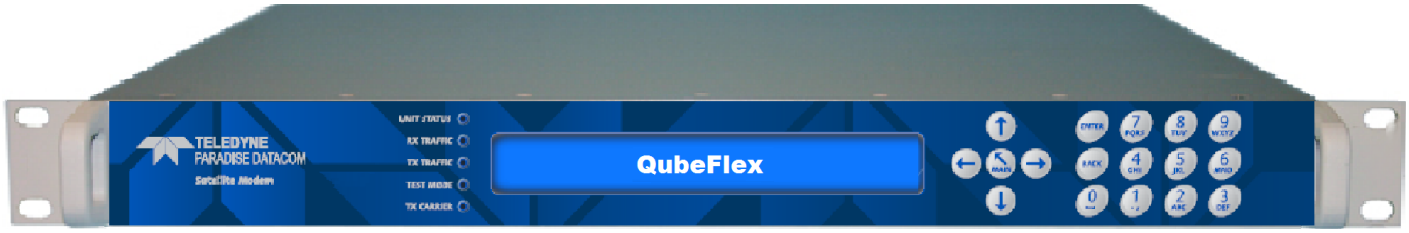
TELEDYNE
PARADISE DATACOM
Everywhereyoulook™

QubeFlex™
CubeSat/SmallSat/LEO Satellite Transceiver/Modem



OVERVIEW

The **QubeFlex™** software-defined modem has been designed for the low-earth orbit CubeSat and smallsat markets. Growing commercial applications demand fast time to market and reliable comms. **QubeFlex™**, as part of our end-to-end comms solution, replaces the do-it-yourself approach with a professional off-the-shelf solution suited to your current and future needs.

Features tailored for CubeSat operation

The **QubeFlex™** supports CCSDS telemetry, Intelsat and other common space transmission and packet standards. Forward error correction ensures data is protected against transmission loss. High data rates ensure maximum data can be received on each satellite pass.

The **QubeFlex™** demodulator will acquire and remain locked to the signal even when faced with the largest Doppler frequency shifts caused by fast-moving low-earth orbit satellites. Demodulator output is formatted for convenient onward computer processing and storage.

FEATURES

- Data rates up to 100Mbps
- Support for CCSDS telemetry & Intelsat standards including Viterbi/Reed-Solomon error correction & scrambling
- Modem is protocol agnostic but includes explicit support for CCSDS.
- Modulation to 3GHz & demodulation to 2.7GHz (includes 2.2 to 2.45GHz S-band)
- Supports other bands (including X) when used with external frequency conversion
- Doppler limits: +/-700kHz, +/-9kHz/s
- Demodulator output options: Ethernet (with optional timestamps & metadata) & EIA-530
- **Q-NET™ Navigator** network control application included as standard
- Our partners provide fully compatible onboard CubeSat transmission systems - please contact us for details
- Supports standard DVB-S2/S2X Rx

Markets and Applications

- CubeSat & smallsats
- Low-earth orbit (LEO) satellites
- Earth & weather observation
- LEO space research projects
- Intelligence gathering
- Space telemetry

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Main Specifications

Frequency	**L-band (standard):** 950 to 2450MHz (covering lower S-band also) (resolution 1Hz) **L-band frequency extension options:** **Tx:** Extends L-band to 3GHz **Rx:** Extends L-band to 2.7GHz **IF (standard):** 50 to 180MHz (resolution 100Hz) N-type connectors for Tx & Rx
Data Rate	**Standard:** 2.4kbps to 2,048kbps **Options:** 5, 10, 25, 60 & 100Mbps
Symbol Rate Limits	2.4ksps to 40Msps
Operating Modes	**CCSDS** (CCSDS 131.0-B-1) Viterbi & Reed-Solomon **Intelsat** (IESS-308) Viterbi & Reed-Solomon **DVB-S2/S2X** Rx path (EN 302 307-1, EN 302 307-2)
Scrambling	**CCSDS** (CCSDS 131.0-B-1) scrambler **Intelsat** V.35 scrambler **DVB-S2/S2X** Rx path scrambler (EN 302 307-1, EN 302 307-2)
Impedance	50Ω
Return Loss	**L-band:** 950MHz—2GHz >16dB; 2GHz—2.45GHz >12dB; **IF:** >18dB

Traffic Interfaces

Standard:

4-port Gigabit Ethernet switch for IP traffic and user control of the modem); *Automatic conversion of all demodulated data to UDP unicast/multicast packets, with optional timestamp and link metadata. Includes explicit handling of CCSDS, these and all other formats can also be output in a 'pass through' mode as generic IP. Output is compatible with various off-the-shelf IP packet capture tools for onward computer processing and storage*

Options:

Serial EIA-530 Interface (RS422, X.21, V.35 & RS232)

High-speed Serial LVDS Interface

In serial mode, the demodulator acts as a transparent pipe, with no attempt being made to interpret the data following the error correction stage

Demodulator

Input Range (dBm)	**IF minimum:** -130 + 10 log (symbol rate) **L-band minimum:** -140 + 10 log (symbol rate) **IF/L-band maximum:** -68 + 10 log (symbol rate)
Doppler Limits	**Frequency shift:** up to +/-700kHz **Rate of change:** up to +/-9kHz/s
Frequency Sweep Width	**Standard:** ±1kHz to ±255kHz; **Extended:** to ±700kHz (1kHz steps)
Maximum Composite	+10dBm
Wanted-to-composite	**L-band:** -102 + 10 log (symbol rate)
Receive Spectral Roll-off	Root-raised cosine filter provides choice of 5% to 60% roll-offs in steps of 1% (includes 5%, 10%, 15%, 20%, 25%, 35%) *Larger roll-offs reduce the carrier peak-to-average-power ratio, which reduces signal distortion, thereby substantially easing smallsat transmitter size, weight and power design constraints*
LNB 10MHz Reference	Via IFL cable; 10MHz ± 0.01ppm; 2dBm ± 1dB (complies with both 0dBm ± 3dB and 3dBm ± 3dB)
LNB Voltage	Programmable 13V, 15V, 18V, 20V or 24V DC to LNB via IFL cable; maximum 0.75A

Forward Error Correction

Note: Viterbi & Reed-Solomon can be used independently of each other as required

CCSDS-compliant Viterbi & Reed-Solomon	**Viterbi:** BPSK, QPSK & OQPSK 1/2, 2/3, 3/4, 5/6, 7/8 **Reed-Solomon:** **Symbols per codeword:** 255 **Error correction values:** 8 & 16 *Codes include (255, 223) & (255, 239) plus shortened codeblocks* **Interleaver depth:** 1
DVB-S2 & DVB-S2X (Rx only)	**DVB-S2** (EN 302 307-1) **DVB-S2X** (EN 302 307-2) *Includes all DVB-S2 and DVB-S2X modcods (both short frame and normal frame) from QPSK up to and including 64APSK*
Intelsat-compliant Viterbi & Reed-Solomon *(including custom settings)*	**Viterbi:** BPSK, QPSK & OQPSK 1/2, 3/4, 7/8 **Reed-Solomon:** *A codeword consists of k data symbols + (n - k) parity symbols, where (n - k)/2 symbol errors per codeword can be corrected.* **Value of n:** 60 to 255 symbols **Value of k:** 40 to 253 symbols in steps of 2 where the current range is restricted to between n - 2 and n - 20 **Interleaver depth:** 4 & 8

Ethernet: Standard Features

IPv4/IPv6	Dual IPv4/IPv6 TCP/IP supporting IPv4/IPv6
DHCP	DHCP client for automatic allocation of M&C IP address
SNMP	SNMP v1, v2c & v3
Web Server	Modem web server M&C interface (inc. tools listed under Test Facilities)
IP Metrics	Tx, Rx throughput (bps, pps) graphs; dropped, errored packet counts
Ethernet MTU Size	All packets generated by the demodulator will conform to the standard MTU of 1500 bytes

Modulator

An integrated, optional, fully functional modulator mirrors the CCSDS operation of the demodulator in every respect; this may be useful for TT&C & bench/satellite test purposes

Output Power (0.1dB steps)	**IF:** 0 to –25dBm **L-band:** 0 to –40dBm (950 to 2150MHz) 0 to –30dBm (2150 to 2450MHz) -5 to –30dBm (2450 to 3000MHz)

Test Facilities

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.)

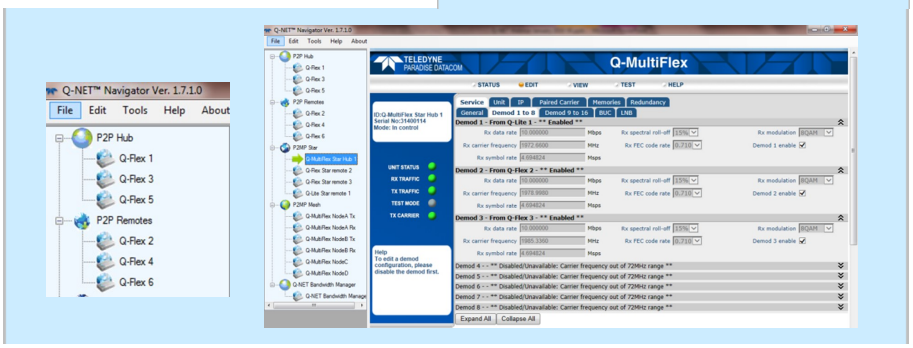
Mechanical/Environmental

Size	1U chassis, 285mm deep excluding front panel handles and rear panel connectors and fans
Weight	3kg
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	EN62368-1:2014
Emissions & Immunity	**Emissions:** EN55032:2015 Class A **Immunity:** EN55032:2017
Operating & Storage Temperature	**Operation:** 0 to 50ºC **Storage:** -20ºC to 70ºC
Humidity	95% relative humidity, non-condensing

Standard DVB-S2/S2X Rx only

*The **QubeFlex™** supports the use of standard DVB-S2 and DVB-S2X in the space segment. This approach provides the data as baseband frames, further allowing the user to extract the data locally with appropriate software running on a Server or PC. (Not provided.)*

Q-NET™ Navigator *supports the control of all Paradise modems and third-party network devices from a single application. Includes easy-to-use navigation, support for multiple operator roles/access levels, continuous status/alarm polling and full access to all modem features.* **Q-NET™ Navigator** *is included as standard, free of charge.*



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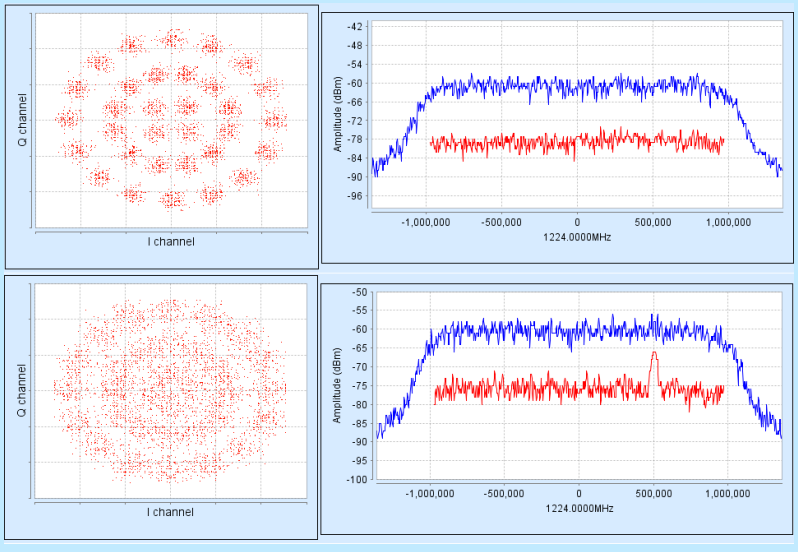
	Option	Description **Fully configurable - pay only for what you need!**
Base Modem	✓	**2.4kbps to 2.048Mbps Tx/Rx CCSDS/Intelsat modem** **4-port Gigabit Ethernet switch for modem control and satellite traffic**; includes all features described under Ethernet Standard Features **CCSDS & Intelsat Forward Error Correction** as described under Forward Error Correction **IF operation: 50 to 180MHz** **L-band/S-band operation (standard): 950 to 2450MHz**; high-stability 10MHz reference **Doppler limits (standard):** +/-255kHz, +/-2.1kHz/s **Carrier roll-offs (standard):** 5%, 10%, 15%, 20%, 25%, 35% **Test facilities:** includes all features described under Test Facilities **AC mains input**
Rx-only		A discount is applied when the modulator function is not required
Data Rate		**5Mbps data rate:** Extends base operation to 5Mbps (*CCSDS Viterbi/Reed-Solomon & Standard DVB-S2/S2X Rx only*)
		10Mbps data rate: Extends 5Mbps operation to 10Mbps (*CCSDS Viterbi/Reed-Solomon & Standard DVB-S2/S2X Rx only*)
		25Mbps data rate: Extends 10Mbps operation to 25Mbps (*CCSDS Viterbi/Reed-Solomon & Standard DVB-S2/S2X Rx only*)
		60Mbps data rate: Extends 25Mbps operation to 60Mbps (*CCSDS Viterbi/Reed-Solomon & Standard DVB-S2/S2X Rx only*)
		100Mbps data rate: Extends 60Mbps operation to 100Mbps (Standard *DVB-S2/S2X Rx only*)
Terrestrial Interfaces		**Serial EIA-530 interface:** Supports RS422/X.21/V.35/RS232; 25-pin D-type female connector; maximum data rate for RS232 is 100kbps and for all the others is 10Mbps
		High-speed LVDS serial interface: 25-pin D-type female connector; maximum data rate is 50Mbps
Standard DVB-S2/S2X (Rx only) *To 100Mbps subject to prevailing modem data rate limits*		**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.
Extended Doppler		Extends base modem Doppler limits from +/-255kHz, +/-2.1kHz/s to +/-700kHz, +/-9kHz/s
Extended Roll-offs		Extends base modem carrier roll-offs to include up to 60% roll-off (selectable in 1% increments)
Tx Frequency Extension		Extends standard Tx L-band/S-band operation upper limit from 2450MHz to 3GHz
Rx Frequency Extension		Extends standard Rx L-band/S-band operation upper limit from 2450MHz to 2750MHz
DC Input		48V DC: K3025 48V DC primary power input (in place of 100 to 240V AC input)



LINKGUARD™

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

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