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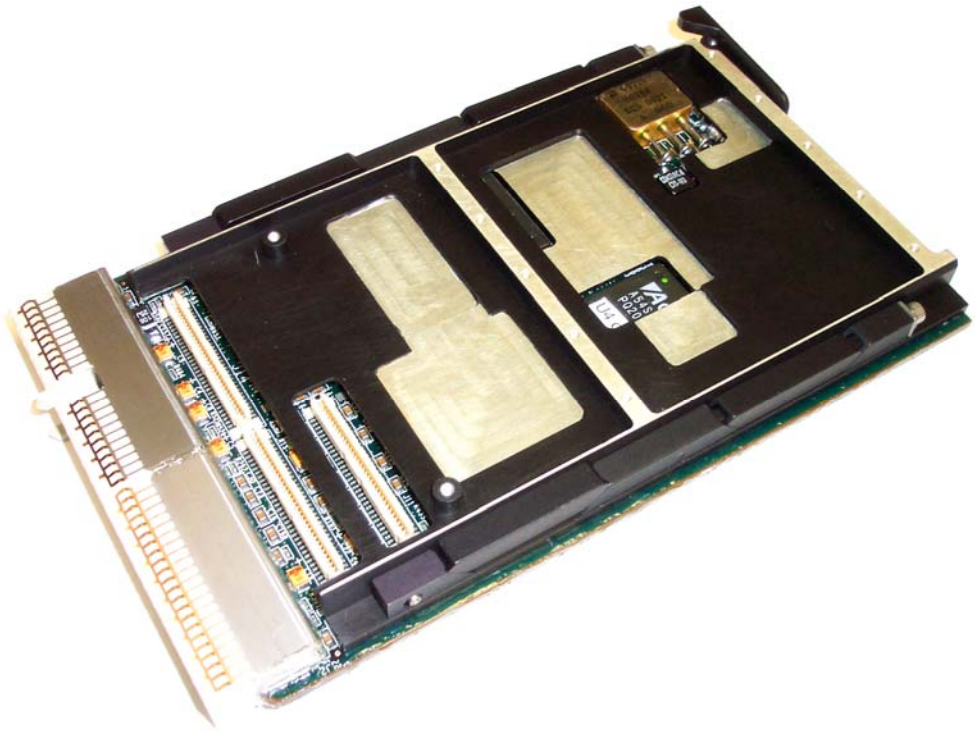
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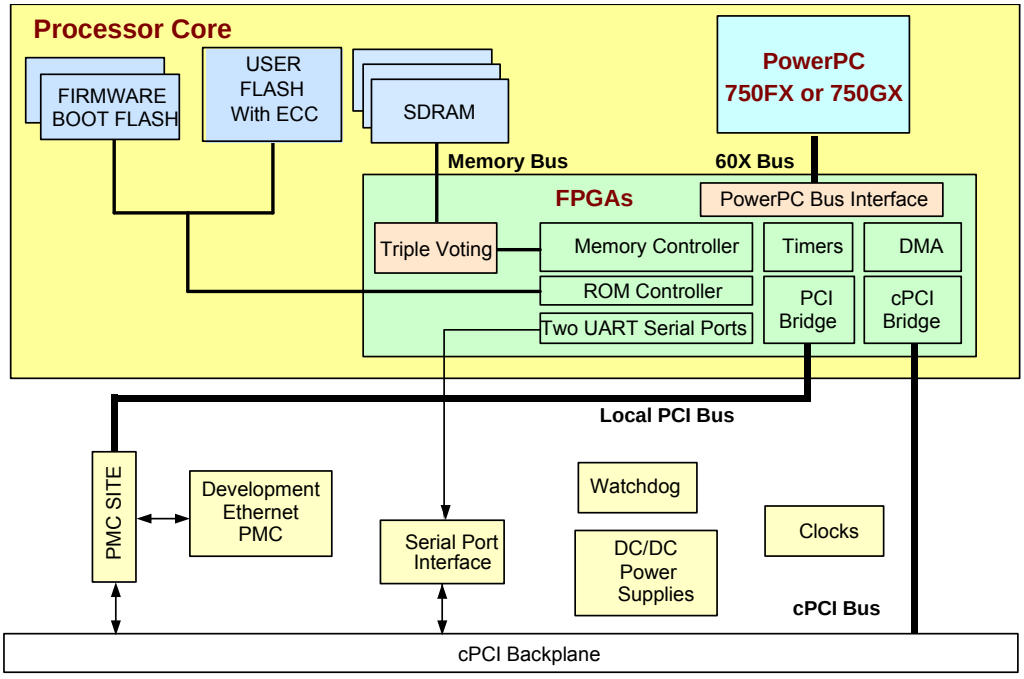
S950

3U cPCI Radiation Tolerant PowerPC SBC



- **Designed for LEO, Mars Terrestrial with an Option for GEO Environments**
- **Single-Slot Conduction-Cooled 3U CompactPCI (cPCI) Single Board Computer (SBC)**
- **High Performance PowerPC® 750FX Processor running at 733 MHz**
  Optional implementation of PowerPC® 750GX Processor running at 1.000 GHz
- **128 MB of SDRAM Arranged in a Triple Redundant Architecture (3 Bits per Cell)**
- **Internal L1 Cache (32 kB) with Parity Check for both Tags and Data**
- **Internal L2 Cache (512 kB) with Parity Check on Tags and ECC Check on Data**
- **1 MB Dual-Redundant Boot**
- **64 MB ECC-Protected User Flash Memory**
- **Two Serial Ports Supporting RS422 Interface**
- **Low Power Consumption**
- **Off-Board Ethernet Interface (10/100 Mbps) for Ground Development**
- **Level-2 Components per NASA GSFC-INST-001 specification are available**

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S950 3U cPCI Radiation Tolerant PowerPC® SBC

Aitech's S950 3U cPCI Radiation Tolerant PowerPC® Single Board Computer (SBC) is a powerful rugged cPCI board, specifically designed to operate in the harsh space radiation environment for mission-critical applications such as redundant mission computer, flight guidance and navigation computer, command and data handling computer, solid state recorder, video controller and manipulator controller.

The S950 board is powered by IBM's 750FX high performance, low power, and Silicon on Insulator (SOI) PowerPC® microprocessor. The SOI technology reduces power consumption, and significantly increases processor speed and radiation tolerance. The optional 750GX processor provides additional performance.

On-board memory resources are protected from radiation effects utilizing a number of strategies: SDRAM is triple redundant, with a voting mechanism incorporated in a radiation tolerant FPGA. Boot flash integrity is guaranteed by dual redundancy (i.e. two independent banks of boot Flash) in combination with a watchdog mechanism.

Complimentary memory resources consist of 64 MB ECC-protected user flash. The user flash has an optional Flash FileSystem Driver (FFD) software package to implement a file-system.

Designed to endure in space environment, the S950 design utilizes radiation tolerant devices for implementing all on board resources such as System Controller (PCI bridge and Memory Controller), cPCI Bridge and other critical system functions including reset mechanism, interrupt controller, two serial ports, four timers/counters and watchdog timer.

To expedite the transition from development to deployment, Aitech provides 100% software compatible development boards and a 10/100BaseT Ethernet interface is provided for software development only.

Designed to withstand the rigors of space environments, the S950 's highly integrated design guarantees the highest performance and versatility available on any rugged conduction cooled cPCI PowerPC® SBC.

Functional Description

Central Processing Unit

The microprocessor selected for the S950 is IBM's 750FX low power, high performance PowerPC® that delivers unmatched computing power with maximum power dissipation of less than 4.0 watts.

The proprietary SOI process used to fabricate the PowerPC® microprocessor results in excellent radiation tolerance characteristics along with low power consumption and increased performance.

Two integer ALU units, 32 kB L1 and 512 kB L2 on-chip data and instruction cache, along with dynamic branch prediction, dramatically increase processing power. The two cache units (L1and L2) maintain high data integrity by protecting their tags and data arrays with ECC and/or Parity protection mechanisms.

Memory

Memory Controller

The S950 memory controller is used to control the SDRAM volatile memory arrays. The memory controller is implemented in a radiation tolerant FPGA and includes the memory data integrity circuits, which are needed to enhance the system reliability in space environment applications.

SDRAM

The board includes up to 128 MB of triple redundant SDRAM. A voting mechanism, implemented in a radiation tolerant FPGA, ensures integrity of SDRAM data based on the contents of the three totally independent SDRAM banks. The voting mechanism is performed on read cycle only to allow data be corrected before sending to the CPU or another requestor on the 60x local PowerPC® bus.

User Flash Memory

64 MB of non-volatile ECC-Protected User Flash memory are available, ensuring sufficient memory resources for numerous applications. Flash memory contents data integrity is maintained through an ECC mechanism implemented in a radiation tolerant FPGA.

Boot Memory

The S950 includes 1 MB of dual redundant boot Flash used to store the on-board Boot firmware. Two independent Flash devices are available, each storing the identical Boot firmware.

A data corruption in the "primary" boot flash device that results in a failure to complete a boot up sequence (the hardware watchdog timer will expire), the board will reset. During the next reset sequence, a hardware mechanism will switch control to the "secondary" boot flash device. If the second device also fails to boot up, the subsequent watchdog reset will retry by toggling between the two boot flash devices alternatively until a successful firmware boot up is completed to disable the watchdog timer.

Once a boot sequence is completed, the user application can initiate a mirror operation to fix the corrupted boot flash device to ensure full data integrity for subsequent reset operations.

PCI Local Bus

The S950 local bus utilizes 32-bit PCI bus clocked at 33MHz. The PCI bus provides interconnection to peripheral I/O (Ethernet and PMC slot) allowing fast access between the PCI devices and the host processor. PCI bus supports both single and burst transfers.

Implemented in a radiation tolerant FPGA, the PowerPC® local bus to PCI bus Bridge device provides the interconnection between the microprocessor to the local PCI bus.

Compact PCI

The S950 is equipped with a complete 32-bit Compact PCI bus interface operating at 33MHz. The cPCI interface implemented in a radiation tolerant FPGA provides access for the local processor to cPCI resources.

The S950 can be configured as a Slot 1 system controller or a standard cPCI board in any other slot in a cPCI bus system. When the S950 is used as the system controller, it can support up to 7 additional cPCI boards in the system (clock signals and arbitration control).

I/O Interfaces

Ethernet Interface

The S950 supports an off-board 10 Mbps and 100 Mbps Ethernet port via the Aitech S950 "Ethernet Developer Kit" for ground development. The physical interface is a 10/100/1000BaseT twisted pair.

Serial Ports

The S950 features two standard serial ports implemented in a radiation tolerant FPGA. These ports provide maximum asynchronous baud rate of 115.2 kbps. Both ports support standard RS422 electrical interfaces. The first port is used as the firmware and software console port.

PMC Slot

To allow for a high degree of flexibility and I/O expansion, the S950 is equipped with one 32-bit PMC site (per VITA 20-2001 with exceptions). PMC cards mount rigidly along the card's stiffening ribs to ensure reliable operation in high shock and vibration environments. This also provides a low-resistance thermal path for heat removal in conduction-cooled applications.

The PMC resides directly on the S950 local 32-bit, 33 MHz PCI bus. Standard, rugged, off-the-shelf radiation tolerant PMC modules may be purchased from Aitech to enhance S950 functionality and features in a single cPCI slot.

Timers/Counters

Four independent 32-bit counters/timers are implemented in a radiation tolerant FPGA. These timers/counters are software programmable and may be programmed to interrupt at regular intervals or act as general purpose timers or counters.

Watchdog Timer

The S950 incorporates an on-board hardware watchdog timer implemented in a radiation tolerant FPGA. The watchdog timer provides a fail indication or resets the CPU in the event of execution failure detection. It may be enabled or disabled through software.

Power Circuits

The S950 generates its specific power supplies on board. These power supplies include the FPGA's core supply (+2.5V) and the PowerPC® 750FX core supply (+1.45V). Power supplies designs utilize high reliability components with high radiation tolerance characteristics.

Software

Test and Diagnostic Features

The S950 is supplied with an extensive firmware package. This package includes startup firmware (boot software), AIMon monitor/debugger tool, AIDiag diagnostic tool, and BIT. BIT may be executed during power-up or at any time after the board has been booted. The S950 provides a COP/JTAG interface to the processor for debugging and development purposes.

On board firmware upgrade is possible via the RS422 console port.

Operating Systems

The S950 is delivered with a complete Board Support Package (BSP) for WindRiver's VxWorks RTOS version 5.5.1. Other Real-Time operating systems (RTOS) support may be available upon request. The BSP includes drivers for on board resources allowing the user to take full advantage of the board's features.

Flash FileSystem Driver (FFD)

The optional FFD product provides a file system for use in the S950 user flash. The FFD can be configured to use part of the user flash to implement a filesystem and leave the remaining flash memory for software images.

Mechanical Features

The S950 is available in a conduction cooled 3U format per VITA 30.1-2002 with exceptions. A custom metal frame provides excellent rigidity and shock resistance. In addition, the custom metal frame provides an array of stiffeners to support rugged PMCs.

Dimensions

Both the development and flight units are offered in conduction-cooled form factor per VITA 30.1-2002 standard.

Thermal Management

A careful mechanical design including custom heatsink modules, wedge locks and extractors combined by a metal frame allow for optimal heat dissipation and strength of the board.

Radiation Performance

- Radiation Tolerant with an effective Total Ionization Dose of greater than 15 krad (Si). Higher total dose tolerance can be available upon request.

Radiation Model parameters: 150 mil of Aluminum shielding at the ISS orbit (335 km at 51.6 degree inclination) calculated from AP8-MAX, AE8-MAX and SHIELDOSE2 models.

- Latch-up Immune with a high LET of 11 MeV▪cm^2/mg
- Low SEU Rate – less than 1 upset per 370 days of operation in LEO with SAA.

Power Requirements

The S950 draws its power +5.0V and +3.3V from the standard cPCI backplane. It generates its own specific power on board (+2.5V and +1.45V). The +12V and –12V are routed to the PMC interface for compliance. The +12V is also used in the PWM circuitry to provide steady power to the processor.

Factory configuration option can provide most of the consumed power from the +5Vdc input to +3.3Vdc input.

S950 typical power consumption is less than 13.5 Watts. The S950 (with 750FX CPU) power consumption is estimated as follows:

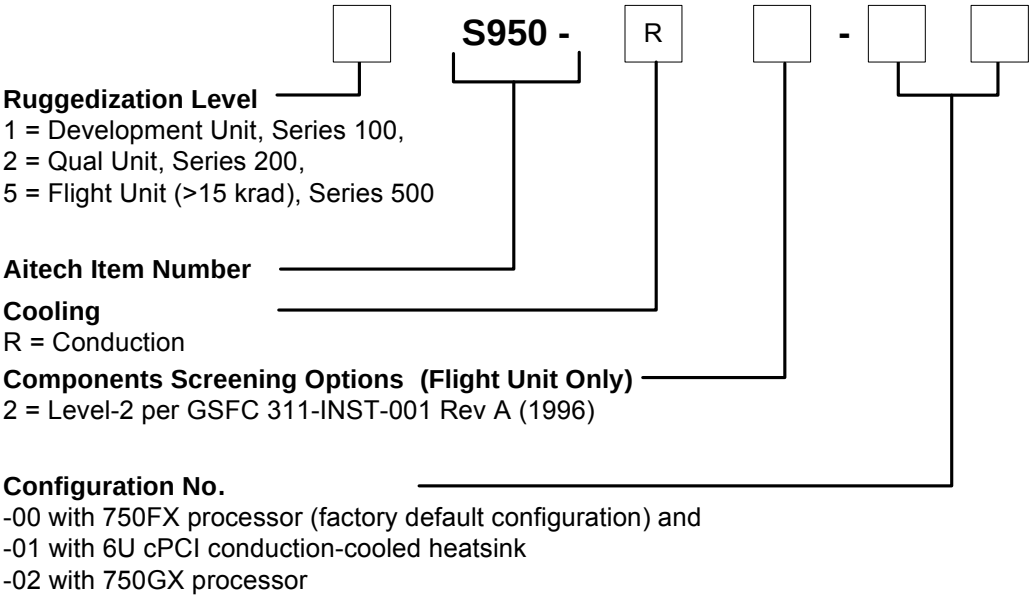
+3.3V	(±5%)	0.25A (typical)
+5V	(±5%)	2.2A (typical)
+12V	(±10%)	0.01A (typical)
-12V	(±10%)	0A

Environmental Features

Please refer to Aitech Ruggedization Datasheet:

http://www.rugged.com/home/rugged.html

Ordering Information



Available Configurations are: 1S950-R-00, 2S950-R-00, 5S950-R2-00
1S950-R-01, 2S950-R-01, 5S950-R2-01
1S950-R-02, 2S950-R-02, 5S950-R2-02

For more information about the S950 or any Aitech product, please contact Aitech Defense Systems sales department at (888) Aitech-8 (248-3248).

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