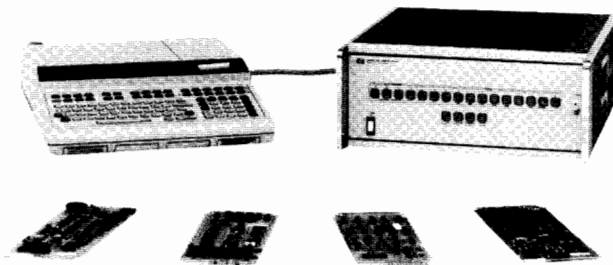




**HEWLETT  
PACKARD**

# Automatic Test, Measurement and Control System

Technical Data\* November 1979



This Automatic Test, Measurement, and Control System can be used in a variety of data acquisition and control applications. A complete array of stimulus outputs and measurement inputs is available with the system. A desktop computer controls your test or process and also prepares the results for presentation.

The system includes:

- a 6940B Multiprogrammer
- a 9825S Desktop Computer
- 16-Bit Parallel Duplex Interface
- Plug-in Stimulus and Measurement Cards
- a Software Library

To configure a system, select from among the 31 different Multiprogrammer plug-in cards — each one is an instrument on a card. These stimulus and measurement cards slide into the Multiprogrammer and the desktop computer controls their activity. The cards supply such stimuli as programmable voltage and current, and take such measurements as voltage, resistance, current, and frequency.

At the heart of the system is the 9825S Desktop Computer. The 9825S features the high-level programming language (HPL), an easy to learn and use language, especially efficient for handling equations and input/output operations.

The 9825S also has interrupt capability. When the Multiprogrammer gives the signal, the 9825S suspends operations to execute a priority program or read new data. The desktop computer then automatically resumes operations at the point of interruption.

The live keyboard is another valuable characteristic of the 9825S. This allows you to perform calculations and execute subroutines as well as list the current program and examine or change program variables while a program is running.

For data and program storage, the system includes a two-track tape cartridge drive. Up to 250,000 bytes of data and programs can be stored on each tape cartridge. The system also allows you to copy the entire contents of memory including all programs, data, flags, Special Function keys, and internal system information, so that the 9825S can be returned to the identical operating environment at a later time.

Other features of the 9825S include:

- 23,228 bytes of read/write memory
- 32 character LED display
- typewriter-like keyboard
- 16 character thermal strip printer
- Plug-in read-only memories (ROMs)
- 12 Special Function keys (24, with shift)
- Trigonometric capability
- 12 significant digits
- Boolean algebra capability
- DMA data transfers

## PROGRAMMING

A Software Library containing preprogrammed routines is provided to simplify the I/O programming. These routines handle all the card programming and data conversion and can be automatically loaded as they are needed by the Autoloader program. The Library contains 40 routines in these categories:

- Analog Input
- Analog Output
- Digital Input
- Digital Output
- Pulse Counting
- Stepping Motor Control
- Timing
- Interrupt Mode
- Temperature Measurement
- Special

Data reduction and analysis utilities for numerical integration, sorting, and plotting are also included with the system.

## PERFORMANCE

High speed burst inputs and outputs may be performed via DMA. In this manner, up to 20,000 outputs or inputs per second may be programmed through the Multiprogrammer. Also, waveforms may be digitized by sampling up to 20,000 points per second.

The non-DMA I/O time of the system is 1.4 ms per transfer. This is the speed encountered when data cannot be burst out a block at a time, but must be transferred one at a time as in control loop applications. Software Library routines take from 30 ms to 115 ms. This time includes overhead set-up, data transfer, and data conversion.

More details regarding the performance of this system is contained in Application Note 282-1.

## SPECIAL SYSTEM FEATURES

All analog input and output signals are isolated from data common. This means there is no electrical common between the desktop computer and your process to pick up noise or create a safety hazard. The analog circuitry is isolated for up to 100V. An isolated digital input card is also available.

Gate-flag handshaking between the Multiprogrammer and your test or process and between the Multiprogrammer and the desktop computer assures accurate and reliable data transfers. This also means that pacing can be done internally by the desktop computer, or externally by a process clock or timer.

\*Data Subject to Change

# Configuring and Ordering Information

## SYSTEM COMPONENTS

### Model

These five building blocks form the basis of the Automatic Test, Measurement and Control System.

#### Desktop Computer

Includes 23,228 bytes of read/write memory, and the following ROMs:  
String—Advanced Programming, 9872 Plotter—General I/O—Extended I/O ..... 9825S

#### 16-Bit Parallel I/O

The high speed interface with DMA capability between the 9825S and the 6940B ..... 98032A Opt. 040

#### Multiprogrammer

The I/O card mainframe. Holds up to 15 Multiprogrammer I/O cards. Includes front panel controls for system debugging ..... 6940B

#### Voltage Regulator

Supplies the isolated power for Analog I/O cards in the 6940B ..... 69351B

#### Software Library

Contains the utility routines for all Multiprogrammer I/O cards ..... 14556A

## I/O CARDS

### MEASUREMENT

### Model

#### Voltage Measurement

Single Channel, 12-bits, 4 ranges:  $\pm 100V$ ,  $\pm 10V$ ,  $\pm 1V$ ,  $\pm 0.1V$ .  
Resolution: 50mV, 5mV,  $500\mu V$ , and  $50\mu V$ . Conversion time:  $30\mu s$  ..... 69422A

Multiple Channel. Relay Scanner for every 6 double-ended channels or 12 single-ended channels of voltage measurement. Use with 69422A. Up to 14 Relay Scanners can be put in each 6940B or 6941B mainframe ..... 69433A

Low Level Voltage, 6 channels,  $\pm 20mV$ , 12-bits, integrating A/D ..... 69423A

#### Waveform Digitization

Maximum sample rate: 33kHz. Unpaced ..... 69422A

For crystal controlled pacing, add Frequency Reference card ..... 69601B

#### Current Measurement

12-bits, from  $\pm 20mA$  to  $\pm 1000A$  ..... 69422A

#### Resistance Measurement

12-bits, from  $10\Omega$  to  $100k\Omega$  with programmable range ..... 69370A/69422A

#### Temperature Measurement

6 Channels, 12-bits, thermocouple types B, E, J, K, T, R, and S ..... 69423A

#### Totalization

12-bit binary up and down counting. Includes debounce circuit for counting contact closures ..... 69435A

#### Frequency Measurement

For frequencies between .001Hz and 200kHz, with programmable range ..... 69600B/69435A

## I/O Cards (Continued)

**Model**

### Time Interval Measurement

For time intervals between 10 $\mu$ s and 4095 seconds

For programmable range add a 69433A Relay card ..... 69601B/69435A

### STIMULUS

#### Voltage

Single Channel, 12-bit,  $\pm 10V @ 5mA$ . Resolution:

5mV, Accuracy:  $\pm 5mV$  ..... 69321B

4 Channel, 10-bit,  $\pm 10V @ 5mA$ . Resolution:

20mV, Accuracy:  $\pm 20mV$  ..... 69322A

Higher Power (0 to 100V, 10 to 10,000 watts)

Program HP power supplies with Resistance

Programming cards ..... 69501A thru 69513A

#### Current

Single Channel, 12-bit, 0 to 20mA, Resolution: 5 $\mu A$ .

Compliance voltage: 10.5V ..... 69370A

#### Resistance

6 or 12-bits, resolution from 2 $\Omega$  to 50 $\Omega$  ..... 69501A thru 69513A

#### Pulse Train Output

0 to 2047 pulses at one of two program selected outputs.

Frequency nominally at 100Hz ..... 69335A

#### Stepping Motor Control

0 to 2047 steps, clockwise or counterclockwise, used with

commercially available stepping motors and translators ..... 69335A

#### Programmable One-Shot

Duration from 1 $\mu s$  to 409.5s. Accuracy: .01% ..... 69600B

#### Time Base Reference

References 1Hz, 10Hz, 100Hz, 1kHz, 10kHz, 100kHz. Accuracy: .01% ..... 69601B

### DIGITAL INPUT

12-bit TTL or 12 volt logic ..... 69431A

12-bit Isolated. Each bit draws 3mA ..... 69430A

### DIGITAL OUTPUT

12-bit TTL or 12 volt logic. Each bit will sink 32mA in the low state ..... 69331A

Relay Output. 12 relays per card, mercury wetted ..... 69433A

### INTERRUPT INPUT

12-bit, contact closure. Interrupts the computer when

the interrupting condition is satisfied ..... 69434A

12-bit, TTL. Interrupts the computer when any bit changes state ..... 69436A

### BREADBOARDS

Breadboard Input. Provides input buffering and space for user circuits ..... 69480A

Breadboard Output. Provides output buffering and space for user circuits .... 69380A

Blank Breadboard. A blank card for user circuits ..... 69280A

## OPTIONAL SYSTEM COMPONENTS

### Model

6941B	Extender. Use when more than 15 I/O cards are to be used in a system. Each 6941B will hold up to 15 additional I/O cards. A maximum of 15 Extenders may be used with a 6940B Multiprogrammer.
14541A	Chaining Cable. One required for each 6941B.
98034A	HP-IB Interface. Can be used to interface HP-IB instruments to the system.
9872A	Plotter. For plotting data in four colors.
9866B	Thermal Line Printer. An 80 column, page width printer for programs or data printing.
9885M	Flexible Disk Drive. Each disk can store up to 500k bytes of data or programs.
14551A	Service Kit. Includes spare parts and troubleshooting software for the 6940B Multiprogrammer.

## TRAINING COURSES

9825S Classes are taught regionally every month. Ask your HP field engineer for data sheet no. 5953-0969 for more information.

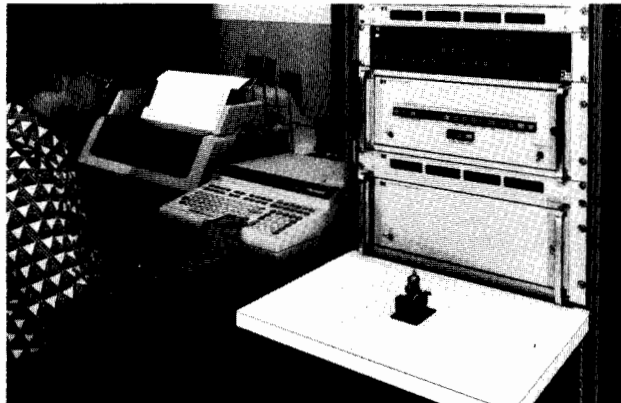
6940B Classes are taught monthly at HP's New Jersey facility. Ask your HP field engineer for data sheet no. 5952-4026 for more information.

## SYSTEM POWER REQUIREMENTS

Input Power 100V +5%, -10%, 5.7A  
120V +5%, -10%, 5.5A  
220V +5%, -10%, 2.8A  
240V +5%, -10%, 2.75A

*Note: Voltage is switch selectable.*

Line Frequency 48 to 66Hz.

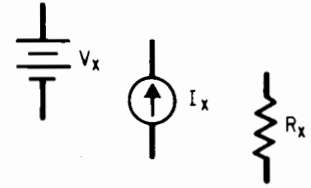


# Applications

## MEASUREMENT

The system can measure voltage, current, resistance, temperature, frequency, time duration, and count data. Physical properties can be measured by converting the physical property, such as weight or volume, to a proportional voltage with a transducer and measuring this voltage with an analog to digital voltage converter. In this manner, weight, volume, pressure, and flow rate can be measured. The accuracy of these measurements will be in the range of  $\pm 0.2\%$ .

The system can be used for stand alone data acquisition in quality control, facilities monitoring, incoming inspection, process monitoring, and remote station monitoring applications. The measurements can be paced by the Multiprogrammer's crystal controlled time base, they can be externally triggered, or they can free run.

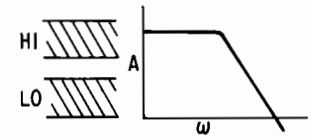


## TEST

The programmable outputs of the system can be used to stimulate units under test. Digital Output cards can provide logic states to the inputs of digital devices under test and Digital Input cards can read the devices' outputs.

Analog Output cards provide test inputs to analog ICs. The ICs' outputs are read back using Analog Input cards. Power to units under test is controlled with Power Supply Programming cards.

These systems are used in the testing of printed circuit modules, relays, solenoids, digital submodules, semiconductor wafers, cables, electromechanical devices, and modular power supplies.

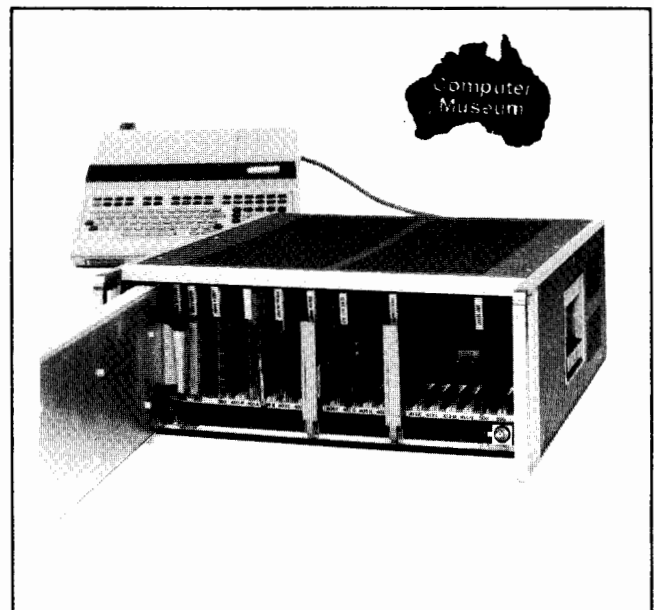
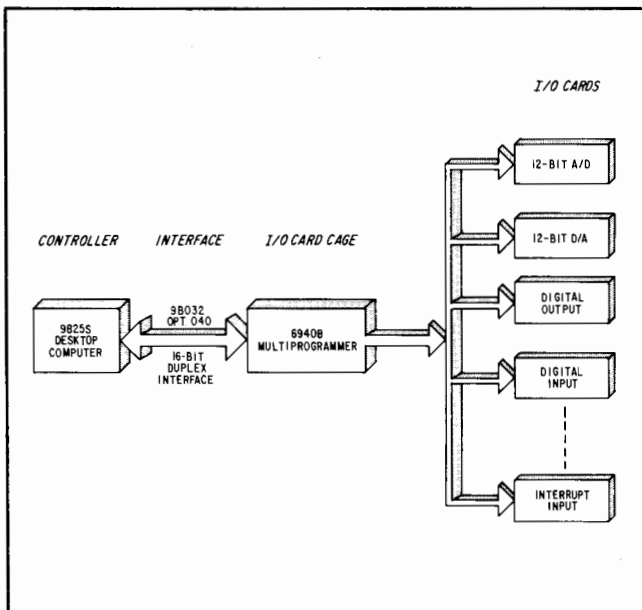
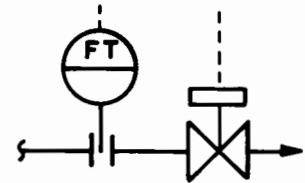


## CONTROL

This system can solve many process control and factory automation problems. Current Control cards or Pulse Output cards are used to adjust setpoints in supervisory control systems. Proportional, rate, and reset control algorithms are easily implemented with HPL software.

Automatic screwdrivers are controlled by the Stepping Motor Control card to automatically set potentiometers and align television sets. HP power supplies with outputs up to 100V and 1000A can be controlled with this system.

For power management applications, wattmeter outputs can be connected to Pulse Counter cards. As abnormal peaks occur, loads can be temporarily shed by Relay cards or solid state AC switches controlled by Digital Output cards. Meanwhile, ambient temperature can be measured with the Low Level A/D card.



**Documentation Supplied**

9825S Operating and Programming  
Manual  
Quick Reference Guide (2)  
Error Booklet  
Test Cartridge Manual  
Multiprogrammer Operating and  
Service Manual  
Multiprogrammer User's Guide  
Software Library User's Manual

**HP Part No.**

09825-90000  
09825-90010  
09825-90015  
09825-90037  
  
06940-90007  
59500-90005  
14556-90001

**Accessories Supplied**

Utility Pack  
Blank Data Cartridge  
Test Cartridge  
Dust Cover  
Tape Head Cleaner  
Special Function Key Overlays —  
Blank (5)  
Spare Fuses  
1.5A  
3.0A  
I/O Slot Covers (3)

**HP Part No.**

09825-10000  
98200A  
09825-90036  
9222-0495  
8500-1251  
  
7120-4802  
  
2110-0043  
2110-0003  
5040-7723

The following data sheets contain further information on the HP Automatic Test,  
Measurement and Control System:

6940B Multiprogrammer Technical Data ..... 5952-4025  
9825S Desktop Computer Specifications ..... 5953-1013



For more information, call your local HP Sales Office or nearest Regional Office: Eastern (301) 258-2000; Midwestern (312) 255-9800; Southern (404) 955-1500; Western (213) 877-1282; Canadian (416) 678-9430. Ask the operator for instrument sales. Or write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. In Europe: Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box, CH 1217 Meyrin 2, Geneva, Switzerland. In Japan: Yokogawa-Hewlett-Packard Ltd., 29-21, Takaido-Higashi 3-chome, Suginami-ku, Tokyo 168.