mips

Open RISC Technology

riscPC/ISA Design Kit PRELIMINARY PRODUCT INFORMATION

November, 1993

- ❏ Design kit provides technology to build MIPS RISC-based PCs to run *Microsoft Windows NT*
- ❏ Includes both:
  - hardware technology and
  - software technology
- ❏ MIPS RISC-based PCs deliver two to four times the performance of equivalent Intel x86-based systems for *Microsoft Windows NT*
- ❏ Shortens time-to-market with tested and proven system design methodology
- ❏ Minimizes R&D costs with easily adaptable and modular design technology
- ❏ Minimizes system design costs by leveraging existing Intel x86-based motherboard designs
- ❏ Hardware technology provided includes:
  - a MIPS RISC-based PC design featuring the high-performance riscPC/ISA CPU card
  - schematics and netlist
  - board layout information
  - Gerber files and layout pen-plots
  - ASIC design information
  - bill of materials
- ❏ Software technology provided includes source code license for a PROM and HAL (Hardware Abstraction Layer) kit that contain:
  - *Microsoft Windows NT* HAL customized for riscPC/ISA systems
  - boot and initialization firmware
  - PROM build documentation

1 .0 Introduction

The riscPC/ISA design kit offered through MIPS Technologies' Open Design Center, provides hardware, software and firmware technology to build a low-cost MIPS RISC-based personal computer to run *Microsoft's Windows NT* operating system. Using this technology, existing Intel x86 based personal computer designs can be incrementally modified to include a MIPS RISC microprocessor that replaces the Intel i386, i486 or Pentium CPU. MIPS RISC microprocessor technology enables PC manufacturers to offer products with two to four times the performance advantage over existing Intel-based systems that run *Microsoft Windows NT.*

The riscPC/ISA design kit shortens time-to-market, minimizes R&D cost, leverages existing PC designs and allows product differentiation for PC manufacturers.

The power of MIPS RISC technology is demonstrated through the riscPC/ISA: a 66 MHz MIPS R4400-based PC that runs *Microsoft Windows NT*. The key element of the riscPC/ISA design is a pair of bridge ASIC's (TigerShark) that translate the MIPS R4000 system bus to an Intel i486-type bus interface. The MIPS RISC CPU with the bridge ASIC's and MIPS firmware, replace the Intel CPU and BIOS PROM. All the other components on the PC motherboard remain unchanged, therefore the cost of a MIPS RISC-based PC is near equivalent to the Intel CPU-based machine.

2 .0 riscPC/ISA system configuration

The riscPC/ISA system was derived by modifying an existing 33 Mhz Intel i486DX system based on OPTi's AM-DXBB motherboard design. The base-board includes a dedicated OPTi CPU Bus slot for an Intel i486DX or i386 CPU-card, two EISA connectors for the OPTi Local Bus, 5 ISA bus slots and supports up to 32 Mbytes of DRAM. The riscPC/ISA CPU-card replaces the Intel i486DX CPU-card and the resulting system architecture is shown in Figure 1.

The riscPC/ISA system runs *Microsoft Windows NT* with the following base-board, ISA bus-based I/O cards and memory configuration:

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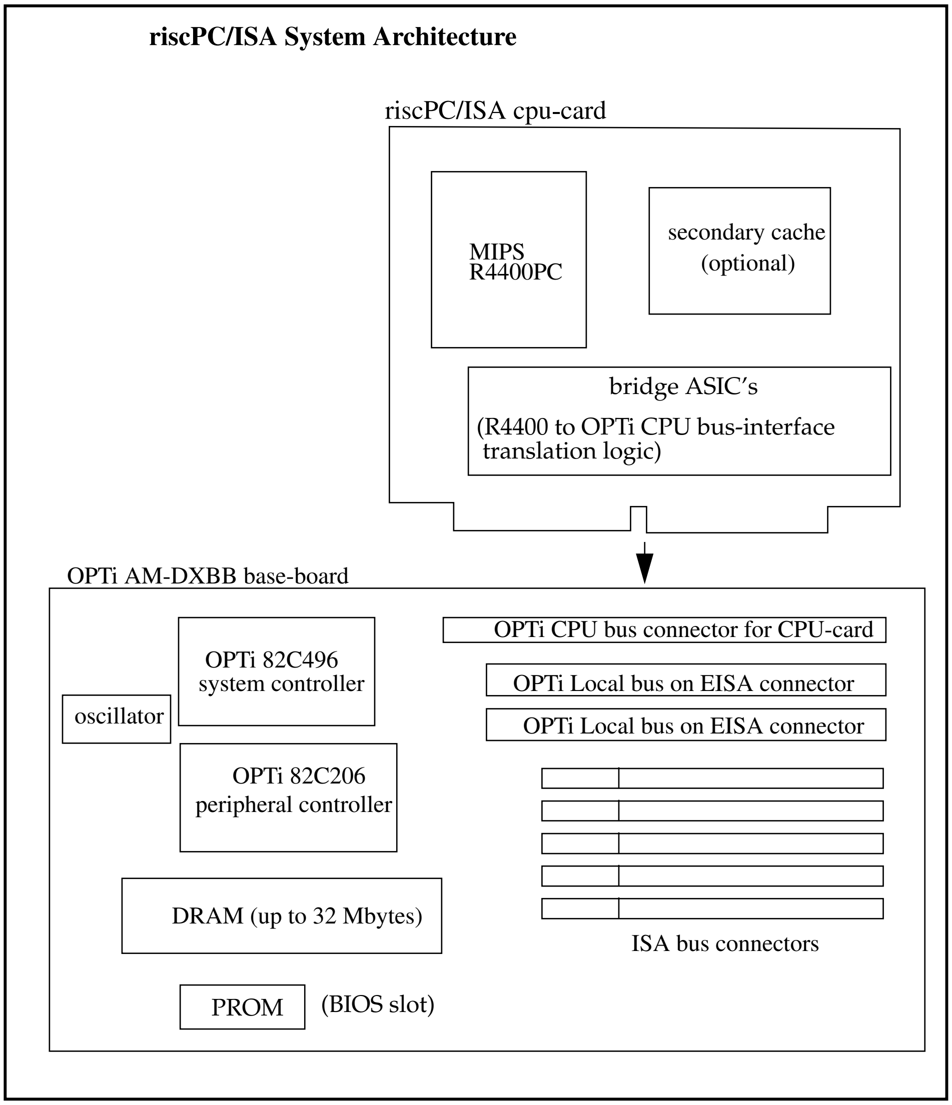

Figure 1- riscPC/ISA system architecture

- base-board -33Mhz AM-DXBB from Aten Research
- memory -16/32 Mbyte DRAM (60 ns 4 Mbyte SIMM's)
- video card- Orchid Fahrenheit 1280 or Appian Renegade I graphics accelerator
- ethernet card- 3COM 3C503-16 Etherlink II
- audio card- Creative Labs, SoundBlaster PRO
- serial card(mouse)- Logitec, Microsoft
- SCSI card- adaptec 1542C
- IDE card: Acculogic sIDE-3/PLUS

3 .0 riscPC/ISA CPU-card

The riscPC/ISA CPU-card is based on a 66 Mhz MIPS R4400PC microprocessor and supports up to1 Mbyte of secondary cache. The functional blocks of the CPU-card are shown in Figure 2. The R4400PC is a high performance 64-bit CPU with an integrated floating point processor and 32 Kbytes of primary cache memory. The R4400PC is packaged in a 179-pin PGA and is designed to operate up to 150 Mhz.

The *I_CNTLR* and the *C_CNTLR* ASIC's translate the R4400 system bus interface to a Intel i486-type bus protocol that interfaces directly with the OPTi CPU bus-interface. The ASIC's multiplex the 64-bit R4400 system bus down to a 32-bit i486 CPU bus and include a write-through secondary cache controller. The ASIC's also re-map the MIPS R4000 architecture memory map to emulate the Intel i486 memory and I/O address space. The ASIC's are packaged in low-cost, 160-pin PQFP packages and are designed to operate at bus frequencies up to 50 Mhz.

The riscPC/ISA card includes 1 Mbyte of secondary cache implemented using 15ns 128Kx8 SRAMs. The secondary

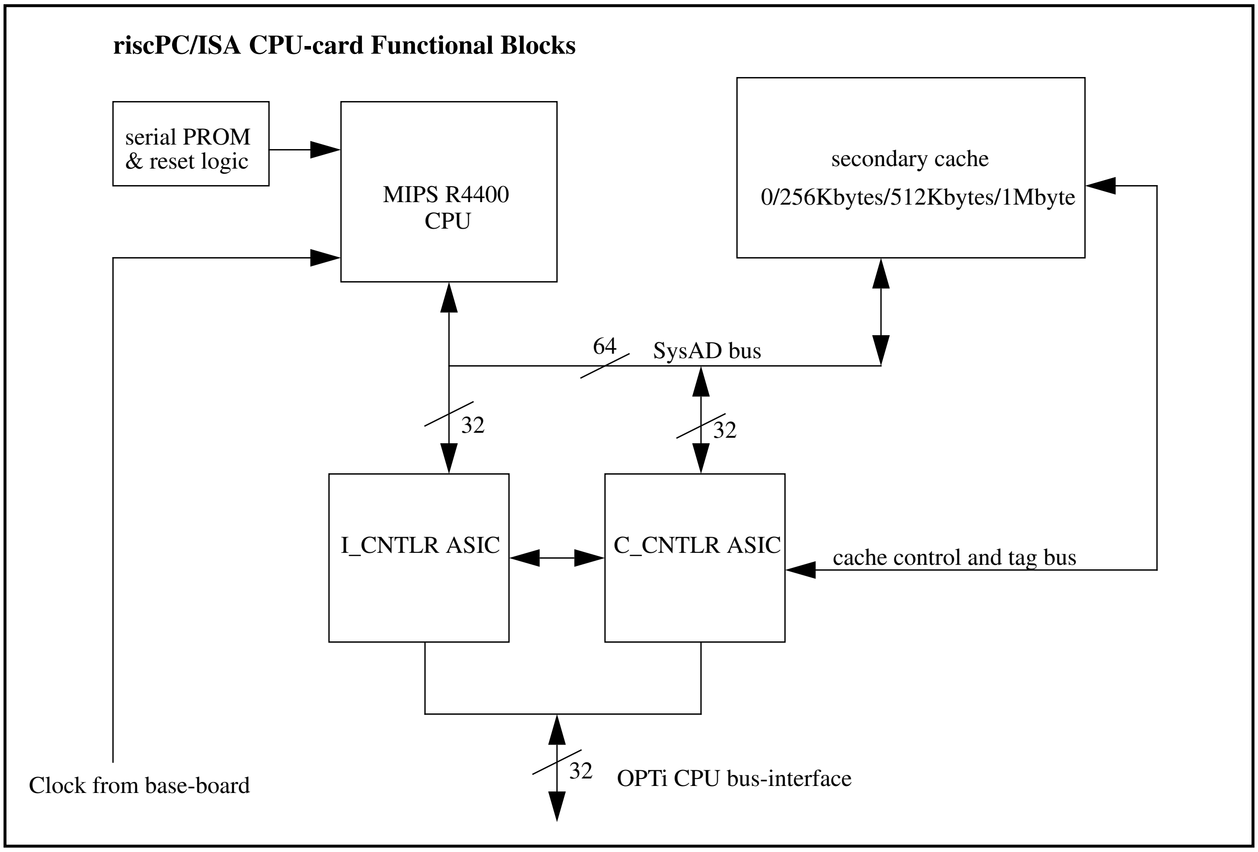

Figure 2- riscPC/ISA CPU-card Functional Blocks

cache is optional and the ASIC cache controller can be disabled via software. The ASIC's support a minimum cache size of 64 Kbytes and the architecture provides sufficient tag bits and address lines to support a maximum cache size of 4 Gbytes.The secondary cache is directly connected to the 64-bit system bus of the R4400PC for maximum memory bandwidth and performance.

The CPU master clock for the R4400PC is obtained from the AM-DXBB base-board instead of a local oscillator. The R4400PC includes a system interface clock divider, that allows the CPU to run at a higher frequency than the system bus for higher performance.

The serial PROM in the reset block of Figure 2 is needed to configure the various operating parameters of the R4400PC.

The board layout of the riscPC/ISA CPU-card is shown in Figure 3. Any R4400PC pin-compatible MIPS microprocessor can be used in the CPU-card to obtain different price-performance points. These include the R4000PC, R4200PC and the R4600 (Orion).

4 .0 Hardware Design Kit

The hardware design kit license includes:

- schematic database of the riscPC/ISA CPU-card
- layout database of the riscPC/ISA CPU-card
- pen-plots of CPU-card PCB layers
- *I_CNTLR* and *C_CNTLR* ASIC documentation
- bill of materials of riscPC/ISA CPU-card

The CPU-card schematic was done using OrCAD's *SDT 386+* and the database is available on DOS-format floppy diskette. The board layout was done in Cadence's *Allegro* and the database is available on a floppy diskette written under the unix *tar* format. A hard-copy of the schematics, pen-plots, ASIC documentation and BOM is also provided.

5 .0 Software License

The software license includes binary and source code rights to the PROM and HAL kit that contain:

- *Microsoft Windows NT* HAL customized for riscPC/ISA systems

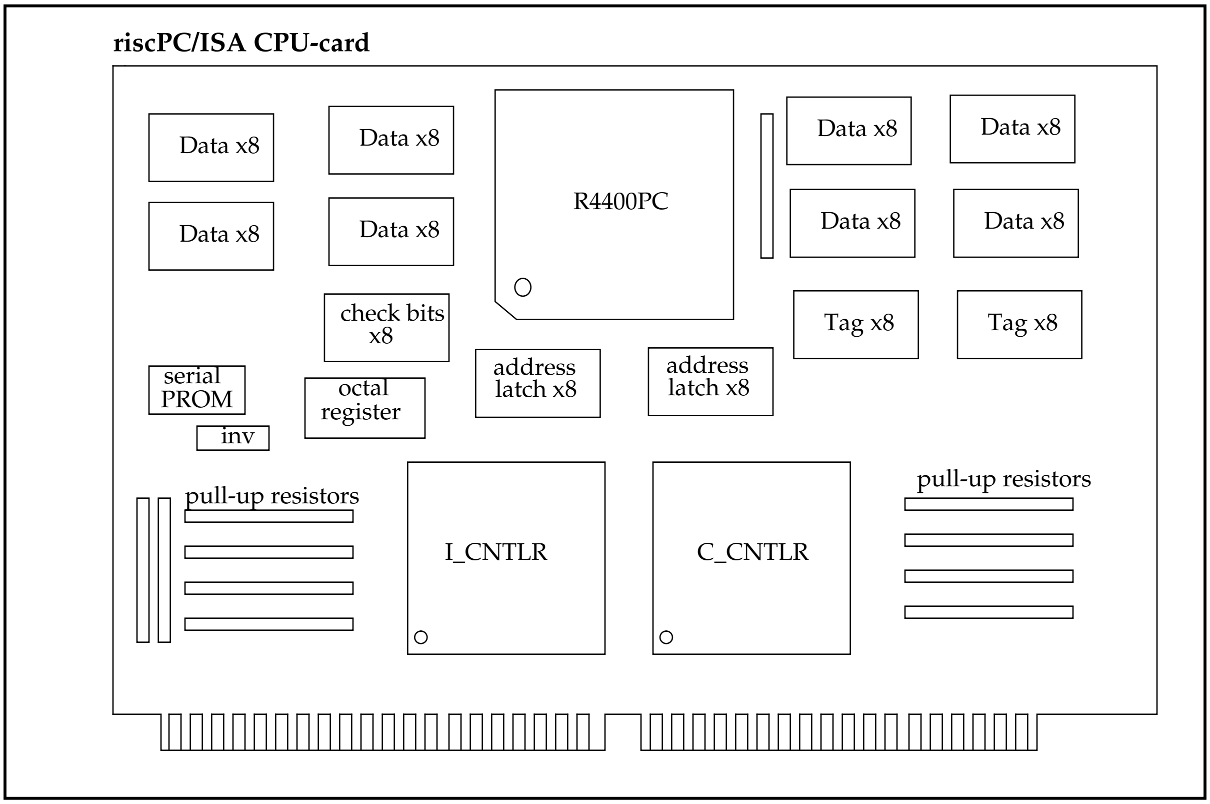

Figure 3- riscPC/ISA CPU-card layout

- boot and initialization firmware
- PROM build documentation

PROM and HAL kit source code can only be obtained if the following software is licensed directly from Microsoft:

- *Microsoft Windows NT Software Development Kit*
- *Microsoft Windows NT Device Driver Kit*
- *Microsoft Windows NT HAL Development Kit*

The source code and binaries of the PROM and HAL kit are provided on DOS-format floppy diskettes.

6 .0 License Agreement

The *riscPC/ISA Design Kit License Agreement* from MIPS Technologies' Open Design Center (ODC), gives licensees the rights to riscPC/ISA technology. The basic license provides complete information on riscPC/ISA CPU-card and includes binaries for HAL and PROM kit software. The basic license can be extended to include source code for PROM and HAL kit, if the software licenses described in Section 5, are obtained directly from Microsoft.

There is a one time licensing fee of $5000 for the riscPC/ISA Design Kit and no additional software or hardware royalties for using riscPC/ISA technology.

7 .0 ODC Technical Support

Technical support for the riscPc/ISA Design Kit is available from MIPS Technologies' Open Design Center by calling the following numbers:

- inside the U.S. call - (800) 998-6477
- outside the U.S. call - (415) 390-2136

Limited technical assistance is available for custom designs based on the riscPC/ISA Design Kit.

8 .0 Component Suppliers

TigerShark ASIC's are available from:

Toshiba - (714) 455 2000

The HAL and PROM kit is also available from:

AMI - (404) 263-8181

MIPS R4400/R4000 microprocessors are available from:

Toshiba	- (714) 455-2000
IDT	- (408) 492-8332
NEC	- (415) 965-6236
LSI Logic	- (408) 433-6882
Siemens	- (408) 777-4952