AIR ROUTE SURVEILLANCE 3D RADAR

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**Introduction**

Indra’s ARSR-10D3 is a modular, fully solid-state 3D primary radar (PSR) that incorporates the latest technologies for airport and air route surveillance. It provides accurate aircraft position information, including flight height.

These detection and 3D position estimation capabilities are achieved even under extreme conditions of weather, ground clutter and natural or man-made interference, and both with cooperative and non-cooperative aircrafts.

In this sense ARSR-10D3 radar complements the surveillance function of the Monopulse Secondary Radar (MSSR) allowing the detection and tracking of aircrafts without operative SSR transponder.

Besides aircraft detection and tracking, the radar includes a weather processor that provides the controller with the weather information required for safe air traffic control management.
Principal Features Summary

- Overall fulfilment of ICAO and EUROCONTROL requirements
- Operation at L Band (1250 to 1350 MHz), which provides better performances in adverse weather conditions that radars operating at higher bands
- Circular polarization is not necessary for L-band
- Planar array antenna, pencil beam antenna patterns, electronically steered in elevation and mechanically scanning in azimuth
- Architecture based on modular transmitters and receivers modules that provides graceful degradation
- Dual Chain
- Dual frequency operation
- 3D aircraft position information based on Monopulse Technique both in azimuth and elevation, and Pulse Compression in range
- Efficient use of time and energy through the suited configuration of transmitted waveforms and instrumented range for each elevation beam
- MTD/MTI processing techniques in the Doppler frequency domain for clutter cancellation
- Special techniques to avoid harmful effects of multiple-time-around signals caused for example by anomalous propagation
- Integrated Track-While-Scan Process with Kalman filters, for aircraft tracking, false alarm number reduction and suppression of detection caused by low speed objects like terrestrial vehicles
- Weather Processor providing 6 level intensity mapping according to ICAO standards
- Complete set of available configurations with different Instrumented Coverage / Rotation Rate for fulfilment of specific customer requirements
- Fully high-level software programmable Signal and Data Processor based on commercially-available (COTS) latest-generation multiprocessor boards
- Time stamping of targets reports based on GPS time reference
- Mechanically designed for supporting a LVA Secondary Radar antenna providing required interfaces for joint PSR/MSSR operation
- Data Processor including a PSR/MSSR Combiner that merges primary radar data from ARSR-10D3 with secondary radar data from the MSSR
- Remote and Local Control and Monitoring supported. Local control is performed from a Local Operation Workstation with radar data display capability and friendly Graphical User Interface
- Integrated built-in-test (BIT) system for automatic fault detection and isolation
- Redundancy in overall system design providing high Operational Availability
- Modular design that eases future upgrades and improvements

High Reliability and Availability

High flexibility supported by modular, repetitive and redundant architecture which offers soft-fail capability in case of any array element failure and easy maintainability with a minimum number of spares.

Very reliable system: MTBCF >20,000 hours, MTTR < 30 minutes and System Availability > 99.99%.
Operation Highlights

3D Pencil Beam Technique
The ARSR-10D3 is a "pencil beam" radar. This "pencil-type" high-gain beam is aimed with phase control to several transmit/receive pointing elevations whilst the antenna is mechanically rotated in azimuth.

Each beam can be configured with the number of pulses, pulse energy, instrumented range and processing type that are more appropriate taking into account the required instrumented coverage and the characteristics of clutter in the elevation volume covered by the beam.

Detection is improved since only can be affected by the clutter or interference present in the beam that points to the aircraft.

High elevation beams are virtually free of surface clutter making aircraft detection more feasible than with conventional 2D radars. This 3D radar system provides with altitude data of aircrafts not needing their cooperation.

Planar Array Antenna and Distributed Solid-State Design
It is based on a planar array antenna composed of vertically stacked horizontal linear arrays.

Driven by modular solid-state transmitters and receivers, that electronically synthesizes a transmit/receive antenna pattern with narrow beam width both in azimuth and elevation.

Monopulse Technique
Another specific feature of ARSR-10D3 radar is the achievement of high accuracy and resolution of aircrafts in azimuth by the use of Monopulse technique.

This technique, based on simultaneous reception of signals through two antenna patterns, sum-type and difference-type patterns, is also used for estimation of aircraft elevation, which is the first step for aircraft height calculation.

Range accuracy and resolution is obtained by digital pulse compression by using phase modulated waveforms and very low side lobe level filter response.

Frequency Diversity
The ARSR-10D3 is a dual frequency radar. It simultaneously operates with two frequency channels. This feature provides better detection and accuracy performances specially for small aircrafts and interference conditions.

Anti-Clutter Capabilities
Detection of aircrafts immersed in terrain or weather clutter is achieved by the use of MTD Doppler processing.

Aircrafts with low radial velocities can also be detected by the clutter-free high elevation beams or by the low elevation beams which provide superclutter visibility based on Clutter Map detection techniques.
Features

Antenna
- Electronic Elevation scanning.
- N° of Elevation beams: Programmable.
- Polarization: Linear (Circular not necessary in 3-D L-band radars).

Digital Signal & Data Processor
- Dual Processor.
- MTD.
- Improvement Factor: 55 dB.
- Clutter maps.
- Weather processor: 6-level, ICAO.
- Output capability: up to 1000 targets.
- Output Format: ASTERIX.

Transmitter
- Soft-Fail Distributed Solid State.

Receiver
- Dual receiver chain.
- STC.
- Rx channels:
  - Sum, Diff Az., Diff Elev. (ARSR-10D3)
  - Sum, Diff Elev. (ARSR-10D3LR)
- Dual frequency channels.
- Digital demodulation.

### Technical characteristics

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<thead>
<tr>
<th></th>
<th>ARSR-10D3</th>
<th>ARSR-10D3LR</th>
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<tbody>
<tr>
<td><strong>GENERAL CHARACTERISTICS</strong></td>
<td></td>
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</tr>
<tr>
<td>Frequency</td>
<td>1250 to 1350 MHz</td>
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<tr>
<td>Range coverage</td>
<td>70 NM / 100 NM (Operator selectable)</td>
<td>250 NM</td>
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<td>Elevation coverage</td>
<td>&gt;40°</td>
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<td>Altitude coverage</td>
<td>80,000 ft</td>
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<tr>
<td>Rotation rate</td>
<td>15 rpm / 12 rpm (Operator selectable)</td>
<td>5 rpm</td>
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<tr>
<td>Monopulse</td>
<td>Azimuth &amp; Elevation</td>
<td>Elevation</td>
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<tr>
<td>Availability</td>
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<td>99.99 %</td>
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<tr>
<td><strong>ACCURACY</strong></td>
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<tr>
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<td>Azimuth</td>
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<td>Elevation</td>
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<td><strong>RESOLUTION</strong></td>
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<tr>
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