Experience Summary on Microsemi RTG4 designs

SEFUW: SpacE FPGA Users Workshop, 4th Edition
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Overview

- Product Scope
- Image Processing Board
- RTG4 Design Experience
PRODUCT SCOPE
Jena-Optronik GmbH
RVS-ARP

RVS for ATV / HTV / Cygnus
42 Flight Models delivered, 48 under contract, flawless flight heritage
Market Opportunities

In-Orbit Servicing

3D LIDAR

Debris Removal

In-Orbit Assembly

Planetary Landing

ENVISAT

DEOS (Airbus DS)

e.Deorbit (ESA)

Europa Lander (NASA)
**LIDAR Pose Estimation**

**RVS3000-3D Pose Estimation**

- LIDAR + Image processing = “One Box Solution”
- Real-time calculation of 6DOF information
- Application of Iterative Closest Point Algorithm
- Matching between LIDAR scans and target CAD model

**Debris Removal Scenario**

**Match Scan Data with CAD Model**
IMAGE PROCESSING BOARD
High Performance In-Orbit Computing Plattform
Main Challenges

- Stable Core Supply for rapid changing loads
- IP Core support for memories
- Limitation of IO types
- Decoupling condensators (more than 300 for fully populated RTG4)
- Mounting of CCGA 1657 RTG4 package
PCB Stackup

Key Aspects

- 16 layer Stackup
- 8 signal layers capable of routing out up to 80 % of the RTG4 IO pins
- blind and buried via technology
- 2 supply voltage layers
- Via-In-Pad Technology
- No SERDES support!
Key Aspects

• Mechanical stress due to vibration and temperature changes
PCB Mounting

Key Aspects

- Mechanical stress due to vibration and temperature changes
- Low CTE Material to minimize the thermal stress between PCB and CCGA package

<table>
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<tr>
<th>CTE for</th>
<th>Unit</th>
<th>FR4</th>
<th>Hitachi 705G</th>
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<tr>
<td>X-Axis</td>
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<td>Z-Axis</td>
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PCB Mounting

Key Aspects

- Mechanical stress due to vibration and temperature changes
- Low CTE Material to minimize the thermal stress between PCB and CCGA package
- Corner Pins to stabilize outer columns
PCB Mounting

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Qualification has been passed for CCGA1752 packages in 2015

Delta qualification for CCGA1657 with 1 mm pitch is expected to be finished in Q2/2018
RTG4 DESIGN EXPERIENCE
Main Challenges

- Accuracy of Power Estimator
  - First estimation of ~ 5 W for our design
  - 1.5 W for the whole board during Lab Tests!
  - Rerun of power estimation with the latest spread sheet -> 12 mW less

- Iterating the spread sheet values parameters by using the final synthesis values for register count, clock tree etc.
  ➔ Still 3.6 W
  ➔ oversized power supply
Main Challenges

• Accuracy of Power Estimator
• asynchronous reset net limitations
  Why asynchronous resets?

  - Heritage designs use asynchronous resets
  - Defined state of flip flops and IOs during power up
  - Change FF state if clock is not present anymore -> SpW RX part

**Conclusion:** one asynchronous reset net is not enough!

Microsemi approach of net segmentation result often in unroutable designs
RTG4 Design Experience

Main Challenges

• Accuracy of Power Estimator
• asynchronous reset net limitations
• Libero Design Suite
  - use of Libero is mandatory for RTG4
  - TCL interface is available but not all functions are supported yet (IP cores)
  - Integrated make mechanism is annoying
  - Better error massages are appreciated
Main Challenges

- Accuracy of Power Estimator
- asynchronous reset net limitations
- Libero Design Suite
- Microsemi Support
  - Slow flow of information (TNs, CNs, document updates)
  - FAE support is overloaded -> only 1 FAE is not enough
  - Customer support via online platform
    - Long response time of a week or more
    - different customer service members every time
    - Quality of replies differs a lot
    - 1 issue was closed without any comment
TANK YOU FOR YOUR ATTENTION

QUESTIONS?