DMD2050E MIL-STD-188-165A/STANAG 4486 Edition 3 Compliant Universal Satellite Modem

Satellite Modems

Overview

The DMD2050E 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), fully complies with STANAG 4486 Edition 3, as well as the IESS-308, IESS-309, IESS-310 & IESS–315 commercial standards.

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 is supported including BPSK, QPSK, OQPSK, 8PSK, 8-QAM, 16-QAM and 16APSK.

Typical Users

- Government & Military

Common Applications

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

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

The DMD2050E also supports Information Throughput Adaptation (ITA). Also referred to as Adaptive Coding and Modulation (ACM), ITA enables modems on each side of a point-to-point link to use the modulation and coding combination that maximizes throughput, and automatically adapts the optimum operating point as conditions (such as weather) change.

Data rates range from 2.4 kbps to 52 Mbps and symbol rates from 4.8 ksps to 30 Msps. The modem provides standard MIL-STD-188-114 (EIA-530 / RS-422), and EIA-613 (HSSI) serial interfaces and 10/100/1000Base-T Gigabit Ethernet interfaces. A dual IF interface supports low IF (52-88, 104-176 MHz), and L-Band (950-2000 MHz) frequency ranges.

Features

- Standards Compliance:
  - MIL-STD-188-165A (all modes)
  - STANAG 4486 Edition 3
  - OM-73
  - IESS-308/309/310/314/315
- Standard Data Interfaces
  - MIL-STD-188-114 (EIA-530)
  - EIA-613 (HSSI)
  - Ethernet 10/100/1000Base-T (GigE)
- Serial / Ethernet multiplexing capability
- AES-256 TRANSEC, FIPS-140-2 L2 certified
- Key Loader Interface
- Ethernet Flow Control & Quality of Service (QoS)
- Integrated DoubleTalk Carrier-in-Carrier
- LDPC, TPC, 165B Turbo, Viterbi, Reed Solomon, Trellis & Sequential FEC
- FEC rates 1/1, 5/16, 1/2, 2/3, 3/4, 7/8, 19/20 and others
- BPSK, QPSK, OQPSK, 8PSK, 8-QAM, 16-QAM, 16APSK
- Information Throughput Adaption (ITA)
- 2.4 kbps to 52 Mbps
- 70 ± 18 MHz and 140 ± 36 MHz IF, and 950 – 2000 MHz L-Band in 1 Hz steps
- DC input power -48 VDC option
- High-stability reference
- Asynchronous overhead
- Automatic Uplink Power Control

Compatibility

The DMD2050E is interoperable with the DMD2050, DMD20, DMD50, DMD1050, SLM-5650/5650A, CDM-625, CDM-600/600L, CDM-570/570L, as well as many other Comtech satellite modems. It is also compatible with modems from other vendors that are compliant with MIL-STD-188-165A/B or IESS-308/309/310 open standards.

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.

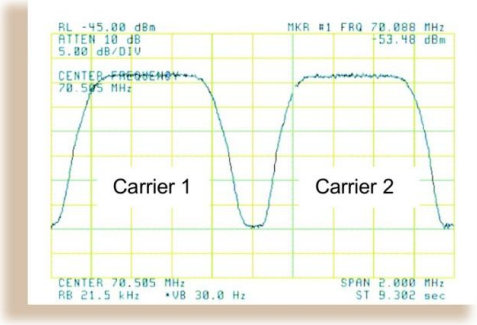


Figure 1

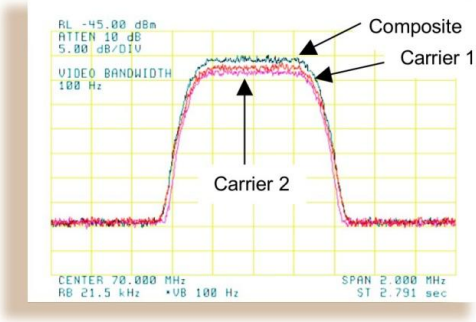


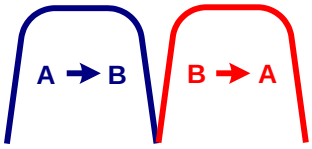
Figure 2

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.

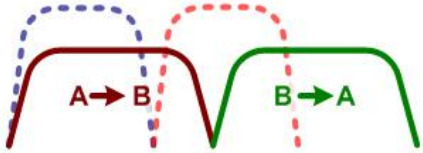
DoubleTalk Carrier-in-Carrier can be used to save transponder bandwidth and/or transponder power thereby allowing successful deployment in bandwidth-limited as well as power-limited scenarios.

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

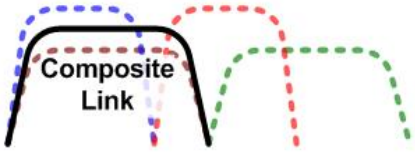
The conventional link is using 8PSK, TPC 3/4:



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 our RCS-11 and RCS-20 redundancy switches. The RCS-11 can be configured to support 1:1 redundancy for any DMD-2050E configuration. The RCS-20 provides the same functionality for M:N redundant system architectures.

TRANSEC / Key Loader

A transmission security (TRANSEC) module provides bulk AES-256 encryption/decryption in accordance with STANAG 4486 Edition 3 and the Federal Information Processing Standards (FIPS)-140-2 Level 2 specifications. A key loader interface is available to reduce configuration complexity and simplify TRANSEC key management (Key Loader device is sold separately).

Flow Control & QoS

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

Information Throughput Adaption

In ITA mode, modems automatically communicate the maximum efficiency modulation and coding mode to be used by the distant end modem, maximizing throughput and link availability under all conditions. Modulation and coding changes are made seamlessly, so there is no reacquisition time or data loss when modems change parameters to maintain optimum performance.

Specifications

Modulator

Modulation	BPSK, QPSK,OQPSK,8PSK,8-QAM, 16-QAM,16APSK
IF Tuning Range	70 ± 18 MHz and 140 ± 36 MHz in 1 Hz steps
L-Band Tuning Range	950 – 2000 MHz in 1Hz steps
Impedance	IF: 50 Ohm (75 Ohm optional) L-Band: 50 Ohm
Connector	TNC: 50 Ohm (75 Ohm BNC opt.) 70/140 IF SMA: 50 Ohm, L-Band
VSWR	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: ± 0.5 dB over frequency and temp
Output Spectral Mask	Meets MIL-188-165A or IESS- 308/309/310
Spurious	-55 dBc In-band (50 -180 MHz, 950- 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 8PSK/16-QAM 3/4, 7/8 STANAG 4486 Ed. 3 Turbo Codes BPSK: 2/3, 3/4, 7/8, 19/20 QPSK: 1/2, 2/3, 3/4, 7/8, 19/20 8PSK/16APSK: 1/2, 2/3, 3/4, 7/8, 19/20 LDPC (optional) BPSK: 1/2 QPSK/OQPSK: 1/2, 2/3, 3/4 8PSK/8-QAM: 2/3, 3/4 16-QAM: 3/4
Outer Encoder	Reed-Solomon Intelsat Custom (N, K) Reed-Solomon
Data Clock Source	Internal, external, RX recovered
Internal Stability	5×10^{-8} (0.05 ppm)

Demodulator

Demodulation	BPSK, QPSK,OQPSK,8PSK,8-QAM, 16-QAM, 16APSK
IF Tuning Range	70 ± 18 MHz and 140 ± 36 MHz in 1 Hz steps
L-Band Tuning Range	950 – 2000 MHz in 1Hz steps
Impedance	IF: 50 Ohm (75 Ohm optional) L-Band: 50 Ohm
Connector	TNC: 50 Ohm, (75 Ohm BNC optional) SMA: 50 Ohm, L-Band
VSWR	IF < 1.5:1, L-Band < 2.0:1
Output Spectral Mask	Meets MIL-188-165A or IESS- 308/309/310
Input Level	+10 to -55 dBm symbol rate (SR) > 3.2 Msps +10 to -55 -10log10(3.2/SR), < 3.2 Msps
Total Input Power	+20 dBm or +40 dBc (the lesser)
FEC	Same as modulator
Outer Decoder Options	Reed-Solomon Intelsat 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
Clock	Transmit, external, RX recovered or SCT (internal)

Monitor and Control

Ethernet 10Base-T/Remote RS-485/Terminal RS-232
Web browser, menu driven command line interface, SNMPv2

Terrestrial Interfaces

Standard Interfaces	MIL-STD-188-114 (EIA-530/RS-422) EIA-613 (HSSI) Ethernet 10/100/1000Base-T (GigE)

Environmental & Physical

Prime Power	100 to 240 VAC, 50 to 60 Hz, <120W maximum -48 VDC (optional)
Operating Temperature	-10 to +60°C
Storage Temperature	-40 to 85°C
Humidity	95% maximum, 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	10.0 lbs (4.5 kg)

Available Options

How Enabled	Option
FAST	DoubleTalk Carrier-in-Carrier
FAST	TPC FEC
FAST	Sequential, TPC, & LDPC FEC
Hardware	BNC or TNC 70/140 MHz IF Connectors
FAST	Key Loader Firmware
Hardware	Key Loader Device (separate unit)
Hardware	-48 VDC prime power

Key Loader Device

Example Modes and Performance

Mod / FEC	Code Rate	BW Eff. (bit/sym)	Eb/No Guaranteed (Typical)				Data Rate Range (kbps)
			10^{-5}	10^{-6}	10^{-7}	10^{-8}	
Legacy Modes							
BPSK VIT	1/2	0.50	5.5 (5.1)	6.1 (5.7)	6.7 (6.2)	7.4 (6.8)	2.4 – 14,100
QPSK VIT	1/2	1.00	5.5 (5.1)	6.1 (5.7)	6.7 (6.2)	7.4 (6.8)	4.8 – 28,300
QPSK VIT	3/4	1.50	6.8 (6.3)	7.6 (7.0)	8.3 (7.7)	8.9 (8.4)	7.2 – 42,400
QPSK VIT	7/8	1.75	7.9 (7.2)	8.6 (7.9)	9.3 (8.6)	10.2 (9.4)	8.4 – 49,500
QPSK VIT R-S	1/2	0.92	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	1.38	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	1.61	6.5 (6.0)	6.7 (6.4)	6.9 (6.7)	7.2 (7.1)	7.8 – 44,000
QPSK SEQ	1/2	1.00	5.6 (5.1)	5.9 (5.4)	6.3 (5.8)	6.7 (6.2)	4.8 – 2,048
QPSK SEQ	3/4	1.50	6.1 (5.6)	6.5 (6.1)	7.0 (6.5)	7.4 (6.9)	7.2 – 2,048
QPSK SEQ	7/8	1.75	6.9 (6.4)	7.4 (6.9)	7.9 (7.4)	8.4 (7.9)	8.4 - 2,048
8PSK TRE	2/3	2.00	8.2 (6.4)	9.0 (7.2)	9.8 (8.1)	10.4 (8.9)	9.6 – 52,000
8PSK TRE R-S	2/3	1.84	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	0.31	2.5 (2.3)	2.7 (2.5)	2.9 (2.7)	3.1 (2.9)	2.4 – 3,125
BPSK TPC	21/44	0.48	2.7 (2.4)	2.9 (2.6)	3.1 (2.8)	3.3 (3.0)	2.4 – 4,773
QPSK TPC	21/44	0.95	2.7 (2.4)	2.9 (2.6)	3.1 (2.8)	3.3 (3.0)	4.3 – 9,545
QPSK TPC	3/4	1.50	3.6 (3.2)	3.8 (3.4)	4.1 (3.7)	4.4 (4.0)	6.7 – 15,000
QPSK TPC	7/8	1.75	4.2 (3.9)	4.3 (4.0)	4.4 (4.1)	4.5 (4.2)	7.8 – 17,500
8PSK TPC	3/4	2.25	6.0 (5.6)	6.3 (5.8)	6.5 (6.0)	6.7 (6.3)	10.0 – 20,000
8PSK TPC	7/8	2.63	6.9 (6.5)	7.0 (6.6)	7.1 (6.7)	7.2 (6.8)	11.6 – 20,000
16-QAM TPC	3/4	3.00	7.0 (6.7)	7.4 (7.1)	7.8 (7.5)	8.2 (7.9)	13.3 – 20,000
16-QAM TPC	7/8	3.50	8.0 (7.6)	8.1 (7.7)	8.2 (7.8)	8.3 (7.9)	15.5 – 20,000
STANAG 4486 Edition 3 Turbo Modes							
BPSK 4486 Turbo	2/3	0.656	2.6 (2.2)	2.65 (2.25)	2.7 (2.3)	2.8 (2.4)	64 – 19,861
BPSK 4486 Turbo	3/4	0.737	3.1 (2.7)	3.15 (2.75)	3.2 (2.8)	3.3 (2.9)	64 – 22,331
BPSK 4486 Turbo	7/8	0.860	4.2 (3.8)	4.3 (3.9)	4.4 (4.0)	4.5 (4.1)	64 – 26,032
BPSK 4486 Turbo	19/20	0.933	5.9 (5.5)	6.0 (5.6)	6.2 (5.7)	6.2 (5.8)	64 – 28,250
QPSK 4486 Turbo	1/2	0.982	1.8 (1.4)	1.9 (1.5)	2.0 (1.6)	2.1 (1.7)	64 – 29,731
QPSK 4486 Turbo	2/3	1.307	2.6 (2.2)	2.7 (2.3)	2.8 (2.4)	2.9 (2.5)	64 – 39,561
QPSK 4486 Turbo	3/4	1.464	3.4 (3.0)	3.5 (3.1)	3.6 (3.2)	3.7 (3.3)	64 – 44,456
QPSK 4486 Turbo	7/8	1.710	4.0 (3.6)	4.1 (3.7)	4.2 (3.8)	4.3 (3.9)	64 – 51,784
QPSK 4486 Turbo	19/20	1.856	5.9 (5.5)	6.0 (5.6)	6.1 (5.7)	6.2 (5.8)	64 – 52,000
8PSK 4486 Turbo	1/2	1.468	3.5 (3.1)	3.6 (3.2)	3.7 (3.3)	3.9 (3.5)	256 – 44,456
8PSK 4486 Turbo	2/3	1.953	5.0 (4.6)	5.1 (4.7)	5.2 (4.8)	5.3 (4.9)	256 – 52,000
8PSK 4486 Turbo	3/4	2.192	6.0 (5.6)	6.1 (5.7)	6.2 (5.8)	6.3 (5.9)	256 – 52,000
8PSK 4486 Turbo	7/8	2.551	7.2 (6.8)	7.3 (6.9)	7.5 (7.1)	7.9 (7.5)	256 – 52,000
8PSK 4486 Turbo	19/20	2.767	9.5 (9.1)	9.6 (9.2)	9.7 (9.3)	9.8 (9.4)	256 – 52,000
16APSK 4486 Turbo	1/2	1.953	4.7 (4.3)	4.9 (4.4)	4.9 (4.5)	5.0 (4.6)	256 – 52,000
16APSK 4486 Turbo	2/3	2.593	6.5 (6.0)	6.6 (6.1)	6.7 (6.2)	6.7 (6.3)	256 – 52,000
16APSK 4486 Turbo	3/4	2.910	7.4 (7.0)	7.5 (7.1)	7.6 (7.3)	7.7 (7.3)	256 – 52,000
16APSK 4486 Turbo	7/8	3.382	8.5 (8.4)	8.7 (8.5)	8.8 (8.6)	8.9 (8.7)	256 – 52,000
16APSK 4486 Turbo	19/20	3.670	10.5 (10.2)	10.7 (10.4)	10.8 (10.5)	10.9 (10.6)	256 – 52,000
LDPC Modes							
BPSK LDPC	1/2	0.50	2.0 (1.7)	2.1 (1.8)	2.2 (1.9)	2.3 (2.0)	2.4 – 14,100
QPSK LDPC	1/2	1.00	2.0 (1.7)	2.1 (1.8)	2.2 (1.9)	2.3 (2.0)	4.8 – 20,000
QPSK LDPC	2/3	1.33	2.3 (2.0)	2.4 (2.1)	2.5 (2.2)	2.6 (2.3)	6.4 – 20,000
QPSK LDPC	3/4	1.50	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	2.00	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	2.25	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	3.00	6.8 (6.2)	6.9 (6.4)	7.0 (6.6)	7.1 (6.8)	14.4 – 20,000