



## Digital Sub-System

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*Cosmic RAY Telescope for the Effects of Radiation*



## Overview

- Requirements
- Implementation topology
- Communications Interface
- Support Functions
- Conclusions

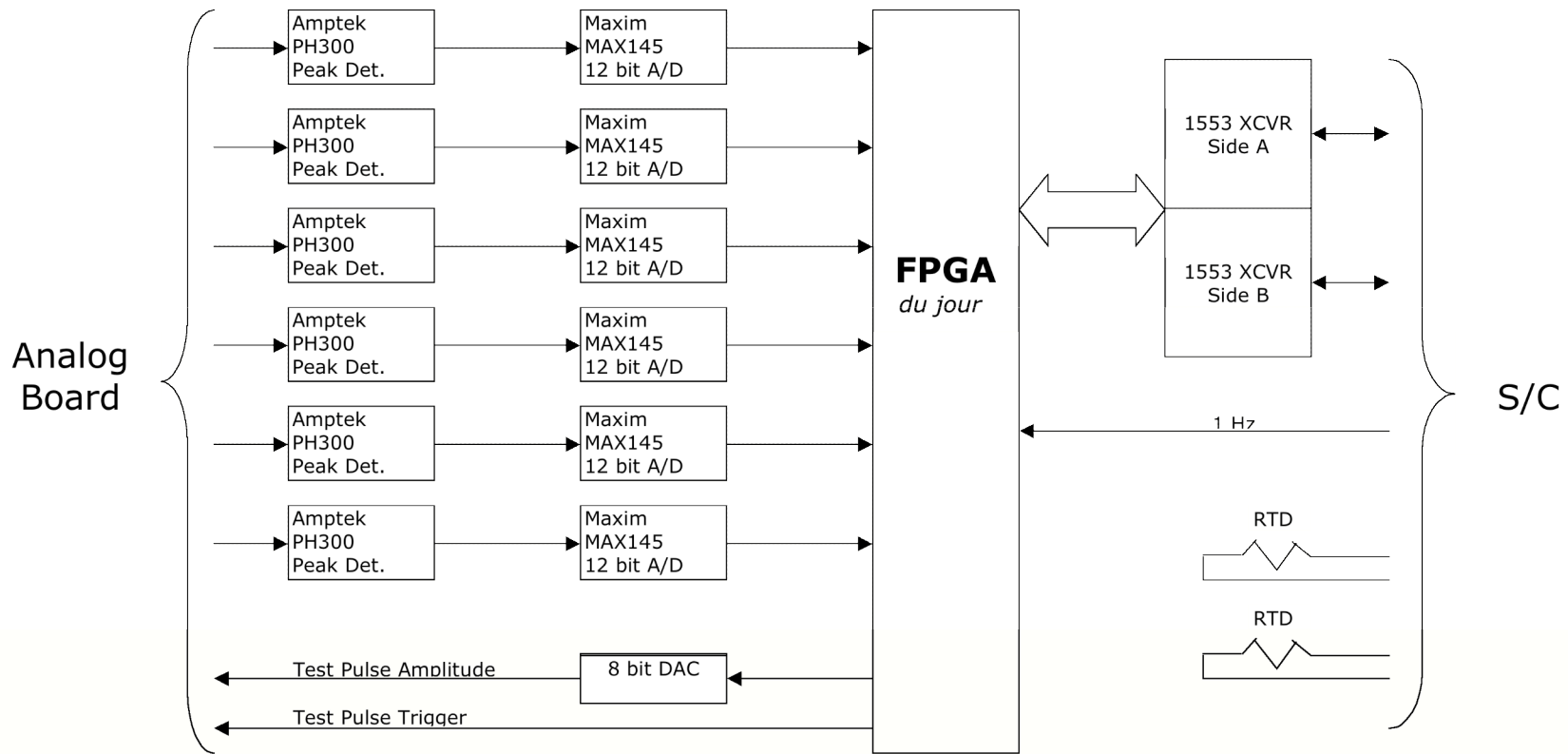
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## Requirements for the Digital Sub-System

- Accept and process analog signal with 300:1 dynamic range (1000:1 goal)
- Filter the science data from the 6 detectors according to uplinked parameters
- Format the science telemetry into CCSDS packets and send out on the 1553 bus
  - Low data rate for GCR background: 3 events/sec typical .....(312 bps)
  - High data rate for SEP flare: 1200 events/sec saturation .....(88800 bps)
- Provide secondary science data once per second: 22 bytes .....(176 bps)
  - Valid event counter, invalid event counter, telemetry stall counter, *etc.*
- Provide engineering data once per 16 seconds: 54 bytes .....(27 bps)
- Receive 1 Hz pulse to time tag the science data to a 1 second resolution
- Receive telecommands from the 1553 bus
- Provide electrical calibration signals to the analog board

## Digital Sub-System Block Diagram





## Command and Telemetry Interface

- Commands delivered to Spacecraft as CCSDS packets, 2 to 8 data bytes
  - Discrete commands for test pulse on/off, biases on/off, system reset
  - Individual video chain (logical) on/off
  - Arbitrary detector coincidence map to define valid events
  - Time of next 1 Hz pulse; used to time tag data
- Primary science delivered to Spacecraft as variable length CCSDS packets
  - Secondary header includes time tag and instrument serial number
  - Energy data packed as 12-bit sextuples for each valid event; 72 bits/event
  - A maximum of 48 events can be packed into a maximum length packet
  - A minimum of 1 and a maximum of 25 packets/second are retrieved by the Spacecraft
- Secondary science delivered to Spacecraft once per second as fixed CCSDS packet
  - Video chain status, calibration signal status, bias voltage status
  - Valid event counter, rejected event counter, telemetry stall counter
- Housekeeping delivered to Spacecraft once per 16 seconds as fixed CCSDS packet

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## Other Functions

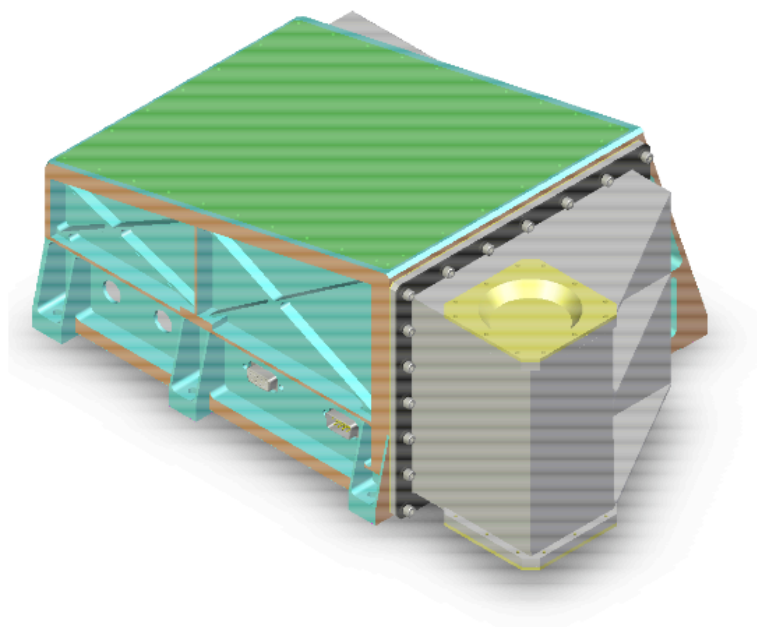
- Provide regulated power for analog and digital functions consistent with EICD requirements
  - Current design is one +/-6VDC dual supply, one +5VDC supply
  - EMC challenge is not severe being inside sealed box with standard interfaces and standard MIL power filters.
- Provide bias voltage for detectors
  - Current design is 70VDC and 220VDC at 10 microamps
- Provide one passive temperature sensor for s/c use
- Survival heaters incorporated inside instrument
- No operational heaters currently foreseen.



## Conclusions

- Interfaces and requirements well defined
- Work to do prior to CDR
  - Detailed design, parts selection, and performance verification of the peak stretcher
  - Selection of FPGA -- functionality and reliability considerations
  - Detailed design of bias supplies

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