Spacelink^{NGT} IF Transceiver

To fulfil the market demand for a cost-effective and highly integrated IF transceiver for use in ground segment, VSAT/SATCOM terminals, range test equipment & EGSE; Satellite Services B.V. have developed a Next Generation Technology product, being a single-board IF transceiver. This compact (2U/19") unit is able to satisfy many different requirements / applications.

The single-board IF transceiver supports all space<>ground link elements required for an operational ground segment or VSAT/SATCOM terminal. Depending on the configuration desired, certain functions can be made optional and added/expanded later when desired.

The IF transceiver supports concurrent operation of an up- and downlink both of which can operate at the same minimum/maximum bitrates (i.e. symmetric links.

The standard IF frequency supported is 70 MHz RX/TX or alternatively a 230 MHz version is available. Other IF frequencies can be supported as specific factory build variants.

Except for the initial up/down conversion, all filtering, modulation and demodulation functions are performed digitally, thus ensuring efficient and stable operation with a wide degree of (on-line) user programmability.

A fully featured unit is able to perform concurrent TX and RX at two identical or separate IF frequencies. Each modulation and demodulation chain effectively offers 3 modulators (2x subcarrier, 1x carrier) and 3 demodulators (1x carrier, 2x subcarrier) to support a variety of modulation schemes and ranging (option).

The carrier and subcarrier demodulators support hard- and soft-decision outputs that are available at the output connectors. (LVDS or RS-422 physical interfaces depending on factory configuration).

Setup, Control and Status monitoring is performed via a TELNET connection to the IF transceiver that is equipped with a 10baseT Ethernet interface.

As a unique feature of the IF transceiver is that is allows the (advanced) end-user to change/pre-set low-level DSP/FPGA parameters applicable to the demodulation and modulation blocks.

The hardware/firmware of the transceiver is also in-circuit programmable, allowing for future in-the-field updates.

Features
- Single-board design
- Compact 2U, 19" unit
- Front-panel status LED's for TX/RX
- Preset configuration via front-panel buttons (for black-box deployment)
- 70 or 230 MHz IF Receiver / Transmitter
- Fully based on Digital Signal Processing for modulation and demodulation.
- Back panel monitoring and signal insertion possibilities throughout different modem stages (i.e. subcarrier outputs and insertion)
- Support for BPSK, QPSK and OQPSK modulation / demodulation (8-PSK optional)
- Maximum symbol rate: 20 Msps for BPSK/QPSK up- and downlinks
- Direct PM (incl. SPL) and subcarrier(s) on PM carrier supported
- ESA PRN ranging support for modulation & demodulation
- Doppler compensation
- Doppler simulation on uplink (full spectrum)
- External subcarrier / SPL input
- QPSK differential encoder/decoder (ECSS OQPSK option available)
- 10 MHz external reference clock input
- External Bit clock output for subcarrier modulation
- BER within 1 dB of theoretical limit
- Selectable hard- or soft-decision demodulator outputs
- 2 sets of serial inputs/outputs, support LVDS or RS-422 (factory configuration)
- 10BaseT Ethernet interface to support TELNET based external control/status
- Internal 13 MHz IF loopback (Built-in-Test)
- Future expansions for support of other modulation schemes / standards
- Optional Convolutional decoder/encoder

Applications
- Ground segment
- VSAT/SATCOM terminals
- Point-point bi-directional datalinks
- Range TX/RX
- IF interface / modems for EGSE
- Test & Simulation environments

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Specifications are subject to change without notice – Version: 2d -This datasheet is provided for information only
See also: www.spacelinkngt.com for other products and updates

Specifications

Transmitter		Receiver	
IF output centre frequency	70 MHz ± 4 MHz *OR* 230/240 MHz (factory build)	IF receive centre frequency	70 MHz ± 4 MHz
IF Bandwidth	Dependent on bit rate	Noise figure	< 8 dB
IF synthesiser steps	<100 Hz	IF input level	-30 dBm to - 90 dBm (bitrate dependant)
Accuracy of internal reference oscillator	± 5 ppm	IF input impedance	50 Ohm
Output power level	-30 dBm to +10 dBm (adjustable in 1 dB steps)	IF synthesiser steps	≤ 10 Hz
Internal frequency sweeping Range: Rate:	± 1 kHz to ± 1 MHz 0 to 175 kHz/s (set on 100 ms point intervals)	IF filter	Digital Linear phase FIR filters
Modulation (direct on carrier)	PM, BPSK, QPSK & OQPSK	IF filter bandwidth	Programmable from 10 kHz to 20 MHz (linked to bitrate)
Modulation (with subcarrier)	PM	Doppler compensation	± 500 kHz @70 MHz IF
Subcarrier modulation	BPSK, QPSK & OQPSK	Max. Doppler rate	± 52 kHz /s
Subcarrier frequency	8 kHz - 4 MHz	Carrier demodulation	PM, BPSK, QPSK& OQPSK
Subcarrier synthesiser step	0.005 Hz	Subcarrier frequency	8 kHz - 4 MHz
Direct BPSK subcarrier suppression	Typical > 70 dB (measured with 262144 Hz subc.)		
Modulation index	≤ 1.5 radians peak ≥ 0.1 radians peak	Subcarrier demodulation	BPSK, QPSK & OQPSK
IF Output impedance	50 Ohm	SPL decoder	If signal is PM with SPL coded signal only
Differential encoding	QPSK - Gray Code, Modulo-4 Finite Sum Operation	Differential decoding	QPSK - Gray Code, Modulo-4 Finite Sum Operation
Modulator data inputs	NRZ-L, NRZ-M, SPL (1 of 2 source selection) Physical interface: Diff-ECL, LVDS, RS-422 (factory build)	Signal outputs	NRZ-L & Clock (no decoding) (output routing selectable to 2 sets of signals/connectors)
Input bit rate	1 kbps - 1 Mbps BPSK modulated on subcarrier 2 kbps - 2 Mbps QPSK modulated on subcarrier, 1 ksps - 20 Msps SPL direct PM on carrier 1 ksps - 20 Msps BPSK / QPSK directly on carrier	Bit rate	1 kbps - 1 Mbps BPSK modulated on subcarrier 2 kbps - 2 Mbps QPSK modulated on subcarrier 1 ksps - 20 Msps SPL direct PM on carrier 1 ksps - 20 Msps BPSK / QPSK directly on carrier
Clock output for subcarrier data synchronisation	1 kHz - 1 MHz (in 0.01 Hz steps)	Bit rate resolution	< 0.01 Hz (<10 Mbps)
Data input modes (QPSK)	Separate I/Q channel or combined	Data output mode (QPSK)	Separate I / Q
External subcarrier input	1 Vpp, 50 Ohm		
Ranging tone frequency	100 kHz – 1.5 MHz		
Ranging modulation scheme	PCM/PSK/PM (ESA PRN ranging)	Signal acquisition threshold	C/No < 27 dBHz (for 2Bn = 30 Hz) for a pure carrier signal
Ranging Pseudo Noise code length	2^N-1 bits with N selectable from 0 to 20	Carrier acquisition time	< 2 seconds
Ranging tone modulation index	45 or 28 degrees	Physical interface	Diff-ECL/LVDS/ RS-422 (factory build)
Carrier modulation index	Minimum (ranging only) 0.1 rad peak nominal (ranging only) 1.2 rad peak Maximum (ranging and TC) ≤ 1.4 rad peak	Ranging	Ranging signal demodulation *(No range signal processing at present)*
Subcarrier amplitudes	Adjustable from 0- 1.875 Vpp (125 mV steps for each subcarr.)	Demodulator degradation	<1 dB of theoretical curve
Harmonics and spurious	≤ - 60 dBc		
Phase noise	-94 dB/sqrt (Hz) at 100 kHz from carrier (70 MHz IF)		
External reference oscillator	10 MHz, 2 Vpp into 50 Ohm		
Monitoring points	13 MHz IF, combined Subcarrier outputs, carrier modulator input	Monitoring points	13 MHz IF, carrier demodulator output (2x)

Customer specific optimisations are possible - Datasheet values are indicative to 70 MHz TX/RX Mk2 production version