CDM-600 Open Network Satellite Modem 2.4 kbps to 20 Mbps

INTRODUCTION

The CDM-600 is an Open Network modem, fully compliant with Intelsat IESS-308, 309, 310, 314, and 315. It is available in three data rate ranges - Low-rate variable (2.4 kbps to 5.0 Mbps), Mid-Rate variable (2.4 kbps to 10 Mbps) and High-Rate variable (2.4 kbps to 20.0 Mbps)

The modem includes T1, E1, T2, and E2 G.703 interfaces, in addition to EIA422, V.35, EIA232, 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.

FEATURES

- Forward Error Correction choices include Turbo Product Coding (IESS-315 compliant), Viterbi, Sequential, Reed-Solomon, TCM, and LDPC
- Open Network compatible and backwards compatible with the CDM-500/CDM-550 and CDM-550T
- Intelsat Intermediate Data Rate (IDR)
- Intelsat Business Services (IBS)
- 52 to 88 MHz and 104 to 176 MHz IF range
- Data rate range from 2.4 kbps to 20 Mbps
- Software-selectable 50/75Ω IF port impedance
- Automatic Uplink Power Control (AUPC)
- BPSK, QPSK, OQPSK, 8-PSK, 8-QAM, and 16-QAM modulation types
- Asymmetric Loop Timing
- 1:1 and 1:10 redundancy switches available

FEATURE ENHANCEMENTS

Enhancing the CDM-600's performance and adding features is quickly accomplished on site, using FAST access codes purchased from Comtech EF Data. To enable these features, simply enter the code at the front panel.

APPLICATION

The CDM-600 provides a cost-effective solution for today's higher data rate satellite circuits, and will replace many older modems reaching the end of their life cycle.

TURBO PRODUCT CODING

The CDM-600 offers all traditional FEC methods and incorporates an optional Turbo Product Codec (TPC).

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.

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 which offers the same bandwidth efficiency of 8-PSK but with improved BER performance and tracking in noisy environments.

DROP AND INSERT

Full Drop and Insert functionality is available as an option. The CDM-600 offers 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 circuitat 1/576th of the user data rate. This is achieved with the addition of only 2.2% overhead.

EDMAC OPERATION

A special feature of the CDM-600 is its 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 (Embedded Distant-end Monitor and Control). 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.

Comtech EF Data's RF transceivers (C-band and Ku-band) may be controlled from the front panel of the modem using a low data rate FSK signal on the Rx IF cable. An RF Transceiver at the distant end of a satellite link may also be controlled and monitored through 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.

COMTECH EF DATA
A SUBSIDIARY OF COMTECH TELECOMMUNICATIONS CORP.

CDM-600 Open Network Satellite Modem
2.4 kbps to 20 Mbps

SYSTEM SPECIFICATIONS

Frequency Range	52 to 88 MHz and 104 to 176 MHz 100 Hz resolution
Input/Output Impedance	50 and 75 Ω (Front panel selectable)
IF Connectors	BNC, female
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)

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 Mbps
7/8 QPSK/OQPSK	8.4 kbps to 17.5 Mbps
2/3 8-PSK	4.8 kbps to 20.0 Mbps
Uncoded	4.8 kbps to 20.0 Mbps

Turbo Product Coding Rates:

21/44 BPSK	**4.8 kbps to 3.2 Mbps**	**(High Rate = 4.77 Mbps)**
5/16 BPSK	**4.8 kbps to 2.048 Mbps**	**(High Rate = 3.12 Mbps)**
1/2 QPSK/OQPSK	**4.8 kbps to 9.54 Mbps**	**(High Rate Turbo Card)**
3/4 QPSK/OQPSK	**7.2 kbps to 5.0 Mbps**	**(High Rate = 15 Mbps)**
3/4 8-PSK	**10.8 kbps to 5.0 Mbps**	**(High Rate = 20 Mbps)**
3/4 16-QAM	**14.4 kbps to 5.0 Mbps**	**(High Rate = 20 Mbps)**
7/8 QPSK/OQPSK	**8.4 kbps to 17.5 Mbps**	**(High Rate Turbo Card)**
7/8 8-PSK	**12.6 kbps to 20.0 Mbps**	**(High Rate Turbo Card)**
7/8 16-QAM	**16.8 kbps to 20.0 Mbps**	**(High Rate Turbo Card)**
0.95 QPSK/OQPSK	**9.1 kbps to 18.888 Mbps**	**(High Rate Turbo Card)**
0.95 8-PSK	**13.6 kbps to 20 Mbps**	**(High Rate 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 (8-PSK, 8-QAM)	***9.6 kbps to 19.0 Mbps***
3/4 (QPSK/OQPSK)	***7.2 kbps to 15.0 Mbps***
3/4 (8-PSK, 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 and OQPSK) Rate 3/4 and 7/8 (QPSK, OQPSK and 16-QAM w/RS)
Sequential	Rate 1/2, (BPSK, O/QPSK) 3/4 and 7/8 (O/QPSK)
Pragmatic TCM	8-PSK 2/3
Low Rate TPC	BPSK 21/44, 5/16; QPSK/OQPSK 3/4; 8-PSK 3/4; 16-QAM 3/4
High Rate TPC	BPSK 21/44, 5/16; QPSK/OQPSK 1/2, 3/4, 7/8, 0.95; 8-PSK 3/4, 7/8, 0.95; 16-QAM 3/4, 7/8
LDPC	BPSK 1/2, QPSK/OQPSK 2/3, 3/4, 8-PSK 2/3, 3/4, 8-QAM 2/3 , 3/4, and 16-QAM 3/4
Reed-Solomon	Intelsat compliant and proprietary modes available
Uncoded	BPSK, QPSK and 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

MODULATOR

Output Spectrum/filtering	Meets IESS-308/309 power spectral mask
Frequency Stability	Standard: ±1.5 ppm, 0 to 50ºC (32 to 122ºF) Option: ±0.02 ppm, 0 to 50ºC (32 to 122ºF)
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	0 to –20 dBm, 0.1 dB steps
Accuracy	± 0.5 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

DEMODULATOR

Input Power Range	-30 to -60 dBm
Max Composite Level	+35 dBc, up to -5 dBm
Acquisition Range	±1 to ±32 kHz (1 kHz steps)
Acquisition Time	Dependent on data rate, FEC and acquisition range

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 CDM-600 Manual for details)*		

Viterbi and 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)
8-PSK TCM/RS (IESS-310)	*(Consult CDM-600 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 CDM-600 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, EXT REF, 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 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

ESC SPECIFICATIONS

IDR (Total Overhead 96 kbps)	
Voice Orderwire	2 ADPCM (input: 4-wire VF), or 64 kbps data
Data Orderwire	8 kbps (EIA-422 interface)
Backward Alarms	Form C contacts, hardware or software mapped
IBS (Total Overhead 1/15 x data rate)	
ASYNC Data Orderwire	1/2000 x data rate
Backward Alarm	Form C contacts

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	8-PSK modulation (and 8-QAM if TPC/LDPC Codec is installed)
FAST	LDPC to 10 Mbps
FAST	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 Board – Low Rate 5 Mbps (21/44, 5/16, 3/4)
Hardware	Turbo Codec Board – High Rate 20 Mbps (21/44, 5/16, 1/2, 3/4, 7/8, 0.95)
Hardware	High-stability Internal Reference (2 x 10^{-8}) with external input capability
Hardware	CIC-20 HSSI Interface Converter
Hardware	TPC/LDPC Codec Board (Base to 5 Mbps)

COMTECH EF DATA
A SUBSIDIARY OF COMTECH TELECOMMUNICATIONS CORP.

SATCOM SERVICES
www.satcom-services.com

Mike Termondt
mike@satcom-services.com
Phone: 1.805.649.1384
Fax: 1.805.649.1174