Colorado State University

Sea-Pol Radar

Sea-Pol is a dual-polarization ship-deployable C-band radar featuring dynamic platform stabilization

FEATURES

- 250 kW Magnetron transmitter, low-maintenance solid-state modulator
- Dynamic platform stabilization
- 1° beamwidth low side lobe antenna
- Modular design, containerized shelter with all radar electronics
- State of the art RVP900 signal processor and IRIS user interface
- Fully remotely operable
- Excellent image rejection to avoid interference from other radars
- Built-in automatic calibration system
- Built-in navigation system (INU)

The CSU Sea-Pol ship- and land-deployable radar measures dual-polarization data over a range in excess of 200 km. It is designed for operation aboard Global-class research ships operated by the US oceanographic community. The radar operates at C-band (5.65 GHz) and has a 4.3m stabilized antenna system.

An inertial navigation unit (INU) measures ship motion and sends compensation commands to the antenna positioner. Doppler velocity data is also corrected for ship velocity. This permits high quality data to be collected at sea, correcting for ship roll and pitch up to 7 degrees.

The radar operates in simultaneous transmit and receive mode, as well as horizontal-only mode, with a sensitivity of -7 dBZ at 100 km. A variety of pulse widths and PRFs are supported, within a 0.12% duty cycle limit

The radar is packaged in ISO-668 1C containers for transportability and ease of deployment.

The Sea-Pol radar is based in Greeley, Colorado, at Colorado State University. It can be deployed on ships and at remote field sites. An example of such a deployment is the 2019 PISTON-2 field campaign where Sea-Pol was shipped to Keelung, Taiwan, loaded onto the R/V Sally Ride and spent 22 days at sea in support of the campaign.

Technical Data

System Specifications	
Input Power	Single phase 240V/100A or 480V/50A, 60 Hz
Power connection	Meltric DS100 series 240V or 480V connectors
Typical radar power	4500 W
Typical HVAC power	8000 W
External data connection	Ethernet (CAT5e/fiber-optic)
Data rate required	10 Mbit/s (min), 100 Mbit/s (optimal)

Antenna Platform and Radome	
Radome type	5.4 m, fiberglass panels
Platform height	10ft/3m from deck
Total height	27ft/8.4m from deck
Environmental specifications	115 mph/185 km/h wind speed
Radar shelter	20' ISO 1C container, with HVAC, insulation

Pedestal	
Type	Elevation over azimuth
Elevation limits	-5° – 80°
Maximum scan rate	30 °/s
Acceleration	12 °/s²
Position accuracy	< 0.1°
Weight	800 kg

Transmitter	
Type	Coaxial magnetron SFD-373A
Modulator type	Solid state
Frequency range	5.5 – 5.7 GHz
Peak power	250 kW
Pulse widths	0.36, 0.67, 1.24 or 2.0 µs
Duty Cycle	0.12% maximum
Pulse Rep. Frequency	50 – 2400 Hz
Average Power	300 W
Polarization Modes	HV, H

Antenna	
Reflector diameter	4.3 m
Gain (typical)	45 dBi
Beam width	< 1.0°
Peak side lobes	< -27 dB (typ. < -30 dB)
Integrated X-pol isolation	< -29 dB
X-pol isol. at boresight	< -40 dB
H/V alignment	< 0.1 °
Weight	170 kg

Signal Processing	
Signal processor	Vaisala RVP900
Azimuth averaging	2 – 1024 pulses
Clutter filter	Adaptive (GMAP), > 50 dB clutter suppression
Data outputs	All dual-polarization moment data
Dual PRF velocity de-aliasing	2:3, 3:4 or 4:5
IF digitization	16 bit, 100 MHz
Number of range bins	Up to 8168
Optional data output	Raw I/Q time-series
Processing modes	Pulse pair, FFT
Range resolution	54, 100, 180 or 300m

Radar Receiver	
Type	Dual-stage, dual-channel IF downconverter and digitizer
Noise figure	< 3.5 dB
Dynamic Range	> 99 dB
Image rejection	> 100 dB (including waveguide filters)
Tuning range	5.5 – 5.7 GHz
First IF	442 MHz
Second IF	60 MHz

Post-processing software

Raw radar products are post-processed to generate secondary products including rain rate and hydrometeor identification. Post-processing can be customized to suit the needs of field campaigns. Output data is written in CfRadial-compliant netCDF files. Data is transferred to remote locations using FTP, rsync or LDM. Quick-look images are generated and posted to a webserver for immediate access to the data.

Local Operations and Data Storage

The radar shelter provides workstations to operate the radar locally. Servers are available to run post-processing code. Local data storage is available to prevent data loss during network outages.

The radar is normally operated remotely through its network connection; connectivity of 10 Mbit/s is required for reliable remote operation.

Contact information

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