

### Overview

The CDM-625 Advanced Satellite Modem builds on Comtech EF Data's legacy of providing the most efficient satellite modems. It is the first modem to combine advanced Forward Error Correction (FEC) such as VersaFEC® and Low Density Parity Check (LDPC) codes with the revolutionary DoubleTalk® Carrier-in-Carrier® bandwidth compression, allowing for maximum savings under all conditions. This combination of advanced technologies enables multi-dimensional optimization, allowing satellite communications users to:

- Minimize operating expenses (OPEX)
- Maximize throughput without using additional transponder resources
- Maximize availability (margin) without using additional transponder resources
- Minimize capital expenses (CAPEX) by allowing a smaller BUC/HPA and/or antenna
- Or, a combination to meet specific business needs

### Features

- DoubleTalk Carrier-in-Carrier bandwidth compression
- Adaptive Coding and Modulation (ACM)
- IP Packet Processor with header compression, payload compression and advanced Quality of Service (QoS)
- Dual Band Capability: 70/140 MHz and L-Band in same unit
- Data Rate: 18 kbps to 25 Mbps
- Symbol Rate: 18 ksp/s to 12.5 Msp/s
- Modulation: BPSK, QPSK/OQPSK, 8-PSK/8-QAM, 16-QAM
- FEC: Viterbi, Sequential, Concatenated Reed Solomon, TCM, Turbo Product Code (TPC) (IESS-315 Compliant), LDPC Code and VersaFEC (low-latency LDPC)
- Widest Range of data interfaces: EIA-422/530, V.35, G.703 T1, G.703 E1, G.703 T2, G.703 E2, Quad G.703 E1, ASI, LVDS, HSSI, 4-port 10/100Base-T Ethernet
- 4-port managed Ethernet switch with VLAN and QoS
- Sub Mux to multiplex IP/Ethernet traffic with serial or G.703 traffic
- Drop & insert for T1/E1
- Enhanced D&I++ for single T1/E1 & quad E1
- Management: 10/100Base-T Ethernet with SNMP, Distant End SNMP Proxy, HTTP, Telnet and EIA-232/EIA-485
- Embedded Distant-end Monitor and Control (EDMAC)
- Automatic Uplink Power Control (AUPC)
- Engineering Service Channel (ESC/ESC++)
- Standard high-stability internal reference ( $\pm 6 \times 10^{-8}$ )
- 5-tap Adaptive Equalizer
- L-Band TX: 10 MHz reference for BUC, FSK communications and optional BUC power supply
- L-Band: Advanced FSK for LPOD M&C
- L-Band RX: 10 MHz reference and LNB power supply
- Open network modes
- CDM-600/L emulation mode
- 1:1 and 1:10 redundancy switches available
- Backwards compatible with CDM-500/CDM-550, CDM-550T, CDM-570/L and CDM-600/L Satellite Modems
- Interoperable with many Comtech EF Data Satellite Modems: CDM-Qx/L, SDM-8000, 300A, and 300L3

### 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.

### Typical Users

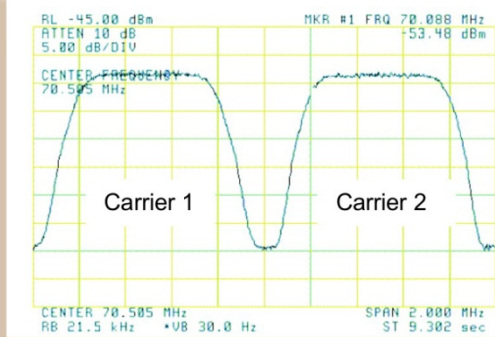
- Mobile Operators
- Telecom Operators
- Satellite Service Providers
- Government & Military
- Enterprise
- Offshore

### Common Applications

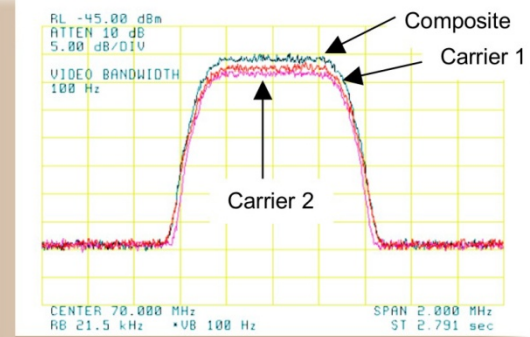
- Mobile Backhaul
- G.703 Trunking
- IP Trunking
- Offshore & Maritime Communications
- Enterprise
- Communications on-the-Move
- Satellite News Gathering

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.

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. Alternatively, DoubleTalk Carrier-in-Carrier can be used to achieve very high spectral efficiencies E.g., DoubleTalk Carrier-in-Carrier when used with 16-QAM approaches the bandwidth efficiency of 256-QAM (8 bps/Hz).

When combined with VersaFEC or LDPC/TPC, it can provide unprecedented savings in transponder bandwidth and power utilization. This allows for its successful deployment in bandwidth-limited and power-limited scenarios, as well as reduction in earth station BUC/HPA power requirements.

Carrier-in-Carrier® is a Registered Trademark of Comtech EF Data  
DoubleTalk® is a Trademark of Applied Signal Technology, Inc.  
VersaFEC® is a Registered Trademark of Comtech AHA Corp.

### **VersaFEC Forward Error Correction**

CDM-625 is the first modem to offer VersaFEC, a patented system of high performance short-block low-latency LDPC codes designed to support latency-sensitive applications, such as cellular backhaul over satellite. VersaFEC provides excellent coding gain with lowest possible latency. VersaFEC's Eb/No performance is similar to that of DVB-S2 (short block) or LDPC (16k block) with 70-90% lower latency. Compared to TPC, VersaFEC can provide coding gain of 1.0 dB or more.

The new Ultra Low Latency (ULL) codes provide even lower latency compared to standard VersaFEC codes.

### **Adaptive Coding & Modulation (ACM)**

Satellite users have traditionally relied on worst case link margin to overcome rain fade which leads to significant inefficiencies. ACM converts the fade margin into increased throughput – gain of 100% or more is possible. The CDM-625 with VersaFEC was specifically architected to support ACM for IP/Ethernet traffic. ACM maximizes throughput under all conditions – rain fade, inclined orbit satellite operation, antenna mis-pointing, noise, interference and other impairments.

VersaFEC ACM can provide almost 85% reduction in latency compared to DVB-S2 (short block).

ACM can also be used with DoubleTalk Carrier-in-Carrier.

### **Low Density Parity Check Codes (LDPC) & Turbo Product Codes (TPC)**

CDM-625 offers an integrated LDPC and 2<sup>nd</sup> Generation TPC codec. LDPC is an advanced Forward Error Correction technique capable of providing performance much closer to Shannon limit. The current LDPC implementation can provide 0.7 to 1.2 dB additional coding gain compared to an equivalent TPC code.

In order to take full advantage of the increased coding gain provided by LDPC, Comtech EF Data has developed a patented 8-QAM modulation that allows for acquisition and tracking at much lower Eb/No compared to 8-PSK.

## Dual Band Capability

CDM-625 supports 70/140 MHz and L-Band capability in the same unit with independently selectable transmit and receive IF. This simplifies sparing and stocking in networks requiring 70/140 MHz and L-Band units.

## 4-Port Managed Ethernet Switch with VLAN & QoS

CDM-625 base modem incorporates a 4-port 10/100Base-T managed Ethernet switch with VLAN capability and priority-based Quality of Service. Access (Native) Mode and Trunk Mode are supported. Traffic can be prioritized using port-based priority or VLAN priority. The maximum Ethernet frame size is 1536 bytes.

## IP Packet Processor

The IP Packet Processor enables efficient IP networking and transport over satellite by adding routing capability with very low overhead encapsulation, header compression, payload compression and Quality of Service to the CDM-625. The advanced QoS combined with header and payload compression ensures the highest quality of service with minimal jitter and latency for real-time traffic, priority treatment of mission critical applications and maximum bandwidth efficiency.

### Header Compression

The IP Packet Processor incorporates industry-leading header compression for IP traffic. Header compression can reduce the 40 byte IP/UDP/RTP header to as little as 1 byte. For TCP/IP, the 40 byte header is reduced to as little as 3 bytes. For applications such as VoIP, header compression can provide bandwidth savings exceeding 60%. E.g. the 8 kbps G.729 voice codec requires 24 kbps of IP bandwidth once encapsulated into an IP/UDP/RTP datagram. With header compression, the same voice call needs about 8.5 kbps – a saving of almost 65%. And, bandwidth requirements for typical Web/HTTP traffic can be reduced by 10% or more with TCP/IP header compression.

### Payload Compression

The IP Packet Processor incorporates industry-leading payload compression for IP traffic. Implemented in the hardware for maximum throughput and efficiency, payload compression can reduce the required satellite bandwidth by as much as 40-50%.

### Streamline Encapsulation (SLE)

The IP Packet Processor incorporates Comtech EF Data's patent-pending very low overhead Streamline Encapsulation (SLE). SLE can reduce the encapsulation overhead by as much as 65% compared to industry standard HDLC.

### Advanced Quality of Service (QoS)

The IP Packet Processor incorporates multi-level QoS to ensure the highest quality service with minimal jitter and latency for real-time traffic, priority treatment of mission critical applications and maximum bandwidth efficiency.

Supported modes are:

- DiffServ – Industry-standard method of providing QoS enabling seamless co-existence in networks that implement DiffServ
- Max/Priority – Provides multi-level traffic prioritization with the ability to limit maximum traffic per priority class
- Min/Max – Provides a Committed Information Rate (CIR) to each user defined class of traffic with the ability to allow a higher burstable rate depending on availability

## Quad E1 Interface (QDI) with Enhanced D&I++

The CDM-625 supports a Quad E1 interface that can aggregate up to four full or fractional E1s into a single carrier, with very low overhead. This provides significant CAPEX savings by reducing the number of modems and could possibly reduce the BUC/HPA size by eliminating the multi-carrier backoff. A proprietary, closed network drop & insert (D&I++) allows for dropping or inserting any combination of 1 to 31 time slots on each E1. D&I++ is supported for E1-CCS only.

For QDI operation, all E1s must have a common clock source.

## IP Sub Multiplexer

The IP sub mux allows multiplexing IP/Ethernet traffic with serial or G.703 traffic into a single carrier. This is particularly useful for cellular backhaul when both E1 and IP backhaul is required. This reduces the number of modems and could possibly reduce the BUC/HPA size by eliminating the multi-carrier backoff. The IP sub mux ratio ranges from 9:1 (IP data rate is 9 times that of the serial or G.703 data rate) to as low as 1:59.

## EDMAC & AUPC

The CDM-625 supports EDMAC, EDMAC-2, EDMAC-3 and AUPC. EDMAC/EDMAC-2/EDMAC-3 can be used to monitor and control the distant end of a satellite link using a proprietary overhead channel. EDMAC-3 is also used for SNMP management of the distant end modem. AUPC enables automatic uplink power control for a duplex link.

## Management & SNMP Proxy

The modem can be managed via the front panel, the remote M&C port (EIA-232/EIA-485), or the 10/100Base-T Ethernet port. With support for SNMP, HTTP and Telnet, the modem can be easily integrated into an IP-based management system.

The CDM-625 can also act as SNMP proxy for the distant end modem. This allows distant end modem management using SNMP without requiring an end-to-end IP link.

## Advanced FSK for LPOD Monitoring & Control

The Advanced FSK allows for monitoring and control of LPOD through modem front panel menus, serial remote control and Telnet.

## CDM-600/CDM-600L Emulation Mode

CDM-625 can be placed in CDM-600 or CDM-600L emulation mode. This permits easy integration into an existing CDM-600/L setup without changes to M&C platform or redundancy switches.

## Feature Enhancements

Enhancing the capability of the CDM-625 in the field is easy. Features that do not require additional hardware can be added on site, using FAST access codes purchased from Comtech EF Data.

## Specifications

|   |  |
|---|--|
| Data Rate   | 18 kbps to 25 Mbps, in 1 bps steps (modulation, FEC & data interface dependant)  |
| Symbol Rate   | 18 ksp/s to 12.5 Msps  |
| Operating Frequency   | 50 – 180 MHz (standard) and 950 – 2000 MHz (Option), 100 Hz resolution, independent TX and RX operation  |
| Major Operating Modes (See User Manual For Details)                           | Open network, per IESS-308 / 309 / 310 / 314 transparent, closed network per IESS-315 LDPC / TPC Codec (optional plug-in module) VersaFEC Codec (optional plug-in module) with ACM or Constant Coding & Modulation (CCM) EDMAC Framed with/without AUPC RS Outer Codec High rate ESC / Enhanced ESC (ESC++) Drop & insert (D&I) / Enhanced D&I++ Quad E1 drop & insert (QDI) DoubleTalk Carrier-in-Carrier (optional plug-in module)                   |
| <b>FEC Options</b>  |  |
| None  | Uncoded BPSK/QPSK/OQPSK  |
| Viterbi: k=7, per IESS-308/309  | Rate 1/2 BPSK/QPSK/OQPSK<br>Rate 3/4 QPSK/OQPSK<br>Rate 7/8 QPSK/OQPSK   |
| Viterbi with Reed Solomon   | Rate 3/4 16-QAM<br>Rate 7/8 16-QAM   |
| Sequential  | See CDM-625 user manual for details  |
| Reed Solomon  | Open network and closed network modes  |
| TCM (Per IESS-310)  | 8-PSK/TCM Rate 2/3   |
| Integrated LDPC and TPC (2 <sup>nd</sup> Gen) Codec (Optional Plug-in Module) | <u>LDPC Code Rates</u><br>Rate 1/2 BPSK/QPSK/OQPSK<br>Rate 2/3 QPSK/OQPSK/8-PSK/8-QAM<br>Rate 3/4 QPSK/OQPSK/8-PSK/8-QAM/16-QAM<br><u>TPC Code Rates</u><br>Rate 5/16 BPSK<br>Rate 21/44 BPSK/QPSK/OQPSK<br>Rate 3/4 QPSK/OQPSK/8-PSK/8-QAM/16-QAM<br>Rate 7/8 QPSK/OQPSK/8-PSK/8-QAM/16-QAM<br>Rate 0.95 QPSK/OQPSK/8-PSK/8-QAM   |
| VersaFEC Codec (Optional Plug-in Module)                                      | BPSK Rate 0.488<br>QPSK Rate 0.533, 0.631, 0.706, 0.803<br>8-QAM Rate 0.576 (ECCM), 0.642, 0.711, 0.780<br>16-QAM Rate 0.644 (ECCM), 0.731, 0.780, 0.829, 0.853<br>BPSK 0.493 (ULL)<br>QPSK 0.493, 0.654, 0.734 (ULL)  |
| Scrambling  | IDR Mode, no RS, - per ITU V.35 (Intelsat variant)<br>IBS mode, no RS - per IESS-309, externally frame synchronized<br>Transparent Closed Network mode, no RS or Turbo coding - per ITU V.35 (Intelsat variant)<br>EDMAC mode, no RS coding - externally frame synchronized - proprietary<br>Turbo Product Code/LDPC/VersaFEC modes - externally frame synchronized - proprietary<br>All RS modes - externally frame synchronized per IESS-308/309/310 |
| Management  | 10/100Base-T Ethernet with SNMP, HTTP and Telnet support, EIA-232, EIA-485 (2- or 4-wire)  |
| Form C Relays   | Hardware fault, RX and TX traffic alarms, open network backward alarms   |
| External Reference (Input OR Output)  | BNC connector<br><u>Input</u> : 1, 2, 5, or 10 MHz, -6 dBm to +10 dBm, 50 $\Omega$ /75 $\Omega$ (nominal)<br><u>Output</u> : 10 MHz, 2.7 V peak-to-peak $\pm$ 0.4 V, low impedance output  |

### Data Interfaces

|  |                                      |
|--|--------------------------------------|
| EIA-422/-530 DCE , Up to 14 Mbps   | 25-pin D-sub (female)                |
| V.35 DCE , Up to 14 Mbps   |                                      |
| LVDS Serial , Up to 25 Mbps  | 25-pin D-sub (female)                |
| HSSI Serial , Up to 25 Mbps  |                                      |
| G.703 T1, 1.544 Mbps (Balanced 100 $\Omega$ )  | 9-pin D-sub (female) or BNC (female) |
| G.703 T2, 6.312 Mbps (Unbalanced 75 $\Omega$ or balanced 110 $\Omega$ )              |                                      |
| G.703 E1, 2.048 Mbps (Unbalanced 75 $\Omega$ or balanced 120 $\Omega$ )              |                                      |
| G.703 E2, 8.448 Mbps (Unbalanced 75 $\Omega$ )                                       |                                      |
| ASI , Up to 25 Mbps  | BNC (female)                         |
| Additional 2.048 Mbps E1 Ports for Quad-E1 (Balanced 120 $\Omega$ )                  | 9-pin D-sub (female)                 |
| Overhead Data  | 44-pin High-density D-sub (male)     |
| Modem Alarms   | 15-pin D-sub (male)                  |
| 4-port 10/100Base-T Managed Ethernet Switch (Optional IP Packet Processor Available) | 4 x RJ-45                            |

### Modulator

| Frequency Stability     | $\pm$ 0.06 ppm ( $\pm$ 6 x 10 <sup>-8</sup> ), 0° to 50°C (32° to 122° F) with internal reference  |              |                         |       |        |       |       |       |        |       |         |
|-------------------------|--|--------------|-------------------------|-------|--------|-------|-------|-------|--------|-------|---------|
| Transmit Filtering      | Per IESS-308   |              |                         |       |        |       |       |       |        |       |         |
| Transmit Filter Rolloff | 25%, 35%   |              |                         |       |        |       |       |       |        |       |         |
| Harmonics and Spurious  | Better than -60 dBc/4 kHz (typically <-65 dBc/4kHz)<br>Measured from 1 to 500 MHz (50-180 MHz band)<br>Measured F <sub>0</sub> $\pm$ 500 MHz (950-2000 MHz band)   |              |                         |       |        |       |       |       |        |       |         |
| Transmit On/Off Ratio   | -60 dBc minimum  |              |                         |       |        |       |       |       |        |       |         |
| Output Phase Noise      | < 0.480° rms double sided, 100 Hz to 1 MHz (Minimum 16 dB better overall than the Intelsat IESS-308/309 requirements)<br><table><tr><th><u>dB/Hz</u></th><th><u>Frequency Offset</u></th></tr><tr><td>-63.0</td><td>100 Hz</td></tr><tr><td>-73.0</td><td>1 kHz</td></tr><tr><td>-83.0</td><td>10 kHz</td></tr><tr><td>-93.0</td><td>100 kHz</td></tr></table><br>Fundamental AC line spurious is -42 dBc or lower<br>The sum of all other single sideband spurious, from 0 to 0.75 x symbol rate, is -48 dBc or lower | <u>dB/Hz</u> | <u>Frequency Offset</u> | -63.0 | 100 Hz | -73.0 | 1 kHz | -83.0 | 10 kHz | -93.0 | 100 kHz |
| <u>dB/Hz</u>            | <u>Frequency Offset</u>  |              |                         |       |        |       |       |       |        |       |         |
| -63.0                   | 100 Hz   |              |                         |       |        |       |       |       |        |       |         |
| -73.0                   | 1 kHz  |              |                         |       |        |       |       |       |        |       |         |
| -83.0                   | 10 kHz   |              |                         |       |        |       |       |       |        |       |         |
| -93.0                   | 100 kHz  |              |                         |       |        |       |       |       |        |       |         |
| Output Power            | 50-180 MHz:<br>0 to -25 dBm, 0.1 dB steps<br>950-2000 MHz:<br>0 to -40 dBm, 0.1 dB steps   |              |                         |       |        |       |       |       |        |       |         |
| Power Accuracy          | 50-180 MHz:<br>$\pm$ 0.5 dB over frequency, data rate, modulation type and temperature range of 15 to 35° C<br>$\pm$ 0.8 dB over frequency, data rate, modulation type and temperature range of 0 to 50° C<br>950-2000 MHz:<br>$\pm$ 0.7 dB over frequency, data rate, modulation type and temperature range of 15 to 35° C<br>$\pm$ 1.0 dB over frequency, data rate, modulation type and temperature range of 0 to 50° C   |              |                         |       |        |       |       |       |        |       |         |



|                                |  |
|--------------------------------|--|
| Output Impedance & Return Loss | 50-180 MHz: 50 $\Omega$ /75 $\Omega$ , 16 dB minimum return loss (18 dB typical), BNC connector<br>950-2000 MHz: 50 $\Omega$ , 19 dB minimum return loss (21 dB typical), Type-N connector |
| Clocking Options               | Internal, $\pm 0.06$ ppm (SCT)<br>External, locking over a $\pm 100$ ppm range (TT)<br>Loop timing (RX satellite clock) – supports asymmetric operation<br>External clock                  |
| External TX Carrier Off        | By TTL 'low' signal or external contact closure  |
| BUC Reference (10 MHz)         | Via TX IF center conductor, 10.0 MHz<br>$\pm 0.06$ ppm (with internal reference), selectable ON/OFF, 0.0 dBm $\pm 3$ dB  |
| BUC Power Supply (HW Option)   | 24 VDC, 4.17 Amps max., 90 W @ 50° C<br>48 VDC, 3.125 Amps max., 150 W @ 50° C (180 W @ 30° C)<br>Supplied through TX IF center conductor and selectable on/off via M&C control.           |

### Demodulator

|                                    |   |
|------------------------------------|---|
| Input Power Range, Desired Carrier | 50-180 MHz: -105 + 10 log (symbol rate) to -70 + 10 log (symbol rate) dBm<br>950-2000 MHz: -130 + 10 log (symbol rate) to -80 + 10 log (symbol rate) dBm  |
| Max Composite Operating Level      | <b>50-180 MHz:</b><br>94 – 10 log (symbol rate, desired carrier) dBc, +10 dBm max., with the additional requirement that within $\pm 10$ MHz of the desired carrier the composite power is $\leq +30$ dBc<br><b>950-2000 MHz:</b><br>102 – 10 log (symbol rate, desired carrier) dBc, +10 dBm max., with the additional requirement that within $\pm 10$ MHz of the desired carrier the composite power is $\leq +30$ dBc |
| Absolute Maximum                   | +20 dBm   |
| Adaptive Equalizer                 | 5-tap design, selectable on/off   |
| Acquisition Range                  | Programmable in 1 kHz increments  |
| Below 64 ksymbols/sec              | $\pm 1$ kHz to $\pm (R_s/2)$ kHz, where $R_s$ = symbol rate in ksymbols/sec   |
| Between 64 and 389 ksymbols/sec    | $\pm 1$ kHz to $\pm 32$ kHz   |
| Above 389 ksymbols/sec             | $\pm 1$ kHz to $\pm (0.1 * R_s)$ kHz, up to a maximum of $\pm 200$ kHz  |
| Acquisition Time                   | Highly dependent on data rate, FEC rate, and demodulator acquisition range.<br>E.g.: 120 ms average at 64 kbps, R1/2 QPSK, $\pm 10$ kHz acquisition sweep range, 6 dB Eb/No   |
| Plesiochronous/ Doppler Buffer     | Selectable from 64 to 262,144 bits, in 16-bit steps (Additional limitations for G.704 frame boundaries)   |
| Receive Clock                      | RX satellite, TX terrestrial, external reference  |
| Clock Tracking                     | $\pm 100$ ppm minimum   |
| LNB Reference (10 MHz)             | Via RX IF center conductor, 10.0 MHz<br>$\pm 0.06$ ppm (with internal reference), selectable on/off, -3.0 dBm $\pm 3$ dB  |
| LNB Voltage                        | Selectable on/off, 13 VDC, 18 VDC per DiSeq 4.2 and 24 VDC at 500 mA maximum  |
| Monitor Functions                  | $E_b/N_0$ estimate, corrected BER, frequency offset, buffer fill state, receive signal level  |

### DoubleTalk Carrier-in-Carrier

|  |  |
|--|--|
| Delay Range  | 0 to 330 ms  |
| Power Spectral Density Ratio (Interferer to Desired) | BSPK/QPSK/8-PSK/8-QAM: -7 dB to +11 dB<br>16-QAM: -7 dB to +7 dB |
| Maximum Symbol Rate Ratio                            | 3:1 (TX:RX or RX:TX)   |

|                        |  |
|------------------------|--|
| Eb/No Degradation      | <u>0 dB Power Spectral Density Ratio</u><br>BPSK/QPSK/OQPSK: 0.3 dB<br>8-QAM: 0.4 dB<br>8-PSK: 0.5 dB<br>16-QAM: 0.6 dB<br><u>+10 dB power spectral density ratio</u><br>Additional 0.3 dB |
| Satellite Restrictions | Satellite in "loop-back" mode (i.e., the transmit station can receive itself)<br>"Non-processing" satellite (i.e., does not demodulate or remodulate the signal)                           |

### Available Options

|          |   |
|----------|---|
| Hardware | 100 – 240 VAC, 175 W AC primary power supply  |
| Hardware | -48 VDC, 125 W primary power supply   |
| Hardware | 24 VDC, 90 W @ 50° C BUC power supply, AC or DC primary power supply  |
| Hardware | 48 VDC, 150 W @ 50° C (180 W @ 30° C) BUC power supply, AC or DC primary power supply                                     |
| Hardware | Integrated TPC (2 <sup>nd</sup> generation) and LDPC Codec module   |
| Hardware | DoubleTalk Carrier-in-Carrier module  |
| Hardware | VersaFEC Codec module   |
| Hardware | IP Packet Processor   |
| FAST     | L-Band IF (in addition to 70/140 MHz)   |
| FAST     | Modem data rate – 10 Mbps, 15 Mbps, 20 Mbps or 25 Mbps  |
| FAST     | 8-PSK and 8-QAM modulation (8-QAM requires TPC/LDPC or VersaFEC Codec)  |
| FAST     | 16-QAM modulation   |
| FAST     | TPC/LDPC Codec data rate – 10 Mbps, 15 Mbps, 20 Mbps or 25 Mbps   |
| FAST     | DoubleTalk Carrier-in-Carrier license (full) – 512 kbps, 1.1 Mbps, 2.5 Mbps, 5 Mbps, 10 Mbps, 15 Mbps, 20 Mbps or 25 Mbps |
| FAST     | DoubleTalk Carrier-in-Carrier license (fractional) 2.5 Mbps, 5 Mbps, 10 Mbps, 15 Mbps, 20 Mbps or 25 Mbps                 |
| FAST     | VersaFEC Codec data rate (CCM) – 2.5 Mbps, 5 Mbps or 16 Mbps  |
| FAST     | VersaFEC Codec symbol rate (ACM) – 300 ksp/s, 1.2 Msps or 4.1 Msps  |
| FAST     | Open network – IBS with high rate IBS ESC, IDR and audio  |
| FAST     | D&I / D&I++ for single Port T1/E1   |
| FAST     | D&I++ For Quad E1 Port 2, 3 and 4   |
| FAST     | Quality of Service (requires IP Packet Processor)   |
| FAST     | Header Compression (requires IP Packet Processor)   |
| FAST     | Payload Compression (requires IP packet processor)  |

### Accessories

|            |   |
|------------|---|
| CRS-170A   | 1:1 Modem Redundancy Switch (L-Band)                                  |
| CRS-180    | 1:1 Modem Redundancy Switch (70/140 MHz)                              |
| CRS-300    | 1:10 Modem Redundancy Switch (Not available with IP Packet Processor) |
| CRS-280    | 1:10 IF Redundancy Switch (70/140 MHz)                                |
| CRS-280L   | 1:10 IF Redundancy Switch (L-Band)                                    |
| CRS-500    | 1:N Modem Redundancy System (For use with IP Packet Processor Only)   |
| CRS-282XXX | 1:10 IF Redundancy Switch (For use with CRS-500)                      |

### Environmental And Physical

|              |   |
|--------------|---|
| Temperature  | Operating: 0 to 50°C (32 to 122°F)<br>Storage: -25 to 85°C (-13 to 185°F) |
| Power Supply | 100 – 240 VAC, +6%/-10%, 50/60 Hz, auto sensing<br>-48 VDC (HW option)    |

