

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

To simply integrate and operate the ERSDEM, each unit is provided with remote control software (Windows/ Linux) that can be run on a standard PC with a LAN connection to the unit. All settings and real-time status of the Demodulator, Test Modulator and External Interface Module can be controlled and monitored by means of this software. A real-time demodulator scatter diagram application is also included. From the CMS basic scripts can be created and executed to allow single-click unit configuration.

### X / S-Band interfacing

There are a number of 1U/19" up/down converter products available in the Spacelink<sup>NGT</sup> product range. These products have been specifically designed to be implemented to work complimentary to the ERSDEM-2.5 modems. It is then possible to extend the ERSDEM IF range to S-Band (1.9-2.3 or 2.3 -2.9 GHz) and X-Band (8.0-8.5 GHz). Please take note of the separate datasheets for more information.

### Experience

The ERSDEM-2.5 modem technology has been developed in collaboration with the Australian Institute for Telecommunications Research (ITR). The modem technology is based on the experiences gained from the earlier ERSDEM-1 and 2 series of High-Speed digital demodulators that have successfully been used for different earth observation satellites.

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. This lead to a unique integrated and high performance system, that accomodates many application areas. Due to its compatibility with other hardware and software within the Spacelink<sup>NGT</sup> product range, easy expansion and system integration can be offered.

### Future expansion

At the end of 2005; the last phase of the joint ITR / SSBV product expansion and research into the ERSDEM-3 demodulator/Test Modulator has been entered.

This research will benefit the existing ERSDEM-2.5 (i.e. 4D-8PSK extension) as well facilitate the release of the new ERSDEM-3 product that will feature bit-rate performance up to 1 Gbit/sec and up to 4 channel demodulation within a single module.

As such, ERSDEM-3 will further remove technological and performance barriers in this field and enable cost-effective implementation of current and future satellite programmes and technologies.

### Application Areas

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



ERSDEM CMS screenshot



ERSDEM-2.5 Dii with S-Band down-converter, demodulator and integrated Raw Data Ingestion platform and data processor for Real-time level-0 processing and simulation



SpacelinkNGT ESA/CCSDS Level-0 TM processor GUI

## Contact information

For further information, please consult our website. You can also contact us at:

Satellite Services B.V.  
Scheepmakersstraat 40  
2222 AC Katwijk aan Zee  
The Netherlands

T: +31 71 - 402 8120  
F: +31 71 - 402 7934

info@satserv.nl

<http://www.satserv.nl> (corporate website)  
<http://www.spacelinkngt.com> (product website)

# Spacelink<sup>NGT</sup> High-Rate Multi-Mission Modem (ERSDEM-2.5)



The Spacelink<sup>NGT</sup> Multi-Mission High-Rate Satellite Modem 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-2.5 was specifically designed in response to market demand for affordable yet High-performance and Multi-Satellite High-Rate Modems and associated Ingest/Level-0 processing equipment.

The ERSDEM-2.5 incorporates the latest System-On-a-Programmable-Chip (SOPC) technology and is based on fully digital (de)modulation techniques and proven algorithms. The demodulator & test modulator operate on a programmable IF span from 700 to 750 MHz and supports bit rates from 6 Mbps – 320 Mbps<sup>1</sup> in several BPSK and (O/S)QPSK modes.

One of the unique characteristics of the ERSDEM-2.5 is the Single-Board implementation. Due to this, a single (VME form-factor) module operates as a standalone Demodulator or Test Modulator. This includes remote control/status and configuration via on-board Ethernet TCP/IP.

The demodulator can be combined with a Test Modulator, which can be used for short- and long-loop tests as well as system diagnostics and pre-pass testing. The Test Modulator includes a built-in Noise Generator, BER tester, PBRS pattern generator as well as a programmable Doppler & Sweep generator. The coding, modulation and satellite configurations match those of the demodulator.

Both the Demodulator and Test Modulator feature two physical (SMA) IF inputs/outputs. The active input for the demodulator can be selected through software. For the Test Modulator both outputs are active at the same time. The IF can be tuned from 700-750 MHz.

A variety of baseband inputs and outputs are supported. Standard interfaces include Differential-ECL and LVDS (customer specific adaptations possible). The modem supports I/Q merged or unmerged inputs/outputs and selectable data swapping/inversion as well as clock edges that can be selected for each interface individually.

Currently supported modulation schemes include: BPSK, QPSK, OQPSK, UOQPSK and AQPSK. The CCSDS 4D-GMSK modulation is expected to be available as from Q2/2006 as an additional in-the-field firmware/license update. Supported data coding formats include: NRZ-L, NRZ-M, NRZ-S and SPL with an optional VITERBI decoder (up to 110 Mbps). A differential encoder/decoder is included for ambiguity resolving in Q-PSK mode.

Set-up, Control and Status monitoring of each module is performed through an industry standard 10/100Base-T Ethernet interface. This supports a TELNET-like command/status interface and includes an HTTP / FTP server with on-line information, documentation and built-in support for firmware updates and new satellite configuration files.

Complimentary software provided with the standalone units include a easy-to-use remote GUI for System Control & Status and a real-time Scatter diagram.

<sup>1</sup> Bitrates above 320 Mbps (up to 450 Mbps) can be supported on special tuned units, please consult Satellite Services B.V. for further information

## Features

### Demodulator

- Full digital implementation
- Single-board solution
- Direct IF conversion and digital filtering
- 700-750 MHz tuneable IF in 1 kHz steps
- Input level range from 0 to –50 dBm (rate dependant)
- 2 MHz Doppler/AFC tracking circuit (programmable)
- Data rates from 6 Mbps – 320 Mbps (QPSK)
- Modulation: BPSK, QPSK, OQPSK, UOQPSK & AQPSK (In-Field upgrade for future modulation schemes)
- QPSK differential decoding/ambiguity resolving
- NRZ-L, NRZ-M, NRZ-S, SPL decoding
- VITERBI decoder (Rate ½ K=7) up to 110 Mbps
- Product Confidence Data (PCD) output to baseband via serial (LVDS) interface and LAN
- AM output (0-5 V) for antenna tracking
- Dual data outputs for baseband & external equipment
- Individual I/Q merged or unmerged modes for each output

### Test modulator

- Full digital implementation
- Single board solution
- 700-750 MHz tuneable IF output range
- Matching coding / modulation types of demodulator
- User programmable Doppler & Sweep generator
- Built-in BER tester with internal link to demodulator
- PRBS and user programmable frame generator
- 540 - 910 MHz programmable flat noise source (typ. < 1 dB) output
- External Data Clock output
- Asynchronous / Synchronous data sampling
- I/Q merged or unmerged modes

### Control/Status interface (each module)

- Telnet like remote control/status interface
- TCP/IP - Ethernet (10/100BaseT)
- Built-in HTTP server with Manual, ICDs and References

### Satellite support

- Satellite configurations supported through configuration files
- Support for future satellites/modes through in field updates/new configuration files (FTP upload) ERSDEM hardware/firmware can be upgraded in the field to support specific modulation / coding schemes

## Demodulator & Test Modulator Specifications

Speed Demodulator		Test Modulator	
<b>IF inputs</b>	Standard: 700-750 MHz +/- 2 MHz (1 kHz steps)  2 inputs available, input selection under software/configuration file control	<b>IF outputs</b>	700-750MHz +/- 2MHz  (two identical IF outputs available in parallel)
<b>Input level range</b>	700-750 MHz: 0 to -50 dBm	<b>Modulation types</b>	BPSK, QPSK, OQPSK, UOQPSK, AO-QPSK
<b>AFC</b>	+/- 2 MHz (width programmable) typical full 600 kHz range (+/-300kHz) scan time: < 2 seconds. Programmable	<b>Data stream generation (internal)</b>	Supports multiple internal data sources such as arbitrary PRBS patterns up to 232 symbols and arbitrary pattern buffer up to 64536 symbol
<b>Doppler shift</b>	Programmable sweeps (fine/coarse rate and range) Max +/- 2 MHz (Search & Track principle)	<b>Bit error rate tester</b>	Built-in BER tester with built-in signal route for feedback from demodulator to allow IF (short/long) loopback BER tests
<b>Max. Doppler rate</b>	50 kHz / sec	<b>Data formats</b>	NRZ-L, NRZ-M, NRZ-S, SPL
<b>AGC time constant</b>	Set up for 10-90% step response = 250ms. Programmable	<b>Doppler Sweep</b>	In built sweeping functions for satellite Doppler simulation
<b>Max bit clock freq. offset</b>	1e-4 of Bit rate		
<b>Supported modulation types</b>	BPSK, QPSK, OQPSK, UOQPSK, AQPSK <sup>1</sup>		
<b>Data formats</b>	NRZ-L, NRZ-M, NRZ-S, SPL	<b>Modulation types</b>	BPSK, QPSK, OQPSK, UOQPSK, AO-QPSK
<b>Decoding</b>	QPSK differential decoding  Optional VITERBI decoder (Rate= 1/2 K=7) up to 110 Mbps	<b>Attenuation</b>	Overall IF signal attenuator: 720 Mhz output signal level from 0 to -50 dBm in 1 dB steps
<b>Product Confidence Data (PCD)</b>	Available via dedicated LVDS serial interface as well as via LAN	<b>Encoding</b>	QPSK differential encoding  Optional Convolutional encoder (Rate= 1/2 K=7)
<b>Bit rates<sup>2</sup></b>	6 Mbps to 320 Mbps (QPSK)	<b>Bit rates</b>	6 Mbps to 320 Mbps (QPSK)
<b>Implimentation loss</b>	0.7 - 1.0 dB typically @ 1.0E-6		
<b>Configuration</b>	Multiple satellites within nominal specification range can be supported through user selection. (No limit on no. of missions stored, other than Non-Volatile storage media)  Configurations can normally be loaded and become operational in less than 30 seconds	<b>Noise source</b>	540 to 910 MHz noise source output (internal/external) Maximum Output power is typically -94 dB/Hz Flatness typically < 1 dB to a Max of 2 dB Noise power controllable in software, 0 to 31.5 dB in 0.5 dB steps
<b>Threshold (Es/No=dB) (worst case)</b>	BPSK : typ Landsat5/Envisat-L ~ 0 dB QPSK : typ Landsat7/Envisat-H ~ 1 dB OQPSK : typ AQUA ~ 1 dB Viterbi : typ Terra ~ 0 dB	<b>Clock source</b>	Internal / External Bitclock output to external source
<b>Data outputs</b>	Differential ECL and LVDS baseband outputs. (separate I/Q or combined)  I/Q/Cik outputs (ECL, external) I/Q/Cik outputs (LVDS, external) I/Q/Cik outputs (LVDS, internal return to Test Modulator)	<b>Internal clock stability</b>	5 ppm
		<b>Data inputs</b>	Differential ECL and LVDS baseband inputs. (separate I/Q or combined)  I/Q/Cik inputs (ECL, external) I/Q/Cik inputs (LVDS, external) I/Q/Cik inputs (LVDS, internal link to Demodulator)

<sup>1</sup> Other modulation types such as 4D-8PSK and future 16QAM can be supported as part of system expansion/options

<sup>2</sup> Bitrates above 320 Mbps (up to 450 Mbps) can be supported on special tuned units, please consult us for further information

### Modular implementation

The ERSDEM-2.5 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.

At present the following ERSDEM-2.5 single-board modules are available: (not including other baseband / up-down conversion. See further for details)

- ERSDEM-2.5 High-Speed Demodulator
- ERSDEM-2.5 High-Speed Test Modulator
- External Interface Module  
(offering ECL/LVDS I/O from selectable interfaces including level conversion to/from ECL)
- ERSDEM-2.5 High-Rate Interface Module  
(offering serial/parallel LVDS I/O and mapping on single-cable Gbit serial interface to SSBV baseband equipment)

From an integration / mechanical point of view, different off-the-shelf models of the ERSDEM-2.5 are currently available:

- ERSDEM-2.5 DT (4U/19")  
Offers a Demodulator, Test Modulator and EIM into a single 4U/19" rack mountable housing.
- ERSDEM-2.5i (4U/19")  
Offers a Demodulator, Test Modulator, EIM and provisions for direct SSBV baseband hardware interfacing.  
(incl. LED info on front-panel)
- ERSDEM-2.5 Di (3U/19")  
Offers a Demodulator and LVDS interface to SSBV Raw Data Ingestion equipment that is delivered integrated with the unit. This includes LED and LCD front-panel information and Raw Data Ingestion software on the baseband platform.  
(upgradeable to Level-0 Processor or custom processing)
- ERSDEM-2.5 TS (3U/19")  
Offers a Test Modulator and LVDS interface to SSBV Raw Data Simulation / Serialisation equipment that is delivered with the unit. This includes LED and LCD front-panel information and Data Simulation software on the baseband platform.  
(upgradeable to Level-0 simulator/encoder)

Since all modules (including power-supplies) can simply be removed from the back of the unit, in-the-field maintenance can be easily undertaken and the unit can easily be reconfigured. Alternative system configurations, such as dual-demodulation chains can also be accommodated.

### 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 extension of the input/output frequency range IF converters and X/S-band up/down converters are also available from the Spacelink<sup>NGT</sup> product range.

The ERSDEM-2.5i/Di are special versions of the unit that feature direct integration with Satellite Services B.V. High-Speed Telemetry baseband equipment via LVDS and/or Gbit serial links. With these versions of the unit; the baseband hardware/software status can be read directly from the ERSDEM-2.5i front-panel (LED/LCD). The complete baseband equipment and modem are operated from the supplied application software that complements the hardware to compose a high-speed multi-satellite Telemetry Processing and Simulation system capable of real-time Raw Data Ingestion, (CCSDS/ESA) Level-0 processing, data ingestion/archiving and LAN data distribution.

The baseband hardware is composed of a plug-in card from Satellite Services B.V. which is integrated into a commercial server platform that also runs the application level software. This hardware features SOPC technology to accommodate a variety of TM processing and simulation functions and standards and furthermore supports the accurate tagging of TM data with a time code (IRIG-B) and the Product Confidence Data as provided by the ERSDEM-2.5 demodulator.

TM acquisition is either controlled through locally entered downlink acquisitions (GUI) or autonomously (unassisted) through ASCII and /or XML formatted acquisition directives. Processed data can either be archived on the unit itself or be streamed to archiving media or LAN (10/100/Gigabit Ethernet) via NFS, FTP or other industry standard protocols.

An easy to use Graphical User Interface provides overall control and status monitoring of all hardware/software elements integrated into the system including support tools for archiving, PCD inspection, archive data exploring and scatter plotting.

A special multi-channel implementation is available which supports multi-link demodulator operation including in-system diagnostics, pre-pass self-test and automatic faulty chain take-over during operation. (Please, consult SSBV for more information.)