RC6280™ RISComputer™

The RC6280 expands the range of RISComputer power and sets a new standard for computing performance.

The MIPS RC6280 RISComputer represents a breakthrough in computing power. Now the entire range of UNIX® systems software and applications can run faster than ever before. The RC6280 has the computing power and I/O features required to provide new solutions for large system applications.

mips™

Performance

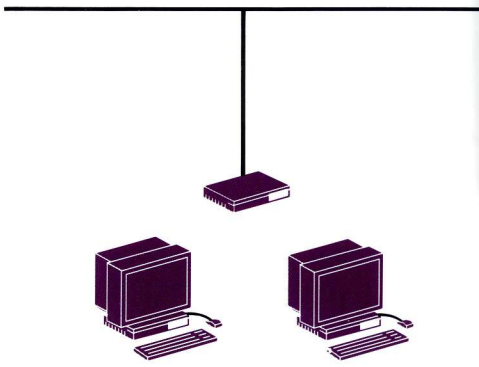
- 55 mips performance for technical and commercial computing.
- 200 MB per second cumulative I/O bandwidth across six independent VME buses.
- 10.3 double precision Linpack Mflops (compiled) for compute-intensive scientific problems.
- Advanced I/O subsystem for large system configurability and I/O-intensive applications.
- Tuned operating system and networking support for large compute and file server requirements.
- 592 KB multilevel cache for efficient access to program instruction and data at high processing speeds.

Configurability

- Up to 256 MB main memory for large programs and multiple users.
- Multiple VME buses and expansion cabinets for large system configurations.
- Support for industry-standard VME controllers and high-performance, block-mode peripherals.
- Support for multiple Ethernet,™ disk and serial I/O controllers in each VME subsystem.
- Back-up storage on 2 GB 8-mm cartridge tape or ½-inch magnetic tape.

Software

- Binary-compatible with the complete line of MIPS RISComputers and RISCstations.™
- SVID-compliant UNIX operating system, BSD and System V converged.
- Suite of high-performance optimizing compilers, including C, FORTRAN, Pascal, COBOL, Ada® and PL/I.
- Networking standards such as TCP/IP, Network File System (NFS™), DECnet™ and X.25.
- RISCwindows,™ MIPS native implementation of the standard X Windows System™ combined with OSF Motif.™
- Extensive development tools, from MIPS and from third-party vendors.
- Wide range of third-party application software available.



Desktop
Server

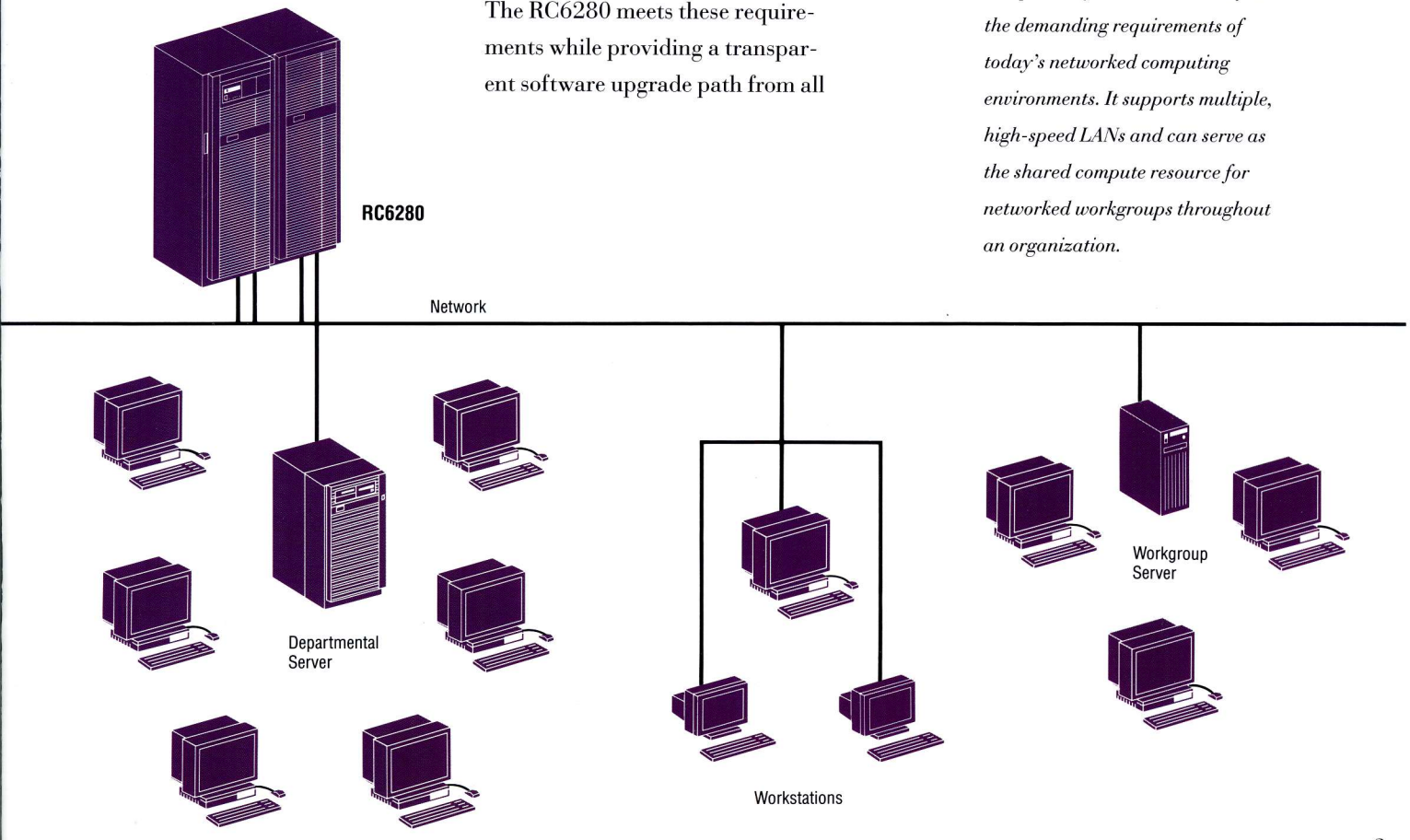
The Power of RISC is in the System

A distinct advantage of RISC (Reduced Instruction Set Computing) is that the architecture can be rapidly implemented in new technologies as they become available. MIPS pioneering philosophy of tightly integrating the design of the RISC CPU, memory management system, operating system and optimizing compilers, independent of chip process technology, allows system software and applications to be moved to these different technologies as they become available. The result is that MIPS offers the widest binary-compatible RISC system product line in the industry.

The RC6280, MIPS most advanced RISComputer, uses third-generation RISC technology to set a new standard for high-performance computing. The RC6280 provides a new level of system performance: 55 mips, 10.3 Mflops (DP Linpack), large memory and disk capacity and advanced networking capabilities. This unparalleled power is achieved while adhering to industry standards in software, peripheral controllers, networking and communications.

MIPS RC6280: An Enterprise Server

Today's client/server and shared resource computing environments place increased emphasis on powerful, high-capacity servers. The RC6280 meets these requirements while providing a transparent software upgrade path from all MIPS RISComputers. The high level of performance and system configuration flexibility of the RC6280 distinguish this MIPS RISComputer as a powerful *enterprise server:* A machine for large scientific and commercial applications. The RC6280 RISComputer is a system that can provide database, communications, print, file, mail and compute services to hundreds of networked users throughout an organization.



The power of the RC6280 satisfies the demanding requirements of today's networked computing environments. It supports multiple, high-speed LANs and can serve as the shared compute resource for networked workgroups throughout an organization.

RC6280 Power

MIPS RC6280 derives its exceptional power from the third generation of RISComponents.™ The high-performance specifications are achieved by tightly integrating the RC6280 CPU to a unique multilevel cache and 266 MB per second System Bus.

A memory hierarchy of primary cache, secondary cache and main memory is used to attain maximum execution speed. The 64 KB primary instruction cache and 16 KB primary data cache feed the CPU at full-rated speed. The 512 KB secondary cache is large enough to substantially improve the cache hit rate. The combination of a fast primary cache and a large secondary cache deliver useful instructions and data to the CPU to maximize performance.

The 55-mips CPU delivers balanced integer and floating point speed far superior to other general purpose computers available today.

MIPS RC6280 compute capability is complemented by exceptional I/O performance to prevent I/O bottlenecks. The 266 MB per second System Bus interfaces through I/O adapters to as many as six independent VME buses. The VME buses allow all standard VME controllers to interface to the System Bus. In addition, the RC6280 uses advanced block-mode controllers for the critical disk and Ethernet interfaces.

Systems Software

The software foundation for RC6280 RISComputers is MIPS port of the UNIX operating system, RISC/os,™ which has been tuned for maximum performance. RISC/os provides the system and user interface utilities of the converged System V and BSD versions of UNIX to support a wide range of applications, including MIPS C language with optimizing compiler and runtime support. Communications protocols for Ethernet networking, the Berkeley Fast File System, and the Network File System (NFS) are supported for transparent file sharing between systems.

The entire suite of MIPS language products is available on the MIPS RC6280 RISComputer. In addition to the C language, RISComputers support FORTRAN with VMS extensions, Pascal, COBOL, Ada, and PL/I. All language compilers include multilevel optimization capability designed to maximize program execution speed with the RC6280's processor.

Networking

The RC6280 enterprise server can act as the shared resource for many departments and workgroups. This advanced networking capability supports multiple Ethernet lines and makes the performance and storage capacity of the RC6280 available to users across the entire network. MIPS RISC/os supports TCP/IP, NFS, RISCommDN™ (DECnet) and X.25. Such flexibility allows the RC6280 to function productively in any networked environment.

Application Development Tools

The RC6280 RISComputer system supports both MIPS own and third-party development tools. RISC/os includes the full UNIX development environment of both System V and BSD, including compiling and debugging tools, source code control, and documentation support tools. MIPS unique profiling tool, *Pixie*, and MIPS System Programmer's Package (SPP) are available for advanced development environments.

More than a dozen development languages are available, including MIPS RISCompilers and third-party products. Third-party development environments include LISP, PROLOG, Micro Focus COBOL/2,™ BBX Business Basic, DBL, RPG/II, PICK,® Oracle,® INFORMIX,® PROGRESS™ and ACCELL.™

Application Software

The RC6280 delivers its high performance using mainstream software available today, unlike other high-performance machines that require vectorization, parallelization or other special program preparation. MIPS RC6280 sup-

Large systems can be configured easily with multiple VME buses and additional expansion cabinets.

ports a wide range of applications, including software development, office automation, business administration, computer-aided engineering, database management, networking and communications.

Leading software developers have joined MIPS RISCware™ Program and offer their products directly to MIPS system customers. MIPS worldwide value-added resellers and OEMs also deliver turnkey systems with applications specially bundled with MIPS systems. Combined, these applications developers make hundreds of solutions available to users of the RC6280.

Configurations

The RC6280 main cabinet contains the System Bus card cage with slots for the CPU, main memory, and I/O adapters. The main cabinet also has a six-slot, triple-high VME card cage and room for cartridge tape and disk subsystems. A base RC6280 system can be configured in the main cabinet.

A typical RC6280 configuration requires one or more expansion and peripheral cabinets. The VME cabinet has a 12-slot triple-high VME card cage, power supply and room for system disks and magnetic tape drive. Up to five VME cabinets can be configured on large systems. The peripheral cabinet can contain additional system disks. RC6280 configurations are air-cooled and do not require special cooling facilities.

Implementation Technology

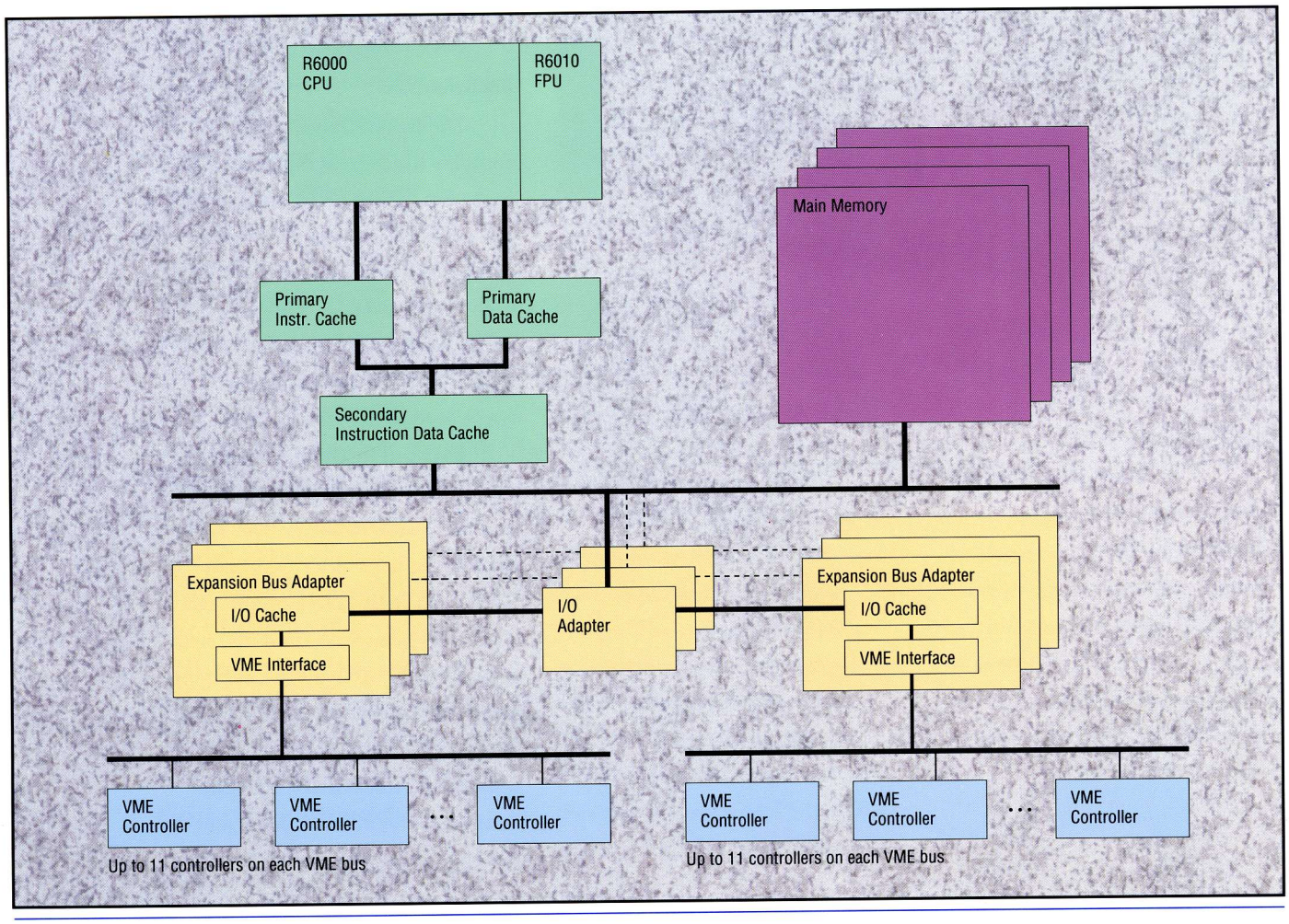
The RC6280 employs state-of-the-art computer system technology to deliver its superior performance. The CPU and floating point unit are custom bipolar VLSI Emitter-Coupled Logic (ECL) RISComponents. The caches are implemented using high-speed BiCMOS and ECL static RAMs. The ECL components are confined to the processor board and System Bus controllers. Most of the system and I/O logic are implemented using standard TTL. Main memory uses standard CMOS DRAMs. This implementation makes the performance of ECL RISC technology available in a conventionally packaged, air-cooled data center system.

Processor Module

The key to delivering high system performance is keeping the CPU busy with useful data and instructions. The RC6280 achieves this through an innovative multi-level caching scheme.

The 64 KB primary instruction cache and 16 KB primary data cache provide instructions and data via separate buses to the CPU at a combined rate in excess of 500 MB per second. These direct-mapped write-through caches are implemented using high-speed BiCMOS SRAMs. The primary caches use the virtual address generated in the CPU; no translation to a physical address is required. This eliminates the address translation delay and delivers the fastest possible access to instructions and data.

Functional block diagram of the RC6280 RISComputer.



The 512 KB secondary cache is shared between instructions and data. This two-way, set-associative, writeback cache is implemented with high-speed BiCMOS SRAMs. A physical address is generated for the secondary cache using an on-chip TLB (Translation Look-aside Buffer) mechanism. Physical addresses are used on the secondary cache so the operating system only tracks one copy of data.

The primary cache is fast enough to keep up with the processor; the secondary cache is large enough to substantially improve the cache hit rate (the observed cache hit rate on a wide range of programs is 99.5 percent). This combination minimizes pipeline stalls to allow the RC6280 CPU to run at full speed.

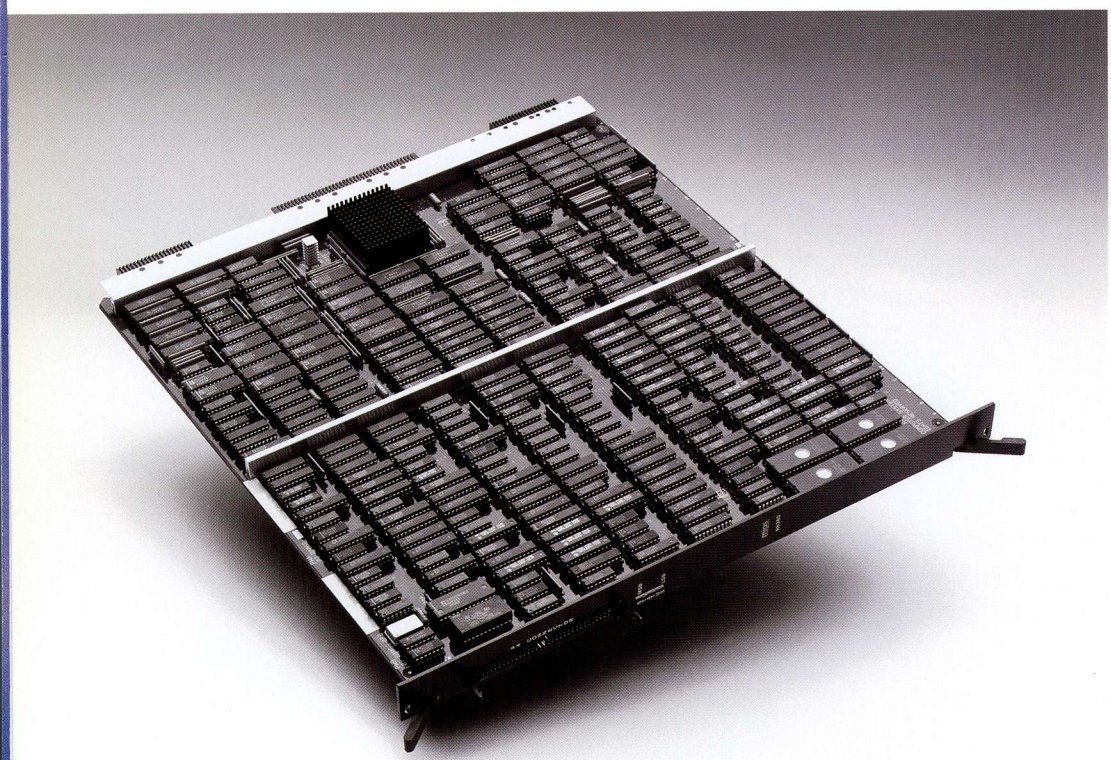
The RC6280 state-of-the-art processor board contains the CPU, FPU, high-speed, multi-level cache and bus controller circuitry.

Floating Point Unit

The RC6280 delivers high floating point performance by tightly coupling a floating point unit (FPU) to the R6000™ CPU chip. The floating point controller is directly connected to the R6000 processor and accelerates the execution of floating point instructions. The floating point controller contains a 16-entry register file that handles both single- and double-precision operands. The FPU performs floating point add, subtract, and conversion operations. Assisted by a dedicated multiplier chip, the FPU also accelerates multiply, divide and square root operations.

I/O Adapter

The performance of the CPU is matched by an I/O subsystem capable of providing 200 MB per second cumulative I/O bandwidth. The structure of the I/O subsystem is shown in the RC6280 block diagram. Each I/O adapter, capable of transferring data to and from the System Bus at 66 MB per second, interfaces the System Bus to two 33 MB per second Expansion Buses.



Each I/O adapter can interface with two independent VME buses for expanded I/O capability.

The RC6280 can support three I/O adapters to interface to as many as six Expansion Buses. The Expansion Bus adapter interfaces the Expansion Bus to a standard VME bus card cage, and contains an I/O to maximize VME bus throughput.

System Bus

The CPU processor board communicates with main memory and the I/O adapter through the System Bus. The System Bus is the high-speed backbone of the RC6280 and is designed to optimize processor-to-memory and I/O block-mode transfers. This 4-byte wide, 15 ns synchronous bus provides a 266 MB per second channel to memory and I/O adapters. The System Bus uses differential line drivers and a centrally distributed differential clock to minimize skew. With no net current flowing across the backplane connectors (except on transaction boundaries) the noise immunity of the system is dramatically increased. Word parity is maintained on all transactions on the System Bus.

Each connection to the System Bus is controlled by a bus controller chip that contains I/O queues and all necessary logic to maximize bus utilization. Ten slots are available on the System Bus for the CPU board, I/O adapters and memory.

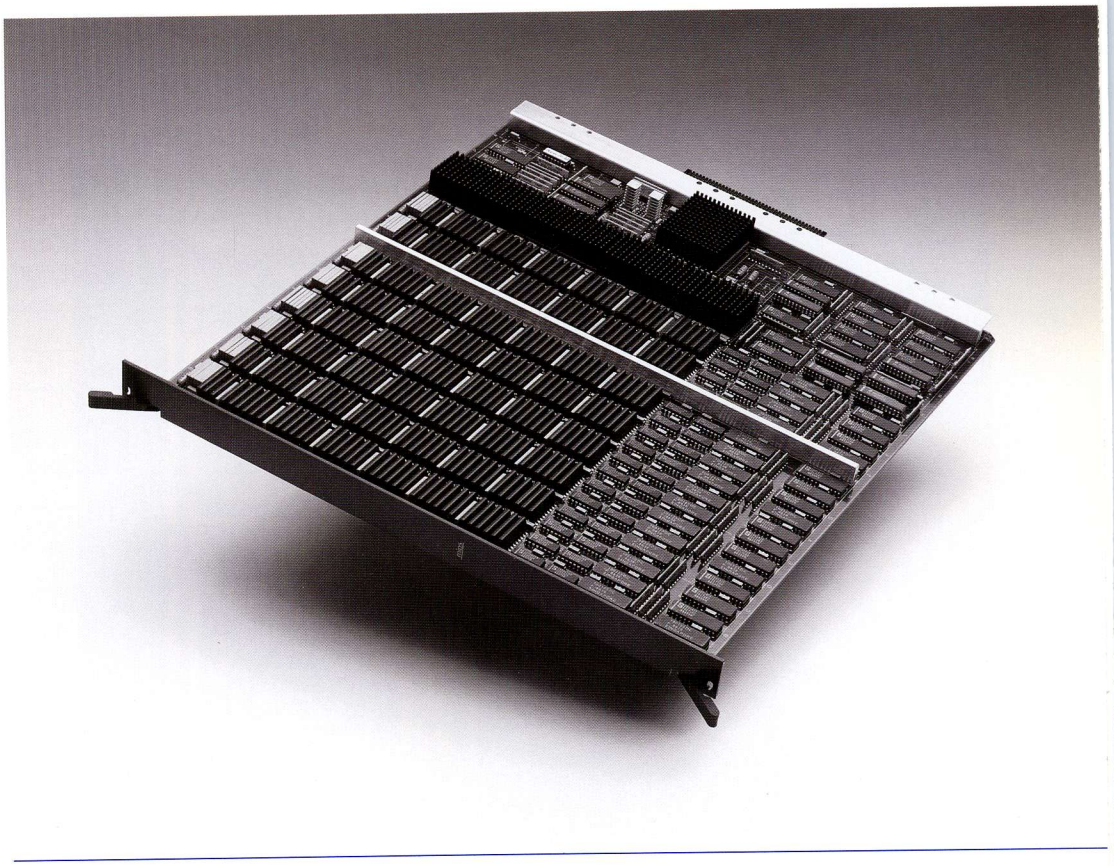
Main Memory

The RC6280 can support up to eight 32 MB memory boards for a maximum configuration of 256 MB of main memory. Each memory board contains 32 MB of RAM, control logic and a bus controller chip. The bus controller chip handles the memory refresh timing and performs single-bit error correcting and double-bit error detection on each 32-bit word.

The eight-way word-interleaved memory supports all memory operations (word, partial word, and block read/write and synchronization) for high-speed communications with the CPU and I/O adapter. Data queues on the bus controller chip provide efficient use of the System Bus bandwidth.

Peripherals

The RC6280 supports the fastest block-mode VME I/O controllers. These controllers contain local processing power and I/O buffers to support block-mode data transfers in up to 256-byte blocks. Disk, Ethernet and tape peripherals take advantage of this block-mode transfer capability and significantly improve I/O performance. The RC6280 supports SMD disk controllers to interface with 8-inch Winchester disks. These block-mode controllers support either two or four SMD drives. VME SCSI controllers provide the interface to the SCSI bus for ¼-inch cartridge tape, ½-inch magnetic tape and 8-mm cartridge tape drives.



Each 32 MB memory board contains error correction circuitry and uses memory interleaving techniques for faster data access.

Packaging

The RC6280 is packaged in a data center cabinet that has a 24.0-by 36.5-inch footprint and stands 62.5 inches high. The power supplies (4500 watts total) in the main cabinet provide power to all System Bus modules (CPU, I/O adapter and memory), VME controllers and peripherals. The 17-slot card cage is partitioned for 10 System Bus slots and seven triple-high VME slots. One VME slot is occupied by the Expansion Bus adapter card, leaving six slots available for user configuration. The minimum configuration includes three VME controllers: SMD disk controller, Ethernet controller and SCSI bus controller.

The main cabinet power supply and cooling assembly are at the bottom of the cabinet with the card cage directly above it. There may be up to three peripheral trays in the main cabinet: one for the ¼-inch cartridge tape and optional 8-mm tape drive, and two additional trays to accommodate up to four SMD disks.

The VME cabinet contains a 12-slot VME card cage and a 1600-watt power supply. With an Expansion Bus adapter cabled to the main cabinet's I/O adapter, the VME card cage has 11 slots available for user configuration. There is also an optional peripheral cabinet (no VME card cage) available to house disks and user-supplied rack-mount peripheral devices.

RC6280 Specifications

Performance	
Mips rating*	55
Dhrystones/sec	109,000
Clock frequency	66.7 MHz
Cycle time	15.0 ns

Floating Point	
Add time, SP	45 ns
Add time, DP	45 ns
Mul time, SP	60 ns
Mul time, DP	90 ns
Div time, SP	195 ns
Div time, DP	330 ns
Whetstones, SP	39,000/sec
Whetstones, DP	32,000/sec
Linpack, SP	13.9 Mflops
Linpack, DP	10.3 Mflops
Linpack, coded SP	15.7 Mflops
Linpack, coded DP	12.9 Mflops

Processor	
Architecture	MIPS RISC
CPU type	MIPS R6000
Chip technology	Bipolar ECL
Word length	32 bits
GP registers	32
Pipeline levels	5
Primary instruction cache	64 KB
Primary data cache	16 KB
Secondary instruction/data cache	512 KB
Min main memory	32 MB
Max main memory	256 MB
Memory config	32 MB/slot, 8 slots
Error detection	On-board single-bit correction, double-bit detection
Virtual addr space	4 GB, 2 GB/proc
MMU page size	16 KB

Floating Point Processor	
FPU type	MIPS R6010
Chip technology	Bipolar ECL
FP registers	16
FP word length	64
Pipeline levels	6

System Bus	
Data	32-bit
Bandwidth	266 MB/sec
Cycle time	15 ns
Error detection	Word parity

I/O Subsystem	
Interface	Multiple VME
Max VME buses	6
Configuration	12 slots/card cage
I/O Bandwidth	33 MB/VME bus

Serial I/O	
Format	RS-232C, DB-25S
Base system	16 ports, two console ports
Expansion cabinet	64 ports
Max baud rate	9600 in, 19.2 K out
Modem Control	Standard

Disk Drive	
Type	8″ Winchester
Controller	SMD, Block-mode
Recording type	Winchester
Capacities	655 MB formatted
Avg seek time	16.5 ms
Average latency	8.3 ms
Avg access time	24.8 ms
Power	150 watts/drive
Disk drive MTBF	40,000 hrs
Configurations	4 in main cabinet, up to 28 in VME/ expansion cabinets
Weight	17.7 kg (39 lbs)/drive

SCSI Bus	
Format	ANSI X3.131-1986
Max transfer rate	4.0 MB/sec sync
Target devices	up to 7, sync or async

Ethernet Control	
Protocol	IEEE 802.3 std
Media type	Coaxial cable (thick)
Data rate	10 MB/sec
Access control	CSMA/CD protocol
Ports	Four/VME bus

Cartridge Tape Drive	
Size	5.25″ half height
Format	¼″ tape
Controller	SCSI, integral
Capacity	120 MB (QIC-120)
Optional	60 MB (QIC-24)
Tape speed	90 ips, streaming
Power consumed	25 watts
Tape drive MTBF	12000 hours @ 25% duty
Configuration	1 in main cabinet

Back-up Storage	
Size	5.25″ half height
Format	8-mm cartridge
Controller	SCSI, integral
Capacity	Up to 2 GB
Drive MTBF	20,000 hrs
Configuration	1 in main cabinet
Technology	Helical Scan
Transfer Rate	246 KB/second
Non-recov. error rate	<1 in 10^{13} bits

Mag Tape Drive	
Format	½″ reel tape
Controller	SCSI, integral
Capacity	180 MB (2400 ft tape)

Tape speed	50/100 ips
Power consumed	350 watts
Tape drive MTBF	4800 hrs @ 25% duty
Configuration	1 in expansion cabinet

Dimensions, Weights and Power

	System Cabinet	VME Cabinet
Height	62.5″ (165 cm)	62.5″ (165 cm)
Width	24.0″ (61 cm)	24.0″ (61 cm)
Depth	36.5″ (93 cm)	36.5″ (93 cm)
Weight (typical)	800 lbs (365 kg)	800 lbs (365 kg)
Shipping weight	1000 lbs (450 kg)	1000 lbs (450 kg)
Power supply	4500 watts	1600 watts
AC circuit rating	6900 volt amps	2400 v.a. typ
Heat in BTUs/hr	15,400 (4500 watts)	5,500 (1600 watts)

Regulatory

RFI emissions:	FCC Class A, VDE Class A
Safety	UL, CSA, TUV, VDE, IEC

Facility Planning

Ambient temp, op	5°C to 35°C
Relative humidity	10 to 80% non-c
Altitude	to 3000 m (10,000 ft)
AC Voltage	180 to 265 three phase
AC Frequency	47 to 63 Hz
AC power cord length	2 m (6 ft)

*Based on a suite of 15 benchmarks with the execution time set to a reference such that a VAX™ 11/780 with software as released in 1988 is rated to 1.0 mips.

Specifications subject to change without notice.

The RC6280, expansion bus and peripherals are conveniently packaged in a conventionally cooled data center cabinet.

The Power of RISC is in the System

MIPS Computer Systems, Inc.
928 Arques Avenue
Sunnyvale, CA 94086-3650
408.720.1700

Canada
Ontario
416.624.4286

Europe
United Kingdom
011.44.628.890.535

Asia
Japan
011.81.3.219.6091

M5-00022