Galileo radar

The Galileo radar is a fully-coherent W-band single-polarisation pulsed Doppler radar designed for observations of cloud microphysics and climatology. It is based on a crystal-controlled reference and synthesizers plus frequency multiplier chains to generate all necessary RF and system timing signals. The transmitter is based on a high-power pulsed millimetre-wave amplifier tube, while the receiver is a single-conversion superheterodyne. A pair of mutually-aligned dishes in a bistatic configuration form the radar antenna, so as to provide sufficient transmit-receive isolation.

The radar provides real-time measurement and display of the full Doppler spectrum and of the spectral moments Z, v, and w. Full time-series of I and Q data may also be recorded for more detailed off-line studies.

The specification of the radar is as follows:

Parameter	Value and comments
Radar type	Fully-coherent, single-polarisation Doppler
Operating frequency	94.008 GHz
Transmit polarisation	Vertical
Receive polarisation	Vertical
System noise figure	9.5 dB including miscellaneous losses
Transmit power	1.5 kW peak pulse
Range resolution	75 m
Maximum number of range-gates per ray	400
Number of pulses averaged per ray	6250
Maximum unambiguous range	24 km
Maximum unambiguous velocity	5 m / s

Antenna type	2 Cassegrain-fed parabolic dishes (bistatic)
Diameter	0.46 m
Gain	50.0 dBi
Beamwidth	0.49° (FWHM; -3 dB, 1-way)
First sidelobe level	-20 dB (1-way, estimated)
Scan rate	Fixed-pointing at any desired azimuth / elevation
Far-field distance	131 m

Receiver type	Single-conversion super-heterodyne, 60 MHz IF
Noise figure	9 dB excluding miscellaneous losses
IF type	Logarithmic detector and linear amplifier with I/Q detector
IF bandwidth	4 MHz
Video bandwidth	2 MHz
Dynamic range	72 dB

Transmitter type	Extended interaction klystron amplifier (EIKA)
Peak power	1.5 kW
Pulse-width	0.5 μs
Pulse repetition frequency	6250 Hz
Pulse-coding	Un-coded, rectangular pulse

Data acquisition / processing system	Pentium PC plus custom ADC / timing cards
Number of channels	4 (of which 3 are in use)
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 display system	Local colour monitor and web-page
Archive data format	netCDF

Measurements	Doppler spectrum; Z, v, w 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; prediction of mm-wave radio propagation effects; satellite sensor ground-truth verification

A detailed description of the radar sub-system hardware is given in ‘A fully-coherent 94 GHz radar for the characterisation of clouds’ by J. D. Eastment, AMS 29 th International Conference on Radar Meteorology, Montreal, Quebec, Canada. 12 th – 16 th July, 1999. Paper P3.15. Proceedings Volume pp 442 – 445. Examples of data from the Galileo radar are presented in numerous publications by R. J. Hogan et al.

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