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Service Guide

Agilent 4072A Advanced Parametric Tester

Agilent 4073A Ultra Advanced Parametric Tester

Edition 5



Agilent Part Number: E3102-90500
March 2002

Printed in Japan

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Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page change only when a new edition is published. No information is incorporated into a reprinting unless it appears as a prior update; the edition does not change when an update is incorporated.

The software revision code printed before the date indicates the version level of the software product at the time the manual or update was issued. Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one to one correspondence between product updates and manual updates.

Edition 1	For Agilent 4070 System Software Revision B.02.00, June 1999
Edition 2	For Agilent 4070 System Software Revision B.02.10, June 2000
Edition 3	For Agilent 4070 System Software Revision B.03.00, September 2000
Edition 4	For Agilent 4070 System Software Revision B.03.00, March 2001
Edition 5	For Agilent 4070 System Software Revision B.03.01/C.03.01, March 2002

Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual may impair the protections provided by the equipment. In addition, it violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies, Inc. assumes no liability for customer's failure to comply with these requirements.

NOTE Agilent 4072A/4073A complies with INSTALLATION CATEGORY II for main input and INSTALLATION CATEGORY I for measurement input terminals, and POLLUTION DEGREE 2 defined in IEC 1010-1.

The 4072A/4073A is INDOOR USE product.

The 4072A/4073A is CLASS 1 LASER product based on IEC 825-1 optical wave:

AEL power is less than 0.2 mW.

Wavelength is 650 nm of continuous wave.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The power terminal and the power cable must meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operation personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Agilent Technologies Sales and Service Office for services and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as in the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING **Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.**

Safety Symbols

The general definitions of safety symbols used on equipment or in manuals are listed below.



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.



Indicates dangerous voltage and potential for electrical shock. Do not touch terminals that have this symbol when instrument is on.



Protective conductor terminal.

It is intended for connection to an external protective conductor for protection against electric shock in case of a fault or the terminal of a protective earth electrode.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current.

Direct current.



Electrical shock.

ON (Supply).



OFF (Supply).

CAT1 — Means INSTALLATION CATEGORY I. Measurement terminals on the testheads comply with INSTALLATION CATEGORY I.

WARNING — The warning sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION — The caution sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE — The note sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

Electrical Work Types

The definitions of electrical work types are as follows.

Work Type 3 — Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposure does not exceed 30 Vrms, 42.4 Vpeak, 60 Vdc, and 240 VA.

Work Type 4 — Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposure can exceed 30 Vrms, 42.4 Vpeak, 60 Vdc, 240 VA, or hazardous RF current.

In This Manual

Purpose

CAUTION The information in this manual is provided for use by trained service personnel only. To avoid electrical shock, do not perform any procedures in this manual unless qualified to do so.

This manual contains service information used to repair the Agilent 4072A advanced parametric tester and the Agilent 4073A ultra advanced parametric tester.

For information regarding installing the 4072A/4073A, refer to the *Installation Guide*.

For information regarding calibrating the 4072A/4073A, refer to the *System Calibration Guide*.

Audience

This manual is intended for Agilent customer engineers who perform the 4072A/4073A tester repair.

Contents

Chapter 1 , “General Information,” provides an overview, product configurations, products and options, accessories, and service tools for the 4072A/4073A.

Chapter 2 , “Tester Hardware and Software Information,” provides the 4072A/4073A hardware and software information.

Chapter 3 , “Troubleshooting,” provides information on troubleshooting the 4072A/4073A.

Chapter 4 , “Replacement Procedures,” provides part replacement procedures for the 4072A/4073A.

Chapter 5 , “Replaceable Parts,” provides information about 4072A/4073A replaceable parts.

Appendix A , “Error Messages,” describes the error messages that may be returned when an error occurs during the 4072A/4073A operation.

Other Manuals

The following manuals are available for servicing the 4072A/4073A.

Agilent 4070 User's Guide (Agilent part number E3102-90000)

Agilent 4072A/4073A Installation Guide (Agilent part number E3102-90520)

Agilent 4072A/4073A System Calibration Guide (Agilent part number E3102-90510)

Agilent 4072A/4073A Pre-Installation Guide (Agilent publication number 5968-4911E)

For information on user operation and programming of the 4070, see the following manuals.

Agilent 4070 Programming Guide for BASIC Users (Agilent part number E3102-90010)

Agilent 4070 Programming Reference for BASIC Users (Agilent part number E3102-90110)

Agilent 4070 Programming Guide for C Users (Agilent part number E3102-90020)

Agilent 4070 Programming Reference for C Users (Agilent part number E3102-90120)

Agilent 4070 Quick Reference for C Users (Agilent part number E3102-90140)

Agilent 4070 Maintenance Guide (Agilent part number E3102-90200)

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Tables

1 General Information

This chapter consists of the following sections:

- “Agilent 4072A/4073A Tester Overview”
- “Products and Options”
- “Available Accessories”
- “Serial Number Prefixes”
- “Service Tools”

For Agilent 4072A/4073A performance verification information and specifications, refer to the *System Calibration Guide*.

Agilent 4072A/4073A Tester Overview

The Agilent 4072A advanced parametric tester and the Agilent 4073A ultra advanced parametric tester are designed to perform precision dc and capacitance measurement, flash memory cell testing, and other high-frequency applications. The tester is used for evaluation of new processes or designs for semiconductor devices, and to monitor semiconductor production processes.

The 4072A/4073A is an all-in-one parametric test solution. The 4072A/4073A includes all of the features and capabilities of the 4071A, with the 4073A having the added capability of ultra low current measurements.

Figure 1-1 Overview of the Agilent 4072A/4073A Tester



The 4072A/4073A consists of a system cabinet and a testhead, with the following measurement resources:

- Measurement resources in the system cabinet:
  - ❑ Agilent 4284A precision LCR meter for capacitance measurements (optional)
  - ❑ Agilent 3458A multimeter for differential dc voltage measurements (optional)
- Pulse sources in the system cabinet:
  - ❑ A maximum of five Agilent 8110A 150 MHz pulse generators (optional)
  - ❑ A maximum of five Agilent 81110A 330/165 MHz pulse/pattern generators (optional)
  - ❑ A maximum of two Agilent 8114A 100 V/2 A programmable pulse generators (optional)
- Measurement resources in the testhead:
  - ❑ A maximum of eight source monitor units (SMUs) and one ground unit (GNDU) for dc parametric measurements
- Measurement path in the testhead
  - ❑ For the 4072A switching matrix: 9 input ports and a maximum of 49 outputs (measurement pins)
  - ❑ For the 4073A high-resolution (HR) switching matrix: 9 input ports and a maximum of 49 outputs (measurement pins)
  - ❑ Auxiliary (AUX) ports: eight input ports
  - ❑ High-frequency (HF) matrix: six input ports
  - ❑ Pulse switch: seven semiconductor relays

Figure 1-2 shows an overall block diagram of the 4072A/4073A. The standard 4072A/4073A contains:

- A system cabinet, which includes the emergency off (EMO) panel, power distribution unit (PDU), testhead power supply (TH PS), testhead fan, and cabinet fan
- A testhead, which includes 3 medium power SMUs (MPSMUs), GNDU, and 12 pin boards (for 4072A)
- A testhead, which includes 1 high-resolution SMU (HRSMU), 2 MPSMUs, GNDU, and 12 high-resolution (HR) pin boards (for 4073A)
- Cables between the system cabinet and testhead
- A main power cable (for voltage options 200 and 208 only)

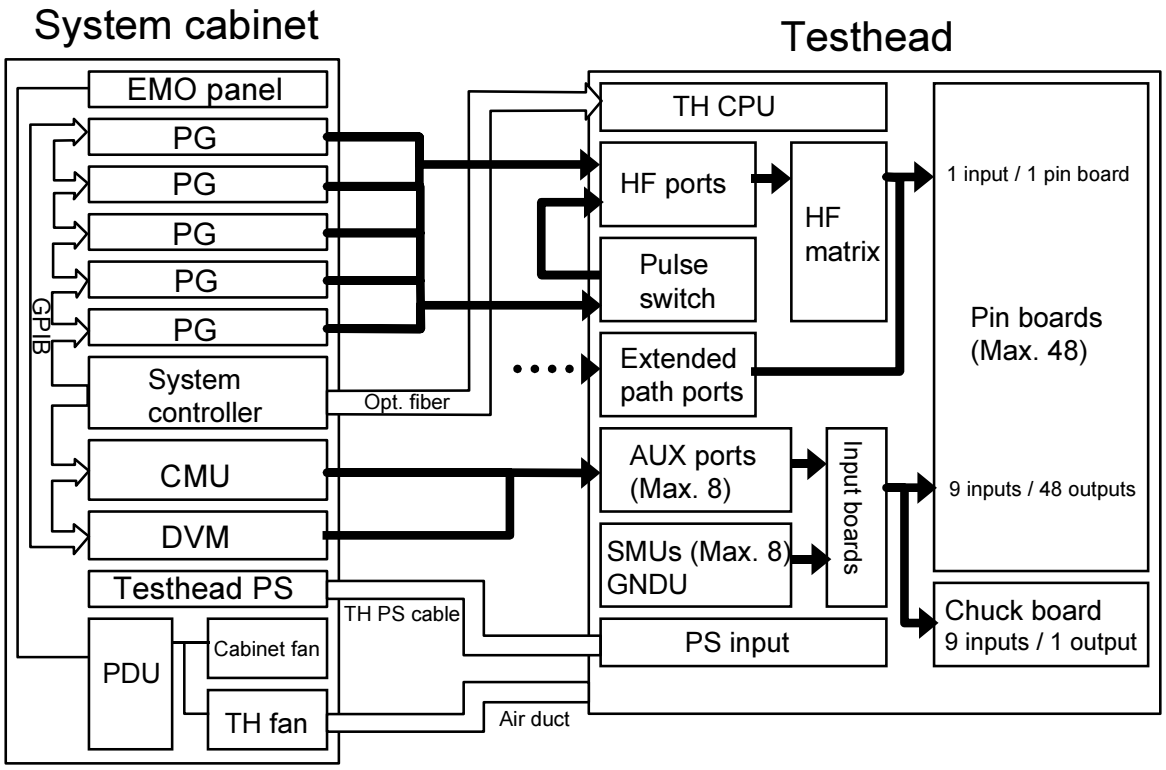
The system cabinet is connected with the testhead using:

- An air duct (for cooling the testhead internally)
- Testhead power cables
- Optical fiber cables (for controlling the testhead)
- Test leads for the CMU (4284A) and DVM (3458A)
- PG cables

An HP 9000 Series Model 745i, Model 745/132L, or Model C3600 workstation is used as the 4072A/4073A's system controller. The system controller has an optical interface card for controlling the testhead, as well as two external GPIB interface cards. One is for controlling an automatic wafer prober and the other one is for controlling the CMU, DVM, and PGU. The system controller can be rack-mounted in the system cabinet.

The 4072A/4073A is usually used with an automatic wafer prober. For wafer prober docking information, refer to the *Pre-Installation Guide*.

Figure 1-2 Agilent 4072A/4073A Block Diagram



The components and subsystems in the system cabinet and testhead are as follows:

- System cabinet
  - ❏ Emergency off (EMO) panel
  - ❏ System controller:
    - Agilent E3170A/AJ
      HP 9000 Series 700 Model 745i industrial workstation (HP A2638B)
    - Agilent E3171A/AJ (JP10F-)
      HP 9000 Series 700 Model 745/132L industrial workstation EISA bus (HP A4964A #110)
    - Agilent E3171A/AJ (JP20F-)
      HP 9000 Series 700 Model 745/132L industrial workstation PCI bus (HP A4964A #111)
    - Agilent E3172A/AJ
      HP visualize workstation Model C3600 (HP A5992A)

    with 17-inch monitor or flat panel display, optical interface card, and two GPIB interfaces
  - ❏ Capacitance measurement subsystem (CMS): Agilent E3102A/E3103A option 011
    Agilent 4284A precision LCR meter with option 001 and 006
  - ❏ dc measurement subsystem (DCS) for differential voltage measurement: E3102A/E3103A option 012
    Agilent 3458A multimeter
  - ❏ Pulse generator (PG):
    - E3102A/E3103A option 550 (maximum of five[1])
      Agilent 8110A 150 MHz pulse generator
    - E3102A/E3103A option 551 (maximum of five[1])
      Agilent 81110A 330/165 MHz pulse/pattern generator
    - E3102A/E3103A option 552 (maximum of two)
      Agilent 8114A 100 V/2 A programmable pulse generator
  - ❏ Power distribution unit (PDU)
  - ❏ Testhead power supply (TH PS)
  - ❏ Cabinet fan
  - ❏ Testhead fan

1. For the E3102A/E3103A option 026 DDS rack mount kit or the E3157B DDS rack mount kit, the maximum number of pulse generators is four. For details, see figure 1-6 on page 30.

Figure 1-3 Agilent 4072A/4073A PG Configurations (8110A, 8114A, and E3171A/AJ)

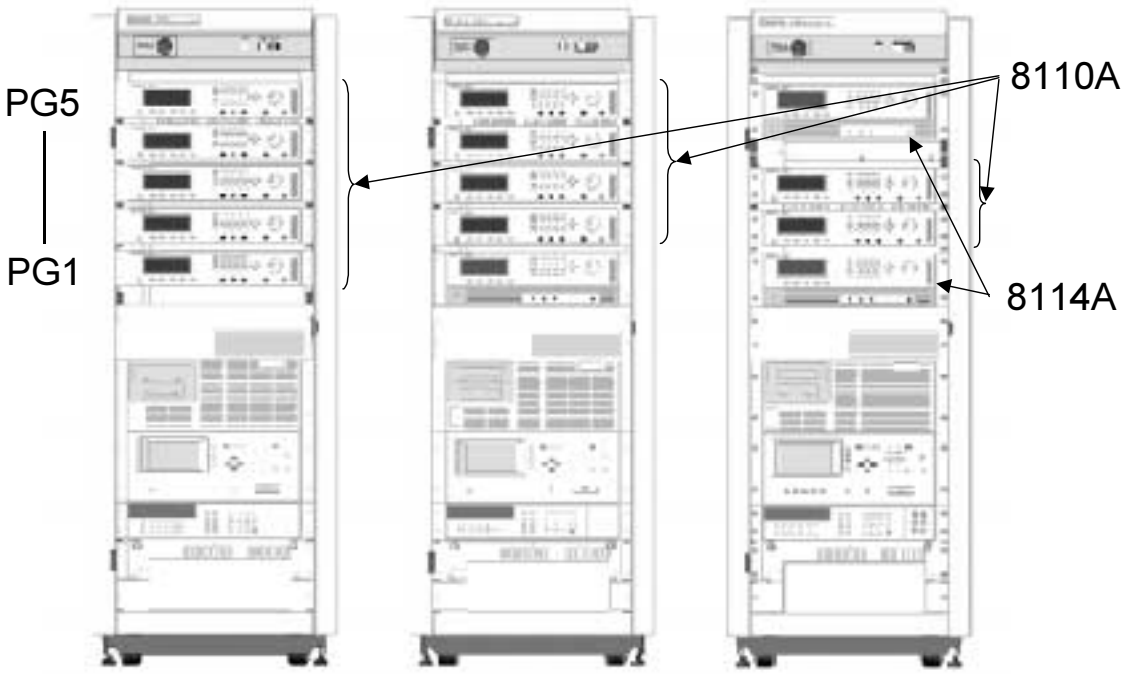


Figure 1-4 Agilent 4072A/4073A PG Configurations (81110A, 8114A, and E3171A/AJ)

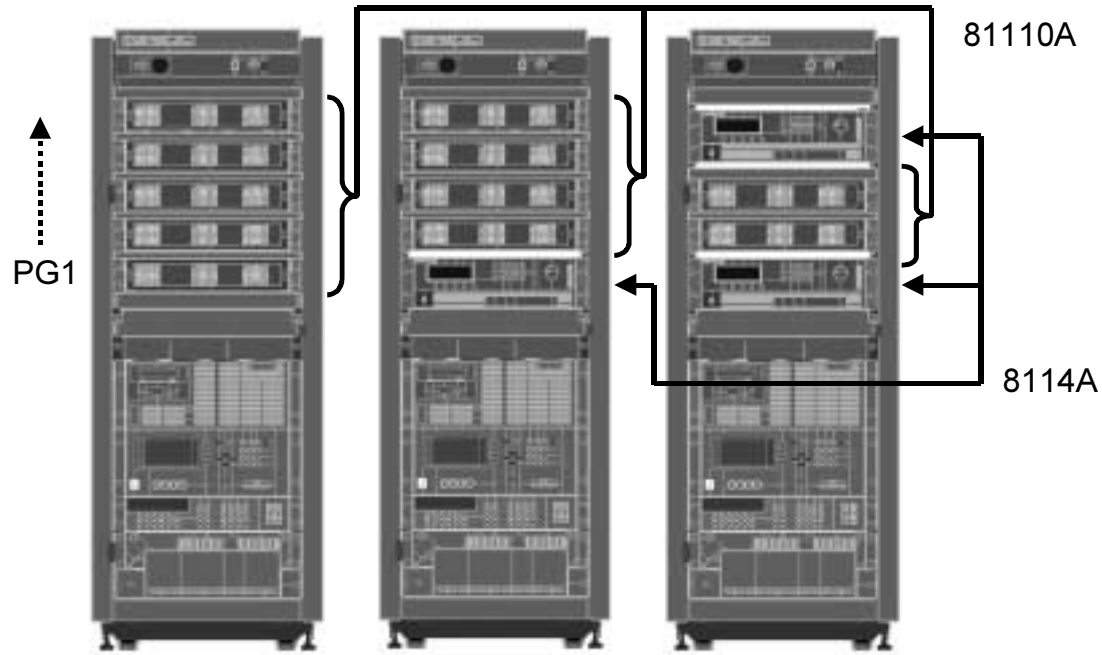


Figure 1-5 Agilent 4072A/4073A PG Configurations (81110A, 8114A, and E3172A/AJ)

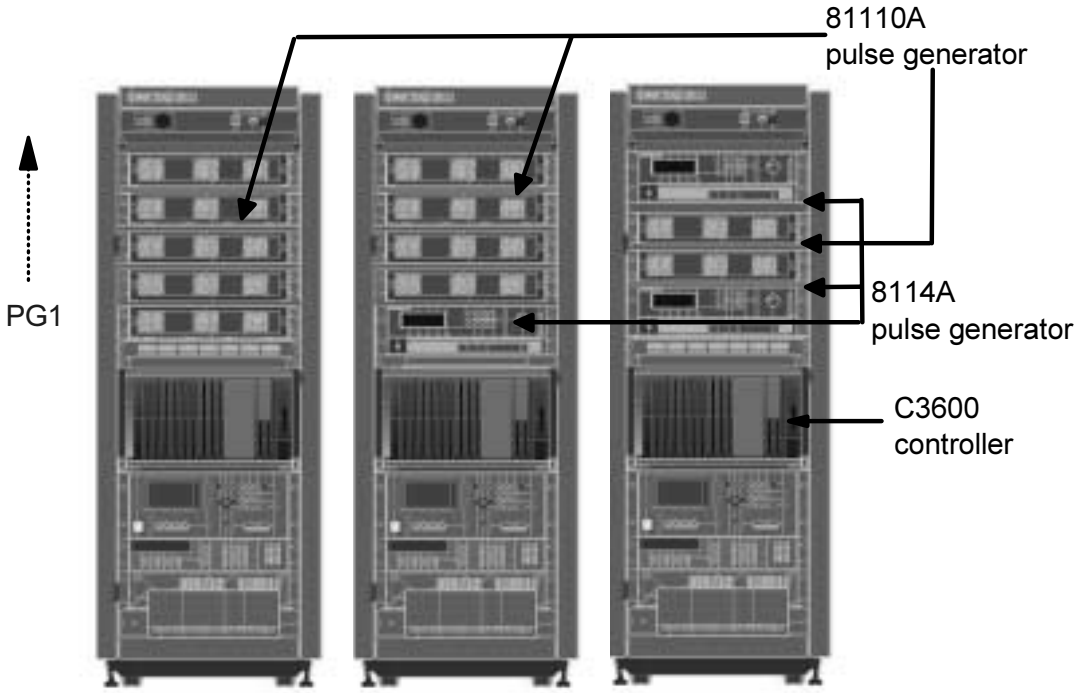
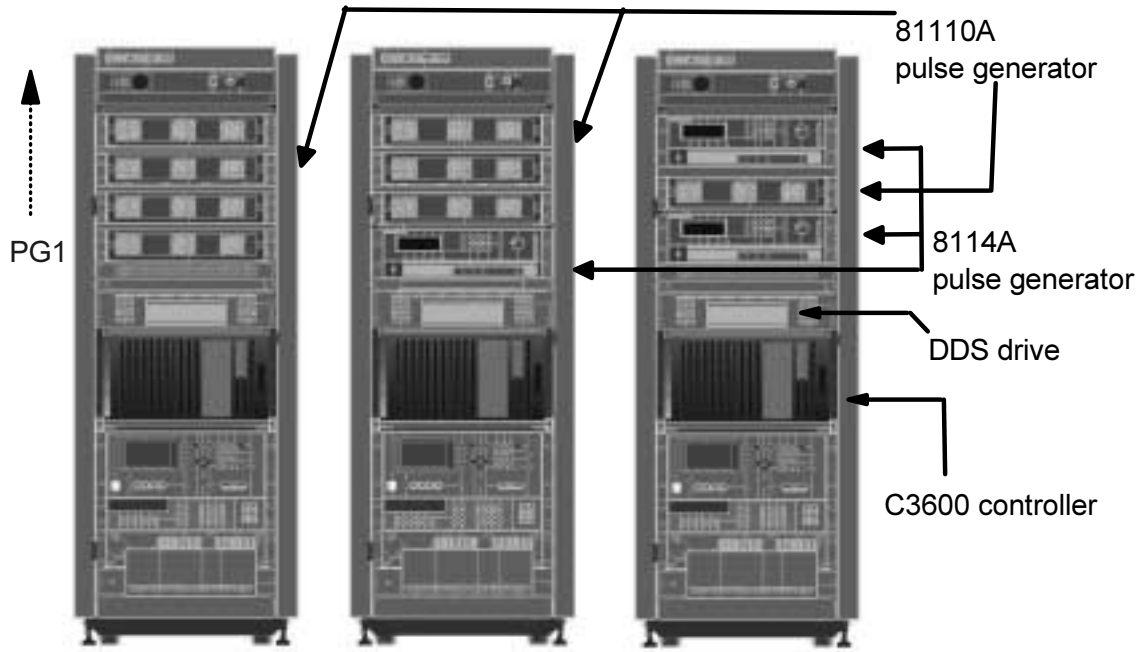


Figure 1-6 Agilent 4072A/4073A PG Configurations (81110A, 8114A, E3172A/AJ with DDS driver)



- testhead
  - ❑ testhead CPU board with optical interface
  - ❑ dc measurement subsystem (DCS):

    a maximum of eight 100 V/100 mA medium power SMUs (MPSMU)

    a maximum of two 200 V/1 A high-power SMUs (HPSMU)

    a maximum of two high-resolution SMUs (HRSMU)
  - ❑ ground unit (GNDU)
  - ❑ switching matrix (for 4072A) and HR switching matrix (for 4073A):

    The switching matrix connects any of the nine input ports to any of the measurement pins (a maximum of 49, including the chuck connection).

    One measurement pin requires one standard pin board (for 4072A) or high-resolution (HR) pin boards (for 4073A) in the matrix.
  - ❑ AUX ports:

    There are eight AUX ports for external instruments. Ports 1 and 2 are triaxial input ports (non-Kelvin), and are used for low current measurement. Ports 3 through 6 are BNC two-pair input ports (Kelvin). Ports 5 and 6 are used for connecting the DVM. Ports 7 and 8 are BNC input ports, and are used for connecting the CMU.
  - ❑ extended path:

    There are also 48 extended path inputs for directly connecting external instruments. Each extended path input connects to the corresponding measurement pin via the HF matrix.
  - ❑ high-frequency (HF) matrix:

    There are six ports for PGU input or other external instruments. The HF matrix consists of two blocks. One HF matrix block is used as a 3-input/24-output matrix. HF ports 1, 2, and 3 can access pin boards 1 through 24. HF ports 4, 5, and 6 can access pin boards 25 through 48. These HF ports can be connected using the 1-to-2 adaptors and configured as a 3-input/48-output matrix.
  - ❑ pulse switch:

    There are ten pulse switch inputs (PSIs), seven pulse switch outputs (PSOs), and two pulse switch controls (PSCs) for making multi-level pulse or open/close conditions. They are synchronized with a pulse generator (PG) output connected to a PSC or testhead CPU.

Products and Options

Table 1-1 through table 1-5 list the products and options for the 4072A/4073A.

Table 1-1 Agilent 4072A Advanced Parametric Tester

Agilent Product No.	Option No.	Description
E3102A		Advanced parametric tester with system cabinet (includes three 100 V/100 mA SMUs, 12 pin boards, and a license to use the 4070 software)
	001	Add one pin board (Agilent E3121A)
	002	Add one 100 V/100 mA SMU (MPSMU)
	003	Add one 200 V/1 A SMU (HPSMU)
	005	Non-Kelvin personality board (Agilent E3145A)
	006	Kelvin personality board (Agilent E3145B)
	007	Test fixture adapter (Agilent E3140A) and universal test fixture (Agilent E3141A)
	009	Cable extension fixture (Agilent E3146A)
	011	Add an Agilent 4284A precision LCR meter
	012	Add an Agilent 3458A digital multimeter
	020	Rack mount kit for a 17-inch monitor
	022[a]	Rack mount kit for an external CD-ROM drive
	023[b]	Rack mount kit for a 745/132L controller
	024	Rack mount kit for a flat panel display
	025	Rack mount kit for a C3600 controller
	026	Rack mount kit for an external DDS drive
	050	50 Hz line frequency
	060	60 Hz line frequency
	200	200 V line voltage
	208	208 V line voltage
	220	220 V line voltage
	240	240 V line voltage
	500	Add a pulse generator integration kit
	550[a]	Add one Agilent 8110A pulse generator (with 2 output channels)
	551	Add one Agilent 81110A pulse generator (with 2 output channels)
	552	Add one Agilent 8114A pulse generator (with 1 output channel)
	ES1	Replace with an EISA optical I/F board
	SP1	Ring oscillator evaluation kit
	UK6	Commercial calibration certificate with test data

a. This was discontinued in April 2000.
b. This was discontinued in April 2001.

Table 1-2 Agilent 4073A Ultra Advanced Parametric Tester

Agilent Product No.	Option No.	Description
E3103A		Ultra advanced parametric tester with system cabinet (includes one HRSMU, two 100 V/100 mA SMUs, 12 HR pin boards, and a license to use the 4070 software)
	001	Add one high resolution pin board (Agilent E3122A)
	002	Add one 100 V/100 mA SMU (MPSMU)
	003	Add one 200 V/1 A SMU (HPSMU)
	004	Add one high resolution SMU (HRSMU)
	011	Add an Agilent 4284A precision LCR meter
	012	Add an Agilent 3458A multimeter
	020	Rack mount kit for a 17-inch monitor
	023[a]	Rack mount kit for a 745/132L controller
	024	Rack mount kit for a flat panel display
	025	Rack mount kit for a C3600 controller
	026	Rack mount kit for an external DDS drive
	050	50 Hz line frequency
	060	60 Hz line frequency
	200	200 V line voltage
	208	208 V line voltage
	220	220 V line voltage
	240	240 V line voltage
	500	Add a pulse generator integration kit
	551	Add one Agilent 81110A pulse generator (with 2 output channels)
	552	Add one Agilent 8114A pulse generator (with 1 output channel)
	ES1	Replace with an EISA optical I/F board
	SP1	Ring oscillator evaluation kit
	UK6	Commercial calibration certificate with test data

a. This was discontinued in April 2001.

Table 1-3 System Controller (Model 745/132L) with Software Pre-Installed

Agilent Product No.	Option No.	Description
E3171A[a]		Controller for 4070 series: UNIX workstation (Model 745/132L) with four EISA slots, 128 MB RAM, 4 GB HDD, 17 monitor, localization kit, two GPIB I/Fs, 1-year warranty, and LTU of HP-UX, BASIC/UX, and C. Pre-installed software
	001	Add external CD-ROM drive
	019	Replace a 17-inch monitor with a 19-inch color monitor
	A08	Add a 4 GB SCSI disk drive
	AMB	Add a 1.4 MB floppy disk drive
	ATS	Add a 4 GB 3.5-inch DDS drive with data compression
	ATW	Add an internal x12 CD-ROM drive
	FPD	Replace a 17-inch color monitor with FPD
E3171AJ[a]		Controller for 4070 series: UNIX workstation (Model 745/132L) with four EISA slots, 128 MB RAM, 4 GB HDD, 17 monitor, localization kit, two GPIB I/Fs, 1-year warranty, and LTU of HP-UX, BASIC/UX, and C. Pre-installed software
	001	Add external CD-ROM drive
	019	Replace a 17-inch monitor with a 19-inch color monitor
	A08	Add a 4 GB SCSI disk drive
	AMB	Add a 1.4 MB floppy disk drive
	ATS	Add a 4 GB 3.5-inch DDS drive with data compression
	ATW	Add an internal x12 CD-ROM drive
	FPD	Replace a 17-inch color monitor with FPD

a. This was discontinued in April 2001.

Table 1-4 System Controller (Model C3600) with Software Pre-Installed

Agilent Product No.	Option No.	Description
E3172A[a]		Controller for 4070 series: UNIX workstation (Model C3600) with three PCI slots, 512 MB RAM, 36GB HDD (18GB x 2), CD-ROM drive, 17-inch CRT, localization kit, two GPIB I/Fs, 1-year warranty, and LTU of HP-UX, BASIC/UX, and C. Pre-installed software.
	001	Add external DDS drive
	002	Add an external DDS drive
	019	Replace a 17-inch monitor with a 19-inch color monitor
	102	For HP-UX 10.2 pre-install
	110	For HP-UX 11i pre-install
	FPD	Replace a 17-inch color monitor with FPD
E3172AJ[a]		Controller for 4070 series: UNIX workstation (Model C3600) with three PCI slots, 512 MB RAM, 36GB HDD (18GB x 2), CD-ROM drive, 17-inch CRT, localization kit, two GPIB I/Fs, 1-year warranty, and LTU of HP-UX, BASIC/UX, and C. Pre-installed software.
	001	Add external DDS drive
	002	Add an external DDS drive
	019	Replace a 17-inch monitor with a 19-inch color monitor
	102	For HP-UX 10.2 pre-install
	110	For HP-UX 11i pre-install
	FPD	Replace a 17-inch color monitor with FPD
E3172B		Controller for 4070 series: UNIX workstation (Model C3600) with three PCI slots, 512 MB RAM, 36GB HDD (18GB x 2), CD-ROM drive, 17-inch CRT, localization kit, two GPIB I/Fs, 1-year warranty, and LTU of HP-UX, BASIC/UX, and C. Pre-installed software.
	002	Add an external DDS drive
	019	Replace a 17-inch monitor with a 19-inch color monitor
	102	For HP-UX 10.2 pre-install
	110	For HP-UX 11i pre-install
	200	Add an optical interface
	ABA	U.S. - English localization
	ABJ	Japan - Japanese localization
	FPD	Add a FPD

a. This was discontinued in February 2002.

Table 1-5 System Controller (Model C3700) with Software Pre-Installed

Agilent Product No.	Option No.	Description
E3173A		High-end controller for 4070 series: UNIX workstation (Model C3700) with 512 MB RAM, 36 GB HDD (18GB × 2), CD-ROM drive, localization kit, two GPIB I/Fs, 1-year warranty, and LTU of HP-UX 11i, BASIC/UX &C. Pre-installed software
	002	Add an external DDS drive
	019	Replace a 17-inch monitor with a 19-inch color monitor
	110	For HP-UX 11i pre-install
	200	Add extra optical I/F for upgrade purpose
	ABA	English localization
	ABJ	Japanese localization
	FPD	Replace a 17-inch color monitor with FPD

Available Accessories

Table 1-6 through table 1-13 list the available accessories for the 4072A/4073A.

- accessories for connecting the device under test
- accessories for connecting instruments to the testhead
- accessories for expanding measurement capability or for servicing
- rack mount kits for the system cabinet
- control software (SPECS)
- software media and manual sets

Table 1-6 Accessories for Connecting the Device Under Test

Agilent Product No. or Agilent Part No.	Description
E3140A	Test fixture adapter[a]
E3141A	Universal test fixture
E3145A	Personality board for non-Kelvin connection
E3145B	Personality board for Kelvin connection
E3146A	Cable extension fixture
E3144-60001	Card fixture[a]
E3190-60042	PV open fixture[a]

a. This is furnished with the 4073A.

Figure 1-7 Agilent E3140A Test Fixture Adapter



Figure 1-8 Agilent E3141A Universal Test Fixture

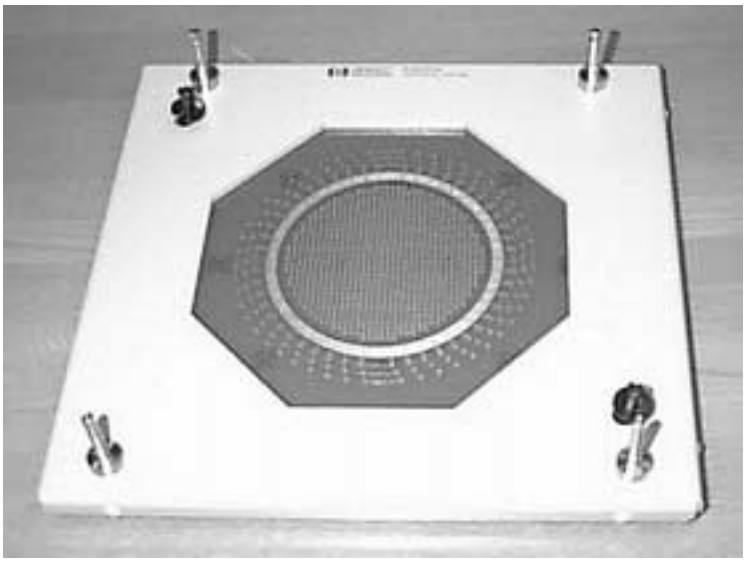


Figure 1-9 Direct Docking



Figure 1-10 Agilent E3145A/B Personality Board and Wiring

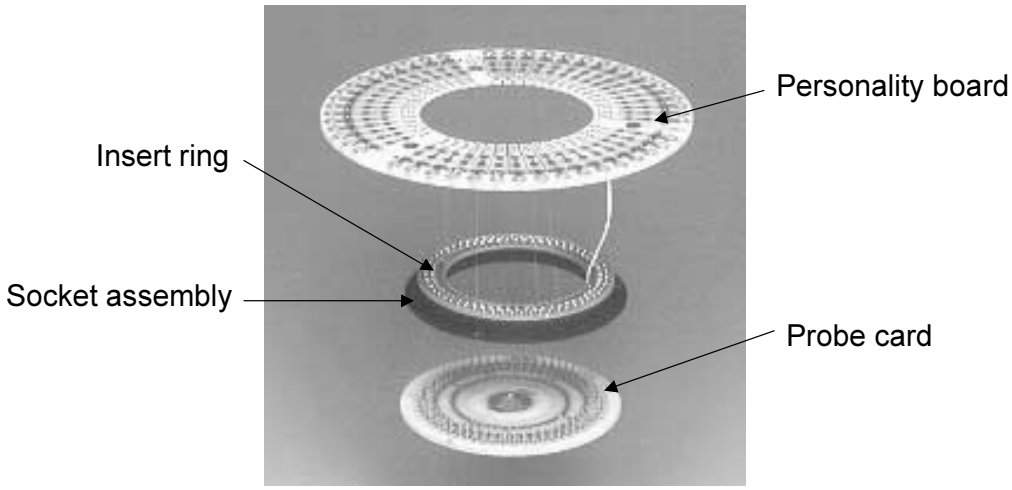


Figure 1-11 E3144-60001 Card Fixture



Figure 1-12 E3190-60042 PV Open Fixture



Table 1-7 Accessories for Connecting Instruments to Testhead

Agilent Product No. or Agilent Part No.	Description
E3148A	Extended adapter. Contents: - Extended adapter - Cable assembly for 8 pin connections
16048E	Test leads for connecting the 4284A (Furnished with the E3102A option 011)
1250-2405C	BNC T-type (m-f-f) adapter for connecting the 4284A (Two adapters are required to connect the 4284A. Two adapters are furnished with the E3102A/E3103A option 011.)
E3120-61683	Test leads for connecting the 3458A (Furnished with the E3102A/E3103A option 012)
1250-0595	Triaxial (m)-to-BNC(f) adapter (This is required for connecting the pulse output to the AUX 1 or 2 port. Two adapters are furnished with the E3102A/E3103A option 500.)
E3125-61042	1-to-2 adapter (Three connectors are furnished with the E3102A/E3103A)
E3125-61607	BNC cable for pulse switch (Seven cables are furnished with the E3102A/E3103A option 500.)
E3150-61022	Transition time convertor (Furnished with the E3102A/E3103A option 522)
E3150-61601	PG cable assembly (Furnished with the E3102A/E3103A option 551 and 552)
E3150-61603	BNC cable for transition time converter (Furnished with the E3102A/E3103A option 552)
04192-61002	Feed through, 50 Ω (Furnished with the E3102A/E3103A option 522)

Table 1-8 Accessories for Expanding Measurement Capability or for Servicing

Agilent Product No.	Option No.	Description
E3121A		Pin board
E3122A		High-resolution (HR) pin board
E3131A		100 V/100 mA medium power source monitor unit (MPSMU)
E3132A		200 V/1 A high-power source monitor unit (HPSMU)
E3133A		High-resolution source monitor unit (HRSMU) for the 4073A
E3190A		PV tool set
	001	Add Module for Pulse Test
E3195A		200 V/1 A SMU upgrade kit

Figure 1-13 Agilent E3190A PV Tool Set



Table 1-9 Spare Parts Kits for the Agilent 4072A/4073A

Agilent Product No.	Option No.	Description
E3191A		Spare parts kit for 4071A and 4072A: Basic spare parts set covers 70% of testhead and cabinet H/W failures. Includes 3 pin boards, 2 MPSMU, and 12 pin contacts.
	001	Coverage Upgrade to 90%
	002	Add one HPSMU (1 A/200 V)
	010	(4072A only) Add HF matrix parts
	100[a]	(4071A only) Add 100/120 Vac fans for JP10D-
	101[a]	(4071A only) Add 100/120 Vac fans for JP20D- and JP30D-
	200[a]	(4071A only) Add 220/240 Vac fans for JP10D-
	201	Add 200/208/220/240 Vac fans for the 4071A (JP20D- and JP30D-) and 4072A
E3192A		Spare Parts Kit for 4073A: Basic spare parts set covers 70% of testhead and cabinet H/W failures. Includs 3 HR pin boards, 1 MPSUM, 1 HRSMU and 12 pin contants.
	001	Coverage upgrade to 90%
	002	Add one 1 A/200 V SMU (HPSMU)
	003	Add a 100 mA/100 V SMU (MPSMU)
	004	Add one high-resolution SMU (HRSMU)
	010	Add spare parts for HF matrix
	201	Add testhead and cabinet fans

a. This was discontinued in January 2002.

Table 1-10 Upgrade Kits for the Agilent 4072A/4073A

Agilent Product No.	Option No.	Description
E3196A		Upgrade kit from the 4071A to 4072A
	200	200 V line voltage
	208	208 V line voltage
	220	220 V line voltage
	240	240 V line voltage
	500	Add a pulse generator integration kit
	550[a]	Add the 8110A pulse generator (with 2 output channels)
	551	Add the 81110A pulse generator (with 2 output channels)
	552	Add the 8114A pulse generator (with 1 output channel)
E3197A		Upgrade kit from the 4071A to 4073A
	001	Add one high resolution pin board (E3122A)
	004	Add one high resolution SMU (E3133A)
	023	Rack mount kit for 745/132L SPU
	200	200 V line voltage
	208	208 V line voltage
	220	220 V line voltage
	240	240 V line voltage
	500	Add a pulse generator integration kit
	551	Add one 81110A pulse generator (with 2 output channels)
	552	Add one 8114A pulse generator (with 1 output channel)
E3198A		Upgrade kit from 4072A to 4073A
	001	Add one high resolution pin board (E3122A)
	004	Add one high resolution SMU (E3133A)
	023	Rack mount kit for 745/132L SPU

a. The E3196A option 550 was discontinued in April 2000.

Table 1-11 Rack Mount Kits for System Cabinet

Agilent Product No.	Option No.	Description
E3151A		Rack mount kit for the 4284A LCR meter
E3152A		Rack mount kit for the 3458A multimeter
E3153A		Rack mount kit for the pulse generator
	001	For the first pulse generator
	002	For the 8110A
	003	For the 81110A
	004	For the 8114A
	100	Upgrade for the 81110A and the 745/132L controller
	101	Upgrade for the 81110A and the C3600 controller
E3155A[a]		Rack mount kit for the HP A2287A 17-inch monitor
E3155B[a]		Rack mount kit for the HP A4330A 17-inch monitor
E3155C		Rack mount kit for the HP A4490A 17-inch monitor
E3155D[a]		Rack mount kit for the HP D2838W 17-inch monitor
E3155E		Rack mount kit for the HP D8900A 17-inch monitor
E3155F		Flat panel display rack mount kit
E3156A[a]		Rack mount kit for the 745i controller
E3156B		Rack mount kit for the 745/132L controller
E3156C		Rack mount kit for the C3600 controller
E3157A[b]		Rack mount kit for the CD-ROM drive
E3157B		Rack mount kit for the DDS drive

a. This was discontinued in July 2001.
b. This was discontinued in April 2000.

Table 1-12 Software and Manual Sets

Agilent Product No.	Description
E3113C	Media and manual of 4070 and O/S: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system softwre (For HP-UX 10.20)
E3113CJ	Media and manual of 4070 and O/S: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system softwre (For HP-UX 10.20)
E3113D	Media and manual of 4070 and O/S: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system softwre (For HP-UX 11i)
E3113DJ	Media and manual of 4070 and O/S: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system softwre (For HP-UX 11i)
E3113L[a]	License to use BASIC/UX and C/ANSI C.
E3114C	Media and manual of 4070, SPECS, and OS: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system software, and SPECS (For HP-UX 10.20)
E3114CJ	Media and manual of 4070, SPECS, and OS: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system software, and SPECS (For HP-UX 10.20)
E3114D	Media and manual of 4070, SPECS, and OS: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system software, and SPECS (For HP-UX 11i)
E3114DJ	Media and manual of 4070, SPECS, and OS: Provides media (CD-ROM) and manuals of HP-UX, C/ANSI C, BASIC/UX, SICL, 4070 series system software, and SPECS (For HP-UX 11i)

a. This was discontinued in November 2000.

Table 1-13 Manual Sets

Agilent Product No.	Description
E3161B	English user manuals for the Agilent 4070 series testers
E3161BJ[a]	Japanese user manuals for the Agilent 4070 series testers

a. This was discontinued in June 2001.

Table 1-14 Control Software (Agilent SPECS)

Agilent Product No.	Option No.	Description
E3180B		SPECS Software for the HP 9000 Series 700
	AAF	Software (on CD-ROM) and manuals (English)
	AAH[a]	Software (on DDS) and manuals (English)
E3180BJ		SPECS software for the HP 9000 Series 700
	AAF	Software (on CD-ROM) and manuals (Japanese)
	AAH[a]	Software (on DDS) and manuals (Japanese)
E3180D		Media and manual of SPECS for HP-UX 11i (English)
E3180DJ		Media and manual of SPECS for HP-UX 11i (Japanese)
E3180L		License to use SPECS - online and 3 edit mode LTUs
E3181L[a]		License to use SPECS - online LTU only
E3183L		License to use SPECS - offline debug mode
E3165A		SPECS manual set (English)
E3165AJ[b]		SPECS manual set (Japanese)

a. This was discontinued in November 2000.
b. This was discontinued in June 2001.

Table 1-15 Reliability Evaluation (WLR)

Agilent Product No.	Option No.	Description
E3185B		PDQ-WLR software media (CD-ROM) and manual
E3185D		PDQ-WLR software media and manual for HP-UX 11i
E3185L		PDQ-WLR license-to-use (LTU)
	062	LTU for the Agilent 4062UX
	070	LTU for the Agilent 4070 series testers
E3186A		PDQ-AT software media (CD-ROM) and manual
E3186D		PDQ-AT software media and manual for HP-UX 11i
E3186L		PDQ-AT software license-to-use (LTU)
E3187A		Bundled product of PDQ-WLR and AT with the SPECS (English)
	062	LTU for the 4062UX
	070	LTU for the Agilent 4070 series testers
E3187AJ		Bundled product of PDQ-WLR and AT with the SPECS (Japanese)
	062	LTU for the 4062UX
	070	LTU for the Agilent 4070 series testers
E3187D		Bundled product of PDQ-WLR/AT with SPECS for HP-UX 11i (English)
E3187DJ		Bundled product of PDQ-WLR/AT with SPECS for HP-UX 11i (Japanese)

Serial Number Prefixes

Agilent Technologies uses a two-part serial number which is stamped on the serial number plate attached to the product. The first five letters and digits are the serial number prefix and the last five digits are the suffix. The first two letters indicate the country where the product was manufactured. The prefix changes when a significant change is made to the product. The suffix is assigned sequentially and is unique to each product.

Some sections, paragraphs, tables, and figures in this manual have the serial number prefix information as follows:

Table 1-16

Abbreviations	Description
JP10G-	4072A with a serial number prefix of JP10G
JP20G-	4072A with a serial number prefix of JP20G
JP30G-	4072A with a serial number prefix of JP30G
JP10H-	4073A with a serial number prefix of JP10H
JP20H-	4073A with a serial number prefix of JP20H
JP10F-	E3171A/AJ with a serial number prefix of JP10F
JP20F-	E3171A/AJ with a seiral number prefix of JP20F

The following shows the changes of each serial number prefix.

Table 1-17 Serial Number Prefixes

Model No. or Agilent Product No.	Serial No. Prefix	Changes
4072A	JP10G	Initial release (No shelter plate)
	JP20G	81110A support[a]
	JP30G	• Agilent E3172A (C3600 workstation) support[b] • PDU modification (power outlet protector and fan protectors)
4073A	JP10H	Initial release[a]
	JP20H	• Agilent E3172A (C3600 workstation) support[b] • PDU modification (power outlet protector and fan protectors)
E3171A/AJ	JP10F	Initial release
	JP20F	Delete FDD

a. The system cabinet includes the E3153A option 100.
b. The system cabinet includes the E3153A option 101.

Service Tools

The following tools are required for servicing the 4072A/4073A.

- ❏ Agilent 3458A multimeter (with option 002 and 1BP)
- ❏ Agilent 16353A standard resistor set
- ❏ Agilent 16380A standard air capacitor set
- ❏ Agilent 16380C capacitance standard set
- ❏ Agilent E3190A PV tool set (with option 001)
- ❏ Agilent 54750A oscilloscope
- ❏ flat-tip screwdrivers
- ❏ pozidrive screwdrivers
- ❏ hex screwdrivers (H3 and H5)
- ❏ torx screwdrivers
- ❏ nut driver (H8)
- ❏ spanner (H8)
- ❏ nipper
- ❏ wire strippers
- ❏ slip-joint pliers
- ❏ hand-held multimeter
- ❏ lint free gloves (Agilent part number 9300-0148)
- ❏ tool for zip lock sealing (Agilent part number 8710-1576)
- ❏ tweezers (Agilent part number E3196-60003)
- ❏ testhead stand (Agilent part number E3196-60002)
- ❏ *Agilent 4070 User's Guide* (Agilent part number E3102-90000)
- ❏ *Agilent 4072A/4073A System Calibration Guide* (Agilent part number E3102-90510)

NOTE If the 4072A/4073A is used in a clean room, take special precautions to preserve the air purity in the clean room. Give a thorough air bath to tools, test equipment, replacement parts, and so on.

2 Tester Hardware and Software Information

This chapter contains Agilent 4072A/4073A hardware and software information, and consists of the following sections:

- “Agilent 4072A/4073A Block Diagram”
- “System Cabinet Components”
- “Testhead Assemblies”
- “Power Distribution Unit (PDU) Operation”
- “Tester Core Process and Tester Startup Process”
- “Miscellaneous Software Operations”

Agilent 4072A/4073A Block Diagram

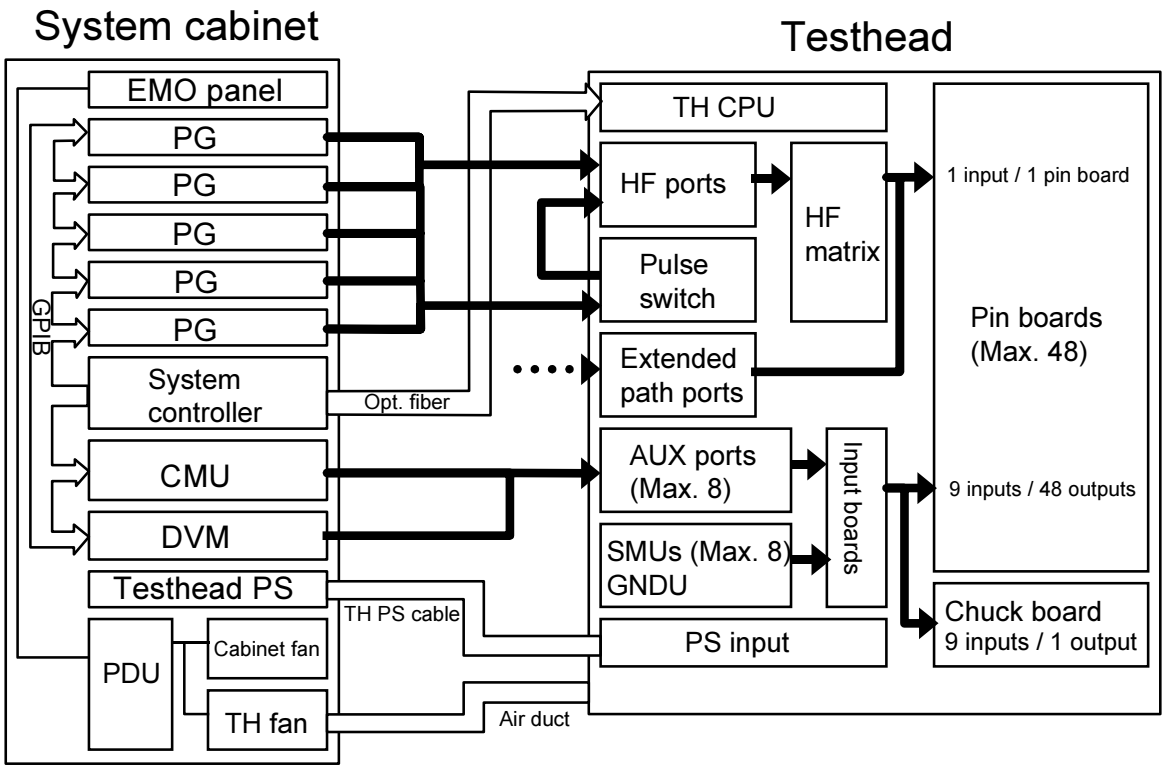
The 4072A/4073A consists of a system cabinet and a testhead. Figure 2-1 shows an overall block diagram of the 4072A/4073A.

System Cabinet.

The system cabinet contains the following main components:

- emergency off (EMO) panel
- power distribution unit (PDU)
- testhead power supply (TH PS)
- testhead fan
- cabinet fan
- Agilent 4284A precision LCR meter for capacitance measurement (optional)
- Agilent 3458A multimeter for differential voltage measurement (optional)
- a maximum of five Agilent 8110A 150 MHz pulse generators (optional)
- a maximum of five Agilent 81110A 330/165 MHz pulse/pattern generators (optional)
- a maximum of two Agilent 8114A 100 V/2 A programmable pulse generators (optional)
- Model 745i, Model 745/132L, or Model C3600 workstation (optional)
- 17-inch color monitor (optional), or flat panel display (optional)
- CD-ROM drive (optional)
- DDS drive (optional)

Figure 2-1 Agilent 4072A/4073A System Block Diagram



System Controller.

The HP 9000 Series 700 Model 745i industrial workstation has a 100 MHz system board, 64 MB main memory (minimum), and 2 GB hard disk (minimum).

The HP 9000 Series 700 Model 745/132L industrial workstation has a 132 MHz system board, 128 MB main memory (minimum), and 4 GB hard disk (minimum).

The HP visualize workstation model C3600 has a 552 MHz processor, 512 MB main memory (minimum), and 9 GB (minimum) or 18 GB hard disk.

The system controller has the following interface cards:

- GPIB interfaces

  The GPIB interface cards are for controlling the measurement instruments and automatic wafer prober. Two GPIB interfaces are provided with the 4072A/4073A's system controller:

  Agilent E3170A/AJ (Model 745i):
  Two Agilent E2071 EISA high-speed GPIB interface cards.

  Agilent E3171A/AJ (Model 745/132L):
  Two Agilent E2071D EISA high-speed GPIB interface cards (JP10F-)
  or Agilent E2078A PCI GPIB interface cards (JP20F-).

  Agilent E3172A/AJ/B (C3600) and Agilent E3173A (C3700):
  Two Agilent E2078A PCI GPIB interface cards.

- optical interface card

  The optical interface card is for controlling the testhead. An optical interface card is provided with the 4072A/4073A tester. There are two types of optical interface cards, EISA and PCI.

Figure 2-2 HP 9000 Series 700 Model 745/132L Industrial Workstation

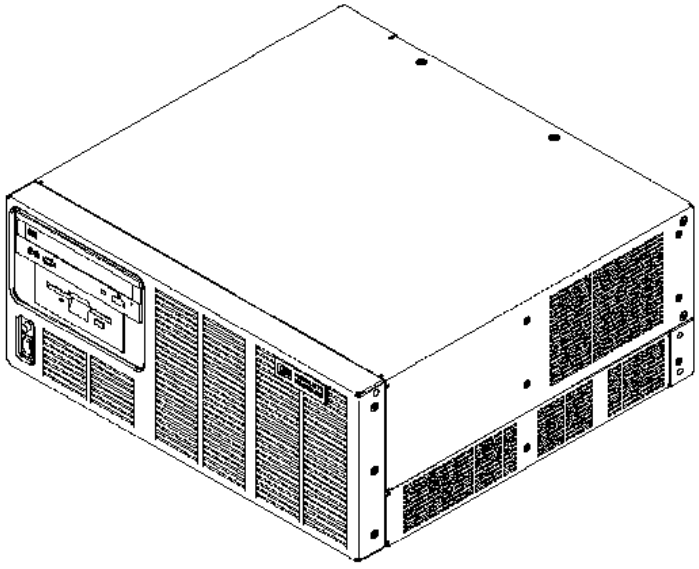


Figure 2-3 HP Visualize Workstation C3600/C3700



Testhead.

The testhead contains the following main components:

- a maximum of eight source monitor units (SMUs)
- ground unit (GNDU)
- For the 4072A: a maximum of 49 outputs in the switching matrix (SWM)
- For the 4073A: a maximum of 49 outputs in the high-resolution switching matrix (HRSWM)
- high-frequency (HF) matrix
- pulse switch

For more details regarding the testhead, see “Testhead Assemblies” on page 62.

System Cabinet Components

This section explains the following system cabinet components:

- "Power Distribution Unit (PDU) and Testhead Power Supply (TH PS)"
- "Emergency Off (EMO) Panel"
- "Testhead Fan and Cabinet Fan"
- "Agilent 4284A Precision LCR Meter (CMU)"
- "Agilent 3458A Multimeter (DVM)"
- "Agilent 8110A 150 MHz Pulse Generator (PG)"
- "Agilent 81110A 330/165 MHz Pulse/Pattern Generator (PG)"
- "Agilent 8114A 100 V/2 A Programmable Pulse Generator"
- "Trigger Distributor"
- "Transition Time Converter"

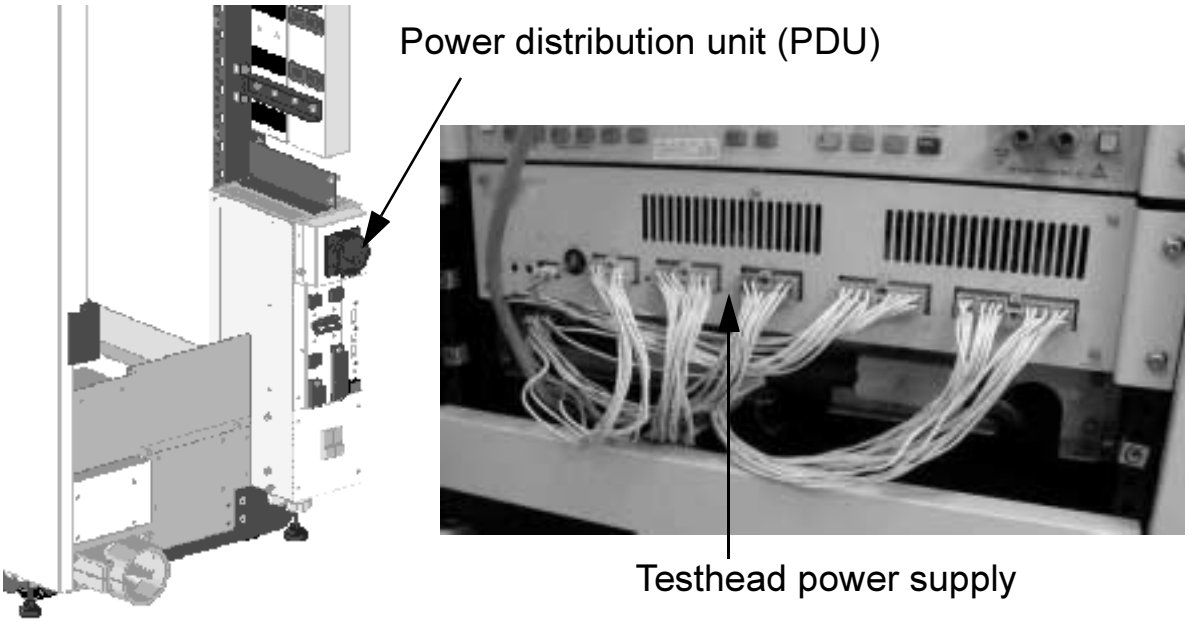
Power Distribution Unit (PDU) and Testhead Power Supply (TH PS)

The PDU obtains ac power from a power switchboard or outlet at the installation site and distributes ac power to the instruments and the system controller in the system cabinet. The PDU also supplies ac power to the testhead power supply (TH PS). The TH PS supplies dc voltage to the testhead.

The emergency off (EMO) panel, testhead fan, and cabinet fan are connected to the PDU.

For more details regarding the PDU and EMO panels, see "Power Distribution Unit (PDU) Operation" on page 93.

Figure 2-4 Power Distribution Unit (PDU) and Testhead Power Supply (TH PS)

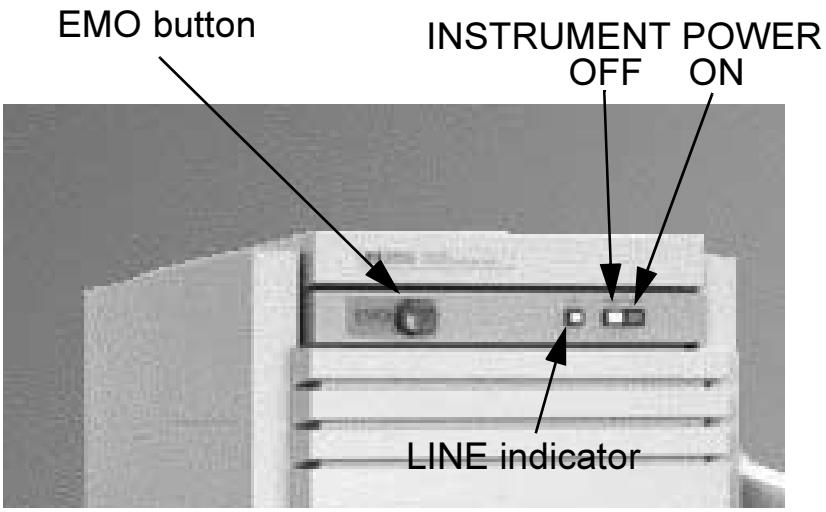


Emergency Off (EMO) Panel

The EMO panel is located at the top front of the 4072A/4073A system cabinet. The panel has an EMO button (large red button), LINE indicator, and INSTRUMENT POWER ON and OFF switches.

The EMO button is used to immediately shut down the 4072A/4073A power in an emergency. When the EMO button is pressed, all measurement instruments, the system controller, and the testhead are shut off.

Figure 2-5 Emergency Off (EMO) Panel



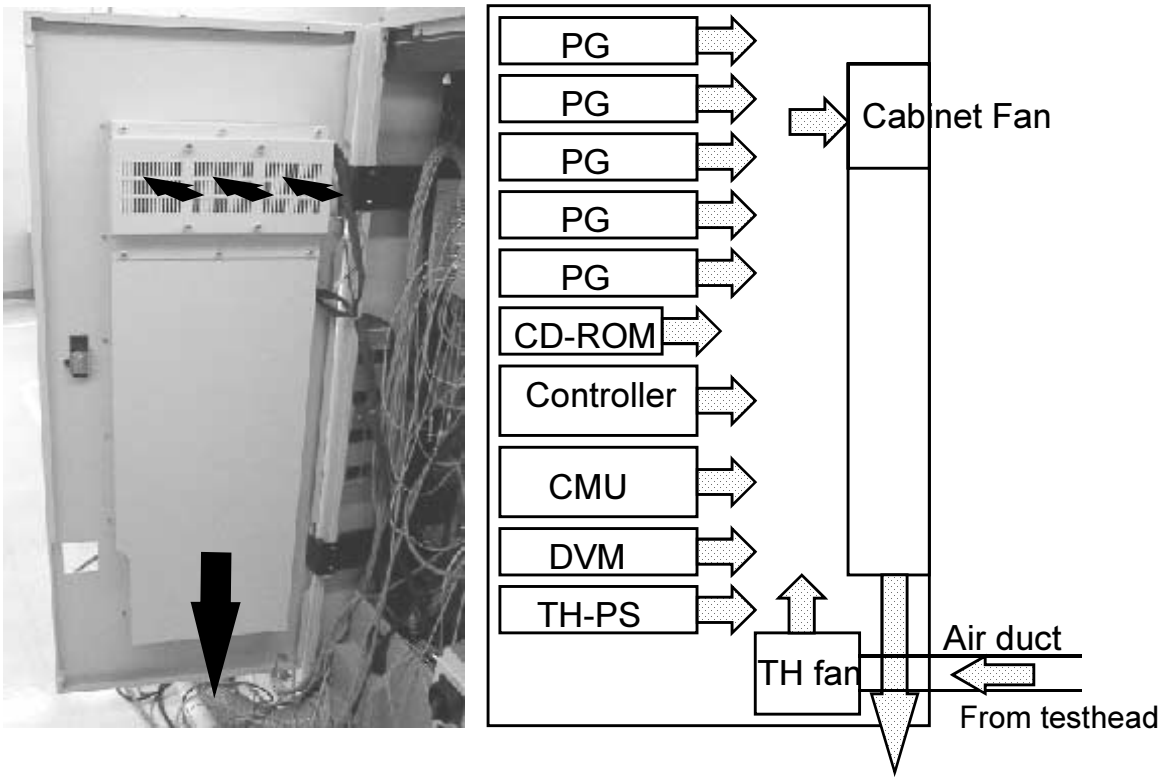
Testhead Fan and Cabinet Fan

The 4072A/4073A uses an air cooling method to cool down the components in the system cabinet and the SMU area of the testhead.

There are two types of cooling fan assemblies in the system cabinet, the cabinet and testhead fan assemblies. The cabinet fan assembly is located at the top of the system cabinet rear door and consists of three fans. The testhead fan assembly is at the bottom rear side of the system cabinet.

The testhead fan draws air from the testhead to the system cabinet through the air duct. The three cabinet fans draw the warm air down and out of the system cabinet at a maximum rate of 10 cubic meters per minute.

Figure 2-6 Air Cooling



Agilent 4284A Precision LCR Meter (CMU)

The 4284A (CMU) is used for capacitance measurements. The accuracy is specified between any two measurement pins, except the chuck connection pin. The CMU specifications are as follows:

measurement range:	1 fF to 1.2 nF and 10 nS to 7.5 mS (1 MHz)
	1 fF to 10 nF and 1 nS to 6.3 mS (100 kHz)
	1 fF to 100 nF and 0.1 nS to 6.3 mS (10 kHz)
	10 fF to 100 nF and 0.1 nS to 0.63 mS (1 kHz)
measurement frequency:	1 kHz, 10 kHz, 100 kHz, and 1 MHz
dc bias voltage:	±40 V
measurement speed:	medium and long

Figure 2-7 Agilent 4284A Precision LCR Meter



Agilent 3458A Multimeter (DVM)

The 3458A (DVM) is used for differential voltage measurements. The DVM specifications are as follows:

Table 2-1 Voltage Measurement Range, Resolution, and Accuracy

Full Scale Voltage Range	Resolution	Accuracy for 4072A (% of reading + volt)	Accuracy for 4073A (% of reading + volt)
0.1 V	0.1 µV	—	0.01% + 100 µV
1 V	1 µV	0.01% + 300 µV	0.01% + 100 µV
10 V	10 µV	0.01% + 300 µV	0.01% + 200 µV
100 V	100 µV	0.02% + 1 mV	0.02% + 1 mV

Figure 2-8 Agilent 3458A Multimeter



Agilent 8110A 150 MHz Pulse Generator (PG)

The 8110A (PG) is used for forcing high frequency pulse. A maximum of five 8110As (without an 81110A and 8114A) can be installed into the system cabinet as shown in figure 1-3. The PG specifications are as follows:

pulse level (at open load):	±19 V
pulse period:	350 ns to 999.0 ms
pulse width:	50 ns to 999 ms
transition time:	20 ns to 200 ms

Figure 2-9 Agilent 8110A 150 MHz Pulse Generator



NOTE The 8110A and 81110A cannot be installed in the same cabinet.

Agilent 81110A 330/165 MHz Pulse/Pattern Generator (PG)

The 81110A (PG) is used for forcing high frequency pulse. A maximum of five 81110As (without an 8110A and 8114A) can be installed into the system cabinet as shown in figure 1-4. If the DDS is mounted into the system cabinet, a maximum of four 81110As can be installed into them as shown in figure 1-6. The PG specifications are as follows:

pulse level (at open load):	±19 V
pulse period:	350 ns to 999.5 ms
pulse width:	50 ns to 999.0 ms
transition time:	20 ns to 200 ms

Figure 2-10 Agilent 81110A 330/165 MHz Pulse/Pattern Generator



Agilent 8114A 100 V/2 A Programmable Pulse Generator

The 8114A (PG) is used for forcing high frequency and high voltage pulse. A maximum of two 8114As (with a maximum of two 8110As or two 81110As) can be installed into the system cabinet as shown in figure 1-3 or figure 1-4. The PG specifications are as follows:

pulse level (at open load):	–49.9 V to +50 V
pulse period:	350 ns to 999 ms
pulse width:	150 ns to 150 ms
transition time:	65 ns (fixed)

Figure 2-11 Agilent 8114A 100 V/2 A Programmable Pulse Generator



Trigger Distributor

The trigger distributor consists of two blocks. Block 1 is for normal mode trigger, and Block 2 is for pattern mode trigger. The trigger distributor sends the trigger, which comes from the master PG (PG1 for normal mode; PG2 for pattern mode), to the slave PGs (PG2 through PG5 for normal mode; PG3 through PG5 for pattern mode). Also, the trigger distributor sends the trigger to the oscilloscope, which is used in the performance verification.

There are two trigger modes: normal and pattern mode. The normal mode trigger is distributed from the master PG (PG1) trigger out to the slave PG (PG2 through PG5) EXT inputs. The pattern mode trigger is distributed from the first slave PG (PG2) trigger out to the other slave PG (PG2 through PG5) CLK inputs.

The trigger distributor is installed at the top rear side of the system cabinet as shown in figure 2-14.

Figure 2-12 Trigger Distributor Connections

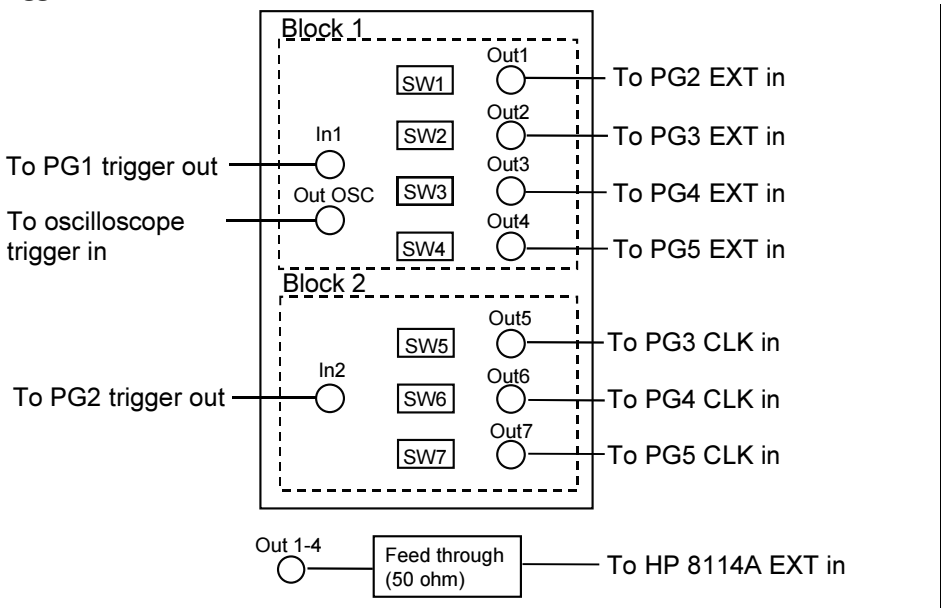
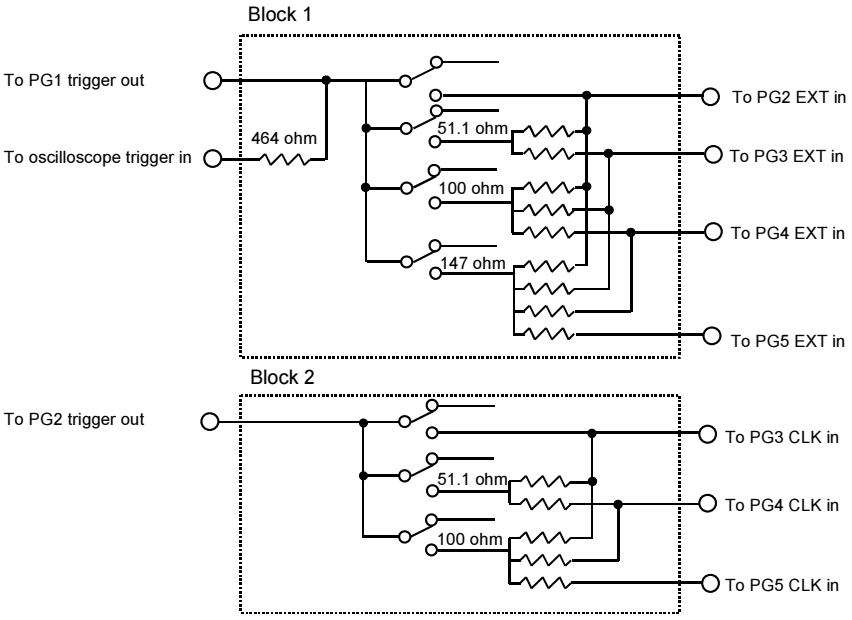


Figure 2-13 Trigger Distributor Circuit Diagram



Transition Time Converter

The transition time converter is installed in the system cabinet as shown in figure 2-14, and connected between the 8114A and testhead (two transition time converters are installed if two 8114As are installed). Because the 8114A cannot control the transition time, the transition time converter converts the transition time of the 8114A output pulse, and prevents overshooting.

Figure 2-14 Trigger Distributor and Transition Time Converter

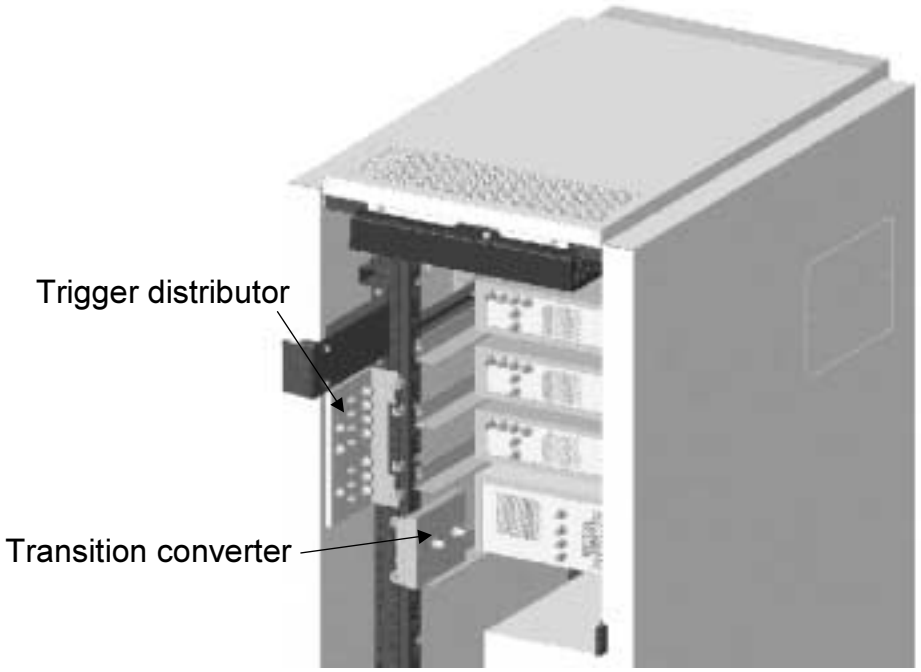
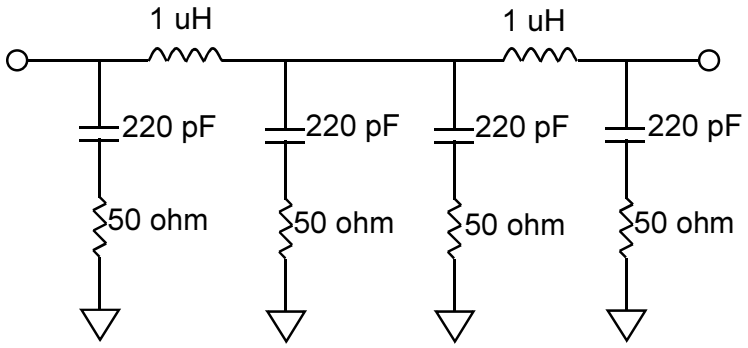


Figure 2-15 Transition Time Converter Circuit Diagram

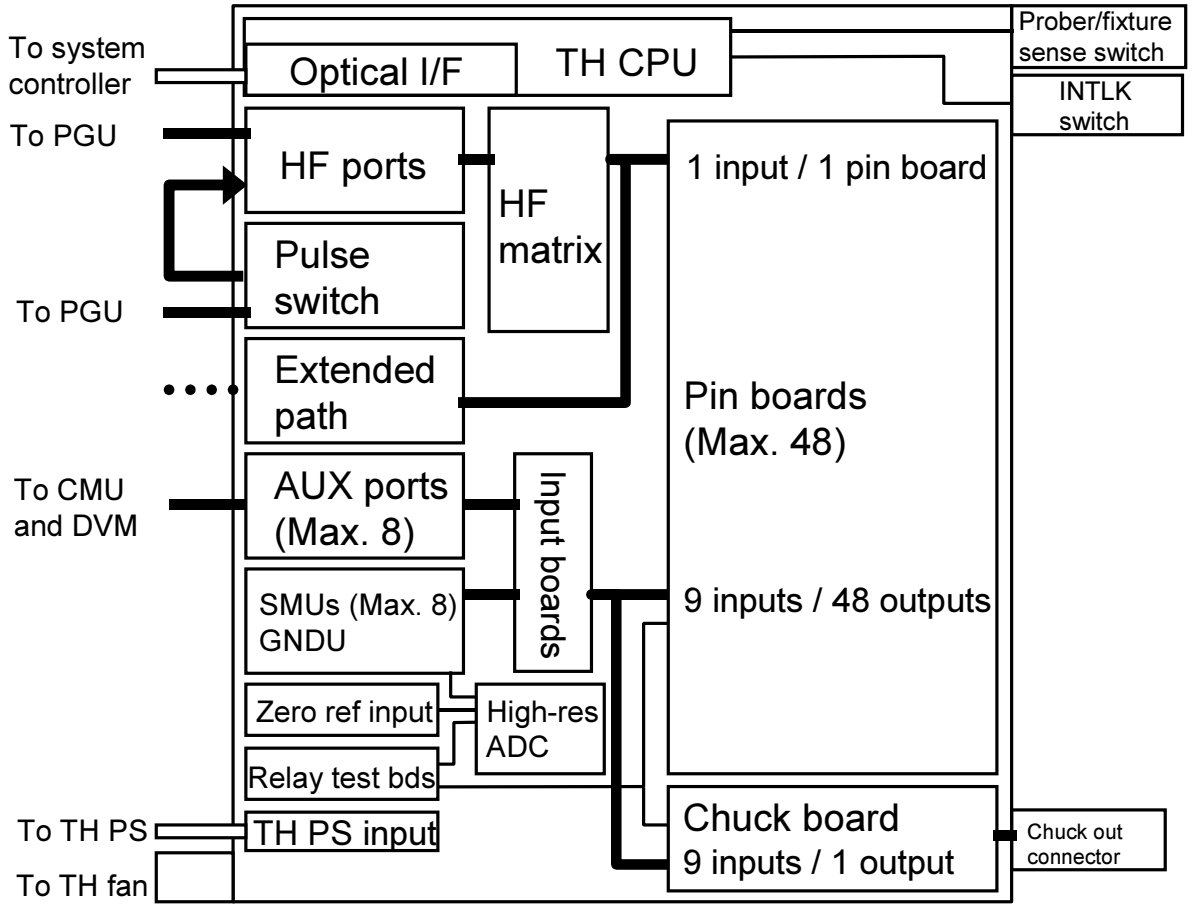


Testhead Assemblies

Figure 2-16 shows a block diagram of the testhead. The testhead consists of the following assemblies:

- "Auxiliary (AUX) Ports"
- "Input Selection Block"
- "Extended Paths"
- "Chuck Connection Output Connector"
- "Zero Reference Connector"
- "Switching Matrix (SWM) and High-Resolution Switching Matrix (HRSWM)"
- "Source Monitor Unit (SMU)"
- "High-Resolution ADC Board"
- "Motherboards"
- "Ground Unit (GNDU)"
- "HF Ports and HF Matrix"
- "Pulse Switch"
- "Relay Test Board"
- "TH PS Input Board"
- "Testhead CPU Board"
- "Interlock and Sensors"

Figure 2-16 Testhead Block Diagram



Auxiliary (AUX) Ports

The testhead has eight auxiliary (AUX) ports for connecting instruments that are external to the testhead. Table 2-2 lists the AUX ports.

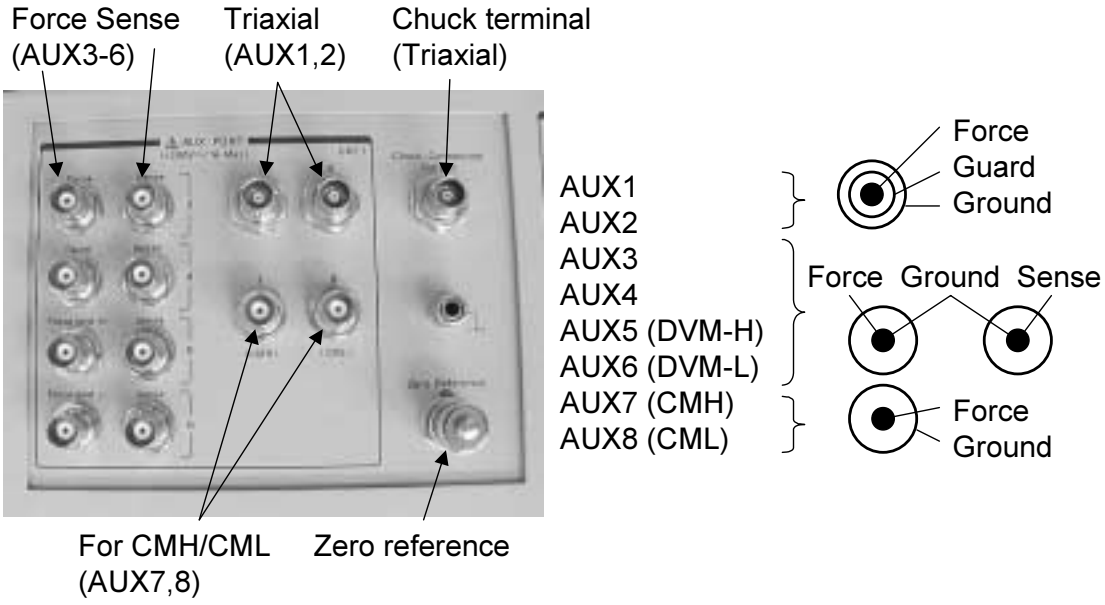
The SMUs (inside the testhead) and the AUX ports (for external instruments) are internally connected to the input selection block, which selects the inputs for the switching matrix. The input selection block determines whether internal SMUs or external instruments are connected to the switching matrix.

Table 2-2 AUX Ports Connectors

Port No.	Description	Connector Type	Signal[a]
1	Low current input port	TRIAX	Force/Guard/GND
2	Low current input port	TRIAX	Force/Guard/GND
3	Kelvin input port	BNC (2)	Force/GND, Sense/GND
4	Kelvin input port	BNC (2)	Force/GND, Sense/GND
5 (DVM-H)	Kelvin input port	BNC (2)	Force/GND[b], Sense/GND
6 (DVM-L)	Kelvin input port	BNC (2)	Force/GND[c], Sense/GND
7 (CMH)	AUX port	BNC	Force/GND[d]
8 (CML)	AUX port	BNC	Force/GND[e]

a. For TRIAX: core/center/outer For BNC: core/outer
b. Connected to the 3458A multimeter HI terminal.
c. Connected to the 3458A multimeter LO terminal.
d. Connected to the 4284A LCR meter Hcur/Hpot terminals.
e. Connected to the 4284A LCR meter Lcur/Lpot terminals.

Figure 2-17 AUX port Connectors



Input Selection Block

The input selection block selects which inputs of this block are connected to the nine input ports of the switching matrix (SWM) and the high-resolution switching matrix (HRSWM). The inputs of this block are eight internal SMUs, GNDU, and eight external instruments (by way of the eight AUX ports).

This block can select what is connected to each SWM input port (1 to 8), an internal SMU or an external instrument (connected to the AUX port).

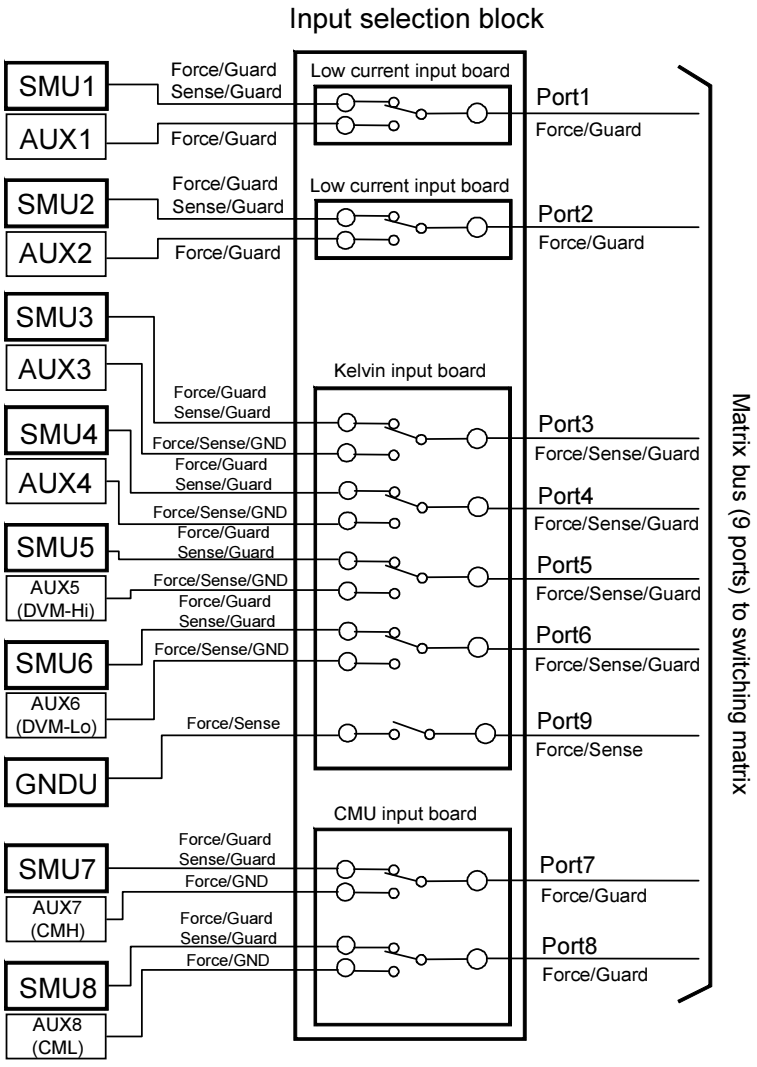
This block also determines whether the GNDU is connected to the SWM input port 9.

Figure 2-18 shows a block diagram of the input selection block.

The input selection block consists of the following:

- two low current (LC) input boards (for the 4072A) or two HR LC input boards (for the 4073A) (port 1 and 2)
- Kelvin input board (for the 4072A) or HR Kelvin input board (for the 4073A) (port 3 through 6)
- CMU input board (port 7 and 8)

Figure 2-18 Input Selection Block



Low Current Input Board and High-Resolution Low Current Input Board

The low current (LC) input board and high-resolution low current (HRLC) input board have two SMB connectors for an SMU and one SMB connector for the AUX input. The connector cover is installed on one SMB connector of the HRLC input board.

The force and sense lines of the MPSMU are connected to the SMB connectors on the board. When the MPSMU is connected to the HRLC input board, the connector cover installed on the SMB connector must be removed. When the HRSMU is connected to the HRLC input board, the connector cover must be installed on the SMB connector. The cable coming from the AUX 1 or 2 port is connected to the SMB connector for the AUX port.

The measurement paths are fully guarded by covers. The output of the low current input board is a coaxial contact pin with guard (for one matrix block) and an SMB connector (for the other matrix block). The output connects to the low current path of the matrix motherboard. For ultra low current measurement, the HRLC input board uses the relays, whose characteristics are lower noise and less thermal effect of current flow than the relay used on the LC input board.

Figure 2-19 Low Current Input Board and High Resolution Low Current Input Board

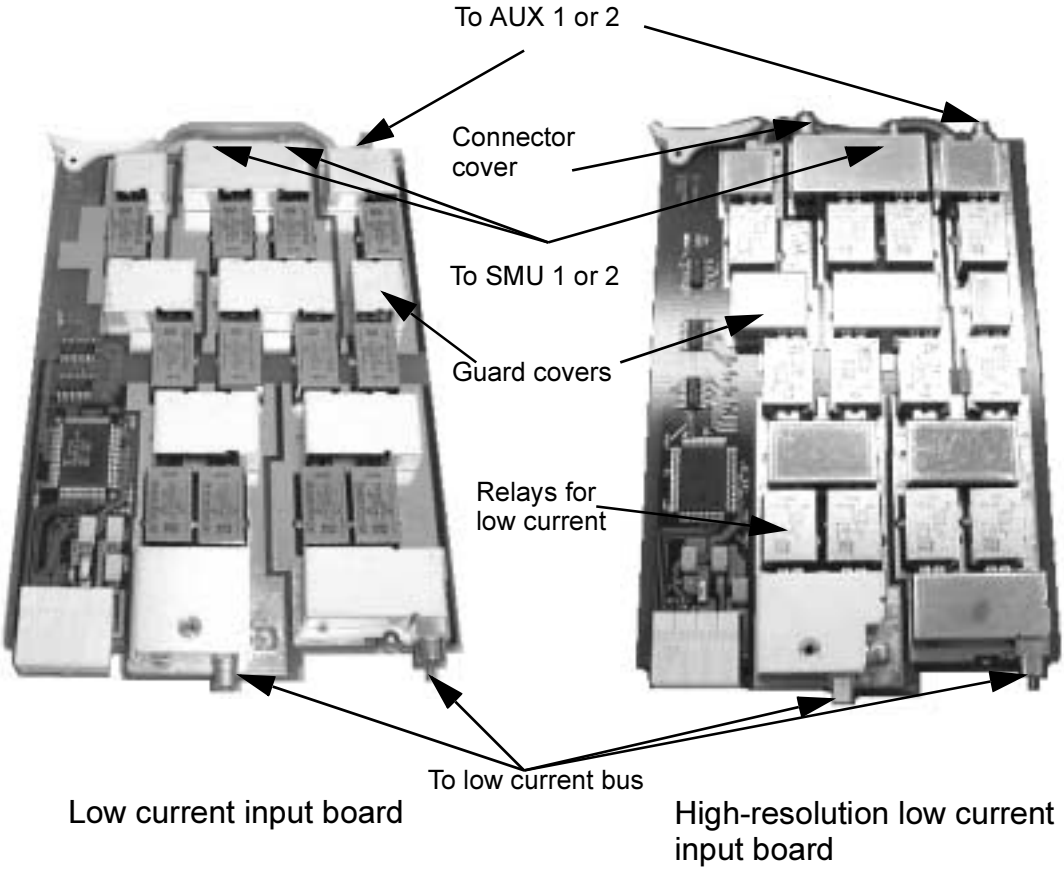
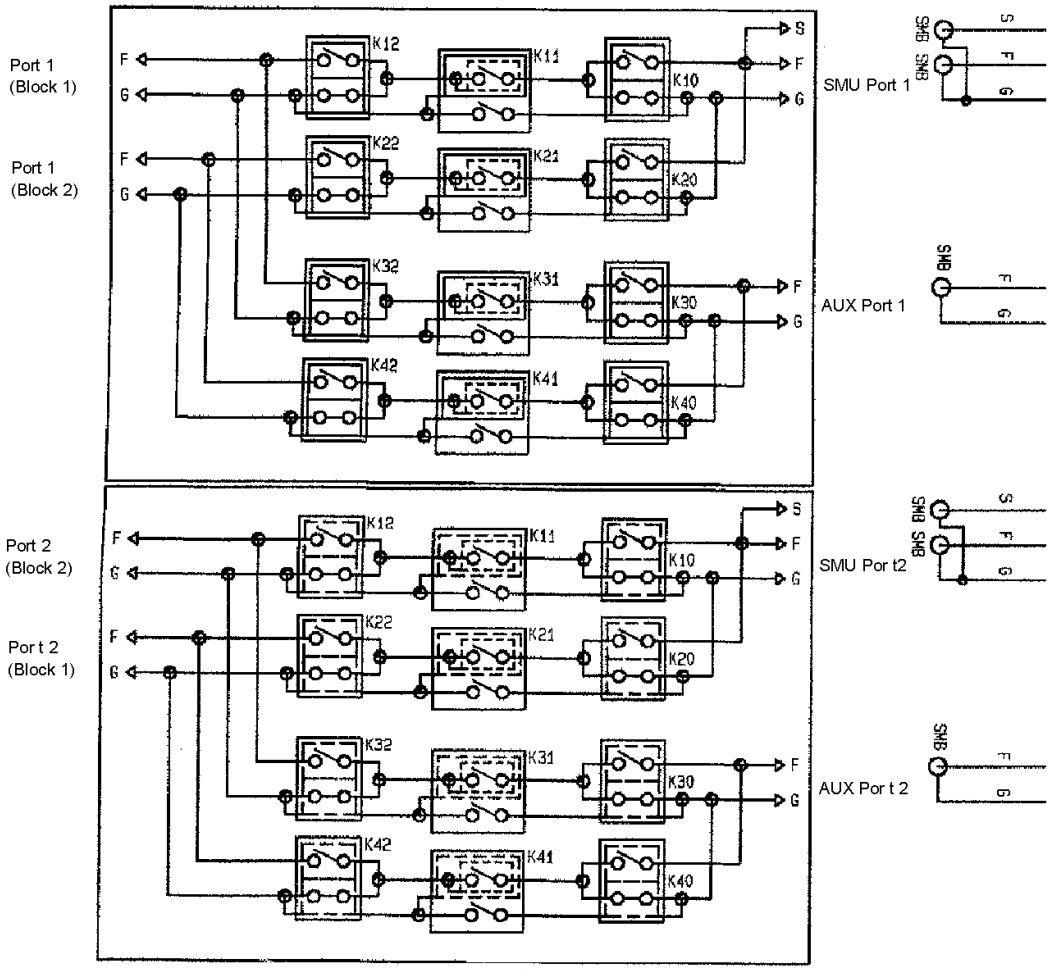


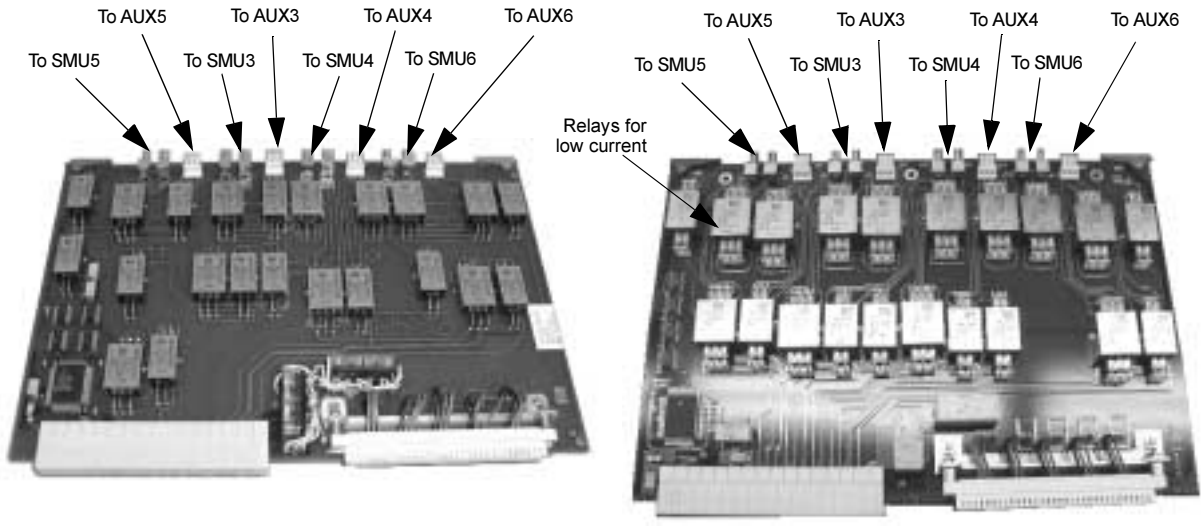
Figure 2-20 Low Current Input Board and High-Resolution Low Current Input Board Circuit Diagram



Kelvin Input Board and High Resolution Kelvin Input Board

The Kelvin input board and high-resolution (HR) Kelvin input board have four pairs of SMB connectors for force and sense input of SMU 3 through 6, and four in-line connectors for AUX 3 through 6. The output connects to the Kelvin connection path of the motherboard. For the low current measurement, the HR Kelvin input board uses the relays, whose characteristics are less thermal effect of current flow than the relay used on the Kelvin input board.

Figure 2-21 Kelvin Input Board and High-Resolution Kelvin Input Board



Kelvin input board

High-resolution Kelvin input board

Figure 2-22 Kelvin Input Board Circuit Diagram

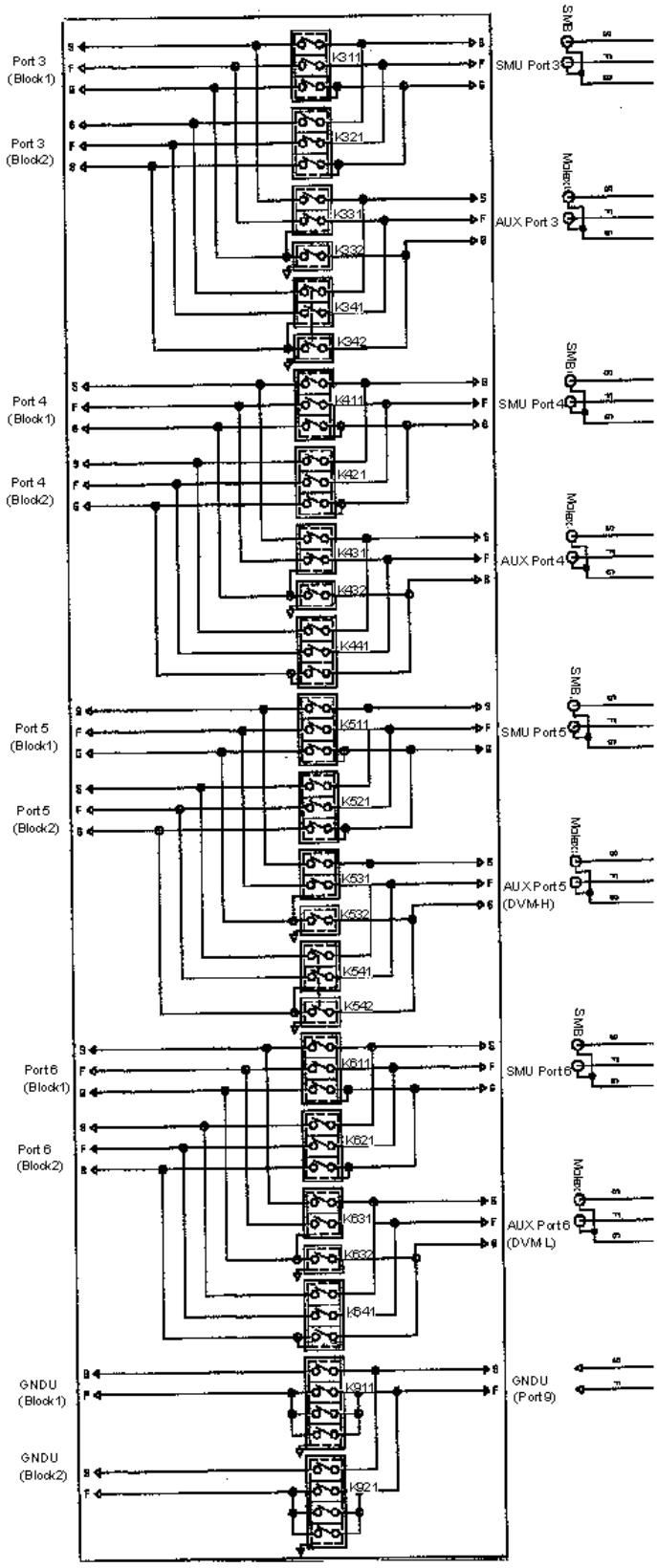
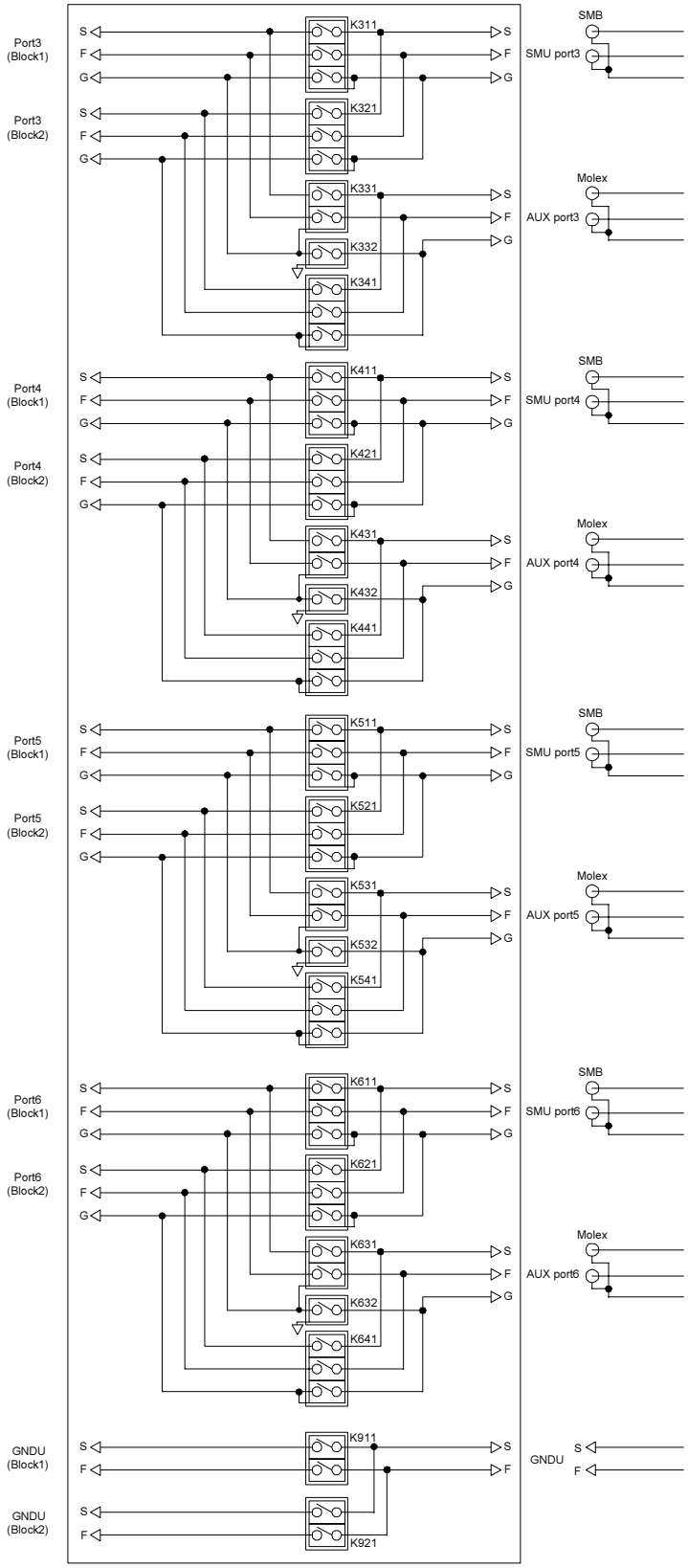


Figure 2-23 High-Resolution Kelvin Input Board Circuit Diagram



CMU Input Board

The CMU input board has two pairs (SMU 7 and 8) of SMB connectors (SMU force and sense) and two (AUX 7 and 8) SMB connectors. The SMU force and SMU sense lines are connected on the board. The output connects to the motherboard.

Figure 2-24 CMU Input Board

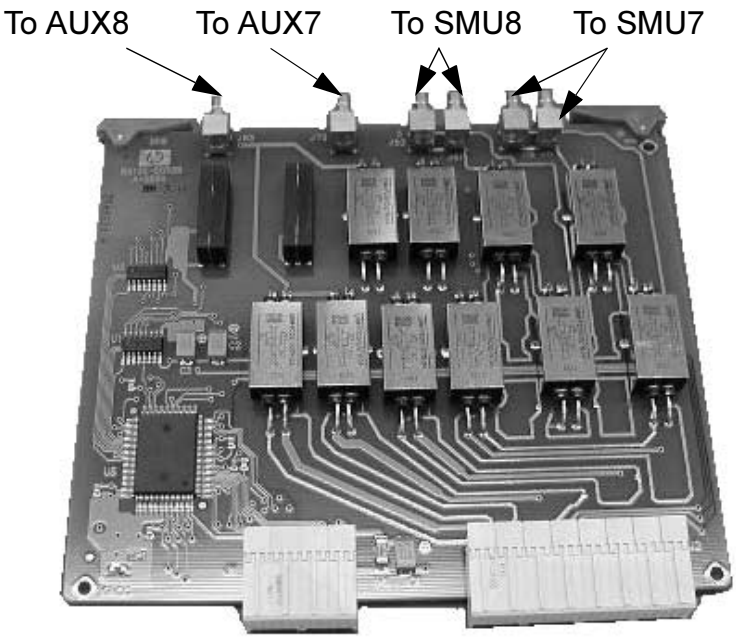
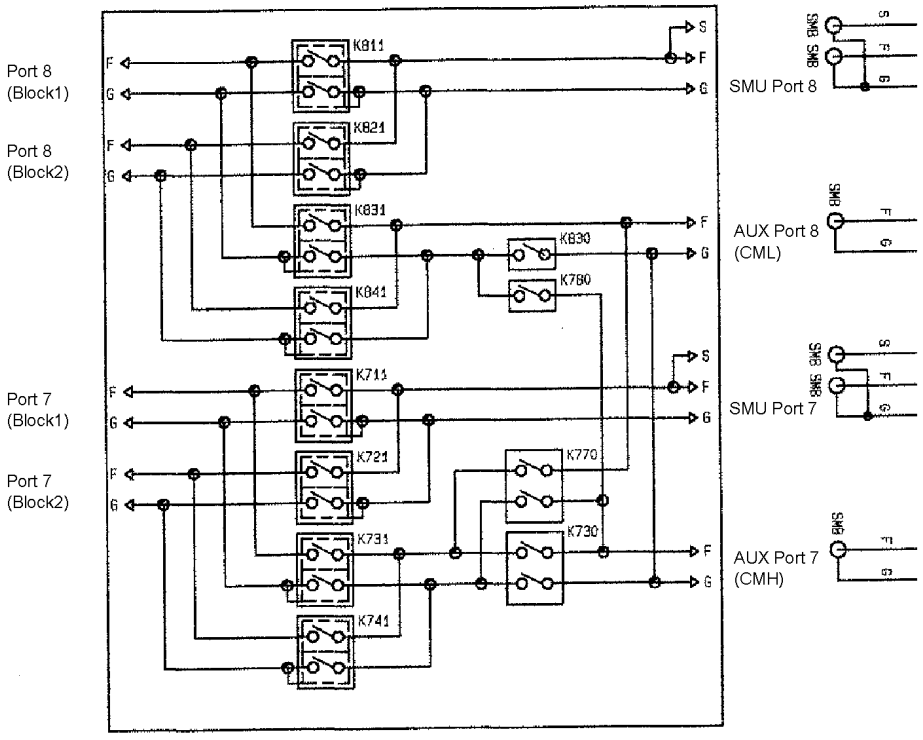


Figure 2-25 CMU Input Board Circuit Diagram



Extended Paths

The EXTENDED PATH connectors on the testhead side panel and the Agilent E3148A extended adapter directly connect an instrument to a pin board in the switching matrix, without passing through the input selection block. An external instrument can be connected to any of the 48-pin boards.

The E3148A extended adapter is attached to the EXTENDED PATH connectors on the testhead as shown in figure 2-26.

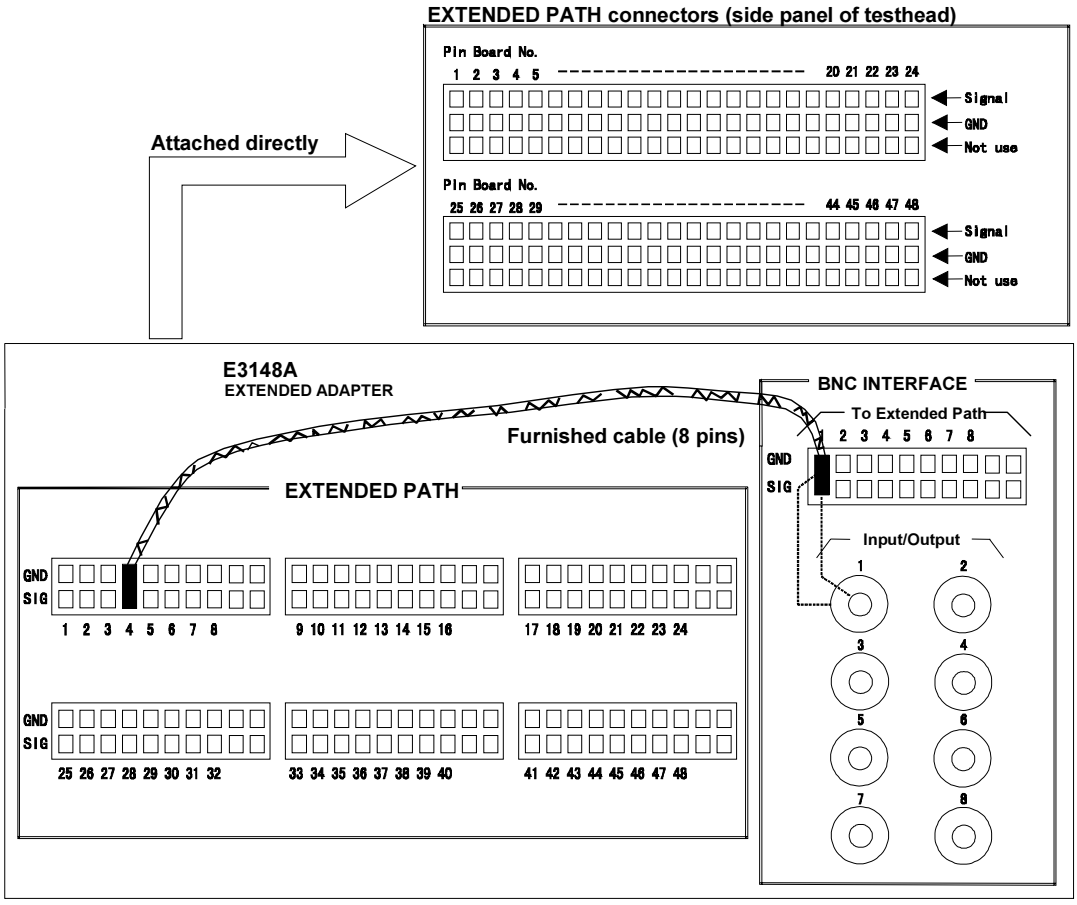
Users can connect an external instrument to the E3148A as follows:

- Connect the instrument directly to any of the 48 pins in the EXTENDED PATH block.
- If the external instrument has a BNC connector, connect the instrument to any of the eight BNC connectors for the BNC INTERFACE block. These eight BNC connectors are connected internally to the related pins for the To Extended Path connector.

The E3148A is furnished with a cable assembly, a connector with 8-pin connection cables. Users can connect this assembly to the BNC INTERFACE block, then use the 8-pin connection cables to connect the desired pins of the BNC INTERFACE block to any 8 pins of the EXTENDED PATH block.

For example, if a user connects an instrument output to BNC connector 1, and the BNC INTERFACE block pin 1 to the EXTENDED PATH block pin 4 using the furnished cable assembly, then the instrument output is directly connected to pin board 4 (testhead measurement pin 4) of the switching matrix.

Figure 2-26 Extended Path and Extended Adapter

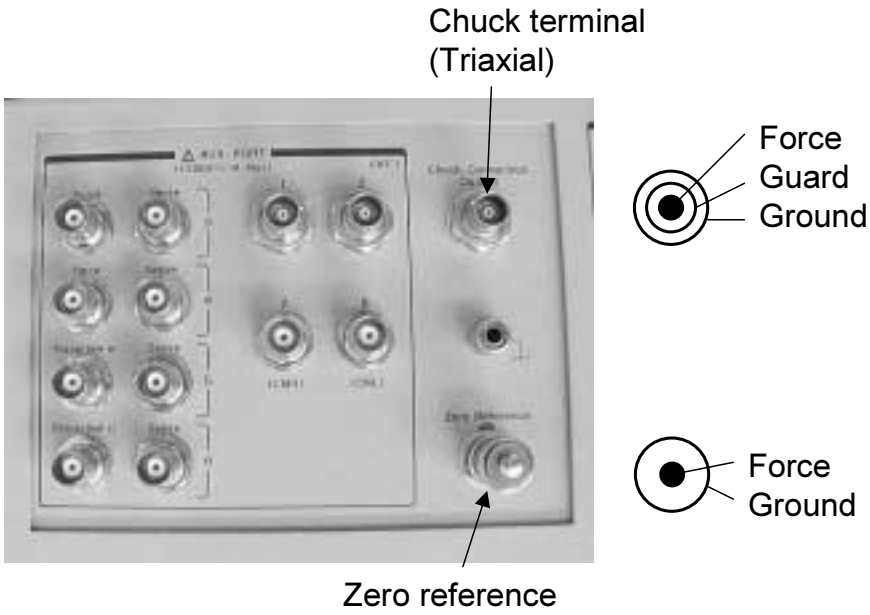


Chuck Connection Output Connector

The Chuck Connection Output connector is used to supply voltage/current to the wafer prober chuck terminal by way of an exclusive pin board (chuck connection pin board) in the testhead.

The Chuck Connection Output connector is a female triaxial connector with force, guard, and ground conductors.

Figure 2-27 Chuck Connection Output Connector



Zero Reference Connector

The Zero Reference connector is internally connected to the high-resolution ADC board, and may be used to input the external zero reference voltage from an external instrument.

This connector is usually not used and a BNC shorting cap is attached to it.

NOTE Use this connector when performing the 4072A/4073A performance verification.

Switching Matrix (SWM) and High-Resolution Switching Matrix (HRSWM)

The 4072A switching matrix (SWM) consists of the maximum of 48 pin boards and 1 chuck connection pin board. The 4073A high-resolution switching matrix (HRSWM) consists of the maximum of 48 high-resolution (HR) pin boards and 1 high-resolution (HR) chuck connection pin board.

Both switching matrixes can connect any of the nine input ports to any of the available measurement pins. In the matrix, one measurement pin occupies one pin board. The matrix has a minimum of 12 measurement pins/pin boards and a maximum of 48 pin boards. There is one additional pin board for the chuck connection pin and any of the nine input ports can be connected to the chuck connection pin.

There are also paths (extended paths) for directly connecting external instruments, that are connected to the Extended Path connector, to individual pin boards.

The nine input ports and the extended paths are described below:

- input ports 1 to 8: for internal SMUs or external equipment connected to testhead AUX connectors

  These ports can be connected to any pin board. The input selection block selects SMU or AUX input, as described in “Input Selection Block”.

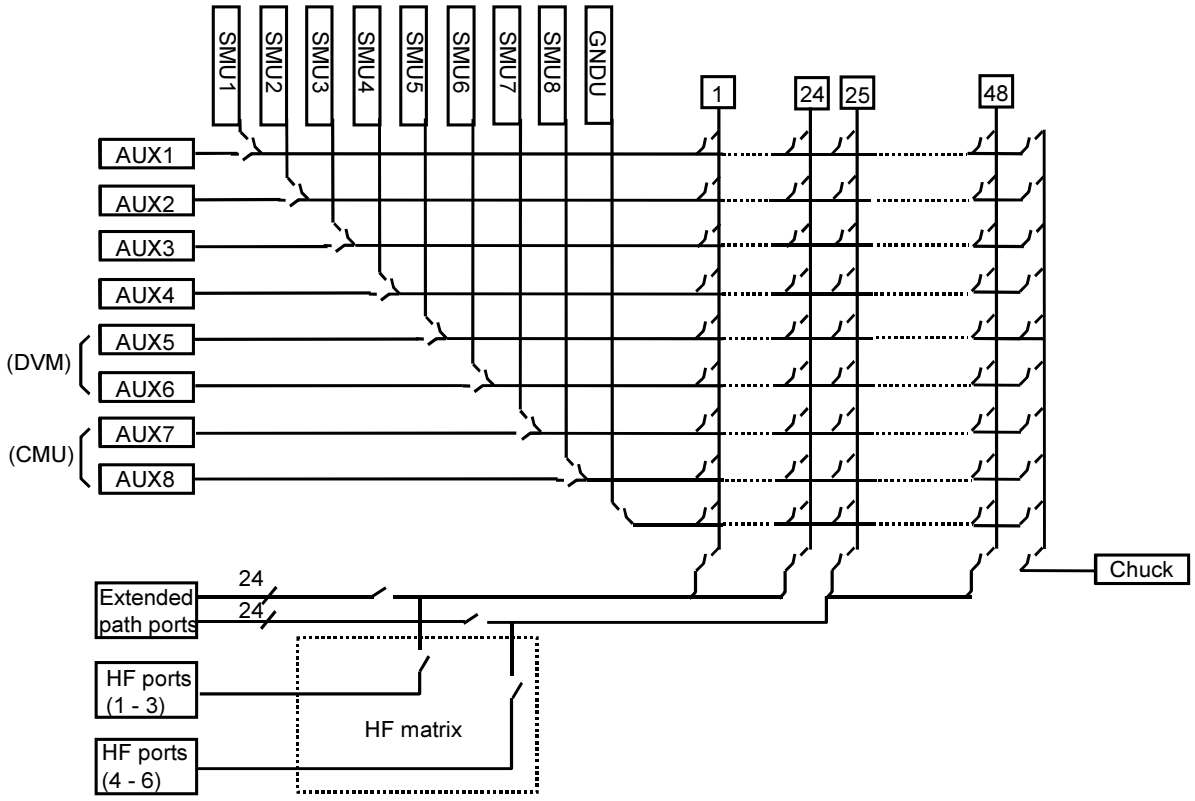
- input port 9: for GNDU. This port can be connected to any pin board. The GNDU is connected to input port 9 by way of the Input Selection block, as described in “Input Selection Block”.

- extended paths: for external equipment connected to the Extended Path connector.

  External equipment can be connected directly to one pin board, as described in “Extended Paths”.

Figure 2-28 shows the connection of the input ports and extended paths to the SWM pin boards.

Figure 2-28 (High-Resolution) Switching Matrix Block Diagram



Pin Board and High-Resolution Pin board

A pin board and a high-resolution (HR) pin board have nine (port 1 through 9) inputs and three output contact pins (force, sense, and guard) covered by a guard. For port 1 and port 2, coaxial contact pins with a guard are used. Some of the pin board areas are also guarded by covers (see figure 2-29). For ultra low current measurement, the HR pin board uses the relays, whose characteristics are lower noise and less thermal effect of current flow than the relay used on the pin board. Figure 2-30 and figure 2-31 show the circuit diagram of the pin board and HR pin board.

To connect a wafer test device to the measurement pins (pin boards), a direct docking probe card or personality board is used, and the testhead is mounted on a wafer prober.

To connect a packaged device to the SWM measurement pins (pin boards), a test fixture is mounted on the testhead.

Figure 2-29 Pin Board and High-Resolution Pin Board

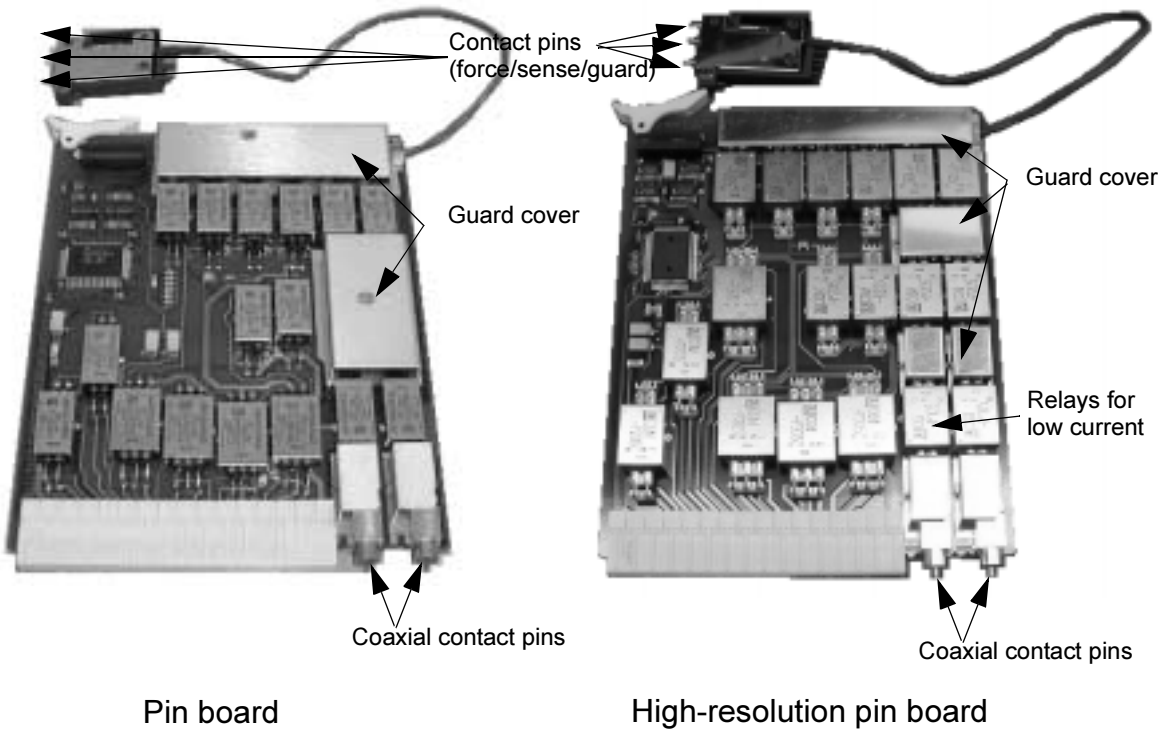


Figure 2-30 Relay Test Board and Pin Board Circuit Diagram

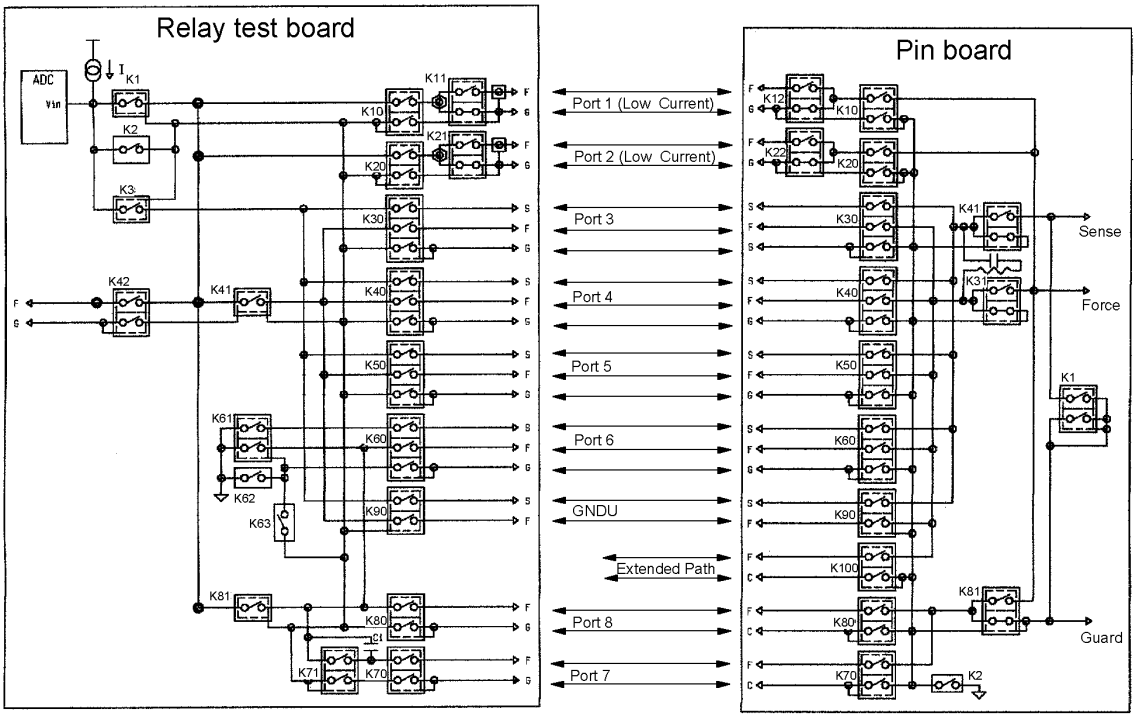
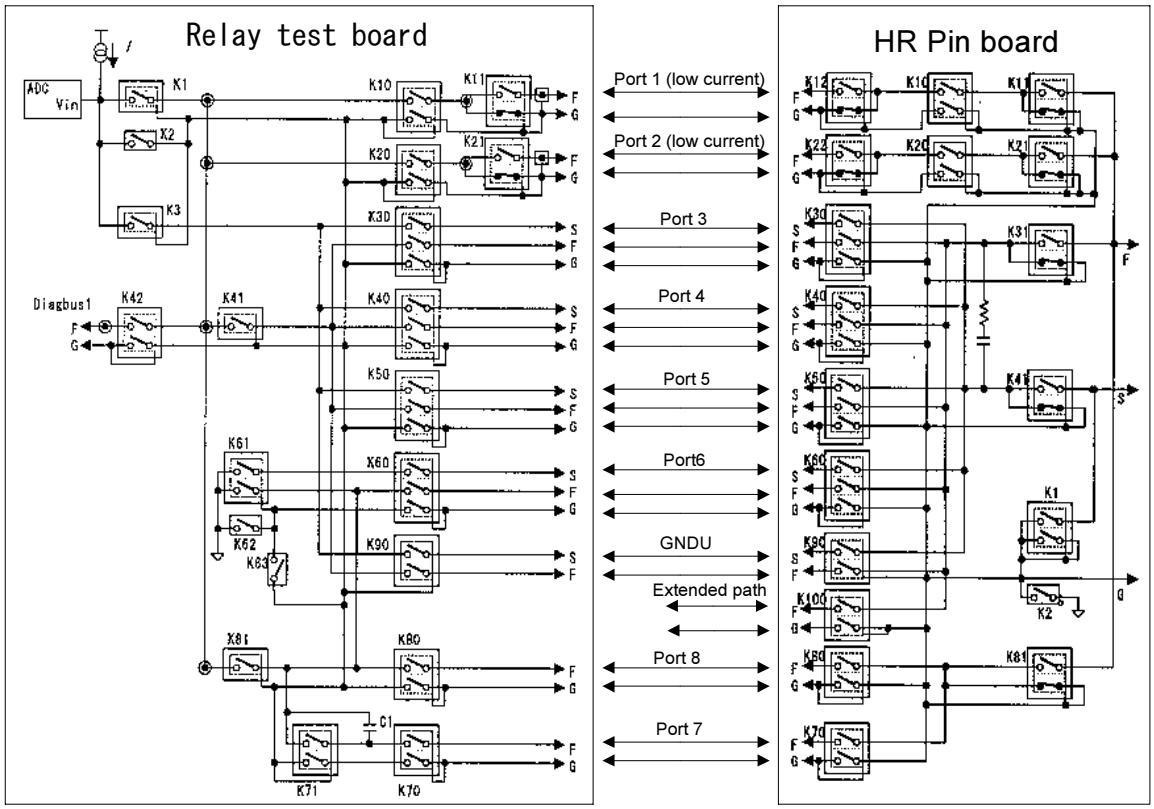


Figure 2-31 Relay Test Board and High-Resolution Pin Board Circuit Diagram



Chuck Connection Pin Board and High-Resolution Chuck Connection Pin Board

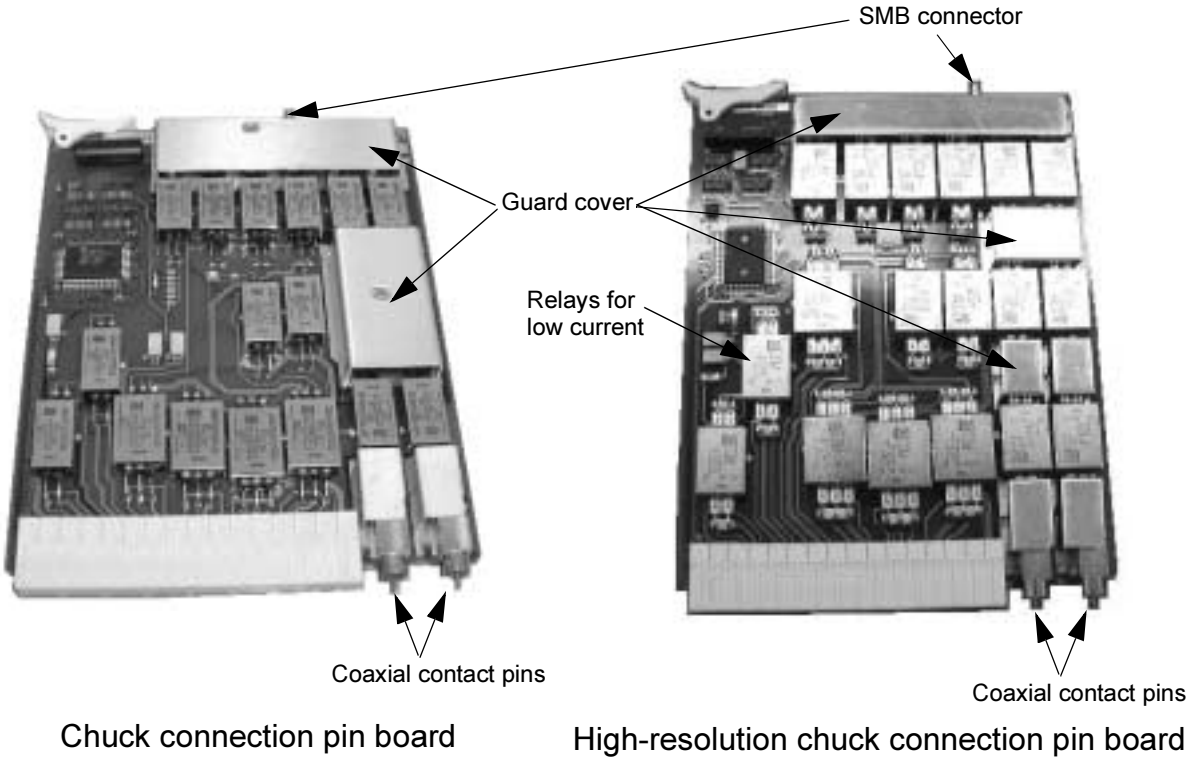
Any one of the following input ports can be connected to the chuck connection pin board:

- port 1 to 8 (for SMU or AUX)
- port 9 (for GNDU)

The only difference between a pin board/HR pin board and chuck connection pin board/HR chuck connection pin board is the type of output. The chuck connection pin board and HR chuck connection pin board have an SMB connector instead of a cable with contact pins.

The output connects the Chuck Connection Output connector.

Figure 2-32 Chuck Connection Pin Board and High-Resolution Chuck Connection Pin Board



Source Monitor Unit (SMU)

The source monitor unit (SMU) is used for forcing and measuring dc current and voltage. Three kinds of SMUs, high resolution source monitor unit (HRSMU), medium power source monitor unit (MPSMU), and high power source monitor unit (HPSMU) are available. The HRSMU and MPSMU can force and measure maximum 100 mA/100 V. For ultra low current measurement, the HRSMU has a 10 pA and 100 pA current force and measurement range. The HPSMU can force and measure a maximum of 1 A/200 V.

Each SMU has a 16-bit successive-approximation type ADC (high-speed/per-channel ADC) for high speed measurements. Using the high-speed/per-channel ADC, the measurement speed increases but the resolution decreases (compared with the ADC on the high-resolution ADC board explained in “High-Resolution ADC Board”).

The testhead has 10 slots for installing SMUs, and a maximum of 8 SMUs can be installed in the testhead. Each SMU installed in the testhead is connected to the input selection block, where the SMUs (SMU1 through SMU8) are connected to the SWM input port 1 through 8, respectively. The HRSMU can be installed in port 1 and port 2 of the 4073A only. The HPSMU can be installed in ports 3 and 4 only.

Figure 2-33 MPSMU

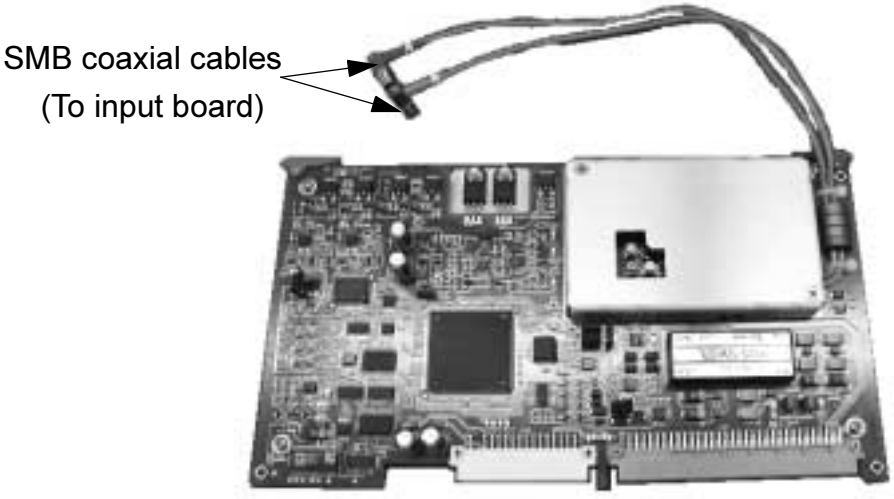


Figure 2-34 HRSMU

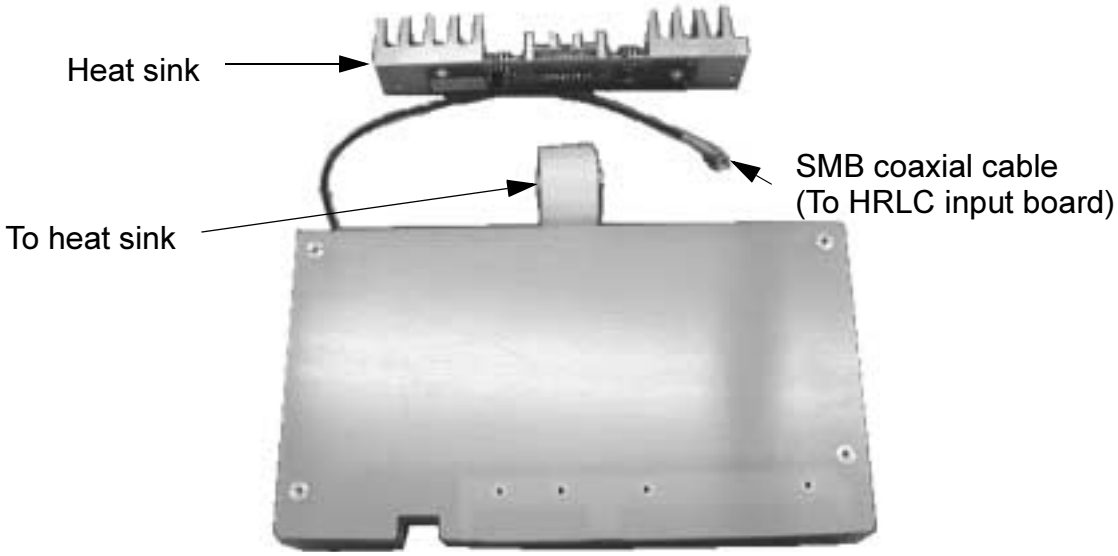


Figure 2-35 HPSMU

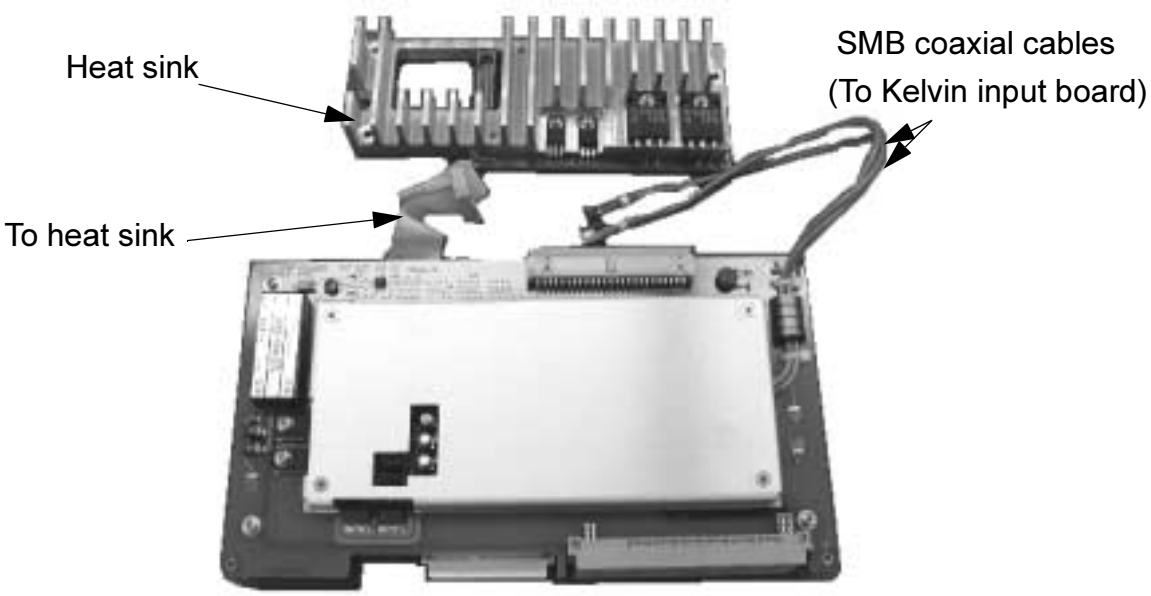


Figure 2-36 SMU Circuit Diagram

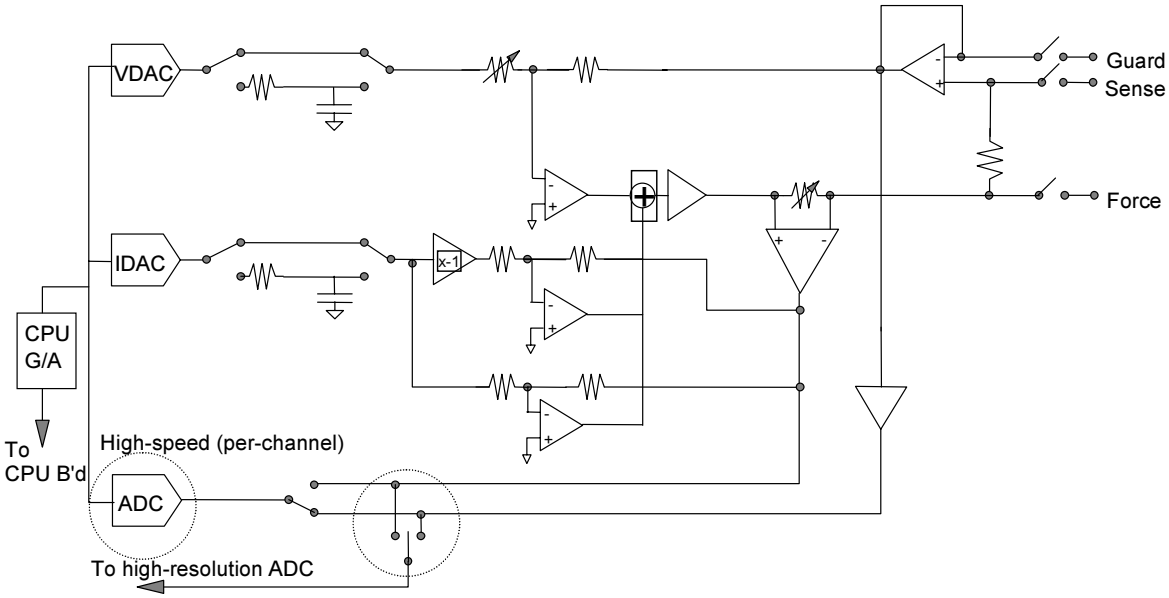


Figure 2-37 SMU Configuration

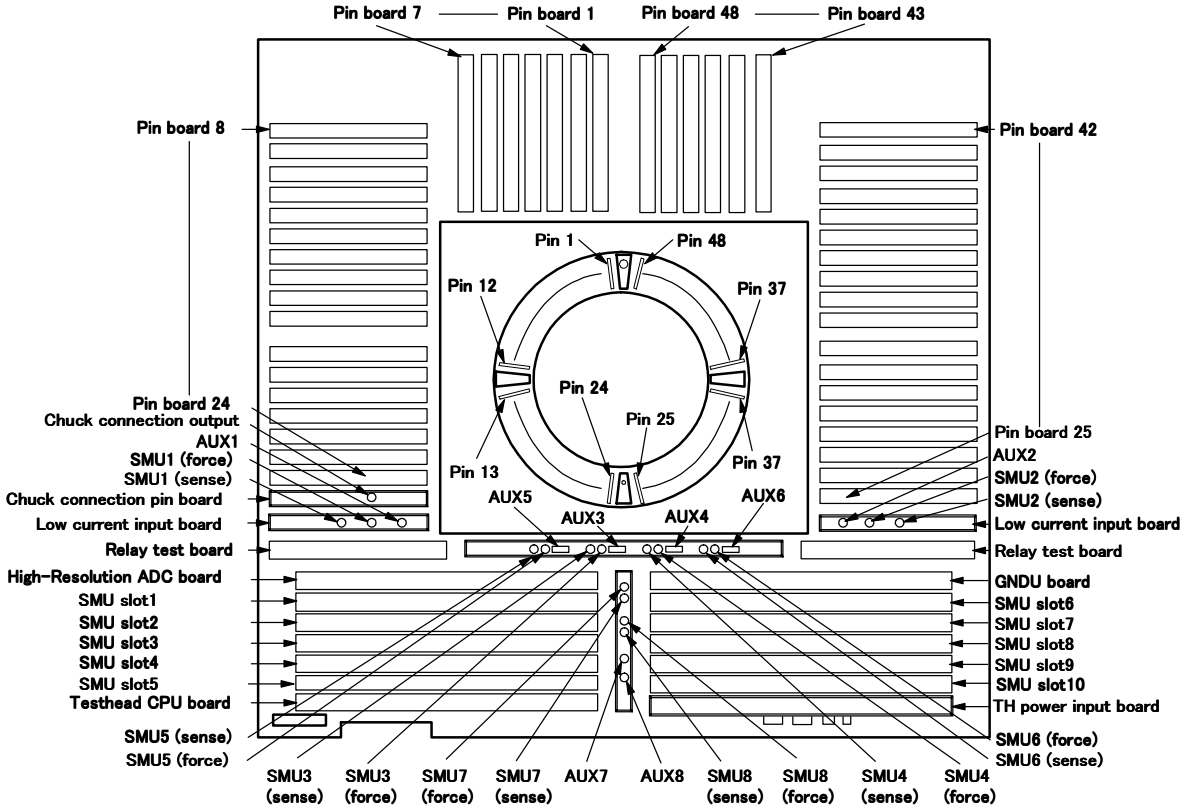


Table 2-3 MPSMU only (for Agilent 4072A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	2
2	3	MPSMU	Default
3	5	MPSMU	1
4	7	MPSMU	4
5	—	—	—
6	2	MPSMU	Default
7	4	MPSMU	Default
8	6	MPSMU	3
9	8	MPSMU	5
10	—	—	—

Table 2-4 One HPSMU (for Agilent 4072A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	1
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	3
6	2	MPSMU	Default
7	4	MPSMU	Default
8	6	MPSMU	2
9	8	MPSMU	4
10	—	—	—

Table 2-5 Two HPSMUs (for Agilent 4072A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	Default
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	2
6	2	MPSMU	Default
7	6	MPSMU	1
8	4	HPSMU	Optional HPSMU
9			
10	8	MPSMU	3

Table 2-6 One HRSMU (for Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	2
2	3	MPSMU	Default
3	5	MPSMU	1
4	7	MPSMU	4
5	—	—	—
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	3
10	8	MPSMU	5

Table 2-7 Two HRSMUs (for Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	HRSMU	Optional HRSMU
2			
3	3	MPSMU	Default
4	5	MPSMU	1
5	7	MPSMU	3
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	2
10	8	MPSMU	4

Table 2-8 One HRSMU and One HPSMU (for Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	1
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	3
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	2
10	8	MPSMU	4

Table 2-9 Two HRSMUs and One HPSMU (for Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	HRSMU	Optional HRSMU
2			
3	3	HPSMU	Optional HPSMU
4			
5	5	MPSMU	Default
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	1
10	7	MPSMU	2

Table 2-10 One HRSMU and Two HPSMUs (for Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	1
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	2
6	2	HRSMU	Default
7			
8	4	HPSMU	Optional HPSMU
9			
10	6	MPSMU	3

Table 2-11 Two HRSMUs and Two HPSMUs (for Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	HRSMU	Optional HRSMU
2			
3	3	HPSMU	Optional HPSMU
4			
5	5	MPSMU	Default
6	2	HRSMU	Default
7			
8	4	HPSMU	Optional HPSMU
9			
10	6	MPSMU	Default

High-Resolution ADC Board

The high-resolution ADC board is used for the following purposes:

- obtaining higher (21-bit) SMU measurement resolution than the high-speed/per-channel (16-bit) ADCs on the SMUs
- calibration and diagnostics of SMUs
- diagnostics
- performance verification
- voltage and resistance reference calibration

Also, the high-resolution ADC board generates the reference voltages (±5 V, ±7 V, and +10 V) and supplies the following to:

- SMUs: potential common (0 V), ±5 V, and +10 V
- GNDU: potential common (0 V) and +5 V

The high-resolution ADC board includes the following components:

AD converter:	used to obtain higher SMU measurement resolution (21-bit equivalent integration-type ADC).
Reference resistors:	used for calibration and diagnostics of SMU. 5, 100, 10 k, 1 M, and 100 MΩ are mounted.
Voltage regulator:	provides reference voltages (±5 V, ±7 V, and +10 V).
Microprocessor unit:	is an Intel 80C196.
EEPROM:	for storing voltage and resistance reference values.
EPROM:	for storing firmware, which controls the ADC operation.

The high-resolution ADC board is connected to several blocks by the following internal buses:

Logic bus:	connects to the testhead CPU board for receiving control signals from the testhead CPU board.
Diag bus:	connects the ADC and reference resistors to the switching matrix for executing the 4072A/4073A diagnostics.
Cal bus:	connects the reference resistors to the SMUs to execute the SMU calibration.
AD bus:	connects to the SMUs and GNDU for receiving SMU voltage/current monitor signals to obtain higher measurement resolution, and for supplying the voltages (0 V potential common, ±5 V, and +10 V) to the SMUs and voltages (0 V potential common and +5 V) to the GNDU.

Figure 2-38 High-Resolution ADC Board

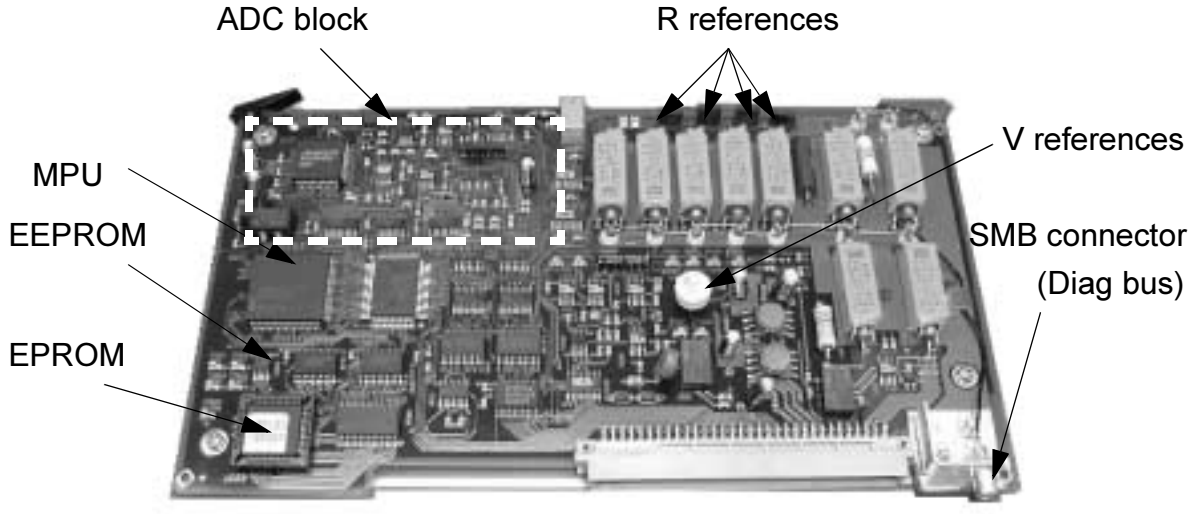
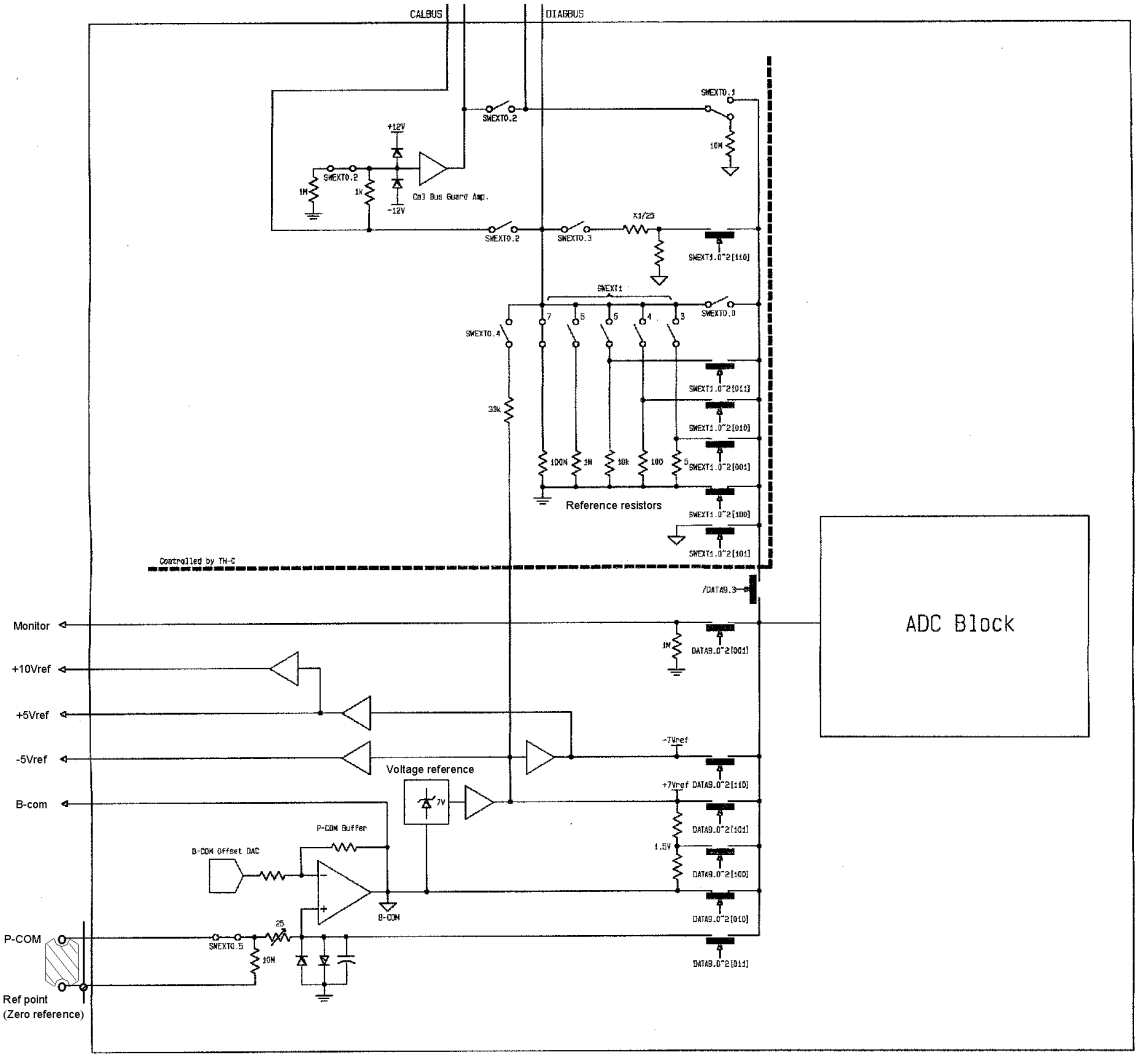


Figure 2-39 High-Resolution ADC Board Circuit Diagram



Motherboards

There are five types of motherboards, listed below.

- matrix motherboards:

  Matrix motherboard 1 (for block 1) is used to connect pin boards 1 through 24, the chuck connection pin board, relay test board, low current input board, and Kelvin input board. Matrix motherboard 2 (for block 2) is used to connect pin boards 25 through 48, the relay test board, low current input board, and Kelvin input board.

  The matrix motherboards includes measurement paths, power supply lines, and logic buses. The diag bus cables (SMB cables) are connected on the matrix motherboard to connect the relay test boards (on the matrix motherboard) and high-resolution ADC board (on the SMU motherboard). The low current paths (for ports 1 and 2) on the matrix motherboards are fully guarded.

  Matrix motherboard 1 and 2 have been redesigned for the 4073A. These matrix motherboards are backwards compatible and can be used with the 4072A.

- SMU motherboard:

  The SMU motherboard is used to connect the testhead CPU board, SMUs, GNDU, and high-resolution ADC board.

  The SMU motherboard includes cal buses, AD buses, logic buses, and power supply lines. Also, diag bus cables (SMB cables) are connected to the SMU motherboard to connect the relay test boards (on the matrix motherboard) and high-resolution ADC board (on the SMU motherboard).

- mini-motherboards:

  Mini-motherboard 1 (for block 1) is used to connect the SMU motherboard, HF matrix addressing board, and matrix motherboard 1. Mini-motherboard 2 (for block 2) is used to connect between the SMU motherboard and matrix motherboard 2.

  The mini-motherboards includes power supply lines and logic buses. Mini-motherboard 2 also includes the temperature sensor, TS2.

Figure 2-40 Testhead Mini-Motherboards

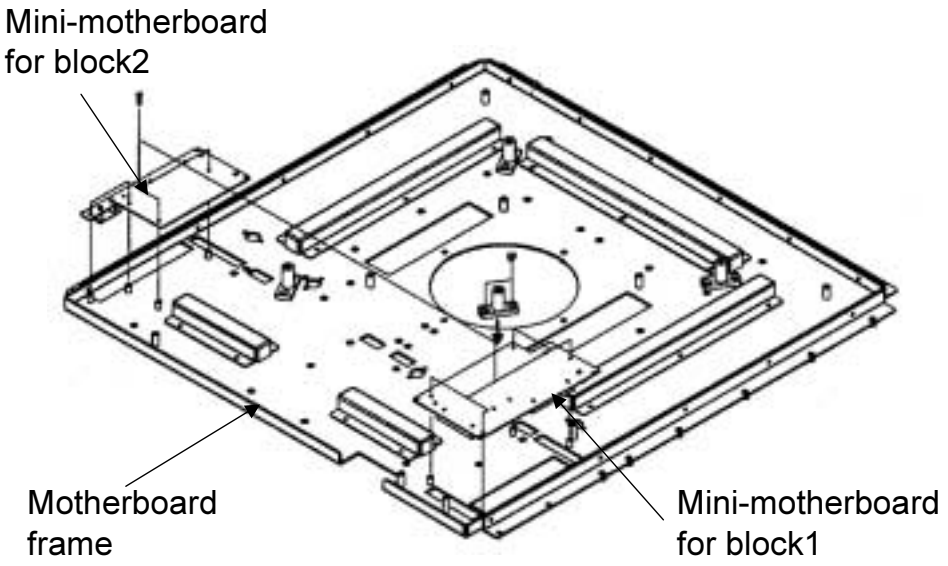
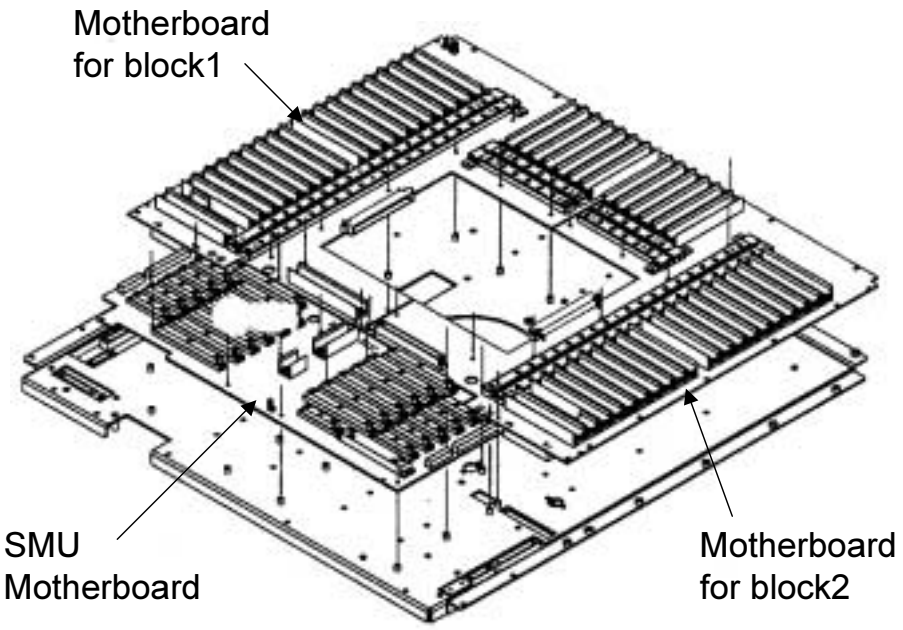


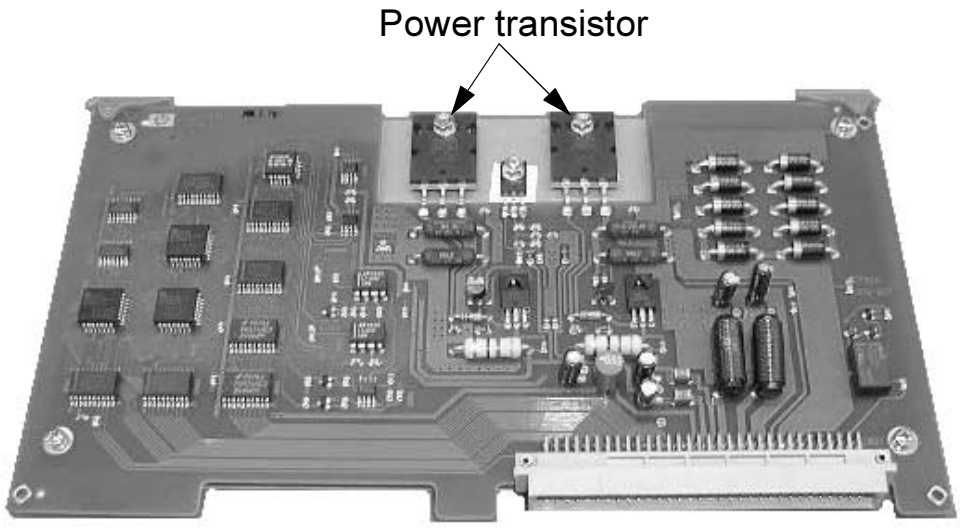
Figure 2-41 Testhead Motherboards



Ground Unit (GNDU)

The ground unit (GNDU) is a 0 V source. The GNDU output is connected to the input selection block that can connect the GNDU to input port 9 of the switching matrix. The maximum output current of the GNDU is ±1.6 A.

Figure 2-42 Ground Unit (GNDU)



HF Ports and HF Matrix

There are six high-frequency (HF) ports for PGU input or other external instruments. The HF matrix consists of two blocks. One HF matrix block is used as the 3-input/24-output matrix. HF ports 1, 2, and 3 can access pin boards 1 through 24. HF ports 4, 5, and 6 can access pin boards 25 through 48. These HF ports can be connected using the 1-to-2 adapters, and configured as a 3-input/48-output matrix.

The HF matrix consists of six HF matrix boards, two HF matrix connection boards, extended path cables, and HF matrix addressing board. The HF matrix boards are the main boards in the HF matrix, and consist of the HF relays as shown in figure 2-44. The HF matrix connection boards connect between the HF matrix boards. The extended path cables connect the extended path ports, HF matrix, and matrix motherboards. The HF matrix addressing board consists of digital buses.

The HF matrix block diagram is shown in figure 2-43 and HF matrix board is in figure 2-44.

Figure 2-43 HF Matrix Block Diagram

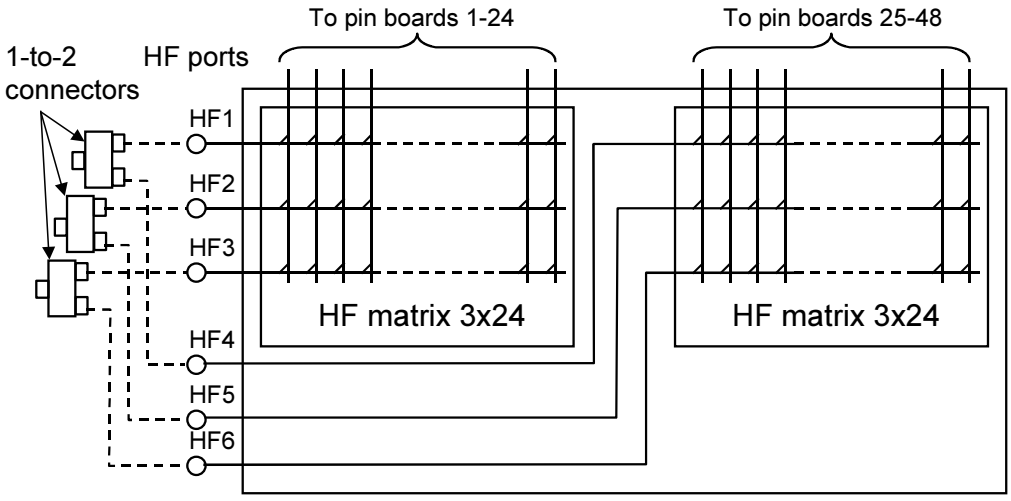
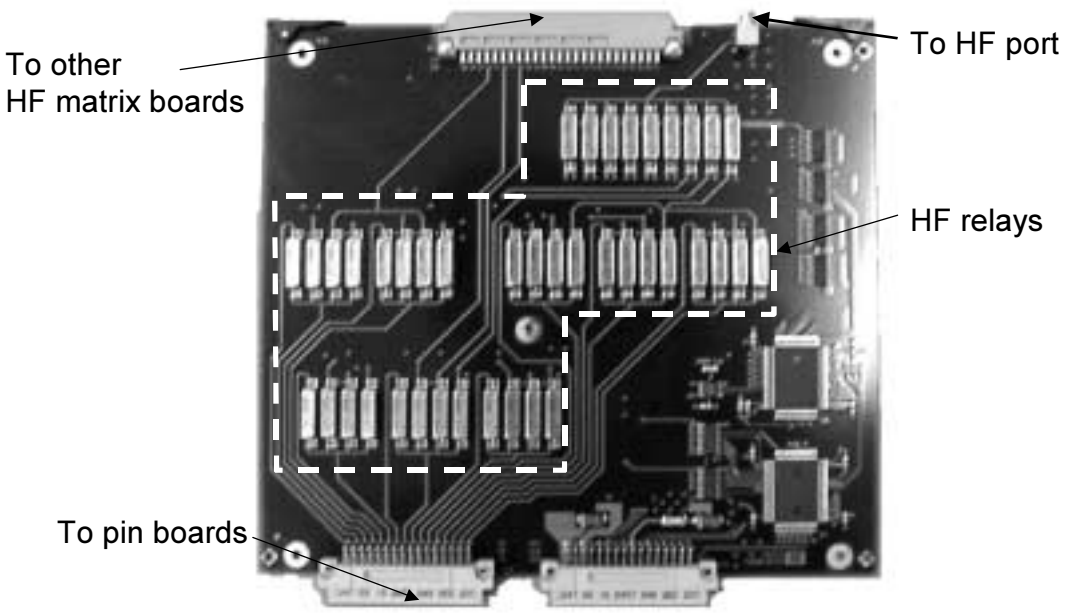


Figure 2-44 HF Matrix Board



Pulse Switch

The pulse switch consists of two blocks (two pulse switch boards) and is used for making multi-level pulse or open/close conditions. There are four pulse switch inputs (PSIs) and four pulse switch outputs (PSOs) for making open/close conditions, and six PSIs and three PSOs for making multi-level pulse conditions. The pulse switch, which makes the open/close conditions, can be set for normally on or normally off conditions using the 4072A/4073A system software.

The PG outputs are connected to the PSIs, and the PSOs are connected to HF ports or AUX ports using the pulse switch connection cables. The PG outputs are connected to pulse switch controls (PSCs) for controlling the pulse switch. The pulse switch is controlled by one of the following three control modes:

- Each block is independently controlled by the pulse switch control (PSC):
  - ❏ Block 1 is synchronized with PSC1.
  - ❏ Block 2 is synchronized with PSC2.
- Both block 1 and block 2 are synchronized with PSC1.
- The pulse switch is controlled by the testhead CPU (this mode cannot be synchronized with PG outputs).

All of the relays used on the pulse switch boards are semiconductor relays (not mechanical relays), because semiconductor relays last longer than mechanical relays. Although the pulse performance of semiconductor relays is worse than for mechanical relays, it is acceptable for evaluating flash memory cells.

Figure 2-45 Pulse Switch Circuit Diagram

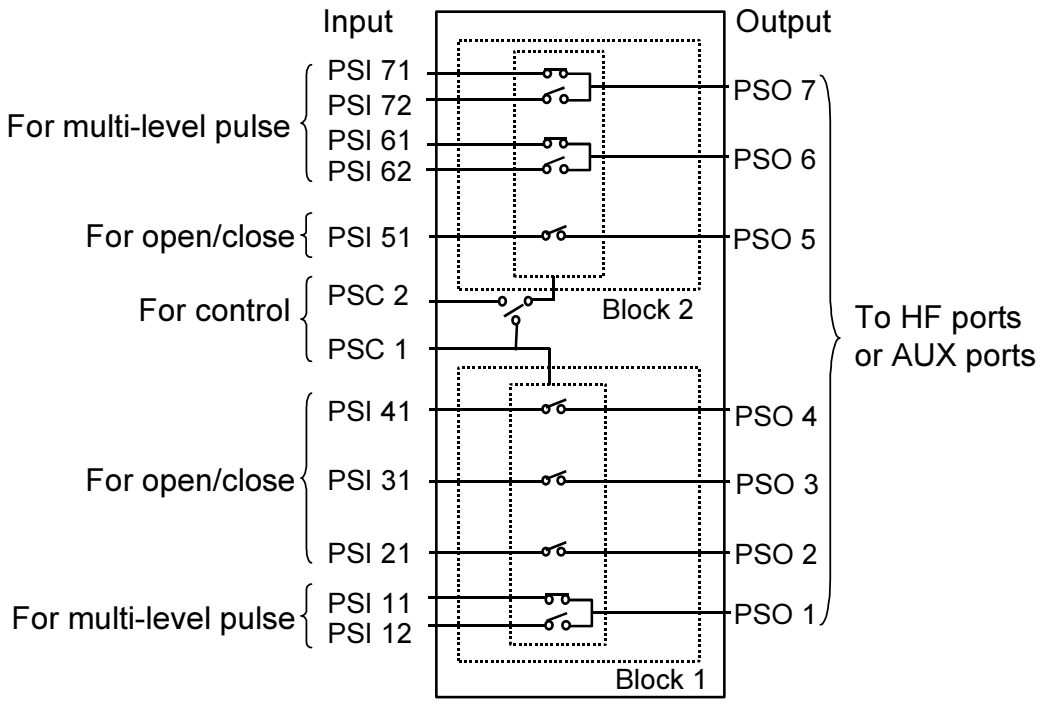


Figure 2-46 Pulse Switch Board

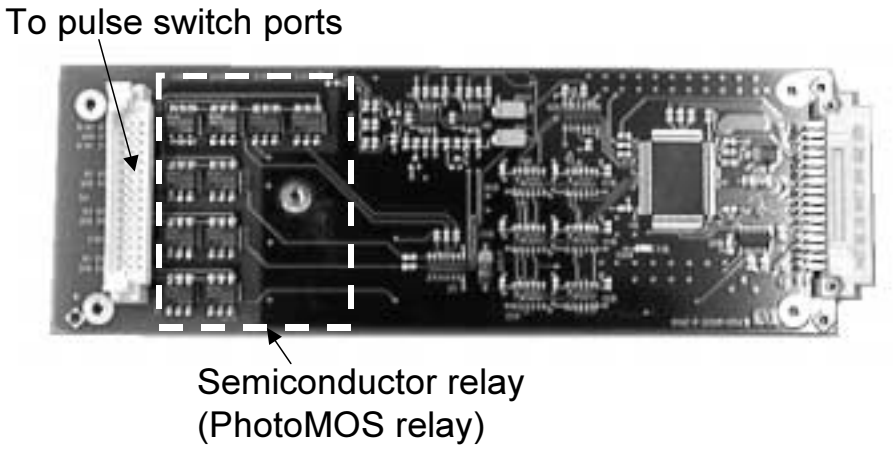
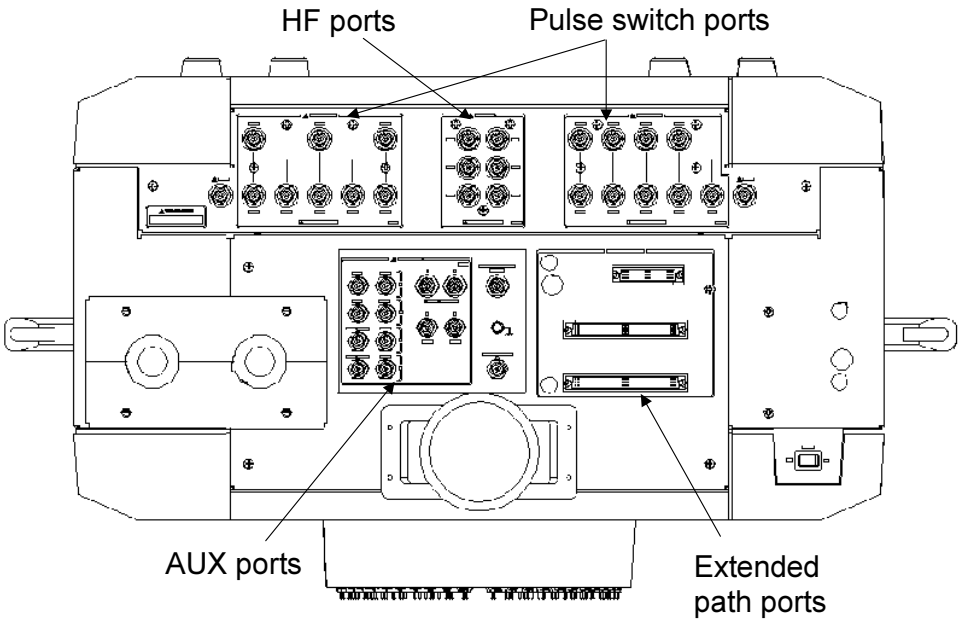


Figure 2-47 Testhead Port Layout



Relay Test Board

The relay test board is used to execute the 4072A/4073A diagnostics.

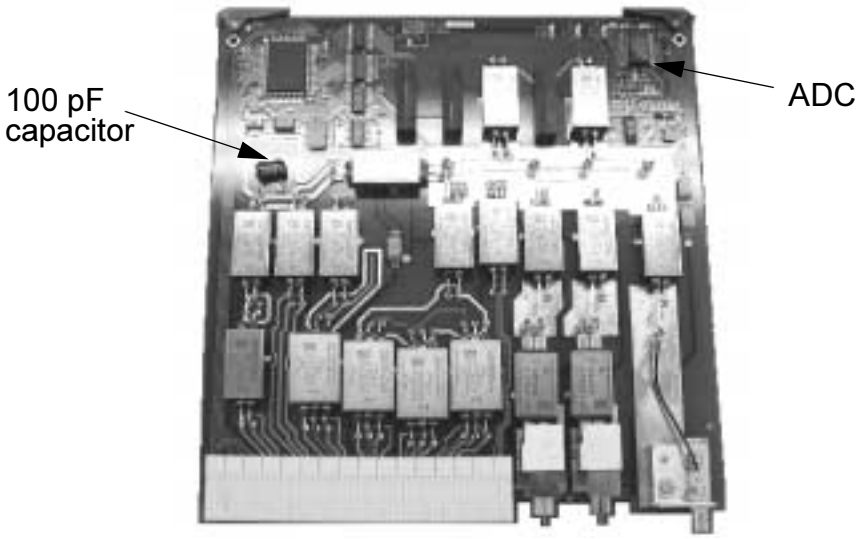
The relay test board includes the following components:

Current source: for relay tests.

Reference capacitor: for the 4284A diagnostics. 100 pF capacitor is mounted.

Figure 2-30 shows a circuit diagram of the relay test board.

Figure 2-48 Relay Test Board

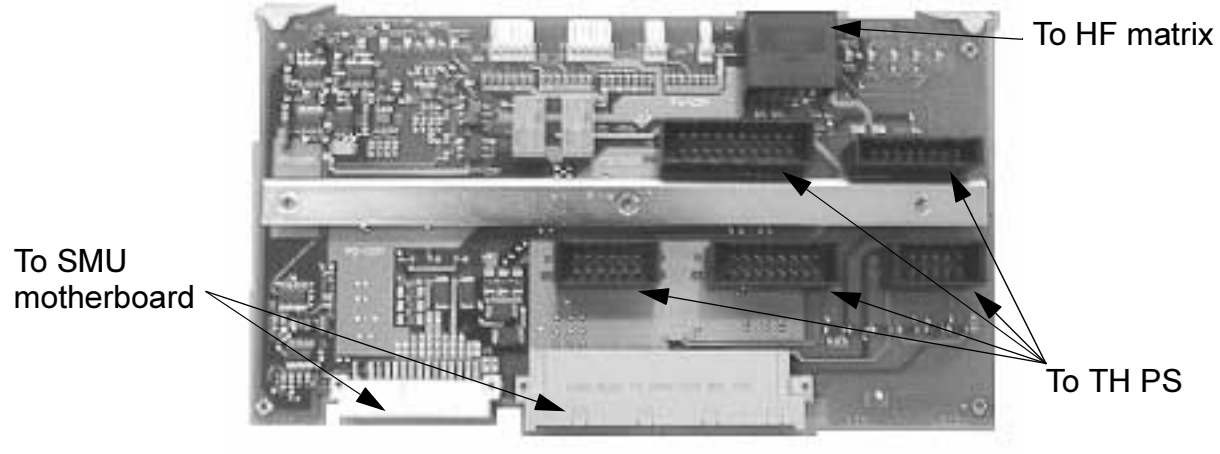


TH PS Input Board

The TH PS input board receives dc voltages (+5 Vd, ±5 Va, +12 Vr, ±15 Va, ±20 Va, ±35 Va, ±60 Va, ±135 Va, and ±250 Va) from the testhead power supply (TH PS), and supplies the voltages to the testhead. (Vd is for digital, Vr is for relays, and Va is for analog.)

The TH PS input board includes the temperature sensor, TS1.

Figure 2-49 TH PS Input Board



Testhead CPU Board

The testhead CPU board receives commands from the system controller, by way of the optical interface in the system controller and the optical cables, and controls the testhead. The testhead CPU board transfers the SMU measurement data, status of the testhead, and so on, to the system controller.

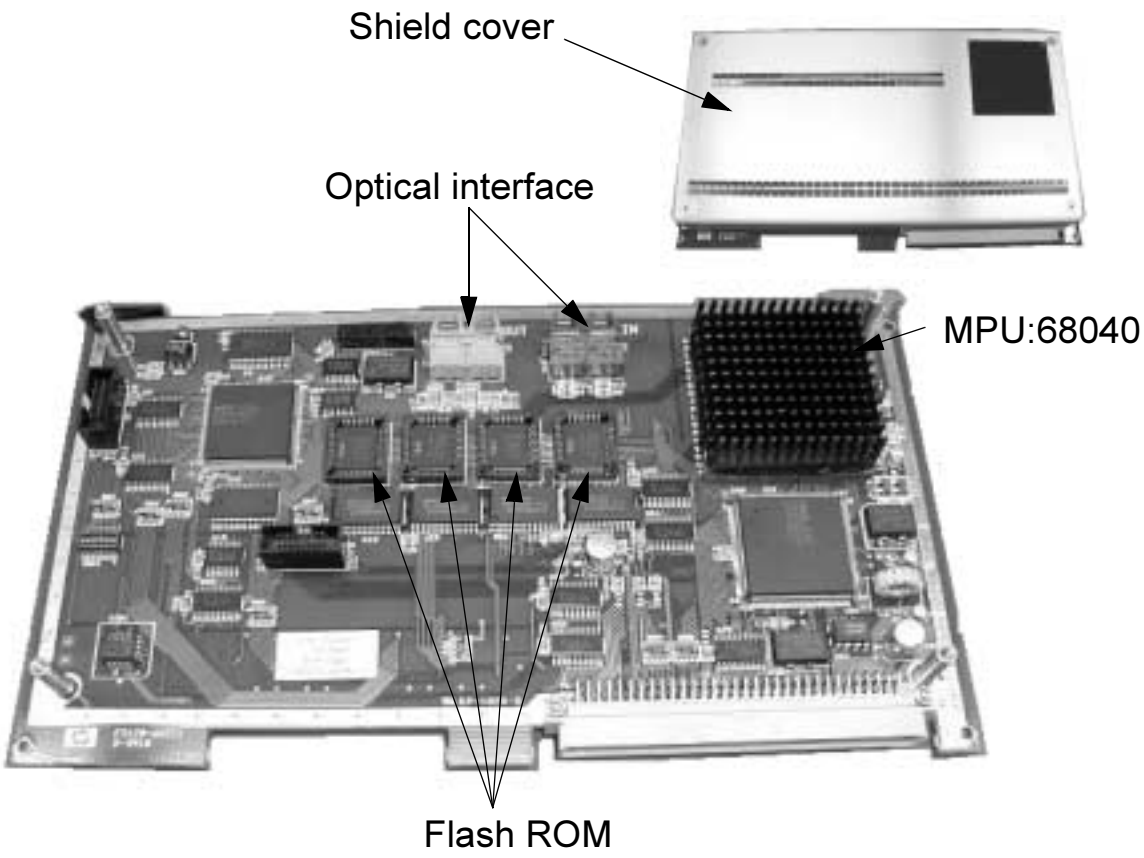
The data between the system controller and the testhead CPU is buffered and asynchronous, so the waiting time for command execution is minimized.

The testhead CPU board is covered by an aluminum shield and includes the following components:

Optical interface:	four terminals (IN: clock in, data in; OUT: clock out, data out)
Microprocessor unit:	Motorola 68040 (25 MHz)
Flash ROM:	boot loader, firmware, and power line frequency information

When the wafer prober sense switch or the interlock switch (two interlock contact pins) is opened, the testhead hardware disables all the testhead outputs by opening relays and turns off the OUTPUT ENABLED LED. This is done with a simple circuitry without the testhead CPU's intervention. However, the testhead CPU board does monitor the status of these two switches and informs the system controller of their status. For more details on interlock, see "Interlock and Sensors".

Figure 2-50 Testhead CPU Board



Interlock and Sensors

Figure 2-51 shows the interlock and sensors block diagram.

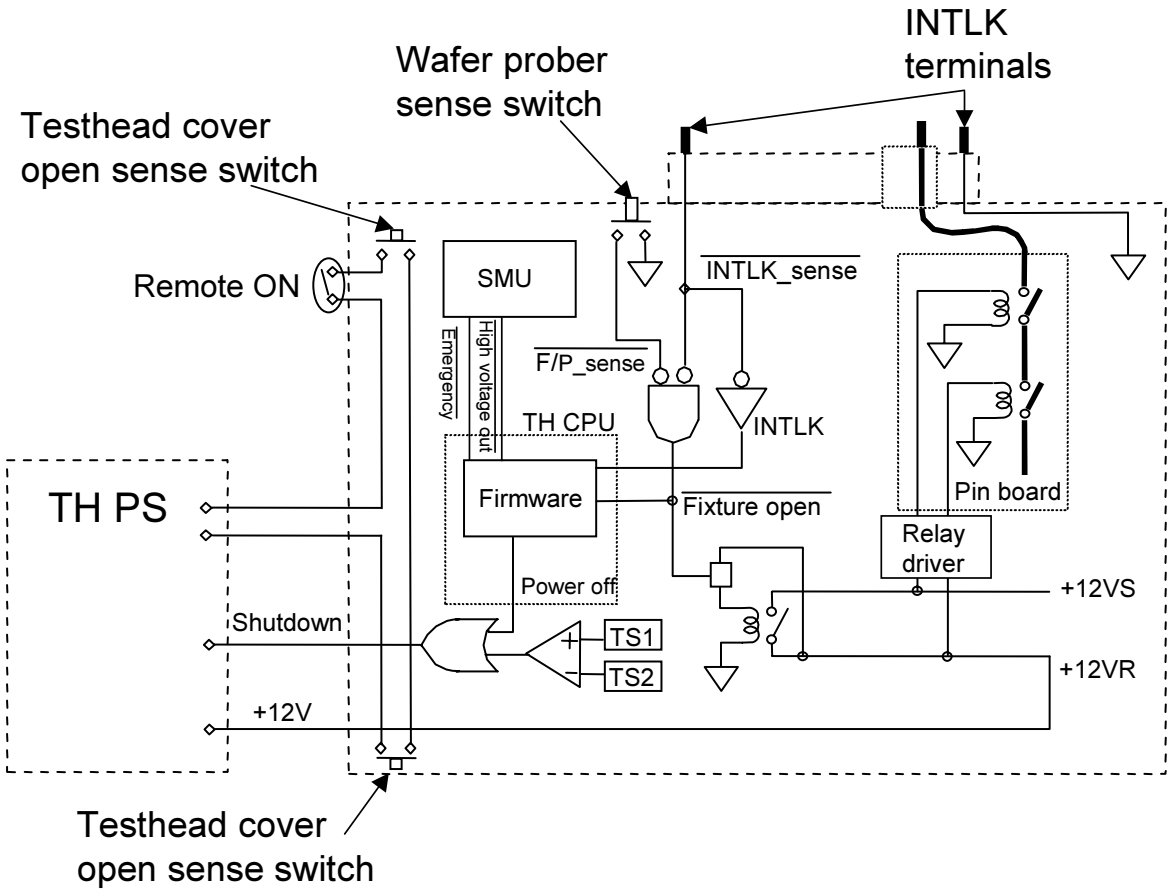
If the testhead cover open sense switches sense that the testhead top and bottom cover are open, they then disable the testhead power supply (TH PS) outputs. The remote ON switch on the testhead also disables the TH PS outputs.

The wafer prober sense switch senses if the testhead is mounted on the wafer prober, or if the fixture is installed on the testhead. The interlock (INTLK) terminals sense if the measurement pins (INTLK terminals) are touching the probe card or fixture. If either the wafer prober sense switch or the INTLK terminals open, the +12 VS disabled and the relays, located directly in front of the measurement pins, open. The firmware also initializes the SMU.

If either of the following conditions occur, the shutdown signal is sent to the TH PS and the TH PS shuts down.

- An emergency status occurs in an SMU.
- A high voltage out status occurs in an SMU.
- The temperature difference between temperature sensor 1 (TS1) on the TH PS input board and temperature sensor 2 (TS2) on the mini-motherboard 2 exceeds 20°C.

Figure 2-51 Interlock and Sensors Block Diagram



Power Distribution Unit (PDU) Operation

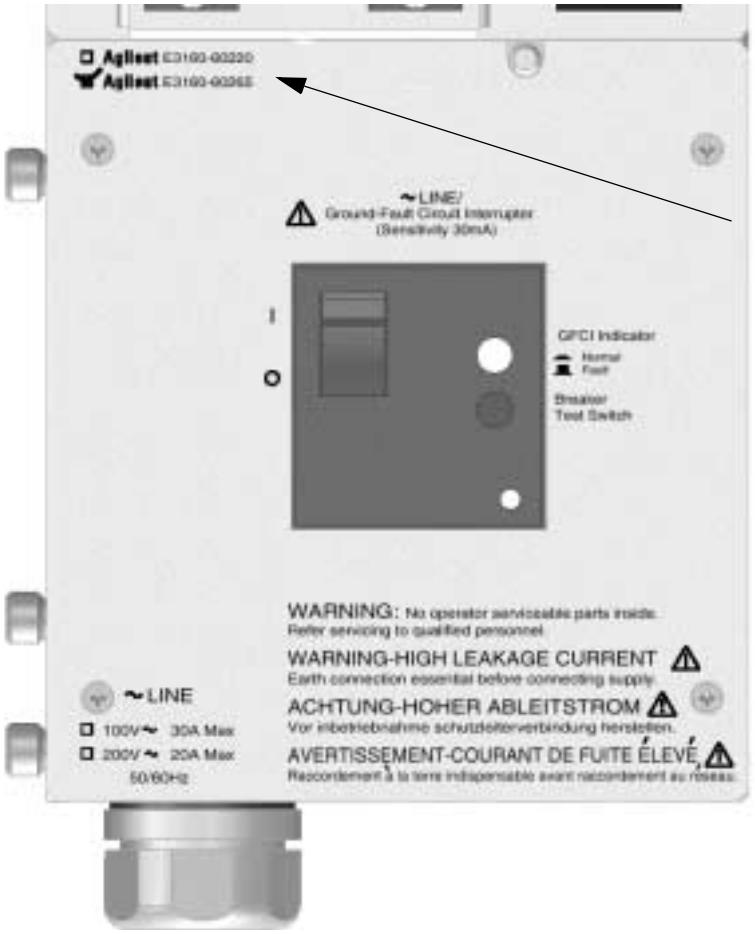
The PDU receives ac power from a power switchboard or outlet at the installation site and distributes that ac power to the following components in the system cabinet:

- Controller power outlets
- Instrument power outlets
- DVM and CMU power outlets (for the 200/208 V option only)
- EMO panel
- Testhead fan
- Cabinet fan
- Testhead power supply using an instrument power outlet

The PDU is of two types. If the serial number of the 4072A/4073A is JP30G- or JP20H-, the new type PDU is included. The protect circuit of the new PDU is different from the old type. Before reading this section, check the part number of the PDU. The part number is displayed on the panel of the main breaker. Figure 2-52shows the PDU panel of the main breaker. Table 2-12 shows voltage options and PDU part numbers.

These PDUs are replaceable at the unit level.

Figure 2-52 PDU Panel of Main Breaker



Part number

Table 2-12 Agilent 4072A/4073A Line Voltage Option and Part number of PDU

Option No.	Applicable Line Voltage	Agilent Part No. of New PDU	Agilent Part No. of Old PDU
E3102A/E3103A option 200	200 Vac	E3160-60265	E3160-60065
E3102A/E3103A option 208	208 Vac	E3160-60266	E3160-60066
E3102A/E3103A option 220	220 Vac	E3160-60267	E3160-60067
E3102A/E3103A option 240	240 Vac	E3160-60268	E3160-60068

Figure 2-53 shows the connection between the PDU and other units, as well as the location of each unit. If the PDU part number is the old type, the fan protector switches are separated by function for the TH fan and the cabinet fan as in figure 2-54.

Figure 2-55 through figure 2-57 are the overall PDU circuit diagrams.

Figure 2-53 Power Distribution Unit Block Diagram

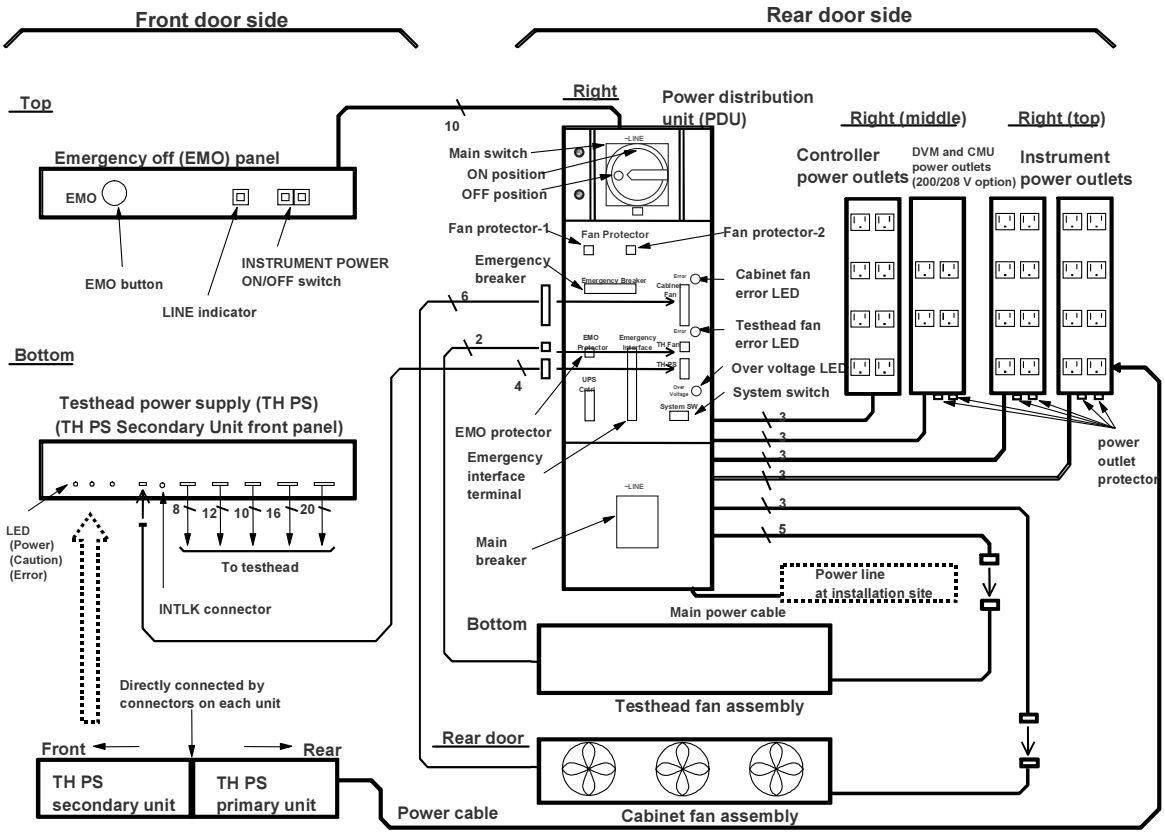


Figure 2-54 Fan Protector Switch for Old Type PDU



Main Switch

The main switch turns the ac power to the PDU on or off. The main switch can be operated without opening the rear door. The main switch has a lockout function. (See "Safety Considerations" in chapter 3.)

Main Breaker

The main breaker turns the ac power to the PDU on or off. If excessive current (over 15 A) flows through the main breaker, the ac power to the PDU is turned off.

Emergency Breaker, and System Switch

The emergency breaker turns on or off the ac power to the controller power outlets. To turn on the ac power to the controller power outlets:

1. Set the main breaker to ON.
2. Set the emergency breaker to ON.
3. Set the main switch to ON. (The LINE indicator is turned on.)
4. If the Over Voltage Error LED is lit, check the ac input voltage. See "Checking the Power Supply" in chapter 3.
5. Press the system switch.

NOTE The interval between steps 3 and 5 must be within 20 seconds. If it exceeds 20 seconds, the cabinet fan error LED is lit. In this case, turn the main switch off, and repeat steps 3 through 5.

6. When you press the INSTRUMENT POWER ON switch, the green LED in this switch is turned on and ac power is applied to the DVM and CMU power outlets and instrument power outlets.

The following events turn off the emergency breaker:

- 130% or higher input voltage is detected.
- Excessive current (over 10 A) flows through the emergency breaker.
- The EMO button is pressed.
- The EMO protector is set to the "Out" (extended) position.

- The Ext Control terminal is open.

NOTE When the emergency breaker is set to OFF, you cannot set it to ON immediately. You will need to wait approximately 3 seconds until the circuit is discharged.

Main Contactor.

The main contactor turns on or off the ac power to the DVM and CMU power outlets and instrument power outlets. To turn on the ac power to the DVM and CMU power outlets and instrument power outlets, perform the following procedure:

1. Turn on the ac power to the controller power outlets. (See **Emergency Breaker, and System Switch**.)
2. Press the INSTRUMENT POWER ON switch.

The following events turn off the main contactor:

- The emergency breaker is set to OFF. (See **Emergency Breaker**.)
- The INSTRUMENT POWER OFF switch is pressed.
- The cabinet fan protector is set to the “Out” (extended) position.
- The cabinet fan stops or slows down.
- The cabinet fan speed sensor cable is disconnected or broken.

EMO Button.

The EMO button (the large red button on the EMO panel) is used to turn off the power to all of the power outlets. When the EMO button is in its normal (“Out”) position, ac power is applied to the emergency breaker. If the EMO button is pressed, the emergency breaker is set to OFF. This turns off the ac power to all of the power outlets, and turns off the LINE indicator.

To turn on all of the power outlets again, you must set the EMO button to its normal position as follows:

1. Set the EMO button to its normal position by rotating the button clockwise.
2. Set the emergency breaker to ON.
3. If the Over Voltage Error LED is lit, check the ac input voltage. See “Checking the Power Supply” in chapter 3.
4. Press the system switch.

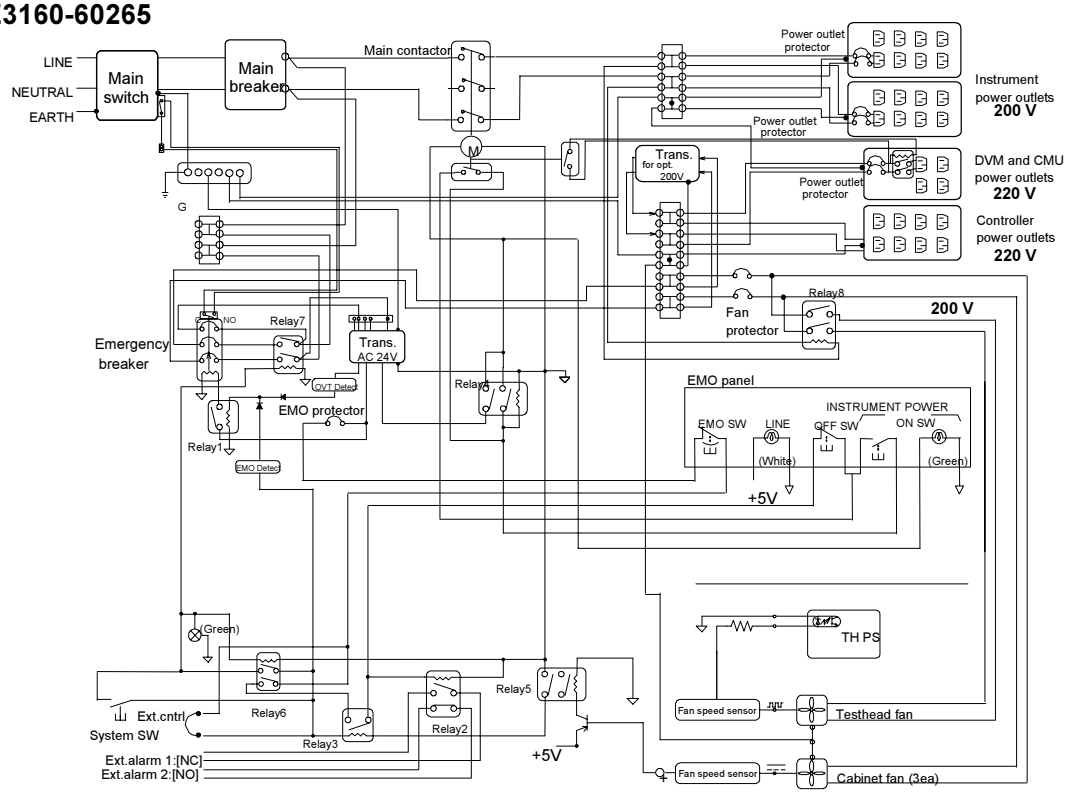
NOTE The interval between steps 2 and 4 must be within 20 seconds. If it exceeds 20 seconds, the cabinet fan error LED is lit. In this case, turn the emergency breaker off and repeat steps 2 through 4.

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5. Press the INSTRUMENT POWER ON switch.

Figure 2-55 Power Distribution Unit Circuit Diagram (200 V)

E3160-60265



E3160-60065

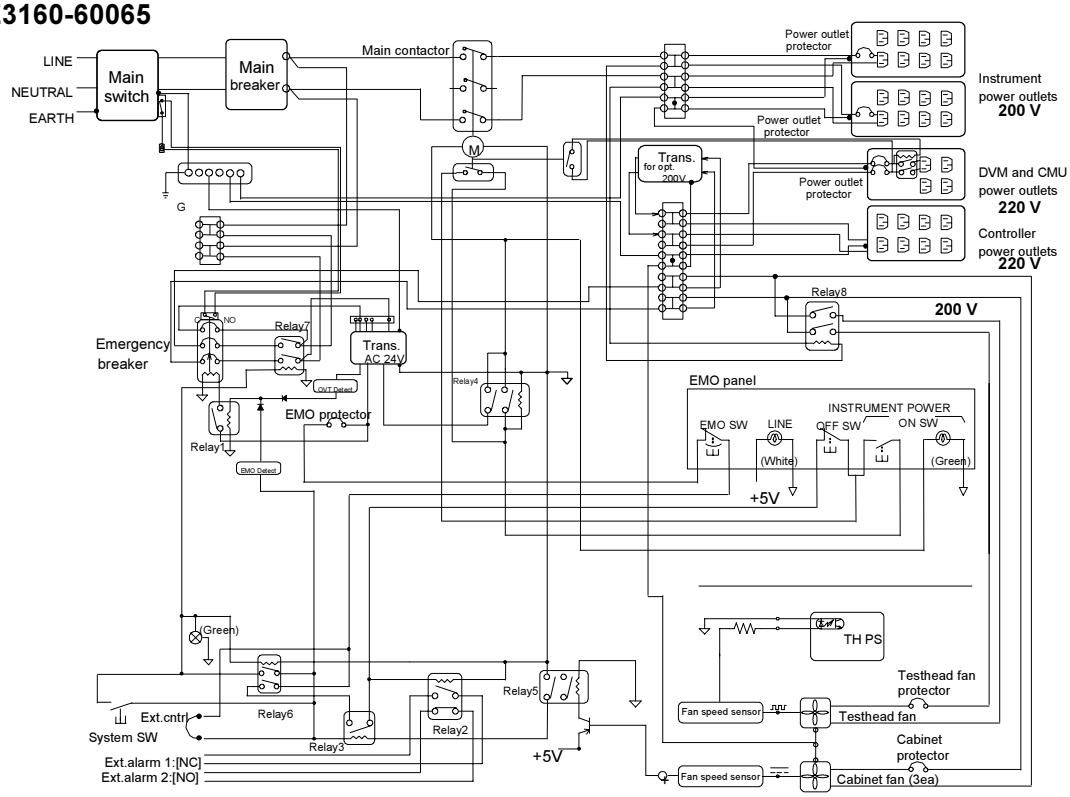
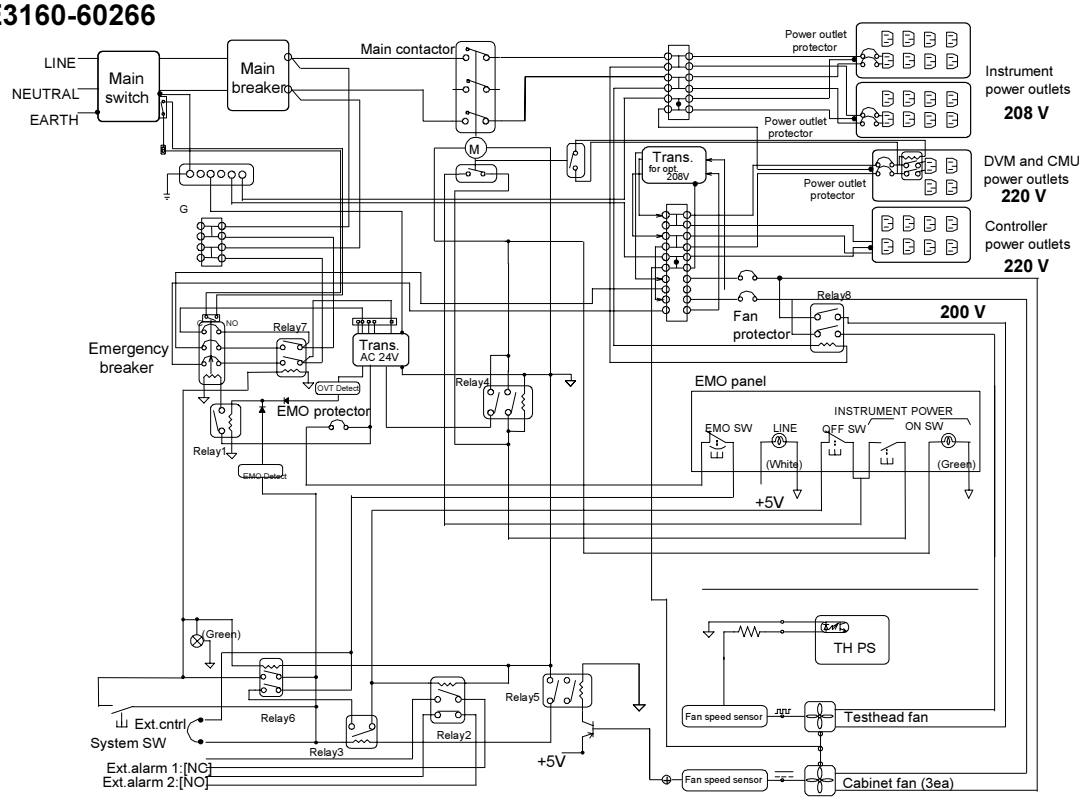


Figure 2-56 Power Distribution Unit Circuit Diagram (208 V)

E3160-60266



E3160-60066

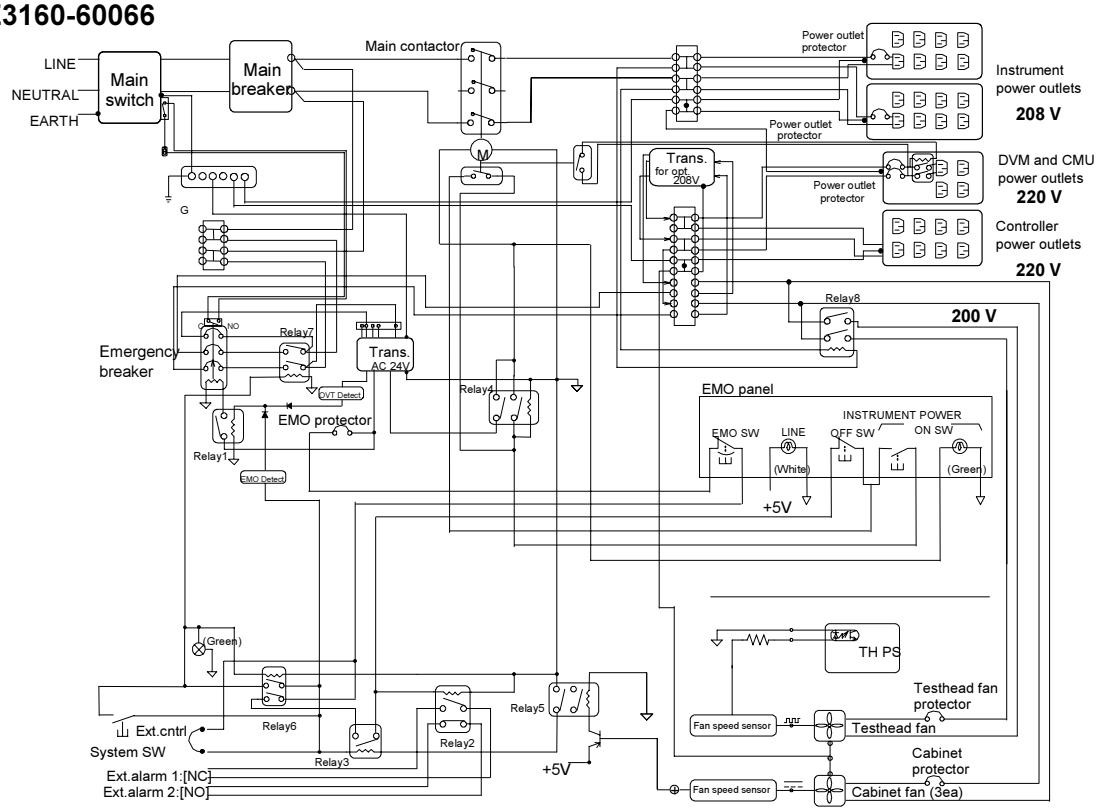
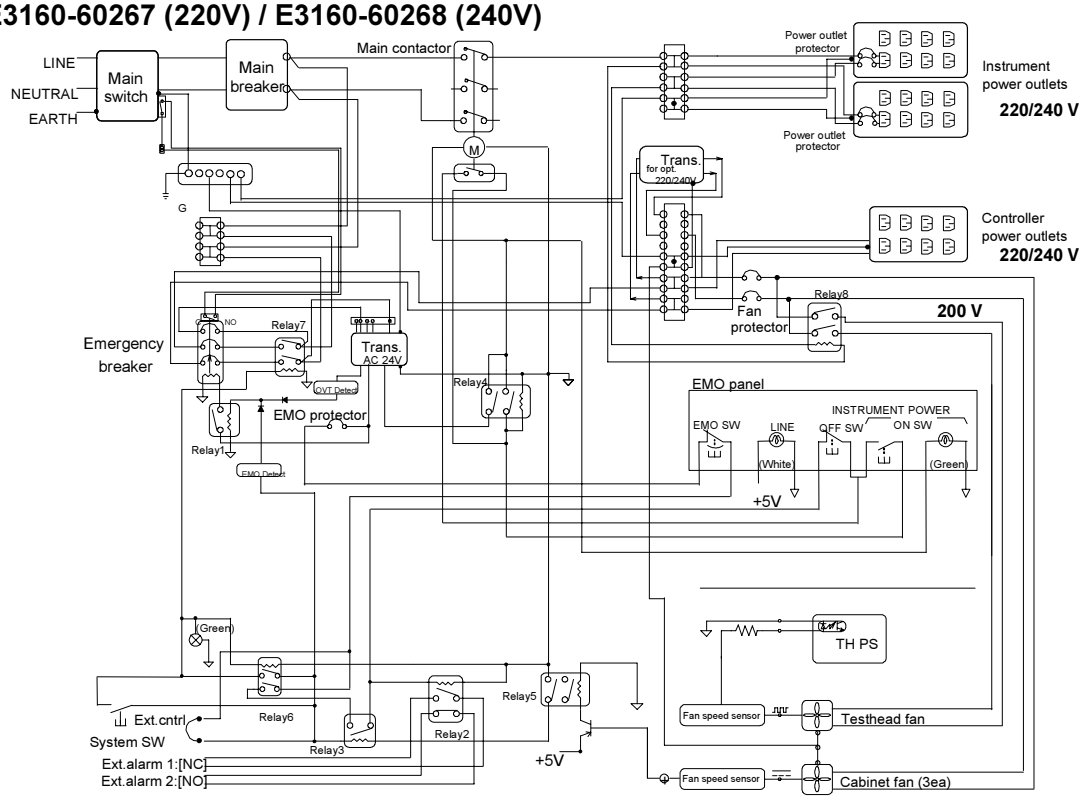
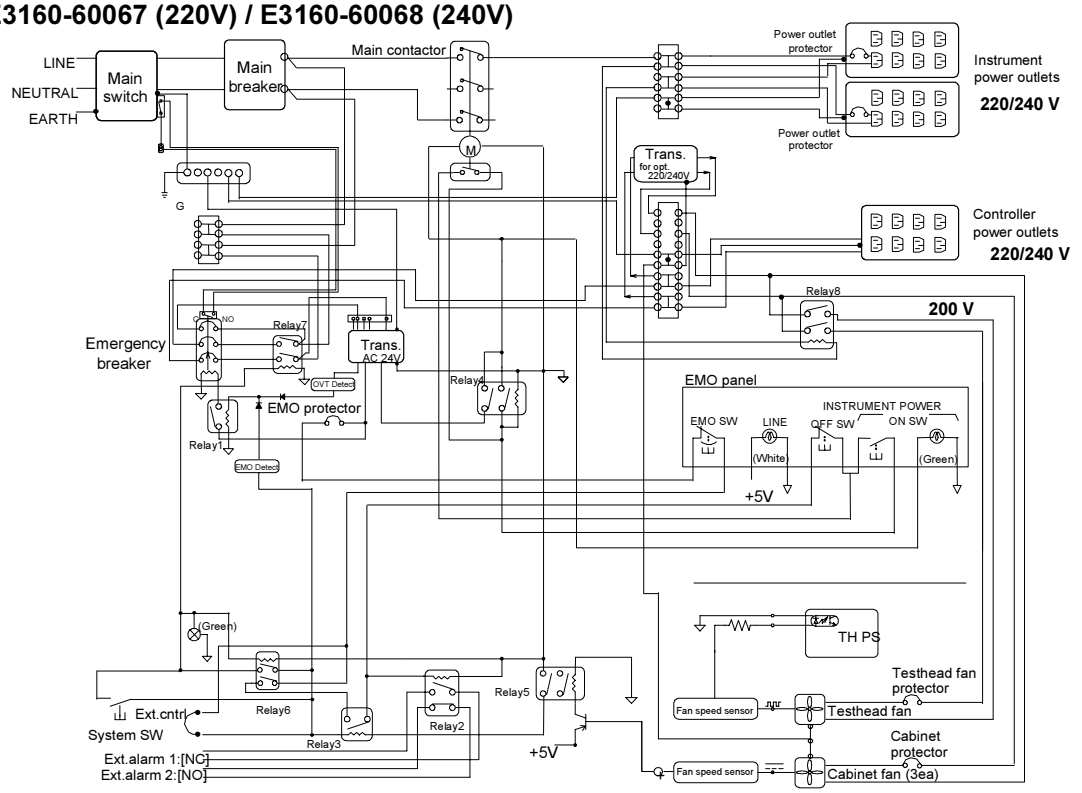


Figure 2-57 Power Distribution Unit Circuit Diagram (220/240 V)

E3160-60267 (220V) / E3160-60268 (240V)



E3160-60067 (220V) / E3160-60068 (240V)



INSTRUMENT POWER ON Switch.

The INSTRUMENT POWER ON switch on the EMO panel is used to turn on power to the instrument power outlets and DVM and CMU power outlets.

When the main breaker, emergency breaker, and main switch are set to ON and the system switch is pressed, pressing the INSTRUMENT POWER ON switch sets the main contactor to ON. This supplies the ac power to the instrument power outlets, and turns on the green LED in this switch.

INSTRUMENT POWER OFF Switch

The INSTRUMENT POWER OFF switch on the EMO panel is used to turn off the power to the instrument power outlets. When this switch is pressed, the main contactor is set to OFF, and the green LED in the INSTRUMENT POWER ON switch turns off.

LINE Indicator

The LINE indicator is turned on when the main switch, main breaker, and the emergency breaker are set to ON. This means that if the system switch is pressed, ac power is applied to the controller power outlets. Then, if the INSTRUMENT POWER ON switch is pressed, ac power is applied also to the instrument power outlets.

Over Voltage Error Indicator

The over voltage error indicator LED will light if the input voltage is 118% of nominal, or higher. Also, 130% or higher input voltage causes the emergency breaker to turn off. If this LED is lit, check the ac input voltage. (See "Checking the Power Supply" in chapter 3.)

EMO Protector

The EMO protector is set to the "Out" (extended) position if an excessive current (over 3 A) flows through the Emergency Interface terminal. This causes the emergency breaker to turn off, turns off the ac power to all the power outlets, and turns off the LINE indicator. This functions the same as pressing the EMO button.

Fan Protector (Only for new type of PDU)

The fan protector -1 or the fan protector -2 is set to the "Out" (extended) position if an excessive current (over 2 A) flows into the cabinet fan and the testhead fan. The cabinet fan then stops and the main contactor is set to OFF, ac power to the DVM and CMU power outlets and instrument power outlets is turned off, and the green LED in the INSTRUMENT POWER ON switch is turned off. However, the testhead fan also stops and the PDU turns off the testhead power supply.

To recover from this situation after troubleshooting:

1. Press the fan protector -1 and -2 to set it to the "In" (retracted) position.
2. Set the emergency breaker to OFF.
3. Set the emergency breaker to ON.

Cabinet Fan Protector (Only for old type of PDU)

The cabinet fan protector is set to the "Out" (extended) position if an excessive current (over 2 A) flows into the cabinet fan. The cabinet fan then stops and the main contactor is set to OFF, ac power to the DVM and CMU power outlets and instrument power outlets is turned off, and the green LED in the INSTRUMENT POWER ON switch is turned off.

To recover from this situation after troubleshooting:

1. Press the cabinet fan protector to set it to the "In" (retracted) position.
2. Set the emergency breaker to OFF.
3. Set the emergency breaker to ON.

Testhead (TH) Fan Protector (Only for old type of PDU)

The TH fan protector is set to the "Out" (extended) position if an excessive current (over 2 A) flows into the testhead fan. The testhead fan stops and turns off the testhead power supply.

Power Outlet Protector

The power outlet protector is set to the "Out" (extended) position if an excessive current (over 2 A for the DVM and CMU power outlets; over 10 A for the instrument power outlets) flows into the power outlets. This turns off the ac power to the power outlets.

Cabinet Fan Error Indicator

The cabinet fan error indicator LED will be lit if one of the following occurs:

- The cabinet fan stops or slows down.
- The cabinet fan speed sensor cable is disconnected or broken.
- The fan protector or the cabinet fan protector is set to the "Out" (extended) position.
- More than 20 seconds elapses between turning on the main switch and the system switch.

Testhead Fan Error Indicator

The testhead fan error indicator LED will be lit if one of the following occurs:

- The testhead fan stops or slows down.
- The testhead fan speed sensor cable is disconnected or broken.
- The fan protector or the testhead fan protector is set to the "Out" (extended) position.

Emergency Interface Terminals

The emergency interface terminals allow users to connect an extra emergency off switch, alarm, or signal lamp that will operate when an emergency occurs.

Ext. Control — Users can connect these terminals to an extra emergency off switch or relay outside the 4072A/4073A. Devices other than the switch and relay cannot be connected.

The voltage at this terminal is 24 Vac.

Ext. Alarm 1 (NC) — Users can connect these terminals to a device, such as a signal lamp or alarm, to indicate that the 4072A/4073A has an emergency. The terminals are internally connected to a relay that is closed under normal conditions.

The maximum input voltage/current rating to this terminal is 24 Vac/3 A.

Ext. Alarm 2 (NO) — Users can connect these terminals to a device, such as a signal lamp or alarm, to indicate that the 4072A/4073A has an emergency. The terminals are internally connected to a relay that is open under normal conditions.

The maximum input voltage/current rating to this terminal is 24 Vac/3 A.

NOTE Under normal conditions, the tester is turned on and works correctly.

Testhead Power Supply Operation

The testhead power supply receives ac power from an instrument power outlet in the system cabinet and supplies dc voltage to the testhead.

The testhead power supply consists of a primary unit and a secondary unit. The primary unit receives ac power and supplies dc voltage (385 V) to the secondary unit. The secondary unit regulates the dc voltage from the primary unit and supplies dc voltages to the testhead.

WARNING **The output connectors on the secondary unit front panel have a maximum of 250 Vdc output voltage.**

When you connect or disconnect the testhead power cables to or from the testhead, turn off the testhead power supply, and verify that the green LED on the testhead power supply goes out. Do *not* touch the output connectors when the testhead power supply is turned on.

The testhead power supply is turned off when one of the following conditions occur:

- The testhead fan stops or slows down.
- The testhead fan speed sensor cable is disconnected or broken.
- The fan protector -1 or -2 is set to the “Out” (extended) position.
- The power outlet protector on the instrument power outlets is set to the “Out” (extended) position.
- The testhead cover is removed.
- The Power switch for the testhead is set to Off.
- The Line switch on the rear of the testhead power supply is set to Off.
- The INSTRUMENT POWER switch is set to OFF.
- The testhead power supply is in an over-current protection status.
- The testhead power supply is in an over-voltage protection status.
- The testhead power supply is in an under-voltage protection status.
- The testhead power supply is in an overheat protection status.
- The temperature difference between the two temperature sensors in the testhead (in the air-cooled area where the SMUs, CPU, and ADC are installed) exceeds 20°C.
- The SMU output is in an over-voltage status (approximately 130 V).
- The signal cable between the testhead and the testhead power supply is broken or disconnected.
- The control cable between the PDU and the testhead power supply is broken or disconnected.

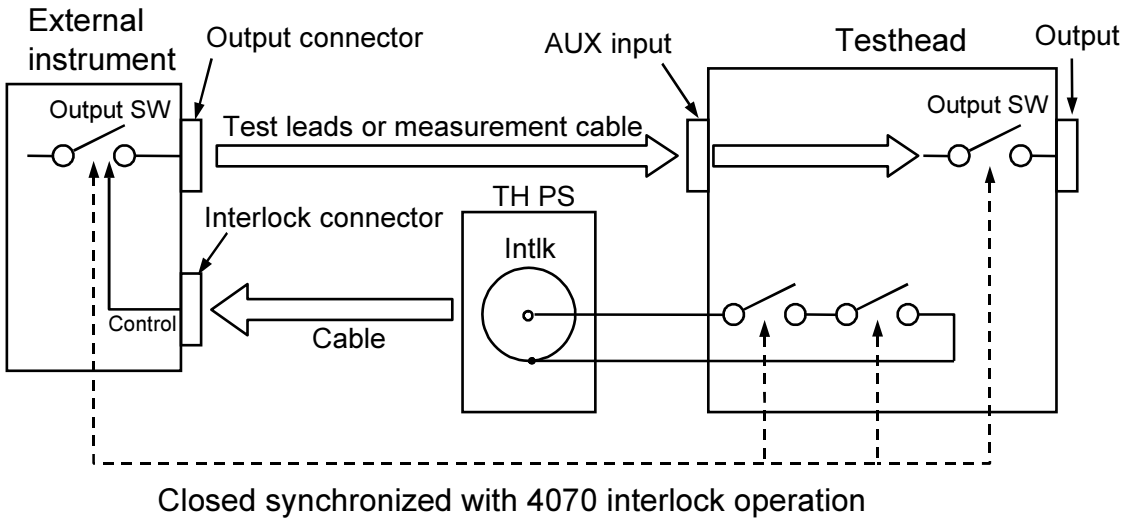
To recover from this situation after troubleshooting:

1. Press two fan protectors to set it to the “In” (retracted) position.
2. Press the power outlet protectors to set it to the “In” (retracted) position.
3. Press the INSTRUMENT POWER OFF switch.
4. Press the INSTRUMENT POWER ON switch.

The front panel of the testhead power supply secondary unit has three LEDs and seven connectors, listed below.

Power LED (green)	indicates that the condition of the testhead power supply is normal.
Caution LED (yellow)	turns on when one of the following situations occur: • The testhead fan stops or slows down. • The testhead fan speed sensor cable is disconnected or broken. • The fan protector -1 or -2 is set to the “Out” (extended) position. • The testhead power supply is in an over-current protection status. (The Error LED also turns on.) • The temperature difference between the two testhead temperature sensors is greater than 20°C. • The SMU output is in an over-voltage status (approximately 130 V). • The signal cable between the testhead and the testhead power supply is broken or disconnected. • The control cable between the PDU and the testhead power supply is broken or disconnected.
Error LED (red)	turns on when one of the following situations occur: • The testhead power supply is in an over-current protection status. (The Caution LED also turns on.) • The testhead power supply is in an over-voltage protection status. • The testhead power supply is in an under-voltage protection status. • The testhead power supply is in an overheat protection status.
Ctrl connector	must be connected to the power distribution unit.
Signal connector	must be connected to the testhead.
Out 1 connector	must be connected to the testhead.
Out 2 connector	must be connected to the testhead.
Out 3 connector	must be connected to the testhead.
Out 4 connector	must be connected to the testhead.
Intlk connector	used to control the interlock operation of an external instrument connected to the AUX input of the testhead. If the instrument's interlock connector is connected to the Intlk connector, the interlock operation of the instrument is synchronized with the 4072A/4073A interlock operation. The external instrument must have a low active interlock function, like the Agilent 4142B. A connection example is shown in figure 2-58. The connector type is BNC, the rating is 2 A/30 Vdc, and the minimum applied load rating is 10 μA/10 mVdc.

Figure 2-58 Intlk Connector Connection Example



Tester Core Process and Tester Startup Process

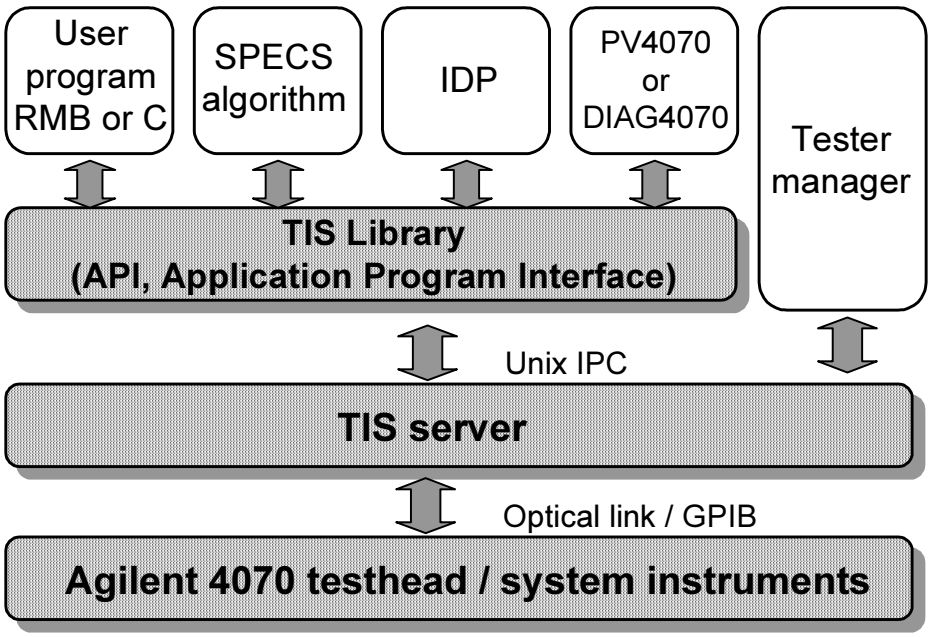
This section explains the concepts and basic operation of the tester core process (**TIS server**).

To run programs that access the 4072A/4073A tester hardware (such as diagnostics, performance verification, interactive debugging panel, SPECS algorithm, and user applications), a process called the TIS server must already be running on the system controller.

NOTE In the default setting, the TIS server will automatically start during the system controller start-up process. If you do not need to start the TIS server automatically, edit the `/etc/rc.config.d/hp4070` file as follows:

```
          :
  HP4070SYS = 0      ⇐ Change "1" to "0"
          :
```

Figure 2-59 TIS Server and Other Programs



To verify if the TIS server is running:

1. Log in to the system controller.
2. Enter the following:

```
$ ps -ef | grep tis
```

3. When the TIS server is running, you will obtain output information similar to the following:

```
root   285      1   0   16:23:03  ?   0:09 tis_online -ioff -e -a
```

(`tis_online` is the TIS server process.)

To start the TIS server, all instruments in the cabinet and the testhead must already be turned on. Otherwise, the TIS server process does not run or is terminated. For example, if you turn on the system controller first, and then turn the instruments and the testhead on, the TIS server either will not run or will be terminated when you turn on the instruments and the testhead.

If you turn off the testhead power when the TIS server is running, the TIS server will be terminated.

To manually restart the TIS server, execute `/opt/hp4070/bin/hp4070 -start` as follows:

```
$ hp4070 -start
```

Then, verify that the `tis_online` process is running. It takes approximately one minute for the TIS server to be ready once it is started. You can monitor the TIS server's startup process by viewing the tester event log file `/var/opt/hp4070/syslog4070`:

```
$ tail -f /var/opt/hp4070/syslog4070
```

Figure 2-60 Event Log File Example (TIS Server Startup)

```
Feb 16 16:23:04 1998 hpyidmaj:tis_online:Start TIS Daemon
Feb 16 16:23:05 1998 hpyidmaj:tis_online:synclock
Feb 16 16:23:05 1998 hpyidmaj:tis_online:initHardware
Feb 16 16:23:05 1998 hpyidmaj:tis_online:execute addon/start
Feb 16 16:23:05 1998 hpyidmaj:tis_online:initialize HP-IB instruments
Feb 16 16:23:11 1998 hpyidmaj:tis_online:initialize TestHead
Feb 16 16:23:11 1998 hpyidmaj:tis_online:Opt I/F Card Selftest
Feb 16 16:23:25 1998 hpyidmaj:tis_online:Checking TestHead Power-on
Feb 16 16:23:26 1998 hpyidmaj:tis_online:Abort Test Head
Feb 16 16:23:26 1998 hpyidmaj:tis_online:Wait Test Head OPC
Feb 16 16:23:26 1998 hpyidmaj:tis_online:Test Head reset start
Feb 16 16:23:26 1998 hpyidmaj:tis_online:Test Head selftest start
Feb 16 16:23:53 1998 hpyidmaj:tis_online:Test Head Selftest pass
Feb 16 16:23:53 1998 hpyidmaj:tis_online:Test Head selftest finish
Feb 16 16:23:53 1998 hpyidmaj:tis_online:Test Head ask config
Feb 16 16:23:53 1998 hpyidmaj:tis_online:checking connection
Feb 16 16:23:53 1998 hpyidmaj:tis_online:synclock
Feb 16 16:23:53 1998 hpyidmaj:expmon4070:Exception Monitor Ready
Feb 16 16:23:53 1998 hpyidmaj:tis_online:######Ready to Start#####
```

The message `######Ready to Start#####` indicates the TIS server is ready.

As shown in figure 2-60, the TIS server initializes the tester hardware and performs the testhead self test.

To manually stop the TIS server, enter:

```
$ hp4070 -shutdown
```

Tester Startup Process

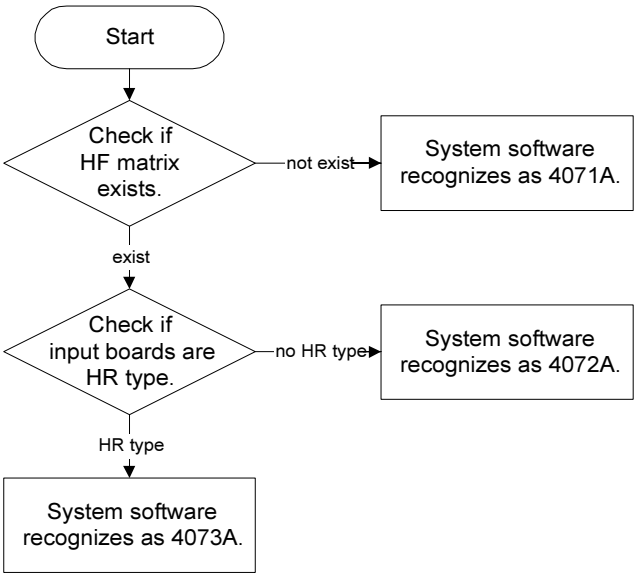
In the TIS server start-up process, the following occurs:

- Displays the copyright message
- Starts up and initializes the TIS daemon
- Waits for the testhead to start up
- Executes testhead self-test
- Confirms and initializes the standard measurement resources
  - ❑ Testhead firmware revision
  - ❑ Presence of the SMU
  - ❑ SMU type (MPSMU, HPSMU, or HRSMU)
  - ❑ SMU revision
  - ❑ Pin Board type (Pin Board or HR Pin Board)
  - ❑ Presence of the GNDU
  - ❑ GNDU revision
  - ❑ Presence of the CMU (with option 001)
  - ❑ Presence of the DVM
  - ❑ Connections between the SMUs/GNDU and input boards
  - ❑ Connections between the CMU and AUX ports 7, 8
  - ❑ Connections between the DVM and AUX ports 5, 6
- Confirms and initializes additional measurement resources
  The additional measurement resources are described in the `/opt/hp4070/addon/start` file.

Checking the Matrix Configuration

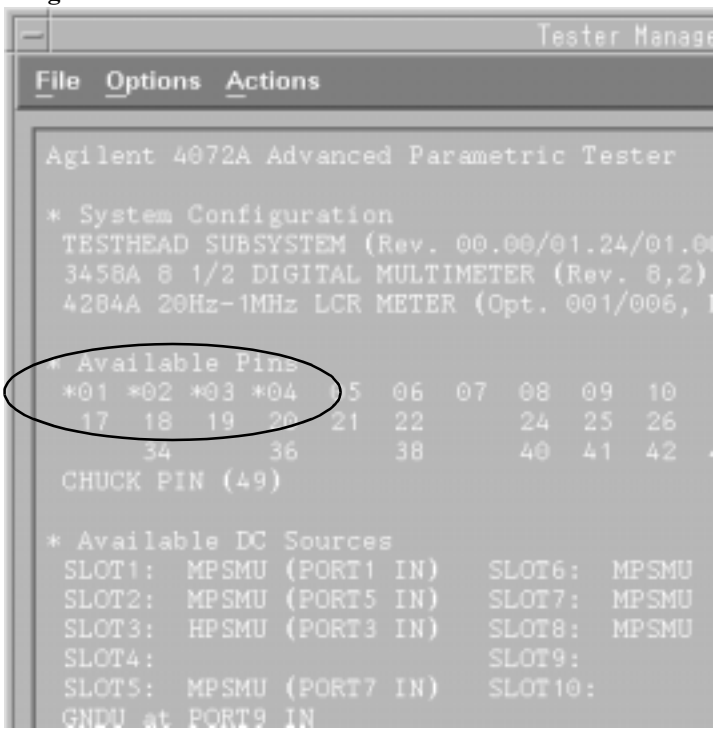
In the tester start-up process (`hp4070 -start`), the TIS daemon checks the tester (4071A, 4072A, or 4073A) and board type used in the matrix. Figure 2-61 shows the procedure used by the TIS daemon to check the tester type.

Figure 2-61 Checking Tester Type



The Tester Management Panel (`hp4070 -login` command) displays an asterisk (*) beside the pin board number if a high-resolution type board(s) is installed in the 4072A or if a standard type board(s) is installed in the 4073A, as shown in figure 2-62.

Figure 2-62 Tester Management Panel with Unstable Boards



Miscellaneous Software Operations

This section explains the following commands:

`/opt/hp4070/bin/sys4070`

`/opt/hp4070/bin/hp4070`

`/opt/hp4070/bin/cal4070`

`/opt/hp4070/bin/exph4070`

For performance verification (`/opt/hp4070/bin/pv4070`), see the *System Calibration Guide*.

For diagnostics (`/opt/hp4070/bin/diag4070`), see chapter 3.

For interactive debugging panel (`/opt/hp4070/bin/idp4070`), see the *User's Guide*.

For PG connection (`/opt/hp4070/bin/pgconn4070`), see the *User's Guide*.

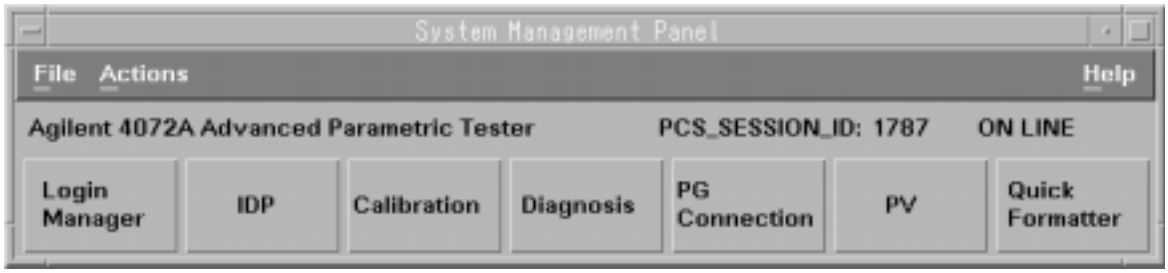
For off-line configuration (`/opt/hp4070/bin/offconf4070`), see the *Agilent SPECS User's Guide*.

The `/opt/hp4070/bin/sys4070` Command

The `/opt/hp4070/bin/sys4070` command opens the System Management Panel that is used to launch the following windows:

- Tester Management Panel (`/opt/hp4070/bin/hp4070`)
- Interactive Debugging Panel (`/opt/hp4070/bin/idp4070`)
- Calibration (`/opt/hp4070/bin/cal4070`)
- Diagnostics (`/opt/hp4070/bin/diag4070`)
- PG Cable Connection (`/opt/hp4070/bin/pgconn4070`)
- Performance Verification (`/opt/hp4070/bin/pv4070`)
- Quick Formatter (`/opt/hp4070/bin/view4070`)

Figure 2-63 System Management Panel



You can also control and monitor the TIS server using the `Actions` menu as follows:

TIS Daemon Start executes the `/opt/hp4070/bin/hp4070 -start` command.

TIS Daemon Stop executes the `/opt/hp4070/bin/hp4070 -stop` command.

Log viewer opens the Log viewer, and displays the status of TIS server (This is the same as the `tail -f /var/opt/hp4070/syslog4070` command.

The `/opt/hp4070/bin/hp4070` Command

The `/opt/hp4070/bin/hp4070` command has various options other than the `-start` and `-shutdown` options explained in "Tester Core Process and Tester Startup Process".

`-start`	starts the TIS server.
`-shutdown`	stops the TIS server.
`-login`	creates a test session, initializes the tester hardware, and performs the SMU self-calibration. The default execution mode is "online". You can add `offline` to select the offline mode. You can add `-no-smucal` to skip the SMU self-calibration.
`-logout`	finishes the test session.
`-init`	initializes the tester hardware. This option is effective only if you are already logged in.
`-portmap file`	specifies the port number mapping file.
`-optimize number`	specifies the optimization level (0, 1, 2, or 3).
`-ccomp file`	specifies the level two capacitance compensation file.
`-smucal`	performs SMU self-calibration. This option is effective only if you are already logged in.
`-show`	shows the tester configuration information. This option is effective only if you are already logged in.

When you run the `hp4070` command without options, a dialog box (hp4070 Login window) for selecting the execution mode (ON LINE or OFF LINE) appears. After selecting the execution mode, a test session starts and the system configuration is displayed in the Tester Management Panel window.

Figure 2-64 Tester Management Panel with hp4070 Login

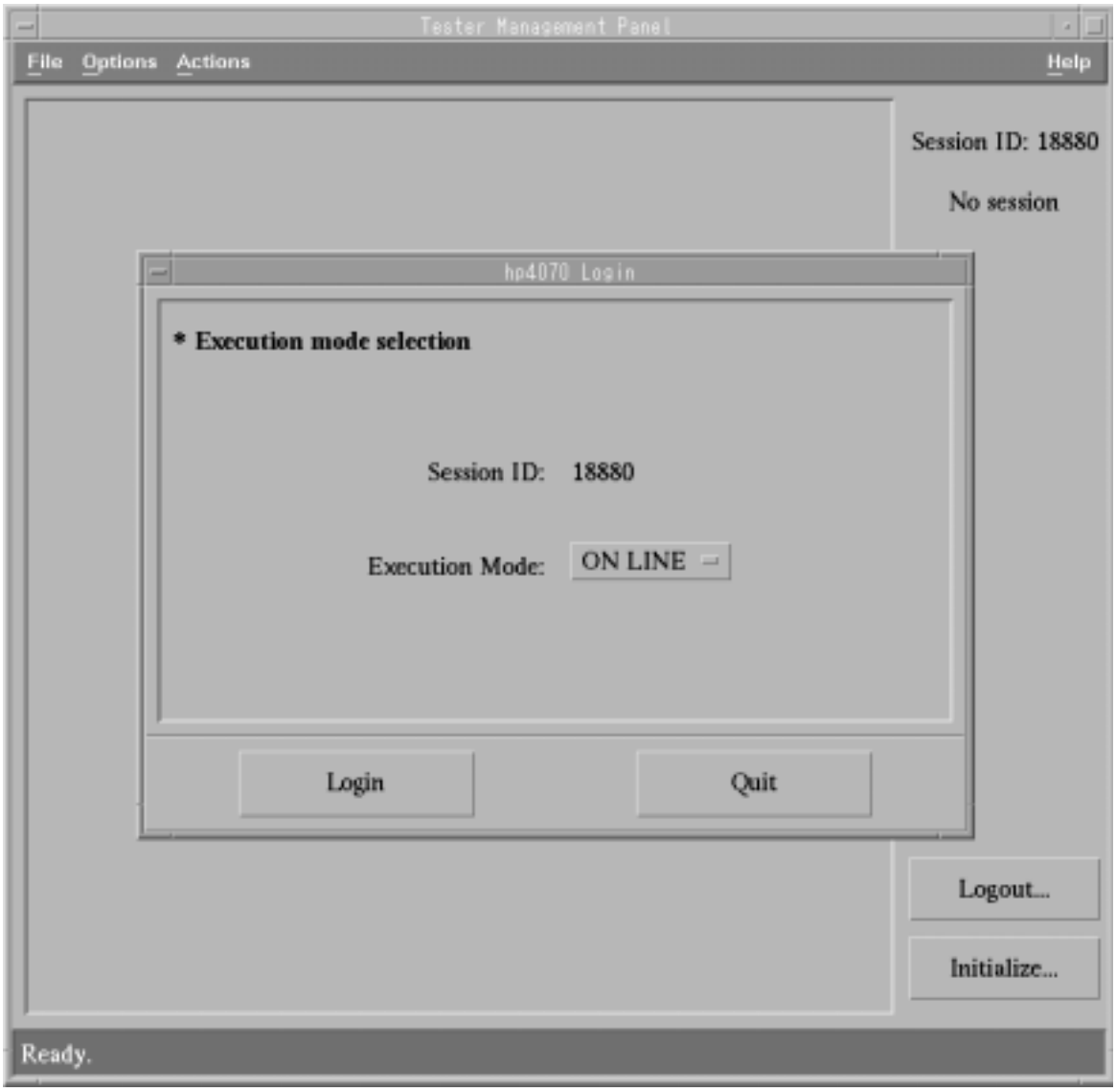
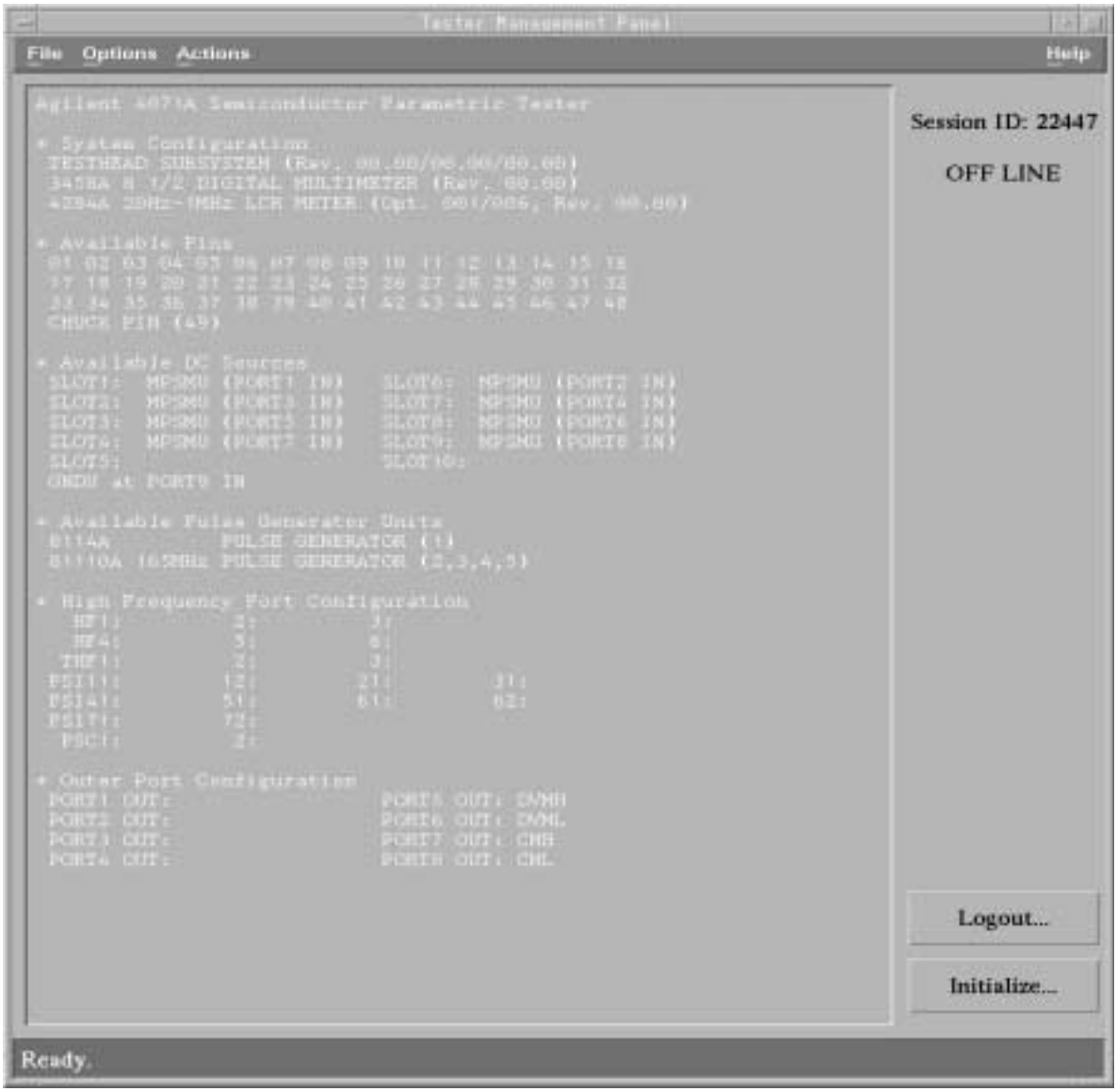


Figure 2-65 Login Screen for Tester Management Panel



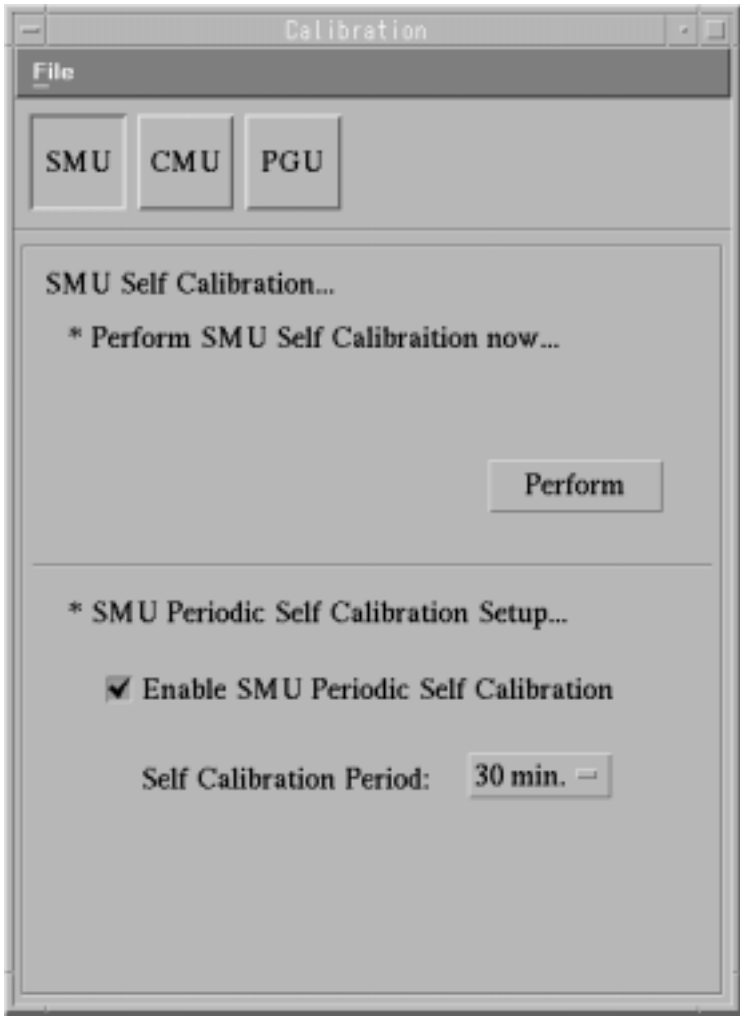
The HP BASIC program `/opt/hp4070/bin/START` also executes `hp4070 -login`.

For more information regarding the `hp4070` command and the `/opt/hp4070/bin/START` program, see the *User's Guide*.

The `/opt/hp4070/bin/cal4070` Command

The `/opt/hp4070/bin/cal4070` command performs the SMU self-calibration, the CMU error compensation, and the PGU calibration.

Figure 2-66 Calibration Window for SMU Self-Calibration

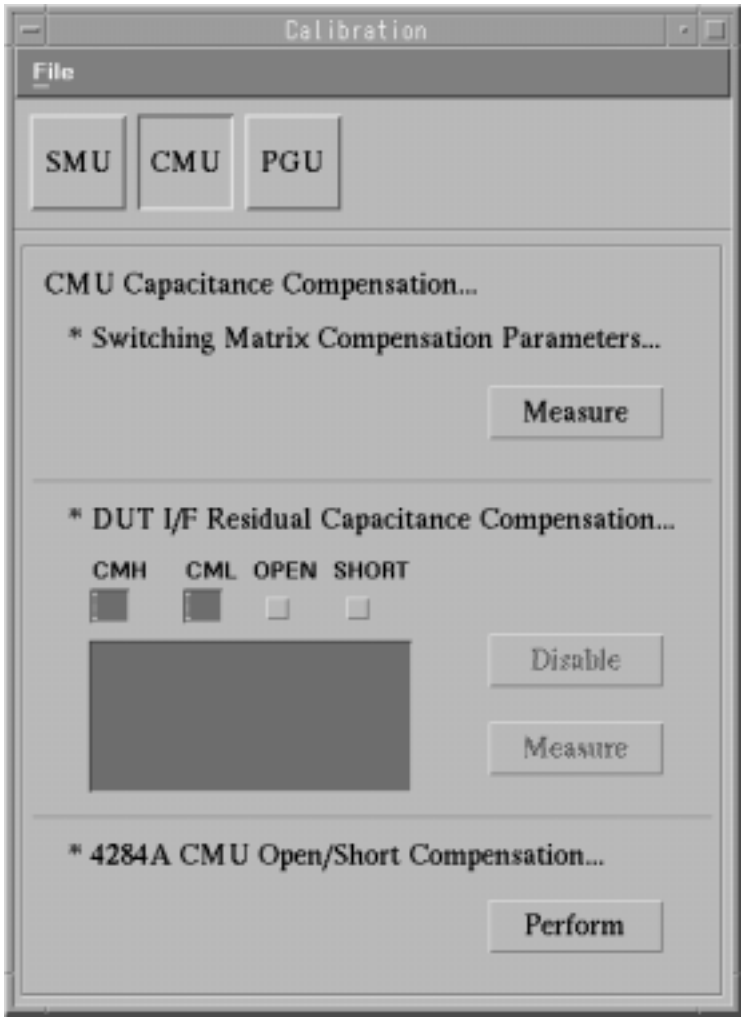


The SMU self-calibration compensates the SMU temperature error. For the 4073A, the input board and matrix motherboard errors are also compensated in the SMU self-calibration.

Agilent Technologies recommends users perform an SMU self-calibration at least once a day, and also when the temperature has changed more than 3°C since the last SMU self-calibration. Agilent Technologies also recommends users set up an automatic execution of the SMU self-calibration using the SMU Periodic Self-Calibration Setup area in the Calibration window. (Click the check button for `Enable SMU Periodic Self-Calibration` and choose the desired self-calibration period from the `Self-Calibration Period` option menu.)

The SMU self-calibration is also done when the `hp4070 -login` command is executed.

Figure 2-67 Calibration Window for CMU Error Compensation



There are three CMU error compensation levels:

- 4284A CMU Open/Short Compensation

  This data is for the 16048E 4-meter test leads and is stored in the CMU itself. Re-measure this data if the CMU is repaired or the test leads are replaced.

- Switching Matrix Compensation

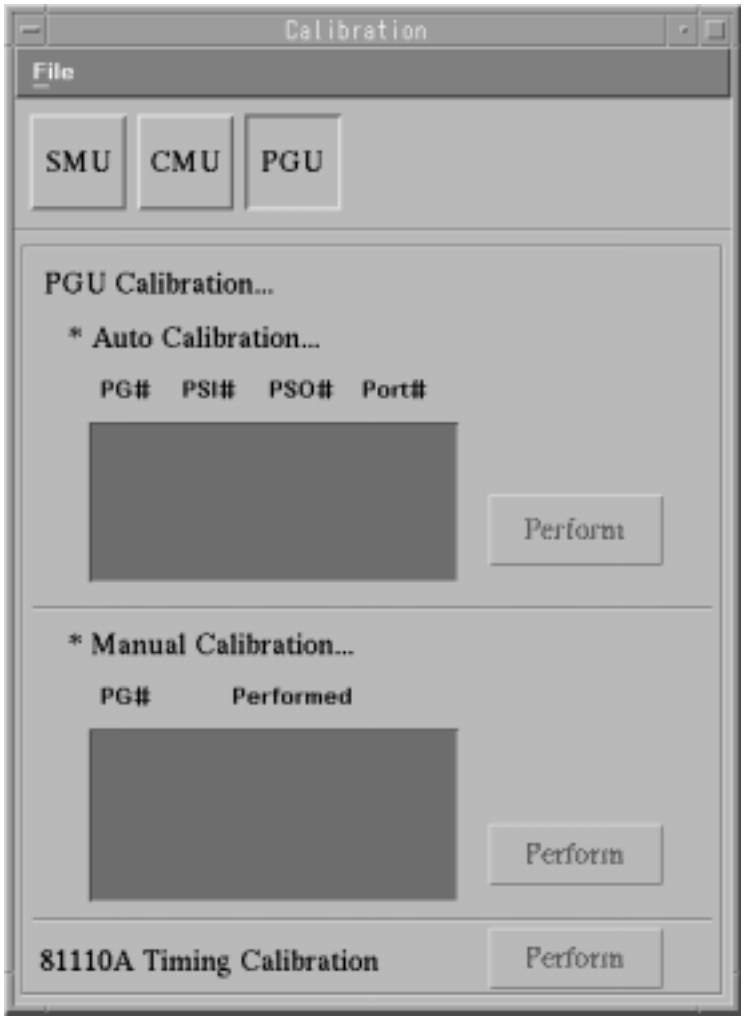
  (This is called level 1 compensation.) This data is for the testhead (compensation up to the measurement pins) and is stored in a system file. Re-measure this data if the testhead measurement pin configuration is changed.

- DUT I/F Residual Capacitance Compensation:

  (This is called level 2 compensation.) By default, error compensation is performed only up to the measurement pins. However, the `cal4070` command also provides the ability to compensate error factors beyond any two capacitance measurement pins (for example, up to the probe needles). This function is not used after repair or switching matrix configuration changes. Users can measure this data, for example, when the probe card is changed and store the data in a file.

For more information about the `cal4070` command, see the *User's Guide* and *System Calibration Guide*.

Figure 2-68 Calibration Window for PGU Calibration



The PGU calibration calibrates the PG output voltage. The PGU calibration must be done when:

- A PGU is replaced.
- A PGU is added to the 4072A/4073A.
- The system software is reinstalled.
- The calibration data file (`/etc/opt/hp4070/pgcaldata`) is deleted.
- A system-level calibration service is done.

There are two calibration levels as follows:

- Auto Calibration

  For auto calibration, the cable connection does not have to be changed, however, the auto calibration only calibrates the PGUs that can be connected to the high-resolution ADC without changing the cable connection. Therefore, the following PGUs can be calibrated by auto calibration.

  ❏ PGUs that are connected to HF ports or AUX ports directly

  ❏ PGUs that are connected to HF ports or AUX ports via the pulse switch

  The PGUs that can be calibrated are displayed in the window.

- Manual Calibration

  For manual calibration, the cable connection must be changed, however, all PGUs can be calibrated. The cable connection must be changed for PGUs when either of the following conditions apply:

  ❏ PGUs are connected to the pulse switch control (PSC) of the pulse switch.

  ❏ PGUs are not connected anywhere.

  The PGUs that can be calibrated are displayed in the window.

If the system includes a 81110A, the perform action button of the 81110A timing calibration is sensitive. The timing calibration is performed by selecting the perform action button. The timing calibration calibrates the delay time and width time of the PGU (81110A).

The `/opt/hp4070/bin/exph4070` Command

The `/opt/hp4070/bin/exph4070` command is used to display an error window if a testhead emergency occurs. For example:

- The testhead fan stops.
- A testhead power failure occurs.

To monitor the testhead emergency status, execute the `exph4070` command in the background:

```
$ exph4070 &
```

NOTE If a testhead emergency occurs, an error message is also added to the `/var/opt/hp4070/syslog4070` file.

For more information about the `exph4070` command, see the *User's Guide*.

3 Troubleshooting

This chapter provides troubleshooting and repair information for the Agilent 4072A/4073A, and contains the following sections:

- “Safety Considerations”
- “Checking the Power Supply”
- “Checking the System Controller and Software”
- “Checking the System Configuration”
- “Using the Diagnostics Program”

A troubleshooting overview for the 4072A/4073A is shown below.

1. If the 4072A/4073A loses power:

   Check the operation of the power distribution unit (PDU), emergency off (EMO) panel, cabinet fan, testhead fan, and the testhead power supply (TH PS).

   See “Checking the Power Supply”.

2. If the system controller cannot execute the `hp4070` command or cannot control the 4072A/4073A:

   Check the system controller setup and verify that the system software is installed properly.

   See “Checking the System Controller and Software”.

3. If the `hp4070` command execution results do not match the actual system configuration:

   Check the system configuration file. Also check the optical interface and the GPIB interface.

   See “Checking the System Configuration”.

4. If you have trouble with the 4072A/4073A functionality:

   Check the functionality of the testhead and the system instruments by executing the diagnostics program.

   See “Using the Diagnostics Program”.

After troubleshooting, repair the 4072A/4073A by replacing the defective part. For part replacement procedures, see chapter 4 .

After replacing a part, verify the 4072A/4073A functionality and performance by running a *full* diagnostics. Also perform the performance verification procedures that verify the replaced part. For performance verification procedures, refer to the *System Calibration Guide*. For the relationship between replaceable parts and performance verification procedures, see chapter 5 .

NOTE Several troubleshooting procedures described in this chapter require access to several components/assemblies in the 4072A/4073A system cabinet and testhead. For the location of components and assemblies, see chapter 5 .

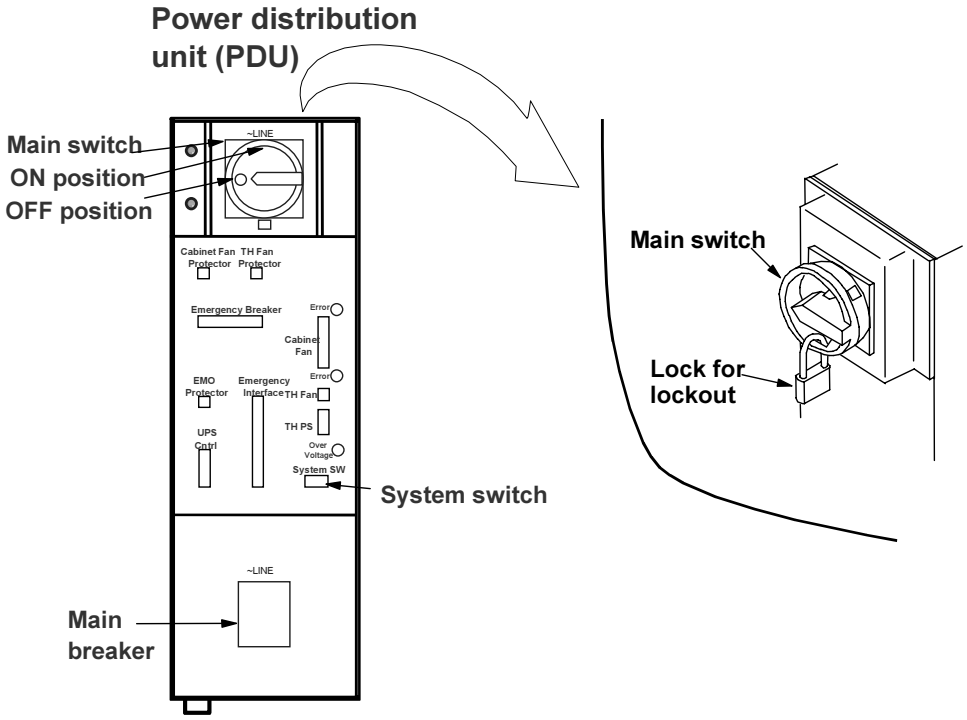
Safety Considerations

All warnings, cautions, and notes given throughout this guide must be observed to ensure the safety of both service and non-service personnel and to prevent damage to the system and any system components.

WARNING **Several procedures described in this chapter are performed with power applied and protective covers removed. Only trained service personnel, aware of the hazards involved, should perform these procedures. When troubleshooting can be performed without power applied, turn the power off. After repairs are completed, make sure all safety features are intact and are functioning properly, and that all necessary parts are connected to their protective grounds.**

WARNING **To ensure the safety of non-service personnel, use the lockout mechanism of the 4072A/4073A main switch if you leave the installation site while troubleshooting the power supply. Set the 4072A/4073A main switch to off and lock the main switch. This prevents the 4072A/4073A from being accidentally turned on by non-service personnel.**

Figure 3-1 PDU and Main Switch



Lockout procedure

1. Shut down the system controller.
2. Set the main switch to off and lock the switch.
3. Place a tag on the switch. Indicate the name of the personnel responsible for servicing the 4072A/4073A on the tag.

Release procedure

1. Open the rear door.
2. Confirm the main breaker is set to ON.
3. Confirm the emergency breaker is set to ON.
4. Unlock the main switch.
5. If the Over Voltage Error LED is lit, check the ac input voltage. See “Checking the Power Supply”.
6. Press the System switch.

NOTE The interval between steps 4 and 6 must be within 20 seconds. If it exceeds 20 seconds, the cabinet fan error LED is lit. In this case, turn the main switch off, and repeat steps 4 through 6.

7. Press the INSTRUMENT POWER ON switch.

Checking the Power Supply

If the 4072A/4073A loses power, check the operation of the power distribution unit (PDU), emergency off (EMO) panel, cabinet fan, testhead fan, and the testhead power supply (TH PS).

Before Troubleshooting the Power Supply

Before implementing the procedures described in "Troubleshooting the Power Supply", do the following:.

1. Confirm that the site power line is turned off.
2. Disconnect the main power cable from the site power line.
3. Turn the site power line on.
4. *Electrical Work Type 4:*

   Check the voltage applied to the site power line. If correct voltage does not appear, troubleshoot the site power line.
5. Turn the site power line off.
6. Disconnect the main power cable from the PDU.
7. Check the conductivity of the main power cable. If the conductivity is not approximately 0 Ω, replace the main power cable.
8. Connect the main power cable to the PDU.
9. Confirm that the site power line is turned off, then connect the main power cable to the site power line.

Troubleshooting the Power Supply

Troubleshoot the power supply using the following procedure. For the location of the components described in this procedure, see figure 3-2.

Electrical Work Type 3:

WARNING **24 V is forced to the uninsulated parts of the EMO rear panel. DO NOT TOUCH THESE PARTS.**

1. Confirm that the site power line is turned off.
2. Confirm which type of PDU is used.

NOTE The PDU is of two types. If the serial number of the 4072A/4073A is JP30G- or JP20H-, the new type of PDU is included. The protect circuit of the new PDU is different from the old type. Before you confirm the function of the PDU, check the part number of the PDU. The part number is displayed on the panel of main breaker as shown in figure 2-52. For details about voltage options and part number, see table 2-12 on page 94.

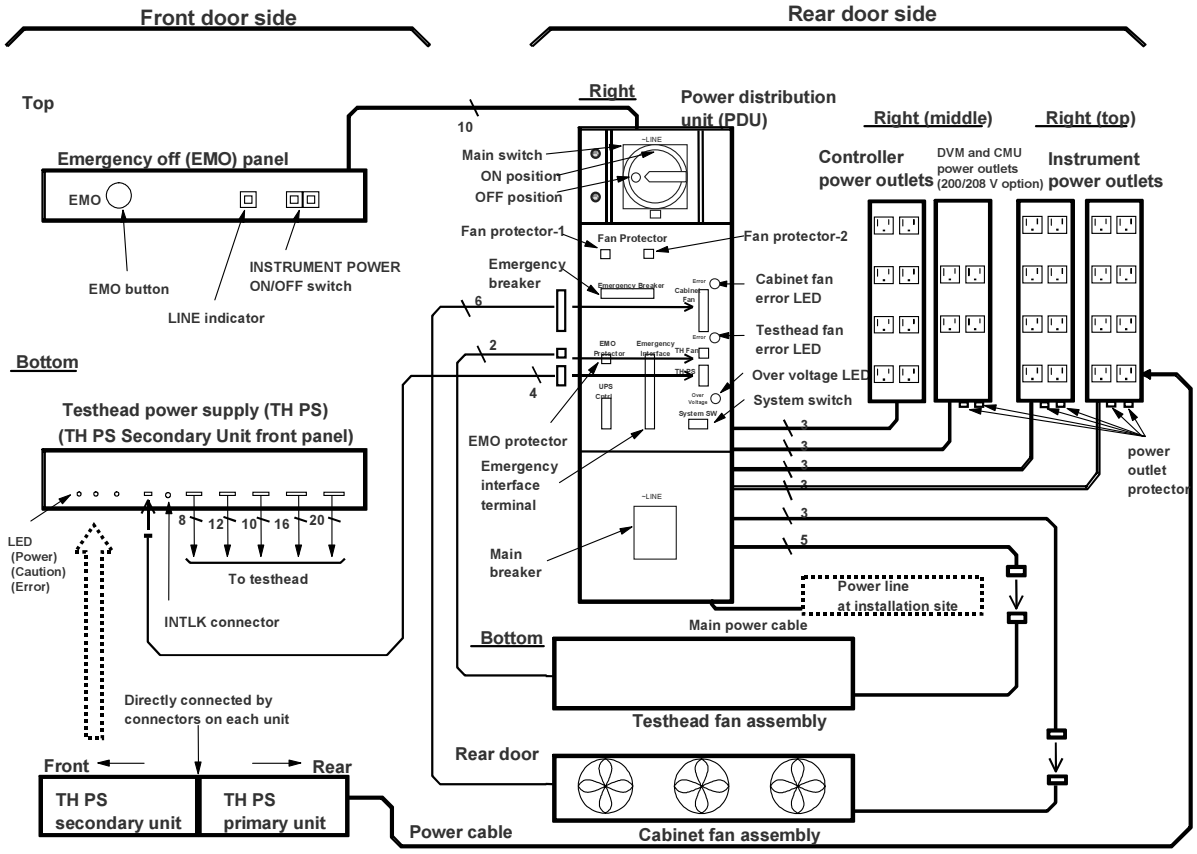
3. Disconnect all power cords from the power outlets in the system cabinet.

4. Confirm that the following cables are connected properly.
   - Signal cable between the TH Fan connector on the PDU and the testhead fan assembly
   - Signal cable between the Cabinet Fan connector on the PDU and the cabinet fan assembly
   - Signal cable between the TH PS connector on the PDU and the Ctrl connector on the testhead power supply (TH PS) front panel.
   - Cable between the EMO panel and the PDU
   - Cable between the testhead fan assembly and the PDU
   - Cable between the cabinet fan assembly and the testhead fan assembly
   - Cable between the PDU and the instrument power outlets
5. Set the Emergency Interface terminal on the PDU as follows:

   Ext Alarm 1 and 2 terminals: Do not connect any wire.

   Ext Control terminals: Short with shorting bar.
6. Turn on the site power line.

Figure 3-2 Troubleshooting the Power Supply



7. If the part number of the PDU is E3160-60265, E3160-60266, E3160-60267, or E3160-60268, set the following:

Main switch:	ON position
EMO button:	Normal (extended) position
Main breaker:	OFF position
Emergency breaker:	OFF position
EMO protector:	“In” (retracted) position
Fan protector -1:	“In” (retracted) position
Fan protector -2:	“In” (retracted) position
Outlets protector:	“In” (retracted) position

   If the part number of the PDU is E3160-60065, E3160-60066, E3160-60067, or E3160-60068, set the following:

Main switch:	ON position
EMO button:	Normal (extended) position
Main breaker:	OFF position
Emergency breaker:	OFF position
EMO protector:	“In” (retracted) position
Cabinet fan protector:	“In” (retracted) position
Testhead fan protector:	“In” (retracted) position
Outlets protector:	“In” (retracted) position

8. Check the power distribution unit (PDU), cabinet fan, and the emergency off (EMO) panel. See table 3-1.
9. Check the testhead fan. See table 3-4 and table 3-5.
10. Check the testhead power supply and the TH PS input board in the testhead. See “Checking the Testhead Power Supply”.

Table 3-1 Checking the PDU and EMO Panel

Step	Check Item	Action
1	Set the main breaker and emergency breaker to ON. Can you set all the breakers to ON?	If yes: Go to step 2. If no: Replace the PDU.
2	Check the Over Voltage LED. Is the Over Voltage LED lit?	If yes: Troubleshoot the site power line. If no: Go to step 3.
3	Press the System switch. Are the cabinet fans operating (3 fans)?	If yes: Go to step 4. If no: Check the cabinet fan. Go to table 3-2 or table 3-3.
4	Check the cabinet fan error LED. Is the cabinet fan error LED lit?	If yes: Set the main breaker and emergency breaker to OFF, and try to complete steps 1 through 3 within 20 seconds. If no: Check the cabinet fan. Go to table 3-2 or table 3-3.
5	Check the line voltage of the controller power outlets on the PDU. Does the proper voltage appear? The voltage depends on the site line voltage (200, 208, 220, or 240 Vac).	If yes: Go to step 6. If no: Replace the PDU.
6	Check the LINE indicator on the EMO panel. Is the LINE indicator lit?	If yes: Go to step 7. If no: Replace the EMO panel.
7	Press the ON switch on the EMO panel. Check the line voltage of the instrument power outlets in the system cabinet. Does the proper voltage appear? The voltage depends on the site line voltage (200, 208, 220, or 240 Vac).	If yes: Go to step 10. If no: Go to step 8.
8	Set the main breaker and emergency breaker to OFF. Check the ON switch. Is it OK?	If yes: Go to step 9. If no: Replace the EMO panel.
9	Check the conductivity of the instrument power outlets. Is it OK?	If yes: Replace the PDU. If no: Replace the instrument power outlets.
10	(200/208 V only) Check the line voltage of the DVM and CMU power outlets in the system cabinet. Does the proper voltage (220 V) appear?	If yes: Go to step 11. If no: Replace the DVM and CMU power outlets.

Table 3-1 Checking the PDU and EMO Panel

Step	Check Item	Action
11	Is the green LED in the ON switch lit?	If yes: End. If you need to perform full PDU and EMO panel checks, go to step 12. If no: Replace the EMO panel.
12	Press the OFF switch on the EMO panel. Check the line voltage of the instrument power outlets in the system cabinet. Does the voltage go to 0 V?	If yes: Go to step 14. If no: Go to step 13.
13	Set the main breaker and emergency breaker to OFF. Check the OFF switch. Is it OK?	If yes: Replace the PDU. If no: Replace the EMO panel.
14	Check the conductivity of the Ext Alarm 1 and 2 terminals. Does the resistance of the terminals indicate the following? Ext Alarm 1: approximately 0 Ω. Ext Alarm 2: high resistance.	If yes: Go to step 15. If no: Replace the PDU.
15	Press the EMO button on the EMO panel. Check the line voltage of the controller power outlets on the PDU. Does the voltage go to 0 V?	If yes: Go to step 17. If no: Go to step 16.
16	Set the main breaker and emergency breaker to OFF. Check the EMO button. Is it OK?	If yes: Replace the PDU. If no: Replace the EMO panel.
17	Check the conductivity of the Ext Alarm 1 and 2 terminals. Does the resistance of the terminals indicate the following? Ext Alarm 1: high resistance. Ext Alarm 2: approximately 0 Ω.	If yes: Go to step 18. If no: Replace the PDU.
18	Confirm that the emergency breaker is set to OFF, remove the shorting bar connected between the Ext Control terminals, and set the EMO button to the normal position. Try to set the emergency breaker to ON. Can you set the emergency breaker to ON?	If yes: Replace the PDU. If no: Go to step 19.

Table 3-1 Checking the PDU and EMO Panel

Step	Check Item	Action
19	Confirm that the emergency breaker is set to OFF, and reinstall the shorting bar. Try to set the emergency breaker to ON. Can you set the emergency breaker to ON?	If yes: Go to step 20. If no: Replace the PDU.
20	Confirm that the emergency breaker is set to ON. Set the EMO protector to the “Out” (extended) position. Check the line voltage of the controller power outlets on the PDU. Does the voltage go to 0 V?	If yes: Go to step 21. If no: Replace the PDU.
21	Set the EMO protector to the “In” (retracted) position, and set the emergency breaker to ON. Does the LINE indicator turn on?	If yes: End (no problem). If no: Replace the PDU.

Table 3-2 Checking Cabinet Fan for E3160-60265, E3160-60266, E3160-60267, and E3160-60268

Step	Check Item	Action
1	Confirm that two fan protectors are set to the "In" (retracted) position. Then set the emergency breaker to OFF, wait at least 3 seconds, and set the emergency breaker and system switch to ON. Confirm that the LINE indicator is lit. Are the cabinet fans operating (3 fans)?	If yes: Go to step 5. If no: Go to step 2.
2	Is the fan protector -1 or -2 set to the "Out" (extended) position?	If yes: Go to step 3. If no: Go to step 4.
3	After setting the emergency breaker and main breaker to OFF, disconnect the power cable connected to the testhead fan from the PDU. To disconnect it, push the latches and pull out the connector. Set two fan protectors to the "In" (retracted) position. Then set the main breaker and the emergency breaker to ON. Confirm that the LINE indicator is lit. Are two fan protectors set to the "Out" (extended) position?	**WARNING** **When disconnecting the connector, make sure that no power is applied to the system.** If yes: Replace the cabinet fan. If no: Go to step 4. After checking the cabinet fan, go to table 3-4.
4	Is the cabinet fan error LED lit? **NOTE** If the Testhead Fan Error LED is lit, ignore this LED.	If yes: Replace the cabinet fan assembly. If no: Replace the PDU and cabinet fan assembly.
5	Is the Cabinet Fan Error LED lit?	If yes: Go to step 6. If no: End. To continue the cabinet fan operation check, go to step 7.
6	Did it take more than 20 seconds to do step 1?	If yes: Go to step 1, and complete step 1 within 20 seconds. If no: Replace the PDU.
7	Set the fan protector -1 or -2 to the "Out" (extended) position. Have the cabinet fans stopped?	If yes: Go to step 8. If no: Replace the PDU.
8	Set two fan protectors to the "In" (retracted) position. Set the emergency breaker to OFF, wait at least 3 seconds, then set it to ON. Confirm that the cabinet fans are operating.	End (no problem).

Table 3-3 Checking Cabinet Fan for E3160-60065, E3160-60066, E3160-60067, and E3160-60068

Step	Check Item	Action
1	Confirm that the cabinet fan protector is set to the “In” (retracted) position. Then set the emergency breaker to OFF, wait at least 3 seconds, and set the emergency breaker and system switch to ON. Confirm that the LINE indicator is lit. Are the cabinet fans operating (3 fans)?	If yes: Go to step 4. If no: Go to step 2.
2	Is the cabinet fan protector set to the “Out” (extended) position?	If yes: Replace the cabinet fan. If no: Go to step 3.
3	Is the Cabinet Fan Error LED lit?	If yes: Replace the cabinet fan assembly. If no: Replace the PDU and cabinet fan assembly.
4	Is the Cabinet Fan Error LED lit?	If yes: Go to step 5. If no: End. To continue the cabinet fan operation check, go to step 6.
5	Did it take more than 20 seconds to do step 1?	If yes: Go to step 1, and complete step 1 within 20 seconds. If no: Replace the PDU.
6	Set the cabinet fan protector to the “Out” (extended) position. Have the cabinet fans stopped?	If yes: Go to step 7. If no: Replace the testhead fan assembly.
7	Set the cabinet fan protector to the “In” (retracted) position. Set the emergency breaker to OFF, wait at least 3 seconds, then set it to ON. Confirm that the cabinet fans are operating.	End (no problem).

Table 3-4 Checking Testhead Fan for E3160-60265, E3160-60266, E3160-60267, and E3160-60268

Step	Check Item	Action
	This troubleshooting procedure must be done after confirming that the PDU, cabinet fan, and EMO panel are operating normally.	
1	Set the main breaker, emergency breaker, and system switch to ON. Confirm that the LINE indicator is lit, and both fan protectors are set to the “In” (retracted) position. Then press the INSTRUMENT POWER ON switch. Is the testhead fan operating?	If yes: Go to step 4. If no: Go to step 2.
2	Is the fan protector -1 or -2 set to the “Out” (extended) position?	If yes: Replace the testhead fan assembly. If no: Go to step 3.
3	Wait at least 20 seconds after pressing the INSTRUMENT POWER ON switch. Is the TH Fan Error LED on the PDU lit?	If yes: Replace the testhead fan or testhead fan assembly. If no: Replace the PDU, testhead fan, or testhead fan assembly.
4	Wait at least 20 seconds after pressing the INSTRUMENT POWER ON switch. Is the TH Fan Error LED on the PDU lit?	If yes: Replace the PDU or testhead fan. If no: End. To continue the testhead fan operation check, go to step 5.
5	Set the fan protector -1 or -2 to the “Out” (extended) position. Have the cabinet fan and testhead fan stopped?	If yes: Go to step 6. If no: Replace the PDU.
6	Set two fan protectors to the “In” (retracted) position. Set the emergency breaker to OFF, wait at least 3 seconds, then set it to ON. Press the INSTRUMENT POWER ON switch. Confirm that the testhead fan is operating.	End (no problem).

Table 3-5 Checking Testhead Fan for E3160-60065, E3160-60066, E3160-60067, and E3160-60068

Step	Check Item	Action
	This troubleshooting procedure must be done after confirming that the PDU, cabinet fan, and EMO panel are operating normally.	
1	Set the main breaker, emergency breaker, and system switch to ON. Confirm that the LINE indicator is lit, and the testhead fan protector is set to the “In” (retracted) position. Then press the INSTRUMENT POWER ON switch. Is the testhead fan operating?	If yes: Go to step 4. If no: Go to step 2.
2	Is the testhead fan protector set to the “Out” (extended) position?	If yes: Replace the testhead fan assembly. If no: Go to step 3.
3	Wait at least 20 seconds after pressing the INSTRUMENT POWER ON switch. Is the TH Fan Error LED on the PDU lit?	If yes: Replace the testhead fan or testhead fan assembly. If no: Replace the PDU, testhead fan, or testhead fan assembly.
4	Wait at least 20 seconds after pressing the INSTRUMENT POWER ON switch. Is the TH Fan Error LED on the PDU lit?	If yes: Replace the PDU or testhead fan. If no: End. To continue the testhead fan operation check, go to step 5.
5	Set the testhead fan protector to the “Out” (extended) position. Has the testhead fan stopped?	If yes: Go to step 6. If no: Replace the PDU.
6	Set the testhead fan protector to the “In” (retracted) position. Press the OFF switch, then press the ON switch. Confirm that the testhead fan operates.	End (no problem).

Checking the Testhead Power Supply

The testhead power supply (TH PS) unit supplies dc voltages to the testhead. The testhead operates when dc voltages are supplied to the testhead normally.

To troubleshoot the testhead power supply, several assemblies in the testhead must be checked. See the block diagram in figure 3-3.

Check the testhead power supply as follows.

Electrical Work Type 3:

WARNING **24 V is forced to the uninsulated parts of the EMO rear panel. DO NOT TOUCH THESE PARTS.**

1. Disconnect all of the cables connected to the AUX PORT connectors, Chuck Connection Output connector, and EXTENDED PATH connectors on the testhead side panel.
2. Open the measurement pins for the testhead.
3. Connect a power cord between the testhead power supply (TH PS) and an instrument power outlet in the system cabinet.
4. Set the following, and confirm that the LINE indicator is lit.

   main switch: ON

   main breaker: ON

   emergency breaker: ON
5. Press the System switch.
6. Press the ON switch and confirm that the green LED in the ON switch is lit.
7. Confirm that the testhead fan operates. If the testhead fan does not operate, troubleshoot the testhead fan assembly.
8. Set the LINE switch on the TH PS rear panel to ON. If the LINE switch cannot be set to the on position, confirm that TH PS primary unit and secondary unit are connected the same. If they are connected the same and the LINE switch cannot be set to the on position, replace the TH PS.
9. Set the power switch on the testhead side panel to ON. The TH PS and testhead will turn on if they are operating normally.
10. Check the LED status on the TH PS front panel. Depending on which LEDs are lit, do one of the following:

WARNING **Dangerous voltages are applied to several terminals inside the testhead. Turn *OFF* the testhead and the testhead power supply before removing the protective cover. Do not turn on the testhead and the testhead power supply while accessing the inside of the testhead, and until you have reinstalled the protective cover on the testhead.**

- If only the Power LED is lit:

  The testhead power supply (TH PS) will operate normally.

- If only the Caution LED is lit:

  In this status, the testhead will not turn on. The following may cause this error:

  ❑ overheating inside the testhead

  ❑ the testhead fan does not operate

  ❑ the SMU output is over voltage (approximately 130 V)

  Check the following parts, and replace any defective parts:

  ❑ testhead fan assembly

  ❑ cable between the PDU and the THPS

  ❑ air duct

  ❑ SMUs in the testhead

  ❑ testhead CPU board in the testhead

  ❑ TH PS input board

  ❑ mini-motherboard 2

- If only the Error LED is lit:

  In this status, the testhead will not turn on. The following may cause this error:

  ❑ overheating inside the testhead power supply

  ❑ testhead power supply over voltage

  ❑ testhead power supply under voltage

  Turn off the testhead and testhead power supply, and cool down the testhead power supply if it has overheated. Turn on the testhead power supply and testhead.

  If the error status has not changed (*only* the Error LED is lit), replace the testhead power supply (both primary unit and secondary unit). If the status has changed, see the appropriate instructions.

- If the Power LED and another LED are lit:

  The testhead power supply secondary unit should be replaced.

- If the Error LED and Caution LED are lit:

  This error is caused by over current in the testhead power supply output. In this error status, the testhead cannot turn on. The following parts should be checked.

  ❑ pin boards

  ❑ SMUs

  ❑ motherboards

  ❑ any assemblies that the measurement signal passes through

  Check the parts and replace any defective assemblies.

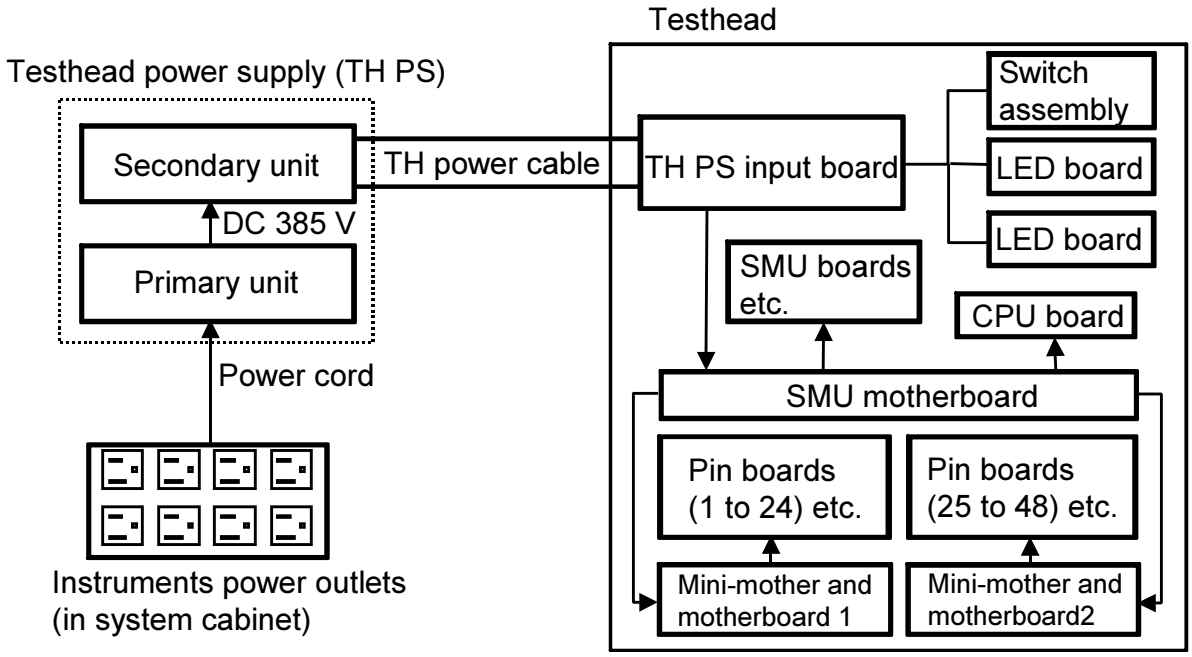
- If no LED is lit:

  The testhead power supply and testhead do not turn on in this status. This will occur if at least one of the parts listed below is defective:

  - ❑ TH PS input board in the testhead
  - ❑ power switch assembly in the testhead
  - ❑ testhead power cable
  - ❑ testhead power supply
  - ❑ power cord between the testhead power supply and instrument power outlet

  Check the assemblies and replace any defective parts.

Figure 3-3 Testhead Power Supply



Checking the System Controller and Software

If the system controller cannot execute the `hp4070` command or cannot control the 4072A/4073A, check the following:

- ❏ setup of the system controller
- ❏ software installation

Checking the Setup of the System Controller

Before turning on the system controller, check the following:

- ❏ the system controller and peripherals are set up and connected properly
- ❏ the optical interface card is installed in a system controller card slot
- ❏ the optical fiber cables are connected between the controller and the 4072A/4073A testhead
- ❏ two GPIB interface cards are installed in the system controller card slots
- ❏ the GPIB cables are connected between the controller and the 4072A/4073A system instruments

If one of the components is not set up correctly, fix any of the components that are not set up correctly.

NOTE If the optical interface card is not installed in the system controller, you must reinstall the 4072A/4073A system software. Refer to the *Installation Guide*.

NOTE When you use the 4072A/4073A with a 745i/100 system controller, we strongly recommend that you do not use the built-in GPIB interface. If the 4072A/4073A system instruments, especially the 8114A, is connected to the built-in GPIB interface, the interface may hang up intermittently.

Checking the Software Installation

Turn on the system controller, then check the software installation as follows.

1. Confirm that HP-UX starts up properly.

   If HP-UX does not start up, reinstall HP-UX and other software required to execute the Agilent 4070 system software. The software required for the 4070 system software is as follows:

   - ❏ HP-UX
   - ❏ HP BASIC/UX or C/ANSI C
   - ❏ SICL

   For more information, refer to the *Installation Guide*.

2. Execute the `hp4070 -login offline` command. This command starts up the 4072A/4073A OFFLINE mode operating environment. If this command can be executed, the 4070 system software is ready for use.

   If this command cannot be executed, you must reinstall the 4070 system software and the optical interface card. Refer to the *Installation Guide*.

3. Execute the `hp4070 -logout` command. This command is used to quit the 4072A/4073A operating environment.

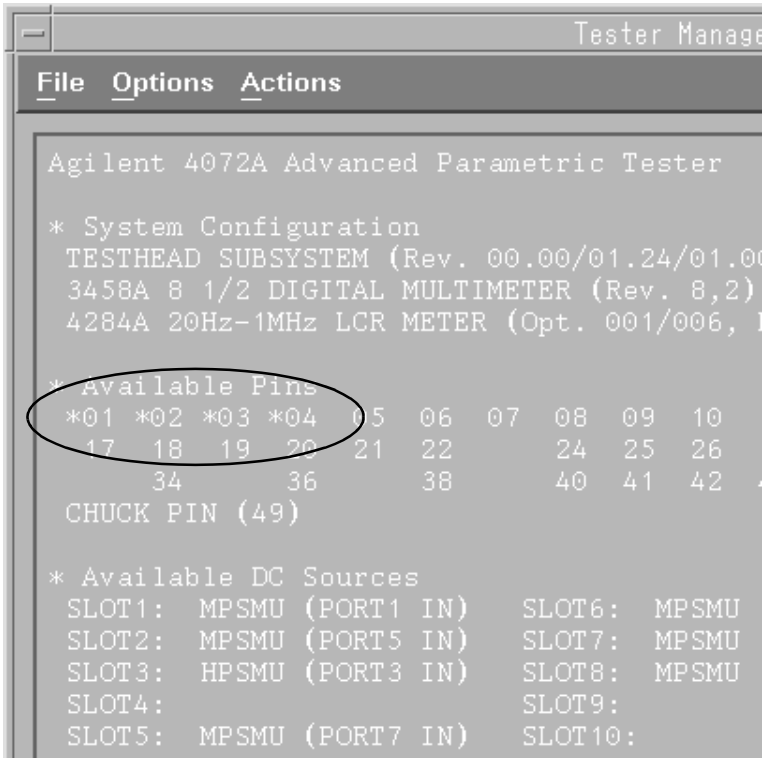
Checking the System Configuration

Execute the `hp4070 -login` command and check the system configuration. If the `hp4070 -login` command execution results do not match the actual configuration of the 4072A/4073A tester, check the following:

- ❏ configuration file (`/etc/opt/hp4070/config/1` file)
- ❏ GPIB addresses of the system instruments
- ❏ GPIB interface card and GPIB cables
- ❏ optical interface card and optical fiber cables
- ❏ connection of the system instrument measurement cables

The `hp4070 -login` command displays an asterisk (`*`) beside the pin board number as shown in figure 3-4 if high-resolution type board(s) is installed in the 4072A or standard type board(s) is installed in the 4073A.

Figure 3-4 Tester Management Panel with Unsuitable Pin Boards



Executing the `hp4070 -login` Command

The `hp4070 -login` command checks the 4072A/4073A system configuration and displays the results. Figure 3-5 shows an example of the `hp4070 -login` command execution results. This example shows the system configuration for the 4072A, which consists of a DVM, CMU, PGUs, testhead with 48 pin boards, chuck connection pin board, and SMUs (both MPSMUs and HPSMUs). This also shows the connections between system instruments and testhead ports (AUX and HF ports). The DVM is connected to the testhead AUX 5 and 6 input ports, the CMU is connected to the testhead AUX 7 and 8 input ports, and the PG11 is connected to the HF port 1.

Execute the `hp4070 -login` command as follows:

1. Confirm that the following cables are connected properly.

   - ❏ optical fiber cables between the testhead and system controller
   - ❏ GPIB cables between the system controller and system instruments

   If a connection is not correct, connect the cable properly. Refer to the *Installation Guide*.

2. Turn on the 4072A/4073A (system cabinet, testhead, and the system instruments).
3. Verify that the TIS server is running. To check it, open the system management panel and choose `Action: TIS Daemon Start`.

   ```
   $ sys4070
   ```

4. Enter the following command. (Or use the GUI: enter `hp4070` without options and then select ON LINE.)

   ```
   $ hp4070 -login online
   ```

Figure 3-5 Example of the `hp4070 -login` Command Execution Results

```
Agilent 4072A Advanced Parametric Tester

* System Configuration                                  <=  lists measurement resources connected
 TESTHEAD SUBSYSTEM (Rev. XX.XX/XX.XX/XX.XX)               to system controller
 3458A 8 1/2 DIGITAL MULTIMETER (Rev. XX.XX)
 4284A 20Hz-1MHz LCR METER (Opt. 001/006, Rev. XX.XX)

* Available Pins                                        <=  shows available pins inside testhead
 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16
 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
 CHUCK PIN (49)

* Available DC Sources                                  <=  shows available SMUs and slot number
 SLOT1:  MPSMU (PORT1 IN)   SLOT6:  MPSMU (PORT2 IN)       inside testhead
 SLOT2:  MPSMU (PORT3 IN)   SLOT7:  MPSMU (PORT6 IN)
 SLOT3:  MPSMU (PORT5 IN)   SLOT8:
 SLOT4:  MPSMU (PORT7 IN)   SLOT9:  HPSMU (PORT4 IN)
 SLOT5:                     SLOT10: MPSMU (PORT8 IN)
 GNDU at PORT9 IN

* Available Pulse Generator Units                       <=  shows available PGUs
 81110A 165MHz PULSE GENERATOR (2,3)
 8114A         PULSE GENERATOR (1)

* High Frequency Port Configuration                     <=  shows connection between HF ports and
   HF1: PG11    2:         3:                               PGUs
   HF4:          5:         6:
  THF1:          2:         3:
 PSI11:         12:        21:        31:
 PSI41:         51:        61:        62:
 PSI71:         72:
  PSC1:          2:

* Outer Port Configuration                              <=  shows connection between AUX ports and
 PORT1 OUT:                 PORT5 OUT: DVMH                 system instruments
 PORT2 OUT:                 PORT6 OUT: DVML
 PORT3 OUT:                 PORT7 OUT: CMH
 PORT4 OUT:                 PORT8 OUT: CML
```

Troubleshooting Using the `hp4070 -login` Command Execution Results

If the `hp4070 -login` command execution results do not match the actual configuration of the 4072A/4073A tester, check the configuration file (`/etc/opt/hp4070/config/1` file), the optical interface, and the GPIB interface as shown in table 3-6.

Figure 3-6 Example of the `/etc/opt/hp4070/config/1` File

```
# Agilent 4070 configuration file
# lines beginnign with '#' is comment line

# version: this file format version
version:2

# testhead.slot: Opt I/F card slot number of HOST computer
# testhead.timeout: Opt I/F interrupt time value (DO NOT CHANGE)
testhead.slot:1              <= slot number where optical interface card is installed
testhead.timeout:100000      <= timeout for testhead (in sec)

# hpibif.total: number of GPIB I/F card
# hpibif.NO.address: GPIB IF address of NO-th card
# hpibif.timeout: GPIB timeout value (DO NOT CHANGE)
hpibif.total:1             <= number of GPIB card used for system instruments
hpibif.1.address:7         <= logical unit number of GPIB card used for system instruments
hpibif.timeout:5000000   <= GPIB timeout (in sec)

# cmu84.exist: 4284A existence (1: exist, 0: not-exist)
# cmu84.hpibif.address: GPIB IF address connected to 4284A
# cmu84.busaddress: 4284A GPIB bus address
# cmu84.cable: cable length of 4284A (1 or 4)
cmu84.exist:1              <= 1:CMU exists; 0:no CMU
cmu84.hpibif.address:7   <= logical unit number of GPIB card connected to CMU
cmu84.busaddress:17      <= GPIB address of CMU
cmu84.cable:4              <= cable length of test leads for CMU (in meters)

# dvm3458.1.exist: 3458A existence (1: exist, 0: not-exist)
# dvm3458.1.hpibif.address: GPIB IF address connected to 3458A
# dvm3458.1.busaddress: 3458A GPIB bus address
dvm3458.1.exist:1            <= 1:DVM exists; 0:no DVM
dvm3458.1.hpibif.address:7 <= logical unit number of GPIB interface card connected to DVM
dvm3458.1.busaddress:22    <= GPIB address of DVM

# hfmatrix: HF Matrix existence (1: exist, 0: not-exist)
hfmatrix:1                 <= 1:HF matrix exists; 0:no HF matrix
# pulsemux: Pulse Switch #1/#2 existence (1: exist, 0: not-exist)
pulsemux:1                 <= 1:pulse switch exists; 0:no pulse switch

# pgName.pgNo.hpibIFaddr.hpibBusaddr:existence
#    pgName = pg8110 or pg8114 or pg81110
#    pgNo = PG logical number (1, 2, 3, 4, 5, 6, 7)
#           PG of PGNo=1 is always needed.
#    hpibIFaddr = GPIB IF address connected to the PG
#    hpibBusaddr = the PG GPIB bus address
#    existence = the PG existence (1: exist, 0: not-exist)

pg8114.1.7.10:1 <= PG name.PG number.GPIB logical unit number.GPIB address:PG existence
pg8110.2.7.11:1 <= PG name.PG number.GPIB logical unit number.GPIB address:PG existence
pg8110.3.7.12:1 <= PG name.PG number.GPIB logical unit number.GPIB address:PG existence
```

Table 3-6 Checking the System Configurations

Step	Check Item	Action
1	Check the system configuration file (`/etc/opt/hp4070/config/1` file). Are all definitions OK?	If yes: Go to step 2. If no: Edit and correct the definition. See figure 3-6 for an example of the configuration file.
2	Check `System Configuration` and `Available Pulse Generator Unit` for the results. Do the results ignore any system instruments?	If yes: Go to step 3. If no: Go to step 5.
3	Check the GPIB address settings for the system instruments. Are the settings OK?	If yes: Go to step 4. If no: Set the addresses properly.
4	Check the GPIB cables and the GPIB interface card. Are they OK?	If yes: Troubleshoot the system instrument. Refer to the instrument service manual. If no: Replace the defective parts.
5	Check `System Configuration` for the results. Do the results ignore the testhead?	If yes: Go to step 6. If no: Go to step 7.
6	Check the optical fiber cables and the optical interface card in the system controller. Are they OK?	If yes: Replace the testhead CPU board. If no: Replace defective parts.
7	Check `Available Pins` for the results. Are all pin numbers correct?	If yes: Go to step 8. If no: Check the pin board. See “Checking the Pin Board”.
8	Check `Available DC Sources` for the results. Is the SMU configuration correct?	If yes: Go to step 9. If no: Check the SMU board. See “Checking the SMU Board”.
9	Check the `High Frequency Port Configuration` for the result. Is the port connection correct?	If yes: Go to step 11. If no: Go to step 10.
10	Check the PG cables. Are the cables OK?	If yes: Troubleshoot the pulse generator. Refer to the pulse generator service manual. If no: Replace the cable.
11	Check `Outer Port Configuration` for the results. Is the port connection correct?	If yes: End. If no: Go to step 12.
12	Check the measurement cables. Are the cables OK?	If yes: Troubleshoot the system instrument. Refer to the instrument service manual. If no: Replace the cable.

Checking the Pin Board

If the `Available Pins` results do not match the actual configuration, use the following procedure:

1. Execute the `hp4070 -logout` command and `hp4070 -shutdown` command.
2. Turn off the testhead.
3. Remove the testhead bottom cover and the docking plate inside the testhead.
4. Exchange the position of the ignored pin board(s) and the recognized pin board(s).

   Make sure to remove the cable and contact pins together with each pin board, and attach them at the new position. See figure 3-7.
5. Reinstall the docking plate and the bottom cover.
6. Turn on the testhead.
7. Execute the `hp4070 -start` command and the `hp4070 -login` command.
8. Check the `hp4070 -login` command execution results, and do the following:

   - If the ignored pin number has changed, the ignored pin board(s) are defective. Replace the ignored pin board(s).
   - If the result has not changed, the motherboard (block 1 or block 2) is defective. Replace the motherboard where the ignored pin board is installed.

If an asterisk (*) is displayed beside the pin board number, do the following:

- For the 4072A, verify that the high-resolution type board (HR pin board, HR Kelvin input board, or HRLC input board) is not installed.
- For the 4073A, verify that the standard type board (pin board, Kelvin input board, or LC input board) is not installed.

Checking the SMU Board

If the `Available DC Sources` results do not match the actual configuration, use the following procedure:

1. Execute the `hp4070 -logout` command and the `hp4070 -shutdown` command.
2. Turn off the testhead.
3. Remove the testhead bottom cover and the docking plate inside the testhead.
4. Verify that each SMU is installed in the appropriate slot listed in table 3-7 through table 3-15.
5. Exchange the position of the ignored SMU board(s) and the recognized SMU board(s).

   Make sure to remove the coaxial cable and each SMU board together, and attach them in the new position. See figure 3-7.
6. Reinstall the docking plate and the bottom cover.
7. Turn on the testhead.
8. Execute the `hp4070 -start` command and the `hp4070 -login` command.
9. Check the `hp4070 -login` command execution results, and do the following:

   - If the ignored SMU number has changed, the ignored SMU board(s) are defective. Replace the ignored SMU board(s).
   - If the result has not changed, the SMU motherboard is defective. Replace the SMU motherboard.

Figure 3-7 Contact Pin Cable and SMU Cable (MPSMUs Only)

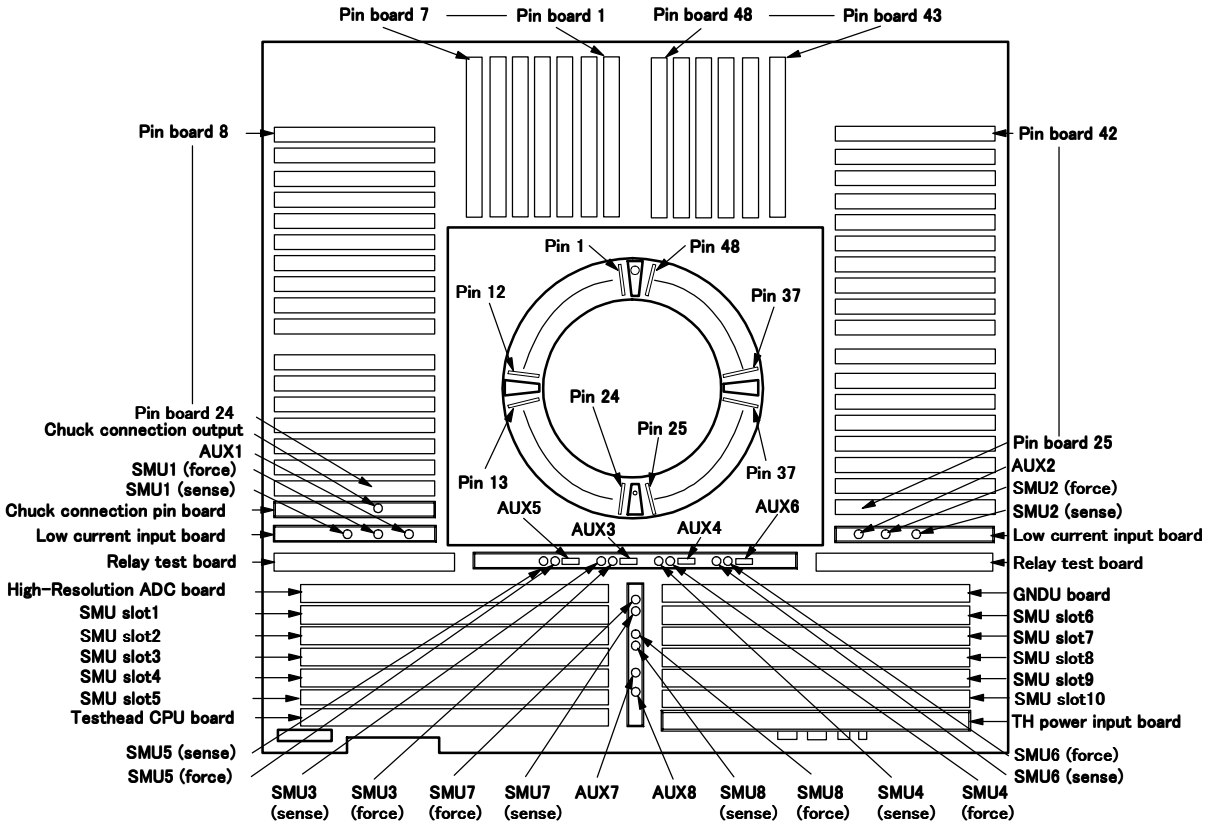


Table 3-7 MPSMU Only (Agilent 4072A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	2
2	3	MPSMU	Default
3	5	MPSMU	1
4	7	MPSMU	4
5	—	—	—
6	2	MPSMU	Default
7	4	MPSMU	Default
8	6	MPSMU	3
9	8	MPSMU	5
10	—	—	—

Table 3-8 One HPSMU (Agilent 4072A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	1
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	3
6	2	MPSMU	Default
7	4	MPSMU	Default
8	6	MPSMU	2
9	8	MPSMU	4
10	—	—	—

Table 3-9 Two HPSMUs (Agilent 4072A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	Default
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	2
6	2	MPSMU	Default
7	6	MPSMU	1
8	4	HPSMU	Optional HPSMU
9			
10	8	MPSMU	3

Table 3-10 One HRSMU (Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	2
2	3	MPSMU	Default
3	5	MPSMU	1
4	7	MPSMU	4
5	—	—	—
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	3
10	8	MPSMU	5

Table 3-11 Two HRSMUs (Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	Optional HRSMU
2			
3	3	MPSMU	Default
4	5	MPSMU	1
5	7	MPSMU	3
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	2
10	8	MPSMU	4

Table 3-12 One HRSMU and One HPSMU (Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	1
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	3
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	2
10	8	MPSMU	4

Table 3-13 Two HRSMUs and One HPSMU (Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	HRSMU	Optional HRSMU
2			
3	3	HPSMU	Optional HPSMU
4			
5	5	MPSMU	Default
6	2	HRSMU	Default
7			
8	4	MPSMU	Default
9	6	MPSMU	1
10	7	MPSMU	2

Table 3-14 One HRSMU and Two HPSMUs (Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	MPSMU	1
2	5	MPSMU	Default
3	3	HPSMU	Optional HPSMU
4			
5	7	MPSMU	2
6	2	HRSMU	Default
7			
8	4	HPSMU	Optional HPSMU
9			
10	6	MPSMU	3

Table 3-15 Two HRSMUs and Two HPSMUs (Agilent 4073A)

Slot Number	Port Number	Installed SMU	Installation order for additional SMUs
1	1	HRSMU	Optional HRSMU
2			
3	3	HPSMU	Optional HPSMU
4			
5	5	MPSMU	Default
6	2	HRSMU	Default
7			
8	4	HPSMU	Optional HPSMU
9			
10	6	MPSMU	Default

Using the Diagnostics Program

The diagnostics program checks the functionality of the 4072A/4073A. The program also performs trouble isolation and lists suspected defective parts (FRUs: field replaceable units) if the 4072A/4073A fails diagnostics.

The test results (`Pass` or `Fail`) and the suspected defective parts are displayed on the computer screen. The data will be stored in the `/var/opt/hp4070/diag/DIAGdata` file.

When the 4072A/4073A fails diagnostics, check the parts suspected by the diagnostics program, then replace the defective part. For part replacement procedures, see chapter 4 .

Table 3-16 shows the diagnostics test item versus the field replaceable part tested or related to the test.

The following sections explain how to execute the diagnostics program, and includes a summary of each test.

- "Executing the Diagnostics Program"
- "Displaying and Printing the Test Results"
- "Executing the Diagnostics Program from the Command Line"
- "Executing Diagnostics Selectively from the Command Line"
- "Checking the Diagnostics Log and Results Files"
- "100: Testhead Selftest"
- "110: Reference Configuration Check"
- "120: Relay Test"
- "121: HF Matrix Relay Test"
- "130: GNDU Test"
- "131: SMU V/I Test"
- "132: DC Leakage Test"
- "140: CMU C/G Test"
- "141: CMU DC Bias Test"
- "150: DVM Test"
- "160: PG Selftest"
- "161: PG Connection Test"
- "162: Pulse Switch Test"
- "163: PG Output Level Test"
- "164: PG Trigger Test"

NOTE The diagnostics program is *not* a performance verification program, that is, the diagnostics program does not verify that the system meets its specifications.

To verify the performance of the system, refer to the *System Calibration Guide*, and execute the performance verification program. Also, chapter 5 shows the relationship between replaceable parts and performance verification items.

Table 3-16 Diagnostics Test Item versus Field Replaceable Parts

Field Replaceable Parts	Diagnostics Test Item (3-digit number: Test Number)													
	100	120	121	130	131	132	140	141	150	160	161	162	163	164
	Testhead Selftest	Relay Test	HF Matrix Relay Test	GNDU Test	SMU V/I Test	DC Leakage Test	CMU C/G Test	CMU DC Bias Test	DVM Test	PG Selftest	PG Connection Test	Pulse Switch Test	PG Output Level Test	PG Trigger Test
Board assemblies (installed in testhead)														
Testhead CPU board	√	√	√	√	√	√	√	√	√		√	√	√	√
High-resolution ADC board	√			√	√			√			√	√	√	√
SMU motherboard	√	√		√			√	√			√	√	√	√
SMU board	√	√			√	√			√		√	√	√	√
GNDU board	√	√		√					√					
Low current input board	√	√			√	√					√	√	√	√
Kelvin input board		√		√	√	√			√		√	√	√	√
CMU input board		√			√	√	√	√			√	√	√	√
Mini-motherboard 1		√		√										
Mini-motherboard 2														
Matrix motherboard		√	√	√	√	√	√	√	√		√	√	√	√
Relay test board		√	√	√	√	√	√	√	√		√	√	√	√
Pin board		√				√					√	√	√	√
Chuck connection pin board		√				√								
HF matrix board			√								√	√	√	√
HF matrix backplane board			√									√		
HF matrix connection board			√											
Pulse switch board											√	√	√	√
Cables														
HF port cable		√					√	√	√		√	√	√	√
Block 1 flat cable		√		√										
CMU matrix cable		√			√	√	√	√			√	√	√	√
Extended path input cable		√	√								√	√	√	√
Diag bus cable				√	√			√	√		√	√	√	√
HF matrix relay power cable			√											
PG cable											√	√	√	√
Pulse switch connection cable											√	√	√	√
CMU cable (HP 16048E)							√	√						
DVM cable[a]									√					
PG EXT input cable														√
PG CLK input cable														√
HF port cable											√	√	√	√
Pulse switch connection cable											√	√	√	√
PG trigger out cable														√
System instruments and board assemblies (installed in the system cabinet)														
CMU (4284A)							√	√						
DVM (3458A)									√					
PG (8114A/8110A/81110A)										√	√	√	√	√
PG trigger distributor														√

a. Agilent part number for the DVM cable is E3120-61683.

Executing the Diagnostics Program

Execute the diagnostics program as follows:

1. The wafer prober sense switch and the interlock switch (two interlock contact pins) on the testhead must be ON (sense condition). To do this, use one of the following procedures:
   a. If you are using an automatic wafer prober:
      i. Set the personality board on the wafer prober or the direct docking probe card.
      ii. Set the testhead on the wafer prober. If the personality board is already wired to the probe card/probe card adapter, do not contact the probe card to anything. The probe card needles must be open.
   b. If you are using the Agilent E3140A test fixture adapter and Agilent E3141A universal test fixture:
      i. Set the E3140A test fixture adapter on the testhead.
      ii. Set the E3141A universal test fixture on the adapter, then open the fixture measurement pins.
      iii. Close the lid of the test fixture adapter.
2. Verify if the TIS server is running. To check it, type:

   ```
   $ ps -ef | grep tis
   ```

   If the TIS server is running, the tis_online daemon appears.

   ```
   user 20049     1  0  Mar  3  ?       2:04 tis_online -ioff -e -a
   ```

   If the TIS server is not running, run the TIS server using the following command:

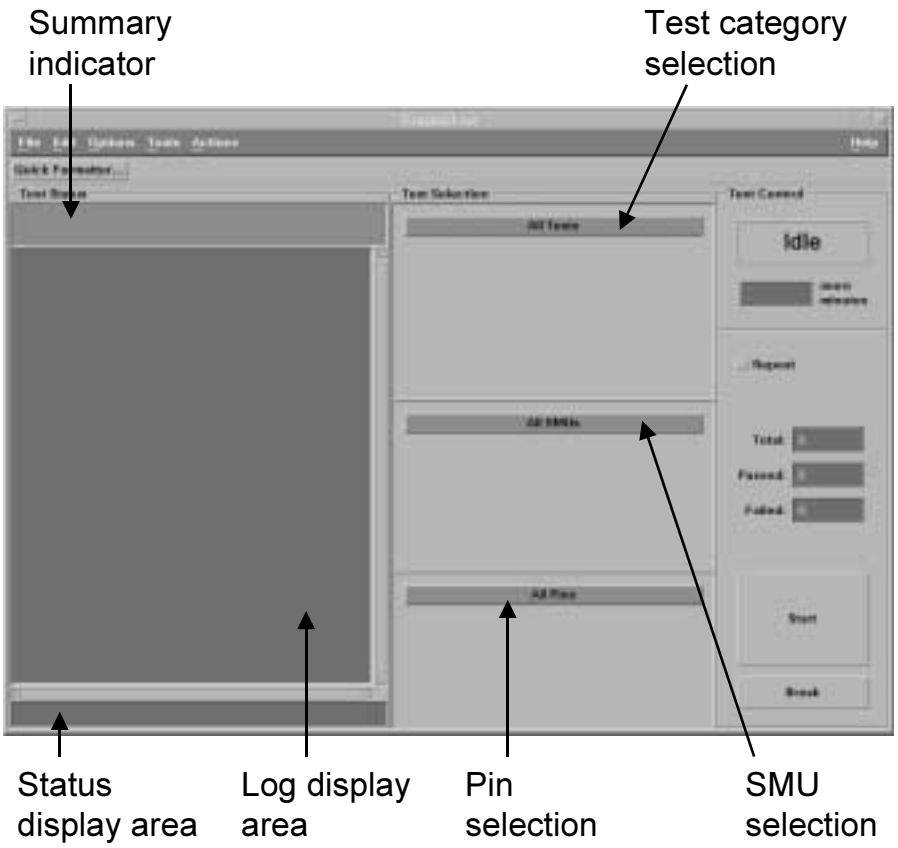
   ```
   $ hp4070 -start
   ```

3. Execute the `/opt/hp4070/bin/diag4070` command as follows.

   ```
   $ diag4070
   ```

4. The Diagnostics window opens.

Figure 3-8 Diagnostics Window



5. Select the test to be executed.

   By default, all test categories, all SMUs, and all pins are selected to be tested.

   You can change the test selection using the selection buttons in the Test Selection area in the Diagnostics window.

Test category selection	The top button toggles between All Tests and Selected Tests. If you toggle to Selected Tests, check buttons will appear for selecting test categories.
SMU selection	This area appears only if All Tests or an SMU-related test is selected in the Test Category Selection area. This button toggles between All SMUs and Selected SMUs. If you toggle to Selected SMUs, check buttons will appear for selecting SMUs.
Pin selection	This area appears only if All Tests or Relay Test is selected in the Test Category Selection area. This button toggles between All Pins and Selected Pins. If you toggle to Selected Pins, an area appears for selecting measurement pins, and check buttons will appear for selecting the chuck pin and input selection board.

NOTE You can save and load test selection information by choosing `File: Save Test Selection...` and `File: Load Test Selection...`.

NOTE These diagnostics results are overwritten in the `/var/opt/hp4070/diag/DIAGdata` file. Only the latest results remain in the file.

To specify a file for saving test data, choose `File: Preserve Test Result...` before executing the diagnostics.

6. To start the diagnostics, click **Start** in the Test Control area.

   The execution time (approximate value) is displayed in the Test Control area. This value decreases as the diagnostics program executes.

   During a test, the test status is displayed in the Test Status area, as described below.

   Summary indicator — The top area of the Test Status area. When the 4072A/4073A successfully passes the first test category, "Pass" (in green text) is displayed. If any test fails, "Fail" (in red text) is displayed and remains, even if the following tests pass.

   The "Pass" or "Fail" display is cleared by the next diagnostics start action.

   Log display area — A summarized test log is displayed in this area. Figure 3-9 and figure 3-10 show display examples of the diagnostics results.

   The displayed log is reset by the next diagnostics start action.

   Status display area — The present status of a test is displayed.

   You can stop or repeat test execution from the Test Control area.

   `Repeat` button — If this check button is selected, you can specify how many times to execute the diagnostics. You can also select `Unlimited` execution, which will continue to execute the diagnostics program until you click **Break** in the Test Control area.

   Break button — Stops the diagnostics.

Figure 3-9 Result Display Example (PASS all)

```
PASS: (100) Testhead Selftest
PASS: (110) Reference Configuration Check
PASS: (120) Relay Test
PASS: (121) HF Matrix Relay Test
PASS: (130) GNDU Test
PASS: (131) SMU V/I Test
PASS: (132) DC Leakage Test
PASS: (140) CMU C/G Test
PASS: (150) DVM Test
PASS: (160) PG Selftest
PASS: (161) PG Connection Test
PASS: (162) Pulse Switch Test
PASS: (163) PG Output Level Test
PASS: (164) PG Trigger Test
```

Figure 3-10 Fault Isolation Display Example

```
Fault Isolation begin.

Fault Isolation focuses on this test item:
(140) CMU C/G Test

Failure unit is probably among these FRUs:
 * CMU Input Board
 * Outer Port Cable (Port 7)
 * Outer Port Cable (Port 8)
 * CMU
 * CMU Cable

Failure unit is probably not among these FRUs:
 * Relay Test Board (Block 1)
 * Matrix Mother 1 Board
 * SMU Mother Board
 * CMU Matrix Cable (1)
 * CMU Matrix Cable (3)
 * Relay Test Board (Block 2)
 * Matrix Mother 2 Board
 * CMU Matrix Cable (2)
 * CMU Matrix Cable (4)

Fault Isolation end.
```

Diagnostics Program Options

Kelvin Connection Test

The Kelvin connection test option allows you to choose whether to execute relay test testcase 29, which checks the defective pin board cable between the PC board and the pin socket. For testcase 29, the force pin and the sense pin must be shorted by the non-Kelvin connection probe card or fixture.

You can also choose whether the diagnostics displays the failure when testcase 29 fails. Figure 3-11 shows the dialog box used to select the Kelvin connection test options.

Figure 3-11 Kelvin Connection Test



Manual Mode

This test option tests AUX port relays.

Before executing the diagnostics in manual mode, you must remove all connectors and cables connected to the AUX ports, except the CMU and DVM cables. This test forces a constant current to the AUX ports to confirm the AUX port relay operations and may damage the unsupported instruments if you connected.

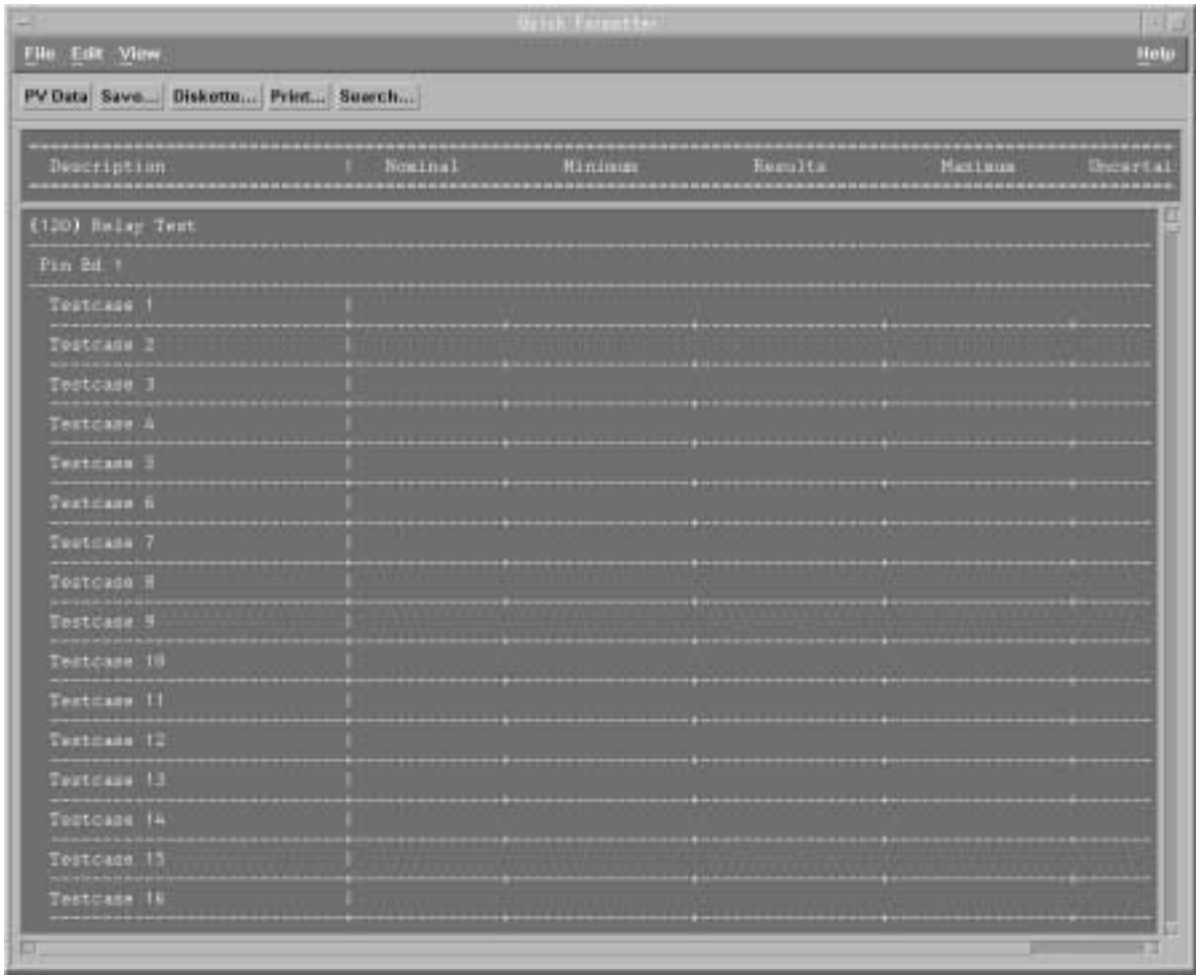
To execute the diagnostics in manual mode, choose the `Option: Request User Operation` menu, and click **Start** in the diagnostics window.

Displaying and Printing the Test Results

After the diagnostics program is executed, the test data is stored in the `/var/opt/hp4070/diag/DIAGdata` file. If you need to report the test results, you can use the quick formatter to display and print out the test results. The following describes how to display and print test results using the quick formatter.

1. Click **Quick Formatter...** in the Diagnostics window or execute the `/opt/hp4070/bin/view4070` command.

Figure 3-12 Quick Formatter Window



2. Choose `File: Load: File...` in the Quick Formatter window, and choose the data file to report. The diagnostics data files are stored in the `/var/opt/hp4070/diag` directory.
3. To print out the diagnostics data displayed in the quick formatter window, use the following procedure.
   a. Click **Print...** in the quick formatter window. The print window appears.
   b. Type the printer name.
   c. Click **OK**.
4. To store the formatted data in a text file, use the following procedure.
   a. Click **Print...** in the quick formatter window. The print window appears.
   b. Type:
      `cat > file_name`
   c. Click **OK**.

Executing the Diagnostics Program from the Command Line

You can execute the diagnostics program without the GUI window as described below:

1. The wafer prober sense switch and the interlock switch (two interlock contact pins) on the testhead must be ON (sense condition). See "Executing the Diagnostics Program".
2. The TIS server must be running.
3. Enter the following command.

   ```
   $ diag4070 -all
   ```

   The diagnostics results will be displayed on the system controller screen. Figure 3-9 and figure 3-10 show display examples of the diagnostics results.

NOTE The `diag4070 -all` command does not execute the relay test for AUX ports connected to unsupported system instruments. In this case, use the `-manual` option instead of the `-all` option, as shown below.

1. Disconnect the unsupported system instruments from the testhead AUX connectors.
2. Execute the following:

   ```
   $ diag4070 -manual
   ```

3. The following message is displayed.

   ```
   $ diag4070 -manual
   You select a manual mode. Is it OK?
   Type c (continue) or b (break), then press Return.
   ```

4. Type `c`, then press **Return**.

The `-manual` option executes the same tests as `-all`, as well as the relay test for the AUX ports for unsupported system instruments.

If you want to only execute the relay test for the AUX ports for unsupported system instruments, execute the following:

```
$ diag4070 -manual -category 120
```

For usage of the `-category` option, see "Executing Diagnostics Selectively from the Command Line".

Executing Diagnostics Selectively from the Command Line

To execute specific tests only, the `diag4070` command has the following options:

- `-category` *`number`*

  Specify the *`number`* of the desired tests to execute:

Test *`number`*	Description
100	Testhead Selftest
110	Reference Configuration Check
120	Relay Test
121	HF Matrix Relay Test
130	GNDU Test
131	SMU V/I Test
132	DC Leakage Test
140	CMU C/G Test
141	CMU DC Bias Test
150	DVM Test
160	PG Selftest
161	PG Connection Test
162	Pulse Switch Test
163	PG Output Level Test
164	PG Trigger Test

  Example:

  This example executes the Relay Test only.

```
$ diag4070 -category 120
```

- `-smu` *`number`*

  This is a supplemental option for `-category`. Specify the *`number`* of desired SMUs to test. The SMU related tests (SMU V/I Test: 131 and DC Leakage Test: 132) are executed only for the SMUs specified.

  Example:

  This example executes the SMU V/I Test only for SMU2 and SMU3.

```
$ diag4070 -category 131 -smu 2 3
```

- `-pin` *`number`*

  This is supplemental option for `-category`. Specify the *`number`* of desired measurement pins to test in the Relay Test.

  Example:

  This example executes the Relay Test only for pins 2 and 4.

```
$ diag4070 -category 120 -pin 2 4
```

Checking the Diagnostics Log and Results Files

Diagnostics results are written to the `/var/opt/hp4070/diag/log` and `/var/opt/hp4070/diag/DIAGdata` files in ASCII format. See these files to troubleshoot the 4072A/4073A.

- `log` file

  The `/var/opt/hp4070/diag/log` file stores the following information:

  - ❏ time when diagnostics started
  - ❏ test results (Pass or Fail)
  - ❏ defective parts suspected
  - ❏ time when diagnostics finished

NOTE The diagnostics results written to the `log` file are added to the files. The latest results are at the end of the file. To see the latest results, open the file in any text editor, and go to the end of the file.

- `DIAGdata` file

  The `/var/opt/hp4070/diag/DIAGdata` file stores the following information for each test item:

  - ❏ name of test item
  - ❏ name of subtest for the test item
  - ❏ test execution condition
  - ❏ unit of measured value
  - ❏ expected value
  - ❏ lower limit
  - ❏ measured value
  - ❏ higher limit
  - ❏ test results

Symbols Used in Test Results	Definition
" "	Pass
"***"[a]	Fail
">>>"	Fail (over limit)
"<<<"	Fail (under limit)
">"	Fail (over margin)
"<"	Fail (under margin)

a. This symbol is used only with the Testhead Self-test, Relay Test, HF Matrix Relay Test, DVM Self-test (part of the DVM Test), and PG Self-test, which do not judge a pass-fail status based on the measurement value.

NOTE These diagnostics results are overwritten in the `DIAGdata` file. Only the latest results remain in the `DIAGdata` file. The latest ten diagnostics data items are held as `DIAGdata`*N* files in the `/var/opt/hp4070/diag` directory.

100: Testhead Selftest

This test performs a self-test of the testhead CPU board, the high-resolution ADC board, the GNDU board, and the SMU boards installed in the testhead.

Test number:	100
Estimated test time:	13 + 4 × N seconds, maximum 45 seconds (N: Number of SMUs)
Requirements for execution:	None
Defective parts suspected:	❑ units (SMUs and/or GNDU) that fail the self-test ❑ if multiple units fail the self-test, suspect the high-resolution ADC board and SMU motherboard ❑ if SMUs connected to the low current port fail the test, suspect the SMUs and low current input board ❑ (4073A only) if SMUs fail the self-test, suspect the SMUs, input boards, and matrix motherboard
Test signal flow:	a. `SMU board ⇒ SMU motherboard ⇒ high-resolution ADC board` b. `GNDU board ⇒ SMU motherboard ⇒ high-resolution ADC board`
Error codes:	If a self-test fails, the error code is displayed in the status display area of diagnostics window. Table 3-17 shows the error codes and descriptions.

Table 3-17 Testhead Selftest Error Codes

Error Code	Description
33095681, 33095682, 33095683, 33095684	SMU function test failed.
33161217, 33161218, 33161219	SMU CMR amplifier test failed.
33226753, 33226754, 33226755, 33226756, 33226757, 33226758, 33226759, 33226760, 33226761, 33226762	SMU voltage force and measurement test failed.
33292289, 33292290, 33292291, 33292292, 33292293, 33292294, 33292295	SMU current force and measurement test failed.
33357825, 33357826, 33357827, 33357828, 33357829, 33357830, 33357831	SMU self-test failed.
33423361, 33423362, 33423363	SMU 1 nA/10 nA range resistor test failed.
33488897	GNDU self-test failed.
33554433	High-resolution ADC cal/diag bus function test failed.
33619969, 33619970, 33619971, 33619972	High-resolution ADC self-test failed.
33882113, 33882114, 33882115, 33882116, 33882117, 33882118, 33882119, 33882120, 33882121, 33882122	CPU board self-test failed.
33947648	Pin board self-test failed.
34013184	LC input board self-test failed.
34078720	Kelvin input board self-test failed.
34144256	CMU input board self-test failed.
34209792	Relay test board self-test failed.
34275328	Extended I/O board self-test failed.

110: Reference Configuration Check

This test confirms the existence of hardware and the power line frequency setting for the testhead, using the system configuration file (`/etc/opt/hp4070/config/refconfig1`). This test does not do trouble isolation, and does not list suspected defective parts.

Test number: 110

Summary of test:

1. Confirms that the following hardware exists:
   - ❑ pin boards (in the testhead)
   - ❑ HF matrix (in the testhead)
   - ❑ Pulse switch (in the testhead)
   - ❑ SMUs (in the testhead)
   - ❑ CMU (4284A)
   - ❑ DVM (3458A)
   - ❑ PGUs (8114A, 81110A, or 8110A)
2. Confirms the power line frequency setting for the testhead.

Estimated test time: 1 second

Requirements for execution: None

120: Relay Test

This test checks the relays on the relay test boards, pin boards, chuck connection pin board and input boards. This test also performs contact cleaning of the relays. The actual name of the input board depends on the AUX input ports as follows:

- ❏ AUX input port 1: low current input board (1)
- ❏ AUX input port 2: low current input board (2)
- ❏ AUX input port 3 to 6: Kelvin input board
- ❏ AUX input port 7 and 8: CMU input board

Test number: 120

Summary of test:

1. Makes a connection (one of a. through q. shown in *`Testhead signal flow`*, which connects the current source on the relay test board to the common (ground)).
2. Performs contact cleaning of the relay.
3. Forces current `If`, using the current source on the relay test board.
4. Measures voltage `Vm`, using the relay test board.
5. Confirms that the resistance `Vm`/`If` indicates the normal value.
6. Opens the relays one by one.
7. Confirms that the relays do not stick (short).
8. Repeats the steps above for all connections shown in *`Test signal flow`*.

Estimated test time: 7 + 6 × N seconds, maximum 301 seconds (N: Number of pin boards)

Requirements for execution:

- ❏ Pin board must be installed in the testhead.
- ❏ Relay test for the AUX input ports is executed when CMU and/or DVM are connected to the testhead, or by executing the `diag4070 -manual` command. See “Executing the Diagnostics Program from the Command Line”.

Defective parts suspected:

- ❏ pin boards for the failed paths
- ❏ input boards for the failed paths
- ❏ if multiple failed pin boards are detected on one of the matrix motherboards, suspect the relay test board, matrix motherboard and Kelvin input board.
- ❏ if the failure is in the path through the GNDU, suspect all parts from the Kelvin input board to the GNDU board (See j. and k. in *`Test signal flow`*.)
- ❏ if the failure is in the path through the AUX input connector, suspect all parts from the input board to the AUX input connector (See l. to q. in *`Test signal flow`*.)

Test signal flow:

a. relay test board (1 and 2)

b. relay test board (1) ⇒ diagnostics bus ⇒ relay test board (2)

c. relay test board (1) ⇒ matrix motherboard (1) ⇒ pin board

d. relay test board (2) ⇒ matrix motherboard (2) ⇒ pin board

e. relay test board (1) ⇒ matrix motherboard (1) ⇒ pin board ⇒ matrix motherboard (1) ⇒ relay test board

f. relay test board (2) ⇒ matrix motherboard (2) ⇒ pin board ⇒ matrix motherboard (2) ⇒ relay test board (2)

g. relay test board (1) ⇒ matrix motherboard (1) ⇒ pin board ⇒ matrix motherboard (1) ⇒ extended path input cable ⇒ extended path input connector

h. relay test board (2) ⇒ matrix motherboard (2) ⇒ pin board ⇒ matrix motherboard (2) ⇒ extended path input cable ⇒ extended path input connector

i. relay test board (1) ⇒ matrix motherboard (1) ⇒ input board ⇒ matrix motherboard (2) ⇒ relay test board (2)

j. relay test board (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ matrix motherboard (1) ⇒ mini-motherboard (1) ⇒ block 1 flat cable ⇒ SMU motherboard ⇒ GNDU

k. relay test board (2) ⇒ matrix motherboard (2) ⇒ Kelvin input board ⇒ matrix motherboard (1) ⇒ mini-motherboard (1) ⇒ block 1 flat cable ⇒ SMU motherboard ⇒ GNDU

l. relay test board (1) ⇒ matrix motherboard (1) ⇒ low current input board (1 or 2) ⇒ outer port cable ⇒ AUX (1 or 2) input connector

m. relay test board (2) ⇒ matrix motherboard (2) ⇒ low current input board (1 or 2) ⇒ outer port cable ⇒ AUX (1 or 2) input connector

n. relay test board (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ outer port cable ⇒ AUX (one of 3 to 6) input connector

o. relay test board (2) ⇒ matrix motherboard (2) ⇒ Kelvin input board ⇒ outer port cable ⇒ AUX (one of 3 to 6) input connector

p. relay test board (1) ⇒ matrix motherboard (1) ⇒ CMU matrix cable ⇒ SMU motherboard ⇒ CMU input board ⇒ outer port cable ⇒ AUX (7 or 8) input connector

q. relay test board (2) ⇒ matrix motherboard (2) ⇒ CMU matrix cable ⇒ SMU motherboard ⇒ CMU input board ⇒ outer port cable ⇒ AUX (7 or 8) input connecto

Relays used in Relay Test: Table 3-18 through table 3-23 list the relays used in each testcase.

Table 3-18 Relays Used in Each Pin Board Testcase

Board Assy	Relay	Testcase																															
		1[a] (101)[b]	2[a] (102)[b]	3[a] (103)[b]	4[a] (104)[b]	5[a] (105)[b]	6[a] (106)[b]	7[a] (107)[b]	8[a] (108)[b]	9[a] (109)[b]	10[a] (110)[b]	11[a] (111)[b]	12[a] (112)[b]	13[a] (113)[b]	14[a] (114)[b]	15[a] (115)[b]	16[a] (116)[b]	17[a] (117)[b]	18[a] (118)[b]	19[a] (119)[b]	20[a] (120)[b]	21[a] (121)[b]	22[a] (122)[b]	23[a] (123)[b]	24[a] (124)[b]	25[a] (125)[b]	26[a] (126)[b]	27[a] (127)[b]	28[a] (128)[b]	29[ac] (129)[b]	130[b]	131[b]
Pin board / chuck connection pin board	K1								√																	√						
	K2																				√		√				√	√				
	K10	√	√	√	√																										√	√
	K11[b]	√	√		√																										√	√
	K12	√	√		√																										√	√
	K20					√	√	√																								
	K21[b]					√	√																									
	K22					√	√																									
	K30								√	√	√	√												√	√		√	√	√		
	K31																										√	√				
	K40												√	√	√											√						
	K41								√																√	√			√			
	K50															√	√	√														
	K60			√				√	√	√	√	√	√	√	√	√	√	√	√	√		√		√							√	√
	K70				√																		√	√								
	K80	√	√			√	√														√	√							√	√		
	K81	√	√		√	√	√														√		√						√	√		
	K90																		√	√												
	K100																								√	√						
Relay test board	K1	√	√		√	√	√				√			√			√			√	√		√					√	√		√	√
	K2			√				√				√			√			√				√		√	√							
	K3								√	√			√			√			√							√	√			√		
	K10	√	√	√	√																										√	
	K11	√	√	√	√																										√	
	K20					√	√	√																								√
	K21					√	√																									√
	K30								√	√	√	√												√	√		√	√	√		
	K40												√	√	√											√						
	K41										√			√			√			√								√	√			
	K50															√	√	√														
	K60			√				√	√	√	√	√	√	√	√	√	√	√	√	√		√		√							√	√
	K61	√	√		√	√	√			√	√		√	√		√	√		√	√									√	√		
	K62			√				√	√			√			√			√				√		√							√	√
	K70				√																		√	√								
	K71				√																		√	√								
	K80	√	√			√	√														√	√							√	√		
	K81																				√		√									
	K90																		√	√												

a. This is for Agilent 4072A only.
b. This is for Agilent 4073A only.
c. This testcase is executed only when the force and sense are shorted at the top of measurement pins.

Table 3-19 Relays Used in LC Input Board Testcase

Board Assy	Relay	Test case																															
		SMU 1 Port (with SMU)						SMU 1 Port (without SMU)					AUX 1 Port					SMU 2 Port (with SMU)						SMU 2 Port (without SMU)					AUX 2 Port				
		1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5
Relay test board 1	K1	√		√				√	√		√		√	√		√			√		√					√					√		
	K2					√						√					√						√										
	K10	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√																
	K11	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√																
	K20																	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	K21																	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	K61		√		√													√		√				√			√		√			√	
	K62						√			√					√							√			√			√		√				√
	K63						√			√					√							√			√			√		√				√
	K81		√		√													√		√				√			√		√			√	
Relay test board 2	K1		√		√					√					√			√		√				√	√		√		√	√		√	
	K2						√															√						√					√
	K10	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√																
	K11	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√																
	K20																	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	K21																	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	K61	√		√				√			√		√			√			√		√												
	K62					√			√			√		√			√						√			√					√			
	K63					√			√			√		√			√						√			√					√			
	K81	√		√				√			√		√			√			√		√												
LC input board	K10	√	√			√	√	√	√	√		√						√	√			√	√	√	√	√		√					
	K11	√	√	√	√	√	√	√	√	√	√	√						√	√	√	√	√	√	√	√	√	√	√					
	K12	√	√	√	√	√	√	√	√		√	√						√	√	√	√	√	√	√	√		√	√					
	K20	√	√			√	√	√	√	√		√						√	√			√	√	√		√		√					
	K21	√	√	√	√	√	√	√	√	√	√	√						√	√	√	√	√	√	√	√	√	√	√					
	K22	√	√	√	√	√	√	√		√	√	√						√	√	√	√	√	√	√		√	√	√					
	K30												√	√	√		√												√	√	√		√
	K31												√	√	√	√	√												√	√	√	√	√
	K32												√	√		√	√												√	√		√	√
	K40												√	√	√		√												√	√	√		√
	K41												√	√	√	√	√												√	√	√	√	√
	K42												√		√	√	√												√		√	√	√

Table 3-20 Relays Used in Kelvin Input Board Testcase (1 of 2)

Board Assy	Relay	Testcase																			
		SMU Port 3						AUX Port 3				SMU Port 4						AUX Port 4			
		1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	6	1	2	3	4
Relay test board 1	K1		√	√					√				√	√					√		
	K2					√				√						√				√	
	K3	√	√					√				√	√					√			
	K30	√	√	√	√	√	√	√	√	√											
	K40											√	√	√	√	√	√	√	√	√	
	K41			√	√				√					√	√				√		
	K61		√		√								√		√						
	K62						√										√				
	K63						√										√				
	K81		√		√								√		√						
Relay test board 2	K1	√			√			√				√			√			√			
	K2						√				√						√				√
	K3	√	√					√				√	√					√			
	K30	√	√	√	√	√	√	√	√		√										
	K40											√	√	√	√	√	√	√	√		√
	K41			√	√				√					√	√				√		
	K61	√		√				√	√			√		√				√	√		
	K62					√										√					
	K63					√										√					
	K81	√		√				√	√			√		√				√	√		
Kelvin input board	K311	√	√	√	√	√	√														
	K321	√	√	√	√	√	√														
	K331							√	√												
	K332									√											
	K341							√	√		√[a]										
	K342[b]										√[b]										
	K411											√	√	√	√	√	√				
	K421											√	√	√	√	√	√				
	K431																	√	√		
	K432																			√	
	K441																	√	√		√

a. This is for Agilent 4073A only.
b. This is for Agilent 4072A only.

Table 3-21 Relays Used in Kelvin Input Board Testcase (2 of 2)

Board Assy	Relay	Testcase																							
		SMU Port 5						AUX Port 5				SMU Port 6						AUX Port 6				GNDU Port			
		1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	6	1	2	3	4	1	2	3	4
Relay test board 1	K1		√	√					√				√	√					√				√	√	
	K2					√				√						√				√					
	K3	√	√					√				√	√					√				√	√		
	K41			√	√				√					√	√				√					√	
	K50	√	√	√	√	√	√	√	√	√															
	K60											√	√	√	√	√	√	√	√	√					
	K61		√		√								√		√								√		
	K62						√										√								
	K63						√										√								
	K81		√		√								√		√								√		
	K90																					√	√	√	
Relay test board 2	K1	√			√			√				√			√			√				√			√
	K2						√				√						√				√				
	K3	√	√					√				√	√					√				√	√		
	K41			√	√				√					√	√				√						√
	K50	√	√	√	√	√	√	√	√		√														
	K60											√	√	√	√	√	√	√	√		√				
	K61	√						√	√			√		√				√	√			√			
	K62					√										√									
	K63					√										√					√				
	K81	√		√				√	√			√		√				√	√			√			
	K90																					√	√		√
Kelvin input board	K511	√	√	√	√	√	√																		
	K521	√	√	√	√	√	√																		
	K531							√	√																
	K532									√															
	K541							√	√		√[a]														
	K542[b]										√[b]														
	K611											√	√	√	√	√	√								
	K621											√	√	√	√	√	√								
	K631																	√	√						
	K632																			√					
	K641																	√	√		√				
	K911																					√	√	√	
	K921																					√	√		√

a. This is for Agilent 4073A only.
b. This is for Agilent 4072A only.

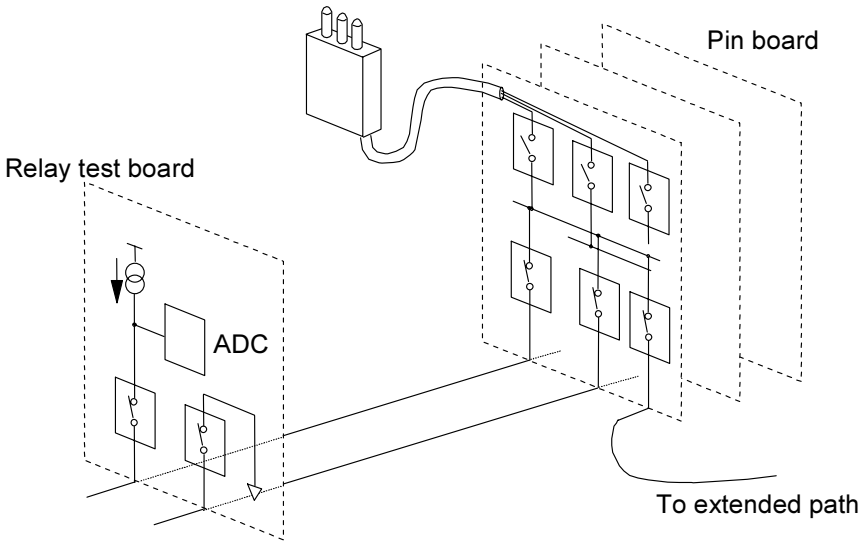
Table 3-22 Relays Used in CMU Input Board Testcase

Board Assy	Relay	Testcase																				
		SMU 7 Port				SMU 8 Port				AUX 7 and 8 Ports												
		1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	13
Relay test board 1	K1	√				√				√				√		√						
	K2			√				√				√	√		√			√		√		
	K61		√				√				√						√					
	K62				√				√										√		√	
	K63				√				√										√		√	
	K70	√	√	√	√									√	√							
	K80					√	√	√	√	√	√	√	√			√	√	√	√	√	√	
	K81	√				√				√				√		√						
Relay test board 2	K1		√				√				√						√				√	
	K2				√				√										√			√
	K61	√				√				√				√		√				√		
	K62			√				√				√			√			√				
	K63			√				√				√			√			√				
	K70	√	√	√	√									√	√	√	√	√	√	√	√	√
	K80					√	√	√	√	√	√	√										
	K81		√				√				√						√				√	
CMU input board	K711	√	√	√	√																	
	K721	√	√	√	√																	
	K730																			√	√	√
	K731													√	√							
	K741													√	√	√	√	√	√	√	√	√
	K770															√	√	√	√			
	K780																	√	√	√	√	
	K811					√	√	√	√													
	K821					√	√	√	√													
	K830												√									
	K831									√	√	√	√			√	√	√	√	√	√	
	K841									√	√	√										

Table 3-23 Relays Used in Relay Test Board Testcase

Board Assy	Relay	Testcase					
		1	2	3	4	5	6
Relay test board under test	K1	√	√		√	√	
	K2			√			√
	K10	√					
	K20		√				
	K42					√	√
	K61				√		
	K62	√	√	√			
	K63	√	√	√			
	K81				√		
Relay test board installed in opposite block	K42					√	√
	K61					√	
	K81					√	
	K62						√
	K63						√

Figure 3-13 Relay Test



121: HF Matrix Relay Test

This test checks the relays on the HF matrix boards and the K100 relay on each pin board. This test also performs contact cleaning of the relays.

The HF matrix board relays K1 through K8, used for the extended path, are not tested. These relays are checked in the relay test of the performance verification.

Test number: 121

Summary of test:

1. Makes a connection a. or b. shown in *`Testhead signal flow`*, which connects the current source on the relay test board to the common (ground).
2. Performs contact cleaning of the relay.
3. Forces current `If`, using the current source on the relay test board.
4. Measures voltage `Vm`, using the relay test board.
5. Confirms that the resistance `Vm`/`If` indicates the normal value.
6. Opens the relays one by one.
7. Confirms that the relays do not stick (short).
8. Repeats the steps above for all testcases shown in table 3-25 through table 3-30.

Estimated test time: 60 seconds

Requirements for execution:

- ❏ At least 12 pin boards whose pin numbers are a multiple of 4 (4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, and 48) must be installed in the testhead.
- ❏ The HF matrix must exist.

Defective parts suspected:

- ❏ The pin boards for the failed paths
- ❏ The HF matrix board for the failed paths
- ❏ If multiple failed pin boards or HF matrix boards on one of the matrix motherboard, suspect the matrix motherboard or relay test board.

Test signal flow:

a. `relay test board (1) ⇒ matrix motherboard (1) ⇒ pin board ⇒ extended path input cable ⇒ HF matrix board (1, 2, and 3) ⇒ extended path input cable ⇒ pin board ⇒ matrix motherboard (1) ⇒ relay test board (1)`

b. `relay test board (2) ⇒ matrix motherboard (2) ⇒ pin board ⇒ extended path input cable ⇒ HF matrix board (4, 5, and 6) ⇒ extended path input cable ⇒ pin board ⇒ matrix motherboard (2) ⇒ relay test board (2)`

Relays used in HF Matrix Relay Test: Table 3-24 lists the relays used in all of the testcases for the HF Matrix Relay Test. The marked relays in table 3-25 through table 3-30 are used in each testcase. Figure 3-14 shows the relays on the HF matrix boards.

Table 3-24 Relays Used in All Testcases

Board Assy	Relays
Relay test board	K1, K3, K30, K41, K60, K61, K71
Output pin board[a]	K30, K31, K41, K100
Input pin board[a]	K31, K41, K60, K100

a. See figure 3-15.

Table 3-25 Relays Used in Each Testcase (1 of 6)

Board Assy	Relay	Testcase																		
		1-4-8-1 (1-44-48-1)	1-4-12-1 (1-44-36-1)	1-4-16-1 (1-44-40-1)	1-4-20-1 (1-44-28-1)	1-4-24-1 (1-44-32-1)	1-8-12-1 (1-48-36-1)	1-8-16-1 (1-48-40-1)	1-8-20-1 (1-48-28-1)	1-8-24-1 (1-48-32-1)	1-12-16-1 (1-36-40-1)	1-12-20-1 (1-36-28-1)	1-12-24-1 (1-36-32-1)	1-16-20-1 (1-40-28-1)	1-16-24-1 (1-40-32-1)	1-20-24-1 (1-28-32-1)	1-12-16-13-1	1-12-16-14-1	1-20-24-15-1	1-20-24-16-1
Pin 4 (44)	K100	√	√	√	√	√														
Pin 8 (48)		√					√	√	√	√										
Pin 12 (36)			√				√				√	√	√				√	√		
Pin 16 (40)				√				√			√			√	√		√	√		
Pin 20 (28)					√				√			√		√		√			√	√
Pin 24 (32)						√				√			√		√	√			√	√
HF 1 (HF 6)	K12		√				√				√	√	√							
	K13			√				√			√			√	√					
	K22				√				√			√		√		√				
	K23					√				√			√		√	√				
	K102	√	√	√	√	√														
	K103	√					√	√	√	√										
	K410	√	√	√	√	√														
	K810	√					√	√	√	√										
HF 2 (HF 5)	K102																√	√		
	K103																√	√		
	K410																	√		
	K412		√				√				√	√	√				√			
	K510																√			
	K512																√			
	K710																	√		
	K713																	√		
	K810																√			
	K813			√				√			√			√	√			√		
HF 3 (HF 4)	K102																		√	√
	K103																		√	√
	K410																			√
	K422				√				√			√		√		√			√	
	K510																		√	
	K522																		√	
	K710																			√
	K723																			√
	K810																		√	
	K823					√				√			√		√	√				√

Table 3-26 Relays Used in Each Testcase (2 of 6)

Board Assy	Relay	Testcase																		
		1-12-16-2 (1-36-40-2)	1-12-20-2 (1-36-28-2)	1-12-24-2 (1-36-32-2)	1-12-4-2 (1-36-44-2)	1-12-8-2 (1-36-48-2)	1-16-20-2 (1-40-28-2)	1-16-24-2 (1-40-32-2)	1-16-4-2 (1-40-44-2)	1-16-8-2 (1-40-48-2)	1-20-24-2 (1-28-32-2)	1-20-4-2 (1-28-44-2)	1-20-8-2 (1-28-48-2)	1-24-4-2 (1-32-44-2)	1-24-8-2 (1-32-48-2)	1-4-8-2 (1-44-48-2)	1-20-24-13-2	1-20-24-14-2	1-4-8-15-2 (1-44-48-15-2)	1-4-8-16-2 (1-44-48-16-2)
Pin 4 (44)	K100				√				√			√		√		√			√	√
Pin 8 (48)						√				√			√		√	√			√	√
Pin 12 (36)		√	√	√	√	√														
Pin 16 (40)		√					√	√	√	√										
Pin 20 (28)			√				√				√	√	√				√	√		
Pin 24 (32)				√				√			√						√	√		
HF 1 (HF 6)	K102																		√	√
	K103																		√	√
	K410																			√
	K422				√				√			√		√		√			√	
	K510																		√	
	K522																		√	
	K710																			√
	K723																			√
	K810																		√	
	K823					√				√			√		√	√				√
HF 2 (HF 5)	K12		√				√				√	√	√							
	K13			√				√			√			√	√					
	K22				√				√			√		√		√				
	K23					√				√			√		√	√				
	K102	√	√	√	√	√														
	K103	√					√	√	√	√										
	K410	√	√	√	√	√														
	K810	√					√	√	√	√										
HF 3 (HF 4)	K102																√	√		
	K103																√	√		
	K410																	√		
	K412		√				√				√	√	√				√			
	K510																√			
	K512																√			
	K710																	√		
	K713																	√		
	K810																√			
	K813			√				√			√			√	√			√		

Table 3-27 Relays Used in Each Testcase (3 of 6)

Board Assy	Relay	Testcase																		
		1-20-24-3 (1-28-32-3)	1-20-4-3 (1-28-44-3)	1-20-8-3 (1-28-48-3)	1-20-12-3 (1-28-48-3)	1-20-16-3 (1-28-40-3)	1-24-4-3 (1-32-44-3)	1-24-8-3 (1-32-48-3)	1-24-12-3 (1-32-36-3)	1-24-16-3 (1-32-40-3)	1-4-8-3 (1-44-48-3)	1-4-12-3 (1-44-36-3)	1-4-16-3 (1-44-40-3)	1-8-12-3 (1-48-36-3)	1-8-16-3 (1-48-40-3)	1-12-16-3 (1-36-40-3)	1-4-8-13-3 (1-44-48-13-3)	1-4-8-14-3 (1-44-48-14-3)	1-12-16-15-3 (1-36-40-15-3)	1-12-16-16-3 (1-36-40-16-3)
Pin 4 (44)	K100		√				√				√	√	√				√	√		
Pin 8 (48)				√				√			√			√	√		√	√		
Pin12 (36)					√				√			√		√		√			√	√
Pin 16 (40)						√				√			√		√	√			√	√
Pin 20 (28)		√	√	√	√	√														
Pin 24 (32)		√					√	√	√	√										
HF 1 (HF 6)	K102																√	√		
	K103																√	√		
	K410																	√		
	K412		√				√				√	√	√				√			
	K510																√			
	K512																√			
	K710																	√		
	K713																	√		
	K810																√			
	K813			√				√			√			√	√			√		
HF 2 (HF 5)	K102																		√	√
	K103																		√	√
	K410																			√
	K422				√				√			√		√		√			√	
	K510																		√	
	K522																		√	
	K710																			√
	K723																			√
	K810																		√	
	K823					√				√			√		√	√				√
HF 3 (HF 4)	K12		√				√				√	√	√							
	K13			√				√			√			√	√					
	K22				√				√			√		√		√				
	K23					√				√			√		√	√				
	K102	√	√	√	√	√														
	K103	√					√	√	√	√										
	K410	√	√	√	√	√														
	K810	√					√	√	√	√										

Table 3-28 Relays Used in Each Testcase (4 of 6)

Board Assy	Relay	Testcase																	
		2-4-20-5-1 (2-44-28-45-1)	2-4-12-5-1 (2-44-36-45-1)	2-4-20-6-1 (2-44-28-46-1)	2-4-12-6-1 (2-44-36-46-1)	2-8-20-7-1 (2-48-28-47-1)	2-8-12-7-1 (2-48-36-47-1)	2-12-4-13-2 (2-36-44-37-2)	2-12-20-13-2 (2-36-28-37-2)	2-12-4-14-2 (2-36-44-38-2)	2-12-20-14-2 (2-36-28-38-2)	2-16-4-15-2 (2-40-44-39-2)	2-16-20-15-2 (2-40-28-39-2)	2-20-12-21-3 (2-28-36-29-3)	2-20-4-21-3 (2-28-44-29-3)	2-20-12-22-3 (2-28-36-30-3)	2-20-4-22-3 (2-28-44-30-3)	2-24-12-23-3 (2-32-36-31-3)	2-24-4-23-3 (2-32-44-31-3)
Pin 4 (44)	K100	√	√	√	√			√		√		√			√		√		√
Pin 8 (48)						√	√												
Pin12 (36)			√		√		√	√	√	√	√			√		√		√	
Pin 16 (40)												√	√						
Pin 20 (28)		√		√		√			√		√		√	√	√	√	√		
Pin 24 (32)																		√	√
HF 1 (HF 6)	K12							√		√									
	K13											√							
	K22														√		√		
	K23																		√
	K102							√		√		√			√		√		√
	K410	√	√	√	√			√		√		√			√		√		√
	K510	√	√																
	K512	√																	
	K522		√																
	K610			√	√														
	K612			√															
	K622				√														
	K710					√	√												
	K713						√												
	K723					√													
	K810					√	√												
HF 2 (HF 5)	K12													√		√			
	K13																	√	
	K22		√		√														
	K23						√												
	K102		√		√		√							√		√		√	
	K410		√		√		√	√	√	√	√			√		√		√	
	K510							√	√										
	K512							√											
	K522								√										
	K610									√	√								
	K612									√									
	K622										√								
	K710											√	√						
	K713												√						
	K723											√							
	K810											√	√						
HF 3 (HF 4)	K12	√		√															
	K13					√													
	K22								√		√								
	K23												√						
	K102	√		√		√			√		√		√						
	K410	√		√		√			√		√		√	√	√	√	√		
	K510													√	√				
	K512													√					
	K522														√				
	K610															√	√		
	K612															√			
	K622																√		
	K710																	√	√
	K713																		√
	K723																	√	
	K810																	√	√

Table 3-29 Relays Used in Each Testcase (5 of 6)

Board Assy	Relay	Testcase																	
		3-4-20-1-1 (3-44-28-41-1)	3-4-12-1-1 (3-44-36-41-1)	3-4-20-2-1 (3-44-28-42-1)	3-4-12-2-1 (3-44-36-42-1)	3-4-20-3-1 (3-44-28-43-1)	3-4-12-3-1 (3-44-36-43-1)	3-12-4-9-2 (3-36-44-33-2)	3-12-20-9-2 (3-36-28-33-2)	3-12-4-10-2 (3-36-44-34-2)	3-12-20-10-2 (3-36-28-34-2)	3-12-4-11-2 (3-36-44-35-2)	3-12-20-11-2 (3-36-28-35-2)	3-20-12-17-3 (3-28-36-25-3)	3-20-4-17-3 (3-28-44-25-3)	3-20-12-18-3 (3-28-36-26-3)	3-20-4-18-3 (3-28-44-26-3)	3-20-12-19-3 (3-28-36-27-3)	3-20-4-19-3 (3-28-44-27-3)
Pin 4 (44)	K100	√	√	√	√	√	√	√		√		√			√		√		√
Pin 8 (48)																			
Pin12 (36)			√		√		√	√	√	√	√	√	√	√		√		√	
Pin 16 (40)																			
Pin 20 (28)		√		√		√			√		√		√	√	√	√	√	√	√
Pin 24 (32)																			
HF 1 (HF 6)	K11							√		√		√							
	K21														√		√		√
	K101	√	√	√	√	√	√												
	K102	√	√	√	√	√	√		√		√		√		√		√		√
	K110	√	√																
	K111	√																	
	K121		√																
	K210			√	√														
	K211			√															
	K221				√														
	K310					√	√												
	K311					√													
	K321						√												
	K410	√	√	√	√	√	√		√		√		√		√		√		√
HF 2 (HF 5)	K11													√		√		√	
	K21		√		√		√												
	K101							√	√	√	√	√	√						
	K102		√		√		√	√	√	√	√	√	√		√		√		√
	K110							√	√										
	K111							√											
	K121								√										
	K210									√	√								
	K211									√									
	K221										√								
	K310											√	√						
	K311											√							
	K321												√						
	K410		√		√		√	√	√	√	√	√	√		√		√		√
HF 3 (HF 4)	K11	√		√		√													
	K21								√		√		√						
	K101													√	√	√	√	√	√
	K102		√		√		√		√		√		√	√	√	√	√	√	√
	K110													√	√				
	K111													√					
	K121														√				
	K210															√	√		
	K211															√			
	K221																√		
	K310																	√	√
	K311																	√	
	K321																		√
	K410		√		√		√		√		√		√	√	√	√	√	√	√

Table 3-30 Relays Used in Each Testcase (6 of 6)

Board Assy	Relay	Testcase																	
		11-1-1 (11-41-1)	11-2-1 (11-42-1)	11-3-1 (11-43-1)	11-5-1 (11-45-1)	11-6-1 (11-46-1)	11-7-1 (11-47-1)	11-9-2 (11-33-2)	11-10-2 (11-34-2)	11-11-2 (11-35-2)	11-13-2 (11-37-2)	11-14-2 (11-38-2)	11-15-2 (11-39-2)	11-17-3 (11-25-3)	11-18-3 (11-26-3)	11-19-3 (11-27-3)	11-21-3 (11-29-3)	11-22-3 (11-30-3)	11-23-3 (11-31-3)
Pin 1 (41)		√																	
Pin 2 (42)			√																
Pin 3 (43)				√															
Pin 5 (45)					√														
Pin 6 (46)						√													
Pin 7 (47)							√												
Pin 8 (48)		√	√	√	√	√	√												
Pin 9 (33)								√											
Pin 10 (34)									√										
Pin 11 (35)										√									
Pin 13 (37)	K100										√								
Pin 14 (38)												√							
Pin 15 (39)													√						
Pin 16 (40)								√	√	√	√	√	√						
Pin 17 (25)														√					
Pin 18 (26)															√				
Pin 19 (27)																√			
Pin 21 (28)																	√		
Pin 22 (29)																		√	
Pin 23 (30)																			√
Pin 24 (31)														√	√	√	√	√	√
HF 1 (HF 6)	K101	√	√	√															
	K102				√	√													
	K103	√	√	√	√	√													
	K110	√																	
	K210		√																
	K310			√															
	K510				√														
	K610					√													
	K710						√												
	K810	√	√	√	√	√	√												
HF 2 (HF 5)	K101							√	√	√									
	K102										√	√							
	K103							√	√	√	√	√							
	K110							√											
	K210								√										
	K310									√									
	K510										√								
	K610											√							
	K710												√						
	K810							√	√	√	√	√	√						
HF 3 (HF 4)	K101													√	√	√			
	K102																√	√	
	K103													√	√	√	√	√	
	K110													√					
	K210														√				
	K310															√			
	K510																√		
	K610																	√	
	K710																		√
	K810													√	√	√	√	√	√

Figure 3-14 Relay Locations on Each HF Matrix Board

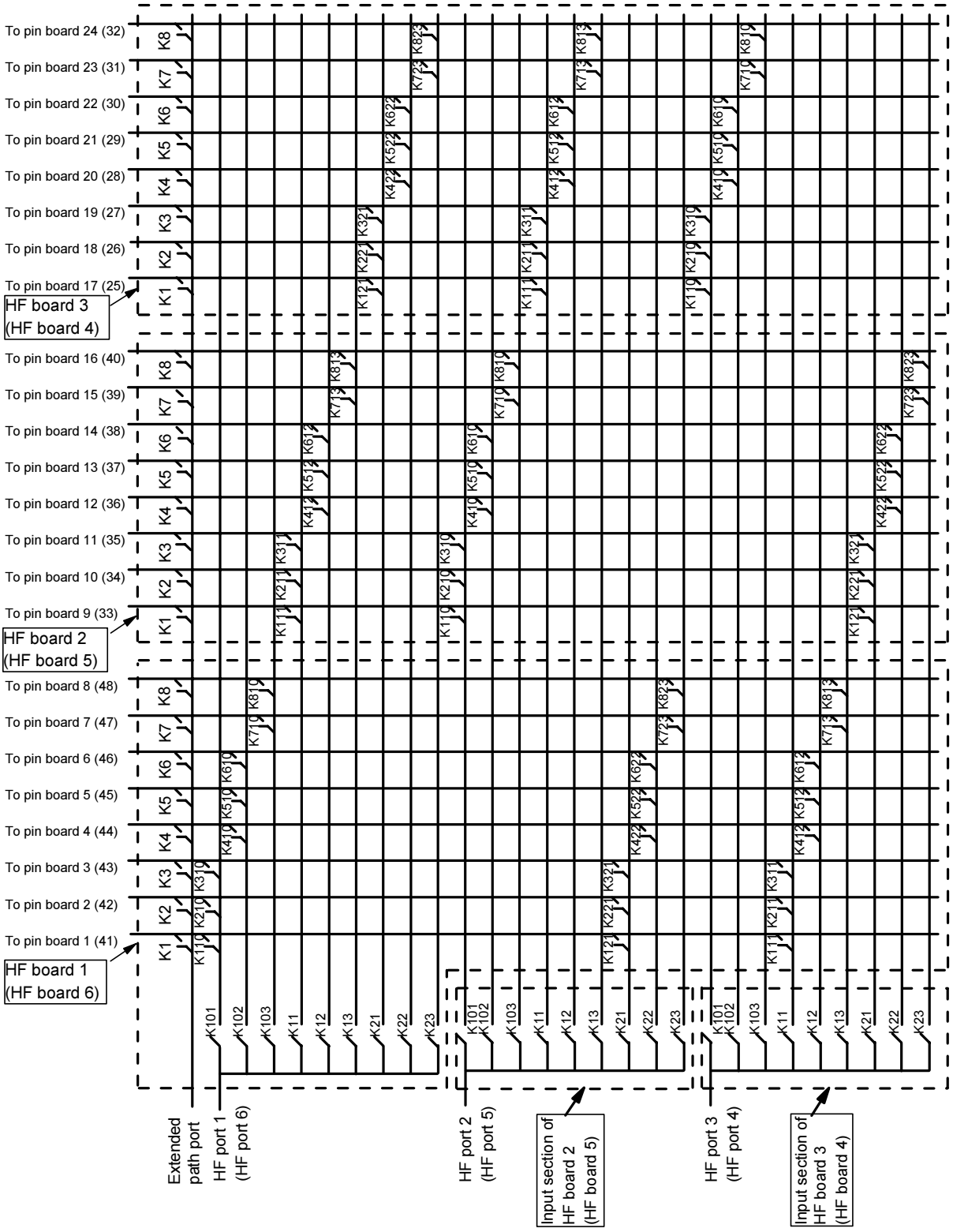
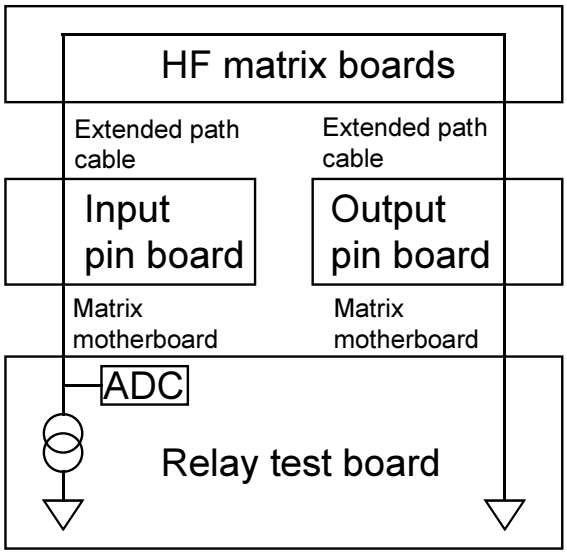


Figure 3-15 HF Matrix Relay Test



130: GNDU Test

This test checks the voltage of the ground unit (GNDU) using the high-resolution ADC board.

Test number: 130

Summary of test:

1. Makes connection a. shown in *Test signal flow*, that connects the GNDU to the high-resolution ADC board.
2. Measures the voltage using the high-resolution ADC board.
3. Makes connection b. shown in *Test signal flow*, and measures the voltage.

Estimated test time: 5 seconds.

Requirements for execution: None.

Defective parts suspected:

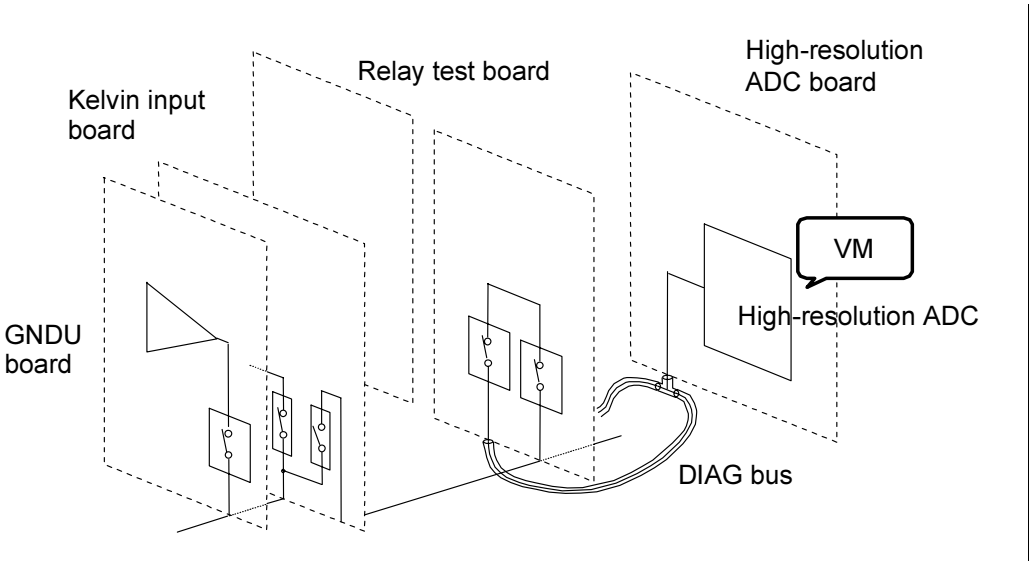
- ❑ If a failure is detected on either a or b, suspect all parts from the Kelvin input board to diagnostics bus.
- ❑ If a failure is detected on both a and b, suspect the high-resolution ADC board, and parts from the GNDU board to the Kelvin input board.

Test signal flow:

a. `GNDU ⇒ SMU motherboard ⇒ block 1 flat cable ⇒ mini-motherboard (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ diagnostics bus ⇒ high-resolution ADC board`

b. `GNDU ⇒ SMU motherboard ⇒ block 1 flat cable ⇒ mini-motherboard (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ diagnostics bus ⇒ high-resolution ADC board`

Figure 3-16 GNDU Test



131: SMU V/I Test

This test checks the force and measurement capabilities of the SMUs using the high-resolution ADC board. This test is executed for all SMUs installed in the testhead.

Test number: 131

Summary of test:

- ❏ Forcing Voltage/Measuring Voltage:
  1. Makes connection a. shown in *Test signal flow* that connects the SMU to the high-resolution ADC board.
  2. Forces voltage by the SMU and the high-resolution ADC board at the following voltage points.
     - ❏ 0 V, ±0.2 V, and ±2 V in 2 V range.
     - ❏ 0 V, ±2 V, and ±20 V in 20 V range.
     - ❏ 0 V, ±4 V, and ±40 V in 40 V range.
     - ❏ 0 V, ±10 V, and ±100 V in 100 V range.
     - ❏ (HPSMU only) 0 V, ±20 V, and ±200 V in 200 V range.
  3. Compares the voltage measured by the SMU with the voltage measured by the high-resolution ADC board.
  4. Makes connection b. shown in *Test signal flow*, and repeats the steps above.
  5. Repeats the steps above for all SMUs.
- ❏ Forcing Current/Measuring Current:
  1. Makes connection a. shown in *Test signal flow* that connects the SMU to the high-resolution ADC board.
  2. Forces current by the SMU through the reference resistor R on the high-resolution ADC board at the following current points.
     - ❏ (HRSMU only) ±1 pA and ±8 pA in ±10 pA range for low current ports.
     - ❏ (HRSMU only) ±10 pA and ±80 pA in ±100pA range for low current ports.
     - ❏ ±0.1 nA and ±0.8 nA in 1 nA range for low current ports.
     - ❏ ±1 nA and ±8 nA in 10 nA range.
     - ❏ ±10 nA and ±80 nA in 100 nA range.
     - ❏ ±0.1 μA and ±0.8 μA in 1 μA range.
     - ❏ ±1 μA and ±8 μA in 10 μA range.
     - ❏ ±10 μA and ±80 μA in 100 μA range.
     - ❏ ±0.1 mA and ±0.8 mA in 1 mA range.
     - ❏ ±1 mA and ±8 mA in 10 mA range.
     - ❏ ±10 mA and ±40 mA in 100 mA range.
     - ❏ (HPSMU only) ±100 mA and ±250 mA in 1 A range.

3. Measures voltage `Vr` using the high-resolution ADC board, and calculates current `Vr/R`.
4. Measures current using the SMU.
5. Compares the current measured using the SMU with the current `Vr/R`.
6. Makes connection b. shown in *`Test signal flow`*, and repeats the steps above.
7. Repeats the steps above for all SMUs.

❏ Common Mode Rejection:

1. Opens the SMU output terminal at the input boards.
2. Forces 0 V from the SMU and measures current `I1` in the 1 mA range.
3. Forces +100 V from the SMU and measures current `I2` in the 1 mA range.
4. Forces −100 V from the SMU and measures current `I3` in the 1 mA range.
5. Compares `I1` with `I2`.
6. Compares `I1` with `I3`.
7. Repeats the steps above for all SMUs.

Where the actual name of the input board depends on the internal SMU ports, as follows:

❏ SMU 1: low current input board (1)

❏ SMU 2: low current input board (2)

❏ SMU 3 to 6: Kelvin input board

❏ SMU 7 and 8: CMU input board

Estimated test time: 30 × N seconds, maximum 240 seconds (for MPSMU and HPSMU)

630 × N seconds, maximum 1260 seconds (for HRSMU)

N: Number of SMUs

Requirements for execution: SMU must be installed in the testhead.

Defective parts suspected:

❏ If a failure is detected on both a and b, suspect the high-resolution ADC board and all parts from SMU to input board.

❏ If a failure is detected on either a or b, suspect all parts from the input board to the diagnostics bus.

❏ If a failure is detected on some input ports, suspect all parts from the relay test board to the high-resolution ADC board.

Test signal flow:

For forcing voltage/measuring voltage and forcing current/measuring current:

a. `SMU board ⇒ input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ diagnostics bus ⇒ high-resolution ADC board`

b. `SMU board ⇒ input board ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ diagnostics bus ⇒ high-resolution ADC board`

For common mode rejection:

`SMU board (⇒ Input board)`

Figure 3-17 SMU Test VFVM

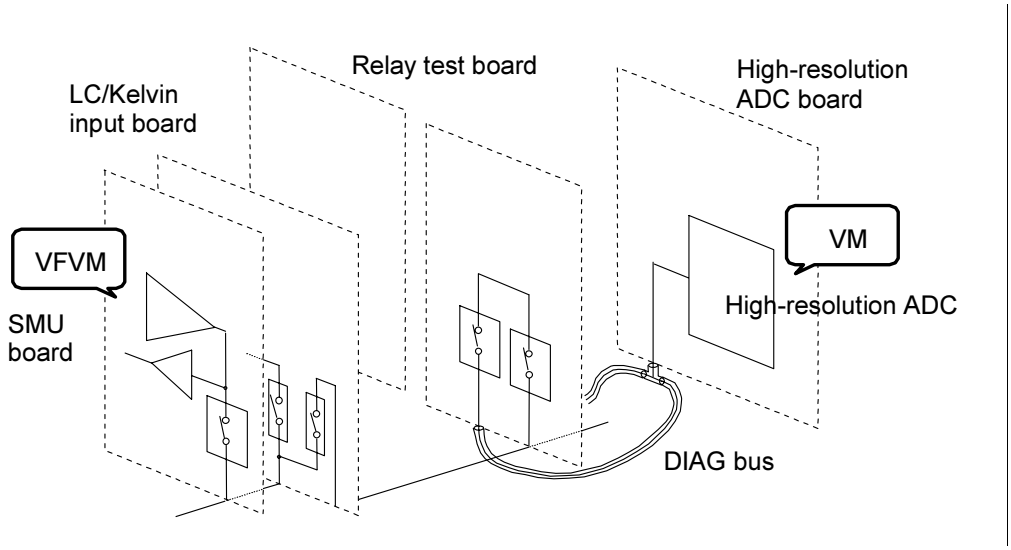
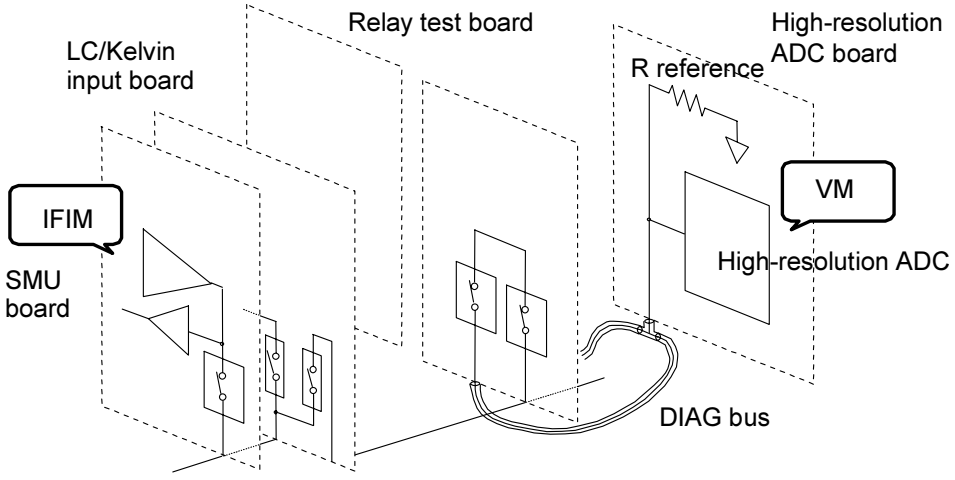


Figure 3-18 SMU Test IFIM



132: DC Leakage Test

This test checks the isolation of the matrix output ports using the SMU when all pin boards are in the open condition. This test is executed for all SMUs installed in the testhead.

Test number: 132

Summary of test:

1. Makes connections 1-a. and 1-b. shown in *Test signal flow* for SMUs (A) and (B), respectively.
2. Forces voltage from the SMUs as follows, waits approximately 10 seconds, and measures the current using the SMUs (at 1 nA range).

SMU	Measurement Voltage		
SMU (A)	0 V	−100 V	+100 V
SMU (B)	0 V	+100 V	−100 V

3. Makes connections 2-a. and 2-b. shown in *Test signal flow* for SMUs (A) and (B), respectively.
4. Forces voltage shown above, waits approximately 10 seconds, and measures the current using the SMUs (at 1 nA range).
5. Repeats the steps above for all SMUs.

Where the actual name of the input board depends on the internal SMU ports as follows:

- ❏ SMU 1: low current input board (1)
- ❏ SMU 2: low current input board (2)
- ❏ SMU 3 to 6: Kelvin input board
- ❏ SMU 7 and 8: CMU input board

Estimated test time: 5 + 30 × N seconds, (maximum 245 seconds). (N: Number of SMUs)

Defective parts suspected:

- ❏ If a failure is detected on both 1-a and 2-a, suspect all parts from the SMU (A) to the input board.
- ❏ If a failure is detected on both 1-b and 2-b, suspect all parts from the SMU (B) to the input board.
- ❏ If a failure is detected on either 1-a or 2-a, suspect all parts from the input board to the pin board for the failed path.
- ❏ If a failure is detected on either 1-b or 2-b, all parts from the input board to the pin board for the failed path.

Test signal flow:

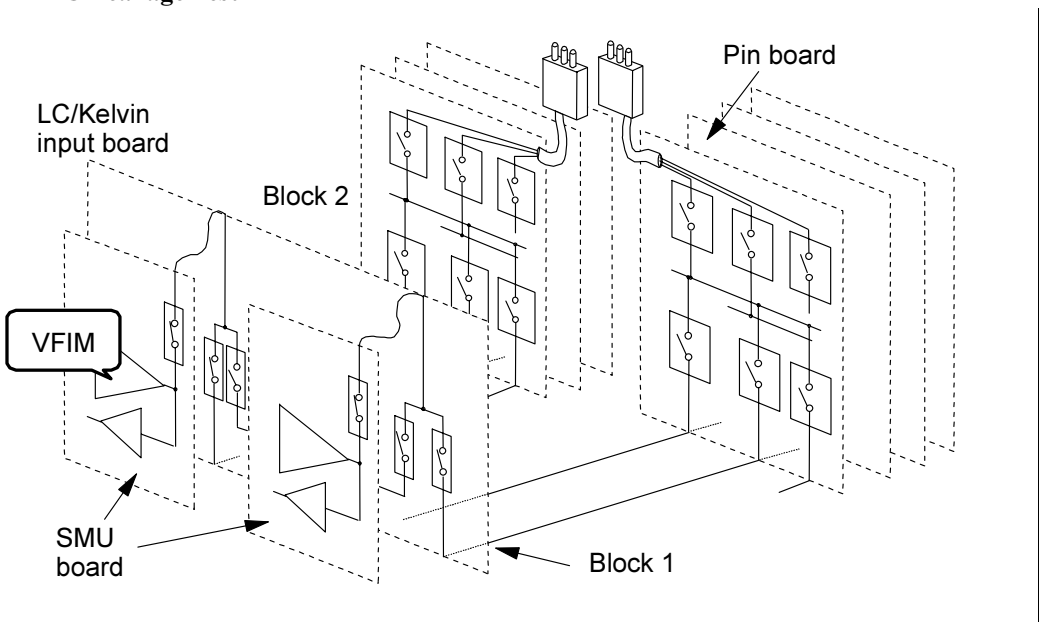
```
1-a. SMU board (A) ⇒ input board ⇒ matrix motherboard
(1) ⇒ pin board (1~24) and chuck connection pin board
and relay test board (1)

1-b. SMU board (B) ⇒ input board ⇒ matrix motherboard
(2) ⇒ pin board (25~48) and relay test board (2)

2-a. SMU board (A) ⇒ input board ⇒ matrix motherboard
(1) ⇒ pin board (25~48) and relay test board (2)

2-b. SMU board (B) ⇒ input board ⇒ matrix motherboard
(2) ⇒ pin board (1~24) and chuck connection pin board
and relay test board (1)
```

Figure 3-19 DC Leakage Test



140: CMU C/G Test

This test checks the capacitance measurement capability of the CMU (4284A) using the reference capacitor on the relay test board.

Test number: 140

Summary of test:

1. Makes connection a. shown in *Test signal flow* that connects the CMU to the relay test board.
2. Measures capacitance of the reference capacitor (100 pF) at the following measurement frequency of the CMU:
3. Makes connection b. shown in *Test signal flow*, and measures capacitance as described above.

Measurement Frequency: 1 kHz, 10 kHz, 100 kHz, and 1 MHz.

Estimated test time: 8 seconds.

Requirements for execution: CMU (4284A) must be installed in the 4072A/4073A.

Defective parts suspected:

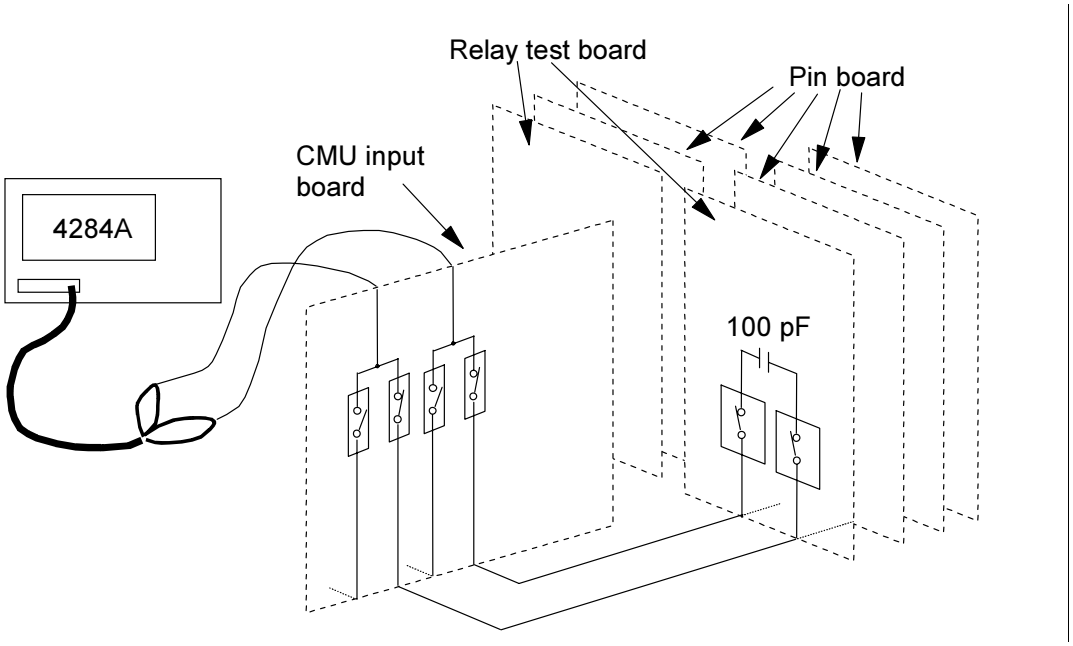
- ❏ If a failure is detected on both a and b, suspect all parts from the CMU to the CMU input board.
- ❏ If a failure is detected on either a or b, suspect all parts from the CMU input board to the relay test board.

Test signal flow:

a. `CMU ⇒ CMU cable ⇒ AUX input port (7 and 8) ⇒ outer port cable ⇒ CMU input board ⇒ SMU motherboard ⇒ CMU matrix cable ⇒ matrix motherboard (1) ⇒ relay test board (1)`

b. `CMU ⇒ CMU cable ⇒ AUX input port (7 and 8) ⇒ outer port cable ⇒ CMU input board ⇒ SMU motherboard ⇒ CMU matrix cable ⇒ matrix motherboard (2) ⇒ relay test board (2)`

Figure 3-20 CMU C/G Test



141: CMU DC Bias Test

This test checks the DC bias capability of the CMU (4284A) using the high-resolution ADC board.

Test number: 141

Summary of test:

1. Makes connection a. shown in *Test signal flow* that connects the CMU to the high-resolution ADC board.
2. Measures the DC bias output of the CMU using the high-resolution ADC board at the following DC bias settings of the CMU:

   DC bias: 0, ±1.5, ±2, ±4, ±8, ±20, and ±40 V
3. Makes connection b. shown in *Test signal flow*, and measures the capacitance as described above.

Estimated test time: 34 seconds.

Requirements for execution: CMU (4284A) must be installed in the 4072A/4073A.

Defective parts suspected:

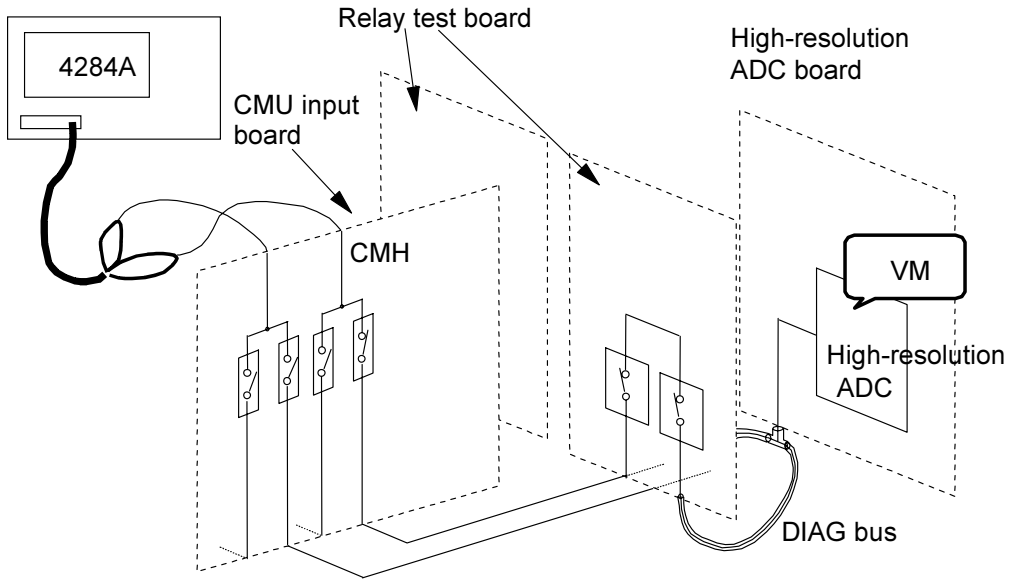
- ❑ If a failure is detected on both a and b, suspect the high-resolution ADC board and all parts from the CMU to the CMU input board.
- ❑ If a failure is detected on either a or b, suspect all parts from the CMU input board to the diagnostics bus.

Test signal flow:

a. `CMU ⇒ CMU cable ⇒ AUX input port (7 and 8) ⇒ outer port cable ⇒ CMU input board ⇒ SMU motherboard ⇒ CMU matrix cable ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ diagnostics bus ⇒ high-resolution ADC board`

b. `CMU ⇒ CMU cable ⇒ AUX input port (7 and 8) ⇒ outer port cable ⇒ CMU input board ⇒ SMU motherboard ⇒ CMU matrix cable ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ diagnostics bus ⇒ high-resolution ADC board`

Figure 3-21 CMU DC Bias Test



150: DVM Test

This test executes the self-test for the DVM (3458A) and checks the differential voltage measurement capability for the DVM using the SMU board and GNDU board. This test uses the SMU that is addressed at the lowest port number among the normal SMUs installed in the testhead.

Test number:	150
Summary of test:	1. Makes connections 1-a and 1-b shown in *Test signal flow*. 2. Forces the following voltage for the SMU and measures voltage using the SMU and DVM: 0, ±1, ±10, and ±40 V. 3. Makes connections 2-a and 2-b shown in *Test signal flow*. 4. Forces voltage and measures the voltage as described above.
Estimated test time:	83 seconds.
Requirements for execution:	❑ DVM (3458A) must be installed in the 4072A/4073A. ❑ SMU must be installed in the testhead.
Defective parts suspected:	❑ DVM, if DVM fails its self-test. ❑ If a failure is detected on both 1-a and 2-a, suspect all parts from the DVM to the Kelvin input board. ❑ If a failure is detected on both 1-b and 2-b, suspect all parts from the DVM to the Kelvin input board. ❑ If a failure is detected on either 1-a or 2-a, suspect all parts from the Kelvin input board to the diagnostics bus for the failed path. ❑ If a failure is detected on either 1-b or 2-b, suspect all parts from the Kelvin input board to the diagnostics bus for the failed path.

Test signal flow:

`1-a. SMU board ⇒ input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ outer port cable ⇒ AUX input port (5) ⇒ DVM cable ⇒ DVM`

`1-b. GNDU ⇒ SMU motherboard ⇒ block 1 flat cable ⇒ mini-motherboard (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ matrix motherboard (2) ⇒ Kelvin input board ⇒ outer port cable ⇒ AUX input port (6) ⇒ DVM cable ⇒ DVM`

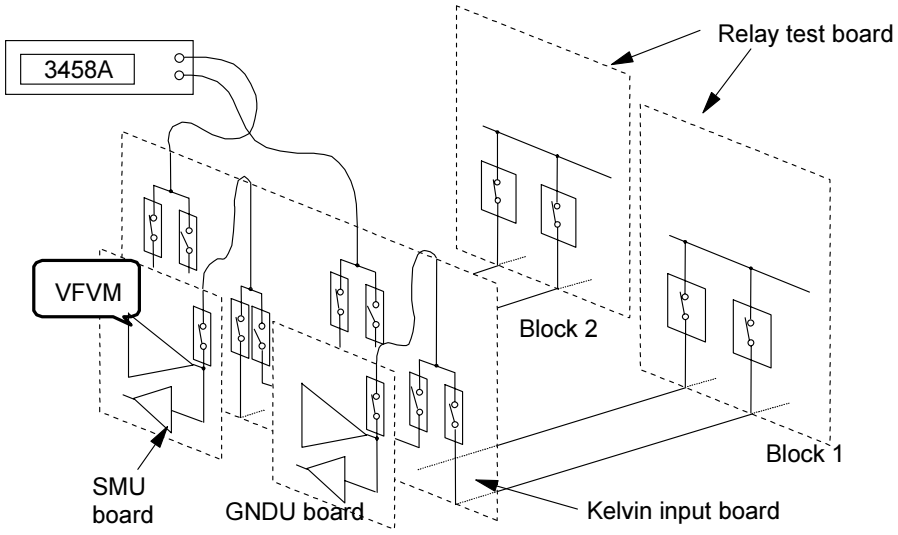
`2-a. GNDU ⇒ SMU motherboard ⇒ block 1 flat cable ⇒ mini-motherboard (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ outer port cable ⇒ AUX input port (5) ⇒ DVM cable ⇒ DVM`

`2-b. SMU board ⇒ input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ matrix motherboard (1) ⇒ Kelvin input board ⇒ outer port cable ⇒ AUX input port (6) ⇒ DVM cable ⇒ DVM`

Where the actual name of the input board depends on the SMU used for this test.

- ❏ SMU port 1: low current input board (1)
- ❏ SMU port 2: low current input board (2)
- ❏ SMU port 3 to 6: Kelvin input board
- ❏ SMU port 7 and 8: CMU input board

Figure 3-22 DVM Test



160: PG Selftest

This test executes the selftest of PGs using the `*TST?` command.

Test number: 160

Estimated test time: 5 × N seconds (N: Number of PGs)

Requirements for execution: PG (8114A, 81110A, or 8110A) must be installed in the 4072A/4073A.

Defective parts suspected: PG that fails the self-test

161: PG Connection Test

This test compares the connection information in the connection file (`/etc/opt/hp4070/config/pgconnection`) with actual PG cable connections.

Test number: 150

Summary of test:

1. Makes connections a., b., c., or d. shown *`in Test signal flow`*.
2. Forces 5 V and measures the voltage using the high-resolution ADC board.

Estimated test time: 5 × N seconds (N: Number of PGs)

Requirements for execution:

- ❏ PG (8114A, 81110A, or 8110A) must be installed in the 4072A/4073A.
- ❏ PG cable must be connected to an HF port or an AUX port. If the PG cable is connected to a pulse switch input (PSI), the pulse switch output (PSO) must be connected to an HF port or an AUX port.
- ❏ Pin board must be installed in each block if a PGU output is connected to an HF port.

Defective parts suspected:

- ❏ PGs for the failed path
- ❏ Cables for the failed path
- ❏ HF matrix boards for the failed path
- ❏ Pulse switch boards for the failed path
- ❏ Pin boards for the failed path
- ❏ Input boards for the failed path
- ❏ Relay test board
- ❏ High-resolution ADC board

Test signal flow:

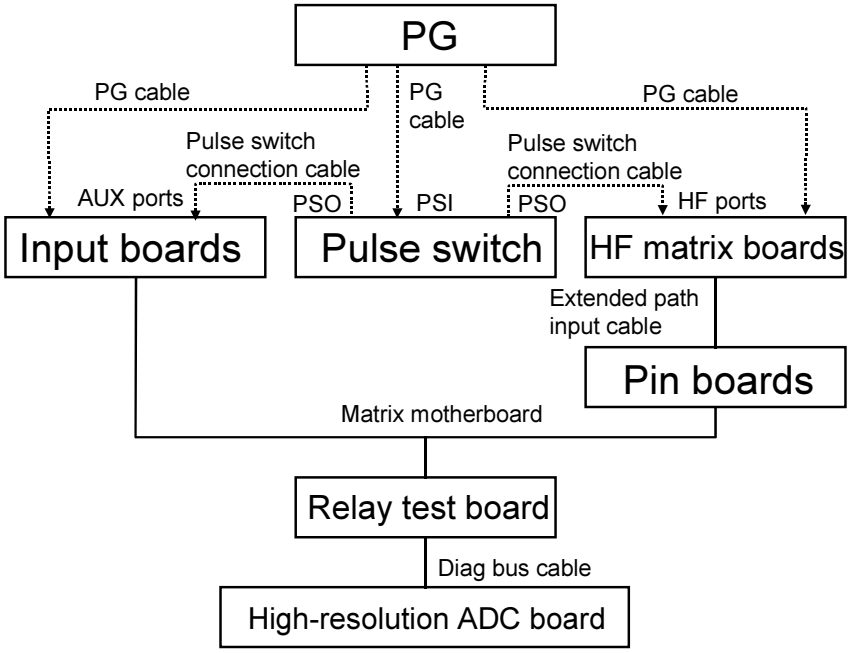
a. PGU ⇒ PG cable ⇒ (pulse switch ⇒) HF port (1, 2, or 3) ⇒ HF port cable ⇒ HF matrix board (1, 2, or 3) ⇒ extended path input cable ⇒ youngest number of pin board installed in block 1 ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board

b. PGU ⇒ PG cable ⇒ (pulse switch ⇒) HF port (4, 5, or 6) ⇒ HF port cable ⇒ HF matrix board (4, 5, or 6) ⇒ extended path input cable ⇒ youngest number of pin board installed in block 2 ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board

c. PGU ⇒ PG cable ⇒ (pulse switch ⇒) AUX port (1, 3, 5, or 7) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board

d. PGU ⇒ PG cable ⇒ (pulse switch ⇒) AUX port (2, 4, 6, or 8) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board

Figure 3-23 PG Connection Test



162: Pulse Switch Test

This test checks the relays on the pulse switch board.

Test number: 162

Summary of test:

1. Makes connections a., b., c., or d. shown in *`Test signal flow`*.
2. Closes the pulse switch. (The PG connected to the PSC controls the pulse switch.)
3. Forces 5 V and measures the voltage using the high-resolution ADC board.
4. Opens the pulse switch. (The PG connected to the PSC controls the pulse switch.)
5. Forces 5 V and measures the voltage using the high-resolution ADC board.
6. If the test fails, the connection test is executed. (The testhead CPU controls the pulse switch.)

Estimated test time: 5 × N seconds (N: Number of PGs)

Requirements for execution:

- ❑ PG (8114A, 81110A, or 8110A) must be installed in the 4072A/4073A.
- ❑ PG cable must be connected to an HF port or an AUX port through the pulse switch.
- ❑ PG cable must be connected to a pulse switch control (PSC).
- ❑ Pin board must be installed in each block, if a pulse switch output (PSO) is connected to an HF port.

Defective parts suspected:

- ❑ PGs connected to the pulse switch control (PSC)
- ❑ PG cables connected to the pulse switch control (PSC)
- ❑ PGs for the failed path
- ❑ Cables for the failed path
- ❑ HF matrix boards for the failed path
- ❑ Pulse switch boards for the failed path
- ❑ Pin boards for the failed path
- ❑ Input boards for the failed path
- ❑ Relay test boards
- ❑ High-resolution ADC board

Test signal flow:

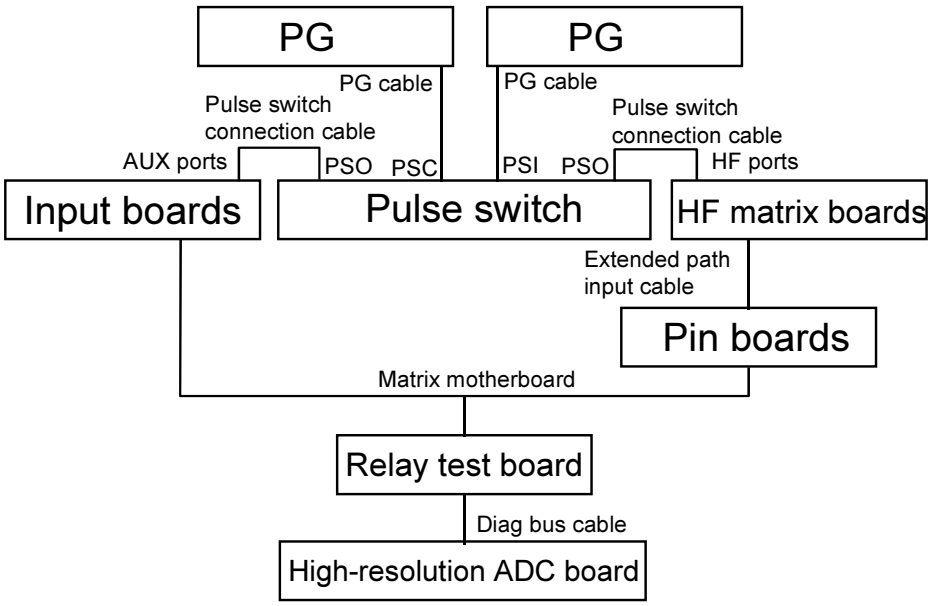
a. PGU ⇒ PG cable ⇒ pulse switch ⇒ HF port (1, 2, or 3) ⇒ HF port cable ⇒ HF matrix board (1, 2, or 3) ⇒ extended path input cable ⇒ youngest number of pin board installed in block 1 ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board

b. PGU ⇒ PG cable ⇒ pulse switch ⇒ HF port (4, 5, or 6) ⇒ HF port cable ⇒ HF matrix board (4, 5, or 6) ⇒ extended path input cable ⇒ youngest number of pin board installed in block 2 ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board

c. PGU ⇒ PG cable ⇒ pulse switch ⇒ AUX port (1, 3, 5, or 7) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board

d. PGU ⇒ PG cable ⇒ pulse switch ⇒ AUX port (2, 4, 6, or 8) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board

Figure 3-24 Pulse Switch Test



163: PG Output Level Test

This test checks the PGU outputs level.

Test number: 163

Summary of test:

1. Makes connection a., b., c., or d. shown in *`Test signal flow`*.
2. Forces 5 V and measures the voltage using the high-resolution ADC board.
3. Forces voltages (±19 V for the 81110A or 8110A or ±49 V for the 8114A) and measures the voltages using the high-resolution ADC board.

Estimated test time: 5 × N seconds (N: Number of PGs)

Requirements for execution:

- ❏ PG (8114A, 81110A, or 8110A) must be installed in the 4072A/4073A.
- ❏ PG cable must be connected to an HF port or an AUX port. If the PG cable is connected to a pulse switch input (PSI), the pulse switch output (PSO) must be connected to an HF port or an AUX port.

Defective parts suspected:

- ❏ PGs for the failed path
- ❏ Cables for the failed path
- ❏ HF matrix boards for the failed path
- ❏ Pulse switch boards for the failed path
- ❏ Pin boards for the failed path
- ❏ Input boards for the failed path
- ❏ Relay test board
- ❏ High-resolution ADC board

Test signal flow:

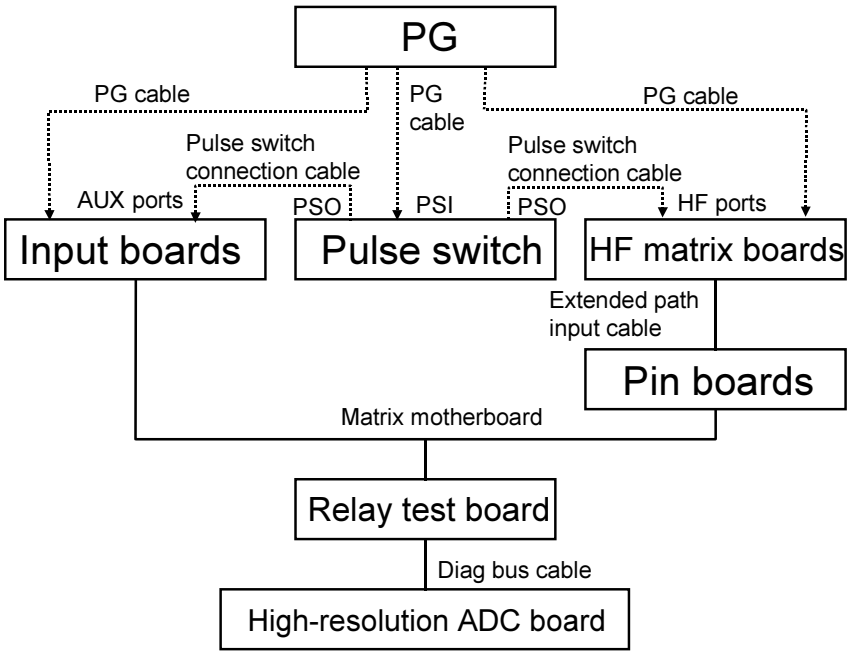
a. `PGU ⇒ PG cable ⇒ (pulse switch ⇒) HF port (1, 2, or 3) ⇒ HF port cable ⇒ HF matrix board (1, 2, or 3) ⇒ extended path input cable ⇒ youngest number of pin board installed in block 1 ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board`

b. `PGU ⇒ PG cable ⇒ (pulse switch ⇒) HF port (4, 5, or 6) ⇒ HF port cable ⇒ HF matrix board (4, 5, or 6) ⇒ extended path input cable ⇒ youngest number of pin board installed in block 2 ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board`

c. `PGU ⇒ PG cable ⇒ (pulse switch ⇒) AUX port (1, 3, 5, or 7) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board`

d. `PGU ⇒ PG cable ⇒ (pulse switch ⇒) AUX port (2, 4, 6, or 8) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board`

Figure 3-25 PG Output Level Test



164: PG Trigger Test

This test checks the trigger distributor and trigger cable connections by checking the PGU pulse outputs.

Test number: 164

Summary of test:

1. Makes connection a., b., c., or d. shown in *Test signal flow*.
2. Forces 5 V and measures the voltage using the high-resolution ADC board.
3. Forces a ±2 V pulse and measures the voltages.
4. Repeats step 3 for each PGU.
5. Changes the PG mode to pattern mode.
6. Forces a ±2 V pulse and measures the voltages.
7. Repeats step 6 for each PGU.

Estimated test time: 40 × N seconds (N: Number of PGUs)

Requirements for execution:

- ❏ PG (8114A, 81110A, or 8110A) must be installed in the 4072A/4073A.
- ❏ PG cable must be connected to an HF port or an AUX port. If the PG cable is connected to a pulse switch input (PSI), the pulse switch output (PSO) must be connected to an HF port or an AUX port.

Defective parts suspected:

- ❏ Trigger distributor
- ❏ Trigger cables
- ❏ PGs for the failed path
- ❏ Cables for the failed path
- ❏ HF matrix boards for the failed path
- ❏ Pulse switch boards for the failed path
- ❏ Pin boards for the failed path
- ❏ Input boards for the failed path
- ❏ Relay test board
- ❏ High-resolution ADC board

Test signal flow:

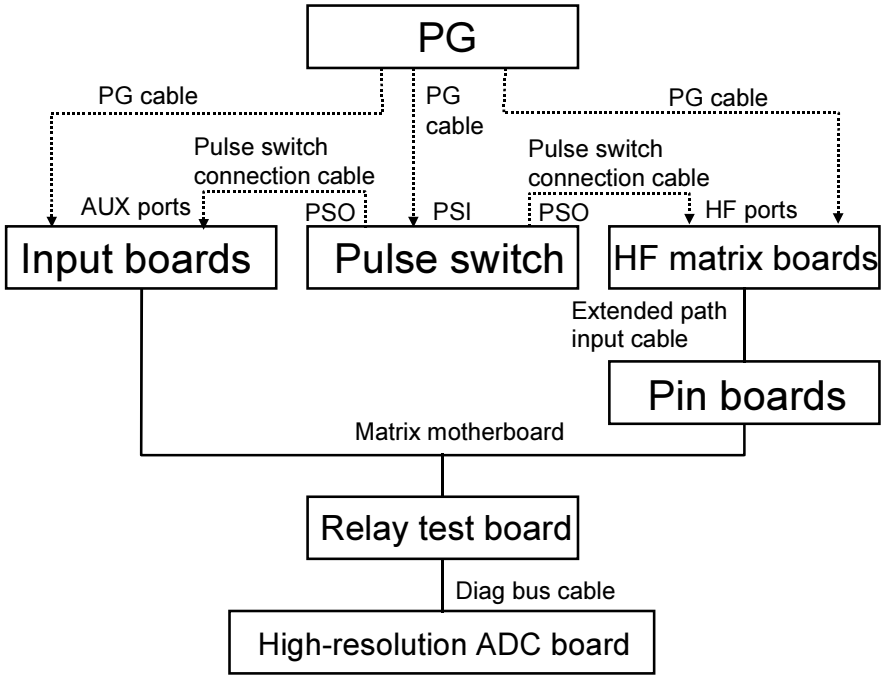
a. PGU ⇒ PG cable ⇒ (pulse switch ⇒) HF port (1, 2, or 3) ⇒ Outer port cable ⇒ HF matrix board (1, 2, or 3) ⇒ extended path cable ⇒ youngest number of pin board installed in block 1 ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board

b. PGU ⇒ PG cable ⇒ (pulse switch ⇒) HF port (4, 5, or 6) ⇒ Outer port cable ⇒ HF matrix board (4, 5, or 6) ⇒ extended path cable ⇒ youngest number of pin board installed in block 2 ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board

c. PGU ⇒ PG cable ⇒ (pulse switch ⇒) AUX port (1, 3, 5, or 7) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (1) ⇒ relay test board (1) ⇒ high-resolution ADC board

d. PGU ⇒ PG cable ⇒ (pulse switch ⇒) AUX port (2, 4, 6, or 8) ⇒ Outer port cable ⇒ input board ⇒ matrix motherboard (2) ⇒ relay test board (2) ⇒ high-resolution ADC board

Figure 3-26 PG Trigger Test



4 Replacement Procedures

This chapter provides procedures for replacing Agilent 4072A/4073A parts. This chapter also includes the tools required for each procedure, when applicable.

This chapter contains the following sections:

- “Safety Considerations”
- “System Cabinet”
- “PDU and EMO Panel”
- “Testhead Fan and Cabinet Fan”
- “Testhead Boards”
- “Testhead Motherboards”
- “Air Duct and Cables”
- “TH PS, TH Power Cables, System Instruments, System Controller, and FPD”
- “Updating the Testhead Firmware”

Safety Considerations

WARNING **Only trained service personnel, aware of the hazards involved, should perform parts replacement.**

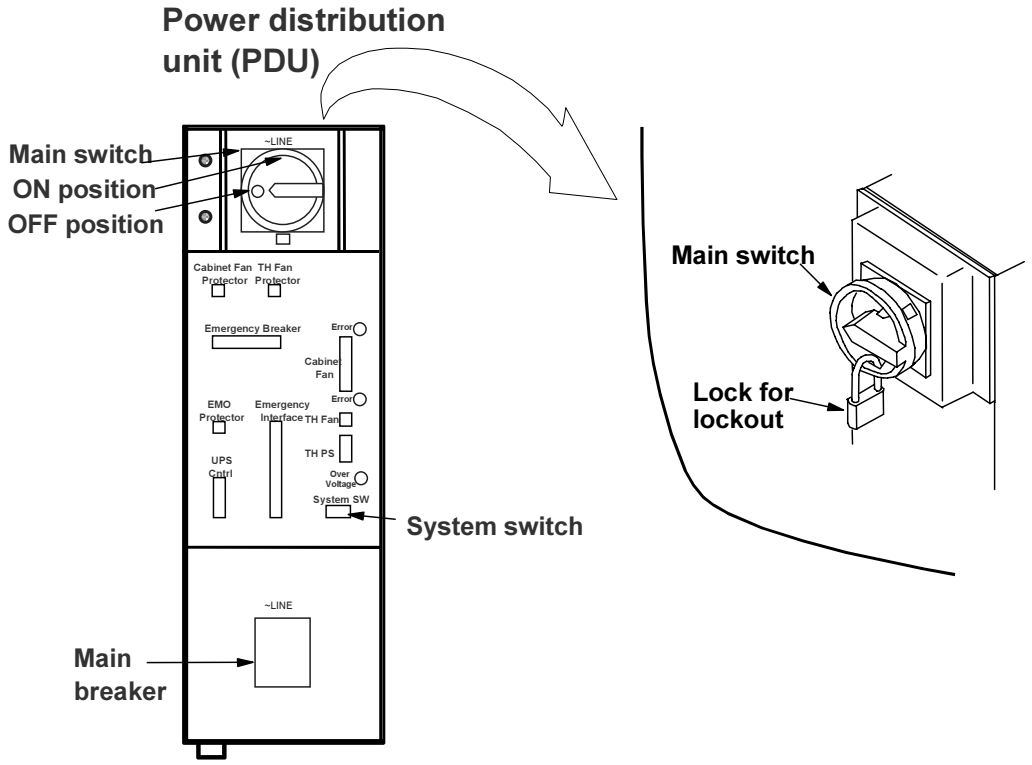
After repairs are completed, make sure all safety features are intact and are functioning properly, and that all necessary parts are connected to their protective grounds.

WARNING **The equipment or part which is heavyer than 4.5 kg must be replaced by two Agilent customer engineers (CEs).**

WARNING **Turn *OFF* the 4072A/4073A before removing the protective covers. Dangerous voltage may be applied to several terminals inside the testhead and the units in the system cabinet. Do not turn on the 4072A/4073A while accessing internal components, or until the protective covers are reinstalled.**

WARNING **To ensure the safety of non-service personnel, use the lockout mechanism of the main switch of the 4072A/4073A if you leave the installation site while replacing a part in the cabinet. Set the main switch of the 4072A/4073A to off and lock the main switch. This prevents the 4072A/4073A being accidentally turned on by non-service personnel.**

Figure 4-1 PDU and Main Switch



Lockout procedure:

1. Shut down the system controller.
2. Set the main switch to off and lock the switch.
3. Place a tag on the switch. Indicate the name of the responsible personnel servicing the 4072A/4073A on the tag.

Release procedure:

1. Open the rear door.
2. Confirm the main breaker is set to ON.
3. Confirm the emergency breaker is set to ON.
4. Unlock the main switch.
5. (If the Over Voltage Error LED is lit, check the ac input voltage. See “Checking the Power Supply” in chapter 3 .)
6. Press the system switch.

NOTE The interval between steps 4 and 6 must be within 20 seconds. If it exceeds 20 seconds, the cabinet fan error LED is lit. In this case, turn the main switch off, and do steps 4 through 6 again.

7. Press the INSTRUMENT POWER ON switch.

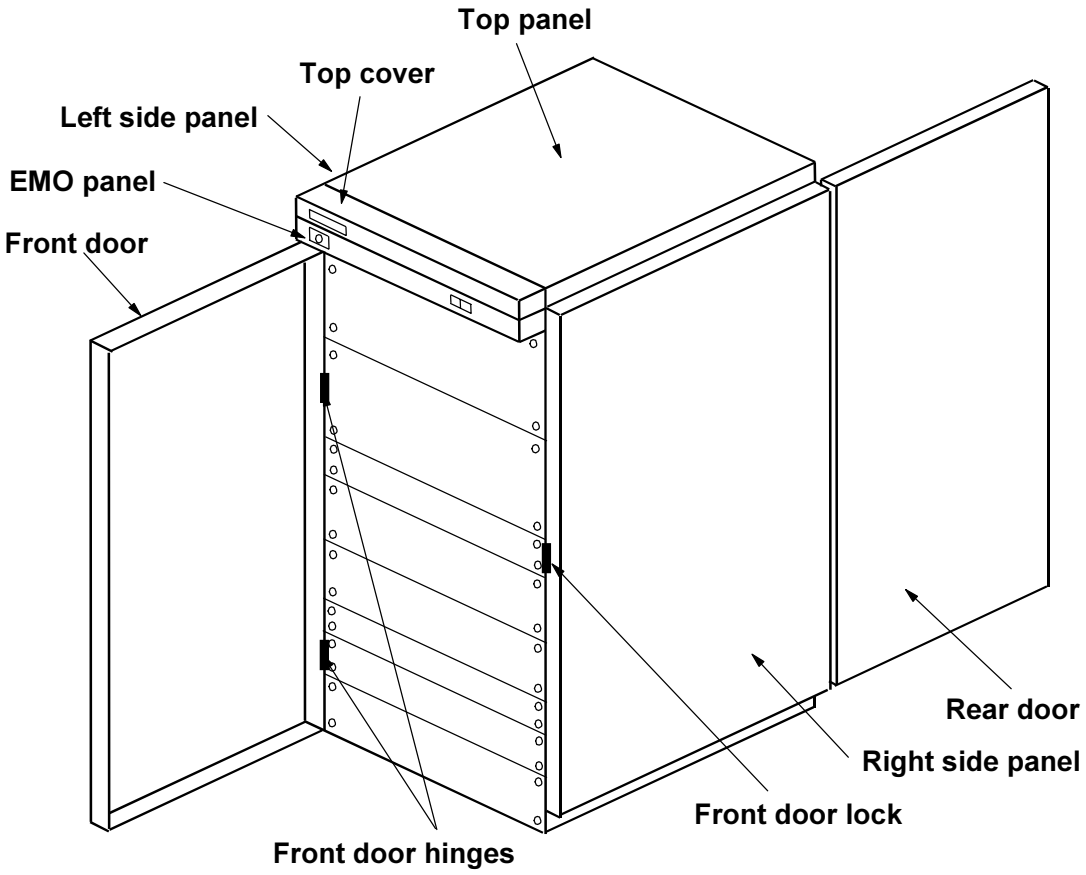
System Cabinet

This section provides procedures for removing system cabinet parts, and contains the following sections.

- "To Remove Top Panel"
- "To Remove Top Cover"
- "To Remove Left Side Panel"
- "To Remove Front Door Hinges"
- "To Remove Front Door Lock"

Figure 4-2 shows the part locations in the system cabinet.

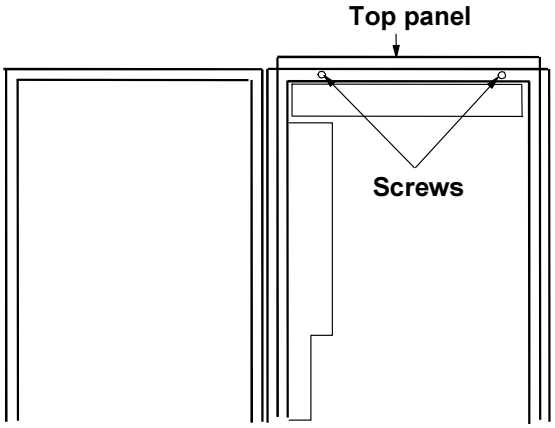
Figure 4-2 System Cabinet



To Remove Top Panel

1. Open the rear door.
2. Unscrew the two torx screws at the rear of the top panel. (torx screwdriver No. 25)
3. Slide the top panel to the rear.
4. Remove the top panel.

Figure 4-3 Removing Top Panel

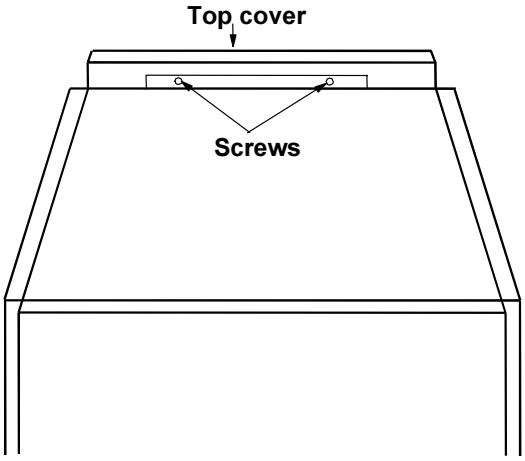


System cabinet rear view

To Remove Top Cover

1. Remove the top panel. To remove it, see “To Remove Top Panel”.
2. Unscrew the two torx screws at the rear of the top cover. (torx screwdriver No. 25)
3. Lift up and remove the top cover.

Figure 4-4 Removing Top Cover

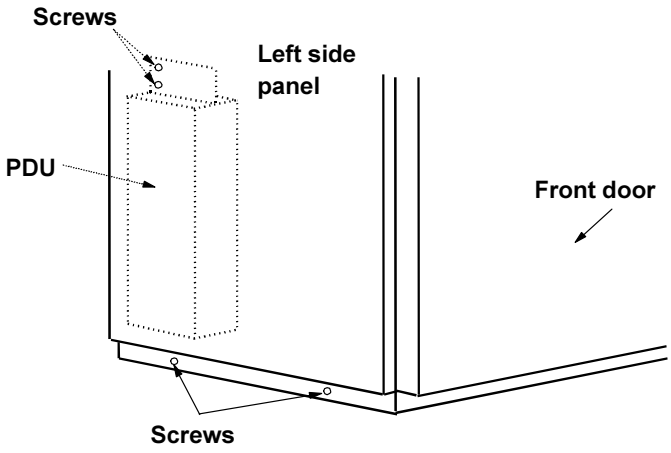


System cabinet rear view

To Remove Left Side Panel

1. Unscrew the two torx screws attaching the PDU to the left side panel. (torx screwdriver No. 25)
2. Unscrew the two torx screws at the bottom of the left side panel. (torx screwdriver No. 25)
3. Lift up and remove the left side panel.

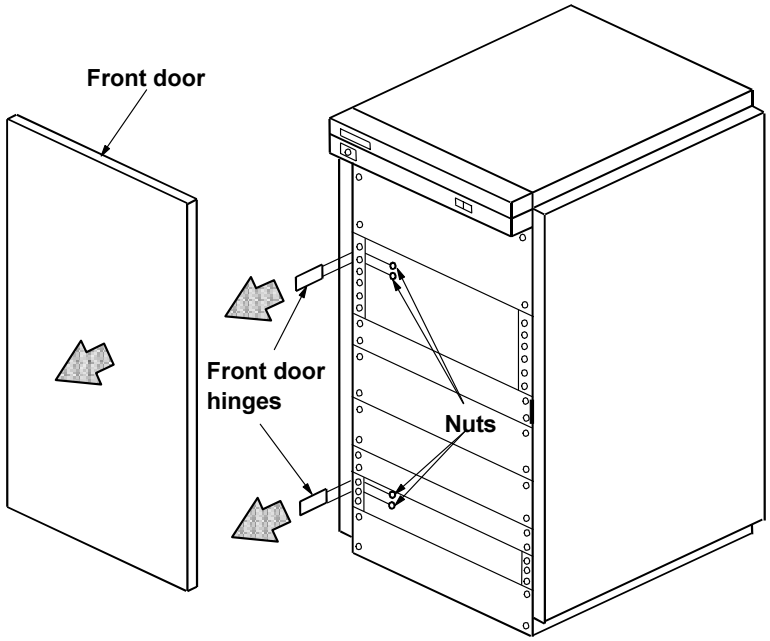
Figure 4-5 Removing Left Side Panel



To Remove Front Door Hinges

1. Remove the front door.
2. Remove the monitor or blank panel, which is installed by the hinges. (torx screwdriver No. 25)
3. Remove the two hinges. To remove them, unscrew the four nuts behind the hinges. (spanner H8)

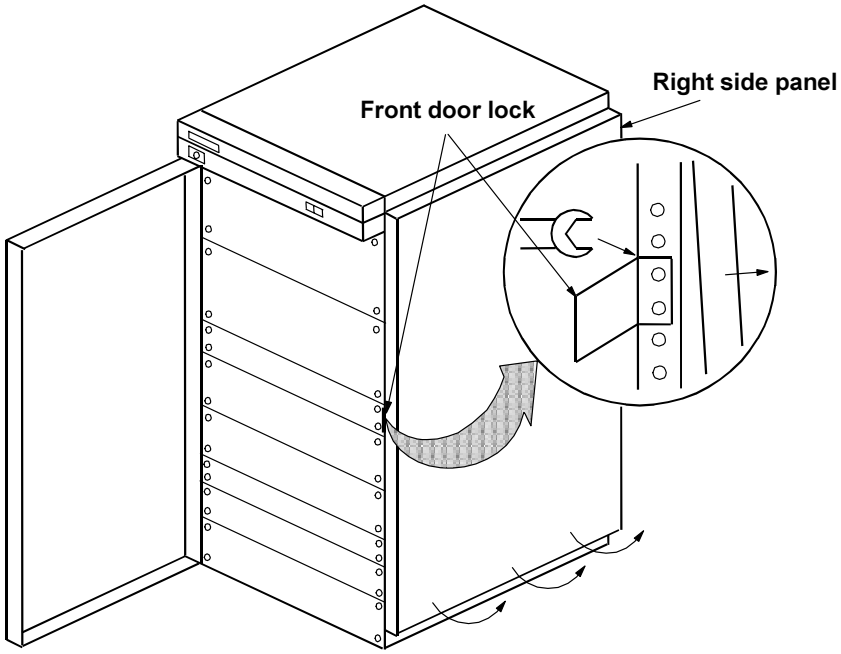
Figure 4-6 Removing Front Door Hinges



To Remove Front Door Lock

1. Remove the system controller, or blank panel, which is installed by the front door lock. (torx screwdriver No. 25)
2. Remove the right side panel. To remove it, unscrew the two torx screws at the bottom of the right side panel. (torx screwdriver No. 25)
3. Remove the front door lock. To remove it, unscrew the two nuts behind the front door lock. (spanner H8)

Figure 4-7 Removing Front Door Lock



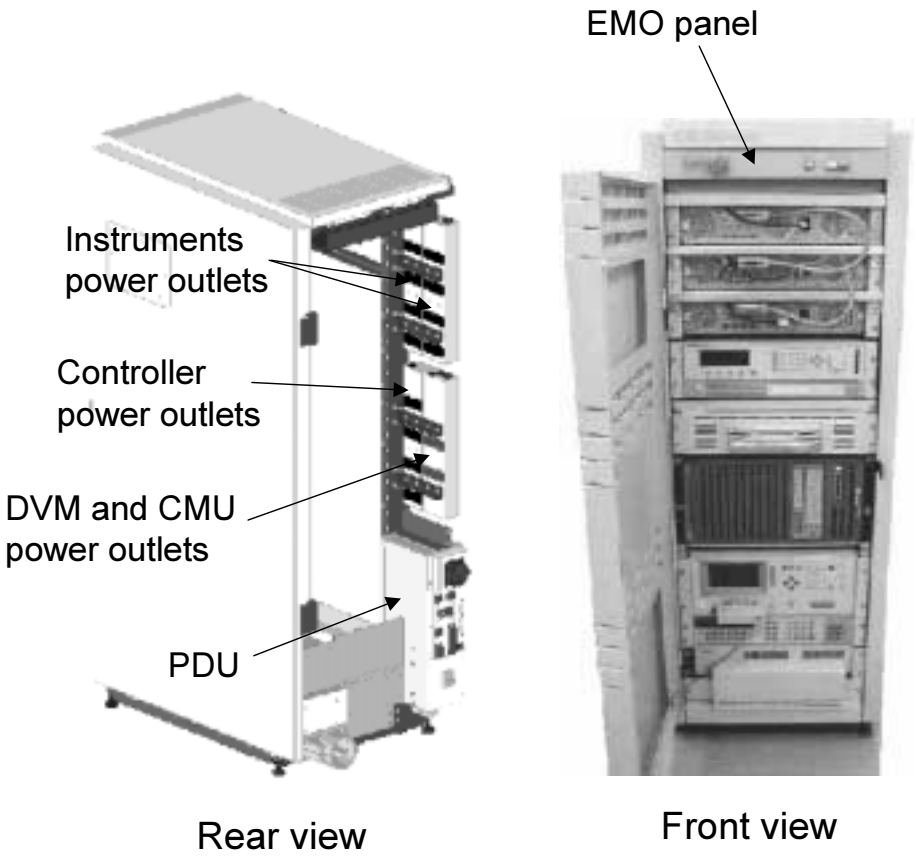
PDU and EMO Panel

This section provides procedures for removing the PDU and the EMO panel, and contains the following sections.

- "To Remove PDU"
- "To Remove EMO Panel"
- "To Remove Power Outlets"

Figure 4-8 shows the PDU, power outlets, and EMO panel locations in the system cabinet.

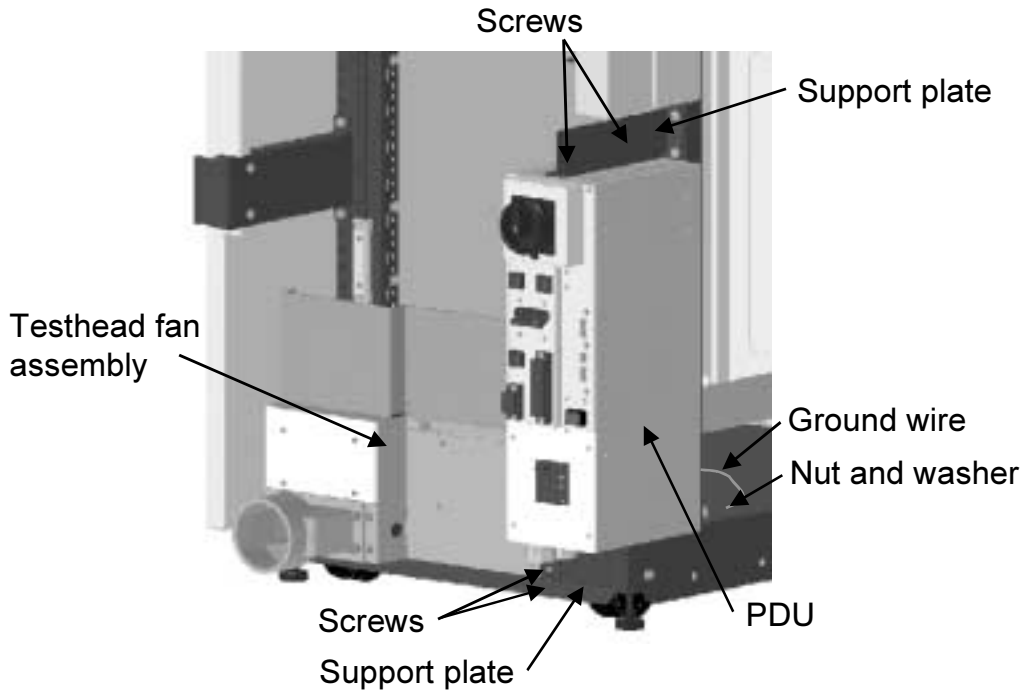
Figure 4-8 PDU, Power Outlets, and EMO Panel



To Remove PDU

1. Set the breaker for the switch board to the OFF position.
2. Remove the main power cable from the PDU. If the PDU is a 200/208 V option, disconnect the plug from the receptacles of the installation site. (pozidrive screwdriver)
3. Remove the left side panel. To remove it, see “To Remove Left Side Panel”.
4. Remove the cover on the PDU. To remove it, unscrew four screws. (pozidrive screwdriver) See figure 4-10.
5. Remove the EDU board. To remove it, unscrew six screws. (pozidrive screwdriver)
6. Disconnect the EMO panel cable from the PDU.
7. Disconnect the power cable connected to the testhead fan. To remove it, push the latches and pull out the connector.
8. Disconnect the power cable connected to the cabinet fan. To remove it, push the latches and pull out the connector.
9. Remove the instrument power outlets, controller power outlets, and DVM and CMU power outlets from the system cabinet. To remove it, see “To Remove Power Outlets”.
10. Remove the ground wire. To remove it, unscrew the nut at the bottom of the system cabinet. (nut driver H8)
11. Unscrew the four torx screws fixing the PDU with two support plates, and then remove the PDU.

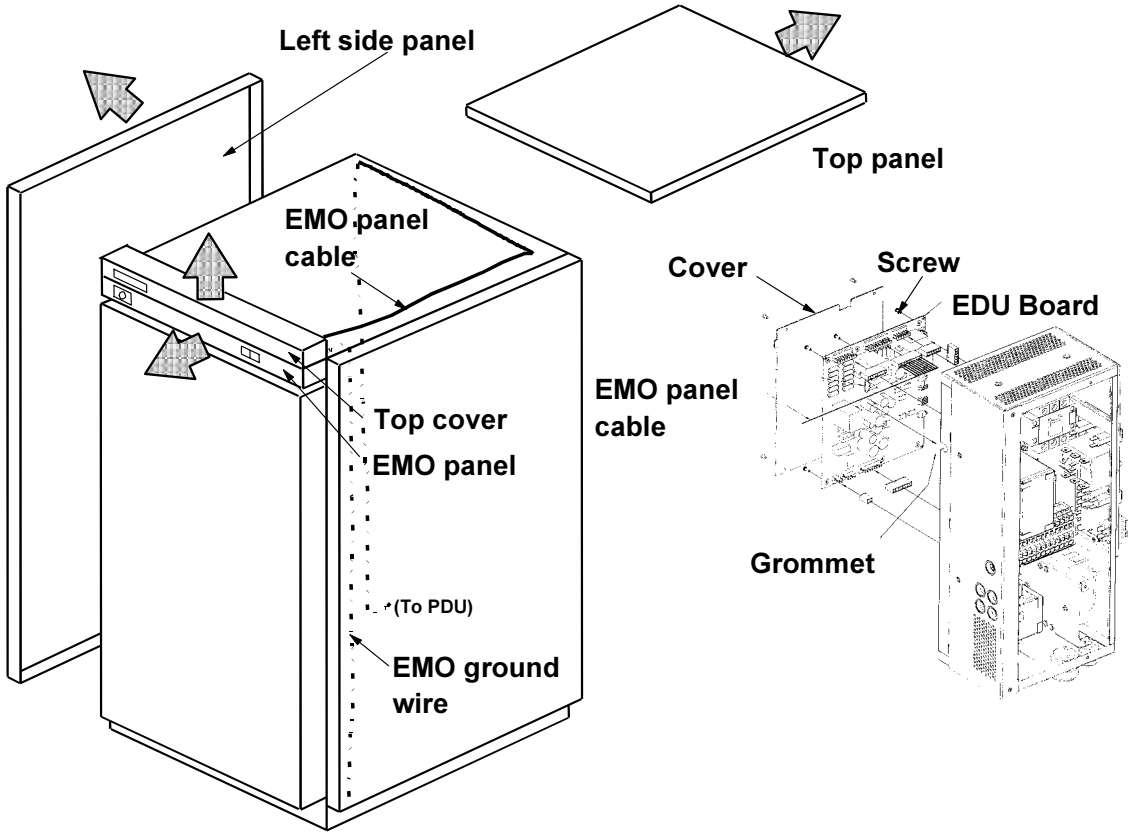
Figure 4-9 Removing PDU



To Remove EMO Panel

1. Set the breaker for the switch board to the OFF position.
2. Remove the top panel. To remove it, see “To Remove Top Panel”.
3. Remove the top cover. To remove it, see “To Remove Top Cover”.
4. Remove the left side panel. To remove it, see “To Remove Left Side Panel”.
5. Remove the cover on the PDU. To remove it, unscrew four screws. (pozidrive screwdriver)
6. Remove the EDU board. To remove it, unscrew six screws. (pozidrive screwdriver)
7. Disconnect the EMO panel cable from the PDU.
8. Remove the EMO panel. To remove it, unscrew two screws on the bottom of the EMO panel. (torx screwdriver)
9. Remove the EMO ground wire. To disconnect it, unscrew the nut at the bottom of the system cabinet. (nut driver H8)

Figure 4-10 Removing EMO Panel

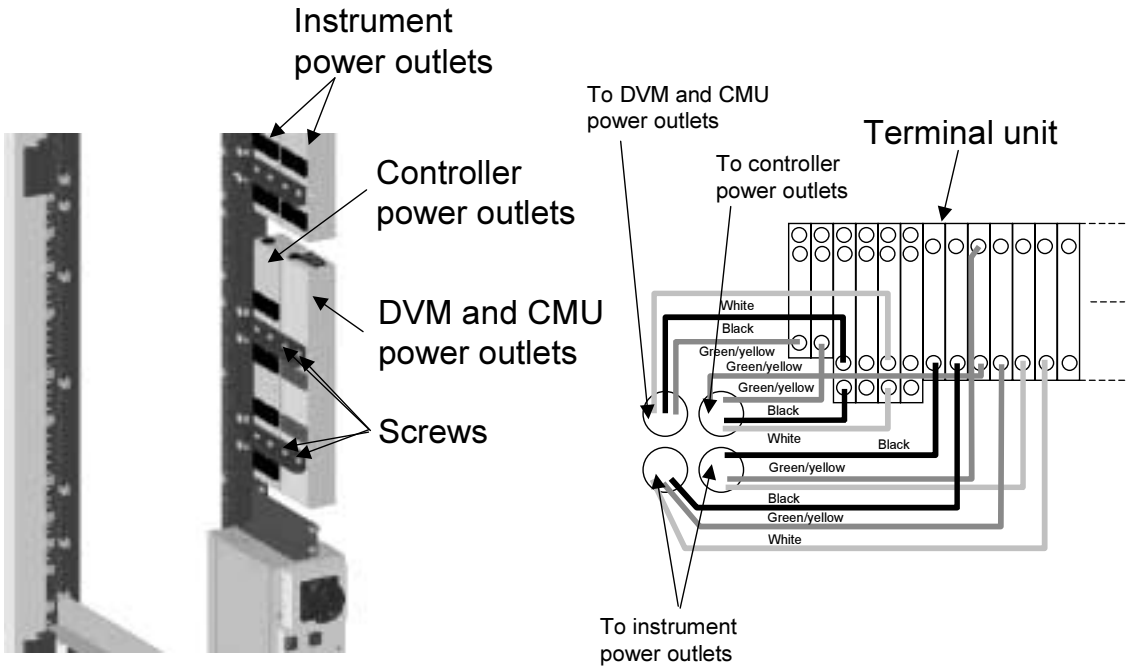


To Remove Power Outlets

If you remove only the instrument power outlets, controller power outlets, or DVM and CMU power outlets; do steps 1 through 4. If you remove the power outlets with the PDU, do step 4 only.

1. Set the breaker for the switch board to the OFF position.
2. Remove the left side panel of system cabinet. To remove it, see “To Remove Left Side Panel”.
3. Remove the left cover on the PDU. To remove it, unscrew four screws. (pozidrive screwdriver)
4. Remove three wires from the terminal unit. (flat-tip screwdriver)
5. Remove the power outlets. To remove it, unscrew the four torx screws. (torx screwdriver)

Figure 4-11 Removing Power Outlets



Testhead Fan and Cabinet Fan

This section provides procedures for removing the testhead fan and the cabinet fan, and contains the following sections.

- "To Remove Testhead Fan Assembly"
- "To Remove Cabinet Fan"

To Remove Testhead Fan Assembly

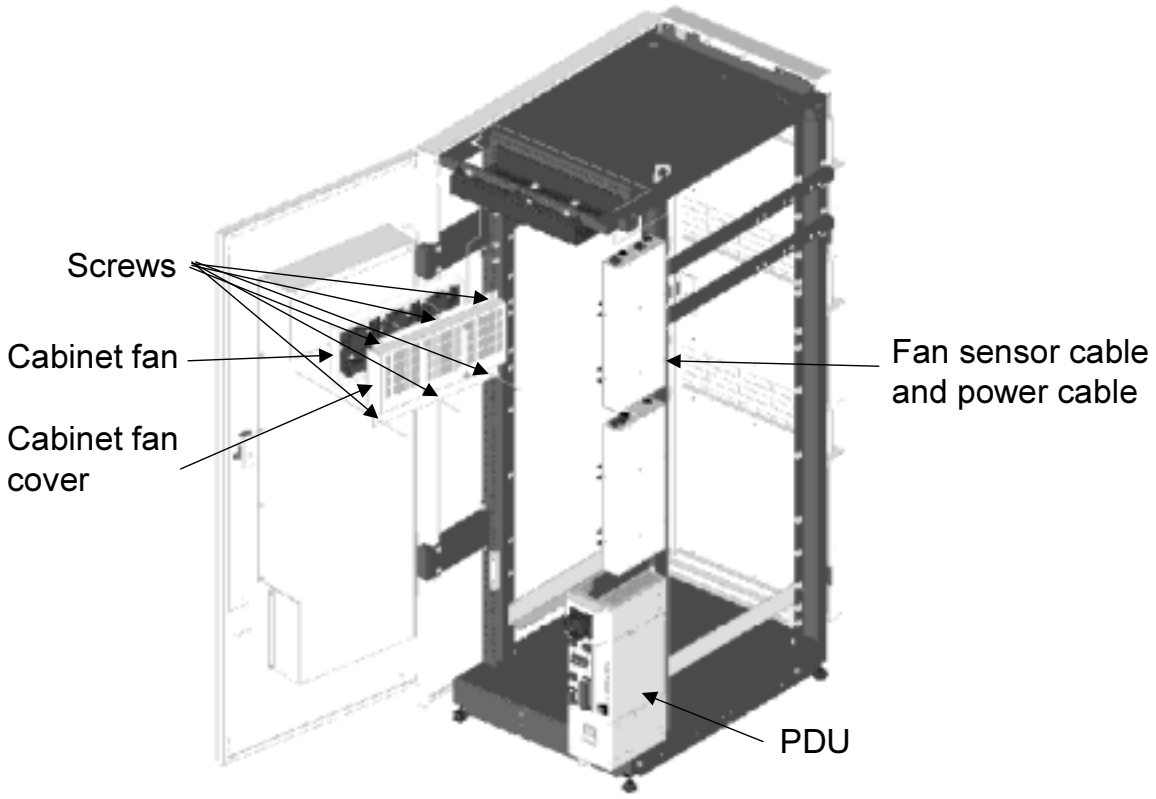
1. Remove the air duct, optical fiber cables, and ground wire. To remove them, see "To Remove Air Duct and Cables (System Cabinet Side)".
2. Disconnect the power cable connected to the testhead fan. To disconnect it, push the latches and pull out the connector.
3. Cut the cable ties that secure the fan sensor cable, and remove it. (nipper)
4. Disconnect the testhead fan sensor cable from the PDU.
5. Remove the testhead fan assembly from the system cabinet. To remove it, unscrew the four torx screws at the side of the testhead fan assembly. (torx screwdriver No. 25)

NOTE The testhead fan is obsoleted. If the testhead fan breaks, replace the testhead fan assembly.

To Remove Cabinet Fan

1. Remove the top panel. To remove it, see “To Remove Top Panel”.
2. Remove the left side panel. To remove it, see “To Remove Left Side Panel”.
3. Disconnect the fan sensor cable from the PDU.
4. Disconnect the power cable connected to the cabinet fan. To disconnect it, push the latches and pull out the connector.
5. Remove the cabinet fan cover with the cabinet fan assembly. To remove it, unscrew the six screws at the top and bottom of the cabinet fan cover. (pozidrive screwdriver)
6. Remove the cabinet fan assembly from the cabinet fan cover. To remove it, unscrew the four screws on the cabinet fan cover. (pozidrive screwdriver)

Figure 4-12 Removing Cabinet Fan



Testhead Boards

This section provides procedures for removing the boards inside the testhead, and contains the following sections.

- "To Remove (High-Resolution) Pin Board"
- "To Remove Chuck Connection Pin, Low Current Input, Kelvin Input, CMU Input, or Relay Test Board"
- "To Remove SMU, GNDU, TH CPU, or High-Resolution ADC Board"
- "To Remove TH PS Input Board"
- "To Remove Pulse Switch Board"
- "To Remove HF Matrix Board"

Figure 4-13 shows the part locations outside the testhead. Figure 4-14 shows the part locations inside the testhead.

Figure 4-13 Testhead, Outside View

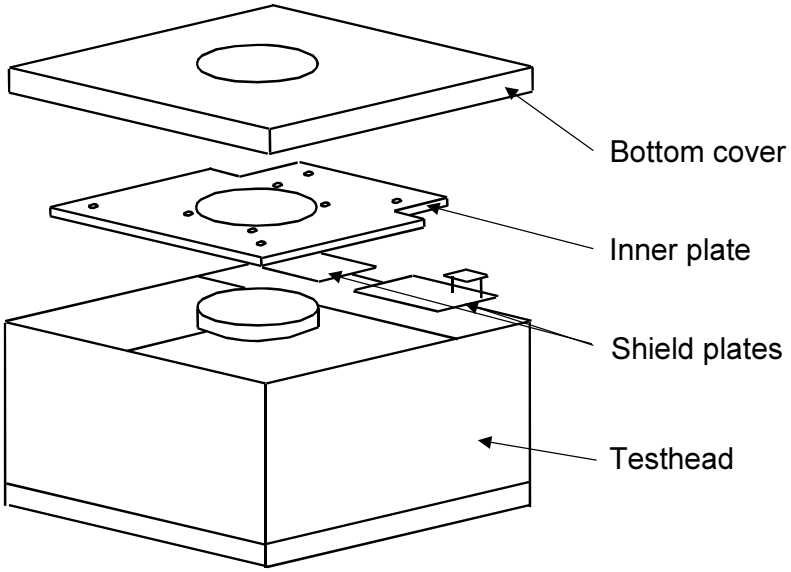
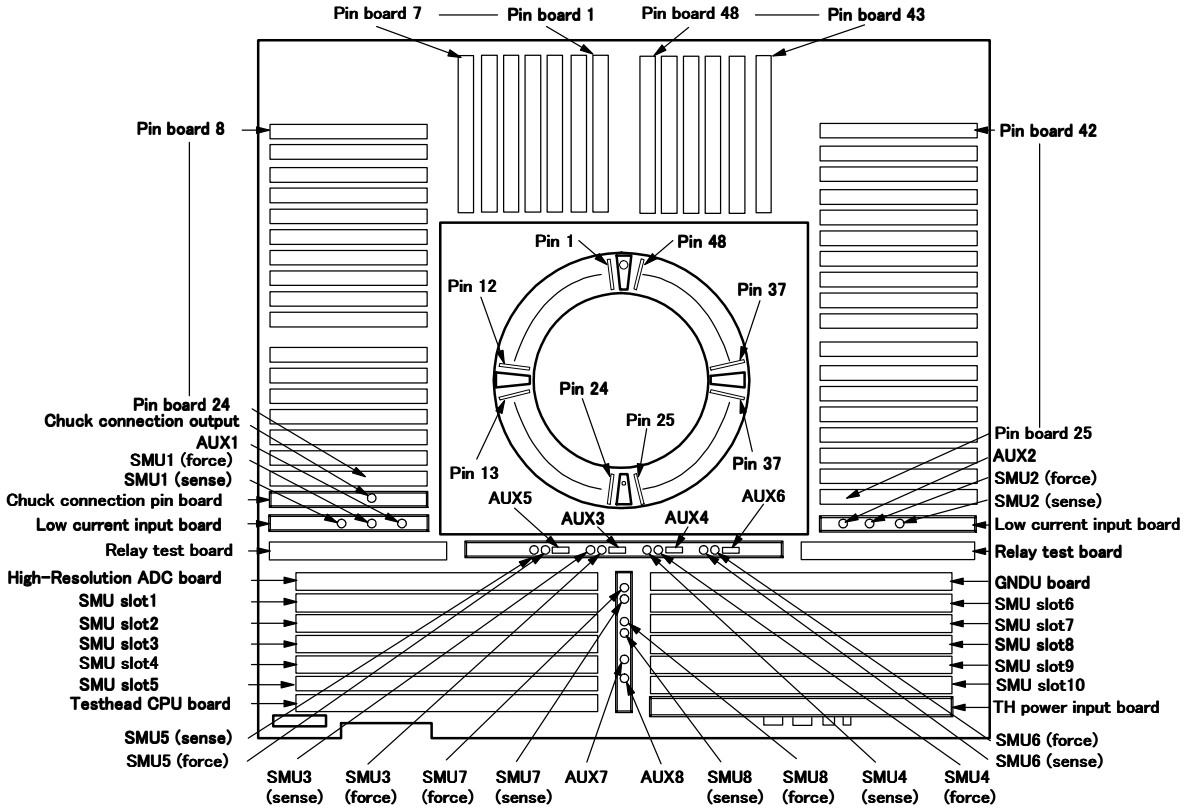
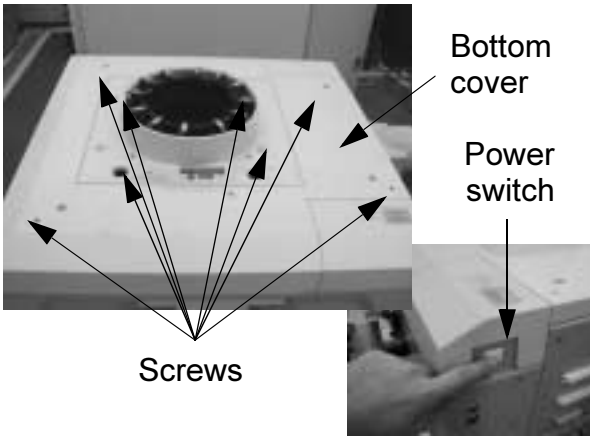


Figure 4-14 Testhead, Inside View

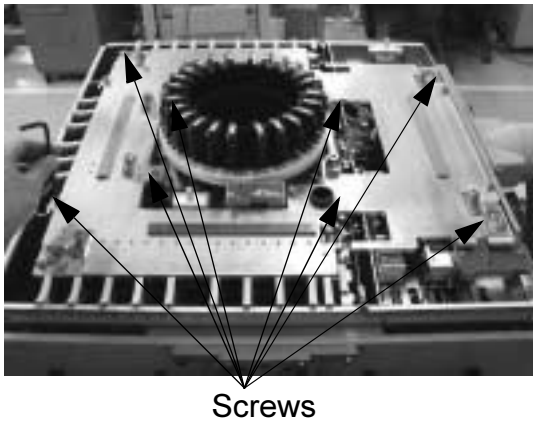


CAUTION Do not touch the testhead board with bare hands. When you remove the testhead boards, put on the lint free gloves (Agilent part number 9300-0148). Oil, perspiration, and dirt may degrade measurement accuracy.

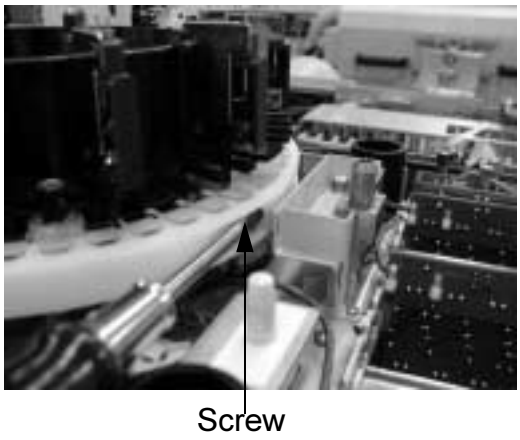
To Remove (High-Resolution) Pin Board

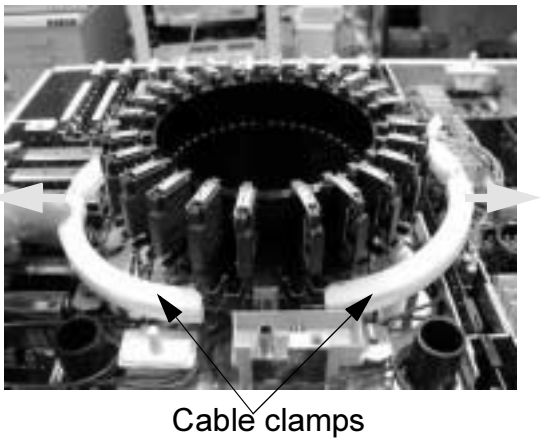


1. Turn off the testhead power, and remove the bottom cover. (hex screwdriver H3)



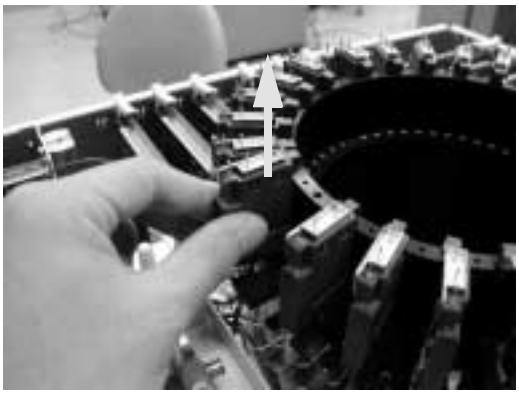
2. Remove the inner plate. (hex screwdriver H5)



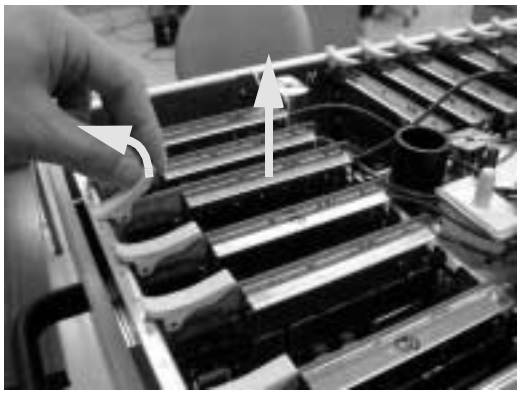


3. (4073A only) Remove the cable clamps. (flat-blade screwdriver)

NOTE When you re-install the cable clamps, fix it with a hollow down.

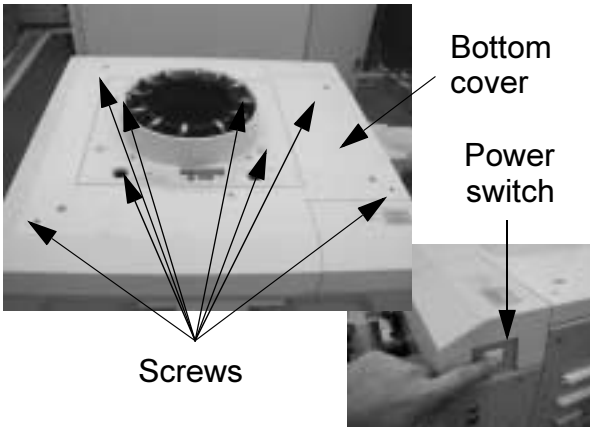


4. Remove the measurement pin socket.

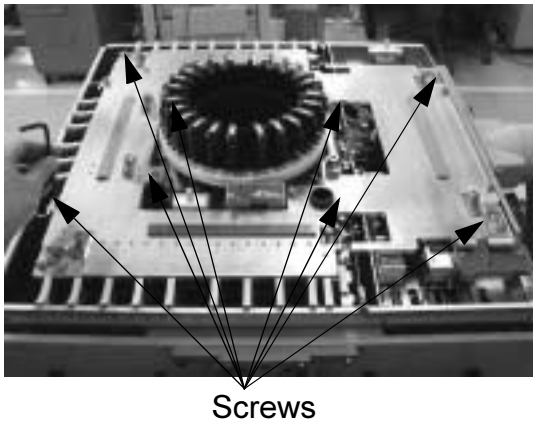


5. Remove the (high-resolution) pin board.

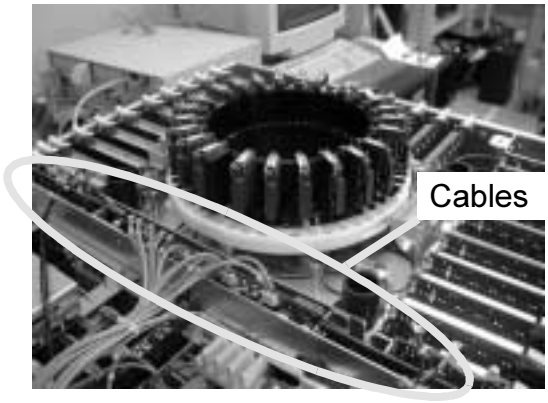
To Remove Chuck Connection Pin, Low Current Input, Kelvin Input, CMU Input, or Relay Test Board



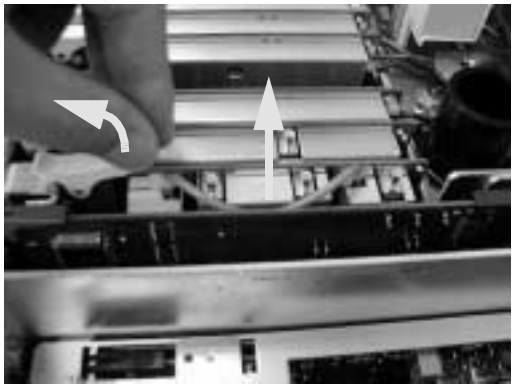
1. Turn off the testhead power, and remove the bottom cover. (hex screwdriver H3)



2. Remove the inner plate. (hex screwdriver H5)

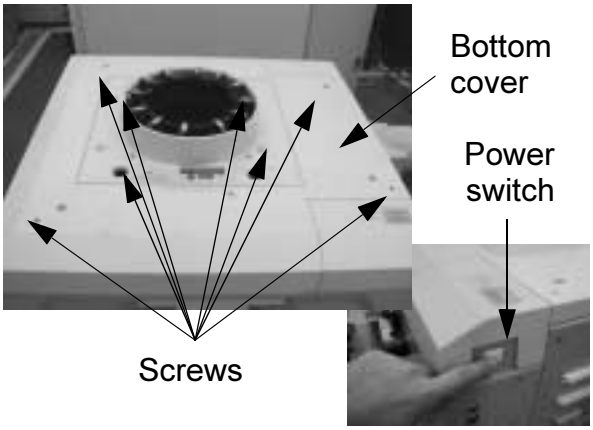


3. If any cables are connected, disconnect the cables.

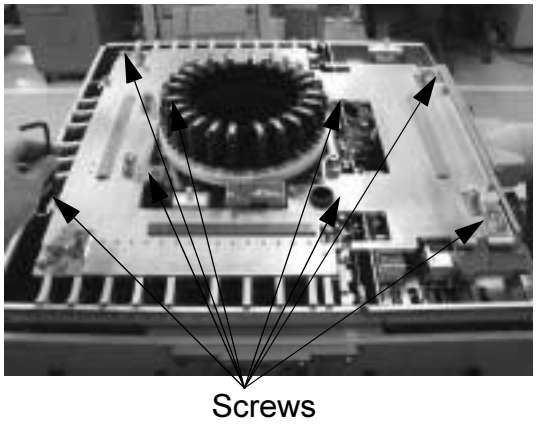


4. Remove the board.

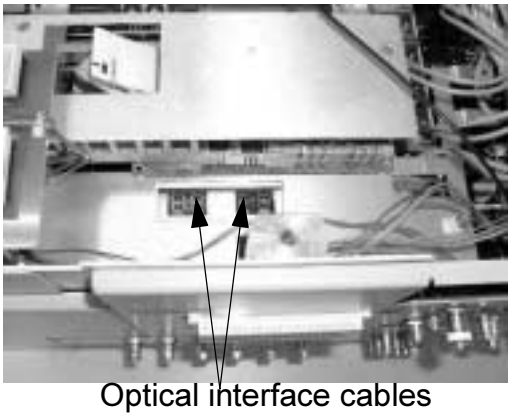
To Remove SMU, GNDU, TH CPU, or High-Resolution ADC Board



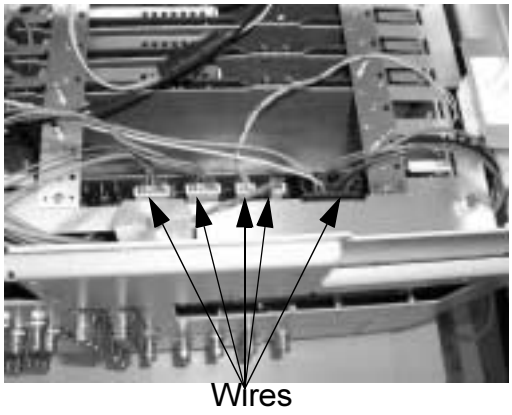
1. Turn off the testhead power, and remove the bottom cover. (hex screwdriver H3)



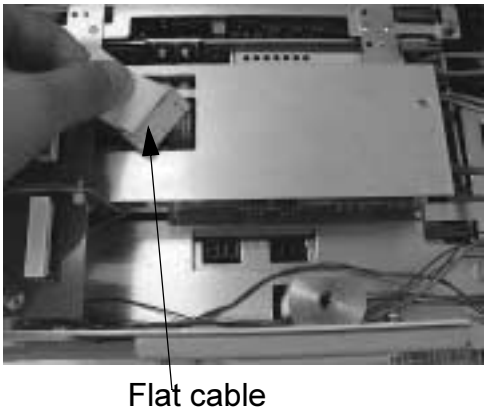
2. Remove the inner plate. (hex screwdriver H5)



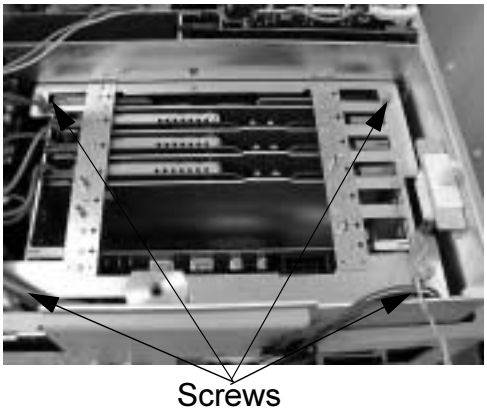
3. If you remove the board installed in the SMU1 side, disconnect the optical interface cables at the top of TH CPU.



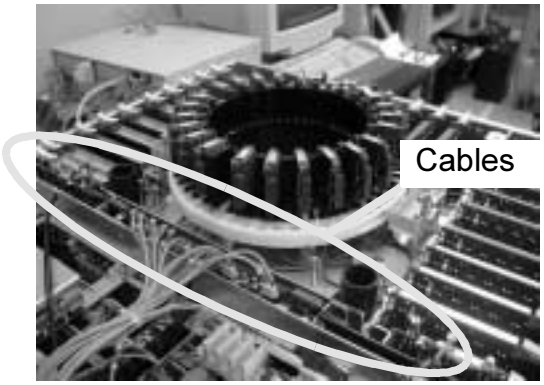
4. If you remove the board installed in the SMU2 side, disconnect the wires connected at the top of TH PS input board.



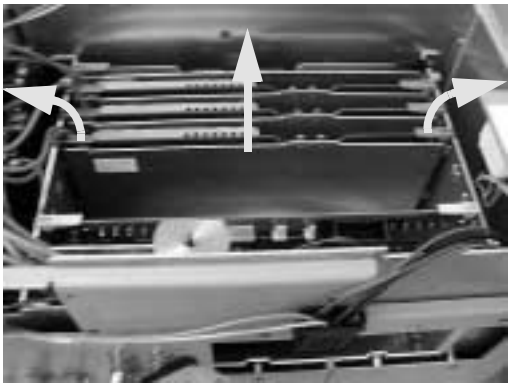
5. If an HPSMU or HRSMU is installed, disconnect the flat cable between the SMU and power transistor module with heat sink.



6. Remove the shield plate. (flat-tip screw driver)



7. If any cables are connected, disconnect the cables from the board.

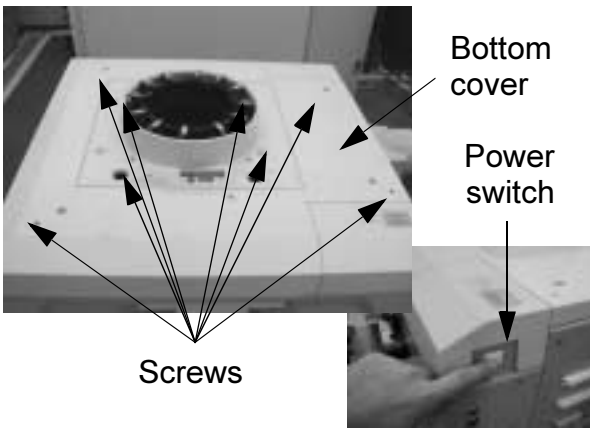


8. Remove the board.

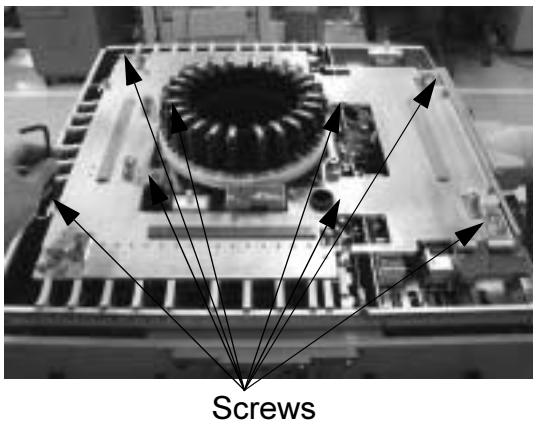
NOTE If you replace a new TH CPU board, check the testhead firmware revision. See "Updating the Testhead Firmware".

If you replace a new high-resolution ADC board, check the calibration date of the voltage and resistance references. Refer to chapter 2 of *System Calibration Guide*.

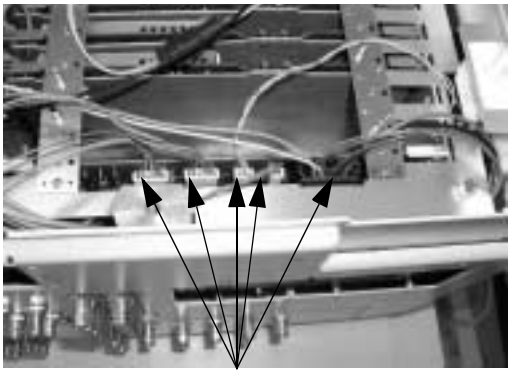
To Remove TH PS Input Board



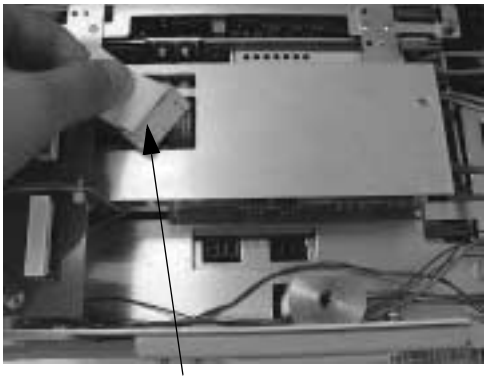
1. Turn off the testhead power, and remove the bottom cover. (hex screwdriver H3)



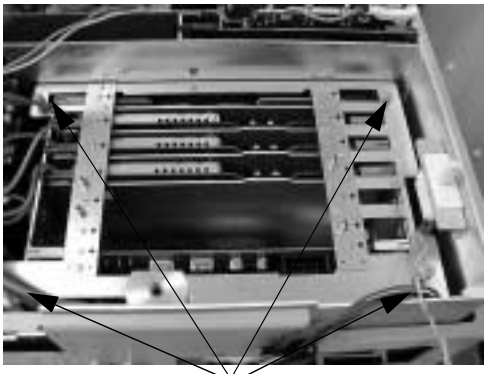
2. Remove the inner plate. (hex screwdriver H5)



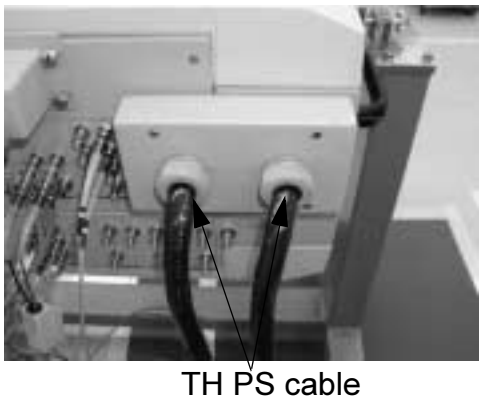
3. Disconnect all the wires connected at the top of TH PS input board.



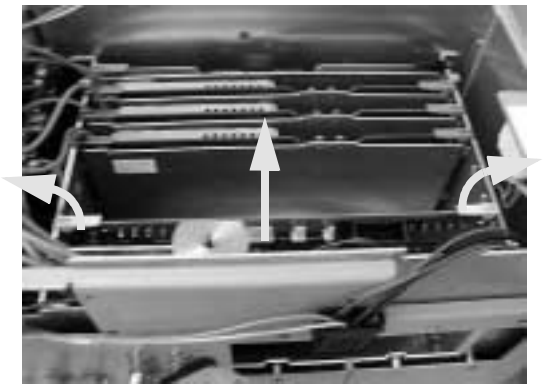
4. If an HPSMU or HRSMU is installed, disconnect the flat cable between the SMU and power transistor module with heat sink.



5. Remove the shield plate. (flat-tip screw driver)



6. Remove the testhead power cable. To remove it, see "To Remove TH Power Cables (Testhead Side)".

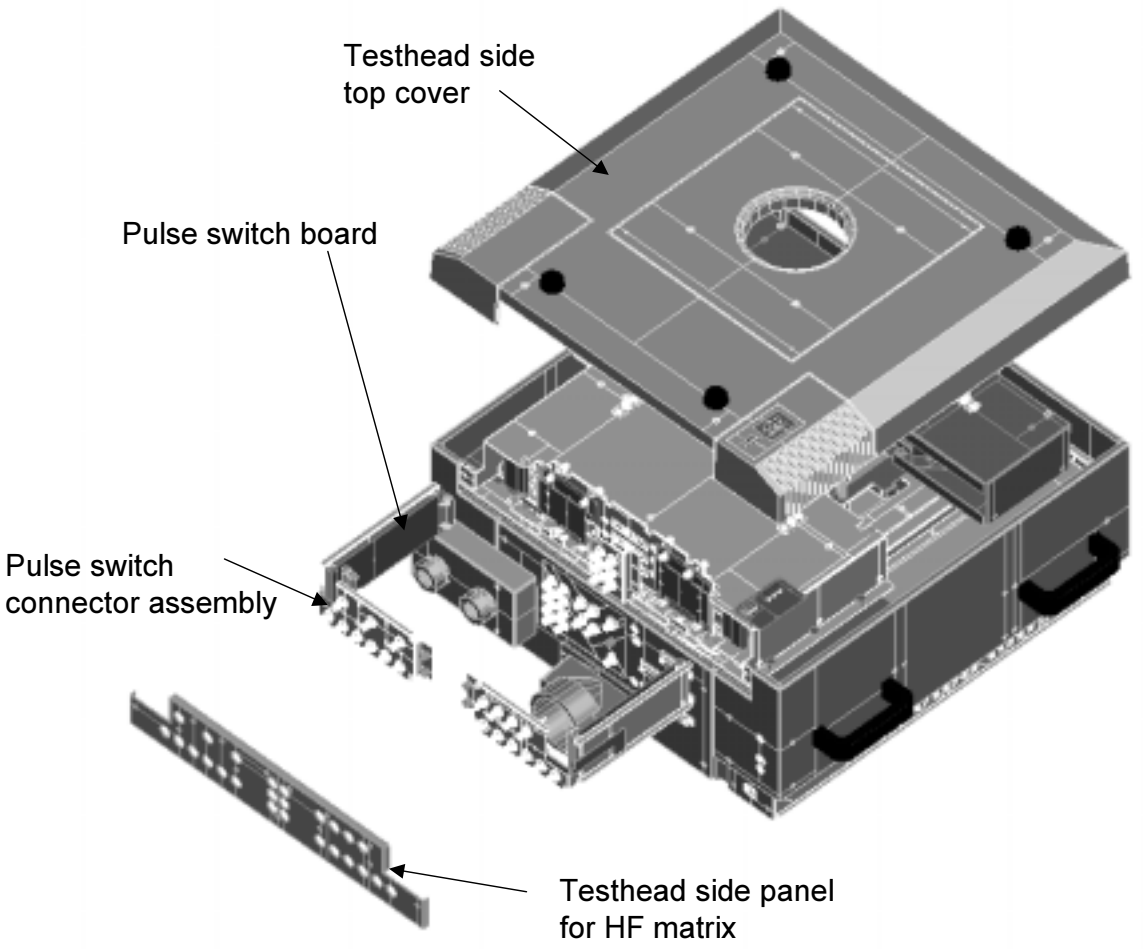


7. Remove the TH PS input board.

To Remove Pulse Switch Board

1. Remove the top cover. (hex screwdriver H3)
2. Remove the testhead side panel for HF matrix. (pozidrive screwdriver)
3. Remove the pulse switch connector assembly with pulse switch board. (flat-tip screwdriver)
4. Remove the pulse switch board from pulse switch connector assembly. To remove it, disconnect the cables and unscrew the screws. (pozidrive screwdriver)

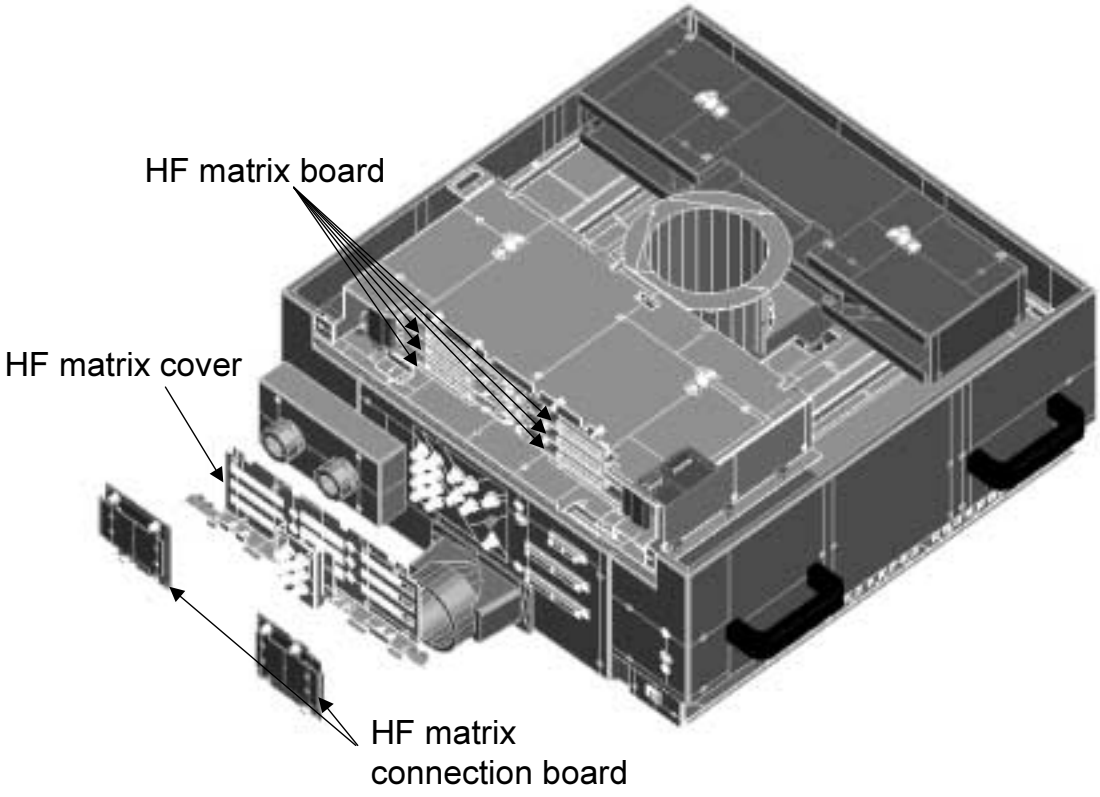
Figure 4-15 Removing Pulse Switch Board



To Remove HF Matrix Board

1. Remove the pulse switch connector assembly. To remove it, see “To Remove Pulse Switch Board”.
2. Remove the HF matrix connection boards. (flat-tip screwdriver)
3. Disconnect the six SMB cables connected to the HF matrix boards.
4. Remove the HF matrix cover with HF matrix connector assembly. (flat-tip screwdriver)
5. Remove the HF matrix board.

Figure 4-16 Removing HF Matrix Board

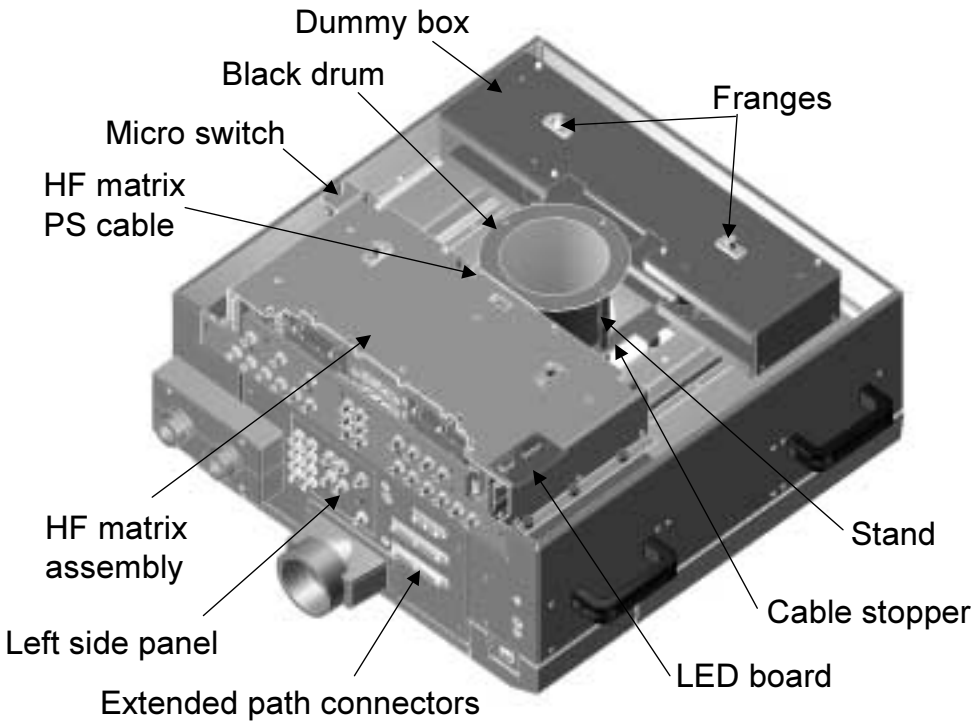


Testhead Motherboards

Remove the SMU motherboard, matrix motherboard 1, and matrix motherboard 2 by using the following procedure:

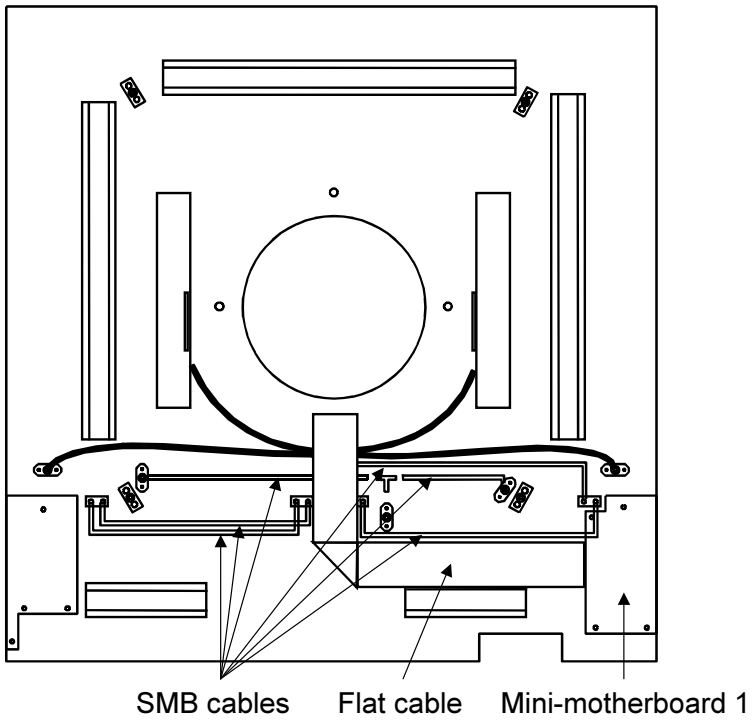
1. Remove all the boards installed at the bottom of the testhead. To remove them, see “Testhead Boards”.
2. Remove the top cover of the bottom of the testhead. (hex screwdriver H3)
3. Remove the black drum, stands, and cable stoppers, which are installed at the center of the testhead. (pozidrive screwdriver)
4. Remove the dummy box using following procedure.
   a. Remove the two flanges on the dummy box. (pozidrive screwdriver)
   b. Remove the dummy box. (flat-tip screwdriver)
5. Remove the LED board on the HF matrix assembly. (pozidrive screwdriver)
6. Disconnect the wires connected to the micro switch.

Figure 4-17 Removing Testhead Motherboard (1 of 3)



7. Remove the HF matrix assembly using following procedure.
   a. Disconnect the HF matrix power supply cable from the HF matrix assembly.
   b. Disconnect the flat cable from the HF matrix assembly.
   c. Disconnect the extended path cables with plate form the matrix motherboard.
   d. Remove the HF matrix assembly from the testhead, and put it at the position of dummy box was installed. (pozidrive screwdriver and flat-tip screwdriver)
   e. Remove the frame under the HF matrix assembly. (pozidrive screwdriver)
   f. Remove the extended path connectors from the testhead frame. To remove it, remove the left side panel. (pozidrive screwdriver)
   g. Remove the HF matrix assembly with the extended path cables.
8. Remove the motherboard frame from the testhead. To remove it, unscrew the 29 screws at the edge of the testhead. (pozidrive screwdriver)
9. Disconnect the six SMB cables connected to the connectors on the motherboard frame.
10. Remove the ground wire of the flat cable, and disconnect the flat cable connected to the mini-motherboard 1. (pozidrive screwdriver)

Figure 4-18 Removing Testhead Motherboards (2 of 3)

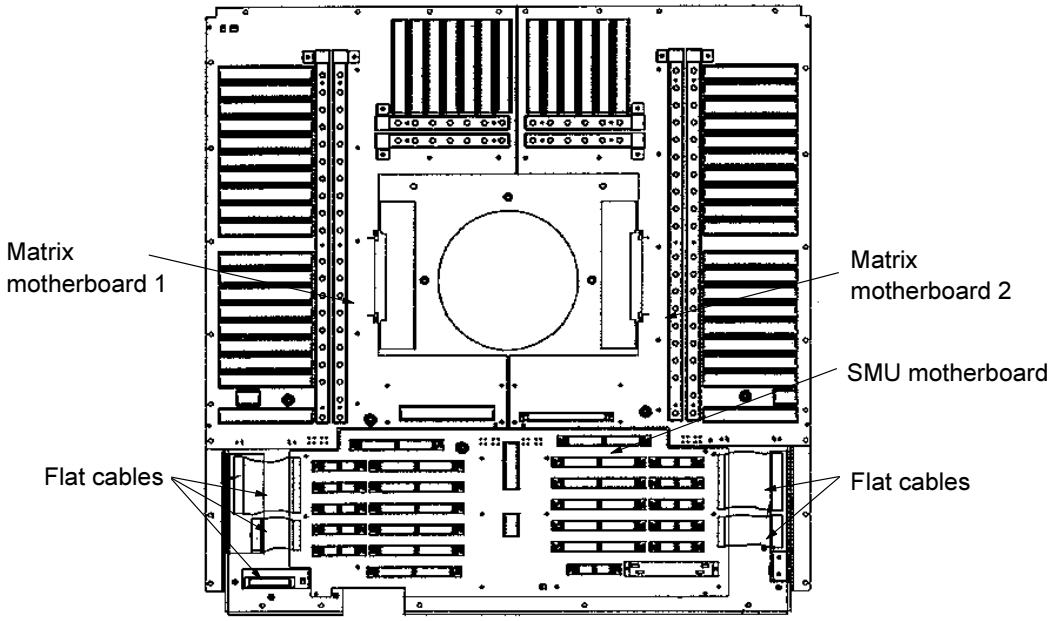


11. Disconnect the five flat cables on the mini-motherboards.
12. Remove two mini-motherboards. To remove them, unscrew the eight screws on the mini-motherboards. (pozidrive screwdriver)
13. Remove the SMU motherboard and matrix motherboards.

    To remove matrix motherboard 1, unscrew the 11 screws on the matrix motherboard 1. (pozidrive screwdriver)

    To remove matrix motherboard 2 or the SMU motherboard, unscrew the 12 screws on the motherboard. (pozidrive screwdriver)

Figure 4-19 Removing Testhead Motherboards (3 of 3)



Air Duct and Cables

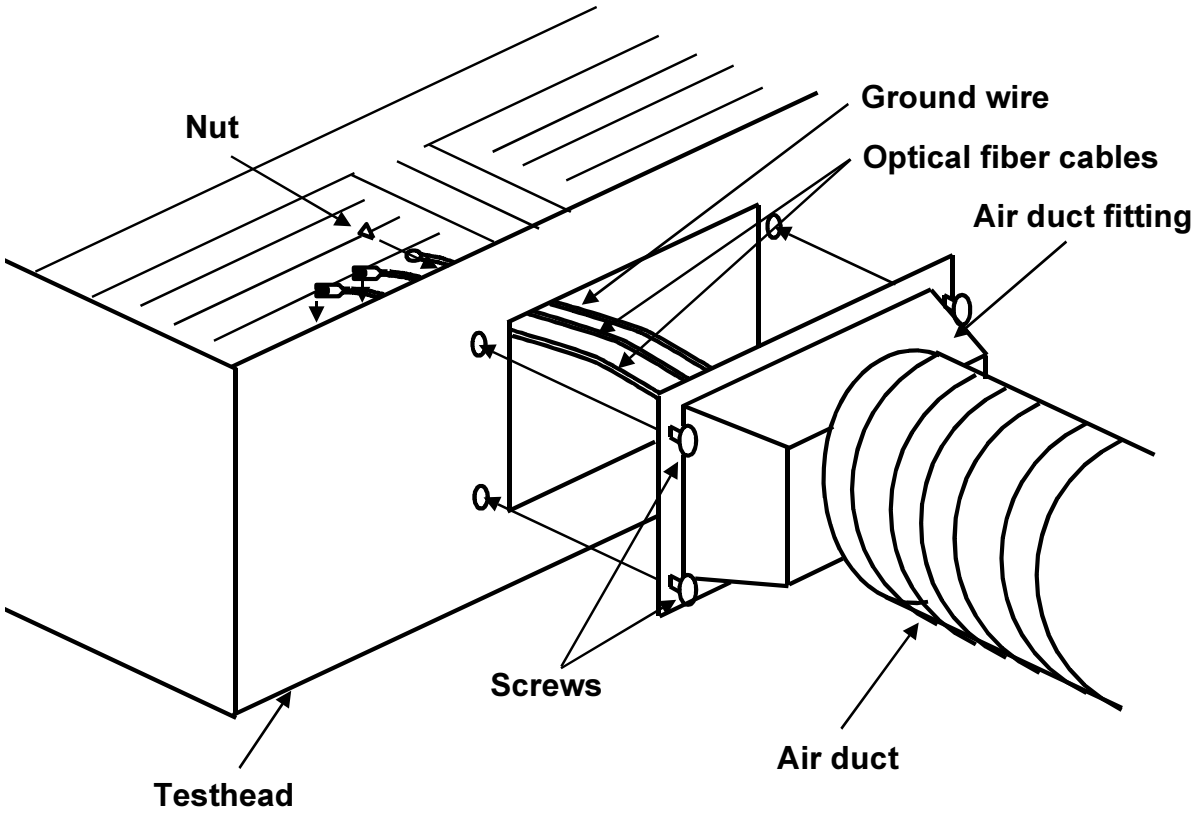
This section provides procedures for removing the air duct, optical fiber cables, and ground wire that connect between the testhead and the system cabinet. This section contains the following sections.

- "To Remove Air Duct and Cables (Testhead Side)"
- "To Remove Air Duct and Cables (System Cabinet Side)"

To Remove Air Duct and Cables (Testhead Side)

1. Remove the bottom cover and inner plate of the testhead. (hex screwdriver H3 and H5)
2. Remove the ground wire. To remove it, unscrew the screw. (pozidrive screwdriver)
3. Disconnect the optical fiber cables from the TH CPU board.
4. Remove the air duct from the testhead. To remove it, unscrew the four screws on the air duct fitting. (flat-tip screwdriver)

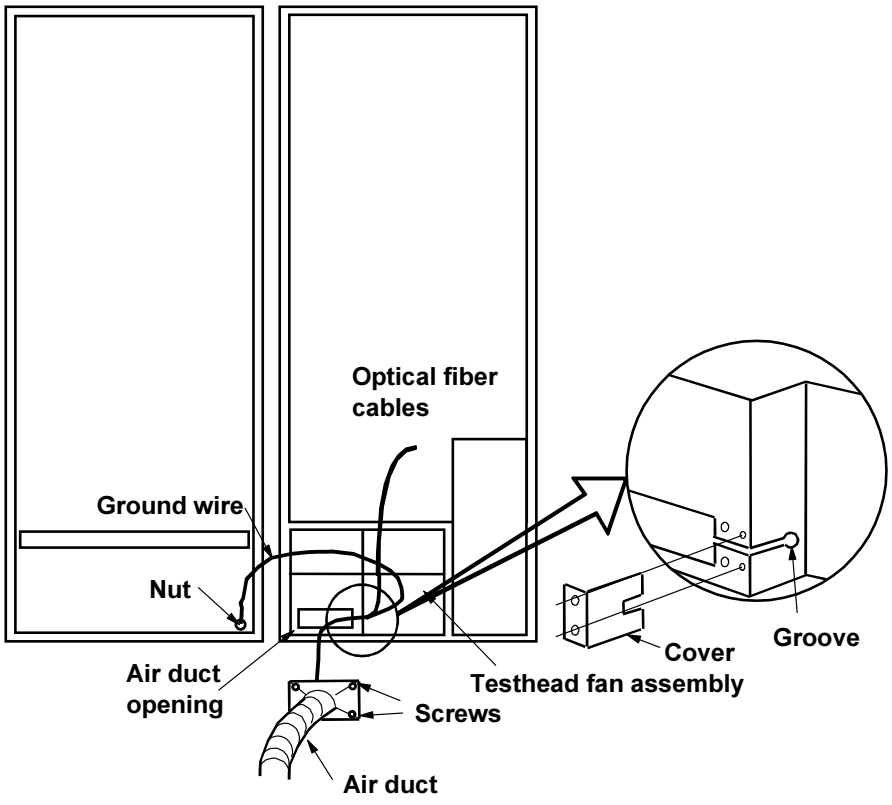
Figure 4-20 Removing Air Duct and Cables (Testhead Side)



To Remove Air Duct and Cables (System Cabinet Side)

1. Open the rear door.
2. Remove the ground wire at the bottom of the rear door. (nut driver H8)
3. Disconnect the optical fiber cables from the optical interface of the system controller.
4. Remove the groove cover. To remove it, unscrew the two screws. (pozidrive screwdriver)
5. Remove the air duct from the testhead fan assembly. To remove it, unscrew the four screws on the air duct fitting. (flat-tip screwdriver)

Figure 4-21 Removing Air Duct and Cables



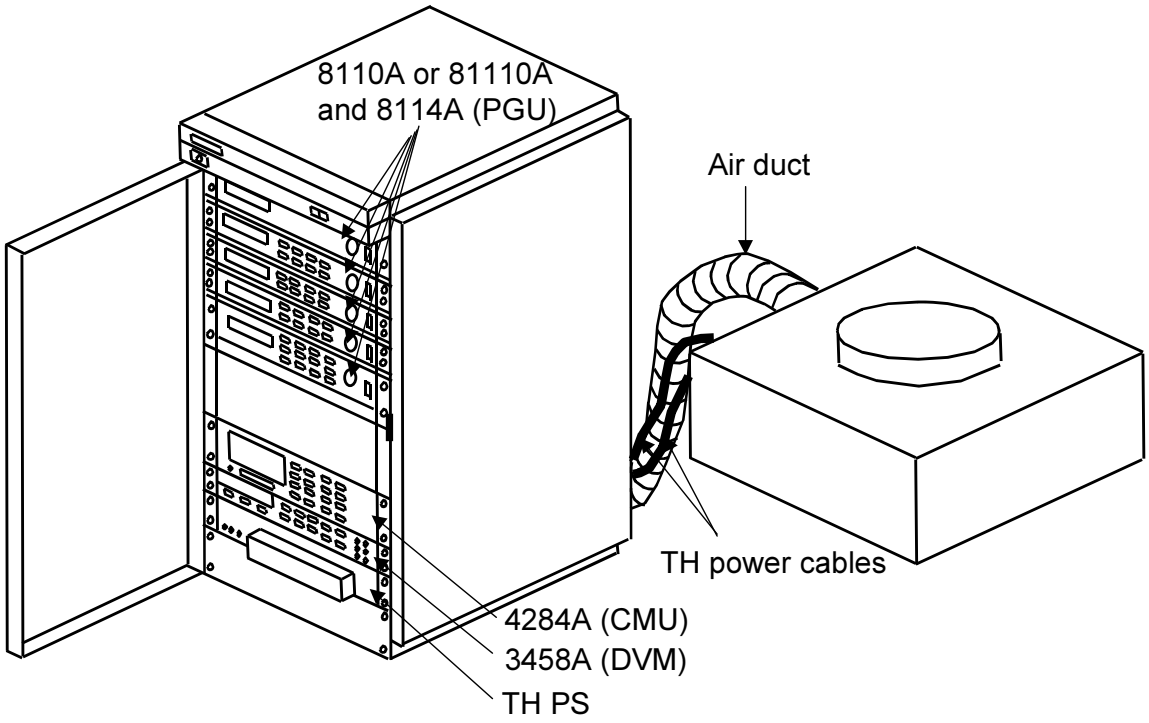
TH PS, TH Power Cables, System Instruments, System Controller, and FPD

This section provides procedures for removing the TH PS, TH power cables, and system instruments; and contains the following sections.

- "To Remove TH PS"
- "To Remove TH Power Cables (Testhead Side)"
- "To Remove TH Power Cables (Cabinet Side)"
- "To Remove CMU (Agilent 4284A)"
- "To Remove DVM (Agilent 3458A)"
- "To Remove PG (Agilent 8110A/8114A)"
- "To Remove PG (Agilent 81110A)"
- "To Remove Flat Panel Display"

Figure 4-22 shows the part locations for the TH PS, TH power cables, and system instruments.

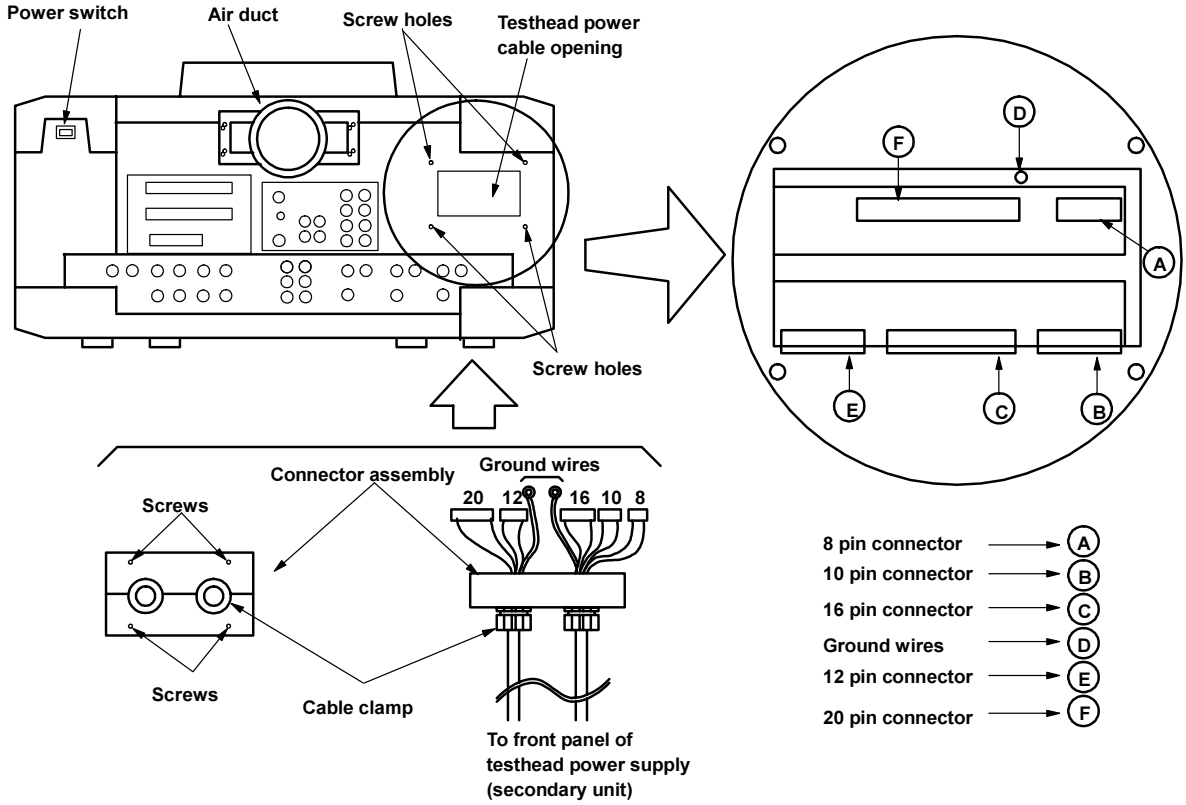
Figure 4-22 TH PS, TH Power Cables, and System Instruments



To Remove TH Power Cables (Testhead Side)

1. Remove the cover for the TH power cables. To remove it, unscrew the four screws on the cover. (flat-tip screwdriver)
2. Remove the ground wires at position “D”, as shown in figure 4-23. To remove them, unscrew the screw at position “D”. (pozidrive screwdriver)
3. Remove all the connectors that are connected to the TH PS input board. To remove them, push the latches and pull out the connector.
4. Remove the TH power cables.

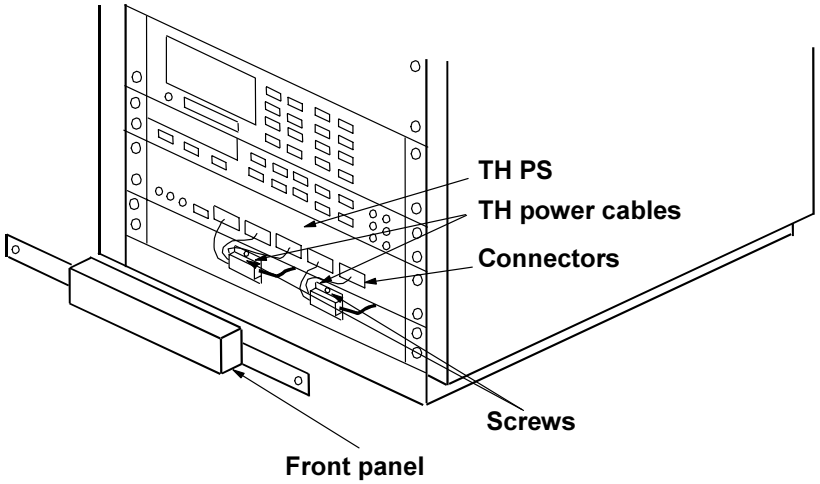
Figure 4-23 Removing TH Power Cable (Testhead Side)



To Remove TH Power Cables (Cabinet Side)

1. Open the front door.
2. Remove the front panel of the TH PS. To remove it, unscrew the four screws. (torx screwdriver No. 25)
3. Disconnect all the connectors connected to the TH PS. To remove them, push the latch and pull out the connector.
4. Remove the cable tie at the rear of the system cabinet.
5. Remove the TH power cables. To remove them, unscrew the four screws. (pozidrive screwdriver)

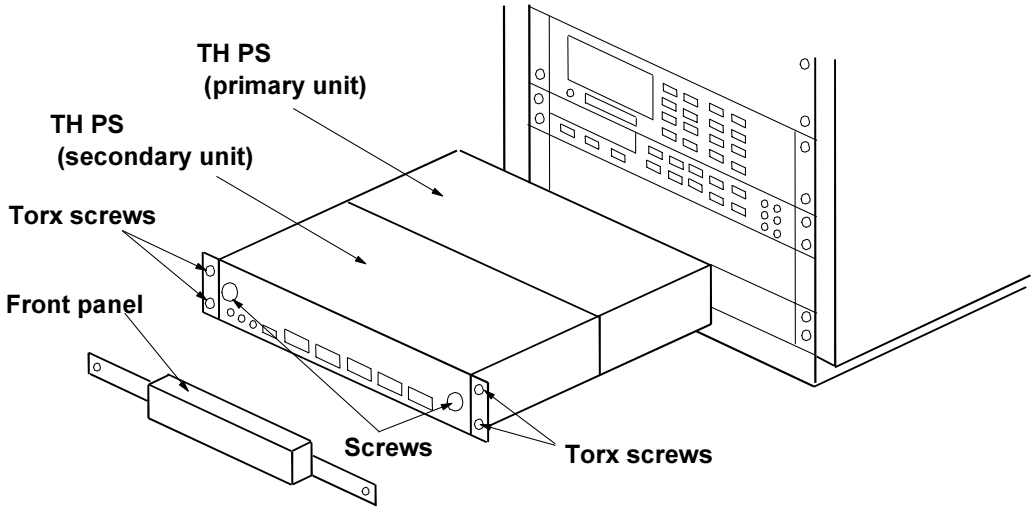
Figure 4-24 Removing TH Power Cable (Cabinet Side)



To Remove TH PS

1. Remove the power cord at the rear of the TH PS.
2. Remove the front panel.
3. Disconnect all the connectors connected to the TH PS front panel.
4. Remove both the TH PS primary unit and secondary unit. To remove them, unscrew the four torx screws. (torx screwdriver No. 25)
5. Split the primary unit and secondary unit. To split them, unscrew the two screws at the front of the TH PS secondary unit.

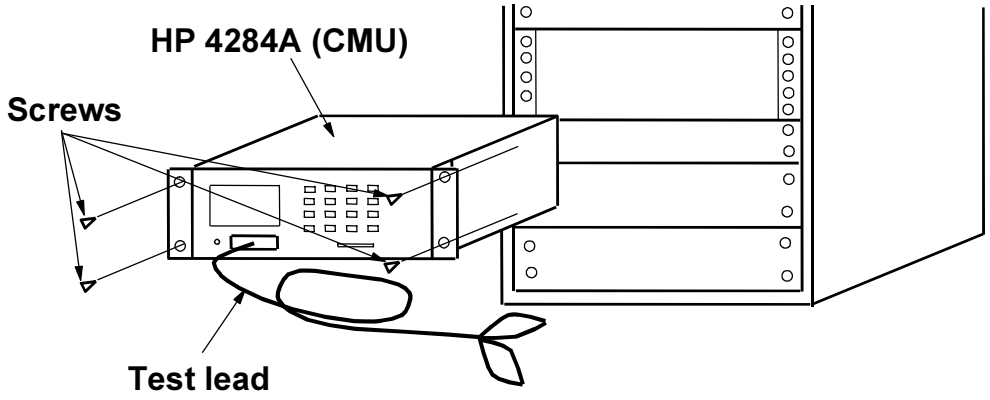
Figure 4-25 Removing TH PS



To Remove CMU (Agilent 4284A)

1. Remove the power cord and GPIB cable at the rear of the CMU.
2. Remove the test lead at the front of the CMU.
3. Remove the CMU. To remove it, unscrew the four torx screws. (torx screwdriver No. 25)

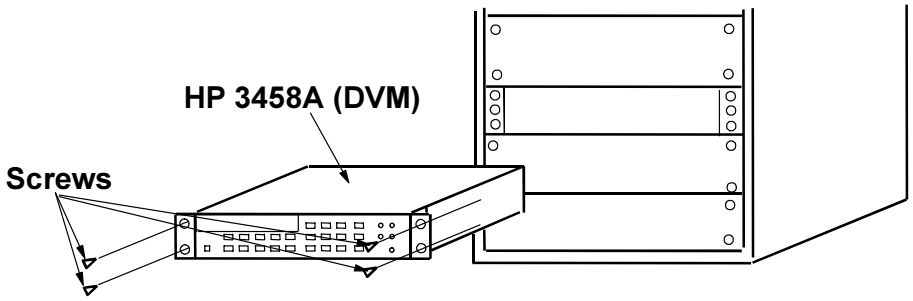
Figure 4-26 Removing CMU



To Remove DVM (Agilent 3458A)

1. Disconnect the power cord and GPIB cable at the rear of the DVM.
2. Remove the test lead at the rear of the DVM.
3. Remove the DVM. To remove it, unscrew the four torx screws. (torx screwdriver No. 25)

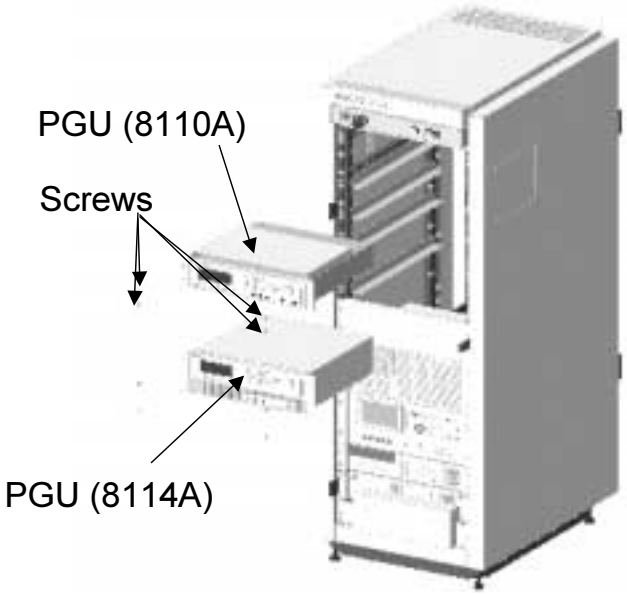
Figure 4-27 Removing DVM



To Remove PG (Agilent 8110A/8114A)

1. Disconnect the power cord and GPIB cable at the rear of the PG.
2. Disconnect the PG cable assemblies at the rear of the PG.
3. Disconnect the trigger cables at the rear of the PG.
4. Remove the PG. To remove it, unscrew the four torx screws. (torx screwdriver No.25)

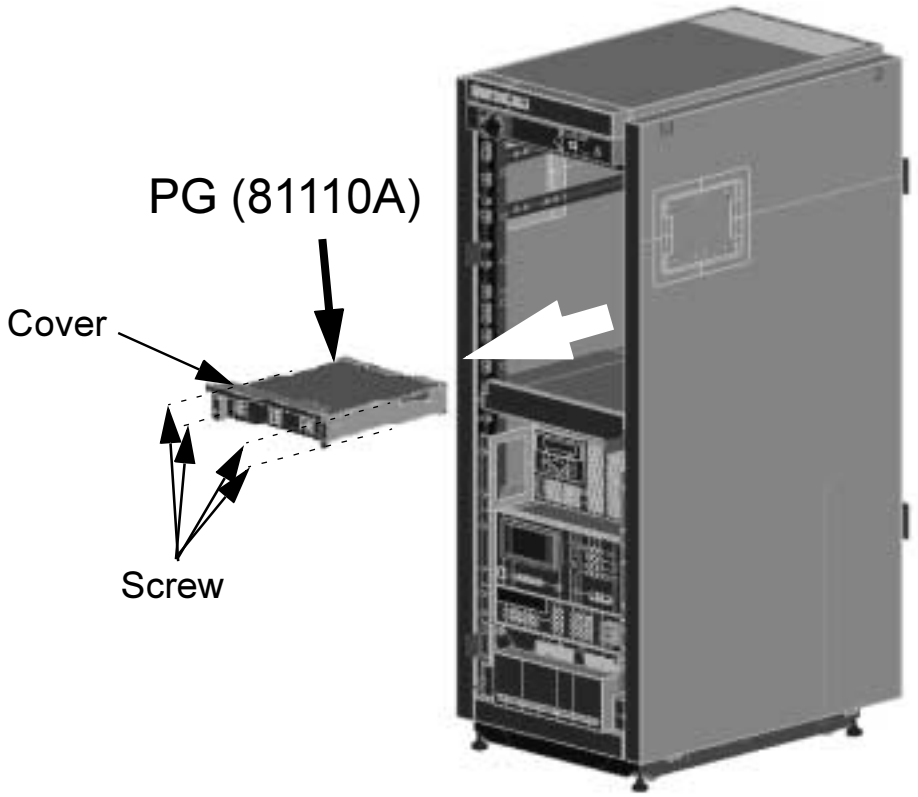
Figure 4-28 Removing PG (Agilent 8110A/8114A)



To Remove PG (Agilent 81110A)

1. Disconnect the power cord, GPIB cable, and clock trigger cable at the rear of the PG.
2. Disconnect the PG cable assemblies, trigger cable at the front of the PG.
3. Remove the cover at the rear of the PG.
4. Remove the PG. To remove it, unscrew the four torx screws. (torx screwdriver No.25)

Figure 4-29 Removing PG (Agilent 81110A)



To Remove the System Controller (745i/100, 745/132L, and C3600)

1. Disconnect the power cord, GPIB cables, monitor cable, key board cable, and other peripherals.
2. Remove the system controller. To remove it, unscrew four or two screws. (torx screwdriver No.25)

To Remove Flat Panel Display

To remove the flat panel display, use the following procedures. For more detailed information, please refer to the *Agilent E3155F Installation Guide*.



1. Disconnect the monitor cable and power cord.

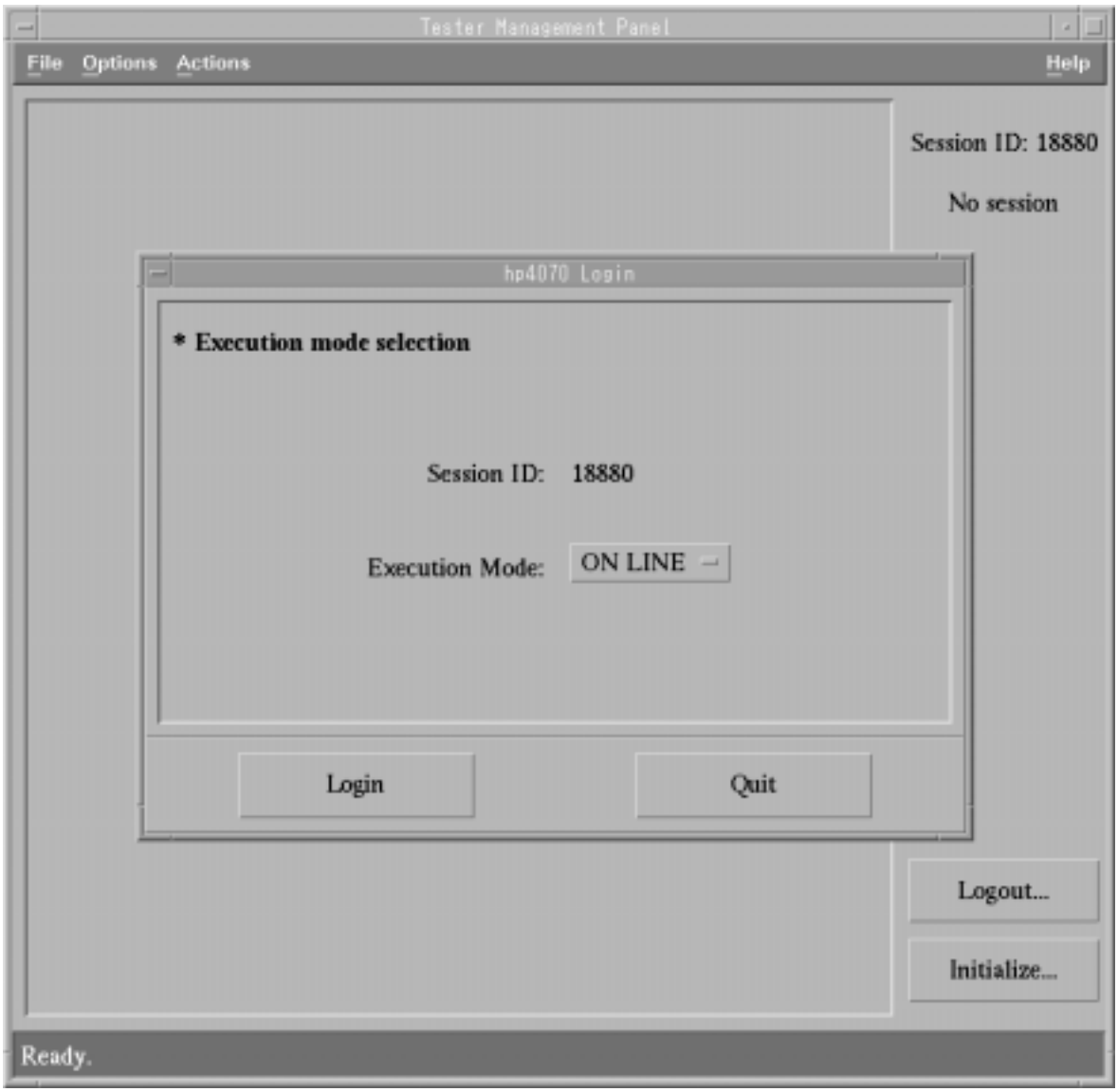


2. Remove the attachment for FPD.

Updating the Testhead Firmware

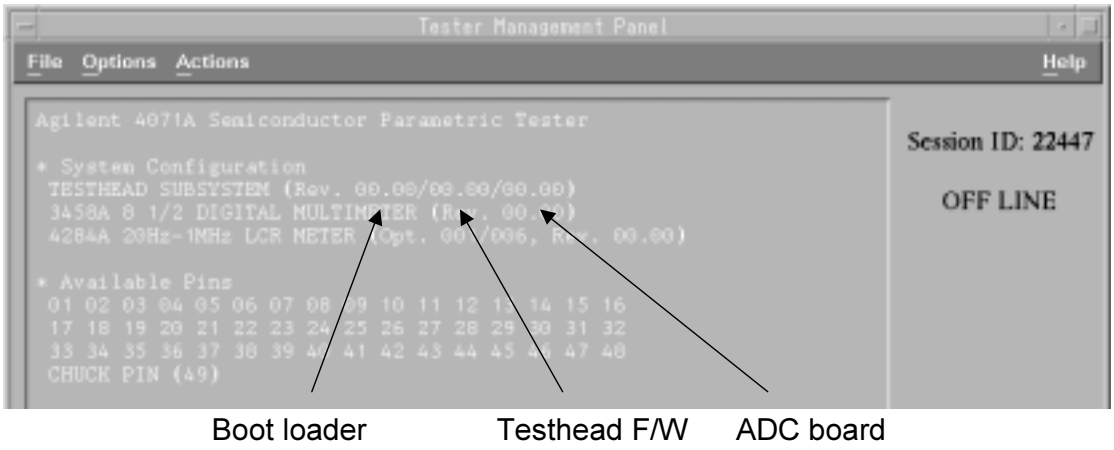
1. Turn on the 4072A/4073A, all system instruments, and the system controller.
2. Log in as superuser (`root`).
3. Check if the TIS server is running. To check it, type:
   ```
   # ps -ef | grep tis
   ```
   If the TIS server is running, the `tis_online` daemon appears.
   ```
   user 20049    1  0  Mar  3  ?     2:04 tis_online -ioff -e -a
   ```
   If the TIS server is not running, run the TIS server using the following command:
   ```
   # /opt/hp4070/bin/hp4070 -start
   ```
4. Execute the `hp4070` command. This command displays the testhead firmware revision in the window.
   ```
   # /opt/hp4070/bin/hp4070
   ```
   The tester management panel and hp4070 login window appear.

Figure 4-30 Tester Management Panel with hp4070 Login



5. Choose **ON LINE**, and click **Login**. The testhead firmware revision is displayed on the tester management panel.

Figure 4-31 Login Screen for the Tester Management Panel



6. Click **Logout...** in the tester management panel, then click **Quit** in the hp4070 login window.
7. Stop the TIS server using the following command:
   ```
   # /opt/hp4070/bin/hp4070 -shutdown
   ```
8. Confirm the firmware revision installed in the system controller.
   ```
   # ll /opt/hp4070/firmware
   ```
   The firmware that is installed in the system controller is listed.
   ```
   -r--r--r-- 1 root sys 941444 Sep 1 2000 fw1.41.bin
   -r--r--r-- 1 root sys 188416 Sep 1 2000 pflash
   ```
9. Update the testhead firmware as follows:
   ```
   # cd /opt/hp4070/firmware
   # ./pflash fw1.41.bin

   Agilent 4070 firmware maintenance utility

   current flash revision: 01.26
   switching to flash update mode ........done.

   boot ROM 01.00 started.

   read 941444 bytes from fw1.41.bin
   total data size = 941444 bytes

   sent 100% of data
   CRC check passed.

   rebooting ..........done.

   flash update completed.
   new flash revision: 01.41
   #
   ```
   It will take approximately 1 minute and 30 seconds to finish the `pflash` command.

NOTE Use the latest firmware to execute this command.

10. After updating, reconfirm the testhead firmware revision. To confirm it, see step 4 and 5 above.

5 Replaceable Parts

This chapter provides information for the Agilent 4072A/4073A replaceable parts, and contains the following sections:

- “Abbreviations”
- “System Cabinet Replaceable Parts”
- “Testhead Replaceable Parts”
- “Testhead Power Cable Replaceable Parts”
- “Accessories”
- “Accessories Replaceable Parts”

These sections include:

- replaceable part lists
- illustrated part locations with reference designation

The replaceable part lists provide:

- Agilent part number
- exchange part number (if applicable)
- quantity used
- description of the part
- required operations (if applicable)

NOTE After replacing a part, you must execute the *full* diagnostics procedure to confirm the tester operation. If there are any required PV tests and adjustments, these will be shown in the parts list.

WARNING **Only trained service personnel, aware of the hazards involved, should perform parts replacement.**

After repairs are completed, make sure all safety features are intact and are functioning properly, and that all necessary parts are connected to their protective grounds.

WARNING **Turn *OFF* the 4072A/4073A before removing the protective covers. Dangerous voltage may be applied to several terminals inside the testhead and the units in the system cabinet. Do not turn on the 4072A/4073A while accessing internal components, or until the protective covers are reinstalled.**

Abbreviations

Table 5-1 lists the abbreviations used in the part lists and schematics.

Table 5-1 Abbreviations

Abbreviation	Description
ADC	Analog-to-digital converter
AUX	Auxiliary
CMU	Capacitance measurement unit
CPU	Central processor unit
EDU	Emergency detect unit
EMO	Emergency off
(f)	Female
GNDU	Ground unit
HEX	Hexagonal
HF	High frequency
HPSMU	High power source monitor unit
HR	High resolution
HRSMU	High resolution source monitor unit
I/F	Interface
LC	Low current
(m)	Male
MPSMU	Medium power source monitor unit
PDU	Power distribution unit
PG	Pulse generator
PGU	Pulse generator unit
SMU	Source monitor unit
SW	Switch
STD	Standard
TH	Testhead
TH PS	Testhead power supply
Triax	Triaxial

System Cabinet Replaceable Parts

Table 5-2 through table 5-6 list the replaceable parts of the system cabinet. Figure 5-1 through figure 5-5 show the replaceable part locations. Before you read this section, check the serial number of the 4072A/4073A.

Table 5-2 System Cabinet Replaceable Parts for Agilent 4072A (JP10G-)

Reference Designation	Agilent P/N (Exchange P/N)	Quantity	Description
1	E3160-60183	1	Front door, large
	E3160-65081	1	Front door, small[a]
2	2680-0278	48	Torx screw, 10-32
3	E3160-60176	1	EMO panel assembly[b]
4	E3160-00256	5	Blank panel
5	E3160-00251	1	Blank panel
6	E3160-00253	1	Blank panel
7	E3160-00254	2	Blank panel
8	E3160-00252	1	Blank panel
9	E3160-61012 (E3160-69012)	1	Testhead power supply, secondary
10	E3160-00210	1	Front panel

a. This part is included in the 17-inch monitor rackmount kit, and is used to mount the monitor into the system cabinet.
b. The EMO panel assembly includes the panel to the PDU cable assembly.

Figure 5-1 System Cabinet Part Locations for Agilent 4072A (JP10G-)

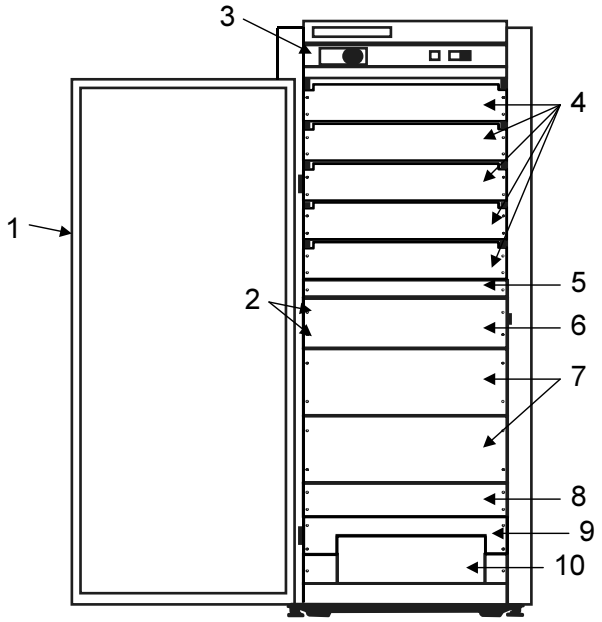


Table 5-3 System Cabinet Replaceable Parts for Agilent 4072A (JP20G- and JP30G-) and 4073A (JP10H- and JP20H-)

Reference Designation	Agilent P/N (Exchange P/N)	Quantity	Description
1	E3160-60183	1	Front door, large
	E3160-65035	1	Front door, small[a]
2	2680-0278C	48	Torx screw, 10-32
3	E3160-60176	1	EMO panel assembly[b]
4	E3160-04065	1	Blank panel
5	E3160-00258	1	Blank panel
6	E3160-00259	4	Blank panel
7	E3160-04066	1	Blank panel
8	E3160-00257	1	Front panel[c]
9	E3160-00254	2	Blank panel
10	E3160-00252	1	Blank panel
11	E3160-610012 (E3160-69012)	1	Testhead power supply, secondary
12	E3160-00208	1	Front panel

a. This part is included in the 17-inch monitor rackmount kit, and is used to mount the monitor into the system cabinet.
b. The EMO panel assembly includes the panel to the PDU cable assembly.
c. This part is for JP20G- and JP10H-.

Figure 5-2 System Cabinet Part Locations Agilent 4072A (JP20G- and JP30G-) and Agilent 4073A (JP10H- and JP20H-)

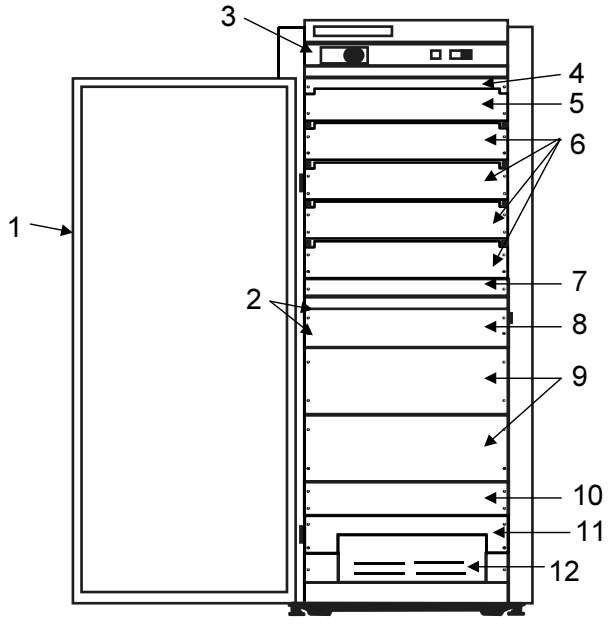


Table 5-4 System Cabinet Replaceable Parts for Agilent 4072A (JP20G-) and Agilent 4073A (JP10H-)

Reference Designation	Agilent P/N (Exchange P/N)	Quantity	Description
1	E3160-00150	1	Chassis for mounting shelter plate, right
2	E3160-00151	1	Chassis for mounting shelter plate, left
3	E3160-00606	1	Shelter plate
4	E3160-00607	2	Cover for the DVM airflow
5	E3160-00608	1	Angle for mounting shelter plate, right
6	E3160-00609	1	Angle for mounting shelter plate, left
7	E3160-01265	1	Hinge, right
8	E3160-01266	1	Hinge, left
9	E3160-04101	1	Fan cover for the system controller[a]
10	E3160-00610	1	Rear plate for TH PS
11	0590-0804	14	Nut 10-32
12	2680-0278C	39	Screw 10-32
13	0515-1012	4	Screw M4 L8
–	E3160-00611	1	Rear plate for system controller[b]
–	E3160-00612	1	Rear plate for CMU[b]
–	E3160-00613	1	Rear plate for DVM[b]

a. This is for 745/132L. When the 745i is installed, this part is not required.
b. This part is used when each instrument or system controller is not installed in the system cabinet.

Figure 5-3 System Cabinet Part Locations, Inside (JP20G- and JP10H-)

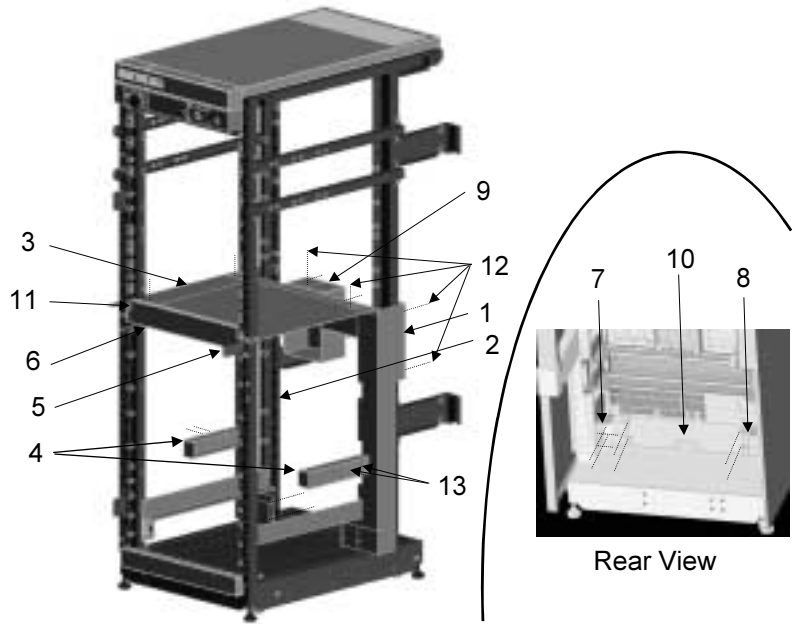


Table 5-5 System Cabinet Replaceable Parts for Agilent 4072A (JP30G-) and Agilent 4073A (JP20H-)

Reference Designation	Agilent P/N (Exchange P/N)	Quantity	Description
1	E3160-00152	1	Chassis for mounting shelter plate, right
2	E3160-00153	1	Chassis for mounting shelter plate, left
3	E3160-00620	1	Shelter plate
4	E3160-00607	2	Cover for the DVM airflow
5	E3160-00618	1	Angle for mounting shelter plate, right
6	E3160-00619	1	Angle for mounting shelter plate, left
7	E3160-01265	1	Hinge, right
8	E3160-01266	1	Hinge, left
9	E3160-04068	1	Front panel
10	E3160-00610	1	Rear plate for TH PS
11	0590-0804	14	Nut 10-32
12	2680-0278C	36	Screw 10-32
13	0515-1012	4	Screw M4 L8
–	E3160-00621	1	Rear plate for system controller[a]
–	E3160-00622	1	Rear plate for CMU[a]
–	E3160-00613	1	Rear plate for DVM[a]

a. This part is used when each instrument or system controller is not installed in the system cabinet.

Figure 5-4 System Cabinet Part Locations, Inside (JP30G- and JP20H-)

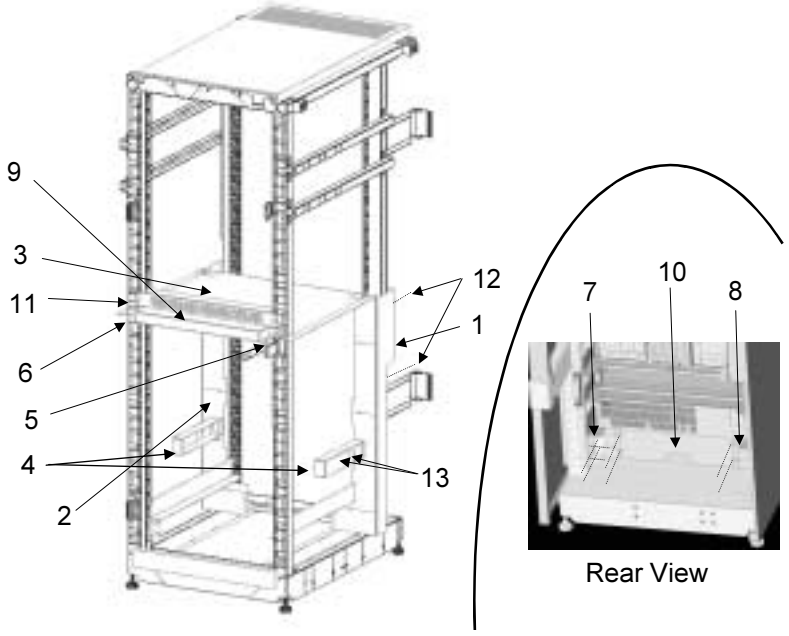
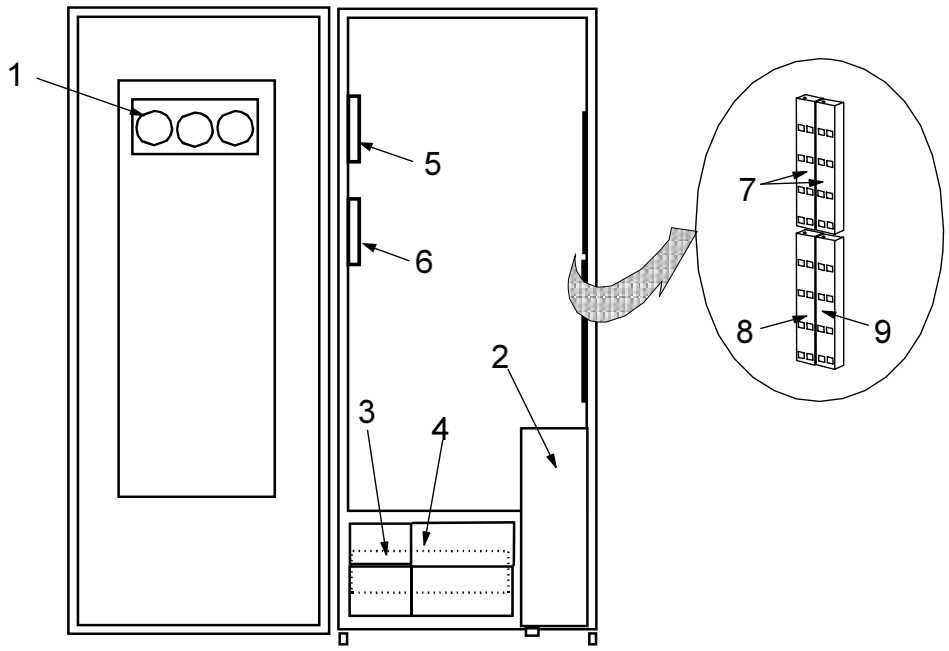


Table 5-6 System Cabinet Replaceable Parts, Rear

Reference Designation	Agilent P/N (Exchange P/N)	Quantity	Description
1	E3160-60075	1	Cabinet fan assembly
2	E3160-60265	1	Power distribution unit, 200 V
	E3160-60266	1	Power distribution unit, 208 V
	E3160-60267	1	Power distribution unit, 220 V
	E3160-60268	1	Power distribution unit, 240 V
3	E3160-61011 (E3160-69011)	1	Testhead power supply, primary
4	E3160-60138	1	Testhead fan assembly
5	E3150-61021	1	Trigger distributor[a]
6	E3150-61022	Up to 2	Transition time convertor[b]
7	E3160-60148	2	Instrument power outlets[c]
8	E3160-60047	1	Controller power outlets[c]
9	E3160-60069	1	DVM and CMU power outlets[d]
–	E3160-61641	1	Main power cable assembly (inside Japan)
–	E3160-61642	1	Main power cable assembly (outside Japan)
–	E3160-61643	1	Main power cable assembly

a. This is included in the Agilent E3102A/E3103A option 500.
b. This is included in the Agilent E3102A/E3103A option 552.
c. This is included with the power distribution unit.
d. This is included with the 200/208 V power distribution unit only.

Figure 5-5 System Cabinet Part Locations, Rear View



Testhead Replaceable Parts

Table 5-7 through table 5-15 list the replaceable parts for the testhead. Also, table 5-7, table 5-8, and table 5-11 list the PV tests and adjustments that must be performed after replacing the appropriate part.

Figure 5-6 through Figure 5-12 show the exploded view and replaceable part locations inside the testhead.

Table 5-7 Testhead Top Side Replaceable Parts (1 of 4)

Reference Designation	Agilent Part Number	Quantity	Description	PV Tests and Adjustments
1	E3125-66503	1	Pulse switch board 2	Pulse switch test
2	E3125-60011	1	Pulse switch connector assembly 2[a]	None
3	E3125-00201	1	Testhead side panel, HF matrix	None
4	E3125-66502	1	Pulse switch board 1	Pulse switch test
5	E3125-60010	1	Pulse switch connector assembly 1[a]	None
6	0515-1012	13	Screw M4	None
7	E3125-66518	1	LED board, power on indicator	None
8	1990-2221	1	LED, yellow[b]	None
9	1990-1883	1	LED, green[b]	None
–	1990-1219	–	LED, red	None

a. This part does not include the pulse switch board.
b. This part is included with the LED board.

Figure 5-6 Testhead Top Side Replaceable Parts (1 of 4)

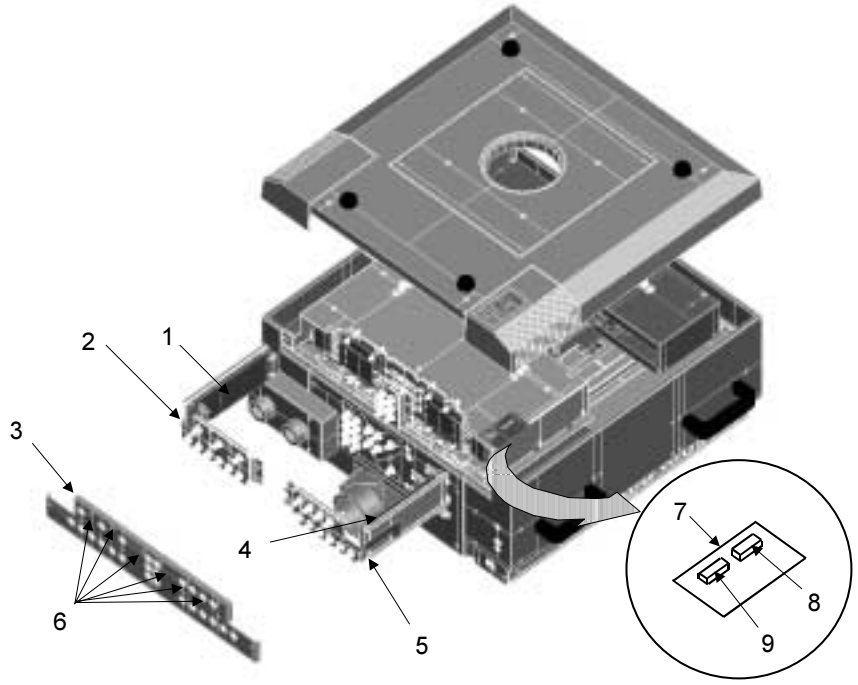


Table 5-8 Testhead Top Side Replaceable Parts (2 of 4)

Reference Designation	Agilent Part Number	Quantity	Description	PV Tests and Adjustments
1	E3125-66507	2	HF matrix connection board	None
2	E3125-66501	6	HF matrix board	HF matrix relay test
3	E3125-61608	6	HF cable assembly	None
	2950-0035	6	Nut	None
	16147-09001	6	Washer	None
	2190-0054	6	Washer lock	None
4	E3125-60012	1	HF matrix cover	None
5	E3125-60007	1	Dummy box	None
6	0515-1012	8	Screw M4	None
7	E3125-24005	2	Stand, long	None
8	3101-3006	1	Micro switch	None
9	E3125-61602	1	Power supply cable assembly	None
10	E3125-60006	1	Extended path input cable assembly[a]	None
11	E3125-66505	1	HF matrix addressing board	None

a. This assembly includes HF matrix back plane board.

Figure 5-7 Testhead Top Side Replaceable Parts (2 of 4)

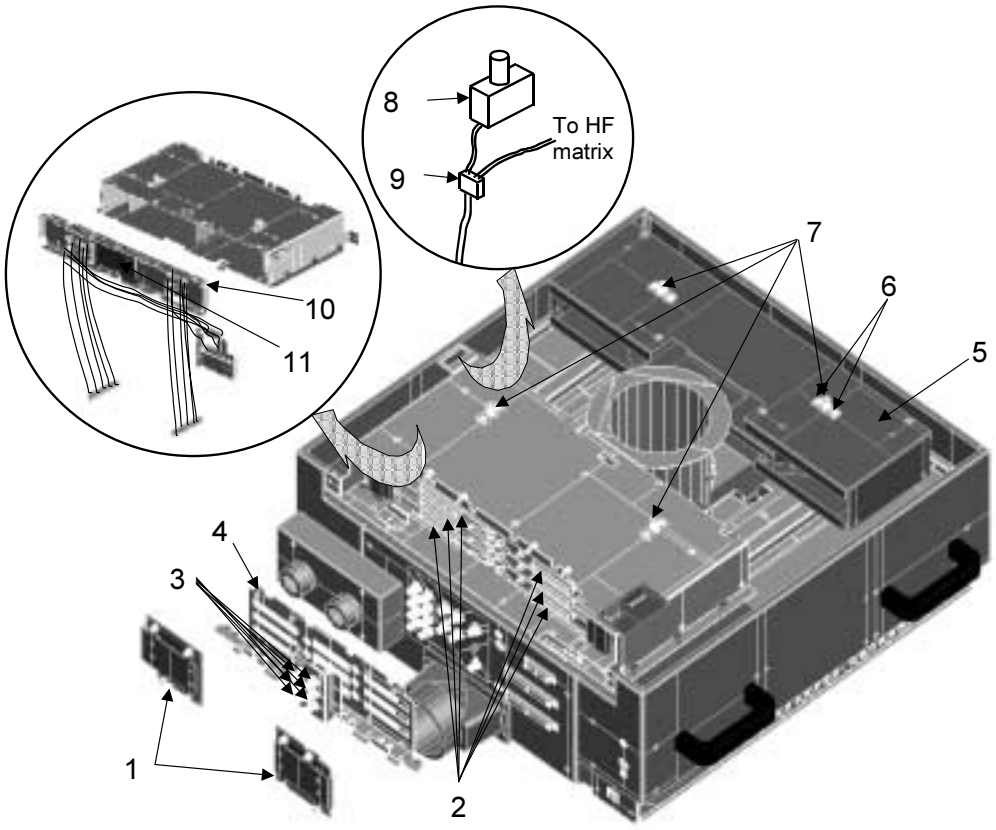


Table 5-9 Testhead Top Side Replaceable Parts (3 of 4)

Reference Designation	Agilent Part Number	Quantity	Description
1	E3120-06001	1	Cable stopper 1
2	E3120-06002	1	Cable stopper 2
3	0515-2079	4	Screw M4 L8
4	E3125-24010	2	Pole
5	E3125-04003	1	Cylinder, black
6	E3125-00603	1	Support plate
7	E3125-61606	1	Flat cable
8	E3125-24002	2	Stand, short
9	0515-1012	4	Screw M4

Figure 5-8 Testhead Top Side Replaceable Parts (3 of 4)

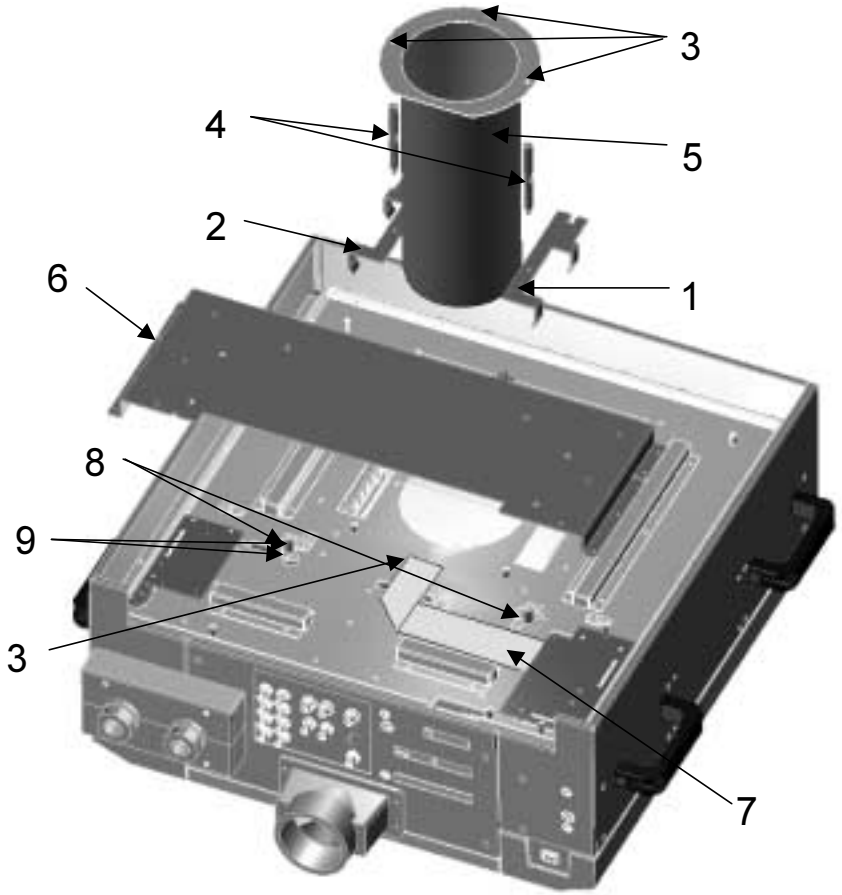


Table 5-10 Testhead Top Side Replaceable Parts (4 of 4)

Reference Designation	Agilent Part Number	Quantity	Description
1	E3120-60002	1	Motherboard frame assembly
2	0515-1012	28	Screw M4
3	0515-1550	8	Screw M3 L8
4	E3125-00205	1	Testhead side panel, rear
5	–	–	Coaxial cable from matrix motherboard 1[a]
6	E3120-66525	1	Mini-motherboard 2
7	–	–	Coaxial cable from matrix motherboard 2[a]
8	E3120-61653	4	Coaxial cable, SMB (CMU matrix cable)
9	E3120-61655	1	Coaxial cable, SMB
10	1250-1391	1	Adapter, SMB-T
11	E3120-61654	1	Coaxial cable, SMB
12	E3125-60006	–	Extended path input cable assembly[b]
13	E3125-66524	1	Mini-motherboard 1
14	E3120-00204	1	Testhead side panel, left (cable side)
15	E3125-00207	1	Testhead side panel, front
16	E3125-00206	1	Testhead side panel, right
17	E3120-60012	5	SMB Connection Assy

a. This is included with the matrix motherboard.
b. This assembly includes the HF matrix back plane board.

Figure 5-9 Testhead Top Side Replaceable Parts (4 of 4)

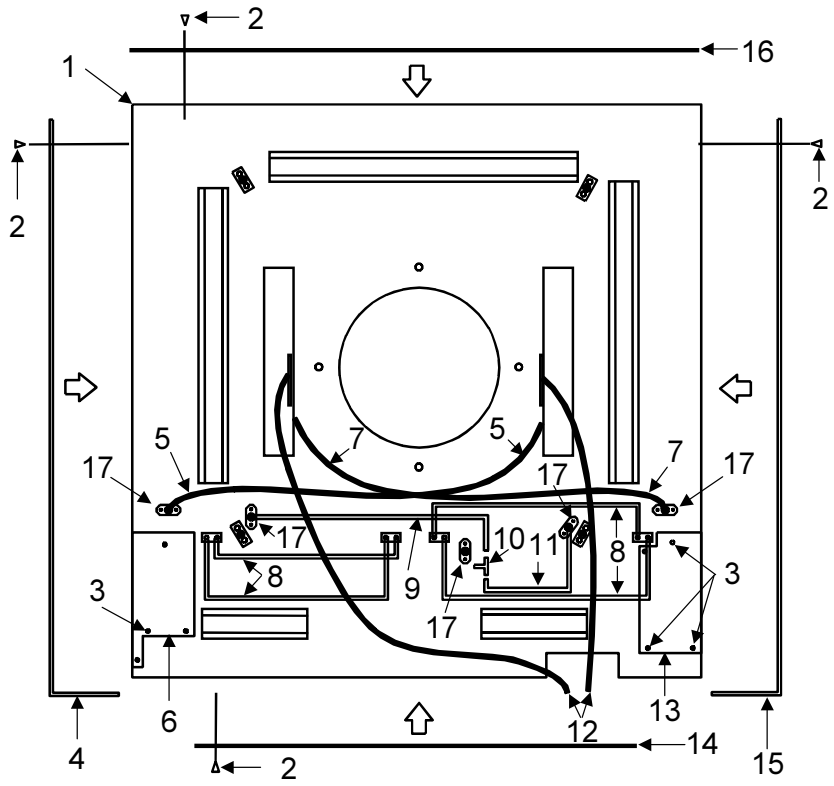


Table 5-11 Testhead Bottom Side Replaceable Parts

Reference Designation	Agilent P/N (Exchange P/N)	Quantity	Description	PV Tests and Adjustments
1	E3126-66527	1	Matrix motherboard 1 with SMB coaxial cable[a]	Residual resistance test Isolation and offset current test
2	E3120-66561	1	Chuck connection pin board	Residual resistance test[b] Isolation and offset current test
2	E3126-66531	1	High-resolution chuck connection pin board	Residual resistance test[b] Isolation and offset current test
3	E3120-66512	2	Low current input board	Residual resistance test[c] Isolation and offset current test[c]
3	E3126-66511	2	High-resolution low current input board	Residual resistance test[c] Isolation and offset current test[c]
4	E3120-66526	2	Relay test board	None
5	E3120-66502	1	High-resolution ADC board	V/R calibration[d] SMU voltage force and measurement test SMU current force and measurement test
6	E3120-66571 (E3120-69571)	1	Testhead CPU board (with optical interface)	Testhead firmware update[e] Configure command for frequency setting
7	E3120-61674	1	Power switch cable assembly	None
8	E3120-00201	1	External input connector plate assembly[f]	Residual resistance test
9	E3120-66521	1	SMU motherboard	None
10	E3120-66544	1	TH PS input board[g]	None
11	E3120-61676	1	Micro switch cable assembly for bottom cover sense	None
12	E3120-66533	1	GNDU board	GNDU output voltage test
13	E3120-66513	1	Kelvin input board	Residual resistance test[c] Isolation and offset current test[c]
13	E3126-66513	1	High-resolution Kelvin input board	Residual resistance test[c] Isolation and offset current test[c]
14	E3120-66535	1	CMU input board	Residual resistance test[c] Isolation and offset current test[c]
15	E3120-61675	1	Micro switch cable assembly for prober/fixture sense[h]	None
–	E3120-61686	1	Interlock cable assembly	None
16	E3126-66528	1	Matrix motherboard 2, with SMB coaxial cable[a]	Residual resistance test Isolation and offset current test
17 - 26	E3131-66511 (E3131-69511)	Up to 8	MPSMU board with SMB coaxial cables	SMU voltage force and measurement test[b] SMU current force and measurement test[b] SMU output resistance test[b]
17,18,22,23	E3133-61001 (E3131-69001)	Up to 2	HRSMU board with SMB coaxial cable	SMU voltage force and measurement test[b] SMU current force and measurement test[b] SMU output resistance test[b]
–	E3133-66503	Up to 2	HRSMU power transistor module with heat sink	SMU voltage force and measurement test[b] SMU current force and measurement test[b]
19,20,24,25	E3132-60001 (E3132-69001)	Up to 2	HPSMU board with SMB coaxial cables	SMU voltage force and measurement test[b] SMU current force and measurement test[b] SMU output resistance test[b]

Table 5-11 Testhead Bottom Side Replaceable Parts

Reference Designation	Agilent P/N (Exchange P/N)	Quantity	Description	PV Tests and Adjustments
–	E3132-66503	Up to 2	HPSMU power transistor module with heat sink[i]	SMU voltage force and measurement test[b] SMU current force and measurement test[b]
27 - 74	E3121-66511	Up to 48	Pin board	Relay test[b] Residual resistance test[b] Isolation and offset current test[b]
27 - 74	E3122-66501	Up to 48	High-resolution pin board	Relay test[b] Residual resistance test[b] Isolation and offset current test[b]
–	0360-2066	Up to 146	Contact pin (probe card side)	None
–	0960-0931	Up to 98	Contact pin (pin board LC input motherboard side)	None

a. For the cable connection, see figure 5-9.
b. Only for the repaired board.
c. Only for the repaired ports.
d. Only if the last calibration date is more than one year. To check the last calibration date, refer to the *System Calibration Guide*.
e. Only if the testhead firmware revision is older than the firmware revision installed in the system controller. To update the testhead firmware, see "Updating the Testhead Firmware" in Chapter 4.
f. For assembling the connector plate, see figure 5-14.
g. Interlock cable to prober/fixture sense switch is E3120-61684.
h. Interlock cable from TH PS input board is E3120-61686.
i. For the details, see figure 5-12.

Figure 5-10 Testhead Bottom Side Replaceable Parts

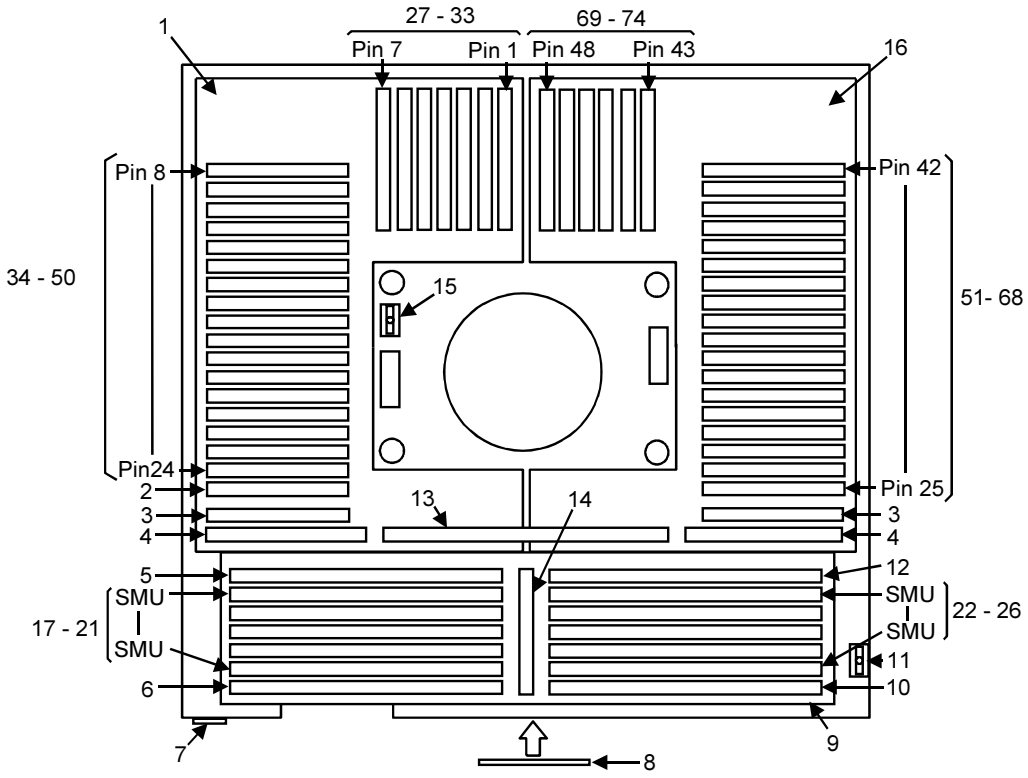


Table 5-12 Testhead Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	0360-2066	2	Contact pin
2	E3120-61682	1	Interlock cable assembly
3	E3120-24003	1	Holding ring
4	E3120-00618	1	Fitting ring plate
5	E3120-24006	1	Stand off
6	0515-0195	8	Screw M6 L20[a]
7	E3120-24031	8	Spacer[a]
8	0510-1652	8	Retainer[a]
9	E3120-60004	1	Top cover (opposite side of measurement pins)
–	E3120-60011	1	Cylinder cover
10	E3126-60010	1	Shield plate (SMU 1 side)[b]
11	E3120-66518	1	LED board, power on indicator[c]
12	0515-1550	2	Screw M3 L8[d]
13	E3126-60009	1	Shield plate (SMU 2 side)[b]
14	E3126-60015	1	Inner plate for docking
15	E3120-60003	1	Bottom cover (measurement pin side)
16	1440-0412	4	Handle
17	0515-0195	8	Screw M6 L20
18	E3126-60001	1	Cable clamp[e]
19	E3126-60002	1	Cable clamp with screws[e]
–	E3120-04510	1	Pogo pin cover

a. This part is included with the docking inner plate.
b. See table 5-13 and figure 5-12.
c. LED board is mounted on the shield plate (SMU 1 side).
d. These are used for mounting the LED board on the shield plate.
e. This part is for 4073A only.

Figure 5-11 Testhead Replaceable Parts

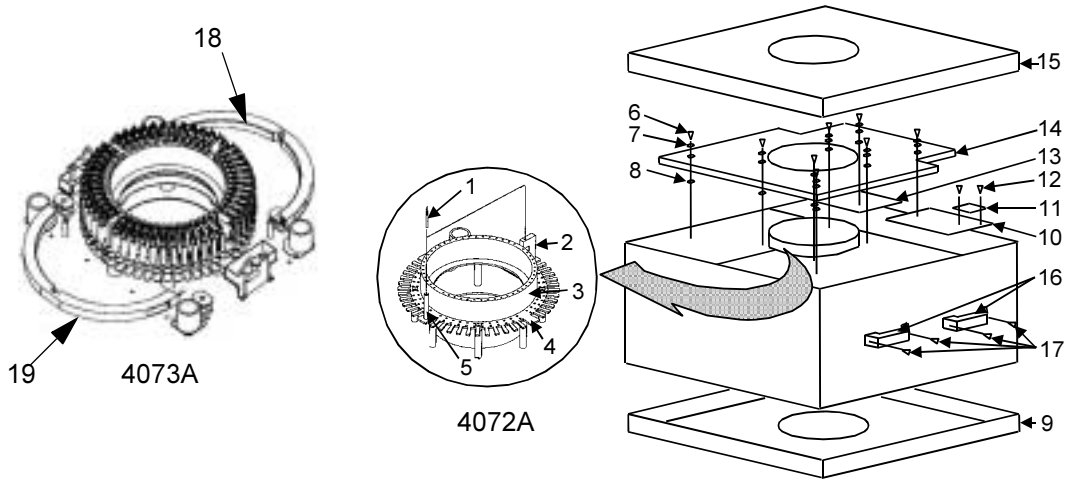


Table 5-13 HPSMU Power Transistor Module with Heat Sink Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	0515-0914	Up to 6	Screw M3
2	E3132-04002	Up to 2	Cover
3	E3132-24002	Up to 6	Stand off
4	E3132-66503	Up to 2	HPSMU power transistor module with heat sink[a]
5	E3126-60010	1	Shield plate 1 (SMU1 side)
6	E3126-60009	1	Shield plate 2 (SMU2 side)

a. For the repaired board, perform the SMU voltage force and measurement test and SMU current force and measurement test.

Figure 5-12 HPSMU Power Transistor Module with Heat Sink Replaceable Parts

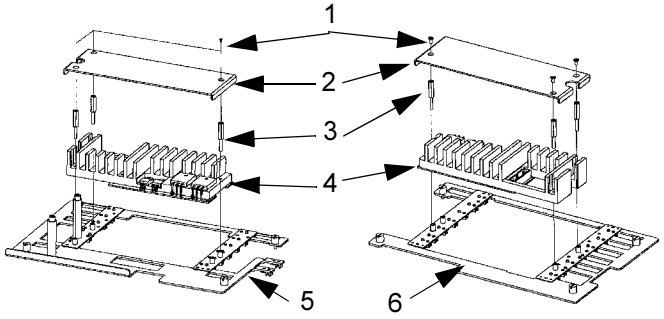


Table 5-14 HRSMU Power Transistor Module with Heat Sink Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	0515-0914	Up to 4	Screw M3
2	E3133-04002	Up to 2	Cover
3	E3132-24002	Up to 4	Stand off
4	E3133-66503	Up to 2	HRSMU power transistor module with heat sink

Figure 5-13 HRSMU Power Transistor Module with Heat Sink Replaceable Parts

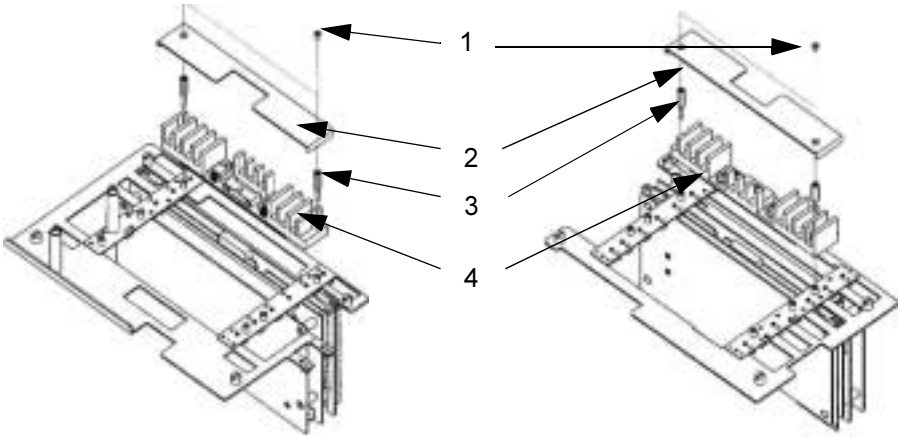
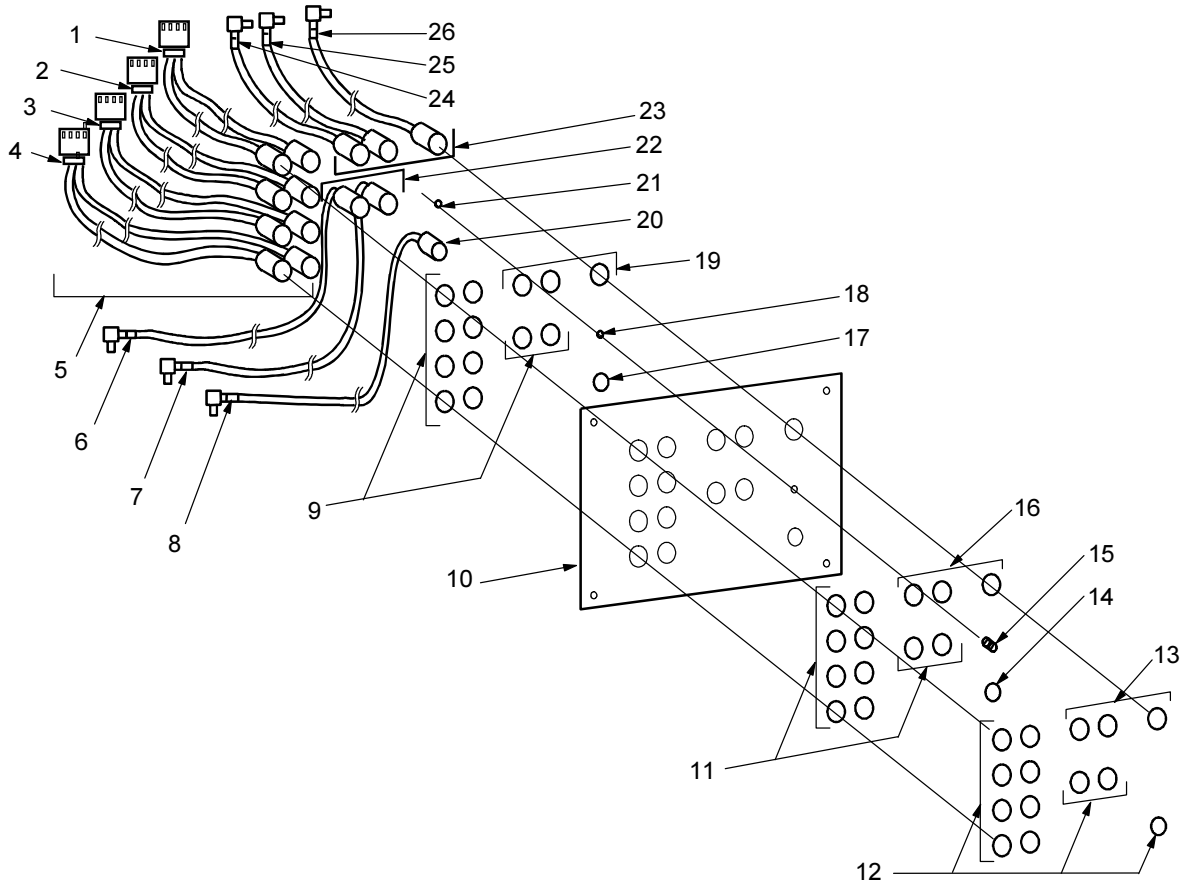


Table 5-15 External Input Connector Plate Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	7121-2954	1	Wire marker “3”
2	7121-2953	1	Wire marker “4”
3	7121-4691	1	Wire marker “5”
4	7121-4692	1	Wire marker “6”
5	E3120-61672	4	Coaxial cable assembly, 2 BNC-flat[a]
6	7121-4879	1	Wire marker “7”
7	7121-4880	1	Wire marker “8”
8	7121-4586	1	Wire marker “P”
9	2190-0054	10	Washer lock
10	E3120-00201	1	Connector plate for external input ports
11	16147-09001	10	Washer
12	2950-0035	11	Nut
13	–	3	Nut[b]
14	5040-3324	1	Insulator
15	1510-0130	1	Binding post
16	E3120-24021	3	Washer
17	5040-3325	1	Insulator
18	2190-0084	1	Washer lock
19	–	3	Washer[b]
20	E3120-61679	1	Coaxial cable assembly, BNC-SMB[c]
21	2950-0006	1	Nut
22	E3120-61673	2	Coaxial cable assembly, BNC-SMB[d]
23	E3120-61671	2	Coaxial cable assembly, Triax-SMB[e]
24	7121-2956	1	Wire marker “1”
25	7121-2955	1	Wire marker “2”
26	7121-0449	1	Wire marker “C”
27	E3120-61661	1	Coaxial cable assembly, Triax-SMB[f]

a. These are used for AUX 3, 4, 5, and 6. For cable connections, see figure 4-14.
b. This is included with the coaxial cable assembly (Agilent part number E3120-6167).
c. These are used for zero reference. For cable connections, see figure 4-14.
d. These are used for AUX 7 and 8. For cable connections, see figure 4-14.
e. These are used for AUX 1 and AUX 2. For cable connections, see figure 4-14.
f. This is used for the chuck connection. For cable connections, see figure 4-14.

Figure 5-14 External Input Connector Plate Replaceable Parts



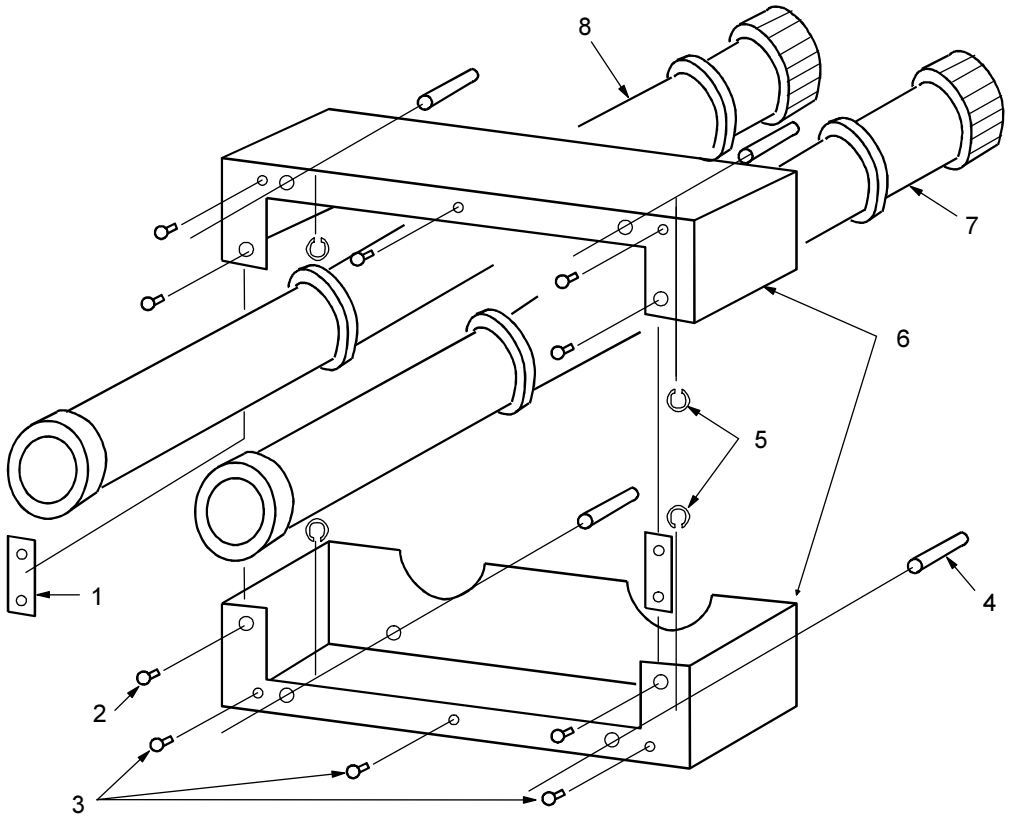
Testhead Power Cable Replaceable Parts

Table 5-16 lists the replaceable parts for the testhead power cable. Figure 5-15 shows an exploded view of the testhead power cable.

Table 5-16 Testhead Power Cable Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	E3120-00130	2	Adapter plate for TH PS input covers
2	0515-0914	4	Screw M3 L6
3	6960-0016	6	Plug hole
4	E3120-24020	4	Screw
5	0510-0305	4	E-Ring
6	E3120-04007	2	Cover for fixing testhead power cables
7	E3120-61680	1	Testhead power cable (with 3 connectors)
8	E3120-61681	1	Testhead power cable (with 2 connectors)

Figure 5-15 Testhead Power Cable Replaceable Parts



Accessories

Table 5-17 lists accessories that are included with the 4072A/4073A, and their respective Agilent part number.

Table 5-17 Furnished Accessories

Agilent Part Number Product Number	Quantity	Description	PV Tests and Adjustments
E3160-66503	1	Optical I/F board (PCI)[a]	None
E3160-66542	1	Optical I/F board (ISA)[b]	None
E3120-61603	1	Optical fiber cable assembly (pair)[c]	None
E3120-60008	2	Air duct fitting	None
E3120-40005	1	Air duct	None
E3120-61678	1	Ground wire	None
04145-61622	1	Triax cable for chuck connection output	None
1250-0929	1	BNC short cap for zero reference connector	None
1250-2652	1	Triax(f)-BNC(m) adapter (for chuck connection output)	None
4284A	1	Precision LCR meter	CMU open/short compensation[d] CMU capacitance and conductance test CMU dc bias output voltage test
1250-2405	2	BNC-T adapter	None
3458A	1	Digital multimeter	DVM differential voltage measurement test
8110A	Up to 5	150 MHz pulse generator	Pulse level test Pulse parameter test PG skew calibration PG level calibration[d]
81110A	Up to 5	330/165 MHz pulse/pattern generator	Pulse level test Pulse parameter test PG skew calibration PG level calibration[d] PG timing calibration[d]
8114A	Up to 2	100 V/2 A programmable pulse generator	Pulse level test Pulse parameter test PG skew calibration PG level calibration[d]
E3171-61011 (E3171-69011)	1	15-inch flat panel display	None
E3171-61013 (E3171-69013)	1	17-inch flat panel display	None
16048E (16048-60002)	1	CMU test leads	CMU open/short compensation[d]
E3120-61683	1	DVM test leads	None
E3150-61021	1	Trigger distributor	None

Table 5-17 Furnished Accessories

Agilent Part Number Product Number	Quantity	Description	PV Tests and Adjustments
E3150-61022	Up to 2	Transition time convertor	None
E3150-61601	Up to 10	PG cable assembly	None
E3150-61002	Up to 2	PG cable assembly (for between the 8114A and transition time convertor)	None
1250-0595	2	Triaxial-to-BNC adapter	None
E3150-61602	Up to 2	BNC(m)-to-BNC(m) cable assembly, 115 cm, white	None
04062-61604	Up to 3	BNC(m)-to-BNC(m) cable assembly, 115 cm, yellow	None
04062-61608	Up to 4	BNC(m)-to-BNC(m) cable assembly, 115 cm, blue	None
04192-61002	1	Feedthrough, 50 Ω	None
8710-1576	1	Tool, zip lock sealing	None
E3125-61042	3	1-to-2 adapter	None
E3125-61607	7	BNC cable for pulse switch	None
E3160-04063	1	Cover	None
E3150-89101	1	Label	None
E3196-60003	1	Tweezers[e]	None
E3196-60002	1	Testhead stand[e]	None
E3144-60001	1	Card fixture[f]	None

a. For the 4072A (JP20G-) and 4073A (JP10H-).
b. For the JP10G-. When you order the E3102A/E3103A option ES1, this part is furnished in spite of optical I/F board (PCI) (Agilent part number E3160-66503) for the EISA bus controller.
c. If only one optical fiber cable is replaced, use the optical fiber cable assembly (Agilent part number E3120-61601).
d. Use the `/opt/hp4070/bin/cal/cal4070` command. Refer to chapter 2 of the *System Calibration Guide*.
e. This is furnished with the upgrade kit from the 4071A to 4072A.
f. This is furnished with the 4073A only.

Accessories Replaceable Parts

This section provides the part lists and an exploded view of the following accessories.

- Agilent E3140A test fixture adapter
- Agilent E3141A universal test fixture
- Agilent E3146A cable extension fixture
- Agilent E3148A extended adapter
- Agilent E3151A rack mount kit for Agilent 4284A LCR meter
- Agilent E3152A rack mount kit for Agilent 3458A multimeter
- Agilent E3153A rack mount kit for PG
- Agilent E3155A rack mount kit for HP A2287A 17-inch monitor
- Agilent E3155B rack mount kit for HP A4330A 17-inch monitor
- Agilent E3155C rack mount kit for HP A4490A 17-inch monitor
- Agilent E3155D rack mount kit for HP D2838W 17-inch monitor
- Agilent E3155E rack mount kit for HP D8900A 17-inch monitor
- Agilent E3155F flat panel display rack mount kit
- Agilent E3155G rack mount kit for HP D8906A 17-inch monitor
- Agilent E3156A rack mount kit for 745i controller
- Agilent E3156B rack mount kit for 745/132L controller
- Agilent E3156C rack mount kit for C3600 controller
- Agilent E3157A rack mount kit for CD-ROM drive
- Agilent E3157B rack mount kit for DDS drive
- Agilent E3102A/E3103A option SP1 ring oscilator evaluation kit

Agilent E3140A Replaceable Parts

Table 5-18, table 5-19, and table 5-20 list replaceable parts for the E3140A test fixture adapter for the 4072A/4073A. Figure 5-16, figure 5-17, and figure 5-18 show an exploded view of the E3140A.

Table 5-18 Agilent E3140A Replaceable Parts (1 of 3)

Reference Designation	Agilent Part Number	Quantity	Description
1	0515-0914	4	Screw M3 L6
2	E3140-25004	1	Knob
3	E3140-23001	1	Lever
4	E3140-23006	1	Lever
5	6960-0076	4	Plug hole
6	94809-87104	1	Label
7	0535-0031	8	Nut M3

Figure 5-16 Agilent E3140A Replaceable Parts (1 of 3)

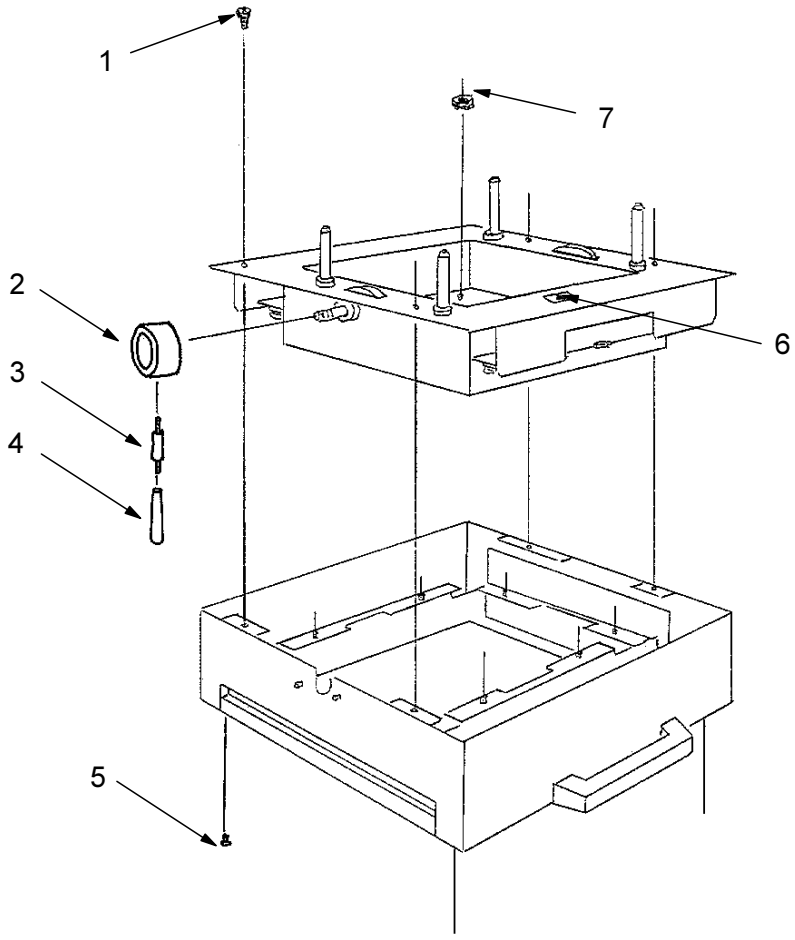


Table 5-19 Agilent E3140A Replaceable Parts (2 of 3)

Reference Designation	Agilent Part Number	Quantity	Description
1	0535-0031	4	Nut M3
2	E3140-01202	1	Angle
3	1440-0187	2	Handle
4	0535-0031	2	Nut M3
5	E3140-01204	1	Angle
6	E3140-24011	1	Stopper
7	4324-0146	1	Rubber
8	E3140-60011	1	Cover
9	0510-0043	2	E-Ring
10	0535-0031	1	Nut M3
11	E3140-25003	1	Knob
12	1460-2568	2	Spring
13	E3140-23005	1	Bar
14	4324-0146	1	Rubber
15	E3140-01214	1	Angle
16	3110-0406	2	Hinge
17	0515-1550	4	Screw M3 L8
18	0515-1550	4	Screw M3 L8
19	2190-0644	1	Washer
20	E3140-61601	1	Cable
21	0535-0031	3	Nut M3
22	E3140-01203	1	Angle
23	E3140-60020	1	Cover
24	E3140-24007	2	Block
25	0535-0031	4	Nut M3
26	E3140-01205	1	Angle
27	E3140-01211	1	Angle
28	0535-0031	2	Nut M3

Figure 5-17 Agilent E3140A Replaceable Parts (2 of 3)

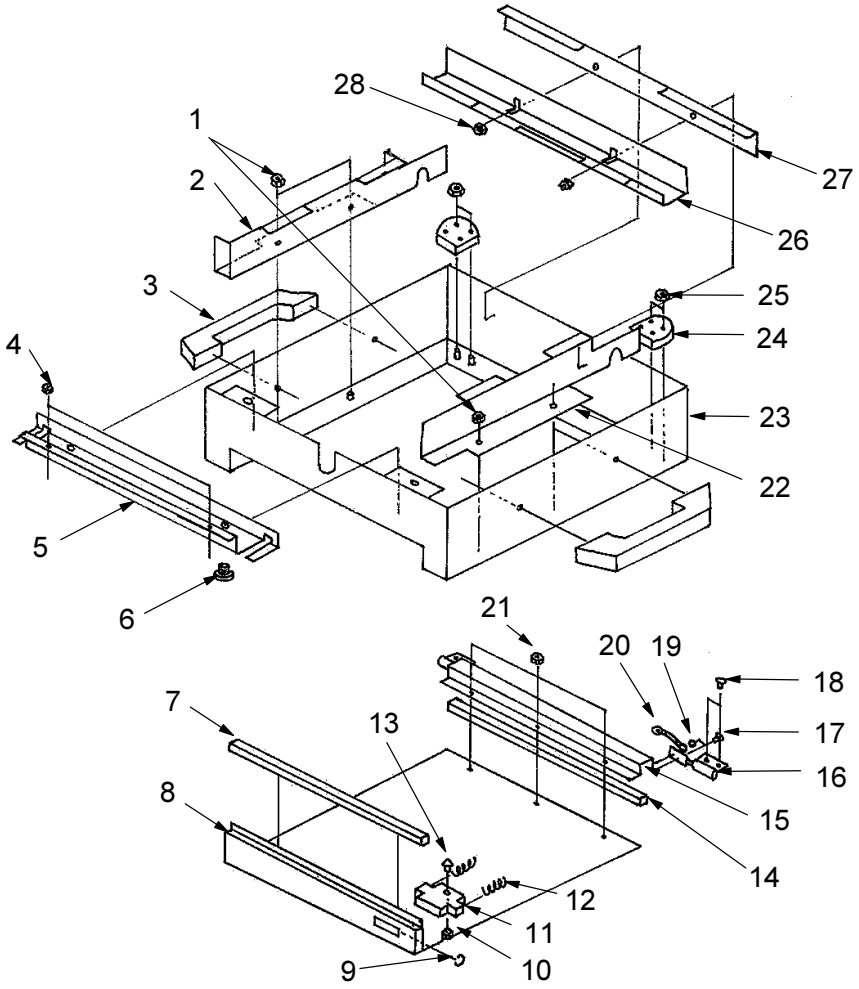
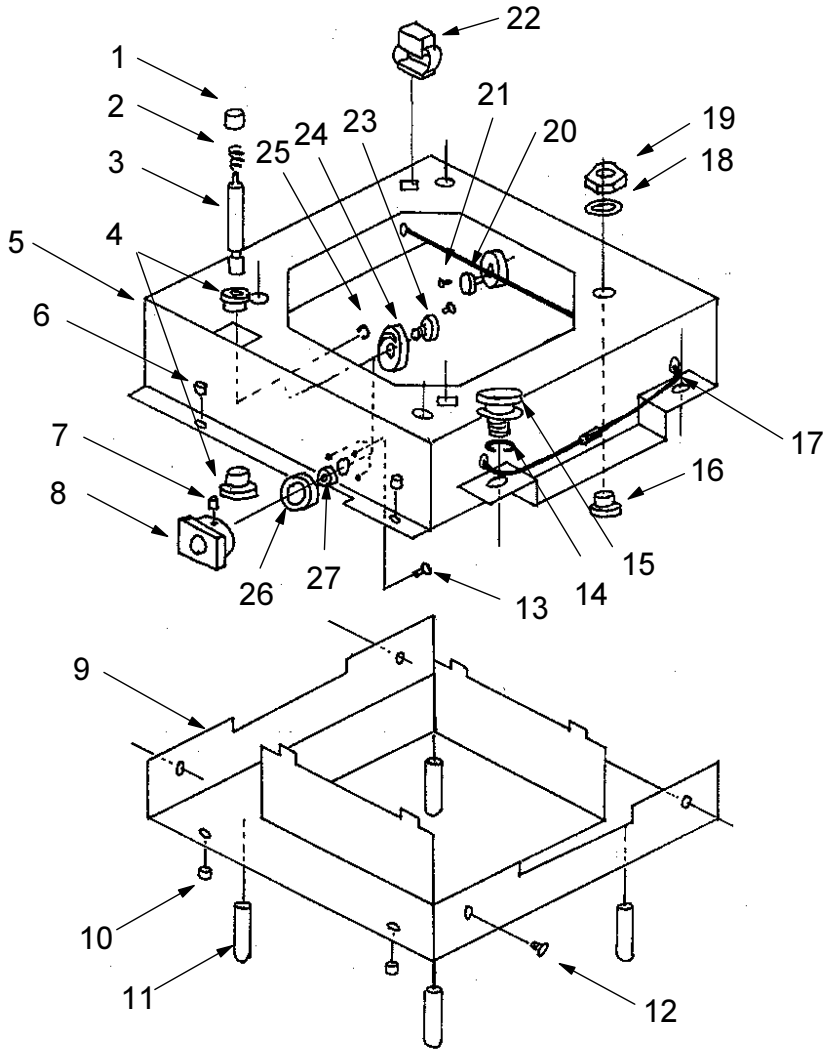


Table 5-20 Agilent E3140A Replaceable Parts (3 of 3)

Reference Designation	Agilent Part Number	Quantity	Description
1	E3140-23002	1	Pad
2	1460-2565	1	Spring
3	E3140-23003	2	Rod
4	0400-0157	2	Insulator
5	E3140-00101	1	Frame
6	0535-0031	8	Nut M3
7	0515-0763	2	Screw M3
8	E3140-24004	2	Collar
9	E3140-00102	1	Frame
10	6960-0016	4	Plug hole
11	E3140-25002	4	Guide
12	0515-0914	4	Screw M3 L6
13	0515-1005	6	Screw M3 L10
14	2190-0695	4	SW M6
15	1500-0894	4	Pulley
16	E3140-24005	4	Guide
17	E3140-60001	2	Wire
18	2190-0104	4	Washer
19	2950-0132	4	Nut
20	E3140-24002	1	Shaft
21	0515-1005	6	Screw M3 L10
22	1390-1067	2	Receptacle
23	E3140-24001	1	Shaft
24	E3140-29003	2	Cam
25	0510-0045	1	E-Ring
26	1410-1408	2	Bearing
27	E3140-24003	2	Holder

Figure 5-18 Agilent E3140A Replaceable Parts (3 of 3)



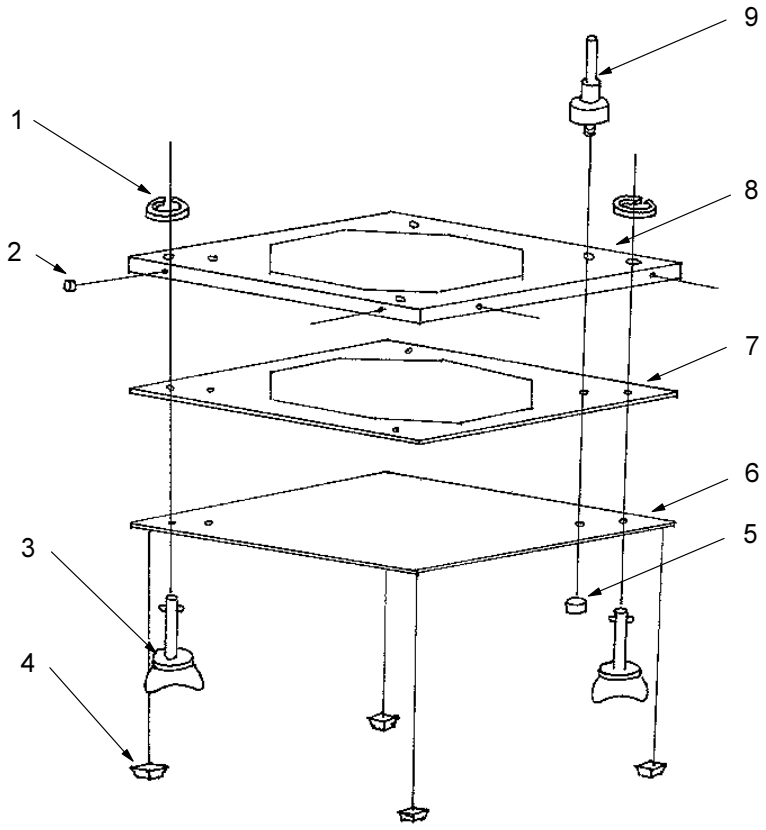
Agilent E3141A Replaceable Parts

Table 5-21 lists the E3141A universal test fixture replaceable parts for the 4072A/4073A. Figure 5-19 shows an exploded view of the E3141A.

Table 5-21 Agilent E3141A Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	0510-1649	2	Retainer
2	6960-0016	8	Plug hole
3	1390-1070	2	Stud
4	0403-0469	4	Foot
5	0535-0031	4	Nut
6	E3141-26501	1	Motherboard
7	E3141-00601	1	Plate
8	E3141-04501	1	Cover
9	E3141-24001	4	Guide

Figure 5-19 Agilent E3141A Replaceable Parts



Agilent E3146A Replaceable Parts

Table 5-22, table 5-23, and table 5-24 list the E3146A cable extension fixture replaceable parts for the 4072A/4073A. Figure 5-20, figure 5-21, and figure 5-22 show exploded views of the E3146A.

Table 5-22 Agilent E3146A Replaceable Parts (1 of 3)

Reference Designation	Agilent Part Number	Quantity	Description
1	E3146-04003	1	Cover
2	6960-0016	8	Plug hole
3	E3146-00601	1	Plate
4	E3146-26501	1	Motherboard
5	0403-0469	4	Foot
6	0535-0031	3	Nut M3
7	E3146-24001	1	Stud
8	E3190-24001	49	Stud
9	0380-4452	96	Teflon stud
10	0515-1550	4	Screw M3 L8
11	E3146-24003	1	Insulator
12	1250-1163	1	BNC connector
13	E3146-25001	1	Boss
14	2190-0102	1	Washer
15	2950-0035	1	Nut

Figure 5-20 Agilent E3146A Replaceable Parts (1 of 3)

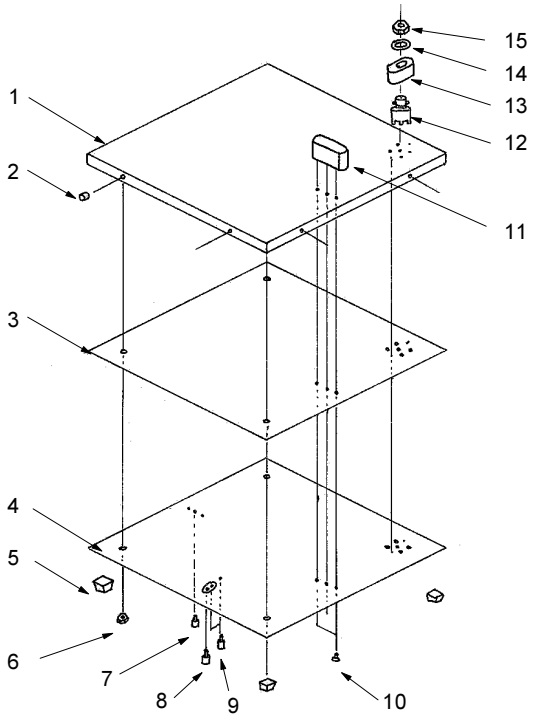


Table 5-23 Agilent E3146A Replaceable Parts (2 of 3)

Reference Designation	Agilent Part Number	Quantity	Description
1	E3146-23002	1	Pad
2	1460-2565	1	Spring
3	E3140-23003	2	Rod
4	0400-0157	2	Insulator
5	E3146-00101	1	Frame
6	0535-0031	8	Nut M3
7	0515-0763	2	Screw M3
8	E3140-24004	2	Collar
9	E3146-00102	1	Frame
10	6960-0016	4	Plug hole
11	E3140-25002	4	Guide
12	0515-0914	4	Screw M3 L6
13	0515-1005	6	Screw M3 L10
14	2190-0695	4	SW M6
15	1500-0894	4	Pulley
16	E3140-24005	4	Guide
17	E3140-60001	2	Wire
18	2190-0104	4	Washer
19	2950-0132	4	Nut
20	E3140-24002	1	Shaft
21	0515-1005	6	Screw M3 L10
22	1390-1067	2	Receptacle
23	E3140-24001	1	Shaft
24	E3140-29003	2	Cam
25	0510-0045	1	E-Ring
26	1410-1408	2	Bearing
27	E3140-24003	2	Holder

Figure 5-21 Agilent E3146A Replaceable Parts (2 of 3)

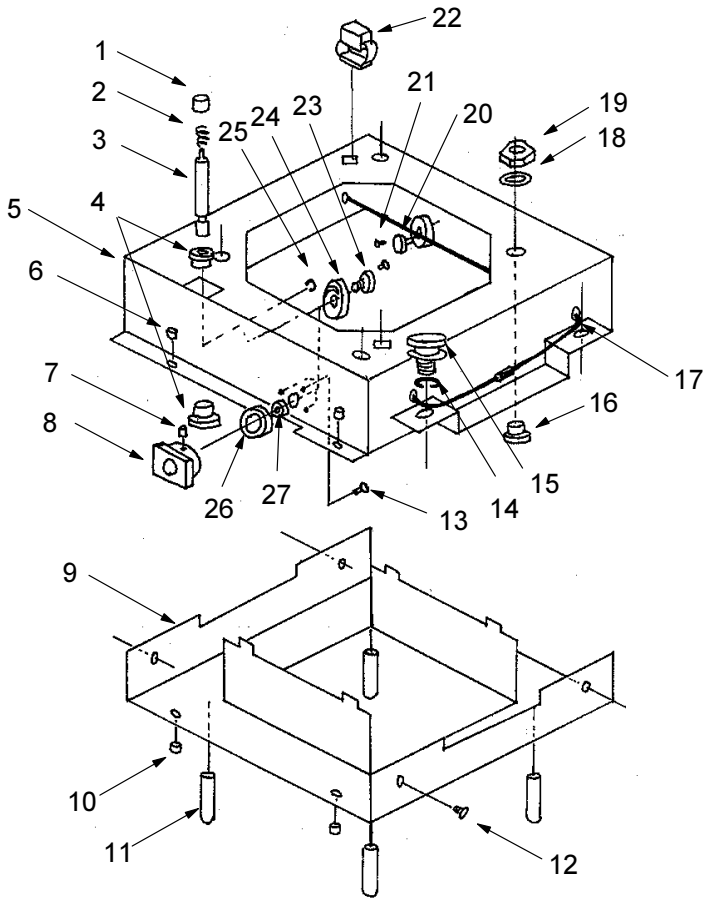
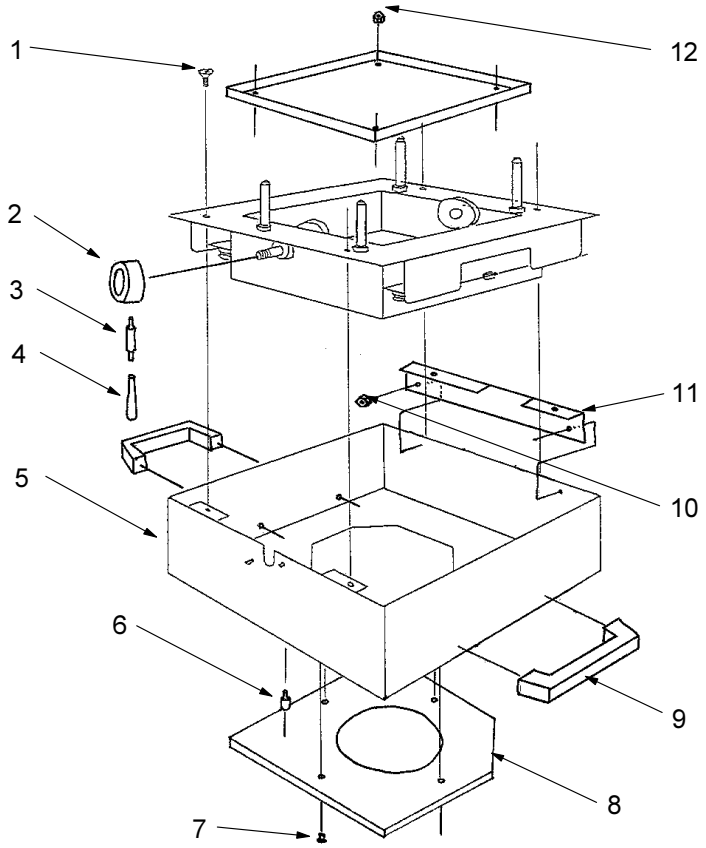


Table 5-24 Agilent E3146A Replaceable Parts (3 of 3)

Reference Designation	Agilent Part Number	Quantity	Description
1	0515-0914	4	Screw M3 L6
2	E3140-25004	1	Knob
3	E3140-23001	1	Lever
4	E3140-23006	1	Lever
5	E3146-60020	1	Cover
6	E3146-23002	1	Bar
7	0515-0914	4	Screw M3 L6
8	E3146-00202	1	Panel
9	1440-0187	2	Handle
10	0535-0031	2	Nut M3
11	E3140-01211	1	Angle
12	0535-0031	4	Nut M3

Figure 5-22 Agilent E3146A Replaceable Parts (3 of 3)



Agilent E3148A Replaceable Parts

Table 5-26 and table 5-27 list the replaceable parts for the E3148A extended adapter. Figure 5-23 and figure 5-24 show exploded views of the E3148A.

Table 5-25 Agilent E3148A Replaceable Parts (1 of 2)

Reference Designation	Agilent Part Number	Quantity	Description
1	E3148-66501	1	Motherboard
2	E3148-04004	1	Cover
3	0515-1550	1	Screw M3 L8
4	E3148-00201	1	Panel
5	2190-0102	8	Washer
6	2950-0035	8	Nut

Figure 5-23 Agilent E3148A Replaceable Parts (1 of 2)

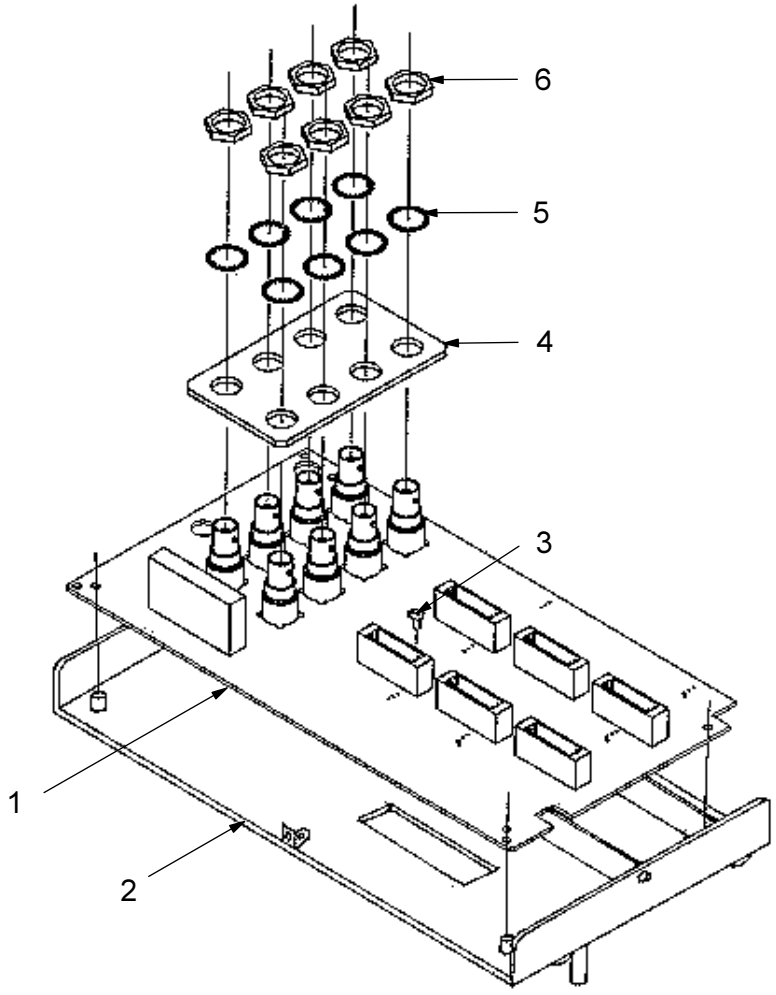
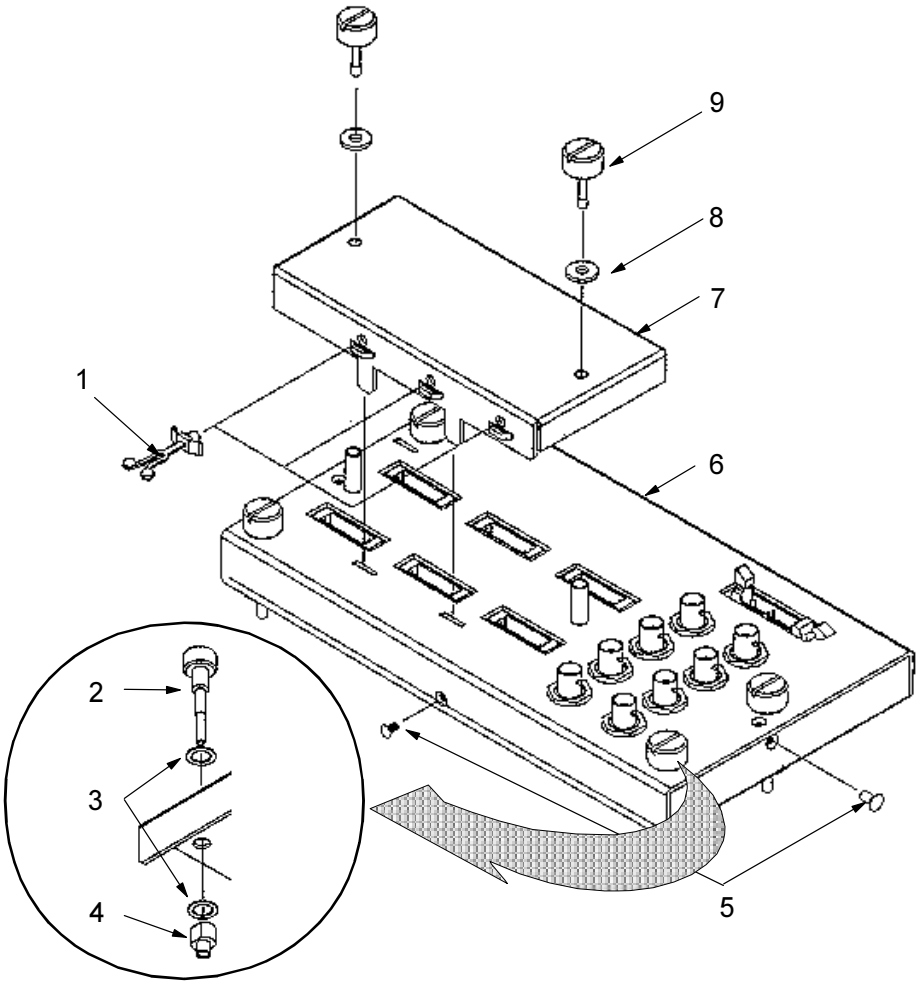


Table 5-26 Agilent E3148A Replaceable Parts (2 of 2)

Reference Designation	Agilent Part Number	Quantity	Description
1	1400-2221	3	Niplocker
2	E3148-24001	4	Screw
3	3050-0789	8	Washer
4	E3148-24002	4	Sleeve
5	0515-0914	4	Screw M3 L6
6	E3148-04502	1	Cover
7	E3148-04003	1	Cover
8	2190-0320	2	Washer
9	E3148-24005	2	Screw
-	E3148-61602	1	Cable assembly

Figure 5-24 Agilent E3148A Replaceable Parts (2 of 2)



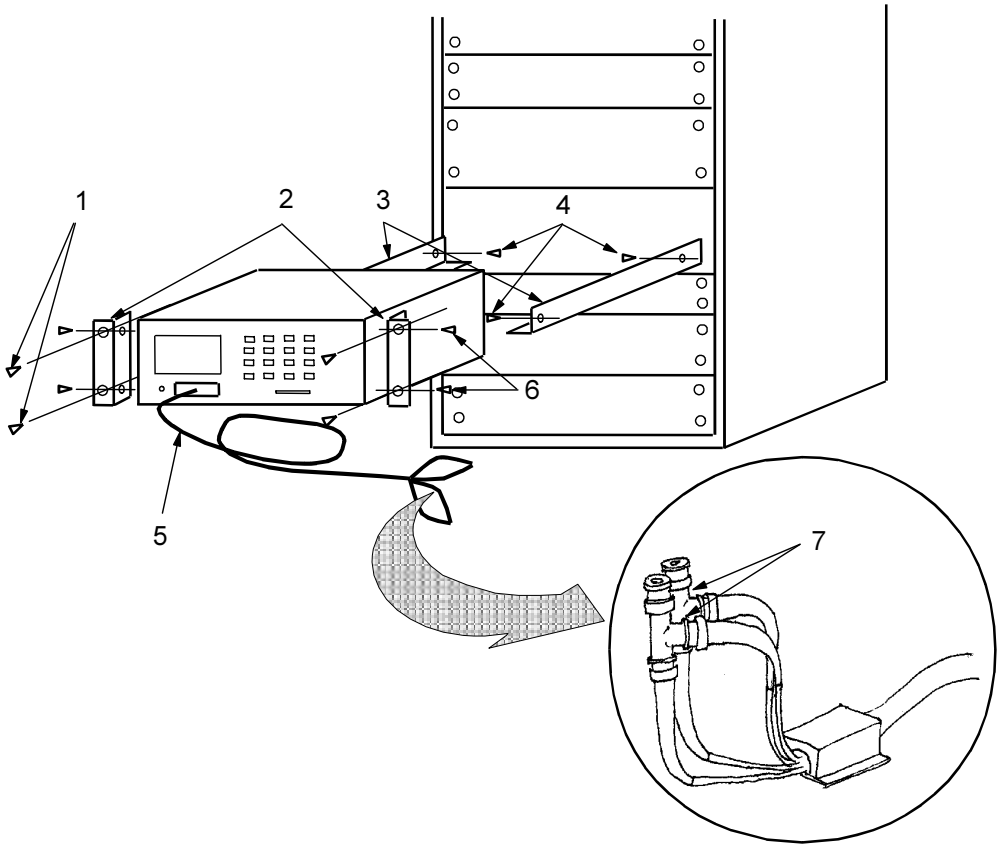
Agilent E3151A Replaceable Parts

Table 5-28 lists the replaceable parts for the E3151A rack mount kit for the 4284A LCR meter. Figure 5-25 shows an exploded view of the E3151A.

Table 5-27 Agilent E3151A Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	2680-0278	4	Screw 10-32
2	E3160-01215	2	Flange
3	E3160-01261	2	Support rail
4	2680-0278	4	Screw 10-32
5	16048-60002	1	Agilent 16048E test leads
6	0515-1718	4	Screw M4x12
7	1250-2405	3	BNC-T (m-f-f) type adapter
–	8120-1625	1	Power cord, universal
–	8120-3445	1	GPIB cable, 1 m

Figure 5-25 Agilent E3151A Replaceable Parts



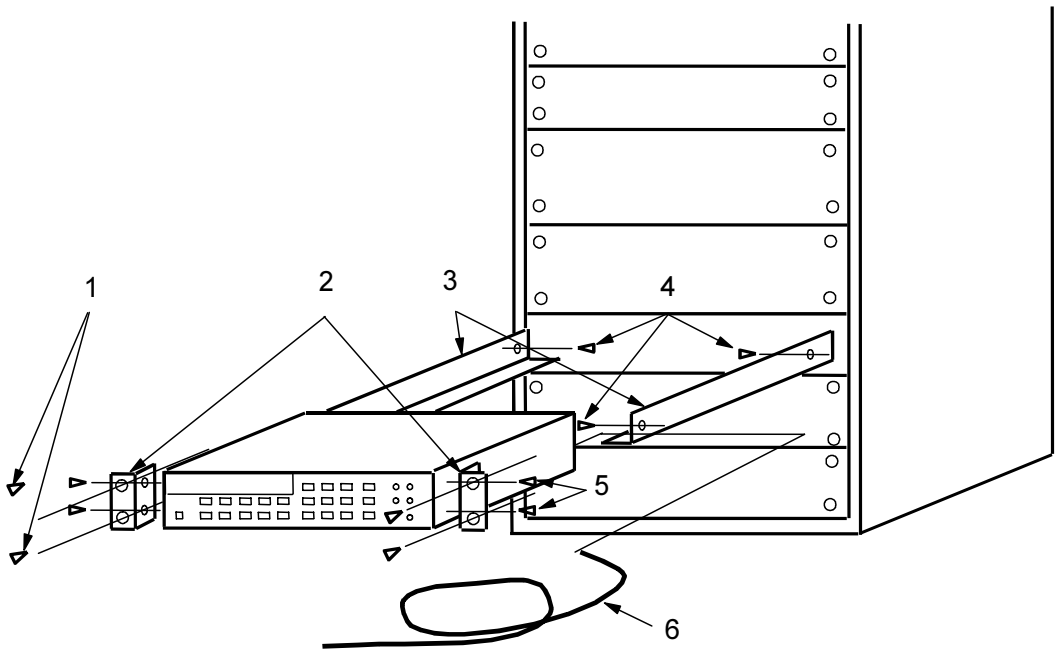
Agilent E3152A Replaceable Parts

Table 5-28 lists the replaceable parts for the E3152A rack mount kit for the 3458A multimeter. Figure 5-26 shows an exploded view of the E3152A.

Table 5-28 Agilent E3152A Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	2680-0278	4	Screw 10-32
2	E3160-01216	2	Flange
3	E3160-01261	2	Support rail
4	2680-0278	4	Screw 10-32
5	0515-1718	4	Screw M4x12
6	E3120-61683	1	Test leads (BNC-banana-plug cable)
–	8120-1625	1	Power cord, universal
–	8120-3445	1	GPIB cable, 1 m

Figure 5-26 Agilent E3152A Replaceable Parts



Agilent E3153A Rack Mount Kit

Table 5-29 lists the replaceable parts for the E3153A rack mount kit for the Agilent 8110A, Agilent 81110A, and Agilent 8114A pulse generator. Figure 5-27 through figure 5-31 shows an exploded view of the E3153A. For details how to install this kit, refer to the *E3153A Installation Guide*.

Table 5-29 Agilent E3153A Replaceable Parts (1 of 4)

Reference Designation	Agilent Part Number	Quantity	Description
E3153A option 001			Fist PG Integration Kit
–	1250-0595	2	Triaxial to BNC adapter
–	1400-0493C	4	Cable tie
–	1400-2242	1	Zipper tube
–	2680-0278C	5	Screw 10-32
–	8120-3446	1	GPIB cable, 2 m
–	8710-1576	1	Tool for zip lock sealing
–	E3125-61042	3	1-to-2 adapter
–	E3125-61607	7	BNC cable for pulse switch
1	E3150-61021	1	Trigger distributor
2	E3150-61602	2	BNC(m)-to-BNC(m) cable assembly, 115 cm, white
3	E3160-04063	1	Cover[a]
E3153A option 002			Rack Mount Kit for the 8110A
4	04062-61604	1	BNC(m)-to-BNC(m) cable assembly, 115 cm, yellow
5	04062-61608	1	BNC(m)-to-BNC(m) cable assembly, 115 cm, blue
6	0515-1718	4	Screw M4
–	2680-0278	4	Screw 10-32
–	8120-1763	1	Power cord
–	8120-3444	1	GPIB cable, 50 cm
7	E3150-61601	2	PG cable assembly
–	E3150-89101	1	Label
8	E3160-01251	2	Flange
9	E3160-01263	2	Support rail

a. This part is used for the top of 8110A pulse generator.

Table 5-30 Agilent E3153A Replaceable Parts (2 of 4)

Reference Designation	Agilent Part Number	Quantity	Description
E3153A option 003			Rack Mount Kit for the 81110A
4	04062-61604	1	BNC(m)-to-BNC(m) cable assembly, 115 cm, yellow
5	04062-61608	1	BNC(m)-to-BNC(m) cable assembly, 115 cm, blue
6	0515-1718	8	Screw M4
–	2680-0278	4	Screw 10-32
–	8120-1763	1	Power cord
–	8120-3444	1	GPIB cable, 50 cm
7	E3150-61601	2	PG cable assembly
–	E3150-89101	1	Label
10	E3160-01267	2	Support rail
11	E3160-04102	1	Cover[a]
12	E3160-60100	1	Flange, right
13	E3160-60101	1	Flange, left
E3153A option 004			Rack Mount Kit for the 8114A
4	04062-61604	1	BNC(m)-to-BNC(m) cable assembly, 115 cm, yellow
5	04062-61608	1	BNC(m)-to-BNC(m) cable assembly, 115 cm, blue
14	04192-61002	1	Feed through, 50 Ω
–	2680-0278	6	Screw 10-32
15	5062-3977	1	Rackmount kit
–	8120-1763	1	Power cord
–	8120-3445	1	GPIB cable, 1 m
16	E3150-61022	1	Transition time converter
7	E3150-61601	2	PG cable assembly
17	E3150-61603	1	BNC cable for transition time converter, 50 cm
–	E3150-89101	1	Label
9	E3160-01263	2	Support rail

a. This part is used for each 81110A installed in the system cabinet. For the top of the 81110A, use the E3160-04065 which is included in the E3153A option 100 or option 101.

Table 5-31 Agilent E3153A Replaceable Parts (3 of 4)

Reference Designation	Agilent Part Number	Quantity	Description
E3153A option 100			Upgrade Kit for the 81110A Rack Mount Kit
–	0515-1012	4	Screw M4 L8
–	0535-0081	8	Nut M5×0.8
–	0590-0804	14	Nut 10-32
–	2680-0278C	41	Screw 10-32
18	E3160-00150	1	Chassis for mounting shelter plate, right
19	E3160-00151	1	Chassis for mounting shelter plate, left
20	E3160-00208	1	Front panel for TH PS
21	E3160-00257	1	Front panel
–	E3160-00258	1	Blank Panel[a]
22	E3160-00606	1	Shelter plate
23	E3160-00607	2	Cover for the DVM airflow
24	E3160-00608	1	Angle for mounting shelter plate, right
25	E3160-00609	1	Angle for mounting shelter plate, left
26	E3160-00610	1	Rear plate for TH PS
–	E3160-00611	1	Rear plate for system controller[b]
–	E3160-00612	1	Rear plate for CMU[b]
–	E3160-00613	1	Rear plate for DVM[b]
27	E3160-01219	2	Flange
28	E3160-01265	1	Hinge, right
29	E3160-01266	1	Hinge, left
30	E3160-04065	1	Cover for the top of the 81110A
31	E3160-04066	1	Blank Panel
32	E3160-04101	1	Fan cover for the system controller[c]

a. This part is used at the top position installed pulse generator in the system cabinet. For details, see.figure 5-2 on page 237.
b. These parts are used when each instrument is not installed in the system cabinet.
c. This is for 745/132L. When the 745i is installed, this part is not required.

Table 5-32 Agilent E3153A Replaceable Parts (4 of 4)

Reference Designation	Agilent Part Number	Quantity	Description
E3153A option 101			Upgrade Kit for the 81110A with the C3600
–	0515-1012	4	Screw M4 L8
–	0535-0081	8	Nut M5×0.8
–	0590-0804	14	Nut 10-32
–	2680-0278C	36	Screw 10-32
–	2680-0320	4	Screw 10-32×.75
33	E3160-00152	1	Chassis for mounting shelter plate, right
34	E3160-00153	1	Chassis for mounting shelter plate, left
35	E3160-04068	1	Front panel
–	E3160-00258	1	Blank Panel[a]
36	E3160-00620	1	Shelter plate
37	E3160-00607	2	Cover for the DVM airflow
38	E3160-00618	1	Angle for mounting shelter plate, right
39	E3160-00619	1	Angle for mounting shelter plate, left
–	E3160-00621	1	Rear plate for C3600 controller[b]
–	E3160-00622	1	Rear plate for CMU[b]
–	E3160-00613	1	Rear plate for DVM[b]
20	E3160-00208	1	Front panel for TH PS
26	E3160-00610	1	Rear plate for TH PS
28	E3160-01265	1	Hinge, right
29	E3160-01266	1	Hinge, left
30	E3160-04065	1	Cover for the top of the 81110A

a. This part is used at the top position installed pulse generator in the system cabinet. For details, see figure 5-2 on page 237.
b. These parts are used when each instrument is not installed in the system cabinet.

Figure 5-27 Agilent E3153A Replaceable Parts (1 of 5)

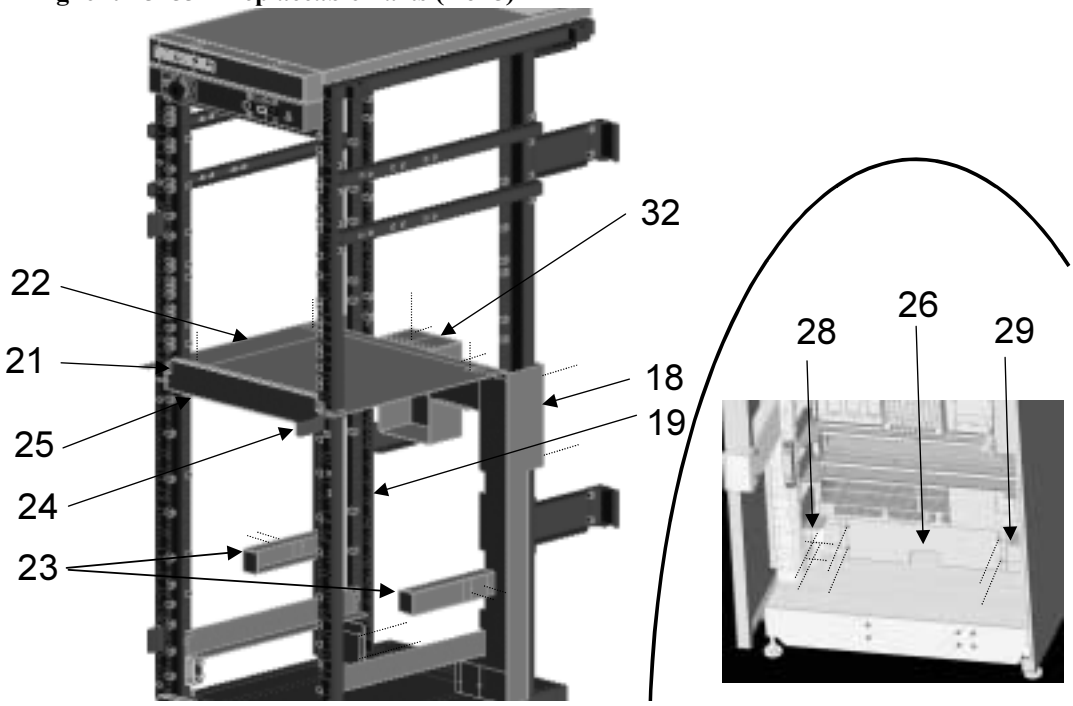


Figure 5-28 Agilent E3153A Replaceable Parts (2 of 5)

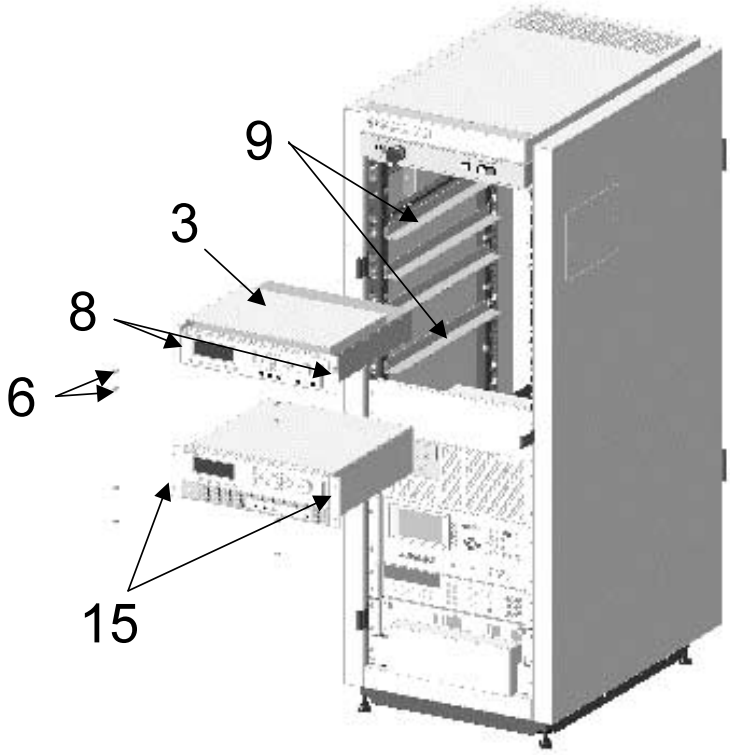


Figure 5-29 Agilent E3153A Replaceable Parts (3 of 5)

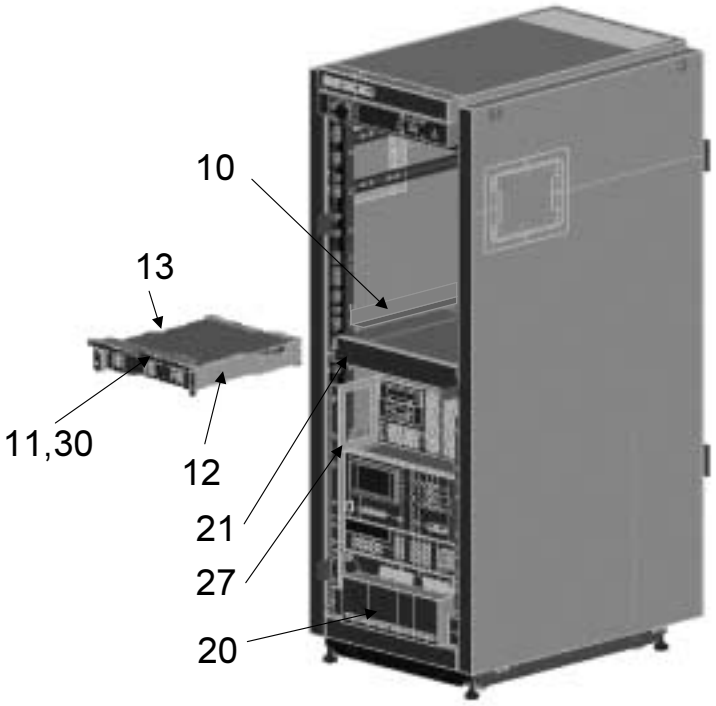
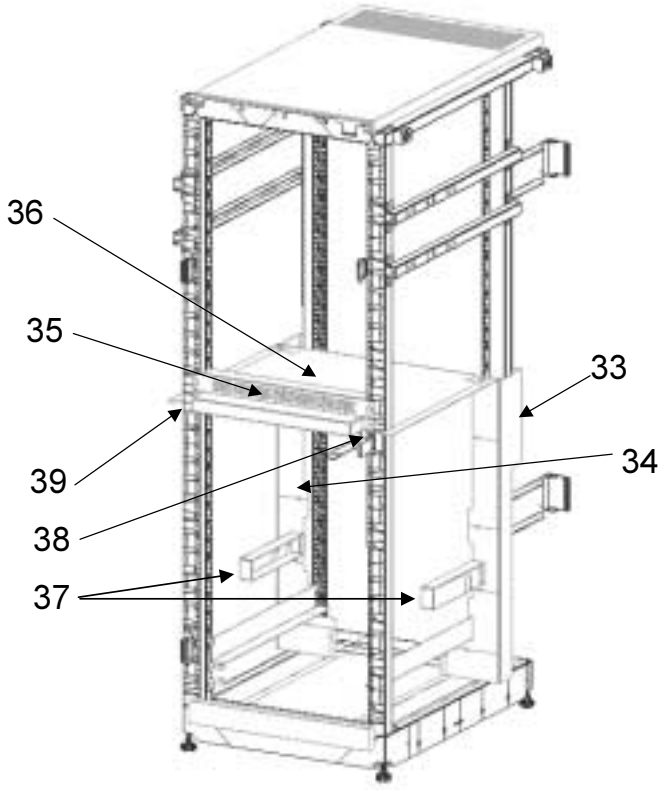


Figure 5-30 Agilent E3153A Replaceable Parts (4 of 5)

Figure 5-31 Agilent E3153A Replaceable Parts (5 of 5)



Agilent E3155A Replaceable Parts

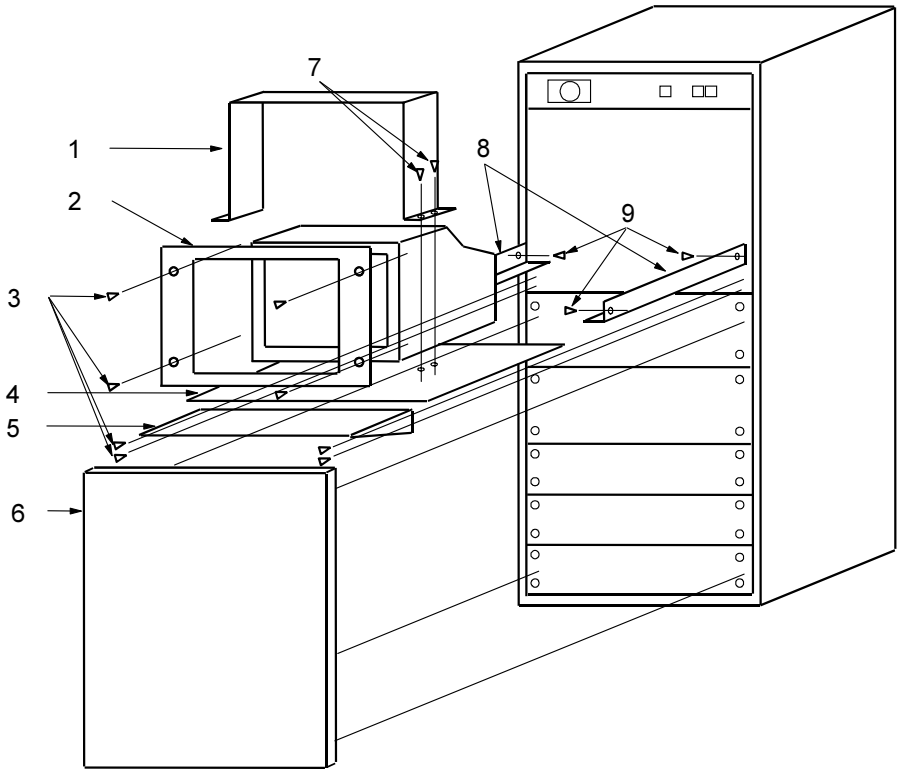
Table 5-33 lists the replaceable parts for the E3155A rack mount kit for the HP A2287A 17-inch monitor. Figure 5-32 shows an exploded view of the E3155A.

Table 5-33 Agilent E3155A Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	E3160-04061	1	Cover
2	E3160-00261	1	Front panel
3	2680-0278C	8	Screw 10-32[a]
4	E3160-00161	1	Support shelf
5	E3160-00166	1	Keyboard shelf
6	E3160-65035	1	Front door, small
7	2680-0278C	4	Screw 10-32
8	E3160-01258	1	Support rail extension adapter[b]
9	2680-0278C	4	Screw 10-32
–	8120-1625	1	Power cord, universal

a. These are furnished with the system cabinet.
b. This part is used for the 4071A (JP10D-).

Figure 5-32 Agilent E3155A Replaceable Parts



Agilent E3155B Replaceable Parts

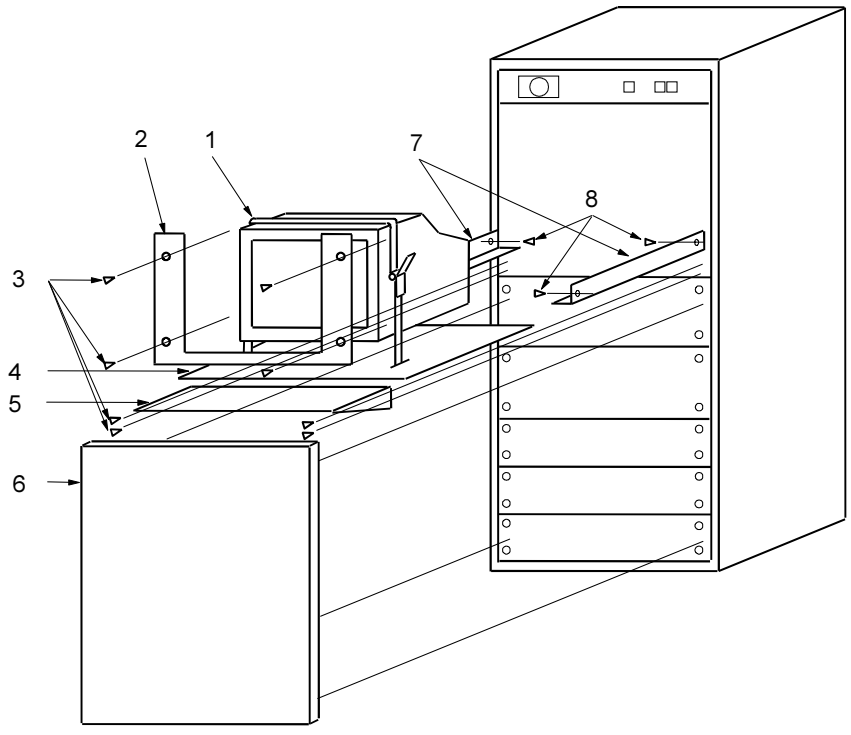
Table 5-34 lists the replaceable parts for the E3155B rack mount kit for the HP A4330A 17-inch monitor. Figure 5-33 shows an exploded view of the E3155B.

Table 5-34 Agilent E3155B Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	9223-0678	1	Belt
2	E3160-00263	1	Front panel
3	2680-0278C	8	Screw 10-32[a]
4	E3160-00165	1	Support shelf
5	E3160-00166	1	Keyboard shelf
6	E3160-65035	1	Front door, small
–	E3160-01258	2	Support rail extension adapter[b]
7	E3160-01261	2	Support rail
8	2680-0278C	4	Screw 10-32
–	8120-1625	1	Power cord, universal
–	E3155-90002	1	Installation Guide

a. These are furnished with the system cabinet.
b. This part is used for the 4071A (JP10D-).

Figure 5-33 Agilent E3155B Replaceable Parts



Agilent E3155C Replaceable Parts

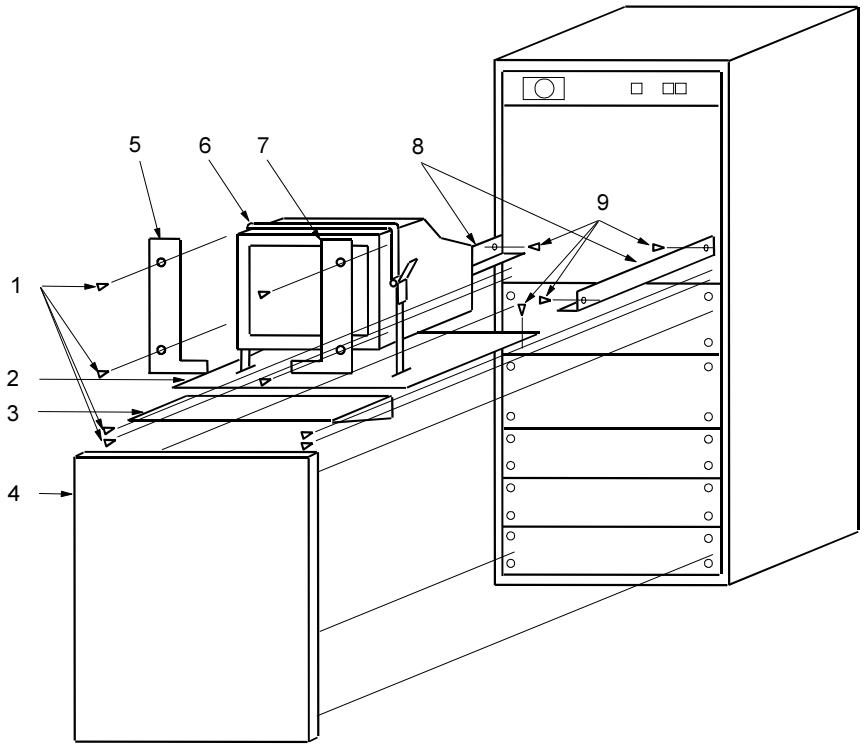
Table 5-35 lists the replaceable parts for the E3155C rack mount kit for the HP A4490A 17-inch monitor. Figure 5-34 shows an exploded view of the E3155C.

Table 5-35 Agilent E3155C Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	2680-0278C	8	Screw 10-32[a]
2	E3160-00170	1	Support shelf
3	E3160-00166	1	Keyboard shelf
4	E3160-65035	1	Front door, small
5	E3160-00265	1	Front panel, left side
6	9223-0678	1	Belt
7	E3160-00264	1	Front panel, right side
8	E3160-01218	2	Support rail
9	2680-0278C	6	Screw 10-32
–	8120-1625	1	Power cord, universal
–	E3155-90012	1	Installation Guide

a. These are furnished with the system cabinet.

Figure 5-34 Agilent E3155C Replaceable Parts



Agilent E3155D Replaceable Parts

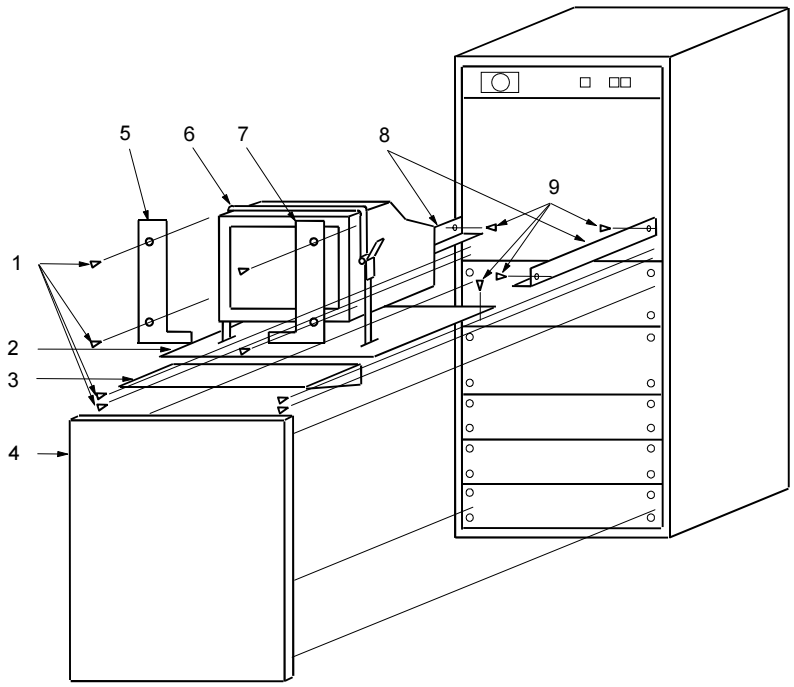
Table 5-36 lists the replaceable parts for the E3155D rack mount kit for the HP D2838W 17-inch monitor. Figure 5-35 shows an exploded view of the E3155D.

Table 5-36 Agilent E3155D Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	2680-0278C	8	Screw 10-32[a]
2	E3160-00174	1	Support shelf
3	E3160-00177	1	Keyboard shelf
4	E3160-65035	1	Front door, small size
5	E3160-00269	1	Front panel, left side
6	9223-0678	1	Belt
7	E3160-00268	1	Front panel, right side
–	E3160-01258	2	Support rail extension adapter[b]
8	E3160-01261	2	Support rail
9	2680-0278C	8	Screw 10-32
–	8120-1625	1	Power cord, universal
–	E3155-90022	1	Installation Guide

a. These are furnished with the system cabinet.
b. This part is used for the 4071A (JP10D-).

Figure 5-35 Agilent E3155D Replaceable Parts



Agilent E3155E Replaceable Parts

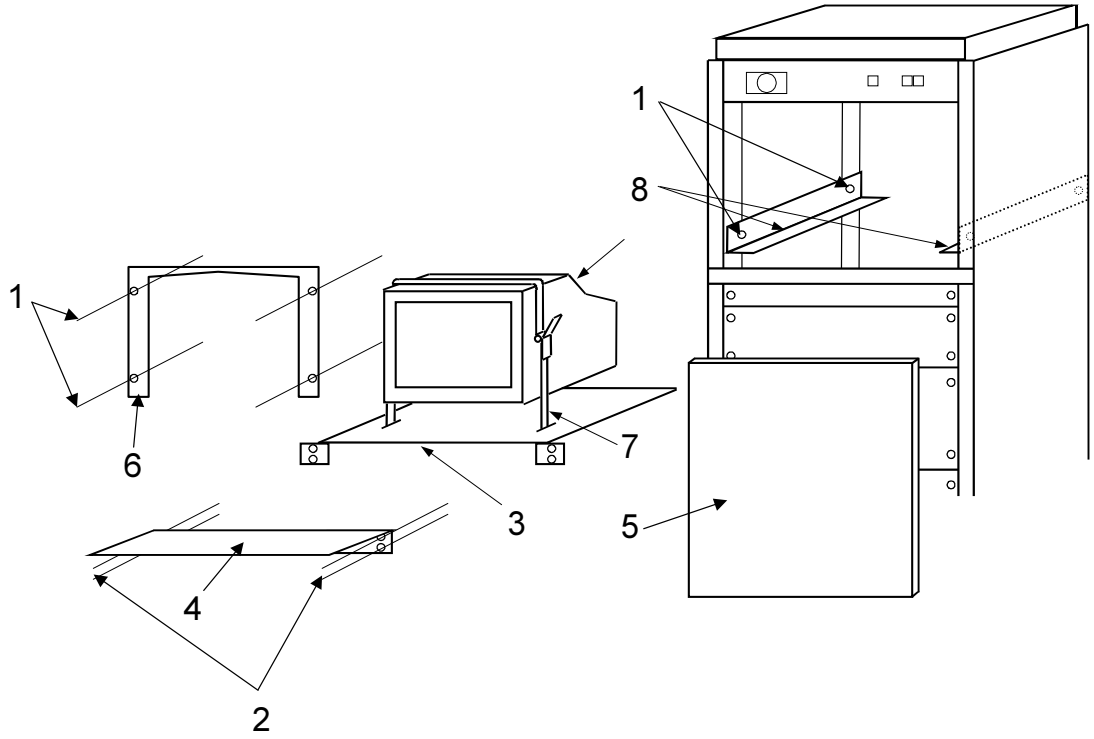
Table 5-37 lists the replaceable parts for the E3155E rack mount kit for the HP D8900A 17-inch monitor. Figure 5-36 shows an exploded view of the E3155E.

Table 5-37 Agilent E3155E Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	2680-0278C	8	Screw 10-32×.5[a]
2	2680-0320	4	Screw 10-32×.75
3	E3160-00185	1	Support shelf
4	E3160-00179	1	Keyboard shelf
5	E3160-65035	1	Front door, small
6	E3160-00275	1	Front panel
7	9223-0678	1	Belt
8	E3160-01264	2	Support rail
–	8120-1625	1	Power cord, universal
–	E3155-90030	1	Installation Guide

a. These are furnished with the system cabinet.

Figure 5-36 Agilent E3155E Replaceable Parts



Agilent E3155F Replaceable Parts

Table 5-38 lists the replaceable parts for the E3155F flat panel display rack mount kit. For more detailed information, please refer to the *Agilent E3155F Installation Guide*.

Table 5-38 Agilent E3155F Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
–	0515-2079	8	Screw M4×8
–	1400-0249	5	Cable tie
–	2680-0607	4	Screw, bolt 10-32
–	3050-0226	4	Washer
–	3050-0893	8	Washer flat M4
–	3050-1013	8	Washer[a]
–	E3120-61687	1	Monitor extension cable (3m)
–	E3155-90042	1	Installation Guide
–	E3160-61691	2	USB extension cable
–	E3160-65021	1	Side panel (large)
–	E3160-65022	1	Side panel (small)
–	E3160-65023	1	Long arm with four bolts
–	E3160-65024	1	Short arm
–	E3160-65025	2	Fixing set
–	E3160-65026	1	FPD attachment set
–	E3160-65027	1	Keyboard tray assembly
–	E3160-65028	1	Cover

a. These parts are used when the flat panel display leans.

Agilent E3155G Replaceable Parts

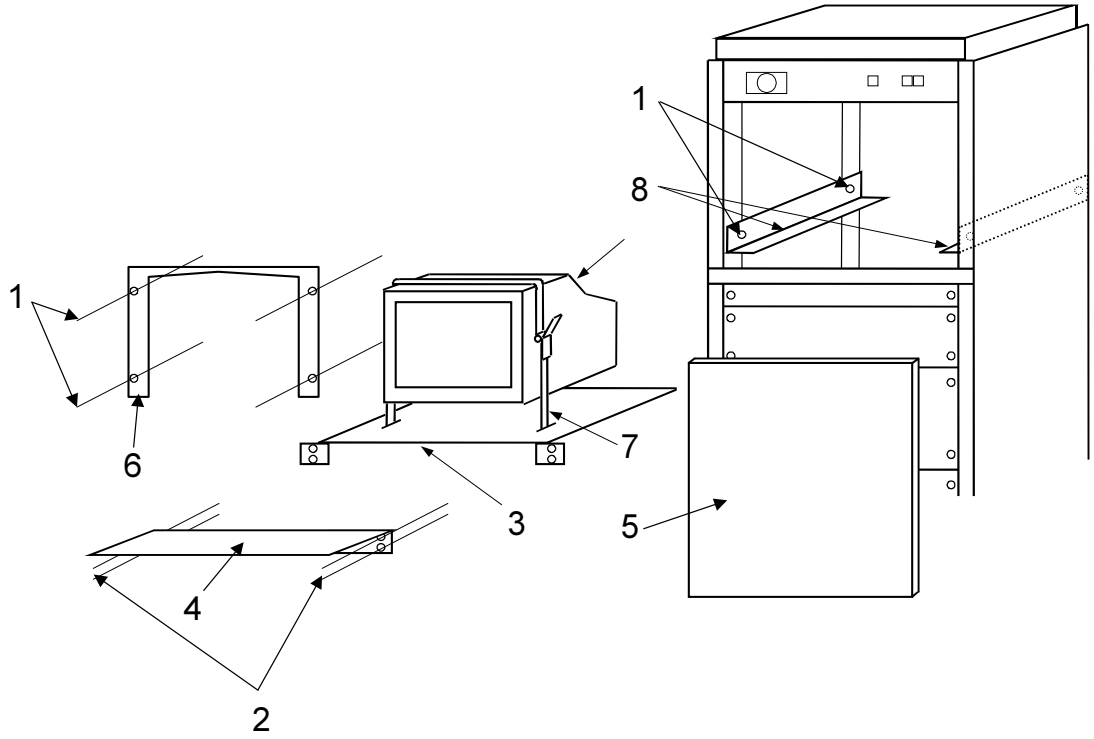
Table 5-39 lists the replaceable parts for the E3155G rack mount kit for the HP D8906A 17-inch monitor. Figure 5-37 shows an exploded view of the E3155G.

Table 5-39 Agilent E3155G Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	2680-0278C	8	Screw 10-32×.5[a]
2	2680-0320	4	Screw 10-32×.75
3	E3160-00195	1	Support shelf
4	E3160-00179	1	Keyboard shelf
5	E3160-65035	1	Front door, small
6	E3160-00295	1	Front panel
7	9223-0678	1	Belt
8	E3160-01264	2	Support rail
–	8120-1625	1	Power cord, universal
–	E3155-90030	1	Installation Guide

a. These are furnished with the system cabinet.

Figure 5-37 Agilent E3155G Replaceable Parts



Agilent E3156A Replaceable Parts

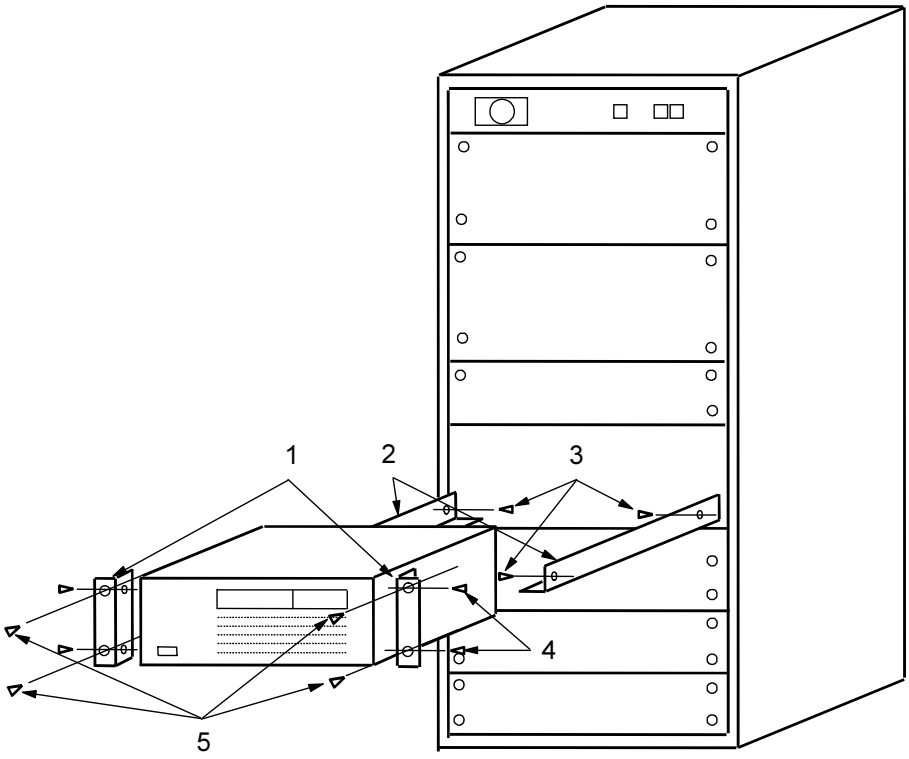
Table 5-40 lists the replaceable parts for the E3156A rack mount kit for the 745i controller. Figure 5-38 shows an exploded view of the E3156A.

Table 5-40 Agilent E3156A Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	E3160-01215	2	Flange
2	E3160-01261	2	Support rail
–	E3160-01258	2	Support rail extension adapter[a]
3	2680-0278	4	Screw 10-32
4	0515-1718	4	Screw M4×12
5	2680-0278C	8	Screw 10-32[b]
–	HP 46081A	1	ITF buffer/speaker module
–	8120-1625	1	Power cord, universal
–	E3120-61677	1	Monitor extension cable

a. This part is used for the 4071A (JP10D-).
b. These are furnished with the system cabinet.

Figure 5-38 Agilent E3156A Replaceable Parts



Agilent E3156B Replaceable Parts

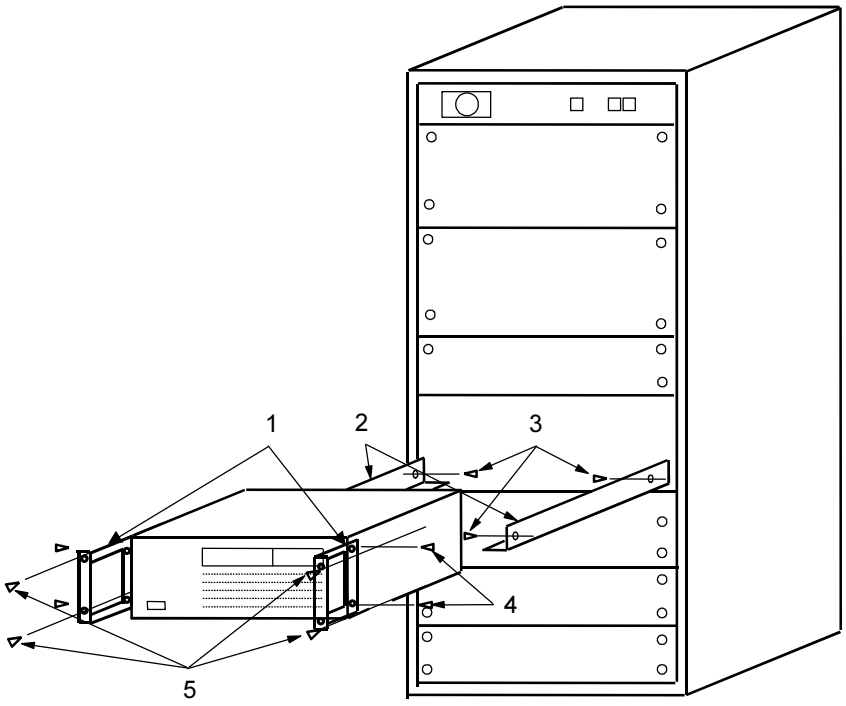
Table 5-41 lists the replaceable parts for the E3156B rack mount kit for the 745/132L controller. Figure 5-39 shows an exploded view of the E3156B.

Table 5-41 Agilent E3156B Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
–	E3160-01215	2	Flange[a]
1	E3160-01219	2	Flange
2	E3160-01262	2	Support rail
–	E3160-01258	2	Support rail extension adapter[b]
3	2680-0278	4	Screw 10-32
4	0515-1718	4	Screw M4×12
5	2680-0278C	4	Screw 10-32[c]
–	8120-1625	1	Power cord, universal
–	E3120-61677	1	Monitor extension cable
–	E3120-61685	1	4-meter RS12-PS12 cable

a. This part is used for the 4071A and 4072A (JP10G-).
b. This part is used for the 4071A (JP10D-).
c. These are furnished with the system cabinet.

Figure 5-39 Agilent E3156B Replaceable Parts



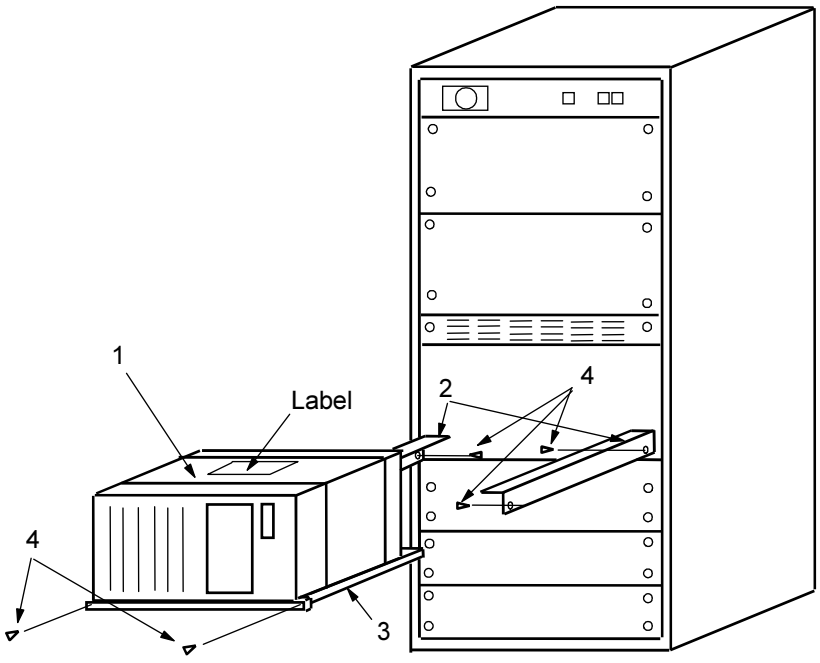
Agilent E3156C Replaceable Parts

Table 5-42 lists the replaceable parts for the E3156C rack mount kit for the C3600 controller. Figure 5-40 shows an exploded view of the E3156C.

Table 5-42 Agilent E3156C Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	E3160-04099	1	Cover
2	E3160-01269	2	Rail
3	E3160-60103	1	Frame
–	0515-0914	6	Screw M3×0.5
–	2510-0120	2	Screw 8-32
4	2680-0278	6	Screw 10-32
–	8120-1625	1	Power cord, universal
–	8120-4753	1	Power cord (Inside Japan)
–	E3156-90001	1	Installation Guide

Figure 5-40 Agilent E3156C Replaceable Parts



Agilent E3157A Replaceable Parts for the HP C2944D and HP C2948A

Table 5-43 lists the replaceable parts of the E3157A rack mount kit for the HP C2944D and HP C2948A CD-ROM drives. Figure 5-41 shows an exploded view of the E3157A.

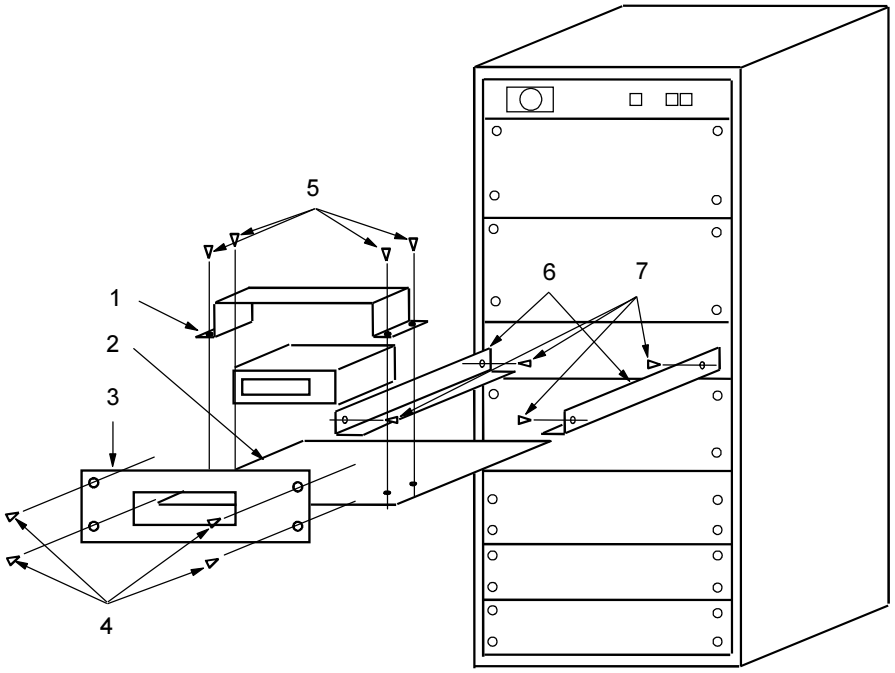
NOTE The CD-ROM drive cannot be mounted into the system cabinet of 4072A (JP10G-) and 4073A (JP10H-).

Table 5-43 Agilent E3157A Replaceable Parts for the HP C2944D and HP C2948A

Reference Designation	Agilent Part Number	Quantity	Description
1	E3160-04062	1	Cover
2	E3160-00164	1	Support shelf
3	E3160-00262	1	Front panel
4	2680-0278C	4	Screw 10-32[a]
5	2680-0278C	4	Screw 10-32
6	E3160-01262	2	Support rail
–	E3160-01258	2	Support rail extension adapter[b]
7	2680-0278C	4	Screw 10-32
–	8120-1625	1	Power cord, universal

a. These are furnished with the system cabinet.
b. This part is used for the 4071A (JP10D-).

Figure 5-41 Agilent E3157A Replaceable Parts for the HP C2944D and HP C2948A



Agilent E3157A Replaceable Parts for the HP C4310A

Table 5-44 lists the replaceable parts of the E3157A rack mount kit for the HP C4310A CD-ROM drive. Figure 5-42 shows an exploded view of the E3157A.

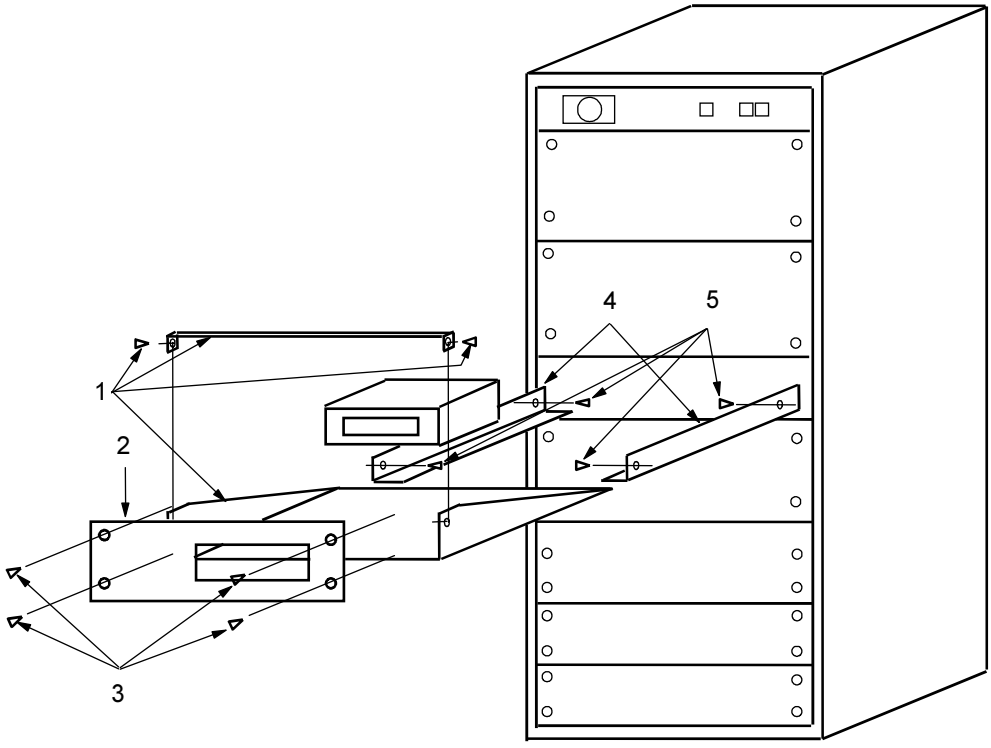
NOTE The CD-ROM drive cannot be mounted into the system cabinet of 4072A (JP20G-) and 4073A (JP10H-).

Table 5-44 Agilent E3157A Replaceable Parts for the HP C4310A

Reference Designation	Agilent Part Number	Quantity	Description
1	E3160-00171	1	Support shelf
2	E3160-00266	1	Front panel
3	2680-0278C	4	Screw 10-32[a]
4	E3160-01262	2	Support rail
–	E3160-01258	2	Support rail extension adapter[b]
5	2680-0278C	4	Screw 10-32
–	8120-1625	1	Power cord, universal

a. These are furnished with the system cabinet.
b. This part is used for the 4071A (JP10D-).

Figure 5-42 Agilent E3157A Replaceable Parts for the HP C4310A



Agilent E3157B Replaceable Parts

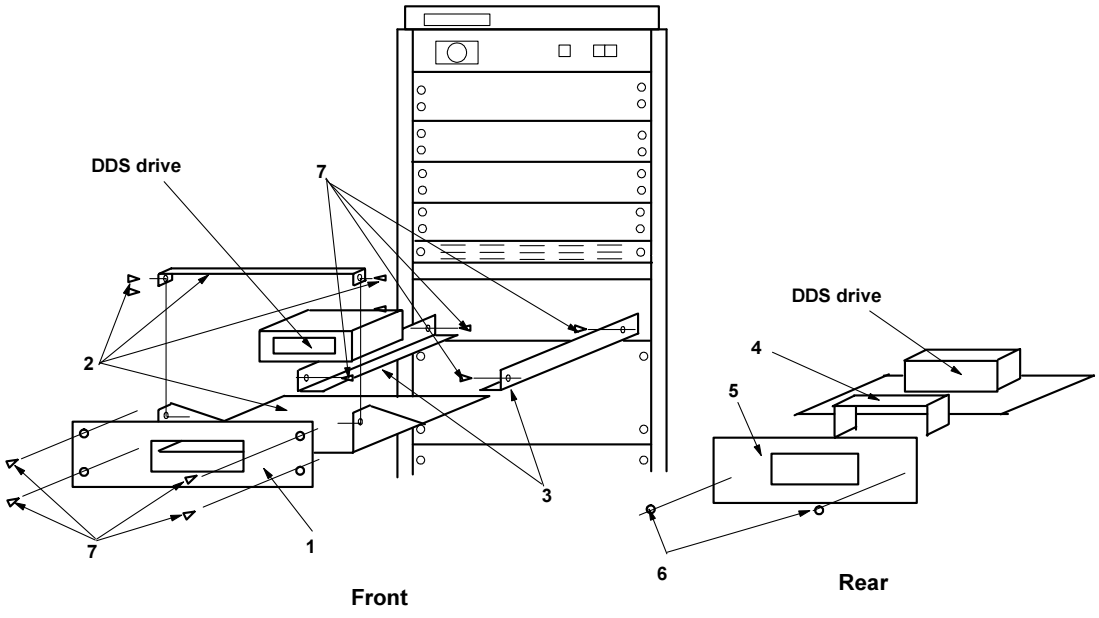
Table 5-45 lists the replaceable parts for the E3157B rack mount kit for the HP C3664A and C6364A DDS drive. Figure 5-43 shows an exploded view of the E3157B.

Table 5-45 Agilent E3157B Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	E3160-00286	1	Front panel
2	E3160-00190	1	Support shelf
3	E3160-01263	2	Rail
4	E3160-00193	1	Chassis[a]
5	E3160-00623	1	Rear panel[a]
6	0535-0081	2	Nut hex M5×0.8[a]
7	2680-0278C	8	Screw 10-32
–	0590-0804	12	Sheet nut[b]
–	E3160-01288	1	Bracket, left[a]
–	E3160-01289	1	Bracket, right[a]
–	E3160-01298	1	Flange[c]
–	E3160-01299	1	Flange[c]
–	E3160-09003	1	Bracket[c]

a. These parts are not used when installing to a system cabinet having a serial number prefix JP10G.
b. Four sheet nuts are used for attaching the shelter plate (E3160-00620).
c. These parts are used for the 8114A pulse generator.

Figure 5-43 Agilent E3157B Replaceable Parts



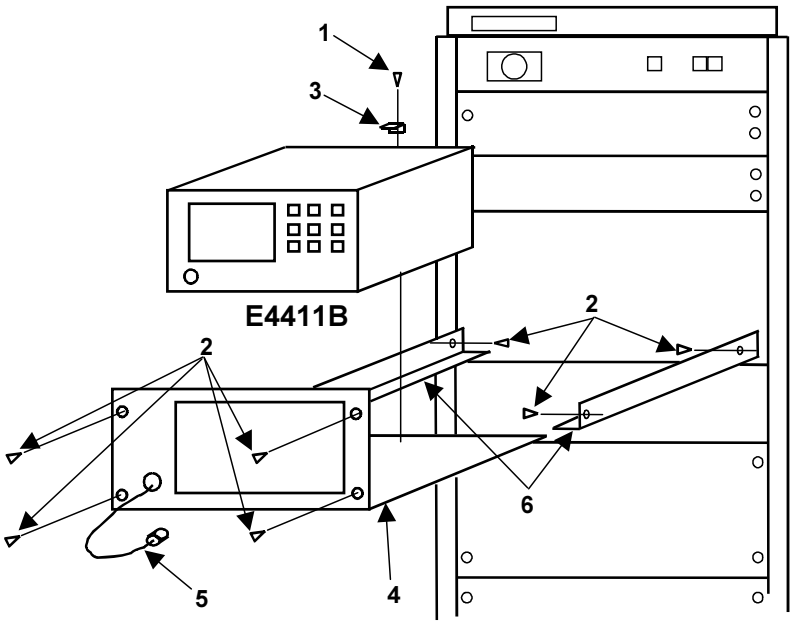
Agilent E3102A/E3103A Option SP1 Replaceable Parts

Table 5-46 lists the replaceable parts for the E3102A/E3103A option SP1 ring oscilator evaluation kit. Figure 5-44 shows an exploded view of the E3102A/E3103A option SP1.

Table 5-46 Agilent E3102A/E3103A Option SP1 Replaceable Parts

Reference Designation	Agilent Part Number	Quantity	Description
1	0515-2079	1	Screw M4×8
–	0590-0804	10	Sheet nut
2	2680-0278C	10	Screw 10-32
–	8120-1625	1	Power cord, universal
3	E3150-06001	1	Stopper
4	E3150-20001	1	Support shelf
5	E3150-61601	1	BNC cable, 4.6 m
6	E3160-01263	2	Support rail

Figure 5-44 Agilent E3102A/E3103A Option SP1 Replaceable Parts



A Error Messages

1-xxxxx

- **1-10001 System software inconsistency discovered.**
  1-10002 System software inconsistency discovered in session login mechanism.
  1-10003 System software inconsistency discovered in session logout mechanism.

  Unknown error occurred during the 4070 system software execution, or login/logout session. Cannot continue the session. Execute hp4070 -logout, then execute hp4070 -login again.

- **1-10004 Cannot allocate memory.**

  Could not allocate enough memory. Execute hp4070 -logout, then execute hp4070 -login again.

- **1-10006 Cannot set socket buffer size.**
  1-10007 Failed to call socket().
  1-10008 Failed to call bind().
  1-10009 Failed to call listen().
  1-10010 Failed to call symlink().
  1-10011 Failed to call accept().
  1-10012 Failed to call connect().
  1-10013 Failed to call shmget().
  1-10014 Failed to call shmat().

  Unknown error occurred in the 4070 system software. Execute hp4070 -logout, then execute hp4070 -login again. Or reboot HP-UX.

- **1-10015 Cannot open hardware configuration file(in /etc/opt/hp4070/config/).**
  1-10016 Cannot fstat() hardware configuration file(in /etc/opt/hp4070/config/).
  1-10017 Cannot mmap() hardware configuration file(in /etc/opt/hp4070/config/).
  1-10018 Cannot read() hardware configuration file(in /etc/opt/hp4070/config/).
  1-10019 Cannot unmmap() hardware configuration file(in /etc/opt/hp4070/config/).

  Could not open the configuration file (`/etc/opt/hp4070/config/1`). Check the configuration file. If problem is not found in the data, permission and so on, re-install the 4070 system software.

- **1-10020 Cannot allocate event handler table.**

  Too many test programs are running. Or too many events are registered by the `Wait_event` command. Stop unnecessary test programs.

- **1-10021 Cannot read Optical Interface Special Data Register 0.**
  1-10022 Cannot ioctl() Optical Interface Card.
  1-10023 Cannot ioctl() Optical Interface Card.
  1-10024 Cannot ioctl() Optical Interface Card.
  1-10025 Cannot read Optical Interface Special Data Register N.
  1-10029 Cannot ioctl() Optical Interface Card N.

  Error occurred when accessing the optical interface card. Execute hp4070 -logout, then execute hp4070 -login again. Or the optical interface card may be defective.

- **1-10026 Power Fail occurred. TIS Daemon process is going to die.**

  Testhead was turned off. Turn the testhead on. And execute hp4070 -login.

- **1-10027 Another online TIS Daemon is running.**

  Another online TIS daemon is already running. Only one online TIS daemon can be running.

- **1-10028 Cannot open optical interface device file.**

  Could not open the optical interface device file. Check the following device files. If problem is not found in the data, permission and so on, execute the configure command after removing the `/dev/hp4070` directory. The permission of the file must be `crw-rw-rw-`.

  - ❏ `/dev/hp4070/opt_s`*`N`*
  - ❏ `/dev/hp4070/opt_s`*`N`*`f0`
  - ❏ `/dev/hp4070/opt_s`*`N`*`f1`
  - ❏ `/dev/hp4070/opt_s`*`N`*`f2`
  - ❏ `/dev/hp4070/opt_s`*`N`*`s0`
  - ❏ `/dev/hp4070/opt_s`*`N`*`s1`
  - ❏ `/dev/hp4070/opt_s`*`N`*`s2`

  where, *`N`* is the ISA slot number (1, 2, 3, or 4) where the optical interface card is installed.

- **1-10031 Cannot fork expmon4070 (errno=*`N`*).**

  Could not execute expmon4070. Check /opt/hp4070/lbin/expmon4070. The permission must be `-r-xr-xr-x`. If too many processes are running, kill unnecessary processes.

  where, *`N`* is the error number returned by the HP-UX kernel or system call.

- **1-10032 OptCard selftest(register r/w test) error.**
  1-10033 OptCard selftest(FIFO memory r/w test) error.
  1-10034 OptCard selftest(communication test) error.

  Failed on the self-test of the optical interface card installed in the system controller. Replace the optical interface card.

- **1-10035 Test Head is not in normal mode. Cannot continue TIS Daemon.**

  Unknown problem occurred in the testhead. Turn off the power of the testhead and on again. Then restart the TIS server again.

- **1-20001 Client Table full. Please quit some applications that use TIS library.**

  Too many test programs or test algorithms are running. Stop unnecessary programs or algorithms.

- **1-20003 Error in iclear() on accessing GPIB device.**
  1-20004 Error in itimeout() on accessing GPIB device.
  1-20005 Error in igpibllo() on accessing GPIB device.
  1-20006 Error in iprintf() on accessing GPIB device.
  1-20007 Error in iopen() on accessing GPIB device.
  1-20008 Error in iwrite() on accessing GPIB device.
  1-20009 Error in iread() on accessing GPIB device.
  1-20022 Error in igpibbusstatus().

  Error occurred in accessing GPIB interface. Check the GPIB interface card or the system instruments.

- **1-20010 Error in ioctl() on accessing optical interface.**
  1-20011 Error in write() on accessing optical interface.
  1-20012 Error in read() on accessing optical interface.
  1-20014 Error in select() on accessing optical interface (errno=*N*).
  1-20015 Error in select() on accessing optical interface.

  Error occurred in accessing the optical interface. Check the optical interface card or direction of optical interface cables.

  where, *N* is the error number returned by the HP-UX kernel or system call.

- **1-20013 Optical Interface Timeout.**

  Time out occurred when accessing the testhead. Check the test program. Or turn off the testhead.

- **1-20016 Error in read() on accessing socket.**
  1-20018 Error in close() of socket.
  1-20019 Error in write() on accessing socket.

  Error occurred in accessing the testhead CPU.

- **1-20020 Cannot load C compensation data file.**

  Could not read the capacitance compensation data. Check the data and permission of the `/etc/opt/hp4070/ccdata` file and `/etc/opt/hp4070/ccdata0` file.

- **1-20021 C compensation data is not loaded.**

  TIS command needs the capacitance compensation data. Related to error No. 1-20020. Solve error No. 1-20020.

- **1-20085 CMU GPIB error occurred.**

  GPIB error occurred during communication with the 4284A. Check the GPIB interface card, GPIB cable, and 4284A.

- **1-20086 DVM GPIB error occurred.**

  GPIB error occurred during communication with the 3458A. Check the GPIB interface card, GPIB cable, and 3458A.

- **1-30001 Cannot make connection because no session is logged in now.**

  No session is logged in now. Execute hp4070 -login.

- **1-30002 Cannot make connection because of wrong session id.**

  Wrong session ID was specified. Use correct session ID, or log out of unnecessary session.

- **1-30003 Request was refused because the TIS Daemon is not in the normal state. Current state is *N*.**

  where, *N*(=1 to 6) means the following status.

  - ❏ 1: Testhead power fail occurred.
  - ❏ 2: Testhead emergency (Over Current or Over voltage) occurred.
  - ❏ 3: Test fixture is open.
  - ❏ 4: Interlock is open.
  - ❏ 5: Testhead firmware is abnormal. Replace Testhead CPU board.
  - ❏ 6: Another client program (test algorithm, etc.) is in abort process.

  This error message appears because of the above status. Solve the problem corresponding to the status.

- **1-30004 Optical Interface timeout.**

  Time out occurred during communication with the testhead. Check the optical interface card and the optical fiber cables.

- **1-30005 GPIB timeout.**

  Time out occurred during communication with the system instruments. Check the GPIB interface card, GPIB cable, and the system instruments.

- **1-30006 Hardware Exception occurred and cannot accept any request.**

  Sub-message for error No. 1-30003.

- **1-30007 A client is in aborting sequence.**

  Sub-message for error No. 1-30003.

- **1-30008 SICL error occurred:** *N*.

  Error occurred during communication with the system instruments. Check the GPIB interface card, GPIB cable, and the system instruments.

- **1-30009 Cannot make connection. Only one Debugging Panel may run at a time.**

  Tried to open a second Interactive Debugging Panel in same session. You can open only one debugging panel at a time in same session.

- **1-30010 Cannot make connection. Another Diagnostics is running.**

  Only one Diagnostics program can run at a time. Use the Diagnostics program that is already running. Or stop the program that is already running to newly run the Diagnostics program.

- **1-30011 Cannot make connection. Another Performance Verification is running.**

  Only one performance verification (PV) program can run at a time. Use the program that is already running. Or stop the program that is already running to newly run the PV program.

- **1-30012 Request was refused because Diagnostics or PV is running.**

  Test program using TIS cannot be executed when the Diagnostics program or the performance verification (PV) program is running. Stop the Diagnostics program or the PV program to run the test program using TIS.

- **1-30013 TIS command cannot be executed because the testhead is in power failure.**

  TIS command cannot be executed because a power failure was detected in the testhead. Turn on the power to the testhead again, then restart the TIS server.

- **1-30014 TIS command cannot be executed because over voltage or current is forced to SMUs.**

  The TIS command cannot be executed because over voltage or over current is being forced to the SMUs from external instruments or SMUs.

- **1-30015 TIS command cannot be executed because the fixture is open.**

  The TIS command cannot be executed because the test fixture lid is open. Close the lid of test fixture.

- **1-30016 TIS command cannot be executed because the interlock is open.**

  The TIS command cannot be executed because the interlock circuit is open. Close the interlock circuit.

- **1-30017 TIS command cannot be executed because the testhead cannot work properly.**

  The TIS command cannot be executed because the testhead cannot work properly. There is something wrong with the optical interface communication, or something wrong with the testhead. Contact the nearest Agilent Technologies Sales and Service office if the system cannot be restarted.

- **1-30018 TIS command cannot be executed because the system is running an internal process.**

  The TIS command cannot be executed because the system is running an internal process.

- **1-30019 TIS command cannot be executed because an abnormal condition exists.**

  The TIS command cannot be executed because an abnormal condition in the system. Remove the abnormal condition before executing the TIS command again.

- **1-30021 Detected wrong (*Type1*) pin board(s). Exchange pin(s) marked with "*" for the *Type2* pin board(s).**
  1-30022 Detected wrong (*Type1*) chuck connection pin board. Exchange for the *Type2* chuck connection pin board.
  1-30023 Detected wrong (*Type1*) low current input board(s). Exchange for the *Type2* low current input board(s).
  1-30024 Detected wrong (*Type1*) kelvin input board(s). Exchange for the *Type2* kelvin input board(s).
  1-30025 Detected wrong type of kelvin input board or low current input board(s). Exchange for the correct type of kelvin or low current input board(s).

  ❑ If *Type1* is HR type and *Type2* is standard type: The high-resolution type board is installed in the 4072A. Exchange the high-resolution type board for the standard type board.

  ❑ If *Type1* is standard type and *Type2* is HR type: The standard type board is installed in the 4073A. Exchange the standard type board for the high-resolution type board.

2-xxxxx

- **2-10002 Cannot open file. filename:** *File*

  Could not open the file specified by *File*. Confirm the file name and permission of the file.

- **2-10004 An illegal format data exists. filename:** *File*, **data:** *Data*

  Tried to open file with invalid data format. Change the data format of the data *Data* in the file *File*.

- **2-10008 An improper option is specified. option:** *Option*

  Improper value (*Option*) was specified for the option. Specify the option properly.

- **2-10009 An improper argument is specified. option:** *Option*, **argument:** *Argument*

  Argument value (*Argument*) invalid for the option (*Option*) was specified. Specify the argument properly.

- **2-10014 Cannot execute command. command path:** *Path*

  Could not execute the command path *Path*. Re-install the 4070 system software.

- **2-10019 Cannot get character input.**

  Could not read the character input. Maximum 1024 characters.

- **2-11001 Failed to write the test selection file. Check permission.**

  Un-specifiable error occurred in write operation of the test selection file. Check the permission of the file.

- **2-13002 An error occurred in TIS.**

  Error occurred in TIS. Refer to the additional messages.

- **2-14001 Cannot open Optical Interface Card device file.**

  Could not open the device file for the optical interface card. Check the configuration file (`/etc/opt/hp4070/config/1`) and specify the proper slot number for the optical interface card. Or kill the unnecessary process that opened the optical interface card device file.

- **2-14003 An error occurred in Optical Interface Card Loopback test.**

  Optical interface card failed the loopback test. Check the optical fiber cables or the optical interface card.

- **2-21001 No test is selected. Please select at least one test.**

  No test is selected in the "Test Selection" field. Select at least one test.

- **2-21002 No SMU is selected. Please select at least one SMU.**

  No SMU is selected in the "Test Selection" field. Select at least one SMU.

- **2-21003 No Pin is selected. Please select at least one pin, chuck or input board.**

  No pin is selected in the "Test Selection" field. Select at least one pin, chuck pin, or input board.

- **2-21004 Only a numeric value is allowed here.**

  Invalid character (non-numeric) is entered in the input field for numeric character. Enter a numeric value.

- **2-21005 Only an integer value is allowed here.**

  Invalid character (non-integer) is entered in the input field for integer. Enter an integer value.

- **2-21006 Invalid repeat count. Must be 1 to 999999 (integer).**

  Wrong value is specified for how many times to repeat the test. The value must be 1 to 999999.

- **2-21007 Invalid margin ratio. Must be 0.0 to 1.0 (float).**

  Wrong value is specified for the marginal ratio used to define the marginal test limit. The value must be 0.0 to 1.0.

- **2-21008 Can't read the file. The file does not exist or no read permission.**

  The file could not be read. The file does not exist or does not have read permission. Check if the file exists or check the permission of the file.

- **2-21009 Can't write the file. The file or directory has no write permission, or the directory does not exist.**

  The file could not be written. The file or directory for the file does not have write permission. Or the directory does not exist. Check that the directory exists, and check the permission of the directory and the file.

- **2-21012 Failed to start diagnostics (errno = *N*).**

  HP-UX kernel error No. *N* occurred in starting diagnostics. Check if the `/opt/hp4070/lbin/diagBody4070` program exists and check the permission of the program. If the program does not exist, re-install the 4070 system software. Or check the number of processes in progress, and kill unnecessary process.

- **2-21013 Can't preserve the result data file (errno = *N*). Check permission or maybe diagnostics was not executed yet.**

  HP-UX kernel error No. *N* occurred in preserving the result data file by File: Preserve data... menu on the Diagnostics window. Execute diagnostics once at least. Or check the permission of the file and `/var/opt/hp4070/diag` directory.

- **2-21014 Failed to write the result data (errno = *N*). Check permission.**

  HP-UX kernel error No. *N* occurred in writing the result data. Check the permission of the file and `/var/opt/hp4070/diag` directory.

- **2-21015 Failed to read result data file (errno = *N*). Check permission.**

  HP-UX kernel error No. *N* occurred in reading the result data. Check the permission of the file and `/var/opt/hp4070/diag` directory.

- **2-21016 Failed to write to result data file (errno = *N*). Check permission or free disk space.**

  HP-UX kernel error No. *N* occurred in writing the result data file. Check the permission of the file and `/var/opt/hp4070/diag` directory. Or check the free disk space. File system full may cause this error.

- **2-23001 ADC Board is defective or not installed.**

  The high-resolution ADC board is not installed or may be defective. Install or replace the board.

- **2-23002 GNDU is defective or not installed.**

  The GNDU board is not installed or may be defective. Install or replace the board.

- **2-23003 Chuck Connection Board is defective or not installed.**

  The chuck connection pin board is not installed or may be defective. Install or replace the board.

- **2-23004 LC Input Board (Port *Port_No*.) is defective or not installed.**

  The low current input board is not installed or may be defective. Install or replace the board.

- **2-23005 Kelvin Input Board is defective or not installed.**

  The kelvin input board is not installed or may be defective. Install or replace the board.

- **2-23006 CMU Input Board is defective or not installed.**

  The CMU input board is not installed or may be defective. Install or replace the board.

- **2-23007 Relay Test Board (Block** *Block_No*.**) is defective or not installed.**

  The relay test board is not installed or may be defective. Install or replace the board.

- **2-23011 ADC Board attenuation factor measurement failed. port:** *Port*, **expected:** *Data1*, **measured:** *Data2*

  High-resolution ADC board failed the attenuation factor measurement test. If all ports failed this test, replace the high-resolution ADC board, otherwise follow the diagnostics execution results.

- **2-23012 ADC Board guard amp offset measurement failed. port:** *Port*, **measured:** *Data*

  High-resolution ADC board failed the guard amplifier offset measurement test. Follow the diagnostics execution results. If all ports failed this test, replace the high-resolution ADC board.

- **2-23021 Status error occurred in SMU. port:** *Port*, **status:** *Status*

  Status error occurred in the SMU specified by *Port*. Check the SMU if the 4070 failed the diagnostics.

- **2-23022 Status error occurred in CMU. status:** *Status*

  Status error occurred in the CMU. Check the CMU if the 4070 failed the diagnostics.

- **2-23023 Status error occurred in DVM. status:** *Status*

  Status error occurred in the DVM. Check the DVM if the 4070 failed the diagnostics.

- **2-23031 HF Matrix Board N is defective or not installed.**

  Reference configuration file (`/etc/opt/hp4070/config/refconfig1`) shows the existence of HF matrix board N, but it is not detected by the testhead firmware. HF matrix board may not be installed or may be defective. Install or replace the board.

- **2-23032 HF Matrix Addressing Board is defective or not installed.**

  Reference configuration file (`/etc/opt/hp4070/config/refconfig1`) shows the existence of HF matrix addressing board, but it is not detected by the testhead firmware. HF matrix addressing board is not installed or may be defective. Install or replace the board.

- **2-23033 Pulse Switch N Board is defective or not installed.**

  Reference configuration file (`/etc/opt/hp4070/config/refconfig1`) shows the existence of pulse switch board N, but it is not detected by the testhead firmware. Pulse switch board N is not installed or may be defective. Install or replace the board.

- **2-23041 SMU (port:** *N*) **is defective or not installed.**

  The SMU board is not installed in port *N* or may be defective. Confirm that the SMU configuration. hp4070 -login command displays the 4070 system configuration.

- **2-44343 Low Current Input Board** *N* **inner port test was skipped.**

  The low current input board relay test was skipped because of an SMU error. Repair the SMU connected to the low current input board *N*.

- **2-31001 File already exists. Do you want to replace it?**

  If you want to replace the data, select **OK** button. Or else, select **Cancel** button.

- **2-31002 The test(s) requested on non-existent resources will be ignored.**

  Invalid test item, SMU, or pin number is selected. The selection is ignored.

- **2-33001 Cannot identify Pin Board. pin:** *Pin*

  Actual pin board configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.

- **2-33002 Cannot identify SMU Board. port:** *Port*

  Actual SMU configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.

- **2-33003 Cannot identify CMU.**

  Actual CMU configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.

- **2-33004 Cannot identify DVM.**

  Actual DVM configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.

- **2-33005 Testhead Power Line Cycle is mismatching. reference:** *Ref* **[Hz], actual:** *Act* **[Hz]**

  Actual line frequency did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual frequency.

- **2-33006 Cannot identify HF Matrix.**

  The command attempts to control the HF matrix, even though the reference configuration file (`/etc/opt/hp4070/config/refconfig1`) has the information of no MF matrix installed. Check the following items:

  ❑ If the command that you execute is correct.

  ❑ If the reference configuration file includes the correct system configuration information.

- **2-33007 Cannot identify Pulse Switch.**

  The command attempts to control the pulse switch, even though the reference configuration file (`/etc/opt/hp4070/config/refconfig1`) has the information of no pulse switch installed. Check the following items:

  ❑ If the command that you execute is correct.

  ❑ If the reference configuration file includes the correct system configuration information.

- **2-33008 Cannot identify** *PGn***.**

  The command attempts to control the *PGn*, even though the reference configuration file (`/etc/opt/hp4070/config/refconfig1`) has the information of no *PGn* installed. Check the following items:

  ❑ If the command that you execute is correct.

  ❑ If the reference configuration file includes the correct system configuration information.

- **2-33009** *PGn* **type or GPIB address mismatch.**

  The *PGn* definition in the reference configuration file (`/etc/opt/hp4070/config/refconfig1`) is not correct. Check if the reference configuration file includes the correct system configuration information.

- **2-33011Cannot find pin for connection test. Port:** *Port***.**

  Cannot execute the connection test. At least one pin board must be installed in:

  - ❏ Slot 1 to 24 for the HF ports 1, 2, and 3.
  - ❏ Slot 25 to 48 for the HF ports 4, 5, and 6.
  - ❏ Slot 1 to 48 for the AUX ports 1 to 8.

- **2-41001 Margin detection disabled.**

  Detection mode for the marginal limit was disabled.

- **2-45001 Relay contact check failed.**
  description: *Testcase*
  measured: *Data1***, offset:** *Offset***, Rmeas:** *Data2*
  Rlimit: *Limit*

  Failed in the contact check of the HF Matrix Relay Test. Check the connection of the short adapter. Or do troubleshooting and replace defective part.

- **2-45002 Relay stuck check failed.**
  description: *Testcase*
  board: *board***, relay:** *relay***, measured:** *Data1***, expected:** *Data2*

  Failed in the open check of the HF matrix relay test. Do troubleshooting and replace defective part.

- **2.45101 PG selftest failed.**
  description: *PGn* **Status code:** *Code*
  Message: *PG_Error_Message*

  Failed in the selftest of the PG. Do troubleshooting and replace defective part.

- **2-45201 PG connection test failed.**
  description: *PGn*
  port: *Port***, expected:** *Data1***, measured:** *Data2*

  Failed in the PG connection test. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45202 PG connection test marginally passed.**
  description: *PGn*
  port: *Port***, expected:** *Data1***, measured:***Data2*

  Passed in the PG connection test but the result is nearly test limit. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45301 Pulse switch test failed.**
  description: *PGn*
  port: *Port***, control:** *TH***, expected:** *Data1***, measured:** *Data2*

  Failed in the testhead controlled pulse switch test. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45302 Pulse switch test marginally passed.**
  description: *PGn*
  port: *Port*, **control:** *TH*, **expected:** *Data1*, **measured:** *Data2*

  Passed in the testhead controlled pulse switch test but the result is nearly test limit. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45303 Pulse switch test failed.**
  description: *PGn*
  port: *Port*, **control:** *N*, **switch:** *Switch*, **expected:** *Data1*, **measured:** *Data2*

  Failed in the PG controlled pulse switch test (multiplexer switch). Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45304 Pulse switch test marginally passed.**
  description: *PGn*
  port: *Port*, **control:** *N*, **switch:** *Switch*, **expected:** *Data1*, **measured:** *Data2*

  Passed in the PG controlled pulse switch test (multiplexer switch) but the result is nearly test limit. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45305 Pulse switch test failed.**
  description: *PGn*
  port: *Port*, **control:** *N*, **switch:** *Switch*, **expected:** *Data1*, **measured:** *Data2*

  Failed in the PG controlled pulse switch test (open/close switch). Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45306 Pulse switch test marginally passed.**
  description: *PGn*
  port: *Port*, **control:** *N*, **switch:** *Switch*, **expected:** *Data1*, **measured:** *Data2*

  Passed in the PG controlled pulse switch test (open/close switch) but the result is nearly test limit. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45401 PG output level test failed.**
  description: *PGn*
  port: *Port*, **expected:** *Data1*, **measured:** *Data2*

  Failed in the PG output level test. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45402 PG output level test marginally passed.**
  description: *PGn*
  port: *Port*, **expected:** *Data1*, **measured:** *Data2*

  Passed in the PG output level test but the result is nearly test limit. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45501 PG trigger test failed.**
  description: *PGn*
  port: *Port*, **expected:** *Data1*, **measured:** *Data2*

  Failed in the PG trigger test. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

- **2-45502 PG trigger test marginally passed.**
  description: *PGn*
  port: *Port*, **expected:** *Data1*, **measured:** *Data2*

  Passed in the PG trigger test but the result is nearly test limit. Check the cable connection and connect properly. Or do troubleshooting and replace defective part.

3-xxxxx

- **3-10001 System software inconsistency discovered.**

  Unknown error occurred during the Agilent 4070 system software execution. Cannot continue the session.

- **3-10002 Cannot open file. filename:** *File*

  Could not open the file specified by *File*. Check the file name and permission of the file.

- **3-10004 An illegal format data exists. filename:** *File*, **data:** *Data*

  Tried to open file with invalid data format. Change the data format of the data *Data* in the file *File* or remake dataflow.

- **3-10006 Cannot write data to file. filename:** *Filename*

  Could not write data to *Filename*. Check the permission of file or directory. Or check the free disk space. File system full may cause this error.

- **3-10015 Cannot execute command. command path:** *Path*

  Check the *Path* command. The command may not have execute permission. If problem is not found, re-install Agilent 4070 system software.

- **3-10023 Failed to open Standard Set calibration data directory.**

  Could not open `/etc/opt/hp4070/diag/caldata` directory. Check the data directory. If problem is not found in the directory, permission and so on, re-install the Agilent 4070 system software.

- **3-10024 Cannot rename file. filename:** *Filename*

  Could not rename the file. Check the permission of file or directory. If problem is not found, re-install the Agilent 4070 system software.

- **3-11001 Failed to write the test selection file.**

  Un-specifiable error occurred during write operation of the test selection file. Check the permission of file.

- **3-11002 Failed to open temporary PVheader file.**

  Could not open `/var/opt/hp4070/diag/PVheader` file. Check the free disk space. File system full may cause this error. If problem is not found, re-install the Agilent 4070 system software.

- **3-11003 pvBody4070 process is already running. Something is wrong.**

  The pvBody4070 process has been started. Check the pvBody process.

- **3-11004 Failed to open pipe (errno =** *N***).**

  HP-UX kernel error No. *N* occurred during communication with diagnostics program. Exit from the Agilent 4070 system software environment, then log into it again. Then execute diagnostics program.

- **3-11005 Failed to invoke diagBody4070 program (errno =** *N***).**

  HP-UX kernel error No. *N* occurred when starting diagnostics. Check if the diagBody4070 program exists and check the permission of the program. If the program does not exist, re-install the Agilent 4070 system software. Or check the number of processes in progress, and kill unnecessary process.

- **3-13002 An error occurred in TIS.**

  Error occurred in TIS. Refer to the additional messages.

- **3-16001 Memory exhausted.**

  The measurement data could not be loaded because of small free memory space. Stop unnecessary applications and close windows to increase free memory.

- **3-16010 Failed to open the file. Check permission or diskette.**

  The file was not loaded/saved because error occurred during load/save of file. Check the permission of the file. Or check the diskette.

- **3-16011 Failed to read the file. Check permission or diskette.**

  The file was not loaded because error occurred during load of file. Check the permission of the file. Or check the diskette.

- **3-16012 Failed to write the file. Check permission or diskette.**

  The file was not saved because error occurred during save of file. Check the permission of the file. Or check the diskette.

- **3-16013 Failed to end printing (errno = *N*).**

  Error No. *N* occurred at end of printing. Cannot close the pipe for LP command.

- **3-20001 Failed to read Standard Set calibration data.**

  Could not read the data file in `/etc/opt/hp4070/diag/caldata` directory. Check the permission of the data file and directory.

- **3-20002 Failed to write Standard Set calibration data.**

  Could not write the data file in `/etc/opt/hp4070/diag/caldata` directory. Check the permission of the data file and directory.

- **3-20003 Failed to remove Standard Set calibration data.**

  Could not remove the data file in `/etc/opt/hp4070/diag/caldata` directory. Check the permission of the data file and directory.

- **3-21001 No test is selected. Please select at least one test.**

  No test is selected in the "Test Selection" field. Select at least one test.

- **3-21002 No SMU is selected. Please select at least one SMU.**

  No SMU is selected in the "SMU Selection" field. Select at least one SMU.

- **3-21003 No Pin is selected. Please select at least one pin, chuck or input board.**

  No pin is selected in the "Pin Selection" field. Select at least one pin or chuck pin.

- **3-21004 Failed to open the profile data file.**

  Could not open the profile data file. Check if the file exists and permission of file or directory. If this message is displayed when you open the system default file, check the `/etc/opt/hp4070/diag/PVprofile` file.

- **3-21005 Failed to read the profile data file.**

  Could not read the profile data file. Check if the file exists and permission of file or directory.

- **3-21006 Failed to write to the profile data file.**

  Could not write the profile data file. Check if the file exists and permission of file or directory. If this message is displayed when you write the system default file, check the `/etc/opt/hp4070/diag/PVprofile` file.

- **3-21008 Can't read the file. The file does not exist or no read permission, or the directory does not exist.**

  The file could not be read. The file or directory for the file does not have read permission. Or the directory does not exist. Check that the directory exists, and check the permission of the directory and the file.

- **3-21009 Can't write the file. The file or directory does not have write permission, or the directory does not exist.**

  The file could not be written. The file or directory for the file does not have write permission. Or the directory does not exist. Check that the directory exists, and check the permission of the directory and the file.

- **3-21010 The DMM address for PV is not specified. Specify GPIB address in Configuration Window.**

- **3-21011 Standard C/R set to be used is not specified. Specify their serial numbers in Configuration Window.**

- **3-21012 Specified value for** *Equipment_Name* **exceeds the ±5% range limit against the nominal value. Set the correct value.**

- **3-21013 GPIB address must be integer value. Specify an integer value for DMM address.**

  A non-integer value is specified for GPIB address. Specify an integer value.

- **3-21022 The Oscilloscope address for PV is not specified.**
  Specify GPIB address in Configuration Window.

  No GPIB address for the 54750A or 86100A oscilloscope is specified in the Standard Selection window. Specify the GPIB address of the oscilloscope.

- **3-21023 Specified Oscilloscope GPIB address is an integer.**
  Specify an integer value.

  Specified GPIB address value for the 54750A or 86100A oscilloscope is not integer. Specify a proper integer value for the GPIB address of the oscilloscope.

- **3-23001 ADC Board is defective or not installed.**

  The high-resolution ADC board is not installed or may be defective. Install or replace the board.

- **3-23002 GNDU Board is defective or not installed.**

  The GNDU board is not installed or may be defective. Install or replace the board.

- **3-23003 Chuck Connection Pin Board is defective or not installed.**

  The chuck connection pin board is not installed or may be defective. Install or replace the board.

- **3-23004 LC Input Board (Port** *Port_No.***) is defective or not installed.**

  The low current input board is not installed or may be defective. Install or replace the board.

- **3-23005 Kelvin Input Board is defective or not installed.**

  The Kelvin input board is not installed or may be defective. Install or replace the board.

- **3-23006 CMU Input Board is defective or not installed.**

  The CMU input board is not installed or may be defective. Install or replace the board.

- **3-23007 Relay Test Board (Block** *Block_No.***) is defective or not installed.**

  The relay test board is not installed or may be defective. Install or replace the board.

- **3-23011 ADC Board attenuation factor measurement failed.**
  port: *Port*, **expected:** *Data1*, **measured:** *Data2*

  The high-resolution ADC board failed the attenuation factor measurement test. Follow the performance verification execution results. If all ports failed this test, replace the high-resolution ADC board.

- **3-23012 ADC Board guard amp offset measurement failed.**
  port: *port*, **measured:** *Data*

  The high-resolution ADC board failed the guard amplifier offset measurement test. Follow the diagnostics execution results. If all ports failed this test, replace the high-resolution ADC board.

- **3-23021 Status error occurred in SMU. port:** *port*, **status:** *Data*

  Status error occurred in the SMU specified by *Port*. Check the SMU if the Agilent 4071A/4072A failed the performance verification.

- **3-23022 Status error occurred in CMU. status:** *Status*

  Status error occurred in the CMU. Check the CMU if the Agilent 4071A/4072A failed the performance verification.

- **3-23023 Status error occurred in DVM. status:** *Status*

  Status error occurred in the DVM. Check the DVM if the Agilent 4071A/4072A failed the performance verification.

- **3-23030 Error in iopen() on GPIB device (DMM for PV).**

  An error in iopen() occurred when the PV4070 program tries to communicate the DMM (3458A). Confirm if the specified logical unit of the DMM is correct or if the SICL configuration has the specified logical unit entry.

- **3-23031 DMM for PV is not found.**

  The DMM (3458A) for PV is not responded by the serial polling on the specified logical unit+GPIB address. Check the following items:

  ❑ If the GPIB address setting of the DMM is correct.

  ❑ If another GPIB device other than the DMM is on the specified GPIB address.

  ❑ If the GPIB cable is not broken.

- **3-23032 The DMM address must specify both logical unit and GPIB address.**

  Logical unit or GPIB address of the DMM is not specified in the Standard Selection window. Specify both the logical unit and GPIB address of the DMM.

- **3-23034 Error in iread()/iwrite() on GPIB device (DMM for PV).**

  An error occurred during the HP-UX communication between the computer and the DMM (3458A). Check the following items:

  ❑ If the GPIB cable is not broken.

  ❑ If the GPIB interface of the computer is not broken.

  ❑ If the GPIB interface of the DMM (3458A) is not broken.

- **3-23036 Each test pin must be connected to different connector pin.**

  Multiple test pins are connected to the same connector. Change the pin assignment.

- **3-23051 HF Matrix Board *N* is defective or not installed.**

  Reference configuration file (`/etc/opt/hp4070/config/refconfig1`) shows the existence of HF matrix board *N*, but it is not detected by the testhead firmware. HF matrix board may not be installed or may be defective. Install or replace the board.

- **3-23052 HF Matrix Addressing Board is defective or not installed.**

  Reference configuration file (`/etc/opt/hp4070/config/refconfig1`) shows the existence of HF matrix addressing board, but it is not detected by the testhead firmware. HF matrix addressing board is not installed or may be defective. Install or replace the board.

- **3-23053 Pulse Switch *N* Board is defective or not installed.**

  Reference configuration file (`/etc/opt/hp4070/config/refconfig1`) shows the existence of pulse switch board N, but it is not detected by the testhead firmware. Pulse switch board N is not installed or may be defective. Install or replace the board.

- **3-23054 Error in iopen() on GPIB device (Oscilloscope for PV).**

  An error in iopen() occurred when the PV4070 program tried to communicate the 54750A or 86100A oscilloscope. Confirm if the specified logical unit of the 54750A or 86100A is correct or if the SICL configuration has the specified logical unit entry.

- **3-23055 Oscilloscope for PV is not found.**

  The oscilloscope (54750A or 86100A) for PV is not responded by the serial polling on the specified logical unit+GPIB address. Check the following items:

  ❑ If the GPIB address setting of the oscilloscope is correct.

  ❑ If another GPIB device other than the oscilloscope is on the specified GPIB address.

  ❑ If the GPIB cable is not broken.

- **3-23056 The Oscilloscope address must specify both logical unit and GPIB address.**

  Logical unit or GPIB address of the oscilloscope is not specified in the Standard Selection window. Specify both the logical unit and GPIB address of the oscilloscope.

- **3-23057 Error in iread()/iwrite() on GPIB device (Oscilloscope for PV).**

  An error occurred during the HP-UX communication between the computer and the oscilloscope (54750A or 86100A). Check the following items:

  ❑ If the GPIB cable is not broken.

  ❑ If the GPIB interface of the computer is not broken.

  ❑ If the GPIB interface of the oscilloscope is not broken.

- **3-23070 Error in itimeout() on GPIB device (DMM for PV).**
  3-23071 Error in iclear() on GPIB device (DMM for PV).
  3-23072 Error in itermchr() on GPIB device (DMM for PV).

  An error occurred when the computer tried to initialize the DMM (3458A). Check the following items:

  ❑ If the GPIB cable is not broken.

  ❑ If the GPIB interface of the computer is not broken.

  ❑ If the GPIB interface of the DMM is not broken.

  ❑ If the DMM is working correctly.

- **3-23080 Error in itimeout() on GPIB device (Oscilloscope for PV).**
  3-23081 Error in iclear() on GPIB device (Oscilloscope for PV).
  3-23082 Error in itermchr() on GPIB device (Oscilloscope for PV).

  An error occurred when the computer tried to initialize the oscilloscope (54750A or 86100A). Check the following items:

  ❏ If the GPIB cable is not broken.

  ❏ If the GPIB interface of the computer is not broken.

  ❏ If the oscilloscope is working correctly.

  ❏ If the GPIB interface of the oscilloscope is not broken.

- **3-24302 Cannot find available SMU. Please check using DIAG4070.**

  Could not find available SMU for calibrating the relay test board. Check the testhead configuration by using DIAG4070.

- **3-24303 Failed to calibrate a relay test board. Please check using DIAG4070.**

  Could not calibrate a relay test board and could not check of measurement pin position is correct. Check the relay test board by using DIAG4070.

- **3-24501 Each test pin must be connected to different connector pin.**

  Multiple test pins are connected to the same connector. Change the pin assignment.

- **3-24801 Cannot specify chuck connection pin for test pin.**

  Chuck connection pin was specified to be CMU bias test pin. Set CMU bias test pin to other pin.

- **3-24901 One of 1/2/3/4/48 pin should be available for SMU Output Resistance Test.**

  Check the pin board 1, 2, 3, 4 and 48 by using DIAG4070.

- **3-24902 Pin *N* is defective or not installed. SMU Output Resistance Test needs this pin board.**

  The pin *N* is not installed or may be defective. Check the pin *N* by using DIAG4070.

- **3-24903 The SMU Output Resistance Test requires at least two SMUs.**

  SMU is defective or at least two SMUs are not installed. Check the SMU function and configuration by using DIAG4070.

- **3-24951 Each test pin must be in different block.**

  Pulse level test and pulse parameter test require that at least one pin board is installed in each matrix block of the testhead. One pin board must be installed in the slot numbers 1 to 24, and another pin board must be in the numbers 25 to 48.

- **3-24952 Each test pin must be a multiple of 4.**

  Test pins specified for the pulse parameter test must be multiples of 4. That is, they are 4, 8, 12, 16,..., 48. Check the pin configuration.

- **3-25001 Calibration Bus(block: *N*) does not have enough performance. Please check using DIAG4070**.

  The calibration is discontinued because calibration bus does not have enough performance. Check the calibration bus by using DIAG4070 and calibrate again.

- **3-25002 SMU** *N* **does not have enough performance. Please check using DIAG4070. (***V* **[V]:** *I* **[A],** *V* **[V]:** *I* **[A])**

  The calibration is discontinued because SMU *N* does not have enough performance. Check the SMU *N* by using DIAG4070 and calibrate again.

- **3-25003 Failed to measure Reference Resistor.**
  (measured: *Measured_R* **[ohm], expected:** *Expected_R* **[ohm])**

  3-25004 Failed to measure Reference Resistor.
  (expected: *R1* **[ohm], min:** *R2* **[ohm], max:** *R3* **[ohm])**

  Could not measure the reference resistor. Check the cable connections, DMM for PV, and high-resolution ADC board.

- **3-25011 ADC Reference Volt measurement failed. (measured:** *Measured_V* **[V], expected:** *Expected_V* **[V]).**

  3-25012 ADC B-COM Volt measurement failed.(B-COM: *V* **[V])**

  Check the high-resolution ADC board by using DIAG4070. Or check the cable connections.

- **3-25021 ADC R Ref Calibration must be executed before SMU R Calibration.**

  The R Ref Calibration was not executed before SMU Ref Calibration. Re-calibrate SMU reference by using **Cal SMU**.

- **3-25031 Vtop/Vbase measurement for skew calibration was failed. Check** *PGn-HFm* **connection.**

  Failed to measure Vtop or Vbase value for the skew calibration. Check the cable connections between the *PGn* and *HFm*. If the skew calibration still fails with this error, check the cable connections between the PV pulse fixture and signal input connector of the oscilloscope.

- **3-25032** *PGn* **delay time measurement for skew calibration was failed.**

  Failed to measure delay times for the skew calibration. Check the cable connections between the *PGn* and *HFm*. If the skew calibration still fails with this error, check the cable connections between the PV pulse fixture and signal input connector of the oscilloscope.

- **3-26001 Can't read the file.The file does not exist or no read permission or illegal path name is specified. Check the path name.**
- **3-26002 Can't write the file. The file or directory has no write permission, or an illegal path name is specified. Check the path name.**
- **3-26003 Failed to initiate spooler command. Check the specified command.**
- **3-26004 Failed to print (errno =** *Error***).**

  Could not send the data to spooler command. Check the spooler setting.

- **3-26006 Failed to open diskette directory. Check the following:**
  DOS format diskette is inserted into the disk drive.
  The specified disk drive path name is correct.
  The scsifloppy device driver is present in the HP-UX kernel.
  The DOS-UTIL fileset is installed.
- **3-26010 File format error. Specified field delimiter is not found. Check the file format and delimiter specification.**
- **3-26011 File format error. Specified string quotation mark is not found. Check the file format and quotation specification.**
- **3-26012 File format error. Numerical value is not found in a numeric field.**

- **3-26013 File format error. No valid data.**
- **3-27001 An error occurred in Testhead. status:** *Status*

  Testhead timeout occurred when ADC board was calibrated. Check the ADC board, testhead CPU board and so on.
- **3-31001 File already exists. Do you want to overwrite it?**

  If you want to overwrite the data, select **OK** button. If not, select **Cancel** button.
- **3-31002 The test(s) requested on non-existent resources will be ignored.**

  Invalid test item, SMU, or pin number is selected. The selection is ignored.
- **3-33001 Cannot identify Pin Board. pin:** *Pin*

  Actual pin board configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.
- **3-33002 Cannot identify SMU Board. port:** *Port*

  Actual SMU configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.
- **3-33003 Cannot identify CMU.**

  Actual CMU configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.
- **3-33004 Cannot identify DVM.**

  Actual DVM configuration did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual configuration.
- **3-33005 Testhead Power Line Cycle in config file does not match actual line frequency. reference:** *Ref* **[Hz], actual:** *Act* **[Hz]**

  Actual line frequency did not match the configuration file (`/etc/opt/hp4070/config/refconfig1`). Check the configuration file and define the actual frequency.
- **3-33006 Cannot identify HF Matrix.**

  The command attempts to control the HF matrix, even though the reference configuration file (`/etc/opt/hp4070/config/refconfig1`) has the information of no MF matrix installed. Check the following items:

  ❏ If the command that you execute is correct.

  ❏ If the reference configuration file includes the correct system configuration information.
- **3-33007 Cannot identify Pulse Switch.**

  The command attempts to control the pulse switch, even though the reference configuration file (`/etc/opt/hp4070/config/refconfig1`) has the information of no pulse switch installed. Check the following items:

  ❏ If the command that you execute is correct.

  ❏ If the reference configuration file includes the correct system configuration information.

- **3-33088 Cannot identify** *PGn***.**

  The command attempts to control the *PGn*, even though the reference configuration file (`/etc/opt/hp4070/config/refconfig1`) has the information of no *PGn* installed. Check the following items:

  ❑ If the command that you execute is correct.

  ❑ If the reference configuration file includes the correct system configuration information.

- **3-36001 File already exists. Do you want to overwrite it?**

  If you want to overwrite the data, click **OK** button. If not, click **Cancel** button.

- **3-41001 Is it ok to remove the Standard Set calibration data? Note that this operation is not recoverable.**

  If you want to remove the data, select **OK** button. If not, select **Cancel** button.

- **3-41002 Do you want to discard all unsaved changes? Note that this operation is not recoverable.**

  If you want to discard all unsaved changes, select **OK** button. If not, select **Cancel** button.

- **3-41003 The currently modified data will be lost. Do you want to save them before loading the new Standard Set data?**

  If you want to save the data, select **OK** button. If not, select **Cancel** button.

- **3-45701 Relay contact check failed.**
  description: *Testcase*
  measured: *Data1*, **offset:** *Offset*, **Rmeas:** *Data1*, **Rlimit:** *Limit*

  Failed in the contact check of the HF Matrix Relay Test. Check the connection of the short adapter. Or do troubleshooting and replace defective part.

- **3-45702 Relay stuck check failed.**
  description: *Testcase*
  measured: *Data1*, **offset:** *Offset*, **Rmeas:** *Data1*, **Rlimit:** *Limit*

  Failed in the open check of the HF Matrix Relay Test. Do troubleshooting and replace defective part.

- **3-45801 Pulse switch test failed.**
  description: *Testcase*
  measured: *Data*

  Failed in the pulse switch test (on/off test). Check the test lead connections and connect properly. Or do troubleshooting and replace defective part.

- **3-45901 Pulse level test failed.**
  description: *Testcase*
  measured: *Data*

  Failed in the pulse level test. Check the connection from PGU and HF port to the signal input port of the oscilloscope. And connect properly. Or do troubleshooting and replace defective part.

- **3-45921 Pulse parameter test failed.**
  description: *Testcase*
  measured: *Data*

  Failed in the pulse parameter test (except for overshooting). Check the connection from PGU and HF port to the signal input port of the oscilloscope. And connect properly. Or do troubleshooting and replace defective part.

- **3-45922 Pulse parameter test failed due to overshoot.**
  description: *Testcase*
  measured: *Data*

  Failed in the pulse parameter test due to overshoot. Check the connection from PGU, HF port to 54751A. And connect properly. Or do troubleshooting and replace defective part.

4-xxxxxx

- **4-110001 Cannot make connection because no session is logged in now.**

  Before starting up the IDP, you need to log in to the 4070 operating environment. Execute hp4070 -login command before executing idp4070 command.

- **4-110004 Break connection because TIS Daemon process was down.**

  TIS daemon was down during IDP operation. Log in to the 4070 again, and execute idp4070 command.

- **4-110005 Cannot send event data to idp4070.**

  IDP was down abnormally. Exit IDP by choosing File: Exit menu on the IDP window.

- **4-120001 Cannot allocate memory for reading last measurement data.**

  The measurement data could not be loaded when choosing File: Open Last Test menu on the Graph window of IDP because of small free memory space. Stop unnecessary applications and close windows to increase free memory size.

- **4-202004 Allocation size is too large. Ignored.**

  Tried to load data file that was edited or broken. Internal error. Number of vector data is larger than the allocated size. Excess data is not set.

- **4-202005 Data size is larger than allocated size. The data is ignored.**

  Tried to load data file that was edited or broken. Internal error. Tried to set number of vector data that was negative number. No action.

- **4-202006 Invalid block number is selected. Ignored.**

  Internal error. Block number of the data block to be cleared is a negative number or over the maximum number. No action.

- **4-202007 Selected block size is too large. Last selected block is ignored.**

  Tried to load data file that was edited or broken. Internal error. Too large block size was specified for block selection. The block is not selected.

- **4-202009 Measurement vector number is invalid. The vector is ignored.**

  Tried to load data file that was edited or broken. Internal error. Tried to set number of the vector data that is negative number, zero, or over the number of registered data. The vector data is not set.

- **4-205011 Warning: Illegal data format in data file. Ignored. Too long line. Line =** *Line_No.*.

  Data file to be loaded was edited or broken. Number of characters in line *Line_No.* of data file to be loaded was over 128 characters. The line is ignored. Delete the line or edit the line so that it is 128 or less characters.

- **4-205012 Warning: Too many data in one data block: <= 2002 data per data block. Used only the first 2002 data.**

  Data file to be loaded was edited or broken. Number of data in a vector data is over 2002. Only the first 2002 data are loaded. Delete the excess data so that number of data is 2002 or less.

- **4-205013 Warning: Bad data Tag found in data file. Ignored. Line =** *Line_No.*.

  Data file to be loaded was edited or broken. Invalid specifier was used in line *Line_No.* of the data file. The line is ignored. Delete the line. Or edit the data file. Use ": (colon)", for example, "BX:", "BY:" and so on, to indicate the specifiers.

- **4-205014 Warning: Cannot use Attributes Tag in data block portion. Ignored. Use this Tag in header portion of data file. Line =** *Line_No.*.

  Data file to be loaded was edited or broken. Attribute tag is inserted in line *Line_No.* of the data file to be loaded. The line is ignored. Delete the line.

- **4-205015 Warning: Illegal data format in data file. Ignored. Line =** *Line_No.*.

  Data file to be loaded was edited or broken. Non-numeric data is included in line *Line_No.*. The line is ignored. Delete the non-numeric data, or exchange it with the numeric data.

- **4-205016 Warning: Illegal range format in data file for** *Data***. Ignored. Line =** *Line_No.*.

  Data file to be loaded was edited or broken. Could not get the data from the lines #XI, #X and #Y for graph in the data file. The line *Line_No.* is ignored. Delete the line. Or edit the file and insert the proper value.

- **4-205018 Warning: Illegal Character in data file for** *Data*. **Used NULL String. Line =** *Line_No.*.

  Data file to be loaded was edited or broken. Invalid character was used in line *Line_No.*. The line is ignored. Edit the file. Numeric characters, and '–' (minus), '+' (plus), '_' (underscore), ' ' (space), '.' (period) and ',' (comma) are allowed for the data.

- **4-205019 Warning: Illegal string description in data file. Ignored. Line =** *Line_No.*.

  Data file to be loaded was edited or broken. Strings are not enclosed by double quotations ('). The line *Line_No.* is ignored. Edit the file and properly enclose the strings by double quotations.

- **4-205101 Warning: Bad data range for Log scale;***Axis*. **Turned off log scale mode.**

  Tried to set minimum value or maximum value of X axis or Y axis in log scale to 0 or negative value. Graph scale is set to linear scale automatically. The data must be positive value for log scale.

- **4-205102 Warning: Bad data for Log scale. Turned off log scale mode.**

  Tried to set X-axis data or Y-axis data in log scale to negative value. Graph scale is set to linear scale automatically. The data must be positive value for log scale.

- **4-205103 Warning: Bad range for scale. Set previous value.**

  Difference between maximum value and minimum value of the graph is almost 0. Minimum value and maximum value are set to the previous values automatically. Specify a bigger difference.

- **4-205112 Warning: No Y data. Cannot plot any data.**

  Data file to be loaded was edited or broken. Internal error. Y vector data does not exist although X vector data exists. Graph does not plot any data. Create one Y vector data at least.

- **4-211000 Can't open file.**

  Error occurred during loading/saving the IDP data file. The data file is not loaded/saved. Confirm that the directory for the data file exists, and the permission of the directory and the data file.

- **4-211001 Can't write file.**

  Error occurred while saving the IDP data file. The data file is not saved. Confirm that there is sufficient free disk space. Prepare approximately 10 KByte for one IDP data file.

- **4-211002 Can't read file.**

  Size of the data file is less than the size of IDP data file. The data file is not loaded. Specify the IDP data file name properly. If the file was edited, the file cannot be loaded.

- **4-211003 Saving to a file is not allowed when some resource fields are modified.**

  Tried to save the IDP data file before setup was completed (clicking **Set** button) on the IDP window. The data file is not saved. Close the Save Dialog and click **Set** button. Then save the data file.

- **4-211004 File format revision mismatch. Can't read the file.**

  Tried to load data file, but did not match the IDP data format. The data file is not loaded. Specify the file name of the IDP data. If the IDP data file was edited and changes made, the data file cannot be loaded.

- **4-211005 Can't close the resource display when some resource fields are modified.**

  Tried to delete a resource from the Resource Selection dialog before setup for the resource was completed (clicking **Set** button) on the IDP window. The resource is not deleted from the Resource Selection dialog. Close the Resource Selection dialog, click **Set** button. Then delete the resource from the Resource Selection dialog.

- **4-211006 Can't open last measurement data.** *Test_name* **doesn't create array data.**
  4-211007 Can't open last measurement data. No measurement has been performed.
  4-211008 Can't open last measurement data. There is no measurement data. The measurement might have been executed on offline system.

  Data on the Graph window does not change. Before choosing File: Open Last Test menu, you must execute measurement that makes array data.

  File: Open Last Test menu on the Graph window is used to display array data that was measured in the On-line mode.

- **4-212001 Cannot create measurement blocks.**

  Number of measurement data exceeds the maximum number. Measurement block is not created. Clear the data loaded on the Graph.

- **4-212002 Cannot create vector data blocks.**

  Tried to load data file that was edited or broken. Internal error. Number of data for vector data is zero, negative number, or exceeds the maximum number. No action.

- **4-212003 Cannot allocate data.**

  Tried to load data file that was edited or broken. Internal error. Tried to create data with negative number or over the maximum number.

- **4-215100 Error: Data block index value must be 1 to 7.**

  Tried to load data file that was edited or broken. Internal error. Data block index value must be 1 to 7.

- **4-215150 Error: Bad file name: May be too long file name or no suffix;***File_name*.

  Name of file to load is too long or no suffix. The file is not loaded. Enter the proper name for the file on the Load dialog, and try to load the file again.

- **4-215151 Error: Bad file suffix.**

  Suffix of the file name entered is not '.dpg' or '.dps'. The file is not loaded. Enter the proper name for the file in the Load Dialog, and try to load the file again.

- **4-215152 Error: Bad file type; not an ordinary file.**

  File is not ASCII file. The file is not loaded. Enter the proper name for the file in the Load Dialog, and try to load the file again.

- **4-215155 Error: Too long file path name. Maximum 1018 characters.**

  File name over 1018 characters was entered. The file is not saved. Use file name with 1018 or less characters and try to save the file again.

- **4-215156 Error: Specified path name is too long. Only the leading 1023 characters are used.**

  Path name over 1023 characters was entered. The file is not saved. Use path name with 1023 or less characters and try to save the file again.

- **4-215301 Error: Syntax error in dump command;** *Command*.

  Syntax error occurred in dump command. Enter the proper command for dump/print.

- **4-215303 Error: Cannot generate PostScript code.**

  Temporary PostScript file could not be created. Secure enough free disk space for temporary file.

- **4-225001 System Error: Cannot open data file;** *File_name*.

  Specified data file does not exist, improper directory is specified, or temporary file for dump cannot be created. Check the name of data file, or permission of the file and directory. Or secure enough free disk space for temporary file.

5-xxxxx

- **5-10001 Cannot make connection with TIS Daemon. No session or environment variable PCS_SESSION_ID is not properly set.**

  Execute hp4070 -login command. Or confirm the setting of the environmental variable `PCS_SESSION_ID`.

- **5-10002 Cannot allocate memory. Please quit and try again.**

  To allocate memory, stop the action and try it again.

- **5-10003 Environmental variable: PCS_SESSION_ID is not set.**

  Quit from the 4070 operating environment, set `PCS_SESSION_ID`, and then log in again.

6-xxxxx

- **6-20001 Cannot translate 4062 port address into 4070 port address.**

  Specified port address for the 4062 could not be translated to the 4070 port address. Check the port address, and specify the correct port address.

- **6-20002 Invalid port is assigned.**

  Specified port address is not correct. Confirm the port address.

- **6-20003 Invalid pin is assigned.**

  Specified pin number is not correct. Confirm the pin number.

- **6-20004 [F_ROM] Pin number must be 0 to 48.**

  Pin number must be 0 to 48. Enter a valid value.

- **6-20005 Specified pin board is defective or not installed.**

  Pin board for the specified pin number is not installed or defective. Confirm the pin board configuration. hp4070 -login command displays the 4070 system configuration.

- **6-20006 From_pin is out of range.**

  Pin number assigned for the *first pin* parameter of the `Connect_th` command is not correct. Confirm the pin number.

- **6-20007 To_pin is out of range.**

  Pin number assigned for the *last pin* parameter of the `Connect_th` command is not correct. Confirm the pin number.

- **6-20008 1st parameter must be 1 (connect) or 0 (disconnect).**

  Wrong value was specified for the first parameter of `Tap_port` command. The value must be 0 (disconnect) or 1 (connect). Check the value and specify the proper value.

- **6-20009 2nd parameter must be port address of SMU/AUX port 1 or 2.**

  Wrong value was specified for the second parameter of `Tap_port` command. The value must be the port address of SMU port 1 or 2, or AUX port 1 or 2. Check the value and specify the proper value.

- **6-20010 3nd parameter must be port address of SMU/AUX port 1 or 2.**

  Wrong value was specified for the third parameter of `Tap_port` command. The value must be the port address of SMU port 1 or 2, or AUX port 1 or 2. Check the value and specify the proper value.

- **6-20011 Improper SMU voltage range specified.**

  Voltage range setting for SMU is not correct. Check the value of the output voltage and the voltage range, and specify the proper value.

- **6-20012 Improper SMU voltage source, voltage output range, or compliance specified.**

  Output voltage value, voltage output range, or current compliance value are not correct. Verify the values of output voltage, voltage output range, and current compliance and then specify the correct value.

- **6-20013 Improper SMU current range specified.**

  Current range setting of SMU is not correct. Check the value of the output current and the current range, and specify the proper value.

- **6-20014 Improper SMU current source or compliance specified.**

  Value of output current or voltage compliance is not correct. Check the value of output current and voltage compliance, and specify the proper value.

- **6-20015 Specified SMU is defective or not installed.**

  Specified SMU board is not installed or defective. Confirm the SMU configuration. hp4070 -login command displays the 4070 system configuration.

- **6-20016 Source pin must be connected to an SMU.**

  Specified pin board is not connected to SMU. Check the measurement program. The program must have a program line that connects the SMU to the pin board *before* the program line that forces the output of the SMU specified by the pin number.

- **6-20017 Source port must be an SMU or a pin connected to an SMU.**

  Source port address used in the `Force_meas` command is not correct. Source port address must be SMU port address or the pin number of the pin board connected to the SMU. Check the port address and specify the proper value.

- **6-20018 Measure pin must be connected to an SMU.**

  Specified pin board is not connected to SMU. Check the measurement program. The program must have a program line that connects the SMU to the pin board *before* the program line that performs measurement using the SMU specified by the pin number.

- **6-20019 Measure port must be an SMU or a pin connected to an SMU.**

  Measurement port address is not correct. Measurement port address must be SMU port address or the pin number of the pin board connected to the SMU. Check the port address and specify the proper value.

- **6-20020 3rd parameter must be 1 (voltage source) or 2 (current source).**

  Wrong value was specified for the third parameter of `Force_meas` command. The value must be 1 (voltage source) or 2 (current source). Check the value and specify the proper value.

- **6-20021 Wait time must be 0 to 655.35 sec.**

  Specified value for the wait time is out of range. The value must be 0 to 655.35 seconds. Check the value and specify the proper value.

- **6-20022 Hold time must be 0 to 655.35 sec.**

  Specified value for the hold time is out of range. Available value for the hold time is 0 to 655.35 sec. Check the value and specify the proper value.

- **6-20023 Port must be CMH when forcing voltage on CMU.**

  Invalid port was specified for the `Force_v` command. When setting the dc bias of CMU, the CMH port address must be specified. Check the port address and specify the correct port.

- **6-20024 Wait time must be 0 to 655.35 sec.**

  Wait time value is not correct. Available value for the wait time is 0 to 655.35 sec. Check the value and specify the proper value.

- **6-20025 Size of port array must be greater than or equal to 1.**

  No port is defined for the array used to specify the multiple ports. Check the value and size of the array, and define the array properly.

- **6-20026 1st parameter must be an SMU port address or a pin connected to an SMU.**

  Wrong value was specified for the first parameter of the `Stand_by_port` command. The value must be the SMU port address or the pin number of the pin board connected to the SMU. Check the value and specify the value properly.

- **6-20027 2nd parameter must be an SMU port address or a pin connected to an SMU.**

  Wrong value was specified for the second parameter of the `Stand_by_port` command. The value must be the SMU port address or the pin number of the pin board connected to the SMU. Check the value and specify the value properly.

- **6-20028 3rd parameter must be an SMU port address or a pin connected to an SMU.**

  Wrong value was specified for the third parameter of the `Stand_by_port` command. The value must be the SMU port address or the pin number of the pin board connected to the SMU. Check the value and specify the value properly.

- **6-20029 *M*th parameter must be an SMU port address or a pin connected to an SMU.**

  Wrong value was specified for the *M*th parameter of the `Stand_by_port` command. The value must be the SMU port address or the pin number of the pin board connected to the SMU. Check the value and specify the value properly.

- **6-20030 Cannot connect Extended I/O port to the Chuck terminal.**

  Cannot specify Extended Path port for the `Connect_chuck` command. Specify an SMU, GNDU, or AUX port address for the `Connect_chuck` command.

- **6-20031 Ports must be SMU or CMU.**

  Invalid port was specified for the `Disable_port` command. Must specify an SMU or CMU port address, or the pin number of a pin board connected to the SMU or CMU. Check the port value and specify the port properly.

- **6-20032 Adc must be 0 (ADC_PERCH) or 1 (ADC_REF).**

  Wrong value was specified for the parameter to select ADC. The value must be 0 (high-speed ADC) or 1 (high-resolution ADC). Check the value and specify the value properly.

- **6-20033 Filter must be 0 (FILTER_OFF) or 1 (FILTER_ON).**

  Wrong value was specified for the parameter to select SMU filter status. The value must be 0 (filter off) or 1 (filter on). Check the value and specify the value properly.

- **6-20034 Wait time ratio must be 0.0 to 10.0.**

  Wrong value was defined for the wait time factor. The value must be 0 to 10. Check the value and specify the value properly.

- **6-20035 Integration time mode setting must be 0, 1, 2, or 3.**

  Wrong value was specified for the mode parameter of the `Set_smu` or the `Set_adc` command. The value must be 0 (manual), 1 (short), 2 (medium) or 3 (long). Check the value and specify the proper value.

- **6-20036 Averaging or integration time is out of range.**

  Wrong value was specified for the integration time or averaging parameter of the `Set_adc` or the `Set_smu` command, or the integration time parameter of the `Set_adc3458` command. Check the value and specify the proper value.

- **6-20037 Autozero must be 0 (AUTOZERO_OFF) or 1 (AUTOZERO_ON).**

  Wrong value was specified for the auto zero parameter of the `Set_adc` or the `Set_adc3458` command. The value must be 0 (auto zero off) or 1 (auto zero on). Check the value and specify the proper value.

- **6-20038 Port must be an SMU or a pin connected to an SMU.**

  Port address setting is not correct. The port address must be the SMU port address or the pin number of the pin board connected to the SMU. Check the value and specify the proper value.

- **6-20039 Port must be an SMU or a pin connected to an SMU.**

  Port address setting is not correct. The port address must be the SMU port address or the pin number of the pin board connected to the SMU. Check the value and specify the proper value.

- **6-20040 Search mode must be 0 to 15 for Set_bsearch, 0 to 11 for Set_lsearch.**

  Wrong value was specified for the search mode parameter of the `Set_lsearch` or the `Set_bsearch` command. The search mode value for the `Set_lsearch` must be 0 to 11, and the value for the `Set_bsearch` must be 0 to 15.

- **6-20041 Upper search boundary is equal to lower search boundary.**

  Same value was set for the start/stop parameters of the `Set_lsearch` command or the min/max parameters of the `Set_bsearch` command. Start (or min) value must be different from the stop (or max) value.

- **6-20042 Step value must be greater than 0 for Set_lsearch or Set_bdv_search.**

  Wrong value was specified for the step parameter for the `Set_lsearch` or the `Set_bdv_search` command. The value must be greater than 0.

- **6-20043 Target value must be less than measurement compliance.**

  Too large value was specified for the target parameter of the `Set_lsearch` or the `Set_bsearch` command. The value must be less than the value of the compliance parameter.

- **6-20044 Convergence condition in Accuracy mode must be 0 to 100.**

  Value of the convergence condition parameter of the `Set_bsearch` command in the Accuracy mode is out of range. The value must be 0 to 100.

- **6-20045 Convergence condition in Times mode must be 0 to 16.**

  Value of the convergence condition parameter of the `Set_bsearch` command in the Times mode is out of range. The value must be 1 to 16.

- **6-20046 Delay time must be 0 to 65.535 sec.**

  Setting value of the delay time is out of range. The value must be 0 to 65.535 sec. Check the value and specify the proper value.

- **6-20047 Skip_back value must be 0 to 100.**

  Wrong value was specified for the skip back parameter of the `Set_lsearch` command. The value must be 0 to 100.

- **6-20048 Set_skip may not be used with Set_bsearch or Set_bdv_search.**

  Cannot use the `set_skip` command with the `set_bsearch` or the `Set_bdv_search` function in C language programming environment. Use the `set_skip` command with the `set_lsearch`.

- **6-20049 Set_bsearch or Set_lsearch is not called before Search is called.**

  Before executing Search command, the `Set_lsearch` or the `Set_bsearch` command must be executed to define the search measurement setup. The setup defined by the `Set_lsearch` or the `Set_bsearch` command is canceled by the `Init_system` command.

- **6-20050 Compliance mode is not available for voltage measurement of Set_lsearch.**

  For the search mode 8 to 11 (compliance mode) of the `Set_lsearch` command, the output mode of sense port SMU must be set to VF (voltage force) mode. Before executing the `Set_lsearch` command, enter statement (for example, `Force_v`) to set the SMU output mode to VF mode.

- **6-20051 Sweep mode setting must be –4 to 4 (integer).**

  Improper sweep mode was specified for the `Set_iv` or the `Set_piv` command. The value must be –4 (Current, log, double), –3 (Voltage, log, double), –2 (Current, log, single), –1 (Voltage, log, single), 1 (Voltage, linear, single), 2 (Current, linear, single), 3 (Voltage, linear, double), or 4 (Current, linear, double). Check the sweep mode setting and set the proper mode.

- **6-20052 Number of steps must be 2 to 1001.**

  Improper number of steps was specified for the `Set_iv` or the `Set_piv` command. Value must be 2 to 1001. Check the value and set the proper value.

- **6-20053 Improper power compliance is specified.**

  Setting of the power compliance is out of range. Check the value and set the proper value.

- **6-20054 Sweep stop mode must be 1 (continue on error) or 2 (stop on error).**

  Improper stop mode was specified for the sweep measurement command. The value must be 1 (continue on error) or 2 (stop on error). Check the setting and set the proper value.

- **6-20056 Measurement mode must be 1 (voltage) or 2 (current).**

  Improper measurement mode was specified for the `Sweep_iv` or the `Rsweep_iv` command. The value must be 1 (voltage measurement mode) or 2 (current measurement mode).

- **6-20057 Start and stop values have different polarity.**

  In the logarithmic sweep measurement mode, polarity of the start and stop value must be the same.

- **6-20058 Hold time must be 0 to 655.35 sec.**

  Setting of hold time is wrong. The value must be 0 to 655.35.

- **6-20059 Difference of start and stop must be greater than** *`Voltage`*

  For the `Set_bdv` command, the difference between the *`start`* value and the *`stop`* value must be 10 V or more.

  For the `Set_ileak` command, the difference between the *`output voltage`* value and the *`start`* value must 10 V or more.

- **6-20060 Detection interval mode must be 0 (short) or 1 (long).**

  Improper *`detection interval`* was specified for the `Measure_bdv` or the `Measure_ileak` command. The value must be 0 (short mode) or 1 (long mode).

- **6-20061 Skip value must be 1 to 20000.**

  Improper *`skip`* value was specified for the `Set_lsearch` command. The value must be 1 to 20000.

- **6-20062 Target value must be less than the sense port compliance.**

  Improper target value was specified for the `Set_lsearch` command. The value must be less than compliance of sense port.

- **6-20063 Sync port must have the same V/I output mode as the control variable.**

  SMU output mode of the sync SMU defined for the `Set_sync` command must be the same output mode of the search SMU defined for the `Set_bsearch` or the `Set_lsearch` command. Set the SMU output mode of the sync SMU by entering the `Force_v` or the `Force_i` command before entering the `Set_sync` command.

  The `Force_v` command is used to set the voltage output mode, and the `Force_i` command is used to set the current output mode.

- **6-20064 Improper synchronous search offset value is specified.**

  Offset value of the `Set_sync` command is out of range. Or the offset value is not correct for the settings of the start/stop values of the `Set_lsearch` command or the min/max values of the `Set_bsearch` command. Set the proper value.

- **6-20066 Offset value of synchronous search port or compliance is improper.**

  Sync port SMU output did not match to the compliance value. Check the offset and compliance values of the `Set_sync` command, and the start/stop values of the `Set_lsearch` command or the min/max values of the `Set_bsearch` command, and set the proper value.

- **6-20067 Synchronization polarity mode must be 0 (positive) or 1 (negative).**

  Improper synchronization polarity mode was specified for the `Set_sync` command. The value must be 0 (positive sync) or 1 (negative sync).

- **6-20068 Synchronous sweep ratio must be 0.01 to 10.0.**

  Improper synchronous sweep ratio value was specified for the `Set_sync` command. The value must be 0.01 to 10.0.

- **6-20069 Improper synchronous sweep offset value specified.**

  Improper synchronous sweep offset value was specified for the `Set_sync` command. Check the value and set the proper value.

- **6-20070 Calculated start, stop or compliance of synchronous sweep is improper.**

  Sync port SMU output is out of range, or does not match to the compliance value. Check the offset, ratio and compliance values of the `Set_sync` command, or the start/stop values of the command for sweep measurement.

- **6-20071 Measurement mode must be 0 (linear) or 1 (saturation).**

  Invalid mode was specified for the `Measure_vth` command. The mode must be 0 (linear region) or 1 (saturation region).

- **6-20072 Number of points must be 2 to 20.**

  Invalid number of points was specified for the `Measure_vth` command. The number of points must be 2 to 20.

- **6-20073 Compliance must be specified when SMU V/I output mode is changed.**

  In the optimization level is 2 or 3, compliance value cannot be omitted for a command (`Force_v`, `Force_i`, etc.) that changes the SMU output mode. Confirm the optimization level and set the compliance value properly.

- **6-20074 Invalid pin number specified for Hpin.**

  Invalid pin number was specified for the CMU high port of the `Corr_cmu` command. Check the pin number and set the correct number.

- **6-20075 Invalid pin number specified for Lpin.**

  Invalid pin number was specified for the CMU low port of Corr_cmu command. Check the pin number and set the correct number.

- **6-20076 C Compensation file is not loaded.**

  TIS command requires that capacitance compensation was executed before loading the capacitance compensation data file. Check `/etc/opt/hp4070/ccdata` file and `/etc/opt/hp4070/ccdata0` file, and the permission of the files.

- **6-20077 Cp should not be 0.**

  Cp value of the `Conv_mode` command was set to zero. Cp value must not be zero.

- **6-20078 Proper sweep measurement is not done.**

  `Status_miv` command could not read the measurement status of the last sweep measurement. Sweep measurement was not done properly. Check the measurement program. Or sweep measurement may be now in progress.

- **6-20079 Current is too large.**

  Too large current value was set for the `Set_bdv` command. Set the proper value.

- **6-20080 Vg_start and Vg_stop should not be same.**

  Same value was set for gate start and stop voltages of the `Set_vth` command. The same value cannot be set for these parameters. Set the values properly.

- **6-20081 Gate step voltage value must be greater than 0 V.**

  Gate step voltage must be greater than 0 V for the `Set_vth` command. Set the value correctly.

- **6-20082 Id_start must be less than measurement port compliance.**

  `Drain search start` current of the `Set_vth` command must be less than the compliance value of the measurement port. Set the value properly.

- **6-20083 Delay time must be 0 to 65.535 sec.**

  Delay time value of the `Set_vth` command is out of range. Value must be 0 to 65.535 seconds. Set the value properly.

- **6-20084 Vg Skip_back value must be 0 to 100.**

  Vg Skip_back value of the `Set_vth` command is out of range. Value must be 0 to 100. Set the value properly.

- **6-20085 Vg Skip value must be 1 to 20000.**

  Vg Skip value of the `Set_vth` command is out of range. Value must be 1 to 20000. Set the value properly.

- **6-20086 Id_start value must be –0.1 to 0.1 A.**

  Drain start current value of the `Set_vth` command is out of range. Value must be –0.1 to 0.1 A. Set the value properly.

- **6-20090 Sweep_miv or Rsweep_miv can be used with Set_iv, not Set_piv.**

  `Sweep_miv` and `Rsweep_miv` commands for the multi-channel sweep measurement can only be used for sweep that was set up by the `Set_iv` command. The commands cannot be used with pulsed sweep, which is set up by the `Set_piv` command. Check and change the program.

- **6-20100 Measurement port is not connected to any pins.**

  Measurement SMU port is not connected to any pin board. Connect the SMU to the measurement pin.

- **6-20101 Sweep port is not connected to any pins.**

  Sweep measurement SMU port is not connected to any pin board. Connect the SMU to the measurement pin.

- **6-20102 The synchronous sweep port is not set up.**

  An array was specified in the `Sweep_miv` command for returning source values of synchronous sweep port, but synchronous port was not set up. Either delete the array name from the `Sweep_miv` or set up synchronous sweep port by using the `Set_sync`.

- **6-20103 The synchronous sweep port is not connected to any pins.**

  Synchronous sweep port is not connected to any pin board. Connect the SMU to the measurement pin.

- **6-20120 Force mode must be 1 (voltage force) or 2 (current force).**

  Improper mode was specified for the force mode of the `Set_pbias` command. The value must be 1 (voltage force) or 2 (current force).

- **6-20121 Pulse sweep mode setting must be –4 to 4 (integer).**

  Improper *`pulse sweep mode`* was specified for the `Set_piv` command. The value must be 1 (linear voltage), 2 (linear current), 3 (linear voltage double), 4 (linear current double), –1 (logarithmic voltage), –2 (logarithmic current), –3 (logarithmic voltage double), or –4 (logarithmic current double).

- **6-20122 Measurement mode must be 1 (voltage) or 2 (current).**

  Improper *`measurement mode`* was specified for the `Measure_p` command. The value must be 1 (voltage measurement) or 2 (current measurement).

- **6-20123 Peak and base current must have the same polarity.**

  For current, the *`pulse base`* and *`pulse peak`* values must be the same polarity for the `Set_pbias` command. Check the values and set the proper values.

- **6-20124 Peak, start and stop current must have the same polarity.**

  For current, *`pulse base`*, *`start value`*, and *`stop value`* must be the same polarity for the `Set_piv` command. Check the values and set the proper values.

- **6-20125 Width value must be 0.0005 to 2 sec.**

  Pulse width value is out of range. Value must be 0.0005 to 2 sec with 0.0001 sec resolution. Set the correct value.

- **6-20126 Period value must be 0.005 to 5 sec.**

  Pulse period value is out of range. Value must be 0.005 to 5 sec with 0.0001 sec resolution. Set the correct value.

- **6-20128 Period value must be greater than width + 2ms.**

  Pulse period value must be greater than pulse width + 2 ms. Set the pulse period or pulse width value correctly.

- **6-20200 Set_pbias must be executed before Measure_p.**

  No setup for the `Measure_p` command. Execute the `Set_pbias` command before executing the `Measure_P` command.

- **6-20201 Set_iv or Set_piv must be executed before Sweep_iv.**

  No setup for the `Sweep_iv` command. Execute the `Set_iv` or the `Set_piv` command before executing the `Sweep_iv` command.

- **6-20202 No measurement to stop by Rsweep_stop.**

  No real time sweep measurement to stop. `Rsweep_stop` is used for stopping *real-time* sweep measurements only.

- **6-20203 Set_iv or Set_piv must be executed before Rsweep_iv.**

  No setup for the `Rsweep_iv` command. Execute the `Set_iv` or the `Set_piv` command before executing the `Rsweep_iv` command.

- **6-20204 Set_iv must be executed before Rsweep_miv.**

  No setup for the `Rsweep_miv` command. Execute the `Set_iv` command before executing the `Rsweep_miv` command.

- **6-20205 Set_iv must be executed before Sweep_miv.**

  No setup for the `Sweep_miv` command. Execute the `Set_iv` command before executing the `Sweep_miv` command.

- **6-20206 Set_lsearch, Set_bsearch, or Set_bdv_search must be executed before Search or Search_iv.**

  No setup for the `Search` or the `Search_iv` command. Execute the `Set_lsearch`, `Set_bsearch`, or `Set_bdv_search` command before executing the `Search` or the `Search_iv`.

- **6-20207 Synchronous port must be different from the primary sweep port.**

  Must use different SMU ports for the primary sweep port and synchronous port.

- **6-20208 Synchronous port must be different from the primary search port.**

  Must use different SMU ports for the primary search port and synchronous port.

- **6-20209 No sweep or search setup was set before Set_sync.**

  No setup for the `Set_sync` command. Execute the `Set_iv`, the `Set_piv`, the `Set_bsearch`, or the `Set_lsearch` command before executing the `Set_sync` command.

- **6-20210 Set_bdv must be executed before Measure_bdv.**

  No setup for the `Measure_bdv` command. Execute the `Set_bdv` command before executing the `Measure_bdv` command.

- **6-20211 Set_ileak must be executed before Measure_ileak.**

  No setup for the `Measure_ileak` command. Execute the `Set_ileak` command before executing the `Measure_ileak` command.

- **6-20212 Set_lsearch, Set_bsearch, or Set_bdv_search must be executed before Rsearch or Rsearch_iv.**

  No setup for the `Rsearch` or the `Rsearch_iv` command. Execute the `Set_lsearch` , the `Set_bsearch`, or the `Set_bdv_search` command before executing the `Rsearch` or the `Rsearch_iv`.

- **6-20213 No measurement to stop by Rsearch_stop.**

  No real time search measurement to stop. `Rsearch_stop` is used for stopping *real-time* search measurements only.

- **6-20214 Set_vth must be executed before Measure_vth.**

  No setup for the `Measure_vth` command. Execute the `Set_vth` command before executing the `Measure_vth` command.

- **6-20215 Synchronous port must be different from the pulse bias port.**

  Must use different SMU ports for the pulse bias port and synchronous port.

- **6-20216 Pulse bias port must be different from the Synchronous port.**

  Must use different SMU ports for the synchronous port and the pulse bias port.

- **6-20220 Cannot call Status_miv during a sweep measurement.**

  Cannot execute the `Status_miv` command while *`real-time`* sweep measurement is executing.

- **6-20221 Fine search start current value must be smaller than breakdown current value.**

  The current value for fine search start must be smaller than the breakdown current value which sets compliance of an SMU in the `Set_bdv_search` command.

- **6-20222 Fine search start current and breakdown current must have the same polarity.**

  The setup current values for fine search start and breakdown current must be the same polarity for the `Set_bdv_search` command. Check the polarity and set the correct values.

- **6-20223 Cannot omit fine search start parameter.**

  Fine search start value must be specified when the skip parameter value is greater than 1 for the `Set_bdv_search` command.

- **6-20224 Compliance check delay time must be 0 to 65.535 sec.**

  Setting value for compliance check delay is out of range. The value must be 0 to 65.535 sec. Check the value and specify it correctly.

- **6-20301 Invalid mode number specified.**

  Mode number specified in the `Set_rangemode` is incorrect. The mode number must be 0 or 1.

- **6-20402 Integration time mode setting must be 0, 1, 2, 3, or 4.**

  Integration time mode setting must be 0, 1, 2, 3, or 4. Enter a valid value.

- **6-20403 Must specify integration time mode setting for higher current range (0, 1, 2, 3, or 4).**

  The integration time mode is not set for the higher current range. You must specify the integration time.

- **6-21001 Specified pin is not connected to any ports.**

  Pins specified by the `Disable_port` command are not connected to any port. Specify the pin number of a pin board that is connected to a port.

- **6-21002 SMU output voltage incompatible with set voltage range.**

  Wrong value was set for the SMU output voltage and voltage range. Set the values properly.

- **6-21003 SMU output current incompatible with set current range.**

  Wrong value was set for the SMU output current and current range. Set the values properly.

- **6-22001 CMU bias voltage must be –40 to 40 Vdc.**

  Wrong value was specified for the bias voltage of CMU. The value must be 0 to ±40 Vdc for 4284A equipped with option 001.

- **6-22002 CMU bias voltage must be –2, –1.5, 0, 1.5, or 2 Vdc.**

  Wrong value was specified for the bias voltage of CMU. The value must be 0, ±1.5, or ±2 Vdc for 4284A without option 001.

- **6-22003 CMU integration time mode setting must be 1, 2, or 3.**

  Invalid parameter was set for the integration time of the `Set_cmu84` command. The value must be 1 (short), 2 (medium) or 3 (long).

- **6-22004 CMU signal level must be 0.005 V or more.**

  Too small value was set for the signal level by the `Set_cmu84` command. The value must be greater than 0.005 V.

- **6-22005 CMU signal level must be 20.0 V or less.**

  Too large value was set for the signal level by the `Set_cmu84` command. The value must be 20 V or less for 4284A equipped with option 001.

- **6-22006 CMU signal level must be 2.0 V or less.**

  Too large value was set for the signal level by the `Set_cmu84` command. The value must be 2 V or less for 4284A without option 001.

- **6-22007 CMU frequency must be 19.8 Hz or more.**

  Too small value was set for the measurement frequency of CMU. The value must be 19.8 Hz or more.

- **6-22008 CMU frequency must be 1 MHz or less.**

  Too large value was set for the measurement frequency of CMU. The value must be 1 MHz or less.

- **6-22009 CMU is defective or not installed.**

  CMU (4284A) is not installed in the 4070, or may be defective. Execute hp4070 -login command and check the configuration of the 4070. If necessary, do the diagnostics.

- **6-22010 There is no capacitance and conductance data in buffer.**

  Capacitance/conductance measurement was not executed properly. CMU (4284A) may be defective. Do the diagnostics.

- **6-22011 Set_cv84 must be executed before Sweep_cv84.**

  No setup for the `Sweep_cv84` command. Execute the `Set_cv84` command before executing the `Sweep_cv84` command.

- **6-22012 Number of C-V sweep steps must be 2 to 1001.**

  Number of steps for the `Set_cv84` command is out of range. The value must be 2 to 1001.

- **6-22013 Hold time and delay time must be 0.0 to 650.0 sec.**

  Hold time or delay time value of the `Set_cv84` command is out of range. The value must be 0.0 to 650.0.

- **6-22014 4284A option 001 is not present.**

  C-V sweep measurement needs 4284A equipped with the option 001. Execute hp4070 -login command and check the configuration of the 4070.

- **6-23001 DVM is defective or not installed.**

  DVM (3458A) is not installed in the 4070, or may be defective. Execute hp4070 -login command and check the configuration of the 4070. If necessary, do the diagnostics.

- **6-23002 DVM is not set to DC voltage measurement mode.**

  DVM (3458A) is not in the dc voltage measurement mode. Set the mode correctly using front panel or GPIB command. Or DVM may be defective. If necessary, do the diagnostics.

- **6-23003 DVM GPIB address is not set or invalid.**

  Address3458 command was executed even though the DVM (3458A) is not installed in the 4070. Confirm the measurement program.

- **6-23100 Failed to call igpibbusstatus().**

  GPIB interface card may be defective.

- **6-24001 Testhead Power Fail state.**

  Testhead is turned off. Turn on the testhead. If testhead cannot turn on, check the testhead power supply.

- **6-24002 Testhead Emergency state.**

  Testhead is in the emergency status. Do the diagnostics.

- **6-25000** *Command* **is UNSUPPORTED.**

  The 4070 system software does not support the command specified by *Command*. Do not use *Command*.

- **6-25001 Improper PGU unit address Address. Enter correct value.**

  The available value depends on the configuration of the PGUs. To get the unit address from the port number, use FNPort or PORT.

- **6-25002 No PGU on the unit address. Enter correct value or check PGU.**

  There is no PGU on the unit address you specified, or the PGU is defective. Confirm the unit address and enter a valid value. Verify the PGU is operating correctly.

- **6-25003 Must specify unit address of PGU disconnected from testhead.**

  You must specify the unit address of the PGU disconnected from the testhead. Execute pgconn4070 and verify that the value in the PG connection file matches the actual PGU connection, then specify the unit address of the PGU disconnected from the testhead.

- **6-25004 Pin number must be 1 to 24 for the HF port. Enter correct value.**

  An invalid pin number was entered. Pin numbers 1 to 24 are available for the HF port you specified.

- **6-25005 Pin number must be 25 to 48 for the HF port. Enter correct value.**

  An invalid pin number was entered. Pin numbers 25 to 48 are available for the HF port you specified.

- **6-25006 Pin number must be 1 to 48 for the THF port. Enter correct value.**

  An invalid pin number was entered. Pin numbers 1 to 48 are available for the THF port you specified.

- **6-25007 Port address must be 20201 to 20206, or 20211 to 20213.**

  An invalid port address was entered. Addresses 20201 to 20206 are available for the HF port, and addresses 20211 to 20213 are available for the THF port. Enter a valid port address.

- **6-25008 Must specify the port connected to the PGU.**

  You must specify the port connected to the PGU. Execute pgconn4070 and verify that the value in the PG connection file matches the actual PGU connection, then specify the port connected to the PGU.

- **6-25009 Only CH1 is available for the PGU in 3-level pulse output mode.**

  The PGU specified is in the 3-level pulse output mode. Only CH1 is available for the PGU. Use CH1.

- **6-25010 Only CH1 is available for the PGU in 3-level pulse output mode.**

  The PGU specified is in the 3-level pulse output mode. Only CH1 is available for the PGU. Use CH1.

- **6-25011 Improper port address. Enter correct value.**

  Improper port address value is specified. You must specify the correct value for port connected to the PGU.

- **6-25012 Mode value must be 0 or 1. Enter correct value.**

  `Set_sr_control` TIS error. The mode parameter value must be 0 (independent) or 1 (synchronous).

- **6-25013 Port number must be PSC1, 2, or PSO1 to 5.**

  `Set_sr_mode` TIS error. The port address parameter must be PSC1, 2, or PSO2 to 5.

- **6-25014 Mode value must be 0 or 1. Enter correct value.**

  `Set_sr_mode` TIS error. The mode parameter value must be 0 (Normally Closed) or 1 (Normally Open).

- **6-25015 Port number must be PGU address, PSC1, 2, or PSO1 to 7.**

  `Connect_sr` TIS error. The port address parameter must be PGU address, PSC1, 2, or PSO1 to 7.

- **6-25016 PGU must be connected to the pulse switch control port 1 or 2.**

  `Connect_sr` TIS error. When a PGU unit address is specified for the port parameter the PGU must be connected to pulse switch control port 1 or 2. Specify a valid unit address and verify the PGU is connected correctly.

- **6-25017 To use Connect_sr/Switch_sr, independent mode must be set by Set_type_pg.**

  `Set_sr_pg` TIS error. To control switching by using the `Connect_sr` or the `Switch_sr` the mode parameter value must be 1 (independent mode).

- **6-25018 Port address must be HF, THF, AUX, PSI, or PGU address.**

  An illegal port address was specified. Port address must be HF, THF, AUX, PSI, or PGU address.

- **6-25019 Must specify the port connected to the PGU.**

  You must specify the port connected to the PGU. Execute pgconn4070 and verify that the value in the PG connection file matches the actual PGU connection, then specify the port connected to the PGU.

- **6-25020 Only CH1 is available for the PGU in 3-level pulse output mode.**

  `Set_type_pg` TIS error. The PGU you specified is in the 3-level pulse output mode. Only CH1 is available for the PGU. Use CH1.

- **6-25021 Mode value must be 1 to 3. Enter correct value.**

  `Set_type_pg` TIS error. The mode parameter value must be 1 (2-level pulse), 2 (3-level pulse by one PGU), or 3 (3-level pulse by multiplexer). Enter a a valid mode value.

- **6-25022 Only CH1 is available for the PGU in 3-level pulse output mode.**

  `Set_type_pg` TIS error. Mode=2 is available only for CH1 of the PGU. Use CH1.

- **6-25023 Mode value must be 1 or 3 for this port.**

  `Set_type_pg` TIS error. For the 8114A pulse generator. Mode 1 (2-level pulse) and 3 (3-level pulse by multiplexer) are available for this port. Enter a valid mode value.

- **6-25024 PGU must have two channels for 3-level pulse output.**

  The PGU you specified has only one channel. For 3-level pulse output use a PGU with two output channels.

- **6-25025 Must specify the port connected to the PGU.**

  You must specify the port connected to the PGU. Execute pgconn4070 and verify the value in the PG connection file matches the actual PGU connection, then specify the port connected to the PGU.

- **6-25026 Only CH1 is available for the PGU in 3-level pulse output mode.**

  `Set_level_pg` TIS error. The PGU specified is in the 3-level pulse output mode. Only CH1 is available for the PGU. Use CH1.

- **6-25027 Invalid port for using pulse switch.**

  `Set_level_pg` TIS error. The PGU specified is in the 3-level pulse output mode. Pulse switch is available for the port set to the 2-level pulse or 3-level pulse by the multiplexer. Enter a valid port value.

- **6-25028 Port address must be HF, THF, AUX, PSI, or PGU address.**

  An improper port address was specified. Port address must be HF, THF, AUX, PSI, or PGU address.

- **6-25029 Must specify the port connected to the PGU.**

  You must specify the port connected to the PGU. Execute pgconn4070, and verify the value in the PG connection file matches the actual PGU connection, then specify the port connected to the PGU.

- **6-25030 Only CH1 is available for the PGU in 3-level pulse output mode.**

  The PGU specified is in the 3-level pulse output mode. Only CH1 is available for the PGU. Use CH1.

- **6-25031 PGU must have two channels for 3-level pulse output.**

  The PGU specified has only one channel. Use a PGU with two output channels for 3-level pulse output.

- **6-25032 Invalid port for using pulse switch.**

  `Set_time_pg` TIS error. The PGU specified is in the 3-level pulse output mode. Pulse switch is available for the port which is set to the 2-level pulse or 3-level pulse by the multiplexer. Enter a a valid port value.

- **6-25033 Specify width2 parameter value.**

  `Set_time_pg` TIS error. A Width2 parameter must be specified. Values from 3.3 nsec to 999 msec, or 10.0 nsec to 900 msec (for the 8114A) are available. See the `Set_time_pg` command reference for the required parameters.

- **6-25034 Delay2 parameter value must equal width1 plus delay1 or more.**

  `Set_time_pg` TIS error. A Delay2 parameter value must equal width1 plus delay1 or more. Values from 0 to 999 msec, or 0 to 900 msec (for the 8114A) are available.

- **6-25035 Mode value must be 0, 1, or 2. Enter correct value.**

  `Set_sr_pg` TIS error. The mode parameter value must be 0 (reset), 1 (independent), or 2 (synchronous with pulse). Enter a a valid mode value.

- **6-25036 Specify width parameter value, if mode is set to 2.**

  `Set_sr_pg` TIS error. A width parameter must be specified. Values from 2 msec to 999 msec, or 2 msec to 900 msec (for the 8114A) are available. The width parameter is optional if the Set_sr_pg mode parameter is not 2.

- **6-25037 Must specify the PGU connected to the pulse switch control port.**

  `Set_sr_pg` TIS error. Connect the PGU to the pulse switch control port correctly and execute pgconn4070. Verify the value in the PG connection file matches the actual PGU connection, then specify the PGU connected to the pulse switch control port. See the `Set_sr_pg` command reference for restrictions on the PGU.

- **6-25038 period value too short.**

  `Force_pg` and `Prep_pg` TIS error. The period parameter must be more than or equal to the sum of the timing parameters defined by the `Set_time_pg` command. Enter a valid value.

- **6-25039 Cannot execute the TIS during pulse output.**

  During pulse output the 4072A reports this error by the TIS which controls the PGU setup or the switching matrix PGU path. The TIS stops the program with this error, and also stops pulse output.

- **6-25040 Count value must be 0 to 10000000.**

  `Force_pg` or `Start_pg` TIS error. The count parameter value must be from 0 to 10000000. If the count value is 1 to 10000000, `Force_pg` or `Start_pg` starts the pulse output, and waits for the last count of the pulse. For a count value of 0, the `Force_pg` or `Start_pg` triggers a continuous pulse output and finishes immediately. The pulse output continues until a `Stop_pg` TIS is received. During continuous pulse output the 4072A can receive TIS, but causes error 6-25039. See 6-25039.

- **6-25041 Install or turn on master PG.**

  Cannot detect the master PG. Install or turn on the master PG. The master PG is the pulse generator unit which has the PG logical number 1. See the configuration file (`/etc/opt/hp4070/config/1`) to specify the master PG. This file contains the PG name, PG logical number, bus address, and GPIB address.

- **6-25042 Time accuracy mode must be 0 or 1.**

  `Set_mode_pg` TIS error. The mode parameter value must be 0 (normal) or 1 (pattern). Mode=1 is not available for the 8114A.

- **6-25043 Define slave #1 PG.**

  Pattern mode (`Set_mode_pg`, mode=1) needs slave #1 PG. The slave #1 PG is the pulse generator unit which has the PG logical number 2. Edit the configuration file (`/etc/opt/hp4070/config/1`) and define the slave #1 PG. See 6-25044.

- **6-25044 Install or turn on slave #1 PG.**

  Pattern mode (`Set_mode_pg`, mode=1) needs slave #1 PG. Install and turn on the slave #1 PG. See 6-25043.

- **6-25045 For pattern mode, period value must be 120 μsec or more.**

  In the pattern mode (`Set_mode_pg`, mode=1), the period parameter value must be 120 μsec or more. Enter a a valid period value.

- **6-25046 Do not enter Set_level_pg for the pulse switch control port.**

  You cannot set the pulse output level of the PGU connected to the pulse switch control port. Do not enter `Set_level_pg`.

- **6-25047 Do not enter Set_type_pg for the pulse switch control port.**

  You cannot set the pulse mode of the PGU connected to the pulse switch control port. Do not enter `Set_type_pg`.

- **6-25048 Must specify the pulse switch control port connected to the PGU.**

  You must specify the pulse switch control port connected to the PGU. Execute pgconn4070 and verify the value in the PG connection file matches the actual PGU connection, then specify the pulse switch control port connected to the PGU.

- **6-25049 Do not use 8114A as the slave #1 PG.**

  When the time accuracy is set to pattern mode (`Set_mode_pg`, mode=1) the 8114A pulse generator cannot be used as slave #1. Use normal mode (`Set_mode_pg`, mode=0), or change the configuration by editing the configuration file `/etc/opt/hp4070/config/1`. See 6-25042 and 6-25043.

- **6-25050 Period value for 8114A must be Max msec or less.**

  The period value of the 8114A pulse generator must be Max msec or less. Enter a valid period value.

- **6-25051 Specify period value. The value for 8114A must be Max msec or less.**

  The 4072A automatically calculates the period parameter setting for the 8114A pulse generator in the `Force_pg` or the `Prep_pg` command. If this automatically calculated value exceeds Max msec, then you must manually or explicitly specify the period value.

- **6-25052 PGU (N) is defective or not connected. Check PGU and enter correct port.**

  You must specify the port connected to the PGU. Specify the correct port, and verify the PGU is installed and working correctly.

- **6-25053 Cannot execute Command Name during pulse output.**

  During pulse output, the 4072A causes this error by the TIS which controls the PGU setup or the switching matrix PGU path. The TIS stops the program with this error, and also stops pulse output.

- **6-25054 Output voltage of PGUs connected to PSO N must be same polarity or the difference must be 45 V or less.**

  When an 8110A and an 8114A are connected to PSO1, 6, or 7 using a multiplexer switch, the absolute value of the amplitude of the pulses must be 45 V or less. If the amplitude of the pulses must be 45 V the polarity of the pulses must be the same.

- **6-25055 PG Voltage exceeds the limit. Check the PG voltage connected to PSO N.**

  When using the 8110A and 8114A with a multiplexer, the signal was not output correctly. Verify that the 8110A and the 8114A are connected to PSON and that amplitude of the pulse is set correctly. If this does not correct the error, reduce the amplitude of each pulse.

- **6-25056 PGU output voltage exceeds the limit. Check PGXX output amplitude.**

  Check the amplitude of the PGXX output. The limit is –19 V. If necessary, reduce the amplitude of the signal. If this does not correct the error, contact the nearest Agilent Technologies Sales and Service office.

- **6-25057 Mode value must be 0 to 2. Enter correct value.**

  `Switch_sr` TIS error. Mode must be 0, 1, or 2. Enter a valid mode number.

- **6-25058 Mode value must be 0 to 2. Enter correct value.**

  `Connect_sr` TIS error. Mode must be 0, 1, or 2. Enter a valid mode number.

- **6-25059 Port number must be PSC1, 2, or PSO1 to 7.**

  `Switch_sr` TIS error. The port address parameter must be PSC1, 2, or PSO1 to 7.

- **6-25501 PG Error.**

  An error occurred in the pulse generator unit. The pulse generator will provide detailed error messages.

- **6-25502 PGN pulse level is out of range.**

  The pulse level value is out of range. See the `Set_level_pg` command reference for the available range, and then enter a valid range.

- **6-25503 Load impedance value must be 2.5 ohm to 999 kohm.**

  The load impedance value must be 2.5 ohm to 999 kohm. Enter a valid impedance value.

- **6-25504 Load impedance value must be 10 ohm to 999 kohm.**

  The load impedance value of the 8114A must be 10 ohm to 999 kohm. Enter a valid impedance value.

- **6-25505 *AmpN* value is out of range.**

  `Set_level_pg` TIS error. The *AmpN* parameter value is out of range. See the `Set_level_pg` command reference for the available range, and then enter a valid value.

- **6-25506 3-level pulse output value (*AmpN*) is out of range.**

  `Set_level_pg` TIS error. The *AmpN* parameter value is out of range for the 3-level pulse output port (`Set_type_pg`, mode=2). See the `Set_level_pg` command reference for the available range, and then enter a valid value.

- **6-25507 Sum of 3-level pulse output value is out of range.**

  `Set_level_pg` TIS error. The sum of Amp1 and Amp2 is out of range for the 3-level pulse output port (`Set_type_pg`, mode=2). See the `Set_level_pg` command reference for the available range, and enter a valid value.

- **6-25508 Invalid setup combination of Amp and Base.**

  `Set_level_pg` TIS error. Cannot set the pulse level due to an invalid combination of the Amp value and Base value. See the `Set_level_pg` command reference for the available range, and then enter a valid combination.

- **6-25509 Pulse width (Value) is out of range.**

  `Set_time_pg` TIS error. The width parameter value must be 3.3 nsec to 999 msec, or 10 nsec to 900 msec for the 8114A. Enter a valid range value.

- **6-25510 Delay time (Value) plus skew is out of range.**

  `Set_time_pg` TIS error. The delay parameter value must be 0 to 999 msec, or 0 to 900 msec for 8114A. Enter a valid delay value. The skew between the PG outputs can cause this error.

- **6-25511 Invalid pulse leading time (Value). The value must be 2.0 nsec to 200 msec.**

  `Set_time_pg` TIS error. The leading edge transition time must be 2.0 nsec to 200 msec. Enter a valid transition value.

- **6-25512 Invalid pulse trailing time (Value). The value must be 2.0 nsec to 200 msec.**

  `Set_time_pg` TIS error. The trailing edge transition time must be 2.0 nsec to 200 msec. Enter a valid transition value.

- **6-25513 Leading time and trailing time must be in the same range.**

  `Set_time_pg` TIS error. Both the leading and trailing time must be in the same range. See the `Set_time_pg` command reference for available ranges and then enter a valid value.

- **6-25514 PG Error. Cannot change arming source.**

  Cannot change the arming source. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25515 PG Error. Cannot change pattern mode.**

  Cannot change the pattern mode. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25516 PG Error. Cannot measure trigger period.**

  The pulse generator cannot measure the trigger period. The trigger cable may be disconnected or defective. Or the PGU may be defective. Verify the trigger cable connection and the operation of the PGU.

- **6-25517 Cannot open file (errno = Error No.):** *File_name*

  Cannot open the specified file. Check the file name, permission, and so on.

- **6-25518 Cannot write file (errno = Error No.)**

  Cannot write the file. Check the file name, permission, and so on.

- **6-25519 Cannot read file (errno = Error No.)**

  Cannot read the specified file. Check the file name, permission, and so on.

- **6-25520 PG setup file revision mismatch.**

  The PG setup file does not match the present revision.

- **6-25521 Configuration mismatch.**

  The current configuration does not match the configuration written in the PG setup file. The PG setup file is the file saved by Save_pg TIS.

- **6-25522 PG (N) Error. No response to combined channel query.**

  No response from the PGU for the combined channel query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25523 PG (N) Error. No response to arming source query.**

  No response from the PGU for the arming source query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25524 PG (N) Error. No response to period source query.**

  No response from the PGU for the period source query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25525 PG (N) Error. No response to trigger count query.**

  No response from the PGU for the trigger count query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25526 PG (N) Error. No response to pattern mode query.**

  No response from the PGU for the pattern mode query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25527 PG (N) Error. No response to period query.**

  No response from the PGU for the period query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25528 PG (N) Error. No response to switch query.**

  No response from the PGU for the switch query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25529 PG (N) Error. No response to rload query.**

  No response from the PGU for the rload query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25530 PG (N) Error. No response to delay query.**

  No response from the PGU for the delay query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25531 PG (N) Error. No response to width query.**

  No response from the PGU for the width query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25532 PG (N) Error. No response to leading edge query.**

  No response from the PGU for the leading edge query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25533 PG (N) Error. No response to trailing edge query.**

  No response from the PGU for the trailing edge query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25534 PG (N) Error. No response to complement query.**

  No response from the PGU for the complement query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25535 PG (N) Error. No response to voltage level query.**

  No response from the PGU for the voltage level query. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25536 PG Error. Cannot change period source.**

  Cannot change period source. The PGU may be defective or it may be a TIS fatal error. Verify the PGU is operating correctly.

- **6-25537 Set_level_pg Amp value is out of range.**

  `Set_level_pg` TIS error. For 8114A pulse generator. The Amp parameter value is out of range. See the `Set_level_pg` command reference for the available range, and then enter a valid value.

- **6-25538 Can't open file. filename:** *`File`*

  Could not open the file specified by *`File`*. Confirm the file name and permissions of the file.

- **6-25539 Can't load the offline configuration file. File format incorrect.**

  Could not read the offline configuration file because the file format is incorrect. Check the format of the file you loaded.

- **6-25540 Can't save the offline configuration file.**

  Could not save the offline configuration file. Check the permissions of the file and directory.

- **6-25901 [F_ROM] Port address (Terminal Name) must be unique.**

  Each terminal must be set to a unique port address. Set each terminal to a unique port address.

- **6-25902 [F_ROM] Relay mode must be enabled.**

  Relay mode must be enabled to use pulse switch. Execute F_set_relay_md(1) to enable the relay mode.

- **6-25903 [F_ROM] Port (Terminal Name) must be connected to pulse switch output.**

  A port must be connected to the pulse switch output. Connect the port and specify the correct port.

- **6-25904 [F_ROM] Port (Terminal Name) must be connected to pulse switch output 1, 6, or 7.**

A port must be connected to the pulse switch output 1, 6, or 7. Connect the port and specify the correct port.

- **6-25905 [F_ROM] Port (Terminal Name) must be connected to pulse switch output 2, 3, 4, or 5.**

  A port must be connected to the pulse switch output 2, 3, 4, or 5. Connect the port and specify the correct port.

- **6-25906 Invalid count (Value). The value must be 1to 1000000000.**

  The count parameter value must be 1 to 1000000000. Enter a valid value.

- **6-25907 [F_ROM] PGU (Terminal Name) must be unique.**

  Each terminal must be connected to a unique PGU. Connect each terminal to a unique PGU.

- **6-25908 [F_ROM] Invalid port address for Terminal Name.**

  `F_set_fport` PARA error. The port address must be 20201 to 20206 for HF port, and 20211 to 20213 for THF port, and 20101 to 20108. Enter a valid port address.

- **6-25909 [F_ROM] Invalid PGU connection for Terminal Name.**

  The PGU must be connected to the specified port through the pulse switch. Connect the PGU to the pulse switch input and specify a valid port.

- **6-30002 SMU Calibration Fail.**

  SMU failed the calibration. Do the diagnostics, and do troubleshooting.

- **6-30003 Automatic SMU Calibration Fail.**

  SMU failed the automatic calibration. Do the diagnostics, and do troubleshooting.

- **6-30004 Automatic SMU Calibration Pass.**

  SMU passed the automatic calibration.

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- **7-10001 Power Fail occurred.**

  Testhead power fail occurred. Troubleshoot the testhead power supply and the testhead.

- **7-10002 Over Current or Voltage occurred.**

  Over current or over voltage occurred in the testhead. Troubleshoot the testhead.

- **7-10003 Fixture is opened.**

  Prober/Fixture Sense switch of the testhead is open. Close the sense switch of the testhead.

- **7-10004 Interlock is opened.**

  Interlock of the testhead is open. Close the interlock switch of the testhead.

- **7-10005 Illigal Run Mode in Testhead.**

  This error occurs if the testhead CPU receives any command when the testhead CPU is rebooting. You do not need to care this error.

- **7-10006 Hardware Status returned to the normal state.**

  The 4070 hardware status returned to the normal state. The 4070 can be used normally.

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- **8-10001 Failed to fork TIS Server (errno =** *Error_No.***).**

  hp4070 command or START program failed to start up the TIS server in fork().

  - ❏ If *Error_No.* is 11: Too many processes are running. Kill unnecessary processes or reconfigure kernel to extend maximum number of processes.
  - ❏ If *Error_No.* is 12: Too small swap space or memory to execute TIS server. Increase the swap space or memory.

- **8-10002 Failed to exec TIS Server (errno =** *Error_No.***).**

  hp4070 command or START program failed to start up the TIS server in execv().

  - ❏ If *Error_No.* is 13: Check the permission and directory path of tis_online or tis_offline file.
  - ❏ If *Error_No.* is 249: Too many symbolic links are made for directory path of tis_online or tis_offline file.
  - ❏ If *Error_No.* is 8: tis_online or tis_offline file is not set as an executable file. Set the file as an executable file.
  - ❏ If *Error_No.* is 12: Too small memory to execute TIS server.
  - ❏ If *Error_No.* is 26: tis_online or tis_offline file is opened without write protection.

- **8-11001 TIS server died.**

  hp4070 -shutdown command was executed, or testhead was turned off. Or fatal error occurred in testhead.

- **8-11002 Inconsistent exception (***Error_No.***).**

  TIS server detected illegal error that is not defined as 4070 error condition.

- **8-20001 Invalid parameter.**

  Improper command parameter was specified for hp4070 command. Check the parameter.

- **8-20002 Inconsistent parameters.**

  Invalid multiple command parameters were specified for hp4070 command. Check the parameter.

- **8-20003 Incomplete parameter specification.**

  Command parameter defined for hp4070 command is insufficient. Check the parameters.

- **8-20004 Already logged in.**

  You have already logged into the 4070 operating environment.

- **8-20005 No such session (***Error_No.***).**

  You have not logged into the 4070 operating environment yet. No session to log out.

- **8-20006 System busy (Used by session:** *Session_ID***).**

  The 4070 has already been logged into as the on-line mode by another user specified by *Session_ID*. On-line mode allows one user to use the 4070.

- **8-20007 Session ID must be 1 to 999999.**

  Improper session ID was specified for the environmental parameter PCS_SESSION_ID. The value must be 1 to 999999.

- **8-20008 Optimization level setting must be 0, 1, 2 or 3.**

  Improper value was specified for hp4070 -optimize command. Value must be 0, 1, 2, or 3.

- **8-20009 Too many OFF LINE sessions.**

  Too many users logged into the 4070 off-line mode. Maximum 5 users can log into the 4070 off-line mode.

- **8-20010 Invalid unit on port** *Port_No.*.

  Invalid measurement unit is assigned for the 4062 port number *Port_No.* on the port map file. Maybe the port map file was edited incorrectly. Define the port number mapping properly.

- **8-20011 Invalid 4070 port selection on 4062 port** *Port_No.*.

  Improper 4070 port number is assigned for the 4062 port number *Port_No.* on the port map file. Maybe the port map file was edited incorrectly. Define the port number mapping properly.

- **8-20012 Duplicate 4142B slot specification on 4062 port** *Port_No.*.

  Multiple measurement units are assigned for the 4062 *Port_No.* on the port map file. Only one unit must be defined for one port. Define the port number mapping properly.

- **8-20013 41420A SMU is in slot 1 on 4062 port** *Port_No.*.

  Cannot assign the 41420A SMU for 4062 port *Port_No.* on the port map file because the 41420A uses two module slots of the 4142B. Define the port number mapping properly.

- **8-20014 Can't read the port map file.** *Reason*.

  Port map file could not be read because of the reason shown in *Reason*. Check the file name and the permission of the file and directory.

- **8-20015 Can't load the portmap file. File format incorrect.**

  Port map file could not be loaded because the file format is incorrect.

- **8-20016 Can't load the DUMCONFG file. File format incorrect.**

  The `4062UX DUMCONFIG` file used for port mapping could not be loaded because the file format is incorrect.

- **8-20017 Can't read the DUMCONFIG file** *Reason*.

  The `4062UX DUMCONFIG` file could not be read because of the reason shown in *Reason*. Check the file name, and the permission of the file and directory.

- **8-20018 Can't save the portmap file.** *Reason*.

  Port map file could not be saved because of the reason shown in *Reason*. Check the directory name, and the permission of the file and directory.

- **8-21001 Testhead Over Voltage.**

  SMU in testhead is over voltage. Testhead is automatically shut down.

- **8-22001 Insufficient args (Something's wrong).**
  8-22002 Invalid auto cal interval specified (Something's wrong).

  Error occurred in cal4070 command. Internal error.

- **8-22003 Failed at Matrix Mother Board C/G measurement (status:** *Status*).
  8-22004 Failed at Matrix Mother Board offset measurement (status: *Status*).
  8-22005 Failed at Matrix Mother Board R/L measurement (status: *Status*).
  8-22006 Failed at Testhead offset measurement (status: *Status*).

  Improper capacitance compensation data was returned by CMU (4284A). Check the measurement cable, or execute the relay test of testhead.

- **8-22008 Invalid configuration; Pin Board *Pin_No.* is not present.**
  8-22009 Invalid configuration; Chuck Connection Pin Board is not present.

  Cannot execute the capacitance compensation measurement, because the pin board specified by *Pin_No.* or the chuck connection pin board is not installed in the testhead, or defective. Check the configuration and install the pin board properly.

- **8-22010 Cannot read the file. The file does not exist or does not have read permission.**

  The specified file cannot be read because the file does not exist or does not have read permission.

- **8-22011 Cannot write the file. The file does not exist. Or the file or the directory does not have write permission.**

  The specified file cannot be written. Because the file does not exist, or the file or specified directory does not have write permission.

- **8-22021 Unable to use the same matrix *Pin_No.* for CMH and CML. Specify different pin number.**

  Unable to measure compensation data for level 2 capacitance measurement because the same matrix pin number shown as *Pin_No*. for CMH and CML is specified. Use a different pin number for each port.

- **8-22022 The specified matrix *Pin_No.* does not exist. Use a valid pin.**

  When executing compensation data measurement for level 2 capacitance measurement, a non-existing matrix pin was specified as *Pin_No*. Check available pins and use a valid pin number.

- **8-22030 Cannot find available SMU.**

  The system cannot find any SMUs to measure the PGU compensation data. To execute the PGU calibration, at least one SMU must be installed. Check the actual SMU configuration.

- **8-22031 Cannot find available Matrix Pin.**

  The system cannot find any pin boards for the PGU calibration. To execute the PGU calibration, at least one pin board must be installed for each matrix block. Check the actual pin board configuration.

- **8-22032 Can't save pg calibration data into "/etc/opt/hp4070/pgcaldata" file.**

  The compensation data cannot be saved in the `/etc/opt/hp4070/pgcaldata` file. Check the following items:

  - ❑ The `/etc/opt/hp4070/pgcaldata` must exist.
  - ❑ The permission, owner, and group of this file must be `-rw-r--r--`, "`root`", and "`sys`", respectively.

- **8-22033 Can't load pg calibration data file "/etc/opt/hp4070/pgcaldata".**

  The cal4070 program cannot load the PGU compensation data correctly because of the wrong data format. Copy the `/etc/opt/hp4070/pgcaldata` file from the `/opt/hp4070/newconfig` directory, then execute the cal4070 again.

- **8-22050 Failed at timing calibration *PGnn*. Error: *Error_message***

  The timing calibration for *PGnn* (81110A) from cal4070 program is failed.

- **8-23001 Can't open C compensation data file *File_name* for loading (errno = *Error_No.*).**

  Capacitance compensation data file could not be open because of the reason specified by *Error_No.*.

- **8-23002 Can't open C compensation data file *File_name* for saving (errno = *Error_No.*).**

  Capacitance compensation data file could not be saved because of the reason specified by *Error_No.*.

- **8-23003 Can't read C compensation data file** *File_name* **(errno =** *Error_No.***).**

  Capacitance compensation data file could not be read because of the reason specified by *Error_No.*.

- **8-23004 Invalid C compensation data file format.**

  Capacitance compensation data file could not be read because of invalid file format. Check the file name.

- **8-23005 C compensation data file does not match the present Pin Board configuration.**

  Pin board configuration might be changed. Cannot execute the capacitance compensation properly for the present pin board configuration.

- **8-23501 Cannot find HF Matrix board. Check Port value in PG connection file.**

  The HF matrix board is not installed or it is defective. Edit the PG connection file and delete the PG address set to the specified port (Port).

- **8-23502 One PG must be defined for the relative HF and THF ports. Check Port value in PG connection file.**

  Different PG addresses are defined for the relative HF and THF ports. A single PG address must be defined for the ports. Edit the PG connection file and set a single PG or PSO address, or delete the address set to the specified port (Port).

- **8-23503 Invalid PG connection data on Port. Specified PG or PSO does not exist.**

  An invalid PG or PSO address is defined in the PG connection file. Set the available PG or PSO address to the specified port (Port).

- **8-23504 Cannot find Pulse Switch Block N. Check Port value in PG connection file.**

  Pulse switch block 1 or 2 is not installed or is defective. Edit the PG connection file and delete the PG address set to the specified port (Port) and to port PSI1/2/3/4 or PSI5/6/7.

- **8-23505 Invalid parameter for pgconn4070.**

  An invalid parameter was set for the pgconn4070 command execution. Set the parameter properly or execute pgconn4070 with no parameter.

- **8-23506 Syntax error in dump command.**

  An improper command is entered in the print dialog box. Enter the proper command.

- **8-23507 Cannot search connection for OFF LINE session.**

  Actual PG connection cannot be searched for offline session.

- **8-32002 File already exists. OK to overwrite the file?**

  The file name you specified already exists. Click OK to overwrite the file. Click No to cancel.

- **8-24001 Usage:** *Parameter*

  Improper command parameter was specified for the `setlf` command. Specify the command parameter properly.

- **8-24002 Can't open Optical Interface device file (***Reason***).**

  Failed to open the optical interface device file by `setlf` command because of the reason shown in *Reason*.

- **8-24003 Can't open Optical Interface device file (***Reason***). Perhaps shutting down the system by hp4070 -shutdown is required.**

  Failed to open the optical interface device file by `setlf` command because the 4070 is used by another user (process ID).

Execute hp4070 -shutdown before executing `setlf` command.

- **8-24004 Can't write to the Optical Interface device file (*Reason*).**

  Failed to write the optical interface device file by `setlf` command because of the reason shown in *Reason*.

- **8-24005 Can't read from the Optical Interface device file (*Reason*).**

  Failed to read the optical interface device file by `setlf` command because of the reason shown in *Reason*.

- **8-25020 Can't load the offline configuration file. File format incorrect.**

  Could not read the offline configuration file because the file format is incorrect. Check the format of the file you loaded.

- **8-25021 Can't save the offline configuration file.**

  Could not save the offline configuration file. Check the permission of the file and directory.

- **8-27001 Failed to monitor the log file (/var/opt/hp4070/syslog4070). The log file might not exist.**

  The System Management Panel failed to monitor the log file (`/var/opt/hp4070/syslog4070`). Verify the file exists. Check the permissions of the file or directory.

- **8-27002 Online TIS daemon is not running.**

  The online TIS daemon is not running. Execute the hp4070 -start command.

- **8-27003 Online TIS daemon is already running.**

  Another online TIS daemon is already running. Only one online TIS daemon can run at a time.

- **8-27004 The selected file is not writable. Select another file.**

  The selected file is not writable. Select another file or check the permissions of the file.

- **8-40004 The port map table has been modified. Is it OK to discard the changes?**

  The port map table was modified. Click **OK** to close the dialog box without saving the changes. Click **No** to cancel.

- **8-40005 File already exists. Do you want to overwrite it?**

  The file name you specified already exists. Click **OK** to overwrite the file Click **No** to cancel.

- **8-40006 Is it OK to overwrite the default port map file?**

  You are going to overwrite the default port map file. Click **OK** to overwrite the file. Click **No** to cancel.

- **8-40007 HF port map table has been modified. Is it OK to discard the changes?**

  The HF port map table was modified. Click **OK** to close the dialog box without saving the changes. Click **No** to cancel.

- **8-40008 Is it OK to overwrite the default HF port map file?**

  You are going to overwrite the default HF port map file. Click **OK** to overwrite the file. Click No to cancel.

- **8-40009 Pulse switch table has been modified. Is it OK to discard the changes?**

  The pulse switch table was modified. Click **OK** to close the dialog box without saving the changes. Click **No** to cancel.

- **8-40010 Is it OK to overwrite the default pulse switch file?**

  You are going to overwrite the default pulse switch file. Click **OK** to overwrite the file. Click **No** to cancel.

- **8-42016 Failed to measure calibration data of following PGU.**
  PGnn, *PGnn*, *PGnn*
  Please check using diag4070.
  PG level calibration data will not be updated.

  Abnormal data is measured for the *PGnn*. The level calibration data for the *PGnn* is not updated. Confirm the PG functions by using the diag4070.

- **8-43001 PG connection table was modified. OK to exit the program without saving?**

  The PG connection table was modified. Click **OK** to exit the program without saving the changes. Click **No** to cancel.

- **8-43002 OK to overwrite the default PG connection file?**

  You are going to overwrite the default PG connection file. Click **OK** to overwrite the file. Click **No** to cancel.

- **8-43003 PG connection table was modified. OK to open new file without saving?**

  The PG connection table was modified. Click **OK** to open the new file without saving the changes. Click **No** to cancel.

- **8-43004 OK to exit the program?**

  You are going to exit the program. Click **OK** to exit the program. Click **No** to cancel.

- **8-43005 Searching PGU connections.**

  This message is displayed while searching the PG connection.

- **8-46001 Offline configuration was modified. Is it OK to exit the offline configuration tool without saving?**

  To exit the offline configuration tool without saving, click the **OK** button. If you do *not* want to exit, click the **Cancel** button.

- **8-46002 Is it OK to overwrite the default Offline configuration file?**

  To overwrite the default offline configuration file, click the **OK** button. If you do *not* want to overwrite the file, click the **Cancel** button.

- **8-46003 Offline configuration was modified. Is it OK to open a new file without saving?**

  To open a new file without saving the existing file, click the **OK** button. If you *want* to save the existing file, click the **Cancel** button.

- **8-46004 Is it OK to exit the offline configuration tool?**

  To exit the program, click the **OK** button. If you do *not* want to exit, click the **Cancel** button.

- **8-46005 Is it OK to select 12 pins (pins in multiples of 4)?**

  To select 12 pins (pins in multiples of 4), click the **OK** button. If you do *not* want 12 pins, click the **Cancel** button.

- **8-46006 Is it OK to select 24 pins (even number of pins)?**

  To select 24 pins (even number of pins), click the **OK** button. If you do *not* want 24, click the **Cancel** button.

- **8-46007 Is it OK to select 48 pins?**

  To select 48 pins, click the **OK** button. If you do *not* want 48, click the **Cancel** button.

- **8-46008 Is it OK to clear all pins?**

  To clear all pins, click the **OK** button. If you do *not* want to clear all pins, click the **Cancel** button.

- **8-47001 Is it OK to exit the System Management Panel?**

  To exit the System Management Panel, click the **OK** button. If you do *not* want to exit, click the **Cancel** button.

42-xxxxx

- **42-11020 Parameter name can consist of alphanumeric, space, underscore and period characters only.**
  42-11022 Parameter name must be 15 characters or less.

  Maximum number of characters for parameter name in the IDP setup window is 15.

- **42-11023 Failed to start idpcgen program (*Reason*).**

  Number of processes may be more than the limitation specified in kernel parameter, or available swap space or memory is not sufficient. The error message reported by the HP-UX kernel is shown in Reason.

- **42-11024 A directory name must be specified.**

  A directory name must be specified in the Code Directory field of the Generate Code window.

- **42-11025 A file name must be specified.**

  A file name must be specified in the Source Code Name field of the Generate Code window.

- **42-11026 BASIC line number and its incremental number must be positive.**

  The line number and the incremental number in the BASIC Program Line Numbering field of the Generate Code window must be positive.

- **42-11028 Must specify Algorithm Function Name.**

  An algorithm function name must be specified in the Code Generation Setup window.

- **42-11029 Algorithm function name must begin with an alpha character.**

- **42-23000 Syntax error.**
  Usage: idpcgen {-b|-c} [-mhpfvSP] [-t directory] [-i file] [-o name] [-l 0(TIS)|1(algorithm)|2(program)] [-L [begin_num[,increment_num]]]

-b	Generates BASIC program
-c	Generates C program
-m	Generates Makefile for C language compile
-h	Generates C language header (.h file extension) file
-p	Generates program code for IDP running in the same session idpcgen executed
-f	Forces the specified output file to be overwritten
-v	Displays warning messages
-S	Generates or overwrites SPECS algorithm library spec file
-P	Generates program code using template file for pules
-t directory	Specifies that directory template file exists
-i file	Specifies IDP setup file (.dps file extension) from which program code is generated
-o name	Specifies file name (without file extension) program is saved to
-l 0|1|2	Specifies code generation level
-L begin num, increment_num	Specifies BASIC line numbering

- **42-23001 Must specify one option: -b (BASIC) or -c (C)**

  Idpcgen command must be used with -b (BASIC) or -c (C) option to specify generated programming language.

- **42-23002 Unable to specify -b (BASIC) and -c (C) language options together.**

  Idpcgen command cannot specify both -b (BASIC) and -c (C) language options at the same time.

- **42-23003 Unable to specify -i and -p options together.**

  Idpcgen command cannot specify both -i (specifies .dps IDP setup file) and -p (specifies IDP setup window currently open) options at the same time.

- **42-23004 Failed to open input file** *File_name* **(***Reason***).**

  Idpcgen command failed to open specified *File_name*.dps IDP setup file. Cause of the error is shown in *Reason*.

- **42-23005 Must specify IDP setup file name with -i option.**

  Ipdcgen command must specify IDP setup file name from which the command generates the measurement program file.

- **42-23006 Failed to open output file** *File_name* **(***Reason***).**

  Idpcgen command failed to open output file specified as *File_name*. The cause of the error is shown in *Reason*.

- **42-23007 The specified file name already exists. Use -f option to overwrite it.**

  The output file name for measurement program generated by the idpcgen command already exists. To overwrite the file, specify the -f option with the idpcgen command, or if you do not want to overwrite the file, change the output filename.

- **42-23008 Must specify file name with -o option.**

  When -o option is specified, the idpcgen command must specify a file name without a file extension.

- **42-23009 Failed to open template directory** *Directory_name* **(***Reason***).**

  The idpcten command, used with the -t option, failed to open the specified directory *Directory_name*. The cause of the error is shown in *Reason*.

- **42-23010 Must specify directory name with -t option.**

  When -t option is specified, the idpcgen command must specify a directory name.

- **42-23011 Improper generation level** *Level_number***. Specify 0, 1, or 2 with -l option.**

  Idpcgen command has the wrong *Level_number* setup for -l option (code generation level option). With -l option, specify 0, 1, or 2.

- **42-23012 Must specify 0, 1 or 2 with -l option.**

  When -l option is specified, the idpcgen command must specify a code generation level number.

- **42-23013 Failed to open IPC connection to IDP (***Reason***).**

  Idpcgen command with -p option failed to open IPC connection to IDP. The cause of the error is shown in *Reason*.

- **42-23014 Failed to connect IPC to IDP (***Reason***).**

  Idpcgen command with -p option failed to connect IPC to IDP. The cause of the error is shown in Reason.

- **42-23015 idpcgen failed to communicate with IDP process (*Reason*).**

  Idpcgen command with -p option failed to communicate with the process IDP generated because of the error shown in *Reason*.

- **42-23016 Possible incorrect IDP setup file. Record format mismatched.**

  The file specified by the idpcgen command includes an unrecognized record. May be using an incorrect or incorrectly modified IDP setup file.

- **42-23017 Unable to generate program coding for IDP file created by Rev. B.01.20 or earlier.**

  Idpcgen cannot generate program code for IDP setup file created by 4070 system rev. B.01.20 or earlier. Load the IDP setup file in the 4070 rev. B.01.20 IDP setup window, then save the setup and execute the idpcgen command again. Or, after loading the IDP setup file in the rev. B.01.20 environment, generate program code in the IDP environment.

- **42-23018 Possible incorrect IDP setup file. Record format mismatched.**

  The file specified by the idpcgen command includes an unrecognized record. May be using an incorrect or incorrectly modified IDP setup file.

- **42-23100 Identical name (*Parameter_name*) cannot be used for different data types.**

  The IDP setup file, specified by the idpcgen command, has the identical parameter name setup shown in *Parameter_name* for a different data type. Change the parameter name in the IDP setup window.

- **42-23101 Failed to open template file *File_name* (*Reason*).**

  Idpcgen command failed to open the template file shown as *File_name*. The cause of the error is shown in *Reason*.

- **42-23102 Failed to read template file (*Reason*).**

  Idpcgen command failed to read the template file. The cause of the error is shown in *Reason*.

- **42-23200 Unknown Token. Replace `@' with `@@'.**

  There is an unknown token starting with `@' in the template file specified by the idpcgen command. Replace `@' with `@@'.

- **42-23301 Unknown variable type found: *Variable_type* (*Variable_name*); assumed REAL.**

  In the Algorithm Spec Editor, the setup for *Variable_type* shown in *Variable_name* is incorrect. The setup variable type is ignored and the code is generated as type real.

- **42-33000 Unrecognizable input record: Record**

  The IDP setup file specified by the idpcgen command, has an incorrect record that is not recognized by the code generation function. The IDP setup file may be modified incorrectly. The incorrect record is ignored.

- **42-33001 Duplicate *Parameter_name* exists. Change th *Parameter_name*.**

  The IDP setup file, specified by the idpcgen command, has a duplicate *Parameter_name*. Change the *Parameter_name* in the IDP setup window.

- **42-33002 Template file *File_name* is not in directory shown in *Directory_name*.**

  Template file *File_name* does not exist in the directory specified by *Directory_name*, when using idpcgen with the -t option.

- **42-33003 Unable to access the specified template directory. Default template** *File_name* **is loaded.**

  Unable to find the template file. The idpcgen command cannot access the specified template directory.

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