

THE HY-2 RADAR ALTIMETER AND SCATTEROMETER

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ABSTRACT HY-2, the China's satellite for oceanic dynamic environment measurement, is planned to be launched around 2010. The main payloads of HY-2 include a dual-frequency radar altimeter equipped with a three-band nadir-looking radiometer for atmospheric delay correction, a Ku-band radar scatterometer, and a five-band scanning radiometer. This presentation outlines the specifications, parameters, and design of the HY-2 radar altimeter and scatterometer.

KEY WORDS: HY-2 Satellite, Ocean monitoring, Radar altimeter, Scatterometer, Radiometer

1. INTRODUCTION

HY-2, the China's satellite for oceanic dynamic environment measurement, is planned to be launched within 5 years. The main payloads of HY-2 include a radar altimeter (RA) equipped with a three-band nadir-looking radiometer for atmospheric delay correction, a Ku-band radar scatterometer (SACT), and a five-band scanning radiometer. HY-2 will be the first comprehensive microwave remote sensing satellite for oceanographic applications in China.

HY-2 is a polar-orbit satellite with an orbit height of 963km, and the repeat periods are either 14 days or 168 days.

The RA/HY-2, the correction radiometer, and the SCAT/HY-2 are being developed in our institute. In this paper, the status and some detailed specifications about the RA/HY-2 and SCAT/HY-2 will be introduced.

2. THE HY-2 ALTIMETER

RA/HY-2 is a dual-frequency (Ku and C band) radar altimeter. The DDS generator of RA/HY-2 provides chirp signal with bandwidths of 320, 80 and 20MHz for Ku band, and 320MHz for C band. The solid-state power amplifiers are used for both Ku and C channels. Both OCOG and MLE algorithm are used for the on board tracker. Figure 1 is the diagram of RA/HY-2. The main specifications are the following:

- Height accuracy: 4cm (for 20m SWH)
- SWH accuracy: <10% or 0.5m
- σ^0 accuracy: <0.5dB
- Frequency: 13.58GHz and 5.25GHz
- Pulse width: 102.4 us
- Chirp bandwidths: 320/80/20MHz for Ku;
320MHz for C
- PRF: 1-4KHz
- Antenna dimension: 1.2m
- Antenna gain: 42dBi for Ku, 35dBi for C
- Transmitting peak power: 20W
- AGC range: 60dB
- A/D: 8 bits
- Orbit height: 963km

- Orbit inclination angle: 99°
- Local crossing time for the descending nodes: 6:00 or 18:00

The system of RA/HY-2 includes the following units:

- Antenna;
The antenna of RA/HY-2 is a paraboloidal reflector antenna. The two frequencies will share the reflector with a dual-frequency feed.
- T/R switch;
This unit includes the T/R switch network and the internal calibration loop.
- Frequency synthesizer;
The frequency synthesizer provides the entire frequency signals for the system, including the local oscillator frequency, the reference frequency and the clock signals.
- Transmitter;
The transmitter consists of DDS (direct digital synthesizer) signal generator, the up-converter, frequency multiplier, and the solid-state RF power amplifier.
- Receiver;
The receiver consists of LNA (low noise amplifier), the deramp-mixer, the down-converter, and the I-Q detector.
- Processing unit;
This unit consists of A/D converters, the DSP (digital signal processing) unit and the system control unit. The DSP unit will conduct the tracking operation. The data transfer between RA/HY-2 and the HY-2 platform will also be done by this unit.
- Second power supply unit;

Like other similar spaceborne radar altimeter, RA/HY-2 is equipped with a three-band nadir-looking radiometer for atmospheric delay correction. The frequencies are 18.7GHz, 23.8GHz and 37GHz.

3. THE HY-2 SCATTEROMETER

SCAT/HY-2 is a pencil-beam conically scanning radar scatterometer. It utilizes a full-deramp pulse compression receiver to increase the number of independent measurement samples and improve the measurement precision. A transmitter signal generator will create a LF-chirp pulse with a bandwidth of 1-3MHz for transmitting, while a separate receiving reference signal generator will create a LF-chirp pulse with a bandwidth of 1-5MHz used as the de-ramp receiving reference. Figure 2 is the diagram of RA/HY-2. The main specifications are the following:

- Wind speed range: 2-24m/s (after processing)
- Wind speed accuracy: 2m/s (after processing)
- Wind direction range: 0-360⁰
- σ^0 range: -40-+20dB
- σ^0 accuracy: 0.5dB
- Swath width: >1350km for H; >1700km for V
- Ground resolution: 25km
- Polarization: HH (inner beam) and VV (outer beam)
- Antenna incidence angle: 38⁰ (for inner beam); 44⁰ (for outer beam)
- Antenna gain: 42dBi
- Beam width (azimuth \times tilt): 1.40⁰ \times 1.30⁰ (for H); 1.35⁰ \times 1.20⁰ (for V)
- Antenna dimension: 1.3m
- Transmitting peak power: 120W
- PRF: 100-200Hz
- Frequency: 13.255GHz
- LF bandwidth: 3MHz
- Orbit height: 963km
- Orbit inclination angle: 99⁰
- Local crossing time for the descending nodes: 6:00 or 18:00

The system of SCAT/HY-2 consists of the following units:

- Antenna and scanning servo unit;

The antenna of SCAT/HY-2 is a paraboloidal reflector antenna with a very slightly offset feed. It has two off-nadir pointing beams for the two orthogonal polarizations.

- T/R front-end unit;

This unit includes the high-isolation T/R switch matrix and the internal calibration loop. A very small portion of the RF power from the transmitter will be coupled to the internal calibration loop for inner calibration operation.

- Receiver RF-IF unit;
- I-Q detector unit;
- Transmitting signal unit;

It will generate the linear FM chirp signal for transmitting.

- Reference signal unit;

It will generate the linear FM chirp signal as the reference for the deramp receiver. This signal has the same FM slop as the transmitted pulse so as to cover the range extending within the footprint.

- RF power amplifier;

It is a TWT amplifier to generate 120W transmitting power.

- Frequency synthesizer unit;

The frequency synthesizer provides the entire frequency signals for the system, including the local oscillator frequency, the reference frequency and the clock signals.

- Processing unit;

This unit includes the FFT operation for full-deramp receiving and the noncoherent resolution cell average. The data transfer between SCAT/HY-2 and the HY-2 platform will also be done by this unit.

- Second power supply unit.

4. SUMMARY

HY-2 will be China's first oceanic remote sensing satellite with microwave sensors. The altimeter and scatterometer of HY-2 will promote the research and applications of satellite oceanography of China.

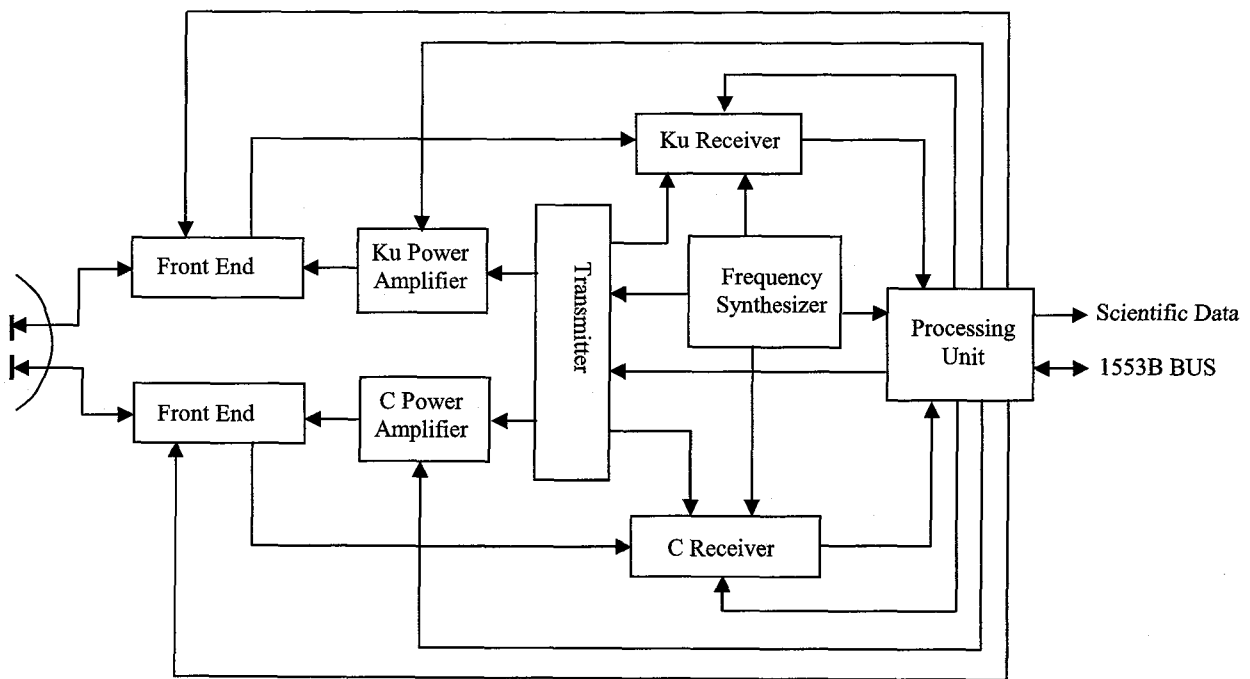


Figure 1 Diagram for RA/HY-2 instrument

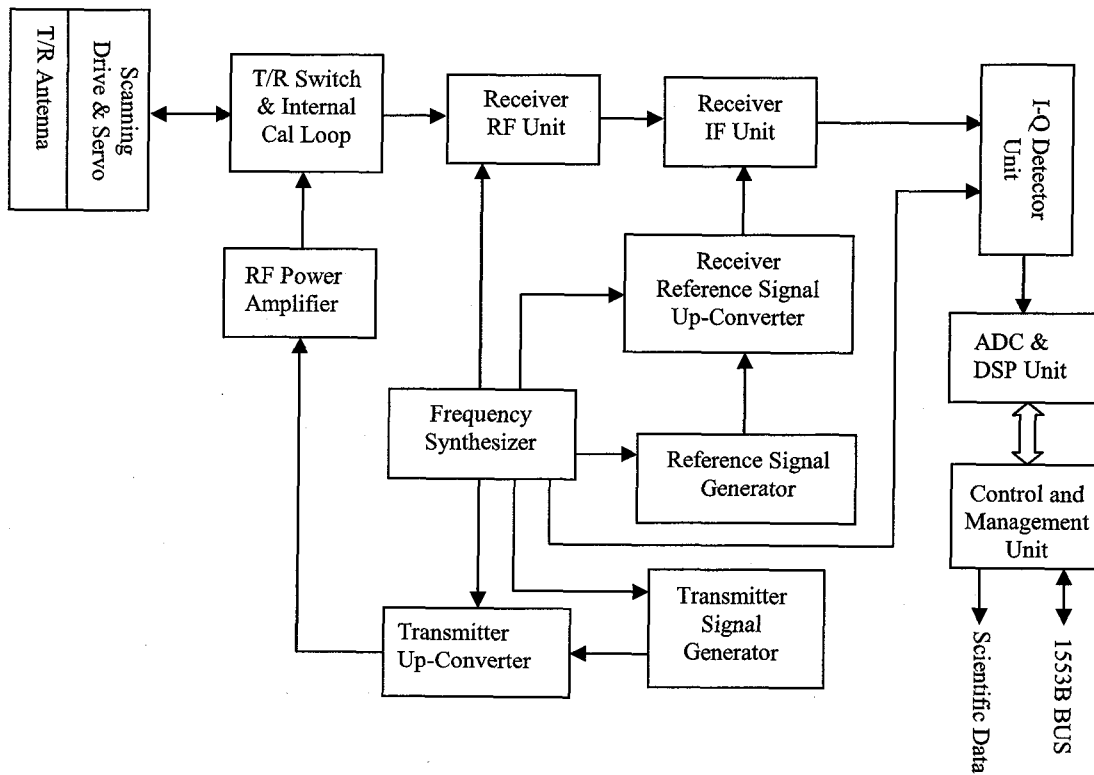


Figure 2 Diagram for SCAT/HY-2 instrument