

### ERSDEM Remote Control & Monitoring Software (CMS)

To simply integrate and operate the ERSDEM, each unit is provided with remote control software that can be run on a standard (windows™) PC.

All configuration settings including real-time status of the Demodulator, Test Modulator and Interface Module(s) can be controlled and monitored by means of this software. A real-time (multi-channel) demodulator scatter diagram application is also included.

### Experience

The ERSDEM-3 modem technology has been developed in long-term partnership with the renowned Institute for Telecommunications Research (ITR) at the university of South Australia..

The modem and interface technology is based on a combination of extensive experiences gained from the earlier ERSDEM-2.5 series as well as joint research into very High-Rate signal processing and interfacing.

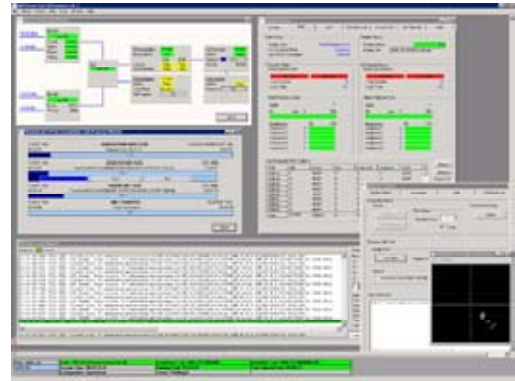
The combined experiences from ITR of Australia and Satellite Services B.V. of The Netherlands, cover all in-depth aspects from RF to baseband processing and product based implementation.

This has lead to a world-class system, that can be deployed in existing and new Earth Observation Data reception and processing systems as well as other High-Speed data exchange applications.

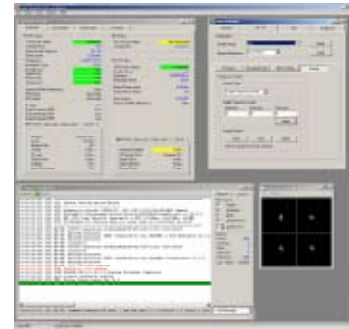
Due to the compatibility with other hardware and software within the Spacelink<sup>NGT</sup> product range, additional expansion and integration with other systems is also guaranteed.

### Application Areas

- Earth Observation stations (multi-mission)
- High-speed data communication
- Spacecraft/transponder development & testing
- EO payload validation/simulation
- High-Speed system simulation & validation
- Modulation and coding research



Spacelink<sup>NGT</sup> Level-0 TM Processor GUI example



ERSDEM CMS screenshot

## Contact information

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# Spacelink<sup>NGT</sup>

## ERSDEM-3 VHRM

### (Versatile High Rate Modem)

The Spacelink<sup>NGT</sup> Versatile High-Rate Modem (ERSDEM-3 VHRM) is one of the flagship products in the Spacelink<sup>NGT</sup> range of Modem & TM/TC equipment of Satellite Services B.V. in The Netherlands.

The ERSDEM-3 is the successor of the ERSDEM-2.5 series. The ERSDEM products are specifically designed in response to market demand for affordable yet High-performance and Multi-Satellite capable High-Rate Modems and associated Ingest/ Level-0 data processing equipment.

The ERSDEM-3 incorporates the latest System-On-a-Programmable-Chip (SOPC) technology and is based on fully digital (de)modulation techniques. The unit supports BPSK, QPSK, OQPSK and 8-PSK modulations with the option for in-field upgrades to support additional modulation and coding schemes.

ERSDEM-3 supports three modes of operation:

- **Single-channel high-rate mode**  
Supporting very high-rate demodulation from 100 to 500 Msym/sec  
This mode includes supports for CCSDS 4D-8PSK TCM decoding/demodulation
- **Single-channel legacy mode**  
Supporting high-rate demodulation from 10 to 110 Msym/sec including support for legacy ERSDEM-2.5 satellite modes such as Terra / Aqua
- **Multi-channel mode**  
Supporting 1 to 4 simultaneous channel demodulations using the same single-board hardware  
bitrates from 10 to 110 Msym/sec per channel (max 4 simultaneously)

The ERSDEM-3 supports single-channel QPSK modulation up to 1 Gbps and 4D-8PSK TCM decoding / demodulation at 2.5 and 2.75 bits/symbol spectrum efficiency with bitrates up to 1.1 Gbps.

The system operates on an S-band IF with an RF bandwidth of 600 MHz.

As for the ERSDEM-2.5, the high-tech implementation of the ERSDEM-3 has allowed for a Single-Board implementation of a modulator / demodulator thus allowing compact and ruggedised system implementation in a range of mechanical / electrical solutions.

The modulator/demodulator module is controlled and monitored directly through Ethernet TCP/IP and each module supports multi-client Telnet, FTP, HTTP and IPC protocols.

ERSDEM-3 is based on the principle of being able to provide either raw (I/Q/Clk) data streams to support existing ground infrastructure or to support a so-called transport stream interface mode.

In this mode, the ERSDEM-3 automatically tags received data with a time-code (based on embedded GPS, IRIG-B or PPS) and Product Confidence Data (PCD). This includes RF, modem and baseband status that is tagged to the received data on programmable intervals/rates. The result is a single transport stream that is suitable for direct data transportation / ingestion and thus removes the need for special data ingestion / processing hardware.

Depending on the mode of operation, baseband interfaces supporting LVDS, Gigabit Ethernet and Gigabit-serial copper/fibre links are available.



## Features

### Demodulator

- Full digital implementation
- Single-board solution
- Versatile operation
- Input frequency range: 2150-2750 MHz
- Input level range from 0 to -50 dBm
- Acquisition range up to +6% of symbol rate
- Tracking range up to 10% of symbol rate
- Doppler rate up to 35 kHz/sec
- Symbol rates from 10 - 500 Msym/sec
- Modulation: BPSK, QPSK, OQPSK, 8-PSK, 4D 8-PSK, UOQPSK, SQPSK
- QPSK differential decoding (independent or combined I/Q)
- NRZ-L, NRZ-M, NRZ-S, SPL decoding (legacy and multi-channel mode)
- VITERBI decoder (Rate 1/2 K=7) up to 110 Msym/sec per channel
- CCSDS 4D-8PSK TCM decoding up to 400 Msym/sec at spectral efficiencies of 2.5 and 2.75 bits/symbol (others can be added)
- Product Confidence Data (PCD) output to baseband via LVDS and Ethernet.
- Direct I/Q/Clk merged or unmerged LVDS interfaces
- Embedded time and Product Confidence Data tagging in Transport Stream Interface mode
- BER Analyzer

### Test modulator

- Full digital implementation
- Either integrated with demodulator or stand alone
- Output frequency range: 2150-2750 MHz
- Matching coding / modulation types of demodulator (1 carrier)
- User programmable Doppler & Sweep generator
- PRBS and user programmable frame generator
- Programmable noise source
- External Data Clock output for baseband data synchronisation
- Direct I/Q merged or unmerged modes or transport stream interface
- Waveform generation mode

### Control/Status interface

- 10/100 Base-T Ethernet LAN interface
- Multi-client Telnet like command/status
- Built-in FTP and HTTP server for firmware/satellite mode updates and on-line System Reference

### Satellite support

- Pre-defined Satellite configurations supported through single configuration file loading
- Support for user-defined satellite modes
- License free

### Time Synchronisation

- On-board GPS time receiver
- PPS input
- NTP

## Single- and Multi-Channel Mode Demodulator Specifications

Multi Channel / Legacy Mode		Single Channel (Very High-Rate mode)	
<b>Number of Channels</b>	1 to 4 channels simultaneously	<b>Number of Channels</b>	1
<b>Sampling Rate (Fs)</b>	8,16, 32 samples per symbol	<b>Sampling Rate</b>	2 samples per symbol
<b>Symbol Rate (Rs)</b>	10 Msym/sec to 110 Msym/sec for each channel	<b>Symbol Rate</b>	100 - 500 Msym/sec
<b>Modulation</b>	BPSK, QPSK, 8PSK, OQPSK, UOQPSK, SQPSK	<b>Modulations Supported</b>	BPSK, QPSK, (4D) 8PSK, OQPSK, SQPSK
<b>LPF Digital filter</b>	23-tap parallel FIR filter for low-pass filtering and decimation	<b>Front-end digital filter</b>	23-tap parallel FIR filter
<b>Rx Digital filter</b>	23-tap standard Root Raised Cosine filter		
<b>Symbol Timing Recovery Loop</b>	Using digital interpolation technique, independently implemented in all 4 channels	<b>Symbol Timing Recovery Loop</b>	Using digital interpolation techniques
<b>Carrier Phase Recovery Loop</b>	Independently implemented in all 4 channels	<b>Carrier Phase Recovery Loop</b>	LUT based phase rotation
<b>Adaptive Equalizer</b>	None	<b>Adaptive Equalizer</b>	Innovative 7-tap complex-valued, symbol-spaced, decision-directed equalizer to counteract bandpass frequency variations
<b>1D Viterbi Decoder</b>	Conv code rate 1/2, K= 7 BPSK Conv code rate 1/2, K= 7 QPSK	<b>4-D 8PSK TCM Decoder</b>	Rate up to 400 Msym/sec at Spectral efficiencies 2.75 and 2.5 bits/symbol
<b>Differential Decoder</b>	Combined or independently in I or Q bit streams	<b>Differential Decoder</b>	Combined or independently in I or Q bit streams
<b>Synchronisation Threshold ES/No in dB</b>	BPSK = -1 dB eg. Envisat-L QPSK = +3dB eg. Landsat-7, Envisat-H OQPSK = +3dB e.g. Aqua UOQPSK = 0dB e.g. Terra	<b>Synchronisation Threshold ES/No in dB</b>	BPSK = -1 dB QPSK = +3dB OQPSK = +3dB
<b>AGC</b>	Dual stage digital assessment: 1st stage: single/multi-channel common gain control. Input signal level range: 0 to -50 dBm.  2nd stage: Independent channel correction to counteract power differences up to +/- 10 dB between adjacent channels.	<b>AGC</b>	Single stage digital assessment based gain control. Input signal level range: 0 to -50 dBm
<b>AFC</b>	Each channel has its own AFC loop. AFC based on search and track approach.  Acquisition range up to +/- 6% of Symbol Rate.  Tracking range optimum up to +/- 10% of Symbol Rate.  Note: at lower symbol rates, the acquisition and tracking rates can be expanded.	<b>AFC</b>	Each channel has its own AFC loop. AFC based on search and track approach.  Acquisition range up to +/- 6% of Symbol Rate.  Tracking range optimum up to +/- 10% of Symbol Rate.
<b>Doppler rate</b>	Maximum 35 KHz/sec	<b>Doppler rate</b>	Maximum 35 kHz/sec
<b>Implementation Loss</b>	0.5 to 1 dB at 1E-6 BER	<b>Implementation Loss</b>	Rate dependant

**Modular implementation**

The ERSDEM-3 is implemented in a modular way. Each of the main functions of the unit, including the power supplies, are implemented as single plug-in modules. This allows a modular configuration of the unit in accordance with the customer or system requirements.

**Integration with other products**

The unit can be used stand-alone as well as integrated with other Satellite Services B.V. products for High-rate baseband TM processing and simulation. (As readily supported with the ERSDEM-2.5 Di & TS.)

For IF frequency conversion, 700-750 MHz legacy IF and X-band (7.9 - 8.5 GHz) up/down converters will also become available.

For backward compatibility, the ERSDEM-3 is equipped with baseband serial and parallel LVDS interfaces as well as supporting an optional ECL converter.

The LVDS data and PCD interfaces are also backwards compatible with the existing ERSDEM-2.5 and other SSBV Data Ingestion and Level-0 Interfacing products.

The innovative Transport Stream Interface mode is an industry-first implementation of data time- and status tagging and data multiplexing. This allows interfacing to a wide range of back-end / baseband interfaces without the need for additional data processing at hardware level.

Initially supported baseband interfaces include: Parallel LVDS, Gigabit Ethernet, and Copper / Fibre based Gigabit serial interfaces with complimentary PCI-Express based interface cards.

Special versions of the ERSDEM-3 include an integrated Data Ingestion / Processing system option with support for a range of industry standard DAS / NAS solutions.

