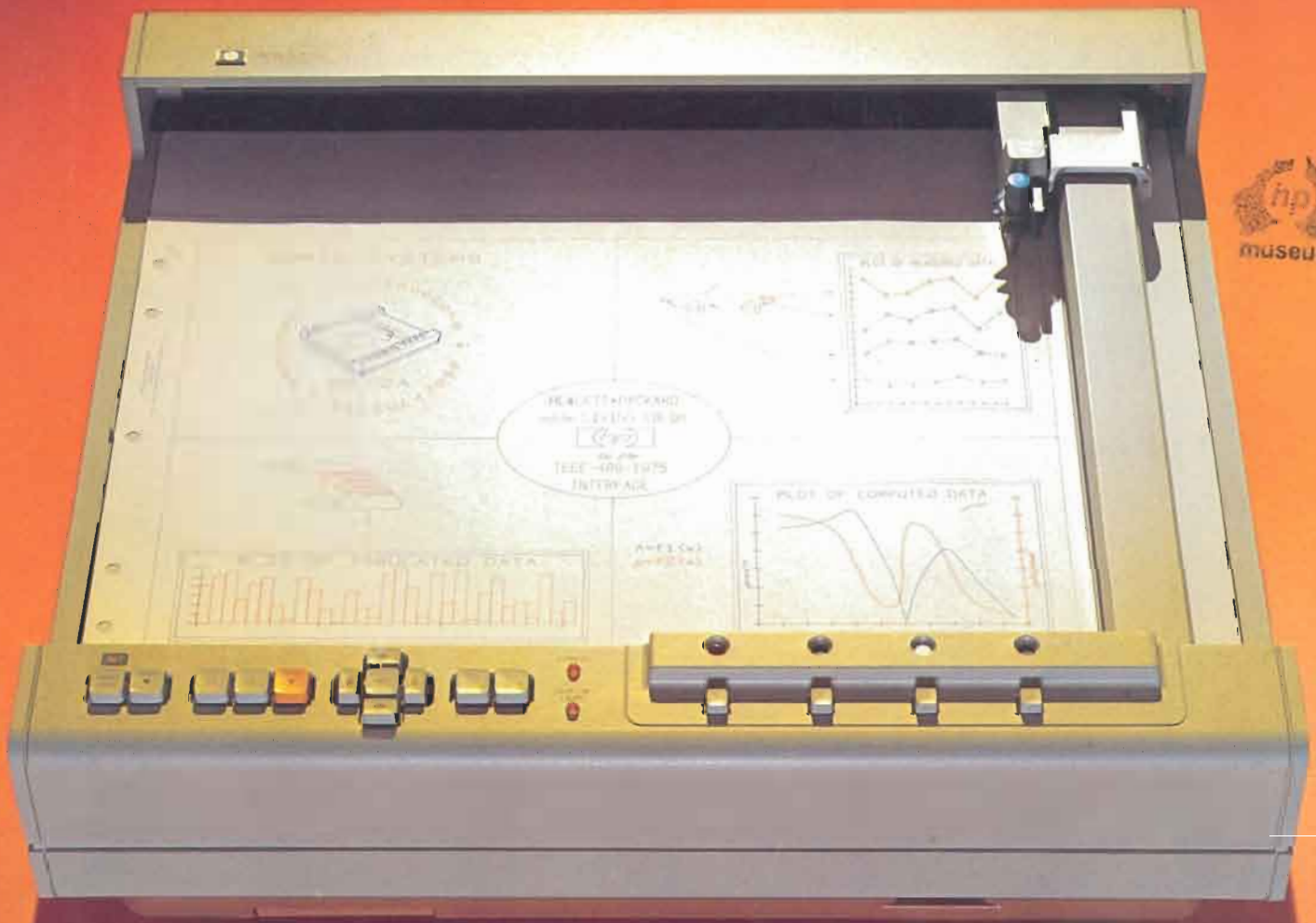
HEWLETT hp PACKARD

9872A Graphics Plotter

TECHNICAL DATA, JULY 1977

Programmable Four-Color Plotting For Your System



The Hewlett-Packard 9872A is a microprocessor-based HP-IB plotter that produces high quality, multicolor graphic plots on any size chart up to 280 x 432 mm (ISO A3). The 9872A offers exceptional line and character quality with addressable moves as small as 0.025 mm (0.001 in.). Thirty-eight different instructions are built in to equip the plotter with such capabilities as point digitizing, labeling, character sizing, and window plotting. The 9872A is interfaced through the Hewlett-Packard Interface Bus (conforms to IEEE 488-1975). With HP-IB, you can connect the plotter to your HP-IB compatible calculator, computer, or other controller using a standard interface cable. Short, easily understood commands and the HP-IB interface enable you to start plotting with only a minimum of programming experience.

Trace identification is enhanced by the use of the 9872A's automatic selection of any of four pens through either program control or front panel pushbuttons. Seven different dashed-line fonts, symbol mode plotting, and user-defined characters aid in trace identification.

Faster, high quality plotting is another contribution of the 9872A. The pen speed is programmable to any one of 36 speeds from 10 mm/s to 360 mm/s. This feature enables you to produce high quality graphics on standard chart paper as well as other media. Typical character plotting speed of three characters per second enables you to produce fully lettered graphs in less time than before.

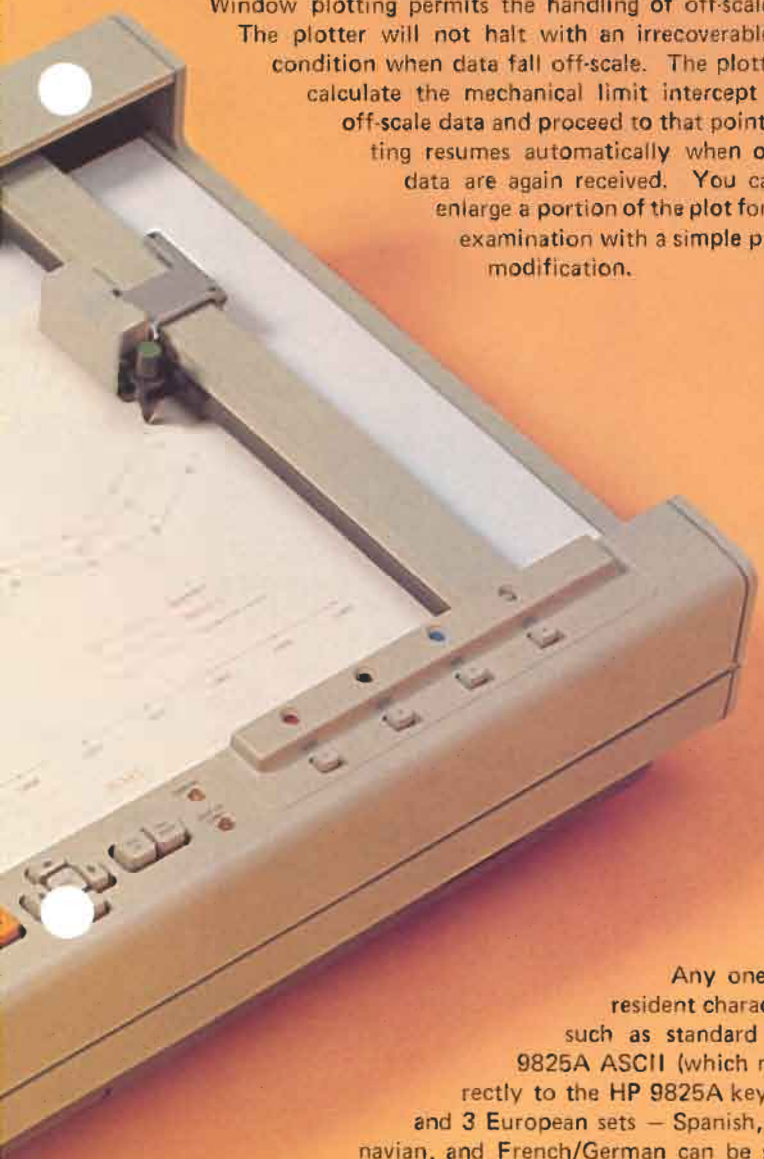
The 9872A is designed to be especially useful in the areas of statistics, medicine, numerical control, surveying, and engineering design. Whether tabulated, measured, or computed data, the 9872A enables you to quickly prepare multicolor plots of excellent line quality and high resolution. Five different character sets, including three European sets, provide application worldwide.

Features

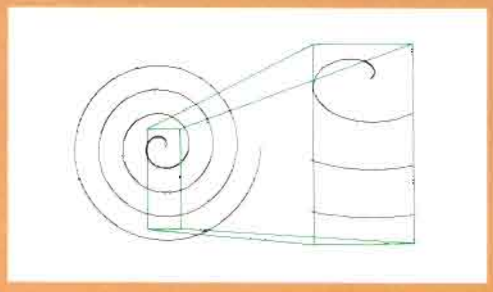
- Programmable selection of 4 pens
- HP-IB interface
- Error-free off scale data handling
- Window plotting
- User-defined characters
- 7 dashed-line fonts
- 5 built-in character sets
- Point digitizing
- Built-in confidence and self-test
- Symbol mode plotting
- Electrostatic hold-down
- Selectable pen velocity
- μ-processor controlled
- Stepper motor drive

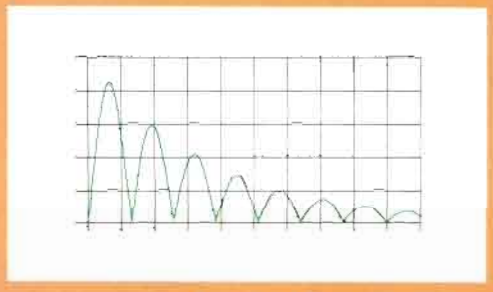
Internal Self-Test Capability

Internal switches and LED displays enable service personnel to locate a faulty module and in some cases a faulty component in a matter of minutes. This feature means less instrument down time and reduced service costs.



Window plotting permits the handling of off-scale data. The plotter will not halt with an irrecoverable error condition when data fall off-scale. The plotter will calculate the mechanical limit intercept of the off-scale data and proceed to that point. Plotting resumes automatically when on-scale data are again received. You can also enlarge a portion of the plot for closer examination with a simple program modification.



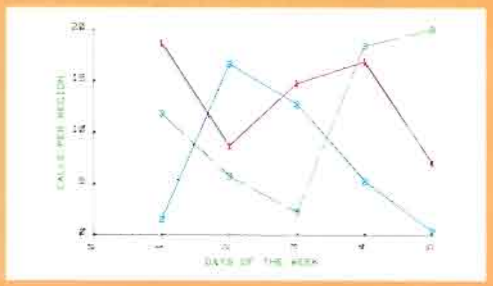


With only a few commands, you can draw the X and Y axes with tick marks. By varying the tick length, an entire grid system can easily be drawn. Draw the grid with one color then plot your data in another — all with easily used program commands.

Any one of five resident character sets such as standard ASCII, 9825A ASCII (which maps directly to the HP 9825A keyboard), and 3 European sets — Spanish, Scandinavian, and French/German can be selected under program control. To simplify the programming effort and offer even more flexibility, the size, slant, and direction of these character sets can be altered using simple program commands.

User defined characters or symbols may be created in the program. To further simplify the programming effort and not use up valuable controller memory space, the size, slant, and direction of the user defined character may be modified with single commands.

For enhanced plot interpretation and trace differentiation, use any of seven dashed-line fonts or a single command for symbol mode plotting. With symbol mode plotting, a user selected ASCII character will be automatically drawn and centered at each data point.



Built-In Plotter Instructions

The Hewlett-Packard Graphics Language is a two-letter mnemonic interface language which allows the user to easily communicate with the 9872A via general I/O statements over the HP-IB interface bus. The 9872A understands 38 different graphics commands from 7 major groups.

VECTOR GROUP
- AP – Automatic pen pick-up.
- PA – Plot absolute.
- PR – Plot relative.
- PU – Pen up.
- PD – Pen down.

CHARACTER GROUP
- CA – Designate alternate character set.
- CS – Designate standard character set.
- CP – Character plot.
- DI – Direction (absolute).
- DR – Direction (relative).
- LB – Label.
- SI – Character size (absolute).
- SR – Character size (relative).
- SL – Character slant (absolute).
- SA – Select alternate character set.
- SS – Select standard character set.
- UC – User character.

LINE TYPE GROUP
- LT – Line type.
- SM – Symbol mode.
- SP – Select pen.
- VA – Velocity automatic.
- VN – Velocity normal.
- VS – Velocity select.

AXES GROUP
- TL – Tick length.
- XT – X Tick.
- YT – Y Tick.

DIGITIZE GROUP
- DC – Digitize clear.
- DP – Digitize point.
- OC – Output current position.
- OD – Output digitized point.

SETUP GROUP
- IP – Input P1, P2.
- IW – Input window.
- OP – Output P1, P2.

CONFIGURATION AND STATUS
- DF – Default values.
- IM – Input mask.
- IN – Initialize.
- OE – Output error.
- OS – Output status.

To demonstrate the simplicity of command usage, the following program plots a 2.5 cm square with each side a different color.

```
"SP1;PA0,0;PD;PA1000,0;SP2;
PA1000,1000;SP3;PA0,1000;SP4;PA0,0"
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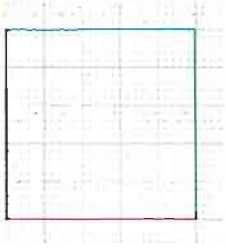


9825A and 9831A ROM's

Plotter ROM's are available to provide convenient operation when using the 9872A with your HP 9825A or 9831A computing controllers. These ROM's further simplify plotter programming by combining certain plotter functions and performing required data formatting.

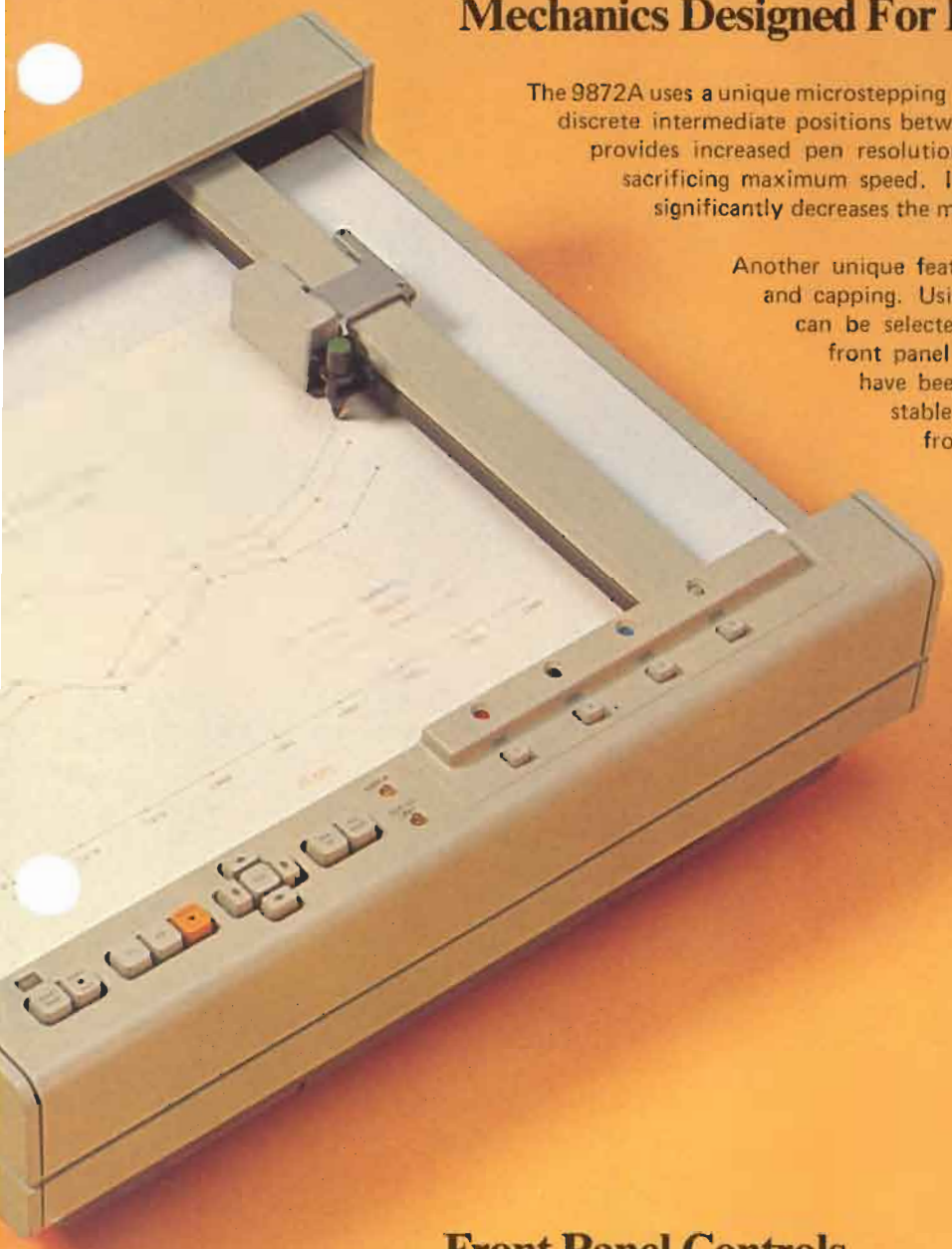
Rear Panel Interface

The plotter address switch can be set to any of 31 different addresses for interface with its controller.

The HP-IB connector provides interface conforming to IEEE 488-1975 standards regarding pin assignments, physical configuration, and voltage levels.

A separate 14-pin connector is provided for users of the HP 9815A computing controller.

A confidence test feature provides the operator with a convenient method of checking and ensuring confidence of the functional capability of the plotter.



Mechanics Designed For Plotting

The 9872A uses a unique microstepping technique which allows the drive system to achieve discrete intermediate positions between the conventional motor steps. This technique provides increased pen resolution (0.025 mm smallest addressable move) without sacrificing maximum speed. In addition, slidewires have been eliminated, which significantly decreases the maintenance required by the operator.

Another unique feature of the 9872A is the automatic pen selection and capping. Using only the natural movement of the pen arm, pens can be selected either by program control or manually by the front panel pushbuttons. No additional motors or solenoids have been used. When the pens are put back in the pen stable, they are automatically capped to prevent the ink from drying out.

A new controlled pen motion mechanism gently lowers the pen to the writing surface, greatly lengthening the life of the writing nib. This prevents the pen tip from bouncing when it first hits the paper thereby retaining its fine line characteristics.

Front Panel Controls Designed For Easy Operation

Chart load controls quickly move the pen arm out of the way to facilitate chart replacement.

Scaling controls P1 and P2 set scaling points for the establishment of graph limits and numerous other plotter functions.

The multifunction enter pushbutton is used for digitizing, initializing, scaling, and pen storage.

Pen controls move the pen at fast or slow speeds to any position for point digitizing, labeling, or setting scaling limits.

An error light and out-of-limits light provide operator information for illegal commands or boundary overruns.

Pen select pushbuttons allow manual selection of four different colored pens.

SPECIFICATIONS

PLOTTING AREA

Y axis: 280 mm (11 in.)
X axis: 400 mm (15.75 in.)
Accommodates up to ISO A3 and 280 x 432 mm (11 x 17 in.) chart paper.

PLOTTING ACCURACY

±0.2% of deflection ±0.2 mm (0.008 in.) [includes linearity and repeatability and assumes the plotter has been "zeroed" exactly to the lower left (0,0) coordinates].

REPEATABILITY

For a given pen: 0.10 mm (0.004 in.)
Pen-to-pen: 0.20 mm (0.008 in.)

ADDRESSABLE RESOLUTION

Smallest addressable move: 0.025 mm (0.001 in.)

SPEED

Maximum: 360 mm/s (14 in./s) in each axis, 509 mm/s (20 in./s) on 45° angle.
Programmable: pen speed may be adjusted to any one of 36 speeds from 10 mm/s (0.4 in./s) to 360 mm/s (14 in./s) in 10-mm/s (0.4-in./s) increments under program control.

VECTOR LENGTH

No limit – any length vector within the plotter's mechanical limits will be plotted to within the previously mentioned accuracy.

CHARACTER PLOTTING SPEED

3 characters/s typically for 2.5-mm (0.01-in.) characters.

OFFSCALE PLOTTING

When offscale data are received by the plotter, the plotter will automatically calculate the mechanical limit intercept of that vector and proceed to that point. As additional offscale data are received, the plotter will monitor the location of these data and resume plotting, once on-scale data are received, by again calculating the new mechanical limit intercept and plotting from that limit to the on-scale data point. Plotting accuracy and repeatability specifications are preserved.

PEN CONTROL

Locally control by front-panel switches or remote control by desktop computer program commands; capable of >20 operations/s.

POWER REQUIREMENTS

Source: 100 V –10%, +5%
120 V –10%, +5%
220 V –10%, +5%
240 V –10%, +5%
(switch selectable)
Frequency: 48 – 66 Hz
Consumption: 100 V/2.2 A
120 V/1.9 A
220 V/960 mA
240 V/900 mA
220 W max

ENVIRONMENTAL RANGE

Temperature: 0°C to 55°C
Relative humidity: 5% to 95% (below 40°C)

SIZE/WEIGHT

Height: 189 mm (7.5 in.)
Width: 497 mm (19.5 in.)
Depth: 455 mm (18 in.)
Net Weight: 18.2 kg (40 lb)
Shipping weight: 25.4 kg (56 lb)
Cube: 0.21 m^3 (7.4 ft^3)

ACCESSORIES SUPPLIED

Item	HP Part No.
Accessory kit (includes four packages of 4-color pack pens, Part No. 5060-6810; Digitizing Sight, Part No. 09872-60027	09872-60070
Operating and Service Manual	09872-90002
10 sheets of chart paper 10 x 15 in. plot area	9270-1004
10 sheets of chart paper 250 x 380 mm plot area	9270-1024
Power cord (appropriate cord supplied, based on origin of sales order)	-- --
Dust cover	9222-0564

ACCESSORIES AVAILABLE

Item	HP Part No.
Plotter pens	
Package of 5 red pens	5060-6784
Package of 5 blue pens	5060-6785
Package of 5 green pens	5060-6786
Package of 5 black pens	5060-6787
4-color pack (red, blue, green, black)	5060-6810
Plotter paper	
10 x 15-in. plot area, 100 sheets	9270-1004
7 x 10-in. plot area, 100 sheets	9270-1006
250 x 380-mm plot area, 100 sheets	9270-1024
180 x 250-mm plot area, 100 sheets	9270-1023
Semi-log:	
10-in. x 2-cycle plot area, 100 sheets	9280-0159
10-in. x 3-cycle plot area, 100 sheets	9280-0160
2-cycle x 15-in. plot area, 100 sheets	9280-0169
3-cycle x 15-in. plot area, 100 sheets	9280-0168
Log-log:	
2-cycle x 3-cycle plot area, 100 sheets	9280-0167
3-cycle x 2-cycle plot area, 100 sheets	9280-0165
3-cycle x 4-cycle plot area, 100 sheets	9280-0171
Blank, 100 sheets	9280-0180
Carrying case	1540-0480
HP-IB Card for use with 9825A and 9831A	98034A
Cables:	
If using multiple HP-IB instruments, order one of the following:	
10631A HP-IB Cable	1 m (3.28 ft)
10631B HP-IB Cable	2 m (6.56 ft)
10631C HP-IB Cable	4 m (13.12 ft)
10631D HP-IB Cable	0.5 m (1.64 ft)
Manuals:	
Interface and Programming Manual	09872-90003

ROMs AVAILABLE

Additional read-only memory blocks for the 9825A and 9831A are available to expand their languages for plotter operation. Although not required, these language ROMs are helpful when programming the 9825A and 9831A.

9825A ROMS: 98215A (for 9872A) Plotter-General I/O ROM
98216A (for 9872A) Plotter-General I/O-Extended I/O ROM
9831A ROM: 98223B Matrix-Plotter ROM

OPTIONS

Option 015: for use with 9815A (includes interface cable with ROM)
Option 025: for use with 9825A (98034A HP-IB Card not supplied)
Option 031: for use with 9831A (98034A HP-IB Card not supplied)

For More Information, Call Your Local HP Sales Office or, in U.S., East (301) 948-6370. Midwest (312) 677-0400. South (404) 434-4000. West (213) 877-1281. Or Write: Hewlett-Packard 1501 Page Mill Road, Palo Alto, California 94304. In Europe, Post Office Box 85, CH-1217 Meyrin 2, Geneva, Switzerland. In Japan, YHP, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

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