Copernicus radar

The Copernicus radar is a fully-coherent K_a-band dual-polarisation pulse-compression Doppler radar designed for observations of cloud microphysics and climatology. It employs a crystal-controlled reference and frequency synthesizers to generate all necessary RF and system timing signals. The transmitter is based on a flexible programmable waveform generator driving a high-power pulsed millimetre-wave amplifier tube. The receiver is a dual-channel, double-conversion superheterodyne with separate IF chains for simultaneous co-polar and cross-polar measurements. A dual-polarisation antenna and a fast, latching circulator-based, transmit polarisation switch complete the design. The radar provides real-time measurement and display of the full Doppler spectrum, the spectral moments and the polarimetric parameters. Time-series data are also available for more detailed off-line analysis.

The specification of the radar is as follows:

Parameter	Value and comments
Radar type	Fully-coherent, dual-polarisation, pulse-compression pulsed Doppler radar. Flexible waveform generation and processing.
Operating frequency	34.960 GHz
Transmit polarisation	Horizontal and vertical, pulse-to-pulse switching
Receive polarisation	Simultaneous co-polar and cross-polar
System noise figure	6 dB including duplexer / miscellaneous losses
Transmit power	1.5 kW peak pulse
Range resolution	75 m, typical
Maximum number of range-gates per ray	500
Number of pulses averaged per ray	5000, typical
Maximum unambiguous range	30 km, typical
Maximum unambiguous velocity	5.36 m / s, typical

Antenna type	Prime-focus fed parabolic dish
Diameter	2.4 m
Gain	55.9 dBi
Beamwidth	0.25° (FWHM; -3 dB, 1-way)
First sidelobe level	-25 dB (1-way, estimated)
Scan rate	Fixed-pointing at any desired azimuth / elevation
Far-field distance	1343 m

Receiver type	Dual-channel, double-conversion super-heterodyne, 60 MHz IF
Noise figure	4.5 dB excluding duplexing / miscellaneous losses
IF type	Dual-channel, logarithmic detector and linear amplifiers with I/Q detectors
IF bandwidth	10 MHz
Video bandwidth	2.5 MHz
Dynamic range	72 dB

Transmitter type	Extended interaction klystron amplifier (EIKA)
Peak power	1.5 kW
Pulse-width	0.5 μs, typical
Pulse repetition frequency	5000 Hz, typical
Pulse-coding	Un-coded rectangular pulse, BPSK or LFM

Data acquisition / processing system	Pentium PC plus custom ADC / timing cards
Number of channels	4
Number of bits per channel	12
Sampling rate	2.5 MHz
System timing / clock frequency generation	Derived from crystal-controlled reference
Algorithms used	FFT-based processing; full Doppler spectrum and 0^{th}, 1^{st} and 2^{nd} moments
Real-time control / display system	Local colour monitor and web-page
Archive data format	netCDF

Measurements	Doppler spectrum; Z, Z_{DR}, LDR, v, w, ϕ_{DP}, K_{DP}, ρ_{HV} and I / Q time-series data
Observation mode	Continuous, long-term statistical observations
Typical studies performed	Cloud climatology; cloud microphysics; comparison of radar-lidar cloud observations; hydrometeor identification (with aircraft verification); effects of cloud and precipitation on terrestrial and earth-space radio propagation; multi-wavelength studies of cloud and precipitation; satellite sensor ground-truth verification.

For further information, please contact:

Dr. J. D. Eastment
Chilbolton Group
RAL Space
STFC Rutherford Appleton Laboratory
Harwell Oxford
Didcot
OX11 0QX
U.K.

Tel: +44 (0)1235 446546
Fax: +44 (0)1235 446140
E-mail: jon.eastment@stfc.ac.uk

Web: www.stfc.ac.uk/chilbolton