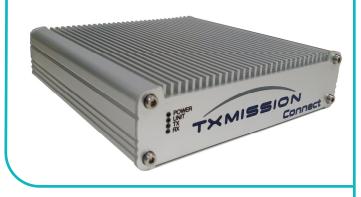# Connect™ Ground Station Modem

OVERVIEW

The Connect ground station modem is a DVB-S2/ S2X and CCSDS-compliant modem that has been designed specifically for use with smallsats. It forms part of our suite of products that covers everything from onboard and ground communications to network management systems.

The popular CCSDS message protocol can optionally be used with all our waveforms, meaning that existing CCSDS solutions can be upgraded to use the latest technology without having to change any of the system data processing elements.

FEATURES

• Data rates up to 1Gbps

• Direct VHF/UHF/IF/L/S/C-band support (other bands supported via the use of external up/down conversion)

• DVB-S2 & DVB-S2X waveforms

• CCSDS Viterbi-RS & CCSDS DVB-S/S2/S2X

• H.265 image & video decompression

• Handles high doppler frequencies

• Demodulated data output via Ethernet or high data rate serial interface

• Can be controlled via a web browser or via our MissionSpan™ NMS

• Dynamically varying data rate (ACM)

• Unique DVB-S2/S2X OQPSK option for low satellite transmit power

• Can host third-party apps (5G/IoT/edge computing/cloud computing, etc.)

• Our products are designed for earth observation, telecoms, space research, IOT/5G, intelligence gathering & other smallsat/LEO/airborne applications

BENEFITS

DVB-S2/S2X maximises the error-free data rate that can be achieved for a given transmit power level and is widely accepted as the most efficient waveform technology available anywhere.

For missions where even lower power consumption on the satellite is required, we can provide our proprietary OQPSK extension to DVB-S2/S2X, which lowers the peak-to-average transmitted power level, thereby reducing or eliminating any distortion to the signal.

In addition, the use of ACM ensures that the maximum amount of data can be downloaded during each satellite pass by continuously adapting the transmitted data rate to match the available received signal level.

This can even be used without feedback from the ground to the satellite, since the position of the satellite relative to the earth (and hence the signal level) is always known.

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Connect™
Ground Station Modem

KEY FEATURES

Function	Ground station modem) for smallsat & airborne applications
Waveforms	DVB-S2 (EN 302 307-1) DVB-S2X (EN 302 307-2) CCSDS DVB-S2 (CCSDS 131.3-B-1) CCSDS DVB-S2X (proprietary CCSDS extension) CCSDS Viterbi/Reed-Solomon (CCSDS 131.0-B-1) CCSDS 4TCM (CCSDS 401)
Data Rate (Tx & Rx)	DVB-S2/DVB-S2X: 50kbps to 1Gbps Viterbi/Reed-Solomon: 9.6kbps to 50Mbps
Symbol Rate (Tx & Rx)	DVB-S2/DVB-S2X: 100ksps to 119Msps Viterbi/Reed-Solomon: 9.6ksps to 40Msps Maximum occupied carrier bandwidth: 125MHz
Frequency Range	VHF/UHF/IF/L/S/C-band (75MHz to 6GHz) SMA connectors for Tx & Rx; plus Rx monitor point (Other frequencies via external up/down conversion)
Data Interfaces	Gigabit Ethernet, LVDS, ASI, USB
Spectral Roll-off	Standard: Root-raised cosine filter provides choice of 5%, 10%, 15%, 20%, 25% & 35% carrier roll-off factors Option: Extended roll-offs of 40%, 50% & 60% (reduces peak-to-average power ratio & amplifier back-off)
DVB-S2/S2X ACM	Varies data rate with satellite position during a satellite pass, maximising throughput for the strength of signal being received
Adaptive Tx Preditstorter	Corrects for linear & non-linear distortion in the RF chain; maximises linear output power & minimises required back-off; up to 2dB performance gain
Real-time Video Decompression	Hardware decompression of image & video data to the H.264/H.265 (HEVC) standards at 4K/Ultra High Definition resolutions & 60Hz frame rate, massively reducing storage requirements & data download
Output Power	-5 to -40dBm

MECHANICAL / ENVIRONMENTAL (1/2)

Size	141mm (W) x 133mm (D) x 36mm (H) A mounting bracket for fitting to a standard 19-inch rack can be provided; three modems can fit side-by-side in 1U of 19-inch rack space
Weight	< 0.5kg
Power Supply	90 to 264V AC input (external adaptor)

MECHANICAL / ENVIRONMENTAL (2/2)

Compliances	FCC, CE & RoHS compliant
Safety	EN 62368-1
Emissions & Immunity	Emissions: EN 55032:2015 Immunity: EN 55024:2010, A1
Operating Temperature	0°C to +50°C

WAVEFORMS / FORWARD ERROR CORRECTION

DVB-S2X (EN 302 307-2)	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 128APSK 3/4, 7/9 256APSK 32/45, 3/4 256APSK-L 29/45, 2/3, 31/45, 11/15 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-S2 (EN 302 307-1)	Normal/Short Frames: 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 *Note: rate 9/10 is not valid for short frames*
Proprietary Extension to DVB-S2/S2X	OQPSK 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 (OQPSK reduces the peak-to-average-power ratio of the transmitted signal compared to QPSK, reducing the required back-off & allowing a higher transmit power without impairing the signal)
CCSDS- compliant Viterbi & Reed-Solomon (CCSDS 131.0- B-1)	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, 233) & (255, 239) plus shortened codeblocks Interleaver depth: 1, 2, 3, 4, 5 & 8
CCSDS- compliant 4TCM (CCSDS 401)	CCSDS 4D 8PSK TCM 3/4, 8/9, 9/10, 10/11, 11/12
Other Modulations	Proprietary 1024QAM

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TELEMETRY, TRACKING & COMMAND

SSH/Telnet/ Serial	A command line interface can be used to securely log in to the satellite modem over the TT&C uplink. This can be used to monitor & configure every aspect of the modem
Web User Interface	The satellite modem supports a built-in web server that serves web pages to any web browser for TT&C purposes. This may be useful for both pre-deployment testing & in-orbit operational use.
MissionSpan™ NMS	As part of the ground station control network, it allows all modems (in orbit & on the ground) to be monitored & controlled through a single application

FEATURES / OPTIONS

Features		Options	Description
Hardware Platform	✓	Provided as standard	Chassis & all datasheet features other than those specified below are provided as standard
Data Rate	Select 1 option	100Mbps	Tx & Rx data rates to 100Mbps (50Msps)
		300Mbps	Tx & Rx data rates to 300Mbps (100Msps)
		500Mbps	Tx & Rx data rates to 500Mbps (119Msps)
		1Gbps	Tx & Rx data rates to 1Gbps (119Msps)
Waveforms	Select at least 1 option	DVB-S2	DVB-S2 QPSK, 8PSK, 16APSK & 32APSK operation per EN 302 307-1. Includes 5%, 10%, 15%, 20%, 25% & 35% spectral roll-offs
		DVB-S2X	DVB-S2X QPSK, 8PSK, 8APSK, 16APSK, 32APSK, 64APSK, 128APSK & 256APSK operation per EN 302 307-2. Includes 5%, 10%, 15%, 20%, 25% & 35% spectral roll-offs
		CCSDS DVB-S2/S2X	Note: requires the selection of the DVB-S2 and/or the DVB-S2X option CCSDS DVB-S2 per CCSDS 131.3-B-1 CCSDS DVB-S2X (proprietary CCSDS extension)
		CCSDS Viterbi/RS	CCSDS Viterbi/Reed-Solomon (CCSDS 131.0-B-1)
		DVB-S2/S2X OQPSK	Proprietary extension to DVB-S2/S2X to provide OQPSK modulation
		CCSDS 4TCM	CCSDS 4D 8PSK TCM (CCSDS 401)
		1024QAM	Proprietary 1024QAM (compatible with Quest™ Onboard Smallsat Modem)
ACM		DVB-S2/S2X	Adaptive Coding & Modulation (ACM) mode for use with DVB-S2 & DVB-S2X
Decompression		Video Decompression	H.264/H.265 (HEVC) hardware image & video decompression
Predistortion		Adaptive Tx Predistorter	Predistorts the Tx output in order to compensate for linear & non-linear distor- tion in the received signal
Extended Roll-off		Extended Roll-off	Extends carrier roll-offs to include 40%, 50% & 60%