DMD-2050E

Universal Satellite Modem
Installation and Operation Manual

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

MN-DMD2050E Revision 2

Errata A for MN-DMD2050E Rev 2

Comtech EF Data Documentation Update

DMD2050E

Universal Satellite Modem
Installation and Operation Manual

Part Number MN-DMD2050E
Revision 2

Subject: Chapter 3, Theory of Operation

Errata Part Number: ER-DMD2050E-EA2 (*Errata documents are not subject to revision.)*

PLM CO Number: C-0028800

Comments: The new information will be included in the next released revision of the manual.

IMPORTANT
Set the modem to Loop Timing mode for these Loopback operations:

- Tx/Rx Terrestrial Loopback
- Tx/Rx Baseband Loopback
- Rx Baseband Loopback

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Errata B for MN-DMD2050E Rev 2

Comtech EF Data Documentation Update

DMD2050E

Universal Satellite Modem
Installation and Operation Manual

Part Number MN-DMD2050E
Revision 2

Subject: Chapter 3 and Chapter 4 references to MN-DMDREMOTEOP manual

Errata Part Number: ER-DMD2050E-EB2 (*Errata documents are not subject to revision.)*

PLM CO Number: C-0028804

Comments: The new information will be included in the next released revision of the manual. See the following pages.

4.4.6.6 SNMP (menu)

A description of OID organization is provided in the MN-DMDREMOTEOP manual.

SNMP MENU		
SNMP VERSION	{V1 & V2, V3}	This selection controls the SNMP Version that will be used in messaging between the equipment and it's host. When V1 & V2 is used, RD COMMUNITY and RDWR COMMUNITY are used to determine the authorization of an incoming message. When V3 is used, three contexts are supported: *public*, *mib2*, and *dev*. Context, Authentication and Privacy are a portion of each SNMPV3 message. The *public* context will only allow the user to see the sysoid of the unit. This is the most restricted access possible and only allows the unit to be identified by a host SNMP Station. The *mib2* context allows a user with appropriate authentication to access the mib2 OIDs and the SNMP OIDs. These are of interest primarily to network operators not controlling the satellite link. The *dev* context allows a user with appropriate authentication to access the device control portion of the MIB. These OIDs are used to control the devices satellite link and operation.
TRAP VERSION	{V1, V2}	This controls the type of message format used when a message trap is generated by the equipment and bound for a SNMP Host. Messages will only be sent if the unit has been authorized to do so.
AUTHORIZATION	{TRAPS OFF, TRAPS ON}	This controls the type of message format used when a message trap is generated by the equipment and bound for a SNMP host. Messages will only be sent if the unit has been authorized to do so.
RD COMMUNITY	{16 characters of name}	This menu is only displayed when SNMP VERSION is set to V1 & V2. This is the community that a host must be acting within when an OID variable is requested by a V1/V2 SNMP message.
RDWR COMMUNITY	{16 characters of name}	This menu is only displayed when SNMP VERSION is set to V1 & V2. This is the community that a host must be acting within when an OID variable is being changed by a V1/V2 SNMP message.
TRAP AGENT	{XXX.XXX.XXX.XXX} Hexadecimal Mask {ddd.ddd.ddd.ddd} Decimal Mask	IP address of the device receiving SNMP Traps

- Modem Status, Alarms & Contact Closures (Section 3.2.9)

3.2.6 Terminal Port

This port supports an asynchronous control protocol as described in Chapter 4. It is configured to support RS-232 signal levels. This port is intended for use in computer-based remote M&C. All functions of the modem may be monitored and controlled from this port via a common terminal connected to the Terminal Port. This function is front panel selectable.

The Terminal Mode Control allows the use of an external terminal or computer to monitor and control the modem from a full screen interactive presentation operated by the modem itself. No external software is required other than VT-100 Terminal Emulation Software (e.g. "Procomm" for a computer when used as a terminal. The Control Port is normally used as an RS–232 Connection to the terminal device. The RS-232 operating parameters can be set using the modem Front Panel and stored in Non-volatile memory for future use.

IMPORTANT
Refer to the Remote Protocol Manual (MN-DMDREMOTEOP) for the Terminal, Remote and SNMP screens and protocols.

3.2.7 Modem Remote Communications (RLLP)

The Remote Port located on J20 allows for control and monitoring of parameters and functions via an RS-232 Serial Interface, or RS-485 for RLLP Protocol. 'Equipment Remote Mode' setup can be entered from the front panel or the Web Browser interface under the "System" menu. This requires the user to first set the Remote Port Control to "Remote" then set the Multidrop Address as needed followed by setting the Remote Interface to RS232 or RS485.

Control and status messages are conveyed between the modem and all subsidiary modems and the host computer using packetized message blocks in accordance with a proprietary communications specification. This communication is handled by the Radyne Link Level Protocol (RLLP), which serves as a protocol 'wrapper' for the remote M&C data. See the MN-DMDREMOTEOP manual for more information.

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Errata C for MN-DMD2050E Rev 2

Comtech EF Data Documentation Update

DMD2050E

Universal Satellite Modem
Installation and Operation Manual

Part Number MN-DMD2050E
Revision 2

Subject: Preface, Electrical Safety section, page xx, change power consumption maximum

Errata Part Number: ER-DMD2050E-EC2 (*Errata documents are not subject to revision.)*

PLM CO Number: C-0035622

Comments: The new information will be included in the next released revision of the manual.

Electrical Safety

The DMD2050E has been shown to comply with the EN 60950 Safety of Information Technology Equipment (including electrical business machines) safety standard.

The unit is rated for these nominal operating ranges:

- 100 - 240 volts AC nominal operating range
- 48+/-5 volts DC nominal operating range for a correctly-equipped DC option
- < 120W maximum power consumption

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Errata D for MN-DMD2050E Rev 2

Comtech EF Data Documentation Update

DMD2050E

Universal Satellite Modem
Installation and Operation Manual

Part Number MN-DMD2050E
Revision 2

Subject: EBEM mode set up on the DMD2050E, add 3.8.1 to Section 3.8

Errata Part Number: ER-DMD2050E-ED2 (*Errata documents are not subject to revision.)*

PLM CO Number: C-0035823

Comments: The new information will be included in the next released revision of the manual. See attached page.

3.8 Ebem Framing Unit

The DMD2050E EBEM framing Unit provides the ability to multiplex both Serial (MIL-STD-188-114A or Hgh Speed Serial Interface – HSSI) with Bridged Ethernet payload, overhead and embedded channel data within the over-the-air transport stream.

3.8.1 EBEM Mode Set Up on the DMD2050E

When in EBEM Network Spec mode, the Ethernet interface is always active. Therefore, you cannot select it as the interface type when in EBEM mode. EBEM mode always runs two interfaces simultaneously: the Ethernet interface and one of the serial interfaces (HSSI or MIL-188).

First, make sure one of the serial interfaces (HSSI or MIL-188) is set as the interface type. After you enable EBEM as the Network Spec, both the serial interface and the Ethernet interface will be active. However, only the serial interface shows for the interface menus. The Ethernet interface does not show for the interface menus.

When in EBEM mode, the Modulator and Demodulator DATA menus show the **ETH RATE**. This is where you set the Ethernet data rate.

There is also a **DATA RATE,** which is where you set the serial interface data rate.

- Run only Ethernet by setting an **ETH RATE** and then setting **DATA RATE** to 0.
- Run only serial by setting a serial rate for **DATA RATE** and then setting **ETH RATE** to 0.
- Run Ethernet and serial simultaneously by setting both the serial rate for **DATA RATE** and the Ethernet rate for **ETH RATE**.

The combined Ethernet and serial rates must be within the data rate limits for the configuration in use (Modulation type, FEC etc.). Chapter 7, Technical Specifications, shows the data rate limits for the various Mod Cods.

3.8.1.1 Exit EBEM Mode

To change from EBEM mode to another mode, such as closed network mode, you must first have a serial rate set for **DATA RATE**. For example, if you were running in EBEM mode but using only the Ethernet interface (**ETH RATE** is set but the **DATA RATE** set to 0), the modem will not let you exit the EBEM mode until you enter a valid rate for **DATA RATE**.

Errata E for MN-DMD2050E Rev 2

Comtech EF Data Documentation Update

DMD2050E

Universal Satellite Modem
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Part Number MN-DMD2050E
Revision 2

Subject: Add Appendix K, Compatibility with other DMD Modems

Errata Part Number: ER-DMD2050E-EE2 (*Errata documents are not subject to revision.)*

Comments: The new information will be included in the next released revision of the manual.

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Appendix K. Compatibility with Other DMD Modems

K.1 Compatibility with Other DMD Modems

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
Legacy Modes									
BPSK	Viterbi	1/2	2.4 – 5,000	Standard	Standard	Standard	2.4 – 15,000	Standard	Standard
QPSK	Viterbi	1/2	4.8 – 10,000	Standard	Standard	Standard	4.8 – 30,000	Standard	Standard
		3/4	7.2 – 15,000	Standard	Standard	Standard	7.2 – 45,000	Standard	Standard
		7/8	8.4 – 17,500	Standard	Standard	Standard	8.4 – 52,000	Standard	Standard
	Viterbi + RS	1/2	4.8 – 10,000 * R / N	RS Feature	RS Feature	RS Feature	4.8 – 30,000 * R / N	RS Feature	Standard
		3/4	7.2 – 15,000 * R / N	RS Feature	RS Feature	RS Feature	7.2 – 45,000 * R / N	RS Feature	Standard
		7/8	8.4 – 17,500 * R / N	RS Feature	RS Feature	RS Feature	8.4 – 52,000 * R / N	RS Feature	Standard
	Sequential	1/2	4.8 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	4.8 – 2,048	Sequential Feature	Sequential Feature
		3/4	7.2 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	7.2 – 2,048	Sequential Feature	Sequential Feature
		7/8	8.4 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	8.4 – 2,048	Sequential Feature	Sequential Feature
OQPSK	Viterbi	1/2	4.8 – 10,000	Standard	Standard	Standard	4.8 – 30,000	Standard	Standard
		3/4	7.2 – 15,000	Standard	Standard	Standard	7.2 – 45,000	Standard	Standard
		7/8	8.4 – 17,500	Standard	Standard	Standard	8.4 – 52,000	Standard	Standard
	Viterbi + RS	1/2	4.8 – 10,000 * R / N	RS Feature	RS Feature	RS Feature	4.8 – 10,000 * R / N	RS Feature	Standard
		3/4	7.2 – 15,000 * R / N	RS Feature	RS Feature	RS Feature	7.2 – 15,000 * R / N	RS Feature	Standard
		7/8	8.4 – 17,500 * R / N	RS Feature	RS Feature	RS Feature	8.4 – 17,500 * R / N	RS Feature	Standard
	Sequential	1/2	4.8 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	4.8 – 2,048	Sequential Feature	Sequential Feature
		3/4	7.2 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	7.2 – 2,048	Sequential Feature	Sequential Feature
		7/8	8.4 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	8.4 – 2,048	Sequential Feature	Sequential Feature
8PSK	Trellis	2/3	9.6 – 20,000	8PSK Feature	8PSK Feature	8PSK Feature	9.6 – 52,000	8PSK Feature	Standard
	Trellis + RS	2/3	9.6 – 20,000 * R / N	8PSK + RS Feature	8PSK + RS Feature	8PSK + RS Feature	9.6 – 52,000	8PSK + RS Feature	Standard
16QAM	Viterbi	3/4	14.4 – 20,000	16QAM Feature	16QAM Feature	16QAM Feature	14.4 – 52,000	16QAM Feature	Standard
		7/8	16.8 – 20,000	16QAM Feature	16QAM Feature	16QAM Feature	16.8 – 52,000	16QAM Feature	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
	Viterbi + RS	3/4	14.4 – 20,000 * R / N	16QAM + RS Feature	16QAM + RS Feature	16QAM + RS Feature	14.4 – 52,000	16QAM + RS Feature	Standard
		7/8	16.8 – 20,000 * R / N	16QAM + RS Feature	16QAM + RS Feature	16QAM + RS Feature	16.8 – 52,000	16QAM + RS Feature	Standard
DVB Modes									
BPSK	Viterbi	1/2	2.4 – 4,608	DVB Feature	DVB Feature	DVB Feature	2.4 – 4,608	DVB Feature	DVB Feature
		2/3	3.2 – 6,144	DVB Feature	DVB Feature	DVB Feature	3.2 – 6,144	DVB Feature	DVB Feature
		3/4	3.6 – 6,912	DVB Feature	DVB Feature	DVB Feature	3.6 – 6,912	DVB Feature	DVB Feature
		5/6	4.0 – 7,680	DVB Feature	DVB Feature	DVB Feature	4.0 – 7,680	DVB Feature	DVB Feature
		7/8	4.2 – 8,064	DVB Feature	DVB Feature	DVB Feature	4.2 – 8,064	DVB Feature	DVB Feature
QPSK	Viterbi	1/2	4.8 – 9,216	DVB Feature	DVB Feature	DVB Feature	4.8 – 9,216	DVB Feature	DVB Feature
		2/3	6.4 – 12,288	DVB Feature	DVB Feature	DVB Feature	6.4 – 12,288	DVB Feature	DVB Feature
		3/4	7.2 – 13,824	DVB Feature	DVB Feature	DVB Feature	7.2 – 13,824	DVB Feature	DVB Feature
		5/6	8.0 – 15,359	DVB Feature	DVB Feature	DVB Feature	8.0 – 15,359	DVB Feature	DVB Feature
		7/8	8.4 – 16,127	DVB Feature	DVB Feature	DVB Feature	8.4 – 16,127	DVB Feature	DVB Feature
8PSK	Trellis	2/3	9.6 – 18,431	8PSK + DVB Feature	8PSK + DVB Feature	8PSK + DVB Feature	9.6 – 18,431	8PSK + DVB Feature	DVB Feature
		5/6	12.0 – 20,000	8PSK + DVB Feature	8PSK + DVB Feature	8PSK + DVB Feature	12.0 – 20,000	8PSK + DVB Feature	DVB Feature
		8/9	12.8 – 20,000	8PSK + DVB Feature	8PSK + DVB Feature	8PSK + DVB Feature	12.8 – 20,000	8PSK + DVB Feature	DVB Feature
16QAM	Trellis	3/4	14.4 – 20,000	16QAM + DVB Feature	16QAM + DVB Feature	16QAM + DVB Feature	14.4 – 20,000	16QAM + DVB Feature	DVB Feature
		7/8	16.8 – 20,000	16QAM + DVB Feature	16QAM + DVB Feature	16QAM + DVB Feature	16.8 – 20,000	16QAM + DVB Feature	DVB Feature
TPC Modes									
BPSK	TPC	5/16	1.5 – 3,125	TPC Feature + HW16	TPC Feature + HW18	—	1.5 – 9,375	TPC Feature + HW16	Standard
		21/44	2.3 – 4,773	TPC Feature + HW14	TPC Feature	TPC Feature	2.3 – 14,318	TPC Feature + HW14	Standard
	TPC (SHORT)	7/8-S	4.2 – 8,750	TPC Feature + HW15	—	—	4.2 – 20,000	TPC Feature + HW15	—
QPSK	TPC	21/44	4.6 – 9,545	TPC Feature + HW14	TPC Feature	TPC Feature	4.6 – 20,000	TPC Feature + HW14	Standard
		3/4	7.2 – 15,000	TPC Feature + HW14	TPC Feature	TPC Feature	7.2 – 20,000	TPC Feature + HW14	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
		7/8	8.4 – 17,500	TPC Feature + HW14	TPC Feature	TPC Feature	8.4 – 20,000	TPC Feature + HW14	Standard
		0.495	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
		0.793	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
	TPC (SHORT)	7/8-S	64.0 – 17,500	TPC Feature + HW15	—	—	64.0 – 20,000	TPC Feature + HW15	—
OQPSK	TPC	21/44	4.6 – 9,545	TPC Feature + HW-2	TPC Feature	TPC Feature	4.6 – 20,000	TPC Feature + HW14	Standard
		3/4	7.2 – 15,000	TPC Feature + HW-2	TPC Feature	TPC Feature	7.2 – 20,000	TPC Feature + HW14	Standard
		7/8	8.4 – 17,500	TPC Feature + HW-2	TPC Feature	TPC Feature	8.4 – 20,000	TPC Feature + HW14	Standard
		0.495	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
		0.793	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
	TPC (SHORT)	7/8-S	64.0 – 17,500	TPC Feature + HW15	—	—	64.0 – 20,000	TPC Feature + HW15	—
8PSK	TPC	3/4	10.8 – 20,000	8PSK + TPC Feature + HW14	8PSK + TPC Feature	8PSK + TPC Feature	10.8 – 20,000	8PSK + TPC Feature + HW14	Standard
		7/8	12.6 – 20,000	8PSK + TPC Feature + HW14	8PSK + TPC Feature	8PSK + TPC Feature	12.6 – 20,000	8PSK + TPC Feature + HW14	Standard
		0.495	64.0 – 6,132	8PSK + TPC Feature + HW15	—	—	64.0 – 6,132	8PSK + TPC Feature + HW15	—
		0.793	64.0 – 6,132	8PSK + TPC Feature + HW15	—	—	64.0 – 6,132	8PSK + TPC Feature + HW15	—
		0.750	—	—	—	—	20,000.1 – 52,000	8PSK + TPC Feature + HW15	—
		0.875	—	—	—	—	20,000.1 – 52,000	8PSK + TPC Feature + HW15	—
8QAM	TPC	3/4	10.8 – 20,000	8QAM + TPC Feature + HW16	8QAM + TPC Feature + HW18	—	10.8 – 20,000	8QAM + TPC Feature + HW16	Standard
		7/8	12.6 – 20,000	8QAM + TPC Feature +	8QAM + TPC Feature +	—	12.6 – 20,000	8QAM + TPC Feature +	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
				HW16	HW18			HW16	
16QAM	TPC	3/4	14.4 – 20,000	16QAM + TPC Feature + HW14	16QAM + TPC Feature	16QAM + TPC Feature	14.4 – 20,000	16QAM + TPC Feature + HW14	Standard
		7/8	16.8 – 20,000	16QAM + TPC Feature + HW14	16QAM + TPC Feature	16QAM + TPC Feature	16.8 – 20,000	16QAM + TPC Feature + HW14	Standard
		0.495	64.0 – 6,132	16QAM + TPC Feature + HW15	—	—	64.0 – 6,132	16QAM + TPC Feature + HW15	—
		0.793	64.0 – 6,132	16QAM + TPC Feature + HW15	—	—	64.0 – 6,132	16QAM + TPC Feature + HW15	—
		0.750	—	—	—	—	20,000.1 – 52,000	16QAM + TPC Feature + HW15	—
		0.875	—	—	—	—	20,000.1 – 52,000	16QAM + TPC Feature + HW15	—
165B Turbo Modes									
BPSK	Turbo	1/2	64 – 5,000	—	EBEM Feature + HW17	—	64 – 15,000	EBEM Feature + HW17	Standard
		2/3	64 – 6,667	—	EBEM Feature + HW17	—	64 – 20,000	EBEM Feature + HW17	Standard
		3/4	64 – 7,500	—	EBEM Feature + HW17	—	64 – 22,500	EBEM Feature + HW17	Standard
		7/8	64 – 8,750	—	EBEM Feature + HW17	—	64 – 26,250	EBEM Feature + HW17	Standard
		19/20	64 – 9,500	—	EBEM Feature + HW17	—	64 – 28,500	EBEM Feature + HW17	Standard
QPSK	Turbo	1/2	64 – 10,000	—	EBEM Feature + HW17	—	64 – 30,000	EBEM Feature + HW17	Standard
		2/3	64 – 13,333	—	EBEM Feature + HW17	—	64 – 40,000	EBEM Feature + HW17	Standard
		3/4	64 – 15,000	—	EBEM Feature + HW17	—	64 – 45,000	EBEM Feature + HW17	Standard
		7/8	64 – 17,500	—	EBEM Feature + HW17	—	64 – 52,500	EBEM Feature + HW17	Standard
		19/20	64 – 19,000	—	EBEM Feature + HW17	—	64 – 57,000	EBEM Feature + HW17	Standard
8PSK	Turbo	1/2	256 – 15,000	—	EBEM Feature + HW17	—	256 – 45,000	EBEM Feature + HW17	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
		2/3	256 – 20,000	—	EBEM Feature + HW17	—	256 – 60,000	EBEM Feature + HW17	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW17	—	256 – 67,500	EBEM Feature + HW17	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW17	—	256 – 78,750	EBEM Feature + HW17	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW17	—	256 – 85,500	EBEM Feature + HW17	Standard
16APSK	Turbo	1/2	256 – 20,000	—	EBEM Feature + HW17	—	256 – 60,000	EBEM Feature + HW17	Standard
		2/3	256 – 20,000	—	EBEM Feature + HW17	—	256 – 80,000	EBEM Feature + HW17	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW17	—	256 – 90,000	EBEM Feature + HW17	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW17	—	256 – 105,000	EBEM Feature + HW17	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW17	—	256 – 114,000	EBEM Feature + HW17	Standard
LDPC Modes									
BPSK	HP-LDPC	1/2	2.4 – 5,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	2.4 – 15,000	LDPC Feature + HW16	LDPC Feature
	ULL-LDPC	1/2	2.4 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 14,799	LDPC Feature + HW19	LDPC Feature
QPSK	HP-LDPC	1/2	4.8 – 10,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	4.8 – 20,000	LDPC Feature + HW16	LDPC Feature
		2/3	6.4 – 13,333	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	6.4 – 20,000	LDPC Feature + HW16	LDPC Feature
		3/4	7.2 – 15,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	7.2 – 20,000	LDPC Feature + HW16	LDPC Feature
	ULL-LDPC	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 20,000	LDPC Feature + HW19	LDPC Feature
		2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 20,000	LDPC Feature + HW19	LDPC Feature
		3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 20,000	LDPC Feature + HW19	LDPC Feature
OQPSK	HP-LDPC	1/2	4.8 – 10,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	4.8 – 20,000	LDPC Feature + HW16	LDPC Feature
		2/3	6.4 – 13,333	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	6.4 – 20,000	LDPC Feature + HW16	LDPC Feature
		3/4	7.2 – 15,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	7.2 – 20,000	LDPC Feature + HW16	LDPC Feature
	ULL-LDPC	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 20,000	LDPC Feature + HW19	LDPC Feature
		2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 20,000	LDPC Feature + HW19	LDPC Feature
		3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 20,000	LDPC Feature + HW19	LDPC Feature

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
8PSK	HP-LDPC	2/3	9.6 – 20,000	8PSK + LDPC Feature + HW16	8PSK + LDPC Feature + HW18	8PSK + LDPC Feature + HW20	9.6 – 20,000	8PSK + LDPC Feature + HW20	LDPC Feature
		3/4	10.8 – 20,000	8PSK + LDPC Feature + HW16	8PSK + LDPC Feature + HW18	8PSK + LDPC Feature + HW20	10.8 – 20,000	8PSK + LDPC Feature + HW16	LDPC Feature
8QAM	HP-LDPC	2/3	9.6 – 20,000	8QAM + LDPC Feature + HW16	8QAM + LDPC Feature + HW18	8QAM + LDPC Feature + HW20	9.6 – 20,000	8QAM + LDPC Feature + HW16	LDPC Feature
		3/4	10.8 – 20,000	8QAM + LDPC Feature + HW16	8QAM + LDPC Feature + HW18	8QAM + LDPC Feature + HW20	10.8 – 20,000	8QAM + LDPC Feature + HW16	LDPC Feature
16QAM	HP-LDPC	3/4	14.4 – 20,000	16QAM + LDPC Feature + HW16	16QAM + LDPC Feature + HW18	16QAM + LDPC Feature + HW20	14.4 – 20,000	16QAM + LDPC Feature + HW16	LDPC Feature
TX Direct Sequence Spread Spectrum									
BPSK	HP-LDPC-OFF	1/2	2.4 – 5,000	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 15,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		2.4 – 2,500	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 7,500	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		2.4 – 1,250	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 3,750	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		2.4 – 625	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 1,875	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		2.4 – 313	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 937	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	1/2	2.4 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 4,933	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		2.4 – 2,467	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 2,466	LDPC Feature + HW19	DSSS Feature + LDPC Feature

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
	FACTOR x4		2.4 – 1,233	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 1,233	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		2.4 - 617	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 - 616	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		2.4 - 308	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 - 308	LDPC Feature + HW19	DSSS Feature + LDPC Feature
QPSK	HP-LDPC-OFF	1/2	4.8 – 10,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 10,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		4.8 – 5,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 5,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		4.8 – 2,500	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 2,500	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.8 – 1,250	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 1,250	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.8 - 625	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 625	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 9,866	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		4.7 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 4,933	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		4.7 – 2,467	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 2,466	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.7 – 1,233	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 1,233	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.7 - 617	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 616	LDPC Feature + HW19	DSSS Feature +

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
									LDPC Feature
	HP-LDPC-OFF	2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 13,078	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		6.3 – 6,539	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 6,539	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		6.3 – 3,270	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 3,269	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		6.3 – 1,635	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 1,634	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		6.3 0 817	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 0 817	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 14,686	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		7.0 – 7,342	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 7,342	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		7.0 – 3,671	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 3,671	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		7.0 – 1,836	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 1,835	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		7.0 - 918	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 - 917	LDPC Feature + HW19	DSSS Feature + LDPC Feature
OQPSK	HP-LDPC-OFF	1/2	4.8 – 10,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 10,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		4.8 – 5,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 5,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
	FACTOR x4		4.8 – 2,500	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 2,500	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.8 – 1,250	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 1,250	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.8 – 625	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 625	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 9,866	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		4.7 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 4,933	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		4.7 – 2,467	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 2,466	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.7 – 1,233	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 1,233	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.7 – 617	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 616	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 13,078	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		6.3 – 6,539	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 6,539	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		6.3 – 3,270	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 3,269	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		6.3 – 1,635	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 1,634	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		6.3 – 817	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 817	LDPC Feature + HW19	DSSS Feature +

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
									LDPC Feature
	HP-LDPC-OFF	3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 14,686	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		7.0 – 7,342	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 7,342	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		7.0 – 3,671	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 3,671	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		7.0 – 1,836	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 1,835	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		7.0 - 918	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 - 917	LDPC Feature + HW19	DSSS Feature + LDPC Feature
Satellite Framing									
ALL	IDR 96K	—	T1/E1 / T2/E2	IDR Feature, Framing Only + HW9 for IESS	IDR Feature for Framing	IDR Feature, Framing Only + HW9 for IESS	T1/E1 / T2/E2 / T3/E3	IDR Feature, Framing Only + HW9 for IESS	IDR Feature for Framing
	IBS 1/15	—	N x 64, 64 – 1536, 2048	IBS Feature + HW9 for IESS	IBS Feature (Framing Only)	IBS Feature (Framing Only)	N x 64, 64 – 1536, 2048	IBS Feature	IBS Feature
	EF AUPC	—	Less than 20,000	AUPC Feature	AUPC Feature	AUPC Feature	Less than 20,000	AUPC Feature	Standard
	EDMAC	—	—	EDMAC Feature Framing Only	EDMAC Feature Framing Only	EDMAC Feature Framing Only	—	EDMAC Feature Framing Only	EDMAC Feature Framing Only
	SCC	—	—	Enhanced Async Feature	Enhanced Async Feature (Framing Only)	Enhanced Async Feature	—	Enhanced Async Feature	Enhanced Async Feature
	EFFICIENT D&I	—	N x 64, 64 – 1536, 2048	Drop and Insert Feature	Drop and Insert Feature (Framing Only)	Drop and Insert Feature	N x 64, 64 – 1536, 2048	IDR Feature, Framing Only + HW9 for IESS	Drop and Insert Feature (Framing Only)
	EBEM	—	—	—	EBEM Feature + HW5	—	—	—	—
Ethernet HDLC Framing									

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
ALL	RADYNE	—	—	Standard + HW22	Standard (10/100)	Standard (10/100)	—	Standard + HW22	Standard (10/100/1000)
	COMTECH	—	—	Standard + HW22	Standard (10/100)	—	—	Standard + HW22	Standard (10/100/1000)
	MANAGED 570	—	—	Standard + HW22	Standard (10/100)	—	—	Standard + HW22	Standard (10/100/1000)
TRANSEC (HW28) Counter Mode (Interoperable with MD-1366)									
BPSK	Turbo	1/2	64 – 5,000	—	EBEM Feature + HW28	—	64 – 15,000	EBEM Feature + HW28	Standard
		2/3	64 – 6,667	—	EBEM Feature + HW28	—	64 – 20,000	EBEM Feature + HW28	Standard
		3/4	64 – 7,500	—	EBEM Feature + HW28	—	64 – 22,500	EBEM Feature + HW28	Standard
		7/8	64 – 8,750	—	EBEM Feature + HW28	—	64 – 26,250	EBEM Feature + HW28	Standard
		19/20	64 – 9,500	—	EBEM Feature + HW28	—	64 – 28,500	EBEM Feature + HW28	Standard
QPSK	Turbo	1/2	64 – 10,000	—	EBEM Feature + HW28	—	64 – 30,000	EBEM Feature + HW28	Standard
		2/3	64 – 13,333	—	EBEM Feature + HW28	—	64 – 40,000	EBEM Feature + HW28	Standard
		3/4	64 – 15,000	—	EBEM Feature + HW28	—	64 – 45,000	EBEM Feature + HW28	Standard
		7/8	64 – 17,500	—	EBEM Feature + HW28	—	64 – 52,500	EBEM Feature + HW28	Standard
		19/20	64 – 19,000	—	EBEM Feature + HW28	—	64 – 57,000	EBEM Feature + HW28	Standard
8PSK	Turbo	1/2	256 – 15,000	—	EBEM Feature + HW28	—	256 – 45,000	EBEM Feature + HW28	Standard
		2/3	256 – 20,000	—	EBEM Feature + HW28	—	256 – 60,000	EBEM Feature + HW28	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW28	—	256 – 67,500	EBEM Feature + HW28	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW28	—	256 – 78,750	EBEM Feature + HW28	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW28	—	256 – 85,500	EBEM Feature + HW28	Standard
16APSK	Turbo	1/2	256 – 20,000	—	EBEM Feature + HW28	—	256 – 60,000	EBEM Feature + HW28	Standard
		2/3	256 – 20,000	—	EBEM Feature + HW28	—	256 – 80,000	EBEM Feature + HW28	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW28	—	256 – 90,000	EBEM Feature + HW28	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW28	—	256 – 105,000	EBEM Feature + HW28	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW28	—	256 – 114,000	EBEM Feature + HW28	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
TRANSEC (HW28) Block Mode Mode (Interoperable with SLM-5650A) HW-27 Frame Expansion: (3 + 16 * N) / (16 * N), N = 1…16									
BPSK	TPC	5/16	1.5 – 2,632	TPC Feature + HW27	TPC Feature + HW27	—	1.5 – 7,895	TPC Feature + HW27	Standard
		21/44	2.3 – 4,019	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	2.3 – 12,057	TPC Feature + HW27	Standard
QPSK	TPC	21/44	4.6 – 8,038	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	4.6 – 20,000	TPC Feature + HW27	Standard
		3/4	7.2 – 12,632	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	7.2 – 20,000	TPC Feature + HW27	Standard
		7/8	8.4 – 14,737	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	8.4 – 20,000	TPC Feature + HW27	Standard
OQPSK	TPC	21/44	4.6 – 8,038	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	4.6 – 20,000	TPC Feature + HW27	Standard
		3/4	7.2 – 12,632	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	7.2 – 20,000	TPC Feature + HW27	Standard
		7/8	8.4 – 14,737	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	8.4 – 20,000	TPC Feature + HW27	Standard
8PSK	TPC	3/4	10.8 – 18,947	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	10.8 – 20,000	8PSK + TPC Feature + HW27	Standard
		7/8	12.6 – 20,000	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	12.6 – 20,000	8PSK + TPC Feature + HW27	Standard
8QAM	TPC	3/4	10.8 – 18,974	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	10.8 – 20,000	8PSK + TPC Feature + HW27	Standard
		7/8	12.6 – 20,000	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	12.6 – 20,000	8PSK + TPC Feature + HW27	Standard
16QAM	TPC	3/4	14.4 – 20,000	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	14.4 – 20,000	16QAM + TPC Feature + HW27	Standard
		7/8	16.8 – 20,000	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	16.8 – 20,000	16QAM + TPC Feature + HW27	Standard
BPSK	HP-LDPC	1/2	2.4 – 4,211	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	2.4 – 12,632	LDPC Feature + HW27	LDPC Feature
	ULL-LDPC	1/2	2.4 – 4,154	LDPC Feature + HW27	—	LDPC Feature + HW27	2.4 – 12,463	LDPC Feature + HW27	LDPC Feature
QPSK	HP-LDPC	1/2	4.8 – 8,421	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	4.8 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.4 – 11,228	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	6.4 – 20,000	LDPC Feature + HW27	LDPC Feature

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
		3/4	7.2 – 12,632	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	7.2 – 20,000	LDPC Feature + HW27	LDPC Feature
	ULL-LDPC	1/2	4.7 – 8,308	LDPC Feature + HW27	—	LDPC Feature + HW27	4.7 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.3 – 11,013	LDPC Feature + HW27	—	LDPC Feature + HW27	6.3 – 20,000	LDPC Feature + HW27	LDPC Feature
		3/4	7.0 – 12,366	LDPC Feature + HW27	—	LDPC Feature + HW27	7.0 – 20,000	LDPC Feature + HW27	LDPC Feature
OQPSK	HP-LDPC	1/2	4.8 – 8,421	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	4.8 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.4 – 11,228	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	6.4 – 20,000	LDPC Feature + HW27	LDPC Feature
		3/4	7.2 – 12,632	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	7.2 – 20,000	LDPC Feature + HW27	LDPC Feature
	ULL-LDPC	1/2	4.7 – 8,308	LDPC Feature + HW27	—	LDPC Feature + HW27	4.7 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.3 – 11,013	LDPC Feature + HW27	—	LDPC Feature + HW27	6.3 – 20,000	LDPC Feature + HW27	LDPC Feature
		3/4	7.0 – 12,366	LDPC Feature + HW27	—	LDPC Feature + HW27	7.0 – 20,000	LDPC Feature + HW27	LDPC Feature
8PSK	HP-LDPC	2/3	9.6 – 16,842	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	9.6 – 20,000	8PSK + LDPC Feature + HW27	LDPC Feature
		3/4	10.8 – 18,947	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	10.8 – 20,000	8PSK + LDPC Feature + HW27	LDPC Feature
8QAM	HP-LDPC	2/3	9.6 – 16,842	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	9.6 – 20,000	8QAM + LDPC Feature + HW27	LDPC Feature
		3/4	10.8 – 18,947	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	10.8 – 20,000	8QAM + LDPC Feature + HW27	LDPC Feature
16QAM	HP-LDPC	3/4	14.4 – 20,000	16QAM + LDPC Feature + HW27	16QAM + LDPC Feature + HW27	16QAM + LDPC Feature + HW27	14.4 – 20,000	16QAM + LDPC Feature + HW27	LDPC Feature

Errata F for MN-DMD2050E Rev 2

Comtech EF Data Documentation Update

DMD2050E

Universal Satellite Modem
Installation and Operation Manual

Part Number MN-DMD2050E
Revision 2

Subject: Revise 7.11.1, Data Rate Limits for Non-DVB, Revise Appendix K, Compatibility with other DMD Modems,

This erratum supersedes Errata E.

Errata Part Number: ER-DMD2050E-EF2 (*Errata documents are not subject to revision.)*

Comments: The new information will be included in the next released revision of the manual.

7.11 Data Rate Limits

7.11.1 Non-DVB

Non-DVB Data Rate Limits			
Modulation	**Code Rate**	**Min Data Rate**	**Max Data Rate**
BPSK	NONE	4800	10000000
BPSK	VIT 1/2	2400	10000000
BPSK	VIT 3/4	3600	10000000
BPSK	VIT 7/8	4200	10000000
BPSK	SEQ 1/2	2400	2048000
BPSK	SEQ 3/4	3600	2048000
BPSK	SEQ 7/8	4200	2048000
BPSK	TPC 21/44	2400	4772727
BPSK	TPC 5/16	18000	3906200
BPSK	LDPC 1/2	18000	5000000
BPSK	EBEM TURBO 1/2	64000	14903249
BPSK	EBEM TURBO 2/3	64000	19850867
BPSK	EBEM TURBO 3/4	64000	22320240
BPSK	EBEM TURBO 7/8	64000	26019334
BPSK	EBEM TURBO 19/20	64000	26019334
QPSK	NONE	9600	20000000
QPSK	VIT 1/2	4800	20000000
QPSK	VIT 3/4	7200	20000000
QPSK	VIT 7/8	8400	20000000
QPSK	SEQ 1/2	4800	2048000
QPSK	SEQ 3/4	7200	2048000
QPSK	SEQ 7/8	8400	2048000
QPSK	TPC 1/2	4582	9545454
QPSK	TPC 3/4	7200	15000000
QPSK	TPC 7/8	8400	17500000
QPSK	LDPC 1/2	18000	10000000
QPSK	LDPC 2/3	24000	13333333
QPSK	LDPC 3/4	27000	15000000
QPSK	EBEM TURBO 1/2	64000	29716088
QPSK	EBEM TURBO 2/3	64000	39541491
QPSK	EBEM TURBO 3/4	64000	44433962
QPSK	EBEM TURBO 7/8	64000	51758241
QPSK	EBEM TURBO 19/20	64000	52000000

Non-DVB Data Rate Limits			
Modulation	**Code Rate**	**Min Data Rate**	**Max Data Rate**
OQPSK	NONE	9600	20000000
OQPSK	VIT 1/2	4800	20000000
OQPSK	VIT 3/4	7200	20000000
OQPSK	VIT 7/8	8400	20000000
OQPSK	SEQ 1/2	4800	2048000
OQPSK	SEQ 3/4	7200	2048000
OQPSK	SEQ 7/8	8400	2048000
OQPSK	TPC 1/2	4582	9545454
OQPSK	TPC 3/4	7200	15000000
OQPSK	TPC 7/8	8400	17500000
OQPSK	LDPC 1/2	18000	10000000
OQPSK	LDPC 2/3	24000	13333333
OQPSK	LDPC 3/4	27000	15000000
8-PSK	TRE 2/3	9600	52000000
8-PSK	TPC 3/4	40000	20000000
8-PSK	TPC 7/8	48000	20000000
8-PSK	LDPC 2/3	36000	20000000
8-PSK	LDPC 3/4	40500	20000000
8-PSK	EBEM TURBO 1/2	256000	44433962
8-PSK	EBEM TURBO 2/3	256000	52000000
8-PSK	EBEM TURBO 3/4	256000	52000000
8-PSK	EBEM TURBO 7/8	256000	52000000
8-PSK	EBEM TURBO 19/20	256000	52000000
8-QAM	TPC 3/4	40000	20000000
8-QAM	TPC 7/8	48000	20000000
8-QAM	LDPC 2/3	36000	20000000
8-QAM	LDPC 3/4	405000	20000000
16-QAM	VIT 3/4	14400	20000000
16-QAM	VIT 7/8	16800	20000000
16-QAM	TPC 3/4	54000	20000000
16-QAM	TPC 7/8	63000	20000000
16-QAM	LDPC 3/4	54000	20000000
16-APSK	EBEM TURBO 1/2	256000	52000000
16-APSK	EBEM TURBO 2/3	256000	52000000
16-APSK	EBEM TURBO 3/4	256000	52000000
16-APSK	EBEM TURBO 7/8	256000	52000000
16-APSK	EBEM TURBO 19/20	256000	52000000

Appendix K. Compatibility with Other DMD Modems

K.1 Compatibility with Other DMD Modems

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
Legacy Modes									
BPSK	Viterbi	1/2	2.4 – 5,000	Standard	Standard	Standard	2.4 – 15,000	Standard	Standard
QPSK	Viterbi	1/2	4.8 – 10,000	Standard	Standard	Standard	4.8 – 30,000	Standard	Standard
		3/4	7.2 – 15,000	Standard	Standard	Standard	7.2 – 45,000	Standard	Standard
		7/8	8.4 – 17,500	Standard	Standard	Standard	8.4 – 52,000	Standard	Standard
	Viterbi + RS	1/2	4.8 – 10,000 * R / N	RS Feature	RS Feature	RS Feature	4.8 – 30,000 * R / N	RS Feature	Standard
		3/4	7.2 – 15,000 * R / N	RS Feature	RS Feature	RS Feature	7.2 – 45,000 * R / N	RS Feature	Standard
		7/8	8.4 – 17,500 * R / N	RS Feature	RS Feature	RS Feature	8.4 – 52,000 * R / N	RS Feature	Standard
	Sequential	1/2	4.8 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	4.8 – 2,048	Sequential Feature	Sequential Feature
		3/4	7.2 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	7.2 – 2,048	Sequential Feature	Sequential Feature
		7/8	8.4 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	8.4 – 2,048	Sequential Feature	Sequential Feature
OQPSK	Viterbi	1/2	4.8 – 10,000	Standard	Standard	Standard	4.8 – 30,000	Standard	Standard
		3/4	7.2 – 15,000	Standard	Standard	Standard	7.2 – 45,000	Standard	Standard
		7/8	8.4 – 17,500	Standard	Standard	Standard	8.4 – 52,000	Standard	Standard
	Viterbi + RS	1/2	4.8 – 10,000 * R / N	RS Feature	RS Feature	RS Feature	4.8 – 10,000 * R / N	RS Feature	Standard
		3/4	7.2 – 15,000 * R / N	RS Feature	RS Feature	RS Feature	7.2 – 15,000 * R / N	RS Feature	Standard
		7/8	8.4 – 17,500 * R / N	RS Feature	RS Feature	RS Feature	8.4 – 17,500 * R / N	RS Feature	Standard
	Sequential	1/2	4.8 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	4.8 – 2,048	Sequential Feature	Sequential Feature
		3/4	7.2 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	7.2 – 2,048	Sequential Feature	Sequential Feature
		7/8	8.4 – 2,048	Sequential Feature	Sequential Feature	Sequential Feature	8.4 – 2,048	Sequential Feature	Sequential Feature
8PSK	Trellis	2/3	9.6 – 20,000	8PSK Feature	8PSK Feature	8PSK Feature	9.6 – 52,000	8PSK Feature	Standard
	Trellis + RS	2/3	9.6 – 20,000 * R / N	8PSK + RS Feature	8PSK + RS Feature	8PSK + RS Feature	9.6 – 52,000	8PSK + RS Feature	Standard
16QAM	Viterbi	3/4	14.4 – 20,000	16QAM Feature	16QAM Feature	16QAM Feature	14.4 – 52,000	16QAM Feature	Standard
		7/8	16.8 – 20,000	16QAM Feature	16QAM Feature	16QAM Feature	16.8 – 52,000	16QAM Feature	Standard
	Viterbi + RS	3/4	14.4 – 20,000 * R / N	16QAM + RS Feature	16QAM + RS Feature	16QAM + RS Feature	14.4 – 52,000	16QAM + RS Feature	Standard
		7/8	16.8 – 20,000 * R / N	16QAM + RS Feature	16QAM + RS Feature	16QAM + RS Feature	16.8 – 52,000	16QAM + RS Feature	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
DVB Modes									
BPSK	Viterbi	1/2	2.4 – 4,608	DVB Feature	DVB Feature	DVB Feature	2.4 – 4,608	DVB Feature	DVB Feature
		2/3	3.2 – 6,144	DVB Feature	DVB Feature	DVB Feature	3.2 – 6,144	DVB Feature	DVB Feature
		3/4	3.6 – 6,912	DVB Feature	DVB Feature	DVB Feature	3.6 – 6,912	DVB Feature	DVB Feature
		5/6	4.0 – 7,680	DVB Feature	DVB Feature	DVB Feature	4.0 – 7,680	DVB Feature	DVB Feature
		7/8	4.2 – 8,064	DVB Feature	DVB Feature	DVB Feature	4.2 – 8,064	DVB Feature	DVB Feature
QPSK	Viterbi	1/2	4.8 – 9,216	DVB Feature	DVB Feature	DVB Feature	4.8 – 9,216	DVB Feature	DVB Feature
		2/3	6.4 – 12,288	DVB Feature	DVB Feature	DVB Feature	6.4 – 12,288	DVB Feature	DVB Feature
		3/4	7.2 – 13,824	DVB Feature	DVB Feature	DVB Feature	7.2 – 13,824	DVB Feature	DVB Feature
		5/6	8.0 – 15,359	DVB Feature	DVB Feature	DVB Feature	8.0 – 15,359	DVB Feature	DVB Feature
		7/8	8.4 – 16,127	DVB Feature	DVB Feature	DVB Feature	8.4 – 16,127	DVB Feature	DVB Feature
8PSK	Trellis	2/3	9.6 – 18,431	8PSK + DVB Feature	8PSK + DVB Feature	8PSK + DVB Feature	9.6 – 18,431	8PSK + DVB Feature	DVB Feature
		5/6	12.0 – 20,000	8PSK + DVB Feature	8PSK + DVB Feature	8PSK + DVB Feature	12.0 – 20,000	8PSK + DVB Feature	DVB Feature
		8/9	12.8 – 20,000	8PSK + DVB Feature	8PSK + DVB Feature	8PSK + DVB Feature	12.8 – 20,000	8PSK + DVB Feature	DVB Feature
16QAM	Trellis	3/4	14.4 – 20,000	16QAM + DVB Feature	16QAM + DVB Feature	16QAM + DVB Feature	14.4 – 20,000	16QAM + DVB Feature	DVB Feature
		7/8	16.8 – 20,000	16QAM + DVB Feature	16QAM + DVB Feature	16QAM + DVB Feature	16.8 – 20,000	16QAM + DVB Feature	DVB Feature
TPC Modes									
BPSK	TPC	5/16	1.5 – 3,125	TPC Feature + HW16	TPC Feature + HW18	—	1.5 – 9,375	TPC Feature + HW16	Standard
		21/44	2.3 – 4,773	TPC Feature + HW14	TPC Feature	TPC Feature	2.3 – 14,318	TPC Feature + HW14	Standard
	TPC (SHORT)	7/8-S	4.2 – 8,750	TPC Feature + HW15	—	—	4.2 – 20,000	TPC Feature + HW15	—
QPSK	TPC	21/44	4.6 – 9,545	TPC Feature + HW14	TPC Feature	TPC Feature	4.6 – 20,000	TPC Feature + HW14	Standard
		3/4	7.2 – 15,000	TPC Feature + HW14	TPC Feature	TPC Feature	7.2 – 20,000	TPC Feature + HW14	Standard
		7/8	8.4 – 17,500	TPC Feature + HW14	TPC Feature	TPC Feature	8.4 – 20,000	TPC Feature + HW14	Standard
		0.495	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
		0.793	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
	TPC (SHORT)	7/8-S	64.0 – 17,500	TPC Feature + HW15	—	—	64.0 – 20,000	TPC Feature + HW15	—

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
OQPSK	TPC	21/44	4.6 – 9,545	TPC Feature + HW-2	TPC Feature	TPC Feature	4.6 – 20,000	TPC Feature + HW14	Standard
		3/4	7.2 – 15,000	TPC Feature + HW-2	TPC Feature	TPC Feature	7.2 – 20,000	TPC Feature + HW14	Standard
		7/8	8.4 – 17,500	TPC Feature + HW-2	TPC Feature	TPC Feature	8.4 – 20,000	TPC Feature + HW14	Standard
		0.495	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
		0.793	64.0 – 6,132	TPC Feature + HW15	—	—	64.0 – 6,132	TPC Feature + HW15	—
	TPC (SHORT)	7/8-S	64.0 – 17,500	TPC Feature + HW15	—	—	64.0 – 20,000	TPC Feature + HW15	—
8PSK	TPC	3/4	10.8 – 20,000	8PSK + TPC Feature + HW14	8PSK + TPC Feature	8PSK + TPC Feature	10.8 – 20,000	8PSK + TPC Feature + HW14	Standard
		7/8	12.6 – 20,000	8PSK + TPC Feature + HW14	8PSK + TPC Feature	8PSK + TPC Feature	12.6 – 20,000	8PSK + TPC Feature + HW14	Standard
		0.495	64.0 – 6,132	8PSK + TPC Feature + HW15	—	—	64.0 – 6,132	8PSK + TPC Feature + HW15	—
		0.793	64.0 – 6,132	8PSK + TPC Feature + HW15	—	—	64.0 – 6,132	8PSK + TPC Feature + HW15	—
		0.750	—	—	—	—	20,000.1 – 52,000	8PSK + TPC Feature + HW15	—
		0.875	—	—	—	—	20,000.1 – 52,000	8PSK + TPC Feature + HW15	—
8QAM	TPC	3/4	10.8 – 20,000	8QAM + TPC Feature + HW16	8QAM + TPC Feature + HW18	—	10.8 – 20,000	8QAM + TPC Feature + HW16	Standard
		7/8	12.6 – 20,000	8QAM + TPC Feature + HW16	8QAM + TPC Feature + HW18	—	12.6 – 20,000	8QAM + TPC Feature + HW16	Standard
16QAM	TPC	3/4	14.4 – 20,000	16QAM + TPC Feature + HW14	16QAM + TPC Feature	16QAM + TPC Feature	14.4 – 20,000	16QAM + TPC Feature + HW14	Standard
		7/8	16.8 – 20,000	16QAM + TPC Feature + HW14	16QAM + TPC Feature	16QAM + TPC Feature	16.8 – 20,000	16QAM + TPC Feature + HW14	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
		0.495	64.0 – 6,132	16QAM + TPC Feature + HW15	—	—	64.0 – 6,132	16QAM + TPC Feature + HW15	—
		0.793	64.0 – 6,132	16QAM + TPC Feature + HW15	—	—	64.0 – 6,132	16QAM + TPC Feature + HW15	—
		0.750	—	—	—	—	20,000.1 – 52,000	16QAM + TPC Feature + HW15	—
		0.875	—	—	—	—	20,000.1 – 52,000	16QAM + TPC Feature + HW15	—
165B Turbo Modes[1]									
BPSK	Turbo	1/2	64 – 4,970	—	EBEM Feature + HW17	—	64 – 14,910	EBEM Feature + HW17	Standard
		2/3	64 – 6,620	—	EBEM Feature + HW17	—	64 – 19,860	EBEM Feature + HW17	Standard
		3/4	64 – 7,444	—	EBEM Feature + HW17	—	64 – 22,329	EBEM Feature + HW17	Standard
		7/8	64 – 8,677	—	EBEM Feature + HW17	—	64 – 26,031	EBEM Feature + HW17	Standard
		19/20	64 – 9,417	—	EBEM Feature + HW17	—	64 – 28,248	EBEM Feature + HW17	Standard
QPSK	Turbo	1/2	64 – 9.910	—	EBEM Feature + HW17	—	64 – 29,730	EBEM Feature + HW17	Standard
		2/3	64 – 13,187	—	EBEM Feature + HW17	—	64 – 39,558	EBEM Feature + HW17	Standard
		3/4	64 – 14,819	—	EBEM Feature + HW17	—	64 – 44,454	EBEM Feature + HW17	Standard
		7/8	64 – 17,261	—	EBEM Feature + HW17	—	64 – 52,000	EBEM Feature + HW17	Standard
		19/20	64 – 18,725	—	EBEM Feature + HW17	—	64 – 52,000	EBEM Feature + HW17	Standard
8PSK	Turbo	1/2	256 – 14,819	—	EBEM Feature + HW17	—	256 – 44,454	EBEM Feature + HW17	Standard
		2/3	256 – 19,701	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard

[1] The 165B Turbo Modes are calculated with the embedded channel *DISABLED* on a single interface without multiplexing to provide the absolute maximum the modem can be configured with.

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
16APSK	Turbo	1/2	256 – 19,701	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
		2/3	256 – 20,000	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW17	—	256 – 52,000	EBEM Feature + HW17	Standard
LDPC Modes									
BPSK	HP-LDPC	1/2	2.4 – 5,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	2.4 – 15,000	LDPC Feature + HW16	LDPC Feature
	ULL-LDPC	1/2	2.4 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 14,799	LDPC Feature + HW19	LDPC Feature
QPSK	HP-LDPC	1/2	4.8 – 10,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	4.8 – 20,000	LDPC Feature + HW16	LDPC Feature
		2/3	6.4 – 13,333	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	6.4 – 20,000	LDPC Feature + HW16	LDPC Feature
		3/4	7.2 – 15,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	7.2 – 20,000	LDPC Feature + HW16	LDPC Feature
	ULL-LDPC	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 20,000	LDPC Feature + HW19	LDPC Feature
		2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 20,000	LDPC Feature + HW19	LDPC Feature
		3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 20,000	LDPC Feature + HW19	LDPC Feature
OQPSK	HP-LDPC	1/2	4.8 – 10,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	4.8 – 20,000	LDPC Feature + HW16	LDPC Feature
		2/3	6.4 – 13,333	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	6.4 – 20,000	LDPC Feature + HW16	LDPC Feature
		3/4	7.2 – 15,000	LDPC Feature + HW16	LDPC Feature + HW18	LDPC Feature + HW20	7.2 – 20,000	LDPC Feature + HW16	LDPC Feature
	ULL-LDPC	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 20,000	LDPC Feature + HW19	LDPC Feature
		2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 20,000	LDPC Feature + HW19	LDPC Feature
		3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 20,000	LDPC Feature + HW19	LDPC Feature
8PSK	HP-LDPC	2/3	9.6 – 20,000	8PSK + LDPC Feature + HW16	8PSK + LDPC Feature + HW18	8PSK + LDPC Feature + HW20	9.6 – 20,000	8PSK + LDPC Feature + HW20	LDPC Feature
		3/4	10.8 – 20,000	8PSK + LDPC Feature + HW16	8PSK + LDPC Feature + HW18	8PSK + LDPC Feature + HW20	10.8 – 20,000	8PSK + LDPC Feature + HW16	LDPC Feature
8QAM	HP-LDPC	2/3	9.6 – 20,000	8QAM + LDPC Feature + HW16	8QAM + LDPC Feature + HW18	8QAM + LDPC Feature + HW20	9.6 – 20,000	8QAM + LDPC Feature + HW16	LDPC Feature

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
		3/4	10.8 – 20,000	8QAM + LDPC Feature + HW16	8QAM + LDPC Feature + HW18	8QAM + LDPC Feature + HW20	10.8 – 20,000	8QAM + LDPC Feature + HW16	LDPC Feature
16QAM	HP-LDPC	3/4	14.4 – 20,000	16QAM + LDPC Feature + HW16	16QAM + LDPC Feature + HW18	16QAM + LDPC Feature + HW20	14.4 – 20,000	16QAM + LDPC Feature + HW16	LDPC Feature
TX Direct Sequence Spread Spectrum									
BPSK	HP-LDPC-OFF	1/2	2.4 – 5,000	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 15,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		2.4 – 2,500	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 7,500	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		2.4 – 1,250	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 3,750	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		2.4 – 625	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 1,875	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		2.4 – 313	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 937	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	1/2	2.4 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 4,933	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		2.4 – 2,467	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 2,466	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		2.4 – 1,233	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 – 1,233	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		2.4 - 617	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 - 616	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		2.4 - 308	LDPC Feature + HW19	—	LDPC Feature + HW20	2.4 - 308	LDPC Feature + HW19	DSSS Feature + LDPC Feature
QPSK	HP-LDPC-	1/2	4.8 – 10,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 10,000	LDPC Feature + HW19	DSSS Feature +

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
	OFF								LDPC Feature
	FACTOR x2		4.8 – 5,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 5,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		4.8 – 2,500	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 2,500	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.8 – 1,250	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 1,250	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.8 - 625	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 625	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 9,866	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		4.7 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 4,933	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		4.7 – 2,467	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 2,466	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.7 – 1,233	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 1,233	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.7 - 617	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 616	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 13,078	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		6.3 – 6,539	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 6,539	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		6.3 – 3,270	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 3,269	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		6.3 – 1,635	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 1,634	LDPC Feature + HW19	DSSS Feature +

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
									LDPC Feature
	FACTOR x16		6.3 0 817	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 0 817	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 14,686	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		7.0 – 7,342	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 7,342	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		7.0 – 3,671	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 3,671	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		7.0 – 1,836	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 1,835	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		7.0 - 918	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 - 917	LDPC Feature + HW19	DSSS Feature + LDPC Feature
OQPSK	HP-LDPC-OFF	1/2	4.8 – 10,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 10,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		4.8 – 5,000	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 5,000	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		4.8 – 2,500	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 2,500	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.8 – 1,250	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 1,250	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.8 – 625	LDPC Feature + HW19	—	LDPC Feature + HW20	4.8 – 625	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	1/2	4.7 – 9,866	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 9,866	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		4.7 – 4,933	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 4,933	LDPC Feature + HW19	DSSS Feature +

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
									LDPC Feature
	FACTOR x4		4.7 – 2,467	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 2,466	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		4.7 – 1,233	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 1,233	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		4.7 – 617	LDPC Feature + HW19	—	LDPC Feature + HW20	4.7 – 616	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	2/3	6.3 – 13,078	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 13,078	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		6.3 – 6,539	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 6,539	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		6.3 – 3,270	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 3,269	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		6.3 – 1,635	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 1,634	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		6.3 – 817	LDPC Feature + HW19	—	LDPC Feature + HW20	6.3 – 817	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	HP-LDPC-OFF	3/4	7.0 – 14,685	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 14,686	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x2		7.0 – 7,342	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 7,342	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x4		7.0 – 3,671	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 3,671	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x8		7.0 – 1,836	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 – 1,835	LDPC Feature + HW19	DSSS Feature + LDPC Feature
	FACTOR x16		7.0 - 918	LDPC Feature + HW19	—	LDPC Feature + HW20	7.0 - 917	LDPC Feature + HW19	DSSS Feature +

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
									LDPC Feature
Satellite Framing									
ALL	IDR 96K	—	T1/E1 / T2/E2	IDR Feature, Framing Only + HW9 for IESS	IDR Feature for Framing	IDR Feature, Framing Only + HW9 for IESS	T1/E1 / T2/E2 / T3/E3	IDR Feature, Framing Only + HW9 for IESS	IDR Feature for Framing
	IBS 1/15	—	N x 64, 64 – 1536, 2048	IBS Feature + HW9 for IESS	IBS Feature (Framing Only)	IBS Feature (Framing Only)	N x 64, 64 – 1536, 2048	IBS Feature	IBS Feature
	EF AUPC	—	Less than 20,000	AUPC Feature	AUPC Feature	AUPC Feature	Less than 20,000	AUPC Feature	Standard
	EDMAC	—	—	EDMAC Feature Framing Only	EDMAC Feature Framing Only	EDMAC Feature Framing Only	—	EDMAC Feature Framing Only	EDMAC Feature Framing Only
	SCC	—	—	Enhanced Async Feature	Enhanced Async Feature (Framing Only)	Enhanced Async Feature	—	Enhanced Async Feature	Enhanced Async Feature
	EFFICIENT D&I	—	N x 64, 64 – 1536, 2048	Drop and Insert Feature	Drop and Insert Feature (Framing Only)	Drop and Insert Feature	N x 64, 64 – 1536, 2048	IDR Feature, Framing Only + HW9 for IESS	Drop and Insert Feature (Framing Only)
	EBEM	—	—	—	EBEM Feature + HW5	—	—	—	—
Ethernet HDLC Framing									
ALL	RADYNE	—	—	Standard + HW22	Standard (10/100)	Standard (10/100)	—	Standard + HW22	Standard (10/100/1000)
	COMTECH	—	—	Standard + HW22	Standard (10/100)	—	—	Standard + HW22	Standard (10/100/1000)
	MANAGED 570	—	—	Standard + HW22	Standard (10/100)	—	—	Standard + HW22	Standard (10/100/1000)
TRANSEC (HW28) Counter Mode (Interoperable with MD-1366)[2]									
BPSK	Turbo	1/2	64 – 4,965	—	EBEM Feature + HW28	—	64 – 14,901	EBEM Feature + HW28	Standard
		2/3	64 – 6,614	—	EBEM Feature + HW28	—	64 – 19,848	EBEM Feature + HW28	Standard
		3/4	64 – 7,436	—	EBEM Feature + HW28	—	64 – 22,320	EBEM Feature + HW28	Standard

[2] The 165B Turbo Modes when running TRANSEC require the embedded channel to be *ENABLED* and is calculated on a single interface without multiplexing to provide the absolute maximum the modem can be configured with. The TRANSEC itself does not expand the user data only the application of the embedded channel.

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
		7/8	64 – 8,673	—	EBEM Feature + HW28	—	64 – 26,019	EBEM Feature + HW28	Standard
		19/20	64 – 9,412	—	EBEM Feature + HW28	—	64 – 28,236	EBEM Feature + HW28	Standard
QPSK	Turbo	1/2	64 – 9.905	—	EBEM Feature + HW28	—	64 – 29,715	EBEM Feature + HW28	Standard
		2/3	64 – 13,180	—	EBEM Feature + HW28	—	64 – 39,540	EBEM Feature + HW28	Standard
		3/4	64 – 14,811	—	EBEM Feature + HW28	—	64 – 44,433	EBEM Feature + HW28	Standard
		7/8	64 – 17,253	—	EBEM Feature + HW28	—	64 – 51,756	EBEM Feature + HW28	Standard
		19/20	64 – 18,716	—	EBEM Feature + HW28	—	64 – 52,000	EBEM Feature + HW28	Standard
8PSK	Turbo	1/2	256 – 14,811	—	EBEM Feature + HW28	—	256 – 44,433	EBEM Feature + HW28	Standard
		2/3	256 – 19,691	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
16APSK	Turbo	1/2	256 – 19,691	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
		2/3	256 – 20,000	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
		3/4	256 – 20,000	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
		7/8	256 – 20,000	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
		19/20	256 – 20,000	—	EBEM Feature + HW28	—	256 – 52,000	EBEM Feature + HW28	Standard
TRANSEC (HW28) Block Mode Mode (Interoperable with SLM-5650A) HW-27 Frame Expansion: (3 + 16 * N) / (16 * N), N = 1…16									
BPSK	TPC	5/16	1.5 – 2,632	TPC Feature + HW27	TPC Feature + HW27	—	1.5 – 7,895	TPC Feature + HW27	Standard
		21/44	2.3 – 4,019	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	2.3 – 12,057	TPC Feature + HW27	Standard
QPSK	TPC	21/44	4.6 – 8,038	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	4.6 – 20,000	TPC Feature + HW27	Standard
		3/4	7.2 – 12,632	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	7.2 – 20,000	TPC Feature + HW27	Standard
		7/8	8.4 – 14,737	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	8.4 – 20,000	TPC Feature + HW27	Standard
OQPSK	TPC	21/44	4.6 – 8,038	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	4.6 – 20,000	TPC Feature + HW27	Standard
		3/4	7.2 – 12,632	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	7.2 – 20,000	TPC Feature + HW27	Standard
		7/8	8.4 – 14,737	TPC Feature + HW27	TPC Feature + HW27	TPC Feature + HW27	8.4 – 20,000	TPC Feature + HW27	Standard

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
8PSK	TPC	3/4	10.8 – 18,947	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	10.8 – 20,000	8PSK + TPC Feature + HW27	Standard
		7/8	12.6 – 20,000	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	12.6 – 20,000	8PSK + TPC Feature + HW27	Standard
8QAM	TPC	3/4	10.8 – 18,974	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	10.8 – 20,000	8PSK + TPC Feature + HW27	Standard
		7/8	12.6 – 20,000	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	8PSK + TPC Feature + HW27	12.6 – 20,000	8PSK + TPC Feature + HW27	Standard
16QAM	TPC	3/4	14.4 – 20,000	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	14.4 – 20,000	16QAM + TPC Feature + HW27	Standard
		7/8	16.8 – 20,000	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	16QAM + TPC Feature + HW27	16.8 – 20,000	16QAM + TPC Feature + HW27	Standard
BPSK	HP-LDPC	1/2	2.4 – 4,211	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	2.4 – 12,632	LDPC Feature + HW27	LDPC Feature
	ULL-LDPC	1/2	2.4 – 4,154	LDPC Feature + HW27	—	LDPC Feature + HW27	2.4 – 12,463	LDPC Feature + HW27	LDPC Feature
QPSK	HP-LDPC	1/2	4.8 – 8,421	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	4.8 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.4 – 11,228	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	6.4 – 20,000	LDPC Feature + HW27	LDPC Feature
		3/4	7.2 – 12,632	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	7.2 – 20,000	LDPC Feature + HW27	LDPC Feature
	ULL-LDPC	1/2	4.7 – 8,308	LDPC Feature + HW27	—	LDPC Feature + HW27	4.7 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.3 – 11,013	LDPC Feature + HW27	—	LDPC Feature + HW27	6.3 – 20,000	LDPC Feature + HW27	LDPC Feature
		3/4	7.0 – 12,366	LDPC Feature + HW27	—	LDPC Feature + HW27	7.0 – 20,000	LDPC Feature + HW27	LDPC Feature
OQPSK	HP-LDPC	1/2	4.8 – 8,421	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	4.8 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.4 – 11,228	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	6.4 – 20,000	LDPC Feature + HW27	LDPC Feature
		3/4	7.2 – 12,632	LDPC Feature + HW27	LDPC Feature + HW27	LDPC Feature + HW27	7.2 – 20,000	LDPC Feature + HW27	LDPC Feature
	ULL-LDPC	1/2	4.7 – 8,308	LDPC Feature + HW27	—	LDPC Feature + HW27	4.7 – 20,000	LDPC Feature + HW27	LDPC Feature
		2/3	6.3 – 11,013	LDPC Feature + HW27	—	LDPC Feature + HW27	6.3 – 20,000	LDPC Feature + HW27	LDPC Feature
		3/4	7.0 – 12,366	LDPC Feature + HW27	—	LDPC Feature + HW27	7.0 – 20,000	LDPC Feature + HW27	LDPC Feature

Modulation	Code	Rate	Data Rate Range (kbps)	DMD20 / DMD20 LBST HW1 + HW6	DMD1050 / DMD1050T / DMD1050TS HW3 + HW8	OM20 HW1 + HW6	Data Rate Range (kbps)	DMD50 / DMD2050 HW2 + HW7	DMD2050E / DMD2050EU HW2 + HW7 + HW24
8PSK	HP-LDPC	2/3	9.6 – 16,842	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	9.6 – 20,000	8PSK + LDPC Feature + HW27	LDPC Feature
		3/4	10.8 – 18,947	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	8PSK + LDPC Feature + HW27	10.8 – 20,000	8PSK + LDPC Feature + HW27	LDPC Feature
8QAM	HP-LDPC	2/3	9.6 – 16,842	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	9.6 – 20,000	8QAM + LDPC Feature + HW27	LDPC Feature
		3/4	10.8 – 18,947	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	8QAM + LDPC Feature + HW27	10.8 – 20,000	8QAM + LDPC Feature + HW27	LDPC Feature
16QAM	HP-LDPC	3/4	14.4 – 20,000	16QAM + LDPC Feature + HW27	16QAM + LDPC Feature + HW27	16QAM + LDPC Feature + HW27	14.4 – 20,000	16QAM + LDPC Feature + HW27	LDPC Feature

DMD2050E

Universal Satellite Modem
Installation and Operation Manual

Part Number MN-DMD2050E
Revision 2

Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, 480.333.2200, FAX: 480.333.2161

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PREFACE

About this Manual

This manual gives installation and operation information for the Comtech EF Data DMD2050E Universal Product Modem. This is a technical document intended for anyone who operates the unit.

Cautions and Warnings

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

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.

IMPORTANT or **NOTE** indicates information critical for proper equipment function, or a statement that is associated with the task being performed.

Patents and Trademarks

See all of Comtech EF Data's Patents and Patents Pending at http://patents.comtechefdata.com.

Comtech EF Data acknowledges that all trademarks are the property of the trademark owners.

- DoubleTalk® is licensed from "Raytheon Applied Signal Technology".
- DoubleTalk® is a registered trademark of "Raytheon Applied Signal Technology".
- Carrier-in-Carrier® is a registered trademark of Comtech EF Data.

Related Documents

- STANAG 4486 Edition 3
- Department of Defense (DOD) MIL-STD-188-165A, Interoperability and Performance Standards for SHF Satellite Communications PSK Modems (FDMA Operation) (dated November 2005)
- Department of Defense (DOD) MIL-STD-188-114A, Electrical Characteristics of Digital Interface Circuits
- EN300-421 and EN301-210 ETSI
- ETSI EN302-307
- INTELSAT Earth Station Standards IESS-308, -309, -310, and -315
- EUTELSAT SMS

Electrical Safety

The DMD2050E has been shown to comply with the EN 60950 Safety of Information Technology Equipment (including electrical business machines) safety standard.

The unit is rated for these nominal operating ranges:

- 100 - 240 volts AC nominal operating range
- 48+/-5 volts DC nominal operating range for a correctly-equipped DC option
- 250 watts maximum power consumption

Battery

WARNING: DANGER OF EXPLOSION if the battery is incorrectly replaced. The unit contains a Lithium Battery.

Replace the battery with the same or equivalent battery as recommended by the manufacturer.

Dispose of used batteries as required by local and national regulations.

Grounding

CAUTION: CORRECT GROUNDING PROTECTION REQUIRED: Always make sure the ground stud on the rear panel of the unit is connected to protective earth. Correct grounding protection helps prevent personal injury and equipment damage.

In Finland: "Laite on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan."

In Norway: “Apparatet må tilkoples jordet stikkontakt.”

In Sweden: “Apparaten skall anslutas till jordat uttag.”

Fuses

CAUTION: Always replace the fuses with the correct fuse type and rating. Use correct fuses to help prevent damage to the equipment.

The DC unit does not have fuses.

The AC unit requires two common, 2-Amp/250 volts, 20mm x 5mm Slo-Blo® fuses. The fuses are on the rear of the unit, inside the power connector, behind the small plastic cover.

Telecommunications Terminal Equipment Directive

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

Environmental

Do not operate the DMD2050E in an environment where the unit is exposed to extremes of temperature outside the ambient range 0 to 50°C, precipitation, condensation, or humid atmospheres above 95% RH, altitudes (un-pressurised) greater than 2000 metres, excessive dust or vibration, flammable gases, corrosive or explosive atmospheres.

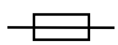
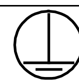
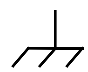
Operation in vehicles or other transportable installations that are equipped to provide a stable environment is permitted. If such vehicles do not provide a stable environment, safety of the equipment to EN60950 may not be guaranteed.

Low Voltage Directive (LVD)

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	Protective Earth / Safety Ground	Chassis Ground

EMC (Electromagnetic Compatibility)

In accordance with European Directive 89/336/EEC, independent testing showed that the DMD2050E complied with these standards:

Emissions	EN 55022 Class B	Limits and methods of measurement of radio interference characteristics of Information Technology Equipment (Also tested to FCC Part 15 Class B)
Immunity	EN 55024	Information Technology Equipment: Immunity Characteristics, Limits, and Methods of Measurement
	EN 61000-3-2	Harmonic Currents Emission
	EN 61000-3-3	Voltage Fluctuations and Flicker

CE Mark

Comtech EF Data declares that the DMD2050E meets the necessary requirements for the CE Mark.

RoHS

The DMD2050E satisfies (with exemptions) the requirements specified in the European Union Directive on the Restriction of Hazardous Substances, Directive 2002/95/EC, (EU RoHS).

Product support

On the web

http://www.comtechefdata.com/support.asp

Return material authorization

http://www.comtechefdata.com/rmaform.asp

Support business hours

Support Business Hours: Monday through Friday, 8:00 a.m. to 5:00 p.m. (MST)

After hours and weekends

Brand:	Comtech EF Data	Tel: +1.480.333.4357
Brand:	Radyne	Tel: +1.602.980.5220

Comtech EF Data and Radyne support contacts

Products	Contact
• Satellite Modems • Modem Accessories • Amplifiers • Converters • Transceivers • Terminals	Tel: +1.480.333.4357 Fax: +1.480.333.2500 Email:techsupport@comtechefdata.com
• IP-Enabled Satellite Modems • IP-Based Modem Accessories • Encapsulators, Receivers, Filtering & Encryption • turboIP® Performance Enhancement Proxies (PEP) • SkyWire™ MDX420 Satellite Network Gateway	Tel: +1.480.333.2433 Fax: +1.480.333.2161 Email:cdmipsupport@comtechefdata.com
• Vipersat Network Products • IP-Enabled Satellite Modems used with VMS	Tel: +1.510.252.1462 - select option #2 Fax: +1.510.252.1695 Email:supportcvni@comtechefdata.com

Warranty Policy

Comtech EF Data products are warranted against defects in material and workmanship for a specific period from the date of shipment, and this period varies by product. In most cases, the warranty period is two years. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective. Repairs are warranted for the remainder of the original warranty or a 90 day extended warranty, whichever is longer. Contact Comtech EF Data for the warranty period specific to the product purchased.

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

All equipment returned for warranty repair must have a valid RMA number issued prior to return and be marked clearly on the return packaging. Comtech EF Data strongly recommends all equipment be returned in its original packaging.

Comtech EF Data Corporation's obligations under this warranty are limited to repair or replacement of failed parts, and the return shipment to the buyer of the repaired or replaced parts.

Limitations of Warranty

The warranty does not apply to any part of a product that has been installed, altered, repaired, or misused in any way that, in the opinion of Comtech EF Data Corporation, would affect the reliability or detracts from the performance of any part of the product, or is damaged as the result of use in a way or with equipment that had not been previously approved by Comtech EF Data Corporation.

The warranty does not apply to any product or parts thereof where the serial number or the serial number of any of its parts has been altered, defaced, or removed.

The warranty does not cover damage or loss incurred in transportation of the product.

The warranty does not cover replacement or repair necessitated by loss or damage from any cause beyond the control of Comtech EF Data Corporation, such as lightning or other natural and weather related events or wartime environments.

The warranty does not cover any labor involved in the removal and or reinstallation of warranted equipment or parts on site, or any labor required to diagnose the necessity for repair or replacement.

The warranty excludes any responsibility by Comtech EF Data Corporation for incidental or consequential damages arising from the use of the equipment or products, or for any inability to use them either separate from or in combination with any other equipment or products.

A fixed charge established for each product will be imposed for all equipment returned for warranty repair where Comtech EF Data Corporation cannot identify the cause of the reported failure.

Exclusive Remedies

Comtech EF Data Corporation's warranty, as stated is in lieu of all other warranties, expressed, implied, or statutory, including those of merchantability and fitness for a particular purpose. The buyer shall pass on to any purchaser, lessee, or other user of Comtech EF Data Corporation's products, the aforementioned warranty, and shall indemnify and hold harmless Comtech EF Data Corporation from any claims or liability of such purchaser, lessee, or user based upon allegations that the buyer, its agents, or employees have made additional warranties or representations as to product preference or use.

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

Chapter 1. Introduction

1.1 Overview

The new DMD2050E Satellite Modem (Figure 1-1) breaks new ground in flexibility and performance. The modulator has the ability to interoperate with military standards based upon MIL-STD-188-165A, MIL – STD-188-16B (Draft Standard), STANAG 4486 Edition 3, OM73 and support commercial standards that include IDR, IBS and DVB. While covering data rates up to 52 Mbps and the ability to switch between spur-free 70/140 MHz operation to L-Band, this duplex modem covers virtually all Military and Commercial Satellite IP, Telecom, Video and Internet applications.

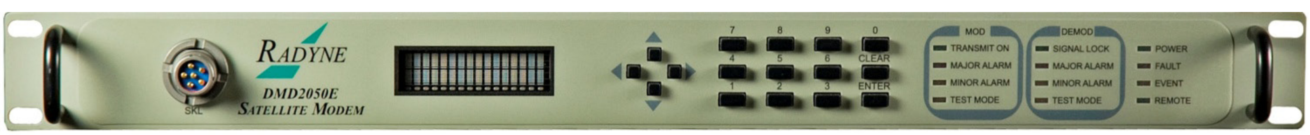


Figure 1-1. DMD2050E Universal Satellite Modem Front Panel

The DMD2050E provides highly advanced and bandwidth efficient forward error correction (FEC). Advanced FEC options include Low Density Parity Check (LDPC), Turbo Product Codes (TPCs) and 165B Turbo Codes. Legacy support for Viterbi, Trellis, Concatenated Viterbi Reed-Solomon, and Sequential FEC are also included. A complete range of modulation types supported include BPSK, QPSK, OQPSK, 8-PSK, 8-QAM, 16-QAM and 16-APSK.

Advanced FEC and modulation capabilities can be integrated with the revolutionary DoubleTalk® Carrier-in-Carrier® bandwidth compression allowing for maximum state-of-the-art performance under all conditions. This combination of advanced technologies enables multi-dimensional optimization, allowing satellite communications users to minimize required satellite bandwidth and maximize throughput without using additional transponder resources.

The DMD2050E supports a full range of Industry Standard Interfaces that include MIL-188-114 (EIA-530), EIA-613 (HSSI), and 10/100/1000 Base T Gigabit Ethernet Bridge. Additional features defined by STANAG 4486 include Serial, Ethernet and Asynchronous overhead data multiplexing/de-multiplexing capabilities.

The extensive list of software options allows for the deployment of a modem with today's needs while keeping an eye toward tomorrow. Additional options and configuration (such as Monitor and Control (M&C) Functions) can be activated in seconds via the front panel. Additional hardware options like Turbo, Interface Expansion, and DC operation complete the modem's dynamic feature coverage.

The DMD2050E's impressive remote accessibility surpasses all others in the field. Remote control via Radyne's trusted RLLP (Radyne Link Level Protocol), Ethernet 10 Base-T SNMP and Web Browser includes control of all the modem's features plus software maintenance. Additionally, the Vacuum Fluorescent Display (VFD) can be supplemented with terminal software running on a PC or laptop.

The modem now presents its entire monitor and control functions on the big screen. Supported by Radyne's extensive line of redundancy switches, converters, encoders and decoders, the DMD2050E can be built into any satellite requirement. Compatibility with current modems, such as Radyne's DMD20, DMD50, DMD2401, DMD15, and DISA certified MIL-188-165 compliant DMD15L are maintained for seamless substitution and addition to existing systems.

1.2 DMD2050E Configurations

The DMD2050E can be configured in the following different ways:

- features and options that are installed when the unit is ordered
- feature upgrades
- hardware options that the user can install at their own location
- options that are installed to a unit that is sent to a Comtech EF Data facility

1.2.1 Features

- Duplex modem operation
- Data rates up to 52 Mbps

- Switchable between spur-free 70/140 MHz and L-Band operations
- AC or DC Power Input
- Functions in virtually all Military and Commercial Satellite IP, Telecom, Video and Internet applications
- Military standards include:
  - MIL-STD-188-165A
  - MIL-STD-188-16B (Draft Standard)
  - STANAG 4486 Edition 3
  - OM73
- Commercial standards include:
  - IDR
  - IBS
  - DVB

1.2.2 Advanced Forward Error Correction and Modulation

The DMD2050E has bandwidth-efficient, advanced forward error correction (FEC). Advanced FEC options include:

- Low Density Parity Check (LDPC)
- Turbo Product Codes (TPCs)
- 165B Turbo Codes

Legacy functions for Viterbi, Trellis, Concatenated Viterbi Reed-Solomon, and Sequential FEC are included.

Modulation types include:

- BPSK
- QPSK
- OQPSK
- 8-PSK
- 8-QAM
- 16-QAM
- 16-APSK

1.2.3 Bandwidth Compression

DoubleTalk® Carrier-in-Carrier® bandwidth compression reduces satellite bandwidth requirements and increases throughput without using additional transponder resources.

1.2.4 Interfaces

Industry-standard interfaces include:

- MIL-188-114 (EIA-530)
- EIA-613 (HSSI)
- 10/100/1000 Base T Gigabit Ethernet Bridge

Additional features defined by STANAG 4486 include Serial, Ethernet and Asynchronous overhead data multiplexing and demultiplexing.

1.2.5 Remote Control and Monitoring

The DMD2050E has a Vacuum Fluorescent Display (VFD) on the front panel. To see monitor and control functions on a larger screen, connect a personal computer (PC) running terminal software to the DMD2050E.

Control of all the DMD2050E features and update the software remotely using RLLP (Radyne Link Level Protocol), Ethernet 10 Base-T SNMP and a web browser.

You can access all the functions with a terminal or PC connected by a serial link also.

1.2.6 Compatibility

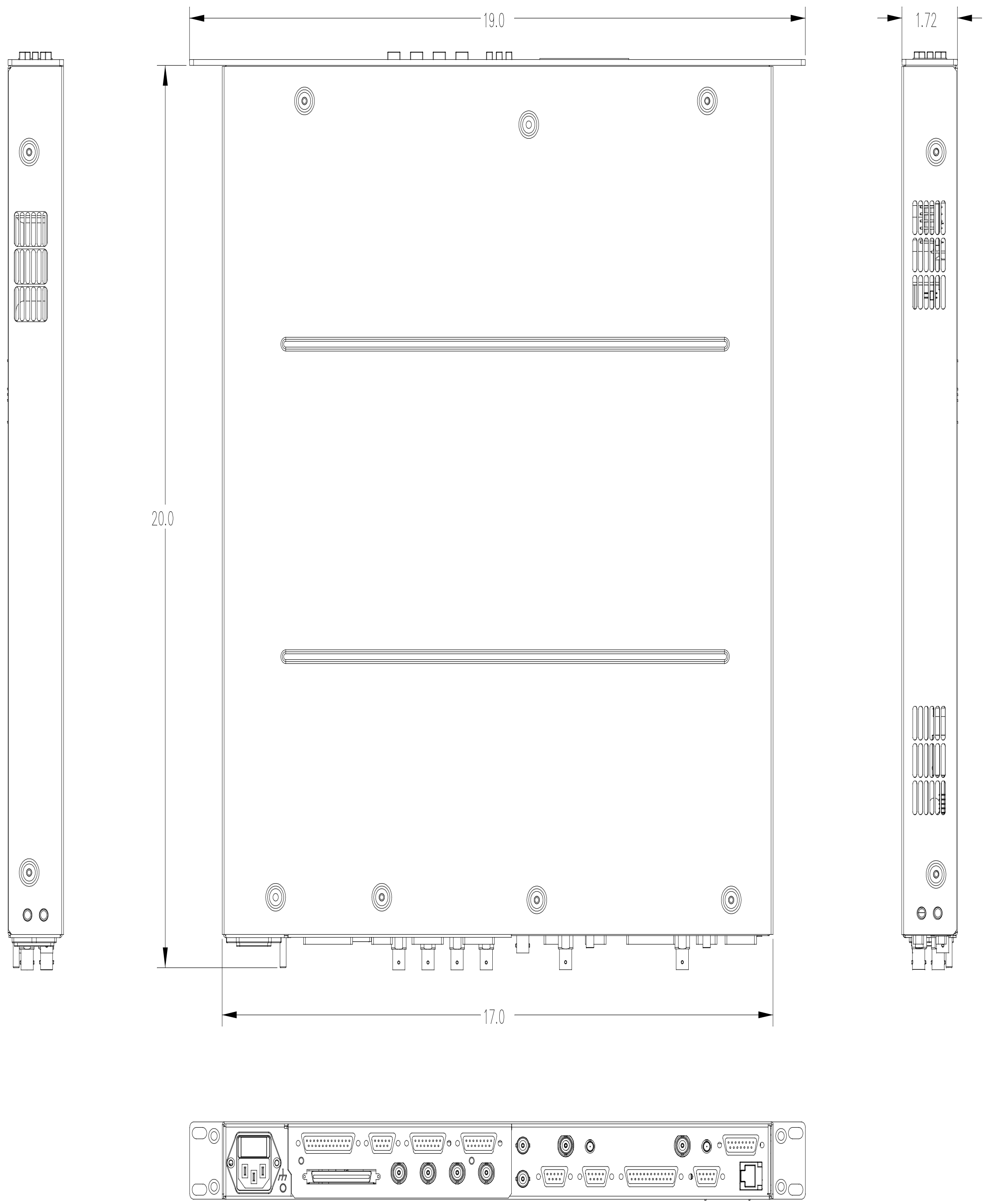
The DMD2050E is compatible with current modems such as:

- DMD20
- DMD50
- DMD2401
- DMD15
- DMD15L (DISA-certified MIL-188-165 compliant)

1.2.7 Physical Description

The DMD2050E is constructed as a 1RU high, rack-mount chassis that can be free-standing as needed. Handles at the front ease removal from and placement into a rack.

1.2.7.1 Dimensional Envelope



1.3 Configurations and Options

The DMD2050E has several configuration possibilities:

- Factory - Install features and options at the factory when the unit is manufactured
- On site – Using approved procedures, authorized personnel install hardware options on site
- Service center - Send a unit to a Comtech EF Data service center for option installation
- Feature upgrades - Operators install software options on site using an access code entered at the front panel

Contact Comtech EF Data for information about available options and feature upgrades.

IMPORTANT

Only authorized service personnel must handle and install hardware options.

The options for the DMD2050E include:

Chassis Options
Standard front Panel with Power Switch on Front
Standard front Panel with Power Switch in Rear
Standard front Panel with Power Switch on Front with Simple Key Loader
Standard front Panel with Power Switch in Rear with Simple Key Loader
Primary Power Options
100-240 VAC
48 VDC
TX IF Connectors Options
50 Ohm TNC
50 Ohm BNC
75 Ohm BNC
CnC Hardware

Soft Options	
L-Band	
Expanded Dynamic Range	
TPC FEC	
Sequencial FEC	
LDPC FEC	
CnC	**CnC Ranges**
	64k-512k
	64k-1000k
	64k-2500k
	64k-5000k
	64k-10M
	64k-15M
	64k-20M
	64k-25M
	64k-30M
	64k-40M
	64k-52M

Chapter 2. Installation

2.1 Unpacking and Inspection

CAUTION
Do not damage the carton contents with a cutting tool. Use a cutting tool that has a maximum blade length of 1/2 inch when you open the carton.

Step	Procedure
1	Inspect all shipping cartons for damage. **Note:** If damage exists, contact the freight company and Comtech EF Data immediately.
2	Cut the tape at the top of the carton.
3	Remove the packing material that covers the equipment.
4	Remove the equipment.
5	Keep the carton and packing material.
6	Inspect the equipment for damage. **Note:** If damage exists, contact the freight company and Comtech EF Data immediately.
7	Compare the equipment to the packing list. **Note:** If the equipment does not match the packing list, contact the freight company and Comtech EF Data immediately.

The carton contains:

Item	Quantity
DMD2050E Universal Satellite Modem	1
Power Cord, six foot with applicable AC Connector	1
Installation and Operation Manual	1

2.2 Installation Safety

The unit is shipped fully assembled. Do not remove the covers when you install the unit.

WARNING
SHOCK HAZARD - There are no user-serviceable parts or configuration settings inside the DMD2050E chassis. There is a shock hazard at the internal power supply module. DO NOT open the DMD2050E chassis under any circumstances.

WARNING:
DANGER OF EXPLOSION if you replace the battery incorrectly. The unit contains a Lithium Battery. Replace the battery with the same or equivalent battery as recommended by the manufacturer.

CAUTION
Protect existing communication traffic. Before you connect power and start the unit, disconnect the transmit output from the operating ground station equipment.

CAUTION: **CORRECT GROUNDING PROTECTION REQUIRED**
Always make sure the ground stud on the rear panel of the unit is connected to protective earth. Correct grounding protection helps prevent personal injury and equipment damage.
In Finland: "Laite on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan."
In Norway: “Apparatet må tilkoples jordet stikkontakt.”
In Sweden: “Apparaten skall anslutas till jordat uttag.”

2.3 Installation Considerations

- Do not install rack slides on the sides of the chassis. Rack slides block airflow to the cooling fans inside the unit.
- Make sure that there is sufficient space for airflow at the sides of the unit.
- In racks where heat is high, make sure to install forced air cooling at the top or bottom of the rack.
- Do not let the temperature inside the rack exceed 50°C (122°F).

2.3.1 Location

The unit is intended for indoor use only. Do not install the unit in an unprotected outdoor location. Direct contact with rain, snow, wind or sun causes damage to the unit.

Do not put units above high heat or an EMF generator. High heat and EMF have an unwanted effect on output signals and receive operations.

Install the unit into any standard 19-inch equipment cabinet or rack. The unit is a one rack unit (RU) (1.75 inches) high and 19 inches deep. It requires a minimum rack depth of 22 inches for cables. If necessary, put the unit on a table or other suitable surface.

When viewed from the rear of the unit, the rear panel lets power enter from the left and IF cables enter from the right. Data and control cables enter from either side, depending on installed options.

You can stack up to a maximum of ten units. Make sure there is a minimum of one RU of empty space for every ten stacked units. The empty space lets air flow in the rack.

2.3.2 Airflow

Make sure the unit has adequate airflow and the airflow is clean and relatively dry.

2.3.3 Temperature

The ambient temperature in the rack must be in the range of 10° and 35° C. The unit operates best in constant temperature.

2.3.4 Electrical Power

The power supply is intended for universal application. The power supply specifications are 100 to 240 VAC, 50 to 60 Hz, 1.0A.

NOTE
If necessary for installing the unit correctly in your location, replace the power cable or power connector with applicable parts.

2.3.5 Cables

To meet EMC directives, make sure to use shielded cables that have the shield terminated to the conductive backshells. To meet low voltage directives, use cables that have insulation flammability ratings of 94 VO or better.

CAUTION

Before you install the mating connectors, first make sure to start the unit and set the **Interface Type** (MIL-188-114A, G.703, etc.) from the front panel. If you do not set the **Interface Type**, there is a risk of damage to the Universal Interface Module.

2.4 Initial Configuration Check

The unit leaves the factory with preset configuration defaults.

IMPORTANT

The transmit and receive interface type settings vary depending on the options ordered from the factory.

When you first start the unit, do an inspection of the preset configuration. To lock up the unit, enter 'IF Loopback Enable' in the Test Menu, or connect a loopback cable from J1 to J2 on the rear of the unit.

See also:

Chapter 4. User Interfaces

2.4.1 Standard Factory Configuration

Setting	Modulator	Demodulator
Data Rate	2.048 Mbps	2.048 Mbps
Mode	Closed Network	Closed Network
Satellite Framing	None	None
Scrambler	V.35 (IESS)	V.35 (IESS)
Drop and Insert	Disabled	Disabled
Inner FEC	1/2 Rate Viterbi	1/2 Rate Viterbi
Outer FEC	Disabled	Disabled
Modulation	QPSK	QPSK
Frequency	70.000000 MHz	70.000000 MHz
Modulator Output Power	-20 dBm	N/A

IMPORTANT

Strap Code 26 can set the following modem configuration. The Frequency and Modulator Output Power are set independently of the strap code.

See also:

Appendix I. Strap Codes

2.5 Modulator Checkout

Make sure that the unit is installed near applicable electrical power and supporting equipment.

2.5.1 Initial Start Up

Typically, new units are shipped from the factory with the Transmit Carrier set to OFF.

CAUTION

Protect existing communication traffic. Before you connect power and start the unit, disconnect the transmit output from the operating ground station equipment.

Disconnect the transmit output from the operating ground station equipment before starting the unit for the first time. Starting the unit with incorrect settings could disrupt the existing communications traffic.

At the rear of the unit, set the power switch to ON. The unit does a diagnostic test each time it is started. If the diagnostic test finds a failure, the Fault LED comes on.

Do the initial configuration check using the front panel or the terminal mode.

The terminal mode shows a full screen of all of the configuration settings. However, you must have a separate terminal or computer and software to use the terminal mode. Start the terminal mode using the front panel to go to the System M&C submenus.

2.5.2 Factory Terminal Settings

Emulation Type	VT-100 (can be changed)
Baud Rate	19.2 K (Can be changed via Front Panel)
Data Bits	8
Parity	No Parity (Fixed)
Stop Bits	1 Stop Bit

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Chapter 3. Theory of Operation

3.1 DMD2050E Hardware

The DMD2050E is based on a two printed circuit card (minimum configuration) design with additional optioned printed circuit cards available for additional features. The minimum configuration consists of an L-Band/IF Assembly and a Digital Baseband Assembly. The optional printed circuit cards include a Turbo Codec printed circuit card and one of several types of Interface printed circuit card (refer to Appendix A). A block diagram of the DMD2050E is shown in Figure 3-1.

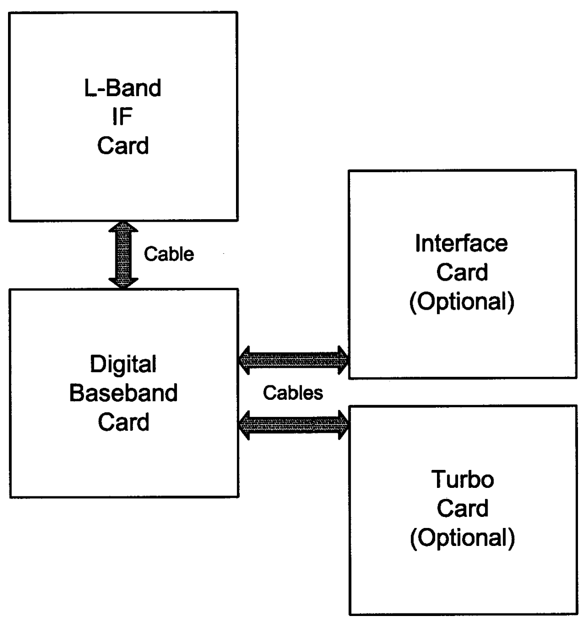


Figure 3-1. DMD2050E Block Diagram

3.1.1 DMD2050E L-Band/IF Printed Circuit Card

The L-Band/IF Printed Circuit Card consists of an analog modulation function, an analog complex downconversion, and two wide-band digital synthesizers. The block diagram of the L-Band/IF Assembly is shown in Figure 3-2.

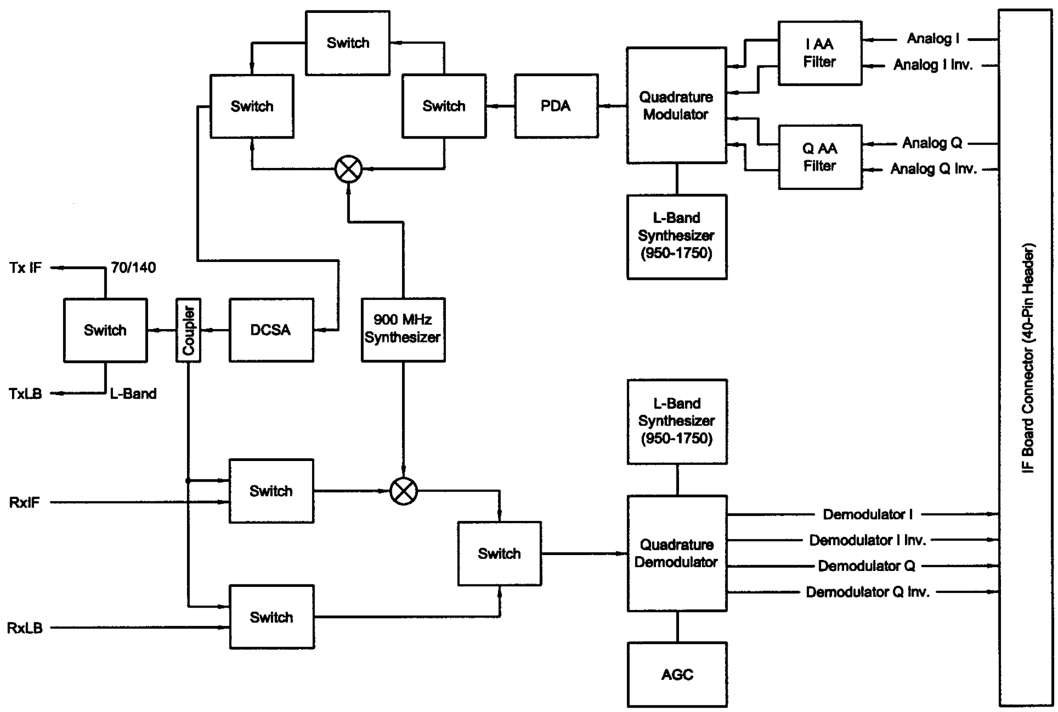


Figure 3-2. IF Card Block Diagram

In the modulator, analog in-phase (I) and quadrature (Q) signals are generated on the Digital Baseband Printed Circuit Card, routed to the L-Band/IF Printed Circuit Card, and modulated at the desired frequency. The L-Band or 70/140 modulated signal is then passed through a microprocessor controlled variable attenuator providing gain control of the output signal.

In the complex downconverter, the signal for demodulation is amplified and sent through a variable wideband attenuator for AGC. The gain-controlled signal is then passed through a complex downconverter to a low IF.

3.1.2 DMD2050E Baseband Processing Printed Circuit Card

The advent of million-plus gate count FPGAs, advanced logic synthesis tools, and DSPs providing hundreds of MIPs enabled the design of a software configurable modem. Large, fast FPGAs now provide designers with what is essentially an on the fly programmable ASIC. High speed, complex digital logic functions that previously could only be implemented in dedicated integrated circuits are now downloaded from a micro-controller through a serial or peripheral interface. When a new digital logic function is needed, a new configuration file is loaded into the FPGA. There is no limit to the number of digital logic configurations available to the FPGA, aside from the amount of Flash memory available to the system microprocessor for storage of configuration files.

The DMD2050E Baseband Processing Printed Circuit Card provides a flexible architecture that allows many different modes of terrestrial and satellite framing, various FEC options, digital voice processing, and several different modulation/demodulation formats. Also included on the Baseband Printed Circuit Card are three synchronous interfaces, an EIA-530 Interface supporting MIL-188-114A and RS-422. All three interfaces are provided on the same DB-25 Connector, and are selectable from the front panel.

A block diagram of the Baseband Processing Card is shown in Figure 3-3.

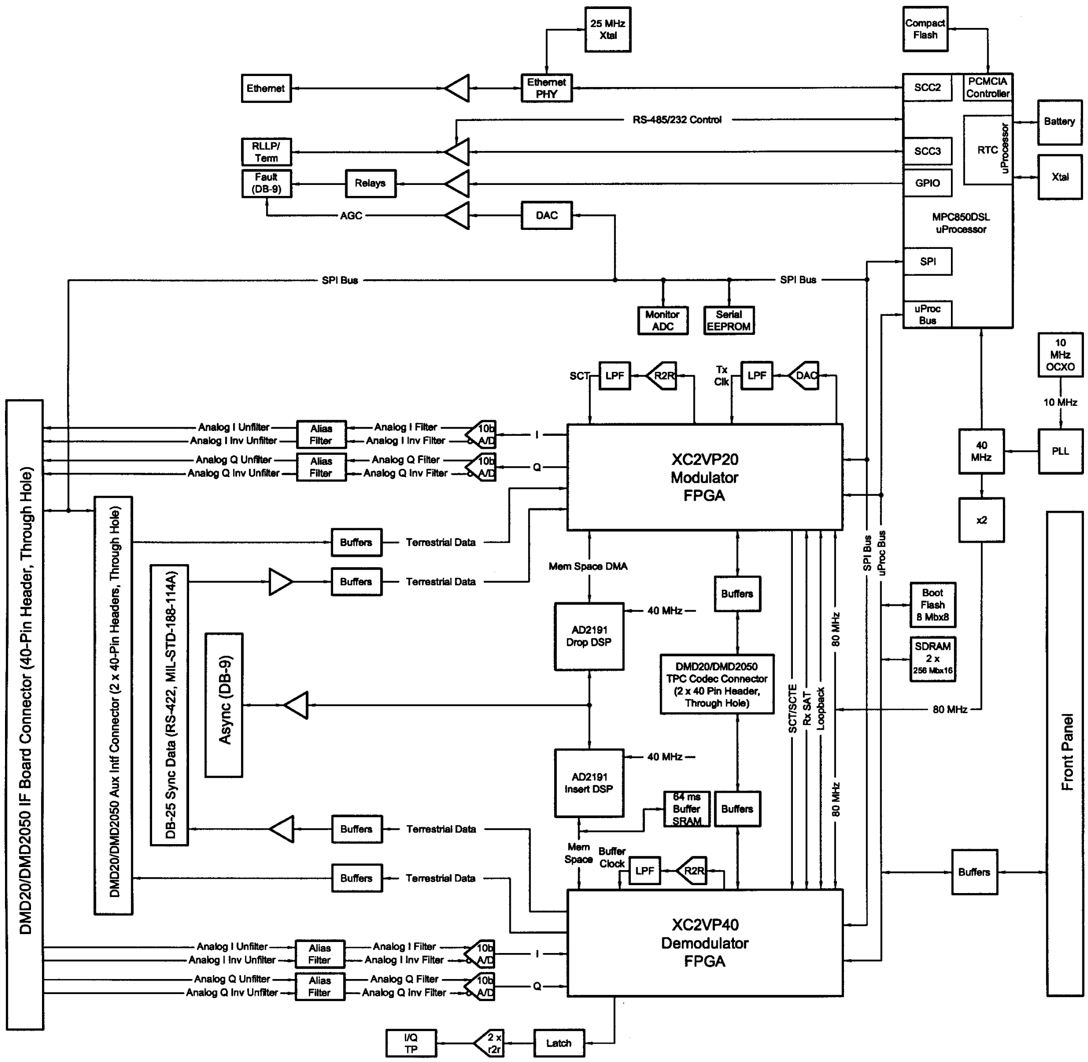


Figure 3-3. DMD2050E Baseband Processing Card Block Diagram

The Baseband Printed Circuit Card also contains the Monitor and Control (M&C) Circuitry responsible for:

- Programmable part setup and initialization
- Continuous control and adjustment of some functions
- Calibration
- Monitoring fault status
- Calculating and displaying measurements
- Calculations
- Monitor and control interface, including front panel and remote
- Configuration and feature set for the unit

The M&C System is based on a powerful microprocessor with a large amount of Flash memory. Several bus architectures are used to interconnect the M&C to all components of the DMD2050E. Communication to the outside world is done via connections to the remote port, terminal port, Ethernet port, and alarm ports. The M&C runs off software programmed into its Flash memory. The memory can be reprogrammed via the Ethernet port to facilitate changes in software.

3.1.3 Enhanced Interface Printed Circuit Card

The normal terrestrial data for the Baseband Processing Card can be re-routed to the enhanced interface card. The enhanced interface card adds a variety of connections to the modem for additional applications

3.2 DMD2050E Functional Block Diagram

Figure 3-4 represents the DMD2050E Functional Blocks. The modem is shown in a typical application with customer data, Tx/Rx RF equipment and an antenna.

3.2.1 Front Panel

The Front Panel includes a 2 x 16 vacuum flourescent display, Indicator LEDs, and a Numeric Keypad (refer to Section 4.1).

3.2.2 Baseband Processing

The Baseband Processor performs all of the functions required for an IBS/IDR Framing Unit, a Reed-Solomon Codec, and an E1/T1 Drop and Insert System. In addition, the Baseband Processing Section provides for transmit clock selection and rate adaptation as well as a rate adapter and Plesiochronous/Doppler (PD) Buffer in the receive direction. A multiplexer is also provided for the SCT Clock Source for Loop Timing Applications. The transmit and receive paths may be configured independently under processor control.

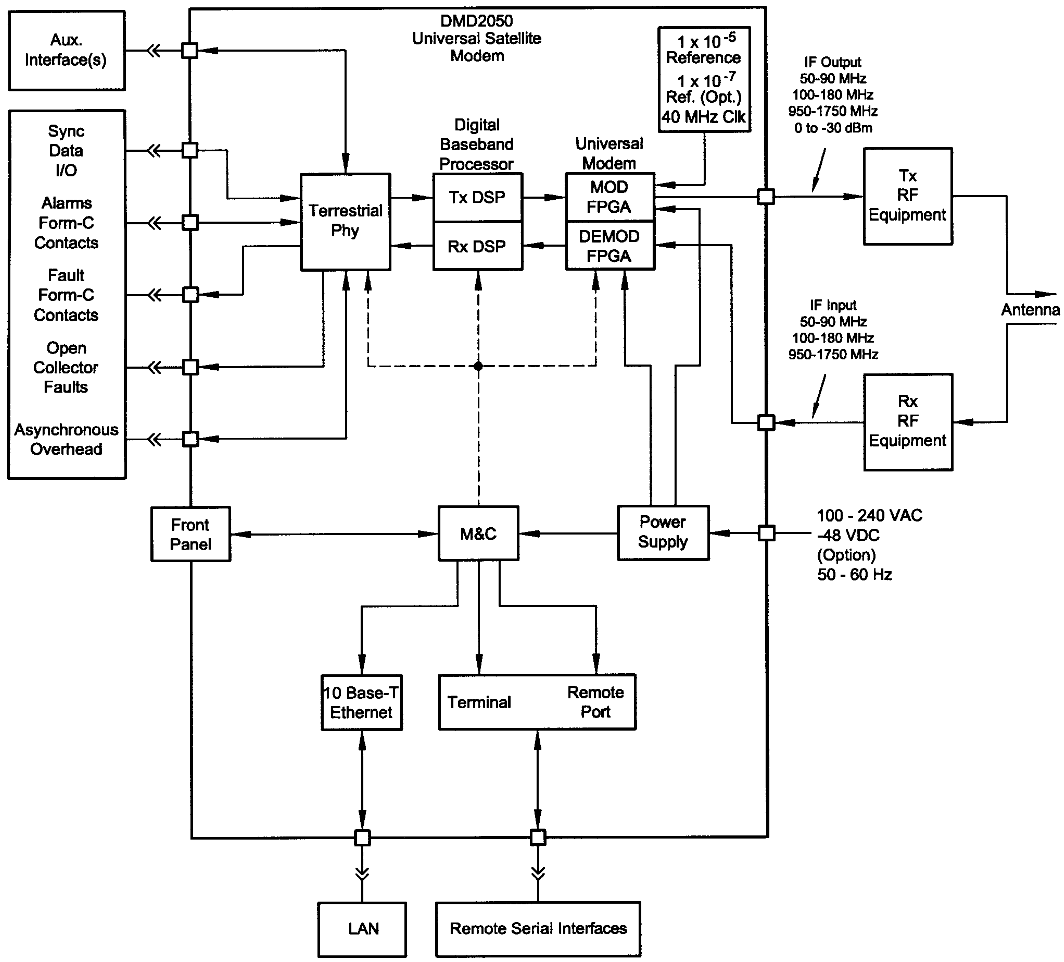


Figure 3-4. DMD2050E Universal Satellite Modem Functional Block Diagram

3.2.3 Tx Baseband Processing

The Tx Data and Clock enters the Baseband Processor, passes through a Rate Adapting FIFO and enters the Framer/Drop Processor. In Closed-Net Mode, the data passes through the framer unaltered. In IDR, IBS, and D&I Modes, the framer adds the appropriate framing and ESC as defined in IESS-308 and 309. In D&I Mode, the framer acquires the terrestrial framing structure, E1 or T1, and synchronizes the Drop Processor. The Drop Processor extracts the desired time slots from the terrestrial data stream and feeds these channels back to the framer. The framer then places the ‘dropped’ terrestrial time slots into the desired satellite channel slots. The data is then sent to the Reed-Solomon Encoder.

The Reed-Solomon Encoder, encodes the data into Reed-Solomon Blocks. The blocks are then interleaved and synchronized to the frame pattern as defined by the selected specification (IESS-308, IESS-309, DVB, etc.). After Reed-Solomon Encoding, the composite data and clock are applied to the BB Loopback Circuit.

3.2.4 Rx Baseband Processing

The Receive Processor performs the inverse function of the Tx Processor. Data received from the satellite passes through the BB Loopback Circuit to the Reed-Solomon Decoder to the Deframer. The Deframer acquires the IBS/IDR/DVB frame, synchronizes the Reed-Solomon Decoder and extracts the received data and overhead from the frame structure, placing the data into the PD Buffer, sending the overhead data to the UIM. In Closed-Net Mode, the data is extracted from the buffer and is sent to the UIM. Backward Alarm indications are sent to the M&C Subsystem. In Drop and Insert Mode, the Insert Processor synchronizes to the incoming terrestrial T1/E1 Data Stream, extracts satellite channels from the PD Buffer, and then inserts them into the desired terrestrial time slots in the T1/E1 Data Stream.

3.2.5 Monitor & Control (M&C) Subsystem

The modems M&C system is connected to most of the circuitry on any board contained in the modem. These connections provide status on the working condition of the circuitry as well as providing the data required for the various measurements the modem provides. The M&C processes this information and generates status indications as well as alarms when necessary. Detailed status information is available via the modems various user interfaces including the remote and terminal ports. An external summary fault is available on the RS422 Data interface

The M&C contains a high-performance microprocessor and is responsible for overall command and control of modem functions. The M&C is constantly monitoring all subsystems of the modem by performing a periodic poll routine and configures the modem by responding to commands input to the system. During each poll cycle, the status of each of the subsystems is collected and reported to each of the external ports. Performance statistics such as Eb/No, buffer fill %, etc. are compiled. If faults are detected, the M&C will take appropriate actions to minimize the effect of such faults on the system (refer to the Fault Matrices in Chapter 6).

The modem supports the following M&C protocols:

- Terminal Interface (Section 3.2.6)
- Remote Port Interface (Section 3.2.7)
- Ethernet M&C, Web Browser & SNMP (Section 3.2.8)

- Modem Status, Alarms & Contact Closures (Section 3.2.9)

3.2.6 Terminal Port

This port supports an asynchronous control protocol as described in Chapter 4. It is configured to support RS-232 signal levels. This port is intended for use in computer-based remote M&C. All functions of the modem may be monitored and controlled from this port via a common terminal connected to the Terminal Port. This function is front panel selectable.

The Terminal Mode Control allows the use of an external terminal or computer to monitor and control the modem from a full screen interactive presentation operated by the modem itself. No external software is required other than VT-100 Terminal Emulation Software (e.g. “Procomm” for a computer when used as a terminal. The Control Port is normally used as an RS–232 Connection to the terminal device. The RS-232 operating parameters can be set using the modem Front Panel and stored in Non-volatile memory for future use.

IMPORTANT

Refer to the Remote Protocol Manual (MN-DMDREMOTEOP) for the Terminal, Remote and SNMP screens and protocols.

3.2.7 Modem Remote Communications (RLLP)

The Remote Port located on J20 allows for control and monitoring of parameters and functions via an RS-232 Serial Interface, or RS-485 for RLLP Protocol. ‘Equipment Remote Mode’ setup can be entered from the front panel or the Web Browser interface under the “System” menu. This requires the user to first set the Remote Port Control to “Remote” then set the Multidrop Address as needed followed by setting the Remote Interface to RS232 or RS485.

Control and status messages are conveyed between the modem and all subsidiary modems and the host computer using packetized message blocks in accordance with a proprietary communications specification. This communication is handled by the Radyne Link Level Protocol (RLLP), which serves as a protocol ‘wrapper’ for the remote M&C data. Complete information on monitor and control software is contained in the following sections.

3.2.8 Ethernet M&C Port

This port is dedicated for Ethernet Communications supporting SNMP, FTP and Web Browser. The port is configured for 10 Base-T communications protocols. The Ethernet M&C Interface requires a standard RJ45 Male connector.

See also:

Appendix D, Web Interface Setup Guide

Appendix F, TCP/IP Ethernet Setup

3.2.9 Modem Monitor Status

The modems M&C system is connected to most of the circuitry on any board contained in the chassis. These connections provide status on the working condition of the circuitry as well as providing the data required for the various measurements the modem provides. The M&C processes this information and generates status indications as well as alarms when necessary. Detailed status information is available via the modems various user interfaces (front panel, remote and terminal). A summary of this information can be connected to external equipment, switches or alarms via the open collector and/or form-C fault connections

Form-C Contacts:

The UIM provides three Form-C Relays under processor control that appear at J15.

Mod Fault: De-energized when any transmit side fault is detected.

Demod Fault: De-energized when any receive side fault is detected.

Common Fault: De-energized when any fault that is not explicitly a Tx or Rx Fault such as an M&C or Power Supply Fault.

Open Collector Faults:

The UIM provides two Open Collector Faults that appear at Pins 18 & 21 on J19.

Mod Fault: Will sink up to 20 ma (maximum) until a transmit or common fault is detected. Will not sink current if a fault is detected.

Demod Fault: Will sink up to 20 ma (maximum) until a receive or common fault is detected. Will not sink current if a fault is detected.

The open collector faults are intended for use in redundancy switch applications in order to provide quick status indications.

3.3 Internal Clock

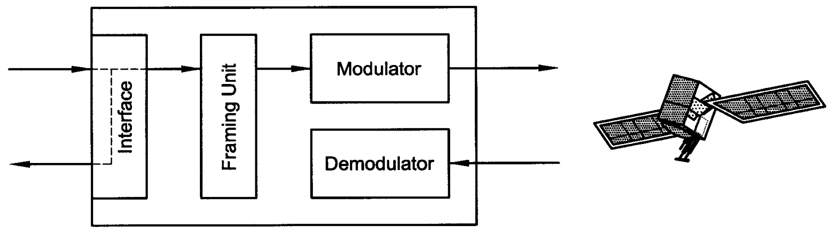
The time and date is kept in order to 'time-tag' system events. User can change the Internal Clock via the front panel, Web Browser or Terminal ports.

3.4 Loopback Features (Terrestrial & IF)

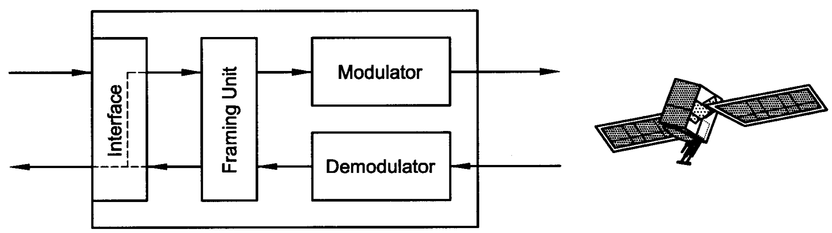
The modem provides for a number of different loopbacks. The Loopback supported are:

- IF Loopback – Tx IF port is looped back to the Rx IF port
- TX Terrestrial Loopback - Tx Data port is looped back to the Rx Data port after the interface driver/receiver. (prior to the framing unit)
- TX Baseband Loopback - Tx Data port is looped back to the Rx Data port after the interface driver/receiver. (after the fraiming unit)
- RX Terrestrial Loopback - Receive Data from the satellite is looped back for retransmission to the satellite, providing a far end loopback. (prior to the framing unit)
- RX Baseband Loopback - Receive Data from the satellite is looped back for retransmission to the satellite, providing a far end loopback. (after to framing unit)
- TX/RX Terrestrial Loopback - provides both Terrestrial loopbacks simultaneously
- TX/RX Baseband Loopback - provides both Baseband loopbacks simultaneously

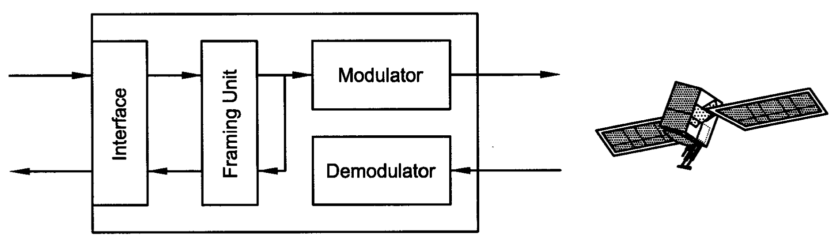
IMPORTANT
Using the loopback with the Ethernet data interface causes unwanted network loops. Before you do any type of data test with an Ethernet data interface, connect two modems back-to-back. Doing the test with one modem and a loopback does not give correct results.



Tx Terrestrial Loopback



Rx Terrestrial Loopback



Tx Baseband Loopback

Figure 3-5. Loopback Functional Block Diagram

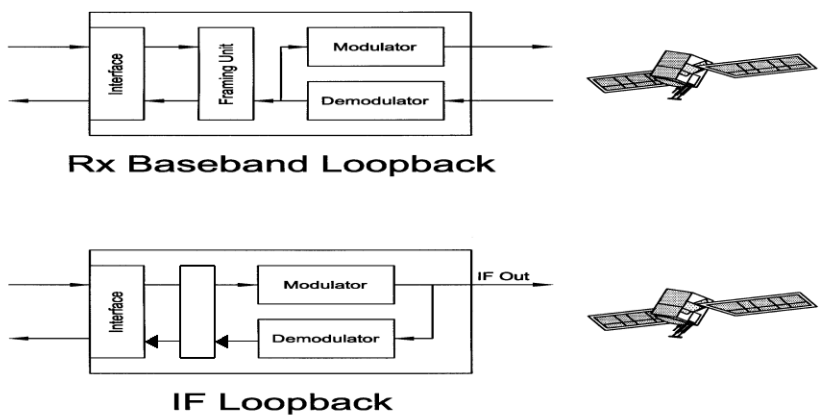


Figure 3-6. Loopback Functional Block Diagram

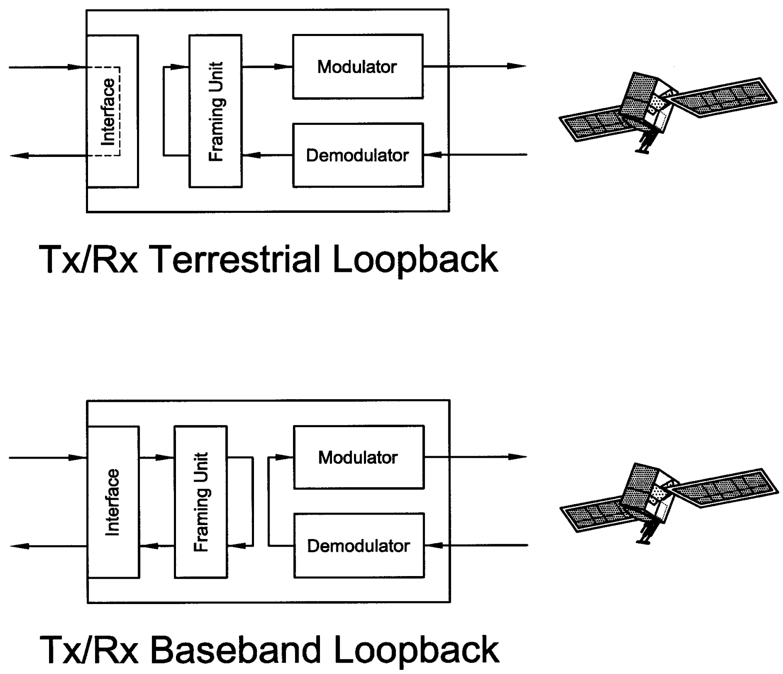


Figure 3-7. Loopback Functional Block Diagram

3.5 DMD2050E Clocking Options

The following paragraphs define the types of clocking options available to the user at the Front Panel of the DMD2050E. Refer to Figure 3-8 for clocking and polarity.

3.5.1 Clock Selection

The modem supports a number of different clocking options that can be recovered from the satellite or the terrestrial links. The various clocking options allow users to determine which clock will best fit their applications. Figure 3-7 gives an overview on how the modem processes the various clocks for the Tx Clock source and the Rx Buffer Clock source. Tx and Rx Clocks may be independently locked.

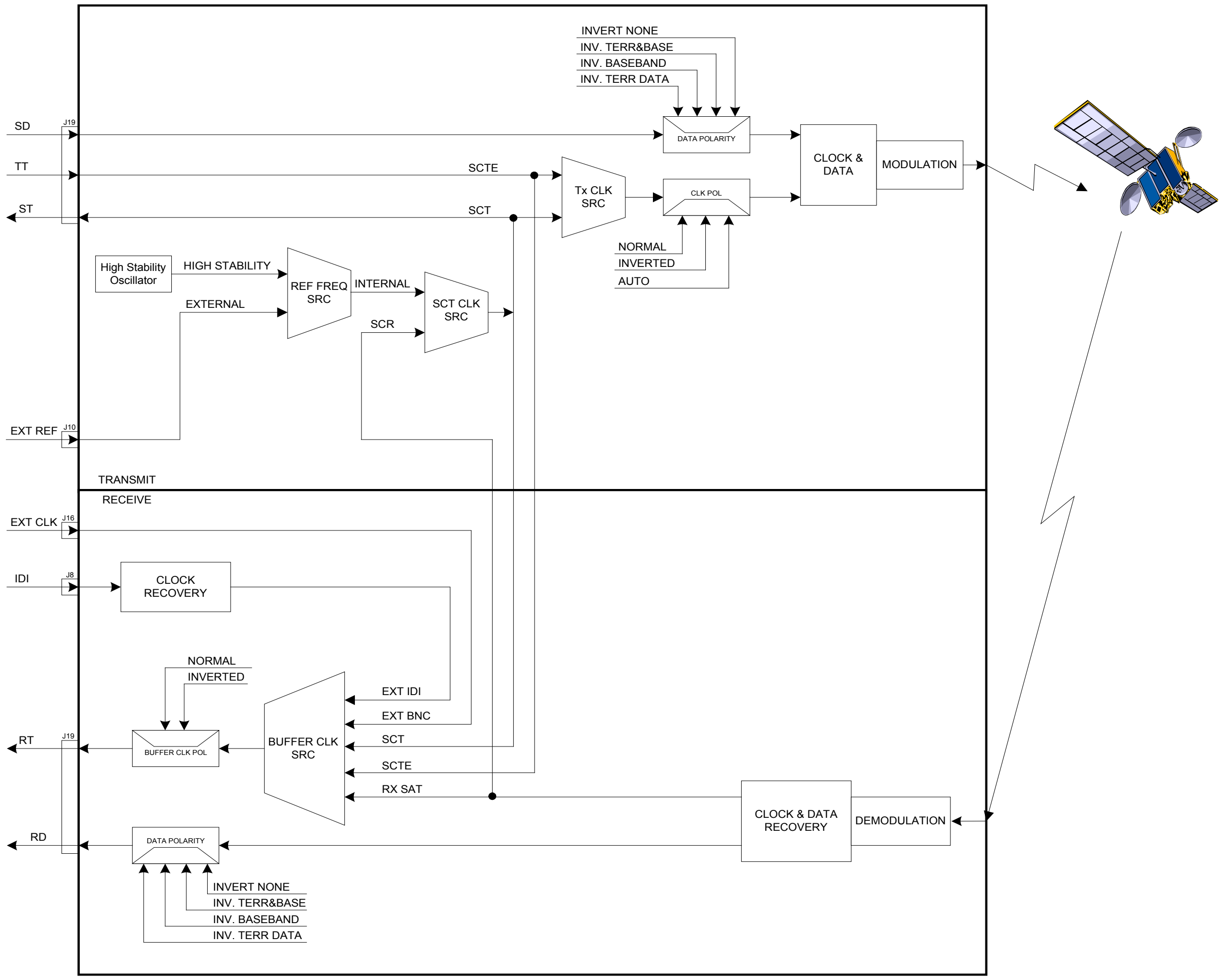


Figure 3-8. Clocking and Polarity Diagram

3.5.2 TX Clock Options

TX clock options can be recovered from the terrestrial interface, satellite interface or internally generated. The allows users to select SCTE Clock (Terrestrial) or the SCT internal clock. The modem also allows user to recover the SCT Clock from the satellite (SCR) or from the modem internally. The modem allows users to select clock polarity. The types of clocking options that are available at the Front Panel include:

- SCT (Internal Oscillator)
- SCTE (External Tx Terrestrial Clock)
- Rx Satellite Clock

3.5.2.1 SCTE: Serial Clock Transmit External

The SCTE clock is the Transmit Terrestrial Clock associated with the data interface. SCTE is an external clock received from the terrestrial equipment and the modem utilizes the terrestrial clock to lock the internal clock.

In Figure 3-7, the Transmit Terrestrial Data enters the modem and is clocked into a dejitter FIFO. Data is clocked out of the FIFO by the Modulator Clock. The Modulator Clock and Phase-Locked Loop (PLL), in conjunction with the Dejitter FIFO, which reduces the input jitter. Jitter reduction exceeds the jitter transfer specified in CCITT G.821.

SCTE is sometimes referred to as Tx Terrestrial Timing or Terminal Timing. Terminal Timing is reference to the RS422 synchronous interfaces.

3.5.2.2 SCT: Serial Clock Transmit

The SCT clock can be generated internally or recovered from the satellite. The SCT clock source can be used as the TX clock source, RX Buffer Clock source and the Terrestrial Terminal equipment for clocking the transmit data. If the SCT clock is recovered from the satellite, then it is referred to as SCR. SCR is also referred to as Receive Clock, Satellite Clock, or Receive Timing (RT).

When SCT clock is configured as Internal, the frequency of the clock is set the same as the Transmit Terrestrial Clock rate. If SCT clock is configured as SCR, the internal clock is set to the same rate as the incoming receive satellite clock. SCT is sometimes referred to as Internal Timing or Send Timing (ST). In the event that the satellite clock is lost, the modem will automatically switch over to the Internal Clock and revert back to SCR when activity is detected.

If SCT is selected, then Terrestrial data that is synchronous to the SCT Clock is required to be supplied by the modem. It is intended for the terminal equipment to use the SCT as its clock source. The Autophase Circuit will automatically ensure that the data is clocked correctly into the modem. Therefore, a return clock is not necessary. The Clock Polarity should be set to Auto.

3.5.3 RX Buffer Clock Options

The modem supports a number of RX Buffer clock options that can be recovered from the satellite, terrestrial links, internally or externally. The various clocking options allow users to determine which clock will best fit their applications. Figure 3-7 gives an overview on how the modem processes the various clocks for the Tx Clock and the Rx Buffer Clock. The modem allows users to select clock polarity Tx and Rx Clocks may be independently locked. The following RX Buffer clock selections are available:

- Rx Satellite Clock (Recovered from Satellite)
- SCTE (External Tx Terrestrial Clock)
- SCT (Internal Oscillator)
- EXC Clock/EXT BNC (External Clock Source)
- EXT IDI (Drop and Insert)

The modem handles RX Buffer clock selections based on source priority levels. The user assigns priorities to the clock sources based on source selections. Source 1 has the highest priority and Source 5 being the last resort or lowest priority. If a fallback clock is selected and activity is lost at the highest priority source, the modem will fall back to the next highest priority clock with activity. When activity resumes on a higher priority source, the modem resumes using the higher priority source

Clock Source	Priority	
RX SAT	1	(of 5)
SCTE	2	(of 5)
SCT	3	(of 5)
EXC BNC	4	(of 5)
EXT IDI	5	(of 5)

Refer to Front panel setup menus or Web Browser manual MN-DMDREMOTEOP.

3.5.3.1 RX SAT Clock

The RX Sat clock is recovered from the satellite that is received from the distant end. If selected the Buffer Clock is lock to the RX sat clock.

3.5.3.2 SCTE: Serial Clock Transmit External

When SCTE is selected as the Rx Buffer clock, the modem receives the clock from the Transmit Terrestrial interface.

3.5.3.3 SCT: Serial Clock Transmit

If SCT clock is selected as the RX Buffer clock source, then it should be configured for internal. SCT is sometimes referred to as Internal Timing or Send Timing (ST).

3.5.3.4 EXT CLK/EXT BNC: External Clock, J16

The External Clock that can be selected as the RX Buffer clock source. This is a 75ohm unbalanced BNC connector. This clock source is also identified as EXT BNC. The External Clock is often used as the station master clock. The RX Clock selection can be accessed in the INTERFACE/RX SETUP menu. The clock frequency, EXT FREQ can be selected, in the Interface/General Menu.

Clock specification	
Frequency	1 MHz to 20 MHz
Level	0.5 Vp-p to 5 Vp-p (Sine or square wave)

3.5.3.5 EXT IDI: Insert Data In

External IDI is used only for E1/T1 Drop and Insert applications. The available T1/E1 Frame Source selections are External, Internal, and IDI/DDO Loopback. The T1/E1 Frame Source selections can be accessed in the INTERFACE/RX SETUP menus. If Ext IDI is selected as the RX Buffer clock, then user must first specify T1/E1 Frame Source.

- External (RX Buffer Clock recovered from the data)
- Internal (RX Buffer Clock recovered from the internal clock)
- IDI/DDO Loopback (RX Buffer Clock recovered from the data and looped back)

3.5.4 EXT REF: External Reference, Top BNC Port, J10

This is not actually a clock, but does have some clocking implications. When the external reference is used, the master oscillator within the modem is locked to the external reference, and the internal accuracy and stability of the unit assumes that of the External Reference. Therefore, not only are the transmit frequencies locked to the external reference, but the modem's internal SCT Oscillator is locked to the external reference as well.

IMPORTANT

The external reference port input is specified as 0 to +6 dBm.

3.6 Transmit Timing Options

As shown in Figure 3-7, Transmit Terrestrial Data enters the modem and is clocked into a dejitter FIFO. Data is clocked out of the FIFO by the Modulator Clock. The Modulator Clock and Phase-Locked Loop (PLL), in conjunction with the Dejitter FIFO, reduces the input jitter. Jitter reduction exceeds the jitter transfer specified in CCITT G.821.

3.6.1 MIL-188-114A, RS-422 (TX Clock Source - SCT or SCTE)

Data must be clocked into the modem by either the SCTE or SCT Source. If EXT CLK is desired as the Tx Clock Source, then SCTE must be supplied to the modem. The output of the dejitter buffer will be clocked with EXT CLK. This case should only be used if SCTE has excessive jitter and will degrade link performance.

If SCTE is selected, then SCTE ***must*** be supplied to the modem. The Clock Polarity should be set to AUTO.

If SCT is selected, then only data that is synchronous to the SCT Clock is required to be supplied to the modem. It is intended for the terminal equipment to use the SCT as its clock source. The Autophase Circuit will automatically ensure that the data is clocked correctly into the modem. Therefore, a return clock is not necessary. The Clock Polarity should be set to Auto.

3.6.2 G.703 Interface

If the G.703 Interface is selected, then the Tx Clock Source will default to SCTE and the Clock Polarity will default to Auto.

Loop timing with a G.703 Interface or Asymmetrical Data Rates requires external equipment at the remote end that is capable of using the recovered RD Clock as source timing for (SCTE) SD. The modem will not manipulate the clock frequency. Therefore, the transmit and receive clock rates must be equal in order for the modem to perform loop timing.

3.6.3 HSSI Interface

If the HSSI Interface is selected, then the Tx Clock Source will default to SCTE and the Clock Polarity will default to Auto.

3.6.4 Ethernet Data Interface (Optional)

The modem support a single port 10/100/1000 Base T Interface. When this interface is selected additional menus will be displayed. Refer to Appendix H for interface set up and description of supporting features.

When Ethernet Data Interface is selected, the Tx Clock Source will default to SCTE and the Clock Polarity will default to Normal. In addition, the Buffer Clock will default to RxSat and the Buffer Clock Polarity will default to Normal.

3.7 Receive Timing Options

Any of the clocking selections, SCTE, SCT, EXT CLK, or RxSat (SCR) may be selected as the Buffer Clock. Data will be clocked out of the buffer at the data rate synchronous to the selected clock source.

3.7.1 Loop Timing

If loop timing is desired (i.e.; the modem timing is slaved to the far end master station), the modem clocks can be configured as follows:

3.7.2 Transmit (MIL-188-114A, RS-422)

Set SCT Source to ‘SCR’. The Tx Terminal Equipment must clock the TX Data with the SCT Clock and return data and SCTE (Optional). If SCTE is returned to the modem from the terminal equipment, set TX CLK SRC to SCTE. If SCTE is not returned to the modem, set TX CLK SRC to SCT. The TX CLK POL should be set to AUTO.

3.7.3 G.703 Interface or Asymmetrical Data Rates

Loop timing with a G.703 Interface or Asymmetrical Data Rates requires external equipment at the remote end that is capable of using the recovered RD Clock as source timing for (SCTE) SD. The modem will not manipulate the clock frequency. Therefore, the transmit and receive clock rates must be equal in order for the modem to perform loop timing.

3.7.4 Receive

Select the Buffer clock to RxSAT (SCR).

3.8 Ebem Framing Unit

The DMD2050E EBEM framing Unit provides the ability to multiplex both Serial (MIL-STD-188-114A or Hgh Speed Serial Interface – HSSI) with Bridged Ethernet payload, overhead and embedded channel data within the over-the-air transport stream.

3.8.1 DMD2050E Information Throughput Adpatation (ITA)

Refer to Appendix I for additional information.

3.8.2 Embedded Channel

The embedded channel is used for exchanging messages between DMD2050E units. ITA, AUPC and TRANSEC traffic encryption/decryption key negotiation are typical examples of messages sent through the DMD2050E embedded channel. The nominal rate of the embedded channel is 4 kbps.

3.9 STANAG Turbo Coding

The DMD2050E provides STANAGE Turbo coding FEC for all specified baseband data rates (64 kbps to 52.0 Mbps) and modulation formats (BPSK, QPSK, 8-PSK, and 16-APSK) with the following code rates: None, 1/2, 2/3, 3/4, 7/8, or 19/20. A decoding function for all Turbo encoded data is also provided.

Turbo codes come extremely close to achieving the absolute maximum channel capacity, in bits per second, for a given transmit power level. For traffic that can tolerate decoding delay and require a low Bit Error Rate (BER) (i.e., 1×10–10), Turbo coding can be used. For traffic such as speech, where excessive decoding delays cannot be tolerated and higher BER can be tolerated.

STANAG Turbo Block Sizes

Block Size (Bits)	Total Composite Data Rate
1024	Data Rate =<1024 kbps
4096	1024 kbps < Data Rate < 4096 kbps
16384	Data Rate ≥ 4096 kbps

3.10 FIPs TRANSEC Module

The DMD2050E FIPS Security Module provides bulk encryption and decryption of traffic over the satellite that conforms to Security Level 2 as defined in FIPS PUB 140-2 using NIST approved 256-bit AES encryption (Advanced Encryption Standard). Bulk Encryption includes all data coming from the baseband user ports (baseband serial port, overhead channel port and the embedded channel). Bulk Decryption decrypts all of the data coming from the baseband demodulator going to the baseband user ports and the embedded channel. Bulk Encryption and Bulk Decryption are supported by independent AES engines, AES keys and counters.

3.10.1 Traffic Encryption and Decryption Keys and Key Generation

The AES key and the initial counter value of the counter are negotiated using the key negotiation algorithm and messages. The resulting key and initial counter value are then loaded into the AES engine.

3.10.1.1 Key Agreement

The Encryption application has the responsibility for negotiating the traffic encryption keys (TEK) used on the link. To accomplish this, the Encryption application utilizes Initiator and Responder roles. The initiator starts the key agreement protocol with the goal of negotiating a TEK used to encrypt the data transmitted on the link by the initiator. The responding end responds to the messages in the key agreement protocol, using the TDK to decrypt the data received on the link. The Initiator is synonymous with Transmitter (modulator) of a link while Responder is synonymous with Receiver (demodulator) of the same link.

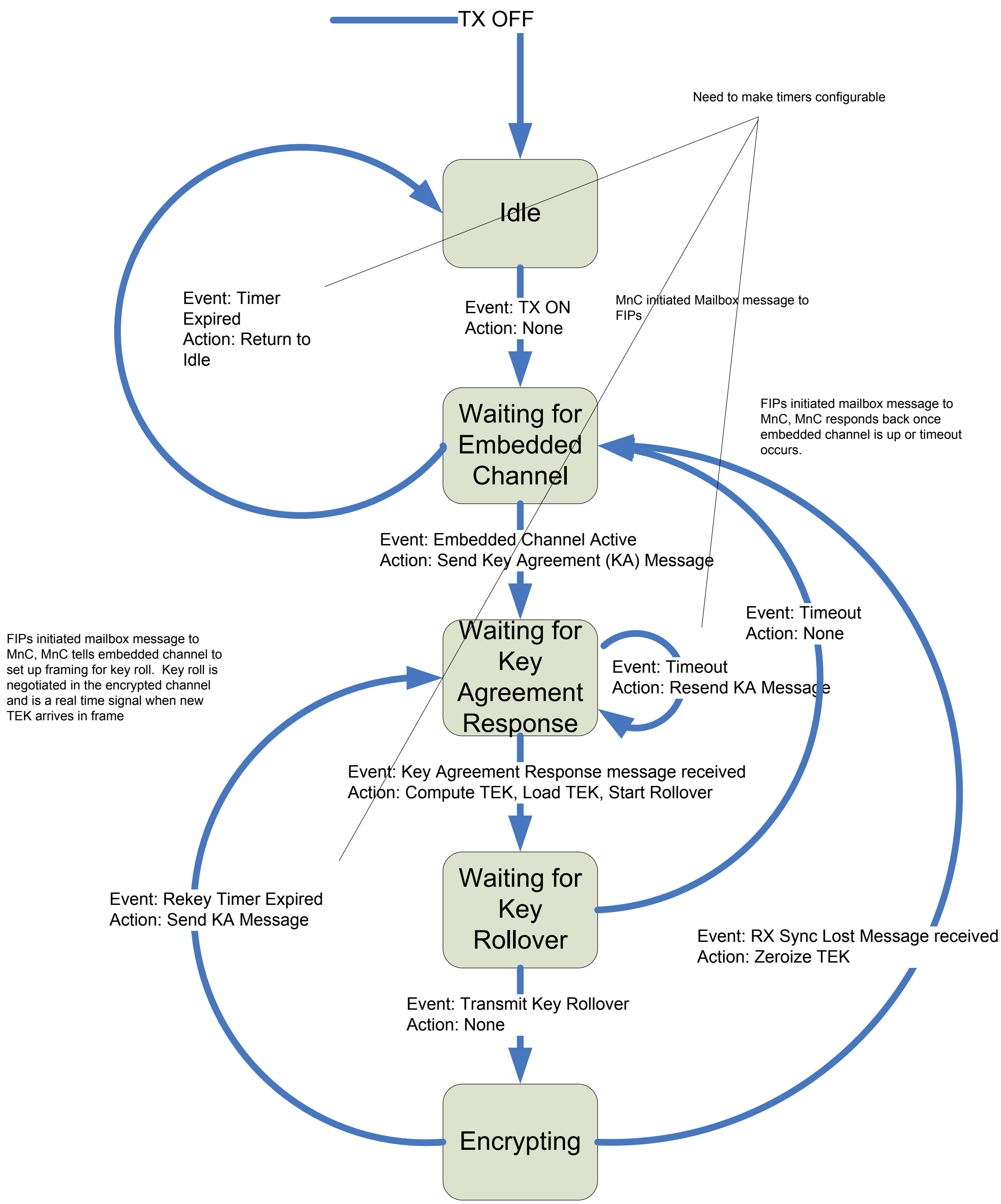


Figure 3-9. Traffic Encryption Key Negotiation

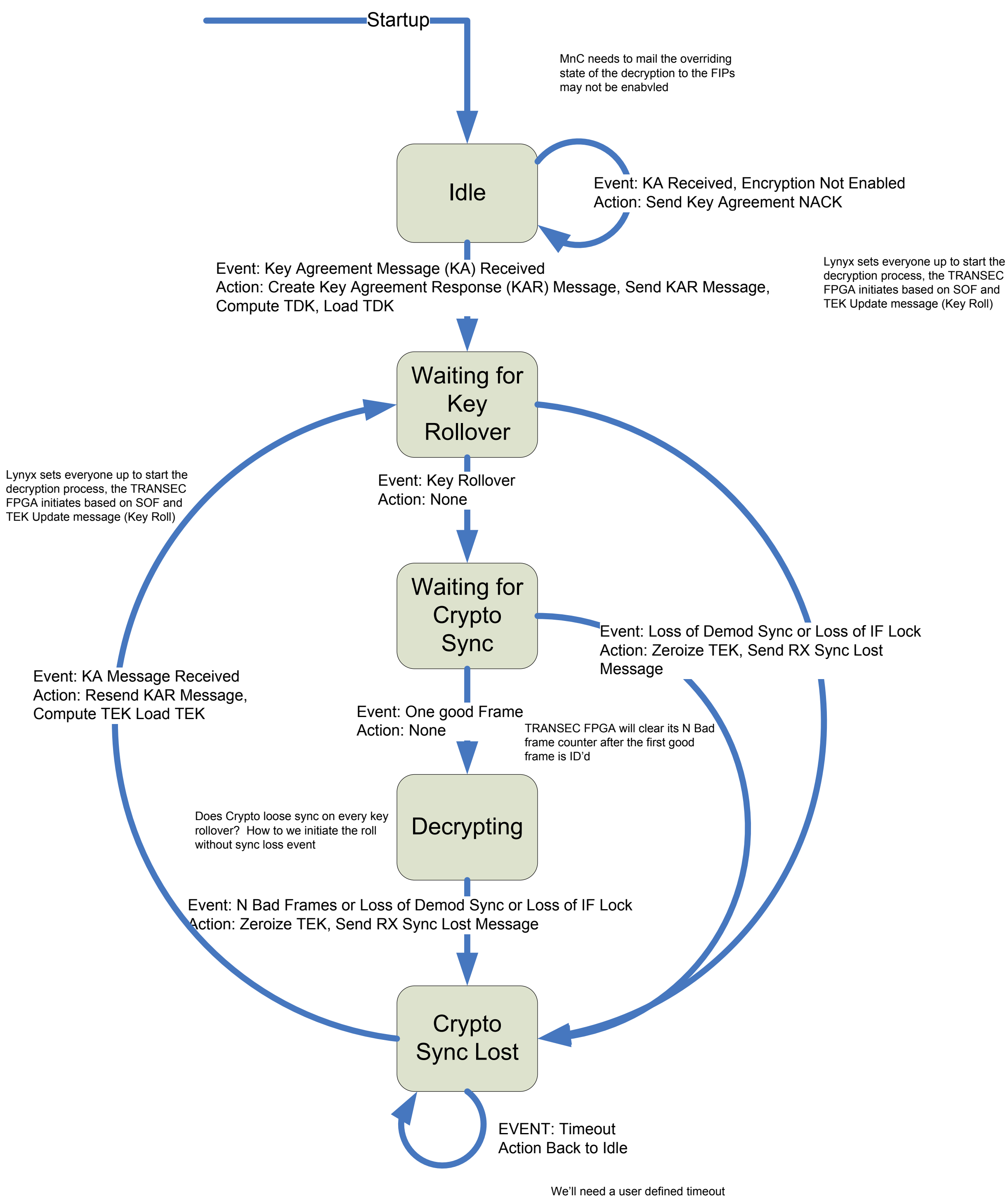


Figure 3-10. Traffic Decryption Key Negotiation

3.10.1.2 Key Agreement Algorithm

The key agreement algorithm used to negotiate a shared secret is the Ephemeral Unified Model, Elliptic Curve Cryptography Cofactor Diffie-Hellman C(2,0,ECC CDH) as specified in the elliptic curve parameters section of NIST SP 800-56A(3).

3.10.1.2.1 Key Derivation

Once the shared secret has been negotiated, the TEK is generated from the shared secret using the Concatenation Key Derivation Function (KDF) as specified in NIST SP 800-56A Section 5.8.1(3). All hashing algorithms use SHA-512 as defined in FIPS 180-2(4).

3.10.1.3 Accessing Encryption/Decryption Features

The DMD2050E enables the Crypto Officer to administer the FIPs module through authentication. The Crypto Officer Administrator can:

- Load software
- Load key material
- Configure operating parameters
- Monitor performance

The Crypto Officer Administrator must log in from the front panel or the handheld key loader.

IMPORTANT

Any operator can Enable and Disable encryption.

Any operator with access to the front panel can zeroize the unit.

NOTE

To configure the modem for legacy mode operation, first use the front panel to disable Encryption.

3.10.1.4 Enabling Encryption from the Front Panel

Use the front panel Modulator and Demodulator menus to enable or disable Encryption. The menu paths are:

- MODULATOR->DATA->ENCRYPTION {DISABLE, ENABLE}
- DEMODULATOR->DATA->ENCRYPTION {DISABLE, ENABLE}

This allows Encryption to function in half-duplex operation.

After you have enabled Encryption from the front panel, set up the Encryption Control parameters.

1. Use the secure web interface (Figure 3-11) or the handheld key-loader (Figure 3-12) to enter Encryption Control parameters.
2. Enter a maximum of 78 numeric characters into the Random Number Generator (**RNG**) **Seed** field.
3. Enter a maximum of 40 alpha numeric characters into the Shared Message Authentication Token (**SMAT**) field.

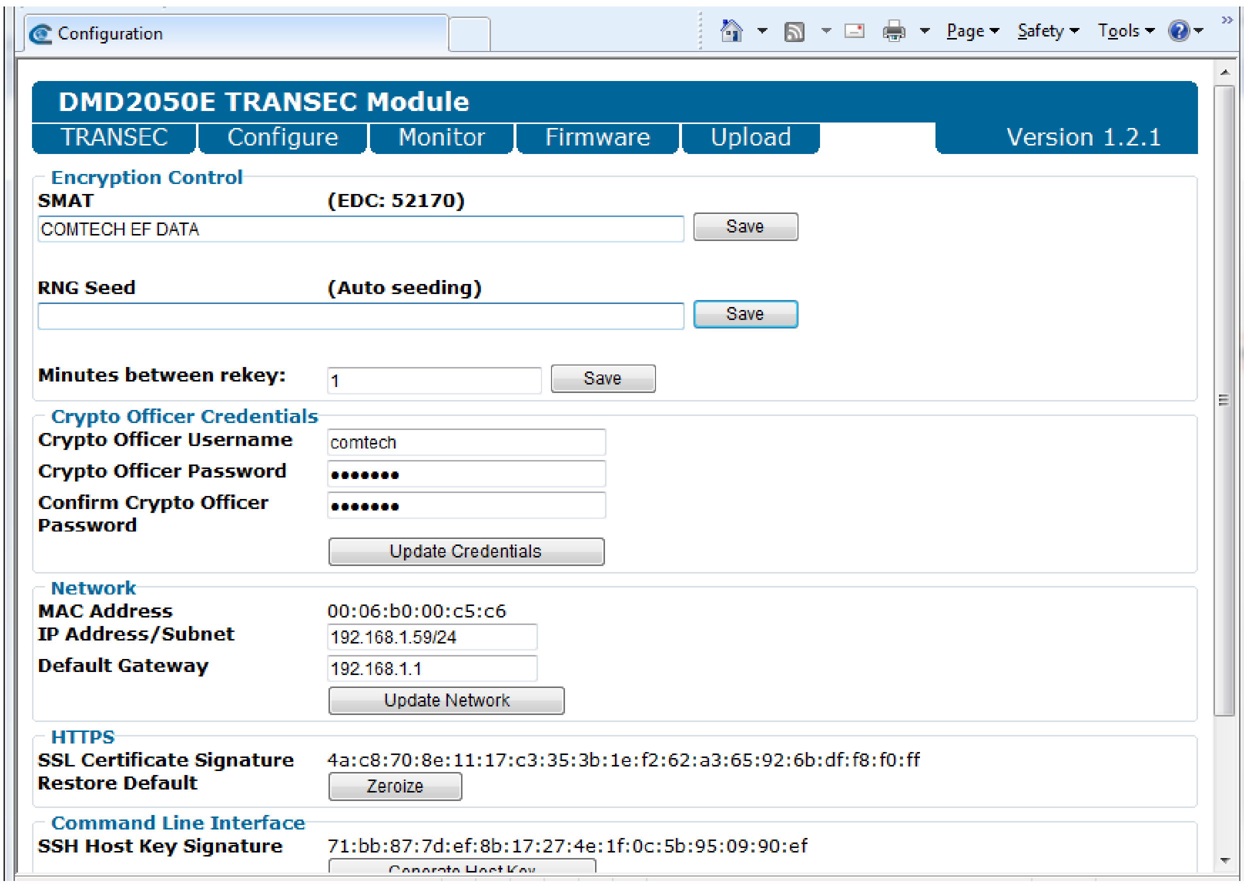


Figure 3-11. TRANSEC Secure Web Browser Configuration Page

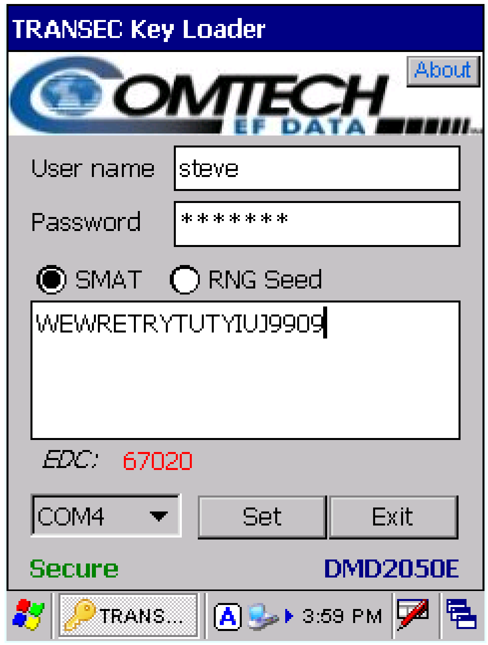


Figure 3-12. DMD2050E Handheld Key Loader

3.11 DoubleTalk Carrier-in-Carrier Option

WARNING
Before you commission a satellite link with Carrier-in-Carrier, make sure that the link is sufficient for normal operation and all system settings are correct. Incorrect link setup has an unwanted effect on the system.

Space segment costs are typically the most significant operating expense for any satellite-based service, having a direct impact on the viability and profitability of the service. For a satellite transponder that has finite resources in terms of bandwidth and power, the leasing costs are determined by bandwidth and power used. Therefore, a satellite circuit should be designed for optimal utilization to use a similar share of transponder bandwidth and power.

The traditional approach to balancing a satellite circuit – once the satellite and earth station parameters are fixed – involves trade-off between modulation and coding. A lower order modulation requires less transponder power while using more bandwidth; conversely, higher order modulation reduces required bandwidth, albeit at a significant increase in power.

Comtech EF Data has added a new dimension to satellite communication optimization: DoubleTalk Carrier-in-Carrier.

3.11.1 What is DoubleTalk Carrier-in-Carrier?

The DMD2050E DoubleTalk Carrier-in-Carrier option utilizes a patented signal processing algorithm developed by Raytheon Applied Signal Technology, that allows both the forward and reverse carriers of a full duplex link to share the same segment of transponder bandwidth, using patented "Adaptive Cancellation." Raytheon Applied Signal Technology uses the term DoubleTalk®, and Comtech EF Data refers to it as DoubleTalk® Carrier-in-Carrier® (CnC).

CnC was first introduced in Comtech EF Data products in the CDM-Qx Satellite Modem and, more recently, in the CLO-10 Link Optimizer.

The implementation of DoubleTalk Carrier-in-Carrier in the DMD2050E has been further refined, and some of the limitations that existed in the CDM-Qx implementation have been overcome.

This innovative technology provides a significant improvement in bandwidth and power utilization, beyond what is possible with FEC and modulation alone, allowing users to achieve unprecedented savings. When combined with advanced modulation and FEC, it allows for multi-dimensional optimization:

- Reduced operating expense (OPEX) – e.g., Occupied Bandwidth & Transponder Power;
- Reduced capital expenditure (CAPEX) – e.g., Block Up Converter/High-Power Amplifier (BUC/HPA) size and/or antenna size;
- Increased throughput without using additional transponder resources;
- Increased link availability (margin) without using additional transponder resources;
- A combination of any of the above to meet different objectives.

Summary***: When carriers share common bandwidth, up to 50% savings in transponder utilization is possible.***

3.11.2 Application Requirements

The following conditions are necessary in order to operate DoubleTalk Carrier-in-Carrier:

- Link must be full duplex.
- A DMD2050E must be used at the end of the link where the cancellation needs to take place.
- The transponder is operated as Loopback. That is, each end of the link must be able to see a copy of its own signal in the return (downlink) path from the satellite. The looped back signal is then subtracted which leaves the signal from the distant end of the link. **DoubleTalk Carrier-in-Carrier cannot be used in spot beam systems.**

- The transponder needs to be "bent-pipe" – meaning no on-board processing, demodulation, regeneration can be employed. Demodulation/remodulation does not preserve the linear combination of the forward and return signals and the resulting reconstituted waveform prevents recovery of the original constituent signals.

Figure 3-1 shows a simplified conceptual block diagram of CnC processing. The two ends of the link are denoted **A** and **B** and the uplink and downlink are shown.

This performance is achieved through advanced signal processing algorithms that provide superior cancellation while tracking and compensating for the following common link impairments:

Time varying delay: In addition to the static delays of the electronics and the round-trip delay associated with propagation to the satellite and back, there is a time-varying component due to movement of the satellite. The CnC module tracks and compensates for this variation.

Frequency offset and drift: Common sources are satellite Doppler shift, up and down converter frequency uncertainties, and other drift associated with the electronics in the DMD2050E itself. The CnC module tracks and compensates for this frequency offset and drift.

Atmospheric effects: Fading and scintillation can affect amplitude, phase, and spectral composition of the signal and the degree to which it correlates with the original signal. The CnC module tracks and compensates for these atmospheric related impairments.

Link Asymmetries: Various asymmetries in the forward and return link can produce differences in the relative power of the two received signal components. These can be both deterministic (static) or random (and time varying). An example of the former would be the differences resulting from antenna size/gain variations between the two ends of the link. An example of the latter would be transient power differences due to different levels of atmospheric fading in the uplinks. CnC compensates for the asymmetries, up to a certain extent.

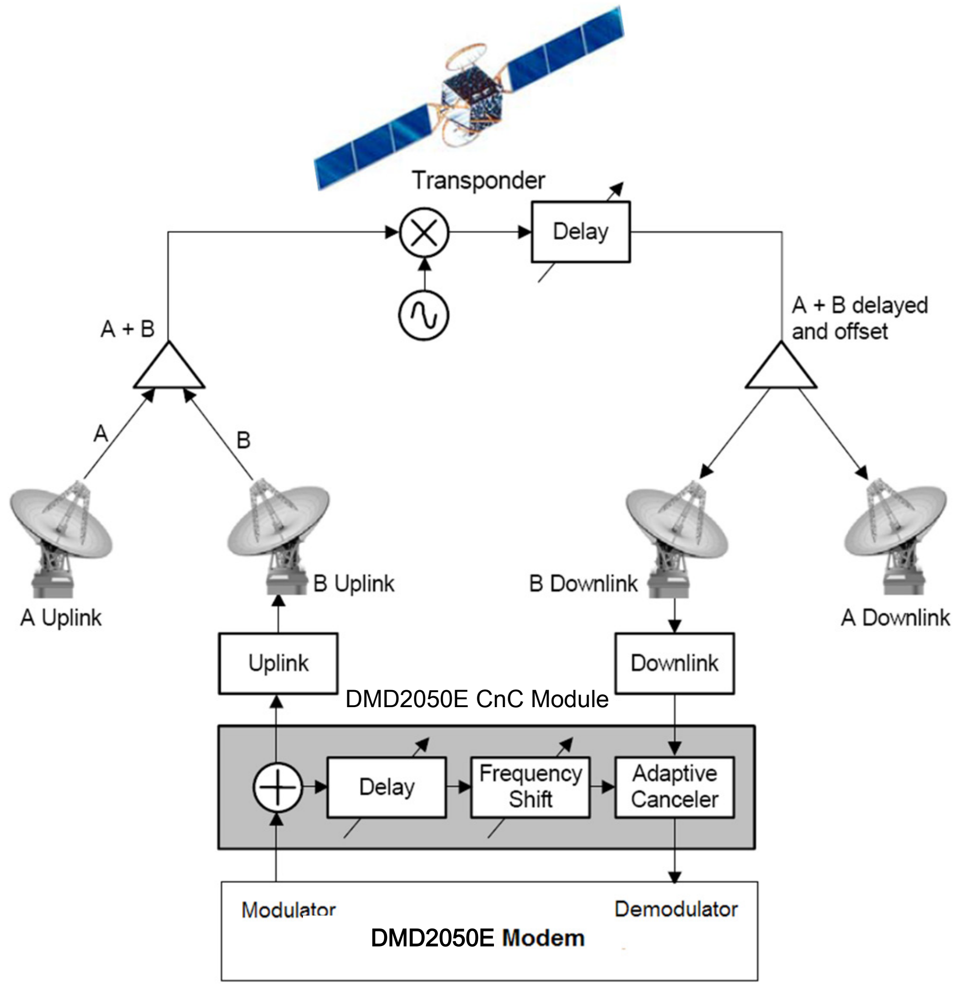


Figure 3-13. Conceptual Block Diagram

In a number of ways, CnC carriers behave similar to conventional carriers in satellite links. They are both exposed to adjacent carriers, cross-polarization and rain fade, and exhibit impairments when any of these become too great. In addition, CnC operates in an environment where:

- Carriers intentionally occupy the same spectral slot;
- Performance depends upon desired and co-located interfering carrier.

3.11.3 Operational Guidelines

The rules for CnC operation are summarized below:

- Both earth stations share the same footprint so each sees both carriers;
- CnC carriers are operated in pairs;
- One outbound with multiple return carriers is not allowed;
- Asymmetric data rates are allowed;

- The ratio of power spectral density is normally less than 11 dB;
- CnC operates with *modems* – **not** *modulators only* or *demodulators only*.

In addition, to minimize 'false' acquisition, observe the following:

- Use of IESS-315 V.35 Scrambler is highly recommended;
- Keep the search delay range as narrow as possible – once the modem has reported the search delay, narrow the search delay range to the nominal reported value +/- 5 ms – for example, if the modem reported delay is 245 ms, narrow the search range to say 240 – 250 ms.
- Use external data source (e.g. Firebird) or internal BER tester when testing Carrier-in-Carrier performance.
- To prevent self-locking in case the desired carrier is lost, it is recommended that the two carriers have some configuration difference – for example, use different settings for Spectrum Inversion.

3.11.4 System Functionality and Operational Considerations

Figure 3-10 illustrates a conventional, full duplex satellite link where two carriers are placed in non-overlapping channels.

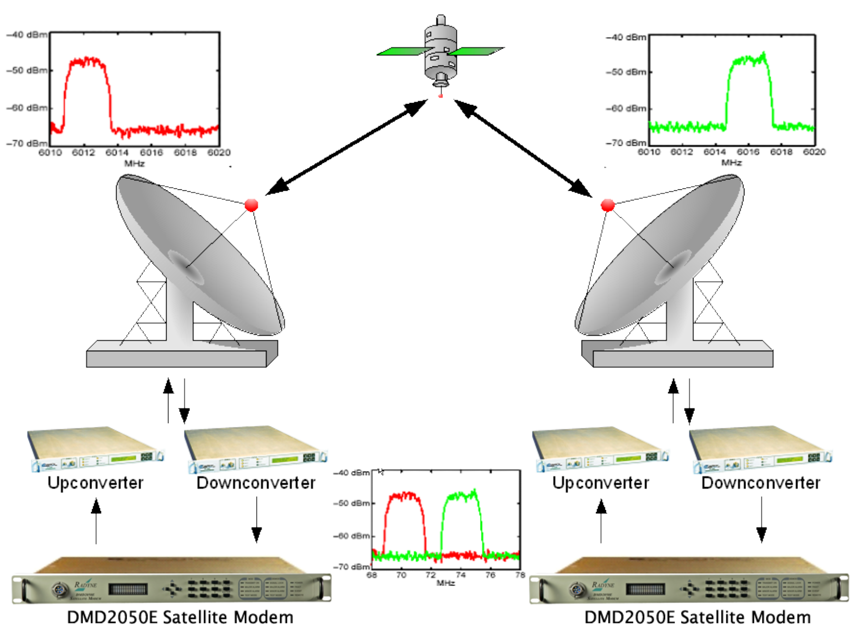


Figure 3-14. Conventional FDMA Link

Figure 3-11 shows the same link using the DMD2050E equipped with the DoubleTalk Carrier-in-Carrier option. Note that now only 50% of the bandwidth is being used, as now both carriers are occupying the same bandwidth.

The transponder downlinks the composite signal containing both carriers on the same band to the DMD2050E which then translates the signal to near baseband where it can be filtered (decimated) and then processed as a complex envelope signal. The DMD2050E then suppresses the version of the near end carrier on the downlink side and then passes the desired carrier to the demodulator for normal processing.

To further illustrate, as shown in **Figure 3-4**, without DoubleTalk Carrier-in-Carrier, the two carriers in a typical full duplex satellite link are adjacent to each other. With DoubleTalk Carrier-in-Carrier, only the composite signal is visible when observed on a spectrum analyzer. Carrier 1 and Carrier 2, shown here for reference only, are overlapping, thus sharing the same spectrum.

The DMD2050E CnC module operates on the near-zero signal before the demodulator, and is waveform agnostic. This means that no prior knowledge of the underlying modulation, FEC, or any other waveform specific parameter is required in order to perform the signal suppression operation. The only caveat to this is that the waveform must be *sufficiently random*.

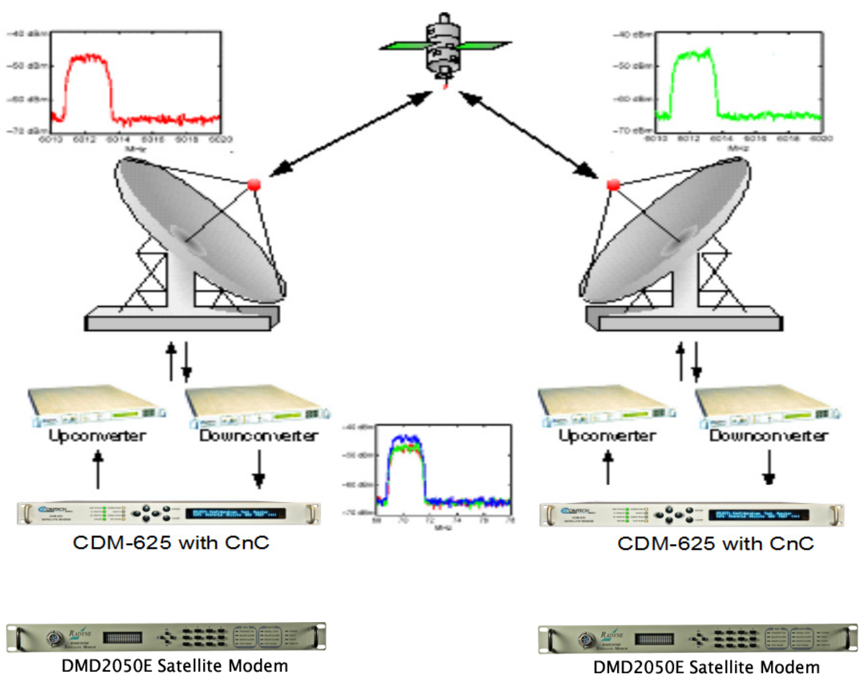
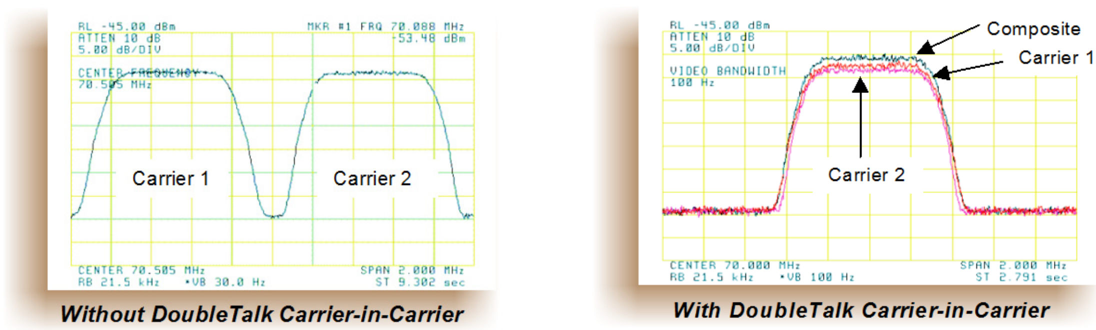


Figure 3-15. Same Link Using DMD2050E and DoubleTalk Carrier-in-Carrier



Traditional Full Duplex Link **Duplex Link with DoubleTalk Carrier-in-Carrier**

Figure 3-16. Duplex Link Optimization

Because acquiring the delay and frequency offset of the interfering carrier is fundamentally a correlation operation, anything deterministic in the interfering carrier (within the correlation window of the algorithm) will potentially produce false correlation peaks and result in incorrect delays and/or frequency. Normally, this is not a problem, since energy dispersal techniques are utilized in the vast majority of commercial and military modems. However, it is something that must be kept in mind when troubleshooting a system that utilizes the DoubleTalk Carrier-in-Carrier technique for signal suppression.

One possible way to mitigate false peaks is to narrow the correlation window. For example, if the delay is known to be around 240ms, set the minimum search delay to 230ms and the maximum search delay to 250ms.

As all advances in modem technologies – including advanced modulation and FEC techniques – approach their theoretical limits of power and bandwidth efficiencies, DoubleTalk Carrier-in-Carrier allows satellite users to achieve spectral efficiencies (bps/Hz) that cannot be achieved with modulation and FEC alone. Table 3-1 illustrates how DoubleTalk Carrier-in-Carrier, when used with 16-QAM, approaches the bandwidth efficiency of 256-QAM (8bps/Hz).

Table 3-1. Spectral Efficiency using DoubleTalk Carrier-in-Carrier

Modulation and Code Rate	Spectral Efficiency (bps/Hz)	
	Traditional SCPC	Carrier-in-Carrier
BPSK 1/2	0.50	1.00
QPSK 1/2	1.00	2.00
QPSK 2/3	1.33	2.67

QPSK 3/4	1.50	3.00
QPSK 7/8	1.75	3.50
8-QAM 2/3	2.00	4.00
8-QAM 3/4	2.25	4.50
8-QAM 7/8	2.63	5.25
16-QAM 3/4	3.00	6.00
16-QAM 7/8	3.50	7.00

As shown here, DoubleTalk Carrier-in-Carrier allows equivalent spectral efficiency using a lower order modulation and/or FEC Code Rate; CAPEX is therefore reduced by allowing the use of a smaller BUC/HPA and/or antenna. And, as DoubleTalk Carrier-in-Carrier can be used to save transponder bandwidth and/or transponder power, it can be successfully deployed in bandwidth-limited as well as power-limited scenarios.

3.11.5 DoubleTalk Carrier-in-Carrier Cancellation Process

The state-of-the-art signal processing technology employed via DoubleTalk Carrier-in-Carrier continually estimates and tracks all parametric differences between the local uplink signal and its image within the downlink. Through advanced adaptive filtering and phase locked loop implementations, it dynamically compensates for these differences by appropriately adjusting the delay, frequency, phase and amplitude of the sampled uplink signal, resulting in excellent cancellation performance.

When a full duplex satellite connection is established between two sites, separate satellite channels are allocated for each direction. If both directions transmitted on the same channel, each side would normally find it impossible to extract the desired signal from the aggregate due to interference originating from its local modulator. However since this interference is produced locally, it is possible to estimate and remove its influence prior to demodulation of the data transmitted from the remote location.

For the DoubleTalk Carrier-in-Carrier cancellation, it is necessary to provide each demodulator with a copy of its local modulator's output.

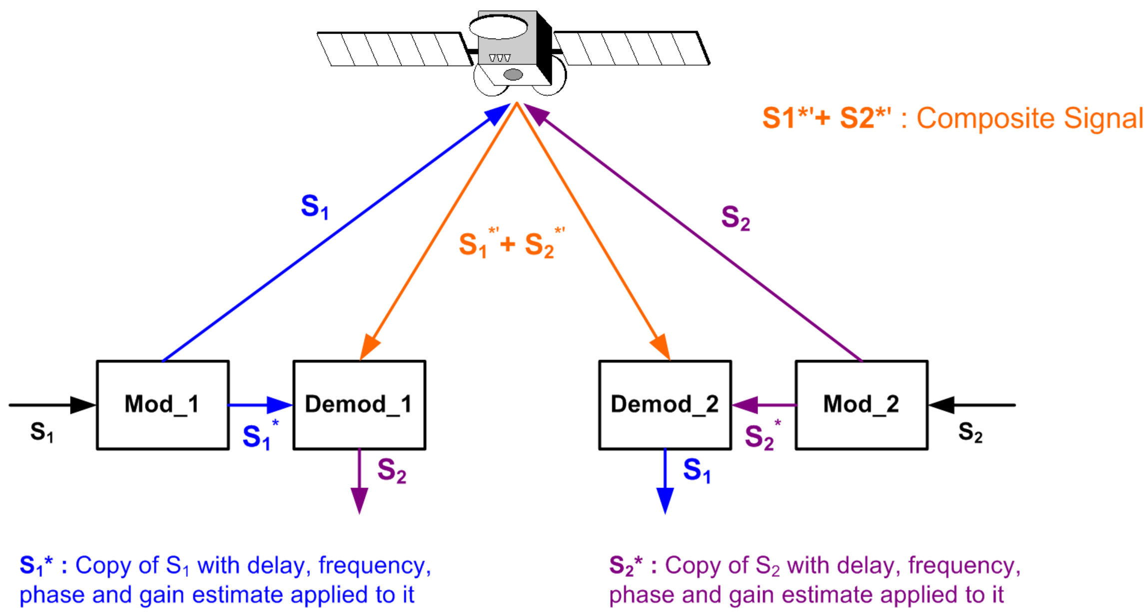


Figure 3-17. DoubleTalk Carrier-in-Carrier Signals

Referring to Figure 3-5: Modem 1 and Modem 2 transmit signals S1 and S2 respectively. The satellite receives, translates, and retransmits the composite signal. The downlink signals S1* and S2*, received at Modem 1 and Modem 2 differ from the transmit signals primarily in terms of phase, frequency, and delay offsets.

Referring to Figure 3-6: For round trip delay estimation, a search algorithm is utilized that correlates the received satellite signal to a stored copy of the local modulator's transmitted signal. The interference cancellation algorithm uses the composite signal and the local copy of S1 to estimate the necessary parameters of scaling (complex gain/phase), delay offset and frequency offset. The algorithm continuously tracks changes in these parameters as they are generally time-varying in a satellite link.

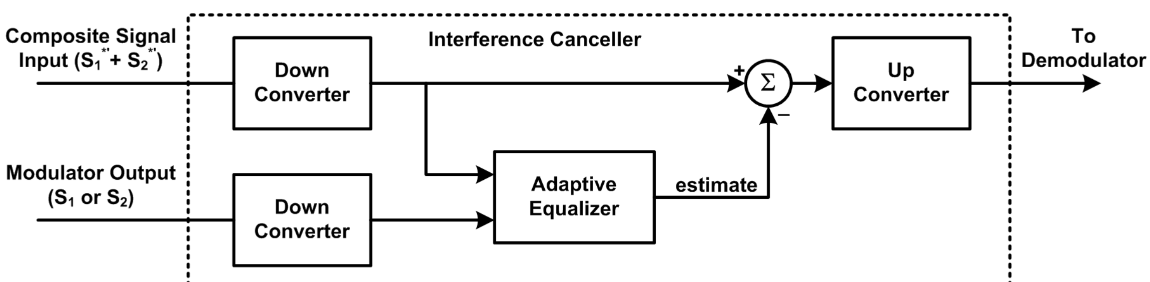


Figure 3-18. Carrier-in-Carrier Signal Processing Block Diagram

The resulting estimate of the unwanted interfering signal is then subtracted from the composite signal. In practical applications, the estimate of the unwanted signal can be extremely accurate.

Unwanted interfering signal suppression of 30 dB or more has been achieved in commercial products with minimal degradation of the demodulator performance.

3.11.6 Margin Requirements

Typical interfering signal cancellation is 28 to 35 dB (depending on the product). The residual interfering signal appears as noise causing a slight degradation of the Eb/No. To compensate for the residual noise, a small amount of additional link margin is required to maintain the BER. Margin requirements depend on the product, modulation and power ratios. For the DMD2050E, the additional margin requirements are:

Modulation	Nominal Margin*
BPSK	0.3 dB
QPSK/OQPSK	0.3 dB
8-PSK	0.5 dB
8-QAM	0.4 dB
16-QAM	0.6 dB

* Equal power and equal symbol rate for the interfering carrier and the desired carrier, i.e., 0 dB PSD ratio. Measured at IF with AWGN, +10 dBc Adjacent Carriers, 1.3 spacing.

3.11.7 Carrier-in-Carrier Latency

Carrier-in-Carrier has no measurable impact on circuit latency.

3.11.8 Carrier-in-Carrier and Adaptive Coding and Modulation

Carrier-in-Carrier is fully compatible with STANAG TURBO Information Throughput Adaptation (ITA) mode of operation in the DMD2050E.

Carrier-in-Carrier combined with STANAG TURBO ITA can provide 100 – 200% increase in average throughput.

3.11.9 Carrier-in-Carrier Link Design

Carrier-in-Carrier link design involves finding the FEC and modulation combination that provides optimal bandwidth utilization. Just like conventional link design, it is an iterative process that involves trying different FEC and modulation combinations with Carrier-in-Carrier until an optimal combination is found.

For optimal Carrier-in-Carrier performance, it is recommended that the two carriers have similar symbol rate and power. This can be achieved by selecting appropriate MODCODs as shown in following sections.

3.11.9.1 Symmetric Data Rate Link

Consider the following example:

Satellite & Transponder	Galaxy 18 @ 123º W, 13K/13K
Earth Station 1	Phoenix, AZ – 4.6 m
Earth Station 2	Phoenix, AZ – 2.4 m
Data Rate	512 kbps / 512 kbps

The traditional link was based on QPSK TPC 3/4 and required 0.96 MHz of leased BW. The LST[1] summary for the traditional link is as follows:

[1] LST is Intelsat's Lease Transmission Plan Program.

Link Analysis Description:			
MultiCarrier Txpdr Lease	**Link 1**	**Link 2**	
Number of links: 2			
Modulation	QPSK	QPSK	
Information Rate	512.0	512.0	kbit/s
FEC Code Rate	.7500	.7500	
R-S Code Rate	N/A	N/A	
Clear Sky Eb/No Available	9.3	8.7	dB
Number of Assigned Carriers	1	1	
Transmit ES Code	4_6M	2_4M	
Transmit ES Size	4.6	2.4	m
Receive ES Code	2_4M	4_6M	
Receive ES Size	2.4	4.6	m
Receive ES G/T	24.5	29.0	dB/K

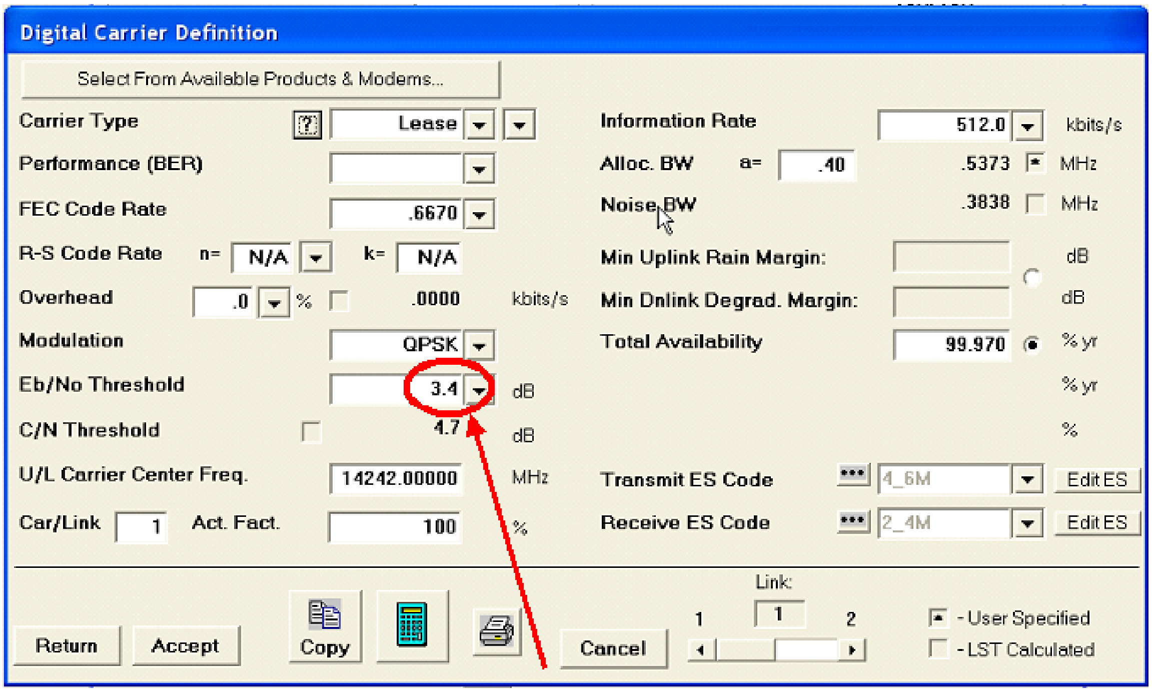
Total Leased Resource Usage:					
LST calculated			Total BW allocated	.9557	MHz
(MultiCarrier Txpdr Lease)			Total BW PEB	.8208	MHz
Total EIRP utilized	20.1	dBW	Total BW utilized	.9557	MHz
Total EIRP available	20.9	dBW	Total BW available	1.0000	MHz
Margin (available-utilized)	.9	dB	Margin (available-utilized)	.0443	MHz

Allocated BW = 0.9557 MHz
PEB = 0.8208 MHz
Leased BW = 0.9557 MHz

Carrier-in-Carrier link design involved trying different Modulation & FEC Code Rates to find the optimal combination:

- 8-QAM, LDPC 2/3 with Carrier-in-Carrier
- QPSK, LDPC 3/4 with Carrier-in-Carrier
- QPSK, LDPC 2/3 with Carrier-in-Carrier
- QPSK, LDPC 1/2 with Carrier-in-Carrier

Link parameters and LST summary for QPSK, LDPC 2/3 with Carrier-in-Carrier is as follows:



Includes IF-RF Margin and CnC Margin

Link Analysis Description:		Link 1	Link 2	
MultiCarrier Txpdr Lease				
Number of links	2			
Modulation		QPSK	QPSK	
Information Rate		512.0	512.0	kbit/s
FEC Code Rate		.6670	.6670	
R-S Code Rate		N/A	N/A	
Clear Sky Eb/No Available		7.9	7.3	dB
Number of Assigned Carriers		1	1	
Transmit ES Code		4_6M	2_4M	
Transmit ES Size		4.6	2.4	m
Receive ES Code		2_4M	4_6M	
Receive ES Size		2.4	4.6	m
Receive ES G/T		24.5	29.0	dB/K

Total Leased Resource Usage:					
LST calculated			Total BW allocated	1.0747	MHz
(MultiCarrier Txpdr Lease)			Total BW PEB	.5777	MHz
Total EIRP utilized	18.6	dBW	Total BW utilized	1.0747	MHz
Total EIRP available	21.4	dBW	Total BW available	1.1000	MHz
Margin (available-utilized)	2.8	dB	Margin (available-utilized)	.0253	MHz

CnC Allocated BW = 1.0747 / 2 = 0.53735 MHz
CnC PEB = 0.5777 MHz
CnC Leased BW = 0.5777 MHz

The link budget summary for the different MODCOD combinations is as follows:

S. No.	Modulation & FEC	Allocated BW (MHz)	PEB (MHz)	Leased BW (MHz)	Savings Compared to Original	PSD Ratio (dB)
1	8-QAM, LDPC 2/3	0.3584	1.1468	1.1468	-20%	2.1
2	QPSK, LDPC 3/4	0.47785	0.6734	0.6734	30%	2.1
3	QPSK, LDPC 2/3	0.53735	0.5777	0.5777	40%	2.1
4	QPSK, LDPC 1/2	0.7168	0.5184	0.7168	25%	2.1

Based on this analysis, QPSK, LDPC 2/3 with Carrier-in-Carrier provides the maximum savings of 40%.

In addition to 40% reduction in Leased Bandwidth, using Carrier-in-Carrier also reduced the required HPA Power by almost 40%:

HPA Power	Traditional Link (QPSK, TPC 3/4)	CnC Link (QPSK, LDPC 2/3)	HPA Power Reduction
HPA @ 4.6 m	0.7 W	0.5 W	40%
HPA @ 2.4 m	1.5 W	1.1 W	36%

3.11.9.2 Asymmetric Data Rate Link

As occupied (or allocated) bandwidth of a Carrier-in-Carrier circuit is dictated by the larger of the two carriers, it is strongly recommended that the smaller carrier be spread as much as possible using a lower order modulation and/or FEC, while meeting the PSD ratio spec. Spreading the smaller carrier using a lower order modulation has multiple benefits:

- Lower order modulation is always more robust;
- Lower order modulation uses less transponder power – this reduces total transponder, and increases available link margin;
- Lower order modulation uses less transmit power on the ground – this can significantly reduce the BUC/SSPA size by not only reducing the transmit EIRP, but also reducing the BUC/SSPA backoff

Consider the following example:

Satellite & Transponder	IS-901 @ 342º W, 22/22 (EH/EH)
Earth Station 1	Africa – 4.5 m
Earth Station 2	Africa – 3.0 m
Data Rate	3000 Mbps / 1000 Mbps

While the traditional link was based on QPSK, TPC 3/4 and required 3.9 MHz of leased bandwidth, the Carrier-in-Carrier link was based on QPSK, LDPC 3/4 and QPSK, LDPC 1/2 and required 2.8 MHz of leased bandwidth.

The savings summary is as follows:

Item	Original Link			With Carrier-in-Carrier and LDPC			Savings
	Hub to Remote	Remote To Hub	Total	Hub to Remote	Remote to Hub	Total	
Data Rate (kbps)	3000	1000		3000	1000		
Modulation	QPSK	QPSK		QPSK	QPSK		
FEC	TPC 3/4	TPC 3/4		LDPC 3/4	LDPC 1/2		
Occupied BW (MHZ)	2.8	0.9	3.7	2.8	1.4	2.8	
Power Eq. BW (MHz)	3.3	0.6	3.9	2.5	0.3	2.8	
Leased BW (MHz)			**3.9**			**2.8**	**27.5%**
Hub HPA (W)	26.0			20.3			**22%**
Remote HPA (W)	10.6			6.4			**40%**

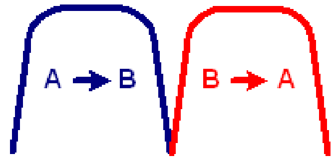
If this link was designed using QPSK, LDPC 3/4 in both directions, it would have required:

Occupied BW	2.8 MHz	
Power Eq. BW	3.0 MHz	7.2% **increase** in Power Eq. BW
Leased BW	3.0 MHz	7.2% **increase** in Leased BW
Hub HPA	20.3 W	
Remote HPA	8.3 W	30% **increase** in Remote power

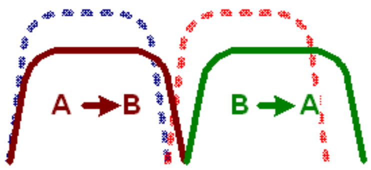
3.11.9.3 Power Limited Links

Carrier-in-Carrier can provide substantial savings even when the original link is power limited. Spreading the carrier by using a lower modulation and/or FEC along with the latest FEC can substantially reduce the total power which can then be traded with bandwidth using Carrier-in-Carrier. The concept is illustrated with the following examples.

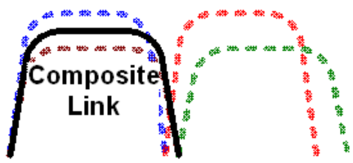
The conventional link is using 8-PSK, TPC 3/4:



Switching to an advanced FEC and using a lower order modulation – e.g., QPSK, STANAG TURBO 7/8 increases the total occupied bandwidth, while reducing the total power equivalent bandwidth:



Now using DoubleTalk Carrier-in-Carrier, the second QPSK, STANAG TURBO 7/8 carrier can be moved over the first carrier – thereby significantly reducing the total occupied bandwidth and total power equivalent bandwidth when compared to the original side-by-side 8PSK, TPC 3/4 carriers:



Consider this example:

Satellite & Transponder	IS-901 @ 342º W, 22/22 (EH/EH)
Earth Station 1	9.2 m
Earth Station 2	4.5 m
Data Rate	2.048 Mbps / 2.048 Mbps

Whereas the original link used 8-PSK TPC 3/4, the Carrier-in-Carrier link used QPSK STANAG TURBO 7/8. The savings summary is as follows:

Item	Original Link			With Carrier-in-Carrier and STANAG TURBO 7/8			Savings
	Hub to Remote	Remote To Hub	Total	Hub to Remote	Remote to Hub	Total	
Data Rate (kbps)	2048	2048		2048	2048		
Modulation	8-PSK	8-PSK		QPSK	QPSK		
FEC	TPC 3/4	TPC 3/4		7/8	7/8		
Occupied BW (MHZ)	1.3	1.3	2.6	1.8	1.8	1.8	
Power Eq. BW (MHz)	2.2	1.0	3.2	1.1	0.5	1.6	
Leased BW (MHz)			3.2			**1.8**	**44%**
Hub HPA (W)	**5.0**			**2.0**			**60%**
Remote HPA (W)	**11.6**			**4.7**			**60%**

Note: 1 dB HPA BO for QPSK, 2 dB HPA BO for 8-PSK, 1 dB Feed Loss.

Using Carrier-in-Carrier and STANAG TURBO 7/8 reduced the leased bandwidth by almost 44% and HPA power by 60%.

3.11.10 Carrier-in-Carrier Commissioning and Deployment

WARNING

Before you commission a satellite link with Carrier-in-Carrier, make sure that the link is sufficient for normal operation and all system settings are correct. Incorrect link setup has an unwanted effect on the system.

First, make sure to do a complete test of the link without Carrier-in-Carrier. Make sure all system adjustments are correct, including external interference, antenna pointing, cabling and SSPA backoff.

Do the following steps for Carrier-in-Carrier commissioning and deployment. You can repeat the steps for different PSD ratio and Eb/No.

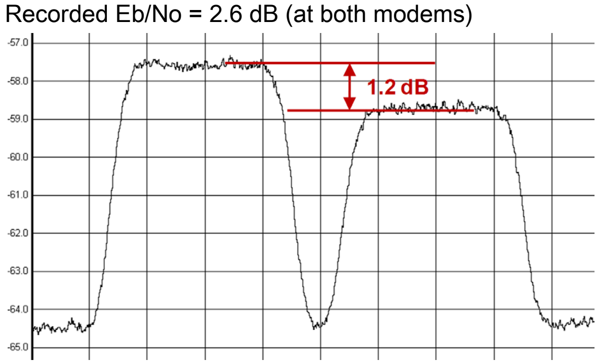
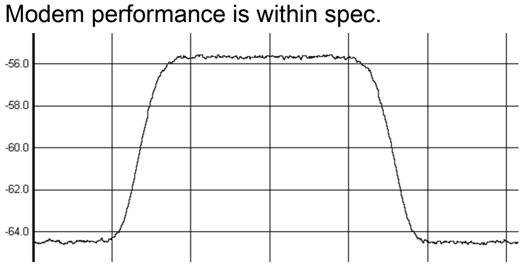
Step	Procedure
1a	Turn ON the carrier at Site A.
1b	Carrier from Site B is OFF.

Step	Procedure
1c	Make sure CnC function is OFF at both sites.
1d	Using a spectrum analyzer, measure Co+No/No at the input to the modem at Site A.
1e	Using a spectrum analyzer, measure Co+No/No at the input to the modem at Site B.
1f	Measure/record Eb/No at Site B. Make sure there is sufficient margin to account for CnC.
1g	Measure/record Receive Signal Level (RSL) at Site B.
2a	Turn OFF the carrier at Site A.
2b	Turn ON the carrier at Site B.
2c	Make sure CnC function is OFF at both sites.
2d	Using a spectrum analyzer, measure Co+No/No at the input to the modem at Site A.
2e	Using a spectrum analyzer, measure Co+No/No at the input to the modem at Site B.
2f	Measure/record Eb/No at Site A. Make sure there is sufficient margin to account for CnC.
2g	Measure/record RSL at Site B.
3a	Using Co+No/No readings calculate PSD ratio at Site A and Site B
3b	If it is not within specification, make necessary adjustments to bring it within specification and repeat measurements in Steps 1 and 2.
3c	Also verify that the RSL is within spec.
4a	Now, do not change the transmit power levels and turn ON both the carriers (on the same frequency).
4b	Turn CnC ON.
4c	Measure/record Eb/No at Site A and B.
4d	Measure/record RSL at Site A and B.
4e	Now compare Eb/No in presence of two overlapping carriers with CnC with Eb/No when only 1 carrier was ON. Eb/No variation should be within spec for that modulation, FEC and PSD ratio.

3.11.11 Validating Carrier-in-Carrier Performance

Carrier-in-Carrier performance can be easily validated by verifying that Eb/No degradation because of Carrier-in-Carrier is within published specification for the observed Power Spectral Density Ratio.

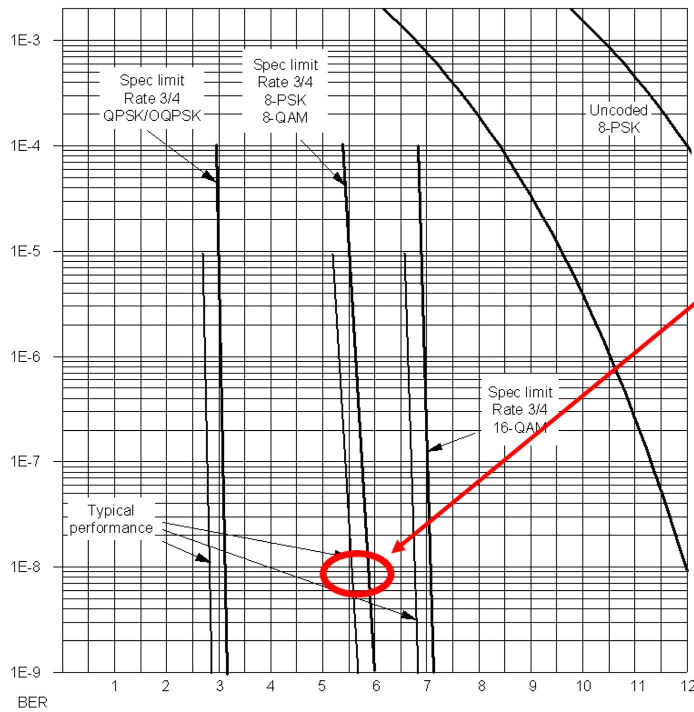
The following steps are recommended for validating Carrier-in-Carrier performance:

Step	Procedure
1a	Set up a conventional side-by-side link of the desired Eb/No:
1b	Carrier-in-Carrier should be OFF.
1c	Record the Eb/No as displayed by the Modems.
1d	Observe the 2 carriers on a spectrum analyzer and record the PSD ratio. Example Link: Full duplex 512 kbps, QPSK, LDPC 2/3 circuit between 4.6 m and 2.4 m antennas Recorded Eb/No = 2.6 dB (at both modems)  PSD Ratio = 1.2 dB (measured at larger Antenna)
2a	Now relocate one of the carriers on top of the other carrier.
2b	Enable Carrier-in-Carrier.
2c	Record the Eb/No as displayed by the Modems.
3a	Calculate change in Eb/No and verify against specification. Example Link: Recorded Eb/No = 2.4 dB Change in Eb/No = 0.2 dB Eb/No Degradation (Spec.) at 1.2 dB PSD = 0.3 dB Modem performance is within spec. 

3.11.12 Operational References

3.11.12.1 Carrier-in-Carrier Link Budget Calculation

The following steps are required for calculating the link budget for a Carrier-in-Carrier Link:

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1</td><td>Calculate the link budget for both carriers in the duplex link, with required CnC margin:


Find the Eb/No corresponding to the desired BER
Add CnC Margin
Add any other margin
Use this compiled value as the Threshold Eb/No for the link budget</td></tr>
<tr><td>2</td><td>Verify that the PDS ration is within spec for the DMD2050E</td></tr>
<tr><td>3</td><td>Calculate the Allocated Bandwidth (BW) and Power Equivalent Bandwidth (PEB) for the duplex link:
• $BW_{Duplex\ Link}$ = Greater of ($BW_{Carrier\ 1}$, $BW_{Carrier\ 2}$)
• $PEB_{Duplex\ Link} = PEB_{Carrier\ 1} + PEB_{Carrier\ 2}$
• Leased $BW_{Duplex\ Link}$ = Greater of ($BW_{Duplex\ Link}$, $PEB_{Duplex\ Link}$)</td></tr>
<tr><td>4</td><td>For an optimal link, the Leased Bandwidth and the Power Equivalent Bandwidth should be equal / nearly equal.</td></tr>
<tr><td>5</td><td>Repeat the link budget process by selecting different Modulation and FEC, until the BW and PEB is nearly balanced.</td></tr>
</table>

3.11.12.2 Estimating PSD Ratio

PSD can be estimated from a link budget using Downlink EIRP and Symbol Rate:

PSD = Downlink EIRP – 10 * Log (Symbol Rate)

PSD Ratio Example:

Carrier	Downlink EIRP	Symbol Rate	Power Spectral Density
A to B	27 dBW	500 ksps	-29.99 dBW/Hz
B to A	24 dBW	375 ksps	-31.74 dBW/Hz

PSD Ratio (@ A) = -29.99 – (-31.74) = 1.75 dB

PSD Ratio (@ B) = 01.74 – (-29.99) = -1.75 dB

3.11.12.3 Estimating PSD Ratio from LST

Carrier Information	**Link 1**	**Link 2**	
Carrier Type	IPL	IPL	
Performance			BER
Modulation	8-Phase	8-Phase	
Eb/No Threshold	5.6	5.6	dB
C/N Threshold	8.6	8.6	dB
Center Frequency	6014.0	6014.0	MHz
Information Rate (IR)	4096.0	4096.0	kbit/s
Overhead (OH)	.0	.0	kbit/s
Data Rate (IR + OH)	4096.0	4096.0	kbit/s
FEC Code Rate	.6667	.6667	
R-S Code Rate	N/A	N/A	
Transmission Rate	6143.7	6143.7	kbit/s
Bandwidths and Margins			
Filter Rolloff Factor	.40	.40	
Allocated Bandwidth	2.8671	2.8671	MHz
Noise Bandwidth	2.0479	2.0479	MHz
Number of Assigned Carriers Per Link	1	1	

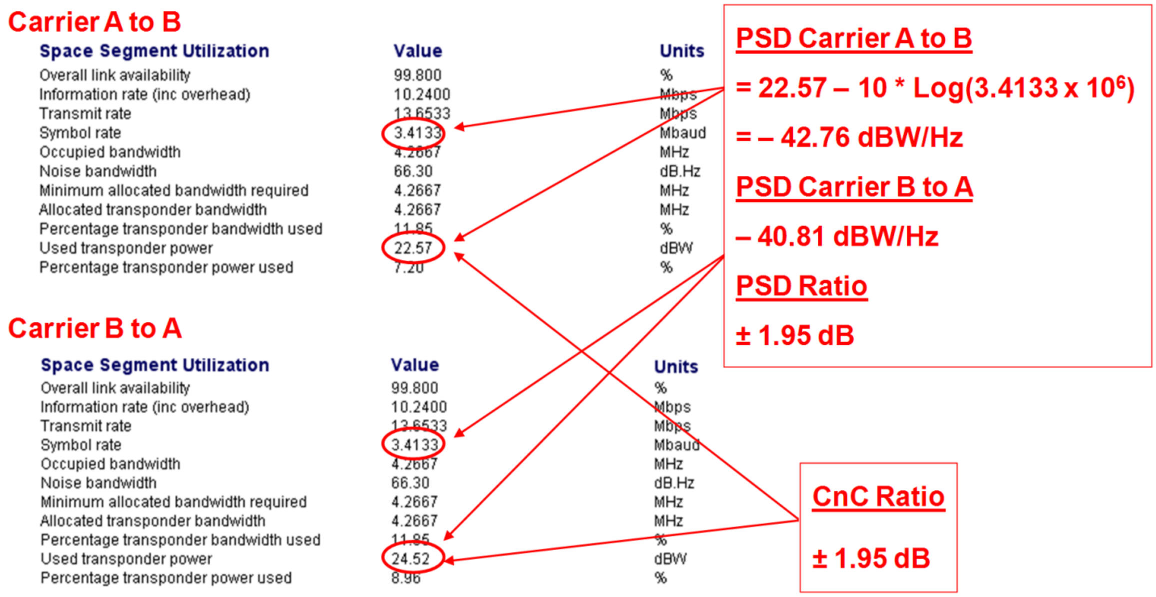
PSD Link 2
15.8 – 10 * Log (2.0479 * 1000000) = – 47.3 dBW/Hz

PSD Ratio
± 1.0 dB

Per Carrier UL & DL eirp (Clr-Sky)	**Link 1**	**Link 2**	
Transmit ES elevation angle	70.4	54.5	deg.
Uplink EIRP per carrier	58.7	57.0	dBW
Pathloss at uplink frequency	199.3	199.5	dB
Gain of 1 m2 antenna	37.1	37.1	dBi
Per carrier FD @SC	-103.5	-105.4	dBW/m2
SC pattern advantage @ES	1.8	2.8	dB
Per carrier BE FD arriving @ SC	-101.7	-102.7	dBW/m2
Transponder BE SFD	-79.0	-79.0	dBW/m2
Per carrier input back-off	-22.7	-23.7	dB
Per carrier output back-off	-20.2	-21.2	dB
Transponder BE saturation EIRP	37.0	37.0	dBW
Downlink BE EIRP	16.8	15.8	dBW

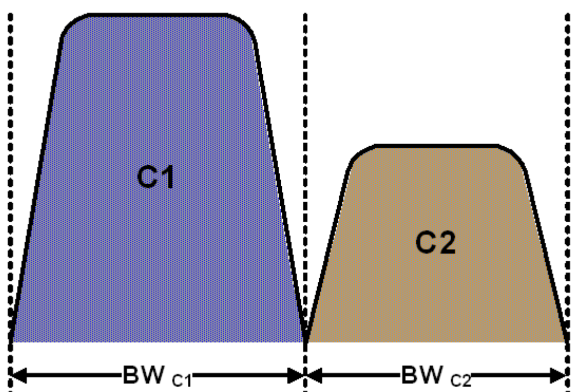
PSD Link 1
16.8 – 10 * Log (2.0479 * 1000000) = – 46.3 dBW/Hz

3.11.12.4 Estimating PSD Ratio from Satmaster



3.11.12.5 Estimating PSD Ratio Using Spectrum Analyzer

PSD Ratio or CnC Ratio can also be estimated using a Spectrum Analyzer capable of integrating the signal power in a given bandwidth.



CnC Ratio (in dB) = Power_{C1} (in dBm) – Power_{C2} (in dBm)

PSD Ratio (in dB) = (Power_{C1} – 10 log BW_{C1} (in Hz)) – (Power_{C2} – 10 log BW_{C2} (in Hz))

= CnC Ratio – 10 log (BW_{C1} / BW_{C2})

If the two carriers have same Symbol Rate / Bandwidth, then the CnC Ratio is same as the PSD Ratio.

3.11.13 DoubleTalk Carrier-in-Carrier Specifications

Operating Mode	Requires the two links to share a common carrier frequency (Outbound and Inbound symbol rates do not have to be equal)
Power Spectral Density Ratio and CnC Ratio	BSPK/QPSK/8-PSK/8-QAM: –7 dB to +11 dB (ratio of power spectral density, outbound interferer to desired inbound) 16-QAM: –7 dB to +7 dB (ratio of power spectral density, outbound interferer to desired inbound) Note: With asymmetric carriers the absolute power ratio (or CnC ratio) would be different, depending on the ratio of the symbol rates. Example: Outbound interferer = 1 Msymbols/sec Desired Inbound = 500 ksymbols/sec Ratio of power spectral density = +7 dB Absolute power ratio (CnC Ratio) = +7dB + (10 log Outbound/desired symbol rate) = +10 dB
Maximum Symbol Rate Ratio	3:1 (TX:RX or RX:TX)
Inbound/Outbound frequency uncertainty	Within the normal acquisition range of the demod, as follows: Below 32 ksymbols/sec: ±1 to ± (Rs/2) kHz, where Rs = symbol rate in ksymbols/sec Between 32 and 389 ksymbols/sec: ± 1up to a maximum of ± 32kHz Above 389 ksymbols/sec: ±1 to ± (0.1Rs) kHz, up to a maximum of ± 200 kHz
Delay range	0-330 ms
Eb/No Degradation (equal Inbound/Outbound power spectral density)	BPSK = 0.3dB QPSK = 0.3dB OQPSK = 0.3dB 8-PSK = 0.5dB 8-QAM = 0.4dB 16-QAM = 0.6dB For +10 dB power spectral density ratio (outbound interferer 10 dB higher than desired inbound) add an additional 0.3 dB
Monitor Functions	Delay, in milliseconds Frequency offset (between outbound interferer and desired inbound). 100 Hz resolution CnC ratio, in dB (ratio of absolute power, outbound interferer to desired inbound)

3.11.14 Carrier-in-Carrier Summary

Comtech EF Data's DoubleTalk Carrier-in-Carrier can provide significant savings in operational expenses. The following should be considered when evaluating DoubleTalk Carrier-in-Carrier:

- DoubleTalk Carrier-in-Carrier can only be used for full duplex links where the transmitting earth station is able to receive itself.
- DoubleTalk Carrier-in-Carrier can be used in both bandwidth limited and power limited situations.
- The maximum savings is generally achieved when the original link is symmetric in data rate.

3.11.15 Glossary

Allocated Bandwidth

Bandwidth or Allocated Bandwidth or Occupied Bandwidth is the frequency space required by a carrier on a transponder.

For example, a Duplex E1 (2.048 Mbps) Circuit with 8-PSK Modulation, FEC Rate 3/4 and 1.4 Spacing requires:

2.548 MHz = 2.048 / (3 * 0.75) * 1.4 * 2

For a 36 MHz transponder, 2.548 MHz corresponds to 7.078% Bandwidth Utilization.

Power Equivalent Bandwidth

Power Equivalent Bandwidth (PEB) is the transponder power used by a carrier, represented as bandwidth equivalent.

PEB Calculation Example:

- Transponder EIRP = 37 dBW
- Output Backoff (OBO) = 4 dB
- Available EIRP = 37 – 4 = 33 dBW = $10^{3.3}$ = 1955.26 Watts
- Transponder Bandwidth = 36 MHz
- Power Available / MHz = 1955.26 / 36 = 54.424 W
- If a carrier uses 24 dBW, its PEB = $10^{2.4}$ / 54.424

  = 4.532 MHz

This corresponds to 12.59% of available transponder power.

Leased bandwidth

Almost all satellite operators charge for the Leased Bandwidth (LBW). Leased Bandwidth or Leased Resource is the greater of the Allocated Bandwidth and Power Equivalent Bandwidth.

For example, if a carrier requires 3 MHz of Allocated BW and 4.5 MHz of PEB, the Leased Bandwidth is 4.5 MHz

Power Spectral Density (PSD)

Power Spectral Density (PSD) is the signal power per unit bandwidth: **dBW / Hz** *or* **dBm / Hz**

For example: Signal power = 20 dBm

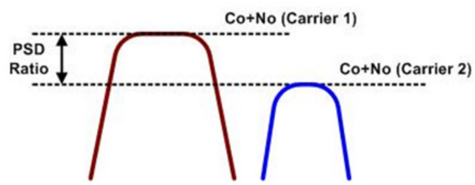
Signal bandwidth = 500 kHz

PSD = 20 – 10 *log (500 * 1000)

= -36.99 dBm / Hz

PSD Ratio

PSD ratio is the ratio of power spectral density of the interfering carrier and the desired carrier. If looking at the 2 carriers side-by-side on a spectrum analyzer:



Eb/No

Ratio of Energy per bit (Eb) to Noise density (No): Unit is dB

C/N

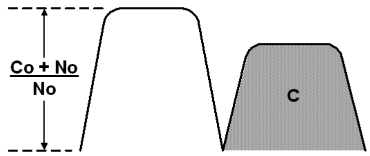
Carrier Power (C) to Noise (N) ratio: Unit is dB

C/No

Carrier Power (C) to Noise Density (N_o) ratio: Unit is dBHz

Co+No/No

Carrier Density (C_o) + Noise (N_o) to Noise Density (N_o) ratio: Unit is dB



$C/N = C/N_o - 10 \log B$ [*where B is bandwidth in Hz*]

$E_b/N_o = C/N_o - 10 \log R$ [*where R is data rate in bits/sec*]

$= C/N + 10 \log B - 10 \log R$

$= C/N - 10 \log (\text{Spectral Efficiency})$

$E_b/N_o = 10 \log (10^{((Co+No/No)/10)} - 1) - 10 \log (\text{Spectral Efficiency})$

[*Spectral Efficiency is in bps / Hz*]

3.12 TPC and Low Density Parity Check (LDPC) Coding

In the past few years there has been an unprecedented resurgence in interest in Forward Error Correction (FEC) technology. The start of this new interest has its origins in the work done by Claude Berrou *et al*, and the 1993 landmark paper, *Near Shannon Limit Error Correcting Coding and Decoding – Turbo Codes*. FEC is considered an essential component in all wireless and satellite communications in order to reduce the power and bandwidth requirements for reliable data transmission.

Claude Shannon, considered by many to be the father of modern communications theory, first established the concept of Channel Capacity in his 1948 paper *A Mathematical Theory of Communication*. This places an absolute limit on how fast it is possible to transmit error-free data within a channel of a given bandwidth, and with given noise conditions within that channel. He concluded that it would only be possible to approach this limit through the use of source encoding – what is familiar today as Forward Error Correction.

Shannon postulated that if it were possible to store every possible message in the receiver, finding the stored message that most closely matched the incoming message would yield an optimum decoding method. However, for all but the shortest bit sequences, the memory required for this, and the time taken to perform the comparisons, makes this approach impractical. For all practical purposes, the memory requirement and the decoding latency become infinite.

For many years, there were few advances in the quest to approach the Shannon Limit. The Viterbi algorithm heralded a major step forward, followed in the early 1990s by the concatenation of a Viterbi decoder with Reed-Solomon hard-decision block codes. It remained clear, however, that the Shannon Limit was still an elusive target.

Berrou's work on Turbo Codes showed, through the use of an ingeniously simple approach (multiple, or *iterative* decoding passes) that it is possible to achieve performance close to the Shannon Limit. Berrou's early work dealt exclusively with iteratively-decoded convolutional codes (Turbo Convolutional Coding, or TCC), but in time the iterative approach was applied to a particular class of block codes called Product Codes – hence Turbo Product Coding (TPC). TPC exhibits inherently low decoding latency compared with TCC, and so is considered much more desirable for 2-way, interactive satellite communications applications.

In August 1999, Comtech became the first company in the world to offer satellite modems that incorporate TPC. Since its inception, Comtech has continued to develop and refine its implementation of TPC in its products, and now offers a comprehensive range of code rates (from Rate 5/16 to Rate 0.95) and modulations (from BPSK to 16-QAM). However, in the past few years, as part of the general interest in Turbo coding, a third class of Turbo coding has emerged: Low Density Parity Check Codes (LDPC).

LDPC is more like TPC than TCC in that it is an iteratively-decoded block code. Gallager first suggested this in 1962 but, at the time, the implementation complexity was considered to be too great; for decades, it remained of purely academic interest. Further interest in LDPC was stimulated in 2003, when the Digital Video Broadcasting (DVB) committee adopted LDPC codes (proposed by Hughes Network Systems) as the basis for the new DVB-S2 standard. Now, however, with silicon gates being cheap, plentiful and fast, an LDPC decoder can easily be accommodated in a large Field Programmable Gate Array (FPGA) device.

The LDPC method on its own produces an undesirable ‘flaring’ in the Bit Error Rate (BER) *vs.* Eb/No characteristic, and for this reason it is desirable to concatenate a short BCH code with LDPC. This concatenation produces almost vertical BER *vs.* Eb/No curves, as can be seen in the performance graphs that are presented later. In order to take full advantage of the coding gain increase that LDPC provides, it became necessary to find an alternative to 8-PSK.
Comtech EF Data has therefore developed an 8-QAM approach that permits acquisition and tracking at much lower values of Eb/No than 8-PSK. Comtech’s implementation of 8-QAM is the subject of a U.S. Patent, granted in 2007.

Comtech EF Data chose the CDM-600 platform as the first satellite modem in which to implement both LDPC and 8-QAM, and the DMD2050E includes a newer technology version of the original design.

3.12.1 LDPC versus TPC

Is LDPC better than TPC? The answer must be ‘sometimes, but not always’, and there are issues such as latency that must be taken into consideration. Figure 3-15 graphs the performance of various TPC and LDPC modes relative to the Shannon Limit – the Channel Capacity is shown for both QPSK and 8-PSK. Error free transmission is not possible for values of spectral efficiency (capacity) *vs*. Eb/No above these limit curves. The horizontal distance to the limit provides a metric of overall performance.

It can be seen from this graph that, for Code Rates above 3/4, Comtech's TPCs are very close (1-1.5 dB) to the Shannon Limit. However, at 3/4 and below, LDPCs are performing 0.7-1.2 dB better than TPCs.

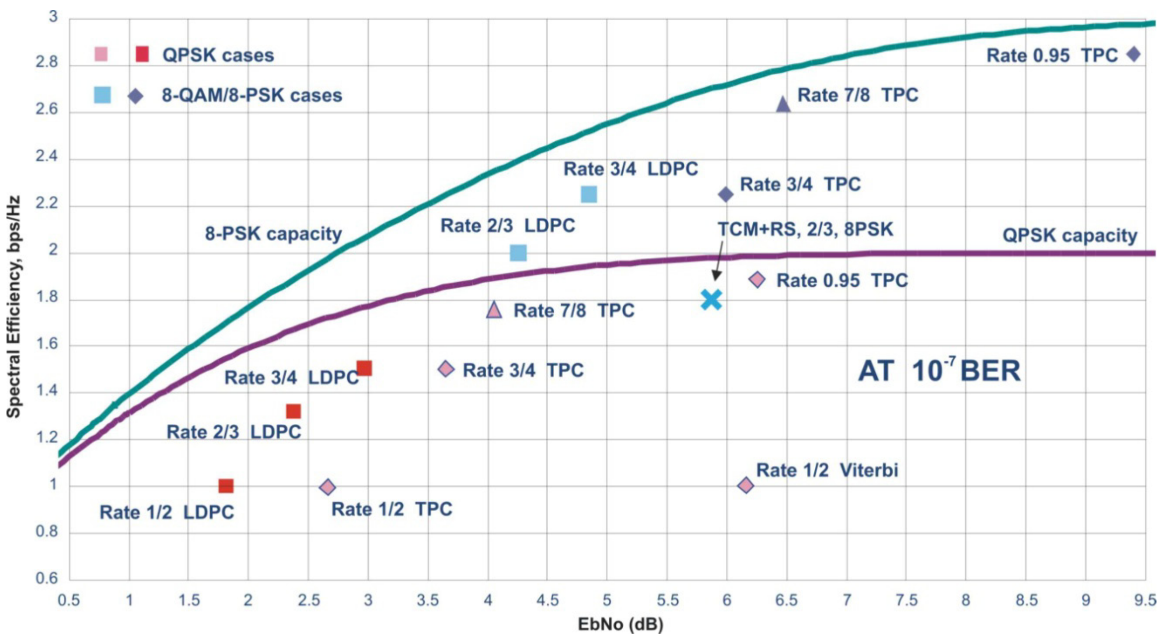


Figure 3-19. TPC & LDPC Modes Performance (Relative to Shannon Limit)

It is clear that, in order to provide the best possible performance over the range of code rates from 1/2 to 0.95, both an LDPC and a TPC codec need to be offered.

In order to meet this requirement, Comtech EF Data has developed a combination LDPC/TPC Codec module that can be added to the DMD2050E Modem. Table 3-2 outlines the operating modes provided by this module.

Table 3-2. Available TPC and LDPC Modes

Mode	Code Rate/Modulation	Lower Data Rate Limit (kbps)	Upper Data Rate Limit (kbps)
TPC	Rate 21/44 BPSK (aka 1/2)	18.0	5965.9
	Rate 5/16 BPSK	18.0	3906.2
	Rate 21/44 QPSK, OQPSK (aka 1/2)	18.0	11931.8
	Rate 3/4 QPSK, OQPSK	27.0	18750.0
	Rate 3/4 8-PSK , 8-QAM	40.0	25000.0
	Rate 3/4 16-QAM	54.0	25000.0
	Rate 7/8 QPSK, OQPSK	31.5	21875.0
	Rate 7/8 8-PSK , 8-QAM	48.0	25000.0

Mode	Code Rate/Modulation	Lower Data Rate Limit (kbps)	Upper Data Rate Limit (kbps)
	Rate 7/8 16-QAM	63.0	25000.0
	Rate 0.95 QPSK, OQPSK (aka 17/18)	34.2	23611.1
	Rate 0.95 8-PSK , 8-QAM (aka 17/18)	52.0	25000.0
LDPC	Rate 1/2 BPSK	18.0	6250.0
	Rate 1/2 QPSK, OQPSK	18.0	12500.0
	Rate 2/3 QPSK, OQPSK	24.0	16666.6
	Rate 2/3 8-PSK , 8-QAM	36.0	25000.0
	Rate 3/4 QPSK, OQPSK	27.0	18750.0
	Rate 3/4 8-PSK , 8-QAM	40.5	25000.0
	Rate 3/4 16-QAM	54.0	25000.0

This new LDPC/TPC codec module may be installed in any existing DMD2050E as a simple field upgrade, or can be pre-installed in new modems ordered from the factory. It also requires the appropriate FAST codes for enabling operation beyond the base data rate limit of 5 Mbps.

Please contact the Sales Department at Comtech EF Data for pricing and delivery information.

Table 3-3 compares all TPC and LDPC modes available in Comtech EF Data's DMD2050E, and shows Eb/No performance and spectral efficiency (occupied bandwidth) for each case. This information will be of particular interest to satellite operators wishing to simultaneously balance transponder power and bandwidth. The large number of modes offered will permit, in the majority of cases, significant power and/or bandwidth savings when compared with existing schemes such as concatenated Viterbi/Reed-Solomon, or the popular 8-PSK/Trellis/Reed-Solomon (Intelsat IESS-310).

Table 3-3. Comparison of all Comtech EF Data TPC and LDPC Modes
(DMD2050E with LDPC/TPC Codec)

Mode	Eb/No at BER = 10^{-6} (typical)	Eb/No at BER = 10^{-8} (typical)	Spectral Efficiency (bps per Hertz)	Symbol Rate	Occupied * Bandwidth for 1 Mbps Carrier
*QPSK Rate 1/2 Viterbi **	5.5 dB	6.8 dB	1.00 bps/Hz	1.0 x bit rate	1190 kHz
BPSK Rate 1/2 LDPC	1.7 dB	1.9 dB	0.50 bps/Hz	2.0 x bit rate	2380 kHz
BPSK Rate 21/44 TPC	2.8 dB	3.0 dB	0.48 bps/Hz	2.1 x bit rate	2493 kHz
BPSK Rate 5/16 TPC	2.4 dB	3.0 dB	0.31 bps/Hz	3.2 x bit rate	3808 kHz
QPSK/OQPSK Rate 1/2 LDPC	1.7 dB	1.9 dB	1.00 bps/Hz	1.0 x bit rate	1190 kHz
QPSK/OQPSK Rate 21/44 TPC	2.8 dB	3.3 dB	0.96 bps/Hz	1.05 x bit rate	1246 kHz
QPSK/OQPSK Rate 2/3 LDPC	2.1 dB	2.4 dB	1.33 bps/Hz	0.75 x bit rate	892 kHz
QPSK/OQPSK Rate 3/4 LDPC	2.7 dB	2.9 dB	1.50 bps/Hz	0.67 x bit rate	793 kHz
QPSK/OQPSK Rate 3/4 TPC	3.4 dB	4.0 dB	1.50 bps/Hz	0.67 x bit rate	793 kHz
QPSK/OQSK Rate 7/8 TPC	4.2 dB	4.3 dB	1.75 bps/Hz	0.57 x bit rate	678 kHz
QPSK/OQPSK Rate 0.95 TPC	6.0 dB	6.5 dB	1.90 bps/Hz	0.53 x bit rate	626 kHz
*8-PSK Rate 2/3 TCM ** and RS (IESS-310)*	5.6 dB	6.2 dB	1.82 bps/Hz	0.56 x bit rate	666 kHz
8-QAM Rate 2/3 LDPC	4.3 dB	4.6 dB	2.00 bps/Hz	0.50 x bit rate	595 kHz
8-QAM Rate 3/4 LDPC	4.7 dB	5.0 dB	2.25 bps/Hz	0.44 x bit rate	529 kHz
8-PSK/8-QAM Rate 3/4 TPC	6.1 dB	6.7 dB	2.25 bps/Hz	0.44 x bit rate	529 kHz
8-PSK/8-QAM Rate 7/8 TPC	6.7 dB	6.9 dB	2.62 bps/Hz	0.38 x bit rate	453 kHz
8-PSK/8-QAM Rate 0.95 TPC	9.2 dB	10.2 dB	2.85 bps/Hz	0.35 x bit rate	377 kHz
16-QAM Rate 3/4 LDPC	6.7 dB	6.8 dB	3.00 bps/Hz	0.33 x bit rate	396 kHz
16-QAM Rate 3/4 TPC	7.4 dB	8.1 dB	3.00 bps/Hz	0.33 x bit rate	396 kHz
16-QAM Rate 7/8 TPC	7.9 dB	8.1 dB	3.50 bps/Hz	0.28 x bit rate	340 kHz
*16-QAM Rate 3/4 ** Viterbi/Reed-Solomon*	7.5 dB	8.0 dB	2.73 bps/Hz	0.37 x bit rate	435 kHz
*16-QAM Rate 7/8 ** Viterbi/Reed-Solomon*	9.0 dB	9.5 dB	3.18 bps/Hz	0.31 x bit rate	374 kHz

* The occupied bandwidth is defined at the width of the transmitted spectrum taken at the –10 dB points on the plot of power spectral density. This equates to 1.19 x symbol rate for the DMD2050E transmit filtering.

** Included for comparative purposes

3.12.2 TPC and LDPC Summary

FOR	AGAINST
Exceptionally good BER performance – significant improvement compared with every other FEC method in use today.	Nothing!
Most modes have no pronounced threshold effect – fails gracefully.	
Exceptional bandwidth efficiency .	
Coding gain independent of data rate (in this implementation).	
Low decoding delay for TPC.	
Easy field upgrade in DMD2050E.	

3.13 Reed-Solomon Codec

Utilizing a Reed-Solomon (R-S) Outer Codec concatenated with a Convolutional Inner Codec is an effective way to produce very low error rates even for poor signal-to-noise ratios while requiring only a small increase in transmission bandwidth. Typically, concatenating an R-S Codec requires an increase in transmission bandwidth of only 9 – 12% while producing a greater than 2 dB improvement in E_b/N_o. R-S is a block Codec where K data bytes are fed into the encoder which adds 2t = (N – K) check bytes to produce an N byte R-S block. The R-S decoder can then correct up to “t” erred bytes in the block.

See also:

Figure 3-20. Reed-Solomon Encoder Functional Block Diagram

Figure 3-21. Reed-Solomon Decoder Functional Block Diagram

Table 3-1. Spectral Efficiency using DoubleTalk Carrier-in-Carrier

3.13.1 Reed-Solomon Operation in the DMD2050E

When the Reed-Solomon Codec is enabled, data is fed to the R-S Encoding Section of the DMD2050E where it is scrambled, formed into blocks, R-S encoded, and interleaved. Unique words are added so that the blocks can be reformed in the Receiving Modem (see Figure 3-20 and Figure 3-21). Data is then sent to the modulator where it is convolutionally encoded, modulated and transmitted to the satellite.

When the signal is received and demodulated by the Receiving Modem, it is fed to a Viterbi Decoder for the first layer of error correction. After error correction is performed by the Viterbi Decoder, the unique words are located and the data is deinterleaved and reformed into blocks. The R-S Decoder then corrects the leftover errors in each block. The data is then descrambled and output from the R-S Section.

3.13.2 Reed-Solomon Code Rate

The R-S Code Rate is defined by (N, K) where N is the total R-S block size in bytes - data + check bytes - and K is the number of data bytes input into the R-S Encoder. The transmission rate expansion required by the R-S Codec is then defined by N/K. The DMD2050E automatically sets the correct R-S code rate for IDR/IBS open network operation in accordance with the data shown in Table 3-4. In Closed Net Mode, the DMD2050E allows the following N and K setting: (126, 112), (219, 201), (194, 178), (225, 205).Variable Reed-Solomon rates are available on the optional AS/5167 Super Card. Refer to Appendix A for further information.

3.13.3 Interleaving

The DMD2050E allows for interleaving depths of 4 or 8 R-S Blocks. This allows burst errors to be spread over 4 or 8 R-S blocks in order to enhance the error correcting performance of the R-S Codec. For Intelsat Network Modes, the DMD2050E automatically sets the interleaving depth to 4 for QPSK or BPSK, or 8 for 8PSK. In Closed Network Mode, the interleaver depth can be manually set to 4 or 8, and in DVB Network Mode, the DMD2050E automatically sets the interleaver depth to 12.

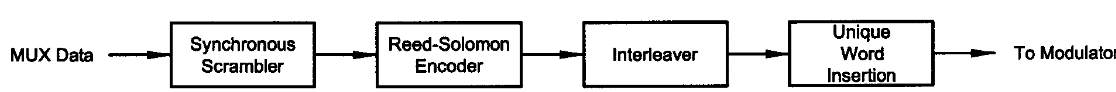


Figure 3-20. Reed-Solomon Encoder Functional Block Diagram

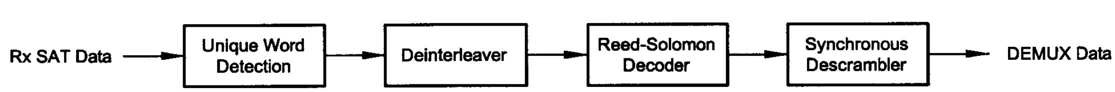


Figure 3-21. Reed-Solomon Decoder Functional Block Diagram

Table 3-4. Reed-Solomon Codes

Type of Service	Data Rate (Kbps)	R-S Code (n, k, t) [1]	Bandwidth Expansion [(n/k) -1]	Interleaving Depth	Maximum [2] R-S Codec Delay (ms)
Small IDR (With 16/15 O/H)	64	(126, 112, 7)	0.125	4	115
	128	(126, 112, 7)	0.125	4	58
	256	(126, 112, 7)	0.125	4	29
	384	(126, 112, 7)	0.125	4	19
	512	(126, 112, 7)	0.125	4	15
	768	(126, 112, 7)	0.125	4	10
	1024	(126, 112, 7)	0.125	4	8
	1536	(126, 112, 7)	0.125	4	5
IDR (With 96 Kbps O/H)	1544	(225, 205,10)	0.0976	4	9
	2048	(219, 201, 9)	0.0896	4	7
	6312	(194, 178, 8)	0.0899	4	2
	8448	(194, 178, 8)	0.0899	4	<2
8PSK	1544	(219, 201, 9)	0.0896	8	18
	2048	(219, 201, 9)	0.0896	8	13
	6312	(219, 201, 9)	0.0896	8	4
	8448	(219, 201, 9)	0.0896	8	3
DVB	All	(204, 188, 8)	0.0851	12	-

1. n = code length, k = information symbols and t = symbol error correcting capability.
2. Design objective.

3.14 DMD2050E Automatic Uplink Power Control (AUPC Operation)

Refer to Appendix G for additional information.

3.15 Asynchronous Overhead Operation (Async Port / ES-ES Communications)

This port is dedicated for ES-ES Communications supported by either RS232 or RS485 signal levels. The baud rate and protocol can be selected from the Front Panel. The port may be configured for a number of communications protocols. Overhead data to/from the UIM is routed to/from the framer/deframer. This port is also used by SCC Framing for the in-band data.

The Asynchronous Framing/Multiplexer is capable of multiplexing a relatively low-speed overhead channel onto the terrestrial data stream resulting in a slightly higher combined or aggregate data rate through the modem. The overhead channel is recovered at the far end. This added channel is termed variously “An Overhead Channel”, ”Service Channel”, “Async Channel” or in IESS terminology an “ES to ES Data Channel.” The basic frame structure used by the multiplexer is that specified in the IESS-309 Standard, resulting in a 16/15 Aggregate t0 through-Data Ratio.

For Regular Async: (Standard IBS), the Baud Rate is approximately 1/2000 of the Data Rate listed in Table 3-5.

For Enhanced Async: (IBS Async.), the Baud Rate is selectable, but Data Rate is limited.

The maximum Baud Rate is 19,200 bps for IBS Async. Two software-controlled modes are designed into the card to best utilize the available bits; “Standard IBS” and “IBS (Async)”. The characteristics of the Channel Interface is also determined by the standard or Async mode.

The Async Channel can be set under software-control to either RS-232 or RS-485 mode. The pin assignments for both modes are shown in Table 3-5. The “RS-485” Setting controls the output into tri-state when the modem is not transmitting data, allowing multiple modem outputs to be connected together.

Table 3-5. Baud Rate Examples

Kbps	Standard IBS Baud Rate Example	Kbps	Enhanced Mode Baud Rate Example
128	64	9.6	300
256	128	19.2	600
384	192	32	600
512	256	64	1200
640	320	128	2400
768	384	192	4800
896	448	256	4800
1024	512	320	9600
1152	576	384	9600
1280	640	448	9600
1408	704	512	9600
1536	768	576	9600
1664	832	640	19200
1792	896	704	19200
1920	960	768	19200
1920	960	768	19200
2048	1024	832	19200

Kbps	Standard IBS Baud Rate Example	Kbps	Enhanced Mode Baud Rate Example
		896	19200
		960	19200
		1024	19200
		1088	19200
		1152	19200
		1216	19200
		1280	19200
		1344	19200
		1408	19200
		1472	19200
		1536	19200
		1600	19200
		1664	19200
		1728	19200
		1792	19200
		1856	19200
		1920	19200
		1984	19200
		2048	19200

3.16 Standard IBS Mode

In the first or “Normal” mode, all bit assignments are per the IBS standard. The bits of Overhead Housekeeping byte 32 are implemented as shown in Table 3-6.

Table 3-6. Bits of Overhead Housekeeping Byte 32

Bit 1	ES to ES Data Channel	This bit is routed directly to the ES to ES Data Channel. Its data rate is 1/512th of the aggregate rate (or 1/480th of the through terrestrial data rate), and is normally used to super-sample an asynchronous data channel.
Bit 2	Frame Alignment	Part of the Frame Alignment word.
Bit 3	Backward Alarm	Transmit and Receive with main processor to activate Main Alarm/LED.
Bit 4	Multiframe Message	As per IBS.
Bits 5 and 6	Spare	Not currently utilized.
Bits 7 and 8	Encryption Utilization	Not currently utilized.

The ratio of the Through Terrestrial Data Channel Rate to the aggregate rate is 15/16. The standard transmit and receive channels of the ES to ES Data Channel in Standard IBS Mode are raw channels operating at the specific bit rate as controlled by the data channel rate, without buffering. In addition, no clocks are provided with this channel. Since it would be rare that the data rate provided was exactly that required for a standard rate device, the only method of communicating using this channel is to allow it to super-sample the user data.

3.17 Asynchronous Multiplexer Mode

Since many of the frame bits in the standard IBS mode are not used, an “Enhanced” Multiplexer Mode has been implemented that can be engaged under software control. Since this mode changes the use of many of the framed non-data bits, this mode is only usable when the DMD2050E is at both ends of a link. In this mode, the overhead signaling bytes 16 and 48 can be used to implement a significantly higher speed ES to ES Data Channel under software control. When implemented, this rate is 16 times that of the normal IBS standard, or 1/30th of the terrestrial data rate (1/32nd of the aggregate rate).

NOTE
For true asynchronous channel operation, select the **IBS Async** mode.

3.18 ESC Backward Alarms

When running in IDR Mode and if the modem has the ESC Option, there will be four Backward Alarms available for use by the earth stations at each end of the link (both ends must have the ESC option). These alarms are accessed via the ESC ALARMS Port. The four alarms are controlled by four relays, each having a normally open, normally closed, and a common connection. The common connections of these relays (referred to as Backward Alarm Inputs) can be connected to whichever system on the earth station that the user wishes to trigger the backward alarm. When ground is applied to the Common (Input) Connection of one of these relays, that relay and associated backward alarm will then be in a “no fault” state. When the ground is removed, the relay and the associated Tx Backward Alarm will toggle to the faulted state. When in the faulted state, the receive end of the link will receive that backward alarm that is initiated at the transmit end of the link.

The user can connect whichever systems on the earth stations that they desire to these Backward Alarms Relays as long as they will supply ground to the Backward Alarm Relay Input in the “no fault” condition and the ground will be removed in the “faulted” condition.

For example: the user could connect the Demod Summary Fault of the modem to the Backward Alarm 1 Input, so that if the demod went into Major Alarm (such as a Carrier Loss), Backward Alarm 1 would be transmitted to the receive end of the link. At the receive end, it would show up as Rx Backward 1 (Receive Backward Alarm 1).

3.18.1 To Disable the ESC Backward Alarms

If the ESC ALARMS Port will not be used and the Backward Alarm Indications are to be disabled, you will need to connect pins 19, 11, 22 and 23 to pin 1 (Gnd).

3.19 Satellite Control Channel (SCC)

The SCC format uses a variable overhead rate to transmit an asynchronous data channel in addition to the normal data channel. The SCC asynchronous mode implemented on the DMD2050E is "PassThru" Mode.

In Pass Thru Mode, there is no formatting or deformatting of the input data in the buffer, and it is transmitted on a first-in first-out basis. In band data entering the remote port is inserted into the user data stream. The in-band data is received and passed on to the user without any deformatting or depacketizing involved. The maximum in band rate supported is 115200bps.

The Asynchronous Data Interface (J17) is a 9-Pin Female “D” Connector. The data interface is either RS232 or RS485 via a front panel selection.

See also:

Chapter 5. External Connections

3.19.1 SCC Framing Structure

Each SCC frame consists of the following:

- A 10-bit synchronization pattern called the Synchronizing Word.
- Multiple variable length slots filled with user data.
- Multiple 10-bit control words that contains eight bits of in-band data (the extra two bits are for the async start/stop).

The number of user data slots and control words per frame is selected by the SCC Control Ratio Parameter. This can be any value from 1 to 1 through 1 to 7. A higher ratio allows a lower overhead rate but since there are less Sync Words, there is a higher acquisition time.

The following examples show a control ratio of 1 to 3 and 1 to 1. Example 1 shows three Control Words for every Synchronizing Word, and Example 2 shows one Control Word for every Synchronizing Word.

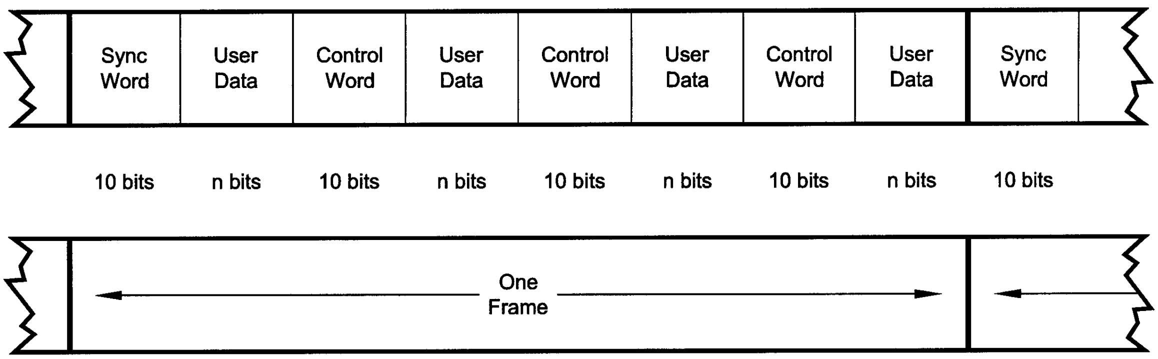


Figure 3-22. 1 to 3 Control Ratio

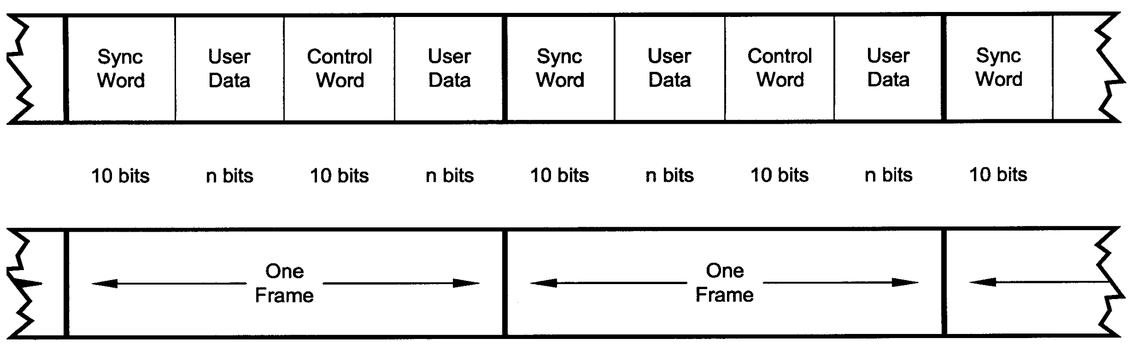


Figure 3-23. 1 to 1 Control Ratio

The Control Ratio of the receiving units must match the Control Ratio of the transmitting unit.

3.19.2 Aggregate Data Rate

The aggregate data rate equals the following:

User Data Rate + In-Band Rate + Synchronizing Overhead Rate

Because SCC must adjust the overhead so that there are an equal number of user data bits in each slot, the synchronizing overhead cannot be easily calculated. However, dividing the In-Band Rate by the Control Ratio can approximate it. The following equation shows the basic calculation of this rate:

Aggregate Date Rate = User Data Rate + In-Band Rate + (In-Band Rate/Control Ratio)

As an example, given the following parameters:

User Data Rate:	1,024,000 bps
In-Band Rate:	19,200 bps
Control Ratio:	1 to 7

Aggregate data rate = 1,024,000 + 19,200 + (19,200/7) or approximately 1,045,942 (actually 1045974).

This gives an overhead ratio of 1,045,974/1,024,000 = 1.021

In addition, another constraint changes the actual Aggregate Data Rate. The user data slot size is limited to 2,500 bits. Because of this, the modem increases the in-band rate to reduce the user data slot size. This only happens at higher user data rates.

IMPORTANT

The maximum **In-Band Rate** is 115200. The **Async Interface Rate** must be equal to or greater than 115200.

3.19.3 Overhead Rate Comparison

The SCC Overhead Ratio varies depending on the User Data Rate, the In-Band Rate, and the Control Ratio. This gives SCC the advantage of lower overhead rates when compared to IBS, which has a fixed overhead ratio of 16/15 or 1.067. The following table gives some example overhead rates for different user data and control ratios.

User Data Rate	In-Band Rate	Control Ratio	Aggregate Data Rate	Overhead Ratio
512,000	19,200	1/7	533,974	1.043
1,024,000	19,200	1/7	1,045,974	1.021
2,048,000	19,200	1/7	2,069,951	1.011
3,072,000	19,200	1/7	3,093,943	1.007
4,096,000	19,200	1/7	4,117,951	1.005
6,312,000	19,200	1/7	6,337,248	1.004
6,312,000	19,200	1/3	6,337,606	1.004
6,312,000	19,200	1/1	6,350,418	1.006

3.19.4 Actual Overhead Rate Calculation

The following is the actual calculation the modem does to calculate the overhead ratio:

1. The modem calculates the minimum in-band rate to limit the size of the user data slots to 2,500 bits (the result is truncated to an integer).

   *Minimum In-Band = (User Data Rate * Control Ratio)/((Control Ratio + 1) * 250)*

2. Using the bigger of Minimum In-Band or the selected In-Band, the modem calculates the number of bits for each user data slot (result is truncated to an integer).

*Slot Bits = (User Data Rate * (Control Ratio * 10))/(In-band Rate * (Control Ratio + 1))*

The actual ratio the modem uses is:

Actual Ratio = (Slot Bits + 10)/Slot Bits

Example 1:

User Data Rate: 1,024,000 bps

In-Band Rate: 19,200 bps

Control Ratio: 1 to 7

Minimum In-Band = (1,024,000 * 7)/((7 + 1) * 250) = 3,584 *(less than In-Band Rate)*

Slot Bits = (1,024,000 * (7 * 10))/(19,200 * (7 + 1)) = 466

Actual Ratio = (466 + 10)/466 = 1.021

Example 2:

User Data Rate: 6,312,000 bps

In-Band Rate: 19,200 bps

Control Ratio: 1 to 7

Minimum In-Band = (6,312,000 * 7)/((7 + 1) * 250) = 22,092 (*more than In-Band Rate)*

Slot Bits = (6,312,000 * (7 * 10))/(22,092 * (7 + 1)) = 2,500

Actual Ratio = (2,500+ 10)/2,500= 1.004

3.20 SCC OVERHEAD CHANNEL SETUP

1. Set the Framing Mode (located under Mod and Demod Data Menus) to SCC. After doing this, two new menus will appear to the right of the Framing Menu, for both the Mod and Demod. The new menus will be:

   SCC CTL RATIO

   SCC INBAND RATE

2. Set the desired SCC control ratio:

   SCC CTL RATIO {1/1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7}

   This allows the user to simulate the framing used by the Satellite Control Channel Option (Pass-Thru Mode only). The SCC CTL RATIO is the ratio of overhead in-band data to synchronizing words.

3. Set the desired SCC in-band rate:

   SCC INBAND RATE {300 to 115200}

   This allows the user to request the rate of in-band data for the overhead channel. This sets the overhead amount only. The actual amount of data that can be passed through the overhead channel will be set under “ES Baud Rate” (see Step 6 below).

4. Under the Interface > General menus, locate the TX ASYNC MODE (menu).

5. Under the TX ASYNC MODE Menu, set the desired ES Interface type:

   ES INTERFACE {RS-232, RS-485}

   This allows the user to select the interface type.

6. Under TX ASYNC MODE Menu, set the desired baud rate for the ASYNC Port (J17). This will be the baud rate that will pass through the overhead channel:

   ES BAUD RATE {150 - 115200}

   This allows the user to select the baud rate of the ASYNC port (J17) in SCC Mode.

7. Under TX ASYNC MODE Menu, set the desired ES BITS/CHAR:

   ES BITS/CHAR {7,8}

   This allows the user to choose between 7 or 8 bits of data.

8. Repeat Steps 4 through 7 under the RX ASYNC MODE (menu)

9. The physical connection to the DMD2050E for the overhead channel will be the DB-9 Female Port labeled ASYNC (J17).

SCC Overhead Chart Examples (Viterbi 3/4 w/V.35 Scrambler)			
Modem Data Rate Kbps	SCC Control Channel Rate	In-Band Overhead Rate Setting	Symbol Rate
9.6	1/1	300	6800
9.6	1/2	300	6700
9.6	1/3	300	6667
9.6	1/4	300	6650
9.6	1/5	300	6641
9.6	1/6	300	6634
9.6	1/7	300	6629
9.6	1/1	9600	19200
9.6	1/2	9600	17067
9.6	1/3	9600	15543
9.6	1/4	9600	14400
9.6	1/5	9600	14400
9.6	1/6	9600	14400
9.6	1/7	9600	14400
512	1/1	9600	354165
512	1/2	9600	350948
512	1/3	9600	349867
512	1/4	9600	349346
512	1/5	9600	349201
512	1/6	9600	348802
512	1/7	9600	348658

3.21 Locating the DMD2050E ID Code Operational Procedure

Unique ID codes let you add feature upgrades to the unit. You do not have to return the unit to the factory.

After you purchase new features, Comtech EF Data gives you a new ID code. Enter the new ID code into the unit to activate the new features.

Find the unique ID Code:

1. Make sure that the unit is on.
2. Use the Arrow Keys (◄ ► ▲ ▼)on the front panel to go to the System Menu. This is the top-level menu.
3. Press the Down Arrow ▼ once, then press the Left Arrow ◄ once to go to the HW/FW Config Screen.
4. Press the Down Arrow ▼ once, then press the Left Arrow ◄ once to go to the Features Screen.
5. Press the Down Arrow ▼ once.
   A two-row screen appears . The top row is the unique ID number for the unit. It is a 12-digit code (3 sets of 4 digits). Write down the unique ID number for your Comtech EF Data sales representative.

```
####.####.####
----.----.----
```

   The second row shows three groups of dashes (----.----.----). The dashes show where to enter the new ID code given to you by Comtech EF Data.
6. Use the number keys on the front panel to enter the new ID code from Comtech EF Data and press **ENTER**.
   If the new ID code is accepted (within three attempts), the screen shows “Upgrade Mgr: Entry Accepted” and the new features are unlocked. After the new features are unlocked, dashes (----.----.----) replace the new ID code on the screen.

If the new ID code is not accepted, the display shows “Further Attempts Require a Reboot”. You must stop and start the power before you can try again.

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Chapter 4. User Interfaces

4.1 User Interfaces

The DMD2050E has three interfaces available for typical operations:

- Front Panel
- Remote Port
- Terminal

4.2 Front Panel Interface

Figure 4-1 shows the front panel. Table 4-1 describes each of the functional areas:

- Vacuum Fluorescent Display (VFD)
- Arrow Keys
- Numeric Keys
- LED Lights

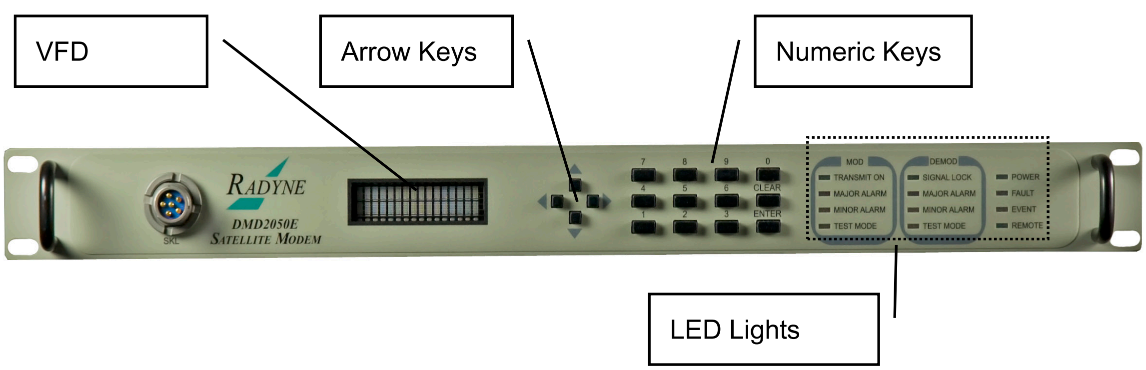

Figure 4-1. Front Panel

Table 4-1. Front Panel Functions

Area	Function
VFD	Shows operating parameters and configuration data
Arrow Keys	Controls the up, down, right and left cursor position on the display
Numeric Keys	Allows entry of data
LED Lights	Shows the status of the unit, see section 4.2.4.

4.2.1 VFD - Vacuum Fluorescent Display

The VFD is a 2-line by 16-character vacuum fluorescent display. The light dims automatically after the VFD has been inactive for some time.

The VFD shows different data in two areas. The upper area shows the parameter that is being monitored, such as Frequency or Data Rate. The lower area shows the value of the monitored parameter.

4.2.2 Arrow Keys

Use the arrow keys (◀ ▲ ▼ ▶), to

- Move through menus and parameters
- Move the cursor on the display
- Increase or decrease values
- Change parameters

4.2.3 Numeric Keys

Use the Numeric, Clear and Enter keys to enter data into the unit.

Table 4-2. Front Panel Key Functions

Parameter Type	0 – 9	▲	▼	◀	▶	Clear & ◀	Clear & ▶
Fixed Point Decimal	Change Digit	Change ± (If Signed)	Change ± (If Signed)	Move left	Move right	N/A	N/A
Unsigned Hexadecimal	Change Digit	Increase Digit	Decrease Digit	Move left	Move right	N/A	N/A
Enumerated	N/A	Last Value	Next Value	N/A	N/A	N/A	N/A
Date/ Time	Change Digit	N/A	N/A	Move left	Move right	N/A	N/A

Parameter Type	0 – 9	▲	▼	◀	▶	Clear & ◀	Clear & ▶
IP Address	Change Digit	Increase Digit	Decrease Digit	Move left	Move right	N/A	N/A
Text Strings	Change Character	Increase Character	Decrease Character	Move left	Move right	Clears left of cursor inclusive	Clears right of cursor inclusive

4.2.4 LED Lights

LED lights on the front panel show the status of the unit. The colors of the LEDs have these meanings:

- Green = normal operating condition
- Yellow = incorrect operating condition
- Red = fault condition that causes lost communications

Table 4-3. Front Panel LED Lights

LED	Color	Function
Modem LED Lights		
Power	Green	The unit is on.
Fault	Red	A hardware fault exists in the unit.
Event	Yellow	The unit has an event stored in memory. Use the front panel or the terminal mode to examine stored events.
Remote	Green	The unit is in the process of updating firmware with FTP.
Modulator LED lights		
Transmit On	Green	The transmitter is on.
Major Alarm	Red	The transmit direction has failed and the transmitter is disabled.
Minor Alarm	Yellow	A transmit warning condition exists.
Test Mode	Yellow	The transmitter is active in Test Mode.
Demodulator LED lights		
Signal Lock	Green	The receiver is locked to an incoming carrier and data, including FEC Sync.
Major Alarm	Red	The receive direction has failed and traffic is lost.
Minor Alarm	Yellow	A receive warning condition exists.
Test Mode	Yellow	The receiver is active in Test Mode.

4.3 Parameter Setup

4.3.1 Select a Parameter

Use the arrow keys to move through the menus. To select a parameter, press ENTER. The first space of the parameter flashes to show it is selected.

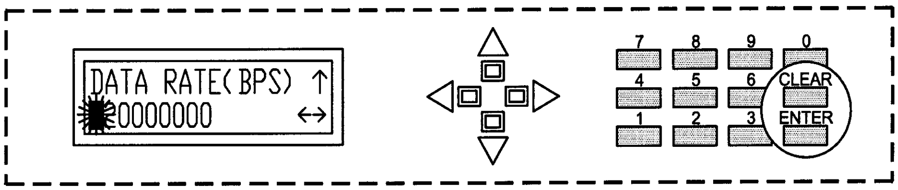

Figure 4-2. Enter New Parameters

4.3.2 Enter and Save a New Parameter

Use the numeric keys to enter new data into the parameter.

Press ENTER to save the new data.

4.3.3 Change a New Parameter Before Saving

To make changes before you press ENTER, press CLEAR. After you press CLEAR, the display shows the original parameter without any changes. Press ENTER, then enter the new data, and press ENTER once again to save the new data.

4.4 Front Panel Main Menus

The Front Panel control screens are organized into several Main Menus.

- Modulator
- Demodulator
- Interface
- Monitor
- Alarms
- System
- Test

Main menus have parameters and submenus. Arrows on the VFD show which arrow keys to use to move through the parameters and submenus.

4.4.1 MODULATOR Main Menu and Parameters

4.4.1.1 NETWORK SPEC (menu)

The NETWORK SPEC command activates a group of preset parameters. These preset parameters help reduce keystrokes and potential compatibility problems.

NETWORK SPEC	{MIL 188-165A, EBEM, IDR, IBS, DROP & INSERT, CLOSED NET, DVB}

NETWORK SPECS and data rates must be compatible. If you set data rates first, the system allows only the applicable NETWORK SPEC. If you set the NETWORK SPEC first, the system allows only the applicable data rates.

The following parameters are set for each NETWORK SPEC. You cannot change these parameters while the unit is operating in the selected NETWORK SPEC mode:

NETWORK SPEC	DATA RATES	FRAMING	SCRAMBLER	SPECTRUM
MIL-STD 188-165A (MILSTD-188-165A)	9.6 K – 51.848 Mbps	None	OM73	MIL 188 165[a]
EBEM (EBEM)	64 K – 51.848 Mbps	EBEM	EBEM	MIL 188 165[a]
IDR (IESS-308)	1.544, 2.048, 6.312, 8.448 Mbps	96 Kbps (IDR)	V.35	Intelsat
	< 1.544	1/15 (IBS)	IESS-309	Intelsat
IBS (IESS-309)	≤ 2048	1/15 (IBS)	IESS-309	Intelsat
DROP & INSERT	n x 64 n = 1, 2, 3, 4, 5, 6, 8, 10,12, 15, 16, 20, 24, 30	1/15 (IBS)	IESS-309	Intelsat
DVB EN301-201 and EN300-421	All Rates	DVB	DVB	DVB 0.25, 0.35
Closed Net	All possible combinations are allowed. NOTE: DVB settings require the DVB NETWORK SPEC and EBEM settings require the EBEM NETWORK SPEC.			

4.4.1.2 STRAP CODE

The STRAP CODE is another means for quickly setting several parameters at one time. STRAP CODE parameters include:

- Data Rate
- Inner Code Rate
- Satellite Framing
- Scrambler
- Drop and Insert
- Outer Code Rate (Reed-Solomon)
- Modulation
- Network Spec

See Appendix I, Strap Codes for more data.

4.4.1.3 IF (menu)

IF MENU		
FREQUENCY (MHz)	{50 – 90 MHz, 100 – 180 MHz, or 950 - 2050 MHz}	Enter the Modulator IF Output Frequency of the modem in 1 Hz increments.
POWER (dBm)	{0 to -45 dBm}	Enter the Transmitter Power Level.
CARRIER	{ON, OFF, AUTO, VSAT, RTS}	Select the carrier type.
SPECTRUM	{NORMAL, INVERTED}	Invert the direction of rotation for PSK Modulation. Normal meets the IESS Specification.
MODULATION	{BPSK, QPSK, OQPSK, 8PSK, 8QAM, 16APSK, 16QAM}	Select the modulation type.
SPECTRAL MASK	{MIL-188-165A, INTELSAT 0.35, DVB SAT 0.35, DVB SAT 0.25}	Set the spectral shape of Tx Data Filter.
COMPENSATION	{0 to 1 dB}	Set the offset on the transmit output power (allows for some specific cable loss up to 1dB).

4.4.1.4 DATA (menu)

DATA MENU		
DATA RATE (bps)	See Chapter 7 Technical Specifications	Set the Data Rate in bps steps via the Front Panel Arrows or Keypad.
SYMB RATE (sps)		View the Symbol Rate. Set the symbol rate (ITA Mode ONLY)
INNER FEC	Viterbi	{1/2, 3/4, 7/8, None}
	Optional FEC Rates:	
	Sequential	{1/2, 3/4, 7/8}
	CSC	{3/4}

DATA MENU		
	Trellis (8PSK)	{2/3}
	TPC (BPSK)	{5/16, 21/44} ≤ 20Mbps
	TPC (OQPSK/QPSK)	{1/2, 3/4, 7/8} ≤ 20Mbps
	TPC (8PSK/8QAM)	{3/4, 7/8}
	TPC (16QAM)	{3/4, 7/8}
	DVB VIT	{2/3, 5/6}
	DVB Trellis	{3/4, 5/6, 7/8, 8/9}
	LDPC (B/O/QPSK)	{1/2, 2/3, 3/4}
	LDPC (8PSK/8QAM)	{2/3, 3/4}
	LDPC (16QAM)	{3/4}
	Turbo (B/Q/8/16APSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
IFEC INTERLEAVER	{DISABLE, ENABLE}	Disable or enable the IFEC Interleaver.
DIFF CODING	{ENABLED, DISABLE}	Enable or disable the Differential Encoder. Having the encoder enabled ensures proper phase lock. May not be adjustable in some modes.
SCRAMBLER SEL	{NONE, V.35-IESS, V.35 CITT, V.35 EF, IBS w/Optional Framing and optional Reed-Solomon, Reed-Solomon Scrambler w/Optional Framing, CCITT, V.35FC, OM-73, V.35EF_RS, TPC SCRAMBLER (Turbo Codec), DVB, EDMAC, EBEM}	Select the scrambler type.
SCRAMBLER CTRL	{ENABLED, DISABLE}	Enable or disable scrambler operation.
SAT FRAMING	{1/15 (IBS), 1/15 (Async), 96 Kbps (IDR), DVB, EDMAC, EFAUPC, SCC, NONE, EFFICIENT D&I, EBEM, None}	Select the framing type.
IN-BAND RATE	{150, 300, 600, 1200, 2400, 4800, 9600 19200}	ED&I Only Available when enhanced async is enabled, sets the Earth Station to Earth station in-band rate. In most cases, this should be set to the same rate or higher than the ES port baud rate. When this rate is set lower than the ES port baud rate, make sure that the actual transmission rate does not exceed the in-band rate, otherwise, characters will be dropped.

DATA MENU		
TERR FRAMING	{NONE, 188, 204}	DVB Only
DATA POLARITY	{INV. TERR & BASE, INV. BASEBAND, INV.TERR DATA, NONE}	Invert the Tx Data polarity.
BPSK SYMBOL PAIR	{NORMAL, SWAPPED}	BPSK Mode Only Swap the I & Q Channels.
ESC OVERHEAD	{VOICE X2, DATA 64KBPS}	IDR ESC Channel is used for Voice or 64 K data channel.

4.4.1.4.1 EBEM NETWORK SPEC Parameters

IMPORTANT When EBEM Network is selected, these parameters are available:		
OVERHEAD CHAN	{OFF, 8K,16K, 24K, 32K, 40K,48K, 56K, 64K}	Select the overhead channel bandwidth.
EMBEDDED CHAN	{ENABLE, DISABLE}	Enable or disable the embedded overhead channel.
ENCRYPTION	{ENABLE, DISABLE}	Enable or disable encryption mode
ETH RATE	{XXXXXXXXX}	Select Ethernet rate.

4.4.1.4.2 SCC FRAMING Parameters

IMPORTANT When SCC Framing is selected, these parameters are available.		
SCC CTL RATIO	{1/1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7}	Simulate the framing used by the Satellite Control Channel Option (Pass Thru Mode only). The SCC CTL RATIO is the ratio of overhead in-band data to synchronizing words.
SCC INBAND RATE	{300 to 115200} when using SCC Framing	Request the rate of in-band data for the overhead channel.

4.4.1.5 REED-SOLOMON (menu)

IMPORTANT When Reed-Solomon is selected, these parameters are available.		
ENABLE/DISABLE	{ENABLED, DISABLE}	Enable or disable the Reed-Solomon Encoder.
RS RATE	{Refer to Table 3-1 for valid n/k values}	Displays the currently used n, k Reed-Solomon Codes. In Closed Net Mode, you can select custom R-S Codes.
INTERLVR DEPTH	{4, 8, 12}	Select the Reed-Solomon interleaver depth. In Closed Net Mode, you can select a depth of 4 or 8.

4.4.1.6 AUPC (menu)

IMPORTANT

AUPC Menus are available only when these conditions are true:

- The modulator is in Closed Net Network Spec
- Framing is set to EFAUPC or IBS 1/15
- Or the modulator is in EBEM mode and ITA is not enabled

4.4.1.7 LOCAL AUPC (menu)

NOTE

When modems are configured for Radyne AUPC, the remote Eb/No is displayed in the Monitor Menus.

LOCAL AUPC MENU		
AUPC MODE	{DISABLED, NEAR SIDE, RADYNE, EFDATA}	**DISABLED**: Enable or disable the Local AUPC Function of the local modem. **EBEM:** Enables EBEM Local AUPC Function. In the event the remote demodulator losses lock, the local output power level will adjust itself to the nominal level. This nominal power should be set to a level high enough to re-establish communications regardless of rain fade. **EFDATA**: Enables EFDATA Local AUPC Function. In the event that the remote or local demodulator losses lock, the output power level will adjust itself to the level settings indicated in the 'REMOTE CL ACTION' Menu or the 'LOCAL CL ACTION'. **RADYNE:** Enables Radyne Local AUPC Function. In the event the remote demodulator losses lock, the local output power level will adjust itself to the nominal level. This nominal power should be set to a level high enough to re-establish communications regardless of rain fade. **NEAR SIDE:** Enables NEARSIDE Local AUPC function. In the event the local demodulator losses lock due to signal loss, the output power level will adjust itself to the nominal level. This nominal power should be set to a level high enough to re-establish communications regardless of rain fade.
NOMINAL TX POWER	{0 TO -45 dB}	Set the nominal Transmit Power. The nominal transmit power is the default output power level.

LOCAL AUPC MENU		
MINIMUM TX POWER	**{0 to -45 dB}**	Set the minimum Transmit Power. **EBEM:** When configured for EBEM AUPC, the minimum Transmit Power is the lowest power setting that will be used when the remote modem commands a decrease of the Transmit Power from the Local modem. **EFDATA AUPC:** When configured for EFDATA AUPC the minimum Transmit Power is the lowest power setting that will be used when the local modem commands a decrease of the Transmit Power from the Remote modem. **RADYNE:** When configured for Radyne AUPC, the minimum Transmit Power is the lowest power setting that will be used when the remote modem commands a decrease of the Transmit Power from the Local modem. **NEARSIDE:** When configured for NEARSIDE AUPC the minimum Transmit Power is the lowest power setting that will be used by the local modem when the Eb/No increases above the Eb/No target.
MAXIMUM TX POWER	**{0 to -45 dB}**	Set the maximum Transmit Power. **EBEM:** When configured for EBEM AUPC, the maximum Transmit Power is the highest power setting that will be used when the remote modem commands an increase of the Transmit Power from the Local modem **EF AUPC:** When configured for EF AUPC, the maximum Transmit Power is the highest power setting that the local modem will use when the local modem commands an increase in Transmit power from the Remote modem. **RADYNE:** When configured for Radyne AUPC, the maximum Transmit Power is the highest power setting that will be used when the remote modem commands an increase of the Transmit Power from the Local modem **NEARSIDE:** When configured for NEARSIDE AUPC the maximum Transmit Power is the highest power setting that will be used by the local modem when the Eb/No decreases below the Eb/No target.

LOCAL AUPC MENU		
TARGET Eb/No	**{4.0 to 16 dB}**	Set the desired E_b/N_o for the local receiver. **RADYNE AUPC:** When configured for Radyne AUPC, this setting is compared against the remote E_b/N_o and commands to the local modem to increase or decrease the local transmit power. **EF AUPC:** When configured for EF AUPC, this setting is compared against the local received E_b/N_o and commands to the remote modem to increase or decrease transmit power. **NEARSIDE:** When configured for NEARSIDE AUPC, this setting is compared against the received E_b/N_o of the local modem and commands to the local modem to increase or decrease transmit power.
TARGET Es/No	**{1.0 to 25 dB}**	Set the desired E_s/N_o for the local receiver. **EBEM AUPC:** When configured for EBEM AUPC, this setting is compared against the remote E_s/N_o and commands to the local modem to increase or decrease the local transmit power.
TRACKING RATE	**{0.5 to 6.0}**	Set the rate at which the commands to increase or decrease Transmit Power are sent. Each command will result in a 0.5 dB increase or decrease in Transmit Power from the remote transmitter. The tracking rate is adjustable from 0.5 dB per minute to 6.0 dB per minute in 0.5 dB steps. **(Only available when EFAUPC is selected as the framing)**
LOCAL CL ACTION	**{HOLD, NOMINAL, MAXIMUM}**	Set the Remote Transmit Power Setting to be used when the local modem receiver loses lock. The setting can be 'HOLD' (no action taken), 'NOMINAL' (the nominal Transmit Power Setting is used), and 'MAXIMUM' (the maximum Transmit Power Setting is used). **(Only available when EFAUPC is selected as the framing)**
REMOTE CL ACTION	**{HOLD, NOMINAL, MAXIMUM}**	Set the Local Transmit Power Setting to be used when the remote modem receiver loses lock. The setting can be 'HOLD' (no action taken), 'NOMINAL' (the nominal Transmit Power Setting is used), and 'MAXIMUM' (the maximum Transmit Power Setting is used).

4.4.1.8 REMOTE AUPC (menu)

NOTE

Remote AUPC Menus are available only when the modem is configured for EF AUPC.

REMOTE AUPC MENU		
AUPC MODE	{DISABLE,NEAR SIDE, EFDATA}	Enable or disable the AUPC Function of the remote modem. The remote AUPC Function is the response of the local modem to commands for an increase or decrease of the Transmit Power in 0.5 dB steps and the command to change to the setting indicated in the 'REMOTE CL ACTION' Menu of the remote modem upon receiver loss of lock.
LOOPBACK	{DISABLE, ENABLE}	Enable or disable the Baseband Loopback Test Mode of the remote modem.
TX 2047 TEST	{DISABLE, ENABLE}	Enable or disable the Transmit 2047 Pattern Test Mode of the remote modem.
RX 2047 BER:		Reports the BER measurement of the receiver 2047 Pattern Test Mode of the remote modem. BER is reported from the 1x10^{-5} to 1x10^{-7} in tenth decade steps. If the pattern does not synchronize or is out of range, 'NO DATA' is displayed.

4.4.1.9 ITA (menu)

	IMPORTANT When the EBEM Network Specification is selected these parameters are available.	
ITA Option	{DISABLED, ENABLED}	Enable or disable the ITA Function.
BPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate

8PSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate

4.4.2 DEMODULATOR Main Menu and Parameters

4.4.2.1 NETWORK SPEC (menu)

The NETWORK SPEC command activates a group of preset parameters. These preset parameters help reduce keystrokes and potential compatibility problems.

NETWORK SPEC	{MIL 188-165A, EBEM, IDR, IBS, DROP & INSERT, CLOSED NET, DVB}

NETWORK SPECS and data rates must be compatible. If you set data rates first, the system allows only the applicable NETWORK SPEC. If you set the NETWORK SPEC first, the system allows only the applicable data rates.

The following parameters are set for each NETWORK SPEC. You cannot change these parameters while the unit is operating in the selected NETWORK SPEC mode:

NETWORK SPEC	DATA RATES	FRAMING	SCRAMBLER	SPECTRUM
MIL-STD 188-165A (MILSTD-188-165A)	9.6 K – 51.848 Mbps	None	OM73	MIL 188 165[a]
EBEM (EBEM)	64 K – 51.848 Mbps	EBEM	EBEM	MIL 188 165[a]
IDR (IESS-308)	1.544, 2.048, 6.312, 8.448 Mbps	96 Kbps (IDR)	V.35	Intelsat
	< 1.544	1/15 (IBS)	IESS-309	Intelsat
IBS (IESS-309)	≤ 2048	1/15 (IBS)	IESS-309	Intelsat
DROP & INSERT	n x 64 n = 1, 2, 3, 4, 5, 6, 8, 10,12, 15, 16, 20, 24, 30	1/15 (IBS)	IESS-309	Intelsat
DVB EN301-201 and EN300-421	All Rates	DVB	DVB	DVB 0.25, 0.35

Closed Net	All possible combinations are allowed. NOTE: DVB settings require the DVB NETWORK SPEC and EBEM settings require the EBEM NETWORK SPEC.

4.4.2.2 STRAP CODE

The STRAP CODE is another means for quickly setting several parameters at one time. STRAP CODE parameters include:

- Data Rate
- Inner Code Rate
- Satellite Framing
- Scrambler
- Drop and Insert
- Outer Code Rate (Reed-Solomon)
- Modulation
- Network Spec

See Appendix I, Strap Codes for more data.

4.4.2.3 IF (menu)

IF MENU		
FREQUENCY (MHz)	{50 – 90 MHz, 100 – 180 MHz, or 950 - 2050 MHz}	Enter the Modulator IF Frequency in 1 Hz increments.
SPECTRUM	{NORMAL INVERTED}	Invert the direction of rotation for PSK Modulation. Normal meets the IESS Specification.
MODULATION	{BPSK, QPSK, OQPSK, 8PSK, 8QAM, 16APSK, 16QAM}	Select the demodulation type.
SPECTRAL MASK	{MIL-188-165A, INTELSAT 0.35, DVB 0.35, DVB 0.25}	Set the spectral shape of Tx Data Filter.
SWEEP RANGE (kHz)	{±0 to 255 kHz}	Set the acquisition range for the demodulator
SWEEP DELAY (Sec)	{0.0 – 6500.0 sec}	Set the reacquisition delay time in 1/10th second increments.
REACQ RANGE (Hz)	{0 – 65500 Hz}	Set the reacquisition sweep in 1 Hz increments.
AGC TCONST (ms)	{0 – 99999ms}	Set AGC Time Constant when in RFM mode
ADJ CARRIER PWR	{Normal, Suppressed}	Set adjacent carrier as Normal or Suppressed (High Power). Unit will increase or decrease post discrimination gain appropriately.
FAST ACQUISITION	{DISABLE, ENABLED}	Disable or enable the RX Fast Acquisition for low symbol rates.

IF MENU		
INPUT THRESHOLD (dBm)	{-30 to –90}	Sets the minimum carrier receive level when a carrier drops below this level. The modem will sweep and try to acquire a new signal. This prevents extremely small carriers from falsely locking the modem.
EB/NO ALARM	{0.0 – 9.9 dB}	Select an EB/NO level that will trigger an alarm when the received EB/NO is worse.

4.4.2.4 DATA (menu)

DATA MENU		
DATA RATE (bps)	Refer to Technical Specs	Set the Data Rate in bps steps via the Front Panel Arrows or Keypad.
SYMB RATE (sps)		View the Symbol Rate.
INNER FEC	Viterbi	{1/2, 3/4, 7/8, None}
	Optional FEC Rates:	
	Sequential	{1/2, 3/4, 7/8}
	CSC	{3/4}
	Trellis (8PSK)	{2/3}
	TPC (BPSK)	{5/16, 21/44} ≤ 20Mbps
	TPC (OQPSK/QPSK)	{1/2, 3/4, 7/8} ≤ 20Mbps
	TPC (8PSK/8QAM)	{3/4, 7/8}
	TPC (16QAM)	{3/4, 7/8}
	DVB VIT	{2/3, 5/6}
	DVB Trellis	{3/4, 5/6, 7/8, 8/9}
	LDPC (B/O/QPSK)	{1/2, 2/3, 3/4}
	LDPC (8PSK/8QAM)	{2/3, 3/4}
	LDPC (16QAM)	{3/4}
	EBEM (B/QPSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
	EBEM (8PSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
	EBEM (16APSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None} Select the Rx Code Rate and Type.
IFEC INTERLEAVER	{DISABLE, ENABLE}	Disable or enable the IFEC Interleaver.
DIFF CODING	{ENABLED, DISABLE}	Enable or disable the Differential Decoder. Having the decoder enabled ensures proper phase lock. May not be adjustable in some modes.

DATA MENU		
SCRAMBLER SEL	{NONE, V.35-IESS, V.35 CITT, V.35 EF, IBS w/Optional Framing and optional Reed-Solomon, Reed-Solomon Scrambler w/Optional Framing, CCITT, V.35FC, OM-73, V.35EF_RS, TPC SCRAMBLER (Turbo Codec), DVB, EDMAC, EBEM}	Select the descrambler type.
SCRAMBLER CTRL	{ENABLED, DISABLE}	Enable or disable the descrambler operation.
SAT FRAMING	{1/15 (IBS), 1/15 (Async), 96 Kbps (IDR), EDMAC, EFAUPC, SCC, EBEM, None}	Select the Framing Type.
TERR FRAMING	{NONE, 188, 204}	**DVB Only**
DATA POLARITY	{INV. TERR & BASE, INV. BASEBAND, INV.TERR DATA, NONE}	Invert the Rx Data polarity.
SYMBOL PAIR	{NONE, SWAPPED}	**BPSK Mode Only** Swap the I & Q Channels.
ESC OVERHEAD	{VOICE X2, DATA 64KBPS}	IDR ESC Channel is used for Voice or 64 K data channel.

See also:

4.4.1.4.1 EBEM NETWORK SPEC Parameters

4.4.1.4.2 SCC FRAMING Parameters

4.4.2.5 REED-SOLOMON (menu)

	IMPORTANT When the Reed-Solomon option is installed, these parameters are available.	
ENABLE/DISABLE	{ENABLED, DISABLE}	Enable or disable the Reed-Solomon decoder.
RS RATE	{Refer to Table 3-1 for valid n/k values}	Displays the currently used n, k Reed-Solomon Codes. In Closed Net Mode, you can select custom R-S Codes.
INTERLVR DEPTH	{4, 8, 12}	Select the Reed-Solomon interleaver depth. In Closed Net Mode, you can select a depth of 4 or 8.

4.4.2.6 CNC (menu)

IMPORTANT
When the Carrier-in-Carrier® option is installed, these parameters are available.

Enable/Disable	{Enabled, Disabled}	Enable or disable the CnC.
MIN SRCH DELAY	{Minimum Search Delay (ms), 0 to Max}	
MAX SRCH DELAY	{Maximum Search Delay (ms), Min to 330ms}	
FREQ OFFST RNG	{Range of Frequency Offset (KHz) between the Interferer and the desired received signal. (+/- 1Khz to +/- 32Khz)}	

4.4.2.7 ITA (menu)

IMPORTANT
When the EBEM Network Specification is selected these parameters are available.

ITA Option	{DISABLED, ENABLED}	Enable or disable the ITA Function.
BPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
ITA MARGIN	0.00 .. 2.00 dBm	Sets the ITA link margin (added to the default entry in Es/No
ITA HYSTERESIS	0.00 .. 2.00 dBm	Sets the ITA hysteresis used to overlap the ITA switching point

4.4.3 INTERFACE Main Menu and Parameters

4.4.3.1 TX SETUP (menu)

TX SETUP MENU		
CIRCUIT ID		Enter a Tx Circuit Identifier. Circuits can be given up to an 11 Character alphanumeric identity such as LINK1.
TERR INTERFACE	{RS423 SERIAL, M2P PARALLEL, DVB PARALLEL, G.703 E2, G.703 T2 BAL, G.703 T2 UNBAL, G.703 E1 BAL, G.703 E1 UNBAL, G.703 T1 AMI, G.703 T1 B8ZS, V.35, HSSI, ASI, ETHERNET, MIL-188-114A}	Select the Transmit Interface Type.
TX CLK SRC	{SCTE, SCT}	Select the Transmit Clock Source.
TX CLK POL	{AUTO, NORMAL, INVERTED}	Select the Clock Polarity for the Tx Terrestrial Clock relative to the Tx Data. “Auto” detects wrong polarity and automatically corrects. If G.703 Interface is selected, this selection cannot be changed.
SCT CLK SRC	{INTERNAL (SCT), SCR (Rx SAT CLK)}	Select SCT Source to be either the SCT Oscillator or RX Satellite Clock. Rx SAT CLK is used for loop timing.
DROP & INSERT	**(Menu)**	See DROP & INSERT (menu)
TX ASYNC MODE	(**Menu**)	See TX ASYNC MODE (menu)

IMPORTANT When Ethernet Interface is selected or EBEM Network specification is enabled, these parameters are available.		
ETH FLOW CONTROL	{Disabled, Enabled}	Disable or enable flow control. *Only visible when Ethernet is selected as the interface type.*
ETH DAISY CHAIN	{Disabled, Port 4}	**Not Available with only one physical port** Disable the Ethernet Port Daisy Chaining or enable it on Port 4. *Only visible when Ethernet is selected as the interface type.*
ETH QOS TYPE	{NORMAL, PORT BASED}	Selects the priority hierarchy of processing an IEEE 803.3ac Tag, Ipv4 Type of Service Field / Differentiated Services Field, or Ipv6 Traffic Class Field. The Port Based priority overrides any standard priority. When operating in this mode, (JS1) has the highest priority and (JS4) has the lowest.
ETH QOS QUEUE	{FAIR WEIGHTED, STRICT PRIORITY}	Selects the queue weighting of 8, 4, 2, 1 that insures even the lowest priority traffic gets some bandwidth. Strict Priority insures that the higher priority traffic will always be transmitted before any lower priority traffic. With this setting, the lower priority traffic can starve.
ETH CRC ROUTE	{NORMAL, BYPASS}	**Not Available in EBEM Mode** Determines how the modem will route a packet with a bad CRC. In **normal** mode, the modem will drop a packet that has an incorrect CRC. In **bypass** mode the modem will pass on the packet even with an incorrect CRC.
ETH HDLC	{RADYNE, COMTECH, MANAGED 570}	**Not Available in EBEM Mode** Selects Radyne HDLC, Comtech HDLC or Managed 570 Mode.

4.4.3.1.1 DROP & INSERT (menu)

DROP & INSERT MENU		
DROP MODE	{NONE, T1-D4, T1-ESF, PCM-30, PCM-30C, PCM-31, PCM-31C, T1-D4-S, T1-ESF-S.}	Select any mode from the list.
MAP COPY	{SRC Map to Dest Map}	Copy drop and insert maps. Tx ACT map is the drop map currently being used by the modem. Source and destination may be any of the following: TX ACT, RX ACT, TX EDIT, RX EDIT, USER 1 - USER 8, ROM 1 -ROM 8
SAT CH TERRCH		Edit the Tx edit map to specify the terrestrial slots that will be dropped into assigned satellite channels. The satellite channels are fixed and the number of channels is determined by the data rate. The terrestrial time slots available are determined by the drop mode. The finished Tx edit map is copied to the Tx ACT map before it is used by the modem.

4.4.3.1.2 TX ASYNC MODE (menu)

TX ASYNC MODE MENU		
TX ASYNC MODE	{ES-ES, ESC ENHANCED}	ES-ES is the normal IBS Async Channel. ESC Enhanced can be selected in Closed Net and uses the Overhead Signaling bytes in the IBS Overhead to pass asynchronous data. This menu is not available when SCC is selected.
ES INTERFACE	{RS-232, RS-485}	Select the interface type.
ES BAUDRATE	{150 – 1024} For IBS ES to ES	**ES to ES**: Fixed Baud Rate based on IBS Network Specification. See Table 3-3.
	{150 – 19200} For ES to ES Enhanced	**ES to ES Enhanced**: Select the Interface Baud Rate. See Table 3-3.
	{150 – 115200} For SCC Communications	**SCC**: Select the interface Baud rate. Interface Rate must be equal to or greater than the In-Band Rate.
ES BITS/CHAR	{7, 8}	Choose either 7 or 8 bit data.

4.4.3.2 RX SETUP (menu)

<table>
<tr><td colspan="3">RX SETUP MENU</td></tr>
<tr><td>CIRCUIT ID</td><td></td><td>Enter the Rx Circuit Identifier. Circuits can be as DLINK1</td></tr>
<tr><td>TERR INTERFACE</td><td>{RS423 SERIAL, M2P PARALLEL, DVB PARALLEL, G.703 E2, G.703 T2 BAL, G.703 T2 UNBAL, G.703 E1 BAL, G.703 E1 UNBAL, G.703 T1 AMI, G.703 T1 B8ZS, V.35, HSSI, ASI, ETHERNET, MIL-188-114A}</td><td>Select the Receive Type.</td></tr>
<tr><td>BUFF SIZE (msec)</td><td>{0 - 64 msecs}</td><td>Allows the user to set the Doppler Buffer Size in msec.</td></tr>
<tr><td>BUFFER CLK SRC</td><td>{SCTE (External), SCT (Internal), Rx Sat, EXTBNC, EXT IDI}
Priority {1-5}
SRC DEPTH {1-5}</td><td>Assign priorities to the clock sources. 1 being the highest priority and 5 being the last resort. The menu has three fields; the first field is the name of the clock source, the second field is the priority entry area, and the last field is the depth of the list. In the priority field, the up/down arrow keys will scroll through the list displaying the names and the current priority. When the desired clock name is displayed, the number keys may be used to assign a priority value. Pressing <Enter> will re-sort the list. Do this until the clock sources are prioritized in the order desired. Use the left/right arrow keys to move the cursor to the depth field. This field assigns the number of entries to use. The number keypad or the up/down arrows can be used to change the value.
<table>
<tr><th>Clock Source</th><th>Priority</th><th colspan="3">SRC Depth</th></tr>
<tr><td>RX SAT</td><td>1</td><td>of</td><td>3</td><td rowspan="3">Only these are used</td></tr>
<tr><td>SCTE</td><td>2</td><td>of</td><td>3</td></tr>
<tr><td>SCT</td><td>3</td><td>of</td><td>3</td></tr>
<tr><td>EXT BNG</td><td>4</td><td>of</td><td>3</td><td rowspan="2">Only these are used</td></tr>
<tr><td>EXT IDI</td><td>5</td><td>of</td><td>3</td></tr>
</table></td></tr>
<tr><td>BUFFER CLOCK POL</td><td>{NORMAL, INVERTED}</td><td>Select the Buffer Clock Polarity for the Tx Terrestrial Clock relative to the Tx Data. If G.703 Interface is selected, this selection cannot be changed.</td></tr>
<tr><td>DROP & INSERT</td><td>(Menu)</td><td>See DROP & INSERT (menu)</td></tr>
<tr><td>RX ASYNC MODE</td><td>(Menu)</td><td>See RX ASYNC MODE (menu)</td></tr>
<tr><td>TERR STREAMING</td><td>{BYTE OUTPUT, PACKET OUTPUT} ASI only</td><td>Byte Output = Continuous Mode
Packet Output = Burst Mode</td></tr>
</table>

4.4.3.2.1 DROP & INSERT (menu)

INSERT MODE	{NONE, T1-D4, T1-ESF, PCM-30, PCM-30C, PCM-31, PCM-31C, T1-D4-S, T1-ESF-S.}	Select any mode from the list.
T1/E1 FRAME SRC	{INTERNAL, EXTERNAL, IDI/DDO LOOPBACK}	Selects the frame source for T1 or E1 framing. Note: IDI/DDO loop is an internal loopback of the terrestrial clocks not to be used simultaneously with external loopback cable.
MAP COPY	{TxACT, RxACT, TxEDIT, RxEDIT, USER1….USER8, ROM1….ROM8}	Copy drop and insert maps. RxACT map is the insert map currently being used by the modem. Source and destination may be any of the following: TX ACT, RX ACT, TX EDIT, RX EDIT, USER 1 - USER 8, ROM 1 -ROM 8
SAT CH TERRCH		Edit the Tx edit map to specify the terrestrial slots that will be dropped into assigned satellite channels. The satellite channels are fixed and the number of channels is determined by the data rate. The terrestrial time slots available are determined by the drop mode. The finished Tx edit map is copied to the Tx ACT map before it is used by the modem.

4.4.3.2.2 RX ASYNC MODE (menu)

RX ASYNC MODE MENU		
RX ASYNC MODE	{ES-ES, ESC ENHANCED}	ES-ES is displayed when IBS Network Spec is selected. ESC Enhanced can be selected in Closed Net and uses the Overhead Signaling bytes in the IBS Overhead to pass asynchronous data. This menu is not available when SCC is selected.
ES INTERFACE	{RS-232, RS-485}	Select the interface type.
ES BAUDRATE	{150 – 1024} IBS ES to ES	**ES to ES**: Fixed Baud Rate based on IBS Network Specification. Available rates are listed in Table 3-3.
	{150 – 19200} ES to ES Enhanced	**ES to ES Enhanced**: Select the Interface Baud Rate. This selection will allow the user to set rate as listed in Table 3-3.
	{150 – 115200} SCC Communications	**SCC**: Select the interface Baud rate. Interface Rate must be equal to or greater than the In-Band Rate.
ES BITS/CHAR	{7, 8}	Choose either 7 or 8 bit data

4.4.3.3 GENERAL (menu)

GENERAL MENU		
EXT FREQ (MHz)	{Variable Through Data Rate}	Select the external clock frequency in MHz.
REF FREQ SRC	{EXTERNAL, HIGH STABILITY}	Select the Frequency Reference Source.
REF FREQ (MHz)		Select the reference clock frequency in MHz.
BB RELAYS	{IBS ALMs, IBS/MNR ALMs, IBS/MNR/MJR ALM, RTS ALARM, CnC Switch}	**IBS ALMs**: Only supports IBS prompt and service alarms. **Note**: The following menus are only supported in closed network: **CnC 1:1 SWITCH**: Supports bypassing certain CnC faults when modem in 1:1 redundancy configuration. **IBS/MNR ALMs**: Only supports IBS prompt and service alarms and minor alarms **IBS/MNR/MJR ALM**: Only supports IBS prompt and service alarms, minor and major alarms. **RTS ALARM**: Allows contact closures to be activated when the carrier is configured for RTS signaling. Refer to Radyne App Note 230 for addition information on utilizing this feature as Keyline Operation. **CnC Switch:** Available only when CnC option is installed with CnC hardware, allows user to bypass the alarms associated with a non cancelled carrier when in a redundant configuration.

4.4.4 MONITOR Main Menu and Parameters

MONITOR MENU	
EVENTS	Displays a history of events recorded in the event buffer. A maximum of 100 events may be stored in the buffer. Upon receipt of the 101st event, the first received event is automatically deleted, and so on, maintaining the maximum 100 events.
ERASE EVENTS.. PRESS CLEAR	Press CLEAR to clear the contents of the Event Buffer.
INPUT LVL (dBm)	Displays the estimated receive signal level as seen by the Demodulator.
FREQ OFFSET (Hz)	Displays the received carrier frequency offset as measured by the modem.
AGC VOLATAGE (V)	Monitored AGC Value for use in external equipment, such as Radios.
EBNO (dB)	Displays the estimated E_b/N_o as seen by the demodulator.
ESNO (dB)	Available when the demodulator is in EBEM Mode: Displays the estimated E_s/N_o as seen by the demodulator.

MONITOR MENU	
CORRECTED BER	The CBER display shows an estimated corrected bit error rate of the modem. Depending on the symbol rate the modem is running, the high-end performance scale of this display will vary (10 E^{-9}, 10^{-10} or 10^{-11}). At some symbol rates, a better than scale reading will appear as 0.0 x 10^{-00}. At other symbol rates, it will appear as E**. In either case, they both mean performance is better than the scale upper limit.
VOLTAGES (Menu)	See VOLTAGES (menu)
RX BUFFER LEVEL	{0 – 100%} Displays the status of the Doppler Buffer.
RX BUFFER RESET (ENTER)	Press ENTER to re-center the Doppler Buffer.
RAW BER	Displays the estimated channel error rate (before decoding) measured by the modem. (Viterbi and Trellis only)
BIT ERRORS	Displays the current error count from the Viterbi Decoder. (NOT DISPLAYED FOR TPC OR LDPC MODES)

4.4.4.1 LINK STATUS (menu)

> **IMPORTANT**
> When the TERRESTRIAL INTERFACE parameter is ETHERNET, these additional status items are visible. See also TX SETUP (menu) or RX SETUP (menu).

TOTAL PACKETS	Displays the total number of Ethernet packets received from the satellite
ERROR PACKETS	Displays the number of erred Ethernet packets received from the satellite
PKT ERROR RATE	Displays the satellite Packet Error Rate
PKT STATS RESET	Press ENTER to reset the Ethernet packet statistics.
JS1 PORT	Displays the current status of LAN Port 1. See Note.
JS2 PORT	Displays the current status of LAN Port 2. See Note.
JS3 PORT	Displays the current status of LAN Port 3. See Note.
JS4 PORT	Displays the current status of LAN Port 4. See Note.
WAN STATUS	Displays the current status of the WAN Port. See Note.

NOTE

Port status indicators are:

Down:	The link is down.
Unresolved:	Unable to agree on connection speed.
10 Mbps Half:	Connected at 10 Base-T Half Duplex.
10 Mbps Full:	Connected at 10 Base-T Full Duplex.
100 Mbps Half:	Connected at 100 Base-T Half Duplex.
100 Mbps Full:	Connected at 100 Base-T Full Duplex.
Not used:	The port is not available.

4.4.4.2 VOLTAGES (menu)

VOLTAGES MENU	
TEMPERATURE	Displays internal temperature.
+1.5V RX SUPPLY	Displays the measured voltage of the 1.5 Volt Rx power bus located inside the modem.
+1.5V TX SUPPLY	Displays the measured voltage of the 1.5 Volt Tx power bus located inside the modem.
+3.3V SUPPLY	Displays the measured voltage of the +3.3 Volt power bus located inside the modem.
+5V SUPPLY	Displays the measured voltage of the +5 Volt power bus located inside the modem.
+12V SUPPLY	Displays the measured voltage of the +12 Volt power bus located inside the modem.
+20V SUPPLY	Displays the measured voltage of the +20 Volt power bus located inside the modem.
-12V SUPPLY	Displays the measured voltage of the -12 Volt power bus located inside the modem.

4.4.4.3 CnC (menu)

IMPORTANT

When the Carrier-in-Carrier® option is installed, these parameters are available.

CnC DELAY		Routine delay (ms)
CnC FREQ OFFST		Runtime Frequency Offset (KHz) between interferer and the correct received signal.
CnC RATIO		Power Ratio between interferer and the correct signal in dB.
RX BUFFER LEVEL	{0 – 100%}	Displays the status of the Doppler Buffer.
RX BUFFER RESET (ENTER)		Press ENTER to re-center the Doppler Buffer.

4.4.4.4 ITA (menu)

IMPORTANT

When in EBEM Mode and the ITA option is enabled this menu available.

TX WAVEFORM	{UNAVAVILABE, Mod and CR} See section 4.4.1.9	Displays the current modulation and code rate operating in the transmitter
RX WAVEFORM	{UNAVAVILABE, Mod and CR} See section 4.4.2.7	Displays the current modulation and code rate operating in the receiver

4.4.5 ALARMS Main Menu and Parameters

Alarm details are described in Chapter 6, Maintenance and Troubleshooting.

	CAUTION Masked alarms can cause unwanted effects in the performance of the unit.

CURRENT	See Chapter 6, Maintenance and Troubleshooting for more data about alarms.
LATCHED	These alarms are latched to catch intermittent failures:
BACKWARD	Backward alarms are alarms that are fed back to or received from the other end of the satellite link.

4.4.6 SYSTEM Main Menu and Parameters

DATE (MM/DD/YY)		Enter the current date.
TIME {HH:MM:SS}		Enter the current time.
CONFIG COPY	{CURRENT, CFG1….FG10}	Save and copy modem configurations.

4.4.6.1 FRONT PANEL (menu)

BRIGHTNESS	{100%, 75%, 50%, 25%}	Controls the VFD brightness.
BKLT TIMEOUT	{00 - 99}	Enter the length of time (in minutes) of keyboard inactivity before the backlight shuts off. 00 = no timeout.
KEY CLICK	{ENABLE, DISABLE}	Enable or disable the audible beep each time a key is pressed. Illegal entries will still cause a beep to be heard.
LED TEST	{ENTER}	Tests all front panel LEDs.

4.4.6.2 REMOTE CONTROL

REMOTE CONTROL	{TERMINAL, COMPUTER}	Select between terminal RS-232 control and remote port M&C RS-232/-485 control.

4.4.6.3 TERMINAL (menu)

TYPE	{VT-100, WYSE50, VIEWPOINT}	Select the emulation type.
BAUD RATE	{150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200}	Enter the terminal baud rate.

4.4.6.4 REMOTE PORT (menu)

ADDRESS	{32 - 255}	Enter the Remote Port Multidrop Address.
BAUD RATE	{150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38,400, 57600, 115200}	Enter the Remote Port Baud Rate.
INTERFACE	{RS-232, RS-485}	Enter the Remote Port interface type.

4.4.6.5 TCP/IP (menu)

<table>
<tr><td colspan="3">TCP/IP MENU</td></tr>
<tr><td>BOOT MODE</td><td>{DEFAULT, NON-VOL, BOOTP, IP TEST}</td><td>DEFAULT: During initialization (boot up), the modem will restore the web setting to the standard IP Mask and addresses supplied by the modem. The modem will be taken off the network and will not be accessible. The Default settings are:
<table>
<tr><td>IP Address Mask:</td><td>255.000.000.000</td><td>(FF.00.00.00 hex)</td></tr>
<tr><td>Modem IP Address:</td><td>010.000.000.001</td><td>(C0.A8.00.EE hex)</td></tr>
<tr><td>Server IP Address:</td><td>010.001.001.001</td><td>(0A.01.01.01 hex)</td></tr>
<tr><td>Router IP Address:</td><td>010.000.001.001</td><td>(0A.00.01.01 hex)</td></tr>
</table>

BOOTP: During initialization (boot up), the modem will get the names, masks, and IP Addresses of the modem, router, and server.
NON-VOL: Stores and uses IP Mask and addresses as provided by the user.
IP TEST: Stores and uses IP Mask and addresses to fixed settings as listed below.
<table>
<tr><td>Bootp Server Tag:</td><td>206</td><td></td></tr>
<tr><td>IP Address Mask:</td><td>255.255.255.000</td><td>(FF.FF.FF.00 hex)</td></tr>
<tr><td>Modem IP Address:</td><td>192.168.0.238</td><td>(C0.A8.00.EE)</td></tr>
<tr><td>Server IP Address:</td><td>192.168.000.101</td><td>(C0.A8.00.65)</td></tr>
<tr><td>Router IP Address:</td><td>192.168.000.102</td><td>(C0.A8.00.66)</td></tr>
</table></td></tr>
</table>

TCP/IP MENU		
BOOTp SERVER	{128 – 257, default is 206}	Only used if Bootp is selected in Boot Mode. Should be consistent with the tag expected by the users Bootp Server.
MODEM HOST		The Host Modem for the network.
IP ADDR MASK	{XXX.XXX.XXX.XXX}	The IP Address Mask of the local network. The mask is expressed in a hexadecimal format, and must be a valid TCP/IP Mask. This field should be set before changes are made to the Modem or Router Address.
MODEM IP ADDR	{XXX.XXX.XXX.XXX}	The IP Address of the modem. This address should be consistent for the mask defined. This address is expressed in hexadecimal format. Broadcast and loop back addresses will not be allowed. These are addresses with all subnet bits set to 0's or 1's.
SERVER IP ADDR	{XXX.XXX.XXX.XXX}	The IP Address of the Boot Server and the address of the SNMP Trap Server when SNMP is active. If a server is used and there is no local router, this address must be consistent with the modem address. If a router has been specified, the address is presumed to be reachable via the router. Broadcast and loop back addresses will not be allowed. These are addresses with all subnet bits set to 0's or 1's.
ROUTER IP ADDR	{XXX.XXX.XXX.XXX}	The IP Address of the Local Network Router. If a router is present on the local network, this address must be consistent with the IP Mask and the subnet of the modem. If no router is present, then the address should be set to a foreign address. This address is expressed in hexadecimal format. Broadcast and loop back addresses will not be allowed. These are addresses with all subnet bits set to 0's or 1's.
MODEM EADDR	{001065010000}	Displays the Ethernet address of the device. Set at the factory and is a unique identifier for the Ethernet physical interface.
ETHER RATE	{10 MBPS/HD}	The data rate for the local Ethernet Interface. 10 Mbps/HD – for 10 Base-T in either half-duplex or full duplex.

IMPORTANT

To change the display for the IP ADDRESS MASK, MODEM IP ADDRESS, SERVER IP ADDRESS, and ROUTER IP ADDRESS, press all four arrow keys simultaneously.

4.4.6.6 SNMP (menu)

A description of OID organization is provided in the MIB portion of this manual (Appendix C).

SNMP MENU		
SNMP VERSION	{V1 & V2, V3}	This selection controls the SNMP Version that will be used in messaging between the equipment and it's host. When V1 & V2 is used, RD COMMUNITY and RDWR COMMUNITY are used to determine the authorization of an incoming message. When V3 is used, three contexts are supported: *public*, *mib2*, and *dev*. Context, Authentication and Privacy are a portion of each SNMPV3 message. The *public* context will only allow the user to see the sysoid of the unit. This is the most restricted access possible and only allows the unit to be identified by a host SNMP Station. The *mib2* context allows a user with appropriate authentication to access the mib2 OIDs and the SNMP OIDs. These are of interest primarily to network operators not controlling the satellite link. The *dev* context allows a user with appropriate authentication to access the device control portion of the MIB. These OIDs are used to control the devices satellite link and operation.
TRAP VERSION	{V1, V2}	This controls the type of message format used when a message trap is generated by the equipment and bound for a SNMP Host. Messages will only be sent if the unit has been authorized to do so.
AUTHORIZATION	{TRAPS OFF, TRAPS ON}	This controls the type of message format used when a message trap is generated by the equipment and bound for a SNMP host. Messages will only be sent if the unit has been authorized to do so.
RD COMMUNITY	{16 characters of name}	This menu is only displayed when SNMP VERSION is set to V1 & V2. This is the community that a host must be acting within when an OID variable is requested by a V1/V2 SNMP message.
RDWR COMMUNITY	{16 characters of name}	This menu is only displayed when SNMP VERSION is set to V1 & V2. This is the community that a host must be acting within when an OID variable is being changed by a V1/V2 SNMP message.
TRAP AGENT	{XXX.XXX.XXX.XXX} Hexadecimal Mask {ddd.ddd.ddd.ddd} Decimal Mask	IP address of the device receiving SNMP Traps

4.4.6.7 FTP (menu)

PORT	{XXXX}	Select the desired port number. Factory default is set to 21. Port 21 is a reserved port utilized by the File Transfer Protocol for FTP control traffic.
USER ID		Enter the user identification for access to an FTP session.
PASSWORD		Enter the password for access to an FTP session.

4.4.6.8 WEB (menu)

WEB MENU			
CONFIRMATION		{ENABLE, DISABLE}	Enable = System requires confirmation response if a change is made to the modem output Disable = No confirmation response is required
USER 1, USER 2, USER 3	**ACCESS GROUP**	{NO GROUP, GUEST, OPER, ADMIN}	NO GROUP = Denies all access GUEST = Guests can access most of the site to see modem parameters. OPER = Operators can monitor and control parameter settings, and change their own authentication passwords. ADMIN = Administrators can monitor and control the parameters, change any user's name and authentication password, and modify IP network settings. ADMIN setting gives access to the entire site.
	AUTH PASSWORD	{xxxxxxxx}	User to select password. The user can modify the Authorization Passwords. The user name can have up to 14 characters supporting alpha and numeric characters. Alpha characters can be entered using the up and down arrow keys. Numeric characters can be selected by using the number keys on the front panel. The user can clear all characters from the front panel screen.
	USER RESET		Resets group and password.

4.4.6.9 TRANSEC (menu)

TRANSEC MENU		
IP ADDR MASK	{XXX.XXX.XXX.XXX}	The IP Address Mask of the TRANSEC Module. The mask is expressed in a hexadecimal format, and must be a valid TCP/IP Mask. This field should be set before changes are made to the Modem or Router Address.
MODEM IP ADDR	{XXX.XXX.XXX.XXX}	The IP Address of the TRANSEC Module. This address should be consistent for the mask defined. This address is expressed in hexadecimal format. Broadcast and loop back addresses will not be allowed. These are addresses with all subnet bits set to 0's or 1's.
ROUTER IP ADDR	{XXX.XXX.XXX.XXX}	The IP Address of the Router. If a router is present on the local network, this address must be consistent with the IP Mask and the subnet of the modem. If no router is present, then the address should be set to a foreign address. This address is expressed in hexadecimal format. Broadcast and loop back addresses will not be allowed. These are addresses with all subnet bits set to 0's or 1's.

4.4.6.10 HW/FW CONFIG (menu)

FIRMWARE REV	Displays the firmware part number and revision.
M&C REV	Displays the installed Monitor and Control revision.

4.4.6.10.1 MAIN BOARD (menu)

NOTE

Only the applicable VCO adjustment screens are displayed.

IMPORTANT

These fields are protected to prevent accidental changes. To change a field, press all four arrow keys at the same time.

INT VCO ADJUST	{0% - 100%}	Adjusts the internal frequency reference for calibration. Only displayed of the system reference clock is INTERNAL.
HI STAB VCO ADJUST	{0% - 100%}	Adjusts the internal frequency reference for calibration. Only displayed if the system reference clock source is HI STABILITY.
LARGEST HB GAP		Used for factory test only.
SOFT RESET	{ENTER}	Resets the modem.

IF BOARD (menu)	Indicates the part number for the IF Board Assembly.
IF RX LVL OFFSET	Used for factory test only.
LB RX LVL OFFSET	Used for factory test only.
AGC DAC	Used for factory test only.
AGC FE DAC	Used for factory test only.
I OFFSET	Used for factory test only.
Q OFFSET	Used for factory test only.
STEP ATTN	Used for factory test only.
TX DAC	Used for factory test only.
TX ADC	Used for factory test only.

TERR INTFC BRD	Indicates the part number for the Terrestrial Interface Assembly.

CODEC BOARD (menu)	Indicates the part number for the Codec Board.
RX FPGA IMAGE	Used for factory test only.
TX FPGA IMAGE	Used for factory test only.
FX FPGA IMAGE	Used for factory test only
TPC CODEC IMAGE	Used for factory test only.

FRONT PANEL BOARD	Indicates the assembly number for the front panel board.

CNC BOARD (menu)	Indicates the part number for the CNC Board.
DEBUG MODE	{ENABLED, DISABLED}
CNC DEBUG REGS1	Used for factory test only.
CNC DEBUG REGS2	Used for factory test only.
CNC DEBUG REGS3	Used for factory test only.
CNC DEBUG REGS4	Used for factory test only.
SCALE AMPLTD	Used for factory test only.
AR THRESH FACTOR	Used for factory test only.
PLL LOOP THRESH	Used for factory test only.
ACQ CNTR THRESH	Used for factory test only.
PLL LOOP GAIN	Used for factory test only.

4.4.6.10.2 FEATURES (menu)

5012.2840.2417	{____.____.____}	Installs purchased feature upgrades (see Appendix A). Whether or not the feature has been upgraded, or if the feature requires a hardware upgrade (contact the Customer Service Department or Sales for hardware and software upgrades).

4.4.6.10.3 UPGRADE LIST (menu)

UPGRADE LIST MENU		
10 MBPS, 20 MBPS, 52 MBPS (The highest option installed hides the lower rates.)		
52 MBPS	IBS	16QAM
TURBO 52 MBPS	IDR	TPC 7/8 SHORT
RXIF	D&I	ETHERNET WAN MONITOR
TXIF	ENH ASYNC	8QAM
RXLBAND	AUPC	LDPC 52 MBPS
TXLBAND	EDMAC	CNC 52 MBPS
RS	OM73 SCRAMBLIN	EBEM
RS CUSTOM	SEQ	LOW TX POWER
DVB	8PSK	

4.4.7 TEST Main Menu and Parameters

<table>
<tr><td colspan="3">TEST MENU</td></tr>
<tr><td>TX TEST PATTERN</td><td>{NONE, 2047, 2^15-1, 2^23-1}</td><td>Enables the tests listed above.</td></tr>
<tr><td>RX TEST PATTERN</td><td>{NONE, 2047, 2^15-1, 2^23-1}</td><td>Enables the tests listed above.</td></tr>
<tr><td>PATTERN SYNC</td><td>{YES, NO}</td><td>Yes indicates that the RX Test Pattern is in sync.</td></tr>
<tr><td>TST PAT ERR CNT</td><td>{NO SYNC, nnnn x 10n}</td><td>Displays the number of errors detected by the test pattern checker.</td></tr>
<tr><td>TST PATT BER</td><td>{NO SYNC, nnnn x 10-n}</td><td>Displays the measured BER for the test pattern.</td></tr>
<tr><td>RESTART TST PAT ((ENTER))</td><td></td><td>Press ENTER to restart the test.</td></tr>
<tr><td>LOOPBACK</td><td>{IF, TERR TX/RX, TERR TX, TERR RX, NONE, BASEBAND TX/RX, BASEBAND RX, BASEBAND TX, IFEC TX}</td><td rowspan="2">Terrestrial Loopback is performed at the Terrestrial Interface.
IF: IF loopback loops the IF output of the Modulator to the IF input of the Demodulator. If using 8PSK or 16QAM Modulation, the output power must be above -15 dB.
TERR TX/RX: Enables both. Baseband loopback is performed at interface between the Baseband Processor Card and the Modem Card. This ensures Framer/Deframer integrity.
BASEBAND TX/RX: Enables both Baseband Tx and Baseband Rx.
NONE: No loopback performed.
TERR RX: (Distant Loop) Sends received satellite data to the Modulator for transmission to the distant end.
BASEBAND RX: Sends Rx data from the Modem Card to the Tx data input to the Modem Card.
TERR TX: Sends Tx Terrestrial Data to Rx data out.
BASEBAND TX: Sends Tx data to the receive input to the BB Card.</td></tr>
<tr><td colspan="2">IMPORTANT

LOOPBACK WITH ETHERNET DATA INTERFACE
Unwanted network loops can result from using the loopback function with the Ethernet data interface. Make sure to use two modems connected directly to each other for any Ethernet interface data testing. Undesirable results will occur if you use one modem and a loopback</td></tr>
<tr><td>Carrier TYPE</td><td>{NORMAL, CW, DUAL, OFFSET, POS FIR, NEG FIR}</td><td>Sets the type of carrier. Normal: Causes the Modulator to output normal modulation.
CW: Causes the Modulator to output a pure carrier.
DUAL: Causes a double sideband output.
OFFSET: Causes a single sideband output.
POS FIR: For manufacturer's use only.
NEG FIR: For manufacturer's use only.</td></tr>
</table>

TEST MENU		
IQ SAMPLING	{ENABLE/DISABLE}	Enables the I & Q pattern on the Web Browser Interface.
IQ SPCTRM SMPLING	{ENABLE, DISABLE}	Enables the Frequency Spectrum pattern on the Web Browser.
ICMP PING	{NONE, BOOTp SERVER, TRAP AGENT, TCP/IP ROUTER}	Used to ping the Router

4.5 Terminal Mode Control

The Terminal Mode Control lets you use an external terminal or computer to monitor and control the unit. Typically, the Control Port is the RS–232 Serial Interface connection to the terminal device.

In Terminal Mode Control, the unit shows a full-screen, interactive display using built-in software. The only external software that is required is VT-100 Terminal Emulation Software.

NOTE
Refer to the Remote Protocol Manual (MN-DMDREMOTEOP) for the terminal screens.

4.5.1 Terminal Mode Screens

The Terminal Mode has eight screens. Use these screens to set the following parameters:

- Modulator
- Event
- Latched Alarm
- Insert Controls
- Demodulator
- Alarm
- Drop Controls
- Interface

NOTE
Refer to the Remote Protocol Manual (MN-DMDREMOTEOP) for the terminal screens.

4.5.2 Terminal Mode Operations

Use the interactive Terminal Mode screens to program the unit. Typically, you select a parameter by entering the applicable ID number, then enter and save new data for that parameter.

NOTE
Items without ID numbers show status only and you cannot change them.

For example, to change the transmit data rate, enter ID number ‘33’ at the terminal. The screen then requests either multiple-choice or numerical input.

For multiple-choice input, press SPACE until your choice is shown. Press ENTER to save the choice.

For numerical input, use the number keys to input the data. Press ENTER to save the data.

To cancel numerical input before you save it, press ESC.

NOTE
Using an invalid input key causes the terminal to show an error message.

4.5.3 Setup for Terminal Mode

NOTE
When you use the terminal for the first time, use the $ (dollar) character to reset the memory.

1. Connect the RS-232 cable between the terminal device and the REMOTE J20 connector on the rear of the unit.
2. Set up Terminal Mode Communications and Protocol from the front panel of the unit.
    a. Set the **System** > **Remote Control Mode** parameter to **Terminal**.
    b. Set the **System** > **Terminal** > **Baud Rate** parameters as necessary:
        - Select from serial baud rates of 150, 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200
3. Set the **System** > **Terminal** > **Type**.

- Select from the three emulation types: **VT100**, **WYSE50**, **VIEWPOINT**
- Set terminal parameters to (**8, N, 1**):
    - 8 data bits
    - No parity
    - 1 stop bit

If using a computer as a terminal, set emulation to **VT100**. Use HyperTerminal or ProComm on the computer.

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Chapter 5. External Connections

Figure 5-1. DMD2050E Universal Satellite Modem Front Panel

Figure 5-2. DMD2050E Rear Panel

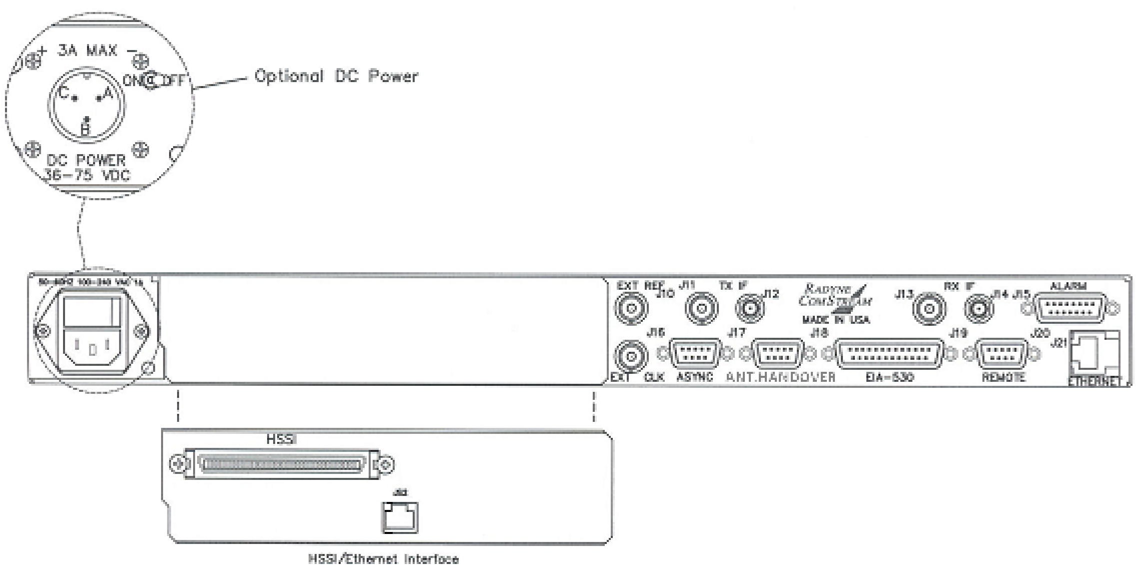

Figure 5-3. DMD2050E Rear Panel Configurations

5.1 Power Connectors, Ground and Switches

The DMD2050E units have either AC or DC power connectors (see Figure 5-3).

Power Type	Location	Prime Power	Maximum Power Consumption
AC	Rear panel	100 – 240 VAC, 50 – 60 Hz	1A
DC	Rear panel	48V ± 5VDC	3A

Table 5-1. Pinouts for DC Power Connector

Pin	Description
A	–
B	Ground
C	+

5.1.1 Ground Connector

A chassis ground connector (#10-32 threaded stud), is adjacent to the power connector.

CAUTION: CORRECT GROUNDING PROTECTION REQUIRED: Always make sure the ground stud on the rear panel of the unit is connected to protective earth. Correct grounding protection helps prevent personal injury and equipment damage.

In Finland: "Laite on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan."

In Norway: “Apparatet må tilkoples jordet stikkontakt.”

In Sweden: “Apparaten skall anslutas till jordat uttag.”

5.1.2 Power Switch

The DMD2050E units have the power switch located either adjacent to the power connector or on the front panel.

5.2 Front Panel Connections

5.2.1 Key Loader Interface

Label	Location	Description	Connector Type
SKL	Front Panel	Key Loader Interface Port	RS-232, 6-pin audio connector (GC283)

Connect a hand-held PC to the Key Loader Interface to upload the Shared Message Authentication Token (SMAT) to the modem. See the MN-DMD2050E-TKL manual for more information

Table 5-2. Pinouts for SKL Key Loader Interface (RS-232) 6-Pin Female GC283 Connector

Pin No.	Signal Name	Signal	Direction
A	Ground	GND	---
B	Transmit Data RS-232	TX KEY A	Output
C	Receive Data RS-232	RXD-232	Input
D	NC	NC	---
E	Receive Data RS-232	RX KEY B	Input
F	NC	No Connect	

5.3 Rear Panel Connectors

CAUTION

Before you connect any cable to the unit, examine the connector labels. Make sure to use the correct mating connector when you connect a cable to the unit.

5.3.1 HSSI / Ethernet Connectors

Label	Description	Connector Type	Notes
HSSI J1	High-Speed Serial Interface Port	50-pin SCSI-2	1. Complies with the HSSI Functional and Electrical Specifications 2. Electrical levels are ECL 3. Gapped clocking is not allowed
ETHERNET 10/100/1000 DATA INTERFACE JS2	Ethernet Data Interface Port	RJ45 10/100/1000 Base-T	1. Allows Auto-Crossover and Auto-Sensing

Table 5-3. Pinouts for J1 HSSI 50-Pin SCSI-2 Connector

Pin No. (+)	Pin No. (–)	Signal Name	Description	Direction
1	26	SG	Signal Ground	---
2	27	RT	Receive Timing	Output
3	28	CA	DCE Available	Output
4	29	RD	Receive Data	Output
6	31	ST	Send Timing (SCT)	Output
7	32	SG	Signal Ground	---
8	33	TA	DTE Available	Input
9	34	TT	Terminal Timing (SCTE)	Input
11	36	SD	Send Data	Input
13	38	SG	Signal Ground	---
14 - 18	39 – 43	5 Ancillary to DCE	Reserved	Input
19	44	SG	Signal Ground	---
20 - 23	45 - 48	4 Ancillary from DCE	Reserved	Output
24	49	TM	Test Mode	Output
25	N/A	MOD_FLT	Alarm	Output
50	N/A	DMD_FLT	Alarm	Output

5.3.2 EXT REF (J10)

Label	Description	Connector Type	Input Levels	Frequencies (MHz)
EXT REF J10	External Reference Port	50 Ohm Female BNC	0.3 to 5 Vpp (Sine or Square wave)	1.0 1.544 2.0 2.048 5.0 10.0

5.3.3 IF Connectors (Transmit and Receive) J11, J12, J13, J14

Label	Description	Connector Type	IF Frequencies Programmable in 1 Hz steps	Power Levels Programmable in 0.1 dBm steps
TX IF J11	Transmit IF Output Port	50 Ohm Female TNC 70/140 MHz IF	50 to 90 MHz 100 to 180 MHz	0 to -25 dBm
RX IF J13	Receive IF Input Port	50 Ohm Female TNC 70/140 MHz IF	50 to 90 MHz 100 to 180 MHz	
TX L-BAND IF J12	Transmit L-Band IF Output Port	50 Ohm Female SMA L-Band IF	950 to 2050 MHz	0 to -25 dBm
RX L-BAND IF J14	Receive L-Band IF Output Port	50 Ohm Female SMA L-Band IF	950 to 2050 MHz	

5.3.4 ALARM (J15)

Label	Description	Connector Type
ALARM J15	Alarm Port	15-pin Female D

The Alarm port uses contact closures to identify the status of the unit. Pins 1 through 6 supply Form C contacts for major alarm status on the modulator and demodulator.

Normally Open or Normally Closed conditions indicate a FAULTED or OFF state.

- C = Closed
- NO = Normally Open
- NC = Normally Closed

Table 5-4. Pinouts for J15 ALARM Port 15-pin Female D Connector

Pin No.	Signal Name	Signal	Direction
1	Mod Fault - C	MF-C	No Direction
2	Mod Fault – NC	MF-NC	No Direction
3	Mod Fault – NO	MF-NO	No Direction
4	Demod Fault - C	DF-C	No Direction
5	Demod Fault – NC	DF-NC	No Direction
6	Demod Fault – NO	DF-NO	No Direction
7	Prompt - C	CEF-C	No Direction
8	Prompt – NC	CEF-NC	No Direction
9	Prompt – NO	CEF-NO	No Direction
10	Service – C	SP1-NO	No Direction
11	Service – NC	SP1-NC	No Direction
12	Service – NO	SP2-NO	No Direction
13	No Connect	SP2-NC	No Direction
14	AGC Out	AGC	No Direction
15	Ground	GND	---

Use the front panel to set up Prompt and Service alarm summaries. Select one summary type for each alarm type:

Prompt Alarms Summaries	Service Alarms Summaries
a) Prompt alarms b) Prompt and Tx Minor alarms c) Prompt and Tx minor and Tx Major alarms	a) Service alarms b) Service and Rx Minor alarms c) Service and Rx minor and Rx Major alarms

5.3.4.1 IBS Network Alarms Configuration

IBS Prompt Alarms	IBS Service Alarms
Pins 7 through 9	Pins 10 through 12
Includes TX Minor Alarms or TX Minor Alarm and TX Major Alarms	Includes RX Minor Alarms or RX Minor Alarms and RX Major Alarms

5.3.4.2 Closed Net Alarms Configuration

When the unit is configured for a Closed Net operation, the contact closures for Prompt and Service alarms are used for a summary of either:

- All major and minor alarms
- All minor alarms

Use the General menu, Baseband Relays to configure this operation.

5.3.4.3 RTS Carrier Alarms Configuration

RTS Carrier Alarms
Pins 10 through 12

Service alarms can be configured for the RTS Carrier Alarms. The Baseband Relay can be set to monitor the RTS Carrier. When the RTS Carrier is used and the Baseband Relay is configured for RTS Keyline, the Service alarms pins 10 through 12 are used for monitoring the RTS signal.

See Radyne App Note 230 for more information.

5.3.5 EXT CLK (J16)

Label	Description	Connector Type	Input Levels
EXT CLK J16	External Clock Port	75 Ohm Female BNC 70/140 MHz IF	0.3 to 5 Vpp (Sine or Square wave)

5.3.6 ASYNC (J17)

Label	Description	Connector Type
ASYNC J17	Asynchronous Data Interface Port	9-pin Female D

Table 5-5. Pinouts for J17 ASYNC Port 9-pin Female D Connector

Pin No.	Signal Name	Signal	Direction
1	Receive Data B	RXD_B	Output
2	Receive Data A	RXD_A	Output
3	Transmit Data A	TXD_A	Input
4	Transmit Data B	TXD_B	Input
5	Ground	GND	---
6	No Connect	DSR	---
7	No Connect	RTS	---
8	No Connect	CTS	---
9	No Connect	NC	---

5.3.7 ANT. HANDOVER (J18) (Future Option)

5.3.8 MIL-188-114A (J19)

Label	Description	Connector Type
MIL-188-114A J19	EIA-530 Port (RS-422)	25-pin Female D

Table 5-6. Pinouts for J19 MIL-188-114A Port 25-pin Female D Connector

Pin No.	Signal Name	Signal	Direction
1	Shield	---	---
2	Send Data A (-)	SD-A	Input
3	Receive Data A (-)	RD-A	Output
4	Request To Send A (-)	RS-A	Input
5	Clear To Send A (-)	CS-A	Output
6	Data Mode A (-)	DM-A	Output
7	Signal Ground	SGND	---
8	Receiver Ready A (-)	RR-A	Output
9	Receive Timing B (+)	RT-B	Output
10	Receiver Ready B (+)	RR-B	Output
11	Terminal Timing B (+)	TT-B	Input
12	Send Timing B (+)	ST-B	Output
13	Clear T Send B (+)	CS-B	Output
14	Send Data B (+)	SD-B	Input
15	Send Timing A (-)	ST-A	Output
16	Receive Data B (+)	RD-B	Output
17	Receive Timing A (-)	RT-A	Output
18	Modulator Fault - Open Collector	MF	Output
19	Request To Send B (+)	RS-B	Input
20	Data Terminal Ready A (-)	TR-A	Input
21	Demodulator Fault	DF	Output
22	Data Mode B (+)	DM-B	Output
23	Data Terminal Ready B (+)	TR-B	Input
24	Terminal Timing A (-)	TT-A	Input
25	No Connect	---	---

5.3.9 Monitor and Control Connectors J20, J21

Label	Description	Connector Type
REMOTE J20	Remote Monitor and Control Port (RS-485 or RS-232)	9-pin Female D
ETHERNET J21	Ethernet Monitor and Control Port	Female RJ-45

Table 5-7. Pinouts for J20 REMOTE Port (RS-485 or RS-232) 9-pin Female D Connector

Pin No.	Signal Name	Signal	Direction
1	Transmit Data RS-485 (+)	TX-485-B	Output
2	Transmit Data RS-232	TXD-232	Output
3	Receive Data RS-232	RXD-232	Input
4	NC	NC	---
5	Ground	GND	---
6	Transmit Data RS-485 (–)	TX-485-A	Output
7	NC	No Connect	---
8	Receive Data RS-485 (+)	RX-485-B/CTS	Input
9	Receive Data RS-485 (–)	RX-485-A	Input

Chapter 6. Maintenance and Troubleshooting

6.1 Periodic Maintenance

6.1.1 Battery Replacement

WARNING: DANGER OF EXPLOSION if the battery is incorrectly replaced. The unit contains a Lithium Battery. Replace it with an equivalent battery that is specified by the manufacturer. Dispose of used batteries in compliance with local and national regulations.

6.1.2 Clock Adjustment

Adjust the clock only when an internal clock source is not accurate. Adjust internal VCO speed from the front panel.

6.1.3 Fuse Replacement

CAUTION: Always replace the fuses with the correct fuse type and rating. Use correct fuses to help prevent damage to the equipment.

A DMD2050E with a front panel switch has an external fuse on the rear of the unit, inside the power connector, behind the small plastic cover.

A DMD2050E with a rear panel power switch does not have an external fuse.

6.2 Troubleshooting

6.2.1 Basic Troubleshooting Procedures

1) Make sure all interface signals are correct.
2) If the unit is not operating correctly, replace it with an equivalent unit that is known to operate correctly.
3) If replacing the unit does not correct the problem, examine the power supply and electrical wiring for problems.

6.2.2 Troubleshooting Symptoms and Causes

6.2.2.1 Symptom: The modem does not acquire the incoming carrier.

Causes:

- There is an incorrect receive input to modem.
- The receive carrier level is too low.
- The receive carrier frequency is outside of the acquisition range.
- The transmit carrier is incompatible.
- The modem is in test mode.

6.2.2.2 Symptom: The ASYNC port is not configured correctly.

Causes:

- The switches are set incorrectly.

6.3 Alarms

6.3.1 Major Transmit Alarms

Alarm	Description	Status
FPGA CFG	A transmit FPGA hardware failure exists.	{Pass/Fail, Unmasked/Masked}
DSP CFG	A transmit FPGA failure exists.	{Pass/Fail, Unmasked/Masked}
SCT Clock PLL	The Tx SCT Clock PLL is not locked. This alarm flashes on during certain parameter changes. If the alarm is on constantly, there is a configuration problem within the modem.	{Pass/Fail, Unmasked/Masked}
SYM Clock PLL	The Tx Symbol Clock PLL is not locked. This alarm flashes on during certain parameter changes. If the alarm is on constantly, there is a configuration problem with the incoming clock to the modem (SCTE).	{Pass/Fail, Unmasked/Masked}
LB Synth PLL	The Tx L-Band Synthesizer is not locked. This alarm flashes on during certain parameter changes. If the alarm is on constantly, there is a configuration problem within the modem.	{Pass/Fail, Unmasked/Masked}
IF Synth PLL	The Tx IF Synthesizer is not locked. This alarm flashes on during certain parameter changes. If the alarm is on constantly, there is a configuration problem within the modem.	{Pass/Fail, Unmasked/Masked}
Forced Alarm	Allows the user to disable or enable forcing of the Tx summary alarm.	{DISABLED, ENABLED}
Ethernet WAN	The WAN Port is not operating.	{Pass/Fail, Unmasked/Masked}
TRANSEC NOT RDY	This alarm is acgtive during the time that the TRANSEC card is booting	{Pass/Fail, Unmasked/Masked}

6.3.2 Major Rx Alarms

Alarm	Description	Status
FPGA CFG	A receive FPGA hardware failure exists.	{Pass/Fail, Unmasked/Masked}
DSP CFG	A receive DSP failure exists.	{Pass/Fail, Unmasked/Masked}
SIGNAL LOCK	The demod cannot lock to a signal.	{Pass/Fail, Unmasked/Masked}

Alarm	Description	Status
INPUT LVL THRESH	Indicates the Rx level has fallen below the input threshold level.	{Pass/Fail, Marked/Unmarked}
FRAME LOCK	The Framing Unit cannot find the expected framing pattern.	{Pass/Fail, Unmasked/Masked}
MULTIFRAME LOCK	The Framing Unit cannot find the expected framing pattern.	{Pass/Fail, Unmasked/Masked}
LB SYNTH PLL	The Rx L-Band Synthesizer is not locked. This alarm flashes on during certain parameter changes. If the alarm is on constantly, there is a configuration problem within the modem.	{Pass/Fail, Unmasked/Masked}
IF SYNTH PLL	The Rx IF Synthesizer is not locked. This alarm flashes on during certain parameter changes. If the alarm is on constantly, there is a configuration problem within the modem	{Pass/Fail, Unmasked/Masked}
Forced Alarm	Allows the user to disable or enable forcing of the Rx summary alarm.	{DISABLED, ENABLED}
Ethernet WAN	The WAN Port is not operating.	{Pass/Fail, Unmasked/Masked}

6.3.3 Minor Tx Alarms

Alarm	Description	Status
TERR CLK ACT	No Terrestrial Clock activity exists.	{Pass/Fail, Unmasked/Masked}
TERR DATA ACT	No Tx Data activity exists.	{Pass/Fail, Unmasked/Masked}
TX TERR AIS	AIS is found in the Tx Data Stream.	{Pass/Fail, Unmasked/Masked}
DnI FRAME LOCK	In Drop Mode, the framing unit cannot find the exported terrestrial framing pattern.	{Pass/Fail, Unmasked/Masked}
DnI M-FRAME LOCK	In Drop Mode, the framing unit cannot find the exported terrestrial framing pattern.	{Pass/Fail, Unmasked/Masked}
DROP CRC	Indicates if the Circular Redundancy Check is passing in PCM-30C and PCM-31C Modes	{Pass/Fail, Unmasked/Masked}
TX DVB FRAME LOCK	The Tx Input Data Stream Framing does not match the selected Tx Terr Framing. An incorrect Tx Terr Framing is selected. Incorrectly framed The Tx Input Data Stream is framed incorrectly.	{Pass/Fail, Unmasked/Masked}
TX CLK SRC FALLBK	Indicates that the clock resource has fallen.	{Pass/Fail, Unmasked/Masked}

Alarm	Description	Status
TPC CONFLICT CHK	Indicates that the TPC parameters are not configured correctly. (only visible when TPC enabled)	{Pass/Fail, Unmasked/Masked}

6.3.3.1 Minor Rx Alarms

Alarm	Description	Status
BUFF UNDERFLOW	A Doppler Buffer underflow occurred.	{Pass/Fail, Unmasked/Masked}
BUFF NEAR EMPTY	The Doppler Buffer is about to underflow.	{Pass/Fail, Unmasked/Masked}
BUFF NEAR FULL	The Doppler Buffer is about to overflow.	{Pass/Fail, Unmasked/Masked}
BUFF OVERFLOW	A Doppler Buffer overflow occurred.	{Pass/Fail, Unmasked/Masked}
RX DATA ACTIVITY	There is no Rx Data activity. For the Ethernet Interface, no Ethernet port is active (no cable is plugged in).	{Pass/Fail, Unmasked/Masked}
SAT AIS	AIS is detected in the receive satellite data stream.	{Pass/Fail, Unmasked/Masked}
DnI FRAME LOCK	Drop/insert data is frame locked.	{Pass/Fail, Unmasked/Masked}
DnI M-FRAME LOCK	Drop/insert data has multiframe lock.	{Pass/Fail, Unmasked/Masked}
INSERT CRC	The Circular Redundancy Check is passing in PCM-30C and PCM-31C Modes.	{Pass/Fail, Unmasked/Masked}
T1/E1 SIGNALING	The T1/E1 Signal is not locked.	{Pass/Fail, Unmasked/Masked}
IFEC LOCK	The Inner Codec is not locked.	{Pass/Fail, Unmasked/Masked}
OFEC LOCK	The Reed-Solomon Decoder is not locked.	{Pass/Fail, Unmasked/Masked}
INTERLEAVER	The Reed-Solomon Interleaver is not synchronized.	{Pass/Fail, Unmasked/Masked}
RS UNCORR, WORD	Indicates status of the Reed-Solomon uncoded word fault.	{Pass/Fail, Unmasked/Masked}
LDPC IFEC LOCK	Indicates that the Framing Unit is unable to find the expected framing pattern.	{Pass/Fail, Unmasked/Masked}
EBNO (dB)	The Eb/No is outside of limits.	{Pass/Fail, Unmasked/Masked}

Alarm	Description	Status
RX AGC LEVEL	Indicates Rx level is below allowable limits.	{Pass/Fail, Unmasked/Masked}
IBS BER	More than 1 in 1000 bits in error exist in IBS mode.	{Pass/Fail, Unmasked/Masked}
RX DVB FRAME LOCK	The Rx Satellite Data Stream Framing is not DVB.	{Pass/Fail, Unmasked/Masked}
EMBEDDED CHAN	Indicated that the embedded chnnel is enabled but not in synchronization	{Pass/Fail, Unmasked/Masked}

6.3.3.2 Drop and Insert Alarms

Alarm	Description	Status
Multiframe Lock	The insert framer is not in sync.	
CRC Lock	An Insert CRC Fault occurred. This is valid in T1-ESF, PCM-30, or PCM-30C Modes.	
T1 Signaling	An Insert T1 Yellow Fault occurred. This is valid in T1-ESF, T1D4, or SCL-96 Modes.	
E1 FAS (E1 Frame Acquisition Sync)	An E1 FAS Fault occurred. This is valid in PCM-30, or PCM-30C, PCM-31, or PCM-31C Modes.	
E1 MFAS (E1 Multi-Frame Acquisition Sync)	An E1 MFAS Fault occurred. This is valid in PCM-30, or PCM-30C, PCM-31, or PCM-31C Modes.	

6.3.3.3 Common Major Alarms

Alarm	Description	Status
TERR FPGA CFG	An Interface Card FPGA configuration failure exists, possibly caused by a missing or incorrect file.	{Pass/Fail, Unmasked/Masked}
CODEC FPGA CFG	A Turbo Codec Card FPGA configuration failure exists, possibly caused by a missing or incorrect file.	{Pass/Fail, Unmasked/Masked}
CODEC DEV CFG	Indicates Turbo Codec Card ASIC configuration failure.	{Pass/Fail, Unmasked/Masked}
+1.5V RX SUPPLY	Shows the measured voltage of the 1.5 Volt Rx power bus inside the modem.	{Pass/Fail, Unmasked/Masked}
+1.5V TX SUPPLY	Shows the measured voltage of the 1.5 Volt Tx power bus inside the modem.	{Pass/Fail, Unmasked/Masked}

Alarm	Description	Status
+3.3V SUPPLY	Shows the measured voltage of the +3.3 Volt power bus inside the modem.	{Pass/Fail, Unmasked/Masked}
+5V SUPPLY	Shows the measured voltage of the +5 Volt power bus inside the modem.	{Pass/Fail, Unmasked/Masked}
+12V SUPPLY	Shows the measured voltage of the +12 Volt power bus inside the modem.	{Pass/Fail, Unmasked/Masked}
+20V SUPPLY	Shows the measured voltage of the +20 Volt power bus inside the modem.	{Pass/Fail, Unmasked/Masked}
EXT CLOCK ACT	The External Clock is not active.	{Pass/Fail, Unmasked/Masked}
EXT REF ACT	No activity exists on the External Reference.	{Pass/Fail, Unmasked/Masked}
EXT REF LOCK	The External Reference PLL is not locked.	{Pass/Fail, Unmasked/Masked}
ETHERNET WAN	Displays the current status of the WAN	{Pass/Fail, Unmasked/Masked}
TRANSEC PWR TEST	Displays the results of the Power On Self Test (POST) done by the TRANSEC module when installed.	{Pass/Fail, Unmasked/Masked}

6.4 Alarm Masks

The DMD2050E self-monitors and isolates faults. Alarms for these faults are categorized as:

- Active Alarms
- Common Equipment Alarms
- Backward Alarms

CAUTION
Masked alarms can cause unwanted effects in the performance of the unit.

You can mask certain alarms. Masking alarms can be helpful during debugging, or when you need to to lock out a known failure.

When an alarm is masked, the front panel LEDs and the Fault Relays are not activated, but the Alarm is shown in the display.

6.4.1 Active Alarms

6.4.1.1 Major Alarms

If a major alarm is on constantly, the modem has a hardware failure.

A major alarm flashes briefly during configuration changes and power-up. No action is necessary.

Alarms are grouped into transmit and receive alarms. Transmit and receive alarms are completely independent of each other.

6.4.1.2 Minor Alarms

Minor alarms show that a problem exists outside of the modem. Examples of such problems are:

- Loss of terrestrial clock
- Loss of terrestrial data activity
- Transmit or receive AIS condition

Alarms are grouped into transmit and receive alarms. Transmit and receive alarms are completely independent of each other.

6.4.2 Common Equipment Alarms

Common equipment alarms occur when the unit has problems that affect both transmit and receive operations. Most common equipment alarms occur when there is a hardware failure in the unit, such as a malfunctioning power supply.

External reference and external clock alarms occur when a unit has a configuration problem, not a hardware failure.

6.4.3 Latched Alarms

Latched alarms are used for intermittent failures. If a fault occurs, the fault indication is "latched" even if the alarm goes away.

After the unit is configured and operating correctly, clear any latched alarms.

CLEAR LATCHED ((ENTER))	Press ENTER to reset the latched alarms.

These alarms are latched to catch intermittent failures:

TX MAJOR (menu)	**{Pass/Fail}**	**TX MINOR (menu)**	**{Pass/Fail}**
FPGA CFG		TERR CLK ACT	
DSP CFG		TERR DATA ACT	
SCT CLOCK PLL		TX TERR AIS	
SYM CLOCK PLL		DnI FRAME LOCK	
LB SYNTH PLL		DnI M-FRAME LOCK	
IF SYNTH PLL		DROP CRC	
ETHERNET WAN		TX DVB FRM LOCK	
TRANSEC NOT RDY		TX CL,SRC FALLBK	
		TPC CONFLICT CHK	

RX MAJOR (menu)	**{Pass/Fail}**	**RX MINOR (menu)**	**{Pass/Fail}**
FPGA CFG		BUFF UNDERFLOW	
DSP CFG		BUFF NEAR EMPTY	
SIGNAL LOCK		BUFF NEAR FULL	
INPUT LVL THRESH		BUFF OVERFLOW	
FRAME LOCK		RX DATA ACTIVITY	

RX MAJOR (menu)	{Pass/Fail}	RX MINOR (menu)	{Pass/Fail}
MULTIFRAME LOCK		SAT AIS	
LB SYNTH PLL		DnI FRAME LOCK	
IF SYNTH PLL		DnI M-FRAME LOCK	
ETHERNET WAN		INSERT CRC	
		T1/E1 SIGNALING	
		IFEC LOCK	
		TPC CONFLICT CHK	
		OFEC LOCK	
		INTERLEAVER	
		RS UNCORR. WORD	
		EBNO	
		RX AGC LEVEL	
		IBS BER	
		RX DVB FRM LOCK	
		EMBEDDED CHAN	

COMMON (menu)	{Pass/Fail}	VOLTAGE (menu)	{Pass/Fail}
TERR FPGA CFG		+1.5V RX SUPPLY	
CODEC FPGA CFG		+1.5V TX SUPPLY	
CODEC DEV CFG		+3.3V SUPPLY	
EXT CLOCK ACT		+5V SUPPLY	
EXT REF ACT		+12V SUPPLY	
EXT REF LOCK		-12V SUPPLY	
ETHERNET WAN		+20V SUPPLY	
TRANSEC PWR TEST			

NOTE
These alarms show the status of the alarms RECEIVED FROM the distant satellite end.

IDR1 SAT ALARM 1	{PASS, FAIL}	
IDR1 SAT ALARM 2	{PASS, FAIL}	
IDR1 SAT ALARM 3	{PASS, FAIL}	
IDR1 SAT ALARM 4	{PASS, FAIL}	
IBS SAT ALARM	{PASS, FAIL}	
T1E1 SATTERR ALM	{PASS, FAIL}	
SAT MAP SUMMARY	{NONE, BK 1; BK 2; BK 1&2; BK 3; BK 1&3; BK 2&3; BK 1&2&3; BK 4; BK 1&4; BK 2&4; BK 1&2&4; BK 3&4; BK 1&3&4; BK 2&3&4; BK 1&2&3&4}	Summary alarm is given when criteria meets the selection above.

NOTE
These alarms show the control status of the alarms TRANSMITTED TO the distant satellite end.

IDR1 SAT CNTRL	{STNDRD, FRC ON, FRC OFF}
STNDRD:	Set Alarm functions in a normal configuration
FRC ON:	Forces an ON alarm status that is transmitted to the distant end.
FRC OFF:	Forces an OFF alarm status that is transmitted to the distant end.
IDR2 SAT CNTRL	{STNDRD, FRC ON, FRC OFF}
IDR3 SAT CNTRL	{STNDRD, FRC ON, FRC OFF}
IDR4 SAT CNTRL	{STNDRD, FRC ON, FRC OFF}
IBS SAT CNTRL	{STNDRD, FRC ON, FRC OFF}
T1E1 TERR CNTRL	{STNDRD, FRC ON}
IBS TX PROMPT	{STNDRD, FRC ON}
IBS TX SERVICE	{STNDRD, FRC ON}

6.4.4 Backward Alarms

Backward alarms are received from the distant end of the satellite link.

In IBS mode (including Drop & Insert), Backward Alarm 1 is the only alarm used. If the demodulator at the distant end loses the signal lock, Backward Alarm 1 is received.

6.5 IBS Alarms and Actions

Figure 6-1 and Table 6-1show the IBS alarms and actions to be taken at the earth station, the terrestrial data stream and the satellite. These alarms include those detected on the terrestrial link and those detected from the satellite.

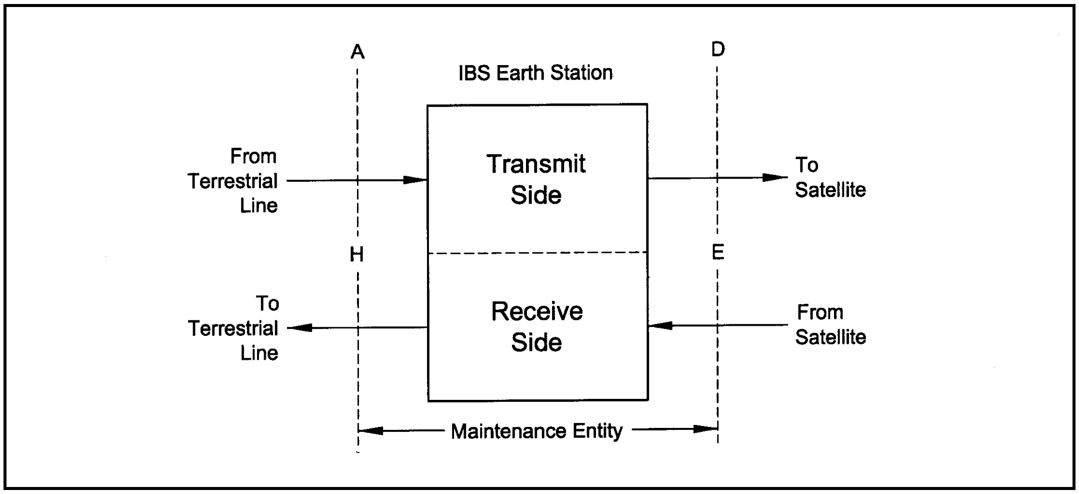

Figure 6-1. IBS Alarms

Table 6-1. IBS Fault Conditions and Actions (includes Drop and Insert)

Fault Detected on Terrestrial Link (Across Interface A)	Action In Earth Station	Action to Terrestrial (Across Interface H)	Action to Satellite (Across Interface D)
FA1 - Loss of Terrestrial Input	AS1, 2 - IBS Prompt, Service Alarm	AH2 - ‘1’ in Bit 3 of NFAS TSO, Yellow Alarm	AD1 - AIS in Relevant TSs
FA2 - Loss of Terrestrial Signaling	AS1 - IBS Prompt Alarm	AH2 - ‘1’ in Bit 3 of NFAS TSO, Yellow Alarm	AD3 - ‘1111’ in RelevantTS16s
FA3 - Loss of Terrestrial Frame	AS1 - IBS Prompt Alarm	AH2 - ‘1’ in Bit 3 of NFAS TSO, Yellow Alarm	AD1 - AIS in Relevant TSs
FA4 - Loss of Terrestrial Multiframe	AS1 - IBS Prompt Alarm	AH2 - ‘1’ in Bit 3 of NFAS TSO, Yellow Alarm	AD3 - ‘1111’ in Relevant TS16s
FA5 - BER of 1x 10^{-3} or Greater on Terrestrial Input	AS1 - IBS Prompt Alarm	AH2 - ‘1’ in Bit 3 of NFAS TSO, Yellow Alarm	AD1 - AIS in Relevant TSs
FA6 - Alarm Received on Terrestrial Input	---	---	AD2 - ‘1’ in Bit 3 of Byte 32
Fault Detected From Satellite (Across Interface E)	**Action In Earth Station**	**Action to Terrestrial (Across Interface H)**	**Action to Satellite (Across Interface D)**
FA1 - Loss of Satellite Signal Input	AS1, 2 - IBS Prompt, Service Alarm	AH1, 3 - AIS in TSs, ‘1111’ in TS16	AD2 - ‘1’ in Bit 3 of Byte 32
FA2 - Loss of Satellite Frame	AS1, 2 - IBS Prompt, Service Alarm	AH1, 3 - AIS in TSs, ‘1111’ in TS16	AD2 - ‘1’ in Bit 3 of Byte 32
FA3 - Loss of Satellite Multiframe	AS1, 2 - IBS Prompt, Service Alarm	AH1, 3 - AIS in TSs, ‘1111’ in TS16	AD2 - ‘1’ in Bit 3 of Byte 32
FA4 - BER of 1E-3 or Greater From Satellite Input	AS1, 2 - IBS Prompt, Service Alarm	AH1, 3 - AIS in TSs, ‘1111’ in TS16	AD2 - ‘1’ in Bit 3 of Byte 32
FA5 - Alarm Received From Satellite Input	AS2 - IBS Service Alarm	AH2 - ‘1’ in Bit 3 of NFAS TS0, Yellow Alarm	---

Chapter 7. Technical Specifications

7.1 Modulator

Modulator Specifications	
Modulation	BPSK, QPSK, OQPSK, 8-PSK, 8-QAM, 16-QAM, 16-APSK
IF Tuning Range	50 to 90, 100 to 180 MHz in 1 Hz Steps
L-Band Tuning Range	950 to 2050 MHz in 1 Hz Steps
Impedance	IF, 50 Ohm (75 Ohm Optional)
	L-Band, 50 Ohm
Connector	TNC, 50 Ohm
	SMA, 50 Ohm, L-Band
Return Loss	IF, 1.5:1
	L-Band, 2.0:1
Output Power	0 to -40 dBm
Output Stability	IF, ±0.5 dB Over Frequency and Temperature
	L-Band, ±.5 dB Over Frequency and Temperature
Output Spectrum	Selectable Meets MIL-188-165A/B or IESS 308/309/ 310 Power Spectral Mask
Spurious	-55 dBc In-Band (50 to 90 MHz, 100 to 180 MHz, 950 to 2050 MHz)
	-45 dBc Out-of-Band
On/Off Power Ratio	>60 dB
Scrambler	OM-73, CCITT, V.35 or IBS
FEC	
Viterbi	{1/2, 3/4, 7/8, None} K = 7
Sequential	{1/2, 3/4, 7/8}
CSC	{3/4}
Trellis (8-PSK)	{2/3}
Turbo (BPSK)	{21/44,5/16} ≤ 20Mbps
Turbo (OQPSK/QPSK)	{1/2, 3/4, 7/8} ≤ 20Mbps
Turbo (8-PSK/8-QAM)	{3/4, 7/8} ≤ 20Mbps

Modulator Specifications	
Turbo (16-QAM)	{3/4, 7/8} ≤ 20Mbps
DVB VIT	{2/3, 5/6}
DVB Trellis	{3/4, 5/6, 7/8, 8/9}
LDPC (BPSK)	{1/2}
LDPC (OQPSK/QPSK)	{1/2, 2/3, 3/4}
LDPC (8-PSK/8-QAM)	{2/3, 3/4}
LDPC (16-QAM)	{3/4}
STANAG Turbo (B/QPSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
STANAG Turbo (8-PSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
STANAG Turbo (16-APSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
Outer Encoder Options	Reed-Solomon INTELSAT (DVB Optional)
	Custom (N, K) Reed-Solomon
Data Clock Source	Internal, External, Rx Recovered
Internal Stability	5×10^{-8}

7.2 Demodulator

Demodulator Specifications	
Demodulation	BPSK, QPSK, OQPSK, 8-PSK, 8-QAM, 16-QAM, 16-APSK
IF Tuning Range	50 to 90, 100 to 180 MHz in 1 Hz Steps
L-Band Tuning Range	950 to 2050 MHz in 1 Hz Steps
Impedance	IF, 50 Ohm (75 Ohm Optional)
	L-Band, 50 Ohm
Connector	TNC, 50 Ohm
	SMA, 50 Ohm, L-Band
Return Loss	IF, 1.5:1
	L-Band, 2.0:1
Spectrum	MIL-188-165A, INTELSAT IESS 308/309/310, DVB
Input Level	-55 to +10 dBm
	and 10 log (Symbol Rate) -120 dBm / Hz, SR < 2500 k
Total Input Power	+20 dBm or +40 dBc (the Lesser)
FEC	
Viterbi,	{1/2, 3/4, 7/8, None} K = 7
Sequential	{1/2, 3/4, 7/8}
CSC	{3/4}
Trellis (8-PSK)	{2/3}
Turbo (BPSK)	{21/44,5/16} ≤ 20Mbps

Demodulator Specifications	
Turbo (OQPSK/QPSK)	{1/2, 3/4, 7/8} ≤ 20Mbps
Turbo (8-PSK/8-QAM)	{3/4, 7/8} ≤ 20Mbps
Turbo (16-QAM)	{3/4, 7/8} ≤ 20Mbps
DVB VIT	{2/3, 5/6}
DVB Trellis	{3/4, 5/6, 7/8, 8/9}
LDPC (BPSK)	{1/2}
LDPC (OQPSK/QPSK)	{1/2, 2/3, 3/4}
LDPC (8-PSK/8-QAM)	{2/3, 3/4}
LDPC (16-QAM)	{3/4}
STANAG Turbo (B/QPSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
STANAG Turbo (8-PSK-PSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
STANAG Turbo (16-APSK)	{1/2, 2/3, 3/4, 7/8, 19/20, None}
Decoder Options	Reed-Solomon INTELSAT (DVB Optional)
	Custom (N, K) Reed-Solomon
Descrambler	OM-73, CCITT V.35 or IBS
Sweep Range	Programmable ±1 kHz to ± 255 kHz
Reacquisition Range	Programmable ±1 Hz to 65500 Hz
Sweep Delay Value	0 to 6500 seconds in 100 msec Steps

7.3 Plesiochronous Buffer

Size	0 msec to 64 msec
Centering	Automatic on Underflow/Overflow
Centering Modes	IBS: Integral Number of Frames
	IDR: Integral Number of Multi-Frames
Clock	Transmit, External, Rx Recovered or SCT (Internal)

7.4 Monitor and Control

Ethernet 10 BaseT/Web Browser
Remote RS-485/Terminal RS-232/DMD15 Protocol Compatible

7.5 Terrestrial Interfaces

MIL-188-114A, HSSI
GiGE 10/100/1000 Base-T

7.6 IBS/Synchronous Interface (Standard)

MIL-188-144A/RS-422/-530	All Rates, Differential, Clock/Data, DCE

7.7 High-Speed Serial Interface (HSSI) & Gigi Ethernet Data Interface

HSSI	HSSI, Serial, 50-Pin SCSI-2 Type Connector (Female)
Ethernet Data Interface	One RJ-45, Auto-Crossover, Auto-Sensing, 10/100/1000 Ethernet Data Ports. Complies with IEEE 802.3 and IEEE 802.3u.

7.8 Key loader interface

RS-232 Audio 6-Pin/GC283

7.9 Environmental

Prime Power	100 to 240 VAC, 50 to 60 Hz, 250 Watts Maximum
	48 VDC (Optional)
Operating Temperature	-10 to +60°C, 95% Humidity, Non-Condensing
Storage Temperature	-20 to 70°C, 99% humidity, Non-Condensing

7.10 Physical

Size	19” W x 19.25” D x 1.75” H
	(48.26 x 48.89 x 4.45 cm)
Weight	6.5 Pounds (3.0 Kg)

7.11 Data Rate Limits

7.11.1 Non-DVB

Non-DVB Data Rate Limits			
Modulation	**Code Rate**	**Min Data Rate**	**Max Data Rate**
BPSK	NONE	4800	10000000
BPSK	VIT 1/2	2400	10000000
BPSK	VIT 3/4	3600	10000000
BPSK	VIT 7/8	4200	10000000
BPSK	SEQ 1/2	2400	2048000
BPSK	SEQ 3/4	3600	2048000
BPSK	SEQ 7/8	4200	2048000
BPSK	TPC 21/44	2400	4772727
BPSK	TPC 5/16	18000	3906200
BPSK	LDPC 1/2	18000	5000000
BPSK	EBEM TURBO 1/2	64000	29730647
BPSK	EBEM TURBO 2/3	64000	39560865
BPSK	EBEM TURBO 3/4	64000	44455732
BPSK	EBEM TURBO 7/8	64000	51783601
BPSK	EBEM TURBO 19/20	64000	52000000
QPSK	NONE	9600	20000000
QPSK	VIT 1/2	4800	20000000
QPSK	VIT 3/4	7200	20000000
QPSK	VIT 7/8	8400	20000000
QPSK	SEQ 1/2	4800	2048000
QPSK	SEQ 3/4	7200	2048000
QPSK	SEQ 7/8	8400	2048000
QPSK	TPC 1/2	4582	9545454
QPSK	TPC 3/4	7200	15000000
QPSK	TPC 7/8	8400	17500000
QPSK	LDPC 1/2	18000	10000000
QPSK	LDPC 2/3	24000	13333333
QPSK	LDPC 3/4	27000	15000000
QPSK	EBEM TURBO 1/2	64000	14865324
QPSK	EBEM TURBO 2/3	64000	19780433
QPSK	EBEM TURBO 3/4	64000	22227866
QPSK	EBEM TURBO 7/8	64000	25891801
QPSK	EBEM TURBO 19/20	64000	26000000

Non-DVB Data Rate Limits			
Modulation	Code Rate	Min Data Rate	Max Data Rate
OQPSK	NONE	9600	20000000
OQPSK	VIT 1/2	4800	20000000
OQPSK	VIT 3/4	7200	20000000
OQPSK	VIT 7/8	8400	20000000
OQPSK	SEQ 1/2	4800	2048000
OQPSK	SEQ 3/4	7200	2048000
OQPSK	SEQ 7/8	8400	2048000
OQPSK	TPC 1/2	4582	9545454
OQPSK	TPC 3/4	7200	15000000
OQPSK	TPC 7/8	8400	17500000
OQPSK	LDPC 1/2	18000	10000000
OQPSK	LDPC 2/3	24000	13333333
OQPSK	LDPC 3/4	27000	15000000
8-PSK	TRE 2/3	9600	52000000
8-PSK	TPC 3/4	40000	20000000
8-PSK	TPC 7/8	48000	20000000
8-PSK	LDPC 2/3	36000	20000000
8-PSK	LDPC 3/4	40500	20000000
8-PSK	EBEM TURBO 1/2	256000	44455732
8-PSK	EBEM TURBO 2/3	256000	52000000
8-PSK	EBEM TURBO 3/4	256000	52000000
8-PSK	EBEM TURBO 7/8	256000	52000000
8-PSK	EBEM TURBO 19/20	256000	52000000
8-QAM	TPC 3/4	40000	20000000
8-QAM	TPC 7/8	48000	20000000
8-QAM	LDPC 2/3	36000	20000000
8-QAM	LDPC 3/4	405000	20000000
16-QAM	VIT 3/4	14400	20000000
16-QAM	VIT 7/8	16800	20000000
16-QAM	TPC 3/4	54000	20000000
16-QAM	TPC 7/8	63000	20000000
16-QAM	LDPC 3/4	54000	20000000
16-APSK	EBEM TURBO 1/2	256000	52000000
16-APSK	EBEM TURBO 2/3	256000	52000000
16-APSK	EBEM TURBO 3/4	256000	52000000
16-APSK	EBEM TURBO 7/8	256000	52000000
16-APSK	EBEM TURBO 19/20	256000	52000000

7.11.2 DVB

DVB Data Rate Limits				
Modulation	Code Rate	DVB Mode	Min Data Rate	Max Data Rate
BPSK	VIT 1/2	187 Mode	2400	4583333
BPSK		188 Mode	2400	4607843
BPSK		204 Mode	2400	5000000
BPSK	VIT 2/3	187 Mode	2934	6111111
BPSK		188 Mode	2950	6143790
BPSK		204 Mode	3200	6666666
BPSK	VIT 3/4	187 Mode	3300	6875000
BPSK		188 Mode	3318	6911764
BPSK		204 Mode	3600	7500000
BPSK	VIT 5/6	187 Mode	3667	7638888
BPSK		188 Mode	3687	7679738
BPSK		204 Mode	4000	8333333
BPSK	VIT 7/8	187 Mode	3850	8020833
BPSK		188 Mode	3871	8063725
BPSK		204 Mode	4200	8750000
QPSK	VIT 1/2	187 Mode	4400	9166666
QPSK		188 Mode	4424	9215686
QPSK		204 Mode	4800	10000000
QPSK	VIT 2/3	187 Mode	5867	12222222
QPSK		188 Mode	5899	12287581
QPSK		204 Mode	6400	13333333
QPSK	VIT 3/4	187 Mode	6600	13750000
QPSK		188 Mode	6636	13823529
QPSK		204 Mode	7200	15000000
QPSK	VIT 5/6	187 Mode	7334	15277777
QPSK		188 Mode	7373	15359476
QPSK		204 Mode	8000	16666666
QPSK	VIT 7/8	187 Mode	7700	16041666
QPSK		188 Mode	7742	16127450
QPSK		204 Mode	8400	17500000
8-PSK	TRE 2/3	187 Mode	8800	18333333
8-PSK		188 Mode	8848	18431372
8-PSK		204 Mode	9600	20000000
8-PSK	TRE 5/6	187 Mode	11000	20000000
8-PSK		188 Mode	11059	20000000
8-PSK		204 Mode	12000	20000000

DVB Data Rate Limits				
Modulation	**Code Rate**	**DVB Mode**	**Min Data Rate**	**Max Data Rate**
8-PSK	TRE 8/9	187 Mode	11550	20000000
8-PSK		188 Mode	11797	20000000
8-PSK		204 Mode	12800	20000000
16-QAM	TRE 3/4	187 Mode	13200	20000000
16-QAM		188 Mode	13271	20000000
16-QAM		204 Mode	14400	20000000
16-QAM	TRE 7/8	187 Mode	15400	20000000
16-QAM		188 Mode	15483	20000000
16-QAM		204 Mode	16800	20000000

7.12 BER Specifications

7.12.1 BER Performance (Viterbi)

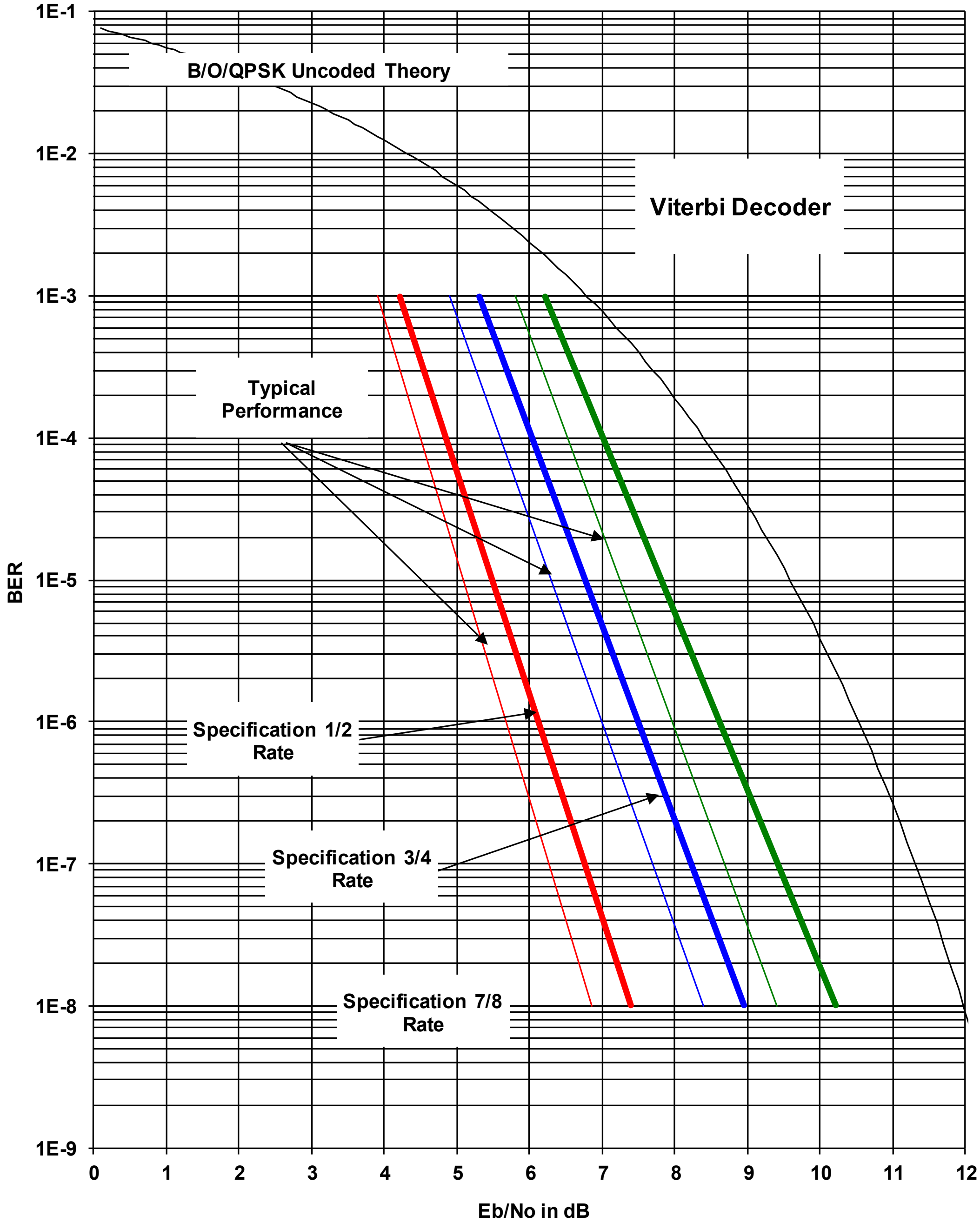

Figure 7-1. DMD2050E B/O/QPSK BER Performance (Viterbi)

Note: Eb/No values include the effect of using differential decoding and v.35 descrambling.

7.12.2 BER Performance (Sequential)

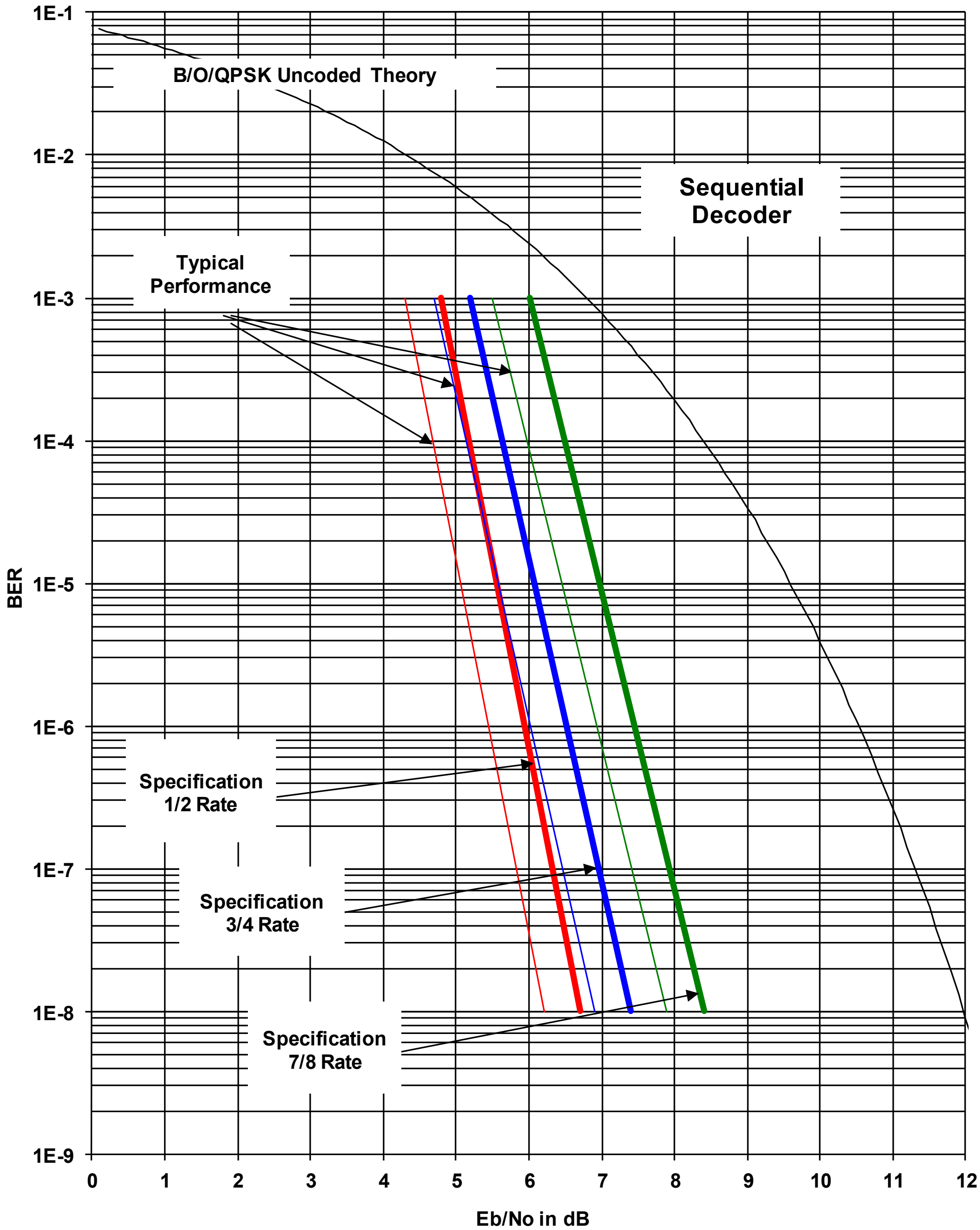

Figure 7-2. DMD2050E B/O/QPSK BER Performance (Sequential)

Note: Eb/No values include the effect of using differential decoding and v.35 descrambling.

7.12.3 BER Performance (Viterbi with Reed-Solomon)

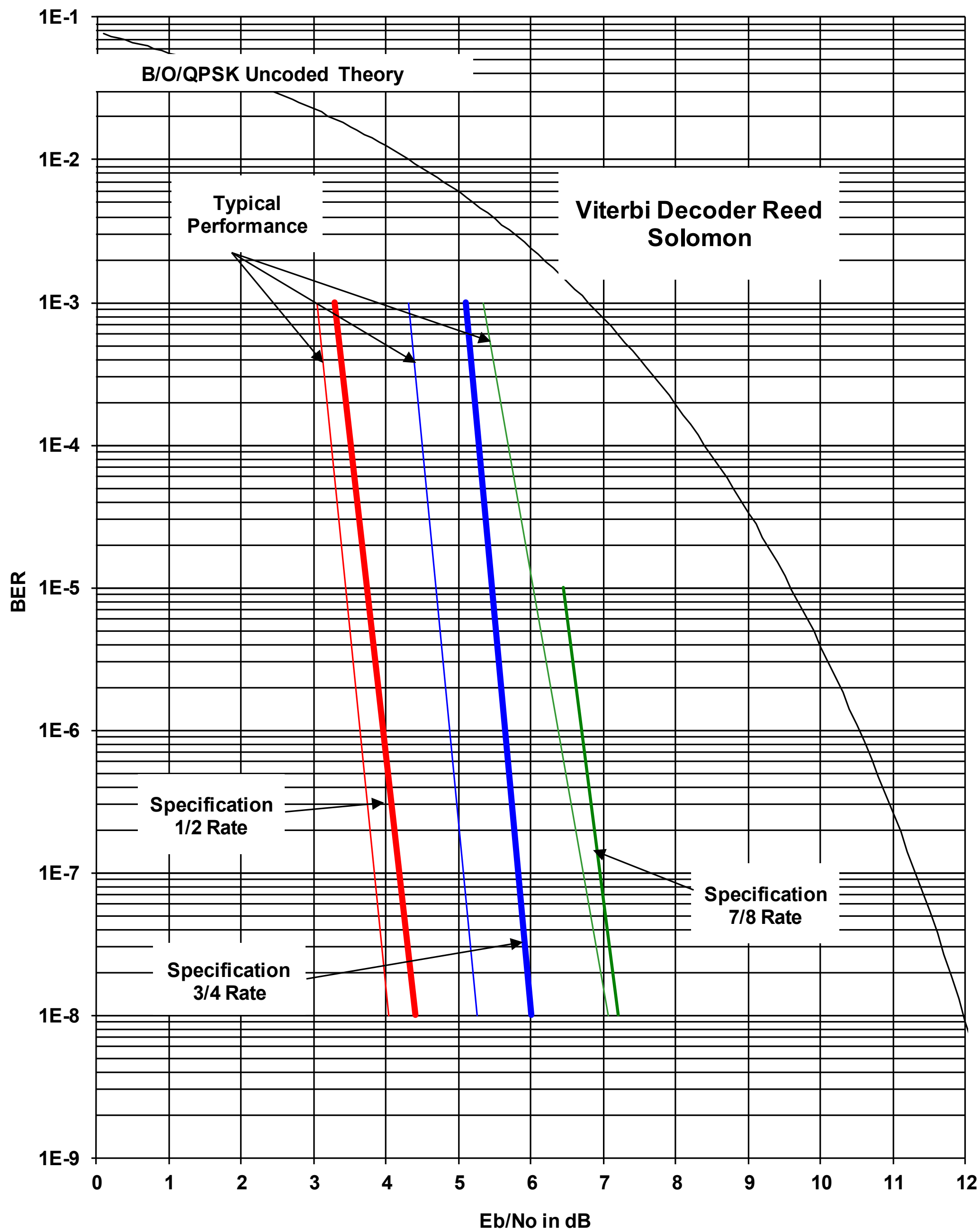

Figure 7-3. DMD2050E B/O/QPSK BER Performance (Viterbi with Reed-Solomon)

Note: Eb/No values include the effect of using differential decoding.

7.12.4 BER Performance (Turbo)

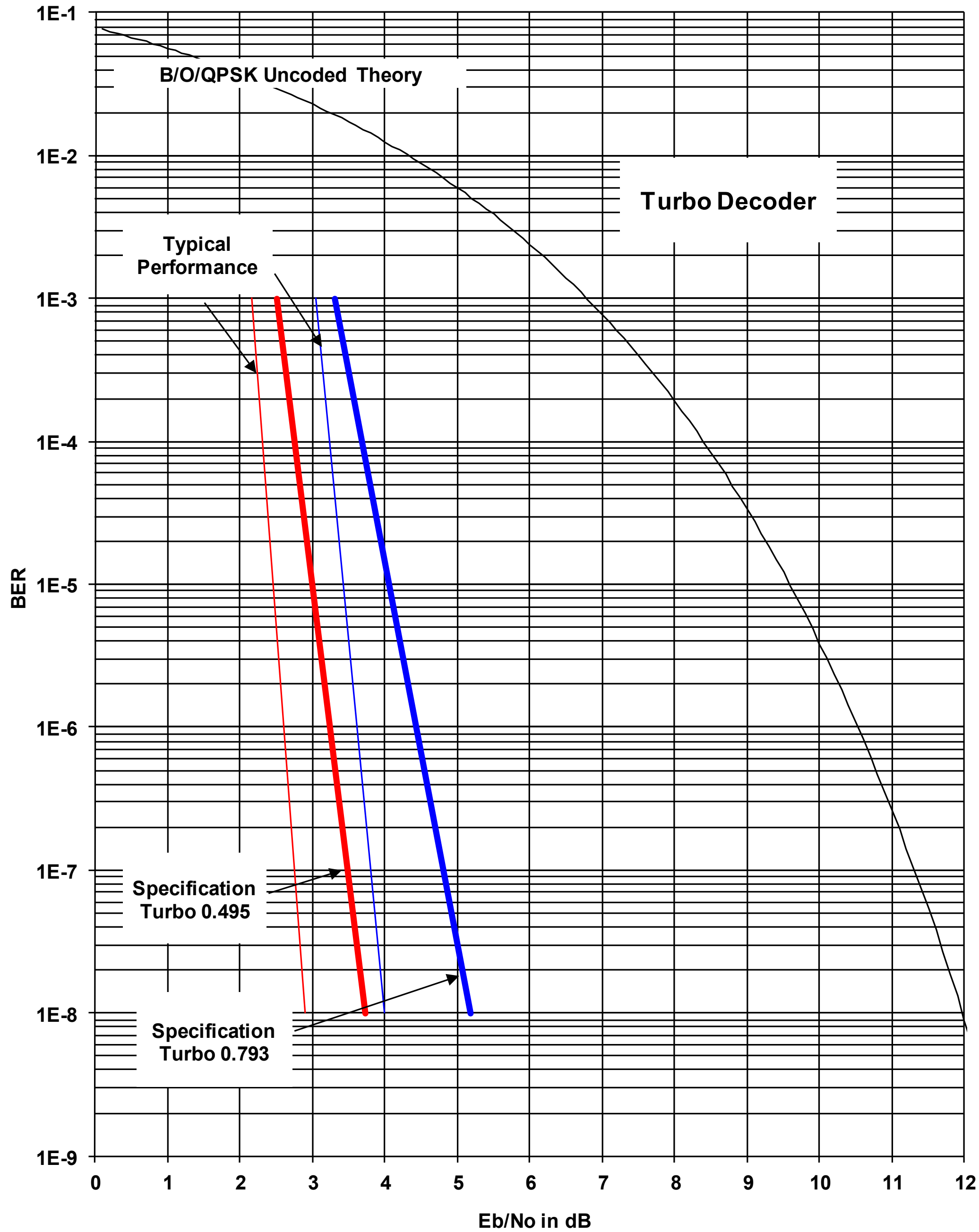

Figure 7-4. DMD2050E B/O/QPSK BER Performance (Turbo)

Note: Eb/No values include the effect of using interleaving and maximum iterations.

7.12.5 BER Performance (8PSK Trellis)

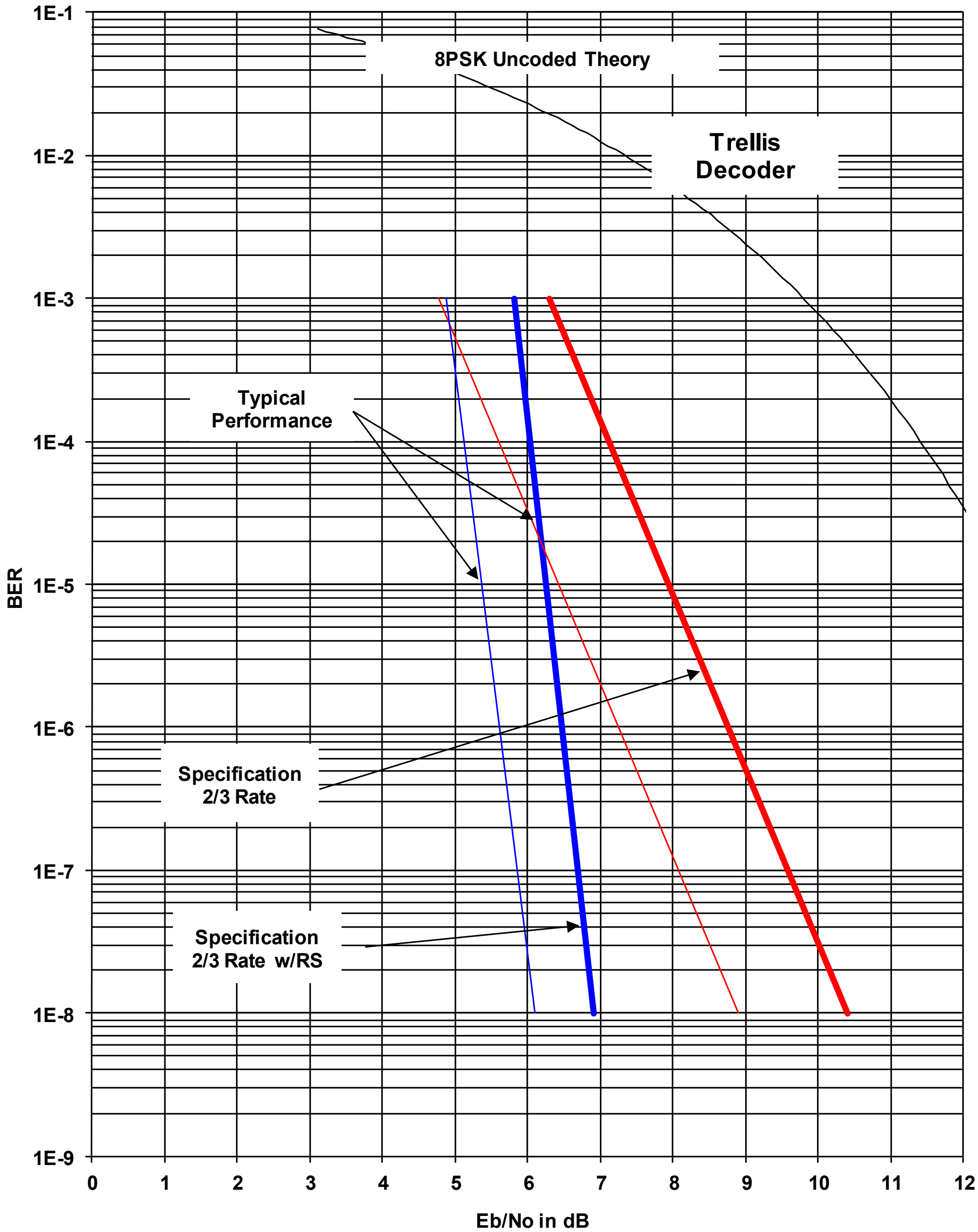

Figure 7-5. DMD2050E 8PSK BER Performance (Trellis)

Note: Eb/No values include the effect of using differential decoding and v.35 descrambling.

7.12.6 BER Performance (8PSK Turbo)

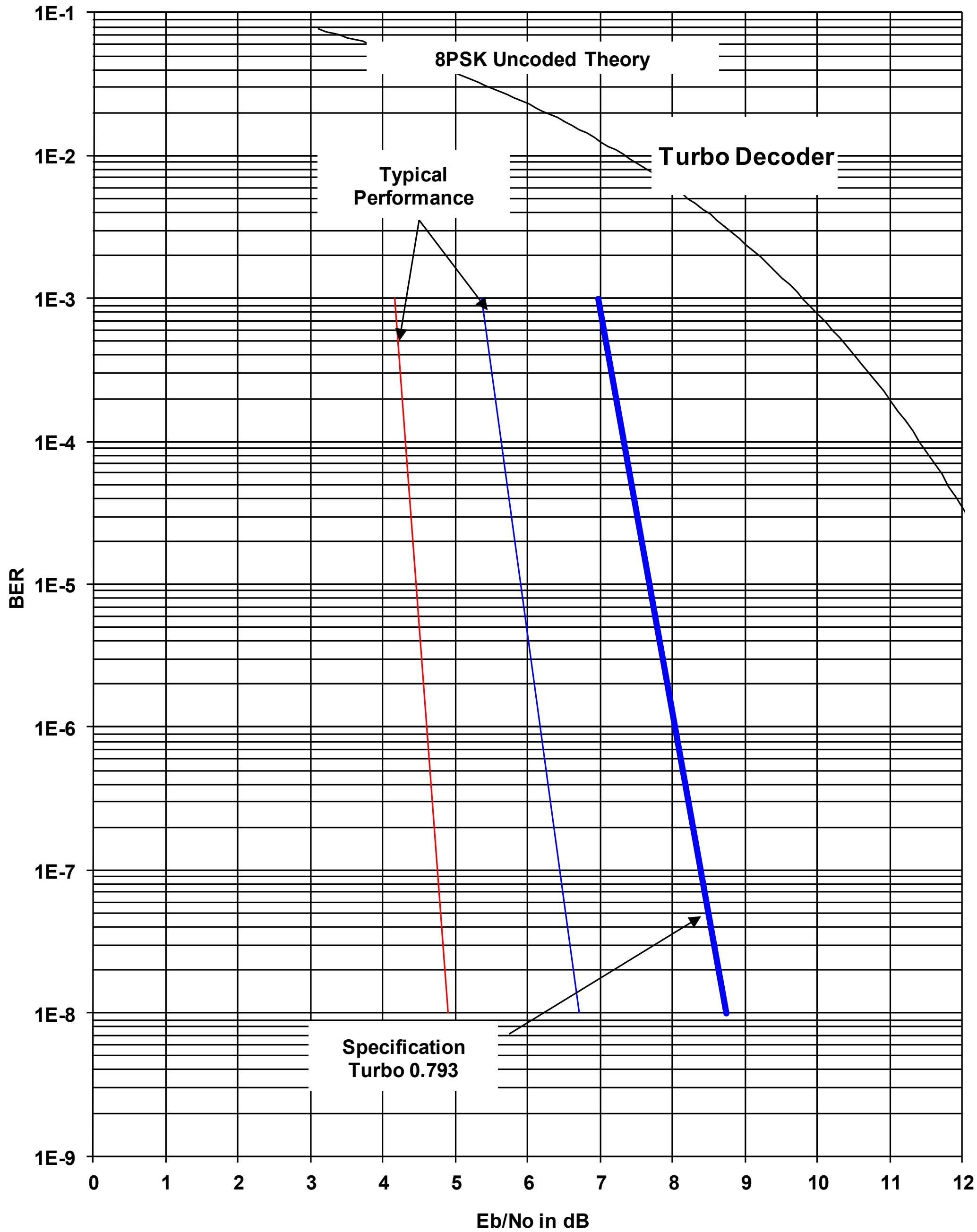

Figure 7-6. DMD2050E 8PSK BER Performance (Turbo)

Note: Eb/No values include the effect of using interleaving and maximum iterations.

7.12.7 BER Performance (16QAM Viterbi)

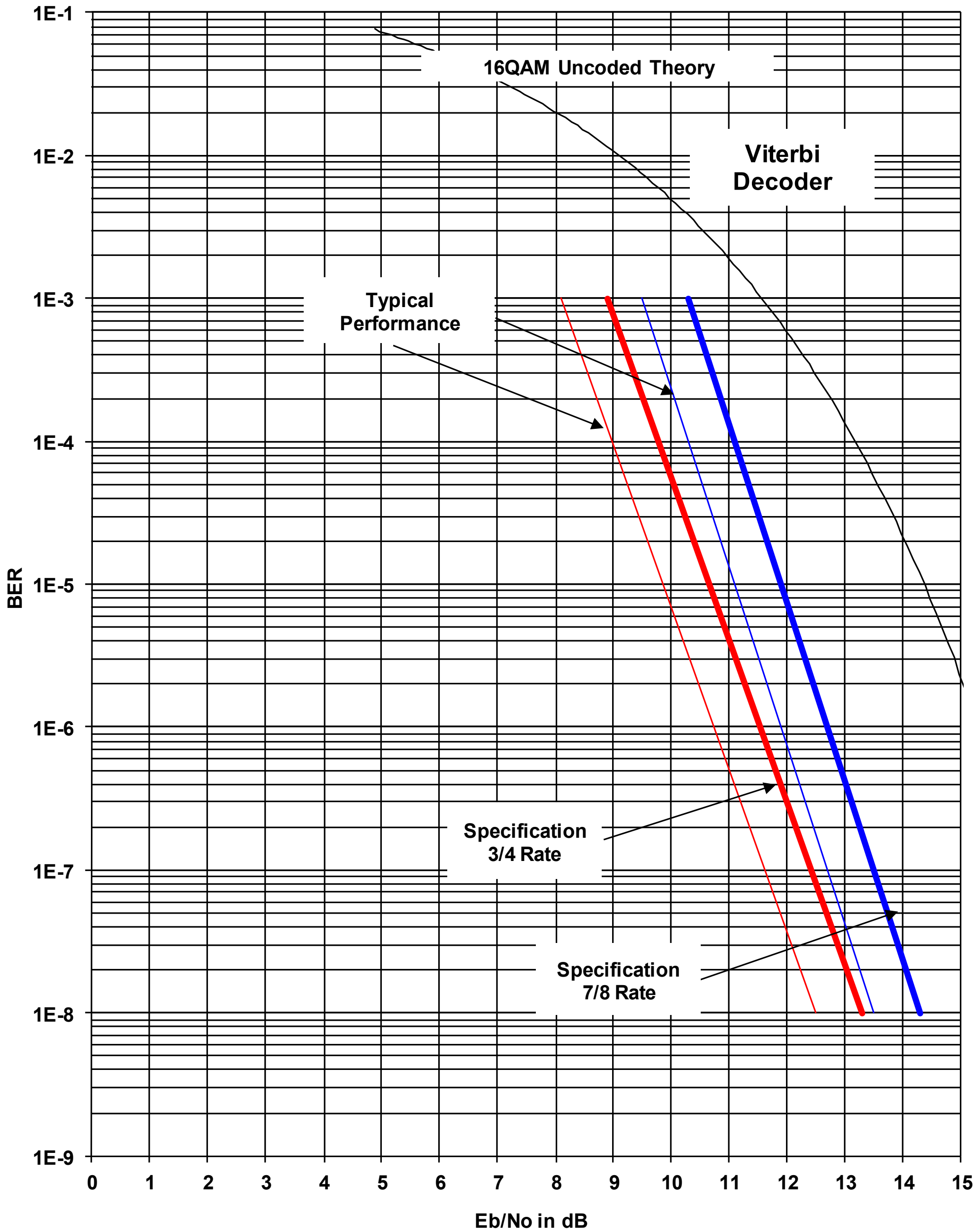

Figure 7-7. DMD2050E 16QAM BER Performance (Viterbi)

Note: Eb/No values include the effect of using differential decoding and v.35 descrambling.

7.12.8 BER Performance (16QAM Viterbi with Reed-Solomon)

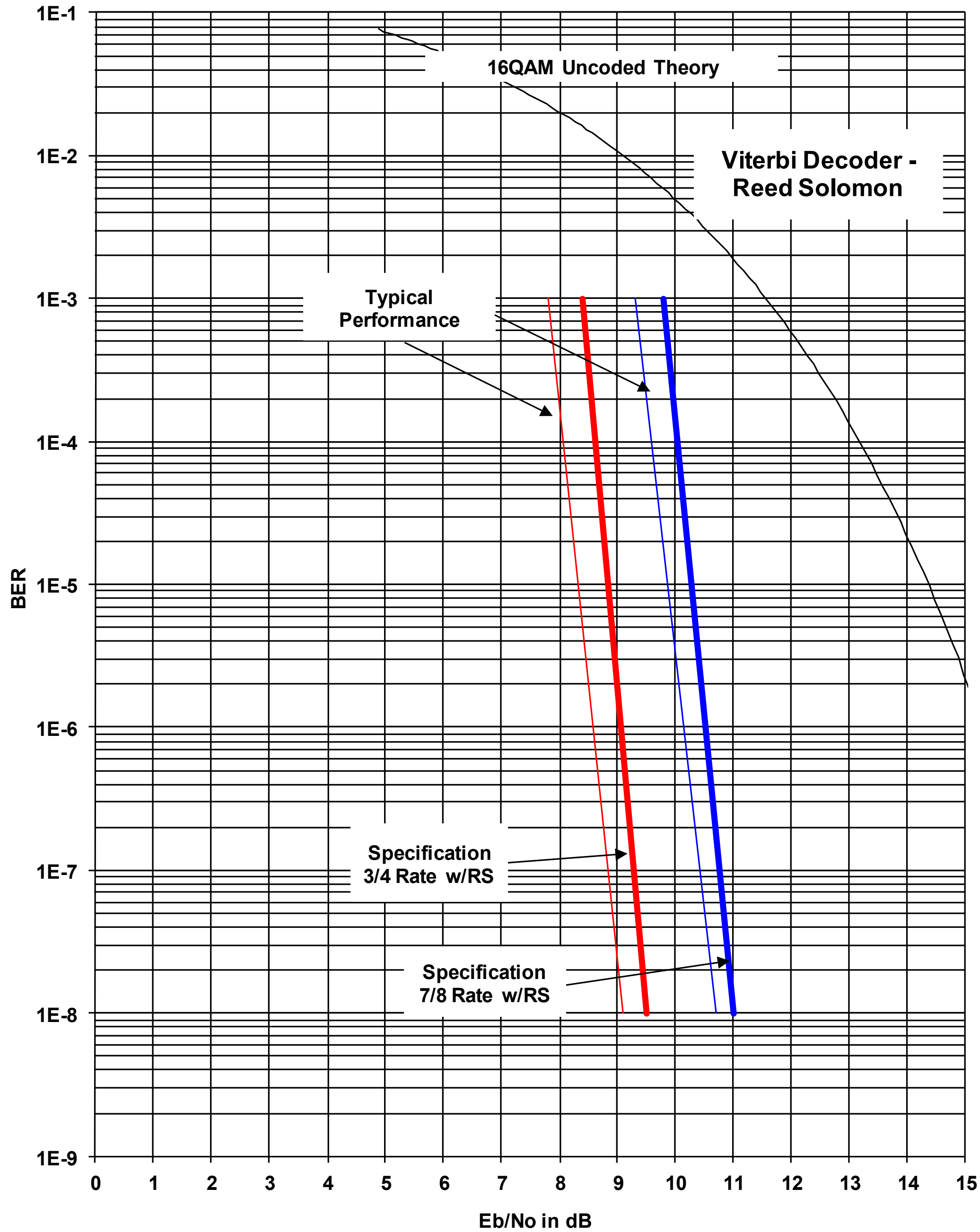

Figure 7-8. DMD2050E 16QAM BER Performance (Viterbi with Reed-Solomon)

Note: Eb/No values include the effect of using differential decoding.

7.12.9 BER Performance (16QAM Turbo)

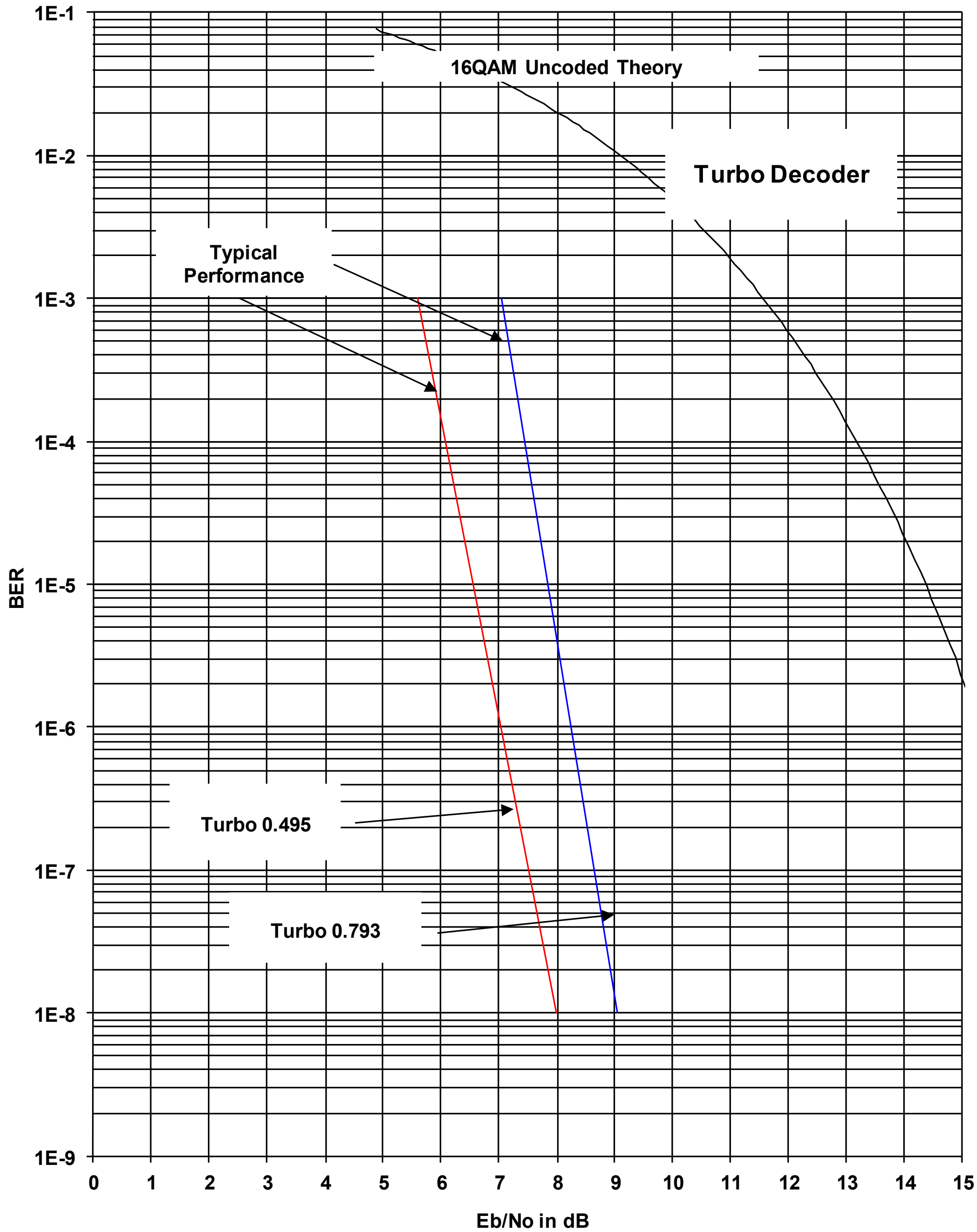

Figure 7-9. DMD2050E 16QAM BER Performance (Turbo)

Note: Eb/No values include the effect of using interleaving and maximum iterations.

7.12.10 BER Performance (OQPSK Turbo)

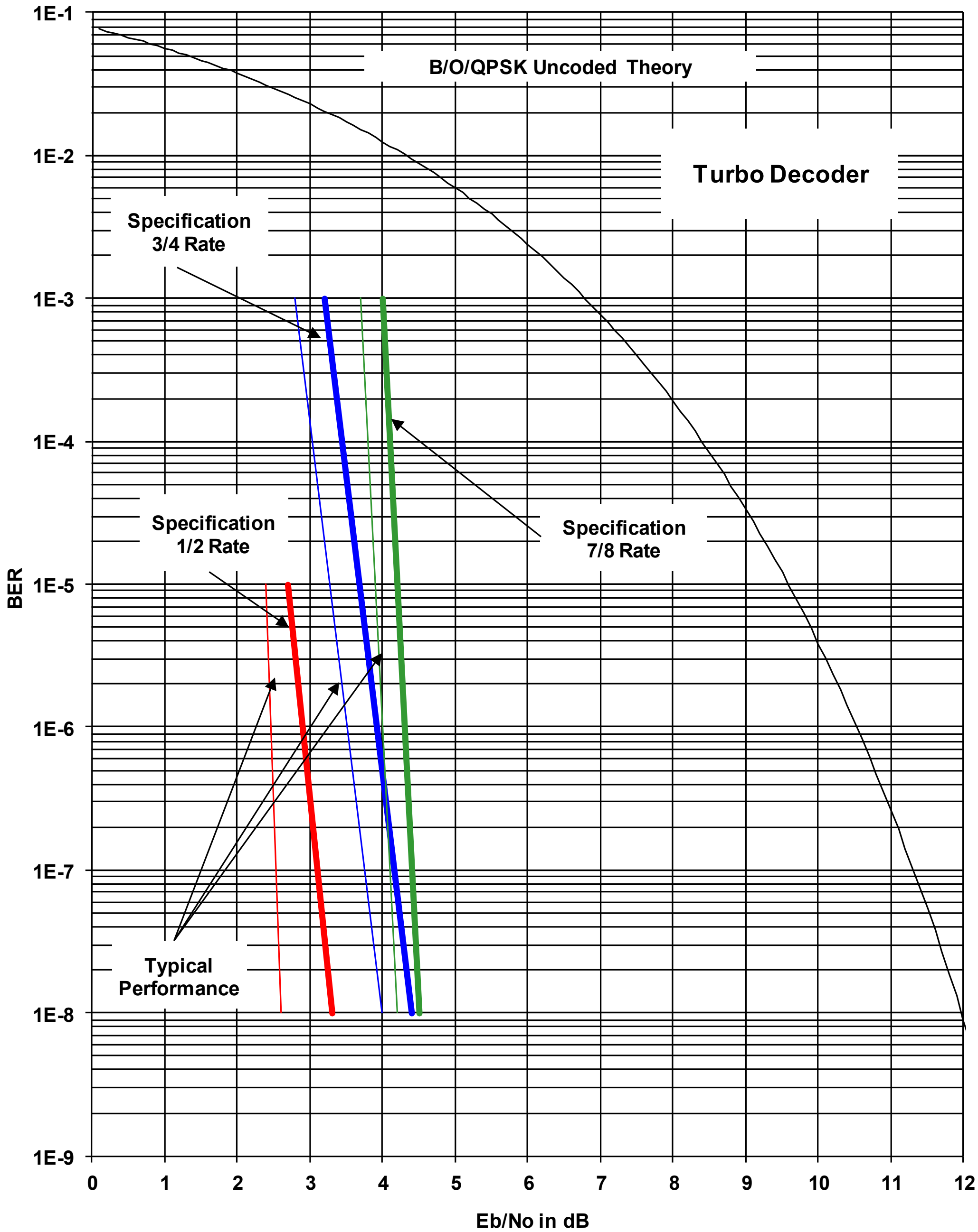

Figure 7-10. DMD2050E OQPSK BER Performance (Turbo)

7.12.11 BER Performance (BPSK Turbo)

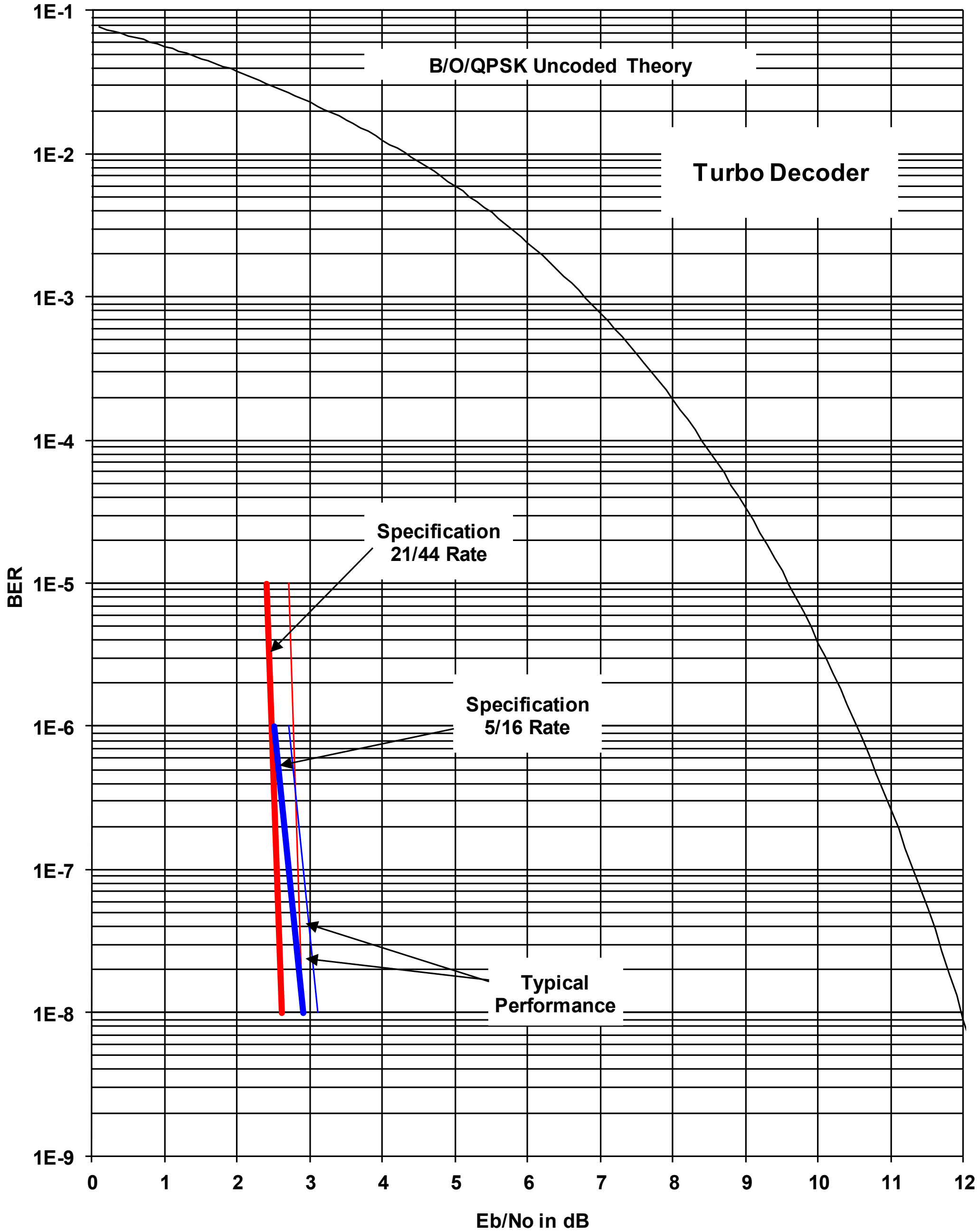

Figure 7-11. DMD2050E BPSK BER Performance (Turbo)

7.12.12 BER Performance (8PSK Turbo)

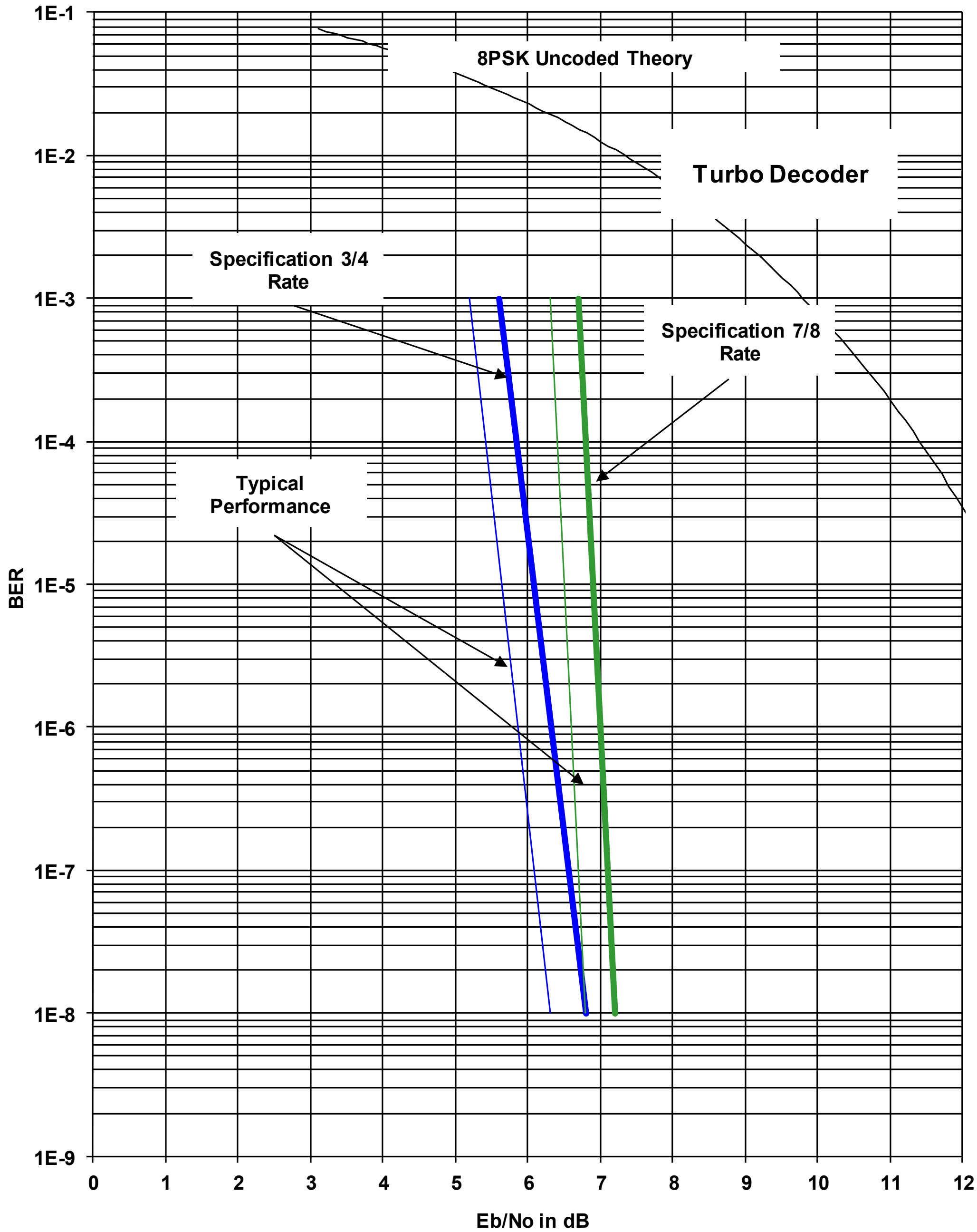

Figure 7-12. DMD2050E 8PSK BER Performance (Turbo)

7.12.13 BER Performance (16QAM Turbo)

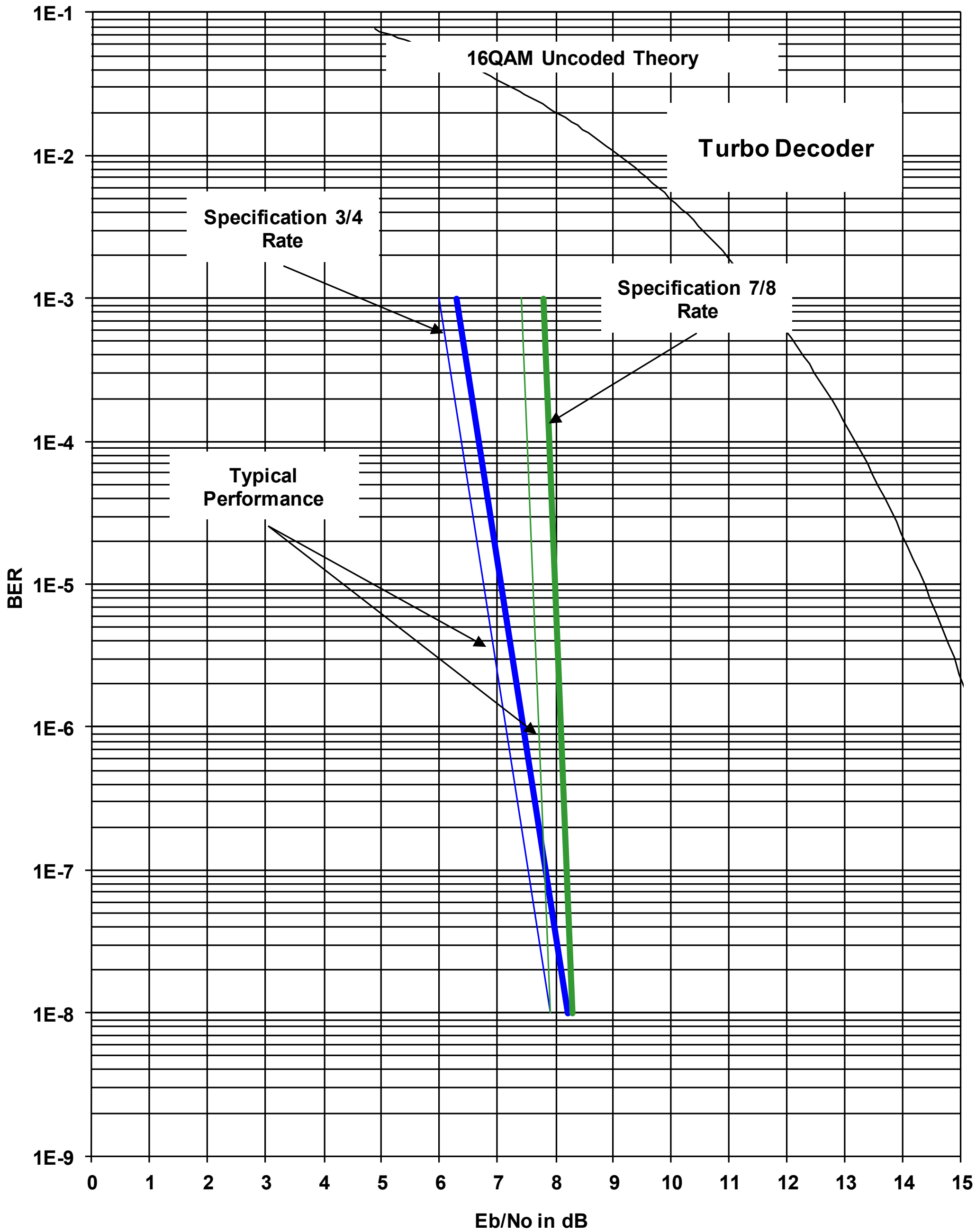

Figure 7-13. DMD2050E 16QAM BER Performance (Turbo)

7.12.14 B/O/QPSK BER Performance (LDPC)

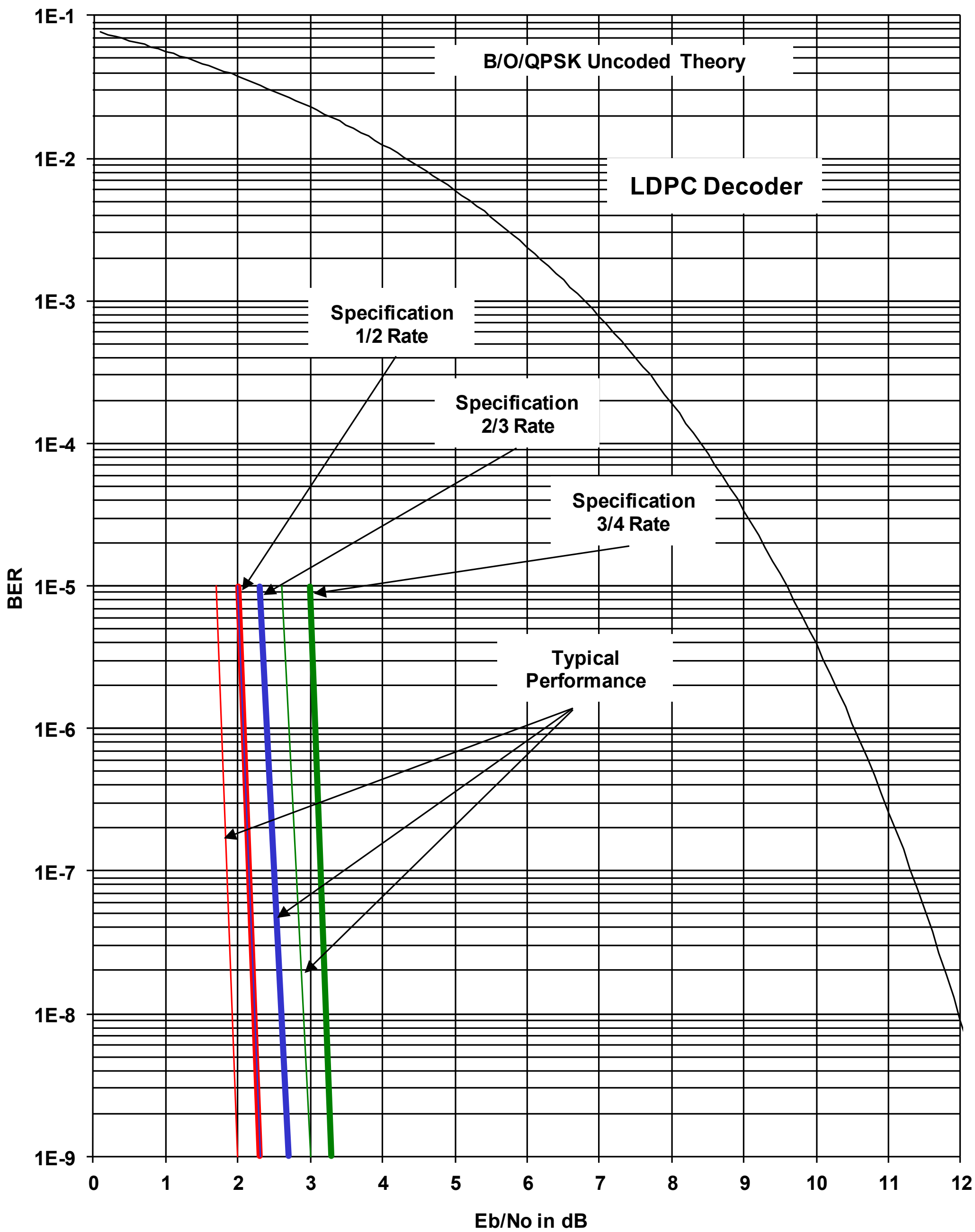

Figure 7-14. DMD2050E B/O/QPSK BER Performance (LDPC)

7.12.15 8PSK / 8QAM BER Performance (LDPC)

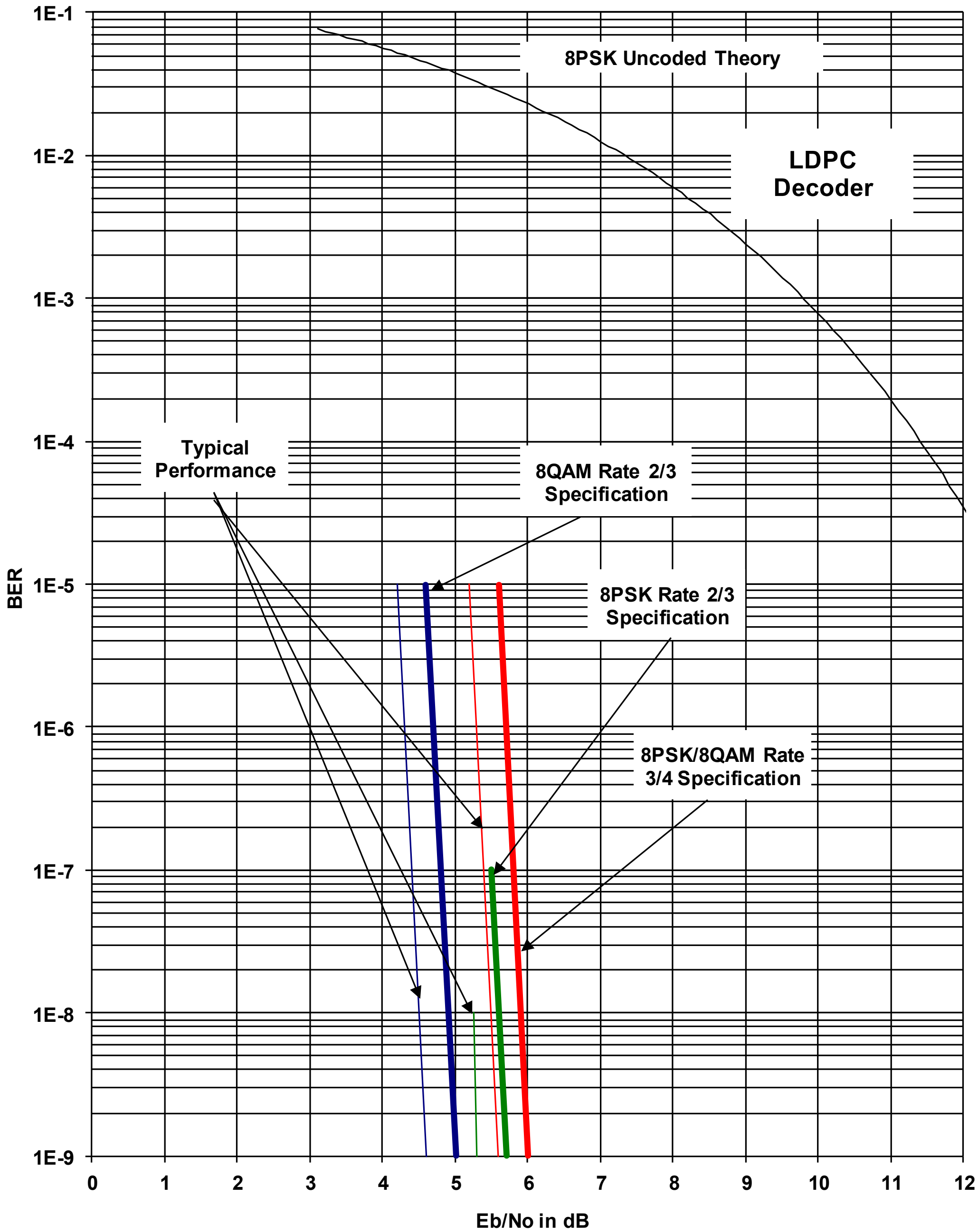

Figure 7-15. DMD2050E 8PSK / 8QAM BER Performance (LDPC)

7.12.16 16QAM BER Performance (LDPC)

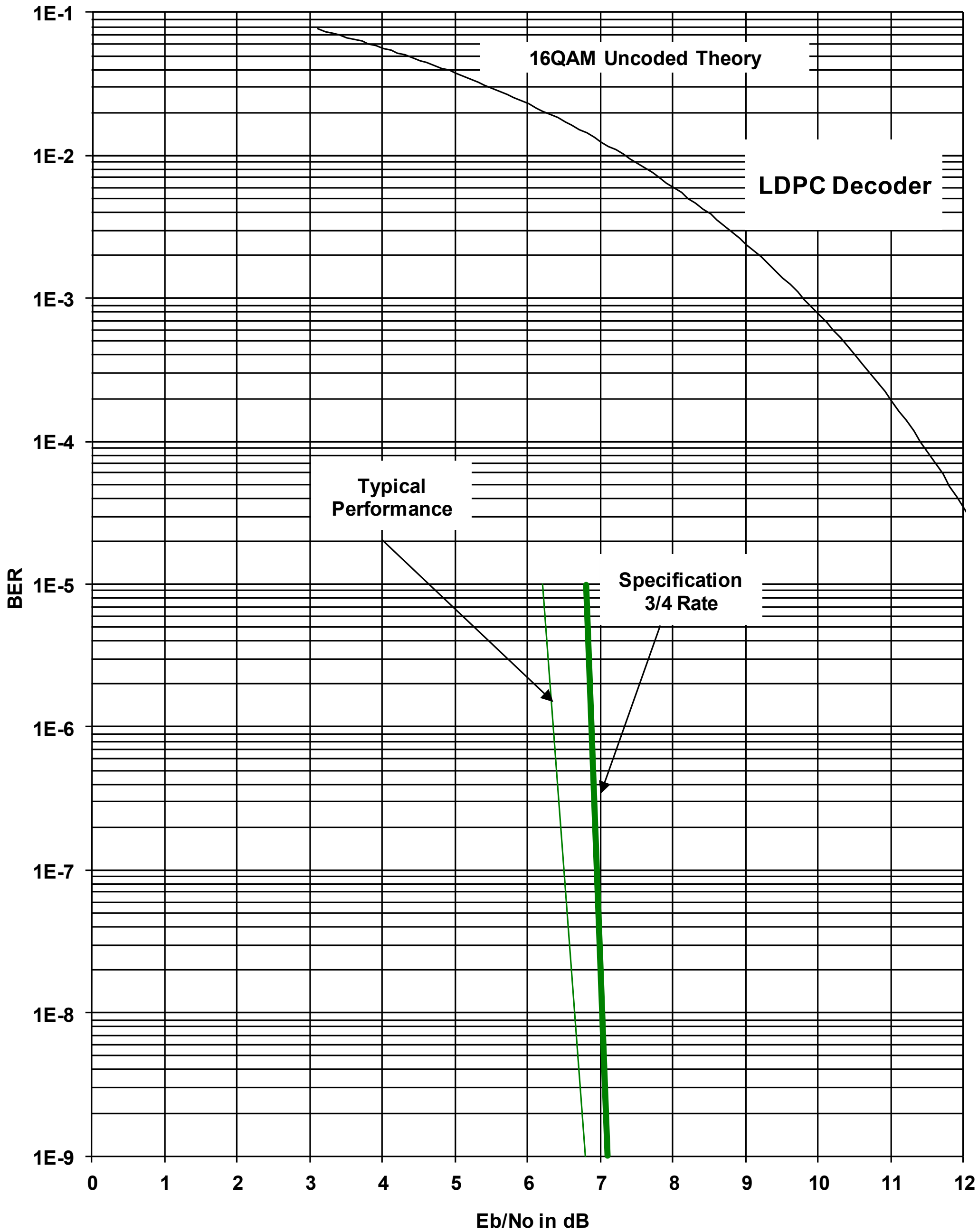

Figure 7-16. DMD2050E 16QAM BER Performance (LDPC)

7.12.17 BER Performance B/O/QPSK (MILSTD 188-165B or STANAG) Turbo

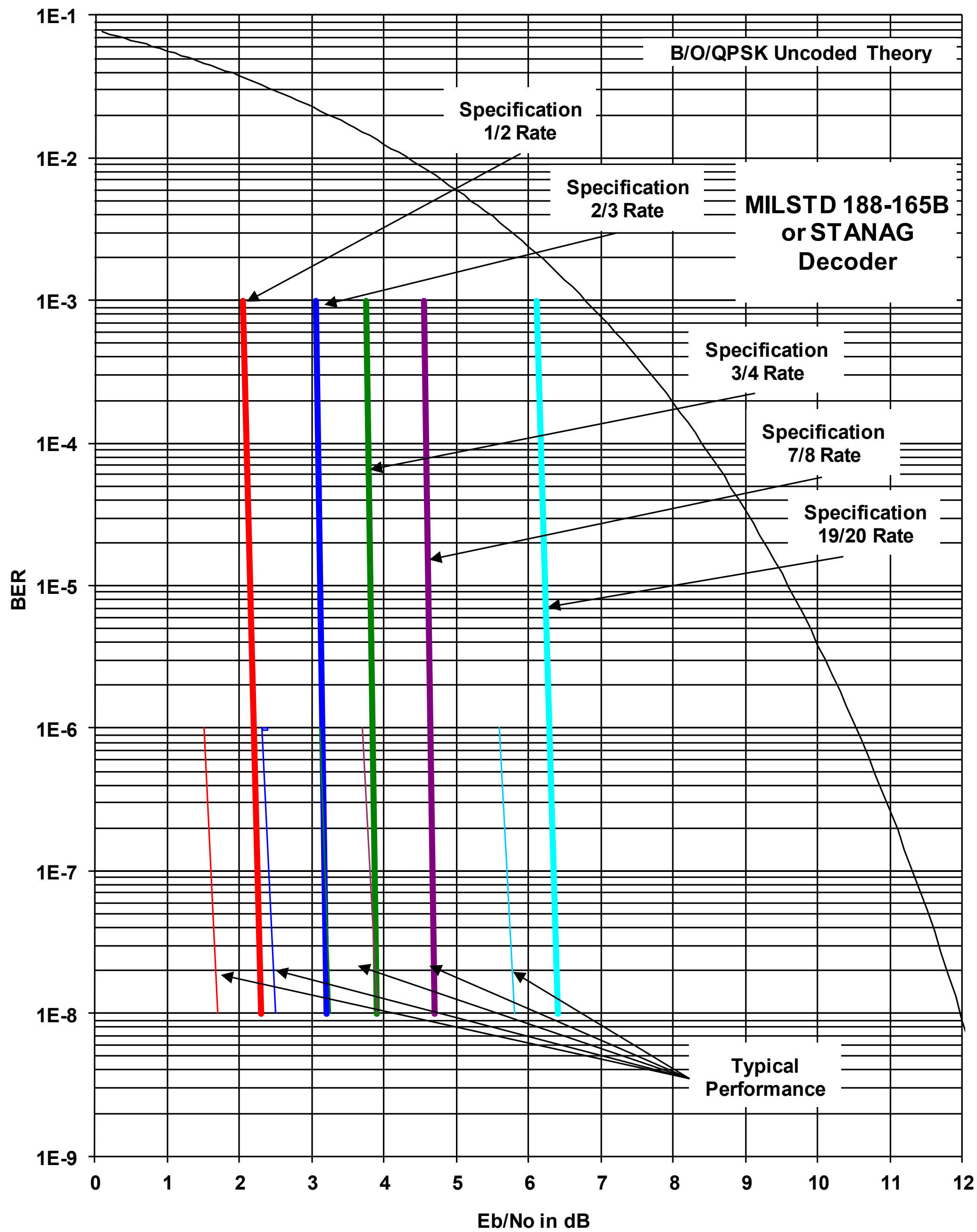

Figure 7-17. DMD2050E BER Performance B/O/QPSK (MILSTD 188-165B or STANAG) Turbo

Note: Eb/No to Bit-Error-Ratio 77values based on 16k block size

7.12.18 BER Performance 8-PSK (MILSTD 188-165B or STANAG) Turbo

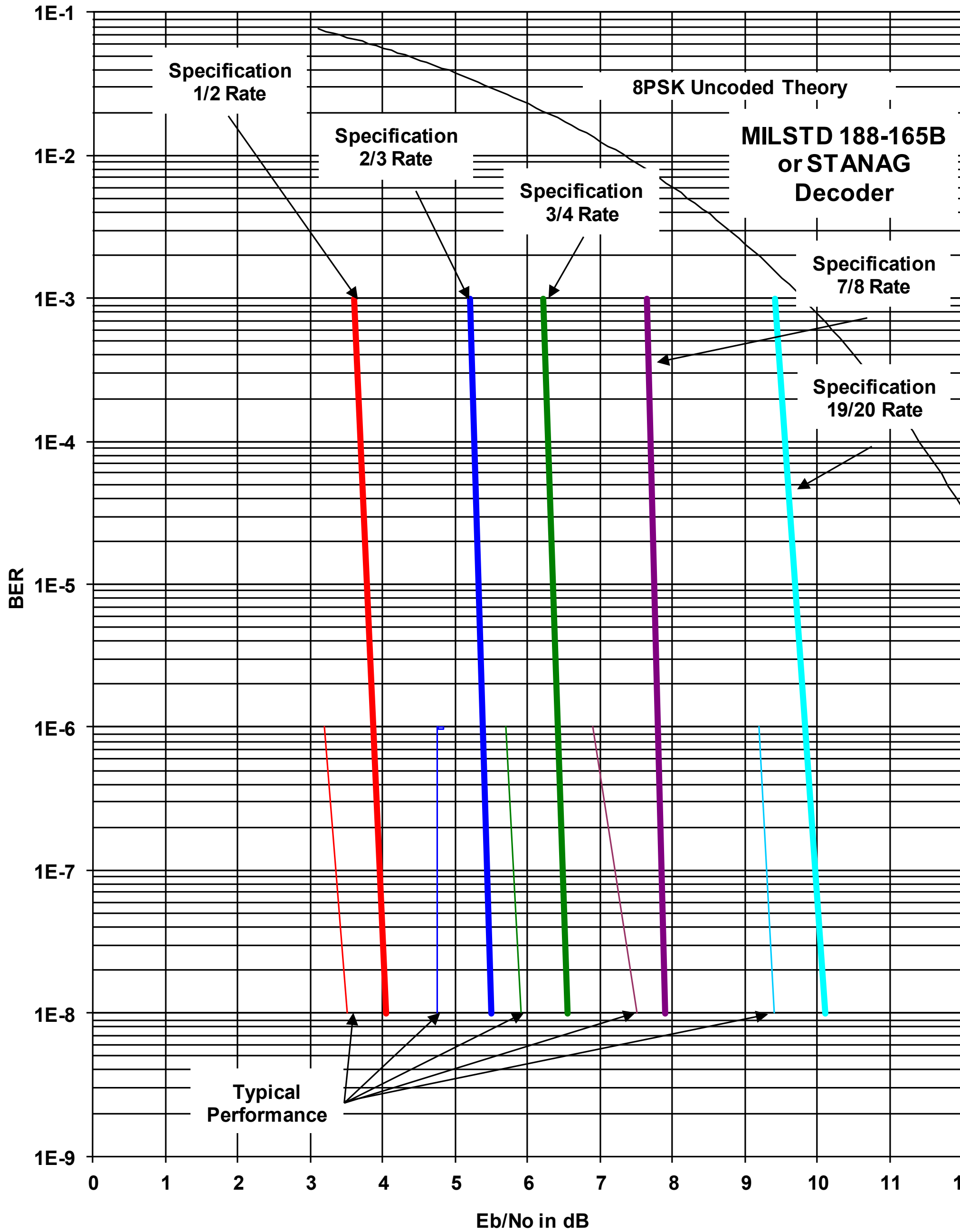

Figure 7-18. DMD2050E BER Performance 8-PSK (MILSTD 188-165B or STANAG) Turbo

Note: Eb/No to Bit-Error-Ratio 77values based on 16k block size

7.12.19 BER Performance 16APSK (MILSTD 188-165B or STANAG) Turbo

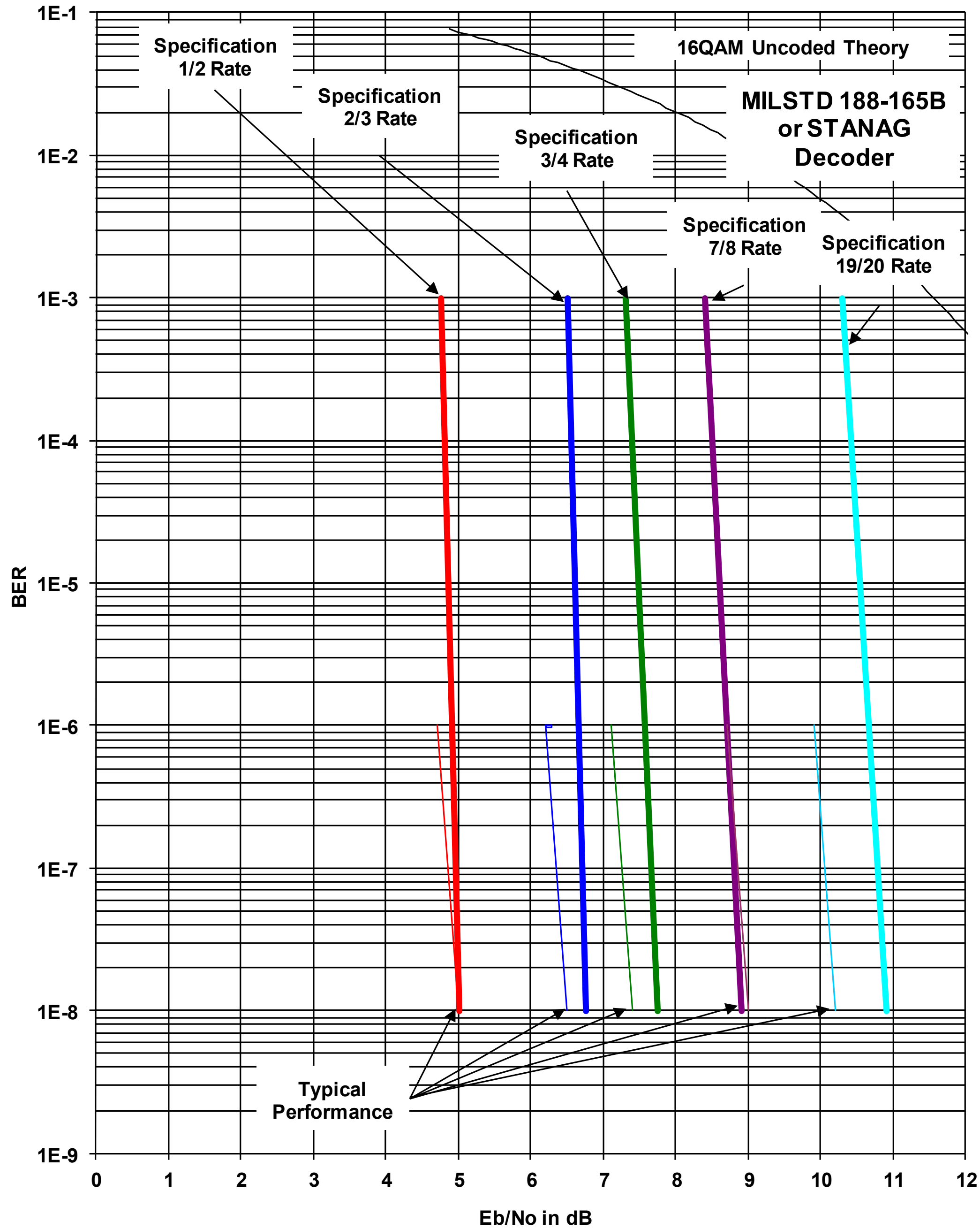

Figure 7-19. DMD2050E BER Performance 16APSK (MILSTD 188-165B or STANAG)

Note: Eb/No to Bit-Error-Ratio 77values based on 16k block size

Table 7-1 - B/O/QPSK BER Performance (Viterbi)						
BER	Specification			Typical		
	1/2 Rate	3/4 Rate	7/8 Rate	1/2 Rate	3/4 Rate	7/8 Rate
1E-3	4.2 dB	5.3 dB	6.2 dB	3.9 dB	4.9 dB	5.8 dB
1E-4	4.8 dB	6.1 dB	7.1 dB	4.5 dB	5.6 dB	6.5 dB
1E-5	5.5 dB	6.8 dB	7.9 dB	5.1 dB	6.3 dB	7.2 dB
1E-6	6.1 dB	7.6 dB	8.6 dB	5.7 dB	7 dB	7.9 dB
1E-7	6.7 dB	8.3 dB	9.3 dB	6.2 dB	7.7 dB	8.6 dB
1E-8	7.4 dB	8.9 dB	10.2 dB	6.8 dB	8.4 dB	9.4 dB
1E-9	8.2 dB	9.7 dB	11 dB	7.4 dB	9.1 dB	10.1 dB
1E-10	9 dB	10.3 dB	11.7 dB	8.1 dB	9.8 dB	10.5 dB

Table 7-2 - B/O/QPSK BER Performance (Sequential)						
BER	Specification			Typical		
	1/2 Rate	3/4 Rate	7/8 Rate	1/2 Rate	3/4 Rate	7/8 Rate
1E-3	4.8 dB	5.2 dB	6 dB	4.3 dB	4.7 dB	5.5 dB
1E-4	5.2 dB	5.7 dB	6.4 dB	4.7 dB	5.2 dB	5.9 dB
1E-5	5.6 dB	6.1 dB	6.9 dB	5.1 dB	5.6 dB	6.4 dB
1E-6	5.9 dB	6.5 dB	7.4 dB	5.4 dB	6.1 dB	6.9 dB
1E-7	6.3 dB	7 dB	7.9 dB	5.8 dB	6.5 dB	7.4 dB
1E-8	6.7 dB	7.4 dB	8.4 dB	6.2 dB	6.9 dB	7.9 dB
1E-9	7.1 dB	7.8 dB	8.9 dB	6.6 dB	7.4 dB	8.4 dB
1E-10	7.4 dB	8.3 dB	9.4 dB	6.9 dB	7.8 dB	8.9 dB

Table 7-3 - B/O/QPSK BER Performance (Viterbi - w/RS)						
BER	Specification			Typical		
	1/2 Rate	3/4 Rate	7/8 Rate	1/2 Rate	3/4 Rate	7/8 Rate
1E-3	3.3 dB	5.1 dB	-	3 dB	4.3 dB	5.3 dB
1E-4	3.5 dB	5.3 dB	-	3.2 dB	4.5 dB	5.7 dB
1E-5	3.8 dB	5.4 dB	6.5 dB	3.4 dB	4.7 dB	6 dB
1E-6	4.1 dB	5.6 dB	6.7 dB	3.6 dB	4.9 dB	6.4 dB
1E-7	4.2 dB	5.8 dB	6.9 dB	3.8 dB	5.1 dB	6.7 dB
1E-8	4.4 dB	6 dB	7.2 dB	4 dB	5.3 dB	7.1 dB
1E-9	4.7 dB	6.1 dB	7.5 dB	4.2 dB	5.4 dB	7.4 dB
1E-10	5 dB	6.3 dB	7.8 dB	4.4 dB	5.6 dB	7.7 dB

Table 7-4 - B/O/QPSK BER Performance (Turbo)				
BER	Specification		Typical	
	Turbo 0.495	Turbo 0.793	Turbo 0.495	Turbo 0.793
1E-3	2.5 dB	3.3 dB	2.2 dB	3 dB
1E-4	2.7 dB	3.7 dB	2.3 dB	3.2 dB
1E-5	3 dB	4.1 dB	2.5 dB	3.4 dB
1E-6	3.2 dB	4.4 dB	2.6 dB	3.6 dB
1E-7	3.5 dB	4.8 dB	2.7 dB	3.8 dB
1E-8	3.7 dB	5.2 dB	2.9 dB	4 dB
1E-9	4 dB	5.6 dB	3 dB	4.2 dB
1E-10	4.2 dB	5.9 dB	3.2 dB	4.4 dB

Table 7-5 - 8PSK BER Performance (Trellis)				
BER	Specification		Typical	
	2/3 Rate	2/3 Rate w/RS	2/3 Rate	2/3 Rate w/RS
1E-3	6.3 dB	5.8 dB	4.8 dB	4.9 dB
1E-4	7.3 dB	6.1 dB	5.6 dB	5.1 dB
1E-5	8.2 dB	6.3 dB	6.4 dB	5.4 dB
1E-6	9 dB	6.5 dB	7.2 dB	5.6 dB
1E-7	9.8 dB	6.7 dB	8.1 dB	5.8 dB
1E-8	10.4 dB	6.9 dB	8.9 dB	6.1 dB
1E-9	11.1 dB	7.1 dB	9.7 dB	6.3 dB
1E-10	11.9 dB	7.3 dB	10.5 dB	6.6 dB

Table 7-6 - 8PSK BER Performance (Turbo)				
BER	Specification		Typical	
	Turbo 0.495	Turbo 0.793	Turbo 0.495	Turbo 0.793
1E-3	-	7 dB	4.2 dB	5.4 dB
1E-4	-	7.3 dB	4.3 dB	5.6 dB
1E-5	-	7.7 dB	4.5 dB	5.9 dB
1E-6	-	8 dB	4.6 dB	6.2 dB
1E-7	-	8.4 dB	4.7 dB	6.4 dB
1E-8	-	8.7 dB	4.9 dB	6.7 dB
1E-9	-	9.1 dB	5 dB	7 dB
1E-10	-	9.5 dB	5.2 dB	7.3 dB

Table 7-7 - 16QAM BER Performance (Viterbi)				
BER	Specification		Typical	
	3/4 Rate	7/8 Rate	3/4 Rate	7/8 Rate
1E-3	8.9 dB	10.3 dB	8.1 dB	9.5 dB
1E-4	9.8 dB	11.1 dB	9 dB	10.3 dB
1E-5	10.7 dB	11.9 dB	9.9 dB	11.1 dB
1E-6	11.5 dB	12.7 dB	10.7 dB	11.9 dB
1E-7	12.4 dB	13.5 dB	11.6 dB	12.7 dB
1E-8	13.3 dB	14.3 dB	12.5 dB	13.5 dB
1E-9	14.2 dB	15.1 dB	13.4 dB	14.3 dB
1E-10	15 dB	15.9 dB	14.2 dB	15.1 dB

Table 7-8 - 16QAM BER Performance (Viterbi w/RS)				
BER	Specification		Typical	
	3/4 Rate	7/8 Rate	3/4 Rate	7/8 Rate
1E-3	8.4 dB	9.8 dB	7.8 dB	9.3 dB
1E-4	8.6 dB	8.1 dB	8.1 dB	9.6 dB
1E-5	8.9 dB	8.3 dB	8.3 dB	9.9 dB
1E-6	9.1 dB	8.6 dB	8.6 dB	10.2 dB
1E-7	9.3 dB	8.8 dB	8.8 dB	10.4 dB
1E-8	9.5 dB	9.1 dB	9.1 dB	10.7 dB
1E-9	9.8 dB	9.3 dB	9.3 dB	11 dB
1E-10	10 dB	9.6 dB	9.6 dB	11.3 dB

Table 7-9 - 16QAM BER Performance (Turbo)				
BER	Specification		Typical	
	Turbo 0.495	Turbo 0.793	Turbo 0.495	Turbo 0.793
1E-3	-	-	5.6 dB	7 dB
1E-4	-	-	6.1 dB	7.4 dB
1E-5	-	-	6.6 dB	7.8 dB
1E-6	-	-	7 dB	8.2 dB
1E-7	-	-	7.5 dB	8.6 dB
1E-8	-	-	8 dB	9 dB
1E-9	-	-	8.5 dB	9.4 dB
1E-10	-	-	9 dB	9.9 dB

Table 7-10 - (O)QPSK BER Performance (Turbo)						
BER	Specification			Typical		
	1/2 Rate	3/4 Rate	7/8 Rate	1/2 Rate	3/4 Rate	7/8 Rate
1E-3	-	3.2 dB	4 dB	-	2.8 dB	3.7 dB
1E-4	-	3.4 dB	4.1 dB	-	3 dB	3.8 dB
1E-5	2.7 dB	3.6 dB	4.2 dB	2.4 dB	3.2 dB	3.9 dB
1E-6	2.9 dB	3.8 dB	4.3 dB	2.6 dB	3.4 dB	4 dB
1E-7	3.1 dB	4.1 dB	4.4 dB	2.8 dB	3.7 dB	4.1 dB
1E-8	3.3 dB	4.4 dB	4.5 dB	3 dB	4 dB	4.2 dB

Table 7-11 - BPSK BER Performance (Turbo)				
BER	Specification		Typical	
	5/16 Rate	21/44 Rate	5/16 Rate	21/44 Rate
1E-5	-	2.7 dB	-	2.4 dB
1E-6	2.7 dB	2.9 dB	2.5 dB	2.6 dB
1E-7	2.9 dB	3.1 dB	2.7 dB	2.8 dB
1E-8	3.1 dB	3.3 dB	2.9 dB	3 dB

Table 7-12 - 8PSK BER Performance (Turbo)				
BER	Specification		Typical	
	3/4 Rate	7/8 Rate	3/4 Rate	7/8 Rate
1E-3	5.6 dB	6.7 dB	5.4 dB	6.3 dB
1E-4	5.8 dB	6.8 dB	5.6 dB	6.4 dB
1E-5	6 dB	6.9 dB	5.8 dB	6.5 dB
1E-6	6.2 dB	7 dB	6 dB	6.6 dB
1E-7	6.4 dB	7.1 dB	6.2 dB	6.7 dB
1E-8	6.8 dB	7.2 dB	6.6 dB	6.8 dB

Table 7-13 - 16QAM BER Performance (Turbo)				
BER	Specification		Typical	
	3/4 Rate	7/8 Rate	3/4 Rate	7/8 Rate
1E-3	6.3 dB	7.8 dB	6 dB	7.4 dB
1E-4	6.7 dB	7.9 dB	6.4 dB	7.5 dB
1E-5	7 dB	8 dB	6.7 dB	7.6 dB
1E-6	7.4 dB	8.1 dB	7.1 dB	7.7 dB
1E-7	7.8 dB	8.2 dB	7.5 dB	7.8 dB
1E-8	8.2 dB	8.3 dB	7.9 dB	7.9 dB

Table 7-14 - B/O/QPSK BER Performance (LDPC)						
BER	Specification			Typical		
	1/2 Rate	2/3 Rate	3/4 Rate	1/2 Rate	2/3 Rate	3/4 Rate
1E-5	2 dB	2.3 dB	3 dB	1.7 dB	2 dB	2.6 dB
1E-9	2.3 dB	2.7 dB	3.3 dB	2 dB	2.3 dB	3 dB

Table 7-15 - 8PSK / 8-QAM Rate BER Performance (LDPC)								
BER	8PSK				8-QAM			
	Specification		Typical		Specification		Typical	
	2/3 Rate	3/4 Rate	2/3 Rate	3/4 Rate	2/3 Rate	3/4 Rate	2/3 Rate	3/4 Rate
1E-5	-	5.6 dB	-	5.2 dB	4.6 dB	5.6 dB	4.2 dB	5.2 dB
1E-9	5.7 dB	6 dB	5.3 dB	5.6 dB	5 dB	6 dB	4.6 dB	5.6 dB

Table 7-16 - 16QAM BER Performance (LDPC)		
BER	Specification	Typical
	3/4 Rate	3/4 Rate
1E-5	6.8 dB	6.2 dB
1E-9	7.1 dB	6.8 dB

Table 7-17 - B/O/QPSK BER Performance (MILSTD 188-165B or STANAG) Turbo										
BER	Specification 16K Block					Typical 16K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	2.05 dB	2.9 dB	3.6 dB	4.45 dB	5.9 dB	-	-	-	-	-
1E-4	2.1 dB	3 dB	3.7 dB	4.5 dB	6 dB	-	-	-	-	-
1E-5	2.15 dB	3.05 dB	3.75 dB	4.55 dB	6.1 dB	-	-	-	-	-
1E-6	2.2 dB	3.1 dB	3.8 dB	4.6 dB	6.2 dB	1.5 dB	2.3 dB	3.1 dB	3.7 dB	5.6 dB
1E-7	2.3 dB	3.15 dB	3.85 dB	4.65 dB	6.3 dB	1.6 dB	2.4 dB	3.2 dB	3.8 dB	5.7 dB
1E-8	2.3 dB	3.2 dB	3.9 dB	4.7 dB	6.4 dB	1.7 dB	2.5 dB	3.3 dB	3.9 dB	5.8 dB
1E-9	2.4 dB	3.25 dB	3.95 dB	4.75 dB	6.5 dB	-	-	-	-	-
1E-10	2.4 dB	3.3 dB	4 dB	4.8 dB	6.6 dB	-	-	-	-	-
BER	Specification 4K Block					Typical 4K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	2.35 dB	3.2 dB	3.8 dB	4.5 dB	5.8 dB	-	-	-	-	-
1E-4	2.4 dB	3.3 dB	3.9 dB	4.6 dB	6 dB	-	-	-	-	-
1E-5	2.45 dB	3.4 dB	4 dB	4.7 dB	6.2 dB	-	-	-	-	-
1E-6	2.5 dB	3.45 dB	4.1 dB	4.8 dB	6.3 dB	-	-	-	-	-
1E-7	2.55 dB	3.5 dB	4.2 dB	4.9 dB	6.4 dB	-	-	-	-	-
1E-8	2.6 dB	3.55 dB	4.25 dB	5 dB	6.5 dB	-	-	-	-	-
1E-9	2.65 dB	3.6 dB	4.3 dB	5.1 dB	6.6 dB	-	-	-	-	-
1E-10	2.7 dB	3.65 dB	4.35 dB	5.2 dB	6.7 dB	-	-	-	-	-
BER	Specification 1K Block					Typical 1K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	3.1 dB	3.9 dB	4.4 dB	5.1 dB	6 dB	-	-	-	-	-
1E-4	3.3 dB	4.1 dB	4.6 dB	5.3 dB	6.5 dB	-	-	-	-	-
1E-5	3.5 dB	4.3 dB	4.8 dB	5.5 dB	6.85 dB	-	-	-	-	-
1E-6	3.7 dB	4.45 dB	5 dB	5.7 dB	7.2 dB	-	-	-	-	-
1E-7	3.8 dB	4.6 dB	4.15 dB	5.9 dB	7.5 dB	-	-	-	-	-
1E-8	3.9 dB	4.75 dB	5.3 dB	6.1 dB	7.8 dB	-	-	-	-	-
1E-9	4 dB	4.9 dB	5.4 dB	6.3 dB	8 dB	-	-	-	-	-

Table 7-18 - 8PSK BER Performance (MILSTD 188-165B or STANAG) Turbo										
BER	Specification 16K Block					Typical 16K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	3.6 dB	5.2 dB	6.2 dB	7.65 dB	9.4 dB	-	-	-	-	-
1E-4	3.7 dB	5.3 dB	6.3 dB	7.7 dB	9.6 dB	-	-	-	-	-
1E-5	3.8 dB	5.35 dB	6.4 dB	7.75 dB	9.8 dB	-	-	-	-	-
1E-6	3.9 dB	5.4 dB	6.45 dB	7.8 dB	9.9 dB	3.2 dB	4.75 dB	5.7 dB	6.9 dB	9.2 dB
1E-7	4 dB	5.45 dB	6.5 dB	7.85 dB	10 dB	3.3 dB	4.7 dB	5.8 dB	7.1 dB	9.3 dB
1E-8	4.05 dB	5.5 dB	6.55 dB	7.9 dB	10.1 dB	3.5 dB	4.75 dB	5.9 dB	7.5 dB	9.4 dB
1E-9	4.1 dB	5.55 dB	6.6 dB	7.95 dB	10.2 dB	-	-	-	-	-
1E-10	4.1 dB	5.6 dB	6.6 dB	8 dB	10.3 dB	-	-	-	-	-
BER	Specification 4K Block					Typical 4K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	4.2 dB	5.8 dB	6.5 dB	7.5 dB	9.1 dB	-	-	-	-	-
1E-4	4.3 dB	5.9 dB	6.6 dB	7.7 dB	9.4 dB	-	-	-	-	-
1E-5	4.4 dB	6 dB	6.7 dB	7.9 dB	9.7 dB	-	-	-	-	-
1E-6	4.5 dB	6.1 dB	6.8 dB	8 dB	9.9 dB	-	-	-	-	-
1E-7	4.6 dB	6.2 dB	6.9 dB	8.1 dB	10 dB	-	-	-	-	-
1E-8	4.7 dB	6.3 dB	7 dB	8.2 dB	10.2 dB	-	-	-	-	-
1E-9	4.8 dB	6.4 dB	7.1 dB	8.3 dB	10.35 dB	-	-	-	-	-
1E-10	4.9 dB	6.5 dB	7.2 dB	8.4 dB	10.5 dB	-	-	-	-	-
BER	Specification 1K Block					Typical 1K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	4.6 dB	6.1 dB	6.9 dB	7.8 dB	9.3 dB	-	-	-	-	-
1E-4	4.9 dB	6.4 dB	7.2 dB	8.2 dB	9.8 dB	-	-	-	-	-
1E-5	5.1 dB	6.6 dB	7.4 dB	8.5 dB	10.2 dB	-	-	-	-	-
1E-6	5.3 dB	6.8 dB	7.6 dB	8.75 dB	10.6 dB	-	-	-	-	-
1E-7	5.5 dB	7 dB	7.8 dB	9 dB	11 dB	-	-	-	-	-
1E-8	5.6 dB	7.15 dB	8 dB	9.2 dB	11.4 dB	-	-	-	-	-
1E-9	5.65 dB	7.25 dB	8.1 dB	9.4 dB	11.7 dB	-	-	-	-	-

Table 7-19 - 16APSK BER Performance (MILSTD 188-165B or STANAG) Turbo										
BER	Specification 16K Block					Typical 16K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	4.75 dB	6.5 dB	7.3 dB	8.4 dB	10.3 dB	-	-	-	-	-
1E-4	4.8 dB	6.55 dB	7.4 dB	8.5 dB	10.5 dB	-	-	-	-	-
1E-5	4.85 dB	6.6 dB	7.5 dB	8.6 dB	10.6 dB	-	-	-	-	-
1E-6	4.9 dB	6.65 dB	7.6 dB	8.7 dB	10.7 dB	4.7 dB	6.2 dB	7.1 dB	8.7 dB	9.9 dB
1E-7	4.95 dB	6.7 dB	7.7 dB	8.8 dB	10.8 dB	4.9 dB	6.4 dB	7.3 dB	8.9 dB	10 dB
1E-8	5 dB	6.75 dB	7.75 dB	8.9 dB	10.9 dB	5 dB	6.5 dB	7.4 dB	9 dB	10.2 dB
1E-9	5.05 dB	6.8 dB	7.8 dB	9 dB	11 dB	-	-	-	-	-
BER	Specification 4K Block					Typical 4K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	5.1 dB	6.7 dB	7.8 dB	8.9 dB	10.4 dB	-	-	-	-	-
1E-4	5.2 dB	6.8 dB	7.9 dB	9.05 dB	10.7 dB	-	-	-	-	-
1E-5	5.3 dB	6.9 dB	8 dB	9.2 dB	10.9 dB	-	-	-	-	-
1E-6	5.4 dB	7 dB	8.1 dB	9.3 dB	11.1 dB	-	-	-	-	-
1E-7	5.5 dB	7.1 dB	8.2 dB	9.4 dB	11.25 dB	-	-	-	-	-
1E-8	5.6 dB	7.2 dB	8.3 dB	9.5 dB	11.4 dB	-	-	-	-	-
1E-9	5.7 dB	7.3 dB	8.4 dB	9.6 dB	11.5 dB	-	-	-	-	-
BER	Specification 1K Block					Typical 1K Block				
	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate	1/2 Rate	2/3 Rate	3/4 Rate	7/8 Rate	19/20 Rate
1E-3	5.6 dB	7.1 dB	8.1 dB	8.8 dB	10.4 dB	-	-	-	-	-
1E-4	5.8 dB	7.4 dB	8.4 dB	9.15 dB	10.9 dB	-	-	-	-	-
1E-5	6.1 dB	7.6 dB	8.7 dB	9.5 dB	11.3 dB	-	-	-	-	-
1E-6	6.3 dB	7.8 dB	8.9 dB	9.7 dB	11.7 dB	-	-	-	-	-
1E-7	6.45 dB	8 dB	9.1 dB	9.9 dB	12.1 dB	-	-	-	-	-
1E-8	6.6 dB	8.2 dB	9.3 dB	10.1 dB	12.5 dB	-	-	-	-	-
1E-9	6.65 dB	8.3 dB	9.4 dB	10.3 dB	12.9 dB	-	-	-	-	-

7.13 AGC Output Voltage

The AGC Output Voltage is a function of the Input Power Level in dBm. The AGC Output Voltage is found on the Alarm connector Pin 14 of J15.

Figure 7-13. AGC Voltage Monitor

Appendix A. Product Options

A.1 Hardware Options

These enhanced interface cards are available:

DC Input Prime Power	Allows for an optional 48VDC Input Power Source
DoubleTalk® Carrier-in-Carrier® (CnC)	Allows for an optional CnC upgrade

A.2 Custom Options

Custom options are available for the DMD2050E. Get most custom options through firmware and software changes.

Example Custom Options	
Data Rates	Modulation Formats
Scrambler and Descramblers	Uses for the ES-ES Overhead Channel
Overhead Framing Structures	Drop and Insert

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Appendix B. Front Panel Upgrades and Demonstration Mode

B.1 Introduction

The DMD2050E Universal Satellite Modem allows you to install feature demonstrations and permanent upgrades using the front panel.

Demonstration upgrades operate only during a 30-day evaluation period. Purchased upgrades continue to operate as part of the permanent configuration.

B.2 Required Equipment

The unit is shipped fully assembled. Do not remove the covers when you install the unit.

B.3 Procedures

Whether you are demonstrating or installing upgrades, the procedures are similar.

- Find and record the features and options that you want to add to the unit.
- Find and record the Unit ID.
- Order the demonstration or upgrade code from Comtech.
- Use the front panel to enter this code and install the demonstration or upgrade

If you use the demonstration mode, another procedure is necessary to cancel the demonstration before the trial period automatically ends.

B.3.1 Record the Features and Options

Find and record the features and options that you want to add to the unit.

1. Go to the MAIN Menu.
2. Go to the SYSTEM Menu.
3. Go to the HW/FW CONFIG Menu.
4. Go to the FEATURES Menu. The lower line shows NORMAL.
5. Go to the UPGRADE LIST Menu.
6. Scroll through the list of features and options.
7. Record the items you want to upgrade.

The Option is on the top line.

The Status is on the bottom line.

Option Status	Description
INSTALLED	The option is already available in the feature set of the unit.
HW & KEY REQ	The option is not installed and requires additional hardware. Contact Comtech for help.
HW REQUIRED	The option requires additional hardware. Contact Comtech for help.
KEY CODE REQ	The option is available as an upgrade that you install using the front panel.

B.3.2 Record the Unit ID

Comtech requests the Unit ID when you order an upgrade or a demonstration. Use the front panel to find and record the Unit ID:

1. Go to the MAIN Menu.
2. Go to the SYSTEM Menu.
3. Go to the HW/FW CONFIG Menu.
4. Go to the FEATURES Menu. (The lower line shows NORMAL.)
5. Press ▼ to show the Unit ID.
6. Record the Unit ID.

```
1234.1234.1234
----.----.----
```

The 12-digit Unit ID is on the top line.

B.3.3 Order the Demonstration or the Upgrade

Contact Comtech to order the demonstration or the upgrade. Record the 12-digit code that Comtech gives you. This code operates only with the applicable Unit ID.

CAUTION

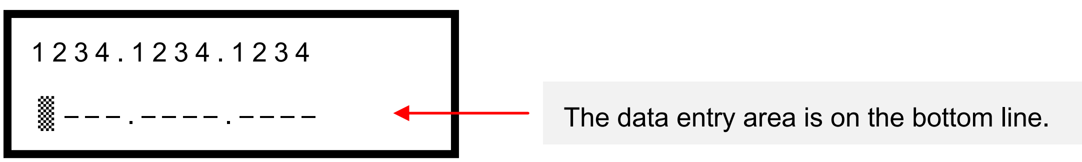
When the demonstration period ends, the demonstration upgrades stop. The unit returns to the permanent configuration automatically. Traffic can be interrupted and data paths can require restoration.

To prevent these service problems, cancel the demonstration mode before the demonstration period ends.

B.3.4 Install the Code

Use the front panel to enter this code and install the upgrade:

1. Go to the MAIN Menu.
2. Go to the SYSTEM Menu.
3. Go to the HW/FW CONFIG Menu.
4. Go to the FEATURES Menu. (The lower line shows NORMAL.)
5. Press ▼ to show the Unit ID.
6. Press ENTER to start data entry. The cursor flashes to show that data entry is available.
7. Use the numeric keys to enter the new code.
8. Press ENTER to accept the data.



NOTE

If the code is correct, the display shows CODE ACCEPTED. If the code is invalid, the display shows INVALID CODE.

IMPORTANT

Make sure to enter the correct code. After three invalid attempts, set the power switch to OFF, then ON, before you can try again.

B.3.5 Demonstration Mode Considerations

The unit uses several indicators to show that it is in demonstration mode:

TEST MODE LEDs Flash	The MOD and DEMOD TEST MODE LEDs flash when the unit is operating in demonstration mode. The flashing occurs even if the unit is in a test mode where the LED light is normally on constantly.
FEATURES Menu	On the FEATURES menu, the lower line shows DEMO.
UPGRADE LIST Menu	On the UPGRADE LIST menu, the lower line shows DEMO. The upgrade is available to use during the demonstration period.

IMPORTANT

If you let the demonstration mode expire, service interruption is possible.

B.3.6 Cancel the Demonstration Mode

IMPORTANT

If you cancel the demonstration mode, the unit returns to operating with the former permanent configuration immediately.

After a demonstration mode has been canceled, you cannot restart it with the same demonstration code. Request a new code to start a new demonstration.

Use the front panel to cancel the demonstration mode:

1. Go to the MAIN Menu.
2. Go to the SYSTEM Menu.
3. Go to the HW/FW CONFIG Menu.
4. Go to the FEATURES Menu. (The lower line shows DEMO.)
5. Press ▼ to show the Unit ID.
6. Press ENTER to start data entry. The cursor flashes to show that data entry is available.
7. Use the numeric keys to enter the cancel code: 0000 0000 0000.
8. Press ENTER to accept the code.

The demonstration mode stops immediately. The permanent configuration features return to operation. The TEST MODE LEDs stop flashing.

Appendix C. Carrier Control

C.1 Carrier Control and Alarms

If a TX major alarm occurs, modulator output is muted automatically. This automatic muting prevents the modulator from using an unknown spectrum and possibly disturbing adjacent carriers.

To override an automatic muting of the output, mask the alarm that is causing the fault. This mask lets the transmission continue, even if the fault occurs.

C.2 Carrier States and Changes to Programming

The carrier states affect how the modulator output restarts after you change the modulator output and satellite footprint.

NOTE
The interface (front panel or terminal) also affects how the modulator output restarts after this type of change is made.

The table compares the effects of using the interfaces and carrier states.

Function	CARRIER ON		CARRIER AUTO		CARRIER VSAT		CARRIER RTS	
	Front Panel	Terminal	Front Panel	Terminal	Front Panel	Terminal	Front Panel	Terminal
Output stops	X	X	X	X	X	X	X	X
Confirm change request	X				X		X	
Wait for signal lock					X			
RTS is ON							X	
Start output automatically	X		X	X	X		X	
Start output manually		X				X		X

C.3 Carrier States

These are the carrier states:

- Carrier OFF
- Carrier ON
- Carrier AUTO
- Carrier VSAT
- Carrier RTS

You set the carrier states using the CARRIER menu. The path is:

MODULATOR ▸ IF ▸ CARRIER {OFF, ON, AUTO, VSAT, RTS}

C.3.1 Carrier OFF

The modulator output is OFF.

If you change the modulator output and satellite footprint, then the unit sets the carrier state to Carrier OFF. The carrier state stays OFF until you confirm the change.

C.3.2 Carrier ON

The carrier state is Carrier ON.

You change the modulator output and the satellite footprint.

If you use the front panel to make the change:

1. The output is stopped automatically.
2. A popup message prompts you to confirm the change.
3. The output starts again automatically.

If you use a terminal to make the change:

1. The output is stopped automatically.
2. You restart the output.

C.3.3 Carrier AUTO

The carrier state is Carrier AUTO.

You change the modulator output and the satellite footprint.

If you use the front panel OR a terminal to make the change:

1. The output is stopped automatically.

2. The output starts again automatically.

C.3.4 Carrier VSAT

The carrier state is Carrier VSAT.

You change the modulator output and the satellite footprint.

If you use the front panel to make the change:

1. The output is stopped automatically.
2. A popup message prompts you to confirm the change.
3. The unit waits for signal lock to occur on the demodulator.
4. The output starts again automatically.

If you use a terminal to make the change:

1. The output is stopped automatically.
2. You restart the output.

C.3.5 CARRIER RTS

The carrier state is Carrier RTS.

You change the modulator output and the satellite footprint.

If you use the front panel to make the change:

1. The output is stopped automatically.
2. A popup message prompts you to confirm the change.
3. The unit checks the Request to Send (RTS) status.
4. If RTS is ON, the output starts again automatically.
5. If RTS is OFF, the output does not start.

If you use a terminal to make the change:

1. The output is stopped automatically.
2. You restart the output.

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Appendix D. Web Interface Setup Guide

D.1 Introduction

The web interface lets Radyne products connect and communicate through the Ethernet port. The connection is a 10Base-T Ethernet connection.

You use the web interface to control and monitor the parameters and functions of these connected units.

To find out if the unit has the Web interface, use the front panel <SYSTEM> control screen and make sure that you can see the WEB submenu. If you do not see the WEB submenu, contact customer service for help.

See also:

Radyne Remote Operations, part number MN-DMDREMOTEOP

D.2 Setup

D.2.1 TCP-IP Menus

IMPORTANT
Before you use the web interface, make sure that the TCP-IP menus are set up correctly.

See also:

Appendix F, TCP-IP Ethernet Setup

D.2.2 IP Address

IMPORTANT
Before you set an IP address, contact the IT authority in your organization for help.

The BOOT MODE setting controls access to the IP address for the unit. The unit is shipped from the factory with the BOOT MODE set to DEFAULT (a fixed address that is not accessible).

To access the unit through the Ethernet port, set the Boot Mode to IP TEST (a fixed IP address that is accessible).

To use an alternate IP address, change the BOOT MODE to NON-VOL. You can program NON-VOL to any valid IP address.

D.3 Web Interface Security

Access rights and authentication parameters are stored in the web user database. Anyone who uses the web interface must have a user account in the web user database. A user account contains four parameters:

- User ID
- Access Group
- Authentication Password
- Web User

D.3.1 Default User Accounts

Initially, the web user database contains three factory-default user accounts. The parameters in those accounts are:

USER ID	Access Group	Authentication Password	Web User
USER 1	GUEST	guest	guest
USER 2	OPER	oper	oper
USER 3	ADMIN	admin	admin

D.3.2 User Account Data

IMPORTANT

All entries are case-sensitive.

Parameter	Character type	Maximum	Minimum	Restrictions
User ID	ASCII Printable Characters	13	0	None
Authentication Password	ASCII Printable Characters	13	0	None
Web User	ASCII Printable Characters	13	0	None

Access Group	Access Level	Description
GUEST	View Only	Guests see most of the site and modem parameter settings.
OPER	Limited Access	Operators monitor and control modem parameters, and change their own authentication passwords.
ADMIN	Full Access	Administrators monitor and control modem parameters, change any user's name and authentication password, and modify IP network settings. This setting has full access to the entire site.
NO GROUP	No Access	These users do not have any access to the web interface.

D.1 User Account Setup

The front panel gives full administrative access to the parameters that control the unit, including web interface security.

Use the arrow keys to move through the menus and parameters:

SYSTEM ▾

    WEB ▾

        CONFIRMATION ▾

            USER 1 ▾

                ACCESS GROUP {GUEST, OPER, ADMIN, NO GROUP}

                AUTH PASSWORD

                USER RESET

            USER 2 ▾

            USER 3 ▾

IMPORTANT

All entries are case-sensitive.

To set up a User Account, do these steps:

1. Edit the User ID.
2. Edit the Access Group.
3. Edit the Authentication Password.

D.1.1 Edit the User ID.

1. Select the User ID.
2. Press ENTER.
3. Move the cursor to the first character.
4. Press CLEAR and the ▸ right button to delete the characters.
5. Use the direction buttons and numeric keys to enter the new User ID.
6. Press ENTER to save the change.

D.1.2 Edit the Access Group.

1. Select ACCESS GROUP.
2. Press ENTER.
3. Press the ▾ down button until you see the new Access Group.
4. Press ENTER to save the change.

D.1.3 Edit the Authentication Password.

1. Select AUTH PASSWORD.
2. Press ENTER.
3. Move the cursor to the first character.
4. Press CLEAR and the ▸ right button to delete the characters.
5. Use the direction buttons and numeric keys to enter the new authentication password.
6. Press ENTER to save the change.

D.2 Reset a User Account

Sometimes, it is necessary to reset a user account to the factory defaults. For example, a user account may be locked because of too many incorrect password attempts. Release the lock by resetting the user account. Then, set up the user account again.

To reset a User Account, do these steps:

1. Select the User ID.
2. Press the ▾ down button.
3. Press the ▸ right button until you see USER RESET.
4. Press ENTER to reset the User Account.

1. USER 1: This will allow the operator to change the user name, assign the Access group, authorized password for “USER 1”. Upon entering the following fields will be displayed:
   a. ACCESS GROUP: This will allow the assignment of “No Group”, “ADMIN”, “OPER”, or GUEST to USER 1.
   b. AUTH PASSWORD: This will allow for the entry of the password for USER 1.
   c. USER RESET: Using this command will allow the factory defaults (as listed in the table above) to be restored to USER 1. This can be used in the event that USER 1 is locked out due to password restriction.
2. USER 2: This has the same menu structure as USER 1.
3. USER 3: This has the same menu structure as USER 1.

Radyne’s Web configuration allows for the support of 3 user profiles. These are configured through the ‘PASSWORD/SETUP ACCESS section in the Web Browser.

D.3 Confirmation

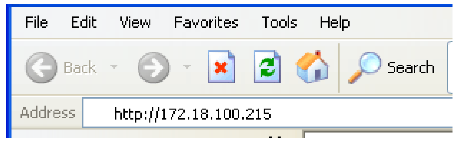
You can enable or disable a confirmation prompt.

CONFIRMATION	ENABLED – causes a prompt that asks you to confirm or cancel changes. DISABLED – no prompt occurs. Changes are effective immediately after you press ENTER.

D.4 Equipment Website

Once you know that the modem is accessible through the internet, do these steps:

1. Start the internet browser.
2. Type the modem's IP address in the address field, and then press [**Enter**].



The WEB browser equipment introduction page opens.

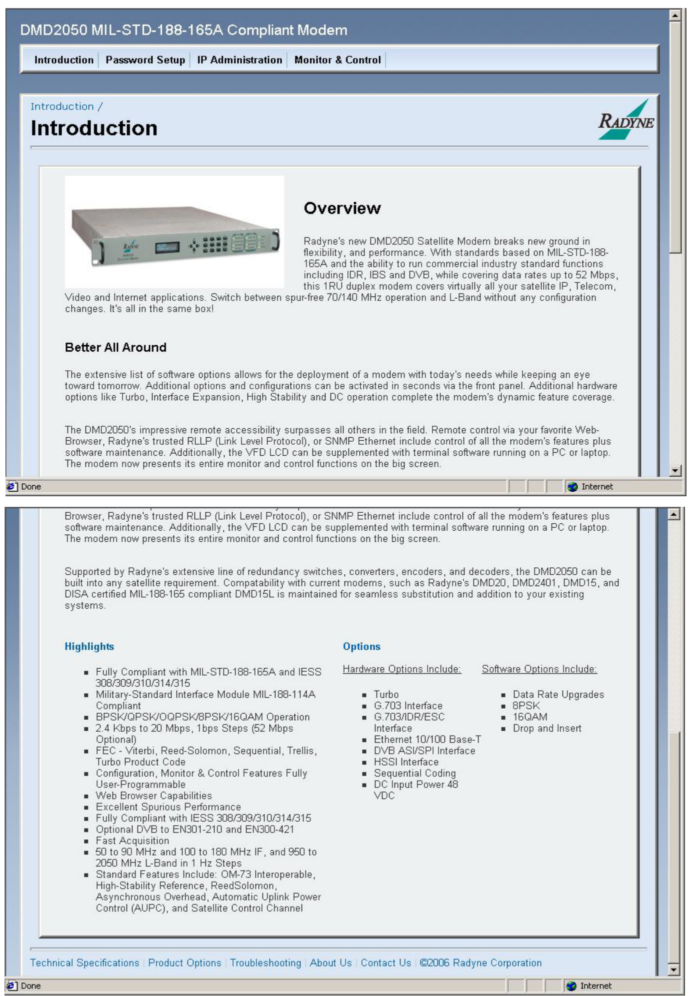


Figure D-1. WEB Browser Equipment Introduction Page

The Introduction page shows general information, such as:

- Type of equipment
- Equipment features and capabilities overview
- Hardware and software options that are available

Other links are available on the Introduction page:

- Links to the PDF files that contain technical specifications and product options
- Links to the Comtech EF Data website and customer service pages

D.4.1 Log in to the Equipment Website

You must log in before you can go to other pages in the website. The login controls your access to resources and actions in the website.

If you attempt to go to any other page in the website, the Login window requests your login.

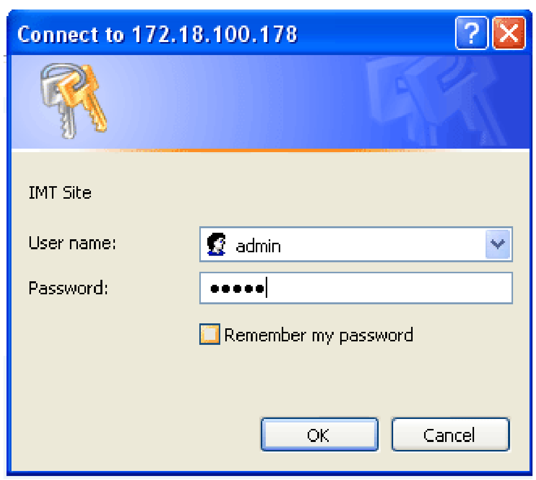


Figure D-2. Login Window

See section D.3.1 for the factory default user name and password.

Enter “admin” for the user name and “admin” for the password to gain access with full privileges to the other pages within the browser.

After a successful login, you can go to the other pages in the website.

D.5 Web Page Appearance

This page displays the Monitor and Control section of the modem web interface. The page has an appearance that resembles the DMD2050E layout.

The front panel display section of the page shows the current front panel alarm status of the modem. This display is updated immediately any time the status changes.

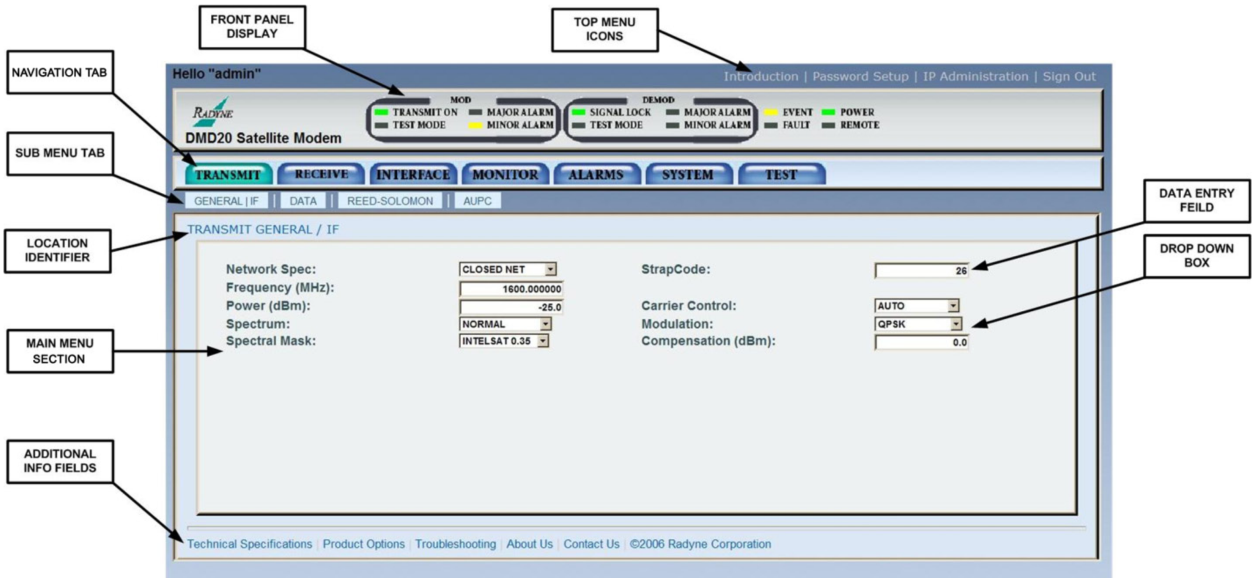


Figure D-3. Monitor and Control Web Page

The navigation tabs correspond to the front panel top-level menus. Move the cursor over a navigation tab to see the related sub-menu. The sub-menus correspond to the front panel sub-menus.

Below the navigation tabs, the main menu section shows the current programmed control state. At the top of the main menu section, location identifiers show the path to the current page.

D.6 Configure Web Browsers for the Radyne WEB Interface

D.6.1 Configure Internet Explorer 9 for the Radyne WEB Interface

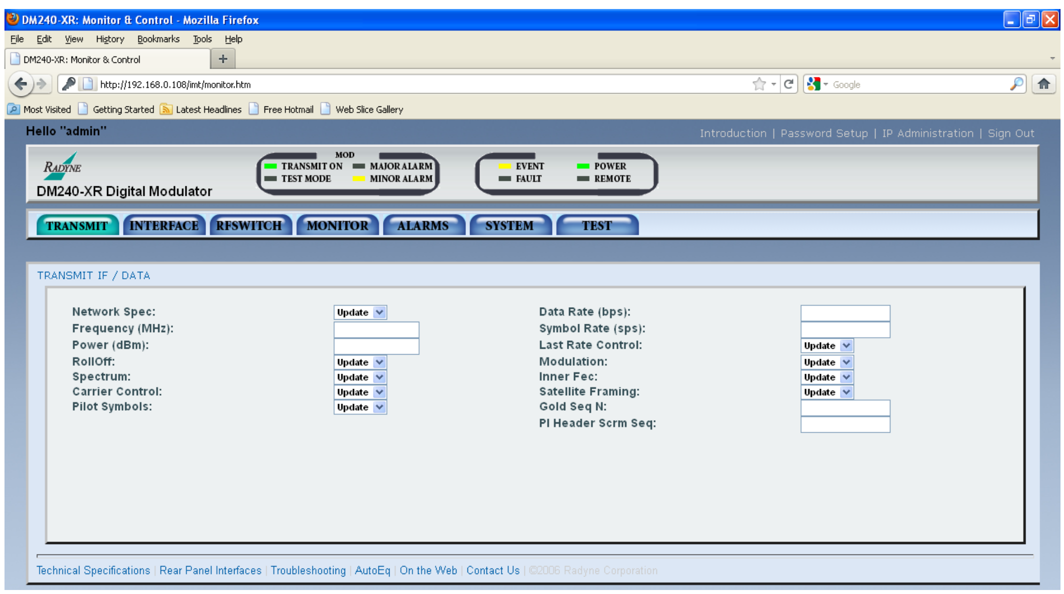
Click the **Compatibility View** button on the address bar.

When **Compatibility View** is active, the color of the button is blue.

If **Compatibility View** is active, the **Monitor & Control** window should be displayed correctly.

D.6.2 Configure Firefox for the Radyne WEB Interface

On the **Monitor & Control**, **Password Setup** or **IP Administration** windows, some fields may be blank or contain **Update**.



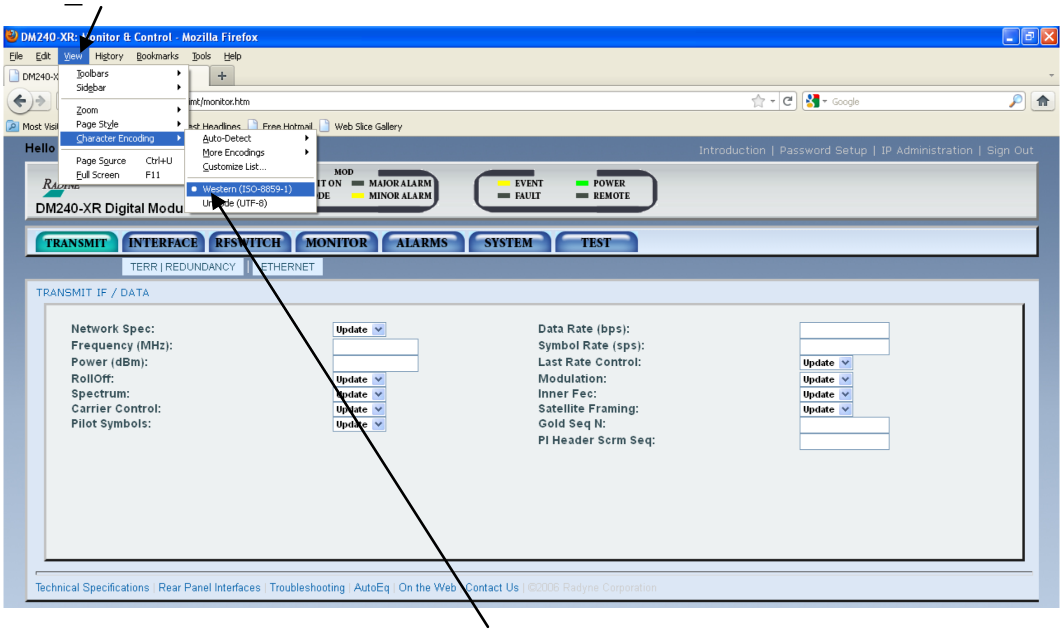
To correct the display, either 1) change the encoding, or, 2) install the Internet Explorer Tab V2 add-on.

NOTE

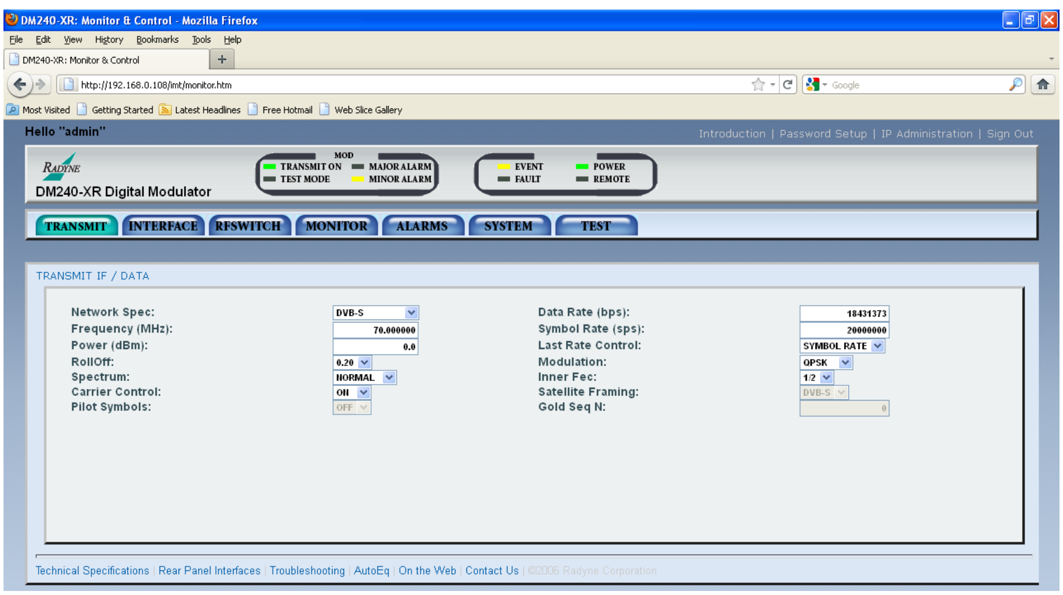
If you leave a window and return, it may be necessary to correct the display again.

D.6.2.1 Change the encoding:

Click View on the Firefox menu bar.



Select Character Encoding and click Western (ISO-8859-1). The page refreshes and shows the correct values.

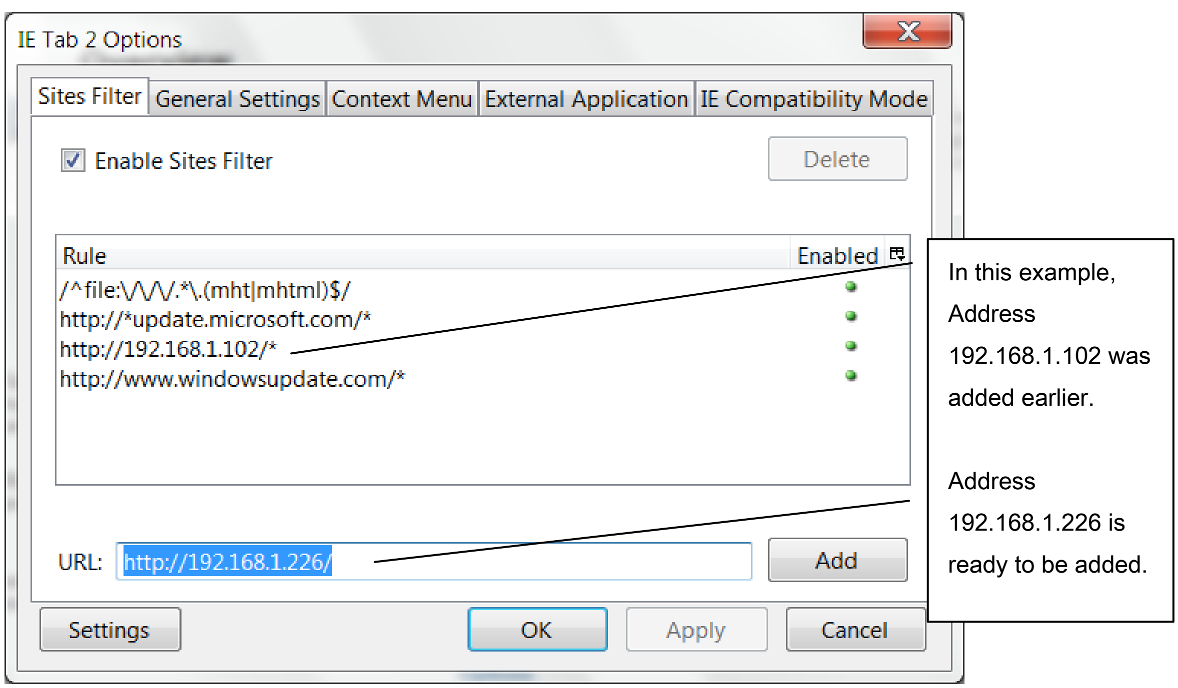


D.6.2.2 Install the Internet Explorer Tab V2 add-on

The Internet Explorer (IE) Tab V2 add-on lets you open WEB browser pages in Internet Explorer 7 mode. The link to the add-on is https://addons.mozilla.org/en-US/firefox/addon/ie-tab-2-ff-36/

Download and install IE Tab V2. After IE Tab V2 is installed, Firefox restarts.

Go to **Tools / IE Tab 2 Options** and add the Radyne product IP address to the **Sites Filter**.

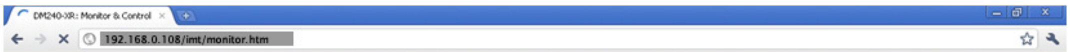


After the IP address is added to the **Sites Filter**, the WEB browser pages show correct values.

D.6.3 Configure Chrome for the Radyne WEB Browser

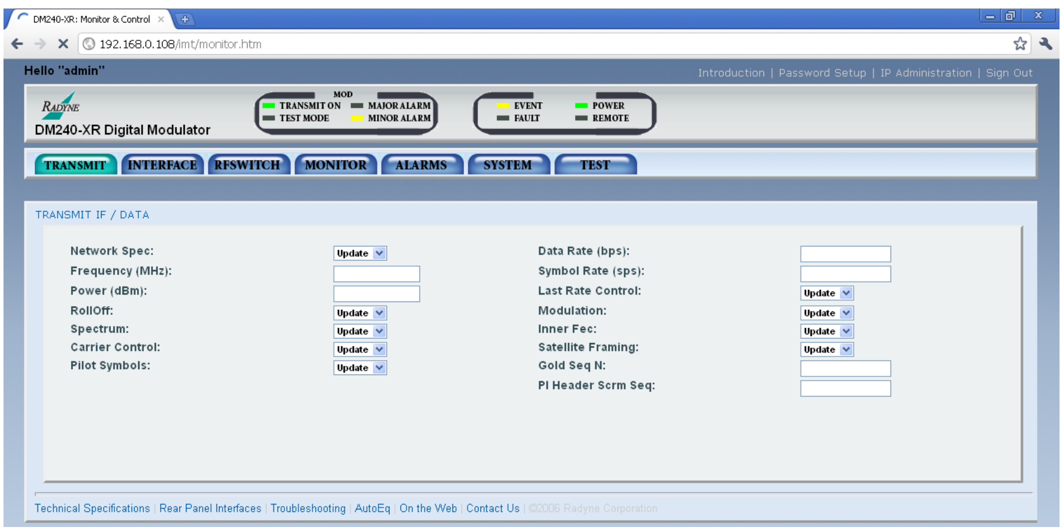
When you open the **Monitor & Control** window, you may see the error message “This webpage is not available”.

Click the Chrome address bar.



Make sure the full address is highlighted, and then press **Enter**. The **Monitor & Control** window opens.

On the **Monitor & Control**, **Password Setup** or **IP Administration** windows, some fields may be blank or contain **Update**.



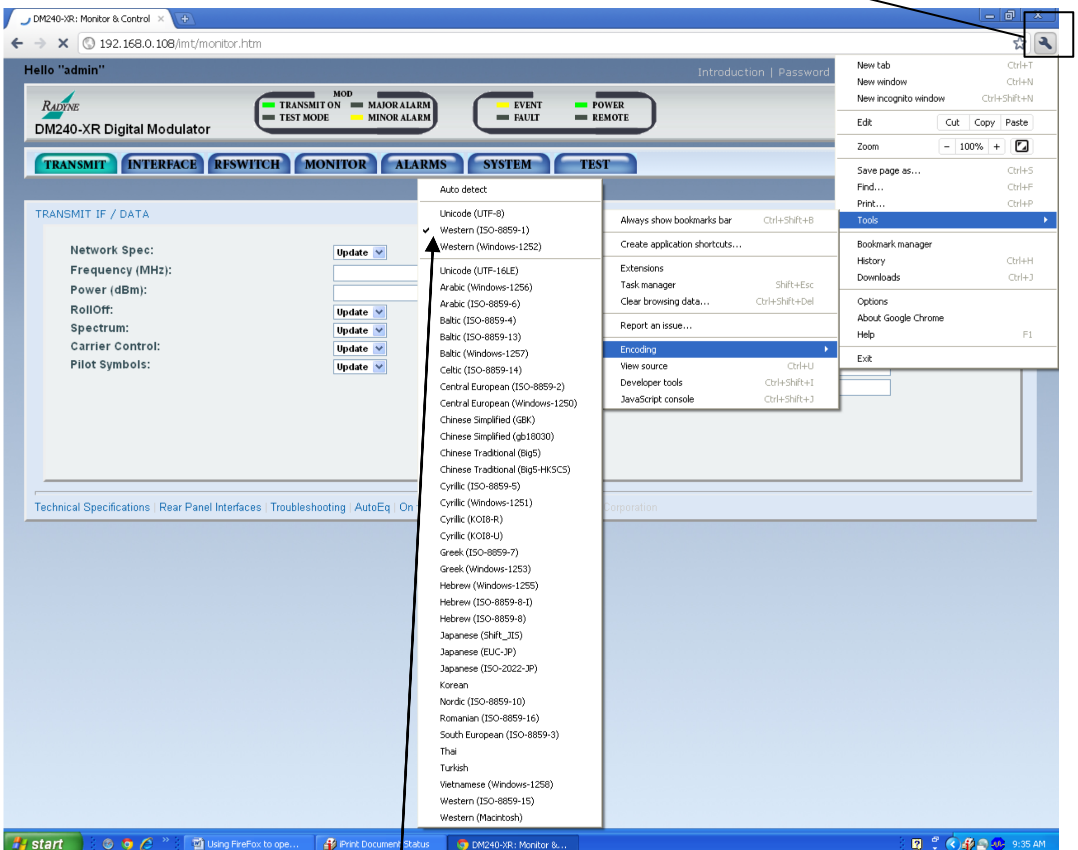
To correct the display, either 1) change the encoding, or, 2) install the Internet Explorer Tab V2 add-on.

NOTE

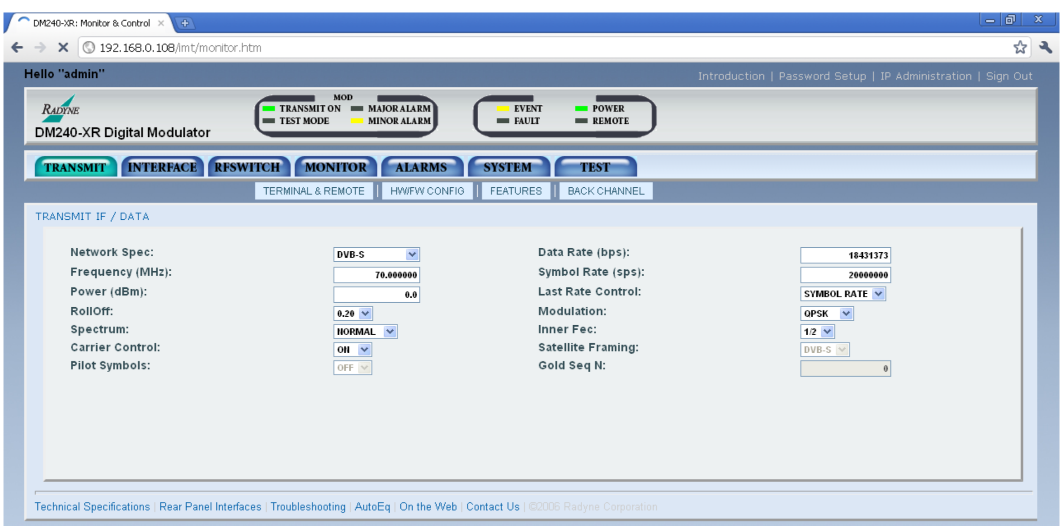
If you leave a window and return, it may be necessary to correct the display again.

D.6.3.1 Change the encoding

On the Chrome address bar, click the wrench icon (Customize and Control Google Chrome).



Go to **Tools** / **Encoding** and click **Western (ISO-8859-1)**. The page refreshes and shows the correct values.



D.6.3.2 Install the Internet Explorer Tab for Chrome

The Internet Explorer (IE) Tab lets you open WEB browser pages in Internet Explorer 7 mode. The link to install IE Tab is:

https://chrome.google.com/webstore/search/IE%20Tab?utm_source=chrome-ntp-icon

To install IE Tab, click **+ ADD TO CHROME** next to **IE Tab**.

After IE Tab is installed, the IE Tab icon  shows in the address bar.

To use IE Tab, click the icon. After IE Tab is started, the WEB browser pages show correct values.

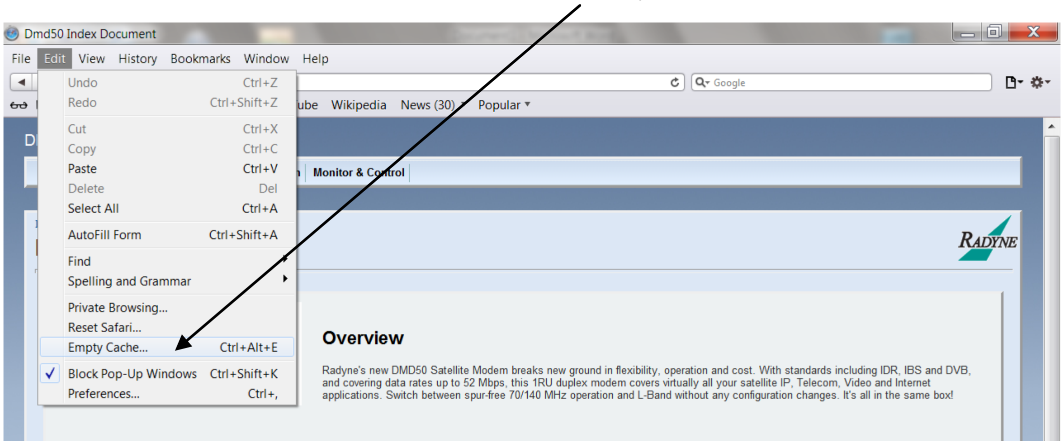
D.6.4 Configure Safari for the Radyne WEB Browser

IMPORTANT

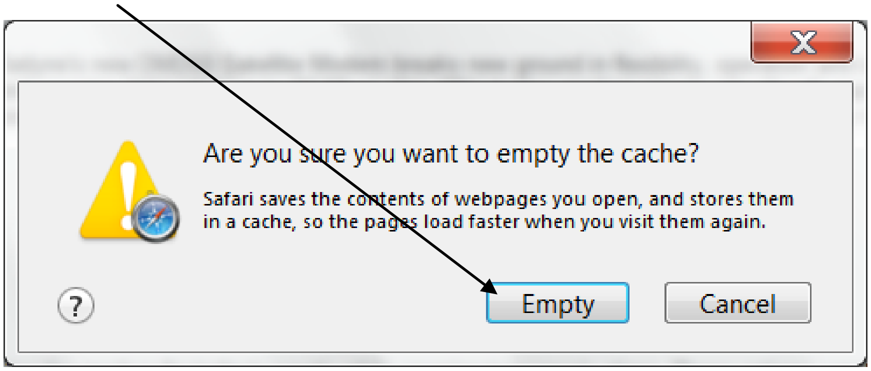
First, make sure to empty the browser cache.

D.6.4.1 Empty the browser cache

On the Safari menu bar, click **Edit** and then click **Empty Cache...**



Click **[Empty]** on the confirmation popup window.



After the browser cache is empty, open the **Monitor & Control** page.

CAUTION

If you do not empty the browser cache before you open the **Monitor & Control** page, communication can be lost. If communication is lost, you must reset the Ethernet M&C port on the Radyne product.

D.6.4.2 Reset the Ethernet M&C port

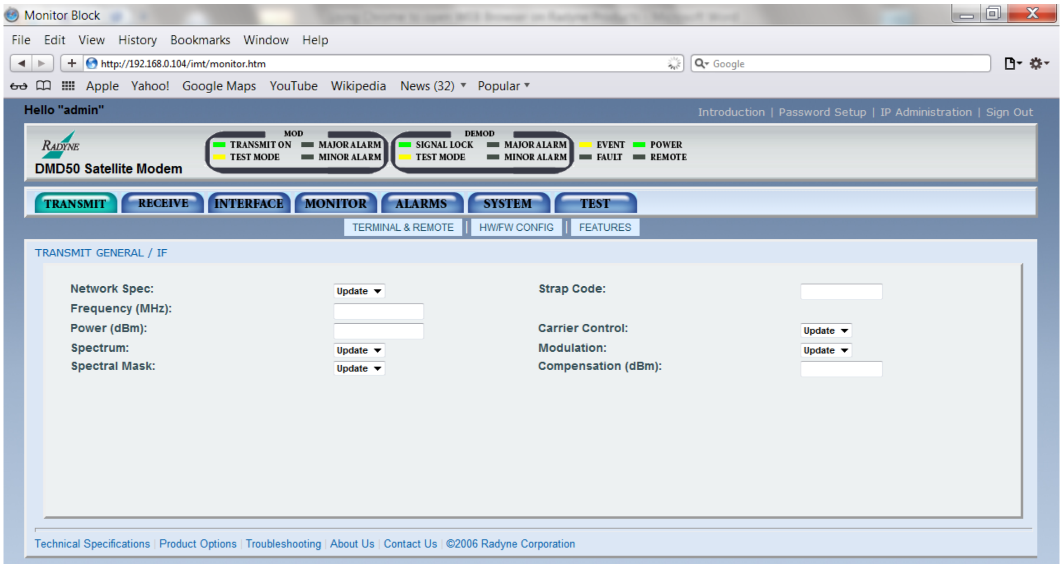
To reset the Ethernet M&C port, either 1) cycle the electrical power **OFF** and **ON**, or, 2) re-enter the **Modem IP Address**. Re-entering the **Modem IP Address** avoids traffic disruption.

D.6.4.3 Re-enter the Modem IP address

1. Go to **SYSTEM / TCP/IP / MODEM IP ADDR**.
2. Press **ENTER**.
3. Type the new **IP Address** and press **ENTER**.
4. Press **ENTER** again.
5. Retype the new **IP Address** and press **ENTER**.

IMPORTANT
You must change the **IP Address**. If you just press **ENTER** repeatedly without changing the **IP Address**, the Ethernet M&C port is not reset.

On the **Monitor & Control**, **Password Setup** or **IP Administration** windows, some fields may be blank or contain **Update.**



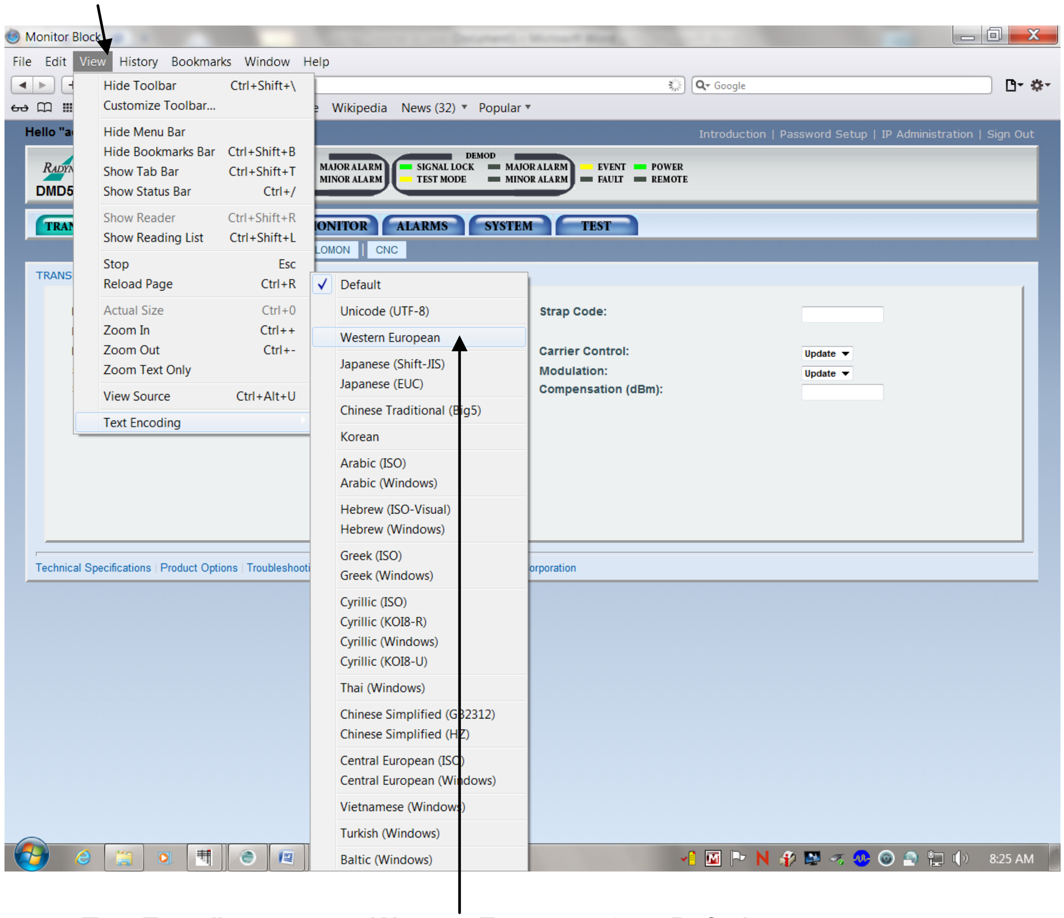
To correct the display, change the encoding.

NOTE

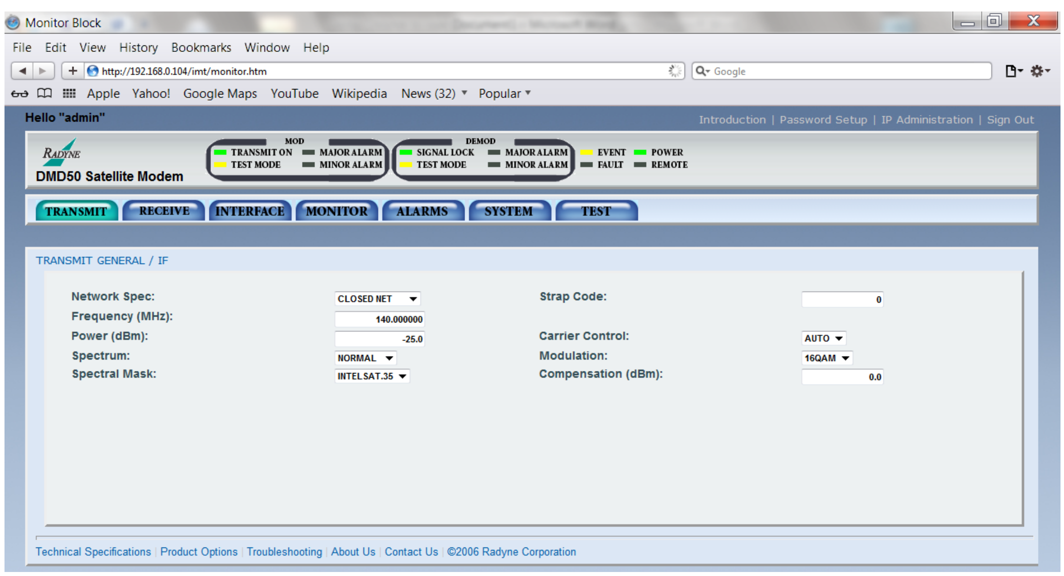
If you leave a window and return, it may be necessary to correct the display again.

D.6.4.4 Change the encoding

Click **View** on the Safari menu bar.

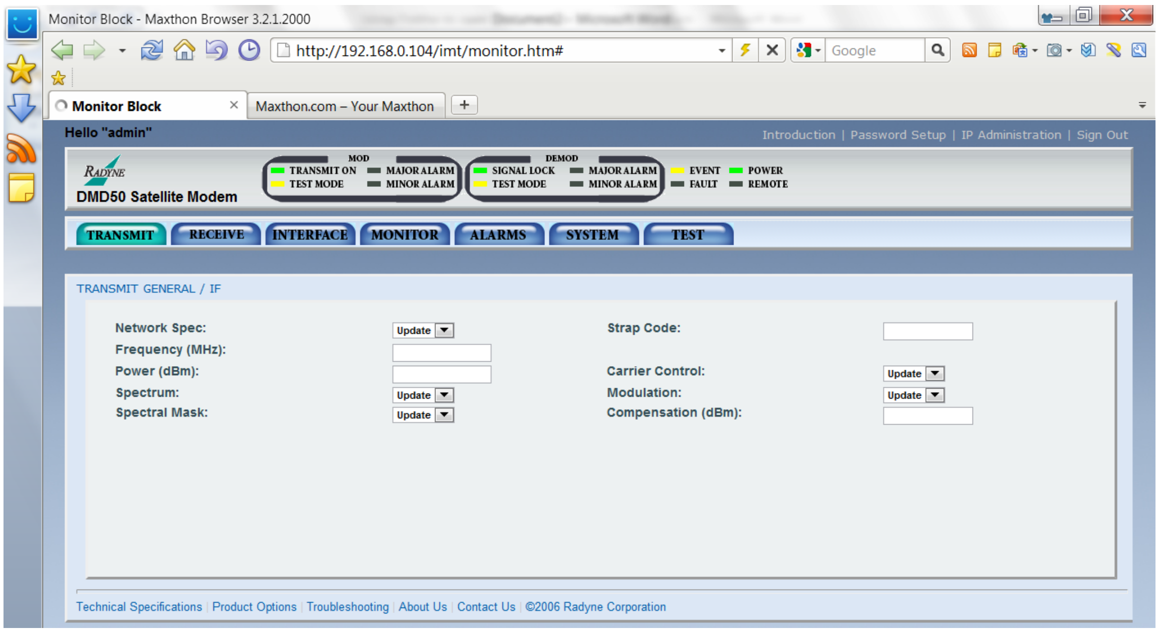


Select **Text Encoding** and click **Western European**. (The **Default** selection is not applicable.) The page refreshes and shows the correct values.



D.6.5 Configure Maxthon for the Radyne WEB Browser

On the **Monitor & Control**, **Password Setup** or **IP Administration** windows, some fields may be blank or contain **Update.**



To correct the display, either 1) change the browser mode, or, 2) change the encoding.

NOTE

If you leave a window and return, it may be necessary to correct the display again.

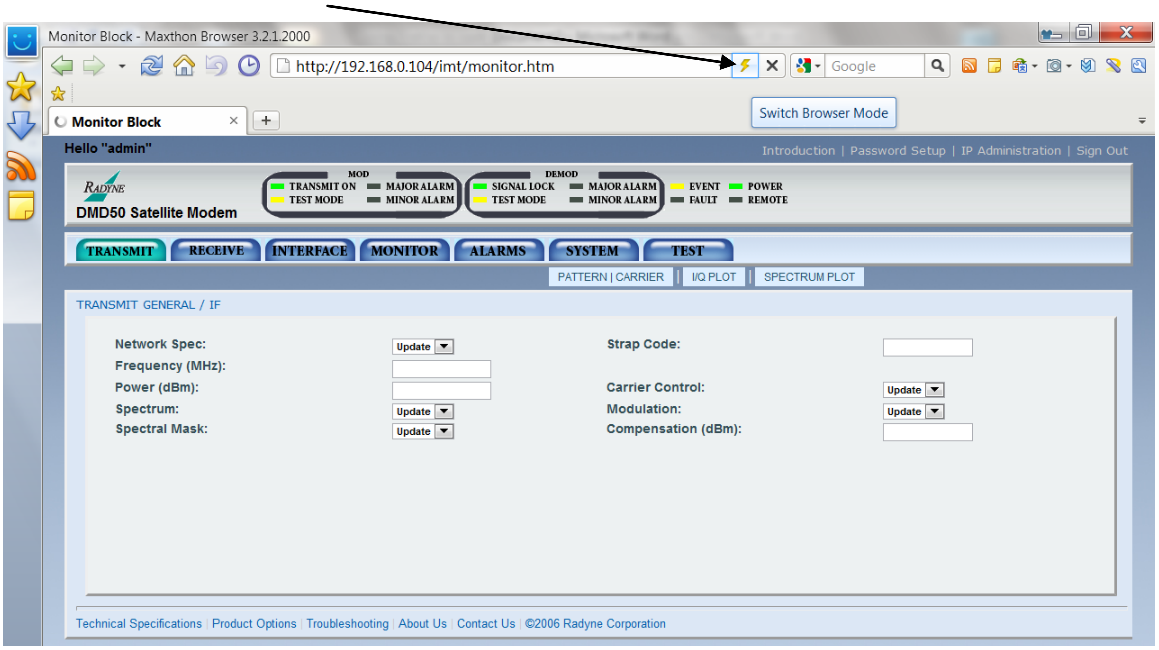
D.6.5.1 Change the browser mode

Two browser modes are possible:

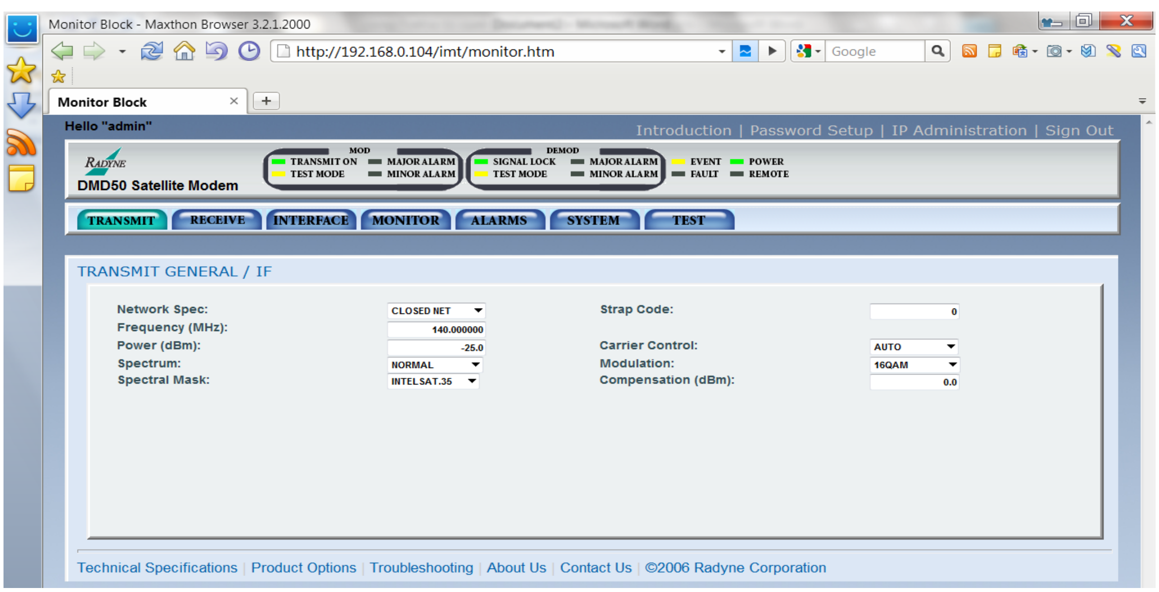
Ultra Mode  (default)

Retro Mode 

Click the browser mode icon at the right of the address bar.

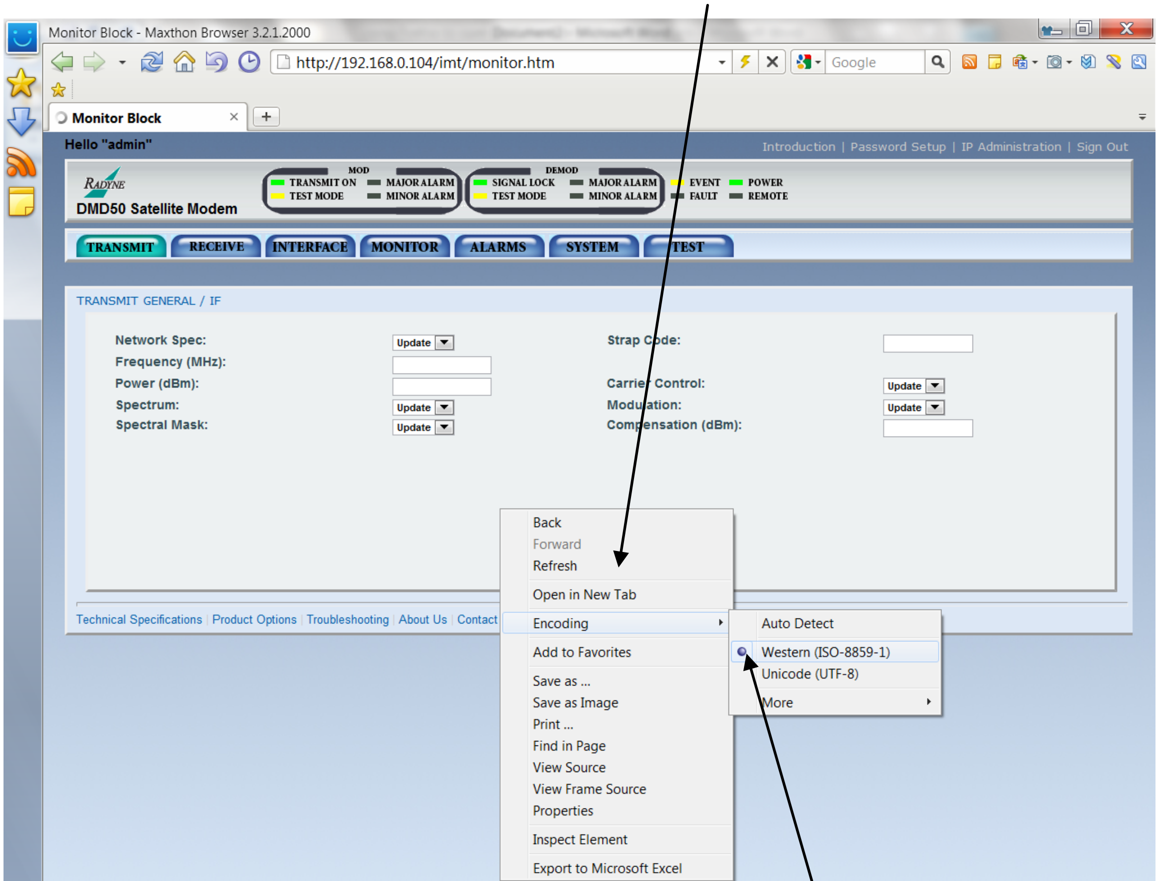


Select **Retro Mode** . The page refreshes and shows the correct values.

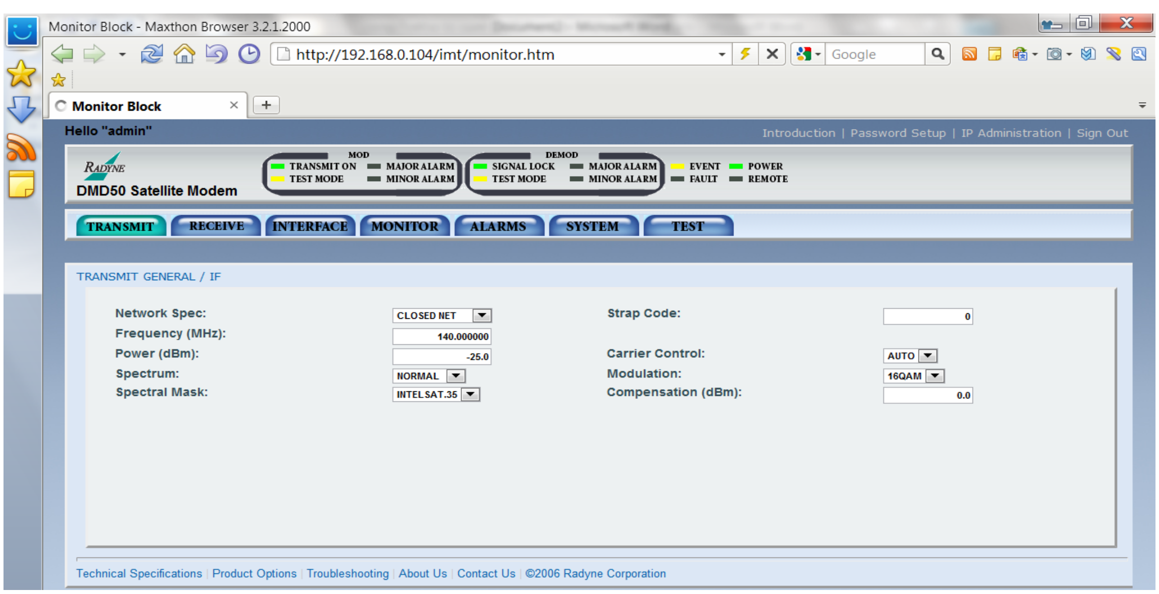


D.6.5.2 Change the encoding

On the Monitor & Control page, right click to open the browser menu.



Select **Encoding**, and then click the encoding type that is already selected. The page refreshes and shows the correct values.



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Appendix E. Drop and Insert (Standard and Efficient Options)

E.1 Introduction

Drop and Insert (D&I) functions let a full T1 or E1 terrestrial trunk and a fractional Nx64 Kbps satellite channel work together.

The framing of the terrestrial trunk is specified in CCITT G.704. The D&I specifications agree with IBS, small IDR, and Radyne Proprietary Efficient D&I Framing Structures.

The Drop and Insert functions are independent of each other. The Drop function lets you select the timeslots that are dropped for transmission over the link in the specified satellite channels. The Insert function lets you select the timeslots into which the received satellite channels are inserted.

E.2 System Requirements

The unit must have all of these requirements before you can use D&I:

- G.703 interface card installed
- Open Network Drop and Insert installed
- Firmware Revision F05058-AY 6.1 (or later)

Compare the system requirements with the configuration of the unit.

Objective	Menu Path	Requirement
Find the firmware revision status.	SYSTEM ▾ HW/FW CONFIG ▾ FIRMWARE ▾	F05058-AY 6.1 (or later)

Objective	Menu Path	Requirement
Find the G.703 interface card status.	SYSTEM ▾ HW/FW CONFIG ▾ TERR INTFC BRD ▾	01-PLR5660 or AS/4975 (or equivalent)
Find the Open Network Drop and Insert status.	SYSTEM ▾ HW/FW CONFIG ▾ FEATURES ▾ UPGRADE LIST	D&I INSTALLED (required) Optional settings are: ENH ASYNC INSTALLED AUPC INSTALLED

Update the unit with the latest firmware, if necessary. Download the latest firmware from the Comtech website.

E.3 Configuration Examples

The four-port G.703 Interface allows one or more modems to be looped together using the same T1 or E1 trunk.

The Transmit Data Trunk is brought into the modem via the Send Data In (SDI) Port. From there, the TX Baseband Processor extracts the selected timeslots from the G.704 Frame and prepares them for transmission. The original trunk data is sent out of the modem unaltered via the Send Data Out (SDO) Port. The Receive Data Trunk is brought into the modem via the Insert Data In (IDI) Port. The data is buffered inside the modem and the RX Baseband Processor inserts satellite data into the selected timeslots in the G.704 Frame. The modified terrestrial trunk is then output via the Receive Data Out (RDO) Port.

Figure E-1 shows two modems looped together. This configuration could be simplified to just use one modem, or extended to use more than two modems. Figure E-2 shows an alternative method of looping where all of the drop (transmit) data is processed prior to performing any insert (receive) processing. In both configurations, the terrestrial trunk is providing the timing for the satellite transmission and for the terrestrial receive.

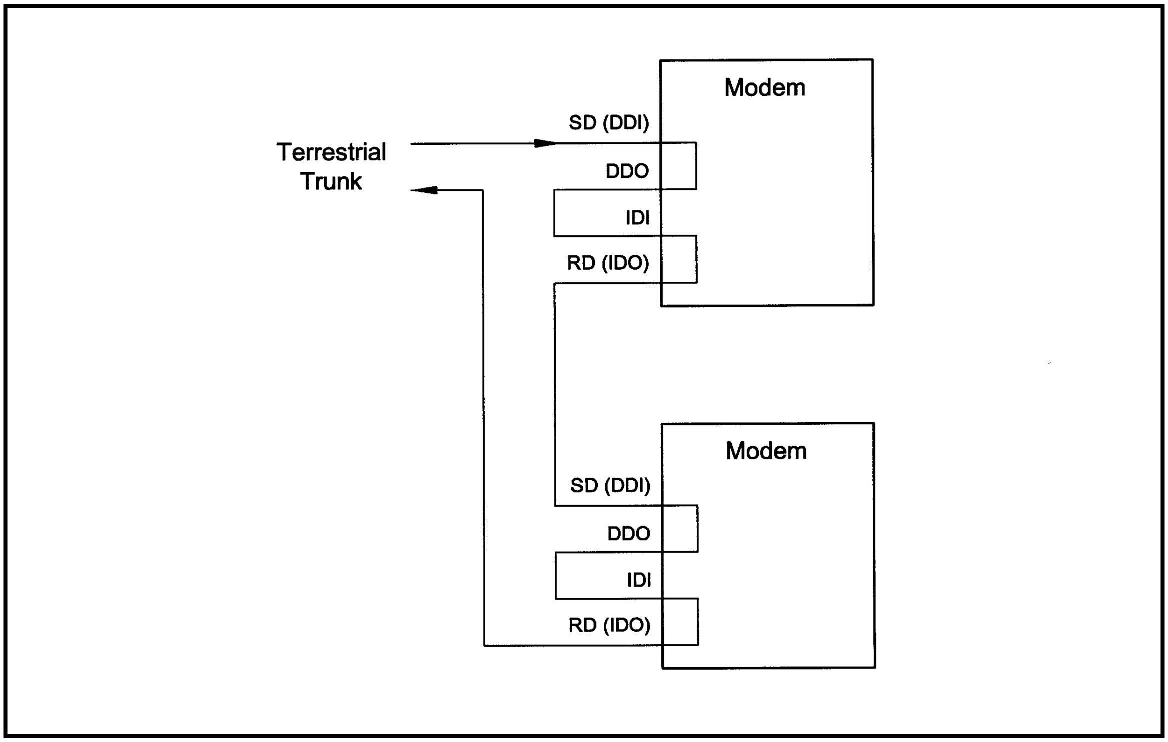


Figure E-1. Looped Modems

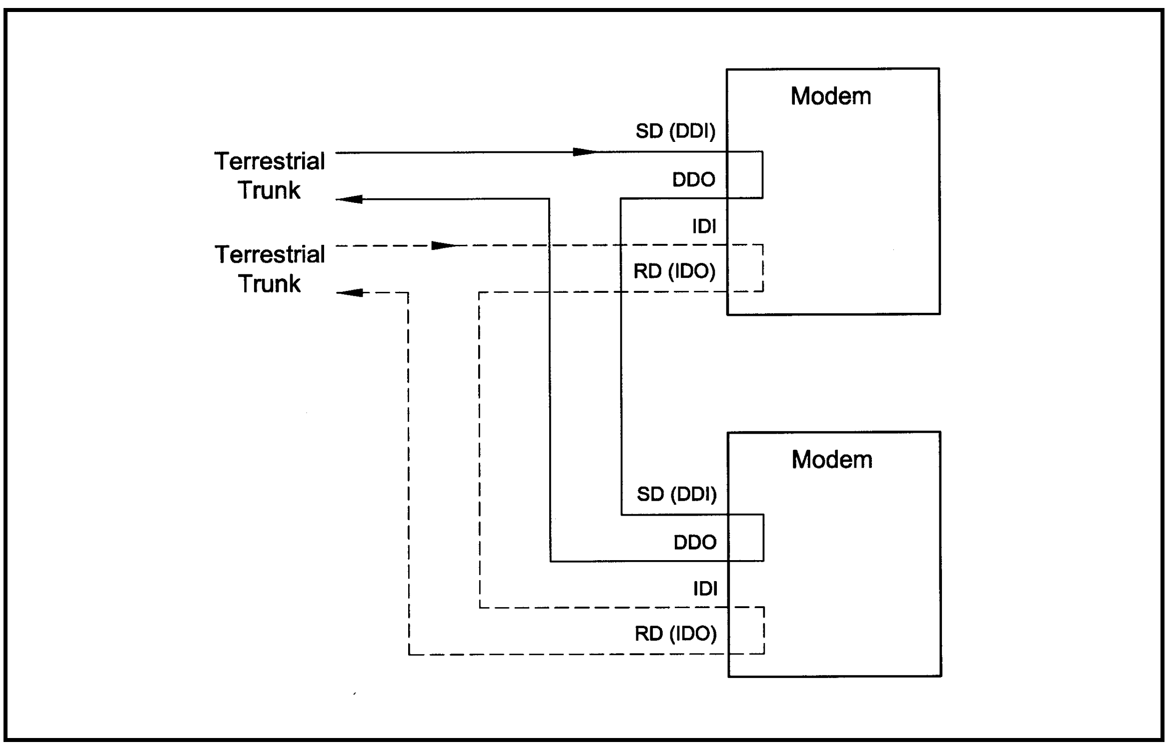


Figure E-2 Looped Modems with Separate D&I Trunks

E.4 Functional Descriptions

E.4.1 Drop Only

When Drop is enabled and Insert is disabled, the unit performs a drop-only function. Framed E1 or T1 Data is input via the Send Data In Port, the selected timeslots are dropped into the IBS frame structure, and the unaltered terrestrial data is output via the Send Data Out Port (see Figure E-3).

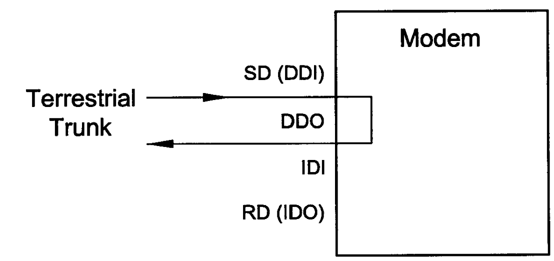


Figure E-3 Drop Only

E.4.2 Insert Only

When Insert is enabled and Drop is disabled, the unit performs an insert-only function. If framed terrestrial E1 or T1 Data is available, it should be input via the Insert Data In Port. The Terrestrial Data is buffered inside the Modem. The RX Baseband Processor inserts satellite data into the selected timeslots in the G.704 Frame and the modified terrestrial data is then output via the Receive Data Out Port (see Figure E-4).

If framed terrestrial data is not available, selection of the Internal T1/E1 frame source will cause the modem to generate the required G.704 Frame. The Satellite Data will be inserted into the selected timeslots, and the resulting terrestrial data will be output via the Receive Data Out Port. Any non-inserted timeslots in the G.704 Frame will be filled with the appropriate Idle Code (see Figure E-5).

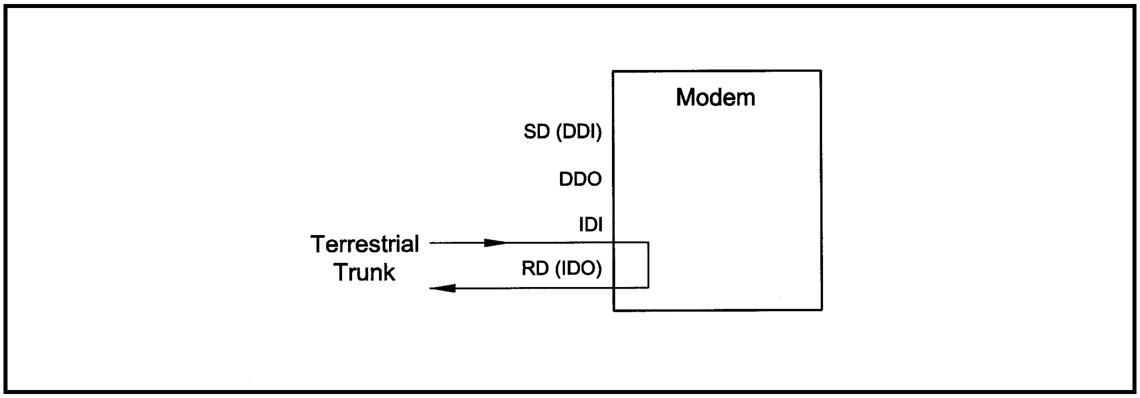


Figure E-4 Insert Only with Eternal Frame Source

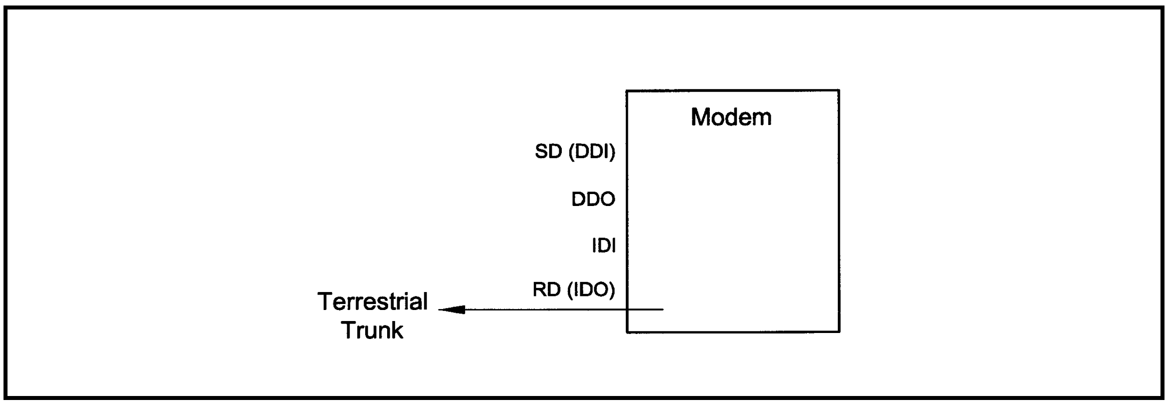


Figure E-5 Insert Only with Internal Frame Source

E.4.3 Data Formats

The terrestrial data formats compatible with D&I include:

E1 Data	T1 Data
PCM-30	T1-D4
PCM-30C	T1-ESF
PCM-31	SLC-96
PCM-31C	

E.4.3.1 PCM-30

The PCM-30 Mode of Operation supports an E1 Interface with Multiframe Alignment (MFAS) and Channel Associated Signaling (CAS). The user may independently program n timeslots to drop and n timeslots to insert where n = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, or 30. In addition to the selected drop timeslots, the Transmit Function also extracts the appropriate ABCD signaling bits from terrestrial timeslot 16 for transmission in IBS Frame as required. Conversely, the Receive Function extracts received ABCD signaling bits from the IBS Frame and inserts them in timeslot 16 of the appropriate terrestrial frame. This transmission and reception of ABCD signaling based upon the drop and insert timeslots is performed automatically and is transparent to the user. In PCM-30 mode, the user may *not* select timeslot 16 as a Drop or Insert Timeslot.

E.4.3.2 PCM-30C

The PCM-30C Mode of Operation supports an E1 Interface with Multiframe Alignment (MFAS) and Channel Associated Signaling (CAS). In addition, the Drop function verifies the received terrestrial CRC checksum and the Insert function calculates the required CRC checksum. The user may independently program n timeslots to drop and n timeslots to insert where n = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, or 30. In addition to the selected Drop timeslots, the Transmit Function also extracts the appropriate ABCD signaling bits from terrestrial timeslot 16 for transmission in IBS Frame as required. Conversely, the Receive Function extracts received ABCD signaling bits from the IBS frame and inserts them in timeslot 16 of the appropriate terrestrial frame. This transmission and reception of ABCD signaling based upon the Drop and Insert timeslots is performed automatically and is transparent to the user. *In PCM-30C Mode*, *the user may not select timeslot 16 as a Drop or Insert Timeslot*.

E.4.3.3 PCM-31

The PCM-31 Mode of Operation supports an E1 Interface with no Multiframe Alignment (MFAS) or Channel Associated Signaling (CAS). The user may independently program n timeslots to drop and n timeslots to insert where n = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, or 30. Because there is no implied ABCD signaling, the user is free to select timeslot 16 as a Drop *or* Insert Timeslot.

E.4.3.4 PCM-31C

The PCM-31C Mode of Operation supports an E1 Interface with no Multiframe Alignment (MFAS) or Channel Associated Signaling (CAS). In addition, the Drop Function verifies the received terrestrial CRC checksum and the Insert Function calculates the required CRC checksum. The user may independently program ‘n’ timeslots to drop and ‘n’ timeslots to insert where ‘n’ = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, or 30. Because there is no implied ABCD signaling, the user is free to select timeslot 16 as a Drop *or* Insert Timeslot.

E.4.3.5 T1-D4/T1-D4-S

The T1-D4 Mode of Operation supports a T1 Interface with 12 frames per multiframe. The user may independently program n timeslots to drop and n timeslots to insert where n = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, or 30. Robbed Bit Signaling (RBS) is handled without any need for operator intervention and is transparent to the user.

E.4.3.6 T1-ESF/T1-ESF-S

The T1-ESF Mode of Operation supports a T1 Interface with 24 frames per multiframe. The CRC-6 checksum is automatically checked by the Drop Function and generated by the Insert Function and placed in the appropriate F-bit positions in the terrestrial multiframe. The user may independently program n timeslots to drop, and n timeslots to insert, where n = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, or 30. Robbed Bit Signaling (RBS) is handled without any need for operator intervention and is transparent to the user.

E.4.4 Systems with Multiple Destinations

The independence of the Drop and Insert functions works well in systems with multiple destinations. Figure E-6 shows a system with one Hub site and three remote sites. At the Hub site, thirty channels are being transmitted to all three remote sites and a fractional set of channels is being received from each remote site. At the other end of the link, each remote site is transmitting a fractional E1 to the Hub site as well as receiving all 30 channels from the Hub site. It also identifies those channels intended for it, and inserts them into the terrestrial data stream.

E.4.5 Drop and Insert Mapping

The following displays under Interface D&I Setup (both Tx and Rx), are editing displays only:

SATCh TS

Enter to Edit

Any changes made in these displays are made on the screen, but *are not* entered into the modem. Once these menus are configured, the Mapping Menu must be used to actually enter the settings into the modem.

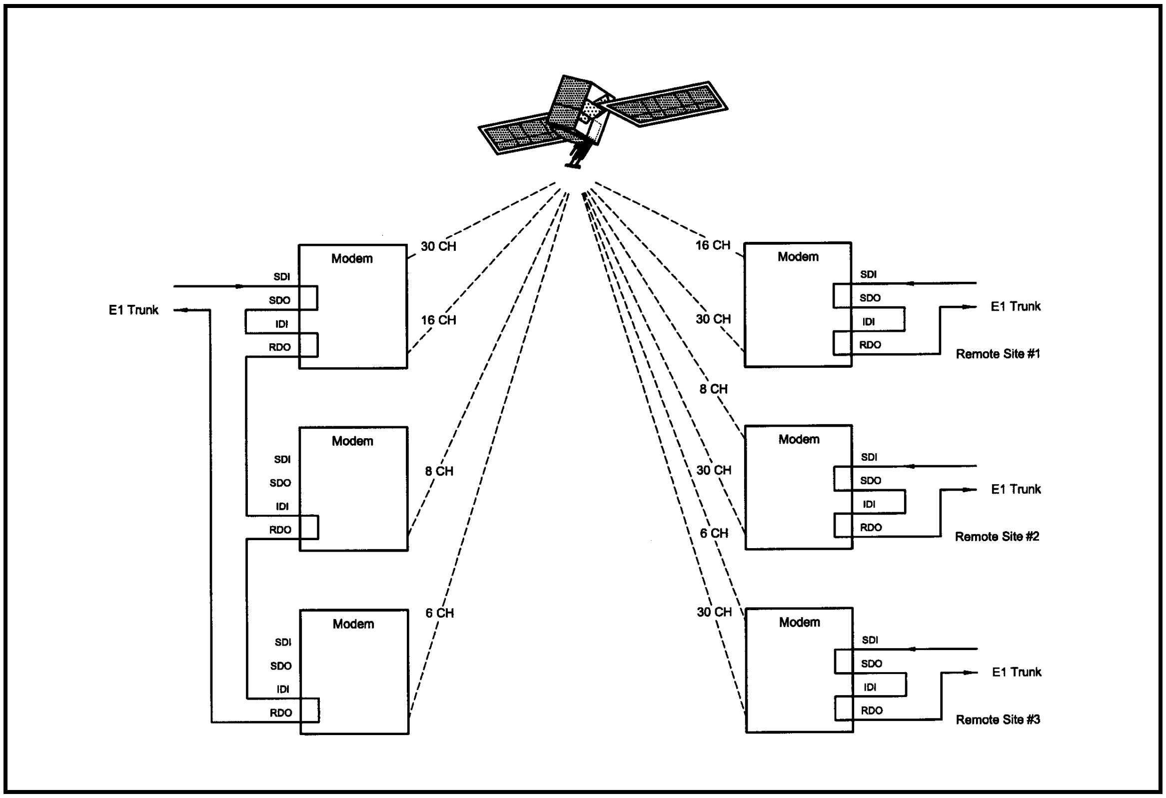


Figure E-6 Communications among Multiple Destinations

<u>Example :</u>

For a modem w/ Drop and Insert enabled at a data rate of 256 (with timeslots assigned 1 - 1, 2 - 2, etc.). At a data rate of 256, the modem will allow 4 channels to assign timeslots. Under the Tx Menu, assign the timeslots that are to be used to the 4 channels. CH1 is assigned to TS1 (Timeslot #1), CH2 to TS 2, CH3 to TS3 and CH4 to TS4, <ENTER> must be depressed after assigning each individual TS. Once the timeslots are assigned to the channels, use the Left or Right Arrow Key to scroll to the Mapping Menu. This menu will appear in the following way:

Map Copy

******* *******

This is the menu where the channel assignments are actually entered into the modem. To do this, perform the following steps:

For the Transmit Side:

1. Push <ENTER> to get the flashing cursor.
2. Use the Up Arrow Key to make the left portion of the display read “TX EDIT”.
3. Use the Right or Left Arrow Keys to switch the flashing cursor to the right portion of the display.
4. Use the Up or Down Arrow Key to until the right hand portion displays “TX ACTIVE”.
5. The mapping display should now look like this:

Map Copy

TX EDIT > TX ACTIVE

6. Push <ENTER> to enter this command. This tells the modem to configure to the settings that were assigned in the Channel/Timeslot display.

For the Receive Side:

1. With Rx Side Channels configured as follows: CH1 to TS1, CH2 to TS2, CH3 to TS3, and CH4 to TS4.
2. After the timeslots are assigned properly, scroll to the Mapping Menu and use the above procedure to enter the settings into the modem.
3. Set the display to read:

Map Copy

RX EDIT > RX ACTIVE

4. Press <ENTER> to enter the settings into the modem.

To View the current Timeslot Assignment:

1. If there is a question of the channels not being entered properly, the Mapping Menu may be used to see how the channels/timeslots are configured in the modem.
2. Use <ENTER> and the Arrow Keys to make the mapping menu read (for the Tx Side):

Map Copy

TX ACTIVE > TX EDIT

3. Press <ENTER>. The modem has now copied the current Tx Settings to the Tx Channel/Timeslot Display.
4. For the Rx Side:

Map Copy

RX ACTIVE > RX EDIT

5. Press <ENTER>. The modem has now copied the current Rx Settings to the Rx Channel/Timeslot display).

IMPORTANT

It is not mandatory to assign timeslots in sequential order, although the lowest timeslot must be entered in the lowest channel. For example, timeslots may be assigned 1 - 2, 2 - 5, etc.; but not 1 - 5, 2 - 2.

E.5 Configuring the Modem for Drop and Insert

Several dependencies exist when configuring the modem for Drop and Insert (D&I). The following paragraphs explain these dependencies and provide the user with the information required to ensure smooth transition into D&I and to minimize the potential impact of these dependencies.

E.5.1 Data Rate

Data Rate affects the Drop and Insert function in the following ways:

- It determines the number of Satellite Channels that will be displayed in the Edit Maps.
- It contributes to the Operational Mode selection process. Trying to change the Operational Mode to D&I when a data rate is not set to a valid D&I rate will result in the error message 'INVALID DATA RATE,' and the mode change will not be allowed.
- It contributes to the Terrestrial Framing Mode selection process. Trying to select a T1-type Drop Mode such as T1-ESF with the mod data rate set to 1920000 bps (a valid E1 D&I rate but not a valid T1 rate) will result in the error message 'INVALID DROP MODE' and the selection will not be allowed. Trying to select a T1 type Insert Mode such as T1-D4 with the demod data rate set to 1920000 bps will result in the error message INVALID INSERT MODE and the selection will not be allowed.
- Once D&I Mode has been selected, trying to change the data rate to something other than another valid D&I data rate will result in the error message 'RATE OUT OF BOUNDS' and the change will not be allowed.
- Once D&I Mode has been selected with a T1 Terrestrial Framing Mode, attempting to change the data rate to 1920000 will result in the error message 'RATE OUT OF BOUNDS' and the change will not be allowed.

Therefore, the data rate should be entered as the first step in configuring the modem for D&I. The Mod Data Rate should be set according to the number of timeslots to be dropped and the Demod Data Rate should be set according to the number of timeslots to be inserted. The following table gives the allowable D&I data rates based on the number of slots (n) to be dropped or inserted.

n = 1, data rate = 64000

n = 2, data rate = 128000

n = 3, data rate = 192000

n = 4, data rate = 256000

n = 5, data rate = 320000

n = 6, data rate = 384000

n = 8, data rate = 512000

n = 10, data rate = 640000

n = 12, data rate = 768000

n = 15, data rate = 960000

n = 16, data rate = 1024000

n = 20, data rate = 1280000

n = 24, data rate = 1536000

n = 30, data rate = 1920000 (valid with E1 Interface only)

E.5.2 Operational Network Specification

The Network Specification of the Modem often determines which additional menus and displays are available for use by the operator. The D&I Mode-specific menus will not be displayed unless the Network Specification of the modem is set to D&I. Therefore, the second step in configuring the modem should be to set the Network Specification to D&I. At this point, the D&I specific menus in the Interface section will become available and will remain available until the Network Specification of the modem is changed to something other than D&I.

When the Network Specification is changed to something other than D&I, the D&I specific menus will automatically disappear.

E.5.3 Terrestrial Framing - Drop Mode/Insert Mode

The Drop Mode Selection and the Insert Mode Selection identify the Terrestrial Data-Framing Format. As previously mentioned, their selection is influenced by the Modulator and Demodulator Data Rates, and trying to select a T1 Type Framing Format with a data rate of 1920000 bps will result in an error message. In turn, the selection of the terrestrial framing formats influences the satellite channel to terrestrial timeslot mappings in the following manner:

> The selection of T1-D4, T1-ESF, or SLC-96 type terrestrial framing format limits the terrestrial timeslots to values from 1 - 24.
>
> The selection of PCM-30 or PCM-30C type terrestrial framing limits the terrestrial timeslots to values from 1 - 15, 17 - 31. In these modes, terrestrial timeslot 16 is reserved for ABCD signaling and may not be dropped or inserted.
>
> The selection of PCM-31 or PCM-31C type terrestrial framing limits the terrestrial timeslots to values from 1 - 31. Therefore, the terrestrial framing format should be identified via the Drop Mode and Insert Mode entries prior to editing the Drop or Insert satellite channel to terrestrial timeslot maps.

E.5.3.1 Insert Terrestrial Frame Source

The Insert Terrestrial Frame Source selection tells the Modem from where the Insert Terrestrial Frame is coming.

External: Indicates that the terrestrial frame is to be input via the Insert Data In Port.

Internal: Indicates that the modem needs to generate the terrestrial frame and that all non-inserted timeslots need to be filled with the appropriate idle code based upon the terrestrial framing (T1 or E1).

The selection of the Insert Terrestrial Frame Source also influences the Buffer Clock selection in the following manner:

When the Insert Terrestrial Frame Source selection is set to External, the received satellite data will be clocked out of the Doppler Buffer based upon the clock recovered from the insert data input. Therefore, the Buffer Clock selection will automatically be set to External and cannot be modified. Attempts to select a different buffer clock will result in the error message INVALID BUFFER CLOCK and the selection will not be allowed.

When the Insert Terrestrial Frame Source selection is set to Internal, the operator needs to specify how data should be clocked out of the Doppler Buffer. In this case, the operator will be able to select SCTE, SCT, RX SAT, or EXT EXC as the source for the Buffer Clock. Therefore, the Insert Terrestrial Frame Source selection should be made prior to attempting to change the Buffer Clock. In most instances, the Insert Terrestrial Frame Source selection will be set to External and the Buffer Clock will automatically be set to External.

E.5.4 D&I Sample Configurations and D&I Clock Setup Options

The following are several examples of how to configure the modem for D&I. Also, see Figures 3-14 through 3-17 for the D&I Clocking Setup Options Available.

Example 1: Drop 512 Kbps from a T1 trunk, 3/4 Rate Viterbi

Insert 512 Kbps into a T1 trunk, 3/4 Rate Viterbi

Drop 512 Kbps from a T1 trunk, 3/4 Rate Viterbi

Under Interface:

Under TX Setup:

Set Tx Type according to your hardware configuration (example: G703BT1B8ZS)

Set Tx Clock = SCTE

Under Tx D&I:

Set Drop Mode = T1-D4

Use SATCh TS edit capability to define desired mapping of

Satellite Channels to drop Terrestrial Slots

Use Map Copy to copy Tx Edit to Tx Active

Under Modulator:

Under Mod Data:

Set Data Rate = 512000

Set Conv Enc = 3/4 Rate VIT

Under Modulator:

Set Network Spec. = Drop and Insert

Under Interface:

Under TX Setup:

Set Tx Type according to your hardware configuration (example: G703BT1B8ZS)

Set Tx Clock = SCTE

Under Tx D&I:

Set Drop Mode = T1-D4

Use SATCh TS edit capability to define desired mapping of

Satellite Channels to drop Terrestrial Slots

Use Map Copy to copy Tx Edit to Tx Active

Under Modulator:

Under Mod IF:

Set Frequency to desired value

Turn IF Output Power On

Under Demodulator:

Under Demod Data:

Set Data Rate = 512000

Set Conv Enc = 3/4 Rate VIT

Under Interface:

Under RX Setup:

Set Rx Type according to your hardware configuration

Set Buff Size to desired depth

Under Rx D&I:

Set Insert Mode = T1-D4

Set T1 E1 Frm Src = External

Use SATCh TS edit capability to define proper mapping of

Satellite Channels to insert Terrestrial Slots

Use Map Copy to copy Rx Edit to Rx Active

Under Demodulator:

Under Demod IF:

Set Frequency to desired value

Under Demodulator:

Set Network Spec. = Drop and Insert

Example 2: Multidestinational Remote Site Programming

Drop 512 Kbps from a T1 trunk, 3/4 Rate Viterbi.

Extract 512 Kbps from a 1536 Kbps carrier and insert into a

T1 trunk, 3/4 Rate Viterbi.

Drop 512 Kbps from a T1 trunk, 3/4 Rate Viterbi

Configuration setup is exactly as previously shown in Example 1.

Extract 512 Kbps from a 1536 Kbps carrier and insert into a T1 trunk, 3/4 Rate Viterbi

Under Interface:

Under RX Setup:

Set Rx Type according to your hardware configuration

Set Buff Size to desired depth

Under Rx D&I:

Set Insert Mode = T1-D4

Set T1 E1 Frm Src = External

Use SATCh TS edit capability to define proper mapping of Satellite Channels to insert Terrestrial Slots

For Satellite Channels that are not to be inserted, enter “NI” (No Insert) for the Terrestrial Slot

Use Map Copy to copy Rx Edit to Rx Active

Under Demodulator:

Under Demod Data:

Set Data Rate = 1536000

Set Conv Enc = 3/4 Rate VIT

Under Demodulator:

Set Network Spec. = Drop and Insert

Under Demodulator:

Under Demod IF:

Set Frequency to desired value.

E.5.4.1 D&I Clock Setup Examples

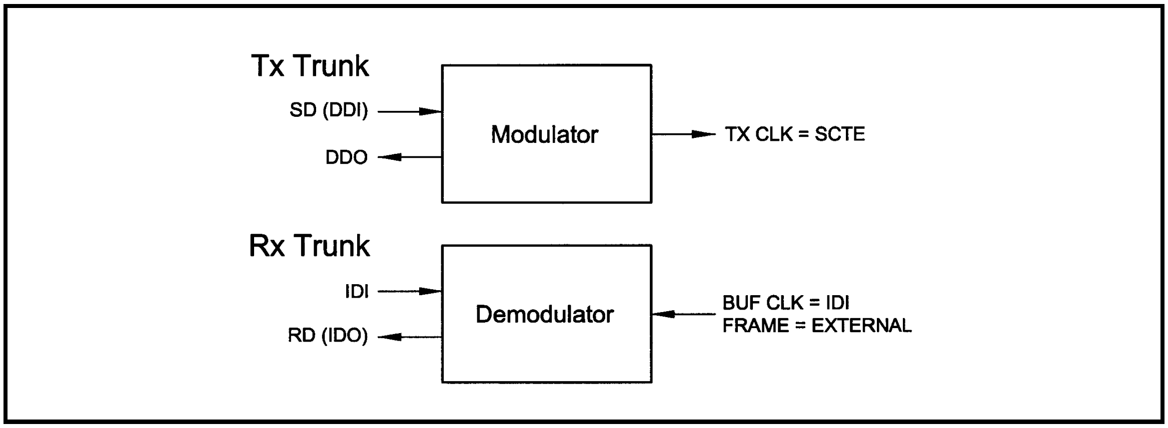


Figure E-7 Transmit Trunk and Receive Trunk

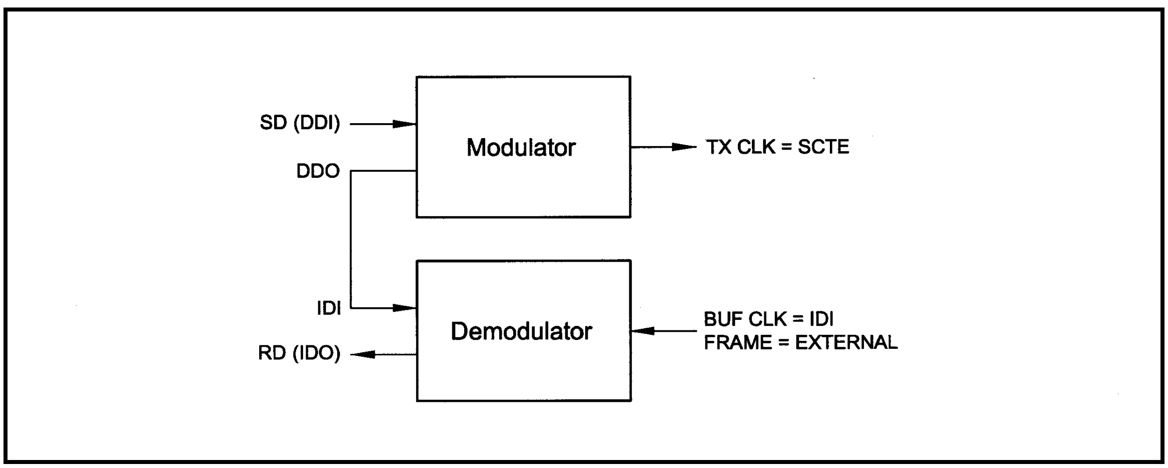


Figure E-8 Single Truck

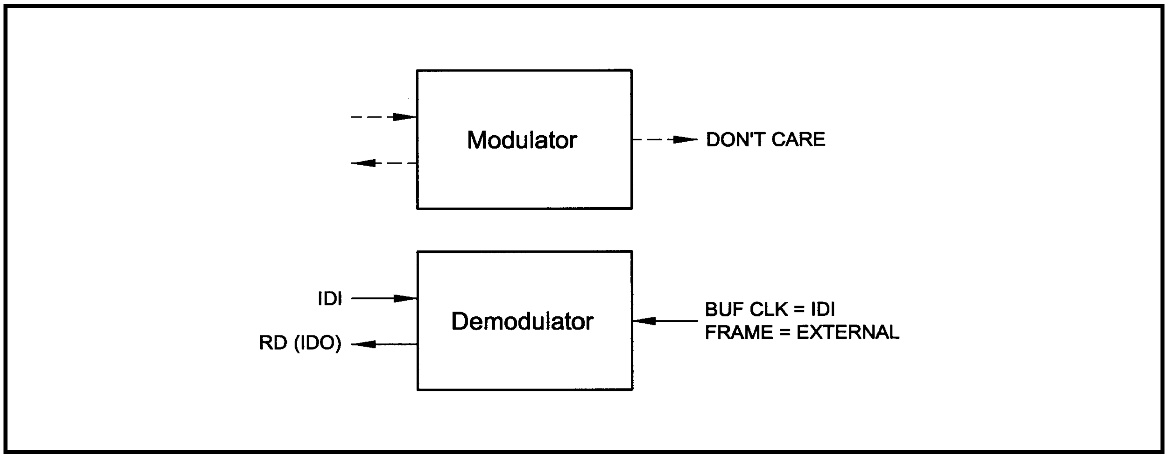


Figure E-9 Rx Only With Trunk

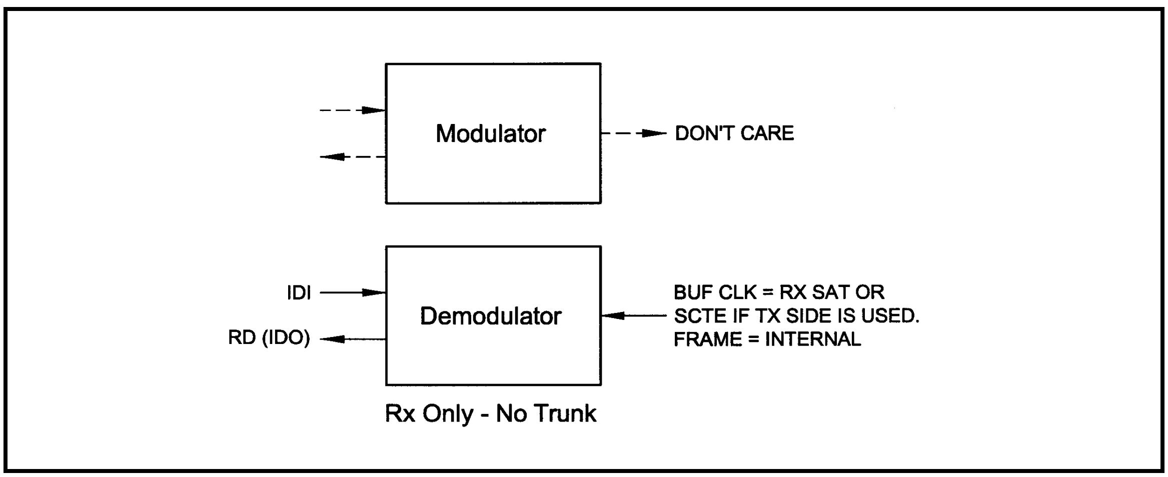


Figure E-10 Rx Only No Trunk

E.6 D&I Maps and Map Editing

The Drop and Insert multiplexer is programmed by loading it with a transmit and receive map. Maps always contain 30 entries, although, only the first “n” entries are relevant (see Table E-1).

The modem includes provisions to copy, change, and store the D&I transmit and receive maps directly from the Front Panel or via the remote MandC link. These maps are tables that are used to define and configure the D&I functions. Each map contains up to 30 entries, which are enough to define the channel assignments for a T1 (24 channel) or E1 (30 channel) frame structure. Maps that are created are stored in non-volatile battery backed-up memory within the modem and remain unchanged after a power-down.

Table E-1. D&I Multiplexer Map Locations Used

Data Rate (Kbps)	Map Locations Used (n = 1, 2,4,8,16,24,30)
64	1
128	1-2
256	1-4
384	1-6
512	1-8
768	1-12
1024	1-16
1536	1-24
1920	1-30

It is important to understand that each map contains up to 30 usable entries. In many cases a smaller number of entries will be relevant, except when the data rate is 1920 Kbps, in which case 30 entries will used by the multiplexer. To determine the number of relevant entries, divide the data rate by 64 Kbps.

For example:

At 384 Kbps, 384/64 = 6 entries.

Therefore, in this case only the first six entries of the map would be relevant.

The Modem is equipped with eight permanently stored default maps, which are designated ROM 1 through ROM 8. The user may also define, modify, and save an additional eight maps which are designated USER 1 through USER 8.

IMPORTANT

ROM maps are read-only and may not be modified (see Table H-2).

Table E-2. D&I ROM Maps

ROM Map	T1/E1 Time Slot																													
#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
3	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
4	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
5	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6
6	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
7	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Since the D&I Functions are separate and distinct, two separate maps must be configured at the start of the D&I Multiplexer Operation. These are the Tx (transmit) Active Map for Drop Mapping and the Rx (receive) Active Map for Insert Mapping. The number of entries in each map is determined by the data rates selected. Each map entry consists of an IBS Time Slot assignment and the Terrestrial (T1 or E1) Channel Number to which it is assigned. Drop Mapping and Insert Mapping are completely separate and independent.

The map that is actually used for the Drop Function is the Tx Active Map; the map that is actually used for the Insert function is the Rx Active Map. Two additional maps exist: the Tx Edit Map and the Rx Edit Map. The Edit Maps are the buffer areas that are used when creating or modifying a map through the modem's LCD; when editing is complete, the appropriate map should be copied to the Active Map.

Any map may be copied to any other map with the exception of the ROM maps. These maps may only be the source of the data used to create a User, Edit, or Active Map.

Maps can be created in the map editor and stored as "User Maps". New "Active Maps" can be downloaded during Modem Operation but this will result in a temporary disruption of service on the terrestrial line or the Satellite transmission.

The following paragraphs give examples of typical configurations that could use the ROM Maps as templates. The ROM Map used would have to be first copied to the appropriate Active Transmit (Drop) and/or Active Receive (Insert) Map(s) before it could be used. To use a modification of a ROM Map, the ROM Map must first be copied to the appropriate Edit Map, then modified, and then copied to the appropriate Active Map.

IMPORTANT

The mapping of channels to time slots is arbitrary; it is not necessary to map CH1 to TS1, CH2 to TS2, etc. The channel to the time slot mapping may be in any order within the constraints of the number of available channels.

For example, ROM Map 1 could be used as the template for an Active Transmit (Drop) Map within a modulator configured for 64 Kbps operation. Only the first time slot of the T1 or E1 frame would be dropped into the modulator transmit path. The Drop Multiplexer would know to look only at the first entry in the Active Transmit table and would ignore the other 29 entries. If the map contained an "8" in its first entry, the eighth channel of the T1/E1 frame would be sent to the modulator.

ROM Map 2 could be used as the template for an Active Receive (Insert) Map within a demodulator configured for 128 Kbps operation. The demodulated data in the receive path would be inserted into the first two time slots of the T1 or E1 frame. The Insert Multiplexer would know to look only at the first two entries in the Active Receive table and would ignore the other 28 entries. If the first two entries were modified to contain a 27 and 28, the data would be inserted into the 27th and 28th time slots of the E1 frame.

ROM Map 3 could be used as the template for an Active Transmit (Drop) Map with a modulator and/or demodulator configured for 256 Kbps operation. The T1 or E1 Data in the transmit path or the demodulated data in the receive path would be dropped from and/or inserted into the first four time slots of the T1 or E1 frame. The Multiplexer would know to look only at the first four entries in the Active map(s) and would ignore the other 26 entries.

ROM Map 4 could be used as the template for an Active Transmit (Drop) or Active Receive (Insert) Map with a modulator and/or demodulator configured for 384 Kbps operation. The T1 or E1 Data in the transmit path or the demodulated data in the receive path would be dropped from and/or inserted into the first six time slots of the T1 or E1 frame. The Insert Multiplexer would know to look only at the first six entries in the Active map(s) and would ignore the other 24 entries. To Drop the last six channels of a T1 frame into a modulator transmit path, the first six entries of the Active Transmit map should contain 19, 20, 21, 22, 23, and 24.

ROM Map 5 could be used as the template for an Active Transmit (Drop) and/or Active Receive (Insert) Map with a modulator and/or demodulator configured for 512 Kbps operation. The T1 or E1 Data in the transmit path or the demodulated data in the receive path would be dropped from and or inserted into the first eight time slots of the T1 or E1 frame. The Multiplexer would know to look only at the first eight entries in the Active map(s) and would ignore the other 22 entries.

To insert data received from a demodulator into channels 17 through 24 of an E1 frame, the first eight entries of the Active Receive map should contain 17, 18, 19, 20, 21, 22, 23, and 24.

ROM Map 6 could be used as the template for an Active Transmit (Drop) and/or Active Receive (Insert) Map with a modulator and/or demodulator configured for 768 Kbps operation. The T1 or E1 Data in the transmit path or the demodulated data in the receive path would be dropped from and or inserted into the first 12 time slots of the T1 or E1 frame. The Multiplexer would know to look only at the first 12 entries in the Active map(s) and would ignore the other 18 entries. To insert data received from a demodulator into channels 3 through 14 of an E1 frame, the first 12 entries of the Active Receive map should contain 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14.

ROM Map 7 could be used as the template for an Active Transmit (Drop) and/or Active Receive (Insert) Map with a modulator and/or demodulator configured for 1920 Kbps operation. This would be used with E1 frames where time slot 16 is not used for the multiframe alignment signal and therefore channels 1 through 30 are mapped directly with time slots 1 through 30.

ROM Map 7 could also be used as the template for an Active Transmit (Drop) and/or Active Receive (Insert) Map with a modulator and/or demodulator configured for 1024 Kbps operation. This would be used with T1 or E1 frames where channels 1 through 16 are mapped into time slots 1 through 16 (in any order). Map slots 17 through 30 would be ignored.

ROM Map 7 could also be used as the template for an Active Transmit (Drop) and/or Active Receive (Insert) Map with a modulator and/or demodulator configured for 1536 Kbps operation.

This would be used with T1 frames where channels 1 through 24 are mapped into time slots 1 through 24 (in any order). Map slots 25 through 30 would be ignored.

ROM Map 8 could also be used as the template for an Active Transmit (Drop) and/or Active Receive (Insert) Map with a modulator and/or demodulator configured for 1920 Kbps operation. However, this mapping would be relevant with E1 frames where time slot 16 is used for the multiframe alignment signal and therefore channels 1 through 30 are mapped to time slots 1 through 16 and 17 through 31.

E.7 Efficient Drop and Insert Introduction

The following paragraphs describe the menu structure and procedure for configuring a Radyne DMD20 / DMD2050 / DMD50 modem for Efficient Drop and Insert Mode.

E.8 Prerequisite

In order for a modem to be configured for efficient Drop and Insert, the modem must have a G.703 Interface card installed and Open Network Drop and Insert must be enabled. If you modem does not have the required hardware and/or feature set enabled, you will need to contact your Comtech salesperson to order the appropriate hardware and/or feature set upgrade. If your modem has the appropriate hardware, but the software revision is prior to AY, you will need to download the latest modem firmware from the Comtech FTP website.

The following menus illustrate how to determine whether or not your modem has the required hardware and feature set options.

SYSTEM

HW/FW CONFIG

FIRMWARE

F05058-AY 6.1 or later required

SYSTEM

HW/FW CONFIG

TERR INTFC BRD

01-AS/4975 or PLR5660 or equivalent required

SYSTEM

HW/FW CONFIG

FEATURES

UPGRADE LIST

D&I

INSTALLED required

ENH ASYNC

INSTALLED optional, required if desired

AUPC

INSTALLED optional, required if desired

E.9 Efficient Drop and Insert Mode

With Efficient Drop and Insert, the terrestrial interface selections, terrestrial framing modes, terrestrial to satellite mapping, ES to ES channel, satellite and terrestrial backward alarm functionality, and the In Station Prompt and Deferred Service alarm operation are identical to that of the Open Network standard. In addition, the selection and operation of Enhanced Async and AUPC are identical to their closed network IBS counterparts. For more information on these selections, see the appropriate section of the User's manual.

The following menu selections are utilized for controlling the additional functionality available with efficient Drop and Insert:

MODULATOR or DEMODULATOR

NETWORK SPEC

CLOSED NET — Efficient Drop and Insert is a Closed Network selection

SAT FRAMING

EFFICIENT D&I — The satellite frame type is Efficient Drop and Insert

DATA

DATA RATE (bps)

N x 64000 — The data rate can be set to any N x 64 kbps rate based on the desired number of drop or insert slots. The following values of N are allowed based on the terrestrial interface and terrestrial framing types shown

T1	Any framing	Any N from 1 to 24
E1	Any PCM31	Any N from 1 to 31
E1	Any PCM30	Any N from 1 to 30 as TS 16 is automatically transmitted

SCRAMBLER CTRL

DISABLED — The Efficient Drop and Insert mode utilizes a frame synchronous energy dispersal technique that is always on, thus there is no need for any additional scrambling

INBAND RATE

150 — Available when enhanced async is enabled, this field

300 — allows the operator to set the Earth Station to Earth

600	station in-band rate. In most cases, this should be set to the
1200	same rate or higher than the ES port baud rate. When this
2400	rate is set lower than the ES port baud rate, the user must
4800	insure that the actual transmission rate does not exceed the
9600	in-band rate, otherwise, characters will be dropped
19200	

E.9.1 Calculating the Required Satellite Bandwidth

In order to calculate the satellite bandwidth (i.e. the symbol rate), we must first calculate the Efficient D&I Rate (i.e. the data rate plus the overhead required for Efficient Drop and Insert). From there, the calculation of the required satellite bandwidth is identical to all other modes of operation and simply takes into account modulation type and forward error correction.

In this section, we will cover the calculation of the basic Efficient D&I Rate, as well as, the two cases that alter the basic rate.

E.9.2 Calculating the Basic Efficient D&I Rate

When E1 signaling is not required (all T1 and PCM31 cases) and Enhanced Async is not enabled (the Earth Station to Earth station link is the standard ES-ES), the Efficient D&I Rate for N timeslots is as follows:

Efficient D&I Rate = Data Rate + (N * 250 bps)

In other words, the basic Efficient Drop and Insert Rate only requires 250 bps of overhead per slot, while at the same time providing all of the functionality found in the open network standard plus Automatic Uplink Power Control. By comparison, the open network standard requires 4267 bps per slot, so by utilizing Efficient Drop and Insert, Radyne customers can realize a bandwidth savings of over 4000 bps per slot.

E.9.3 Calculating the Efficient D&I Rate with E1 Signaling

When E1 signaling is enabled (PCM-30, PCM30C), an additional 2000 bps per slot are required to carry the E1 signaling. So the Efficient D&I Rate for N timeslots is:

Efficient D&I Rate increase = N * 2000 bps

With the open network standard requiring 4267 bps per slot, Efficient Drop and Insert provides a bandwidth savings of over 2000 bps per slot when E1 signaling is required.

E.9.4 Calculating the Efficient D&I Rate with Enhanced Asynchronous Overhead

The amount of overhead required to carry the Enhanced Async is driven by the in-band baud rate. The calculation is a two step process involving the in-band baud rate and the number of slots as follows:

X = Truncation of (In-Band Baud Rate / (N * 125))

Efficient D&I Rate increase = X * N * 125 bps

Because of the truncation, this increase in bandwidth is guaranteed to be less than the baud rate itself.

Summary and Examples:

The following examples further illustrate how to calculate the Efficient D&I rate which can be summarized for N timeslots as:

Efficient D&I Rate = Data Rate + (N * 250 bps)

With E1 signaling add

N * 2000 bps

With Enhanced Async add

(Truncation (In-Band Baud / (N * 125))) * (N * 125) bps

Example 1a:

5 Drop Slots with T1-D4 framing, standard ES to ES overhead

For 5 Drop Slots, the Data Rate would be 5 * 64000 or 320000 bps

The Efficient D&I Rate would be 320000 + (5 * 250) bps = 321250 bps

The Open Network rate is over 20,000 bps higher at 341333 bps.

Example 1b:

Change to E1-PCM30 framing (E1 Signaling), standard ES to ES overhead

Add 5 * 2000 bps to our previous calculation gives 331250 bps

Still saving over 10,000 bps compared to the open network standard.

Example 1c:

Change to Enhanced Async with In-Band Baud Rate of 1200

X = Truncation of (1200 / (5 * 125)

X = Truncation of (1.92)

X = 1

Add 1 * 5 * 125 bps to our previous calculation gives 331875 bps

An increase of 625 bps to carry 1200 baud

Example 2a:

10 Drop Slots with T1-D4 framing, standard ES to ES overhead

For 10 Drop Slots, the Data Rate would be 10 * 64000 or 640000 bps

The Efficient D&I Rate would be 640000 + (10 * 250) bps = 642500 bps

The Open Network rate is over 40,000 bps higher at 682667 bps.

Example 2b:

Change to E1-PCM30 framing (E1 Signaling), standard ES to ES overhead

Add 10 * 2000 bps to our previous calculation gives 662500 bps

Still saving over 20,000 bps compared to the open network standard.

Example 2c:

Change to Enhanced Async with In-Band Baud Rate of 1200

X = Truncation of (1200 / (10 * 125)

X = Truncation of (0.96)

X = 0

The rate stays at the previous value of 662500

With 10 slots, there is no increase required to carry 1200 baud Enhanced Async. It is passed transparently in the Efficient Drop and Insert overhead.

Appendix F. TCP/IP Ethernet Setup

F.1 Introduction

The modem supports SNMP, FTP protocols and the Web Browser. Utilization of the protocols is dependent upon proper set up of the TCP-IP menus. This document is to be used only as a guideline for setting up the TCP-IP menus. Contact the IT manager for proper guidance to ensure setup is successful. For additional information on the various WEB or SNMP configurations and descriptions refer to the Remote Protocol Manual (MN-DMDREMOTEOP).

F.2 TCP/IP Network Configuration

Using the Front Panel display and arrow keys, scroll thru the System menu until the TCP / IP sub menu is displayed. Each unit requires proper configuration with the correct network settings.

IMPORTANT
Before you set any IP address, contact the IT authority in your organization for help.

Enter into the TCP / IP menu and the following Sub menus will appear, however the order may vary.

1. Boot Mode: This allows for the selection of the operating boot mode for the TCP / IP. Several selections are available and are described below. When configuring the modem for Web Browser, Boot Mode must be set to "NON-VOL". A brief description of the available selections are:

   a. Default: If the Ethernet interface is not to be used, select this mode. No IP Address or mask changes will be allowed while in this mode of operation. The following parameters will be set and will not change until the boot mode is changed. The IP addresses are non accessible addresses.

      - IP MASK 255.000.000.000

- MODEM IP ADDR 010.000.000.001
- SERVER IP ADDR 010.001.001.001
- ROUTER IP ADDR 010.000.001.001

b. BOOTp: When enabled, at boot time, the modem will use the Bootp Protocol to automatically get names, masks, and IP Addresses of the modem, router, and server from the Network Manager. This should be consistent with the tag expected by the users Bootp Server (see the next menu selection for setting the BOOTp TAG). If Bootp is not enabled, the modem will ignore the BOOTp Tag setting.

c. NON-VOL: This will allow for setting up all required IP Addresses and will store the information to the non-volatile memory. Upon power cycle, the modem will restore the saved settings into the correct fields.

d. IP TEST: The IP Test selection is similar in behavior to the Default selection. When enabled, the following preset parameters will be programmed and will not change until the selection is changed. To edit these parameters, change the boot mode to NON-VOL.

- IP MASK 255.255.255.000
- MODEM IP ADDR 192.168.000.238
- SERVER IP ADDR 192.168.000.101
- ROUTER IP ADDR 192.168.000.102

2. BOOT SERVER TAG: This allows for the selection of the operating boot tag when operating in the BOOTp Mode. The default setting of 206 is automatically selected when the boot mode is set to 'DEFAULT' (factory preset mode).

3. MODEM HOST: This displays the unit Host name that is operating, such as "DMD20". This is a read only display.

4. IP ADDR MASK: This will allow for the entry of the IP Address Mask. This will need to be entered based on the Network settings. Refer to your IP Administrator if you do not know this address for the correct address setting. Example IP Address Mask setting: 255.255.000.000.

5. MODEM IP ADDR: This will allow for the entry of the Modem's individual network IP Address. Each device on the network will have a unique address. Refer to the IT administrator for the correct address setting. Example Modem IP Address setting: 172.018.100.215.

6. SERVER IP ADDR: This allows for the setup of the Network Server IP Address. This section refers to the Host that will be used to optionally boot the DMD20 on power-up and is the SNMP Trap Server. This IP Address needs to be consistent with the Modem IP Address. Broadcast

and loop back addresses will not be allowed. Example Server IP Address setting: 172.018.004.250.

7. ROUTER IP ADDR: This allows for the setup of the Network Router IP Address. If a router is present on the local network, and it is to be used, this address must be consistent with the IP Address Mask and the subnet of the modem. If no router is present, then the address should be set to a foreign address. Broadcast and loop back addresses will not be allowed. Router not used example: Router IP Address setting: 010.000.001.001.
8. MODEM EADDR: This displays the Modem (Unit) Ethernet Address. The Modem Ethernet Address is configured at the factory. It is a unique Radyne equipment identifier Address. Example: 0010650903EB
9. ETHER RATE: This displays the current Ethernet port data rate. If multiple rates are available, then a selection can be made to specify the Ethernet port data rate (10BaseT). Example Ethernet port Data Rate: 10 MBPS/HD

F.3 Network Configuration Summary

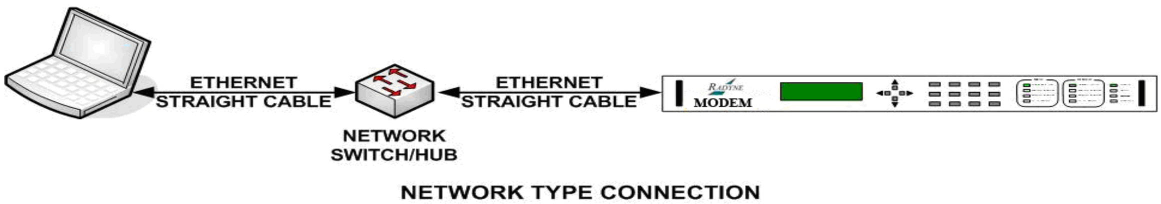
If the above steps were followed and the information was entered, then the following would be the TCP / IP configuration summary for a 'no router specified' setup:

1. Boot Mode = NON-VOL
2. Bootp Server Tag = 206
3. Modem Host= DMD20
4. IP Address Mask = 255.255.0.0
5. Modem IP Address = 172.18.100.215
6. Server IP Address = 172.18.4.250
7. Router IP Address = 010.000.001.001
8. Modem Ethernet Address= 0010650903EB
9. Ethernet Rate = 10 MBPS/HD

F.4 Ethernet Test

F.4.1 Connecting the Modem Ethernet Cable to a Network Link

1. *Connect the Network Switch (Hub) to the Modem Ethernet port (J9) using standard RJ-45 to RJ-45 10BaseT (CAT-5) Cables as shown below.*

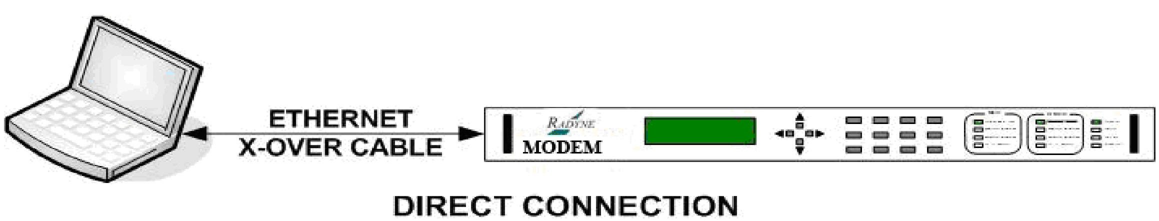


DMD2050E Ethernet Network Connection

F.4.2 Connecting the Modem Ethernet Cable Directly to a Computer (without a Network)

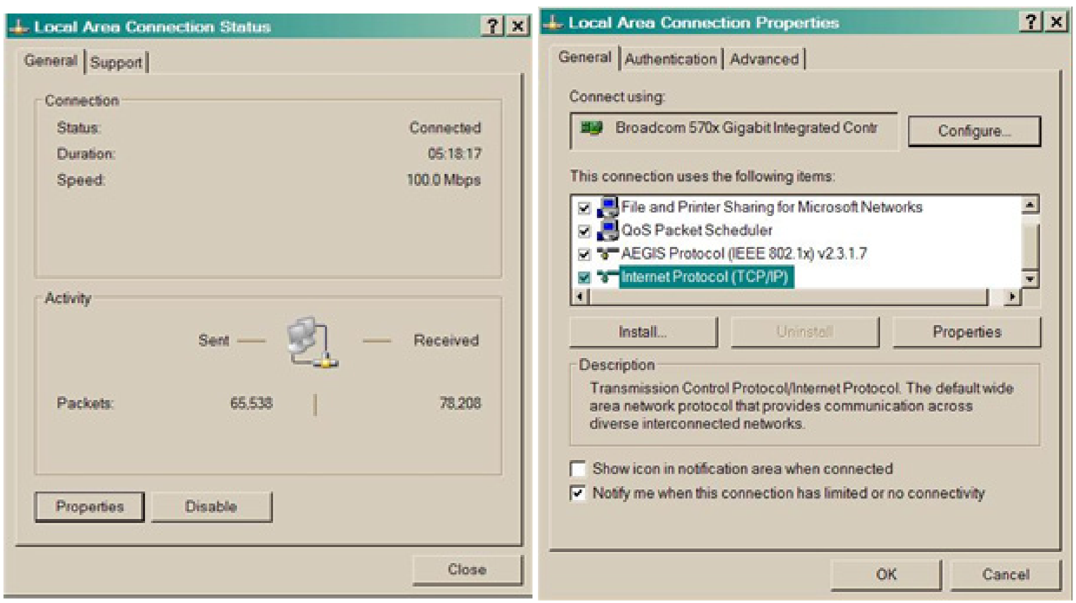
The user can directly connect to the equipment without connecting to a network. This will often occur at remote sites where a network is not available. To connect, the user will need an Ethernet Crossover (Null) cable. The pinout for this cable is as follows,

RJ45 Connector A	RJ45 Connector B
Pin #1	Pin #3
Pin #2	Pin #6
Pin #3	Pin #1
Pin #4	Pin #4
Pin #5	Pin #5
Pin #6	Pin #2
Pin #7	Pin #7
Pin #8	Pin #8



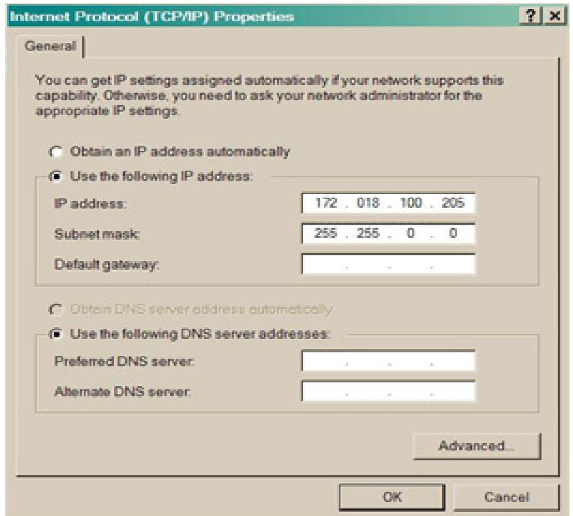
The computer TCP/IP must be configured correctly to obtain connectivity. The following instructions apply to Windows 2000 or XP Classic specifically.

1. Click the Start button.
2. Select Settings and click Control Panel.
3. Double-click Network Connections.
4. Select Local Area Connection for the applicable Ethernet adapter. Typically, it is the first Local Area Connection listed.
5. Double-click Local Area Connection.
6. Click Properties.



Local Area Connection Status and Properties Windows

7. Make sure that Internet Protocol (TCP/IP) is checked.
8. Select Interconnect Protocol (TCP/IP) and click the Properties button.



Internet Protocol (TCP/IP) Properties

9. Select “Use the following IP Address”.
10. Enter an IP Address that is different from the equipment IP address by at least 5 digits. The computer and the equipment cannot use the same address.
11. Enter a Subnet Mask. This must be the same subnet mask that is programmed into the equipment.
12. Click the OK button to complete the PC Configuration. You may need to restart the computer for the changes to take effect.

NOTE
To reconnect the computer to a network, Select “Obtain an IP address automatically”.

F.5 Testing the Ethernet Connection using the Ping Program (Optional)

To verify that connectivity and settings are correct, use the Ping command to report if the Host (Equipment) is correctly responding. This is accomplished by opening the MSDOS Command Prompt and executing a Ping command as shown in the following example.

1. Open MSDOS Command Prompt. The Screen will display:

   Microsoft Windows XP [Version 5.1.2600]

   (C) Copyright 1985-2001 Microsoft Corp.

2. At the Command Prompt Enter "ping 172.18.100.215" (Enter the IP Address of the equipment to be tested). The screen will display:

   Microsoft Windows XP [Version 5.1.2600]

   (C) Copyright 1985-2001 Microsoft Corp.

   C:\> ping 172.18.100.215

3. If the ping is successful the screen will display:

   C:\>ping 172.18.100.215

   Pinging 172.18.100.215 with 32 bytes of data:

   Reply from 172.18.100.215: bytes=32 time=109ms TTL=64

   Reply from 172.18.100.215: bytes=32 time<1ms TTL=64

   Reply from 172.18.100.215: bytes=32 time=2ms TTL=64

   Reply from 172.18.100.215: bytes=32 time=123ms TTL=64

   Ping statistics for 172.18.100.215:

   Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

   Approximate round trip times in milli-seconds:

   Minimum = 0ms, Maximum = 123ms, Average = 58ms

4. If the ping is unsuccessful the screen will display:

```
C:\>ping 172.18.100.215

Pinging 172.18.100.215 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.18.100.215:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Check the following items that may lead to the unsuccessful response:

a. Verify that the correct cables are connected to the Ethernet port and that they are secured.
b. The Link Light is illuminated.
c. The IP Address that is used matches the Modem's IP Address.
d. The Server and Modem are on the same subnet.

Appendix G. AUPC Operation

G.1 Automatic Uplink Power Control (AUPC Operation)

The modem has an optional built-in provision for Automatic Uplink Power Control, AUPC. AUPC is useful when operating power levels are affected by environmental changes in the atmosphere. AUPC attempts to adjust local power output to maintain a constant Eb/No at the receiver location.

The modem supports three versions of AUPC. They include Radyne AUPC, EF AUPC and Near Side AUPC. Radyne AUPC and EF AUPC use satellite overhead to send messages between the local and remote ends of an SCPC link. The messaging is done with IBS 1/15 and EF AUPC Framing messages.

G.1.1 Radyne AUPC

In this case, Target Eb/No indicates the remote value the local unit wants to maintain by adjusting the local power level.

Radyne AUPC can be set to operate on either or both directions of a link but always require a bi-directional channel. Enabling AUPC on one side of the link will activate AUPC on the distant end of the link. It is necessary that both the Modulator and Demodulator be set to the appropriate framing for AUPC options to be editable and for the AUPC function to operate properly.

Examples of the basic Radyne AUPC Operations are described as follows:

Assume that the two modems, one at each end of the link, are set to Radyne AUPC operation. Only one direction is discussed, but the same functions could be occurring in both directions simultaneously.

Local Modem is transmitting to Remote modem under normal conditions and the Remote modem has a receive Eb/No of 7.5 dB. Local modem has been set to a Target Eb/No of 7.5 dB with an output power level of -15 dBm.

It begins raining at Remote site and the Eb/No drops to –7.0 then –6.8 dB. Remote Modem is constantly sending update messages of its Eb/No to Local modem. When Local modem sees the drop in the remote Eb/No, it slowly begins to raise the output power, and will continue to adjust if the remote Eb/No continues to drop. As the rain increases in intensity, the remote Eb/No decreases but Local modem continues to increase its power level to compensate.

When the rain diminishes, Local modem will see the remote Eb/No begin to increase. Local modem will lower its power level. The operation is therefore a feedback control loop with the added complication of a significant time delay.

G.1.2 EF AUPC

In EF AUPC mode, the Target Eb/No indicates the local unit wants the remote unit to maintain a power level sufficient to provide the local Eb/No value.

EF AUPC can be set to operate on either or both directions of a link but always require a bi-directional channel. Enabling AUPC on one side of the link will activate AUPC on the distant end of the link. It is necessary that both the Modulator and Demodulator be set to the appropriate framing for AUPC options to be editable and for the AUPC function to operate properly.

Examples of the basic EF AUPC Operations are described as follows:

Assume that the two modems, one at each end of the link, are set to AUPC operation. Only one direction is discussed, but the same functions could be occurring in both directions simultaneously.

The local modem is transmitting to modem at a remote locale under normal conditions. The remote modem has a receive Eb/No of 7.5 dB. The local modem has been set with a Target Eb/No of 7.5 dB, and has a current power output of –15 dBm.

It begins to rain at the local site, and the Eb/No drops to –7.0 then –6.8 dB. The local modem is constantly sending update messages of its Eb/No to the remote modem. When the remote modem sees the drop in the Eb/No, it slowly begins to raise its output power, and will continue to do so until the Target Eb/No is restored at the local site.

When the rain diminishes, the local modem’s Eb/No will begin to increase. The remote modem will now lower its power level to restore the target value. The operation is therefore a feedback control loop with the added complication of a significant time delay.

G.1.3 Near Side AUPC

Near Side AUPC is a loop back system that adjusts the broadcast uplink signal when local conditions change. This is done by having the Near Side AUPC attempt to adjust the outbound power to compensate for local weather.

The local receiver must be tuned and locked to the transmitter and then the internal Eb/No., is used for feedback. This creates a Tx-Satellite-Rx control loop.

Near Side AUPC is primarily used for broadcast applications since the modem cannot expect to receive data from a distant location. Near Side AUPC can be utilized with any satellite framing or Network mode.

There are safeguards built into the AUPC System. First, the modulator has two parameters, which allow control of the maximum and minimum output power Levels. Second, a nominal, or default, power level is specified which takes effect if the receive signal or messaging is lost. This nominal power should be set to a level high enough to re-establish communications regardless of rain fade.

EF AUPC also provides some control over the rate of power change; while the Radyne and Near Side AUPC use a optimized rate for rain fade compensation.

G.1.4 EBEM AUPC

In this case, Target Es/No indicates the remote value the local unit wants to maintain by adjusting the local power level.

EBEM AUPC can be set to operate on either or both directions of a link but always require a bi-directional channel operating in EBEM Mode. Enabling AUPC on one side of the link will activate AUPC on the distant end of the link. It is necessary that both the Modulator and Demodulator be set with the embedded channel enabled and ITA mode disabled for EBEM AUPC options to be editable and for the AUPC function to operate properly.

Examples of the basic EBEM AUPC Operations are described as follows:

Assume that the two modems, one at each end of the link, are set to EBEM AUPC operation. Only one direction is discussed, but the same functions could be occurring in both directions simultaneously.

Local Modem is transmitting to Remote modem under normal conditions and the Remote modem has a receive Es/No of 7.5 dB. Local modem has been set to a Target Es/No of 7.5 dB with an output power level of -15 dBm.

It begins raining at Remote site and the Es/No drops to –7.0 then –6.8 dB. Remote Modem is constantly sending update messages of its Es/No to Local modem through the embedded channel. When Local modem sees the drop in the remote Es/No, it slowly begins to raise the output power, and will continue to adjust if the remote Es/No continues to drop. As the rain increases in intensity, the remote Es/No decreases but Local modem continues to increase its power level to compensate.

When the rain diminishes, Local modem will see the remote Es/No begin to increase. Local modem will lower its power level. The operation is therefore a feedback control loop with the added complication of a significant time delay.

The AUPC Menu Functions and their descriptions are shown in Table G-1 and Table G-2.

Table G-1. Local AUPC Functions

Function	AUPC Available Options	Description
AUPC MODE	DISABLE, NEARSIDE, RADYNE, EFDATA	Enables/Disables the AUPC to function locally
NOMINAL POWER	0 TO -25 dB	Sets default output power to be used
MINIMUM POWER	0 TO -25 dB	Sets minimum output power to be used
MAXIMIM POWER	0 TO -25 dB	Sets maximum output power to be
TARGET Eb/No	4.0 TO 16 dB	Desired E_b/N_0 of remote modem
TARGET Es/No	0.0 TO 25 dB	**EBEM MODE ONLY:** Desired E_s/N_0 of remote modem
RANGE Es/No	0.0 TO 2.0 dB	**EBEM MODE ONLY:** Dead range of desired E_s/N_0 where no action is taken
TRACKING RATE	6.0 to 0.5 dB/MIN	Adjustable in .5dB increments
LOCAL CL ACTION	HOLD, MAXIMUM, NOMINAL	Allows user to determine what power setting the remote modem will use in the event of a carrier loss at the local side.
REMOTE CL ACTION	HOLD, MAXIMUM, NOMINAL	This setting allows users to determine what local output power setting to use in the event that the remote end has a carrier loss.

1. The AUPC Menus are located under the Modulator Menu as shown in Section 4.
2. The EF AUPC Menu displays when EFAUPC Framing is enabled in the Demod and Mod set up menus.
3. Highlighted areas are activated when modem is set to EF AUPC

Table G-2. Remote AUPC Functions (EF AUPC Only)

Function	AUPC Available Options	Description
AUPC MODE	Disable, EFDATA	Enables/Disables the AUPC to function remotely
LOOPBACK	Enabled/Disabled	Loop back test over satellite link
TX 2047 TEST BER	Enabled/Disabled	Initiates 2047 Test pattern BER Test
RX 2047 BER	Status Menu	Identifies the BER status on the distant RX side
AUPC DEF LVL		Sets default output power to be used

The Remote AUPC Menus are only supported by EFAUPC

Appendix H. Ethernet Data Interface Setup

H.1 Configuring the modem to use the Ethernet Data Interface (Optional)

When the optional Ethernet Data Interface Card is installed, all of the Ethernet related menus become available and can be used to control the interface as follows:

Under the Interface Menu:

Under the Tx Setup Menu:

Set the Terrestrial Interface to Ethernet.

Set the Ethernet Flow Control as desired.

Set the Ethernet Daisy Chain as desired.

Set the Ethernet QOS Type as desired.

Set the Ethernet QOS Queue as desired.

Set the Tx Clock to SCTE.

Set the Tx Clock Polarity to Normal.

Under the Interface Menu:

Under the Rx Setup Menu:

Set the Terrestrial Interface to Ethernet.

Set the Buffer Size to Zero.

Set the Buffer Clock to Rx Sat.

Set the Buffer Clock Polarity to Normal.

When Ethernet Data Interface is selected, the Tx Clock Source will default to SCTE and the Clock Polarity will default to Normal. In addition, the Buffer Clock will default to RxSat and the Buffer Clock Polarity will default to Normal.

See also:

Chapter 4, User Interfaces

H.1.1 Ethernet Flow Control

When disabled, if a packet is received for transmission and no packet buffer space is available, the incoming packet is discarded.

When enabled, flow control is used to throttle the transmission station in order to avoid overrunning the transmit buffers, which would in turn cause packets to be dropped. The throttling mechanism used depends upon the interface and whether it is half-duplex or full duplex.

H.1.1.1 Half-Duplex Flow Control

In half-duplex mode, the unit uses industry standard backpressure to support flow control as follows:

When available buffer space is almost gone, the modem will force a collision on the input port when it senses an incoming packet. This collision will cause the transmitting station to back off and retry the transmission.

The interface will stop forcing collisions as soon as free buffer space becomes available.

H.1.1.2 Full-Duplex Flow Control

In full-duplex mode, the interface implements IEEE 8802.3x flow control as follows:

When available buffer space is almost gone, the unit sends out a pause frame with the maximum pause time to stop the remote nodes from transmitting.

The interface sends out another pause frame with the pause time set to zero as soon as free buffer space becomes available.

H.1.2 Ethernet Daisy Chain

When disabled, Port 4 (JS4) on the Ethernet Data Interface operates normally. Data received on Port 4 that is not addressed to other equipment on the LAN side, is transmitted over the satellite.

When Port 4 is selected for Daisy Chain, any data received on Port 4 (JS4) is forwarded to of the other LAN side ports (Ports 1 - 3) and is not transmitted over the satellite. This is extremely useful in a point-to -multipoint configuration as illustrated in Figure H-1.

H.1.3 Ethernet QOS Type

When Normal QOS is selected, the interface determines a packets priority based on the following:

- IEEE 803.3ac Tag when present
- IPv4 Type of Service / Differentiated Services Field
- Ipv6 Traffic Class

When Port Based QOS is selected, the interface determines the priority of a packed based upon the port on which it arrived.

- Port 1 (JS1) has the highest priority
- Port 2 (JS2) has the second highest priority
- Port 3 (JS3) has the second lowest priority
- Port 4 (JS4) has the lowest priority

H.1.4 Ethernet QOS Queue

When Fair Weighted queuing is selected, the interface transmits packets at a rate of 8, 4, 2, and 1 from the highest priority queue to the lowest respectively. With fair weighted queuing, all queues with data in them are guaranteed to receive some bandwidth.

When Strict Priority is selected, the interface transmits packets from the highest priority queue until it is empty. It then begins transmitting data from the next highest priority queue. If higher priority data arrives, the interface finishes the current packet and then goes back to transmitting packets from the higher priority queue until it is again empty. Care must be taken when selecting Strict Priority, as it is entirely possible for the lower priority queues to be stalled indefinitely.

H.1.5 Setting Up The DMD2050E Ethernet Bridge To Operate Like A FIFO

In certain circumstances, it may be desirable to have the Ethernet interface operate in a FIFO like manner with no reordering of packets. This can be established by using a single port on the Ethernet interface and setting the Ethernet QOS Type to Port Based and the Ethernet QOS Queue to Strict Priority. When Setup and used in this manner, the packets will be transmitted in the exact order in which they are received.

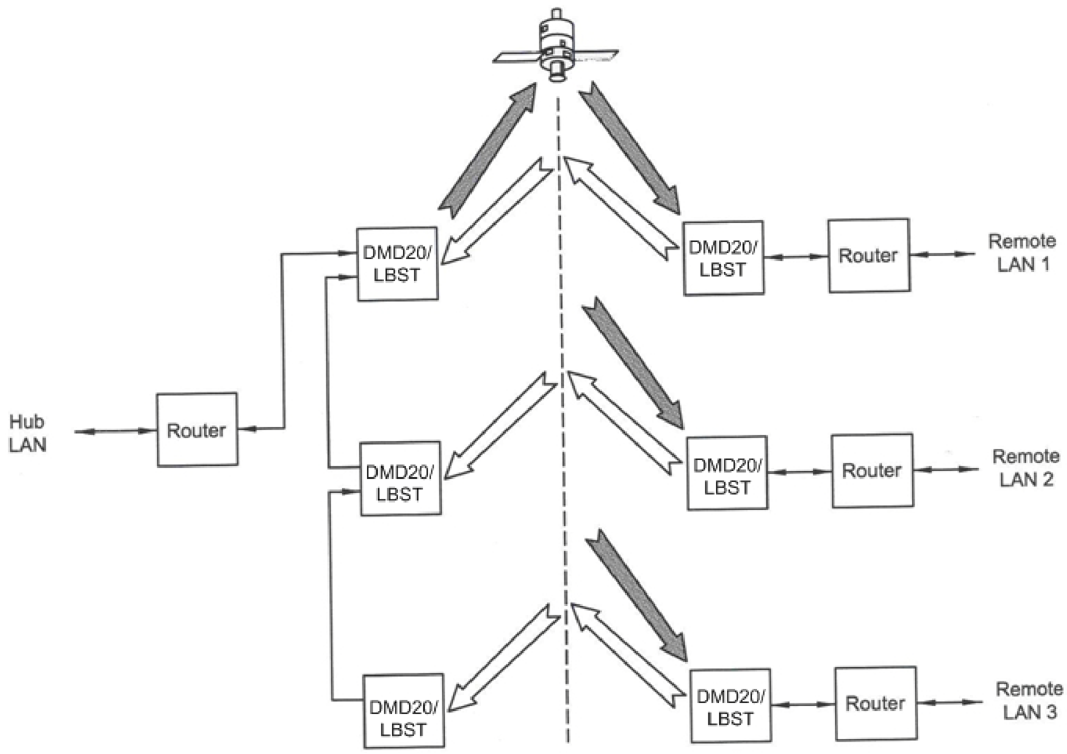


Figure H-1. Point-to-Multipoint with Daisy Chaining

H.1.6 Packet Statistics

The following statistics are available under the Monitor Menu when the Ethernet Data Interface is selected.

Total Packets	This Counter displays the total number of Ethernet packets received from the satellite.
Error Packets	This counter displays the total number of Ethernet packets received from the satellite that had errors.
Packet Error Rate	This displays the Ethernet Packet Error Rate (PER) from the satellite.
Packet Statistics Reset	Allows the user to reset the Ethernet Total Packets and Ethernet Error Count by pressing <Enter>.
Link Status	The following status is available under the Monitor Menu/Link Status Sub-Menu when the Ethernet Data Interface is selected
Port 1 Status	Displays the current status of LAN Port 1.
Port 2 Status	Displays the current status of LAN Port 2.
Port 3 Status	Displays the current status of LAN Port 3.
WAN Status	Displays the current status of the WAN Port.

For each of the above-listed ports, the status may take on one of the following values/meanings.

Down	The link is down.
Unresolved	Unable to agree on connection speed.
10 Mbps Half	Connected at 10 Base-T Half Duplex.
10 Mbps Full	Connected at 10 Base-T Full Duplex.
100 Mbps Half	Connected at 100 Base-T Half Duplex.
100 Mbps Full	Connected at 100 Base-T Full Duplex.

If all four LAN Ports are down, a Tx Data Activity Minor Alarm will be generated.

If the WAN Port is down, ax and Rx Ethernet WAN Major Alarm will be generated.

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Appendix I. Strap Codes

I.1 Strap Codes

The Strap Code is a quick set key that sets many of the modem parameters. For quick setup of the modem, Strap Codes are very helpful. When a Strap Code is entered, the modem is automatically configured for the code's corresponding data rate, overhead, code rate, framing, scrambler type and modulation.

I.1.1 An example of how to set a strap code

Example: At the Front Panel <Modulator> Menu, depress '↓', then move '→' to the 'Strap Code' Submenu and enter #16. The modem will be automatically configured to the parameters shown below in the highlighted row 'Strap Code 16'.

For the available strap codes, see Table I-1.

NOTE

Dis = Disable in Table I-1.

Table I-1. Strap Codes

Strap Code (Decimal)	Data Rate (Kbps)	Overhead	Code Rate	Type	Framing Type	Scrambler Type	Drop and Insert	Reed-Solomon	Modulation	Mode
1	64	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
2	128	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
3	256	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
5	384	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
6	512	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
9	768	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
4	1536	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
10	1920	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
8	2048	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
12	2048	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
16	1544	96K	3/4	VIT	IDR	V.35 (IESS)	Dis	Dis	QPSK	IDR
32	2048	96K	3/4	VIT	IDR	V.35 (IESS)	Dis	Dis	QPSK	IDR
64	6312	96K	3/4	VIT	IDR	V.35 (IESS)	Dis	Dis	QPSK	IDR
128	8448	96K	3/4	VIT	IDR	V.35 (IESS)	Dis	Dis	QPSK	IDR
24	56	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
33	56	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
34	64	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
36	64	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
40	128	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
48	128	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
65	256	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
66	256	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
68	320	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
72	320	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
80	384	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
96	384	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
129	512	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
130	512	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT

Strap Code (Decimal)	Data Rate (Kbps)	Overhead	Code Rate	Type	Framing Type	Scrambler Type	Drop and Insert	Reed-Solomon	Modulation	Mode
132	768	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
136	768	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
144	896	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
44	896	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
7	1344	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
11	1344	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
13	1536	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
14	1536	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
19	1544	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
21	1544	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
22	1920	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
25	1920	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
26	2048	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
28	2048	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
37	2368	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
38	2368	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
41	48	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
160	1544	965/1024	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
52	1920	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
69	6312	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
70	8448	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
73	3152	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
74	3152	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
76	3264	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
81	3264	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
88	512	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
97	1024	1	1/2	VIT	CNT	V.35 (IESS)	Dis	Dis	QPSK	CNT
98	1024	1	3/4	VIT	CNT	V.35 (IESS)	Dis	Dis	QPSK	CNT
112	64	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
131	128	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
133	256	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
134	192	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
137	192	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
138	320	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT

Strap Code (Decimal)	Data Rate (Kbps)	Overhead	Code Rate	Type	Framing Type	Scrambler Type	Drop and Insert	Reed-Solomon	Modulation	Mode
140	320	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
145	384	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
100	448	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
146	448	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
104	576	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
148	576	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
152	640	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
161	640	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
162	704	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
164	704	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
168	768	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
193	832	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
194	832	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
196	896	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
208	896	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
224	960	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
15	960	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
23	1024	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
27	1024	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
29	1536	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
30	1088	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
39	1088	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
43	1152	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
46	1152	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
51	1216	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
53	1216	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
54	1280	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
57	1280	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
58	1344	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
67	1408	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
71	1408	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
75	1472	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
77	1472	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
78	1600	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT

Strap Code (Decimal)	Data Rate (Kbps)	Overhead	Code Rate	Type	Framing Type	Scrambler Type	Drop and Insert	Reed-Solomon	Modulation	Mode
83	1600	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
85	1664	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
86	1664	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
89	1728	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
90	1728	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
92	1792	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
99	1792	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
101	2048	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
102	1856	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
105	1856	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
106	2048	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
120	1544	965/1024	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	IBS
135	1984	16/15	1/2	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
139	1984	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT
45	3088	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
141	3088	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
176	4000	1	1/2	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
116	4000	1	3/4	VIT	NONE	V.35 (IESS)	Dis	Dis	QPSK	CNT
60	1344	16/15	3/4	VIT	IBS	IBS	Dis	Dis	QPSK	CNT

I.2 Sample Applications

The following section provides brief application notes for operating the modem and explains by example how to configure the modem for some of the most popular configurations.

The following information illustrates the allowable combinations for Mode and Data Rate.

Allowable Combinations: Mode/Rate/Framing.

IDR:

8.448 Mbps	3/4, 7/8 Rate FEC
6.312 Mbps	1/2, 3/4, 7/8 Rate FEC
2.048 Mbps	1/2, 3/4, 7/8 Rate FEC
1.544 Mbps or Below	1/2, 3/4, 7/8 Rate FEC

IBS:

2.048 Mbps or below	1/2, 3/4, 7/8 Rate

Closed Network:

8.448:	96 Kb Framing or No Framing, 3/4, 7/8 Rate FEC
6.312:	96 Kb Framing or No Framing, 1/2, 3/4, 7/8 Rate FEC
2.048:	96 Kb Framing or 1/15 Framing or No Framing, 1/2, 3/4, 7/8 Rate FEC
1.544:	96 Kb Framing or 1/15 Framing or No Framing, 1/2, 3/4, 7/8 Rate FEC
Any Rate 2.048 & lower:	1/15 Framing or No Framing, 1/2, 3/4, 7/8 Rate FEC

I.2.1 Operational Case Examples

IMPORTANT

Make sure to set the data rate to 512 Kbps initially. This data rate is applicable to all modes of operation.

I.2.1.1 Case 1: IDR 8.448 Mbps, 3/4 Rate Viterbi

Start with the Data Rate = 512 Kbps

<u>**Modulator:**</u>

Method 1 -

Under Interface Menu:

Set Interface type

Set Tx clock selection

Set mode to IDR

Under Mod Data Menu:

Set code rate to 3/4 VIT

Set data rate for 8448000

Under Mod IF Menu:

Set desired Tx frequency and power level

Turn IF ON

Method 2 -

Under Interface Menu:

Set Interface type

Set Tx clock selection

Set Mod strap code to: 128

Under Mod IF Menu:

Set desired Tx frequency and power level

Turn IF on

Demodulator:

Method 1 -

Under Interface Menu:

Set Interface type

Set Buff clock selection

Set Buffer Size

Set mode to IDR

Under Demod IF Menu:

Set desired Rx frequency

Under Demod data Menu:

Set code rate to 3/4 VIT

Set data rate for 8448000

Method 2 -

Under Interface Menu:

Set Interface type

Set Buff clock selection

Set Buffer Size

Set Demod strap code to 128

Under Demod IF Menu

Set desired Rx frequency

I.2.1.2 Case 2: IBS 1.544 Mbps, 3/4 Rate Viterbi

Start with the Data Rate – 512 Kbps

<u>Modulator:</u>

Method 1 -

Under Interface Menu:

Set Interface type

Set Tx clock selection

Set Framing to 1/15

Set mode to IBS

Under Mod Data Menu:

Set code rate to 3/4 VIT

Set data rate for 1544000

Under Mod IF Menu:

Set desired Tx frequency and power level

Turn IF ON

Method 2 -

Under Interface Menu:

Set Interface type

Set Tx clock selection

Set Mod strap code to: 120

Under Mod IF Menu:

Set desired Tx frequency and power level

Turn IF on

Demodulator:

Method 1 -

Under Interface Menu:

Set Interface type

Set Buff clock selection

Set Buffer Size

Set Framing to 1/15:

Set mode to IBS:

Under Demod IF Menu:

Set desired Rx frequency

Under Demod Data Menu:

Set code rate to 3/4 VIT

Set data rate for 1544000

Under Interface Menu:

Set Interface type

Set Buff clock selection

Set Buffer Size

Method 2 -

Under Interface Menu:

Set Interface type

Set Buff clock selection

Set Buffer Size

Set Demod strap code to: 120

Under Demod IF Menu:

Set desired Rx frequency

I.2.1.3 Case 3: Closed Network, 3/4 Rate Viterbi, IBS Overhead

Start with the Data Rate = 512 Kbps

Modulator:

Method 1 -

Under Interface Menu:

Set Interface type

Set Tx clock selection

Set mode to IDR

Under Mod Data Menu:

Set code rate to 3/4 VIT

Set Framing for 1/15

Under Mod IF Menu:

Set desired Tx frequency and power level

Turn IF ON

Method 2 -

Under Interface Menu:

Set Interface type

Set Tx clock selection

Set Mod strap code to: 101

Under Mod IF Menu:

Set desired Tx frequency and power level

Turn IF on

<u>**Demodulator:**</u>

Method 1 -

Under Interface Menu:

Set Interface type

Set Buff clock selection

Set Buffer Size

Set mode to: Closed Net

Under Demod IF Menu:

Set desired Rx frequency

Under Demod data Menu:

Set code rate to 3/4 VIT

Set Framing for 1/15

Method 2 -

Under Interface Menu:

Set Interface type

Set Buff clock selection

Set Buffer Size

Set Demod strap code to: 101

Under Demod IF Menu:

Set desired Rx frequency

I.2.1.4 Case 4: Loop Timing Example

Method 1 -

Under Interface Menu:

Under Tx Setup Menu:

Set INTF to RS-422

Set SCT Source to SCR

Set Tx Clock to SCTE

Set mode to IBS

Method 2 -

Under Interface Menu:

Under Tx Setup Menu:

Set INTF to RS-422

Set SCT Source to SCR

Set Tx Clock to SCTE

Set mode to Closed Net

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Appendix J. ITA Operation

J.1 Information Throughput Adaptation (ITA Operation)

Information Throughput Adaptation (ITA) also known as Adaptive Coding and

Modulation (ACM), allows the DMD2050E to mitigate downlink rain-fades by means of adapting the throughput of the modem effectively decreasing the modulation and coding by fixing the symbol rate and changing data rate to keep a constant power spectral density. When ITA is operating using the DMD2050E partner modem indicates the highest possible data rate constrained to a fixed symbol rate.

ITA turns fade margin into increased link capacity – gains of 100% or more are possible, compared to traditional static FDMA links. This is accomplished by automatically adapting the modulation type and FEC code rate to give highest possible information throughput. ITA maximizes throughput regardless of link conditions (noise or other impairments, clear sky, rain fade, etc). Initial setup is easy, and then requires no further user intervention. With a static traditional FDMA system, severe rain fading can cause the total loss of the link, and zero throughput. ITA keeps the link up (with lower information throughput) – and can yield much higher system availability. ITA in the DMD2050E used in conjunction with the EBEM framing unit adjusting the IP traffic in either IP Only or mixed serial IP mode.

J.1.1 Properties of ITA on the DMD2050E:

- The DMD2050E output power remains constant before, during, and after state changes.
- The DMD2050E output spectral density remains constant before, during, and after state changes.
- When ITA is enabled, the DMD2050E will automatically constrain the dynamic bit rate to conform to the limitations of the terrestrial interface that is selected for use in the DMD2050E configuration.
- ITA can only be enabled when the DMD2050E is operating in the EBEM mode.
- Operation of ITA and AUPC are mutually exclusive, both cannot be active at the same time.
- The code rate block size will remain fixed for the duration of the ITA operation, independent of the bit rate.
- When the link is set up for ITA, the symbol rate is entered by the operator, at a resolution of 1 sps. The DMD2050E will automatically calculate the data rate.
- The embedded channel is used for exchanging ITA messages between DMD2050E modems.

J.1.2 Basic Setup (Example)

The modems will be initially configured in the lowest modulation and coding rate for the characteristic of the link. ITA uses a combination or composite data rate (serial + Ethernet) that will allow selection of any ITA waveforms. This means that all combinations of modulation and code rate have enough Ethernet bandwidth to achieve proper configuration and that all modulation and code rates are of the same block size. The setup will cover each of the four modulations and each of the five code rates by selecting various combinations. Table J-1 is a rank ordering of modulation and coding rates entered by the operator, by Es/No requirement. The bits/Symbol provides an indication of the efficiency of the particular combination selected. The test case ITA waveforms are shown in Table J-1.

Table J-1 - ITA Waveforms and Selection

Modulation	Code Rate	Bits/Symbol	Typical Eb/No	Required Es/No	Selected Test Cases
16APSK	0.95	3.800	10.25	16.05	*
8PSK	0.95	2.850	9.31	13.86	
16APSK	0.875	3.500	8.40	13.84	*
8PSK	0.875	2.650	7.50	11.69	
16APSK	0.75	3.000	6.59	11.37	
16APSK	0.667	2.667	5.64	9.90	
8PSK	0.75	2.250	5.64	9.16	*
QPSK	0.95	1.900	6.18	8.96	
8PSK	0.667	2.000	4.70	7.71	
QPSK	0.875	1.750	4.81	7.24	
16APSK	0.5	2.000	4.01	7.02	*
BPSK	0.95	0.950	6.12	5.90	
QPSK	0.75	1.500	3.55	5.31	
8PSK	0.5	1.500	3.16	4.92	
QPSK	0.667	1.330	2.97	4.22	*
BPSK	0.875	0.875	4.78	4.20	
BPSK	0.75	0.750	3.52	2.27	
QPSK	0.5	1.000	2.07	2.07	
BPSK	0.667	0.667	2.95	1.19	*
BPSK	0.5	0.500	2.06	-0.95	

Initial configuration will be the lowest modulation and coding combination. In this example BPSK Turbo 2/3 Rate. Selecting a serial rate of 2048k and a symbol rate of 640k allows all possible combinations (except BPSK 1/2) this will be relevant later, to be achieved within a common block size, so this was selected, shown in Table J-2. The ITA configuration is then entered as shown in Table J-3, and shown in Figure J-1 through Figure J-6.

J.1.2.1 Initial DMD2050E Modem Setup

Table J-2 - Initial Modem Setup

FW: F05280-AH28 REV 4.4.28 (7/06 9:47)					
DMD2050E MENU SETTINGS (UUT)				DMD2050E MENU SETTINGS (Reference)	
MAIN MENU	MENU OPTION	PARAMENTER	VALUE	PARAMENTER	VALUE
INTERFACE	TX SETUP	TERR INTERFACE	MIL-188-114A	TERR INTERFACE	MIL-188-114A
INTERFACE	RX SETUP	TERR INTERFACE	MIL-188-114A	TERR INTERFACE	MIL-188-114A
MODULATOR	NETWORK-SPEC	NETWORK SPEC	EBEM	NETWORK SPEC	EBEM
MODULATOR	IF	FREQUENCY (MHz)	137.5 MHz	FREQUENCY (MHz)	142.5 MHz
MODULATOR	IF	POWER (dBm)	-25	POWER (dBm)	-25
MODULATOR	IF	CARRIER	ON	CARRIER	ON
MODULATOR	IF	SPECTRUM	NORMAL	SPECTRUM	NORMAL
MODULATOR	IF	MODULATION	BPSK	MODULATION	BPSK
MODULATOR	IF	SPECTRAL MASK	MIL188 165A	SPECTRAL MASK	MIL188 165A
MODULATOR	DATA	DATA RATE (bps)	2048000	DATA RATE (bps)	2048000
MODULATOR	DATA	INNER FEC	TURBO 2/3	INNER FEC	TURBO 2/3
MODULATOR	DATA	IFEC INTERLEAVE	DISABLED	IFEC INTERLEAVE	DISABLED
MODULATOR	DATA	DIFF CODING	DISABLED	DIFF CODING	DISABLED
MODULATOR	DATA	SCRAMBLER SEL	EBEM	SCRAMBLER SEL	EBEM
MODULATOR	DATA	SCRAMBLER CTRL	ENABLED	SCRAMBLER CTRL	ENABLED
MODULATOR	DATA	SAT FRAMING	EBEM	SAT FRAMING	EBEM
MODULATOR	DATA	OVERHEAD CHAN	OFF	OVERHEAD CHAN	OFF
MODULATOR	DATA	EMBEDDED CHAN	ENABLED	EMBEDDED CHAN	ENABLED
MODULATOR	DATA	ENCRYPTION	DISABLED	ENCRYPTION	DISABLED
MODULATOR	DATA	ETH RATE (bps)	640000	ETH RATE (bps)	640000
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
MODULATOR	ITA	ITA OPTION	DISABLED	ITA OPTION	DISABLED
MODULATOR	ITA	(see ITA submenu Setup)	N/A	(see ITA submenu Setup)	N/A
MODULATOR	REED-SOLOMON	ENABLE/DISABLE	DISABLE	ENABLE/DISABLE	DISABLE
DEMODULATOR	NETWORK-SPEC	NETWORK SPEC	EBEM	NETWORK SPEC	EBEM
DEMODULATOR	IF	FREQUENCY (MHz)	142.5 MHz	FREQUENCY (MHz)	137.5 MHz
DEMODULATOR	IF	SPECTRUM	NORMAL	SPECTRUM	NORMAL
DEMODULATOR	IF	MODULATION	BPSK	MODULATION	BPSK
DEMODULATOR	IF	SPECTRAL MASK	MIL188 165A	SPECTRAL MASK	MIL188 165A
DEMODULATOR	DATA	DATA RATE (bps)	2048000	DATA RATE (bps)	2048000
DEMODULATOR	DATA	INNER FEC	TURBO 2/3	INNER FEC	TURBO 2/3
DEMODULATOR	DATA	IFEC INTERLEAVE	DISABLED	IFEC INTERLEAVE	DISABLED
DEMODULATOR	DATA	DIFF CODING	DISABLED	DIFF CODING	DISABLED
DEMODULATOR	DATA	SCRAMBLER SEL	EBEM	SCRAMBLER SEL	EBEM
DEMODULATOR	DATA	SCRAMBLER CTRL	ENABLED	SCRAMBLER CTRL	ENABLED
DEMODULATOR	DATA	SAT FRAMING	EBEM	SAT FRAMING	EBEM
DEMODULATOR	DATA	OVERHEAD CHAN	OFF	OVERHEAD CHAN	OFF
DEMODULATOR	DATA	EMBEDDED CHAN	ENABLED	EMBEDDED CHAN	ENABLED
DEMODULATOR	DATA	ENCRYPTION	DISABLED	ENCRYPTION	DISABLED
DEMODULATOR	DATA	ETH RATE (bps)	640000	ETH RATE (bps)	640000
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
DEMODULATOR	ITA	ITA OPTION	DISABLED	ITA OPTION	DISABLED
DEMODULATOR	ITA	(see ITA submenu Setup)	N/A	(see ITA submenu Setup)	N/A
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
DEMODULATOR	REED-SOLOMON	ENABLE/DISABLE	DISABLE	ENABLE/DISABLE	DISABLE
INTERFACE	RX SETUP	BUFF SIZE (msec)	0	BUFF SIZE (msec)	0
INTERFACE	RX SETUP	BUFFER CLK SRC, PRIORITY, SRC DEPTH	RX SAT, 1, 1	BUFFER CLK SRC, PRIORITY, SRC DEPTH	RX SAT, 1, 1
INTERFACE	RX SETUP	BUFFER CLOCK POL	NORMAL	BUFFER CLOCK POL	NORMAL
MONITOR	RX BUFFER RESET	PRESS ENTER TO RECENTER	ENTER	PRESS ENTER TO RECENTER	ENTER

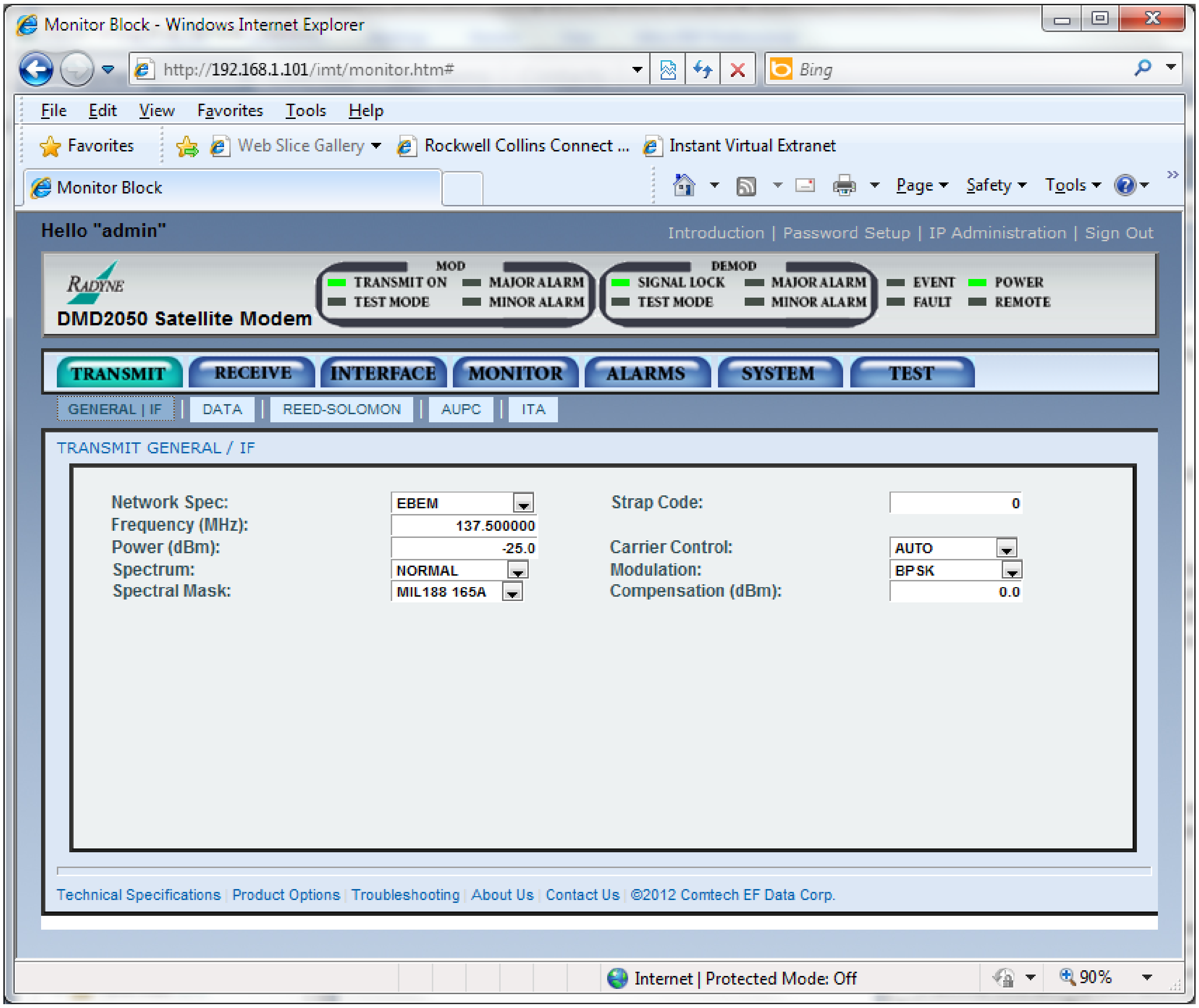

Figure J-1 - Initial Setup DMD2050E, Modulator IF

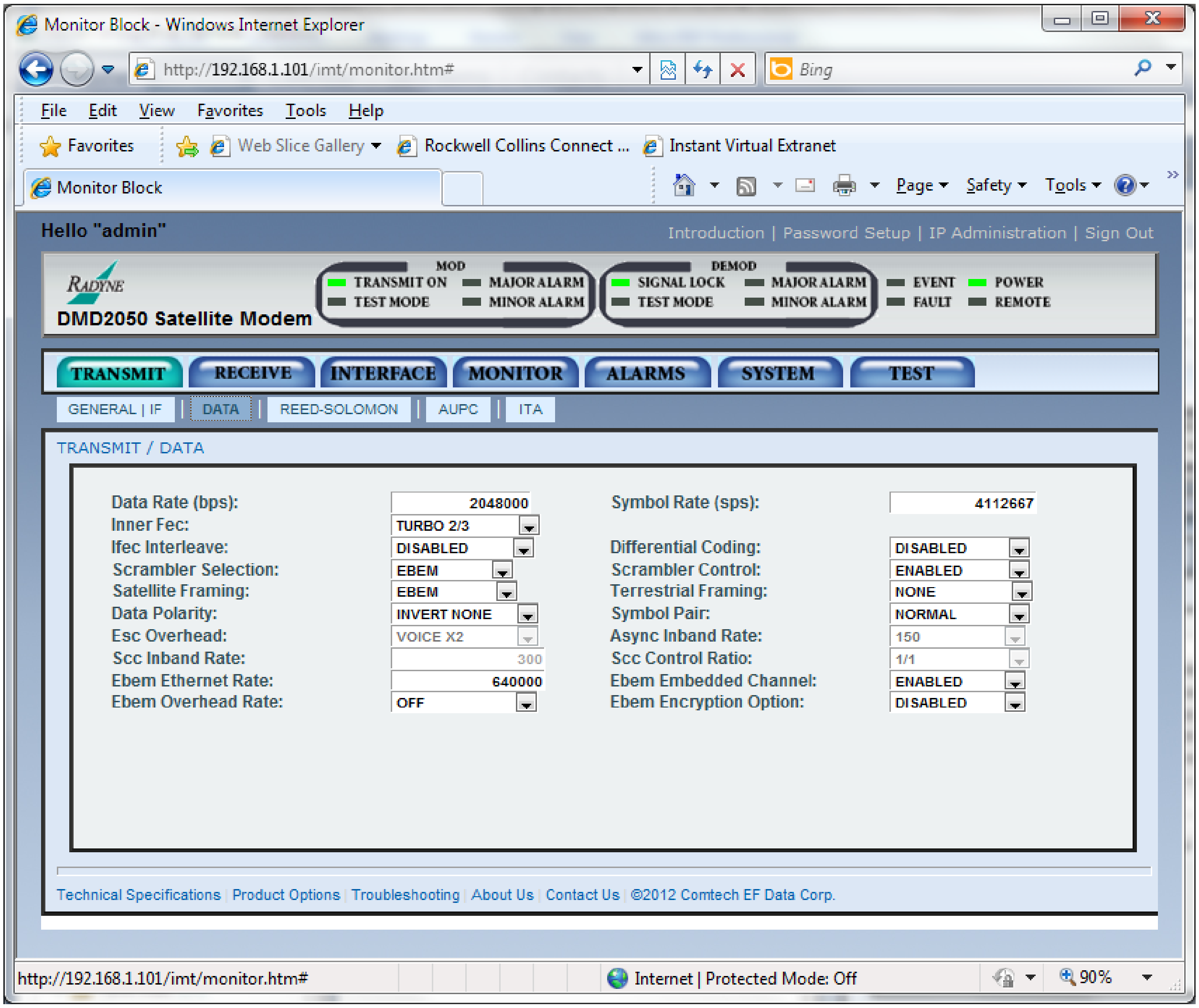

Figure J-2 - Initial Setup DMD2050E, Modulator Data

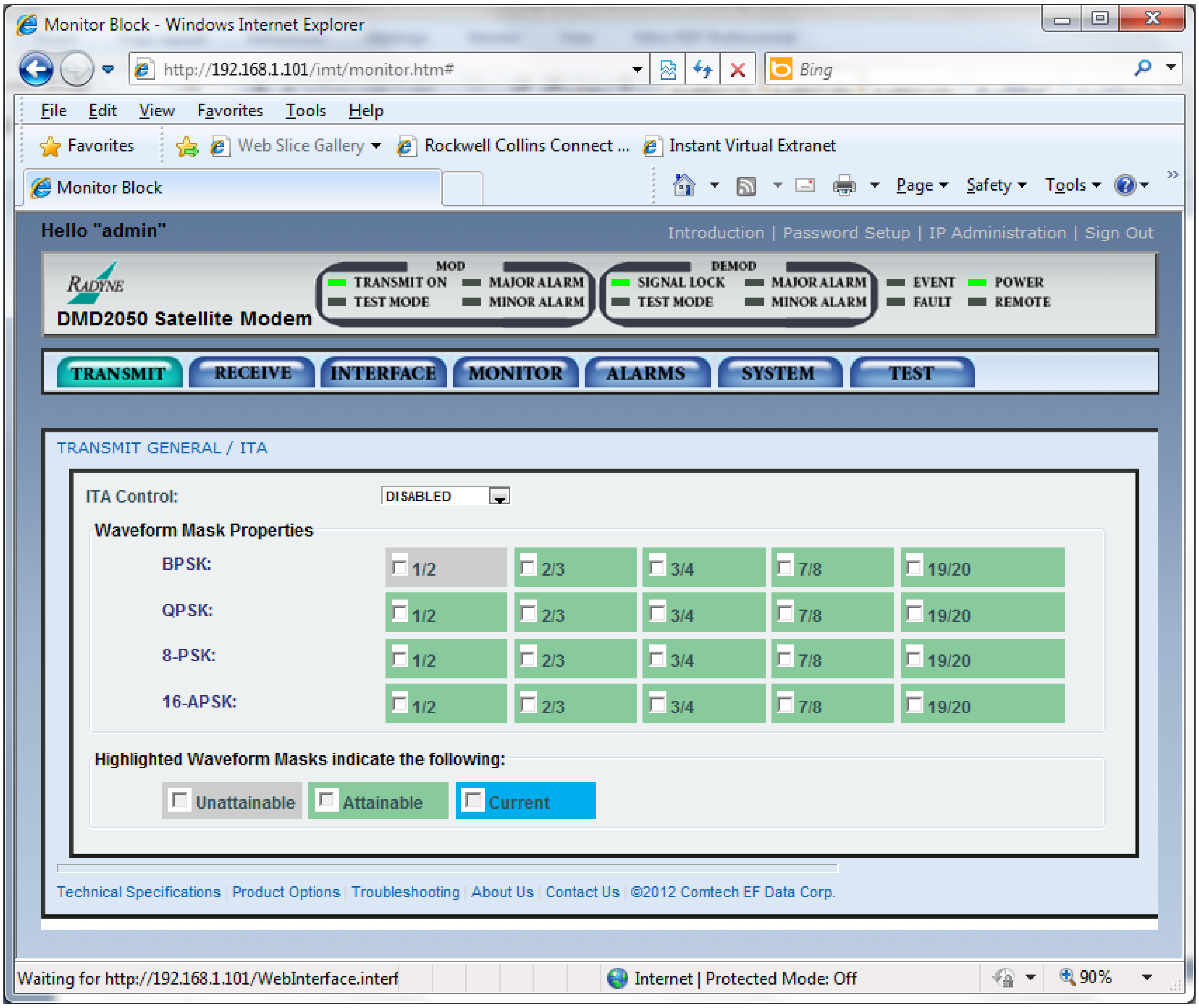

Figure J-3 - Initial Setup DMD2050E, Modulator ITA

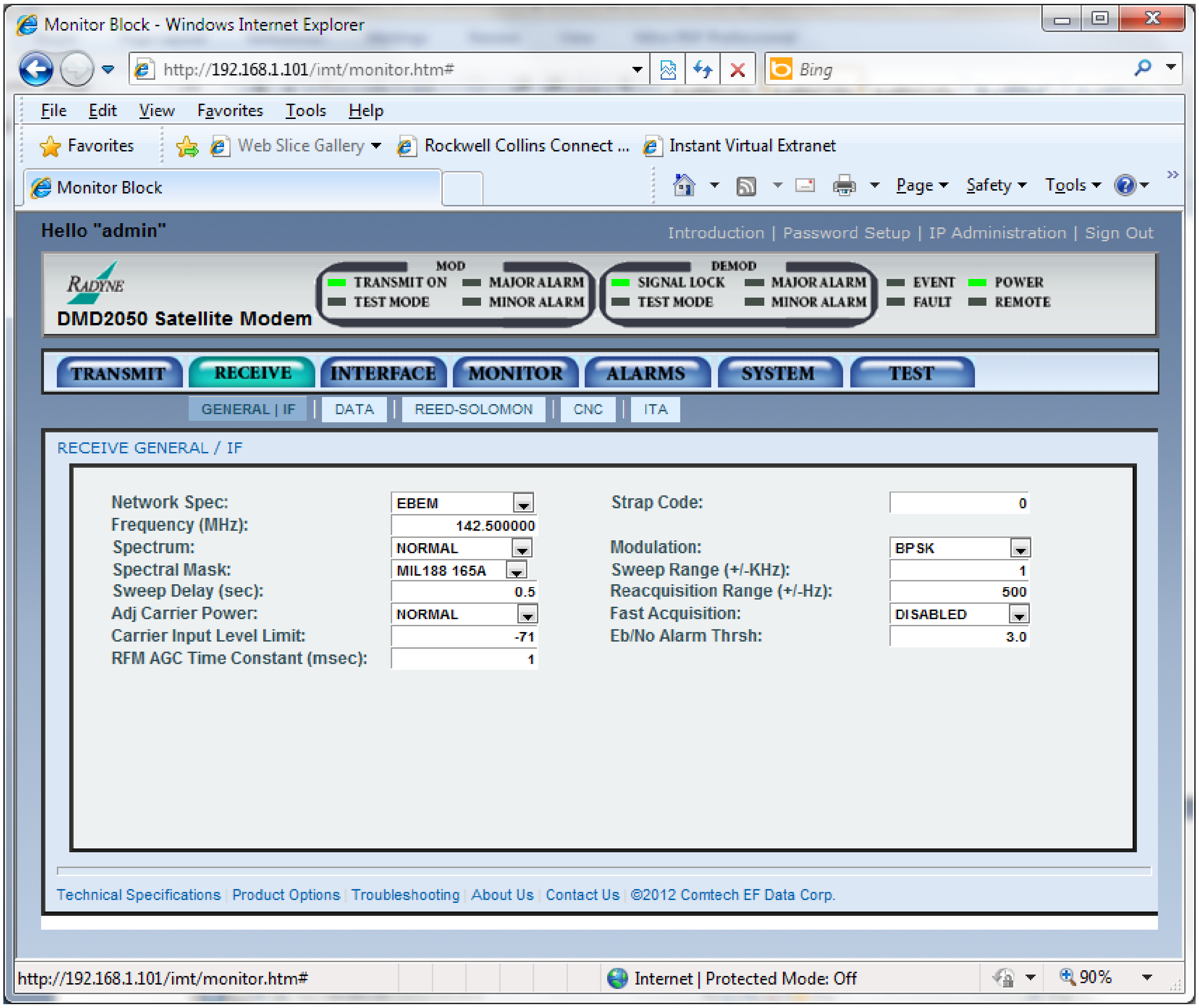

Figure J-4 - Initial Setup DMD2050E, Demodulator IF

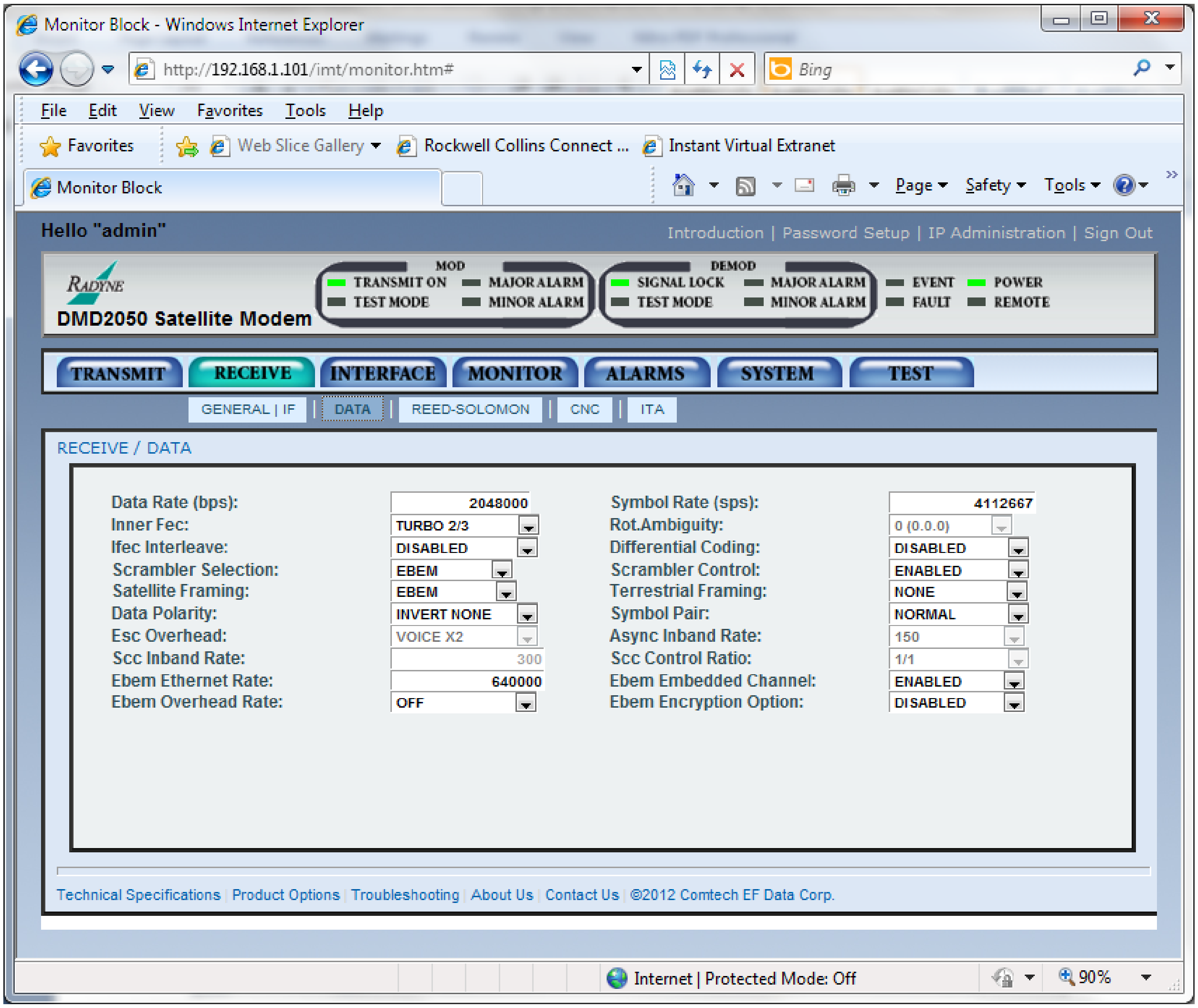

Figure J-5 - Initial Setup DMD2050E, Demodulator Data

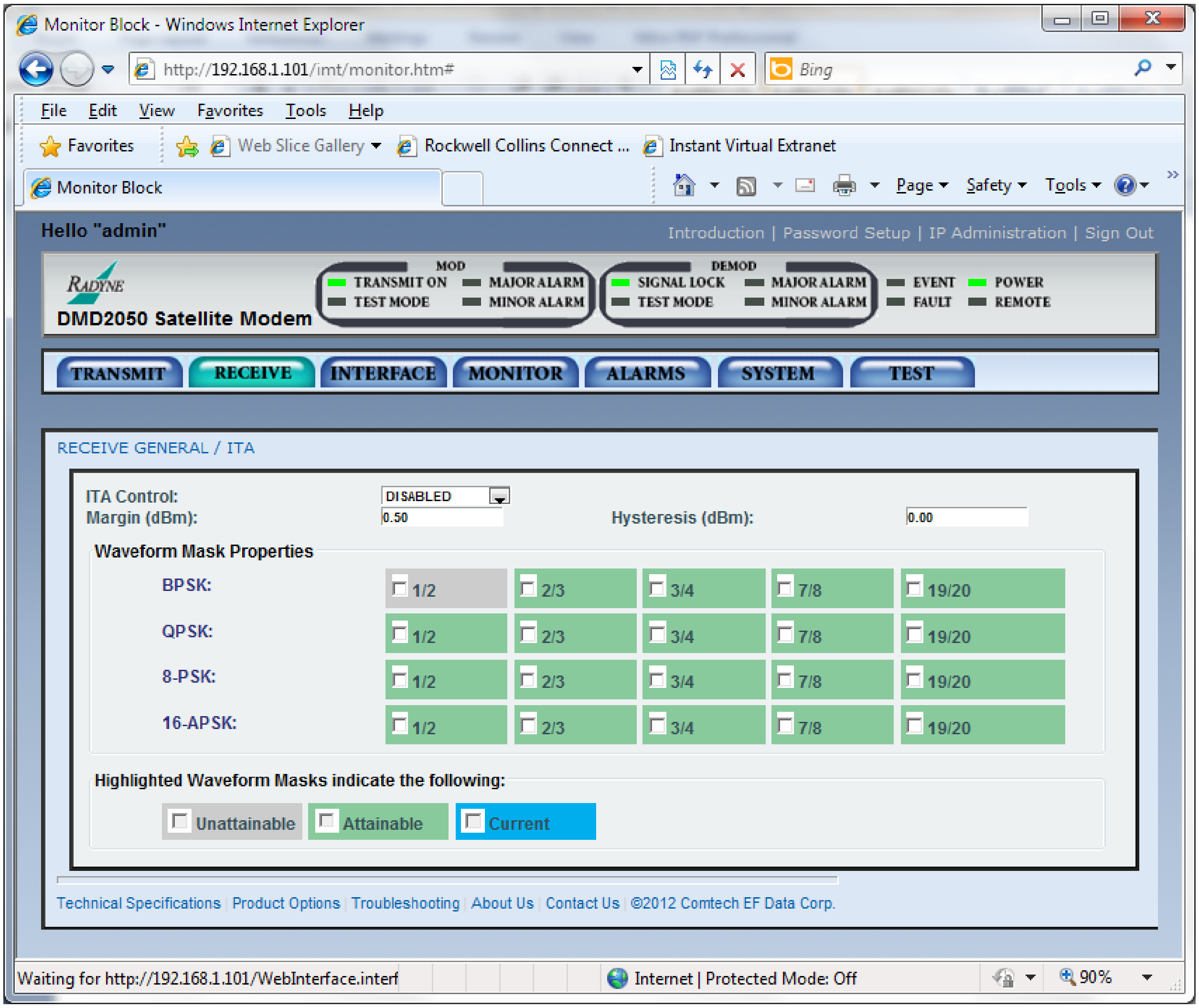

Figure J-6 - Initial Setup DMD2050E, Demodulator ITA

At this point verify that both serial traffic and Ethernet traffic is properly passing through the system.

Enable and setup the ITA function of the modems as shown in Table J-3, once the ITA Option has been enabled the ITA waveform masks

Table J-3 - ITA Setup

FW: F05280-AH28 REV 4.4.28 (7/06 9:47)

DMD2050E MENU SETTINGS (UUT)				DMD2050E MENU SETTINGS (Reference)	
MAIN MENU	**MENU OPTION**	**PARAMENTER**	**VALUE**	**PARAMENTER**	**VALUE**
INTERFACE	TX SETUP	TERR INTERFACE	MIL-188-114A	TERR INTERFACE	MIL-188-114A
INTERFACE	RX SETUP	TERR INTERFACE	MIL-188-114A	TERR INTERFACE	MIL-188-114A
MODULATOR	NETWORK-SPEC	NETWORK SPEC	EBEM	NETWORK SPEC	EBEM
MODULATOR	IF	FREQUENCY (MHz)	137.5 MHz	FREQUENCY (MHz)	142.5 MHz
MODULATOR	IF	POWER (dBm)	-25	POWER (dBm)	-25
MODULATOR	IF	CARRIER	ON	CARRIER	ON
MODULATOR	IF	SPECTRUM	NORMAL	SPECTRUM	NORMAL
MODULATOR	IF	MODULATION	BPSK	MODULATION	BPSK
MODULATOR	IF	SPECTRAL MASK	MIL188 165A	SPECTRAL MASK	MIL188 165A
MODULATOR	DATA	DATA RATE (bps)	2048000	DATA RATE (bps)	2048000
MODULATOR	DATA	INNER FEC	TURBO 2/3	INNER FEC	TURBO 2/3
MODULATOR	DATA	IFEC INTERLEAVE	DISABLED	IFEC INTERLEAVE	DISABLED
MODULATOR	DATA	DIFF CODING	DISABLED	DIFF CODING	DISABLED
MODULATOR	DATA	SCRAMBLER SEL	EBEM	SCRAMBLER SEL	EBEM
MODULATOR	DATA	SCRAMBLER CTRL	ENABLED	SCRAMBLER CTRL	ENABLED
MODULATOR	DATA	SAT FRAMING	EBEM	SAT FRAMING	EBEM
MODULATOR	DATA	OVERHEAD CHAN	OFF	OVERHEAD CHAN	OFF
MODULATOR	DATA	EMBEDDED CHAN	ENABLED	EMBEDDED CHAN	ENABLED
MODULATOR	DATA	ENCRYPTION	DISABLED	ENCRYPTION	DISABLED
MODULATOR	DATA	ETH RATE (bps)	640000	ETH RATE (bps)	640000
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
MODULATOR	ITA	ITA OPTION	ENABLED	ITA OPTION	ENABLED
MODULATOR	ITA	(see ITA submenu Setup)	N/A	(see ITA submenu Setup)	N/A
MODULATOR	REED-SOLOMON	ENABLE/DISABLE	DISABLE	ENABLE/DISABLE	DISABLE
DEMODULATOR	NETWORK-SPEC	NETWORK SPEC	EBEM	NETWORK SPEC	EBEM
DEMODULATOR	IF	FREQUENCY (MHz)	142.5 MHz	FREQUENCY (MHz)	137.5 MHz
DEMODULATOR	IF	SPECTRUM	NORMAL	SPECTRUM	NORMAL
DEMODULATOR	IF	MODULATION	BPSK	MODULATION	BPSK
DEMODULATOR	IF	SPECTRAL MASK	MIL188 165A	SPECTRAL MASK	MIL188 165A
DEMODULATOR	DATA	DATA RATE (bps)	2048000	DATA RATE (bps)	2048000
DEMODULATOR	DATA	INNER FEC	TURBO 2/3	INNER FEC	TURBO 2/3
DEMODULATOR	DATA	IFEC INTERLEAVE	DISABLED	IFEC INTERLEAVE	DISABLED
DEMODULATOR	DATA	DIFF CODING	DISABLED	DIFF CODING	DISABLED
DEMODULATOR	DATA	SCRAMBLER SEL	EBEM	SCRAMBLER SEL	EBEM
DEMODULATOR	DATA	SCRAMBLER CTRL	ENABLED	SCRAMBLER CTRL	ENABLED
DEMODULATOR	DATA	SAT FRAMING	EBEM	SAT FRAMING	EBEM
DEMODULATOR	DATA	OVERHEAD CHAN	OFF	OVERHEAD CHAN	OFF
DEMODULATOR	DATA	EMBEDDED CHAN	ENABLED	EMBEDDED CHAN	ENABLED
DEMODULATOR	DATA	ENCRYPTION	DISABLED	ENCRYPTION	DISABLED
DEMODULATOR	DATA	ETH RATE (bps)	640000	ETH RATE (bps)	640000
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
DEMODULATOR	ITA	ITA OPTION	ENABLED	ITA OPTION	ENABLED
DEMODULATOR	ITA	(see ITA submenu Setup)	N/A	(see ITA submenu Setup)	N/A
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
DEMODULATOR	REED-SOLOMON	ENABLE/DISABLE	DISABLE	ENABLE/DISABLE	DISABLE
INTERFACE	RX SETUP	BUFF SIZE (msec)	0	BUFF SIZE (msec)	0
INTERFACE	RX SETUP	BUFFER CLK SRC, PRIORITY, SRC DEPTH	RX SAT, 1, 1	BUFFER CLK SRC, PRIORITY, SRC DEPTH	RX SAT, 1, 1
INTERFACE	RX SETUP	BUFFER CLOCK POL	NORMAL	BUFFER CLOCK POL	NORMAL
MONITOR	RX BUFFER RESET	PRESS ENTER TO RECENTER	ENTER	PRESS ENTER TO RECENTER	ENTER

The ITA Menu Functions and their descriptions are shown in Table J-4 and Table J-5.

Table J-4. Transmit ITA Functions

Function	ITA Available Options	Description
ITA Option	{DISABLED, ENABLED}	Enable or disable the ITA Function.
BPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate

Table J-5. Receive ITA Functions

Function	AUPC Available Options	Description
ITA Option	{DISABLED, ENABLED}	Enable or disable the ITA Function.
BPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
BPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
QPSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
8PSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 1/2	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 2/3	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 3/4	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 7/8	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
16APSK 19/20	{NOT SELECTED, SELECTED}	Used to select the mod/code rate
ITA MARGIN		
ITA HYSTERESIS		

Table J-6 – ITA Waveform Masks (Modulator UUT)

DMD2050E MENU SETTINGS (UUT)			
MAIN MENU	MENU OPTION	PARAMENTER	VALUE
MODULATOR	ITA	BPSK 1/2	NOT SELECTSED
MODULATOR	ITA	BPSK 2/3	SELECTED
MODULATOR	ITA	BPSK 3/4	NOT SELECTSED
MODULATOR	ITA	BPSK 7/8	NOT SELECTSED
MODULATOR	ITA	BPSK 19/20	NOT SELECTSED
MODULATOR	ITA	QPSK 1/2	NOT SELECTSED
MODULATOR	ITA	QPSK 2/3	SELECTED
MODULATOR	ITA	QPSK 3/4	NOT SELECTSED
MODULATOR	ITA	QPSK 7/8	NOT SELECTSED
MODULATOR	ITA	QPSK 19/20	NOT SELECTSED
MODULATOR	ITA	8PSK 1/2	NOT SELECTSED
MODULATOR	ITA	8PSK 2/3	NOT SELECTSED
MODULATOR	ITA	8PSK 3/4	SELECTED
MODULATOR	ITA	8PSK 7/8	NOT SELECTSED
MODULATOR	ITA	8PSK 19/20	NOT SELECTSED
MODULATOR	ITA	16APSK 1/2	SELECTED
MODULATOR	ITA	16APSK 2/3	NOT SELECTSED
MODULATOR	ITA	16APSK 3/4	NOT SELECTSED
MODULATOR	ITA	16APSK 7/8	SELECTED
MODULATOR	ITA	16APSK 19/20	SELECTED

Table J-7 – ITA Waveform Masks (Demodulator UUT)

DMD2050E MENU SETTINGS (UUT)			
MAIN MENU	MENU OPTION	PARAMENTER	VALUE
DEMODULATOR	ITA	BPSK 1/2	NOT SELECTSED
DEMODULATOR	ITA	BPSK 2/3	SELECTED
DEMODULATOR	ITA	BPSK 3/4	NOT SELECTSED
DEMODULATOR	ITA	BPSK 7/8	NOT SELECTSED
DEMODULATOR	ITA	BPSK 19/20	NOT SELECTSED
DEMODULATOR	ITA	QPSK 1/2	NOT SELECTSED
DEMODULATOR	ITA	QPSK 2/3	SELECTED
DEMODULATOR	ITA	QPSK 3/4	NOT SELECTSED
DEMODULATOR	ITA	QPSK 7/8	NOT SELECTSED
DEMODULATOR	ITA	QPSK 19/20	NOT SELECTSED
DEMODULATOR	ITA	8PSK 1/2	NOT SELECTSED
DEMODULATOR	ITA	8PSK 2/3	NOT SELECTSED
DEMODULATOR	ITA	8PSK 3/4	SELECTED
DEMODULATOR	ITA	8PSK 7/8	NOT SELECTSED
DEMODULATOR	ITA	8PSK 19/20	NOT SELECTSED
DEMODULATOR	ITA	16APSK 1/2	SELECTED
DEMODULATOR	ITA	16APSK 2/3	NOT SELECTSED
DEMODULATOR	ITA	16APSK 3/4	NOT SELECTSED
DEMODULATOR	ITA	16APSK 7/8	SELECTED
DEMODULATOR	ITA	16APSK 19/20	SELECTED

Table J-8 – ITA Waveform Masks (Reference Modulator)

DMD2050E MENU SETTINGS (Reference)			
MAIN MENU	MENU OPTION	PARAMENTER	VALUE
MODULATOR	ITA	BPSK 1/2	NOT SELECTSED
MODULATOR	ITA	BPSK 2/3	SELECTED
MODULATOR	ITA	BPSK 3/4	NOT SELECTSED
MODULATOR	ITA	BPSK 7/8	NOT SELECTSED
MODULATOR	ITA	BPSK 19/20	NOT SELECTSED
MODULATOR	ITA	QPSK 1/2	NOT SELECTSED
MODULATOR	ITA	QPSK 2/3	SELECTED
MODULATOR	ITA	QPSK 3/4	NOT SELECTSED
MODULATOR	ITA	QPSK 7/8	NOT SELECTSED
MODULATOR	ITA	QPSK 19/20	NOT SELECTSED
MODULATOR	ITA	8PSK 1/2	NOT SELECTSED
MODULATOR	ITA	8PSK 2/3	NOT SELECTSED
MODULATOR	ITA	8PSK 3/4	SELECTED
MODULATOR	ITA	8PSK 7/8	NOT SELECTSED
MODULATOR	ITA	8PSK 19/20	NOT SELECTSED
MODULATOR	ITA	16APSK 1/2	SELECTED
MODULATOR	ITA	16APSK 2/3	NOT SELECTSED
MODULATOR	ITA	16APSK 3/4	NOT SELECTSED
MODULATOR	ITA	16APSK 7/8	SELECTED
MODULATOR	ITA	16APSK 19/20	SELECTED

Table J-9 – ITA Waveform Masks (Reference Demodulator)

DMD2050E MENU SETTINGS (Reference)			
MAIN MENU	MENU OPTION	PARAMENTER	VALUE
MODULATOR	ITA	BPSK 1/2	NOT SELECTSED
MODULATOR	ITA	BPSK 2/3	SELECTED
MODULATOR	ITA	BPSK 3/4	NOT SELECTSED
MODULATOR	ITA	BPSK 7/8	NOT SELECTSED
MODULATOR	ITA	BPSK 19/20	NOT SELECTSED
MODULATOR	ITA	QPSK 1/2	NOT SELECTSED
MODULATOR	ITA	QPSK 2/3	SELECTED
MODULATOR	ITA	QPSK 3/4	NOT SELECTSED
MODULATOR	ITA	QPSK 7/8	NOT SELECTSED
MODULATOR	ITA	QPSK 19/20	NOT SELECTSED
MODULATOR	ITA	8PSK 1/2	NOT SELECTSED
MODULATOR	ITA	8PSK 2/3	NOT SELECTSED
MODULATOR	ITA	8PSK 3/4	SELECTED
MODULATOR	ITA	8PSK 7/8	NOT SELECTSED
MODULATOR	ITA	8PSK 19/20	NOT SELECTSED
MODULATOR	ITA	16APSK 1/2	SELECTED
MODULATOR	ITA	16APSK 2/3	NOT SELECTSED
MODULATOR	ITA	16APSK 3/4	NOT SELECTSED
MODULATOR	ITA	16APSK 7/8	SELECTED
MODULATOR	ITA	16APSK 19/20	SELECTED

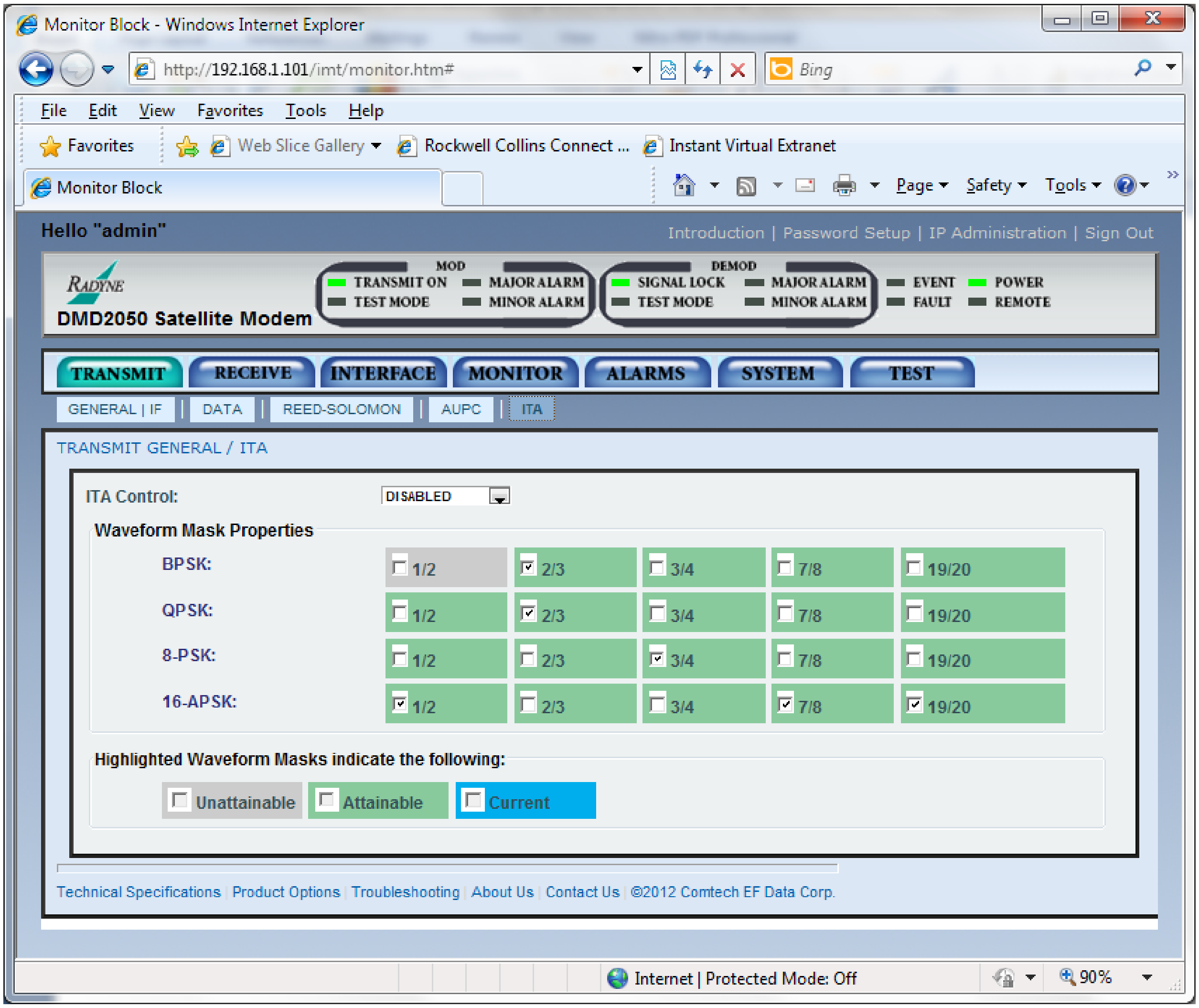

Figure J-7 - Initial Setup DMD2050E, Modulator ITA

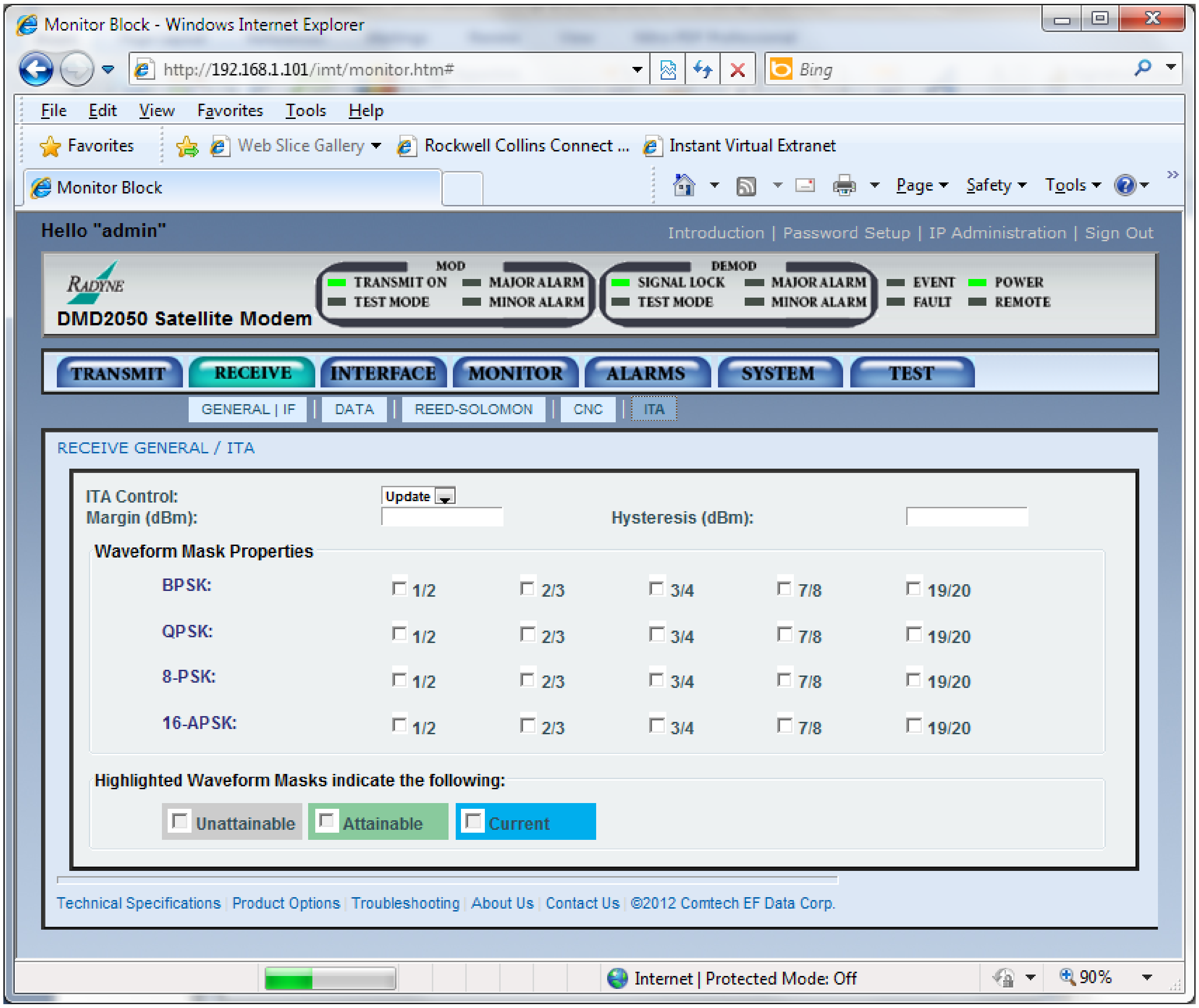

Figure J-8 - Initial Setup DMD2050E, Demodulator ITA

To setup ITA Mode first select all the appropriate waveforms you are intending to run. Waveforms marked “unattainable” are not allowed because the current symbol rate cannot be obtained based on the current serial rate selected, in other words the remaining Ethernet rate will be less than zero. Set the same waveforms in both the TX ITA and RX ITA functions so they match.

Adjust uplink power to a moderate value of approximately 16 dB C/N at 8.3 MSPS.

On the receiver I suggest setting the margin to 1 dB and leave the hysteresis at 0.

Next enable the ITA control. The Web page status will indicate and the indicator for the current waveform will follow what the system is currently operating at. This is the case in both the transmission and receives functions. This will start the process of adaptation. At 16 dB Es/No this will ramp up the mod/cod every thirty seconds until the threshold value is reached.

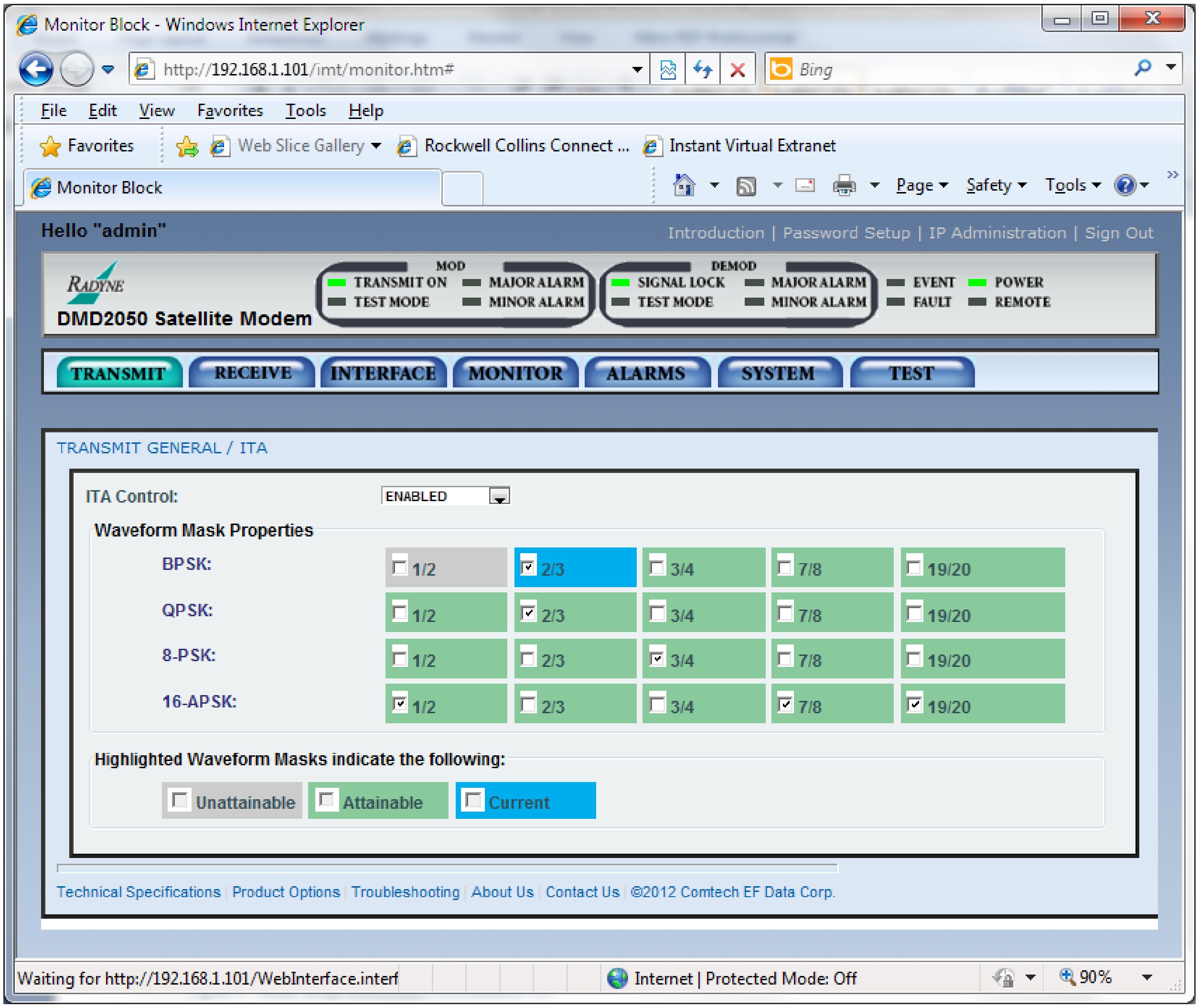

Figure J-9- Initial Setup DMD2050E, Modulator ITA (Enabled)

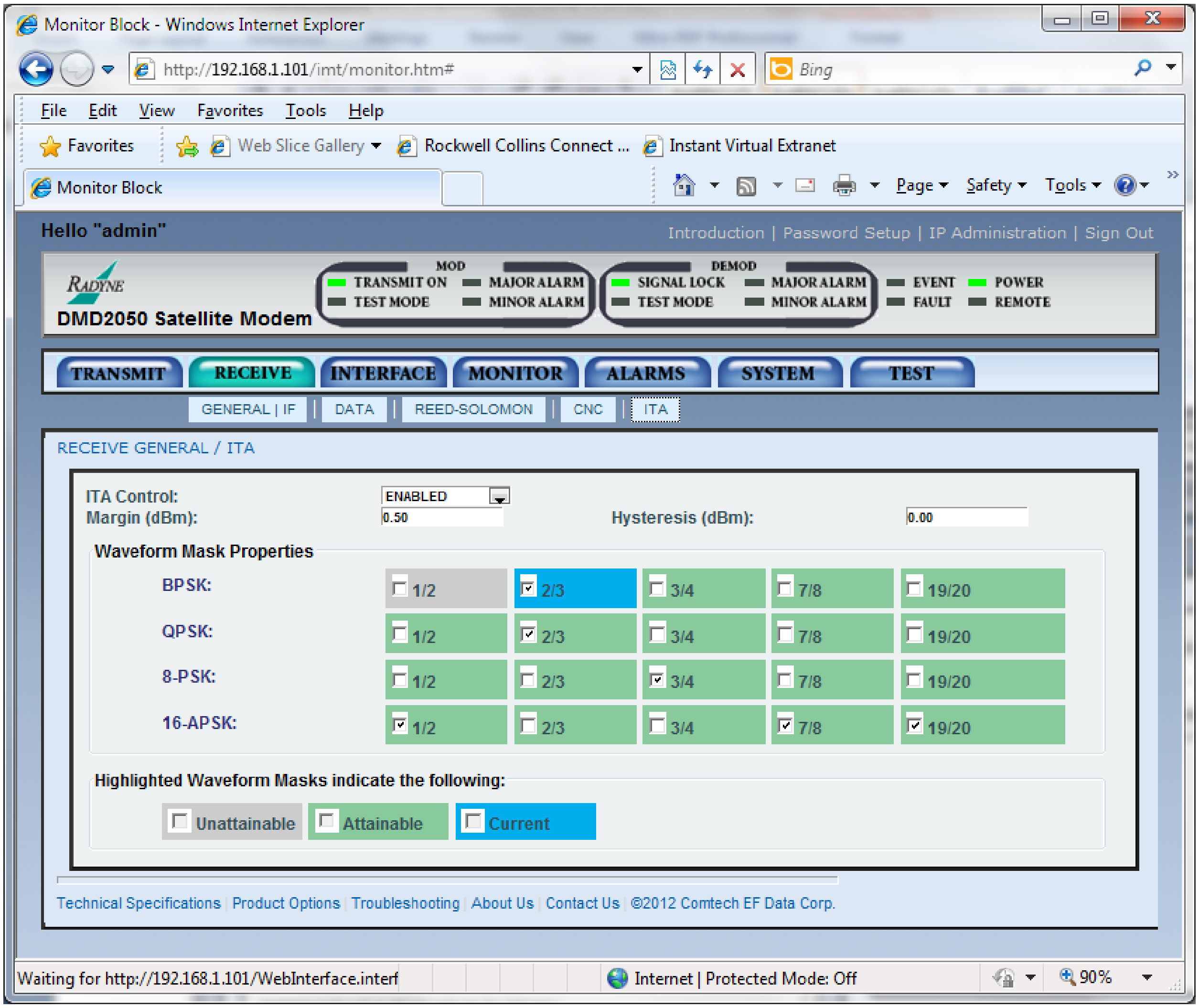

Figure J-10 - Initial Setup DMD2050E, Demodulator ITA (Enabled)

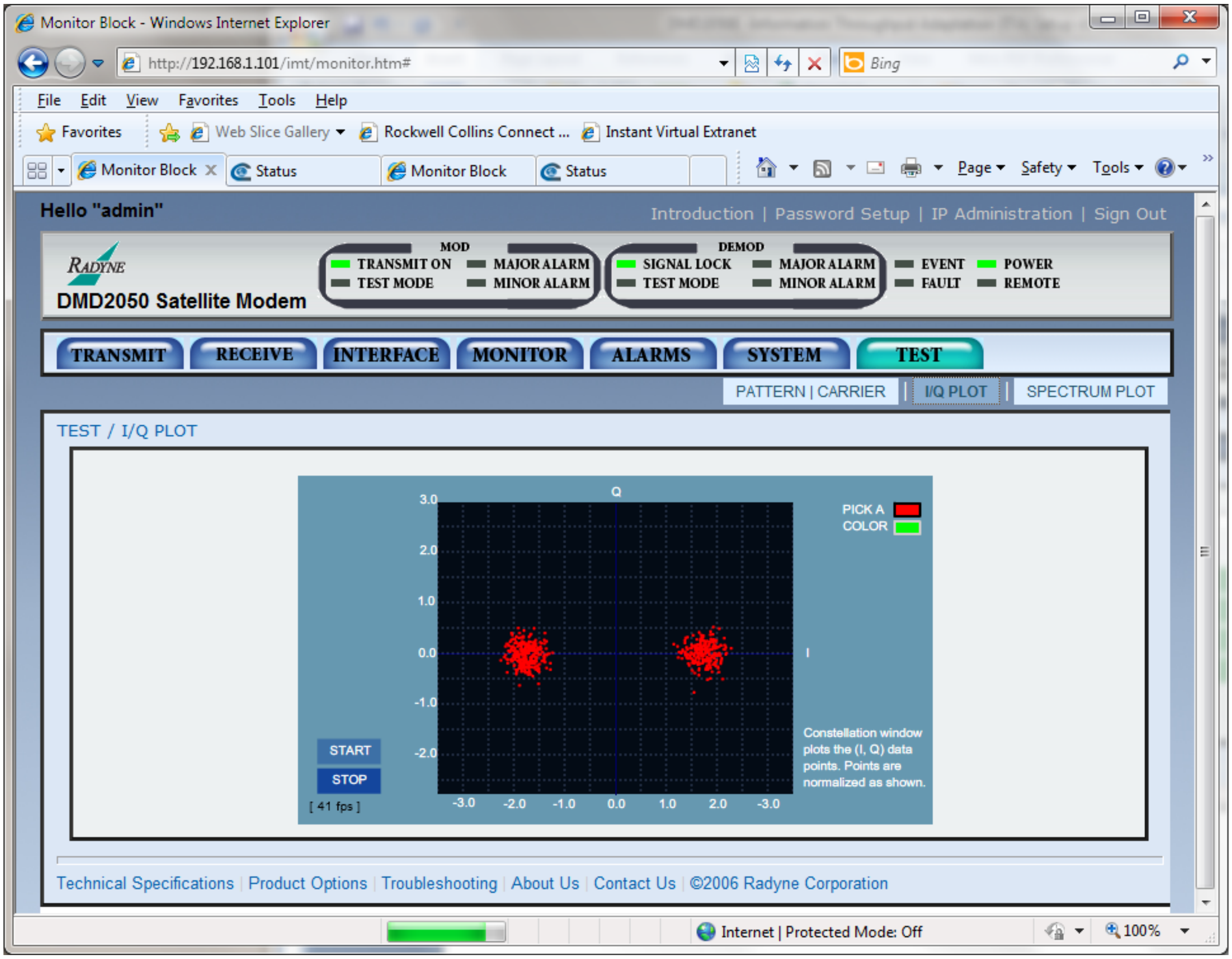

Figure J-11 –DMD2050E I/Q for BPSK 2/3

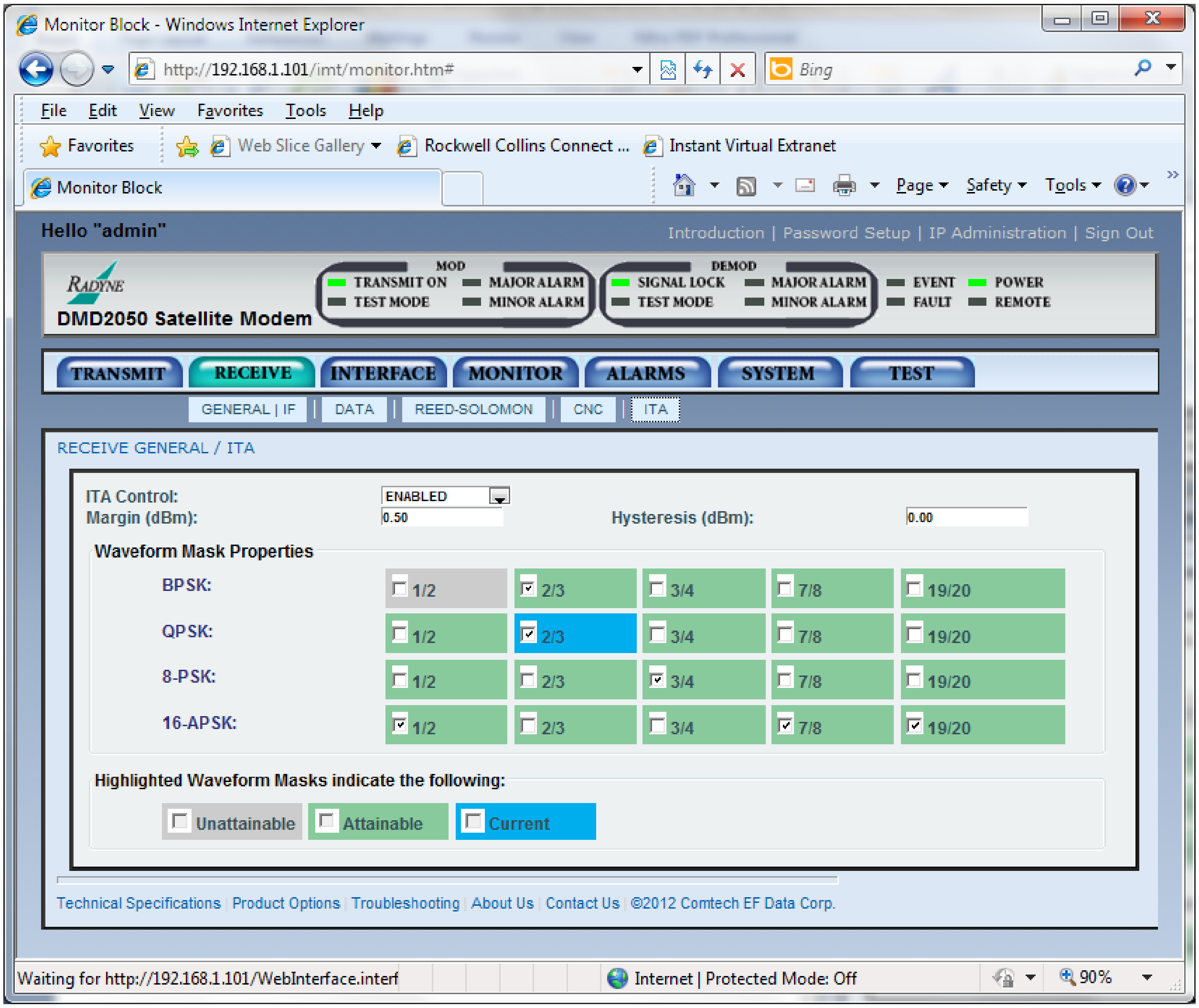

Figure J-12 –DMD2050E ITA Status for QPSK 2/3

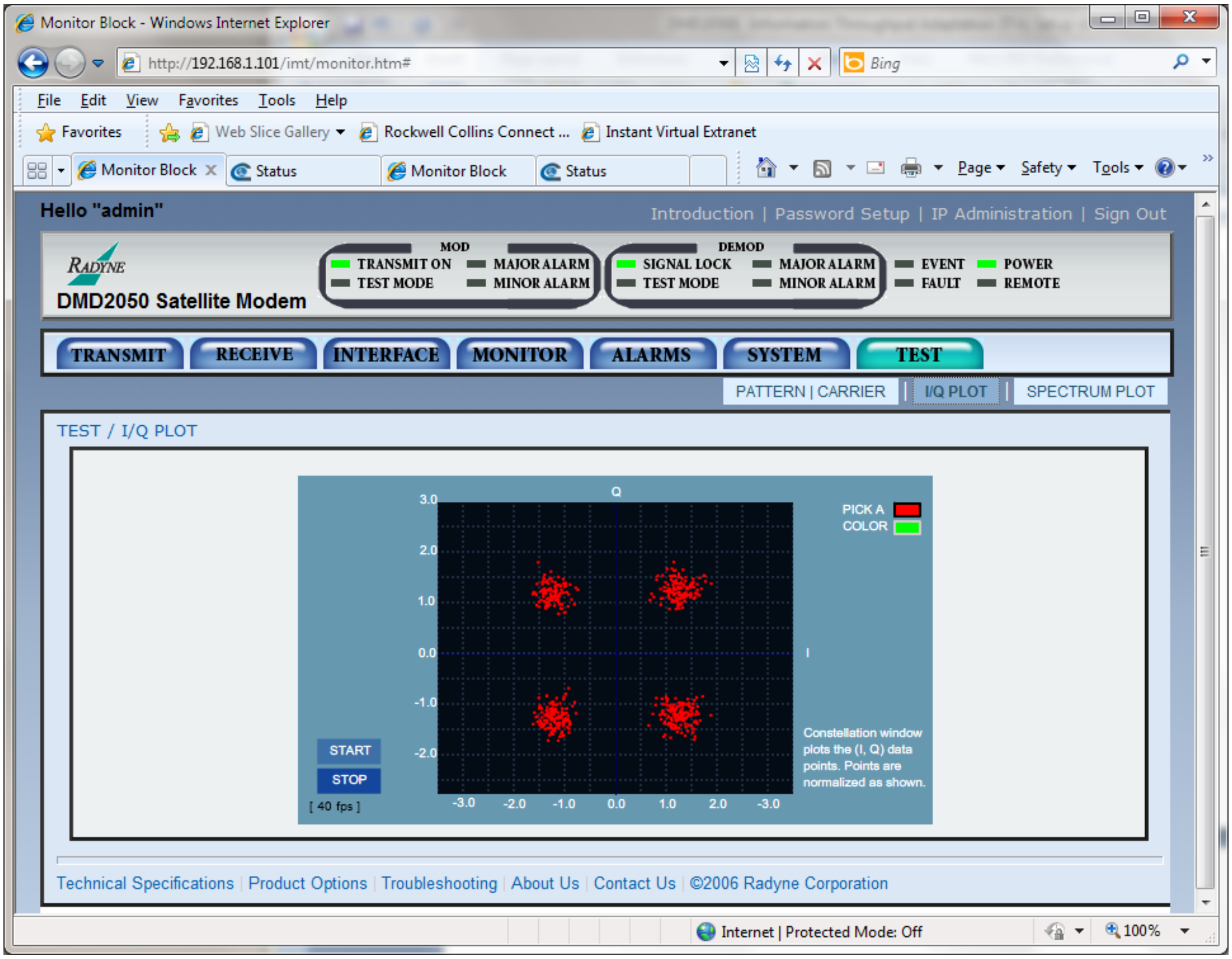

Figure J-13 –DMD2050E I/Q for QPSK 2/3

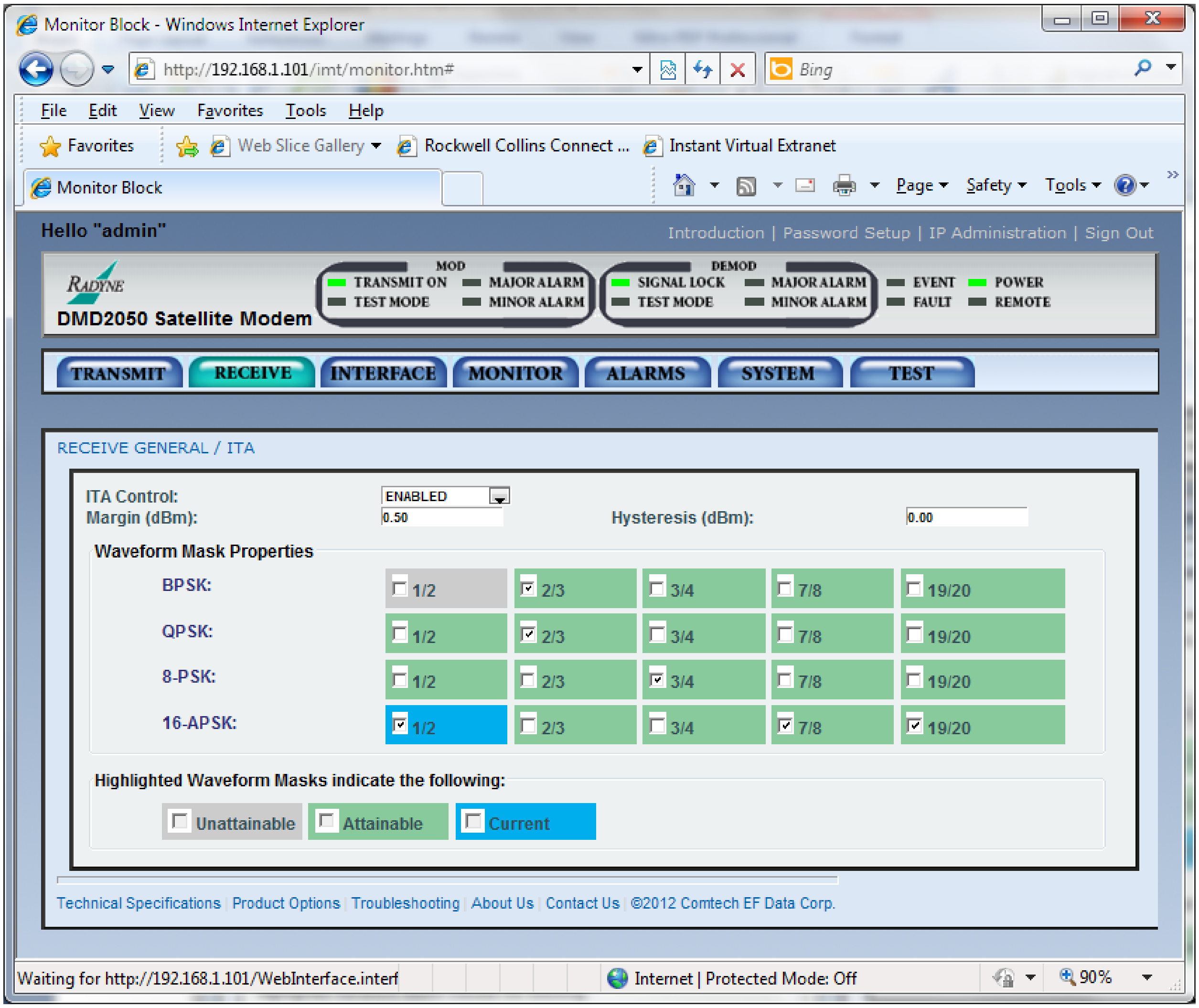

Figure J-14 –DMD2050E ITA Status for 16APSK 1/2

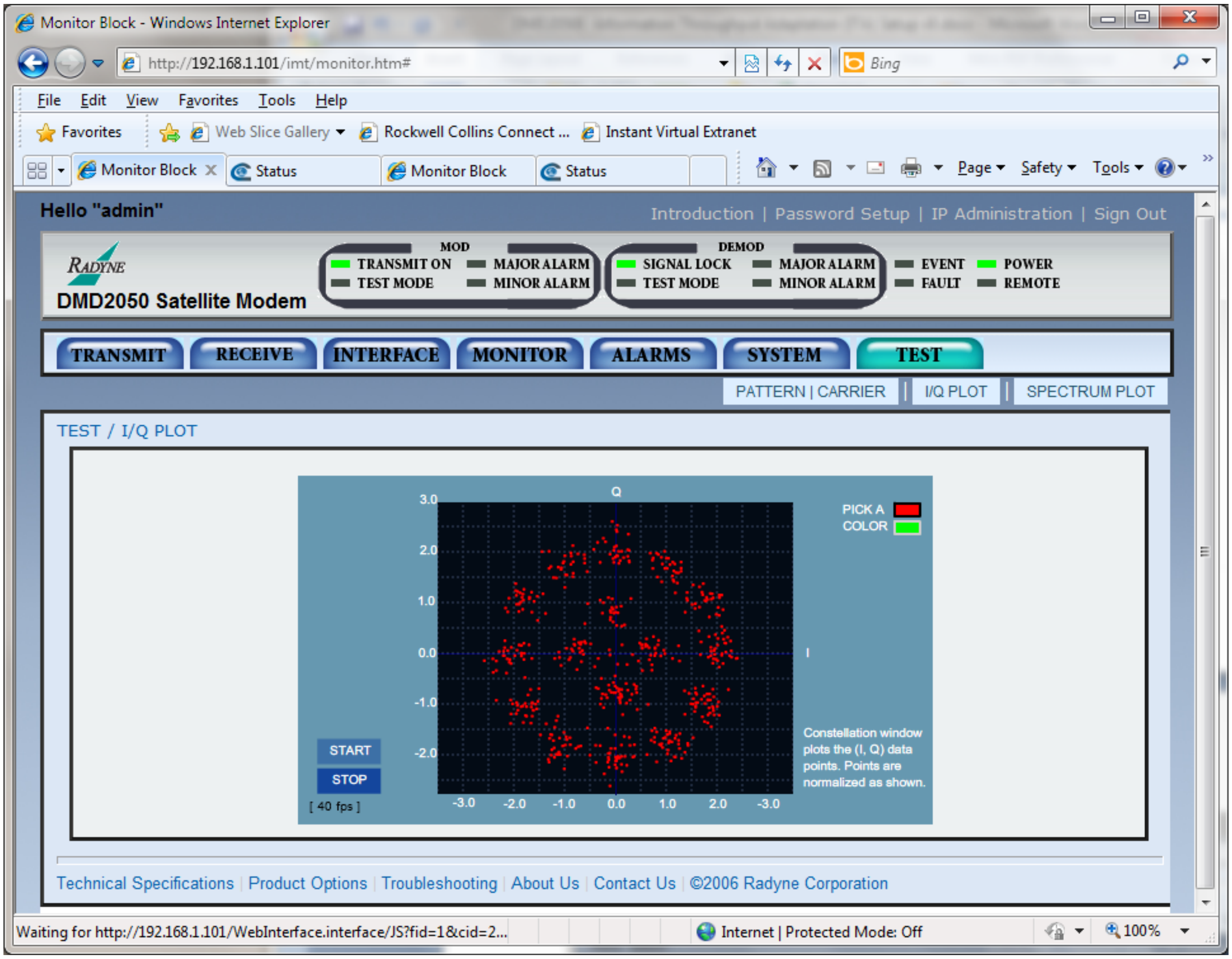

Figure J-15 –DMD2050E I/Q for 16APSK 1/2

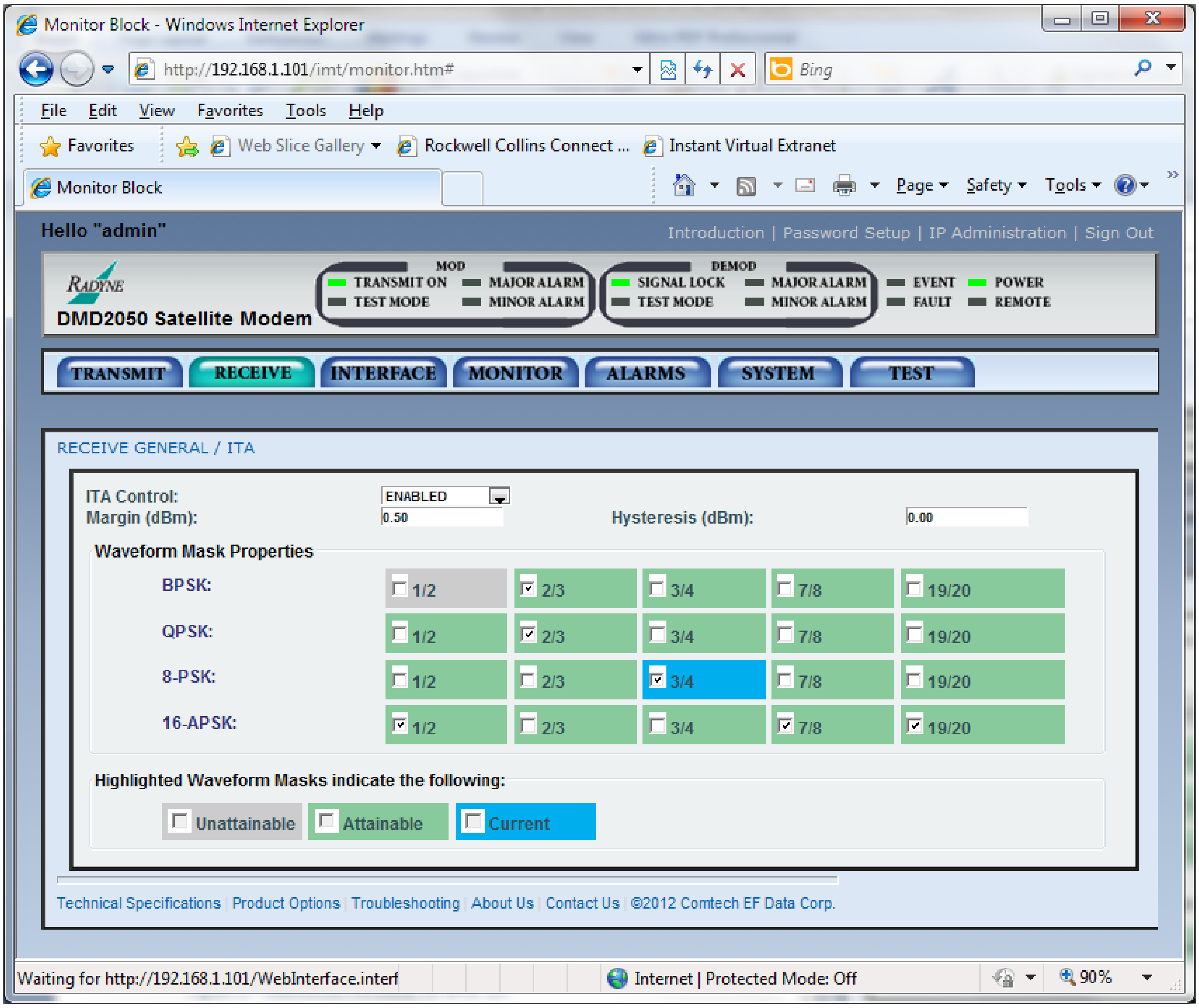

Figure J-16 –DMD2050E ITA Status for 8PSK 3/4

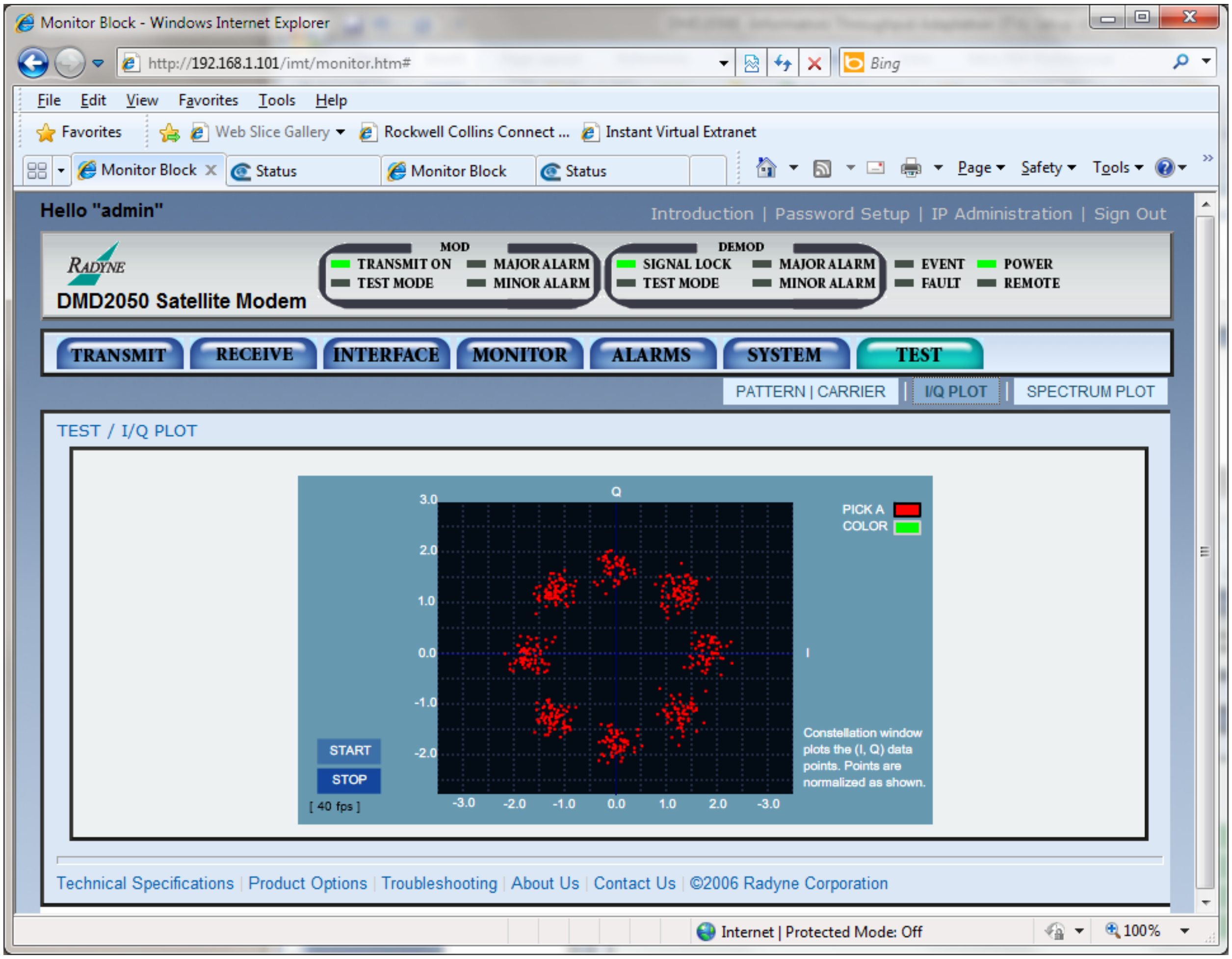

Figure J-17 –DMD2050E I/Q for 8PSK 3/4

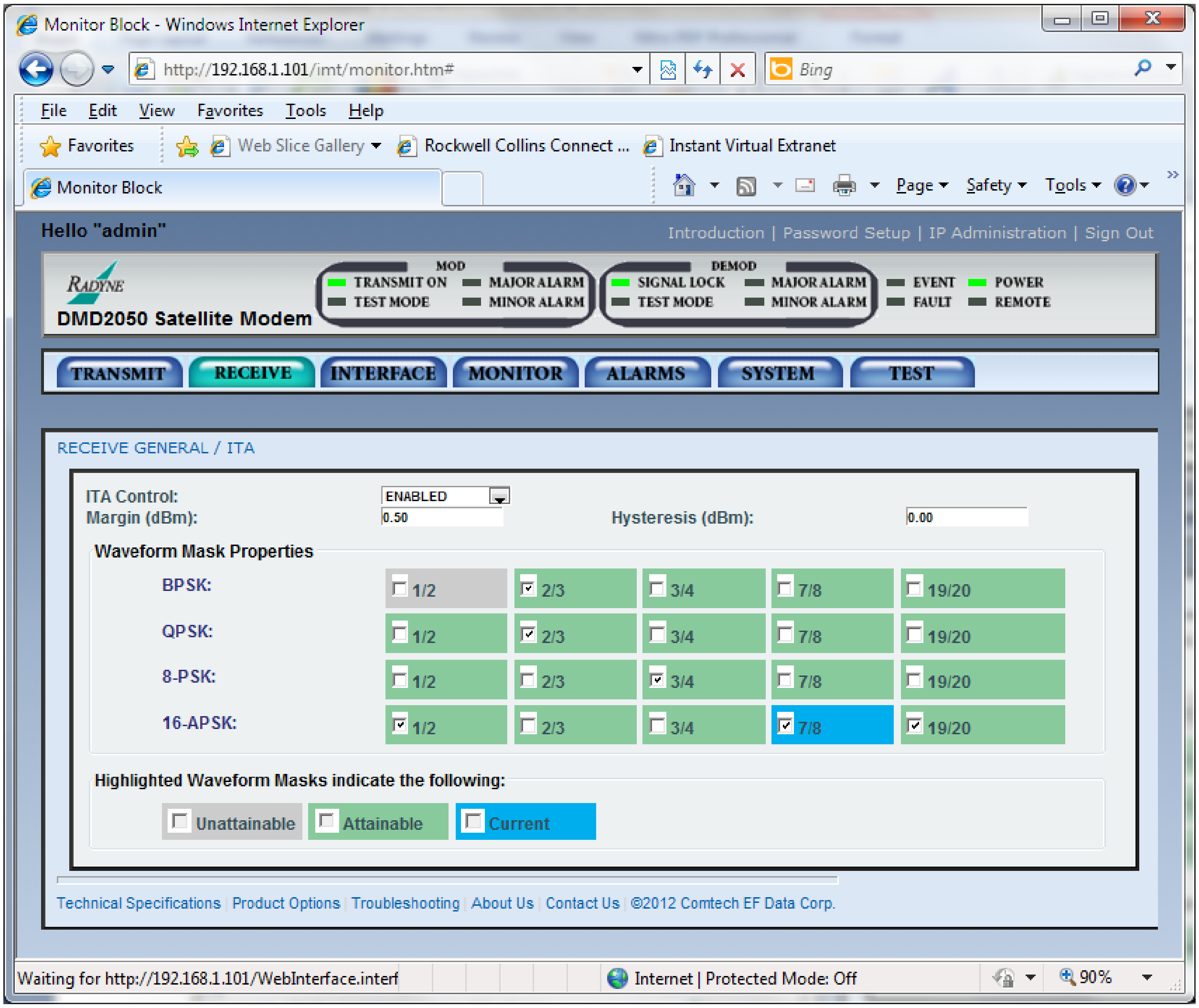

Figure J-18 –DMD2050E ITA Status for 16APSK 7/8

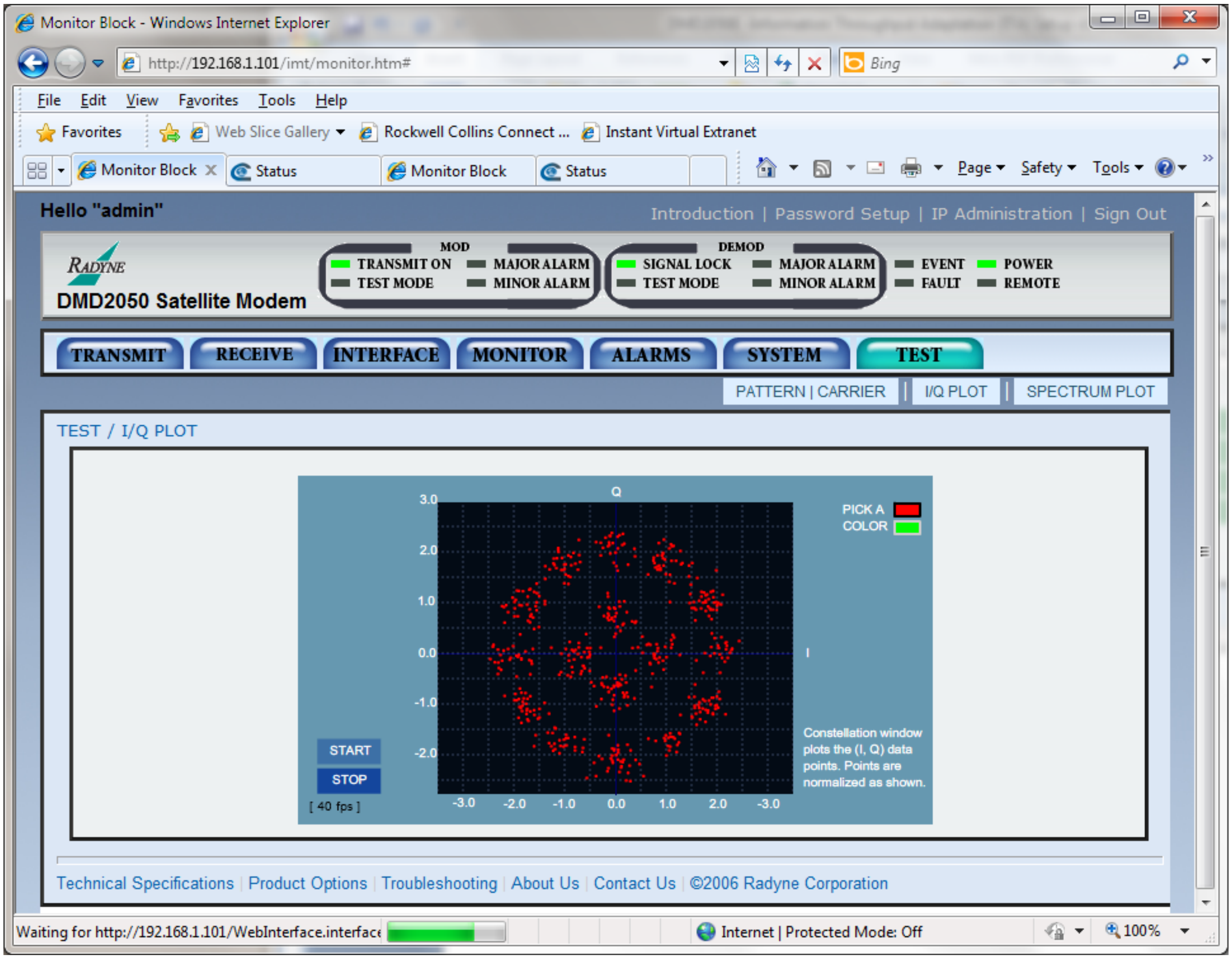

Figure J-19 –DMD2050E I/Q for 16APSK 7/8

At this point changing the noise source level will dynamically change the selected waveforms. You can simulate fades by attenuating the receive signal to the system.

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- RSA is no longer included, found in the OpenSSL library
- IDEA is no longer included, its use is deprecated
- DES is now external, in the OpenSSL library
- GMP is no longer used, and instead we call BN code from OpenSSL
- Zlib is now external, in a library
- The make-ssh-known-hosts script is no longer included
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- MD5 is now external, in the OpenSSL library
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*
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*
* @author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>
* @author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>
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