



## INTEGRATED SECONDARY SURVEILLANCE MODE S RADAR

SIR-S/I is a Mode S solution for the detection of cooperative targets in surveillance services. It has been designed to comply with the international standards for Secondary Surveillance Radar (SSR) systems and to guarantee a high degree of maintainability and reliability.

### THE SOLUTION

The SIR-S/I Secondary Surveillance Radar is a modular system fully compliant with ICAO and EUROCONTROL recommendations on Mode S operation. It can be installed as standalone equipment or integrated (co-mounted) with a Primary Surveillance Radar (PSR).

SIR-S/I is a dual-channel system with automatic changeover, solid state transmitter and receiver designed for unmanned operation. The dual channel system is housed in a single cabinet providing an integrated solution with embedded tracking function and embedded ADS-B channel.

SIR-S/I can operate in SSR Conventional Modes (1, 2, 3/A, C), Mode S Elementary and Enhanced Surveillance up to full Extended data link operation employing level 5 transponders. It is equipped with a dedicated ADS-B receiving channel and processing chain in order to acquire, decode and process 1090MHz Extended Squitter messages from Omni and Sum MSSR antenna channels. The SIR-S/I ADS-B receiving channel is designed according to ICAO Annex 10, RTCA DO-260, RTCA DO-260A, RTCA DO-260B specifications.

Mode S allows high data integrity (synchronous garbling elimination, defruiting), unambiguous aircraft identification, improved situation awareness and safety enhancements by the use of the additional information extracted from the transponder (Call-Sign, Selected Altitude, Ground Speed, Magnetic Heading, etc.).

The antenna used with the equipment is the ALE-9 LVA antenna, designed for full monopulse operation. It provides high directional properties in azimuth and high aperture in the vertical plane, as recommended by ICAO, in particular for Enhanced Mode S Surveillance (EHS) operation.

# SIR-S/I

The SIR-S/I Mode S operation has been fully tested and in the framework of the EUROCONTROL Pre-Operational Mode S Station Implementation Programme (POEMS). In addition, the system is compliant with all the SSR and Mode S performance requirements demonstrating outstanding performances in terms of accuracy figures and de-garbling, defruiting algorithm efficiency.

## SYSTEM FEATURES

### State-of-the-art technology

- Latest generation of RF power transistors
- Very large scale integration (SMD technique)
- Latest generation processor and architectures

### Full redundancy of critical items

The system includes two transmitter units, two receiver units, two processor units and an automatic changeover unit.

### Improved azimuth monopulse estimation

Two algorithms (Amplitude and Sign Processing (ASP) and Dot Product Processing (DPP) are used for the azimuth angle estimation in order to improve detection performance. A selection logic activates DPP algorithm for replies very close to boresight in order to minimise estimate errors.

### Full Mode S operation

Mode S can be activated with just one click both locally and remotely via Remote Control and Monitoring Station. Mode S functions include Surveillance Coordination (Cluster) among stations, data link with aircraft and extensive supervision by a graphical user-interface.

### ADS-B channel

The SIR-S/I ADS-B processing chain processes Mode S ADS-B replies and outputs the positional information, the appropriate validity time, any quality factor, or other information included in the ADS-B message.

The processing chain decodes the ADS-B information as defined in the most recent version of the ICAO Manual on Mode S Specific Services, EUROCAE ED-129, RTCA DO-260/260A and DO-260B for the following Mode S ADS-B Extended Squitter (DF17/DF18/DF19) subtypes:

- Surface and airborne position
- Aircraft status identification and type
- Airborne Velocity
- Test Messages – Mode A Code
- Target State and Status
- Aircraft Operational Status

### Extended performance monitoring

- Extensive embedded BITE for fault detection with local/remote capabilities
- Processing of replies from test transponder
- Generation of replies at RF level with TTG circuitry
- On-line receiver logarithmic characteristic calibration

## TECHNICAL CHARACTERISTICS

|  |  |
|--|--|
| Range  | Up to 256 NM   |
| Detection volume   | Up to 66000 feet, 360° horizontal plane, up to 45 vertical plane   |
| Scane rate   | Up to 15 rpm   |
| Single cabinet with reduced physical dimensions                                    | Height = 32U, Width = 19", Depth = 27.56"  |
| Fully solid state transmitter with plug in modules                                 |  |
| High TX duty cycle (66% peak - 6% average)   |  |
| ISLS and IISLS capabilities  |  |
| Receiver with three amplitude and phase matched LOG channels (RX Dynamics > 80 dB) |  |
| RSLs capability  |  |
| Range-azimuth programmable STC   |  |
| Multiprocessor based on a power PC platform  |  |
| Extensive monitoring logic for failure detection/ isolation                        |  |
| II/SI code operation management  |  |
| Mode S probability of detection  | > 99%  |
| Probability of code validation   | ≥ 98% (3/A) and ≥ 96 (C) in the operational environment  |
| Mode S range accuracy  | < 30m (RMS) for SSR equipped transponder aircraft<br>< 15m (RMS) for Mode S equipped transponder aircraft                                |
| Mode S azimuth accuracy  | < 0.068° (RMS)   |
| Range/Azimuth resolution   | Eurocontrol Area 1 (Pd > 98 %, Pdc > 98 %),<br>Eurocontrol Area 2 (Pd > 98 %, Pdc > 90 %),<br>Eurocontrol Area 3 (Pd > 60 %, Pdc > 30 %) |
| MTBFc  | > 63000 Hrs  |
| MTTR   | < 20 min   |
| Availability (Ai)  | > 0.99999  |
| Output data  | Independently configurable (plot/track) in terms of outputs number and data formats  |

### SSR/MODE S SURVEILLANCE

Target reports (plot/track) data - Asterix Cat 1, 2, 34, 48

### ADS-B SURVEILLANCE

Target reports (plot/track) data ADS-B messages - Asterix Cat 021

Edition configurable: Ed. 0,23, 0,26, 2,1

Target reports (plot/track) data ADS-B messages - Asterix Cat 010, Edition: 1.1

CNS/ATM Ground Station Service messages - Asterix Cat 023, Edition: 1.2

ASTERIX CAT 247 rev. 1.2: category Version Number