
VXI Mainframe, C-Size, 13-Slot, 1000 Watt HP E8404A Technical Specifications

- 13-Slot, C-size
- Enhanced monitoring for confident measurements
- Color graphics display
- 1000 watts of usable power
- Efficient, quiet cooling improves VXI module performance
- Compliant with VXIbus & VXIplug&play Specifications



HP E8404A

Description

The HP E8404A C-size, 13-slot VXI mainframe is the high-performance mainframe in Hewlett-Packard's new VXI mainframe family. It delivers innovative cooling technology, improved backplane design, high reliability, easy maintenance, and versatile accessories. The power supply in the HP E8404A VXI mainframe provides 1000 watts of usable power, sufficient for the most demanding automated test applications. The innovative air distribution system in this mainframe provides extremely quiet and efficient cooling.

Enhanced monitoring of the HP E8404A mainframe provides superior cooling control and details regarding temperatures throughout the mainframe, power supply voltages and currents, fans operation, system status, history queue, and stripcharts or histograms for easy diagnostics. This information is available on the full color display or through VXIbus or RS-232 connection. A front panel diagnostics connector allows continuous local or remote system monitoring. This mainframe also complies with the VXI specification by providing injector surface rails used by the HP QUIC easy module insertion and extraction system. Superior cooling, reliable design and enhanced monitoring make the HP E8404A an excellent choice for all VXI test system applications.

Refer to the HP Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Enhanced Monitoring

- VXIbus or RS-232 communication
- 3 temperature sensors per slot
- Cooling control
- Power supply voltage and current
- Stripcharts and histograms for easy diagnostics
- Audible warnings of over-limit conditions
- History queue
- *VXIplug&play* WIN Framework driver
- English, French, German, and Spanish language support

State-of-the-art enhanced monitoring is provided on the HP E8404A VXI mainframe. The enhanced monitor board plugs into the backplane from the rear of the mainframe; it does not occupy a slot in the mainframe or tie up a MODID line.

The enhanced monitoring is message based, allowing easy communication with the mainframe for the user over RS-232 or through the VXIbus. SCPI commands are used to address the mainframe. A *VXIplug&play* WIN Framework driver is provided.

Temperature monitoring includes module exhaust temperatures at three points on every slot, power supply temperature and ambient temperature. Measurements at the front, center and rear of every slot provide an accurate assessment of the temperature fluctuations over a variety of cards, whose hottest components may vary in position. Display screens are provided for overall temperature map, temperature limits set, stripcharts and histograms of each slot.

Temperature monitoring is also used for cooling control. Both the absolute temperature of the slots and the temperature rise over ambient temperature are measured. Cooling speed is increased when either an absolute temperature or a temperature rise approaches its respective limit. The user may adjust these control limit ranges programmatically.

Speeds of power supply fans and the impeller are displayed as a percentage of full speed and as the number of rotations per minute.

All seven voltages, + 5 V standby and the optional user-supplied external 5 V power are measured. Current monitoring is provided and power is calculated for each power supply voltage. Overview display screens are provided for all these data; more detailed information is also available in stripcharts and histograms. These values are visible on the display and are available through the VXI and RS-232 interfaces.

Warning alarms occur when a temperature is over limit, power supply voltages are out of VXI specification, when current or total power exceeds user set limits, or for certain user-defined conditions. A beeper provides audible warnings; it is enabled or disabled through a SCPI command or through the front panel keys.

The enhanced monitor includes a maintenance timer. This timer may be set, queried, and reset by the user for support of scheduled maintenance activities, such as cleaning the optional air filter.

The enhanced monitor may operate independently of line power by providing external + 5 V power. When line power goes down, communication with the enhanced monitor is possible via the RS-232 interface.

Remote power-on is available via the diagnostic connector "remote on signal" or through a SCPI command.

Localization enables the user to select English, French, German, or Spanish languages on the display for ease of operation worldwide.

Color Graphics Display

A full color graphical display on the front of the HP E8404A VXI mainframe provides frame status, including:

- Temperatures at front, center and rear of every slot
- Ambient and power supply temperatures
- Power supply voltages
- Power supply currents
- Total power
- Fans speeds
- User-defined text messages
- System log and timer
- History

1000W Power Supply

The HP E8404A VXI mainframe features over 1000 watts of usable power from 0 °C to 55 °C. Ample dynamic and peak currents are provided for most applications.

Superior Cooling

The innovative cooling design in the HP E8404A VXI mainframe provides extremely quiet and efficient cooling. Carefully engineered airflow provides the ultimate in cooling with a minimum of noise. Outstanding back pressure performance insures airflow through dense modules. Separate power supply cooling fan(s) provides an independent air path for reliable cooling of the power supply.

All fans operate in either Variable or Full Speed mode. A two-position switch on the mainframe's front panel controls the speed mode. Full Speed mode is recommended for maximum cooling and/or if acoustic noise is not a concern; all air movers (cardcage impeller and power supply fan(s)) are operated at full capacity at all times. In Variable Speed mode, the fan speed will vary depending on the temperature rise in the mainframe, and the ambient temperature. Variable Speed mode operation allows the quietest operation while providing sufficient cooling for the modules in the mainframe.

Airflow is conveniently routed into the rear and exhausted out the sides of the mainframe. This allows mainframes to be stacked or rack-mounted directly on top of one another.

At-a-Glance Confidence in Operation

The front panel indicator lights on the HP E8404A VXI mainframe gives immediate visual indication that the power supply voltages are operating within the VXI Specification, the temperatures are within limit, and that the fans are operational. Backplane activity and SYSFAIL indicators are also provided.

The system can be reset easily from the front panel, providing reset even when the Slot 0 is inaccessible due to cabling.

The diagnostic connector, conveniently located on the front of the mainframe, provides connection for remote monitoring of power supply voltages, power supply and reference temperatures, and fans function. This connector also allows remote on/standby, access to +5VSTDBY, ACFail, and SYSRESET. The connector's functionality is a superset of the functionality on the HP E1401B Mainframe, allowing software and hardware compatibility with existing applications. Up to 1A of +5VSTDBY may be provided by the user through the connector. Up to 1 A each of + 5 V and + 12 V are available for external applications through the connector.

Improved, Highly Reliable Backplane Design

The backplane features solid state automatic daisy-chain jumpering for the VMEbus grant and interrupt acknowledge lines, eliminating the need for hand selection of switch settings. Full differential distribution of the CLK10 signal is provided on the backplane. This minimizes jitter and skew, providing a clean timing source for VXI instrument modules. The surface mount backplane improves both reliability and stripline signal performance.

HP generates SYSRESET and ACFail on the backplane. This is necessary for full compliance with the VXI Specification, but is not generally implemented by other manufacturers.

Easy Maintenance Rear-Accessible Power Supply and Impeller

Convenient access to the power supply, cooling and monitoring systems is provided through the mainframe's rear panel; a replacement power supply or fan can be installed without removing the mainframe from a rack. The power supply's plug-in design makes repairing easy.

The monitor control board and the impeller for module cooling are easily replaced. The internal fan for the power supply, an integral part of the supply, is easily replaced with the power supply itself. If the optional Air Filter Accessory Kit is installed, air filters may be replaced without tools.

Accessories and Configurations

Optional Rack Mounting Kits

Three rack mounting kits are available for the mainframe, providing versatile options for installation in an HP or a non-HP rack. The following rack mounting kits are available: Standard Adapter Kit, Flush Mount Adapter Kit and VXI *plug&play* Compliant Adapter Kit.

Standard Adapter Kit for Recess, Flush or Forward Rack Mounting

Using the Standard Adapter Kit (Opt. 923 or HP E8400-80923), the mainframe can be recess mounted up to 10.6 inches in ~1/2 inch increments. (Recess mounting is required for compatibility with the tinted acrylic door.) The mainframe can also be mounted extended from the front of the rack from 0 to 5.8 inches in ~1/2 inch increments, allowing mounting in racks with shallow depths. The Standard Adapter Kit includes handles and requires the HP E3664A Support Rail Kit or the HP 1494-0411 Rack Slide Kit.

Flush Mount Adapter Kit

The Flush Mount Adapter Kit (Opt. 924 or HP E8400-80924), the least expensive of the adapter kits, allows flush rack mounting of the mainframe. It does not include handles. The Flush Mount Adapter Kit requires the HP E3664A Support Rail Kit. The Flush Mount Adapter Kit is not compatible with the tinted acrylic door or with the rack slides.

VXI*plug&play* Compliant Adapter Kit

The VXI*plug&play* Compliant Adapter Kit (Opt. 925 or HP E8400-80925) provides rack mounting compatible with the VXI*plug&play* VPP-8 Specification for ease of interconnect with MacPanel, Virginia Panel, or other VXI*plug&play*-compatible ICA receivers. The Adapter Kit locates the mainframe in the position prescribed by the VXI*plug&play* Systems Alliance and provides four mounting holes for attachment of the receiver adapter frame. The VXI*plug&play* Compliant Adapter Kit requires the HP E3663A Support Rail Kit or the HP 1494-0411 Rack Slide Kit.

Electromagnetic Compliance (EMC) Accessories

The standard mainframe is suitable for the majority of applications. For more demanding EMC applications, a Chassis Shield Kit, Backplane Connector Shields, and EMC Filler Panels are available.

Chassis Shield Kit

The Chassis Shield Kit (HP E8400-80919) is used to provide additional isolation or shielding between noisy or sensitive modules. These newly designed, patent pending chassis shields are easy to install and are grounded in all four corners.

Backplane Connector Shields

Backplane Connector Shields (Opt. 918 or HP E8400-80918) are useful for improving the ground connection between a module and the backplane. For a few modules, they are necessary for EMC compliance to EN55011 and CISPR11. For the vast majority of modules, they are not necessary. Note that these shields are *only* useful if the module includes contacts conforming to VXI Spec B.7.2.3.

EMC Filler Panels

EMC Filler Panels (HP E8400-60202) are used to provide a continuous connection across the front opening of the mainframe. All HP modules include EMC contacts to the adjacent slot. Using EMC Filler Panels in the empty slots completes the connection and reduces radiated emissions and increases radiated and ESD immunity.

Optional Air Filter

Air filters are not necessary on these mainframes. However, an optional Air Filter Kit (Opt. 938 or HP E8401-80938) is available for use in demanding environments. The airflow is reduced less than 10% with a clean air filter installed.

Cable Routing

In rack-mount installations, cables can be routed to the front of the mainframe or from below the mainframe.

The optional Cable Tray (Opt. 914 or HP E8400-80914) allows cable routing under the mainframe. The Cable Tray may be mounted to provide three different heights: one EIA rack unit (44.5 mm), two EIA rack units, and halfway between one and two EIA rack units. It is compatible with the HP E3664A Support Rail Kit and the HP 1494-0411 Rack Slide Kit. If the mainframe is used on a benchtop, the mainframe feet may be removed and reinstalled on the bottom of the Cable Tray.

Optional Door

An optional Tinted Acrylic Door (Opt. 915 or HP E8400-80915) is available for use in rack-mount installations. All of the modules installed in the mainframe are accessible when this door is open. The door hinges on the right so that its latch mechanism occupies the space outside Slot 0, allowing the door to close with the minimum recess into the rack. Its hinges are a lift-off type so that the door may be easily removed when open. It is fabricated of acrylic to provide adequate strength and superior scratch resistance when compared to polycarbonate.

The Tinted Acrylic Door Kit requires and is compatible with the Standard Adapter Kit (Opt. 923 or HP E8400-80923) only.

Documentation

The mainframe documentation consists of a User and Service Manual. The manual is distributed on the HP Universal Instrument Drivers CD-ROM supplied with the mainframe and a variety of other HP VXI products. It is also available on the HP Website. This documentation describes all mechanical aspects for the mainframe and its accessories. A printed copy of this manual is also included.

Warranty

Hewlett-Packard provides a standard 3-year return-to-HP warranty on this mainframe. Opt. W01 converts the standard warranty to 1-year on-site.

Product Specifications

Mechanical

Mainframe height:	352 mm (13.9 inches) (8 EIA rack units)
Mainframe width:	424.5 mm (16.7 inches)
Mainframe depth:	631 mm (24.9 inches)
Mainframe weight:	25 kg (55 lbs.)

Available Current

Voltage	Peak Current I_{MP} (Amps) @ 55 °C:	Dynamic Current I_{MD} (Amps) @ 55 °C:
+5 V:	90 A	9 A
+12 V:	15 A	2.5 A
-12 V:	15 A	2.5 A
+24 V:	15 A	5 A
-24 V:	15 A	5 A
-5.2 V:	60 A	8 A
-2 V:	30 A	5 A

Power

Temperature range:	0-55 °C
Available power (90-264 Vac):	1902 W
Usable power (110-264 Vac):	1000 W
Usable power (90-110 Vac):	950 W

Power Input

Input voltage:	90-264 Vac (single continuous range)
Input frequency:	47-66 Hz (across full input voltage range)
Inrush current:	
At input voltage 100 Vac:	40 A typ.
At input voltage 264 Vac:	70 A typ.

Power Switch:

On/Standby switch on front with lighted indicator.

May be switched On/Standby remotely via diagnostic connector.

May be switched On/Standby via SCPI command.

+5VSTDBY

(Power may be provided by the user to the +5VSTDBY bus on the VXI backplane.)

Current:	1 A max
Voltage range:	5.25 V max., 4.875 V min.
Connector:	Pins 8 and 21 of the diagnostic connector

External +5VSTDBY

(Power may be provided by the user to operate the enhanced monitor in the absence of line power.)

Current:	500 mA min. (needed for enhanced monitor operation), 1.5 A max. on connector.
Voltage range:	5.25 V max., 4.875 V min.
Connector:	Rear panel

Power Supply Protection

All voltages are protected from over-temperature, over-voltage, over-current, short-to-ground and short-to-other-output. Protection mode is full shutdown.

Recovery occurs when the fault condition is removed and power on/standby is cycled.

Acoustic Noise

(Sound power at bystander position one meter in front of mainframe.)

High-speed fan:	55 dBA
Variable fan on low speed:	42 dBA

Shielding

Front panel EMC gasketing:	Front panel gasketing provided per VXI Rev. 1.4, B.7.2.3
Backplane shielding:	Backplane connector shields per VXI Rev. 1.4, B.7.2.3
Intermodule chassis shielding:	Intermodule chassis shields per VXI Rev. 1.4, B.7.3.4

Airflow

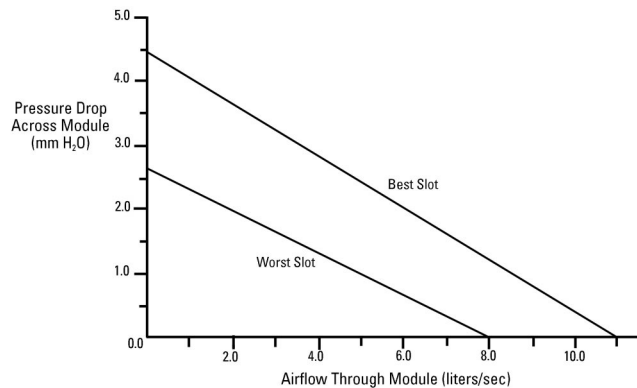
Airflow is routed into the rear and exhausted out the upper sides of the mainframe. Allow 50 mm of clearance for proper air flow.

Fan Speed

(Cooling Mode, High or Variable, switchable on the front panel. Controls both module impeller and power supply fan.)

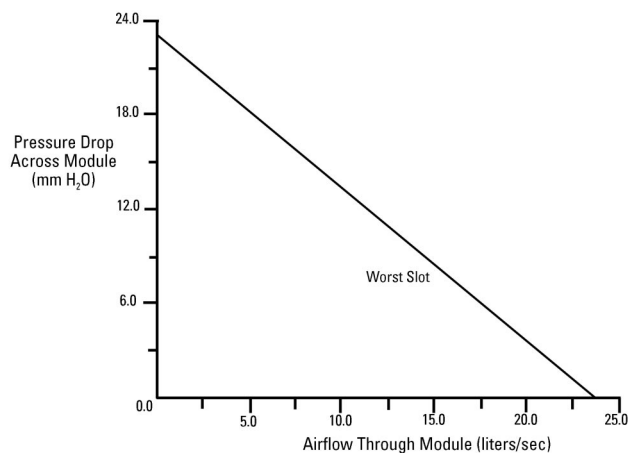
High fan speed mode:	Full airflow all the time
Variable fan speed mode:	Fan speed increments through 8 discreet speeds as a function of ambient, module, and power supply temperatures.

E8401A/02A/03A/04A Cooling Specification Charts



VXI-8 Specification Draft 2.0. Fixture revision 1.7.

- VXI-8 Standard Modules installed in all other slots.
- Performance shown for Worst Slot (slot 1) and Best Slot (slot 10).
- Front-to-Rear Variance 13% worst case. Typically 10%-12% in most slots.
- Fans on Full Speed. Minimum airflow is approximately 50% with fans on Variable Speed.
- Air Filter Kit not installed. Airflow is reduced approximately 10% with clean air filters installed.
- Measurements taken at 1,500 m altitude.



All other slots blocked. Airflow decreases as additional slots are opened.

- Performance shown for Worst Slot (slot 2). Airflow is greater in all other slots.
- Fans on Full Speed. Minimum airflow is approximately 50% with fans on Variable Speed.
- Air Filter Kit not installed. Airflow is reduced approximately 10% with clean air filters installed.
- Measurements taken at 1,500 m altitude.

Backplane Specifications

- Solid-state automatic daisy-chain jumpering for BUS GRANT and IACK signals.
- Full differential distribution of CLK10.
- ACFAIL* and SYSRESET* in full compliance with the VMEbus and VXIbus Specifications.
- Surface mount construction and no sockets for maximum reliability.

Basic Monitor Specifications

Indicators:

- Power-on or Standby status
- Power supply output voltages monitor
- Power supply temperature monitor
- Module temperatures monitor
- Fans status monitor
- Backplane activity monitor
- Backplane SYSFAIL monitor

Switches:

- On/Standby
- Fan Mode: Switches all fans between Full Speed and Variable Speed modes
- Reset: Asserts backplane signals SYSRESET and ACFAIL

Diagnostic connector:

- Output all 7 backplane voltages for monitoring
- Output +5 V and +12 V for remote applications. 1 A max each
- Input +5VSTDBY to backplane. 1 A max total for pins 5 and 18
- Remotely operate On/Standby
- Power supply temperature output
- Reference temperature output
- Fans OK output, same as Fans indicator
- Backplane voltages OK output
- SYSRESET*, input or output
- ACFAIL*, output
- Ground

Enhanced Monitoring

	Function	Specification	Display	Interface VXI	RS-232
Temperature Monitor	Module exhaust temperature:	13 slots, front/mid/rear	Output	Output	Output
	Ambient temperature:		Output	Output	Output
	Power supply temperature:		Output	Output	Output
	Temperature limits:	Module absolute, ΔT , ambient	Output	In/Out	In/Out
	Stripcharts:	Modules, ambient	Output	Output	Output
	Histograms:	Modules, ambient	Output	Output	Output
	Warnings:	Out-of-limit conditions	Output	Output	Output
Power Monitor	Voltages:	7 VXI, 5VSTDBY	Output	Output	Output
	Current:	7 VXI	Output	Output	Output
	Power:	Calculated (V*I)	Output	Output	Output
	Voltage Limits:	Fixed		Output	Output
	Current Limits:	7 VXI	Output	In/Out	In/Out
	Power Limits:	Total	Output	In/Out	In/Out
	Stripcharts:	7 VXI, 5VSTDBY, total, PSTemp	Output	Output	Output
	Histograms:	7 VXI, 5VSTDBY, total, PSTemp	Output	Output	Output
	Warnings:	Out-of-limit conditions	Output	Output	Output
Fan Monitor	Fan speed: % full, RPM	Module impeller, PS fans	Output	Output	Output
	Stripcharts: RPM	Module impeller, PS fans	Output	Output	Output
	Histograms: RPM	Module impeller	Output	Output	Output
	Fan speed control:	Closed loop control in Var mode			
	Warnings:	Out-of-limit conditions	Output	Output	Output
History	System log:	Hrs on, last cal, etc.	Output	Output	Output
	Maintenance timer:		Output	In/Out	In/Out
	History queue:	Event description & time	Output	Output	Output
	Min/max values:	Temperature, power supply, fans		Output	Output
	Histograms:	Temperature, power supply, fans	Output	Output	Output
Time Base	Accuracy:	± 120 ppm			
	Aging:	± 5 ppm/year			
	Resolution:	2 sec			
Test & Calibrate	Calibration:	Temperature, voltage		Input	Input
	Self-test:		Output	In/Out	In/Out
VXI	VXI device type:	Message-based servant, programmable-interrupter, statically-addressed, A16 device			
	LADD:	Rear panel switch	Output	Output	Output
	Device code:	618		Output	Output
RS-232 Interface	Baud rate:	300, 1200, 2400, 4800, 9600	Output	In/Out	In/Out
	Parity:	Even, Odd, None	Output	In/Out	In/Out
	Character size:	7,8	Output	In/Out	In/Out
	Pace:	Xon/Xoff, None	Output	In/Out	In/Out
	Hardware handshake:	RTS	Output	In/Out	In/Out
Display	Resolution:	256 x 64 pixels			
	Colors:	16			
	Type:	Liquid Crystal Display			
	Size:	92mm x 25mm			
	Average bulb life:	25,000 hours			
	Language support:	English, French, German, Spanish			
	User-defined messages:	200 characters, 4 lines max	Output	In/Out	In/Out
	Display contrast:		In/Out		
	Screen saver On/Off:		In/Out	In/Out	In/Out
	Beeper On/Off:		In/Out	In/Out	In/Out

Environmental

Temperature

Operating temperature range:	0 °C - + 55 °C
Storage temperature range:	-40 °C - + 75 °C

Humidity

Operating humidity range:	Up to 95% RH from 0 °C to + 40 °C, Up to 65% RH from + 40 °C to + 55 °C
Storage humidity range:	Up to 95% RH from 0 °C to + 55 °C, Up to 65% RH from + 55 °C to + 75 °C

Altitude: Up to 3000 m

Standards Compliance

100% compatible with the VXIbus Specification Revision 1.4. E8402A/04A command set compatible with IEEE-488.1, IEEE-488.2, and SCPI-1995.0

Repair

(Diagnosis and troubleshooting through the front panel monitor and connector.)

MTTR = Mean Time to Repair

MTTR, power supply:	<10 min. (w/mainframe and modules fully installed in rack)
MTTR, impeller and/or fan:	<10 min. (w/mainframe and modules fully installed in rack)
MTTR, enhanced monitor control board:	5 - 10 min. (w/mainframe and modules fully installed in rack)

General Specifications

VXI Characteristics

VXI device type:	Mainframe
Data transfer bus:	All per VXIbus Specification, Rev 1.4
Size:	C
Slots:	13 available
Connectors:	P1/P2
Shared memory:	n/a
VXI busses:	All per VXIbus Specification, Rev 1.4

Instrument Drivers

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
HP Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	10.2 planned 1998

Ordering Information

Description	Product No.
13-Slot, C-Size VXI Mainframe, high performance, with 1000 W power supply and Enhanced Monitoring	HP E8404A
Module Installation Using Standard Settings	HP E8404A 500
Cable Tray Kit	HP E8404A 914
Tinted Acrylic Door Kit	HP E8404A 915
Installed Backplane Connector Shields	HP E8404A 918
Standard Rack Mount Adapter Kit	HP E8404A 923
Flush Rack Mount Adapter Kit	HP E8404A 924
VXIplug&play (VPP-8) Compatible Rack Mount Kit	HP E8404A 925
Air Filter Accessory Kit	HP E8404A 938
Convert 3 year Return-to-HP to 1 yr OnSite Warr.	HP E8404A W01
Extra User and Service Manual	HP E8402-90000
Cable Tray Kit	HP E8400-80914
Tinted Acrylic Door Kit	HP E8400-80915
Backplane Connector Shields Kit	HP E8400-80918
Intermodule Chassis Shield Kit	HP E8400-80919
EMC Filler Panel, 1-slot	HP E8400-60202
Replacement VXI Slot Filler Panels:1-Slot:	HP E8400-00204
3-Slot:	HP E8400-00205
7-Slot:	HP E8400-00206
Standard Rack Mount Adapter Kit	HP E8400-80923
Flush Rack Mount Kit	HP E8400-80924
VXIplug&play (VPP-8) Compatible Rack Mount Kit	HP E8400-80925
Air Filter Accessory Kit	HP E8400-80938
Support Rail for Standard Rack Mount Adapter or Flush Rack Mount Kit	HP E3664A
Support Rail Kit for VXIplug&play (VPP-8) Rack Mount Kit	HP E3663A
Rack Slide Kit for Standard Adapter Kit or VXIplug&play (VPP-8) Compatible Rack Mount Kit	HP 1494-0411
Replacement 1000 W Power Supply for HP E8403A	HP 0950-3277

Related Literature

1998 Test System and VXI Products Data Book,
HP Pub. No. 5966-2812E

1998 Test System and VXI Products Catalog,
HP Pub. No. 5966-2815

Warranty

Standard Hewlett-Packard VXIbus hardware products are warranted against defects in materials and workmanship for a period of three years unless otherwise noted. HP software and firmware products that are designated by HP for use with a hardware product, when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship.

For a complete and detailed warranty statement please see the *HP Test System and VXI Products Data Book* or visit the HP Website at <http://www.hp.com/go/vxi>.

HP Website Directory

Main HP Website
<http://www.hp.com>

HP Test and Measurement
<http://www.hp.com/go/tmdir>

HP VXI Product Information
<http://www.hp.com/go/vxi>

HP VXI Channel Partners
<http://www.hp.com/go/vxichanpart>

HP VEE Application Website
<http://www.hp.com/go/hpvee>

Data Acquisition and Control Website
http://www.hp.com/go/data_acq

HP Instrument Driver Downloads
http://www.hp.com/go/inst_drivers

For more information about Hewlett-Packard test & measurement products, applications, services, and for a current sales office listing, visit our website, <http://www.hp.com/go/tmdir>. You can also contact one of the following centers and ask for a test and measurement sales representative.

United States:

Hewlett-Packard Company
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1 800 452 4844

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Hewlett-Packard Canada Ltd.
5150 Spectrum Way
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