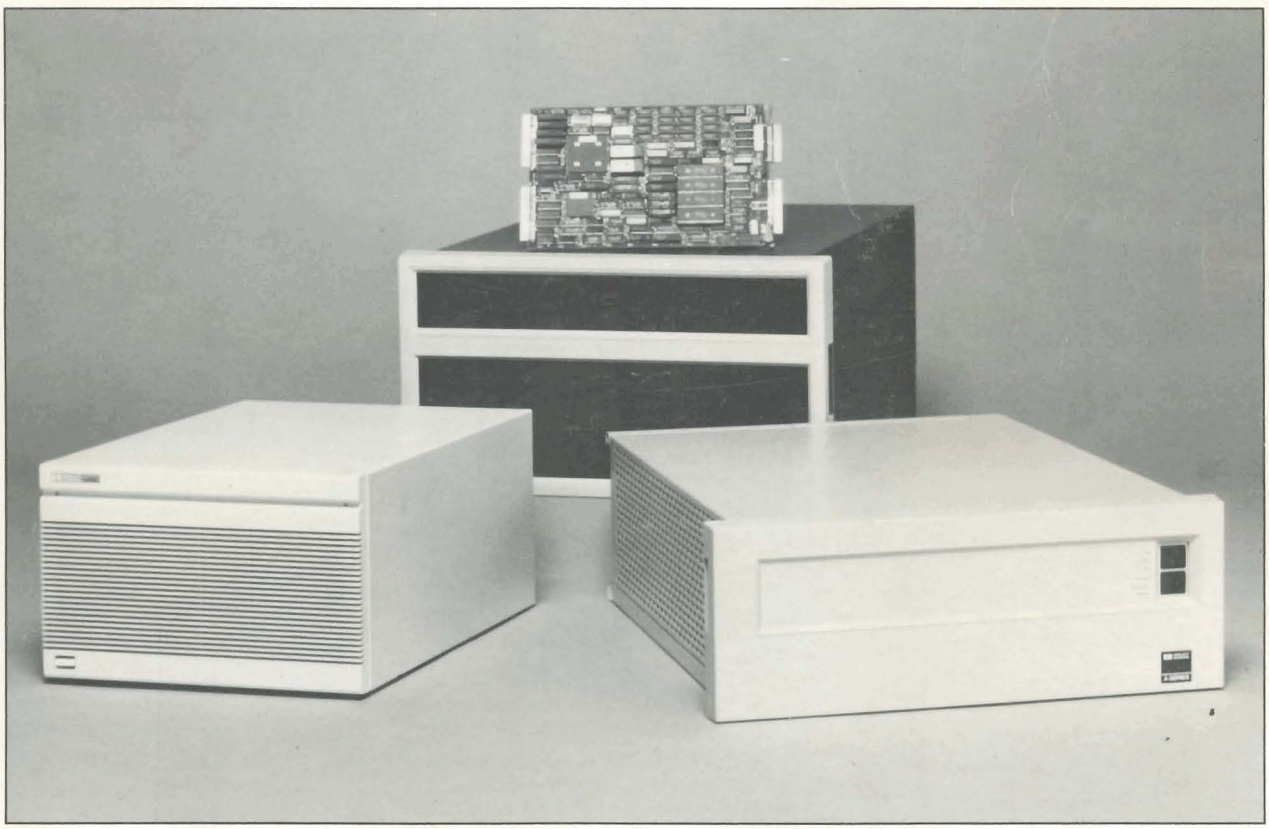
HEWLETT PACKARD

HP 1000 A-Series

Computer Handbook

5th Edition



What's Changed in This Handbook

Introduction

This Fifth Edition of the A-Series Computer handbook has been updated to reflect all of the latest changes in the HP 1000 A-Series product line.

NOTE: Because all interface, networking, and peripheral data sheets have been deleted, you should seriously consider keeping your Fourth Edition A-Series Computer Handbook for reference to data sheet information that is no longer provided in this Fifth Edition.

We've Added . . .

A Networking overview section, pages 5-1 and 5-2.

We've Deleted . . .

A700 Computers, SPUs and related products.

All interface data sheets in Section 4*.

All networking data sheets in Section 5*.

All terminal, modem, and bar code reader data sheets in Section 7†.

All graphics device data sheets in Section 8†.

All printer data sheets in Section 9†.

All disk, magnetic tape unit, and cartridge tape subsystem data sheets in Section 10†.

* Interface and networking data sheet information formerly available in Sections 4 and 5 can now be found in the HP AdvanceNet Specification Guide, 5956-4144, or a later revision, which is available from Hewlett-Packard Field Sales Offices.

† Individual terminal, graphics device, printer, disk, magnetic tape unit, and cartridge tape subsystem data sheets are published by the supplying divisions and are available from Hewlett-Packard Field Sales Offices.

The Product Number Index is on the rear of the Contents Index page that faces this page.

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Quick Reference Index

Product Number Index

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HP 1000 A-Series Real-time Computers, Product Overview

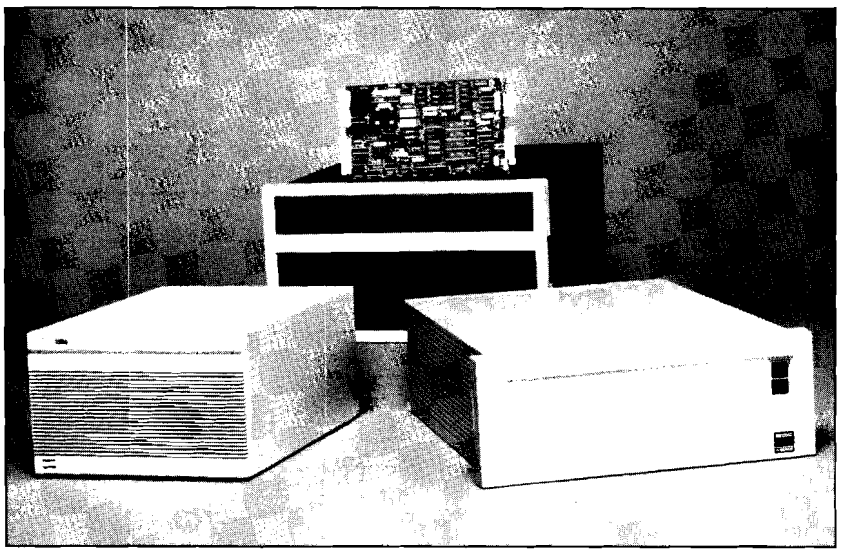
Versatile Design for a Wide Variety of Applications

HP 1000 A-Series computers are open, modular machines that are designed for real-time multiprogramming, multi-user applications in research, communications, manufacturing, and other fields that require real-time response. A choice of three processors and a wide variety of interfaces and software equips HP 1000 A-Series computers to effectively solve many different real-time application problems. Typical uses, many of which are developed and marketed by OEMs and other value-added businesses, include:

- Monitoring of power distribution or telecommunications networks.
- Control of orbiting satellites.
- Monitoring and control of temperature, lighting, and power consumption in buildings.
- Automatic testing.
- Textile layout and cutting.
- Cartography.
- Lab automation.
- Project management.
- Machine and process control.
- Supervisory control of programmable controllers.

Hardware Engineered for Real-Time Use

HP 1000 A-Series computers achieve true real-time responsiveness with:



Fast, Efficient Handling of I/O. External sensors, measuring instruments, and other I/O devices connect to HP 1000 systems via I/O interfaces and an I/O system with multi-level, vectored hardware interrupt that expedites I/O. Each HP 1000 I/O channel has its own interrupt priority level. Interrupts directly initiate the appropriate service programs with no time wasted in polling I/O channels. Extremely fast interrupt response times are sustained even under heavy system loading. Direct memory access speeds data transfers to/from memory with minimal involvement of the CPU.

Fast Processing of Data. HP 1000 Systems can process data at base instruction rates to 1.3 MIPS and floating point processing speeds to 821 KWIPS-B1D. This shortens the time needed to process input data, evaluate results, and initiate real-time action.

Clocked Operations Timing. A time base generator provides precisely-timed interrupts for maintaining a real-time clock.

Large Main Memory Capacity. Up to 32 megabytes of main memory can be provided to keep most critical programs resident and ready to execute quickly, avoiding the delays inherent in moving programs to and from disc.

Real-Time Operating Software

Multiprogramming simplifies subdivision of the myriad tasks involved in real-time applications into multiple programs. With the multiprogramming supported under the RTE-A operating system for HP 1000 computer systems, the tasks used to collect data from the external environment, process that data, evaluate it, and generate appropriate control outputs, operator messages, reports, or other displays can be programmed individually, then configured into the RTE-A system for coordinated execution.

Inter-Process Communication. Processes executing under RTE-A can exchange data quickly and flexibly via class (mailbox) I/O, RTE-A extended memory areas for data, and/or virtual memory for data.

Price/performance values: the HP 1000 A-Series gives more for the money.

		A400	A600+	A900
Base set instruction speed		0.4 MIPS	0.4 MIPS	1.3 MIPS
Relative price† for box computer		1.92	2.5	8.5
Relative price† for board computer		1.0	1.95	Not Available
Floating Point (B1D Whetstones)		122 kwips	113 kwips	821 kwips
Cache Memory		No	No	4 KB Standard
Error-Correcting (ECC) Memory		No	Optional	Standard
Memory Capacity		0.5 to 32 MB	0.5 to 32 MB	0.75 to 32 MB
Pipeline Architecture		No	No	Yes
I/O Bandwidth		4.3 MB/sec	4.3 MB/sec	3.7 MB/sec
DMA per channel		Yes	Yes	Yes
User Microprogrammable		No	No	Yes
Scientific Instruction Set		No	No	Standard
Vector Instruction Set		No	No	Standard
Integrated 19.4 MB Winchester and 630 KB microfloppy disks		Optional	Optional	Optional
Available as:	System	No	Yes	Yes
	Micro System*	Yes	Yes	Yes
	Box Computer	Yes	Yes	Yes
	Board Computer	Yes	Yes	No

† Relative list price with minimum memory; A400 Board Computer price is defined as equal to 1.

* Can be mounted on a stand with wheels, racked in a 19-inch EIA cabinet, or placed on a benchtop.

Event Interrupt Scheduling is the core of RTE-A's real-time capability. Event interrupts from external devices are connected via I/O interfaces and pro- cessed by central interrupt control (CIC) programs. CIC initiates the execution of appropriate application programs and the standard RTE driver routines that control the exchange of data between main memory and external devices.

Time Scheduling uses a real-time clock maintained by RTE-A and time "ticks" from the computer's time base generator. Programs to be run at specific times or intervals are entered into a "time" list that RTE-A checks after each clock tick. The real-time clock also supports I/O timeout and time-slicing allocation of execution time among "background" programs.

Program-to-Program Scheduling is supported via an operating system call that enables one program to initiate execution of another.

User Scheduling. A program can be scheduled by a user command from a terminal.

Priority Control grants execution preference to programs in the order of the relative importance assigned to them, with a choice of 32767 priority levels.

Multi-User Program Development. RTE-A supports multiple users with log-on access control and protected user environments. Individual copies of the editor, compilers or assembler, program linker, and symbolic debugger can be used for program development by different users at the same time.

Program and Data Space Management. RTE-A and the dynamic mapping system support multiple program partitions in up to 32 MB of main memory. Many different programs can be kept resident in main memory, ready to execute, avoiding disk-access delays, and making possible completely memory-based operation.

RTE-A also supports Extended Memory Areas for main memory resident data up to 1.998 MB. Larger memory requirements for data are accommodated by the Virtual Memory Area, up to 128 MB in main memory and on disk.

Large Program Support. The Virtual Code+ (VC+) extension to RTE-A subdivides large programs into code segments. During execution, VC+ loads the segments into main memory as they are needed, transparently and automatically. VC+ can be used to give the user up to 7.75 MB of code space, provided that no subroutine in the program is longer than 62 kB.

Software Operating System

RTE-A Capabilities

- Disk or memory based
- Typical sysgen time = 15 minutes
- Hierarchical file system
- Power fail with autorestart
- Priority-based scheduling with time-slicing

VC+ Capabilities

- Application security
- File protection
- Multi-user, multiprogramming
- Logon/Logoff
- Sharable code
- Outspooling
- Up to 128 MB of Virtual (VMA) data
- Up to 7.75 MB of virtual code

Additional Software-Supported Capabilities

- Graphics, including 2-D, 3-D, and interactive graphics capabilities, with device independence supported by a library of device handlers.
- Data Base Management with on-line Query capability for interactive access and printout of reports. One of the two systems available provides extensive data base recovery capabilities for protection from data loss.
- Data pairing for protection of data through configuration of disc volumes in mirrored pairs on separate disc drives, connected via separate interfaces.
- LAN Communication with other HP 1000, HP 3000, and HP 9000 systems.
- Point-to-Point Communication with other HP 1000 and HP 3000 systems.
- Remote Job Entry Communication with IBM or plug-compatible systems.
- X.25 communication with other HP 1000 systems, HP 3000 systems, and other computer systems.
- Coordination of Programmable Controllers on the factory floor.
- Quality Data Management.

A Choice of Three Capability Levels

To cost-effectively match the widely-varying needs of real-time applications, HP 1000 computers are offered at three different levels of capability, all completely compatible with each other, as listed in the facing table.

Integration Levels

HP 1000 Systems are available at three levels of integration, as shown in Figure 1-1, next page, and described below.

System Processor Units (SPUs) include a box computer, an interface to the system disc, the operating system with VC+ and diagnostics, the box computer, site prep consultation and installation/checkout services, and 90-day on-site warranty. The high level of integration of the SPU simplifies design, ordering, and implementation of systems that use a system console and a system disc, both of which are ordered separately. The SPU also complies with FCC and VDE EMI regulations, which gives OEMs a head start on EMI compliance of their HP 1000 processor-based systems.

Box Computers incorporate the CPU card(s) in a fully-powered card cage that can be installed in a rack cabinet. Because a system console and system disc are not prerequisites to purchase, the HP 1000 box computer offers OEMs and system designers more configuration flexibility than the SPU.

For example, the box computer can be configured to function as a remote distributed systems node without a system console for local operator communication. The operating system, diagnostics, memory and interface cards and peripheral devices required to complete a usable system are ordered separately.

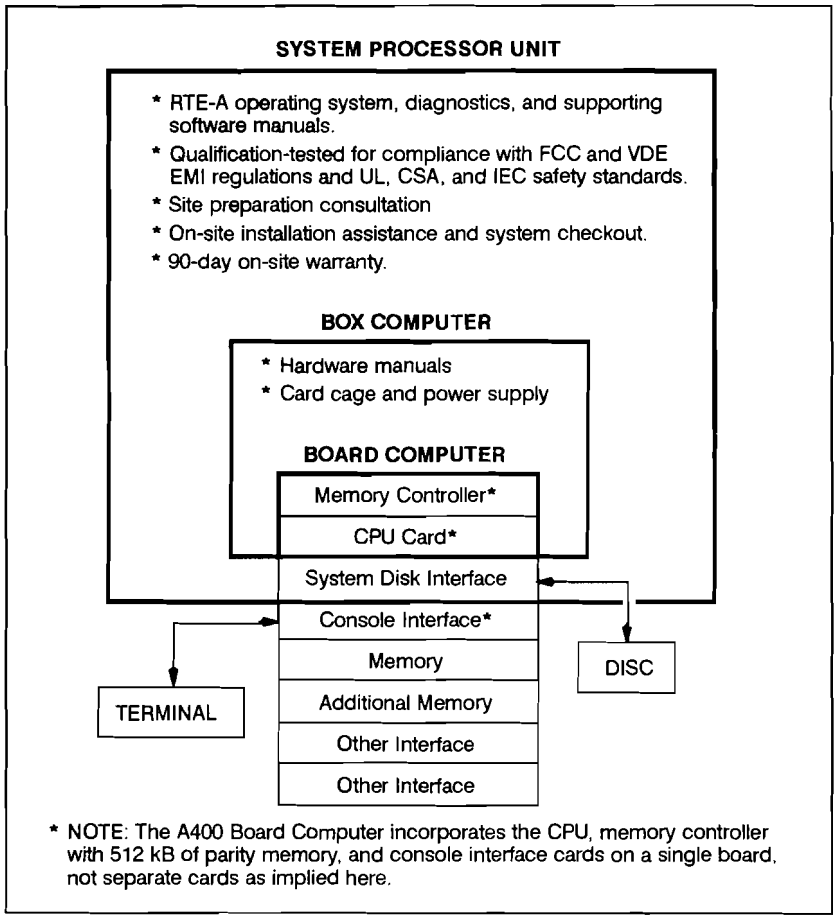
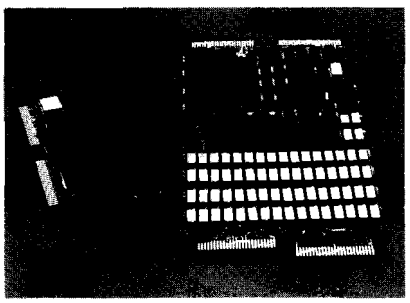


Figure 1-1. HP 1000 A-Series Integration Levels

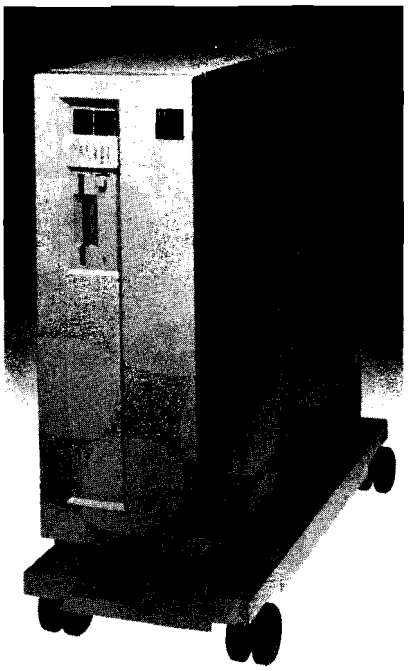


Board Computers are offered principally to OEMs for embedded controller applications. Their system designs often require custom integration to fit into a particular physical package and/or to meet cost requirements. The A400 processor and the A600+ processor are available at the board computer level of integration.

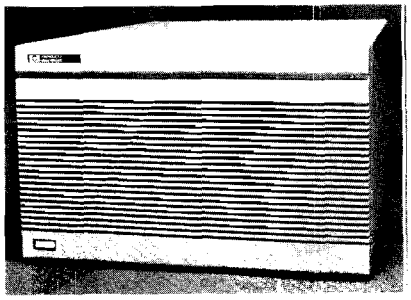
Package Choices

Three basic package choices are offered to enable users to satisfy their needs for memory and I/O capacity economically. They are:

The 20-Slot Box (above) is available as a box computer or as an SPU. This package offers the greatest capacity for memory and I/O cards.



The Micro/1000 Package (above) has 14 card cage slots and is a good choice for medium sized systems because of its compactness and versatility. It can be used atop a table, desk, or workbench, installed in a rack mounting cabinet, or placed in a vertical floor mount that combines convenient under-desk or deskside placement with rollabout mobility on its own casters. The Micro/1000 package is available at both the SPU and box computer levels of integration, and complies with EMI regulations at both levels.



The Micro 14/16 "Cooler" Package (above), with six card cage slots, offers lowest cost packaging for low-end systems based on A400 or A600+ computers. Exceptionally efficient cooling equips computers in this package to operate at ambient temperatures to 60°C. This and its 1.5G operating shock spec make it ideal for use under tough environmental conditions. This package differs from the other two in that it does not support I/O interfaces that require 25 kHz ac supply, or battery backup of memory.

I/O Extenders based on the 20-Slot package and the Micro/1000 package can be used to add 18 or 12 I/O channels to the I/O capacity of HP 1000 A600+ or A900 computers (but not A400 computers) in the 20-Slot or Micro/1000 package.

Compatibility Across all A-Series Processors

From the A400 through the A900, all A-Series computers operate under the same RTE-A real-time executive system. And they all use exactly the same I/O interfaces. Applications developed on the powerful A900 system can be transported to, and executed on, any of the other A-Series computers without change.

Upward Compatibility with HP 9000 Series 800 Systems

PORT/HP-RX applications migration tools available for HP 9000 Series 800 systems promote compatibility of HP 1000 A-Series systems with the Hewlett- Packard's HP-UX based HP 9000 Series 800 superminicomputer systems.

Applications developed for HP 1000 A-Series computers are thus made transportable with relatively little effort to HP 9000 Series 800 systems, which can support up to twenty times as many users, when a need for more power or capacity develops. An RMTERM/840 Terminal Emulator is available for use in downloading complete RTE-A operating systems from HP 9000 Series 800 systems via an RS-232C serial link.

Industry-Standard Connection to Other Systems

HP's commitment to industry standards is implemented in A-Series connectivity options that include:

- HP-IB, our implementation of the IEEE 488 standard for communication.
- X.25 packet switching network packages.
- Programmable Controller Interfaces (PCIFs).
- IEEE 802.3 LAN and related high-level packages.
- Three ways to link A-Series computers with IBM mainframes, so they can exchange data.

Software Tools:

Programmer Productivity Tools

- Interactive screen editor
- Symbolic debugger
- Delta backup utilities
- FORTRAN, Pascal, BASIC
- Macroassembler package
- Program activity profiler
- Microprogramming package

Run-time Tool Packages

- Interactive forms human interface
- Graphics interface library
- Database management package
- Programmable controller interface

Networking Packages

- LAN - ARPA Services/1000
- LAN - Network Services/1000
- Distributed systems
- X.25 communications
- RJE/MRJE

A-Series Computer Peripherals

Integrated 19.4 MB Winchester and 630 KB microfloppy disks for Micro/1000 package

Terminals:	character/block mode, alpha/graphics, color, touch
Fixed disks:	20 - 571 MB
Printers:	dot-matrix, monochrome and color inkjet, and laser
Graphics devices:	plotters, tablets, color graphics displays, and printers
Bar code:	readers and printers
Mag tape:	6250, 1600, and 800 cpi recording densities
Cartridge tape:	autochanger or single cartridge

Hand-held and portable computers

A-Series I/O Interfaces

Communications

- Single-channel serial
- Programmable serial (PSI)
- 8-channel serial multiplexer
- Expanded multiplexer
- Color video monitor RGB
- Networking 802.3 LAN

Measurement and Control

- HP-IB (IEEE-488)
- Sixteen bit parallel
- 8-channel A/D, expandable to 40 channels
- 4-channel DAC
- Digital I/O
- Breadboard interface
- PROM storage module

Open System Tools for Customization

The application versatility of HP 1000 A-Series computers depends considerably upon the open system tools that are available for customization. This begins with a complete set of program development tools (editors, compilers, Macro assembler, and debugger). The RTE-A system is modularly configurable to support open I/O on all A-Series computers, with a wide variety of interfaces and peripherals. And open I/O extends to support of customer-written I/O drivers, including a customer training course in RTE I/O driver writing.

A program profiler is available for isolating the most time-consuming parts of programs as the first step in tuning them for faster, more efficient execution. Other open-system tools include a breadboard interface, a user-programmable communications interface, Engineering Reference Documentation, RTE-A operating system source code, and a logic analyzer interface for detailed analysis of system functions.

Beyond these tools, HP also offers customization training classes and two additional levels of customer engineering support:

- A worldwide team of knowledgeable Application Engineers, who work with OEMs and system designers on custom solutions, and
- A Custom Engineering Department, which provides custom products for unique needs.

Pace-Setting Reliability

Because HP knows reliability is critical in real-time applications, we've paid a great deal of attention to it. And it shows up as monthly maintenance fees for A-Series products that are half the rate of our closest competitors because A-Series failure rates are LOW. A-Series computers run for YEARS between failures.

Unexcelled Service and Support

In surveys by Datapro Corporation over the past six years, Hewlett-Packard has been rated #1 in service and support categories, and #1 in overall customer satisfaction more consistently than any other vendor. Our worldwide local support teams are comprised of experienced HP hardware and software engineers. One telephone call can produce assistance, whenever and wherever it is needed – from 300 locations in 72 countries.

Sample Custom Products:

High Speed Buffered Parallel Interface

- I/O rates to 3 MB/sec
- 600 KB/sec continuous transfer rate

Watchdog Timer and Clock

- Failsafe alarm for detecting CPU failures
- Battery-sustained time-of-day clock

Dual-Port, Dual-CPU Disk Driver

- Both CPUs can access multiple disk drives
- Building block for redundant systems

Sync/Async 8-Channel Multiplexer

- Programmable SBC, EPROM, and RAM
- Full-duplex modem control on all channels

Hewlett-Packard is committed to support A-Series real-time computers through the year 2010, assuring continuity of HP service and support for a long time to come. During that time, HP's lower maintenance rates will significantly reduce total cost of ownership of HP 1000 A-Series computers.

Training Programs

HP-sponsored classes, conferences, and user groups provide ongoing information flow and training for HP 1000 A-Series computer users. HP can provide in-depth factory training on driver writing, I/O design, and on operating system internals, and service training classes.

Engineering Assistance

HP offers complete project management, planning, and implementation services from more than 35 regional Project Centers worldwide. HP project teams can work on integration of all the products, services, training, and vendors needed to achieve a successful solution. Additional custom services are available from HP factory engineering groups and value-added solution suppliers.

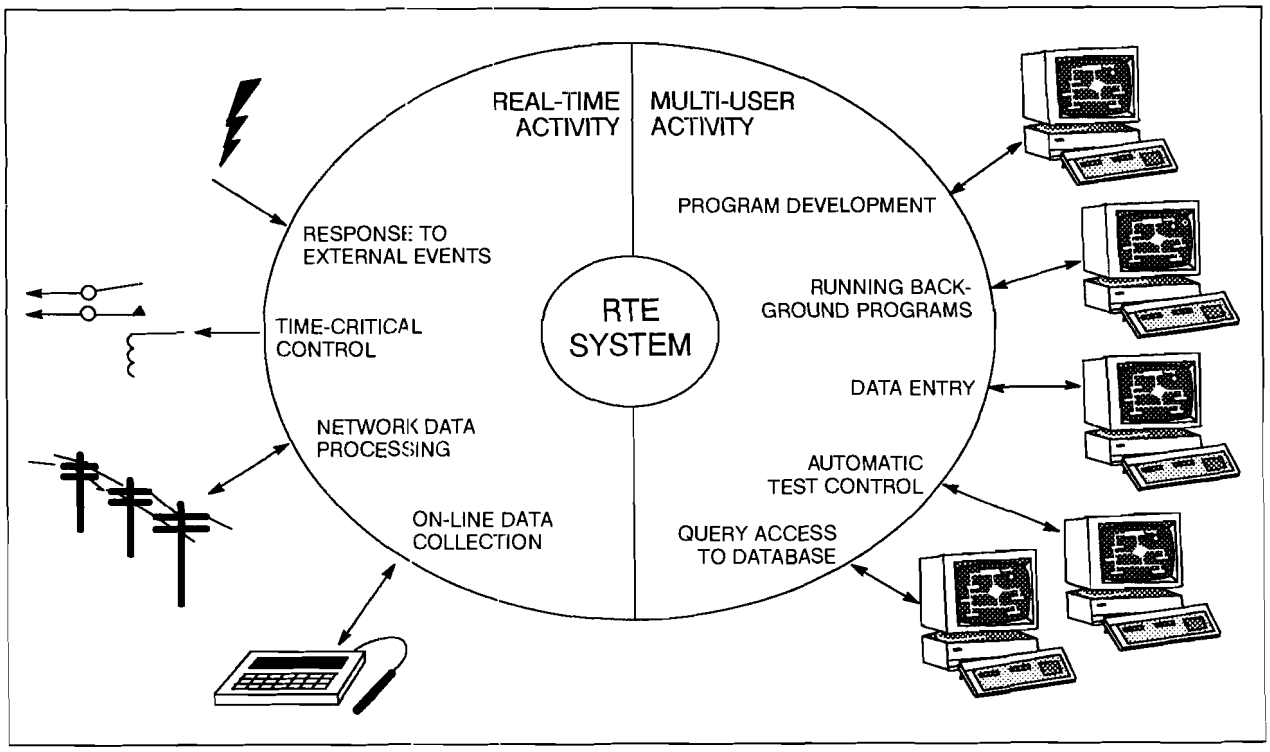
HP Programs for OEMs and Other Value-Added Businesses.

HP recognizes that no single vendor can offer complete solutions for all applications. Therefore, we are committed to building strong, ongoing relationships with original equipment manufacturers (OEMs), system designers, and other value-added solutions suppliers. HP offers a variety of programs and services to help make value-added businesses successful and profitable. One example is HP's commitment to provide open I/O on all real-time computers.

HP provides demo/development systems at a substantial discount. Volume discounts are based on units or dollars. OEMs can maximize their discount by leveraging system, component, and peripheral purchases. OEM discounts apply to HP system upgrades as well as new purchases. Trade credits are given to OEMs for system upgrades even if their customers buy an upgrade directly from Hewlett-Packard.

NOTES:

Real-Time Executive (RTE) Operating Systems



Features

- True multiprogramming with concurrent program execution.
- Time, event, program-to-program, and user scheduling of program execution.
- Time slicing within each priority level.
- File management capabilities for creation, maintenance and manipulation of files by users or programs.
- Interactive debug and screen Editor to aid program development.
- Reliability features such as powerfail/auto restart and device I/O timeout.
- On-line system generation.
- RTE drivers and device subroutines for supported peripherals, including Hewlett- Packard Interface Bus (HP-IB)* for multiple instrument support.
- Support of powerful software, including Graphics/1000-II, Image/1000, ARPA/1000, NS/1000, and DS/1000-IV.
- Multi-lingual programming in assembly language and, optionally, FORTRAN, Pascal, and BASIC.
- Non-swappable memory-resident programs for fastest response to interrupts.

* The Hewlett-Packard Interface Bus (HP-IB) implements IEEE Standard 488-1978, "Digital Interface for programmable instrumentation", identical ANSI Standard MC1.1, and IEC recommendation 625-1. (The IEC recommendation specifies use of a different connector.)

Introduction

Real-Time Executive (RTE) is a disk or memory based software system used for management of operations and resources of HP 1000 computer systems. RTE systems provide true multiprogramming capability for monitoring and controlling concurrent events in real time. The configuration flexibility of RTE systems makes it easy to accommodate a wide variety of application requirements.

Today's RTE family, an outgrowth of the first RTE system introduced in 1969, consists of two different, but closely related systems. The differences of these systems depend on the computer series supported, as summarized in Table 2-1, next page. However, program requests and operator commands are functionally compatible between the RTE systems and only a few program calls differ between systems, which simplifies use of multiple HP 1000 computers of different series.

The RTE Operating System Family

RTE-A supports HP 1000 A-Series computers, which have a distributed intelligence I/O architecture. RTE- 6/VM supports the HP 1000 E/F-Series computers, which have a centralized intelligence I/O architecture. Each operating system is briefly discussed below within these categories. For comparison, see Table 2-1.

The RTE-A System for Distributed Intelligence I/O

RTE-A is HP's real-time executive operating system for HP 1000 A-Series distributed intelligence I/O architecture computers. It is configurable for either disc-based or memory-based operation and can manage up to 32 megabytes of memory. It supports Extended Memory Areas for data, the 92078A VC+ extension package for code and data separation (supporting programs up to 7.75 megabytes), and up to 128 megabytes of Virtual Memory for data. Automatic program cloning and standardized LUs are supported in the RTE-A/VC+ environment for the convenience of multiple users.

The RTE-6/VM System for Centralized Intelligence I/O

RTE-6/VM is HP's real-time executive operating system for HP 1000 E/F-Series (discontinued) computers. It manages up to 2M bytes of memory, and combines Extended Memory and Virtual Memory-for-data capabilities with a friendly session-monitor environment for multi-user access to the system.

Table 2-1. RTE Specifications Summary

OPERATING SYSTEMS		92077A RTE-A	92084A RTE-6/VM
HP 1000 SERIES SUPPORTED		A-Series	E/F-Series
STANDARD IN HP 1000 MODELS		26, & 29, & Micro 24, 26, & 29	60
MEMORY	Minimum Required Maximum Supported	512 KB 32 MB	512 KB 2 MB
PROGRAM CAPACITY AVAILABLE TO USER	Maximum Overlay Code Max. Length of Res. Pgm Maximum Path Length No. of Prog. Partitions	7.75 MB w/92078A* 64 KB 7.75 MB w/92078A 62 KB without 92078A 255 max. fixed part.	Not applicable 1.8 MB† Not applicable 64 KB 64
VIRTUAL MEMORY FOR DATA (VMA)	Max. Prog-Accessible VMA Space Max. Working Set Size	128 MB 2 MB	128 MB 1.8 MB†
EXTENDED MEMORY AREAS (EMAs)	Maximum EMA Space No. of Sharable EMAs No. of Prog Sharing EMA	1.99 MB per program 15 per system 63	1.8 MB† 8 to 60 per system 256
OTHER SYSTEM CAPACITY SPECS	No. of Logical Units No. of I/O Select Codes that can use DMA simultaneously System Available Memory	254 if not limited by table-space 24 64 KB, maximum	255 2 §
REAL-TIME PROGRAM SCHED.	By Time By Event By Another Program By a User Number of Priority Levels	Yes Yes Yes Yes 32767	Yes Yes Yes Yes 32767
MULTI-USER SUPPORT	Log-on Access Control Session Accounting User Capability Control Protected User Env. By Multi-Terminal Mon. By Time-Slicing Among Users	w/92078A w/92078A w/92078A w/92078A Yes Yes	Yes Yes Yes Yes Yes Yes
PROGRAM DEVELOP-MENT SUPPORT	File Manager Command Interpreter Input Spooling Output Spooling Batch Processing Interactive Screen Editor Symbolic Debug/1000 Link/1000 Linkage Editor Absolute Program Loader	Included Included No w/92078A‡ No Yes w/92860A Included No	Included Included Yes Yes Yes Yes w/92860A Included Included

* RTE-A without 92078A VC+ supports segmentation of large programs by the user.

† Space available for programs and data in RTE-6/VM is equal to total memory less that used by the system; memory available for EMA is equal to total memory less that used by the system, resident llibraries, programs, and software subsystems.

§ System available memory in RTE-6/VM depends upon the memory available after provision for drivers, ID Segment Tables, EQT tables, etc.

‡ Output spooling in RTE-A without 92078A VC+ is to printer only, not to any other device.

Table 2-1. RTE Specifications Summary, continued

OPERATING SYSTEMS		92077A RTE-A	92084A RTE-6/VM
PERFOR-MANCE ENHANCE-MENT	Program Activity Profiling	w/92083A	w/92083A
	Microprogram Dev.	w/92049A (for A900)	w/92061A
PROGRAM LAN-GUAGES	BASIC Compiler & Interp.	w/92857A	w/92857A
	FORTRAN 77 Compiler	w/92836A	w/92836A
	Pascal Compiler	w/92833A	w/92833A
	Macro Assembler	Included	Included
GRAPHICS SUPPORT	Device-Independent Libr.	w/92861A	w/92861A
	Interactive & 3-D	w/92862A & 92861A	w/92862A & 92861A
DATA MANAGE-MENT	DataPair/1000 Disk Mirroring	w/92050A	Not supported
	IMAGE/1000 DBMS	w/92069A	w/92069A
	IMAGE/1000-II DBMS	w/92081A	w/92081A
MFG APPL SOFTWARE	Progr. Controller Link	w/94200B & one of 94202A - 94207A	Not supported
	Quality Decision Mgt.	w/92131A	Not supported
INTER-SYSTEM COMM.	ARPA Services/1000	w/98170A	Not supported
	Network Services/1000	w/91790A	Not supported
	DS/1000-IV	w/91750A	w/91750A
	DSN/X.25 Comm.	w/91751A	w/91751A
	RJE to IBM 360/370	w/91781A or 91782A	w/91781A or 91782A
	Prog-Prog Comm to IBM	w/91784A	w/91784A

RTE Description

Real Time Multiprogramming

RTE operating systems supervise the execution of multiple programs, which can be used to perform several different functions concurrently. For example, under RTE control, a program can send data to and receive data from peripheral equipment, another program can display information to a user, and a third program can be used for program development. All of these programs, and more, can run concurrently and independently.

Program Scheduling. RTE schedules programs on a priority basis by retrieving them from a scheduled list ordered by program priority. RTE provides these methods of scheduling programs:

- External events recognized by the system as interrupts can cause their individual interrupt-handling programs to be scheduled.
- A program can be scheduled by another program through an operating system call.
- Programs can be scheduled to execute once or repeatedly at a particular time of day or at a specified time interval. A system clock is maintained as part of the operating system functions.
- A program may be scheduled by a user command from a terminal.

The calling program or the user may choose to wait for the scheduled program to complete execution, or may continue with other operations without waiting.

Priority Management. RTE supports 32767 levels of priority, giving a user close control over the order of task execution. When a higher priority program is added to the scheduled list, any lower priority program currently executing will be suspended, and the higher priority program will begin execution.

Real-Time and Background programs are distinguished by their priority, with a background priority boundary value that is identified at system generation time.

Time Slicing. RTE-controlled multiple programs of the same "background" priority can be run on a time-sliced basis. In this scheme, each program of a particular priority is granted the same execution time "slice" as every other program running at the same priority, in a round-robin scheduling arrangement.

The basic time slice interval length is set during system generation. This can be used by the system manager to assure an equitable allocation of program execution time. Monopolization of the system by any individual compute-bound background program can thus be avoided.

Real-time programs will not be time-sliced even if more than one is assigned the same priority. A time-critical task can thus execute to completion without interruption.

Memory Utilization

RTE operating systems vary with respect to memory utilization as discussed below.

RTE-A User Program Areas. RTE-A places all user program space (up to 32M bytes less the space used by the system) above the system. User program space may be subdivided into as many as 255 fixed partitions and an essentially unlimited number of dynamically-allocated partitions.

User memory spaces can be divided at system bootup into fixed partitions and dynamically allocated memory. Critical programs can be assigned to fixed partitions to assure fastest possible response to requests for their execution. Memory partitions are allocated to other programs from a dynamic memory pool as needed. If enough space is not free, the system will swap out inactive or lower priority programs to make space.

Addition of VC+ to RTE-A provides for separation of code and data and for the totally transparent development, loading, and execution of programs as large as 7.75 megabytes. (For more information, see the 92078A VC+ data sheet on page 2-15.)

If the VC+ package is not installed, a program larger than 64k bytes can be segmented into overlays, sharing the same physical memory space when called upon to execute. A main (or root) segment, not overlaid by other segments, contains the static data. Thus, information can be passed from one overlaying segment to another and preserved throughout the execution of the program. Static information can also be maintained in EMA or VMA. Segment load and execute services are provided by RTE-A.

RTE-6/VM User Program Areas. Memory partitions are defined during system generation and can be redefined during system boot-up. The amount of memory available for partitions is equal to the size of total physical memory in the computer, less the memory used for the RTE system (as much as 1.9M bytes is available to the user in a 2M byte system). Partitions can be divided into real-time or background categories. Programs scheduled for execution will be loaded into the smallest partition available. If none is available and the priority of the scheduled program is higher than programs already in memory, the lowest priority program will be swapped out to free a partition.

Extended Memory Areas (EMAs) for data. EMA extends the logical address space of a program up to the available physical memory. EMA can contain arrays or other data, but not code, making it useful for large amounts of data storage, acquisition and processing. Disk access is not necessary, allowing fast data acquisition from real-time devices. Segmented and CDS programs can use EMA. Sharable EMA partitions can be shared by up to 63 programs on RTE-A and up to 256 programs on RTE-6/VM and multiple sharable EMAs can be defined on one system.

Virtual Memory Areas (VMAs). VMA is a demand-paged Virtual Memory Area (VMA) for up to 128M bytes of data. FORTRAN and Pascal/1000 programs require only one additional control statement per module to use VMA. From then on, access to VMA is virtually transparent.

Interrupts

RTE uses the multi-priority level, vectored hardware interrupt system for detection of power failures, protect violations, parity errors, unimplemented instructions and time base ticks, as well as all device I/O interrupts. When one or more interrupts occur simultaneously, the interrupt with the highest hardware priority is recognized first. The hardware maintains all interrupts until they are serviced by the operating system, so no interrupt is forgotten or overlooked.

The A-Series distributed intelligence I/O architecture supported by RTE-A provides simultaneous DMA capability for up to 24 I/O interface cards, thereby minimizing the number of I/O interrupts. Under RTE-A, DMA can be used to transfer data directly into or from memory even for the slowest device connected to an interface, minimizing CPU overhead. Only after a full buffer of data has been transferred will an interrupt be generated.

The E/F-Series centralized intelligence I/O architecture supported by RTE-6/VM can use two program-assignable DMA channels simultaneously.

System Integrity

The integrity of RTE systems is protected by the following features:

- Optional auto restart after power failure.
- Operating system protection from accidental modification by user programs and user program protection from accidental modification by each other.

- Optional "downing" of a failed I/O device with a message to the operator or with a programmatic return of the error status to the calling program.
- Optional locking of certain system resources to user programs for their exclusive use.
- Optional protection of disk files from unauthorized access.
- Return of control to a program that requests I/O from a "down" or locked device.
- Optional deallocation of class numbers "owned" by a program that terminates abnormally.
- Isolation of a memory fault to the affected partition (which is "downed" by RTE-6/VM). The program aborts. Execution of programs in other partitions continues without interruption and the affected program can be loaded into another partition.
- Isolation of a memory fault to the affected page (which is flagged by RTE-A). In RTE-A, a memory partity error in a dynamically-allocated user partition aborts the program running in that partition. The affected page is flagged and excluded from further use. The affected program can be reloaded into another partition without stopping the system. Programs in other partitions continue to execute normally. A parity error in a reserved partition causes the program to be aborted. RTE-A "downs" the entire partition, not just the bad page. Reboot and change of memory partitioning are required to recover the use of good pages in a downed reserved partition.
- Account password control of user access to the system (RTE-A requires VC+ for this capability).
- Protection of disk cartridges and other resources allocated to session users (RTE-A requires VC+).
- Control of command capabilities available to session users (RTE-A requires VC+).
- Optional exclusive assignment protection of disk tracks (RTE-6/VM only).
- Optional user and group file domains (RTE-6/VM only).

How Input/Output in RTE-A Differs from Input/Output in RTE-6/VM

With A-Series distributed intelligence I/O architecture, up to 24 I/O channels have Direct Memory Access (DMA), thereby minimizing system overhead. With E/F-Series centralized intelligence I/O, DMA is dynamically program-assignable to any two I/O channels at a time in the system.

RTE I/O Features

- **Optional timeout on I/O requests** can be used to prevent an inoperative I/O device from halting the entire system.
- **I/O suspend with auto rescheduling at I/O completion** allows other non-I/O bound programs to run.
- **Programmatic use of class I/O** can allow a pro- gram to continue execution while an I/O operation is processed.
- **Buffering of output to slow devices** allows a program to be swapped out during an I/O operation.
- **Mailbox I/O between multiple programs** frees programs from reliance upon the integrity of a common data area shared and maintained by all interacting programs.
- **One-driver support of multiple interfaces** of the same kind promotes efficient use of memory.
- **Input buffering** through the use of class I/O.
- **Waiting list of backlogged I/O requests** keeps each I/O device optimally utilized.
- **Automatic "downing" of an I/O device** on a controller in event of an equipment error without affecting other devices on the same controller.
- **Interleaving of requests** to devices on a multi-device interface maximizes system throughput (RTE-A only).
- **Spooling of output to printer** boosts throughput with minimal use of main memory for buffering (RTE-A requires VC+).
- **Write-read request** on an interactive serial device accomplishes two successive I/O operations with only one system call, eliminating 50% of system call overhead. This is especially useful in an operator-prompting scheme where the prompting message is first written out before waiting for a reply (RTE-A only).
- **Standard or user-definable error recovery** (RTE-A only).

- **Class buffer rethreading** for programmatic movement of class buffers from one completed class queue to another without the use of additional SAM or system overhead (RTE-A only).

- **Up to 255 logical units** (individual devices) and up to 255 equipment tables (device controllers), each with up to 64 subchannels.

  NOTE: The number of logical units supportable in RTE-A depends upon memory available for table space in the particular configuration. This number may be less than 254.

- **No-suspend I/O** option can be used to prevent suspension of critical programs because of I/O device malfunctioning (returns control to calling program when device failure is detected).

- **Optional program ownership of class numbers** permits deallocation of class numbers for a program that terminates abnormally.

- **Exclusive assignment of I/O devices** can be used to ensure that a low-priority program completes its use of a printer or other device without having that use preempted by another program.

On-Line Program Development Tools

Command Interpreter and File Manager. The Command Interpreter (CI) and File Manager (FMGR) support creating, deleting, storing, copying, packing, and listing of disk files using interactive user commands. CI and FMGR provide a user interface to I/O devices (including disk files) and system capabilities (such as program scheduling and system status information).

CI provides access to both single-level cartridge directories and hierarchical directories, while FMGR provides access to disk files on single-level cartridge directories only.

All disk files are referenced by name under both CI and FMGR. Disk files can be automatically extended to additional storage space when an attempt is made to write beyond the current end of file. A file can be extended up to 255 times.

The hierarchical directory structure accessible from CI also provides time stamping information. The times of creation, last update, and last access of files are recorded in hierarchical directories. Hierarchical file names may use up to 16 characters (versus only 6 characters for FMGR files), and hierarchical path names may contain up to 64 characters. FMGR cartridge directories can be converted to CI hierarchical volumes using RTE utilities.

CI and FMGR both support command files, including powerful test and control statements and control variables. CI has extensive file name masking capabilities, which FMGR has more limited masking capabilities.

File Management Package. Programs may access both CI and FMGR files using File Management Package (FMP) calls. Certain FMP calls can access only FMGR files, but most FMP calls can access both CI (hierarchical) and FMGR files. All the file management capabilities provided by CI and FMGR can be duplicated programmatically using FMP calls.

The Edit/1000 Screen Editor provides a variety of tools for entering and correcting program, data, or text files on the disk. In addition to its convenient screen mode, Edit/1000 provides character string search and correction capabilities that let the user locate and change all occurrences of a particular string of characters throughout a file, or only in specific lines or columns of a file. It also offers powerful line copy, move, break and join capabilities. Of course, these capabilities are in addition to the usual line or character display, insertion, replacement, and deletion capabilities normally expected in a program editor.

Link/1000 collects user's relocatable program files and referenced library routines to produce an executable program file. The output is a memory image of the program with entry points resolved from the snapshot file of the particular generated system. Link/1000 can be operated interactively, from a runstring, or by commands included in a file. The Link run-string supports the running of many loads through a transfer file. (This is especially helpful to a user who has updated RTE under Customer Support Service or Software Subscription Service and must reload user programs for the latest version of the operating system. Certain programs can run on different generations without reloading or relinking.)

Interactive Program Debugger. The optional 92860A Symbolic Debug/1000 package (see page 2-31) provides powerful program debug capabilities.

User and Program Requests (u & p)

See Table 2-2, next page.

Utilities and Libraries Provided in Both RTE-A and RTE-6/VM

- Utilities for formatting, initialization and sparing of disk tracks; saving and restoring of files from disk or cartridge to magnetic tape, and vice versa; and disk-to-disk copying in an efficient, packed format
- Logical Unit and I/O Table information utilities for displaying the current I/O configuration.
- System status reporting utilities for indicating active programs and describing program states, such as down or locked I/O devices and status of memory partitions.
- A relocatable merge program for combining relocatable files together into a single file.
- A fast help utility for on-line explanation of commands.
- A math/utility library for calculations and related processing.
- An HP-IB Library for simplification of HP-IB instrument programming.
- A system library with a variety of system-level subroutine calls, such as resource number requests, (RNRQ), LU lock requests (LURQ), a parsing routine (PARSE), a formatted time routine (FTIME), and a programmatic execution of operator commands routine (MESSS).
- A decimal string arithmetic library for addition, subtraction, multiplication, and division of decimal character string numbers that exceed the integer, floating point, extended, and double precision capabilities of the other libraries.

Table 2-2. RTE User (u) and Program (p) Requests

RTE-A	RTE-6/VM	REQUESTS
		Program Scheduling and Time-of-Day Clock Requests
u & p	u & p	Schedule programs to be run, with or without wait for completion.
u & p	u & p	Terminate or suspend program execution.
u & p	u & p	Activate operator-suspended program.
u & p	u & p	Change program priorities.
u	u	List status of all programs or currently executing programs.
u & p	u & p	Request program execution at a specified time or specified interval.
u & p	u & p	Set the real-time clock.
u & p	u & p	Obtain time (current year, day, and time-of-day for program; day of themonth, year, and day of the week for user.
		Program Development Requests
u	u	Compile or assemble programs.
u	u	Enter, test, debug, edit, and run BASIC programs.
u	u	Trace program execution, examine and modify memory and/or register contents, or perform other debugging operations.
u	u	Edit program, data, and text files.
u	u	Install relocatable programs and subroutines into a generated system.
		Input/Output Requests
u	u	List I/O configuration in terms of table description and drivers.
p	p	Read from/write to any I/O device with or without wait.
p	p	Get status of queued read requests or the resulting input data.
u & p	u & p	Control functions on mag tape or other peripheral device.
u & p	u & p	Check I/O device or controller status.
u	u	Alter I/O device timeout parameters.
u	u	Alter device logical unit assignment.
u & p	u & p	Control I/O device availabillity to programs.
u	u	Alter device buffering assignments.
		Resource Control Requests
u	u	Display partition table.
p	p	Allocate/release own disc tracks.
p	p	Allocate/release global disc tracks.
u & p	p	Enable/disable swapping.
p	p	Request resource lock/unlock.
p	p	Request device lock/unlock.
n.a.	p	Request partition status.
u	u	Display or change program size.
p	p	Determine size of own address space.
u	u	Unlock sharable EMA partition.
u	u	Establish working set size.
p	n.a.	Load program code segment from disc.
p	n.a.	Reserve buffer space outside the program space.
p	n.a.	Get current status of memory.
		Command Interpreter, File Manager, and File Management Package Requests
u & p	u & p	Create, locate, open, and close files.
u & p	u & p	Rename and purge files.
u & p	u & p	List or dump contents of a file to another file or to a peripheral device.
u & p	u & p	Copy a file from one disk logical unit to another.
u & p	u & p	List contents of a disk file directory.
u & p	u & p	List contents of a cartridge directory of the disc logical units that are mounted on the system.
u & p	u & p	Unpurge files prior to re-use of the affected file space.
u	u	Pack a disc logical unit.
p	p	Write in a random or sequential file.
p	p	Read from a random or a sequential file using relative record number.
u & p	u & p	Mount and dismount cartridges.

Legend: u = User Request p = Program Request n.a. = Not available

NOTE: Table 2-2 is continued on the next page.

Table 2-2. RTE User (u) and Program (p) Requests, continued

RTE-A	RTE-6/VM	REQUESTS
		Miscellaneous Requests
u & p	p	Determine the type of device (such as terminal, cartridge tape unit, or printer), given the device number.
p	n.a.	Determine which terminal was used to run the current program.
p	p	Convert integers from ASCII to binary.
p	p	Pass message or data buffers between programs.
p	p	Retrieve a parameter string entered by the user who runs the program.
p	p	Execute some system requests as if they had been entered by a user.
p	p	Parse a command buffer into ASCII and and integer fields.

Legend: u = User Request p = Program Request n.a. = Not available

- A cartridge tape formatting utility for TF, FC, and FST file backup utilities.
- Utilities for converting FMGR files to the hierarchical file system of the Command Interpreter **(CI),** for repacking CI files, for scanning CI disk directories and reporting inconsistencies, for reporting CI disk space taken by a specific user or directory, and for scanning the free space table of CI disks to report the amount of free space and the largest individual space available.
- A routine for verification of CS/80 pushbutton backup and restore.
- A library index routine for creating indexed user libraries to increase program loading speed.
- A program for displaying status of system class numbers.
- A utility for printing files on any HP 1000 supported system printer.
- File backup utilities with incremental backup capability.
- A utility for managing files in HP's inter-system file interchange (LIF) format.
- A program for comparing two source files and identifying lines that differ and/or lines that are similar between the two files.
- An HPCRT library with terminal handling and miniformatter routines.

Utilities Provided Only in RTE-A

- A utility for installing the bootup file (BOOTEX) onto the beginning of a disk.
- A utility for conversion of an absolute binary program file to a memory image file, or vice versa.
- A utility for combining memory image program files with a system image to make a memory-based system.

Utilities Provided Only in RTE-6/VM

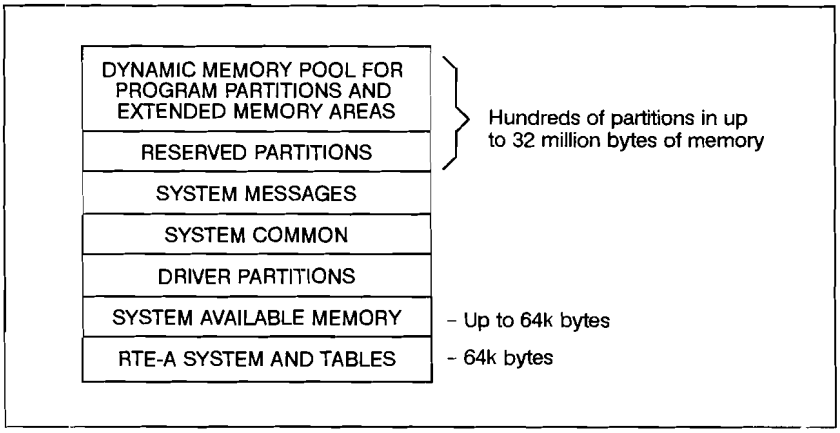
- Support for an on-line diagnostic and verification package (91711B) for monitoring the functional operation of system hardware.
- Utilities for creating soft-key files and setting up terminal soft-keys.
- A session accounts program (ACCTS) for configuration and control of Session Monitor accounts. A similar capability is available on RTE-A with the 92078A VC+ extension.
- A utility (LGTAT) for reporting the ownership of system disc tracks.
- A utility for on-line loading and replacement of drivers without system regeneration.
- An interface to compilers (COMPL) and interface to compilers and loaders (CLOAD) for one-step compilation and loading of user programs with automatic outspooling.
- A fast command utility for on-line explanation of the syntax of all interactive RTE commands and error messages and support for creation of user-defined message files for interactive user programs.
- A large program segmenter that helps users to prepare Multi-Level Segmentation (MLS) Loader command files for segmentation of large programs (not needed for RTE-A).
- A cross-reference generator for identifying external routines that are called by a specified module and the routines in a specified module and for verifying the integrity of MLS Loader command files.

92077A RTE-A Operating System

Introduction

The RTE-A Real-Time Executive operating system, product number 92077A, is a Real-Time Executive system for HP 1000 A-Series computers. This system provides true multiprogramming capability and may be configured as a memory-based or disk-based system. RTE-A requires a minimum of 512k bytes of main memory for a primary system, but can support up to 32 megabytes.

RTE-A is the "core" operating system for A-Series computers. Additional products, such as the 92078A Virtual Code+ (VC+) enhancement package, add to the basic functions of RTE-A, but without affecting its basic compatibility across the entire line of A-Series computers.



RTE-A System with 512k bytes to 32M bytes of memory

Features

- All base capabilities of an RTE system as defined in the RTE operating systems data sheet on page 2-1, plus these additional features:
- Management of 512k bytes to 32M bytes of main memory with DMA access to any part of memory.
- File system capable of supporting up to 20 gigabytes of disk storage.
- Support of large programs (up to 7.75 megabytes) with the 92078A Virtual Code+ (VC+) package.
- Enhanced multi-user interface with the 92078A Virtual Code+ (VC+) package.
- Output spooling to printer.
- DS transparency between RTE-A systems.
- Virtual memory for data arrays up to 128 megabytes, divided between main memory and disk.
- Extended Memory Areas up to 2 megabytes resident in main memory, up to 15 of which are sharable by up to 63 programs.
- Hundreds of user partitions, which may be reserved and/or efficiently allocated as needed from a dynamic memory pool.
- Up to 255 logical units if there is sufficient table space in memory.
- Up to 64 kilobytes of System Available Memory for buffered I/O and other uses.
- Partitioned operating system, including driver partitions, allowing larger systems.
- Command interpreter with online help for commands and support for:
  - 16-character file names
  - Hierarchical directories and subdirectories
  - Time stamping
  - Unpurge capability
  - Files managed under the previous file management system
- Efficient I/O, with:
  - Drivers that take advantage of the advanced A-Series I/O design with DMA per channel, minimizing I/O processing overhead
  - Modular device and interface drivers that work together to promote I/O efficiency.

RTE-A: A Large-Capacity Multi-User System

Large Main Memory Capacity

Hewlett-Packard's RTE-A system can operate in as little as 512k bytes of memory, but can manage large-system applications in up to 32 megabytes.

Plenty of Partitions for Programs

RTE-A can manage a number of dynamically allocated partitions for multiple users that is limited by the amount of main memory available. Partitions can be as small as 4 kilobytes or as large as 2 megabytes, of which 64 kilobytes is available for program code. Extensive capacity for data is provided by VMA and EMA as defined below. Critical programs can be made resident in up to 255 fixed partitions to assure the fastest possible response to requests for their execution. Other programs are assigned partition space from the dynamic memory pool according to need, using the smallest suitable block of memory. This makes the most efficient use available memory capacity. If a large enough free block of memory is not available, the system will swap out an inactive or lower priority program to make space.

Support for Large Programs

RTE-A can be extended by the optional 92078A Virtual Code+ (VC+) Package. The VC+ package supports separation of code and data and the totally transparent development, loading, and execution of programs as large as 7.75 megabytes. (See page 2-15 for more information.)

If the VC+ package is not provided, a program too large to fit into available user program space can be divided into multiple segments of code, each of which will overlay another, sharing the same physical memory space when called upon to execute. A main (or root) segment, which is not overlaid by other segments, contains the data area common to the other segments through which information can be passed from one overlaying segment to another. Segment load and execute services are provided by RTE-A.

A Gigabyte Capacity Disk File System

The RTE-A file system can support up to 20 gigabytes of disk memory, based on use of currently available disks. Supportable disk space is limited mainly by card cage spaces available for disk interfaces and the capacity of available disk drives.

Lots of Virtual Memory Space for Data

Up to 2 megabytes of the user's partition can be used as the working set of a disk-Virtual Memory Area (VMA) for data arrays as large as 128 megabytes.

Multiple Extended Memory Areas (EMAs) Sharable Among Multiple Programs

Up to 15 different sharable EMAs (SHEMAs) can be set up, within the limits of available memory. A SHEMA can accommodate up to 2 megabytes of data that is accessed quickly because it is all in main memory.

Each SHEMA can be shared by up to 63 different programs. This is especially useful in multi-task process monitoring and control systems in which one program acquires data, another uses the data to alter control outputs, and yet another analyzes or graphically displays the data. In addition to SHEMAs, any number of other non-sharable EMAs can be set up, each for the exclusive use of one program, within the limits of available main memory.

Separately-Mapped System Available Memory (SAM and XSAM)

Separate mapping of System Available Memory (SAM) in SAM and now XSAM (Extended SAM) spaces can make up to 128 kilobytes (2 x 64 kilobytes) available for buffering I/O requests or other uses as well as for such longer-lived data structures, such as LU bitmaps, Signal control blocks, signal queues, and timer blocks. This much SAM can support a tremendous amount of system I/O activity. In addition, separate mapping of SAM frees up space in the system map for larger system tables, also making possible a much larger system.

Human Engineered for Easy Use

Simplified System Generation and Loading

RTE-A systems are generated by the RTAGN utility program. This program may run concurrently with other programs on a disc-based RTE-A system and can also be executed on RTE-6/VM host systems to generate RTE-A systems for dedicated applications. System generation is done in a semi-automatic mode from a file which the user prepares in advance to provide commands to RTAGN. Extensive use of default options simplifies command file preparation. Further user assistance is provided by command file examples in the RTE-A System Generation and Installation Manual. I/O configuration, often the most complex part of system generation, is simplified by built-in identifiers in the software drivers.

After the command file has been prepared, system generation is typically accomplished in less than 10 minutes. The generator provides a generation list file of all messages and descriptions during the generation process, a generated system file from which the new operating system can be booted up, and a snapshot file that contains all the values of the entry points used by the new system. The snapshot file is used by Link to produce memory image program files.

Transportable Program Files

After initial loading on an RTE-A system, most programs can be transported to another RTE-A system for execution without reloading, relocating, or relinking. A few programs (typically those using system common) are not transportable and require reloading.

A Hierarchical File System With Many User-Requested Enhancements

The RTE-A Command Interpreter (CI) file system supports hierarchical directories. It also supports time stamping of the times of creation, last update, and last access; names up to 16 characters long, files as large as the hundreds of megabytes provided by one disk drive; and file unpurging. To take advantage of most of the CI file system features, user's FMGR file directories must be reformatted and programs must be modified. Directory reformatting can be done by a utility included with RTE-A or as part of a save/restore activity. For users who do not wish to reformat their old file directories, the Command Interpreter also supports FMGR files (but without many features of the enhanced file system) for concurrent use with files accessed via the hierarchical directories.

Disk Access by Name

RTE-A has a unified file structure for all disk space allocations in the system. This includes system and program files and user files for source, relocatable, or executable programs and data. Regardless of how it is used, every disk space allocation can be identified and accessed by a file name because its location is registered in a file directory.

Single-Command Changeover to Another System

To boot an RTE-A system from a disc, the BOOTEX (Boot Extension) program is invoked with a single command to the computer's Virtual Control Panel (VCP) program. BOOTEX locates the operating system file on disk and then configures the system according to a user-defined command file. BOOTEX then loads the operating system into memory and starts it running to complete the boot-up process. With the aid of the VCP ROM and the BOOTEX program, a user may boot-up an RTE-A operating system by name from anywhere on a disk instead of some fixed and reserved physical disk location. This is accomplished via a terminal or distributed systems point-to-point link that temporarily serves as the Virtual Control Panel for the system.

Single-command switchover facilitates switching to an updated RTE-A with the latest revision of software modules generated into it. This same capability also makes it easy to generate and use multiple RTE-A operating systems, each optimized for a specific application. As the need arises to use one of these operating systems for a specific application, it can be easily booted up in less than a minute.

With RTE-A, a new system is booted up using a command file, or through interaction with an operator at the VCP terminal. Memory configuration in RTE-A is done at boot-up and any bad pages can be defined at that time.

Improved Multi-User Environment

RTE-A's command processor helps the user to manage files, programs, and system resources without a detailed knowledge of the operating system. This includes on-line help for each command, easily understood error messages, use of blanks or commas as delimiters, wild card file operations, program and status reports, and command file input. The optional 92078A VC+ package further improves the RTE-A multi-user environment with logon control, private programs and files to protect users from each other, and standard user and superuser capability levels.

Design and Supportable Capacities of RTE-A

RTE-A is designed to support a maximum of 255 logical units (LUs) and 255 fixed partitions. However, the number of LUs and partitions that can be supported also depends upon the availability and composition of use of the approximately 33k bytes of memory that is available for system tables. For that reason, the full design capacities may not be realizable in some configurations.

Functional Specifications

See page 2-2.

Optional Software

See page 2-2.

Operational Requirements

A600 Hardware Revision Code

Model 6* and 16* Systems and 2106AK*, 2136A/B*, and 2156A* Computers with serial prefix earlier than 2326 must be upgraded to work with RTE-A; contact your HP Customer Engineer or your nearest HP Sales Office for more information.

For HP 1000 Systems

System Processor Units (SPUs) for HP 1000 Model 6*†, 16*†, 17†, 19†, 26, 27*, and 29 systems and Micro 24, Micro 26, Micro 27*, and Micro 29 systems with supported system console and system disc include and satisfy operational requirements of the RTE-A operating system.

* Discontinued product listed here for reference only.

† See paragraph on A600 hardware revision code, above.

For User-Assembled Stand-Alone Systems

See Table 2-3.

Supported System Consoles

See Table 7-1, page 7-1 of this handbook.

Supported System Disks

Hard disks are required for program development, virtual memory, and/or system generation. For supported system disks, see Table 10-1, page 10-2 of this handbook.

Table 2-3. Requirements for User-Assembled RTE-A Systems

Computer Product Number and Name	Interface(s) Required	Other Requirements
HP 12100A (A400) Single-Board Computer (SBC) OR HP 2106BK*/CK/DK (A600+) Board Computer WITH appropriate connections and power supply	HP 12100A's on-board I/O or HP 12040D 8-Ch Multiplexer & HP 12009A HP-IB Interface (optional)	Supported system console; system disk is optional.
HP 2424A (A400) Micro 14 Computer (based on HP 12100A SBC) HP 2434A (A400) Micro 24 Computer (based on HP 12100A SBC)	OR HP 12100A's on-board I/O or HP 12040D 8-Ch Multiplexer	OR Remote HP 1000 system connected via RS-232C link
HP 2156B*/C/D (A600+) Computer HP 2137A*/B* (A700) Computer HP 2139A*/B (A900) Computer HP 2426E*/F*/G/H (A600+) Micro 16 Computer HP 2436A*/E*/G/H (A600+) Micro 26 Computer HP 2437A*/B* (A700) Micro 27 Computer HP 2439A*/B (A900) Micro 29 Computer	OR HP 12007B or HP 12044A DS/1000-IV point-to-point interface	OR Remote NS/1000 or DS/1000-IV Network Node

* Discontinued product, listed here for reference only.

Ordering Information

HP 92077A RTE-A Real-Time Executive Operating System (must order one of Use Options 400 through 897)

RTE-A consists of:

1. The following software on Media Option 022, 044, 051, or 061, **one of which must be ordered:**
   a. A catalog file describing the set of software on the medium by part numbers and revision date codes.
   b. Primary RTE-A operating system, except with Option 051.
   c. On-line system generator.
   d. Macro/1000 Assembler, Edit/1000 interactive screen editor, and LINK linkage editor.
   e. HP-IB, relocatable, and decimal string arithmetic libraries.
   f. Command interpreter and file management package.
   g. System utilities.
2. HP 92077K RTE-A Manuals (see separate product listing on the next page).

HP 92077A Media Options

022: Provides software on CS/80 cartridge tape.

044: Provides software on 270 kB microfloppy disk for HP 12120A*/ 12122A Integrated Disks in Micro/ 1000 package or HP 9122C/ D* or 9133A*/B*/H*/L*, or 9153B*/C Disk.

051: Provides software on 1600 cpi, 9-track mag tape.

061: Provides software on 1600 cpi, 9-track mag tape in CS/80 disc format.

92077A/R/E Use Options

400: Use in HP 12100A Single Board Computer, HP 2134A Model 24 Computer, 2424A Micro 14 Computer, or 2434A Micro 24 Computer.

600: Use in HP 2106BK*/CK/DK Board Computer 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, or 2436A*/E*/G/H Micro 26 Computer.

601: Upgrade from previous version of 92077A/R/E option 600 to latest version of same for customer not on support service.

700: Use in HP 2137A*/B* Computer or 2437A*/B* Micro 27 Computer.

701: Upgrade from previous version of 92077A/R/E option 700 to latest version of same for customer not on support service.

890: Use in HP 2139A*/B Computer or 2439A*/B Micro 29 Computer or in any other A-Series computer. With 92077A, option 890 includes the right to purchase one or more 92077R/E products with Use Option 400, 600, 700, and/ or 890 for use on a corresponding additional computer(s).

* Discontinued product listed here for reference only.

891: Upgrade from previous version of 92077A/R/E option 890 to latest version of same for customer not on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

HP 92077R Use of RTE-A for Program Development and Execution on One Additional Computer System (must order one of Use Options 400 through 897)

The 92077R product is available only to customers who have purchased a license to use 92077A. 92077R consists of:

1. The right to make one copy of software purchased with the 92077A RTE-A system for use on an additional system.
2. 92077K RTE-A Manuals (see separate product listing).

NOTE: To assure proper support, we recommend that a user who intends to use copies ("R" products) of other HP software products, such as the Graphics/1000-II Device-Independent Graphics Library, with RTE-A, purchase the 92077R product (above) rather than the 92077E Execute-only product (below).

92077R Option 100

Deletes manuals from the 92077R product.

HP 92077E Right to Execute RTE-A On One Additional Computer System (must order one of Use Options 400 through 897)

This is a low-cost license for an OEM. (Excludes program development and on-line system generation use on the system for which 92077E is purchased.) No manual or software is supplied with this product, which is simply a license to execute RTE-A and user programs developed to run under RTE-A on a dedicated A-Series application system.

HP 92077K RTE-A Manuals Package

The 92077K RTE-A manuals package consists of manuals organized in a set of 10 binders, as follows:

1. RTE-A Binder Volume 1 (92077-64011) with: 92077-90036 RTE-A Index and Glossary. 92077-90038 RTE-A Primary System Software Installation Manual. 92077-90039 Getting Started with RTE-A. 92077-90056 System Manager's Manual.
2. RTE-A Binder Volume 2 (92077-64012) with: 92077-90002 RTE-A User's Manual. 92074-90001 Edit/1000 User's Manual.
3. RTE-A Binder Volume 3 (92077-64013) with: 92077-90004 RTE-A Utilities Manual.
4. RTE-A Binder Volume 4 (92077-64014) with: 92059-90001 Macro/1000 Assembler Reference Manual. 92077-90050 RTE-A Software Entry Point Directory.
5. RTE-A Binder Volume 5 (92077-64015) with: 92077-90007 RTE-A Programmer's Reference Manual. 92077-90035 RTE-A LINK User's Manual.
6. RTE-A Binder Volume 6 (92077-64016) with: 92077-90037 Relocatable Libraries Reference Manual.
7. RTE-A Binder Volume 7 (92077-64017) with: 92077-90019 RTE-A Driver Designer's Manual. 92077-90034 RTE-A System Generation and Installation Manual.

8. RTE-A Binder Volume 8 (92077-64018) with: 92077-90013 RTE-A System Design Manual. 92077-90011 RTE-A Driver Reference Manual. 59310-90064 HP-IB User's Manual.

9. RTE-A Binder Volume 9 (92077-64019) with: 5180-6728 Computer User's Catalog Flyer. 5954-6304 Interex brochure.

10. RTE-A Binder Volume 10 (92077-64020) with: 92077-90020 RTE-A Quick Reference Guide.

Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

92078A Virtual Code + (VC +) Extension of RTE-A

Introduction

HP 92078A Virtual Code+ (VC+) is an extension package for 92077A RTE-A Real-Time Executive operating systems with revision code 2326 or higher. This package extends RTE-A system capabilities to support code and data separation making possible transparent execution of programs up to 7.75 megabytes as well as reentrant and recursive use of shared program code. Also included is an improved environment for multi-user operations, output spooling, LU redirection, and logging of error messages to a file.

Features

- Support for separation of code and data, permitting:
  - Transparent development, loading, and execution of programs as large as 7.75 megabytes
  - Re-entrant and recursive use of shared program code
- Enhanced environment for multi-user operations on RTE-A
- Spooling of output to any device or file in addition to the standard RTE-A system's print program
- LU redirection to other LUs or files
- Echoing of system error messages to a file

How VC+ Code and Data Separation Increases RTE-A Capacity and Efficiency

Large Program Capacity on 16-bit Minicomputers. The separation of code from data in the VC+ enhancement package makes handling of large programs easier than ever before. Unlike the method of code overlays used by previous RTE systems, large programs are broken into code segments transparently and automatically. This VC+ service effectively gives the user up to 7.75 megabytes of code space, with the only concern being that no subroutine be longer than 60,000 bytes. In most instances, users will be able to compile, load, and run large programs in any supported language without any special conversion.

More Space for Data Without Using EMA. Programs with up to 60k bytes of code may now run without needing EMA, due to the increased space available for data when it is separated from the code. Such programs will run significantly faster because of reduced data access times when EMA is not used.

Sharing of Code is another advantage of the code and data separation supported by the VC+ package. Multiple programs can share one code partition while owning distinct data partitions, saving memory space that could otherwise be required by multiple copies of code. The number of disk accesses also decreases because a code partition shared by many programs is loaded into main memory only once, which helps to improve overall system performance. It is important to note, however, that shared code is supported only for programs that have separated code and data (new code). A user's application program written in FORTRAN, Pascal, or BASIC must be recompiled to support code sharing. Programs written in Macro/1000 Assembly language can be enhanced to include the instructions to separate the code and data.

A Secure Environment for Multi-User Operations

Logon Access Control by VC+ restricts system access to users who have been assigned a logon name and (optionally) a password. The logon and password access controls are associated with an individual directory of files that is integrated with the hierarchical file system of RTE-A and a program that executes upon logon to assist or inform the user.

32 Capability Levels are available for fine tuning of system security to the needs of many different applications. Each user is assigned a capability level (0-31) and system functions (commands, utilities, and calls) and files can be assigned a required capability level. A user request for a particular function or file is honored only if that user's capability level matches the access requirements for that function or file.

File Protection can now be set up for an individual owner, a group, and other, non-group, users of the system. Access and the nature of access (read and/or write) to files set up under RTE-A's Command Interpreter, can be selectively set for the owner, members of the owner's group, and others.

Private Programs help to prevent interference between users. Private programs are application programs created and run by the user. The private program is uniquely defined by its name and the terminal from which it is run.

System Programs are programs, such as PRINT or EDIT that can be run by anyone on the system. Each system program has a unique name and can be aborted only by a superuser.

Protection of User's Programs is supported by the file read and/or write protection provisions of RTE-A. A program file that is read protected from other users cannot be run by anyone but its owner and users with equal or higher capability levels.

CPU Usage and Connect Time Can Be Limited for individual members of a group or an entire group. A user or group that has exceeded its CPU and/or connect time limit during a session is locked out of subsequent logons, which actively prevents further overuse by that person or group. Reinstatement of the ability to log on requires resetting of the time totals or an increase in the time limit.

LU Access Control can be used to designate which LUs a user or group may access. This can be used to reserve a different set of terminals and hard copy peripherals for different groups.

Extended Output Spooling

The basic capability of RTE-A is restricted to printer outspooling. The VC+ package extends this capability to support outspooling to any device, redirection of input or output from one logical unit (LU) to another LU, and the ability to route data destined for an LU to a file. VC+ also provides spool status, restart capability, spooling control at the user level, and logging of serious error messages (plus a time stamp) to a file. Spooling is both programmatic and interactive.

Functional Specifications

Large Program Support

Maximum Program Length: Up to 128 code segments X up to 31 pages (63,488 bytes) per code segment (7.75 megabytes).

Maximum Module Length: 60 kilobytes.

Large Data Array Support Within the bounds of available memory, VC+ can be used to support megabyte-sized programs without affecting the program's access or mode of access to data areas larger than 64k bytes. Shared Extended Memory Areas for main memory resident data arrays up to 2 megabytes and Virtual Memory for Data Arrays up to 128 megabytes in main memory and on disk are supported.

Code Sharing

Basic Principle: Multiple programs can share one code partition while owning different data partitions.

Segment Sharing: Shared code segments are not supported; all of a shared program's code segments must be in memory at the same time; only entire programs can be shared.

Requirement: Only programs that have separated code and data can be shared. Existing application programs written in FORTRAN, Pascal, or BASIC must be recompiled to convert them to take advantage of shared code support. Existing programs written in Assembly language must be converted manually, a considerable effort that will normally preclude their shared use. However, assembly language subroutines are often transportable to code and data sharing programs with no changes.

Extended Outspooling

Outspooling to a Device: Output can be routed to an intermediate disc LU and later to the intended LU when it is free.

LU Redirection: Input or output can be routed from one LU to another LU.

Output to a File: Data destined for an LU can be routed to a file.

Error Logging: The extended outspooling capability of VC+ supports the logging of serious errors, plus a timestamp, to a disk file for later analysis by the system manager.

Operational Requirements

For Older HP 1000 A-Series Systems

HP 2186A/B* and 2196A/B* System Processor Units for Model 6* and 16* Systems that have been up- graded with the 12107A* upgrade kit and 2197A/B* and 2199A/B* System Processor Units for Model 17* and 19* Systems satisfy operational requirements of the RTE-A operating system with VC+.

For the Latest HP 1000 A-Series Systems

HP 2186C*/D*, 2196C*/D*/G/H, 2197C*/D*/E*, and 2199C*/D*/E System Processor Units (SPUs) for HP 1000 Model 6*, 26, 27*, and 29 systems and 2484A, 2486A*/B/C, 2487A*/B*, and 2489A*/B SPUs for HP 1000 Micro 24, 26, 27*, and 29 systems with supported system console and system disc satisfy operational requirements of the RTE-A operating system with VC+.

* Discontinued product listed here for reference only.

For User-Assembled, Stand-Alone Systems

Any of the computers listed in Table 2-3, page 2-12 in the RTE-A data sheet.

System Console and System Disk

The RTE-A system with VC+ has the same requirement for a system console for operator communication as RTE-A. A supported system disc is an absolute requirement for VC+ support under RTE-A.

Memory Required

At least 512k bytes.

Ordering Information

HP 92078A RTE-A Virtual Code+ System Extension Package (must order one of Use Options 400 through 897)

The Virtual Code+ package consists of:

1. The following software on Media Option 022, 044, or 051, **one of which must be ordered:**
   a. A catalog file describing the set of software on the medium by part numbers and revision date codes.
   b. Code and data separation and virtual code support software.
   c. Enhanced multi-user environment software.
   d. Extended outspooling software.
2. 92078-90001 RTE-A Virtual Code+ (VC+) System Extension (manual).

92078A Media Options

022: Provides software on CS/80 cartridge tape.
044: Provides software on Microfloppy disk for HP 12120A*/ 12122A Integrated Disks in Micro/ 1000 Package or HP 9122C/ D* or 9133A*/B*/H*/L* or 9153B*/C Disk.

051: Provides software on 1600 cpi, 9-track mag tape.

92078A/R/E Use Options

400: Use in HP 12100A Single Board Computer, HP 2424A Micro 14 Computer, 2434A Micro 24 Computer, or HP 2484A* Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D* Model 26 SPU, or 2486A* Micro 26 SPU.

601: Upgrade from previous version of 92078A/R/E option 600 to latest version of same for customer NOT on support service.

700: Use in HP 2137A*/B* Computer or 2437A*/B* Micro 27* Computer or 2487A* Micro 27* SPU.

890: Use in HP 2139A*/B Computer or 2439A*/B Micro 29 Computer or 2489A* SPU or in any other A-Series computer. With 92078A, option 890 includes the right to purchase one or more 92078R/E products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 92078A/R/E option 890 to latest version of same for customer NOT on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

HP 92078R Use Of VC+ Package On One Additional Computer System (must order one of Use Options 400 through 897)

The 92078R product is available only to customers who have purchased a license to use 92078A. 92078R consists of the right to make one copy of software purchased with the 92078A VC+ package for use on an additional system and the 92078-90001 RTE-A Virtual Code+ (VC+) System Extension Manual.

HP 92078E Right to Execute VC+ On One Additional Computer System (must order one of Use Options 400 through 897)

This is a low-cost license for an OEM. No manual or software is supplied with this product, which is simply a license to execute VC+ and user programs that depend upon it under 92077E Right-to-Execute RTE-A on a dedicated A-Series application system.

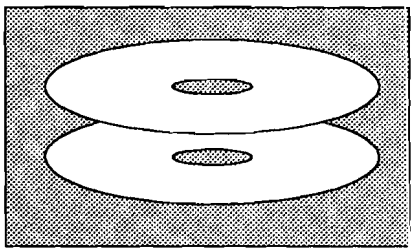
Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

* Discontinued product listed here for reference only.

NOTES:

92050A
Datapair/1000



Introduction

HP 92050A Datapair/1000 supports configuration of disk volumes in mirrored pairs in RTE-A systems for data protection and high availability. These paired volumes are configured on separate disk drives, each connected via its own HP-IB interface for maximum protection against failure. The Datapair package uses a pseudo disk driver as a user-transparent manager for the mirrored pairs, a PAIR utility to create, verify, and restore paired volumes, and a PAIO utility to display the current disk mirroring configuration for the Datapair/1000 system.

Features

- User-transparent protection from data loss caused by disk failure
- Automatic real-time redundancy to assure high availability of data
- Down volume restoration
- Paired volume verification
- Uninterrupted read/write access even if one volume in a pair goes "down"
- Support for a variety of disks
- Maintenance of mirrored configuration integrity across boots

Datapair/1000 Software

1. Pseudo driver IDP31, which initiates I/O requests to the disk drivers for each volume of the pair and passes the mirrored configuration of any mirrored volume that changes to MIMON.

2. PAIR Utility, which:
   a. Defines paired relationships between disk volumes.
   b. Controls the state (Up, Down, or Standby) of each volume in a pair.
   c. Restores a "Down" volume of a pair track-by-track from the good volume.
   d. Verifies paired volumes, track-by-track.
   e. Displays current volumes and pair relationships.

3. PAIO Utility, which displays current mirroring configuration for:
   a. A specific mirrored volume.
   b. A range of mirrored volumes.
   c. The entire Datapair/1000 system.

4. PINIT is the Datapair/1000 initialization program. It is used to start up MIMON.

5. PREPAIR Utility, which:
   a. Modifies the system file to set up and determine mirrored volumes at the next boot.
   b. Creates an information file to keep up-to-date information on mirrored volumes. This is used by BOOTEX to assure that the mirrored volumes are up to date at the next boot-up of the system.

6. MIMON Utility, which monitors all mirrored volume activity and updates the information file whenever there is any change to the mirrored volume configuration.

Functional Description

After assignment of the pairing of disk volumes using PAIR, accesses to paired volumes are made via pseudo driver IDP31, using the logical unit number assigned to the pair. IDP31 issues write access requests to both volumes of the pair. Read accesses alternate between the volumes to assure the earliest possible discovery of errors. Control access requests are handled like writes and are issued to both volumes of a pair.

After setup, both write and read accesses are transparent to the user. Disk access calls are the same as would be used to access a single volume. This provides two identical copies of the data. For maximum security, the volumes of a pair are on different drives, each accessed via its own HP-IB interface.

If either volume of a pair goes Down due to a failure, normal read and write accesses to the good volume continue as if nothing had happened. The PAIR utility is used to copy the good volume to restore a Down volume after the Down volume has been repaired. Write operations write into both volumes during the restoration process, thereby assuring continuity of data.

The PAIO Utility can be run by any user to show a table with all of the mirrored volumes on the system, even when PAIR is busy. The PAIO display shows pair relationships and status of the LUs. It also indicates volumes that are NOT defined.

Functional Specifications

Operating Requirements

Operating System: Datapair/1000 operates under the RTE-A Real-Time Executive system and requires Revision 5.0 of RTE-A.

Supported Disk Memories: Datapair/1000 supports HP 7920M and 7925M disk memories interfaced via HP-IB and the 12745D HP-IB Adapter Kit and also supports all CS/80 and SS/80 disks that use device driver DD*33 to communicate with RTE-A. No other disks are supported.

NOTE: Some supported disks may be considered unsuitable for an application because of the time they need to perform certain operations. For example, the HP 7933H/XP and 7935H/XP disks take several minutes to spin-up after a power failure. HP 791xP/R Disks with integrated Cartridge Tape Drive may become unavailable for one or two minutes after a tape is inserted into the tape drive.

Volume Matching: Both volumes of a mirrored pair must have the same number of tracks and must be on disks that have the same number of sectors per track and the same number of bytes per sector.

Logical Sectors Per Track: Maximum of 64.

Other Configuration Requirements: One continually used 32 KB partition and one 64 KB partition that must be available for occasional use.

Restrictions on Pairings: Any volume may be be paired, including the bootable volume. However, if a bootable volume is paired, it must be paired with another bootable volume.

Write Access Overlapping

Each volume of a pair is accessed via its own controller (HP-IB interface), so write accesses are overlapped, minimizing the time required for automatic real-time redundancy.

Ordering Information

HP 92050A Datapair/1000 (must order one of Use Options 400 through 897)

Datapair/1000 consists of:

1. The software summarized above, on media option 022 or 051, **one of which must be ordered,** and a license to use Datapair/1000 on one system.
2. 92050-90001 Datapair/1000 Reference Manual.
3. 92050-90011 Datapair/1000 Self-Study Guide.
4. 92050-90003 RTE-A Quick Reference Guide insert.

92050A Media Options

022: Provides software on CS/80 Cartridge Tape.

051: Provides software on 1600 cpi, 9-track mag tape.

92050A/R Use Options

400: Use in HP 12100A Single Board Computer, 2134A, 2424A, or 2434A Computer or 2484A*/B SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D, 2426E*/F*/G/H, or 2436A*/E*/G/H Computer or 2196C*/D*/G/H or 2486A*/B/C SPU.

700: Use in HP 2137A*/B* or 2437A*/B* Computer or 2197C*/D*/E* or HP 2487A*/B* SPU.

890: Use in HP 2139A*/B or 2439A*/B Computer or 2199C*/D*/E or 2489A*/B SPU, or in any other A-Series computer. With 92050A, option 890 includes the right to purchase one or more 92050R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

HP 92050R Right to copy Datapair/1000 (must order one of Use Options 400 through 897)

The 92050R product is available only to customers who have purchased a license to use 92050A. 92050R consists of:

1. The right to make one copy of software purchased with the 92050A product.
2. 92050-90001 Datapair/1000 Reference Manual.
3. 92050-90011 Datapair/1000 Self-Study Guide.
4. 92050-90003 RTE-A Quick Reference Guide insert.

Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

* Discontinued product listed here for reference only.

Device Drivers Included in RTE-A

See Table 2-4, below, for relocatable device driver routines that are included in the RTE-A operating system.

Table 2-4. Device Drivers Supplied with RTE-A for A-Series Computer Systems

NOTE: Currently-available devices and interfaces are listed below in **BOLD FACE** type; all other devices and interfaces, in the lighter typeface and flagged with an asterisk (*), are discontinued products listed here for reference only.

Supported Devices or Capabilities		Device Driver	Supported Interface	Interface Driver
TERMINALS				
C1001A/G/W	**Display Terminal**	DD*00	12005A*/**12005B Async Serial Interface**	ID*00 ID*01 †
2382A*	Office Display Terminal			
2392A*	Display Terminal			
2393A	**Graphics Terminal**		12040A*/B*/C* Eight-Channel Async Multiplexer	IDM00
2397A	**Color Graphics Terminal**			
2621A*/B*	Display Terminal			
2622A*	Display Terminal	DDC00	**12040D Eight-Channel Async Multiplexer**	ID800 ID801 ‡
2623A*	Graphics Terminal			
2624A*/B*	Display Terminal			
2625A*	Dual System Terminal		**12100A Single-Board Computer Four-Channel On-Board I/O Multiplexer**	ID400
2626A*	Display Station			
2627A*	Color Graphics Terminal			
2628A*	Word Processing Terminal		12005A*/**12005B Async Serial Interface**	ID100 ID101 †
2645A*#	Display Station			
2648A*#	Graphics Terminal			
2647A*#	Intelligent Graphics Terminal			
45610B*	Touchscreen Terminal	DD*00	37222A* Integral Modem Interface	IDM00
72425A*	Vectra Model 25 PC**			
72435A*	Vectra Model 35 PC**			
72425A*	Vectra Model 25 PC**			
PRINTERS connected via Multiplexer				
2225D	**Thinkjet Printer**	DD*00	12040A*/B*/C* Eight-Channel Async Multiplexer	IDM00
2227A	**Quietjet Plus Printer**			
2228A	**Quietjet Printer**			
2235B	**RuggedWriter 480 Printer**			
2276A	**DeskJet Printer**			
2563A+049*	Line Printer			
2563B+049	**Line Printer**	DDC00	**12040D Eight-Channel Async Multiplexer**	ID800
2564B+049	**Line Printer**			
2565A+049*	Line Printer			
2566A+049*	Line Printer			
2566B+049	**Line Printer**			
2631A*	Printer			
2684D	**LaserJet/2000 Printer**		**12100A Single-Board Computer Four-Channel On-Board I/O Multiplexer**	ID400
2686A*	Laserjet Printer			
2686A+300*	Laserjet Plus Printer			
2932A	General-Purpose Printer			
2933A*	Factory Data Printer			
2934A	**Business Printer**			
33440A	**LaserJet Series II Printer**			
3630A+001	**PaintJet Printer**			

* Discontinued product listed here for reference only.

† Driver ID*01 or ID101 supports both modem and direct connect communication with terminals.

‡ Driver ID801 is required instead of ID800 for 12040D used with the 37214A Systems Modem.

\# Cartridge tape units in 2645A, 2648A, and 2647A Terminals require Device Driver DD*20 w/DD*00 and DDC01 w/DDC00.

** 724xxA Vectra PCs require monochrome or color monitor connected via appropriate adapter card, serial-parallel, or dual serial dual serial interface, disk operating system, and AdvanceLink 2392 software to function as an HP 1000 A-Series terminal.

Table 2-4. Device Drivers Supplied with RTE-A for A-Series Computer Systems, continued

NOTE: Currently-available devices and interfaces are listed below in **BOLD FACE** type; all other devices and interfaces, in the lighter typeface and flagged with an asterisk (*), are discontinued products listed here for reference only.

Supported Devices or Capabilities		Device Driver	Supported Interface	Interface Driver
PRINTERS connected via HP-IB				
2563A+214*	Line Printer	DDC12	**12009A HP-IB Interface**	ID*37
2563B+214	**Line Printer**			
2564B+214	**Line Printer**			
2565A+214*	Line Printer			
2566A+214*	Line Printer			
2566B+214	**Line Printer**			
2608S+214*	Line Printer			
2235B	**RuggedWriter 480 Printer**	DD*12	**12009A HP-IB Interface**	ID*37
2631A*	Printer			
2932A*	General-Purpose Printer			
2933A*	Factory Data Printer			
2934A	**Business Printer**			
2671A*	Thermal Printer	NOTE A	**12009A HP-IB Interface**	ID*37
2671G*	Graphics (thermal) Printer			
2673A*	Intelligent Graphics Printer			
GRAPHICS DEVICES				
7440A+001	**Colorpro Plotter**	DD*00 NOTE B	12040A*/B*/C* Eight-Channel Async Multiplexer	IDM00
7470A+001*	Two-pen Plotter			
7475A+001	**Six-pen Plotter**			
7510A*	Color Film Recorder	DDC00 NOTE B	**12040D Eight-Channel Async Multiplexer**	ID800
7550A	**Auto Sheet Feed Plotter**			
7570A	**Draftpro Plotter**		**12100A Single-Board Computer Four-Channel On-Board I/O Multiplexer**	ID400
7580B+060*	Drafting Plotter			
7585B+060*	Drafting Plotter			
7586B+060*	Drafting Plotter			
7595A	**DraftMaster I Plotter**			
7596A	**Draftmaster II Plotter**			
7225B	Plotter with 17501A HP-IB Interface	NOTES B and C	**12009A HP-IB Interface**	ID*37
7440A+002	**Colorpro Plotter**			
7475A+002	**Six-pen Plotter**			
7510A*	Color Film Recorder			
7550A	**Auto Sheet Feed Plotter**			
7570A	**Draftpro Plotter w/17570A HP-IB I/F**			
7580B+060*	Drafting Plotter			
7585B+060*	Drafting Plotter			
7586B+060*	Drafting Plotter			
9111A*	Graphics Tablet			
9872A*/B*/S*	Graphics Plotter			
9872C*/T*	Graphics Plotter			
7595A	**DraftMaster I Plotter**			
7596A	**Draftmaster II Plotter**			

* Discontinued product listed here for reference only.

NOTE A: 2671A, 2671G, and 2673A Printers are supported only by HP-IB interface driver ID.37, so all output to those printers must transfer character strings at the interface level.

NOTE B: Device handlers for graphics devices are provided in the 92861A Version 2.0 Graphics/1000-II Device-Independent Graphics Library.

NOTE C: HP-IB connected plotters and other graphics devices are supported by HP-IB interface driver ID.37 and device handlers in the 92861A Version 2.0 Graphics/1000-II Device-Independent Graphics Library, which is required for operation.

Table 2-4. Device Drivers Supplied with RTE-A for A-Series Computer Systems, continued

NOTE: Currently-available devices and interfaces are listed below in **BOLD FACE** type; all other devices and interfaces, in the lighter typeface and flagged with an asterisk (*), are discontinued products listed here for reference only.

Supported Devices or Capabilities		Device Driver	Supported Interface	Interface Driver
INDUSTRIAL WORKSTATION TERMINALS				
3081A	**Industrial Workstation Terminal**	None	12040A*/B*/C* Eight-Ch Async Mpxer	IDM00
			12040D Eight-Ch Async Multiplexer	ID800
			12100A Single-Board Computer Four-Channel On-Board I/O Multiplexer	ID400
DISKS AND CARTRIDGE TAPE DRIVES (CTDs)				
12120A*	20 MB Fixed Disk + 630 KB Microfloppy for integration in Micro/1000 CPU/SPU	None	12022A* Interface Included with Integrated Disks product or option	ID*27
12121A*	20 MB Fixed Disk for integration into Micro/1000 CPU/SPU			
263xA/E/248xA	Opt. 110* 10 MB Fixed Disk + 270 KB Microfloppy for integration in Micro/1000 CPU/SPU			
263xA/E/248xA	Opt. 111* 15 MB Fixed Disk + 270 KB Microfloppy for integration in Micro/1000 CPU/SPU			
12122A	**20 MB Fixed Disk + 630 kB Microfloppy for integration into Micro/1000 CPU/SPU**	DD*33	**12009A HP-IB Interface**	ID*37
35401A + 100	**Autochanger Cartridge Tape Subsystem**			
7907A*	40 MB Fixed/Removable Disk			
7908P/R*	16 MB Fixed Disk w/Cartridge Tape Drive			
7911P/R*	28 MB Fixed Disk with CTD			
7912P/R*	65 MB Fixed Disk with CTD			
7914CT*	131 MB Fixed Disk with CTD			
7914P/R*	131 MB Fixed Disk with CTD			
7914ST*	131 MB Fixed Disk + 1600 cpi MTU**			
7933H/XP*	404 MB Fixed Disk			
7935H/XP*	404 MB Removable Media Disk			
7936H/XP	**307 MB Fixed Disk**			
7937H/XP	**571 MB Fixed Disk**			
7941A*	24 MB Fixed Disk			
7942A*	24 MB Fixed Disk + Cartridge Tape Drive			
7945A*	55 MB Fixed Disk			
7946A*	55 MB Fixed Disk + Cartridge Tape Drive			
7957A*	81 MB Fixed Disk			
7957B	**81 MB Winchester Disk Drive**			
7958A*	130 MB Fixed Disk			
7958B	**152 MB Winchester Disk Drive**			
7959B	**304 MB Winchester Disk Drive**			
7962B	**152 MB Winchester Disk Drive**			
7963B	**304 MB Winchester Disk Drive**			
9122C	**(Dual 1.42 MB) Floppy Disk Drive**			
9122D*	Dual 630 kB Microfloppy Disks			
9133D*	15 MB Fixed Disk + 630 KB Microfloppy			
9133H*	20 MB Fixed Disk + 630 KB Microfloppy			
9133L*	40 MB Fixed Disk + 630 KB Microfloppy			
9134D*	15 MB Fixed Disk			
9134H*	20 MB Fixed Disk			
9134L*	40 MB Fixed Disk			
9144A	**Cartridge Tape Subsystem**			
9145A	**Cartridge Tape Subsystem**			
9153B*	20 MB Fixed Disk + 630 kB Microfloppy			
9153C	**Winchester Disk Drive**			
9154B*	20 MB Fixed Disk			

* Discontinued product listed here for reference only.

** The 1600 cpi magnetic tape unit in the 7914ST product requires a separate 12009A HP-IB interface and uses magnetic tape device driver DD*24.

Table 2-4. Device Drivers Supplied with RTE-A for A-Series Computer Systems, continued

NOTE: Currently-available devices and interfaces are listed below in **BOLD FACE** type; all other devices and interfaces, in the lighter typeface and flagged with an asterisk (*), are discontinued products listed here for reference only.

Supported Devices or Capabilities	Device Driver	Supported Interface	Interface Driver
DISKS AND CARTRIDGE TAPE DRIVES (CTDs), continued			
7906M+102* 19 MB MAC Master Cartridge Disk 7920M+102* 50 MB MAC Master Disk 7925M+102* 120 MB MAC Master Disk	DDM30	**12009A HP-IB Interface**	ID*37
9121A* Dual 270 kB Microfloppy Disks 9133A* 4.6 MB Fixed Disk + 270 KB Microfloppy 9133B* 9.2 MB Fixed Disk + 270 KB Microfloppy 9133V+004* 4.5 MB Fixed Disk + 270 KB Microfloppy 9133XV+010* 9.6 MB Fixed Disk + 270 kB Microfloppy 9134A* 4.6 MB Fixed Disk 9134B* 9.2 MB Fixed Disk 9134XV+010* 9.6 MB Fixed Disk 9895A* Dual 1.2 MB Flexible Disks	DD*30	**12009A HP-IB Interface**	ID*37
MAGNETIC TAPE UNITS			
7970E+626/636* 1600 cpi Magnetic Tape Unit 7971A+140/144* 1600 cpi Magnetic Tape Unit	DD*23	**12009A HP-IB Interface**	ID*37
7974A 1600 cpi Magnetic Tape Unit 7978A* 6250/1600 cpi Magnetic Tape Unit 7978B* 6250/1600 cpi Magnetic Tape Unit **7979A 1600 cpi Autoloading MTU** **7980A 6250/1600 cpi Autoloading MTU** **7980XC 6250/1600 cpi Autoloading MTU with data compression**	DD*24	**12009A HP-IB Interface**	ID*37
NON-DEVICE DRIVER-SUPPORTED CAPABILITIES			
Disk emulation for read-in of programs from PROM storage	None	**12008A PROM Storage Module**	ID*36
Power fail/auto restart of system operations	None	**12013A, 12154A,** 12157A*, **or 12157B Battery Backup Card**	ID*43
Interfacing of various parallel I/O devices	None	**12006A Parallel Interface**	ID*50
CPU-to-CPU communication via parallel link	None	**12006A Parallel Interface**	ID*52
Digitizing of Analog Input signals	None	12060A*/**12060B A-to-D Converter**	ID*50
Analog Output	None	**12062A D-to-A Converter**	ID*50
Interfacing of digital inputs and outputs	None	**12063A Isolated Digital I/O Interface**	ID*50

* Discontinued product listed here for reference only.

RTE-A Revision 5.0 Performance Brief

Introduction

Effective with Revision 5.0, RTE-A includes the following enhancements:

- Ability to support larger programs than the previous revision.
- Increased, and more flexible, system security.
- Improved directory access when moving up a directory tree and improved wild card addressing of groups of files.
- Support of Symbolic Debug/1000 improvements, which are described in the Symbolic Debug/1000 data sheet on page 2-23.
- Support of the RTE Profile Monitor for analysis of the execution time distribution of programs.
- Improved linking of programs, saving at least 20% of the space used by programs in Code and Data Separation format, increasing the number of routines that can be linked, and faster linking via VMA access.

Twenty-eight Tests of Real-Time Performance

The following test results are reported for all A-Series processors:

Tests 1A and 1B, Interrupt Acknowledge Latency (the time from interrupt to non-privileged (Test 1A) or Privileged (Test 1B) user program).

Test 2, Interrupt Response Latency (the time from interrupt to the first executable line in a driver partition).

Tests 3 and 4, I/O Turnaround, HP-IB and Parallel Interface Only (the time between completion of one I/O request on a queue and initiation of the next request).

Test 5, I/O Turnaround, HP-IB Interface and CS/80 Disk (the time between completion of one I/O request on a queue and start of actual data transfer, which includes disk head seek time).

Test 6, Context Switch Latency (for RTE is the same as Test 1A, above, so separate results are not provided).

Test 7, Semaphore Clear With Context Switch (the time required to dispatch a process suspended on a locked semaphore (resource number)).

Tests 8 and 9, Message Passing With Context Switch (the time between a call sending the message to dispatch a process suspended waiting for that message, whose length is 1 byte in Test 8, 80 bytes in Test 9).

Tests 10 through 13, I/O Time-to-Completion (the time between an I/O request and rescheduling of the calling process upon completion of that request for HP-IB and Parallel Interfaces and 1-byte and 80-byte transfers).

Tests 14 through 16, Disk Time-to-Completion (the times required to write 512 bytes, 8 kB, and 32 kB of data to a disk after the head is positioned; these tests are a follow-on of Test 5.) The actual times depend upon the disk used.

Tests 17 through 28, File System Timing (the times required to write to or read from a file of the specified type and size). The actual times depend upon the disk used.

The Test Results

Test 1A, Interrupt Acknowledge Latency for Non-Privileged Driver (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	0.792	0.806	0.872	0.438
Max.	2.216	4.246	3.340	1.744
Med.	1.585	1.648	2.827	1.443
Mean	1.541	1.723	2.384	1.207
Std Dev	0.516	0.746	0.743	0.395

Test 1B, Interrupt Acknowledge Latency for Privileged Driver (times in microseconds)

Proc.	A400	A600+	A700*	A900
Min.	27.72	8.36	10.20	5.60
Max.	52.72	59.32	58.00	29.28
Med.	33.20	30.20	33.48	15.48
Mean	39.98	31.23	41.13	16.57
Std Dev	11.29	10.49	12.57	3.02

Test 2, Interrupt Response Latency (times in microseconds)

Proc.	A400	A600+	A700*	A900
Min.	157.5	166.0	173.4	78.6
Max.	224.3	274.4	241.9	142.5
Med.	172.9	182.2	190.2	104.6
Mean	172.9	181.7	190.9	99.7
Std Dev	13.49	14.29	15.06	14.42

Test 3, I/O Turnaround for HP-IB Interface (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	1.386	1.355	1.332	0.591
Max.	1.447	1.419	1.412	0.625
Med.	1.382	1.369	1.346	0.598
Mean	1.393	1.372	1.357	0.600
Std Dev	0.022	0.013	0.022	0.008

* Discontinued product, listed here for reference only.

Test 4, I/O Turnaround for Parallel Interface (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	0.972	0.933	1.047	0.423
Max.	1.026	1.030	1.115	0.560
Med.	0.975	0.936	1.066	0.438
Mean	0.984	0.942	1.069	0.447
Std Dev	0.018	0.020	0.015	0.034

Test 5, I/O Turnaround for HP 7912 Disk (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	37.55	38.63	37.75	36.00
Max.	39.83	40.05	40.30	37.10
Med.	39.07	39.09	39.53	36.34
Mean	39.01	39.22	39.49	36.39
Std Dev	0.536	0.448	0.642	0.361

Test 7, Semaphore Clear with Context Switch (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	1.301	1.393	1.434	0.609
Max.	1.474	1.554	1.614	0.641
Med.	1.304	1.395	1.434	0.620
Mean	1.315	1.408	1.516	0.619
Std Dev	0.042	0.044	0.089	0.009

Test 8, Passing of 1-Byte Message with Context Switch (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	2.829	2.895	3.011	1.421
Max.	3.003	3.061	3.200	1.456
Med.	2.846	2,914	3,032	1,453
Mean	2.854	2.922	3.040	1.450
Std Dev	0.040	0.041	0.043	0.009

Test 9, Passing of 80-Byte Message with Context Switch (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	2.911	2.958	3.092	1.486
Max.	2.932	2.982	3.273	1.504
Med.	2.929	2.977	3.095	1.499
Mean	2.925	2.974	3.131	1.497
Std Dev	0.007	0.008	0.069	0.005

Test 10, I/O Time-to-Complete 1-byte Transfer to Mag Tape Unit via HP-IB (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	33.15	33.96	32.50	27.74
Max.	33.98	34.74	35.35	28.36
Med.	33.47	34.24	34.63	27.94
Mean	33.55	34.28	34.57	28.00
Std Dev	0.227	0.206	0.574	0.230

Test 11, I/O Time-to-Complete 80-byte Transfer to Mag Tape Unit via HP-IB (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	34.27	35.10	35.40	28.83
Max.	35.22	36.81	36.70	29.46
Med.	34.73	35.34	35.70	29.19
Mean	34.75	35.45	35.78	29.13
Std Dev	0.255	0.355	0.354	0.200

Test 12, I/O Time-to-Complete 1-byte Transfer to Loop-Back Hood via Parallel Interface (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	3.410	3.711	3.756	1.812
Max.	6.579	6.740	7.080	3.164
Med.	3.573	3.874	3.803	1.896
Mean	3.751	4.122	4.011	2.021
Std Dev	0.818	0.884	0.667	0.381

Test 13, I/O Time-to-Complete 80-byte Transfer to Loop-Back Hood via Parallel Interface (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	3.428	3.719	3,773	1,822
Max.	6.411	6.743	4.201	4.273
Med.	3.460	3.862	3.888	1.915
Mean	3.631	3.960	3.903	2.030
Std Dev	0.598	0.619	0.113	0.496

Test 14, HP 7912 Disc Time-to-Complete 512-byte Transfer (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	6.26	12.86	8.96	4.25
Max.	20.79	20.83	19.93	20.08
Med.	16.97	16.54	15.85	4.98
Mean	16.25	16.52	15.56	7.22
Std Dev	2.70	1.30	1.53	4.45

Test 15, HP 7912 Disk Time-to-Complete 8k-byte Transfer (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	14.16	20.42	18.15	12.19
Max.	48.31	44.02	43.16	46.80
Med.	30.46	29.91	28.10	28.33
Mean	33.37	32.66	32.04	25.88
Std Dev	9.86	9.06	9.31	9.97

Test 16, HP 7912 Disk Time-to-Complete 32k-byte Transfer (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	61.06	60.64	59.99	55.15
Max.	88.82	90.19	87.50	90.50
Med.	77.64	86.32	78.54	74.37
Mean	79.82	82.57	79.60	76.21
Std Dev	8.27	6.42	7.99	8.42

Test 17, Sequential Write of 512 bytes to Type 3 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	4.570	4.376	4.580	3.517
Max.	5.124	4.835	4.785	3.822
Med.	4.793	4.668	4.783	3.820
Mean	4.838	4.668	4.779	3.814
Std Dev	0.102	0.075	0.028	0.042

Test 17A, Sequential Write of 512 bytes to Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	6.751	6.746	6.752	5.151
Max.	7.085	7.229	6.804	5.343
Med.	6.754	6.747	6.755	5.153
Mean	6.802	6.792	6.756	5.167
Std Dev	0.083	0.102	0.009	0.041

* Discontinued product, listed here for reference only.

Test 18, Sequential Write of 8k bytes to Type 3 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	51.03	50.68	50.83	49.38
Max.	51.59	56.15	51.04	49.52
Med.	51.40	50.85	51.02	49.52
Mean	51.35	51.21	51.02	49.51
Std Dev	0.187	1.170	0.027	0.020

Test 18A, Sequential Write of 8k bytes to Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	84.81	84.71	91.98	66.38
Max.	85.96	86.01	92.48	69.08
Med.	85.27	85.04	92.00	66.40
Mean	85.22	85.07	92.01	66.51
Std Dev	0.238	0.254	0.089	0.488

Test 19: Sequential Write of 32k bytes to Type 3 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	202.2	201.7	201.7	196.3
Max.	202.9	207.3	201.9	196.5
Med.	202.4	202.2	201.9	196.5
Mean	202.4	202.3	201.9	196.5
Std Dev	0.169	0.747	0.048	0.036

Test 19A: Sequential Write of 32k bytes to Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	339.4	338.9	367.0	265.4
Max.	340.2	340.6	367.1	265.5
Med.	339.8	340.0	367.0	265.5
Mean	339.8	340.0	367.0	265.5
Std Dev	0.211	0.382	0.046	0.032

Test 20, Sequential Read of 512 bytes from Type 3 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	40.36	40.37	40.58	39.38
Max.	40.87	41.36	40.60	36.49
Med.	40.57	40.70	40.59	39.39
Mean	40.59	40.65	40.59	39.40
Std Dev	0.163	0.148	0.004	0.031

Test 20A, Sequential Read of 512 bytes from Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	4.053	4.097	4.100	2.889
Max.	4.164	5.844	4.307	3.070
Med.	4.101	4.099	4.102	2.890
Mean	4.104	4.187	4.108	2.905
Std Dev	0.016	0.380	0.037	0.040

Test 21, Sequential Read of 8k bytes from Type 3 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	74.15	77.97	84.38	71.68
Max.	75.49	80.45	85.87	71.95
Med.	74.70	78.97	85.27	71.71
Mean	74.79	79.08	85.15	71.72
Std Dev	0.321	0.544	0.420	0.048

Test 21A, Sequential Read of 8k bytes from Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	43.20	43.16	43.25	42.07
Max.	44.51	43.68	43.73	58.04
Med.	43.36	43.33	43.25	42.15
Mean	43.44	43.38	43.28	42.67
Std Dev	0.202	0.139	0.091	2.855

Test 22, Sequential Read of 32k bytes from Type 3 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	173.4	173.3	173.2	168.6
Max.	174.4	174.7	173.3	168.8
Med	174.0	174.0	173.3	168.6
Mean	173.9	174.0	173.3	168.7
Std Dev	0.245	0.273	0.014	0.056

Test 22A, Sequential Read of 32k bytes from Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	173.1	172.7	172.8	168.3
Max.	174.0	173.9	173.1	169.4
Med.	173.7	173.5	173.0	168.4
Mean	173.6	173.5	173.0	168.5
Std Dev	0.249	0.327	0.060	0.269

Test 23, Random Write of 512 bytes to Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	65.86	68.37	63.82	52.50
Max.	67.03	69.21	64.01	55.57
Med.	66.21	68.69	63.83	52.83
Mean	66.35	68.70	63.85	52.98
Std Dev	0.300	0.244	0.055	0.505

Test 24, Random Write of 8k bytes to Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	81.78	83.45	90.37	77.87
Max.	83.41	84.44	91.17	81.02
Med.	82.59	83.91	90.70	78.19
Mean	82.60	83.95	90.73	78.30
Std Dev	0.313	0.238	0.171	0.665

Test 25, Random Write of 32k bytes to Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	341.7	342.3	368.6	280.3
Max.	343.6	344.1	369.2	282.8
Med.	342.5	343.3	369.0	280.4
Mean	342.5	343.3	369.0	280.7
Std Dev	0.437	0.548	0.155	0.792

Test 26, Random Read of 512 bytes from Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	33.59	33.61	34.13	27.87
Max.	34.25	34.11	34.67	28.16
Med.	33.76	33.78	34.46	27.96
Mean	33.73	33.87	34.41	27.99
Std Dev	0.152	0.173	0.101	0.076

Test 27, Random Read of 8k bytes from Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	46.83	47.20	47.90	41.46
Max.	47.99	47.74	48.88	44.28
Med.	47.26	47.36	48.23	41.70
Mean	47.24	47.46	48.25	41.83
Std Dev	0.282	0.159	0.192	0.467

* Discontinued product, listed here for reference only.

Test 28, Random Read of 32k bytes from Type 2 File (times in milliseconds)

Proc.	A400	A600+	A700*	A900
Min.	180.2	180.1	181.8	171.3
Max.	181.3	181.8	182.4	171.7
Med.	180.9	181.1	182.0	171.5
Mean	180.8	181.1	182.0	171.5
Std Dev	0.346	0.429	0.180	0.109

* *Discontinued product, listed here for reference only.*

Edit/1000

Introduction

Edit/1000 is a powerful screen editor designed to help programmers develop software quickly and accurately with minimal effort. Edit/1000 helps the user to create and manipulate files of upper and lower case ASCII characters. Lines, strings, and characters can be inserted, deleted, copied, or moved within the file. Files to be edited can be source language programs or text material.

Features

- Convenient screen mode entry and editing of files.
- Powerful character string search and replacement capabilities.
- Commands for copying and moving lines within the edit file.
- Ability to create a new file or back up a partly-edited file without leaving edit mode.
- Provision for recovery of edit file after system halt.
- On-line command summary, with ability to obtain more information about any command, easily accessible to the user without leaving the editor or having to refer to a manual.

Functional Description

Operating Modes

Edit/1000 interacts with the user through edit commands and is designed to operate in the following modes:

- Screen mode, in which the user types in a screen of text and modifies the text using any of the HP terminal's editing features.
- Line mode, in which edit commands operate on groups of one or more lines.

Screen Mode

In the screen mode, the editor treats the terminal screen as a window through which the user can view a section of text, such as a subroutine or a paragraph. A cursor within this window indicates the character at which editing will take place. The user controls the cursor with the help of the terminal and can also move the window forward or backward any number of lines within the file. The editing facilities of the terminal are used, which offloads the system substantially. The user is working directly with single keystroke commands, which are often faster and more convenient to use than the line edit commands of the editor.

Advanced Line Editing Capabilities

In addition to the basic text maintenance functions of retrieve, insert, add, change, and delete, Edit/1000 provides sophisticated character string search and replace capabilities that can be used to change any string of characters in the file to another string, or can selectively change character strings within specified columns only. This greatly simplifies the change of variable names throughout a program, or terminology throughout a text file.

Merging of source files, merging and breaking of lines, and powerful copy and move functions facilitate electronic cut and paste rearrangement of program code or text in the edit file. Copying of repeated table headings or copying and editing of similar text to various appropriate places in the edit file can be a particularly powerful time and effort saver.

Display of lines before and after the current line, viewing the previous or next screen, tab setting, and the ability to undo modification are other highly useful capabilities built into Edit/1000.

Interactive Instructions

Edit/1000 provides for on-line interactive explanation of its commands to help the casual user who may have forgotten some of the available commands or how some commands are used.

On-Line File Creation and Edit File Backup

Edit/1000 supports creation and storage of the current edit file without leaving the editor. Similarly, the current state of the edit file can be backed up, also without leaving the editor. This is particularly helpful in safeguarding the time and effort invested in a partly completed edit.

Recovery After System Halt

The current edit file is continually maintained by Edit/1000 in a separate working file. If a system halt has interrupted an edit the request for edit after the system has come back on line causes entry into a recovery mode in which the working file is given its original name, or a completely new name. The edit can then be resumed, editing on that file.

Functional Specifications

Environment

HP 1000 Computer System operating under RTE-A.

Character Set

All ASCII characters.

Ordering information

Edit/1000 software and User's Manual (92074-90001) are included in HP 1000 A-Series Computer Systems, in the HP 92077A RTE-A operating system.

Software Support

Software support for Edit/1000 is included with software support for RTE-A.

92860A
Symbolic Debug/1000

```
     40            RE    = DCOS   (ANG)
     41            IM    = DSIN   (ANG)
     42     2      IF   ( .NOT.   NEW   .AND.   K*K0   .GE.   1 ) GO TO 4
     43 C         ------------------------------------------------
     44 C           COMPUTE TWIDDLES IF NECESSARY ...
     45 C         ------------------------------------------------
     46            U(1) = DCMPLX( RE , -SIGN(IM,DBL(K)) )
>    47            DO  3  I   =   2,L2N
     48     3      U(I)   =   U(I-1)*U(I-1)
     49            K0 = K
     50 C         ----------------
     51 C           BUTTERFLIES.
     52 C         ----------------
     53     4      SBY2 = N
     54            DO 7 STAGE = 1,L2N

DEB.A> b 47/fft
Breakpoint set at 47/fft
DEB.A> p
Break at 47/fft
DEB.A> d L2N new re u(I)
L2N = 5      NEW = true       RE = 0.980785282244344
U(I) = (0.980785282244344, -0.195090312760225)
DEB.A> m L2N 6
L2N: 5 => 6
DEB.A>
```

Introduction

Symbolic Debug/1000 is an interactive symbolic debugger for source-level FORTRAN, Pascal, compiled BASIC, and Macro programs on RTE-A or RTE-6/VM based HP 1000 systems. Variables are displayed or modified using names from the original program. Load maps and program listings are not needed. One and two word integer, two, three, and four word reals, logical, complex, character, Hollerith, and structured data types are supported.

Symbolic Debug resides in a separate partition from the program being debugged to eliminate program code space intrusion. Debug is capable of adopting a program after it has begun to execute – it is not required to be the "father" program to the "son" program being debugged. A single-stepping, source-line capability displays the current and adjacent lines during execution. Conditional breakpoints can be used to monitor variable values and stop the program at a specified value.

Using the profiling capability, the user can determine which subroutine is using the most program time and optimize the code to decrease execution time. A small, simple command set, the use of dozens of English error messages, and an on-line "help" facility make Symbolic Debug/1000 a friendly and powerful programmer's productivity tool.

Features

- Can adopt a program to be debugged after execution has started.
- Can display source code during execution.
- Non-intrusive debugging -- Symbolic Debug resides in a partition separate from program being debugged.
- Support for EMA, VMA, and RTE segmentation.
- Support for all data types.
- Profiling capability for isolation of slow subroutines.
- Source line-by-line single stepping capability.
- Up to 50 conditional breakpoints to stop program at specified variable value.

Functional Description

Symbolic Debug recognizes the names, types, and locations of all the variables and routines used in the program, eliminating the need for load maps, symbol table dumps, and mixed listings. The value of a variable can be examined as fast as its name can be typed.

The user interacts with the program as it runs and can examine or alter variable values while the program runs without having to insert statements into the code. Bugs can be found quickly, since there's no need to recompile and load every time a new bug occurs.

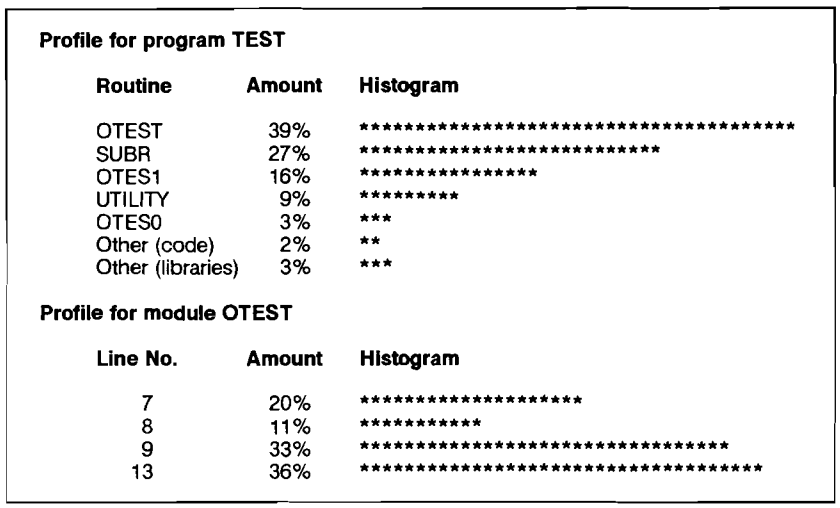
Symbolic Debug resides in a memory partition separate from the program. No code space is lost and no extra statements are added in order to debug. The program being debugged runs exactly as it would normally. No bugs are introduced by the debugger, and more importantly, bugs don't disappear when the debugger is present, only to reappear when the debugger is not used. There is no need to restructure a program just to debug it.

Symbolic Debug recognizes what line of source code is about to be executed, and identifies it on the CRT display. Programs can be debugged in the language in which they were written, without the need for inverse listings or mixed listings.

Symbolic Debug detects RTE program violations, such as an attempt to access protected memory. After such a violation, memory locations can be examined to determine the cause of the problem. Symbolic Debug pinpoints the line of source code that caused the error, giving the user an interactive tool for catching and correcting system violations.

Up to 50 breakpoints can be used to monitor program variables and halt the program if a variable reaches a specified value.

Non-interactive debugging, in which users submit debug commands in a file and have results logged in another file, is also supported. This automates the debugging process, so users don't have to wait for bugs whose symptoms may take hours or even days to appear.



Profile for program TEST

Routine	Amount	Histogram
OTEST	39%	**
SUBR	27%	**************************
OTES1	16%	****************
UTILITY	9%	*********
OTES0	3%	***
Other (code)	2%	**
Other (libraries)	3%	***

Profile for module OTEST

Line No.	Amount	Histogram
7	20%	********************
8	11%	***********
9	33%	**********************************
13	36%	************************************

A built-in profile monitor (example above) helps to isolate slow parts of programs. High-level analysis of activity distribution within the program helps to identify time-consuming subroutines that should be optimized in order to improve execution time.

Debug Command Summary

B <Loc> Sets breakpoint at specified location.

C <Loc> Clears breakpoint at specified location.

D <Loc> Displays variable.

E Aborts program and exits debug.

F Finds string in source file.

D Displays histogram.

I <f1 [f2]> Executes a set of commands from file f1 and optionally logs the output to file f2.

L <Loc> Lists a screenful of source code in your program.

M <Loc> <val> Modifies the value of a variable.

O Requests overview mode for program profiling.

P <line> Allows your program to proceed to the next breakpoint or a specified line.

S Steps to the next line of source code.

T <Loc> Shows location executed without stopping the program.

V <number> Changes the number of source lines displayed on the screen.

W Shows callers of the current subroutine.

? Requests help.

Levels of Support

For FORTRAN, Pascal, BASIC, and Assembly Language Programs

All appropriate Symbolic Debug/1000 features are supported when debugging FORTRAN, Pascal/1000, BASIC/1000C, and Macro/1000 Assembly language programs.

For Ada/1000* Programs

Symbolic Debug/1000 support for Ada programs is limited to:

- Modification and display of simple variables.
- Setting breakpoints.
- Single-stepping.

Ordering information

HP 92860A Symbolic Debug/1000 (must order one of Use Options 400 through 897)

Symbolic Debug/1000 consists of:

1. The Symbolic Debug/1000 software on media option 022, 044, 050, or 051, **one of which must be ordered.**
2. 92860-90001 Symbolic Debug/1000 User's Manual.
3. 92860-90002 Symbolic Debug/1000 Configuration Guide.

* Identifies discontinued product listed here for reference only.

92860A Media Options

022: Provides software on CS/80 cartridge tape.

044: Provides software on microfloppy disc for HP 12120A*/12122A Integrated Disks in Micro/1000 package or HP 9122C/D* or 9133A*/B*/H*/L*, or 9153B*/C Disk.

050: Provides software on 800 cpi, 9-track mag tape.

051: Provides software on 1600 cpi, 9-track mag tape.

* Identifies discontinued product listed here for reference only.

HP 92860R Use of Symbolic Debug/1000 on One Additional Computer System (must order one of Use Options 400 through 897)

1. The right to make one copy of software purchased with the 92860A Symbolic Debug/1000 for use on an additional system.
2. 92860-90001 Symbolic Debug/1000 User's Manual.
3. 92860-90002 Symbolic Debug/1000 Configuration Guide.

92860A/R Use Options

400: Use in HP 12100A Single Board Computer, HP 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

601: Upgrade from previous version of 92860A/R option 600 to latest version of same for customer NOT on support service.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

701: Upgrade from previous version of 92860A/R option 700 to latest version of same for customer NOT on support service.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E/F*-Series computer or SPU. With 92860A, option 890 includes the right to purchase one or more 92860R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 92860A option 890 to latest version of same for customer NOT on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

* Identifies discontinued product listed here for reference only.

Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision for definitions of software support products.

NOTES:

92836A
FORTRAN 77

Introduction

HP 92836A FORTRAN 77 is a full implementation of the latest ANSI Standard for FORTRAN. This powerful language processor includes many extensions for compatibility with mainframe implementations of FORTRAN to simplify program migration to the HP 1000.

HP 92836A FORTRAN 77 operates under HP 1000's RTE-A and RTE-6/VM real-time executive operating systems, taking full advantage of the extended features available such as large data and program capabilities. In addition, FORTRAN 77 programmers can directly call external routines written in Pascal or Macro/1000 Assembler to maximize flexibility and performance yet minimize program development efforts.

HP 92836A FORTRAN 77 supports the Command Interpreter file system in RTE-A and RTE-6/VM and code and data separation for support of large programs under RTE-A/VC+.

Features

- Full ANSI 77 FORTRAN (X3.9-1978).
- Compatibility with ANSI 66 FORTRAN.
- Fast compilation.
- Support for variables and arrays using up to 128M bytes of virtual storage.
- Generation of CDS output code for RTE-A/VC+ systems.
- Full MIL-STD-1753 extensions.
- Extensions to enhance mainframe compatibility.
- Long names with up to 16 significant characters.
- Double complex data type.
- System programming extensions.
- Transparent access to remote files in a distributed systems network.
- Local optimization for efficient generated code.
- Compatibility with other HP 1000 software subsystems such as Graphics/1000-II, DS/1000-IV, and Image/1000.

How FORTRAN 77 Provides More Powerful Programming

Structured Control Flow for Simplified Coding

IF THEN ELSE construct: IF(...) THEN, ELSE, ELSEIF(...) THEN, and ENDIF statements are included for enhanced readability.

Faster, more flexible DO loops: DO loops can be specified for zero trip; trip count is precomputed; and the index can be integer, real or double.

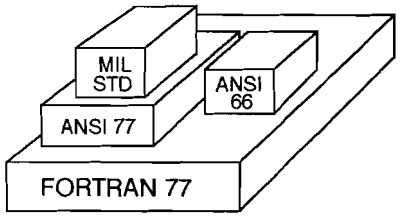
Alternate returns: Allows program flow to return to a statement other than the one following the subroutine statement call (e.g. for error processing).

Alternate entries: Allows multiple entry points to a program, increasing program modularity.

STOP and PAUSE: These statements display character strings as well as numbers.

Powerful Data Manipulation

CHARACTER data type: replacing Hollerith constants and data in ANSI 66, CHARACTER data offers easy string manipulation.



Expressions valid in most contexts: In most places where a variable or constant is legal, so is an expression.

Constant expressions in declarations: With PARAMETER statements, programs can be 'parameterized' so that array sizes and other constant values need not be hard coded.

Variable dimensions as runtime expressions: Array upper and lower bounds (for parameters) can be computed from other parameters and COMMON variables.

Additional intrinsic functions: included are functions for rounding, various transcendentals and string manipulation.

Generic intrinsic functions: single names may be used for all versions of an intrinsic (e.g. SIN in place of DSIN) for most FORTRAN library functions.

General-Purpose I/O

OPEN, CLOSE, INQUIRE statements: for disc files and devices. INQUIRE can be used to investigate properties of a file.

Direct access I/O: allows any record in a direct-access file to be read or written quickly by record number.

List-directed I/O: Input data can be 'free-field' and appropriate formats are chosen for output data. In both cases, FORMAT statements are unnecessary.

Internal files: allows the power of FORMAT number conversions to be used with character variables or arrays like the ACSII 'buffer'.

Error handling (ERR=, END=, IOSTAT=): an error specifier enables more control over actions to be taken when an I/O error is detected.

Additional format capabilities: For example, control over printing of leading zeros.

READ and PRINT to standard devices: Logical unit number can be defaulted to (possibly different) standard input and output devices.

New Declarations

PARAMETER statement: to give names to con- stants. Allows 'parameterization' of programs, includ- ing values that can control conditional compilation.

IMPLICIT statement: used to change the default implicit types within a program unit.

SAVE statement: causes the values of local variables in a subprogram to be saved from one call to the next, even if the subprogram is in a disk-resident segment.

Implied DO loops in DATA statements: Portions of arrays can be initialized and subscripts of arrays within the 'DO' can be expressions.

INTRINSIC statement: specifies that a intrinsic function is to be passed to a subprogram. Names declared EXTERNAL will not be intrinsics.

PROGRAM statement: optional statement to name the main program.

Array dimensions: Arrays can have up to seven dimensions.

Array declarators: Upper and lower bounds of array dimensions can be specified in array declarators.

HP 1000 Extensions to ANSI 77 FORTRAN

Mainframe compatibility

Selection of ANSI 66 or 77 semantics: where FORTRAN 77 is incompatible with the previous standard or common industry practice, HP's compiler provides alternative interpretations on a user-selectable basis.

Long names: up to 16 significant characters.

Embedded underscore: allowed in symbolic names.

ENCODE and DECODE statements: provides memory-to-memory formatting.

IBM-style direct access READ and WRITE: may be formatted or unformatted.

Byte-length data types: e.g. INTEGER*4.

Embedded comments: an exclamation point can be placed after any statement signifying an end-of-line comment.

Extended-range DO loops: permits transfer of control out of a DO-loop and then back in.

Hollerith data manipulation: Hollerith data can be used in DATA statements, READ/WRITE, and as arithmetic operands.

Quoted Hollerith constants in DATA statements: Both character and non-character variables can be initialized with ASCII in DATA statements.

Double precision COMPLEX data types: As approved by the IFIP WG 2.5 on Numerical Software.

Compliance with MIL-STD 1753

DO WHILE looping construct: allows execution of a DO-loop while a logical expression holds true.

END DO: used as a terminal statement of a DO-loop The matching DO may omit the statement number.

Nested INCLUDE: allows inclusion of text (e.g. COMMON declarations) from another file. INCLUDE is offered as both a statement and directive, and permits nonrecursive nesting.

Bit manipulation intrinsics: Functions for logical and circular shifting, set/clear/test bit, bit field extraction, bit field move, and masking operations.

IMPLICIT NONE statement: removes implicit types so that all variables must be explicitly typed. All implicit types assume the normal default values.

Octal and hexadecimal constants in DATA statements.

System Programming Capabilities

Conditional compilation is achieved through the coordinated use of named constants, constant folding, and dead code removal.

Aliasing of subprogram names to allow special characters.

Specification of non-standard calling sequences.

Extension of .AND.,.OR., .NOT., .EQV.,.NEQV., .XOR. to integer data.

Bit shifting, extraction and testing intrinsics.

EQUIVALENCEing of character and non-character data.

Intrinsic function to get actual number of parameters passed to a subprogram.

HP-IB (IEEE 488) device control via secondary addressing and control buffers.

Virtual Data Capabilities

Local variables and common blocks may be used in up to 128M bytes of virtual memory.

Double integer subcripts may be used to access arrays with dimensions greater than 32767 elements.

Program Form

Lower case accepted (mapped to upper case).

Descriptive error messages .

Optional compilation of lines beginning with "D".

Integers may be defaulted to single or double length.

Functional Specifications

Applicable Standard

HP 1000 FORTRAN 77 is a superset of both ANSI FORTRAN X3.9-1978 and X3.9-1966.
Environment

Environment

Operating system: HP 1000 Computer Systems operating under RTE-A or RTE-6/VM that meet the minimum hardware requirements of the operating system, plus a list device.

Memory requirements:

Program Size	Memory Required
Up to 1,000 lines	64 KB (32 pages)
Up to 30,000 lines	140 KB (70 pages)

Compilation speed (CPU time only)

1500-3000 lines per minute.

Data Types

See Table 2-5, below.

Optimizations by the Compiler

Constant expression folding: Compile-time evaluation of expressions that involve only constant values, named constants, and arithmetic, logical and relational operators. Some folding of character operations is also performed.

DO statements: The compiler takes advantage of constant initial, final and step values.

Subscript evaluation: Parts of subscripts that can be evaluated at compile time are removed from the generated code; subscript calculations are done with in-line code.

Dead code removal: Unreachable code within IF- THEN-ELSE, DO-WHILE, and DO constructs is removed (i.e. no code is generated).

Logical and arithmetic IF: Branch structure optimizations decrease program size and improve execution speed. For example, the compiler detects if statement numbers in an arithmetic IF statement are not distinct.

Compiler Options

L: Produces listing.

M: Produces mixed listing.

T: Produces table of symbols (type, address, etc.).

C: Produces cross-reference of symbols.

D: Compiles debug lines.

Q: Adds relative addresses of statements to listing.

E: EMA transparency; causes all subroutine parameters to use 32-bit addresses.

X and Y: Selects default double precision size to be 48 or 64 bits, respectively.

I and J: Selects default integer size to be 16 or 32 bits, respectively.

S: Causes symbolic debugging information to be placed in the relocatable file.

Table 2-5. FORTRAN 77 Data Types

DATA TYPE	PRECISION (digits)	SIZE (bits)	RANGE
INTEGER*2	5 - 6	16	-32768 to 32767
INTEGER*4	9 - 10	32	-2,147,483,648 to 2,147,483,647
LOGICAL*2	--	16	.true./.false.
LOGICAL*4	--	32	.true./.false.
REAL*4	6.6 - 6.9	32	$\pm 1.47 \times 10^{-39}$ to $\pm 1.70 \times 10^{39}$
REAL*8	16.3 - 16.6	64	$\pm 1.47 \times 10^{-39}$ to $\pm 1.70 \times 10^{39}$
COMPLEX*8	6.6 - 6.9	64	
COMPLEX*8	16.3 - 16.6	128	
CHARACTER		1 to 32767	256 characters, the full ASCII set
HOLLERITH		2 to 8 chars.	

NOTE: For COMPLEX data, table applies to real and imaginary parts separately.

FORTRAN Library Functions

See Table 2-6, at right.

Figure 2-6. FORTRAN Library Functions

Transcendental and Trig		Convert	Max/Min Mod, etc.	Bit Manip.	Char. and Misc.
*SQRT	DSIND	IFIX	MIN	IAND	CHAR
DSQRT	*COSD	FLOAT	MINO	IOR	ICHAR
CSQRT	DCOSD	SNGL	MIN1	NOT	INDEX
*SIN	*TAND	*DBLE	AMINO	IXOR	LEN
DSIN	DTAND	*REAL	AMIN1	IEOR	LLT
CSIN	*ASIN	*INT	DMIN1	ISHFT	LLE
*COS	DASIN	AINT	*MAX	ISHFTC	LGE
DCOS	*ACOSN	DINT	MAX0	IBITS	LGT
CCOS	DACOS	DDINT	,MAX1	BTEST	
*TAN	*ATAN	IDINT	AMAX0	IBSET	ISSW
DTAN	DATAN	*NINT	AMAX1	IBCLR	DPROD
CTAN †	ATAN2	IDNINT	DMAX1	MVBITS	PCOUNT
*EXP	DATAN2	ANINT	*MOD		
DEXP †	ASIND	DNINIT	AMOD		
CEXP	DASIND	*IMAG	DMOD		
*LOG10	*ACOSD	AIMAG	*SIGN		
ALOG10	DACOSD	CMPLX	ISIGN		
DLOG10	*ATAND	DCMPLX	DSIGN		
*LOG	DATAND	CONJG	*DIM		
ALOG	*ABS		IDIM		
DLOG	IABS		DDIM		
CLOG	DABS				
*SIND	CABS				

† identifies generic form.

Ordering Information

HP 92836A FORTRAN 77 (must order one of Use Options 400 through 897)

HP 92836A FORTRAN 77 includes:

1. FORTRAN 77 compiler and library on software media option 020, 022, 044, 050, or 051, **one of which must be ordered.**
2. 92836-90001 FORTRAN 77 Reference Manual.

92836A Media Options

022: Provides software on CS/80 Cartridge Tape.

044: Provides software on Microfloppy disc for HP 12120A*/ 12122A Integrated Disks in Micro/ 1000 Package or HP 9122C/ D* or 9133A*/B*/H*/L* or 9153B*/C Disk.

050: Provides software on 800 cpi magnetic tape.

051: Provides software on 1600 cpi magnetic tape.

* Discontinued product.

HP 92836R Right to Copy FORTRAN 77 Compiler for Use on an Additional Computer System (must order one of Use Options 400 through 897)

The HP 92836R Right to Copy product is available only to customers who have purchased HP 92836A without an upgrade option. 92836R consists of:

1. The license to make one copy of software purchased with 92836A for use on an additional system.
2. 92836-90001 FORTRAN 77 Reference Manual.

92836A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D* /G/H Model 26 SPU, or 2486A*/ B/C Micro 26 SPU.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

* Discontinued product.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E/F*-Series computer or SPU. With 92836A, option 890 includes the right to purchase one or more 92836R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 92836A/R option 890 to latest version of same for customer NOT on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

Software Support

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

92833A
Pascal/1000

Introduction

The HP 92833A Pascal/1000 compiler supports program development in the Pascal high-level, block-structured programming language in HP 1000 Computer Systems operating under Hewlett-Packard's RTE-A, RTE-A/VC+, or RTE-6/VM real-time exec- utive operating system. Pascal/1000 is the implementation of HP Pascal for the HP 1000 computer family.

HP Pascal is a superset of ANSI Pascal, and is supported on most HP computer systems. Pascal/1000 also provides important extensions that take full advantage of HP 1000 capabilities. Pascal/1000 object programs can be executed in HP 1000 Computer Systems operating under HP's RTE-A, RTE-A/VC+, and RTE-6/VM systems as well as in the discontinued RTE-IVB, RTE-IVE, RTE-XL, and RTE-L systems.

HP 92833A Pascal/1000 supports the Command Interpreter and hierarchical directories in RTE-A, RTE-A/VC+, and RTE-6/VM. The HP 92833A compiler also supports Code and Data Separation (CDS) capability for large programs in the RTE-A/VC+ system in addition to support of non-CDS program development. Under RTE-A/VC+, the Pascal compiler itself is a CDS program, so multiple compilations share one copy of the compiler's code.

Features

- Easily-understood programming.
- Powerful, compact syntax.
- Modern block-structured language.
- Logical organization that facilitates documentation, modification, and maintenance of programs.
- Early detection of errors at compile and run time.
- Fast debugging with 92860A Symbolic Debug/1000.
- Separate compilation of modules with interface checking at compile time.
- Improved program reliability.
- Clearly defined data structures complemented by flexible user-declared data types.
- Generation of CDS output code for RTE-A/VC+ systems.
- Access via Command Interpreter file system as well as FMGR file system.
- FORTRAN and Macro/1000 Assembly language subroutines.
- Files in the Heap.
- Fast execution.
- String data type.
- Hexadecimal, octal, and binary data support.
- 16- and 32-bit integer, single and double precision real, Boolean, character, text file, and user-defined data types using arrays, records, sets, files, pointers, and variable-length strings.
- Shared compiler in RTE-A/VC+ systems.
- Compatibility with HP 1000 software subsystems, such as Image/1000, Graphics/1000-II, and DS/1000-IV.

Pascal Standards

Pascal/1000 is an extension of HP Pascal, which in turn is an extension of ANSI Pascal.

HP Pascal Extensions of ANSI Pascal

1. An OTHERWISE clause may be specified in the CASE statement.
2. Compiler options (ANSI, PARTIAL, EVAL, LIST, PAGE, and INCLUDE) may be specified to control various aspects of the compilation and its output.
3. A constant expression may appear in an HP Pascal program anywhere that a constant may appear in ANSI Pascal.
4. Constants of structured data types may be declared in the CONST section of a block.
5. CONST, TYPE, and VAR sections of a declaration may be intermixed and repeated.
6. Halt procedure may be used for abnormal termination of a program.
7. The underscore (_) may appear in identifiers, but not as the first character.
8. A function may return a structured type (array, record, set, or string), but not a file type or or a structure containing a file type.
9. Longreal numbers identical with type REAL, but providing greater precision, are supported.
10. The standard constant, minint, is defined to be the smallest integer representable on the machine.

11. File I/O includes:
    a. Direct access I/O, using predefined routines open, seek, readdir, writedir, maxpos, and last pos.
    b. Append procedure to open a file to write, starting at the end of the file.
    c. Close procedure to explicitly close any file.
    d. "Deferred get" procedure to support interactive input.
    e. Read procedure that accepts variables of enumerated types, PAC types,and string types.
    f. Write procedure that accepts expressions of enumerated and string types.
    g. Position function that returns index of the current position for any file which is not a textfile.
    h. Linepos function that returns the integer number of characters which the program has read from or written to a textfile since the last line marker.
    i. Prompt procedure flushes the output buffer of a textfile without writing a line marker.
    j. Overprint procedure causes a line to be overprinted when a textfile is printed. A carriage return is performed without line feed.

12. STRING data type, which consists of a packed array of CHAR with a declared maximum length and an actual length that may vary at run time, is supported. Several operators, procedures, and functions manipulate strings. Assignment (:=) operator may be used to assign strings or string literals to strings. Concatenation (+) produces a string composed of two other strings.

13. Record variant declaration in which the variant part of a record field list may have subranges of constant expressions as case constants.

14. String literals support permits the encoding of control characters or any other single ASCII character after the # symbol. The # character may be used to include any ASCII character within a string literal.

Pascal/1000 Extensions to HP Pascal

1. REAL and LONGREAL constant expressions are supported.
2. Subprograms or segments may be separately compiled.
3. Additional compiler options are supported (see Compiler Options section, below).
4. Some user-callable library routines are provided in the Pascal runtime libraries.

Functional Specifications

Supportable Configurations

The HP 92833A Pascal/1000 Compiler supports the following configurations.

CDS Configuration: Code and Data Separation (CDS) minimizes memory requirements for four to six concurrent compilations, as compared to the non- CDS Configuration. The CDS configuration is supportable only in RTE-A systems with VC+

Non-CDS Configuration: The non-CDS configuration does not support Code and Data Separation (CDS). It is supportable in RTE-A systems with or without VC+ and in RTE-6/VM systems.

Requirements

Main Memory: Main memory requirements for HP 92833A Pascal/1000 depend upon the working set size and the number of concurrent compilations to be supported, as listed in tables 2-7 and 2-8, next page. Within the limits specified, a larger working set gives faster compilation while using more main memory and less disk memory. Compilation performance is given on the next page.

NOTE: The information in Tables 2-7 and 2-8 is provided for general guidance only. Memory requirements of new releases of Pascal/1000 may differ from the requirements given in Tables 2-7 and 2-8. The customer is responsible for checking memory requirements of the current release of Pascal/1000 with an HP Systems Engineer to determine the adequacy of system memory.

Disk Memory: A hard disk with at least 40M byte capacity is required to support Pascal/1000 program development.

Character Set

Alphabetic characters: All upper and lower case characters (A through Z and a through z).

Numeric characters: The ten digits 0 through 9.

Special characters: blank; currency symbol ($); apostrophe ('); left and right parentheses; comma (,); plus, minus, equals, less than, and greater than symbols (+,-,=,<, >); decimal point (.); slash; colon and semi-colon; left and right brackets; left and right braces; carat (^); @ symbol; # sign; asterisk (*); and underscore (_).

Compilation Performance

Single-User Compilation Speeds: See Tables 2-9 and 2-10.

Multi-User Compilation Speeds: Compile speeds show less than 10% degradation for up to three concurrent compilations when each compilation is allocated its own working set of 110 pages for CDS use, 350 to 450 pages for non-CDS use.

Data Types

Integer: A 32-bit quantity, including sign, that ranges from –2,147,483,648 to +2,147,483,647.

Real: A 32-bit quantity with sign, exponent, and mantissa that ranges from 2^{-128} to 2^{127}, with 6 to 7 decimal digit accuracy.

Longreal: A 64-bit quantity with sign, exponent, and mantissa with same range as Real, above, but with 16 to 17 decimal digit accuracy.

Boolean: A 16-bit variable in which only the low order bit is used to determine the Boolean value true (1) or false (0).

Char: Values are the set of characters defined by the 8-bit ASCII character set.

Subrange type: A data type can be identified as a subrange of another ordinal type (Integer, Boolean, Char, or enumeration type) in which the least and largest values of the subrange are identified.

Array type: A structure consisting of a fixed number of components which are all of the same type, called the component type in which the elements of the array are designated by indices. The array type definition specifies the component type and the index type. Component type may be any type, including another structured type.

Table 2-7. Main Memory Requirements for CDS Configurations

Working Set Pages	Memory Required (KB) by Number of Concurrent Compilations					
	1	2	3	4	5	6
100	564	1126	1388	1650	1912	2174
90	844	1086	1328	1570	1812	2054
80	824	1046	1268	1490	1712	1934
70†	804	1006	1208	1410	1612	1814
60	784	966	1148	1330	1512	1694
50	764	926	1088	1250	1412	1454
40	744	886	1028	1170	1312	1454

† 70 pages is the default size of the working set.

Table 2-8. Main Memory Requirements for Non-CDS Configurations

Working Set Pages	Memory Required (KB) by Number of Concurrent Compilations					
	1	2	3	4	5	6
450	900	1800	2700	3600	4500	5400
425	850	1700	2550	3400	4250	5100
400	800	1600	2400	3200	4000	4800
375	750	1500	2250	3000	3750	4500
350	700	1400	2100	2800	3500	4200
325	650	1300	1950	2600	3250	3900
300	600	1200	1800	2400	3000	3600
275	550	1100	1650	2200	2750	3300
250	500	1000	1500	2000	2500	3000
225	450	900	1350	1800	2250	2700
200†	400	800	1200	1600	2000	2400
175	350	700	1050	1400	1750	2100
150	300	600	900	1200	1500	1800

† 200 pages is the default size of the working set.

Table 2-9. Compilation Speeds for CDS Configurations

Computer	Number of Pgm Lines	Compilation Speed (Lines/Minute) by Number of Working Set Pages				
		40	80	60	100	n/s
A900	800 5700	n/s 400	1000 800	1100 1300	1100 1400	n/s n/s
A400, A600+, and A700*	800 5700	n/s 200	600 400	600 600	600 600	n/s n/s

* Discontinued product, listed here for reference only.

Table 2-10. Compilation Speeds for Non-CDS Configurations

Computer	Number of Pgm Lines	Compilation Speed (Lines/Minute) by Number of Working Set Pages				
		200	250	300	350	400
A900	800 5700	500 600	600 500	900 700	1000 1200	1000 1400
A400, A600+, and A700*	800 5700	300 400	400 300	500 400	500 600	600 600
E* and F*-Series	800 5700	300 400	n/s 300	n/s 400	500 500	500 500

* Discontinued product, listed here for reference only.

String type: A variable-length ASCII character series (up to 32767 characters) represented by a variable.

Record type: A structure consisting of a fixed number of components that can be of different types. For each component, called a field, the record definition specifies its type and an identifier.

Set type: Defines a range of values which is the powerset of a base type, which can be Integer, Boolean, Char, or subrange or any enumeration type.

File type: Defines a structure consisting of a sequence of components that are all of the same type. The number of components (length) of the file is not fixed by the file definition.

Compiler Options

ALIAS: Specifies externally-accessible name of a Pascal program or module.

ANSI: Issues warnings for non-ANSI constructs.

ASMB: Specifies options to the assembler.

AUTOPAGE: Automatically pages before each routine in the listing.

BASIC_STRING: Converts Pascal string parameters to BASIC strings.

BUFFERS: Defines the number of file buffers.

CDS: Requests generation of CDS instructions.

CODE: Enables code generation.

CODE_CONSTANTS: Places structured constants in code space.

CODE_INFO: Requests printing of generated code size information.

CODE_OFFSETS: Prints the code offset of each Pascal line in the listing.

DEBUG: Generates information needed by HP 92860A Symbolic Debug/1000.

DIRECT: Use of faster calling sequence for a given procedure.

EMA: Specifies EMA and MSEG sizes.

EMA_VAR: Allocates selected global variable in EMA/VMA.

ERROREXIT: Specifies error return on an external routine.

FAST_REAL_OUT: Use faster, less precise output routines for real numbers.

FIXED_STRING: Converts Pascal string parameters to FORTRAN7x strings.

HEAP: Chooses small or large heap model for the program.

HEAP_DISPOSE: Chooses heap management algorithm.

HEAPPARMS: Specifies one or two word VAR parameter addresses.

IDSIZE: Specifies the number of significant characters in identifiers (1 to 150)

IMAGE: Reserves buffer space for Image programs.

INCLUDE: Requests inclusion of source from another file for compilation.

INCLUDE_DEPTH: Specifies maximum depth of include file nesting.

KEEPASMB: Saves the generated assembly file after compilation.

LINES: Specifies the number of lines per page in the listing.

LINESIZE: Specifies the maximum number of characters in a textfile line.

LIST: Generates compiler listing.

Ordering Information

HP 92833A Pascal/1000 (must order one of Use Options 400 through 897)

HP 92833A Pascal/1000 includes:

1. Pascal/1000 CDS and Non-CDS compiler, library, and error message file on software media option 022, 044, 050, or 051, **one of which must be ordered.**
2. 92833-90005 Pascal Programmer's Reference Manual.
3. 97082-90002 Programming in Pascal (tutorial manual).
4. 92833-90006 Pascal/1000 Software Numbering Catalog.

92833A Media Options

022: Provides software on CS/80 Cartridge Tape.

044: Provides software on Microfloppy disk for HP 12120A*/ 12122A Integrated Disks in Micro/ 1000 Package or HP 9122C/ D* or 9133A*/B*/H*/L* or 9153B*/C Disk.

050: Provides software on 800 cpi magnetic tape.

051: Provides software on 1600 cpi magnetic tape.

* Identifies discontinued product listed here for reference only.

String type: A variable-length ASCII character series (up to 32767 characters) represented by a variable.

HP 92833R Right to Copy Pascal/1000 Compiler for Use on an Additional Computer System (must order one of Use Options 400 through 897)

The HP 92833R Right to Copy product is available only to customers who have purchased HP 92833A without an upgrade option. 92833R consists of:

1. The license to make one copy of software purchased with 92833A for use on an additional system.
2. 92833-90005 Pascal Programmer's Reference Manual.
3. 97082-90002 Programming in Pascal (tutorial manual).
4. 92833-90006 Pascal/1000 Software Numbering Catalog.

92833A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

702: Upgrade from 92832A/R to 92833A/R for use on E*/F*-Series system for customer WITH support service for 92832A/R.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E/F*-Series computer or SPU. With 92833A, option 890 includes the right to purchase one or more 92833R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 92833A/R option 890 to latest version of same for customer NOT on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

* Identifies discontinued product listed here for reference only.

Software Support

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

NOTES:

92857A
BASIC/1000C

Introduction

BASIC/1000C is a BASIC language subsystem for multi-user conversational program development, testing, debugging, execution, and compilation in hard disk based HP 1000 Computer Systems operating under RTE-A, RTE-A/VC+, or RTE-6/VM.

Features

- Interpreter with editor and multifunction debugger for fast, friendly, conversational program development.
- Compiler for very fast run-time performance and source security.
- Compatible with approximately 100 statements of HP 9826*/9845* Desktop Computer BASIC.
- HP-IB statements.
- Multi-user system with multi-user interrupt handling.
- User-controlled error handling statements.
- Labelled common.
- 15-character variable names and line labels.
- Integer, double integer, and two-word and four-word floating point data types.
- Interpreter-controlled execution of large BASIC programs in EMA/VMA.
- Support of large compiled BASIC programs using segmentation.
- Support for large data arrays in EMA/VMA.
- Access to compiled subroutines written in BASIC, FORTRAN, Pascal, and Macro/1000.
- Compatibility with other HP 1000 software subsystems via subroutine calls.

Functional Description

The Power of HP 9800 Series Desktop BASIC

The statement and capability set of BASIC/1000C is built upon a kernel set of approximately 100 statements and functions that are compatible with the BASIC used on the HP 9826A* and similar Hewlett-Packard 9800 Series Desktop Computers. Capabilities include single and double integer and two- and four-word floating point data types for a choice of precision, the convenience of multicharacter variable and label names, input/output to specific devices, including HP-IB devices, user-defined interrupt handling, formatted and unformatted I/O, and access to disk file storage for data and programs. In addition to providing very good computational power on HP 1000-originated applications, BASIC/1000C's substantial compatibility with Desktop BASIC facilitates migration of applications from thousands of single-user HP 9800 Series Desktop Computers around the world to the more versatile multi-user environment of HP 1000 Computer Systems.

The Ease and Convenience of Conversational Programming with the Interpreter

BASIC programs are entered into the system via a terminal or a file. The BASIC/1000C Interpreter checks each statement as it is entered. If a statement contains a syntax error, the line editor is invoked and a message is issued to help the user correct that statement. A built-in debugger helps to correct program execution errors. The debugger can be used to display and change variables, trace program flow control, step "n" lines in the program, set breakpoints, and continue program execution from any line number within the program.

The Efficiency and Speed of Compiled Programs

BASIC/1000C is the first BASIC subsystem for HP 1000 Computer Systems to include both an interpreter and a compiler. After BASIC/1000C programs have been entered, tested, and debugged with the interpreter, the compiler can be used to translate the source code to relocatable object code for loading and execution in the same way, and as fast as, compiled FORTRAN or Pascal programs. Using compiled BASIC programs also helps to make the source code more secure, an important consideration for OEMs and software houses.

Multi-User Operation With On-Line Program Development

Multi-user operation is supported in the RTE system by individually-identified copies of the BASIC/1000C Interpreter, each serving a different user. The interpreter operates in either conversational (program development) mode or run (program execution) mode. Under RTE, several copies of the BASIC/1000C Interpreter can be used for program development while others are running programs. At the same time, developed programs can be compiled by multiple copies of the BASIC/1000C Compiler and previously-compiled BASIC, FORTRAN, Pascal, or Macro/1000 programs can be executing.

* Identifies discontinued product listed here for reference only.

Plenty of Space for Program Development and Data

Within the limits of available main memory and disk memory, the BASIC/1000C Interpreter supports programs of up to megabyte size and data arrays of up to six subscripts, with up to 32767 elements per subscript . This is done using the VMA/EMA and program segmentation facilities of the RTE operating system. To use the large program or large data array capability, interpreted programs require no special action; compiled programs require the use of compiler directives to manage VMA/EMA and the use of BASIC statements to manage program segments. On RTE-A with VC+, program segments are managed by the operating system and no special action is required by the user. These compiler statements and directives are ignored by the interpreter so that a program can be interpreted or compiled.

Plus the Ability to Take Advantage of Existing Software

BASIC/1000C can call subroutines written in other programming languages. Thus, applications in BASIC can take advantage of existing software, or subroutines can be written in the most efficient language, such as Macro/1000 Assembly language, and even optimized through the use of program profiling, where maximum execution speed is required.

How BASIC/1000C Relates to Other BASIC/1000 Subsystems

With respect to capability, BASIC/1000C is generally a superset of BASIC/1000D and BASIC/1000L. BASIC/1000C differs from BASIC/1000D and L in that it offers multi-user, real-time interrupt handling instead of the single-user, real-time task scheduling of BASIC/1000D and L. Also, some BASIC/1000C functions have different keywords and/or different ordering of parameters. Because of these differences, programs written for use with BASIC/1000D or L will require modification for use with BASIC/1000C.

How BASIC/1000C Extends the Scope of Desktop BASIC

BASIC/1000C matches HP 9800 Series Desktop BASIC as closely as is practical. However, unlike Desktop BASIC, which is designed for the single user, BASIC/1000C takes advantage of the more powerful real-time, multi-user environment of the RTE operating system and its subsystems. This results in some differences in program statement repertoire and structure. Also, RTE software subsystems, such as Image, are accessed by program calls, rather than direct, firmware-based BASIC statements as in 9800 Series Desktop BASIC. To accommodate these differences, programs written in Desktop BASIC will require modification to run in BASIC/1000C.

Functional Specifications

Environment

Operating System: HP 1000 A-Series Computer System with hard disc operating under RTE-A or HP 1000 E*/F*-Series Computer System operating under RTE-6/VM that meets the minimum hardware requirements of the operating system plus enough memory for all concurrent program development and program compilation sessions.

* Identifies discontinued product, listed here for reference only.

Interpreter Memory Requirements: The interpreter consists of two programs, the BASIC Editor, which requires a 50-page (100 kB) partition for each user, and the BASIC Executor. Partition requirement for the Executor is 200-pages (400 kB) for each user. Unless a program uses strings or arrays larger than 2 KB, no noticeable performance improvement is realized in a partition larger than 200 pages.

Compiler Memory Requirements: The compiler requires a Virtual Memory partition of 190 pages (380 kB). Compilation speed ranges from 500 to 650 lines per minute.

Compiler Disk Requirements: The compiler, interpreter, and auxiliary files require at least 20 MB of disk space to load and run.

Program Scheduling in the RTE Environment

Interpreter and Compiler Scheduling: The BASIC/1000C Interpreter and Compiler are user-scheduled programs, multiple copies of which can be scheduled at the same time by different users.

Interrupt-Scheduled Execution of Subprograms Within User's Programs: BASIC/1000C includes an ON INTR statement that can be used to cause the execution of a subprogram in response to an HP-IB SRQ interrupt from a specified device in RTE-6/VM or HP-IB SRQ, GPIO, and terminal interrupts in RTE-A.

Scheduling of Compiled Programs: In addition to having the ON INTR scheduling capability of the interpreter, compiled BASIC/1000C programs can be scheduled within the RTE operating system by the user, time, event, or another program, in the same way as any other compiled or assembled program.

Data Types

Single Integer: A 16-bit quantity, including sign, that ranges from -32768 to 32767.

Double Integer: A 32-bit quantity, including sign, that ranges from -2,147,483,648 to +2,147,483,647.

Short: A 32-bit quantity with sign, exponent, and mantissa that ranges from 1.47 x 10^{-39} to 1.7 x 10^{38}, with 6 to 7 decimal digit accuracy.

Real: A 64-bit quantity with sign, exponent, and mantissa with same range as Short, above, but with 16 to 17 decimal digit accuracy.

String: A set of up to 32767 characters, the values of which are defined by the 8-bit ASCII character set.

Program Data Capacity

BASIC/1000C supports arrays with up to six subscripts, up to 32767 elements per subscript, for a total array size of approximately (2^{27}-600,000) bytes, using the EMA/VMA capability of the RTE system.

Program Form

Acceptability of Lowercase: Except for keywords, which must be in uppercase, all program content can be in uppercase and lowercase. Names resembling keywords which are not keywords must contain at least one lowercase character.

Descriptive Error Messages: Error messages describe the nature of errors, in most cases sparing the user the inconvenience of consulting the manual to interpret error numbers. However, error numbers are included in most error messages to provide a reference to more detailed information.

Numeric Type Defaulting: Floating point constants, and variables that are not specifically given a type in the program, have a default floating point type that may be set by the user.

Variable and Label Names: Names of variables and labels may use up to 15 significant characters, including uppercase and lowercase letters, digits, and underscores. An all caps variable or label must not also be a keyword.

BASIC/1000C and RTE Subsystems

The BASIC/1000C Interpreter and Compiler works with the following RTE subsystems:

1. 92861A Graphics/1000-II Version 2.0 Device-Independent Graphics Library,.
2. 92081A Image/1000-II Data Base Management System.
3. 92069A Image/1000 Data Base Management System.
4. 91750A DS/1000-IV Network Software.
5. 92860A Symbolic Debug/1000 (compiled BASIC programs only).

The BASIC/1000C Interpreter also works with the 92862A Graphics/1000-II Version 2.0 Advanced Graphics Package with a limit of 60 Kbytes of AGP routines accessible from any one BASIC program.

Compiler Options That Affect the Program Listing

Lines per page.

List on/off.

Page feed for control of program listing.

$BASIC or **$TITLE** for headings on LOAD MAP or LISTING.

Compiler Options That Affect Program Structure or Execution

Default two/four-word floating point for setting size of all floating point constants and default-type variables.

EMA for specifying common blocks to be stored in EMA/VMA.

$PROGRAM directive for specifying program name.

$CDS ON/OFF for specifying VC+ support for A-Series systems.

$DEF for specifying external function, return type, and parameter type.

$SUB for specifying external subroutine parameter type.

$SEGMENT for specifying segment boundaries in single-level disk segmentation.

$REALTIME ON/OFF for specifying interrupt handling (requires extra code).

Program priority designation for RTE system.

Range on/off for control of runtime range checking for expression overflow. Turn-off of range checking significantly improves program execution speed and reduces memory requirements.

Ordering Information

HP 92857A BASIC/1000C (must order one of Use Options 400 through 897)

BASIC/1000C consists of:

1. BASIC/1000C Interpreter and BASIC/1000C Compiler on software Media Option 022, 044, 050, or 051, **one of which must be ordered.**
2. 92857-90001 BASIC/1000C Reference Manual.
3. 92857-90002 BASIC/1000C Configuration Guide.
4. 92857-90003 BASIC/1000C Quick Reference Guide.

92857A Media Options

022: Provides software on CS/80 cartridge tape.

044: Provides software on microfloppy disk for HP 12120A*/12122A Integrated Disks in Micro/1000 package or HP 9122C/D*, 9133A*/B*/H*/L*, or 9153B*/C Disk.

050: Provides software on 800 cpi, 9-track mag tape.

051: Provides software on 1600 cpi, 9-track mag tape.

* Identifies discontinued product listed here for reference only.

HP 92857R Right to copy BASIC/1000C for Use on One Additional Computer System (must order one of Use Options 400 through 897)

The HP 92857R product is available only to customers who have purchased a license to use 92857A without an upgrade option. 92857R consists of:

1. The license to make one copy of software purchased with 92857A for use on an additional system.
2. 92857-90001 BASIC/1000C Reference Manual.
3. 92857-90002 BASIC/1000C Configuration Guide.
4. 92857-90003 BASIC/1000C Quick Reference Guide.

92857A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

601: Upgrade from previous version of 92857A/R option 600 to latest version of same for customer NOT on support service.

603: Upgrade from 92076A BASIC/1000L to 92857A for use in A600 system for user on software support service.

604: Upgrade from 92076A BASIC/1000L to 92857A for use in A600 system for user NOT on software support service.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

701: Upgrade from previous version of 92857A/R option 700 to latest version of same for customer NOT on support service.

703: Upgrade from 92076A BASIC/1000L or 92101A BASIC/1000D to 92857A for use in A700 or E/F-Series system for user on software support service.

704: Upgrade from 92076A BASIC/1000L or 92101A BASIC/1000D to 92857A for use in A700 or E/F-Series system for user NOT on software support service.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E/F*-Series computer or SPU. With 92857A, option 890 includes the right to purchase one or more 92857R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 92857A option 890 to latest version of same for customer NOT on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

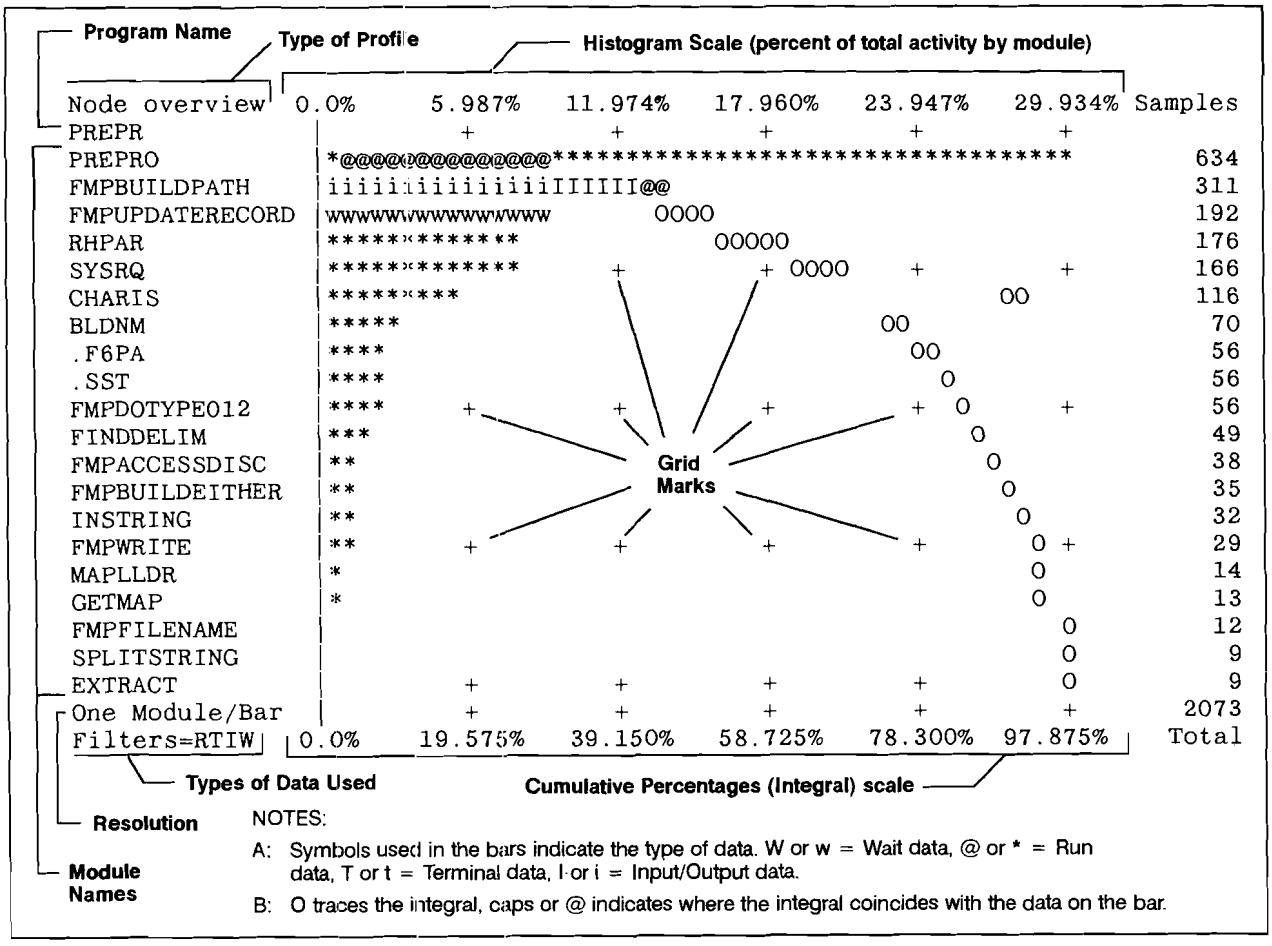
897: Upgrade to Use Option 890 from Use Option 700.

Software Support

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

* Identifies discontinued product listed here for reference only.

92083A RTE
Profile Monitor



Sample Node Overview Histogram and Integral Program Activity Profile

Introduction

The RTE Profile Monitor (Profiler) is a software package designed to help users improve program execution speed for more efficient utilization of HP 1000 Computer Systems. Because program execution speed is often critical, the Profiler is an important tool for users who are faced with the need to reduce execution time of their programs. The Profiler can be used on any program executing under 92077A RTE-A or 92084A RTE-6/VM, revision 5.0 or later.

Features

- Interactive, conversational program profiling.
- Profiling of programs written in any language.
- Profiling of real-time, background, segmented, or unsegmented programs without program modification.
- Wide choice of activity data collection options.
- Frequency distribution and histogram plots.
- Activity tracking down to the individual instruction.

Program Profiling and Performance

Programs typically spend 80% to 90% of their time in less than 5% of the code. Once identified, crucial areas of code can usually be optimized to significantly reduce overall program execution time. The Profiler simplifies the location of crucial areas of code by providing a precise analysis of the activity distribution within the program.

Once the Profiler has pinpointed the crucial code areas of a program, execution time can be shortened by:

- Source code modification.
- Reprogramming in assembly language.
- Reprogramming in microcode.

Execution time of a program written in a high-level language can be reduced by optimizing commonly used program loops, changing buffer sizes in system calls, and restructuring crucial program algorithms.

Most frequently used program code can be rewritten in assembly language for a typical three to four times improvement over high level language code.

Micro-code provides even more impressive improvement, typically three to five times faster than the same code implemented in assembly language. Microcode runs faster than assembly language because program instruction fetch time is largely eliminated, microcoding can specify CPU and I/O operations more efficiently than assembly language, and micro-instructions can accomplish more operations in parallel. The HP 92049A (A900) and HP 92061A (E-Series) RTE Microprogramming Packages support microcode development.

The RTE Profile Monitor User's Manual provides what-to-do instructions that are related to the various parts of program code that may be taking too much execution time. This helps the user reduce program execution times with a minimum of effort.

Operation

The Profiler functions in phases. In the first, or sample phase, the profiled program is executed while being monitored by a program called CTRAC. After data collection by CTRAC, a second program (PREPRO) reformats the data and prepares it for fast access. A third program, CPLOT, then plots the activity profile of the target program.

Initially, CPLOT uses a module interval that displays an entire program, or program segment, on a single page. Both the integral of frequency distribution and a histogram are provided, showing percentage of execution time used plotted to the right of a listing of module names or relative addresses, which is easily correlated with a "Q" listing of the program.

Areas of high activity on the initial plot can be further investigated by asking CPLOT to plot a narrower range of addresses. The new plot can have a resolution as small as one instruction (Figure 2-1, facing), precisely pin-pointing those instructions on which the program is spending most of its time. To simplify interpretation, CPLOT omits instructions with no activity, flagging the fact that those instructions have been omitted with two leading asterisks on the relative address of the next active instruction.

Functional Specifications

RTE Profile Monitor Requirements

Operating Environment: HP 1000 Computer System with disc memory operating under HP 92077A RTE-A or 92084A RTE-6/VM, revision 5.0 or later.

Priority Requirements: CTRAC and D.RTR must be the only active priority 1 programs. The target program should be the only program executing at the next highest priority. No other program should be active at any priority between CTRAC and the target program. It is desirable that CTRAC and the target program be the only active programs in the system.

CTRAC Memory Requirement: 23 pages (46 Kbytes).

CPLOT Memory Requirement: 65 pages (130 Kbytes).

PREPRO Memory Requirement: 63 pages (126 Kbytes).

RTE Profile Monitor CTRAC Options

Target Program Control: The target program can be run by CTRAC or it can be scheduled by another process.

Timing of the Start of CTRAC Action: CTRAC can take data right from the start of execution of the target program, or its data taking can be started later with a GO, CTRAC command. This facilitates selective polling of only certain phases of a program.

RTE Profile Monitor CPLOT Options

Filtering: CTRAC takes data for all program states and keeps track of the state. This allows CPLOT to filter out data and display only data of interest. CPLOT can display:

- Run data.
- I/O data.
- Terminal I/O data (only under RTE-6/VM).

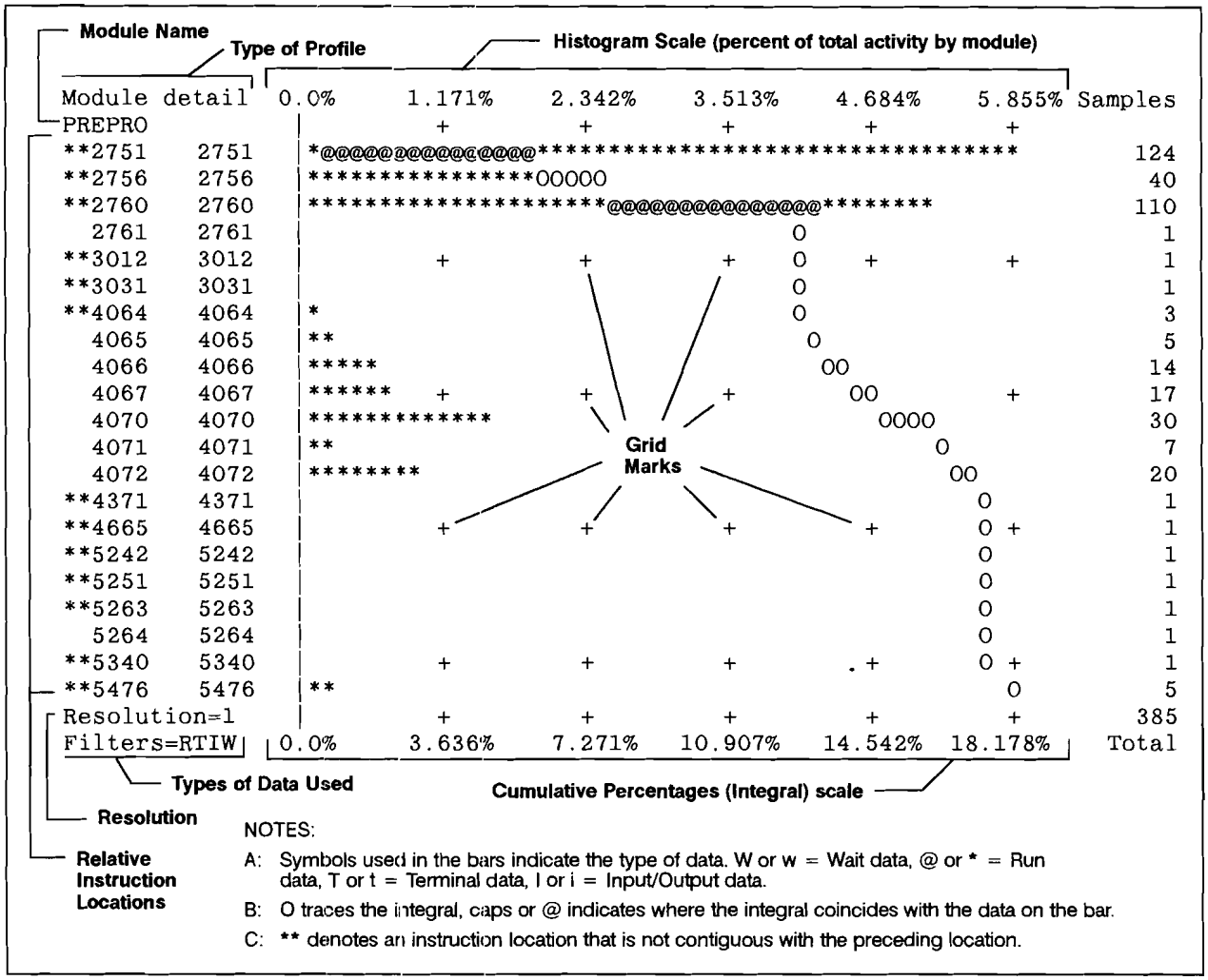


Figure 2-1. Sample Module Detail Histogram and Integral Program Activity Profile

- General Wait data.
- Any combination of Run, I/O, Terminal I/O, and General Wait data.

Histogram, Integral, and Tabular Data: CPLOT plots the histogram, integral, and tabular data in one easy-to-use screen, as shown in Figure 2–1 on this page and in the activity profile on page 2-49.

Initial Analysis: CPLOT can do an initial analysis which covers the entire address span of the target program on a single page, as shown on in the activity profile on page 2-49. Program segments are covered individually, each on its own page. Precision is to the module level. If not desired, the initial analysis may be bypassed.

Range of Interest: CPLOT provides for specifying the range of addresses whose activity data is to be displayed. With this capability, it is possible to determine the activity of each individual instruction.

Segment Specification: CPLOT provides for requesting a particular segment to be plotted.

Relative Address: CPLOT plots relative module addresses. These addresses are the same as those found on a "Q" listing from the high level language compiler, which makes it easy to relate the profile to the code being profiled.

Graph Naming: CPLOT automatically identifies each graph with the module name, resolution, filter used, and an indication if the whole module is plotted (module overview) or just a section (module detail).

Printer Control: CPLOT allows the user to preview a plot before sending it to the print file. The user can thus adjust the range of interest as desired before printing a hard copy.

Data Compression: CPLOT plots only areas that have data, so much more detail can be plotted in a given graph. As noted in Figure 2-1, previous page, addresses following omitted instruction addresses are flagged with a ** prefix, to alert the user.

Ordering Information

HP 92083A RTE Profile Monitor

The HP 92083A RTE Profile Monitor includes:

1. RTE Profile Monitor software on Media Option 022, 050, or 051, **one of which must be ordered.**
2. RTE Profile Monitor User's Manual (92082-90001).

92083A Options

022: Provides software on CS/80 cartridge tape.

050: Provides software on 800 cpi magnetic tape.

051: Provides software on 1600 cpi magnetic tape.

HP 92083R Right to Copy RTE Profile Monitor Software for Use on an Additional Computer System

The HP 92083R Right to Copy product is available only to customers who have purchased a license to use 92083A. HP 92083R consists of:

1. The license to make one copy of software purchased with 92083A for use on an additional system.
2. RTE Profile Monitor User's Manual (92082-90001).

Software Support

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

92049A A900 RTE Microprogramming Package

Introduction

HP 92049A is an RTE Microprogramming Package for HP 1000 A900 computers. Supported under the RTE-A real-time operating system, this package provides all the software tools needed for development by the user of customized microprogrammed instructions for HP 1000 A900 Computers.

Features

- On-line operation in RTE-A operating system.
- PROM code generator for outputting production microcode to PROM "burn-in" equipment.
- Dynamic Writable Control Store overlay utilities that load Writable Control Store from memory.
- Support for HP 1000 microprogram development.

How Microprogramming Benefits the User

Microprogramming gives users maximum control over the performance of their applications. Computers often spend 90% of execution time in less than 10% of the program code. By microprogramming frequently-used or especially time-consuming software routines in microcoded routines, called as single instructions on the macrocode level, execution can typically run 3 to 10 times faster. This can significantly accelerate the execution speed of applications. In addition, custom-designed micro-programmed instructions can make it practical to perform applications that could not be satisfactorily supported using the basic instruction set of the computer. And, key routines from value-added software suppliers can be microcoded to prevent uncontrolled copying from one machine to others.

Functional Description

The HP 92049A package provides a powerful and friendly microprogramming capability using the free-format syntax of a Paraphraser. The Paraphraser includes many Pascal-like features that facilitate microprogram development and simplify maintenance.

The RTE Paraphraser (MPARA) converts a source microprogram into binary object code in a standard microinstruction format for the WCS I/O Utility routine (WLOAD). The source may be entered from a standard RTE text file or from a peripheral device. Editing of the source microprogram is accomplished using the Edit/1000 screen editor that is included with the RTE operating system.

The WCS I/O Utility Routine (WLOAD) uses an ID driver to transfer microprogram object code prepared by MPARA from a file or input device into the HP 12205A A900 Control Store Board.

RTE Driver ID.42 provides software linking between MPARA, WLOAD, and the HP 12205A Control Store Board. The driver is configured into the RTE operating system during system generation and can be called directly with an EXEC call or through the WLOAD routine. Because it uses Direct Memory Access, ID.42 can load 4,096 microinstructions from main memory into WCS in less than 33 milliseconds.

WLOAD also translates MPARA binary object code into binary code formatted for ROM firmware. This output can be used for "burning" PROMs for mounting in the PROM control store area of the Control Store Board.

Profiling of program activity by the HP 92083A RTE Profile Monitor is available to identify those crucial areas that can most significantly benefit from being microcoded. Executing under the RTE-A operating system, the profile monitor plots the percent of time spent in various parts of a program.

Functional Specifications

Environment

The HP 92049A RTE Microprogramming Package operates in an HP 1000 A900 system with 768k bytes or more memory and hard disc operating under the HP 92077A RTE-A operating system. Supported computers and SPUs include the HP 2139A*/B, 2199C*/D*/E, 2439A*/B, and 2489A*/B.

* Identifies discontinued product, listed here for reference only.

Memory Usage

A 64k byte partition is required to support MPARA and all other HP 92049A software modules.

Control Store Hardware Required

The HP 92049A RTE Microprogramming Package requires one HP 12205A Control Store Board.

Control Store Available to the User

The HP 12205A Control Store Board provides 4k 48-bit words of Writable Control Store plus space for mounting 2k 48-bit words of PROM control store ROMs.

Ordering Information

HP 92049A RTE Microprogramming Package

The HP 92049A RTE Microprogramming Package consists of:

1. The MPARA, WLOAD, and ID.42 software modules on Media Option 022, 044, or 051, **one of which must be ordered.**
2. 92049-90001 RTE Microprograming Package Reference Manual.
3. 92049-90002 RTE Driver ID.42 Programming and Operation Manual.

92049A Media Options

022: Provides software on CS/80 cartridge tape.

044: Provides software on Microfloppy disk for HP 12120A*/ 12122A Integrated Disks in Micro/1000 Package or HP 9122C/D* or 9133A*/B*/H*/L* or 9153B*/C Disk.

051: Provides software on 1600 cpi magnetic tape.

* Discontinued product, listed here for reference only.

HP 92049R Use Of RTE Microprogramming Package On One Additional Computer System

The HP 92049R product is available only to customers who have purchased HP 92049A. HP 92049R consists of:

1. The right to make one copy of software purchased with the 92049A RTE Microprogramming Package for use on an additional system.
2. 92049-90001 RTE Microprograming Package Reference Manual.
3. 92049-90002 RTE Driver ID.42 Programming and Operation Manual.

Software Support

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

Macro/1000 Assembler

Introduction

Macro/1000 is an assembler designed to give users complete control over each computer instruction while significantly enhancing productivity through full macro capabilities and high-order language type constructs. At the same time, Macro/1000 offers full upward compatibility with the RTE-IVB* assembler while providing approximately double its assembly performance.

Features

- Structure.
- Macro capabilities that enhance code portability and program readability.
- Library of commonly-used macros.
- Conditional assembly instructions.
- Modularity.
- File and string manipulation utilities.
- 16-character variable names.
- Symbolic addressing.
- Enhanced error control and reporting.
- Extremely fast compilations.
- Compatibility with HP 1000 software subsystems, such as Image/1000, Graphics/1000-II, and DS/1000-IV.

Functional Description

Macro/1000 is a superset of the RTE-IVB* Assembler, with the following extensions:

Powerful Macro Facility
A macro facility supports the passing of constants, labels, expressions, and complete instructions as parameters. Macros can be nested within macros, with the level of nesting limited only by the amount of disk memory. Macro/1000 further allows recursion and cross-recursion between macro definitions to enhance the programmer's capabilities.

String Manipulation Utilities

These four assembly-time string manipulation utilities can be used in expressions:

A Length construct can be used to measure the character count in a string, allowing various changes to the string's content without further edits to the code used for string manipulation.

A Substring utility helps the programmer to operate on segments of a character string.

Upper Case Map changes lower case characters to upper case characters.

A Type attribute can be used to determine whether an assembly time variable has been declared to be integer, character, or not yet declared.

File Manipulation Instructions

Macro/1000 file manipulation instructions can be used to merge separate files and assemble them together as independent macros or subroutines. An INCLUDE statement can be used to copy a designated file of code, macro definitions, or data into the source at a desired point. A MACLIB statement can be used to identify a file as a macro library.

New Pseudo Operations

Macro/1000 provides 23 new pseudo operations which give the programmer more control over assembly time options. These include commands to specify where a table of literal values is located, to repeat a sequence of code, to fix the size of an Extended Memory Area (EMA), or to define an address to EMA.

Functional Specifications

Environment

Operating System: Macro/1000 executes on any HP 1000 Computer System operating under RTE-A or RTE-6/VM.

Memory Requirements: 36 Kbytes, minimum; best performance is achieved with more memory, up to a maximum of 64 Kbytes.

Compilation Speed (CPU time): 5000-6000 lines per minute.

Macro Program Execution: Generated code runs under RTE-A or RTE-6/VM, rev code 2140 or later.

* RTE-IVB is a discontinued product listed here for reference only.

Character Set

Alphabetic Characters: All upper and lower case characters (A through Z and a through z).

Numeric Characters: The ten digits 0 through 9.

Special Characters: blank; equal, plus, minus, less than, and greater than symbols; period; comma; asterisk; slash and backslash; left and right parentheses; single and double quotes; left and right brackets; colon and semicolon; currency symbol (e.g., $); percent sign; question mark; exclamation point; ampersand; at sign (@); sharp sign (#); and carat (^).

Program Form

Lower Case: Lower case keywords are accepted and mapped into upper case for improved readability.

Comment Lines: Comments can be transcribed into a source program in various ways. An asterisk in the first position or semicolon as the first nonblank character is accepted as the start of a comment line. Additionally, characters following a backslash (\) in an operand field are interpreted as comments.

Error Directory: Macro/1000 incorporates one of the most descriptive error message directories available on HP 1000 Computer Systems, in addition supporting the declaration and listing of user-defined errors.

Assembler Options

R: Produces relocatable assembly.

A: Produces absolute assembly.

L: Produces program listing.

C: Produces cross-reference table of symbols, labels, and op codes.

Q: Omits op code fields from instruction values that appear in the program listing.

T: Produces Symbol Table Listing.

M: Creates Macro library.

Ordering information

Macro/1000 software and the Macro/1000 Reference Manual (92059-90001) are included in HP 1000 A-Series Computer Systems, in the HP 92077A RTE-A operating system.

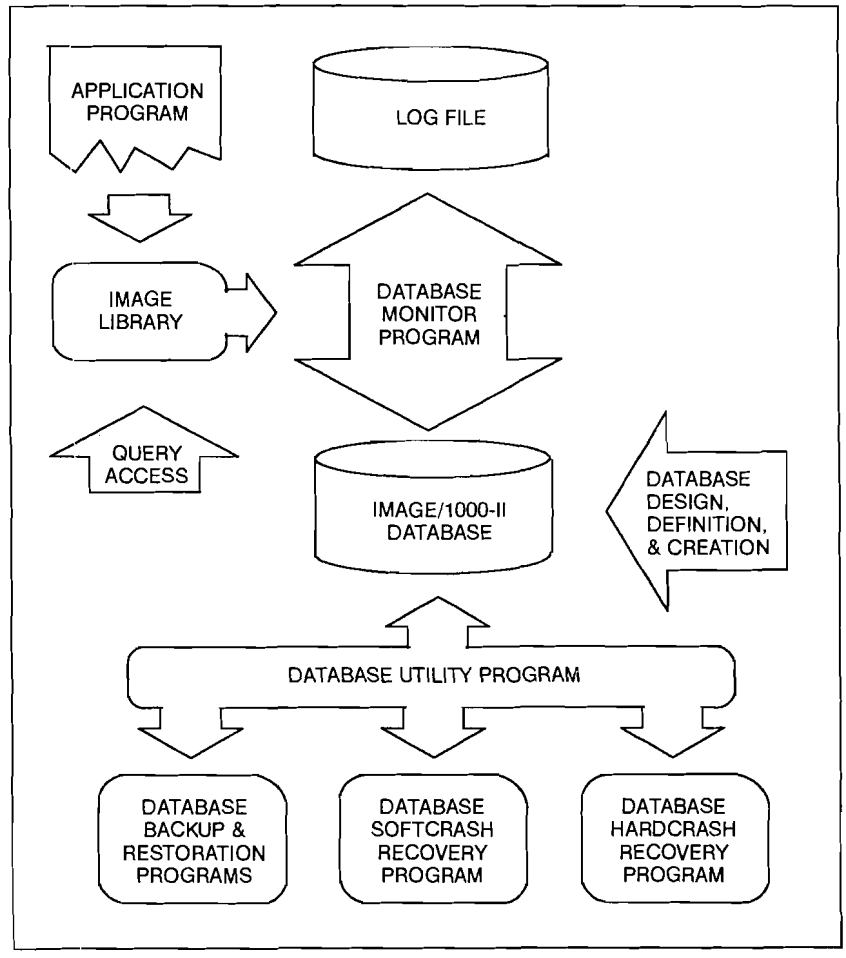
Software Support

Software support for Macro/1000 is included with software support for RTE-A.

92081A
Image/1000-II

Introduction

Image/1000-II is a general-purpose database management software system with Query designed for use in HP 1000 Computer Systems managed by HPs RTE-A and RTE-6/VM operating Systems. Image/1000-II provides a complete software package for consolidating large quantities of data into a single, interrelated database that can be shared by many different users for a wide variety of purposes. In combination with Distributed Systems/1000-IV software, Image/1000-II services remote database access requests. Image/1000-II includes recovery features that protect database systems from loss of data, thus ensuring high availability and improved productivity. The product is well suited to applications that are sensitive to data loss, or excessive downtime.



Features

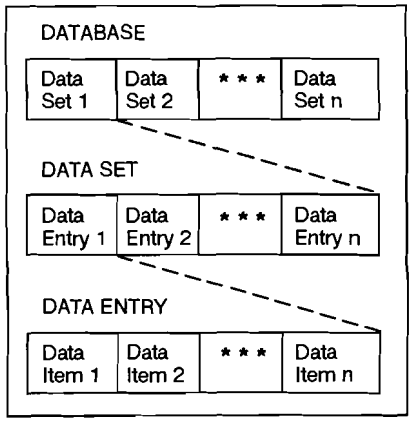
- Host language subroutines for logical transaction definition and the ability to undo a transaction.
- Optional transaction logging and recovery for guaranteed data integrity and high data availability.
- Roll-back recovery for fact recovery from loss of volatile memory, with minimum downtime.
- Roll-forward recovery for data protection against disk crash.
- Data set locking for multi-user, multi-program, concurrent access to multiple data sets within a database.
- Single program control of all database access.
- Concurrent access for up to 100 users per database.
- Single-word integer, double-word integer, two-word real, four-word read, and ASCII character string data types supported.
- Existing Image/1000 data bases can by physically restructured as Image/1000-II databases using a utility program.
- Host language subroutines callable from Pascal, FORTRAN, BASIC/1000C, HP RTE Assembly or Macro/1000 Assembly Language.
- Database capacity up to 3.2 Gbytes under RTE-6/VM and RTE-A.
- Protection against unauthorized access at database and data item level.
- Up to 16 search keys per data set for fast data access.
- Remote data base access via DS/1000-IV.
- Recovery of allocated Image resources from aborted programs.
- Query facility that provides the non-programmer with English-like commands to easily retrieve, alter, and report information.
- Support of Code and Data Separation in RTE-A with VC+.
- Support of both Command Interpreter (CI) and FMGR file systems.

Functional Description

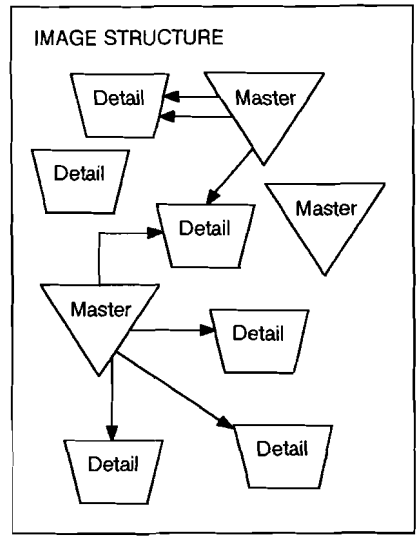
Image/1000-II Database Structure

Image/1000-II is primarily a path oriented or chain approach to data retrieval. Pointers are maintained which logically connect records with common attributes into chained lists. This allows cross-referenced access to collections of data down to the smallest unit and makes it possible to access related data very quickly.

An Image/1000-II data base consists of one or more data sets (files) that have some logical relationship to one another. A data set consists of one or more fixed length data entries (records). A data entry consists of one or more data items (fields).



Image/1000-II supports master and detail data sets. Master data sets are a collection of key values used for fast access to information stored either in the master data set or a related detail data set. Master data sets can be linked to more than one item in a detail data set. Access to a data entry in a master data set may be calculated (hashed), based on the key value of the data entry. Access to data entries in a detail data set is usually via a key value that is chained from a related master data set. Data entries can also be accessed serially or directly.



Reasons for Using Image/1000-II

Strong Foundation

Image/1000-II is built on the solid foundation established by the Image Database Management software family and the RTE-A and RTE-6/VM Real-Time Executive operating systems. It is 100 percent backward compatible with 92069A Image/1000 on the call level.

High Speed Data Access

Single program (DBMON) control of all database access and a memory cache for data, decreases the number of disc accesses. Image/1000-II's capacity to service 100 concurrent active programs, and the ability to lock on the data set level provide the means to develop applications with high throughput requirements.

Database Integrity

In order to protect against database corruption, Image/1000-II keeps a file of all "before-images" prior to modifying the database. A before-image is a copy of a data record made before modification begins. If a system crash occurs, the before-images are restored, ensuring a physically consistent database.

To ensure logical database integrity following a program abort or memory failure, Image/1000-II uses a roll-back logging scheme and maintains a disk log file of transactions as they are performed. A transaction is a group of logically related Image calls in which all or none must be completed. In the event of a crash, Image can redo completed transactions and undo incomplete transactions.

To prevent loss of data from disk failure, transactions can be logged to a permanent storage device, such as a magnetic tape, using "roll-forward" logging. This transaction log is available for database restoration in the event of a disk crash. A utility program is provided which recreates all transactions completed between the time of the last backup and a crash.

Data Independence

The description of the database is independent of the programs that access the database. Image/1000-II maintains all the pointers necessary to logically relate the data. Programmers can access the database without concern for how the data is physically structured. It is possible to reorganize the data without requiring a change to any programs. Application programs can be modified without a need to change the data structure or the physical data storage devices.

Multiple Usage of Data

Common data may be shared between the different application programs that use the database, thereby reducing data redundancy and physical storage. Independent data files that contain redundant information can be updated simultaneously.

Ease of Data Access

The database can be accessed by either a user-written application program or by the Query language facility included with Image/1000-II. Application programs can be written in Pascal, FORTRAN, BASIC/1000C, or Macro/1000 Assembler language. The database can be accessed with a host language, using one of four reading methods: serial (sequential), direct (as with a file management system), calculated (hashed), or chained (using a key item). The database also allows users to have chained entries alphabetically or numerically ordered by a secondary item value. Query, a program which allows non-programmers to easily locate, report and update data values, is excellent for ad hoc inquiry to the database, either interactively or in batch mode. Query enhancements include time and date stamping, the implementation of transaction commands, right margin truncating of ASCII files in reports, and select file defaulting.

Data Security

Each data item in the database can be protected from unauthorized access by the assignment of a security code. By specifying a different privacy level for read and write operations on each data item, users can be permitted to read but not change a particular data item.

Remote Database Access

Image/1000-II combined with DS/1000-IV allows programs on a local HP 1000 Computer System to access remote Image/1000-II databases at RTE-6/VM and RTE-A based systems*. Query can also be scheduled at a remote system site using LU mapping if a DS/1000-IV link is available. The remote site would be the location of the database to be accessed.

Image/1000-II Components

To handle your information needs, Image/1000-II provides easy-to-use software for the following database tasks:

- Creating the Database.
- Querying the Database.
- Host Language Access.
- Maintaining the Database.

Creating the Database

Using DBDS, Image/1000-II processes a description of the user database (called a schema) and produces an internal system description of the database (called a root file) along with the data sets used by the Image/1000-II system. The user describes the data and their interrelationships, security, and the required storage using a database definition language.

After creation of the database, the user can then use the DBBLD (Database Build) utility program to load data into the database. DBBLD can be used for both initially storing large amounts of data into a database, or adding data to existing databases.

Querying the Database

An Image/1000-II database can be accessed by Query to allow the non-programmer to retrieve and report data from a database or to update information in the database through easy-to-use English-like commands. Query also provides the experienced programmer fast, easy access to the database to help debug application programs.

* NOTE: The user program on the local system must be loaded with the Image/1000-II library, and the remote system must be executing the Image/1000-II subsystems DBMON and RDBAM.

Security. Query adheres to all security provisions that are specified during the definition phase of an Image/1000-II database. A security code must be specified to access a database. Query returns an error if a user attempts to access a database or data item without the correct security code and privacy level words.

Multicriteria Data Selection. Precise information can be retrieved from a data set using logical relationships between data items and their values (is, is not, is less than, etc.) using logical connectors (ANDs and ORs).

Reporting Data. After information is retrieved from a database, Query can format and generate a variety of reports that can be listed to either a device or file. Reports can include page headings, column headings, page numbers, etc. Items of data can appear in a report, can be format edited, averaged, totaled, and subtotaled. Information to be reported can be sorted by multiple categories.

Updating a Database. Information retrieved can be modified or deleted from the database. New records can also be added with automatic linkage. Using Query to update a database can be a time-saver for one-time changes.

Procedure Capability. Query procedures provide a convenient way of storing particular Query commands in a disc file for repeated use without having to retype them. These procedures aid in finding data entries in the database, reporting them, and updating the database.

Batch Capability. Query can also be executed in a batch mode without operator interaction. Query commands that would normally be entered interactively can be stored in a disk file for repeated use. The disk file created for batch Query can also use Query procedures for some of the required responses. One example use of Query in a batch mode would be the creation of a particular report on a regular basis where the development of an application program is not justified.

Query Command Set

DATA-BASE	Identifies database to be accessed.
SELECT-FILE	Identifies file to be used for retrieving data entries
FIND	Multicriteria data selection
REPORT	Report formatting and generation with sorting
UPDATE	Data modification, addition, and deletion
CREATE	Creates a procedure
DISPLAY	Displays a procedure
EXECUTE	Executes a program
DESTROY	Deletes a procedure
TRANSBEGIN	Starts a transaction
TRANSEND	Ends a transaction
TRANSMEMO	Writes a comment to the transaction log
TRANSUNDO	Allows user to undo a pending transaction
FORM	Displays database structure
HELP	Explains purpose and form of Query commands
LIST	Changes list device
EXIT	Exits from Query
XEQ	Allows users to enter Query commands from a command file and return to an interactive mode

Remote Query. Image/1000-II combined with DS/1000-IV allows an HP 1000 Computer System to execute Query at a remote DS/1000-IV node that has an RTE-A or RTE-6/VM based Image/1000-II database. Accessing a remote Image/1000-II database with Query merely requires executing Query at the Image/1000-II system you wish to access, using LU mapping. With both DS/3000 and DS/1000-IV, an HP 1000 system can become a virtual HP 3000 terminal, with the HP 1000 user gaining access to an Image/3000 database Query/3000.

Host-Language Access

Up to 20 databases can be opened to a program. Host language access allows the user to tailor a program to the specific application. Query is actually an application program generalized to serve novice users, but it cannot offer the flexibility and efficiency of an application program written for a particular task. The combination of host language access and Query allows both programmers and novices to access the database in the most cost-effective way.

The following fifteen subroutines are included for host language access of the database. Your application programs can be written in Pascal, FORTRAN, BASIC/1000C, HP RTE Assembly or Macro/1000 Assembly language.

DBOPN (Data Base Open). Prepares a database for subsequent access by other Image/1000-II subroutines. This includes specifying a level word, thereby establishing the data items a particular user can access. Up to 100 users can open the database.

DBINF(Data Base Information). Provides information about the organization and components of the database being accessed. The information can be the type and length of data items, the relationships between data, etc.

DBFND (Data Base Find). Locates the beginning of a data chain with a calculated (hashed) value based on the key item. This is done in order to perform subsequent chained reads via DBGET.

DBGET (Data Base Get). Accesses the database in a variety of ways. A master data set can be accessed in a calculated (hashed), serial, or direct fashion. A detail data set can be accessed in a chained read, serial, or direct fashion.

DBUPD (Data Base Update). Modifies existing data.

DBPUT (Data Base Put). Adds new data.

DBDEL (Data Base Delete). Deletes existing data.

DBLCK (Data Base Lock), Gives the user temporary exclusive use of the database to update entries.

DBUNL (Data Base Unlock). Releases the database or data sets to full use by others.

DBCLS (Data Base Close). Closes the database and prevents further access.

DBBEG (Data Base Transaction Begin). Defines the beginning of a logical transaction.

DBEND (Data Base Transaction End). Defines the end of a logical transaction. Upon completion, the transaction will be logged.

DBMEM (Data Base Transaction Memo). Requests logging of a memo record in the log files. This log record contains user provided text information.

DBUND (Data Base Transaction Undo). Allows program to undo a currently open or incomplete transaction.

DBCTL (Posting Control). Allows the user to have immediate or delayed posting of records for a database when transactions are not being logged for that database.

Maintaining the Database

A database maintenance utility, DBUTL, provides functions useful for database backup, restructuring, defining of log files, defining of log status, cleanup of Image resources held by inactive programs, control of database access, softcrash recovery and hardcrash recovery. Some of these functions are available through the following programs scheduled through DBUTL.

DBSTR (Data Base Store). Copies the complete database, including structural information, onto magnetic tape or additional disc, for backup security. DBSTR also allows optional verification of the magnetic tape. No restructuring of the database is possible using this program.

DBRST (Data Base Restore). Restores a root file and a database from a magnetic tape or additional disc created by DBSTR.

DBULD (Data Base Unload). Copies data from an existing database onto magnetic tape or additional disc. Unloading the database using this routine allows the user to reload the database into a different database structure.

DBLOD (Data Base Load). Builds a database according to a specified root file from a magnetic tape or additional disc created by the DBULD program. DBLOD users have the option to restore the data to the same database structure or create a new database structure using a new database definition.

DBRBR (Data Base Roll-Back Recovery). Performs soft crash recovery.

DBRFR (Data Base Roll-Forward Recovery). Performs hard crash recovery.

DBARC (Roll-Forward Log Archive). Allows archiving of roll-forward log disk files to magnetic tape. DBARC also allows optional verification of the magnetic tape.

DBSPA (Data Base Space). Reports number of entries in use and entries available. DBSPA is scheduled through File Manager, rather than DBUTL.

Functional Specifications

Database Capacity and Syntax

Database: May contain up to 50 data sets. Total database size is limited only by the total available storage, which depends upon the capacity of the discs interfaced to the system and the number of I/O channels available for disc interfaces.

Data Set: May contain up to $2^{31}-1$ (>2 billion) data entries. However, a data set cannot span multiple disk sub-channels, limiting the data set size to a maximum 571 Mbytes.

Data Entry: May contain up to 4096 bytes. All data entries within a given data set have the same record format. There can be up to 127 unique data item names per data entry.

Data Item Types: Integer number with values –32768 to +32767, double integer numbers with values –2147483648 to +2147483647, two-word real numbers with values 1.47×10^{-39} to 1.70×10^{38}, four-word real numbers with values the same as two-word real numbers, but with greater precision, and ASCII character strings with up to 255 characters.

Detail Data Sets per Master Data Set: 16.

Search Items (keys) per Detail Data Set: 16.

Database and Data Set Names: 1-6 characters.

Data Item Name: 1-6 characters. A database may contain up to 255 unique data item names and those names may be repeated in the description of more than one data set.

Security Code: Integer 1 to 32767 or two ASCII characters.

Privacy Level Word: 1-6 character.

Configuration Information

Remote Database Access: RTE-A or RTE-6/VM based Image/1000-II database can be accessed from a remote DS/1000 node by Query and with a Pascal, FORTRAN, or Macro/1000 Assembly language program using Image/1000-II subroutines. Requires software revision 2040 or later for DS/1000-IV (91750A).

Programming Languages: FORTRAN IV, Pascal, Real-Time BASIC, and Macro/1000 Assembly language.

Multi-User Capability: A centralized monitor program, DBMON, accesses the database and limits the total number of database opens on a system to 100.

Upgrading from 92069A Image/1000: To upgrade from 92069A to 92081A Image/1000-II, databases must be unloaded using DBULD and reloaded using DBLOD, 92081A utilities. Existing user programs written with Image/1000 calls can be moved to Image/1000-II without being changed. However, large programs may need to be resegmented, depending on the calls used.

Minimum System Requirements: Same as HP 92077A RTE-A, with B.83 PCO or later, and 92084A RTE-6/VM, revision 2226.

Memory Usage
Minimum system: 400 KB.
Additional for roll-forward logging: 48 KB.
Additional per remote user: 48 KB.

IMAGE PROGRAM		Prog. Size (KB)	Uses Database Buffers?
Schema Processor	DBDS	124	No
Query		40*	Yes
Utilities	DBBLD	52	Yes
	DBSTR	64	No
	DBRST	64	No
	DBULD	64	Yes
	DBLOD	64	Yes
	DBSPA	22	Yes
	DBUTL	64	No
	DBARC	50	No
Remote DB Access	RDBAM	12	No
	RDBAP	48	Yes

* Add 8 KB for support of execution from a remote DS/1000-IV node.

The following require EMA partitions for buffers:

IMAGE PROGRAM		Prog. Size (KB)	Min. Part. Size (KB)
Utilities	DBRBR	62	160
	DBRFR	62	160
DB Monitor	DBMON†	64	220

† DBMON is a VMA program with a minimum working set of 80 pages (160 KB). In some cases, its performance may be increased with a larger working partition for internal data buffers.

Installation

In HP 1000 Computer System: The Image/1000-II Database Management System software is an integrated, working part of the primary operating system.

When Purchased as a Software Component: Image/1000-II is a customer-installed product; installation assistance is available from your local Hewlett-Packard Field Service office at prevailing service rates.

Ordering Information

HP 92081A Image/1000-II Database Management System With Query for RTE-A or RTE-6/VM Use. (Must order one of Use Options 400 through 897.)

Image/1000-II consists of:

1. Image/1000-II software on Media Option 022, 044, 050, or 051, **one of which must be ordered.**
2. 92081-90001 Image/1000-II User's Manual.
3. 92081–90002 Image/1000-II Software Numbering Catalog.

92081A Media Options

022: Provides software on CS/80 cartridge tape.

044: Provides software on microfloppy disks for HP 12120A*/12122A Integrated Disks in Micro/1000 package or HP 9122C/D* or 9133A*/B*/H*/L* or 9153B*/C Disk.

050: Provides software on 800 cpi mag tape.

051: Provides software on 1600 cpi mag tape.

HP 92081R Right to Copy 92081A Image/ 1000-II Software for Use on an Additional Computer System. (Must order one of Use Options 400 through 897)

The 92081R product is available only to customers who have purchased a license to use 92081A. 92081R consists of:

1. The right to make one copy of software purchased with the 92081A Image/1000-II Data Base Management System for use on an additional system.
2. 92081-90001 Image/1000-II User's Manual.
3. 92081-90002 Image/1000-II Software Numbering Catalog.

92081A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/D Micro 16 Computer, 2436A*/E*/G/D Micro 26 Computer, 2196C*/D*/G/D Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

601: Upgrade from 92069A/R or previous version of 92081A/R option 600 to latest version of 92081A/R option 600 for customer NOT on software support service.

602: Upgrade from 92069A/R option 600 to 92081A/R option 600 for customer who is on software support service.

* Identifies discontinued product listed here for reference only.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

701: Upgrade from 92069A/R or previous version of 92081A/R option 700 to latest version of 92081A/R option 700 for customer NOT on software support service.

702: Upgrade from 92069A/R option 700 to 92081A/R option 700 for customer who is on software support service.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E/F*-Series computer or SPU. With 92081A, option 890 includes the right to purchase one or more 92081R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from 92069A/R or previous version of 92081A/R option 890 to latest version of 92081A/R option 890 same for customer NOT on support service.

892: Upgrade from 92069A/R option 890 to 92081A/R option 890 for customer who is on software support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

* Identifies discontinued product listed here for reference only.

Recommended Additional Equipment

In addition to the basic hardware required to support the host RTE operating system, computer systems with the 92081A Image/1000-II Database Management System should also include a line printer for fast printout of reports and either a magnetic tape unit or an additional disk drive for data base backup.

Software Support Products

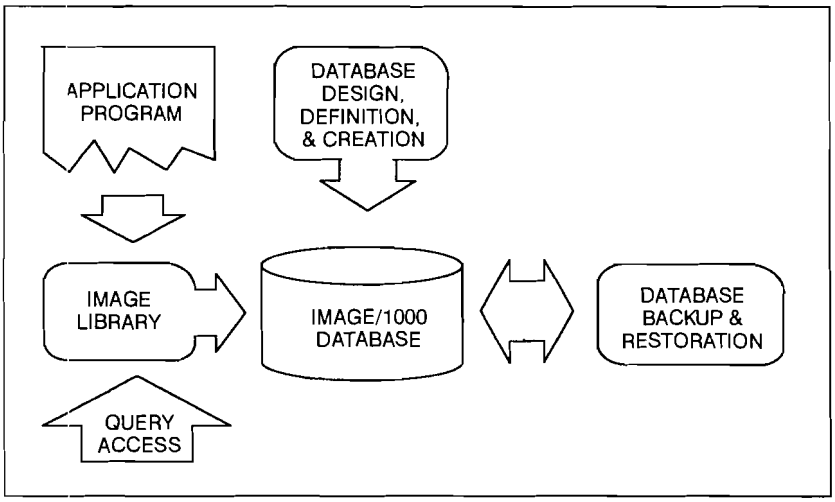
See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

NOTES:

92069A
Image/1000

Introduction

Image/1000 is a general-purpose database management software system with Query designed for use in HP 1000 Computer Systems managed by HPs RTE-A, RTE-6/VM, and RTE-IVB* operating Systems. Image/1000 provides a complete software package for consolidating large quantities of data into a single, interrelated database that can be shared by many different people for a wide variety of purposes. In combination with Distributed Systems/1000 software, Image/1000 services remote database access requests.



Features

- Image/1000 databases can be restructured without needing to change your application programs.
- Host language subroutines callable from Pascal, FORTRAN, BASIC/1000C, HP RTE Assembly or Macro/1000 Assembly Language.
- Minimum data redundancy through file consolidation.
- Protection against unauthorized access at database and data item level.
- Database capacity up to 3.2 Gbytes under RTE-A and RTE-6/VM; 960 Mbytes under RTE-IVB*.
- Up to 16 search keys per data set for fast data access.
- Sorted chains that order entries by a secondary item value.
- Utilities that build, maintain, restructure, and back up the database.
- Remote data base access via DS/1000-IV.
- Query facility that provides the non-programmer with English-like commands to easily retrieve, alter, and report information.

* RTE-IVB is a discontinued product, listed here for reference only

Reasons for Using an Image/1000 Database

Data Independence

The description of the database is accessible from application programs. Applications can be written which are not dependent on the structure of the database, making the application data independent.

Programmers can access the database without concern for how the data is physically structured. It is possible to reorganize the data without requiring a change to any programs. Likewise, application programs can be modified without a need to change the data structure or the physical data storage devices.

Multiple Usage of Data

Common data may be shared between the different groups that use the database. Use of the same data by different programs reduces data redundancy, since it's not necessary to create and maintain data files for each application program. Physical storage requirements are reduced and only one set of data needs to be maintained. The problem of how to simultaneously update independent data files that contain redundant information is also easily eliminated by using an Image/1000 database.

Data Security

Data can be security code protected from unauthorized access with Image/1000. Each data item in the database also has an associated privacy level that limits access to authorized users. With Image/1000, you can specify a different privacy level for read and write operations on each data item. This is useful when you would like to allow someone to read but not change a particular data item.

Data Access

The database can be accessed by either a user-written application program or by the Query language facility included with Image/1000. Application programs can be written in Pascal, FORTRAN, or Assembly language. Image/1000 also provides for access from BASIC programs. The database can be accessed with a host-language using one of four methods: serial, or direct as with a file management system; calculated (hashed); or chained using a key item. The database also allows users to have chained entries alphabetically or numerically ordered by a secondary item value. Query is a program for non-programmers to easily locate, report and update data values in the database. Query is excellent for ad hoc inquiry to the database either interactively or in a batch mode.

Remote Database Access

Image/1000 combined with DS/1000-IV allows the user to write programs that run on a local HP 1000 Computer System to access remote Image/1000 databases at RTE-A, RTE-6/VM, and RTE-IVB*, based systems†. Query can also be scheduled locally to execute at a remote database. This means that an Image database can be easily shared with other HP 1000s in the Distributed Systems Network.

* RTE-IVB is a discontinued product, listed here for reference only.

† NOTE: Image/1000 is required on the local system if programs to be used for accessing Remote Databases are to be developed on the local system.

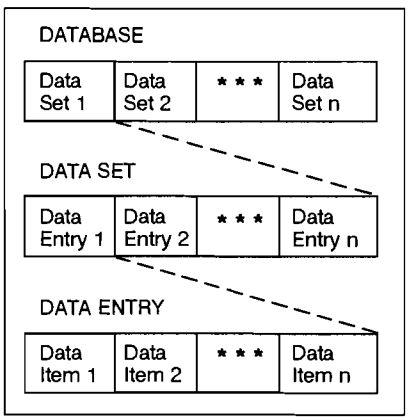
Proven Performance

Image/1000 is a member of Hewlett-Packard's Image Database Management Software family. Image/1000 has been successfully used by over 1000 HP 1000 Computer System customers since 1976. Image/1000 is based on RTE-A, RTE-6/VM, and RTE-IVB*, the newest and most powerful members of the disk-based, real-time executive operating system family. RTE systems have been put to work in thousands of installations throughout the world since 1968.

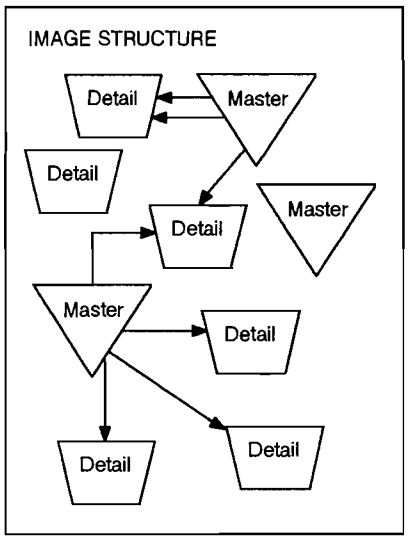
Image/1000 Database Structure

Image/1000 is primarily a path oriented or chain approach to data retrieval. Pointers are maintained which logically connect records with common attributes into chained lists. This allows cross-referenced access to collections of data down to the smallest unit and makes it possible to access related data very quickly.

As shown below, an Image/1000 database consists of one or more data sets (files) that have some logical relationship to one another. A data set consists of one or more fixed length data entries (records). A data entry consists of one or more data items (fields).



Image/1000 supports master and detail data sets. Master data sets are a collection of key values used for fast access to information stored either in the master data set or a related detail data set. Master data sets can be linked to more than one item in a detail data set. Access to a data entry in a master data set may be calculated (hashed), based on the key value of the data entry. Access to data entries in a detail data set is usually via a key value that is chained from a related master data set. Data entries can also be accessed serially or directly. Master and detail data sets can be chained together as shown below.



Image/1000 Components

To handle your information needs, Image/1000 provides easy-to-use software for the following database tasks:

- Creating the Database.
- Querying the Database.
- Host Language Access.
- Maintaining the Database.

Creating the Database

Image/1000 processes a description of the user database (called a schema) and produces an internal system description of the database (called a root file) along with the data sets used by the Image/1000 system. The user describes the data and their interrelationships, security, and the required storage using a database definition language.

After creation of the database, the user can then use the DBBLD (Database Build) utility program to load data into the database. DBBLD can be used for both initially storing large amounts of data into a database, or adding data to existing databases.

Querying the Database

An Image/1000 database can be accessed by Query to allow the non-programmer to retrieve and report data from a database or to update information in the database through easy-to-use English-like commands. Query also provides the experienced programmer fast and easy access to the database to help debug an application program.

Security. Query adheres to all security provisions that are specified during the definition phase of an Image/1000 database. A security code must be specified to access a database. Privacy level words are required for read and write operations on each data item. Query returns an error if a user attempts to access a database or data item without the correct security code and privacy level words.

Multicriteria Data Selection. Precise information can be retrieved from a data set using logical relationships between data items and their values (is, is not, is less than, etc.) using logical connectors (ANDs and ORs).

Security. Query adheres to all security provisions that are specified during the definition phase of an Image/1000 database. A security code must be specified to access a database. Privacy level words are required for read and write operations on each data item. Query returns an error if a user attempts to access a database or data item without the correct security code and privacy level words.

Multicriteria Data Selection. Precise information can be retrieved from a data set using logical relationships between data items and their values (is, is not, is less than, etc.) using logical connectors (ANDs and ORs).

Reporting Data. After information is retrieved from a database, Query can format and generate a variety of reports that can be listed to either a device or file. Reports can include page headings, column headings, page numbers, etc. Items of data can appear in a report, can be format edited, averaged, totaled, and subtotaled. Information to be reported can be sorted by multiple categories.

Updating a Database. Information retrieved can be modified or deleted from the database. New records can also be added with automatic linkage. Using Query to update a database can be a time-saver for one-time changes, but an application program will be more efficient for predicable and scheduled changes. Generally, it is desirable to perform most updates via application programs where the data can be checked for validity.

Procedure Capability. Query procedures provide a convenient way of storing particular Query commands in a disk file for repeated use without having to retype them. There are three types of Query procedures that aid in finding data entries in the database, reporting them, and updating the database. Query provides commands to help create, edit, and destroy procedures.

Batch Capability. Query can also be executed in a batch mode without operator interaction. Query commands that would normally be entered interactively can be stored in a disk file for repeated use. The disk file created for batch Query can also use Query procedures for some of the required responses. One example usage of Query in a batch mode would be the creation of a particular report on a regular basis where the development of an application program is not justified.

Query Command Set

DATA-BASE	Identifies database to be accessed.
SELECT-FILE	Identifies file to be used for retrieving data entries
FIND	Multicriteria data selection
REPORT	Report formatting and generation with sorting
UPDATE	Data modification, addition, and deletion
CREATE	Creates a procedure
DISPLAY	Displays a procedure
EXECUTE	Executes a program
DESTROY	Deletes a procedure
FORM	Displays database structure
HELP	Explains purpose and form of Query commands
LIST	Changes list device
EXIT	Exits from Query
XEQ	Allows users to enter Query commands from a command file and return to an interactive mode

Remote Query. Image/1000 combined with DS/1000-IV allows an HP 1000 Computer System to execute Query at a remote DS/1000-IV node that has an RTE-A, RTE-6/VM, or RTE-IVB* based Image/1000 database. Accessing a remote Image/1000 database with Query merely requires executing Query at the Image/1000 system you wish to

* RTE-IVB is a discontinued product, listed here for reference only.

access, using the DS/1000-IV REMAT program. With both DS/3000 and DS/1000-IV, an HP 1000 system can become a virtual HP 3000 terminal, with the HP 1000 user gaining access to an Image/3000 database Query/3000.

Host-Language Access

Ten subroutines are included with Image/1000 for host language access of the database. Your application programs can be written in Pascal, FORTRAN, BASIC, or Assembly language.

More than one database can be opened to a program. For that reason, there is an access control program (DBCOP) included with Image/1000.

Host language access allows the user to tailor a program to the specific application. Query is actually an application program generalized to serve novice users, but it cannot offer the flexibility and efficiency of an application program written for a particular task. The combination of host language access and Query allows both programmers and novices to access the database in the most cost-effective way.

Remote Image/1000 databases can be easily accessed using DS/1000-IV software. The remote database you wish to access can be specified with a node number when the database is opened with DBOPN subroutine. Two programs (RDBAM and RDBAP) included with DS/1000-IV for Remote Database Access (RDBA) service remote requests from user-written programs.

Ten subroutine calls provide the user with the capability of opening multiple databases for access; reading, writing, and updating elements; retrieving information about the database structure; locking and unlocking a database; and closing a database. These are:

DBOPN (Data Base Open). Prepares a database for subsequent access by other Image/1000 subroutines. This includes specifying a level word, thereby establishing the data items a particular user can access. Since multiple users can open the database, a coordinating program (DBCOP) provides for database sharing.

DBINF (Data Base Information). Provides information about the organization and components of the database being accessed. The information can be the type and length of data items, the relationships between data, etc.

DBFND (Data Base Find). Locates the beginning of a data chain with a calculated (hashed) value based on the key item. This is done in order to perform subsequent chained reads via DBGET.

DBGET (Data Base Get). Accesses data in the database in a variety of ways. A master data set can be accessed in a calculated (hashed), serial, or direct fashion. A detail data set can be accessed in a chained read, serial, or direct fashion.

DBUPD (Data Base Update). Modifies existing data.

DBPUT (Data Base Put). Adds new data to a database.

DBDEL (Data Base Delete). Deletes existing data.

DBLCK (Data Base Lock), Gives the user temporary exclusive use of the database to update entries.

DBUNL (Data Base Unlock). Relinquishes exclusive user control and restores the database to full use by others.

DBCLS (Data Base Close). Closes the database and prevents further access.

Maintaining the Database

Six utility programs in Image/1000 aid in the maintenance of databases. These utilities are useful for database backup, database restructuring, inquiring database capacity, and recovering a database closed improperly. Four of the utilities (DBULD, DBLOD, DBSTR, DBRST) can be used in a batch mode. The six utilities and their functions are:

DBSTR (Data Base Store). Copies the database root file and an existing database onto magnetic tape or additional disk. This is a physical unload for the purpose of backup security; it cannot be used to restructure the database.

DBRST (Data Base Restore). Restores a root file and a database from a magnetic tape or additional disk created by DBSTR. No modification of the database structure is allowed.

DBULD (Data Base Unload). Copies data from an existing database onto magnetic tape or additional disk. Unloading the database using this routine allows the user to reload the database into a different database structure.

DBLOD (Data Base Load). Builds a database according to a specified root file from a magnetic tape or additional disk created by the DBULD program. DBLOD users have the option to restore the data to the same database structure or create a new database structure using a new database definition.

DBSPA (Data Base Space). Reports number of entries in use and entries available.

RECOV (Data Base Recovery). Closes previously opened databases that were not properly closed and gives status information on databases which are open.

Functional Specifications

Database Capacity and Syntax

Database: May contain up to 50 data sets. Total size under RTE-A or RTE-6/VM is a maximum of 3.2 Gbytes, which may contain up to 255 unique data items. Total database size under RTE-IVB* is limited only by the total available storage, presently a maximum of 960M bytes in RTE–IVB* (8 HP 7925* Disk Drives).

Data Set: May contain up to 2^{31}-1 (> 2 billion) data entries under RTE-A, RTE-6/VM or RTE-IVB*. However, a data set cannot span multiple disk subchannels, limiting the data set size to a maximum of 2G bytes under RTE-A or RTE-6/VM, 120M bytes under RTE-IVB*.

Data Entry: May contain up to 4096 bytes. All data entries within a given data set have the same record format. There can be up to 127 unique data item names per data entry.

Data Item Types: Integer number with values –32768 to +32767, Real numbers with values 1.47×10^{-39} to 1.7×10^{38}, and ASCII character strings with up to 255 characters.

* Identifies discontinued product, listed here for reference only

Data Item Arrays: Array of any single data item type. There may be up to 255 elements in the array. When using Query, the REPORT ALL and UPDATE commands process all the elements of an item array. However, the Query FIND and REPORT commands will only process the first element of an item array.

Detail Data Sets per Master Data Set: 16.

Search Items (keys) per Detail Data Set: 16.

Database and Data Set Names: 1-6 characters.

Data Item Name: 1-6 characters. A database may contain up to 255 unique data item names and those names may be repeated in the description of more than one data set.

Security Code: Integer 1 to 32767 or two ASCII characters.

Privacy Level Word: 1-6 characters.

Configuration Information

Remote Database Access: RTE-A, RTE-6/VM or RTE-IVB* based Image/1000 database can be accessed from a remote DS/1000 node by Query and with a Pascal, FORTRAN, or Assembly language program using Image/1000 subroutines. Software revision 2040 or later for DS/1000-IV (91750A) is required.

Programming Languages: FORTRAN IV, Pascal, Real-Time BASIC, and HP RTE Assembly or Macro/1000 Assembly language.

Multi-User Capability: The RTE File Manager limits the user to seven programs opening any one file. Since any program accessing the database must open the root file, this means that only seven users can access the same database at any one time unless a program is written that is an interface between the database and other programs accessing the database.

Upgrading from 92063A* Image/1000: 92069A Image/1000 is not compatible with 92063A* Image/1000. However, databases and programs using the 92063A* software can be modified to work with the 92069A software. A DBUP utility in the 92069A software unloads a 92063A* database in a form that allows the 92069A DBLOD utility to reload the database for access with the 92069A Image/1000. Schema modifications and execution of the 92069A schema processor should take place before reloading the data into the 92069A database.

Minimum System Requirements: Same as 92077A RTE-A, 92084A RTE-6/VM, or 92068A RTE-IVB* systems.

Memory Usage
Minimum system: 270 KB
Additional per remote user: 48 KB.

Installation

In HP 1000 Computer System: The Image/1000 Database Management System software will be an integrated, working part of the primary operating system.

When Purchased as a Software Component: Image/1000 is a customer-installed product; installation assistance is available from your local Hewlett-Packard Field Service office at prevailing service rates.

Ordering Information

HP 92069A Image/1000 Database Management System With Query for RTE-A, RTE-6/VM, or RTE-IVB* Use. (Must order one of Use Options 400 through 897.)

Image/1000 consists of:

1. Image/1000 software on Media Option 022, 044, 050, or 051, one of **which must be ordered**.

2. 92069-90001 Image/1000 User's Manual.

3. 92069–90002 Image/1000 Software Numbering Catalog.

92069A Media Options

022: Provides software on CS/80 cartridge tape.

044: Provides software on microfloppy disks for HP 12120A*/ 12122A Integrated Disks in Micro/1000 package or HP 9122C/D* or 9133A*/B*/ H*/L* or 9153B*/C Disk.

050: Provides software on 800 cpi mag tape.

051: Provides software on 1600 cpi mag tape.

HP 92069R Right to Copy 92069A Image/ 1000 Software for Use on an Additional Computer System. (Must order one of Use Options 400 through 897)

The 92069R product is available only to customers who have purchased a license to use 92069A. 92069R consists of:

1. The right to make one copy of software purchased with the 92069A Image/1000 Database Management System for use on an additional system.

2. 92069-90001 Image/1000 User's Manual.

3. 92069–90002 Image/1000 Software Numbering Catalog.

92069A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/ DK Board Computer, 2156B*/C/ D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/ G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

601: Upgrade from previous version of 92069A/R option 600 to latest version of same for customer NOT on software support service.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

701: Upgrade from previous version of 92069A/R option 700 to latest version of same for customer NOT on software support service.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E/F*-Series computer or SPU. With 92069A, option 890 includes the right to purchase one or more 92069R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

* Identifies discontinued product, listed here for reference only.

891: Upgrade from previous version of 92069A/R option 890 to latest version of same for customer NOT on software support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

Recommended Additional Equipment

In addition to the basic hardware required to support the host RTE operating system, computer systems with the 92069A Image/ 1000 Database Management System should also include a line printer for fast printout of reports and either a magnetic tape unit or an additional disk drive for database backup.

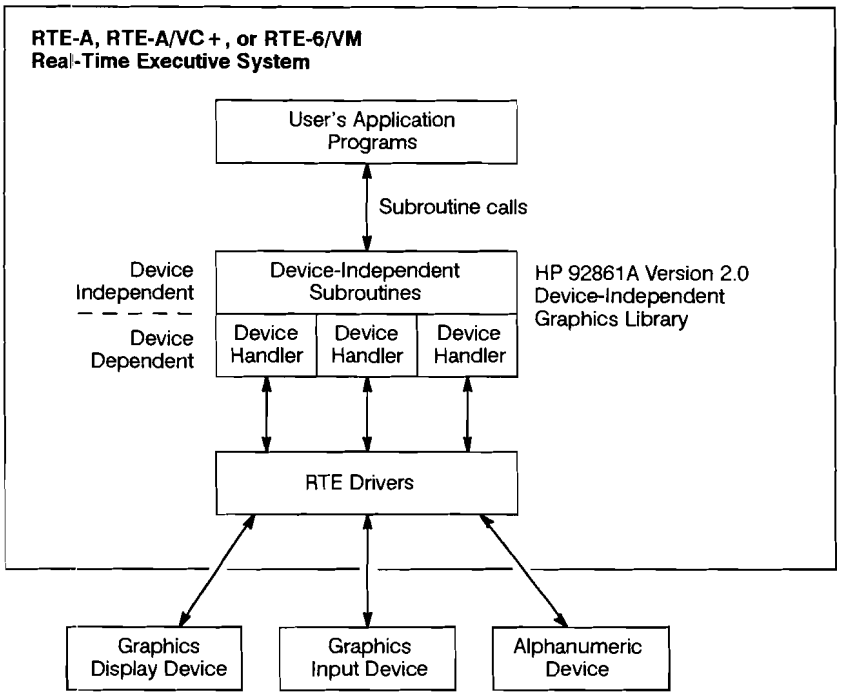
Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

92861A Device-Independent Graphics Library (DGL)

Introduction

The HP 92861A Device-Independent Graphics Library (DGL) is the basic building block for Graphics/1000-II Version 2.0 applications on HP 1000 Computer Systems operating under RTE-A, RTE-A/VC+, or RTE-6/VM. The DGL provides a device-independent interface which is designed to support the HP 92862A Version 2.0 Advanced Graphics Package (AGP) and to facilitate implementation of other user's graphics applications on HP 1000 Computer Systems.



Features

- Support under hierarchical Command Interpreter file system.
- Optional large program support using code and data separation in RTE-A/VC+.
- Efficient design for fast execution, minimal memory requirements.
- Device-independent graphics primitives for simplified development of graphics applications.
- Multilingual programmability in FORTRAN, Pascal, and Macro/1000.

Highly-Efficient Support of User's Graphics Applications

DGL software consists of CDS† and non-CDS† graphics subroutines and device handler modules that become a part of the user's application program. By itself, DGL is most valuable for well-defined two-dimensional display applications, such as continuous process control monitors and standardized graphs from dedicated testing applications. OEMs and end users who take advantage of the off-the-shelf DGL package can save the time and cost of developing their own graphics interface software. The DGL routines are designed to make basic graphics image generation and interaction functions available to the user via very efficient device-independent, high-level program calls. Because of the design emphasis on efficiency, OEMs and end users will find these to be fast-executing routines which use relatively little memory and can be applied to a wide variety of applications.

† CDS = Code and Data Separation in the RTE-A/VC+ operating system.

On a Growing List of Graphics Devices

DGL supports the graphics devices listed in Table 2-11, next page, with the intent to extend support to additional graphics devices. Support service for 92861A will automatically provide new device handlers and other enhancements as they are released.

Functional Specifications

Viewing Transformation Capability

The DGL maps each point in two-dimensional user space to a point on the display surface without software clipping.

Graphics Workstation Definition

Within the Graphics/1000-II environment, the user performs I/O through a graphics workstation. The graphics workstation is a set of logical I/O devices, which can be thought of as a "super device". In DGL, a graphics workstation will usually have a graphics display device and may also include

one of each of the other logical functions listed below, some or all of which may be implemented on a single physical device. Workstations may also consist of more than one physical device. See Table 2-11 for the logical device functions on the various physical graphics devices supported by DGL.

Four Types of Graphics Input Devices

Button: Returns integer value depending upon key or button actuated.

Keyboard: Returns alphanumeric data entered on a keyboard by a user.

Locator: Returns X-Y coordinate information designated by the user using a terminal cursor, digitizer, or graphics tablet.

Valuator: Returns scalar real value entered by a user as the relative position of a terminal cursor, digitizer, or graphics tablet.

Graphics Output Devices

Graphics Display: Any graphics output device, such as a plotter, CRT display, or printer.

Alphanumeric Display: Any device suitable for displaying or printing alphanumerics.

Graphics Subroutine Capabilities

See Table 2-12.

Compatibility

Operating System: RTE-A, RTE-A/VC+, or RTE-6/VM.

Program Languages: FORTRAN 77, Pascal/1000, and Macro/1000 Assembly language.

Table 2-11. Graphics Devices Supported by DGL

Supported Devices	A-Series Interface and Cable	E*/F*-Series Inteface and Cable	Logical Dev. Codes
RASTER TERMINALS			
2393A 2397A 2625A* Opt. 523 2628A* Opt. 523 9666A	12040D# & 40242M or 12005B Opt. 002	12792C & 40242M 12966A Opt. 106	A, B, D, K, L, V
2623A* 2626A*	12040D# & 13222Y or 12005B Opt. 005	12792C & 13222Y 12966A Opt. 105	
2647F*	12040D# & 13232Y or 12005B Opt. 004	12792C & 13232Y 12966A Opt. 001†	
2647A* 2648A* 2649C*/G*	Not supported in A-Series	12792C & 13232Y 12966A Opt. 001†	
RASTER DISPLAY			
13279B*	12065A	Not supported	D
INPUT DEVICES			
9111A*	12009A‡	59310B‡	B. L. V
9874A*	12009A‡	59310B‡	A, B, L, V
VECTOR DISPLAYS			
1350S*/1351S*	12009A‡	59310B‡	D
1350S* or 1351S* with 9111A*	Not supported in A-Series	59310B‡	
VECTOR PLOTTERS			
7220C*/7220T* 7221A*/7221B* 7221C*/7221S* 7221T*	Not supported in A-Series	12966A Opt. 004†	D, L
7225B* w/17501A* 7440A Opt. 002 7470A* Opt. 002 7475A Opt. 002 7550A 7570A w/17570A 758xB* Opt. 060 7595A 7596A 9872x*	12009A‡	59310B‡	
7440A Opt. 001 7470A* Opt. 001 7475A Opt. 001 7570A 758xB* Opt. 060 7595A 7596A	12040D# & 13242N	12792C & 13242N	
7550A	12040D# & 17355D	12792C & 17355D	
COLOR FILM RECORDER			
7510A*	12009A‡	59310B‡	D
7510A*	12040D# & 17355D	12792C & 17355D	

Table 2-11. Graphics Devices Supported by DGL, continued

Supported Devices	A-Series Interface and Cable	E*/F*-Series Inteface and Cable	Logical Dev. Codes
RASTER PRINTERS			
2227A 2228A	12040D# & 13242N	Not supported in E*/F*-Series	D
2235B 2563A* Opt. 049 2563B Opt. 049 2564B Opt. 049 2565A* Opt. 049 2566A* Opt. 049 2566B Opt. 049 2932A* 2934A	12040D# & 92219G	Not supported in E*/F*-Series	
2235B 2563A* Opt. 214 2563B Opt. 214 2564B Opt. 214 2565A* Opt. 214 2566A* Opt. 214 2566B Opt. 214 2932A* Opt. 046 2934A Opt. 046	12009A‡	Not supported in E*/F*-Series	
2563A* Opt. 210 2563B Opt. 210 2564B Opt. 210 2565A* Opt. 210 2566A* Opt. 210 2566B Opt. 210	Not supported in A-Series	12821A Opr. 001	
2608A* Opt. 210 2608S* Opt. 210	Not supported in A-Series	Option 210 includes 26099A or 12821A Opt. 001 interface.	

* Obsolete product listed here for reference only.

Or four-port multiplexer of the 12100A A400 Single-Board Computer.

† Compliance of this product with U.S. or German EMI regulations has not been confirmed.

‡ HP 12009A and 59310B interfaces include cable to the first device on the HP-IB bus; use HP 10833x cables to additional devices.

Logical Device Codes:
A = Alphanumeric Display
B = Button
D = Graphics Display
K = Keyboard
L = Locator
V = Valuator

Supported Graphics Devices: See Table 2-11.

Extent of Device Support: The 92861A DGL provides a system-level set of graphics subroutines that are device and application independent. Each supported graphics device has its own set of features and capabilities. The 92861A DGL supports those device features that are most important to the majority of HP 1000 application areas. DGL also supports application program access to special features which are available with the graphics device. DGL-supported device features are described in the 92861A manuals.

Table 2-12. DGL Subroutine Capabilities

OUTPUT	
ZALPH	Sends text string to alphanumeric display.
ZDRAW	Draws a line on the graphics display.
ZMARK	Draws a marker on the graphics display.
ZMOVE	Sets starting position.
ZPGDD	Draws a polygon on the graphics display, using device hardware for area fill.
ZPGDI	Draws a polygon on the graphics display, using software-generated area fill.
ZPOLY	Draws connected line sequence on the display.
ZTEXT	Draws graphics text on the graphics display.
PRIMITIVE ATTRIBUTES	
ZCOLM	Chooses color model (RGB or HSL) for interpreting parameters in the color table.
ZCOLR	Sets color attribute.
ZCSIZ	Sets character size attribute.
ZDCOL	Redefines color of an entry in the color table.
ZDPST	Defines entry in polygon interior style table.
ZHIGH	Sets highlight attribute.
ZKSTL	Sets linestyle attribute.
ZLWID	Sets linewidth attribute.
ZPICL	Sets polygon interior color attribute.
ZPILS	Sets polygon interior linestyle attribute.
ZPSTL	Sets polygon interior style attribute.
INPUT	
ZBUTN	Awaits button press, returns value to program.
ZKYBD	Awaits keyboard-entered character string, returns string to program.
ZLOCP	Defines locator echo position on the display.
ZSLOC	Samples locator, returns value to program.
ZSVAL	Samples valuator, returns value to program.
ZWLOC	Awaits operator response, returns locator value to program.
ZWVAL	Awaits operator response, returns valuator value to program.

Continued on next page.

Table 2-12. DGL Subroutine Capabilities, continued

CONTROL/WORKSTATONS	
ZAEND	Disables alphanumeric device.
ZAINT	Enables alphanumeric device.
ZBEGN	Initializes the DGL system.
ZBEND	Disables the button device.
ZBINT	Enables the button device.
ZBMOD	Sets batching mode (whether picture changes are immediate or buffered).
ZDEND	Disables the graphics display.
ZDINT	Enables the graphics display.
ZEND	Terminates the DGL system.
ZKEND	Disables the keyboard device.
ZKINT	Enables the keyboard device.
ZLEND	Disables the locator device.
ZLINT	Enables the locator device.
ZMCUR	Makes the picture current.
ZNEWF	Initiates a new frame action (clears graphics display or moves the recording medium to a fresh drawing area).
ZVEND	Disables the valuator device.
ZVINT	Enables the valuator device.
VIEWING TRANSFORMATIONS AND CONVERSIONS	
ZASPK	Defines aspect ratio of virtual coordinate system.
ZDLIM	Defines logical limits of graphics display.
ZDPMM	Converts world coordinates to millimeters on the locator device.
ZVIEW	Defines viewport boundaries.
ZWIND	Defines window boundaries.
INQUIRY	
ZIACS	Returns character size which will be used on the graphics display.
ZIPST	Returns polygon style of an entry in the polygon style table.
ZIROL	Returns color modelling parameters associated with a specified index in the current color table.
ZIWS	Returns information about the DGL system.
SPECIAL INTERFACES	
ZIESC	Performs a device-dependent inquiry from a graphics display device.
ZOESC	Performs a device-dependent output to a graphics display device.

Installation

HP 92861A DGL is a customer installed product, which is easily linked from its relocatable libraries to satisfy the graphics communication requirements of the user's applications. It is not generated into the RTE operating system.

Minimum System Requirements

Same as basic 92077A RTE-A, 92077A/92078A RTE-A/VC+, or 92084A RTE-6/VM system, plus one graphics device selected from Table 2-11.

Memory Required for Vector-to-Raster Conversion in Software for Raster Printers

At least 500 pages (1 MB) of EMA or 100 pages (200 KB) of working set for VMA for vector-to-raster conversion using software included in the DGL.

Ordering Information

HP 92861A Graphics/1000-II Device-Independent Graphics Library (DGL) (must order one of Use Options 400 through 897)

HP 92861A DGL includes:

1. The DGL software and a catalog file describing it on Media Option 022, 044, 050, or 051, **one of which must be ordered.**
2. 97084-90000 DGL Programmer's Reference Manual.
3. 92861-18999 DGL Software Numbering Catalog.
4. 92861-90003 Graphics/1000-II Device Handlers Reference Manual.
5. 24998-90010 AGP/DGL Product Demonstration Instruction Sheet.

92861A Media Options

022: Provides software on CS/80 Cartridge Tape.

044: Provides software on Microfloppy disk for HP 12120A*/12122A Integrated Disks in Micro/1000 Package or HP 9122C/D* or HP 9133A*/B*/H*/L* or HP 9153B*/C Disk.

050: Provides software on 800 cpi magnetic tape.

051: Provides software on 1600 cpi magnetic tape.

HP 92861R Right to Copy DGL for Use on an Additional Computer System (must order one of Use Options 400 through 897)

The HP 92861R Right to Copy product is available only to customers who have purchased HP 92861A without an upgrade option. 92861R consists of:

1. The license to make one copy of software purchased with 92861A for use on an additional system.
2. 97084-90000 DGL Programmer's Reference Manual.
3. 92861-18999 DGL Software Numbering Catalog.
4. 92861-90003 Graphics/1000-II Device Handlers Reference Manual.
5. 24998-90010 AGP/DGL Product Demonstration Instruction Sheet.

* Discontinued product, listed here for reference only.

92861A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/ G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

601: Upgrade from previous version of 92861A/R option 600 to latest version of same for customer NOT on support service.

602: Upgrade from 92841A/R option 600 to 92861A/R option 600 for customer on support service.

603: Upgrade from 92841A/R option 600 to 92861A/R option 600 for customer NOT on support service.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

701: Upgrade from previous version of 92861A/R option 700 to latest version of same for customer NOT on support service.

702: Upgrade from 92841A/R to option 700 92861A/R option 700 for customer on support service.

703: Upgrade from 92841A/R to option 700 92861A/R option 700 for customer NOT on support service.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E*/F*-Series computer or SPU. With 92861A, option 890 includes the right to purchase one or more 92861R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 92861A/R option 890 to latest version of same for customer NOT on support service.

892: Upgrade from 92841A/R option 890 to 92861A/R option 890 for customer on support service.

893: Upgrade from 92841A/R option 890 to 92861A/R option 890 for customer NOT on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

* Discontinued product, listed here for reference only.

Software Support Products

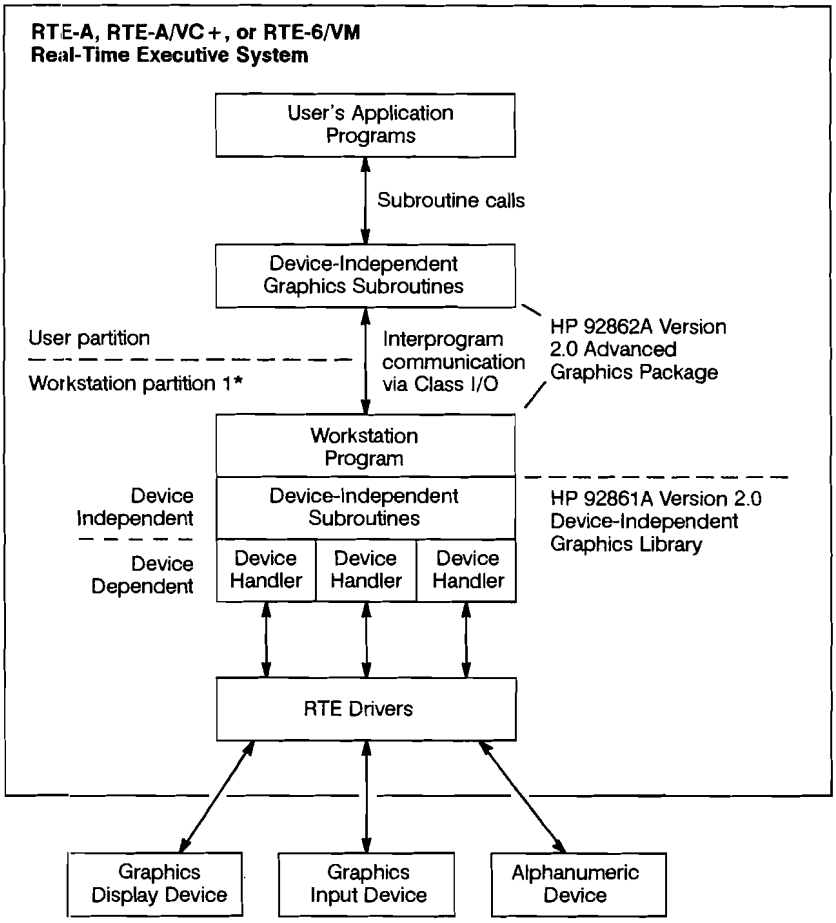
See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

NOTES:

92862A Advanced Graphics Package (AGP)

Introduction

The HP 92862A Advanced Graphics Package (AGP) is an interactive three-dimensional graphics package for use on HP 1000 Computer Systems with the HP 92861A Device-Independent Graphics Library (DGL), both operating under RTE-A, RTE-A/VC+, or RTE-6/VM.



* Each graphics workstation consists of one display device, one alphanumeric message device, and up to five different logical input devices; AGP supports up to eight concurrently active workstations.

Features

- Support under hierarchical Command Interpreter file system.
- Optional large program support using code and data separation in RTE-A/VC+.
- Two and three dimensional viewing transformations.
- Perspective and parallel projections.
- Full clipping capability.
- Picture segmentation for fast interactive manipulation of graphics images.
- Pick input function to facilitate user interaction with picture segments to be displayed or changed.
- Efficient design for fast execution, minimal memory usage.
- Workstation program for coordinated operation of a logical graphics display device, up to five different types of logical graphics input devices (locator, pick, button, keyboard, and valuator), and one alphanumeric device.
- Device-independence.
- Support for concurrent operation of up to eight workstations for simultaneous graphics input/output.
- Six different fonts for graphics text.
- Multilingual programmability in FORTRAN, Pascal, and Macro/1000.
- Error reporting facilities.

Three-Dimensional Interactive Graphics Programming Power

Three-Dimensional Viewing Transformations

The Advanced Graphics Package (AGP) provides very sophisticated viewing transformations. These include windowing, clipping, and viewporting with parallel or perspective projections.

Picture Segmentation

Application programs can use AGP to manipulate parts of a picture, called segments, as single entities for operations, such as highlighting or erasure. With the aid of interactive picking, this facilitates rapid interactive changing of picture elements by a user.

Interactive Picking

A high-level "picking" function is available for interactive applications. When the user points with the stylus of a graphics tablet or other "pick" input device to the primitives of line, set of lines, or text on the display, AGP returns the segment name and the pick identifier for the specific primitives to the application program. This segment and primitive I.D. return is based on a two-level segmented file, which is similar to the pick recommendations of the SIGGRAPH CORE proposal. Normally, without picking, only the X-Y coordinate of the graphics tablet would be returned to the application program, which would then have to decide what the user was pointing at. Because the AGP software performs this picking function, the application programmer saves considerable programming time and effort needed to implement this complex computer graphics function.

Efficient Operational Structure

The AGP software consists of CDS† and non-CDS† graphics subroutines that are used in application programs, a set of modules for configuring workstation programs, and a sample graphics monitor program. As shown in the diagram on page 77, the application program with AGP graphics subroutines and the workstation program are separate. This maximizes the application program's available code and data space. At the same time, this arrangement also makes very effective use of the overall system through concurrent processing in the multitasking RTE system.

The user's application program can communicate with up to eight workstation programs simultaneously, each in its own partition and each driving its own set of graphics devices. At the start of execution, the application program initiates each workstation program. All subsequent graphic commands are automatically transmitted to each enabled workstation for output. The workstation program communicates with the graphics devices comprising the workstation via the device-independent subroutines and device handlers of the HP 92861A Device-Independent Graphics Library (DGL).

† CDS = Code and Data Separation in the RTE-A/VC+ operating system.

Functional Specifications

Viewing Capabilities

AGP supports viewing of two-dimensional (2-D) and three-dimensional (3-D) objects from any position.

3-D Projection Choices

AGP supports both perspective and parallel projection of 3-D objects.

Windowing

The user's "window", which is used to clip the picture, can be rotated or otherwise moved in any direction with respect to the object being viewed. Depth clipping is supported so that primitives of a 3-D image that are outside of specified "hither" and "yon" clipping planes can be eliminated.

Segmentation

The transformed images of the AGP output primitives specified by the user can be stored in a Segment Display Area (SDA) from which they can be written onto graphics display devices and in which they may be manipulated, modified, highlighted, etc. Each user-specified block of output primitives that makes up a picture segment results in an image that is part of the total picture. Because each segment has a user-assigned name, it is easily referenced by application programs to selectively display or modify parts of the total image. AGP supports one level of segmentation, which precludes nesting of picture segments. Picking identification within segments provides a second level of picture element selectability.

Picking

AGP supports the use of a logical "pick" device, such as a graphics terminal cursor or a data tablet stylus. Within AGP, the "pick" X-Y coordinates are processed against the SDAs to return to the application program both the picture segment name and any pick identification that has been associated by the user with a specific output primitive (line or series of lines, markers, text, etc.) within that picture segment.

Graphics Output Primitives

Moves: The current position is set to the specified coordinates (moved to a new position) without drawing a line.

Lines: A single straight line is drawn from the current position to a specified point.

Polylines: A connected line sequence from the current position to and through a series of points read from an array in memory.

Markers: At least 19 different marker symbols can be drawn with placement at the current position.

Graphics Text

High-quality Text: High-quality text, which is completely generated, positioned, spaced, modelled, and translated in software, affords a choice of any of the six graphics text fonts provided with AGP (see box below). It is completely device independent.

English Gothic!
Simplex Roman!
Triplex Roman!
Simplex Script!
Eurostyle!
ΛΠΕΕΚ!

Medium-quality Text: Medium-quality text characters are generated by the hardware character generator of the graphics output device (or device handler software simulating such a hardware generator) and positioned by software. There is no choice of graphics text font and positioning is limited to control of character-to-character, and line-to-line spacing.

Low-quality Text: Low-quality text is generated and spaced entirely by the hardware character generator of the graphics output device (or device handler software simulating such a hardware generator). It is device dependent.

Graphics Font Text Storage: Graphics text fonts, including user-designed fonts, are stored in, and accessed from, font files on the disk.

Workstations

Definition: Within the Graphics/1000-II environment, the user performs I/O through a graphics workstation. The graphics workstation is a set of logical I/O devices which can be thought of as a "super device" which can be physically configured from one or more real devices. A graphics workstation can have a graphics display device and may also include one of each of the other logical devices coded in Table 2-13, next page, some or all of which may be implemented on one physical device, such as an HP 2393A Graphics Terminal. Workstations may also consist of more than one physical device. See Table 2-13 for the logical device functions that are available on the various physical devices supported under AGP and DGL.

Number of AGP Graphics Workstations: Up to eight per AGP application program.

Five Types of Graphics Input Devices

Button: Returns integer value depending upon key or button actuated.

Keyboard: Returns alphanumeric data entered on a keyboard by a user.

Locator: Returns X-Y coordinate information designated by the user using a terminal cursor, digitizer, or graphics tablet.

Valuator: Returns scalar real value entered by a user as the relative position of a terminal cursor, digitizer, or graphics tablet.

Pick: Returns segment name and pick identifier of output primitive designated by operator using devices, such as a terminal cursor or digitizer.

Table 2-13. Graphics Devices Supported by AGP

Device Product Numbers	Usable in Series	Logical Device Codes
RASTER TERMINALS		
2393A, 2397A, 2623A*, 2627A*, 2625A* + 523, 2628A* + 523, 2647F*	A, E*, F*	A,B,D,K, L,P,V
2647A*, 2648A*, 2649C*/G*	E*, F* only	
INPUT DEVICES		
9111A*	A, E*, F*	,B,L,P,V
9874A*	A, E*, F*	,A,B,L,P,V
RASTER DISPLAY		
13279B*	A, E*, F*	D
VECTOR DISPLAYS		
1350S*/1351S*	A, E*, F*	D
1350S* + 9111A* 1351S* + 9111A*	E*, F* only	D
VECTOR PLOTTERS		
7220x*, 7221x*	E*, F*	D,L
7225B*, 7440A, 7475A, 7470A*, 7550A, 7570A	A, E*, F*	
758xA*/B*, 7595A, 7596A, 9872x*	A, E*, F*	D,L,P
COLOR FILM RECORDER		
7510A*	A, E*, F*	D
RASTER PRINTERS		
2227A, 2228A, 2235B	A	D
2563A*/B, 2564B, 2565A*, 2566A*/B, 2932A*, 2934A	A, E*, F*	
2608A*/S*	E*, F*	

* Discontinued product, listed here for reference.

Logical Device Codes:
A = Alphanumeric Display
B = Button
D = Graphics Display
K = Keyboard
L = Locator
P = Pick
V = Valuator

Graphics Output Devices

Graphics Display: Any graphics output device, such as a plotter, CRT display, or printer.

Alphanumeric Display: Any device suitable for displaying or printing alphanumerics.

Graphics Subroutine Capabilities

See Table 2-14.

Compatibility

Operating System: RTE-A, RTE-A/VC+, or RTE-6/VM.

Program Languages: FORTRAN 77, Pascal/1000, and Macro/1000 Assembly language.

Supported Graphics Devices: Graphics devices are operated through the HP 92861A Device-Independent Graphics Library (DGL), so AGP support is the same as for DGL; see the DGL data sheet for supported graphics devices.

Extent of Device Support: Together, HP 92862A AGP and 92861A DGL provide a system-level set of graphics subroutines that are device and application independent. Each supported graphics device has its own set of features and capabilities. AGP and DGL supports those device features that are most important to the majority of HP 1000 application areas. AGP and DGL also support application program access to special features which are available with the graphics device. AGP-supported device features are described in the 92861A and 92862A manuals.

Memory Requirements

Base: 0.5 MB.

For Vector-to-Raster Conversion in Software for Raster Printers: At least 500 pages (1 MB) of EMA or 100 pages (200 KB) of working set for VMA.

For Each Workstation Program: 20-64 KB non-CDS, 10-56 KB for code segment and 6-38 KB for data segment with CDS.

Installation

HP 92862A AGP is a customer installed product, which is easily linked from its relocatable libraries along with appropriate 92861A DGL subroutines and device handlers to satisfy the graphics requirements of the user's applications. An appropriate workstation program(s) must be configured and linked before an application program(s) is run. A monitor program for communications between the application program(s) and the workstation program(s) must also be linked.

Minimum System Requirements

Same as basic 92077A RTE-A, 92077A/92078A RTE-A/VC+, or 92084A RTE-6/VM system, plus the 92861A DGL product and one graphics device selected from Table 2-13.

Table 2-14. AGP Subroutine Capabilities

OUTPUT* (Appearance of output depends upon Primitive Attributes, below)	
JnDRW	Draws absolute positioned line from current position.
JnMOV	Sets current position to absolute point.
JnMRK	Draws absolute positioned marker symbol.
JnPGN	Draws absolute positioned polygon, using coordinates in a buffer .
JnPLY	Draws absolute positioned sequence of lines from current position, using coordinates in a buffer .
JRnDR	Draws a relative positioned line from the current position.
JRnMK	Draws a relative positioned marker symbol.
JRnMV	Sets the new current position to the point specified relative to the current position.
JRnPG	Draws relative positioned polygon, using coordinates in a buffer .
JRnPL	Draws relative positioned sequence of lines from current position, using coordinates in a buffer .
JTEXH	Writes high-quality text generated completely by software, with a choice of fonts.
JTEXL	Writes low-quality text using the hardware character generator of graphics display device.

* n in these calls = 2 for 2-D graphics, 3 for 3-D graphics.

PRIMITIVE ATTRIBUTES	
JCOLM	Chooses color model (RGB or HSL) for interpreting parameters in the color table.
JCOLR	Sets color attribute.
JCORI	Defines character orientation.
JCSIZ	Sets current character size attribute.
JDCOL	Redefines color of an entry in the color table.
JDPST	Defines entry in polygon interior style table.
JFONT	Sets current font for writing high quality text.
JPICL	Sets polygon interior color attribute.
JJUST	Specifies text justification.
JLWID	Sets line width attribute.
JPILS	Sets polygon interior line style attribute.
JPKID	Sets current pick I.D. attribute that is applied to future primitives inside of picture segments.
JPSTL	Sets polygon interior style attribute.

Table 2-14. AGP Subroutine Capabilities, continued

PICTURE SEGMENT ATTRIBUTES	
JGDET	Sets system-maintained detectability attribute that is given to subsequently-created picture segments.
JGHI	Sets system-maintained highlighting attribute that is given to subsequently-created picture segments.
JGVIS	Sets system-maintained visibility attribute that is given to subsequently-created picture segments.
JSDET	Controls detectability of an existing segment.
JSHI	Controls highlighting of an existing segment.
JSVIS	Controls visibility of an existing segment.
JSVAL	Controls visibility of all existing segments.
PICTURE SEGMENTATION AND NAMING	
JCLOS	Closes the open picture segment.
JCLR	Removes all segments from the graphics system and clears the display.
JOPEN	Creates and opens a new, empty picture segment.
JPURG	Purges an existing picture segment.
JRNAM	Renames an existing picture segment.
JSDF	Creates a disk file that the system uses as an extension to the segmented display area.
VIEWING TRANSFORMATIONS	
JASPK	Defines virtual coordinate system aspect ratio.
JCLPD	Controls hither and yon (depth) clipping.
JCLPW	Controls window clipping.
JCMOD	Controls application of the modelling transformation to all subsequent primitives.
JDLIM	Sets user-defined logical display limits of the graphical output device.
JDMOD	Defines a 4 x 4 modelling matrix.
JDPMM	Converts from visual coordinates to millimeters on the graphics display.
JDPTH	Defines hither and yon clipping planes.
JHAND	Defines world coordinate system to be right or left handed.
JLLIM	Defines limits of locator device.
JLPMM	Converts from virtual coordinates to millimeters on the graphics pick device.

Table 2-14. AGP Subroutine Capabilities, continued

VIEWING TRANSFORMATIONS, continued	
JPROJ	Defines type of 3-D projection (perspective or parallel) and where the center of projection lies.
JRSET	Resets viewing transformation to initialization values.
JVDIS	Defines distance from view reference point to the viewplane along viewplane normal.
JVIEW	Defines the 2-D viewport.
JVPLN	Defines viewplane orientation.
JVREF	Defines world coordinate location of the view reference point.
JWTOV	Converts a world point to virtual coordinates.
JWTOW	Converts a virtual point to world coordinates.
JWIND	Defines boundaries of the viewplane clipping window.
INPUT	
JBUTN	Awaits button press, returns value to program.
JKYBD	Awaits keyboard string entry.
JLOCP	Sets locator echo reference position.
JPICK	Invokes logical pick input function and returns picture segment name and pick I.D. of the "picked" primitive within that picture segment.
JPIKP	Sets pick echo position on graphics display.
JSLOC	Samples locator, returns value to program.
JSVAL	Samples valuator, returns value to program.
JWLOC	Awaits user response, returns locator value to program.
JWVAL	Awaits user response, returns valuator value to program.
INQUIRY	
JICOL	Returns color parameters associated with an index in the color field.
JICP	Returns current position in 3-D world coordinates (X, Y, and Z).
JIMAT	Returns current value of a specified 4 x 4 transformation matrix.
JInRE	Returns 'n' (1, 2, 3, or 4) real values describing a specified aspect of the current state of the graphic system.
JIPST	Returns polygon style of an entry in a specified workstation's polygon style table.
JISGA	Returns attributes of specified picture segment.
JISGW	Returns workstation names that a picture is bound to.

Table 2-14. AGP Subroutine Capabilities, continued

INQUIRY continued	
JITSZ	Returns size of a text string.
JIWS	Returns information on op code specified workstation configuration and capabilities.
JT1IN	Returns an integer value describing a specified aspect of the current state of the graphic system.
JIWND	Returns 3-D untransformed world coordinates of viewplane clipping window.
SPECIAL INTERFACES	
JIESC	Performs a device-dependent inquiry from a graphics display device.
JOESC	Performs a device-dependent output operation to a graphics display device.
CONTROL/WORKSTATIONS	
JALPH	Sends a text string to the system alphanumeric display device.
JBATC	Initiates a batch of updates to the graphics display surface.
JBEGN	Initializes the graphics system.
JDDEV	Disables a logical device other than the graphical display device.
JDINT	Initializes graphics workstation (and output device if present).
JEDEV	Enables a logical device.
JEND	Terminates the graphics system.
JIERR	Returns the most recent AGP error.
JIVOF	Ends immediate-visibility batching mode.
JIVON	Sets batching mode to provide immediate visibility of picture changes.
JMCUR	Updates the displayed picture(s) with the most current infomration, but without ending system batching mode.
JNEWF	Initiates new frame action (clears graphics display or moves the recording medium to a fresh drawing area and redraws all segments, removing any primitives outside of segments).
JSERR	Sets error reporting level and graphics aborting levels.
JUPDT	Ends JBATC operation and updates images on the enabled display surfaces.
JWEND	Terminates workstation.
JWOFF	Disables graphical output to a workstation.
JWON	Enables graphical output to a workstation.

Ordering Information

HP 92862A Graphics/1000-II Advanced Graphics Package (AGP) (must order one of Use Options 400 through 897)

HP 92862A AGP includes:

1. The AGP software and a catalog file describing it on Media Option 022, 044, 050, or 051, **one of which must be ordered.**
2. 97085-90000 AGP User's Guide.
3. 97085-90005 AGP Reference Manual.
4. 92862-90001 AGP Reference Manual Supplement.

92862A Media Options

022: Provides software on CS/80 Cartridge Tape.

044: Provides software on Microfloppy disk for HP 12120A*/12122A Integrated Disks in Micro/1000 Package or HP 9122C/D* or HP 9133A*/B*/H*/L* or HP 9153B*/C Disk.

050: Provides software on 800 cpi magnetic tape.

051: Provides software on 1600 cpi magnetic tape.

HP 92862R Right to Copy AGP for Use on an Additional Computer System (must order one of Use Options 400 through 897)

The HP 92862R Right to Copy product is available only to customers who have purchased HP 92862A without an upgrade option. 92862R consists of:

1. The license to make one copy of software purchased with 92862A for use on an additional system.
2. 97085-90000 AGP User's Guide.
3. 97085-90005 AGP Reference Manual.
4. 920862-90001 AGP Reference Manual Supplement.

92862A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

601: Upgrade from previous version of 92862A/R option 600 to latest version of same for customer NOT on support service.

602: Upgrade from 92842A/R option 600 to 92862A/R option 600 for customer on support service.

603: Upgrade from 92842A/R option 600 to 92862A/R option 600 for customer NOT on support service.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU, 2109E*, 2113E*, or 2117F* Computer, or 2178C* Model 60 SPU.

701: Upgrade from previous version of 92862A/R option 700 to latest version of same for customer NOT on support service.

702: Upgrade from 92842A/R option 700 to 92862A/R option 700 for customer on support service.

703: Upgrade from 92842A/R option 700 to 92862A/R option 700 for customer NOT on support service.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E*/F*-Series computer or SPU. With 92862A, option 890 includes the right to purchase one or more 92862R products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 92862A/R option 890 to latest version of same for customer NOT on support service.

892: Upgrade from 92842A/R option 890 to 92862A/R option 890 for customer on support service.

893: Upgrade from 92842A/R option 890 to 92862A/R option 890 for customer NOT on support service.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

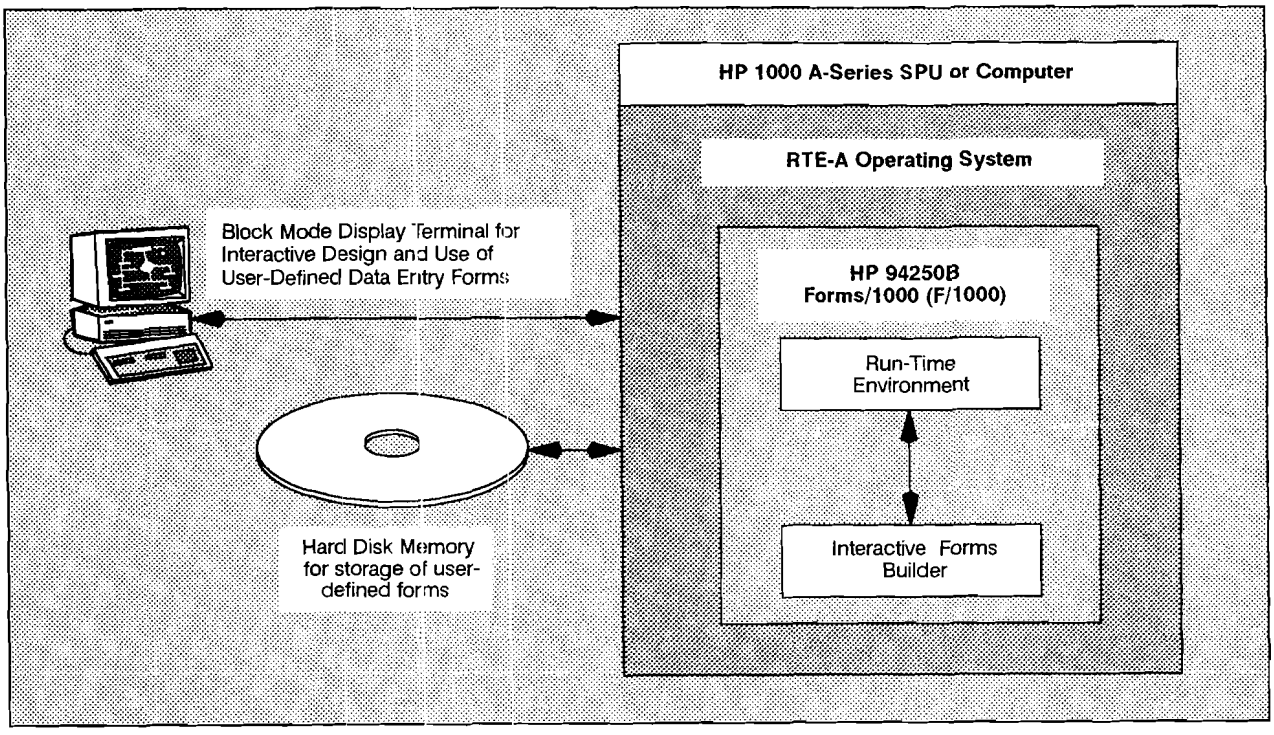
897: Upgrade to Use Option 890 from Use Option 700.

Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

* Discontinued product, listed here for reference only.

94250B Forms/1000 (F/1000)



Introduction

The HP 94250B Forms/1000 (F/1000) package provides a software interface between application programs and users communicating with HP 1000 A-Series computer systems via block mode terminals. F/1000 supports interactive creation, storage, display, and modification of forms used for man-machine communication. Through the medium of the user-defined forms, which may be stored in disk files or main memory, F/1000 manages all terminal I/O and systematizes data access and data entry.

Features

- Interactive Forms Builder for design and modification of forms.
- Compiled forms for maximum throughput
- Support of memory-resident forms for quick access.
- Programmatic interface callable from Pascal and FORTRAN 77.
- Access to input and output data via named fields.
- Automatic data editing and data type checking.
- Choice of Integral or Non-Integral Forms Access Library, for normal or small application program partition size.
- Support for:
  - HP block mode terminals, including color terminals.
  - Terminal soft-key and video enhancement features, including color.
  - Point-to-point (including fiber optic) and multiplexer connections.
  - Help screens for user guidance and error recovery.
- Access of terminals independent of connection and type of terminal.
- Support for complete localization for native language use.

Benefits

- Greatly reduced effort in design, coding, testing, and maintenance of terminal dialog and output sections of application programs.
- Easy localization and personalization of application programs without coding changes.
- Easy access to terminal features, such as color, video enhancements, block mode, softkeys, and cursor positioning.

Functional Description

F/1000 consists of two parts: the Forms Run-Time Environment (Integral or Non-Integral Forms Access Routines) and the Interactive Forms Builder.

The Forms Run-Time Environment

The Forms Run-Time Environment is the software interface between application programs and terminal users. This interface manages terminal I/O for the application program and provides a friendly environment for the user.

The application program can select a form to be displayed, can add variable data by addressing named data fields, and can request its display on the terminal's screen. The application program also can define softkeys or request display of a help screen.

The terminal user's response is also handled by the Run-Time Environment interface. The interface accepts the entered data, makes designer-specified checks of data type, prompts the user to correct the input if necessary, then signals completion of the user's response to the application program. The application program then accesses the entered data by addressing named data fields. If the application program detects a user error, it can highlight the data fields in error with an alternate video enhancement, such as blinking, or request display of an appropriate Help screen.

The Interactive Forms Builder

The Interactive Forms Builder (use not included in the HP 94250E right-to-execute product) provides the application developer with the ability to design data display/entry forms interactively. The layout of fields and the size, type, and name of each field are all definable. Screen design may be completed with definition of softkeys. The forms are displayed as they are "built" and are stored in disk files for later callup and use by application programs.

An extra feature is the simple modification of existing forms. The form to be modified is displayed, modified, and then stored in its own disk file. An optional verification capability can be used to compare modi- fied forms for inconsistencies with existing forms.

The Interactive Forms Builder can execute concurrently with other programs, including application programs that use forms.

Functional Specifications

Environment

Computer System: HP 1000 A-Series system with 512 Kbytes or more memory operating under the RTE-A real-time executive system.

Currently-Available Supported Terminals: HP 700/92†, 2393A, and 2397A

† The HP 700/92 terminal is supported as an emulated HP 2392A Display Terminal.

Discontinued Supported Terminals Listed Here for Reference Only: HP 2382A, 2392A, 2622A, 2623A, 2624B, 2625A, 2626A, 2627A, 2628A, 2645A, 2647A/F, 2648A, 3092A, 3093A, and 45610B (HP150).

Supported Terminal Connection Methods:

- Point-to-point, including fiber-optic connection.
- Multiplexer point-to-point connections.

Supported Programming Languages: Pascal/1000 and FORTRAN 77.

Memory Requirements

Interactive Forms Builder: One 84 Kbyte partition.

Integral Forms Access Library: 24 Kbytes, maximum, not including referenced system routines.

Non-Integral Forms Access Library: 5 Kbytes, maximum, not including referenced system routines.

Forms Monitor (with Non-Integral Forms Access Library only): 54 Kbytes.

Field Specifications

Number of Fields: Up to 255 named fields per system.

Field Size: Up to 1840 characters in all fields.

Data Types Supported: Short Integer, Short Real, and Character.

Installation

HP 94250B Forms/1000 is a customer-installed product that is easily loaded from the relocatable modules and libraries that are supplied. A new system generation is not required.

Ordering information

HP 94250B Forms/1000 Software Package (Must order one of Use Options 400 through 897)

Forms/1000 consists of:

1. The Interactive Forms Builder and Run-Time Environment Software described in this data sheet on media option 022, 044, or 051, **one of which must be ordered.**
2. 94250-90005 F/1000 Reference Manual.
3. 94250-90006 Getting Started with F/1000.

94250B Media Options

022: Provides software on CS/80 Cartridge Tape.

044: Provides software on Microfloppy disk for HP 12120A*/12122A Integrated Disks in Micro/1000 Package or HP 9122C/D* or HP 9133A*/B*/H*/L* or HP 9153B*/C Disk.

051: Provides software on 1600 cpi magnetic tape.

HP 94250R Use of F/1000 on One Additional Computer System (Must order one of Use Options 400 through 897)

The 94250R product is available only to customers who have purchased a license to use 94250B. 94250R consists of:

1. The license to make one copy of software purchased with the 94250B product for use on one additional system.
2. 94250-90005 F/1000 Reference Manual.
3. 94250-90006 Getting Started with F/1000.

HP 94250E Right to Execute the F/1000 Run-Time Environment On One Additional Computer System (must order one of Use Options 400 through 897)

This is a low-cost license for an OEM. No manual or software is supplied with this product, which is simply a license to execute the Run-Time Environment of F/1000 and user programs that depend upon it under 94250E Right-to-Execute F/1000 on a dedicated A-Series application system. The use of the F/1000 Forms Builder is expressly **NOT** licensed under the HP 94250E product.

94250B/R/E Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

601: Upgrade from previous version of 94250B option 600 to latest version of same for customer NOT on support service.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* or Micro 27 SPU.

701: Upgrade from previous version of 94250B option 700 to latest version of same for customer NOT on support service.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU or in any other A/E/F*-Series computer or SPU. With 94250B, option 890 includes the right to purchase one or more 94250R/E products with Use Option 400, 600, 700, and/or 890 for use on a corresponding additional computer(s).

891: Upgrade from previous version of 94250B option 890 to latest version of same for customer NOT on support service.

894: Upgrade from Use Option 400 to 890.

896: Upgrade from Use Option 600 to 890.

897: Upgrade from Use Option 700 to 890.

Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

* Discontinued product, listed here for reference only.

NOTES:

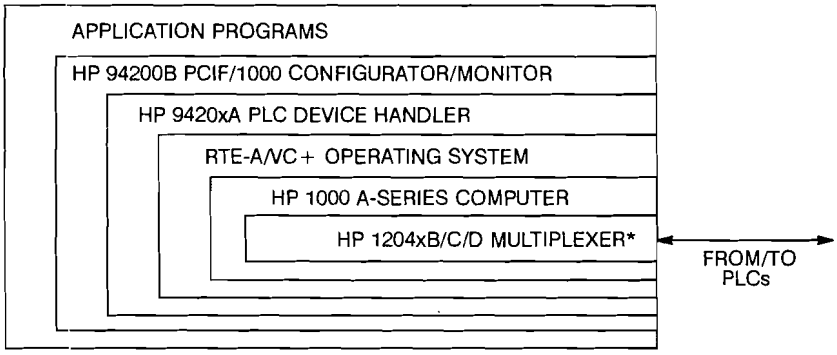
94200B Programmable Controller Interface/1000 (PCIF/1000)

Introduction

Programmable Logic Controllers (PLCs) provide direct control of the factory floor devices that perform specific manufacturing activities on the factory floor. Higher level computers provide management of large areas of activities on the factory floor. Quite often, custom software is required to provide communications between PLCs and management systems.

HP Programmable Controller Interface/1000 (PCIF/1000) provides device communications management for the plant floor to meet industrial automation requirements today. PCIF/1000 manages communications with factory floor devices providing high-level access to control factory floor operations and retrieve information. PCIF/1000 is modular, so system developers can implement only the modules required for their particular application.

PCIF/1000 consists of a primary management or "Configuration and Monitor" module, and any of several alternate PLC Device support modules, as shown in the diagram at top right. The modular design of the PCIF/1000 family accommodates itself to any combination of supported PLCs. This design minimizes software and support costs while making efficient use of memory in the host computer. The high-level command facilities of PCIF/1000 provide an easy-to-use foundation for development of PLC supervisory application programs.



* Each PLC Device Handler requires its own multiplexer(s).

Supported PLC Devices

Allen-Bradley: PLC, PLC-2, PLC-3, and PLC-5.

Gould-Modicon: 484-2x1 through 2x6, 584A, 584L, 584M, 884, and 984.

Texas Instruments: 5-TI, 520, 520C, 530C, and PM550.

General Electric: GE Series 6: Models 60, 600, and 6000.

Siemens: S5-110S, S5-115U, S5-130W, S5-150A,150K, 150S, and 150U.

Telemecanique: TSX60, TSX80, and TSX90.

Support of Additional Devices

A PCIF/1000 Handler Development Guide is available to help experienced HP 1000 software engineers to develop linkages to additional factory floor devices. The guide provides concepts, sample files, and instructions on how to develop, test, and use "custom" handlers.

Features

- Downloading of programs, data or process parameters, and commands for coordinated changeover of production operations.
- Uploading of status, data, and programs facili- tates checking and monitoring of production operations.
- On-line, menu-driven configuration facilitates changes to the PLC network topology.
- Common commands for all types of supported PLCs simplifies user programming.

- Protocol-dependent routines are executed by intelligent, microprocessor based multiplexer interface*, minimizing host computer overhead.
- Individual definition of the level of interaction allowable between any PLC and the programs accessing it, for protection of critical PLC functions.
- Communication with PLCs from multiple programs in the host computer for simplified implementation of complex applications.
- Transparent access to PLCs when programming in FORTRAN 77 or Pascal.

* Except with Gould-Modicon and Texas Instruments PLCs.

Effective coordination of PLCs

PCIF/1000 software provides an indispensible communications link between supervisory controllers or LAN gateways and PLCs, which may number over a hundred. In addition to PCIF communication, the following qualities are important in supervisory systems used to coordinate PLCs.

Capacity

The supervisory system must be able to accommodate the application programs it uses for PLC coordination and data processing, as well as the programs, commands, and data it exchanges with the PLCs. The multi-megabyte main memory capacity of HP 1000 A-Series computers and their powerful multiprogrammability amply satisfy capacity requirements for supervision of multiple PLCs.

Real-Time Responsiveness

Manufacturing processes require quick response to high-priority events encountered by the PLCs. HP 1000 A-Series systems and their RTE-A operating system build on over 20 years experience with real-time applications in an installed base of over 100,000 systems. A-Series real-time capabilities include event-interrupt, time, program-to-program, and user scheduling of multiple programs. User-specified priorities give execution preference to the highest priority programs, so the most urgent tasks get done before less important ones. Critical programs can be kept in main memory, ready to run at a millisecond's notice, with no waiting for program transfer from disk.

The high performance RTE-A software is matched by fast hardware processing at rates to 3 MIPS and up to 500,000 FLOPs. This speeds completion of processing and action by the system.

HP 94200B PCIF/1000 Modules

Configurator

The configurator uses information from the system manager for integrating the required PLC device handlers with the run-time monitor. It also checks for completeness and coherence of the configuration and issues a warning if it detects an error. A modified configuration can be prepared on-line at any time, even while the Monitor is supervising a current configuration. Restart with an alternate configuration typically interrupts PCIF/1000 communications for less than a minute. The configurator requires the following information.

- types of PLCs to be connected and multiplexer ports used for the connections;
- communication characteristics of the links;
- PLC system configuration.

Monitor

After configuration and startup, the monitor dispatches requests from the user's supervisory application program to the proper PLCs for action. All monitor actions are transparent to the user.

Subroutine Library

The subroutine library provides access from FORTRAN or Pascal programs to the standard commands of PCIF/1000.

HP 9420xA Device Handlers and Connections

The HP 94202A through 94207A Device Handlers, listed below, adapt requests and replies exchanged between the Monitor and the PLCs to the protocol requirements Device handlers to support other PLCs may be available as a special. Contact the HP 1000 Sales Center in Cupertino, CA for more information.

HP 94202A Allen-Bradley PLC Device Handler (see Figure 2-2 for connections).

HP 94203A Gould-Modicon PLC Device Handler (see Figure 2-3 for connections).

HP 94204A Siemens PLC Device Handler (see Figure 2-4 for connections).

HP 94205A Telemecanique PLC Device Handler (see Figure 2–5 for connections).

HP 94206A General Electric PLC Device Handler (see Figure 2-6 for connections).

HP 94207A Texas Instruments PLC Device Handler (see Figure 2-7 for connections).

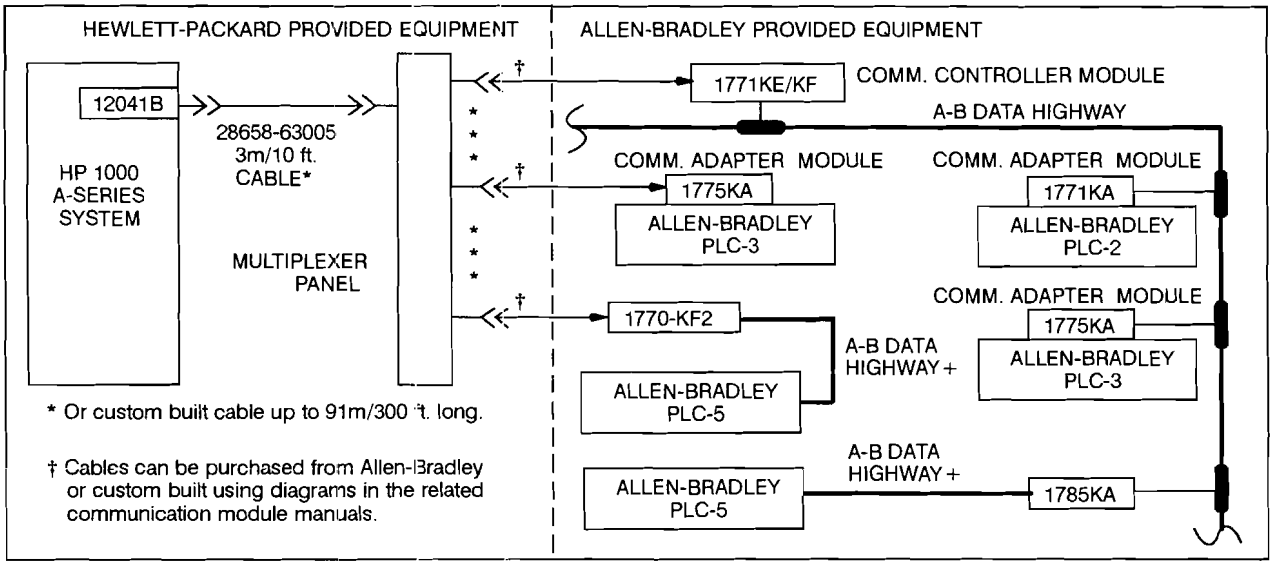


Figure 2-2. Connection of Allen-Bradley PLCs to HP 1000 A-Series Systems

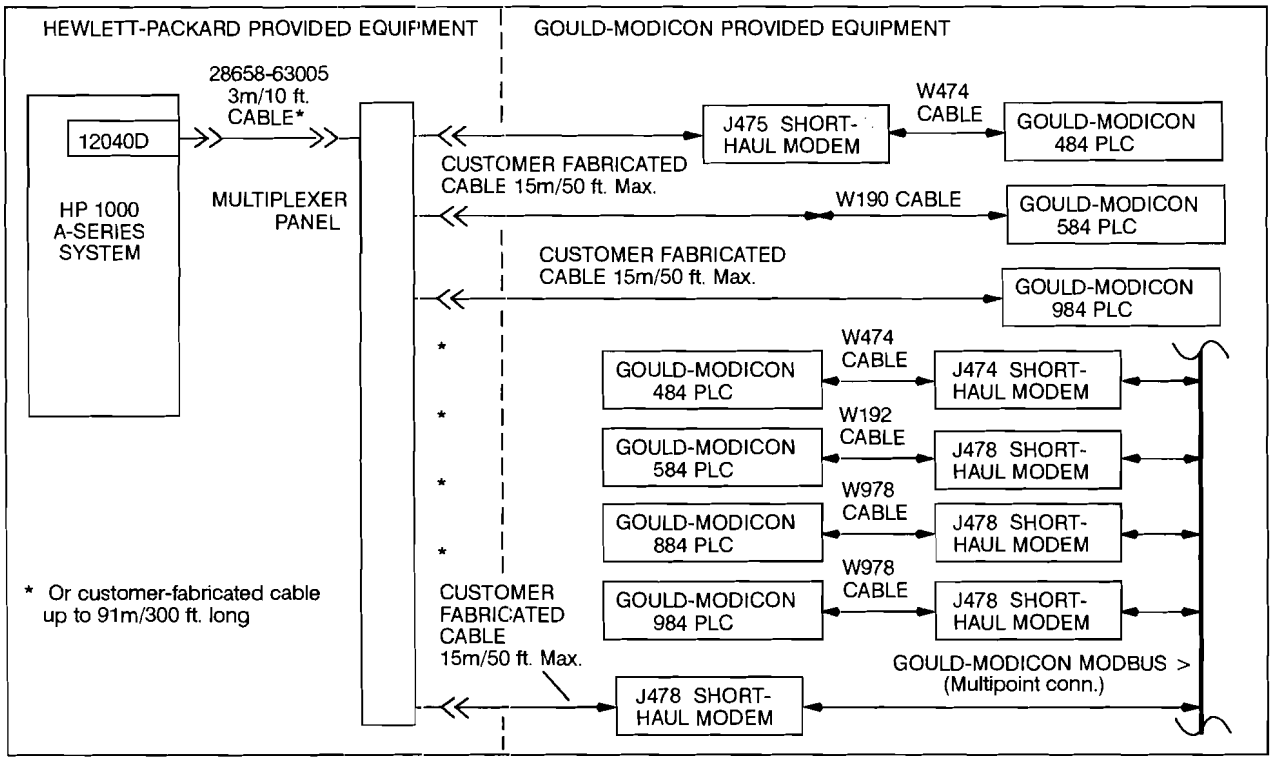


Figure 2-3. Connection of Gould-Modicon PLCs to HP 1000 A-Series Systems

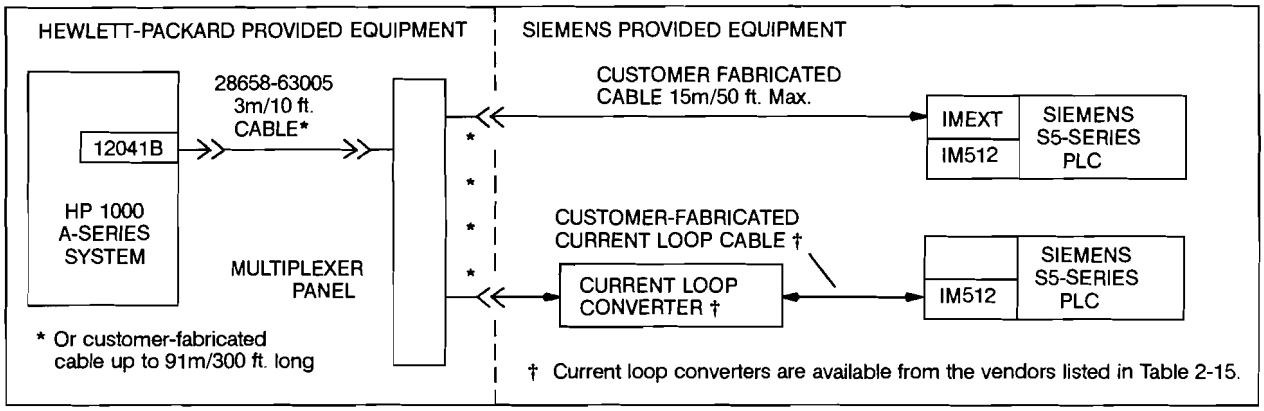


Figure 2-4. Connection of Siemens PLCs to HP 1000 A-Series Systems

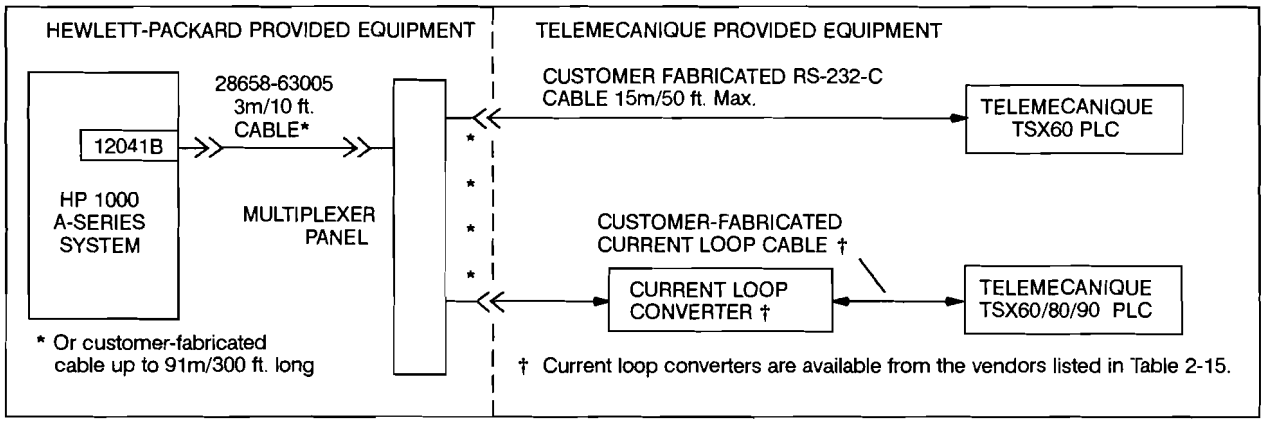


Figure 2-5. Connection of Telemecanique PLCs to HP 1000 A-Series Systems

Table 2-15. Current Loop Converters and Maximum Cable Lengths for Siements and Telemecanique PLCs

VENDORS OF TESTED CURRENT LOOP CONVERTERS	CONVERTER TYPE	NO. OF CHAN.	MAXIMUM CABLE LENGTH TESTED* , BY DATA RATES		
			9600 BITS/SEC	4800 BITS/SEC	2400 BITS/SEC
BLACK BOX Mayview road park drive Box 12800 Pittsburgh, Pa 15241	B-CL050 (CLIC) B-CL204 B-CL208 B-CL212 B-CL216	1 4 8 12 16	150m/490 ft.	450m/1475 ft.	750m/2460 ft.
CYBERSIS Chemin Malacher Zirst 38240 Meylan, France	BCI-010	1	300m/984 ft.	750m/2460 ft.	750m/2460 ft.
EUROTERMINAL 19 Place Loire Silic 182 94563 Rungis, France	ET-80	1	150m/490 ft.	600m/1968 ft.	750m/2460 ft.

Current Loop Converters from other manufacturers may also be usable but have not been tested.

* These cable lengths provide an indication of capability; longer lengths may be usable, but Hewlett-Packard assumes no responsibility for performance of equipment or cables made by other manufacturers or customers.

Operational Requirements for HP-Provided Equipment

1. HP 1000 A-Series Computer or Micro/1000 Computer ordered as component or in 219xC*/D*/E/G/H or 248xA*/B/C System Processor Unit, with:
   a. HP 92077A RTE-A operating system. The HP 92078A VC+ enhancement is also required for the Gould-Modicon device handler or concurrent execution of more than one device handler and is strongly recommended for all use of PCIF.
   b. At least 2 megabytes of main memory.
   c. At least 20 megabytes of disk memory.

2. HP 92836A FORTRAN 77 or 92833A Pascal/1000.

3. An HP block mode display terminal (HP 700/92, 2392A*, 2393A, 2397A, 2623A*, 2624B*, 2625A*, 2626A*, 2627A*, 2628A*, or 45610B*).

4. One to three HP 12041B multiplexer(s) and/or 12040C*/D multiplexer(s), as appropriate (the multiplexers include an 8-channel connector panel).

5. Cables to PLC hardware (Figures 2-2 through 2-7).

* Discontinued product listed here for reference only.

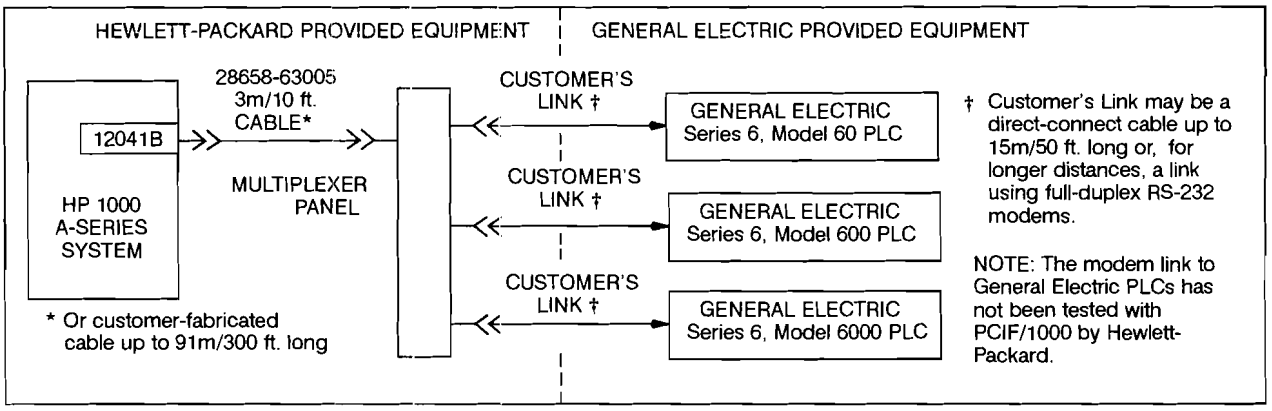


Figure 2-6. Connection of General Electric PLCs to HP 1000 A-Series Systems

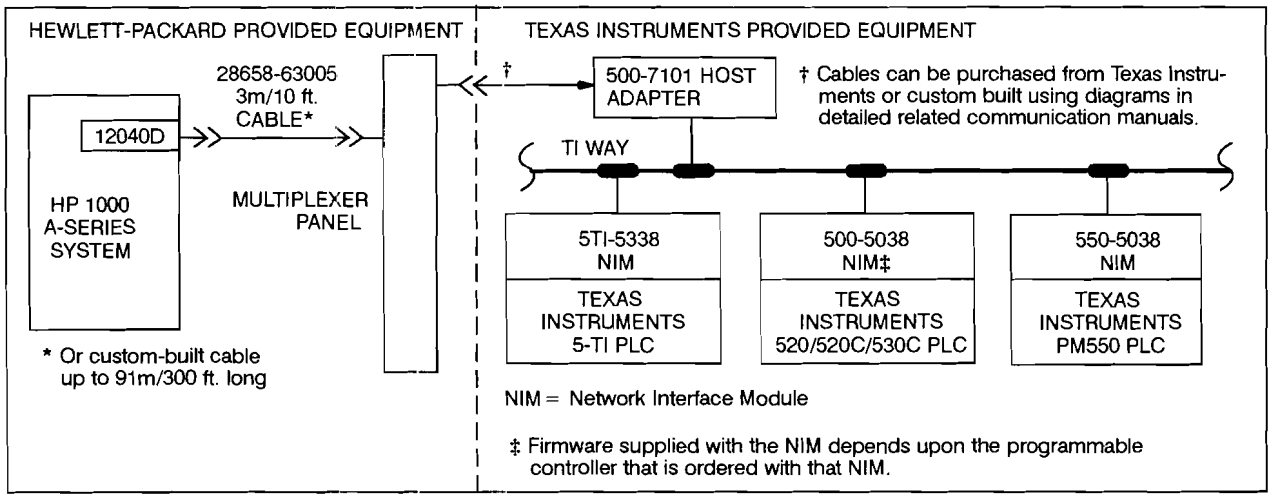
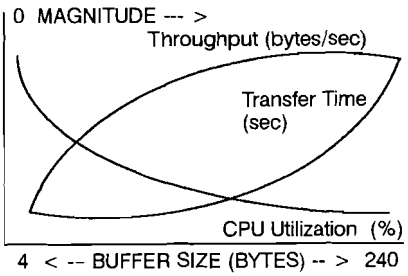


Figure 2-7. Connection of Texas Instruments PLCs to HP 1000 A-Series Systems



Performance

Performance Parameters

PCIF/1000 performance with respect to the following parameters varies with buffer size as shown above.

Transfer Time: Elapsed time between a read/write request(s) to a PLC (or group of PLCs) and its (their) completion.

Data Throughput: Total number of bytes read from or written to the PLC(s) divided by the transfer time.

CPU Utilization: The average percentage of CPU capacity used during actual PCIF/1000 program/data transfers to/from PLCs is greatest with short transfers (small buffers) because the CPU is involved more frequently than with long transfers (large buffers). Overall CPU utilization by PCIF/1000 depends upon message traffic density.

Performance with Texas Instruments PLCs

Throughput rates and transfer times for Texas Instruments PLCs will be similar to those listed in Table 2-16 for Gould-Modicon PLCs, since the Texas Instrument PLCs use the same HP 12040D multiplexer interface that is used for communication with the Gould-Modicon PLCs.

Table 2-16. PCIF/1000 READD/WRITED Performance with Allen-Bradley, Gould-Modicon, and General Electric PLCs

Programmable Logic Controller (PLC)	Avg. Transfer Time (seconds)		Throughput per PLC (bytes per second)	
	4-byte buffer	240-byte buffer	4-byte buffer	240-byte buffer
READD Performance with one PLC on one communication highway				
Allen-Bradley PLC-2	0.15	0.78	26.84	308.28
Gould-Modicon 484, 584, 884, & 984	0.1#	0.79#	40.0#	303.22#
General Electric Series 6	0.09	0.43	42.78	558.14
WRITED Performance with one PLC on one communication highway.				
Allen-Bradley PLC-2	0.15	not tested	27.3	not tested
Gould-Modicon 484, 584, 884, & 984	0.11#	0.87#	35.72#	275.54#
General Electric Series 6	0.1	0.44	41.24	549.2
READD Performance with five communications highways, one PLC/highway				
Allen-Bradley PLC-2	0.63	0.96	6.32	249.74
Gould-Modicon 484, 584, 884, & 984	0.3	1.35	13.28	177.18
General Electric Series 6	0.25	0.79	16.1	549.2
WRITED Performance with five communications highways, one PLC/highway				
Gould-Modicon 484, 584, 884, & 984	0.81	3.65	4.94	65.76
General Electric Series 6	0.1	0.44	41.22	549.2

These figures differ no more than 5% from one model of Gould-Modicon PLC to another.

Performance with Siemens and Telemecanique PLCs

Throughput rates and transfer times for Siemens and Telemecanique PLCs will be similar to those listed in Table 2-16 for Allen-Bradley PLCs, since the Siemens and Telemecanique PLCs use the same microprocessor based, intelligent HP 12041B multiplexer interface that is used for communication with the Allen-Bradley PLCs.

Performance with Allen-Bradley, Gould- Modicon, and General Electric PLCs

See Table 2-16.

Command Set

PCIF/1000 supports access to programmable controllers as if they were files on disk, using the following commands, which can be called from application programs written in FORTRAN 77 or Pascal:

PCIF_OPEN/CLOSE initiates/terminates a dialog between an application program and PCIF/1000.

PC_CONNECT/Disk establishes/breaks a link between a PLC and PCIF/1000.

PC_READD reads data from PLC memory.

PC_WRITED downloads data into PLC memory.

PC_READP reads program(s) from PLC memory.

PC_WRITEP downloads program(s) into PLC memory.

PC_LOCK restricts PLC access to a specific application program.

PC_UNLOCK frees access to a LOCKed PLC.

PC_PCSTAT requests status (run, program, or test mode) of a PLC.

PC_SYSTAT provides logical status of the system, relative to a PLC.

PC_CANCEL cancels all previous requests sent to a PLC that have not yet terminated.

PC_START/STOP starts/stops a program already resident in a PLC (not supported by Allen-Bradley PLCs).

PC_ENQUIRY retrieves data from requests made without wait or from unsolicited messages from PLCs.

PC_IDENT identifies PLC manufacturer and model.

PC_GETKEY/RELKEY obtains/releases system resources needed for managing asynchronous (requests made without wait) from application programs.

PC_ENUNSOL/DIUNSOL enables/disables receipt by application program of unsolicited messages from a PLC (not supported by Gould-Modicon or Telemecanique PLCs).

PC_TRANS accesses PLC without using the standard functions of PCIF/1000.

HP 94202A-94207A Device Handler Specifications

See Table 2-17.

Table 2-17. HP 94202A - 94207A PLC Device Handler Specifications

DEVICE HANDLER	SUPPORTED PLCs	PROTOCOL	COMPUTER INTERFACE	PLCs PER INTERFACE
HP 94202A	Allen-Bradley PLC, mini-PLC-2, PLC-2/15, PLC-2/30, PLC-3, and PLC-5	Data Highway 1 and Data Highway Plus	HP 12041B Multiplexer	Up to 256 (Note A)
HP 94203A	Gould-Modicon 484-2x1 through 2x6, 584A, 584L, 584M, 884, and 894	Gould-Modicon Modbus ASCII mode (RS-232-C)	HP 12040D Multiplexer	Up to 256 (Note A)
HP 94204A	Siemens S5-110S, S5-115U, S5-130W, S5-150A, S5-150K, S5-150S, and S5-150U	Siemens 3964 communications protocol	HP 12041B Multiplexer	Up to 8
HP 94205A	Telemecanique TSX60, TSX80, and TSX90	Proprietary to Telemecanique	HP 12041B Multiplexer	Up to 8
HP 94206A	General Electric Series Six, Models 60, 600, and 6000	GE CCM2 Peer-to-peer communications protocol. Master-slave mode is NOT supported	HP 12041B Multiplexer	Up to 8
HP 94207A	Texas Instruments 5-TI, 520, 520C, 530C, and PM550	TI-WAY	HP 12040D Multiplexer	Up to 256 (Note A)

NOTE A: The number of PLCs actually usable per system depends upon system performance requirements.

NOTE B: PCIF/1000 can support up to three multiplexers, dependent upon overall RTE-A table space usage of the particular system.

NOTE C: The 12040D Multiplexer can be used for the A-Series system console AND connection of Gould-Modicon or Texas Instrurments PLCs.

NOTE D: The standard and optimum link data rate on a multiple PLC network is 9600 bps.

Ordering Information

Programmable Controller Interface/1000 (PCIF/1000) is ordered as a primary Configurator/Monitor module (94200B) and any of several PLC Device Handler modules (94202A through 94207A). Alternatively, the customer may purchase the Configurator/Monitor module and the Handler Development Guide (94201-90003) when developing a Device Handler module to fulfill their special requirements.

9420xA/B Software

When ordered with the appropriate Use and Media options, which are listed later in this section, each 9420xA/B software product includes:

1. A copy of the relocatable software on the option-specified media.

2. A license to use that software on the processor specified by the Use Option.

3. Supporting documentation.

NOTE: Appropriate Media Option and Use Option are required for ordering.

9420xR Right to copy 9420xA/B Software

For use on an additional system, customers can purchase the right to make one copy of 9420xA/B software for use on the processor specified by Use Option. The 9420xR product does NOT include documentation.

PCIF/1000 Software, Right to Copy, and Documentation Products Summary

HP 94200B PCIF/1000 Configurator/Monitor and diagnostic software, license for one system.

HP 94200R Right to Copy 94200B Software to one additional system.

HP 94200Z Manual Set for 94200B Software, including:

1. 94200-90002 PCIF/1000 Reference Manual.

2. 94200-17500 Getting Started with PCIF/1000, a self-paced on-line familiarization program on Media Option 022, 044, or 051, **one of which MUST be ordered.** (Media Option ordered for 94200B also specifies media for familiarization program included in those products).

HP 94202A PCIF/1000 Device Handler for Allen-Bradley PLCs, license for one system.

HP 94202R Right to Copy 94202A Software to one additional system.

HP 94202Z Using PCIF/1000 with Allen-Bradley Programmable Controllers Reference Manual.

HP 94203A PCIF/1000 Device Handler for Gould-Modicon PLCs, license for one system.

HP 94203R Right to Copy 94203A Software to one additional system.

HP 94203Z Using PCIF/1000 with Gould-Modicon Programmable Controllers Reference Manual.

HP 94204A PCIF/1000 Device Handler for Siemens PLCs, license for one system.

HP 94204R Right to Copy 94204A Software to one additional system.

HP 94204Z Using PCIF/1000 with Gould-Modicon Programmable Controllers Reference Manual.

HP 94205A PCIF/1000 Device Handler for Telemecanique PLCs, license for one system.

HP 94205R Right to Copy 94205A Software to one additional system.

HP 94205Z Using PCIF/1000 with Telemecanique Programmable Controllers Reference Manual.

HP 94206A PCIF/1000 Device Handler for General Electric PLCs, license for one system.

HP 94206R Right to Copy 94206A Software to one additional system.

HP 94206Z Using PCIF/1000 with General Electric Programmable Controllers Reference Manual.

HP 94207A PCIF/1000 Device Handler for Texas Instruments PLCs, license for one system.

HP 94207R Right to Copy 94207A Software to one additional system.

HP 94207Z Using PCIF/1000 with Texas Instruments Programmable Controllers Reference Manual.

HP Part Number 94201-90003 PCIF/1000 Handler Development Guide.

PCIF/1000 Software Media Options

022: Provides software on CS/80 cartridge tape.

044: Provides software on microfloppy disk for HP 12120A*/12122A Integrated Disks in Micro/1000 package or HP 9122C/D* or 9133A*/B*/H*/L*, or 9153B*/C Disk.

051: Provides software on 1600 cpi, 9-track mag tape.

PCIF/1000 Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, 2487A*/B* Micro 27 SPU.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU.

894: Upgrade to Use Option 890 from Use Opt 400.

896: Upgrade to Use Option 890 from Use Opt 600.

897: Upgrade to Use Option 890 from Use Opt 700.

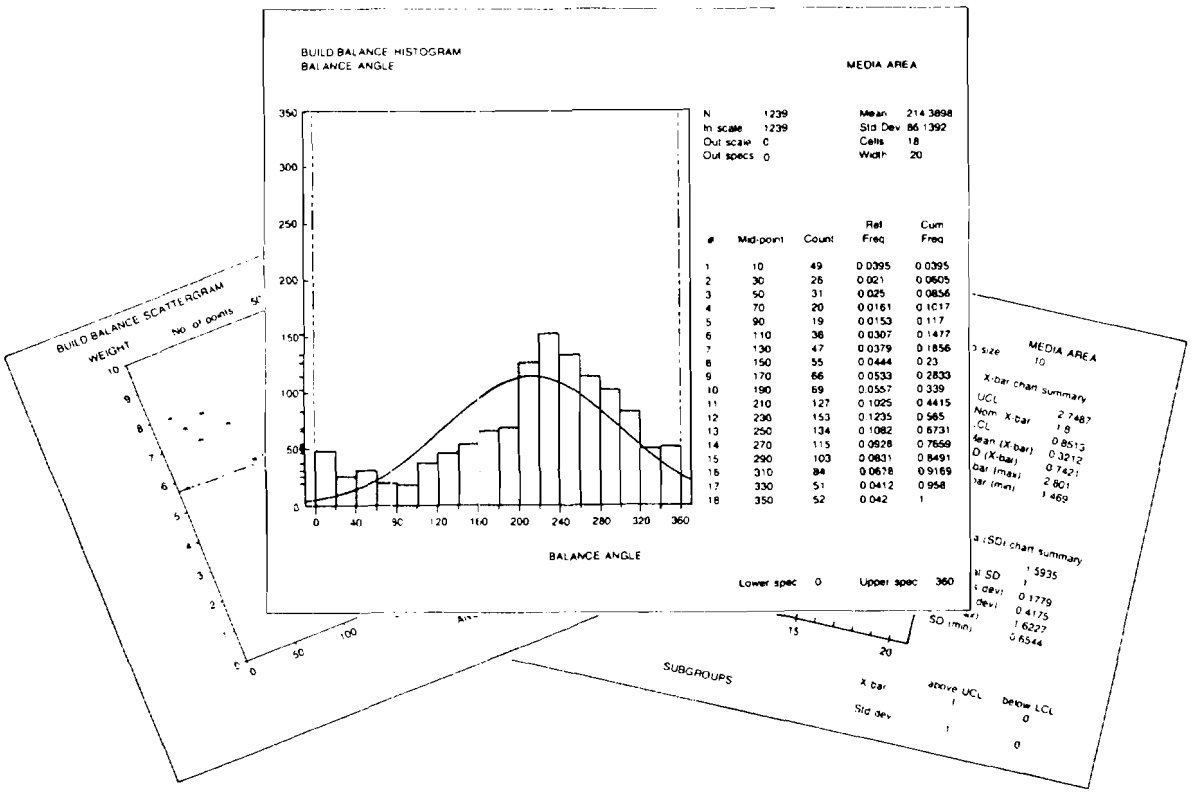
* Identifies discontinued product, listed here for reference only.

Support for PCIF/1000

HP TeamLine Support for the RTE-A operating system supporting PCIF/1000 is strongly recommended for the first year of operation. Thereafter, HP ResponseLine Center Support (RCS) is recommended. Support on the TeamLine and ResponseLine levels includes unambiguous isolation of problems to the HP-provided products, which will be resolved by Hewlett-Packard, or to the PLC equipment, with problem resolution the responsibility of the PLC equipment vendor. See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

NOTES:

92131A Quality Decision Management/1000 (QDM/1000)



Introduction

HP Quality Decision Management/1000 (QDM/1000) is an applications software package for analyzing manufacturing processes and product quality. Control charts and Pareto charts can be generated to help production and quality assurance engineers identify statistically significant product defects and process problems. Data collected on-line can also be used to generate scattergrams, histograms, and tabular reports. These outputs identify the manufacturing process causes of product quality deviations.

A menu and prompt/response approach facilitates configuration of data collection transactions, report and graph formats, and data archival and system maintenance functions, all without the need for programming experience.

Extensive "hooks" for user programs provide additional data input, output, and analysis flexibility.

Features

- Powerful, menu-driven report and graph writer for precise selection and analysis of collected data.
- Menu or prompt/response driven user interface for easy configuration, modification and system use by non-programmers.
- Controlled access via password assignments.
- Pre-defined database for simplifying system design efforts.
- Database editor for modification of data in the databases.
- User-defined data collection prompts for system customization to specific application requirements.
- Extensive user-defined data validation for parametric (numerical) and attribute (descriptive) data.
- Data collection supported from HP display terminals and HP 9000 Series 200/300 Computers.
- Flexible user extensions for data collection from any device that can transfer a formatted ASCII file to an HP 1000 computer.
- Data integrity through database utilities and system management programs.
- Monochrome or color graphic terminal output.

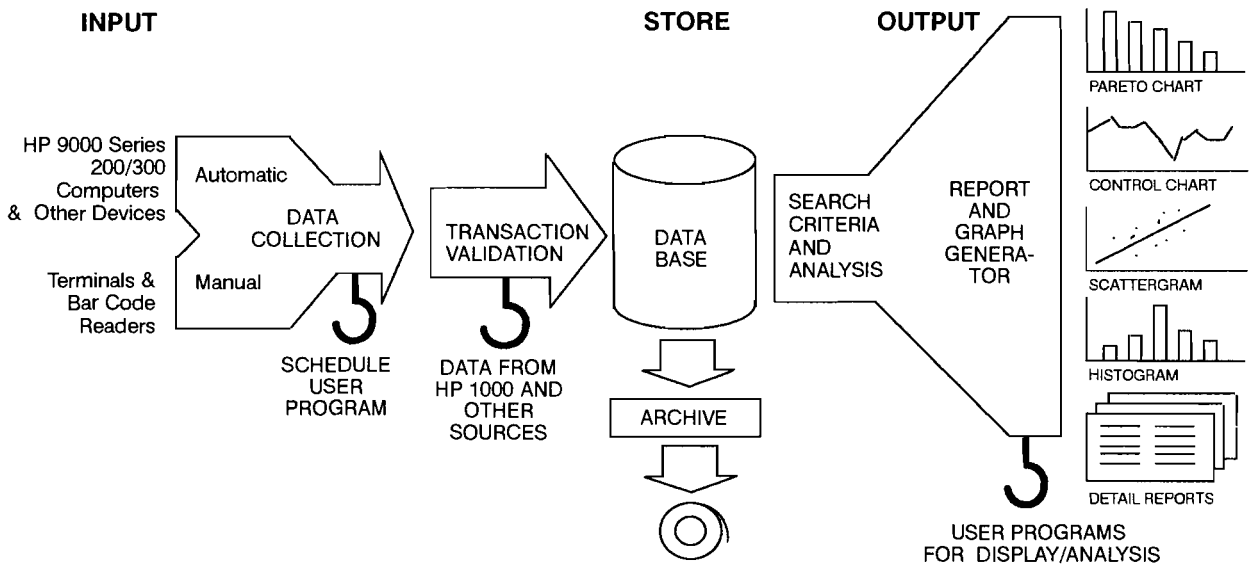


Figure 2-8. HP Quality Decision Management/1000 Functional Diagram

Functional Description

HP QDM/1000 provides data collection, validation, and storage to a database, which is central to the system. Engineers can statistically analyze the data and output the results in tabular or graphical format. A functional diagram is shown in Figure 2-8.

The pre-defined database is transparently configured by the user during the menu-driven transaction design process. Manual data collection follows a prompt/response sequence on a terminal, while automatic data collection occurs on HP 9000 Series 200/300 Computers that accumulate data via user-written BASIC programs. These programs format the data, then forward the entire transaction to HP QDM/1000. Transactions are validated and added to the database. Invalid transactions are posted to an error log. Parameters and attributes are validated in both manual and automatic transactions.

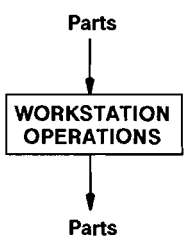
User extensions are illustrated by the hooks in Figure 2-8. The left hook enables a user to activate an external program from both automatic and manual data collection. In its simplest form, this hook can be used to collect an input automatically. For example, instead of requiring an operator to key in a reading from a digital voltmeter, the value can be collected automatically. Another use in manual and automatic data collection modes is to schedule a program that pre-processes data or diverts it to some specialized storage or validation routine. The transaction validation hook accepts any formatted file.

Users also define search criteria as well as report and graph formats via menus. Once search criteria, analysis requirements, and output formats have been defined, they can be stored as a procedure name. An unsophisticated user can request one of these predefined reports. Conversely, a manufacturing engineer or other sophisticated user could interactively define a new report linking various parameters and attributes from different workstations in order to isolate and identify defect causes.

The right hook illustrates the capability of storing the result of a search into a disk file. The user can then access the file through user-written programs that perform specialized data analysis and display functions or return modified data to the QDM graph generator. For example, costs per failure type might be added to a Pareto of cost of non-conformance.

Model of Production

The QDM/1000 database is designed for workstation oriented production environments. The database implicitly defines this model of production:



Multiple parts go through the workstation and different operations are performed on the parts.

User Configurable Prompt	Operator Response

TRANSACTION DATA
(identifies the transaction)

Workstation ?	:Spray station 2
Part number ?	:0142-2009
Operation ?	:Paint
Unit ID No. ?	:1,2,3,4,5
Workorder No.?	:A234-22

PROCESS COMMON DATA (all parts)

Drying temperature ?	500 degrees F
Drying time ?	20 minutes

UNIT SPECIFIC DATA
(unique to unit ID number)

Unit 1	Color ?	Blue
Unit 2	Color ?	Red
Unit 3	Color ?	Green
Unit 4	Color ?	Yellow
Unit 5	Color ?	Vermillion

For each combination of workstation, part number, and operation, a data collection transaction can be identified.

Each data collection transaction can have up to three sections:

- Transaction data (e.g., who, what, where)
- Process Common data (common to all of the parts)
- Unit Specific data (specific to an individual part)

The table at left illustrates the three types of data from a spray painting operation. A workorder, A234-22, for five 0142-2009 parts is being painted by Joe Worker at spray station 2. The individual parts have unique serial numbers. 1, 2, 3, 4, and 5. The parts are spray painted different colors and then placed in a 500-degree F drying oven for 20 minutes. This example includes just one workstation. An actual application would have multiple workstations, such as Receiving/Incoming Inspection, Final Test, Fabrication, Assembly, etc.

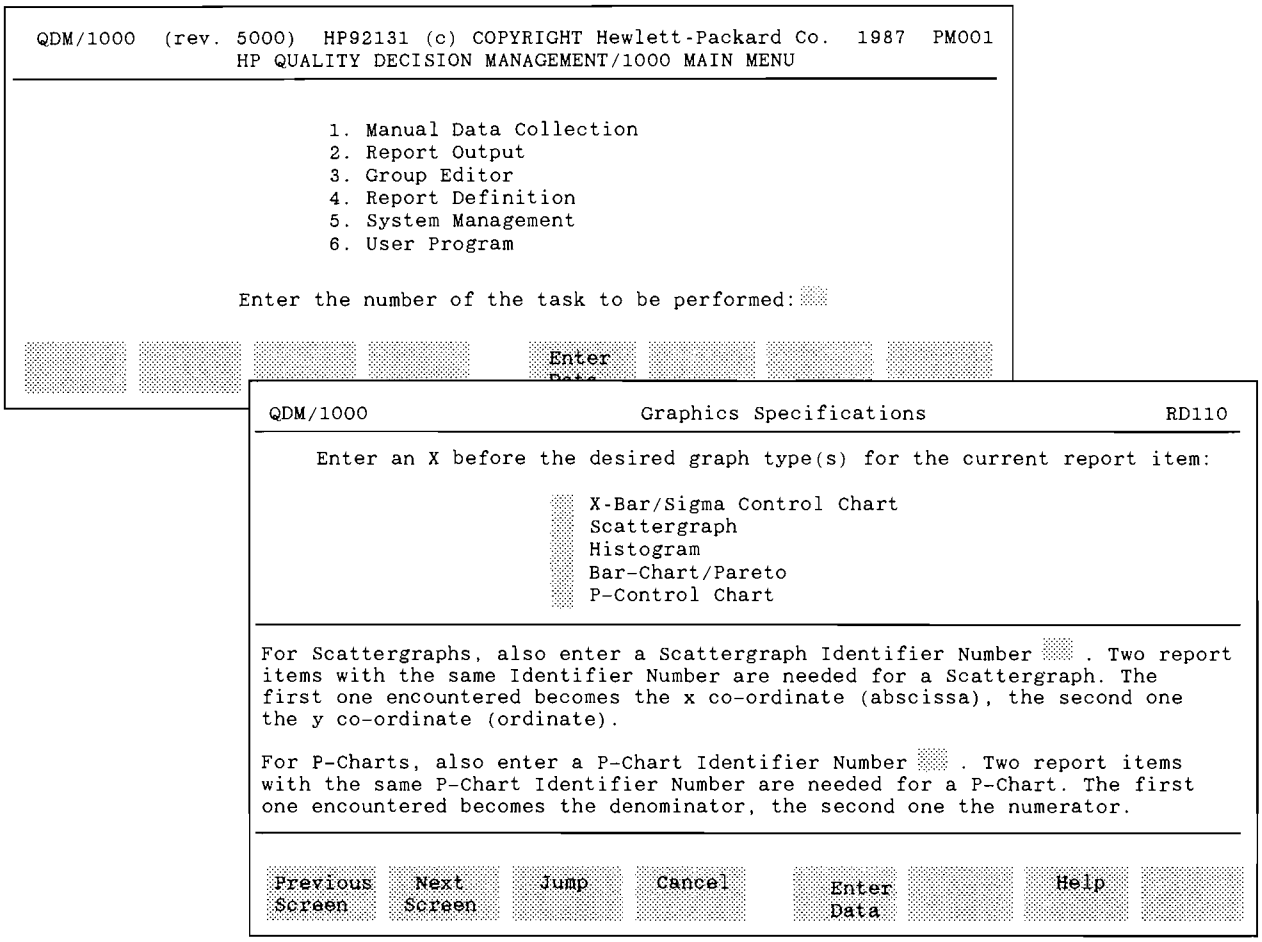
Using HP QDM/1000

The matrix at the bottom of the page indicates key application areas for HP Quality Decision Management/1000 and the product features and benefits of each area.

Product Details

System functions are accessed via the menu-driven user interface screens (see main menu, next page). One or more of the six functions can be offered on each terminal. The user can select any one of these choices, perform their task, and then return the terminal to the main menu. The functional capability for each of these modes is described on the next page.

Application	QDM/1000 Features	Benefits
Incoming Inspection	Displays inspection instructions, generates vendor rating reports, control charts of defect rates and vendor quality.	Prioritizes vendors, reduces number of vendors, and increases vendor responsiveness to quality demands.
Product Test: Electronic, Electro-mechanical, final, in-process, component	Manual and automatic on-line data collection, test procedure display. Provides statistica monitoring of defect levels and decision support graphics and reports.	• Optimizes test process, schedules calibrations, determines minimum number of readings. • Reaction to statistically significant defect rates. • Production defect data availability for correlation to manufacturing process data, identification of causes of quality problems.
History tracking/ Audit Trail	On-line data collection of pertinent traceability facts, archived but available for recall to satisfy regulatory requirements.	• Responsiveness to regulatory requirements.
Statistical process/ product monitoring	On-line data collection from incoming inspection, manufacturing process, and test areas. Statistical graphs/reports to monitor manufacturing process quality and product defect. Correlation between product defect data and defect cause data facilitates identification of specific defect causes: • Poor workmanship. • Faulty material. • Weak manufacturing process execution. • Wrong manufacturing process definition. • Faulty product design.	• High, predictable yields. • Lower production costs. • Reduced rework costs. • Lower scrap levels. • Reduced labor content. • Accurate vendor quality feedback/correlation. • Reduced cycle times and inventory levels.



MANUAL DATA can be collected from a terminal keyboard or optional bar code wand, for both para-metric and attribute data. The transaction format follows the prompt/response sequence described in the Model of Production. Prompts are user-defined via the CONFIGURATOR function (a subset of the System Management function).

REPORT OUTPUT can be predefined or customized by the user.

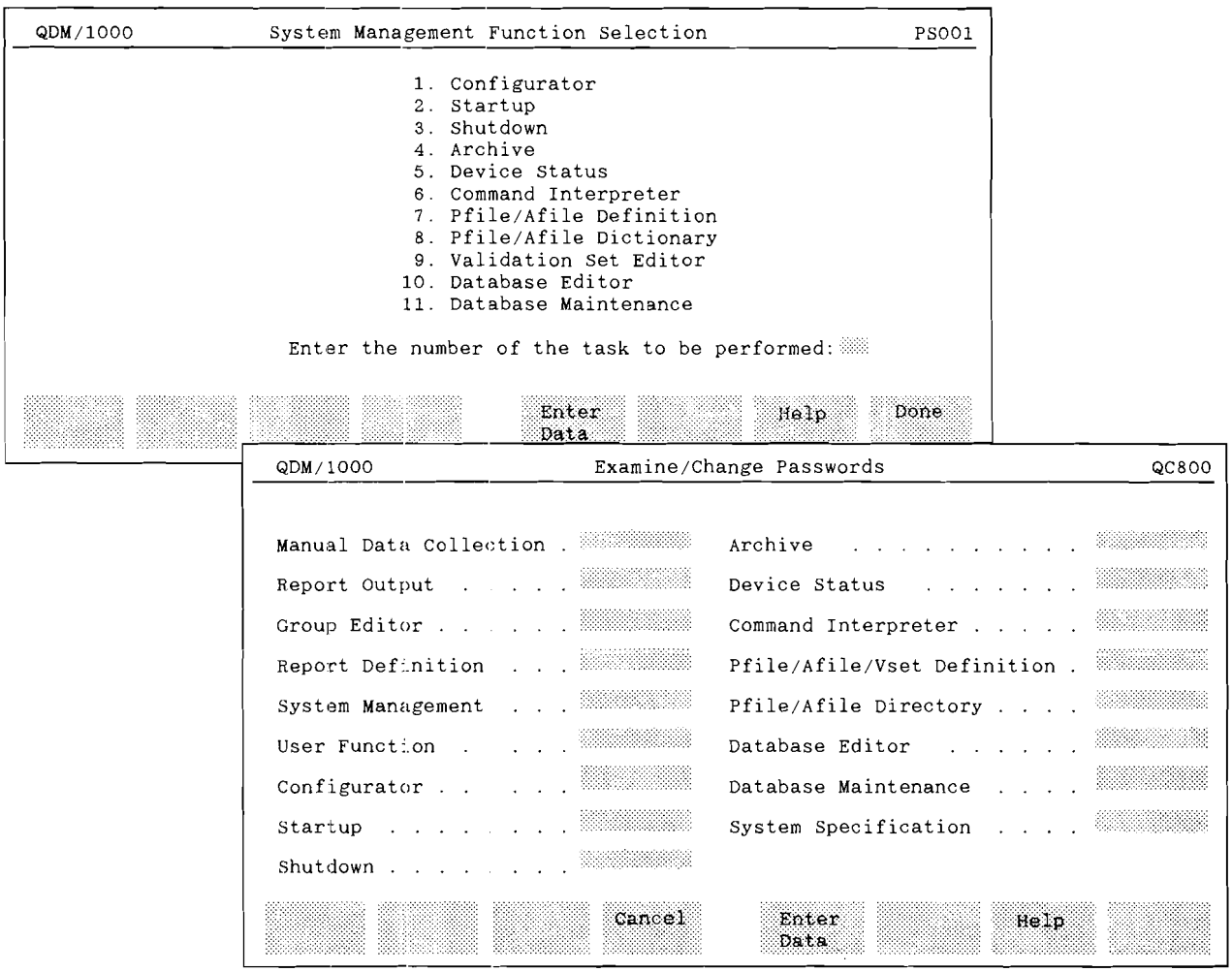
- P-charts, to monitor defect rates of products with pass/fail defect distribution, based on attribute data.
- X-bar and sigma charts, with user-definable titles and subtitles.
- Histograms, of parametric data autoscaled or user specified, with optional normal curve superimposed.
- Scattergrams of parametric data. Correlation coefficient and line of regression can be optionally requested.
- Pareto charts of attribute data.
- Bar charts of attribute data.
- Tabular Reports, with format and content user-specifiable.

GROUP EDITOR defines arbitrary groups of up to 24 unit IDs in order to avoid re-entering individual IDs for each transaction.

REPORT DEFINITION specifies data selection criteria and report/graph formats. The user can create or modify a report definition, or obtain a listing of currently defined reports with comments.

SYSTEM MANAGEMENT function manages eleven subfunctions (see menu, next page):

- **Configurator:** Menu-driven user interface to help non-programmers configure, modify and implement the system. Specifies transaction data, prompt strings and validation criteria. Identifies passwords and input/output devices.
- **Startup** program: Brings system on-line with assured data and programmatic integrity



- **Shutdown** program: Shutdown is used to halt database activity for archive and maintenance functions.
- **Archive**: Defines selection criteria and schedules data extraction program.
- **Command Interpreter**: Allows access to operating system for system maintenance, database maintenance, or direct use of HP 1000 utilities and capabilities.
- **Device Status**: Provides "snapshot" of what is happening in the system.
- **Pfile/Afile Definition**: Defines validation criteria and prompts for parameters and attributes in the Process Common and Unit Specific portions of the data collection transaction.

Parametric Data
Units, degrees F, lbs, cm, etc.
Default value
Upper and lower bounds
Upper and lower specifications
Validation set (user-defined table lookup)
160-character help message

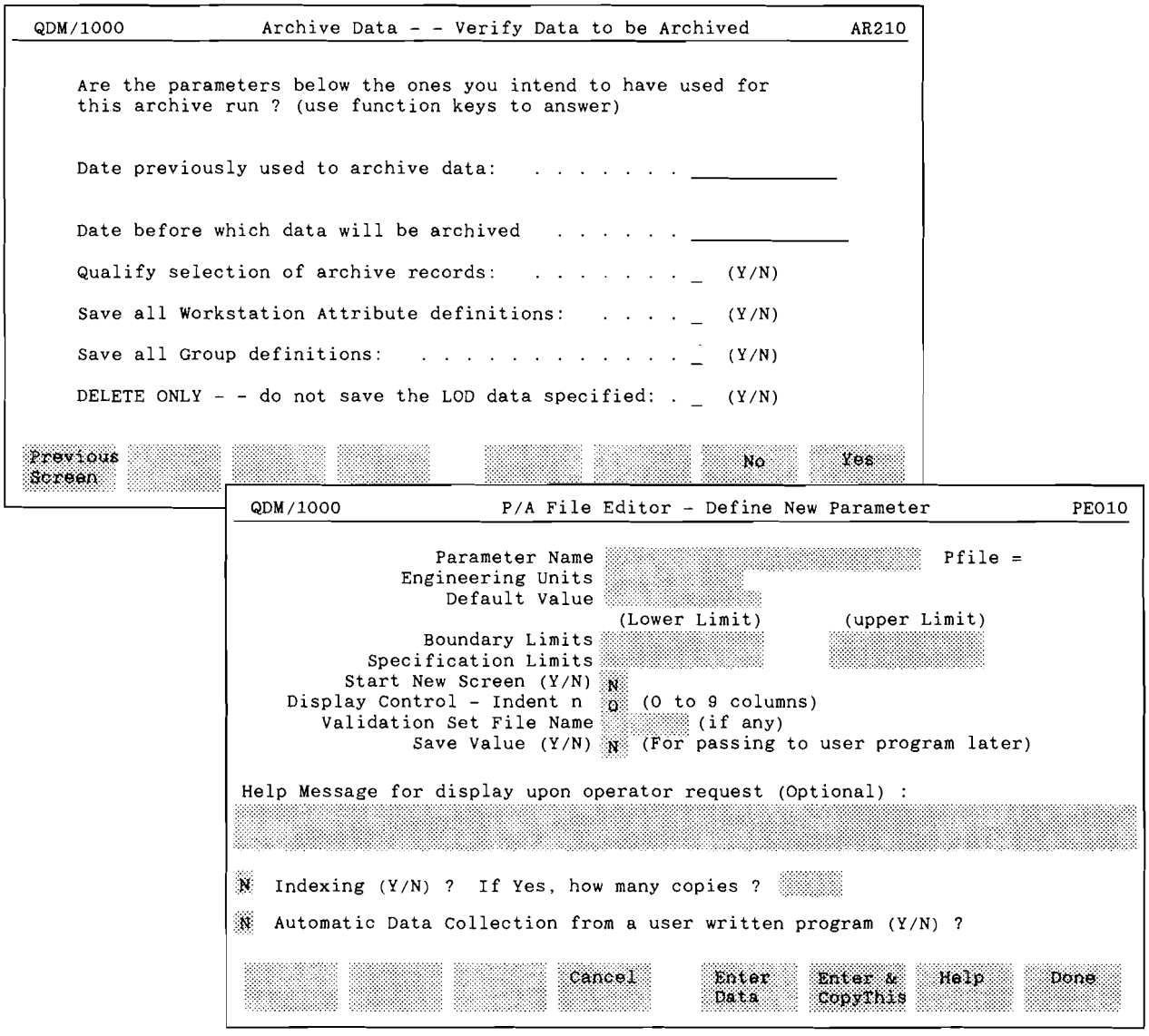
Attribute Data
Format
Default value
Validation set (user-defined table lookup)
160-character help message

- **Pfile/Afile Dictionary**: Lists names of parameters and attributes in any PFILE or AFILE.
- **Validation Set Editor**: Allows easy creation and maintenance of validation sets for PFILEs and AFILEs.
- **Database Maintenance**: Accesses Image/1000-II database subsystem utilities.
- **Database Editor**: Supports modification of the database.

User Program supports scheduling of user application programs from within QDM. One program can be scheduled from each QDM terminal. The menu item name is configurable for each terminal as well.

Data Input Auto Schedule. Parametric and attribute data collected in both manual and automatic transactions can trigger user-written programs. These user-written programs can be used in several ways:

- Data can be collected by a program, thus eliminating the need for manual keyboard entry.
- Both manual and automatic transactions can start a program that manipulates or reduces raw data. For example, an alarm capability can be implemented by passing data to a program that compares the data to a limit. Exceeding the limit could generate an alarm.
- Data can be pre-processed by having a program calculate summary statistics of certain parameters prior to being added to the database. This reduces the number of records that have to be searched to generate a report.



- Data can be diverted before it is added to the application database. Data of interest to other MIS/EDP departments, such as WIP, labor vouchering and production sequence data can be "stripped out" of transactions for transfer to another MIS/EDP system.

Other Automatic Collection Devices. Any device with file transfer and data formatting ability that can be interfaced to an HP 1000 computer is a potential system for data collection device. The system validates the transaction prior to processing the data.

User-defined Output. The report output function generates a specially formatted data file, according to user specified search criteria and analysis. A graphing module is auto-scheduled for creation of the graphical output. Two programmatic extensions are:

- Graphing user-specified data files. If file data is properly formatted, the graphing module will create a graph of data from the user's file.

- Data file. Instead of graphing the data file, it can be given a name. Specialized analysis and display programs then can be written to manipulate it.

Specifications

Number of Devices

This is highly dependent upon the system configuration. Factors which affect the maximum number of devices are:
- number of ID segments
- number of memory descriptors
- power fail driver
- DS/1000; LU mapping, size of network
- Data Link

A good rule of thumb is a maximum of forty MUX devices. This can be increased; contact the local HP Software Engineer for details.

Performance

Direct Report/Graph Search Response Time: 1 to 10 min.

NOTE: After a search has been completed, the time required for hard copy output depends on the speed of the graphics device and the volume of data.

Automatic Data Collection Transactions/Hour, A900: 620, maximum.

Automatic Data Collection Units/Hour, A900: 2950, maximum (with 50 units/transaction).

NOTE: In general, as the number of units/transaction increases and/or the number of specific parameters, attributes and comments per unit increases, the transactions/hr decreases. Refer to the HP QDM/1000 Performance Brief 5954-0305.

Archiving Deletions/hour, A900: 4700 units, maximum.

92131A System Requirements

1. **HP 1000 Micro 24, 26, 27*, or 29 or Model 26, 27*, or 29 RTE-A and VC+ Computer System** with supported system console and appropriate media option, selected from the following:

   022: CS/80 cartridge tape.

   051: 1600 cpi magnetic tape.

   Suggested system console is HP 700/92 or 2392A.

2. **Main memory.** At least 3 megabytes of main memory (a detailed application analysis may determine a need for more than 3 megabytes of memory).

3. **Software subsystems,** which must be included in the system.
   a. Order the following subsystems:
      (1) 92081A/R Image/1000-II with Query
      (2) 92861A/R Graphics/1000-II (DGL)

   OR

   b. A development pack that provides those subsystems.

4. **Hard disk:** Any A-Series compatible system disk(s) that can provide at least 130 megabytes of disk storage capacity. More may be needed for large user databases and other user requirements. (See the HP 1000 Configuration and Ordering Guide, 5959-7811 or later revision, for disk choices.)

5. **Printer:**
   a. 2563B Option 214 Line Printer, 233-300 LPM.

   OR

   b. 293xA Option 046 Printer.

6. **Plotter:**
   a. 7440A Option 002 Colorpro Plotter

   AND/OR

   b. 7475A Opt 002 Six-pen Plotter

   AND/OR

   c. 7550A Eight-pen Plotter with Automatic Sheet Feed

   AND/OR

   f. 7470A Option 002 Two-pen Plotter*

   AND/OR

   g. 7580B/85B/86B Option 060, C/D/E-size Drafting Plotter*

7. **Interface cards:**
   a. One 12009A HP-IB card for printer/plotter interface

   AND/OR

   b. One 12040D 8-Channel Multiplexer Interface for every 8 devices

* Discontinued product, listed here for reference.

c. One 12092A Interface* for automatic data collection devices that must be connected to the system via data link

8. Magnetic Tape Subsystem, for database backup and logging, selected from the following:

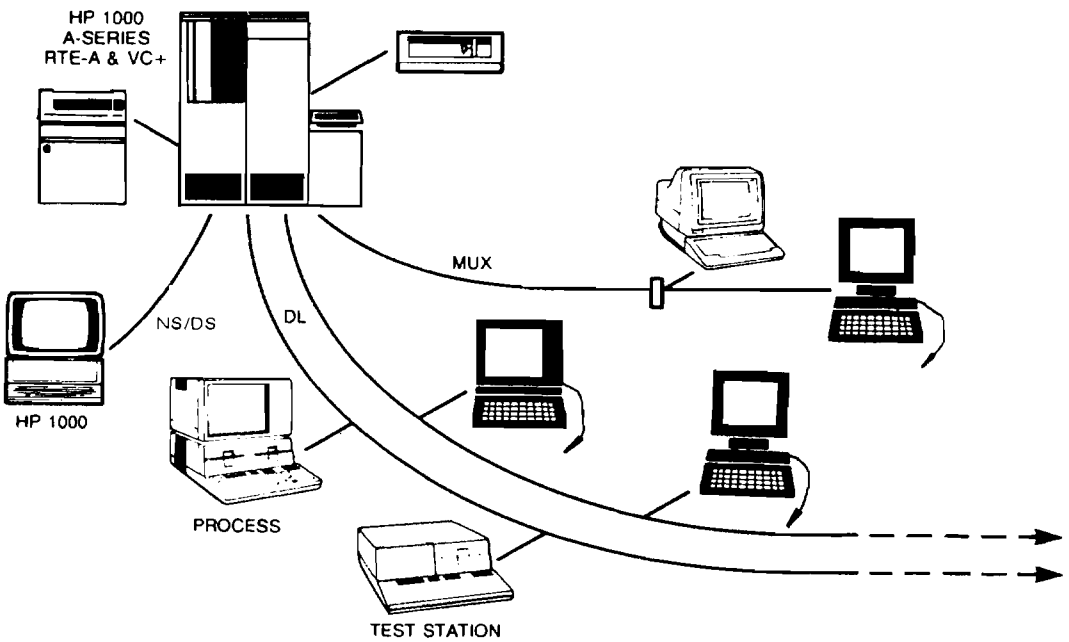
a. 7979A Autoloading 1600 cpi Mag Tape Unit
OR
b. 7980A Autoloading 6250/1600 cpi Mag Tape Unit
OR
c. 7974A Mag Tape Unit* with appropriate option
OR
d. 7978B magnetic tape unit*

* Discontinued product, listed here for reference.

9. Assorted manual and automatic data collection and output devices, as follows:

a. **Manual Data Input and Devices.** HP QDM/1000) supports all HP Display or Graphics terminals that can be connected to HP 1000 A-Series systems via multiplexer, as listed in the HP 1000 Configuration and Ordering Guide, 5959-7811 or a later revision, except for the HP 2621B Display Terminal, which does not support block mode operation. QDM/1000 also supports the HP 92916A Bar Code Reader when connected via HP 239xA Terminals.

b. **Automatic Data Input Devices.** HP Quality Decision Management/1000 includes user sub-routines written in BASIC for automatic data collection by HP 9000 Series 200/300 computers. Other automatic data collection devices can be used, but the user must program the subroutines needed to transmit the data to the HP 1000 system executing QDM/1000.



HP Quality Decision Management/1000 Configuration

Ordering Information

92131A HP Quality Decision Management/1000 Software (must order one of Use Options 400 through 897)

The 92131A product includes:

1. 92131A relocatable software package on Media option 022 or 051, **one of which MUST be ordered.**

2. HP 92131Z QDM/1000 Manuals Set (see separate product listing, below).

92131A Media Options

022: Provides software on CS/80 cartridge tape.

051: Provides software on 1600 cpi mag tape.

92131R Right to Copy HP Quality Decision Management/1000 For Use on One Additional Computer System (must order one of Use Options 400 through 897)

The 92131R Right to Copy product is available only to customers who have purchased the 92131A product. 92131R consists of:

1. A license to make one copy of software purchased with 92131A for use on one additional computer system.

2. A license to make one copy of the HP 92131Z QDM/1000 Manuals Set.

NOTE: HP Quality Decision Management/1000 has been modified to support certain local languages. Contact your local sales office concerning availability.

92131A/R Use Options

400: Use in HP 12100A Single Board Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A*/B Micro 24 SPU.

600: Use in HP 2106BK*/CK/DK Board Computer, 2156B*/C/D Computer, 2426E*/F*/G/H Micro 16 Computer, 2436A*/E*/G/H Micro 26 Computer, 2196C*/D*/G/H Model 26 SPU, or 2486A*/B/C Micro 26 SPU.

700: Use in HP 2137A*/B* Computer, 2437A*/B* Micro 27 Computer, 2197C*/D*/E* Model 27 SPU, or 2487A*/B* Micro 27 SPU.

890: Use in HP 2139A*/B Computer, 2439A*/B Micro 29 Computer, 2199C*/D*/E Model 29 SPU, or 2489A*/B Micro 29 SPU.

894: Upgrade to Use Option 890 from Use Option 400.

896: Upgrade to Use Option 890 from Use Option 600.

897: Upgrade to Use Option 890 from Use Option 700.

92131Z HP Quality Decision Management/1000 Manuals Set

The 92131Z Manuals Set consists of:

1. 92131-90001 User Reference Manual.

2. 92131-90002 System Manager Manual.

3. 92131-90003 Installation Guide.

* Identifies discontinued product, listed here for reference only.

Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products, including factory automation applications support of QDM/1000.

HP QDM-Assist Products

92131A+61A: Implementation Analysis.

92131A+63A: Implementation Team Training.

92131A+65A: Project Implementation Assistance.

92131A+65Z: Additional Project Implementation Assistance Unit.

Memory Requirements Estimator

Introduction

Software uses main memory capacity when it is loaded into the computer to execute and disk memory capacity when it is installed in disk files from which it can be loaded into the computer to execute. If a software item, such as a compiler, is to be used by more than one person at a time, each additional user needs space for his (or her) use of the software in main memory, in addition to any on-line main memory space required by common control routines, libraries, etc.

The table below, which continues on pages 2-107 through 2-109, provides a systematic means of estimating memory requirements. The summation of basic and per-user main memory requirements and disk memory requirements uses simple multiplications and additions based on the selections made in the Estimator table. Listed first are multiple-use software items which require the most memory per user, such as the Pascal compiler. This order is used because their requirements will also easily support those of software subsystems which require less main memory space per user if the user changes from compiling programs in one language to compiling programs in another language.

Software Capability and related requirements	**Qty/No. of Users**	**Main Memory (Megabytes)**		**Disk Memory (Megabytes)**	
		Unit	**Total**	**Unit**	**Total**
PROGRAM DEVELOPMENT *(Each active user will require a display terminal. A line printer should be provided for listing programs)*					
In 92833A Pascal/1000? (enter 1 in Qty if yes)	____	x 0.6*	____	x 20	____
How many programmers will be using Pascal/1000 at the same time?	____	x 0.2*	____	n/a	n/a
* For working set size of 70 pages					
Using 92857A BASIC/1000C? (enter 1 in Qty if yes)	____	n/a	n/a	x 20	____
How many programmers will be using the BASIC/1000 Interpreter at the same time (in addition to max. number using Pascal/1000)?	____	x 0.5	____	n/a	n/a
How many programmers will be using the BASIC/1000 Compiler at the same time (in addition to max. number using Pascal/1000 plus max. number using the BASIC/1000C Interpreter)?	____	x 0.38	____	n/a	n/a
Using 92836A FORTRAN 77? (enter 1 in Qty if yes)	____	n/a	n/a	x 0.5	____
How many programmers will be using the FORTRAN 77 Compiler at the same time (in addition to max. number using Pascal/1000 plus max. number using the BASIC/1000C Interpreter and/or Compiler)?	____	x 0.14	____	n/a	n/a
Using 92860A Symbolic Debug/1000? (enter 1 in Qty if yes)	____	n/a	n/a	x 0.4	____
PERFORMANCE ENHANCEMENT					
Using 92083A RTE Profile Monitor? (enter 1 in Qty if yes)	____	n/a	n/a	x 0.1	____
Using 92049A RTE Microprogramming Package? (A900 only -- enter 1 in Qty if yes) *(Also requires 12205A A900 Control Store Board)*	____	x 0.06	____	x 0.1	____
DATA PROTECTION					
92050A Datapair/1000 for configuration of disk volumes in mirrored pairs for data protection and high availability? (enter 1 in Qty if yes) *(Also requires an additional 12009A HP-IB Interface and duplicate disk(s).)*	____	x 0.1	____	x 0.3	____
	Totals		____		____

Software Capability and related requirements	Qty/No. of Users	Main Memory (Megabytes)		Disk Memory (Megabytes)	
		Unit	Total	Unit	Total
DATA BASE MANAGEMENT					
(A magnetic tape unit or an additional disk drive should be provided for data base backup and a line printer should be provided for fast printout of reports)					
92081A IMAGE/1000-II Data Base Management System for applications that are especially sensitive to data loss or excessive downtime? (enter 1 in Qty if yes)	____	x 0.4	____	x 4	____
Will roll-forward logging be used? (enter 1 in Qty if yes)	____	x 0.05	____	n/a	n/a
How many users will be accessing the data base remotely at the same time?	____	x 0.05	____	n/a	n/a
92069A IMAGE/1000 Data Base Management System for general data base applications? (enter 1 in Qty if yes)	____	x 0.27	____	x 2.2	____
How many users will be access the data base remotely at the same time?	____	x 0.05	____	n/a	n/a
2-D & 3-D GRAPHICS AND GRAPHICS WORKSTATIONS					
Using 92861A Graphics/1000-II Device Independent Graphics Library (DGL)? (enter 1 in Qty if yes) *(DGL and supported devices are corequisties for all HP-supported Graphics I/O on HP 1000 A-Series Computer Systems.)*	____	n/a	n/a	x 4.5	____
Using 92862A Graphics/1000-II Advanced Graphics Package (AGP) for 3-D and workstation uses? (enter 1 in Qty if yes) *(DGL and supported devices are prerequisites to AGP.)*	____	x 0.5	____	x 1.5	____
For vector-to-raster conversion in software	____	x 1.0	____	n/a	n/a
How many graphics workstations are to be supported?	____	x 0.07	____	n/a	n/a
FORMS DATA ENTRY					
94250B Forms/1000 for creation, storage, use, and modification of data entry forms on non-graphics and graphics display terminals? (enter 1 in Qty if yes) *(Requires one or more block mode display terminals for use.)*	____	x 0.1	____	x 1.0	____
NETWORK COMM. WITH OTHER HP SYSTEMS					
98170A ARPA Services/1000 Software for High Level Communication with other HP 1000, HP 9000, or Vectra PC Systems? (enter 1 in Qty if yes) *(requires 12076A interface for operation).*	____	x 1.0??	____	x 4.5??	____
91790A NS/1000 Network Services Software for High Level Communication with other HP 1000, 3000, or 9000 Systems? (enter 1 in Qty if yes) *(requires 12076A, 12007B, 12044A, 12073A, or 12082A interface or face or 91751A X.25/1000 software and 12075A interface for operation).*	____	x 1.0	____	x 4.5	____
91750A DS/1000-IV Distributed Systems Software for communication with other HP 1000 or 3000 systems? (enter 1 in Qty if yes) *(requires 12007B, 12044A, 12073A, or 12082A interface or 91751A 91751A X.25/1000 software and 12075A interface for operation).*	____	x 0.25	____	x 0.75	____
ACCESS TO X.25 PACKET SWITCHED NETWORKS					
91751A X.25/1000 Software for communications access to public or private packet-switched network? (enter 1 in Qty if yes) *(Requires 12075A X.25 interface for operation).*	____	x 0.08	____	x 0.62	____
	Totals		____		____

Software Capability and related requirements	Qty/No. of Users	Main Memory (Megabytes)		Disk Memory (Megabytes)	
		Unit	Total	Unit	Total
NETWORK COMMUNICATIONS WITH IBM AND PLUG-COMPATIBLE SYSTEMS					
91781A RJE/1000 -II Software for Remote Job Entry to IBM or Plug-Compatible System? (enter 1 in Qty if yes)*(Requires 12043A Multi-Use Programmable Serial Interface for operation.)*	____	x 0.09	____	x 0.4	____
91782A MRJE/1000 Software for Multileaving Remote Job Entry to IBM or Plug-Compatible System? (enter 1 in Qty if yes)*(Requires 12043A Multi-Use Programmable Serial Interface for operation.)*	____	x 0.33	____	x 0.8	____
91784A PMF/1000 Software for Interactive Communication with IBM or Plug-Compatible System? (enter 1 in Qty if yes)*(Requires 12043A Multi-Use Programmable Serial Interface listed below for operation.)*	____	x 0.6	____	x 2.6	____
MANAGEMENT AND ANAYSIS OF QUALITY DATA					
92131A QDM/1000 Software for Quality Decision Management? (enter 1 in Qty if yes) *(Requires 92081A IMAGE/1000-II, 92861A Graphics/ 1000-II DGL, display terminals as required for data entry and review, a printer and a plotter for hard copy, and a magnetic tape unit for database backup and data logging.The base requirement listed here supports one graphics device, one manual collection device, and automatic data collection.)*	____	x 1.6	____	x 36	____
How many additional manual data collection devices will be used?	____	x 0.1	____	n/a	n/a
How many additional concurrent report generators will be used?	____	x 0.25	____	n/a	n/a
How many desktop data collection links will be used?	____	x 0.05	____	n/a	n/a
COMMUNICATION WITH PROGRAMMABLE LOGIC CONTROLLERS (PLCs)					
94200B PCIF/1000 Configurator/Monitor Software? (enter 1 in Qty if yes) *(Requires one of the device handlers listed below for operation.)*	____	x 1.5	____	x 0.5	____
94202A Device Handler for Allen-Bradley PLCs? (enter 1 in Qty if yes) *(Requires 12041B Multi-Use Multiplexer for operation.)*	____	n/c	____	n/c	____
94203A Device Handler for Gould-Modicon PLCs? (enter 1 in Qty if yes) *(Requires 12040D 8-channel multiplexer for operation.)*	____	n/c	____	n/c	____
94204A Device Handler for Siemens PLCs? (enter 1 in Qty if yes) *(Requires 12041B Multi-use 8-channel multiplexer for operation.)*	____	n/c	____	n/c	____
94205A Device Handler for Telemecanique PLCs? (enter 1 in Qty if yes) *(Requires 12041B Multi-use 8-channel multiplexer for operation.)*	____	n/c	____	n/c	____
94206A Device Handler for General Electric PLCs? (enter 1 in Qty if yes) *(Requires 12041B Multi-use 8-channel multiplexer for operation.)*	____	n/c	____	n/c	____
94207A Device Handler for Texas Instruments PLCs? (enter 1 in Qty if yes)*(Requires 12040D 8-channel multiplexer for operation.)*	____	n/c	____	n/c	____
	Totals		____		____

Software Capability and related requirements	Qty/No. of Users	Main Memory (Megabytes)		Disk Memory (Megabytes)	
		Unit	Total	Unit	Total
OPERATING SYSTEM AND ENHANCEMENTS					
92077A RTE-A Real-Time Executive Operating System *(Included in all HP 1000 A-Series System Processor Units. Main and disk memory requirements are for disk-based primary system.)*	1	x 0.5	____	x 20	____
92078A VC+ Enhancement for RTE-A? (enter 1 in Qty if yes) *(Requires RTE-A. Is included in all HP 1000 A-Series System Processor Units.)*	____	n/c	n/a	n/c	n/a
MAIN MEMORY AND DISK MEMORY ESTIMATES					
A. Total Minimum Memory (totals from pages 2-106 through 2-108			____		____
B. Estimated additional Main Memory for customer's applications (at least 2 times, potentially up to 10 times the minimum main memory total, listed above).			____		
C. Estimated additional Disk Memory for customer's applications (at least 2 times, potentially up to 10 times the minimum main memory total, listed above).					____
D. Total Estimated Main Memory and Disk Memory Requirements.			____		____

NOTE: The total minimum main and disk memory requirements derived directly with the Estimator include ***ONLY*** the requirements for HP software products to be included in the system. As such they are ***absolute minimums*** and may not be sufficient even to support useful activity with all software loaded. A System's Engineer's estimate of the ***additional*** main and disk memory needed for the user's applications must be added to the minimum figures in the last section of the requirements estimator table, above. The main and disk memory requirements for the user application programs and data necessarily depend upon the size and nature of the application and its data storage requirements. Depending upon those factors, the additional main and disk memory requirement can easily be ***2 to 10 times the minimum*** determined directly by the Estimator, though the increase for main memory may be less than for disk memory, or vice versa.

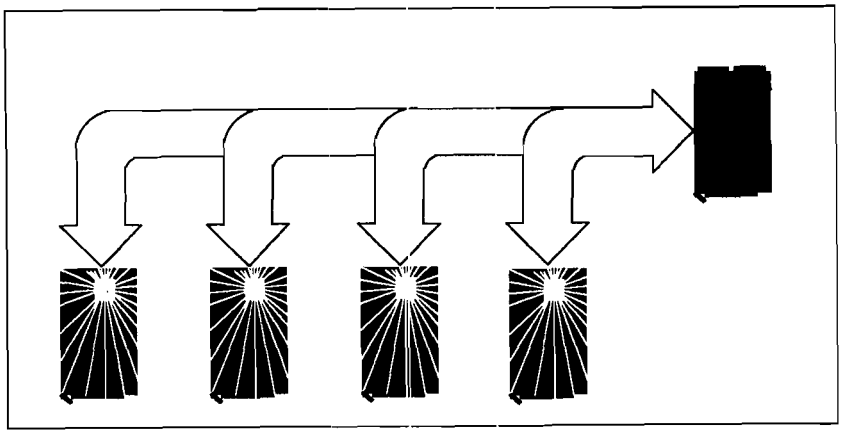
Table 3-1. HP 1000 A-Series Performance-Packaging Summary

COMPARISON ITEMS	A900 Computer	A700 Computer*	A600+ Computer	A400 Computer
BASE PROCESSING SPEED				
- Average	1.3 MIPS	0.4 MIPS	0.4 MIPS	0.4 MIPS
- Fastest Instructions	3 MIPS	1 MIPS	1 MIPS	1 MIPS
FLOATING POINT SPEED	Hardware FPP is Standard	12156A Hardware FPP is Standard	Floating Point is Firmware Based	Floating Point is Firmware Based
- B1D Whetstones	821 kwips	340 kwips	113 kwips	122 kwips
- Single-precision, F/W	Not applicable	54,400 FLOPS	64,000 FLOPS	54,400 FLOPS
- Single-precision, H/W	500,000 FLOPS	204,000 FLOPS	Not applicable	Not applicable
- Double-precision, H/W	245,000 FLOPS	99,700 FLOPS	Not applicable	Not applicable
SCIENTIFIC INSTRUCTION SET	Standard	Standard	Software equivalent routines	Software equivalent routines
- Single-precision	50,000 oper/sec	36,000 oper/sec	Not specified	Not specified
VECTOR INSTRUCTION SET	Standard	Standard	Software equivalent routines	Software equivalent routines
- Single-precision speed	688,000 oper/sec	245,000 oper/sec	Not specified	Not specified
- Single-precision setup	4.9 microsec	13.5 microsec	Not specified	Not specified
- Double-precision speed	421,000 oper/sec	144,000 oper/sec	Not specified	Not specified
- Double-precision setup	6.2 microsec	13.5 microsec	Not specified	Not specified
MAIN MEMORY CAPACITY				
- ECC (1M-bit RAMs)	8 MB to 32 MB	Not supported	Not supported	Not supported
- ECC (256K-bit RAMs)	3 MB to 18 MB	1 MB to 8 MB	512 KB to 8 MB	Not supported
- ECC (64K-bit RAMs)	768 KB to 4.5 MB	512 KB to 2 MB	Not supported	Not supported
- Parity (64K-bit RAMs)	Not supported	512 KB to 4 MB	512 KB to 4 MB	512 KB to 4 MB
- Parity (1M-bit RAMs)	Not supported	2 MB to 32 MB	2 MB to 32 MB	2 MB to 32 MB
CARD CAGE SLOTS USED BY CPU & BASE MEMORY	5 - Base memory is purchased separately	5 - Base memory is purchased separately	2	1
MEMORY CYCLE TIME	181 nanosec, average effective at 88% cache hit rate	500 nanosec	454 nanosec	454 nanosec
I/O BANDWIDTH				
- Output	2.5 MB/sec	4.0 MB/sec	4.27 MB/sec	4.27 MB/sec
- Input	3.7 MB/sec	4.0 MB/sec	4.27 MB/sec	4.27 MB/sec
AVAILABLE CARD CAGE SLOTS				
- In 20-slot computer	15†	15†	18	19
- In Micro/1000 comp.	9†	9†	12	13
- In "Cooler" Package	Not supported	Not supported	4	5
USER MICROPROGAMMABILITY	Yes. 4k words of WCS and 2k words of PCS are available.	Yes. 8k words of control store are available.	Not supported	Not supported
PACKAGING				
- Rack cabinet systems	Model 29 (2199E)	Model 27 (2197E)*	Model 26 (2196G/H)	Not available
- Micro/1000 systems	Micro 29 (2489B)	Micro 27 (2487B)*	Micro 26 (2486B/C)	Micro 24 (2484B)
- 20-slot box computers	2139B	2137B*	2156C/D	2134A
- Micro/1000 computers	2439B	2437B*	2436G/H	2434A
- "Cooler" pkgd computers	Not available	Not available	Micro 16 (2426G/H)	Micro 14 (2424A)

* Discontinued product, listed here for reference.

† After allowance for one separately-purchased memory array card, which is required for operation.

HP 1000 A-Series Computer Design and Specifications



Introduction

The HP 1000 A-Series comprises a compatible family of computers that feature distributed intelligence input/ output. This design uses an I/O processor on each interface to maximize I/O efficiency and minimize CPU involvement with I/O operations, thereby optimizing overall processor price/performance for a wide variety of applications. This section covers the A400, A600+, and A900 computers. A700 computers have been discontinued.

Features

- Total compatibility of comparable instructions in all A-Series computers.
- A wide choice of computer performance levels from 0.4 to 1.3 million instructions/sec and 64K to 500K floating point operations/sec.
- Distributed intelligence I/O design for DMA per channel efficiency.
- High reliability and maintainability through the use of simple packaging, self test, and board level diagnostics.
- Built-in dynamic mapping system, memory protect, and time base generator.
- Memory capacity up to 32 MB with only four memory array cards.
- Support for Virtual Memory for data to 128 MB and up to 15 Extended Memory Areas for data up to 2 MB, each accessible to as many as 63 different programs.
- Extensive software support including operating system, FORTRAN and Pascal compilers, BASIC interpreter and compiler, Macroassembler, screen editor, data base management system, graphics software, distributed systems networking, and manufacturing applications.
- Boot loaders included for boot-up from:
  - Adjacent computer system in an NS/1000 or DS/1000-IV Distributed Systems Network.
  - Disk drive
  - Magnetic tape
  - PROM Storage Module
- Remote loading and diagnosis for programming and operation of systems from remote sites.

Overview (See Table 3-1, facing.)

The A900 Computer

The A900 is Hewlett-Packard's fastest HP 1000 Computer. Pipeline technology with cache memory, boosted even more by a fast hardware floating point processor with scientific and vector instruction sets, provides good computation speed. Base set speed of 1.3 million instructions per second and 500,000 floating point operations per second provide enough computational power to conquer thousands of applications that have previously been far beyond the reach of minicomputers. 3 MB and 8 MB Error Correcting Code (ECC) memory array cards are available, as is battery backup is to maximize system integrity. Up to four 8 MB memory array cards can be used to provide a total of 32 MB of memory, enough capacity for very large applications. User microprogramming is supported for the development of special instructions or the conversion to firmware of frequently-used software routines to significantly-faster executing microcode.

The A600+ Computer

The A600+ is a full-function microcomputer that offers the HP 1000 user 0.4 million instructions per second performance at surprisingly low cost. Although the A600+ is a microprogrammed computer, it is not designed to support microprogramming by the user. This two-board microcomputer is available with two base memory choices: 512 KB parity memory or 1 MB ECC memory. Either base memory choice can support up to 32 MB of parity memory. The ECC memory choice can be expanded to 8 MB of ECC memory.

The A400 Computer

The new A400 computer is a single-board microcomputer with 0.5 MB of on-board parity memory, a four-port on-board I/O multiplexer, and performance about 10% faster than the A600+ microcomputer. It is a single-board design that accommodates only parity memory, expandable from a base 512 KB to as much as 32 MB.

Packaging

Rack Cabinet Systems. The A600+, A700, and A900 Computers are available in free-standing Model 26 and 29 Systems configured around a set of basic system elements, called the System Processor Unit (SPU). These systems are managed by the RTE-A Real-Time Executive Operating System, which supports multi-programming, high-level program languages, virtual memory and sharable extended memory areas for data, data base management, distributed systems networking, graphics software, and up to 32 MB of main memory in the Model 26 or 29.

All of these systems include the VC+ enhancement to RTE-A for execution of programs up to 7.75 MB.

The SPU hardware consists of the A-Series Computer as described below, HP-IB disk interface and, with 14 to 17 card cage slots available for additional memory and I/O cards. This is housed in a separately-purchased short cabinet or tall cabinet with extra rack space for additional equipment.

To the SPU, OEMs and end users add a system console interface, operator (system console) terminal, one or more hard disks, the required rack cabinet, and other peripheral devices as needed for their applications. Multiple fixed disks with up to 571 MB capacity can be used on the system. Over 2.2 GB of disk capacity can be connected via a single disk interface.

Micro/1000 systems. For applications that require A400, A600+, or A900 performance in a small space, the respective processors are available in a Micro/1000 package as the Micro 24, 26, and 29 systems.These systems, which have a 14-slot card cage (vs 20 slots in the larger systems) can include integral 19.4 MB fixed and 630 KB microfloppy disks or any of the disks available with the Model 26 and 29 systems. The Micro/1000 systems include VC+ support for programs to 7.75 MB.

Computers. The A400, A600+, and A900 computers are available in packaged form as the 2134A, 2156C/D, and 2139B (box) Computers for users who desire to package their own hardware and software. These box computers include a 20-slot card cage, of which 15 to 19 card cage slots are available after provision for computer and memory circuit boards of the base configuration.
The A400, A600+, and A900 computers are also available in the Micro/1000 package as the 2434A, 2436G/H, and 2439B Computers.

For smaller systems, the A400 and A600+ computers are available as the 2424A Micro 14 Computer and as the 2426G/H Micro 16 Computer, in a 6-slot "cooler" package with 4 or 5 slots available for additional memory and I/O cards.

Board Computers. The A400 computer is available as the 12100A Single-Board Computer for packaging into small OEM applications. The A600+ computer is available as the 2106CK/DK two-board set for packaging into OEM products.

Memory System

The memory array cards available for A-Series computers include parity and ECC memory cards based on 1M-bit RAMs for all A400, A600+, and A900 computers. Up to four memory array cards can be used to provide up to 32M bytes of parity memory in A400 or A600+ systems, up to 32M bytes of ECC memory in A900 systems. Up to 8 MB of ECC memory can be provided instead of parity memory in A600+ systems. ECC and parity memory can be used together in A600+ systems, within the limitation of a maximum of four memory array cards. In Micro 29 computers and SPUs, only two card cage slots are usable for memory array cards, which reduces memory capacity in that package to 16 MB.

Interfaces and Peripherals

A full line of HP manufactured interfaces and peripheral devices support the highly flexible configuration of one-vendor systems to satisfy a wide variety of application requirements.

Central Processor

A900 Processor Description

Cache memory for fast processing. Pipeline technology gives the A900 computer a superfast 133 nsec cycle time for each successful cache memory access. The cache incorporates hardware address create logic for fast next-address generation and supports a 32-bit data bus to the memory controller. With a hit rate typically 88%, memory access time averages about 181 nanoseconds.

A hardware floating point processor speeds floating point calculations. An integrated set of floating point chips accelerates processing for single and double precision floating point operations to real-time speeds – over 575,000 single precision additions or subtractions per second, over 535,000 multiplications per second, and over 250,000 divisions per second.

A Scientific Instruction Set (SIS) of nine single precision and nine double precision trigonometric and transcendental functions and a polynomial evaluation instruction uses the fast floating point computational power of the A900 to solve complex scientific and engineering calculations quickly and accurately. For example, the A900 can make over 65,000 single-precision square root calculations per second and over 38,000 hyperbolic tangent calculations per second at hardware speeds. This capability is useful for function approximation, such as curve fitting or or correction for non-linear response of a strain gage, thermocouple, or other transducer.

$$Z = \frac{a + a_1x + a_2x^2 + \ldots + a_nx^n}{b + b_1x + b_2x^2 + \ldots + b_nx^n}$$

A Vector Instruction Set (VIS) applies the A900's floating point processing power to highly-efficient repetitive processing of vectors and matrices. Because they take advantage of the inherent efficiency of vector processing, the VIS instructions can achieve rates ranging from over 267,000 operations per second for single-precision vector divide to over 830,000 operations per second for vector add, subtract,and multiply, after initial setup times of 4 to 5 microseconds.

Error Correcting Code (ECC) Memory. The customer can choose a base memory capacity of either 3 MB or 8 MB, the latter expandable to 32 MB. The ECC capability corrects all single-bit errors without interrupting the operating system, which maximize system integrity and reliability.

User microprogrammability is supported by an optional control store board and an easy-to-use, Pascal-like Paraphraser. This gives the user the ability to convert software routines that are frequently used or especially time consuming to microcoded routines that typically run 2 to 10 times faster.

A600+ Processor Description

Bit-Slice Central Processor. The A600+ computer is implemented on a single card with bipolar bit-slice microprocessors. The processor is a horizontally microprogrammed CPU with a 56-bit wide microword format. The wide microword format eliminates the need for decode logic so the A600+ computer responds to microinstructions with maximum speed and efficiency and provides high performance at surprisingly low cost.

1M bytes of memory and controller on a single card. The A600+ Memory Controller includes 512 KB of parity memory or 1 MB of Error Correcting Code (ECC) memory on one card. Either memory controller supports one to four parity memory cards (up to 32 MB). The ECC memory controller supports up to four ECC memory cards (up to 8 MB).

NOTE: Hardware floating point and user microprogramming are not supported in the A600+ computer.

A400 Processor Description

The A400 computer, 0.5 MB of parity memory, and four on-board serial I/O channels are all packed compactly onto a single board. VLSI techniques make possible the high packaging densities required while also providing about 10% faster performance than the A600+ two-board computer. The A400 can support up to 32 MB of parity memory, but cannot support ECC memory.

NOTE: Hardware floating point and user microprogramming are not supported in the A400 computer.

High-Level Program Accelerator Instructions

All of the A-Series computers include instructions designed to accelerate the execution speed of programs written in FORTRAN or Pascal. These microcoded routines speed up parameter passing and other commonly used high-level program operations 2 to 20 times, compared to the same routines in software.

Virtual Control Panel

A ROM-based Virtual Control Panel (VCP) program enables an operator to perform control panel functions via a local or remote-connected terminal or an adjacent HP 1000 Computer System through a standard serial, multiplexer (channel 1) or NS/1000 or DS/1000-IV I/O interface card. Only one I/O interface card in the system can be given this capability at any one time. That I/O card can connect to a terminal or other computer system accessible only to the system manager or the maintenance department. The operator at the VCP terminal or system can examine and change the contents of registers and memory locations, control program execution, initiate the self test, and select a bootstrap loader and initiate the boot-up of a system.

Because of its remote operating ability the VCP can be used for remote isolation of system faults, which can help to minimize support costs for OEM products that use the A-Series components. When not being used as the VCP, the VCP-assigned terminal can be used in the same way as any other terminal on the system, except for the break key.

Boot-up Sources and Auto Boot-up

The A-Series computers support boot-up from the following sources, of which sources 1 through 3 can be used for auto boot-up.

1. An adjacent HP 1000 System in an NS/1000 or DS/1000-IV network via the 12007A/B or 12044A interface.
2. A disk memory via the 12009A HP-IB interface.
3. 12008A or 93568P PROM Storage Module.
4. A 797xA/E or 7980A/XC Magnetic Tape Unit via the 12009A HP-IB interface.

Self Test and Diagnostics

Microcoded and macrocoded self tests check the CPU, memory, and the I/O masters of installed interfaces, either automatically on power-up or when requested by an operator via the Virtual Control Panel. HP 24612A and 24398B diagnostic packages are also available for stand-alone testing of all computer hardware, including I/O interfaces. A BASIC-like interpreter is provided in the 24612A package to help the user prepare diagnostics for user-designed interfaces.

Extensive Software Support

Operating System Software

92077A RTE-A Real-Time Executive operating system for 512 KB to 32 MB memory and 92078A VC+ for support of programs to 7.75 MB - - both are included in 219xE/G/H Systems and 248xB/C Micro/1000 Systems)

Program Development Software

92836A FORTRAN 77 Compiler.

92833A Pascal/1000 Compiler.

92857A BASIC/1000C Interpreter-Compiler package.

Macro/1000 Assembler (included in RTE-A).

Edit/1000 Interactive Screen Editor (included in RTE-A).

92860A Symbolic Debug/1000.

92083A RTE Profile Monitor.

Microprogram Development Software

92045A* RTE Microprogramming Package for A700.

92049A RTE Microprogramming Package for A900.

* HP 92045A RTE Microprogramming Package is a discontinued product listed here for reference only.

Data Management Software

Command Interpreter (included in RTE-A).

File Manager (included in RTE-A).

96050A Datapair/1000 Disk Mirroring software.

96081A Image/1000-II Data Base Management System.

92069A Image/1000 Data Base Management System.

Graphics Software

92861A Version 2.0 Graphics/1000-II Device-Independent Graphics Library for general graphics support.

92862A Version 2.0 Graphics/1000-II Advanced Graphics Package for interactive and/or 3-D graphics support.

Communications Software

91750A DS/1000-IV Network software for communication with other HP 1000 systems or HP 3000 systems.

91751A DSN/X.25 software for communication with other systems via packet-switching networks.

91781A RJE/1000-II software for remote job entry to IBM or IBM plug-compatible systems.

91782A DSN/MRJE software for multileaving remote job entry to IBM or IBM plug-compatible compatible systems.

91784A PMF/1000 Programmable Mainframe facility software for interactive exchange of data with IBM or IBM plug-compatible systems.

91790A NS/1000 Software for system-to-system communication via LAN, X.25, or point-to-point links.

98170A ARPA/1000 Software for system-to-system communication via LAN links.

Manufacturing Applications Software

92131A QDM/1000 Quality Decision Management Software.

94200B through 94207B PCIF/1000 Programmable Controller Interface Software.

Communications Support

A-Series computers can communicate with terminals and other systems in the following ways:

- With terminals via single-channel interface, eight-channel multiplexer interface, or data link/multipoint interface*.
- With other HP 1000 systems via DS/1000-IV HDLC point-to-point interface or multidrop Data Link*.
- With HP 3000 systems via DS/1000-IV Bisync point-to-point interface.
- With HP 1000 A-Series, HP 3000, HP 9000, and other systems via LAN.
- With HP 1000, HP 3000, and other systems via DSN/X.25 interface to packet-switching networks.
- With IBM or IBM plug-compatible system via Multi-Use Programmable Serial interface and remote job entry or program-to-program communications software.

* Data Link/multipoint communications requires HP 91732A Data Link Software, which is a discontinued product.

Input/Output

Distributed Intelligence Architecture Boosts I/O Efficiency and Simplifies Programming

Computation and input/output are often both entirely controlled by the central processor. In A-Series computers, the central processor has been relieved of I/O DMA processing. That function has instead been assigned to an individual processor (IOP) on each interface card. Thus, the CPU is freer to process data. The CPU, the IOPs on each interface, and memory all communicate with each other via a common bus, except in the A900, which has a separate I/O bus.

Low-Overhead I/O

I/O Processor-Managed DMA. The built-in intelligence of each IOP supports autonomous control of I/O operations. This includes high-speed direct memory access (DMA) and can even include chained multiple DMA transfers with CPU involvement only at the start and completion of the entire chain.

DMA Per Channel. The standard IOP is provided on every A-Series interface, supporting direct memory access (DMA) on all I/O channels.

I/O Access Priority. Priority of I/O interrupt and access to memory is controlled by interface card position on the card cage bus with respect to the CPU. The interface closest to the CPU has the highest priority those farther down the bus have successively lower priority.

Simplified I/O Programming. The same level of intelligence that supports DMA-per-channel operation also simplifies I/O programming. The master IOP logic recognizes interface I/O addressing independently of I/O card position on the card cage bus. This supports standardization of I/O addresses and functions in programs without requiring any particular arrangement of I/O cards in the card cage.

Compatibility with other HP 1000 Computers

Compatibility with HP 1000 M/E/F-Series. A-Series computers execute the same HP 1000 base set instructions as HP 1000 M, E, and F-Series. Except for dynamic mapping instructions, virtual memory instructions, and I/O instructions, other A-Series instructions beyond the base set as defined have the same mnemonics and format as in HP 1000 M, E, and F-Series computers, which facilitates program transportability between HP 1000 A-Series computers and HP 1000 M/E/F-Series computers.

I/O drivers written for use with the RTE-6/VM or RTE-IVB operating system will have to be rewritten for use with RTE-A.

Compatibility with HP 1000 L-Series. A-Series computers execute the entire L-Series instruction set. Programs written for use under RTE-L or RTE-XL will run without change under RTE-A.

Specifications

Central Processor

Implementation: Microprogrammed LSI and MSI hardware.

Data path width: 16 bits.

A400 and A600+ Bus structure: Single backplane bus for memory, processor, and I/O.

A900 Bus structure: Single backplane bus for I/O, which accesses processor and memory via the cache memory.

VCP-Accessible Registers:

Register	Type
A	16-bit accumulator
B	16-bit accumulator
X	16-bit index register
Y	16-bit index register
Q	15-bit base register
P	15-bit program counter
T	16-bit memory transfer register
M	15-bit manual data register
E	1-bit extend register
O	1-bit overflow register
CIR	6-bit Central Interrupt register
V	16-bit memory Violation register
Z	16-bit bounds register
I	1-bit Interrupt System status register
ES	32-bit memory Error Syndrome register
PE	24-bit Parity Error address register
WMAP	16-bit logical map select register

Register access: All registers can be selected for display or modification via the Virtual Control Panel.

Instruction formats: Combined single word, Single word, and Double word.

Addressing modes: Direct multilevel-indirect, single word, double word, and register implicit, indexed, and indirect indexed.

A900 Microcontrol Processor

Implementation: Hardwired MSI, with pipelined data paths.

Instruction Cycle Time: 133 nanoseconds.

Control Path: 48 bits.

Data Path: 16 bits.

Registers:
Standard registers = 5 (A, B, X, Y, & Z) x 16 bits and 2 (P and Q) x 15 bits.
Scratch registers = 2 x 16 bits, non-pipelined, 12 x 16 bits, pipelined, and 896 x 16 bits cache memory locations addressable as scratch registers.
Instruction register = 1 x 16 bits.
Switch register = 1 x 8-bits.
Status flag registers = 2 x 1-bit.
LED register = 1 x 8 bits.
Processor control = 4 x 16-bits.
Processor status = 4 x 16 bits and 3 x 8 bits.
Subroutine levels stack = 16 x 15 bits and 3 x 16 bits.
Memory address = 3 x 8-bits.
Microaddress vector = 1 x 15 bits and 1 x 8 bits.

Microinstruction formats:
Type 1 Conditional special field execution or conditional return, all special fields available.
Type 2 Conditional jump, conditional jump subroutine, 8-bit target address.
Type 3 Unconditional jump, unconditional jump subroutine, 15-bit target address.
Type 4 16-bit immediate data operations.

Bus structure: Two-address architecture. Three or four addresses allowed for some operands and registers. Multiple register stores available in the same cycle. Two separable store buses allow splitting of data paths. Separate data path for memory address registers. Main memory and I/O transactions are conducted on separate buses and are arbitrated by the cache.

Control memory structure:
Type = Bipolar LSI Semiconductor read/write or PROM.
Address space = 32,768 words.
Word size = 48 bits.
Cycle time = 133 nanoseconds.

Control processor instructions:
Number = 265 total, up to 13 combinable in one instruction word.
Operations = 8 total.
Special = 45 total.
ALU = 18 total.
Conditional = 35 total.
Store = 20 total.
Memory operations = 8 total.
L Bus (source/store) = 64 total.
R Bus (source/store) = 64 total.

Memory

Memory Products: See Table 3-2.

ECC Memory in A600+ Computer: The 12110A*/B 512 KB*/1 MB ECC Memory Controller is required for support of ECC memory in A600+ computers. Addition of ECC memory array cards must satisfy this equation:

$$\frac{\text{Installed Memory Size}}{\text{Size of Array Card to Add}} = \text{An Integer}$$

Addition of 12103A*, C, and D Array Cards in A400 and A600+ Computers: Additions of 12103A, C, and D Memory array cards to an A400 or A600+ computer must satisfy the same equation as addition of ECC memory in A600+ computers.

Addition of 12103K, L, and M Array Cards in A400 and A600+ Computers: HP 12103K, L, and M parity memory array cards can be added to existing memory at any 0.5 MB boundary -- no particular progression of array card capacities is required. For example, an HP 12103M 8 MB Parity Memory Array Card can be added directly to an A400 SPU or computer to provide a total of 8.5 MB of memory.

* Discontinued product, listed here for reference only.

Table 3-2. A-Series Memory Products

Memory Product	Size (MB)	Cycle Time (nsec) in: A400	A600+	A900
The following parity memory array cards use 1 M-bit NMOS RAMs				
12103K 12103L 12103M	2.0 4.0 8.0	454	454	n/s
The following ECC memory array card uses 1 M-bit NMOS RAMs				
12221B	8.0	n/s	n/s	181†
The following ECC memory controllers use 256 K-bit NMOS RAMs				
12110A* 12110B	0.5 1.0	n/s	454	n/s
The following ECC memory array cards use 256 K-bit NMOS RAMs				
12111A 12111B 12111C	0.5 1.0 2.0	n/s	454	n/s
12221A	3.0	n/s	n/s	181†
The following parity memory controllers use 64 K-bit NMOS RAMs				
12102A* 12102B	0.12 0.5	n/s	454	n/s
The following parity memory array cards use 64 K-bit NMOS RAMs				
12103A*	0.12	n/s	454	n/s
12103C 12103D	0.5 1.0	454	454	n/s
The following ECC memory array card uses 64 K-bit NMOS RAMs				
12220A*	0.75	n/s	n/s	181†

† 181 nanosec average cycle time in A900 assumes 88% cache "hit" rate; hit rate depends upon program locality.

* Discontinued product, listed here for reference only.

n/s = not supported.

A900 Cache Size: 4K bytes.

A900 Cache Cycle Time: 133 nanoseconds.

A900 Cache Fault Processing Time: Typically 539 nanoseconds.

Intermixing of Memory Cards: ECC memory cards based on 256K RAMs can be mixed with parity or ECC memory cards based on 64K RAMs, if the cards based on 256K RAMs are installed between the memory controller (or CPU card in A600+ computers) and the cards based on 64K RAMs.

Memory Structure: 32 pages of 2048 bytes with direct access to current or base page (page 00), indirect or indexed access to all other pages.

A900 Memory Expansion: To 16K pages (32 MB) using 12221B 8 MB ECC Memory Array Cards based on 1M-bit RAMs.

A600+ ECC Memory Expansion: To 4K pages (8 MB) using ECC memory cards based on 256K-bit RAMs.

A400 and A600+ Parity Memory Expansion: To 16K pages (32 MB) using parity memory cards based on 1M-bit RAMs.

Memory Protection: Write or read or read/write on a page-by-page basis.

Error Correction: A modified Hamming code is generated on all memory writes and stored for checking. All reads are monitored to check the accuracy of the stored data. All single-bit errors are corrected and all double-bit errors are detected. The system ignores single-bit (corrected) errors. Other detected errors are signalled as a memory error interrupt.

Floating Point Data Formats

Single-Precision: 32 bits (4 bytes), providing at least 6 significant decimal digits in mantissa.

Double-Precision: 64 bits (8 bytes), providing at least 16 significant decimal digits in mantissa.

Exponent Range: 2^{-128} to 2^{127} in all floating point numbers.

Decimal Equivalent: Approximately 10^{38}.

Fixed Point Data Formats

Single-Precision: 16 bits (2 bytes), twos complement integer.

Double-Precision: 32 bits (4 bytes), twos complement integer.

Scientific Instruction Set (SIS) Data Formats and Accuracy (A900 only)

Scientific Instruction Set Data Formats: Single- and double-precision floating point.

Scientific Instruction Set Accuracy: See Table 3-3.

Table 3-3. Scientific Instruction Set Accuracy

Scientific Instruction Set Functions	RMS Relative Error: Single Precision	Double Precision
Sine	9.2E-8	1.2E-16
Cosine	7.7E-8	1.3E-16
Tangent	1.5E-7	1.9E-16
Arc Tangent	1.5E-7	2.3E-16
Hyperbolic Tangent	2.2E-7	5.5E-16
Square Root	6.7E-8	1.6E-17
Exponentiation	3.2E-7	8.8E-17
Natural Log	1.2E-7	1.3E-16
Base 10 Log	1.6E-7	1.3E-16

Interrupt system

Vectored priority interrupt structure with the following priority assignments and select codes (next page). Note that select codes do not necessarily match priorities.

Priority	Select Code	Interrupt Function
1	00005	Parity Error
2	00010	Unimplemented Instruction
3	00007	Memory Protect Violation
4	00004	Power Fail Warning
5	00017	VCP Break
6	00006	Time Base Generator "Tick"
7	00011-00016	Reserved for special functions
8+	00020-00077	I/O Device Interrupts

Power Fail Provisions: When primary line power falls below a predetermined level while the CPU is running, a power fail warning signal from the power supply causes an interrupt to memory location 00004. Memory location 00004 is intended to contain a jump-to-subroutine (JSB) instruction to a power fail subroutine, such as that included in RTE-A. A minimum of 5 milliseconds is available to execute the power fail subroutine.

Battery Backup and Auto Restart: Battery backup of memory by the 12154A Battery Backup Card in Micro/1000 systems or the 12157B Battery Backup System in the A-Series systems or computers makes possible auto restart after power failure. Restoration of power triggers a memory saved signal if the backup battery has not fully discharged. The memory saved signal enables the CPU to automatically jump to and resume execution of the program that was running when the power failed.

Memory Protect: Protects memory on a page-by-page basis against alteration or entry by programmed instructions, except those involving the A and B registers. A memory protect violation interrupts the CPU and saves the address of the violating instruction in a register on the memory controller card, from which it can be made accessible in the A or B register by a single Assembly language instruction.

Memory protect also prevents execution of privileged instructions (mapping instructions and all I/O instructions except those referencing select code 01, the CPU status register and the overflow register). This limits control of I/O and mapping operations to the operating system or other privileged programs.

Time Base Generator Interrupt: A time base generator interrupt is provided for maintaining a real-time clock. The interrupt request is made when the CPU signals, at 10-millisecond intervals, that its internal clock is ready to roll over. Timing accuracy of the time base generator is ±2.16 seconds per (24 hour) day.

Unimplemented Instruction Interrupt: An unimplemented instruction interrupt is requested when the CPU signals that the last instruction fetched was not recognized. This interrupt provides a straightforward entry to software routines for the execution of instruction codes not recognized by the CPU.

I/O Master Processor

Purpose: To maintain the high performance of the CPU, an I/O Master Processor is used as the standard input/output interface circuit to the A-Series system backplane. The I/O Master includes an I/O processor chip, which executes I/O instructions, and other circuits that make high speed transfer possible. Every A-Series I/O interface card has the I/O Master processor.

Determination of I/O Address: I/O address select code is set for each interface by select code address switches on the interface and is therefore independent of interface card position along the backplane bus.

I/O Addressing: An I/O interface is pre-addressed by presetting its select code into a Global Register (GR). Thereafter, this leaves the six select code bits of I/O instructions available for addressing registers or for other functions on the interface.

I/O Device Interrupt Priority: Priority depends upon I/O interface card position along the backplane, with respect to the CPU card.

I/O Interrupt Procedure:

1. One or more I/O interfaces requests an interrupt.
2. The CPU responds to the interrupt request of the highest priority interface (that closest to the CPU) by executing the instruction in a memory location that corresponds to the select code of the interface.

Interrupt Masking: The I/O Master logic includes an interrupt mask register which provides for selective inhibition of interrupts from specific interfaces under program control. This capability can be programmed to temporarily cut off undesirable interrupts from any combination of interfaces when they could interfere with crucial transfers.

Interrupt Latency When There is No DMA Interference:

Computer	Latency
A900	3.7 to 13 µs, 4 µs, typical
A600+	4.7 to 40 µs, 5.1 µs, typical
A400	4.2 to 36 µs, 4.6 µs, typical

* Interrupts cannot be serviced until a DMA cycle or an instruction in progress has completed execution. The worst-case latency is based on time to complete the longest uninterruptible instruction. Instructions with longer execution times are interruptible.

Self-Configured, Chained DMA: The IOP chip also supports a self-configuring mode of operation. In this mode, instead of interrupting after a block transfer, the IOP fetches a new set of control words for the next transfer, reconfigures itself, and initiates a block transfer. This process continues as long as additional sets of control words are available.

Data Packing Under DMA: When byte mode is specified in control word instructions, the IOP automatically packs or unpacks bytes.

I/O Master Signals and Timing: See the HP 1000 L-Series I/O interfacing guide (02103-90005).

Maximum Achievable DMA Rate (I/O) Bandwidth):

Comp.	Input	Output
A900	3.7 MB/sec 1.85 MW/sec	2.5 MB/sec 1.25 MW/sec
A600+ & A400	4.27 MB/sec 2.13 MW/sec	4.27 MB/sec 2.13 MW/sec

Self-Configured DMA Timing Between Successive Block Transfers of a Chained Series:

Comp.	Timing
A900 A600+ A400	5.2 to 8.1 microseconds 4.5 to 7.1 microseconds 4.5 to 7.1 microseconds

Instruction Repertoire and Execution Times: See Table 3-4.

Safety and EMI Qualification

See the Microsystem, System, Computer, and Board Computer data sheets.

Physical Characteristics

See the Microsystem, System, Computer, and Board Computer data sheets.

Ordering Information

See the Microsystem, System, Computer, and Board Computer data sheets.

Table 3-4. Instruction Repertoire and Execution Times

Instruction		Execution Time (microseconds) in A900	A600+	A400
Memory Reference Instructions:	ADA, ADB, IOR, XOR, and LDA, LDB	0.267	0.908	0.817
	STA/B - STA/B,I 0.400	1.362 - 1.589	1.226 - 1.43	
	CPA/B without skip - with skip	0.533	1.135	1.022
	ISZ without skip - with skip	0.533	1.362	1.226
	JSB/JSB,I	0.533/0.667	1.362/1.589	1.226/1.43
	JMP/JMP,I	0.133/0.267	0.681/1.362	0.613/1.226
	Each indirect address level, except the first, for JSB,I, or JMP,I, or STA/B,I	0.133	0.454	0.409
Alter-Skip Instructions - all instructions and combinations		0.267 - 0.533	1.35 - 1.362	1.215 - 1.226
Shift-Rotate Instructions - all instructions and combinations		0.267	1.35 - 2.270	1.215 - 2.043
Extended Arithmetic Instructions:	DLD/DST	0.533	1,816/2.043	1.634/1.839
	MPY	2.267	5.498	4.948
	DIV	6.267	2.497 - 10.44	2.247 - 9.396
	ASL with one shift 0.800	1.816	1.634	
	Per additional ASL shift	Zero	0.454	0.409
	LSL/RRL with one shift	0.400	1.135	1.022
	ASR/LSR with one shift	0.677	1.362/1.135	1.226/1.022
	RRR with one shift/RRR 16 (Swap)	0.677	1.589/1.816	1.43/1.634
	Per additional LSL/RRL/ASR/LSR/RRR shift	Zero	0.227	0.204
	JLA, JLB	0.533	1.362	1.226

Table 3-4. Instruction Repertoire and Execution Times, continued

Instruction			Execution Time (microseconds) in A900	A600+	A400
Input/Output Instructions	HLT, xx		3.067	17.49	15.74
	Sel. Code 00:	STF/CLF SFC, SFS, skip/no skip LIA/B - OTA/B CLC - STC	0.667/0.933 0.933 3.067 - 3.867 2.000 - 0.400	1.362 1.589 6.356 - 4.944 1.362	1.226 1.43 5.72 - 4.45 1.226
	Sel. Code 01:	STF, CLF - STC, CLC SFC, SFS, skip/no skip LIA/B - OTA/B	0.267 0.400 1.867 - 0.400	1.362 1.362 1.362	1.226 1.226 1.226
	Sel. Code 02:	STF, CLF STC CLC SFC, SFS, skip/no skip LIA/B - OTA/B	0.800 0.800 0.800 0.800 3.067 - 3.600	2.043 2.043 N/A 1.589 6.356 - 4.767	1.839 1.839 N/A 1.43 5.72 - 4.29
	Sel. Code 03:	CLC - STC CLF, SFS, and SFC STF LIA/B - OTA/B	0.400 0.400 1.067 3.067 - 3.333	N/A N/A N/A 6.356 - 5.488	N/A N/A N/A 5.72 - 4.939
	Sel. Code 04:	STF CLF - SFC/SFS LIA/B - OTA/B STC/CLC	2 millisec* 0.400 - 0.800 0.533 0.667	N/A N/A 1.362 1.589	N/A N/A 1.226 1.43
	Sel. Code 05: (Memory Error)	STF/CLF SFC, SFS, skip/no skip LIA/B - OTA/B STC/CLC	0.400 0.400 0.800 - 2.133 0.800	1.362 1.589 1.589 1.362	1.226 1.43 1.43 1.226
	Sel. Code 06: (Time Base Generator "Tick")	STF/CLF SFC, SFS, skip/no skip LIA/B - OTA/B STC/CLC	0.800 0.800 0.400 0.800	1.362 1.589 1.362 - 1.816 2.951/3.632	1.226 1.43 1.226 - 1.634 2.656/3.269
	Sel. Code 07: (Memory Protect Violation)	CLF/CLC - STF STC LIA/B - OTA/B SFC, SFS skip/no skip	0.400 - 0.800 0.933 0.533 - 0.400 0.400	N/A 1.362 1.362 N/A	N/A 1.226 1.226 N/A
	Sel. Code 20+: (Input/Output Interfaces)	STC, CLC STF, CLF SFC, SFS skip/no skip LIA/B, MIA/B - OTA/B	1.333 - 2.667 1.200 2.400/1.333 3.067 - 3.333	2.951 2.951 4.086/2.951 5.902 - 4.994	2.656 2.656 3.667/2.656 5.312 - 4.495
Operating System Instructions	.WFI (Basic = Loop) .SIP/.CPUID .FWID		Until interrupt 0.667/0.400 1.733	Until interrupt 0.908 0.908	Until interrupt 0.817 0.817
Extended Instruction Group	ADX, ADY/LDX, LDY CAX, CBX, CAY, CBY, CXA, CXB, CYA, CYB DSX, DSY, ISX, ISY skip/no skip LAX, LBX, LAy, LBY/STX, STY SAX, SAY, SBX, SBY XAX, XAY, XBX, XBY JLY/JPY Each indirect address level		0.400 0.400 0.667 0.533 0.533 0.533 0.533/0.400 0.133	1.589/1.362 0.908 1.135 1.589 1.816 1.135 1.135 0.454	1.43/1.226 0.817 1.022 1.43 1.634 1.022 1.022 0.409
Bit Manipulation Instructions	CBS, SBS TBS, skip/no skip		0.800 0.800	2.724 2.951	2.452 2.656

* STF for select code 04 in the A900 flushes the cache. N/A = Not Applicable N/S = Not Specified

Table 3-4. Instruction Repertoire and Execution Times, continued

Instruction		Execution Time (microseconds) in A900	A600+	A400
Byte Manipulation Instructions	CBT	1.467	2.270	2.043
	Additional for 2 bytes in A900	0.400	N/A	N/A
	Additional per byte in A600+ or A400	N/A	3.589	3.23
	LBT, odd/even byte	0.667/0.800	1.816/2.270	1.634.2.043
	MBT	1.333	4.313 - 6.129	3.882 - 5.516
	Additional per byte	0.133	0.454 - 1.022	0.409 - 0.920
	SBT	0.933	2.270 - 2.724	2.043 - 2.452
	SFB, compare exit/terminal exit	1.733	2.497 - 2.724	2.247 - 2.452
	Additional for 2 bytes in A900	0.400	N/A	N/A
	Additional per byte in A600+ or A400	N/A	1.135	1.022
Word Manipulation Instructions	CMW	1.733	2.755	2.48
	Additional for 4 words in A900	1.200	N/A	N/A
	Additional per byte in A600+ or A400	N/A	1.135	1.022
	MVW + Addtional per word	0.933 + 0.267	2.270 + 0.908	2.043 + 0.817
High-Level Program Execution Accelerator Instructions	.ENTR/.ENTP (basic, see "Add'l per word")	1.600	2.724/2.951	2.452/2.656
	.ENTN/.ENTC (basic, see "Add'l per word")	1.200	2.270	2.043
	Additional per word without indirects	0.267	0.908	0.817
	Additional per indirect address level	0.133	0.454	0.409
	.CPM	1.200	2.951	2.656
	.SETP + Additional per word	1.067 + 0.267	2.724 + 0.454	2.452 + 0.409
	..FCM	1.600	1,135 - 5.448	1.022 - 4.903
	..TCM	2.267	9.761 - 10.44	8.785 - 9.396
	.NGL	2.400	4.540 - 8.399	4.086 - 7.559
	.DBL	1.600	5.221	4.699
	.DFER/.CFER	1.600/1.867	4.767/5.675	4.29/5.108
	.ZFER/.XFER	2.933/1.333	9.761/3.859	8.785/3.473
	.FLUN	N/S	1.362	1.226
	.PACK	N/S	1.816 - 9.988	1.634 - 8.989
	.PWR2	N/S	1.362 - 3.178	1.226 - 2.86
Dynamic Mapping Instructions	XLA1/B1, XSA1/B1,XLA2/B2, XSA2/B2	0.800	1.589 - 1.816	1.43 - 1.634
	XCA1/B1, skip/no skip & XCA2/B2, no skip	1.067	1.816	1.634
	MB00/01/02/10/11/12/20/21/22	1.600	1.589 - 3.405	1.43 - 3.065
	Additional per byte	0.133	2.270 - 2.724	2.043 - 2.452
	MW00/11/22 + Additional per word	1.067 + 0.267	2.724 + 0.908	2.452 + 0.817
	MW01/02/10/12/20/21 + Add'l per word	1.067 + 0.267	2.724 + 1.135	2.452 + 1.022
	LPMR/SPMR	0.933	3.632	3.269
	LDMP/STMP	9.200/9.333	38.14/38.36	34.33/34.52
	LWD1/LWD2	1.333/1.200	1.362	1.226
	SWMP/SIMP	0.667	3.859/2.724	3.23/2.452
	XJMP	1.867	4.086	3.677
	XJCQ	2.000	5.448	4.903
Virtual Memory Instructions	.LBP/.LBPR	1.733/2.000	10.67/11.80	9.603/10.62
	.LPX/.LPXR	2.133/2.533	12.03/13.85	10.83/12.47
	.IMAP (Basic)	3.600	23.15#	20.84#
	.IRES (Basic)	1.733	13.39#	12.05#
	Additional per .IMAP or .IRES parameter	2.000	10.44	9.396
	.JMAP (Basic)	3.200	36.09#	32.48#
	.JRES (Basic)	1.333	26.11	23.5
	Additional per .JMAP or .JRES parameter	2.000	9.307	8.376
	.PMAP	1.600	7.264	6.538
Double Integer Instructions	.DAD, .DSB, .DSBR	0.800	2.497	2.247
	.DIM, .DDE/.DNG	0.667/0.933	1.135/1.589	1.022/1.43
	.DIS, .DDS	0.933	3.859	3.23
	.DCO	1.333	2.497 - 2.951	2.247 - 2.656
	.DMP	2.400	3.178 - 13.85	2.86 - 12.47
	.DDI	5.200	3.632 - 16.34	3.269 - 14.71
	.DDIR	5.333	4.450 - 17.48	4.005 - 15.73

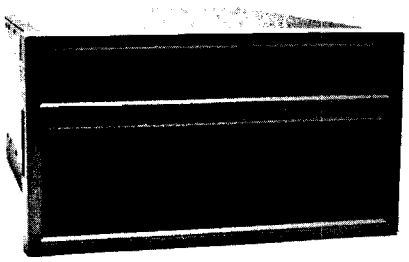
With one parameter. N/A = Not Applicable N/S = Not Specified

Table 3-4. Instruction Repertoire and Execution Times, continued

Instruction		Execution Time (microseconds) in A900	A600+	A400
Code and Data Separation (VC+) Instructions	CACQM CBCQ	0.533	1.362 - 1.589	1.226 - 1.43
	CCQA, CCQB	0.533	0.908	0.817
	CAZ, CBZ, CZA, CZB, ADQA, ADQB	0.533	0.908	0.817
	CIQA, CIQB	0.667	1.589	1.43
	SDSP + Additional element of display	0.933 + 0.400	2.043 + 0.908	1.839 + 0.817
	PCALI + Additional per parameter	1.867 + 0.400	4.540 + 0.908	4.086 + 0.817
	PCALX+ Additional per parameter	7.84 + 0.400	22.70 + 0.908	20.43 + 0.817
	PCALV+ Additional per parameter	7.98 + 0.400	23.15 + 0.908	20.84 + 0.817
	PCALR+ Additional per parameter	2.667 + 0.400	7.264 + 0.908	6.358 + 0.817
	PCALN+ Additional per parameter	2.667 + 0.400	6.810 + 0.908	6.129 + 0.817
	EXIT without/with segment mapping	0.931/6.11	2.270/19.52	2.043/17.57
	EXIT1 without/with segment mapping	0.931/6.11	2.497/19.75	2.247/17.78
	EXIT2 without/with segment mapping	1.064/6.11	2.730/19.98	2.457/17.98
Single-Precision Floating Point Instructions	.FAD	1.733	8.853 - 17.71	7.75 - 26.00
	.FSB	1.733	9.534 - 18.84	7.75 - 26.00
	.FMP	1.867	17.03 - 21.11	13.75 - 25.25
	.FDV	4.000	5.448 - 27.92	18.25 - 29.75
	FLOAT (Conversion from single integer)	1.867	2.270 - 5.675	1.75 - 6.50
	.FLTD (Conversion from double integer)	2.000	1.589 - 7.037	N/S
	FIX (Conversion to single integer)	1.733	2.497 - 6.356	1.50 - 6.50
	.FIXD (Conversion to double integer)	2.133	1.816 - 7.945	N/S
Double-Precision Floating Point Operations	.TADD	3.467	11.35 - 27.92	23 - 26
	.TSUB	3.467	12.94 - 29.51	23 - 26
	.TMPY	3.467	11.35 - 64.01	57 - 59
	.TDIV	8.533	12.94 - 65.15	68 - 72
	.TFTS (Conversion from single integer)	1.867	4.540 - 8.853	9.5 - 10.4
	.TFTD (Conversion from double integer)	2.000	5.221 - 9.988	10 - 11.1
	.TFXS (Conversion to single integer)	2.267	4.086 - 8.626	8.0 - 9.5
	.TFXD (Conversion to double integer)	2.400	4.313 - 9.761	9.5 - 10.7
Scientific Instruction Set Instructions	Sine/Cosine	18 - 20	N/A	N/A
	Tangent	21 - 25		
	Arc Tangent	14 - 22		
	Hyperbolic Tangent	10 - 26		
	Exponentiation	19		
	Natural or Base 10 logarithm	19		
	Square Root	15		
Vector Instruction Set Instructiion Set (VIS) Instructions		Execution Times (microseconds) are given as n.ns (setup) + n.n/e (per vector/matrix element)		
Single Precision	Double Precision	A900 Single Precision	A900 Double Precision	
.VADD, .VSUB	.DVADD, .DVSUB	4.9s + 1.2/e	6.1s + 2.0/e	
.VMPY	.DVMPY	5.1s + 1.2/e	6.1s + 2.0/e	
.VDIV	.DVDIV	4.3s + 3.7/e	4.7s + 7.2/e	
.VSAD, .VSSB	.DVSAD, .DVSSB	4.8s + 1.1/e	5.7s + 1.6/e	
.VSMY	.DVSMY	5.1s + 1.2/e	5.9s + 1.6/e	
.VSDV	.DVSDV	3.7s + 3.7/e	4.0s + 7.2/e	
.VPIV	.DVPIV	6.8s + 1.6/e	8.4s + 2.7/e	
.VABS	.DVABS	4.8s + 1.1/e	5.6s + 1.6/e	
.VSUM	.DVSUM	4.0s + 2.4/e	4.1s + 2.1/e	
.VNRM	.DVNRM	4.4s + 2.4/e	4.5s + 2.1/e	
.VDOT	.DVDOT	8.0s + 3.2/e	7.4s + 2.5/e	
.VMAX, .VMIN	.DVMAX, .DVMIN	4.1s + 0.7-2.7/e	4.3s + 0.7-3.3/e	
.VMAB, .VMIB	.DVMAB, .DVMIB	4.1s + 2.1-2.5/e	4.3s + 2.5-3.2/e	
.VMOV	.DVMOV	2.8s + 0.7/e	3.1s + 1.2/e	
.VSWP	.DVSWP	2.8s + 1.2/e	3.1s + 2.3/e	

N/A = Not Applicable N/S = Not Specified

Model 24, 26, and 29 Computer Products



Introduction

The Model 24, 26, and 29 Computer Products offer a choice of A400, A600+, and A900 processors housed in a 20-slot card cage. See Table 3-5, below, for a summary of the Model 24-29 computers and Model 26-29 SPUs. See the A-Series Computer Design and Specifications data sheet on page 3-1 for comparison of A400, A600+, and A900 capabilities.

OEMs and end users add a system cabinet, terminal interface, system console, system disk, and other peripheral devices, such as multiple disks, as needed for their applications. The Model 29 SPU also requires at least one memory array card (not included in the base SPU).

Features

- 20-slot card cage for maximum memory and I/O capacity.
- Disk memory expandable to over 2.2 GB on one card cage slot with multiple disks.
- Front-to-rear air flow cabinet maximizes system cooling efficiency and equipment reliability.
- Power fail detection and auto restart with optional 12157B Battery Backup System.
- Compliance with UL, CSA, and IEC-380 safety standards.
- Compliance with FCC Class A and VDE Level A EMI regulations.

Computer Description and Specifications

For functional description and specifications of the A400, A600+, and A900 computers, memory systems, input/output system, software and diagnostic support, compatibility, and specifications, see the A-Series Computer Design and Specifications data sheet on page 3-1.

Available HP-IB Capacity

The 12009A HP-IB interface included in Model 26, and 29 SPUs can support up to four hard disks. Although the HP-IB interface can address up to a total of 14 devices, it is advisable to use a different HP-IB interface to connect non-disk devices to the system to assure optimum performance.

Table 3-5. Model 24, 26, and 29 Computer Products Summary

	COMPUTERS (Include only CPU and memory controller; all other components, software, and services must be ordered separately.)			**SYSTEM PROCESSOR UNITS (SPUs)** (Include CPU, memory controller, disk interface, RTE-A operating system with VC+, site prep consultation, on-site installation, and 90-day on-site warranty. Requires system cabinet, system console, console interface, and system disk.)	
Processor	A400	A600+	A900	A600+	A900
Product Number	2134A	2156C/D	2139B	2196G/H	2199E
Name	Model 24 Computer	Model 26 Computer	Model 29 Computer	Model 26 SPU	Model 29 SPU
Serial I/O Channels	4 included	None included	None included	None included	None included
Base Memory	512 KB Parity	512 KB Parity/ 1 MB ECC	None included	512 KB Parity/1 MB ECC	None included
Maximum Memory	32 MB Parity	32 MB Parity/ 8 MB ECC	32 MB ECC	32 MB Parity/8 MB ECC	32 MB ECC
Av. Card Cage Slots	19; 15 with max. memory	18; 14 with max. memory	16; 12 with max. memory	17; 13 with max. memory	15; 11 with max. memory

System Processor Unit Prerequisites

To Satisfy Functional Requirements

System Console and Console Interface. All HP 219xE/G/H System Processor Units require a system console and console interface selected from those listed in Table 3-6, for local operator communication with the system.

Table 3-6. Compatible System Consoles and Connection Choices

TERMINAL		CONNECT USING	
Product Number	Type	12040D + Cable	12005B + Opt.
C1001x 2393A 2397A	Alpha Graphics Graphics	40242M	002
NOTE: The following additional terminals are discontinued products, listed here for reference only.			
2382A	Alpha	40242M	002
2392A	Alpha	40242M	002
2621B	Alpha	40242M	002
2622A	Alpha	13222Y	001/005
2623A	Graphics	13222Y	001/005
2624B	Alpha	13222Y	001/005
2625A	Alpha	40242M	002
2626A	Alpha	13222Y	001/005
2627A	Graphics	13222Y	001/005
2628A	Alpha	40242M	002
45610B	Alpha	40242M	002

System Disk and Software Load/Backup Device. For operating system and program development support, all HP 219xE/G/H System Processor Units require a system disk and a software load/backup device, selected from those listed in Table 3-7.

Memory in HP 2199E. The HP 2199E System Processor Unit does not include any base memory. This system therefore requires a separately-purchased memory array card(s) with at least 3 MB.

To Satisfy Regulatory Requirements

HP 219xE/G/H System Processor Units must be installed in a separately-purchased HP 29429A Cabinet with 29429-94001 front door or 29431G option 053 Cabinet to comply with safety and EMI regulations.

Computer Prerequisites for Operation

Operating Software

All HP 1000 A-Series Computers require RTE-A or a user-programmed operating system for management of input/output, user's program scheduling commands or program requests, management of main memory and disk memory files, etc. The HP 92077A RTE-A operating system must be purchased for the first A-Series computer. HP 92077R rights to copy RTE-A may be purchased for additional computers. The HP 2134A and 2156C/D Computers include a right to execute RTE-A as a configured system, excluding program development or system generation on that system. Rights to execute can be purchased separately for HP 2139B Computers.

System Communications Console

All HP 1000 A-Series Computers require a console for system communication. This can be a local console and console interface selected from those listed in Table 3-6, or a terminal at an adjacent remote HP 1000 computer system connected to the computer via a DS/1000-IV HDLC network interface link. The four-port On-Board I/O Multiplexer in the HP 2134A Computer can be used as the system console interface instead of the 12040D or 12005B, provided that a 40242Y cable is used instead of a 40242M cable.

A Bootup Device

All HP 1000 A-Series computers require a device from which they can be "booted up". This can be one of the system disk-software load/backup devices listed in Table 3-7, in which case the computer will require a 12009A HP-IB interface to the disk. However, the computer can also be "booted up" from:

1. A disk at an adjacent remote HP 1000 computer system connected to the computer via a DS/1000-IV HDLC interface.
2. A magnetic tape unit or cartridge tape unit via a 12009A HP-IB (disk) interface.
3. An HP 12008A or 93568P PROM Storage Module.

Memory in HP 2139B

The HP 2139B Computers does not include any base memory. It therefore requires a separately-purchased memory array card(s) with at least 3 MB.

Electrical Specifications

Computer/SPU AC Power Requirements

Std Line Voltage: 115V, -25%/+20% (86-138V).

Option 015 Line Voltage: 230V, -23%/+20% (178-276V).

Line Frequency: 47.5 to 66 Hz.

Power: 700W (1000 VA, assuming Power Factor = 0.7).

Power Cable: The standard 2134A, 2156C/D, 2139B Computer and the standard 219xE/G/H SPU includes a 3 m (10 ft.) power cable with NEMA 51–15P power plug. No power cable is provided with the Option 015 version of the computers.

Table 3-7. Compatible System Disks and Software Load/Backup Devices

SYSTEM DISKS					SOFTWARE LOAD/BACKUP DEVICES		
Product Number	**Type**	**Disk Cap. (MB)**	**Avg Xfer Rate (KB/s)**	**Avg Acc. Time (ms)**	**Product Number**	**Type**	**Comments**
7936H	Hard, fixed	307	1000	31	7979A	Autoloading1600 cpi Mag Tape Unit	79xxA/B/E Magnetic Tape Unit requires additional 12009A HP-IB interface
7936XP	Hard, fixed, w/cache	307	1000	31	7980A	Autoload 6250/1600 cpi Mag Tape Unit	
7937H	Hard, fixed	571	1000	31	7980XC	Autoload 6250/1600 cpi Mag Tape Unit	
7937XP	Hard, fixed, w/cache	571	1000	31	7974A* + 800	1600/800 cpi Mag Tape Unit	
7957B	Hard, fixed	81	875	29	7970E* +	1600 cpi Mag Tape Unit	
7958B	Hard, fixed	152	875	29	626 or 636		
7959B	Hard, fixed	304	875	29	7978B*	6250/1600 cpi Mag Tape Unit	
7962B	Hard, fixed	152	875	29	35401A	Autochanger Cartridge Tape Subsystem	
7963B	Hard, fixed	304	875	29	9144A/9145A	Cartridge Tape Subsystem	
NOTE: The following additional disks are discontinued products, listed here for reference only.							
7911R 7912R 7914R	Hard, fixed, with CS/80 CTU	28.1 65.6 131.2	983 983 983	35 35 36		Cartridge Tape Unit is included in HP 7911R, 7912R, or 7914R Disk.	
7914ST 7914TD	Hard, fixed w/1600 cpi mag tape drive	131.2 131.2	983 983	36 36		Mag Tape Unit is included in 7914ST & 7914TD products; it requires a second 12009A HP-IB interface.	
7933H 7933XP 7935H 7935XP 7941A 7945A	Hard, fixed Hard, fixed, w/cache Hard, removable Hard, removable, with cache Hard, fixed Hard, fixed	404.4 404.4 404.4 404.4 23.8 55.5	1000 1000 1000 1000 625 625	32 32 32 32 49 49		See listings for 7936H through 7963B above.	
7942A 7946A	Hard, fixed, w/built-in 9144A CTU	23.8 55.5	625 625	49 49		HP 9144A Cartridge Tape Unit is included in HP 7942A or 7946A Disk.	
7957A 7958A	Hard, fixed Hard, fixed	81 130	853 853	42 42		See listings for 7936H through 7963B above.	

NOTE: Average transfer rate is based on the minimum time required to transfer one track without overrun.

* Discontinued product, listed here for reference only.

Peripherals Power Requirements

See Table 3-11 on page 3-49.

DC Current Available and Required for I/O Interfaces and Accessories

The computer/SPU power supply provides enough current for any combination of A-Series interfaces or other A-Series plug-ins that can be accommodated in the computer/SPU card cage.

Environmental Specifications

Temperature

SPU Operating Temperature: 10° to 40°C (50° to 104°F).

Computer Operating Temperature: 0° to 55°C (32° to 131°F) to 3048 meters (10,000 feet). Maximum temperature is linearly derated 2°C (3.6°F) for each 304.8 meters (1,000 feet) increase in altitude above 3048 meters. The maximum temperature is 45°C (113°F) at 4572 meters (15,000 feet).

Rate of Change for System Disk: < 10°C (18°F) per hour for any compatible Disk.

Non-operating Temperature: -40° to 75°C (-40° to 167°F), exclusive of system disk.

Relative Humidity

20% to 80% non-condensing.

Altitude

Operating: To 4.6 km (15,000 ft).

Non-operating: To 15.3 km (50,000 ft).

Vibration and Shock

Conditions: Tests performed with computer in rack mounted configuration, unpowered.

Vibration Test: 0.38 mm constant displacement over a sweep range of 5 Hz to 55 Hz to 5 Hz for a system without disks, resulting in a "g" range of 0.2 at 5 Hz to 2.1 at 55 Hz. With disks, the displacement was 0.19 mm and the "g" range varied from 0.02 at 5 Hz to 1.2 at 55 Hz. Two 7.5-minute sweep cycles were run with 10 minute dwell times at the resonant points. Three test modes (top to bottom, front to back, and side to side) were used. Two resonant frequencies, 44 Hz and 50 Hz were found in each mode.

Shock Test: A half sine wave shock lasting 11 milliseconds applies a force of 30 gs to the computer. Three shocks were applied to all six surfaces (18 shocks, total).

Results: The computer incurred no physical damage and operated successfully between the tests and after the tests.

Operation Under Continuous Vibration: Contact factory for review of any application that requires operation under continuous vibration.

Safety Qualification

HP 1000 A-Series Computers SPUs meet Underwriter's Laboratory (UL), Canadian Standards Association (CSA), and International Electrotechnical Commission (IEC) safety standards. Safety compliance of SPUs requires installation in an HP 29429A Cabinet with 29429-94001 front door or HP 29431G option 053 Cabinet, in the position shown in Figure 3-1, at right.

EMI Compliance

HP 1000 Model 26 and 29 SPUs comply with Federal Communications Commission (FCC) Class A and Verband Deutscher Elektrotechniker (VDE) Level A regulations for Electro Magnetic Interference (EMI) when installed in an HP 29429A Cabinet with 29429-94001 front door or 29431G Option 053 Cabinet, in the position shown in Figure 3-1, below.

Physical Characteristics

Dimensions

Computer/SPU: 26.6 cm (10.5 in.) high, 48.3 cm (19 in.) wide, 61.2 cm (24 in.) deep.

29429A Cabinet for SPU: 72 cm (28.3 in.) high, 63.5 cm (25 in.) wide, 81.3 cm (32 in.) deep.

29431G Cabinet for SPU: 161.3 cm (63.4 in.) high, 63.5 cm (25 in.) wide, 81.3 cm (32 in.) deep.

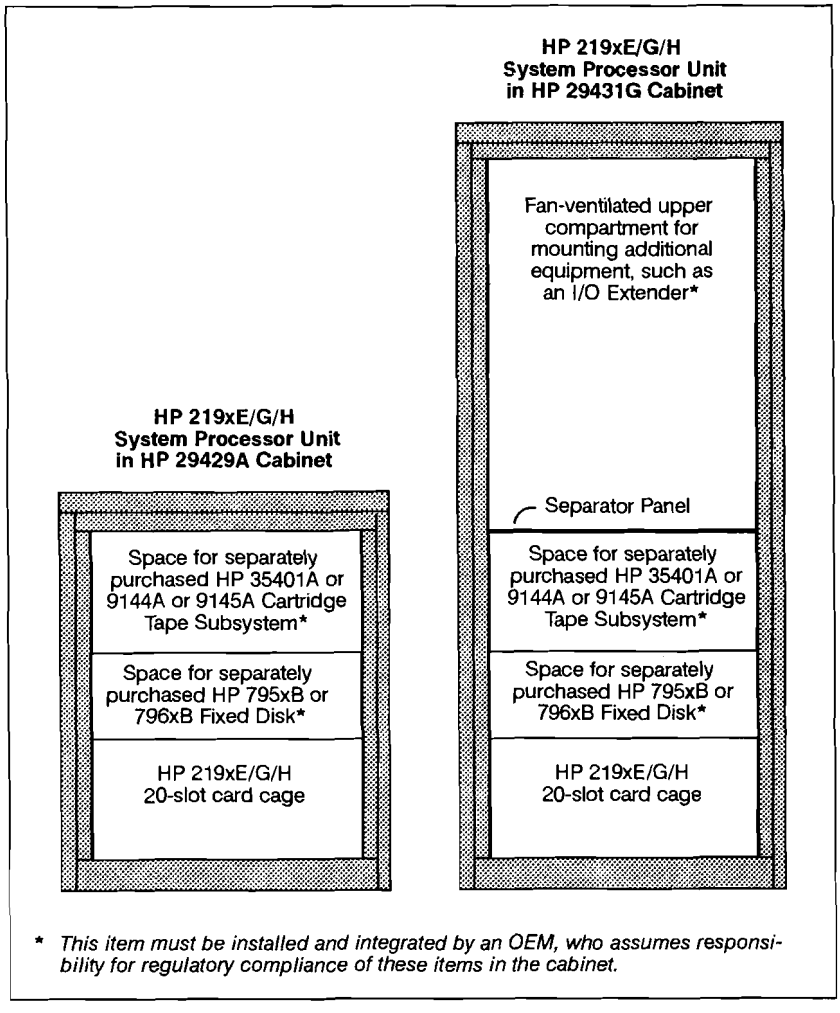


Figure 3-1. Rack Layout of HP 219xE/G/H System Processor Unit in HP 29429A and 29431G Cabinets

Net Weight

Computer/SPU: 29.1 kg (64 lb).

29429A Cabinet for SPU: 65.2 kg (143.5 lb).

29431G Cabinet for SPU: 110.6 kg (243.5 lb).

Ventilation

Four fans provide 10.7 cubic meters per minute (380 CFM) airflow through the computer/SPU card cage from front to rear. The HP 29429A Option 053 or 29431G Option 053 Cabinet required for regulatory compliance of Model 26 and 29 SPUs has perforations in the cabinet front and rear doors to facilitate front-to-rear ventilation provided by the fans.

System Processor Units Ordering Information

NOTE: See the SPU prerequisites on page 3-14 that must also be ordered to satisfy functional and regulatory requirements.

HP 2196G "Parity" System Processor Unit for HP 1000 Model 26 Computer System

The 2196G System Processor Unit includes:

1. CPU and memory as follows:
   a. 12102B Memory Controller Card with 512 KB parity memory.
   b. 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory frontplane connector.
2. 12009A-D01 HP-IB Interface to Disk.
3. 12151A (12151-60024) 20-slot card cage with power supply and ventilation.
4. Software and supporting documentation as follows:
   a. RTE-A Master, RTE-A Primary system, VC+ enhancement, and 24612A and 24398B diagnostics, on user-specified media.
   b. License to use RTE-A and VC+ on one System.
   c. RTE-A, VC+, and diagnostics manuals (see pages 2-13, 2-17, and 3-61 in this handbook for manuals furnished).
5. 02156-90002 HP 1000 A600+ Computer Installation and Service Manual.
6. 02156-90001 HP 1000 A600+ Computer Reference Manual.
7. 02196-90002 HP 1000 Model 26/27/29 Computer System Installation and Service Manual.
8. 02103-90005 Computer I/O Interfacing Guide.
9. 12009-90001 HP 12009A HP-IB Interface Reference Manual.
10. 59310-90064 HP-IB User's Guide.
11. 02172-90009 System Support Log.
12. Site preparation consultation.
13. On-site installation assistance and checkout by a Hewlett-Packard service engineer, including integration and test with primary system.
14. 90-day on-site warranty.
15. Four 93285A Engineering Units incorporated in the SPU in the course of manufacturing by Hewlett-Packard.

HP 2196H "ECC" System Processor Unit for HP 1000 Model 26 Computer System

The 2196H System Processor Unit (SPU) is similar to the 2196G SPU, but with a 12110B 1 MB ECC Memory Controller instead of the 12102B Memory Controller.

HP 219xE/G/H Options

NOTE: Must order media option 022 or 061.

015: Operation from 230V ac power. Power options for system console, disk, and other peripherals must be ordered separately.

022: Software on CS/80 cartridge tape for use with 791xR disk or 35401A, 9144A, or 9145A Tape Cartridge Subsystem (excludes option 061).

061: Software on 1600 cpi mag tape (excludes option 022).

HP 2199E System Processor Unit for HP 1000 Model 29 Computer System

The 2199E System Processor Unit includes:

1. CPU and memory as follows:
   a. 12201A Sequencer card with ROMs.
   b. 12202A Data Path card with Floating Point Processors.
   c. 12203A Cache Control card with VCP ROMs.
   d. 12204A Memory Controller card.
2. 12009A-D01 HP-IB Interface to Disk.
3. 12210A (12210-60009) 20-slot card cage with power supply and ventilation.
4. Same as for 2196G, above.

5. 02139-90002 HP 1000 A900 Computer Installation and Service Manual.

6. 02139-90001 HP 1000 A900 Computer Reference Manual.

7 through 15. Same as for 2196G, above.

Computers Ordering Information

NOTE: See the computer prerequisites on page 3-14 that must also be ordered to satisfy requirements for operation.

HP 2134A Computer

The 2134A Computer includes:

1. 12100A A400 Single-Board computer with 512 KB of parity memory and four-channel On-Board I/O Multiplexer.
2. 12100-60002 Four-channel On-Board I/O breakout cable.
3. 12151A (12151-60024) 20-Slot box with power supply and ventilation.
4. 02134-90001 HP 1000 A400 Computer Installation and Service Manual.
5. 02424-90001 A400 Computer Reference Manual.
6. 02103-90005 Computer I/O Interfacing Guide.
7. 92077E with Option 400, Right-to-Execute RTE-A.
8. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

HP 2156C "Parity" Computer

The 2156C Computer includes:

1. CPU and memory as follows:
   a. 12102B Memory Controller Card with 512 KB parity memory.
   b. 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory frontplane connector.
2. 12151A (12151-60024) 20-Slot box with power supply and ventilation.
3. 02156-90002 HP 1000 A600+ Computer Installation and Service Manual.
4. 02156-90001 HP 1000 A600+ Computer Reference Manual.
5. 02103-90005 Computer I/O Interfacing Guide.
6. 92077E with Option 600, Right-to-Execute RTE-A.
7. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

HP 2156D "ECC" Computer

The 2156D Computer is similar to the 2156C Computer, but with a 12110B 1 MB ECC Memory Controller instead of the 12102B Memory Controller.

HP 2156C/D Option

015: Operation from 220V ac power. Power options for terminals and other peripherals must be ordered separately.

HP 2139B Computer

The 2139B Computer includes:

1. CPU and memory as follows:
   a. 12201A Sequencer card with ROMs.
   b. 12202A Data Path card with Floating Point Processors.
   c. 12203A Cache Control card with VCP ROMs.
   d. 12204A Memory Controller card.
2. 12210A (12210-60009) 20-Slot box with power supply and ventilation.
3. 02139-90002 HP 1000 A900 Computer Installation and Service Manual.
4. 02139-90001 HP 1000 A900 Computer Reference Manual.
5. 02103-90005 Computer I/O Interfacing Guide.
6. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

Optional Software

See Extensive Software Support listings on page 3-4 of this handbook.

Memory Expansion and Array Connectors

Parity Memory Array Cards for 2134A, 2156C/D, and 2196G/H

12103B 512 KB Parity Memory Array Card

12103C 1 MB Parity Memory Array Card

12103K 2 MB Parity Memory Array Card

12103L 4 MB Parity Memory Array Card

12103M 8 MB Parity Memory Array Card

ECC Memory Array Cards for 2156D, and 2196H

12111A 512 KB ECC Memory Array Card

12111B 1 MB ECC Memory Array Card

12111C 2 MB ECC Memory Array Card

Memory Array Connectors for 2134A, 2156C/D, and 2196G/H

12038A Connector to 1 array card

12038B Connector to 2 array cards

12038C Connector to 3 array cards

12038D Connector to 4 array cards

Memory Array Cards and Array Connectors for 2139B and 2199E

12221A 3 MB ECC Memory Array Card
12221B 8 MB ECC Memory Array Card

12222A Connector to 1 array card

12222B Connector to 2 array cards

12222C Connector to 3 array cards

12222D Connector to 4 array cards

Accessories

System Cabinets

29429A Cabinet with 29429-94001 front door designed to house 219xE/G/H System Processor Units in compliance with UL, CSA, and IEC Safety and FCC and VDE EMI regulations. Safety and EMI compliance of cabinet-housed equipment other than the SPU is the customer's responsibility.

29431G Option 053 Cabinet designed to house an 219xE/G/H System Processor Unit (SPU) in compliance with UL, CSA, and IEC Safety and FCC and VDE EMI regulations while providing an upper compartment for rack mounting other equipment. Safety and EMI compliance of cabinet-housed equipment other than the SPU is the customer's responsibility.

Plug-In Accessories

12157B Battery Backup System using sealed lead-acid batteries for Model 2x Computers with Serial Prefix 2648 or greater. The 12157B provides 15 to 90 minutes of sustaining power for up to four memory array cards, depending upon the system configuration, state of charge, and temperature; additional hold-up time can be achieved by connecting an external battery.

NOTE A: This accessory is installed in the computer power supply and does NOT use a card cage slot.

NOTE B: Customers who want to add battery backup to Model 2x Computers with Serial Prefix smaller than 2648 will have to replace their power supply with that used in Model 2x Computers with Serial Prefix 2648 or greater, which is compatible with the 12157B product. Contact your nearest HP Sales and Service Office for more information.

12205A A900 Control Store Board provides 4K words of writable control store and mounting space for 2K words of 2K control store PROMs in HP 2139B Computer or 2199E SPU.

Interfaces

The Model 24, 26, and 29 Computers and Model 26 and 29 SPUs can use all of the interfaces listed in section 4 of this handbook, including those that require 25 kHz power.

Peripheral Devices

HP 1000 Model 24, 26 and 29 Computers and Model 26 and 29 SPUs support the peripheral devices listed and described in sections 7 through 10 of this handbook.

Engineering Reference Documentation

For Model 24 (A400): 02424-90003 HP 1000 A400 Computer Engineering and Reference Documentation.

For Model 26 (A600+): 02156-90003 HP 1000 A600 Computer Engineering and Reference Documentation.

For Model 29 (A900): 02139-90003 HP 1000 A900 Computer Engineering and Reference Documentation.

NOTES:

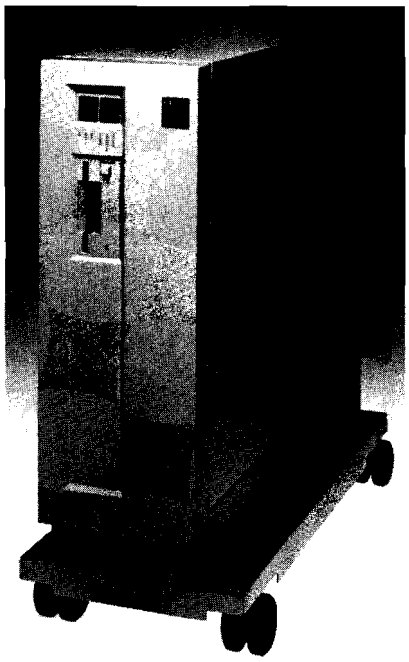
Micro 24, 26, and 29 Computer Products

Introduction

The Micro 24, 26, and 29 Computer Products offer a choice of A400, A600+, and A900 processors housed in a rugged, compact, versatile Micro/1000 package for the computer and System Processor levels of integration. The Micro/1000 package can be placed on a table, workbench, or desk or mounted in a standard 19-inch EIA rack cabinet or in a vertical mounting accessory on casters for moving it where necessary. The Micro/1000 package includes a cabinet, power supply, 14 card cage slots for CPU, memory, control store, and I/O cards, and dedicated slots for 25 kHz sine wave and battery backup cards. The Micro/1000 package can also accommodate integrated disks for software installation and backup. See Table 3-8, below, for a summary of the Micro 24-29 computers and systems and the A-Series Computer Design and Specifications data sheet on page 3-1 for comparison of A400, A600+, and A900 capabilities.

Features

- Rugged, compact, versatile Micro/1000 package.
- 14-slot card cage plus dedicated slots for 25 kHz and battery backup cards.
- Choice of integrated disks or external disks.
- Power fail detection and auto restart with optional 12154A Battery Backup Card.
- Disk memory expandable to over 2.2 GB on one card cage slot with multiple external disks.
- Compliance with UL, CSA, and IEC-380 safety standards and with FCC Class A and VDE Level A EMI regulations.



Micro/1000 Computer with 12122A Integrated Disks on 40025A Vertical Floor Mount

Table 3-8. Micro/1000 Computers and System Processor Units Summary

	COMPUTERS (Include only CPU and memory controller; all other components, software, and services must be ordered separately.)			**SYSTEM PROCESSOR UNITS (SPUs)** (Include CPU, memory controller, disk interface, RTE-A operating system with VC+, site prep consultation, on-site installation, and 90-day on-site warranty. Requires system console, console interface, and system disk.)		
Processor	A400	A600+	A900	A400	A600+	A900
Product Number	2434A	2436G/H	2439B	2484B	2486B/C	2489B
Name	Micro 24 Computer	Micro 26 Computer	Micro 29 Computer	Micro 24 SPU	Micro 26 SPU	Micro 29 SPU
Serial I/O Channels	4 included	None included	None included	4 included	None included	None included
Base Memory	512 KB Parity	512 KB Parity/ 1 MB ECC	None included	512 KB Parity	512 KB Parity/ 1 MB ECC	None included
Maximum Memory	32 MB Parity	32 MB Parity/ 8 MB ECC	32 MB ECC	32 MB Parity	32 MB Parity/ 8 MB ECC	32 MB ECC
Av. Card Cage Slots	13; 9 with max. memory	12; 8 with max. memory	9; 7 with max. memory	12; 8 with max. memory	11; 6 with max. memory	8; 6 with max. memory

Description and Specifications

For functional description and specifications of the A400, A600+, and A900 computers, memory systems, input/output system, software and diagnostic support, compatibility, and specifications, see the A-Series Computer Design and Specifications data sheet on page 3-1.

Card Cage Considerations

How Battery Backup Reduces Card Cage Capacity

The 12154A Battery Backup Card is an extra thick card that occupies its dedicated card cage slot 16 and slots 14 and 15 as well. See Figure 3-2, top right. If a battery backup card is not installed, slots 14 and 15 will be usable for I/O interface cards, provided that the total power used by all cards does not exceed power supply capacity.

Main Memory Capacity in Micro 29

As shown in Figure 3-2, above, the Micro/1000 is designed to support memory, CPU, and control store cards in the right-hand seven slots of its card cage. The Micro 29 uses five card cage slots for its CPU and memory control cards, and one separately purchased memory array card. Slot number 7 is available for a second memory array card and slot number 1 can be used for a 12205A A900 control store card. Either or both of those slots can instead be used for an I/O interface. Maximum ECC memory is thus limited to 16 megabytes (two 12221B 8 MB memory array cards) by the card cage slot limitation.

Card Cage Configuration Examples

See figures 3-3 through 3-5.

Slot No.	Left side of card cage seen from rear	Slot No.	Right side of card cage seen from rear
9	Available for I/O Card	1	Available for memory, CPU, control store, and I/O cards
10	Available for I/O Card	2	
11	Available for I/O Card	3	
12	Available for I/O Card	4	
13	Available for I/O Card	5	
14	Battery Backup or I/O Card	6	
15	Battery Backup or I/O Card	7	
16	Battery Backup Card	8	25 kHz Sine Wave Card

Figure 3-2. General Layout of Micro/1000 Card Cage (seen from rear)

Slot No.	Left side of card cage seen from rear	Slot No.	Right side of card cage seen from rear
9	Other I/O Card	1	12103D 1 MB Parity Memory Card
10	Other I/O Card	2	12103D 1 MB Parity Memory Card
11	Other I/O Card	3	12103C 0.5 MB Parity Memory Cd
12	Other I/O Card	4	12100A Single Board Computer
13	Other I/O Card	5	12009A HP-IB Disk Interface
14	Battery Backup or I/O Card	6	Other I/O Card
15	Battery Backup or I/O Card	7	Other I/O Card
16	Battery Backup Card	8	25 kHz Sine Wave Card

Figure 3-3. Micro 24 Card Cage Layout Example (seen from rear)

Slot No.	Left side of card cage seen from rear	Slot No.	Right side of card cage seen from rear
9	Other I/O Card	1	12111C 2 MB ECC Memory Card
10	Other I/O Card	2	12111C 2 MB ECC Memory Card
11	Other I/O Card	3	12111B 1 MB ECC Memory Card
12	Other I/O Card	4	12110B ECC Memory Control Cd
13	Other I/O Card	5	A600+ CPU Card
14	Battery Backup or I/O Card	6	12009A HP-IB Disk Interface
15	Battery Backup or I/O Card	7	Console I/O Card
16	Battery Backup Card	8	25 kHz Sine Wave Card

Figure 3-4. Micro 26 Card Cage Layout Example (seen from rear)

Slot No.	Left side of card cage seen from rear	Slot No.	Right side of card cage seen from rear
9	12009A HP-IB Disk Interface	1	12205A Control Store Card
10	Console I/O Card	2	12201A Sequencer Card
11	Other I/O Card	3	12202A Data Path Card
12	Other I/O Card	4	12203A Cache Control Card
13	Other I/O Card	5	12204A Memory Controller Card
14	Battery Backup or I/O Card	6	12221B 8 MB ECC Memory Card
15	Battery Backup or I/O Card	7	12221B 8 MB ECC Memory Card
16	Battery Backup Card	8	25 kHz Sine Wave Card

Figure 3-5. Micro 29 Card Cage Layout Example (seen from rear)

Available HP-IB Capacity

The 12009A HP-IB interface included in Micro 24, 26, and 29 SPUs can support up to four hard disks. Although the HP-IB interface can address up to a total of 14 devices, a different HP-IB interface should be used to connect non-disk devices to the system to assure optimum performance.

System Processor Unit Prerequisites

System Console and Console Interface

HP 248xB/C System Processor Units require a system console and console interface selected from those listed in Table 3-9, for local operator communication with the system. The four-port On-Board I/O (OBIO) multiplexer can be used as the system console interface in 2484B SPUs instead of the 12040D or 12005B interface. The system console connection to the A400 OBIO multiplexer MUST use a 40242Y cable instead of a 40242M cable, as footnoted in Table 3-9.

System Disk and Software Load/Backup Device

For operating system and program development support, all HP 248xB/C System Processor Units require a system disk and a software load/backup device, selected from those listed in Table 3-10 (next page).

Memory in HP 2489B

The HP 2489B System Processor Unit does not include any base memory. This system thereforerequires a separately-purchased memory array card(s) with at least 3 MB.

Table 3-9. Compatible System Consoles and Connection Choices

TERMINAL		CONNECT USING	
Product Number	Type	12040D + Cable	12005B + Opt.
C1001x 2393A 2397A	Alpha Graphics Graphics	40242M	002
NOTE: The following additional terminals are discontinued products, listed here for reference only.			
2382A	Alpha	40242M*	002
2392A	Alpha	40242M*	002
2621B	Alpha	40242M*	002
2622A	Alpha	13222Y	001/005
2623A	Graphics	13222Y	001/005
2624B	Alpha	13222Y	001/005
2625A	Alpha	40242M*	002
2626A	Alpha	13222Y	001/005
2627A	Graphics	13222Y	001/005
2628A	Alpha	40242M*	002
45610B	Alpha	40242M*	002

* Use 40242Y cable instead of 40242M cable for direct connection to the four-port on-board I/O Multiplexer in the HP 2484B SPU or 2434A Computer.

Computer Prerequisites for Operation

Operating Software

All HP 1000 A-Series Computers require RTE-A or a user-programmed operating system for management of input/output, user's program scheduling commands or program requests, management of main memory and disk memory files, etc. The HP 92077A RTE-A operating system must be purchased for the first A-Series computer. HP 92077R rights to copy RTE-A may be purchased for additional computers. The HP 2434A and 2436G/H Computers include a right to execute RTE-A as a configured system, excluding program development or system generation on that system. Rights to execute can be purchased separately for HP 2439B Computers.

System Communications Console

All HP 1000 A-Series Computers require a console for system communication. This can be a local console and console interface selected from those listed in Table 3-9, or a terminal at an adjacent remote HP 1000 computer system connected to the computer via a DS/1000-IV HDLC network interface link. The four-port On-Board I/O Multiplexer in the HP 2434A Computer can be used as the system console interface instead of the 12040D or 12005B, provided that a 40242Y cable is used instead of a 40242M cable.

A Bootup Device

All HP 1000 A-Series computers require a device from which they can be "booted up". This can be one of the system disk-software load/backup devices listed in Table 3-10, in which case the computer will require a 12009A HP-IB interface to the disk. However, the computer can also be "booted up" from:

1. A disk at an adjacent remote HP 1000 computer system connected to the computer via a DS/1000-IV HDLC interface.

2. A magnetic tape unit or cartridge tape unit via a 12009A HP-IB (disk) interface.

3. An HP 12008A or 93568P PROM Storage Module.

Memory in HP 2439B

The HP 2439B Computer does not include any base memory. This computer therefore requires a separately-purchased memory array card(s) with at least 3 MB.

Table 3-10. Compatible System Disks and Software Load/Backup Devices

SYSTEM DISKS					SOFTWARE LOAD/BACKUP DEVICES		
Product Number	**Type**	**Disk Cap. (MB)**	**Avg Xfer Rate (KB/s)**	**Avg Acc. Time (ms)**	**Product Number**	**Type**	**Comments**
12122A	Built-in, hard, fixed, with Microfloppy	19.4 0.6	150 17	75 225		Included microfloppy drive	
7936H 7936XP 7937H 7937XP 7957B 7958B 7959B 7962B 7963B	Hard, fixed Hard, fixed, w/cache Hard, fixed Hard, fixed, w/cache Hard, fixed Hard, fixed Hard, fixed Hard, fixed Hard, fixed	307 307 571 571 81 152 304 152 304	1000 1000 1000 1000 875 875 875 875 875	31 31 31 31 29 29 29 29 29	7979A 7980A 7980XC 7974A* + 800 7970E* + 626 or 636 7978B* 35401A 9144A/9145A	Autoloading1600 cpi Mag Tape Unit Autoload 6250/1600 cpi Mag Tape Unit Autoload 6250/1600 cpi Mag Tape Unit 1600/800 cpi Mag Tape Unit 1600 cpi Mag Tape Unit 6250/1600 cpi Mag Tape Unit Autochanger Cartridge Tape Subsystem Cartridge Tape Subsystem	79xxA/B/E Magnetic Tape Unit requires additional 12009A HP-IB interface
NOTE: The following additional disks are discontinued products, listed here for reference only.							
7911R 7912R 7914R	Hard, fixed, with CS/80 CTU	28.1 65.6 131.2	983 983 983	35 35 36		Cartridge Tape Unit is included in HP 7911R, 7912R, or 7914R Disk.	
7914ST 7914TD	Hard, fixed w/1600 cpi mag tape drive	131.2 131.2	983 983	36 36		Mag Tape Unit is included in 7914ST & 7914TD products; it requires a second 12009A HP-IB interface.	
7933H 7933XP 7935H 7935XP 7941A 7945A	Hard, fixed Hard, fixed, w/cache Hard, removable Hard, removable, with cache Hard, fixed Hard, fixed	404.4 404.4 404.4 404.4 23.8 55.5	1000 1000 1000 1000 625 625	32 32 32 32 49 49		See listings for 7936H through 7963B above.	
7942A 7946A	Hard, fixed, w/built- in 9144A CTU	23.8 55.5	625 625	49 49		HP 9144A Cartridge Tape Unit is included in HP 7942A or 7946A Disk.	
7957A 7958A	Hard, fixed Hard, fixed	81 130	853 853	42 42		See listings for 7936H through 7963B above.	
9133L	Hard, fixed fixed, w/Microfloppy	39.9 0.6	187 17	40 430		Included microfloppy drive	
9153B	Hard, fixed fixed, w/Microfloppy	19.4 0.6	150 17	85 430		Included microfloppy drive	
9134L 9154B	Hard, fixed Hard, fixed	39.9 19.4	187 150	40 85	9144A	Cartridge Tape Subsystem	

NOTE: Average transfer rate is based on the minimum time required to transfer one track without overrun.

* Discontinued product, listed here for reference only.

Electrical Specifications

AC Power Requirements of 243xA/B/G/H Computer or 248xB/C SPU

Std Line Voltage: 115V -25%/ +20% (86-138V).

Opt 015 Line Voltage: 230V -23%/+20% (178- 276V).

Line Frequency: 47.5-66 Hz.

Power: 500W (690 VA).

Maximum Operating Current. 6A in 115V configuration, 3A in 230V configuration.

Power Cable: The standard 243xA/B/G/H computer or 248xB/C SPU includes a 2 m (6.5 ft.) power cable with NEMA type 5-15P power plug). Units ordered with option 015 are provided with a power cable appropriate for the destination country.

Peripherals Power Requirements

See Table 3-11 on page 3-49.

DC Current Available and Required for I/O Interfaces and Accessories

See Table 3-12 on page 3-51.

Environmental Specifications

Temperature

Operating (without 12122A Integral Disks): 0° to 55°C (32° to 131°F) to 3048m (10,000 ft.). Maximum temperature is linearly derated 2°C (3.6°F) for each 304.8m (1,000 ft.) increase in altitude. Resulting temperature range is 0° to 45°C (32° to 113°F) at 4572m (15,000 ft.).

Operating (with12122A Integral Disks): 5° to 45°C (40° to 113°F); maximum rate of change < 10°C (18°F) per hour.

Non-operating Temperature with 12122A Integral Disks: -40° to 60°C (-40° to 140°F).

Non-operating Temperature without 12122A Integral Disks: -40° to 75°C (-40° to 167°F).

Relative Humidity

Operating without 12122A Integral Disk: 5% to 95%, non-condensing.

Operating with 12122A Integral Disk: 20% to 80% non-condensing.

Altitude

Operating: To 4.6 km (15,000 ft).

Non-operating: To 15.3 km (50,000 ft).

Vibration and Shock

2434A Computer/2484A SPU Operating Vibration: 0.43G rms, distributed as follows:

Frequency (Hz)	Power Spectral Density (G^2/Hz)
5	0.002
5 - 15	-1.5 dB/octave
15	0.0015
12 - 200	-6.0 dB/octave
200 - 350	0.00012
350 - 500	-6.0 dB/octave

2434A Computer/2484B SPU Operating Shock: 1.5G peak, 1/2 sine, 6 to 9 ms duration, 45 Hz crossover.

2434A Computer/2484B SPU Non-operating Shock: 7.0G peak, 1/2 sine, 6 to 9 ms duration, 45 Hz crossover.

2436G/H, 2437B, and 2439B Computers and 2486B/C, 2487B, and 2489B SPUs Vibration and Shock: These products are type tested for normal shipping and handling vibration and shock (contact factory for review of any application that requires operation under continuous vibration).

Safety Qualification

HP 243xA/B/G/H and 248xB/C computers and SPUs meet Underwriter's Laboratory (UL), Canadian Standards Association (CSA), and International Electrotechnical Commission (IEC) safety standards.

EMI Compliance

HP 243xA/B/G/H and 248xB/C computers and SPUs comply with Federal Communications Commission (FCC) Class A and Verband Deutscher Elektrotechniker (VDE) Level A regulations for Electro Magnetic Interference (EMI).

Physical Characteristics

Package

HP 243xA/B/G/H and 248xB/C Micro/1000 computers and SPUs are housed in a standard 19-inch EIA rack mountable package.

Dimensions in cm and (inches)

Rack Mounting Micro/1000 Package: 17.8 cm (7 in.) high x 48.3 cm (19 in.) wide x 64.8 cm (25.5 in.) deep.

Micro/1000 Package in 40025A Vertical Floor Mount: 61.6 cm (24.25 in.) high x 24.5 cm (10 in.) wide x 62.2 cm (24.5 in.) deep.

Net Weight

2434A or 2484B: 16 kg (35.2 lb).

2436G/H or 2486B/C: 16.3 kg (36 lb).

2439B or 2489B: 18.1 kg (40 lb).

12122A Integrated Disks Adds: 2.27 kg (5 lb).

40025A Vertical Floor Mount Adds: 5.68 kg (12 lb).

Cooling

Four fans provide left-to-right airflow through the Micro/1000 card cage and for the power supply and 12122A integrated disks. When cooling requirements permit, a dual-speed feature allows the fans to operate at lower speed, thus reducing noise.

System Processor Units Ordering Information

NOTE: See the prerequisites on page 3-23 that must also be ordered to satisfy operational requirements.

HP 2484B System Processor Unit for HP 1000 Micro 24 Computer System

The 2484B System Processor Unit includes:

1. 12100A A400 Single-Board computer with 512 KB of parity memory and four-channel On-Board I/O multiplexer.
2. 12100-60002 Four-channel On-Board I/O break-out cable.
3. 2430A (02430-60022) rack-mountable Micro/1000 package with power supply and 14-slot card cage plus dedicated slots for 25 kHz sine wave and battery backup cards.
4. 02430-90001 Micro/1000 Computer System Installation and Service Manual.
5. 02424-90001 A400 Computer Reference Manual.
6. 02103-90005 Computer I/O Interfacing Guide.
7. 12009A HP-IB Interface to system disk.
8. 12009-90001 HP 12009A HP-IB Interface Reference Manual.
9. Software and supporting documentation as follows:
   a. RTE-A Master, RTE-A Primary system, VC+ enhancement, and 24612A and 24398B diagnostics, on user-specified media.
   b. License to use RTE-A and VC+ on one System.
   c. RTE-A, VC+, and diagnostics manuals (see pages 2-13, 2-17, and 3-61 in this handbook for manuals furnished).
10. On-site installation assistance and checkout by a Hewlett-Packard service engineer, including integration and test with primary system.
11. 90-day on-site warranty.
12. Four 93285A Engineering Units incorporated in the SPU in the course of manufacturing by Hewlett-Packard.

HP 248xB/C Options

NOTE: Must order media option 022, 044, or 061.

015: Operation from 230V ac power. Power options for system console, disk, and other peripherals must be ordered separately.

022: Software on CS/80 cartridge tape for use with 791xR disk or 35401A or 9144A Tape Cartridge Subsystem (excludes options 044 and 061).

044: Software on 270 KB Microfloppy disks for use with 12122A Integral Disks or 9133L* or 9153B* external disks (excludes options 022 and 061).

061: Software on 1600 cpi mag tape (excludes options 022 and 044).

151: Installation preparation kit for 12122A Integrated Disks.

* Discontinued product, listed here for reference only.

HP 2486B "Parity" System Processor Unit for HP 1000 Micro 26 Computer System

The 2486B System Processor Unit includes:

1. 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory frontplane connector.
2. 12102B Memory Controller Card with 512 KB parity memory.
3. 2430A (02430-60022) rack-mountable Micro/1000 package with power supply and 14-slot card cage plus dedicated slots for 25 kHz sine wave and battery backup cards.
4. 02430-90001 Micro/1000 Computer System Installation and Service Manual.
5. A600+ computer manuals, as follows:
   a. 02156-90002 HP 1000 A600+ Computer Installation and Service Manual.
   b. 02156-90001 HP 1000 A600+ Computer Reference Manual.

6 through 12. Same as for 2484B SPU, above.

HP 2486C "ECC" System Processor Unit for HP 1000 Micro 26 Computer System

The 2486C System Processor Unit (SPU) is similar to the 2486B SPU, but with a 12110B 1 MB ECC Memory Controller instead of the 12102B Memory Controller.

HP 2489B System Processor Unit for HP 1000 Micro 29 Computer System

The 2489B System Processor Unit includes:

1. CPU cards, as follows:
   a. 12201A Sequencer card with ROMs.
   b. 12202A Data Path card with Floating Point Processors.
   c. 12203A Cache Control card with VCP ROMs.
   d. 12204A Memory Controller card.
2. 2430B (02430-60023) rack-mountable Micro/1000 package with power supply and 14-slot card cage plus dedicated slots for 25 kHz sine wave and battery backup cards.

3. 02430-90001 Micro/1000 Computer System Installation and Service Manual.
4. A900 computer manuals, as follows:
   a. 02139-90002 HP 1000 A900 Computer Installation and Service Manual.
   b. 02139-90001 HP 1000 A900 Computer Reference Manual.

5 through 11. Same as 6 through 12 for 2484B SPU, above.

Computers Ordering Information

NOTE: See the prerequisites on page 3-23 that must also be ordered to satisfy requirements for operation.

HP 2434A HP 1000 Micro 24 Computer

The 2434A Computer includes:

1. 12100A A400 Single-Board computer with 512 KB of parity memory and four-channel On-Board I/O multiplexer.
2. 12100-60002 Four-channel On-Board I/O break-out cable.
3. 2430A (02430-60022) rack-mountable Micro/1000 package with power supply and 14-slot card cage plus dedicated slots for 25 kHz sine wave and battery backup cards.
4. 02430-90001 Micro/1000 Computer System Installation and Service Manual.
5. 02424-90001 A400 Computer Reference Manual.
6. 02103-90005 Computer I/O Interfacing Guide.
7. 92077E Option 400 Right to Execute RTE-A.
8. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

HP 243xA/B/G/H Options

015: Operation from 230V ac power. Power options for system console and other peripherals must be ordered separately.

151: Installation preparation kit for 12122A Integrated Disks.

HP 2436G HP 1000 Micro 26 "Parity" Computer

The 2436G Computer includes:

1. 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory frontplane connector.
2. 12102B Memory Controller Card with 512 KB parity memory.
3. 2430A (02430-60022) rack-mountable Micro/1000 package with power supply and 14-slot card cage plus dedicated slots for 25 kHz sine wave and battery backup cards.
4. 02430-90001 Micro/1000 Computer System Installation and Service Manual.
5. A600+ computer manuals, as follows:
   a. 02156-90002 HP 1000 A600+ Computer Installation and Service Manual.
   b. 02156-90001 HP 1000 A600+ Computer Reference Manual.
6. 02103-90005 Computer I/O Interfacing Guide.
7. 92077E Option 600 Right to Execute RTE-A.
8. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

HP 2436H HP 1000 Micro 26 "ECC" Computer

The 2436H Computer is similar to the 2436G Computer, but with a 12110B 1 MB ECC Memory Controller instead of the 12102B Memory Controller.

HP 2439A HP 1000 Micro 29 Computer

The 2439A Computer includes:

1. CPU cards, as follows:
   a. 12201A Sequencer card with ROMs.
   b. 12202A Data Path card with Floating Point Processors.
   c. 12203A Cache Control card with VCP ROMs.
   d. 12204A Memory Controller card.
2. 2430B (02430-60023) rack-mountable Micro/1000 package with power supply and 14-slot card cage plus dedicated slots for 25 kHz sine wave and battery backup cards.
3. 02430-90001 Micro/1000 Computer System Installation and Service Manual.
4. A900 computer manuals, as follows:
   a. 02139-90002 HP 1000 A900 Computer Installation and Service Manual.
   b. 02139-90001 HP 1000 A900 Computer Reference Manual.
5. 02103-90005 Computer I/O Interfacing Guide.
6. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

Optional Software

See page 3-4 of this handbook.

Memory Expansion and Array Connectors

Parity Memory Array Cards for 2434A, 2436G/H, 2484B, and 2486B/C

12103B 512 KB Parity Memory Array Card

12103C 1 MB Parity Memory Array Card

12103K 2 MB Parity Memory Array Card

12103L 4 MB Parity Memory Array Card

12103M 8 MB Parity Memory Array Card

ECC Memory Array Cards for 2436H, and 2486C

12111B 1 MB ECC Memory Array Card

12111C 2 MB ECC Memory Array Card

Memory Array Connectors for 2434A, 2436G/H, 2484B, and 2486B/C

12038A Conn. to 1 array card

12038B Conn. to 2 array cards

12038C Conn. to 3 array cards

12038D Conn. to 4 array cards

Memory Array Cards and Array Connectors for 2439A and 2489A

12221A 3 MB ECC Memory Array Card

12221B 8 MB ECC Memory Array Card

12222A Conn. to 1 array card

12222B Conn. to 2 array cards

Micro/1000 Accessories

Integrated Disks and Vertical Floor Mount

12122A Integrated Disks: 19.4 MB fixed, hard disk and 630 KB microfloppy disk, and 12009A HP-IB interface to the computer.

40025A Vertical Floor Mount provides a convenient base on casters for compact vertical deskside or under table mounting and mobility of Micro 24, 26, or 29 systems.

Plug-in Hardware Accessories

12154A Battery Backup Card provides 45 to 210 minutes of sustaining power for up to four memory array cards, depending upon the system configuration, state of charge, and temperature; additional hold-up time can be achieved by connecting an external battery.

12159A 25 kHz Sine Wave Card provides up to 30W of 39V rms ac power (two phases) at 25 kHz, which is filtered from the output of the power supply switcher.

12205A A900 Control Store Board provides 4k words of writable control store and mounting space for 2k words of 2k control store PROMs in HP 1000 Micro 29 System.

Interfaces

The HP 243xA/B/G/H computers and 248xB/C SPUs can use all of the interfaces listed in section 4 of this handbook, including those that require 25 kHz power when the Micro/1000 computer or SPU is equipped with the 12159A 25 kHz Sine Wave Card.

Peripheral Devices

HP 1000 Micro 24, 26, and 29 Systems support the peripheral devices listed and described in sections 7 through 10 of this handbook.

Engineering Reference Documentation

For Micro 24 (A400): 02424-90003 HP 1000 A400 Computer Engineering and Reference Documentation.

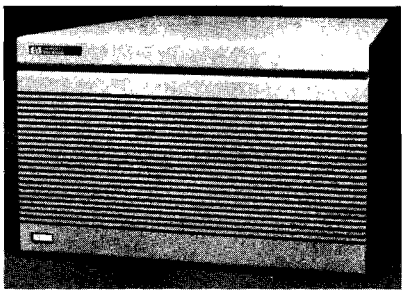
For Micro 26 (A600+): 02156-90003 HP 1000 A600 Computer Engineering and Reference Documentation.

For Micro 29 (A900): 02139-90003 HP 1000 A900 Computer Engineering and Reference Documentation.

Micro 14 and 16 Computers

Model Designation	Micro 14	Micro 16 (Parity)	Micro 16 (ECC)
Product Number	2424A	2426G	2426H
Av. Card Cage Slots	5	4	4
Serial I/O Channels	4 included	4 included	4 included
Base Memory	512 KB included	512 KB included	1 MB included
Max. Parity Memory*	32 MB	24.5 MB	24 MB*
Max. ECC Memory*	Not supported	Not supported	6 MB*
Av. Card Cage Slots with Max. Memory	1	1	1

* Maximum memory sizes listed assume use of only parity memory array cards or only ECC memory array cards. Parity and ECC memory array cards can be used together in the same 2426H Computer, up to a maximum of three memory array cards (maximum total memory will be less).



Introduction

The HP 2424A Micro 14 and 2426G/H Micro 16 Computers provide A400 and A600+ processing power in HP's smallest, lowest cost box computer package. These computers combine a six-slot card card cage with highly-efficient ventilation for cell control or other applications in the heat of the factory floor. They include a license to execute HP's powerful RTE-A operating system for economical application to low end real-time uses.

Despite their relatively small card cage, the Micro 14 and Micro 16 computers, coupled with efficient multi-channel interfaces and cost-effective HP peripheral devices, offer users surprising power and excellent value for many different applications. Best of all, these computers execute the same programs as the larger A400, A600+, and A900 Computer Systems. This facilitates transfer of applications from central development systems to the Micro 14 or 16.

Features

- Compact computer with 6-slot card cage offers a low priced package for low-end applications.
- Highly-efficient ventilation with front-to-rear air flow cabinet provides superior tolerance of high operating temperatures.

Description and Specifications

For functional description and specifications of the A400 and A600+ computers, memory systems, input/output system, software and diagnostic support, compatibility, and specifications, see the A-Series Computer Design and Specifications data sheet on page 3-1.

Exclusions

- Battery backup is not supported; an uninterruptible power supply is recommended for applications that would otherwise use battery backup.
- 25 kHz power is not available, so interfaces that require 25 kHz ac power are not supported.
- Support services, such as installation, site prep consulting, and on-site warranty service are NOT included with 2424A or 2426G/H Computers, but may be purchased separately from your local HP field office.
- Right to execute RTE-A, included with the 2424A and 2426G/H Computers, does NOT include the right to develop programs or generate systems.

Electrical Specifications

AC Power Requirements

Line Voltage: 120V -28%/+17% (86-140V) or 240V -28%/+15% (172- 276V).

Line Frequency: 47.5 to 66 Hz.

Maximum Power Required: 216W (300 VA).

Power Cable: 3m (10 ft.) power cable with NEMA 5-15P power plug.

Peripherals Power Requirements

See Table 3-11 on page 3-49.

DC Current Available and Required for I/O Interfaces and Accessories

See Table 3-12 on page 3-51.

Environmental Specifications

Temperature

Operating: 0° to 60°C (32° to 140°F) to 3048m (10,000 ft.). Maximum temperature is linearly derated 2°C (3.6°F) for each 304.8m (1,000 ft.) increase in altitude. Resulting temperature range is 0° to 50°C (32° to 122°F) at 4572m (15,000 ft.).

Non-operating Temperature: -40° to 75°C (-40° to 167°F).

Altitude

Operating: To 4.6 km (15,000 ft.).

Non-operating: To 15.3 km (50,000 ft.).

Relative Humidity

5% to 95% non-condensing.

Shock and Vibration

Operating Shock: 1.5G peak, 1/2 sine, 6 to 9 milliseconds duration, 45 Hz crossover.

Non-Operating Shock: 7G peak, 1/2 sine, 6 to 9 milliseconds duration, 45 Hz crossover.

Operating Vibration: 0.43G rms, distributed as follows:

Frequency (Hz)	Power Spectral Density (G^2/Hz)
5	0.002
5 - 15	-1.5 dB/octave
15	0.0015
12 - 200	-6.0 dB/octave
200 - 350	0.00012
350 - 500	-6.0 dB/octave

Safety Qualification

HP 2424A and 2426G/H Computers meet Underwriter's Laboratory (UL), Canadian Standards Association (CSA), and International Electrotechnical Commission (IEC) safety standards.

EMI Compliance

HP 2424A and 2426G/H Computers comply with Federal Communications Commission (FCC) Class A and Verband Deutscher Elektrotechniker (VDE) Level A regulations for Electro Magnetic Interference (EMI).

Physical Characteristics

Dimensions

20.5 cm (8.1 in.) high, 32.5 cm (12.8 in.) wide, 50 cm (19.7 in.) deep.

Net Weight

13.2 kg (29 lb).

Ventilation

One fan provides balanced air flow through the computer card cage from front to rear with a flow design that assures even cooling of all components.

Ordering Information

NOTE: HP 2424A and 2426G/H Computers require the RTE-A operating system and a compatible terminal connected via serial interface (included in 2424A computer) and cable or a DS/1000-IV interface linked to another HP 1000 Computer System for operation.

HP 2424A Computer

The 2424A Computer includes:

1. 12100A CPU card including 512 KB of on-board parity memory and four On-Board serial I/O channels.
2. 12100-60002 Four-channel On-Board I/O breakout cable.
3. 02420-60101 6-Slot box with power supply and ventilation.
4. 02420-90001 Micro 14/16 Installation and Service Manual.
5. 02424-90001 HP 1000 A400 Computer Reference Manual.
6. 02103-90005 Computer I/O Interfacing Guide.
7. 92077E + 400 Right to Execute RTE-A.
8. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

HP 2426G "Parity" Computer

The 2426G Computer includes:

1. CPU and memory as follows:
   a. 12102B Memory Controller Card with 512 KB parity memory.
   b. 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory frontplane connector
2. 02420-60101 6-Slot box with power supply and ventilation.
3. 02156-90002 HP 1000 A600+ Computer Installation and Service Manual.
4. 02156-90001 HP 1000 A600+ Computer Reference Manual.
5. 02103-90005 Computer I/O Interfacing Guide.
6. 92077E + 600 Right to Execute RTE-A.
7. 90-day return-to-HP Warranty. Installation, Site Prep, and On-site Warranty are available at additional cost.

HP 2426H "ECC" Computer

The 2426H Computer is similar to the 2426G Computer, but with a 12110B 1 MB ECC Memory Controller instead of the 12102B Memory Controller.

Optional Software

See page 3-4 of this handbook.

Memory Expansion and Array Connectors

Parity Memory Array Cards for 2424A and 2426G/H

12103B 512 KB Parity Memory Array Card

12103C 1 MB Parity Memory Array Card
12103K 2 MB Parity Memory Array Card
12103L 4 MB Parity Memory Array Card

12103M 8 MB Parity Memory Array Card

ECC Memory Array Cards for 2426H

12111A 512 KB ECC Memory Array Card

12111B 1 MB ECC Memory Array Card

12111C 2 MB ECC Memory Array Card

Array Connectors for 2424A and 2426G/H

12038A Connector to 1 array card

12038B Connector to 2 array cards

12038C Connector to 3 array cards

12038D Connector to 4 array cards

Accessories

Interfaces

HP 2424A and 2426G/H Computers can use the interfaces listed in section 4 of this handbook, except those that require 25 kHz power.

Cabinets

HP 2424A and 2426G/H Computers are especially designed to rack in any of the following cabinets:

HP 92211L Taboret Cabinet
Provides 52.3 cm (20.6 in.) of vertical mounting height.

HP 92211R Minirack Cabinet
Provides 57.5 cm (22.6 in.) of vertical mounting height. An HP 92211S Slide Rail Kit is also required for mounting the 2424A or 2426G/H Computer in the 92211R Cabinet.

HP 12905A 19-inch Adapter
For rack mounting 2424A or 2426G/H Computers in standard 19-inch EIA rack cabinets.

Peripheral Devices

HP 2424A and 2426G/H Computers support the peripheral devices listed and described in sections 7 through 10 of this handbook.

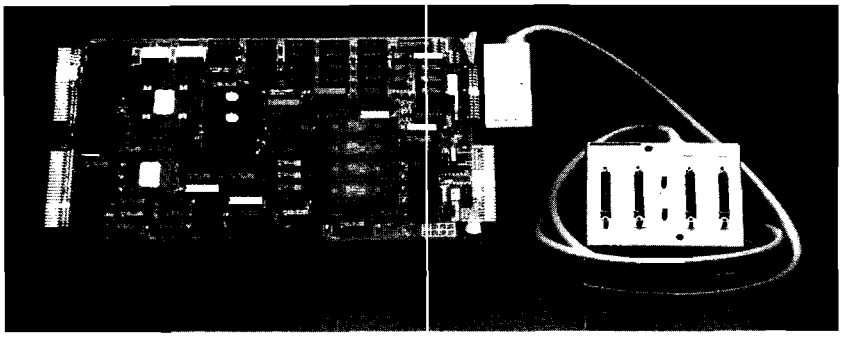
Engineering Reference Documentation

For 2424A (A400): 02424-90003 HP 1000 A400 Computer Engineering and Reference Documentation.

For 2426G/H (A600+): 02156-90003 HP 1000 A600+ Computer Engineering and Reference Documentation.

NOTES:

12100A Single-Board Computer



Introduction

The HP 12100A is a single-board computer (SBC) designed for applications that require a rugged, reliable, low-cost, compact real-time computer.

On a single plug-in card, the 12100A provides an 0.4 MIPS CPU, 512 KB of parity memory, and a four-port serial I/O multiplexer, two ports of which support modem control. It is a completely compatible member of the HP 1000 A-Series computer family capable of operating under RTE-A, with or without VC+, in the same way as any other member of the HP 1000 A-Series family. It is thus especially well suited as the brains of low-cost target systems for applications developed on larger A-Series based program development systems.

Because of its completeness, including both memory and serial I/O with the CPU on a single board, the 12100A does not require a backplane or a box. It thus lends itself well to special packaging in systems developed by OEMs. However, the 12100A will plug into any existing A600+ 6-, 14-, or 20-slot backplane with up to four memory cards and as many A-Series I/O cards as the backplane will hold. It is available packaged in the 20-slot backplane as the 2134A Model 24 Computer (data sheet on page 3-13), in the 14-slot backplane as the 2434A Micro 24 Computer or the 2484B Micro 24 System Processor Unit (data sheet on page 3-21). It is also available packaged in the six slot backplane as the 2424A Micro 14 Computer (data sheet on page 3-29). In any of these backplanes, the on-board memory of the 12100A can be expanded from its base 512 KB to 32 MB of parity memory, using additional memory array cards.

Features

- Maximum packaging flexibility for OEMs and other systems designers.
- 512 KB of on-board parity memory, expandable to 32 MB of parity memory with additional memory array cards.
- Four-port On-Board I/O multiplexer.
- High reliability and maintainability through the use of reduced circuit area.

Description and Specifications

For functional description and specifications of the A400 computer, memory systems, input/output system,software and diagnostic support, compatibility, and specifications, see the A-Series Computer Design and Specifications data sheet on page 3-1.

On-Board I/O (OBIO)

The 12100A SBC includes OBIO circuits consisting of an I/O Processor (IOP), I/O master logic, and four serial ports. The serial ports provide the following capabilities:

- Asynchronous, full-duplex operation.
- Two channels support modems with CTS, RTS, DSR, CD, DTR, and RI control-status lines.
- 300, 1200, 9600, and 19.2k baud rates individually selectable for each port. 76.8k baud is supportable via RS-422 connection.
- ENQ/ACK or XON/XOFF protocol.
- 300, 1200, 9600, and 19.2k baud rates individually selectable for each port. 76.8k baud is supportable via RS-422 connection.
- Cable length to 15 meters for RS-232 connection, to 50 meters for RS-423 connection, to 1200 meters for RS-422 connection.

Electrical Specifications

DC Voltage and Current Requirements

DC Voltages:	+5V	+12V	-12V
Tolerance:	5%	10%	10%
Current:	5.7A	0.065A	0.09A

Maximum DC Power Required

32W.

DC Regulation Requirement

Less than 2% periodic and random deviation, including distribution losses, switching noise, and noise injected into the line from other sources.

Additional Electrical Requirements for Stand-alone Operation

PON+: A power reset line that should be held low for at least 5 milliseconds after the +5V supply reaches steady-state regulation, as defined above. At the end of the 5 millisecond delay PON+ should go high, signalling that power to the A400 processor is usable. PON+ should go low just after the +5V supply goes out of regulation.

Sample Power Supply Circuit: Figure 3-6 shows a simple circuit that meets normal requirements of the 12100A SBC, including the PON+ signal.

Battery Backup: If power supplied to the 12100A SBC and its on-board memory fails, processing stops and any data and code in RAM memory is lost. Although the operating system and application program can be recovered by rebooting the system, critical real-time data may be lost. This problem can be avoided by providing power through an uninterruptible power supply to maintain the entire system through a power failure.

If an inactive system is tolerable during a power failure, but the code and data must be maintained, the 12100A supports battery backup of its memory only. This function is necessary only if the application code and data must be maintained in memory during a power outage. Otherwise, memory can be reloaded when power is restored.

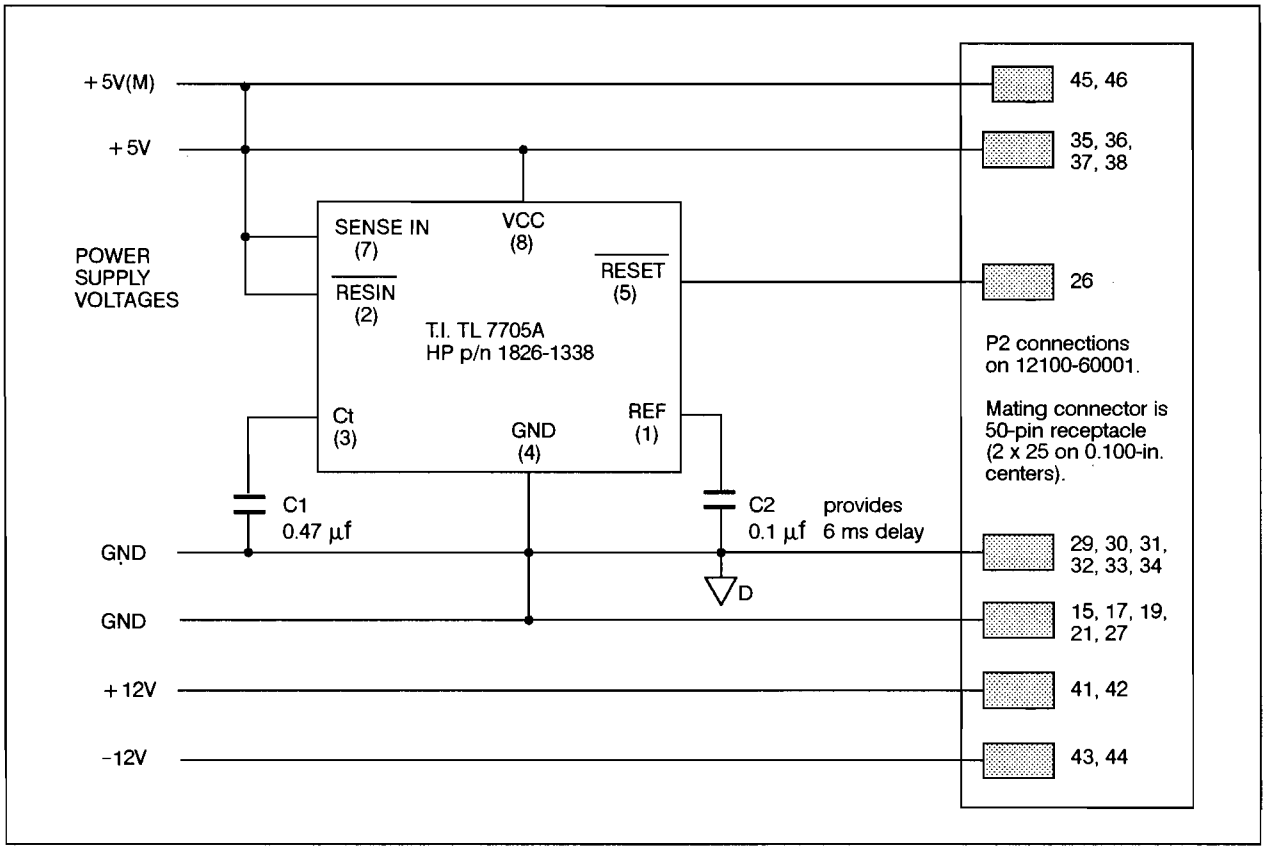


Figure 3-6. Sample Power Supply Circuit for Stand-alone HP 12100A Single-Board Computer

To implement battery backup and auto restart of the operating system, two additional signals, PFW– and MLOST– are needed. The +5V(M) pins on P2 must be connected to an uninterruptible +5V supply. The power fail warning signal (PFW–) should be generated at least 500 microseconds before the +5V supply leaves regulation.

PFW– is used with the memory lost signal (MLOST–), which should remain high as long as +5V(M) is in regulation. PON+, described earlier, determines whether the 12100A is active or inactive. PFW– signals the operating system to stop all operations in an orderly fashion prior to PON+ going low. For more detailed information, consult the HP 1000 A400 Computer Engineering and Reference Documentation (02424-90003), which is available from Hewlett-Packard.

DC Current Required for I/O Interfaces and Accessories

See Table 3-12 on page 3-51.

Radio Frequency Interference

The 12100A SBC, like all electronic products, emits radio frequency interference (RFI) during normal operation. The RFI signature typical of the 12100A is illustrated in Figures 3-7 and 3-8.

Mounting, enclosure, power supply, and cabling all affect the amplitude and frequency of radiated emissions. In addition to other aspects of design directed toward minimization of RFI, the ground button on the 12100-60002 On-Board I/O breakout cable should be connected to the enclosure in which the 12100A SBC is installed. This connection can be made through conductive foam rubber on the hood retentionbracket which supports the cable hood used for external cable connections.

Environmental Specifications

Temperature

Operating in Still Air: 0° to 60° C (32° to 140°F) to 3048m (10,000 ft.). Maximum temperature is linearly derated 2°C (3.6°F) for each 304.8m (1,000 ft.) increase in altitude. Resulting temperature range is 0° to 50°C (32° to 122°F) at 4572m (15,000 ft.).

Operating with Airflow of 100 Lineal Feet/Min.: 0° to 65° C (32° to 149° F) to 3048m (10,000 ft.). Maximum temperature is linearly derated 2°C (3.6°F) for each 304.8m (1,000 ft.) increase in altitude. Resulting temperature range is 0° to 55°C (32° to 131°F) at 4572m (15,000 ft.).

Non-Operating: -55° to 75° C (-67° to 167° F).

Altitude

Operating: To 4572 meters (15,000 feet).

Non-Operating: To 15300 meters (50,000 feet).

Relative Humidity

5% to 95% with minor condensation.

Maximum Heat Dissipation

112 BTU/hr.

Shock and Vibration

Operating Shock: 3G peak, 1/2 sine, 6 to 9 milliseconds duration, 45 Hz crossover.

Non-Operating Shock: 14 G peak, 1/2 sine, 6 to 9 milliseconds duration, 45 Hz crossover.

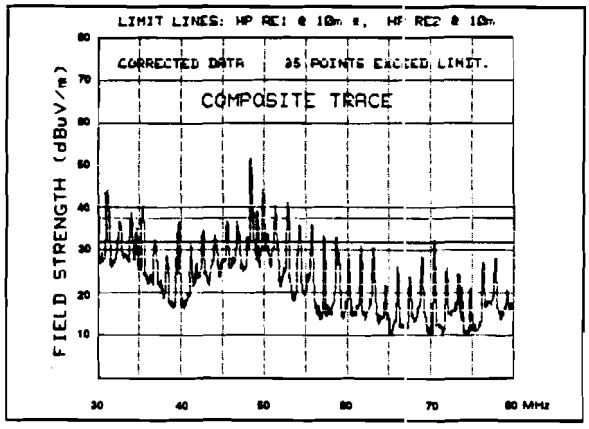


Figure 3-7. HP 12100A RFI Signature, 30-80 MHz

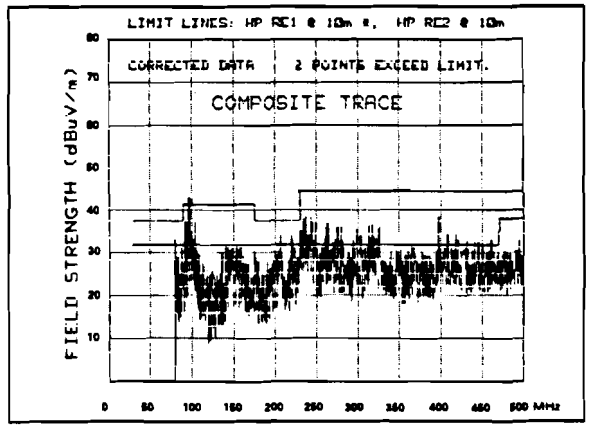


Figure 3-8. HP 12100A RFI Signature, 0-500 MHz

Operating Vibration: 0.86G rms, distributed as follows:

Frequency (Hz)	Power Spectral Density (G^2/Hz)
5	0.004
5 - 15	-1.5 dB/octave
15	0.003
12 - 200	-6.0 dB/octave
200 - 350	0.00024
350 - 500	-6.0 dB/octave

Physical Characteristics

Dimensions

17.15 cm (6.75 in.) wide, 29.85 cm (11.75 in.) long, 1.27 cm (0.5 in.) thick.

Net Weight

0.455 kg (1 lb).

Installation

The 12100A SBC can plugged into a card cage or mounted on a panel or chassis, using four mounting holes provided at each corner, as shown in Figure 3-9, below. For panel/chassis mounting, the mounting holes are sized to accept M3, three millimeter screws. A minimum standoff of 8 millimeters from a flat panel is required under the board to permit cable access to connector J2. The I/O cable and power connector should also be mounted in place with a simple bracket. Forcing connectors onto a board easily damages them.

Cooling

The 12100A SBC is designed to operate in ambient temperatures to 60°C in still air. Provision of air flow across the SBC at a rate of 100 lineal feet per second permits operation at temperatures to 65°C.

Stand-alone Memory-Based Operation under RTE-A

An RTE-A operating system that requires less than 32 KB of memory can be generated for the 12100A SBC. This multitasking system supports all four channels

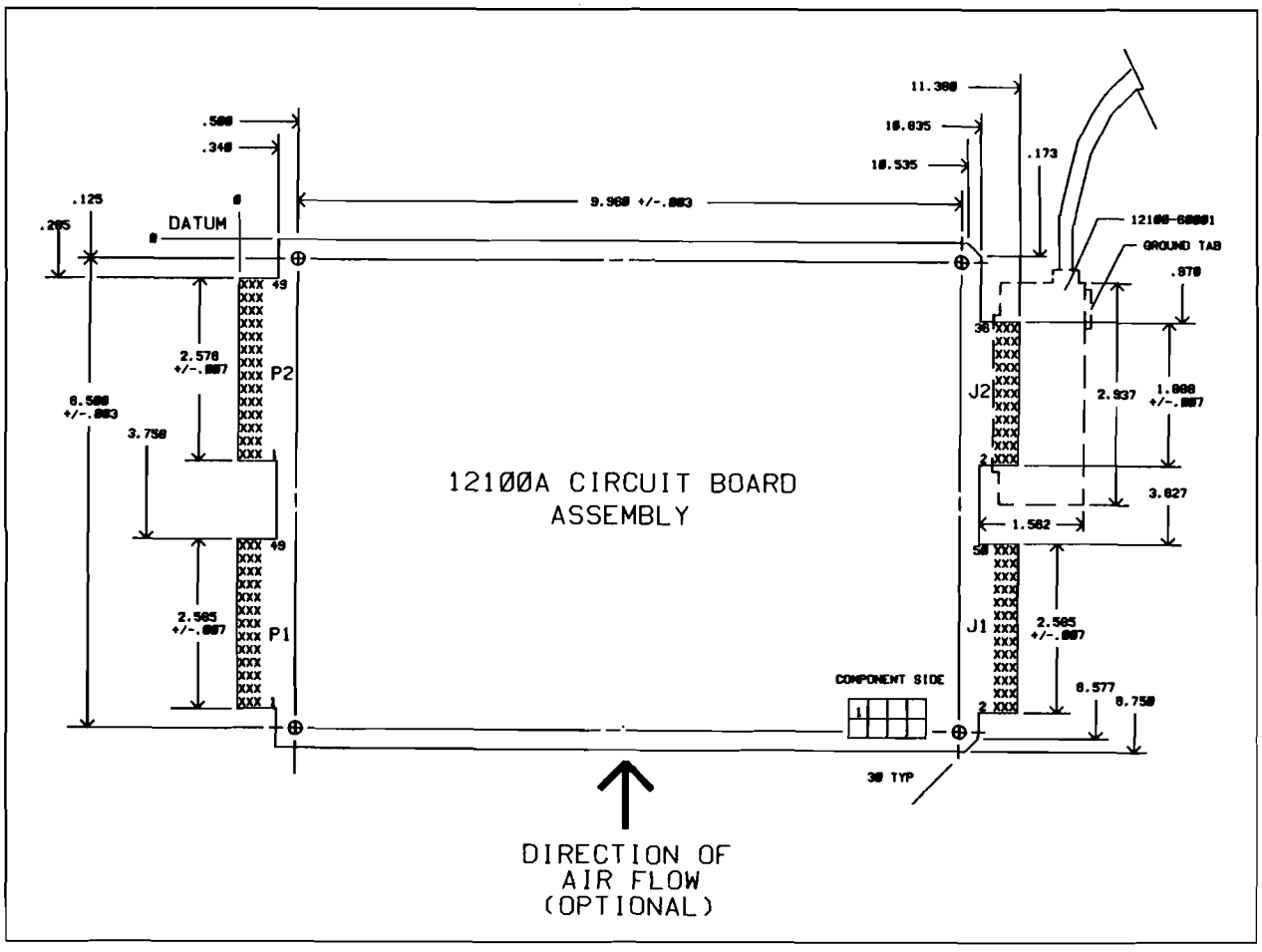


Figure 3-9. HP 12100A Single-Board Computer Measurements and Airflow

of On-Board I/O and leaves approximately 480 KB of memory for user's application software. Complete documentation including system generation build and answer files are included in the RTE-A System Generation Manual (92077-90034).

Downloading Software to the SBC

The 12100A SBC contains 512 KB of RAM memory which can be downloaded with an RTE-A operating system and applications programs from another HP 1000 A-Series computer, from an HP 9000 Model 840 Computer, or from an HP 150 Personal Computer. Either the Model 840 or the A-Series system may be connected via an autoanswer modem.

Model 840 and A-Series

Program RMTERM performs the download operation from the host computer by communicating with a boot loader resident in ROM on the 12100A SBC. RMTERM for A-Series computers is included with the RTE-A operating system. RMTERM/840 for the HP 9000 Model 840 can be obtained with the HP-UX operating system and is documented in the RMTERM/840 Terminal Emulator Application Brief on page 6-5 of this handbook.

Typically, a 512 KB transfer from the Model 840 at 19.2k baud requires about 9 minutes. When two A400 systems are connected, code and data can be transferred between them at a rate of 76.8k baud, reducing the transfer time by 75%.

HP 150 Personal Computers

The HP 150 can be used as a terminal and a file download device with the 12100A SBC. Files are transferred to/from the HP 150 using the 9356H Cassette Tape Emulator program (manual part number 93564-90003), Because the HP 150 acts as a terminal in this mode, the 12100A SBC can be booted up from the HP 150 connected to its Virtual Control Panel (VCP) port via one of its four serial On-Board I/O channels. Also, an RTE-A operating system can be downloaded from an HP 150 microfloppy and booted up on the 12100A.

Ordering Information

HP 12100A Single Board Computer

The 12100A Single Board Computer includes:

1. 12100A CPU card (12100-60001) with 512 KB of on–board parity memory and four On-Board serial I/O channels.
2. 12100-60002 Four-channel On-Board I/O breakout cable.
3. 02424-90001 HP 1000 A400 Computer Reference Manual.

Accessories

Hardware, Software, and Peripherals

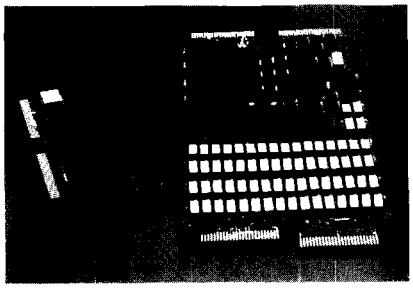
When appropriately packaged and provided with appropriate peripheral devices, the 12100A Single Board Computer can use any of the accessories that are available for the 2134A Model 24 Computer, 2434A/2484B Micro 24 Computer/SPU or the 2424A Micro 14 Computer, as listed on pages 3-19, 3-28, and 3-31.

Engineering Reference Documentation

02424-90003 HP 1000 A400 Computer Engineering and Reference Documentation.

NOTES:

2106CK/DK Board Computer



Introduction

The A600+ computer is offered at the board level of integration as the HP 2106CK/DK Board Computer for OEMs and other designers who choose to design their own packaging for their system products. The 2106CK consists of a CPU card and a memory controller with 512 KB parity memory; the 2106DK substitutes a 1 MB ECC memory controller. Up to four memory array cards can be added to provide up to 32 MB of parity memory to the 2106CK/DK, up to 8 MB of ECC memory to the 2106DK.

The 2106CK/DK is a completely compatible member of the HP 1000 A-Series computer family capable of operating under RTE-A, with or without VC+, in the same way as any other member of the HP 1000 A-Series family. It is thus especially well suited as the brains of low-cost target systems for applications developed on larger A-Series based program development systems.

The 2106CK/DK is also available in twenty-slot rack mounting computers and SPUs, fourteen-slot micro/ 1000 computers and SPUs, and in the six-slot Micro 16 Computer. Because it is a two-card board computer, it will require a user-furnished backplane if not ordered in an HP box computer or SPU.

Features

- Maximum packaging flexibility for OEMs and other systems designers.
- 512 KB of parity memory, expandable to 32 MB of parity memory in 2106CK/DK or 8 MB of ECC memory in 2106DK.
- High reliability and maintainability through the use of reduced circuit area.

Description and Specifications

General

For functional description and specifications of the A600+ computer, memory systems, input/output system, software and diagnostic support, compatibility, and specifications, see the A-Series Computer Design and Specifications data sheet on page 3-1.

Memory

Memory Included in 2106CK: 512 KB of parity memory.

Memory Included in 2106DK: 1 MB of ECC memory.

Memory Supportable by 12013A Battery Backup Card: 512 KB parity memory controller or 1 MB ECC memory controller. Additional memory array cards cannot be supported.

Maximum Parity Memory: 32 MB in 2106CK/DK.

Maximum ECC Memory: 8 MB in 2106DK.

Electrical Specifications

DC Voltage and Current Requirements

DC Voltage:	+5V
Tolerance:	5%
2106CK Current:	10.8A
2106DK Current:	11.1A

Maximum DC Power Required

53.5W.

DC Regulation Requirement

Less than 2% periodic and random deviation.

DC Current Required for I/O Interfaces and Accessories

See Table 3-12 on page 3-51.

Environmental Specifications

Ventilation and Temperature

Ventilation: Airflow of 1.13 cubic meters per minute (40 CFM) across the CPU and memory cards at the operating temperatures listed below is required to maintain 2106CK/DK board temperature within proper operating range.

Operating Temperature: 0° to 55° C (32° to 131° F) to 3048m (10,000 ft.) altitude; maximum temperature thereafter is linearly derated 2° C (3.6° F) for each 304.8m (1,000 ft.) increase of altitude. Resulting temperature range is 0° to 45° C (32° to 113° F) at 4572m (15,000 ft.) above sea level.

Non-Operating Temperature: –40° to 60° C (–40° to 140° F).

Altitude

Operating: To 4572 meters (15,000 feet).

Non-Operating: To 15300 meters (50,000 feet).

Relative Humidity

5% to 95% with minor condensation.

Maximum Heat Dissipation

184 BTU/hr.

Physical Characteristics

Dimensions (Each Board)

17.15 cm (6.75 in.) wide, 29.85 cm (11.75 in.) long, 1.27 cm (0.5 in.) thick.

Net Weight (Both Boards)

0.682 kg (1.5 lb).

Ordering Information

HP 2106CK "Parity" Board Computer

The 2106CK Board Computer includes:

1. 12105-60001 A600+ CPU Card and instruction set and VCP ROMs.
2. 12102B Memory Controller Card with 512 KB parity memory.
3. 12038A Memory Frontplane connector.
3. 02424-90001 HP 1000 A400 Computer Reference Manual.

HP 2106DK "ECC" Board Computer

The 2106DK Board Computer includes:

1. 12105-60001 A600+ CPU Card and instruction set and VCP ROMs.
2. 12110B Memory Controller Card with 1 MB ECC memory.
3. 12038A Memory Frontplane connector.
3. 02424-90001 HP 1000 A400 Computer Reference Manual.

HP 12013A Battery Backup Card

When fully charged, provides 60 minutes of sustaining power for a 12102B 512 KB Parity Memory Controller or a 12110B 1 MB ECC Memory Controller.

Accessories

Hardware, Software, and Peripherals

When appropriately packaged and provided with appropriate peripheral devices, the 2106CK/DK A600+ Board Computer can use any of the accessories that are available for the 2196G/H Model 26 SPU, 2436G/H or 2486B/C Micro 26 Computer/SPU, 2156C/D Computer, or the 2426G/H Micro 16 Computer.

Engineering Reference Documentation

02156-90003 HP 1000 A600+ Computer Engineering and Reference Documentation.

Adding and Mixing Memory

Maximum Memory

A maximum of four memory array cards can be installed in an A-Series system, except where the card cage will not support that number (see list below). Four memory array cards is sufficient to provide 32 MB of parity memory in A400 or A600+ systems, 32 MB of ECC memory in A900 systems, or 8 MB ECC memory in A600+ systems.

Computer/SPU Model Desig.	Max. Array Cards Supported
Micro 29	Two
Micro 27*	Two
Model 16	Three
All Other	Four

* Discontinued product, listed here for reference only.

Rules for Adding Memory

Adding HP 12103K/L/M Parity Memory Array Cards in A400 and A600+

The HP 12103K/L/M Parity Memory Array Cards can be added to existing memory in an A400 or A600+ system at any 0.5 MB page boundary; no particular progression of array card sizes is required. For example, you can add a 12103M 8 MB card directly to an A400 computer to provide 8.5 MB of memory.

Adding HP 12221B ECC Memory Array Cards in A900

The HP 12221B ECC memory array cards can be added to existing memory in an A900 system by locating them next to the memory controller and moving array cards with less capacity to the other side of the 12221B cards.

Adding "Old" Parity Memory Array Cards in A400 or A600+

The basic rule for addition of HP 12103C/D Parity Memory Array Cards to an A400 or A600+ system is that this equation must be satisfied:

$$\frac{\text{Installed Memory Size}}{\text{Size of Array Card to Add}} = \text{An Integer}$$

For example, an HP 12103D 1 MB Parity Memory Array Card can be added to the 512 KB memory controller in an A400 system only if a 12103C 512 KB array card is added first to make installed memory size equal to or greater than the 1 MB to be added.

Adding ECC Memory Array Cards in A600+

The basic rule for addition of ECC memory to an A600+ system is that the system must have an ECC memory controller. ECC memory additions must also satisfy this equation:

$$\frac{\text{Installed Memory Size}}{\text{Size of Array Card to Add}} = \text{An Integer}$$

For example, an A600+ system with a 1 MB ECC memory controller must have added to it an HP 12111B 1 MB ECC Memory Array Card to bring total memory to 2 MB before an HP 12111C 2 MB ECC Memory Array Card can be added.

Mixing ECC and Parity Memory in A600+ Systems

Within the total limitation of a maximum number of array cards, HP 12111x ECC memory array cards and HP 12103x parity memory array cards can be used together in the same system. ECC memory can thus be used to assure maximum availability of the operating system and critical resident programs and data; lower-priced parity memory can be used for programs and data that do not require the extra protection of ECC memory.

Use of Memory Connectors

HP 12038A, B, C, and D and 12221A, B, C, and D controller-to-array card connectors are used to connect one, two, three, and four memory array cards, respectively, to the memory controller. Any change in the total number of array cards connected requires a different memory connector. For example, an increase from two memory array cards to three in an A400 or A600+ system would require replacing the 12038B memory connector in the system with a 12038C memory connector.

NOTES:

12205A A900 Control Store Board

Introduction

The 12205A Control Store Board offers both writable control store and PROM control store support for user microprograms in HP 1000 A900 computer systems. For development, testing, dynamic overlaying, and output of user's microprograms to the A900 control store board provides 4K of writable control store (WCS). For stable microcode, the control store board also provides space for mounting 2K words of 2K PROMs containing user's microcode. In addition to the hardware support provided by the 12205A Control Store Board, development of user's microprograms and dynamic loading and overlaying of WCS are software supported in a disk-based RTE-A environment by the 92049A RTE Microprogramming package (see the 92049A data sheet on page 2-53).

Features

- Software support with 92049A RTE Microprogramming Package in disk-based RTE-A operating system.
- Writable Control Store (WCS) support for microcode development, testing, dynamic overlaying, and output in 4K words of WCS.
- Fast loading of WCS overlays at 166K instruction words per second DMA transfer rate using WLOAD utility of 92049A Microprogramming Package.
- PROM Control Store (PCS) support for up to 2K words of stable user microcode.
- WCS can override installed PROM-based microcode.
- Control processor programs sharable among multiple users.

WCS Description

WCS on the 12205A Control Store Board is a dual-port memory. One port connects to the control processor's control store interface and the other to the A900 computer backplane. Control processor instructions can be loaded into the 12205A WCS section using DMA transfers from memory via the computer backplane. Standard I/O instructions are then used to configure control store module addresses and enable the control processor's control store interface, thereby granting access to the loaded subroutines by the control processor.

PCS Description

The PCS section on the 12205A Control Store Board provides mounting for 2K words of nonvolatile control memory storage capacity for user-written instruction set enhancements, when 2K PROMs are used. Control store module addresses are switch selectable, with a given module configurable to any even 2K address block within control store address space. Users can supply recommended vendors with necessary information for generating PROM chips that are compatible with the 12205A, or can "burn" their own. The microprograms in PROMs are mounted on the PCS section of the 12205A board, which is conveniently installed in the card cage of the A900 computer system.

Functional Specifications

Environment

The 12205A Control Store Board is usable only in 2139A*/B Computers, 2199C*/D*/E Model 29 System Processor Units (SPUs), and 2439A*/B and 2489A*/B Micro 29 Computers and SPUs.

* Discontinued product, listed here for reference only.

Capacity

WCS: 4K words, one module of 4096 words.

PCS: Mounting for 2K words, one module of 2048 words, six PROMs per module.

Word Size

48 Bits.

Microinstruction Cycle Time

133 nanoseconds.

Recommended PROM for 12205A Control Store Board

AMD 27S291.

Configuration Information

Card Cage Slots Required: The 12205A Control Store Board is installed in card cage slot 1 (maximum of one 12205A Control Store Board per system).

Software Recommended: 92049A A900 RTE Microprogramming Package.

Installation: Set the select code switches on the WCS card to the appropriate select code I/O address and plug the card into card cage slot 1. Connect the front plane between the control store board and the sequencer card.

DC Voltage and Current Requirements

Base, for WCS: 3.7A at +5Vdc, 0.06A at +12Vdc.

PCS Adds: 0.7A at +5Vdc.

Weight

0.455 kg (1 lb).

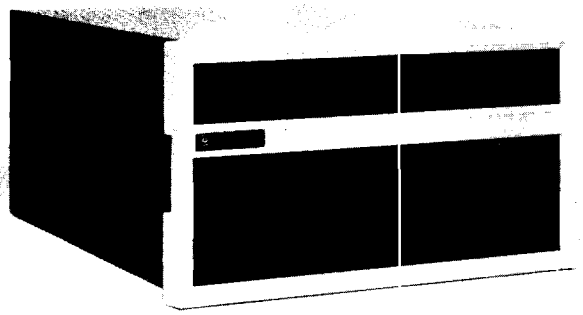
Ordering Information

HP 12205A Control Store Board

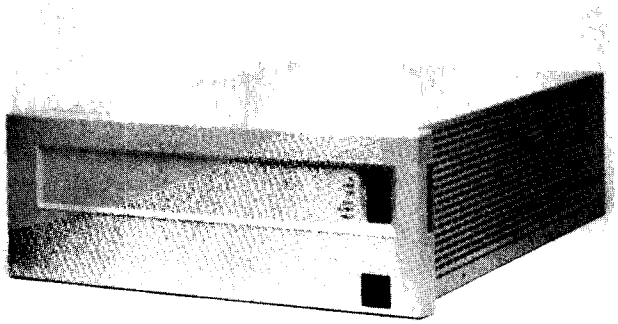
The 12205A Control Store Board includes:

1. 12205-60001 WCS Card.
2. 1AF5-6001 I/O Processor.
3. 12205-60002 Frontplane.
4. 12205-90001 A900 Control Store Installation and Service Manual.

12025A/B I/O Extenders



HP 12025B I/O Extender

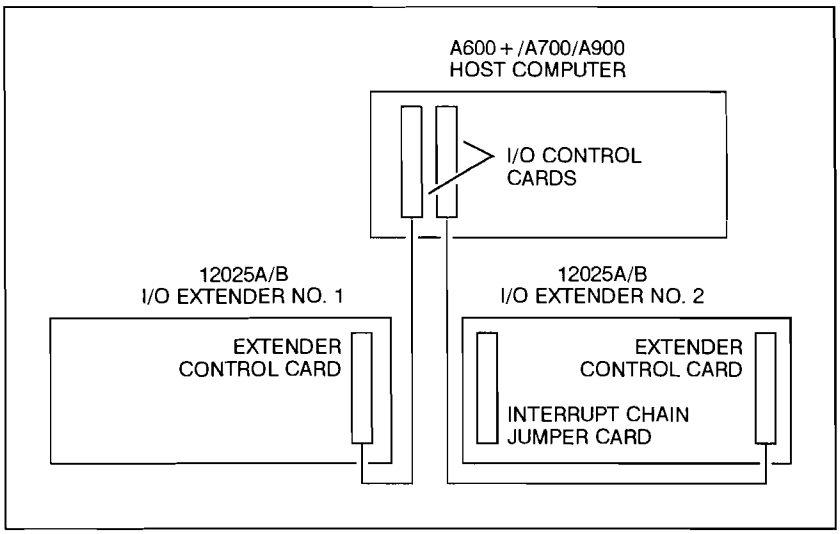


HP 12025A I/O Extender

Introduction

Two I/O Extenders are offered for use with HP 1000 A-Series Computers, except A400s. The HP 12025A I/O Extender adds 12 I/O channels to system capacity and the HP 12025B adds 18 I/O channels. With multiple I/O Extenders, up to 48 I/O channels can be provided.

The I/O Extenders connect to the host computer as if they were peripheral devices (see diagram at right). Each extender thus uses one I/O channel in the host computer while adding 13 or 19 card cage slots for I/O for a net addition of 12 or 18 I/O channels



Host Computer – I/O Extender Connections

Features

- Compatibility with A-Series distributed intelligence architecture.
- Software transparency (I/O Extenders are designed to permit use of existing software without modification where applications are not time critical).
- Up to 48 I/O channels with multiple I/O extenders.
- Choice of 12 or 18 additional I/O channels per I/O Extender.

Functional Specifications

I/O Channels Added by I/O Extenders

EXTENDER	CHANNELS ADDED		
	BY 1 EXTENDER	BY 2 EXTENDERS	BY 3 EXTENDERS
12025A	12	24	36
12025B	18	35*	52**

* If the I/O Control Card is not the last one in the computer, a jumper card is required in the second extender, reducing the number of net I/O channels it adds from 18 to 17.

** The HP 1000 instruction set limits the number of I/O channels usable by the host computer to 48, including those added by I/O Extenders.

Maximum Number of I/O Channels

Effective with RTE-A revision 2440, a maximum of 48 I/O channels is supported in computer and I/O extenders. However, the number of usable I/O channels may be limited by RTE-A system table space. An HP Systems Engineer should check the supportability of any proposed system that is to use more than 16 I/O interface cards or 24 multiplexer channels.

Compatibility

Computer Series	Serial Prefix	12025A/B Compatibility Status
A400	All	Not tested and not supported
A600+	All	Unconditionally compatible
A700*	2500+	Compatible
A700*	<2500	Requires an upgrade from Specials Engineering if part numbers of the ROMs on the A700 lower CPU card are not 12152-80053 thru 80056, or a group with higher 800xx numbers.
A900	2500+	Compatible
A900	<2500	Requires an upgrade from Specials Engineering if the cache board part number is not 12203-60011 or higher and may also require updated firmware.
A600*	All	Not tested and not supported
L-Ser*	All	Not compatible

* Discontinued product, listed here for reference only.

Extender Usage Recommendation

I/O interfaces critical to system performance, such as the disk interface, must be installed in the computer, not the extender. This avoids potential impairment of performance resulting from the fact that an interrupt to an interface in the extender interrupts DMA in the extender.

Maximum DMA Data Rates in Host CPUs and I/O Extenders

	DMA I/O Bandwidth (MB/second) for		
	A600+	A700*	A900
Input in cpu	4.27	4.0	3.7
Input in Ext.	4.27	4.0	3.7
Output in cpu	4.27	4.0	2.5
Output in Ext.	1.7	1.6	1.25

* Discontinued product, listed here for reference only.

Exclusions

The Battery Backup Card (12154A or 12157B) is not supported in the 12025A or 12025B I/O Extender.

Control Store Cards (12153A, 12155A, and 12205A) are not supported in the 12025A or 12025B I/O Extender.

Electrical Specifications

AC Power Requirements

Std Line Voltage: 115V -25%/+20% (86-138V).

Opt 015 Line Voltage: 230V -23%/+20% (178- 276V).

Line Frequency: 47.5 to 66 Hz.

Power Cable: The standard 12025A/B I/O Extender includes a 3m (10 ft.) power cable with NEMA 5-15P power plug. No power cable is provided with the option 015 version of either of these extenders.

12025A Power: Up to 500W (690 VA).

12025B Power: Up to 700W (1000 VA, assuming Power Factor = 0.7).

DC Current Available and Required for I/O Interfaces

See Table 3-12 on page 3-51.

Environmental Specifications

Temperature

Operating : 0° to 55°C (32° to 131°F) to 3048m (10,000 ft.). Maximum temperature is linearly derated 2°C (3.6°F) for each 304.8m (1,000 ft.) increase in altitude. Resulting temperature range is 0° to 45°C (32° to 113°F) at 4572m (15,000 ft.).

Non-operating Temperature: –40° to 60°C (–40° to 140°F).

Altitude

Operating: To 4.6 km (15,000 ft).

Non-operating: To 15.3 km (50,000 ft).

Relative Humidity

5% to 95% non-condensing.

Vibration and Shock

HP 12025A and B I/O Extenders are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Safety

HP 12025A and 12025B I/O Extenders comply with recognized international safety standards.

Physical Characteristics

Dimensions

12025A: 22.2 cm (8.75 in.) high, 48.3 cm (19 in.) wide, 64.8 cm (25.5 in.) deep.

12025B: 31.1 cm (12.25 in.) high, 48.3 cm (19 in.) wide, 61.2 cm (24 in.) deep.

Weight

12025A: 14.1 kg (31 lb).

12025B: 26.8 kg (59 lb).

Ventilation

Four fans provide cooling airflow for the 12025A/B I/O Extenders.

12025A Airflow Direction: Left-to-right.

12025B Airflow Direction: Front-to-rear.

Installation

Rack Mounting in A-Series System Cabinets

Installation of HP 12025A/B I/O Extenders in 29431G Cabinets is illustrated in Figure 3-10. The I/O Extenders can be installed:

Above a 20-slot Computer. A 12025B I/O Extender can be installed in the lower compartment of the 29431G Cabinet. This requires 29431G Cabinet Option 053, which provides a lower front door with louvers. The 12025B I/O Extender can also be installed in the comparable position in a 29429A Option 053 Cabinet. A set of 12679C Support Rails is also required.

NOTE: Because it does not use front-to-rear ventilation, the 12025A I/O Extender cannot be installed in the lower compartment of 29431G Cabinets.

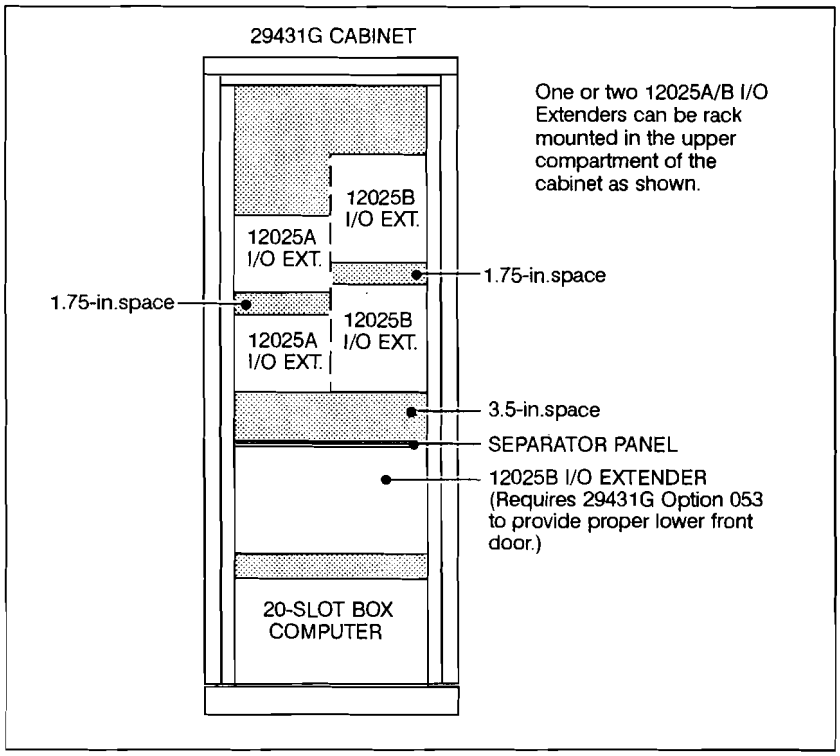


Figure 3-10. A-Series I/O Extender Rack Mounting Positions in HP 29431G Cabinet

In the Upper Compartment of the 29431G Cabinet. One or two 12025A or 12025B I/O Extenders can be installed in the upper compartment of the 219xC (29431G) SPU cabinet, provided that:

1. Only 12025A or only 12025B I/O Extenders are installed in the upper compartment. A 12025A I/O Extender cannot be installed in the upper compartment with a 12025B because they differ with respect to the direction of ventilating airflow through them.
2. The upper front door of the cabinet is deleted for installation of 12025B I/O Extenders (but not for 12025A I/O Extenders) by ordering 29431G Option 051. This permits the front-to-rear airflow required for self-ventilation of the 12025B I/O Extenders. For details of trim installation, see the 40027A Door Trim Kit Installation Manual (40027-90002).
3. All unoccupied vertical mounting space is covered by filler panels.

Cable Management in Older 219xA*/C* or 29431F* Cabinets

HP 219xA*/C* or 29431F* Cabinets shipped before May 1, 1985 may not be able to accommodate more than 24 cables exiting the cabinet. Systems expanded so that 24 or more cables are exiting the cabinet may have to be racked in a 29431G Cabinet, which can accommodate 48 cables.

12025A Installation Versatility

The 12025A I/O Extender is based on the versatile Micro/1000 package. It can be placed atop a table, desk, or workbench, mounted upright in a 40025A Vertical Floor Mount with convenient roll-about mobility, or installed in the upper compartment of a 29431G Cabinet, as shown in Figure 3-10 (page 3-47).

Installation of 12025A/B in non-HP Cabinet

If rack mounted in a non-HP cabinet, the 12025A I/O Extender must be spaced at least 1.75 inches above any rack-mounted 791xR* CS/80 Disk, or a steel panel must be interposed between the disk and the 12025A I/O Extender.

A non-HP cabinet for rack mounting the 12025A/B I/O Extender must have enough space to house the 12025A/B (see Dimensions specification under Physical Characteristics, page 3-47) and must support, or at least not interfere with, the ventilation airflow in the 12025A/B I/O Extender (left-to-right in the 12025A, front-to-rear in the 12025B), to assure long life and trouble-free operation. Compliance with EMI regulations cannot be specified by HP for systems, with or without I/O Extenders, that are installed in non-HP rack cabinets.

Ordering Information

HP 12025A I/O Extender

The 12025A I/O Extender includes:

1. 02430-60014 I/O Extender Box Assembly with 0950-1646 Power Supply.
2. 8120-1378 2.28m (7.5 ft.) power cord.
3. 12025-60001 I/O Control Card.
4. 12025-60002 Extender Control Card.
5. 12025-60003 Jumper Card.
6. 12025-60007 2.5m (8.2 ft.) CPU-to-Extender Cable.
7. 12025-90001 HP 12025A/B I/O Extender Hardware Support Manual.

HP 12025B I/O Extender

The 12025B I/O Extender includes:

1. 12151-60001 I/O Extender Box Assembly with 0950-1671 Power Supply.
2. 8120-1378 2.28m (7.5 ft.) power cord.
3. 12025-60001 I/O Control Card.
4. 12025-60002 Extender Control Card.
5. 12025-60004 Jumper Card.
6. 12025-60007 2.5m (8.2 ft.) CPU-to-Extender Cable.
7. 12025-90001 HP 12025A/B I/O Extender Hardware Support Manual.

* Discontinued product, listed here for reference only.

12025A/B Option

015: Operation from 230V ac power.

12025A/B Accessories

12159A 25 kHz Sine Wave Card for 12025A.

12679C Support Rails for Rack Mounting.

40025A Vertical Floor Mount for 12025A.

Reference Tables

Introduction

Tables 3-11, 3-12, 3-13, and 3-14 in this section respectively summarize ac power requirements, computer power supply and card cage slot availability and requirements, physical characteristics, and Environmental specifications for HP 1000 Computers, Peripheral Devices, and Computer Plug-ins.

Table 3-11. Peripheral Power Requirements

PRODUCT NUMBER AND NAME		MAX. AC POWER (Note A)	VOLTAGE LIMITS (V)		FREQ. LIMITS (Hz)	
			115V	230V	60 Hz	50 Hz
TERMINALS						
C1001A/G/W	700/92 DISPLAY TERMINAL	35W	90-132	173-240	47-66	47-66
C1003A/G	700/41 ENTRY LEVEL ASCII TERMINAL	35W	90-132	173-240	47-66	47-66
2393A	GRAPHICS TERMINAL	95W	100-120	200-240	47-66	47-66
2397A	COLOR GRAPHICS TERMINAL	115W	100-120	200-240	47-66	47-66
9666A	OPERATOR INTERFACE UNIT	270W	90-132†	198-264‡	48-66	48-66
PRINTERS						
2225D	THINKJET PRINTER	18W	108-126	216-252	48-63	47.5-63
2227A/2228A	QUIETJET PLUS/QUIETJET PRINTER	18W	90-132†	198-264‡	48-63	47.5-63
2235B	RUGGEDWRITER PRINTER	80W	90-132†	198-264‡	48-66	47.5-63
2276A	DESKJET PRINTER	25W	90-132†	198-264‡	48-63	47.5-63
2563B	LINE PRINTER	230W(t)	90-126†	198-252‡	48-66	48-66
2564B	LINE PRINTER	240W(t)	90-126†	198-252‡	48-66	48-66
2566B	LINE PRINTER	575W(t)	90-126†	198-252‡	48-66	48-66
2684D	LASERJET/2000 PRINTER	1400W	90-126†	198-264‡	58-62	48-52
2934A	PRINTER	300VA	90-126†	198-252‡	48-66	48-66
33440A	LASERJET SERIES II PRINTER	870W	104-126	198-264‡	58-62	48-52
3630A	PAINTJET PRINTER	20W	90-132†	198-264‡	48-66	48-66
PLOTTERS						
7440A	COLORPRO PLOTTER	20W	90-126†	198-252‡	48-66	48-66
7475A	6-pen PLOTTER	35W	90-126†	198-252‡	48-66	48-66
7550A	PLOTTER with Auto Sheet Feed	100W	90-126†	198-252‡	48-66	48-66
7570A	DRAFTPRO PLOTTER	80W	90-126†	198-252‡	48-66	48-66
7595A/96A	DRAFTMASTER I/II PLOTTER	105W	90-126†	198-252‡	48-66	48-66
DISKS AND CARTRIDGE TAPE UNITS						
35401A	AUTOCHANGER TAPE CARTRIDGE S/S	125W	90-125	180-250	48-66	48-66
7936/37H/XP	FIXED DISK	440W	90-132†	198-264‡	48-66	48-66
7957B-9B	WINCHESTER DISK DRIVES	85W	90-132†	198-264‡	48-66	48-66
7952B/7963B	WINCHESTER DISK DRIVES	147W	90-132†	198-264‡	48-66	48-66
9122C	FLOPPY DISK DRIVE	67W	86-127	195-253	48-66	48-66
9144A/9145A	TAPE CARTRIDGE SUBSYSTEM	125W	90-125	180-253	48-66	48-66
9153C	WINCHESTER DISK DRIVE	50W	86-127	195-253	48-66	48-66
MAGNETIC TAPE UNITS						
7979A/7980A	6250/1600 cpi MAGNETIC TAPE UNIT	250W	90-132†	198-264‡	48-66	48-66

Note A: Power Factor (PF) is typically about 0.75 with a range of 0.7 to 0.78. Use of a power factor of 0.7 to 0.72 to estimate ac input requirements in Volt-Amps (VA) from Watts (W) is recommended to assure sufficient total input power (VA = W/PF). To estimate ventilation or air conditioning requirements in BTU per hour, multiply Watts by 3.418. To determine heat dissipation requirements in kilogram-calories per hour, multiply Watts by 0.8598.

† Range shown for 115V here includes user-selectable choice of 100V or 120V input plus the voltage tolerance; there may be a gap between 105V and 108V.

‡ Range shown for 230V here includes user-selectable choice of 220V or 240V input plus the voltage tolerance.

t Denotes typical power consumption, not maximum.

Table 3-11. Peripheral Power Requirements, continued

PRODUCT NUMBER AND NAME		MAX. AC POWER (Note A)	VOLTAGE LIMITS (V)		FREQ. LIMITS (Hz)	
			115V	230V	60 Hz	50 Hz
OTHER PERIPHERALS						
2334A PLUS	MULTIMUX	115Wt	86-127	195-253	48-66	48-66
3074A/M	DATA LINK ADAPTER	11W	87-126	173-253	48-66	48-66
37204A	MULTIPOINT HP-IB EXTENDER	10VA	90-126†	198-252‡	48-66	48-66
37214A	SYSTEMS MODEM CARD CAGE	53W	90-126†	198-252‡	48-66	48-66
DISCONTINUED PERIPHERAL DEVICES, LISTED HERE FOR REFERENCE ONLY						
2382A	OFFICE DISPLAY TERMINAL	80W	90-126†	198-252	59-61	49-51
2392A	DISPLAY TERMINAL	50W	86-126	173-253	47-66	47-66
2627A*	COLOR GRAPHICS TERMINAL	250W	90-126†	198-252	57-63	47.5-52.5
Other 262x	TERMINAL	120W	90-126†	198-252	57-63	47.5-52.5
262x Opt 050	INTEGRAL PRINTER	50W	90-126†	198-252	57-63	47.5-52.5
2645A	DISPLAY STATION	140W	89-126†	196-253	59-61	49-51
2648A	GRAPHICS TERMINAL	150W	89-126†	196-253	59-61	49-51
45610B	HP TOUCHSCREEN TERMINAL	110W	86-126	173-253	57-63	47.5-52.5
2563A	LINE PRINTER	230W(t)	90-126†	198-252‡	48-66	48-66
2565A/66A	LINE PRINTER	550W(t)	90-126†	198-252‡	48-66	48-66
2601A	DAISYWHEEL PRINTER	180W	85-132†	187-264‡	49-61	49-61
2671A/G*	THERMAL/GRAPHICS PRINTER	50W	90-126†	198-252‡	47-66	47-66
2673A	INTELLIGENT GRAPHICS PRINTER	75W	90-126†	198-252‡	47-66	47-66
2686A	LASERJET PRINTER	850W	104-126	198-264‡	59.4-60.6	49.5-50.5
2687A	DESKTOP LASER PAGE PRINTER	840W	104-126	198-264‡	59.4-60.6	49.5-50.5
2932A	PRINTER	300VA	90-126†	198-252‡	48-66	48-66
39301A	FIBER OPTIC MULTIPLEXER	14W	90-126†	198-252‡	48-66	48-66
39800A/39801A	BAR CODE READER	20VA	90-126†	198-252‡	48-66	48-66
82905B	IMPACT PRINTER	100W	90-132†	198-264‡	48-66	48-66
82906A	DOT-MATRIX PRINTER	70W	90-132†	198-264‡	48-66	48-66
7470A	2-pen PLOTTER	25W	90-126†	198-252‡	48-66	48-66
7510A	COLOR FILM RECORDER	150W	90-126†	198-252‡	48-66	48-66
7580B/85B	DRAFTING PLOTTER	182W	90-126†	198-252‡	48-66	48-66
7586B	DRAFTING PLOTTER	182W	90-126†	198-252‡	48-66	48-66
9111A	GRAPHICS TABLET	25W	90-132†	198-264‡	48-66	48-66
7907A	FIXED/REMOVABLE DISK SUBSYSTEM	200W	90-132	180-264	48-66	48-66
7908P/R	FIXED DISK w/CARTRIDGE TAPE UNIT	400W	88-127	180-255	48-66	48-66
791xP/R	FIXED DISK w/CARTRIDGE TAPE UNIT	700W	90-126†	198-252‡	54-66	48-55
7914CT	FIXED DISK w/CARTRIDGE TAPE UNIT	700W	90-126†	198-252‡	54-66	48-55
7914ST	FIXED DISK w/1600 cpi MAG TAPE UNIT	1220W	90-125†	198-250‡	54-66	48-55
7914TD	FIXED DISK w/1600 cpi MAG TAPE UNIT	1100W	104-126	207-252	54-66	48-55
7933H/XP	FIXED DISK	1400W	90-132†	198-264‡	48-66	48-66
7935H/XP	REMOVABLE MEDIA DISK	1400W	90-132†	198-264‡	48-66	48-66
7941A/7945A	FIXED DISK	65W(t)	90-132†	198-264‡	48-66	48-66
7942A/7946A	FIXED DISK w/CARTRIDGE TAPE UNIT	120W(t)	90-132†	198-264‡	48-66	48-66
7957A/7958A	FIXED DISK	97VA(t)	90-132†	198-264‡	48-66	48-66
9122D	Dual MICROFLOPPY DISK	72W	86-127	180-253	48-66	48-66
9133x	FIXED + MICROFLOPPY DISK	100W	86-127	180-253	48-66	48-66
9134x	FIXED DISK	100W	86-127	180-253	48-66	48-66
9153B	FIXED + MICROFLOPPY DISK	50W	86-127	180-253	48-66	48-66
9154B	FIXED DISK	50W	86-127	180-253	48-66	48-66
7970E/7971A	1600 cpi MAGNETIC TAPE UNIT/SUBSYS	400W	104-126	207-252	48-66	48-66
7974A	1600 cpi MAGNETIC TAPE UNIT	520W	90-125†	198-250‡	48-66	48-66
7978B	6250/1600 cpi MAGNETIC TAPE UNIT	636W	90-125†	198-250‡	48-66	48-66
13279B	19-INCH COLOR MONITOR	170W	90-128	180-257	54-66	45-55

Note A: Power Factor (PF) is typically about 0.75 with a range of 0.7 to 0.78. Use of a power factor of 0.7 to 0.72 to estimate ac input requirements in Volt-Amps (VA) from Watts (W) is recommended to assure sufficient total input power (VA = W/PF). To estimate ventilation or air conditioning requirements in BTU per hour, multiply Watts by 3.418. To determine heat dissipation requirements in kilogram-calories per hour, multiply Watts by 0.8598.

† Range shown for 115V here includes user-selectable choice of 100V or 120V input plus the voltage tolerance; there may be a gap between 105V and 108V.

‡ Range shown for 230V here includes user-selectable choice of 220V or 240V input plus the voltage tolerance.

t Denotes typical power requirement, not maximum.

Table 3-12. Computer Power Supply and Card Cage Slot Availability (+) and Requirements (–)

PRODUCT NUMBER AND NAME		CARD CAGE SLOTS	DIRECT CURRENT AT				25 kHz AC Pwr at 39V RMS	TOTAL POWER SUPPLY
			+5V	+5V(M)	+12V	-12V		
COMPUTERS								
12100A	A400 SINGLE-BD COMP w/512 KB	-1	- 4.2A	-1.5A	- 0.07A	-0.09A	0.0W	-32.0W
2106CK	A600+ "Parity" BOARD COMPUTER	-2	- 9.6A	-1.1A	0.0A	0.0A	0.0W	-53.5W
2106DK	A600+ "ECC" BOARD COMPUTER	-2	- 9.7A	-1.3A	0.0A	0.0A	0.0W	-55.0W
2134A	MODEL 24 COMPUTER w/512 KB	+ 19	+55.8A	+ 8.3A	+ 5.5A	+ 3.4A	+50.0W	n/s
2137B*	MODEL 27 COMPUTER w/o memory	+ 16	+39.9A	+ 9.6A	+ 5.6A	+ 3.5A	+50.0W	n/s
2139B	MODEL 29 COMPUTER w/o memory	+ 16	+42.8A	+ 9.0A	+ 5.5A	+ 3.5A	+50.0W	n/s
2156C	MODEL 26 "Parity" COMPUTER	+ 18	+50.4A	+ 8.7A	+ 5.6A	+ 3.5A	+50.0W	n/s
2156D	MODEL 26 "ECC" COMPUTER	+ 18	+50.3A	+ 8.5A	+ 5.6A	+ 3.5A	+50.0W	n/s
2424A	MICRO 14 COMPUTER w/512 KB	+ 5	+17.3A†	0.0A	+ 2.03A†	+ 1.01A†	Not Sup.	+119.0W
2426G	MICRO 16 "Parity" COMPUTER	+ 4	+12.3A†	0.0A	+ 2.1A†	+ 1.1A†	Not Sup.	+83.9W
2426H	MICRO 16 "ECC" COMPUTER	+ 4	+11.9A†	0.0A	+ 2.1A†	+ 1.1A†	Not Sup.	+82.4W
2434A	MICRO 24 COMPUTER w/512 KB	+ 13	+38.8A‡	+ 5.4A‡	+ 6.93A‡	+ 2.91A‡	0.0W	+268.0W
2436G	MICRO 26 "Parity" COMPUTER	+ 12	+33.4A‡	+ 5.8A‡	+ 6.7A‡	+ 3.0A‡	0.0W	+246.0W
2436H	MICRO 26 "ECC" COMPUTER	+ 12	+33.4A‡	+ 5.7A‡	+ 6.7A‡	+ 3.0A‡	0.0W	+245.5W
2437B*	MICRO 27 COMPUTER w/o memory	+ 10	+23.0A‡	+ 6.7A‡	+ 7.0A‡	+ 3.0A‡	0.0W	+198.5W
2439A	MICRO 29 COMPUTER w/o memory	+ 10	+27.9A‡	+ 3.0A‡	+ 7.0A‡	+3.0A‡	0.0W	+222.5W
SYSTEM PROCESSOR UNITS (SPUs)								
2196G	MODEL 26 "Parity" SPU	+ 17	+47.9A	+ 8.8A	+ 5.5A	+ 3.5A	+50.0W	n/s
2196H	MODEL 26 "ECC" SPU	+ 17	+47.8A	+ 8.6A	+ 5.5A	+ 3.5A	+50.0W	n/s
2197E*	MODEL 27 SPU w/o memory	+ 15	+37.8A	+ 9.6A	+ 5.5A	+ 3.5A	+50.0W	n/s
2199E	MODEL 29 SPU w/o memory	+ 15	+40.7A	+ 9.0A	+ 5.4A	+ 3.5A	+50.0W	n/s
2484B	MICRO 24 SPU w/512 KB	+ 12	+36.7A‡	+ 5.4A‡	+ 6.83A‡	+ 2.91A‡	0.0W	+256.3W
2486B	MICRO 26 "Parity" SPU	+ 11	+31.3A‡	+ 5.8A‡	+ 6.6A‡	+ 3.0A‡	0.0W	+234.3W
2486C	MICRO 26 "ECC" SPU	+ 11	+31.2A‡	+ 5.6A‡	+ 6.6A‡	+ 3.0A‡	0.0W	+232.8W
2487B*	MICRO 27 SPU w/o memory	+ 9	+20.9A‡	+ 6.7A‡	+ 6.9A‡	+ 3.0A‡	0.0W	+186.8W
2489B	MICRO 29 SPU w/o memory	+ 9	+25.8A‡	+ 3.0A‡	+ 6.9A‡	+ 3.0A‡	0.0W	+210.8W
A400, A600+, AND A700* PARITY MEMORY ARRAY CARDS								
12103C	512 KB PARITY MEM ARRAY, Addr	- 1	- 1.1A	-1.0A	0.0A	0.0A	0.0W	-11.0W
12103C	Unaddressed	- 1	- 1.1A	-0.6A#	0.0A	0.0A	0.0W	-8.5W
12103D	1 MB PARITY MEM ARRAY, Addr	- 1	- 1.3A	-1.6A	0.0A	0.0A	0.0W	-14.5W
12103D	Unaddressed	- 1	- 1.3A	-1.0A#	0.0A	0.0A	0.0W	-11.5W
12103K	2 MB PARITY MEM ARRAY, Addr	- 1	- 0.9A	-1.0A	0.0A	0.0A	0.0W	-9.5W
12103K	Unaddressed	- 1	- 0.9A	-0.6A#	0.0A	0.0A	0.0W	-7.5W
12103L	4 MB PARITY MEM ARRAY, Addr	- 1	- 0.9A	-1.3A	0.0A	0.0A	0.0W	-11.0W
12103L	Unaddressed	- 1	- 0.9A	-0.7A#	0.0A	0.0A	0.0W	-8.0W
12103M	8 MB PARITY MEM ARRAY, Addr	- 1	- 0.9A	-2.1A	0.0A	0.0A	0.0W	-15.0W
12103M	Unaddressed	- 1	- 0.9A	-0.7A#	0.0A	0.0A	0.0W	-8.0W
A600+ AND A700* ECC MEMORY ARRAY CARDS								
12111A	512 kB ECC MEM ARRAY, Addr	- 1	- 1.6A	-0.93A	0.0A	0.0A	0.0W	-12.7W
12111A	Unaddressed	- 1	- 1.6A	-0.3A#	0.0A	0.0A	0.0W	-9.5W
12111B	1 MB ECC MEMORY ARRAY, Addr	- 1	- 1.6A	-1.0A	0.0A	0.0A	0.0W	-13.0W
12111B	Unaddressed	- 1	- 1.6A	-0.37A#	0.0A	0.0A	0.0W	-9.9W
12111C	2 MB ECC MEMORY ARRAY, Addr	- 1	- 1.6A	-1.6A	0.0A	0.0A	0.0W	-16.0W
12111C	Unaddressed	- 1	- 1.6A	-0.65A#	0.0A	0.0A	0.0W	-11.3W

FOOTNOTES: n/s = not specified; nnc = no net change; n/a = not applicable

* = Discontinued product listed here for reference only.

† = Total power output from the 2424A/2426G/H computer power supply cannot exceed 151W, maximum, nor can the maximum available current from any power supply output be exceeded; subtract the current/power usage from the availablecurrent/power in the table to confirm that the maximums will not be exceeded.

‡ = Total power output from the 243xA/B/G/H or 248xB/C power supply cannot exceed 300W, maximum, nor can the maximum available current from any power supply output be exceeded; subtract the current/power usage from the available current/power in the table to confirm that the maximums will not be exceeded.

= Unaddressed memory cards draw only standby current from the +5V(M) power supply.

Table 3-12. Computer Power Supply and Card Cage Slot Availability (+) and Requirements (–), continued

PRODUCT NUMBER AND NAME	CARD CAGE SLOTS	DIRECT CURRENT AT				25 kHz AC Pwr at 39V RMS	TOTAL POWER SUPPLY
		+5V	+5V(M)	+12V	-12V		
A900 MEMORY ARRAY CARDS							
12221A 3 MB ECC MEMORY ARRAY, Addr	- 1	-1.1A	-2.1A	0.0A	0.0A	0.0W	-16.0W
12221A Unaddressed	- 1	-1.1A	-1.2A#	0.0A	0.0A	0.0W	-11.5W
12221B 8 MB ECC MEMORY ARRAY, Addr	- 1	-1.1A	-1.4A	0.0A	0.0A	0.0W	-12.5W
12221B Unaddressed	- 1	-1.1A	-0.6A#	0.0A	0.0A	0.0W	-8.5W
INTERFACES							
12005A*/B ASYNC SERIAL INTERFACE	- 1	- 1.6A	0.0A	- 0.2A	-0.1A	0.0W	-11.6W
12006A PARALLEL INTERFACE	- 1	- 1.9A	0.0A	- 0.2A	0.0A	0.0W	-11.9W
12007B HDLC MODEM I/FTO HP 1000	- 1	- 2.6A	0.0A	- 0.4A	0.0A	0.0W	-20.2W
12009A HP-IB INTERFACE	- 1	- 2.1A	0.0A	- 0.1A	0.0A	0.0W	-11.7W
12040C*/D 8-CH ASYNC MULTIPLEXER	- 1	- 2.5A	0.0A	- 0.1A	-0.1A	0.0W	-15.2W
12041A*/B MULTI-USE 8-CH MULTIPLEXER	- 1	- 2.5A	0.0A	- 0.1A	-0.1A	0.0W	-15.2W
12042B PROGRAMMABLE SERIAL I/F	- 1	- 2.6A	0.0A	- 0.4A	-0.2A	0.0W	-20.2W
12043A PROGRAMMABLE SERIAL I/F	- 1	- 2.6A	0.0A	- 0.4A	-0.2A	0.0W	-20.2W
12044A HDLC DIR CONN I/F TO HP 1000	- 1	- 2.4A	0.0A	- 0.3A	-0.1A	0.0W	-16.8W
12060B HIGH-LEVEL ANALOG I/P CARD □	- 1	- 1.1A	0.0A	0.0A	0.0A	-7.3W□	-12.8W
12061A EXPANSION MULTIPLEXER CARD □	- 1	- 0.1A	0.0A	0.0A	0.0A	-2.0W□	-2.5W
12062A ANALOG OUTPUT CARD □	- 1	- 1.2A	0.0A	0.0A	0.0A	-7.6W□	-13.6W
12063A 16/16 ISOLATED DIGITAL I/O CD □	- 1	- 1.0A	0.0A	0.0A	0.0A	-11.4W□	-16.4W
12065A COLOR VIDEO MONITOR I/F	- 1	- 3.7A	0.0A	- 0.5A	-0.02A	0.0W	-24.0W
12072A DS/1000-IV DATA LINK SLAVE I/F	- 1	- 1.5A	0.0A	- 0.2A	-0.1A	0.0W	-11.1W
12073A BISYNC MODEM I/FTO HP 3000	- 1	- 2.6A	0.0A	- 0.4A	-0.2A	0.0W	-20.2W
12075A DSN/X.25 (LAP-B NETWORK I/F	- 1	- 2.6A	0.0A	- 0.4A	-0.2A	0.0W	-20.2W
12076A LAN/100 LINK INTERFACE	- 1	- 4.5A	0.0A	- 0.5A	-0.38A	0.0W	-33.5W
12082A BISYNC DIR CONN I/FTO HP 3000	- 1	- 2.4A	0.0A	- 0.3A	-0.1A	0.0W	-16.8W
12092A DATA LINK MASTER INTERFACE	- 1	- 2.6A	0.0A	- 0.4A	-0.2A	0.0W	-20.2W
37203L* HP-IB EXTENDER CARD □	- 1	- 0.8A	0.0A	- 0.4A	-0.2A	-0.8W□	-4.8W
37203L* + 001 HP-IB EXTENDER CARD using fiber optic cable comm.	- 1	- 0.8A	0.0A	- 0.4A	-0.2A	0.0W	-4.0W
37222A* INTEGRAL MODEM INTERFACE	- 1	- 1.2A	0.0A	- 0.1A	-0.1A	-0.8W	-8.4W

FOOTNOTES: n/s = not specified; nnc = no net change; n/a = not applicable

* = Discontinued product listed here for reference only.

= Unaddressed memory cards draw only standby current from the +5V(M) power supply.

□ = This card requires 25 kHz power, which precludes its use in the 2122A*/B*, 2136A*/B*, 2142A*/B*, or 2186C*/D* Microsystem or the 2424A, 2426E*/G, or 2426F*/H Micro 14/16 Computer and requires the addition of the 12159A Sine Wave Card in 243xA/B/E*/G/H Micro 24/26/27/29 Computers or 248xA*/B Micro 24/26/27/29 System Processor Units.

† = Total power output from the 2424A/2426G/H computer power supply cannot exceed 151W, maximum, nor can the maximum available current from any power supply output be exceeded; subtract the current/power usage from the available current/power in the table to confirm that the maximums will not be exceeded.

‡ = Total power output from the 243xA/B/G/H or 248xB/C power supply cannot exceed 300W, maximum, nor can the maximum available current from any power supply output be exceeded; subtract the current/power usage from the available current/power in the table to confirm that the maximums will not be exceeded.

Table 3-12. Computer Power Supply and Card Cage Slot Availability (+) and Requirements (–), continued

PRODUCT NUMBER AND NAME	CARD CAGE SLOTS	DIRECT CURRENT AT				25 kHz AC Pwr at 39V RMS	TOTAL POWER SUPPLY
		+5V	+5V(M)	+12V	-12V		
I/O EXTENDERS -- Power supply in I/O Extenders is only available to interfaces installed in the I/O Extender							
12025A I/O EXTENDER	+12	+38.9A	0.0A	+ 7.0A	+ 3.0A	0.0W	+300.0W
12025B I/O EXTENDER	+18	+58.0A	0.0A	+ 5.6A	+ 3.5A	+50.0W	+448.0W
MISCELLANEOUS PLUG-IN ACCESSORIES							
12008A PROM STORAGE MODULE	- 1	- 2.0A	0.0A	- 0.1A	0.0A	0.0W	-11.2W
12010A BREADBOARD INTERFACE◖	- 1	- 0.8A	0.0A	- 0.1A	0.0A	0.0W	-5.2W
12011A EXTENDER CARD	- 1	0.0A	0.0A	0.0A	0.0A	0.0W	n/a
12012A PRIORITY JUMPER CARD	- 1	0.0A	0.0A	0.0A	0.0A	0.0W	n/a
12013A* BATTERY BACKUP CARD	- 1	0.0A	0.0A	- 0.1A	0.0A	0.0W	n/s
12153A* A700 WRITABLE CONTROL STORE	- 1	- 4.1A	0.0A	- 0.1A	-0.02A	0.0W	-21.7W
12154A BATTERY BACKUP for 243xA/248xA	- 2	0.0A	0.0A	- 0.1A	-0.02A	0.0W	-8.0W
12155A* A700 PROM CONTROL STORE, fully loaded	- 1	- 6.3A	0.0A	0.0A	0.0A	0.0W	-31.5W
12156A* A700 HARDWARE FLOATING POINT PROCESSOR CARD	- 1	- 4.0A	0.0A	0.0A	0.0A	0.0W	-20.0W
12157B BATTERY BACKUP for 213xA, 2156B, or 219xC/D	- 1	0.0A	-3.0A	- 0.1A	-0.02A	0.0W	n/s
12159A SINE WAVE CARD for 243xA/248xA	- 1	- 1.5A	0.0A	0.0A	0.0A	+30.0W	-6.0W

FOOTNOTES: n/s = not specified; nnc = no net change; n/a = not applicable

* = Discontinued product listed here for reference only.

□ = This card requires 25 kHz power, which precludes its use in the 2122A*/B*, 2136A*/B*, 2142A*/B*, or 2186C*/D* Microsystem or the 2424A, 2426E*/G, or 2426F*/H Micro 14/16 Computer and requires the addition of the 12159A Sine Wave Card in 243xA/B/E*/G/H Micro 24/26/27/29 Computers or 248xA*/B Micro 24/26/27/29 System Processor Units.

◖ = The requirements listed here for the Breadboard Interface do not include power for circuits added by the user.

† = Total power output from the 2424A/2426G/H computer power supply cannot exceed 151W, maximum, nor can the maximum available current from any power supply output be exceeded; subtract the current/power usage from the available current/power in the table to confirm that the maximums will not be exceeded.

‡ = Total power output from the 243xA/B/G/H or 248xB/C power supply cannot exceed 300W, maximum, nor can the maximum available current from any power supply output be exceeded; subtract the current/power usage from the available current/power in the table to confirm that the maximums will not be exceeded.

Table 3-13. Peripherals Physical Characteristics

PRODUCT NUMBER AND NAME		DIMENSIONS HEIGHT x WIDTH x DEPTH Centimeters and (Inches)		RECOMMENDED FLOOR SPACE meters and (feet)	NET WEIGHT kg and (lb)
TERMINALS					
C1001x	700/92 DISPLAY TERMINAL	33x46.8x52.8	(13x18.4x20.8)	Table mounting	10.7 (23.5)
C1003x	700/41 ENTRY LEVEL ASCII TERM.	33x46.8x52.8	(13x18.4x20.8)	Table mounting	10.7 (23.5)
2393A	GRAPHICS TERMINAL	44.5x45.6x55	(17.5x18x21.7)	Table mounting	16.4 (36.1)
2397A	COLOR GRAPHICS TERM	44.5x45.6x55	(17.5x18x21.7)	Table mounting	20.3 (44.8)
9666A	OPERATOR INTERFACE UNIT	43.8x42.9x49.7	(17.3x16.9x19.5)	Bench or rack mtg	
PRINTERS					
2225D	THINKJET PRINTER	8.9x29.2x20.6	(3.5x11.5x8.1)	Table mounting	3.1 (6.8)
2227A	QUIETJET PLUS PRINTER	12.1x52.7x22.1	(4.8x20.8x8.7)	Table mounting	4.7 (10.34)
2228A	QUIETJET PRINTER	11.8x39.5x21.4	(4.7x15.5x8.4)	Table mounting	3.9 (8.6)
2235B	RUGGEDWRITER PRINTER	20.9x60x35	(8.2x23.6x13.7)	Table mounting	15.9 (35)
2276A	DESKJET PRINTER	20.2x44x37.7	(8x17.3x14.8)	Table mounting	6.5 (14.3)
2563B	LINE PRINTER	100x59.5x76.2	(39.4x23.4x30)	1 x 3 (3 x 9)	160 (352)
2563B	LINE PRINTER w/Opt 114	27x60x45	(10.75x23.3x17.8)	Table mounting	75 (165)
2564B	LINE PRINTER	100x59.5x76.2	(39.4x23.4x30)	1 x 3 (3 x 9)	160 (352)
2564B	LINE PRINTER w/Opt 114	27x60x45	(10.75x23.3x17.8)	Table mounting	75 (165)
2566B	LINE PRINTER	110x98.3x63.5	(43.3x38.7x25)	1 x 3 (3 x 9)	211 (465)
2684D	LASERJET/2000 PRINTER	125x145x64	(48.8x56.55x25)	1 x 3 (3 x 9)	204 (448)
293xA	PRINTERS	18.5x60x36.5	(7.3x23.9x14.4)	Table mounting	20.4 (45)
33440A	LASERJET SERIES II PRINTER	22.8x45.4x81.5	(8.5x18x24.5)	Table mounting	22.4 (50)
3630A	PAINTJET PRINTER	9.8x44.2x30.2	(3.9x17.4x11.9)	Table mounting	5 (11)
PLOTTERS AND GRAPHICS TABLETS					
46087x	GRAPHICS TABLET (HPIL)	6.4x38.5x31	(2.5x15x12)	Table mounting	3 (6.5)
46088x	GRAPHICS TABLET (HPIL)	6.4x52x39	(2.5x20.5x15.5)	Table mounting	5 (11)
7440A	COLORPRO PLOTTER	12.5x46x30.8	(4.9x18.1x12.1)	Table mounting	5.5 (12)
7475A	6-pen PLOTTER	12.7x56.8x36.7	(5x22.4x14.5)	Table mounting	7 (16)
7550A	PLOTTER w/Auto Sheet Feed	21.5x67x89.6	(8.5x26.4x35.3)	Table mounting	17.3 (38)
7570A	DRAFTPRO PLOTTER	103x114x52	(40.6x44.9x20.5)	2 x 2 (6 x 6)	30 (66)
7595A	DRAFMASTER I PLOTTER	120x134.6x50.8	(47x53x20)	2 x 2 (6 x 6)	73 (160)
7596A	DRAFMASTER II PLOTTER	120x134.6x50.8	(47x53x20)	2 x 2 (6 x 6)	75 (164)
DISKS AND CARTRIDGE TAPE UNITS					
35401A	AUTOCHGR TAPE CART S/S	26x32.5x57.5	(10.2x12.8x22.6)	Rack or table mtg	22.6 (49.8)
7936/7x	FIXED DISK	27.2x32.4x74.1	(10.7x12.8x29.2)	Rack mounting	56.7 (125)
795xB	WINCHESTER DISK DRIVES	13.2x32.5x28.5	(5.2x12.8x11.2)	Table or rack mtg	10.6 (23.2)
796xB	WINCHESTER DISK DRIVES	13.2x32.5x55.4	(5.2x12.8x21.7)	Table or rack mtg	14.8 (32.7)
9796xB	Additional Drivc in 796xB	No change	No change	No change	3.6 (7.9)
9122C	FLOPPY DISK DRIVE	7.5x32.5x28.5	(3x12.8x11.2)	Table or rack mtg	5.2 (11.5)
9144A	TAPE CARTRIDGE SUBSYS	12.5x32.5x28.5	(5x12.8x11.2)	Table or rack mtg	7.6 (16.8)
9145A	TAPE CARTRIDGE SUBSYS	12.5x32.5x28.5	(5x12.8x11.2)	Table or rack mtg	8.0 (17.6)
9153C	WINCHESTER DISK DRIVE	10.6x32.5x28.5	(4.2x12.8x11.2)	Table or rack mtg	10.7 (23.6)
MAGNETIC TAPE UNITS					
7979A	AUTOLOADING 1600 cpi MTU	100x60x80	(39.4x23.6x31.5)	3 x 3 (9 x 9)	136.5 (300)
7980A	AUTOLDG 6250/1600 cpi MTU	100x60x80	(39.4x23.6x31.5)	3 x 3 (9 x 9)	136.5 (300)
	Second Drive in 7979A/7980A	No change	No change	No change	38.5 (85)
OTHER PERIPHERALS					
2334A	MULTIMUX	14x42.5x54	(5.5x16.8x21.3	Rack or table mtg	13 (29)
3074x	DATA LINK ADAPTER	5x25x11	(2x9x4.4)	Table mounting	1 (2.2)
37204A	MULTIPOINT HP-IB EXTENDER	7.1x21.2x25.4	(2.8x8.3x10)	Rack mounting	1.7 (3.7)
37214A	SYST MODEM CARD CAGE	17.8x43.8x33	(7x17.3x13)	Rack mounting	7.5 (16.5)
92915A	BAR CODE READER (HPIL)	3.7x12x21.5	(1.5x4.7x8.5)	Table mounting	0.5 (1.1)
92916A	BAR CODE READER (HPIL)	3.7x12x21.5	(1.5x4.7x8.5)	Table mounting	0.5 (1.1)

Table 3-13. Peripherals Physical Characteristics, continued

PRODUCT NUMBER AND NAME		DIMENSIONS HEIGHT x WIDTH x DEPTH Centimeters and (Inches)		RECOMMENDED FLOOR SPACE meters and (feet)	NET WEIGHT kg and (lb)
DISCONTINUED PERIPHERAL DEVICES, LISTED HERE FOR REFERENCE ONLY					
2382A	OFFICE DISPLAY TERMINAL	28.7x30.5x48.5	(11.3x8x15.1)	Table mounting	10.0 (22)
2392A	DISPLAY TERMINAL	31.7x45.5x58.2	(12.5x17.9x22.9)	Table mounting	13.0 (28.7)
262x	TERMINALS	44x38x66.5	(17.3x15x26)	Table mounting	22.3 (49)
264xA	TERMINALS	34.2x44.4x64.8	(13.5x17.5x25.5)	Table mounting	22.8 (50)
45610B	TOUCHSCREEN TERMINAL	28.7x45.6x53	(11.3x18x20.9)	Table mounting	12.2 (27)
2565A	LINE PRINTER	110x98.3x63.5	(43.3x38.7x25)	1 x 3 (3 x 9)	204 (450)
2601A	DAISYWHEEL PRINTER	25.3x61x48.1	(10x24x19)	Table mounting	34 (75)
2608x	LINE PRINTER	104.2x68x55.5	(41x26.5x21.8)	1 x 3 (3 x 9)	97.7 (215)
2671x	PRINTER/GRAPHICS PRTR	10.5x42.8x42.4	(4.1x16.9x16.7)	Table mounting	12.7 (28)
2673A	INTELL. GRAPHICS PRTR	10.5x42.8x42.4	(4.1x16.9x16.7)	Table mounting	14.1 (31)
2674A	INTEGR. PRTR for 45610B	See 45610B	See 45610B	See 45610B	2.9 (6.4)
2686A	LASERJET PRINTER	29.3x47.5x72.3	(11.4x18.5x28.2)	Table mounting	32 (71)
2687A	DESKTOP LASER PRINTER	28x51x50	(11x20x19.5)	Table mounting	62.7 (138)
	Controller included w/2687A	28x15x50	(11x6x19.5)	Table mounting	5.5 (12)
82905B	IMPACT PRINTER	10.7x37.4x30.5	(4.2x14.7x12)	Table mounting	5.5 (12.1)
82906A	DOT-MATRIX PRINTER	10x42x34.7	(3.9x16.5x13.7)	Table mounting	7.5 (16.5)
7470A	2-pen PLOTTER	12.7x43.2x34.3	(5x17.3x13.5)	Table mounting	6 (13.5)
7510A	COLOR FILM RECORDER	21.5x60.9x45.7	(8.5x24x18)	Table mounting	20.8 (46)
7580B	DRAFTING PLOTTER	118.8x108.7x55.7	(46.8x42.8x21.9)	2 x 2 (6 x 6)	63.6 (140)
7585B	DRAFTING PLOTTER	118.8x139.2x55.7	(46.8x54.8x21.9)	2 x 2 (6 x 6)	70.4 (155)
7586B	DRAFTING PLOTTER	118.8x139.2x55.7	(46.8x54.8x21.9)	2 x 2 (6 x 6)	86.4 (190)
9111A	GRAPHICS TABLET	8.5x44x44	(3.4x17.3x17.3)	Table mounting	5.8 (12.8)
7907A	FIXED/REM DISK SUBSYS	18x32.5x46.7	(7.1x12.8x18.4)	Rack or table mtg	25 (55)
7908P	S-A FIXED DISK w/CTU	72x35.4x74	(28.4x14x29.1)	1 x 2 (3 x 6)	72.7 (160)
7908R	R/Mtg FIXED DISK w/CTU	17.7x48.3x68.7	(7x19x27.1)	Rack mounting	37.1 (87.6)
791xP	S-A FIXED DISK w/CTU	72x35.4x74	(28.4x14x29.1)	1 x 2 (3 x 6)	85.4 (188)
791xR	R/Mtg FIXED DISK w/CTU	31.1x48.3x70.5	(12.25x19x27.8)	Rack mounting	67.3 (148)
7914CT	S-A FIXED DISK w/CTU	72x37.5x77.7	(28.4x14.8x30.5)	1 x 2 (3 x 6)	109 (239)
7914ST	FIXED DISK w/1600 cpi MTU	160x60x80	(63x23.6x31.5)	3 x 3 (9 x 9)	261 (574)
7914TD	FIXED DISK w/1600 cpi MTU	161.3x63.5x81.3	(63.4x25x32)	3 x 3 (9 x 9)	272.2 (600)
7933x/5x	FIXED/REM. MEDIA DISK	82.5x55.2x83.4	(32.5x21.7x32.8)	1 x 3 (3 x 9)	154 (339.5)
7941A/5A	FIXED DISK	13x32.5x28.5	(5.1x12.8x11.2)	Table or rack mtg	9.9 (21.8)
7942A/6A	FIXED DISK w/CTU	20.8x32.5x28.5	(8.2x12.8x11.2)	Table or rack mtg	15.8 (34.8)
795xA	FIXED DISK	13.2x32.5x28.5	(5.2x12.8x11.2)	Table or rack mtg	9.9 (21.8)
9122D	Dual MICROFLOPPY DISK	7.6x32.5x28.5	(3x12.8x11.2)	Table or rack mtg	4.5 (10)
9133D/H	FIXED + MICROFLOPPY DISK	13.2x32.5x28.5	(5.2x12.8x11.2)	Table or rack mtg	10.5 (23)
9133L	FIXED + MICROFLOPPY DISK	13.2x32.5x28.5	(5.2x12.8x11.2)	Table or rack mtg	10.5 (23)
9134D/H	FIXED DISK	13.2x32.5x28.5	(5.2x12.8x11.2)	Table or rack mtg	9.5 (21)
9134L	FIXED DISK	13.2x32.5x28.5	(5.2x12.8x11.2)	Table or rack mtg	9.5 (21)
9153B	FIXED + MICROFLOPPY DISK	10.7x32.5x28.5	(4.2x12.8x11.2)	Table or rack mtg	7.7 (16.2)
9154B	FIXED DISK	10.7x32.5x28.5	(4.2x12.8x11.2)	Table or rack mtg	6.8 (14.9)
9895A	FLEXIBLE DISK MEMORY	19.2x48.3x57.5	(7.6x19x22.6)	Table or rack mtg	26.8 (59)
7970E	1600 cpi MTU	66.7x48.3x30.4	(26.3x19x12)	Rack mounting	68.2 (150)
7971A	1600 cpi MAG TAPE SUBSYS	158.5x62.3x90.5	(62.4x24.5x35.6)	3 x 3 (9 x 9)	195 (430)
	Second Drive in 7971A	No change	No change	No change	59 (130)
7974A	1600 cpi MTU	160x60x77.5	(63x23.6x30.5)	3 x 3 (9 x 9)	181.8 (400)
7978B	6250/1600 cpi MTU	160x60x78	(63x23.6x30.7)	3 x 3 (9 x 9)	188 (414)
39301A	FIBER OPTIC MPXER	7.2x42.5x8.9	(2.9x16.8x3.5)	Table mounting	3.5 (7.5)
3980xA	BAR CODE READER	7.1x26x18.9	(2.8x10.3x7.4)	Table mounting	2 (4.4)
13279B	19-INCH COLOR MONITOR	39.9x48.2x59.8	(15.7x19x23.6)	Rack or table mtg	36.7 (81)

Table 3-14. Peripherals Environmental Specifications

PRODUCT NUMBER AND NAME	TEMPERATURE °C (°F)		RELATIVE HUMIDITY (Non-condensing)	MAXIMUM ALTITUDE Meters (Feet)	
	OPERATING	NON-OPERATING		OPERATING	NON-OPER
TERMINALS					
C1001x 700/92 DISPLAY TERMINAL	0-55 (32-131)	-40-70 (-40-158)	15% - 90%	Not specified	Not specified
C1003x 700/41 ENTRY LEVEL ASCII TER.	0-55 (32-131)	-40-70 (-40-158)	15% - 90%	Not specified	Not specified
239xA TERMINALS	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
9666A OPERATOR INTERFACE UNIT	0-60 (32-140)	-40-70 (-40-158)	5% - 95%	4572 (15,000)	15240 (50,000)
PRINTERS					
2225D THINKJET PRINTER	10-40 (50-104)	-20-60 (-4-140)	10% - 90%	Not specified	Not specified
2227A QUIETJET PLUS PRINTER	10-40 (50-104)	-20-60 (-4-140)	10% - 90%	Not specified	Not specified
2228A QUIETJET PRINTER	10-40 (50-104)	-20-60 (-4-140)	10% - 90%	Not specified	Not specified
2235B RUGGEDWRITER PRINTER	5-40 (41-104)	-40-70 (-40-158)	15% - 80%	Not specified	Not specified
2276A DESKJET PRINTER	10-40 (50-104)	-40-60 (-40-140)	10% - 70%	Not specified	Not specified
256xB LINE PRINTERS	10-50 (50-122)	-40-75 (-40-167)	30% - 80%	4572 (15,000)	15240 (50,000)
2684D LASERJET/2000 PRINTER	10-32 (50-91)	0-35 (32-95)	20% - 80%	2500 (8,200)	15000 (49200)
293xA PRINTERS	0-55 (32-131)	-40-75 (-40-167)	10% - 70%	4572 (15,000)	15240 (50,000)
33440A LASERJET SERIES II PRINTER	10-32 (50-91)	0-35 (32-95)	20% - 80%	2500 (8,200)	15000 (49200)
3630A PAINTJET PRINTER	15-30 (59-86)	-40-70 (-40-158)	20% - 70%	Not specified	Not specified
PLOTTERS					
7440A COLORPRO PLOTTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
7475A 6-pen PLOTTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
7550A PLOTTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
Auto Sheet Feed w/7550A	10-40 (50-104)	-40-75 (-40-167)	20% - 80%	4572 (15,000)	15240 (50,000)
7570A DRAFTPRO PLOTTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	Not specified	Not specified
7595A DRAFTMASTER I PLOTTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	Not specified	Not specified
7596A DRAFTMASTER II PLOTTER	0-55 (32-131)	-40-75 (-40-167)	30% - 70%	Not specified	Not specified
DISKS AND CARTRIDGE TAPE UNITS					
12122A INTEGR. DISKS for Micro 24/26/27/29 SPU/Computer	5-45 (32-113)	-40-60 (-40-140)	20% - 80%	4572(15,000)	15240 (50,000)
35401A AUTOCHANGER TAPE CARTRIDGE SUBSYSTEM	5-40 (41-104)	-40-75 (-40-167)	20% - 80%	4572 (15,000)	Not specified
7936x FIXED DISK	0-55 (32-131)	-40-70 (-40-158)	5% - 95%	4572 (15,000)	15240 (50,000)
7937x FIXED DISK	0-55 (32-131)	-40-70 (-40-158)	5% - 95%	4572 (15,000)	15240 (50,000)
795xB WINCHESTER DISK DRIVES	5-45 (41-113)	-40-65 (-40-149)	8% - 80%	4572 (15,000)	15240 (50,000)
796xB WINCHESTER DISK DRIVES	5-40 (41-104)	-40-65 (-40-149)	8% - 80%	4572 (15,000)	15240 (50,000)
9122C FLOPPY DISK DRIVE	10-40 (50-104)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
914xA TAPE CARTRIDGE SUBSYS	5-40 (41-104)	-40-75 (-40-167)	20% - 80%	4572 (15,000)	15240 (50,000)
9153C WINCHESTER DISK DRIVE	10-40 (50-104)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
MAGNETIC TAPE UNITS					
7979A AUTOLDG 1600 cpi MTU	15-32 (59-90)	-40-70 (-40-158)	20% - 80%	3000 (9,840)	15240 (50,000)
7980A AUTOLDG 6250/1600 cpi MTU	15-32 (59-90)	-40-70 (-40-158)	20% - 90%	3000 (9,840)	15240 (50,000)
OTHER PERIPHERAL DEVICES					
2334A MULTIMUX	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
3074x DATA LINK ADAPTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
37204A MULTIPT HP-IB EXTENDER	0-55 (32-131)	-40-75 (-40-167)	Not spec'd	Not specified	Not specified
37214A SYST MODEM CARD CAGE	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
9291xA BAR CODE READERS (HPIL)	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)

Table 3-14. Peripherals Environmental Specifications, continued

PRODUCT NUMBER AND NAME	TEMPERATURE °C (°F)		RELATIVE HUMIDITY (Non-condensing)	MAXIMUM ALTITUDE Meters (Feet)	
	OPERATING	NON-OPERATING		OPERATING	NON-OPER
DISCONTINUED PERIPHERAL DEVICES, LISTED HERE FOR REFERENCE ONLY					
2382A OFFICE DISPLAY TERMINAL	0-55 (32-131)	-40-60 (-40-140)	5% - 95%	4572 (15,000)	15240 (50,000)
2392A DISPLAY TERMINAL	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
262x TERMINALS without printer	0-55 (32-131)	-40-60 (-40-140)	5% - 95%	4572 (15,000)	15240 (50,000)
262x TERMINALS with printer	5-40 (41-104)	-40-60 (-40-140)	5% - 80%	4572 (15,000)	15240 (50,000)
264xA TERMINALS without CTUs	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	7620 (25,000)
264xA TERMINALS with CTUs	5-40 (41-104)	-10-60 (-15-140)	20% - 80%	4572 (15,000)	7620 (25,000)
45610B TOUCHSCREEN TERMINAL	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
2563A LINE PRINTER	10-50 (50-122)	-40-75 (-40-167)	30% - 80%	4572 (15,000)	15240 (50,000)
2565A LINE PRINTER	10-40 (50-104)	-40-75 (-40-167)	30% - 80%	4572 (15,000)	15240 (50,000)
2566A LINE PRINTER	10-40 (50-104)	-40-75 (-40-167)	30% - 80%	4572 (15,000)	15240 (50,000)
2601A DAISYWHEEL PRINTER	7-41 (45-105)	-29-57 (-20-135)	10% - 80%	2438 (8,000)	7620 (25,000)
2608x LINE PRINTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
2671x PRINTER/GRAPHICS PRTR	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
THERMAL PAPER for 267x	0-40 (32-104)	-40-40 (-40-104)	20% - 90%	4572 (15,000)	15240 (50,000)
2686A LASERJET PRINTER	10-32 (50-91)	0-35 (32-95)	20% - 80%	2500 (8,200)	15240 (50,000)
2687A DESKTOP LASER PRINTER	10-30 (50-86)	-40-40 (-40-104)	20% - 90%	2500 (8,200)	15240 (50,000)
82905B IMPACT PRINTER	5-35 (41-95)	-30-65 (-22-149)	10% - 80%	3048 (10,000)	15240 (50,000)
82906A DOT-MATRIX PRINTER	5-35 (41-95)	-30-65 (-22-149)	10% - 80%	3048 (10,000)	15240 (50,000)
7470A 2-pen PLOTTER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
7510A COLOR FILM RECORDER	0-55 (32-131)	-40-75 (-40-167)	Not specified	Not specified	Not specified
758xB DRAFTING PLOTTER	0-40 (32-104)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
Roll Feed w/7586B	10-30 (50-86)	-40-75 (-40-167)	30% - 70%	4572 (15,000)	15240 (50,000)
9111A GRAPHICS TABLET	0-55 (32-131)	-40-65 (-40-149)	5% - 90%	4572 (15,000)	15240 (50,000)
7907A FIXED/REM DISK SUBSYS	10-40 (50-104)	-40-75 (-40-167)	5% - 95%	3000 (9,840)	15240 (50,000)
7908P S-A FIXED DISK w/CTU	10-40 (50-104)	-40-65 (-40-149)	20% - 80%	4572 (15,000)	15240 (50,000)
7908R R/Mtg FIXED DISK w/CTU	10-40 (50-104)	-40-65 (-40-149)	20% - 80%	4572 (15,000)	15240 (50,000)
791xP/R FIXED DISK w/CTU	10-40 (50-104)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
7914ST FIXED DISK w/1600 cpi MTU	15-32 (59-90)	-10-60 (14-140)	20% - 80%	3000 (9,840)	15240 (50,000)
7914TD FIXED DISK w/1600 cpi MTU	10-40 (50-104)	-10-60 (14-140)	20% - 80%	3000 (9,840)	3000 (9,840)
7933x FIXED DISK	10-40 (50-104)	-40-65 (-40-149)	8% - 80%	3000 (9,840)	15240 (50,000)
7935x REMOVABLE MEDIA DISK	10-32 (50-90)	-40-65 (-40-149)	8% - 80%	3000 (9,840)	15240 (50,000)
7941A FIXED DISK	5-45 (41-113)	-40-60 (-40-140)	8% - 80%	4572 (15,000)	15240 (50,000)
7945A FIXED DISK	5-45 (41-113)	-40-60 (-40-140)	8% - 80%	4572 (15,000)	15240 (50,000)
7942A FIXED DISK w/CTU	5-45 (41-113)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
7946A FIXED DISK w/CTU	5-45 (41-113)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
795xA FIXED DISK	5-45 (41-113)	-40-65 (-40-149)	8% - 90%	4572 (15,000)	15240 (50,000)
9122D Dual MICROFLOPPY DISK	10-45 (50-113)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
9133D FIXED + MICROFLOPPY DISK	10-45 (50-113)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
9133H FIXED + MICROFLOPPY DISK	10-45 (50-113)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
9133L FIXED + MICROFLOPPY DISK	10-45 (50-113)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
9134D FIXED DISK	10-45 (50-113)	-40-60 (-40-140)	5% - 95%	4572 (15,000)	15240 (50,000)
9134H FIXED DISK	10-45 (50-113)	-40-60 (-40-140)	5% - 95%	4572 (15,000)	15240 (50,000)
9134L FIXED DISK	10-45 (50-113)	-40-60 (-40-140)	5% - 95%	4572 (15,000)	15240 (50,000)
9153B FIXED + MICROFLOPPY DISK	10-45 (50-113)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
9154B FIXED DISK	10-45 (50-113)	-40-60 (-40-140)	5% - 95%	4572 (15,000)	15240 (50,000)
9895A FLEXIBLE DISK MEMORY	10-40 (50-104)	-40-60 (-40-140)	20% - 80%	4572 (15,000)	15240 (50,000)
7970E 1600 cpi MTU	0-55 (32-131)	-40-75 (-40-167)	20% - 80%	3000 (9,840)	15240 (50,000)
7971A 1600 cpi MAG TAPE SUBSYS	0-55 (32-131)	-40-75 (-40-167)	20% - 80%	3000 (9,840)	15240 (50,000)
7974A 1600 cpi MTU	15-32 (59-90)	-40-75 (-40-167)	20% - 80%	3000 (9,840)	15240 (50,000)
7978B 6250/1600 cpi MTU	15-32 (59-90)	-40-75 (-40-167)	10% - 90%	3000 (9,840)	15240 (50,000)
13279B 19-INCH COLOR MONITOR	0-50 (32-122)	Not specified	10% - 90%	3048 (10,000)	Not specified
39301A FIBER OPTIC MPXER	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)
3980xA BAR CODE READERS	0-55 (32-131)	-40-75 (-40-167)	5% - 95%	4572 (15,000)	15240 (50,000)

Engineering and Reference Documentation

Introduction

Engineering and Reference Documents (ERDs) for HP 1000 A400, A600+, and A900 computers are published by Hewlett-Packard. The ERDs provide comprehensive technical descriptions of the respective processors, with coverage detailed enough to give solution creators ample information for successful design of I/O and other logic boards for use with any HP 1000 A-Series target machine.

Features

- Theory of operation of major subsystems
- Block diagrams
- Logic diagrams
- Schematics
- Timing diagrams
- Memory design and addressing
- Interrupt system design
- Interface design requirements
- Power supply design and requirements

Comprehensive Design Information for HP 1000 Solution Creators

The HP 1000 A-Series Engineering and Reference Documents (ERDs) provide detailed design information for OEMs and other solution creators who need to modify the HP 1000 or design specialized interface circuits.

The following generalized list of contents conveys the depth and breadth of coverage that the HP 1000 A-Series Engineering and Reference Documents offer the HP 1000 A-Series OEM customer:

- **Computer overview,** including a general discussion of the machine, its features, and its overall specifications.
- **Processor operations** provides block diagrams, definitions of signals and functions, timing diagrams, word formats, interrupt processing, instruction decoding, I/O accessing, system level I/O, virtual control panel operation, and other details needed to thoroughly understand the processor's functions.
- **Memory operations** describes the memory controller, memory array cards, frontplane and backplane connections, memory addressing, data transfer rates, memory refresh operations, memory mapping, and memory access timing, to list just a few topics.
- **Backplane,** gives a physical and electrical description, interface requirements, and signal timing.
- **Control store (for A900 only),** discusses theory of operation of the control store card(s), backplane address logic, backplane data logic, and frontplane interface.
- **Power supply** provides descriptions of the power supplies that may be used with the particular machine, giving logical signals used in conjunction with RTE-A power fail/autorestart, specifications, theory of operation, replaceable parts, and discussion of accessory cards, such as battery backup and 25 kHz ac filter cards.
- **On-Board I/O (for A400 only)** describes the I/O Master for interfacing to the backplane, the port processors, port processor initialization and self test, VCP slave functions, and the On-Board I/O cable, supported by connection diagrams.

Ready to Help You Customize HP 1000 A-Series Based Solutions

Regardless of which HP 1000 A-Series platform you choose, Engineering and Reference Documentation is available to help you to design your solution around it. Simply order the ERDs listed below that are applicable to your needs.

02424-90003 HP 1000 A400 Computer Engineering and Reference Documentation.

02156-90003 HP 1000 A600 Computer Engineering and Reference Documentation.

02139-90003 HP 1000 A900 Computer Engineering and Reference Documentation.

System Racking Information

Rack-Mounting Information

Computers, extenders, disks, tape units, and other equipment available for HP 1000 A-Series Systems may be installable in any of several different rack cabinets, as summarized in Table 3-15 on pages 3-62 through 3-64.

Basic HP 219xE/G/H SPU Racking

HP 1000 A-Series HP 219xE/G/H System Processor Units (SPUs) must be rack mounted in an HP 29429A or 29431G cabinet as shown in Figure 3-11, below, to assure compliance with safety and EMI regulations. The 29429A Cabinet must be ordered with a part number 29429-94001 front door and the 29431G Cabinet MUST be ordered with option 053 to replace a standard cutout front door (formerly required for use with discontinued HP 791xR Disks). This provides with a door that has ventilation louvers instead of the cutout door. The HP 2196G/H or 2199E SPU is housed in a 20-slot card cage. Space immediately above the SPU is available for other equipment, such as a separately-purchased disk and/or a cartridge tape subsystem for software installation and backup.

Computer Compartment Ventilation

The computer provides its own front-to-rear ventilation, as must any other item installed in the computer compartment. Louvers in the front and rear doors facilitate self-ventilation by equipment in the computer compartment.

Upper Compartment in HP 29431G Cabinet

Above the computer compartment, the HP 29431G cabinet provides a panel-separated upper compartment with 80 cm (31.5 in.) of vertical space for rack mounting other equipment.

Air circulation fans in the upper compartment support equipment with left-to-right ventilation **OR** right-to-left ventilation **OR** front-to-rear ventilation. To assure proper heat dissipation, all equipment in the upper compartment must use the same type of ventilation. For proper front-to-rear ventilation, the HP 29431G option 053 cabinet must also be ordered

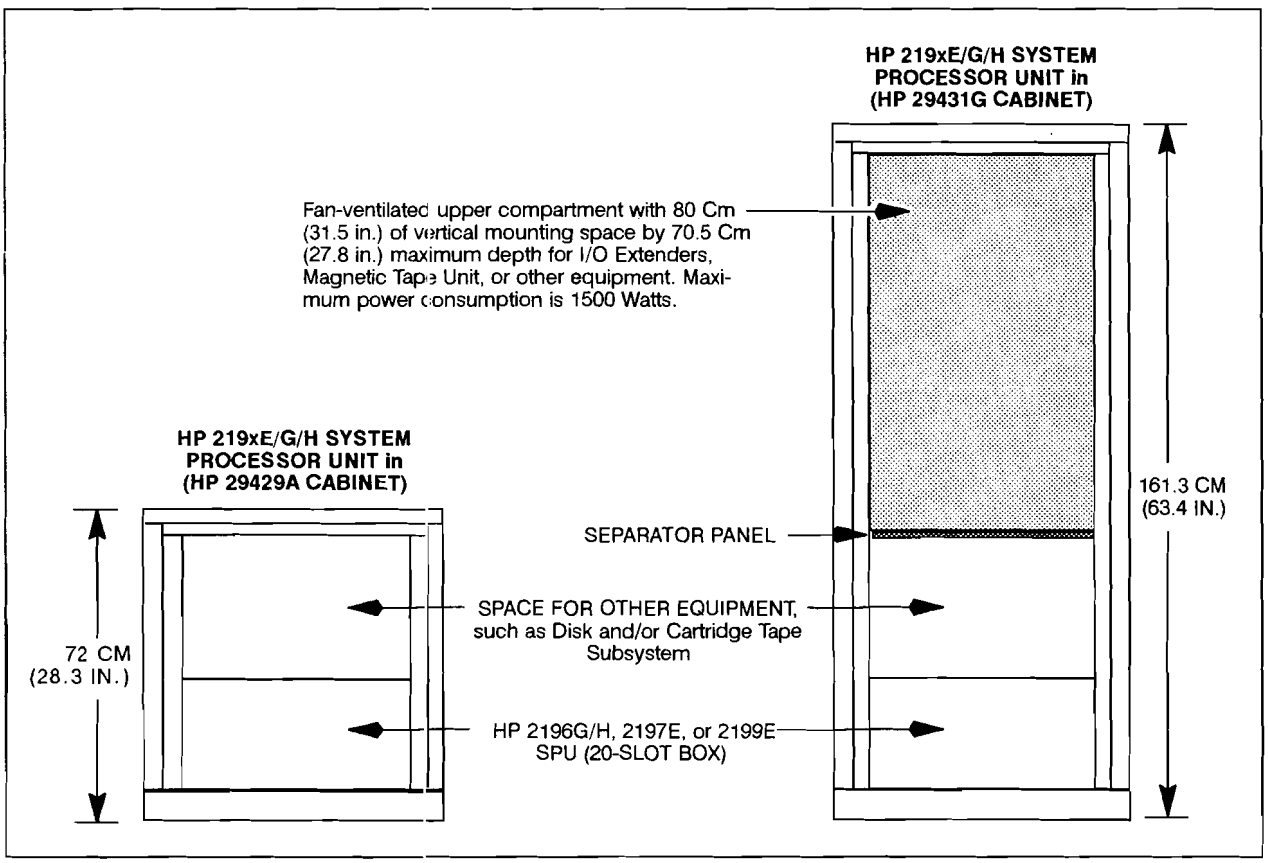


Figure 3-11. HP 1000 A-Series 219xE/G/H System Processor Unit Racking

with option 051, which substitutes trim for rack mounting a magnetic tape unit for the upper compartment front door that is standard. Details of trim installation are given in the HP 40027A Trim Kit Installation Manual (40027-90002). All unoccupied vertical mounting space must be covered by blank panels. A maximum of 1500 watts can be dissipated by the upper compartment ventilation.

Safety and EMI Compliance

Except for the 219xE/G/H SPU, the customer is responsible for the safety and EMI compliance of all equipment installed in the 29429A or 29431G Cabinet. Pertinent safety issues, especially in the upper compartment of the 29431G Cabinet include the possibility of fire hazard from overheating and susceptability of the cabinet to tipping, especially with equipment that may be slid partway out of the upper compartment for servicing.

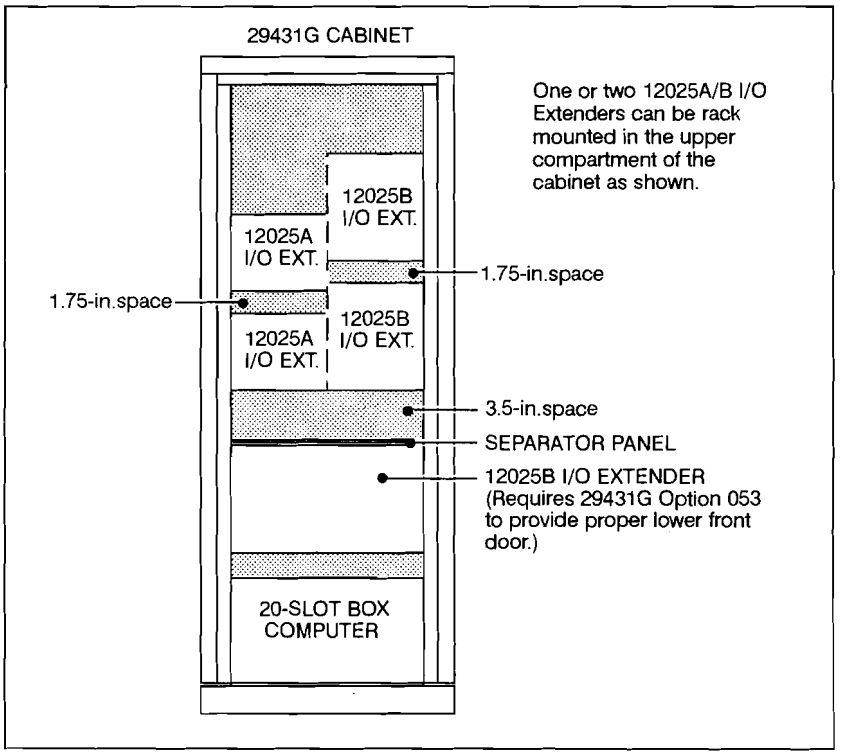


Figure 3-12. A-Series I/O Extender Rack Mounting Positions in HP 29431G Cabinet

Racking of 12025A/B I/O Extenders in HP 29431G Cabinets

HP 12025A I/O Extenders, which do not use front-to-rear ventilation, must be mounted in the upper compartment of the HP 29431G Cabinet. Two 12025A I/O Extenders can be racked in HP 29431G Cabinets (see Figure 3-12). An HP 12025B I/O Extender, which uses front-to-rear ventilation, can be rack mounted in the space above the 219xE/G/H SPU. HP 12025B I/O Extenders can also be rack mounted in the upper compartment of the 29431G option 053 cabinet, provided that the 29431G option 053 cabinet also has option 051, which replaces the upper door with mag tape unit trim to assure proper front-to-rear self-ventilation by the 12025B I/O Extender(s).

Racking of Micro 2x Computers or SPUs in HP 29431G Cabinets

Micro/1000 (HP 243xA/B/G/H) Computers and (248xB/C) SPUs use left-to-right ventilation and thus must be rack mounted in the upper compartment of the HP 29431G Cabinet. Two Micro/1000 computers packages can be racked in HP 29431G Cabinets, as shown in Figure 3-13, next page.

Installation of Other Equipment in the Computer Compartment

Other equipment can be installed above the SPU in the HP 29429A or 29431G Cabinets, if:

1. It is self-ventilated, using front-to-rear ventilation.
2. It fits into 31.1 cm (12.25 in.) of vertical mounting space to a maximum depth of 70.5 cm (27.8 in.).
3. It consumes no more than 700 watts.
4. The customer is prepared to assume responsibility for the safety and EMI compliance of that equipment.

Racking of Micro 14 and 16 Computers in the HP 29429A or 29431G Cabinet

The HP 2424A Micro 14 Computer and 2426G/H Micro 16 Computers are housed in the "cooler" package. Rack mounting of these cooler-packaged computers in the HP 29429A or 29431G Cabinet requires an HP 12905A

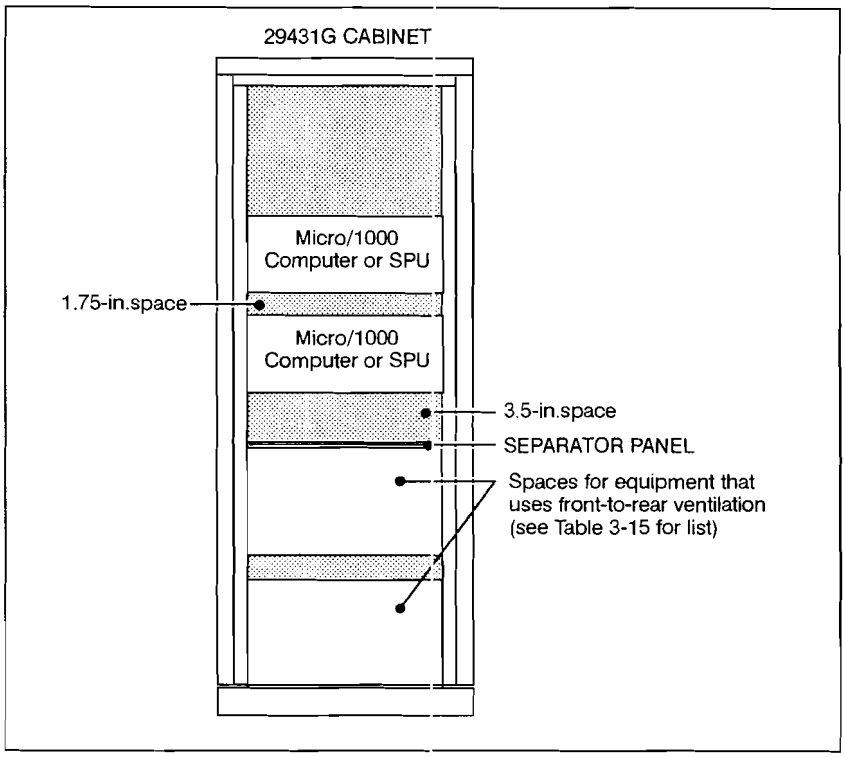


Figure 3-13. Rack Mounting of Micro/1000 Computers and SPUs in HP 29431G Cabinet

Rack Mount Adapter. Because these computers use front-to-rear ventilation, they can be mounted in the computer compartment of either cabinet or the upper compartment of the 29431G option 053 Cabinet. Rack mounting in the upper compartment also requires 29431G cabinet option 051, which removes the upper door to support front-to-rear airflow.

Bolting HP 29431G Cabinets Together

Two HP 29431G Cabinets can be secured to each other using an HP 40026A Tie-Together Kit. However, the HP 29431G Cabinets are not designed to be bolted or otherwise tied together with other cabinets of any kind. Bolting more than two 29431G Cabinets together requires special engineering.

Rack Mounting in HP Design-Plus Cabinets

Although they can be adapted to rack mount in the HP 29429A or 29431G 19-inch wide EIA rack Cabinet, the HP 2424A Micro 14 Computer and 2426G/H Micro 16 Computer are designed to rack in HP Design-Plus Cabinets, including the HP 92211L Taboret Cabinet and the HP 92211R Mini Rack Cabinet. Most of the rack mountable devices listed in Table 3-15 (next page) can also be rack mounted in HP 92211L/R cabinets. These include the HP 35401A, 7907A*, 7936H/XP, 7937H/XP, 7941A*, 7942A*, 7945A*, 7946A*, 7957A*/B, 7958A*/B, 7959B, 7962B, 7963B, 9133H*, 9133L*, 9134H*, 9134L*, 9144A, 9153B*, and 9154B*.

* Discontinued product listed here for reference only.

Rack Mounting in Other Cabinets

If A-Series computers and compatible peripheral devices are rack mounted in a cabinet other than those discussed in this information sheet, that cabinet must have enough space to house the components and must support, or at least not interfere with, the ventilation air flow of the rack mounted equipment to assure long life and trouble-free operation. **Compliance with EMI regulations and safety standards cannot be supported by Hewlett-Packard for systems that are installed in other cabinets.**

Table 3-15. HP 1000 A-Series Systems Equipment Rack Mounting Information Summary

RACK-MOUNTING EQUIPMENT				RACK MOUNTING INFORMATION			
PRODUCT NO. AND NAME	VERTICAL PANEL SPACE REQUIRED	MAX. POWER (Watts)	INTERNAL AIR FLOW DIRECTION	CABINET PRODUCT NUMBER	VERTICAL PANEL SPACE AVAILABLE IN THE CABINET	MAX. POWER (Watts) IN CABINET	RACK ADAPTER OR ADAPTATION REQUIRED
HP 12025A I/O EXTENDER	22.3 cm (8.75 in.)	500	Left-to-right	**29431G (U)**	(see Figure 3-12)	1500	12679C
HP 12025B I/O EXTENDER	31.3 cm (12.25 in.)	700	Front-to-rear	**29431G(U)**	(see Figure 3-12)	1500	12679B 29431G+051 29431G+053
				29431G(L)	(see Figure 3-12)	1400	
HP 2134A, 2139B, or 2156C/D COMPUTER	31.3 cm (12.25 in.)	700	Front-to-rear	**29429A**	(see Figure 3-11)	1400	12679B 29429A† 29431G+053
				29431G (L)	(see Figure 3-11)	1400	
HP 2196G/H, 2197E, or 2199E SPU	31.3 cm (12.25 in.)	700	Front-to-rear	**29429A**	(see Figure 3-11)	1400	12679B 29429A† 29431G+053
				29431G (L)	(see Figure 3-11)	1400	
HP 2424A, 2426G, or 2426H COMPUTER	22.3 cm (8.75 in.)	190	Front-to-rear	**29431G (U)**	80 cm (31.5 in.)	1500	12905A and 29431G+051
				29431G (L)	62.6 cm (24.5 in.)	1400	12905A
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
HP 243xA/B/G/H COMPUTER or 248xB/C SPU	22.3 cm (8.75 in.)	500	Left-to-right	**29431G (U)**	(see Figure 3-14)	1500	12679C
HP 35401A CARTRIDGE AUTOCHANGER TAPE SUBSYSTEM	26.7 cm (10.5 in.)	125	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	35490A and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	35490A and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
				19511A	53.4 cm (21 in.)	N/A	None
HP 7907A* FIXED/ REMOVABLE MASS STORAGE SUBSYSTEM	22.3 cm (8.75 in.)	145	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19507A and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19507A and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S

U = Upper compartment of 29431G Cabinet; internal airflow direction must be the same in all equipment in upper compartment.

L = Lower compartment of 29431G Cabinet (can be used only for equipment with internal airflow from front to rear).

† = 29429A Cabinet MUST be equipped with 29429-94001 Front Door (has ventilation louvers instead of cutout for 791xR disk).

N/A = Not Applicable; cabinet does not provide power distribution or ventilation.

* = Discontinued product, listed here for reference only.

Table 3-15. HP 1000 A-Series Systems Equipment Rack Mounting Information Summary, continued

RACK-MOUNTING EQUIPMENT				RACK MOUNTING INFORMATION			
PRODUCT NO. AND NAME	VERTICAL PANEL SPACE REQUIRED	MAX. POWER (Watts)	INTERNAL AIR FLOW DIRECTION	CABINET PRODUCT NUMBER	VERTICAL PANEL SPACE AVAILABLE IN THE CABINET	MAX. POWER (Watts) IN CABINET	RACK ADAPTER OR ADAPTATION REQUIRED
HP 7911R*, 7912R*, or 7914R* FIXED DISK	31.3 cm (12.25 in.)	700	Front-to-rear	**29431G (L)**	(see Figure 3-12)	1400	None
				29429A	(see Figure 3-12)	1400	None
				7914ST*	31.3 cm (12.25 in.)	700	None
HP 7936H/XP or 7937H/XP FIXED DISK	26.7 cm (10.5 in.)	320	Front-to-rear	**29431G (U)**	62.6 cm (24.5 in.)	1400	19512A and 29431G+051
				19511A	53.4 cm (21 in.)	N/A	None
				19514A	213.6 cm (84 in.)	N/A	None
HP 7941A* or 7945A* FIXED DISK	13.3 cm (5.25 in.)	85	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19500A and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19500A and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
HP 7942A* or 7946A* FIXED DISK	22.2 cm (12.25 in.)	120	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19501A and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19501A and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
HP 7957A*/B, 7958A*/B, or 7959B FIXED DISK	13.3 cm (5.25 in.)	85	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19500B and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19500B and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
HP 7962B or 7963B FIXED DISK	13.3 cm (5.25 in.)	85	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19500B and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19500B and 29431G+051
				92211R	57.2 cm (22.5 in.)	N/A	92211S

U = Upper compartment of 29431G Cabinet; internal airflow direction must be the same in all equipment in upper compartment.

L = Lower compartment of 29431G Cabinet (can be used only for equipment with internal airflow from front to rear).

N/A = Not Applicable; cabinet does not provide power distribution or ventilation.

* = Discontinued product, listed here for reference only.

Table 3-15. HP 1000 A-Series Systems Equipment Rack Mounting Information Summary, continued

RACK-MOUNTING EQUIPMENT				RACK MOUNTING INFORMATION			
PRODUCT NO. AND NAME	VERTICAL PANEL SPACE REQUIRED	MAX. POWER (Watts)	INTERNAL AIR FLOW DIRECTION	CABINET PRODUCT NUMBER	VERTICAL PANEL SPACE AVAILABLE IN THE CABINET	MAX. POWER (Watts) IN CABINET	RACK ADAPTER OR ADAPTATION REQUIRED
HP 7970ER* Opt 636 Remarketed MAGNETIC TAPE UNIT	66.7 cm (26.3 in.)	400	Cooled by convection (no fan)	**29431G (U)**	80 cm (31.5 in.)	1500	29431G+051
HP 7974A*/7978B* MAG TAPE UNIT	Includes cabinet	N/A	N/A	Includes cabinet	N/A	N/A	None
HP 7979A/7980A MAG TAPE UNIT	Includes cabinet	N/A	N/A	Includes cabinet	N/A	N/A	None
HP 9122C FLOPPY DISK	7.5 cm (2.9 in.)	100	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19500B and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19500B and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
HP 9133H* or 9133L* FIXED DISK PLUS MICROFLOPPY or 9134H* or 9134L* FIXED DISK	13.3 cm (5.25 in.)	100	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19500B and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19500B and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
HP 9153C FIXED DISK, with or without Microfloppy Disk HP 9153B* FIXED DISK PLUS MICROFLOPPY or 9154B* FIXED DISK	13.3 cm (5.25 in.)	100	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19500B and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19500B and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S
HP 9144A/9145A TAPE CARTRIDGE SUBSYSTEM	13.3 cm (5.25 in.)	100	Front-to-rear	**29431G (L)**	62.6 cm (24.5 in.)	1400	19500A and 29431G+053
				29431G (U)	80 cm (31.5 in.)	1500	19500A and 29431G+051
				92211L	52 cm (20.47 in.)	N/A	None
				92211R	57.2 cm (22.5 in.)	N/A	92211S

U = Upper compartment of 29431G Cabinet; internal airflow direction must be the same in all equipment in upper compartment.

L = Lower compartment of 29431G Cabinet (can be used only for equipment with internal airflow from front to rear).

N/A = Not Applicable; cabinet does not provide power distribution or ventilation.

* = Discontinued product, listed here for reference only.

24398B and 24612A Diagnostic Packages

Introduction

The HP 24398B and 24612A Diagnostic Packages support standalone testing of A-Series computers, memory, interface cards, and CS/80 and other HP-IB connected disks and magnetic tape units. See Table 3-16 on the next page.

Features

- Checkout of A-Series CPUs, memory, most interfaces, and the Floating Point Processor in A900.
- Checkout of disks and mag tape units.
- A "BASIC-like" Diagnostic Design Language for easy design of diagnostics for user-developed interfaces based on the 12010A Breadboard Interface or for specialist-level analysis.
- Test hoods for complete verification of interface cards.
- Support for remote diagnosis via telephone lines and Bell 103 or equivalent modem and the computer's Virtual Control Panel.

Configuration Requirements

Processor and Memory

Any A-Series computer or System Processor Unit with at least 128 KB of memory.

Loading Devices

For 24612A: Any disk or subsystem capable of reading CS/80 cartridge tape (Media Option 022), micro-floppy disks (Media Option 044), or 1600 cpi magnetic tape (Media Option 051).

For 24398B: Any disk or subsystem capable of reading CS/80 cartridge tape (Media Option 022, the only media choice).

Console Device

Any A-Series compatible system console as listed in the Peripheral Device Support section of the HP 1000 A-Series Ordering Guide, (5959-7811, or later revision). A console device is required for running the Diagnostic Design Language Interpreter, the 24398B diagnostics, and the 12072A Data Link Slave Interface. The console device is optional for running any of the other interface diagnostics.

Ordering Information

In System Processor Units

The HP 24398B and 24612A Diagnostic Packages are included with A-Series System Processor Units (2196G/H, 2199E, 2484B, 2486B/C, and 2489B).

For Computers

The HP 24398B and 24612A Diagnostic Packages must be ordered separately for A-Series Computers.

HP 24612A A-Series Processor and Interface Diagnostics Package

See Table 3-16, next page, for diagnostics and learning products included in the 24612A product.

HP 24612A Media Options

022: Diagnostics on CS/80 Cartridge Tape (excludes options 044 and 051).

044: Diagnostics on microfloppy disks for HP12120A*/12122A Integrated Disks in Micro/1000 package or HP 9122D or 9133A*/B*/H*/L or 9153B Disk (excludes options 022 and 051).

051: Diagnostics on 1600 cpi Magnetic Tape (excludes options 022 and 044).

* Discontinued product listed here for reference only.

HP 24398B A-Series Disk, Mag Tape, and Systems Modem Diagnostics Package

See Table 3-16, next page, for diagnostics and learning products included in the 24398B product.

HP 24398B Media Option

022: Diagnostics on CS/80 Cartridge Tape.

Table 3-16. A-Series Diagnostics Packages Summary

SUPPORTED FUNCTION OR PRODUCT	SOFTWARE ITEM	MANUAL PART NO.	TEST HOOD PART NO(S).
HP 24612A A-SERIES PROCESSOR AND INTERFACE DIAGNOSTICS			
Diagnostic operation and troubleshooting.	Diagnostic control system with Basic Control Module	24612-90001	Not applicable
Development of diagnostics for user-designed interfaces or specialist-level diagnosis.	Diagnostic Design Language Interpreter	24612-90002	Not applicable
Checking of CPU instructions, memory, A700* Floating point processor, and I/O logic and processing functions such as interrupt handling, time base generator, dynamic mapping, memory protect, parity checking, and direct memory access (DMA).	Kernel diagnostic	24612-90003	Not applicable
Checking of these basic A-Series computer interfaces: - 12005A/B Asynchronous Serial Interface - 12006A Parallel Interface - 12008A PROM Storage Module - 12009A HP-IB Interface - 12100A A400 On-Board I/O	Individual diagnostics for each interface	24612-90011	24397-60003 24397-60004 12100-60003
Checking of these NS/1000 (DS/1000-IV) interfaces based on the Programmable Serial Interface Card: - 12007B HDLC Modem Interface to HP 1000 - 12044A HDLC Direct-Connect Interface to HP 1000 - 12073A Bisync Modem Interface to HP 3000 - 12082A Bisync Direct-Connect Interface to HP 3000	Diagnostic	24612-90011	5061-3453 and 5061-3460
Checking of 12040B*/C*/D or 12041A*/B 8-Channel Asynchronous Multiplexer	Diagnostic	24612-90011	5061-4901
Checking of 12072A DS/1000-IV Data Link Slave I/f	Diagnostic	24612-90011	5061-4909
Checking of 12153A* A700 Writable Control Store Card	Diagnostic	24612-90011	Not applicable
Checking of 12060B and 12061A High-Level Analog Input and Expansion Multiplexer Cards	Diagnostic	24612-90011	12060-60003 and 12061-60002
Checking of 12062A Analog Output Card	Diagnostic	24612-90011	12062-60002
Checking of 12063A Digital I/O Card	Diagnostic	24612-90011	12063-60002
HP 24398B A-SERIES DISK, MAG TAPE, AND SYSTEMS MODEM DIAGNOSTICS			
Checking of 79xxM* MAC Disks	Diagnostic	5955-4355	Not applicable
CS/80 Disks Exerciser	Diagnostic	5955-3462	Not applicable
7974A*/7978A*/B* Mag Tape Drive Exerciser	Diagnostic	5958-9137	Not applicable
7970E* Mag Tape Drive Verifier	Diagnostic	24398-90008	Not applicable
Checking of 37214A Systems Modem	Diagnostic	24398-90008	Not applicable

* Discontinued product, listed here for reference only.

91156A/B and 91157A/B Development Packs

Introduction

HP 91156A/B and 91157A/B provide a convenient means of ordering packs of popular software items at attractive package prices.

Prerequisites

At least 1 megabyte of memory (3 megabytes in A900) is prerequisite to ordering the HP 91156A/B and 91157A/B Development Packs, but 3 megabytes or more is recommended for best performance.

Features

- Easily-ordered packages of software used by application developers.
- Availability for all A-Series System Processor Units.
- FORTRAN 77, Pascal/1000 and BASIC/1000C programming languages and Symbolic Debug/1000 for program development support.
- Choice of Image/1000-II or Image/1000.
- Device-Independent Graphics Library for graphics programming.
- Choice of packages with or without VC+.

Description

Items in all of the Development Packs

- HP 92836A FORTRAN 77 Compiler.
- HP 92833A Pascal/1000 Compiler.
- HP 92857A BASIC/1000C Interpreter and Compiler.
- HP 92860A Symbolic Debug/1000.
- HP 92861A Graphics/1000-II Device-Independent Graphics Library, Version 2.0.

Items Selectable by the Development Pack Ordered

- HP 92078A VC+ Enhancement to RTE-A (provided only in HP 91156A/B Development Packs). Since HP 1000 A-Series 219xE/G/H and 248xB/C SPUs all now include VC+, the 91156A/B Development Pack should be ordered only for systems based on HP 1000 A-Series Computers, not systems based on SPUs.
- HP 92081A Image/1000-II Database Management System (provided only in HP 91156A and 91157A Development Packs).
- HP 92069A Image/1000 Database Management System (provided only in HP 91156B and 91157B Development Packs).

Licensing and Rights to Copy

The development packs grant the right to use the included software on one system. They do NOT include the right to purchase right to copy licenses for any of the included software.

Ordering Information

HP 91156A Development Pack with VC+ and Image/1000-II (Must order one of Use Options 400-890 and one of Media Options 022-051)

The HP 91156A Development Pack includes:

1. HP 92836A FORTRAN 77 Compiler.
2. HP 92833A Pascal/1000 Compiler.
3. HP 92857A BASIC/1000C Interpreter and Compiler.
4. HP 92860A Symbolic Debug/1000.
5. HP 92861A Graphics/1000-II Device-Independent Graphics Library, Version 2.0.
6. HP 92078A VC+ Enhancement to RTE-A.
7. HP 92081A Image/1000-II Database Management System.

HP 91156B Development Pack with VC+ and Image/1000 (Must order one of Use Options 400-890 and one of Media Options 022-051)

The HP 91156B Development Pack includes:

1. HP 92836A FORTRAN 77 Compiler.
2. HP 92833A Pascal/1000 Compiler.
3. HP 92857A BASIC/1000C Interpreter and Compiler.
4. HP 92860A Symbolic Debug/1000.
5. HP 92861A Graphics/1000-II Device-Independent Graphics Library, Version 2.0.

6. HP 92078A VC+ Enhancement to RTE-A.

7. HP 92069A Image/1000 Database Management System.

HP 91157A Development Pack with Image/1000-II (Must order one of Use Options 400-890 and one of Media Options 022-051)

The HP 91157A Development Pack includes:

1. HP 92836A FORTRAN 77 Compiler.

2. HP 92833A Pascal/1000 Compiler.

3. HP 92857A BASIC/1000C Interpreter and Compiler.

4. HP 92860A Symbolic Debug/1000.

5. HP 92861A Graphics/1000-II Device-Independent Graphics Library, Version 2.0.

6. HP 92081A Image/1000-II Database Management System.

HP 91157B Development Pack with Image/1000 (Must order one of Use Options 400-890 and one of Media Options 022-051)

The HP 91157B Development Pack includes:

1. HP 92836A FORTRAN 77 Compiler.

2. HP 92833A Pascal/1000 Compiler.

3. HP 92857A BASIC/1000C Interpreter and Compiler.

4. HP 92860A Symbolic Debug/1000.

5. HP 92861A Graphics/1000-II Device-Independent Graphics Library, Version 2.0.

6. HP 92069A Image/1000 Database Management System.

Development Pack Use Options

400: Use in HP 12100A Single Board Computer, 2134A Computer, 2424A Micro 14 Computer, 2434A Micro 24 Computer, or 2484A Micro 24 SPU.

600: Use in HP 2106CK/DK Board Computer, 2156C/D Computer, 2426G/H Micro 16 Computer, 2436G/H Micro 26 Computer, or 2486C/D Micro 26 SPU.

700: Use in HP 2137B* Computer, 2437B* Micro 27 Computer, 2197E* Model 27 SPU or 2487B* Micro 27 SPU.

890: Use in HP 2139B Computer, 2439B Micro 20 Computer, 2199E Model 29 SPU or 2489B Micro 29 SPU.

Development Pack Media Options

022: Software on CS/80 Cartridge Tape (excludes options 044 and 051).

044: Software on microfloppy disks for HP 12120A*/12122A Integrated Disks in Micro/1000 package or HP 9122C/D* or 9133A*/B*/H*/L* or 9153B* Disk (excludes options 022 and 051).

051: Software on 1600 cpi Magnetic Tape (excludes options 022 and 044).

Software Support Products

See the HP 1000 A-Series Ordering Guide, 5959-7811 or a later revision, for definitions of software support products.

Interfaces Overview

A Wide Choice of Interfaces

Input/output interfaces are the crucial connecting link between the system and external peripheral devices and other computer systems. Table 4-1, below, lists the HP 1000 A-Series interfaces by category. For technical data on the respective interfaces, see the HP AdvanceNet Specification Guide, 5956-4144 or a later revision.

Table 4-1. HP 1000 A-Series Input/Output Interfaces

Category	Product Number and Name	Use
Multi-device	HP 12009A HP-IB Interface	Interfacing disks, cartridge tape subsystems, magnetic tape units, printers, plotters, and other HP-IB devices to the system.
	HP 12040D 8-Channel Multiplexer	Interfacing terminals, printers, plotters, programmable logic controllers, and other serial devices to the system.
	HP 12041B Multi-Use 8-Channel Multiplexer	Interfacing programmable logic controllers to the system.
System-to-System Communication	HP 12007B HDLC Modem Interface	Communication via modem and telephone line link with remote HP 1000 System.
	HP 12044A HDLC Direct Connect Interface	Communication via hard-wired connection with another HP 1000 System.
	HP 12073A Bisync Modem Interface	Communication via modem and telephone line link with remote HP 3000 System.
	HP 12082A Bisync Direct Connect Interface	Communication via hard-wired connection with HP 3000 System.
	HP 12075A X.25 Network Interface	Communication with other systems or terminals via X.25 Packet-Switching Network.
	HP 12076A LAN/1000 Link Interface	Communication with other systems or terminals via IEEE 802.3 or Ethernet Local Area Network.
	HP 12043A Multi-Use Programmable Serial	Communication with IBM or Plug-compatible systems via modem and telephone line link.
	HP 12072A Data Link Slave Interface	Communication via multidrop data link with a 12092A Data Link Master Interface in another HP 1000 System.
	HP 12092A Data Link Master Interface	Communication via multidrop data link with 12072A Data Link Slave Interfaces in other HP 1000 Systems.
Measurement and Control	HP 12060B High-Level Analog Input Card	Measurement of 8 ±1.23V to 10.23V fs analog input channels at rates to 55,000 channels per second.
	HP 12061A Expansion Multiplexer Card	Addition of 32 channels to the input capacity of the 12060B card.
	HP 12062A Analog Output Card	Provision of four isolated +10.23V fs analog outputs with 12-bit resolution.
	HP 12063A Isolated Digital I/O Card	Provides 16 opto-isolated inputs and 16 relay-isolated outputs.
Other Interfaces	HP 12005B Asynchronous Serial Interface	Interfacing a single terminal to the system.
	HP 12006A Parallel Interface	Interfacing 8 or 16-bit data buses to the system.
	HP 12010A Breadboard Interface	Provides I/O master and space for 60 16-pin wire wrap sockets for user-developed interfaces.

Table 4-1. HP 1000 A-Series Input/Output Interfaces, continued

Category	Product Number and Name	Use
Other Interfaces, continued	HP 12042B Programmable Serial Interface	Breadboard for user-developed modem communications interface.
	HP 12065A Color Video Interface	Connection of color graphics output to RGB Color Video Monitors.

Multi-device Interface Connections

Multiple devices connect to the HP 12009A HP-IB interface and the HP 12040D 8-Channel Multiplexer as shown in Figures 4-1 and 4-2. The acronym HP-IB represents the full name "Hewlett-Packard Interface Bus", which is a bus cable whose connection daisy-chains from one device to the next, as illustrated in Figure 4-1. Multiple devices connect to the multiplexer via its 8-connector panel, as shown in Figure 4-2.

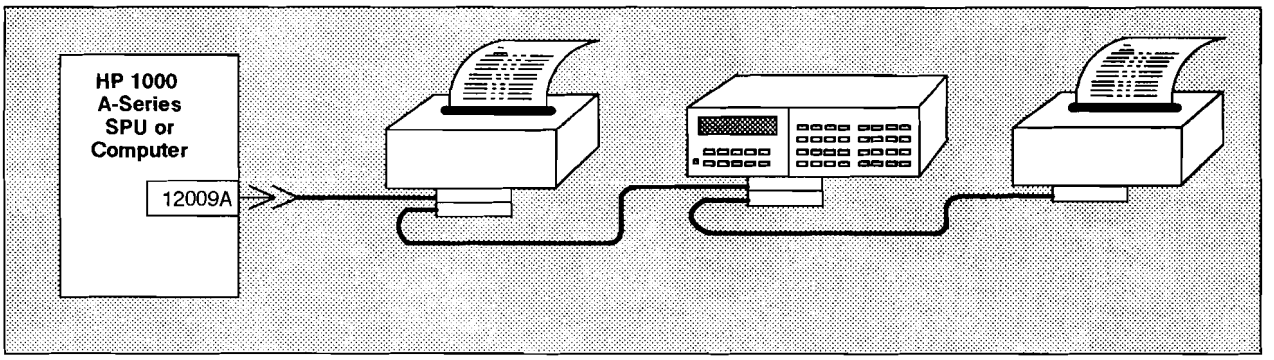


Figure 4-1. HP-IB Device Connections via 12009A HP-IB Interface

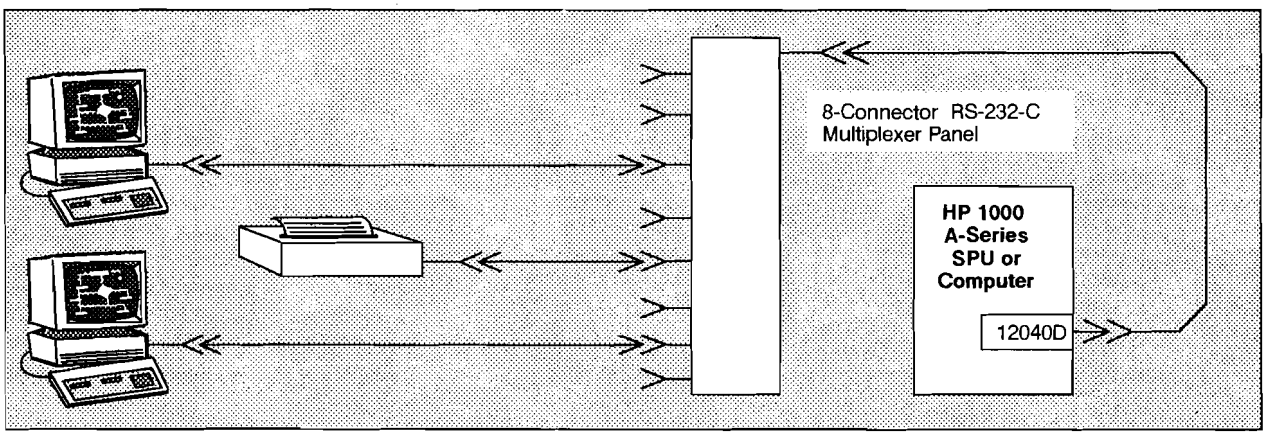


Figure 4-2. RS-232-C Device Connections via 12040D 8-Channel Multiplexer

Extension of HP-IB Transmission Distances

When it is necessary to extend the transmission distance between the system and peripheral devices beyond the limit of 15 meters (48.75 ft.) for high speed HP-IB operation, this can be accomplished with the HP 37204A Multipoint HP-IB Extender for the HP 12009A HP-IB Interface.

The HP 37204A HP-IB Extender translates parallel HP-IB data into a high-speed serial bit stream, which it transmits to another extender via 75 ohm coaxial cable (or optionally via fiber optic cable) at rates to 60,000 bits per second. Two coaxial ports support daisy-chaining of multiple HP-IB Extenders as shown in Figure 4-3, below, for maximum configuration flexibility. The optional fiber optic connection works at full speed up to the maximum transmission distance of 1.25 km (4100 ft.) vs a drop to 1/10 the data rate for distances greater than 250 meters with coaxial cable links. Fiber optic communication also:

1. Overcomes the effects of severe electrical noise.

2. Permits connection between buildings without concern for lightning hazards.

3. Renders electronic eavesdropping extremely difficult.

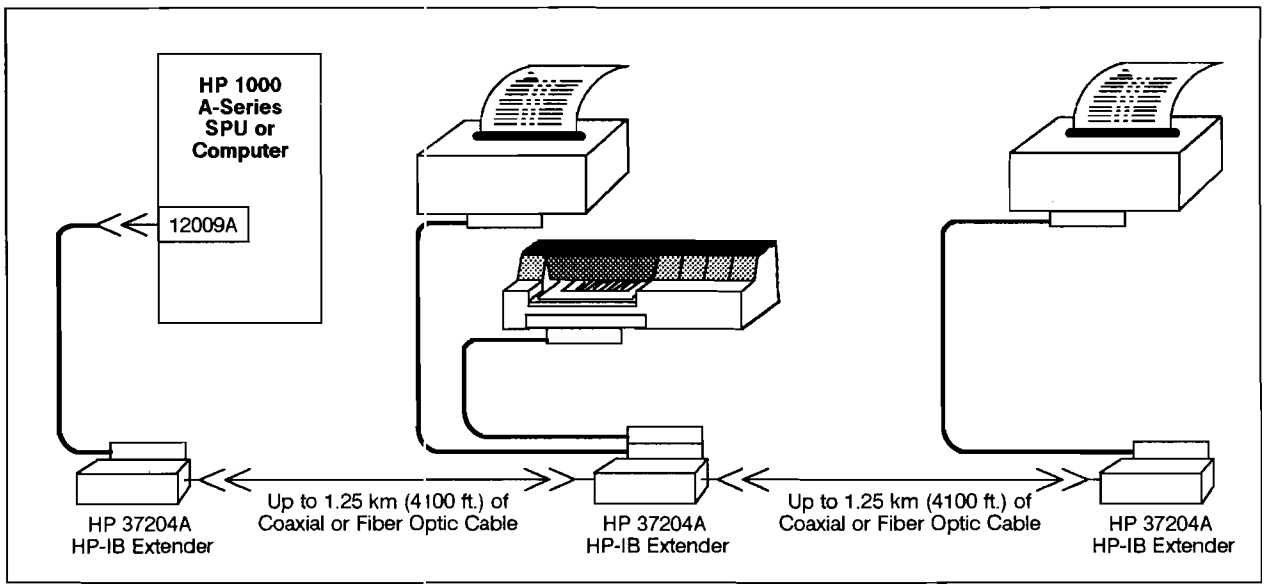


Figure 4-3. HP-IB Device Connections via HP 37204A HP-IB Extenders

NOTES:

Networking Overview

Networking Choices

Table 5-1, below, lists the Communications Packages and interfaces that are available to support network communications between HP 1000 A-Series systems and other systems. For technical data on the respective communications packages and interfaces, see the HP AdvanceNet Specification Guide, 5956-4144 or a later revision.

Table 5-1. Network Communications Packages and Interfaces for HP 1000 A-Series Systems

Communications Package	Interface	Capabilities	Communication with
91750A DS/1000-IV	12007B	Modem point-to-point communication	Remote HP 1000 system
	12044A	Direct connect point-to-point communication	Remote HP 1000 system
	12073A	Modem point-to-point communication	Remote HP 3000 system
	12081A	Direct connect point-to-point comm.	Remote HP 3000 system
	12092A*	Multidrop Data Link communication (Master)	Remote HP 1000 Data Link Slave System(s)
	12072A	Multidrop Data Link communication (Slave)	Remote HP 1000 Data Link Master System
		Remote Commanding	Remote HP 1000 or HP 3000 System
		Remote Query (user) Access to Image/1000 database in remote system	Remote HP 1000 System
		Remote Database (program) Access to Image/1000 database in remote system	Remote HP 1000 System
		Program-to-Program Communication with remote system	Remote HP 1000 or HP 3000 System
		Remote File (program) Access to files on a remote system	Remote HP 1000 or HP 3000 System
		Remote Exec Calls (program requests) for action by executive in remote system	Remote HP 1000 or HP 3000 System
91790A NS/1000	12076A	LAN communication	Remote HP 1000† HP 3000, HP 9000, Series 300 or 800, DEC VAX, or Vectra PC system
		Network File Transfer (NFT)	Remote HP 1000†, HP 3000, HP 9000, Series 300 or 800, DEC VAX, or Vectra PC system
		Telecommunications Network (TELENET)	Remote HP 1000†, HP 9000, Series 300 or 800, DEC VAX, or Vectra PC system
		Network Interprocess Communication (Net IPC)	Remote HP 1000†, HP 3000, HP 9000, Series 300 or 800, or Vectra PC system
		Remote Process Management (RPM)	Remote HP 1000 A-Series system
	12007B	Modem point-to-point communication	Remote HP 1000 system
	12044A	Direct connect point-to-point communication	Remote HP 1000 system
	12073A	Modem point-to-point communication	Remote HP 3000 system
	12081A	Direct connect point-to-point comm.	Remote HP 3000 system
		Remote Commanding	Remote HP 1000 or HP 3000 System

* Data link master communication also requires 91732A Data Link software, which has been discontinued; rights to copy 91732A can still be purchased.

† HP 1000 A-Series computers only.

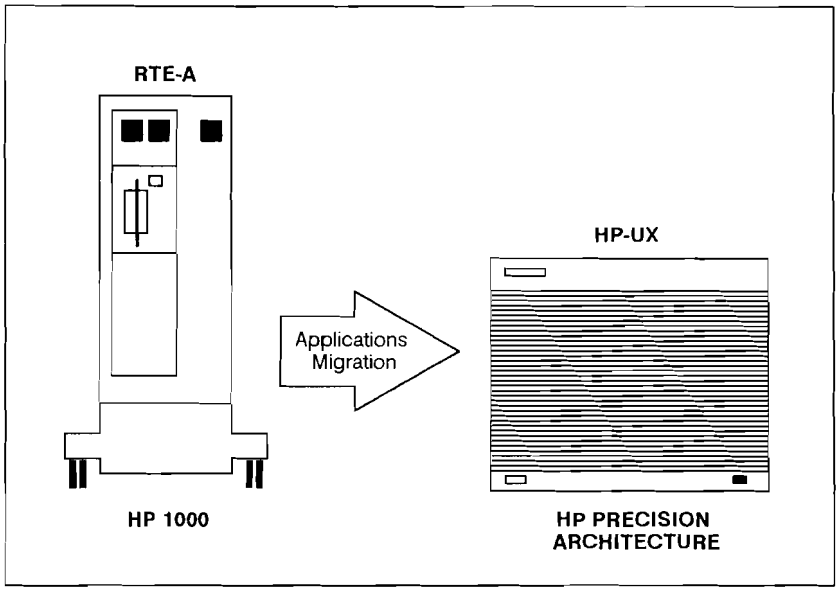
Table 5-1. Network Communications Packages and Interfaces for HP 1000 A-Series Systems, continued

Communications Package	Inter-face	Capabilities	Communication with
91790A NS/1000, continued	See previous page	Remote Query (user) Access to Image/1000 database in remote system	Remote HP 1000 System
		Remote Database (program) Access to Image/1000 database in remote system	Remote HP 1000 System
		Program-to-Program Communication with remote system	Remote HP 1000 or HP 3000 System
		Remote File (program) Access to files on a remote system	Remote HP 1000 or HP 3000 System
		Remote Exec Calls (program requests) for action by executive in remote system	Remote HP 1000 or HP 3000 System
98170A ARPA Services/1000	12076A	LAN communication	Remote HP 1000, HP 9000, Series 300 or 800, Vectra or IBM PC, or Sun (680x0) system
		File Transfer Protocol (FTP)	Remote HP 1000, HP 9000, Series 300 or 800, Vectra or IBM PC, or Sun (680x0) system
		Telecommunications Network (TELENET)	Remote HP 1000, HP 9000, Series 300 or 800, Vectra or IBM PC, or Sun (680x0) system
91751A X.25 Link/1000	12075A	Communication via private or public X.25 packet-switched networks	Any remote system capable of communicating via the packet-switched network via direct user access to X.25 level 3. With HP 91750A DS/1000-IV communications software, the X.25 Link/1000 supports full DS/1000-IV networking with remote HP 1000 and HP 3000 systems via packet-switched network.
91781A RJE/1000-II	12043A	Remote job entry communication via modem and telephone line link, emulating IBM 2780 and 3780 workstations	Remote IBM or plug-compatible system with JES2, JES3, or HASP II job entry system OR Remote HP 1000 with RJE or RJE/1000-II OR Remote HP 3000 with RJE OR Remote HP 9000 with RJE
91782A MRJE/1000	12043A	Multileaving remote job entry communication via modem and telephone line link, emulating IBM HASP Multileaving workstations	Remote IBM or plug-compatible system with JES2, JES3, or HASP II (version 4 or later) job entry system
91784A PMF/1000	12043A	Interactive program communication via modem and telephone line link, emulating IBM 3270 series cluster controllers	Remote IBM or plug-compatible system with VTAM, BTAM, TCAM, including ACF versions of VTAM and TCAM

92562A PORT/RX
HP-UX Migration Utilities

Introduction

PORT/RX is a collection of utilities for migrating applications from HP 1000 RTE-6/VM and RTE-A to HP Precision Architecture (HP-PA) with HP-UX. PORT/RX utilities minimize the porting effort for high level applications and data. Key elements of PORT/RX include a Migration Analysis Utility, file and data transport utilities, and RTE intrinsics emulation routines on HP-UX. These utilities are complemented by compatible high level languages and translators to ease the migration of subsystem dependent code.



Features

- Migration and Coexistence Documentation
- Migration Analysis Utility
- RTE Emulation Software
- RTE Interactive Environment on HP-UX
- RTE to HP-UX Data Transfer Utilities
- IMAGE Migration Utilities
- FORTRAN Conversion Utilities
- Compatible Subsystems:
  - FORTRAN
  - Pascal
  - C
  - FORMS

The Migration Process

PORT/RX provides utilities to help users port their applications from the HP 1000 product line to the HP 9000 Series 800 product line. PORT/RX supports source level migration to fulfill those objectives. There are three steps in the migration process: Evaluation, Transport, and Conversion.

Evaluation/Preparation

The Migration Evaluation Kit contains, among other things, the utililties that run on HP 1000 and a complete set of migration documentation. It gives a preliminary estimation of the difficulties that will be involved in migrating an application.

Using the manuals listed in the documentation section as a guide, applications under development can be designed for maximum portability to HP Precision Architecture systems. The Migration Analysis Utility scans source code and identifies RTE system and subsystem dependencies and notes whether or not they are emulated with PORT/RX. This information, along with error messages from the HP-PA compiler, will indicate the areas in the application which will require modification.

Application Transport

Programs (source code) and data (ASCII or binary) are transported to the HP-PA system via mag tape or NS/1000. (Rtear will enable the user to read source or data files in RTE file format and move them onto HP-UX.) Source code also can be transported via LAN using Network Services utilities.

Conversion

Programs are compiled on the HP-UX system, which allows non-emulated code to run in native mode. Most RTE file system, EXEC, and system library routines are emulated. RTE dependencies not emulated must be rewritten by the user, using equivalent HP-UX intrinsics (see Figure 6-1, next page).

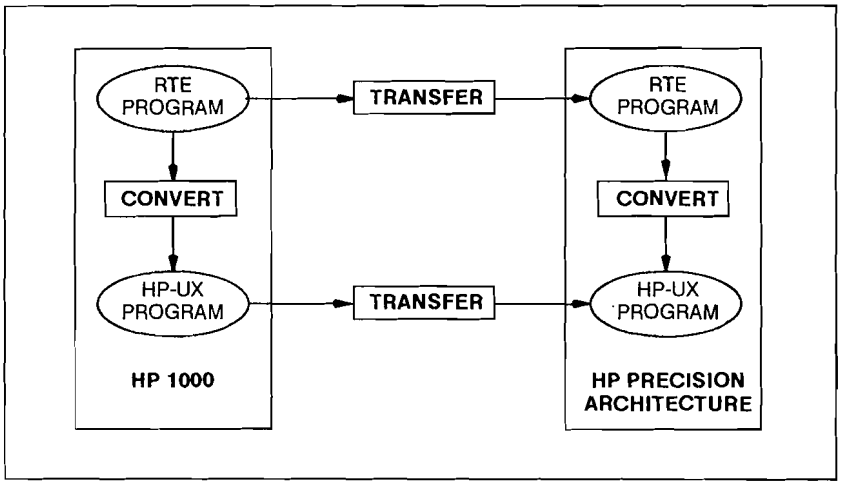


Figure 6-1. Program Conversion Process

Syntactic and semantic differences in HP 1000 FORTRAN programs are converted to HP FORTRAN 77/UX equivalents either programmatically or by the user. A FORTRAN conversion utility translates those differences; otherwise they are identified by the HP FORTRAN 77/UX compiler. The Language Migration Guides also help identify language differences and provide conversion details.

ASCII data needs no conversion. Binary data is converted using instructions in the PORT/RX *Migration User's Guide* (Pub. No. 92561-90003) and associated utilities. Data in floating point format must be converted to IEEE format via a user program using floating point conversion subroutines provided in PORT/RX (see Figure 6-2, below).

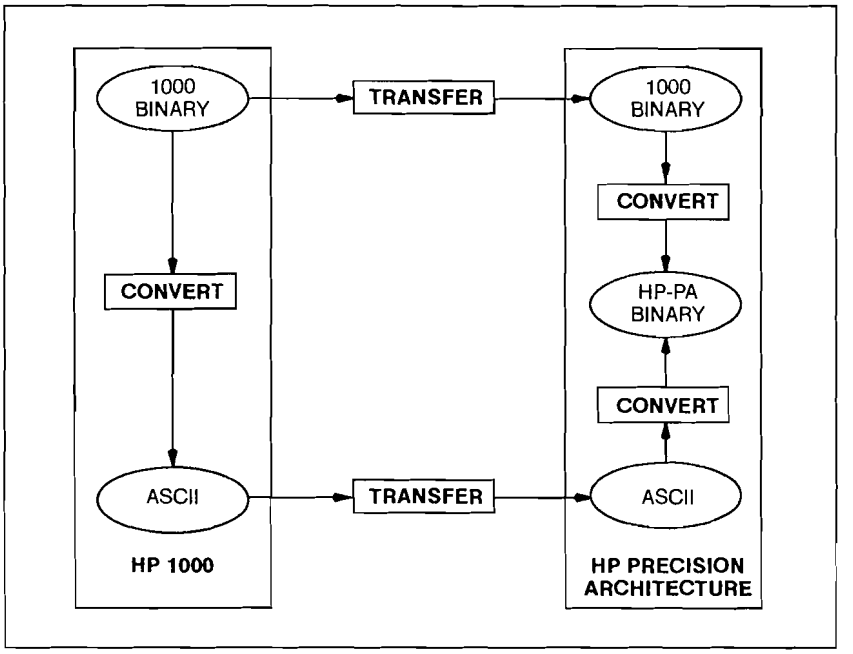


Figure 6-2. Data Conversion Process

PORT/RX and Migration Tools

Programming for Portability Guide

The ease with which software is ported from one architecture to another depends on the emphasis placed on portability during the design and implementation of the application. Guidellines for maximizing the ability to port from RTE-A and RTE-6/VM applications to HP Precision Architecture/HP-UX are covered in the *Programming for Portability Guide* (Pub. No. 92561-90001). The guide describes language, operating system, and subsystem considerations.

All manuals associated with PORT/RX are available under the single product number 92561K.

Migration Analysis Utility

The Migration Analysis Utility can be used on both the HP 1000 and the HP 9000 Series 800. It scans source code for HP 1000 system and subsystem dependencies. It generates a report pointing out the lines that contain non-emulated, partially emulated, and fully emulated RTE calls. The Migration Analysis Utility scans programs written in C, Pascal, and FORTRAN and flags RTE system library, FMP, EXEC, IMAGE, DS, and Graphics call dependencies. The Migration Analysis Utility and the HP Precision Architecture compilers can be used to estimate and plan the migration effort.

RTE System Library Emulation

Over 80% of RTE System Library calls are emulated in HP-UX. Those emulated calls typically account for 98% of the calls to system library routines. Non-emulated calls include those used for session accounting and programmatic spooling, which are not used frequently in RTE programs. Recoding for non-emulated calls is documented in the *PORT/RX Migration User's Guide.*

RTE EXEC Emulation

Most RTE EXEC calls are emulated under PORT/HP-RX. Emulated EXEC calls include those which:

- Perform I/O operations
- Terminate or suspend programs
- Load program segments into memory
- Schedule other programs
- Perform class I/O
- Time schedule programs.

PORT/HP-RX supports EXEC calls to HP-IB, GPIO, RS–232C, 9-track mag tape, and line printers. Disks are supported through the file system; programs which make EXEC calls to disk will have to be modified to use HP-UX directly.

RTE File System Emulation

PORT/RX contains an emulated RTE file system that includes both the FMGR and CI file systems. Over 85% of the RTE file system calls are emulated under PORT/RX.

PORT/RX does not support applications that access the same RTE files using both language and FMP I/O calls.

Assembly Language Programs

Due to the architectural dependencies of assembly language, programs written in HP 1000 assembler must be rewritten to port to HP Precision Architecture systems. Often, raw application speed can be maintained by rewriting assembly-language routines in an optimized high level language, such as C.

Interactive RTE Services

Entering the command rtesh at the HP-UX prompt will put the user into a "CI-like" environment for converting RTE emulated programs and supporting the creation and maintenance of an emulated RTE file system. The following RTE commands are emulated under rtesh:

```
AT   BR   CL   CO   CR   DL
EX   GO   IO   LI   MO   OF
PR   PROT PU   RN   RP   RU
SS   WD   WH   XQ   ??   CRDIR
OWNER
```

In addition, an EDIT/1000-like screen editor is provided, which supports most EDIT/1000 features.

Command Files

The structures if-then-else-if, while-do-done, and return are offered on command file mode only, as is access to all the RTE shell prompts.

Code Size Reduction

PORT/RX has built-in mechanisms that reduce the size of required executables on disk. The PORT/RX scheme is similar to shared libraries in the sense that only one copy of the emulated library exists. As a result, a reduction in the size of executables, up to a magnitude of three times, can be seen, depending on the size of the application and the types of emulated calls.

Other Migration Issues

Database Migration Utilities

Although the HPIMAGE interface of ALLBASE is quite similar to IMAGE/1000, architectural differences make 100% compatibility impossible. Migration utilities can be used to port application programs and databases. IMAGE/1000 applications can be recompiled and executed on HP-UX with a run-time translator intercepting IMAGE/1000 calls and making the appropriate call to HPIMAGE. Only 1% of the calls are architecturally dependent and will have to be changed or removed for translator compatibility. The Migration Analysis Utility flags those incompatible calls.

Two tools are used in moving the database from RTE to HP-UX. The Database Migration Unload utility unloads and simultaneously converts IMAGE/1000 databases into HPIMAGE format. A Root-file Decompiler utility converts IMAGE/1000 root files into HPIMAGE schema files. A manual conversion is necessary to convert IMAGE/1000-I rootfiles. The database migration utilities come standard with HP ALLBASE.

Graphics

Graphics support for HP Precision Architecture HP-UX systems includes DGL/AGP/HP-UX, which differs slightly from DGL/AGP on HP 1000 systems. The differences relate primarily to error handling and the use of device file names in HP-UX vs LU parameters in RTE. The Migration Analysis Utility flags differences. PORT/RX documentation provides instructions for recoding. The DGL/AGP documentation further identifies areas of difference and offers instructions for porting.

Networking

Networking on HP Precision Architecture/HP-UX systems is based on Network Services software and LAN 9000 Series 800 Link hardware. HP Precision Architecture HP-UX systems can communicate via the LAN with HP 1000 A-Series systems and HP 9000 Series 200/300/500 systems running Network Services software. HP 1000 A-Series can serve as gateways between HP 1000 E/F-Series systems running DS/1000-IV and HP Precision Architecture systems.

HP 1000 A-Series applications using Network Services (NS) calls can generally be ported to HP Precision Architecture systems based on NS/9000 Series 800 services. A- and E/F-Series applications using DS/1000-IV can be evaluated using the Migration Analysis Utility to flag calls that don't map directly to NS/1000 and HP Precision Architecture Network Services. DS/1000-IV to NS/1000 migration documentation explains how to recode to achieve DS/1000-IV functionality on NS/1000.

Subsystem Compatibility

FORTRAN

Series 800 FORTRAN 77 on HP Precision Architecture systems is compatible with HP 1000 FORTRAN and HP 9000 FORTRAN. All FORTRAN 77 compilers are based on the ANSI 77 standard.

Much of the HP 1000 FORTRAN feature set is compatible with FORTRAN 77 on HP Precision Architecture. For HP 1000 and Series 800 incompatible features, a FORTRAN conversion utility (FTNCUT), supplied with the PORT/RX package, can be run on a source program prior to compilation on the HP Precision Architecture system to provide easier migration from the HP 1000 or Series 800. The PORT/RX package increases feature set compatibility by supplying RTE emulation software. This allows most RTE EXEC calls within FORTRAN to be executed on HP Precision Architecture.

HP 9000 Series 800 and Series 300 FORTRAN 77 are hightly compatible. Ease of migration varies based on the system-dependent features used.

Pascal

HP Pascal/HP-UX is a superset of HP Standard Pascal, which is based on the ANSI/IEEE 770X3.97-1983 and ISO 7185-1983 standards. Although Pascal/HP-UX currently is not validated against the ANSI and ISO standards, it meets most of the requirements of the standrds.

Pascal/1000 is based on HP Standard Pascal and includes extensions, which can be flagged by the Pascal/1000 compiler.

C

Corporate Computer Systems (CCS) provides a C compiler for the HP 1000 that is compatible with HP C/HP-UX on HP Precision Architecture. HP 1000/C conforms with the emerging ANSI standard. However, HP C/HP-UX does not fully conform with the emerging ANSI standard.

HP 9000 Series 300 and Series 800 HP C/HP-UX compilers are highly compatible. Ease of migration varies based on the system-dependent features used.

FORMS

An emulated implementation of FORMS/1000 is provided on HP Precision Architecture. F1000/HP-UX is 100% compatible with FORMS/1000, so no changes to Forms calls are required when moving an application from an HP 1000 system to an HP Precision Architecture system.

Migration Consulting

Migration consulting for your specific application is available through HP's Application Engineering Organization. Contact your local HP Sales Office for details.

System Environment

PORT/RX is supported on the HP 9000 Series 800 systems, HP-UX release 3.0 or later.

The Migration Evaluation Kit is supported on HP 1000 systems operating under RTE-A or RTE-6/VM.

Ordering Information

92562A PORT./RX, including the 92561K documentation set.

92561A Migration Evaluation Kit, including Migration Analysis Utility, database migration utilities, transport utilities, and 92561K documentation set.

92561K Documentation Set, consisting of:

1. 92561-90001 Programming for Portability Guide.
2. 92561-90002 PORT/RX Migration Analysis Utility Manual.
3. 92561-90003 PORT/RX Migration User's Guide.
4. 92561-90004 PORT/RX Reference Manual.

RMTERM/840 Terminal Emulator Application Brief

Introduction

RMTERM/840 (ReMote TERM) allows an user terminal connected to an HP 9000 Model 840* system to act as a virtual terminal to a remote computer system. Communication takes place from the Series 800 system via a second RS-232C port connected to the remote system. RMTERM/840 is a C Language program which executes on HP 9000 Model 840* systems.

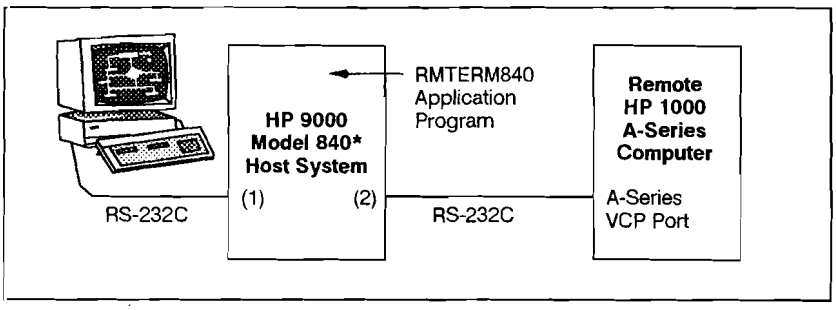
RMTERM/840 can be used to download and boot an HP 1000 RTE-A operating system (type 1 file) if the Model 840* is connected to the Virtual Control Panel (VCP) port of the target HP 1000 A-Series computer. Once the operating system is downloaded, RMTERM acts as the system console on the A-Series computer. This allows remote HP 1000 A-Series systems to be controlled by a terminal on the Model 840*. Other ASCII and binary files may also be transferred.

RMTERM/840 will run from any terminal connected to the Model 840*, and will connect to an HP 1000 with a transfer rate up to 19.2K baud. The file "rmterm.c" is the source for RMTERM/840 and is included in the Appendix of this application brief. The "rmterm.c" source code is also available from the HP 1000 Contributed Library.

Features

- Download and boot RTE-A Operating Systems from HP-UX
- Boot remote disk based RTE-A operating systems from HP-UX

* The HP 9000 Model 840 Computer is a discontinued product; RMTERM/840 should also function on other HP 9000 Series 800 systems, but has not been tested on them by Hewlett-Packard.



NOTE: The information presented in this application brief is provided as a convenience to Hewlett-Packard customers. With regard to the information presented, Hewlett-Packard disclaims any and all liability and makes no warranties, express or implied, including fitness for a particular purpose. The information may be subject to change without notice.

- Log continuous data to an HP-UX file from a remote A-Series computer
- Terminal connection to remote HP 1000 A- Series computer System
- Transfer ASCII files between HP-UX and RTE-A (RTE-A file types 3 and 4)
- Transfer RTE-A Operating System files from RTE-A to HP-UX
- Transfer binary files from HP-UX to RTE-A (using a simple program on the A-Series)

Hardware Requirements

The program requires two RS-232 ports, one connected to the terminal on the Model 840* host computer (connection 1 in the diagram above), and another port connected between the Model 840* and a remote system (connection 2 in the diagram). RMTERM/840 will make the Model 840* terminal appear physically connected to the remote system.

See the HP-UX System Administration Manual (92453-90004) for details describing the standard HP-UX terminal connection 1.

Connection 2 requires a male-to-male 3 wire RS-232 cable with pins 2 and 3 reversed. When the A-Series is used as the remote computer a modem cable is used (HP part number 92218A).

NOTE: Overrun problems can occur if the remote system's baud rate is faster than the host system's baud rate and flow control is disabled. This occurs because data comes in faster than it can be displayed on the terminal. Eventually the buffers will be overrun.

ENQ/ACK handshaking controls the flow of data between the Model 840* terminal and an A-Series computer. ENQ is a byte of data sent from the A-Series approximately every 80 characters. Once an ENQ is sent, additional data will not be sent until ACK is received by the A-Series, or a time out occurs in the A-series. Although the XON/XOFF protocol is normally used in HP-UX systems, HP terminals support the ENQ/ACK protocol. See the HP terminal configuration manual and enable the ENQ/ACK protocol inside the terminal. Because ENQ and ACK are ASCII data, they will be sent through the Model 840* directly to the terminal thus enabling flow control. XON/XOFF protocol in the remote computer can be enabled in the same manner. Using the RTE-A CN34B request, disable XON/XOFF flow control in HP-UX and enable XON/XOFF protocol inside the terminal.

Software Configuration

The HP 1000 A-Series or other remote computer will need no special software, because RMTERM/840 will emulate a standard terminal.

In the Model 840, HP-UX normally places a "getty" on a terminal, producing interactive prompts for the user. The "getty" will not be needed during the operation of RMTERM. Reconfigure the communication port which will connect the Model 840 to the remote system by changing the "/etc/inittab" file as shown below.

```
# The bold line removes the "getty" from
# the 840 communication port to the
# remote system. This example:
# tty4p4. "9600f" is a baud rate defined
# in "/etc/gettydefs" but "rmterm" will
# force a reconfiguration of the port

  g1:2:respawn:/etc/getty -h tty4p1 9600f
  g2:2:respawn:/etc/getty -h tty4p2 9600f
  g3:2:respawn:/etc/getty -h tty4p3 9600f
                    .
                    .
                    .
g4:2:off:/etc/getty -h tty4p4 9600f
                    .
                    .
                    .
  g5:2:respawn:/etc/getty -h tty4p5 9600f
```

After /etc/inittab has been modified, the system may be rebooted, or "telinit -q" can be used to inform the system of the change. Now, there is no terminal "getty" to interfere with RMTERM communications.

Running RMTERM/840

To start RMTERM, type,

```
rmterm TTY [-sSPEED]
```

where TTY is the port on the host system which is connected to the remote system, and "SPEED" is the baud rate of the link. RMTERM changes TTY to /dev/TTY, so do not enter the full path name.

Using the "tty4p1" connection configured above, the following command line could be entered:

```
rmterm tty4p4 -s9600
```

Once executing in remote terminal mode, RMTERM clears the screen and shows a status line highlighted across the top. To leave remote terminal mode and enter command mode, touch the break key. At this point you may generate a break ("b" command), leave RMTERM ("l" command), enter the RTE-A System download sequence ("d" command), or transfer files between the host and remote systems ("r" for RTE to HP-UX or "h" for HP-UX to RTE). Touching any other key returns you to remote terminal mode. Figure 6-3, next page, is an example of an RMTERM session.

Exiting RMTERM reconfigures the ports, and returns control back to the shell which started the RMTERM process.

Note: In remote terminal mode, touching the "break" key sends a break to HP-UX returning RMTERM to command mode. In command mode entering the break command ("b") sends a break to the remote system (like touching the "break" key on the actual HP 1000 terminal).

RMTERM A-Series Download Mode

RMTERM/840 contains a download subroutine, which allows an HP1000 type 1 system file to be downloaded to any A-Series remote system via the remote's VCP (Virtual Control Panel) port. This allows a remote A-Series system without a disk to be booted and controlled by a terminal on the Model 840. The RMTERM remote terminal mode also allows access to the VCP so that the desired VCP command may be used to boot a remote disk based system.

All handshakes with the HP1000 Virtual Control Panel are handled automatically by the download routine. If the first handshake completes normally, a message will indicate this fact. Download progress information (the number of 64k byte chunks transmitted) will be sent to the host terminal. See Figure 6-3 for a sample download session. To stop the download process, use the QUIT function (usually the "ctrl |" key defined by "stty" on HP-UX systems).

Download mode will transfer a memory based system of 0.5 MB in approximately 9 minutes at 19.2k baud, or 18 minutes at 9600 baud.

Download in non-interactive batch mode by using,

```
rmterm TTY [-sSPEED] -d
SELECTCODE DOWNLOADFILE -b
```

The "-b" is used to generate a break, which satisfies HP 1000 speed sensing selection (so downloading will occur at the desired baud rate).

RMTERM Continuous Data Logging

By using the "-l" option in the RMTERM shell command string continuous data logging may be initiated on the HP-UX system,

```
rmterm TTY [-sSPEED] -lLOGFILE
[-a [ok]]
```

The process is first initiated on HP-UX. Afterwards, any output from the A-Series I/O port will be logged to LOGFILE, continuously, until the RMTERM process is terminated. During data logging, ACK/ENQ handshaking (satisfying the ENQ/ACK handshaking of the HP 1000) is handled by RMTERM using the "-a" option. Previous log files can be overwritten by using the "ok" option.

```
% rmterm
Remote terminal mode usage:
      RMTERM TTY [-sSPEED]
HPUX-RTE file transfer only usage:
      RMTERM TTY [-sSPEED] -h [SOURCEFILE [DESTINATIONFILE [FILETYPE [ok]]]]
RTE-HPUX file transfer only usage:
      RMTERM TTY [-sSPEED] -r [SOURCEFILE [DESTINATIONFILE [ok]]]
HP1000 download only usage:
      RMTERM TTY [-sSPEED] -d [SELECTCODE [DOWNLOADFILE [-b]]]
Data log only usage:
      RMTERM TTY [-sSPEED] -lLOGFILE [-a [ok]]
Quit data log usage:
      RMTERM -qPID

% rmterm tty4p4 -s19200
     RMTERM: Remote terminal/file transfer/download program to HP1000
Term: 9600 baud  REMOTE TERMINAL MODE  Link: /dev/tty4p4     Link speed: 19200 baud

CI>
[PRESS BREAK KEY]
                        Leaving Remote Terminal Mode
(D)ownload, (R)te->hpux, (H)pux->rte, (L)eave RMTERM, or (B)reak remote (continue)?
[PRESS B KEY]
                        Sending a BREAK to remote
                Resuming Remote Terminal Mode (BREAK to quit/download/break remote)
  P 001321 A 000001 B 000000      RW 100002 M 001320 T 014643
VCP>
[PRESS BREAK KEY]
                        Leaving Remote Terminal Mode
(D)ownload, (R)te->hpux, (H)pux->rte, (L)eave RMTERM, or (B)reak remote (continue)?
[PRESS D KEY]
                        Download remote. Normal QUIT (34) in effect
What is the select code of serial device? (^D to quit) 77
What is the name of the file to download with (^D to quit)   rte_system.sys
Download HP1000 A-Series with file "rte_system.sys"
Download 2 full 64k byte blocks followed by a 6144 bytes partial block
...first handshake to HP1000 complete
...finished a 64k byte block
...finished a 64k byte block
DOWNLOAD SUCCESSFUL
                Resuming Remote Terminal Mode (BREAK to quit/download/break remote)
*RTE-A READY*
[PRESS BREAK KEY]
                        Leaving Remote Terminal Mode
(D)ownload, (R)te->hpux, (H)pux->rte, (L)eave RMTERM, or (B)reak remote (continue)?
[PRESS R KEY]
RS-232 File transfer utility RTE-A --> HPUX
Path name of RTE-A source file? (^D to quit)   /system/rte_system.sys
Path name of HPUX destination file? (^D to quit)   rte_system.sys
Transfer from "/system/rte_system.sys" to "rte_system.sys"
RTE-A file type is 1
        360 Kbytes...
File transfer complete.   "rte_system.sys": 360000 bytes.
                Resuming Remote Terminal Mode (BREAK to quit/download/break remote)
```

Figure 6-3. RMTERM Sample Session

Running RMTERM in background will make the user terminal available for other tasks during the logging operation. As a convenience, RMTERM returns it's process ID which can later be used to terminate the program:

```
rtmterm -qPID
```

PID is the process ID previously returned by RMTERM when the continuous logging mode was initiated.

The following is an example logging session:

```
% rmterm tty4p4 -llgfl &
[1] 14
% PID: 14 To quit logging to "lgfl",
  use "rmterm -q14".
% rmterm -q14
Created "lgfl": 509 bytes
[1]  +Stopped (tty output) rmterm
tty4p4 -llgfl
%
```

RMTERM File Transfer Mode

RMTERM/840 contains a file transfer subroutine, which can be used to transfer files in batch mode from the HP-UX shell command line (without entering remote terminal mode), or during a remote terminal session.

File transfer mode is entered implicitly by using the RMTERM run string. Another method requires touching the "BREAK" key while in RMTERM in remote terminal mode and selecting either (R)te for an RTE to HP-UX file transfer, or (H)pux for an HP-UX to RTE file transfer. During the process, the amount of data transferred will be displayed.

In batch mode the following RMTERM command strings are used:

```
rmterm TTY [-sSPEED] -r
RTEFILE HPUXFILE [ok]
```

will transfer a file from RTE to HP-UX (overwriting the HP-UX file if "ok" is added); or by using

```
rmterm TTY [-sSPEED] -u HPUX-
FILE RTEFILE TYPE [ok]
```

will transfer a file from HP-UX to RTE (overwriting the RTE file if "ok" is added).

How the file transfer process works

RTE to HP-UX

RTE-A file types 1, 3, 4, or 6 can be copied. RMTERM first requests a directory list ("DL" command) from RTE. If the file exists and is type 3 or 4 (ASCII), RMTERM then requests a copy using the RTE Command SP Interpreter "CO" command. Each "CRLF" record terminator is converted to a "\n" (newline in HP-UX). If the RTE-A file type is 1 (memory image such as a system file) or type 6 (program files) the data is transferred verbatim.

HP-UX to RTE

RTE-A destination file types 3 or 4 can be copied. ASCII file type 4 transfers from HP-UX to RTE-A will be forced to type 3. Any ^D characters will be stripped.

Other file types may be transferred with some additional effort. Suppose for example, that the remote system is disk based and you wish to move several type 1 system files from HP-UX to the target. RMTERM cannot use the RTE-A command interpreter CO command because it expects ASCII data. In this case, a special program is needed on the RTE-A system to receive the data and put it in the proper file.

Embedded in the RMTERM source in the Appendix is a FORTRAN program (hpux1.run) which will perform this function.

The RMTERM.C Source Code

The RMTERM source is shown in the Appendix, pages 6-10 through 6-27. The download subroutine included, is designed to transfer a type 1 RTE-A system to a VCP port but the remote system could be another computer, a robot, or a black box. A specific download subroutine may be written which will perform any special file transfer, which is required for a particular application. The data logging routine may be modified to force an action when a specific data stream (such as AUTOR's "powerfail" message) is detected.

After the RMTERM source is edited, recompile it using,

```
cc rmterm.c -o rmterm
```

RMTERM Functional Description

RMTERM.C is divided into six parts: initialization, remote terminal mode, break key processing, file transfer, data logging, and download. Each of these functions are briefly described below. For further information consult the source code.

Initialization

In this section, the parameters passed to RMTERM are verified, with the "DEFAULT_BAUD" substituted if none is passed. The current state of each I/O port is saved (using TCGETA and ioctl), then converted as desired. The SIGINT signal is enabled, so that the BREAK key enters the sigint_handler. Finally the process suspends, waiting for input, using the select call.

Remote Terminal Mode

If no activity occurs for a fixed time (set by the #define INACTIVITY_TO statement) RMTERM will stop, allowing another user to gain access. Otherwise whenever data is available at the communication port or the local terminal port, the data is routed to the local terminal or communication port, respectively.

Break Key Processing

When the break key is depressed, the "sigint_handler" signal handler routine executes. Here the user is prompted for the choice. If a "B" is entered the appropriate subroutine is executed (see next section); if an "L" is entered, the ports are restored and the process terminates. An "R" or a "U" will initiate file transfer. Any other key causes RMTERM to re-enter remote terminal mode.

File Transfer

If the "-u" option is chosen, all parameters are passed to the "HPUXtoRTE" subroutine. In the other case, when the "-r" option is chosen, parameters are passed to the "RTEtoHPUX" subroutine. If any parameters are not included, they default to null, and the subroutine will prompt the user for the proper values. "-" may be used for file names where appropriate to allow stdin and stdout.

Each of the file transfer routines invoke subroutine called "init_ci" to guarantee that a copy of CI is running on the remote system, and to determine if the RTE-A file exists.

Next, depending on the file type, handshaking is performed to allow the file transfer. Note that no data checksums are used, so if data validity is required use a comparator such as HP-UX's "cmp" to guarantee the data.

Data Logging

The "datalog" routine processes the "-q" and the "-l" options. If the "-l" option is selected, the file is opened and all data, until the SIGUSR1 signal is received, is routed to the file. Note that the file may be accessed by other processes during the logging operation. If "-q" is selected, the SIGUSR1 signal is sent to the process ID whose ID number is associated with the "-q" option.

Download

This subroutine performs all the necessary handshakes to facilitate an RTE-A system download (including a %bctSC command to VCP, where SC is the HP 1000 serial port select code). A complex handshake occurs, and the file (the name of which the user inputs) is downloaded, 510 bytes at a time followed by a checksum. When this is finished, RMTERM reverts back to remote terminal mode.

Appendix: RMTERM Source, Version 1.0. (Version 2.0, a superset of Version 1.0, is available).

```
/* RMTERM (ReMoteTerminal) is a program which allows a remote terminal/file
transfer, and download to an HP1000 A-Series system connected via RS-232.
Remote terminal mode is exited by hitting the break key, when one has the
option to generate a break, transfer files, download via RS-232, or exit.

*****************************************************************
* Note: This is given in source format, and is intended as an   *
*       aid to Hewlett-Packard Customers.  Although features    *
*       described have been proven, Hewlett-Packard does not    *
*       support the use of this program.  It is given as a      *
*       starting point for customers who need this type of      *
*       application.                                            *
*                                                                                *
*****************************************************************/

#include <stdio.h>
#include <signal.h>
#include <fcntl.h>
#include <errno.h>
#include <time.h>
#include <termio.h>
#define BUFSIZE 1024                    /* max size for each remote terminal read */
#define PATH_LEN 80                     /* max pathname length for file names */
#define INACTIVITY_TO 900               /* 15 minute auto log off */
#define TTY 0                           /* for array referencing */
#define COM 1                           /* for array referencing */
#define TTYPATH "/dev/tty"              /* the path name for terminal TTY */
#define DEFAULT_BAUD B9600              /* the default baudrate if no "-sSPEED" */
#define SDEFAULT_BAUD "9600"            /* default baudrate string */
#define REC_BYTE_SIZE 510               /* number of characters per download record */
#define RTEBLOCKSIZE 256                /* number of characters per RTE-A file record */
#define CIXDELAY 50000                  /* length of delay loop to compensate for CIX */
#define RETRYMAX 5                      /* number of times to try to get CI prompt */
#define BREAKCOUNT 8                    /* number of ACK's to send after break */
#define MASK(f) (1<<f)    /* perform the bit shift on "1" "f" bits left */
#define SUPSHIFT(string,cptr) for(cptr = string;*cptr != '\0';cptr++) if(*cptr >= 'a' && *cptr <= 'z') *cptr += 'A'-'a'
#define SDOWNSHIFT(string,cptr) for(cptr = string;*cptr != '\0';cptr++) if(*cptr >= 'A' && *cptr <= 'Z') *cptr += 'a'-'A'
#define DELAY(t)          for(t=0;t<CIXDELAY;t++)t += (10*(t/2)) % 10;

extern int errno;
int fd[2];                              /* filedescriptors for TTY and communication TTY */
int justdownloaded;                     /* flag to prevent timeout messages */
short baudrate;                         /* the baud rate value for communication port */
char progname[16];
struct termio io[2];                     /* the original configuration of the two ports */
int logfiledescriptor;                  /* the file descriptor of the log file name */
char logfilename[PATH_LEN];             /* the file name of log file */
int sigint_handler();                   /* signal handler for SIGINT */
int logPID = 0;                         /* the process ID of the logging process */
int logcount = 0;                       /* the number of bytes written to logfile */
struct sigvec sigint_vec = {
            sigint_handler,0,0};
int sigusr1_handler();                  /* signal handler for SIGUSR1 in data log subroutine */
struct sigvec sigusr1_vec = {
            sigusr1_handler,0,0};

main(argc,argv)
int argc;
char **argv;
{
            int nfound,readfds,writefds,exceptfds;
            int filemask[2],i,nbytes,temp,error;
            char *c,buf[BUFSIZE],compath[PATH_LEN],termbaud[6],linkbaud[6];
            struct timeval timeout;
            strcpy(progname,*argv);
            SUPSHIFT(progname,c);       /* Case fold */
```

```
if (argc == 1) show_runstring();          /* exit, showing runstring */
if (argv[1][0] == '-' && argv[1][1] == 'q') {
        if((error = datalog(0,argv[1])) != 0)
                fprintf(stderr,"%s %s returned error: %d\n",
                    prognam,argv[1],error);
        exit(-1);
        exit(0);
}
sprintf(compath,"/dev/%s",argv[1]);
temp = 2;
if ((argc > 2) && argv[2][0] == '-' && argv[2][1] == 's') {
        if (strcmp(argv[2],"-s9600") == 0) baudrate = B9600;
        else if (strcmp(argv[2],"-s19200") == 0) baudrate = B19200;
        else if (strcmp(argv[2],"-s4800") == 0) baudrate = B4800;
        else if (strcmp(argv[2],"-s2400") == 0) baudrate = B2400;
        else if (strcmp(argv[2],"-s1200") == 0) baudrate = B1200;
        else if (strcmp(argv[2],"-s300") == 0) baudrate = B300;
        else {
                fprintf(stderr,"Invalid baud rate\n");
                show_runstring();          /* exit, showing runstring */
        }
        temp++;                    /* show that we used this */
        strcpy(linkbaud,argv[2]+2);
}
else {
        baudrate = DEFAULT_BAUD; /* If no baud given, use default */
        strcpy(linkbaud,SDEFAULT_BAUD);
}
/* Try to open the selected device, and flush it */
if ((fd[COM] = open(compath, O_RDWR)) == -1) {
        perror(compath);
        show_runstring();
}
if ((fd[TTY] = open(TTYPATH, O_RDWR)) == -1) pexit(TTYPATH);
/* Get the current configurations of both ports */
if (ioctl(fd[TTY],TCGETA,&io[TTY]) == -1)
        pexit("ioctl on fd[TTY]");
if (ioctl(fd[COM], TCGETA, &io[COM]) == -1)
        pexit("ioctl on fd[COM]");
/* following errors must restore_ttys_exit, to restore terminal ports */
/* setup the communication TTY */
rawmode_tty(fd[COM],io[COM],baudrate);
/* setup the tty (interactive terminal) */
/* Be sure the line is not configured as a modem, or logged off */
io[TTY].c_cflag &= ~HUPCL;
io[TTY].c_cflag |= CLOCAL;
for (i=argc+1;i<=6;i++)argv[i][0] = '\0'; /* null invalid strings */
if (argc > temp) {
        if (argv[temp][0] == '-' && argv[temp][1] == 'h')
                error = HPUXtoRTE(fd[COM],fd[TTY],argv[temp+1],
                        argv[temp+2],argv[temp+3],argv[temp+4]);
        else if (argv[temp][0] == '-' && argv[temp][1] == 'r')
                error = RTEtoHPUX(fd[COM],fd[TTY],argv[temp+1],
                        argv[temp+2],argv[temp+3]);
        else if (argv[temp][0] == '-' && argv[temp][1] == 'd')
                error = download(fd[COM],fd[TTY],argv[temp+1],
                        argv[temp+2],argv[temp+3]);
        else if (argv[temp][0] == '-' && argv[temp][1] == 'l')
                error = datalog(fd[COM],argv[temp],argv[temp+1],
                        argv[temp+2]);
        else show_runstring();      /* exit, showing runstring */
        if(error == 0) restore_ttys_exit("");
        sprintf(buf,"File transfer returned error %d",error);
        restore_ttys_exit(buf);
}
/* set up the terminal for remote terminal mode */
rawmode_tty(fd[TTY],io[TTY],io[TTY].c_cflag&CBAUD);
if((io[TTY].c_cflag & CBAUD) == B9600) strcpy(termbaud,"9600");
else if((io[TTY].c_cflag & CBAUD) == B19200) strcpy(termbaud,"19200");
else if((io[TTY].c_cflag & CBAUD) == B2400) strcpy(termbaud,"2400");
else if((io[TTY].c_cflag & CBAUD) == B1200) strcpy(termbaud,"1200");
```

```
            else strcpy(termbaud,"????");
            /* enable signals.  Watch for the break cond. (exit remote term mode) */
            sigvector (SIGINT,&sigint_vec,0);
            for (i=0;i<=1;i++) {
                        filemask[i] = MASK(fd[i]);
                        if(ioctl(fd[i],TCFLSH,0)==-1) /* flush the input Queue */
                                    restore_ttys_exit("Error during TCFLSH");
            }
            /* home up, clear screen, and send a memory lock to terminal */
            printf("\n\033m\033H\033J              %s: Remote ",prognam);
            printf("terminal/file transfer/download program to HP1000  \r\n");
            printf("Term: %s baud  REMOTE TERMINAL MODE  Link: %s ",termbaud,compath);
            printf("Link speed: %s baud\r\n",linkbaud);
            printf("\033&dJ      Remote Terminal Mode (");
            printf("BREAK to quit/download/file/break remote");
            printf(")        \r\n l\r"); /* memory lock screen (NL/cursor up)*/
            fflush(stdout);                         /* let the output drain */

            for (;;){
retry_select:
                        readfds = 0;
                        for (i=0;i<=1;i++) readfds |= filemask[i];
                        timeout.tv_sec = INACTIVITY_TO;       /* inactivity timer */
                        timeout.tv_usec = writefds = exceptfds = 0;
                        if ((nfound = select(5,&readfds,&writefds,&exceptfds,
                           &timeout)) <= 0)
                                    if ((errno & EINTR) && (nfound == -1)) {
                                                /* It is okay for us to re-enter select */
                                                goto retry_select;
                                    }
                                    else if (nfound == 0) {
                                           if (justdownloaded != 0) goto retry_select;
                                          else {
                                                 fprintf(stderr,"\r\nInactivity timer expired\r\n");
                                                restore_ttys_exit("");
                                          }
                                    }
                                    else {
                                                fprintf(stderr,"Select returned %d\r\n",nfound);
                                                restore_ttys_exit("Select failed");
                                    }
                        justdownloaded = 0;         /* indicate entrance since download */
                        for(i=0;i<=1;i++)
                                    if (readfds & filemask[i]) {
                                                if((nbytes = vread(fd[i],buf,BUFSIZE)) > 0)
                                                            vwrite(fd[(i+1)%2],buf,nbytes);
                                                else restore_ttys_exit("Select Read ERROR");
                                    }
            } /* End of infinite for loop */

}

sigint_handler()
{
            char choice[1];
            int error;

            /* restore the terminal before we write to it */
            printf("\r\n\033&dJ                    Leaving");
            printf(" Remote Terminal Mode                    \r\n");
            printf("\033&dB(D)ownload,(R)te->hpux,(H)pux->rte,(L)eave %s,",prognam);
            printf("or (B)reak remote (continue)?\r\n");
            vioctl(fd[TTY],TCFLSH,0);               /* flush the input queue */
            nonblocking_io(fd[TTY],0);              /* disable non-blocking I/O */
            vread(fd[TTY],choice,1);
            tolower(choice[0]);         /* convert to lower case */
            if (choice[0] == 'b') {
                        printf("\033&dJ  Sending a BREAK to ");
                        printf("remote   \r\n");
                        vioctl(fd[COM],TCSBRK,0);               /* send a break via COM */
            }
```

```
        else if (choice[0] == 'd') {                    /* download remote */
                justdownloaded = 1;             /* flag that we may timeout here */
                printf("\033&dJ  Download remote.  Normal QUIT");
                printf(" (%o) in effect  \r\n",io[TTY].c_cc[1]);
                if (download(fd[COM],fd[TTY],"","","") != 0)
                        restore_ttys_exit("Download failed");
                /* Reset the ports as we like them */
        }
        else if (choice[0] == 'l') {
                printf("\033&dJ  LEAVING");
                printf(" %s PROGRAM ",progname);
                restore_ttys_exit("");          /* we will not return from this */
        }
        else if (choice[0] == 'r') {
                if((error = RTEtoHPUX(fd[COM],fd[TTY],"","","")) != 0)
                        printf(stderr,"RTEtoHPUX returned error %d\n\r",error);
        }
        else if (choice[0] == 'h')
                if((error = HPUXtoRTE(fd[COM],fd[TTY],"","","","")) != 0)
                        printf(stderr,"HPUXtoRTE returned error %d\n\r",error);
        /* Restore the ports as needed for remote terminal mode */
        rawmode_tty(fd[COM],io[COM],baudrate);
        rawmode_tty(fd[TTY],io[TTY],io[TTY].c_cflag&CBAUD);
        printf("\r\n\033&dJ      Resuming Remote Terminal Mode (");
        printf("BREAK to quit/download/break remote)      \r\n");
}

rawmode_tty(filedescriptor,tty_termio,newbaud)

/* Enable the TTY device (indicated by filedescriptor) for the
        proper communication parameters.  Guarantee that it is performing
        non-blocking I/O.  Do not affect the current contents of "tty_termio",
        so that it may be used for restoration.  If fails, perform PEXIT.  */

struct termio tty_termio;
int filedescriptor,newbaud;

{
        /* enable interrupts on break, ignore parity errors */
        tty_termio.c_iflag = BRKINT | IGNPAR;
        /* do not do any output processing of data */
        tty_termio.c_oflag = 0;
        /* set up the port according to the requested baud rate */
        tty_termio.c_cflag = newbaud | CS8 | CREAD | CLOCAL;
        /* disable signals and do not flush data on breaks */
        tty_termio.c_lflag = NOFLSH;
        /* set up the special characters */
        tty_termio.c_cc[0] = 0;                         /* VINTR character */
        tty_termio.c_cc[1] = 0;                         /* VQUIT character */
        tty_termio.c_cc[2] = 0;                         /* VERASE character */
        tty_termio.c_cc[3] = 0;                         /* VKILL character */
        tty_termio.c_cc[4] = 1;     /* VEOF = MIN = 1 char min to satisfy reads */
        tty_termio.c_cc[5] = 0;     /* VEOL = TIME = 0 = no timeout */
        if (ioctl(filedescriptor,TCSETAW,&tty_termio) == -1)
                pexit(stderr,"rawmode_tty ERROR in ioctl using TCSETAW:");
        /* Enable non-blocking I/O */
        nonblocking_io(filedescriptor,1);               /* enable non-blocking I/O */
}

restore_ttys_exit(s)

char *s;
/* this restores the terminal ports to their original states, then does an
        exit after closing both files, and sending an error message
        if a string was passed.  */
{
        int i;

        for (i=0;i<=1;i++) {
                if (ioctl(fd[i], TCSETAW, &io[i]) == -1)
```

```
                                        perror("TCSETAW in restore_ttys_exit failed\n");
                        if(close(fd[i])==-1)
                                        perror("close failed in restore_ttys_exit\n");
                }
                if (*s == '\0') exit(0);        /* stop the program normally */
                pexit(s);                                       /* stop the program abnormally */
}

pexit(s)
char *s;
{
                perror(s);
                exit(1);
}

download(com_fd,tty_fd,selectcode,downloadfile,sendbreak)
int com_fd,tty_fd;
char *selectcode,*downloadfile,*sendbreak;
/*
Send a break to remote, then perform download to A-Series HP-1000 via
RS-232 port (file com_fd).  Perform necessary handshakes, as required.
*/
{
                struct termio com_io;
                unsigned short downloadaddr,checksum;
                int i,error,filedescriptor,try;
                int num32kblocks,residue,orignum32k;
                int xfer_len,lastrecord,length;
                unsigned char buf[REC_BYTE_SIZE+6];
                char cpath[PATH_LEN];
                char initbuf[9],sc[3];

                /* Setup both ports for normal input */
                cannonical_tty(tty_fd,io[TTY],0,0); /* cannonical, and map CR to NL */
                cannonical_tty(com_fd,io[TTY],baudrate,1); /* no echo */
                if (*selectcode == '\0') {
                                printf("What is the select code of serial device? (^D to quit) ");
                                fflush(stdout);                                 /* Be sure this message gets out first */
                                if (scanf("%2s",sc) == -1) return(0);   /* test for ^D */
                }
                else strcpy(sc,selectcode);
                sc[2] = '\0';                                                   /* only allow two characters */
                if (sendbreak[0] != '\0') {
                                if (strcmp(sendbreak,"-b") != 0) {
                                                fprintf(stderr,"Must use \"-b\" option for break\n");
                                                return(-1);
                                }
                                cannonical_tty(com_fd,io[TTY],B1200,1); /* no echo */
                                vioctl(com_fd,TCSBRK,0); /* send a break via COM */
                                cannonical_tty(com_fd,io[TTY],baudrate,1); /* no echo */
                                DELAY(i);                                       /* let break finish */
                                for(try=BREAKCOUNT;try>0;try--) {       /* satify speed sense */
                                                vwrite(com_fd,"\006",1);
                                                for(i=0;i<5000;i++) length = i+1;               /* delay */
                                }
                                DELAY(i);                                       /* let VCP message finish */
                }
                DELAY(i);
                vioctl(com_fd,TCFLSH,0); /* Flush the incoming data line */
                try = 0;
wait4file:
                if (try++ == 5) {
                                printf("Too many tries, quitting\n");
                                return(0);
                }
                if (*downloadfile == '\0') {
                                printf("What is the name of the file to download with (^D to quit) ");
                                fflush(stdout);                                 /* Be sure this message gets out first */
                                if (scanf("%s",cpath) == -1) return(0);  /* test for ^D */
                }
```

```
else strcpy(cpath,downloadfile);
printf("Download HP1000 A-Series with file \"%s\"\n",cpath);
if ((filedescriptor = open(cpath,O_RDONLY)) == - 1)
            if ((errno & ENOENT) == ENOENT) {
                        printf("%s: cannot open %s\n",prognam,cpath);
                        goto wait4file;
            }
            else restore_ttys_exit("Opening file");
if(vread(filedescriptor,buf+4 REC_BYTE_SIZE) != REC_BYTE_SIZE) {
            fprintf(stderr,"READ of %s returned %d, requesting %d\n",
               cpath,length,REC_BYTE_SIZE);
            fprintf(stderr," file may be too small\n");
            return(0);
}
orignum32k = num32kblocks = *(buf+4) * 0400 + *(buf+5);
residue = *(buf+6) * 0400 + *(buf+7);
printf("Download %d full 64K byte blocks followed by a %d bytes partial block\n",
   num32kblocks,residue);
/* All of the records sent to the HP1000 (buf) are in the following
format:

+--------------------+-----------------------------+
| \#words (byte pairs)    |          don't care         |
+--------------------+-----------------------------+
|  16 bit word of starting address for HP1000 load          |
+--------------------+-----------------------------+
|                    download word \#1 (16 bits)   |
+--------------------+-----------------------------+
|                    download word \#2 (16 bits)   |
+--------------------+-----------------------------+
                     .                             .
                     .                             .
                     .                             .
+--------------------+-----------------------------+
|                    download word \#n-1 (16 bits) |
+--------------------+-----------------------------+
|                    download word \#n (16 bits)   |
+--------------------+-----------------------------+
| arithmetic 16 bit checksum of address -> word \#n         |
+--------------------+-----------------------------+

*/

/* Initiate download by sending the bootstring to VCP */

nonblocking_io(com_fd,0); /* disable non-blocking I/O */
com_io.c_iflag = IGNBRK | IGNPAR;
com_io.c_oflag = 0;
com_io.c_cflag = baudrate | CS8 | CREAD | CLOCAL;
com_io.c_lflag = NOFLSH;
com_io.c_cc[0] = 0;
com_io.c_cc[1] = 0;
com_io.c_cc[2] = 0;
com_io.c_cc[3] = 0;
com_io.c_cc[4] = 9;        /* VEOF = MIN = 9 char min to satisfy reads */
com_io.c_cc[5] = 150;      /* VEOL = TIME = 15.0 second timeout */
vioctl(com_fd,TCSETAW,com_io);
sprintf(initbuf,"%%BCT%s\r",sc);
vwrite(com_fd,initbuf,7);   /* send %BCTsc, sc is select code */
initbuf[9] = '\0';                        /* place a null in buffer */
if((error = vread(com_fd,initbuf,9)) != 9) {
            fprintf(stderr,"Read length error.  Length: %d\n",error);
            return(0);
}
if (strcmp(initbuf,"%BCT77\r\r\n") != 0) {
            fprintf(stderr,"Did not get correct echo from VCP\n");
            return(0);
}
xfer_len = REC_BYTE_SIZE;              /* number of bytes we are sending */
buf[1] = 0;
downloadaddr = 0;
```

```
                printf("...first handshake to HP1000 complete\r\n");
                goto firstentry;                /* start in middle of loop */
                /* download loop */
nextrecord:
                if (num32kblocks == 0)
                        if (downloadaddr + (REC_BYTE_SIZE/2) >= residue)  {
                                lastrecord = 1;
                                xfer_len = (residue - downloadaddr)*2;   /* last record*/
                        }
                        else
                                xfer_len = REC_BYTE_SIZE;               /* near the end */
                else if (downloadaddr + REC_BYTE_SIZE/2 > 0100000) {
                        /* this many bytes will overflow us, send less */
                        xfer_len = (0100000 - downloadaddr)*2;                   /* starting addr */
                }
                else
                        xfer_len = REC_BYTE_SIZE;               /* we can go max size */
                if(vread(filedescriptor,buf+4,xfer_len) != xfer_len) {      /* get next record */
                        fprintf(stderr,"\r\nERROR! READ length = %d, expected %d\r\n\n",
                           error,xfer_len);
                        fprintf(stderr,"downloadaddr = %d, num32kblocks = %d\n\r",
                           downloadaddr,num32kblocks);
                        return(0);
                }
firstentry:
                buf[0] = xfer_len/2;                    /* number of words to send */
                checksum = downloadaddr;                /* initialize checksum */
                buf[2] = downloadaddr / 256;            /* MSB addr */
                buf[3] = downloadaddr % 256;            /* LSB addr */
                if (handshake(com_fd) != 0) return(-1);
                for (i=1;i<xfer_len;i=i+2)              /* xfer_len+3 is last byte */
                        checksum = checksum + (buf[i+3] * 256) + buf[i+4];
                buf[xfer_len+4] = checksum / 256;       /* MSB of checksum */
                buf[xfer_len+5] = checksum % 256;       /* LSB of checksum */
                vwrite(com_fd,buf,xfer_len+6);
                downloadaddr = downloadaddr + xfer_len/2;               /* get new address */
                if ((xfer_len != REC_BYTE_SIZE) && (lastrecord == 0))  {
                        switch (orignum32k-num32kblocks+1){
                        case 64:
                             printf("...finished a 64K byte block (4 megabyte boundary)\n");
                             break;
                        case 32:
                             printf("...finished a 64K byte block (2 megabyte boundary)\n");
                             break;
                        case 16:
                             printf("...finished a 64K byte block (1 megabyte boundary)\n");
                             break;
                        case 8:
                             printf("...finished a 64K byte block (0.5 megabyte boundary)\n");
                             break;
                        case 4:
                             printf("...finished a 64K byte block (0.25 megabyte boundary)\n");
                             break;
                        default:
                             printf("...finished a 64K byte block\n");
                             break;
                        }
                        /* Send the null record to indicate a map set change */
                        for(i=0;i<=5;i++)buf[i] = 0; /* 3 null words to send */
                        if (handshake(com_fd) != 0) return(-1);
                        vwrite(com_fd,buf,6);
                        downloadaddr = 0;
                        num32kblocks--;
                }
                if (lastrecord == 0) goto nextrecord;       /* ...and continue on */

                /* WE ARE FINISHED WITH THE DOWNLOAD! send a RS-CR & wait for esc */

                if(read_esc_seq(com_fd) != 0)return(-1); /* wait for esc...dc1 */
                vwrite(com_fd,"\036\r",2);              /* indicate finished */
                printf("DOWNLOAD SUCCESSFUL"); /* FINISHED */
                return(0);
}
```

```
handshake(comm_filedesc)
/* Perform the proper handshaking to the port (which is connected to
        an RS-232 cable, connected to the VCP port of an HP1000.
        This handshake involves reading 8 bytes, which will be "ESC-&-
        p-1-s-2-R-DC1", then sending 5 bytes (which are ignored
        by VCP), then receiving a DC1.  "comm_filedesc" is the filedescriptor
        returned by an open call to the communication port.  Sets minimal
        read size (MIN) to 1 character.  */
{
        char handshake_buf[8];
        int length;
        struct termio handio;
        vioctl(comm_filedesc,TCGETA,handio);
        handio.c_cc[4] = 8;         /* VEOF = MIN = 8 char min to satisfy reads */
        vioctl(comm_filedesc,TCSETA,handio);
        handshake_buf[8] = '\0';    /* initialize with NULL */
        if((length = vread(comm_filedesc,handshake_buf,8)) != 8) {
                printf("Handshake failed! length = %d\n",length);
                return(-1);
        }
        if(strcmp(handshake_buf,"\033&p1s2R\021") != 0) {
                printf("Handshake failed! receive buf = %s\n",handshake_buf);
                return(-1);
        }
        vwrite(comm_filedesc,"Ignor',5);
        handio.c_cc[4] = 1;         /* VEOF = MIN = 1 char min to satisfy reads */
        vioctl(comm_filedesc,TCSETA,handio);
        handshake_buf[1] = '\0';    /* initialize with NULL */
        if (vread(comm_filedesc,handshake_buf,1) != 1) {
                printf("DC1 Handshake failed! length = %d\n",length);
                return(-1);
        }
        if(strcmp(handshake_buf,"\021") != 0) {
                printf("DC1 handshake failed,receive buf = %s\n",handshake_buf);
                return(-1);
        }
        return(0);
}

read_esc_seq(comm_filedesc)
/*  Verify the esc...dc1 handshake  */
{
        char handshake_buf[8];
        int length;
        struct termio handio;
        vioctl(comm_filedesc,TCGETA,handio);
        handio.c_cc[4] = 8;         /* VEOF = MIN = 8 char min to satisfy reads */
        vioctl(comm_filedesc,TCSETAW,handio);
        if((length = vread(comm_filedesc,handshake_buf,8)) != 8) {
                printf("Handshake failed! length = %d\n",length);
                return(-1);
        }
        return(0);
}

bufcmp(buf,string)
char *buf,*string;
/* This routine is much like strcmp, but allows the buffer to
be of anylength, and just requires that all the characters in buf
match that of string, else return -1.  Note that it is not
a requirement that the first string end in '\0'.  */
{
        int i;
        for(i=0; *buf == *string; buf++,string++,i++);
        if (i == 0) return(-1);         /* failed on first char */
        if((*(string-1) == '\0') || (*string == '\0')) return(0);
        return(-1);
}
```

```
vwrite(filedescriptor,buffer,charlen)
int filedescriptor,charlen;
char *buffer;
/* this subroutine does a VERIFY write.  It checks the error code from
the write, and if fails, prints the appropriate message and exits after
restoring ports.  If passes, it returns the number of characters.  */
{
        int char_count;
        if((char_count = write(filedescriptor,buffer,charlen)) == -1)
                restore_ttys_exit("VWRITE failed");
        if (char_count == charlen) return;
        fprintf(stderr,"VWRITE count failed.  Charlen: %d, char_count: %d\n",
           charlen,char_count);
        restore_ttys_exit();
}

vread(filedescriptor,buffer,maxcharlen)
int filedescriptor,maxcharlen;
char *buffer;
/* this subroutine does a VERIFY read.  It checks the error code from
the read, and if fails, prints the appropriate message, restores terminal
ports, and exits.  If passes, it returns the number of characters.  */
{
        int char_count;
        if((char_count = read(filedescriptor,buffer,maxcharlen)) == -1)
                restore_ttys_exit("VREAD failed");
        return(char_count);
}

vioctl(filedescriptor,options,parameter)
int filedescriptor,parameter;
/* this subroutine does a VERIFY read.  It checks the error code from
the read, and if fails, prints the appropriate message, restores terminal
ports, and exits.  If passes, it returns the number of characters.  */
{
        int error;
        if((error = ioctl(filedescriptor,options,parameter)) == -1)
                restore_ttys_exit("VIOCTL failed");
        return(error);
}

pick(message,choices,CRvalue)
char *message,*choices,CRvalue;
/* send message until receive valid choice.  "choices" is a character string,
all of which must be in lower case letters.  If invalid choice, send the valid
choices and re-prompt.  */
{
        char choice,*c;
sendmsg:
        c = choices;
        printf("%s",message);
        fflush(stdout);                 /* Be sure this message gets out first */
        vread(1,&choice,2);
        if (choice == '\n') choice = CRvalue;
        if (choice >= 'A' && choice <= 'Z')choice+=('a'-'A');
        tolower(choice);
        while(*c != '\0')
                if (*(c++) == choice) return(choice);
        printf("Valid choices: %s\n",choices);
        goto sendmsg;
}

cannonical_tty(filedescriptor,tty_termio,baud,noecho)
/* Enable the TTY device (indicated by filedescriptor) for the
        proper communication parameters.  Guarantee that it is performing
        non blocking I/O.  Do not affect the current contents of "tty_termio",
        so that it may be used for restoration.  Output CRLF for NL.  Use
        current baud rate.  This is what should be used for interactive
        terminal I/O.  If error, exit.  If noecho == 0, do not perform echos,
        or post-process output data.  Disable non-blocking I/O.  Make
        baudrate from baud, unless 0, then use from tty_termio.  */
```

```
struct termio tty_termio;
int filedescriptor,baud,noecho;
{
        /* Set up terminal port (see man page on TERMIO) */
        tty_termio.c_oflag = ONLCR | OPOST;
        if (baud == 0)
                tty_termio.c_cflag=(tty_termio.c_cflag&CBAUD)|CS8|CREAD|CLOCAL;
        else tty_termio.c_cflag = baud | CS8 | CREAD | CLOCAL;
        if (noecho != 0) {
                tty_termio.c_iflag = IGNPAR;
                tty_termio.c_oflag = 0;
                tty_termio.c_lflag = ICANON;
                tty_termio.c_line = '\000';
                tty_termio.c_cc[0] = 0;                 /* VINTR character */
                tty_termio.c_cc[1] = 0;                 /* VQUIT character */
                tty_termio.c_cc[2] = 0;                 /* VERASE character */
                tty_termio.c_cc[3] = 0;                 /* VKILL character */
                tty_termio.c_cc[4] = 1;                 /* VEOF = 1 */
                tty_termio.c_cc[5] = 0;                 /* VEOL = 0 */
        }
        else {
                tty_termio.c_lflag = ISIG | ICANON | ECHO | ECHOE |ECHOK;
                tty_termio.c_oflag = ONLCR | OPOST;
                tty_termio.c_iflag = IGNPAR | ICRNL;
        }
        /* use users's pre-defined EOF, EOL, erase, kill, and QUIT characters */
        vioctl(filedescriptor,TCSETAW,&tty_termio);
        nonblocking_io(filedescriptor,0);          /* disable non-blocking I/O */
        return(0);
}

nonblocking_io(filedescriptor,enable)
int filedescriptor,enable;
/* This routine enables/disables non blocking I/O according to "enable".
If enable != 0, non-blocking I/O is enabled.  If non-blocking I/O is
enabled, ERRNO can give the error message: "operation would block".  */
{
        vioctl(filedescriptor,FIOSNBIO,&enable);
        return;
}

show_runstring()
/* perform an exit after displaying the run string. */
{
        fprintf(stderr, "Remote terminal mode usage:\n\t%s TTY [-sSPEED]\n",prognam);
        fprintf(stderr, "HPUX-RTE file transfer only usage:\n\t%s TTY [-sSPEED] -h [SOURCEFILE [DES-
TINATIONFILE [FILETYPE [ok]]]]\n",
            prognam);
        fprintf(stderr, "RTE-HPUX file transfer only usage:\n\t%s TTY [-sSPEED] -r [SOURCEFILE [DES-
TINATIONFILE [ok]]]\n",
            prognam);
        fprintf(stderr, "HP1000 download only usage:\n\t%s TTY [-sSPEED] -d [SELECTCODE [DOWNLOADFILE
[-b]]]\n",prognam);
        fprintf(stderr,"Data log only usage:\n\t%s TTY [-sSPEED] -lLOGFILE [-a [ok]]\n",prognam);
        fprintf(stderr,"Quit data log usage:\n\t%s -qPID\n",prognam);
        exit(-1);  /* Stop program */
}

RTEtoHPUX(com_fd,tty_fd,rtesource,hpuxdest,ok)
int com_fd,tty_fd;          /* file descriptors of communication and term. ports */
char  *rtesource,*hpuxdest,*ok;
{
        FILE  *fopen(),*fp;
        int temp,bytecount;
        int i,length,type;
        char buf[RTEBLOCKSIZE],initbuf[PATH_LEN];
        char  *c,spath[PATH_LEN],dpath[PATH_LEN];
        cannonical_tty(tty_fd,io[TTY],0,0);      /* cannonical, and map CR to NL */
        printf("RS-232 File transfer utility RTE-A --> HPUX\n");
        if (*rtesource == '\0') {
                printf("Path name of RTE-A source file? (^D to quit) ");
```

```
                fflush(stdout);                         /* Be sure this message gets out first */
                if (scanf("%s",spath) == -1) return(0);  /* test for ^D */
}
else strcpy(spath,rtesource);
if (*hpuxdest == '\0') {
                printf("Path name of HPUX destination file? (^D to quit) ");
                fflush(stdout);                         /* Be sure this message gets out first */
                if (scanf("%s",dpath) == -1) return(0);  /* test for ^D */
}
else strcpy(dpath,hpuxdest);
printf("Transfer from \"%s\" to \"%s\"\n",spath,dpath);
/* we will assume the RTE-A system we are talking to is running
   a copy of CI.  We will create a "co" command to send the file
   out to the RS232 link, and save all input.  Trap the error
   message that the file does not exist.  Send a ^D first in case
   we are in copy mode.  */
if ((type = init_ci(com_fd,spath)) < 0) return(-99);
if (type == 0) {
                fprintf(stderr,"No such RTE-A file, \"%s\"\n",spath);
                return(1);
}
printf("RTE-A file type is %d\n",type);
if ((fp = fopen(dpath,"r")) != NULL) {
                if (*ok == '\0') {
                                sprintf(buf,"\"%s\" already exists, ok to overwrite? [y] ",
                                   dpath);
                                if (pick(buf,"yn",'y') == 'n') return(0);
                }
                else if (strcmp(ok,"ok") != 0) {
                                fprintf(stderr,"Must specify \"ok\" to overwrite file\n");
                                return(0);
                }
}
if ((fp = fopen(dpath,"w")) == NULL) {
                perror(dpath);
                return(0);
}
sprintf(initbuf,"co %s 1;cn $session 34b 2;cn $session 33b 100000b\r",spath);
vwrite(com_fd,initbuf,strlen(initbuf));
vread(com_fd,buf,RTEBLOCKSIZE);
if(strpbrk(buf,initbuf) == NULL) return(-48);
SUPSHIFT(spath,c);
vread(com_fd,buf,RTEBLOCKSIZE);
if (bufcmp(buf,"Copying ") != 0) return(-47);
printf("\n");
bytecount = 0;
if (type == 4 || type == 3) {                   /* Ascii file.  Remove CR's */
                for(;;){
                                if((length = vread(com_fd,buf,RTEBLOCKSIZE)) == 0)
                                                return(-55);
                                i = 0;
                                while(i < length) {
                                                if (iscopy_done(com_fd,buf,i,&length) == 0)
                                                                goto finished;
                                                /* Place all characters but CR in file */
                                                if(buf[i] != '\r') fputc(buf[i],fp);
                                                i++;
                                                if(++bytecount % 1000 == 0)
                                                                printf("\033A\t%d Kbytes...\n",
                                                                                bytecount/1000);
                                }
                }
}
else if ((type == 1) || (type == 6)) {
                rawmode_tty(com_fd,io[COM],baudrate);       /* place in raw mode */
                nonblocking_io(com_fd,0);                   /* disable non-blocking I/O */
                for(;;) {
                                if((length = vread(com_fd,buf,RTEBLOCKSIZE)) == 0) {
                                                DELAY(temp);                /* wait for data */
                                                if((length = vread(com_fd,buf,RTEBLOCKSIZE))
                                                                                                == 0)
                                                                return(-55);
                                }
```

```
                                        i = 0;
                                        while(i < length) {
                                                if (iscopy_done(com_fd,buf,i,&length) == 0)
                                                        goto finished;
                                                fputc(buf[i++],fp);
                                                if (++bytecount % 1000 == 0)
                                                        printf("\033A\t%d Kbytes...\n",
                                                                bytecount/1000);
                                        }
                                }
                        }
                        else {
                                printf("Invalic file type\n");
                                return(-7);
                        }
finished:
                        fflush(fp);
                        fclose(fp);
                        printf("File transfer complete.  \"%s\": %d bytes.\n",dpath,bytecount);
                        return(0);
}

iscopy_done(filedescriptor,buffer,i,length)
int filedescriptor,i,*length;
char *buffer;
/* Test for the "[ok]\r\n" message in the incoming data stream, indicating
that the RTE-A "co" program is finished.  Return(0) if it is.  If "length"
is not long enough for test, a read for the additional characters will be
made, and appended to buffer */
{
                int diff;

                if (buffer[i] != '[') return(-1);
                if ((diff = *length - i) <= 5)
                        *length += vread(filedescriptor,buffer+*length,diff);
                return(bufcmp(buffer+i,"[ok]\r\n"));
}

HPUXtoRTE(com_fd,tty_fd,hpuxsource,rtedest,ftype,ok)
int com_fd,tty_fd;              /* file descriptors of communication and term. ports */
char *hpuxsource,*rtedest,*ftype,*ok;
/* Transfer a file from a HPUX system to an RTE-A system running CI */
{
                FILE  *fopen(),*fp;
                unsigned short checksum;
                int temp,bytecount,ctrl_d;
                int i,type;
                char buf[RTEBLOCKSIZE-2],initbuf[PATH_LEN],fgetc(),toupper();
                char  *c,spath[PATH_LEN],dpath[PATH_LEN];

                cannonical_tty(tty_fd,io[TTY],0,0); /* cannonical, and map CR to NL */
                printf("RS-232 File transfer utility HPUX --> RTE-A\n");
                if (*hpuxsource == '\0') {
                        printf("Path name of HPUX source file? (^D to quit) ");
                        fflush(stdout);                         /* Be sure this message gets out first */
                        if (scanf("%s",spath) == -1) return(0);
                }
                else strcpy(spath,hpuxsource);
                if ((fp = fopen(spath,"r")) == NULL) {                  /* Verify HPUX file exists */
                        perror(spath);
                        return(0);
                }
                if (*rtedest == '\0') {
                        printf("Path name of RTE-A destination file? (^D to quit) ");
                        fflush(stdout);                         /* Be sure this message gets out first */
                        if (scanf("%s",dpath) == -1) return(0);
                }
                else strcpy(dpath,rtedest);
                for(i=0;dpath[i] != '\0';i++)if (dpath[i] == ':') {
                        fprintf(stderr,"Invalid character ':' in \"%s\"\n",dpath);
                        return(-1);
                }
```

```
printf("Transfer from \"%s\" to \"%s\"\n",spath,dpath);
if (*ftype == '\0')
        type = pick("RTE-A file type of destination file? (3) ","1346",'3')-'0';
else {
        if (*ftype == '1') type = 1;
        else if (*ftype == '3') type = 3;
        else if (*ftype == '4') type = 4;
        else if (*ftype == '6') type = 6;
        else {
                fprintf(stderr,"Invalid file type, \"%s\"",ftype);
                exit(-11);
        }
}
if ((temp = init_ci(com_fd,dpath)) < 0) return(-99);
if (temp > 0) { /* guarantee running CI program */
        if (*ok == '\0') {          /* File exists ! */
                sprintf(buf,"\"%s\" already exists, ok to overwrite? [y] ",
                   dpath);
                if (pick(buf,"yn",'y') == 'n') return(0);
        }
        else
                if(strcmp(ok,"ok") != 0) {
                        fprintf("Specify \"ok\" to overwrite file\n");
                        return(-1);
                }
                else printf("Overwriting RTE-A file \"%s\"\n",dpath);
}
if (type == 4) {
        fprintf(stderr,"Final file type will be RTE-A type 3\n");
        type = 3;
}
printf("\n"); /* go down a line for data transfer progress display */
if (type == 3) {
        sprintf(initbuf,"co 1 %s d;cn $session 34b 2;cn $session 33b\r",dpath);
        vwrite(com_fd,initbuf,strlen(initbuf));
        vread(com_fd,buf,RTEBLOCKSIZE);
        SUPSHIFT(dpath,c);
        vread(com_fd,buf,RTEBLOCKSIZE);
        if (bufcmp(buf,"Copying 1 to ") != 0) return(-33);
        bytecount = i = ctrl_d = temp = 0;
        rawmode_tty(fd[COM],io[COM],baudrate);
        nonblocking_io(fd[COM],0);          /* disable non-blocking I/O */
        sleep(1);     /* let the RTE-A copy program catch up */
        while ((buf[i]=fgetc(fp)) != EOF) {
                if(buf[i] == '\004') {
                        if(++ctrl_d == 1)
                                printf("Warning: ^D byte(s) removed\n");
                }
                else if(buf[i] == '\n') {
                        buf[i++] = '\r';
                           /*    DELAY(j);     */
                        vwrite(com_fd,buf,i);
                        buf[i++] = '\n';
                        buf[i] = '\0';
                        if(get_rte_resp(com_fd,buf)!=0)return(-21);
                        i = 0;
                }
                else {
                        if(i++ > RTEBLOCKSIZE-2) {
                                printf("File buffer overflow\n");
                                return(-4);
                        }
                        if(++bytecount % 1000 == 0)
                                printf(" A\t%d Kbytes...\n",
                                        bytecount/1000);
                }
        }
        buf[0] = '\004';            /* a EOT tells RTE we are finished */
        vwrite(com_fd,buf,1);
        if(get_rte_resp(com_fd,"\004[ok]\r\n") != 0)return(-22);
        if (temp != 0) printf("Transferred %d bytes, deleted %d ^D bytes\n",
           bytecount,ctrl_d);
        else printf("Transferred %d bytes\n",bytecount);
```

```
            }
            else if (type == 1 || type == 6) {

/*  to transfer a type 1 or a type 6 file, a program "/PROGRAMS/HPUX1.RUN" is
    required on the HP1000 system.  Below is an example source for this file:

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

ftn7x,q,d
$files 0,0
$cds off
    program HPUX1(4,25),RMTERM/840 type 1 file transfer program<861209.1033>
*
* This program allows a type 1 file to be transferred between a HP9000
*  model 840 (running HP-UX) and an HP-1000 A-Series (running RTE-A).  It
*  is used in place of CI's CO command, to handle binary data.
*
* It is invoked using the string: "RU,HPUX1.RUN,RTE_A_FILE,SIZE,TYPE"
*  Where RTE_A_FILE is the destination file name
*        SIZE is the destination file size (defaults to 10 blocks)
*        TYPE is the destination file type (defaults to type 1)
*
    implicit none
    integer wlen,FmpWrite,areg,breg,i,prams(5),tlog,prambuf(40),val
    integer type,FmpOpen,dcb(144),icheck sum(2),prompt,error,buf(129)
    integer*4 dchecksum
    character*63 filedesc,cpram,name
    equivalence (icheck sum,dchecksum),(cpram,prambuf)

    data prompt/5137B/              ! make prompt character a "LF_"

    call rmpar(prams)
    if (prams(1) .eq. 1) then
      write(1,'("Usage: HPUX1 FILENAME [size] [type]")')
      write(1,'("  Where LU 1 is the input LU and FILENAME is out")')
      write(1,'("  size is number of blocks [10]")')
      write(1,'("  type is file type [1]")')
      stop
    endif
    if (prams(2) .le. 0)prams(2) = 10   ! default = 10 blocks
    if (prams(3) .le. 0)prams(3) = 1    ! default is type 1 file
    call getst(prambuf,-80,tlog)
*
* create the RTE-A file name
*
    call SplitCommand(cpram,name,cpram,',')
    call FmpBuildName(filedesc,name,' ',0,' ',prams(3),prams(2),0,' ')
*
* Try to open the RTE-A file for writing
*
    call FmpPurge(filedesc)         ! be sure file is gone, for type change
    type = FmpOpen(dcb,error,filedesc,'WC',1)
    if (error .lt. 0) then
      call FmpReportError(error,filedesc)
      stop
    endif
*
* Transfer the data
*
    do while (1 .eq. 1)             ! loop forever
      call exec(1,50101B,buf,-258,prompt,-2)
      call abreg(areg,breg)
      if ((iand(areg,377b) .ne. 0) .or. (breg .ne. 258)) then
        write(1,'("ERR: areg: ",o6,"B, breg: ",o6,"B")')areg,breg
        stop
      endif
      dchecksum = 0
      do i=1,128
        val = iand(buf(i),77777B)
        if (buf(i) .lt.0) dchecksum = dchecksum + 100000b
        dchecksum = dchecksum + val
      end do
      if ((buf(129) .eq. 177777B) .and. (icheck sum(2) .eq. 0)) then
```

```
       call FmpClose(dcb,error)
       if (error .lt. 0) call FmpReportError(error,filedesc)
       call exec(2,2001B,3012B,-2)   !send an "ACK,LF" to show done
       stop
      else if (ichecksum(2) .ne. buf(129)) then
       write(1,'("Checksum error: ",i6,"vs",i6)')
   +     buf(129),ichecksum(2)
       stop
      endif
      wlen = FmpWrite(dcb,error,buf,256)
      if (error .lt. 0) then
       call FmpReportError(error,filedesc)
       stop
      endif
      if (wlen .ne. 256) then
       write(1,'("FmpWrite ERROR: WLEN:",i4)')wlen
       stop
      endif
     end do
     end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%      /*

                /* find how many blocks we need to create */
                bytecount = 0;
                while (fgetc(fp) != EOF) bytecount++;
                if ((fclose(fp) == EOF) || (fp = fopen(spath,"r")) == NULL) {
                        perror(spath);
                        return(-8);
                }       /* close...and re-open file */
                sprintf(initbuf,"HPUX1 %s %d %d;cn $session 34b 2;cn $session 33b\r",
                   dpath,(bytecount+RTEBLOCKSIZE-1) / RTEBLOCKSIZE,type);
                vwrite(com_fd,initbuf,strlen(initbuf));
                vread(com_fd,buf,RTEBLOCKSIZE);
                bytecount = 0;
                rawmode_tty(fd[COM],io[COM],baudrate);
                nonblocking_io(fd[COM],0);          /* disable non-blocking I/O */
                for (;;) {
                        if(get_rte_resp(com_fd,"\n") != 0)return(-3);
                        i = 0;
                        if(temp == EOF) break; /* Send end of file record */
                        while ((temp=fgetc(fp)) != EOF) {
                                buf[i++] = temp;
                                if (i == RTEBLOCKSIZE) break;
                        }
                        if (temp == EOF) {
                                if(i == 0) break;       /* Send end of file record */
                                printf("Added %d pad bytes\n",
                                        RTEBLOCKSIZE-i);
                                while(i<RTEBLOCKSIZE)buf[i++]=0;
                        }
                        for(checksum=i=0;i<RTEBLOCKSIZE;i+=2) {
                                checksum += (buf[i]&0377)*0400;
                                checksum += buf[i+1]&0377;
                                if ((bytecount += 2) % 1000 == 0)
                                        printf(" A\t%d Kbytes...\n",
                                                bytecount/1000);
                        }
                        buf[RTEBLOCKSIZE] = checksum/256;
                        buf[RTEBLOCKSIZE+1] = checksum & 255;
                        vwrite(com_fd,buf,RTEBLOCKSIZE+2);
                }
                for(i=0;i<RTEBLOCKSIZE;buf[i++]=0);
                buf[i++]=0377;
                buf[i++]=0377;          /* make invalid: End of File */
                vwrite(com_fd,buf,RTEBLOCKSIZE+2);
                /* Wait for "ACK LF" from HPUX1 program */
                if(get_rte_resp(com_fd,"\006\n") != 0)return(-3);
                printf("Transferred %d bytes (%d RTE-A blocks)\n",
                   bytecount,bytecount/RTEBLOCKSIZE);
        }
        else {
                printf("Invalid type, %d\n",type);
                sprintf(initbuf,"cn $session 34b 2;cn $session 33b\r");
```

```
                        vwrite(com_fd,initbuf,strlen(initbuf));
                        vread(com_fd,buf,RTEBLOCKSIZE);     * remove the echo */
                        return(-30);
                }
                fclose(fp);
                printf("Successful file transfer HPUX --> RTE\n");
                return(0);
}

get_rte_resp(filedescriptor,expected)
int filedescriptor;
char *expected;
/* Verify that RTE-A responded as predicted, else output message and
   display RTE-A message up to a LF.  */
{
                int len,length,i;
                char buf[RTEBLOCKSIZE];

                len = strlen(expected);
                if (len > RTEBLOCKSIZE) restore_ttys_exit("Request length error");
                /*              printf("get_rte_resp(filedescriptor,%s), len = %d\n",expected,len);*/
                length = vread(filedescriptor,buf,len);
                while(length < len)
                        length += vread(filedescriptor,buf+length,len-length);
                i = 0;
                while(*expected != '\0')
                        if ((buf[i] != *expected++) || (i++ == length)) {
                                buf[length+1] = '\0';           /* make it a string */
                                printf("ERROR: RTE-A message: ");
                                while(buf[length] != '\n') {
                                        for(i=0;i<length;i++)if(buf[i] == '\n') {
                                                buf[i+1] = '\0';        /* shorten */
                                                printf("%s",buf);
                                                return(-1);
                                        }
                                        printf("%s",buf);
                                        length = vread(filedescriptor,buf,79);
                                        buf[length+1] = '\0';           /* make it a string */
                                }
                                return(-1);
                        }
                return(0);
}

init_ci(filedescriptor,rtefilename)
int filedescriptor;
char *rtefilename;
/* Initialize and verify CI is running.  Send a ^D first in case we are
   currently performing a "co" command.  If file exists, returns integer file type.
   Returns a 0 if does not exist, and returns -1 if improper CI communication.  */
{
                int length,i,retry;
                long available;
                char resp[RTEBLOCKSIZE],buf[RTEBLOCKSIZE];

                /* set up the communication line */
                cannonical_tty(filedescriptor,io[TTY],baudrate,1); /* no echo */
                /* guarantee have CI.  Send a ^D to terminate any "co" command */
                vioctl(filedescriptor,TCFLSH,0);                /* remove any input */
                vwrite(filedescriptor,"\004",1);
                DELAY(i);   /* allow the ^D to satisfy CI or the CO command */
                vwrite(filedescriptor,"\r",1);
                vioctl(filedescriptor,FIONREAD,&available);
                if (available == 0) DELAY(i);                   /* give it some more time */
                vioctl(filedescriptor,FIONREAD,&available);
                if (available == 0) {
                        vwrite(filedescriptor,"\06",1);                 /* send an ACK */
                        DELAY(i);
                        vwrite(filedescriptor,"\06",1);                 /* send an ACK */
                        vioctl(filedescriptor,FIONREAD,&available);
                        if (available == 0) return(-3);                 /* no data is available */
```

```
        }
        length = vread(filedescriptor,buf,RTEBLOCKSIZE);
        while ((bufcmp(resp+length-3,"\004\r\n") != 0)&&
            (bufcmp(resp+length-4,"\04\021\r\n") != 0)&&
            (bufcmp(resp+length-5,  "\06\04\021\r\n") != 0)){
                if (retry-- == 0) return(-2);
                DELAY(i);   /* allow the line to settle */
                vioctl(filedescriptor,TCFLSH,0);          /* remove any input */
                vwrite(filedescriptor,"\006",1);
                DELAY(i);   /* allow the ACK to satisfy any ENQ-ACK */
                vwrite(filedescriptor,"\004",1);
                DELAY(i);   /* allow the ^D to cause a new read */
                vwrite(filedescriptor,"\r",1);
                vioctl(filedescriptor,FIONREAD,&available);
                if (available == 0) DELAY(i);             /* give it some more time */
                vioctl(filedescriptor,FIONREAD,&available);
                if (available == 0) return(-3);           /* no data is available */
                length = vread(filedescriptor,resp,RTEBLOCKSIZE); /* read CRLF echo */
        }
        sprintf(buf, "cn $session 34b;cn $session 33b 100000b;dl %s f\r",
           rtefilename);
        vwrite(filedescriptor,buf,strlen(buf));
        vread(filedescriptor,resp,RTEBLOCKSIZE);
        if(strpbrk(resp,buf) == NULL) goto invalid;
        vread(filedescriptor,resp,RTEBLOCKSIZE);
        if (bufcmp(resp,"directory ") == 0) {
                vread(filedescriptor,resp,RTEBLOCKSIZE);
                if(strpbrk(resp,"name") == NULL) goto invalid;
                if(strpbrk(resp,"type") == NULL) goto invalid;
                if(get_rte_resp(filedescriptor," \r\n") != 0)return(-1);
                length = vread(filedescriptor,resp,RTEBLOCKSIZE);
                if(get_rte_resp(filedescriptor," \r\n") != 0)return(-1);
                if (length <= 2) return(-1);
                i = resp[length-3] - '0';    /* find file type */
                if (i <= 0 || i >= 7) goto invalid;       /* valid file types */
                return(i);
        }
        else if (bufcmp(resp,"No ") == 0) return(0);      /* file doesn't exist */
        else {
invalid:
                fprintf(stderr,"Invalid RTE response: %s\n",resp);
                return(-1);
        }
}

datalog(com_fd,option,ackenq,ok)
int com_fd;
char *option,*ackenq,*ok;
/* If first two characters of option are '-l': Go into logging mode. Log all
incoming data from the "com_fd" port to the file described in "option" as
-lLOGFILE. This data will now become available to any outside process. Note
that if two ports log to the same file, the writes will be interleaved. If
"ackenq" is "-a", then ACK-ENQ protocol will be used to satisfy ENQ-ACK
handshaking from the HP1000 when logged, and ENQ's will not be logged.

If the first two characters of option are '-q': Quit the logging mode. Close
the file described in "option" by -qLOGFILE. Issue any appropriate messages.
Note that in the '-q' case, the ports are not affected, so error exits are
not through "restore_ttys_exit" routine.

NOTE: it is the */
{
        char buffer[RTEBLOCKSIZE];
        int char_count,pid,ack,i,j;

        if (option[1] == 'q') {
                /* Quit logging */
                pid = atoi(option+2);
                if (kill(pid,0) == -1) {
                        perror(option[2]);          /* display invalid pid number */
                        exit(-1);
```

```
                }
                if (kill(pid,SIGUSR1) == -1) {
                        perror(option|2]);          /* display invalid pid number */
                        exit(-1);
                }
                return(0);
        }
        /* must be a log request */
        strcpy(logfilename,option+2);               /* copy the logging name */
        rawmode_tty(com_fd,io[COM],baudrate);       /* set up for raw data input */
        nonblocking_io(com_fd,0); /* disable non-blocking I/O */
        if (strcmp(ackenq,"ok") == 0) {             /* no ackenq */
                if (strcmp(ok,'-a") == 0)  /* its backwards */
                        ackenq = "-a";
                else ackenq = "";
                ok = "ok";                          /* patch it up */
        }
        if (strcmp(ok,"ok") == 0) {
                if ((logfiledescriptor =
                        open(logfilename,O_CREAT|O_WRONLY|O_APPEND)) == -1) {
                        perror(logfilename);
                        return(-1);
                }
        }
        else if ((logfiledescriptor =
                  open(logfilename,O_EXCL|O_CREAT|O_WRONLY|O_APPEND)) == -1) {
                perror(logfilename);
                return(-1);
        }
        if(chmod(logfilename,0666) != 0) {          /* set for Read/Write all */
                perror(logfilename);
                return(-1);
        }
        logPID = getpid();
        printf("PID: %d  To quit logging to \"%s\", use \"%s -q%d\"\n",
           logPID,logfilename,progname,logPID);
        sigvector (SIGUSR1,&sigusr1_vec,0);
        if (*ackenq == '\0') ack = 0;
        else if (strcmp(ackenq,"-a") == 0) {
                printf("ACK-ENQ handshake mode\n");
                ack = 1;
        }
        else {
                fprintf(stderr,'Invalid option \"%s\".  Use \"-a\"\n",ackenq);
                return(-1);
        }
        for(;;) {
                char_count = vread(com_fd,buffer,RTEBLOCKSIZE);
                if (ack == 1 && buffer[char_count-1] == '\005') { /* ENQ-ACK */
                        vwrite(com_fd,"\006",1);  /* send an ACK */
                        for(i=0;i<char_count;i++)
                                if (buffer[i] == '\005') {
                                        char_count--;  /* ignore the ENQ */
                                        for(j=i;j<char_count;j++)
                                                buffer[j]=buffer[j+1];
                                }
                }
                vwrite(logfiledescriptor,buffer,char_count);
                logcount += char_count;
        }
}

sigusr1_handler()
{
        if(logPID == 0) restore_ttys_exit("NO PID ASSIGNED");
        if (close(logfiledescriptor) == -1) {
                perror(logfilename);
                restore_ttys_exit("SIGUSR1 handler");
        }
        printf("Created \"%s\": %d bytes\n",logfilename,logcount);
        restore_ttys_exit("");
}
```

NOTES:

Terminal Selection and Interfacing

Introduction

This peripherals section contains information on the selection and interfacing of system consoles, additional display terminals, bar code readers, and industrial terminals for HP 1000 A-Series Computer Systems.

System Console Selection

A display terminal must be provided for operator communication with HP 1000 A-Series Computer Systems:

1. in any HP 1000 A-Series Computer System based on a 219xE/G/H, or 248xB/C SPU;

2. in any HP 1000 A-Series System based on a box or board computer that does not receive remote system console support via a DS/1000-IV Distributed Systems network connection.

Except for the HP 700/41, any of the display terminals listed in Table 7-1 can be used as the system console. However, you should specify a minimum-capability terminal for the system console, because extra capability, such as graphics, usually cannot be put to good use on a system console. The other main consideration in selecting a system console is to specify one that uses the same type of cable as most of the other terminals in the system to facilitate connection of another terminal to the system console interface if the system console fails. An industrial terminal, such as the HP 3081A, cannot be used as a system console.

Display Terminal Selection

All display terminals for HP 1000 Computer Systems have an 80 character by 24 line screen. All of the display terminals, except the HP 700/41 support character and block modes and display enhancements, such as underline, inverse video, and blink.

Table 7-1 lists the terminals that are supported on HP 1000 A-Series Computer Systems. The HP 1000 A-Series Ordering Guide (5959-7811 or a later revision) lists connection information for discontinued terminals.

Table 7-1. Supported Display Terminals

Terminal	Name/Description
700/92	Display Terminal
700/41	Terminal†
2393A	Graphics Terminal
2397A	Color Graphics Terminal
The following are discontinued terminals listed here for reference only.	
2382A	Office Display Terminal
2392A	Display Terminal
2621B	Display Terminal
2622A	Display Terminal
2623A	Graphics Terminal
2624B	Display Terminal
2625A	Dual System Terminal
2626A	Display Station
2627A	Color Graphics Terminal
2628A	Word Processing Terminal
45610B	Touchscreen Terminal

† The 700/41 Terminal is NOT usable as a system console. It is a **dumb** terminal that does not support "CI stack" or Edit/1000 screen mode. **Users must write their own device driver for the 700/41 terminal.**

Character Set Availability

The character sets are built into the firmware of the terminal. The ordering option shown in Table 7-2 indicates appropriate keyboard options for the different national versions of currently available terminals.

Table 7-2. Terminal Character Set Options

Character Set	700/92 700/91 Option	2393A 2397A Option
U.S. English	ABA	Std.
Swedish	ABS	101
Norwegian	ABN	102
French	ABF	103
German	ABD	104
U.K. English	ABU	105
European Spanish	ABE	106
Canadian French	ABC	107
Canadian English	ABL	108
Italian	ABZ	109
Dutch	ABH	110
Finnish	ABX	111
Danish	ABY	112
Swiss German	ABP	113
Swiss French	ABQ	114
Latin Spanish	ABM	115
Flemish	ABW	116
Math Char Set	not av.	Std.
Large Characts	not av.	Std.
Line Drawing	Std.	Std.

Display Terminal Interfacing

A Choice of Interfaces

Display terminals can be connected to HP 1000 Computer Systems via:

1. Point-to-point, single-terminal interface (usable for system console).

2. Four-channel On-Board Interface on the A400 CPU card or Eight-channel multiplexer interface (also usable for system console).

3. X.25 interface for connection to remote terminals via modem and packet-switching network (not usable for system console).

Each of these interfacing choices is discussed in the following paragraphs.

Single-Terminal, Point-to-Point Interface

The HP 12005B is a single-terminal, point-to-point interface that supports data rates up to 1920 characters per second. Only 700/92, 2392A, 2393A, and 2397A, Terminals have been tested via the 12005B interface. For connections, see Figure 7-1. Connect options differ for direct and modem connections, as follows:

- Direct connect via 12005B option 002 cable, 5 meters (16.4 ft.), HP Part Number 5061-6634.
- Connect to modem using 12005B option 003 cable, 5 meters (16.4 ft.), HP Part Number 5061-5798.

Multiplexer Interfaces

The 12040D multiplexer interface can be used to connect up to eight terminals to the system via a single I/O channel (see Figure 7-2). The A400 on-board I/O interface (12100A) can be used for connection to the system console and three additional terminals (Figure 7-3) or other multiplexer-connectable devices. In addition to making more efficient use of the system's available I/O channel capacity, multiplexers provide interfacing at a lower cost per channel than point-to-point interfacing whenever more than two terminals and other serial devices are to be connected.

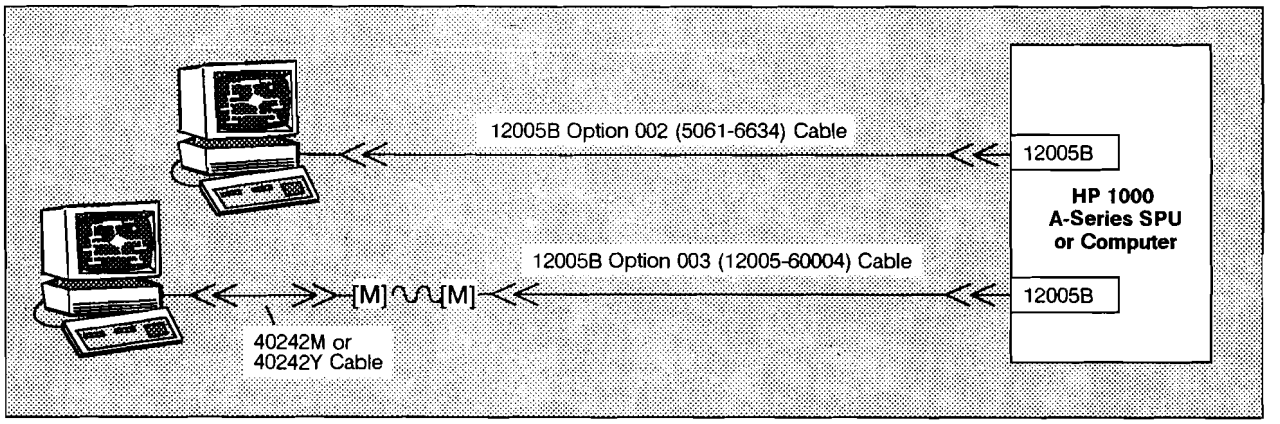


Figure 7-1. Console/Terminal Connection via 12005B Asynchronous Serial Interface

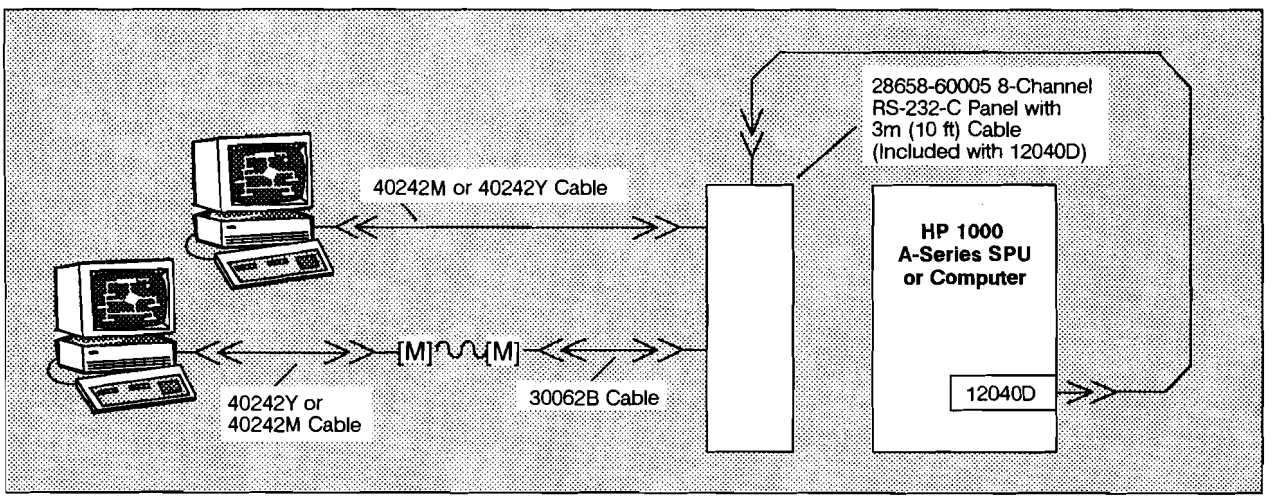


Figure 7-2. Console/Terminal Connection via 12040D 8-Channel Multiplexer

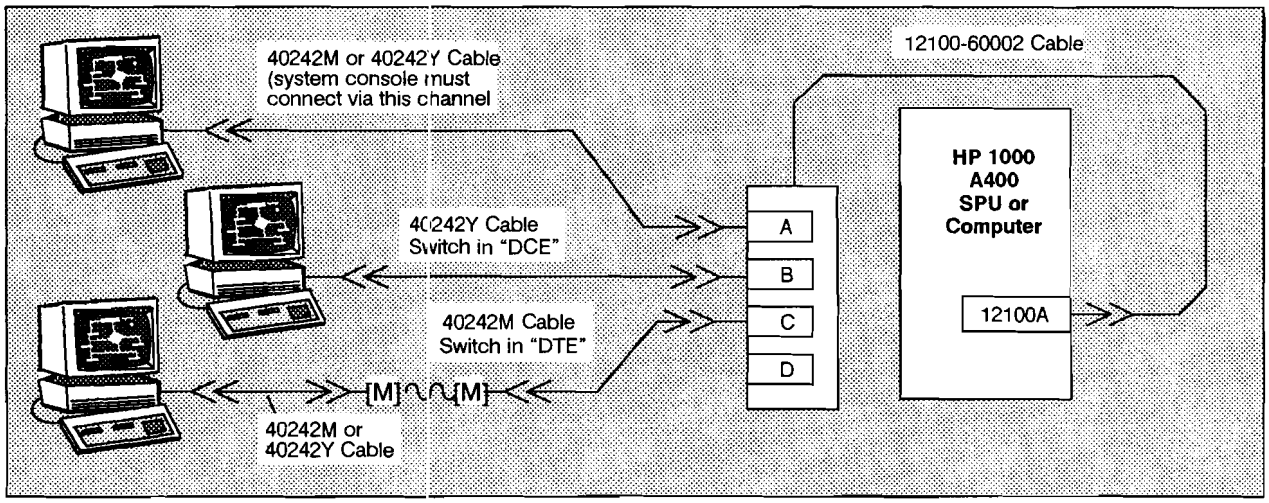


Figure 7-3. Console/Terminal Connection via A400 Four-Port On-Board I/O Multiplexer

For modem connection to remote terminals, the 12040D multiplexer should be used with the 37214A Systems Modem, especially if program control of modem is desired. See Figure 7-4, below.

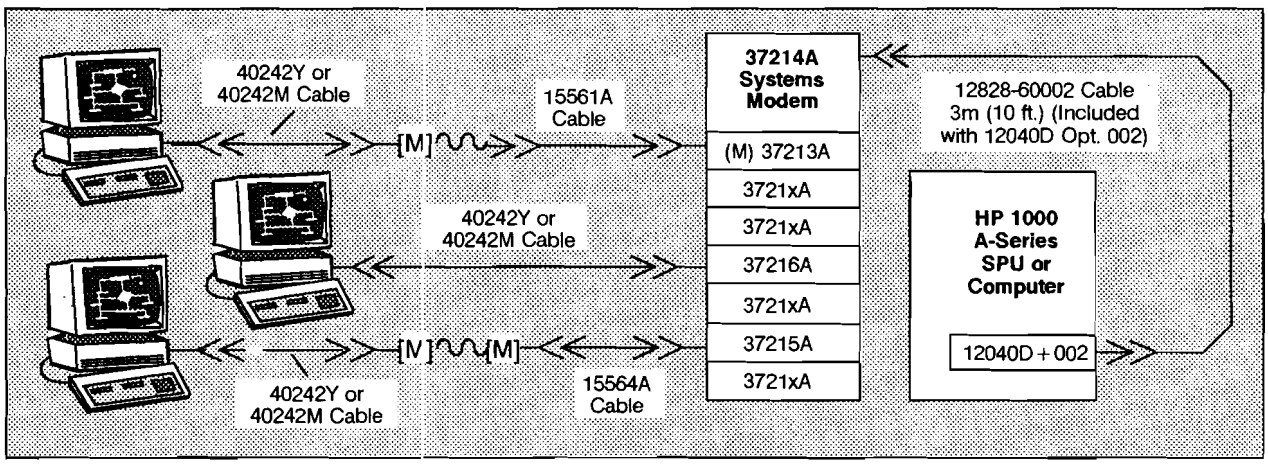


Figure 7-4. Terminal Connection via 12040D Option 002 Multiplexer and 37214A Systems Modem

X.25 Interface

An X.25 interface for the A-Series, HP 12075A, supports connection to remote terminals via modem, packet-switching network, and an HP 2335A X.25 Multiplexer, which functions as a packet assembler/disassembler (PAD) for up to 16 terminals. Terminals connect to the remote HP 2335A with the same cable that would be used to connect to the multiplexer panel (see Figure 7-5, next page). For other information on configuration of the X.25 link to the HP 2335A, see the HP 2335A X.25 Multiplexer data sheet in the HP AdvanceNet Specification Guide, 5956-4144 or a later revision.

Packet-switching connection to terminals offers the advantage of transmission charges that are proportional to actual message traffic, not connect time. The disadvantages of packet-switching connection are:

1. Only character mode operation is supported, which may preclude use with some software packages.

2. Additional software is required (HP 91751A).

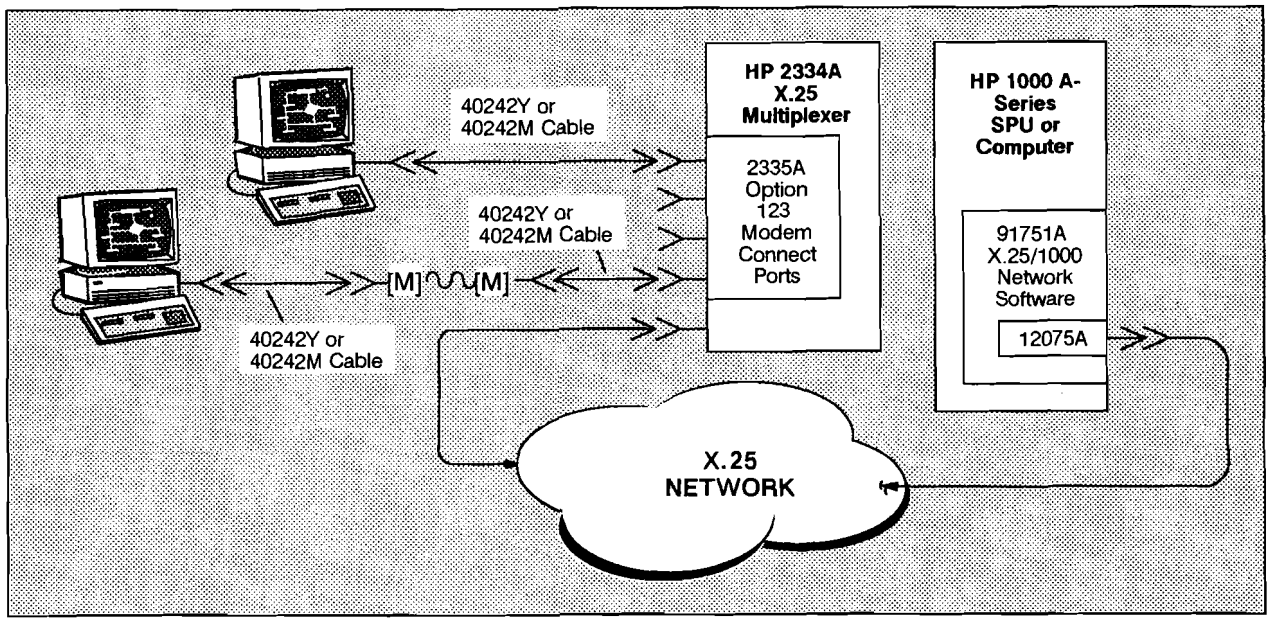


Figure 7-5. Remote Terminal Connection via 12075A X.25 Interface, Packet-Switching Network, and 2335A X.25 Multiplexer

Modems for Linking to Remote Terminals

Communication with terminals over considerable distances usually requires a modem-telephone line link. This link consists of two compatible modems, one interfaced to the computer, the other connected to the terminal. The modems convert the bit streams exchanged between the computer and terminal to a modulated audio signal, which is transmitted over a dial-up telephone connection or a dedicated line leased from the telephone company. The different modems that can be used for connecting remote terminals to HP 1000 A-Series Computer Systems are listed in Table 7-3.

Auxiliary Printers for Terminals

An extensive choice of auxiliary printers can be connected to most HP 1000 A-Series compatible display terminals to provide local hardcopy output, as shown in Table 7-4.

Table 7-3. Modems for HP 1000 A-Series Remote Connection to Terminals

A-SERIES INTERFACE	DATA RATE (bits per sec)	MODEMS AT INTERFACE	MODEMS AT TERMINAL
Point-to-point 12005B + 003	1200	HP 92205A* or Bell Type 212 or Vadic VA3400	HP 92205A* or Bell Type 212 or Vadic VA3400
	2400	HP 92205B	HP 92205B
Four-Channel OBIO Multiplexer in 12100A A400 SBC	1200	HP 92205A* or Bell Type 212 or Vadic VA3400	HP 92205A* or Bell Type 212 or Vadic VA3400
Eight-Channel 12040C/D Multiplexer	1200	HP 37214A plus one 37213A modem card per channel or Vadic VA3400 per channel	HP 92205A* or Bell Type 212 or Vadic VA3400
X.25 12075A	1200	Bell Type 212A	Bell Type 212A
	2400	Bell Type 201C	Bell Type 201C
	4800	Bell Type 208C	Bell Type 208C
	9600	Bell Type 209A	Bell Type 209A
	19200	Supplied by Public Packet Switched Network	Supplied by Public Packet Switched Network

* Use HP 92205C in Canada.

Table 7-4. Auxiliary Printers for Terminals

PRINTER PRODUCT NUMBER	CABLES USED FOR CONNECTION BY TERMINAL AND INTERFACE					
	700/92 or 700/41 (RS-232-C Interface)	2393A/97A Opt 046 (HP-IB Interface)	239xA Opt 092 (RS-232-C Interface)	239xA Opt 093 (Parallel Centronics Interface)	Vectra (24540A Serial/ Parallel Interface)	Vectra (24541A Dual Serial Interface)
2225C	Not supported	Not supported	Not supported	40242D	24542D	Not supported
2225D	40242G	Not supported	40242G	Not supported	24542G	24542G
2227A/2228A	40242G	Not supported	40242G	40242D	24542G or 24542D	24542G
2671A*/G* 2673A*	Not supported	10833A/B/C	Not supported	Not supported	Not supported	Not supported
2671A*/G* + 040 2673A* + 040	40242G	Not supported	40242G	Not supported	Not supported	Not supported
2671A*/G* + 042 2673A* + 042	Not supported	Not supported	Not supported	40242D	Not supported	Not supported
2932A*/2934A	40242G	Not supported	40242G	Not supported	24542G	24542G
2932A* + 042 2934A + 042	Not supported	Not supported	Not supported	40242D	24542D	Not supported
2932A* + 046 2934A + 046	Not supported	10833A/B/C	Not supported	Not supported	Not supported	Not supported

* Discontinued product, listed here for reference only.

Bar Code Reader Input

The time and error potential in the entry of routine data can be minimized by using bar coded labels, tags, badges, or cards. Information as diverse as product part or stock numbers, patient identification numbers for hospital records can be imprinted in an appropriate bar code. Thereafter, the single sweep of a wand can scan and enter the encoded data in about one-third of the time required for keystroked entry by a skilled operator, and with monotonous accuracy.

The HP 92916A Bar Code Reader connects to the HP-HIL port on the keyboard of 2393A and 2397A terminals. It emulates the terminal keyboard in that the bar coded characters it reads are sent to the display and the computer as if they had been keystroked. The 92916A reads these bar codes: 3 of 9, Interleaved 2 of 5, Codabar, and UPC/EAN/JAN.

Bar code printing is optional on the HP 2563B, 2564B, and 2566B Line Printers and standard on the 2934A Printer.

Industrial Terminals

For data collection in factory environments, HP offers the HP 3081A Industrial Workstation Terminal and the Vectra Industrial PC system. (See Figure 7-6 for connections.)

The HP 3081A is a compact, rugged, low-priced terminal with 32-character display and numeric keyboard. Full alphanumeric keyboard and bar code reader are optional. The bar code reader can be equipped with six different input options, including a slot reader, which uses infrared light to read "black on black" codes on badges for security applications.

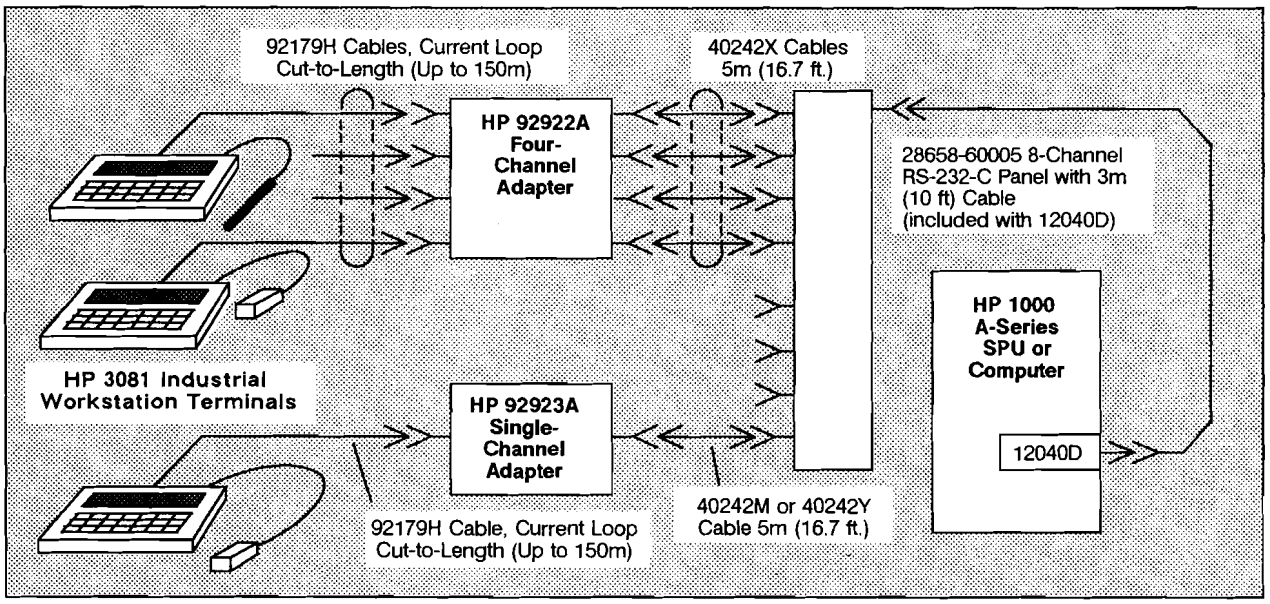


Figure 7-6. HP 3081A Industrial Workstation Terminal Connection

Graphics Devices Selection and Interfacing

Introduction

This section contains information on the selection and connection of graphics display, input, and output devices that are supported under the HP 92861A Device-Independent Graphics Library (DGL).

Graphics Display Terminals and Monitors

Most graphics applications involve interaction, at least during their development. This requires display of a picture with which the user can interact. In addition, displays can simplify complex real-time data relationships, such as those involved in process control, for better operator apprehension and response.

For graphics display on HP 1000 systems, Hewlett-Packard offers the HP 2393A monochrome Graphics Terminal and the HP 2397A Color Graphics Terminal. These terminals provide:

- 6.3 by 8.4 inch (160 by 214 mm) display area.
- 512 by 390 or 640 by 400 resolution.
- Polygon fill with 11 line types.
- 8 colors from a palette of 64 (HP 2397A only).

Connection of the 2393A and 2397A Graphics Terminals to A-Series Computers is covered in the terminal section.

Another display alternative is connection of an RGB color monitor can be connected to HP 1000 A-Series systems via a 12065A Color Video Output Interface, as shown in Figure 8-1. This interface supports:

- 576 by 455 or 512 by 512 resolution.
- Eight styles of polygon fill.
- 16 colors from a palette of 4096.

For more information on the 12065A interface, refer to its data sheet in the HP AdvanceNet Specification Guide, 5956-4144 or a later revision.

Graphics Input

The Device-Independent Graphics Library supports various methods of entering graphics information into HP 1000 Systems. A picture can be created or changed on a graphics terminal screen by using the graphics cursor control keys or the HP Mouse (HP 46060A) to move, draw, or pick objects. The graphics tablet (HP 46087B for A-size and HP 46088B for B- size) is ideal for digitizing and sketching drawings. With the HP-HIL interface on 239xA graphics terminals, you can connect input devices and hardcopy devices simultaneously because up to three input devices can be daisy chained to the keyboard, leaving the auxiliary port free for hardcopy devices.

The 4608xB Graphics tablets and 46060A HP Mouse are connected to HP 239xA graphics terminals as shown in Figure 8-2.

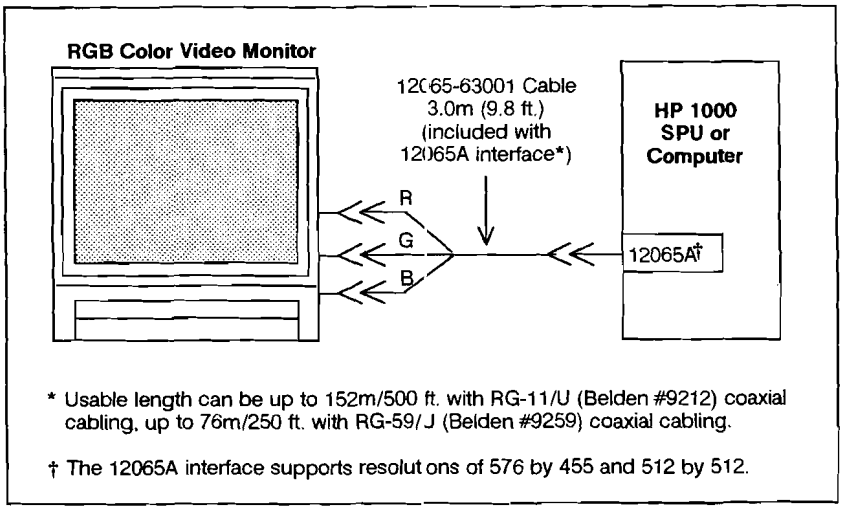


Figure 8-1. Color Video Monitor Connection to HP 1000 A-Series SPU or Computer

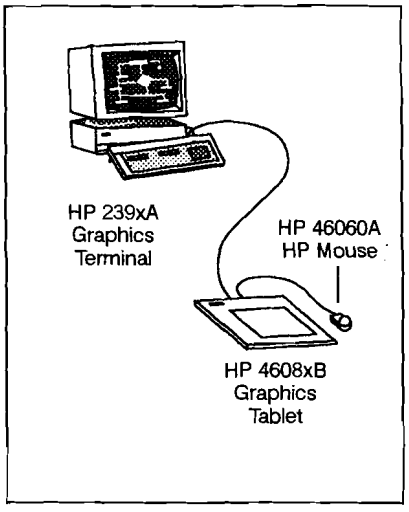


Figure 8-2. Connection of Graphics Input Devices to HP 239xA Terminals

Graphics Hardcopy Output

Graphics Plotters

Graphics plotters provide the most precise hardcopy output. In addition, they offer the means to produce output in multiple colors on plotter paper or on transparent media for projection. A brief list of the plotter capabilities as they are supported in the HP Device-Independent Graphics Library is presented in Table 8-1. Plotter connection to HP 1000 Computer Systems are summarized in Table 8-2.

Graphics Printers

Most of the dot-matrix printers supported on HP 1000 A-Series Computer Systems can be used to print graphics as well as alphanumeric output. In applications for which monochrome graphics output is satisfactory and precision is relatively unimportant, a printer with graphics capability may provide adequate graphics hardcopy.

There are two different types of graphics printing. The first type is a printer that prints a "raster dump" copy of a graphics terminal's graphics display. Interfacing is simple and no system overhead is incurred to get the hard copy output.

The second type of graphics printing uses a vector-to-raster conversion routine from the HP 92861A Device-Independent Graphics Library to generate the raster graphics output for a printer that is connected to the HP 1000 Computer System. Because the graphics data can be processed prior to output, this type of graphics printing provides more control of size and aspect ratio than a simple raster dump from a terminal. Graphics printers are compared in Table 8-3.

Table 8-1. Graphics Plotters Specifications Summary

Plotter Product Number	No. of Pens	Maximum Plot Area		Maximum Pen Down Velocity in./sec (cm/sec)
		inches	(mm)	
7440A	8	7.5 x 10.7	(191 x 272)	15.7 (40)
7470A*	2	7.5 x 10.7	(191 x 272)	15.0 (38)
7475A	6	16.3 x 10.8	(414 x 275)	15.0 (38)
7550A	8	16.2 x 10.7	(411 x 272)	31.5 (80)
7570A	8	24.8 x 37.9	(630 x 964)	15.7 (40)
7580B*	8	24.5 x 48.5	(622 x 1232)	24.0 (60)
7585B*/6B*	8	36.5 x 48.5	(927 x 1232)	24.0 (60)
7595A/6A	8	36.5 x 48.5	(927 x 1232)	24.0 (60)

* Discontinued product, listed here for reference only.

Table 8-2. Graphics Plotter Connections Summary

Plotter	Interface Type	Host Interface required	Cables Required	Other Host Requirements
7440A + 001 7470A* + 001 7475A + 001 7570A 7580B* + 060 7585B* + 060 7586B* + 060 7595A 7596A	RS-232C Direct	12040C*/D Multiplexer or or 4-port On-Board I/O Multiplexer on 12100A A400 Single-Board Computer	13242N	Interface and Device Drivers included with RTE-A (see Device Drivers table on page 2-22) and the 92861A Device-Independent Graphics Library (see data sheet on page 2-71)
7550A			17355D	
7440A + 002 7470A* + 002 7475A + 002 7550A 7570A + 17570A 7580B* + 060 7585B* + 060 7586B* + 060 7595A 7596A	HP-IB	12009A HP-IB interface	10833B/C cables as needed for 2nd through nth devices connected to same HP-IB bus	

* Discontinued product, listed here for reference only.

Figure 8-3. HP Printers Supported by Graphics/1000-II DGL

Printer	Interface	Cable	Print Rate (in./minute)	Resolution (Dots/inch)
2227A QuietJet+ Printer	12040D or 12100A	13242N	Not specified	96 x 96
2228A QuietJet Printer				
2235B RuggedWriter	12040D or 12100A	92219G	Not specified	90 x 90
	12009A Opt 001	10833C/D†		
2563B+049 Line Printer	12040C*/D or 12100A	92219G	29	70 x 72
2563B+214 Line Printer	12009A Opt 001	Incl. w/opt 214		
2564B+049 Line Printer	12040C*/D or 12100A	92219G	66	70 x 72
2564B+214 Line Printer	12009A Opt 001	Incl. w/opt 214		
2566B+049 Line Printer	12040C*/D or 12100A	92219G	50	70 x 72
2566B+214 Line Printer	12009A Opt 001	Incl. w/opt 214		
2932A* Printer	12040C*/D or 12100A	92219G	8	90 x 90
2932A*+046 Printer	12009A Opt 001	10833C/D†		
2934A Printer	12040C*/D or 12100A	92219G	8	90 x 90
2934A+046 Printer	12009A Opt 001	10833C/D†		

† 10833C/D cable is required for an additional printer. Cable included with the 12009A Option 001 interface connects to the first printer or other device on the HP-IB bus.

* Discontinued product, listed here for reference only.

NOTES:

Printers Selection and Interfacing

Printer Selection

Four types of printers are supported on HP 1000 A-Series Computer Systems, making it easy to get the right type of printer for your application. These printer types are compared in Table 9-1 at right with respect to relative cost, print speed, noise level, and estimated print quality. They are further compared in Table 9-2, below, with respect to print rate, paper type, text quality, and bar code printing capability.

Table 9-1. Types of Printers Supported by HP 1000 A-Series Systems

Printer Type	Times ThinkJet Price	Print Speed	Noise Level (dBA)	Print Quality
Monochrome Inkjet	1.0-2.0	150-240 cps	50	C, B, A
Color Inkjet	2.8	167 cps	50	B
Dot-Matrix Impact Serial	3.8-6.1	40-480 cps	56-63	C, B+
Laser	5.4-40	8-20 ppm	50	A
Dot-Matrix Impact Line	11.9-44.6	300-900 lpm	65	B

Inkjet Printers

Inkjet (ThinkJet, QuietJet, DeskJet, and PaintJet) printers offer low price, reasonably fast print speed, and the quietest operation of all printers. Of these printers, the DeskJet offers Laser printer print quality. The PaintJet has the added advantage of being able to make full-color overhead transparencies. This type of printer is useful mainly as a low-cost, light-workload, workstation printer. It should never be considered for use as the only printer in a system.

Dot-Matrix Serial Impact Printers

Dot-matrix serial impact printers combine versatility at reasonable cost with good print speed. Versatility can include graphics image and bar code printing and the ability to trade print speed for better print quality. Good print speed means that a dot-matrix serial impact printer can be used as the only printer on a system with modest-to-average printing requirements.

Laser Printers

Laser printers offer top print quality and print speed faster than dot-matrix serial printers at higher cost. Laser printers are recommended for systems with average printing workload in which high print quality and quiet operation are important and the lack of multipart forms print capability is irrelevant.

Dot-Matrix Impact Line Printers

Dot-matrix impact line printers offer fast print speeds at high

Table 9-2. Printers Supported on HP 1000 A-Series Systems

Printer Type	Printer Product Number and Name	Maximum Print Rate	Paper Type	Print Quality	Bar Codes
Inkjet Printers	2225D *ThinkJet* Printer	150 cps	Std fanfold/cut sheets	Draft	No
	2227A *QuietJet Plus* Printer	160/192 cps	Wide fanfold/cut sheets	NLQ/Draft	No
	2228A *QuietJet* Printer	160/192 cps	Std fanfold/cut sheets	NLQ/Draft	No
	2276A *DeskJet* Printer	120/240 cps	Std fanfold/cut sheets	LQ/Draft	No
	2277A *DeskJet Plus* Printer	120/240 cps	Std fanfold/cut sheets	LQ/Draft	No
	3630A *PaintJet* Printer	167 cps	Std fanfold/cut sheets	NLQ	No
Dot-Matrix Serial Impact Printers	2235B *RuggedWriter*	240/480 cps	Wide fanfold, 6-part forms	LQ/Draft	No
	2932A* General-Purpose Printer	200 cps	Wide fanfold, 6-part forms	Draft	No
	2934A Office Printer	40/67/200 cps	Wide fanfold, 6-part forms	LQ/Draft	Yes
Laser Printers	33440A *LaserJet II* Printer	8 pages/min.	Single sheets	Letter Quality	Yes
	2684A *LaserJet/2000* Printer	20 pages/min.	Single sheets	Letter Quality	Yes
	2686A* *LaserJet* Printer	8 pages/min.	Single sheets	Letter Quality	Yes
	2686A* + 300 *LaserJet* Printer	8 pages/min.	Single sheets	Letter Quality	Yes
Dot-Matrix Line Printers	2563B Line Printer	300/150 lpm	Wide fanfold, 6-part forms	Draft/NLQ	Opt
	2564B Line Printer	600/300 lpm	Wide fanfold, 6-part forms	Draft/NLQ	Opt
	2566B Line Printer	900/248 lpm	Wide fanfold, 6-part forms	Draft/NLQ	Opt
Dot-Matrix Thermal Printers	2671A* Printer	120 cps	Std fanfold or roll, thermal	Draft	No
	2671G* Graphics Printer	120 cps	Std fanfold or roll, thermal	Draft	No
	2673A* Intelligent Graphics Printer	120 cps	Std fanfold or roll, thermal	Draft	No

Print Quality Legend: NLQ = Near Letter Quality LQ = Letter Quality * Discontinued product, listed for reference.

prices. They should be selected for heavy printing workloads.

Printer Interfacing

Printer connections for various printers in A-Series Computer Systems are shown in Figure 9-1 and described in Table 9-3, both below.

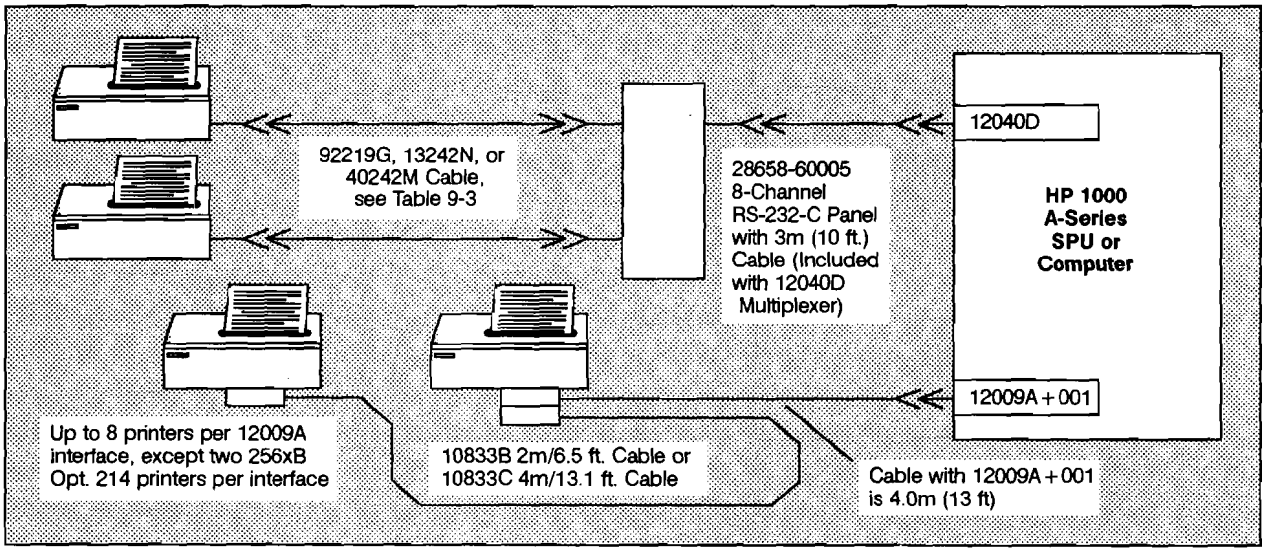


Figure 9-1. Printer Connections to HP 1000 A-Series Systems

Table 9-3. Interfacing of System-Connected Printers to HP 1000 A-Series Systems

MULTIPLEXER CONNECTED PRINTERS		**HP-IB CONNECTED PRINTERS**	
Each printer uses one port of the four-port On-Board I/O multiplexer of the 12100A Single Board Computer or one channel of the 12040B*/C*/D 8-Channel Multiplexer.		Each printer is connected via a 10833B/C cable, using 1/8 of the capacity of the 12009A interface, except as otherwise noted.	
PRINTER	CONNECTS VIA	PRINTER	COMMENTS
2563B with Option 049 2564B with Option 049 2566B with Option 049	92219G Cable	2563B with Option 214 2564B with Option 214 2566B with Option 214 2608SR* with Option 214	A maximum of two 256xB Option 214 Printers and NO OTHER DEVICES can be connected to each 12009A HP-IB interface.
2235B 2932A 2934A	40242M Cable	2235B 2932A with Option 046 2934A with Option 046	Can be used with up to eight (8) HP-IB devices on the same 12009A HP-IB interface. Note, however, that high speed and low speed devices cannot be used on the same 12009A interface.
2225D 2227A 2228A 2276A	13242N Cable	2671A*/G* 2673A* 82906A*	
2684D	40242M Cable		
2686A* 2686A* with Option 300	13242N Cable		
33440A 3630A with Option 001	40242M Cable		

* Discontinued product, listed here for reference only.

Disks and Tape Units Selection and Interfacing

Introduction

This section contains information on the selection and connection of mass storage devices (disks, flexible disks, and cartridge and reel-to-reel magnetic tape units) for HP 1000 A-Series Computer Systems.

System Functions of Mass Storage Devices

Mass storage devices provide for the installation, storage, and backup of the operating system, programs, and data for HP 1000 Computer Systems.

System Bootup

Each system must include a mass storage device that supports bootup to initiate operation of a particular generation or configuration of the operating system. Each system that cannot bootup from another system via a communications link requires a boot-up device. The system boot-up function is supported by all HP 1000-compatible cartridge tape and magnetic tape units and by most, but not all, HP 1000-compatible disks. If the boot-up device is a disk, it is called a system disk.

Hard Disks for Fast Access Storage

Hard disks with moving read/write heads are used to provide fast-access storage of programs and data for these reasons:

1. The hard disk media has a dimensional stability which makes possible writing and reading of magnetic patterns of very high density.
2. The hard disk can be made with enough strength and balance to be rotated at high speeds, which:
   a. Minimizes the rotational delay in accessing data in any particular disk sector.
   b. Maximizes the rate at which data passes beneath the read/write heads, which determines the maximum data transfer rate.

Hard disks with removable media can also be used for input and backup of programs and data. However, the relatively high cost of disk cartridges and disk packs precludes the distribution of most software via removable disk media. Software is usually provided on cartridge tape, magnetic tape, or flexible disk media.

Cartridge Tape and Magnetic Tape Units for Software/Data Input and Backup

Cartridge Tape and Magnetic Tape Units are used for software/data input and backup for these reasons:

1. Magnetic tape is the lowest-cost, high-density recording medium available and is easily mounted, dismounted, and stored.
2. A cartridge or reel of magnetic tape has over 100 times the capacity of a flexible disk, which is essential for backing up large volumes of disk storage.
3. Cartridge tape and magnetic tape drives have high sequential read/write access rates (equaling or exceeding those of flexible disk drives), which are also necessary for backing up large volumes of disk storage.

Flexible Disks for Software Input and Limited-Volume Backup

Flexible disks provide a good medium for installation and backup of individual application programs that can all fit on one flexible disk. However, the limited storage capacity of flexible disks makes them inconvenient and impractical to use for inpstallation or backup of any but the very smallest systems or data bases.

Disk Selection

Types of Disks

The principal types of currently-available disks supported on HP 1000 A-Series Computer Systems are discussed below and compared with respect to capacity and performance in Table 10-1. Discontinued disks that are supported are listed in Table 10-2.

CS/80 Disks. CS/80 disks with capacity-per-drive to 571 MB use Winchester technology wherein the disk is sealed off from environmental contamination. This protection makes possible very high data density, with high capacity in a small space, at very low cost per data byte.

Built-in intelligence and the command set in these disks simplifies interfacing of disks of various capacities. This facilitates upgrading of disk capacity to satisfy changing system requirements.

CS/80 disks can be connected to the same interface as a CS/80 cartridge tape unit, as shown in Figure 10-1, page 10-4. However,, best performance is achieved by using a separate interface for the cartridge tape unit.

Table 10-1. Currently Available Disks Supported in HP 1000 A-Series Computer Systems (Listed in order of increasing capacity.)

Product Number	Name/Description	Capacity per Disk) (MB)	Access Time (millisec)	Average Transfer Rate (KB/sec)
9122C	Dual Microfloppy Disks	2 x 1.42	185	35
12122A	Integrated Fixed Disk and [Microfloppy Disk] for 243xA/B/G/H Computer or 248xB/G/H SPU	19.4 [0.63]	75 [225]	150 [17]
9153C+020	Winchester Disk and [Microfloppy Disk]	20 [1.42]	85 [300]	185 [32]
9153C+021	Winchester Disk	20	85	185
9153C+040	Winchester Disk and [Microfloppy Disk]	40 [1.42]	85 [300]	185 [32]
9153C+041	Winchester Disk	40	85	185
7957B	Winchester Disk	81	28.4	875
7958B	Winchester Disk	152	28.4	875
7962B	Winchester Disk (one drive)	152	28.4	875
97962B	Additional Winchester Disk for 7962B/7963B (max. of 3 drives/796xB)	152	28.4	875
9262B	Removable Winchester Disk (one drive)	152	28.4	875
97902B	Additional Winchester Disk for 9262B/9263B (max. of 2 drives/926xB)	152	28.4	875
7959B	Winchester Disk	304	28.4	875
7963B	Winchester Disk (one drive)	304	28.4	875
97963B	Additional Winchester Disk for 7962B/7963B (max. of 3 drives/796xB)	304	28.4	875
9263B	Removable Winchester Disk (one drive)	304	28.4	875
97903B	Additional Winchester Disk for 9262B/9263B (max. of 2 drives/926xB)	304	28.4	875
7936H/XP	Fixed Disk/Fixed Disk with Cache	307	30.8	1,000
7937H/XP	Fixed Disk/Fixed Disk with Cache	571	30.8	1,000
19521H	Two 7937H Disks in 19511A Cabinet	1142	30.8	1,000
19521XP	Two 7937XP Disks in 19511A Cabinet	1142	30.8	1,000
19522H	Four 7937H Disks in 19514A Cabinet	2284	30.8	1,000
19522XP	Four 7937XP Disks in 19514A Cabinet	2284	30.8	1,000
19524H	Eight 7937H Disks in 19514A Cabinet	4568	30.8	1,000
19524XP	Eight 7937XP Disks in 19514A Cabinet	4568	30.8	1,000

Table 10-2. Discontinued Disks That are Supported in HP 1000 A-Series Computer Systems (Listed in order of increasing capacity.)

Product Number	Name/Description	Capacity per Disk) (MB)	Access Time (millisec)	Average Transfer Rate (KB/sec)
9122D	Dual Microfloppy Disks	2 x 0.63	175	63
9133H	Fixed Disk and [Microfloppy Disk]	19.9 [0.63]	93 [175]	150 [63]
9134H	Fixed Disk	19.9	75	150
9153B	Fixed Disk and [Microfloppy Disk]	20 [0.63]	75 [175]	150 [63]
9154B	Fixed Disk	20	75	150
7941A	Fixed Disk	23	48.4	625
7942A	Fixed Disk and Cartridge Tape Unit	23	48.4	625
7911P/R	Fixed Disk and Cartridge Tape Unit	28	38.4	1,000
9133L	Fixed Disk and [Microfloppy Disk]	39.9 [0.63]	55 [478]	180 [63]
7907A	Fixed Disk and [Removable Disk*]	20.5 [20.5]	44.3	600
7920M/S†	Removable Media MAC Master/Slave Disk	50	33.3	740
7945A	Fixed Disk	55	48.4	625
7946A	Fixed Disk and Cartridge Tape Unit	55	48.4	625
7912P/R	Fixed Disk and Cartridge Tape Unit	65	38.4	1,000
7957A	Fixed Disk	81	41.5	853
7925M/S†	Removable Media MAC Master/Slave Disk	120	36.1	740
7958A	Fixed Disk	130	41.5	853
7914CT/P/R	Fixed Disk and Cartridge Tape Unit	132	40.4	1,000
7914ST/TD	Fixed Disk and 1600 cpi Mag Tape Unit	132	40.4	1,000
7933H/XP	Fixed Disk/Fixed Disk with Cache	404	35.1	1,000
7935H*/XP*	Removable Media Disk/Removable Media Disk with cache	404	35.1	1,000

* RTE-A and subsystem software are not available on the removable media for the 7907A, 7935H, or7935XP, so a separate magnetic tape or cartridge tape device is required for software installation and backup.

† MAC disks do not support bootup of the RTE-A system, so they are useful only as peripheral disks in HP 1000 A-Series systems.

NOTE: 7914TD Does not support bootup of the RTE-A System.

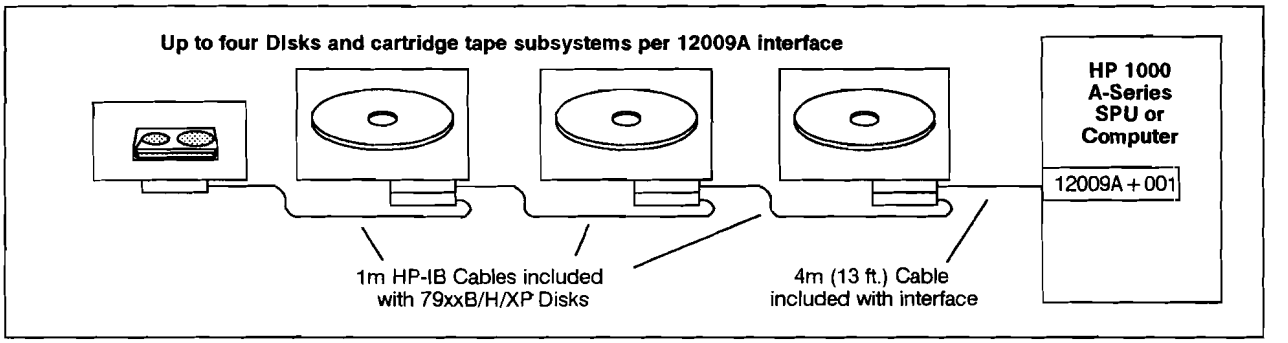


Figure 10-1. Disk and Cartridge Tape Unit Connections to HP 1000 A-Series Computer Systems

Multi-Access Controller (MAC) Disks. MAC disks are discontinued products that it may nonetheless be desired to use on an HP 1000 A-Series system. These disks accommodate multi-system access to a common storage facility. Up to three A-Series computers can be connected to one MAC master disk.

Multi-computer compatibility is supported by the RTE-A and RTE-6/VM operating systems and file managers for computers that access their own exclusive disk spaces on one or more MAC disk drives. Because MAC disks do not support bootup of RTE-A systems, they are useful only as peripheral disks in systems operating under RTE-A.

All of the MAC disks also incorporate removable media for applications which require that capability.

For MAC disk connections to HP 1000 A-Series see Figures 10-2 and 10-3 in the 4th Edition of the A-Series Computer Handbook.

Other Disks. Other disks supported under HP 1000 Computer Systems include small hard disk drives, hard disk/3.5-inch flexible disk drive combinations, and 3.5-inch flexible disk drives. The small hard disk and flexible disk packages are intended for use in small systems in which small size and low cost are overriding considerations. The flexible disks offer a convenient means of loading software into the system and providing copies of software for transportation to other HP 1000 Systems. Connection of these disks to HP 1000 Computer Systems is the same as shown in Figure 10-1, except that a 10833A/B/C cable will be required for each additional disk after the first has been connected using the cable that comes with the required 12009A option 001 interface.

Performance Considerations

Capacity, access time, and transfer rates of the disks that are supported on HP 1000 A-Series Computer Systems are compared in Tables 10-1 and 10-2. The significance of these performance factors is discussed in the following paragraphs.

Capacity. The disk(s) selected must provide enough storage capacity to accommodate the operating system, storage and working space for program development software, space for data bases, and space for other software and data. For help in determining disk storage capacity requirements, use the Memory Requirements Estimator on pages 2-107 through 2-110 of this handbook.

In systems with very large disk storage needs, it may be necessary to connect multiple disk drives to one or more interfaces. The RTE primary systems support up to two disk interfaces, up to 4.5 gigabytes of disk storage using eight 7937H 571-megabyte disks, four per interface. However, it is possible to generate an RTE system that supports more interfaces to increase disk capacity. The capacity can be increased to over 20 gigabytes, limited mainly by computer card cage spaces available for disk interfaces (disk interfacing is not supported in any A-Series I/O Extender) and the capacity of supported disk memories.

Access Time. Access time is the time required for the moving read/write head to reach the area on the disk that is to be accessed. This includes the average time (including controller overhead) that is required for the head to reach the desired track plus the time required for the desired disk sector to come under the read/write head (this time is half that required for one revolution of the disk).

Minimizing access time is most important in real-time applications that are heavily dependent upon disk accesses, such as processing of Virtual Memory Area data arrays for simulation or interactive graphics. Frequent access to data base information is

another situation in which it is particularly desirable to minimize disk access time.

Transfer Rate. Transfer rate is a function of recording density and speed of disk rotation. Fast transfers are most important in applications that involve transfers of large files between systems or frequent overlaying of program segments.

Disk Interfacing

Connection of disks to HP 1000 Computer Systems is illustrated in Figure 10-1.

Multi-interface access to disks may be necessary because the required disk capacity cannot be connected to the system via a single interface. However, multi-interface access may also be used to provide parallel paths that permit multiple disk accesses to take place concurrently, thereby speeding up overall throughput.

Although multi-interface access can be used to speed up overall throughput, the extent to which it is usable for that purpose is limited by the I/O bandwidth of the computer. The aggregate data rate of all concurrent disk transfers and other concurrent transfers cannot exceed the I/O bandwidth of the computer (Table 10-3) and may not quite reach it. Attempts to exceed the computer's I/O bandwidth can even result in loss of data. With MAC disks, which are less intelligent than the CS/80 disks, attempts at simultaneous disk access via two interfaces have exceeded I/O bandwidth and actually resulted in loss of data.

Table 10-3. I/O Bandwidth of A-Series Computers

Processor	I/O Bandwidth (MB/second)
A400 A600+	4.4 4.27
A900	2.5 (output) 3.7 (input)

One CS/80 disk can be connected to the same 12009A interface as one MAC master disk. A maximum of five 79xxS slave disks can be connected to a MAC master disk in A-Series systems. Performance may be degraded because of contention between the two different types of disks on the same HP-IB bus.

Disk Mirroring

Users with special concern for data protection and high availability of software and data may want to configure part or all of their storage capacity in mirrored volumes. Such configuration is supported by the HP 92050A Datapair/1000 product. Both volumes of a mirrored pair must have the same number of tracks and must be on disks that have the same number of sectors per track, and the same number of bytes per sector (see Table 10-4). Any volume may be paired, including the bootable volume. However, if a bootable volume is paired, it must be paired with another bootable volume. Each of the paired volumes must be connected to the system via its own 12009A interface, as shown in Figure 10-2, next page.

The paired volume can include part or all of the capacities of one or several disks. Any unpaired capacity is also available to the system as ordinary disk storage capacity, suggested by the extension of the connection from the upper disk of the pair in Figure 10-2 "To other disk(s)".

Table 10-4. Sector per Track Matching of Disks for Datapair/1000

Disk	Sectors per Track	Bytes per Sector
7907A 791xCT/P/R	64	256
7933H/XP 7935H/XP	92	256
7936H/XP 7937H/XP	123	256
794xA	32	256
795xA/B 796xB 926xB	63	256

NOTE A: The number of disks and disk interfaces that must be ordered to support a pair volume is DOUBLE what would otherwise be required to provide the same capacity.

NOTE B: Other considerations than pairability may be important in the selection of disks for mirroring. For example, HP 7933H/XP and 7935H/XP Disks take several minutes to spin-up to operating speed after a power failure, which might make them unacceptable in some applications. HP 791xP/R Disks may become unavailable for one or two minutes after a tape is inserted into the tape drive.

Magnetic Tape Unit Selection

Performance Considerations

A magnetic tape unit must provide a transfer rate and capacity adequate to the job it has to perform. These, in turn, depend upon recording density, operating mode, and tape speed, as summarized for the various HP 1000-supported magnetic tape units in Table 10-5, next page.

Transfer rate becomes increasingly important as the size of the system or data base to be backed up increases. Backup of a very large system or data base can easily require multiple tapes and one to several hours to complete. A tape unit with a fast transfer rate will get the job done in proportionately less time than a slower tape unit.

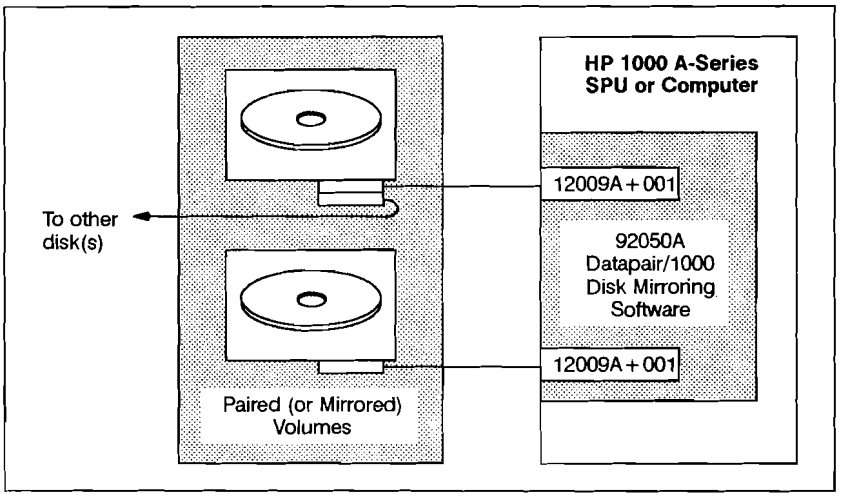


Figure 10-2. Connection of Paired Volumes to HP 1000 A-Series Computer Systems

another situation in which it is particularly desirable to minimize disk access time.

Capacity per reel of tape is another performance factor whose importance increases with the volume of data to be backed up or stored. With a multi-tape backup of a system or a data base, tapes will have to be changed less often on a tape unit recording at a high density that maximizes the data packed on each reel of tape. Tape storage space is also less with higher capacity because fewer reels of tape are needed to store a given volume of data.

Compatibility Considerations

Where a library of tapes already exists, the ability of the magnetic tape unit to read those tapes can be very important. A magnetic tape recorded at 800 cpi can only be read on a tape unit at that density. If only one tape unit can be provided for the system, the need for compatibility with existing tapes may conflict to some extent with the need for high performance.

Operational Modes

Start-stop is the traditional mode of magnetic tape unit operation. The magnetic tape unit starts the tape and reads or writes a record of *n* bytes, stops, starts and reads or writes a record, etc., until an end-of-file mark is reached. The starting and stopping of the tape necessarily slows down the data transfer process. This inefficiency is particularly disadvantageous for system or data base backup, where very large volumes of data must be saved on tape.

Table 10-5 Magnetic Tape Units and Cartridge Tape Subsystems Supported in HP 1000 A-Series Computer Systems

Product Number	Name/Description	Recording Density	Operating Mode	Transfer Rate (kB/sec)	Reel/Cartridge Capacity
7974A*	Magnetic Tape Unit	1600 cpi, 800 cpi optional	Start-Stop or Streaming	80/40 160/80	40/20 MB in 2400 ft.
7978B*	Magnetic Tape Unit	6250/1600 cpi	Streaming	468/120	140/40 MB in 2400 ft.
7979A	Autoloading Mag Tape Unit	1600 cpi, 800 cpi, optional	Streaming	200	40 MB in 2400 ft.
7980A	Autoloading Mag Tape Unit	6250/1600 cpi, 800 cpi optional	Streaming	781/200	140/40 MB in 2400 ft.
7980XC	Autoloading Mag Tape Unit with Data Compression for 2 to 5 times greater capacity for system or data base backup	6250/1600 cpi	Streaming	781/200	140/40 MB in 2400 ft.
9144A	Cartridge Tape Subsystem	10,000 bpi	Streaming	35	67 MB per cartridge
9145A	Cartridge Tape Subsystem	20,000 bpi	Streaming	70	133 MB per cartridge
35401A	Autochanger Cartridge Tape Subsystem	10,000 bpi	Streaming	35	8 cartridges x 67 MB (536 MB per magazine)

* Discontinued product, listed here for reference only.

Streaming mode tape motion is continuous, which typically increases the data transfer rate as compared to start-stop mode. Streaming mode magnetic tape units are supported in A-Series systems, effective with RTE-A revision code 2440.

Mag Tape Unit Interfacing

Connection of magnetic tape units to HP 1000 A-Series Computer Systems is illustrated in Figure 10-3.

Magnetic tape units are connected to A-Series systems via the 12009A HP-IB interface. One 12009A interface can support two HP 797xA Magnetic Tape Units, which can be different units, such as one 7979A and one 7980XC.

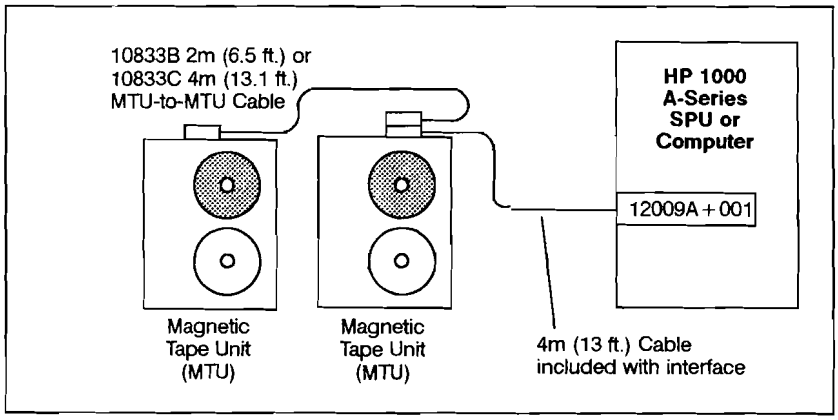


Figure 10-3. Magnetic Tape Unit Connection to HP 1000 A-Series Computer Systems

12122A
Integrated Disks

Introduction

HP 12122A is a separately-ordered product that provides Integrated Disks for A-Series computer systems housed in 243xA/B/G/H Micro/1000 Computers or 248xB/C Micro/1000 System Processor Units. HP 12122A includes a 19.4 MB fixed, hard disk, a microfloppy drive that supports microfloppy disks in both 630 KB double-sided and 270 KB single-sided formats, an HP-IB controller that supports both disks, and an HP 12009A HP-IB interface card.

Functional Specifications

Capacity

Fixed Disk: 19.4 megabytes.

Microfloppy Disk: 630 kilobytes on double-sided disks; this microfloppy disk also supports read/write access to 270 kilobyte single-sided disks.

Additional Use of 12009A Interface: Because of physical limitations, the 12009A interface included in the 12122A product does not support connection of any HP-IB devices other than the integrated disks.

Performance

Fixed Disk: 75 millisecond average access time, 150 KB/sec average transfer rate (based on the minimum time required to transfer one track without overrun).

Microfloppy Disk: 225 millisecond average access time, 17 KB/sec average transfer rate.

System Bootup

Micro/1000 systems can be restored from micro- floppy disks in 270 KB single-sided format* to the 19.4 MB fixed disk. HP software for HP 1000 systems is not available on microfloppy disks in 630 KB double-sided format.

* Double-sided microfloppy disks, which are enclosed in a gray housing, can be formatted and used as single-sided media.

Ordering Information

12122A Integrated Disk Product*

The 12122A Integrated Disk Product includes:

1. 19.4 MB fixed, hard disk.
2. Single microfloppy drive with both 630 KB double-sided and 270 KB single-sided capability.
3. Single HP-IB disk controller for both the 19.4 MB hard disk and the microfloppy disk drive.
4. 12009A HP-IB Disk Interface and cables.
5. 24998-13465 FCO software on microfloppy disk for upgrade of RTE-A system with revision prior to Rev. 5000 to support the 12122A disks.
6. Installation in Micro/1000 computer or SPU at the factory.

* HP 243xA/B/G/H or 248xB/C option 151 must also be ordered to support the installation of the HP 12122A product.

243xA/B/G/H or 248xB/C Option Required for 12122A Integrated Disk Product

151: Installation preparation Kit for the 12122A Integrated Disk Product.