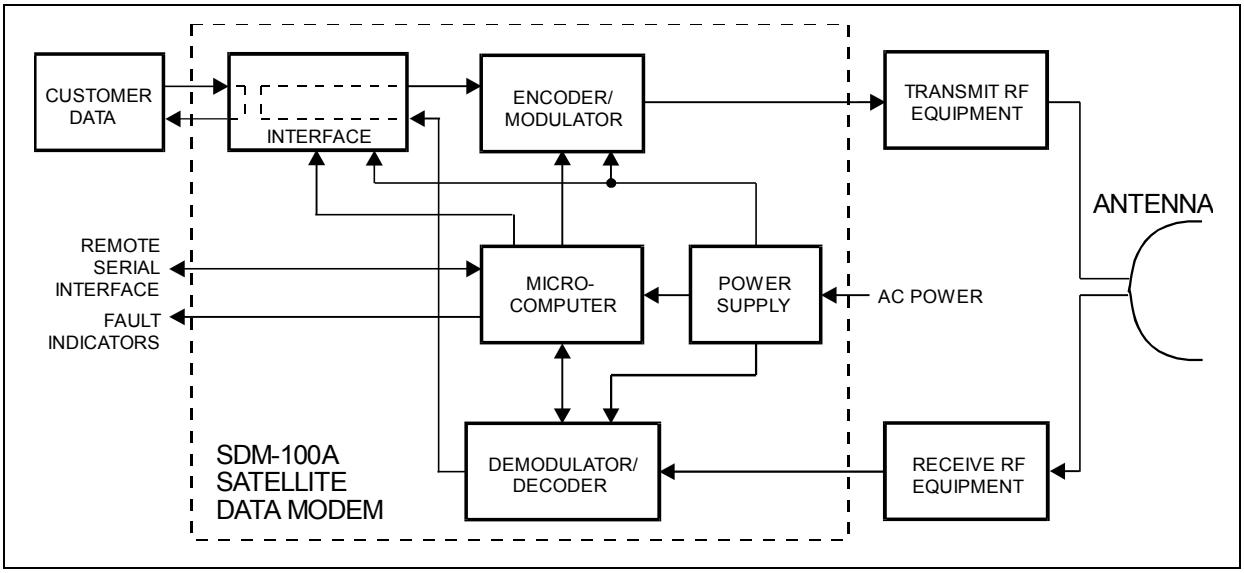

Figure 3-28. Baseband Loopback

Note: When baseband loopback is turned on, the data signal is looped back on the customer side of the interface. This test mode will verify customer equipment, as well as cabling between the modem and the customer equipment.

3.3 Clocking Options

Methods of clocking the data from the terrestrial equipment to the satellite (and vice versa) will depend upon the application. The two most common options and recommended configurations are described in the following paragraphs.

3.3.1 Master/Master

This application is used when both earth stations have high stability clocks, and the receive data will be clocked to the local network.

Refer to Figure 3-29 for the clocking block diagram, transmit clock options, and buffer clock options.

The disadvantages of the Master/Master application is that the receive data will slip, since the clocks will not be synchronized. Also, the transmit and receive data rates must be equal. If "External Clock" is used, it must equal the TX and RX rates as well. However, if the buffer is properly set up, the slips will be an exact frame length, causing minimum loss of data. By using very high stability clocks, the expected time between slips can be many days.

Loss of the buffer clock will mean the buffer will not be emptied, and data will not be available. The buffer clock will normally revert to the low stability internal reference automatically.

3.3.2 Master/Slave

This application is used where the far end earth station does not have local access to a high stability reference clock, or where it is not required to synchronize with a local clock. Refer to Figure 3-30 for the clocking block diagram, transmit clock options, and buffer clock options. 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.

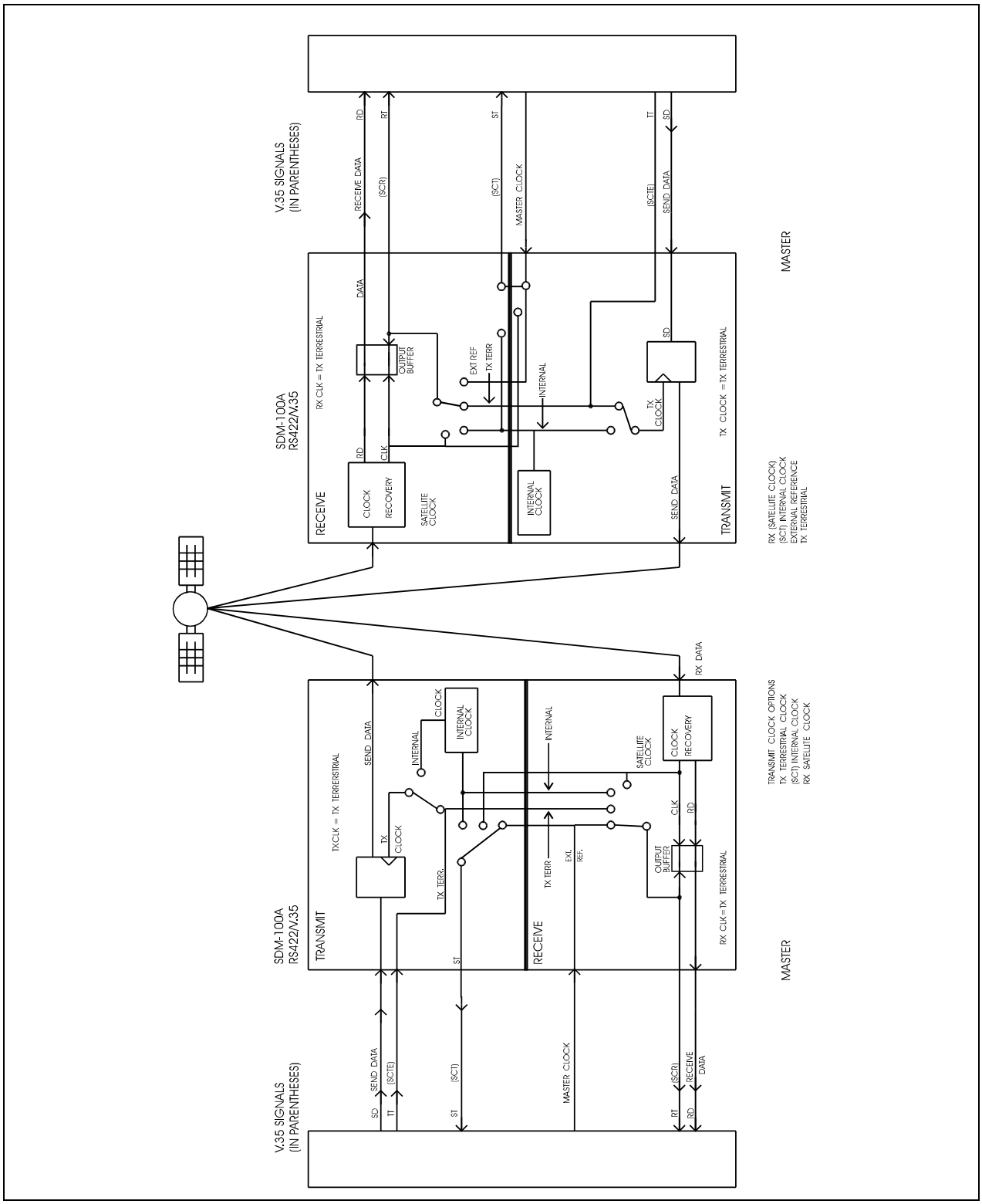

Figure 3-29. Master/Master Clocking Block Diagram

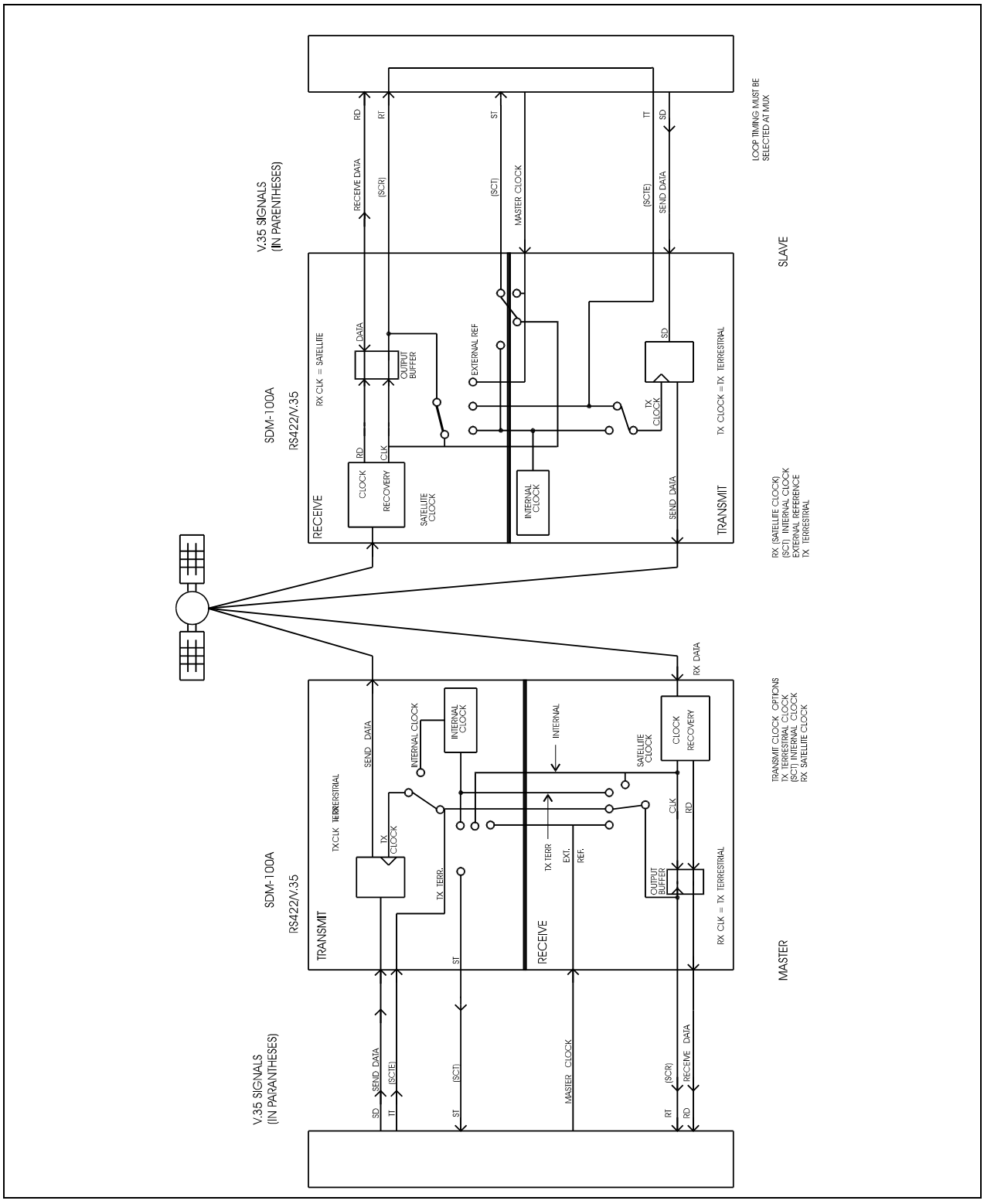

Figure 3-30. Master/Slave Clocking Block Diagram

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Chapter 4. THEORY OF OPERATION

This chapter describes the theory of operation for the various components of the modem.

4.1 Modulator

The modem modulator creates a QPSK or BPSK modulated carrier within the 50 to 180 MHz range from the digital data stream that is provided by the Interface section.

The following subsections make up the modulator:

- Scrambler/differential encoder
- Convolutional encoder
- I&Q Nyquist filters
- Modulator
- Output amplifier
- RF synthesizer

A block diagram of the modulator is shown in Figure 4-1.

4.1.1 Theory of Operation

The modulator is composed of several basic subsections, which comprise the baseband processing and RF sections. The modulator M&C controls all programmable functions on this module.

Fault information from the modulator is sent to the host M&C, and includes:

- Synthesizers out-of-lock
- RF output leveled
- Input data clock activity
- I channel digital filter activity
- Q channel digital filter activity
- AGC level faults

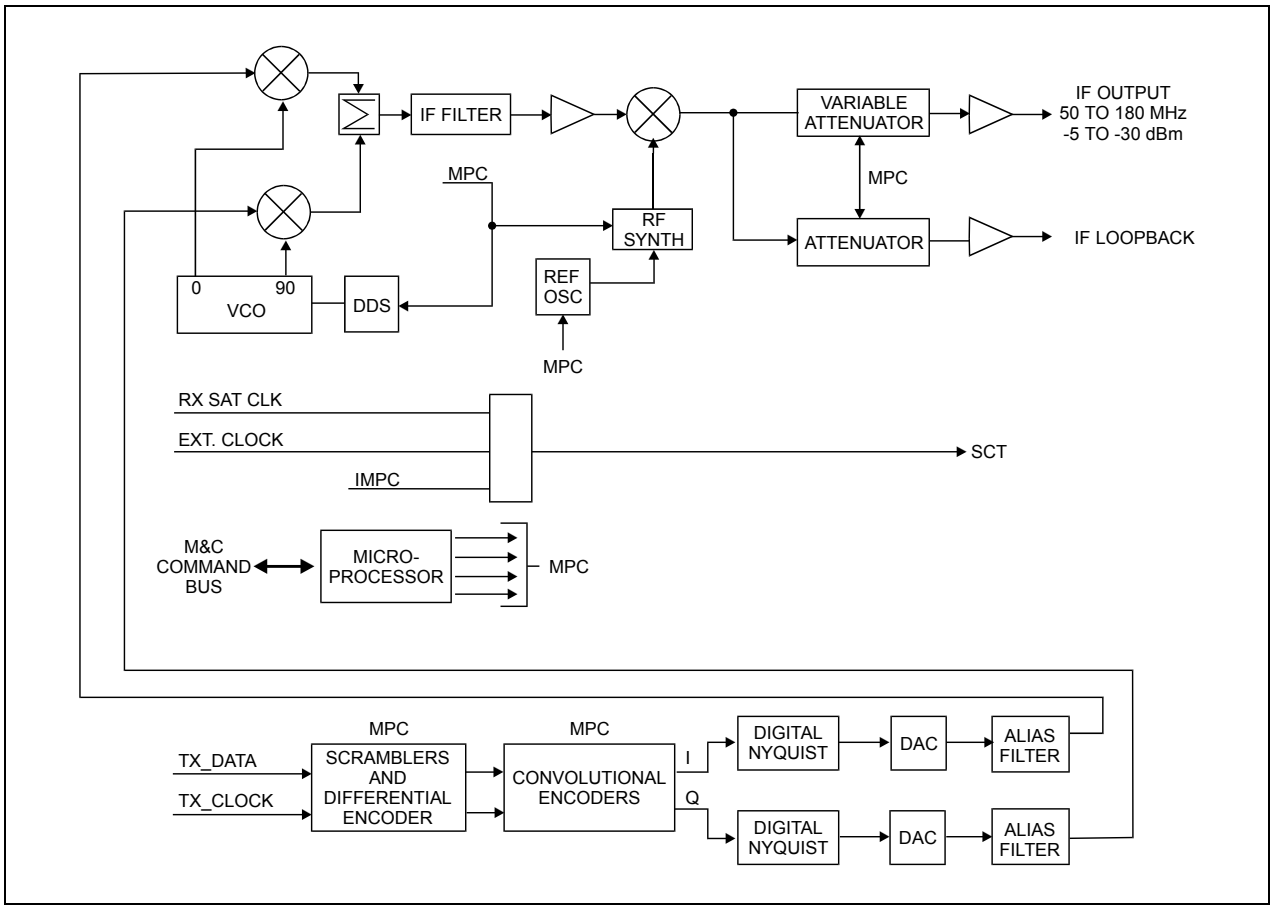


Figure 4-1. Modulator Block Diagram

Data to be transmitted will come from the interface card, via the demodulator. The format is RS-422, and includes a clock synchronous with the data. The data signal at this point is clean and free of jitter.

The data signal then goes to the scrambler (which provides energy dispersal) and then to the differential encoder. The differential encoder is a 2-bit encoder, which allows for resolution of two of the four ambiguity states of the QPSK demodulator.

The data signal passes to the convolutional encoder.

- For Viterbi codes, the convolutional encoder encodes the data at rate 1/2. If the selected code rate is 3/4, then two of every six symbols are punctured out. For every three data bits in, there are four bits out.

- For sequential encoding, the convolutional encoder generates the parity bits from the input data stream that allows for error correction at the far end of the link. The rate of the encoder may be 7/8, 3/4, or 1/2. This means, for example, that for 7/8 rate, 8 bits are output for every 7 bits input.

If the modulator is in the QPSK mode, the data will be split into two separate data streams to drive the in-phase and quadrature channels of the modulator.

From the encoder, the data signal passes through a set of variable rate digital Nyquist filters. There are two identical Nyquist filters:

- One for the in-phase channel
- One for the quadrature channel

The digital Nyquist filters are followed by Digital-to-Analog (D/A) converters and reconstruction filters, which provide spectral shaping and equalization. The filters are controlled by the M&C, so symbol rates up to 128 ks/s can be achieved without requiring the filter to be changed.

The I&Q filtered data signals are applied to the RF modulator, which converts them to a modulated carrier. The spectral shape will be identical to that of the input data streams, but double-sided about the carrier frequency.

The RF synthesizer provides the proper frequencies to convert the modulator IF to the desired output frequency in the 50 to 180 MHz range. The synthesizer has multiple loops, and incorporates a Direct Digital Synthesizer (DDS) chip to accommodate 2.5 kHz steps over a range of 130 MHz. The RF section has a frequency stability of $\pm 1 \times 10^{-5}$.

The signal from the power combiner is sent to the output amplifier, which takes the low-level signal from the modulator section and amplifies it to the proper level for output from the module. It contains circuitry which provides programmable control of the output level over a range of -5 to -30 dBm, in 0.1 dB steps, and power leveling ± 1 dB to maintain the stability of the output level over time and temperature.

When the modulator is in the BPSK mode, the I&Q data are MUXed together, and output as a single data stream. The select line determines which channel (I or Q) is output first.

In the normal (or “Standard”) operation, the I channel data is output from the MUX first, followed by Q channel data. If this order of data does not match the receive BPSK ordering, the modem will not lock. The TX and RX BPSK ordering must be the same in order to get the receiver to lock. Selecting “Non-Standard,” or inverted phase, for TX BPSK ordering will force the MUX to output the In-phase and Quadrature (I&Q) data streams in the opposite order, thereby matching the RX BPSK ordering being received from the other end.

Refer to Figure 4-2 for a timing diagram and schematic diagram explaining BPSK ordering.

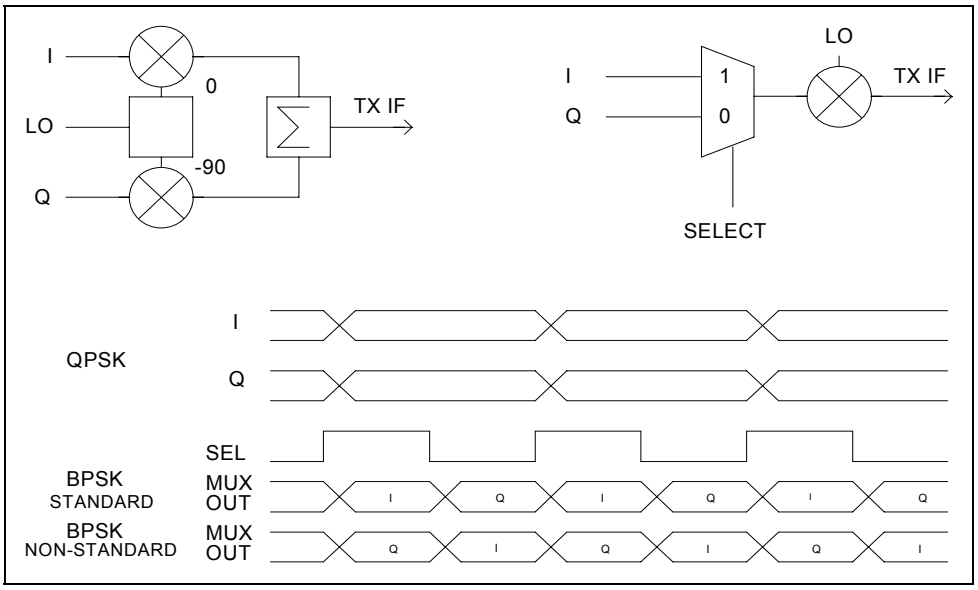


Figure 4-2. BPSK Ordering, Viterbi

4.1.2 Specifications

Modulation Type	QPSK or BPSK
Data Rate Range	19.2 to 128 kbit/s 1/2 Rate, QPSK 28.8 to 192 kbit/s 3/4 Rate, QPSK 33.6 to 224 kbit/s 7/8 Rate, QPSK 9600 bit/s to 64 kbit/s 1/2 Rate, BPSK
Symbol Rate Range	19.2 to 128 ks/s
Test Modes	Carrier Null and Quadrature (Dual and Offset)
Frequency Range	50 to 180 MHz
Frequency Select Method	Synthesized
Frequency Step Size	2.5 kHz
Frequency Stability (RF)	± 10 PPM Internal Oscillator
Frequency Stability (SCT)	± 10 PPM Internal Oscillator
Phase Error	2.5° max.
Filtering Type	Nyquist, Pre-equalized
Spectral Occupancy	Spectral Density is -30 dB at ± 0.75 Symbol Rate
Spurious and Harmonics	-55 dBc, 0 to 500 MHz
Output Power Level Range	-5 to -30 dBm, ± 0.5 dB
Output Stability	± 0.5 dB
Output Power Adjustment	0.5 dB step size
Output Impedance	75Ω, 50Ω optional
Output Return Loss	20 dB minimum
Scrambling	V.35
FEC Encoding	Convolutional K = 7 Viterbi, or Sequential Encoding
Decoding	Soft-Decision Viterbi or Sequential Rate 1/2, 3/4, or 7/8
Reported Faults	AGC Level Fault Synthesizer Fault I Channel Filter Activity Q Channel Filter Activity Clock Activity Fault

4.2 Demodulator

The modem demodulator converts a QPSK or BPSK modulated signal of 50 to 180 MHz to a demodulated baseband data stream. The demodulator then performs error correction on the data stream, using a Viterbi decoding algorithm or a sequential decoder. There also is a summary fault relay that provides a Form-C output located on the demodulator board.

Refer to Figure 4-3 for a block diagram of the demodulator.

4.2.1 Theory of Operation

The demodulator card functions as an advanced, fully digital, coherent phase-lock receiver and Viterbi decoder. The modulated signal enters the RF module, where it is converted from an IF signal at 50 to 180 MHz, to I&Q baseband channels.

The two channels are then passed through anti-aliasing filters, D/A converters, and digital Nyquist filters. The result is a filtered, digital representation of the received signal.

This result is then fed to the Costas loop, where carrier phase lock is performed. A data clock phase-lock loop then recovers the data clock, and the soft decision mapper converts the I&Q samples to 3-bit soft-decision values. The soft decision values are then fed to the Viterbi or sequential decoder, where error detection and correction are performed.

Additionally, the I&Q samples are used to calculate the AGC and Automatic Offset Control (AOC) voltages, which are fed back to the RF module.

Finally, the data signal from the output of the Viterbi decoder is differentially decoded, descrambled with a V.35 or custom descrambler, and routed to the interface card.

4.2.2 Specifications

Data Rates	19.2 to 128 kbit/s 1/2 Rate, QPSK 28.8 to 192 kbit/s 3/4 Rate, QPSK 33.6 to 224 kbit/s 7/8 Rate, QPSK 9.6 to 64 kbit/s 1/2 Rate, BPSK
Symbol Rate	19.2 ks/s to 128 ks/s
IF Frequency	50 to 180 MHz, in 2.5 kHz steps
Input Level	-30 to -55 dBm
Decoding Type	Viterbi: 1/2, 3/4, 7/8 QPSK
Filter Masks	Open Network Closed Network
Scrambler Types	V.35
Modulation Types	QPSK or BPSK

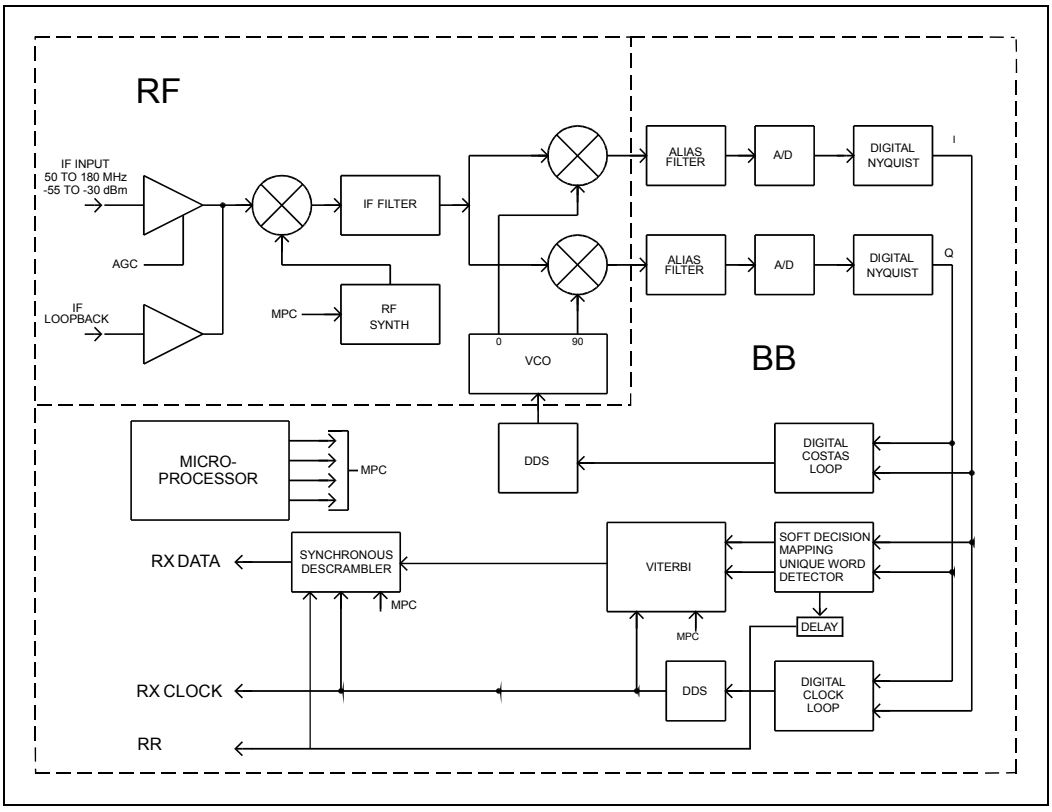


Figure 4-3. Demodulator Block Diagram

4.2.3 Viterbi Decoding Theory

The Viterbi decoder is used in open network applications, typically in IBS or IDR communication systems. The Viterbi decoder operates in conjunction with the convolutional encoder in the transmit modem. They correct transmission channel errors in the received data stream.

Refer to Figure 4-4 for a block diagram of the Viterbi decoder.

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

The data signal passes through an ambiguity resolver, which compensates for the potential 90° phase ambiguity inherent in a QPSK demodulator. If the decoder is operating in 3/4 or 7/8 rate, the data signal is then “de-punctured.” The “de-puncture” pattern is the same as the puncture pattern used in the encoder.

A set of "branch metric" values is then computed for each of the received symbol pairs, related to the probability that the received symbol pair was actually transmitted as one of the four possible symbol pairs. The "branch metrics" are then processed by the Add-Select-Compare (ASC) computer.

The ASC computer makes decisions about the most probable transmitted symbol stream by processing the current branch metrics with the state metrics computed for the 64 previous decoder inputs. The results of the ASC computer are stored in memory called "path memory."

Path memory is 80 states in depth. The path with the maximum metric is designated the survivor path, and its data is used for output. The difference between the minimum and maximum path metrics is used as the means of determining decoder synchronization. The data may then be descrambled and differentially decoded. Both of these processes are optional and may be selected by the user locally or remotely. The data signal out of the differential decoder is sent to the interface card for formatting and output.

The synchronization signal is used for Lock Detect and sent to the M&C. The raw BER count is generated from the minimum and maximum metrics, and sent to the M&C for further processing.

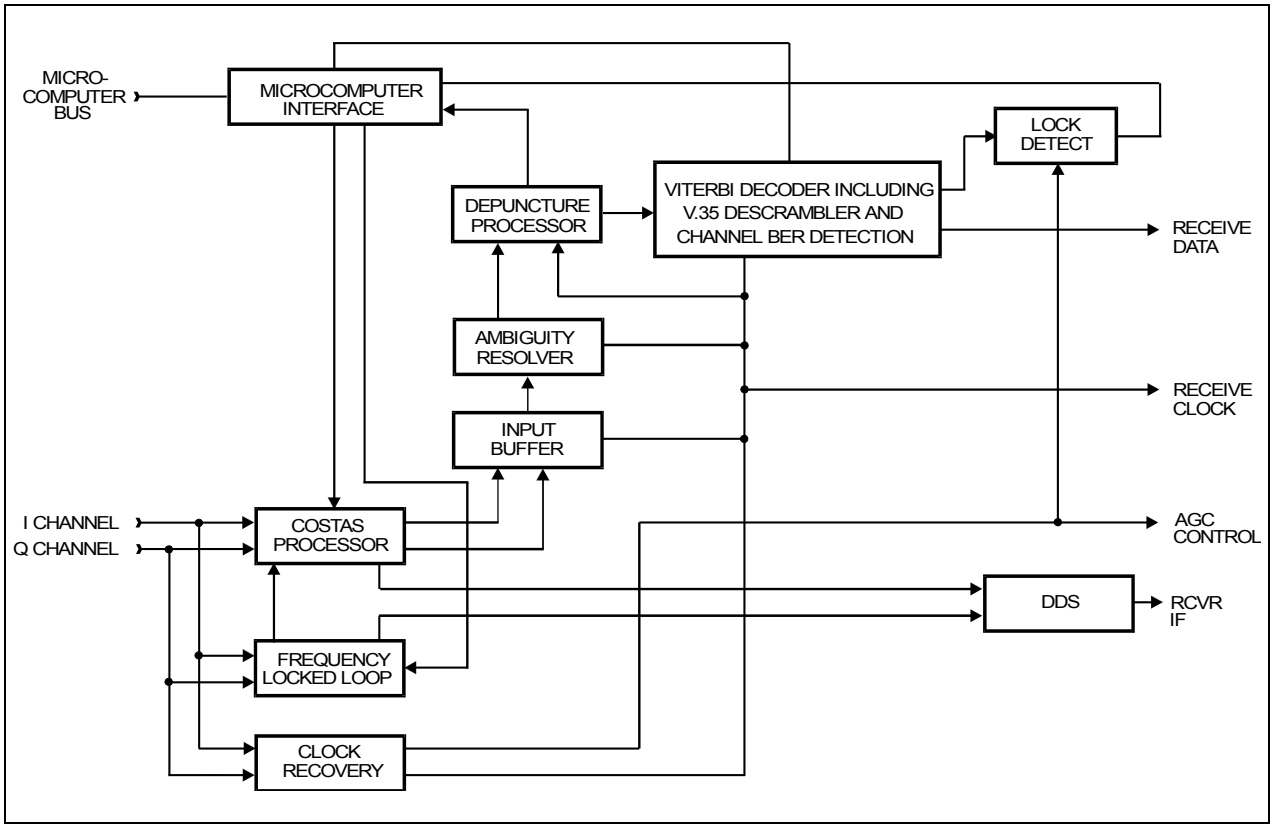


Figure 4-4. Viterbi Decoder Block Diagram

4.2.4 Sequential Decoding Theory

The sequential decoder is used in closed network applications, typically in Frequency Division Multiple Access (FDMA) satellite communications systems. The sequential decoder is optional firmware that plugs onto the demodulator/M&C/interface board. When not installed, sequential encoding and decoding types may not be selected.

Refer to Figure 4-5 for a block diagram of the sequential decoder.

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

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

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

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

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

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

Data enters the input RAM of the decoder from the demod processor in 2-bit soft decision form for both I&Q channels, as shown in the block diagram (Figure 4-5). The input RAM buffers the data to provide history for the backward searches. Data from the RAM passes through the Ambiguity Corrector, which compensates for the potential 90° phase ambiguity of the demodulator.

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

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

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

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

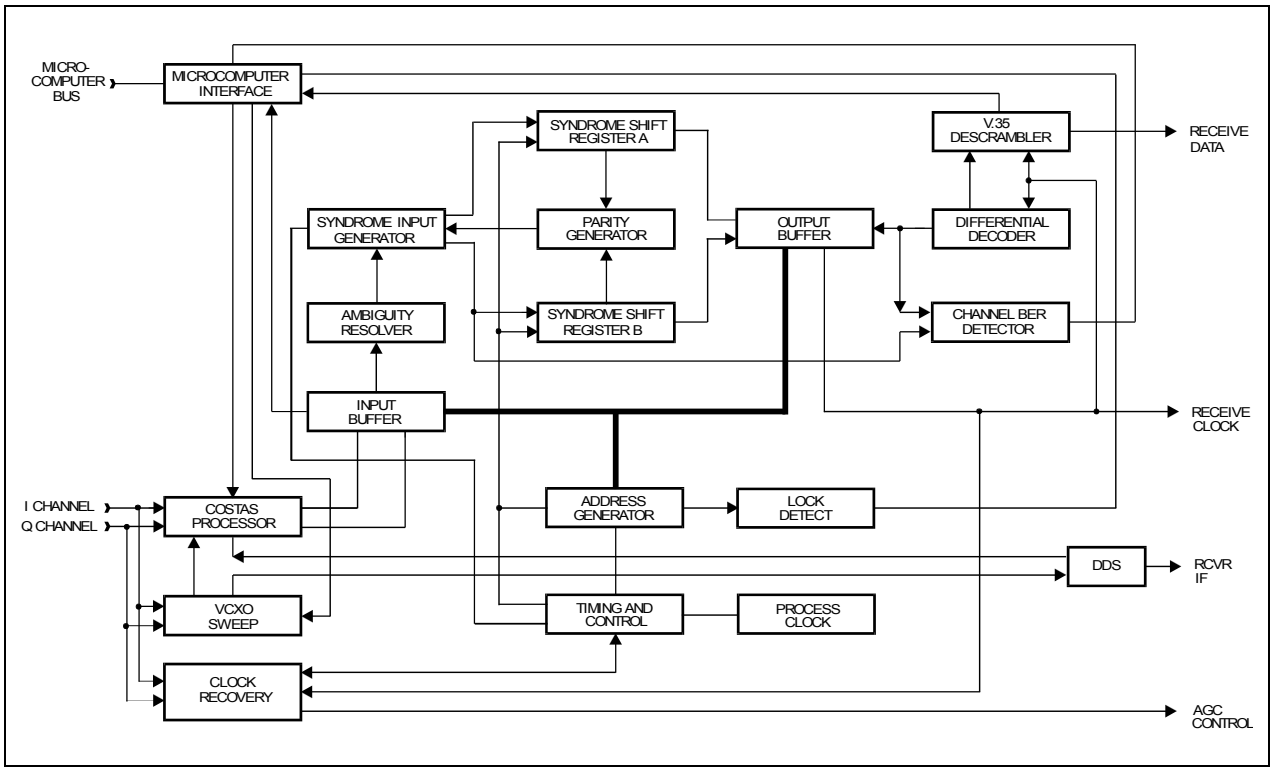


Figure 4-5. Sequential Decoder Block Diagram

4.3 Monitor and Control

A sophisticated microcontroller module is used to perform the monitor and control functions of the modem. This module is located on the demodulator board, and is referred to as the Monitor and Control (M&C). The M&C monitors the modem, and provides configuration updates to other modules within the modem when necessary.

Extensive fault monitoring and status gathering are provided.

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

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

4.3.1 Non-Volatile Memory

Non-volatile memory on the M&C module allows it to retain configuration information for at least one year without power.

Should the modem be powered down, the following sequence is carried out when power is applied to the M&C:

1. The microcontroller checks the non-volatile memory RAM to see if valid data has been retained. If valid data has been retained, the modem is reconfigured to that configuration.

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

4.3.2 M&C Theory of Operation

The M&C module is built around the Intel 80C32 microcontroller, which operates at 11.0592 MHz. The microsystem is designed to support up to 512 kbytes of read-only code memory, and up to 32 kbytes of non-volatile random access data memory. The 80C32 microcontroller supports a serial asynchronous communications channel, with a maximum data rate of 19.2 kbit/s.

4.3.3 Remote Interface Specification

Refer to Appendix A.

4.3.4 Remote Interface Configuration

All modem functions can be remotely controlled and monitored via an RS-485 (or optional RS-232-C) communications link. The 2- or 4-wire, half-duplex RS-485 interface makes it possible to operate up to 255 modems and other units on a common communications link. The RS-232-C interface is used to communicate with a single modem.

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

- RS-485 configuration:

  Install two jumpers (shunts) at RS-485 positions of JP10, and install one jumper at the RS-485 position of JP4. For 2- or 4-wire operation, position jumpers at JP2 and JP3 to the designated positions.

- RS-232-C configuration:

  Install two jumpers (shunts) at RS-232-C positions of JP10, and install one jumper at the RS-232-C position of JP4. For 2- or 4-wire operation, position jumpers at JP2 and JP3 to the designated positions.

4.3.5 Modem Defaults

The M&C has default settings that are loaded into the modem at power-up. These default settings are also loaded each time the modem has been Hard Reset.

The following table lists the defaults settings for each modem configuration parameter.

Defaults			
Modulator Defaults		**Demodulator Defaults**	
Data Rate	A	Data Rate	A
TX Rate A	64 kbit/s, QPSK	RX Rate A	64 kbit/s, QPSK
TX Rate B	96 kbit/s, QPSK	RX Rate B	96 kbit/s, QPSK
TX Rate C	128 kbit/s, QPSK	RX Rate C	128 kbit/s, QPSK
TX Rate D	38.4 kbit/s, QPSK	RX Rate D	38.4 kbit/s, QPSK
TX Rate V	19.2 kbit/s, QPSK	RX Rate V	19.2 kbit/s, QPSK
TX-IF Frequency	70 MHz	RX-IF Frequency	70 MHz
TX-IF Output	OFF	V.35 Descrambler	ON
Mod Power Offset	0 dB	Differential Decoder	ON
TX Power Output	-10 dBm	Demodulator Type	INTELSAT Open
V.35 Scrambler	ON	Decoder Type	Viterbi
Differential Encoder	ON	IF Loopback	OFF
Modulator Type	INTELSAT Open	RF Loopback	OFF
Encoder Type	Viterbi	Sweep Center Freq	0 Hz
CW Mode	Normal (OFF)	Sweep Range	70000 Hz
		BER Threshold	None

Interface Defaults		System Defaults	
TX Clock Source	TX Terrestrial	Time	12:00 AM
Buffer Clock Source	Receive Satellite	Date	7/4/76
TX Clock Phase	Auto	Baud Rate	9600
RX Clock Phase	Normal	Parity	Even
Baseband Loopback	OFF	Address	1
Buffer Size	Bypass	Operation Mode	Duplex

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

- Parity
- Remote Address
- Remote Baud Rate

4.4 Digital Interfaces

The modem interface module is a daughter card that plugs onto the demodulator board. It provides the interface for terrestrial data and overhead signals, and provides the fault reporting output of the modem.

RS-422/449, V.35, RS-232-C, and ASYNC interfaces are available for input and output of terrestrial data.

Both baseband and interface loopbacks are provided.

Terrestrial data rates from 19.2 to 128 kbit/s are supported.

4.4.1 RS-422 Interface

The RS-422 digital interface provides level translation, buffering, and termination between the internal modem signals and the interface connector on the rear panel. Electrical characteristics of the RS-422 interface signals are defined in EIA STD RS-422, and details of the mechanical interface are found in EIA STD RS-449. For the electrical and mechanical specifications, refer to Sections 4.4.1.1 and 4.4.1.2.

Refer to Figure 4-6 for a functional diagram of the interface.

The RS-422 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 it meets the jitter specifications of RS-422/449. This is because a clock phase correction circuit is provided, which shifts the clock away from the data transition times. The clock phasing is jumper selectable at JP1. Refer to Table 4-1 for jumper settings.

- The AUTO setting is used when there is no jitter on the clock source.
- 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.

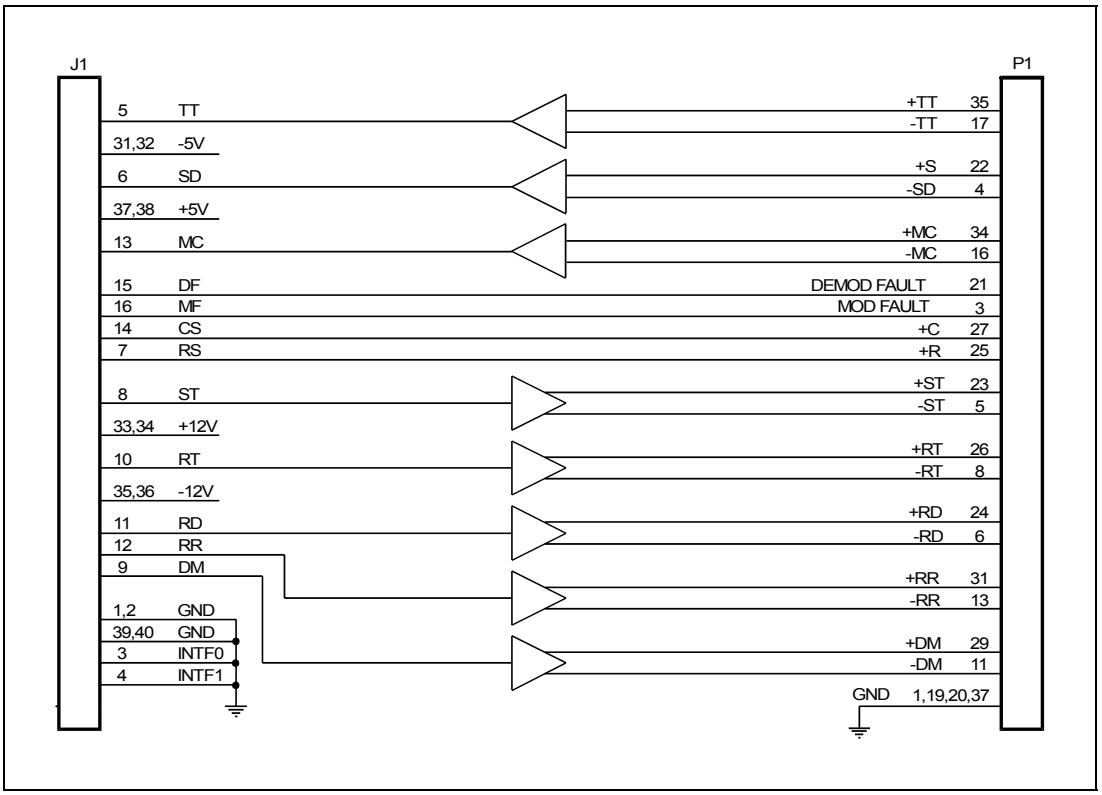


Figure 4-6. RS-422 Block Diagram

Table 4-1. M&C Jumper Settings (AS/4973)

Jumper	Position	Function
JP10	1 to 2	RS-485
	3 to 4	RS-485
	5 to 6	RS-232-C
	7 to 8	RS-232-C
JP22	3 to 4	RS-485 (also 1 to 2 = SDM-100 operation)
	5 to 6	RS-232-C
JP2	1 to 2	4-wire
	2 to 3	2-wire
JP3	1 to 2	4-wire
	2 to 3	2-wire
JP11	1 to 2	CTS shorted to TX FPGA
	3 to 4	CTS shorted to M&C
	5 to 6	CTS shorted to RTS (RTS Loopback)
JP6, JP7	1 to 2	32/64k ROM size
	2 to 3	128/256/512k ROM size

Notes:

1. JP6 selects ROM size for U207, XILINX firmware.
2. JP7 selects ROM size for U208, DSP firmware.

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.

- Receive Clock NORMAL mode should be selected for applications that require the rising edge of the clock to occur in the middle of the data bit time.

- INVERT mode puts the falling edge of RT in the middle of the data bit.

  Note: This selection can be made from the front panel in the Configuration menu or from a remote terminal.

The Request to Send (RTS) line is hard-wired to the Clear to Send (CTS) line by JP11, pins 5 and 6, on the Demodulator/M&C card (AS/4973), 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 RS-422 interface also provides bi-directional relay loopback of both the clock and data at the DCE interface. In LOOPBACK:

- From the DTE side, SD is connected to RD, and either ST or TT (in INTERNAL or EXTERNAL mode) is looped back to RT.

- From the modem side, the received data and recovered clock are routed back to the modulator input for retransmission.

Loop timing is supported by selection of RX Satellite Clock source in the front panel "INTERFACE CONFIGURATION" menu for "TX Clock Source." When RX Satellite is selected, transmit clock (ST) is replaced by the clock recovered from the satellite (RT).

Three fault outputs are provided on dry contact Form-C relays:

- COMMON EQUIPMENT
- MODULATOR
- DEMODULATOR

They are available on the FAULT connector on the rear panel of the modem.

Generation of these fault conditions is described in Chapter 3.

Fault indicators are also provided on TTL open collector drivers on the RS-422 connector.

- The TTL MOD fault indicates one of the following:
  - MODULATOR fault
  - COMMON EQUIPMENT fault
- The TTL DEMOD fault indicates one of the following:
  - DEMOD fault
  - COMMON EQUIPMENT fault

4.4.1.1 Connector Pinouts

The RS-422 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 #
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 *(See note below)* 25 *(See note below)*
Receiver Timing	RT-A RT-B	8 26
Clear To Send	CS-A CS-B	9 *(See note below)* 27 *(See note below)*
Data Mode	DM-A DM-B	11 29
Receiver Ready	RR-A RR-B	13 31
Terminal Timing	TT-A TT-B	17 35
Master Clock (Input)	MC-A MC-B	16 34
Demod Fault	—	21
Mod Fault	—	3
Signal Ground	SG	1, 19, 20, 37

Note: The Request to Send (RTS) line is hard-wired to the Clear to Send (CTS) line by JP11, pins 5 and 6, on the Demodulator/M&C card (AS/4973), since the modem does not support polled operation.

4.4.1.2 Specification

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)	0.0, ± 0.4V
Impedance (RD, RT, ST, DM, RR)	Less than 100Ω, differential
Impedance (SD, TT, MC)	100, ± 20Ω, differential
Polarity	True when B positive with respect to A False when A positive with respect to B
Phasing (RD, RT)	False-to-True transition of RT nominally in center of RD data bit
Symmetry (ST, TT, RT)	50%, ± 5%
Frequency Stability (ST)	± 100 PPM
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

4.4.2 V.35 Interface

The V.35 digital interface provides level translation, buffering, and termination between the internal modem signals and the V.35 DCE interface on the rear panel. Electrical characteristics of the interface signals are defined in CCITT Recommendation V.35. The electrical and mechanical specifications are summarized in Sections 4.4.2.1 and 4.4.2.2.

Refer to Figure 4-7 for a functional block diagram of the interface.

The V.35 interface provides a Serial Clock Transmit (SCT) clock signal at the modem data rate.

- In the INTERNAL clock mode, the data to be transmitted, Send Data (SD), must be synchronized to SCT.
- In the EXTERNAL clock mode, the clock is accepted on the Serial Clock Transmit External (SCTE) input to clock-in the data to be transmitted.

In either case, the phase relationship between the clock and data is not important, as long as it meets the jitter specification. This is because a clock phase correction circuit is provided, which shifts the clock away from the data transition times.

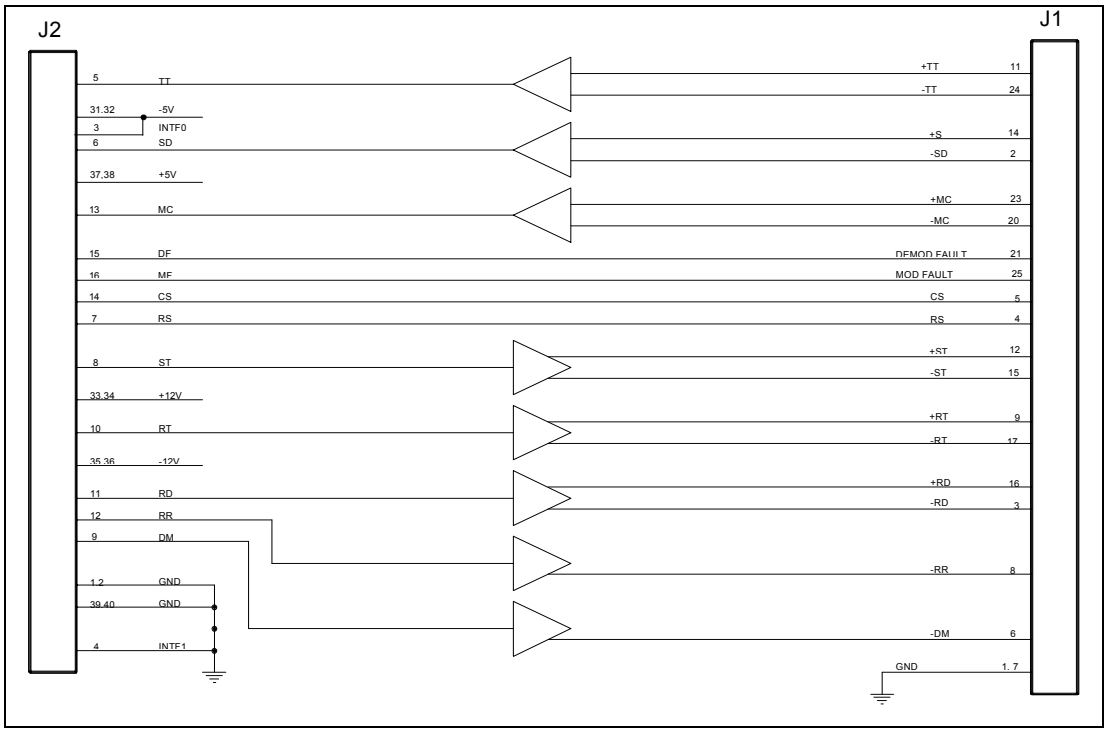


Figure 4-7. V.35 Interface

The clock selection is jumper selectable at JP1 on the front edge of the board.

- 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, while the recovered clock is output on the Serial Clock Receive (SCR) lines.

- Receive Clock NORMAL mode should be selected for applications that require the rising edge of the clock to occur in the middle of the data bit time.
- INVERT mode puts the falling edge of SCR in the middle of the data bit.

  Note: This selection can be made from the front panel in the Configuration menu or from a remote terminal.

The Request to Send (RTS) line is hard-wired to the Clear to Send (CTS) line by JP11, pins 5 and 6, on the Demodulator/M&C card (AS/4973), since the modem does not support polled operation.

Data Set Ready (DSR) indicates that the modem is powered up.

Receive Line Signal Detect (RLSD) indicates that an RF carrier is being received and demodulated with a sufficiently low error rate for the decoder to remain locked.

The V.35 interface also provides bi-directional relay loopback of both the clock and data at the DCE interface. In LOOPBACK:

- From the DTE side, SD is connected to RD, and either SCT or SCTE (in INTERNAL or EXTERNAL mode) is looped back to SCR.

- From the modem side, the received data and recovered clock are routed back to the modulator input for retransmission.

Loop timing is supported by the selection of the RX Satellite Clock source in the Interface Configuration menu of the front panel for “TX Clock Source.” When RX Satellite is selected, the transmit clock (ST) is replaced by the clock recovered from the satellite (RT).

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 3.

Fault indicators are also provided on TTL open collector drivers on the V.35 connector:

- The TTL MOD fault indicates one of the following:

  - MODULATOR fault
  - COMMON EQUIPMENT fault

- The TTL DEMOD fault indicates one of the following:

  - DEMOD fault
  - COMMON EQUIPMENT fault

4.4.2.1 Connector Pinouts

The V.35 interface is provided on the industry standard 34-pin block or 25-pin D connector accessible from the rear panel of the modem. Screw locks are provided for mechanical security of the mating connector.

Signal Function	Name	34-Pin Block Pin #	25-Pin 'D' Pin #
Send Data	SD-A SD-B	P S	2 14
Serial Clock Transmit	SCT-A SCT-B	Y a (AA)	15 12
Receive Data	RD-A RD-B	R T	3 16
Serial Clock Receive	SCR-A SCR-B	V X	17 9
Serial Clock Transmit External	SCTE-A SCTE-B	U W	24 11
Master Clock (Input)	MC-A MC-B	c (CC) d (DD)	20 23
Request To Send	RTS	C *(See note)*	4
Clear To Send	CTS	D *(See note)*	5
Data Set Ready	DSR	E	6
Receive Line Signal Detect	RLSD	F	8
Modulator Fault	---	m (MM)	25
Demodulator Fault	---	n (NN)	21
Shield	Shield		1
Signal Ground	SG	A, B	7

Note: The Request to Send (RTS) line is hard-wired to the Clear to Send (CTS) line by JP11, pins 5 and 6, on the Demodulator/M&C card (AS/4379), since the modem does not support polled operation.

4.4.2.2 Specification

Circuit Supported	SD, SCT, SCTE, RD, SCR, DSR, RLSD, MC, MOD FAULT, DEMOD FAULT
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 GND
Polarity (SD, SCT, SCTE, RD, SCR)	True when B positive with respect to A False when A positive with respect to B
Polarity (RTS, CTS, DSR, RLSD)	True when < -3V with respect to ground False when > +3V with respect to ground
Phasing (SCTE, SCR)	False-to-True transition nominally in center of data bit
Symmetry (SCT, SCTE, SCR)	50%, ± 5%
Frequency Stability (SCT)	± 100 PPM
Modulator Fault	Open collector output, fault is open circuit 15V max, 20 mA current sink max
Demodulator Fault	Open collector output, fault is open circuit 15V max, 20 mA current sink max

4.4.3 RS-232-C Interface

The Electronic Industries Association Standard (EIA) for RS-232-C specifies the mechanical and electrical characteristics of the interface for connecting Data Terminal Equipment (DTE) and Data Communications Equipment (DCE). This applies to both asynchronous and synchronous serial binary data transmission at speeds up to 20 kbit/s, in full- or half-duplex mode. A functional block diagram of the interface is shown in Figure 4-8.

RS-232-C is applicable to the unbalanced interchange of data, timing, and control signals between electronic equipment that has a single common return. It is applicable to private line applications and service over the public switched network.

DTE refers to business machine hardware such as teleprinters, CRTs, front-end ports, CPUs, etc. The DTE equipment is always responsible for providing the interconnection cable, which is terminated in a male, 25-pin connector. The male connector is always associated with DTE equipment.

DCE refers to the transmission facility, or hardware, such as modems. The DCE is equipped with a female connector. The female is always associated with DCE equipment.

Electrical and mechanical characteristics of the RS-232-C interface signals are defined in EIA-STD-RS-232-C. Both electrical and mechanical specifications are summarized in Sections 4.4.3.1 and 4.4.3.2.

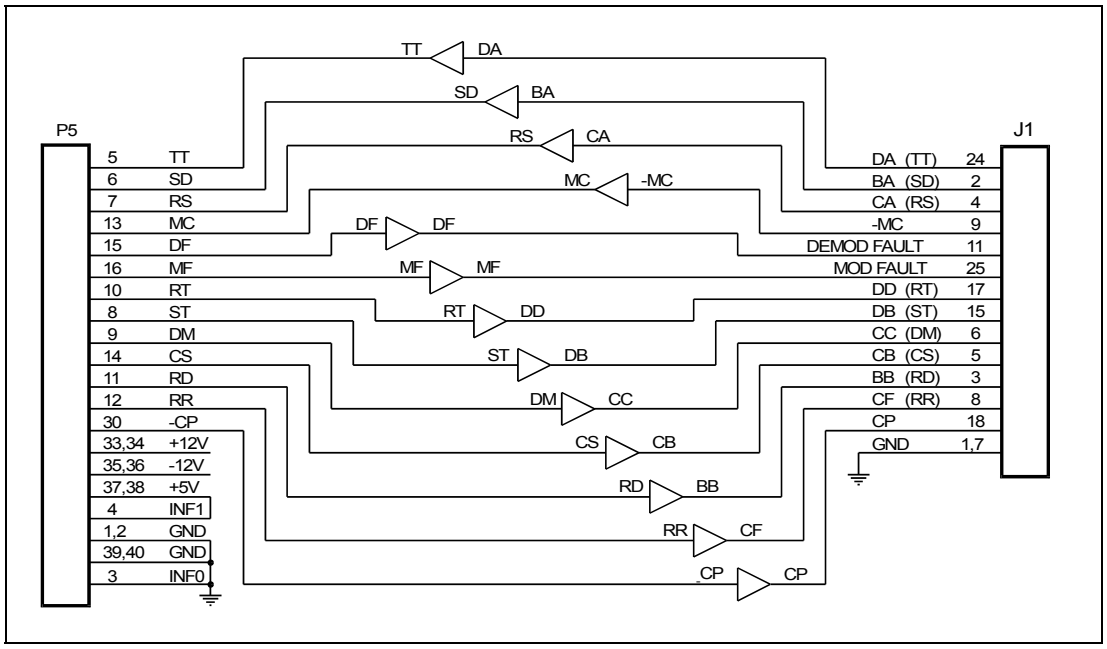


Figure 4-8. RS-232-C Interface

4.4.3.1 Theory of Operation

The RS-232-C interface provides a Send Timing (ST) clock signal at the modem data rate. This signal may be set to NORMAL or INVERT at jumper P3 on the Interface board.

- 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 it meets the jitter specifications of RS-422/449. This is because a clock phase correction circuit is provided, which shifts the clock away from the data transition times.

The TX clock phasing choice is made from the front panel in the Interface Configuration menu.

- The AUTO setting is used when there is no jitter on the clock source.
- The NORMAL setting is used when standard 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) line, while the recovered clock is output on the Receive Timing (RT) line. The RD can be set to NORMAL or INVERT at P4 on the interface card. Receive Clock selections can be made from the front panel in the Configuration Interface menu or from a remote terminal.

- Receive Clock NORMAL mode should be selected for applications that require the rising edge of the clock to occur in the middle of the data bit time.
- INVERT mode puts the falling edge of RT in the middle of the data bit.

The Request to Send (RTS) line is hard-wired to the Clear to Send (CTS) line by JP11, pins 5 and 6, on the Demodulator/M&C card (AS/4973), since the modem does not support polled operation.

Data Mode (DM) indicates that the modem is powered up. DM can be set to NORMAL or INVERT at P1 on the interface card.

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. RR can be set to NORMAL or INVERT at P3 on the interface card.

The RS-232-C interface also provides bi-directional relay loopback of both the clock and data at the DCE interface. In LOOPBACK:

- From the DTE side, SD is connected to RD, and either ST or TT (in INTERNAL or EXTERNAL mode) is looped back to RT.
- From the modem side, the received data and recovered clock are routed back to the modulator input for retransmission.

Loop timing is supported by the selection of the RX Satellite Clock source in the Configuration Interface menu of the front panel for “TX Clock Source.” When RX Satellite is selected, the transmit clock (ST) is replaced by the clock recovered from the satellite (RT).

Two fault outputs are provided on dry contact Form-C relays on the Demodulator/M&C card, and are sent to the interface card. The signals are buffered and output for use in monitoring fault status, and are available on the FAULT connector on the modem rear panel. These are:

- MODULATOR faults
- DEMODULATOR faults

Generation of these fault conditions is described in Chapter 3.

4.4.3.2 Connector Pinouts

The RS-232-C interface is provided on a 25-pin D female connector (DCE) 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, 7
Send Data	SD	2
Receive Data	RD	3
Request To Send	RTS	4 *(See note below)*
Clear To Send	CTS	5 *(See note below)*
Data Mode	DM	6
Receiver Ready	RR	8
Master Clock	MC	9
Demod Fault	DF	11
Send Timing	ST	15
Receive Timing	RT	17
Terminal Timing	TT	24
Mod Fault	MF	25
No Connection		10, 12, 14, 16, 19, 20, 21, 22, 23

Note: The Request to Send (RTS) line is normally hard-wired to the Clear to Send (CTS) line by JP11, pins 5 and 6, on the Demodulator/M&C card (AS/4973).

4.4.4 Asynchronous Interface

Refer to Appendix B.

4.4.5 Terrestrial Interface Change

The modem comes configured for one specific type of interface. To convert to another interface type, a field change is required. Since the modem interface module is a daughter card that plugs onto the demodulator board, it will be necessary to remove the top cover of the modem to make an interface change.

The interface daughter cards are as follows:

Interface	Daughter Card
RS-422	AS/2524
V.35	
34-pin	AS/2532
25-pin	AS/4326
RS-232-C	AS/2533

To change the interface daughter card:

1. Remove the modem top cover.
2. Remove the six screws in the top of the interface daughter card at the rear of the unit.
3. Unplug the daughter card from the Demodulator/M&C/Interface board.
4. Replace the interface with a new daughter card, and replace the six screws.
5. Replace the modem top cover, and re-install the modem into the system.

Chapter 5. MAINTENANCE

This chapter describes system checkout, maintenance, and troubleshooting procedures for the modem.

5.1 System Checkout

The system checkout section is to be used as an aid in setting up a modem within the earth station. There are tables for use in checking to see if the E_b/N_0 is correct, a typical output spectrum, and typical eye pattern and constellation pictures.

5.1.1 Interface Checkout

1. Set modem to IF Loopback (Configuration Interface menu).
2. Set the TX Data Rate and RX Data Rate to valid data/code rates.
3. Turn IF Output on. The modem should lock up.
4. If a data test set is available, set modem to BBLoopback, and connect the data test set to the Interface connector. The modem should lock and run error free.
5. If the modem does not lock, check interface setup, jumpers, and compatibility menus. After correcting the problem, run the test again. The modem should lock up.

5.1.2 Modulator Checkout

The first step in turning up a carrier is to set the output frequency. This is done in the CONFIGURATION menu on the front panel (refer to Chapter 3).

The CONFIGURATION menu also allows the operator to set the output level, turn the output on or off, set the scrambler, differential encoder, clock source, and gives access to the test modes for system check-out.

Available test modes are RF loopback, IF loopback, Baseband loopback, and CW mode.

After the output frequency and level are set, the output must be turned on.

A typical output spectrum is shown in Figure 5-1.

5.1.3 Demodulator Checkout

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 5-2 and Table 5-1 to check for proper E_b/N_0 level. Figure 5-2 is an example of a 1/2 rate carrier operating at an E_b/N_0 of 5.0 dB. (S+N)/N is measured by taking the average level of the noise and the average level of the top of the modem spectrum, as shown. Use this measurement for the first column on Table 5-1. Read across the page to find the S/N and E_b/N_0 for the specific code rate.

Once the demodulator has locked to the incoming signal, the Monitor menu will display signal level, raw BER, corrected BER, and E_b/N_0 (refer to Chapter 3). These functions are not displayed until the demodulator is locked to a carrier.

Typical constellations with noise and without noise are shown in Figure 5-3. To view the constellation, the oscilloscope must be in the X-Y Mode. Connect the oscilloscope to test points TP 37 and TP 38 on the Demodulator/M&C/Interface board.

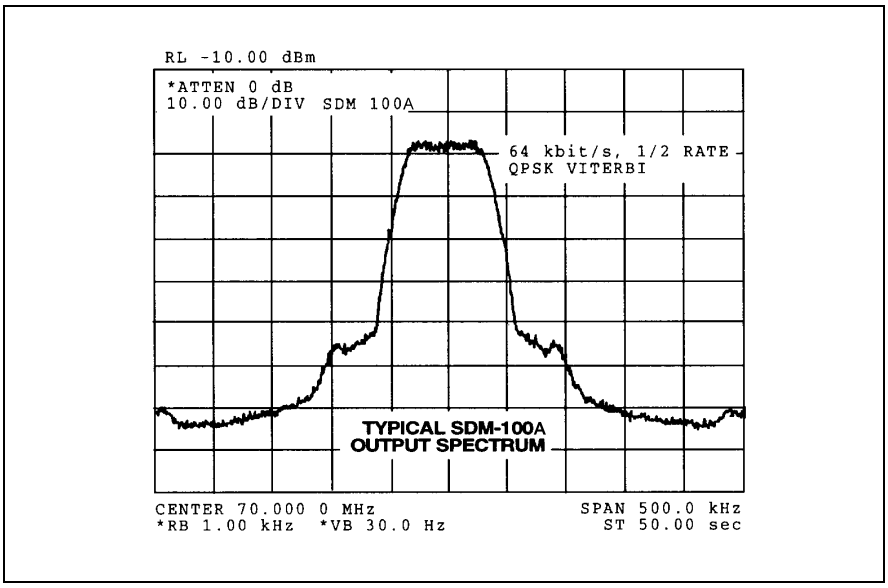


Figure 5-1. Typical Output Spectrum

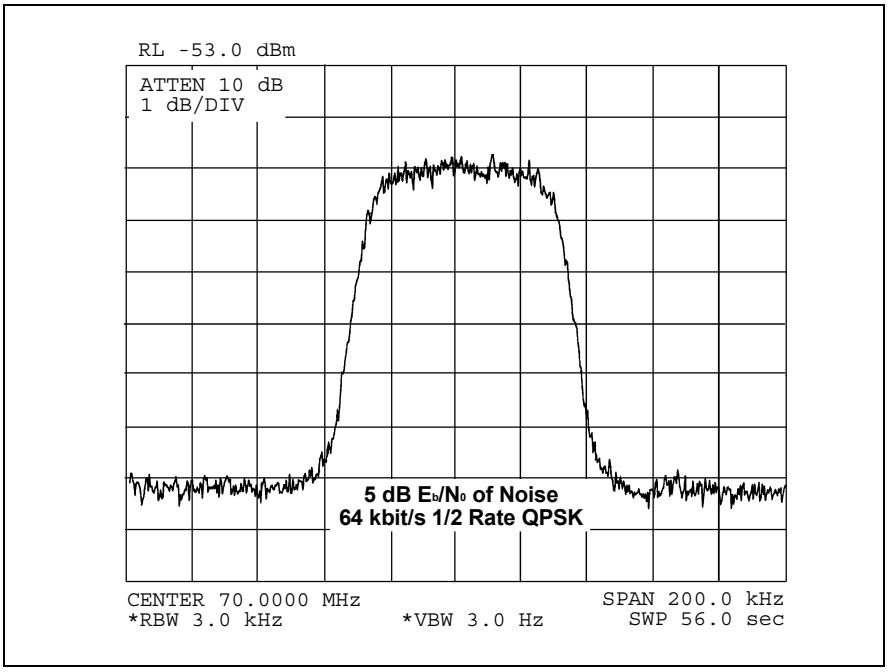
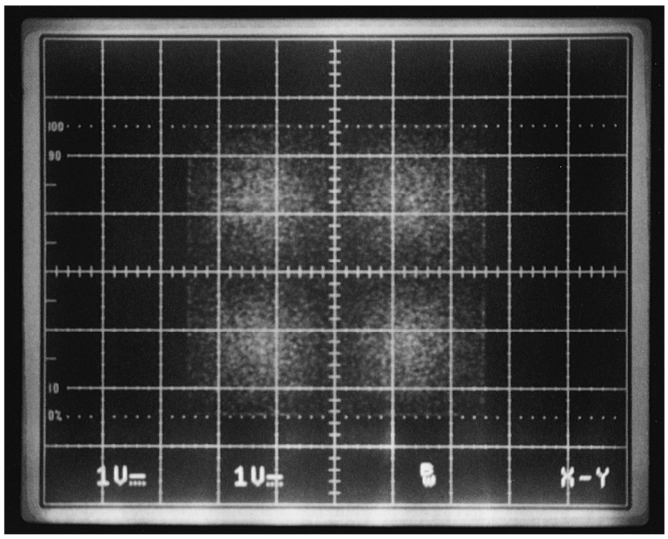


Figure 5-2. Typical Output Spectrum With Noise

Table 5-1. 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

WITH NOISE



WITHOUT NOISE

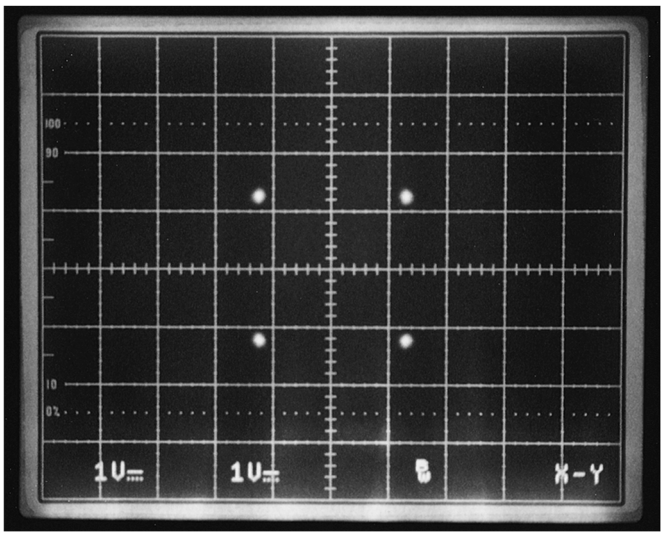


Figure 5-3. Typical Eye Constellations

5.1.4 Test Points

The modem does not have accessible test points. When troubleshooting is required at board level, the cover must be removed.

The following is a list of test points located on the PCB, and a description of the signal that is to be present under normal operation.

5.1.4.1 Demodulator/M&C/Interface Test Points

TP 41	SYMBCK	Symbol Clock
TP 37	DP1	Constellation I Test Point
TP 38	DP2	Constellation Q Test Point
TP 29	GND	Ground
TP 34	DATCLK	Data Rate Clock
TP 4	GND	Ground
TP 3	+5V	Plus 5 Volt
TP 12	SD	Send Data
TP 13	TT	Terminal Timing (Transmit Clock)
TP 14	RD	Receive Data
TP 15	RT	Receive Timing
TP 16	GND	Ground
TP 11	GND	Ground
TP 31	IF SYNTH REF (R143 must be populated)	IF Synthesizer Reference
TP 36	RX CLK	Buffer Output Clock
TP 28	AGC CNRL	Digital AGC control
TP 26	AGC DRV	Analog AGC drive
TP 18	I	I channel Analog RF Output
TP 19	Q	Q channel Analog RF Output
TP 25	GND	Ground
TP 20	Q OFF	Analog Q channel DC offset control
TP 24	I OFF	Analog I channel DC offset control
TP 21	Q CHAN	Q channel Analog anti-alias filter output
TP 22	I CHAN	I channel Analog anti-alias filter output
TP 27	Q A/D IN	Q channel Analog to Digital input
TP 30	I A/D IN	I channel Analog to Digital input
D9	OVFL	Buffer Overflow LED
D10	UNFL	Buffer Underflow LED
D11	XDN/PG	XILINX Done Programming LED

5.1.4.2 Modulator Test Points

TP 1	DATA CLOCK	TTL level clock that is locked to the incoming data to the interface card.
TP 2	SYMBOL CLOCK	TTL level clock that is locked to the incoming clock at the interface card. This clock is running at the symbol frequency and not at the data rate. The frequency is equal to: BPSK = 2X Bit Clock QPSK1/2 = Bit Clock QPSK3/4 = 2/3 X Bit Clock QPSK7/8 = 4/7 X Bit Clock
TP 4	Q DIGITAL FILTER	Analog output from the digital filter.
TP 5	I DIGITAL FILTER	Analog output from the digital filter.
TP 3	Q MIXER	Analog output of the Q channel baseband reconstruction filter and the input to the RF modulator.
TP 6	I MIXER	Analog output of the I channel baseband reconstruction filter and the input to the RF modulator.

5.2 Fault Isolation

The modem has been designed so that a competent technician can isolate fault conditions without removing the modem from its location. The fault monitoring capability of the modem is designed to aid the operator in determining the cause of a failure.

System faults are reported in the Faults menu, and stored faults are reported in the StFaults menu.

Refer to Figure 5-4 for an illustration of the modem fault tree.

Refer to Section 3.2.1.3.1 for further information on each fault.

MOD FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	RX ALARM LED
IF SYNTHESIZER	1	1	1						
DATA CLOCK SYN	1	1	1						
I CHANNEL	1	1	1						
Q CHANNEL	1	1	1						
AGC	1	1	1						
MODULE	1	1	1						
DEMOD FAULTS									
CARRIER DETECT				1	1				
IF SYNTHESIZER				1	1				
I CHANNEL				1	1				
Q CHANNEL				1	1				
DESCRAMBLER				1	1				
BER THRESHOLD									1
MODULE				1	1				

INTERFACE FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY	RX FAULT LED	RX FAULT RELAY	COM EQ FAULT LED	COM EQ FAULT RELAY	TX ALARM LED	RX ALARM LED
TX CLK ACTIVITY TX INTF								1	
BUFFER UNDERFLOW									1
BUFFER RX INTF FLTS									1
BUFFER CLK ACT									1
COMMON EQUIPMENT FAULTS									
BATTERY/CLOCK						1			
-12V POWER SUPPLY						1	1		
+12V POWER SUPPLY						1	1		
+5V SUPPLY						1	1		
CONTROLLER						1	1		
INTERFACE MODULE						1	1		

Figure 5-4. Fault Tree

5.3 Module Identification

The modem PCBs each have an assembly number that is marked on the board. The latest revision is stamped on the board along with the serial number.

EFData tracks the hardware by the assembly number, revision, and serial number.

When replacing a plug-on module, care must be taken to ensure the proper orientation of the card. Refer to the individual sections on each module for the location of the configuration identification.

Refer to Table 5-2 for a list of part numbers and descriptions of various modules used in the modem.

Table 5-2. EFData Part Numbers for Various Modules

Chassis Assembly Base Part # Dash # 1 2	AS/5182-X Description AC, EFD, with Display DC, EFD, with Display
RF Modulator Part # Dash # 1 2 3 4	AS/3995-X Description 50Ω Modulator 75Ω Modulator 50Ω High Power 75Ω High Power
RF Demodulator Part # Dash # 1 2	AS/4401-X Description 50Ω Demodulator 75Ω Demodulator
Sequential Decoder	IC/EFD 8858
Interface (One per Modem) RS-422 V.35 RS-232-C ASYNC ADPCM	 AS/2524 AS/2532 or AS/4326 AS/2533 AS/4089 AS/3916

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Appendix A. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the SDM-100, -100A, -150, and -150A.

- Firmware number: FW/4969-1C and FW/4969-2C
- Software version: 14.7.4

The -2 version is the PLCC (Plastic Leadless Chip Carrier) version, applicable to the SDM-100A and -150A.

The -1 version is the 28-pin DIP version, applicable to the SDM-100 and -150.

A.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.

A.2 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- 7 information bits
- 1 parity bit
- 2 stop bits

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

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

The general message structure is as follows:

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

A.2.1 Start Character

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

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

A.2.2 Device Address

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

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

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

A.2.3 Command/Response

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

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

- >add/?ER1_parity error'cr"lf']
  (Error message for received parity errors.)
- >add/?ER2_invalid parameter'cr"lf']
  (Error message for a recognized command which cannot be implemented or has parameters which are out of range.)
- >add/?ER3_unrecognizable command'cr"lf']
  (Error message for unrecognizable command or bad command syntax.)
- >add/?ER4_modem in local mode'cr"lf']
  (Modem in local error; send the REM command to go to remote mode.)
- >add/?ER5_hard coded parameter'cr"lf']
  (Error message indicating that the parameter is hardware dependent and may not be changed remotely.)

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

A.2.4 End Character

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

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

A.3 Configuration Commands/Responses

A.3.1 Modulator

Modulator Frequency	Command: Response: Status: Response:	<add/MF_nnn.nnnn'cr' >add/MF_nnn.nnnn'cr' RF_OFF'cr''lf'] <add/MF_'cr' >add/MF_nnn.nnnn'cr''lf']	Where: nnn.nnnn = Frequency in MHz, 50.0000 to 180.0000, in 2.5 kHz steps. Note: When the modulator frequency is programmed, the RF output is switched off.
RF Output (IF Output)	Command: Response: Status: Response:	<add/RF_xxx'cr' >add/RF_xxx'cr''lf'] <add/RF_'cr' >add/RF_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator Rate Preset Assignment	Command: Response Status: Response:	<add/AMRx_nnnn_mmm.mmm'cr' >add/AMRx_nnnn_mmm.mmm'cr''lf'] <add/AMRx_'cr' >add/AMRx_nnnn_mmm.mmm'cr''lf']	Where: x = A, B, C, D, or V (Preset designator). nnnn = 1/2, 3/4, 7/8, or BP12 (Coder rate). mmm.mmm = Data rate in kHz. Notes: 1. When ADPCM Interface is selected, only 32.000 and 64.000 are allowed. 2. When the Async Interface is used. If the ASYNC baud rate is higher than allowable for the new data rate, the maximum baud rate will be selected automatically.
Modulator Rate Preset Selection	Command: Response: Status:	<add/SMRx_'cr' >add/SMRx_'cr' RF_OFF'cr''lf'] See MR command.	Where: x = A, B, C, D, or V (Preset designator). Note: Setting the modulator rate turns off the RF transmitter.
Modulator Rate Variable Assignment & Selection	Command: Response: Status:	<add/SMRV_nnnn_mmm.mmm'cr' >add/SMRV_nnnn_mmm.mmm'cr' RF_OFF'cr''lf'] See MR command.	Where: nnnn = 1/2, 3/4, 7/8, or BP12 (Coder rate). mmm.mmm = Data rate in kHz. Notes: 1. Setting the modulator turns off the RF transmitter. 2. When ADPCM Interface is selected, only 32.000 and 64.000 are allowed. 3. When the Async Interface is used. If the ASYNC baud rate is higher than allowable for the new data rate, the maximum baud rate will be selected automatically.
Set Modulator Power Offset	Command: Response: Status: Response:	<add/MPO_snn.n'cr' >add/MPO_snn.n'cr''lf'] <add/MPO_'cr' >add/MPO_snn.n'cr''lf']	Where: snn.n = +49.9 to -49.9, in 0.1 dB increments. Note: The modulator power offset is added to the nominal power level to adjust the transmit power range.

Set Modulator Output Power Level	Command: Response: Status: Response:	<add/MOP_snn.n'cr' >add/MOP_snn.n'cr''lf'] <add/MOP_'cr' >add/MOP_snn.n'cr''lf']	Where: snn.n = -30.0 to -5.0, in 0.1 steps (nominal range in dBm). Notes: 1. The nominal power range is modified relative to the value specified by the modulator power offset (MPO_). 2. The MOP_ command will return status only when local AUPC is enabled.
Scrambler Enable	Command: Response: Status: Response:	<add/SE_xxx'cr' >add/SE_xxx'cr''lf'] <add/SE_'cr' >add/SE_xxx'cr''lf']	Where: xxx = ON or OFF.
Differential Encoder Enable	Command: Response: Status: Response:	<add/DENC_xxx'cr' >add/DENC_xxx'cr''lf'] <add/DENC_'cr' >add/DENC_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator Type	Command: Response: Status: Response:	<add/MT_xxxx'cr' >add/MT_xxxx'cr''lf'] <add/MT_xxxx'cr' >add/MT_xxxx'cr''lf']	Where: xxxx = INTL (INTELSAT OPEN NETWORK), EFD (EF DATA CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), FDC (FAIRCHILD CLOSED NETWORK), or SDM51 (SDM51 COMPATIBLE).
Modulator Encoder Type	Command: Response: Status: Response:	<add/MET_xxx'cr' >add/MET_xxx'cr''lf'] <add/MET_xxx'cr' >add/MET_xxx'cr''lf']	Where: xxx = VIT (K-7 VITERBI ENCODER) or SEQ (SEQUENTIAL ENCODER).
Transmit BPSK Data Ordering	Command: Response: Status: Response:	<add/TDA_xxx'cr' >add/TDA_xxx'cr''lf'] <add/TDA_xxx'cr' >add/TDA_xxx'cr''lf']	Where: xxx = NRM (STANDARD) or INV (NON-STANDARD).
Modulator Spectrum Rotation	Command: Response: Status: Response:	<add/MSR_xxxx'cr' >add/MSR_xxxx'cr''lf'] <add/MSR_'cr' >add/MSR_xxxx'cr''lf']	Where: xxxx = NRM (normal spectrum) or INV (inverted spectrum).
Reed-Solomon Encoder Enable	Command: Response: Status: Response:	<add/RSEN_xxx'cr' >add/RSEN_xxx'cr'lf'] <add/RSEN_'cr' >add/RSEN_xxx'cr'lf']	Where: xxx = ON or OFF.
Modulator Spectrum Rotation	Command: Response: Status: Response:	<add/MSR_xxxx'cr' >add/MSR_xxxx'cr''lf'] <add/MSR_'cr' >add/MSR_xxxx'cr''lf']	Where: xxxx = NRM (normal spectrum) or INV (inverted spectrum).

A.3.2 Demodulator

Set Demod Frequency	Command: Response: Status: Response:	<add/DF_nnn.nnnn'cr' >add/DF_nnn.nnnn'cr''lf'] <add/DF_'cr' >add/DF_nn.nnnn'cr''lf']	Where: nnn.nnnn = Frequency in MHz, 50.0000 to 180.0000, in 2.5 kHz steps.
Demod Rate Preset Assignment	Command: Response Status: Response:	<add/ADRx_nnnn_mmm.mmm'cr' >add/ADRx_nnnn_mmm.mmm'cr''lf'] <add/ADRx_'cr' >add/ADRx_nnnn_mmm.mmm'cr''lf']	Where: x = A, B, C, D, or V (Preset designator). nnnn = 1/2, 3/4, 7/8, or BP12 (Decoder rate). mmm.mmm = Data rate in kHz. Notes: 1. When ADPCM Interface is selected, only 32.000 and 64.000 are allowed. 2. When the Async Interface is used. If the ASYNC baud rate is higher than allowable for the new data rate, the maximum baud rate will be selected automatically.
Demod Rate Preset Selection	Command: Response: Status:	<add/SDRx_'cr' >add/SDRx_'cr''lf'] See DR command.	Where: x = A, B, C, D, or V (Preset designator).
Demod Rate Variable Assignment & Selection	Command: Response: Status:	<add/SDRV_nnnn_mmm.mmm'cr' >add/SDRV_nnnn_mmm.mmm'cr''lf'] See DR command.	Where: nnnn = 1/2, 3/4, 7/8, or BP12 (Decoder rate). mmm.mmm = Data rate in kHz. Notes: 1. When ADPCM Interface is selected, only 32.000 and 64.000 are allowed. 2. When the Async Interface is used. If the ASYNC baud rate is higher than allowable for the new data rate, the maximum baud rate will be selected automatically.
Descramble Enable	Command: Response: Status: Response:	<add/DE_xxx'cr' >add/DE_xxx'cr''lf'] <add/DE_'cr' >add/DE_xxx'cr''lf']	Where: xxx = ON or OFF.
Differential Decoder Enable	Command: Response: Status: Response:	<add/DDEC_xxx'cr' >add/DDEC_xxx'cr''lf'] <add/DDEC_'cr' >add/DDEC_xxx'cr''lf']	Where: xxx = ON or OFF.
RF Loopback	Command: Response: Status: Response:	<add/RFL_xxx'cr' >add/RFL_xxx'cr''lf'] <add/RFL_'cr' >add/RFL_xxx'cr''lf']	Where: xxx = ON or OFF.
IF Loopback	Command: Response: Status: Response:	<add/IFL_xxx'cr' >add/IFL_xxx'cr''lf'] <add/IFL_'cr' >add/IFL_xxx'cr''lf']	Where: xxx = ON or OFF.

Sweep Center Frequency	Command: Response: Status: Response:	<add/SCF_snnnnn'cr' >add/SCF_snnnnn'cr"lf'] <add/SCF_'cr' >add/SCF_snnnnn'cr"lf']	Where: snnnnn = -35000 to +35000, in 1 Hz steps.
Sweep Width Range	Command: Response: Status: Response:	<add/SWR_nnnnn'cr' >add/SWR_nnnnn'cr"lf'] <add/SWR_'cr' >add/SWR_nnnnn'cr"lf']	Where: nnnnn = 0 to 70000, in 1 Hz steps.
Bit Error Rate Threshold	Command: Response: Status: Response:	<add/BERT_xxxx'cr' >add/BERT_xxxx'cr"lf'] <add/BERT_'cr' >add/BERT_xxxx'cr"lf']	Where: xxxx = NONE, or $1E^{-n}$ (where n = 3, 4, 5, 6, 7, or 8).
Demod Type	Command: Response: Status: Response:	<add/DT_xxxx'cr' >add/DT_xxxx'cr"lf'] <add/DT_xxxx'cr' >add/DT_xxxx'cr"lf']	Where: xxxx = INTL (INTELSAT OPEN NETWORK), EFD (EF DATA CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), or FDC (FAIRCHILD CLOSED NETWORK).
Demod Decoder Type	Command: Response: Status: Response:	<add/DDT_xxx'cr' >add/DDT_xxx'cr"lf'] <add/DDT_xxx'cr' >add/DDT_xxx'cr"lf']	Where: xxx = VIT (K-7 VITERBI ENCODER) or SEQ (SEQUENTIAL ENCODER).
Receive BPSK Data Ordering	Command: Response: Status: Response:	<add/RDA_xxx'cr' >add/RDA_xxx'cr"lf'] <add/RDA_xxx'cr' >add/RDA_xxx'cr"lf']	Where: xxx = NRM (STANDARD) or INV (NON-STANDARD).
Demod Spectrum Rotation	Command: Response: Status: Response:	<add/DSR_xxxx'cr' >add/DSR_xxxx'cr"lf'] <add/DSR_'cr' >add/DSR_xxxx'cr"lf']	Where: xxxx = NRM (normal spectrum) or INV (inverted spectrum).
Reed-Solomon Decoder Enable	Command: Response: Status: Response:	<add/RSDE_xxx'cr' >add/RSDE_xxx'cr'lf'] <add/RSDE_'cr' >add/RSDE_xxx'cr'lf']	Where: xxx = ON, OFF, or CORR_OFF

A.3.3 Interface

Transmit Clock	Command: Response: Status: Response:	<add/TC_xxx'cr' >add/TC_xxx'cr"lf'] <add/TC_'cr' >add/TC_xxx'cr"lf']	Where: xxx = INT (internal SCT clock), EXT (external TX terrestrial clock), or SAT (receive satellite clock).
Transmit Clock Phase	Command: Response: Status: Response:	<add/TCP_xxxx'cr' >add/TCP_xxxx'cr"lf'] <add/TCP_'cr' >add/TCP_xxxx'cr"lf']	Where: xxxx = NRM (normal clock phasing), INV (inverted clock phasing), or AUTO (automatic clock phasing).
Buffer Clock	Command: Response: Status: Response:	<add/BC_xxx'cr' >add/BC_xxx'cr"lf'] <add/BC_'cr' >add/BC_xxx'cr"lf']	Where: xxx = INT (internal SCT clock), EXT (external TX terrestrial clock), SAT (receive satellite clock), or REF (external reference clock).
Receive Clock Phase	Command: Response: Status: Response:	<add/RCP_xxxx'cr' >add/RCP_xxxx'cr"lf'] <add/RCP_'cr' >add/RCP_xxxx'cr"lf']	Where: xxxx = NRM (normal clock phasing) or INV (inverted clock phasing).
Baseband Loop Back	Command: Response: Status: Response:	<add/BBL_xxx'cr' >add/BBL_xxx'cr"lf'] <add/BBL_'cr' >add/BBL_xxx'cr"lf']	Where: xxx = ON or OFF.
Interface Buffer Size			Buffer size programming is supported in two formats; bits, or milli-seconds. The selected format must be chosen using the buffer programming command (IBP_).
Interface Buffer Size (Bit Format)	Command: Response: Status: Response:	<add/IBS_nnnnn'cr' >add/IBS_nnnnn'cr"lf'] <add/IBS_'cr' >add/IBS_nnnnn'cr"lf']	Where: nnnnn = 64 to 65536, in 16 bit increments.
Interface Buffer Size (Milli-second Format)	Command: Response: Status: Response:	<add/IBS_nn'cr' >add/IBS_nn'cr"lf'] <add/IBS_'cr' >add/IBS_nn'cr"lf']	Where: nn = 0 to 50 (buffer size in milli-seconds).
Interface Buffer Center	Command: Response:	<add/IBC_'cr' >add/IBC_'cr"lf']	
Interface Buffer Program	Command: Response: Status: Response:	<add/IBP_xxx'cr' >add/IBP_xxx'cr"lf'] <add/IBP_'cr' >add/IBP_xxx'cr"lf']	Where: xxx = BITS or MS (milli-seconds).
Interface ADPCM Program	Command: Response: Status: Response:	<add/ADP_xxx'cr' >add/ADP_xxx'cr"lf'] <add/ADP_'cr' >add/ADP_xxx'cr"lf']	Where: xxx = ON or OFF. Note: Only valid when ADPCM board is installed.

Interface Subscriber/ Trunk Emulation	Command: Response: Status: Response:	<add/SBTR_xxx'cr' >add/SBTR_xxx'cr"lf'] <add/SBTR_'cr' >add/SBTR_xxx'cr"lf']	Where: xxx = SUB or TRK. Note: Only valid when ADPCM board is installed.
E & M Signal Type	Command: Response: Status: Response:	<add/EMS_n'cr' >add/EMS_n'cr"lf'] <add/EMS_'cr' >add/EMS_n'cr"lf']	Where: n = 1 to 5, in steps of 1. Note: Only valid when ADPCM board is installed.
Interface Encoding Law	Command: Response: Status: Response:	<add/LAW_y'cr' >add/LAW_y'cr"lf'] <add/LAW_'cr >add/LAW_y'cr"lf']	Where: y = A (A-Law) or U (u-Law).
Off Hook Alert Enable	Command: Response: Status: Response:	<add/HOOK_xxx'cr' >add/HOOK_xxx'cr"lf'] <add/HOOK_'cr >add/HOOK_xxx'cr"lf']	Where: xxx = ON or OFF. Note: Only valid when ADPCM board is installed.
Interface Service Channel Level	Command: Response: Status: Response:	<add/ISCL_xx_nnn'cr' >add/ISCL_xx_nnn'cr"lf'] <add/ISCL_xx'cr' >add/ISCL_xx_nnn'cr"lf']	Where: xx = TX or RX (service channel designator). nnn = -20 to +10, in steps of 1 (service channel level in dBm). Note: Only valid when ADPCM board is installed.
Interface RD Signal	Command: Response: Status: Response:	<add/RD_xxx'cr' >add/RD_xxx'cr"lf'] <add/RD_'cr' >add/RD_xxx'cr"lf']	Where: xxx = NRM or INV. Note: Only valid when ADPCM board is installed.
Interface SD Signal	Command: Response: Status: Response:	<add/SD_xxx'cr' >add/SD_xxx'cr"lf'] <add/SD_'cr' >add/SD_xxx'cr"lf']	Where: xxx = NRM or INV. Note: Only valid when ADPCM board is installed.
Interface RR Signal	Command: Response: Status: Response:	<add/RR_xxx'cr' >add/RR_xxx'cr"lf'] <add/RR_'cr' >add/RR_xxx'cr"lf']	Where: xxx = NRM or INV. Note: Only valid when ADPCM board is installed.
Interface DM Signal	Command: Response: Status: Response:	<add/DM_xxx'cr' >add/DM_xxx'cr"lf'] <add/DM_'cr' >add/DM_xxx'cr"lf']	Where: xxx = NRM or INV. Note: Only valid when ADPCM board is installed.
Interface ASYNC Communi-cations Program	Command: Response: Status: Response:	<add/ACP_xxx'cr' >add/ACP_xxx'cr"lf'] <add/ACP_'cr' >add/ACP_xxx'cr"lf']	Where: xxx = ON or OFF. Note: Only valid when ASYNC board is installed.
ASYNC Transmit Overhead Baud Rate	Command: Response: Status: Response:	<add/TOBR_nnnnn'cr' >add/TOBR_nnnnn'cr"lf'] <add/TOBR_'cr' >add/TOBR_nnnnn'cr"lf']	Where: nnnnn = 150, 300, 600, 1200, or 2400. Note: Only valid when ASYNC board is installed with ASYNC enabled.

ASYNC Receive Overhead Baud Rate	Command: Response: Status: Response:	<add/ROBR_nnnnn'cr' >add/ROBR_nnnnn'cr''lf'] <add/ROBR_'cr' >add/ROBR_nnnnn'cr''lf']	Where: nnnnn = 150, 300, 600, 1200, or 2400. Note: Only valid when ASYNC board is installed with ASYNC enabled.
ASYNC Transmit Channel Character Length	Command: Response: Status: Response:	<add/TCCL_n'cr' >add/TCCL_n'cr''lf'] <add/TCCL_'cr' >add/TCCL_n'cr''lf']	Where: n = 5, 6, 7, or 8 (characters). Note: Only valid when ASYNC board is installed with ASYNC enabled.
ASYNC Receive Channel Character Length	Command: Response: Status: Response:	<add/RCCL_n'cr' >add/RCCL_n'cr''lf'] <add/RCCL_'cr' >add/RCCL_n'cr''lf']	Where: n = 5, 6, 7, or 8 (characters). Note: Only valid when ASYNC board is installed with ASYNC enabled.
ASYNC Transmit Channel Stop Bits	Command: Response: Status: Response:	<add/TCSB_n'cr' >add/TCSB_n'cr''lf'] <add/TCSB_'cr' >add/TCSB_n'cr''lf']	Where: n = 1 or 2 (stop bits). Note: Only valid when ASYNC board is installed with ASYNC enabled.
ASYNC Receive Channel Stop Bits	Command: Response: Status: Response:	<add/RCSB_n'cr' >add/RCSB_n'cr''lf'] <add/RCSB_'cr' >add/RCSB_n'cr''lf']	Where: n = 1 or 2 (stop bits). Note: Only valid when ASYNC board is installed with ASYNC enabled.
ASYNC Transmit Overhead Channel Parity	Command: Response: Status: Response:	<add/TOCP_xxxx'cr' >add/TOCP_xxxx'cr''lf'] <add/TOCP_'cr' >add/TOCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE. Note: Only valid when ASYNC board is installed with ASYNC enabled.
ASYNC Receive Overhead Channel Parity	Command: Response: Status: Response:	<add/ROCP_xxxx'cr' >add/ROCP_xxxx'cr''lf'] <add/ROCP_'cr' >add/ROCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE. Note: Only valid when ASYNC board is installed with ASYNC enabled.
Interface Loop Timing	Command: Response:	<add/ILT_xxx'cr' >add/ILT_xxx'cr''lf']	Where: xxx = ON or OFF.
ASYNC Overhead Communi-cations Type	Command: Response: Status: Response:	<add/OCT_xxxxx'cr' >add/OCT_xxxxx'cr''lf'] <add/OCT_'cr' >add/OCT_xxxxx'cr''lf']	Where: xxxxx = RS232 or RS485. Note: Only valid when ASYNC board is installed.
Interface Wire Type	Command: Response:	<add/IWT_xxx'cr' >add/IWT_xxx'cr''lf']	Where: xxx = ON or OFF. Note: Only valid when ASYNC board is installed.
Terrestrial Communi-cations Type	Command: Response: Status: Response:	<add/TCT_xxxxx'cr' >add/TCT_xxxxx'cr''lf'] <add/TCT_'cr' >add/TCT_xxxxx'cr''lf']	Where: xxxxx = RS232 or RS485. Note: Only valid when ASYNC board is installed.
Interface SD Signal Command	Command: Response:	<add/ISSD_xxx'cr' >add/ISSD_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface RS Signal Command	Command: Response:	<add/ISRS_xxx'cr' >add/ISRS_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.

Interface MC Signal Command	Command: Response:	<add/ISMC_xxx'cr' >add/ISMC_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface TT Signal Command	Command: Response:	<add/ISTT_xxx'cr' >add/ISTT_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface RD Signal Command	Command: Response:	<add/ISRD_xxx'cr' >add/ISRD_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface RR Signal Command	Command: Response:	<add/ISRR_xxx'cr' >add/ISRR_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface DM Signal Command	Command: Response:	<add/ISDM_xxx'cr' >add/ISDM_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface CS Signal Command	Command: Response:	<add/ISCS_xxx'cr' >add/ISCS_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface RT Signal Command	Command: Response:	<add/ISRT_xxx'cr' >add/ISRT_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.
Interface ST Signal Command	Command: Response:	<add/ISST_xxx'cr' >add/ISST_xxx'cr''lf']	Where: xxx = NRM or INV. Note: Only valid when ASYNC board is installed.

A.3.4 System

Time Of Day	Command: Response: Status: Response:	<add/TIME_hh:mmxx'cr' >add/TIME_hh:mmxx'cr''lf'] <add/TIME_'cr' >add/TIME_hh:mmxx'cr''lf']	Where: hh = 1 to 12 (hours). mm = 00 to 59 (minutes). xx = AM or PM.
Date	Command: Response: Status: Response:	<add/DATE_mm/dd/yy'cr' >add/DATE_mm/dd/yy'cr''lf'] <add/DATE_'cr' >add/DATE_mm/dd/yy'cr''lf']	Where: mm = 1 to 12 (month). dd = 1 to 31 (day). yy = 00 to 99 (year).
Remote	Command: Response:	<add/REM_'cr' >add/REM_'cr''lf']	This command configures the modem for remote operation. The SDM100A will respond to any status request at any time. However, the SDM100A must be in 'Remote Mode' to change configuration parameters.
Clear Stored Faults	Command: Response:	<add/CLSF_'cr' >add/CLSF_'cr''lf']	This command is used to clear all stored faults logged by the SDM100A.
Modem Operation Mode	Command: Response: Status: Response:	<add/MOM_xxxxxxx'cr' >add/MOM_xxxxxxx'cr''lf'] <add/MOM_'cr' >add/MOM_xxxxxxx'cr''lf']	Where: xxxxxxx = TX_ONLY, RX_ONLY, or DUPLEX. This command configures the modem for simplex or duplex operation modes. When transmit only mode is selected receive faults are inhibited and when receive only mode is selected transmit faults are inhibited.
RTS TX-IF Control Mode	Command: Response: Status: Response:	<add/RTSM_xxx'cr' >add/RTSM_xxx'cr''lf'] <add/RTSM_'cr' >add/RTSM_xxx'cr''lf']	Where: xxx = ON or OFF. This command configures the modem for the RTS TX-IF control mode. If "ON" is selected, the TX-IF output will only be turned on if the incoming RTS signal is asserted (also the TX-IF output has to be programmed ON and no major modulator faults are present). If "OFF" is selected, the TX-IF output will operate normal ignoring the RTS signal.

A.3.5 AUPC

AUPC Local Enable	Command: Response: Status: Response:	<add/LPC_xxx'cr' >add/LPC_xxx'cr''lf'] <add/LPC_'cr' >add/LPC_xxx'cr''lf']	Where: xxx = ON or OFF. Note: When programmed ON, the MOP (Modulator Output Power) command is not allowed, only MOP status is allowed.
AUPC Nominal Power Level	Command: Response: Status: Response:	<add/NOMP_snn.n'cr' >add/NOMP_snn.n'cr''lf'] <add/NOMP_'cr' >add/NOMP_snn.n'cr''lf']	Where: snn.n = -30.0 to -5.0, in 0.1 steps (nominal range in dBm). Note: The nominal power range is modified relative to the value specified by the modulator power offset (MPO_).
AUPC Maximum Power Limit	Command: Response: Status: Response:	<add/MAXP_snn.n'cr' >add/MAXP_snn.n'cr''lf'] <add/MAXP_'cr' >add/MAXP_snn.n'cr''lf']	Where: snn.n = -30.0 to -5.0, in 0.1 steps (nominal range in dBm). Note: The nominal power range is modified relative to the value specified by the modulator power offset (MPO_).

AUPC Minimum Power Limit	Command: Response: Status: Response:	<add/MINP_snn.n'cr' >add/MINP_snn.n'cr''lf'] <add/MINP_'cr' >add/MINP_snn.n'cr''lf']	Where: snn.n = -30.0 to -5.0, in 0.1 steps (nominal range in dBm). Note: The nominal power range is modified relative to the value specified by the modulator power offset (MPO_).
AUPC E_b/N_0 Target Set Point	Command: Response: Status: Response:	<add/ENSP_nn.n'cr' >add/ENSP_nn.n'cr''lf'] <add/ENSP_'cr' >add/ENSP_nn.n'cr''lf']	Where: nn.n = 3.2 to 16.0, in 0.1 increments (E_b/N_0 in dB).
AUPC Maximum Tracking Rate	Command: Response: Status: Response:	<add/MAXT_n.n'cr' >add/MAXT_n.n'cr''lf'] <add/MAXT_'cr' >add/MAXT_n.n'cr''lf']	Where: n.n = 0.5 to 6.0, in 0.5 increments (max. tracking rate in dBm/minute).
AUPC Local Carrier Loss Action	Command: Response: Status: Response:	<add/LCL_xxxx'cr' >add/LCL_xxxx'cr''lf'] <add/LCL_'cr' >add/LCL_xxxx'cr''lf']	Where: xxxx = HOLD, NOM, or MAX (power level setting when local carrier loss).
AUPC Remote Carrier Loss Action	Command: Response: Status: Response:	<add/RCL_xxxx'cr' >add/RCL_xxxx'cr''lf'] <add/RCL_'cr' >add/RCL_xxxx'cr''lf']	Where: xxxx = HOLD, NOM, or MAX (power level setting when remote carrier loss).
Remote Modem AUPC Commands			Notes: 1. Always wait 3 seconds between consecutive remote modem command/status polls. 2. If Local AUPC is not enabled, status commands will return last known condition. They will also request status from the remote modem. This allows a second request to return proper status.
Remote AUPC Enable	Command: Response: Status: Response:	<add/RPC_xxx'cr' >add/RPC_xxx'cr''lf'] <add/RPC_'cr' >add/RPC_xxx'cr''lf']	Where: xxx = ON, OFF, or UNK (remote AUPC enable).
Remote Interface Baseband Loop Back	Command: Response: Status: Response:	<add/RBBL_xxx'cr' >add/RBBL_xxx'cr''lf'] <add/RBBL_'cr' >add/RBBL_xxx'cr''lf']	Where: xxx = ON, OFF, or UNK (remote baseband loop back enable).

A.4 Status Commands/Responses

A.4.1 Configuration

Modulator Config Status	Command: Response:	<add/MCS_'cr' >add/MCS_'cr' RF_xxx'cr' MF_nnn.nnnn'cr' MR_nnnn_mmm.mmm'cr' AMRA_nnnn_mmm.mmm'cr' AMRB_nnnn_mmm.mmm'cr' AMRC_nnnn_mmm.mmm'cr' AMRD_nnnn_mmm.mmm'cr' AMRV_nnnn.mmm.mmm'cr' MPO_snn.n'cr' MOP_snn.n'cr' SE_xxx'cr' DENC_xxx'cr' MT_xxxx'cr' MET_xxx'cr' TDA_xxx'cr' COM_xxx'cr' MSR_xxx'cr' RSEN_xxx'cr"lf']	 RF Output (ON/OFF) Modulator Frequency Modulator Rate Preset 'A' Assignment Preset 'B' Assignment Preset 'C' Assignment Preset 'D' Assignment Preset 'V' Assignment Modulator Power Offset Modulator Output Power Scrambler Enable (ON/OFF) Differential Encoder (ON/OFF) Modulator Type Modulator Encoder Type Transmit BPSK Data Ordering Carrier Only Mode (ON/OFF) Modulator Spectrum Rotation Reed-Solomon Encoder (ON/OFF) The modulator configuration status command causes a block of data to be returned by the addressed modem. The block of data reflects the current configuration status of the modulator module.

Modulator/ Coder Config Program Status	Command:	<add/MCP_'cr'	
	Response:	>add/MCP_'cr'	
		MOM_xxxxxxx'cr'	Modem Operation Mode
		MT_xxxx'cr'	Modulator Type
		MET_xxx'cr'	Modulator Encoder Type
		MF_nnn.nnnn'cr'	Modulator Frequency
		MR_nnnn_mmm.mmm'cr'	Modulator Rate
		MPO_snn.n'cr'	Modulator Power Offset
		MOP_snn.n'cr' (Note 1)	Modulator Output Power
		SE_xxx'cr'	Scrambler Enable (ON/OFF)
		DENC_xxx'cr'	Differential Encoder (ON/OFF)
		TDA_xxx'cr'	Transmit BPSK Data Ordering
		TC_xxx'cr'	Transmit Clock (Source)
		TCP_xxxx'cr'	Transmit Clock Phase
		BBL_xxx'cr'	Baseband Loopback
		ADP_xxx'cr' (Note 2)	Interface ADPCM Programming
		SBTR_xxx'cr' (Note 2)	Interface Subscriber/Trunk Emulation
		EMS_x'cr' (Note 2)	Interface E&M Signal Type
		LAW_y'cr' (Note 2)	Interface Transmit Encoding Law
		ISCL_TX_nnn'cr' (Note 2)	Interface Transmit Service Channel Level
		RD_xxx'cr' (Note 2)	Interface RD Signal
		SD_xxx'cr' (Note 2)	Interface SD Signal
		RR_xxx'cr' (Note 2)	Interface RR Signal
		DM_xxx'cr' (Note 2)	Interface DM Signal
		RTSM_xxx'cr'	RTS TX-IF Control Mode
		ACP_xxx'cr' (Note 3)	Interface ASYNC Programming
		TOBR_nnnnn'cr' (Note 4)	ASYNC Transmit Overhead Baud Rate
		TCCL_n'cr' (Note 4)	ASYNC Transmit Channel Character Length
		TCSB_n'cr' (Note 4)	ASYNC Transmit Channel Stop Bits
		TOCP_xxxx'cr' (Note 4)	ASYNC Transmit Overhead Channel Parity
		LPC_xxx'cr' (Note 4)	AUPC Local Enable
		NOMP_snn.n'cr' (Note 5)	AUPC Nominal Power Value
		MINP_snn.n'cr' (Note 5)	AUPC Minimum Power Value
		MAXP_snn.n'cr' (Note 5)	AUPC Maximum Power Value
		LCL_xxxx'cr' (Note 5)	AUPC Local Carrier Loss
		RCL_xxxx'cr' (Note 5)	AUPC Remote Carrier Loss
		OCT_xxxxx'cr' (Note 3)	ASYNC Overhead Communications Type
		TCT_xxxxx'cr' (Note 3)	Terrestrial Communications Type
		ISSD_xxx'cr' (Note 3)	ASYNC Interface SD Signal
		ISRS_xxx'cr' (Note 3)	ASYNC Interface RS Signal
		ISMC_xxx'cr' (Note 3)	ASYNC Interface MC Signal
		ISTT_xxx'cr' (Note 3)	ASYNC Interface TT Signal
		MSR_xxx'cr'	Modulator Spectrum Rotation
		RSEN_xxx'cr'	Reed-Solomon Encoder (ON/OFF)
		RF_xxx'cr''lf']	RF Output (ON/OFF)
			This command is used by the EF Data M:N protection switch to collect information that is necessary to configure back-up modems. Notes: 1. Status only returned when AUPC option is not enabled. 2. Status only returned when ADPCM board is installed. 3. Status only returned when ASYNC board is installed. 4. Status only returned when ASYNC option is enabled. 5. Status only returned when AUPC option is enabled.

Demodulator Config Status	Command: Response:	<add/DCS_'cr' >add/DCS_'cr' DF_nnn.nnnn'cr' DR_nnnn_mmm.mmm'cr' ADRA_nnnn_mmm.mmm'cr' ADRB_nnnn_mmm.mmm'cr' ADRC_nnnn_mmm.mmm'cr' ADRD_nnnn_mmm.mmm'cr' ADRV_nnnn.mmm.mmm'cr' DE_xxx'cr' DDEC_xxx'cr' RFL_xxx'cr' IFL_xxx'cr' SCF_snnnnn'cr' SWR_nnnnn'cr' BERT_xxxx'cr' DT_xxxx'cr' DDT_xxx'cr' RDA_xxx'cr' DSR_xxx'cr' RSDE_xxx'cr''lf']	 Demodulator Frequency Demodulator Rate Preset 'A' Assignment Preset 'B' Assignment Preset 'C' Assignment Preset 'D' Assignment Preset 'V' Assignment Descrambler Enable (ON/OFF) Differential Decoder (ON/OFF) RF Loopback (ON/OFF) IF Loopback (ON/OFF) Sweep Center Frequency Sweep Width Range BER Threshold Demodulator Type Demodulator Decoder Type Receive BPSK Data Ordering Demodulator Spectrum Rotation Reed-Solomon Decoder The demodulator configuration status command causes a block of data to be returned by the addressed modem. The block of data reflects the current configuration of the demod.

Demod/ Decoder Config Program Status	Command:	<add/DCP_'cr'	
	Response:	>add/DCP_'cr'	
		MOM_xxxxxxx'cr'	Modem Operation Mode
		BERT_xxxx'cr'	BER Threshold
		DT_xxxx'cr'	Demodulator Type
		DDT_xxx'cr'	Demodulator Decoder Type
		DF_nnn.nnnn'cr'	Demodulator Frequency
		DR_nnnn_mmm.mmm'cr'	Demodulator Rate
		DE_xxx'cr'	Descrambler Enable (ON/OFF)
		DDEC_xxx'cr'	Differential Decoder (ON/OFF)
		RFL_xxx'cr'	RF Loopback (ON/OFF)
		IFL_xxx'cr'	IF Loopback (ON/OFF)
		SCF_snnnnn'cr'	Sweep Center Frequency
		SWR_nnnnn'cr'	Sweep Width Range
		RDA_xxx'cr'	Receive BPSK Data Ordering
		BC_xxx'cr'	Buffer Clock (Source)
		RCP_xxxx'cr' (Note 1)	Receive Clock Phase
		BBL_xxx'cr'	Baseband Loop Back
		IBP_xxx'cr'	Interface Buffer Programming
		IBS_nnnnn'cr'	Interface Buffer Size
		ADP_xxx'cr' (Note 2)	Interface ADPCM Programming
		SBTR_xxx'cr' (Note 2)	Interface Subscriber/Trunk Emulation
		EMS_x'cr' (Note 2)	Interface E&M Signal Type
		LAW_y'cr' (Note 2)	Interface Receive Encoding Law
		ISCL_RX_nnn'cr' (Note 2)	Interface Service Receive Channel Level
		RD_xxx'cr' (Note 2)	Interface RD Signal
		SD_xxx'cr' (Note 2)	Interface SD Signal
		RR_xxx'cr' (Note 2)	Interface RR Signal
		DM_xxx'cr' (Note 2)	Interface DM Signal
		ROBR_nnnnn'cr' (Note 3)	ASYNC Receive Overhead Baud Rate
		RCCL_n'cr' (Note 3)	ASYNC Receive Channel Character Length
		ROCP_xxxx'cr' (Note 3)	ASYNC Receive Overhead Channel Parity
		LPC_xxx'cr' (Note 3)	AUPC Local Enable
		ENSP_nn.n'cr' (Note 4)	AUPC E_b/N_0 Target Set Point
		MAXT_n.n'cr' (Note 4)	AUPC Max. Tracking Rate
		OCT_xxxxx'cr' (Note 5)	ASYNC Overhead Communications Type
		TCT_xxxxx'cr' (Note 5)	Terrestrial Communications Type
		ISRD_xxx'cr' (Note 5)	ASYNC Interface RD Signal
		ISRR_xxx'cr' (Note 5)	ASYNC Interface RR Signal
		ISDM_xxx'cr' (Note 5)	ASYNC Interface DM Signal
		ISCS_xxx'cr' (Note 5)	ASYNC Interface CS Signal
		ISRT_xxx'cr' (Note 5)	ASYNC Interface RT Signal
		ISST_xxx'cr' (Note 5)	ASYNC Interface ST Signal
		DSR_xxx'cr'	Demodulator Spectrum Rotation
		RSDE_xxx'cr''lf']	Reed-Solomon Decoder
			This command is used by the EF Data M:N protection switch to collect information that is necessary to configure back-up modems.
			Notes: 1. Status only returned when ASYNC option is not enabled. 2. Status only returned when ADPCM board is installed. 3. Status only returned when ASYNC option is enabled. 4. Status only returned when AUPC option is enabled. 5. Status only returned when ASYNC board is installed.

Interface Config Status	Command:	<add/ICS_'cr'		
	Response:	>add/ICS_'cr'		
		TC_xxx'cr'		Transmit Clock (Source)
		TCP_xxxx'cr'		Transmit Clock Phase
		RCP_xxxx'cr'		Receive Clock Phase
		BBL_xxx'cr'		Baseband Loop Back
		BC_xxx'cr'		Buffer Clock (Source)
		IBP_xxx'cr'		Interface Buffer Programming
		IBS_nnnnn'cr'		Interface Buffer Size
		ADP_xxx'cr'	(Note 1)	Interface ADPCM Programming
		SBTR_xxx'cr'	(Note 1)	Interface Subscriber/Trunk Emulation
		EMS_x'cr'	(Note 1)	Interface RD Signal
		LAW_y'cr'	(Note 1)	Interface Transmit Encoding Law
		HOOK_xxx'cr'	(Note 1)	Interface Off Hook Alert Enable
		ISCL_TX_nnn'cr'	(Note 1)	Interface Transmit Service Channel Level
		ISCL_RX_nnn'cr'	(Note 1)	Interface Receive Service Channel Level
		RD_xxx'cr'	(Note 1)	Interface RD Signal
		SD_xxx'cr'	(Note 1)	Interface SD Signal
		RR_xxx'cr'	(Note 1)	Interface RR Signal
		DM_xxx'cr'	(Note 1)	Interface DM Signal
		ALBJ_xxx'cr'	(Note 1)	Interface Analog Loopback Jumper Status
		RTSM_xxx'cr'		RTS TX-IF Control Mode
		TOBR_nnnnn'cr'	(Note 2)	ASYNC Transmit Overhead Baud Rate
		TCCL_n'cr'	(Note 2)	ASYNC Transmit Channel Character Length
		TCSB_n'cr'	(Note 2)	ASYNC Transmit Channel Stop Bits
		TOCP_xxxx'cr'	(Note 2)	ASYNC Transmit Overhead Channel Parity
		ROBR_nnnnn'cr'	(Note 2)	ASYNC Receive Overhead Baud Rate
		RCCL_n'cr'	(Note 2)	ASYNC Receive Channel Character Length
		ROCP_xxxx'cr'	(Note 2)	ASYNC Receive Overhead Channel Parity
		LPC_xxx'cr'	(Note 2)	AUPC Local Enable
		NOMP_snn.n'cr'	(Note 3)	AUPC Nominal Power Value
		MINP_snn.n'cr'	(Note 3)	AUPC Minimum Power Value
		MAXP_snn.n'cr'	(Note 3)	AUPC Maximum Power Value
		LCL_xxxx'cr'	(Note 3)	AUPC Local Carrier Loss
		RCL_xxxx'cr'	(Note 3)	AUPC Remote Carrier Loss
		ENSP_nn.n'cr'	(Note 3)	AUPC E_b/N_0 Target Set Point
		MAXT_n.n'cr'	(Note 3)	AUPC Max. Tracking Rate
		OCT_xxxxx'cr'	(Note 4)	ASYNC Overhead Communications Type
		TCT_xxxxx'cr'	(Note 4)	Terrestrial Communications Type
		ISSD_xxx'cr'	(Note 4)	ASYNC Interface SD Signal
		ISRS_xxx'cr'	(Note 4)	ASYNC Interface RS Signal
		ISMC_xxx'cr'	(Note 4)	ASYNC Interface MC Signal
		ISTT_xxx'cr'	(Note 4)	ASYNC Interface TT Signal
		ISRD_xxx'cr'	(Note 4)	ASYNC Interface RD Signal
		ISRR_xxx'cr'	(Note 4)	ASYNC Interface RR Signal
		ISDM_xxx'cr'	(Note 4)	ASYNC Interface DM Signal
		ISCS_xxx'cr'	(Note 4)	ASYNC Interface CS Signal
		ISRT_xxx'cr'	(Note 4)	ASYNC Interface RT Signal
		ISST_xxx'cr"lf']	(Note 4)	ASYNC Interface ST Signal
				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. Notes: 1. Status only returned when ADPCM board is installed. 2. Status only returned when ASYNC option is enabled. 3. Status only returned when AUPC option is enabled. 4. Status only returned when ASYNC board is installed.

Automatic Uplink Power Control (AUPC) Config Status	Command: Response:	<add/ACS_'cr' >add/ACS_'cr' LPC_xxx'cr' NOMP_-nn.n'cr' MINP_-nn.n'cr' MAXP_-nn.n'cr' ENSP_n.n'cr' MAXT_n.n'cr' LCL_xxxx'cr' RCL_xxxx'cr'	 Local AUPC Enable (ON/OFF) Nominal Power Value (-5.0 to -30.0) Minimum Power Limit (-5.0 to -30.0) Maximum Power Value (-5.0 to -30.0) E_b/N_0 Target Set Point (3.2 to 9.7) Max. Tracking Rate (0.5 to 6.0) Local Carrier Loss (HOLD, NOM, MAX) Remote Carrier Loss (HOLD, NOM, MAX) The interface (AUPC) configuration status command causes a block of data to be returned by the addressed modem. The block reflects the current configuration of the interface.
Modem Faults Status (Summary)	Command: Response:	<add/MFS_'cr' >add/MFS_'cr' DMD_xxx'cr' MOD_xxx'cr' ITX_xxx'cr' IRX_xxx'cr' CEQ_xxx'cr"lf']	 Demodulator (FLT/OK) Modulator (FLT/OK) Interface Transmit Side (FLT/OK) Interface Receive Side (FLT/OK) Common Equipment (FLT/OK)
Modulator Status	Command: Response:	<add/MS_'cr' >add/MS_'cr' RF_xxx'cr' MOD_xxx'cr' SYN_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' AGC_xxx'cr' SFLT_xx'cr"lf']	 RF Output (ON/OFF) Actual Status Not Config Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) AGC Level (OK/FLT) Number of Stored Faults Logged (0 to 10)
Demodulator Status	Command: Response:	<add/DS_'cr' >add/DS_'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' DSCR_xxx'cr' BERT_xxx'cr' SFLT_xx'cr"lf']	 Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) Descrambler (OK/FLT) BER Threshold (OK/FLT) Number of Stored Faults Logged (0 to 10)
Interface Transmit Side Status	Command: Response:	<add/ITXS_'cr' >add/ITXS_'cr' CLK_xxx'cr' TAC_xxx'cr' (See Note) SFLT_xx'cr"lf']	 Selected Transmit Clock Activity (OK/FLT) Transmit Audio Clip (OK/FLT) Number of Stored Faults Logged (0 to 10) Note: Status only returned when ADPCM board is installed.
Interface Receive Side Status	Command: Response:	<add/IRXS_'cr' >add/IRXS_'cr' CLK_xxx'cr' UNFL_xxx'cr' OVFL_xxx'cr' RAC_xxx'cr' (See Note) DMXL_xxx'cr' (See Note) SFLT_xx'cr"lf']	 Selected Buffer Clock Activity (OK/FLT) Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Receive Audio Clip (OK/FLT) Demultiplexer Lock (OK/FLT) Number of Stored Faults Logged (0 to 10) Note: Status only returned when ADPCM board is installed.

Common Equipment Status	Command: Response:	<add/CES_'cr' >add/CES_'cr' M&C_xxx'cr' INT_xxx'cr' BAT_xxx'cr' +5_xxx'cr' +12_xxx'cr' -12_xxx'cr' MODE_xxxxxx'cr' SFLT_xx'cr"lf']	Monitor & Control Module (OK/FLT) Data Interface Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (OK/FLT) Mode (LOCAL or REMOTE) Number of Stored Faults Logged (0 to 10) The common equipment status command causes a block of data to be returned which indicates the status of the common equipment.
E_b/N_0 Status	Command: Response:	<add/EBN0_'cr' >add/EBN0_xnn.ndB'cr"lf']	Where: x = < or > (data modifier to indicate that the E_b/N_0 is less than or greater than the returned value). nn.n = 1.0 to 99.9 (E_b/N_0 value). Notes: 1. The 'x' (< or >) parameter is only returned if the E_b/N_0 has exceeded the computational resolution of the system. 2. "No Data" is returned if the E_b/N_0 cannot be calculated. 3. "Sampling" is returned if not enough data is currently available to calculate the E_b/N_0 .
Modulator Rate Status	Command: Response:	<add/MR_'cr' >add/MR_nnnn_mmm.mmm'cr"lf']	Where: nnnn = 1/2, 3/4, 7/8, or BP12 (Coder rate). mmm.mmm = Data rate in kHz.
Demodulator Rate Status	Command: Response:	<add/DR_'cr' >add/DR_nnnn_mmm.mmm'cr"lf']	Where: nnnn = 1/2, 3/4, 7/8, or BP12 (Decoder rate). mmm.mmm = Data rate in kHz.
Receive Signal Level Status	Command: Response:	<add/RSL_'cr' >add/RSL_xsnn.ndBm'cr"lf']	Where: x = < or > (data modifier to indicate that the receive signal level is less than or greater than the returned value). s = + or - (receive signal level sign, plus or minus). nn.n = 0.0 to 99.9 (receive signal level magnitude). Notes: 1. The 'x' (< or >) parameter is only returned if the level has exceeded the computational resolution of the system. 2. "No Data" is returned if the level cannot be calculated. 3. "Sampling" is returned if not enough data is currently available to calculate the level.

Current Sweep Value	Command: Response:	<add/CSV_'cr' >add/CSV_snnnnn'cr''lf']	Where: x = < or > (data modifier to indicate that the sweep offset value is less than or greater than the returned value). s = + or - (sweep offset from center). nnnnn = 0 to 35000. Notes: 1. This command returns the current sweep offset value. 2. The 'x' (< or >) parameter is only returned if the level has exceeded the computational resolution of the system. 3. "No Data" is returned if the level cannot be calculated. 4. "Sampling" is returned if not enough data is currently available to calculate the level.
Interface Analog Loopback Jumper Status	Status: Response:	<add/ALBJ_'cr' >add/ALBJ_xxx'cr''lf']	Where: xxx = ON or OFF. Note: Only valid when ADPCM board is installed.
Bulk Consol Analog Status	Command: Response:	<add/BCAS_'cr' >add/BCAS_p1,p2,p3, . . . pn'cr''lf']	This command is similar to the 'BCS_' command but, returns modem analog parameters. Where 'pn' is the last parameter returned. Parameter 1 (p1): Receive Signal Level (ref. "RSL_" command). p1 = xsnn.n, receive signal level in dBm. Parameter 2 (p2): Raw BER (ref. "RBER_" command). p2 = xm.m^{-ee}. Parameter 3 (p3): Corrected BER (ref. "CBER_" command). p3 = xm.m^{-ee}. Parameter 4 (p4): E_b/N_0 (ref. "EBN0_" command). p4 = xnn.n, E_b/N_0 in dB. Parameter 5 (p5): Current Sweep Value (ref. "CSV_" command). p5 = snnnnn, sweep offset value in Hz. Note: Parameters 2 through 5 are dependent on carrier acquisition, if the decoder is not locked empty data blocks are returned (,,,,).

Bulk Consol Status	Command: Response:	<add/BCS_'cr' >add/BCS_p1,p2,p3, . . . pn'cr"lf']	This command causes bulk modem status to be returned. To reduce the length of the response, message parameter data are returned without identifiers. However, parameter identification can be determined by order of return. Each status parameter is terminated with a ',' (comma) except for the last parameter which has the standard message termination sequence ('cr"lf']). Most of the data returned is formatted the same way as the single command status request (refer to the appropriate portions of this document in preceding sections). Where 'pn' is the last parameter returned. Parameter 1 (p1): Modulator RF output (ref. "RF_" command). p1 = n, where 'n' is '0' (off) or '1' (on). Parameter 2 (p2): Modulator IF frequency (ref. "MF_" command). p2 = nnn.nnnn, IF frequency in MHz. Parameter 3 (p3): Modulator rate (ref. "MR_" command). p3 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 4 (p4): Modulator preset 'A' assignment (ref. "ARMA_" command). p4 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 5 (p5): Modulator preset 'B' assignment (ref. "ARMB_" command). p5 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 6 (p6): Modulator preset 'C' assignment (ref. "ARMC_" command). p6 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 7 (p7): Modulator preset 'D' assignment (ref. "ARMD_" command). p7 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 8 (p8): Modulator preset 'V' assignment (ref. "ARMV_" command). p8 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 9 (p9): Modulator power offset (ref. "MPO_" command). p9 = snn.n, modulator power offset in dB. Parameter 10 (p10): Modulator output power level (ref. "MOP_" command). p10 = snn.n, transmitter output power level in dBm. Parameter 11 (p11): Scrambler enable (ref. "SE_" command). p11 = n, where 'n' is '0' (off) or '1' (on). Parameter 12 (p12): Differential encoder enable (ref. "DENC_" command). p12 = n, where 'n' is '0' (off) or '1' (on). Parameter 13 (p13): Modulator type (ref. "MT_" command). p13 = n, where 'n' is '0' (EFD), '1' (INTL), '2' (CSC), '3' (FDC), or 4 (SDM51). Parameter 14 (p14): Modulator encoder type (ref. "MET_" command). p14 = n, where 'n' is '0' (SEQ) or '1' (VIT). Parameter 15 (p15): Transmit BPSK Data Ordering (ref. "TDA_" command). p15 = n, where 'n' is '0' (NRM) or '1' (INV). Parameter 16 (p16): Carrier only mode ON/OFF. p16 = n, where 'n' is '0' (off) or '1' (on). Parameter 17 (p17): Demodulator IF frequency (ref. "DF_" command). p17 = nnn.nnnn, demodulator IF frequency in MHz. Parameter 18 (p18): Demodulator rate (ref. "DR_" command). p18 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 19 (p19): Demodulator preset A assignment (ref. "ADRA_" command). p19 = nnnn_mmm.mmm, code rate/data rate in kbit/s.

			Parameter 20 (p20): Demodulator preset B assignment (ref. "ADRB_" command). p20 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 21 (p21): Demodulator preset C assignment (ref. "ADRC_" command). p21 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 22 (p22): Demodulator preset D assignment (ref. "ADRD_" command). p22 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 23 (p23): Demodulator preset V assignment (ref. "ADRV_" command). p23 = nnnn_mmm.mmm, code rate/data rate in kbit/s. Parameter 24 (p24): Descrambler enable (ref. "DE_" command). p24 = n, where 'n' is '0' (off) or '1' (on). Parameter 25 (p25): Differential decoder enable (ref. "DDEC_" command). p25 = n, where 'n' is '0' (off) or '1' (on). Parameter 26 (p26): RF loopback (ref. "RFL_" command). p26 = n, where 'n' is '0' (off) or '1' (on). Parameter 27 (p27): IF loopback (ref. "IFL_" command). p27 = n, where 'n' is '0' (off) or '1' (on). Parameter 28 (p28): Sweep center frequency (ref. "SCF_" command). p28 = snnnnn, sweep center frequency in Hz. Parameter 29 (p29): Sweep width range (ref. "SWR_" command). p29 = nnnnn, sweep range in Hz. Parameter 30 (p30): BER threshold (ref. "BERT_" command). p30 = xxxx, BER threshold. Parameter 31 (p31): Demodulator type (ref. "DT_" command). p31 = n, where 'n' is '0' (EFD), '1' (INTL), '2' (CSC), or '3' (FDC). Parameter 32 (p32): Demodulator decoder type (ref. "DDT_" command). p32 = n, where 'n' is '0' (SEQ) or '1' (VIT). Parameter 33 (p33): Receive BPSK Data Ordering (ref. "RDA_" command). p33 = n, where 'n' is '0' (NRM) or '1' (INV). Parameter 34 (p34): Transmit clock source (ref. "TC_" command). p34 = n, where 'n' is '0' (INT), '1' (REF), or '2' (EXT). Parameter 35 (p35): Transmit clock phase (ref. "TCP_" command). p35 = n, where 'n' is '0' (NRM), '1' (INV), or '2' (AUTO). Parameter 36 (p36): Buffer clock source (ref. "BC_" command). p36 = n, where 'n' is '0' (INT), '1' (REF), '2' (EXT), or '3' (SAT). Parameter 37 (p37): Receive clock phase (ref. "RCP_" command). p37 = n, where 'n' is '0' (NRM) or '1' (INV). Parameter 38 (p38): Baseband loopback (ref. "BBL_" command). p38 = n, where 'n' is '0' (off) or '1' (on). Parameter 39 (p39): Interface Buffer Programming (ref. "IBP_" command). p39 = n, where 'n' is '0' (BITS) or '1' (MS). Parameter 40 (p40): Interface buffer size (ref. "IBS_" command). p40 = nnnnnn, buffer size in bits or milli seconds. Parameter 41 (p41): Modem operation mode (ref. "MOM_" command). p41 = n, where 'n' is '1' (TX_ONLY), '2' (RX_ONLY), or '3' (DUPLEX). Parameter 42 (p42): MODEM REMOTE/LOCAL mode. p42 = n, where 'n' is '0' (LOCAL) or '1' (REMOTE). Parameter 43 (p43): ADPCM Interface Programming (ref.

			"APD_" command). (Note 1) p43 = n, where 'n' is '0' (off) or '1' (on). Parameter 44 (p44): ADPCM Subscriber/Trunk Emulation (ref. "SBTR_" command). (Note 1) p44 = n, where 'n' is '0' (Subscriber) or '1' (Trunk). Parameter 45 (p45): ADPCM E & M Signal Type (ref. "EMS_" command). (Note 1) p45 = n, where 'n' is '1', '2', '3', '4', or '5' (signal type). Parameter 46 (p46): ADPCM Encoding Law (ref. "LAW_" command). (Note 1) p46 = n where 'n' is 'A' (A-Law) or 'U' (u-Law) Parameter 47 (p47): Off hook alert enable (ref. "HOOK_" command). (Note 1) p47 = n, where 'n' is '0' (off) or '1' (on). Parameter 48 (p48): ADPCM Transmit Service Channel Level (ref. "ISCL_" command). (Note 1) p48 = nnn, service channel level in dBm. Parameter 49 (p49): ADPCM Receive Service Channel Level (ref. "ISCL_" command). (Note 1) p49 = nnn, service channel level in dBm. Parameter 50 (p50): ADPCM RS-422 Send Data Signal Programming (ref. "SD_" command). (Note 1) p50 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 51 (p51): ADPCM RS-422 Receive Signal Programming (ref. "RD_" command). (Note 1) p51 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 52 (p52): ADPCM RS-422 Receiver Ready Signal Programming (ref. "RR_" command). (Note 1) p52 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 53 (p53): ADPCM RS-422 Data Mode Signal Programming (ref. "DM_" command). (Note 1) p53 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 54 (p54): ADPCM Audio Loopback Jumper Status (ref. "ALBJ_" command). (Note 1) p54 = n, where 'n' is '0' (off) or '1' (on). Parameter 55 (p55): RTS TX-IF Control Mode (ref. "RTSM_" command). (Note 1) p55 = n, where 'n' is '0' (off) or '1' (on). Parameter 56 (p56): ASYNC Communications programming ON/OFF (ref. "ASP_" command). (Note 2) p56 = n, where 'n' is '0' (off) or '1' (on). Parameter 57 (p57): Interface Loop Timing (ref. "ILT_" command). (Note 3) p57 = n, where 'n' is '0' (off) or '1' (on). Parameter 58 (p58): ASYNC TX Overhead Baud Rate (ref. "TOBR_" command). (Note 3) p58 = nnnnn, where 'nnnnn' is the currently programmed baud rate. Parameter 59 (p59): ASYNC TX Channel Char. Length (ref. "TCCL_" command). (Note 3) p59 = n, where 'n' is the currently programmed character length. Parameter 60 (p60): ASYNC TX Channel Stop Bits (ref. "TCSB_" command). (Note 3) p60 = n, where 'n' is the current number of stop bits programmed. Parameter 61 (p61): ASYNC TX Channel Parity (ref. "TOCP_" command). (Note 3) p61 = xxxx, where 'xxxx' is the currently programmed parity. Parameter 62 (p62): ASYNC RX Overhead Baud Rate (ref. "ROBR_" command). (Note 3) p62 = nnnnn, where 'nnnnn' is the currently programmed baud rate. Parameter 63 (p63): ASYNC RX Channel Char. Length (ref. "RCCL_" command). (Note 3) p63 = n, where 'n' is the currently programmed character length. Parameter 64 (p64): ASYNC RX Channel Parity (ref. "ROCP_" command). (Note 3)

			p64 = xxxx, where 'xxxx' is the currently programmed parity. Parameter 65 (p65): ASYNC Overhead Communications Type (ref. "OCT_" command). (Note 2) p65 = n, where 'n' is '0' (RS232) or '1' (RS485). Parameter 66 (p66): Interface Wire Type (ref. "IWt_" command). (Note 2) p66 = n, where 'n' is '2' (2-Wire) or '4' (4-Wire). Parameter 67 (p67): Terrestrial Communications Type (ref. "TCT_" command). (Note 2) p67 = n, where 'n' is '0' (RS422) or '1' (V.35). Parameter 68 (p68): ASYNC Interface SD Signal (ref. "ISD_" command). (Note 2) p68 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 69 (p69): ASYNC Interface RS Signal (ref. "ISD_" command). (Note 2) p69 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 70 (p70): ASYNC Interface MC Signal (ref. "IMC_" command). (Note 2) p70 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 71 (p71):ASYNC Interface TT Signal (ref. "ITT_" command). (Note 2) p71 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 72 (p72): ASYNC Interface RD Signal (ref. "IRD_" command). (Note 2) p72 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 73 (p73): ASYNC Interface RR Signal (ref. "IRR_" command). (Note 2) p73 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 74 (p74): ASYNC Interface DM Signal (ref. "IDM_" command). (Note 2) p74 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 75 (p75): ASYNC Interface CS Signal (ref. "ICS_" command). (Note 2) p75 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 76 (p76): ASYNC Interface RT Signal (ref. "IRT_" command). (Note 2) p76 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 77 (p77):ASYNC Interface ST Signal (ref. "IST_" command). (Note 2) p77 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 78 (p78): Modulator Spectrum Rotation "MSR_ command). p78 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 79 (p79): Demodulator Spectrum Rotation "DSR_ command). p79 = n, where 'n' is '0' (NORMAL) or '1' (INVERT). Parameter 80 (p80): Reed Solomon Encoder Enable (ref "RSEN_ command). p80 = n, where 'n' is '0' (off) or '1' (on). Parameter 81 (p81): Reed-Solomon Decoder Enable (ref "RSDE_ command). p81 = n, where 'n' is '0' (OFF) or '1' (CORR_OFF). Notes: 1. Status only returned when ADPCM board is installed. 2. Status only returned when ASYNC board is installed. 3. Status only returned when ASYNC option is enabled. 4. For any parameter other than the last parameter that is not returned, a comma (",") will be returned.

Change Status	Command: Response:	<add/CS_'cr' >add/CS_x'cr"lf']	Where: The 'x' character is defined as follows: '@' = no change since last BCS_ and BCSF_ polls. 'A' = BCS_ response has changed since last BCS_ poll. 'B' = BCSF_ response has changed since last BCSF_ poll. 'C' = Both responses have changed since last BCS_ and BCSF_ polls. This command indicates that a change has or has not occurred on either the BCS_ or the BCSF_ response since the last BCS_ or BCSF_ poll.
Equipment Type	Command: Response:	<add/ET_'cr' >add/ET_tttttttt_xxx.yyy.zzz'cr"lf']	Where: tttttttt = Equipment type. xxx.yyy.zzz = Software version. This command returns the equipment type and the software version of the addressed device.
Monitor & Control Firmware Information	Command: Response:	<add/MCFI_'cr' >add/MCFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddr'cr' mm/dd/yy'cr"lf']	Where: xxx.yyy.zzz = Software version number (0.0.0 to 999.999.999). nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z).
DATA ROM Firmware Information	Command: Response:	<add/DFI_'cr' >add/DFI_'cr' DSP_FW/nnnnnn-ddr'cr' DSP_mm/dd/yy'cr' FPGA_FW/nnnnnn-ddr'cr' FPGA_mm/dd/yy'cr"lf']	Where: nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z).
Interface Type	Command: Response:	<add/IT_'cr' >add/IT_ttttt'cr"lf']	Where: ttttt = RS422, V.35, RS232, ADPCM, or ASYNC. This command returns the Interface equipment type.
Bulk Consol Status AUPC	Command: Response:	<add/BCSA_'cr' >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' (off) or '1' (on). Parameter 2 (p2): Nominal Power Value. p2 = snn.n, where 'snn.n' Nominal Power Value in dBm. Parameter 3 (p3): Minimum Power Value. p3 = snn.n, where 'snn.n' Minimum Power Value in dBm. Parameter 4 (p4): Maximum Power Value. p4 = snn.n, where 'snn.n' Maximum Power Value in dBm. Parameter 5 (p5): E_b/N_0 Target Set Point. p5 = n.n, where 'n.n' 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' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM). Parameter 8 (p8): Remote Carrier Loss. p8 = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).

A.4.2 Error Performance

Raw BER	Command: Response:	<add/RBER_'cr' >add/RBER_xm.mE-ee'cr''lf']	Where: x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. "No Data" is returned if the error rate cannot be calculated. 3. "Sampling" is returned if not enough data is currently available to calculate the error rate.
Corrected BER	Command: Response:	<add/CBER_'cr' >add/CBER_xm.mE-ee'cr''lf']	Where: x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. "No Data" is returned if the error rate cannot be calculated. 3. "Sampling" is returned if not enough data is currently available to calculate the error rate.

A.5 Stored Faults

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

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

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

Modulator Stored Faults	Command: Response:	<add/MSF_#'cr' >add/MSF_# hh:mm:ss MM/DD/YY'cr' MOD_xxx'cr' SYN_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' AGC_xxx'cr''lf']	 Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) AGC Level (OK/FLT)
Demodulator Stored Faults	Command: Response:	<add/DSF_#'cr' >add/DSF_# hh:mm:ss MM/DD/YY'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' DSCR_xxx'cr' BERT_xxx'cr''lf']	 Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) Descrambler (OK/FLT) BER Threshold (OK/FLT)
Interface Transmit Side Stored Faults	Command: Response:	<add/ITSF_#'cr' >add/ITSF_# hh:mm:ss MM/DD/YY'cr' CLK_xxx'cr''lf'] TAC_xxx'cr' (See Note)	 Selected Transmit Clock Activity (OK/FLT) Transmit Audio Clip (OK/FLT) Note: Status only returned when ADPCM board is installed.
Interface Receive Side Stored Faults	Command: Response:	<add/IRSF_#'cr' >add/IRSF_# hh:mm:ss MM/DD/YY'cr' CLK_xxx'cr' UNFL_xxx'cr' OVFL_xxx'cr''lf'] RAC_xxx'cr' (See Note) DMXL_xxx'cr' (See Note) HOOK_xxx'cr' (See Note)	 Selected Buffer Clock Activity (OK/FLT) Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Receive Audio Clip (OK/FLT) Demultiplexer Lock (OK/FLT) Remote Off Hook Fault (OK/FLT) Note: Status only returned when ADPCM board is installed.
Common Equipment Stored Faults	Command: Response:	<add/CSF_#'cr' >add/CSF_# hh:mm:ss MM/DD/YY'cr' M&C_xxx'cr' INT_xxx'cr' BAT_xxx'cr' +5_xxx'cr' +12_xxx'cr' -12_xxx'cr''lf']	 Monitor & Control Module (OK/FLT) Data Interface Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (OK/FLT)

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

			Character 'h': Interface transmit side faults character 2. Bit 6 = 1 always. Bit 5 = Selected Transmit Clock Activity. Bit 4 = ADPCM Transmit Audio Clip. (See Note) Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Note: This bit will only be set if ADPCM is installed. Character 'i': Interface receive side faults character 1. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of interface receive side stored faults. Character 'j': Interface receive side faults character 2. Bit 6 = 1 always. Bit 5 = Selected Buffer Clock Activity. Bit 4 = Buffer Underflow. Bit 3 = Buffer Overflow. Bit 2 = ADPCM Receive Audio Clip. (See Note) Bit 1 = ADPCM Demultiplexer Lock. (See Note) Bit 0 = Remote Off Hook. (See Note) Note: These bits will only be set if ADPCM is installed. Character 'k': Common equipment fault status character 1. Bit 6 = 1 always. Bit 5 = Monitor & Control Module. Bit 4 = Interface Module. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of common equipment stored faults. Character 'l': Common equipment fault status character 2. Bit 6 = 1 always. Bit 5 = Battery/Clock. Bit 4 = +5V power supply. Bit 3 = +12V power supply. Bit 2 = -12V power supply. Bit 1 = reserved. Bit 0 = reserved. Character 'm': Interface Reed-Solomon Unavailable Seconds. Bit 6 = 1 always. Bit 5 = not used. Bit 4 = not used. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of Reed-Solomon Unavailable Seconds stored faults.

Appendix B. OPTIONS

This appendix provides information about the following options:

- Asynchronous/Automatic Uplink Power Control (AUPC Interface)
- ADPCM Voice Interface
- Reed-Solomon Codec

B.1 AUPC Interface

The asynchronous (ASYNC) interface board provides the interface for terrestrial data and a single ASYNC overhead channel.

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

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

RS-485 or RS-232-C interfaces are available for ASYNC channel input and output. These interfaces can also be selected from the front panel. Fixed 1/16 overhead is added to the data when an ASYNC channel is being used. With the ASYNC channel enabled, the terrestrial date rate can be from 9.6 to 224 kbit/s. The ASYNC channel I/O protocol can be as follows:

Baud	150 to 2400
Data bits	5 to 8
Parity	Odd, even, or none
Stop bits	1 or 2

Note: Certain combinations of baud rate, data rate, parity, and stop bits will limit the maximum baud rate allowed for continuous throughput based on terrestrial data rate.

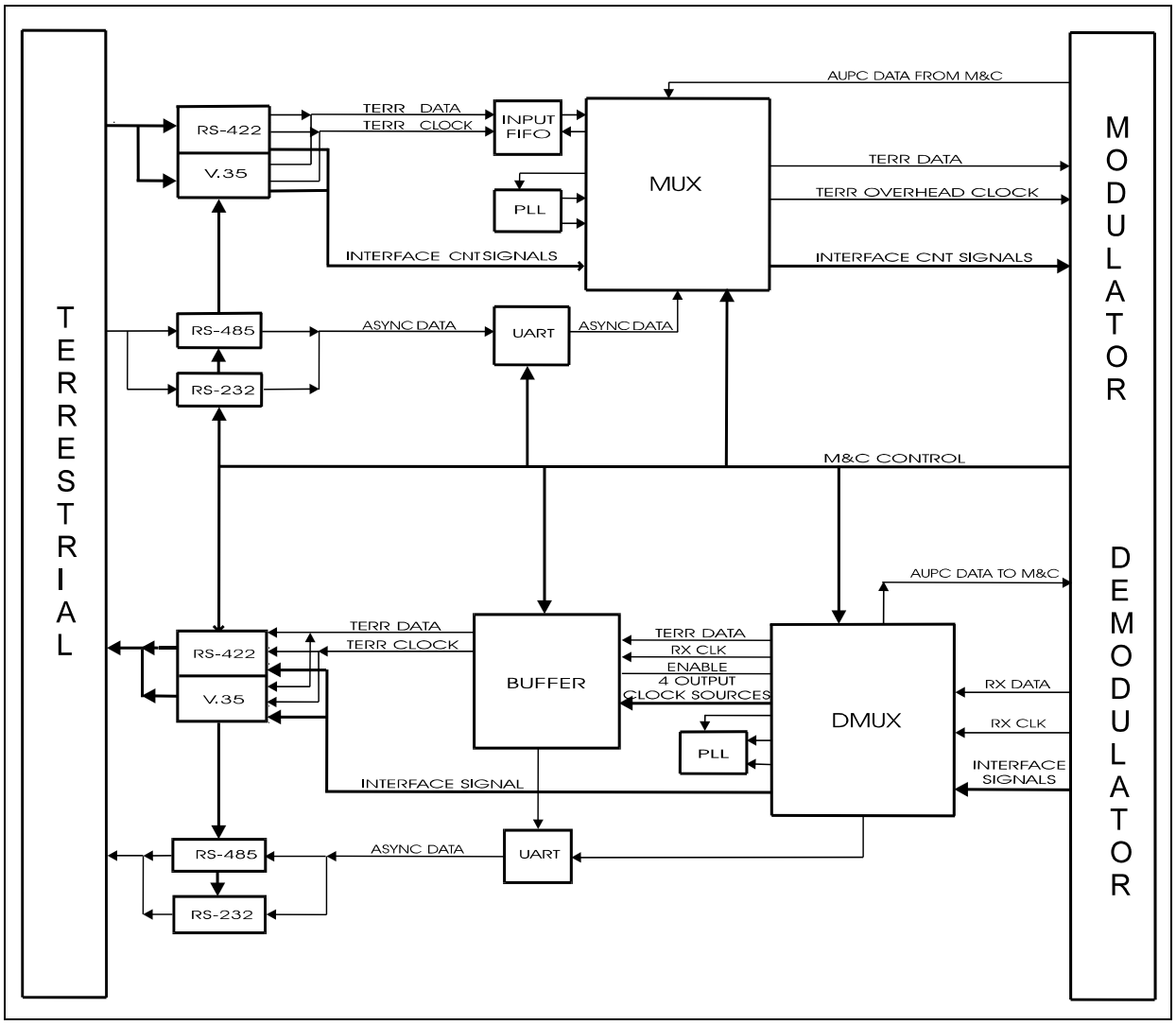
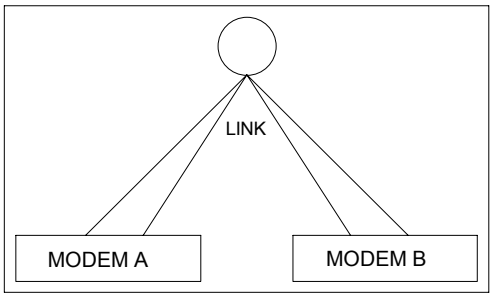


Figure B-1. ASYNC/AUPC Block Diagram

The ASYNC interface PCB also provides its own Doppler buffer, which has a maximum depth of 32 ms at the highest terrestrial data rate. Buffer fill status can be checked in the monitor menu on the front panel of the modem. Depth selection and centering of the buffer are provided in the CONFIG INTERFACE menu.

The AUPC function allows each of two modems that are in a closed link to control the output of the other modem. In order for this feature to function, both modems must have their AUPC options enabled. These options are:

AUPC Enable	Enables the AUPC to function locally.
Nominal Power	Output power level. Can be used for problem conditions, if chosen.
Minimum Power	Sets minimum output power to be used.
Maximum Power	Sets maximum output power to be used.
Target Noise	Desired E_b/N_0 of the local modem.
Tracking Rate	Sets speed at which modems will adjust to output power.
Local CL Action	Defines action that local modem will take if it loses carrier (Maximum, Minimum, or Hold).
Remote CL Action	Defines action that local modem will take if remote modem reports carrier loss (Maximum, Minimum, or Hold).



With AUPC enabled on both modems A and B, as in the above illustration, if modem A loses carrier:

1. Modem A will set its output power as specified by Local CL Action. This will be Maximum, Minimum, or Hold.

2. Modem A will then send a “lost carrier” command to modem B.

3. Modem B will set its output power as specified by its Remote CL Action. This will either be Maximum, Minimum, or Hold.

4. Once modem A has re-acquired the carrier, it will start sending commands to modem B to achieve the desired E_b/N_0. During this time, modem B will be sending commands to modem A to either increase or decrease power to maintain modem B's target E_b/N_0.

   Notes:
   1. Local carrier loss will always take priority over remote carrier loss.
   2. The RX AUPC link is dead when carrier is lost.

B.1.1 Theory of Operation

B.1.1.1 Terrestrial Data Interfaces

Two I/O interfaces are provided for the terrestrial data source: RS-422 and V.35. The ASYNC board is mounted upside-down inside the modem. Therefore, the user must select the terrestrial interface type from the front panel under the UTILITY INTERFACE menu. Once selected, I/O data is routed to and from the appropriate drivers and receivers.

B.1.1.2 ASYNC Data Interfaces

The RS-485 and RS-232-C I/O interfaces are provided for the ASYNC data source. The ASYNC board is mounted upside-down inside the modem. Therefore, the user must select the ASYNC data interface type from the front panel under the UTILITY INTERFACE menu. Once selected, the I/O data is routed to and from the appropriate drivers and receivers.

B.1.1.3 Multiplexer Operation

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

ASYNC data is received by the RX section of a Universal Asynchronous Receiver/ Transmitter (UART) programmed by the M&C for the correct data protocol. The incoming ASYNC data is sampled with a 16x clock in the middle of the bit time.

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

B.1.1.4 Demultiplexer Operation

The operation of the DEMUX section is similar to the operation of the MUX side.

Data, including overhead, is received from the Demodulator card in the modem at the overhead rate.

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

The ASYNC channel data is stripped out of the frame structure, and is buffered up in the TX portion of a UART. The UART then transmits the data with the selected protocol to the appropriate drivers to the end user. The AUPC data is also stripped from the frame structure and is sent to the M&C via a serial interface.

B.1.1.5 Buffer Operation

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

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

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

- TX
- RX
- Internal
- External

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

B.1.1.6 Loop Timing Operation

A loop timing option is provided. When loop timing is selected, the Doppler buffer output clock is forced to the RX clock by the M&C. An M&C-controlled MUX switches the Send Timing (ST) pin to output the RX clock. The RX clock is sent out the ST pin to the appropriate interface drivers and on to the user. The user is left with the option of clocking terrestrial data into the MUX on the transmit side with either the external clock source Terminal Timing (TT) or the internal clock source. The internal clock source is the same as the ST pin.

B.1.1.7 Baseband Loopback Operation

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

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

B.1.1.8 Non-ASYNC Operation

The ASYNC interface has pass-through capability. If ASYNC is turned off in the CONFIG INTERFACE menu, then a standard RS-422 or V.35 interface is selected. The modem will operate as a standard RS-422 or V.35 interface with no overhead. Instead of changing jumpers on the interface PCB to change polarities for various signals, polarity inversion is available in the UTILITY INTERFACE menu for the following signals:

- Send Data (SD)
- Terminal Timing (TT)
- Request to Send (RS)
- Receive Data (RD)
- Receive Timing (RT)
- Receiver Ready (RR)
- Data Mode (DM)
- Monitor and Control (MC)
- Send Timing (ST)

B.1.1.9 ASYNC Channel RS-485 2- and 4-Wire

The ASYNC interface is compatible with either a 2- or 4-wire interface for the RS-485 channel. The 2- or 4-wire operation is selected in the UTILITY INTERFACE menu. In the 2-wire mode, the RS-485 receivers are disabled whenever the data is to be transmitted down the 2-wire interface. In the 4-wire mode, the receiver is always on.

B.1.1.10 Valid ASYNC Baud Rates

The ASYNC baud rates are limited by the terrestrial data rates. The following tables show the relationships between data and baud rates.

If DR <= 15.999K	Max baud rate is 150
If DR <= 31.999K	Max baud rate is 300
If DR <= 63.999K	Max baud rate is 600
If DR <= 127.999K	Max baud rate is 1200
If DR <= 255.999K	Max baud rate is 2400
If DR <= 511.999K	Max baud rate is 4800
If DR <= 1023.999K	Max baud rate is 9600
If DR <= 2047.999K	Max baud rate is 19200
If DR <= 2048.999K	Max baud rate is 38400
If DR = 8.000K	Baud rate can be 150 or lower
If DR = 16.000K	Baud rate can be 300 or lower
If DR = 32.000K	Baud rate can be 600 or lower
If DR = 64.000K	Baud rate can be 1200 or lower
If DR = 128.000K	Baud rate can be 2400 or lower
If DR = 512.000K	Baud rate can be 4800 or lower
If DR = 256.000K	Baud rate can be 9600 or lower
If DR = 1024.000K	Baud rate can be 19200 or lower

B.1.2 Installation Instructions

In order to properly complete the installation, the new ASYNC interface card and the two EPROMs provided must be installed in the bottom board of the modem, marked AS/4973. The EPROMs are installed in U207 and U209 sockets.

The risk of electrical shock can be reduced by ensuring that the modem AC power cord is disconnected. Under no circumstances during the installation should the modem be connected to an AC power source.

Printed Circuit Boards (PCBs) are sensitive to Electrostatic Discharge (ESD). As a result, use ESD precautionary procedures when touching, removing, or inserting PCBs.

B.1.2.1 Top Cover Removal

The following 16 screws must be removed from the modem in order to take off the top cover:

- Five screws located on each side
- Three screws at the front
- Three screws at the back

Once the screws are removed, the top cover can be lifted and slid toward the rear of the modem.

B.1.2.2 Interface Mounting Bracket Removal

To remove the interface:

1. Take out the six mounting screws which secure the interface.
2. Pull the interface straight up until J1 is disconnected.
3. Remove the interface.

B.1.2.3 EPROM Installation

Install the two EPROMs that are provided into the now exposed bottom card (AS/4973). The EPROMs are marked U207 and U209 to help identify which EPROM goes in which socket.

B.1.2.4 ASYNC Interface

Install the new ASYNC interface by lining up the pins on J2 with the receiving header, and firmly push.

Be sure that the pins are lined up correctly with the receiving header. If the pins are not lined up, damage to the modem or interface may occur.

Install the six mounting screws to secure the interface to the standoffs.

B.1.2.5 Installing Top Cover

Re-install the top cover by replacing the 16 screws that were removed in Section B.1.2.1.

B.1.3 Front Panel Operation

The following sections describe the additional front panel operations that are specific to the ASYNC interface. These options are shown in the menu tables in Chapter 3, along with the standard menu windows.

B.1.3.1 Interface Configuration

Baseband Loopback	This option turns the baseband loopback option on or off.
Buffer Size	This option allows the user to select the buffer size in 32-bit increments, from 32 to 8192.
Buffer Center	This option centers the Doppler buffer on command.
ASYNC ON/OFF	This option turns the ASYNC overhead on or off.
Loop Timing	This option puts the modem in a loop timing configuration. The buffer clock and the ST pin on the interface are forced to the RX clock.
TX Baud	This option programs the TX UART to the desired baud rate for the ASYNC channel.
RX Baud	This option programs the RX UART to the desired baud rate for the ASYNC channel.
TX Length	This option programs the TX UART to the desired number of data bits.
RX Length	This option programs the RX UART to the desired number of data bits.
TX Parity	This option programs the TX UART for the desired parity.
RX Parity	This option programs the RX UART for the desired parity.
TX STP	This option programs the TX UART to output the desired number of stop bits.
Local AUPC	This option turns the local modem's AUPC on or off.
Nominal Power	This option programs the nominal power set point for AUPC.
Minimum Power	This option programs the minimum power set point for AUPC.
Maximum Power	This option programs the maximum power set point for AUPC.
Target Noise	This option programs the target noise. The target noise can range from 4.0 to 16.0 dB, in 0.1 dB increments.
Tracking Rate	This option programs the maximum tracking rate. The maximum tracking rate can range from 0.5 to 6.0 dBm per minute.
Local CL	This option programs the action taken by the local modem if Carrier Loss is detected. The local CL can be programmed to maximum, nominal, or hold.
Remote CL	This option programs the action taken by the remote modem if Carrier Loss is detected. The remote CL can be programmed to maximum, nominal, or hold.

B.1.3.2 Modulation Configuration

TX Rate and Type	This option allows the user to chose from a 9.6 to 224 kHz mode of operation with the ASYNC overhead enabled. BPSK 1/2, QPSK 1/2, 3/4, and 7/8 are also supported. With the ASYNC set to OFF, this option works in the standard SDM-100A mode.

B.1.3.3 Demodulation

RX Rate and Type	This option allows the user to chose from a 9.6 to 224 kHz mode of operation with the ASYNC overhead enabled. BPSK 1/2, QPSK 1/2, 3/4, and 7/8 are also supported. With the ASYNC set to OFF, this option works in the standard SDM-100A mode.

B.1.3.4 Utility/Interface

Remote AUPC	This option turns the AUPC mode on the remote modem on or off.
Remote Baseband Loopback	This option sets the remote modem into the baseband loopback mode.
Terrestrial	This option selects the interface type for the terrestrial data.
ASYNC	This option selects the interface type for the ASYNC data.
2-Wire/4-Wire	This option programs the ASYNC interface for either a 2- or 4-wire interface.
SD Invert/Normal	This option inverts the polarity of the SD signal.
RD Invert/Normal	This option inverts the polarity of the RD signal.
RR Invert/Normal	This option inverts the polarity of the RR signal.
DM Invert/Normal	This option inverts the polarity of the DM signal.
RS Invert/Normal	This option inverts the polarity of the RS signal.
CS Invert/Normal	This option inverts the polarity of the CS signal.
MC Invert/Normal	This option inverts the polarity of the MC signal.
RT Invert/Normal	This option inverts the polarity of the RT signal.
ST Invert/Normal	This option inverts the polarity of the ST signal.

B.1.3.5 Specifications

Terrestrial Interface	
Data Rate	9.6 to 224 kHz
Overhead	1/16 overhead
Coding	BPSK 1/2, QPSK 1/2, 3/4, 7/8
ASYNC Interface	
ASYNC Interface Types	RS-485 or RS-232-C 2-wire or 4-wire
Channel Formats	Data bits 5 to 8 Parity = odd, even, or none Stop bits = 1 and 2, 150 to 2400 baud

B.1.3.6 Mechanical Specifications for Connector J1

Pin #	Name	Function
37	SD_A	SEND DATA
38	SD_B	SEND DATA
35	EXC_A	EXT. CLOCK (MC MASTER CLOCK)
19	EXC_B	EXT. CLOCK (MC MASTER CLOCK)
39	RD_A	RECEIVE DATA
40	RD_B	RECEIVE DATA
4	TXD_B	TX DATA (ASYNC CHANNEL)
5	TXD_A	TX DATA (ASYNC CHANNEL)
21	ST	SEND TIMING
22	ST	SEND TIMING
23	RT_A	RECEIVE TIMING
24	RT_B	RECEIVE TIMING
6	RXD_B	RX DATA (ASYNC CHANNEL)
7	RXD_A	RX DATA (ASYNC CHANNEL)
41	DM_A	DATA MODE
32	DM_B	DATA MODE
12	TT_A	TERMINAL TIMING
13	TT_B	TERMINAL TIMING
45	RTS_A	REQUEST TO SEND
29	RTS_B	REQUEST TO SEND
46	RR_A	RECEIVE READY
30	RR_B	RECEIVE READY
47	CTS_A	CLEAR TO SEND
31	CTS_B	CLEAR TO SEND
49	MF	MODULATOR FAULT
33	DF	DEMODULATOR FAULT

B.2 ADPCM Voice Interface

The ADPCM voice interface is capable of providing a single duplex voice channel and Ear and Mouth (E&M) signaling data transmission. The interface also provides an EIA STD RS-422 interface which is user selectable. This optional interface replaces the RS-422, RS-232, or V.35 interfaces.

B.2.1 Theory of Operation

The ADPCM interface is designed to simulate either a trunk or a subscriber circuit. (Refer to Figure B-2.) The E&M circuitry supports types 1 to 5. Trunk or Subscriber configuration and E&M signaling type are user selectable from the front panel in the CONFIG INTERFACE menu.

Refer to Figure B-3 for a modem block diagram with the ADPCM voice interface option.

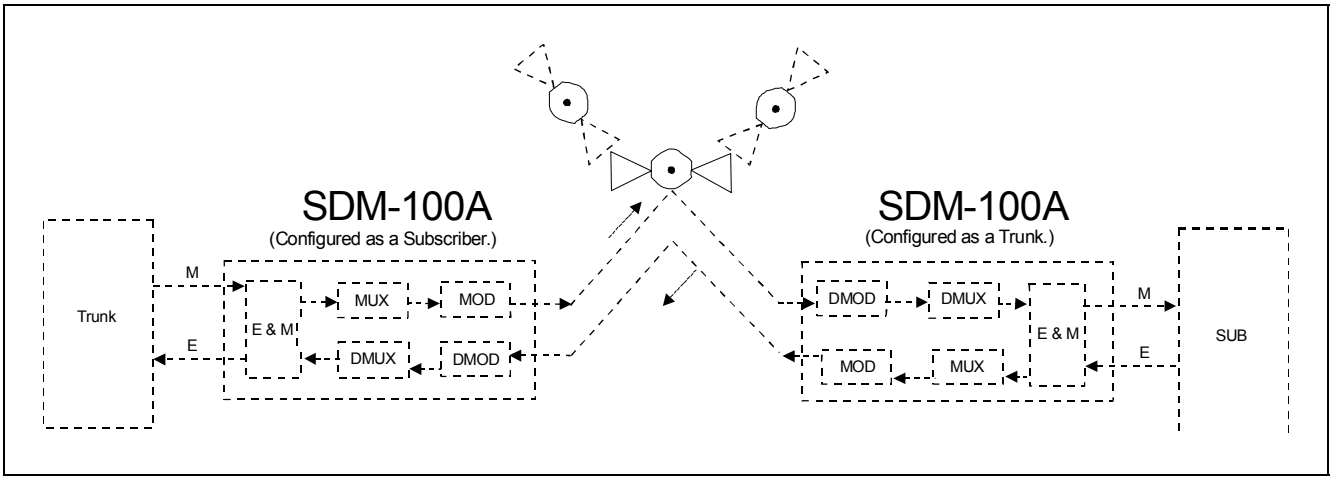


Figure B-2. System Interface Diagram

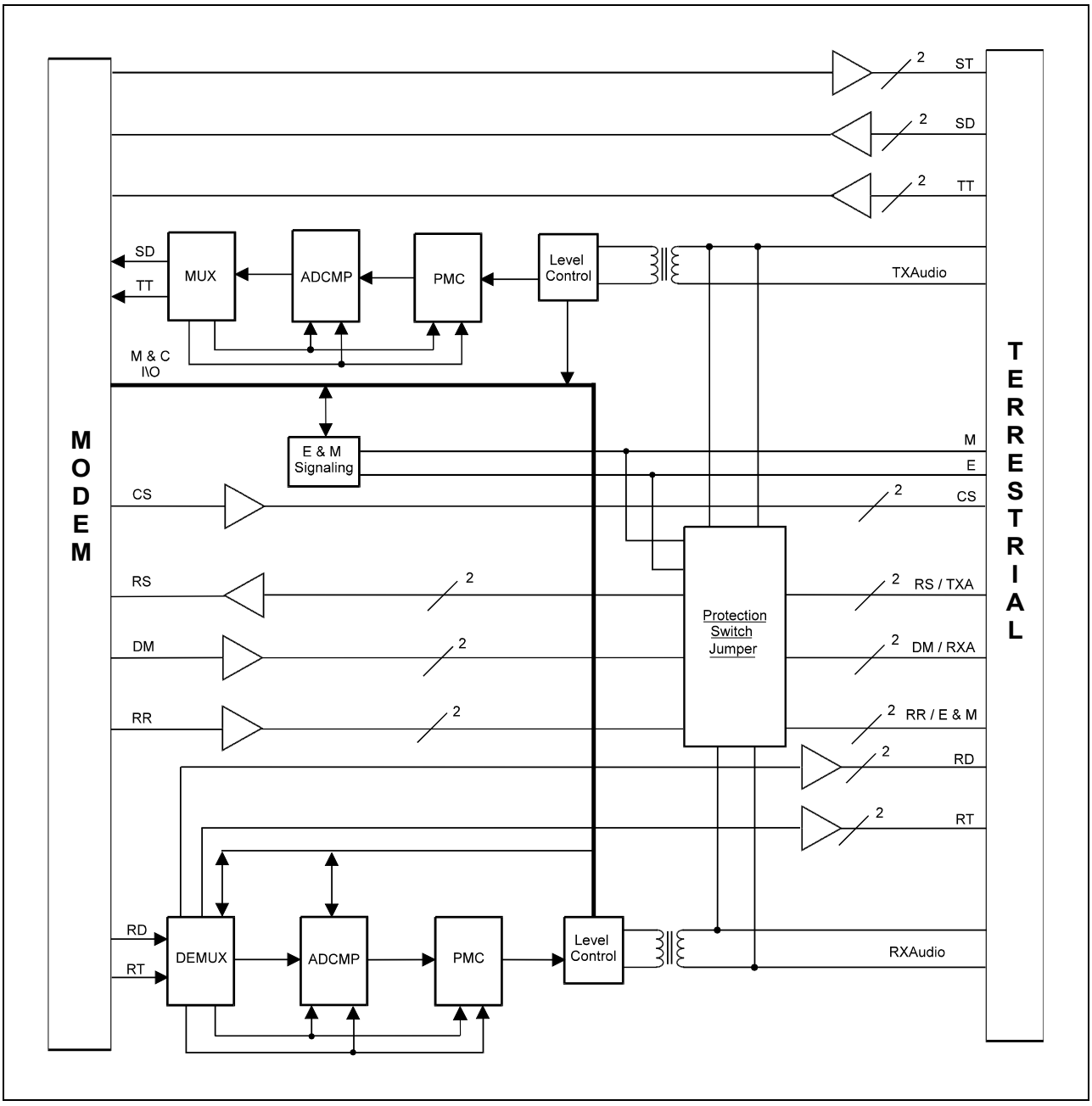


Figure B-3. ADPCM Block Diagram

B.2.1.1 Multiplexer

The ADPCM interface provides a 6-wire, RJ11 phone connector on the back panel for the analog input. The input is a full-duplex four-wire input, with two additional pins for E&M signaling (Refer to Section B.2.3 for the RJ11 pinout specifications). The audio input is transformer-coupled with a 600Ω input load. The signal then passes to a programmable input level control circuit. The audio input level is user selectable in 1 dB steps, from -20 to +10 dBm.

The signal then passes through a filter with a 300 to 3400 Hz bandwidth. The filtered signal passes to a Pulse Code Modulation (PCM) encoder, which encodes the data at 64 kbit/s. The user can select either A-Law or μ-Law operation of the encoder from the front panel. A TX Clip indicator in the FAULT TX menu is provided to monitor excessive input levels.

The 64 kbit/s PCM data from the encoder is compressed to 32 kbit/s, 16 kbit/s, or passed directly to a MUX. The compression rate is selectable from the front panel.

A rate exchange now occurs as the data is input to a FIFO in the MUX, where 1/15 proportional IBS-type framing overhead is added. The multiplexed data is output to the modulator. In pass-through mode (64 kbit/s), the data coming out of the multiplexer is in the form of an IESS-309 IBS frame. Depending on how the modem is configured (trunk or subscriber), either the E or M signal is multiplexed into the overhead framing structure for reception on the other end. Spare bit 4 of byte 32 in the IBS frame is used for the E or M signaling. For 32 kbit/s mode, a pseudo-IBS frame structure is used.

In ADPCM mode, the modulation data rate is fixed at 64, 32, or with BPSK 1/2 or QPSK 1/2, 3/4, or 7/8 coding.

B.2.1.2 Demultiplexer

The receiving section works basically reverse of the transmitter side.

Data is received and demodulated, then routed to a demultiplexer. The DEMUX synchronizes to the IBS framing structure, and removes the IBS overhead. The DEMUX also sends the received E or M signal to the E&M signaling circuitry for level conversion, and on to the RJ11 connector.

The PCM data is input to a FIFO as part of a rate exchange. The FIFO output data is expanded from 32 to 64 kbit/s.

The data passes to the PCM decoder, and is converted to analog.

The analog signal from the PCM decoder then passes through a programmable level control circuit (user selectable from the front panel). An RX Clip detect indicator in the FAULT RX menu is provided, which indicates a reception of an excessive signal. The audio output level is user-selectable from -20 to 10 dBm, in 1 dB steps.

The output signal is transformer-coupled on the RJ11 connector.

B.2.1.3 Protection Switch

A jumper is provided which routes the TX and RX audio signals from the RJ11 connector to the RS-422 connector (Refer to Section B.2.3 for pinout specifications). The jumper positions are identified on the PCB with a Data side and an ADPCM side. When the jumper is installed on the Data side, the modem will not allow the RS-422 interface mode to be selected in order to prevent signal contention. For ADPCM interface, the jumper is installed on the ADPCM side. An indicator in the CONFIG INTERFACE menu indicates the state of this jumper on the ADPCM interface PCB.

B.2.1.4 RS-422 Interface

The user can select either the ADPCM voice channel mode or the RS-422 interface mode from the front panel. If the user selects the RS-422 mode, no IBS framing structure is used, and the modem supports the standard RS-422 interface.

(Refer to Section 4.4.1 for a full description of this mode.)

B.2.2 Front Panel Operation

The following sections describe the additional front panel operations that are specific to the ADPCM interface. These options are shown in the front panel menu tables (Chapter 3).

B.2.2.1 Interface

ADPCM ON/OFF	ADPCM interface ON/OFF selection. If ADPCM is set ON, the ADPCM operation is selected. If ADPCM is set OFF, then the standard RS-422 interface option is selected.
Circuit Type	This option refers to the emulation mode of the SDM-100A ADPCM interface. When the subscriber is selected, the SDM-100A interface is configured as a subscriber circuit. When the trunk is selected, the SDM-100A interface is configured as a trunk.
E&M Signaling	This option allows the user to chose which E&M signaling type is selected. Types 1 through 5 are supported.
Encoding Type	This option configures the audio channel to support either A-law or μ-law encoding.
TX Channel Level	This option allows the user to set the input level for the transmit audio from -20 to +10 dBm, in 1 dBm steps.
RX Channel Level	This option allows the user to set the input level for the receive audio from -20 to +10 dBm, in 1 dBm steps.

B.2.2.2 Modulator Configuration

TX Rate and Type	This option allows the user to choose 64 or 32 kHz mode of operation on the ADPCM. BPSK 1/2, QPSK 1/2, 3/4, and 7/8 are also supported. With ADPCM set OFF, this option works in the standard SDM-100A mode.

B.2.2.3 Demodulator Configuration

RX Rate and Type	This option allows the user to choose 64 or 32 kHz mode of operation on the ADPCM. BPSK 1/2, QPSK 1/2, 3/4, and 7/8 are also supported. With ADPCM set OFF, this option works in the standard SDM-100A mode.

B.2.2.4 Utility/Interface

With ADPCM turned off, the RS-422 signals SD, RD, RR, and DM can be inverted, if desired.

B.2.2.5 TX Alarm Indication

With the ADPCM option turned on, the TX alarm LED will come on if an excessive input level is sensed on the TX+ and TX- lines of the interface.

B.2.2.6 RX Alarm Indication

With the ADPCM option turned on, the RX alarm LED will come on if an excessive input level is received by the DEMUX.

B.2.2.7 DEMUX Lock

With the ADPCM option turned on, the DEMUX alarm will become active if the demultiplexer loses lock.

B.2.2.8 Remote Off Hook

With the ADPCM option turned on, the Remote Off Hook alarm will become active if an indication is detected that the receiving station has taken the receiver off the hook.

B.2.3 Specifications

Voice Encoding		
Audio Encoding	CCITT G.711 and G.721 PCM or ADPCM	
Audio Encoding Rate	64, 32, or 16 kbit/s (user-selectable)	
Audio Encoding Type	CCITT G.711 A-Law or μ-Law (user-selectable)	
Voice Interface		
Audio Interface Type	600Ω Transformer Balanced 4-Wire 2-Wire E&M Signaling	
E&M Signaling	Types 1 to 5 (user-selectable)	
Audio Input Level	-20 to +10 dBm for 0 dBm0, in 1 dB steps	
Audio Output Level	-20 to +10 dBm for 0 dBm0, in 1 dB steps	
Filtering	300 to 3400 Hz Input and Output	
Mechanical		
RJ11	**Pin #**	**Name**
	1	+TX
	2	-TX
	3	+RX
	4	-RX
	5	E
	6	M

		With Protection Switch Jumper on Data	With Protection Switch Jumper on ADPCM
Signal Function	**Pin #**	**Name**	**Name**
SIGNAL GROUND	1, 19, 20, 27	SG	
SEND DATA	4 22	SD-A SD-B	
SEND TIMING	5 23	ST-A ST-B	
RECEIVE DATA	6 24	RD-A RD-B	
REQUEST TO SEND	7 25	RS-A *(see Note below)* RS-B *(see Note below)*	-TX +TX
RECEIVER TIMING	8 26	RT-A RT-B	
CLEAR TO SEND	9 27	CS-A *(see Note below)* CS-B *(see Note below)*	
DATA MODE	11 29	DM-A DM-B	-RX +RX
RECEIVER READY	13 31	RR-A RR-B	E M
TERMINAL TIMING	17 35	TT-A TT-B	
MOD FAULT	3	-	
DEMOD FAULT	21	-	
MASTER CLOCK	16 34	MC-A MC-B	

Note: The Request to Send and Clear to Send lines are jumpered together on the Demodulator/M&C card (AS/4973), since the modem does not support polled operation.

B.3 Reed-Solomon Codec

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

Refer to Figure B-4 for a block diagram of the Reed-Solomon Codec.

The two main sections of the Codec that will be included in the theory of operation are the Reed-Solomon encoder (Section B.3.2.1) and the Reed-Solomon decoder (Section B.3.2.2).

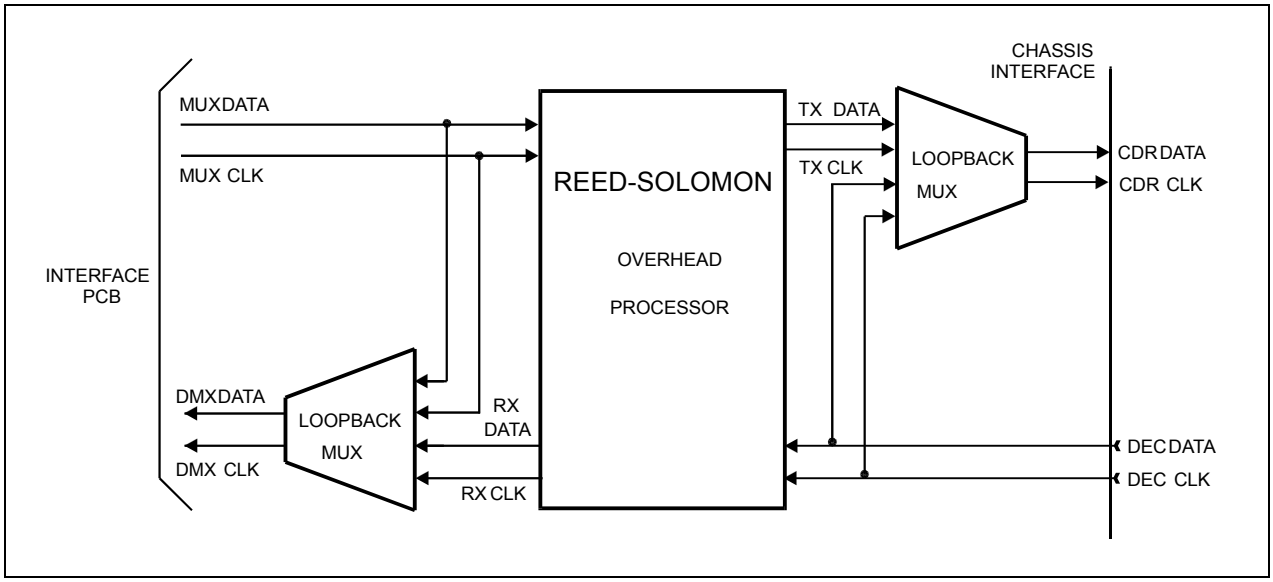


Figure B-4. Reed-Solomon Codec Block Diagram

B.3.1 Reed-Solomon Encoder

A block diagram of the Reed-Solomon encoder section is shown in Figure B-5.

The Reed-Solomon encoder section includes the following circuits:

- Synchronous Scrambler
- Reed-Solomon Codec
- Synchronous First In/First Out
- Serial/Parallel Converter
- Parallel/Serial Converter
- Interleaver

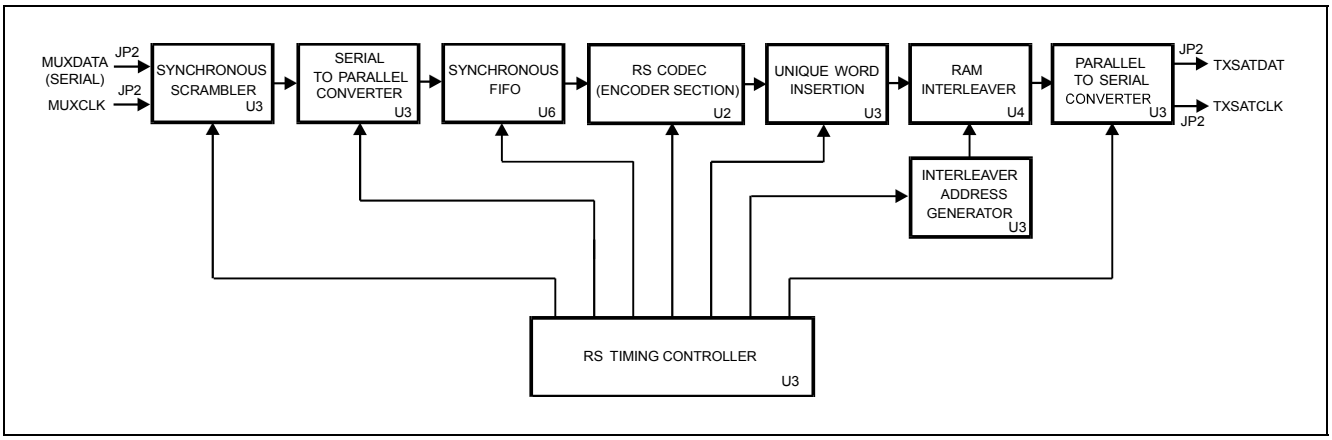


Figure B-5. Reed-Solomon Encoder Section Block Diagram

The data and clock signals (MUXDATA and MUXCLK) come from the multiplexer on the interface PCB, and are sent to the Reed-Solomon encoder section through connector JP2. Since the data input to the Reed-Solomon encoder is serial, the data passes through a self-synchronizing serial scrambler, in accordance with specification INTELSAT-308, Rev. 6B.

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

The data then passes through a serial/parallel converter, which changes the data to an 8-bit word. The word then passes to a synchronous First In/First Out (FIFO) buffer, because the rate is different than the encoded data rate. Once buffered by the FIFO, the data passes to the Reed-Solomon Codec.

Refer to Figure B-6 for the Reed-Solomon code page format. The Reed-Solomon outer Codec reads the data in blocks of ***n*** bytes, and calculates and appends check bytes to the end data block. The letter ***k*** represents the total number of bytes in a given block of data out of the Codec. The letter ***n*** represents the number of data bytes in a given block.

The term, $k - n = 2t$, is the total number of check bytes appended to the end of the data. This is referred to as the "Reed-Solomon overhead." The terms ***k, n***, and ***t*** will vary, depending on the data rate used. The output data is passed to a block-interleaver.

Since errors from the Viterbi decoder usually occur in bursts, a block-interleaver with a depth of 4 is used in accordance with the INTELSAT-308 Rev. 6B specification. The interleaver has the effect of spreading out the errors across blocks of data, instead of concentrating the errors in a single block of data. Since there are fewer errors in any given block, there is a greater chance that the Reed-Solomon decoder can correct the errors on the receiving end of the satellite link. To allow the decoder to synchronize to the data, four unique words are inserted in the last two bytes of the last two pages at the end of each page of data (Figure B-6).

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

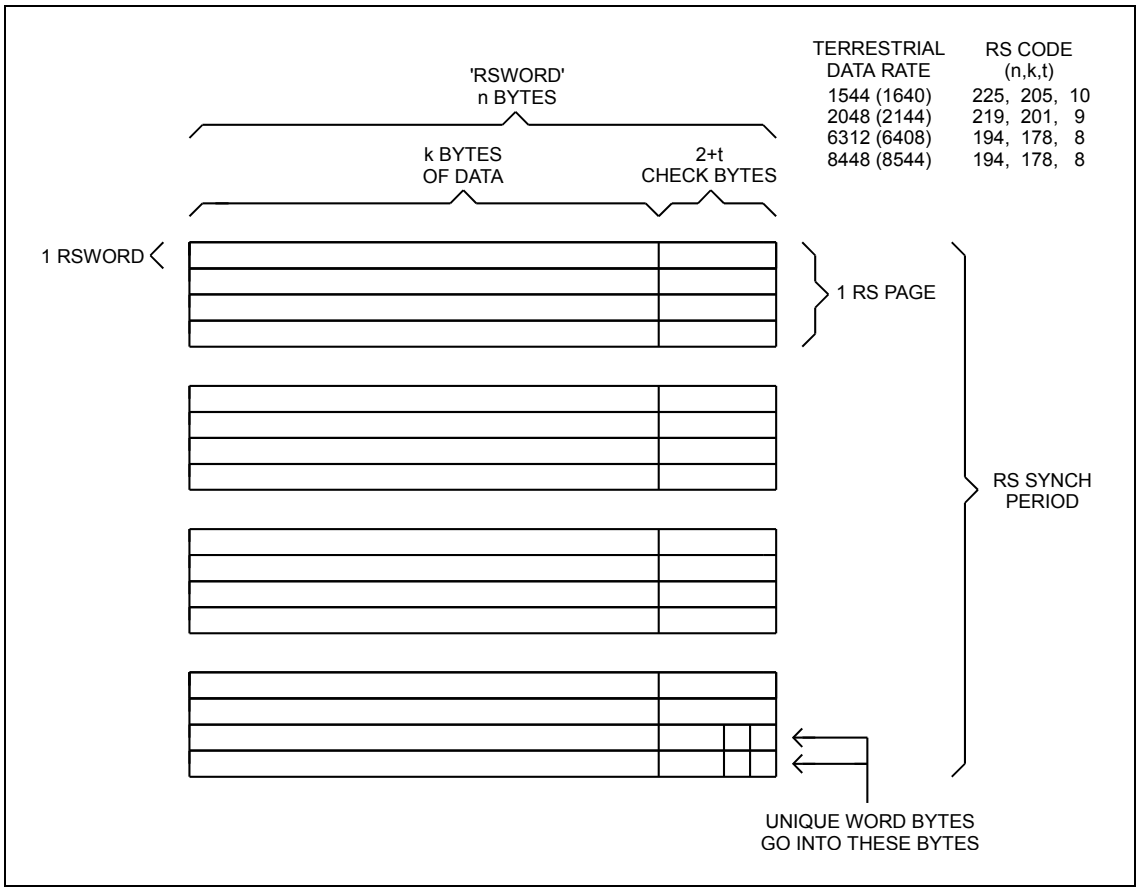


Figure B-6. Reed-Solomon Code Page Format

B.3.2 Reed-Solomon Decoder

Refer to Figure B-7 for a block diagram of the Reed-Solomon decoder section.

The Reed-Solomon decoder section includes the following circuits:

- Serial/Parallel Converter
- Synchronous FIFO
- RAM Interleaver
- Parallel/Serial Converter
- Reed-Solomon Encoder/Decoder
- Synchronous Descrambler

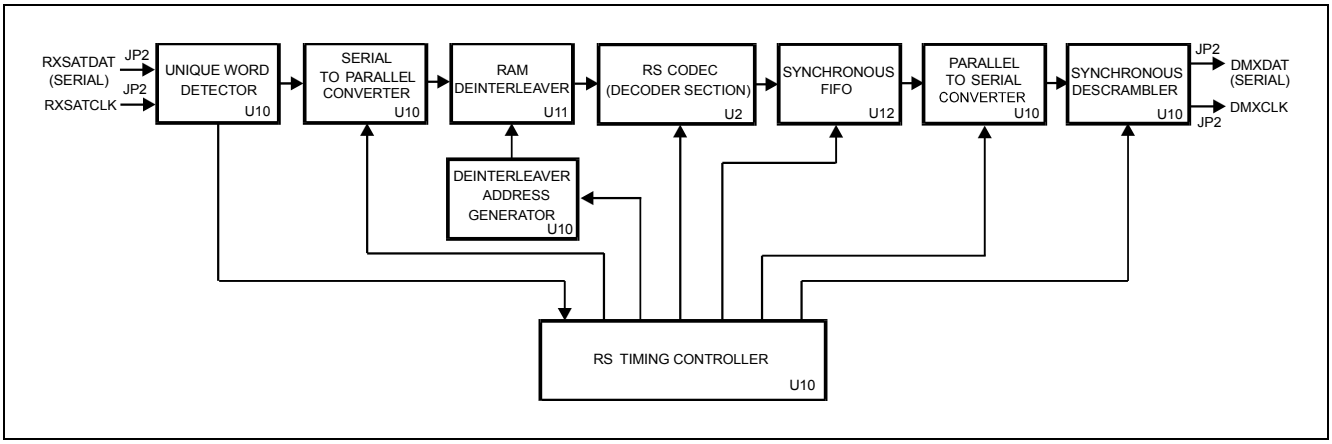


Figure B-7. Reed-Solomon Decoder Section Block Diagram

The data and the clock signals come from the demultiplexer on the interface PCB, and are sent to the Reed-Solomon decoder section through connector JP2.

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

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

Refer to Figure B-6 for the Reed-Solomon code page format. The outer Codec reads the data in blocks of ***n*** bytes and recalculates the check bytes that were appended by the encoder. If the recalculated data bytes do not match the check bytes received, the Codec makes the necessary corrections to the data within the data block. The letter ***k*** represents the total number of bytes in a given block of data out of the Codec. The letter ***n*** represents the number of data bytes in a given block.

The term, ***k - n = 2t***, is the total number of check bytes appended to the end of the data. The terms ***k, n,*** and ***t*** will vary depending on the data rate being used. The Codec then sends the corrected data to a FIFO.

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

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

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Glossary

The following is a list of acronyms and abbreviations that may be found in this manual.

Acronym/ Abbreviation	Definition
Ω	Ohms
A	Ampere
AC	Alternating Current
ADJ	Adjust
ADPCM	Adaptive Differential Pulse Code Modulation
AGC	Automatic Gain Control
AOC	Automatic Offset Control
ASC	Add-Select-Compare
ASYNC	Asynchronous
AUPC	Automatic Uplink Power Control
BB	Baseband
BER	Bit Error Rate
bit/s	bits per second
BPSK	Bi-Phase Shift Keying
C	Celsius
CCITT	International Telephone and Telegraph Consultative Committee
CL	Carrier Loss
COM	Common
CPU	Central Processing Unit
cr	Carriage Return
CRT	Cathode Ray Tube
CS	Clear to Send
CSC	Comstream Compatible
CTS	Clear to Send
CW	Continuous Wave
D/A	Digital-to-Analog
dB	Decibels
dBc	Decibels referred to carrier
dBm	Decibels referred to 1.0 milliwatt
DC	Direct Current

DCE	Data Circuit Terminating Equipment
DDS	Direct Digital Synthesis
Demod	Demodulator
DEMUX	Demultiplexer
DM	Data Mode
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
EFD	EFData Compatible
EIA	Electronic Industries Association
EMC	Electro-Magnetic Compatibility
EXT	External Reference Clock
FDC	Fairchild Data Compatible
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FIFO	First In/First Out
Flt	Fault
FPGA	Field Programmable Gate Array
GND	Ground
Hz	Hertz
I&Q	In-Phase and Quadrature
I/O	Input/Output
IBS	INTELSAT Business Service
IDR	Intermediate Data Rate
IESS	INTELSAT Earth Station Standards
IF	Intermediate Frequency
kbit/s	Kilobits Per Second (10^3 bits per second)
kHz	Kilohertz
Ks/s	Kilosymbols Per Second (10^3 symbols per second)
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
lf	Line Feed
LSI	Large Scale Integration (semiconductors)
M&C	Monitor and Control
mA	MilliAmperes
Max	Maximum
MC	Monitor and Control
MHz	Megahertz
Min	Minimum or Minute
MOP	Modulated Output Power
MPC	Microprocessor Controller
MS	Milliseconds
MUX	Multiplexer
NC	No Connection
NO	Normally Open
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
pF	PicoFarads (10^{12} Farads)
PK	Peak
PPM	Parts Per Million
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RD	Receive Data
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)
SCR	Serial Clock Receive
SCT	Serial Clock Transmit
SCTE	Serial Clock Transmit External
SD	Send Data
SN	Signal-to-Noise Ratio
ST	Send Timing
TP	Test Point
TT	Terminal Timing
TTL	Transistor-Transistor Logic
TX	Transmit (Transmitter)
UART	Universal Asyncronous Receiver/Transmitter
UNK	Unknown
US	United States
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage-Controlled Oscillator
VDC	Volts, Direct Current
W	Watts

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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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