SDM-2020

Satellite Demodulator
Installation and Operation Manual

Part Number MN/SDM2020D.IOM Revision 3

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June 15, 2000

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Registered Company.

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

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Tempe, Arizona 85281 USA

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

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

Table of Contents

Figures

Tables

Overview of Changes to Previous Edition

Changes made to Rev. 2 were:

- Added ASI/LVDS data interface to Table 1-5.
- Revised Specification Table 1-6.
- Update menus to Ver: 4.3.5 to reflect ASI/LVDS interface.
- Added Fault Tree as paragraph 3.5.
- Added Revision Emulation Operation as paragraph 3.6.
- Added paragraph A.8 to reflect ASI/LVDS interface.
- Update Appendix B Remote Specification to FW/6224-1P.

About this Manual

This manual provides installation and operation information for the Comtech EFData SDM-2020 satellite demodulator. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the SDM-2020.

Related Documents

The following documents are referenced in this manual:

- *DVB TM1449, Interfaces for CATV/SMATV Headends and Similar Professional Equipment*
- *DiSEqC Bus Functional Specification – Version 4.2*
- *ETS 300 421, Dec. 1994, "Digital Broadcasting Systems For Television, Sound And Data Services; Framing Structure, Channels Coding And Modulation For 11/12 GHz Services."*
- *EN 301 210, 19 March 1998, Digital Video Broadcasting (DVB) Framing structure, channel coding and modulation for digital satellite News Gathering (DSNG) and other contribution applications by satellite*

Conventions and References

Cautions and Warnings

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

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

Metric Conversion

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing English to Metric conversions.

Recommended Standard Designations

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

Trademarks

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

Reporting Comments or Suggestions Concerning this Manual

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

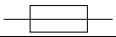
European EMC Directive

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

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

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

International Symbols:

	Alternating Current.
	Fuse.
	Safety Ground.
	Chassis Ground.

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

Warranty Policy

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

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

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from improper installation or maintenance, abuse, unauthorized modification, or operation outside of environmental specifications for the product, or, for damages that occur due to improper repackaging of equipment for return to Comtech EFData.

No other warranty is expressed or implied. Comtech EFData specifically disclaims the implied warranties of merchantability and fitness for particular purpose.

Exclusive Remedies

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EFData shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Disclaimer

Comtech EFData has reviewed this manual thoroughly in order that it will be an easy-to-use guide to your equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EFData reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

If you have any questions regarding your equipment or the information in this manual, please contact the Comtech EFData Customer Support Department.

Chapter 1. INTRODUCTION

This chapter provides an overview, internal assembly tables, and specifications for the SDM-2020 satellite demodulator, referred to in this manual as “the demodulator.”

1.1 Overview

The SDM-2020 (Figure 1-1) is a programmable; variable-rate satellite demodulator used for digital video and high-speed data applications. The demodulator supports open network modes compliant with the ETSI EN 300 421 specification for Digital Video Broadcasting (DVB) by satellite for QPSK and prEN 301 210 specification for 8PSK and 16QAM.

Figure 1-1. SDM-2020 Satellite Demodulator

The modulator and demodulator are intended for use in commercial applications for transmission and reception of digitized video signals. The basic digitized video format supported is defined by the Moving Pictures Experted Group-2 (MPEG-2) (see ISO/IEC DIS 13818-1, Coding of moving pictures and associated audio).

The demodulator also has adative equalization capability. A general block diagram for the demodulator is shown in Figure 1-2.

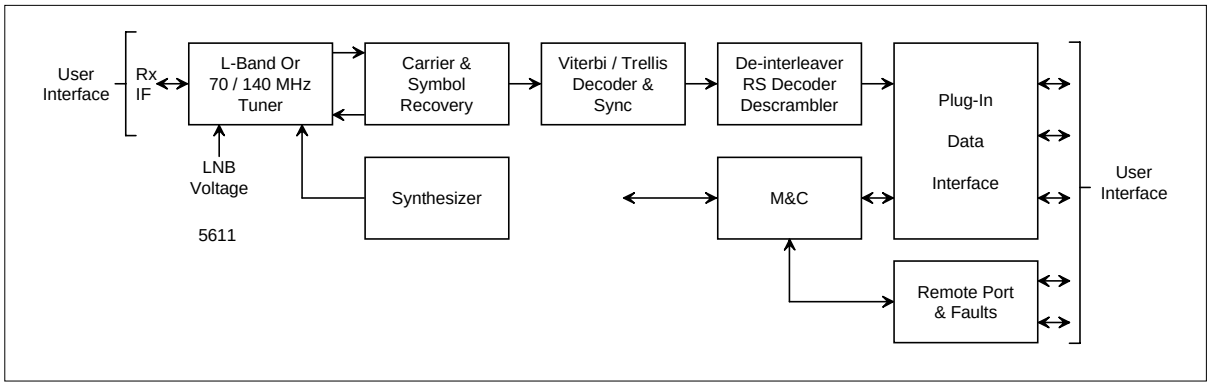


Figure 1-2. Demodulator Block Diagram

Other formats including unframed data are supported by selecting the appropriate data interface. The demodulator uses a plug-in data interface module installed in the rear of the chassis. The data interface module provides flexible adaptation to the various physical and electrical interfaces found in the communications industry. Refer to Appendix A for a detailed description of the data interface module.

The data rate of the demodulator is programmable from 1.5 to 100 Mbit/s, with maximum symbol rates up to 37.5 Msys/s depending upon the modulation, code rate, and data interface. Demodulation formats include QPSK, 8PSK and 16QAM. Operation is based upon the DVB standard. Refer to Appendix B for detailed remote control operation.

The demodulator incorporates concatenated error correction coding for improved signal quality. With concatenated coding, an outer Reed-Solomon Codec is used in tandem with an inner Viterbi or trellis-type Codec. The Reed-Solomon coding is DVB (based on 204, 188, t=8 type code), while the Viterbi and trellis codes are based upon a constraint length K = 7 convolutional coding. This combination significantly reduces the required operating power of the satellite system.

The demodulator is a completely self-contained unit in a standard, one-unit (1U) 19-inch (48.26 cm) rack-mountable enclosure. It includes a backlit LCD display and a standard EFData six-button keypad for user control. Prime power is alternating current (AC) input or optionally direct currect (DC) input. The IF input to the demodulator is L-Band or 70 or 140 (70/140) MHz IF.

A status and control port (available through a 9-pin D connector at the rear of the chassis) provides either serial EIA-232 or EIA-485 (2- or 4-wires) for remote control applications. A second rear panel 9-pin D connector provides fault/alarm status.

The demodulator is designed to meet stringent safety and RF emissions standards, including CE Mark certification. See Section 2.4 for information regarding proper operation for CE emissions.

The demodulator utilizes Fully Accessible System Topology (FAST), EFData's feature for immediate implementation of different options through the user interface keypad, enabling on-location upgrade of the operating feature set—in the rack—without removing a unit from the setup. This feature employs a unique access code to enable configuration of the available hardware. The access code can be purchased at any time from EFData Customer Support. Once obtained, the access code is entered into the unit through the front panel keypad or the rear remote port. When service requirements change, the demodulator can be upgraded to meet the new requirements within minutes after confirmation by EFData Customer Support. Refer to Appendix C for additional information.

Note: There are specific data rate ranges for the various interfaces. See Appendix A.

Refer to Table 1-1 for the Min/Max data and symbol rates for unframed (187) Mode.

Table 1-1. Unframed (187) Mode

Code Rate	Minimum Data Rate (bit/s)	Maximum Data Rate (bit/s)	Minimum Symbol Rate (sym/s)	Maximum Symbol Rate (sym/s)	Remarks
QPSK 1/2	1,375,000	34,375,000	1,500,000	37,500,000	
QPSK 2/3	1,833,333	45,000,000	1,500,000	36,818,181	
QPSK 3/4	2,062,500	45,000,000	1,500,000	32,727,272	
QPSK 5/6	2,291,666	45,000,000	1,500,000	29,454,545	
QPSK 7/8	2,406,250	45,000,000	1,500,000	28,051,948	
8PSK 2/3	2,750,000	68,750,000	1,500,000	37,500,000	
8PSK 5/6	3,437,500	85,937,500	1,500,000	37,500,000	
8PSK 8/9	3,666,666	91,666,666	1,500,000	37,500,000	
16QAM 3/4	4,125,000	91,666,666	1,500,000	33,333,333	
16QAM 7/8	4,812,500	91,666,666	1,500,000	28,571,428	

Refer to Table 1-2 for the Min/Max data and symbol rates for the 188 mode.

Table 1-2. 188 Mode

Code Rate	Minimum Data Rate (bit/s)	Maximum Data Rate (bit/s)	Minimum Symbol Rate (sym/s)	Maximum Symbol Rate (sym/s)	Remarks
QPSK 1/2	1,382,353	34,558,823	1,500,000	37,500,000	
QPSK 2/3	1,843,137	45,000,000	1,500,000	36,622,340	
QPSK 3/4	2,073,529	45,000,000	1,500,000	32,553,191	
QPSK 5/6	2,303,921	45,000,000	1,500,000	29,297,872	
QPSK 7/8	2,419,117	45,000,000	1,500,000	27,902,735	
8PSK 2/3	2,764,705	69,117,647	1,500,000	37,500,000	
8PSK 5/6	3,455,882	86,397,059	1,500,000	37,500,000	
8PSK 8/9	3,686,274	92,156,862	1,500,000	37,500,000	
16QAM 3/4	4,147,058	92,156,862	1,500,000	33,333,333	
16QAM 7/8	4,838,235	92,156,862	1,500,000	28,571,428	

Refer to Table 1-3 for the Min/Max data and symbol rates for the 204 mode.

Table 1-3. 204 Mode

Table 4

Code Rate	Minimum Data Rate (bit/s)	Maximum Data Rate (bit/s)	Minimum Symbol Rate (sym/s)	Maximum Symbol Rate (sym/s)	Remarks
QPSK 1/2	1,500,000	37,500,000	1,500,000	37,500,000	
QPSK 2/3	2,000,000	45,000,000	1,500,000	33,750,000	
QPSK 3/4	2,250,000	45,000,000	1,500,000	30,000,000	
QPSK 5/6	2,500,000	45,000,000	1,500,000	27,000,000	
QPSK 7/8	2,625,000	45,000,000	1,500,000	25,714,285	
8PSK 2/3	3,000,000	75,000,000	1,500,000	37,500,000	
8PSK 5/6	3,750,000	93,750,000	1,500,000	37,500,000	
8PSK 8/9	4,000,000	100,000,000	1,500,000	37,500,000	
16QAM 3/4	4,500,000	100,000,000	1,500,000	33,333,333	
16QAM 7/8	5,250,000	100,000,000	1,500,000	28,571,428	

Notes:

1. Data and symbol rates are effective on hardware shipped through December 1998.

2. Data and symbol rates become effective January 1999.

1.2 Assemblies

1.2.1 Demodulator

The demodulator consists of the assemblies listed in Table 1-5.

Table 1-5. EFData Module Part Numbers

Part Number	Description	Comment
PL/5746	Demodulator Assembly	
PL/5782	IF Module, 75Ω	
PL/6169	Front Panel Assembly	
PL/6170	SDM-2020 Top Assembly	
PL/7732	L-Band 4-Input IF Module, 75Ω	June 1999 and later
PL/8292	70/140 MHz IF (Option) *(see Note)*	May 2000

Note: Operates with P/L7733 Mainboard only.

1.2.2 Data Interfaces

Data interface assemblies are listed in Table 1-6.

Table 1-6. EFData Part Numbers for Data Interface Modules

Part Number	Description
PL/5805	RS422 Serial/Parallel Data Interface
PL/5806-3	RX only ECL/HSSI Serial Data Interface
PL/5807	ASI/RS422 (Asynchronous Serial Interface/Serial Data Interface
PL/5814	LVDS-DVB Serial/Parallel Data Interface
PL/6168	G.703 Data Interface
PL/6175-2	SMPTE 310M Data Interface
PL/8160	ASI/LVDS Interface

The data interface is a plug-in module. The specific requirements for each interface type are provided in Appendix A. As new interfaces are developed, the new data will be added to the appendix. Remote Monitor and Control (M&C) software requirements are listed in Appendix B.

All data interfaces are safety- rated to SELV (IEC 950, Paragraph 1.2.8.5).

For additional data interface availability, contact EFData Customer Support.

1.2.3 FAST Options

Certain options are enabled using EFData's Fully Accessible System Topology (FAST) features described in Appendix C. The software requirements for the FAST options are also listed in Appendix C. Options include:

- Original Equipment Manufacturer (OEM) LCD (See Appendix B)
- 8PSK – DVB
- 16QAM – DVB
- 2 L-Band Inputs
- 4 L-Band Inputs

1.3 Specifications

1.3.1 Demodulator

Table 1-7 describes the demodulator specifications.

Table 1-7. Demodulator Specifications

General Specifications	
Transmission Format	QPSK per EN 300 421 Optional – 8PSK and 16QAM per EN 301 210
BER Performance	See paragraph 1.4. **Notes:** 1. Values shown for 8PSK 8/9 are for symbol rates ≤ 30 Msym/s. 2. For 8PSK 8/9 at symbol rate > 30 Msym/s, add 0.4 dB.
Data Rate/Symbol Rate	1.5 to 100 Mbit/s in 1 bit/s increments depending upon symbol rate and data interface, see Table 1-1, Table 1-2, and Table 1-3.
Equivalent Serial Data Rate at 96 DIN Connector	Minimum and maximum data rate and symbol rates, see Table 1-1, Table 1-2, and Table 1-3. Framing 187 Data Rate = SR x m x CRv x (187/204) 188 Data Rate = SR x m x CRv x (188/204) 204 Data Rate = SR x m x CRv x (204/204) SR = Symbol Rate m = 2 QPSK, 3 8PSK, 4 16QAM CRv = Viterbi/trellis code rate 1/2, 2/3, 3/4, 5/6, 7/8, and 8/9
Data Rate Tolerance	Programmed rate ± 100 ppm
Modulation Type and Inner Code Rate	QPSK: 1/2, 2/3, 3/4, 5/6, 7/8 Optional - 8PSK: 2/3, 5/6, 8/9 Optional - 16QAM 3/4, 16QAM 7/8
Outer Code Rate (Reed-Solomon)	RS (204, 188, t = 8) per EN 300 421 and EN 301 210
Deinterleaving	Depth 12, per EN 300 421 and EN 301 210
Spectral Shaping	Square-root raised cosine, $\propto$ = 0.35 per EN 300 421 and EN 301 210
Energy Dispersal	EN 300 421 and EN 301 210, or None

Table 1-6. Demodulator Specifications (Continued)

General Specifications	
Unit Cooling	Exhaust fan located on left of unit when viewed from the rear.
Front Panel Interface	Keypad + LCD with back lighting
Remote Control Interface	Programmable selection for: EIA-232, EIA-485 (2- or 4-Wire), 9-pin D female connector, serial asynchronous
Fault Interface	Form C, 9-Pin D female
Monitor Interface	9-Pin D female, system test points
AC Input Power Rating	100 to 240 VAC, 50 to 60 Hz universal type 1.0 A at 100 VAC or 0.5 A at 240 VAC. Connection universal type IEC320. **Notes:** 1. This equipment is fitted with a wide-ranging power supply that will operate at +6% to -10% of the min/max voltage range shown above, IEC950, Paragraph 1.6.5. 2. Per manufacturer's published data sheet, the AC power supply has an operating range of 85 to 264 VAC, 47 to 63 Hz universal type. 100W maximum
Power Distribution System	Type TN ONLY (EN 60950, Paragraph 1.2.12.1). **Note:** This equipment shall not be used with single-phase, 3-wire, and PE.
Connection to Supply	Pluggable equipment Type A (EN 60950, Paragraph 1.2.5). **Note:** Equipment, which is intended for connection to the building power, supply wiring via a non-industrial plug and socket or an industrial appliance coupler or both.
Power Supply Fuses	Double-Pole fused. Fuse type: 20mm; 2A T-type HBC (T2A H250V) (IEC 127, Sheet V, approved and UL recognized)
Class of Equipment	Class I Equipment (EN 60950 Paragraph 1.2.4): Electric shock protection by basic insulation and protection earth.
Power Supply Hold-Up	16 ms minimum at 120 VAC 78 ms minimum at 240 VAC
DC Power Input (Optional)	42 to 56 VDC, 100W maximum
Environment: Operating Storage Humidity	 0 to 50°C (32 to 122°F) -40 to +70°C (-40 to 158°F) ≤ 95% , non-condensing
Mounting Dimensions	19-inch rack mount 1 RU, IEC 297, DIN41494 Type 19W x 1.75H x 14D inch (48.26 x 4.44 x 35.56 cm) Older Chassis 19W x 1.75H x 16.1D inch (48.26 x 4.44 x 40.94 cm) Newer Chassis
Weight	≤ 15 lb. (≤ 6.82 kg)
CE Compliance	Required

1.3.2 L-Band and 70/140 MHz Input Demodulator Charactistics

Refer to Table 1-7 for single L-Band charactistics.

Table 1-8. L-Band and 70/140 MHz Input Demodulator Characteristics

Demodulator Specification			
Parameter	**Single L-Band Input (Older L-Band)**	**4 L-Band Inputs (Newer L-Band)**	**Signal 70/140 MHz Input (Optional)**
RX IF Input	950 to 1750 MHz in 2.5 kHz steps	950 to 1750 MHz in 2.5 kHz steps	50 to 90 MHz and 100 to 180 MHz in 2.5 kHz steps
Number of IF Inputs: Standard FAST Option FAST Option	1 Physical Connector	4 Physical Connector 1 RF input connector 2 RF inputs enabled 4 RF inputs enabled	1 Physical Connector
Isolation, Unused Input to Tuner	NA	50 dB minimum	NA
Isolation, Between any Input	NA	50 dB minimum	NA
RX IF Impedance	75Ω	75Ω	75Ω (50Ω Optional)
RX IF Return Loss (minimum)	10 dB	10 dB	18 dB
RX IF Connector	Type F, Female	Type F, Female	BNC, Female
Minimum Input, Desired Carrier C. (See Figure 1-3a and 1-3b)	C = –71 + 10 log (Msym/s) dBm	C = –65 + 10 log (Msym/s) dBm	C = –57 + 10 log (Msym/s) dBm
Input AGC Range, minimum	40 dB	40 dB	30 dB
Input Level, Composite	–5 dBm maximum, additive white Gaussian noise (AWGN)		
Composite/Desired Carrier Ratio	≤ 17 +10 log [37.5/(Msym/s)]		
LNB Power Supply Output (Through Selected Input Only) Selection 1 Selection 2 Selection 3	500 mA maximum, short circuit protected through Type F connector feed: 20 to 24 VDC 12 to14 VDC, V-polarization per DiSEqC 4.2 16 to 20 VDC, H-polarization per DiSEqC 4.2		NA
RX Buffer	None (**Note:** Some Data Interfaces contain a buffer.)		
Acquisition Sweep Range/Increment	0 to ± 500 kHz/1Hz	0 to ± 60 kHz	
Acquisition Time	≤ 5 seconds, typical at ± 50 kHz uncertainty		
BER Performance	*See Tables.*		
Adjacent Carrier Performance	QPSK and 8PSK: Performance degradation will not be more than 0.5 dB in the presence of two-like modulated carriers each spaced 1.3 x symbol rate on either side of the desired carrier and each adjacent carrier 10 dB greater in power than the desired carrier . 16QAM: Performance degradation will not be more than 0.5 dB in the presence of two-like modulated carriers each spaced 1.3 x symbol rate on either side of the desired carrier and each adjacent carrier 10 dB greater in power than the desired carrier for symbol rates < 10 Msys/s and 7 dB, each carrier for symbol rates over 10 Msym/s.		
Spectral Inversion	Automatic, detection with ambiguity resolution		

1.3.3 Remote Port and M&C Specification

Refer to Table 1-8 for remote port and M&C specifications.

Table 1-9. Remote Port and M&C Specifications

Remote Port and M&C Specifications		
M&C Port Remote Control: ASYNC Serial Interface Baud Rate Serial Format Data Bits Stop Bits Remote Port Addressing	 EIA-485 (2/4-wire) or EIA-232 300, 600, 1200, 2400, 4800, 9600, or 19200 bit/s ASCII 8 bit/s with no parity; 7 bit/s with odd/even parity bit 2 Range: 1 to 255	
Control Items:	Data Rate Symbol Rate Framing Type (None, 188, 204) Clock and data phase Modulation Type: QPSK, 8PSK, 16QAM Code Rate BER Threshold (None, 1 x10^{-3} to 1x 10^{-8}) E_b/N_0 Threshold (None, 3.0 to 16.0 dB) RX IF Frequency	2047 Pattern Data Loopback (Where applicable) Scrambler On/Off (Test Mode) RS Correction On/Off DC On/Off (L-Band only) Min. Current limit (Max. Current Limit) Max. Current limit 1 to 1000 mA Date and Time Display contrast
Status	All Configuration Items Spectral Inversion = Normal or Inverted RX Frequency Tracking RX Input Level (dBm)	Corrected BER Raw BER E_b/N_0 LNB current monitor
Faults (Continued)	LNB Current Over/Under Limits Carrier detect (Viterbi) IF synthesizer fault I or Q channel loss of activity BER threshold, except NONE	Module Fault Frame Sync Loss Interface PLLs not locked (where applicable) **Note:** See Appendix B for a complete listing of remote port commands and status items.
Alarms	FIFO full/empty (interface, where applicable)	
Configuration Retention	Non-volatile	
Stored Configurations	10 save and 10 recall	

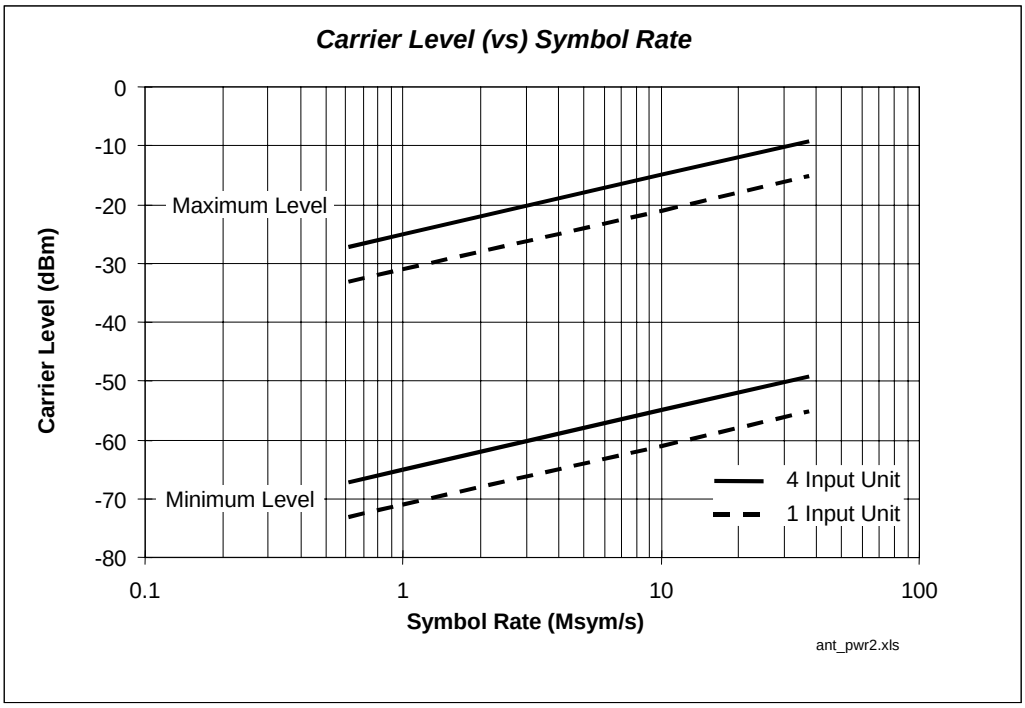


Figure 1-3. Signal Level Characteristics –L-Band

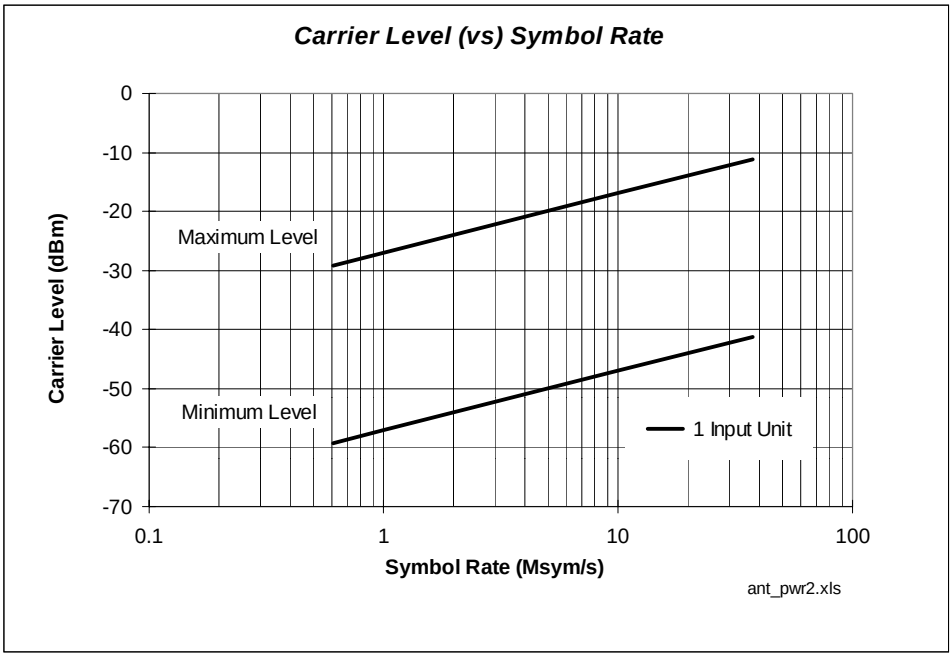


Figure 1-4. Signal Level Characteristics – 70/140 MHz

1.4 BER Performance

1.4.1 QPSK with Reed-Solomon Coding

Refer to Table 1-9 and Figure 1-5.

Table 1-10. QPSK with Reed-Solomon Coding

BER	1/2	2/3	3/4	5/6	7/8
10^{-6}	3.7	4.4	5.0	5.6	5.9
10^{-8}	4.0	4.7	5.3	5.9	6.3
10^{-11}	4.5	5.1	5.8	6.4	6.9

1.4.2 8PSK Reed-Solomon Coding

Note: For 8PSK – 8/9 at symbol rates > 30 Msym/s add 0.4 dB.

Refer to Table 1-10 and Figure 1-6.

Table 1-11. 8 PSK Reed-SolomonCoding

	Eb/No with Reed-Solomon		
BER	2/3	5/6	8/9
10^{-4}	6.0	7.5	8.5
10^{-6}	6.3	7.9	8.8
10^{-8}	6.6	8.3	9.1
10^{-10}	6.9	8.8	9.4

1.4.3 16QAM Reed-Solomon Coding

Refer to Table 1-11 and Figure 1-7.

Table 1-12. 16QAM Reed-Solomon BER Codes

E_b/N_0 with Reed-Solomon		
BER	3/4	7/8
10^{-4}	8.1	10.0
10^{-6}	8.3	10.2
10^{-8}	8.6	10.4
10^{-10}	8.9	10.6

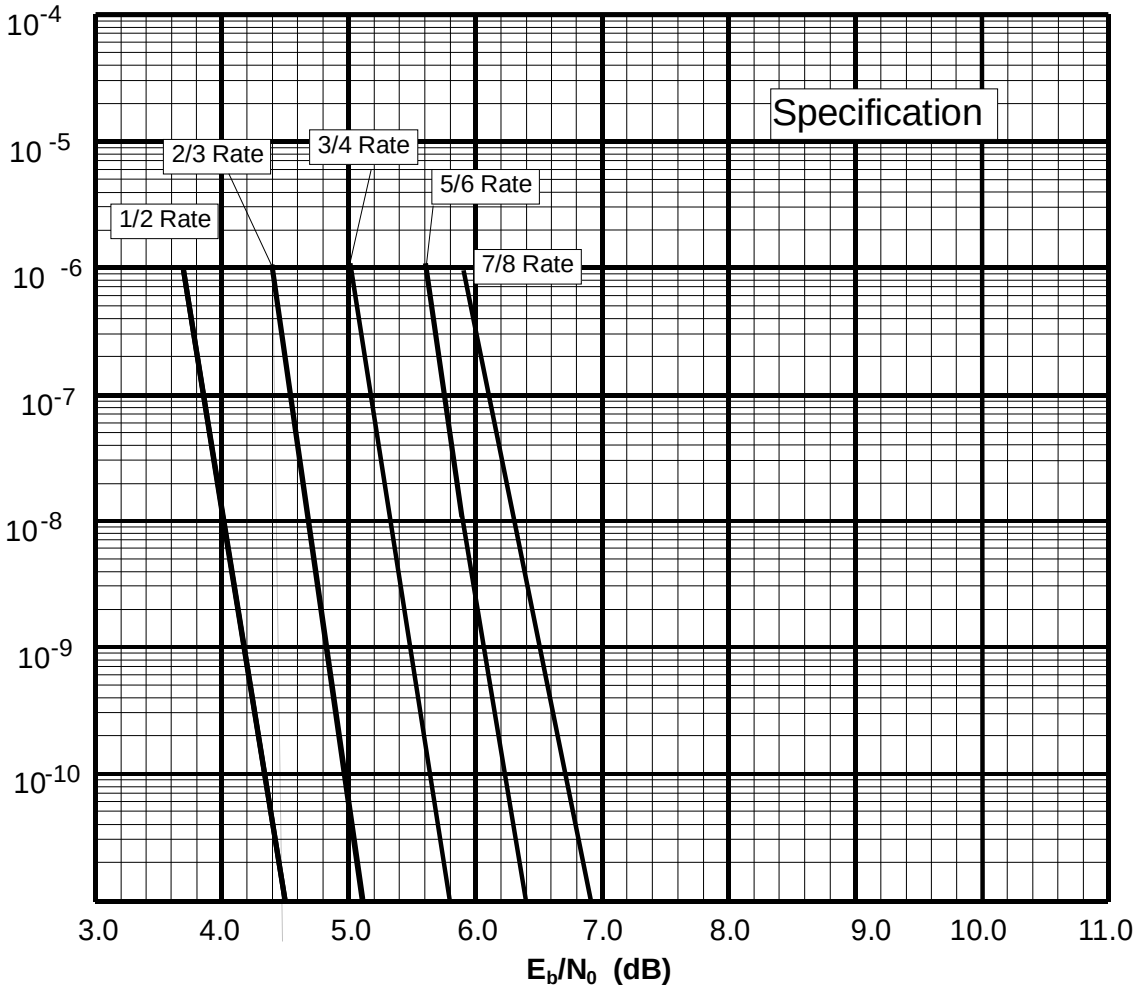


Figure 1-5. QPSK (1/2, 2/3, 3/4, 5/6, 7/8 Rates) with Reed-Solomon

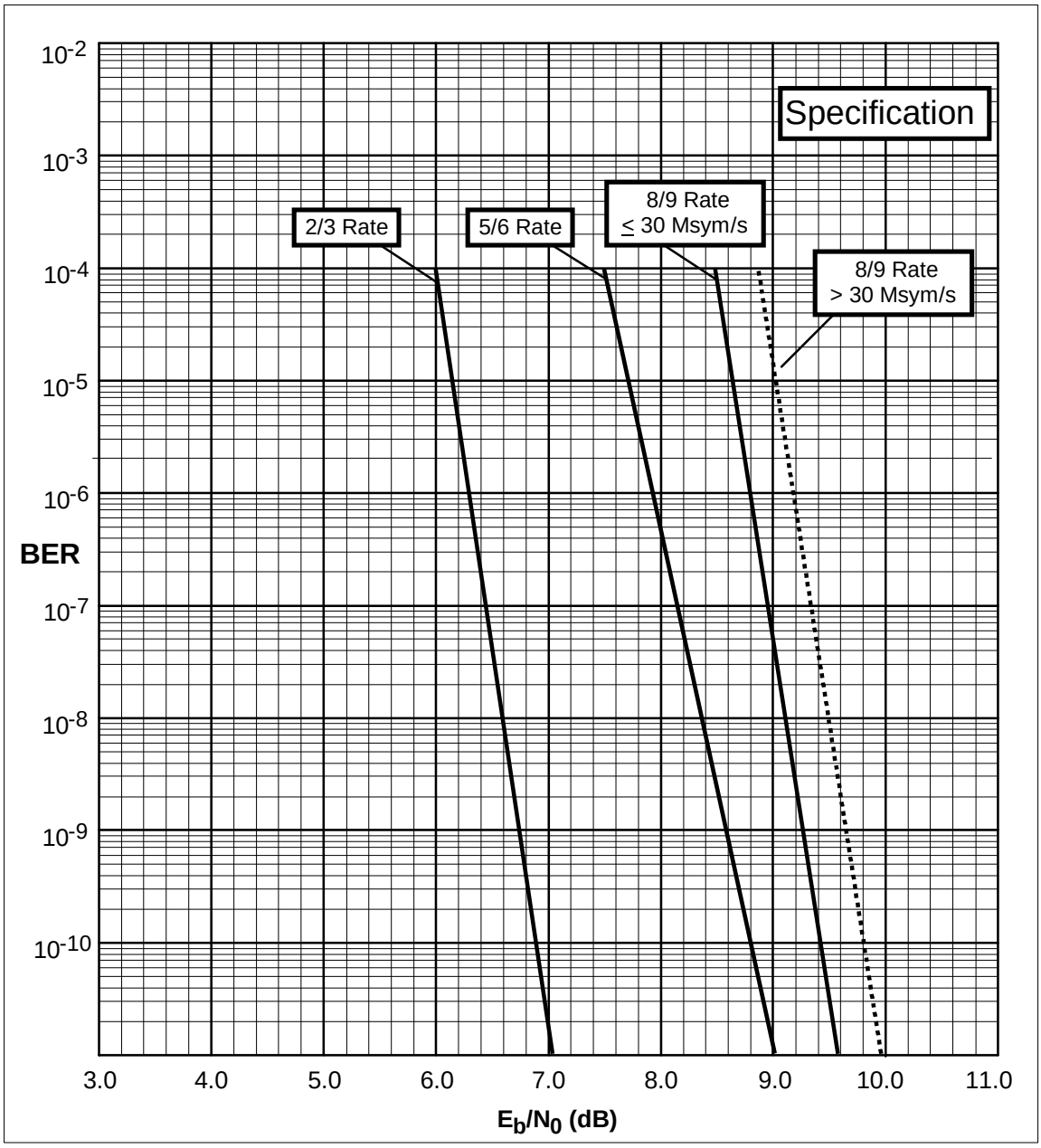


Figure 1-6. 8PSK (2/3, 5/6, 8/9 Rates) With Reed-Solomon

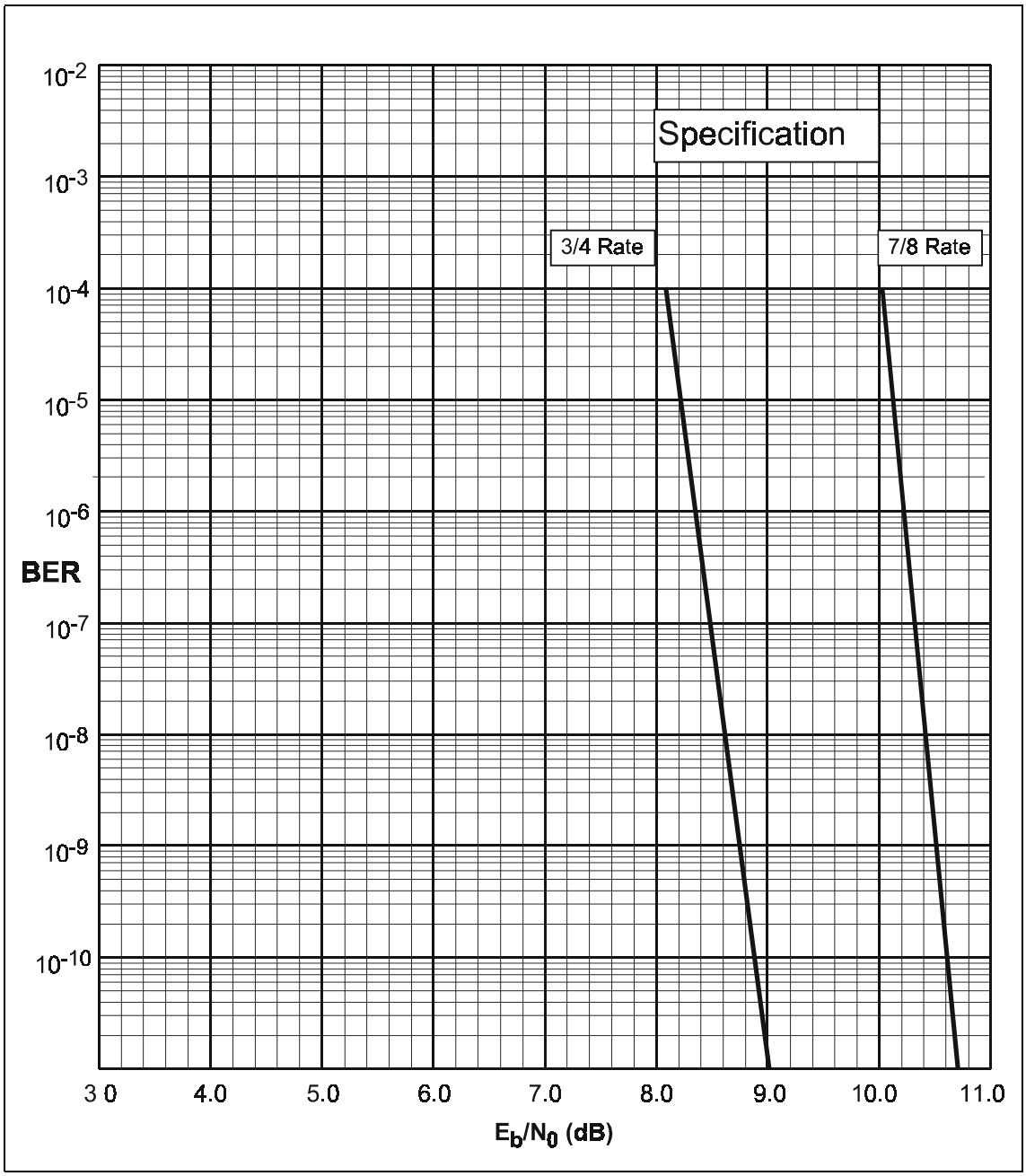


Figure 1-7. 16QAM (3/4, 7/8) Reed-Solomon Decoder

1.5 SDM-2020 Demodulator Envelope

Refer to Figure 1-8 for unit envelope

Note: All dimensions are in inches, metrics are referenced in parentheses.

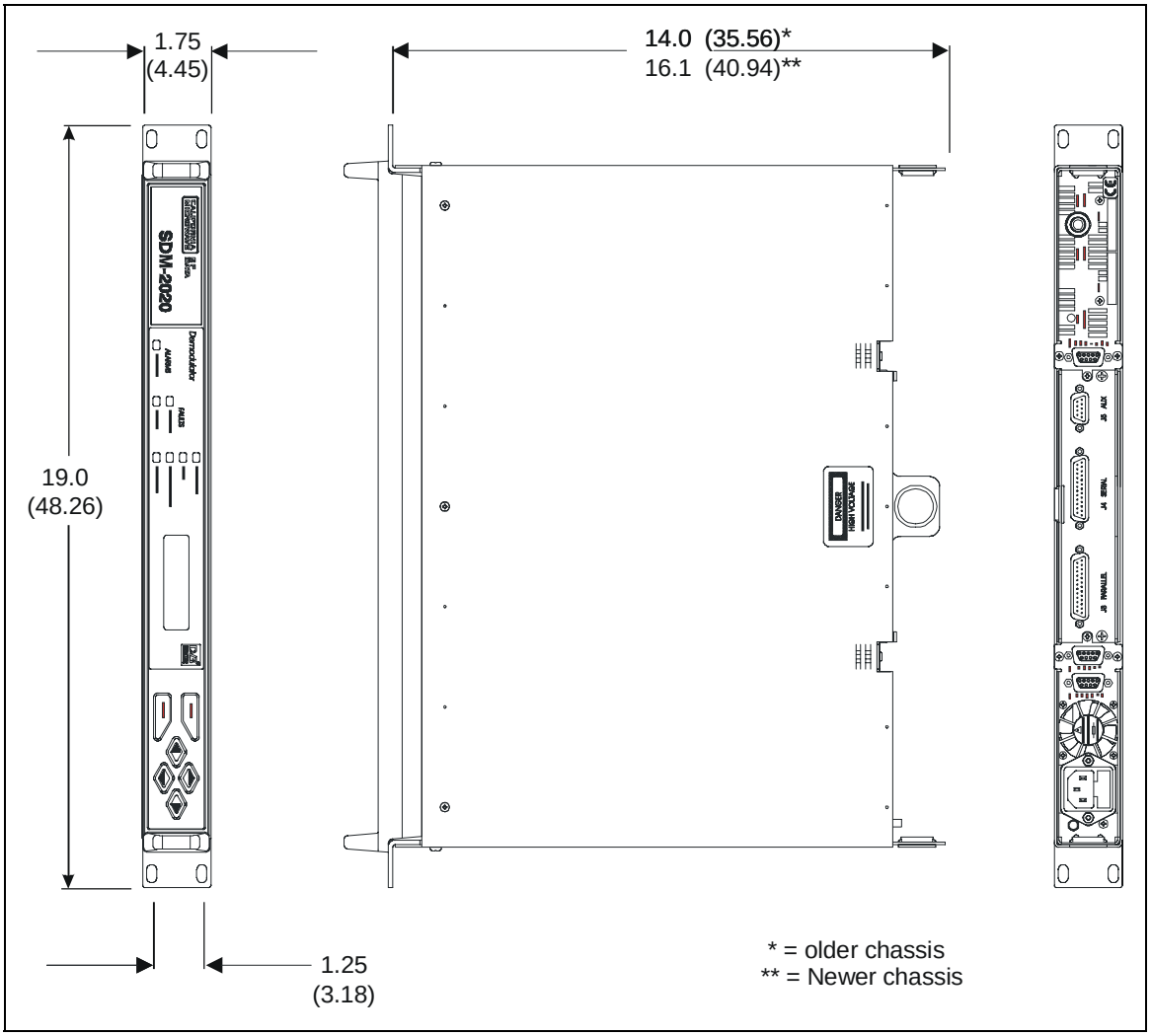


Figure 1-8. SDM-2020 Demodulator Envelope

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Chapter 2. INSTALLATION

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

The equipment contains parts and assemblies sensitive to damage by Electrostatic Discharge (ESD). Use ESD precautionary procedures when touching, removing, or inserting PCBs.

2.1 Unpacking

The demodulator and manual are packaged in pre-formed, reusable, cardboard cartons containing foam inserts for maximum shipping protection.

Do not use any cutting tool that will extend more than 1 inch (2.54 cm) into the container. This can cause damage to the demodulator.

To remove the demodulator:

1. Cut the tape at the top of the carton, which is labeled “OPEN THIS END”.
2. Remove the cardboard/foam inserts covering the demodulator.
3. Remove the demodulator, manual, and power cord from the carton.
4. Save the packing material for storage or reshipment purposes.
5. Inspect the equipment for any possible damage incurred during shipment.
6. Check the equipment against the packing list to ensure the shipment is correct.
7. Refer to Section 2.2 for installation instructions.

2.2 Installation

Note: If there is any problem with the installation, contact EFData's Customer Support Department.

A complete demodulator consists of the SDM-2020 main unit and an optional plug-in data interface. The demodulator is shipped with the data interface installed in the main unit. Changing a data interface is easily accomplished in the field and does not require disassembly of the main unit.

Refer to Section 2.2.1 for information on removing and installing data interface modules.

Install the demodulator (Figure 2-1) as follows:

1. Mount the demodulator chassis in the assigned position of the equipment rack. Support the demodulator with either a rack-mounted shelf, or the two rear rack-mounted brackets supplied with the unit.

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

3. The demodulator will turn on automatically when the primary power connection is made (plugged in).

   Note: Before plugging in the demodulator, become familiar with the front panel operation in Chapter 3.

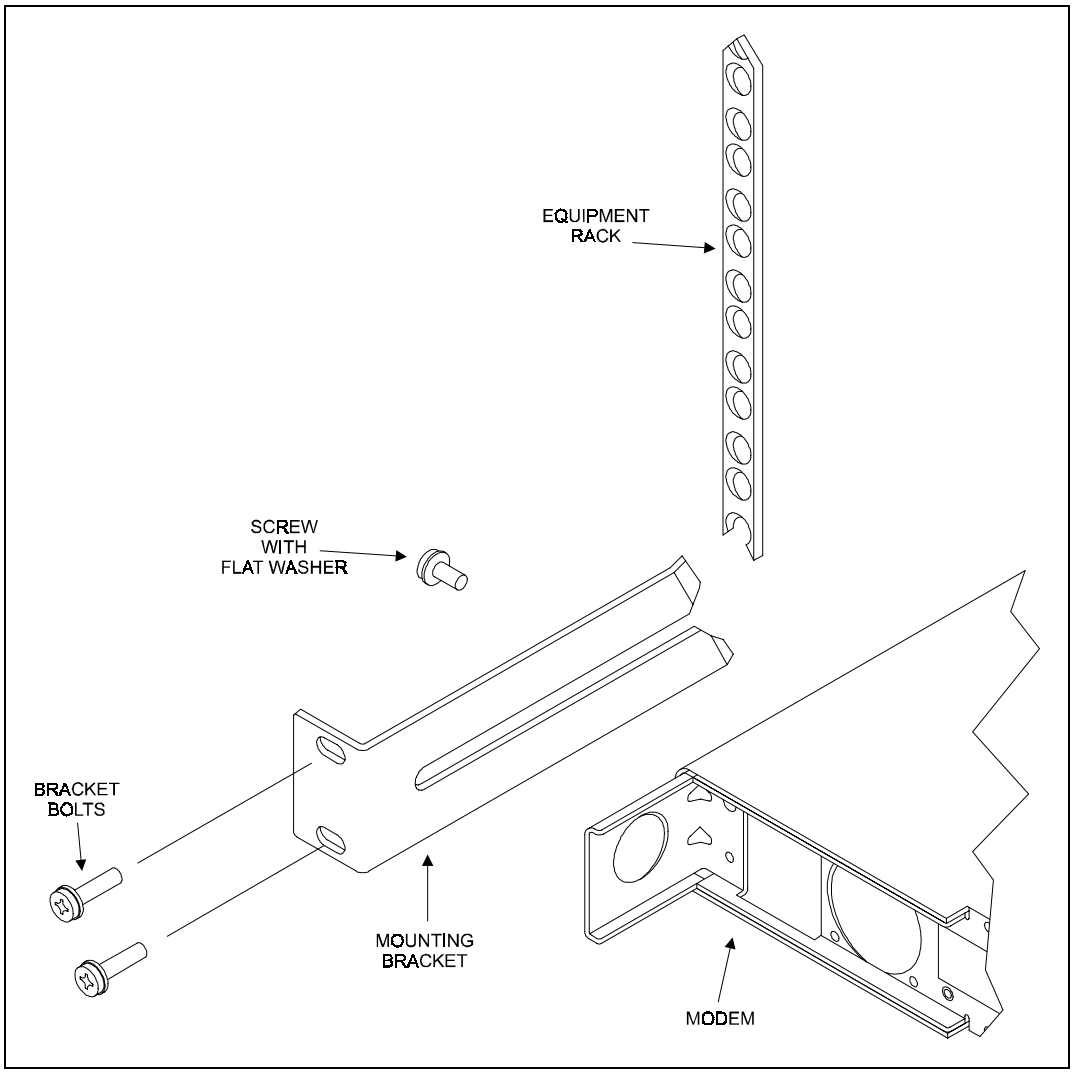

Figure 2-1. Typical Rack Installation

2.2.1 Data Interfaces

Note: Refer to Appendix A for available data interfaces.

CAUTION

To avoid damaging the demodulator, always disconnect the power before removing or installing a data interface.

The data interface is a removable, plug-in module that provides a terrestrial connection to the demodulator. An interface consists of a Printed Circuit Board (PCB) attached to a faceplate. The faceplate contains connectors appropriate for the interface type, and two captive mounting screws.

Figure 2-2 is an example of a typical data interface.

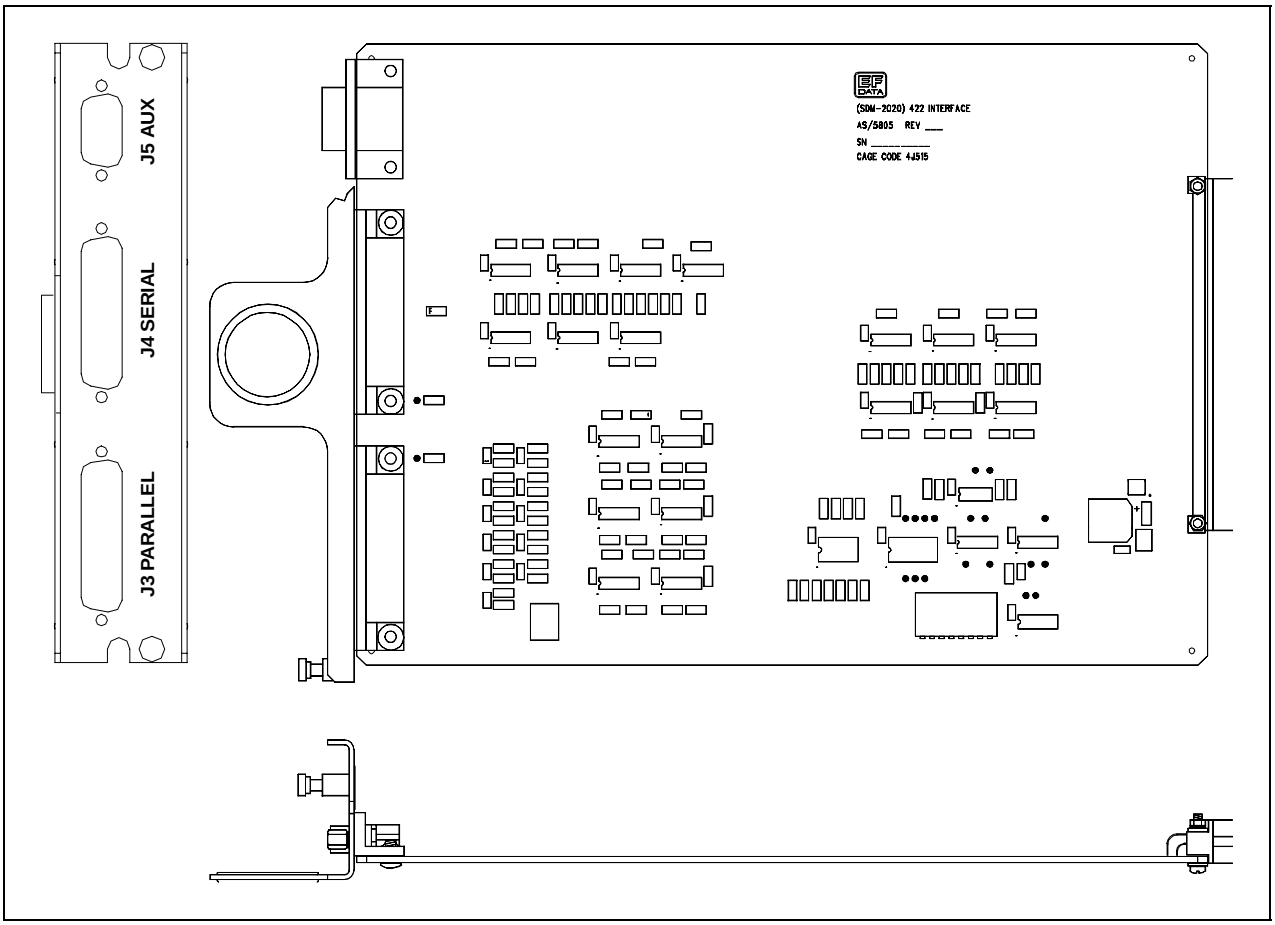

Figure 2-2. Typical Data Interface Module

Note: After a different interface type has been installed, the demodulator recognizes the change upon power up, and defaults to valid parameters for the new interface.

2.2.1.1 Data Interface Removal

1. Disconnect power from the demodulator.
2. Use a Phillips™ screwdriver to loosen the two captive screws on the faceplate of the data interface.
3. Grasp the data interface by the faceplate handle.
4. Carefully pull the data interface out of the slot.

2.2.1.2 Data Interface Installation

1. Disconnect power from the demodulator.
2. Grasp the data interface by the faceplate handle.
3. Locate the opening at the rear of the demodulator.
4. Carefully align the data interface with the card guides inside the demodulator and insert the data interface into the opening.
5. Push the data interface firmly into the slot to ensure a good connection.
6. Align the captive screws located on the faceplate with the holes on the demodulator rear panel.
7. Use a Phillips™ screwdriver to tighten the screws.

2.3 External Connections

The connectors for the main unit are shown in Figure 2-3 or Figure 2-4 and Rear Panel RF Input Connectors (Table 2-1).

The connectors for each plug-in data interface are described in Appendix A.

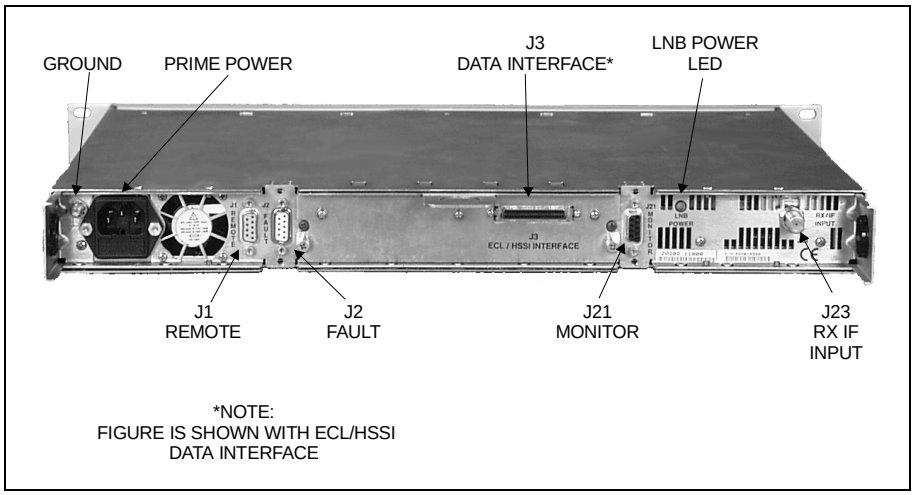

Figure 2-3. Rear Panel, Single RF Input, 70/140 MHz, and Earlier L-Band Units

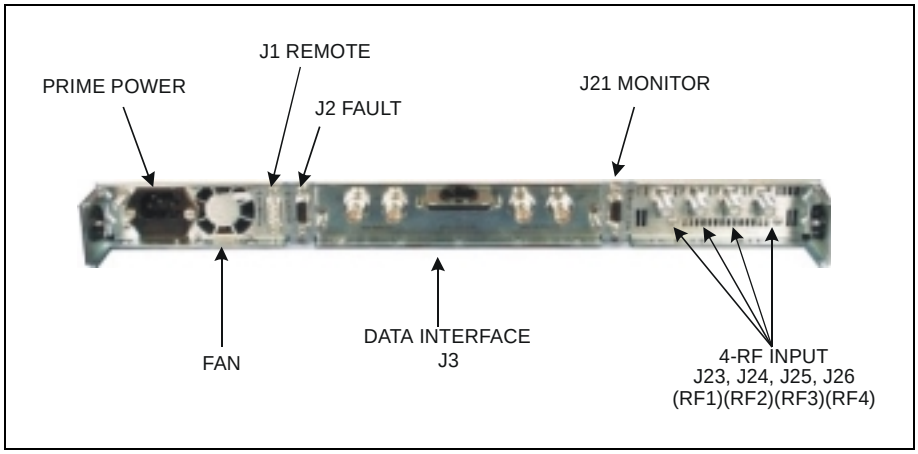

Figure 2-4. Rear Panel, Four-RF Inputs, L-Band Units

Table 2-1. Rear Panel Connectors

Name	Ref. Desig.	Type	Function
Remote	J1	9-pin D, Female	Remote control (M&C)
Fault	J2	9-pin D, Female	Relay Faults
Monitor	J21	9 pin D, Female	Performance Monitor
IF Input (Single-Channel) *(see Note 1)*	J23	Type F, Female	RX IF input, LNB power out.
IF Input (4 Input) *(see Note 2)*	J23, J24, J25, J26	Type F, Female	RX IF Input LNB power out
Prime Power	None	Standard	AC Power Input
GND	None	#10-32 Stud	Chassis Ground
Data Interface Connectors	See Appendix A		

Notes:

1. Single RX IF input is for earlier L-Band units and all 70/140 MHz demodulators. LNB power is available only for L-Band.
2. The 4-channel input IF is only available for L-Band.

2.3.1 Connector Pinout Definitions

Pinout "TYPE" is defined to described signal direction for each pin. The signal direction is relative to the connector.

Definitions for Pinout Types	
I (Input)	A signal goes into the connector.
O (Output)	A signal exits the connector.
I/O (Input/Output)	A signal both enters and exits the connector on the specified pin.
GND (Ground)	The pin is defined as being connected to a power supply ground or return.
N/A (Not Assigned)	The pin is not assigned within the system but may be routed to other connectors. Usually defines spare pins.
N/C (No Connect)	The pin is not connected and is not used within the system.
N/U (Not Used)	The pin is not used but is routed and has other uses within the system.
FC (Form C)	The pin is connected to a "Form C" relay.

2.3.2 Remote Connector and Pinout (J1)

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

The remote connector provides a way for issuing commands and determining the unit's status. This connector provides EIA-232, EIA-485 (2-wire), and EIA-485 (4-wire) operation. The communications protocol and the control and status commands are described in Appendix B.

Table 2-2 provides the pinout of the J1 connector.

Table 2-2. Remote Control Connector Pinout (J1)

Remote Control Connector (J1) Pinout						
EIA-232		**EIA-485(2)**		**EIA-485(4)**		
Signal	**Type**	**Signal**	**Type**	**Signal**	**Type**	**Pin #s**
GND	GND	GND	GND	GND	GND	1
RXD	O	N/A	N/A	N/A	N/A	2
TXD	I	N/A	N/A	N/A	N/A	3
N/A	N/A	+RX/+TX	I/O	+TX	I	4
GND	GND	-RX/-TX	I/O	-TX	I	5
DSR	O	N/A	N/A	N/A	N/A	6
RTS	I	N/A	N/A	N/A	N/A	7
CTS	O	+RX/+TX	I/O	+RX	O	8
N/A	N/A	-RX/-TX	I/O	-RX	O	9

2.3.3 Fault Connector (J2)

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

The fault connector provides FORM-C contact closures for fault reporting. The two FORM-C summary fault contacts are Demodulator and Common Equipment. To obtain a system summary fault, connect all of the FORM-C contacts in parallel.

Table 2-3 provides the pinout of the J2 connector. This table also shows which pins are connected, when a fault or alarm condition occurs. It also states which pins are connected when power to the unit is off.

Table 2-3. Faults Status Relays Connector Pinout (J2)

				Pins Connected		
Signal Function	**Name**	**Pin #**	**Type**	**Fault/ Alarm**	**OK**	**Power OFF**
Common Equipment Fault	CE_NO CE_COM CE_NC	1 2 3	FC FC FC	2-3	1-2	2-3
Demodulator Fault	DEM_NO DEM_COM DEM_NC	4 5 6	FC FC FC	5-6	4-5	5-6
Demodulator Alarm	ALM_NO ALM _COM ALM _NC	7 8 9	FC FC FC	7-8	8-9	8-9

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

2.3.4 Monitor Points (J21)

The monitor points are located on a 9-pin D Sub female-connector at the rear of the unit. The monitor functions are an aid to evaluate performance. Refer to Table 2-4 for connector characteristics.

Table 2-4. Monitor Points (J21)

Item	Characteristics
Monitor Characteristics	
DC Pointing Voltage	This is an aid to assist pointing an antenna. Before the demodulator is locked to the carrier the pointing voltage is a replica of the AGC voltage (Raw). After the demodulator is locked the pointing voltage is a measure of the eye opening. Generally, < 2V, demodulator unlocked and voltage proportional to AGC > 2V, demodulator is locked and the voltage is a measure of the eye opening.
DEMOD I DEMOD Q	These are I and Q test points. They are sub-sampled so that a useful constellation diagram will appear on the oscilloscope. Generally, an oscilloscope has limited horizontal bandwidth when it is used in the X – Y mode. The I and Q test points are typically: • 25 VDC • 2.5V peak-to-peak VDC
M&C Monitor	Factory use only.
AGC Out (Raw)	This signal is proportional to the level of the incoming signal. • 0V corresponds to maximum input power • 10V represents minimum input power

Refer to Table 2-5 for pin assignments.

Table 2-5. Monitor Points (J21) Pin Assignments

Monitor Points			
Signal Function	**Name**	**Pin #**	**Type**
		1	N/C
DC Pointing Voltage	Point_V	2	0
DEMOD Q	Q	3	0
M&C MON		4	0
Ground	GND	5	GND
Not Used		6	N/U
Not Used		7	N/U
DEMOD I	I	8	0
AGC OUT (RAW)	AGC_OUT	9	0

2.3.5 Receive IF Input Connector

2.3.5.1 Single L-Band Input (J23)

The RX IF Input connector (J23) is a 75Ω, F-type female connector. LNB power is provided at connector (J23) and can be disabled from the front panel controls or remote M&C control.

2.3.5.2 Four L-Band Input (J23, J24, J25, and J26)

The RX IF Input Connectors (J23, J24, J25, and J26) are 75Ω, F-type female connectors. LNB power is provided on selected RF input and can be disabled from the front panel, controls, remote M&C control.

2.3.6 AC Power

This unit shall be operated from the type of power source indicated on the marking label. If power source is unknown, contact the local power company. Damage to the unit may be the result.

Type TN System Only (EN 60950, Paragraph 1.2.12.1) - Power Distribution System: Power distribution system having one point direct earthed, the exposed conductive parts of the installation being connected to that point by protective earth conductors. This equipment shall not be used with single-phase three-wire (PE, TT, or IT) type power distribution system.

The A/C power is supplied to the modulator by a standard, detachable, non-locking, 3-prong power cord. The cord connects to a fused IEC 320 type power receptacle.

2.3.7 Fuse Data

Fuse Type	Littlefuse 215002 5 x 20 mm
Fuse	T2A H250V Time Delay, 2A, High Breaking Capacity Double Pole (Approved to IEC 127, Sheet V and Underwriters Laboratories)

To replace a fuse, proceed as follows:

1. Remove the fuseholder on the back of the IEC 320 style A/C input connector (Figure 2-3).

2. Replace fuse with same or equivalent rated part and/or model number.

Refer to Input Power requirements as specified in Chapter 1, 1-6.

2.3.8 DC Power (Optional)

DC power is an available option. Contact EFData Customer Support for further assistance.

2.3.9 Ground (GND) or Earth

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

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

2.4 Proper Operations for Emissions (CE)

Note: To ensure compliance with the EMC Directive 89/336/EEC, properly shielded cables for Data I/O shall be used. These cables shall be doubled-shielded from end-to-end, ensuring a continuous ground shield.

3 Chapter 3. OPERATION

This chapter describes demodulator operation from the front panel and provides an explanation of command functions.

For remote control operation information, refer to Appendix B.

3.1 Introduction

The SDM-2020 demodulator has three general modes of operation controlled by the DVB Framing Type command in the Configuration Interface menu.

Refer to Table 3-1 for a description of the three modes.

Table 3-1. Mode Description

Mode	Description
188	The demodulator receives a 204 byte satellite frame. The outgoing DVB/MPEG2 frame consists of 1 sync byte (047 hex) and 187 bytes of data after the Reed-Solomon check bytes (16 bytes) are removed.
204	The demodulator receives a 204 satellite frame consisting of 1 sync byte (047), plus 187 bytes of data and 16 bytes reserved for check bytes. The outgoing frame contains 204 bytes.
None (187)	In this mode there is no outgoing frame structure. The demodulator receives a 204 byte satellite frame and removes the 1 sync byte and 16 Reed-Solomon check bytes.

Note: The satellite frame is always 204 bytes, and the data format exiting the data interface depends upon the type of interface and the configuration selected. Control functions and status readings are accessible through the front panel keypad/LCD display, or the rear panel remote port.

3.2 Front Panel

The demodulator front panel (Figure 3-1), enables the user to control demodulator configuration parameters and display the demodulator status.

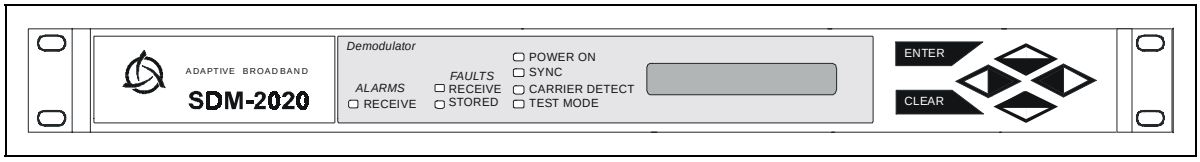

Figure 3-1. Front Panel

The front panel features include:

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

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

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

3.2.1 LED Indicators

The seven LEDs on the front panel indicate:

- Alarms
- Summary fault information
- General demodulator status

Refer to Table 3-2 for indicator descriptions.

Table 3-2. LED Indicator Description, Front Panel

Name	LED	Description
Alarms		
Receive	Yellow	A receive function is in an alarm condition.
Faults		
Receive	Red	A fault condition exists in the receive chain.
Stored	Yellow	A fault has been logged and stored. The fault may or may not be active.
Status		
Power On	Green	Power is applied to the demodulator.
Sync	Green	The demodulator is synchronized to the data.
Carrier Detect	Green	Viterbi/TCM decoder is locked.
Test Mode	Yellow	Flashes when the demodulator is in a test configuration. The test mode status can be identified in the utility system menu in Figure 3-13.

At system level, a fault simultaneously activates the demodulator fault relay, DF, a TTL-OC fault indication, and turns on the red Receive Fault LED. This condition is used by redundancy switches to cause a switch-over to replace a failed unit. Refer to Chapter 1, Fault Tree.

An alarm condition turns on the yellow Receive Alarm LED and activates the demodulator alarm relay. Alarms do not activate the fault indications described above.

For Single L-Band Input Connector Units - There is a status LED visible from the rear panel of the demodulator.

Refer to Table 3-3.

Table 3-3. Rear Panel LED Indicator Description

Name	LED	Description
LNB Power	Green	The LNB power is ON, when the LED is illuminated.

Note: Units with four L-Band input connectors have no LED indicator.

3.2.2 Front Panel Keypad

The front panel keypad (Figure 3-2), permits local operation of the demodulator. The keypad consists of six keys. Each key provides one or more logical functions.

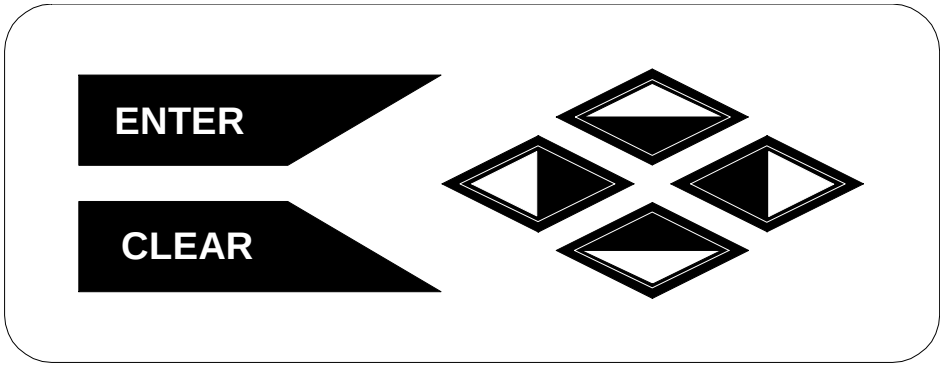

Figure 3-2. Keypad

ENTER	This key is used to select a displayed function or to execute a demodulator configuration change.
CLEAR	This key is used to back out of a selection or to cancel a configuration change which has not been executed using [ENTER]. Pressing [CLEAR] generally returns the display to the previous selection.
Left and Right Diamond Keys	These keys are used to move to the next selection or to move the cursor for certain functions. **Note:** Throughout this chapter, [←] and [→] are used to indicate left and right diamond keys.
Top and Bottom Diamond Keys	These keys are used primarily to change configuration data (numbers). At times, they are also used to move from one section to another. **Note:** Throughout this chapter, [↑] and [↓] are used to indicate top and bottom diamond keys.

The demodulator responds by beeping whenever a key is pressed:

- A single beep indicates a valid entry and the appropriate action was taken.
- A double beep indicates an invalid entry or a parameter is not available for operation.

3.3 Menu System

To access and execute all functions, refer to Figure 3-3 through Figure 3-15. Use the main menu (Figure 3-3) as a quick reference for accessing the demodulator functions.

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

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

The main level of the menu system is Function Select. To access this base menu level, press either [←] or [→]. From the Function Select menu, use [←] or [→] to select one of the functional categories:

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

When the desired function is displayed, select that menu by pressing [ENTER]. After entering the appropriate functional menu, press [←] or [→] to move to the desired function. To return to the previous menu or to exit a function, press [CLEAR].

Notes:

1. Figure 3-3 through Figure 3-15 list the front panel menu selections.
2. Menus that are specific to certain demodulator configurations are only accessible after selecting the appropriate demodulator configuration. This prevents incompatible parameters from being selected accidentally.

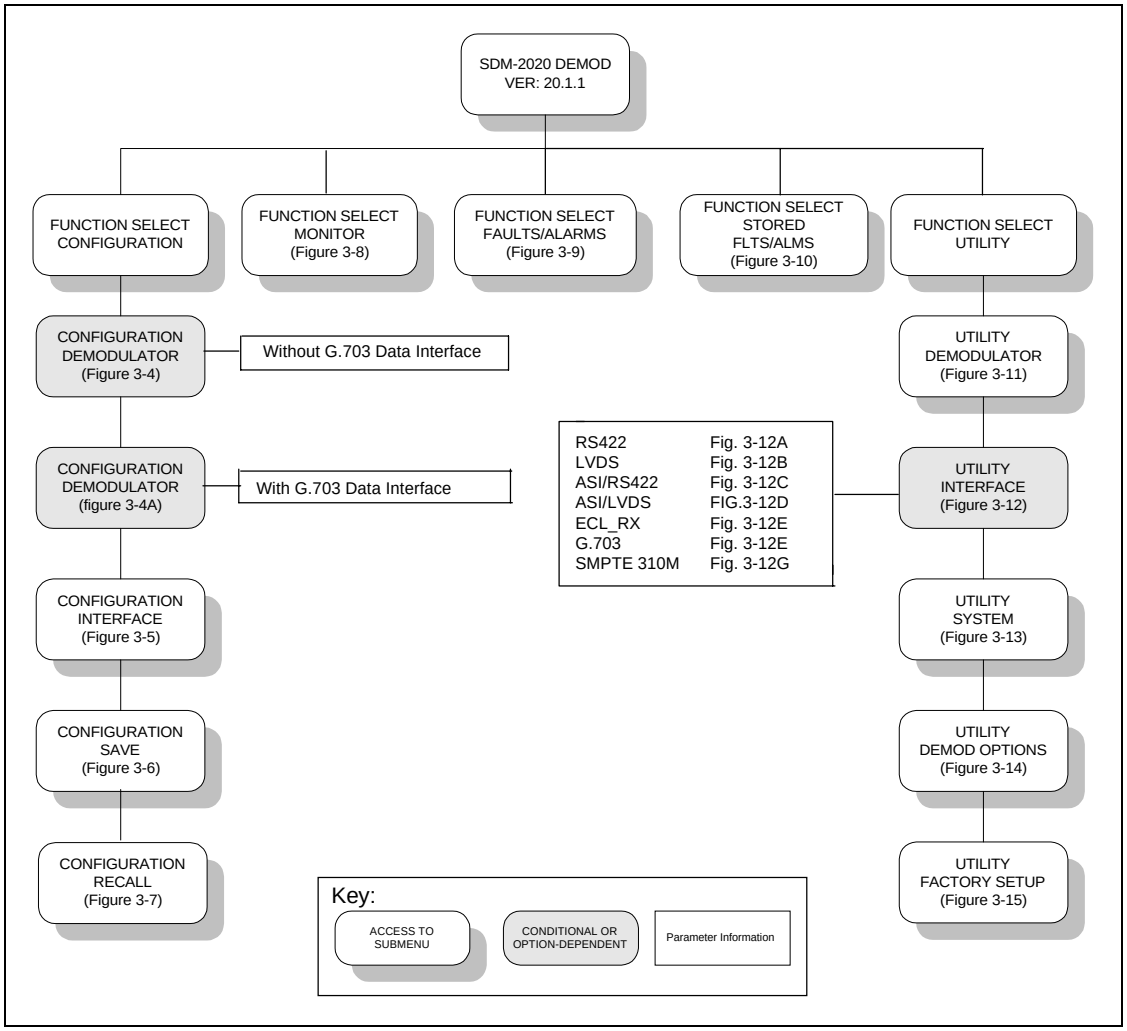

Figure 3-3. Main Menu

3.3.1 Configuration Menus

Demodulator configuration can 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:

- Demodulator
- Interface
- Save
- Recall

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 demodulator. To undo a parameter change prior to executing it, simply press [CLEAR].

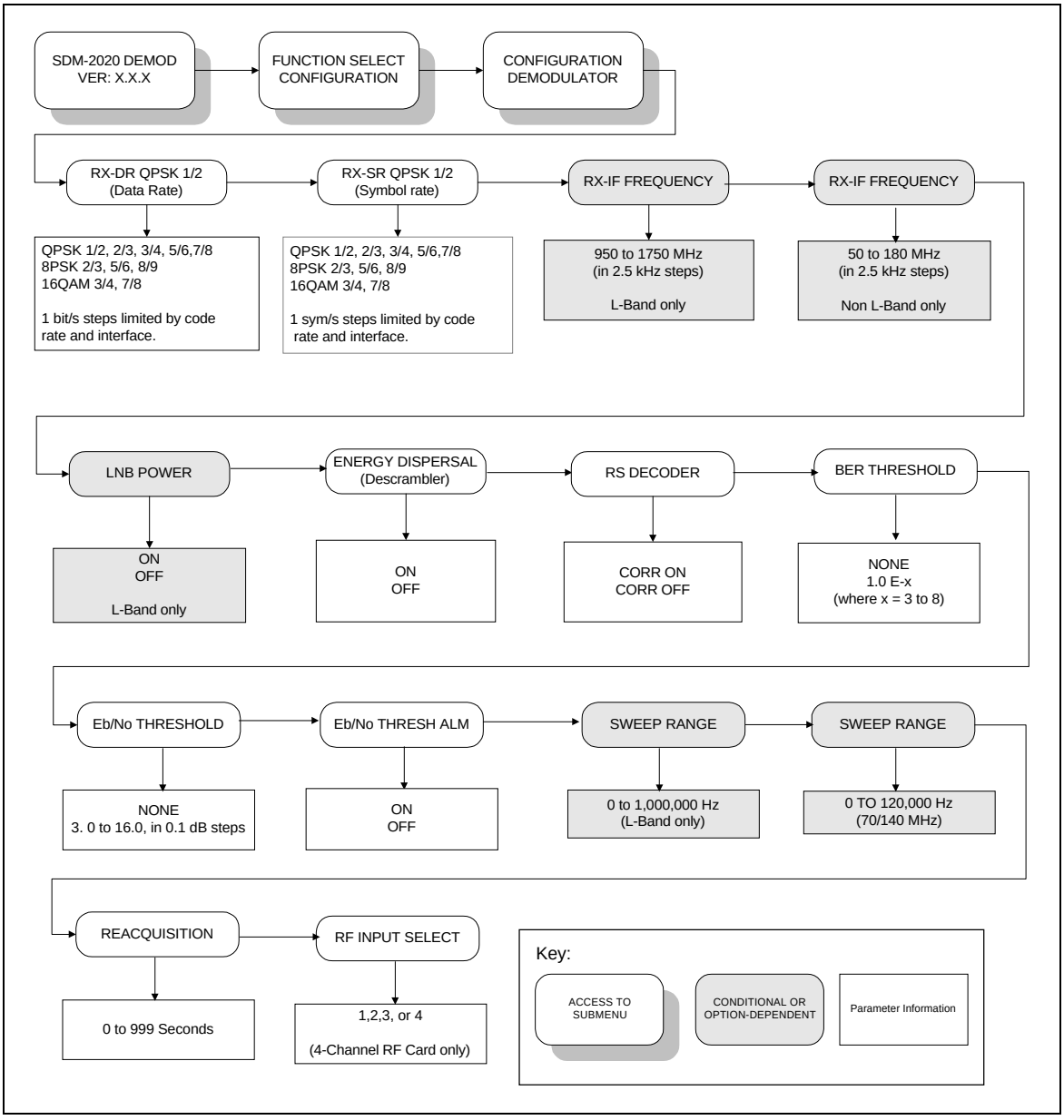

Figure 3-4. Configuration Demodulator Menu <u>without</u> G.703 Data Interface

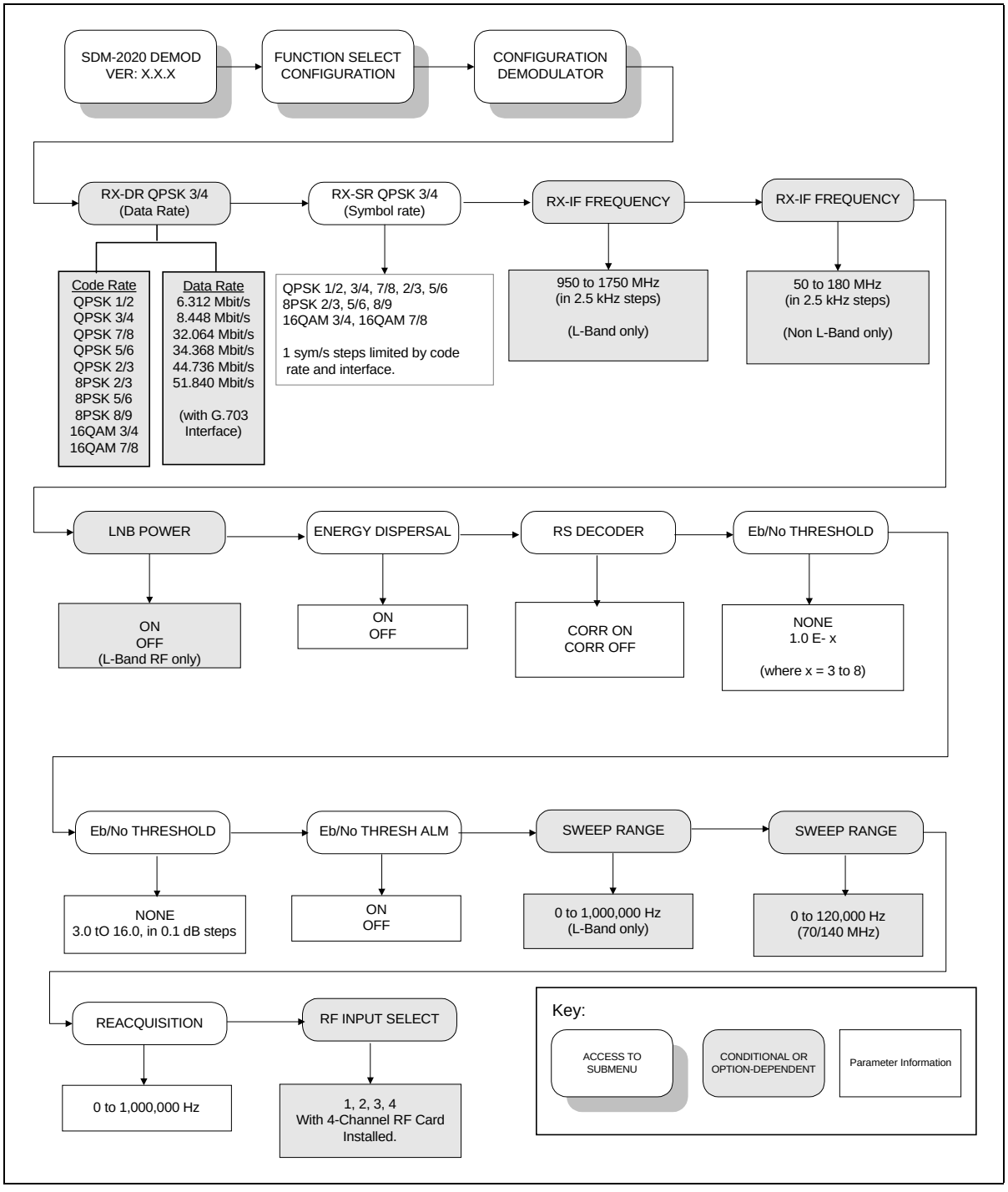

Figure 3-4A. Configuration Demodulator Menu <u>with</u> G.703 Data Interface

3.3.1.1 Configuration Demodulator Menu

Refer to Figure 3-4.

RX-DR QPSK 1/2	**Notes:** 1. Figure 3-4 is reflective of the demodulator menu without G.703 data interface installed. 2. Figure 3-4A is reflective of the demodulator menu with G.703 data interface installed. Programs the demodulator data rate (DR), in 1 bit/s steps, limited by code rate and data interface. On entry, the current data rate 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. **Notes:** 1. Programming is done by either data rate or symbol rate. Data rate refers to the equivalent serial data rate at the data interface connector. 2. Symbol rate refers to the modulation rate after framing, trellis (Viterbi) coding, and Reed-Solomon coding are applied. 3. The framing type selection affects the symbol rate (if programming from the data rate [RX-DR] menu), or the data rate (if programming from the symbol rate [RX-SR] menu). a. If data rate is programmed, the symbol rate menu is updated to reflect the code rate and framing selections. b. If symbol rate is programmed, the data rate display is similarly updated.
RX-SR QPSK 1/2	Programs the demodulator symbol rate (SR), in 1 sym/s steps, limited by code rate and data interface. On entry, the current symbol rate 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. **Notes:** 1. Programming is done by either data rate or symbol rate. Data rate refers to the equivalent serial data rate at the data interface connector. 2. Symbol rate refers to the modulation rate after framing, trellis (Viterbi) coding, and Reed-Solomon coding are applied. 3. The framing type selection affects the symbol rate (if programming from the data rate [RX-DR] menu), or the data rate (if programming from the symbol rate [RX-SR] menu). a. If data rate is programmed, the symbol rate menu is updated to reflect the code rate and framing selections. b. If symbol rate is programmed, the data rate display is similarly updated.

RX-IF FREQUENCY	For L-Band only: Programs the demodulator receive frequency between 950 to 1750 MHz, in 2.5 kHz steps. For 70/140 MHz only: Programs the demodulator receive frequency between 50 to 90 MHz and 100 to 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.
LNB POWER	Programs the LNB Power ON or OFF. (Not Available with 70/140 MHz IF.) **Note:** Default is Off. On entry, the current status of the LNB Power is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
ENERGY DISPERSAL	Programs the descrambler ON or OFF. On entry, the current status of the DVB energy dispersal is displayed. Press [↑] or [↓] to select ON or OFF. Press [ENTER] to execute the change.
RS DECODER	Programs the Reed-Solomon correction OFF or ON. On entry, the current status of the Reed-Solomon decoder is displayed. Press [↑] or [↓], to select CORR OFF or CORR ON. Press [ENTER] to execute the change. CORRECTION OFF MODE: This mode turns off the Reed-Solomon decoder data error correction circuitry. Data flow is then routed through normal data paths, without error corrections. CORRECTION ON MODE: This mode enables the Reed-Solomon decoder to provide data error corrections.
BER THRESHOLD	This function is used to set the BER threshold. If the BER threshold set is exceeded, a receive alarm will be indicated by the status indicators, also a receive alarm relay will engage providing external status at the rear panel. BER threshold may be set for 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.
E_b/N_0 THRESHOLD	Programs the E_b/N_0 target set point. The E_b/N_0 target set point ranges from 3.0 to 16.0 dB, in 0.1 dB steps. On entry, the current E_b/N_0 target set point is displayed with a flashing cursor. Press [↑] or [↓] to increment the digit at the flashing cursor. Press [ENTER] to execute the change

E_b/N_0 THRESH ALM	Programs the Eb/No THRESH ALM ON or OFF. When Off is selected, this function is disabled. When On is selected, the ALARM LED and ALARM Rely are activated when the measured E_b/N_0 falls below the programmed E_b/N_0 THRESHOLD. On entry, the current setting of the EB/NO threshold is displayed. Press[↑] or [↓] to select the desired setting. Press [ENTER] to execute the change
SWEEP RANGE	For L-Band only: Programs the overall travel of the sweep width range during acquisition. The sweep width may be programmed from 0 to 1,000,000 Hz (± 500,000 Hz). When set at 100,000 Hz., the demodulator is in normal acquisition mode (± 50,000 Hz). For 70/140 MHz IF only: Range is 0 to 120,000 Hz. The smaller the range, the faster the demodulator will lock to the receive carrier center (provided the receive carrier center frequency is within the RX IF frequency sweep range). On entry, the current sweep frequency is displayed with a flashing cursor. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment the digit at the flashing cursor. Press [ENTER] to execute the change.
REACQUISITION	Programs the sweep reacquisition mode time duration. This is the time that the demodulator will remain in a narrow sweep after loss of acquisition. After this time runs out, the demodulator will return to the normal acquisition sweep. The reacquisition time is from 0 to 999 seconds. Upon entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Select the number of seconds desired for the reacquisition mode. Press [ENTER] to execute the change.
RF INPUT SELECT	Programs the selected channel as 1, 2, 3, or 4. **Note:** Only available with the 4-Channel card installed. On entry, the current RF Input Channel is displayed. Press[↑] or [↓] to select the desired setting. Press [ENTER] to execute the change

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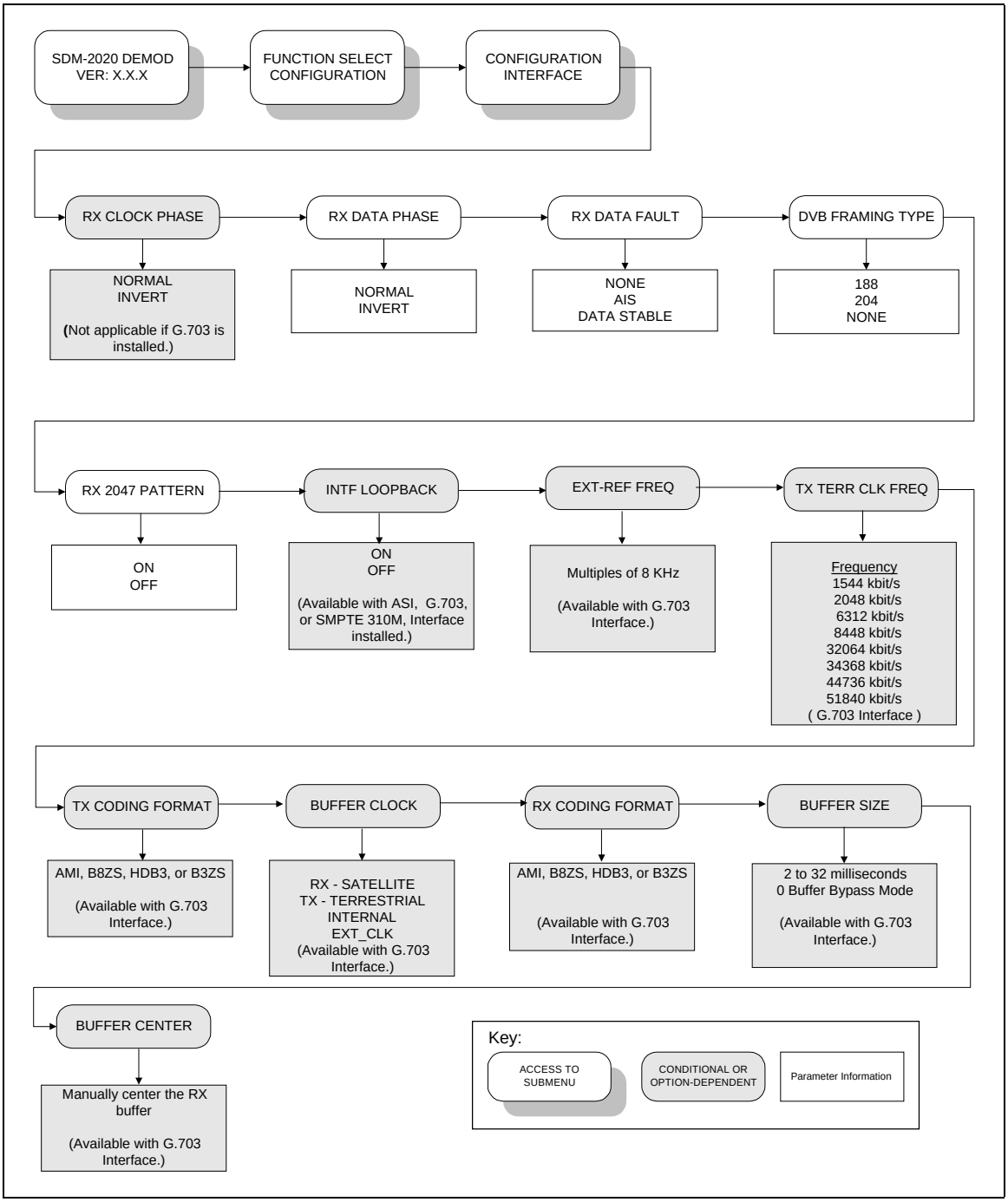

Figure 3-5. Configuration Interface Menu

3.3.1.2 Configuration Interface Menu

Refer to Figure 3-5.

RX CLOCK PHASE	Programs Receive Clock phase to NORMAL or INVERT. On entry, the current setting for the RX Clock Phase is displayed. Press [↑] or [↓] to select NORMAL or INVERT. Press [ENTER] to execute the change.
RX DATA PHASE	Programs Receive Data phase to NORMAL or INVERT. On entry, the current setting for the RX Data Phase is displayed. Press [↑] or [↓] to select NORMAL or INVERT. Press [ENTER] to execute the change.
RX DATA FAULT	Receive data fault. Press a directional key to select one of the following modes (see Note): • NONE: The receive interface alarm DATA/AIS is not activated. • AIS (Alarm Indication Signal): Sets receive interface alarm DATA/AIS to monitor an alarm condition of all 1s in data stream. • DATA STABLE: Sets receive interface fault DATA/AIS to monitor an alarm condition of all 1s or 0s. This is referred to as a data-stable condition, which means that the data is not transitioning. Upon entry, the current RX Data Fault that is being monitored is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** Detection of these conditions produces an alarm indication, not a fault.
DVB FRAMING TYPE	Programs the DVB framing type for 188, 204, or NONE. **Note:** Pressing <ENTER> in this selection, turns Off RX-IF Output. The framing type describes the format of the data into the demodulator. The equivalent serial data rate at the data interface connector is based upon the clock rate of the incoming data stream. Refer to Section 3.1 for information on the different framing types. Upon entry, the current status of the DVB framing type is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
RX 2047 PATTERN **Note:** This is a test mode and the front panel test LED, will blink when 2047 pattern.	Displays “LOCKED” upon detection of a valid 2047 pseudorandom data pattern. Displays “NO DATA” when the demodulator cannot detect a valid 2047 pseudorandom data pattern. Displays: “NOT ENABLED” if “RX 2047 PATTERN” is selected OFF in the <CONFIGURATION><INTERFACE> menu. Upon entry, the current status is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

INTF LOOPBACK	Programs the modem for interface loopback operation. **Note:** Available in ASI, ASI/LVDS, G.703, or SMPTE 310M interface. On entry, the current status of interface loopback is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
EXT-REF FREQUENCY	Programs the external reference clock in multiples of 8 Hz, On entry, the current setting for the EXT-REF frequency is displayed. Press [↑] or [↓] to increase or decrease the frequency. Press [ENTER] to execute the change.
TX TERRESTRIAL CLOCK FREQUENCY	Displays the current TX Terrestrial Clock frequency, as follows: • 1544 kbit/s (available with T1/E1 compat intf) • 2048 kbit/s (available with T1/E1 compat intf) • 6312 kbit/s • 8448 kbit/s • 32064 kbit/s • 34368 kbit/s • 44736 kbit/s • 51840 kbit/s On entry, the current frequency for the TX Terrestrial Clock is displayed. Press [↑] or [↓] to increase or decrease the frequency. Press [ENTER] to execute the change.
TX CODING FORMAT	Programs the transmitter for AMI, B8ZS, HDB3, and B3ZS coding. On entry, the current format for the TX CODING is displayed. Press [↑] or [↓] to change the format. Press [ENTER] to execute the change.
BUFFER CLOCK	Programs the interface buffer output clock to one of the following modes: • 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. • INTERNAL – Sets the buffer clock to operate from the modem internal clock. This also is a fallback clock. • EXT. CLOCK – Sets this clock source to the external clock. On entry, the current Buffer Clock mode is displayed. Press [↑] or [↓] to change the format. Press [ENTER] to execute the change.
RX CODING	Programs the receiver for AMI, B8ZS, HDB3, and B3ZS coding. On entry, the current format for the RX CODING is displayed. Press [↑] or [↓] to change the format. Press [ENTER] to execute the change.
BUFFER SIZE	Sets the size of the buffer. On entry, the current buffer length is displayed. Press [↑] or [↓] to select the desired buffer size. If selecting milliseconds, choose from 2 to 32 milliseconds, in increments of 2 milliseconds or 0 (Bypass).
BUFFER CENTER	This configuration function is used to center the buffer. Choosing YES centers the buffer. On entry, the current position of the buffer is displayed. Press [↑] or [↓] to change the format. Press [ENTER] to execute the change.

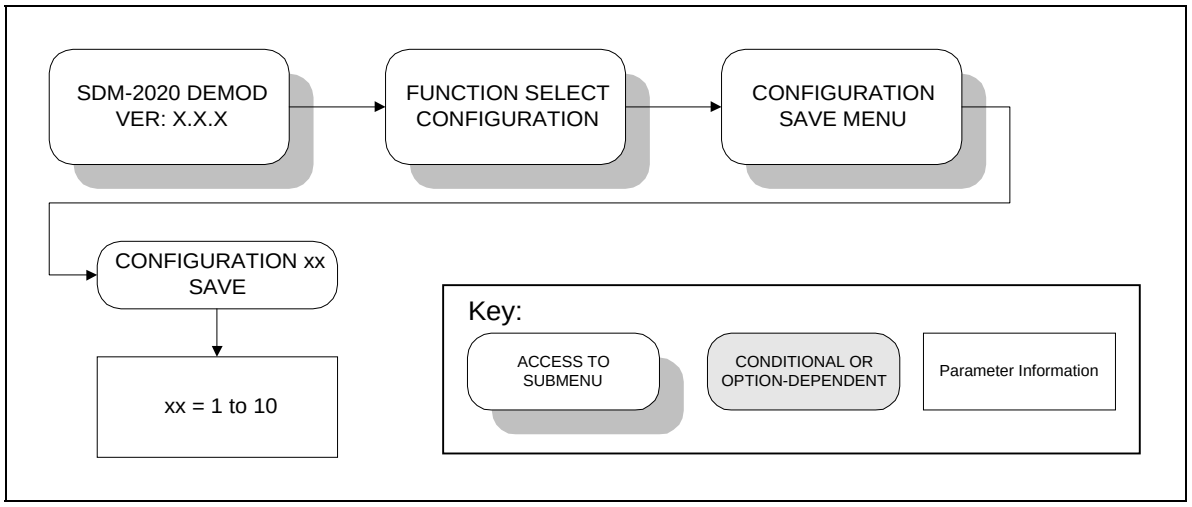

Figure 3-6. Configuration Save Menu

3.3.1.3 Configuration Save Menu

Refer to Figure 3-6.

The Configuration Save menu allows the user to program configuration parameters into memory on the M&C. There are 10 memory locations that may be used to store specific frequently used configuration setups.

After changing the configuration parameters to the desired settings, enter the Configuration Save menu and select memory location 1 through 10 by pressing [↑] or [↓].

Press [ENTER] to execute the save.

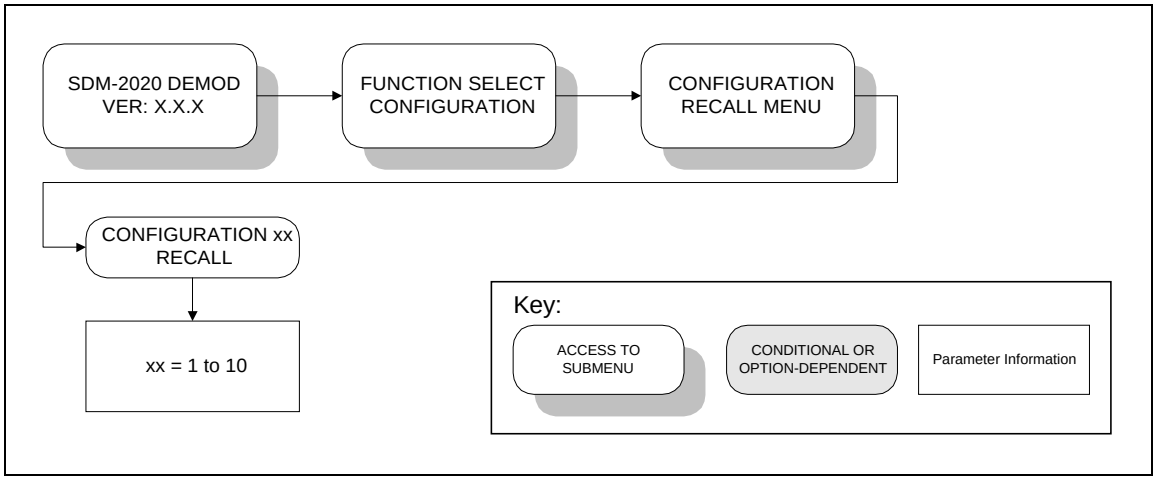

Figure 3-7. Configuration Recall Menu

3.3.1.4 Configuration Recall Menu

Refer to Figure 3-7.

The Configuration Recall menu allows the user to recall a previously saved configuration setup. Upon entry, select memory location 1 through 10 by pressing [↑] or [↓].

Press [ENTER] to execute the recall.

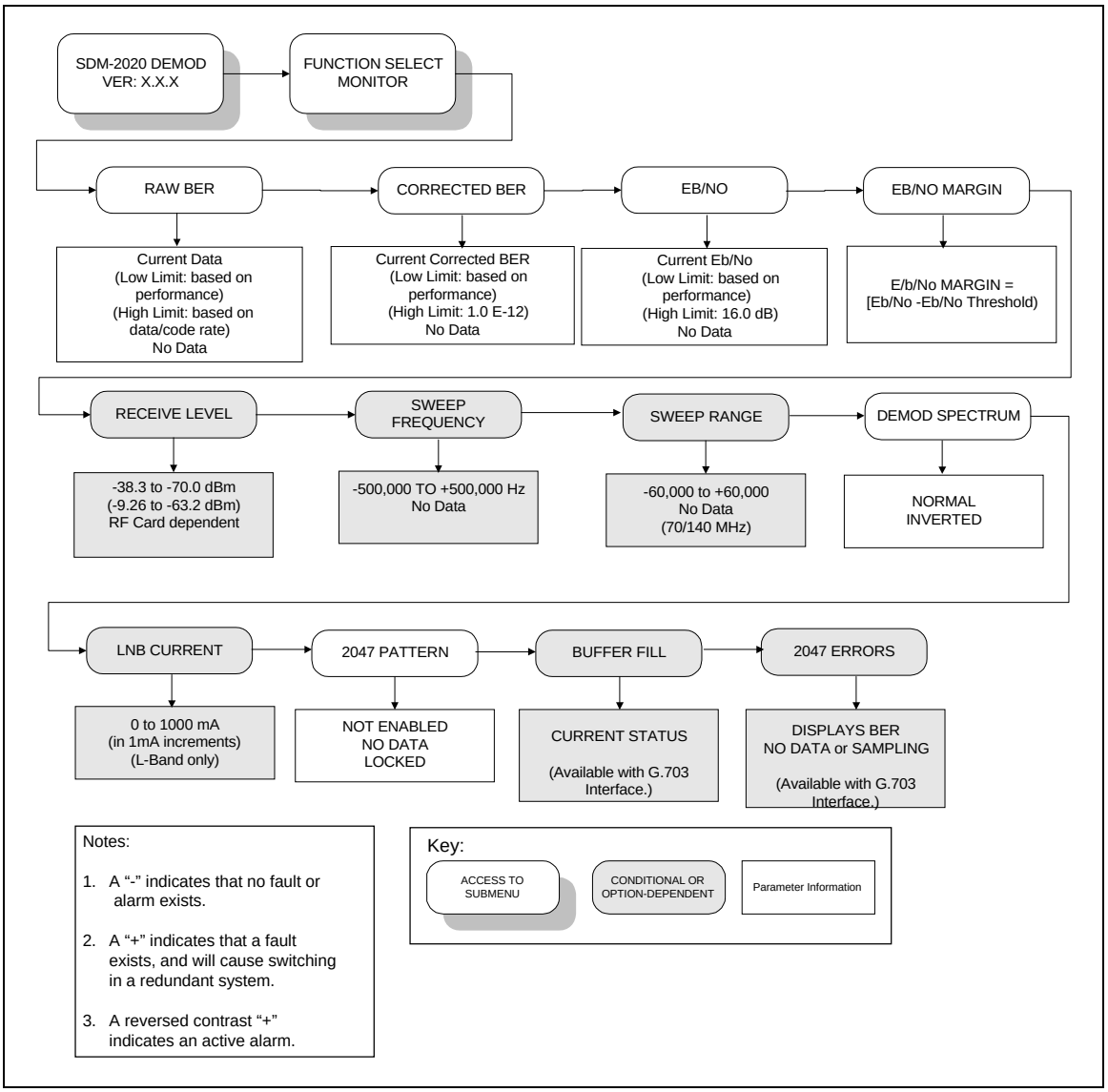

Figure 3-8. Monitor Menu

Note: Refer to Chapter 1, Specifications for the actual operating input signal level.

3.3.2 Monitor

Refer to Figure 3-8.

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	Displays the current BER or No Data (if carrier is not locked). Range: <m.m E-e to >m.m E-e. **Note:** Low limit based on performance. High limit based on data/code rate.
CORRECTED BER	Displays the current corrected BER estimated or No Data (if carrier is not locked). Range: <m.m E-e to >m.m E-e. **Note:** Low limit based on performance. High limit is 1.0 E-12.
E_b/N_0	Displays the current E_b/N_0 estimated or No Data (if carrier is not locked). Range: <mm.m to >mm.m. **Note:** Low limit based on data rate. High limit is 16.0 dB.
E_B/N_0 MARGIN	Displays the current E_b/N_0 margin by calculating: E_b/N_0 Margin = [E_b/N_0 - E_b/N_0 Threshold]
RECEIVE SIGNAL	Displays the signal level (See Figure 1-3). For 1-input connector: Current RX level: -35.0 to –70.0 dBm. For 4-input connector: Current RX level: -9.26 to –63.2 dBm.
SWEEP FREQUENCY	Displays the current sweep frequency. Range: 0 to 1,000,000 Hz (-500,000 to +500,000 Hz).
DEMOD SPECTRUM	Displays the current sense of the RX Demodulator Spectrum as NORMAL or INVERT.
LNB CURRENT	Displays the LNB current (in mA) as CURRENT or LNB POWER OFF.
2047 PATTERN	Displays “LOCKED” upon detection of a valid 2047 pseudorandom data pattern. Displays “NO DATA” when the demodulator cannot detect a valid 2047 pseudorandom data pattern. Displays: “NOT ENABLED” if “RX 2047 PATTERN” is selected OFF in the <CONFIGURATION><INTERFACE> menu.
BUFFER FILL	Displays the current plesiochronous buffer fill status percent. Range: 1 to 99% **Note:** Available only with G.703 Interface installed.
2047 ERRORS	Receives 2047 BER. This is a monitor point that displays the current RX2047 BER. If no data is available, “NO DATA” is displayed. **Notes:** 1. SAMPLING is displayed when gathering data. This process can take several minutes to calculate a BER based on a 2047 test pattern. 2. Available only with G.703 interface installed.

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3.3.3 Faults/Alarms Menus

Refer to Figure 3-9.

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:

- Demodulator 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].

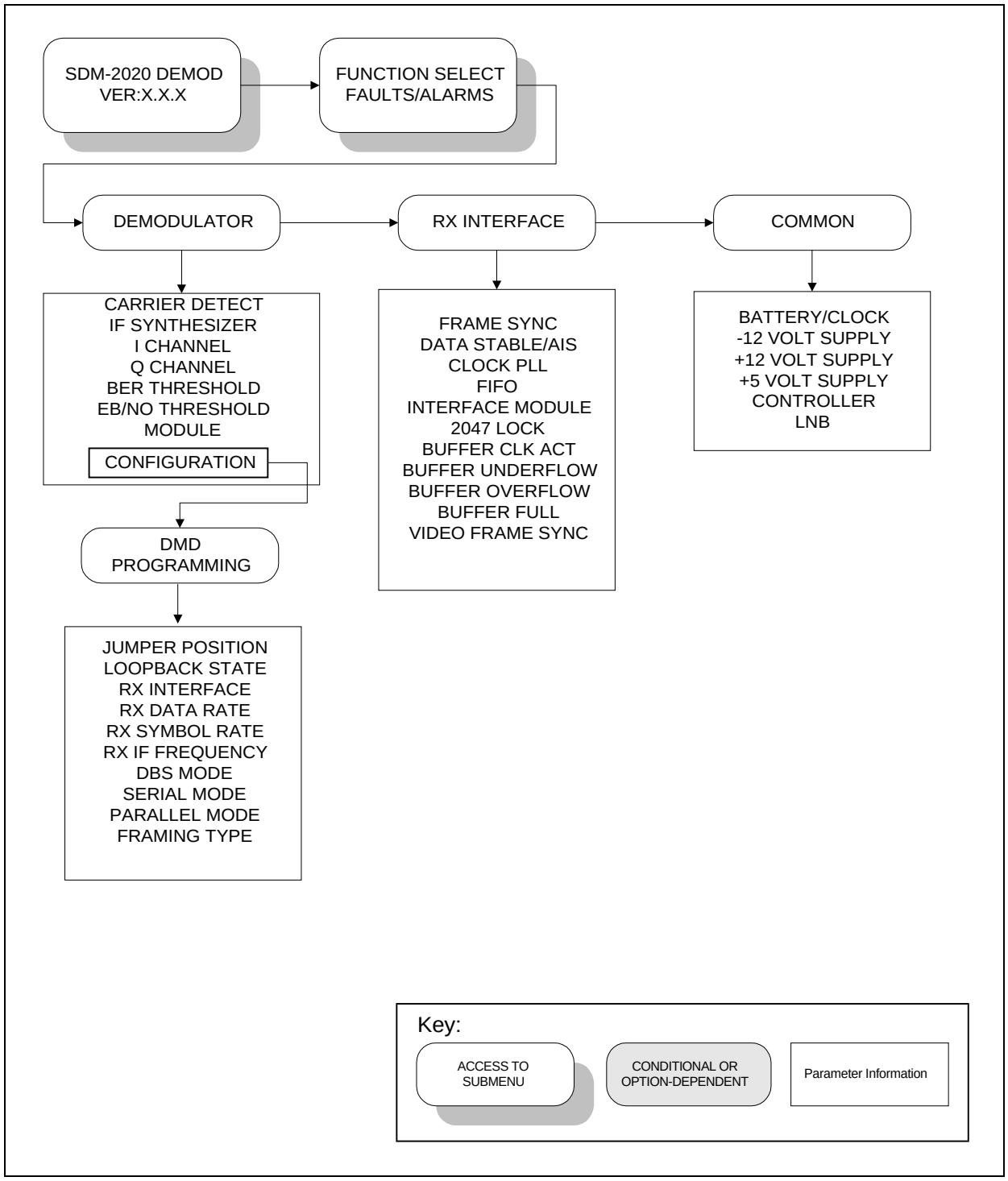

Figure 3-9. Faults/Alarms Menu

3.3.3.1 Demodulator Faults Menu

Refer to Figure 3-9.

Fault/Alarm	Possible Problem and Action
CARRIER DETECT	Carried Detect fault. Indicates the Viterbi/TCM decoder is not locked. This is the most common fault displayed in the demodulator. Any problem from the input data on the demodulator end of the circuit at the output of the decoder, can cause this fault. First, ensure the demodulator has an RF input at the proper frequency and power level. Ensure the demodulator data rate is properly programmed. Verify the frequency of the data transmitted from the modulator, is within 100 ppm.
IF SYNTHESIZER	Indicates the demodulator IF synthesizer is faulted. This is considered a major fault. Return the demodulator for repair.
I CHANNEL	Activity fault for the I channel digital filter. This is considered a major fault. An fault in this position indicates either a fault in the descrambler, or a loss of incoming data.
Q CHANNEL	Activity fault for the Q channel digital filter. Follow the same procedure as for the I channel..
BER THRESHOLD	The preset BER threshold has been exceeded. This is an alarm based on the corrected BER reading on the front panel. Change BER setting, or troubleshoot why corrected BER is high.
E_B/N_0 THRESHOLD	The preset E_b/N_0 threshold has been exceeded. This is an alarm based on the corrected E_b/N_0 reading on the front panel. Change E_b/N_0 setting, or troubleshoot why corrected E_b/N_0 is low.
MODULE	Demodulator module fault. Typically indicates that the demodulator module will not program. Return the demodulator for repair.

3.3.3.2 Configuration Faults Menu

Refer to Figure 3-9.

Fault/Alarm	Possible Problem and Action
CONFIGURATION	Demodulator configuration fault. Indicates the demodulator module or interface does not support a programmed configuration parameter. This fault typically occurs when the programmed configuration is not supported by the module hardware. Pressing [ENTER] with the cursor on the configuration parameter will display a second menu called "DMD PROGRAMMING." Pressing [ENTER] again will display the possible fault combinations to make it easier to determine which incompatibilities exist.
JUMPER POSITION	This fault indicates an invalid state. Usually, the jumper position is incorrect.
LOOPBACK STATE	This fault indicates an invalid state. Usually, the loopback position is incorrect.
RX INTERFACE	Normally this fault will appear with other programming faults to indicate that a particular programming parameter is not valid for that particular interface.
RX DATA RATE	If this fault appears alone, this would usually indicate that the demodulator maximum data rate was exceeded. Refer to Tables 1-1, 1-2, and 1-3, to analyze and reprogram the data rate. If this fault appears with other faults, the combination of faults should help determine which parameters are programmed incorrectly.
RX SYMBOL RATE	The demodulator's Symbol Rate has been exceeded, or is too low.
RX IF FREQUENCY	This fault indicates that the IF frequency is out of the demodulator's specification range. Refer to the MAXIMUM and MINIMUM IF frequency range and readjust the IF frequency.
DBS MODE	Will usually be faulted with other programming faults. DBS mode requires a 204 framing type and requires the data clock to be in Serial Mode. Correct the appropriate fault and re-enter.
SERIAL MODE	Will usually fault when the data rate is exceeded for a particular interface in Serial Mode. Check the combination of faults and determine the best operating parameter. Correct and reprogram.
PARALLEL MODE	Will fault when parallel mode is not a compatible parameter with another selected parameter. Determine the correct course of action and reprogram.
FRAMING TYPE	This fault will usually occur in combination with DBS mode. Other faults may also be present. See DBS mode above. Check combination of faults, correct and reprogram.

3.3.3.3 Receive Interface Faults Menu

Refer to Figure 3-9.

Fault/Alarm	Possible Problem and Action
FRAME SYNC	Indicates that the demodulator cannot synchronize to the data in the selected framing mode. Ensure the correct framing mode is selected.
DATA STABLE/AIS	The data monitored for RX data is coming from the satellite. When AIS is selected for RX data fault in the interface configuration menu, the RX data/AIS is monitoring an alarm condition of all 1's from the satellite. When Data Stable is selected for RX data fault in the Interface Configuration Menu, the RX data/AIS is monitoring a fault condition of all 1's or all 0's. This is a data stable condition meaning that the data is not transitioning. The alarm indicates trouble in receiving data from the satellite. The indication is a monitor function only to help isolate the source of trouble in a system.
CLOCK PLL *(see Note)*	Receiver phase-locked loop fault. Indicates the receiver Phase-Locked Loop is at the wrong frequency or will not lock. Return the Interface card for repair.
FIFO *(see Note)*	This fault indicates a data under-run/over-run condition on the interface card.
INTERFACE MODULE	Interface module fault. Indicates a problem in programming the interface, or no interface present. This could indicate a problem in the M&C, or in the interface between the interface section and M&C. Return the demodulator for repair.
2047 LOCK	2047 lock alarm. Indicates the 2047 lock data pattern is not locked. **Note:** This alarm is only active if 2047 Lock is ON.
BUFFER CLK ACT *(see Note)*	Activity detector alarm of the selected interface RX clock. The interface will fall back to the satellite clock when this fault is active.
BUFFER UNDERFLOW *(see Note)*	Buffer underflow alarm. Indicates that a buffer underflow has occurred.
BUFFER OVERFLOW *(see Note)*	Buffer overflow alarm. Indicates that a buffer overflow has occurred.
BUFFER FULL *(see Note)*	Buffer full alarm. Indicates that the buffer is less than 10% or greater than 90% full.
VIDEO FRAM SYNC	Indicates that the Video Frame SYNC cannot be synchronized.

Note: Not all interfaces have these features. Ensure that the interface installed is programmed for these parameters.

3.3.3.4 Common Equipment Faults Menu

Refer to Figure 3-9.

Fault/Alarm	Possible Problem and Action
BATTERY/CLOCK	M&C battery voltage or clock fault. Indicates a low voltage in the memory battery. **Note:** Typically will be active when a demodulator has been Hard Reset, or the firmware has been changed, and the demodulator is first turned On. If the fault occurs without a firmware change or hard reset of the demodulator, replace the battery on the demodulator board (PL/5746).
-12 VOLT SUPPLY	-12V power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check the -12V line from the power supply or on the board. Check TP17 on the demodulator board (PL/5746), to verify the proper -12V monitor voltage. If this voltage is not at the proper level, this would indicate the power supply is faulted. Return demodulator for repair.
+12 VOLT SUPPLY	+12V power supply fault. Use the same procedure as with -12V Supply fault. To verify the +12V power supply voltage, check TP19 on the demodulator board (PL/5746). A voltage of 12V (± 5%), 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 demodulator board (PL/5746). A voltage of 5V (± 5%), will be monitored when the +5V is at the proper level.
CONTROLLER	Controller fault. Indicates loss of power in the M&C card. **Note:** Typically indicates the controller has gone through a power On-Off cycle.
LNB	LNB fault. Indicates loss of LNB during operation **Note:** Typically indicates the LNB has gone through a power On-Off cycle.

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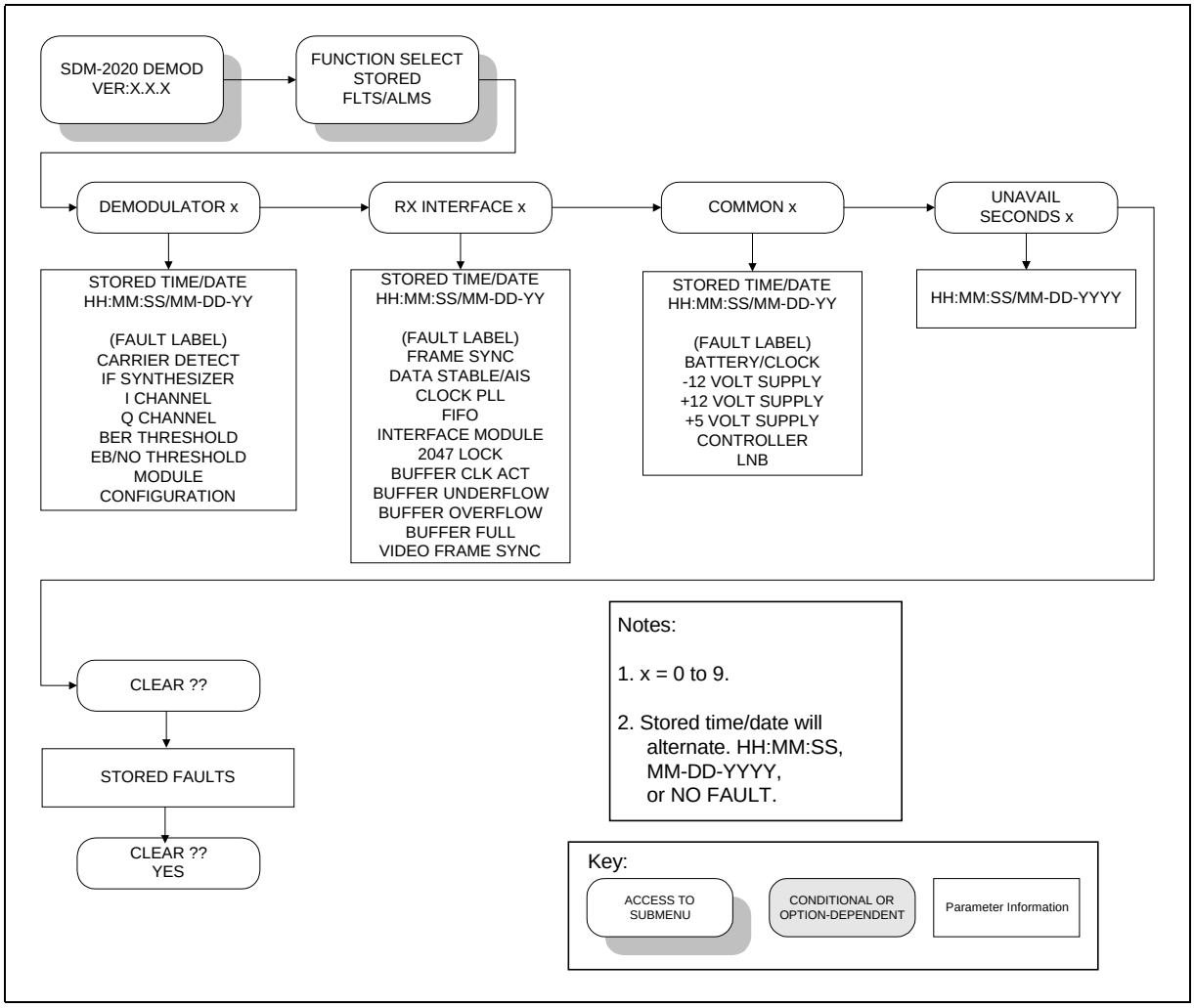

Figure 3-10. Stored Faults/Alarms Menu

3.3.4 Stored Faults/Alarms Menus

Refer to Figure 3-10.

The demodulator stores the first 10 (Flt0 through Flt9) occurrences of fault status changes in each of the four 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, press [ENTER] again to clear.

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, additional faults are ignored until the log is cleared. All stored faults, which have not been used, indicate No Fault on the display.

3.3.4.1 Unavailable Seconds Fault

UNAVAIL SECONDS X **Note:** This is available only with the Reed-Solomon option.	A fault is indicated if there are any errors the Reed-Solomon Codec could not correct during a 1 second interval. X indicates the number of occurrences, up to a maximum of 9. If X = 3, then there were 3 seconds with uncorrectable errors.

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3.3.5 Utility Menus

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

- Demodulator
- Interface
- System
- Demodulator Options
- Factory Setup - (Factory Use Only)

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

Notes:

1. The Utility Factory Setup menu is for EFData service personnel only. Unauthorized access may cause the demodulator to operate incorrectly.
2. Changes in the Utility menu may cause changes in other front panel menus.

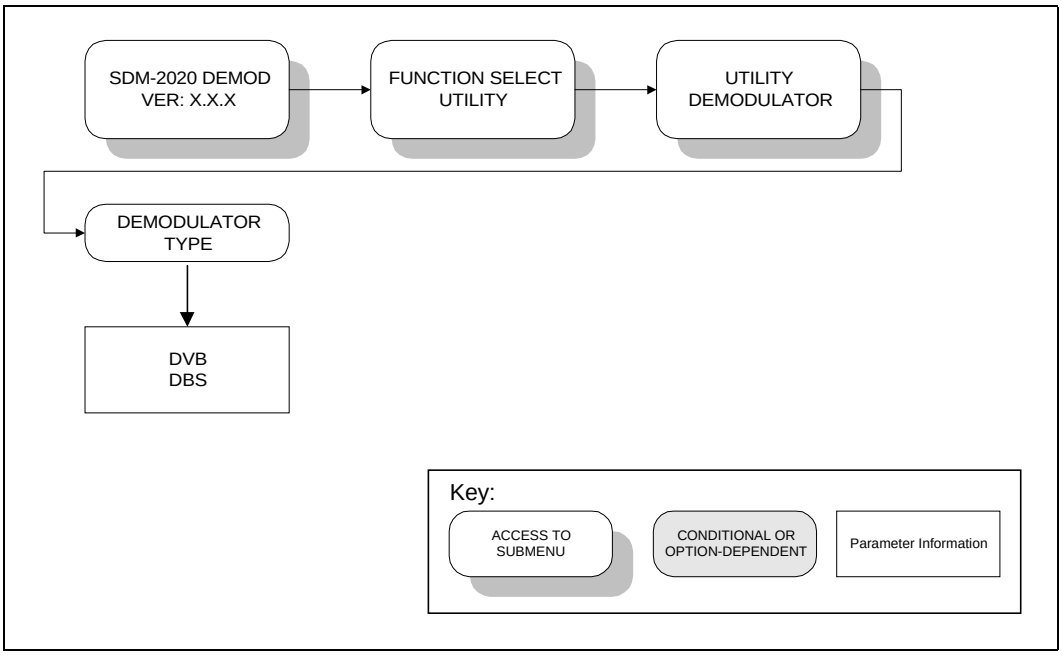

Figure 3-11. Utility Demodulator Menu

3.3.5.1 Utility Demodulator Menu

Refer to Figure 3-11.

DEMODULATOR TYPE	Programs the demodulator to DVB or DBS framing mode. • DVB: Sync pulse is one byte wide. • DBS: 204 framing and Serial mode operation sync pulse is one bit clock wide. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.

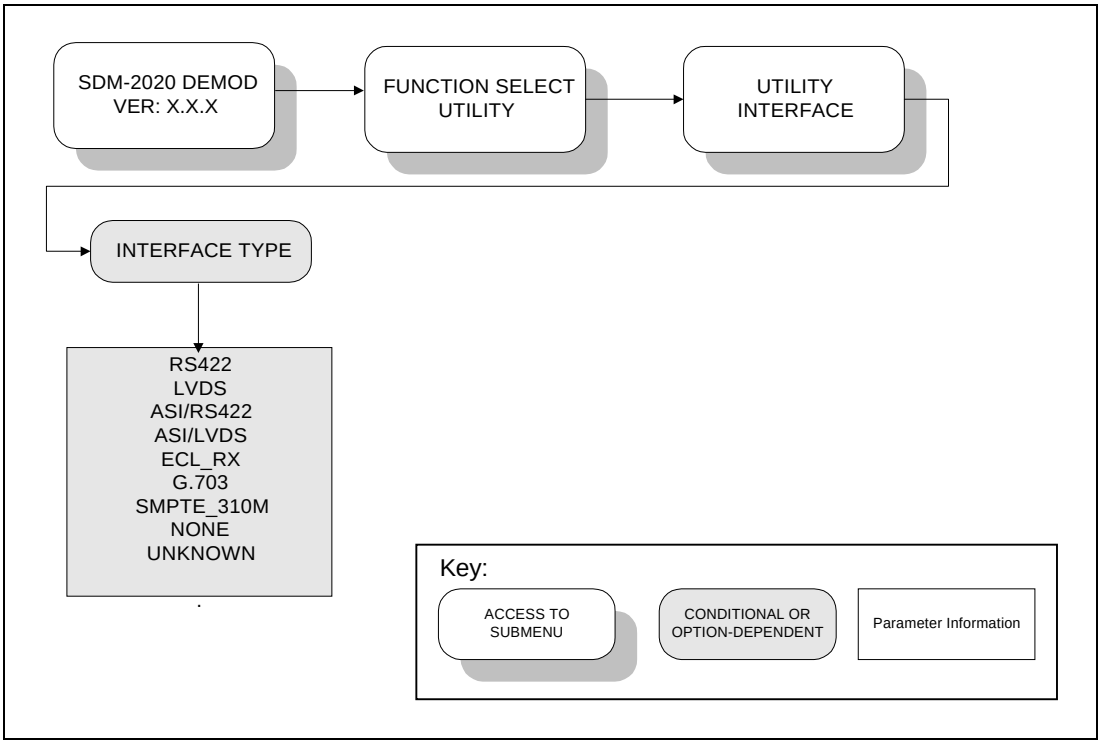

Figure 3-12. Utility Interface Menu

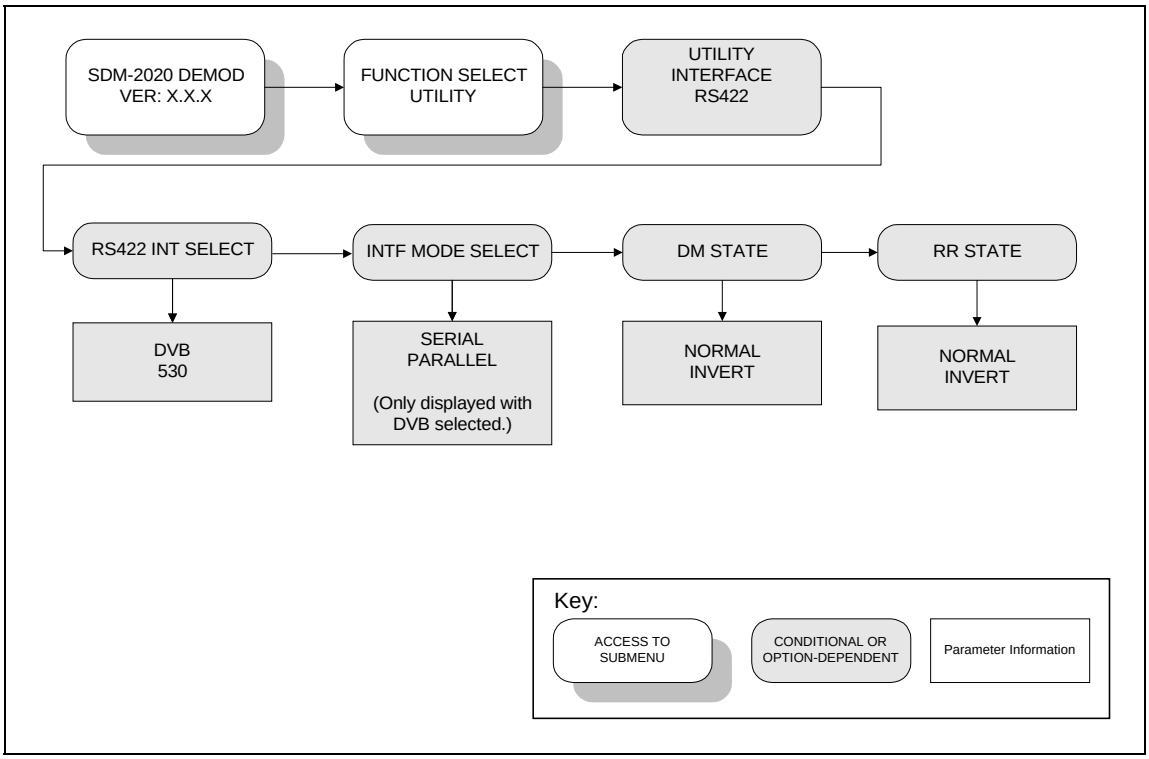

Figure 3-12A. Utility Interface Menu, RS422 Data Interface

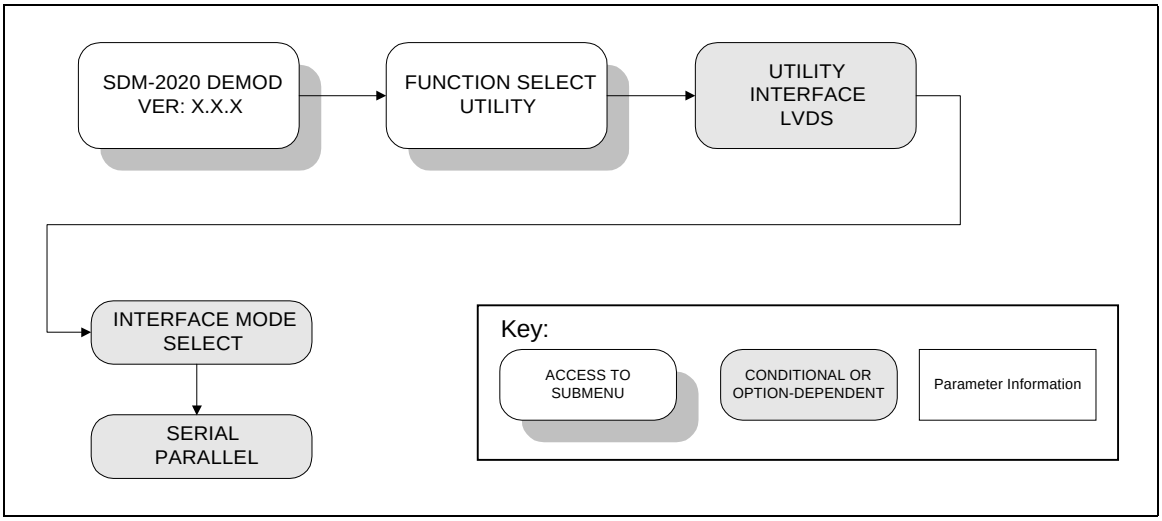

Figure 3-12B. Utility Interface, LVDS

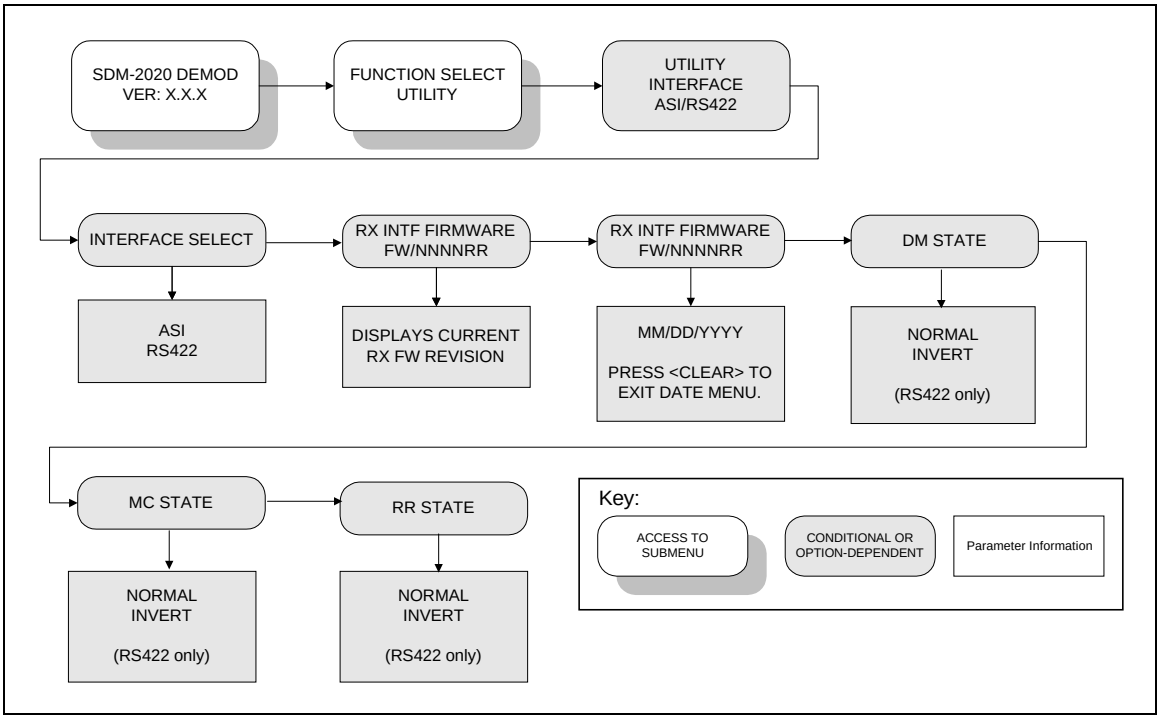

Figure 3-12C. Utility Interface, ASI/RS422 Data Interface

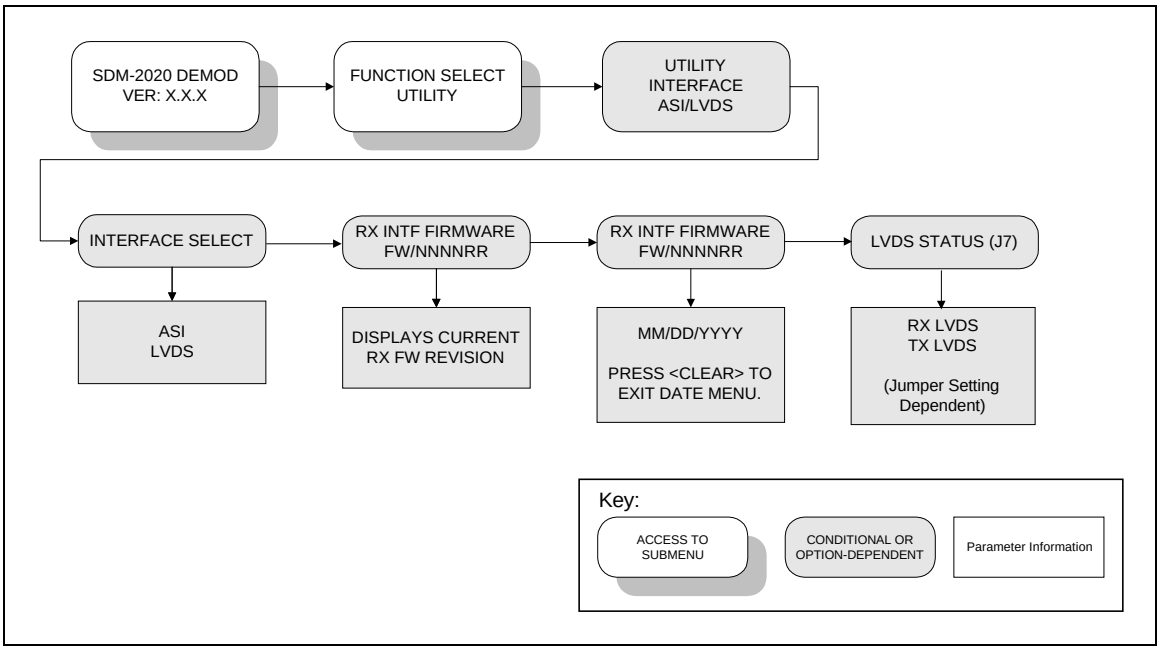

Figure 3-12D. Utility Interface, ASI/LVDS

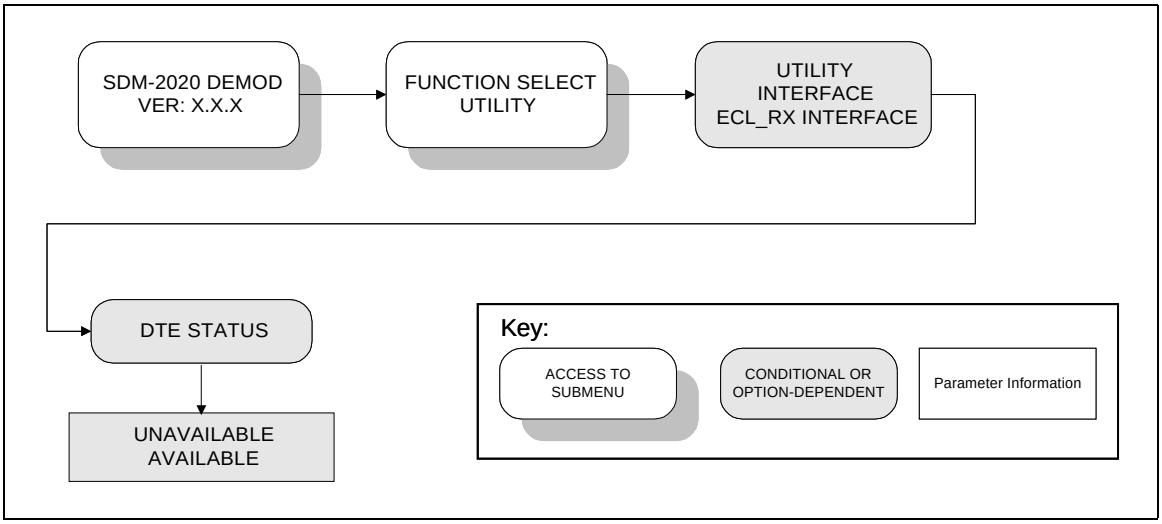

Figure 3-12E. Utility Interface, ECL_HSSI

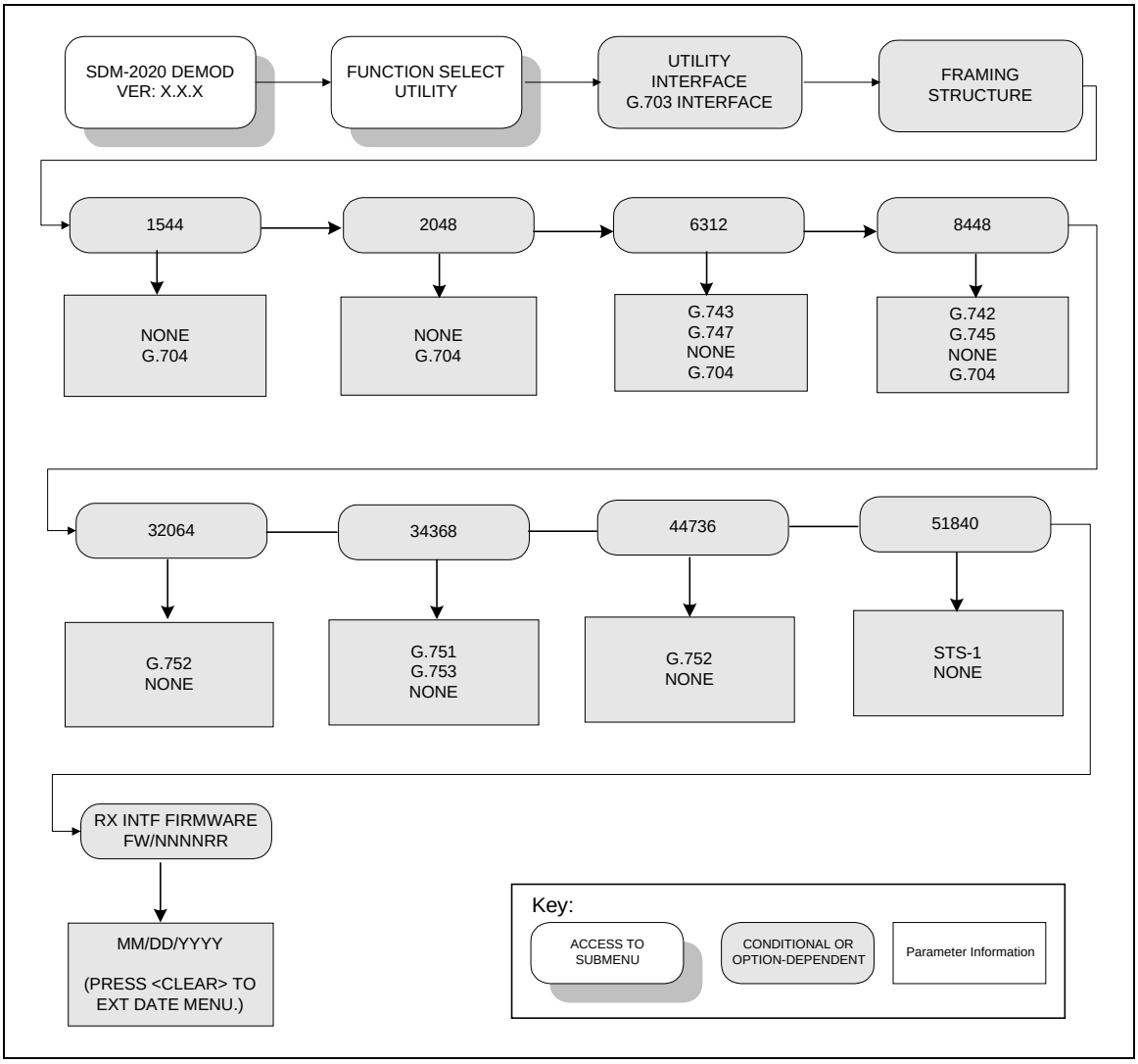

Figure 3-12F. Utility Interface, G.703 Data Interface

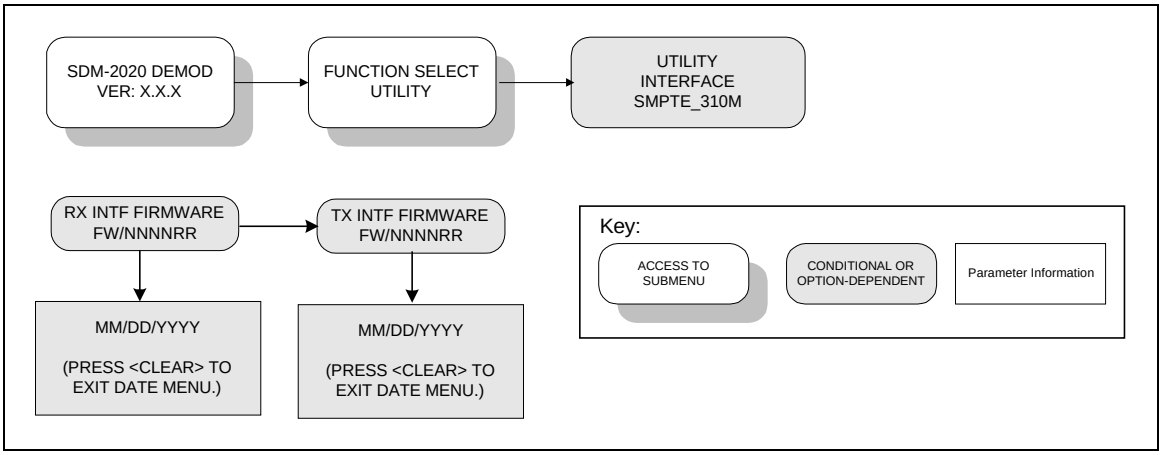

Figure 3-12G. Utility Interface, SMPTE 310M Data Interface

3.3.5.2 Utility Interface Menu

Refer to Figure 3-12.

INTERFACE TYPE	Displays the interface type installed in the demodulator, for example: • RS422 • LVDS • ASI/RS422 • ASI/LVDS • ECL/HSSI_RX • G.703 • SMPTE 310M • NONE • UNKNOWN **Note:** This is a status window only, and no changes can be made from this menu. Refer to Appendix A for information about the front panel menus for specific interface types. **Note:** As additional data interfaces are introduced, they are added to the menu. If an interface is not recognized, then UNKNOWN is displayed. In this case, a later version of firmware may be required to operate with the data interface.

3.3.5.2.1 Utility Interface Menu, RS422

Refer to Figure 3-12A.

INTERFACE SELECT	Displays the current Interface Select, either DVB or 530. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.
INTERFACE MODE SELECT	Displays the current Interface Mode Select, either SERIAL or PARALLEL in the DVB Mode only. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.
DM STATE	Displays the current DM STATE, either NORMAL or INVERT. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.
RR STATE	Displays the current RR STATE, either NORMAL or INVERT. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.

3.3.5.2.2 Utility Interface, LVDS

Refer to Figure 3-12B.

INTERFACE MODE SELECT	Displays the current Interface Mode Select, either SERIAL or PARALLEL. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.

3.3.5.2.3 Utility Interface, ASI/RS422

Refer to Figure 3-12C.

INTERFACE SELECT	Displays the current Interface Select, either ASI or RS422. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.
RX INTF FIRMWARE FW/NNNNRR	Pressing [ENTER] will show the FW release date. Pressing [CLEAR] will exit the date menu.. Displays current RX firmware revision.
DM STATE	Displays the current DM State , either NORMAL or INVERT in an RS-422 Select only. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.
MC STATE	Displays the MC State, either NORMAL or INVERTED in an RS-422 Select only. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change
RR STATE	Displays the current RR State, either NORMAL or INVERT in an RS-422 Select only. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change.

3.3.5.2.4 Utility Interface, ASI/LVDS

Refer to Figure 3-12D.

INTERFACE SELECT	Displays the current Interface Select, either ASI or LVDS. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change
RX INTF FIRMWARE FW/NNNNRR	Pressing [ENTER] will show the FW revision. Pressing [CLEAR] will exit menu.
LVDS STATUS (J7)	Displays the current LVDS Status, either RX LVDS or TX LVDS. (Jumper setting dependent.)

3.3.5.2.5 Utility Interface, ECL/HSSI_RX

Refer to Figure 3-12E.

DTE STATUS	Displays the current DTE Status, either AVAILABLE or UNAVAILABLE. Upon entry, the current status is displayed. Press [↑] or [↓] to change the selection. Press [ENTER] to execute the change

3.3.5.2.6 Utility Interface, G.703

Refer to Figure 3-12F.

FRAMING STRUCTURE: 1544 2048 6312 8448 3206 34368 44736 51840	 NONE, G.704 NONE, G.704 None, G.704, G.743, G.747 None, G.704, G.745, G.742 None, G.752 None, G.751, G.753 None, G.752 None, STS-1
RX INTF FIRMWARE FW/NNNNRR	Pressing [ENTER] will show the FW release date. Pressing [CLEAR] will exit the date menu..

3.3.5.2.7 Utility Interface, SMPTE 310M

Refer to Figure 3-12G.

RX INTF FIRMWARE FW/NNNNRR	Pressing [ENTER] will show the FW release date. Pressing [CLEAR] will exit the date menu..
TX INTF FIRMWARE FW/NNNNRR	Pressing [ENTER] will show the FW release date. Pressing [CLEAR] will exit the date menu..

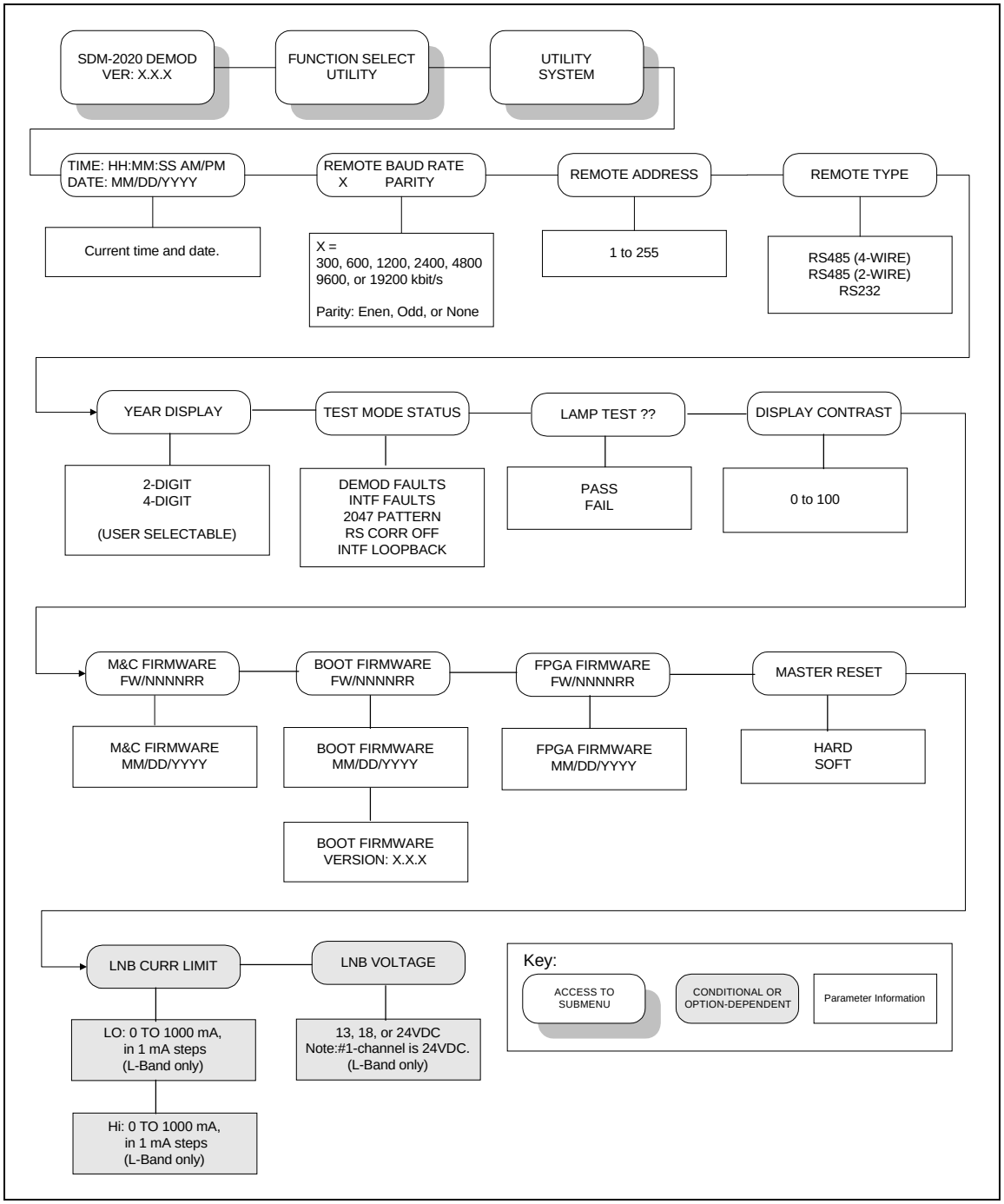

Figure 3-13. Utility System Menu

3.3.5.3 Utility System Menu

Refer to Figure 3-13.

TIME/DATE	Time of day and date set/display function. The current time and date in the demodulator memory are displayed when selected. To set the demodulator 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/PARITY	The current baud rate and parity selection of the demodulator are displayed. To set the demodulator 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 at 300, 600, 1200, 2400, 4800, 9600, or 19200. The parity can be set to EVEN, ODD, or NONE.
REMOTE ADDRESS	The current demodulator 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. **Note:** Address 0 is reserved as a global address.
REMOTE TYPE	Remote interface type selection, choices include: • RS-485 (4-wire) • RS-485 (2-wire) • RS-232 Press an arrow key to make the selection. Press [ENTER] to execute the change.
YEAR DISPLAY	Displays the current year as a 2-digit or a 4-digit number: Example: (2-Digit) 99 (4-Digit) 2000
TEST MODE STATUS	Test mode status indicator. The following demodulator test points are listed in this window and will display a "+" when a test mode is active: • DEMOD FAULTS • INTF FAULTS • 2047 PATTERN • RS CORR OFF • INTRFCE LOOPBACK To view the test modes, press [ENTER]. Press [←] or [→] to move through the list of test modes.
LAMP TEST ??	Lamp test function to verify the front panel indicators. Press [ENTER] to turn on all of the front panel indicators for 3 seconds.

DISPLAY CONTRAST	Set the contrast level 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 FIRMWARE	Displays M&C module firmware version. Upon entry, the date of release of this firmware will be displayed. Upon second entry, the firmware date of release is displayed. This is a status window only
BOOT FIRMWARE	Displays the boot firmware number. Upon entry, the date of release of this firmware will be displayed. Upon second entry, the firmware date of release is displayed. The third entry will display the firmware version number. This is a status window only
FPGA FIRMWARE	Displays FPGA firmware version. Upon entry, the date of release of this firmware will be displayed. Upon second entry, the firmware date of release is displayed. This is a status window only.
MASTER RESET	Master reset function.  ***When a hard reset is initiated, the demodulator hardware is reset, and all default configuration settings will be installed. When a soft reset is initialized, the demodulator 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 demodulator. If Hard is selected, press [→] until the cursor is on YES, and press [ENTER].
LNB CURRENT LIMIT	Set up menu for Low and Hi current thresholds. Range is 0 to 1000 mA. Press [ENTER] once to access change mode. Press [↑] or [↓] to alternate between the Low and Hi LNB current thresholds. Press [→] to move the cursor to the appropriate decimal position and use the [↑] or [↓] to change value. Pressing [ENTER] will program the displayed the value. **Note:** The Hi current value shall be > the Low current value.
LNB VOLTAGE	Status Only. Displays the LNB voltage as 13, 18, or 24 VDC. **Notes:** 1. With 4-Channel L-Band Card installed only. 2. 1-Channel L-Band Card is 24 VDC only, no user selection.

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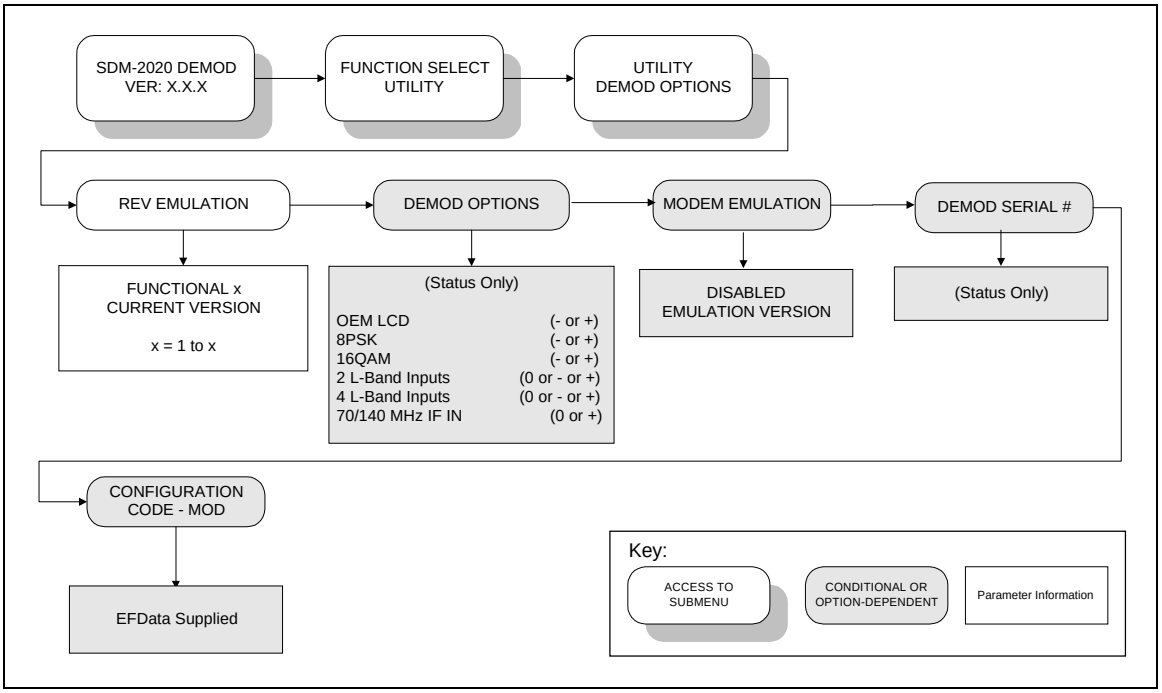

Figure 3-14. Utility Demodulator Options Menu

3.3.5.4 Utility Demodulator Options Menu

Refer to Figure 3-14.

REV EMULATION	Programs an emulation mode of a previous functional revision. Revision emulation allows the user interfaces (either front panel or remote) to emulate a previous version of software. Upon entry, the CURRENT VERSION is displayed. Press a directional key to select the FUNCTIONAL versions. Press [ENTER] to execute the change. **Note:** The Utility menu numbers increase with each software version change.
DEMOD OPTIONS	(Status Only) Displays the following demodulator options: • OEM LCD • 8PSK • 16QAM • 2 L-Band Inputs • 4 L-Band Inputs • 70/140 MHz 1. If the option is installed, the "+" (plus) symbol is displayed to the right of the option 2. If the option is not installed, but is a FAST upgrade the "-" (minus) symbol is displayed to the right of the option. 3. If the option is not installed and not upgradable, the "0" symbol is displayed to the right of the option. 4. If the option is not installed, but is field upgradable, the "X'" symbol is displayed to the right of the option.
MODEM EMULATION	Displays DISABLED or EMULATION VERSION.
DEMOD SERIAL #	(Status Only) Displays the demodulator serial number.
CONFIGURATION CODE–DEMOD	EFData supplied code (FAST). On entry, the current configuration code is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. Entering this code enables the corresponding demodulator option. To purchase an option, contact EFData Customer Support for more information.

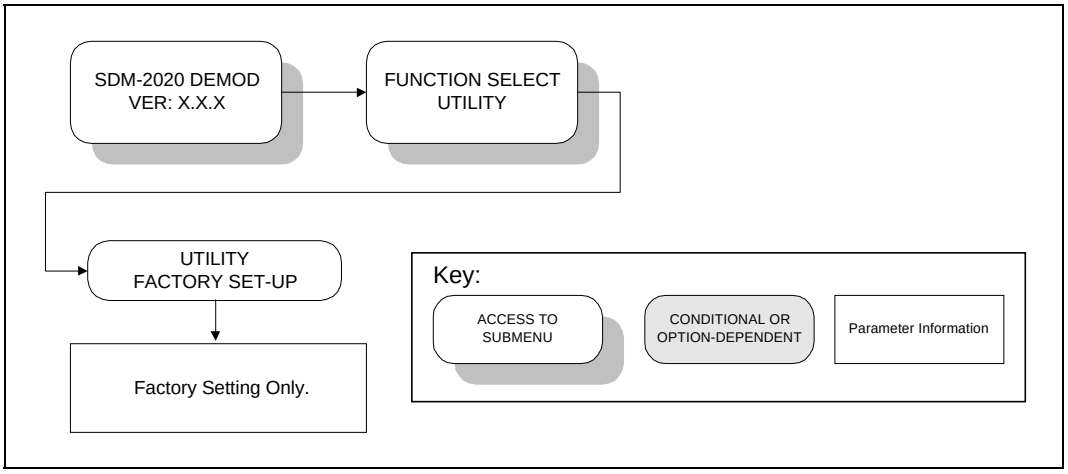

Figure 3-15. Utility Factory Setup Menu

3.3.5.5 Utility Factory Setup Menu

Refer to Figure 3-15.

CAUTION

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

3.4 Initial Defaults

Initial default settings for the demodulator are listed in Table 3-4.

Table 3-4. Initial Defaults

Configuration Demodulator			
Demodulation/Code Rate *(see Note 1)*	QPSK 1/2	Energy Dispersal	On
Data Rate *(see Note 1)*	15.000000 Mbit/s	RS Decoder	Corr On
Symbol Rate *(see Note 1)*	16.276596 Msps	BER Threshold	None
Demodulation/Code Rate (see Note 2)	QPSK 3/4	E_b/N_0 Threshold	None
Data Rate *(see Note 2)*	44.736000 Mbit/s	E_b/N_0 THRESH ALM	Off
Symbol Rate (see Note 2)	32.362213 Msps	Sweep Range	100000 Hz
RX IF Frequency (see Note 3)	1200 MHz	Reacquisition	0 seconds
RX IF Frequency (see Note 4)	70 MHz	RF Input Select	1
LNB Power	Off		
Configuration Interface			
RX Clock Phase *(see Note 1)*	Normal	EXT-REF Freq	1544 kHz *(see Note 2)*
RX Data Phase	Normal	TX TERR CLK Freq	44736 kbit/s *(see Note 2)*
RX Data Fault	None	TX Coding Format	AMI *(see Note 2)*
DVB Framing Type	188	Buffer Clock	RX (Satellite) *(see Note 2)*
RX 2047 Pattern	Off	RX Coding Format	AMI *(see Note 2)*
INTF Loopback *see Note 2)*	Off	Buffer Size	12 ms *(see Note 2)*
Monitor			
Raw BER	2.4 E-3	DEMOD Spectrum	Normal
Corrected BER	4.0 E-3	LNB Current	0 mA
E_b/N_0	16.0 dB	2047 Pattern	No Data
E_b/N_0 Margin	10.0 dBm	Buffer Fill	50%
Receive Signal	-45.0 dBm	2047 Errors	No Data
Sweep Frequency	+0 Hz		
Utility Demodulator			
Demodulator Type	DVB		
Utility Interface			
RS422 Interface Type			
Interface Select	DVB	DM State	Normal
INTF Mode Select	Serial	RR State	Normal
LVDS Interface Type			
INTF Mode Select	Serial		
ASI/RS422 Interface Type			
Interface Select	ASI	DM State	Normal
RX INTF Firmware	FW/NNNNRR	MC State	Normal
RX INTF Firmware	MM/DD/YYYY	RR State	Normal

Table 3-4. Initial Defaults (Continued)

ASI/LVDS Interface Type			
Interface Select	ASI	RX INTF Firmware	MM/DD/YYYY
RX INTF Firmware	FW/NNNNRR	LVDS Status	RX LVDS
ECL/HSSI RX Interface Type			
DTE Status	Unavailable		
G.703 Interface Type			
1544 Framing Structure	G.704	34368 Framing Structure	G.751
2048 Framing Structure	G.704	44736 Framing Structure	G.752
6312 Framing Structure	G.743	51840 Framing Structure	STS-1
8448 Framing Structure	G.742	RX INTF Firmware	FW/NNNNRR
32064 Framing Structure	G.752	RX INTF Firmware	MM/DD/YYYY
SMPTE 310M Interface Type			
RX INTF Firmware	FW/NNNNRR	RX INTF Firmware	MM/DD/YYYY
TX INTF Firmware	FW/NNNNRR	TX INTF Firmware	MM/DD/YYYY
Utility System			
Time	12:00AM	M&C Firmware	MM/DD/YYYY
Date	7/04/76	Boot Firmware	FW/NNNNRR
Remote Baud Rate	9600 bit/s	FPGA Firmware	FW/NNNNRR
Remote Address	1	FPGA Firmware	MM/DD/YYYY
Remote Type	RS485 (4-Wire)	LNB Current Limit (see Note 3)	LO = 0 mA HI = 0 mA
Year Display	4-Digit	LNB Voltage (see Note 4)	13 VDC
Display Contrast	64	AUX RF IN CTRL (see Note 4)	Off
M&C Firmware	FW/NNNNRR		
Utility Demod Options			
Modem Emulation	Disabled		

Notes:

1. Not applicable with G.703 interface installed.
2. Applicable with G.703 interface installed.
3. For L-Band only.
4. For 70/140 MHz only.

3.4.1 (C+N)/N to C/N and E_b/N_0 Conversion

Table 3-5 provides conversions from (C+N)/N to E_b/N_0 that are useful when evaluating satellite links with a spectrum analyzer.

The following equations was used to build the conversion table.

C/N (= Co/No) = 10*Log(10^[(C+N)/N/10]-1)
and Eb/No = C/N – 10*Log(m*CRv) – 10*Log(188/204)

Modulation	Inner Code	E_b/N_0 = C/N +
QPSK	½	0.35
QPSK	2/3	-0.89
QPSK	¾	-1.41
QPSK	5/6	-1.86
QPSK	7/8	-2.08
8PSK	2/3	-2.66
8PSK	5/6	-3.62
8PSK	8/9	-3.90
16QAM	¾	-4.42
16QAM	7/8	-5.09

Table 3-5. (C+N)/N to C/N and E_b/N_0 Conversion Chart

		Modulation And Code Rate									
		QPSK					8PSK			16QAM	
		1/2	2/3	3/4	5/6	7/8	2/3	5/6	8/9	3/4	7/8
(C+N)/N	C/N	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No	Eb/No
5.0	3.35	3.70	2.45	1.94	1.49	1.27	0.69	-0.28	-0.56	-1.07	-1.74
5.5	4.06	4.42	3.17	2.66	2.20	1.99	1.41	0.44	0.16	-0.35	-1.02
6.0	4.74	5.10	3.85	3.34	2.88	2.67	2.09	1.12	0.84	0.33	-0.34
6.5	5.40	5.75	4.50	3.99	3.54	3.32	2.74	1.77	1.49	0.98	0.31
7.0	6.03	6.39	5.14	4.63	4.17	3.96	3.38	2.41	2.13	1.62	0.95
7.5	6.65	7.00	5.75	5.24	4.79	4.57	3.99	3.02	2.74	2.23	1.56
8.0	7.25	7.61	6.36	5.84	5.39	5.17	4.60	3.63	3.35	2.83	2.16
8.5	7.84	8.19	6.94	6.43	5.97	5.76	5.18	4.21	3.93	3.42	2.75
9.0	8.42	8.77	7.52	7.01	6.55	6.34	5.76	4.79	4.51	4.00	3.33
9.5	8.98	9.34	8.09	7.58	7.12	6.91	6.33	5.36	5.08	4.57	3.90
10.0	9.54	9.90	8.65	8.14	7.68	7.47	6.89	5.92	5.64	5.13	4.46
10.5	10.09	10.45	9.20	8.69	8.23	8.02	7.44	6.47	6.19	5.68	5.01
11.0	10.64	11.00	9.75	9.23	8.78	8.56	7.98	7.02	6.74	6.22	5.55
11.5	11.18	11.54	10.29	9.77	9.32	9.11	8.53	7.56	7.28	6.76	6.10
12.0	11.72	12.07	10.82	10.31	9.85	9.64	9.06	8.09	7.81	7.30	6.63
12.5	12.25	12.60	11.35	10.84	10.38	10.17	9.59	8.62	8.34	7.83	7.16
13.0	12.78	13.13	11.88	11.37	10.91	10.70	10.12	9.15	8.87	8.36	7.69
13.5	13.30	13.66	12.41	11.90	11.44	11.23	10.65	9.68	9.40	8.89	8.22
14.0	13.82	14.18	12.93	12.42	11.96	11.75	11.17	10.20	9.92	9.41	8.74
14.5	14.34	14.70	13.45	12.94	12.48	12.27	11.69	10.72	10.44	9.93	9.26
15.0	14.86	15.22	13.97	13.45	13.00	12.78	12.20	11.24	10.96	10.44	9.77
15.5	15.38	15.73	14.48	13.97	13.51	13.30	12.72	11.75	11.47	10.96	10.29
16.0	15.89	16.24	14.99	14.48	14.03	13.81	13.23	12.26	11.98	11.47	10.80
16.5	16.40	16.76	15.51	15.00	14.54	14.33	13.75	12.78	12.50	11.99	11.32
17.0	16.91	17.27	16.02	15.51	15.05	14.84	14.26	13.29	13.01	12.50	11.83
17.5	17.42	17.78	16.53	16.02	15.56	15.35	14.77	13.80	13.52	13.01	12.34
18.0	17.93	18.29	17.04	16.52	16.07	15.85	15.28	14.31	14.03	13.51	12.84
18.5	18.44	18.79	17.54	17.03	16.57	16.36	15.78	14.81	14.53	14.02	13.35
19.0	18.94	19.30	18.05	17.54	17.08	16.87	16.29	15.32	15.04	14.53	13.86
19.5	19.45	19.81	18.56	18.04	17.59	17.38	16.80	15.83	15.55	15.03	14.37
20.0	19.96	20.31	19.06	18.55	18.09	17.88	17.30	16.33	16.05	15.54	14.87
20.5	20.46	20.82	19.57	19.05	18.60	18.39	17.81	16.84	16.56	16.04	15.38
21.0	20.97	21.32	20.07	19.56	19.10	18.89	18.31	17.34	17.06	16.55	15.88
21.5	21.47	21.82	20.57	20.06	19.61	19.39	18.81	17.84	17.56	17.05	16.38
22.0	21.97	22.33	21.08	20.57	20.11	19.90	19.32	18.35	18.07	17.56	16.89

3.5 Fault Tree

Refer to Table 3-6 for fault tree description.

Table 3-6. Demodulator Fault Tree

DEMODULATOR	FLT LED	FLT RLY	ALM LED	ALM RLY	RX AIS	SYNC LED	COM EQ FLT	INTERFACES (see Note)
Carrier Detect	ON	ON			ON			ALL
IF Synthesizer	ON	ON			ON			ALL
I Channel	ON	ON			ON			ALL
Q Channel	ON	ON			ON			ALL
BER Threshold			ON	ON				ALL
Module	ON	ON			ON			ALL
Configuration	ON	ON			ON			ALL
RX Interface:								
Frame SYNC	ON	ON			ON	OFF		ALL
Data Stable/AIS			ON	ON	OFF			ALL
Clock PLL	ON	ON			ON			ALL
FIFO			ON	ON				ALL
Interface Module	ON	ON			ON			ALL
Buffer Overflow			ON	ON				G.703
Buffer Underflow			ON	ON				G.703
Buffer Clock Activity			ON	ON				G.703
Buffer Full Warning			ON	ON				G.703
2047 Lock			ON	ON				
CEQ:								
Battery/Clock	ON							
-12 Volt Supply	ON						ON	
+ 12 Volt Supply	ON						ON	
+ 5 Volt Supply	ON						ON	
Controller	ON						ON	
LNB	ON							

Note: The following list shows the current available interfaces:

- RS422
- LVDS
- ASI/RS422
- ASI/LVDS
- ECL_HSSI
- G.703
- SMPTE 310M

3.6 Revision Emulation Operation FW/6224-1

Note: The SDM-2020 Demodulator will use FW/7734-1, initiating at version 20.1.1.

To program an emulation mode from FW/6224-1,Version 1.1.1 through the current version, use the revision emulation feature in the Utility Modem Type menu. Refer to Table 3-7.

Table 3-7. SDM-2020 Demodulator Revision Emulation

Software Version #	Firmware #	Description of Change
1.1.1	–	Original release
1.1.2	A	User interface changes.
1.1.3	B	User interface changes.
1.1.4	C	User interface changes.
1.2.1	D	Support for new PC (AS/5746C).
2.2.1	E	User interface changes.
2.2.2	F	Correct interface ID recognition.
2.2.3	G	Added E_b/N_0 Alarm Thresh Alarm.
2.2.4	H	Added SMPTE 310M interface data.
3.3.1	J	Released 16QAM, 4-channel RF Demod support.
4.3.1	K	User interface changes.
4.3.2	L	User interface changes.
4.3.3	M	Added ASI/LVDS data interface.
4.3.5	P	Added jumper and loopback descriptions.

3.7 Revision Emulation Operation FW/7734-1

To program an emulation mode from FW/7734-1,Version 20.1.1 through the current version, use the revision emulation feature in the Utility Modem Type menu. Refer to Table 3-8.

Table 3-8. SDM-2020 Demodulator Revision Emulation

Software Version #	Firmware #	Description of Change
20.1.1	–	Original release

Appendix A. DATA INTERFACES

This appendix describes the plug-in data interface modules used with the SDM-2020 Demodulator.

A.1 Description

Note: The SDM-2020 Demodulator incorporating PCB, AS/7733 will have available any of the following interfaces.

The data interface is a plug-in module that provides a specific terrestrial connection to the demodulator unit. Where practical, both the TX (modulator) and RX (demodulator) paths are incorporated into the data interface. The location for the information on each interface is as follow:

Paragraph No.	Title
A.1	Description
A.2	RS-422 Parallel/Serial Interface
A.3	LVDS (Low Voltage Differential Signal Interface) **Note:** Same as the DVB-SPI.
A.4	ASI/RS422 (Asynchronous Serial Interface/Serial Data Interface)
A.5	ECL/HSSI Serial Data Interface
A.6	G.703 Data Interface
A.7	SMPTE 310M Data Interface
A.8	ASI/LVDS Interface

Note: Different interfaces are described in this appendix. As additional interfaces are developed, the appendix will be revised to include the new interfaces. Contact Comtech EF Data Customer Support for the latest information.

A.1.1 Interface/M&C Software Requirements

Note: This does not apply to SDM-2020 Demodulator incorporating PCB , AS/7733.

As additional data interfaces are introduced, the software is revised to support the operation of each interface. Table A-1 summarizes the minimum software version necessary to operate each interface type.

Table A-1. Minimum Software Revisions

Data Interface	Specification P/N	Minimum Software Version
RS-422	SP/5805	1.1.1
LVDS	SP/5814	1.1.1
ASI/RS-422	SP/5807	1.1.1
ECL/HSSI	SP/5806-1/-2	1.1.2
G.703	SP/6168	2.2.1
SMPTE 310M	SP/6175-1	2.2.4
ASI/LVDS	SP/8160	4.3.3

To avoid damaging the Demodulator, always disconnect the power before removing or installing a data interface.

A.1.2 Transmit/Receive Data

The data format for the transmit (TX) and receive (RX) data interfaces are the same. There are three general modes of operation that are described in Section 3.1:

- None (187)
- 188
- 204

When None (187) mode is selected, no frame structure is expected, while the 188 and 204 modes will synchronize to standard MPEG-2 transport frames. Other supported data formats are referenced in the appropriate section of this appendix, but the data from other frame formats is extracted and converted to one of the three modes of operation.

Figure A-1 and depict the 204-byte packetization for byte parallel and byte serial formats, showing all possible data fields and timing signal relationships. The 188 byte and no framing formats are subsets of the 204 byte format.

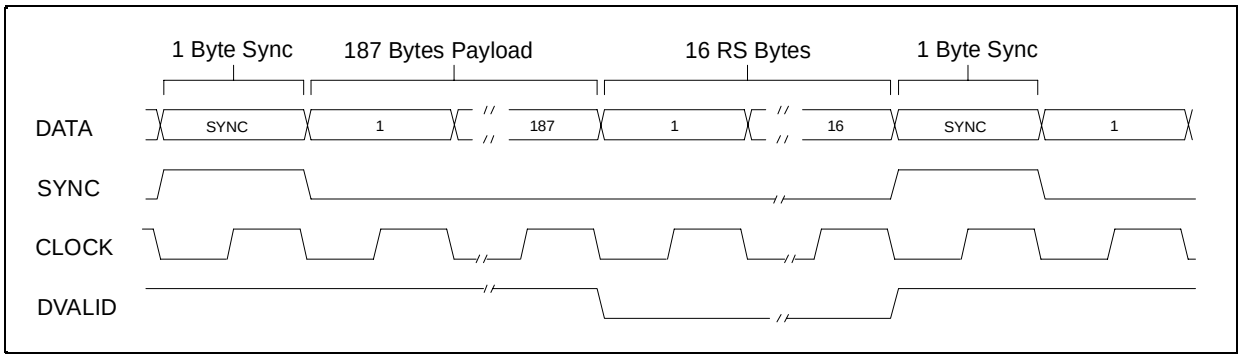

Figure A-1. 204 Byte Parallel Format

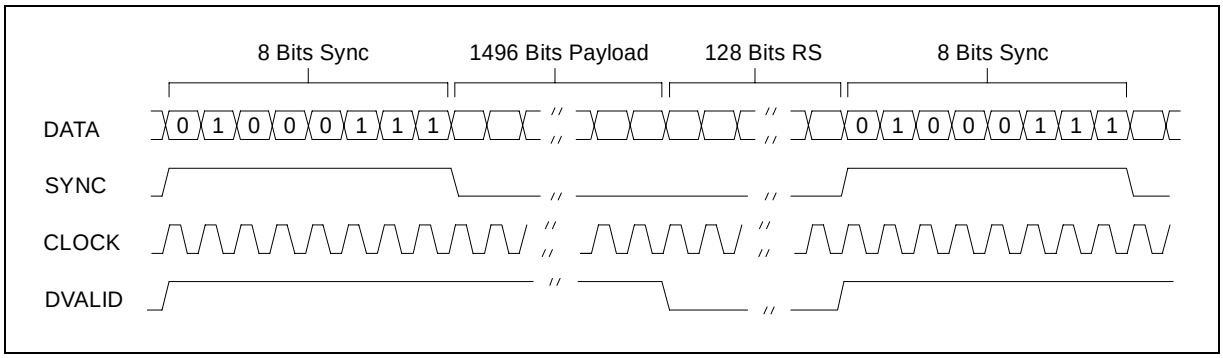

Figure A-2. 204 Byte Serial Format

Note: For proper operation, data and timing must be continuous, and meet the described criteria as specified in Figure A-1, and Table A-2.

Table A-2. 204 Data and Timing

DATA	Payload data is byte parallel, where DATA 7 is the most significant bit; or byte serial, where data is applied to DATA 7 with the most significant bit preceding the least. For 188 and 204 format, the payload is 187 bytes in length, preceded by a sync word. In the 204-byte mode, the payload is followed by 16 bytes of reed-Solomon data, or 16 filler bytes.
CLOCK	The clock is at the bit or byte rate in accordance with serial or parallel mode. The rising edge of the clock is centered on the data.
SYNC	SYNC timing depends upon the selection made for DVB FRAMING TYPE in the Configuration Interface menu (refer to Figure 3-5). DVB Framing Type — SYNC 188 or 204 — The SYNC timing is derived from either the EXT SYNC or CORR ON DATA selection from the Configuration Interface menu. None — The SYNC signal is ignored. For the 188 or 204 byte framing modes, either a SYNC pulse or SYNC byte of value 47h is required, dependent on the modulator configuration. Both may be applied, with only one having effect, dependent upon configuration. When used, the SYNC pulse is active high centered over the SYNC word. In parallel operation, it is one byte clock width. In serial operation, the modulator recognizes the SYNC pulse centered on the entire SYNC bit (8 clocks wide), or centered on the most significant bit of the byte (1 clock wide).
DVALID	Although this signal is identified by both DVB and DBS formats, it is not used by the modulator.

A.2 RS-422 Parallel/Serial Interface

The following paragraphs describe the RS-422 parallel and serial interface. The interface operates at RS-422 signal levels. It accommodates a variety of MPEG2 framing formats and EIA-530 serial data.

A.2.1 Applicable Documents

Applicable specifications, as referenced herein, include:

TM1449	*Interfaces for CATV/SMATV Headends and Similar Professional Equipment.*
TIA/EIA-644	*Telecommunications Industry Standard, Electrical Characteristics Of Low Voltage Differential Signaling (LVDS) Interface Circuits* (originally *Standards Proposal SP-3357*)
RS-422	*Electrical Characteristics of Balanced Voltage Digital Interface Circuits*
EIA-530	*High Speed 25-Position Interface for Data Circuit - Terminating Equipment*

A.2.2 Description

The RS-422 interface has two data connectors and an auxiliary connector supporting various operating modes.

- J3 Parallel/Serial DVB Connector (25-pin D, female):
  - Parallel mode - In this mode, the interface functions like a DVB parallel synchronous interface, but with RS-422 levels. The input is at the byte rate.
  - Serial mode - An alternate form of operation is possible, where the MSB is used for serial input at the bit rate.
- J4 Serial EIA-530 Connector (25-pin D, female):
  - Serial mode only - RS-422 levels with pinout and operation per EIA-530 at a serial clock rate.
- J5 Auxiliary Connector (9-pin D, female):
  - Provides an additional ST Clock (output), plus open collector fault signals.

The appropriate interface control is automatically enabled when the interface module is installed in the Demodulator. The plug-in data interface is programmable for serial or parallel operation from either the front panel keypad or the remote port on the rear panel.

The following cables, or equivalent computer grade cables incorporating twisted, shielded pairs, are recommended:

- Belden type LV Computer M9768 (50Ω) 15 pairs
- Belden 8175 (100Ω) 15 pairs

The Belden 8175 has lower capacitance; however, it has a larger diameter and requires the selection of an appropriate connector shell.

The typical cable length for the serial/parallel interfaces is ≤ 5 meters (16.405 feet).

The interface operates to the specifications described in Table A-3.

Table A-3. RS-422 Interface Specifications

General Specifications	
Interface Type	RS-422/EIA-530 Synchronous, Serial/Parallel.
Data Rate	1.5 to 18 Mbit/s, serial. 1.5 to 100 Mbit/s, parallel.
Data Framing Formats	188, 204 byte packets per ETS 300 421, and None.
Connectors	25-pin, female D for serial data, EIA-530 PIN Out 25-pin, female D for parallel or serial data, DVB PIN Out 9-pin, female D for reference clock from unit (Demodulator only), plus fault.
Electrical Properties	Per RS-422.
Parallel Signal Types	TX: TX Clock, TX Data, Data Valid, and Sync per TM1449. The Demodulator does not require Sync or Data Valid with the 188 or 204 byte patterns. Parallel: RX Clock, RX Data, Data Valid, and Sync per TM1449 Reference (ST equivalent).
Serial Signal Types	Serial: SD, ST, TT, RS, CS, RD, RT, RR (CD).
Voltage Level	4 ± 2V Differential into 100Ω.

A.2.3 Configuration

Note: The jumper location on the interface card is shown in Figure A-3.

A single jumper provides the option for a transmit or receive reference clock on connector J3 (pins 2 and 15). The pins are configured at the factory as signal ground per TM 1449.

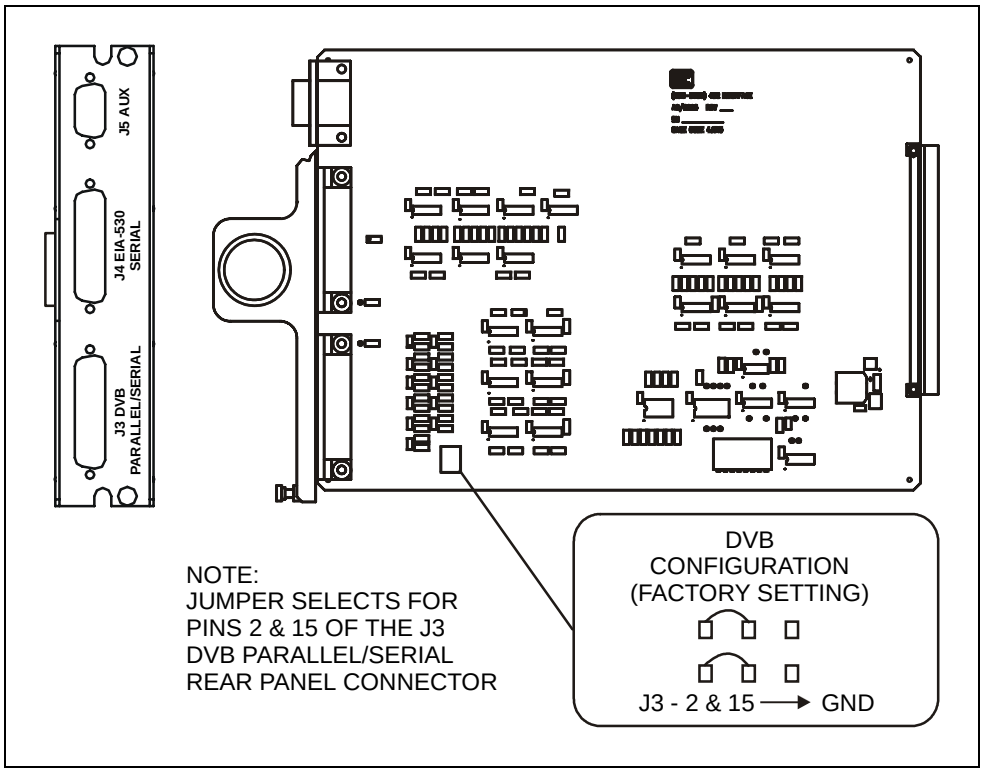

Figure A-3. RS-422 Interface Module PCB

A.2.4 User Interfaces

The following paragraphs describe the RS-422 user interfaces.

A.2.4.1 Parallel, J3, DB25 Female (DVB Parallel/Serial Data Interface)

This data port supports DVB and DBS parallel and serial packetized data. There are three standard frame formats supported, as follows:

- None (187)
- 188
- 204

When None (187) mode is selected, no frame structure is expected, while the 188 and 204 modes will synchronize to standard MPEG-2 transport frames. Other supported data formats are referenced in the appropriate section of this appendix, but the data from other frame formats is extracted and converted to one of the three modes of operation.

A.2.4.1.1 Connector Pinout, J3, Parallel/Serial DVB

The connector is a sub-miniature, 25-pin, female D connector, with threaded jack nuts (refer to Table A-4 for pinout). All signals on this connector are outputs from the demodulator.

When used as a serial data port, Data 7 (pins 3 and 16) are the active data pins.

Signal assignments for pins 2 and 15 are jumper-selectable (Modulator Only). They are defined as signal ground in the DVB definition of TM1449, but may be configured to provide SCT out. Refer to Section A.2.3 for jumper details. Signal levels are as defined in RS-422. Per TM1449, the differential sense of all signal pairs is a logic “1” when “A” is positive with respect to “B.” This is the normal selection in the Configuration Interface menu (see Chapter 3).

Table A-4. DVB Interface Connector Pinout, J3

Pin #	Signal Function/Name	Type	Comment
1	Clock A	I/O	Mod/Demod
2	System GND/REFCLKB	O/GND	Mod/Demod Jumper selectable SCT for Modulator
3	Data 7 A(MSB/Serial)	I/O	Mod/Demod
4	Data 6 A	I/O	Mod/Demod
5	Data 5 A	I/O	Mod/Demod
6	Data 4 A	I/O	Mod/Demod
7	Data 3 A	I/O	Mod/Demod
8	Data 2 A	I/O	Mod/Demod
9	Data 1 A	I/O	Mod/Demod
10	Data 0 A	I/O	Mod/Demod
11	DVALID A	I/O	Mod/Demod
12	SYNC A	I/O	Mod/Demod
13	Cable Shield	I/O	Mod/Demod
14	Clock B	I/O	Mod/Demod
15	System GND/REFCLKA	O/GND	Mod/Demod Jumper selectable SCT for Modulator
16	Data 7 B (MSB/Serial)	I/O	Mod/Demod
17	Data 6 B	I/O	Mod/Demod
18	Data 5 B	I/O	Mod/Demod
19	Data 4 B	I/O	Mod/Demod
20	Data 3 B	I/O	Mod/Demod
21	Data 2 B	I/O	Mod/Demod
22	Data 1 B	I/O	Mod/Demod
23	Data 0 B	I/O	Mod/Demod
24	DVALID B	I/O	Mod/Demod
25	SYNC B	I/O	Mod/Demod

A.2.4.2 Serial, J4, DB25 Female (EIA-530 Serial Data Interface)

This interface has no provision for SYNC or DVALID signals. If framing is desired, a sync byte (47 hex) is embedded into the data stream every 188 or 204 bytes, as selected in the Demodulator configuration. The Demodulator detects the sync byte and formats the serial interface data into a standard, error-protected 204 byte packet.

A.2.4.2.1 Connector Pinouts, J4, EIA-530

The connector is a sub-miniature, 25-pin, female D connector, with threaded jack nuts (refer to Table A-5 for pinout).

Signal functions are as defined in EIA-530.

Notes:

1. The differential sense of all signals is a logic "1" when "B" is positive with respect to "A," as defined in EIA-530.
2. Only those pins indicated as "Demodulator" in the table are applicable.

Table A-5. EIA-530 Serial Interface Connector Pinout (J4)

Pin #	Signal Function	Name	Type	Comment
1	530 Shield	Shield		Mod/Demod
2	Transmit Data (TD-A)	BA-A	I	Modulator
3	Receive Data (RD-A)	BB-A	O	Demodulator
4	Request To Send (RS-A)	CA-A	I	Modulator
5	Clear To Send (CS-A)	CB-A	O	Modulator
6	DCE Ready (DM-A)	CC-A	O	Demodulator
7	Signal Ground	AB	GND	
8	Receive Line Signal Detect (RR-A)	CF-A	O	Demodulator
9	Receive Timing (RT-B)	DD-B	O	Demodulator
10	Receive Line Signal Detect (RR-B)	CF-B	O	Demodulator
11	Terminal Timing (TT-B)	DA-B	I	Modulator
12	Send Timing (ST-B)	DB-B	O	Modulator
13	Clear To Send (CS-B)	CB-B	O	Modulator
14	Transmit Data (TD-B)	BA-B	I	Modulator
15	Send Timing (ST-A)	DB-A	O	Modulator
16	Receive Data (RD-B)	BB-B	O	Demodulator
17	Receive Timing (RT-A)	DD-A	O	Demodulator
18			N/C	
19	Request To Send (RS-B)	CA-B	I	Modulator
20		N/A		
21	Demodulator Fault (DF)	N/A	O	Demodulator
22	DCE Ready (DM-B)	CC-B	O	Demodulator
23		N/A		
24	Terminal Timing (TT-A)	DA-A	I	Modulator
25	Modulator Fault (MF)	N/A	O	Modulator

A.2.4.3 Auxiliary, J5

This port provides for other modem-specific signals not otherwise defined for either or both of the two data connectors.

A.2.4.3.1 Connector Pinout, J5

The connector is a sub-miniature, 9-pin, female D connector, with threaded jack nuts (refer to Table A-6 for connector pinout).

Differential pairs are RS-422 compatible.

Note: The sense of differential signal pairs is a logic "1" when "B" is positive with respect to "A."

Single-ended signals (MF and DF fault signals) are open-collector where:

V_{oh}=12V max. And V_{ol}=0.5V max. @ I_{ol}=8 ma.

A pull-up resistor, external to the equipment, is required.

The fault signals, MF and DF, operate as follows: A fault is indicated by an "OFF" collector (high) and OK status is indicated by an "ON" collector (low).

Table A-6. Auxiliary Connector Pinout (J5)

Pin #	Signal Function	Name	Type	Comment
1			GND	Signal Ground
2	Demod Fault Indicator	DF	O	Demodulator Summary Fault Redundancy switch application
3	Send Timing	ST-A	O	Modulator SCT for terrestrial synchronization
4			N/C	
5	Not Used			
6	Mod Fault Indicator	MF	O	Modulator Summary Fault Redundancy switch application
7	Carrier Detect	/CD	O	Demodulator
8	Send timing	ST-B	O	Modulator SCT for terrestrial synchronization
9	Not Used			

A.2.5 RS-422 Interface Front Panel Menus

If the RS-422 interface module is installed, the Utility Interface menu display commands specific to that interface. The RS-422-specific commands are depicted in Chapter 3, Utility Interface menu.

A.2.6 RS-422 Interface Remote Control Commands

Refer to Appendix B for a listing of RS-422 interface module remote control commands.

A.3 Low Voltage Differential Signal (LVDS) Interface

The following paragraphs describe the LVDS interface. This plug-in module provides the physical and electrical interface between an SDM-2020 modulator or demodulator and DVB or DBS signal sources operating with LVDS electrical characteristics. In TM1449, this interface is called, "SPI."

A.3.1 Applicable Documents

Applicable specifications, as referenced herein, include:

TM1449	*Interfaces for CATV/SMATV Headends and Similar Professional Equipment.*
TIA/EIA-644	*Telecommunications Industry Standard, Electrical Characteristics Of Low Voltage Differential Signaling (LVDS) Interface Circuits* (originally *Standards Proposal SP-3357*)

A.3.2 Description

The LVDS interface has dedicated transmit and receive connectors and an auxiliary connector. The Receive Out connector is used with the demodulator while the Transmit In connector is used with the modulator:

- J3 Receive Out connector (25-pin D, female). This connector supports the following data formats:
  - Parallel format: The interface is a DVB 8-bit parallel synchronous interface. Data and clock exit the connector and the output clock (Clock A and Clock B) is at the byte rate.
  - Serial format: MSB (Data7) is used for serial output data and the output clock (Clock A and Clock B) is at the bit rate.
- J4 Transmit In connector (25-pin D, female):
  - Parallel format: The interface is a DVB 8 bit parallel synchronous interface. Data and clock are input to the connector and the input clock (Clock A and Clock B) is at the byte rate.
  - Serial format: MSB (Data7) is used for serial input data and the input clock (Clock A and Clock B) is at the bit rate.

- J5 Auxiliary connector (9-pin D, female):
  - Provides transmit and receive clock references and open collector fault signals.

The Transmit In or Receive Out interface is automatically enabled when the interface module is installed in the modulator or demodulator. The plug-in data interface is programmable for serial or parallel operation from either the front panel keypad or the remote port on the rear panel.

The following cable, or an equivalent computer-grade cable incorporating twisted, shielded pairs, is recommended:

- Belden 8175

The Belden 8175 has lower capacitance, however it has a larger diameter and requires the selection of an appropriate connector shell.

The typical cable length for the serial/parallel interfaces is ≤ 5 meters (16.405 feet).

The interface operates to the specifications described in Table A-7.

Table A-7. LVDS Specifications

General Specifications	
Interface Type	LVDS/DVB Synchronous, Serial/Parallel.
Data Rate	1.5 to 32 Mbit/s, serial. 1.5 to 100 Mbit/s, parallel.
Data Framing Formats	188, 204 byte packets per ETS 300 421, and None.
Connectors	25-pin D female for transmit data. 25-pin D female for receive data. 9-pin D female for reference clocks plus faults.
Electrical Properties	Per TIA/EIA-644.
Signal Types	TX: TX Clock, TX Data, Data Valid, and Sync per TM1449. The modulator does not require Sync or Data Valid with the 188 or 204 byte patterns.
Voltage Levels	290 ± 40 mV differential into 100Ω

A.3.3 Configuration

The interface (Figure A-4) provides DVB compliant operation when pins 2 and 15 are grounded using the “DVB Configuration” jumper settings described below.

In a demodulator, the LVDS interface (J3) only has provision for DVB Configuration, and the Master Clock Input is not used. See jumpers J2 and J7.

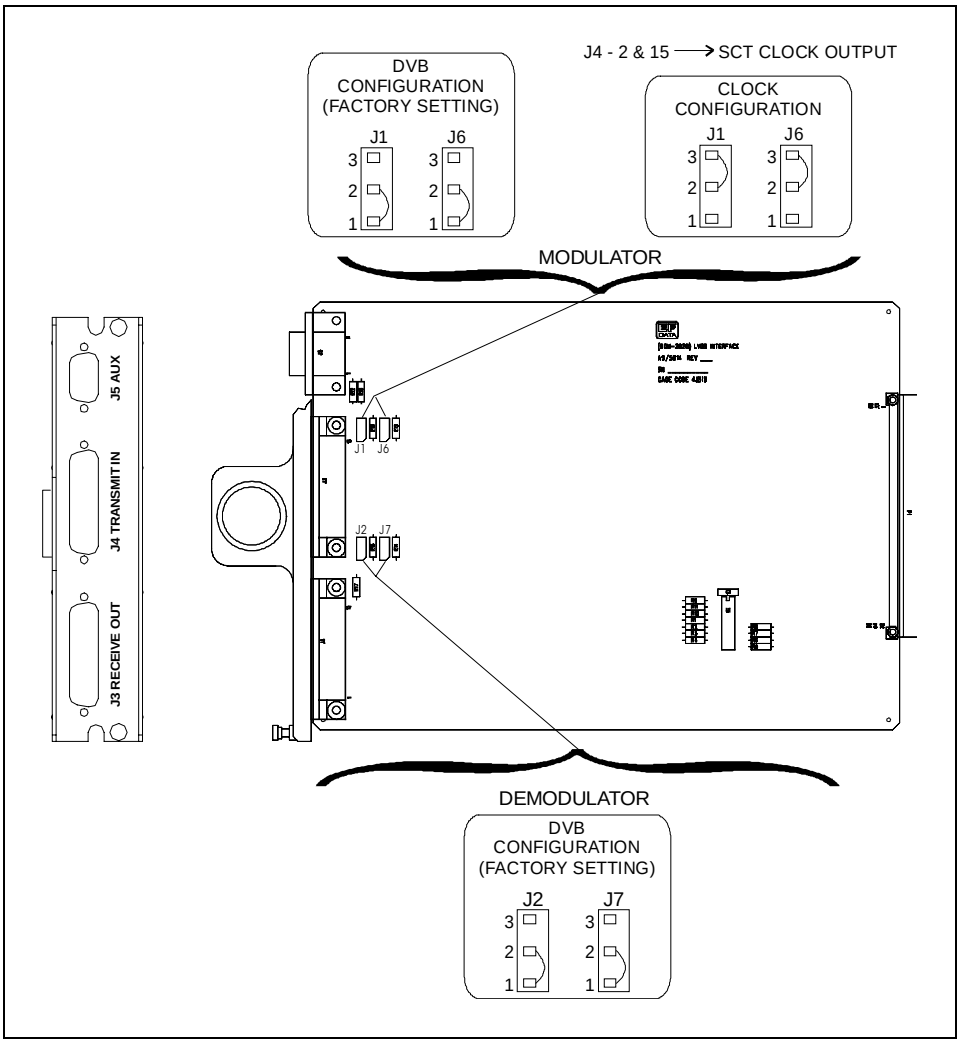

Figure A-4. LVDS Interface Module PCB

A.3.4 User Interfaces

The following paragraphs describe the electrical and physical interfaces, which support terrestrial data and auxiliary information on the LVDS data interface module.

A.3.4.1 Receive/Transmit Data, J3/J4, DB25 Female

There are three general modes of operation controlled via the front panel display/keypad or the remote port. The standard frame formats supported are as follows:

- 188 Mode: The unit outputs a DVB/MPEG2 frame consisting of 1 sync byte (047 hex) and 187 bytes of data. The 16 bytes of Reed-Solomon check data are removed by the demodulator and the 188 byte frame returned to the terrestrial circuit.
- 204 Mode: A 204 byte frame structure consisting of 1 sync byte (047 hex) plus 187 bytes of data and 16 bytes reserved for check bytes is output. The demodulator returns the 204 byte frame to the terrestrial circuit.
- None: In this mode, no frame structure is output. The demodulator removes the 16 Reed-Solomon bytes and the sync byte and returns the data to the terrestrial circuit.

Figure A-1 and depict the 204 byte packetization for byte parallel and byte serial formats at J3 and J4, showing all possible data fields and timing signal relationships.

The 188 byte and no framing formats are subsets of the 204 byte format used over the satellite.

A.3.4.1.1 Connector Pinouts, J3

Note: Table A-8 provides applicable data for the SDM-2020 Demodulator.

The connector is sub-miniature 25-pin D female, with threaded jack nuts.
All signals for this connector are outputs from the Demodulator, except the signal pair on pins 2 and 15 (for an exception, see Figure A-4, for jumper settings).

When used as a serial data port, Data 7 (pins 3 and 16) are the active data pins. For DVB parallel operation, Data 7 through Data 8 are used.

Signal levels are as defined in TIA/EIA-644. Per TM1449, the differential sense of all signal pairs is a logic “1” when “A” is positive with respect to “B”. This is the normal selection in the Configuration Interface menu (see Chapter 3). For DBS applications, the polarity of signals may be inverted from the Configuration Interface menu.

Table A-8. DVB Interface Connector Pinout, J3 Receive Out

Pin #	Signal Function/Name	Type	Comment
1	Clock A	O	Demod
2	System GND	I/GND	Demod, LVDS Interface - N/A, jumper on GND only
3	Data 7 A(MSB/Serial)	O	Demod
4	Data 6 A	O	Demod
5	Data 5 A	O	Demod
6	Data 4 A	O	Demod
7	Data 3 A	O	Demod
8	Data 2 A	O	Demod
9	Data 1 A	O	Demod
10	Data 0 A	O	Demod
11	DVALID A	O	Demod
12	SYNC A	O	Demod
13	Cable Shield	O	Demod
14	Clock B	O	Demod
15	System GND	I/GND	Demod, LVDS Interface - N/A, jumper on GND only
16	Data 7 B (MSB/Serial)	O	Demod
17	Data 6 B	O	Demod
18	Data 5 B	O	Demod
19	Data 4 B	O	Demod
20	Data 3 B	O	Demod
21	Data 2 B	O	Demod
22	Data 1 B	O	Demod
23	Data 0 B	O	Demod
24	DVALID B	O	Demod
25	SYNC B	O	Demod

A.3.4.1.2 Connector Pinouts, J4

Note: Table A-9 is included for reference only. The provided data pertains to the SDM-2020 Satellite Modulator.

The connector is sub-miniature 25-pin D female, with threaded jack nuts (refer to Table A-9 for connector pinouts). All signals for this connector are inputs to the Modulator, except the signal pair on pins 2 and 15 (for an exception, see Figure A-4, for jumper settings).

When used as a serial data port, Data 7 (pins 3 and 16) are the active data pins. For DVB parallel operation, Data 7 through Data 8 are used.

Signal levels are as defined in TIA/EIA-644. Per TM1449, the differential sense of all signal pairs is a logic “1” when “A” is positive with respect to “B”. This is the normal selection in the Configuration Interface menu (see Chapter 3). For DBS applications, the polarity of signals may be inverted from the Configuration Interface menu.

Table A-9. DVB Interface Connector Pinout, J4 TX In

Pin #	Signal Function/Name	Type	Comment
1	Clock A	I	Mod

Pin #	Signal Function/Name	Type	Comment
2	System GND/REFCLKB	O/GND	Mod, Jumper selectable SCT output for Modulator
3	Data 7 A(MSB/Serial)	I	Mod
4	Data 6 A	I	Mod
5	Data 5 A	I	Mod
6	Data 4 A	I	Mod
7	Data 3 A	I	Mod
8	Data 2 A	I	Mod
9	Data 1 A	I	Mod
10	Data 0 A	I	Mod
11	DVALID A	I	Mod, Modulator Ignores
12	SYNC A	I	Mod
13	Cable Shield	I	Mod
14	Clock B	I	Mod
15	System GND/REFCLKA	O/GND	Mod/Demod Jumper selectable SCT output for Modulator
16	Data 7 B (MSB/Serial)	I	Mod
17	Data 6 B	I	Mod
18	Data 5 B	I	Mod
19	Data 4 B	I	Mod
20	Data 3 B	I	Mod
21	Data 2 B	I	Mod
22	Data 1 B	I	Mod
23	Data 0 B	I	Mod
24	DVALID B	I	Mod
25	SYNC B	I	Mod

A.3.4.2 Auxiliary, J5

This port provides for other modem-specific signals not otherwise defined on the data connectors.

A.3.4.2.1 Connector Pinout, J5

The connector is a sub-miniature, 9-pin D female, with threaded jack nuts (refer to Table A-10 for connector pinout).

Differential pairs are LVDS compatible.

Note: The sense of differential signal pairs is a logic “1” when “B” is positive with respect to “A.”

Single ended signals are open collector where:

V_{oh}=12V max. And V_{ol}=0.5V max. @ I_{ol}=8 ma.

A pull-up resistor, external to the equipment, is required.

The fault signals, MF and DF, operate as follows: A fault is indicated by an "OFF" collector (high) and OK status is indicated by an "ON" collector (low).

Table A-10. Auxiliary Connector Pinout

Pin #	Signal Function	Name	Type	Comment
1			GND	Signal Ground
2	Demodulator Fault Indicator	DF	O	Demodulator Summary Fault Redundancy switch application
3	Send Timing	ST-A	O	Modulator SCT for terrestrial synchronization
4			N/C	
5	Not Used			
6	Modulator Fault Indicator	MF	O	Modulator Summary Fault Redundancy switch application
7	Carrier Detect	/CD	O	Demodulator
8	Send Timing	ST-B	O	Modulator SCT for terrestrial synchronization
9	Master Clock	MC-A	I	Demodulator

A.3.5 LVDS Interface Front Panel Menus

If the LVDS interface module is installed, the Utility Interface menu displays commands specific to that interface. Those LVDS-specific commands are depicted in Chapter 3, Utility Interface menu.

A.3.6 LVDS Interface Remote Commands

Refer to Appendix B for a listing of LVDS interface module remote control commands.

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A.4 ASI/RS-422 (Asynchronous Serial Interface and Serial Data Interface)

The following paragraphs describe the ASI/RS-422 Data Interface.

A.4.1 Applicable Documents

Applicable specifications, as referenced herein, include:

TM1449	*Interfaces for CATV/SMATV Headends and Similar Professional Equipment*
RS-422	*Electrical Characteristics of Balanced Voltage Digital Interface Circuits*
EIA-530	*High Speed 25-Position Interface for Data Circuit - Terminating Equipment*

A.4.2 Description

This data interface is a plug-in module that inserts into the rear of the SDM-2020 modulator or demodulator chassis. It provides physical and electrical connection between the external terrestrial circuit and the internal circuitry of the modulator or demodulator. The plug-in interface has full duplex capability but is automatically configured for simplex-transmit or simplex-receive operation.

The ASI/RS-422 interface combines two electrical and physical interfaces into a single assembly. The ASI section provides a DVB-compliant interface with BNC connectors, while the RS-422 section supports serial communications through a standard 25-pin D connector per EIA-530. Operation for either ASI or RS-422 is selected by programming the unit from the front panel keypad/LCD or from the remote port. Only one of the interface types is active at a time. Figure A-5 is a block diagram of the interface; Figure A-6 is a drawing of the ASI module assembly.

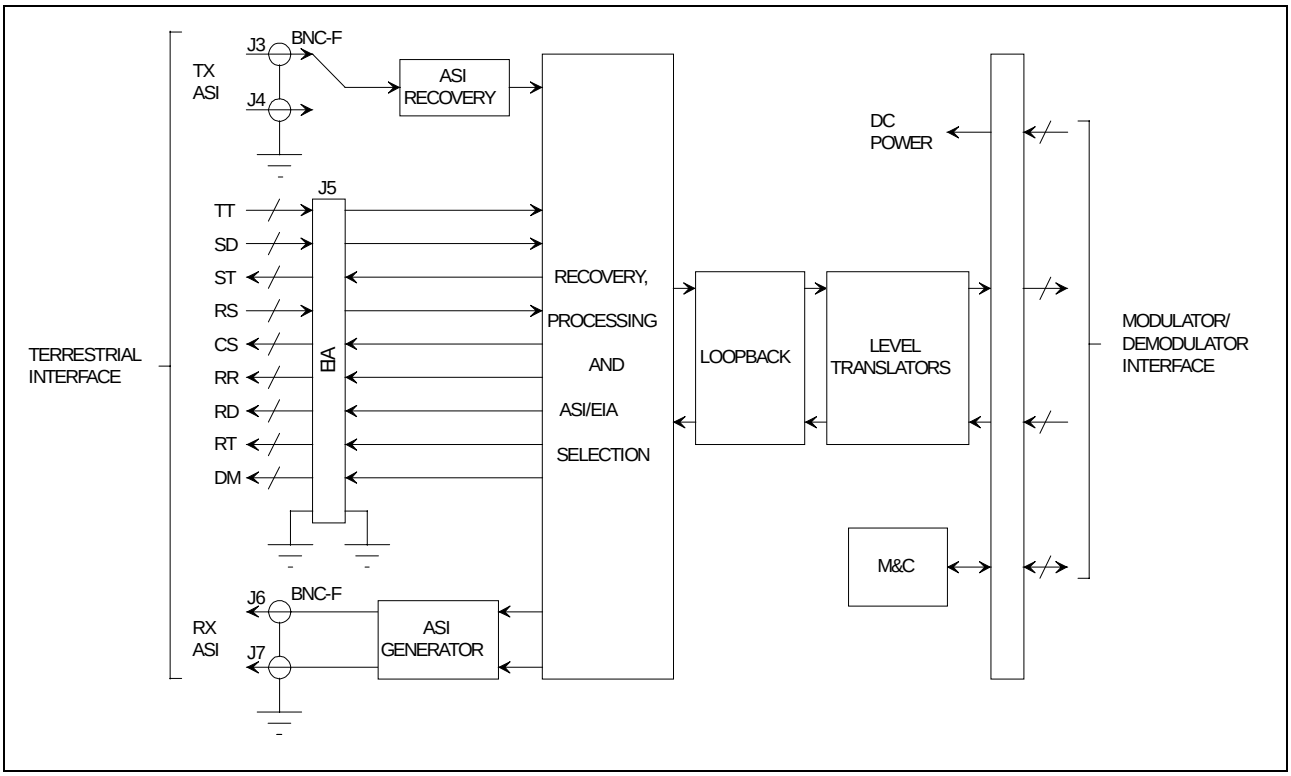

Figure A-5. ASI/RS-422 Interface Block Diagram

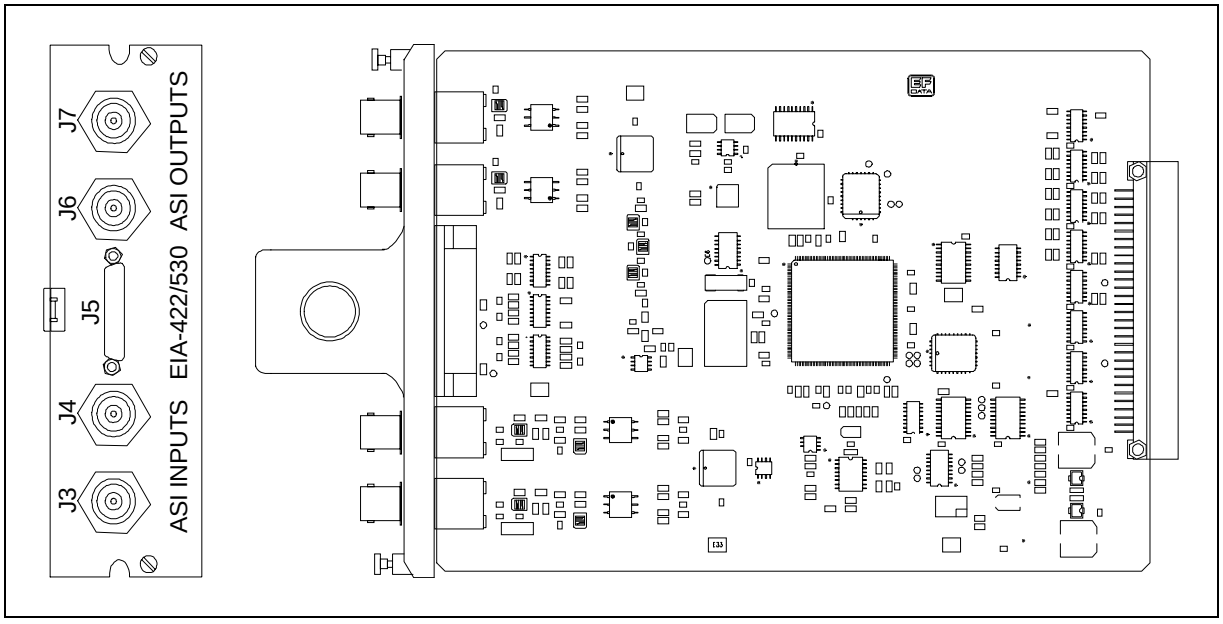

Figure A-6. ASI Module Assembly

A 75Ω coaxial cable (Belden 8281 or equivalent) is recommended for all ASI connectors. Typical coaxial cable length is up to 70 meters (230 feet) with good quality coaxial cable. Typical attenuation of up to 18 dB at 270 MHz is permitted.

The following cable, or equivalent computer grade cables incorporating twisted, shielded pairs, are recommended for the RS-422 interface:

- Belden type LV Computer M9768
- Belden 8175

The Belden 8175 has lower capacitance; however, it has a larger diameter and requires the selection of an appropriate connector shell. The typical cable length for the serial/parallel interfaces is ≤ 5 meters (16.405 feet). The interface operates to the specifications described in Table A-11.

Table A-11. ASI/RS-422 Specifications

General Specifications			
Data Framing Formats	188, 204 byte packets per ETS 300 421, and None.		
Hot Pluggable	Not required. Unit power is turned off prior to removal or insertion of the data interface.		
ASI Specifications			
Data Rate	1.5 to 100 Mbit/s ASI.		
Clock Rate Uncertainty	Programmed data rate ± 100 ppm.		
Transport Clock ASI	The transport rate is 270 Mbit/s for all data rates.		
Impedance	75Ω.		
Return Loss	15 dB, frequencies, 5 to 270 MHz.		
Connectors	BNC female, 75Ω.		
Electrical Properties	Per TM 1449		
Packet Types	Burst or distributed.		
Signal Types	Serial data.		
Voltage Level	800 mV ± 10% into 75Ω.		
ASI Data Loop 3 dB Cutoff Frequency	2 Hz *(see Note 2)*		
Jitter Tolerance	Meets ITU-T G.823 (3/93) and ITU-T G.824 (3/93)		
Jitter Transfer	≤ 0.5 dB peaking up to cutoff frequency. –20 dB per decade beyond cutoff.		
Cable Length, Typical	Rev. – Rev. A	RG59 50 m 100 m	Belden 8281 70 m 140 m
RS-422 Specifications			
Data Rate	1.5 to 18 Mbit/s, serial RS-422.		
Clock Rate Uncertainty	Programmed data rate ± 100 ppm.		
Connectors	25-pin D female per EIA-530.		
Electrical Properties	Per RS-422.		
Signal Types	SD, TT, ST, RD, RT, RS, RR, CS, and DM. Data synchronization is detected by correlating the data stream for the MPEG2 sync pattern per ETS 300 421.		
Voltage Level	4 ± 2V differential into 100Ω.		

Notes:

1. In loopback TX, data is routed through as much of the interface card as practicable before being returned to the RX interface. In a modulator chassis, TX data continues to enter the modulator and is transmitted during loopback. In the demodulator, satellite data is interrupted during loopback and the data entering the TX connector is returned to the RX connector. Demodulator data from the satellite is not routed to the modulator by the data interface.
2. Loop-Through Mode (Modulator Only); is the same as loopback only the yellow TEST MODE LED is not activated.
3. Rev. A or later assemblies include this capability. Rev dash (-) assemblies can be upgraded to this capability.

A.4.3 User Interfaces

The following paragraphs describe the electrical and physical properties of the ASI/RS-422 data interface module.

A.4.3.1 Transmit Input Connectors, J3/J4, BNC, Female

These two connectors accept TX data from the terrestrial interface. By default, J3 is enabled and J4 is disabled. The active input is user programmable and maintained in non-volatile memory of the modulator or demodulator chassis. Both connectors are terminated into 75Ω, whether selected or not.

A.4.3.2 RS-422 Connector, J5, 25-Pin D, Female

This connector is compatible with EIA-530 operation and pin-out. It is a serial interface with RS-422 signals plus the TTL-OC fault signals indicating the status of the modulator or demodulator.

A.4.3.2.1 Connector Pinout, J5

The connector is a 25-pin, female, D type, with threaded jack nuts (refer to Table A-12 for connector pinout).

Notes:

1. RS-422 signal levels are as defined in RS-422.
2. The differential sense of all signal pairs is a logic “1” when “A” is negative with respect to “B.”

Single-ended signals (MF and DF fault signals) are open collector where:

V_{oh}=12V max. and V_{ol}=0.5V max. @ I_{ol}=8 ma.

A pull-up resistor, external to the equipment, is required.

The fault signals, MF and DF, operate as follows: A fault is indicated by an “OFF” (high) and OK status is indicated by an “ON” (low).

Table A-12. RS-422 Connector Pinout (Per EIA-530), J5

Pin #	Signal Function	Name	Type	Comment
1	530 Shield	Shield		Mod/Demod
2	Transmit Data (TD-A)	BA-A	I	Modulator
3	Receive Data (RD-A)	BB-A	O	Demodulator
4	Request To Send (RS-A)	CA-A	I	Modulator
5	Clear To Send (CS-A)	CB-A	O	Modulator
6	DCE Ready (DM-A)	CC-A	O	Demodulator
7	Signal Ground	AB	GND	
8	Receive Line Signal Detect (RR-A)	CF-A	O	Demodulator
9	Receive Timing (RT-B)	DD-B	O	Demodulator
10	Receive Line Signal Detect (RR-B)	CF-B	O	Demodulator
11	Terminal Timing (TT-B)	DA-B	I	Modulator
12	Send Timing (ST-B)	DB-B	O	Modulator
13	Clear To Send (CS-B)	CB-B	O	Modulator
14	Transmit Data (TD-B)	BA-B	I	Modulator
15	Send Timing (ST-A)	DB-A	O	Modulator
16	Receive Data (RD-B)	BB-B	O	Demodulator
17	Receive Timing (RT-A)	DD-A	O	Demodulator
18			N/C	
19	Request To Send (RS-B)	CA-B	I	Modulator
20	Not Used			
21	Demodulator Fault (DF)	DF	O	Demodulator
22	DCE Ready (DM-B)	CC-B	O	Demodulator
23	Not Used			
24	Terminal Timing (TT-A)	DA-A	I	Modulator
25	Modulator Fault (MF)	MF	O	Modulator

A.4.3.3 Receive Output Connectors, J6/J7, BNC, Female

Duplicate signals exit both of these connectors on the demodulator to deliver receive data to the terrestrial interface. J6 and J7 are both active at all times, and no selection is required.

A.4.4 ASI/RS-422 Interface Front Panel Menus

When the ASI/RS-422 interface is selected, only the commands that apply to that specific interface (ASI or RS-422) are displayed. Refer to Chapter 3, Utility Interface menu.

A.4.5 ASI/RS-422 Remote Interface Commands

Refer to Appendix B for a listing of ASI/RS-422 interface module remote control commands.

A.5 ECL/HSSI Interface

This ECL/HSSI interface plug-in module provides the physical and electrical interface between an SDM-2020 modulator or demodulator and a serial ECL signal source operating with TIA/EIA-612 electrical characteristics.

A.5.1 Applicable Documents

Applicable specifications, as referenced herein, include:

ETS 300 421	Digital broadcasting systems for television, sound and data services
TM1449	Interfaces for CATV / SMATV Headends and Similar Professional Equipment, 10th Working Draft
TIA/EIA-612	Electrical Characteristics for an Interface at Data Signaling Rates up to 52 Mbit/s (HSSI)
TIA/EIA-613	High Speed Serial Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment (HSSI)
Cisco HSSI spec	HSSI High Speed Serial Interface Design Specification, rev. 3.0

A.5.2 Description

The ECL/HSSI data interface is an optional rear panel field-installed plug-in, and provides the modulator and demodulator with a emitter coupled logic (ECL) serial data electrical interface.

A.5.3 Specifications

A.5.3.1 Specification Summary

Refer to Table A-13.

Table A-13. Specification Summary

Terrestrial (User) Data Interface:	
Type	Synchronous serial
Data Rate	1.5 to 70 Mbit/s
Signals Supported	RT, RD, ST, TT, SD, TA, CA, LA, LB, LC, TM, TPSYNC, TDVALID, CD, DF, MF, RPSYNC, RDVALID
Electrical	Per EIA-612 (10KH ECL)
Connector	50-pin mini-D female per EIA-613 (HSSI)
Framing Format Compatibility	TM1449 (DVB) DBS (1.5 to 32 Mbit/s only) Transport frame is 188 or 204 MPEG-2 transport stream or none (No Framing).

A.5.4 Terrestrial (User) Data Interface

A.5.4.1 Terrestrial Transport Protocols

The demodulator/modulator is compatible with TM1449 transfer of MPEG-2 data signals in the standardized transport layer format. The demodulator/modulator also supports DBS (DBS-PS-007) no framing (187 bytes) format modes (Table A-14).

Table A-15 summarizes the primary characteristics of each transport protocol. The SDM-2020 was designed to comply with these primary interface standards, however; custom interfaces can be supported as outlined in the data transfer modes definition section of this document.

Table A-14. Framing Format Summary

Framing Format Summary					
Transport Protocol	**Transport Package Size (bytes)**	**Sync Byte**	**Sync Byte Strobe**	**Data Valid Strobe**	**Comments**
TM1449 (DVB)	188, 204	yes	yes	yes	SYNC active for byte time.
DBS	204	yes	yes	no	SYNC active for bit time. Extend one bit time for error.
No Framing	187	no	no	no	data stream.

Table A-15. Terrestrial Transport Protocols

Data Valid	For all TX framing modes, the data valid input "DVALID" will be ignored. Packet structures and validity of data will be based on the programmed frame format. For all RX framing modes, the data valid output "DVALID" will operate as defined in the frame mode definitions.
Transmit Interface Synchronization Modes	The transmit interface supports two synchronization modes: 1. Sync Byte Data Correlation Mode - Frame synchronization is correlated from the packet input data, based on the embedded sync word (47 HEX). In this mode the "SYNC" input is ignored. 2. External Sync Mode - Frame synchronization is based on the external "SYNC" input. In this mode the data which occupies the sync byte data position(s) is over written with a valid sync word (47 HEX) based on the occurrence of the "SYNC" input timing by the Modem. **Notes:** 1. The frame synchronization mode is not directly selectable by the user from the front panel interface. 2. Refer to the SDM-2020 Modulator for synchronization mode.
Serial Data Formats	The processing order shall always start from the MSB (i.e. "0") of the sync word-byte (i.e., 01000111).
187 Byte (no framing) Serial Format	The 187 byte format contains no framing information. Figure A-7 shows the general packet arrangement from the receiver. There is no sync, so the "SYNC" signal is always logic "0". Since data is always present, the data valid signal "DVALID" is always logic "1". The SYNC and DVALID signals into the transmitter are not utilized
188 Byte Serial Format	The 188 byte serial format consists of 1 sync byte (8 bits, MSB first), followed by 187 payload bytes (1496 bits). Figure A-8 shows the signal relationships for the 188 byte serial interface. The DVALID signal into the transmitter is not utilized.
204 Byte Serial Format	The 204 byte serial format consists of 1 sync byte (8 bits, MSB first), 187 payload bytes (1496 bits), and 16 dummy bytes (128 bits for Reed-Solomon check-sum). Typically the 16 dummy bytes reserved for Reed-Solomon coding are set to zero (logic low), this is a requirement at the receive interface. Figure A-9 shows the signal relationships for the 204 byte serial format. Note that the "DVALID" signal is de-asserted during the last 16 bytes of the frame. The DVALID signal into the transmitter is not utilized.
204 Byte DBS Serial Format	A special case of the 204 byte format is the Digital Broadcast via Satellite (DBS) mode. The DBS mode is the same as the general 204 byte format except that the sync pulse is only asserted during the first bit of the sync byte. Figure A-10 shows the signal relationships for the 204 byte DBS serial format. The DVALID signal into the transmitter is not utilized.

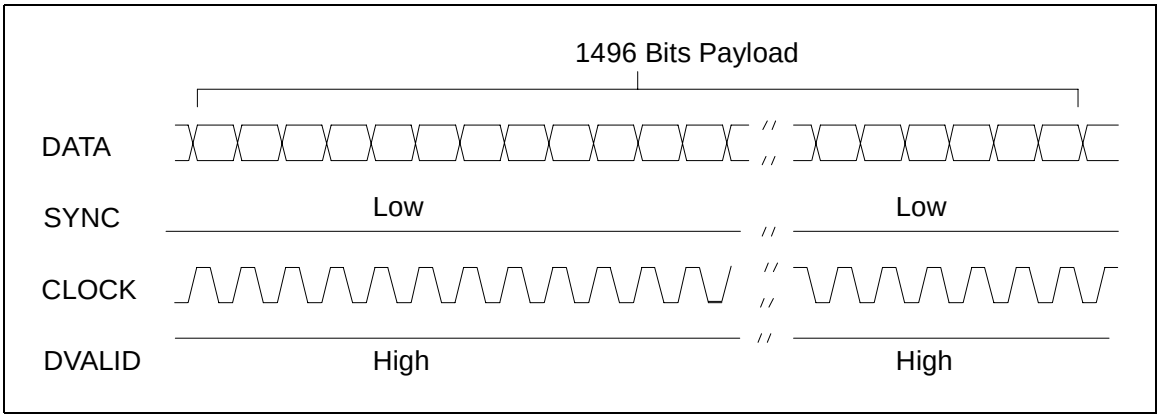

Figure A-7. 187 Byte (no framing) Serial Format

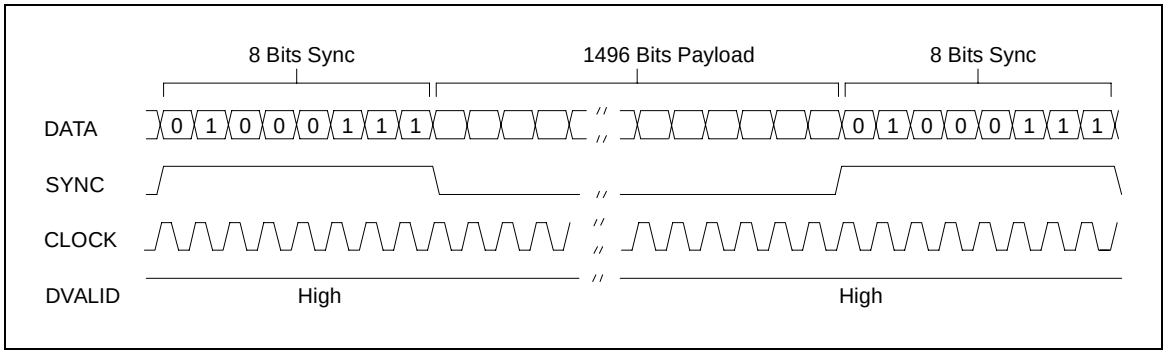

Figure A-8. 188 Byte Serial Format

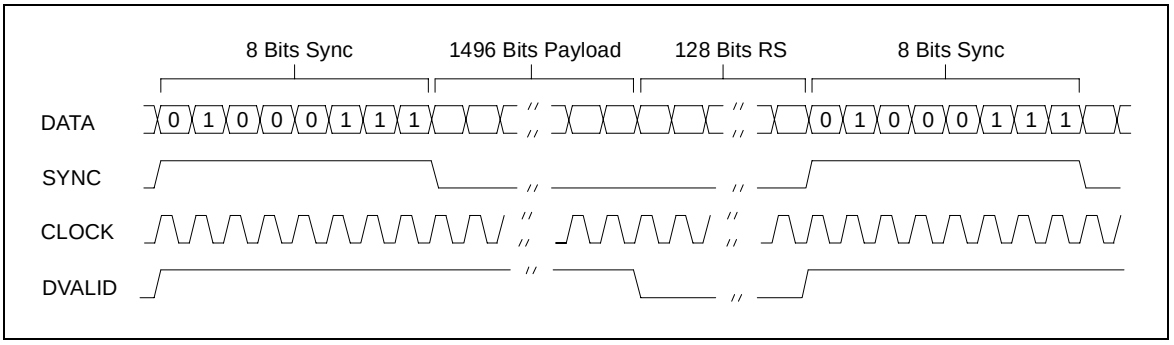

Figure A-9. 204 Byte Serial Format

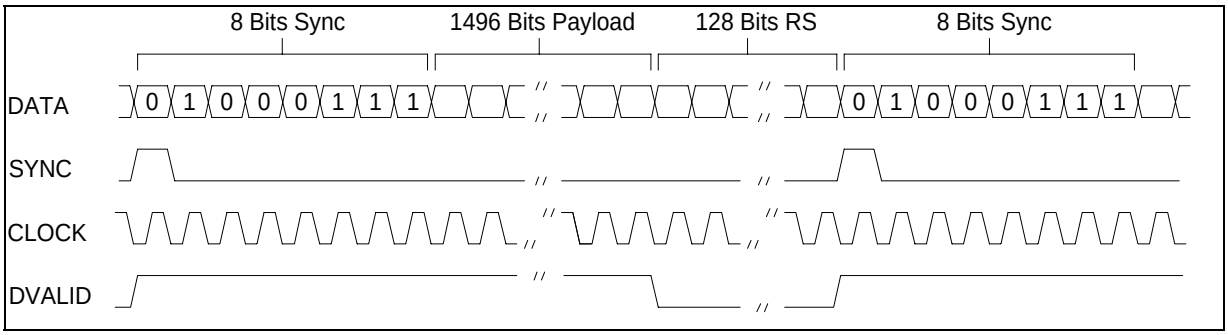

Figure A-10. 204 Byte DBS Serial Format

A.5.4.2 Terrestrial Signal Definition

Refer to Table A-16 and Figure A-11 for HSSI pinout.

Table A-16. HSSI Pinout (J3)

HSSI/EIA-613 Interface Connector Pinout					
Signal Function	**HSSI Signal**	**EIA-613 Circuit**	**Pin # (+, -)**	**Circuit Direction**	**Comment**
Signal Ground	SG	102	1, 26		Mod/Demod
Receive Timing	RT	115	2, 27	from DCE	Demodulator
DCE Available	CA	107	3, 28	from DCE	Mod/Demod
Receive Data	RD	104	4, 29	from DCE	Demodulator
Loopback Circuit C	LC	undefined	5, 30	from DCE	Mod/Demod
Send Timing	ST	114	6, 31	from DCE	Modulator
Signal Ground	SG	102	7, 32		Mod/Demod
DTE Available	TA	108/2	8, 33	to DCE	Mod/Demod
Terminal Timing	TT	113	9, 34	to DCE	Modulator
Loopback Circuit A	LA	143	10, 35	to DCE	Mod/Demod
Send Data	SD	103	11, 36	to DCE	Modulator
Loopback Circuit B	LB	144	12, 37	to DCE	Mod/Demod
Signal Ground	SG	102	13, 38		Mod/Demod
TX PSYNC *(See Note 1).*	TPSYNC	undefined	14, 39	to DCE	Modulator
TX DVALID *(See Note 1).*	TDVALID	undefined	15, 40	to DCE	Modulator
Reserved (to DCE)			16, 41		unused
Reserved (to DCE)			17, 42		unused
Reserved (to DCE)			18, 43		unused
Signal Ground	SG	102	19, 44		Mod/Demod
Carrier Detect (lock) *(See Notes 1 and 2).*	CD	undefined	20	from DCE	Demodulator
Demodulator Fault *(See Notes 1 and 3).*	DF	undefined	45	from DCE	Demodulator
Modulator Fault *(See Notes 1 and 3).*	MF	undefined	21	from DCE	Modulator
Reserved (to DTE)			46		unused
RX PSYNC *(See Note 1).*	RPSYNC	undefined	22, 47	from DCE	Demodulator
RX DVALID *(See Note 1).*	RDVALID	undefined	23, 48	from DCE	Demodulator
Test Mode	TM	142	24, 49	from DCE	Mod/Demod
Signal Ground	SG	102	25, 50		Mod/Demod

Notes:

1. Bold signal function names are non-HSSI defined signals. On Cisco routers there is no connection to those pins. Reference the Comtech EF Data web site for an Application Note describing the use of the SDM-2020 with Cisco routers.
2. TTL - output.
3. TTL - open collector output.

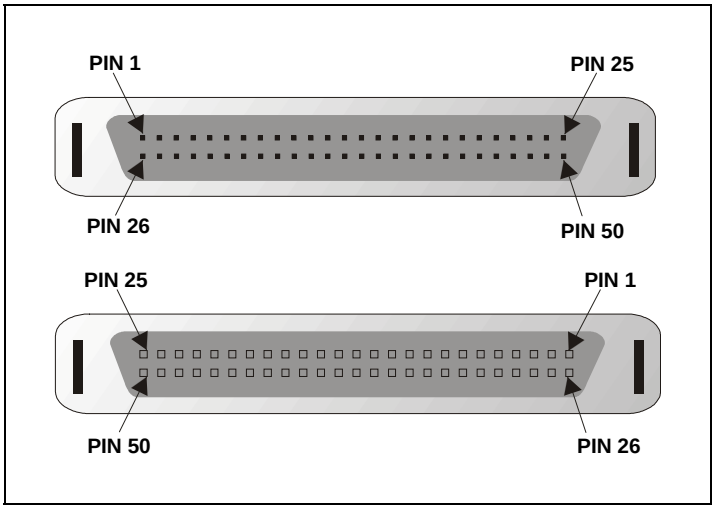

Figure A-11. ECL/HSSI Connector, Pin Location

HSSI (High Speed Serial Interface per Cisco Systems, Inc.) and EIA-613 (High Speed Serial Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment) specifications define the high speed serial port functionality. The serial port will be referred to as the HSSI Interface. The HSSI Interface is compatible with EIA-613/EIA-612.

Additional non-standard signals will be included on reserved pins and are highlighted in the signal definition table.

Note: Standard EIA-613 defines the interconnection of data terminal equipment (DTE) and data circuit-termination equipment (DCE) utilizing high speed serial circuits. The SDM-2020 modulator/demodulator is defined as a DCE. Figure A-12 shows the HSSI signal flow and naming convention for defined signals.

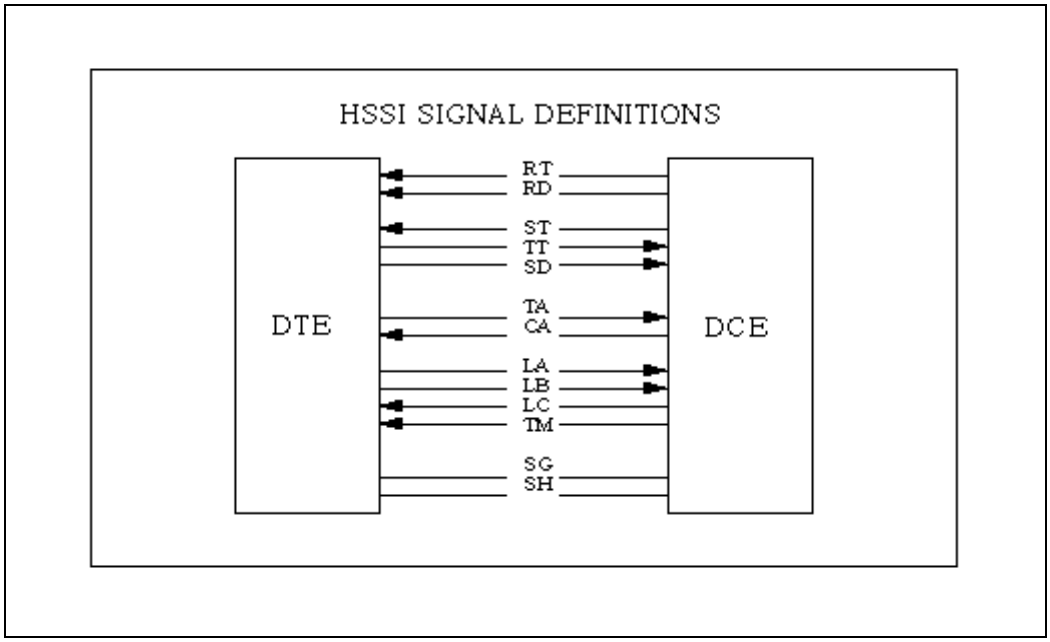

Figure A-12. HSSI Signal Flow

Terminal A “+” of the generator shall be positive with respect to terminal B “-” for a binary 1 or ON state. The B “-” terminal of the generator shall be positive with respect to the terminal A “+” terminal for a binary 0 or OFF state.

A.5.4.3 Terrestrial Extended Signal Definitions

The HSSI specification has no provision for SYNC or DVALID signals. If terrestrial data framing is desired, a sync byte (47 hex) is embedded into the data stream every 188 or 204 bytes, as selected in the modulator configuration. The modulator detects the sync byte and formats the serial interface into a standard, error-protected 204 byte packet.

In order to support TM1449, PSYNC and DVALID will be routed to RESERVED (from DCE) HSSI pins. Refer to Table A-17 for definition of signals.

Table A-17. Definition of Signals

Signal	Definition
Transmitter Synchronization Signal (TX PSYNC)	Indicates the beginning of a transport packet by signaling the SYNC byte. Active per defined format timing.
Transmitter Data Valid (TX DVALID)	Indicates valid data at the interface. Active per defined format timing.
Carrier Detect (CD)	Indicates Demodulator carrier tracking loop locked. Status output. TTL output. Active High (programmable).
Demodulator Fault (DF)	Open collector TTL signal indicating Demodulator Fault. Active High. External pull-up required.
Modulator Fault (MF)	Open collector TTL signal indicating Modulator Fault. Active High. External pull-up required.
Receiver Synchronization (RX PSYNC)	Indicates the beginning of a transport packet by signaling the SYNC byte. Active per defined format timing.
Receiver Data Valid (RX DVALID)	Indicates valid data at the interface. Active per defined format timing.

A.5.4.4 Terrestrial Data Rate

The terrestrial interface supports synchronous data transfer rates from 1.5 to 70 Mbit/s.

Notes:

1. EIA-612 (Electrical Characteristics for an Interface at Data Signaling Rates up to 52 Mbits/s) defines the electrical characteristics required for data transfers up to 52 Mbits/s utilizing ECL driver/receiver technology.
2. The HSSI port will comply with EIA-612 for transfers less than 52 Mbits/s.
3. For short distances, an SCSI-2 cable will work, although the impedance will be wrong.

The recommended cable is a CISCO "CAB-HSI1 (DTE to DCE)" or "CAB-HNUL (DCE to DCE)" incorporating twisted, shielded pairs. The maximum cable length should be ≤ 3 ft (7.62 cm) for the 70 Mbits/s transfer rates.

A.5.4.5 Terrestrial Electrical Characteristics

All signals are balanced, differentially driven, and received at standard 10K/100K ECL levels. Table A-18 summarizes the electrical properties of the HSSI interface.

Table A-18. HSSI General Specifications

General Specifications	
Connectors	50-pin mini-D female for EIA-613 (HSSI) data.
Electrical Properties	Per EIA-612 (10KH ECL). TTL/TTL open-collector.
Typical Voltages Levels	Differential voltage: ≥ 590 mV, 110Ω load Input voltage range: -0.5 to -2.0V Referenced to receiver common.

A.5.4.6 Terrestrial Timing

The nominal interface timing is as follows:

- Clock is 50% duty cycle
- Data/control signals transition on the rising (low to high) edge of the clock
- Data/control signals are stable on the falling (high to low) edge of the clock

Figure A-13 shows the nominal interface timing.

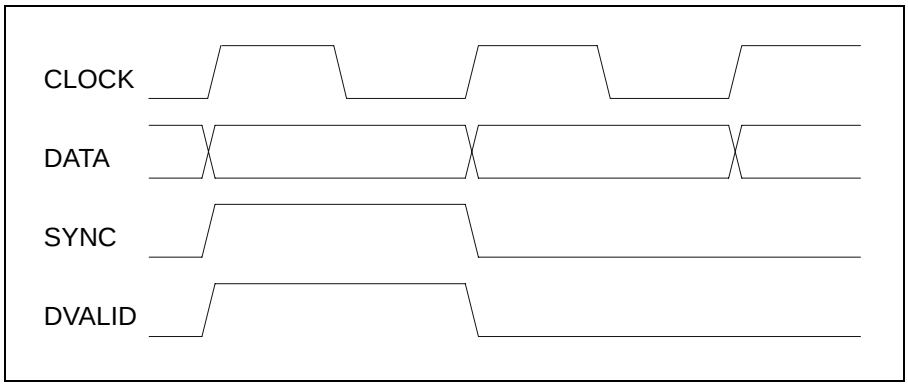

Figure A-13. Nominal Interface Timing

Use the timing diagram shown in Figure A-14 for the worst case interface timing specifications.

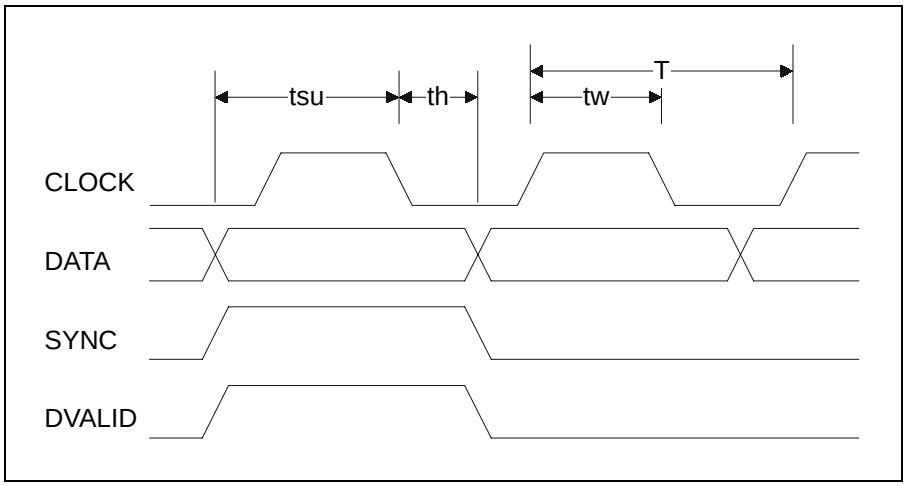

Figure A-14. Interface Timing

The timing parameters for the serial data transmit interface are listed in Table A-19.

Table A-19. Transmit Timing Parameters

Parameter	Description	Min	Max	Units
f	Operating frequency (1/T)	1.5	100	MHz
T	Clock period (1/f)	10	666	nsec
t_w	Clock pulse width	4	-	nsec
t_{su}	Setup time, DATA or SYNC to CLOCK	3	-	nsec
t_h	Hold time, CLOCK to DATA or SYNC invalid	3	-	Nsec

The timing parameters for the serial data receive interface are listed in Table A-20.

Table A-20. Receive Timing Parameters

Parameter	Description	Min	Max	Units
f	Operating frequency (1/T)	1.5	100	MHz
T	Clock period (T)	10	666	nsec
t_w	Clock pulse width	4	-	nsec
t_{su}	Setup time, DATA, DVALID, or SYNC to CLOCK	3	-	nsec
t_h	Hold time, CLOCK to DATA, DVALID or SYNC invalid	3	-	nsec

A.5.4.7 Terrestrial TX Clock Phase

The ECL/HSSI interface supports TX clock phase inversion. Terrestrial data is sampled on the falling edge of TT clock in normal phase selection. In inverted phase selection, the terrestrial data will be sampled on the rising edge of TT clock.

A.5.4.8 Terrestrial RX Clock Phase

The ECL/HSSI interface supports RX clock phase inversion. Terrestrial data (RD) is synchronous to RT. In normal mode, the falling edge of the RT clock will be centered on the RD signal. In inverted phase selection, the rising edge of RT clock will be centered on the RD signal.

A.5.5 Monitor and Control Functions

A.5.5.1 System Implementation

Refer to Table A-21 for signal definition.

Table A-21. Signal Definition

Signal	Definition
TA (Data Terminal Equipment Available) LA (Loopback Circuit A) LB (Loopback Circuit A)	These signals are inputs from the HSSI interface. The state of these inputs is read by the M&C from the ECL/HSSI interface status register.
CA (Data Communication Equipment Available) LC (Loopback Circuit C) TM (Test Mode)	These signals are outputs from the HSSI interface. The state of these outputs is controlled by the M&C writing the ECL/HSSI interface control register.
TA	This signal indicates the DTE is available for data transfers. When the DTE is not available the RF output will be turned Off and the DTE status menu shall reflect DTE unavailable.
LA and LB loopback input control signals	These signals are available to the M&C, but no functional support is required.

Upon Modem power-up the CA output is set UNAVAILABLE until all modem initialization has been completed and no faults are detected. After completion of initialization the CA line is set AVAILABLE. Any detectable faults that cause the modem to be place in an non-operational mode shall set CA UNAVAILABLE.

TM output shall be set ACTIVE if the ECL/HSSI interface is commanded into Loopback mode. TM shall be INACTIVE for all other modes.

LC output is not supported, and is set inactive for all modes.

A.5.5.2 Faults

Refer to Table A-22 for ECL/HSSI fault indicators to the HSSI connector (Reserved DCE pins) from the modem interface.

Table A-22. Fault Signal Definitions

Signal	Definition
Carrier Detect (CD)	Indicates Demodulator carrier tracking loop locked. Status output. TTL output. Active High (programmable).
Modulator Fault (DF)	Open collector TTL signal indicating Demodulator fault. Active High. An external pull-up resistor is required.
Modulator Fault (MF)	Open collector TTL signal indicating Modulator fault. Active High. An external pull-up resistor is required.

A.5.5.3 ECL/HSSI Interface Front Panel Menus

Refer to Chapter 3, Utility Interface menu.

A.5.5.4 ECL/HSSI Interface Remote Control Commands

Refer to Appendix B for a listing of ECL/HSSI interface module remote control commands.

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A.6 G.703 Data Interface

The following paragraphs describe the G.703 data interface.

A.6.1 Applicable Documents

Applicable documents, as referenced herein, include:

- *ITU-T G.703, Physical/Electrical Characteristics Of Hierarchical Digital Interfaces*
- *ITU -T G.704, Synchronous Frame Structures Used At Primary And Secondary Hierarchical Levels*
- *ITU-T G.742, General Considerations On Second Order Multiplex Equipment*
- *ITU-T G.743, Second Order Digital Multiplex Equipment Operating At 6312 kbit/s And Using Positive Justification*
- *ITU-T G.745, Second Order Digital Multiplex Equipment Operating At 8448 kbit/s And Using Positive/Zero/Negative Justification*
- *ITU-T G.747, Second Order Digital Multiplex Equipment Operating At 6312 kbit/s And Multiplexing Three Tributaries At 2048 kbit/s*
- *ITU-T G.751, Digital Multiplex Equipments Operating At The Third Order Bit Rate Of 34,368 kbit/s And The Fourth Order Bit Rate Of 139,264 kbit/s And Using Positive Justification*
- *ITU-T G.752, Characteristics of Digital Multiplex Equipments Based On A Second Order Bit Rate Of 6312 kbit/s And Using Positive Justification*
- *ITU-T G.753, Third Order Digital Multiplex Equipment Operating At 34,368 kbit/s And Using Positive/Zero/Negative Justification*
- *ITU-T G.823, The Control Of Jitter And Wander Within Digital Networks Which Are Based On The 2048 kbit/s Hierarchy*
- *ITU-T G.824, The Control Of Jitter And Wander Within Digital Networks Which Are Based On The 1544 kbit/s Hierarchy*
- *Bellcore SONET STS-1*

A.6.2 Description

The G.703 data interface is a plug-in module that inserts into the rear of the SDM-2020 Satellite Demodulator chassis. It provides physical and electrical connection between terrestrial data equipment and the internal circuitry of the demodulator. The interface is designed for full duplex capability and is automatically configured for simplex RX operation.

The interface operates at the digital hierarchy Mbit/s of:

- 1.544
- 2.048
- 6.312
- 8.448
- 32.064
- 34.368
- 44.736 (per ITU-T G.703)
- 51.840 (per SONET STS-1)

Refer to Figure A-15 for G.703 block diagram and for assembled view.

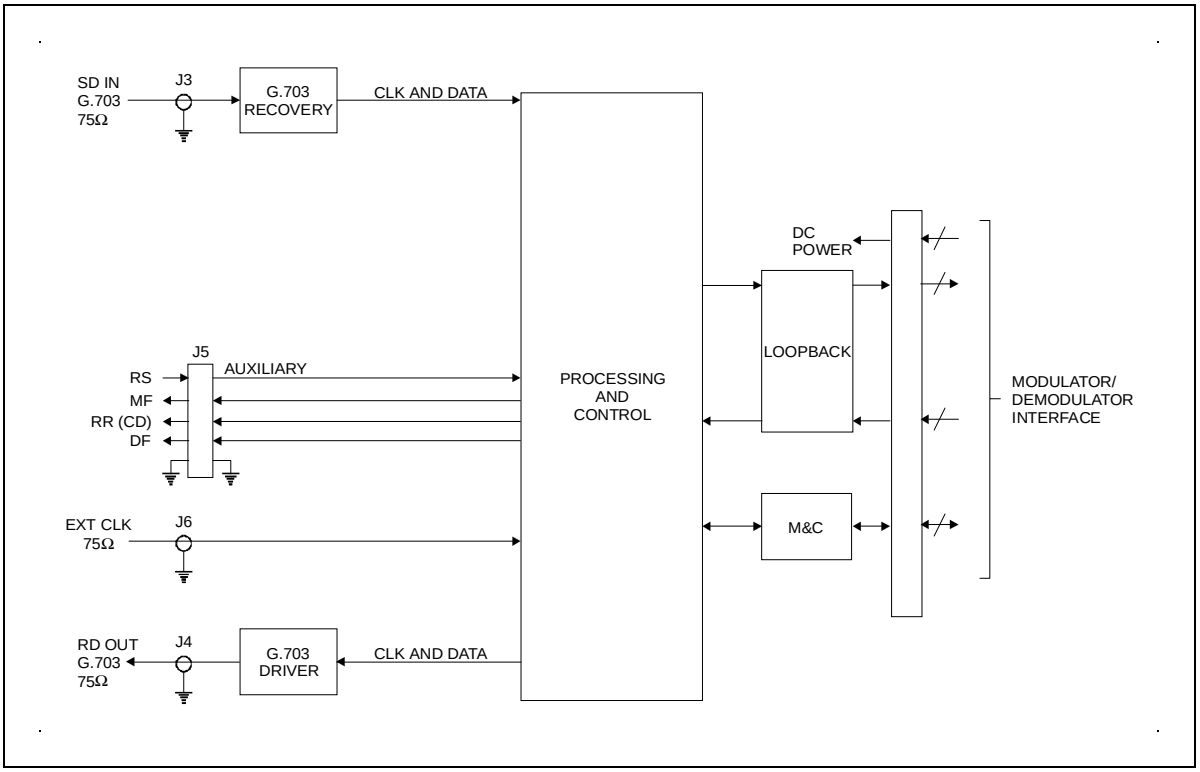

Figure A-15. G.703 Block Diagram

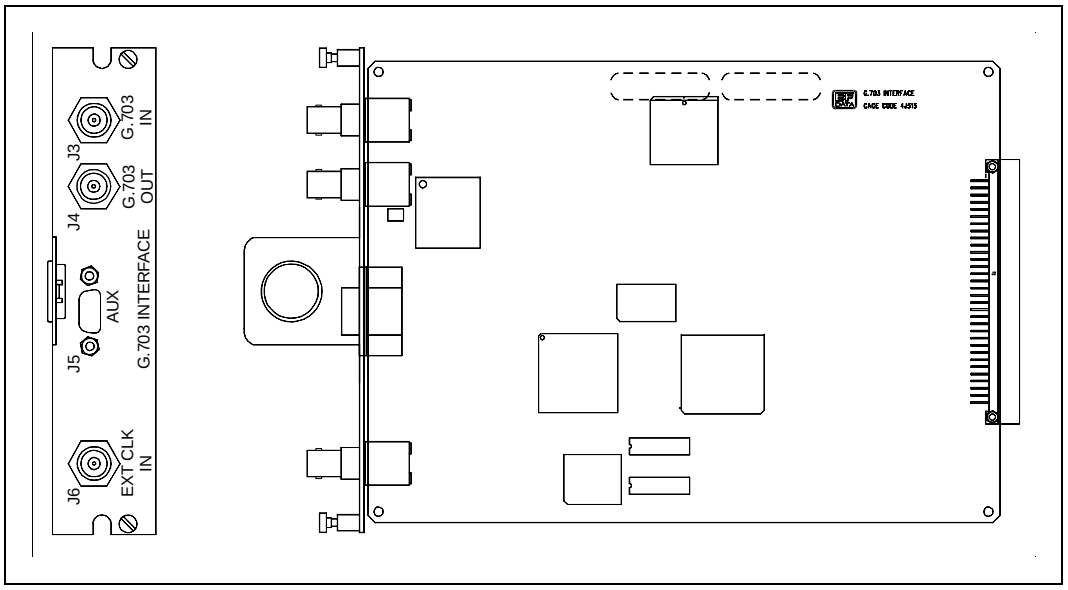

Figure A-16. G.703 Interface Assembly

A.6.3 Specifications

Table A-23 is a summary of the G.703 data interface specifications, demodulator application.

Table A-23. G.703 Specification

G.703 Specifications	
General	Per ITU-T G.703 where applicable unless otherwise specified
Data Rates (programmable)	• 1.544 Mbit/s • 2.048 Mbit/s • 6.312 Mbit/s • 8.448 Mbit/s • 32.064 Mbit/s • 34.368 Mbit/s • 44.736 Mbit/s (per ITU-T G.703) • 51.840 Mbit/s (per Bellcore SONET STS-1)
Internal Clock Accuracy	10ppm
Line Coding	AMI (none), HDB3, B8ZS, or B3ZS
Interface Loopback	ON or OFF
Interface Loop-Through	ON or OFF
Jitter Characteristics	Per ITU-T G.823 and ITU-T G.824 where applicable
RX 2047 Pattern Correlation	ON/OFF (programmable test mode with error rate reporting)
TX Data Interface	
Input Signal Characteristics	Per ITU-T G.703
Input Impedance	75Ω
Connector Type	BNC (female)
RX Data Interface	
Output Signal Characteristics	Per ITU-T G.703
Output Impedance	75Ω
Connector Type	BNC (female)
Receive Buffer	Plesiochronous/Doppler
Buffer Size	2 milliseconds to 32 milliseconds, programmable in steps of 2 ms
Frame Structures	(Programmable for plesiochronous buffer slips) 1.544 Mbit/s - none, G.704 2.048 Mbit/s - none, G.704 6.312 Mbit/s - none, G.704, G.743, or G.747 8.448 Mbit/s - none, G.704, G.742, or G.745 32.064 Mbit/s – none, G.752 34.368 Mbit/s - none, G.751, or G.753 44.736 Mbit/s – none, G.752 51.840 Mbit/s – none, STS-1
Buffer Output Clock Source (programmable)	Internal, TX terrestrial (recovered), external reference, or satellite (bypass)

Table A-23. G.703 Specification (Continued)

G.703 Specifications (Continued)	
External Reference Clock	
Input Signal Characteristics	Sine wave or square wave with duty cycle of 50% (± 10%)
Input Amplitude	0.5 to 5.0V peak to peak
Input Impedance	75Ω ± 5%
Input Frequency	1.544 to 20.0 MHz in steps of 8.0 kHz or at RX data rate
Connector Type	BNC (female)
Auxiliary Functions Port	
Signals	DF (demodulator fault, open collector TTL output) CD (carrier detect, TTL output)
Connector Type	9-pin sub-D (female)
Controlled Items:	
Data	Date Rate Line Coding
Test Modes	Interface Loop-Through Interface Loopback RX2047 Pattern
Buffer/Doppler/Plesiochronous	Size Clock Source Frame Structure Buffer Centering
Monitor Functions	
RX Interface Faults	Buffer underflow, buffer overflow, buffer clock activity, buffer clock PLL, buffer full, data/AIS, 2047 pattern lock, FPGA program
Buffer Fill Status	1 to 99%
RX 2047 Error Rate	1E-3 to 5 E-8 (with one magnitude accuracy)

A.6.4 Receive Specifications

The following receive specifications apply when the G.703 data interface is installed in an SDM-2020 Demodulator.

A.6.4.1 Receive Data Rate 1.544 Mbit/s Specifications

Refer to Table A-26 for data rate specifications.

Table A-24. RX Data Rate 1.544 Mbit/s

Parameter	Specification
Data Rate	1.544 Mbit/s, ± 30 ppm
Line Coding	B8ZS and AMI at 1.544 Mbit/s
Pulse Shape	Rectangular per ITU-T-G.703, Figure 12/G.703.
Jitter Characteristics: Input Jitter Output Jitter	 Complies with ITU-T-G.824 and Table 1/G824. In accordance with ITU-T-G.824 and Figure 1/G.824.

A.6.4.2 Receive Data Rate 2.048 Mbit/s Specifications

Refer to Table A-25 for data rate specifications.

Table A-25. RX Data Rate 2.048 Mbit/s

Parameter	Specification
Data Rate	1.544 Mbit/s, ± 30 ppm
Line Coding	B8ZS and AMI at 2.048 Mbit/s
Pulse Shape	Rectangular per ITU-T-G.703, Figure 12/G.703.
Jitter Characteristics: Input Jitter Output Jitter	 Complies with ITU-T-G.824 and Table 1/G824. In accordance with ITU-T-G.824 and Figure 1/G.824.

A.6.4.3 Receive Data Rate 6.312 Mbit/s Specifications

Refer to Table A-26 for data rate specifications.

Table A-26. RX Data Rate 6.312 Mbit/s

Parameter	Specification
Data Rate	6.312 Mbit/s, ± 30 ppm
Line Coding	B8ZS and AMI at 6.312 Mbit/s
Pulse Shape	Rectangular per ITU-T-G.703, Figure 12/G.703.
Jitter Characteristics: Input Jitter Output Jitter	 Complies with ITU-T-G.824 and Table 1/G824. In accordance with ITU-T-G.824 and Figure 1/G.824.

A.6.4.4 Receive Data Rate 8.448 Mbit/s Specifications

Refer to Table A-27 for data rate specification.

Table A-27. RX Data Rate 8.448 Mbit/s

Parameter	Specification
Data Rate	8.448 Mbit/s, ± 30 ppm
Line Coding	HDB3 and AMI at 8.448 Mbit/s
Pulse Shape	Rectangular with pulse width of 59 ns. per ITU-T-G.703, Figure 13/G.703.
Jitter Characteristics: Input Jitter Output Jitter	 Complies with ITU-T-G.823 and Table 1/G.823. Complies with ITU-T-G.823 and Figure 1/G.823

A.6.4.5 Receive Data Rate 32.064 Mbit/s Specifications

Refer to Table A-28 for data rate specifications.

Table A-28. RX Data Rate 32.064

Parameter	Specification
Data Rate	32.064 Mbit/s, ± 10 ppm
Line Coding	HDB3 and AMI at 32.064 Mbit/s
Pulse Shape	Per ITU-T-G.703
Jitter Characteristics: Input Jitter Output Jitter	 Complies with ITU-T-G.824 and Table 1/G.824. Complies with ITU-T-G.824 and Figure 1/G.824.

A.6.4.6 Receive Data Rate 34.368 Mbit/s Specifications

Refer to Table A-29 for data rate specifications.

Table A-29. RX Data Rate 34.368

Parameter	Specification
Data Rate	34.368 Mbit/s, ± 20 ppm
Line Coding	HDB3 and AMI at 34.368 Mbit/s
Pulse Shape	Per ITU-T-G.703, Figure 17/G.703
Jitter Characteristics: Input Jitter Output Jitter	 Complies with ITU-T-G.823, and Table 1/G.823. Complies ITU-T-G.823 and Figure 1/G.823.

A.6.4.7 Receive Data Rate 44.736 Mbit/s Specifications

Refer to Table A-30 for data rate specifications.

Table A-30. RX Data Rate 44.736

Parameter	Specification
Data Rate	44.736 Mbit/s, ± 20 ppm
Line Coding	B3ZS and AMI at 44.736 Mbit/s
Pulse Shape	Per ITU-T-G.703, Figure 14/G.703
Jitter Characteristics: Input Jitter Output Jitter	 Complies with ITU-T-G.824, and Table 1/G.824. Complies ITU-T-G.824 and Figure 1/G.824.

A.6.4.8 Receive Data Rate 51.840 Mbit/s Specifications

Refer to Table A-31 for data rate specifications.

Table A-31. RX Data Rate 51.840 Mbit/s

Parameter	Specification
Data Rate	51.840 Mbit/s, ± 20 ppm
Line Coding	B3ZS and AMI at 51.840 Mbit/s
Pulse Shape: Amplitude Pulse Width Pulse Mask	 ± 1.75V (± 10%) 9.64 ns (± 10%) Per TA-NWT-000253 (STS-1)
Jitter Characteristics	Input Jitter: Complies with ITU-T-G.824, Table 1/G.824 scaled from those defined for 44.736 Mbit/s to apply to 51.840 Mbit/s.

A.6.5 Receive Doppler/Plesiochronous Buffer Specifications

A.6.5.1 Buffer Size

The operator can set the buffer size, ranging from 2 milliseconds to 32 milliseconds, in 2 millisecond steps. There is also a buffer bypass selection, buffer size of 0 milliseconds.

A.6.5.2 Frame Structures

The unit provides programmable plesiochronous buffer slips.

Frame structures provided according to data rate:

- 1544 kbit/s - None or G.704
- 2048 kbit/s - None or G.704
- 6312 kbit/s - None, G.704, G.743, or G.747
- 8448 kbit/s - None, G.704, G.742, or G.745
- 32064 kbit/s - None or G.752
- 34368 kbit/s - None, G.751, or G.753
- 44736 kbit/s - None, G.752
- 51840 kbit/s - None or STS-1

A.6.5.3 Buffer Clock Sources

The unit shall provide for buffer clock source selections.

Source selections:

- Internal
- Transmit terrestrial
- External Reference
- RX satellite

A.6.5.4 Buffer Clock Backup

In the event of failure of the selected buffer clock the unit automatically selects the RX satellite clock as the backup.

A.6.5.5 Buffer Centering

The unit provides buffer centering capability. The buffer can be set to 50% by the operator via the front panel. Buffer centering also occurs automatically after each of the following: receive signal acquisition, change in buffer size, change in buffer reference, and an overflow/underflow condition. During overflow or underflow conditions a Demod alarm is indicated. A buffer full condition is reported when the buffer exceeds 90% full, or when the buffer falls below 10%.

A.6.5.6 General Receive Specifications

Refer to Table A-32 for general RX specifications.

Table A-32. General RX Specification

RX 2047 Pattern Generation	The unit supplies a 2047 test pattern substitution into the RX data path and perform BER calculations on that pattern, with the results reported to the host unit.
AIS/Data Fault Detection	The unit provides AIS (all 1's) or data fault (all 1's or 0's) detection on the incoming RX data stream.
RX AIS Assertion	The unit provides AIS substitution into the RX data path when commanded by the host unit.
RX Output Stable	The unit provides data stable (all 1s) into the RX data path when installed in a unit RX data stable shall be removed when either interface loopback or interface loop-through is turned on.
Buffer Reference Clock Activity	The unit provides activity detection for RX Satellite Clock, TX Terrestrial, and External Clock sources. An alarm condition is communicated to the host unit when lack of activity is detected.
RX Buffer PLL Fault Detection	The unit provides RX Buffer PLL fault detection. When the RX buffer PLL is not locked a fault condition is communicated to the host unit.
FPGA Program Error Detection/Reporting	The unit detects TX and RX FPGA programming errors and reports errors to the host unit.

A.6.6 Interface Loop - Through

The interface provides a “Loop-Through” mode of operation. The loop-through mode is intended to allow synchronization of RX data (RD) to send data (SD) when an SDM-2020 demodulator and a SDM-2020 modulator are co-located (see Figure A-17) Loop-through mode is selectable only when the G.703 interface is installed in an SDM-2020 modulator.

- Interface Operation Within SDM-2020 Modulator

  When loop-through mode is executed (turned on) send data (SD) at the input to the interface is routed to both the interface receive data (RD) output and the host modulator data input. This mode of operation does not interfere with transmission of data over the satellite link. Transparent to the user, the following actions occur on the interface:

  - Recovered clock and data from the send data (SD) input is looped to the interface RX data path.
  - Interface RX data rate and line coding are set the same as TX.
  - The RX Doppler/plesiochronous buffer is set for minimum depth and buffer reference clock is set to TX Terrestrial.

- Interface Operation Within SDM-2020 Demodulator

  Although loop-through mode is not selectable when the G.703 interface is installed in a SDM-2020 demodulator, the following items must be considered when setting up the demodulator.

  - Connect receive data (RD) output of the co-located modulator to the send data (SD) of the co-located demodulator.
  - Set the interface transmit data rate and line coding the same as the co-located modulator.
  - Set the G.703 interface buffer clock reference to Transmit Terrestrial.

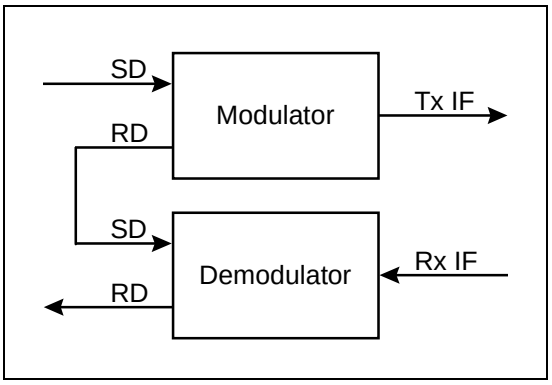

Figure A-17. Co-Located Modulator and Demodulator

A.6.7 Test Modes

A.6.7.1 Interface Loopback

The unit provides an “Interface-Loopback” test mode of operation. When loopback mode is executed (turned on), send data (SD) at the input to the interface is routed to both the interface receive data (RD) output and the host modulator data input.

Send data (SD) is routed through as much of the interface circuitry as possible before being returned to the receive data (RD) output. This mode of operation does not disrupt transmission of data over the satellite link when installed in an SDM-2020 modulator.

A.6.8 Terrestrial Interface Types

A.6.8.1 Send Data (SD), Receive Data (RD), and External Clock Connectors J3, J4 & J6

The Send Data (SD) (J3), Receive Data (RD) (J4) and Ext. Clock (J6) connectors are all BNC type connectors, and are terminated into 75Ω.

A.6.8.2 Auxiliary Functions Connector, J5

This port provides for other modem-specific signals not otherwise defined for either or both of the two data connectors. (Refer to Table A-33).

The connector is a 9-pin sub-miniature D female, with threaded jack nuts.

Demodulator Fault (DF**)** is a single ended open collector signal, where:

Voh=12V max. and Vol=0.5V max. @ Iol=8 ma.

A pull-up resistor external to the equipment is required.

A (DF) fault is indicated by an OFF (Vout = Hi) open collector transistor and the normal OK state is indicated by an ON transistor (Vout = Lo).

The Carrier Detect (CD) signal is a TTL output. When CD is high, it indicates the demodulator is locked.

Table A-33. G.703 Auxiliary Connector Pinout

Auxiliary Connector Pinout				
Signal Function	**Name**	**Pin #**	**Type**	**Comment**
		1	GND	Signal Ground
Demod Fault Indicator	DF	2	O	Demodulator Summary Fault Redundancy switch application, TTL open collector output
Not Used	N/A	3, 5, 8, 9	N/A	Wire to spare pad
Carrier Detect	CD	7	O	Demodulator, TTL output

A.6.9 Environmental Requirements

Temperature Range: Operational Storage	 0 to 50°C (32 to 122°F) -40 to 70°C (-40 to 158°F)
Humidity	0 to 95% Non-Condensing
Operational Shock	MIL-STD-167-1
Survivability Shock/Vibration	MIL-STD-810D Method 514.4, Procedure 8, 1 hour per axis

A.6.10 G.703 Interface Front Panel Menus

The applicable menus are dependent on the G.703 interface application. Refer to Chapter 3, Operation.

A.6.11 G.703 Remote Interface Commands

The applicable remote commands are dependent on the G.703 interface application. Refer to Appendix B.

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A.7 SMPTE-310M/SSI Data Interface

This plug-in module provides the physical and electrical interface between external terrestrial data equipment and the demodulator. The SMPTE-310M data interface is based on the DVB's Synchronous Serial Interface (SSI) used with the SDM-2020 Demodulator developed for video and high-speed data applications. The data is input/output on a BNC female connector as an 800-mV signal with biphase mark encoding. A separate auxiliary connector provides fault status.

A.7.1 Applicable Documents

Applicable documents, as referenced herein, include:

- *SMPTE 310M Synchronous Serial Interface for MPEG-2 Digital Transport Stream*
- *TM 1449, Interfaces for CATV/SMATV Headends and Similar Professional Equipment*

A.7.2 Description

The SMPTE 310M data interface is a plug-in module that inserts into the rear panel of the chassis. The data interface provides a physical and electrical connection between the external terrestrial circuit and the internal circuitry of the unit. By convention, a modem is Data Communications Equipment (DCE) where transmit data enters the data interface and receive data exits. The data interface has full-duplex capability but is automatically configured for simplex-transmit or simplex-receive operation, depending upon whether it is plugged into a modulator or demodulator chassis.

Figure A-18 shows the SMPTE 310M data interface block diagram. At a functional level, the data interface has four I/O ports. Transmitted data by the modulator enters the SMPTE-310M data interface at the TX input as a synchronous serial bit stream, while data received by a demodulator is sent by the data interface at the RX outputs as a synchronous serial bit stream. The TX and RX serial data is biphase-mark encoded. The modem interface is byte-oriented interface with clock, data, and synchronous signals. Finally, the auxiliary function port provides status outputs for modulator and demodulator faults as well as input for control and transmission.

Figure A-19 illustrates the SMPTE 310M module assembly.

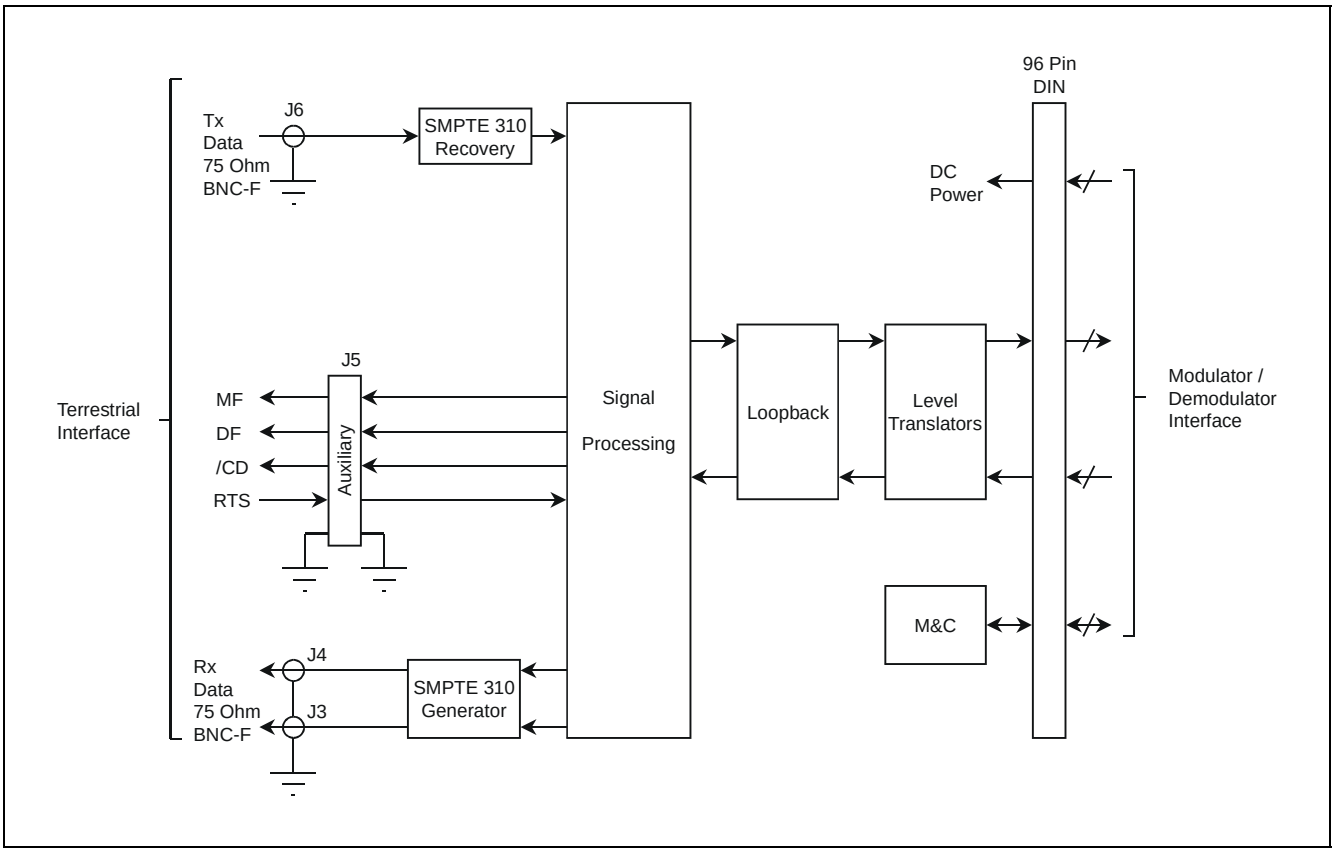

Figure A-18. SMPTE-310M Interface Block Diagram

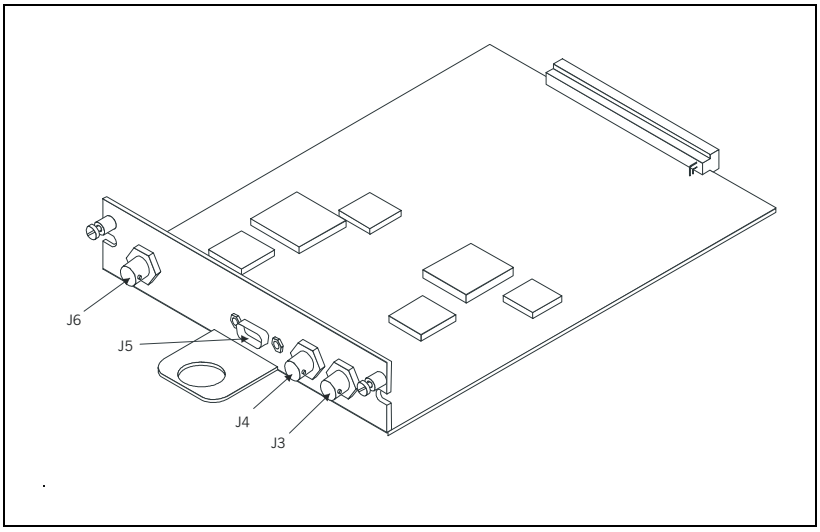

Figure A-19. Module Assembly, Part No. AS/6175-2

A.7.3 Interface Specifications

The following sections describe the detailed requirements for the SMPTE-310M data interface.

A.7.3.1 Specification Summary

Refer to Table A-34 for SMPTE-310M specifications.

Table A-34. SMPTE-310M Specification Summary

Video Interface (Terrestrial)	
Signal Type	Biphase mark coded synchronous serial data per SMPTE-310M and TM 1449.
Connector Type	75Ω BNC.
Interface and Connector Impedance	Resistive 75Ω unbalanced, per SMPTE-310M.
TX and RX Signal Level	800 mV ± 10% per SPMTE-310M.
DC Offset	0.0 V ± 0.5 V.
Rise And Fall Times	The rise and fall times, determined between the 20 and 80% amplitude points shall be within 0.4 ns and 5.0 ns and shall not differ by more than 1.6 ns, per SMPTE-310M.
Overshoot	10% maximum (on both rising and falling edges) per SPMTE-310M.
Receiver Sensitivity	The receiver shall operate with up to 3 dB amplitude loss at 1/2 the interface clock.
Return Loss	30 dB minimum, 100 kHz to the interface clock frequency per SMPTE-310M.
ATSC Data Rate	8VSB: 19.392 658 46 Mbit/s = (4.5 E6) x (684/286) x (564/313)
Clock Accuracy	Programmed data rate ± 100 ppm.
Clock Jitter, Drift And Wander	The interface clock frequency error (drift limit) shall not exceed ± 2.8 ppm. The rate of frequency change (drift rate) shall not exceed 0.028 ppm/s. The jitter in the timing of the interface signal transitions shall not exceed 2 ns p-p, measured over a bandwidth of 1 Hz to 1/100 of the interface clock frequency.
Cable Length, Typical	RG59 180 meters (591 feet) Belden 8281 250 meters (820 feet)
Auxiliary Function Port	
Signals	DF (Demodulator Fault, open-collector output). CD (Demodulator Carrier Detect, TTL output). RTS (Modulator Control, TTL input)
Connector	9 Pin D, female.

Table A-34. SMPTE-310M Specification Summary (Continued)

Monitor and Control	
Monitored Functions	TX – PLL Lock (monitors presence of input data) TX – State of RTS input on auxiliary function port TX - FPGA load failure. RX - FIFO Underflow/overflow. RX - PLL lock. RX - FPGA load failure.
Controlled Functions	Interface Loopback. Interface Loop-through
General	
Framing Formats (to be provided by the demodulator, not this interface)	187 (no framing, pass-through mode). 188 (DVB/MPEG2 frame consisting of a sync. byte and 187 data bytes). 204 (frame consisting of sync. byte , 187 data bytes and 16 Reed-Solomon check bytes).
Environmental	
Operating Temperature Storage Temperature Humidity	0 to + 50°C (32 to + 122°F) -40 to + 70°C (-40 to +158°F) Up to 95% non-condensing.
Physical	
Size	SDM-2020 plug-in module compatible.
Hot Pluggable	Not required. Unit power is turned off prior to removal or insertion of the data interface.

A.7.3.2 Interface Loopback Mode

Refer to Figure A-18.

In loopback mode, data entering the TX connector is returned to the RX output connector after passing through the interface. The data entering the interface at the TX input is routed all the way through the TX path and out to the modulator at J1. All TX signals going to the modulator are routed back to the RX path in place of the normal signals, which would be coming from the demodulator.

- In a Modulator, TX data continues to enter the modulator and is TX during loopback.
- In a Demodulator, satellite data is not routed through the SMPTE-310M Data Interface.

A.7.3.3 Interface Loop-Through Mode

In loop-through mode (Modulator Only), operation is the same as in loopback mode, however, the test mode LED indications are not activated.

A.7.3.4 TX and RX Terrestrial Data Interface Connector (J3, J4, and J6)

Refer to Table A-35 for data interface input and output interface connectors.

Table A-35. TX/RX Terrestrial Data Interface Connector

Terrestrial Data Interfaces	
J3, J4	SMPTE-310M RX Data Outputs, BNC female. Both outputs are active simultaneously.
J6	SMPTE-310M TX Data Input, BNC female.

A.7.3.5 Auxiliary Function Port

The following paragraphs describe the electrical and physical properties of the auxiliary function port.

A.7.3.5.1 Auxiliary Interface Electrical Specification

This port provides input/output of modem-specific signals.

Single ended open collector outputs (external pull-up resistor required) provide indicated Modulator Faults (MF) and Demodulator Faults (DF). For MF and DF, a fault is indicated by an OFF (Vout = Hi) open collector transistor and the normal OK state indicates an ON transistor (Vout = Lo). MF and DF are routed directly from the modulator or demodulator respectively. The characteristics of these outputs are:

Voh = 12V maximum
Vol = 0.5V maximum at Io1 = 8 mA

A carrier detect (CD) output signal provides an indication that the demodulator is locked. The output is TTL compatible. CD is routed directly from the demodulator. The default state of the CD is high when the unit is locked, but the sense will be programmable (function provided at the system level).

A Request to Send (RTS) input is provided to allow for remote control of the modulator transmission carrier. The ability to enable/disable control of the modulator via this signal, as well as the signal polarity, is programmed by the user (function provided at the system level).

A.7.3.5.2 Auxiliary Interface Connector –J5

This port provides input/output of the modem-specific signals. The connector is 9-pin subminiature D female, with threaded jack nuts. Refer to for connector pinouts.

Table A-36. Auxiliary Interface Connector –J5

Auxiliary Connector Pinout				
Signal Function	**Name**	**Pin #**	**Type**	**Comment**
		1	GND	Signal Ground
Demodulator Fault Indicator	DF	2	O	Demodulator Summary Fault. Open Collector. Redundancy switch appplication
		3	N/C	
Request to Send	RTS	4	I	Modulator Request to send. TX control. TTL
		5	N/C	
Modulator Fault Indication	MF	6	O	Modulator Summary Fault. Open collector. Redundancy switch application.
Carrier Detect	CD	7	O	Demodulator. Carrier detect. TTL

Legend: O = Output
I = Input
N/C = No Connection

A.7.4 SMPTE-310M/SSI Defaults

Refer to (Table A-37) for default settings for the interface.

Table A-37. Interface Defaults

Interface Defaults	
RTS Control	Off
RTS State	Normal
Data or Clock Polarity	Normal
Frame Format	188
Loss of Data	Alarm
Clock/Data SYNC	Correlate on data

A.7.5 SMPTE-310M/SSI Interface Front Panel Menus

Refer to Chapter 3, Utility Interface menu.

A.7.6 SMPTE-310M/SSI Remote Interface Commands

Refer to Appendix B for a listing of ASI and RS-422 interface module remote control commands.

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A.8 ASI/LVDS Data Interface

The plug-in module provides the physical and electrical interface between external terrestrial data equipment and the modulator. The ASI/LVDS implements the two most popular DVB Data interfaces. The data is input/output on a BNC female connector as an 800 mV signal with biphase mark encoding. A separate auxiliary connector provides fault status.

A.8.1 Applicable Documents

Applicable specifications, as referenced herein, include:

- *EN 80053-9, Interfaces for CATV/SMATV Headends and Similar Professional Equipment*

A.8.2 Description

This data interface is a plug-in module that inserts into the rear panel of the chassis. The data interface provides a physical and electrical connection between the external terrestrial circuit and the internal circuitry of the unit. By convention, a modem is Digital Communications Equipment (DCE) where transmit data enters the data interface and receive data exits it. The data interface has full duplex capability but is automatically configured for simplex-transmit or simplex-receive operation, depending upon whether it is plugged into a modulator or demodulator chassis.

Figure A-20 shows the ASI/LVDS data interface block diagram. At a functional level, the data interface has three ASI I/O ports. One port is LVDS interface and an auxiliary connector. Transmitted data into the modulator enters the ASI/LVDS data interface at the TX input as a synchronous serial data stream, while data received by a demodulator is sent by the data interface at the RX outputs as a synchronous serial data stream. The ASI data stream is a serial, high-speed 8B/10 encoded signal, while the outputs for modulator and demodulator faults as well as input for control and transmission.

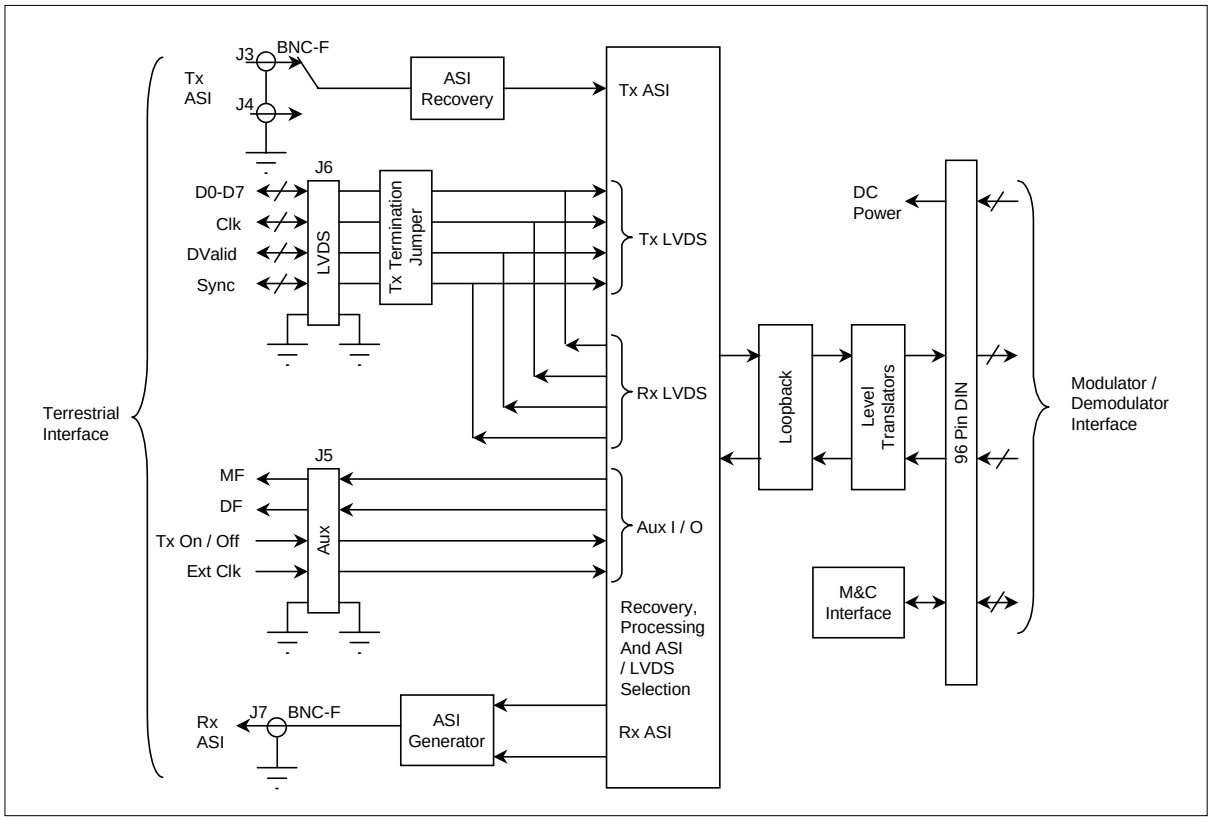

Figure A-20. ASI And LVDS Interface Block Diagram

A.8.3 Interface Specifications

A 75Ω coaxial cable (Belden 8281 or equivalent) is recommended for all ASI connectors. Typical Coaxial cable length is up to 140 meters (460 feet) with good quality coaxial cable. Typical attenuation of up to 18dB at 270 MHz is permitted.The following cables, or an equivalent computer grade cable incorporating twisted, shielded pairs, are recommended for the LVDS interface:

- Belden type LV Computer M9768
- Belden 8175

The Belden 8175 has a lower capacitance, however, it has a larger diameter and requires theselection of an appropriate connector shell. The typical cable length for the serial/parallel interfaces is ≤ 5 meters (16.405 feet).

Table A-38 describes the interface specifications.

Table A-38. ASI/LVDS Specifications

General Specifications	
Data Framing Formats	188, 204 byte packets per ETS 300 421, and None.
Hot Pluggable	Not required. Unit power is turned off before removal or insertion of the data interface.
ASI Specifications	
Data Rate	1.5 to 100 Mbit/s ASI.
Clock Rate Uncertainty	Programmed data rate ± 100 ppm.
Transport Clock ASI	The transport rate is 270 Mbit/s for all data rates.
Impedance	75Ω.
Return Loss	15 dB, frequencies, 5 to 270 MHz.
Loop Functions *(see text)*	Loopback Loop Thru
Connectors	BNC female, 75Ω.
Electrical Properties	Per EN 80053-9.
Packet Types	Burst or distributed.
Signal Types	Serial data.
Voltage Level	800 mV ± 10% into 75Ω.
ASI Data Loop 3 dB Frequency, TX Only	Wide: 2 Hz Narrow: 0.3 Hz
Jitter Tolerance	Meets ITU-T G.823 (3/93) and ITU-T G.824 (3/93)
Jitter Transfer	≤ 0.5 dB peaking up to cutoff frequency. –20 dB per decade beyond cutoff.
Cable Length, Typical	100 meters (328 feet), RG59 140 meters (459 feet), Belden 8281
Delay Variation Of Interface And Modulator	8 bits maximum, QPSK, and 8PSK only. 8PSK 2/3 and 5/6 all data rates. 8PSK 8/9 less than 80 Mbit/s.

Table A-38. ASI/LVDS Specifications (Continued)

LVDS Specifications	
Data Rate	1.5 to 100 Mbit/s, parallel LVDS
Clock Rate Uncertainty	Programmed data rate ± 100 ppm
Connectors	25-Pin D female per EN 80053-9. Same connector is either TX or RX data (See Loopback / Loop Thru)
Electrical Properties	per EN 80053-9
Signal Types	D0 – D7, Sync, Dvalid and Clock per EN 80053-9 Data synchronization is detected by correlating the data stream for the MPEG2 sync pattern per ETS 300 421.
Auxiliary Specifications	
Fault Signal	MF (modulator fault) and DF (demodulator fault). OC-TTL fault outputs.
TX ON / OFF	TTL input, when enabled this signal turns the TX carrier ON / OFF.
Ext Clock	Pin(s) reserved, but not defined
Monitor & Control	
Interface Select	ASI or LVDS
Auxiliary Functions	Transmitter Control: TX IF Control ON / OFF Polarity select Normal or Inverted
Controlled Functions	Interface Select: ASI or LVDS Interface Loopback Interface Loop Thru Data Rate TX ASI Data Input J3 / J4 Select Loss of data. Programmable as Fault or Alarm Clock, Normal or Inverted Data, Normal or Inverted
Monitored Functions	Loss of TX Data (Data Connector Removed): The modulator indicates a loss of sync (framed modes) and transmits all 1s in the data portion of the frame. The demodulator detects the presence of all ones and reports it to the display and remote port. TX clock PLL program error Data violations (TX) FIFO Faults
ASI Data Loop BW Selection	Wide and Narrow
Additional M&C	
Monitored Functions	Loss of TX Data or Clock (Data Connector Removed): The modulator indicates a loss of sync (frame and mode) and transmits all 1s in the data portion of the frame. The demodulator detects the presence of all ones and reports it to the display and remote port.

A.8.3.1 Jumper Selection

There are jumpers located on the ASI/LVDS card that require proper selection. See Figure A-21. A description of the jumpers and application data is as follows:

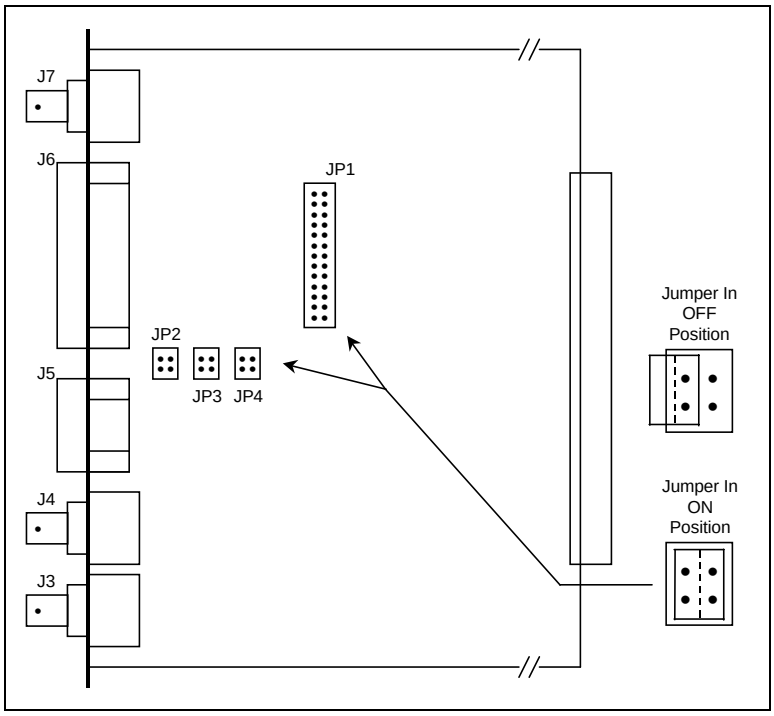

Figure A-21. ASI/LVDS Jumper Selection

Jumper	Description
JP1	Selects whether the LVDS-DVB connector, J6, operates as input or an output
JP2, JP3, and JP4	A single jumper is placed on JP2, JP3, or JP4.

A.8.3.2 Applicable Jumper Data

When the ASI portion of the interface is used JP1 is normally positioned Off so that the pins are not connected. Also, JP2 is normally set to On. This allows installation of the interface in either the modulator or demodulator without moving any jumpers. Refer to Table A-39 for Modulator/Demodulator Jumper Selection.

Table A-39. Modulator /Demodulator Jumper Selection

Modulator Jumper Selection		
Jumper	**ON/OFF**	**Description**
JP1	ON	Selects J6, the LVDS-DVB connector as an input.
JP1	OFF	Normal Setting: Selects J6 as an output for Loopback or Loop Thru operation in conjunction with the ASI signals.
JP2	ON	Normal Setting: Selects pins 2 and 15 of J6 as GND.
JP3	Not Used	For future use.
JP4	ON	Selects pins 2 and 15 as REFCLKB and REFCLKA outputs from J6. This is used as a byte clock reference by other equipment.
JP4	OFF	Normal setting.
Demodulator Jumper Selection		
Jumper	**ON/OFF**	**Description**
JP1	ON	Selects J6 as an input for loopback operation.
JP1	OFF	Normal Setting: Selects J6, LVDS-DVB connector, as an output for RX data. Also, it is used for loopback operation in conjunction with the ASI signals.
JP2	ON	Normal Setting: Selects pins 2 and 15 of J6 as GND.
JP3	Not Used	For future use.
JP4	Not Used	Jumper belongs on J2.

A.8.4 Loopback Connection

Refer to Table A-40 for additional requirements for Loopback.

Table A-40. Looback Connections

ASI Interface is active in Modulator	Loops ASI input, J3 (or J4), to ASI output, J7. If JP1 is Off, then J3 (J4) also loops to J6, the LVDS-DVB parallel output The LVDS signal contains D0-D7, Sync, Dvalid, and Clock
LVDS Interface is active in Modulator	If J1 is On, then J6 (LVDS-DVB input) is looped to the ASI output J7.
ASI Interface is active in Demodulator	JP1 is Off (Normal): When Loopback is engaged the TX ASI (J3) input connects simultaneously to the RX ASI (J7) and to the RX LVDS connector (J6). The LVDS signal contains D0-D7, Sync, Dvalid, and Clock JP1 is On: When Loopback is engaged the TX LVDS (J6) input connects to the RX ASI (J7) connector.
LVDS Interface is active (output) in Demodulator	JP1 is ON: When Loopback is engaged the TX LVDS (J6) input connects to the RX ASI connector (J7). The LVDS signal contains D0-D7, Sync, Dvalid, and Clock. JP1 is OFF (Normal): When Loopback is engaged the TX ASI input connects to the RX ASI connector and to the RX LVDS connector. The LVDS signal contains D0-D7, Sync, Dvalid, and Clock.

A.8.5 Loop Thru

The operation of Loop Thru is the same as Loopback except the normal operating mode not a test mode, and the TEST LED does not illuminate.

A.8.6 Connector Pinout Data

A.8.6.1 ASI Connector Pinout

The ASI interface is shown below:

J3, J4	Transmit Data Input, BNC female
J7	Receive Data Output, BNC female

A.8.6.2 LVDS Connector Pinout (J6)

The LVDS connector (Table A-41) is a 25-Pin D female type, with threaded jack nuts.

LVDS signal levels are as defined in EN 50083-9. The differential sense of all signal pairs is a logic "1" when "A" is positive with respect to "B." Some DBS applications require an inverted data or clock polarity and control of the signal polarity (normal or inverted) is provided.

Input / Output (I/O) of the interface is determined by a) whether it is plugged into a modulator or demodulator and b) Loopback or Loop Thru programming.

Table A-41. LVDS Connector Pinout (J6)

Signal Function/Name	Pin #	Type	Comment
Clock A	1	I / O	Mod / Demod
System Gnd / REFCLKB	2	O / Gnd	Mod / Demod, Demod – GND only, no clock available
Data 7 A(MSB/Serial)	3	I / O	Mod / Demod
Data 6 A	4	I / O	Mod / Demod
Data 5 A	5	I / O	Mod / Demod
Data 4 A	6	I / O	Mod / Demod
Data 3 A	7	I / O	Mod / Demod
Data 2 A	8	I / O	Mod / Demod
Data 1 A	9	I / O	Mod / Demod
Data 0 A	10	I / O	Mod / Demod
DVALID A	11	I / O	Mod / Demod
SYNC A	12	I / O	Mod / Demod
Cable Shield	13	I / O	Mod / Demod
Clock B	14	I / O	Mod / Demod
System Gnd / REFCLKA	15	O / Gnd	Mod / Demod Demod – GND 0nly, no clock available
Data 7 B (MSB/Serial)	16	I / O	Mod / Demod
Data 6 B	17	I / O	Mod / Demod
Data 5 B	18	I / O	Mod / Demod
Data 4 B	19	I / O	Mod / Demod

Signal Function/Name	Pin #	Type	Comment
Data 3 B	20	I / O	Mod / Demod
Data 2 B	21	I / O	Mod / Demod
Data 1 B	22	I / O	Mod / Demod
Data 0 B	23	I / O	Mod / Demod
DVALID B	24	I / O	Mod / Demod
SYNC B	25	I / O	Mod / Demod

A.8.6.3 Auxiliary Connector Pinout (J5)

The ausiliary connector is either a 9-Pin D female connector or a modular telephone jack connector with 6 pins.

- Single ended signals, such as the faults MF and DF, are open collector where:

  Voh=12V max. and Vol=0.5V max. @ Iol=8 ma.

A pull-up resistor external to the equipment is required. A fault is indicated in the modulator or demodulator when the open collector is OFF. An ON collector indicates an OK status.

- Ext Clk is an LVDS input.
- Carrier Detect is a TTL output. TX IF ON / OFF is a single ended TTL input.
- Table A-42 is the pin-out for a 9-Pin D female connector.

Table A-42. Auxiliary Connector Pinout (J5)

Signal Function	Name	Pin #	Type	Comment
		1	GND	Signal Ground
Demod Fault Indicator	DF	2	O	Demodulator Summary Fault Redundancy switch application
SCT-A	SCT-A	3	O	LVDS Clock (A) From Modulator
TX IF ON / OFF	TXOn-Off	4	I	TTL
EXT Clk-B	MC-B	5	I	Demodulator, LVDS
Mod Fault Indicator	MF	6	O	Modulator Summary Fault Redundancy switch application
Carrier Detect	CD	7	O	Demodulator
SCT-B	SCT-B	8	O	LVDS Clock (B) From Modulator
EXT Clk-A	MC-A	9	I	Demodulator, LVDS

Note: Ext clock is designed but not M&C enabled.

A.8.7 ASI/LVDS Interface Defaults

Default settings for the interface are listed in the following table.

Interface Defaults	
Interface Select	ASI
TX-IF Control	Off
Data or Clock	Normal
Frame Format	188
Loss of Data	Alarm
Clock/Data Sync	Correlate on data
Loopback / Loop Thru	OFF
Loop Bandwidth	Wide

Appendix B. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the SDM-2020 demodulator.

- Firmware number: FW/7734-1
- Software version: 20.1.1

B.1 General

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

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

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

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

B.2 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- 1 parity bit (Not applicable to 8 information bit setup)
- 2 stop bits
- 7 information bits or 8 information bits with no parity bit

Messages on the remote link are commands and responses.

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

The general message structure is as follows:

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

B.2.1 Start Character

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

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

B.2.2 Device Address

The device address is the address of the one satellite demodulator 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 demodulator who is connected to a common remote communications link must be assigned its own unique address.

B.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 demodulator 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.

B.2.4 End Character

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

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

B.3 Configuration Commands/Responses

B.3.1 Demodulator Configuration Commands

Demodulator Frequency	Command: Response: Status: Response:	<add/DF_nnnn.nnnn'cr' >add/DF_nnnn.nnnn'cr''lf'] <add/DF_'cr' >add/DF_nnnn.nnnn'cr''lf']	Where: nnnn.nnnn = For L-Band only: Frequency in MHz, 950.0000 to 1750.0000 in 2.5 kHz steps. For 70/140 MHz only: Frequency in MHz, 70.0000 to 180.0000 in 2.5 kHz steps.
Demodulator Rate Assignment	Command: Response: Status: Response:	<add/ADRV_nnnnn_mmm.mmmmmm'cr' >add/ADRV_nnnnn_mmm.mmmmmm'cr''lf'] <add/ADRV_'cr' >add/ADRV_nnnnn_mmm.mmmmmm'cr''lf']	Where: nnnnn = 1/2 (QPSK 1/2) [Decoder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), 5/6 (QPSK 5/6), 2/3 (QPSK 2/3), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 8P89 (8PSK 8/9), 16QAM3/4, 16QAM7/8. mmm.mmmmmm = Data rate in MHz. Note: When using a SMPTE 310M interface, the data rate is fixed at 19.392658 MHz. While the code rate can be changed as applicable, an invalid parameter message will be generated if any other data rate is input for change.
Symbol Rate Assignment	Command: Response: Status: Response:	<add/ASR_nnnnn_mm.mmmmmm'cr' >add/ASR_nnnnn_mm.mmmmmm'cr''lf'] <add/ASR_'cr' >add/ASR_nnnnn_mm.mmmmmm'cr''lf']	Where nnnnn = 1/2 (QPSK 1/2) [Decoder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), 5/6 (QPSK 5/6), 2/3 (QPSK 2/3), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 8P89 (8PSK 8/9), 16QAM3/4, 16QAM7/8. mm.mmmmmm = Symbol rate in MHz. Note: When using a SMPTE 310M interface, the data rate is fixed at 19.392658 MHz. While the code rate can be changed as applicable, an invalid parameter message will be generated if any other data rate is input for change.
Descrambler 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.
Sweep Width Range	Command: Response: Status: Response:	<add/SWR_nnnnnnn'cr' >add/SWR_nnnnnnn'cr''lf'] <add/SWR_'cr' >add/SWR_nnnnnnn'cr''lf']	Where: nnnnnnn= For L-Band only: 0 to 1000000 in 1 Hz steps. For 70/140 MHz only: 0 to 60000 in 1 Hz steps.
Sweep Reacquisi-tion	Command: Response: Status: Response:	<add/SR_xxx'cr' >add/SR_xxx'cr''lf'] <add/SR_'cr' >add/SR_xxx'cr''lf']	Where: xxx = 0 to 999 (number of seconds).

Bit Error Rate Threshold	Command: Response: Status: Response:	<add/BERT_xxxx'cr' >add/BERT_xxxx'cr''lf'] <add/BERT_'cr' >add/BERT_xxxx'cr''lf']	Where: xxxx = NONE, or 1E-n, where n = 3, 4, 5, 6, 7, or 8 (exponent of threshold).
E_b/N_0 Threshold	Command: Response: Status: Response:	<add/EBNT_xxxx'cr' >add/EBNT_xxxx'cr''lf'] <add/EBNT_'cr' >add/EBNT_xxxx'cr''lf']	Where: xxxx = NONE, or 3.0 to 16.0 dB in 0.1 Hz steps.
E_b/N_0 Threshold Alarm	Command: Response: Status: Response:	<add/EBNA_xxx'cr' >add/EBNA_xxx'cr''lf'] <add/EBNA_'cr' >add/EBNA_xxx'cr''lf']	Where: xxx = ON or OFF.
Demodulator Spectrum Rotation	Command: Response: Status: Response:	<add/DSR_xxxxxxx'cr' >add/DSR_xxxxxxx'cr''lf'] <add/DSR_'cr' >add/DSR_xxxxxxx'cr''lf']	Where: xxxxxxx = NRM (normal spectrum), INV (inverted spectrum, or No Data (if carrier is not locked)).
Demodulator Type	Command: Response: Status: Response:	<add/DTPE_xxx'cr' >add/DTPE_xxx'cr''lf'] <add/DTPE_'cr' >add/DTPE_xxx'cr''lf']	Where: xxx = DVB or DBS.
LNB Power	Command: Response: Status: Response:	<add/LNB_xxx'cr' >add/LNB_xxx'cr''lf'] <add/LNB_'cr' >add/LNB_xxx'cr''lf']	Where: xxx = ON or OFF. Note: This command applies to L-Band RF modems.
Set LNB Power Monitor Low Current Threshold	Command: Response: Status: Response:	<add/SPL_nnnn'cr' >add/SPL_nnnn'cr''lf'] <add/SPL_'cr' >add/SPL_nnnn''cr''lf']	Where: nnnn = 0 to 1000 mA in 1 mA steps. Notes: 1. The lower limit specified must be less than the current upper limit. 2. This command applies to L-Band RF modems.
Set LNB Power Monitor High Current Threshold	Command: Response: Status: Response:	<add/SPH_nnnn'cr' >add/SPH_nnnn'cr''lf'] <add/SPH_'cr' >add/SPH_nnnn'cr''lf']	Where: nnnn = 0 to 1000 mA in 1 mA steps. Notes: 1. The lower limit specified must be less than the current upper limit. 2. This command applies to L-Band RF modems.
Reed-Solomon Decoder Enable	Command: Response: Status: Response:	<add/RSDE_xxxx_xxx'cr' >add/RSDE_xxxx_xxx'cr''lf'] <add/RSDE_'cr' >add/RSDE_xxxx_xxx'cr''lf']	Where: xxxx_xxx = CORR_ON or CORR_OFF Note: The Reed-Solomon decoder is always on. The correction, can be selected on or off.
RF Input Select	Command: Response: Status: Response:	<add/RFIN_x'cr' >add/RFIN_x'cr''lf'] <add/RFIN_'cr' >add/RFIN_x'cr''lf']	The commands RFIN_ is only applicable with the installation of a 4-channel RF DEMOD. X = 1, 2, 3, or 4 Note: The RF inputs are designed as a FAST option. Input #1 is always available with a 4-channel RF card installed. Channel #2 is available with the purchase of the “2 L-Band Inputs” option. Also all four inputs are available with the activation of the “4 L-Band Inputs” option. If a single input card is currently installed, only that one input is available and an upgrade is available only at the factory.

LNB Voltage Select	Command: Response: Status: Response:	<add/LNBV_xx'cr' >add/LNBV_xx'cr''lf'] <add/LNBV_'cr' >add/LNBV_xx'cr''lf']	The commands LNBV_ is only applicable with the installation of a 4-channel RF DEMOD. X = 1, 2, 3, or 4

B.4 Interface Status Commands/Responses

Receive Clock Phase	Command: Response: Status: Response:	<add/RCP_xxx'cr' >add/RCP_xxx'cr''lf'] <add/RCP_'cr' >add/RCP_xxx'cr''lf']	Where: xxx = NRM (normal clock phasing) or INV (inverted clock phasing). Note: Not available with G.703 interface.
Receive Data Phase	Command: Response: Status: Response:	<add/RDP_xxx'cr' >add/RDP_xxx'cr''lf'] <add/RDP_'cr' >add/RDP_xxx'cr''lf']	Where: xxx = NRM (normal data phasing) or INV (inverted data phasing).
Receive Data Fault	Command: Response: Status: Response:	<add/RDF_xxxx'cr' >add/RDF_xxxx'cr''lf'] <add/RDF_'cr' >add/RDF_xxxx'cr''lf']	Where: xxxx = NONE, DATA, or AIS.
DVB Framing Type	Command: Response: Status: Response:	<add/RDVB_xxxx'cr' >add/RDVB_xxxx'cr''lf'] <add/RDVB_'cr' >add/RDVB_xxxx'cr''lf']	Where: xxxx = 188, 204, or NONE.
Interface Identification	Status Response:	<add/INID_'cr' >add/INID_xxxxxxxxx'cr''lf']	Where: xxxxxxxxx = RS422, LVDS, ECL_RX, ASI/RS422, ASI/LVDS, G.703, SMPTE 310M, None, or Unknown.
Interface Mode Config.	Command: Response: Status: Response:	<add/ICLK_xxx'cr' >add/ICLK_xxx'cr''lf'] <add/ICLK_'cr' >add/ICLK_xxx'cr''lf']	Where: xxx =SER (Serial mode, CLK = Data rate) or PAR (Parallel mode CLK = Data rate/8). Note: The ICLK_ command is not available when using the ASI/RS422 interface.
Interface Read Error Select (RX 2047 Pattern)	Command: Response: Status: Response:	<add/IRE_xxx'cr' >add/IRE_xxx'cr''lf'] <add/IRE_'cr' >add/IRE_xxx'cr''lf']	Where: xxx = ON or OFF.

B.5 System Configuration Commands/Responses

Time Of Day	Command: Response: Status: Response:	<add/TIME_hh:mmxx'cr' >add/TIME_hh:mmxx'cr''lf'] <add/TIME_'cr' >add/TIME_hh:mmxx'cr''lf']	Where: hh = 1 to 12 (hours). mm = 00 to 59 (minutes). xx = AM or PM.
Date	Command: Response: Status: Response:	<add/DATE_mm/dd/yyyy'cr' >add/DATE_mm/dd/yyyy'cr''lf'] <add/DATE_'cr' >add/DATE_mm/dd/yyyy'cr''lf']	Where: mm = 1 to 12 (month). dd = 1 to 31 (day). yyyy = 00 to 99 (year) in 2-digit year mode and 1975 to 1999 and 2000 to 2075 in 4-digit year mode.
Remote Configures the MODEM for Remote Operation	Command: Response:	<add/REM_'cr' >add/REM_'cr''lf']	The demodulator will respond to any status request at any time. However, the demodulator 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 demodulator.
Save Modem Config.	Command: Response:	<add/SMC_nn'cr' >add/SMC_nn'cr''lf']	Where: n = 1, 2, 3, ..., 10 (stored configuration number). This command saves the current demodulator configuration for recall at a later time using the 'RMC_' command. Up to ten different demodulator configurations can be saved.
Recall Modem Config.	Command: Response:	<add/RMC_nn'cr' >add/RMC_nn'cr''lf']	Where: n = 1, 2, 3, ..., 10 (stored configuration number). This command causes the demodulator to be reprogrammed with configuration parameters previously saved using the 'SMC_' command. One of ten saved configurations can be specified.

B.6 Configuration Status

Demodulator Rate	Command: Response:	<add/DR_'cr' >add/DR_nnnnn_mmm.mmmmmm'cr''lf']	Where nnnnn = 1/2 (QPSK 1/2) [Decoder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8) , 5/6 (QPSK 5/6), 2/3 (QPSK 2/3), 8P23 (8PSK 2/3), 8P56 (8PSK 5/6), 8P89 (8PSK 8/9), 16QAM3/4, 16QAM7/8. mmm.mmmmmm = Data rate in MHz. Note: When using a SMPTE 310M interface, the data rate is fixed at 19.392658 MHz. While the code rate can be changed as applicable, an invalid parameter message will be generated if any other data rate is input for change.
Demodulator Config. Status	Command: Response:	<add/DCS_'cr' >add/DCS_'cr' DF_nnnn.nnnn'cr' DR_nnnn_mmm.mmmmmm'cr' DE_xxx'cr' SWR_nnnnnn'cr' SR_xxx'cr' BERT_xxxx'cr' DSR_xxx'cr''lf'] EBNT_xxxx'cr''lf']	Demodulator Frequency Demodulator Rate Descrambler Enable Sweep Width Range Sweep Reacquisition BER Threshold Demodulator Spectrum Rotation E_b/N_0 Threshold The demodulator configuration status command causes a block of data to be returned by the addressed demodulator. This block of data reflects the current configuration status of the demodulator module. Additional configuration status of new options and features will always be appended to the end.

Demod/ Coder Config. Program Status	Command: Response:	<add/DCP_'cr' >add/DCP_'cr' ISEL_xxxxxx'cr' (Notes 1, 2) ICLK_xxx'cr' (Note 3) RDVB_xxxx'cr' DF_nnnn.nnnn'cr' DR_nnnn_mmm.mmmmmm'cr' DE_xxx'cr' RCP_xxx'cr' RDP_xxxx'cr' RDF_xxxx'cr' SWR_nnnnnnnn'cr' SR_xxx'cr' DM_xxx'cr' (Notes 1, 2) RR_xxx'cr' (Notes 1, 2) MC_xxx'cr' (Note 2) ERF_nnnnn.nnn'cr' (Note 4) TRF_nnnnn.n'cr' (Note 4) ILB_xxx'cr' (Note 4) ICFR_xxxx'cr' (Note 4) BC_xxx'cr' (Note 4) IBS_nn'cr' (Note 4) IRFS_1544_SSSS'cr' (Note 4) IRFS_2048_SSSS"cr' (Note 4) IRFS_6312_SSSS'cr' (Note 4) IRFS_8448_SSSS'cr' (Note 4) IRFS_32064_SSSS'cr' (Note 4) IRFS_34368_SSSS'cr' (Note 4) IRFS_44736_SSSS'cr' (Note 4) IRFS_51840_SSSS'cr''lf'] (Note 4) RFIN_xx'cr' (Note 6) LNBV_xx'cr''lf'] (Note 6)	Interface Select Interface Mode DVB Framing Type Demodulator Frequency Demodulator Rate Descrambler Enable Receive Clock Phase Receive Data Phase Receive Data Fault Sweep Width Range Sweep Reacquisition DM State Control RR State Control MC State Control External Reference Frequency TX Terrestrial Clock Frequency Interface Loopback Interface Coding Format Receive Buffer Clock Source Interface Buffer Size Interface Receive Frame Structure 1544 Interface Receive Frame Structure 2048 Interface Receive Frame Structure 6312 Interface Receive Frame Structure 8448 Interface Receive Frame Structure 32064 Interface Receive Frame Structure 34368 Interface Receive Frame Structure 44736 Interface Receive Frame Structure 51840 RF Input Select LNB Voltage Select Notes: 1. Only displayed when RS422 interface is installed. 2. Only displayed when ASI/RS422 interface is installed. 3. Not displayed when ASI/RS422 or G.703 interface is installed. 4. Only displayed when G.703 interface installed. 5. Not Used. 6. Only displayed if the 4-channel RF card is installed. This command is used by the EFData M:N protection switch to collect information that is necessary to configure back-up demodulators. Because this command (content and/or order) can be changed at any time by EFData, it is advisable that other commands ('DCS_' and 'ICS_', or 'BCS_') be used for M&C systems.

Interface Config. Status	Command: Response:	<add/ICS_'cr' >add/ICS_'cr' RCP_xxx'cr' RDP_xxxx'cr' RDF_xxxx'cr' RDVB_xxxx'cr' ICLK_xxx'cr' (Note 3) INID_xxxxxxxxx'cr' ISEL_xxxxxx'cr' (Notes 2, 4, 6) DM_xxx'cr' (Note 1) RR_xxx'cr' (Note 1) MC_xxx'cr' (Note 2) ERF_nnnnn.nnn'cr' (Note 4) TRF_nnnnn.n'cr' (Note 4) ILB_xxx'cr' (Note 4) ICFR_xxxx'cr' (Note 4) BC_xxx'cr' (Note 4) IBS_nn'cr' (Note 4) IRFS_1544_SSSS'cr' (Note 4) IRFS_2048_SSSS'cr' (Note 4) IRFS_6312_SSSS'cr'' (Note 4) IRFS_8448_SSSS'cr' (Note 4) IRFS_32064_SSSS'cr' (Note 4) IRFS_34368_SSSS'cr' (Note 4) IRFS_44736_SSSS'cr' (Note 4) IRFS_51840_SSSS'cr''lf] (Note 4)	Receive Clock Phase Receive Data Phase Receive Data Fault DVB Framing Type Interface Mode Interface ID Interface Select DM State Control RR State Control MC State Control External Reference Frequency TX Terrestrial Clock Frequency Interface Loopback Interface Coding Format Receive Buffer Clock Source Interface Buffer Size Interface Receive Frame Structure 1544 Interface Receive Frame Structure 2048 Interface Receive Frame Structure 6312 Interface Receive Frame Structure 8448 Interface Receive Frame Structure 32064 Interface Receive Frame Structure 34368 Interface Receive Frame Structure 44736 Interface Receive Frame Structure 51840 Notes: 1. Only displayed when RS422 interface is installed. 2. Only displayed when ASI/RS422 interface is installed. 3. Not displayed when ASI/RS422, G.703, or ASI/LVDS interface is installed. 4. Only displayed when G.703 interface is installed. 5. Not Used. 6. Only displayed when ASI/LVDS interface is installed. The interface configuration status command causes a block of data to be returned by the addressed demodulator. This block reflects the current configuration of the interface. Additional configuration status of new options and features will always be appended to the end.
MODEM Faults Status (Summary)	Command: Response:	<add/MFS_'cr' >add/MFS_'cr' DMD_xxx'cr' IRX_xxx'cr' CEQ_xxx'cr''lf']	Demodulator (FLT/OK) Interface Receive Side (FLT/OK) Common Equipment (FLT/OK)
Demodulator Status	Command: Response:	<add/DS_'cr' >add/DS_'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' BERT_xxx'cr' EBNT_xxx'cr' CONF_xxx'cr' SFLT_xx'cr''lf']	Demodulator Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) BER Threshold (OK/FLT) EB/NO Threshold (OK/FLT) Configuration (OK/FLT) Number of stored faults logged (0 to 10)

Interface Status	Command: Response:	<add/IRXS_'cr' >add/IRXS_'cr' FSYN_xxx'cr' RXD_xxx'cr' PLL_xxx'cr' FIFO_xxx'cr' INT_xxx'cr' 2047_xx'cr''lf'] UNFL_xxx'cr' OVFL_xxx'cr' CLK_xxx'cr' BUFF_xxx'cr' VFSC_xxx'cr' SFLT_xx'cr''lf']	 Frame Sync Lock (OK/FLT) Data Stable/AIS (OK/FLT) Receive Synth PLL Lock (OK/FLT) Receive FIFO (OK/FLT) Interface Module (OK/FLT) 2047 Pattern Lock Detect (OK/FLT) Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Selected Buffer Clock Activity (OK/FLT) Buffer Full (OK/FLT) Video Frame SYNC (OK/FLT) Number of Stored Faults logged (0 to 10)
Common Equipment Status	Command: Response:	<add/CES_'cr' >add/CES_'cr' M&C_xxx'cr' BAT_xxx'cr' -12_xxx'cr' +12_xxx'cr' +5_xxx'cr' +LNB_xxx'cr' MODE_xxxxxx'cr' SFLT_xx'cr''lf']	 Monitor & Control Module (OK/FLT) Battery/Clock (OK/FLT) -12V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) +5V Power Supply (OK/FLT) LNB (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.

B.7 Error Performance Status

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.
Interface Read Error Status (RX 2047 Pattern Status)	Command: Response:	<add/IRES_'cr' >add/IRES_tttt_xn.nE-ee'cr''lf']	Where: tttt = 2047 (indicates type of error being read). < or > (data modifier to indicate that the error rate is less than or greater than the returned value). n.n = 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. This command returns the 2047 error rate (only available when G.703 interface is installed. The IRE_command is used to enable or disable the reading of the 2047 error. If an interface other than G.703 is used, refer to the Non-G.703 section.

Non-G.703 Interface	Command: Response:	<add/IRES_'cr' >add/IRES_xxxxxxxxxx'cr''lf']	Where: xxxxxxxxxx = Not Enabled (refer to Interface Configuration Command, Interface Read Error Select.), Locked (RX locked to transmitter), No Data (RX unlocked to transmitter).
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 (Eb/N0 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.
E_b/N_0 Margin Status	Command: Response:	<add/EBNM_'cr' >add/EBNM_xnn.ndB'cr''lf']	Where: x = < - > (data modifier to indicate that the E_b/N_0 threshold is less than 0). nn.n = -16.0 to +16.0 (EB/NO threshold) Notes: 1. "NO DATA" is returned if the E_b/N_0 has cannot be calculated or if the EB/NO has the computational resolution of the system. 2. 'Sampling' is returned if not enough data is currently available to calculate the E_b/N_0.
Receive Signal Level Status	Command: Response:	<add/RSL_'cr' >add/RSL_xsnn.ndBm'cr''lf']	Where: x = < or > (data modifier to indicate that the receive signal level is less than or greater than the returned value). s = + or - (receive signal level sign, ±). nn.n = 0.0 to 99.9 (receive signal level magnitude). Notes: 1. The 'x' (< or >) parameter is only returned if the level has exceeded the computational resolution of the system. 2. 'No Data' is returned if the level cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the level.

Current Sweep Value	Command: Response:	<add/CSV_'cr' >add/CSV_'cr' CSV_xsnnnnnn'cr' CD_yyy'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). nnnnnn = For L-Band only: 0 to 500000 For 70/140 MHz only: 0 to 30000 yyy = OK or FLT (decoder lock status OK or FAULT). This command returns the current sweep offset value. 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.
LNB Current Monitor Status	Command: Response:	<add/CMS_'cr' >add/CMS_nnnn'cr"lf']	Where: nnnn = 0 to 1000 mA in 1 mA steps. Note: This command applies to L-Band RF modems.

B.8 Stored Faults

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

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

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

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' BERT_xxx'cr' EBNT_xxx'cr' CONF_xxx'cr''lf']	Demodulator Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) BER Threshold (OK/FLT) E_b/N_0 Threshold (OK/FLT) Configuration (OK/FLT)
Interface Receive Side Stored Faults	Command: Response:	<add/IRSF_#'cr' >add/IRSF_# hh:mm:ss MM/DD/YY'cr' FSYN_xxx'cr' RXD_xxx'cr' PLL_xxx'cr' FIFO_xxx'cr' INT_xxx'cr' 2047_xxx'cr' UNFL_xxx'cr' OVFL_xxx'cr' CLK_xxx'cr' BUFF_xxx'cr''lf]	Frame Sync Lock (OK/FLT) Data Stable/AIS (OK/FLT) Receive Synth PLL Lock (OK/FLT) Receive FIFO (OK/FLT) Interface Module (OK/FLT) 2047 Pattern Lock Detect Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Select Buffer Clock Activity (OK/FLT) Buffer Full (OK/FLT)
Common Equipment Stored Faults	Command: Response:	<add/CSF_#'cr' >add/CSF_# hh:mm:ss MM/DD/YY'cr' M&C_xxx'cr' BAT_xxx'cr' - 12_xxx'cr' +12_xxx'cr' +5_xxx'cr' LNB_xxx'cr''lf']	Monitor & Control Module (OK/FLT) Battery/Clock (OK/FLT) -12V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) +5V Power Supply (OK/FLT) LNB (OK/FLT)
Reed-Solomon Unavailable Seconds	Command: Response:	<add/RSSF_#'cr' >add/RSSF_# hh:mm:ss MM/DD/YY'cr' UNA_xxx'cr''lf']	Unavailable Seconds (OK /FLT)
Bulk Consol. Analog Status	Command: Response:	<add/BCAS_'cr' >add/BCAS_p1,p2,p3,p4'cr''lf']	Where: pn is the last parameter returned. This command is similar to the 'BCS_' command but returns demodulator analog parameters. Additional status of new options and features will always be appended to the end.

Where 'pn' = is the last parameter returned.

Parameter Number	Parameter Name (Command Reference)	Description
1	**Receive Signal Level** (ref. 'RSL_' command).	p1 = xsnn.n, receive signal level in dBm.
2	**Raw BER** (ref. 'RBER_' command).	p2 = xm.mE-ee.
3	**Corrected BER** (ref. 'CBER_' command).	p3 = xm.mE-ee.
4	**E_b/N_0** (ref. 'EBN0_' command).	p4 = xnn.n, EB/N0 in dB.
5	**Interface Read Error Status** (ref. IRES_'command).	p5 = tttt_xm.mE-ee
6	**Buffer Fill Status** (ref. IBFS_'command).	p6 = nn%, buffer fill status

Notes:
1. Parameters 2 through 6 are dependent on carrier acquisition, if the decoder is not locked empty data blocks are returned (,,,).
2. Parameters 5 and 6 display only if G.703 interface is installed

Bulk Consol. Status	Command: Response: Status: Response:	<add/BCS_'cr' >add/BCS_p1,p2,p3, . . . pn'cr''lf']	This command causes bulk demodulator status to be returned. To reduce the length of the response, message parameter data are returned without identifiers. However, parameter identification can be determined by order of return. Each status parameter is terminated with a ',' (comma) except for the last parameter which has the standard message termination sequence ('cr''lf']). Most of the data returned is formatted the same way as the single command status request (refer to the appropriate portions of this document in preceding sections). Additional configuration status of new options and features will always be appended to the end.

Where 'pn' is the last parameter returned.

	Parameter Number	Parameter Name (Command Reference)	Description
	1	**MODEM REMOTE/LOCAL mode.**	p1 = n, where 'n' is '0' (LOCAL), '1' (REMOTE).
	2	**Demodulator IF** (ref. 'DF_' command).	p2 = nnnn.nnnn, IF frequency in MHz.
	3	**Demodulator rate** (ref. 'DR_' command).	p3 = nnnn_mmm.mmmmmm, code rate/data rate in Mbps.
	4	**Demodulator rate** (ref. 'ASR_' command).	p4 = nnnn_mm.mmmmmm, code rate/symbol rate in Msps.
	5	**Descrambler enable** (ref. 'DE_' command).	p5 = n, where 'n' is '0' (off) or '1' (on).
	6	**Reserved.**	
	7	**Sweep Width Range** (ref. 'SWR_' command).	p7 = nnnnn, sweep range in Hertz.
	8	**Sweep Reacquisition** (ref. 'SR_' command).	p8 = nnn, reacquisition time in seconds.
	9	**Reserved.**	
	10	**Receive clock phase** (ref. 'RCP_' command).	p10 = n, where 'n' is '0' (NRM), '1' (INV).
	11	**Receive data phase** (ref. 'RDP_' command).	p11 = n, where 'n' is '0' (NRM), '1' (INV).
	12	**Receive data fault** (ref. 'RDF_' command).	p12 = n, where 'n' is '0' (None), '1' (Data stable), '2' (AIS).
	13	**Reserved.**	
	14	**Reserved.**	
	15	**DVB Framing Type** (ref. 'RDVB_' command).	p15 = n, where n = '1' (188), '2' (187 (NONE), or '3' (204).

	16	**Demodulator Spectrum Rotation** (ref. 'DSR_' command).	p16 = n, where 'n' is '0' (NRM), '1' (INV).
	17	**Bit Error Rate Threshold** (ref. 'BERT_'command)	p17 = xxxx, BER threshold
	18 to 20	**Reserved**	
	21	**Interface ID** (ref. 'INID_'command)	p21 = 'xxxxxxxxx', where xxxxxxxxx = interface type
	22	**Interface Clock Mode** (ref. 'ICLK_'command)	p22 = n, where n = ('0' Serial, or '1' = Parallel)
		Note: Parameters 23 to 32 are assigned to the individual interface.	
Bulk Consol. Status Faults	Command: Response:	<add/BCSF_'cr' >add/BCSF_abcdefgh'cr''lf']	This command causes all demodulator fault status to be returned. To reduce the length of the response, fault status is embedded into the bit structure of the characters that are returned. Faults are indicated by a binary 1 in the designated bit position. Additional fault status of new options and features will be appended to the end or use existing reserved bits. Character 'a': demodulator fault status character 1. Bit 6 = 1 always. Bit 5 = demodulator 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 'b': demodulator fault status character 2. Bit 6 = 1 always. Bit 5 = IF Synthesizer Lock. Bit 4 = reserved. Bit 3 = I Channel. Bit 2 = Q Channel. Bit 1 = reserved. Bit 0 = BER threshold. Character 'c': demodulator fault status character 3. Bit 6 = 1 always. Bit 5 = Configuration. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'd': 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 'e': Interface Receive side faults character 2. Bit 6 = 1 always. Bit 5 = Frame Sync Lock. Bit 4 = Reserved. Bit 3 = Data Stable/AIS. Bit 2 = Receive Synthesizer PLL Lock. Bit 1 = Receive FIFO. Bit 0 = Interface module fault. Character 'f': Interface Receive side faults character 3.

			Bit 6 = 1 always. Bit 5 through Bit 0 reserved. Character 'g': Common equipment fault status character 1. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 through Bit 0 = Binary representation. (0 to 10) of the number of common equipment stored faults. Character 'h': Common equipment fault status character 2. Bit 6 = 1 always. Bit 5 = Battery/Clock. Bit 4 = -12 volt power supply. Bit 3 = +12 volt power supply. Bit 2 = +5 volt power supply. Bit 1 = LNB. Bit 0 = Monitor & Control Module.
Change Status	Command: Response:	<add/CS_'cr' >add/CS_x'cr''lf']	Where: The 'x' character is defined as follows: '@' = no change since last BCS_ and BCSF_ polls. 'A' = BCS_ response has changed since last BCS_ poll. 'B' = BCSF_ response has changed since last BCSF_ poll. 'C' = Both responses have changed since last BCS_ and BCSF_ polls. This command indicates that a change has or has not occurred on either the BCS_ or the BCSF_ response since the last BCS_ or BCSF_ poll.
Equipment Type	Command: Response:	<add/ET_'cr' >add/ET_ttttttt_xxx.yyy.zzz'cr''lf']	Where: ttttttt = Equipment type. xxx.yyy.zzz = Software version. 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/yyyy'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).
Boot Control Firmware Information	Command: Response:	<add/BFI_'cr' >add/BFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddr'cr' mm/dd/yyyy'cr''lf']	Where: nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z). xxx.yyy.zzz = Software version number (0.0.0 to 999.999.999) Note: If Dash number is not used, '-dd' will be reported.
DATA ROM Firmware Information	Command: Response:	<add/DFI_'cr' >add/DFI_'cr' FW/nnnnnn-ddr'cr' mm/dd/yyyy'cr''lf']	Where: nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z). Note: If Dash number is not used, '-dd' will be reported.

Modem Operations/ Misc. Information	Command: Response:	<add/MOI_'cr' >add/MOI_'cr' s, OEM_LCD'cr' s, 8PSK'CR''lf']	Where: s = (-) Not Installed, FAST Upgradable, (+) Installed.
Interface Firmware Information	Command: Response:	<add/IFI_'cr' >add/IFI_'cr' FW/nnnnnn-ddr'cr' mm/dd/yyyy'cr''lf']	Where: nnnnnn = Firmware number (0 to 999999) dd = Firmware dash number (0 to 99) r = Firmware revision (–, or A to Z) Note: If dash number is not used, "-dd" willb e reported.
State of Product	Command: Response:	<add/SOP_'cr' >add/SOP_'cr' Product address: add'cr' Data Format; abc'cr' Baud Rate: rrrrr bps'cr' Comm Type: <var-string1>'cr' <var-sring2>'cr''lf']	Where abc = Expalin as follows: a = Number of data bits (7) b = Parity type (O, E, N) c = Number of Stop Bits (1) rrrrr = Baud rate (150, 300, 600, 1200, 2400, 4800, 9600, 14400, 19200) <var-string1> = Variable length strings explaining communication hardware type: RS-485 (2-wire) RS-485 (4-wire) RS-232 <var-string2> = Variable length strings explaining the intention of the product. "Under normal system operation" "REFLASH of BULK firmware required" "REFLASH of M&C firmware required"

B.9 Data Interfaces

B.9.1 RS422 Interface Commands

Interface Select Command	Command: Response: Status: Response:	<add/ISEL_xxx'cr' >add/ISEL_xxx'cr"lf'] <add/ISEL_'cr' >add/ISEL_'cr"lf']	Where: xxx = DVB or 530. This command selects which interface connector will be used for data.
DM State Control	Command: Response: Status: Response:	<add/DM_xxx'cr' >add/DM_xxx'cr"lf'] <add/DM_'cr' >add/DM_xxx'cr"lf']	Where: xxx = NRM (normal sense) or INV (inverted sense). This command controls the logic sense of the DM (DCE-ready) signal.
RR State Control	Command: Response: Status: Response:	<add/RR_xxx'cr' >add/RR_xxx'cr"lf'] <add/RR_'cr' >add/RR_xxx'cr"lf']	Where: xxx = NRM (normal sense) or INV (inverted sense). This command controls the logic sense of the RR (receiver ready) signal.
Where 'pn' is the last parameter returned.			
	Parameter Number	**Parameter Name (Command Reference**	**Description**
	23	**Interface Select** (ref. 'ISEL_"command).	p23 = n, where n = '0' (DVB), '1' (530)
	24	**Reserved**	
	25	**DM State Control** (ref. 'DM_"command)	p25 = n, where n = '0' (Normal), '1' (Parallel)
	26	**RR State Control** (ref. 'RR_'command)	p26 = n, where n = '0' (Normal), '1' Parallel)
	27 to 32	**Reserved**	

B.9.2 ASI/RS422 Interface Commands

Interface Select Command	Command: Response: Status: Response:	<add/ISEL_xxxxx'cr' >add/ISEL_xxxxx'cr''lf'] <add/ISEL_'cr' >add/ISEL_'cr''lf']	Where: xxxxx = ASI or RS422. This command selects which interface connector will be used for data.
DM State Control	Command: Response: Status: Response:	<add/DM_xxx'cr' >add/DM_xxx'cr''lf'] <add/DM_'cr' >add/DM_xxx'cr''lf']	Where: xxx = NRM (normal sense) or INV (inverted sense). This command controls the logic sense of the DM (DCE-ready) signal.
MC State Control	Command: Response: Status: Response:	<add/MC_xxx'cr' >add/MC_xxx'cr''lf'] <add/MC_'cr' >add/MC_xxx'cr''lf']	Where: xxx = NRM (normal sense) or INV (inverted sense). This command controls the logic sense of the MC (Master Clock) signal.
RR State Control	Command: Response: Status: Response:	<add/RR_xxx'cr' >add/RR_xxx'cr''lf'] <add/RR_'cr' >add/RR_xxx'cr''lf']	Where: xxx = NRM (normal sense) or INV (inverted sense). This command controls the logic sense of the RR (receiver ready) signal.

Where 'pn' is the last parameter returned.

	Parameter Number	Parameter Name (Command Reference	Description
	23	**Interface Select** (ref. 'ISEL_"command).	p23 = n, where n = '0' (ASI), '1' (RS422)
	24	**Reserved** Note: Parameters 25 to 28 are assigned to the RS422 interface.	
	25	**DM State Control** (ref. 'DM_"command)	p25 = n, where n = '0' (Normal), '1' (Invert)
	26	**MC State Control** (ref. 'MC_"command)	p26 = n, where n = '0' (Normal), '1' (Invert)
	27	**RR State Control** (ref. 'RR_'command)	p27 = n, where n ='0' (Normal), '1' (Invert)
	28 to 32	**Reserved**	

B.9.3 ECL/HSSI_ RX Interface Commands

ECL DTE Status	Status: Response:	<add/EDTE_'cr' >add/EDTE_xxx'cr''lf']	Where: xxx = UNA (unavailable) or AVA (available). This command polls the ECL interface for the status of the DTE equipment.

Where 'pn' is the last parameter returned.

	Parameter Number	Parameter Name (Command Reference	Description
	23 to 32	**Reserved**	

B.9.4 G.703 Interface Commands

External Clock Reference Frequency	Command: Response: Status: Response:	<add/ERF_nnnnn.n'cr' >add/ERF_nnnnn.n'cr''lf] <add/ERF_'cr' >add/ERF_nnnnn.n'cr"lf']	Where: nnnnn.n = 1544.0 to 20000.0 kHz (external clock frequency in 8.0 kHz steps) or at RX Data Rate
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 (RX Satellite Clock), REF (External Clock-Reference Frequency).
Interface Loopback	Command: Response: Status: Response:	<add/ILB_xxx'cr' >add/ILB_xxx'cr''lf'] <add/ILB_'cr' >add/ILB_'cr''lf']	Where: xxx = On or Off.
Interface Buffer Size	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 32 milliseconds (Buffer size in 2 ms steps)
Interface Buffer Center	Command: Response:	<add/IBC_'cr' >add/IBC_'cr''lf']	Where: nn = 0 to 32 milliseconds (Buffer size in 2 ms steps)
Interface Coding Format Receive	Command: Response: Status: Response:	<add/ICFR_xxxx'cr' >add/ICFRR_xxxx'cr''lf'] <add/ICFR_'cr' >add/ICFR_xxxx'cr''lf']	Where: xxxx = AMI, HDB#, B8ZS, or B3ZS.
Interface Receive Framing Structure	Command: Response: Status: Response:	<add/IRFS_fffff_ssss'cr' >add/IRFS_fffff_ssss'cr''lf'] <add/IRFS_fffff'cr' >add/IRFS_fffff_ssss'cr''lf']	Where: fffff = 1544, 2048, 6312, 8448, 32064, 34368, 44736, or 51840 (frame type). ssss = None, G704, G742, G743, G745, G747, G751, or G753 (framing type). Notes: 1. Valid 1544 frame structures are None and G.704. 2. Valid 2048 frame structures are None and G.704. 3. Valid 6312 frame structures are None, G.704, G.743, and G.747. 4. Valid 8448 frame structures are None, G.704, G.742, and G.745. 5. Valid 32064 frame structures are None and G.752. 6. Valid 34368 frame structures are None, G.751, and G.753. 7. Valid 44736 frame structures are None and G.752. 8. Valid 51840 frame structures are None and STS-1.
TX Terrestrial Clock Reference Frequency	Command: Response: Status: Response:	<add/TRF_nnnnn'cr' >add/TRF_nnnnn'cr''lf'] <add/TRF_'cr' >add/TRF_nnnnn'cr''lf]	Where: nnnnn = 1544, 2048, 6312, 8448, 32064, 34368, 44736, or 51840 in kbit/s.

Interface Buffer Fill Status	Command: Response:	<add/IBFS_'cr' >add/IBFS_nn%'cr''lf']	Where: nn = 1 to 99 (Relative to buffer depth.)

Where 'pn' is the last parameter returned.

	Parameter Number	Parameter Name (Command Reference	Description
	23	**RX Interface Coding Format** (ref. ICFR_ command)	p23 = n, where n = 0 (AMI), 1 (B3ZS), 2 (HDB3), 3 (B8ZS).
	24	**Interface Loopback** (ref. ILB_ command)	p24 = n, where x = 0 (Off) or 1 (On).
	25	**Buffer Clock Source** (ref. BC_ command)	p25 = n, where x = 0 (Off) or 1 (On).
	26	**Interface Buffer Size** (ref. IBS_ command)	p26 = nnnnnn, buffer size in milliseconds
	27	**External Reference Frequency** (ref. ERF_ command)	p27 = nnnnn.n external frequency in kHz
	28	**TX Terrestrial Clock Frequency** (ref. TRF_ command)	p28 = nnnnn, external reference frequency in Mbit/s
	29 to 32	**Reserved**	

B.9.5 SMPTE 310M Interface Commands

Interface Loopback	Command: Response: Status: Response:	<add/ILB_xxx'cr' >add/ILB_xxx'cr''lf'] <add/ILB_'cr' >add/ILB_xxx'cr''lf']	Where: xxx = ON or OFF
Interface Firmware Information	Command: Response: :	<add/IFI_'cr' >add/IFI_'cr''lf'] FW/nnnnn-dr'cr' mm/dd/yyyy'cr''lf']	Where: nnn = Firmware number (0 to 999999). d = Firmware dash number (0 to 99) r = Firmware revision (-, or A to Z)

Where 'pn' is the last parameter returned.

	Parameter Number	Parameter Name (Command Reference	Description
	23	**Interface Loopback** (ref. 'ILB_"command).	p23 = n, where x = '0' (OFF), '1' (ON)
	24 thru 32	**Reserved**	

B.9.6 ASI/LVDS Interface Commands

Interface Select Command	Command: Response: Status: Response:	<add/ISEL_xxxx'cr' >add/ISEL_xxxx'cr''lf'] <add/ISEL_'cr' >add/ISEL_'cr''lf']	Where: xxxx = ASI or LVDS Note: This command selects which interface connector will be used for data.
Interface Loopback	Command: Response: Status: Response:	<add/ILB_xxx'cr' >add/ILB_xxx'cr''lf'] <add/ILB_'cr' >add/ILB_xxx'cr''lf']	Where: xxx = On or Off.
Interface Firmware Information	Command: Response:	<add/IFI_'cr' >add/IFI_'cr' FW/nnnnnn-dr'cr' mm/dd/yyyy'cr''lf']	Where: nnnnnn = Firmware number (0 to 999999) dr = Firmware dash number (0 to 99) r = Firmware revision (–, or A to Z)
DCP Command Configuration	Command: Response:	<add/DCP_'cr' >add/DCP_'cr''lf'] ISEL_xxxx'cr' RDVB_xxxx"cr' DF_nnnn.nnnn'cr' DR_nnnn_mmm.mmmmmm'cr' DE_xxx'cr' RCP_xxx'cr' RDP_xxxx'cr' RDF_xxxx'cr' SWR_nnnnnnnn'cr' SR_xxx'cr' RFIN_x'cr' (Note 1) LNBV_xx'cr''lf'] (Note 1)	 Interface Select DVB Framing Type Demodulator Frequency Demodulator Rate Descrambler Enable Receive Clock Phase Receive Data Phase Receive Data Fault Sweep Width Range Sweep Reacquisition RF Input Select LNB Voltage Select Note 1: Only displayed if the 4-channle RF card is installed.
ICS Command Configuration	Command: Response:	<add/ICS_'cr' >add/ICS_'cr' RCP_xxx'cr' RDP_xxxx'cr' RDF_xxxx'cr' RDVB_xxxx'cr' INID_xxxxxxxxx'cr' ISEL_xxxxxx'cr' ILB_xxx'cr'	 Receive Clock Phase Receive Data Phase Receive Data Fault DVB Framing Type Interface ID Interface Select Interface Loopback
IJI Interface Jumper #1 Setting	Status: Response:	<add/IJI_'cr' >add/IJI_xx'cr''lf']	Where: xx = TX or RX (LVDS) This status only command will display the current jumper setting on the ASI/LVDS PCB. This is a hardware configuration only.

Where 'pn' is the last parameter returned.			
	Parameter Number	**Parameter Name (Command Reference**	**Description**
	23	**Interface Select** (ref. "ISEL_" command)	p23 = n, where n = 0 , 1, (0 = ASI, 1 = LVDS).
	24	**Interface Loopback** (ref. "ILB_ "command)	p24 = n, where x = 0 (Off) or 1 (On).
	25 – 32	**Reserved**	

B.10 OEM LCD Option (Requires FAST Upgrade)

The OEM LCD option permits the user to specify three pieces of information in the equipment.

- Line 1 of the LCD display.
- Line 2 of the LCD display.
- The identification of the unit when the remote port is interrogated for "equipment type."

If the manufacturer is to program this data into the equipment prior to delivery, the user must specify the three strings. The manufacturer requires the string information (as specified in Column 4). The instructions for programming of the data via equipment's remote port is as follows:

Note: The <add/REM_ command is issued.

Parameter	Command/ Response	Remote Specification	String Information
Program OEM String 1 *(see Note 1)*	Command: Response: Status: Response:	<add/OES1_xxxxxxxxxxxxxxx'cr' >add/OES1_xxxxxxxxxxxxxxx'cr''lf'] <add/OES1_'cr' >add/OES1_xxxxxxxxxxxxxxx'cr''lf']	Where : xxxxxxxxxxxxxxx = 16-character string to be displayed on Line 1 of the modem LCD.
Program OEM String 2 *(see Notes 1 and 2)*	Command: Response: Status: Response:	<add/OES2_xxxxxxxxxxxxxxx'cr' >add/OES2_xxxxxxxxxxxxxxx'cr''lf'] <add/OES2_'cr' >add/OES2_xxxxxxxxxxxxxxx'cr''lf']	Where : xxxxxxxxxxxxxxx = 16-character string to be displayed on Line 2 of the modem LCD.
Program OEM String 3 *(see Note 1)*	Command: Response: Status: Response:	<add/OES3_xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'cr' >add/OES3_xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'cr''lf'] <add/OES3_'cr' >add/OES3_xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'cr''lf']	Where : xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx = 32-character string returned when the ET_ (equipment type) command is executed via the remote port..

Notes:

1. A space in the display is created by the exponent character (^) in the string.
2. If a single question mark (?) is used as the OEM string 2, then the current version of the M&C firmware is displayed. This is the usual entry.
3. Spaces are not allowed in OEM string 3. Use an underscore (_) as a separator between characters, see example:

   Incorrect: xxxx yyyy
   Correct: xxxx_yyyy

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Appendix C. FULLY ACCESSIBLE SYSTEM TOPOLOGY (FAST) OPTIONS

This appendix describes the FAST options for the SDM-2020.

C.1 FAST Accessible Options

Comtech EFData's FAST system allows immediate implementation of different options through the user interface keypad. Some FAST options are available through the basic platform unit, while others require that the unit be equipped with optional hardware or that the hardware be installed in the field.

The options available through the FAST architecture include:

	Minimum Version			
Option	**Softwarte Version**	**M&C Firmware**	**Boot Firmware**	**FPGA Firmeware**
OEM LCD	2.1.2	FW/6224-1D		
8PSK - DVB	2.2.1	FW/6224-1D	FW/6222-1	FW/6223B
16QAM - DVB	3.3.1	FW/6224-1J	FW/6222-1	FW/6223E
2 Input L-Band	3.3.1 (see Note 6)	FW/6224-1J		
4 Input L-Band	3.3.1 (see Note 6)	FW/6224-1J		

Notes:

1. Units that shipped on are after October 12, 1998 are DVB compliant for 8PSK.
2. Units that shipped prior to October 12, 1998 can be upgraded for 8PSK-DVB compliance.
3. Contact ADAP Customer Support department for additional information.
4. Software version – see main menu of LCD.
5. Refer to Ultility System menu for:
   a. M&C firmware,
   b. Boot firmware,
   c. FPGA firmware.
6. The 2- and 4-input L-Band require the correct hardware. Check Utility Demodulator Options menu for status.

C.1.1 FAST System Theory

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

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

C.1.2 Implementation

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

C.1.3 Activation Procedure

1. Obtain Demodulator serial number as follows:

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

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

   c. Press [ENTER].

   d. Use [←] and [→] to select Utility Demodulator Type menu.

   e. Press [ENTER].

   f. Use [←] and [→] to select Demodulator Serial # menu.

   g. Record serial number: _____

2. Select desired features as follows:

   a. Use [←] and [→] to select Demodulator Options menu.

   b. Press [ENTER].

   c. Scroll [→] and select Demodulator options.

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

OEM LCD	[ ]
8PSK	[ ]
16QAM	[ ]
2-Input L-Band	[ ]
4-Input L-Band	[ ]

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

   d. Press [CLEAR].

3. Contact ADAP Customer Support to order FAST features.

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

5. Enter access codes as follows:

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

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

   c. Press [ENTER].

   d. Use [←] and [→] to select Utility Demodulator Options menu.

   e. Press [ENTER].

   f. Use [←] and [→] to select Configuration Code Demodulator menu

   g. Press [ENTER].

   h. Menu appears as follows:

      AAAAAAAAAA
      AAAAAAAAAA

   i. Enter the access code.

      Use the following example:

      Use [↑][↓] to input: 5CBB397F4D
      Press [→].
      Use [↑][↓] to input: 773B285AA5
      Press [ENTER].
      Display shows “WRONG CODE ENTERED”.

6. If properly re-initialized, the display exhibits “REINITIALIZED” and resets.

7. Check upgrade as follows:

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

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

   c. Press [ENTER].

   d. Use [←] and [→] to select Utility Demodulator menu.

e. Press [ENTER].

f. Scroll [→] to Demodulator options.

g. Press [ENTER]

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

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

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Glossary

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

Acronym	Definition
Ω	Ohms
16QAM	16 Quadrature Amplitude Modulation
8PSK	8 Phase Shift Keying
A	Ampere
AC	Alternating Current
ADJ	Adjust
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
AM	Amplitude Modulation
ASCII	American Standard Code for Information Interchange
ASI	Asynchronous Serial Interface
BB	Baseband
bit/s	bits per second
C	Celsius
CLK	Clock
COM	Common
CS	Clear to Send
CTS	Clear to Send
CW	Continuous Wave
dB	Decibels
dBc	Decibels referred to carrier
dBm	Decibels referred to 1.0 milliwatt
DC	Direct Current
DCE	Data Circuit Terminating Equipment
Demod	Demodulator
DM	Data Mode
DSR	Data Signal Rate
DVB	Digital Video Broadcasting
EIA	Electronic Industries Association
EMC	Electro-Magnetic Compatibility
ESC	Engineering Service Circuit or Engineering Service Channel
ESD	Electrostatic Discharge

EXT	External Reference Clock
FAST	Fully Accessible System Topology
FIFO	First in/First Out
FW	Firmware
GND	Ground
Hz	Hertz (cycle per second)
I/O	Input/Output
IF	Intermediate Frequency
kHz	Kilohertz (10^3 Hertz)
LCD	Liquid Crystal Display
LDVS	Low Voltage Differential Signal
LED	Light-Emitting Diode
lf	Line Feed
m	mille (10^{-3})
MPEG	Motion Picture Expert Group
M&C	Monitor and Control
Max	Maximum
Mbit/s	Megabits per second
MC	Monitor and Control
MFS	Multiframe Sync
MHz	Megahertz (10^6 Hertz)
Mod	Modulator
MOP	Modulated Output Power
MSB	Most Significant Bit
n	nano (10^{-9})
N/A	Not Applicable
NC	No Connection or Normally Closed
NO	Normally Open
p	pico (10^{-12})
PCB	Printed Circuit Board
PLL	Phase-Locked Loop
PPM	Parts Per Million
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RD	Receive Data
RF	Radio Frequency
RR	Receiver Ready
RS	Ready to Send
RT	Receive Timing
RTS	Request to Send
RX	Receive (Receiver)
RXD	Receive Data
s	Second
SCT	Serial Clock Transmit
SD	Send Data
ST	Send Timing
SYNC	Synchronize
TT	Terminal Timing
TTL	Transistor-Transistor Logic
TX	Transmit (Transmitter)
TXCLK	Transmit Clock
TXD	Transmit Data
US	United States
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage-Controlled Oscillator
VDC	Volts, Direct Current

W	Watt

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Index