Radar Altimeter

A radar altimeter, which is carried aboard satellites, collects elevation signals from land and ocean surfaces. These data are used to determine topographical features.

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1 SENSOR/INSTRUMENT OVERVIEW

1.1 Sensor/Instrument Name

Radar altimeter

1.2 Sensor/Instrument Introduction

The radar altimeter is an instrument on a satellite that measures the distance from the satellite to the Earth's surface using a radar signal. The instrument transmits an electronic pulse in the microwave frequency to the Earth's surface. The microwave pulse reflects off the surface and returns to the sensor. Altitude is determined from the pulse travel time (from transmit to receive) and from the waveform of the returned pulse.

1.3 Sensor/Instrument Mission Objectives

The radar altimeter measures the altitude of the Earth's surface to determine ice sheet topography and small-scale ocean roughness.

1.4 Key Variables

Satellite orbit, tropospheric/ionospheric signals, and geoid model.

1.5 Scanning or Data Collection Concept/Principles of Operation

The radar altimeter sends electromagnetic pulses at a microwave frequency to a land or ocean surface, then detects the reflected signals. The waveform data are then transmitted to a ground receiving station.

2 SENSOR/INSTRUMENT LAYOUT, DESIGN, AND MEASUREMENT GEOMETRY

2.1 Sensor Description

The two major subsystems of the radar altimeter are: A peak power (RF) section and a signal processor.

***GEOSAT radar altimeter**

Transmitter:

- Type -- traveling wave tube
- Peak power (RF) -- 20 Watts (minimum)
- Power consumption -- 70 Watts

Receiver:

- Type -- Dual conversion (500Mhz, 0h)
- Automatic gain control -- 0 to 63 decibels (1-dec steps)

Antenna:

- Type -- 1-m parabolic
- Gain -- >37.6 decibels
- Beamwidth -- 2.0 degrees

Weight:

- Signal processor -- 47 pounds
- RF Section -- 144 pounds

Envelope (in):

- RF section -- 41.25 (diameter) X 11.5 (height) = 15,369 cubic inches (-antenna)
- Antenna -- 41.25 (diameter) X 19.125 (height) = 25,559 cubic inches (incl. feed)
- Signal processor -- 20 (length) X 13.5 (width) X 10 (height) = 2700 cubic inches

*The GEOSAT and SEASAT radar altimeters share mechanical, thermal, and electrical interface characteristics.

2.2 Radar Altimeter Characteristics for Various Satellites

Table 1. Radar Altimeter Characteristics for Various Satellites

Satellite	Frequency (Ghz)	Bandwidth	Wavelength (m)	Range Resolution (m)	Pulse Compression	Wave Height
ERS-1	13.50	400.00	0.02	0.10	8000.00	
ERS-2	13.50		0.02	0.1	58000.00	.13 m
Geos-3	13.90	80.00	0.02	0.50	30.00	±25% (4-10 m)

Satellite	Frequency (Ghz)	Bandwidth	Wavelength (m)	Range Resolution (m)	Pulse Compression	Wave Height
GEOSAT	13.50	320.00	0.02	0.10	30000.00	±10% (1-20 m)
GEOSAT Follow-On	13.50		0.02	0.018	58000.00	.035 m
SEASAT	13.50	320.00	0.02	0.10	1000.00	± 10% (1-20 m)
Skylab	13.90	100.00	0.02	1.00	13.00	1-2 m
TOPEX/ Poseidon	5.3&13.6	320.00	.0566*amp;.02205	0.03	58000.00	.13 m

3 MANUFACTURER OF SENSOR/INSTRUMENT

This section is not applicable.

4 CALIBRATION

4.1 Specifications

The GEOSAT radar altimeter contained an onboard calibration mode that was invoked twice daily to track waveform sample gain and attitude, wave height, automatic gain control, and height.

- For waveform sample gain correction, the onboard tracker operated on a set of 60 waveform samples in the power spectrum outputs of a digital filter bank. Effects, such as in-band ripple and band-edge rolloff of anti-aliasing low-pass filters in the altimeter receiver were removed by individual waveform sample gain correction factors.
- The correction processes of the attitude determination (and related corrections) started with computation of a voltage proportional to attitude (VATT) based on the amplitude of the last eight waveform samples.

5 REFERENCES

MacArthur, John L., Paul C. Marth, Jr., and Joseph G. Wall. 1987. The Geosat radar altimeter. Johns Hopkins APL Technical Digest 8(2): 176-81.

Moody, Thomas B. 1996. Radar altimetry, Internet home page, University of Texas at Austin, Texas. http://www.ae.utexas.edu/courses/ase389/sensors/alt/alt.html.

6 DOCUMENT INFORMATION

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6.3 Document Curator

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