CDM-600 & CDM-600L Open Network Satellite Modems

Modems

Overview

The CDM-600 and CDM-600L are open network satellite modems, which are fully compliant with IESS-308, -309, -310, -314, and -315 from 64 kbps through T2 and E2. They are available in the following three data rate ranges:

Low-Rate variable:	2.4 kbps to 5.0 Mbps
Mid-Rate variable:	2.4 kbps to 10.0 Mbps
High-Rate variable:	2.4 kbps to 20.0 Mbps

In addition, both modems operate in closed network from 2.4 kbps to 20 Mbps. The modems include T1, E1, T2, and E2 G.703 interfaces, in addition to EIA-422, V.35, EIA-232, and serial LVDS. HSSI is provided by adding the CIC-20 interface converter. The architecture is firmware and FPGA-based, and the internal Flash memory allows easy updating via the serial port. The modems offer exceptional flexibility and performance in 1RU enclosures.

Typical Users

- Satellite Service Providers
- Telecom Service Providers
- Broadcasters
- Offshore
- Enterprise

Common Applications

- Mobile Backhaul
- G.703 Trunking

Features

- CDM-600: 50 to 90 or 100 to 180 MHz IF range
  CDM-600L: 950 to 2000 MHz IF range
- Fast acquisition demodulator (± 32 kHz acquisition range, 64 kbps, Rate 1/2 QPSK: 1 sec average)
- BPSK, QPSK, OQPSK, 8PSK, 16-QAM modulation types
- Patented 8-QAM for LDPC
- Data rate range from 2.4 kbps to 20 Mbps
- Forward Error Correction choices include Turbo Product Coding (IESS-315 compliant), Viterbi, Sequential, Reed-Solomon, LDPC and TCM
- Intermediate Data Rate (IDR)
- Intelsat Business Services
- D&I++
- ESC++
- Automatic Uplink Power Control (AUPC)
- Embedded Distant-end Monitor and Control (EDMAC)
- Asymmetric loop timing
- CDM-600: 50 or 75 Ω, front panel selectable
  CDM-600L: transmit 50 Ω, receive 50 or 75 Ω, female Type N connector
- Open network compatible and backwards compatible with the CDM-500/CDM-550, and CDM-550T
- Interoperable with SDM-300A, SDM-300L3 (CDM-600L only)
- 1:1 and 1:10 redundancy switch available

Feature Enhancements

Enhancing the modem's performance is easy. Additional features are added quickly on site, using FAST access codes purchased from Comtech EF Data. To enable these features, simply enter the code at the front panel.

Turbo Product Coding

The modems offer all traditional FEC methods and incorporate an optional Turbo Product Codec (TPC). TPC is a FEC technique that delivers significant performance improvement when compared to Viterbi with concatenated Reed-Solomon. TPC simultaneously offers increased coding gain, lower decoding delay and significant bandwidth savings.

Two TPC codecs are offered as hardware options:

- The Low-Rate TPC codec operates up to 5 Mbps with limited code rates.
- The High-Rate TPC codec operates up to 20 Mbps, and offers a full range of code rates (5/16 through 7/8, and 0.95) with all modulation types from BPSK to 16-QAM

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EDMAC Operation

Special features of the modems are their ability to monitor and control the distant end of a satellite link using a Comtech EF Data proprietary overhead channel. This framed mode is called EDMAC. User data is framed and extra bits are added to pass control, status, and Automatic Uplink Power Control information. This process is completely transparent to the user. An RF transceiver (C-Band and Ku-Band) or Block Up Converter at the distant end of a satellite link may be controlled and monitored from the front panel of the modem using a low data rate FSK signal on the RX IF cable via the EDMAC channel.

Remote Control

The operator may configure and monitor the modem from the front panel, or through the remote M&C port. Ten complete configurations may be stored in the modem. An event log stores alarm and status information in non-volatile RAM, while the Link Statistics log stores link performance (E_b/N_o and AUPC performance) for QoS reporting purposes. SatMac, a Windows-based monitor and control program, is available for configuring the local and distant end modems, transceivers, and redundancy switches.

Low Density Parity Check (LDPC) Coding and 8-QAM Modulation

A third codec is available as a hardware option. The TPC/LDPC Codec combines all TPC functions of the High-Rate TPC option, plus the following new features:

- Improved performance of LDPC codes at 1/2, 2/3, and 3/4 rates to further improve coding gain and bandwidth efficiency.
- 8-QAM modulation that offers the same bandwidth efficiency of 8PSK but with improved BER performance and tracking in noisy environments. The patented (U.S. patent 7,254,188) 8-QAM modulation was developed by Comtech EF Data in order to take full advantage of the increased coding gain provided by LDPC, while allowing for acquisition and tracking at much lower Eb/No compared to 8PSK.

Drop and Insert (D&I++)

Full drop and insert functionality is available as an option. The modems offer two variants of drop and insert (D&I). The first is an Intelsat open network-compliant mode, using the IBS framing (6.7%). The second is CEFD's proprietary enhanced mode, called D&I++. This "n" x 64 kbps mode offers any value of "n" up to 24, and permits the simultaneous use of EDMAC, AUPC (see below) and an ESC circuit at 1/576th of the user data rate. This is achieved with the addition of only 2.2% overhead.

ESC++

A high rate overhead channel is now standard in the new enhanced version of the modems. This provides a separate RS-232 channel allowing up to 4.8 kbaud at 64 kbps and up to 38.4 kbaud at 512 kbps. AUPC also operates in this mode.

Specifications

Frequency Range	CDM-600: 50 to 90 or 100 to 180 MHz, CDM-600L: 950 to 2000 MHz, 100 Hz frequency resolution
Input/Output Impedance	CDM-600: 50 or 75 Ω (front panel selectable) CDM-600L: transmit 50 Ω, receive 50 or 75 Ω, female Type N connector
Data Interfaces	EIA-422/-530, V.35, Sync EIA-232, G.703 balanced or unbalanced, Low Voltage Differential Signal (LVDS), HSSI (*using CIC-20 HSSI/LVDS interface converter*)

Data Rate Range
(1 bps programmable, and fully independent TX and RX rates)

Rate	**Range**
1/2 BPSK	2.4 kbps to 5.0 Mbps
1/2 QPSK/OQPSK	4.8 kbps to 10.0 Mbps
3/4 QPSK/OQPSK	7.2 kbps to 15.0 Mbps
7/8 QPSK/OQPSK	8.4 kbps to 17.5 Mbps
2/3 8PSK	4.8 kbps to 20.0 Mbps
Uncoded	4.8 kbps to 20.0 Mbps

Turbo Product Coding Rates

Rate	**Range**	**High-Rate**
21/44 BPSK	4.8 kbps to 3.2 Mbps	4.77 Mbps
5/16 BPSK	4.8 kbps to 2.048 Mbps	3.12 Mbps
1/2 QPSK/OQPSK	4.8 kbps to 9.54 Mbps	Turbo Card
3/4 QPSK/OQPSK	7.2 kbps to 5.0 Mbps	15 Mbps
3/4 8PSK8PSK	10.8 kbps to 5.0 Mbps	20 Mbps
3/4 16-QAM	14.4 kbps to 5.0 Mbps	20 Mbps
7/8 QPSK/OQPSK	8.4 kbps to 17.5 Mbps	Turbo Card
7/8 8PSK	12.6 kbps to 20.0 Mbps	Turbo Card
7/8 16-QAM	16.8 kbps to 20.0 Mbps	Turbo Card
0.95 QPSK/OQPSK	9.1 kbps to 18.888 Mbps	Turbo Card
0.95 8PSK	13.6 kbps to 20 Mbps	Turbo Card

Low Density Parity Check (LDPC) Rates

1/2 BPSK	4.8 kbps to 5.0 Mbps
1/2 QPSK/OQPSK	4.8 kbps to 10.0 Mbps
2/3 QPSK/OQPSK	6.4 kbps to 13.3 Mbps
2/3 8PSK, 8-QAM	9.6 kbps to 19.0 Mbps
3/4 QPSK/OQPSK	7.2 kbps to 15.0 Mbps
3/4 8PSK, 8-QAM	10.8 kbps to 20.0 Mbps
3/4 16-QAM	14.4 kbps to 20.0 Mbps
Scrambling	Mode dependent - ITU V.35 (Intelsat IESS-308), or externally synchronized (Intelsat IESS-309/-310/-314 or proprietary

FEC Options

Viterbi	Rate 1/2 BPSK, QPSK/OQPSK Rate 3/4 and 7/8 QPSK/OQPSK and 16-QAM w/RS
Pragmatic TCM	8PSK 2/3
Low-Rate TPC	21/44, 5/16 BPSK, and 3/4 8PSK, 3/4 16-QAM
High-Rate TPC	21/44, 5/16 BPSK, 1/2, 3/4, 7/8, 0.95 QPSK/OQPSK, 3/4, 7/8, 0.95 8PSK, and 3/4, 7/8 16-QAM
LDPC	1/2 BPSK, 2/3, 3/4 QPSK/OQPSK, 2/3, 3/4 8PSK, 2/3, 3/4 8-QAM, and 3/4 16-QAM
Reed-Solomon	Intelsat compliant and proprietary modes available
Uncoded	BPSK, QPSK/OQPSK
M&C Interface	EIA-232, EIA-485 (2- or 4-wire)
Form C Relays	TX, RX traffic alarms and unit faults Backward alarms for IDR and IBS

Data Interfaces

Electrical Interface	G.703 (T1, E1, T2, E2), RS-422, V.35, LVDS or Synchronous RS-232 (refer to manual for further information)
Frame Formats Supported	D4 or ESF for T1, CCS for E1 (Also CAS E1 for open network)
Available nx64 kbps Data Rates	1 to 6, 8, 10, 12, 15, 16, 20, 24 or 30 for open network, 1 to 24 for D&I++ enhanced proprietary
Electrical Interface	G.703 (T1, E1, T2, E2), RS-422, V.35, LVDS or Synchronous RS-232 (refer to manual for further information)

ESC Specifications

IDR (Total Overhead 96 kbps)	
Voice Orderwire	2 ADPCM (input: 4-wire VF), or 64 kbps data 8 kbps (EIA-422 interface)
Data Orderwire Backward Alarms	Form C contacts, hardware or software mapped
IBS (Total Overhead 1/15 x data rate)	
ASYNC Data Orderwire Backward Alarm	1/2000 x data rate Form C contacts
ESC++ (Refer to manual)	ASYNC RS-232 at 1.2 to 38.4 kbaud

Modulator

Output Spectrum/Filtering	Meets IESS-308/309 power spectral mask
Frequency Stability	CDM600: ± 1.5 ppm, 0° to 50°C (32° to 122°F) (Standard) ± 0.02 ppm, 0° to 50°C (32° to 122°F) (optional) CDM600L: ± 1.0 ppm, 0° to 50°C (32° to 122°F) (Standard) ± 0.02 ppm, 0° to 50°C (32° to 122°F) (optional)
Harmonics and Spurious	< -55 dBc/4 kHz (Typically < –60 dBc/4 kHz)
Transmit On/Off Ratio	55 dB minimum
Phase Noise	< 0.75 degrees RMS double-sided, 100 Hz to 1 MHz
Output Power	CDM-600: 0 to –20 dBm, 0.1 dB steps, CDM-600L: 0 to –40 dBm, 0.1 dB steps
Accuracy	CDM-600: ± 0.5 dB over frequency and temperature CDM-600L: ± 1.5 dB over frequency and temperature
External TX Carrier Off	By TTL LOW signal
TX Terrestrial	Internal (SCT), EXT TT, Loop
Clock Options	Timing from satellite and EXT CLOCK
BUC FSK Communications	CDM-600L Only: Via TX center conductor with FSK BUCs
ODU/BUC Voltage (Optional)	CDM-600L Only: 24 VDC, 4 amps, 100 W 48 VDC, 3.75 amps, 180 W
BUC 10 MHz	CDM-600L Only: On/Off

Demodulator

Input Power Range	CDM600: -30 to –60 dBm CDM600L: -130 dBm + 10Log (symbol rate) minimum
AGC (CDM-600L Only)	50 dB above minimum
Max Composite Level	+35 dBc, up to –5 dBm
Acquisition Range	± 1 to ± 32 kHz, programmable in 1 kHz steps
Acquisition Time	Dependent on data rate, FEC and acquisition range Example: 1 sec average at 64 kbps Rate 1/2
LNB Voltage	CDM-600L only: 12, 18 or 24 VDC, up to 500mA
LNB 10 MHz	CDM-600L Only: On/Off
Example BER Performance	Met with two adjacent carriers 7 dB higher Guaranteed E_b/N_0, in dB (Typical values in parentheses)

Viterbi (B, Q, and OQPSK)

	1/2	3/4	7/8
10^{-5}	5.4 (4.9)	6.8 (6.3)	7.7 (7.2)
10^{-7}	6.7 (6.2)	8.2 (7.7)	9.0 (8.6)
Sequential	*(Consult manual for details)*		

Viterbi Concatenated Reed-Solomon 220/200 or 200/180 (B, Q, and OQPSK)

	1/2	3/4	7/8
10^{-5}	4.3 (4.0)	5.6 (4.7)	6.5 (6.0)
10^{-7}	4.5 (4.2)	6.0 (5.2)	6.9 (6.5)
8PSK TCM/RS (IESS-310)	*(Consult manual for details)*		

Turbo Product Codec (Q/OQPSK)

	1/2	3/4	7/8	0.95
10^{-6}	2.9 (2.6)	3.8 (3.4)	4.3 (4.0)	6.4 (6.0)
10^{-8}	3.3 (2.8)	4.4 (4.0)	4.5 (4.2)	6.9 (6.5)

(Please consult the manual for a performance listing of all FEC types, Code Rates, and Modulation types.)

Receive Buffer	64 to 262144 bits, in 16 bit increments
Receive Clock Options	RX satellite, TX terrestrial, external reference, insert
Clock Tracking	± 100 ppm minimum
External Clock Input	BNC connector, 2.4 kHz to 20 MHz
External Reference Input (Optional)	SMA female, 1, 2, 5, 10 or 20 MHz
Monitor Functions	E_b/N_0, frequency offset, BER, buffer fill status, RX receive signal level

Drop And Insert

Electrical Interface	G.703, RS-422 or V.35 (T1 or E1)
Frame Formats Supported	D4 or ESF for T1, CCS for E1 (Also CAS E1 for open network)
Available n x 64 kbps Data Rates	1 to 6, 8, 10, 12, 15, 16, 20, 24 or 30 for Open Network 1 to 24 for D&I++ enhanced proprietary

Accessories

CRS-150	CRS-150 1:1 Modem Redundancy Switch (With CRS-170A L-Band IF Switch – CDM-600L)
CRS-300	CRS-300 1:N Modem Redundancy Switch

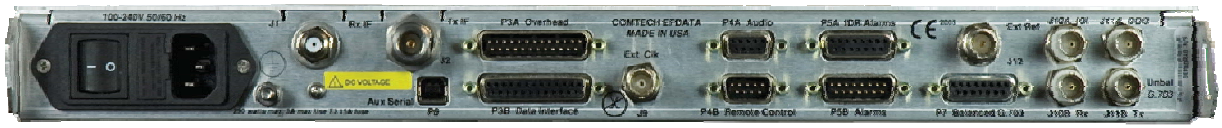
Available Options

How Enabled	Option
N/A	Variable data rate to 5 Mbps (standard)
FAST	Variable data rate to 10 Mbps
FAST	Variable data rate to 20 Mbps
FAST	8PSK modulation (and 8-QAM if TPC/LDPC Codec is installed – CDM-600)
FAST	CDM-600: LDPC to 10 Mbps
FAST	CDM-600: LDPC to 20 Mbps
FAST	16-QAM modulation
FAST	IBS operation
FAST	IBS with high-rate IBS ESC operation
FAST	IDR operation
FAST	Drop & insert operation (open network and D&I++)
FAST	2 Audio IBS Operation
Hardware	Turbo Codec – low-rate 5 Mbps (21/44, 5/16, 3/4)
Hardware	Turbo Codec – high-rate 20 Mbps (21/44, 5/16, 1/2, 3/4, 7/8, 0.95)
Hardware	CDM-600: High-stability internal reference (2×10^{-8}) with external input capability CDM-600L: internal reference 1.0 ppm (standard, not with BUCs) or 0.02 ppm (optional)
Hardware	CIC-20 HSSI interface converter
Hardware	TPC/LDPC Codec (Base to 5 Mbps - CDM-600)
Hardware	RX Type F or Type N connector (CDM-600L)
Hardware	CDM-600L: ODU PS 24 VDC, 100 W, AC or DC input
Hardware	CDM-600L: ODU PS 48 VDC, 180 W, AC or DC input

Environmental & Physical

Temperature	Operating: 0 to 50°C (32 to 122°F) Storage: -25 to 85°C (-13 to 185°F)
Power Supply	100 to 240 VAC, 50/60 Hz 38 to 60 VDC (optional DC)
Power Consumption (see manual)	55 W max. AC, w/o BUC power supply 290 W max. AC, with BUC power supply
Dimensions (1RU) (height x width x depth)	
CDM-600	1.72" x 19" x 13.1" (4.4 x 48.2 x 33.3 cm)
CDM-600L	1.72" x 19" x 18.0" (4.4 x 48.2 x 45.7 cm)
Weight	
CDM-600	10 lbs (4.5 kg) max.
CDM-600L	10 lbs (4.5 kg) max., w/o BUC power supply 11.6 lbs (5.3 kg) max., with BUC power supply

CDM-600 Open Network Satellite Modem back panel



CDM-600L Open Network Satellite Modem back panel