CLM-9600L

L-Band Satellite Modem
2.4 kbps to 20 Mbps

INTRODUCTION

Advanced, state of the art design makes the CLM-9600L the modem of choice for the defense community. The CLM-9600L operates with most major satellite systems in the world and is capable of high-level modulation techniques, such as 8-phase shift keying (8-PSK) and 16-Quadrature Amplitude Modulation (16-QAM). Available Forward Error Correction (FEC) Codecs include: Convolutional Encoder with Viterbi Decoding (CEVD), Sequential, Reed-Solomon (R-S), and Turbo Product Code (TPC).

FEATURES

- BPSK, OQPSK, QPSK, 8-PSK, 16-QAM
- CEVD FEC rates 1/1, 1/2, 3/4, 7/8 (TCM at 2/3)
- TPC FEC rates: 5/16, 21/44, 3/4, 7/8, 0.95
- 2.4 kbps to 20.0 Mbps (code rate dependent)
- L-Band 950 to 1950 MHz frequency range
- Multiple scrambling methods including OM-73
- Flash upgrade capability
- INTELSAT Intermediate Data Rate (IDR) compatible
- INTELSAT Business Services (IBS) compatible
- Drop and Insert (D&I)
- EDMAC Closed network overhead capability for:
  - Automatic Uplink Power Control (AUPC)
  - Asynchronous Service Channel
- Reed-Solomon Codec
- Asymmetrical loop timing

APPLICATION

The CLM-9600L is the ideal modem solution when implementing Tri-Band terminals that require both commercial and government communication access.

The CLM-9600L operates with most major satellite systems, including Intelsat®, PanAmSat®, SES Americom, Loral Skynet® and all U.S. domestic satellites.

The CLM-9600L is fully compatible with modems from other manufacturers that are compliant with the IESS-308/-309/-310/-314/-315 specifications.

TURBO PRODUCT CODING

Turbo coding significantly reduces the inherent decoding delay of Reed Solomon. The coding gain for Turbo product code is amazingly suited for marginal satellite links. TPC simultaneously offers increased coding gain, lower decoding delay, and significant bandwidth savings.

The advanced capabilities of the TPC codec also provide a full range of code rates (from 5/16 through 0.95) with all modulation types from BPSK to 16-QAM. Comtech EF Data's TPC solution is IESS-315 compliant.

EDMAC OPERATION

A special feature of the CLM-9600L 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.

Status and Control of FSK-capable Block Up Converters at the far end is also provided 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.

FEATURE ENHANCEMENTS

Enhancing the CLM-9600L'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.

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SYSTEM SPECIFICATIONS

Frequency Range	950 to 1950 MHz in 100 Hz steps
Input/Output Impedance	50 Ω Tx and 75 Ω Rx
IF Connectors	Tx Type N, female, Rx Type F, female
Data Rate (See Manual)	2.4 kbps to 20 Mbps in 1 bps steps within symbol rate range
Symbol Rate	4.8 ksps to 10 Msps
Scrambling	OM-73, Intelsat IESS-308, -309, -310, -315 or proprietary
FEC Options	
Viterbi	BPSK, QPSK and OQPSK 1/2
	QPSK, OQPSK and 16QAM w/RS 3/4 and 7/8
Sequential	BPSK 1/2, O/QPSK 1/2, 3/4, and 7/8
Pragmatic TCM	8PSK 2/3
Turbo Product Coding	BPSK 21/44, 5/16
(TPC) (Enhanced)	QPSK/OQPSK 1/2, 3/4, 7/8, 0.95
	8PSK 3/4, 7/8, 0.95
	16QAM 3/4, 7/8, 0.95
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

DATA INTERFACE

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)*
Drop And Insert	G.703 (T1 or E1)
Frame formats supported	D4 or ESF for T1, CCS or CAS for E1
N x 64 kbps Data Rates	N = 1 to 6, 8, 10, 12, 15, 16, 20, 24 or 30
ESC Interfaces	
IDR	96 kbps overhead
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	1/15 x data date overhead
ASYNC Data	1/2000 x data rate
Orderwire	Form, C contacts
Backward Alarm	
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 Baseband Clock	BNC connector, 2.4 kHz to 20 MHz
External Frequency Reference	BNC Female, 1, 2, 5, 10 or 20 MHz

10 MHZ REFERENCE

Stability	0.02 ppm standard, 1.0 ppm optional (not with BUCs)			
Power Level	BUC: 0 dBm ± 3dB via Tx center conductor			
	LNB -3 dBm ± 3dB via Rx center conductor			
Phase Noise	dB/Hz	Offset	dB/Hz	Offset
	-80	1 Hz	-140	1 kHz
	-110	10 Hz	-150	10 kHz
	-135	100 Hz	-150	100 kHz

MODULATOR

Output Spectrum/filtering	Meets IESS-308/309 power spectral mask
Frequency Stability	± 0.02 ppm (standard) or ± 1 ppm (optional), 0 to 50ºC
Output Power	0 to -30 dBm, 0.1 dB steps
Accuracy	± 1.5 dB over frequency and temperature
BUC FSK Communications	Via Tx center conductor with FSK BUCs
ODU / BUC Voltage	24 VDC, 4 amps, 100W
(Optional)	48 VDC, 3 amps 150W

ENVIRONMENTAL AND PHYSICAL

Temperature	Operating: 0 to 50ºC (32 to 122ºF)
	Storage: -25 to 85ºC (-13 to 185ºF)
Power Supply	100 to 240 volts AC, 50/60 Hz
Power Consumption	40 W typical (46 W maximum) No BUC PS
	160W maximum with100W BUC PS
	290W maximum with180W BUC PS
Physical Dimensions (1RU)	1.75H x 19.0W x 19 D inch, 4.4H x 48W x 48D mm, approx.
Weight	15 lbs (7.0 kg), approx
Agency Approvals	CE: EN55022 Class B (Emissions), EN50082-1 Part 1 (Immunity), EN60950 (Safety). FCC: Part 15 Class B

DEMODULATOR

Input Power, Minimum	-130 dBm + 10 Log (Symbol Rate)
AGC	50 dB above minimum
Max Composite Level	+30 dBc, up to -5 dBm
Acquisition Range	± 32 kHz, programmable in 1 kHz steps

BER PERFORMANCE

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 OQ-PSK)	**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	*(See the CLM-9600L manual for details.)*		
Viterbi and concatenated Reed-Solomon 220/200 or 200/180			
(B, Q and OQ-PSK)	**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)	*(See the CLM-9600L manual for details.)*		

Turbo Product Codec (Q/OQPSK)	**1/2**	**3/4**	**7/8**	**0.95**
10^{-6}	3.5 (3.2)	3.8 (3.4)	4.3 (4.0)	6.8 (6.4)
10^{-8}	3.6 (3.3)	4.4 (4.0)	4.5 (4.2)	7.4 (7.0)

(See the CLM-9600L manual for a comprehensive listing of the performance of all FEC types, Code Rates, and Modulation types.)

Monitor Functions	E_b/N_0, Frequency Offset, BER, Buffer fill status, Rx receive signal level
LNB Voltage	+13, +18 VDC and 24 VDC at 500 mA max

AVAILABLE OPTIONS

FAST Enabled Options

- Variable data rate to 10 Mbps
- Variable data rate to 20 Mbps
- 8PSK modulation
- 16QAM modulation
- IBS Operation
- IDR Operation
- IBS with High Rate IBS ESC Operation
- Drop & Insert Operation
- 2 Audio IBS Operation

Hardware Enabled Options

- HSSI, CiC-20 plug-in
- Turbo Codec Board – High Rate 20 Mbps
- ODU PS 24 VDC, 100W, AC Input
- ODU PS 48 VDC, 150W, AC Input

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