SAR IMAGING PROCESSING

♦ High Resolution SAR Imaging Processing & Control Unit

♦ SAR Interferometric Radar Altimeter Processing Unit
Applications

- High Resolution Synthetic Aperture Radar imaging instrument for observation satellites.

Main features

- Digital Chirp Generator, with programmable waveforms and pulse repetition frequency
- Radio Frequency Unit and High Power Amplifier control
- Emission and reception channel sequencing with a high timing accuracy
- RF reception channel
- High input bandwidth
- Amplitude Phase Demodulation, and high bandwidth Analogue to Digital Conversion
- Possibility of decreasing the resolution to increase the number of images to store
- Large capacity Solid State Recorder with high acquisition data rate and output source formatting
- Auxiliary data acquisition and storage
- Attractive Mass and Power budget

Background

**Key RADAR programs:**
- JASON1 and 2
- CRYOSAT
- OSIRIS
- METOP
- SAR-Lupe

**Key programs with Solid State Recorder:**
- SPOT5 & HELIOS2
- IRS-P5
- KOMPSAT2

Key Benefits

- Compatible with most of the LEO platforms (MIL 1553 Bus command control, primary bus, …)
- Low budgets & High Throughput
- Flexibility with regards to mission parameters (RADAR sequences and waveforms, file management, …)

Technical description

- Highly integrated design with radar and mass memory functions in the same box
- Reception channel, including high performance analogue amplitude phase demodulator, analogue to digital conversion and very high data rate acquisition implemented in ASIC
- Programmable number of bits of the Analogue to Digital Conversion
- Programmable emission and reception sequencer enabling to perform different types of mission and control different type of RF unit
- Digital chirp generation with the possibility of uploading new waveforms
- MCM 3D technology used for the mass memory to enhance mass and volume budgets
- Internal redundancy for the mass memory
- Serial image telemetry interface (Hotlink), source formatting implemented in FPGA
- MIL 1553 interface
- LVDS interface for the other platform signals (reset, 1Hz reference, …)
- LVDS interface for the RF unit and HPA command-control
- Centralised DCDC converter with distributed power regulation, and distribution of the bus to the Radio Frequency Unit
- Radiation hardened processor & ASICs
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Applications

- High Resolution spaceborne Radar applications for earth observation and exploration

Main features

- In-flight Software uploading capability
- 3 main measurement modes assigned to 3 measurement areas:
  - LRM mode (Low Resolution mode) with a data rate of 60 Kbits/s for oceanographic parameters or ice sheet interiors measurement
  - SAR mode (High Resolution Synthetic Aperture Radar mode) with a data rate of 12 Mbits/s for sea ice measurement
  - SAR Interferometric (Dual Channel High Resolution SAR mode) with a data rate of 24 Mbit/s for ice sheet margins and mountains glaciers measurement

Interfaces

- Telemetry payload
- Bus power and data handling
- RF subsystem (Tx and Rx path)

Production

- Typical delivery schedule: To + 16 months

Key Benefits

- Compatible with most of the LEO platforms (MIL 1553 Bus command control, primary bus, telemetry interface, ...)
- Flexibility with regards to mission parameters (RADAR sequences and waveforms, file management, ...)
- High software processing capability thanks to an internal digital signal processor.

Technical description

Digital part of the instrument:

- Board rack structure
- Integrated design (use of ASICs and FPGAs technologies)
- Radiation hardened
- Latch-up free
- Flight proven design
- Various functions:
  - Digital Chirp generator
  - Radar timing unit and sequencer
  - Two channels Digital Amplitude Phase demodulation
  - Two Channels IEEE 1355 formatting high data rate
  - MIL STB 1553B Platform interface
  - Instrument Control and Processing Unit (DSP21020)
  - DC/DC power distribution

Background

- 2 processing units currently in orbit for TOPEX POSEIDON
- 2 processing units currently in orbit for JASON/POSEIDON2
- 1 flight model for CRYOSAT mission
- 1 flight model for POSEIDON3 mission,
- Current study on a Ka band altimeter
- ASCAT digital + RF unit for scatterometer
- Variety of SAR applications (high bandwidth acquisition)
Digital Unit in its environment: Instrument typical block diagram

Digital Unit typical performance

Chirp generator performance
Duration, bandwidth and PRI programmable
Capability for in-flight reprogramming
Bandwidth: 5 MHz to 500 MHz
Chirp duration: 5 s to 100 s
Phase stability from pulse to pulse
Amplitude ripple < 0.1 dB pp
Phase ripple < 1° pp
Signal to noise ratio > 50 dB

Receiver chains performance
Digital I&Q demodulator: 2 filtering options depending on the chirp bandwidth
Sampling frequency: 90 MHz
Fast Fourier transform: 128 points spectrum

Sequencer performance
Generation of programmable synchronization signals and clocks for RX and TX Chains
Pulse Repetition Frequency: 1 KHz to 20 KHz
Jitter < 50 ps

Formatter performance
• Generation of high data rate scientific TM packets
• IEEE 1355 protocol management

Control Unit functionalities
Communication (TC/TM) with the platform through a MIL STD 1553 data bus
Configuration/control of internal functions and of the instrument (Digital and RF Unit)
Echo processing for tracking purpose
Low data rate scientific TM generation

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