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, 8PSK, 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 range from 4.8 kbps 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 optional 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/8PSK/16-QAM
- 2.4 kbps to 52 Mbps
- 70 ±18 MHz and 140 ± 36 MHz IF, and 950 to 2050 MHz 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 (AU PC)
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.

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 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, 8PSK, 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

**Output Power**
- 0 to -25 dBm

**Output Stability**
- IF: ±0.5 dB over frequency and temperature

**Output Spectrum**
- Selectable and meets MIL-188-165A or IESS-308/309/310 power spectral mask (DV/B-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
- QPSK/OQPSK
- 21/44, 3/4, 7/8
- 8PSK/16-QAM
- 3/4, 7/8
- LDPC (optional)
- BPSK
- QPSK/OQPSK
- 1/2
- QPSK/8-QAM: 2/3, 3/4
- 16-QAM: 3/4

**Outer Encoder**
- Reed-Salomon: Intelsat, DVB, Custom (N, K)

**Data Clock Source**
- Internal, external, RX recovered

**Demodulator**
- BPSK, QPSK, OQPSK, 8PSK, 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
- QPSK/OQPSK
- 21/44, 3/4, 7/8
- 8PSK/16-QAM
- 3/4, 7/8
- LDPC (optional)
- BPSK
- QPSK/OQPSK
- 1/2
- QPSK/8-QAM: 2/3, 3/4
- 16-QAM: 3/4

**Outer Decoder Options**
- Reed-Salomon: Intelsat, DVB, Custom (N, K)

**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

**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 B625 for T1 and HDB3 for E1
- Framing: DS, ESS 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: 1-31 Any combination

**IDR/ESC Interface**
- G.703 T1 (DSX1): 1.544 Mbps, 100 Ohm balanced, AMI and B625
- 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, B625 and B625
- G.703 E2: 8.448 Mbps, 75 Ohm BNC, unbalanced, HDB3
- G.703 E3: 34.368 Mbps, 75 Ohm BNC, unbalanced, HDB3

**IBS/Synchronous Interface**
- MIL-188-114A: 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: 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**

<table>
<thead>
<tr>
<th>How Enabled</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAST</td>
<td>Data rates to 20, 52 Mbps</td>
</tr>
<tr>
<td>FAST</td>
<td>8PSK, 8-QAM, 16-QAM</td>
</tr>
<tr>
<td>Hardware / FAST</td>
<td>TPC to 20, 52 Mbps</td>
</tr>
<tr>
<td>Hardware / FAST</td>
<td>LDPC to 20 Mbps</td>
</tr>
<tr>
<td>Hardware / FAST</td>
<td>DoubleTalk Carrier-in-Carrier: 512 kbps – 52 Mbps</td>
</tr>
<tr>
<td>FAST</td>
<td>G.703 drop &amp; insert</td>
</tr>
<tr>
<td>FAST</td>
<td>IBS &amp; IDR</td>
</tr>
<tr>
<td>FAST</td>
<td>Sequential FEC</td>
</tr>
<tr>
<td>FAST</td>
<td>DVB-S</td>
</tr>
<tr>
<td>Hardware</td>
<td>10/100/1000Base-T Gigabit Ethernet interface</td>
</tr>
<tr>
<td>Hardware</td>
<td>10/100Base-T Fast Ethernet interface</td>
</tr>
<tr>
<td>Hardware</td>
<td>HSSI interface</td>
</tr>
<tr>
<td>Hardware</td>
<td>G.703 Data interface</td>
</tr>
<tr>
<td>Hardware</td>
<td>ASI/SPI Data interface</td>
</tr>
<tr>
<td>Hardware</td>
<td>48 VDC prime power option</td>
</tr>
</tbody>
</table>
BER Performance

Example Modes and Performance

<table>
<thead>
<tr>
<th>Mod / FEC</th>
<th>Code Rate</th>
<th>Eb/No Guaranteed (Typical)</th>
<th>Data Rate Range [kbps]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>10&lt;sup&gt;-2&lt;/sup&gt;</td>
<td>10&lt;sup&gt;-3&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Legacy Modes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPSK VIT</td>
<td>1/2</td>
<td>5.5 (5.1)</td>
<td>6.1 (5.7)</td>
</tr>
<tr>
<td>QPSK VIT</td>
<td>1/2</td>
<td>5.5 (5.1)</td>
<td>6.1 (5.7)</td>
</tr>
<tr>
<td>QPSK VIT</td>
<td>3/4</td>
<td>6.8 (6.3)</td>
<td>7.6 (7.0)</td>
</tr>
<tr>
<td>QPSK VIT</td>
<td>7/8</td>
<td>7.9 (7.2)</td>
<td>8.6 (7.9)</td>
</tr>
<tr>
<td>QPSK VIT R-S</td>
<td>1/2</td>
<td>3.8 (3.4)</td>
<td>4.1 (3.6)</td>
</tr>
<tr>
<td>QPSK VIT R-S</td>
<td>3/4</td>
<td>5.4 (4.7)</td>
<td>5.6 (4.9)</td>
</tr>
<tr>
<td>QPSK SEQ</td>
<td>1/2</td>
<td>5.6 (5.1)</td>
<td>5.9 (5.4)</td>
</tr>
<tr>
<td>QPSK SEQ</td>
<td>3/4</td>
<td>6.1 (5.6)</td>
<td>6.5 (6.1)</td>
</tr>
<tr>
<td>QPSK SEQ</td>
<td>7/8</td>
<td>6.9 (6.4)</td>
<td>7.4 (6.9)</td>
</tr>
<tr>
<td>8PSK TPE</td>
<td>2/3</td>
<td>8.2 (6.4)</td>
<td>9.0 (7.2)</td>
</tr>
<tr>
<td>8PSK TPE R-S</td>
<td>2/3</td>
<td>6.3 (5.4)</td>
<td>6.5 (5.6)</td>
</tr>
<tr>
<td><strong>TPC Modes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPSK TPC</td>
<td>21/44</td>
<td>2.7 (2.4)</td>
<td>2.9 (2.6)</td>
</tr>
<tr>
<td>QPSK TPC</td>
<td>21/44</td>
<td>2.7 (2.4)</td>
<td>2.9 (2.6)</td>
</tr>
<tr>
<td>QPSK TPC</td>
<td>3/4</td>
<td>3.6 (3.2)</td>
<td>3.8 (3.4)</td>
</tr>
<tr>
<td>QPSK TPC</td>
<td>7/8</td>
<td>4.2 (3.9)</td>
<td>4.3 (4.0)</td>
</tr>
<tr>
<td>8PSK TPC</td>
<td>3/4</td>
<td>6.0 (5.6)</td>
<td>6.3 (5.8)</td>
</tr>
<tr>
<td>8PSK TPC</td>
<td>7/8</td>
<td>7.1 (6.7)</td>
<td>7.2 (6.8)</td>
</tr>
<tr>
<td>16-QAM TPC</td>
<td>3/4</td>
<td>7.0 (6.7)</td>
<td>7.4 (7.0)</td>
</tr>
<tr>
<td>16-QAM TPC</td>
<td>7/8</td>
<td>8.0 (7.6)</td>
<td>8.1 (7.7)</td>
</tr>
<tr>
<td><strong>LDPC Modes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPSK LDPC</td>
<td>1/2</td>
<td>2.0 (1.7)</td>
<td>2.1 (1.8)</td>
</tr>
<tr>
<td>QPSK LDPC</td>
<td>1/2</td>
<td>2.0 (1.7)</td>
<td>2.1 (1.8)</td>
</tr>
<tr>
<td>QPSK LDPC</td>
<td>2/3</td>
<td>2.3 (2.0)</td>
<td>2.4 (2.1)</td>
</tr>
<tr>
<td>QPSK LDPC</td>
<td>3/4</td>
<td>3.0 (2.6)</td>
<td>3.1 (2.7)</td>
</tr>
<tr>
<td>8-QAM LDPC</td>
<td>2/3</td>
<td>4.6 (4.2)</td>
<td>4.7 (4.3)</td>
</tr>
<tr>
<td>8-QAM LDPC</td>
<td>3/4</td>
<td>5.6 (5.2)</td>
<td>5.7 (5.3)</td>
</tr>
<tr>
<td>16-QAM LDPC</td>
<td>3/4</td>
<td>6.8 (6.2)</td>
<td>6.9 (6.4)</td>
</tr>
</tbody>
</table>