

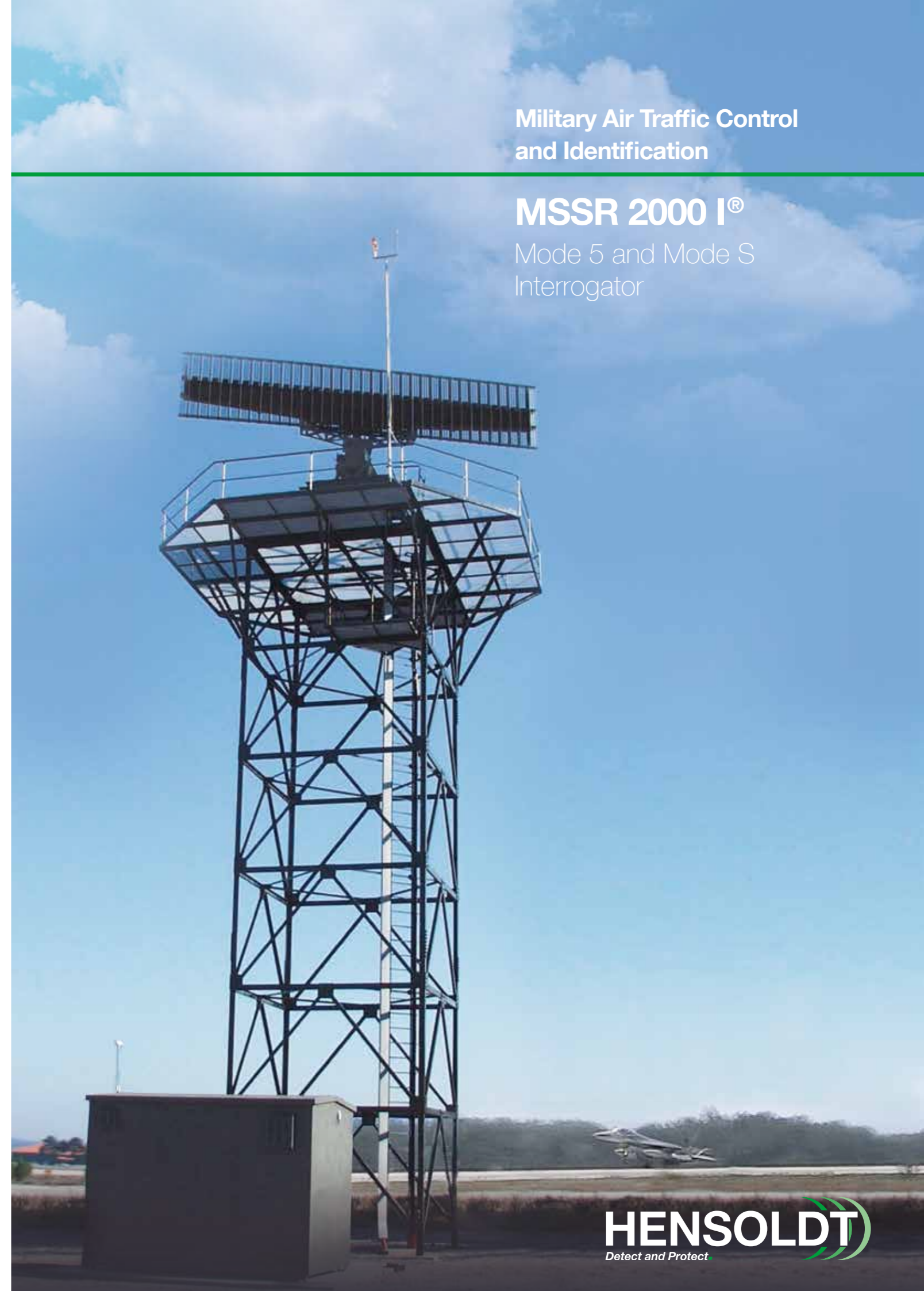
Technical Characteristics

Interrogation Modes			
MkXII-A/S capability	1, 2, 3/A, 4, C, S Enhanced Surveillance and 5 (Levels 1+2)		
Supermode capability	Mode 4, 5 plus any one of MkXA mode or Mode S within one interrogation period		
Interlace capability	Customisable for individual interrogations, sector-specific interrogations, maintaining silent sectors		
Intermode capability	A/C for all-call interrogations only, A/C/S for all-call interrogations		
Mode S capability	Mode S Elementary and Enhanced Surveillance (UF/DF 4, 5, 11, 20, 21; Comm A, Comm B incl. AICB, GICB)		
ADS-B, Extended Squitter (1090 MHz)	Automatic Dependent Surveillance - Broadcast, receipt and extraction of position squitter replies, silent Mode S acquisition, cone of silence tracking, classification of reflections		
Directed interrogation capability	Selective identification/interrogation with any possible interlace pattern, externally induced on 3D position or track number		
MkXII interrogation rate	< 450 Hz, dynamically depending on interlace pattern		
Rate of Mode S all-call interrogations only	typically < 60 Hz (5-6 rpm)		
Interrogation Transmitter			
Transmit frequency	1030 ± 0.01 MHz		
Output power at antenna port	500 W, 1500 W, 2000 W, 2 x 2000 W (scalable)		
Bandwidth	12 MHz		
Gain control	adjustable in steps of 1 dB, independently for Σ and Ω		
Duty cycle (DC) of main beam (according to EUROCONTROL specification, unless otherwise specified)	65% in intervals of 2.4 ms 8.2% in intervals of 40 ms (FAA) 6.4% permanently		
ISLS duty cycle	< 0.1%		
Output VSWR	< 1.5		
Reply Receiver			
Centre frequency	1090 ± 0.5 MHz		
Bandwidth	12 MHz		
Sensitivity	- 89 dBm		
Dynamic range	80 dB		
Gain time control	programmable in sectors		
Instrumented range	0.08 to 331 NM (resolution of 0.06 m) with ASTERIX cat. 048 extension		
Processed range	0.08 NM to max. 331 NM (limit to be predefined)		
Image frequency rejection	> 70 dB		
Performance Figures			
According to EUROCONTROL, using a standard LVA antenna (antenna rotation speed of 10 to 15 rpm):			
Target capacity (equal distribution)	2,000 targets over 360°	400 targets over 45°	110 targets over 3.5°
Range resolution (2 targets with the same azimuth)	≤ 75 m		
Azimuth resolution (2 targets with the same range)	≤ 0.72°		
Range accuracy (mainly due to transponder errors)	$\sigma \leq 30$ m for SSR	$\sigma \leq 15$ m for Mode S	$\sigma \leq 7$ m w/o transponder error
Azimuth accuracy	$\sigma \leq 0.05^\circ$		
Probability of detection: (EUROCONTROL EMS Funct. Spec., v3.11, section 4.2.3.2.1)	≥ 99%		
False alarm rate (EUROCONTROL EMS Funct. Spec., v3.11, section 4.2.5.1)	≤ 0.1%		
Target resolution (EUROCONTROL EMS Funct. Spec., v3.11, section 4.2.7.1, 300 Hz, ATT 5s, M3/A+MC)			
<ul style="list-style-type: none"> area 1: $0.96^\circ < \Delta\theta < 4.68^\circ$, $\Delta R < 2$ NM area 2: $0^\circ < \Delta\theta < 0.96^\circ$, 0.05 NM $< \Delta R < 2$ NM area 3: $0^\circ < \Delta\theta < 0.96^\circ$, 0 NM $< \Delta R < 0.05$ NM 	Pd ≥ 99% Pd ≥ 99% Pd ≥ 83 %	PcvA ≥ 99% PcvA ≥ 99% PcvA ≥ 70 %	PcvC ≥ 99% PcvC ≥ 90 % PcvC ≥ 70 %
External Interfaces			
Power supply	115 to 230 V, 47 to 440 Hz		
Power consumption	< 1500 W (full duty cycle)		
Physical connections	2 x LAN, 4 x RS-422		
Communication layer protocols	X25, UDP, TCP/IP, HDLC		

Military Air Traffic Control and Identification

MSSR 2000 I®

Mode 5 and Mode S Interrogator



MSSR 2000 I

The MSSR 2000 I fulfils all military and civil customer needs for secured and encrypted military IFF interrogators using Mode 5 Levels 1 and 2 and for radar-based air traffic control using Mode S. The MSSR 2000 I is certified pursuant to AIMS 03-1000B and meets all requirements placed by STANAG 4193, edition 3, and by EUROCONTROL's European Mode S Station Functional Specification (version 3.11) on monopulse secondary surveillance radar with MkXII-A and Mode-S capability – offering a favourable price-performance ratio at the same time.

General

The MSSR 2000 I interrogator fulfils all requirements for Mode S enhanced surveillance systems as well as for secured and encrypted military IFF interrogators using Mode 5 Levels 1 and 2.

It incorporates its own data processing and tracking functions, which deliver plot and track data using Mode S for IFF/ATC purposes. The system can be operated fully autonomously within its area of coverage. Its modular architecture, its digital programmable signal processing, its software-controlled post-processing and its system management concept allow customised configurations and performance optimisation to be implemented for various applications in different systems, such as civil and military ATC systems, air defence radars, airport approach control radars or mobile air surveillance systems (seaborne or ground-based).

Operational Advantages

The MSSR 2000 I product family provides the following extraordinary and outstanding features for the benefit of users, operators and maintainers worldwide:

Connection to SSR antennas

Each MSSR 2000 I variant can be connected to any IFF/SSR antenna. If the antenna only offers Σ and Ω channels, the interrogator can also operate in sliding window mode instead of monopulse operation. The stated performance figures are achieved with a standard, 3-channel LVA monopulse antenna as specified by EUROCONTROL. An antenna rotation speed between 60 and 2 rpm and devices with an angular resolution between 10 and 16 bits are suitable.

Motion Compensation

To also support antenna systems that are not mechanically stabilised or to compensate for the movement of the platform, the interrogator offers a customisable serial or LAN interface to import data describing the platform's movements. Using this data, the interrogator performs a 3D coordinate transformation to create a motion-stabilised and corrected air traffic surveillance picture. Even for non-rotating active or passive IFF antennas, the MSSR 2000 I offers integrated beam steering control and full track-while-scan functionality to allow the automatic emission of selective interrogations to be reduced to a minimum.

Directed Interrogation

For military applications, it may be essential to reduce the RF emissions as far as possible or to emit selective interrogations in encrypted, secure mode only.

To fulfil these requirements, the MSSR 2000 I is not only able to provide silent sectors, but can also be run with directed interrogations (ASTERIX cat. 007). Such externally triggered interrogations allow the targets to be selectively identified with any combination of MkXII-A/S interrogation modes. On the receive side, the MSSR 2000 I continues to collect the responses and track the targets.

Mode Interlace Capability

The type of interrogations issued by the MSSR 2000 I is highly customisable. Apart from directed

interrogations, silent sectors and complete 360° interrogations, the system can handle sectors with different interrogation patterns. Within each sector, a different combination of predefined MkXII-A and Mode S interrogations (interlace pattern) can be selected. Even the pulse repetition frequency (PRF) may be different in each sector. Furthermore, it is also possible to repeat any interlace pattern at predetermined scan intervals.

ADS-B (1090 MHz) Mode S Extended and Mode 5 Level 2 Squitter

The MSSR 2000 I is able to receive and extract ADS-B Mode S extended and Mode 5 Level 2 squitter via its three receive channels. This squitter is used for passive acquisition in Mode S, for classification of reflections and internal track support, e.g. for the cone of silence of the radar antenna. The interrogator reports ADS-B messages in ASTERIX category 021. It verifies the transmitted position of aircraft using selective Mode S interrogations.

Mode S Clustering Capability

The MSSR 2000 I is able to operate in a Mode S radar data network as a node of a Mode S cluster according to version 2.06 of EUROCONTROL's EMS ICD regulations, both in central and distributed mode. This enables the operator to overcome Mode S II/SI code shortages by using only a single code for the whole Mode S cluster comprising up to 6 Mode S stations.

Mode 5 Level 1 and 2

Thanks to its digital receiver, the MSSR 2000 I is capable of receiving Mode 5 Level 2 replies and squitters in all three RF channels thus increasing Mode 5 Level 2 coverage. When interrogating and receiving synchronous Mode 5 Level 1 replies, the system calculates the exact azimuth direction of the aircraft using the amplitude and phase monopulses; when Mode 5 Level 2 signals are received, the position of friendly aircraft is decrypted in the report.

Multi-Crypto-Computer Compatibility

The MSSR 2000 I is certified according to AIMS 03-1000B Amendment 1 and is compatible with all crypto-computers which comply with AIMS 04-900A and B, including QRTK4NG, QRTK6NG, SIT2010, KIV78 and KIV77.

Product Variants

The system's modular and thus scalable design allows several variants to be implemented, which ultimately include identical LRUs to ensure maximum commonality in the logistic support chain.

- MSSR 2000 I – 500 W – Mode 5/S
- MSSR 2000 I – 1500 W – Mode 5/S
- MSSR 2000 I – 2000 W – Mode 5/S
- MSSR 2000 I DR
- Naval IFF rack: MSSR 2000 I + Mode 5/S transponder

MSSR 2000 I – 500 W – Mode 5/S

The variant with a transmission power of 500 W and capable of being fully operated in Mode S is particularly appropriate for systems with medium range requirements. For example, it is intended for use in ASR systems. Thanks to a standard large vertical aperture (LVA) antenna, an operating range of more than 150 NM can be achieved.

MSSR 2000 I – 1500 W – Mode 5/S

With a nominal transmission power of 1500 W, the interrogator offers Mode 5/S functionality with a limited duty cycle and the fully instrumented range of 256 NM in a one-box design. This device is completely waterproof and pressure-resistant. Thanks to its very good weight-performance ratio, this variant is suitable for naval platforms.

MSSR 2000 I – 2000 W – Mode 5/S

The Mode S version with 2000 W consists of an interrogator and a booster unit, with the booster comprising 6 transmitter modules. This variant meets all functional system requirements in a single-chain configuration. It is the best choice for

elementary and enhanced surveillance in Mode S over long ranges (256 NM) with a maximum duty cycle, including datalink functionality.

MSSR 2000 I DR

In the DR version, the MSSR 2000 I offers Mode 5/S capability and dual redundancy for any power variant, and also a switch-over unit to meet the availability requirements of state-of-the-art ATC systems. The MSSR 2000 I DR has all necessary interfaces to be integrated into a Mode S cluster for receiving and transmitting surveillance data. Within a Mode S cluster, it can be operated in both central and distributed mode as specified by EUROCONTROL. In addition, it offers high-level Mode S protocols for ADLP and GDLP. In just one 19" cabinet, the MSSR 2000 I DR with 2000 W represents a dual-redundant 2 kW radar station for Mode S enhanced surveillance.

Naval IFF Rack

This variant of the system is suggested for all platforms that require the complete IFF/ATC equipment to identify other aircraft and to be identified. It consists of the MSSR 2000 I in one of the variants described above and a military LTR 400 transponder with Mode 5 Level 2 capability and Mode S Elementary and Enhanced Surveillance capability.



Proven and flexible Platform Integration

The MSSR 2000 I is highly flexible when it comes to integration into platforms. It offers external interfaces based on international standards, such as EUROCONTROL's ASTERIX information exchange standard for command, control and reporting. Moreover, it is compatible with a wide variety of IFF antennas, including dual rotator systems, it can be scaled to meet the customers' specific requirements and can be configured through individual parameter settings. More than 400 units of the MSSR 2000 I have so far been sold to over 40 countries for integration in more than 160 platform types: 50 different types of military and civil ATC platforms, 25 types of mobile ground-based air defence radars and 85 types of naval platforms.

