

# COMPASS

Complete Air Surveillance System

Military & Civilian  
Applications



**easat**<sup>®</sup>  
RADAR SYSTEMS

# easat<sup>®</sup>

RADAR SYSTEMS

The Easat COMPASS Transportable Radar System is a deployable dual-use civil or military air traffic surveillance remote radar system.

Typical uses include as a gap-filler, for temporary deployment or disaster-relief or as an emergency backup radar system, or for deployments to airfields/airstrips without existing radar infrastructure.

The system includes an ICAO & Eurocontrol-compliant modern fully solid-state high-performance S-band primary radar (PSR) and Mode-S secondary radar (MSSR Mode-S) system with integrated ADS-B.

Packaged into two ISO 20 ft containers; the first contains a deployable combined PSR and MSSR antenna, while the second container converts into a climate controlled electronics equipment cabin including a two seat ATM display control.

Enough additional space is available to install further customer equipment such as communications.

Radar, ADS-B, and other data are provided in common ASTERIX

output formats which can be transmitted via data links to additional ATM and/or radar monitoring sites (allowing for autonomous system operation).

# COMPASS

Transportable Air Traffic Radar System  
for Military & Civilian Applications

FULLY  
DEPLOYABLE  
IN 8 HOURS



662 ft

PWX  
348.9 kts 9845 ft

R1880

203 kts 7132 ft

WE

# Antenna System

**A deployable combined S and L band primary and secondary radar antenna system with dual-drive turning system mounted on an electric-lift pedestal and built into a single ISO 20 ft container.**

The antenna features a dual frequency band, carbon fibre composite based reflector which connects to an S-band (2.7-2.9 GHz) PSR and L-band (1.0-1.1 GHz) MSSR Mode-S or optional IFF equipment. Three states of polarization (linear, horizontal, left-hand circular and right-hand circular) are provided for S-band beam by use of polarisation-switching capability for weather & clutter interference rejection.

At L-band, the antenna operates in MSSR by use of three beams: sum, difference and omni. The L-band beacon feed is contained within a common feed/polarizer housing. A side lobe suppression antenna is provided to illuminate the sidelobe suppression beam.

## ELECTRICAL SPECIFICATION – S-BAND

Beam Characteristics	Low Beam	High Beam
Frequency range	'S' band - 2.7 GHz – 2.9 GHz	
Gain (incl. Microwave loss)	33.8 dBi at rotating joint	31.0 dBi at rotating joint
VSWR	1.5:1	1.5:1
Axial Ratio	≤ -19dB averaged over the frequency band	
Azimuth Beamwidth	1.35-1.5°	1.35-1.5°
Azimuth Sidelobes (w.r.t. peak of low beam)	≤ -25.0 dB Max (from 0° to ± 10°) ≤ -32.0 dB Max (from ± 5° to ± 30°) ≤ -35.0 dB Max (from ± 30° to ± 180°)	
Elevation Beamwidth (-3dB)	4.5° nominal	6.0° nominal
Signal Outputs (both beams)	Target - Co-polar signal: Weather - Cross polar signal	

## ELECTRICAL SPECIFICATION – L-BAND

Frequency Range	1030 MHz ± 5 MHz and 1090 MHz ± 5 MHz
Channels	Sum, Delta and Omni
Sum Beam Gain	≥ 23.5 dBi at rotating joint
Sum Beam Azimuth Beamwidth	< 4.5°
Sum Beam Azimuth Sidelobes	≤ -22 dB
Difference Null depth (1090MHz only)	≤ -24 dB w.r.t. lower of the two peaks
Difference Null alignment (1090MHz only)	± 0.2° w.r.t peak of sum beam
Omni Coverage	95 % coverage of all Sum channel sidelobes by a margin of 6 dB



- Lightweight carbon-fibre composite antenna with 20 year design life
- Composite pedestal and robust design structure - in line with MIL and DEF-STAN



## Stowed Control Cabin

ISO 20-ft container: air conditioning, electrical system, lighting, plus:

- **PSR 16 kW / 80 NM**

Fully ICAO & Eurocontrol-compliant S-Band solid-state 80 NM PSR system

- **MSSR Mode-S M10S**

A fully ICAO & Eurocontrol-compliant 250 NM Mode-S secondary radar sensor system

- IFF (up to Mode 5) is optional

- **ADS-B Station M10AL**

Fully ICAO & Eurocontrol-compliant 250 NM WAM-ready ADS-B ground station

- **ATM - 2 Position Displays**



## Stowed Palletised Antenna

Combined S and L band primary and secondary radar antenna system with dual-drive turning system mounted on an electric-lift pedestal and built into a single ISO 20 ft container:

- **S-band**  
2.7 - 2.9 GHz Primary Surveillance Radar  
Multiple states of customisable polarization:  
vertical or horizontal linear, left or right-hand circular
- **Integrated L-band Feed**  
1.03 - 1.09 GHz Monopulse Secondary Surveillance Radar  
Operating in MSSR by use of three beams: sum, difference and omni



**Primary  
Surveillance Radar**  
16 kW / 80 NM

**Secondary  
Surveillance Radar**  
Mode-S (M10S)

**ADS-B  
Ground Station**  
M10AL



**Telecommunications  
Equipment**

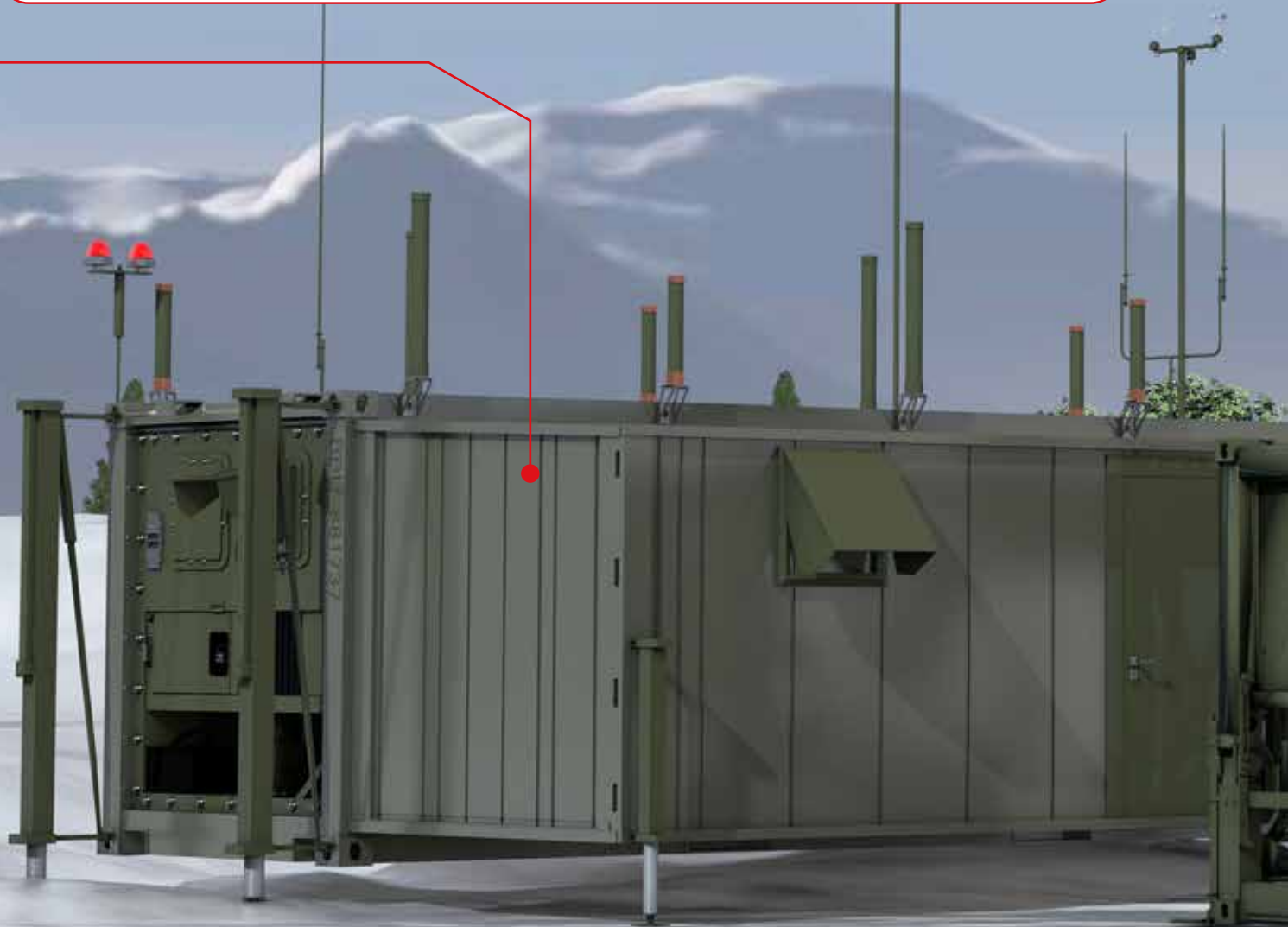
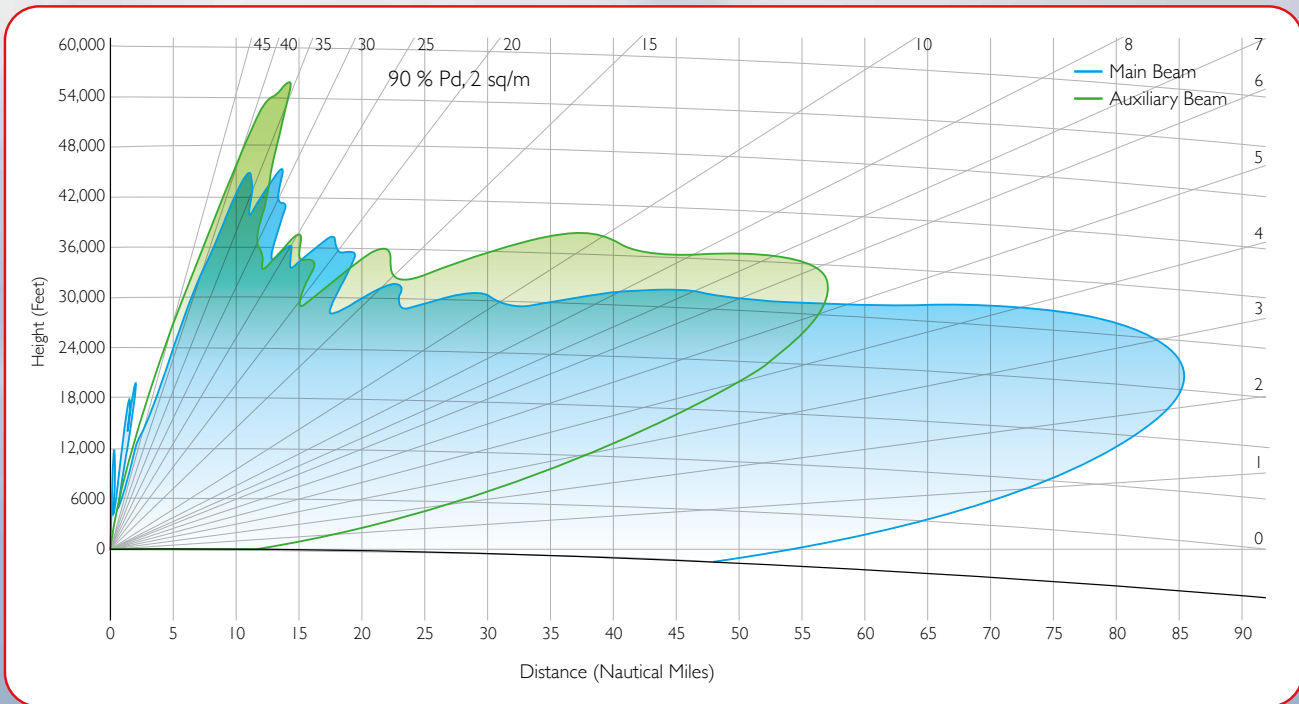
- 2.5 m high x 2.5 m wide x 6 m long extending to 5 m wide x 6 m long
- Fully contained surveillance system in a climate controlled environment



Equipment control and monitoring systems

# Fully Deployed Antenna & Extended Control Cabin

Rapid S  
Deplo



Operational wind speed: 150 km/h

Survival wind speed: 190 km/h

Rotat

System  
Deployment



Rotation rate: 6 - 15 rpm

Temperature Range: -40°C to 70°C (including solar radiation)



## S and L-band Antenna



- Rapidly Deployed Pallet System
- Fully operational in 8 hours
- Lightweight carbon-fibre composite antenna with a 20 year design life
- Dual drive turning system mounted on an electric lift pedestal
- Easily transported by air (C130 / Chinook), rail or road
- 40kw/h UPS to provide 30 mins standby operation



# Primary Surveillance Radar 16 kW / 80 NM

TRANSMITTER	
Frequency band	S-band, 2700 -2900 MHz
Frequency diversity	Yes
Frequency agility	2 configurable frequencies
Amplifier type	Solid-state fail-soft. 12 modules.
Peak RF output power	18 kW - Pulses width 1 $\mu$ s and 75 $\mu$ s
Cooling system	Air-cooling
RECEIVER	
Receiver type	Digital receiver with double frequency converter
Sensitivity	-103 dBm (-119 dBm after pulse compression)
Dynamic range	80 dB (96 dB after pulse compression)
Noise figure	1.5 dB
Number of false target reports (per scan, averaged)	< 10
SIGNAL PROCESSOR	
A-MTD	Yes
Min/Max Doppler speed	20/800 knots
Clutter maps, automatic	Yes
Beam switching maps	Yes
STC maps	Yes
Probability of false alarm (plot processor)	< 10 <sup>-6</sup>
Range accuracy	50 m
Azimuth accuracy	0.1 deg
Range resolution	230 m
Azimuth resolution	2 deg
MTD Improvement factor	> 60 dB
WEATHER RECEIVER AND PROCESSOR	
Single weather receiver	Yes (Dual weather processor option)
Single weather processor (6 levels)	Yes (Dual weather processor option)
Calibration according to USA National Weather standards	Yes
EXTRACTOR AND DATA PROCESSOR	
Track number	1000
Output format	ASTERIX
Output line type	Serial / LAN / Fibre optic radio link
BITE	Yes
LCMS/RCMS	Yes / Yes
Number of parameters to control	160
Number of parameters for monitoring	560
Availability	0.9999
MTBCF	33000 h
MTTR	30 min
POWER SUPPLY	
Primary power supply line:	3N~50 Hz 230/400 VAC
Voltage	+ 10 %, - 15 %
Frequency	+ 5 %
Power consumption, max	8 kW

PSR 16/80 provides detection and measurement of aircraft coordinates within **0.5 to 80NM**, providing radar data transmission to the ATM system for monitoring and providing Air Traffic Management Control.

The radar characteristics meet relevant ICAO and Eurocontrol standards and recommendations monitoring.

## Primary Surveillance Radar 16 kW / 80 NM features includes:

- High reliability with fail-soft transmitter and fully redundant receivers and processors.
- Coherent reception, digital radar signal processing system for a high target detection probability 90% 2m<sup>2</sup> at 80NM.
- Transmission of sounding pulses by means of the air-cooled fail-soft solid-state transmitter.



PSR 16 kW / 80 NM

# Secondary Surveillance Radar Mode-S M10S

PARAMETER	
Coverage:	
- Maximal range	256 NM
- Minimal range	0.25 NM
- Height	66,000 ft
- Elevation	0.3 - 45.0 deg
Repetition frequency	50 ÷ 250 Hz
Rotation period	4 ÷ 10 sec
Maximal number of aircrafts per scan	1,000
Interrogation Modes (selectable in combo: single, dual, triple)	1, 2, 3/A, C, S
Surveillance position accuracy (mean-square error):	
- azimuth	0.068 deg
- range, mode A/C	30 m
- range, mode S	15 m
Surveillance position accuracy (systematic):	
- azimuth, elevations between 0 degrees and 6 degrees	0.022 deg
- azimuth, elevation higher than 6 degrees	0.033 deg
- range	14 m (1/128 NM)
- time stamp	100 ms
Detection probability, no smaller	0.99
Code detection probability, no smaller	0.98

- Polarization mode switching (linear or circular) to rapidly improve weather clutter rejection
- Digital signal generation and compression to ensure high stability
- Weather data processing
- MTD target signal processing
- Adaptive adjustment of digital receiver parameters to allow minimum false reports
- Data plot extraction processing
- Track processing of data
- Radar data recording, playback using PPI
- Local and remote control and monitoring
- Easy integration with Secondary Surveillance Radar
- Operation of PSR without continuous presence of personnel (autonomous operation)
- Suitable for rough terrain transport.

MSSR Mode S M10S is intended to be used for air traffic surveillance of cooperative target aircraft by civil or military authorities.

The system will detect and track aircraft location and movement parameters only for those aircraft with active 1090 MHz transponders. The system complies with all the ICAO requirements and is built using the latest, best known technologies for this type of system.

#### The MSSR M10S features include:

- Solid state high level of integration and modularization using the latest well proven technologies without losing full redundancy in operational equipment to meet system availability.
- Hot stand-by redundant configuration.



MSSR Mode-S (M10S)

# ADS-B Ground Station (M10AL)

PARAMETER	
Coverage:	
- Maximal range	256 NM
- Minimal range	0 NM
- Altitude	66,000 ft
- Coverage Area	360 deg
Maximum number of targets	> 2000
Output data format	ASTERIX CAT021, CAT023 DF-17/18
Refresh rates	Configurable 4, 2, 1, 0.5 sec
Maximum processing time (latency)	0.5 sec
Bandwidth for surveillance information (4 second refresh rate, 100 targets)	16 kbps
Probability of detection (4 second refresh rate)	99%
Automatic failure control	90%
MTBF	217,012 hour
MTTR	5 min
Full redundancy	Yes
BITE system	Yes
Availability	99.999%
Maximal power consumption	< 100 W
Input power	220/380 V

The ADS-B Ground Station M10AL is intended to be used for air traffic control for the civil authorities as an information source about aircraft location and movement parameters. The system complies with all ICAO requirements and is built using the latest, best known technological improvements over this type of systems. It can be used either separately or in combination with a primary surveillance radar (PSR) and secondary surveillance radar (SSR).

M10AL station is designed to receive and process 1090 MHz extended squitter messages by means of antenna system, receiver, demodulator and data processor.

It contains two completely redundant and independent subunits, any kind of failure in one of them does not cause a system halt. Maximum delay of data processing is less than 0.5 seconds. There are two independent ethernet outputs from each of the subunits, each output can be configured independently and each output contains all information (target and status) from both subunits. Typical output format is UDP/IP multicast.

## Antenna Radiation Pattern Near Field Test Facility

Easat Radar Systems have a state-of-the-art, cylindrical, near field test chamber located at our Trentham, UK site.

With a fully calibrated test area of 8m<sup>3</sup> the facility is suitable for a wide variety of antennas including those with polarisation diversity and multiple beam designs.

Every Easat Radar Systems antenna is fully tested within the facility before delivery to customer to ensure optimum performance and detection precision.



**easat**<sup>®</sup>  
RADAR SYSTEMS

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