



## OVERVIEW

The PD155i is a **155Mbps** IP satellite modem/router offering an extensive range of network management and bandwidth optimisation features.

A 4-port Gigabit Ethernet switch, advanced routing and Quality of Service protocols are supported as part of the feature-rich IP functionality.

Traffic shaping allocates bandwidth in a controlled manner between competing data streams. This allows data services -- including the satellite portion of the link -- to be fully provisioned end-to-end rather than being simply 'best effort'.

Large bandwidth reductions are achieved using a range of data compression and acceleration techniques. **Paired Carrier** (incorporating ViaSat's patented PCMA technology) can further halve satellite bandwidth requirements.

State-of-the-art forward-error-correction (FEC) technology includes Turbo and LDPC. Low-latency FastLink LDPC is attractive for low-data-rate links. Single/multistream DVB-S2 is also supported.

Embedded satellite and IP diagnostic tools are included and are the most sophisticated available on the market.

The PD155i is fully compatible with all other Quantum-series modems in IP closed modes.

## FEATURE HIGHLIGHTS

- ▶ Available in IF or L-band
- ▶ Four-port Gigabit Ethernet switch
- ▶ Ethernet bridge (allows any protocol to be passed)
- ▶ Dynamic routing RIP V1, V2; OSPF V2, V3; BGP V4 (including IPv6)
- ▶ Static routing
- ▶ TCP acceleration for optimum use of satellite bandwidth
- ▶ HTTP web acceleration for faster web page delivery
- ▶ Header compression (Ethernet, IP and UDP)
- ▶ IEEE 802.1q VLAN support
- ▶ IEEE 802.1p packet priority tagging
- ▶ IP traffic shaping/Quality of Service
- ▶ SNMP (v1, v2c and v3) network management support
- ▶ DHCP for automatic IP address allocation
- ▶ Embedded web server including: Receive Spectrum Analyzer, Receive Constellation Monitor, Link Tester and IP diagnostic graphs
- ▶ FTP, telnet and email facilities
- ▶ IP address aliasing
- ▶ IP over DVB encapsulation (MPE, ULE, Paradise PXE and MPEG2 over IP)
- ▶ MAC address filtering
- ▶ Mesh, point-to-point and point-to-multipoint topologies including bidirectional and unidirectional links
- ▶ Operation to 155Mbps (45Msps)
- ▶ TPC and FastLink LDPC forward error correction
- ▶ DVB-S2 CCM, VCM and ACM modes
- ▶ Fully compatible with Quantum PD20 and PD60 modems when used in IP closed network modes. Fully compatible with Evolution modems when used in IP closed network SCPC modes (i.e. without DVB-S2).

IP Options	
Throughput Performance	<i>The maximum modem throughput depends on IP traffic format and the features enabled. Bridged IP/UDP data can be processed up to 155Mbps. Please seek assistance from Paradise Datacom in evaluating your particular requirements.</i>
Routing and Bridging	Bridging (standard). Basic routing with static routes (standard). Dynamic routing option: RIP V1 and V2; OSPF V2 and V3; BGP V4
TCP Acceleration	Typical throughput level of 90% of link capacity. 5,000 concurrent accelerated TCP connection limit. Includes HTTP Acceleration (prefetches webpage inline objects to reduce web page download times)
Header Compression	Robust Header Compression to RFC 3095 profile 2 (IP/UDP). Reduces Ethernet/IP/UDP header sizes typically by 90%. 1-way packet processing limit: 58,000 pps; 2-way limit: 44,000 pps.
Traffic Shaping	Provides guaranteed throughput levels for specific IP streams, using standard CIR and BIR settings. Stream differentiation is by IP address, IEEE 802.1p priority class, Diffserv DSCP class or MPLS EXP field
VLAN Support	IEEE 802.1q VLAN support (standard)
	IEEE 802.1p Quality of Service (packet prioritisation) using strict priority or fair weighting queuing
IP over DVB Encapsulation/Decapsulation	Supports MPE, ULE and Paradise PXE. Includes MPE air MAC address filtering
DVB-S2 IP Multistreaming	Point-to-multipoint CCM and VCM multistreaming. VCM allows the FEC error correction to vary for each remote
DVB-S2 ACM	Dynamically varies point-to-point FEC strength and throughput, maximising throughput for the actual link conditions
DHCP, SNMP	DHCP (standard). SNMP (standard) v1, v2c and v3
Web Server	Standard. Embedded web server (standard) M&C interface
IP Diagnostic Graphs	Standard. Shows throughput (bps, pps); dropped, errored packet counts
IP Address Aliasing	Standard. Allows IP ports to exist on multiple subnets at the same time

Paired Carrier	
<i>Transmit and receive carriers are overlaid on top of each other in the same space segment, potentially halving the satellite bandwidth required.</i>	
Carrier Power Spectral Density (CPSD) Ratio	+/-10dB. <i>Calculated as: Near PSD - Far PSD + 10log( Near symbol rate / Far symbol rate )</i>
Eb/No Degradation	Typically 0.0 to 0.5dB depending on modulation type. Worst case is 0.7dB for 10dB CPSD ratio for 16QAM/16APSK
Acquisition Time	Depends on the satellite delay uncertainty; typically under 10 seconds for 1ms of uncertainty
Data Rate Options	512kbps, 1024kbps, 2.5Mbps, 5Mbps, 10Mbps, 15Mbps, 20Mbps, 25Mbps, 40Mbps, 50Mbps, 60Mbps and 100Mbps traffic rate. Minimum Paired Carrier occupied bandwidth is 30kHz; maximum is 36MHz
Symbol Rate Asymmetry	Up to 4:1

Network Configuration	
Network Topology	Point-to-point; point-to-multipoint (star); mesh. Unidirectional/bidirectional links. Mixed DVB-S2/SCPC operation
Modulation	DVB-S2: QPSK; 8PSK; 16APSK SCPC: BPSK; QPSK; OQPSK; 8PSK; 8QAM; 16QAM
FEC	DVB-S2 (LDPC with BCH outer codec), 0.25 to 0.9 SCPC: TPC, 0.5 to 0.875; FastLink Low-Latency LDPC, 0.5 to 0.853; Viterbi, 0.5 to 0.875; TCM, 0.667. Reed-Solomon outer codec available with Viterbi and TCM
Symbol Rate	9.6ksps to 45Msps maximum
Data Rate	4.8kbps to 155Mbps maximum

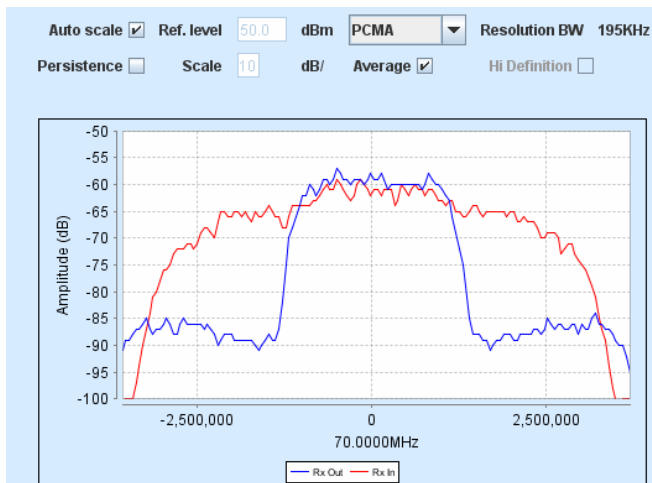


Interfaces		
Terrestrial	4-port RJ45 10/100/Gigabit Ethernet switch plus separate 10/100 BaseT Ethernet RJ45 for monitor and control	
Satellite	Frequency/Connector Type	IF: 50 to 90MHz and 100 to 180MHz (BNC), <b>or</b> L-band: 950 to 1950MHz (with option to 2050MHz) (N-type)
	Output Power Level	IF: 0 to -25dBm, <b>or</b> L-band: -5 to -30dBm
	Input Power Range	IF: -30 to -60dBm wanted signal, <b>or</b> L-band: minimum level -130dBm + 10 log symbol rate (range 50dB above min, limited to -20dBm max)

L-band BUC/LNB Facilities	
BUC Power Supply Options	Mains input, +48V DC 2A output (100W) to BUC via Tx IFL Mains input, +24V DC 4A output (100W) to BUC via Tx IFL Mains input, +48V DC 3.5A output (180W) to BUC via Tx IFL Mains input, +24V DC 6A output (180W) to BUC via Tx IFL +/-48V DC input, +48V DC 3.5A output (180W) to BUC via Tx IFL +/-48V DC input, +24V DC 6A output (180W) to BUC via Tx IFL +48V DC input, +48V DC 3.5A output (180W) to BUC via Tx IFL
LNB Power	+15/24V 0.5A DC to LNB via Rx IFL
FSK Control Option	Allows monitor and control of a compatible BUC from the modem via the Tx IFL
10MHz Reference	10MHz may be provided via the Tx IFL to the BUC and via the Rx IFL to the LNB

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) 48Volts DC option
Safety Standards	EN60950-1
Emission and Immunity Standards	EN55022 Class B (Emissions) EN55024 (Immunity)
Operating Temperature	0 to 50°C
Humidity	95% relative humidity, non-condensing
Compliance	FCC, CE and RoHS compliant

## Paired Carrier Operation



Built-in Paired Carrier web graph showing both of the overlapped carriers.

This is a unique, instant link diagnostic tool when using overlapped carriers.

Fully configurable - only pay for what you need!

	Possible Modes		Description
	SCPC	DVB-S2	
<b>PD155i Base Modem</b>	•	•	950-1950MHz (L-band) or 50-90MHz and 100-180MHz (IF) in 100Hz steps. Quad 10/100/Gigabit Ethernet Traffic card; includes basic Ethernet bridging and static routing traffic modes. Closed Network and Closed Network plus ESC. Advanced ESC: Variable rate Async channel for Closed Net plus ESC operation. AUPC: Automatic Uplink Power Control (operates through ESC channel). Ethernet 10/100 BaseT on RJ45 for M&C. Remote Web Browser based monitoring tools (Spectrum Display, Constellation Monitor and link performance versus time) plus SMTP email client for status notification. DHCP allowing IP address to be allocated dynamically via external DHCP network server
	•		4.8kbps to 10Mbps, 1bps variable rate, BPSK/QPSK/OQPSK. Includes Viterbi FEC, Rates 1/2, 3/4 & 7/8 with k=7. Intelsat Reed-Solomon Outer Codec to IESS 308. IEEE 802.1p QoS supporting choice of strict priority queuing or fair weighting queuing, IEEE 802.1q VLAN support.
		•	50kbps to 10Mbps, 1bps variable rate in DVB-S2 mode, requires a DVB-S2 option
Adds Data Rates to 16,896kbps	•	•	Extends base operation to 16,896kbps
Adds Data Rates to 25Mbps	•	•	Extends 16,896kbps operation to 25Mbps - requires 16,896kbps option
Adds Data Rates to 60Mbps	•	•	Extends 25Mbps operation to 60Mbps - requires 16,896kbps & 25Mbps options
Adds Data Rates to 155Mbps	•	•	Extends 60Mbps operation to 155Mbps - requires 60Mbps, 25Mbps and 16,896kbps options
IP Header Compression	•	•	Adds Robust Header Compression to RFC 3059 (IP/UDP) at throughput rates to 58pkts/s (1-way), 44pkts/s (2-way); includes Ethernet header compression
TCP Acceleration	•	•	TCP/IP Acceleration to 16,896kbps, subject to prevailing data rate limits - overcomes performance problems associated with TCP over satellite. Includes HTTP Acceleration, which prefetches web page inline objects to reduce webpage download times
	•	•	Adds TCP acceleration up to 25Mbps, subject to prevailing data rate limits
	•	•	Adds TCP acceleration up to 60Mbps, subject to prevailing data rate limits
	•	•	Adds TCP acceleration up to 155Mbps, subject to prevailing data rate limits
Ethernet Bridging	•	•	Ethernet Bridging for point-to-multipoint operation when there is a non-satellite return path
IP Traffic Shaping	•	•	Provides guaranteed levels of throughput for specific IP streams. Allows Committed Information Rate and Burst Information Rate to be set for each stream
IP over DVB Encapsulation		•	Encapsulation of IP packets and Ethernet frames over DVB-S2 using MPE, ULE or Paradise PXE protocols
Dynamic Routing	•	•	Supports RIP, OSPF and BGP, plus 64 static routes
DVB-S2 Modulation & Coding		•	DVB-S2 CCM Tx - includes 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 for DVB-S2 use only
		•	DVB-S2 CCM Rx - includes 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 for DVB-S2 use only
Low Rate TPC 2nd Generation Turbo <i>10Mbps maximum</i>	•		Rates 5/16, 21/44, 0.493, 2/3, 3/4, 0.789, 7/8 Paradise (low latency) 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
High Rate TPC 2nd Generation Turbo <i>All data rates subject to prevailing data rate limits</i>	•		Rates 5/16, 21/44, 0.493, 2/3, 3/4, 0.789, 7/8 Paradise (low latency) 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
FastLink 8QAM	•		FastLink 8QAM requires FastLink LDPC
FastLink Low Latency LDPC	•		FastLink LDPC up to 1Mbps, supports BPSK and QPSK, also supports 8PSK - requires 8PSK option, FastLink 8QAM - requires FastLink 8QAM option, and 16QAM - requires 16QAM option ( <b>hardware option</b> )
	•		FastLink LDPC extension to 2.5Mbps - requires FastLink LDPC to 1Mbps
	•		FastLink LDPC extension to 5Mbps - requires FastLink LDPC to 1Mbps and extension to 2.5Mbps
	•		FastLink LDPC extension to 10Mbps - requires FastLink LDPC to 1Mbps plus extension to 2.5Mbps and extension to 5Mbps
	•		FastLink LDPC extension to 25Mbps - requires FastLink LDPC to 1Mbps plus extension to 2.5Mbps, extension to 5Mbps and extension to 10Mbps
	•		FastLink LDPC extension to 60Mbps - requires FastLink LDPC to 1Mbps plus extension to 2.5Mbps, extension to 5Mbps, extension to 10Mbps and extension to 25Mbps
	•		FastLink LDPC extension to 155Mbps - requires FastLink LDPC to 1Mbps plus extension to 2.5Mbps, extension to 5Mbps, extension to 10Mbps, extension to 25Mbps and extension to 60Mbps

Configuration options continue on next page

Fully configurable - only pay for what you need!

	Possible Modes		Description
	SCPC	DVB-S2	
8PSK Including TCM	•		Rate 2/3 8PSK Pragmatic TCM to IESS 310 8PSK Turbo available - requires 2nd Generation Turbo FEC option
16QAM	•		16QAM - requires either 2nd Generation Turbo FEC option or LDPC option
48V DC Input	•	•	Floating 48V DC Primary power input in place of 100-240V AC input ( <b>hardware option</b> )
Custom	•	•	Custom RS Outer Codec values of n, k and interleaver depth
EZ BERT - PRBS Tester	•	•	Internal Bit Error Rate Tester (BERT) can run through main data channel, or ESC/Aux channels, or output/input via the terrestrial interface
Adaptive Signal Pre-distorter	•		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.
Tx Only operation	•	•	Transmit functions only
Rx Only operation	•	•	Receive functions only
Paired Carrier (carrier overlap) <i>subject to prevailing modem data rate limits. Minimum occupied band-width limit of 30kHz, and maximum occupied bandwidth limit of 36MHz</i>	•	•	Paired Carrier Ready, allows carriers to be overlapped thereby reducing the required satellite bandwidth. (hardware option) - requires additional cumulative software options below depending upon data rate required
	•	•	Paired Carrier up to 512kbps traffic rate - requires Paired Carrier Ready option
	•	•	Extends Paired Carrier up to 1024kbps traffic rate - requires 512kbps option
	•	•	Extends Paired Carrier up to 2.5Mbps traffic rate - requires 1024kbps option
	•	•	Extends Paired Carrier up to 5Mbps traffic rate - requires 2.5Mbps option
	•	•	Extends Paired Carrier up to 10Mbps traffic rate - requires 5Mbps option
	•	•	Extends Paired Carrier up to 15Mbps traffic rate - requires 10Mbps option
	•	•	Extends Paired Carrier up to 20Mbps traffic rate - requires 15Mbps option
	•	•	Extends Paired Carrier up to 25Mbps traffic rate - requires 20Mbps option
	•	•	Extends Paired Carrier up to 40Mbps traffic rate - requires 25Mbps option
	•	•	Extends Paired Carrier up to 50Mbps traffic rate - requires 40Mbps option
•	•	Extends Paired Carrier up to 60Mbps traffic rate - requires 50Mbps option	
•	•	Extends Paired Carrier up to 100Mbps traffic rate - requires 60Mbps option	

L-band-only options

	Possible Modes		Description
	SCPC	DVB-S2	
Wideband L-band	•	•	Extends L-band coverage to 950-2050MHz in 100Hz steps
24V 100W BUC PSU	•	•	P3542 AC Input, 24V 100W DC to Tx BUC ( <b>hardware option</b> )
48V 100W BUC PSU	•	•	P3541 AC Input, 48V 100W DC to Tx BUC ( <b>hardware option</b> )
24V 180W BUC PSU	•	•	P3544 AC Input, 24V 180W DC to Tx BUC ( <b>hardware option</b> )
48V 180W BUC PSU	•	•	P3543 AC Input, 48V 180W DC to Tx BUC ( <b>hardware option</b> )
48V DC Input	•	•	Floating 48V DC Primary power input in place of 100-240V AC input ( <b>hardware option</b> )
48V in & 24V BUC PSU	•	•	P3546 Floating 48V DC Input with P3538 +24V 180W DC to Tx BUC ( <b>hardware option</b> )
48V in & 48V BUC PSU	•	•	P3545 Floating 48V DC Input with P3537 +48V 180W DC to Tx BUC ( <b>hardware option</b> )
+48V in & 48V BUC PSU	•	•	P3547 48V DC Primary power input in place of 100-240V AC input ( <b>hardware option</b> )
FSK Control Option	•	•	Controls and monitors single-box Paradise Datacom BUC from the modem ( <b>hardware option</b> )