TELEDYNE
PARADISE DATACOM
A Teledyne Technologies Company

EVOLUTION Series
PD10L
L-Band Satellite Modem

OVERVIEW

The Evolution Series PD10L has been designed for cost-critical modem applications and discerning users who demand quality and reliability at an affordable price. This ***10Mbps*** capable modem offers full compliance with IESS-308, 309, 310, 314 & 315, plus a range of data interfaces including Ethernet. The Evolution Series Satellite Modem design is based on highly programmable logic giving the flexibility of instant feature upgrades and built-in future-proofing.

Advanced Bandwidth-Efficient Features

Evolution Series Modems contain a host of bandwidth-efficient features, which can all be used at the same time.

Paired Carrier™ overlays transmit and receive carriers reducing satellite bandwidth by up to 50%. Paired Carrier™ uses ViaSat's patented PCMA technology.

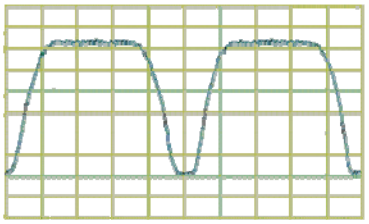
FastLink™ low-latency LDPC has been designed specifically for latency-sensitive applications while giving coding gain that is close to the theoretical limits.

Advanced bandwidth-saving IP features include acceleration and header and payload compression. A sophisticated on-board IP traffic shaping feature allows end-to-end provisioning of quality of service.

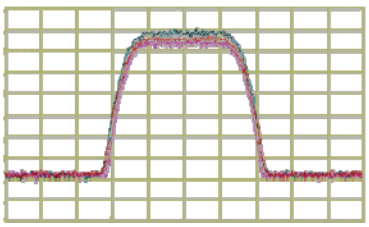
FEATURES

- Data rate options to 10Mbps, 5Msps
- Paired Carrier™ option.
- A wide range of terrestrial interfaces including Ethernet, serial and G.703.
- Advanced IP feature set including TCP acceleration, compression, routing, bridging, traffic shaping, ACM, VCM and throughput/diagnostic graphs.
- FastLink Low-Latency LDPC, 2nd Generation Turbo (TPC) and other FEC options.
- Modulations up to 64QAM.
- **New!** Patent-pending LinkGuard™ signal-under-carrier interference detection.

Paired Carrier™ Operation



Paired Carrier Disabled



Paired Carrier Enabled
Can save 50% on space segment

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EVOLUTION Series

PD10L L-Band Satellite Modem

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Main Specifications

Frequency	950 to 2050MHz (resolution 100Hz) (N -type connector)
Data Rate	4.8kbps to 10Mbps 1bps resolution Operation to 2,048kbps provided as standard; extension options to 5Mbps, 10Mbps
Symbol Rate	9.6ksps to 5Msps
Operating Modes	Closed Network (+ESC) (IESS-315) IBS/IDR (IESS-308/309/310/314) options (IDR includes audio channel option and P1348 emulation option)
Scrambling	IBS: Synchronised to framing per IESS-309 IDR with RS coding: Synchronised to RS overhead IDR, no RS coding, non-TPC FEC: V.35 self-synchronising IDR, no RS coding, with TPC FEC: 2^12-1 up to 10 Mbps Closed+ESC: Synchronised to ESC overhead
L-band Impedance	50Ω
Return Loss	14dB typical
Frequency Reference Stability	<4E-8/yr
External Reference	Clocking only: 1 to 10MHz, 1kHz steps Clocking and RF frequency: 10MHz, 0dBm±1dB
Redundancy	Can be operated in standalone, 1:1 or 1:N redundancy configuration

Traffic Interfaces

Base modem (standard):
Ethernet (10/100 BaseT) IP traffic on RJ45
Traffic options:
IP Traffic card 10/100/1000 BaseT on RJ45 (increases performance compared to base modem IP traffic)
RS422, X.21, V.35 and RS232 on EIA530 connector (25-pin D-type female)
Serial LVDS (25-pin D-type female)
G.703 (balanced on EIA530)
G.703 (unbalanced on BNC 75Ω female)
Quad E1 G.703 (balanced on RJ45)
HSSI (50-pin HD SCSI-2 connector)
Eurocom (D/1, D, C, G)

MultiMux option: generates a single carrier from any mixture of G.703, IP and EIA530 traffic

Modulator

Output Power	0 to –30dBm (0.1dB steps)
Output Power Stability	±0.5dB, 0ºC to 50ºC
Transmit Filter Roll-off	20%, 25%, 35%
Phase Accuracy	±2º maximum
Amplitude Accuracy	±0.2dB maximum
Carrier Suppression	-30dBc minimum
Output Phase Noise	As IESS-316, nominally 3dB better
Harmonics	Better than –55dBc/ 4kHz in band
Spurious	Better than –55dBc/ 4kHz in band
Transmit On/Off Ratio	55dB minimum
Adaptive Signal Predistorter Option	Use with 16QAM to relax HPA backoff by up to 1.6dB. Compensates for HPA non-linearities

Demodulator

Input Range	Minimum: -130+10 log symbol rate Maximum: -80+10 log (symbol rate)
Maximum Composite Signal	+10dBm
Wanted-to-composite Level	-102+10 log (symbol rate)
Frequency Sweep Width	±1kHz to ±32kHz up to 10 Msps (1kHz steps) ±10kHz to ±250kHz above 10 Msps (10kHz steps)
Acquisition Threshold	<5dB Es/No QPSK
Acquisition Time	Dependent on FEC, data rate and sweep width (at 9.6kbps, less than 1s at 6dB Es/No QPSK; at 10Mbps, less than100ms at 6dB Es/No QPSK)
Clock Tracking Range	±100ppm minimum
Receive Filter Roll-off	20%, 25%, 35%
Performance Monitoring	Eb/No (range 0-15dB, ±0.2dB) Frequency offset (100Hz resolution) Receive signal level Buffer fill status
AGC Output	Buffered direct AGC output for antenna tracking, etc.

Forward Error Correction

Modulation	BPSK, QPSK, OQPSK plus options for: 8PSK, 16QAM, FastLink 8QAM, FastLink 16APSK, FastLink 32APSK, FastLink 64QAM
FEC	Note BPSK and (O)QPSK provided as standard; other modulations are options FastLink Low-Latency LDPC option: BPSK 0.499 (O)QPSK 0.532, 0.639, 0.710, 0.798 8PSK/8QAM: 0.639, 0.710, 0.778 16APSK/16QAM: 0.726, 0.778, 0.828, 0.851 32APSK: 0.778, 0.828, 0.886, 0.938 64QAM: 0.828, 0.886, 0.938, 0.960 TPC option: BPSK 5/16, 21/44, 0.493 (Paradise), 2/3, 3/4, 0.789 (Paradise), 7/8 (Paradise), Rate 7/8 de facto (O)QPSK: 5/16, 21/44, 0.493 (Paradise), 2/3, 3/4, 0.789 (Paradise), 7/8 (Paradise), 7/8 de facto, 0.93 (Paradise) 8PSK: 3/4 de facto, 7/8 de facto, 0.93 (Paradise) 16QAM: 3/4 de facto, 7/8 de facto, 0.93 (Paradise) Viterbi: BPSK/(O)QPSK 1/2, 3/4, 7/8 TCM option: 8PSK 2/3 Sequential option: BPSK/(O)QPSK 1/2, 3/4, 7/8 Reed-Solomon outer codec available with Viterbi and TCM

Ethernet Traffic

Throughput Performance	*The maximum modem throughput depends on IP traffic format and the features enabled. Bridged IP/UDP data can be processed up to the modem maximum data rate. Please seek assistance from Paradise Datacom in evaluating your particular requirements.*
Routing and Bridging	Bridging (standard). Static routing (standard). Dynamic routing option: RIP V1, V2; OSPF V2, V3; BGP V4
TCP Acceleration Option	Typical throughput level of 90% of link capacity. IP Traffic card option: Supports 5,000 concurrent accelerated TCP connections (plus at least 35,000 unaccelerated TCP connections) up to the modem maximum data rate. Base modem TCP acceleration option is restricted to 1000 accelerated TCP connections and 10Mbps. IP Traffic card includes HTTP Acceleration (reduces web page download times)
Header Compression Option	IP Traffic card option. Robust Header Compression to RFC 3095. Reduces Ethernet/IP/UDP/RTP header sizes typically by 90%. 1-way packet processing limit: 29,000 pps; 2-way limit: 22,000 pps. Includes Ethernet header compression (compresses 14-byte Ethernet frame to typically one byte)
Traffic Shaping Option	Provides guaranteed throughput levels for IP streams, using Committed Information Rate and Burst Information Rate settings. Stream differentiation is by IP address, IEEE 802.1p priority class, Diffserv DSCP class or MPLS EXP field
Encryption Option	Encrypts all IP traffic using AES with 256-bit keys
VLAN Support	IEEE 802.1q VLAN support (standard)
	IEEE 802.1p Quality of Service (packet prioritisation) using strict priority or fair weighting queuing
DHCP, SNMP	DHCP (standard) for automatic allocation of M&C IP address. SNMP (standard) v1, v2c and v3
Web Server	Embedded web server M&C interface (standard)
IP Diagnostic Graphs	Shows Tx, Rx throughput (bps, pps); dropped, errored packet counts (standard)

EVOLUTION Series

PD10L L-Band Satellite Modem

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Paired Carrier

Paired Carrier	Transmit and receive carriers are overlaid on top of each other in the same space segment. Echo cancellation techniques are used in the demodulator to cancel the transmit carrier and extract the wanted receive carrier signal
Paired Carrier data rate options	256kbps, 512kbps, 1024kbps, 2.5Mbps, 5Mbps, 10Mbps (30kHz minimum occupied bandwidth; operates to maximum symbol rate of modem)
Supported power asymmetry	-10dB to +10dB
Supported symbol rate asymmetry	Up to 12:1
Eb/No degradation	Typically < 0.5dB (0.7dB for 16QAM/16APSK with 10dB power asymmetry)
Mobile Operation	Uses GPS data to continually recalculate position relative to satellite, allowing uninterrupted operation in mobile environments (ships, etc.) anywhere in satellite footprint

Drop & Insert Option

Bearer Types	T1-D4, T1-ESF, E1-G.732
Timeslot Selection	Independent selection of arbitrary timeslots for both drop and insert.
Bearer Generation	Terrestrial bearer may be looped through modem, or terminated after Drop Mux and a new bearer generated by the insert Mux
Timeslot ID	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

Timeslot Re-Ordering	Selected timeslots may be independently re-ordered on both Tx and Rx paths
Multi-Destinational Working	All or only a subset of the received dat a may be inserted into the terrestrial bearer on the receive path for multi-destinational working
Timeslot ID Maintenance	The framed service is extended to maintain the identity of individual timeslots for all values of N from 1 to 31
Signalling	CAS and RBS are fully supported

Advanced ESC

ESC/Aux Port	Provides high rate async ESC or Intelsat low rate async IBS ESC	
Electrical Interface	IP, RS232, RS422 or RS485	
Async ESC	Closed Net Plus ESC	Overhead scales to any ESC baud rate from 0.5% to 70% of the main channel rate
	IBS Option	High rate async channel (1/32nd to 2/32nd of the IBS overhead) providing async baud rates from 0.2% to 5.1% of the terrestrial rate
Advanced Aux	Intelsat low-rate async ESC 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	

Guaranteed Eb/No BER Performance (dB)
(Typical in brackets)

		Rate 1/2	Rate 3/4	Rate 7/8	Rate 2/3	Rate 0.93
Viterbi QPSK	1E-4	4.7 (4.4)	6.1 (5.8)	7.1 (6.8)		
	1E-8	7.2 (6.9)	8.8 (8.5)	9.5 (9.2)		
Sequential (64kbps)	1E-4	4.3 (4.0)	5.4 (5.1)	6.4 (6.1)		
	1E-8	6.4 (6.1)	7.3 (7.0)	8.6 (8.3)		
Sequential (2048kbps)	1E-4	5.6 (5.3)	6.1 (5.8)	6.9 (6.6)		
	1E-8	7.5 (7.2)	8.1 (7.8)	8.4 (8.1)		
Turbo (TPC) QPSK	1E-4	2.7 (2.4)	3.5 (3.2)	4.1 (3.8)		
	1E-6					6.3 (6.0)
	1E-8	3.3 (3.0)	4.5 (4.2)	4.5 (4.2)		6.8 (6.5)
Turbo (TPC) 8PSK	1E-4		5.6 (5.3)	6.8 (6.5)		
	1E-6					9.2 (8.9)
	1E-8		6.8 (6.3)	7.2 (6.8)		9.9 (9.6)
Turbo (TPC) 16QAM	1E-3		6.5 (6.2)	7.7 (7.4)		
	1E-6					10.0 (9.7)
	1E-7		7.8 (7.5)	8.2 (7.8)		
	1E-8					10.7 (10.4)
8PSK/TCM	1E-3				6.3 (6.0)	
	1E-8				10.4 (10.1)	
8PSK/TCM + Reed-Solomon (all rates)	1E-4				6.1 (5.8)	
	1E-10				7.3 (7.0)	

FASTLINK LOW-LATENCY LDPC: SEE SEPARATE DATASHEET

BUC/LNB Facilities

BUC PSU Options	See Configuration Options at end of datasheet
LNB Power	+15/24V 0.5A DC to LNB via Rx IFL
FSK Option	Allows monitor and control of a compatible BUC from the modem via the Tx IFL
10MHz Reference (via IFL to BUC/LNB)	10MHz output level to BUC: +3dBm (+/-1dBm) 10MHz output level to LNB: 0dBm (+/-1dBm)

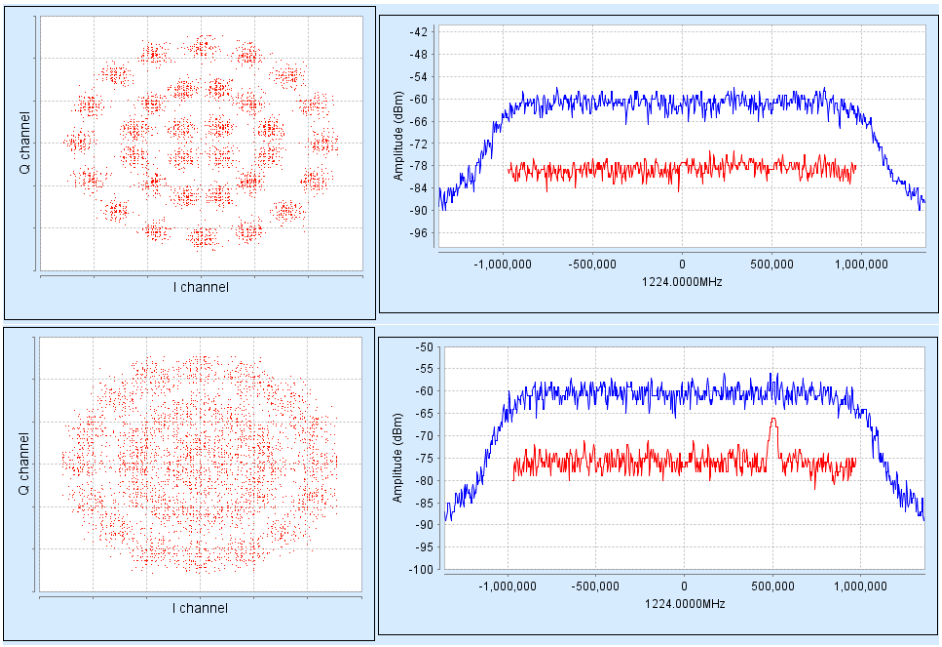
EZ BERT Option

BER Channel	Bit error rate tester operates over main traffic, ESC or Aux channels, allowing BER monitoring while on traffic
Test Patterns	Various test patterns compatible with common BERtesters
Other test modes	Transmit CW (pure carrier) Transmit alternate 1-0 pattern Simulated satellite delay for TCP/IP packets

Mechanical/Environmental

Size	1U chassis, 410mm deep excluding front panel handles and rear panel connectors and fans
Weight	3.5kg
Power Supply	100-240VAC, +6%, -10%, 1A @100V, 0.5A @ 240V, 47-63Hz Fused IEC connector (live and neutral fused); 48V DC option
Safety Standards	EN60950-1
Emission and Immunity	EN55022 Class B (Emissions) EN55024 (Immunity)
Operating Temperature	0 to 50ºC
Humidity	95% relative humidity, non-condensing
Compliance	FCC, CE and RoHS compliant
Alarm Relays	4 Independent Form C relays for unit, Tx, Rx and backward alarms

Built-in Spectrum Analyser showing **LinkGuard™** *Signal-Under-Carrier interference detection without/with interferer present.*



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Fully configurable - pay only for what you need!

	Option	Description
Base Modem	✓	**4.8kbps to 2.048Mbps closed network modem with Ethernet 10/100 BaseT RJ45 for M&C** **L-band operation 950 to 2050MHz**; high-stability 10MHz reference BPSK/QPSK/OQPSK; Viterbi FEC rates 1/2, 3/4 & 7/8; Intelsat Reed-Solomon outer codec Advanced ESC: Variable rate Async channel for Closed Net plus ESC operation AUPC: Automatic Uplink Power Control Web browser monitoring tools: Spectrum Display, Constellation Monitor, TCP/IP throughput IEEE 802.1p QoS; IEEE 802.1q VLAN support G.703 E1 via BNC interface (requires EIA-530 for E1 120 ohm balanced or T1 operation) EZ BERT Internal Bit Error Rate Tester
Data Rate Options		5Mbps data rate: extends base operation to 5Mbps
		10Mbps data rate: extends 5Mbps operation to 10Mbps
IP Traffic Interface (on base modem)		Ethernet 10/100 BaseT on RJ45 for traffic; Ethernet bridge; static routing; IPv4/IPv6 support; IEEE 802.1p QoS; IEEE 802.1q VLAN support
IP Options *(all features require IP Traffic card other than 10Mbps TCP acceleration)*		Traffic Shaping: supports CIR/BIR/priority settings for IP streams classified by IP address, Diffserv class, IEEE 802.1p priority tag or MPLS EXP field
		Header Compression: IP/UDP/TCP/RTP packet header compression (RFC 3095) plus Ethernet header compression
		Payload Compression: TCP/UDP packet payload compression using the Deflate algorithm (RFC 1951)
		Encryption: TCP/IP packet payload encryption using AES with 256-bit keys
		Dynamic Routing: RIP, OSPF, BGP plus static routes
		Web Page Acceleration: acceleration of HTTP requests through pre-fetching of web page contents (requires TCP Acceleration)
		TCP Acceleration: to 10Mbps, subject to prevailing modem data rate limits
Position 1 (must choose 1 option) **hardware option**		EIA-530 (D25 DCE providing selectable RS422/X.21/V.35/RS232, also balanced G.703)
		IDR (IESS 308)
		Blank panel
Position 2 (must choose 1 option) **hardware option**		IP Traffic card (2x10/100/1000 BaseT RJ45)
		EIA-530 (D25 DCE providing RS422/X.21/V.35/RS232, also balanced G.703)
		Quad E1 Multiplexer (balanced G.703 on 4xRJ45 of which one is enabled by default; includes Drop & Insert and IBS satellite framing)
		Serial LVDS (on D25)
		HSSI (on HD50 50-way SCSI-2 connector)
		Blank panel
Position 2 Quad E1 Mux options (only used with Quad E1 Mux card)		Adds Port 2 with Drop & Insert (requires Quad E1 Mux plus data rate option to 5Mbps)
		Adds Port 3 with Drop & Insert (requires Quad E1 Mux with Port 2 option plus data rate options to 10Mbps)
		Adds Port 4 with Drop & Insert (requires Quad E1 Mux with Port 2 & 3 options plus data rate options to 10Mbps)
		MultiMux: multiplexes any mixture of E1, IP and EIA-530 traffic types onto a single carrier; see separate Quad E1 application note for further details
Low-rate TPC *Subject to prevailing data rate limits*		Rates 5/16, 21/44, 3/4 in BPSK, QPSK, OQPSK; Rate 7/8 in QPSK, OQPSK; Rate 0.93 Paradise in QPSK, OQPSK; Rates 3/4, 7/8, 0.93 Paradise in 8PSK (requires 8PSK option); Rates 3/4, 7/8, 0.93 Paradise in 16QAM (requires 16QAM option) *(10Mbps maximum data rate)*
LinkGuard™		Signal-under-carrier interference detection web spectrum graph showing received spectrum and any interference underneath the received carrier while on traffic; automated alarm when interference rises above user-set threshold; supported for all non-DVB-S2 FECs and modulations

Configuration options continue on next page.

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	Option	Description
Paired Carrier™ *Subject to prevailing modem data rate limits. Occupied bandwidth: minimum 30kHz; operates to maximum symbol rate of modem*		Paired Carrier™ hardware option (requires one or more options below); allows Tx & Rx carriers to be overlapped, reducing the required satellite bandwidth
		Paired Carrier™ up to 256kbps (requires Paired Carrier™ hardware option)
		Extends Paired Carrier™ up to 512kbps
		Extends Paired Carrier™ up to 1.024Mbps
		Extends Paired Carrier™ up to 2.5Mbps
		Extends Paired Carrier™ up to 5Mbps
		Extends Paired Carrier™ up to 10Mbps
FastLink™ Low-latency LDPC FEC *subject to prevailing modem data rate limits*		FastLink™ LDPC hardware option (requires one or more additional FastLink™ options below); BPSK & QPSK provided as standard; also supports 8PSK, 8QAM, 8QAM, 16QAM, 32APSK & 64QAM subject to selection of these options
		FastLink™ LDPC up to 1Mbps (requires FastLink LDPC hardware option)
		Extends FastLink™ LDPC to 2.5Mbps
		Extends FastLink™ LDPC to 5Mbps
		Extends FastLink™ LDPC to 10Mbps
		8QAM
		16APSK
		32APSK
		64QAM
8PSK (Includes TCM)		Note use of 8PSK other than with TCM requires either FastLink™ LDPC or TPC FEC option Rate 2/3 8PSK Pragmatic TCM to IESS 310
16QAM		16QAM (requires either FastLink™ LDPC or TPC FEC option)
Tx-only operation		Transmit functions only
Rx-only operation		Receive functions only
24V 100W BUC PSU		P3532 AC input, 24V 100W DC to Tx BUC (hardware option)
48V 100W BUC PSU		P3531 AC input, 48V 100W DC to Tx BUC (hardware option)
24V 200W BUC PSU		P3536 AC input, 24V 200W DC to Tx BUC (hardware option)
48V 200W BUC PSU		P3535 AC input, 48V 200W DC to Tx BUC (hardware option)
48V DC Input		K3002 48V DC primary power supply input in place of 100-240V AC (hardware option)
48V in & 24V BUC PSU		K3002 + P3538: floating 48V DC input, 24V 200W DC to Tx BUC (hardware option)
48V in & 48V BUC PSU		K3002 + P3537: floating 48V DC input, 48V 200W DC to Tx BUC (hardware option)
+48V in & 48V BUC PSU		K3002 + P3539: +48V DC input, +48V 200W DC to Tx BUC (hardware option)
IBS		Satellite Framing to IESS 309 with low rate Intelsat ESC (to IESS 403) & High Rate IBS ESC
Drop / Insert (includes Extended D/I)		G.703 T1/E1 Drop & Insert; E1 CAS & T1 RBS signaling; Rx partial insert for multi-destinational working; timeslot ID maintenance for N=1 to 31
Clock Extension		Provides a high-stability reference clock over satellite (alternative to GPS)
Advanced AUX		Variable rate synchronous Aux channel; option to replace IDR audio channels with serial data
Custom		Custom Reed-Solomon values of n, k & interleaver depth; custom IBS modes; allocation of overhead between ESC & Aux; custom backward alarms
OM-73		OM-73 Scrambling, symbol mapping and Viterbi compatibility
FSK Control Option		Allows monitor & control of a compatible BUC from the Modem (hardware option)
Adaptive Signal Predistorter		Use with 16QAM to relax HPA backoff by up to 1.6dB. Compensates for HPA non-linearities in ground segment and/or transponder. Requires 16QAM option.
Ruggedisation		Adds extra ruggedisation for hostile environments (extra fans, heatsinks, etc.)
Sequential FEC		Rates 1/2, 3/4, 7/8 in BPSK, QPSK, OQPSK to 2.048Mbps
Audio		P1348 emulation mode for IBS 64kbps carrier (2 x audio) or 128kbps (2 x audio + 64kbps data) - requires IBS / SMS & IDR options