



# Evolution Series

## L-band Satellite Modem



**PARADISE  
DATACOM**

AN INTELK PLC COMPANY



### OVERVIEW

The Evolution Series L-band 52Mbps Open/Closed Network Modem is fully compliant with IESS-308, 309, 301, 314, 315 and offers a range of data interfaces including Ethernet, HSSI and serial LVDS, plus a range of modulation schemes including 16QAM. An optional integrated BUC / LNB power supply and 10MHz reference simplifies system architecture, and FSK control of the BUC is also available via the Modem.

The Evolution Series Satellite Modem embodies a new concept in modem design. The core of the Modem is implemented with programmable logic, which allows easy reconfiguration to the needs of the user, and provides future-proof flexibility.

### EASE OF OPERATION

The Modem firmware and software is easily upgraded through an Ethernet management port, plus an innovative new menu structure makes configuration a simple procedure. Advanced user interfaces support the display of text in different languages for universal appeal, and a unique Web User Interface offers full remote control and in-depth performance analysis tools using Internet Explorer without special Monitor & Control software.

### FEATURES

- ▶ Field upgradeable feature set
- ▶ 4.8kbps to 52Mbps in 1 bps steps
- ▶ RS422, X.21, V.35, RS232 interfaces, HSSI, Serial LVDS, G.703 E1/E2/E3/T1/T2/T3 (options) and Ethernet, IP Acceleration (optional)
- ▶ BUC control via FSK (optional)
- ▶ Ethernet Bridging, plus Brouting (optional)
- ▶ BPSK, QPSK, OQPSK, 8PSK (option) & 16QAM (option) Modulation
- ▶ Multi-rate 2nd Generation Turbo (TPC), Viterbi, TCM & Reed-Solomon FEC options
- ▶ 950 - 1950MHz L-band in 100Hz steps
- ▶ Closed Network, Closed Network + ESC, IBS/SMS (option) and IDR (option)
- ▶ Drop and Insert to E1/T1 (option) with extended functions: RBS, CAS
- ▶ Built-in 1:1 Redundancy Controller
- ▶ Embedded web server accessed via standard web browser for management and remote control
- ▶ DC Power to the LNB (standard), DC Power to the BUC (optional)
- ▶ 48V DC Primary Power input option

### REMOTE CONTROL & WEB USER INTERFACE

- ▶ Web User Interface available via embedded web server including Receive Spectrum Analyser, Receive Constellation Monitor, BER Tester and graphing of Eb/No, Rx Power, BER plus other parameters, using Internet Explorer.
- ▶ Ethernet with embedded web server and SNMP network management support
- ▶ RS485 multi-drop addressable
- ▶ M&C via Satellite ESC channel for distant control of Modems and other devices
- ▶ RS232 for direct PC connection

# Evolution Series

## L-band Satellite Modem (950 to 1950MHz)

Common Main Specifications	
Parameter	Evolution Series Modem
Modulation Scheme	BPSK, QPSK, OQPSK, 8PSK (Option), 16QAM (Option)
IF Frequency Range	950MHz to 1950MHz
IF Frequency Resolution	100Hz
Traffic Interface - Electrical	Ethernet (10/100 BaseT) IP Traffic on RJ45 with link and traffic indicators. Electronically Selectable with other interfaces fitted.
Traffic Interface - Options	RS422 including X.21 DCE and DTE emulation, V.35 and RS232 on EIA530 connector 25 pin female D-type (Option) EIA530 maximum 10Mbps, RS232 max 100kbps LVDS 25 pin female D-type (Option) HSSI 50 pin HD SCSI-2 connector (Option) G.703 balanced on EIA530 G.703 unbalanced on BNC female 75Ω
User Traffic Data Rate	4.8kbps - 8,448kbps Extends base operation to 16,896kbps (Option) Extends 16,896kbps to 25Mbps (Option) Extends 25Mbps to 52Mbps (Option) Extensions are cumulative
User Traffic Data Rate Resolution	1bps
Note	The combination of FEC Rate, Modulation scheme and Satellite Overhead limits the Traffic Data Rate Range in all modes.
User Data Rate Range - Closed Network	4.8kbps to 52Mbps no Satellite Overhead (with high Data Rate options)
User Data Rate Range - Minimum Overhead (Closed Network Plus ESC)	As Closed Network above except limits inclusive of overhead of approximately 1.4 times the ESC baud rate. Resolution of 1bps. Supports ESC rate from 110 baud to >38.4kbaud.
User Data Rate Range - IBS/SMS Option	4.8kbps to 10 Mbps (6.7% Satellite Overhead added). Resolution of 1bps.
User Data Rate Range - IDR Option	4.8kbps to 10 Mbps (96k overhead added) Resolution of 8k (limitation of frame structure)
Audio Channels Option (P1348 emulation mode)	Used with IBS/SMS satellite framing and IDR Options to provide 2 x audio 32kbps ADPCM coded channels within a 64kbps IBS carrier, and 2 x audio 32kbps ADPCM coded channels plus 64kbps data within a 128kbps IBS carrier
Inner Forward Error Correction	Viterbi BPSK/QPSK/OQPSK - Rates 1/2, 3/4, 7/8, k=7 to IESS-308/309 Option: TCM 8PSK - Rate 2/3 to IESS-310 Option: TPC BPSK/QPSK/OQPSK - Rates 5/16, 21/44, 0.493 (Paradise), 2/3, 3/4, 0.789 (Paradise), 7/8 (Paradise), Rate 7/8 de facto Options: TPC 8PSK - Rates 3/4 de facto, 7/8 de facto Options: TPC 16QAM - Rates 3/4 de facto, 7/8 de facto
Outer Forward Error Correction	Concatenated Intelsat Reed-Solomon Outer Codec to IESS308/310 with Custom Option offering variable code rate. Maximum traffic rate 10Mbps.
Scrambling - IBS/SMS Option	Synchronised to framing per IESS-309 up to 10 Mbps
Scrambling - IDR Option and Closed Network	With RS Coding; synchronised to RS overhead. Without RS Coding and Non-TPC FEC: V.35 self-synchronising No RS Coding with TPC FEC: 2 <sup>n</sup> 12 <sup>1</sup> up to 10 Mbps
Scrambling - Closed Network Plus ESC	32kbps or above; synchronised to ESC overhead. Less than 32kbps: as per closed network. V.35 Scrambler has CCITT Intelsat "FDC" and "Linkabit" modes up to 52Mbps (with high Data Rate options)
Scrambling - OM-73 Option	OM-73 compliant scrambling
L-band Connectors	N-type female
L-band Impedance	50Ω
Return Loss	14dB minimum
Internal Frequency Reference - Ageing	<1ppm/yr 7.5E-8/yr with High Stability Reference Option
External Reference	Clocking Only: 10MHz in 1kHz steps. Clocking and RF Frequency: 10MHz, 0dBm±1dB

Modulator Specifications	
Parameter	Evolution Series Modem
Output Power Level	-5 to -30dBm Continuously Variable in 0.1dB steps
Output Level Stability	±0.5dB
Transmit Filtering	Intelsat IESS compliant, α = 0.35
Occupied Bandwidth	1.2 times Symbol Rate
Recommended Channel Spacing	1.4 times Symbol Rate
Phase Accuracy	±2° maximum
Amplitude Accuracy	±0.5dB maximum
Carrier Suppression	-30dBc minimum
Output Phase Noise	As IESS-308, nominally 3dB better.
Output Frequency Stability	<1ppm/yr 7.5E-8/yr with High Stability Reference Option
Harmonics	Better than -55dBc/ 4kHz in band No worse than -45dBc out of band to 5GHz
Spurious	Better than -55dBc/ 4kHz in band No worse than -40dBc out of band 10MHz to 5GHz
Transmit On/Off Ratio	55dB minimum
External Transmit Inhibit	By external contact closure or by TTL signal applied to rear panel Alarms & AGC connector

Demodulator Specifications	
Parameter	Evolution Series Modem
Input Range	-20 to -70dBm wanted signal
Maximum Composite Signal	35dB above level of desired input up to a maximum of 10dBm
Frequency Acquisition Range	Selectable from ±1kHz to ±32kHz up to 10 Mbps (1kHz steps) ±10kHz to ±250kHz from 10 to 52 Mbps (10kHz steps)
Acquisition Threshold	<5dB Es/No QPSK
Acquisition Time	At 9.6kbps, less than 1s at 6dB Es/No. QPSK At 10 Mbps, less than 100ms at 6dB Es/No. QPSK
Clock Tracking Range	±100ppm minimum
Receive Filtering	Intelsat IESS compliant. α = 0.35
Performance Monitoring	Measured Eb/No (range 0-15dB, ±0.2dB). Measured Frequency Offset (100Hz resolution). Wanted signal level strength indicator centred on the middle of the Rx. Input range.
AGC Output	Buffered direct AGC output for antenna tracking etc

BER Performance					
		Rate 1/2	Rate 3/4	Rate 7/8	Rate 2/3
Viterbi	1E-4	4.7dB	6.1dB	7.1dB	
QPSK	1E-8	7.2dB	8.8dB	9.5dB	
Turbo (TPC)	1E-4	2.7dB	3.5dB	4.1dB	
QPSK	1E-8	3.3dB	4.5dB	4.5dB	
Turbo (TPC)	1E-4		5.6dB	6.8dB	
8PSK	1E-8		6.8dB	7.2dB	
Turbo (TPC)	1E-3		6.5dB	7.7dB	
16QAM	1E-7		7.8dB	8.2dB	
8PSK/TCM	1E-3				6.3dB
	1E-8				10.4dB
8PSK/TCM + Reed-Solomon (all rates)	1E-4				6.1dB
	1E-10				7.3dB

Clocking and Buffering Specifications	
Parameter	Evolution Series Modem
Clock Integrity	Frequency Locked Loops give phase-hit immune operation even with poor clock sources such as routers etc.
Tx Clocking	Internal Standard (±1ppm) 7.5x10E-8/yr with High Stability Option
	External Tracking range ±100ppm/min
Rx Clock	Slaves Tx timing from Rx clock. (Includes full asymmetric operation)
Rx Clocking	Buffer Disable Clock from Satellite
	Tx input clock Plesiochronous. (Includes full asymmetric operation)
Station Reference Inputs	Internal Standard (±1ppm) 7.5E-8/yr with High Stability Option
	External timing clock (DTE interface only) Station Reference (see below)
Buffer Size	75Ω BNC female Station Clock Connector, transformer isolated. 1MHz to 10MHz in 1kHz steps (accepts sinusoidal >0dBm or square-wave e.g. G.703 para 10)
	120Ω RS422 compatible input, 1MHz to 10MHz in 1kHz steps via Async ESC connector NB: When set to 10MHz, the station reference may replace internal reference to all internal circuitry and reference outputs on the I/F ports. The unit automatically switches back to internal reference if the station reference fails.
	Selectable in 1ms increments from 0ms to 99ms at data rates up to 42Mbps and from 0ms to 80ms at data rates from 42Mbps up to 52Mbps . Automatically adjusted to slip an integer number of terrestrial multi-frame lengths for framed rates Buffer storage: Maximum buffer size - 256kbytes

Framing and Deframing Specifications	
Parameter	Evolution Series Modem
Closed Network Format	Unframed, no overhead.
IBS/SMS Option Format	Intelsat IBS to IESS-309 and IESS-310 up to 10 Mbps, and Eutelsat SMS to EESS501.
IDR Option Format	Intelsat IDR to IESS-308 and IESS-310 up to 10 Mbps.
Closed Network plus ESC Format	Provides variable rate asynchronous ESC, optional synchronous scrambler above 32kbps to replace error multiplying V.35 scrambler, optional backward alarm facility and optional timeslot ID maintenance when used with Drop/Insert, all in minimum possible overhead down to <0.5%
Format of Other Modes	For custom options, see handbook.
Poor BER Performance	Deframer includes extended threshold operation that improves performance when used with Reed-Solomon in very poor BER conditions (where a single uncorrectable RS codeword can contain enough corrupt frame alignment words to knock an Intelsat specified deframer out of frame sync). Up to 10 Mbps

Intelsat Reed-Solomon Codec & Custom Option Specifications	
Parameter	Evolution Series Modem
Maximum traffic rate	10Mbps
Format	Concatenated Reed-Solomon outer codec to IESS-308/310
Code Rate	Default n, k, t = (126, 112, 7) depth 4. Automatically switches to: (225, 205, 10) depth 4 for 1544kbps IDR mode or (219, 201, 9) depth 4 for 2048kbps IDR mode and TCM<=1544kbps or (219, 201, 9) depth 8 for TCM >1544kbps.
Processing Delay (bits)	Combined encoder and decoder: 8 x (2n-k+60) Combined Interleaver/De-Interleaver: 8 x n x Depth (Calculate delay time using data rate including RS overhead).
Custom Option	When fitted allows arbitrary selection of n and k to provide fully variable code rate. 60<n<=255 (n-20)<k<=(n-2) in steps of 2. Interleaving depth of 4 or 8. The custom option allows use of shorter code words to reduce interleaver/de-interleaver delay on low data rate circuits.

Drop & Insert Option Specifications	
Parameter	Evolution Series Modem
Bearer Types	T1-D4, T1-ESF and E1-G.732
Timeslot Selection	Independent selection of arbitrary timeslots for both drop and insert.
Bearer Generation	The terrestrial bearer may be looped through the Drop Mux then Insert Mux, or terminated after the Drop Mux and a new blank bearer generated by the insert Mux. The bearer generated within the Insert Mux provides full multiframe and CRC support and may be generated from the Tx clock, station reference, satellite clock or internal reference.
Bearer Backup	In the event that the Insert Mux bearer clock is lost, or AIS is supplied, then the Insert Mux will switch temporarily to bearer generation mode in order to preserve the receive traffic. The backup bearer may be generated from the station reference, satellite clock or internal reference.
Terrestrial CRC	Fully supported, with front panel display of terrestrial error rate based on CRC (T1-ESF and G.732) or Frame Alignment Word errors (all bearer types).
Timeslot ID Maintenance	The IBS/SMS or Closed Net Plus ESC overhead maintains the identity of individual Drop/Insert timeslots for N=1,2,3,4,5,6,8,10,12,15,16,20,24 and 30. (See extended option below).

Extended Drop & Insert Option Specifications	
Parameter	Evolution Series Modem
Timeslot Re-Ordering	Selected timeslots may be independently re-ordered on both Tx and Rx paths.
Multi-Destination Working	All or only a subset of the received data may be inserted into the terrestrial bearer on the receive path for multi-Destination working.
Timeslot ID Maintenance	The IBS/SMS or Closed Net Plus ESC is extended to maintain the identity of individual timeslots for all values of N from 1 to 31.
Signalling	Both Channel Associated Signalling (CAS) and Robbed Bit Signalling (RBS) are fully supported. For G.732 Drop/Insert, CAS signalling is extracted from terrestrial TS16 and carried over the satellite in IBS/SMS TS16 and TS48 before re-inserting into the distant terrestrial TS16. For RBS, the IBS or Closed Net Plus ESC overheads maintain the identity of the in-band signalling and it is re-inserted into the terrestrial multi-frame in the correct positions to maintain the RBS.



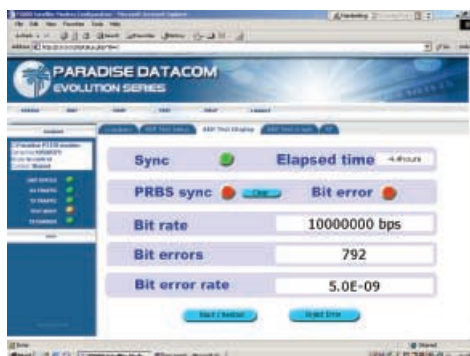
Advanced ESC and Advanced Aux Option Specifications	
Parameter	Evolution Series Modem
ESC/Aux Port	A single port provides the interface for optional high rate async ESC (IBS/SMS option or Closed Net Plus ESC) or the Intelsat low rate async IBS ESC channel.
Electrical Interface	RS232, RS422 or RS485 external interfaces or internal link to remote M&C port (software selected). Other devices externally wired in parallel with M&C port can also be accessed remotely.
Async ESC Option	Closed Net Plus ESC Overhead scales to provide any user specified async ESC baud rate whatever the satellite data rate. ESC limit is approximately 70% of main channel rate, overhead varies from <0.5% to >70%.
	IBS option High rate async data using from 1/32nd to 22/32nd of the IBS overhead, providing async baud rates from 0.2% to 5.1% of the terrestrial rate (e.g., up to >2400 baud at 64kbps). Includes modes compatible with the P300 and P400 Series, P230 & P1300/P1361 (using 20/32nd of the overhead).
IBS Aux Data Channel	With IBS option and Advanced Aux option: Intelsat low rate async ESC definition carried in bit 1 of TS32 providing a synchronous channel at 1/480th of the data rate, allowing up to one quarter of this rate for over-sampled async data. Compliant with Intelsat IESS-403 low rate ESC definition.

BERT Option Specifications	
Parameter	Evolution Series Modem
BER Channel	The BERT may operate through main traffic, ESC data or Aux data channels. Use of ESC & Aux data channels allows continuous real traffic BER performance monitoring whilst the modem carries traffic.
Test Patterns	2 <sup>n</sup> 11-1, 2 <sup>n</sup> 15-1, 2 <sup>n</sup> 20-1, selectable, compatible with common stand-alone BER testers.
Results	Display of error count and average BER.
Autolog	Automatic logging of average BER and other parameters at regular intervals.

Ethernet Traffic	
Parameter	Evolution Series Modem
Standard (unaccelerated)	Throughput depends on traffic format - formats such as UDP that do not require acknowledgements run at up to the maximum data rate of the modem - unaccelerated TCP (which requires acknowledgements) will typically run at up to 128kbps per connection, 80 Connections/Sec
PEP (TCP/IP acceleration) Option	Performance Enhancing Protocol (acceleration) for TCP/IP traffic - overcomes performance problems associated with TCP over satellite Maximum throughput 8448kbps
Traffic mode	Bridging (standard) for point-to-point operation Brouting (Option) for point-to-multipoint and satellite outbound plus non-satellite return.

AUPC Specifications	
Parameter	Evolution Series Modem
Modes of Operation	Monitor of distant Eb/No and BER only, full distant Eb/No maintenance. Unidirectional or Bi-directional operation.
Communication Link	Utilises asynchronous ESC channel on IBS/SMS, IDR and Closed Network plus ESC carriers (ESC from 300 baud, i.e., overheads down to less than 1%). Maximum data rate 10 Msps
User Parameters	Target Eb/No, positive power offset.

Simple to use BER Tester Option allows real time bit error measurements through traffic or ESC channel.

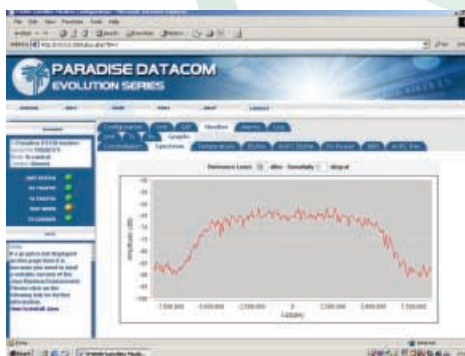


IDR Option Specifications	
Parameter	Evolution Series Modem
IDR ESC Audio	Two 32kbps ADPCM channels
Interface	4-wire 600Ω, +7dBm to -16dBm (programmable in 0.1dB steps).
Backward Alarms	Outputs: Four "form C" relays. Inputs: Four protected inputs, short to 0V to send alarm with matching summary Rx fail output. Alarm inputs software configurable for: a) All external patch, b) 1=Rx fail and 2-4 =external patch, c) 1=Rx fail and 2-4=OK, d) 1-4=Rx fail
ESC/Aux Ports	When the IDR option is fitted, independent ESC & Aux ports on the IDR option replace the single shared ESC/Aux port on the base unit.
ESC Port	RS232, RS422 or RS485 external interfaces or internal link to remote M&C port (software selected). No external cabling required between the ESC and M&C ports for M&C via ESC channel within overhead. Other devices externally wired in parallel with M&C port can also be accessed remotely. Provides clock, data and sync (octet timing) lines.
	IDR Synchronous access to 8kbps IDR ESC. With the Async ESC option, async ESC access to the 8kbps IDR ESC is provided giving up to a 9600 baud async channel
Others	IBS and Closed Net Plus ESC facilities as before installation of IDR option, but now on ESC port on IDR card not shared ESC/Aux port of base unit.
Aux Port	RS232 or RS422 (user selectable). Provides clock and data lines.
	IDR Provides 32 or 64kbps access in place of one or both audio ESC channels.
	IBS Intelsat low rate ESC mode as previously but now via Aux port on IDR card not shared ESC/Aux port of base unit. IDR option also adds sync IBS mode, configurable to use between 1/32nd and 21/32nd of the IBS overhead providing a full sync Aux port at between 0.2% and 4.3% of the main data rate. Aux port provides satellite timing information for P1500 slave Frequency Standard when not configured for Aux data access.

Traffic Log Specifications	
Parameter	Evolution Series Modem
Capacity	Over 6000 entries
Entry Format	Fault message with time and date stamp. Separate entry when fault clears/changes.

Unique Web User Interface provides full Monitor & Control plus graphing of Eb/No, BER, Receive Power and other operating parameters, plus a Receive Spectrum Analyser, Receive Constellation Monitor and BER Tester for detailed signal analysis and performance validation via Internet Explorer.

Built-in Spectrum Analyser for Receive Carrier, Adjacent Carrier and Super-Wide Monitoring (3 bandwidth settings).



Common Specifications	
Parameter	Evolution Series Modem
Loop-backs	Interface Loop (Local and Remote) Framer Loop (Local) RS Loop (Local) FEC Loop (Local) Deframer/Framer Loop (Remote) Internal IF loopback (local, automatically matching Rx IF frequency to Tx)
Test Modes	Transmit CW (Pure Carrier) Transmit Alternate 1-0 Pattern Wideband spectrum analyzer display
Alarm Relays	4 Independent Change-Over Contacts: Unit Fault, Rx Traffic Fault Tx Traffic Fault, Deferred Alarm (backward alarm, BER or Eb/No below user set threshold)
Controller	Motorola PowerPC
Embedded Software	Revised embedded software may be downloaded into FLASH memory via Ethernet port with modem remaining in equipment rack.
Configuration Memories	20 configurations can be stored and recalled from the front panel or remote M&C. Memories can be labeled with text string to aid identification.
User Interface	Clear and intuitive operator interface with plain English dialogue (other languages supported). Graphic display, backlight, high contrast, wide angle LCD. 17 key tactile full keyboard.
Remote Monitor and Control	For multi-drop applications, RS485 interface. For direct to PC applications, RS232 interface (front panel selectable). M&C port may be directly internally linked to ESC port for "over-the-satellite" M&C without cabling. Ethernet (10/100 BaseT) via RJ45, embedded Web server, SNMP agent V1, V2c
Redundancy Features	11 redundancy controller built in. "Y" cables passively split data maintaining impedances. IF inputs/outputs are passively split/combined outside the units. Off-line unit tri-states data outputs and mutes Tx carrier.
Monitor	0-10V analogue output (Signal level, Eb/No, or Rx offset frequency) on Alarms & AGC connector Buffered constellation monitor port on Async ESC connector
Mechanical	1U chassis - 410mm deep, including front panel handles and rear panel connectors and fans.
Weight	3.5 Kg
Power Supply	100-240VAC, +6%, -10%, 1A @100V, 0.4A @ 240V, 47-63Hz. Fused IEC connector (live and neutral fused). 48 Volts DC option
Safety	EN60950-1
EMC	EN55022 Class B (Emissions) EN55082 Part 1 (Immunity)
Environmental	Operating Temperature Range 0-50°C

BUC/LNB facilities	
Parameter	Evolution Series Modem
BUC Power Supply Options	Mains input, +48V DC 3A output (200W) to BUC via Tx IFL Mains input, +24V DC 5.5A output (200W) to BUC via Tx IFL +48V DC input, +48V DC output to BUC via Tx IFL
LNB Power	+15/24V 0.5A DC to LNB via Rx IFL (standard)
FSK Control Option	Requires a BUC Power Supply to be fitted. Allows monitor & control of a compatible BUC from the Modem, via the IFL
10MHz Reference via IFL Option	Requires the High Stability 7.5E-8/yr Reference Oscillator Option. 10MHz may be provided via the Tx IFL to the BUC and via the Rx IFL to the LNB

Built-in Receive Constellation Display for channel diagnostics.

