Intrepid Pico-Class CubeSat System Board

Overview

Tyvak's **Intrepid** Embedded Linux System Board reimagines the CubeSat, providing never before seen capabilities integrated as a single board solution. The design fully conforms to the CubeSat specification, and solves many of the design challenges developers face by including the Electrical Power System, Command and Data Handling System, a custom Embedded Linux OS with device drivers already in place, and post-deployment power-up interfaces. Standard Interfaces include two ultra-low profile daughter boards for custom communication systems, battery modules, or payload electronics, and payload interface connectors providing power and data. Two high-pin count umbilical connectors provide complete debugging access to data lines and peripherals provided to the payload even when fully integrated with the most complex systems.

Features

- System Power Requirements
  - Processor Idle: <200mW
  - 100% SDRAM Read / Write: < 300mW (Highest Power State)

- Command and Data Handling
  - Atmel AT91SAM9G20 Processor @400Mhz
  - 128MB 32bit SDRAM @133Mhz
  - 512MB 8bit NAND Flash
  - 32MB Serial Data Flash (Phase Change Memory)
  - MicroSD Card Slot (**HC** Compatible)
  - Custom Embedded Linux Build
  - Board mass of 55 grams

- Sensors and Peripherals
  - Real Time Clock with Backup Battery
  - 3-Axis Gyro, 3-Axis Accelerometer
  - 3-Axis Magnetometer
  - Six Power Sensors
  - Three Temperature Sensors
  - Pressure Sensor

- Electrical Power System
  - Isolated supplies to Command and Data Handling
  - Accepts solar panel power through Inter-board Connectors
  - Integrated Power Mosfets enabled post deployment
  - Interface custom battery packs through dedicated flat flex connector, or through Daughterboard B
  - Four High Efficiency Buck/Boost Regulators (Up to 95% efficient)
  - 3.7V nominal battery system (Li-Ion)
  - Single Ground Point to Structure
  - Separate Ground allows chosen electronics to never hard reboot

- Fault Tolerance
  - Latch-Up Protection for Memory and Processor
  - Low State of Charge Recovery System
  - Process level software watchdog
  - Internal Atmel Hardware Watchdog
  - External windowed Hardware Watchdog
  - Resistor programmable hard reboot timer (1 to 48 days, or disabled)

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Interfaces (note: unused peripherals act as additional GPIOs)

- **Daughterboard A Interface**
  - SPI with 1 Select
  - I2C
  - 1 GPIO
  - 1 UART
  - 1 Hardware Interrupt
  - Dedicated, resistor adjustable 1.2 to 5.5V Regulator @8W peak power
  - Low power 3.3V for logic and sensors
  - Unregulated Battery Power
  - Hard Reboot Line
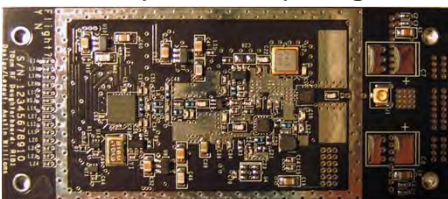 - Processor Power-On Reset

- **Daughterboard B Interface**
  - SPI with 1 Select
  - I2C
  - 1 GPIO
  - 1 UART
  - 1 Hardware Interrupt
  - USB 2.0 (12 Mbps)
  - Dedicated, resistor adjustable 1.2 to 5.5V Regulator @8W peak power
  - Low power 3.3V for logic and sensors
  - Unregulated Battery Power
  - Line to force hard reboot
  - Battery Ground for Custom Battery Packs
  - Processor Power-On Reset

- **Inter-Board Connectors**
  - SPI with 12 Selects
  - 2 I2C (1 Dedicated for Payload)
  - 5 GPIOs
  - 3 UART
  - USB 2.0 (12Mbps)
  - CMOS Image Sensor Interface (16 pins)
  - 5.0V Regulated Power @8W peak power
  - 3.3V Regulated Power @8W peak power
  - Unregulated Battery Power
  - Deployment Indicator
  - Solar Power
  - Processor Power-On Reset

- **Custom Battery Interface**
  - Battery Ground, and Unregulated Power
  - I2C

- **Umbilical A**
  - SPI (All Device)
  - Ethernet
  - RS232 (Terminal Access)
  - Two USB 2.0 (Host)
  - USB 2.0 (Device)
  - Unregulated Battery (Charging)
  - Line to force Hard Reboot
  - Processor Power-On Reset

- **Umbilical B**
  - 2 I2C
  - 3 UART
  - CMOS Image Sensor Interface
  - 6 GPIOs
  - ICE/JTAG Debug Interface
  - Payload Programming (3 Pins)
  - Four Power Good Indicators for Primary Regulated Power

Representative (UHF Radio) Daughterboard :
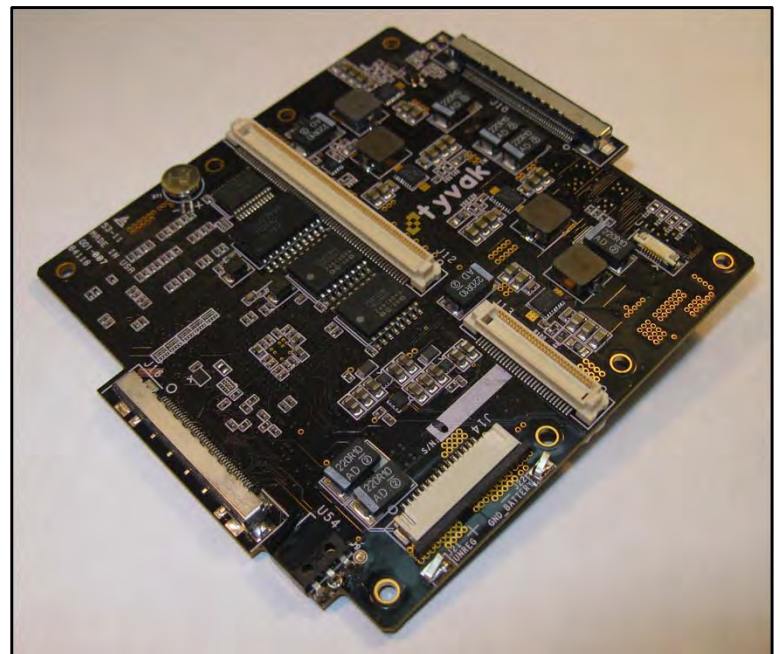
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