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

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 the largest number of satellite modems in the industry. It is fully compliant with MIL-STD-188-165A (all terminal types) and 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

Typical Users

- Government & Military

Common Applications

- Communications at-the-Pause
- Flyaway Communications
- Integrated Satellite Terminal Communications

Data rates range from 2.4 kbps to 52 Mbps and symbol rates range 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 10/100/1000Base-T 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.

Features

- 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 10/100/1000Base-T (GigE), Ethernet 10/100Base-T (Fast Ethernet), HSSI, G.703 T1/E1-T2/E2, G.703 T1/E1-T2/E2 & T3/E3, HSSI & Ethernet 10/100Base-T, HSSI & G.703 T1/E1-T2/E2, HSSI & G.703 T1/E1-T2/E2 & T3/E3, DVB ASI/SPI
- Ethernet flow control & Quality of Service (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 (AUPC)

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 is based on patented bandwidth compression technology originally developed by Applied Signal Technology, Inc. Using “Adaptive Cancellation” it allows transmit and receive carriers of a two-way 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.

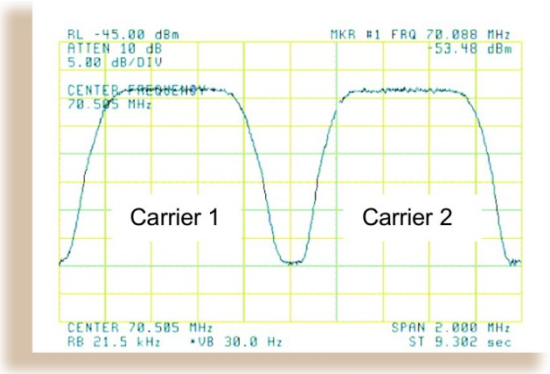


Figure 1

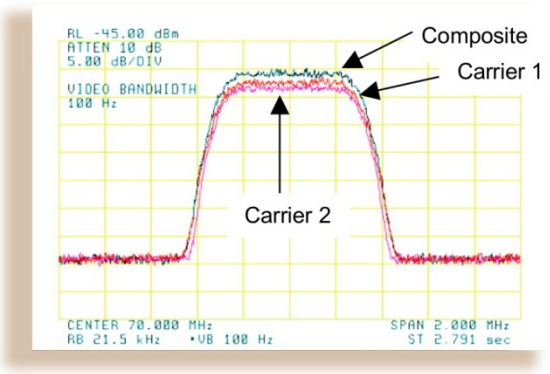


Figure 2

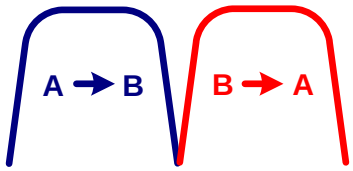
When observed on a spectrum analyzer, only the Composite is visible. Carrier 1 and Carrier 2 are shown in Figure 2 for reference only.

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 efficiencies, DoubleTalk Carrier-in-Carrier utilizing advanced signal processing techniques provides a new dimension in bandwidth efficiency.

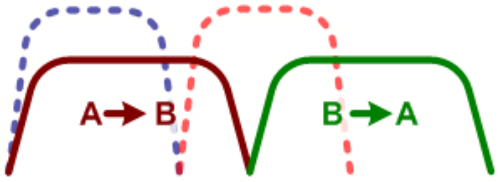
DoubleTalk Carrier-in-Carrier allows satellite users to achieve spectral efficiencies (i.e. bps/Hz) that cannot be achieved with traditional links. For example, DoubleTalk Carrier-in-Carrier when used with 16-QAM approaches the bandwidth efficiency of 256-QAM (8bps/Hz). As DoubleTalk Carrier-in-Carrier allows equivalent spectral efficiency using a lower order Modulation and/or FEC Code, it can simultaneously reduce CAPEX by allowing a smaller BUC/HPA and/or antenna.

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:

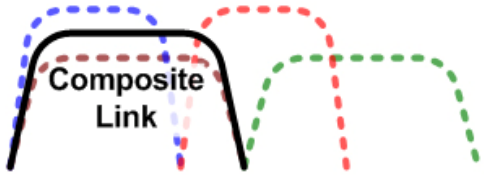
The conventional link is using 8-PSK, TPC 3/4:



Spread the signal by switching to a lower order modulation and/or FEC code – say QPSK, TPC 7/8. This increases the total transponder bandwidth, while reducing the total transponder power:



Now using DoubleTalk Carrier-in-Carrier, the second QPSK, TPC 7/8 carrier can be moved over the first carrier – thereby 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 and 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 queuing options.

Specifications

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 16-QAM: 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 10Base-T/Remote RS-485/Terminal RS-232, Web browser

Terrestrial Interfaces

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

Prime Power	100 to 240 VAC, 50 to 60 Hz, 40 W maximum 48 VDC (optional)
Operating Temperature	-10°to +60°C, 95% humidity, non-condensing
Storage Temperature	-20 to 70°C, 99% humidity, non-condensing
Dimensions (height x width x depth)	1.75" x 19" x 19.25" (4.45 x 48.26 x 48.89 cm)
Weight	8.0 lbs (3.64 kg)

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
Hardware	10/100/1000Base-T Gigabit Ethernet interface
Hardware	10/100Base-T Fast 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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