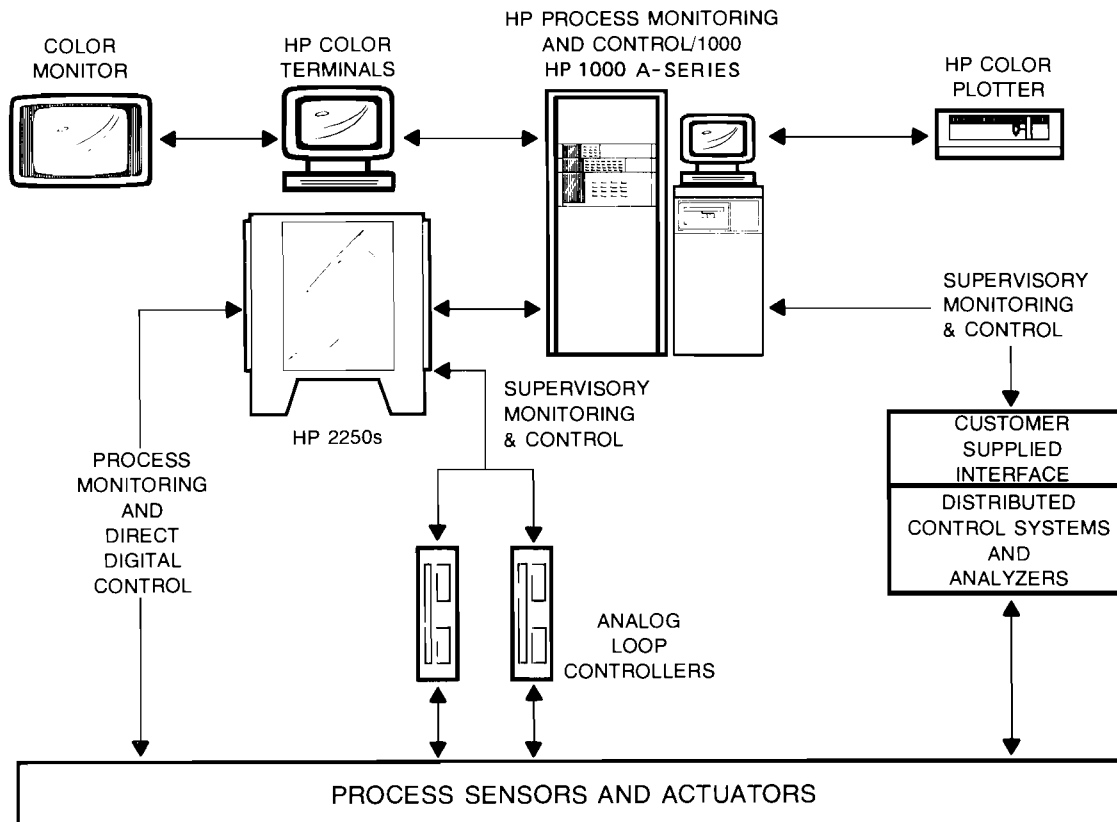


# HP Process Monitoring and Control/1000 Software For HP 1000 A-Series Computers



Manufacturing Productivity Division  
Software for HP 1000 Computer Systems

product number 92121A



HP Process Monitoring and Control/1000 is an applications software package for the monitoring and direct or supervisory control of continuous industrial processes. The software resides in an RTE-A VC+ based HP 1000 A-Series computer, and is interfaced to the process by the HP 2250 Measurement and Control Processor. A fill-in-the-blanks approach to specifying point names, engineering unit conversions, alarms, control loops, historical logs, and color displays allows process engineers without programming experience to implement systems. A function block architecture and extensive "hooks" for custom algorithms or programs provide a very high degree of flexibility.

## Features

- Ease of use for process engineers and process operators
- "Help" key guides first time users
- Interactive, menu-driven configuration procedure specifies hardware I/O and function blocks
- Function block architecture accommodates a wide range of applications
- Color graphic and alphanumeric display of status and alarms on HP color graphics terminal

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- User defined scan intervals of analog and digital inputs and outputs
- Engineering unit conversion, thermocouple and RTD linearization, and nonlinear computations
- Extensive alarm capabilities, including event initiation on alarm
- PID, Boolean logic, ratio calculations, delay, filtering, path select, bumpless transfer, anti-reset windup, and other functions for closed loop control
- Historical logging, trending, and color plotting
- Autoscheduler automatically specifies the order of function block execution
- Autodocumenter prints out alphanumeric groupings of blocks to illustrate interconnections
- Memory resident data base for current data, configuration, and algorithms
- HP 2250 Measurement and Control Processor supported for data acquisition and control
- Support of user-supplied interfaces to non HP equipment
- Support of user-written programs for added customization, including the addition of other algorithms
- Security code control of access

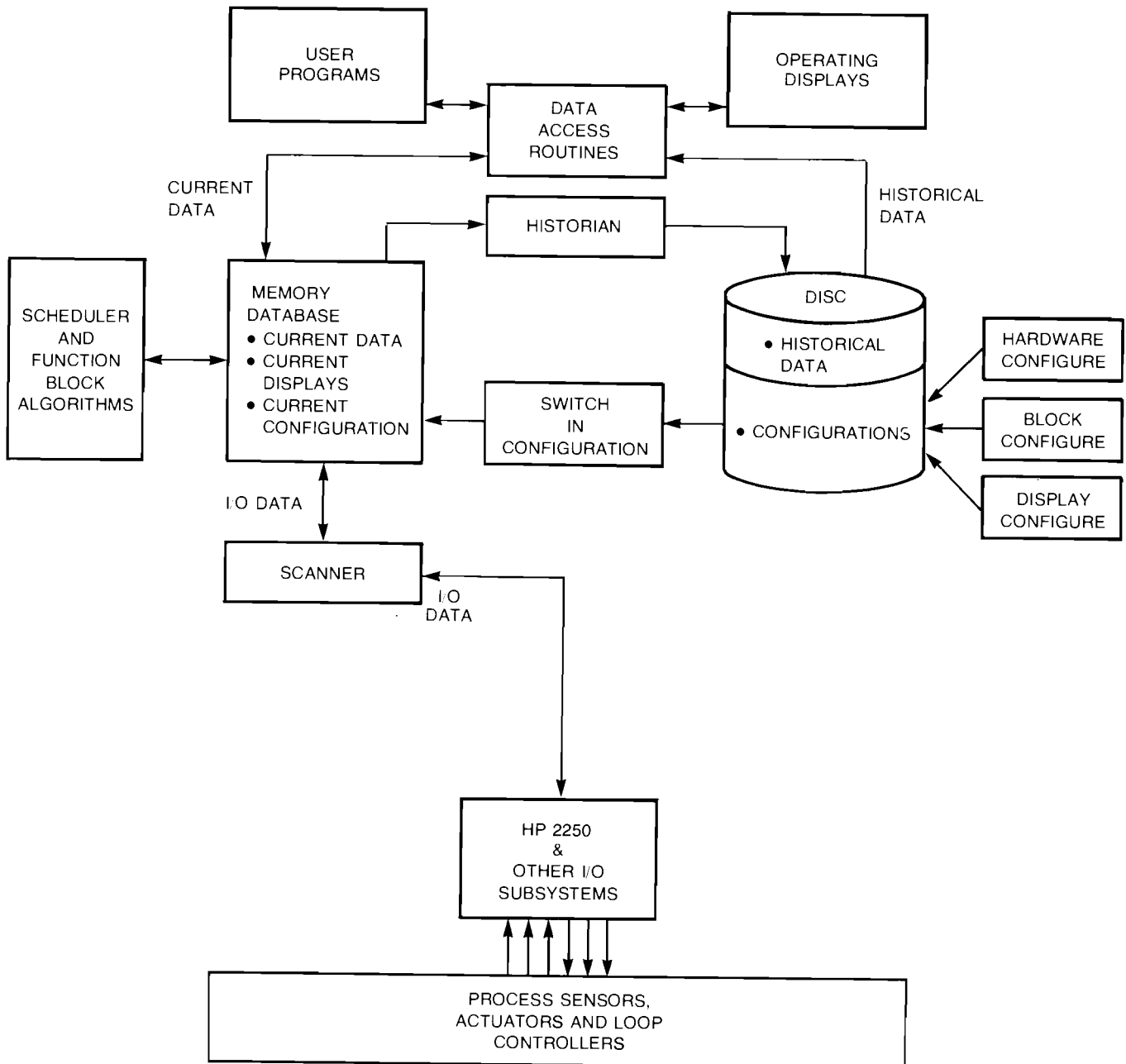


Figure 1. Software Block Diagram

## Application Examples

- Direct monitoring and control of small to medium processes, in discrete manufacturing environments, such as wastewater treatment and furnace control
- Analysis and control of experimental processes such as pilot plants
- Direct digital control (DDC) for processes requiring sophisticated control techniques
- Supervisory setpoint control of analog loop controllers for upgrading older plants to do process optimization, balancing, and analysis
- Replacement of older process computers
- Supervision of distributed control systems to provide optimization, analysis capability and a link to other computers and process analyzers. User hardware and software interface must be provided.

## Functions and use of HP Process Monitoring and Control/1000

### Overview (See Figure 1.)

The major functions performed by HP Process Monitoring and Control/1000 include off-line configuration; on-line, real-time acquisition, computation, control and display; and logging of process data. Each of these real-time functions is executed at an interval which is a multiple of the base scan interval (the unit of time used to coordinate the scheduling of the software). A typical value, in the range of 1-10 seconds, can be attained, depending upon the complexity of the application.

HP Process Monitoring and Control/1000 is memory resident, except for the configurator, historian, and some descriptive information. The memory database contains the current value of all points and block outputs, the parameters for each configured block, pointers linking the blocks, and the list ordering block execution. Also stored in memory are the display layouts and active alarms.

The disc database includes the configuration data for each HP Process Monitoring and Control/1000 system configured, the historical process log, and a log of alarms and errors. The configuration files are mapped into memory when HP Process Monitoring and Control/1000 is put into the operating mode, thereby making real-time operation disc independent.

Database access routines provide full read and write capability to the memory database, and read capability from disc. HP Process Monitoring and Control/1000 may be extended considerably, using these high level FORTRAN subroutine calls. For example, optimization or analysis programs may be incorporated.

Softkeys are used to step from screen-to-screen and to invoke all HP Process Monitoring and Control/1000 functions. Only menu selections, names, and parameters need to be typed into the terminal. A complete system can be implemented without any user-written code. The user is shielded from the operating system unless access to it is expressly desired.

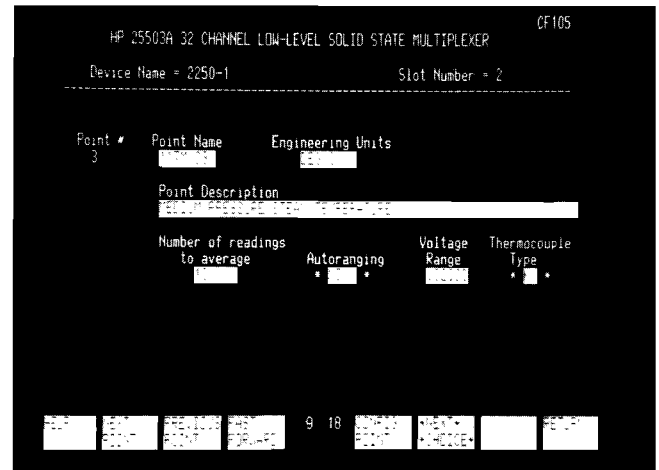


Figure 2. Hardware Configuration

## Configuring HP Process Monitoring and Control/1000 to the Process

Using a fill-in-the-blanks menu-driven format, the Configurator is used to customize HP Process Monitoring and Control/1000 to the process application. A sample configuration screen is shown in Figure 2. Several separate configurations may be created and stored on disc, facilitating changes and experimentation. A new configuration may be created while another is in operation. The five configuration steps are hardware, block, display, historian, and schedule.

1. **The Hardware Configuration** maps the physical I/O points to user-assigned names. Each HP 2250 or other subsystem is given a scan interval. HP 2250 card types and locations are specified. With user software, I/O points in non-HP 2250 subsystems may be specified as well.
2. **The Block Configuration** determines monitoring and alarm functions and control loops. This is done by configuring and linking blocks, and setting parameters such as alarm limits, engineering unit conversions, loop tuning constants, and execution rates.
3. **The Display Configuration** specifies the blocks to be included in each, and the groups to be included in each area. There can be up to 64 areas and 64 groups although the system can be expanded. Scratch groups and areas can be created on-line.
4. **The Historical Configuration** specifies the disc cartridges which will be used to log historical data as well as the rate at which this data will be logged.
5. **The Schedule Configuration** specifies the timing of function block execution. This is easily done using the Autoscheduler, and the results may be manually adjusted.

The Autodocumenter provides an alphanumeric listing and hardcopy of function blocks, indicating their groupings and links. Each loop typically is listed as one grouping.

## Flexible Block Architecture

The function block architecture permits cross-linking of information to accommodate a wide range of monitoring, analysis and control strategies, such as material/energy balancing, and feedforward, cascade, and nonlinear control. Each block may access any points or variables in the process data base. The output of each block is fed to as many other blocks as desired. In this way, simple or complex monitoring functions and control loops are created. Figure 3 shows a typical loop.

Block types include:

1. PID with bumpless transfer, anti-reset windup, local/cascade with setpoint tracking, output limiting.
2. PID as above plus lead/lag compensation on error, control bypass option, non-linear error correction option.
3. Analog and digital constants.
4. Alarming and limiting, high/low, and critical/advisory, with event initiation and deadband.
5. Computation, for engineering unit conversion and other calculations, using 10 predefined algorithms such as filtering, scaling, lead/lag, polynomials, etc. Eight user definable algorithms may be added.
6. Thermocouple and RTD linearization.
7. Nonlinear curve fitting.
8. Analog trending and delay, including accumulations, averaging, and standard deviation.
9. Analog output, positional or incremental with alarm.
10. Analog comparison and multiplexer.
11. Digital output, with alarm.
12. Digital alarming.
13. Boolean logic constructs, using 5 predefined equations. Eight user definable equations may be added.

14. Digital trending and delay.

15. Digital comparison and multiplexer.

16. User written program schedule, with parameter passing.

## On-Line Operation

When the configuration is complete, it may be loaded into memory with one softkey, putting HP Process Monitoring and Control/1000 into operation. The following describes the major modules that are automatically brought into operation, and how the operator uses them.

**Monitor:** This program contains the base scan interval clock and schedules all HP Process Monitoring and Control/1000 functions in the operating mode. At each tick of the clock, operating functions are scheduled in this order: scan inputs, execute blocks, save historical data.

**Scanner:** This module handles all I/O communication with the HP 2250 or other front end subsystem. All data from a given front end is gathered at the same rate, while outputs are executed on an as-needed basis. The scanner provides comprehensive HP 2250 support. Using an HP 2250, HP Process Monitoring and Control/1000 can perform I/O directly to the process for monitoring or direct digital control. Equally well, the HP 2250 and HP Process Monitoring and Control/1000 can perform I/O of pulses and analog or digital signals to loop controllers, thus performing supervisory setpoint control.

The HP 2250 can scan hundreds of process control points, updating the value of each to provide input and output signals to control the process. The HP 2250 takes care of analog input and output conversions and is automatically programmed by the software.

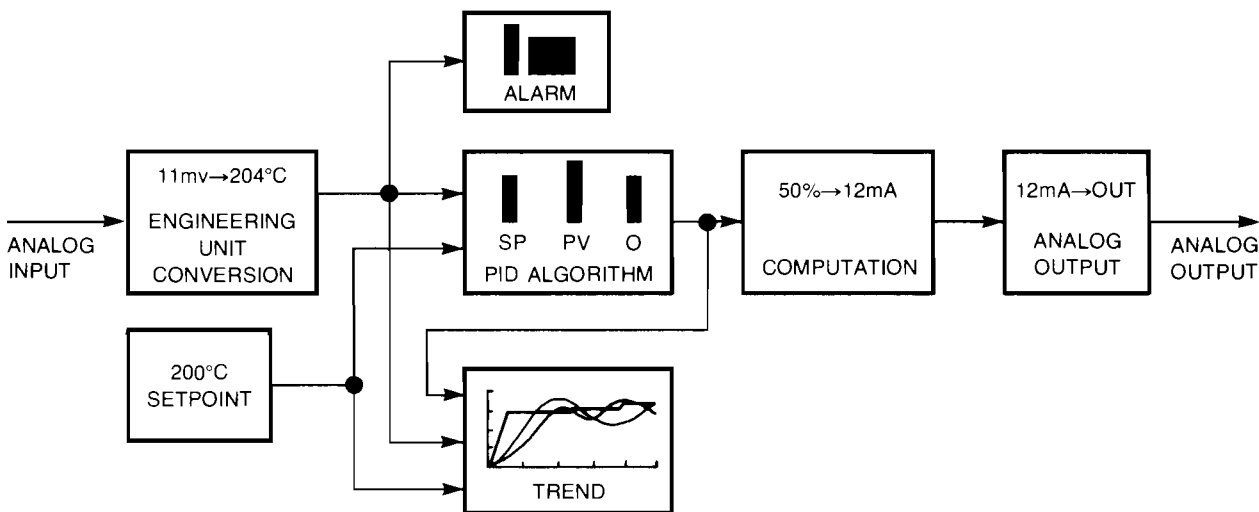


Figure 3. Typical Control Loop

HP Process Monitoring and Control/1000 can also interface to other devices or subsystems, such as analyzers or digital control systems. The scanner can accommodate these subsystems in addition to the HP 2250. Optionally, the data access routines may be used to link or network other systems directly to the memory database. In either case, user written software is required, but all necessary "hooks" are provided.

**Scheduler:** This module includes the function block algorithms and the list indicating timing and order of block execution. The algorithms act on the data in memory, calculating new block output values which are fed to downstream blocks or out to the process.

**Historian:** The historian performs data logging and retrieval. All input points and block outputs are logged to disc at the same, specifiable rate. Magnetic tape backup is supported. The historian provides graphical trend displays and color hard copy plots, showing up to four variables and spanning up to 1000 time samples. Figure 4 shows an historical trend display. Database access routines make more data available for analysis and reporting programs.

**Real-Time Displays:** Color graphic displays are created and updated from the memory database. Softkeys and names select area, group, detail, point, trend, and alarm color displays. The area display shows any four groups. The group display shows any four to 16 blocks, including trends. For example, a group might include a trend, two PID blocks, two alarms, a calculated variable, and three digital states. See Figure 5 for an example. The operator may create additional groups and areas on-line.

Detail displays may be retrieved by name or directly from a group display. Each detail display includes two pages. The first page summarizes key parameters and status, and permits changes such as setpoints or outputs. The second page shows all configured parameters such as loop tuning constants. The point display shows up to 10 scanned input points.

A trend display shows up to three variables versus time. Trends may be cascaded to show both short and long term variations. Historical trends and plots are described above under Historian. Alarm displays are discussed below.

**Manual Intervention and Changes:** Block parameters are changed from the detail displays. Five levels of security determine whether a user can:

1. Change setpoints, status, and outputs.
2. Change tuning or computation parameters.
3. Configure systems off-line.
4. Start/stop operation.
5. Access the RTE operating system.

Using softkeys, the current memory database configuration, parameters and variables may be stored on disc. This saves the state of a "tuned" system for later recall or power fail restart.

**Alarms:** Color graphic alarm blocks may be shown on area, group or detail displays. If any new alarm occurs,

the operator is notified, regardless of display being viewed. From any display, pressing the "Alarm/Error" softkey presents a color coded summary, as shown in Figure 6. This alphanumeric screen shows the time, description, status, and value of each of 20 alarms at a time. Alarms are displayed in chronological order. The operator may acknowledge alarms individually or by screen. Alarms are printed and logged to disc. An historic alarm display shows a similar summary.

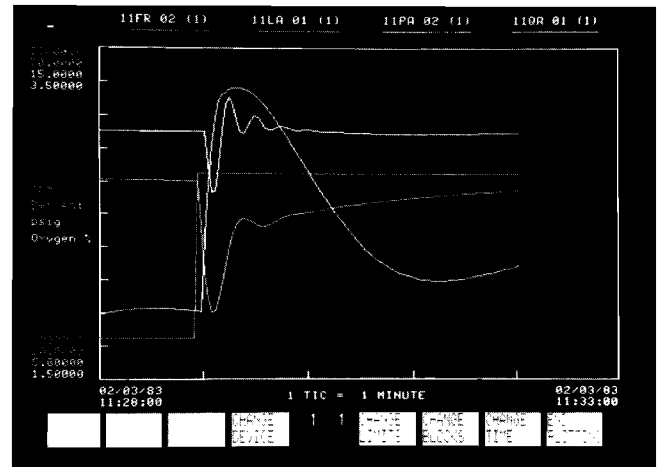


Figure 4. Historical Trend

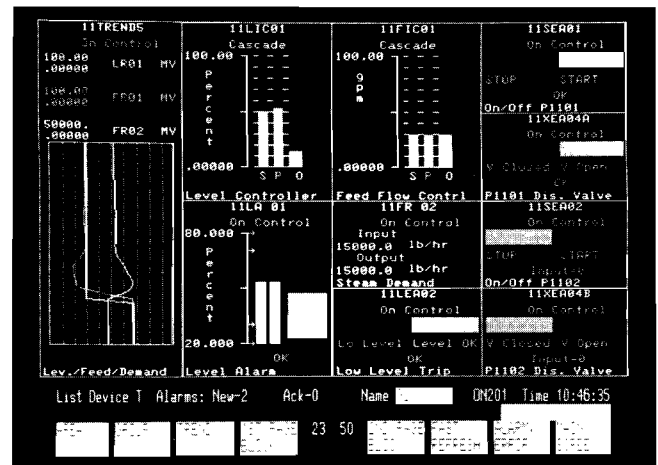


Figure 5. Group Display

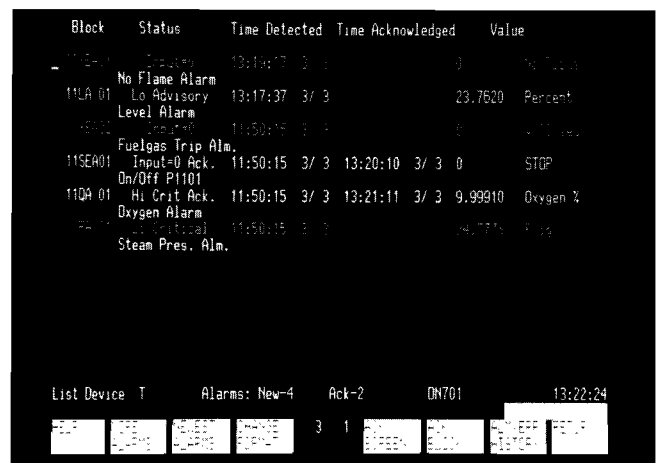


Figure 6. Alarm Summary

## Specifications

**Maximum number of PID loops per second:** See the PMC Performance Brief.

**Maximum number of each type of block:** 1023

**Number of function block types:** 16

**Maximum number of HP 2250s and/or I/O subsystems:** 32

## System requirements

1. **HP 1000 RTE-A VC+ Based A600+, A700 or A900** computer system, Micro/1000 System, Microsystem. For details see the HP 1000 Computer Systems Ordering and Compatibility Information guide.
2. **Option 014** where applicable (deletes standard memory).
3. **Appropriate memory** package, according to the following guidelines:
  - a. 1 display terminal, 800 blocks, 1600 input/output: 1.5 Mb (this is minimum memory required)
  - b. Up to 7 additional display terminals: add 1/2 Mb
  - c. 2700 additional blocks: add 1/2 Mb
  - d. 20,000 additional input points: add 1/2 Mb
4. **HP 12156A** Floating Point Processor for the A700.
5. **HP 92077A** RTE-A Operating System and **HP 92078A** VC+
6. **HP 92841A** Graphics/1000-II DGL Graphics Library
7. **HP 2627A Color Graphics Terminal** (HP 2622A, 2623A, 2624A, 2626A, or 2382A terminals may be used, but only for configuration.)
8. **Hard disc:** 7911P/R, 7912P/R, 7914P/R/TD
9. **Front end:** HP 2250 or comparable user-supplied analog/digital I/O device. (NOTE: Direct connection to the computer of front end devices other than the HP 2250 is not supported by HP. Additional user-written software is required to tie to the HP Process Monitoring and Control/1000 Scanner.)
10. **Printer:**
  - a. 2608S Line Printer, option 214, and 1/14 of 12009A interface for high volume program development, or
  - b. 2631B Printer, option 214 and 1/14 of 12009A interface, for low volume program development.
11. **Graphics Plotter** (Optional, for historical trends):
  - a. 9872C/T GII Graphics plotter with option 100 and 10833x cable.
  - b. 7470A Two-pen plotter with option 002 and 10833x cable.
12. **Interface cards:**
  - a. One 12040B Multiplexer Card with Multiplexer Panel for every eight terminals in the system.
  - b. One 12009A HP-IB interface for each HP 2250.
  - c. One 12009A HP-IB interface for the system printer, optional plotter and other optional devices.

## Ordering information

### 92121A HP Process Monitoring and Control/1000 Software

The 92121A product, which must be ordered with use option 600, 700, 890 or 892, includes:

1. 92121A relocatable software package on Media Option 022 or 051, **one of which must be ordered.**
2. HP Process Monitoring and Control/1000 Configuration and Operation Manual (92120-90002).
3. HP Process Monitoring and Control/1000 Installation Guide (92121-90003).

### 92121A Options

**600:** Use on A600+.

**700:** Use on A700.

**890:** Use on A900.

**892:** Upgrade from A600+/A700 to any A series CPU.

**022:** Provides 92121A software or 7911/12/14 compatible cartridge tape.

**051:** Provides 92121A software on 1600 bpi magnetic tape.

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2. HP Process Monitoring and Control/1000 Configuration and Operation Manual, and HP Process Monitoring and Control/1000 Installation Guide as supplied with 92121A.

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2. HP Process Monitoring and Control/1000 Configuration and Operation Manual, and HP Process Monitoring and Control/1000 Installation Guide as supplied with 92121A.

## **92121Z HP Process Monitoring and Control/1000 Manuals Package**

The 92121Z Manuals Package includes:

1. HP Process Monitoring and Control/1000 Configuration and Operation Manual (92120-90002).
2. HP Process Monitoring and Control/1000 Installation Guide (92121-90003).

## **Software support products available**

- 92121T** Customer Support Service (CSS) for 92121A. Service is subject to local availability and approval. (Same Media Options for updates as for 92121A software.)
- 92121V** Additional site CSS for use on one additional system licensed under 92121M/R. Service is subject to local availability and approval.
- 92121S** Software Subscription Service (SSS) for 92121A software. (Same Media Options for updates as for 92121A.)
- 92121W** Right to reproduce 92121S software updates for one additional system.
- 92121Q** Manual Update Service for one set of manuals purchased with 92121A/M/R/Z.

*NOTE: 92121T/V/S/W support products cover only the 92121A/M/R software. Individual support services must also be ordered to support other software in the system.*





For more information call the HP Sales Office listed in the White Pages. Or write or phone Hewlett-Packard, Manufacturing Productivity Division, 370 West Trimble Rd., San Jose, CA 95131, (408) 263-7500.

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