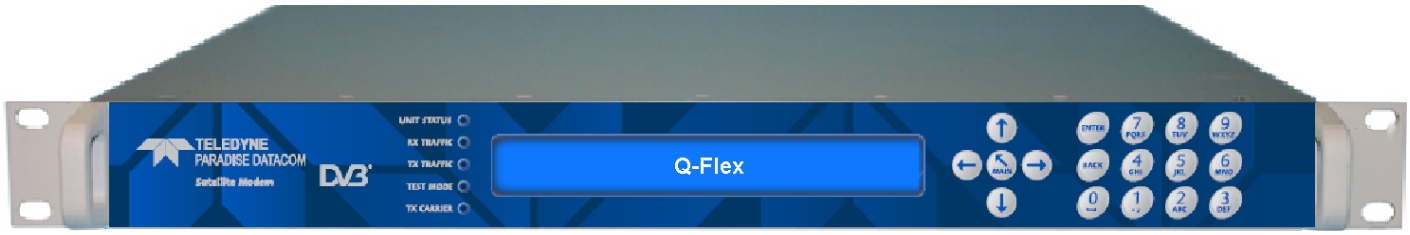
TELEDYNE
PARADISE DATACOM
A Teledyne Technologies Company

Q-Flex™
Dual IF/L-Band Satellite Modem

DVB S2X



OVERVIEW

The **Q-Flex™** modem is a ***flexible software-defined modem*** that does what you want, now and in the future.

The **Q-Flex™'s** ***flexible hardware platform*** **provides point-to-point and point-to-multipoint operation in one unit.**

The **Q-Flex™** modem is ideal for handling all types of IP traffic including video and VOIP but can be fitted with virtually any type of terrestrial interface.

Advanced Bandwidth-Efficient Features

The **Q-Flex™** modem supports the most powerful bandwidth-saving technology available.

DVB-S2X, is between 20% and 60% more bandwidth efficient than its predecessor, DVB-S2.

Paired Carrier+™, our recently enhanced carrier overlap technology, overlays transmit and receive carriers reducing the required satellite bandwidth by 50%.

XStream IP™ bandwidth-saving IP features include ACM, acceleration and header and payload compression. Advanced traffic shaping and metrics ensure that quality of service is delivered in line with Service Level Agreements (SLAs).

FEATURES

- Dual IF/L-band operation
- Data rates to 200Mbps
- **Paired Carrier+™** enhanced carrier overlay
- **XStream IP™** advanced IP optimization suite, including TCP & HTTP acceleration, header & payload compression, traffic shaping, encryption & ACM
- DVB-S2/S2X, **FastLink™** LDPC & TPC
- DVB-S2X modulation up to 256APSK
- Optimized spectral roll-offs, including 5%
- **LinkGuard™** signal-under-carrier interference detection
- Built-in spectrum & constellation monitors
- DVB Carrier ID. Fully compliant with DVB-CID standard
- Multi-demod option
- **Q-NET™ Navigator** network control app
- Terrestrial interfaces include Ethernet & optical Ethernet, EIA-530, G.703 & ASI
- Hybrid carriers: IP with ASI; IP with G.703

Markets and Applications

- IP trunking/backhaul & cellular backhaul
- Corporate/enterprise networking
- Government universal service obligation networks
- Broadcast (Ultra HDTV/HEVC/SDTV)
- Maritime, oil & gas communications
- Intelligence gathering

210058 Issued 6 September 2017

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Main Specifications

Frequency	**L-band:** 950 to 2150MHz (resolution 1Hz) (N-type connector) **IF:** 50 to 90MHz & 100 to 180MHz (resolution 100Hz) (BNC connector)
Data Rate	**Standard:** 2,048kbps **Options:** 5Mbps, 10Mbps, 25Mbps, 60Mbps, 100Mbps and 200Mbps
Data Rate Limits	**DVB-S2/S2X:** 50kbps to 200Mbps **FastLink™ LDPC:** 18kbps to 100Mbps **TPC:** 2.4kbps to 60Mbps 1bps resolution
Symbol Rate Limits	**DVB-S2/S2X:** 100ksps to 50Msps **FastLink™ LDPC:** 18ksps to 40Msps **TPC:** 2.4ksps to 40Msps
Operating Modes	**DVB-S2X** (EN 302 307-2) option **DVB-S2** (EN 302 307-1) option **Closed Network (+ ESC)** (IESS-315) **IBS/IDR** (IESS-308/309/310/314) options
Impedance	**L-band:** 50Ω; **IF:** auto 50Ω/75Ω
Return Loss	**L-band:** >15dB; **IF:** >18dB
Redundancy	1:1 through 1:16 redundancy

Traffic Interfaces

Standard:
- **Gigabit Ethernet** (single RJ45) for IP traffic (plus additional RJ45 for M&C)

Options:
- **4-port Gigabit Ethernet switch** (extends base modem Ethernet traffic port with another 3 Ethernet ports, creating 4-port switch)
- **Optical Gigabit Ethernet/OC-3** (Small Form-Factor pluggable module supporting all common optical standards)
- **EIA-530** (RS422, X.21, V.35 and RS232 on 25-pin D-type female)
- **G.703** E1/T1, E2/T2, E3/T3 (balanced on RJ45; unbalanced 75Ω BNC female)
- **Quad E1 G.703** (balanced RJ45)
- **Quad ASI** (75Ω BNC female)
- **Serial LVDS** (25-pin D-type female)
- **HSSI** (50-pin HD SCSI-2 connector)
- **IDR** (to IESS 308; 50-way female D type connector)

Modulator

Output Power	**IF:** 0 to –25dBm (0.1dB steps) **L-band:** 0 to –40dBm (0.1dB steps)
Output Power Stability/Accuracy	**Stability:** ±1.0dB, 0ºC to 50ºC **Accuracy:** ±0.375dBm
Transmit Filter Roll-off	5%, 10%, 15%, 20%, 25%, 35%
Phase Accuracy	±2º maximum
Amplitude Accuracy	±0.2dB maximum
Carrier Suppression	-30dBc minimum
Output Phase Noise	As EN 302 307, EN 300 421, IESS-308 & EN 301 210; minimum 16dB better than IESS-308/309
Harmonics & Spurious	Better than –60dBc/ 4kHz in-band (at 0dBm to –30dBm output)
Transmit On/Off Ratio	-65dB minimum
BUC PSU Option	24V or 48V DC via IFL cable, 200W
BUC 10MHz Reference	Via IFL cable; 10MHz ± 0.01 ppm; 2dBm ± 1dBm
FSK Control	Allows monitor & control of a compatible L-band BUC from the modem via the Tx IFL cable

Demodulator

Input Range (dBm)	**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	+10dBm
Wanted-to-composite	**IF:** -94 + 10 log (symbol rate) **L-band:** -102 + 10 log (symbol rate)
Frequency Sweep Width	±1kHz to ±255kHz (1kHz steps)
Acquisition Time	Dependent on FEC, data rate and sweep width
Receive Spectral Roll-off	5%, 10%, 15%, 20%, 25%, 35%
LNB 10MHz Reference	Via IFL cable; 10MHz ± 0.01ppm; 2dBm ± 1dBm
LNB Voltage	Programmable 13V, 15V, 18V, 20V or 24V DC to LNB via IFL cable; maximum 0.75A

Multi-Demodulator Option

One demodulator is fitted as standard. Our demodulator add-on card supports 8 demodulators. Up to two demodulator add-on cards can optionally be fitted, supporting up to 16 demodulators in total. In point-to-point operation, the standard demodulator is used. In point-to-multipoint, the multi-demods are used.

*The multi-demod capability extends the flexibility of the modem, converting it into a **Q-MultiFlex™** (**see separate datasheet for full specification**). To keep the purchase price as low as possible, the multi-demod hardware can be fitted to make the modem 'point-to-multipoint ready' and the demods can then be unlocked at a later date in software (in blocks of 4). Or the demods can be enabled from the outset.*

*The modem's personality - **Q-Flex™** or **Q-MultiFlex™** - is then determined purely by which software version you load (freely downloadable from our web site). Features from one datasheet continue to be available after the modem personality has been changed, meaning features common to both datasheets need only be purchased once. Please contact us for more details*

Demodulator options	4, 8, 12 or 16 (total)
Operating Mode	FastLink™ Low-latency LDPC decoder operated in Closed Network mode
Data Rate	**Each inbound:** 18kbps to 100Mbps **Total for all inbounds combined:** Up to 200Mbps 1bps resolution
Symbol Rate	**Each inbound:** 18ksps to 40Msps **Total for all inbounds combined:** Up to 70Msps 1sps resolution

ClearLinQ™ Adaptive Tx Predistorter

Corrects for linear & non-linear distortion in the RF chain (i.e. amplifier and transponder). Applicable to all FECs and modulations. Maximises amplifier linear output power; minimises required back-off. Up to 2dB performance gain

DVB-S2/S2X Rx Adaptive Equaliser

Corrects for slope on the carrier and group delay (typically found at transponder edges, causing inter-symbol interference). The 9-tap Rx equaliser is provided as standard; automatically switched on above 10Msps

DVB Carrier ID Option (ETSI TS 103 129)

Supports the identification of interfering carriers. Allows identification of individual modem carriers by superimposing a low-power CID waveform onto the carrier with negligible degradation. **Supported for all carriers.** The CID waveform contains a unique Carrier ID and other identity information. A carrier monitoring system is required to decode CID waveforms

Paired Carrier+™ Option

Paired Carrier+™ *(25kHz to 54MHz occupied bandwidth)*	Transmit and receive carriers are overlaid in the same space segment. Echo cancellation techniques are used to cancel the unwanted transmit carrier, leaving the wanted receive carrier
Paired Carrier+™ data rate options	256kbps, 512kbps, 1024kbps, 2.5Mbps, 5Mbps, 10Mbps, 15Mbps, 20Mbps, 25Mbps, 30Mbps, 40Mbps, 50Mbps, 60Mbps, 80Mbps, 100Mbps and 200Mbps traffic rate
Carrier Asymmetry	**Power:** -10dB to +10dB **Symbol rate:** Up to 10:1
Eb/No Degradation	Typically less than 0.1dB
Delay Range	0 to 330ms
Mobile Operation	Uses GPS data to continually recalculate position relative to satellite, allowing uninterrupted operation in mobile environments anywhere in satellite footprint

Test Facilities and Alarm Outputs

Built-in Test Tools	As part of built-in web server: Rx constellation monitor; Rx spectrum analyser; **LinkGuard™** Signal-Under-Carrier interference detection; time graphs for key performance indicators (IP throughput, Eb/No, etc.)
BER Tester	Bit error rate tester operates over main traffic or ESC channel, allowing BER monitoring while on traffic. Not available in DVB-S2/S2X modes. Supports various test patterns compatible with common BER testers
Other test modes	Transmit CW Transmit alternate 1-0 pattern Simulated satellite delay for TCP/IP packets
Alarm Relays	4 independent Form C relays for unit, Tx, Rx and deferred alarms

Mechanical/Environmental

Size	1U chassis, 410mm deep excluding front panel handles and rear panel connectors and fans
Weight	3.5kg
Power Supply	90 to 264VAC, 1A @100V, 0.5A @ 240V, 47 to 63Hz Fused IEC connector (live and neutral fused); 24V and 48V DC options
Compliances	FCC, CE and RoHS compliant
Safety Standards	EN60950-1:2006
Emissions & Immunity	**Emissions:** EN55022:2010 Class B **Immunity:** EN55024:2010
Operating Temperature	**Standard:** 0 to 50ºC (storage: -40ºC to 70ºC) **Extended:** 0 to 55ºC when fitted with **Ruggedisation** option
Humidity	95% relative humidity, non-condensing

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Ethernet: Standard Features

Bridging and Static Routing	**Trunking mode:** Hardware Layer 2 bridge supporting 200Mbps bi-directional traffic at up to 500,000 packets per second; zero jitter **Layer 2 switch & Layer 3 router:** Software processing capability of up to 150,000 packets per second
IPv4/IPv6	Dual IPv4/IPv6 TCP/IP supporting IPv4/IPv6 bridging and routing
VLAN Support	IEEE 802.1q VLAN support
	IEEE 802.1p packet prioritisation using strict priority or fair weighting queuing
DHCP	DHCP client for automatic allocation of M&C IP address; DHCP server allocates IP addresses to network devices
NAT	NAT firewall; allows all network devices to share a single IP address when viewed from other end of satellite link
SNMP	SNMP v1, v2c & v3
Access Control Lists	Separate IP and MAC address black/white user access control lists
Network Time Protocol (NTP)	NTP client synchronises modem time & date to NTP server; provides millisecond accuracy
IEEE 1588 V2 Precision Time Protocol (PTP)	PTP hardware implementation with nanosecond-resolution timestamping provides sub-microsecond accurate clock synchronisation; modem implements a PTP boundary clock, operating in both master & slave modes
Web Server	Modem web server M&C interface (including built-in tools listed under Test Facilities)
AAA RADIUS Secure User Login	Authentication, Authorisation & Accounting. Greater access control & accountability. Replaces standard modem login with user's personal network login credentials
IP Metrics	Tx, Rx throughput (bps, pps) graphs; dropped, errored packet counts
sFlow Performance Metrics	sFlow is the industry standard for network monitoring, giving full modem performance visibility to sFlow compatible network management devices
Active Queue Management (AQM)	Implements CoDel (controlled delay) which overcomes buffer bloat by maintaining a constant delay through the modem for all IP packets
MPEG over IP	Supports the efficient transfer of SMPTE 2002-2 MPEG2 transport streams over satellite
OpenAMIP	Support for the Open Antenna Modem Interface Protocol (OpenAMIP) protocol, facilitating the exchange of data with compliant antenna control units (ACUs). Supports antenna deployment/pointing/tracking
Packet Generator/ Analyser	Generates & analyses TCP & UDP packet streams, allowing modem-to-modem IP testing without any PCs
Ethernet MTU Size	**Standard:** 10k bytes **Optical Ethernet:** 16k bytes

Ethernet: XStream IP™ Option

XStream IP™ is an integrated set of IP optimization and traffic management features designed for maximum reliability and bandwidth efficiency. The maximum throughput depends on features enabled & traffic format

Traffic Shaping	Provides guaranteed throughput for priority traffic; supports Committed and Burst Information Rates. Stream classification by VLAN ID, IP address, IEEE 802.1p priority, Diffserv DSCP, PID & MPLS EXP
Header Compression	Robust Header Compression (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	Uses Deflate algorithm (RFC 1951) to compress TCP & UDP packets; typical payload compression of 50%
Dynamic Routing	RIP V1, V2; OSPF V2, V3; BGP V4
TCP Acceleration	Typical throughput level of 90% of link capacity. Supports 10,000 concurrent accelerated TCP connections (plus at least 40,000 unaccelerated TCP connections) up to 100Mbps
HTTP Acceleration	Speeds up download of web pages to web browsers; includes DNS caching
AES-256 Encryption	*Supported on **Q-FlexE™** model only. See separate Q-FlexE™ datasheet*

Ethernet: XStream IP™ DVB-S2X

Provided as standard as part of DVB-S2/S2X

ACM	Dynamically varies modcod with varying link conditions, maximises throughput at all times by converting unused link margin into additional throughput; 100% link availability
VCM	Supports transmission/reception of two ASI streams or, one ASI stream with one IP stream, each with its own modcod for optimal throughput
IP-over-DVB Encapsulation	Supports the transmission of IP packets with/without Ethernet frames over DVB-S2/S2X; encapsulates & decapsulates using GSE (see below), MPE (EN 301 192), ULE (RFC 4326) or Paradise XStream Encapsulation
GSE Encapsulation	Highly efficient encapsulation of IP packets or Ethernet frames; compatible with EN 302 307-2 standard, for use with DVB-S2 and DVB-S2X

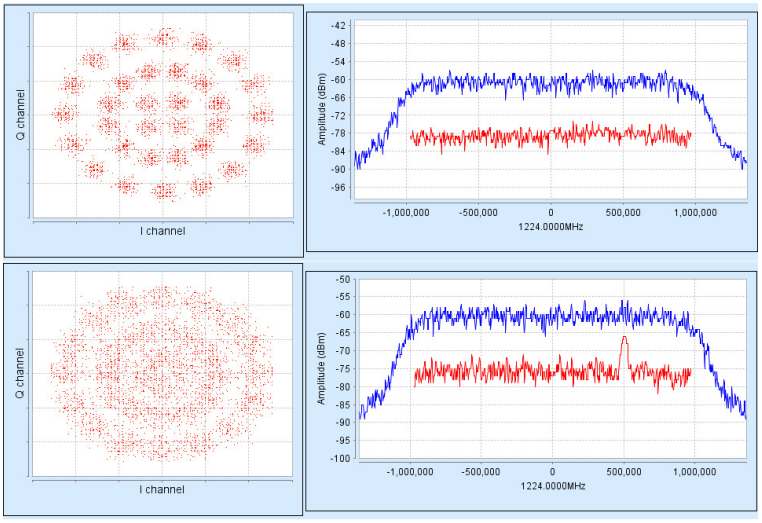
Network Control

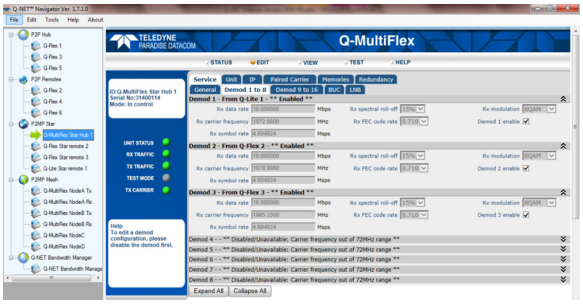
Web browser user interface support is provided as standard. SNMP and command line interfaces support the development of third-party user interfaces. In addition, the following network control application options are available

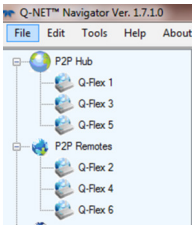
Q-NET™ Navigator	Allows all modems and third-party network devices to be fully controlled through a single application. It provides an easy-to-navigate site map, summary status reporting, etc. Provided as standard, free of charge
Q-NET™ Bandwidth Manager	Provides multi-satellite/transponder carrier planning and high-level system control, monitoring, recording and quality-of-service reporting

LINKGUARD™

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







Network Control: Q-NET™ Navigator

Q-NET™ Navigator *supports the control of all network modems and third-party network devices from a single application. Includes easy-to-use navigation, multiple operator roles/access levels (including Virtual Network Operator support), continuous status/alarm polling and automatic synchronisation of all network configuration changes.* **Q-NET™ Navigator** *is included as standard, free of charge.*

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Forward Error Correction

DVB-S2X (EN 302 307-2) *Includes support for DVB-S2*	**Normal Frame:** **QPSK** 13/45, 9/20, 11/20 **8PSK** 23/36, 25/36, 13/18 **8APSK-L** 5/9, 26/45 **16APSK** 26/45, 3/5, 28/45, 23/36, 25/36, 13/18, 7/9, 77/90 **16APSK-L** 5/9, 8/15, 1/2, 3/5, 2/3 **32APSK** 32/45, 11/15, 7/9 **32APSK-L** 2/3 **64APSK** 11/15, 7/9, 4/5, 5/6 **64APSK-L** 32/45 **Short Frame:** **QPSK** 11/45, 4/15, 14/45, 7/15, 8/15, 32/45 **8PSK** 7/15, 8/15, 26/45, 32/45 **16APSK** 7/15, 8/15, 26/45, 3/5, 32/45 **32APSK** 2/3, 32/45
DVB-S2X Advanced Modulation	**Normal Frame:** **128APSK** 3/4, 7/9 **256APSK** 32/45, 3/4 **256APSK-L** 29/45, 2/3, 31/45, 11/15
DVB-S2X Low-latency Mode *Paradise proprietary extension to DVB-S2X*	**Very Short Frame:** (Frame size of 5,400 bits, reducing latency to 33% of standard DVB-S2 Short frame) **QPSK** 1/5, 4/15, 1/3, 2/5, 7/15, 8/15, 3/5, 2/3, 11/15, 12/15 **8PSK** 11/15, 12/15 **16APSK** 12/15 **Ultra Short Frame:** (Frame size of 3,240 bits, reducing latency to 20% of standard DVB-S2 Short frame) **QPSK** 2/9, 1/3, 4/9, 5/9, 2/3, 7/9 **8PSK** 2/3, 7/9 **16APSK** 2/3, 7/9 **32APSK** 7/9 **64APSK** 7/9
DVB-S2 (EN 302 307-1)	**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 **32APSK** 3/4, 4/5, 5/6, 8/9, 9/10
FastLink™ Low-Latency LDPC	**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	**BPSK** 5/16, 21/44, 3/4, 7/8 **(O)QPSK** 5/16, 21/44, 3/4, 7/8, 0.93 **8PSK** 3/4, 7/8, 0.93 **8QAM** 3/4, 7/8, 0.93 **16QAM** 3/4, 7/8, 0.93

Legacy Forward Error Correction

DVB-S/DSNG *(Provided as standard with Quad ASI card)*	**DVB-S:** QPSK 1/2, 2/3, 3/4, 5/6, 7/8 **DVB-DSNG:** 8PSK 2/3, 5/6, 8/9; 16QAM 3/4, 7/8 (ETSI EN 300421/ 301210 compliant)
Legacy FEC Option	**Viterbi:** BPSK/(O)QPSK 1/2, 3/4, 7/8 **TCM:** 8PSK 2/3 **Sequential:** BPSK/(O)QPSK 1/2, 3/4, 7/8 **Reed-Solomon** outer codec for Viterbi, TCM & Sequential

TPC Performance
Eb/No (dB) at BER 5E-8

	Rate 1/2	Rate 3/4	Rate 7/8	Rate 0.93	
BPSK, (O)QPSK	3.0	4.2	4.2	6.5	
8PSK		6.3	6.8	9.6	
8QAM		6.7	6.8	10.1	
16QAM		7.6	7.9	10.4	

DVB-S/DSNG Performance
Eb/No (dB) at QEF

	Rate 1/2	Rate 2/3	Rate 3/4	Rate 5/6	Rate 7/8	Rate 8/9
QPSK	3.9	4.6	4.0	4.6	5.3	
8PSK		6.9		8.9		9.4
16QAM			9.0		10.7	

DVB-S2 Performance
QEF (PER 10e-7)
Normal frames, Pilots off

	Spectral Efficiency	Eb/No (dB) & Es/No (dB)
QPSK 1/4	0.490243	1.1 (-2.0)
QPSK 1/3	0.656448	0.7 (-1.1)
QPSK 2/5	0.789412	0.7 (-0.3)
QPSK 1/2	0.988858	1.1 (1.1)
QPSK 3/5	1.188304	1.7 (2.4)
QPSK 2/3	1.322253	2.0 (3.2)
QPSK 3/4	1.487473	2.4 (4.1)
QPSK 4/5	1.587196	2.6 (4.6)
QPSK 5/6	1.654663	3.0 (5.2)
QPSK 8/9	1.766451	3.7 (6.2)
QPSK 9/10	1.788612	3.9 (6.4)
8PSK 3/5	1.779991	3.5 (6.0)
8PSK 2/3	1.980636	4.0 (7.0)
8PSK 3/4	2.228124	4.6 (8.1)
8PSK 5/6	2.478562	5.6 (9.5)
8PSK 8/9	2.646012	6.6 (10.8)
8PSK 9/10	2.679207	6.9 (11.2)
16APSK 2/3	2.637201	5.2 (9.4)
16APSK 3/4	2.966728	5.8 (10.5)
16APSK 4/5	3.165623	6.2 (11.2)
16APSK 5/6	3.300184	6.6 (11.8)
16APSK 8/9	3.523143	7.5 (13.0)
16APSK 9/10	3.567342	7.8 (13.3)
32APSK 3/4	3.703295	7.3 (13.0)
32APSK 4/5	3.951571	7.8 (13.8)
32APSK 5/6	4.119540	8.4 (14.5)
32APSK 8/9	4.397854	9.4 (15.8)
32APSK 9/10	4.453027	9.6 (16.1)

DVB-S2X Performance
QEF (PER 10e-7)
Normal frames, Pilots off

	Spectral Efficiency	Eb/No (dB) & Es/No (dB)
QPSK 13/45	0.567805	0.5 (-2.0)
QPSK 9/20	0.889135	0.9 (0.4)
QPSK 11/20	1.088581	1.1 (1.5)
8APSK-L 5/9	1.647211	3.1 (5.3)
8APSK-L 26/45	1.713601	3.2 (5.5)
8PSK 23/36	1.896173	3.6 (6.4)
8PSK 25/36	2.062148	4.1 (7.2)
8PSK 13/18	2.145136	4.3 (7.6)
16APSK-L 1/2	1.972253	3.4 (6.3)
16APSK-L 8/15	2.104850	3.5 (6.7)
16APSK-L 5/9	2.193247	3.6 (7.0)
16APSK-L 3/5	2.370043	3.9 (7.6)
16APSK-L 2/3	2.635236	4.4 (8.6)
16APSK 26/45	2.281645	4.2 (7.8)
16APSK 3/5	2.370043	4.4 (8.1)
16APSK 28/45	2.458441	4.2 (8.1)
16APSK 23/36	2.524739	4.6 (8.6)
16APSK 25/36	2.745734	5.2 (9.6)
16APSK 13/18	2.856231	5.4 (10.0)
16APSK 7/9	3.077225	6.0 (10.9)
16APSK 77/90	3.386618	7.0 (12.3)
32APSK-L 2/3	3.289502	6.5 (11.7)
32APSK 32/45	3.510192	6.5 (12.0)
32APSK 11/15	3.620536	6.7 (12.3)
32APSK 7/9	3.841226	7.5 (13.3)
64APSK-L 32/45	4.206428	8.4 (14.6)
64APSK 11/15	4.338659	8.9 (15.3)
64APSK 7/9	4.603122	9.3 (15.9)
64APSK 4/5	4.735354	9.5 (16.3)
64APSK 5/6	4.933701	10.3 (17.2)

FastLink™ Performance at BER 5E-8
(Note: * denotes BER of 5E-12)

	FEC Rate	Spectral Efficiency	Low BER Eb/No & Es/No	Balanced Eb/No & Es/No	Low Latency Eb/No & Es/No
BPSK	0.499	0.499	2.1 (-0.9)	2.9 (-0.1)	3.4 (0.4)
(O)QPSK	0.532	1.064	2.1 (2.4)	2.6 (2.9)	2.9 (3.2)
(O)QPSK	0.639	1.278	2.4 (3.5)	2.8 (3.8)	3.2 (4.3)
(O)QPSK	0.710	1.42	2.7 (4.2)	3.2 (4.7)	3.7 (5.2)
(O)QPSK	0.798	1.596	3.1 (5.1)	3.9 (6.0)	4.2 (6.2)
8PSK	0.639	1.917	5.4* (8.2)	5.9* (8.7)	6.3* (9.1)
8PSK	0.710	2.13	5.6* (8.9)	5.5 (8.8)	5.8 (9.1)
8PSK	0.778	2.334	5.6 (9.3)	6.1 (9.7)	6.4 (10.1)
8QAM	0.639	1.917	4.4 (7.2)	4.8 (7.6)	5.0 (7.8)
8QAM	0.710	2.13	5.0 (8.3)	5.3 (8.6)	5.5 (8.8)
8QAM	0.778	2.334	5.5 (9.2)	5.9 (9.6)	6.1 (9.8)
16APSK	0.726	2.904	7.6* (12.2)	7.5* (12.1)	7.5 (12.1)
16APSK	0.778	3.112	7.8* (12.7)	7.1 (12.0)	7.5 (12.4)
16APSK	0.828	3.312	7.4 (12.6)	8.1 (13.3)	8.4 (13.6)
16APSK	0.851	3.404	7.9 (13.2)	8.3 (13.6)	8.8 (14.1)
16QAM	0.726	2.904	7.2* (11.8)	6.6 (11.2)	6.8 (11.4)
16QAM	0.778	3.112	6.7 (11.6)	7.1 (12.0)	7.4 (12.3)
16QAM	0.828	3.312	7.2 (12.4)	7.7 (12.9)	8.0 (13.2)
16QAM	0.851	3.404	7.5 (12.8)	8.0 (13.3)	8.4 (13.7)
32APSK	0.778	3.89	9.8* (15.7)	9.6 (15.5)	10.0 (15.9)
32APSK	0.828	4.14	9.8 (16.0)	10.6 (16.8)	10.9 (17.1)
32APSK	0.886	4.43	10.8 (17.3)	11.4 (17.9)	11.9 (18.4)
32APSK	0.938	4.69	12.6 (19.3)	13.2 (19.9)	13.9 (20.6)

DVB-S2 Performance
QEF (PER 10e-7)
Short frames, Pilots off

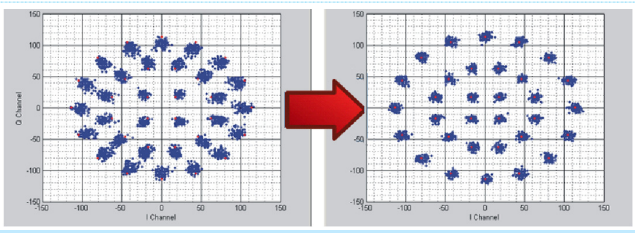
	Spectral Efficiency	Eb/No (dB) & Es/No (dB)
QPSK 1/4	0.365324	2.2 (-2.2)
QPSK 1/3	0.629060	1.3 (-0.7)
QPSK 2/5	0.760928	1.1 (-0.1)
QPSK 1/2	0.848840	1.6 (0.9)
QPSK 3/5	1.156532	2.1 (2.7)
QPSK 2/3	1.288400	2.3 (3.4)
QPSK 3/4	1.420269	2.9 (4.4)
QPSK 4/5	1.508181	3.1 (4.9)
QPSK 5/6	1.596093	3.5 (5.5)
QPSK 8/9	1.727961	4.0 (6.4)
8PSK 3/5	1.725319	4.0 (6.4)
8PSK 2/3	1.922040	4.5 (7.3)
8PSK 3/4	2.118761	5.1 (8.4)
8PSK 5/6	2.381056	6.0 (9.8)
8PSK 8/9	2.577777	7.0 (11.1)
16APSK 2/3	2.548792	5.6 (9.7)
16APSK 3/4	2.809662	6.2 (10.7)
16APSK 4/5	2.983575	6.7 (11.4)
16APSK 5/6	3.157488	7.1 (12.1)
16APSK 8/9	3.418357	8.1 (13.4)
32APSK 3/4	3.493093	8.1 (13.5)
32APSK 4/5	3.709309	8.7 (14.4)
32APSK 5/6	3.925526	9.0 (14.9)
32APSK 8/9	4.249850	10.2 (16.5)

DVB-S2X Performance
QEF (PER 10e-7)
Short frames, Pilots off

	Spectral Efficiency	Eb/No (dB) & Es/No (dB)
QPSK 11/45	0.453236	1.4 (-2.0)
QPSK 4/15	0.497192	1.3 (-1.7)
QPSK 14/45	0.585104	1.1 (-1.2)
QPSK 7/15	0.892796	1.4 (0.9)
QPSK 8/15	1.024664	1.7 (1.8)
QPSK 32/45	1.376313	2.6 (4.0)
8PSK 7/15	1.331876	3.1 (4.3)
8PSK 8/15	1.528597	3.4 (5.2)
8PSK 26/45	1.659745	3.8 (6.0)
8PSK 32/45	2.053188	4.8 (7.9)
16APSK 7/15	1.766184	4.0 (6.5)
16APSK 8/15	2.027053	4.4 (7.5)
16APSK 26/45	2.200966	4.8 (8.2)
16APSK 3/5	2.287923	5.0 (8.6)
16APSK 32/45	2.722705	5.8 (10.2)
32APSK 2/3	3.168769	6.8 (11.8)
32APSK 32/45	3.384985	7.3 (12.6)

PER v BER

Note: A PER of 10e-7 is equivalent to a BER of 6.6 x 10e-11.



Interference Mitigation: ClearLinQ™

'Before and after' constellations showing ClearLinQ™ Adaptive Tx Predistorter compensating for severe non-linear signal distortion to a 32APSK carrier.

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Q-Flex™

Dual IF/L-Band Satellite Modem

TELEDYNE PARADISE DATACOM
A Teledyne Technologies Company

	Option	Description — Fully configurable - pay only for what you need!
Base Modem	✓	**2.4kbps to 2.048Mbps Tx/Rx Closed Network (+ ESC) modem with two Gigabit Ethernet RJ45s for M&C and traffic** respectively; includes all features described under Ethernet Standard Features **IF operation 50 to 90MHz & 100 to 180MHz** **L-band operation 950 to 2150MHz**; high-stability 10MHz reference; FSK **TPC:** BPSK, QPSK, OQPSK, 8PSK, 8QAM and 16QAM; to 60Mbps subject to prevailing modem data rate **LinkGuard™:** Signal-under-carrier interference detection showing any interference underneath the received carrier **AUPC:** Automatic Uplink Power Control **Test facilities:** includes all features described under Test Facilities **AC mains input**
Tx-only		Transmit functions only
Rx-only		Receive functions only
Data Rate		**5Mbps data rate:** Extends base operation to 5Mbps
		10Mbps data rate: Extends 5Mbps operation to 10Mbps
		25Mbps data rate: Extends 10Mbps operation to 25Mbps
		60Mbps data rate: Extends 25Mbps operation to 60Mbps
		100Mbps data rate: Extends 60Mbps operation to 100Mbps (FastLink™, DVB-S2 & DVB-S2X only)
		200Mbps data rate: Extends 100Mbps operation to 200Mbps (DVB-S2 & DVB-S2X only)
XStream IP™		**Traffic Shaping:** Supports CIR/BIR/priority settings for IP streams classified by VLAN ID, IP address, Diffserv class, IEEE 802.1p priority, MPLS EXP field & MPEG2 transport stream PID
		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)
		Dynamic Routing: RIP, OSPF and BGP
		TCP Acceleration: Up to 10,000 concurrent accelerated TCP connections to 100Mbps subject to prevailing data rate
		HTTP Acceleration: Speeds up download of web pages to web browsers; includes DNS caching; *requires TCP acceleration to be on and the modem to be in routing mode*
		AES-256 Encryption: *Please note that AES-256 Encryption (TCP/IP packet payload encryption using AES with 256-bit keys) is supported on the* ***Q-FlexE*** *model only. The Q-FlexE is identical to the standard Q-Flex in every other respect*
XStream IP™ DVB-S2X *Provided as standard as part of DVB-S2/S2X option*		**IP-over-DVB Encapsulation:** Encapsulation of IP packets and Ethernet frames over DVB-S2 using GSE, Paradise XStream Protocol (PXE), MPE or ULE
		ACM: DVB-S2/DVB-S2X ACM (dynamic adjustment of outbound modcod to maximize data rate)
		VCM: Allows either two ASI streams, or one ASI stream and one IP stream, to be multiplexed onto a single carrier; requires Quad ASI hardware option
XStream IP™ Hardware Accelerator		For operation above 100Mbps, use of the **XStream IP™ Hardware Accelerator** is recommended. This offloads several **XStream IP™** functions from the base modem to a special processing card, allowing the base modem to then operate in 'trunking mode' which guarantees correct handling of up to 500,000 packets per second. Includes **TCP Cipher Acceleration**, which supports the acceleration of TCP traffic that has been encrypted using standard IP crypto devices.
DVB-S2X *To 200Mbps subject to prevailing modem data rate limits*		**DVB-S2/S2X CCM Tx:** DVB-S2 QPSK, 8PSK, 16APSK & 32APSK Tx operation per EN 302 307-1. DVB-S2X QPSK, 8PSK, 8APSK, 16APSK, 32APSK & 64APSK Tx operation per EN 302 307-2. Includes 5%, 10%, 15%, 20%, 25% & 35% spectral roll-offs. Includes XStream IP™ DVB-S2X, which comprises ACM, VCM and IP-over-DVB encapsulation
		DVB-S2/S2X CCM Rx: Add-on card supporting DVB-S2 QPSK, 8PSK, 16APSK & 32APSK Rx operation per EN 302 307-1. DVB-S2X QPSK, 8PSK, 8APSK, 16APSK, 32APSK & 64APSK Rx operation per EN 302 307-2. Includes 5%, 10%, 15%, 20%, 25% & 35% spectral roll-offs. Includes XStream IP™ DVB-S2X, which comprises ACM, VCM and IP-over-DVB decapsulation
DVB-S2X Low-latency Mode *Proprietary extension to DVB-S2X*		**Very Short Frame:** Frame size of 5,400 bits, reducing latency to 33% of standard DVB-S2 Short frame; supports QPSK/8PSK/16APSK **Ultra Short Frame:** Frame size of 3,240 bits, reducing latency to 20% of standard DVB-S2 Short frame; supports QPSK/8PSK/16APSK/32APSK/64APSK
DVB-S2X Advanced Modulation		128APSK, 256APSK, 256APSK-L
FastLink™ Low-latency LDPC		Add-on card; includes BPSK, QPSK, OQPSK, 8PSK, 8QAM, 16APSK, 16QAM, 32APSK & 64QAM; to 100Mbps subject to prevailing modem data rate limits; includes 20%, 25% & 35% spectral roll-offs as standard
ClearLinQ™		**Adaptive Tx Predistorter:** Corrects for linear & non-linear distortion in the RF chain (amplifier & transponder). Applicable to all FECs and modulations including DVB-S2X, FastLink™ & TPC

Configuration options continue on next page.

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	Option	Description **Fully configurable - pay only for what you need!**
Paired Carrier+™ *Subject to prevailing modem data rate limits.* *Occupied bandwidth: minimum 25kHz; maximum 54MHz* *Note that* Paired Carrier+™ *is also available as a low-cost 90-day per annum license for redundancy system standby modems - please contact Sales for details*		**Paired Carrier+™ add-on card** (requires one or more options below)
		Paired Carrier+™ up to **256kbps** (requires Paired Carrier+™ add-on card)
		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**
		Extends Paired Carrier+™ up to **15Mbps**
		Extends Paired Carrier+™ up to **20Mbps**
		Extends Paired Carrier+™ up to **25Mbps**
		Extends Paired Carrier+™ up to **30Mbps**
		Extends Paired Carrier+™ up to **40Mbps**
		Extends Paired Carrier+™ up to **50Mbps**
		Extends Paired Carrier+™ up to **60Mbps**
		Extends Paired Carrier+™ up to **80Mbps**
		Extends Paired Carrier+™ up to **100Mbps**
		Extends Paired Carrier+™ up to **200Mbps**
Terrestrial Interfaces *(Please choose up to four hardware options)*		**4-port Gigabit Ethernet Switch:** Extends base modem Ethernet traffic port with 3 Ethernet ports, creating 4-port switch
		Optical Gigabit Ethernet/OC-3: Small Form-factor Pluggable module; supports single-mode & multi-mode fibre & all wavelengths; supports all standard fibre connector types such as SC & LC (subject to provision of suitable mating socket for SFP cage)
		G.703: Provides unbalanced G.703 on 2xBNC 75Ω sockets & balanced G.703 on RJ45; includes G.703 clock extension, which provides a high-stability reference clock over satellite (alternative to GPS); includes Drop & Insert; supports E1, T1, E2, T2, E3 & T3
		EIA-530: D25 DCE supporting RS422/X.21/V.35/RS232
		Quad E1: Balanced G.703 on 4xRJ45; all 4 ports support Drop & Insert and are enabled as standard; supports Closed Network (+ ESC) satellite framing (< 0.5% overhead); MultiMux enabled as standard: dynamically replaces one or two E1 ports with IP and/or EIA-530, allowing combinations such as: 2 E1s + up to 32Mbps IP + up to 8Mbps EIA-530, or 3 E1s + up to 32Mbps IP, or 3 E1s + up to 8Mbps EIA-530, or up to 8Mbps EIA-530 plus up to 32Mbps IP
		Quad ASI: 4xBNC 75Ω sockets; includes DVB-S/DSNG FEC (for use with ASI, or MPEG over IP, or general IP)
		Serial LVDS: On 25-way D-type connector
		HSSI: On HD50 50-way SCSI-2 connector
		IDR: To IESS-308; 50-way female D-type connector; includes Advanced AUX (variable rate synchronous Aux channel; includes option to replace IDR audio channels with serial data); includes Audio option (for IBS carriers this allows 2 x audio in 64kbps or 2 x audio+64kbps data in 128kbps - requires IBS option)
Multi-demodulator *See Q-MultiFlex datasheet for description of point-to-multipoint capabilities*		**'8 Demodulator Hardware' option:** adds one demodulator add-on card supporting 8 demodulators in total
		'16 Demodulator Hardware' option: adds two demodulator add-on cards supporting 16 demodulators in total
		4 demodulators: enables 4 demodulators (requires '8 Demodulator Hardware' option)
		8 demodulators: extends operation from 4 demodulators to 8 demodulators
		12 demodulators: extends operation from 8 demodulators to 12 demodulators (requires '16 Demodulator H/W' option)
		16 demodulators: extends operation from 12 demodulators to 16 demodulators
Optimised Spectral Roll-off		Extends the standard 35%, 25% and 20% roll-off factors to include 5%, 10% and 15% roll-offs for FastLink™, TPC & legacy FECs including DVB-S
Ruggedisation		Ruggedises the modem for harsh environments (fans with higher airflow, heatsinks on key components, etc.)
DVB-CID		**DVB Carrier ID:** Tx carrier identification per ETSI 103 129
IBS		Satellite framing to IESS 309 with low-rate Intelsat ESC (to IESS 403) and high-rate IBS ESC
Legacy FEC		**Sequential** FEC (limited to 2.048Mbps); **TCM** 8PSK 2/3 to IESS 310; **Viterbi** BPSK/QPSK/OQPSK FEC rates 1/2, 3/4 & 7/8; Intelsat **Reed-Solomon** outer codec
DC Input		**24V DC: K3023** 24V DC primary power input (in place of 100 to 240V AC input)
		48V DC: K3018 48V DC primary power input (in place of 100 to 240V AC input)
BUC PSU		**AC In & 24V Out: P3543** AC input, 24V 200W DC to Tx BUC
		AC In & 48V Out: P3544 AC input, 48V 200W DC to Tx BUC
		48V In & 24V Out: P3545 Floating 48V DC input; +24V 200W DC to Tx BUC
		48V In & 48V Out: P3546 Floating 48V DC input; +48V 200W DC to Tx BUC
		+48V In & 48V Out: P3547 +48V DC input; +48V 200W DC to Tx BUC