Prime

2350™ System

Features

Economical, high-performance 32-bit supermini-computer with up to 8MB of error-correcting, high-speed MOS memory.

New packaging design yields efficient use of space and quiet operation for office environments.

Full system start-up achieved in one step.

Advanced, gate array-based processor design.

Compact 5.25-inch Winchester disk drives for cost effective mass storage.

Industry standard 5.25 inch streaming cartridge tape drive.

Pipelined central processor organization allows concurrent processing of two instructions.

Hardware decimal arithmetic to enhance COBOL performance

16KB of high-speed bipolar cache memory to reduce memory access time.

Support for up to 16 terminals and up to 255 active processes.

Hardware-implemented instructions for quad precision floating-point operations.

Protection rings and embedded operating system to ensure memory security.

Automatic microverification and parity checking throughout system.

Diagnostic processor which permits loading of operational and diagnostic microcode.

Hardware and software compatibility with 50 Series™ systems.

Efficient, multifunction PRIMOS® operating system plus a wide range of available system and application software.
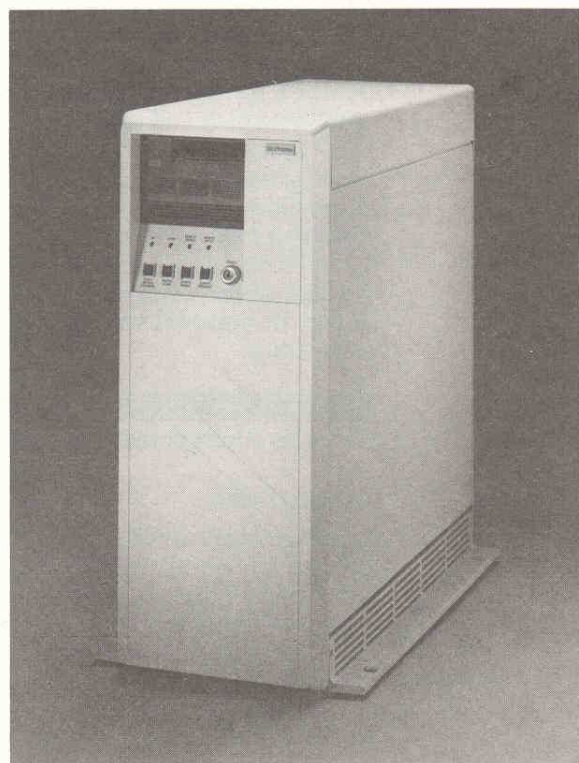
Description

The 2350 system is a high-performance, low cost, compact office system ideal for distributed processing network nodes or compact, multi-user system applications. The 2350 is hardware and software compatible with the entire line of 50 Series systems: users may protect their product investments as their needs grow by upgrading to newer or larger systems.

The 2350 system package includes a 32-bit central processor, 16KB cache memory, 2MB of memory and a diagnostic processor that also acts as a system console interface. The 2350 central processor features loadable control store, which gives the system access to a large library of microcode diagnostics. Moreover, microcode revisions may be loaded through the diagnostic processor into the loadable control store to improve system functionality.

The 2350 supports up to 16 user terminals in an interactive environment of up to 255 active processes. It uses the PRIMOS operating system which supports concurrent interactive and batch processing and is compatible across Prime's entire product line. Like all 50 Series systems, the 2350 may be networked to other Prime® systems using PRIMENET™ communications software and standard Prime controllers.

Designed to fit neatly into the office environment, the 2350 is packaged in a desk-height cabinet that is 29.0 inches (73.66cm) high, 11.3 inches (28.7cm) wide and 30.3 inches (76.96cm) deep. The 2350 cabinet includes a 9-board chassis with a power supply, two board central processor, diagnostic processor, a power distribution unit, and a cable connector bulkhead for easy reconfiguration of user terminals and communications lines.

Each 2350 system contains the CPU, 2MB or 4MB memory, either the nine-line Intelligent Communications Subsystem Model 1 (ICS1), or a 16 line Asynchronous Multi-line Controller (AMLC), the 2350 diagnostic processor, and the combined disk and tape controller; these use 7 of the 9 available slots. The remaining slots can be used for additional memory, communications controllers, and other peripheral controllers. Disk and tape devices reside in the same 29.0-inch (73.66cm) high cabinet as the 2350 system. An additional peripheral cabinet is available to house the optional streaming magnetic tape subsystem.

50 Series Architecture Features

Compatibility

Prime systems are designed for compatibility. Like all 50 Series systems, the 2350 runs under the PRIMOS operating system. This single operating system ensures total software portability across all Prime systems. User programs developed on one system will run on all other 50 Series systems without recompilation or modification. In addition, programmers use the same set of commands on all systems.

32-bit Architecture

The 2350 uses 32-bit architecture for internal operating efficiency and large program support. A system with full 32-bit word length processes more information during each machine cycle than 16-bit systems. As a result, this architecture yields a system which operates inherently faster than 16-bit systems. The 32-bit word length also allows users to specify a very large number of address locations. This permits program design without concern for address space restrictions.

The 2350 system architecture employs custom gate arrays to increase circuit density, providing the functionality and performance typically available in larger systems.

Virtual Memory Management

The mechanisms for virtual memory management are designed for system efficiency and total user transparency. Running under the PRIMOS operating system, the 2350 gives each user a virtual address space much larger than physical memory. Each user has 512MB of virtual address space, including 64MB reserved for private user program space. PRIMOS reserves the balance for shared libraries and operating system functions.

System functions such as I/O are embedded in the virtual address space of each process. This design increases system throughput by using ordinary procedure calls, eliminating the overhead of special system calls. A ring protection mechanism ensures operating system integrity.

Program Environment

Programs for the 2350 system operate in a multi-segment environment that includes a stack segment containing all local variables, a procedure segment containing executable code, and a linkage segment containing statistically allocated variables and linkages to common data. Highly efficient addressing modes provide rapid access to stack and linkage variables. Additionally, implementing the procedure call mechanism in firmware minimizes stack management overhead.

The 2350 stack management mechanisms optimize the efficiency of argument passing, subroutine and procedure calls, arithmetic expressions evaluation, and dynamic allocation of temporary storage. These mechanisms support re-entrant and recursive procedures.

High-density MOS Memory

Main memory of the 2350 system features high-density 256K metal oxide semiconductors (MOS) for speed and compact design. Expandable up to 8MB, the 2350 main memory supports wide-word interleaved operation to accelerate memory transfers. Error-checking and correction logic monitors memory integrity.

Process Exchange

All Prime processors use an advanced process exchange facility to accelerate performance in multi-user environments. This facility manages context switching, which occurs when the processor transfers control from one process or program to another. Prime implements context switching algorithms in firmware for maximum efficiency. These reside in the CPU's micro-programmed control unit.

Register Sets

The 2350 contains 11 register sets, with 32 registers each. Programs may address eight of the eleven register sets. One stores the execution state of the currently active process while the other seven store the state of the last seven previously active processes. If one of these processes is the next process to be activated, the system already has its state loaded and ready for execution. This parallel register set design greatly reduces process exchange overhead in multi-user environments.

The three remaining 32-bit register sets further enhance the processing efficiency of the system. Two sets support the operation of the micro-programmed control unit. The other set contains the 32 direct memory access (DMA) channels.

High-speed Address Buffer

The high-speed Segment Table Lookaside Buffer (STLB) stores frequently-used virtual-to-physical address translations. The STLB's large storage capacity ensures an STLB hit rate of greater than 99%, minimizing address translation overhead. Access to STLB is completely overlapped with access to cache for maximum speed.

Hardware Integrity Features

The 2350 provides hardware system integrity through comprehensive error detection and reporting mechanisms. Microverification routines, invoked automatically when the system is initialized, test the validity of the CPU and controllers. While the system is running, parity checking ensures data integrity throughout the processor's internal busses, registers and other data paths.

In addition, the 2350 system checks the parity of each microcode control word automatically. Main memory error detection and correction detects all double and single-bit errors and corrects single-bit errors. All detected errors are written to the system event log automatically to help Prime's Customer Service Representatives detect component problems quickly.

Protection Rings

A hierarchical multi-ring protection mechanism ensures the security of memory contents. Every program runs at an access privilege level that is hardware enforced. Protection rings prevent processes from accessing unauthorized memory locations.

2350 Special Performance Features

Instruction Pipeline Unit

The Instruction Pipeline Unit (IPU) comprises a two-stage pipeline which operates in parallel with the 2350 system's Instruction Execution Unit (IEU). This design feature improves the throughput of the 2350 system by prefetching and decoding the next anticipated instruction. Providing the 2350 central processor with partially decoded instructions reduces the overhead associated with instruction execution, allowing instructions to be executed more quickly.

An instruction buffer forms the first stage of the pipeline. Prefetch logic included in the pipeline design transfers instructions to the buffer from cache. The buffer stores up to four instruction words on a first-in, first-out basis. Concurrently, the second state of the pipeline translates operation codes and partially deciphers effective operand addresses.

The 2350 system's two-stage, parallel pipeline reduces the amount of work required of the IEU. As a result, the IEU can execute more instructions per second, significantly improving system performance.

Cache Memory

Cache memory stores frequently used instructions and data in fast buffer memory within the central processor, greatly reducing the 2350 system's effective memory access time. The high-speed components and efficient circuit design provide a cache access time of only 80 nanoseconds. With a 16KB capacity and a 95% hit rate, cache memory gives the 2350 an effective main memory access time of only 180 nanoseconds. In addition, an efficient "write through" algorithm eliminates bus delays during main memory writes by letting information be written through cache.

Instruction Set

All 50 Series systems, including the 2350, use a common instruction set. User application programs written for any other 50 Series system will run on the 2350 without alteration.

More than 550 instructions enhance operating system communication, data handling, and process coordination. Highly flexible address formation techniques let all instructions use any one of four user-accessible base registers and 32-bit indirect words in any combination. This allows all memory reference instructions access to the entire virtual address space.

The 2350 instruction set features machine instructions optimized for decimal and character string operations which increase execution speed in commercial high-level language environments. In addition, the 2350 includes microcode assists for frequently used Prime INFORMATION™ data management software instructions.

The 2350 instruction set takes advantage of the 52-bit data paths and 32-bit internal architecture. Seven of the eight 32-bit general purpose registers can be used as index registers. These can also be used for compiler optimization or as fixed-point and logical accumulators.

Operator Interface

Prime designed the 2350 for ease of use. A hard-copy or video terminal may act as the system console as well as a user terminal. The control panel has a system power switch, a halt indicator, and a keylock which ensures authorized use of the system's control panel.

Technical and non-technical users can bring up the 2350 simply by depressing the control panel system power switch. During normal operations, the 2350 does not require any other user action. Once the switch is depressed, power is provided to the electronics and the peripherals contained in the one cabinet.

When the power stabilizes, the diagnostic processor runs a micro-verification routine and reports the results on the system console. Once the diagnostic processor verifies that the CPU and memory operate properly, it loads the appropriate operating system boot routines into main memory. These, in turn, fetch and configure the PRIMOS operating system. After PRIMOS is loaded, the integral battery-powered clock provides the date and time of day before the system becomes available to the user.

Software

The PRIMOS operating system supports both interactive and batch processing on all 50 Series systems. The operating system supports re-entrant shared procedures, letting many users share a single copy of a software module.

Prime offers a comprehensive family of data management products. Central to these are MIDASPLUS™ and PRISAM™ (recoverable) software, indexed sequential access managers and the CODASYL-compliant Prime DBMS. Complementing these data managers are: FORMS for screen management; PRIME/POWER + for querying and reporting on MIDASPLUS and PRIMOS files; and DISCOVER™ software for querying and reporting on PRISAM and Prime DBMS files.

Other Prime software offerings include: the PRIMEWAY™ development and transaction management system; Prime INFORMATION software, a fourth-generation, relational-based data management system; and the Prime Office Automation System (Prime OAS).

For CAD/CAM applications, Prime offers PRIME MEDUSA™ software, a design, drafting and documentation product; the Product Design Graphics System™ (PDGS™); GNC,™ (Graphical Numerical Control); and, the SAMMIE™ ergonomic design software package. In addition, a large library of application packages is available from the Prime Users Library Service (PULSE) and from Joint Marketing Agreement (JMA) that Prime has with third-party software houses.

System Diagnostics

The 2350 includes a sophisticated diagnostic processor that assists at system start-up and runs both local and remote diagnostics. The advanced microdiagnostic processor loads a full 8K words of microdiagnostics at system start-up, before any user code is executed. This provides fast, effective trouble-shooting for identifying hardware problems and for performing comprehensive system software diagnostics. By depressing the "Remote Enable" button on the front panel, the local system operator or administrator initiates remote access. A second button puts the remote terminal in control mode. Once the terminal is in control mode, the system can be run completely from a remote location.

Two control panel indicators display the state of the remote communications link. One indicates that a remote user has been allowed to dial into the system and monitor operation. The second indicates whether or not a remote access is in progress.

Networking

The 2350 is ideal for networking and distributed processing environments. PRIMENET networking software lets Prime Computers communicate among themselves, with terminals, and with other manufacturers' systems. Using PRIMENET facilities, users can remotely log into other systems, share files, and develop distributed applications. For local area networks, the 2350 can be attached in a high-speed RINGNET™ network with any other 50 Series systems. The ring provides inter-systems communication via a coaxial cable or fiber optics for Prime systems using PRIMENET software and a PRIMENET node controller.

The 2350 supports a variety of Prime communications hardware controllers. Available hardware options include IBM BISYNC for HASP and 2780/3780; High-Level Data Link Control (HDLC) protocol for X.25 packet-switching networks; Control Data 200UT; Univac 1004; Honeywell GRTS and ICL 7020 and XBM.

Prime's Distributed Processing Terminal Executive (DPTX) lets the 2350 emulate and support IBM 3271/3277 Display Systems.

Peripherals

Several peripheral products designed for the office environment are available in the 2350 cabinet (two devices per cabinet). Sealed 60MB or 120MB 5.25-inch Winchester disks provide users a highly reliable file and software storage medium. Up to two disks are available on each 2350 system.

Users may archive disk-stored data with an industry-standard ¼ inch cartridge tape drive. A streaming magnetic tape subsystem is available as an option on 2350 systems. PRIMOS utilities are supported to allow users to dump data – physically or logically – from disk to tape and back.

The 2350 supports the nine-line Intelligent Communications Subsystem Model 1 (ICS1) which provides eight asynchronous lines and one synchronous line or the Asynchronous Multi-Line Controller (AMLC), which provides up to 16 asynchronous lines.

A variety of printing devices – band printers, matrix printers, letter-quality printers and matrix plotters – are supported by the 2350. Video and hardcopy terminals are also available.

Terminals

Prime office workstations and terminals provide both a communications and information processing link to the entire 50 Series family.

The PERFORMER™ (PT200™) terminal is a versatile, asynchronous terminal with both character- and block-mode capabilities. With PRIME/SNA™ software, the PT200 can emulate the IBM 3270 terminal in networks using IBM's System Network Architecture. A color monitor and an optional graphics board that supports the Tektronix 4010/4014 interface are available.

The PERFORMER workstation offers full function word processing and features local mass storage and a 16-bit microprocessor. Options are available for spreadsheet analysis and color graphics.

Regulations and Power

The 2350 has been certified to meet U.S. Safety and Noise Emission Regulations – U.L. and FCC EMI – as well as Canadian safety regulations. The system can be configured for North American and European AC power sources. An optional power conditioning module is available for 2350 systems. This unit is useful in areas where commercially supplied power suffers from frequent transient disturbances. Support for an uninterruptible power supply (UPS) has been designed into the 2350.

Specifications

System

Main memory:	Up to 8 MB
Cache memory:	16KB
Effective memory access time:	180 nanoseconds
Virtual address space:	512MB
Terminals supported:	Up to 16
Disk storage:	Up to 240MB
Tape storage:	One quarter inch cartridge tape unit as well as one optional half-inch streaming tape drive

Physical Dimensions:
Height: 29.0" (73.66cm)
Width: 11.3" (28.70cm)
Depth: 30.3" (76.96cm)

Power

Electrical requirements:	104-127 VAC, 59-61 Hz, 8.2 amps operating 208-254 VAC, 49-51 Hz, 4.1 amps operating
Electrical consumption:	1.0 KVA

Environment

Noise level:	Less than 55 dBA
Operating temperature:	10-35 degrees C (50-95 degrees F)
Operating humidity:	10-90% (non-condensing)
Operating altitude:	0-8000 ft (0-2.4Km)
Heat dissipation:	2300 BTU/hour

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