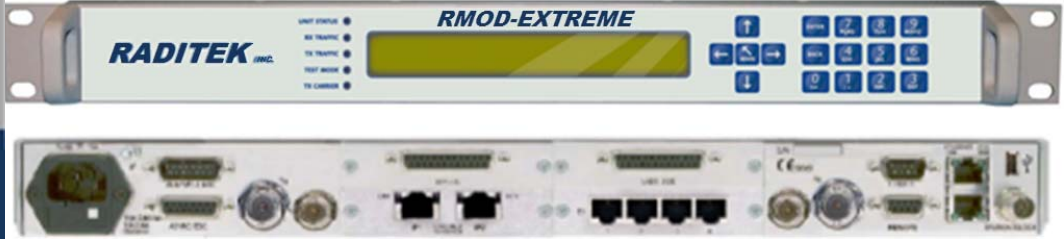


# SCPC-EXTREME Satellite Modem to 64QAM, with data rate: 18K-155 Mbps & dual IF: 70/140M and L band



RADITEK's new *software-defined modem*, the SCPC Extreme modem has a multiband IF: 70MHz, 140MHz and L band. The *hardware platform* has a powerful processor that makes it ideal for handling high speed IP traffic. The modem can be fitted with virtually any standard type of terrestrial interface and *software activated options* will allow it to operate at data rates up to 155Mbps.

*Low cost software activated options* allow you to enable only the features you need at the time, and you can upgrading as needed. Upgrades requiring hardware additions include: the Quad RAD Mux and LDPC+.

### Advanced Bandwidth-Efficient Features

This RMOD-EXTREME has the most powerful SCPC, bandwidth-saving features, such as:

**Simu-Carrier**, which shares the same transmit and receive frequency reducing satellite bandwidth by up to (in some cases) a full 50% at the expense of some Transmit power. NOTE: Using our LDPC+ will save around 2 dB excess Eb/No. Using our **AUPC** (Uplink Power Control), several more dBs can be saved too. This can allow perfect transponder loading and significant cost savings, especially in the case where there is no excess satellite Tx power penalty/cost (such as operating own satellite).

- **Low-latency LDPC+** has been designed for Eb/No extending applications (1 to 2 dB better than TPC)
- **DVB-S2** option is also available.
- Advanced bandwidth-saving IP features include acceleration and header and payload compression.

### Optional features:

- **Multi IF band support:** (70M/140MHz and L-band)
- Data rates 18Kbps to 155Mbps
- DVB-S2-/ACM, to 16APSK. LDPC/BCH, TPC FEC options
- Terrestrial interface options including Ethernet: EIA-530, G.703 (balanced & unbalanced), OC-3, STM-1, Serial LVDS, ASI, HSSI, Quad E1,
- Modulation up to 64QAM
- Simu-Carrier option (reusing uplink frequencies)
- Uplink Power control (AUPC)
- Signal-under-carrier real time interferer detection tool
- Built-in spectrum and constellation monitors tool
- IPv6 compliant
- Drop and insert: T1-D4, T1-ESF, E1-G.732
- Interoperable with other Raditek SCPC modems
- Feature-based pricing and corresponding Software upgradeable features, for many options.
- Advanced ESC: High rate Async and low rate IBS.

### Applications include:

- IP trunking/backhaul
- Mobile backhaul
- SNG
- Maritime communications
- Corporate networking
- Disaster recovery
- Satellite news gathering
- G.703 backhaul
- Advanced IP feature set options, including:
  - TCP acceleration
  - HTTP acceleration,
  - Routing, bridging, encryption
  - ACM (DVB-S2)
  - Header and payload compression
  - Traffic shaping
  - AES 256 encryption (limited availability)

### Part Number: RMOD-Extreme-p3

Description: (High Performance Satellite Modem: EXTREME)

Options	Data Rate	DVBS2	Simu Carrier	Modulation	SCPC	LDPC+
RMOD-EXTREME-p3						

Specifications may be subject to change

10/09/13

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## SCPC Satcom Modem (18K-155 Mbps), (IFs: 70, 140MHz & L band), BPSK to 64QAM, RMOD-EXTREME-p3

Specifications	
Frequency	IF: 50 to 90MHz & 100 to 180MHz (resolution 100Hz) (BNC f/m connector) L-band: 950 to 2050MHz (resolution 100Hz) (N-type f/m connector)
Data Rate	DVB-S2: 50kbps to 155Mbps LDPC+: 4.8kbps to 100Mbps TPC: 4.8kbps to 60Mbps 1bps resolution Operation to 2,048kbps-standard. Options to 5Mbps, 10Mbps, 25Mbps, 60Mbps, 100Mbps and 155Mbps
Symbol Rate	DVB-S2: 100ksps to 45Msps Non-DVB-S2: 9.6ksps to 40Msps
Operating Modes	DVB-S2 (EN 302 307) option Closed Network (+ ESC) (IESS-315) IBS/IDR (IESS-308/309/310/314) options
Scrambling	DVB-S2: as per EN 302 307 IBS: Synchronized to framing per IESS-309 Closed Network + ESC: Synchronized to ESC overhead
Impedance	IF: 50Ω/75Ω L-band: 50Ω
Return Loss	IF: 18dB typical L-band: 14dB typical
Frequency Reference Stability	Ageing <4E-8/yr
External Reference	Clocking only: 1 to 10MHz, 1kHz steps Clocking and RF frequency: 10MHz, 0dBm±1dB
Redundancy	Standalone, 1:1 or 1:N redundancy configuration
Traffic Interfaces	
<b>Base modem (standard):</b> Ethernet (10/100/1000 BaseT) IP traffic on RJ45. Processing capability: 100,000 packets per second <b>Traffic options:</b> EIA-530 (RS422, X.21, V.35 and RS232 on 25-pin D-type female) G.703 (balanced on RJ-45; unbalanced 75Ω BNC female) Quad E1 G.703 (balanced RJ45) Quad ASI (75Ω BNC) STM-1/OC-3/Optical Gigabit Ethernet (small form-factor pluggable module) Serial LVDS (25-pin D-type female), HSSI 50pin HD SCSI-2 connector (50-pin f/m D connector)	
<b>RadMux (4 port Mux) option:</b> Combines from: G.703, IP and EIA-530 traffic (requires Quad E1 option)	

Modulator	
Output Power	IF: 0 to -25dBm (0.1dB steps) L-band: 0 to -30dBm (0.1dB steps)
Output Power Stability	±0.5dB, 0°C to 50°C
Transmit Filter Roll-off	5, 10, 15, 20%, 25%, 35%
Phase Accuracy	±2° maximum
Amplitude Accuracy	±0.2dB maximum
Carrier Suppression	-30dBc minimum
Output Phase Noise	To IESS-316, typ. 3dB better
Harmonics	Better than -55dBc/ 4kHz in band
Spurious	Better than -55dBc/ 4kHz in band
Transmit On/Off Ratio	55dB minimum
Demodulator	
Input Range	IF minimum: -115+10 log (symbol rate) L-band minimum: -130+10 log (symbol rate) IF/L-band maximum: -80+10 log (symbol rate)
Maximum Composite Signal	+10dBm
Wanted-to-composite Level	IF: -94+10 log (symbol rate) L-band: -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 than 100ms at 6dB Es/No QPSK)
Clock Tracking Range	±100ppm minimum
Receive Filter Roll-off	5, 10, 15, 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.

## SCPC Satcom Modem (18K-155 Mbps), (IFs: 70, 140MHz & L band), BPSK to 64QAM, RMOD-EXTREME-p3

Forward Error Correction	
Modulation	<b>1. DVB-S2 (Option):</b> QPSK, 8PSK, 16APSK <b>2a. Non-DVB-S2:</b> BPSK, QPSK, OQPSK <b>2b. Plus options for:</b> 8PSK, 16QAM, <b>2c. Low Latency LDPC+:</b> 8QAM, 16APSK, 32APSK, 64QAM
FEC	<b>1. DVB-S2 (LDPC/BCH) option:</b> QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10  <b>2. Non-DVB-S2:</b> Note <u>BPSK and (O)QPSK provided as standard</u> ; other modulations are optional:  <b>3. Low-Latency LDPC+ option:</b> 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  <b>4. TPC option:</b> BPSK: 5/16, 21/44, 2/3, 3/4, 0.493, 7/8, Rate 7/8 de facto, 0.789, (O)QPSK: 5/16, 21/44, 2/3, 3/4, 0.493 7/8, 7/8 de facto, 0.789, 0.93 8PSK: 3/4 de facto, 7/8 de facto, 0.93 16QAM: 3/4 de facto, 7/8 de facto, 0.93  <b>5. Viterbi:</b> BPSK/(O)QPSK 1/2, 3/4, 7/8  <b>6. TCM option:</b> 8PSK rate:2/3  <b>7. Sequential option:</b> BPSK/(O)QPSK 1/2, 3/4, 7/8  <b>8. Reed-Solomon:</b> 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 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. Supports 5,000 concurrent accelerated TCP connections (plus at least 35,000 unaccelerated TCP connections) up to the modem maximum data rate.
Header Compression Option	Header Compression to RFC 3095. Reduces Ethernet/IP/UDP/ TCP/RTP header sizes typically by 90%. 1-way packet processing limit: 60,000 pps; 2-way limit: 45,000 pps. Includes Ethernet header compression (compresses 14-byte Ethernet frame to typically one byte)
Payload Compression Option	Uses Deflate algorithm (RFC 1951) to compress all TCP/IP packets (TCP and UDP), typically resulting in compression of payloads by 50%
Traffic Shaping Option	Reliable throughput levels for IP streams, using committed info. rate and Burst Info. Rate settings. Stream differentiation is by IP address, IEEE 802.1p priority class, Diff serv DSCP class or MPLS EXP field
Encryption Option	Encrypts all IP traffic using AES with 256-bit keys
IPv6	Provided as standard. Dual IPV4/ IPV6 TCP/IP stack allowing use of both IPv4 and IPv6 addresses for bridging and routing of traffic
VLAN Support	IEEE 802.1q VLAN support (standard) IEEE 802.1p Quality of Service (packet prioritization) 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)
IP over DVB-S2 Encapsulation Option	Supports encapsulation/ decapsulation of MPE (EN301192), ULE (RFC4326) Or RADITEK's advanced RXE
DVB-S2 ACM (option)	Dynamically varies mod/cod with varying link conditions, maximizing throughput at all times by converting unused link margin into additional throughput

## SCPC Satcom Modem (18K-155 Mbps), (IFs: 70, 140MHz & L band), BPSK to 64QAM, RMOD-EXTREME-p3

ODU facilities via IF interface	
FSK Control	Allows monitor & control of a compatible L-band BUC or IF Transceiver from the modem via the Tx IFL cable
Simu-Carrier	
Simu-Carrier	Transmit and receive carriers share/reuse the same bandwidths. Special digital techniques are used in the demodulator to cancel the transmit carrier leaving the receive carrier signal.
Simu-Carrier data rate options	256kbps, 512kbps, 1024kbps, 2.5Mbps, 5Mbps, 10Mbps, 15Mbps, 20Mbps, 25Mbps, 30Mbps, 40Mbps, 50Mbps, 60Mbps, 80Mbps, 100Mbps and 155Mbps traffic rate (30kHz to 54MHz occupied bandwidth)
Power asymmetry	-10dB to +10dB
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 update the position allowing uninterrupted operation in mobile environments (ships, etc.) anywhere in the satellite footprints.

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-next)

Extended Drop & Insert Option	
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	Maintains the identity of individual timeslots for all values of N from 1 to 31
Signaling	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
Async ESC	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	

## SCPC Satcom Modem (18K-155 Mbps), (IFs: 70, 140MHz & L band), BPSK to 64QAM, RMOD-EXTREME-p3

<b>DVB-S2 Performance at BER 1E-6 Guaranteed Es/No (dB) for Normal (64k) Frames</b>											
	Rate 1/4	Rate 1/3	Rate 2/5	Rate 1/2	Rate 3/5	Rate 2/3	Rate 3/4	Rate 4/5	Rate 5/6	Rate 8/9	Rate 9/10
QPSK	-1.6	-0.7	0.3	1.5	2.8	3.4	4.3	5.0	5.5	6.5	6.7
8PSK					6.4	7.2	8.5		9.8	11.0	11.3
16APSK						9.7	10.8	11.6	12.2	13.4	13.7

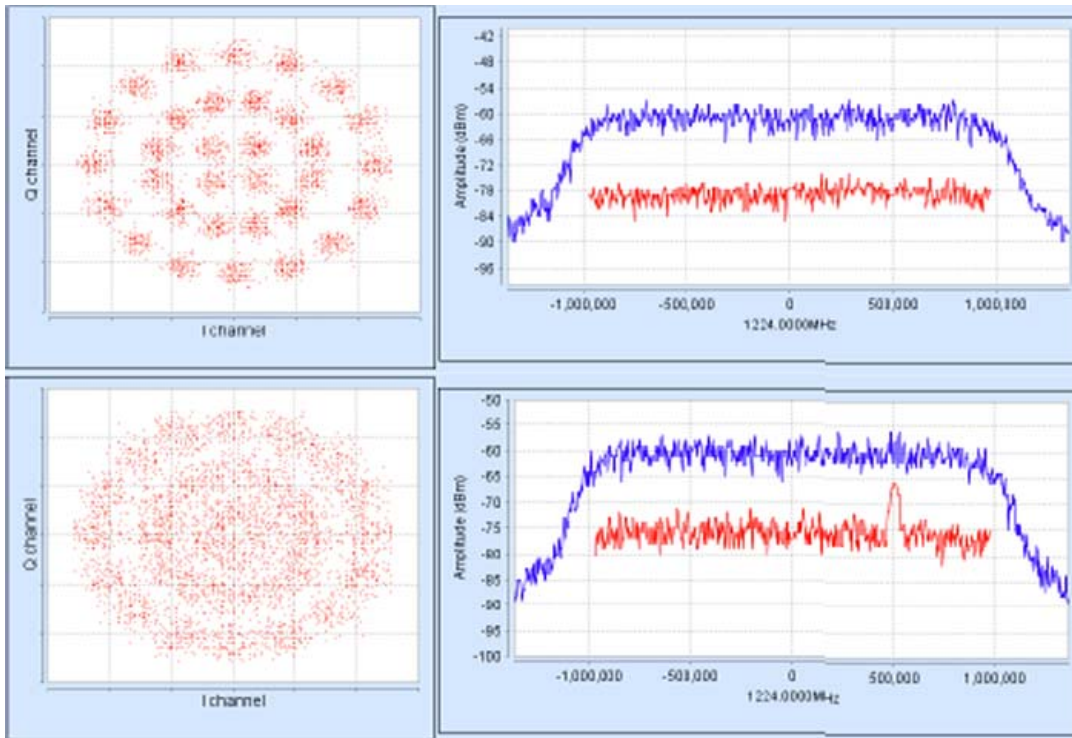
<b>DVB-S2 Performance at BER 1E-6 Guaranteed Es/No (dB) for Short (16k) Frames</b>											
	Rate 1/4	Rate 1/3	Rate 2/5	Rate 1/2	Rate 3/5	Rate 2/3	Rate 3/4	Rate 4/5	Rate 5/6	Rate 8/9	Rate 9/10
QPSK	-1.3	-0.4	0.5	1.9	3.0	3.5	4.4	5.2	5.6	6.7	
8PSK					6.5	7.3	8.6		9.9	11.2	11.3
16APSK						9.8	11.1	11.7	12.3	13.5	

<b>Guaranteed Eb/No BER Performance (dB) (Typical in parentheses)</b>						
		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)
2Turbo (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-6				10.4 (10.1)	
8PSK/TCM + Reed-Solomon (all rates)	1E-4				6.1 (5.8)	
	1E-10				7.3 (7.0)	

## SCPC Satcom Modem (18K-155 Mbps), (IFs: 70, 140MHz & L band), BPSK to 64QAM, RMOD-EXTREME-p3

Mechanical Environmental	
Size	1U chassis, 410mm deep excluding front panel handles and rear panel connectors and fans
Weight	3.5kg
Power Supply	90-250VAC, 1A @100V, 0.5A @ 240V, 47-63Hz Fused IEC connector (live and neutral fused); 48V DC optional
Safety Standards	EN60950-1 2006
Emission and Immunity	EN55022 2006 Class B (Emissions) EN55024 1998 A1 + A2 (Immunity)
Operating Temperature	0 to 50°C
Compliance	FCC, CE and RoHS compliant
Humidity	95% relative humidity, non-condensing
Alarm Relays	4 Independent Form C relays for unit, Tx, Rx and backward alarms

BER Testing Option	
BER Channel	Bit error rate tester operates over main traffic, ESC or Aux channels, allowing BER monitoring while on traffic. Not available in DVB-S2 mode
Test Patterns	Various test patterns compatible with common BER testers
Other test modes	Transmit CW (pure carrier) Transmit alternate 1-0 pattern Simulated satellite delay for TCP/IP packets
<b>IF cable power (and reference) summary</b>	
LNB reference	10M ±0.001ppm, 0dBm ±3 dB
LNB power	15V or 24V 0.5A
BUC power	24 or 48V, 200W



**Carrier Under Carrier, interference monitoring plots, showing an interferer, in real time, that is invisible to a regular Spectrum analyzer, when the data traffic is running. Eb/No degradation is optionally programmable, to alarm at a preset level.**

## SCPC Satcom Modem (18K-155 Mbps), (IFs: 70, 140MHz & L band), BPSK to 64QAM, RMOD-EXTREME-p3

### How does the RMOD-EXTREME-p3 compare to others?

Regarding the Comtech CDM625, for example, EDMAC is a COMTECH ESC channel proprietary command protocol. RADITEK modems do not support EDMAC, per se, but we do have equivalent ESC command protocols.

Some highlights for the RMOD-EXTREME-p3 include:

- Data rates from 18kbps to 10Mbps ( up to 155Mbps).
- Modulations from BPSK to 16QAM (but also 16APSK, 32APSK and 64QAM).
- The equivalent ESC channel control to EDMAC/EDMAC 2.
- Drop & Insert for Single port E1/T1 and Quad E1 D and I (Ports 2, 3, 4).
- The modem hardware itself supports IEEE 1588v2 Precision Time Protocol (PTP) and we are in the process of updating/adding software support for this feature.
- Support for jumbo Ethernet frames (2048 byte).
- We have no direct equivalent of Comtech's CnC-APC, but do support AUPC(Adaptive Uplink Power Control) with SIMU-Carrier.
- Note: We do not support asynchronous E1 streams because, as stated, G.703 actually requires that clocks are synchronous to within +/-50ppm at 2048kbps so there is no actual market, or significant market, that we are aware of for asynchronous timing support??
- SNMP can be used to reboot the modem, if necessary, and can be used for 1:N control.
- The modem supports Robbed-bit Signaling.
- Quality of Service (QoS) supports Layer 2 and Layer 3.

The RADITEK modem that matches (and exceeds) the CDM625 is the new 155Mbps Raditek Extreme. . Essentially the CDM625 doesn't even support standard 20% roll-off (managing only 25% minimum) compared to the 5% roll-off for the Extreme.

	Comtech	Comtech	Paradise	RADITEK	RADITEK Comments
Model:	CDM625	CDM750	PD60	Extreme	
Carrier overlap	√	√	√	√	
Carrier overlap + power control	√	x	x	x	Have SIMU-Carrier and AUPC instead
5% spectral roll-off factor	x	x	√	√	
Low-latency LDPC	√	x	√	√	
Low-latency ACM	√	x	x	x	Under development
Header compression	√	x	√	√	
Payload compression	√	√	√	√	
Encryption	√	x	x	√	
Acceleration	x	x	√	√	
Traffic shaping	√	x	√	√	
Dual IF/L-band	√	√	x	√	
Maximum data rate	25Mbps	169Mbps	100Mbps	155Mbps	

## SCPC Satcom Modem (18K-155 Mbps), (IFs: 70, 140MHz & L band), BPSK to 64QAM, RMOD-EXTREME-p3

Maximum symbol rate	12.5Mpsps	63Mpsps	40Mpsps	45Mpsps	
<b>Model:</b>	<b>Comtech CDM625</b>	<b>Comtech CDM750</b>	<b>Paradise PD60</b>	<b>RADITEK Extreme</b>	<b>RADITEK Comments:</b>
<b>Highest order modulation</b>	<b>16QAM</b>	<b>32APSK</b>	<b>64QAM</b>	<b>64QAM</b>	
DVB-S2	x	√	√	√	
DVB-S2 ACM	x	√	√	√	
ASI	√	x	x	√	<b>Note: Will be available soon (high speed serial Video)</b>
SNMP	√	√	√	√	
AUPC	√	x	√	√	
L-band services	√	√	√	√	
IPv6	x	x	√	√	
Web diagnostic tools	x	x	√	√	
Redundancy switch	√	x	√	√	
VLAN	√	x	√	√	
TPC	√	x	√	√	
4-port ethernet switch	√	x	x	x	<b>Easier to use external switch</b>
4 port MUX	√	x	√	√	
Legacy features (see Note 1)	√	x	√	√	
MPE encapsulation	x	x	√	√	~10% overhead
ULE encapsulation	x	x	√	√	~7% overhead
GSE encapsulation	x	√	x	x	~2% over head
RXE encapsulation (proprietary)	x	x	√	√	~2% over head (Raditek's own encapsulation)
Tx predistorter	x	x	√	x	
Rx adaptive equalizer	x	?	√	√	
Optical Ethernet/STM-1/OC-3	x	√	x	√	<b>Coming soon, can use external adapter for now.</b>
<b>Number of features</b>	<b>19</b>	<b>11</b>	<b>27</b>	<b>30</b>	

Note 1: Legacy features cover G.703, Quad E1, HSSI, LVDS, EIA-530, IBS, IDR, TCM, Sequential, Viterbi, Reed-Solomon