Ursa Minor

Search and Rescue Test Beacon

C/S D&E Phase

The Ursa Minor Search and Rescue Test Beacon transmits an ultra-stable, fully user configurable signal that allows the testing of the Cospas-Sarsat MEOSAR system through all its signal margins.

The Ursa Minor Search and Rescue Test Beacon has been developed for the European Space Agency to test the SAR/Galileo system during IOV and assist in the Cospas-Sarsat D&E phase.

The main function of the Search and Rescue Test Beacon is to transmit known signals within the full range of the Cospas-Sarsat signal specifications to allow the determination of SAR/Galileo system performance behavior, to demonstrate the MEOSAR system and to test new system uses. The SAR-TB generates an ultra-stable signal in frequency, modulation, time and power.

The SAR-TB allows the user to configure and transmit emulated Cospas-Sarsat distress messages to Cospas-Sarsat compatible payloads, including those onboard Galileo satellites. In conjunction with the build in Galileo Receiver, the system may receive and react to (optionally) RLMs from an operational Galileo payload.

Multiple beacons can be simulated as long as their signals do not overlap in time. Various SAR-TB units can be coupled such that also time overlapping transmissions are possible and coordinated control is made easy. In either case, the SAR-TB can be used through the local MMI or remotely.

The following optional expansions are available:

- Transmission of multiple simultaneous signals
- Centralized command and control of multiple beacons
- Return Link Message reception
- Automatic RLM beacon emulation
- Second Generation Signal support
- Delivery in a transportable 19” rack with uninterruptable power supply, monitor and keyboard.
- Other options are available on request.

Test Beacon Specifications

Element	Specification
Beacon transmission waveform	The beacon transmits first generation signals according to the waveform specifications defined in the Specification for Cospas-Sarsat 406 MHz Distress Beacons (document C/S T.001), except where stated differently in this document.
Second generation beacon signal	The second generation beacon signal can be implemented as an option.
Digital message	Supports all possible bit pattern and allows for setting bit values. All signal bits can be manual set by the user.
BCH generation	As per C/S T.001
GPS position in message	As an option, user controlled, the SW can read the GPS/Galileo location at the time of the generation of the script files when the beacon is not transmitting.
Bit rate range	395 to 405 bits/sec
Subsequent burst transmission rate range	2 to 120 seconds. However, for burst repetitions <6s, time synchronisation with GPS cannot be performed. This will result in a (very) slow drift from UTC. As soon as there is a gap in the transmission schedule of at least 6 seconds, the time will be synchronised again.
Burst time accuracy	Max offset <200 nanosecond. The time reference point (anchor), as defined in C/S R.012, shall be the mid-point of the 50% phase crossing of the mid-transitions of the 24th and 25th bits of the transmitted modulated waveform.
Spurious emissions limit	Meets C/S T.001 Spec. Modulation rise and fall times impact the spurious emissions. It might be that due to this variation, the signal falls out of the C/S emission mask.
Modulation index range	0.5 to 2.0 radian in 0.1 radian steps
Modulation rise and fall time range	10 to 250 microsecond
Modulation symmetry	As per requirement in C/S T.001
Output frequency range	406.0 to 406.1 MHz
Output frequency accuracy	Max offset <1 Hz. However, it is hard to validate the output frequency offset accuracy on a modulated signal. While the used HW is specified at a frequency accuracy of better than +/- 0.5 ppb, which equals to better than 1 Hz at 406 MHz, with our current test tools, we can only measure and thus guarantee a max offset of <3 Hz.
Final Stage Power Output	22dBm to 39dBm. The transmission power accuracy will be guaranteed after the first burst at a certain power level since we have a (mostly linear) feedback loop for power control. It is therefore advised to transmit sequences of burst at the same power level.
Output power control	1 dB steps
Logging Capabilities	The beacon provides logging functions.
Indoor Temperature Range	The indoor units of the beacon are designed to operate in an environment with a typical temperature range of 20 ±2 degrees Celsius.
Indoor Humidity Range	The indoor units of the beacon are designed to operate in an environment with a typical relative humidity: less than 70%.
Antennas	Every beacon provides a single linear polarised transmit antenna plus one GNSS antenna and including cabling for up to 30m.
Low Power Tx Interface	The beacon integrates an RF low power output port allowing to analyse the signal transmitted by means of an external measurement instrument.
Interference Signals	Optionally, the beacon can generate bursted CW signals.

Ursa Minor (UMR) is an SME located on the center of Amsterdam. Since 2002 we specialize in the development of dedicated radio equipment, both in hardware as in software.

Competences

The background of Ursa Minor includes expertise in aerospace engineering, software engineering, electrical engineering, signal processing, business and management. Ursa Minor has experience in navigation, (satellite) communication, localization and hardware and software design and implementation. We focus on the development of dedicated test equipment for satellites, ground stations and user equipment in the areas of Search and Rescue and GNSS.

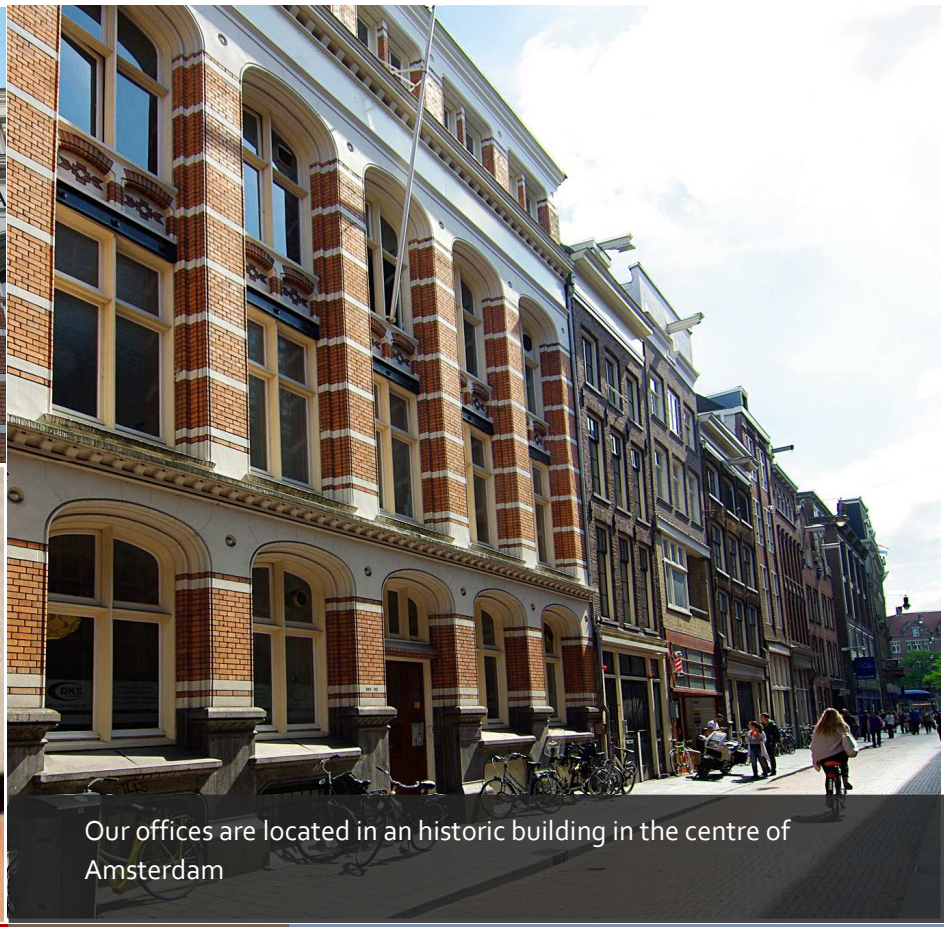
Experience

Ursa Minor has developed the Search and Rescue Test Beacon (SAR-TB) for SAR/Galileo. This hardware is able to emulate all current and planned Cospas-Sarsat signals in RF. It also supports the return link capability of SAR/Galileo. Elaborate Development Support Tools were developed to test the SAR-TB generated signals. This tool is capable to digitize, demodulate and determine various signal parameters.

Ursa Minor was also involved in the following follow-up activities related to this development. Firstly, the SAR-TB was integrated into the Search and Rescue Verification Test Bench (SARVTB), providing end-to end verification and test capability of SAR/Galileo space and ground segments. In addition, service and operational demonstration and test of SAR/Galileo and the wider Cospas-Sarsat system were being performed in the GSARSED project. Furthermore, Ursa Minor has developed the RF end-to-end test tool for the ESA SAR/Galileo ground station MEOLUT.

Ursa Minor has developed the SAR/Galileo Reference Beacon, which is currently installed in 5 locations throughout Europe.

Ursa Minor is currently working on the implementation of the PAALUT Phased Array Antenna for MEOLUT ground stations. This antenna is capable of tracking up to 20 MEOSAR satellites simultaneously with no moving parts.



Our offices are located in an historic building in the centre of Amsterdam

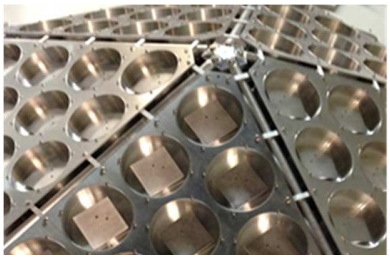
Ursa Minor focuses on cutting edge R&D projects with space applications. Our customers are the European Space Agency, the European Commission, Dutch Government and several commercial companies.

Galileo Search and Rescue Reference Beacon (REFBE)

Ursa Minor has developed the Galileo Search and Rescue Reference Beacon (REFBE) for ESA. There are 5 REFBEs operational in the European coverage area. They are programmed to transmit reference signals in a strict pattern. These signals are extremely accurate and can therefore be used for the collection of Key Performance Indicators (KPIs) for the MEOSAR system.

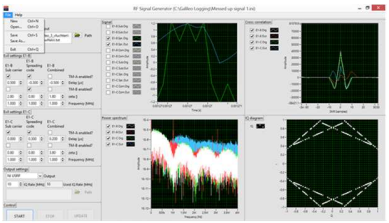
Galileo Search and Rescue Test Beacon (SAR-TB)

Ursa Minor was responsible for the development of the Search and Rescue SAR Test Beacon (SAR-TB) for ESA. The SAR-TB integrates position determination, reception of messages through the Galileo navigation signal and the transmission of distress signals. Hence, the SAR Test Beacon is an advanced two-way user terminal, demonstrating the capability of the Galileo payloads. It has the following main capabilities: Return Link Message support, Emulation of 50 individual SAR beacons per session, Simultaneous transmission of 5 signals, and Transmission of interference signals.



Phased Array Antenna for Search and Rescue (PAASAR)

Ursa Minor takes the technical lead in the development of the Phased Array Antenna for Search and Rescue (PAASAR) under R&D contract by ESA. PAASAR creates the possibility to track up to 20 MEOSAR satellites without moving parts. This is made possible by utilizing a couple of hundred small antennas of which the digitized signals are smartly combined in a high capacity computational FPGA unit. The footprint of PAASAR is comparable with a LEOLUT and is therefore much smaller than a traditional multi-dish MEOLUT.



Evil Wave Form Galileo Simulator (EVILSIM)

Ursa Minor has developed an Evil Wave Form Galileo Simulator (EVILSIM) for the Galileo navigation signal. With this simulator, the behavior of Galileo receivers against feared or evil events due to several fault conditions in the signal generator inside the Galileo satellite can be tested. The system allows real time modification of the error conditions on the generated RF signal.

Marine Safety Services

Ursa Minor have developed several services for marine safety. The first is a web based drift prediction service, EDD, including the novel use of nowcast weather data for increased accuracy drift predictions. In addition, the MTTS project led to a demonstrator system that is an integrated application supplying situational awareness information from multiple sources to leisure vessel users and coastguard, as well as providing limited two-way communications between them. While designed to emulate a system-of-systems including space segment hardware, the implemented web application is functional and would be suitable for integration into other services or use as a stand alone product.

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