DMD2050

MIL-STD-188-165A Compliant Universal Satellite Modem

HIGHLIGHTS

- Standards Compliant: MIL-STD-188-165A (all modes), OM-73, IESS-308/309/310/314/315 and DVB-S per EN301-210 and EN300-421
- Standard MIL-STD-188-114 (EIA-530/RS-422) Serial Data Interface
- Interface options include Ethernet 10/100/1000 BaseT (GigE), Ethernet 10/100 BaseT (Fast Ethernet), HSSI, G.703 T1/E1-T2/E2, G.703 T1/E1-T2/E2 & T3/E3, HSSI & Ethernet 10/100 BaseT, HSSI & G.703 T1/E1-T2/E2, HSSI & G.703 T1/E1-T2/E2 & T3/E3, DVB ASI/SPI
- Ethernet Flow Control & QoS
- Integrated DoubleTalk® Carrier-in-Carrier®
- LPDC, TPC, Viterbi, Reed-Solomon, Trellis, Sequential, DVB-S FEC
- Code Configuration, Monitor and Control Features are Fully User-Programmable
- BPSK/QPSK/OQPSK/8-PSK/16-QAM
- 2.4 Kbps to 52 Mbps
- Optional DVB per EN301-210 and EN300-421
- 70 ±18 MHz and 140 ± 36 MHz IF, and 1350 ± 400 MHz and 1500 ± 500 L-Band in 1 Hz Steps
- Drop and Insert (G.703 Interface)
- IDR, IBS
- DC Input Power 48 VDC option
- High-Stability Reference
- Asynchronous Overhead
- Automatic Uplink Power Control

OVERVIEW

Comtech EF Data's DMD2050 Satellite Modem is designed to comply with the widest possible range of U.S. Government and commercial standards and is compatible with a largest number of satellite modems in the industry. It is fully compliant with MIL-STD-188-165A (all terminal types) as the IESS-308, IESS-309, IESS-310 IESS–315 & DVB-S commercial standards.

The DMD2050 provides highly advanced and bandwidth-efficient forward error correction (FEC). Advanced FEC options include Turbo Product Codes (TPCs) and Low Density Parity Check (LDPC). Legacy support for Viterbi, Trellis, Concatenated Viterbi Reed-Solomon, and Sequential FEC are also included. A complete range of modulation types is supported including BPSK, QPSK, OQPSK, 8-PSK, 8-QAM, and 16-QAM.

Advanced FEC and modulation capabilities are 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
- Maximize throughput without using additional transponder resources
- Maximize availability (margin) without using additional transponder resources
- Enable use of a smaller BUC/HPA and/or antenna
- Or, a combination of the above to meet specific mission needs

Data rates range from 2.4 kbps to 52 Mbps and symbol rates from 4.8 ksps to 30 Msps.

The modem provides a standard MIL-STD-188-114 (EIA-530 / RS-422), serial interface. It can optionally be configured with EIA-613 (HSSI), G.703 (T1/E1/T2/E2 & T3/E3), DVB ASI/SPI and 10/100/1000 BaseT Ethernet Interfaces. Drop & Insert functionality is supported on the G.703 interface.

A dual IF interface supports low IF (52-88, 104-176 MHz), and L-band (950-2000 MHz) frequency ranges.

Cost-effective, ultra-high reliable systems are enabled in conjunction with the RCS-11 1:1 redundancy switch, and/or the RCS-20 M:N redundancy switch.

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DMD2050 MIL-STD-188-165A Compliant Universal Satellite Modem

Compatibility

The DMD2050 is interoperable with the DMD20, DMD50, DMD15/15L SLM-5650/5650A, SLM-8650, SLM-7650, SLM-3650/3650A, SDM-300/300A, CLM-9600, CDM-625, CDM-600/600L, CDM-570/570L, CDM-700, CDM-Qx, and OM 73 satellite modems.

The DMD2050 is compatible with competing modems that are compliant with MIL-STD-188-165A and/or open network IESS-308/-309-310.

DoubleTalk Carrier-in-Carrier

DoubleTalk Carrier-in-Carrier, based on patented "Adaptive Cancellation" technology, allows transmit and receive carriers of a duplex link to share the same transponder space.

Figure 1 shows the typical full duplex satellite link, where the two carriers are adjacent to each other. Figure 2 shows the typical DoubleTalk Carrier-in-Carrier operation, where the two carriers are overlapping, thus sharing the same spectrum.

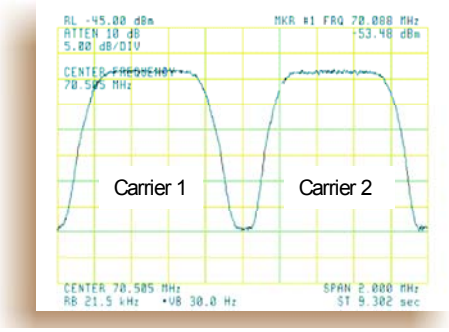


Figure 1. Typical Duplex Link

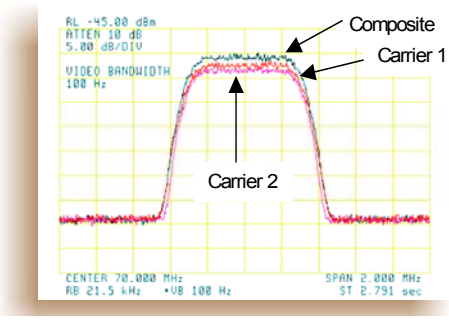


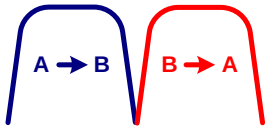
Figure 2. Duplex Link with DoubleTalk Carrier-in-Carrier

DoubleTalk Carrier-in-Carrier is complementary to all advances in modem technology, including advanced FEC and modulation techniques. As these technologies approach theoretical limits of power and bandwidth efficiency, DoubleTalk Carrier-in-Carrier utilizes advanced signal processing techniques to provide a new dimension in bandwidth and power efficiency.

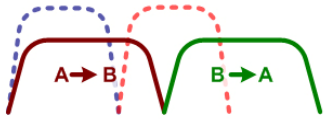
DoubleTalk Carrier-in-Carrier can be used to save transponder bandwidth and/or transponder power thereby allowing successful deployment in bandwidth-limited as well as power-limited scenarios.

The following example illustrates the typical process for implementing DoubleTalk Carrier-in-Carrier in a power-limited scenario:

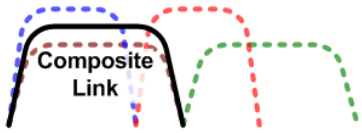
The conventional link is using 8-PSK, TPC 3/4:



Switching to LDPC and using a lower code rate – for example 8-QAM, LDPC 2/3 increases the total transponder bandwidth, while reducing the total transponder power:



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



Redundancy

Ultra high reliability redundant configurations are supported in conjunction with Comtech EF Data's RCS-11 RCS-20 redundancy switches. The RCS-11 can be configured to support 1:1 redundancy for any DMD-2050 configuration. The RCS-20 provides the same functionality for M:N redundant system architectures.

Flow Control & QoS

Pause Frame flow control is supported on the Ethernet interfaces. QoS is also supported, with both strict priority and fair weighted queueing options.

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Modulator

Modulation:	BPSK, QPSK, OQPSK, 8-PSK, 8-QAM and 16-QAM
IF Tuning Range:	70 ±18 MHz and 140 ±36 MHz in 1 Hz Steps
L-Band Tuning Range:	1350 ±400 MHz and 1500 ± 500 MHz in 1Hz Steps
Impedance:	IF: 50 Ohm (75 Ohm Optional) L-Band: 50 Ohm
Connector:	TNC: 50 Ohm SMA: 50 Ohm, L-Band
VSWR	IF < 1.5:1, L-Band < 2.0:1
Output Power:	0 to -25 dBm
Output Stability:	IF: ±0.5 dB Over Frequency and Temperature L-Band: ±.5 dB Over Frequency and Temperature
Output Spectrum:	Selectable and Meets MIL-188-165A or IESS 308/309/310 Power Spectral Mask (DVB-S Optional)
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, K = 7: 1/2, 3/4 and 7/8 Trellis: 2 /3 Turbo Product Code (Optional) BPSK 5/16, 21/44 QPSK/OQPSK 21/44, 3/4, 7/8 8-PSK/16-QAM 3/4, 7/8 LDPC (Optional) BPSK: 1/2 QPSK/OQPSK: 1/2, 2/3, 3/4 8-PSK/8-QAM: 2/3, 3/4 16-QAM: 3/4
Outer Encoder	Reed-Solomon INTELSAT (DVB Optional) Custom (N, K) Reed-Solomon (Optional)
Data Clock Source:	Internal, External, Rx Recovered
Internal Stability:	5 x 10^{-8}

Demodulator

Demodulation:	BPSK, QPSK, OQPSK, 8-PSK, 8-QAM and 16-QAM
IF Tuning Range:	70 ±18 MHz and 140 ±36 MHz in 1 Hz Steps
L-Band Tuning Range:	1350 ± 400 MHz and 1500 ± 500 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
VSWR:	IF < 1.5:1, L-Band < 2.0:1
Spectrum:	Selectable and Meets MIL-188-165A or Intelsat IESS 308/309/310 Compliant
Input Level:	-55 to +10 dBm
Total Input Power:	+20 dBm or +40 dBc (the lesser)
FEC:	Viterbi, K = 7: 1/2, 3/4 and 7/8 Trellis: 2 /3 Turbo Product Code (Optional) BPSK 5/16, 21/44 QPSK/OQPSK 21/44, 3/4, 7/8 8-PSK/16-QAM 3/4, 7/8 LDPC (Optional) BPSK: 1/2 QPSK/OQPSK: 1/2, 2/3, 3/4 8-PSK/8-QAM: 2/3, 3/4 1-6QAM: 3/4
Outer Decoder Options:	Reed-Solomon INTELSAT (DVB-S Optional) Custom (N, K) Reed-Solomon (Optional)
Descrambler:	OM-73, CCITT V.35 or IBS
Acquisition Range:	Programmable ±1 kHz to ±255 kHz
Reacquisition Range:	Programmable ±1 Hz to 25 kHz
Sweep Delay Value:	100 ms to 9000 seconds in 100 ms Steps

Plesiochronous Buffer

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

Monitor and Control

Ethernet 10 BaseT/Remote RS-485/Terminal RS-232, Web Browser

Terrestrial Interfaces

Standard Interface:	MIL-STD-188-114 (EIA-530/RS-422)
Optional Interfaces:	Ethernet 10/100/1000 BaseT (GigE) Ethernet 10/100 BaseT (Fast Ethernet) HSSI G.703 T1/E1-T2/E2 G.703 T1/E1-T2/E2 & T3/E3 HSSI & Ethernet 10/100 BaseT HSSI & G.703 T1/E1-T2/E2 HSSI & G.703 T1/E1-T2/E2 & T3/E3 DVB ASI/SPI

DMD2050 Drop and Insert

Terrestrial Data:	1.544 Mbps or 2.048 Mbps, G.732/733
Line Coding:	AMI or B8ZS for T1 and HDB3 for E1
Framing:	D4, ESF and PCM30 (PCM 30C) or PCM31 (PCM 31C) for E1
Time Slot Selection:	n x 64 contiguous or arbitrary blocks for Drop or Insert
D&I Open Network Satellite Overhead 6.6%	
Time Slots:	TS1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, 30, 31
EFFICIENT D&I Closed Network, Satellite Overhead 0.4%	
Time Slots:	1-31 Any Combination

IDR/ESC Interface

G.703 T1 (DSX1):	1.544 Mbps, 100 Ohm Balanced, AMI and B8ZS
G.703 E1:	2.048 Mbps, 75 Ohm Unbalanced and 120 Ohm Balanced, HDB3
G.703 T2 (DSX2):	6.312 Mbps, 75 Ohm Unbalanced and 110 Ohm Balanced, B8ZS and B6ZS
G.703 E2:	.448 Mbps, 75 Ohm BNC, Unbalanced, HDB3

IBS/Synchronous Interface

MIL-188-144A:	All Rates, Differential, Clock/Data, DCE
RS-232:	(DCE up to 200 Kbps)

Environmental

Prime Power:	100 to 240 VAC, 50 to 60 Hz, 40 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

Physical

Size:	19" Wide x 19.25" Deep x 1.75" High (48.26 cm x 48.89 cm x 4.45 cm)
Weight:	8.0 lbs. (3.64 kg)

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Available Options

How Enabled	Option
FAST	Data Rates to 20, 52 Mbps
FAST	8-PSK, 8-QAM, 16-QAM, 16-APSK
Hardware / FAST	TPC to 20, 52 Mbps
Hardware / FAST	LDPC to 20 Mbps
Hardware / FAST	DoubleTalk Carrier-in-Carrier: 512 kbps – 52 Mbps
FAST	G.703 Drop & Insert
FAST	IBS & IDR
FAST	Sequential FEC
FAST	DVB-S
FAST	AES-256 TRANSEC
Hardware	10/100/1000 BaseT Gigabit Ethernet Interface
Hardware	10/100 BaseT Fasst Ethernet Interface
Hardware	HSSI Interface
Hardware	G.703 Data Interface
Hardware	ASI/SPI Data Interface
Hardware	-48 VDC Prime Power Option

BER PERFORMANCE

Example Modes and Performance

Mod / FEC	Code Rate	Eb/No Guaranteed (Typical)				Data Rate Range [kbps]
		10^{-5}	10^{-6}	10^{-7}	10^{-8}	
Legacy Modes						
BPSK VIT	1/2	5.5 (5.1)	6.1 (5.7)	6.7 (6.2)	7.4 (6.8)	2.4 – 14,100
QPSK VIT	1/2	5.5 (5.1)	6.1 (5.7)	6.7 (6.2)	7.4 (6.8)	4.8 – 28,300
QPSK VIT	3/4	6.8 (6.3)	7.6 (7.0)	8.3 (7.7)	8.9 (8.4)	7.2 – 42,400
QPSK VIT	7/8	7.9 (7.2)	8.6 (7.9)	9.3 (8.6)	10.2 (9.4)	8.4 – 49,500s
QPSK VIT R-S	1/2	3.8 (3.4)	4.1 (3.6)	4.2 (3.8)	4.4 (4.0)	4.8 – 25,100
QPSK VIT R-S	3/4	5.4 (4.7)	5.6 (4.9)	5.8 (5.1)	6.0 (5.3)	7.2 – 37,700
QPSK VIT R-S	7/8	6.5 (6.0)	6.7 (6.4)	6.9 (6.7)	7.2 (7.1)	7.8 – 44,000
QPSK SEQ	1/2	5.6 (5.1)	5.9 (5.4)	6.3 (5.8)	6.7 (6.2)	4.8 – 2,048
QPSK SEQ	3/4	6.1 (5.6)	6.5 (6.1)	7.0 (6.5)	7.4 (6.9)	7.2 – 2,048
QPSK SEQ	7/8	6.9 (6.4)	7.4 (6.9)	7.9 (7.4)	8.4 (7.9)	8.4 - 2,048
8-PSK TRE	2/3	8.2 (6.4)	9.0 (7.2)	9.8 (8.1)	10.4 (8.9)	9.6 – 52,000
8-PSK TRE R-S	2/3	6.3 (5.4)	6.5 (5.6)	6.7 (5.8)	6.9 (6.1	8.9 – 52,000
TPC Modes						
BPSK TPC	5/16	2.5 (2.3)	2.7 (2.5)	2.9 (2.7)	3.1 (2.9)	2.4 – 8,844
BPSK TPC	21/44	2.7 (2.4)	2.9 (2.6)	3.1 (2.8)	3.3 (3.0)	2.4 – 13.506
QPSK TPC	21/44	2.7 (2.4)	2.9 (2.6)	3.1 (2.8)	3.3 (3.0)	4.8 – 20,000
QPSK TPC	3/4	3.6 (3.2)	3.8 (3.4)	4.1 (3.7)	4.4 (4.0)	7.2 – 20,000
QPSK TPC	7/8	4.2 (3.9)	4.3 (4.0)	4.4 (4.1)	4.5 (4.2)	8.4 – 20,000
8-PSK TPC	3/4	6.0 (5.6)	6.3 (5.8)	6.5 (6.0)	6.7 (6.3)	10.8 – 20,000
		7.1 (6.7)	7.2 (6.8)	7.3 (6.9)	7.4 (7.0)	20,000 – 52,000
8-PSK TPC	7/8	6.9 (6.5)	7.0 (6.6)	7.1 (6.7)	7.2 (6.8)	12.6 – 20,000
		7.3 (6.9)	7.4 (7.0)	7.5 (7.1)	7.6 (7.2)	20,000 – 52,000
16-QAM TPC	3/4	7.0 (6.7)	7.4 (7.1)	7.8 (7.5)	8.2 (7.9)	14.4 – 20,000
		7.5 (7.1)	7.7 (7.4)	7.9 (7.6)	8.3 (8.0)	20,000 – 52,000
16-QAM TPC	7/8	8.0 (7.6)	8.1 (7.7)	8.2 (7.8)	8.3 (7.9)	16.84 – 20,000
LDPC Modes						
BPSK LDPC	1/2	2.0 (1.7)	2.1 (1.8)	2.2 (1.9)	2.3 (2.0)	2.4 – 13.506
QPSK LDPC	1/2	2.0 (1.7)	2.1 (1.8)	2.2 (1.9)	2.3 (2.0)	4.8 – 20,000
QPSK LDPC	2/3	2.3 (2.0)	2.4 (2.1)	25(2.2)	2.6 (23)	6.4 – 20,000
QPSK LDPC	3/4	3.0 (2.6)	3.1 (2.7)	3.2 (2.8)	3.3 (3.0)	7.2 – 20,000
8-QAM LDPC	2/3	4.6 (4.2)	4.7 (4.3)	4.8 (4.4)	4.9 (4.5)	9.6 – 20,000
8-QAM LDPC	3/4	5.6 (5.2)	5.7 (5.3)	5.8 (5.4)	5.9 (5.5)	10.8 – 20,000
16-QAM LDPC	3/4	6.8 (6.2)	6.9 (6.4)	7.0 (6.6)	7.1 (6.8)	14.4 – 20,000

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