Agilent 41000 Series Integrated Parametric Analysis and Characterization Environment (Agilent iPACE)

Administration Guide

Agilent Technologies

Notices

Manual Part Number

C1230-90010

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Agilent Technologies	**DECLARATION OF CONFORMITY** According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014	CE

Manufacturer's Name: Agilent Technologies International sarl
Manufacturer's Address: Rue de la Gare 29
Supplier's Address: CH - 1110 Morges
Switzerland

Declares under sole responsibility that the product as originally delivered

Product Name: fA Leakage Low Current Measurement System Solution for Positioner
fA Leakage Low Current Measurement System Solution with Probe Card
10fA Level Automated 14channel Measurement Solution for Probe Card
Ultra Low Current Measurement System Solution for Positioner
Model Number: Agilent C1231A
Agilent C1232A
Agilent C1233A
Agilent C1234A
Product Options: This declaration covers all options of the above product(s)

complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

Low Voltage Directive (2006/95/EC)
EMC Directive (89/336/EEC, amended by 93/68/EEC)

and conforms with the following product standards

EMC	**Standard**	**Limit**
	IEC 61326-1:2005 / EN 61326-1:2006	
	CISPR 11:2003 / EN55011:1998+A1:1999+A2 :2002	Group 1 Class A
	IEC 61000-4-2:2001 /EN 61000-4-2:1995+A1:1998+A2:2001	4 kV CD, 8 kV AD
	IEC 61000-4-3:2002+A1:2002/EN 61000-4-3:2002+A1:2002	3 V/m / 80 MHz-1 GHz / 1.4-2 GHz, 1 V/m / 2-2.7 GHz
	IEC 61000-4-4:2004 / EN 61000-4-4:2004	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:2001/EN 61000-4-5:1995+A1:2001	0.5 kV line-line, 1 kV line-ground
	IEC 61000-4-6:2003 / EN 61000-4-6:1996+A1:2001	3 V, 0.15-80 MHz
	IEC 61000-4-11:2004 / EN 61000-4-11:2004	0 % for 1/0.5 cycle, 0 % for 250/300 cycles, 70 % for 25/30 cycles
	Canada: ICES-001:2004	
	Australia/New Zealand: AS/NZS CISPR 11:2004	

The product was tested in a typical configuration with Agilent Technologies test systems.

Safety IEC 61010-1:2001 / EN 61010-1:2001
Canada: CAN/CSA-C22.2 No. 1010.1-92, NRTL/C

Supplementary Information:
This DoC applies to above-listed products placed on the EU market after:

December 01, 2008
Date

Toshiyuki Kawaji
QA Manager
Agilent Technologies

- **Herstellerbescheinigung**

  GEÄUSCHEMISSION

  Lpa < 70 dB

  am Arbeitsplatz

  normaler Betrieb

  nach DIN 45635 T. 19

- **Manufacturer's Declaration**

  ACOUSTIC NOISE EMISSION

  Lpa < 70dB

  operator position

  normal operation

  per ISO 7779

NOTE

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme à la norme NMB-001 du Canada.

This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Agilent office, or see www.agilent.com/environment/product/ for more information.

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.

- *GROUND THE INSTRUMENT*

  This is Safety Class I 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 example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING **Dangerous Voltage, 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. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

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

Indicates earth (ground) terminal.

Alternating current.

Direct current.

ON (Supply).

OFF (Supply).

STANDBY (Supply).

CAT I Means INSTALLATION CATEGORY I. Measurement terminals on the rear panel 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 personal.

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.

In This Manual

This manual provides the following information of the Agilent 41000 Series Integrated Parametric Analysis and Characterization Environment (Agilent iPACE).

- Chapter 1, "Introduction."

  Describes product overview, specifications, accessories, and options of the Agilent 41000.

- Chapter 2, "Installation and Operation."

  Explains how to install the Agilent 41000 and how to operate the Agilent 41000 system cabinet.

- Chapter 3, "Using Agilent iPACE Verification Tool."

  Explains how to use the Agilent iPACE Verification Tool.

- Chapter 4, "Agilent iPACE Verification Tool."

  Describes the reference information of the Agilent iPACE Verification Tool.

- Chapter 5, "Measurement Techniques."

  Describes measurement techniques to perform low current measurement, low resistance measurement, accurate capacitance measurement, and so on.

- Chapter 6, "Probe Card Interface."

  Describes product overview, specifications, accessories, and options of the Agilent B2220A Probe Card Interface. The probe card interface is a system component of the Agilent 41000 Model 300 and 400.

- Chapter 7, "Service."

  Describes the service information of the Agilent 41000.

NOTE

Other Manuals

For details of system components (instruments), see the manual of each instrument.

Contents

Contents

Contents

Contents

1 Introduction

This chapter provides the following information of the Agilent 41000.

- “Product Overview”
- “System Cabinet”
- “Specifications”
- “Accessories and Options”

Product Overview

Agilent 41000 series Integrated Parametric Analysis and Characterization Environment (Agilent iPACE) is developed to realize the full 1 femtoamp measurement potential of the semiconductor parameter analyzer through a switching matrix, probe card interface, and probe card without any loss in measurement performance. The Agilent 41000 solutions work with the 4155C, 4156C, or E5270B, and are available in both positioner and probe card-based versions. See Table 1-1. These solutions include configurations for a variety of measurement needs along with flexibility for future expansion.

For the expanded measurement requirements, you may add the other instruments, such as digital voltmeters, pulse generators, and network analyzer.

Figure 1-1 **Agilent 41000 Product Image**

In Figure 1-1, the Agilent 41000 contains the system cabinet, the instruments in the cabinet, and the probe card interface that is placed on the auto prober. The auto prober is not included in the Agilent 41000.

Table 1-1 Agilent 41000 Measurement Solutions

	Model 100	Model 200	Model 300	Model 400
Description	ultra-precision, positioner-based	precision, positioner-based, for custom cables	semi-automated, 1 fA leakage, probe card-based	semi-automated, 10 fA leakage, probe card-based
Minimum resolution	E5270B: 0.1 fA/0.5 µV	4156C: 1 fA/0.2 µV E5270B: 1 fA/0.5 µV	4156C: 1 fA/0.2 µV E5270B: 1 fA/0.5 µV	4155C: 20 fA/0.2 µV 4156C: 10 fA/0.2 µV E5270B: 10 fA/0.5 µV
Standard hardware	E5270B with HRSMU/ASU[1]	E5270B or 4156C	E5270B or 4156C	E5270B, 4156C, or 4155C
		B2200A switching matrix, 12 outputs	B2200A switching matrix	B2201A switching matrix
			B2220A probe card interface (24 or 48 pin)	B2220A probe card interface (24 or 48 pin)
	Rack, cables, PDU/EMO[2].	Rack, cables, PDU/EMO[2].	Rack, cables, PDU/EMO[2].	Rack, cables, PDU/EMO[2].
Furnished software	performance integrity verification tools	performance integrity verification tools	performance integrity verification tools	performance integrity verification tools
Optional hardware	4284A LCR meter	4284A LCR meter	4284A LCR meter	4284A LCR meter
		41501B Expander (HPSMU, MPSMU, PGU)	41501B Expander (HPSMU, MPSMU, PGU)	41501B Expander (HPSMU, MPSMU, PGU)
Third-party hardware	Wafer prober and positioner	Wafer prober and positioner	Wafer prober and sub-fA leakage probe card	Wafer prober and low leakage probe card

1. HRSMU is the high resolution source monitor unit. ASU is the atto sense and switch unit.
2. Items can be deleted. PDU is the power distribution unit. EMO is the emergency power-off button.

NOTE

About system components

For the system cabinet, see “System Cabinet” on page 1-9.

For the probe card interface, see “Probe Card Interface” on page 6-1.

For each instrument, see each manual.

Table 1-2 Agilent 41000 Model 100

Function	Component	Option
Analyzer	Agilent E5270B+E5287A+E5288A: HRSMU+ASU [1]	E5287A: HRSMU E5280B: HPSMU [2] E5281B: MPSMU [3]
Switch matrix	-	
C-Meter	Agilent 4284A	Optional
DUT interface	-	
Analyzer connection	Kelvin connection ports	up to 8 ports
Verification software	Agilent iPACE verification tool	
Cabinet	1.6 m height	32 EIA unit
System power supply	Power distribution unit (PDU)	100 V: 15 A, 100-120 V: 20 A, or 200-240 V: 10 A

1. HRSMU is the high resolution source monitor unit. ASU is the atto sense and switch unit. Minimum 1 module is required.
2. HPSMU is the high power source monitor unit.
3. MPSMU is the medium power source monitor unit.

Table 1-3 Agilent 41000 Model 200

Function	Component	Option
Analyzer	Agilent 4156C	Agilent 41501B
	Agilent E5270B	E5287A: HRSMU [1] E5280B: HPSMU [2] E5281B: MPSMU [3]
Switch matrix	Agilent B2200A+B2210A Femto leakage matrix	12, 24, 36 or 48 outputs
C-Meter	Agilent 4284A	Optional
DUT interface	-	
Analyzer connection	Kelvin connection ports	up to 4 ports
Verification software	Agilent iPACE verification tool	
Cabinet	1.6 m height	32 EIA unit
System power supply	Power distribution unit (PDU)	100 V: 15 A, 100-120 V: 20 A, or 200-240 V: 10 A

1. HRSMU is the high resolution source monitor unit.
2. HPSMU is the high power source monitor unit.
3. MPSMU is the medium power source monitor unit.

Table 1-4 **Agilent 41000 Model 300**

Function	Component	Option
Analyzer	Agilent 4156C	Agilent 41501B
	Agilent E5270B	E5287A: HRSMU [1] E5280B: HPSMU [2] E5281B: MPSMU [3]
Switch matrix	Agilent B2200A+B2210A Femto leakage matrix	12, 24, 36 or 48 outputs
C-Meter	Agilent 4284A	Optional
DUT interface	Agilent B2220A	24 or 48 pins
Analyzer connection	Kelvin connection ports	up to 4 ports
Verification software	Agilent iPACE verification tool	
Cabinet	1.6 m height	32 EIA unit
System power supply	Power distribution unit (PDU)	100 V: 15 A, 100-120 V: 20 A, or 200-240 V: 10 A

1. HRSMU is the high resolution source monitor unit. Minimum 1 module is required.
2. HPSMU is the high power source monitor unit.
3. MPSMU is the medium power source monitor unit.

Table 1-5 **Agilent 41000 Model 400**

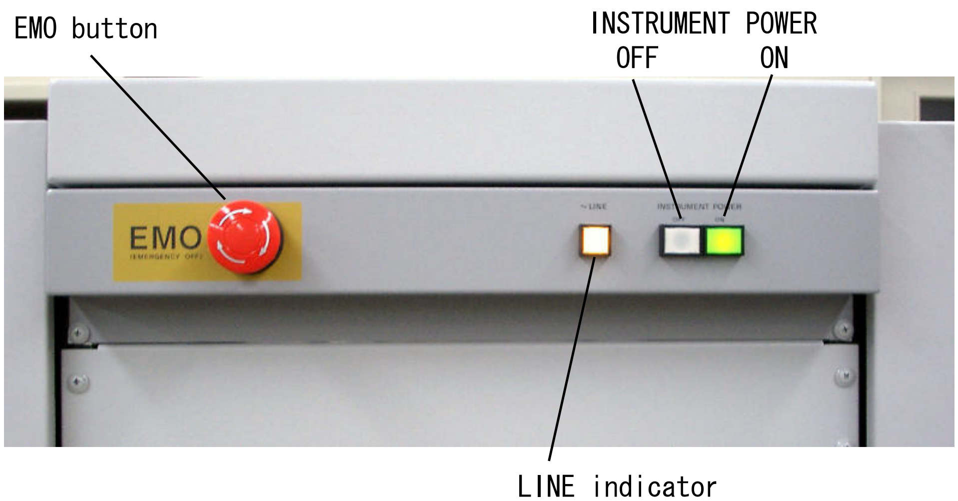
Function	Component	Option
Analyzer	Agilent 4155C or 4156C	Agilent 41501B
	Agilent E5270B	E5287A: HRSMU [1] E5280B: HPSMU [2] E5281B: MPSMU [3]
Switch matrix	Agilent B2201A+B2211A 14ch low leakage matrix	
C-Meter	Agilent 4284A	Optional
DUT interface	Agilent B2220A	24 or 48 pins
Analyzer connection	Kelvin connection ports	up to 4 ports
Verification software	Agilent iPACE verification tool	
Cabinet	1.6 m height	32 EIA unit
System power supply	Power distribution unit (PDU)	100 V: 15 A, 100-120 V: 20 A, or 200-240 V: 10 A

1. HRSMU is the high resolution source monitor unit.
2. HPSMU is the high power source monitor unit.
3. MPSMU is the medium power source monitor unit.

System Cabinet

This section explains important panel features of the Agilent 41000 system cabinet. See Table 1-6 for the EMO/PDU operation and response.

Figure 1-2 **Emergency Power Off (EMO) Panel**



EMO Button

EMO button is used to turn off the power distribution unit (PDU) immediately. If the EMO button is normal position (*out* position), AC power can be applied to the PDU. But if the EMO button is pressed (set to the *in* position), AC power is shut off and the LINE indicator is turned off.

LINE Indicator

LINE indicator lights when AC power is applied to the PDU.

INSTRUMENT POWER ON Button

INSTRUMENT POWER ON button is used to apply AC power to the instruments outlets that are the inside of the system cabinet. If you press this button when the LINE indicator is ON, AC power will be applied to the instruments outlets and the inside green LED will be turned on.

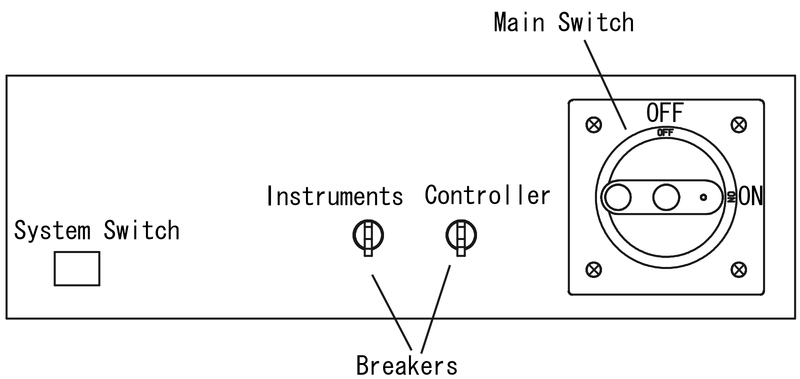
INSTRUMENT POWER OFF Button

INSTRUMENT POWER OFF button is used to shut off AC power to the instruments outlets. If you press this button, AC power to the instruments outlets will be shut off.

Power Distribution Unit

The power distribution unit (PDU) receives AC power from a power switchboard at your site and distributes AC power to the power outlets in the system cabinet and the EMO panel. See Table 1-6 for the EMO/PDU operation and response.

Figure 1-3 **Power Distribution Unit (PDU)**



Instruments Breaker

Instruments breaker protects the equipment connected to the instruments outlets from excessive current. If the excessive current flows through the instruments breaker, AC power to the instruments outlets will be shut off.

The instruments breaker and the controller breaker must be set to the ON position before setting the main switch to the ON position.

Controller Breaker

Controller breaker protects the equipment connected to the controller outlets from excessive current. If the excessive current flows through the controller breaker, AC power to the controller outlets will be shut off.

The instruments breaker and the controller breaker must be set to the ON position before setting the main switch to the ON position.

Main Switch/Breaker

Main breaker protects the PDU from excessive current. If the excessive current flows through the main breaker, AC power will be shut off.

Set the main switch to the ON position, then press the system switch to turn the PDU on.

System Switch

System switch activates the PDU internal circuits. If you press the system switch when the main switch is ON, AC power will be applied to the controller outlets and the inside LED will be turned on.

External EMO Terminals

For connecting an extra emergency power off (EMO) button.

If you need to add an external EMO button, prepare a button and wire it between the Ext. EMO terminals. Opening the terminals shuts off AC power to the PDU (same as setting the EMO button to the *in* position), however it does not change the position of the EMO button on the EMO panel.

When the terminals are shorted (normal condition), steady current (8 mA at 24 Vdc) flows to the terminals.

Remote Control Terminals

For connecting an extra instrument power off button.

If you need to add an external instrument power off button, prepare a button and wire it between the Remote Ctrl. terminals. Opening the terminals shuts off AC power to the instruments outlets (same as pressing the INSTRUMENT POWER OFF button).

When the terminals are shorted (normal condition), steady current (8 mA at 24 Vdc) flows to the terminals.

External Alarm 1 (NC) Terminals

For connecting a signal lamp or alarm that is used to notify that AC power to the PDU is stopped.

The external alarm (Normally Closed) terminals are internally connected to a relay that is closed in the normal condition (when AC power is applied) and is opened in the abnormal condition (when AC power is stopped). The external alarm signal is not changed by opening the Remote Control terminals.

The maximum input is 0.8 A at 24 Vdc. For the external alarm connection, see *Agilent 41000 Preinstallation Guide*.

External Alarm 2 (NO) Terminals

For connecting a signal lamp or alarm that is used to notify that AC power to the PDU is stopped.

The external alarm (Normally Open) terminals are internally connected to a relay that is opened in the normal condition (when AC power is applied) and is closed in the abnormal condition (when AC power is stopped). The external alarm signal is not changed by opening the Remote Control terminals.

The maximum input is 0.8 A at 24 Vdc. For the external alarm connection, see *Agilent 41000 Preinstallation Guide*.

NOTE

Ext. EMO, Remote Ctrl., and Ext. Alarm (NC and NO) Terminals

You can see the terminals on the rear panel of the PDU.

Table 1-6 PDU/EMO Operation and Response

<table>
<tr><th rowspan="2">Operation</th><th colspan="4">Response</th></tr>
<tr><th>AC power to controller outlets</th><th>AC power to instruments outlets</th><th>Ext. Alarm 1 (NC) terminals</th><th>Ext. Alarm 2 (NO) terminals</th></tr>
<tr><td>Sets Main Switch to ON</td><td>not supply</td><td rowspan="2">not supply</td><td>Open</td><td>Close</td></tr>
<tr><td>Presses System Switch</td><td rowspan="4">supply</td><td rowspan="4">Close</td><td rowspan="4">Open</td></tr>
<tr><td>Presses ON Button on EMO Panel</td><td>supply</td></tr>
<tr><td>Presses OFF Button on EMO Panel</td><td rowspan="3">not supply</td></tr>
<tr><td>Opens Remote Ctrl.</td></tr>
<tr><td>Presses EMO Button or opens Ext. EMO</td><td>not supply</td><td>Open</td><td>Close</td></tr>
</table>

To Connect a Signal Lamp

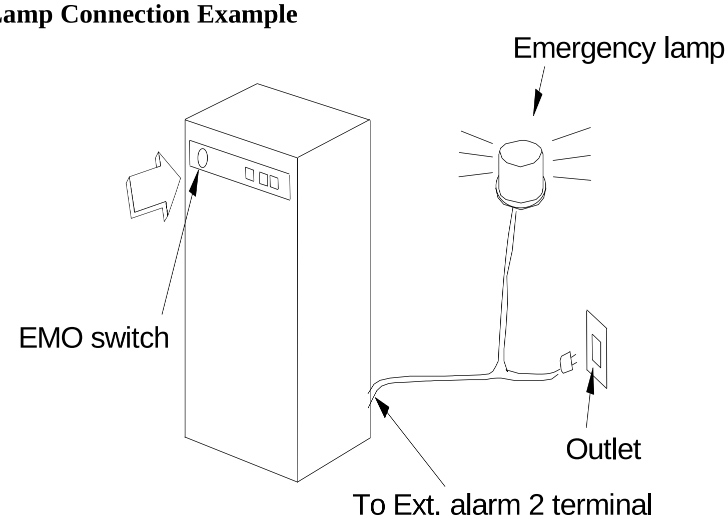
This section shows an example to connect a signal lamp or alarm that is used to notify that AC power to the power distribution unit (PDU) is stopped. Connect a signal lamp to the Ext. Alarm 2 (NO) terminals as shown in the following example. Also see Figure 1-4.

Do not use the outlets in the system cabinet. Because AC power to the outlets will stop when the EMO button is pressed.

WARNING **While at work, never connect anything to the power line outlet for safety.**

1. Connect a wire between a terminal of the signal lamp and one of the Ext. Alarm 2 (NO) terminals.
2. Connect a wire between the other terminal of the signal lamp and the power plug terminal that will be connected to the NEUTRAL of the outlet.
3. Connect a wire between the other side of the Ext. Alarm 2 (NO) terminals and the power plug terminal that will be connected to the LINE of the outlet.

Figure 1-4 Signal Lamp Connection Example



Specifications

The specifications are the performance standards or limits against which these units have been tested. The supplemental information is not warranted, but provides useful information about functions and performance.

Basic Functions

- Probe card direct docking mechanism (Model 300/400)
- High resolution DC measurement
- High resolution capacitance measurement (with Agilent 4284A)
- High performance resource switch capability (with Agilent E5288A for Model 100, with Agilent B2200 for Model 200/300/400)
- Pulsed force/measure (Model 200/300/400 with Agilent 41501B)

Configurations:

- Output pins: 24 or 48 pins (Model 300/400)
- Input ports: 8 triaxial ports (0 to 4 ports selectable Kelvin input) and 6 coaxial ports (Model 200/300/400)
- Analyzer: Agilent E5270B, 4156C (Model 200/300/400), or 4155C (Model 400)
- Additional instruments: Optional
  - Agilent 4284A Precision LCR Meter (as 1 MHz CMU)
  - Agilent 41501B SMU and Pulse Generator Expander (for 4155C/4156C)
- PDU (with EMO): Optional
- Furnished software:

  Measurement path control and path characteristics measurement software (Agilent iPACE Verification Tool)
- Furnished accessories:

  Connection cables between instruments

Specification Condition:

If not noted otherwise, the conditions for specifications and supplemental information are as follows.

- Temperature: 23 °C ± 5 °C
- Relative Humidity (R.H.): 60 % and bellow

System components reference to the specification of each product.

General Specifications

Temperature range:	Operation: 5 °C to 35 °C Storage: – 20 °C to 60 °C
Humidity range:	Operation: 5 % to 70 % R.H., no condensation Storage: • Model 300: < 80 % R.H. at 35 °C, < 60 % R.H. at 60 °C, no condensation • Model 400: < 80 % R.H. at 60 °C, no condensation
Altitude:	Operating: 0 to 2,000 m (6,500 ft) Storage: 0 to 15,240 m (50,000 ft)
Regulatory compliance:	Safety: Low Voltage Directive 73/23/EEC, 93/68/EEC EN61010-1, CSA C22.2 No.1010.1 EMC: EMC Directive 89/336/EEC, 93/68/EEC EN61326-1, ICES-001, AS/NZS CISPR 11
Dimensions:	Cabinet: 1600 mm H × 500 mm W × 700 mm D Probe Card Interface (for Model 300/400): 162 mm H × 390 mm W × 375 mm D, 220 mm H with contact pin
Weight:	Cabinet (for Model 100/200): 100 kg to 150 kg Cabinet (for Model 300/400): 140 kg to 200 kg Probe Card Interface (for Model 300/400): 15 kg
Power requirement:	100-120 V 47-63 Hz: 20 A, 200-240 V 47-63 Hz: 10 A, or 100 V 47-63 Hz: 15 A

Accessories and Options

The following is the furnished accessory for the Agilent 41000 Model 100/200.

- Agilent 41000 System cabinet, 1 set
- Agilent iPACE Verification Tool, 1 ea.
- Agilent 1250-2618 Triaxial (female to female) Adapter, 1 ea.
- Agilent 1250-1708 Triaxial Open Connector, 1 ea.
- Manual CD, 1 ea.

The following is the furnished accessory for the Agilent 41000 Model 300/400.

- Agilent 41000 System cabinet, 1 set
- Agilent iPACE Verification Tool, 1 ea.
- Agilent 1250-2618 Triaxial (female to female) Adapter, 1 ea.
- Agilent 1250-1708 Triaxial Open Connector, 1 ea.
- Manual CD, 1 ea.
- Agilent E3140A Test Fixture Adapter, 1 ea.
- Agilent E3142A Performance Check Fixture, 1 set
    - E3190-60042 PV Open Fixture, 1 ea.
    - E3144-60001 Card Fixture, 1 ea.
- Agilent E3143A Connection Check Fixture, 1 set
    - E3141A (E3141-60005) Universal Fixture, 1 ea.
    - E3143-60001 Connection Check Fixture, 1 ea.

Options and available accessories for Agilent 41000 series are listed below.

Table 1-7 **Options and Available Accessories**

Model Number	Option Item	Description
C1231A		fA Leakage Low Current Measurement System Solution for Positioner (Model 200)
	C1231A-100	100 V Power Line
	C1231A-120	120 V Power Line
	C1231A-200	200 V Power Line
	C1231A-240	240 V Power Line
	C1231A-ABA	Paper Manual, English
	C1231A-ABJ	Paper Manual, Japanese
	C1231A-KLV	Number of Kelvin Connection Channels
C1232A		fA Leakage Low Current Measurement System Solution with Probe Card (Model 300)
	C1232A-003	3 m Cable for Probe Card Interface
	C1232A-004	4 m Cable for Probe Card Interface
	C1232A-012	Matrix 12 Outputs
	C1232A-024	Matrix 24 Outputs
	C1232A-036	Matrix 36 Outputs
	C1232A-048	Matrix 48 Outputs
	C1232A-100	100 V Power Line
	C1232A-120	120 V Power Line
	C1232A-200	200 V Power Line
	C1232A-240	240 V Power Line
	C1232A-ABA	Paper Manual, English
	C1232A-ABJ	Paper Manual, Japanese
	C1232A-KLV	Number of Kelvin Connection Channels
	C1232A-NAN	Delete Analyzer
	C1232A-NIF	Delete Probe Card Interface

Model Number	Option Item	Description
C1233A		10 fA Level Automated 14 channel Measurement Solution for Probe Card (Model 400)
	C1233A-003	3 m Cable for Probe Card Interface
	C1233A-004	4 m Cable for Probe Card Interface
	C1233A-012	Matrix 12 Outputs
	C1233A-024	Matrix 24 Outputs
	C1233A-036	Matrix 36 Outputs
	C1233A-048	Matrix 48 Outputs
	C1233A-100	100 V Power Line
	C1233A-120	120 V Power Line
	C1233A-200	200 V Power Line
	C1233A-240	240 V Power Line
	C1233A-ABA	Paper Manual, English
	C1233A-ABJ	Paper Manual, Japanese
	C1233A-KLV	Number of Kelvin Connection Channels
	C1233A-NAN	Delete Analyzer
	C1233A-NIF	Delete Probe Card Interface
C1234A		Ultra Low Current Measurement System Solution for Positioner (Model 100)
	C1234A-100	100 V Power Line
	C1234A-120	120 V Power Line
	C1234A-200	200 V Power Line
	C1234A-240	240 V Power Line
	C1234A-ABA	Paper Manual, English
	C1234A-ABJ	Paper Manual, Japanese
C1230A	C1230A-PW0	No PDU
	C1230A-PW1	PDU, 100 to 120 V, 20 A maximum
	C1230A-PW2	PDU, 200 to 240 V, 10 A maximum
	C1230A-PW3	PDU, 100 V, 15 A maximum

Model Number	Option Item	Description
4155C		Semiconductor Parameter Analyzer (for Model 400)
	4155C-ABA	Paper Manual Set, English
	4155C-ABJ	Paper Manual Set, Japanese
4156C		Precision Semiconductor Parameter Analyzer
	4156C-ABA	Paper Manual Set, English
	4156C-ABJ	Paper Manual Set, Japanese
E5270B		8 Slot Precision Measurement Mainframe
	E5270B-ABA	Paper Manual Set, English
	E5270B-ABJ	Paper Manual Set, Japanese
B2200A		Femto Leakage Switch Mainframe (for Model 200/300)
	B2200A-ABA	Paper Manual, English
	B2200A-ABJ	Paper Manual, Japanese
B2201A		14ch Low Leakage Switch Mainframe (for Model 400)
	B2201A-ABA	Paper Manual, English
	B2201A-ABJ	Paper Manual, Japanese

Table 1-8 Available Accessories for Model 100

Model Number	Option Item	Description
16493B		Coaxial Cable for 4155/4156 VSU/VMU/PGU
16493J		Interlock Cable
16493K		Kelvin Triaxial Cable
16493L		GNDU Cable
16494A		Triaxial Cable
16048D/E		Test Leads for 4284A
16495E		Blank Plate
16495F		Connector Plate (12 triaxial connectors)
16495G		Connector Plate (24 triaxial connectors)
16495F		Connector Plate (6 triaxial connectors)
16495G		Connector Plate (8 triaxial connectors)
16495K		Connector Plate with Universal Cable Holder
N1253A	N1253A-100	Digital I/O T-cable
	N1253A-200	Digital I/O BNC Box
N1254A	N1254A-100	GNDU to Kelvin Adapter
	N1254A-108	Magnet Stand for ASU

Table 1-9 Available Accessories for Model 200

Model Number	Option Item	Description
16493B		Coaxial Cable for 4155/4156 VSU/VMU/PGU
16493J		Interlock Cable for 4155/4156/E5270
16493K		Kelvin Triaxial Cable from 4156/E5270 to B2200
16493L		GNDU Cable
16494A		Triaxial Cable
16494B		Kelvin Triaxial Cable from B2200 output to 16495F/G
16494F		CMU Input Cable
16495E		Blank Plate
16495F		Connector Plate (12 triaxial connectors)

Model Number	Option Item	Description
16495G		Connector Plate (24 triaxial connectors)
N1253A	N1253A-100	Digital I/O T-cable
	N1253A-200	Digital I/O BNC Box
N1254A	N1254A-100	GNDU to Kelvin Adapter
	N1254A-107	Triax(m)-Triax(f) Adapter

Table 1-10 **Available Accessories for Model 300/400**

Model Number	Option Item	Description
16493B		Coaxial Cable for 4155/4156 VSU/VMU/PGU
16493J		Interlock Cable for 4155/4156/E5270
16493K		Kelvin Triaxial Cable from 4156/E5270 to B2200
16493L		GNDU Cable
16494A		Triaxial Cable
16494C		Kelvin Triaxial Cable from B2200 output to B2220A
16494F		CMU Input Cable
E3140A		Test Fixture Adapter
E3141A		Universal Test Fixture
E3142A		Performance Check Fixture for Low Current
E3143A		Connection Check Fixture Set for PCIF
N1253A	N1253A-100	Digital I/O T-cable
	N1253A-200	Digital I/O BNC Box
N1254A	N1254A-100	GNDU to Kelvin Adapter
	N1254A-107	Triax(m)-Triax(f) Adapter

2 Installation and Operation

This chapter describes how to install the Agilent 41000 and how to operate the Agilent 41000 system cabinet.

- "Installation"
- "Turning the PDU On and Off"
- "Recovering from Power Line Problems"
- "Maintenance"

NOTE

About System Components

For the operation of the instruments (system components of the Agilent 41000), see manuals of each instrument.

NOTE

Site Preparation

You have to perform the site preparation before you receive the Agilent 41000. The site preparation information is described in *Agilent 41000 Preinstallation Guide* that must be delivered to you as soon as the order is accepted.

CAUTION

Before Opening Packing Materials

The Agilent 41000 Model 200/300/400 contains the Agilent B2200 switching matrix that uses the condensation sensitive electronic parts. The condensation will have a negative impact on the Agilent B2200 to operate normally.

Do not open the packing materials, and leave the Agilent 41000 to acclimate it to the installation environment (temperature and humidity). If it is opened without enough acclimation, the Agilent B2200 may damage.

NOTE

Unpacking

After enough time to acclimate the Agilent 41000 to your installation environment, open the packing materials as shown below.

1. Unpack the system cabinet and accessories.
2. Move them to the installation location.

For details, see *Agilent 41000 Preinstallation Guide*.

NOTE

Agilent 41000 Measurement Record of Integrity Verification

Keep this report that shows the measurement performance data, not specifications, when the Agilent 41000 is shipped from the factory. The data is not guaranteed, but can be used as a reference data when you verify the Agilent 41000 measurement performance by using the Agilent iPACE Verification Tool.

Installation

This section provides the information and the procedures needed to install the Agilent 41000.

- "Before Installation"
- "Inspection"
- "Model 100: To Connect ASU"
- "Model 100/200: To Connect 16495"
- "Model 100/200: To Make Your Connector Panel"
- "Model 300/400: To Install B2220A"
- "Model 300/400: To Use Test Fixture"
- "Model 300/400: To Connect Measurement Cables"
- "To Connect Power Cable"
- "To Connect GPIB Cable"
- "To Check Operation"

Before Installation

Before starting the installation, secure enough space to install the Agilent 41000 and prepare the site power line and the receptacle for the Agilent 41000 power cable. Also arrange the installation of the auto prober if necessary. For details, see *Agilent 41000 Preinstallation Guide*.

Inspection

When you open the box that contains the Agilent 41000, check the following:

1. Before unpacking any components, inspect all boxes for any signs of damage that might have occurred during shipment such as:
    - Dents
    - Scratches
    - Cuts
    - Water marks
2. When you open the boxes that contain the Agilent 41000, check the components against the contents lists that are attached to the boxes.

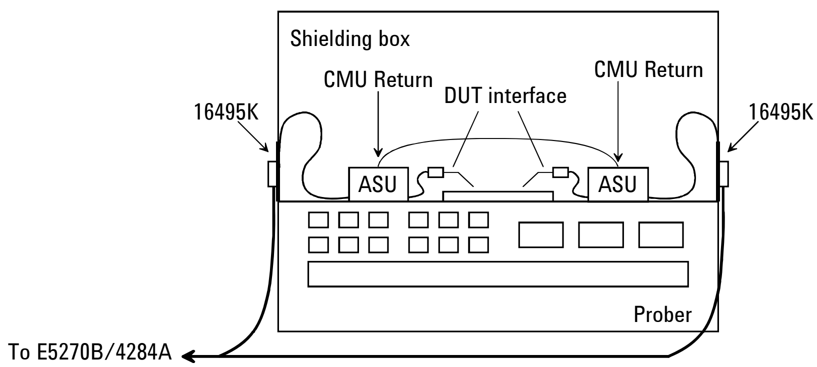
If anything is wrong, notify your local Agilent Technologies sales office.

Model 100: To Connect ASU

The Agilent E5288A Atto Sense and Switch Unit (ASU) will add the 1 pA range to the high resolution SMU (HRSMU) when it is connected between the HRSMU and the device under test (DUT). And the ASU provides the input selection function when instruments are connected to the SMU input and the AUX input.

NOTE For the installation of the ASU and the connection to the DUT interface (probe card, manipulators, and so on), contact your favorite prober vender. The prober vender will have the solutions. Dimensions of the ASU are 132 mm (W) × 50 mm (D) × 88.5 mm (H) excluding the connectors.

Figure 2-1 **Image of ASU Installation**



To install 16495K Fix the 16495K plate to the shielding box or something that will cover the DUT interface. See *Agilent 16495 Installation Guide*. The 16495K is the plate that has the mechanizm to block the light from the cable hole used to pass the cables in the shielding box.

To install ASU

1. Fix the ASU in the shielding box. The ASU must be fixed to the best position for accessing its connectors. The Agilent N1254A-108 Magnetic Stand will be useful for fixing the ASU.
2. Pass the 16493M (D-sub cable, triaxial cable), 16048D/E test leads, BNC cable and so on through the cable hole of the 16495K. They will be connected between the ASU and the instruments
3. Connect the D-sub cable to the ASU D-sub connector.

   Connect the triaxial cable to the ASU Force terminal.

   Connect the cable to the ASU CMU-cur/AUX In terminal. See Figure 2-2.

   - For the Agilent 4284A LCR meter, connect the Agilent 16048D/E test leads.
   - For the non four-terminal-pairs (4TP) instruments, connect the BNC cable to the CMU-cur/AUX In terminal. And open the CMU-pot terminal or cover it by using the BNC open cap.
4. Adjust the cable length in the shielding box, and catch in the cables by using the cover of the 16495K.
5. Connect the cable extended from the DUT interface to the ASU output terminal.

   For the non Kelvin connections, open the Sense terminal or cover it by using the triaxial open cap.

To connect E5270B

1. Turn the Agilent E5270B off.
2. Connect the D-sub cable from the ASU to the HRSMU D-sub connector.
3. Connect the triaxial cable from the ASU to the HRSMU Force terminal.

NOTE

Connect ASU to dedicated HRSMU

The specifications are satisfied and guaranteed for the exclusive combination of the ASU and the HRSMU. So confirm the serial number of the ASU and connect it to the dedicated HRSMU properly.

To connect AUX to instrument

1. Turn the instrument off.
2. Conect the BNC cable from the ASU CMU-cur/AUX In terminal to the instrument. Prepare an adapter if the instrument's input/output connector is not BNC.

To connect 4284A

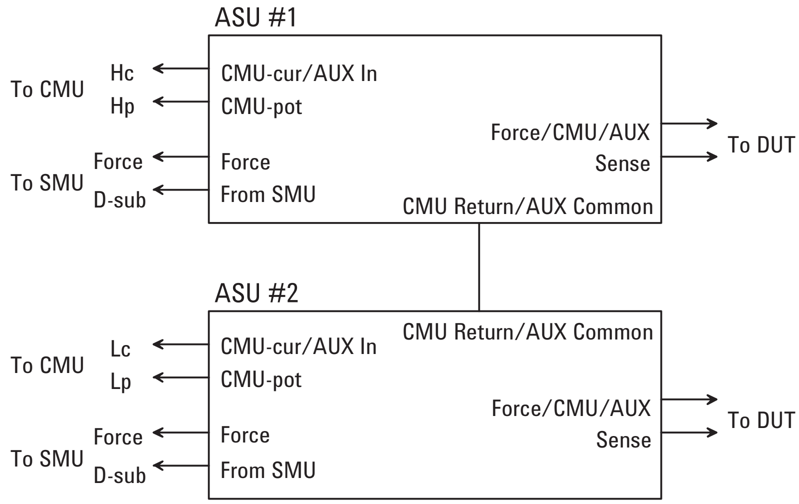
1. Turn the Agilent 4284A off.
2. Prepare two ASUs (#1 and #2).
3. Connect the Agilent 16048D/E test leads to the 4284A.
4. Connect the high potential (Hp) cable of the test leads to the CMU-pot terminal of the ASU #1. See Figure 2-2.
5. Connect the high current (Hc) cable to the CMU-cur/AUX In terminal of the ASU #1.
6. Connect the low potential (Lp) cable to the CMU-pot terminal of the ASU #2.
7. Connect the low current (Lc) cable to the CMU-cur/AUX In terminal of the ASU #2.
8. Prepare the connection wire (both pin terminals) furnished with the ASU and connect it between the CMU Return terminals of the ASU #1 and ASU #2 together.

NOTE

Cables for ASU outputs

To perform capacitance measurements accurately, prepare the cables of the same material, structure, and length for both of the ASU #1 and ASU #2.

Figure 2-2 **To Connect ASU**



Model 100/200: To Connect 16495

The available connector plates are listed in Table 2-1. For connector plate installation information, refer to *Agilent 16495 Installation Guide*.

For the connections between the instruments and the connector plate, use the measurement cables listed in Table 2-2 and Table 2-3, and connect them to the appropriate connectors.

For the connections over the connector plate, see the following tables.

- Table 2-4 shows the GNDU output connections over the connector plate.
- Table 2-5 shows the SMU output connections over the connector plate.
- Table 2-6 shows the AUX output connections over the connector plate.

Also make the interlock circuit and connect it to the instrument's Interlock terminal. For details, see "To Make an Interlock Circuit" on page 2-11. The Agilent E5270B/4155C/4156C provides the interlock function. If the interlock terminal is open, the instrument *cannot* force high voltage more than ±42 V.

NOTE

Making non-Kelvin connection

The Force terminals can be used to force and measure DC voltage or current. If you want to simplify the cable connections, open the Sense terminals and connect the Force terminals only to the connector plate by using the triaxial cables.

If you make the kelvin connection, use both Force and Sense terminals. Connecting the Force and Sense lines together at the terminal of the device under test minimizes the measurement error caused by the residual resistance of the connection cables. The kelvin connection is effective for the low resistance measurement and the high current measurement.

Table 2-1 Connector Plates

Model	Option Item[1]	Connectors
16495F	16495F-001	Triax. (f-f) ×12, GNDU (f-f) ×1, Interlock (f) ×1
	16495F-002	Triax. (f) ×12, GNDU (f) ×1, Interlock (f) ×1
16495G	16495G-001	Triax. (f-f) ×24, GNDU (f-f) ×1, Interlock (f) ×1
	16495G-002	Triax. (f) ×24, GNDU (f) ×1, Interlock (f) ×1
16495H	16495H-001	Triax. (f-f) ×6, Coax. (f-f) ×6, GNDU (f-f) ×1, Interlock (f) ×1
	16495H-002	Triax. (f) ×6, Coax. (f) ×6, GNDU (f) ×1, Interlock (f) ×1
16495J	16495J-001	Triax. (f-f) ×8, Coax. (f-f) ×4, GNDU (f-f) ×1, Interlock (f) ×1
	16495J-002	Triax. (f) ×8, Coax. (f) ×4, GNDU (f) ×1, Interlock (f) ×1
16495K	16495K-001	Connector Plate with Rubber Holder

1. Option 001 provides the through connectors except for the Interlock connector that provides the soldering patterns at the back side. For the option 002, the back of each connector is designed for soldering.

Table 2-2 Model 100 Measurement Cable Connections

Terminal name		Designation on plate [1]	Cable
Interlock		Intlk	Agilent 16493J Interlock Cable
GNDU		GNDU	Agilent 16493L GNDU Cable
E5270B SMU	Force	Odd number from 1 to 24	For Kelvin connection. Agilent 16493K Kelvin Triaxial Cable. 16495F/G/H/J allow 6/12/3/4 Kelvin triaxial connections respectively.
	Sense	Even number from 1 to 24	
E5270B SMU	Force	1 to 24	For non-Kelvin connection. Agilent 16494A Triaxial Cable. 16495F/G/H/J allow 12/24/6/8 triaxial connections respectively.
	Sense	-	For non-Kelvin connection. Open Sense terminal.
4284A	Unknown (H_{CUR}, H_{POT}, L_{CUR}, L_{POT})	-	Connect the Agilent 16048D/E Test Leads and connect it to the Agilent E5288A Atto Sense/Switch Unit (ASU). See “Model 100: To Connect ASU” on page 2-4. Two each of the ASUs are required. Or connect the test leads and connect it to the AUX terminals (coaxial BNC) of the 16495H/16495J connector plate. Then the Agilent 16494F CMU Cable can be used.

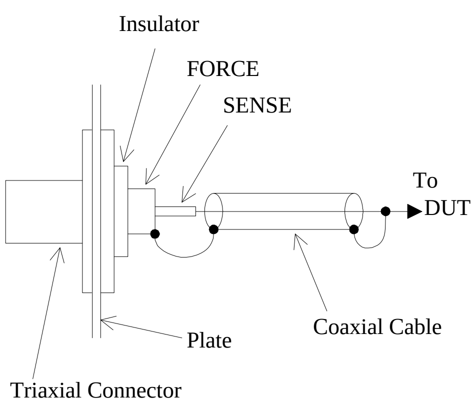
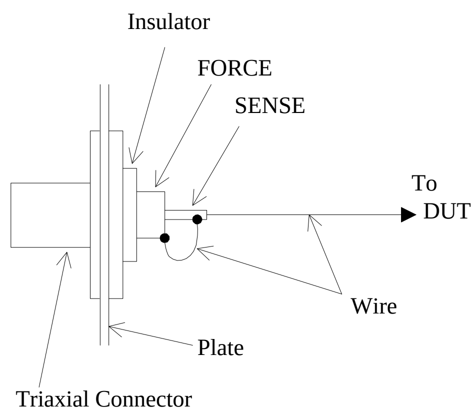
1. Maximum connector number labelled depends on the connector plate.

Table 2-3 Model 200 Measurement Cable Connections

Terminal name		Designation on plate [1]	Cable
Interlock		Intlk	Agilent 16493J Interlock Cable
GNDU		GNDU	Agilent 16493L GNDU Cable
B2200A Output	Force	Odd number from 1 to 24	For Kelvin connection. Agilent 16494B Kelvin Triaxial Cable. 16495F/G allow 6/12 Kelvin triaxial connections respectively.
	Sense	Even number from 1 to 24	
B2200A Output	Force	1 to 24	For non-Kelvin connection. Agilent 16494A Triaxial Cable. 16495F/G allow 12/24 triaxial connections respectively.
	Sense	-	For non-Kelvin connection. Open Sense terminal.
4284A	Unknown (H_{CUR}, H_{POT}, L_{CUR}, L_{POT})	-	Connect the Agilent 16494F CMU cable and connect it to the Agilent B2200A Input 13 (CMH) and 14 (CML).

1. Maximum connector number labelled depends on the connector plate.

Table 2-4 GNDU Output Connections

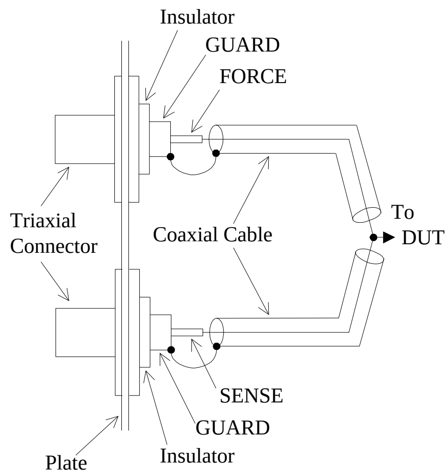
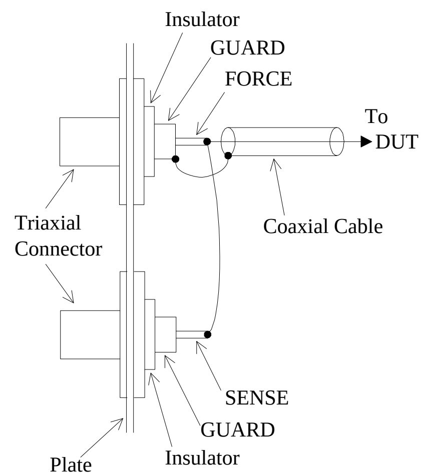
Kelvin connections	non-Kelvin connections
Use a low-noise coaxial cable (Agilent part number 8121-1189) from the connector to the prober, socket, or DUT as shown. To cancel the effects of cable resistance, connect the Sense line and Force line as close as possible to the terminal of the DUT.	Short the Sense and Force on the connector as shown below. Measurement data will include the residual resistance of the connection wire. Use AWG 22 single-strand insulated wire (Agilent part number 8150-2639) from the connector plate to the prober, socket, or DUT. For a quick connection where measurement accuracy is not critical, connect only Force to the DUT, without shorting the Sense and Force. With this connection, the measurement data will include residual resistance from the connection cable between the GNDU and the connector plate.
	

CAUTION

GNDU can sink up to 4A for the Agilent E5270B or 1.6 A for the Agilent 41501B. Use the Agilent 16493L GNDU cable to connect the GNDU to your connector plate or test fixture.

The maximum current rating of the triaxial cable is 1 A, so do *not* use the triaxial cable for the GNDU connection.

Table 2-5 **SMU Output Connections**

Kelvin connections	non-Kelvin connections
Use low-noise coaxial cable (Agilent part number 8121-1191) from the connector to the prober, socket, or DUT as shown. To cancel the effects of cable resistance, connect the Sense line and Force line as close as possible to the DUT terminal. To prevent oscillations, do not use cables longer than 1.5 m. To make accurate measurements when applying high currents, extend the guard as far as possible from the front panel connector to the DUT. Physically stabilize the cables with tape.	The following figure is when the Kelvin triaxial cable is used. If the triaxial cable is used, connect the cable to the Force terminal only. With this connection, the measurement data will include residual resistance from the connection cable. Use low-noise coaxial cable (Agilent part number 8121-1191). To make accurate measurements when applying high currents, extend the guard as far as possible from the front panel connector to the DUT.
	

CAUTION

Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the SMU.

WARNING

Potentially hazardous voltages, up to ±100 V (±200 V for HPSMU), are present at the Force, Sense, and Guard terminals.

To prevent electrical shock, do not expose these lines.

Before turning the instrument on, connect the Intlk terminal to a switch that turns off when the shielding box access door is opened.

Before you touch any connections to these terminals, turn the instrument off, disconnect the power cable, and discharge any capacitors.

Low-Noise Coaxial Cable

For the extended measurement paths over the connector plate, use low-noise coaxial cable (Agilent part number 8121-1191). This cable can maximize the guard effects and minimize the impression of the external noise.

Figure 2-3 shows the cutting example of this cable. Key point is the isolation between the conductive layer and the center conductor. So, cut and trim the end of the cable as shown in this figure by using a cutter and so on.

Figure 2-3 **Coaxial Cable Cutting Example**

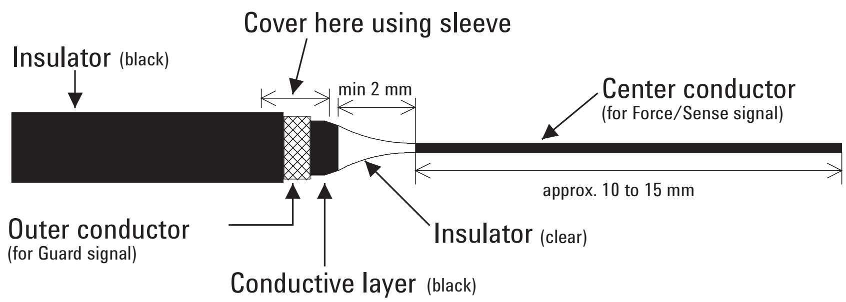
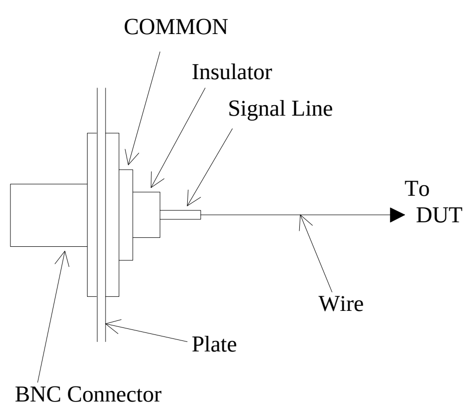
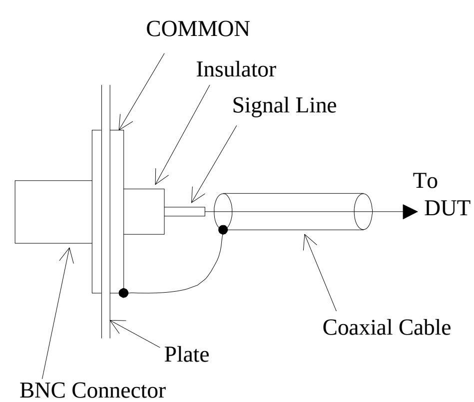


Table 2-6 **AUX (Coax. BNC) Output Connections**

Wire connections	Coaxial connections
Use AWG 24 single-strand insulated wire (Agilent part number 8150-0447) to connect to a prober, socket, or DUT.	Regardless of the output impedance setting, use a low-noise coaxial cable (Agilent part number 8120-0102) from the connector to a prober, socket, or DUT.
	

⚠ To Make an Interlock Circuit

The Agilent E5270B/4155C/4156C provides an interlock terminal to prevent you from receiving an electrical shock from high voltage (more than ±42 V). If the interlock terminal is open, the instrument *cannot* force high voltage more than ±42 V.

You must install an interlock circuit on a shielding box and connect it to the instrument's Interlock terminal to prevent hazardous voltages when the door of the shielding box is open.

Figure 2-4 shows the pin assignments of the interlock connector mounted on a connector plate or test fixture. The left side is the pin assignments seen from the plug side, and the right side is the pin assignments seen from the soldering side.

WARNING **Potentially hazardous voltages may be present at the Force, Guard, and Sense terminals when the interlock terminals are shorted.**

Install the interlock circuit as follows:

1. Mount two mechanical switches on your shielding box, so that the switches close when the door of the shielding box is closed, and open when the door is opened. For the dimensions of the switch, see Figure 2-6 and Figure 2-7.
2. Mount an LED on your shielding box. For the dimensions of the LED, see Figure 2-5.
3. Use wire to connect the two switches in series between pin number 1 and 2 (or 3) of the interlock connector. See Figure 2-4.
4. Use wire to connect the LED between pin number 4 and 5 (or 6) of the interlock connector. See Figure 2-4.

If the instrument's Interlock connector is connected to the interlock circuit, the instrument *cannot* force more than ±42 V when the door is open. When the door is closed, the instrument can force more than ±42 V.

When more than ±42 V is forced from an SMU, the LED lights to indicate *high voltage output*.

Figure 2-4 **Interlock Connector Pin Assignments**

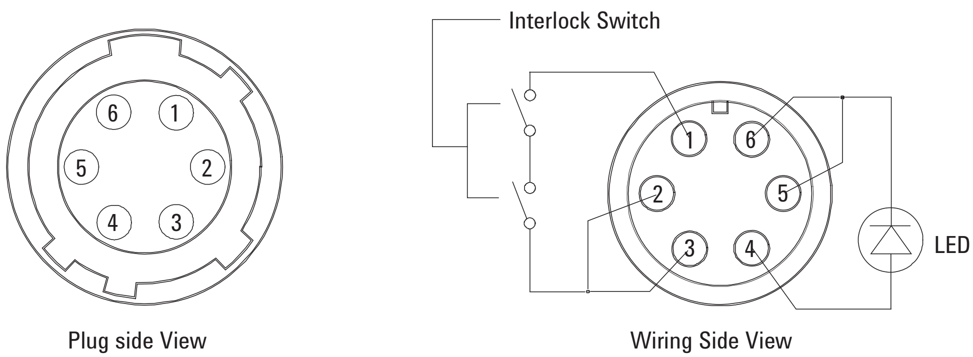


Figure 2-5 **Dimensions of the LED (Agilent part number 1450-0641)**

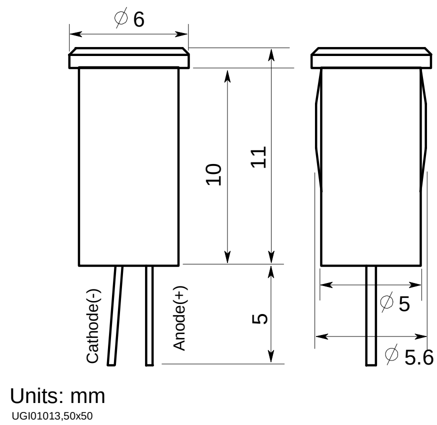


Figure 2-6 **Dimensions of the Interlock Switch (Agilent part number 3101-0302)**

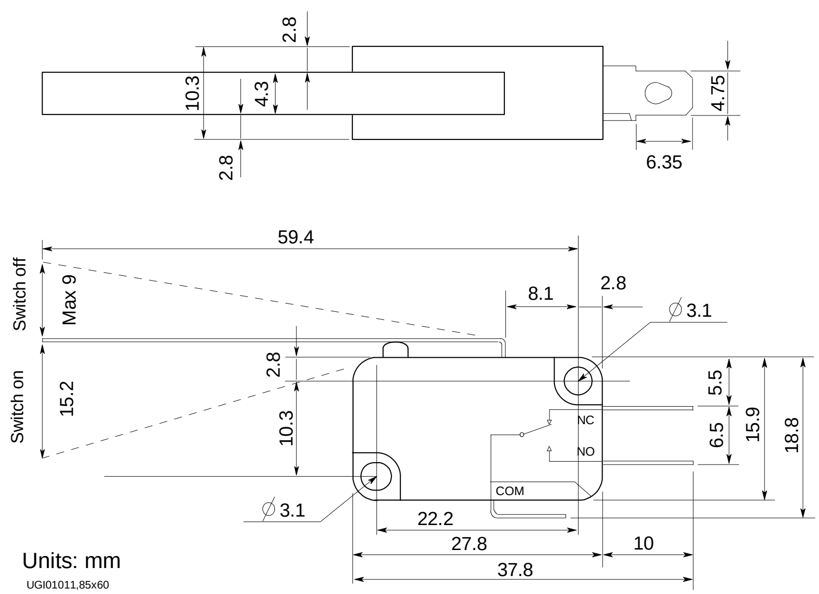
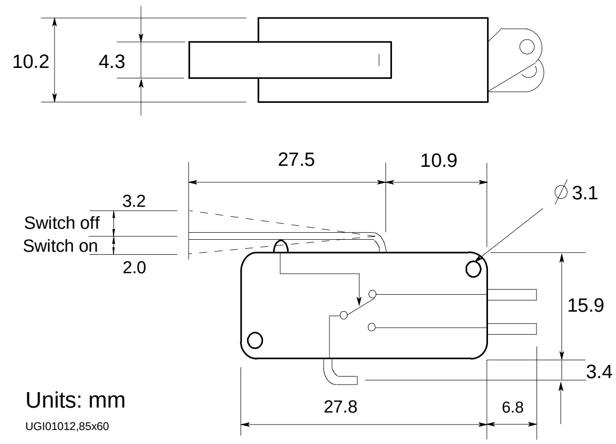


Figure 2-7 **Dimensions of the Interlock Switch (Agilent part number 3101-3241)**



Model 100/200: To Make Your Connector Panel

This section is for you who do not use the Agilent 16495 connector plate.

If you want to mount connectors that accept the measurement cables from the instruments directly on your own connector panel, test fixture, or shielding box, perform the following procedure.

1. Select the appropriate parts for your application. See Table 2-7.
2. Make the holes and mount the connectors on your connector panel. See Table 2-8.

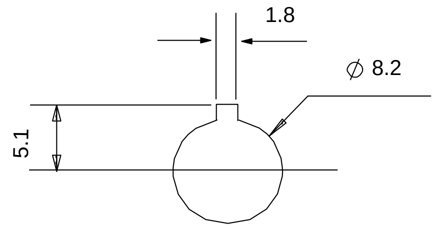
   For Kelvin connections using the 4156C SMU, use Agilent 16493K Kelvin cable. A Kelvin cable requires a Kelvin triaxial connector, which has two connector holes and three screw holes.
3. Build the interlock circuit shown in “To Make an Interlock Circuit” on page 2-11.
4. Attach cables from the connectors to the DUT (device under test). See Table 2-4, Table 2-5, and Table 2-6.

Table 2-7 **Recommended Parts**

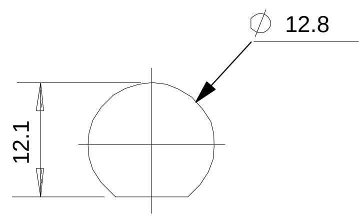
Usage	Agilent Part No.	Description
Making an interlock circuit	1252-1419C	Interlock Connector (6 pin, female)
	3101-0302 or 3101-3241	Switch
	1450-0641	LED ($V_F \cong 2.1$ V @ $I_F = 10$ mA)
	8150-5680	Wire
GNDU output connections	1250-2457	Triaxial Connector (female)
	8121-1189 or 8150-2639	Coaxial Cable or Wire
SMU output connections	1250-2457	Triaxial Connector (female)
	8121-1191	Low Noise Coaxial Cable
AUX output connections	1250-0118	BNC Connector (female)
	8150-0447	Wire
	8120-0102 or 8121-1191	Low Noise Coaxial Cable

Table 2-8 **Dimensions of Connector Holes**

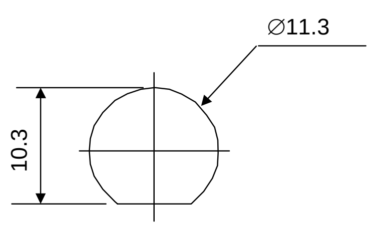
Interlock Connector (in mm)



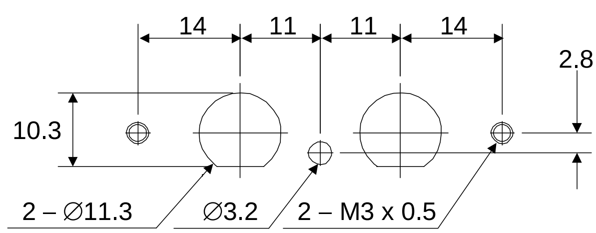
BNC Connector (in mm)



Triaxial Connector (in mm)



Kelvin Triaxial Connector (in mm)



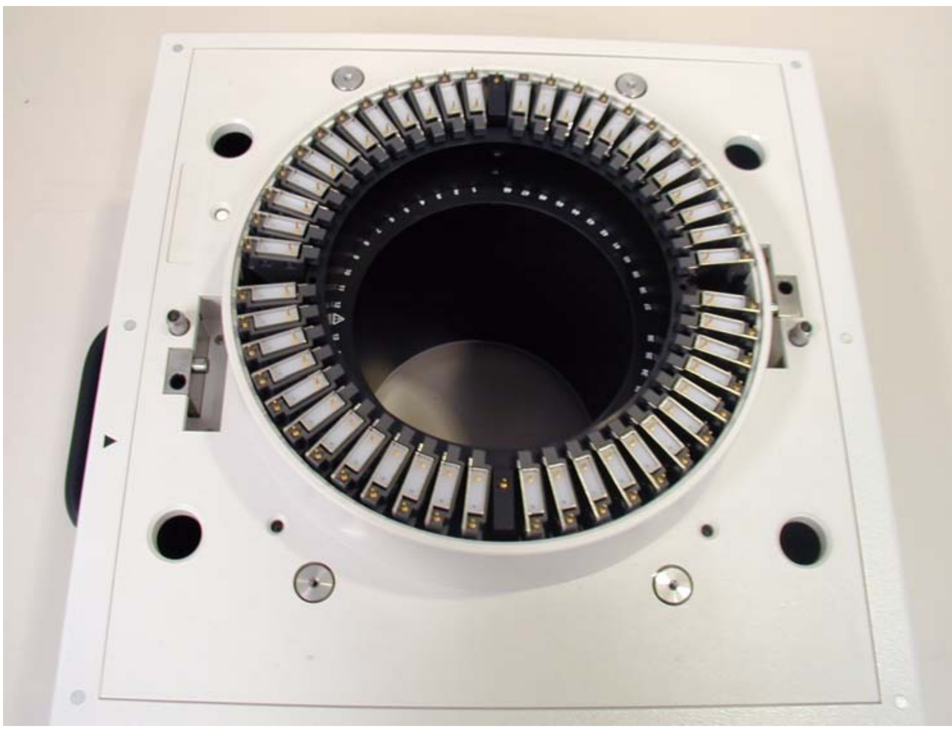
Model 300/400: To Install B2220A

This section describes how to install the Agilent B2220A probe card interface. This information is for you who use the auto prober.

NOTE For the installation of the B2220A and the connection to the DUT interface, contact your favorite prober vender. The prober vender will be able to provide the DUT interface and mechanisms required to install the B2220A.

- "Requirements"
- "Procedure"
- "Before starting measurements"

Figure 2-8 **Agilent B2200A Bottom View (Contact Side)**



Requirements

The Agilent B2220A has been designed to contact its output pins directly with the probe card. So, it must be mounted on the semi-auto prober or full-auto prober accurately and carefully. The prober should have the following features. See Figure 2-9 and Figure 2-10.

- Arm (with hinge, spring, and so on) that has the following functions.
    - To make contact with the probe card accurately and fix the B2220A on the prober when performing test/measurement.
    - To face the B2220A contact side (bottom side) up when performing maintenance.
- A pin that can press the B2220A's prober sense switch when performing test/ measurement.

- Pin holes for the B2220A's guide pins.
- Rack, cramp, or something to reduce stress to the input connectors/cables.

Enough space is required at the side of the prober to access the input cables and to perform maintenance of the B2220A. See "Probe Card Interface" on page 6-1. Also see *Agilent 41000 Preinstallation Guide*.

Figure 2-9 Mounting Agilent B2220A on Auto Prober 1

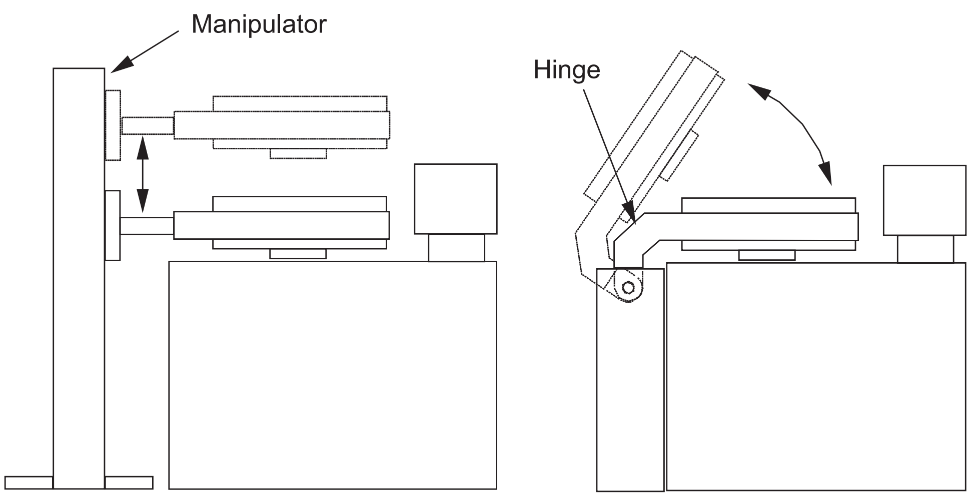
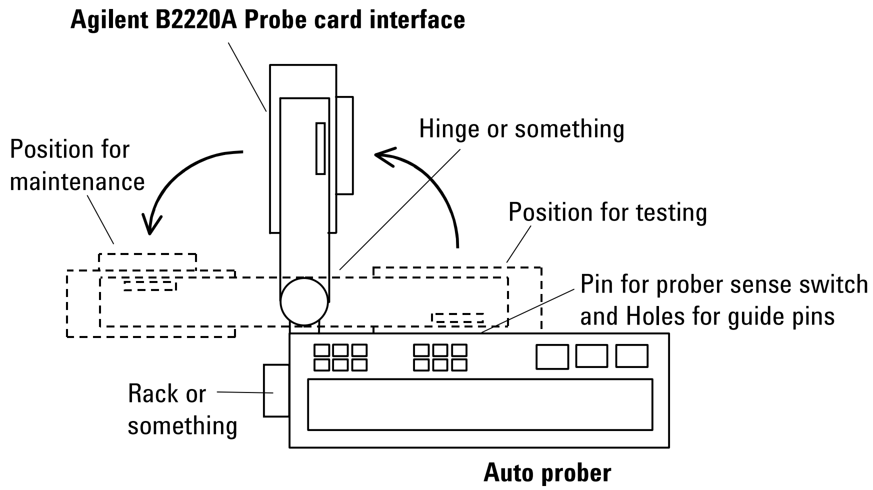


Figure 2-10 Mounting Agilent B2220A on Auto Prober 2



Procedure

The following procedure shows how to install the Agilent B2220A. Do not remove the contact protector and the light shielding panel before starting the procedure. See also “Probe Card Interface” on page 6-1.

1. Place the B2220A. Then, face the contact side (bottom side) up.
2. Unscrew and remove the contact protector from the bottom cover.

   Keep the protector in trust. You may need it for move in future.
3. Mount the B2220A on your prober. See “Requirements” on page 2-15.
4. Connect the connection cables. See “Model 300/400: To Connect Measurement Cables” on page 2-19.

Before starting measurements

The following procedure should be done before starting the measurements. However, the procedure is not needed or should be changed if there is any additional mechanisms such as the microscope on the B2220A in place of the light shielding panel.

1. Unscrew and remove the light shielding panel from the top cover.
2. Fix the probe card on the prober.
3. Make contact between the B2220A and the probe card.
4. Place the test wafer on the wafer chuck, and perform wafer alignment.
5. Replace and screw the light shielding panel.
6. Start the measurements.

Model 300/400: To Use Test Fixture

If you perform the measurement of the package devices, use the test fixture. Then, install the Agilent B2220A as standalone, not on the prober.

Preparation

1. Prepare the following items.
   - Rubber feet, 4 ea. and bond or double-sided adhesive tape

     The rubber feet should be attached on the corner of the B2220A top cover to protect the jutty on the top cover.
   - Agilent E3140A Test Fixture Adapter, 1 ea.
   - Agilent E3141A Universal Test Fixture, 1 ea.
   - Socket(s) for your devices
   - Wire needed to connect between the E3141A's soldering terminals and the socket terminals
   - Solder, soldering bit, and so on
2. Design your test fixture and assemble it as show below.
   a. Put the socket(s) on the top side of the E3141A universal test fixture, and fix it. Then the device contacts must face up.

   b. On the E3141A back side, place a wire between the E3141A's soldering terminal and the socket's terminal, and solder it.

   c. Repeat b as you designed.

Procedure

The following procedure shows how to install the Agilent B2220A. Do not remove the contact protector and the light shielding panel before starting the procedure. See also "Probe Card Interface" on page 6-1.

1. Place the B2220A Then, face the top cover up.
2. Fix a foot at a corner of the top cover using bond or double-sided adhesive tape. And repeat this for four corners. Then, do not fix it on the light shielding panel.
3. Place the B2220A so that the contact side (bottom side) faces up.
4. Unscrew and remove the contact protector from the bottom cover.

   Keep the protector in trust. You may need it for move in future.
5. Attach your test fixture on the E3140A Test Fixture Adapter.
6. Mount the test fixture adapter on the B2220A.
7. Connect the connection cables. See "Model 300/400: To Connect Measurement Cables" on page 2-19.

Model 300/400: To Connect Measurement Cables

Connect measurement cables between the Agilent B2200 switch mainframe outputs and the Agilent B2220A probe card interface inputs as shown below. For the cable connection between instruments, see “Service” on page 7-1.

1. Connect the interlock cable between the Agilent 4155C/4156C/E5270B’s interlock connector and the interlock connector of the Agilent B2220A probe card interface. See Figure 2-11 and Figure 2-12.
2. Connect measurement cables between the Agilent B2200 outputs and the Agilent B2220A inputs. Then, use the triaxial cables if there is no Kelvin connection in the B2200 input, or else use the Kelvin triaxial cables. See Figure 2-12 and Table 2-10.

Table 2-9 Measurement Cables

B2220A connector	Cable
Input 1 to 48 (for 48 pin option)	Agilent 16494A triaxial cable for non-Kelvin connection
	Agilent 16494C Kelvin triaxial cable for Kelvin connection
Input 2 to 48 [1] (for 24 pin option)	Agilent 16494A triaxial cable for non-Kelvin connection
	Agilent 16494C Kelvin triaxial cable for Kelvin connection
Interlock	Agilent 16493J interlock cable

1. There is no odd numbered connectors on the Agilent B2220A 24 pin option. Only the even numbers are available for the 24 pin option.

Figure 2-11 Interlock Cable Connection on Agilent B2220A

WARNING **To prevent electrical shock during use, connect the interlock cable between the interlock connector and the instrument’s interlock connector.**

Figure 2-12 Measurement Cable Connection

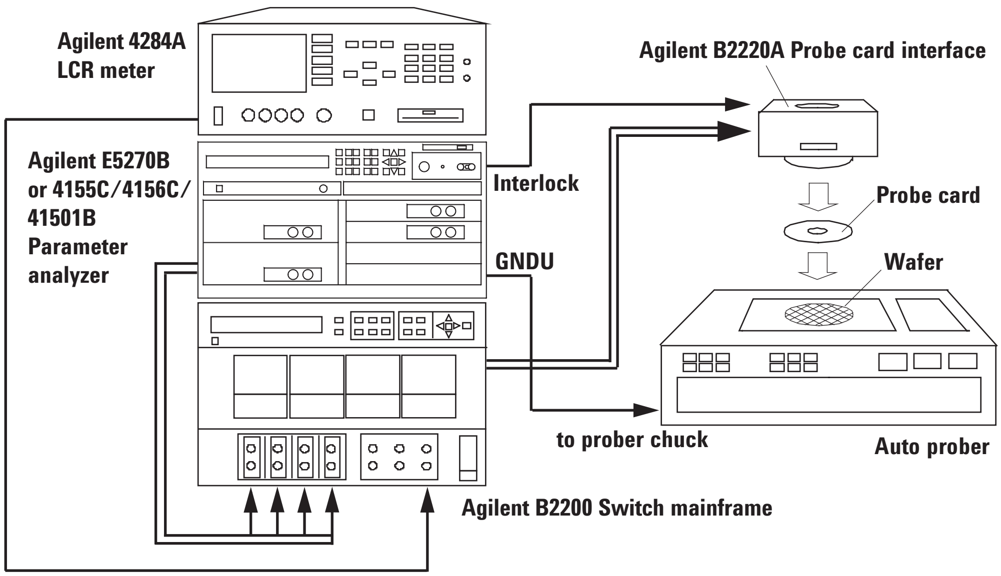


Table 2-10 Agilent B2200 Outputs to Agilent B2220A Inputs Connections

B2200 output	B2220A input: non-Kelvin connection		B2220A input: Kelvin connection	
	48 pin	24 pin	48 pin	24 pin
1	1	2	1	2
2	2	4	2	4
3	3	6	3	6
4	4	8	4	8
5	5	10	5	10
6	6	12	6	12
7	7	14	7	14
8	8	16	8	16
9	9	18	9	18
10	10	20	10	20
11	11	22	11	22
12	12	24	12	24
13	13	26	13	26
14	14	28	14	28
15	15	30	15	30
16	16	32	16	32

B2200 output	B2220A input: non-Kelvin connection		B2220A input: Kelvin connection	
	48 pin	24 pin	48 pin	24 pin
17	17	34	17	34
18	18	36	18	36
19	19	38	19	38
20	20	40	20	40
21	21	42	21	42
22	22	44	22	44
23	23	46	23	46
24	24	48	24	48
25	25	-	25	-
26	26	-	26	-
27	27	-	27	-
28	28	-	28	-
29	29	-	29	-
30	30	-	30	-
31	31	-	31	-
32	32	-	32	-
33	33	-	33	-
34	34	-	34	-
35	35	-	35	-
36	36	-	36	-
37	37	-	37	-
38	38	-	38	-
39	39	-	39	-
40	40	-	40	-
41	41	-	41	-
42	42	-	42	-
43	43	-	43	-
44	44	-	44	-
45	45	-	45	-
46	46	-	46	-
47	47	-	47	-
48	48	-	48	-

To Connect GNDU Cable

The Agilent E5270B or 41501B's GNDU (ground unit) is connected as shown below. The GNDU is normally connected to the prober chuck.

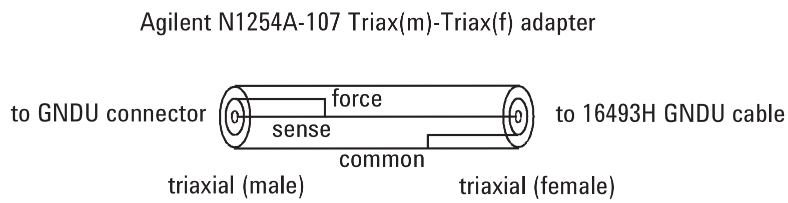
NOTE For the connection to the prober chuck, contact your favorite prober vender.

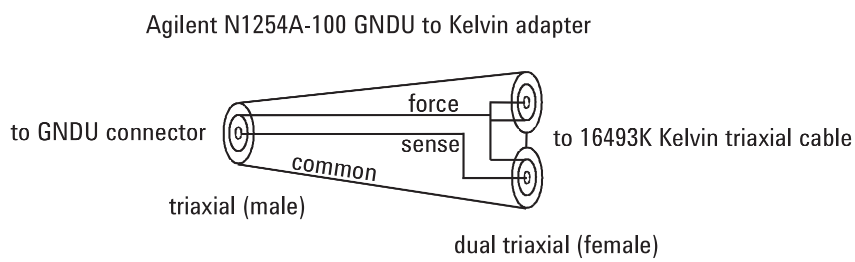
- Non-Kelvin connection (Agilent E5270B or Agilent 41501B)
  1. Connect the Agilent N1254A-107 adapter to the instrument's GNDU connector.
  2. Connect the Agilent 16493H GNDU cable between the adapter and the prober chuck.
- Kelvin connection (Agilent E5270B)
  1. Connect the Agilent N1254A-100 adapter to the instrument's GNDU connector.
  2. Connect the Agilent 16493K Kelvin triaxial cable between the adapter and the prober chuck.

Table 2-11 GNDU Cable and Adapter

	Agilent model/part number	Description
Non-Kelvin connection	16493H	GNDU cable
	N1254A-107 (P/N 1250-2654)	Triax(m)-Triax(f) adapter
Kelvin connection	16493K	Kelvin cable (max. 2.6 A)
	N1254A-100	GNDU adapter

Figure 2-13 Adapters to Connect GNDU Cable





To Connect Power Cable

1. Prepare the site power line and the power receptacle for the Agilent 41000 power cable as described in *Agilent 41000 Preinstallation Guide*.
2. Connect the Agilent 41000 power cable to the power receptacle. The power cable will come from the bottom rear side of the Agilent 41000 system cabinet. It will be connected to the rear panel of the power distribution unit (PDU).

NOTE If your Agilent 41000 do not have PDU option

Connect power cables for instruments to your site power line directly.

To Connect GPIB Cable

- If you use the Agilent 82357A USB/GPIB interface.
    1. Install the Agilent VISA and SICL I/O libraries to your computer (controller). The I/O libraries are furnished with the Agilent 82357A.
    2. Connect the USB connector of the Agilent 82357A to your computer (controller).
    3. Connect the GPIB connector of the Agilent 82357A to an instrument of the Agilent 41000.
- If you use the PCI GPIB interface card (Agilent 82350B or equivalent).
    1. Install the Agilent VISA and SICL I/O libraries to your computer (controller). The I/O libraries are furnished with the Agilent 82350B.
    2. Install the PCI GPIB interface card to your computer (controller).
    3. Connect the GPIB cable between your computer (controller) and an instrument of the Agilent 41000.

To Check Operation

1. Install the Agilent 41000 iPACE Verification Tool software in your computer (controller).
2. Turn the Agilent 41000 on. See “Turning the PDU On and Off” on page 2-24.
3. Use the Agilent 41000 iPACE Verification Tool and check the operation. See “Using Agilent iPACE Verification Tool” on page 3-1.

Turning the PDU On and Off

This section describes how to turn on or off your Agilent 41000 equipped with the power distribution unit (PDU).

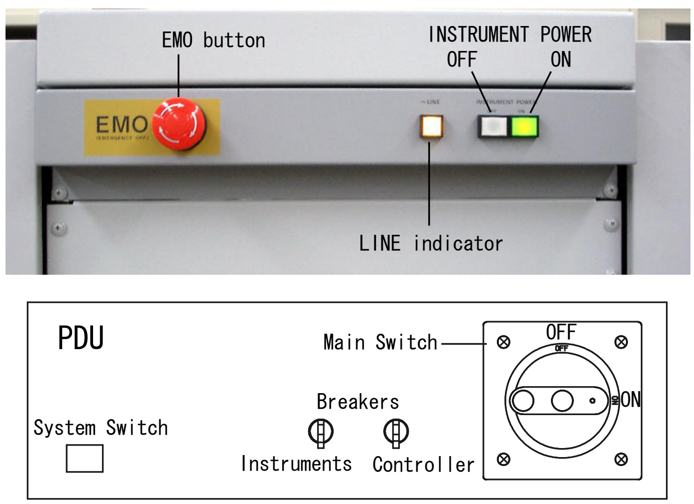
- "To Turn On your System"
- "To Turn Off your System"
- "To Turn Off your System in Emergency"
- "To Reset EMO Button"

WARNING

Electrical Work Type 3:

24 V is forced to the uninsulated parts of the EMO rear panel. Do not touch these parts.

Figure 2-14 **PDU and EMO**



To Turn On your System

1. Set the line ON/OFF switch of the all instruments in the system cabinet to the ON position.
2. Set the PDU instruments breaker to the ON position. The PDU is located on bottom of the system cabinet.
3. Set the PDU controller breaker to the ON position.
4. Set the PDU main switch to the ON position.
5. Press the PDU system switch. Then the inside LED will turn on, which means AC power is applied to the controller outlets that are the inside of the system cabinet.
6. Press the INSTRUMENT POWER ON button on the EMO panel. The green LED in the button will turn on, which means AC power is applied to the instruments outlets that are the inside of the system cabinet.

To Turn Off your System

1. Press the INSTRUMENT POWER OFF button on the EMO panel. This shuts off AC power to the instruments outlets.
2. Perform the shutdown procedure for your computer and turn off its line switch
3. Optional. Set the PDU main switch to the OFF position. This shuts off AC power to the PDU.

CAUTION

Before performing step 3

If the PDU applies AC power to your computer, confirm that the computer has already shut down and then perform step 3. Performing step 3 before shutdown may destroy the file system of the computer.

To Turn Off your System in Emergency

The Agilent 41000 provides the emergency power off (EMO) system that can automatically or manually stop power to the system cabinet PDU (power distribution unit) in an emergency situation. This system is not available for the Agilent 41000 without the PDU/EMO option.

For example, if an earthquake occurs, you can press the EMO button. Power supply to the system stops immediately, thus preventing a potential fire caused by an electrical short circuit.

To turn off your system in an emergency:

1. Press EMO button, which is the large red button on upper front of the system cabinet.

   The EMO button is locked to the *in* position, which shuts off AC power to the PDU.

To Reset EMO Button

NOTE

Before resetting the EMO button

Before resetting the EMO button, make sure that no system instruments are damaged or have recovered from any problems.

1. Rotate the EMO button clockwise to set it to the normal position (*out* position).

   To turn the Agilent 41000 on, see “To Turn On your System” on page 2-24.

Recovering from Power Line Problems

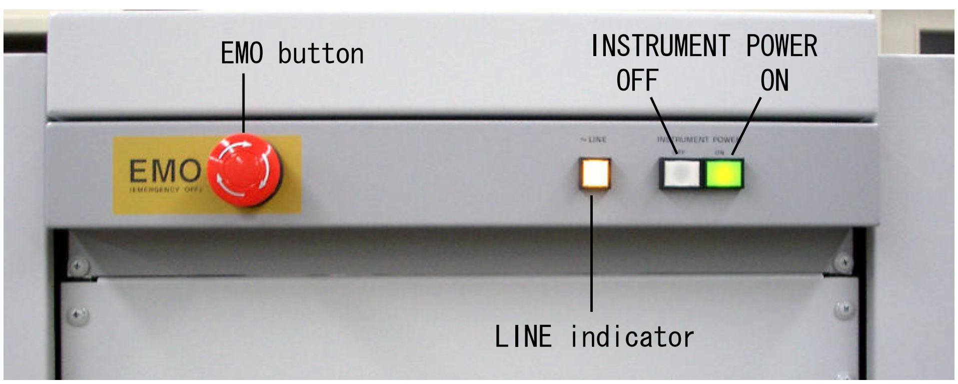
The PDU has protectors to detect power line problems and protect the system from damage. These protectors stop the supply of power from the PDU to the instruments and controller outlets. The following conditions will stop the supply.

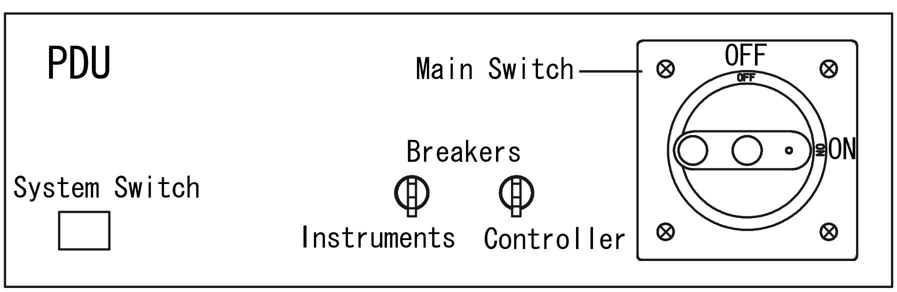
- Excessive current flows through the breaker.
- The EMO button is pressed.
- The Ext. EMO terminal is open.
- The Remote Ctrl. terminal is open.

After fixing problem, use following procedure to reset the breakers.

1. If the EMO button is set to the *in* position, perform the following step.
   a. Set the PDU main switch to the OFF position.
   b. Rotate the button clockwise to set it to the normal position (*out* position).
2. If the instruments breaker is the OFF position, set it to the ON position.
3. If the controller breaker is the OFF position, set it to the ON position.
4. Set the PDU main switch to the ON position.
5. Press the PDU system switch.

Figure 2-15 **PDU and EMO**





Maintenance

Maintenance should be performed periodically to keep the Agilent 41000 in good condition.

Performance Verification

Performance verification must be performed periodically so that the instruments satisfy the specifications, and keep a good condition. It is recommended to perform the performance verification once a year at least. For the performance verification, contact your nearest Agilent Technologies Service Center. Trained service personnel will perform the performance verification.

Cleaning

Before performing cleaning, turn off each instrument of the Agilent 41000, and disconnect power cable from each instrument's rear panel. Use a dry cloth to clean the external case parts.

To prevent electrical shock, do *not* perform cleaning when each instrument is turned on, and do *not* use a wet cloth.

Model 300/400: Cleaning Contact Pins

To clean contact pins and probe card contacts, prepare alcohol and a dryer. Then clean them as shown below.

1. Spray alcohol to pins or contacts.
2. Dry them enough and carefully using the dryer.

Do *not* wipe with a cloth. It may expand dirty area.

Model 300/400: Replacing Contact Pins

Agilent B2220A probe card interface fixes the contact pins on its contact assemblies by using rings. To replace the defective pins, perform the following procedure. You will need a mini-screwdriver and a slip-joint pliers. Also use rubber gloves if possible to prevent the contact pin from dirty.

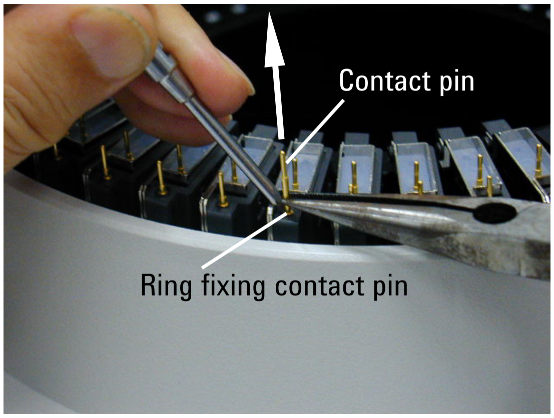
NOTE

Contact Pins

The contact pin consists of the narrow part (pin) and the thick part (tube), and the pin can be inserted into the tube. A spring in the tube works to keep pushing the pin out.

1. Hold the ring that fixes the defective pin. Then use a mini-screwdriver.
2. Clip the thick part of the defective pin, and remove it from the ring. Then use a slip-joint pliers.
3. Clip the thick part of the new pin by using the slip-joint pliers.
4. Embed the new pin in the ring. Then do not insert the pin more than necessary. The thick part must not be fully inserted into the ring.
5. Clean contact pins. See “Cleaning”.

Figure 2-16 **Removing Contact Pins**



Model 300/400: Checking Interlock Circuit

Perform the following steps to check the operation of the interlock circuit of your measurement system.

1. Connect the interlock cable between the B2220A's interlock connector and the instrument's interlock connector.
2. If you use the auto prober, place the B2220A on the prober to set the prober sense switch to the make position.

   If you use your test fixture, close the top cover of the Agilent E3140A Test Fixture Adapter.
3. Set the instrument's all output to 0 (zero) V. The high voltage indicator must turn off.
4. Set a source output voltage to the value more than the instrument's interlock limit value (e.g. 42 V). The high voltage indicator must turn on.
5. Release the B2220A from the prober or open the E3140A top cover to set the prober sense switch to the break position. The high voltage indicator must turn off. And the instrument should cause an error or change voltage to 0 (zero) V. The response depends on the instrument.

3 Using Agilent iPACE Verification Tool

This chapter explains how to use the Agilent iPACE Verification Tool.

- "Overview"
- "Installation"
- "Start-Up"
- "Self-test"
- "Connection Check"
- "Noise Offset Measurement"
- "Settling Time/Leakage Current Measurement"
- "Using Batch Mode"
- "Reading Result Data"

NOTE

About Agilent iPACE Verification Tool

The Agilent iPACE Verification Tool is a non support sample program used to specify any defective components of the Agilent 41000. And the program may be used to know the measurement ability of whole system including the extended measurement paths and so on. Use the verification tool to know the measurement ability of whole system after installation or for the system administration.

Note that the verification tool cannot be used to verify the specifications of the Agilent 41000 and the system components (instruments).

NOTE

To Read This Section

For the Agilent 41000 Model 100 users, ignore the description about the Agilent B2200 and B2220A.

For the Agilent 41000 Model 200 users, ignore the description about the Agilent B2220A.

For the Agilent 41000 Model 300/400 (with option NIF) users, ignore the description about the Agilent B2220A.

For all of the above systems, ignore the description of the test fixture attachment. Connect the triaxial open cap to the following terminals.

- For Model 100:

  E5270B Force/Sense terminals

- For Model 200 and Model 300/400 (with option NIF):

  B2200 Output terminal (or Output N and N+1 terminals for the Kelvin connection)

where, N is an odd number from 1 to 11.

NOTE

Batch Mode Operation

The Agilent 41000 Model 300/400 (without option NIF) fully supports the batch mode operation.

The Agilent 41000 Model 100/200 and the Model 300/400 (with option NIF) do not support the connection check in the batch mode.

NOTE

Agilent 41000 Measurement Record of Integrity Verification

Keep the *Agilent 41000 Measurement Record of Integrity Verification* report. The report shows the following data measured at the factory. The values shown below are just sample.

- Noise/Offset Record

```
#Source, Input, Slot, Output, IOffset[A], Noise[Sigma]
SMU1, 1, 1, 1, -2.115E-13, 8.01234E-15
```

  - IOffset[A]: Averaging value of the all data of the offset current measurement result.
  - Noise[Sigma]: Standard deviation value of the all data of the offset current measurement result.

- Settling/Leakage Record

```
#Source, Input, Slot, Output, ILeak[A], Vstep[V], ISettl(1s)[A],
ISettl(10s)[A]
SMU1, 1, 1, 1, -1.538E-13, 10, -2.55E-13, -2.20E-13
```

  - ILeak[A]: Averaging value of the last 10 data of the leakage current measurement result.
  - ISettl(1s)[A]: Current measurement value of the first data measured after 1 second passed from the measurement start.
  - ISettl(10s)[A]: Current measurement value of the first data measured after 10 second passed from the measurement start.

The report does not guarantee the measurement ability of the Agilent 41000. The data is not the specifications.

Overview

The Agilent iPACE Verification Tool can perform the following test and measurements. This tool will be helpful to specify the defective components of the Agilent 41000 or to know the measurement ability of whole system including the extended measurement paths and so on. It is also useful for the system administration.

- Self-test

  Performs self-test of each instrument. You can see the test results on the Verification Tool window or the log file.

- Connection check

  Controls the specified instrument to force voltage. You can see the results on the Verification Tool window or the log file.

  This function will be helpful to specify the defective components by monitoring the voltage at the end of the probe card interface, measurement cables, instrument terminals, and so on.

- Noise offset measurement

  Performs noise offset measurements. You can see the measurement results on the Verification Tool window or the log file.

- Settling time/leakage current measurement

  Performs settling time and leakage current measurements. You can see the measurement results on the Verification Tool window or the log file.

- Automatic Execution

  Performs any of the self-test, connection check, noise offset measurement, settling time/leakage current measurement automatically.

- Result Data Record

  The result data will be logged into the log file. The default file is as follows.

  folder: <*installed folder*>`/bin`

  file name: `iPACE Verification Tool (Report).txt`

  For example, <*installed folder*> will be as follows.

  `C:\Program Files\Agilent\iPACE Verification Tool A.01.00`

NOTE

To Change the Log File

To change the log file, use the Open Report File dialog box opened by clicking File > Open Report File. After changing the file name, the result data will be logged into the new file.

Installation

This section explains how to install the Agilent iPACE Verification Tool.

- "System Requirements"
- "Installation Procedure"

System Requirements

The following system environment is required to execute the Agilent iPACE verification tool.

- Operating System

  Microsoft Windows 2000 or Windows XP Professional

- Agilent GPIB (IEEE 488) Interface and Agilent IO Libraries M.01.01.04

  Agilent 82357A USB/GPIB interface, E5810A LAN/GPIB gateway, 82350B GPIB interface, or equivalent. These models include Agilent IO libraries.

- Computer and peripherals

  Minimum Requirements:

CPU	Intel Pentium or compatible processor, 300 MHz
Memory	128 Mbyte
Hard disk	20 Mbyte free space

  CD-ROM drive is needed to install the Agilent iPACE verification tool.

- Supported Instruments (Agilent 41000 iPACE system component)
  - DC source/monitor: Agilent 4155C, 4156C, E5270B, or E5270 series
  - Capacitance meter: Agilent 4284A
  - Switching matrix: Agilent B2200A, B2201A, or E5250A

NOTE

If you modify the source code of the Agilent iPACE Verification Tool

The following software are required to modify the source code of the Agilent iPACE verification tool.

- Microsoft Visual Basic.NET version 2003
- Agilent T&M Programmers Toolkit for Visual Studio.NET (W1140A or equivalent)

If you want, prepare and install the software.

Installation Procedure

The installation flow is shown below. If you have already installed the Agilent IO libraries and the Agilent GPIB (IEEE 488) interface on your computer, skip steps 1 through 3.

1. Install Agilent IO libraries.

   Follow the setup program instructions, and complete the installation. Then do not forget to add the VISACOM to the libraries to install. The VISACOM is required to execute the Agilent iPACE verification tool.

2. Install Agilent GPIB interface to your PC.

   See manual of the GPIB interface.

   Note the model number of the GPIB interface, as you may need it to configure the interface (in step 3).

3. Configure and check the GPIB interface.

   See manual of the Agilent IO libraries.

4. Optional. Install Microsoft Visual Basic.NET and Agilent T&M Programmers Toolkit.

   If you are going to modify the program code of the Agilent iPACE verification tool, install the software. Follow the setup program instructions, and complete the installation.

5. Install the Agilent iPACE verification tool.

   a. Insert the Agilent iPACE Verification Tool CD-ROM to the CD-ROM drive connected to your computer.

   b. Execute Setup.exe file on the CD-ROM.

      Follow the setup program instructions, and complete the installation. The required files will be installed in the following folders.

      <*installed folder*>`\bin`

      <*installed folder*>`\src`

      For example, <*installed folder*> will be as follows.

      `C:\Program Files\Agilent\iPACE Verification Tool A.01.00`

NOTE

To check if VISACOM is installed

The VISACOM is required to execute the Agilent iPACE verification tool. Check if the VisaCom folder exists. If you cannot find it, install the Agilent IO libraries again.

VisaCom folder: <*installed folder*>`\VisaCom`

For example, <*installed folder*> will be as follows.

`C:\Program Files\Agilent\IO Libraries`

Start-Up

- “Required Tools”
- “Kelvin Cable Output Signal”
- “Start-Up”

Required Tools

Before starting the verification, prepare the tools listed in Table 3-1. The tools except for the multimeter are furnished with the Agilent 41000.

Table 3-1 **Required Tools**

Agilent model number / part number / description	Purpose	Qty.
E2373A basic 3.5 digit handheld multimeter or equivalent	connection check	1
E3140A test fixture adapter	for all	1
E3142A performance check fixture for low current	noise offset and settling time/ leakage current measurements	1
E3190-60042 PV open fixture [1]		
E3144-60001 card fixture (used to fix probe card) [2]		
E3143A connection check fixture set for PCIF	connection check	1
E3141A (E3141-60005) universal test fixture	for manual mode	
E3143-60001 connection check fixture	for batch mode	
1250-2618 triaxial female to female through adapter	for troubleshooting	1
1250-1708 triaxial open connector		1

1. To perform the measurements at the tip of the B2220A pins, use E3190-60042.
2. To perform the measurements at the tip of the probe card, use E3144-60001.

NOTE For the Agilent 41000 Model 100/200, ignore the Agilent E3140A/E3142A/E3143A. They are required only for the Model 300/400.

Kelvin Cable Output Signal

Even if a Kelvin input is configured to the switch mainframe input, the all switch module outputs must configure the Kelvin output. Then the Kelvin cable must be used to connect between the switch module and the probe card interface. Do not use the triaxial cable.

In this connection, the verification tool controls the switches as shown below.

- to apply the force/sense signals to each line of the Kelvin output properly.
- to apply the non-Kelvin signal to both lines of the Kelvin output.

Start-Up

To start up the Agilent iPACE verification tool, boot the program and set the system configuration as shown below.

1. Click Start, Programs, Agilent iPACE Verification Tool, and iPACE Verification Tool.

   The Set Configuration window and the iPACE Verification Tool window will open.

   On the Set Configuration window, perform the following steps.

2. Specify the GPIB interface by using the `GPIB Name` combo box.

   In Figure 3-1, the VISA name: GPIB0 is selected.

3. Check the check box left next to the `Instrument` combo box. Then do not check the box for the instrument that is not installed in your Agilent 41000.

4. Specify the model number by using the `Instrument` combo box.

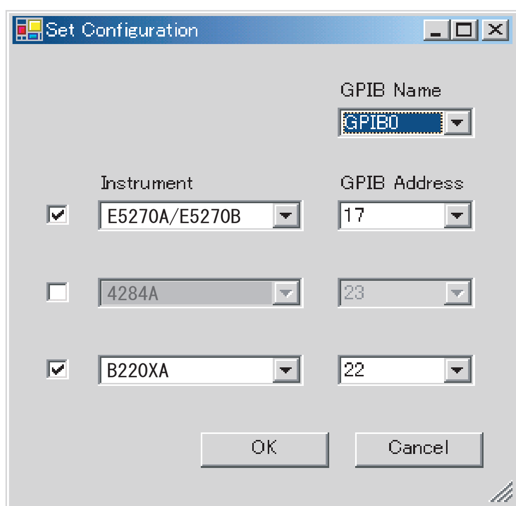
   In Figure 3-1, the E5270B and B2200A are selected.

5. Specify the GPIB Address for each instrument by using the `GPIB Address` combo box.

   In Figure 3-1, address 17 is set to the E5270B and 22 is set to the B2200A.

6. Click **OK** to complete the configuration setup. Or click **Cancel** to cancel the setup. Then the Set Configuration window will close.

Figure 3-1 **Set Configuration Window**



NOTE

To Open Set Configuration Window

You can open the Set Configuration window manually by clicking Config > Set GPIB Address...

Self-test

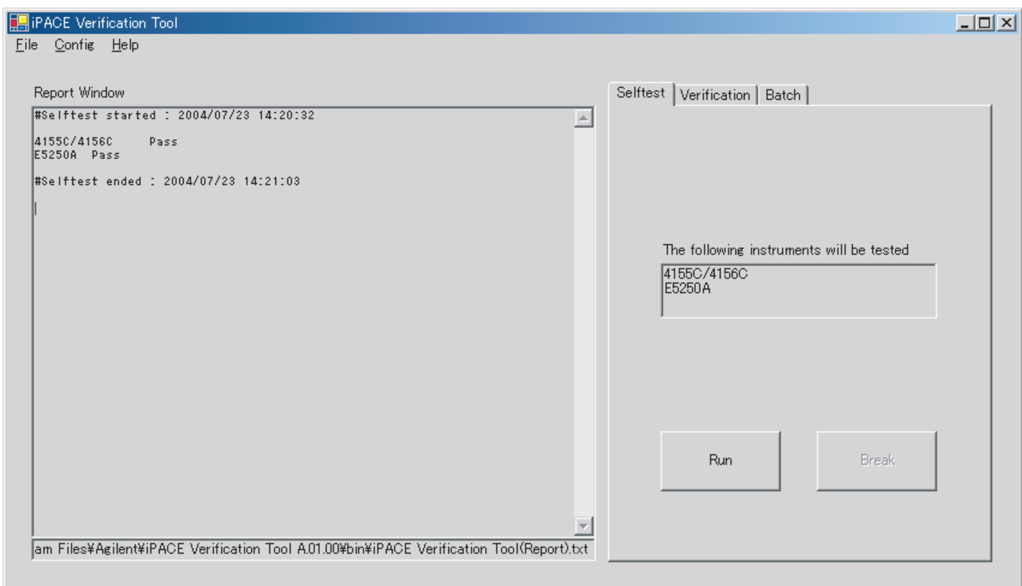
This section explains how to perform the self-test for the system component (instrument). Perform the following procedure after the configuration setup is completed as shown in “Start-Up” on page 3-8.

1. Click the ‘Selftest’ tab on the ‘iPACE Verification Tool’ window.
2. Click **Run** to start the self-test of the all instruments.

   Clicking **Break** aborts the self-test and initializes each instrument.
3. After the test, the test result will be displayed on the ‘Report Window’ area. The result will be also logged into the log file.

For the failed instrument, perform the self-test independently to specify the problem. For the information about each instrument, see manual of each product. Also check the fail status and contact your nearest Agilent Technologies Service Center.

Figure 3-2 **iPACE Verification Tool window - Selftest tab**



Connection Check

This section explains how to perform the connection check. The connection check will be performed by applying voltage from an instrument (voltage source) and monitoring voltage at an output of the Agilent B2220A Probe Card Interface. A hand held multimeter is used to measure the voltage.

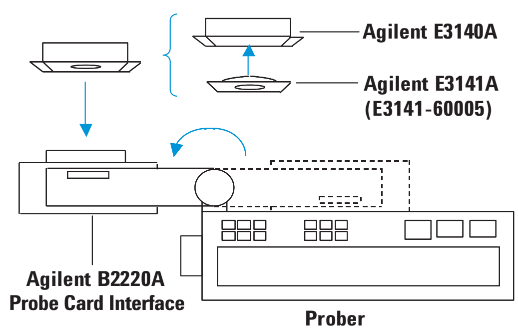
- “Measurement Setup”
- “Execution Procedure”
- “Troubleshooting”

Measurement Setup

Make the following measurement setup to perform the connection check.

1. Attach the Agilent E3141A Universal Fixture to the Agilent E3140A Test Fixture Adapter. See Figure 3-3.
2. Mount the test fixture on the Agilent B2220A.
3. Open the lid of the test fixture adapter.

Figure 3-3 Connection Check Setup



Execution Procedure

Perform the following procedure after the instrument self-test is completed as shown in “Self-test” on page 3-9.

1. On the ‘iPACE Verification Tool’ window, click the ‘Verification’ tab, and select `Connection Path` from the `Test Item` combo box. See Figure 3-4.
2. Specify the voltage source by using `Source`.

   The example in Figure 3-4 selects the SMU2.
3. Specify the switching matrix input port by using `Input Port`.

   The example in Figure 3-4 selects the input port 2.

4. Specify the switching matrix output port by using `Output Slot` and `Output Ch`.

   The example in Figure 3-4 selects the output port 2 of the switch module installed in the slot number 2.

5. Click **Run**. A dialog box opens to confirm the start of the connection check.

   Click **Cancel** to cancel the connection check, or click **OK** to start.

   DC voltage (approximately 10 V) will be applied to the specified output port. And a dialog box opens to prompt you for DC voltage measurement.

6. Contact the following patterns on the Agilent E3141A universal fixture by using a hand held multimeter, and measure DC voltage. The measured value should be about 10 V.

   - Force pattern (F) corresponding to the specified output port
   - Ground pattern (inside circle of the circle drawn by the 48 force patterns)

   For the output ports and the force patterns, see Table 3-2.

7. Click **OK** if the measured value is about 10 V, or click **Cancel** if the value is abnormal. Then the DC voltage output will be stopped.

   The result will be displayed on the ‘Report Window’ area. The result will be also logged into the log file.

8. Repeat 2 through 7 for the measurement paths you want to check.

Figure 3-4 iPACE Verification Tool window - Verification tab - Connection Path

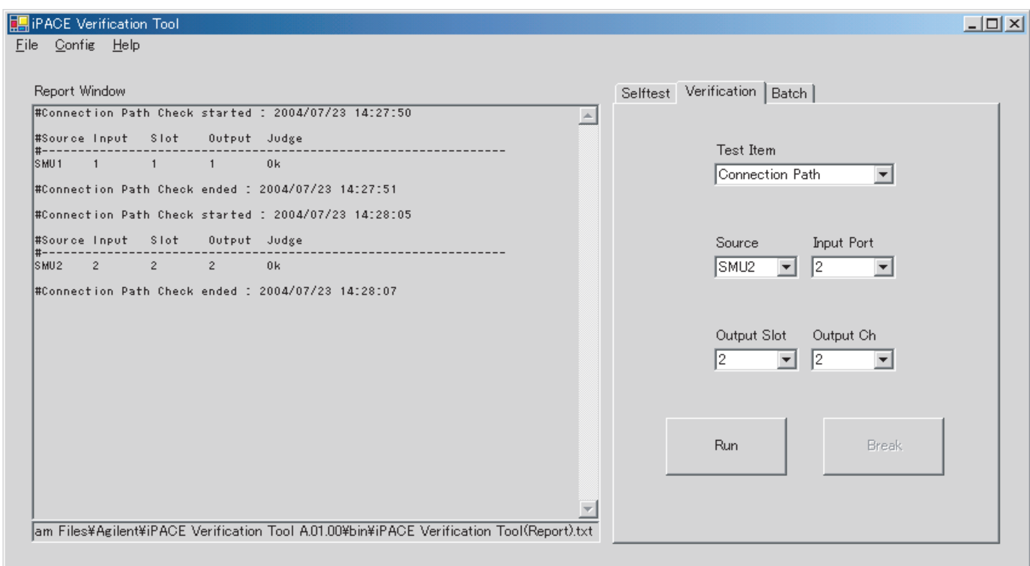


Table 3-2 Output Port and Force Pattern

<table>
<tr><th colspan="2">Output ports</th><th colspan="4">Force pattern (F) numbers on E3141A Universal fixture</th></tr>
<tr><th rowspan="2">Output Slot</th><th rowspan="2">Output Ch</th><th colspan="2">B2220A: non-Kelvin connection</th><th colspan="2">B2220A: Kelvin connection</th></tr>
<tr><th>48 pin</th><th>24 pin</th><th>48 pin</th><th>24 pin</th></tr>
<tr><td rowspan="12">1</td><td>1</td><td>1</td><td>2</td><td rowspan="2">1</td><td rowspan="2">2</td></tr>
<tr><td>2</td><td>2</td><td>4</td></tr>
<tr><td>3</td><td>3</td><td>6</td><td rowspan="2">3</td><td rowspan="2">6</td></tr>
<tr><td>4</td><td>4</td><td>8</td></tr>
<tr><td>5</td><td>5</td><td>10</td><td rowspan="2">5</td><td rowspan="2">10</td></tr>
<tr><td>6</td><td>6</td><td>12</td></tr>
<tr><td>7</td><td>7</td><td>14</td><td rowspan="2">7</td><td rowspan="2">14</td></tr>
<tr><td>8</td><td>8</td><td>16</td></tr>
<tr><td>9</td><td>9</td><td>18</td><td rowspan="2">9</td><td rowspan="2">18</td></tr>
<tr><td>10</td><td>10</td><td>20</td></tr>
<tr><td>11</td><td>11</td><td>22</td><td rowspan="2">11</td><td rowspan="2">22</td></tr>
<tr><td>12</td><td>12</td><td>24</td></tr>
<tr><td rowspan="12">2</td><td>1</td><td>13</td><td>26</td><td rowspan="2">13</td><td rowspan="2">26</td></tr>
<tr><td>2</td><td>14</td><td>28</td></tr>
<tr><td>3</td><td>15</td><td>30</td><td rowspan="2">15</td><td rowspan="2">30</td></tr>
<tr><td>4</td><td>16</td><td>32</td></tr>
<tr><td>5</td><td>17</td><td>34</td><td rowspan="2">17</td><td rowspan="2">34</td></tr>
<tr><td>6</td><td>18</td><td>36</td></tr>
<tr><td>7</td><td>19</td><td>38</td><td rowspan="2">19</td><td rowspan="2">38</td></tr>
<tr><td>8</td><td>20</td><td>40</td></tr>
<tr><td>9</td><td>21</td><td>42</td><td rowspan="2">21</td><td rowspan="2">42</td></tr>
<tr><td>10</td><td>22</td><td>44</td></tr>
<tr><td>11</td><td>23</td><td>46</td><td rowspan="2">23</td><td rowspan="2">46</td></tr>
<tr><td>12</td><td>24</td><td>48</td></tr>
</table>

Output ports		Force pattern (F) numbers on E3141A Universal fixture			
		B2220A: non-Kelvin connection		B2220A: Kelvin connection	
Output Slot	Output Ch	48 pin	24 pin	48 pin	24 pin
3	1	25	-	25	-
	2	26	-		-
	3	27	-	27	-
	4	28	-		-
	5	29	-	29	-
	6	30	-		-
	7	31	-	31	-
	8	32	-		-
	9	33	-	33	-
	10	34	-		-
	11	35	-	35	-
	12	36	-		-
4	1	37	-	37	-
	2	38	-		-
	3	39	-	39	-
	4	40	-		-
	5	41	-	41	-
	6	42	-		-
	7	43	-	43	-
	8	44	-		-
	9	45	-	45	-
	10	46	-		-
	11	47	-	47	-
	12	48	-		-

Troubleshooting

If the proper voltage does not appear, it may be caused by the following reasons.

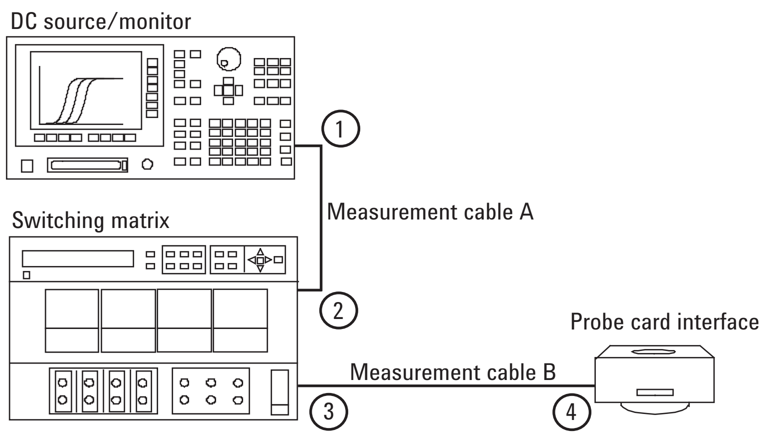
- Contact pins or connectors are dirty.
- Contact pins or cables are defective.
- Any instrument is defective.

NOTE

If you found any defect in the system component

If you found any defect in the system component (DC source/monitor, LCR meter, switching matrix, or probe card interface), contact your nearest Agilent Technologies Service Center.

Figure 3-5 **Connection Check Troubleshooting**



Perform the following step to specify the defective part.

1. Check if connection pins and connectors are clean.

   If they are dirty, clean them and perform the connection check again. See “Cleaning” on page 2-27.

   If you find defective contact, replace the contact pin or measurement cable and perform the connection check again. See “Model 300/400: Replacing Contact Pins” on page 2-28.

2. If the problem still remains, disconnect the measurement cable from the source output connector (1 in Figure 3-5). Then, perform the connection check at the source output connector.

   If the proper voltage does not appear, the instrument (voltage source) will be defective.

3. If the measurement result is good, reconnect the cable to the connector 1. And disconnect cable from the switching matrix input connector (2 in Figure 3-5). Then, perform the connection check at the end of the measurement cable (A in Figure 3-5).

   If the proper voltage does not appear, the measurement cable will be defective. Replace the cable.

4. If the measurement result is good, reconnect the cable to the connector 2. And disconnect cable from the switching matrix output connector (3 in Figure 3-5). Then, perform the connection check at the switching matrix output connector.

   If the proper voltage does not appear, the switch module or mainframe will be defective.

5. If the measurement result is good, reconnect the cable to the connector 3. And disconnect cable from the probe card interface input connector (4 in Figure 3-5). Then, perform the connection check at the end of the measurement cable (B in Figure 3-5).

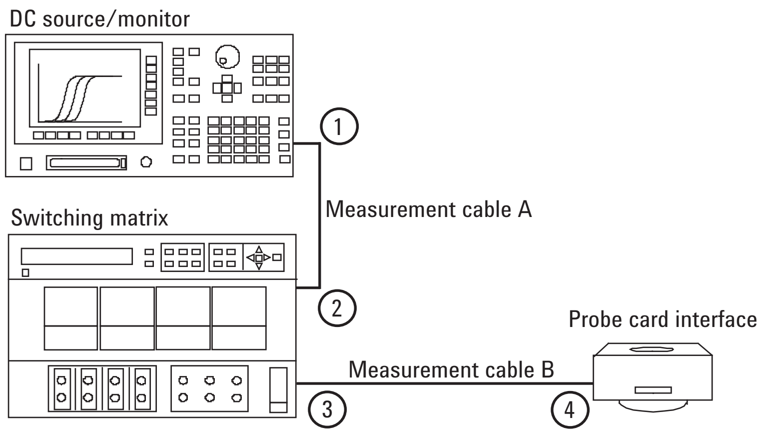
   If the proper voltage does not appear, the measurement cable will be defective. Replace the cable.

6. If the measurement result is good, the probe card interface will be defective. Replace the probe card interface.

NOTE

About the order of the troubleshooting procedure

If you want to change the order of the troubleshooting procedure, arrange it as you like. Then, ignore the second paragraph in each step. You have to judge by yourself. The judgement result depends on the order of the procedure.



Noise Offset Measurement

This section explains how to perform the noise offset measurement. The noise offset measurement will be performed by applying 0 V from the DC source/monitor and monitoring current by the DC source/monitor when the Agilent B2220A outputs are open.

- “Measurement Setup”
- “Execution Procedure”
- “Troubleshooting”

Measurement Setup

Make the following measurement setup to perform the noise offset measurement.

1. If you perform the measurement at the tip of the Agilent B2220A output pins:

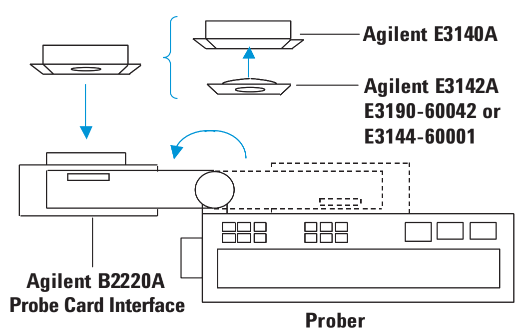
   Attach the E3190-60042 PV Open Fixture to the Agilent E3140A Test Fixture Adapter. See Figure 3-6.

2. If you perform the measurement at the tip of the probe card:

   Attach the probe card to the E3144-60001 card fixture. Then attach the fixture with the probe card to the Agilent E3140A Test Fixture Adapter. See Figure 3-6.

3. Mount the test fixture on the Agilent B2220A.
4. Connect the interlock cable between the DC source/monitor and the Agilent B2220A.
5. Close the lid of the test fixture adapter.

Figure 3-6 **Noise Offset Measurement Setup**



Execution Procedure

Perform the following procedure after the instrument self-test is completed as shown in “Self-test” on page 3-9.

1. On the ‘iPACE Verification Tool’ window, click the ‘Verification’ tab, and select `Noise` from the `Test Item` combo box. See Figure 3-7.
2. Specify the voltage source by using `Source`.

   The example in Figure 3-7 selects the SMU3.
3. Specify the switching matrix input port by using `Input Port`.

   The example in Figure 3-7 selects the input port 3.
4. Specify the switching matrix output port by using `Output Slot` and `Output Ch`.

   The example in Figure 3-7 selects the output port 3 of the switch module installed in the slot number 3.
5. Click **Run**. A dialog box opens to prompt you for the measurement setup and the start of the noise offset measurement.

   Click **Cancel** to cancel the measurement, or click **OK** to start.

   Clicking **Break** aborts the noise offset measurement and initializes the instruments.

   The result will be displayed on the ‘Report Window’ area. The result will be also logged into the log file.

   Wait until a dialog box opens to notify the measurement completion. Then click **OK**.
6. Repeat step 2 through 5 for the measurement paths you want to measure.

NOTE

Measurement condition

Noise offset measurement condition is as follows.

Measurement mode	Spot measurement
Number of measurement points	50
Output voltage	0 V
Measurement range	Auto
Integration time	50 PLC
Wait time	10 sec.

The SMU specified in the `Source` combo box will measure current in this condition.

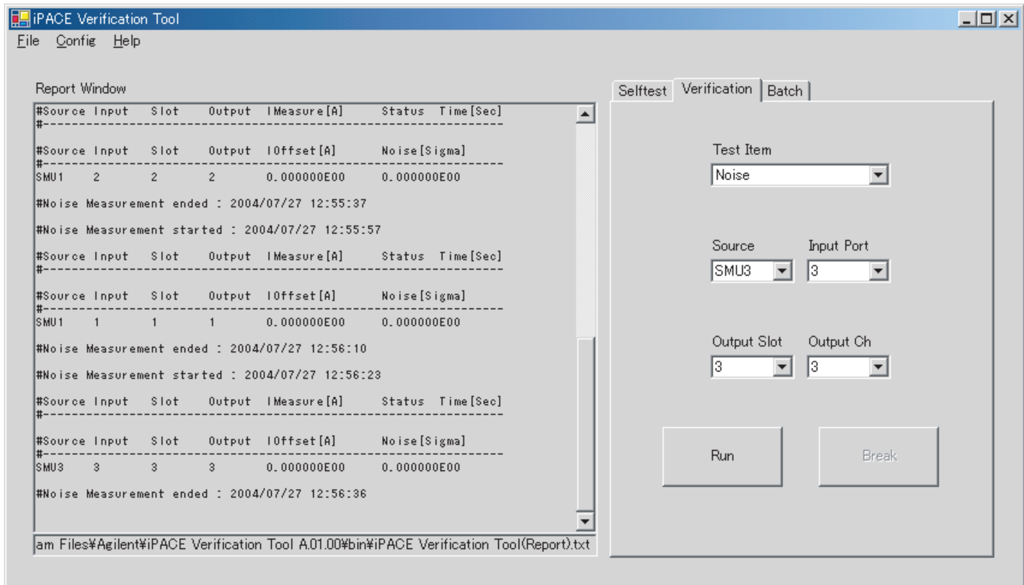
NOTE

About measurement result data

`IOffset` value is given as the average of all measured current.

`Noise` value is given as the standard deviation value of all measured current.

Figure 3-7 **iPACE Verification Tool window - Verification tab - Noise**



Troubleshooting

If the result data is worse than the expected value, check your measurement environment. The following factors can affect the measurement result.

- Temperature change
- Humidity change
- Environmental noise such as pump, motor, light, and so on

See “Measurement Environments” on page 5-3 for the acceptable measurement environments.

To perform troubleshooting, check the system component in the same manner as the method described in “Troubleshooting” on page 3-14. Then, use the adapter/connector listed below to make the open condition at the end of the measurement path such as the cable end and the instrument output terminal.

- Triaxial female to female Adapter (Agilent part number 1250-2618)

  Connect this adapter to the measurement cable, then connect the triaxial open connector to make the open condition at the end of the measurement cable.

- Triaxial Open Connector (Agilent part number 1250-1708)

  Connect this connector directly to the instrument connector to make the open condition at the instrument output connector or to the above adapter to make the open condition at the end of the measurement cable.

Settling Time/Leakage Current Measurement

This section explains how to perform the settling time/leakage current measurement. The settling time/leakage current measurement will be performed by applying voltage (10 V) from the DC source/monitor and monitoring current by the DC source/monitor when the Agilent B2220A outputs are open.

- "Measurement Setup"
- "Execution Procedure"
- "Troubleshooting"

Measurement Setup

Make the following measurement setup to perform the settling time/leakage current measurement.

1. If you perform the measurement at the tip of the Agilent B2220A output pins:

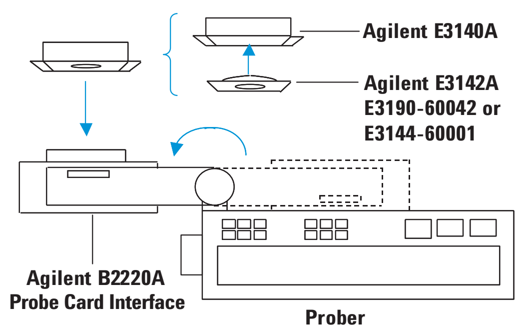
   Attach the E3190-60042 PV Open Fixture to the Agilent E3140A Test Fixture Adapter. See Figure 3-8.

2. If you perform the measurement at the tip of the probe card:

   Attach the probe card to the E3144-60001 card fixture. Then attach the fixture with the probe card to the Agilent E3140A Test Fixture Adapter. See Figure 3-8.

3. Mount the test fixture on the Agilent B2220A.
4. Connect the interlock cable between the DC source/monitor and the Agilent B2220A.
5. Close the lid of the test fixture adapter.

Figure 3-8 **Settling Time/Leakage Current Measurement Setup**



Execution Procedure

Perform the following procedure after the instrument self-test is completed as shown in "Self-test" on page 3-9.

1. On the 'iPACE Verification Tool' window, click the 'Verification' tab, and select `Settling/Leak` from the `Test Item` combo box. See Figure 3-9.
2. Specify the voltage source by using `Source`.

   The example in Figure 3-9 selects the SMU2.
3. Specify the switching matrix input port by using `Input Port`.

   The example in Figure 3-9 selects the input port 2.
4. Specify the switching matrix output port by using `Output Slot` and `Output Ch`.

   The example in Figure 3-9 selects the output port 2 of the switch module installed in the slot number 2.
5. Click **Run**. A dialog box opens to prompt you for the measurement setup and the start of the settling time/leakage current measurement.

   Click **Cancel** to cancel the measurement, or click **OK** to start.

   Clicking **Break** aborts the settling time/leakage current measurement and initializes the instruments.

   The result will be displayed on the 'Report Window' area. The result will be also logged into the log file.

   Wait until a dialog box opens to notify the measurement completion. Then click **OK**.
6. Repeat step 2 through 5 for the measurement paths you want to measure.

NOTE

Measurement condition

Settling time/leakage current measurement condition is as follows.

Measurement mode	Spot measurement
Total measurement time	100 sec (measurement repetition time)
Output voltage	10 V
Measurement range	MPSMU or HPSMU: 1nA Limited Auto
	HRSMU: 100 pA Limited Auto
Integration time	2 PLC
Leak value	average of last ten measured points

The SMU specified in the `Source` combo box will measure current in this condition.

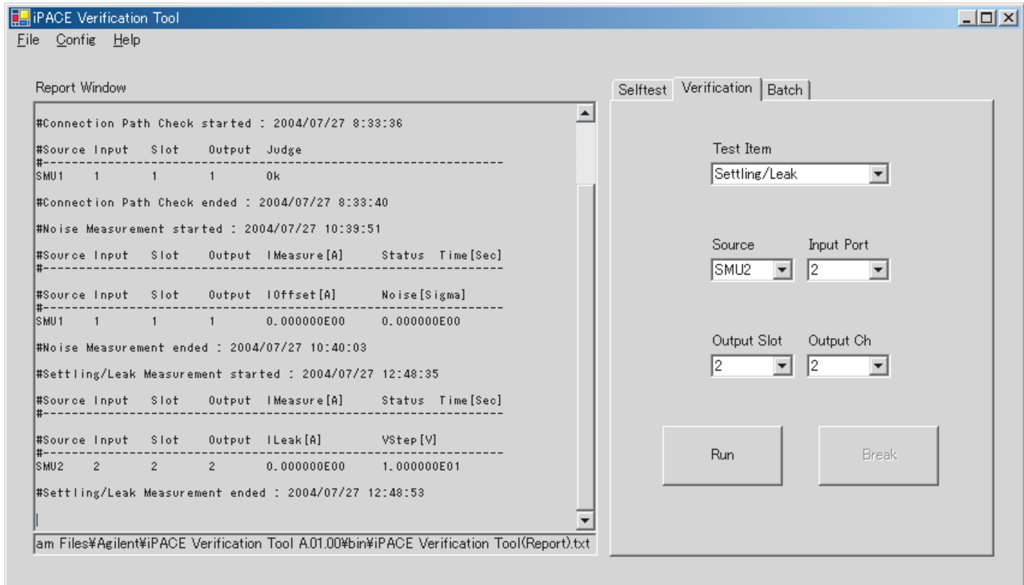
NOTE

About measurement result data

`ILeak` value is given as the averaging value of the last ten measurement data.

`Time` value is given as the time until the current measurement value is stable.

Figure 3-9 **iPACE Verification Tool window - Verification tab - Settling/Leak**



Troubleshooting

If the result data is worse than the expected value, check your measurement environment. The following factors can affect the measurement result.

- Temperature change
- Humidity change
- Environmental noise such as pump, motor, light, and so on

See “Measurement Environments” on page 5-3 for the acceptable measurement environments.

To perform troubleshooting, check the system component in the same manner as the method described in “Troubleshooting” on page 3-14. Then, use the adapter/connector listed below to make the open condition at the end of the measurement path such as the cable end and the instrument output terminal.

- Triaxial female to female Adapter (Agilent part number 1250-2618)

  Connect this adapter to the measurement cable, then connect the triaxial open connector to make the open condition at the end of the measurement cable.

- Triaxial Open Connector (Agilent part number 1250-1708)

  Connect this connector directly to the instrument connector to make the open condition at the instrument output connector or to the above adapter to make the open condition at the end of the measurement cable.

Using Batch Mode

This section explains how to use the batch mode that is the function to perform the self-test, connection check, noise offset measurement, and settling time/leakage current measurement automatically. To use the batch mode, you need a batch file that is used to specify the measurement items and the measurement conditions.

- “Setup”
- “To Perform Batch Mode Verification”
- “To Create Batch File”

Setup

Make the following measurement setup to perform the verification by using the batch mode. The following setup is not required for the self-test.

1. To perform the connection check:

   Attach the E3143-60001 Connection Check Fixture to the Agilent E3140A Test Fixture Adapter. See Figure 3-10.

2. To perform the noise offset measurement or the settling/leakage current measurement:

   - If you perform the measurement at the tip of the Agilent B2220A output pins:

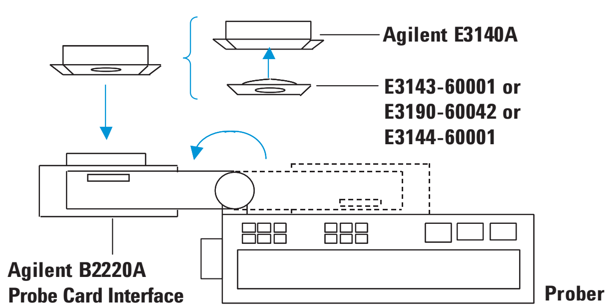
     Attach the E3190-60042 PV Open Fixture to the Agilent E3140A Test Fixture Adapter. See Figure 3-10.

   - If you perform the measurement at the tip of the probe card:

     Attach the probe card to the E3144-60001 card fixture. Then attach the fixture with the probe card to the Agilent E3140A Test Fixture Adapter. See Figure 3-10.

3. Mount the test fixture on the Agilent B2220A.
4. Connect the interlock cable between the DC source/monitor and the Agilent B2220A.
5. Close the lid of the test fixture adapter.

Figure 3-10 **Measurement Setup**



To Perform Batch Mode Verification

Perform the following procedure after the configuration setup is completed as shown in “Start-Up” on page 3-8.

1. On the ‘iPACE Verification Tool’ window, click the ‘Batch’ tab.
2. Click **Open...**. The ‘Open Batch File’ window appears.
3. On the ‘Open Batch File’ window, select the batch file to use and click **Open**.

   The ‘Open Batch File’ window will be closed. And the selected file name will be displayed in the ‘Batch File Name’ field.

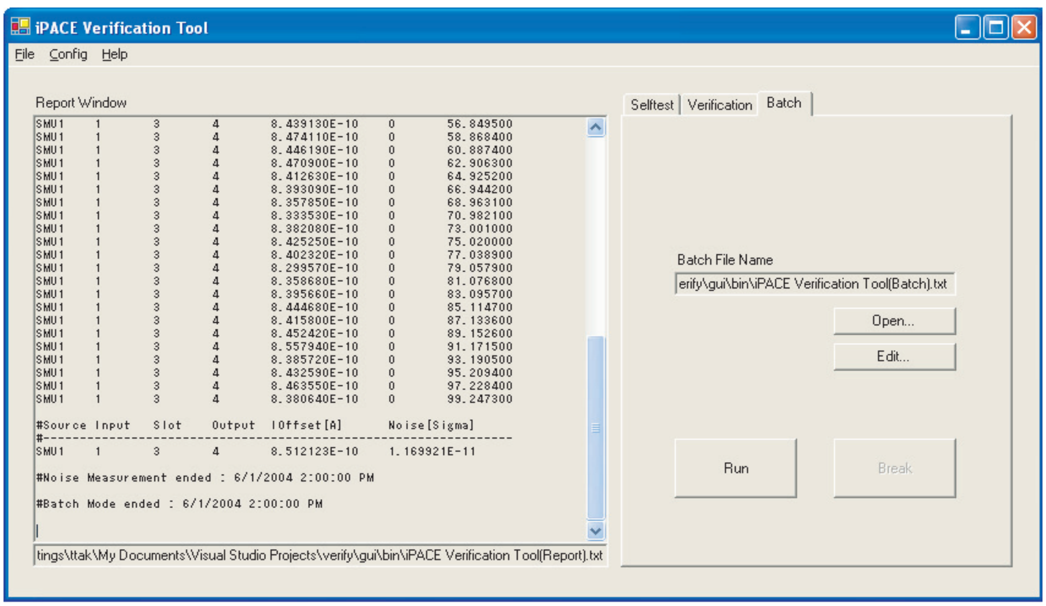
   For the batch file, see “To Create Batch File” on page 3-24.
4. Click **Run** to start the measurements in the batch mode.

   Clicking **Break** aborts the measurement and initializes the instruments.

   The result will be displayed on the ‘Report Window’ area. The result will be also logged into the log file.

   After the measurement is completed, a dialog box opens to notify you of it. Then click **OK**.

Figure 3-11 **iPACE Verification Tool window - Batch tab**



NOTE

Dialog Box

If plural test items are defined in a batch file, a dialog box will open at the beginning of each test item. The dialog box will prompt you for the test fixture setup.

To Create Batch File

This section explains how to create the batch file.

- "Batch File"
- "Connection Check"
- "To Create Batch File"

Especially, you have to understand the measurement mechanisms in the batch mode to define the batch files to perform the connection check.

Batch File

Contents of the batch file are described in this section. Each line of the batch file should contains the following information. The required parameter depends on the test item. The parameters covered by [ ] can be ignored.

```
<test item>[,<s unit>,<s input port>,<s output slot>,<s output ch>[,
<unit>,<input port>,<output slot>,<output ch>]]
```

Table 3-3 Setup Parameters

Parameter	Description [1]
test item	Test item. 0, 1, 2, or 255. 0: connection check 1: noise offset measurement 2: settling time/leakage current measurement 255: selftest
s unit	Source monitor unit. SMU1 to SMU8. For the connection check, *s unit* specifies the voltage source. SMU1 to SMU8, VSU1 to VSU2, PGU1 to PGU2, or CMU.
s input port	SWM input port number [2] that is used for the *s unit* connection. 1 to 14.
s output slot	SWM slot number that is used for the *s unit* connection. 1 to 4.
s output ch	SWM output port number that is used for the *s unit* connection. 1 to 12.
unit	Voltmeter. SMU1 to SMU8, VMU1 to VMU2, or CMU. if CMU is set to *s unit*, set CMU to *unit* too. Then the CMU performs the resistance measurement, not the voltage measurement.
input port	SWM input port number that is used for the *unit* connection. 1 to 14.
output slot	SWM slot number that is used for the *unit* connection. 1 to 4.
output ch	SWM output port number that is used for the *unit* connection. 1 to 12.

1. Available values depend on the system component.
2. SWM means the switching matrix.

Setup Example

- Connection check:

  All parameters must be specified. The program ignores the line that contains the improper value.

  Example: `0,SMU1,1,2,12,SMU4,5,2,9`

  Example: `0,SMU1,1,2,12,SMU4,5,2,7`

  Example: `0,SMU1,1,2,12,SMU4,5,2,5`

  Example: `0,SMU1,1,2,12,SMU4,5,2,3`

  Example: `0,SMU1,1,2,12,SMU4,5,2,1`

- Noise offset measurement:

  Specify the parameters *test item* to *s output ch*. The program ignores the line that contains the improper value.

  For the measurement without switching matrix, do not specify the parameters *s input port*, *s output slot*, and *s output ch*. Then you cannot delete comma.

  Example: `1,SMU1,1,1,1`

  Example: `1,SMU2,2,1,2`

  Example: `1,SMU1,,,`

- Settling time/leakage current measurement:

  Specify the parameters *test item* to *s output ch*. The program ignores the line that contains the improper value.

  For the measurement without switching matrix, do not specify the parameters *s input port*, *s output slot*, and *s output ch*. Then you cannot delete comma.

  Example: `2,SMU1,1,1,1`

  Example: `2,SMU2,2,1,2`

  Example: `2,SMU1,,,`

- Self-test:

  Specify *test item* only.

  Example: `255`

NOTE

Sample Batch File

The following sample batch file is installed in the following folder.

folder: <*installed folder*>`/bin`

file name: `iPACE Verification Tool (Batch).txt`

The contents of the sample batch file is shown in Figure 3-12.

Figure 3-12 Sample Batch File

```
# <test item>[,<unit>,<input port>,<output slot>,<output ch>[,<unit>,<input port>,
<output slot>,<output ch>]]
#
# <test item>   : 0 (connection path), 1 (noise), 2 (settling) or 255 (selftest)
# <unit>        : SMU or CMU name (SMU1, SMU2, ..., CMU)
# <input port>  : input port number in matrix instrument
# <output slot> : output slot in matrix instrument
# <output ch>   : output channel in matrix instrumentthe
# <unit>        : SMU or CMU name (SMU1, SMU2, ..., CMU) (used by connection path)
# <input port>  : input port number in matrix instrument (used by connection path)
# <output slot> : output slot in matrix instrument (used by connection path)
# <output ch>   : output channel in matrix instrument (used by connection path)

255
0,SMU1,1,1,12,SMU2,2,1,10
0,SMU1,1,1,8,SMU2,2,1,6
0,SMU1,1,1,4,SMU2,2,1,2
0,SMU3,3,2,12,SMU4,4,2,10
0,SMU3,3,2,8,SMU4,4,2,6
0,SMU3,3,2,4,SMU4,4,2,2
0,CMU,9,3,12,CMU,1,3,10
0,CMU,9,3,8,CMU,1,3,6
0,CMU,9,3,4,CMU,1,3,2
1,SMU1,1,1,2
1,SMU2,2,1,2
1,SMU3,3,1,2
1,SMU4,4,1,2
2,SMU1,1,1,2
2,SMU2,2,1,2
2,SMU3,3,1,2
2,SMU4,4,1,2
```

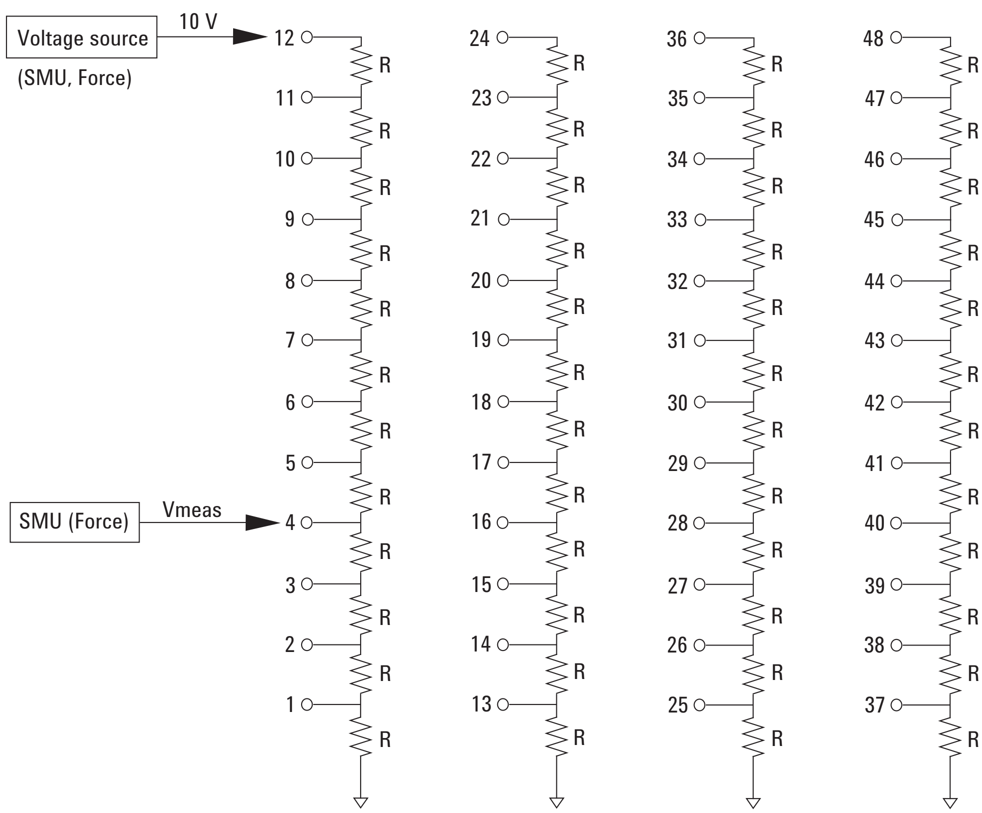
Connection Check

To perform the connection check in the batch mode, the connection check fixture (E3143-60001) must be connected to the Agilent B2220A probe card interface. The fixture has four 12 pin block, and the pins are connected by the resistor as shown in Figure 3-13.

For the 48(24) pin configuration, the batch file should be created upon the following connections of the voltage source (VS) and the voltmeter (VM).

- VS to 12(12), and VM to 1 through 11 (2 through 10)
- VS to 24(24), and VM to 13 through 23 (14 through 22)
- VS to 36(36), and VM to 25 through 35 (26 through 34)
- VS to 48(48), and VM to 37 through 47 (38 through 46)

Figure 3-13 **E3143-60001 Internal Circuit and Voltage Source/Voltmeter Connection (non-Kelvin)**



NOTE

DC Voltage Measurement Result

Without any system error, the measurement result (Vmeas) should be almost equal to the Vcalc value given by the following formula. Then *n* is an integer of 1 to 11 that means the number of resistors between the measurement pin and the ground.

$$Vcalc = 10 \times n / 12 \text{ (V)}$$

For the 24 pin configuration, $Vcalc = 10 \times n / 6$ (V). Then *n* is an even number of 2 to 10.

If the system contains a source monitor unit (SMU) that is connected to the Agilent B2200 switch mainframe by using a Kelvin triaxial cable, the switch module output ports work as the couple output port. See Figure 3-14. You can use one of the following SMUs for the voltage source and the voltmeter.

(1) SMU connected to the Agilent B2200 by the Kelvin cable

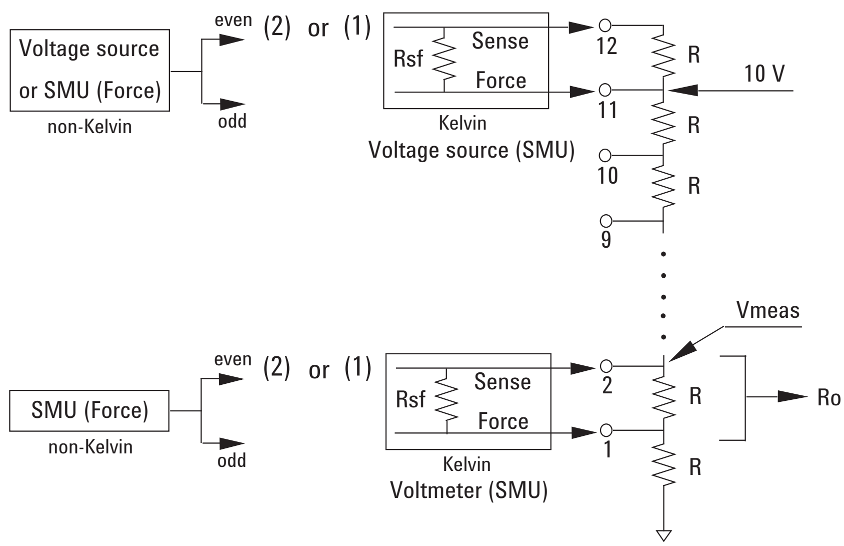
(2) SMU connected to the Agilent B2200 by the triaxial cable (non-Kelvin)

The connection of Figure 3-14 (2, non-Kelvin) will be made by using the switch module. The switch module and the instrument will be controlled by the program.

For the 48(24) pin configuration, the batch file should be created upon the following connections of the voltage source (VS) and the voltmeter (VM). For each cases, the output voltage (10 V) will be applied to the pin 11(10), 23(22), 35(34), or 47(46).

- VS to 11-12 (10-12), and VM to 1-2 through 9-10 (2-4 or 6-8)
- VS to 23-24 (22-24), and VM to 13-14 through 21-22 (14-16 or 18-20)
- VS to 35-36 (34-36), and VM to 25-26 through 33-34 (26-28 or 30-32)
- VS to 47-48 (46-48), and VM to 37-38 through 45-46 (38-40 or 42-44)

Figure 3-14 **Connection of Couple Output Port**



NOTE

DC Voltage Measurement Result

Without any system error, the measurement result (Vmeas) should be almost equal to the Vcalc value given by the following formula. R is the resistance (about 50 kΩ) between the test fixture pins, Ro is the resistance between the pins during the voltmeter is connected, Ro=0 if the voltmeter is connected as shown in Figure 3-14 (2), Rsf is the resistance (about 10 kΩ, depends on SMU) between Force and Sense in the SMU, *n* is an odd number of 1 to 9 that means the number of resistors between the measurement pin and the ground.
For the 24 pin configuration, multiply R by two, and then *n* is 2 or 6.

Vcalc (V) = 10 × (n × R + Ro) / (10 × R + Ro)

Ro (Ω) = 1 / (1/R + 1/Rsf)

To Create Batch File

Open the ‘iPACE Verification Tool’ window, and perform the following step.

1. Click the ‘Batch’ tab.
2. Click **Open...**. The ‘Open Batch File’ window appears.

   On the ‘Open Batch File’ window, select the batch file to use, and click **Open**.

   The ‘Open Batch File’ window will be closed. And the selected file name will be displayed in the ‘Batch File Name’ field.
3. Click **Edit...**. Then the Notepad will open. And it will show the code of the batch file.
4. Edit the batch file as you like.

   See Table 3-3 for the meaning of parameters.
5. Save the batch file as the new file name.

NOTE

Creating Tips

If plural test items are defined in a batch file, a dialog box will open at the beginning of each test item. The dialog box will prompt you for the test fixture setup.

To avoid this interrupt, it is recommended to create a batch file for each test item.

Reading Result Data

This section explains the contents of the result data displayed on the ‘Result Window’ area of the ‘iPACE Verification Tool’ window. The parameters covered by [ ] are optional.

The data will be logged into the log file. In the log file, the parameters are separated by tab.

- Self-test:

```
Model Result
```

- Connection check:

```
Source Input Slot Output Judge
```

- Connection check (batch mode):

```
Source Input  Slot  Output
Unit   MInput MSlot MOutput VMeasure Status Time
```

- Noise offset measurement:

```
Source Input Slot Output IMeasure Status Time
:
Source Input Slot Output IOffset Noise
```

50 data lines will be listed between the above lines.

- Settling time/leakage current measurement:

```
Source Input Slot Output IMeasure Status Time
:
Source Input Slot Output ILeak VStep
```

Data lines for 100 seconds measurement will be listed between the above lines.

NOTE Default Log File

In the default setting, the data will be logged into the following file.

folder: <*installed folder*>`/bin`

file name: `iPACE Verification Tool (Report).txt`

To change the log file, use the Open Report File dialog box opened by clicking File > Open Report File. After changing the file name, the result data will be logged into the new file.

Table 3-4 Parameters in Report File

Parameter	Description
Model	Model number of the instrument that the self-test was performed.
Result	Self-test result. Pass or Fail.
Source	Source monitor unit or voltage source. SMU1 to SMU8, VSU1 to VSU2, PGU1 to PGU2, or CMU.
Input	SWM input port number [1] that was used for the *Source* connection. 1 to 14.
Slot	SWM slot number that was used for the *Source* connection. 1 to 4.
Output	SWM output port number that was used for the *Source* connection. 1 to 12.
Judge	Label of the button clicked by the operator after the connection check was performed manually. Ok or Cancel.
Unit	Voltmeter. SMU1 to SMU8, VMU1 to VMU2, or CMU.
MInput	SWM input port number that was used for the *Unit* connection. 1 to 14.
MSlot	SWM slot number that was used for the *Unit* connection. 1 to 4.
MOutput	SWM output port number that was used for the *Unit* connection. 1 to 12.
VMeasure	Voltage measurement data (V). Or the resistance measurement data (Ω) if *Unit* is CMU.
Status	Status data of *Unit*. 0: normal. For the status data, see manual of the instrument (*Unit*).
Time	Accumulated time from the beginning of the measurement (in second).
IMeasure	Current measurement data.
IOffset	Averaging value of all measured current.
Noise	Standard deviation value of all measured current.
ILeak	Averaging value of the last ten measured current.
VStep	Voltage output value from *Source*.

1. SWM means the switching matrix.

4 Agilent iPACE Verification Tool

This chapter provides the reference information of the Agilent iPACE Verification Tool and consists of the following sections.

- Set Configuration Window
- iPACE Verification Tool Window
- Project Files
- Project Items
- To Change Measurement Conditions

NOTE

System Requirements

For the system requirements to perform the verification tool or modify the program code, see “Installation” on page 3-5.

Set Configuration Window

This window is used to set the system configuration of the Agilent 41000.

GPIB Name Selects the VISA name of the GPIB interface.

Instrument Selects the instrument.

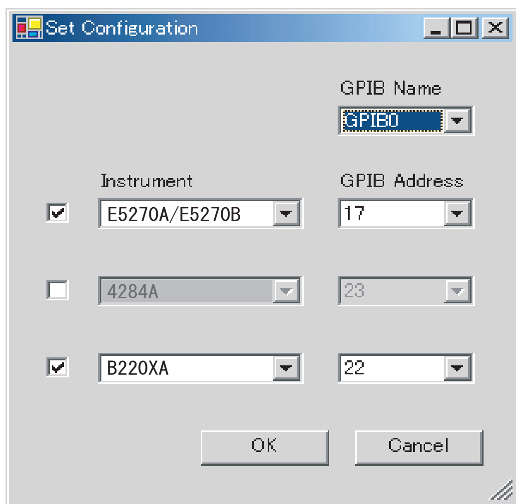
Check the check box of the left side. Then the Instrument combo box will be active.

GPIB Address Selects the GPIB address of the instrument set to the Instrument combo box.

OK Completes the configuration setup, and closes the Set Configuration window.

Cancel Cancels the setup, and closes the Set Configuration window.

Figure 4-1 **Set Configuration Window**



iPACE Verification Tool Window

This section explains GUI of the iPACE Verification Tool window.

File The Open Report File... menu opens the Open Report File window. On the window, selects the log file used to save the measurement result data.

The Exit menu closes the iPACE Verification Tool window.

Config The Set GPIB Address... menu opens the Set Configuration window. See “Set Configuration Window” on page 4-3.

Help The About iPACE Verification Tool... menu displays the revision information of the Agilent iPACE verification tool.

Report Window Displays the measurement result data.

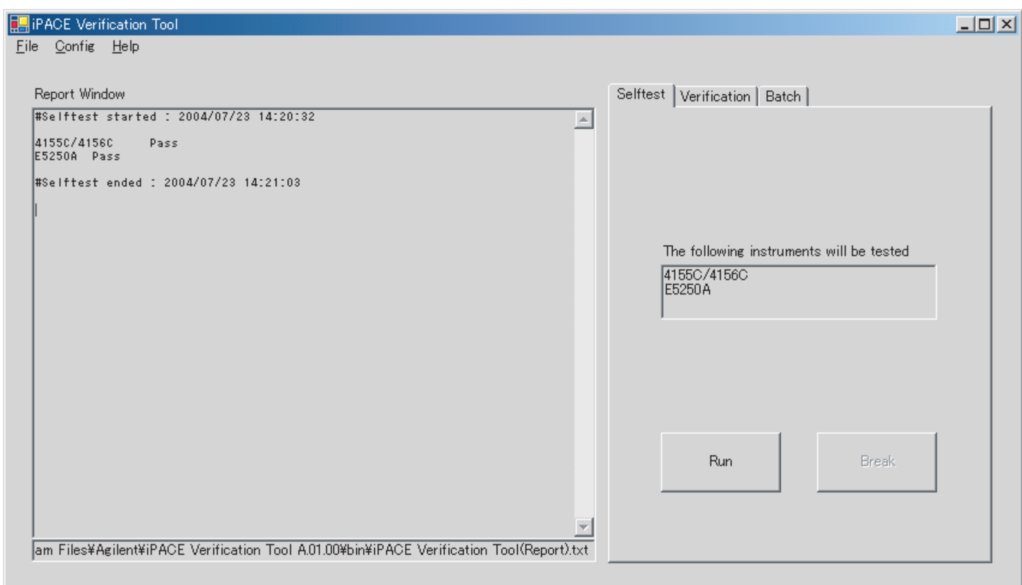
Selftest Tab

Executes the self-test.

Run Starts the self-test of the instruments listed in the text box upper than the button.

Break Aborts the execution of the self-test.

Figure 4-2 **Selftest Tab**



Verification Tab

Executes the connection check, noise offset measurement, or settling time/leakage current measurement.

Test Item Selects the measurement item to perform.

Connection Path	connection check
Noise	noise offset measurement
Settling/Leak	settling time/leakage current measurement

Source Selects the voltage source (voltage output unit).

Input Port Specifies the port number of the switch mainframe input port connected to the voltage source.

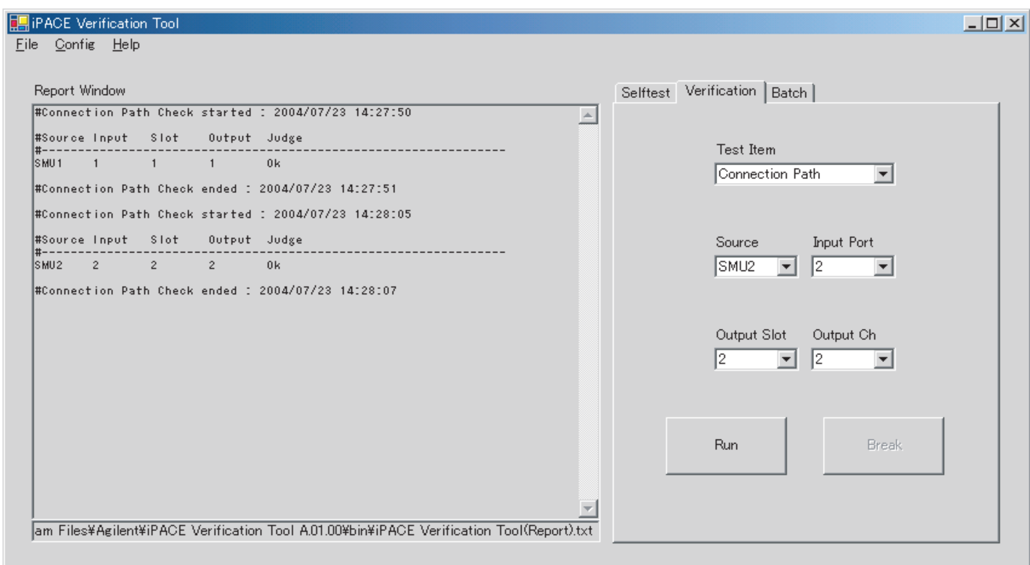
Output Slot Specifies the slot number of the mainframe card slot that installs the switch module used for the measurement path.

Output Ch Specifies the port number of the switch module output that will be the end of the measurement path.

Run Starts the specified measurement.

Break Aborts the measurement execution.

Figure 4-3 **Verification Tab**



Batch Tab

Executes the measurement in the batch mode.

Batch File Name Displays the batch file to execute.

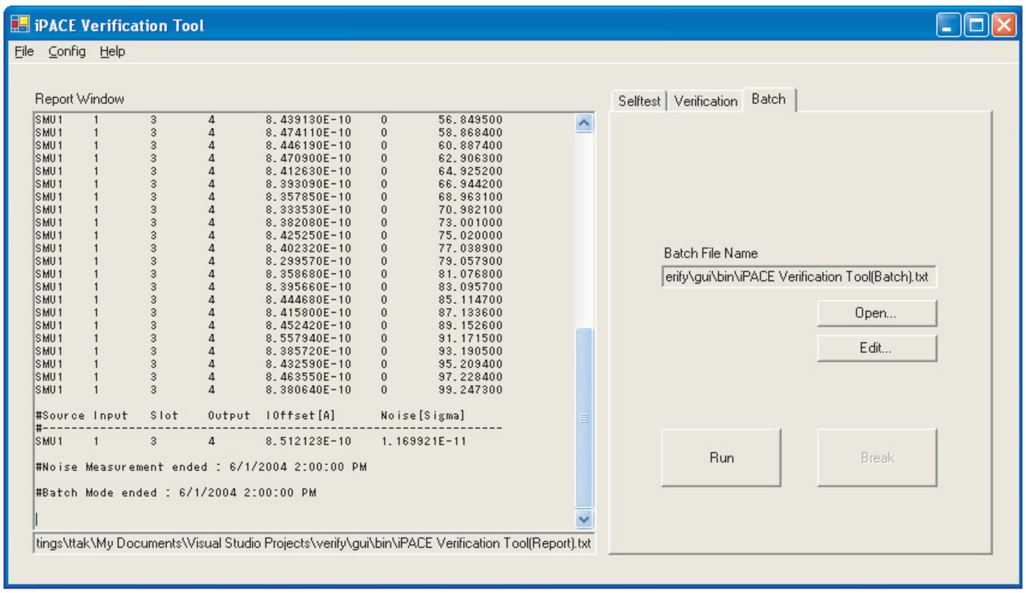
Open... Opens the Open Batch File window. On the window, select the batch file to execute.

Edit... Opens the Notepad and displays the contents of the batch file that is specified by the Batch File Name. You can edit the batch file on the Notepad.

Run Starts the specified measurement.

Break Aborts the measurement execution.

Figure 4-4 **Batch Tab**



Project Files

Agilent iPACE verification tool consists of the following projects.

- Tool

  Main project of the verification tool. Creates the GUI, controls the measurements, displays the measurement results, creates the log file, and so on. This project imports the Control project.

  Location: <installed folder>/src/iPACE Verification Tool

- Control

  Measurement control subprograms are defined in this project. This project activates the Body project.

  Location: <installed folder>/src/iPACE Verification Control

- Body

  This project selects subprograms according to the setup of the GUI. This project imports the Control and Instrument projects.

  Location: <installed folder>/src/iPACE Verification Body

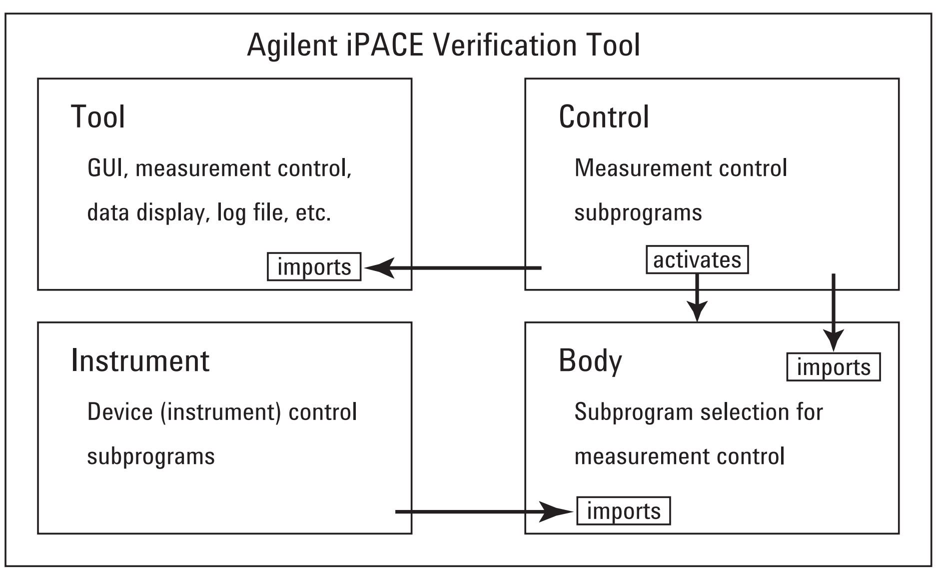
- Instrument

  Device (instrument) control subprograms are defined in this project. Controls a source monitor unit, a LCR meter, and a switching matrix.

  Location: <installed folder>/src/iPACE Verification Instrument

Then, <installed folder> is the folder where this program has been installed.

Figure 4-5 Relations of the Projects



Project Items

Each project consists of the project items shown in the following tables.

- Tool Project Items
- Control Project Items
- Body Project Items
- Instrument Project Items

Table 4-1 **Tool Project Items**

Item name	Description
Main.vb	Creates the iPACE Verification Tool window.
Config.vb	Creates the Set Configuration window.
Parameter.vb	Defines value of the instrument setup parameters (measurement condition). Imports modParameter (Parameter.vb) of the Control project.
Control.vb	Executes the selected measurement or the self-test. Imports modControl (Control.vb) and modParameter (Parameter.vb) of the Control project.
Data.vb	Collects and calculates the measurement result data.
File.vb	Defines a text file (log file) that saves the measurement results.
FileBind.vb	Keeps the contents of the batch file. Inherits File.vb.
FileConfig.vb	Stores the Set Configuration window setup data in the following file. Inherits File.vb. <installed folder>/bin/iPACE Verification Tool(Config)
FileTool.vb	Stores the measurement results in the following file. Also defines title, label, and so on used in the file. Inherits File.vb. <installed folder>/bin/iPACE Verification Tool(Report).txt
Message.vb	Defines messages displayed on a message box or a dialog box.
dlgmsg.vb	Displays the Please Wait ... box when the system configuration is confirmed.
i-pace27.ico	Defines the Agilent iPACE verification tool icon.

Table 4-2 Control Project Items

Item name	Description
Body.vb	Collects the instrument control basic information; instrument model, GPIB card number, address, program internal information, and so on. And activates the Body project.
Control.vb	Defines the measurement control subprograms used for connection path control, source output control, measurement data read, and so on.
KeyCode.vb	Defines key code used by the measurement control subprograms.
Parameter.vb	Defines the current/voltage output range, the current/voltage/resistance measurement range, and the several measurement functions.
Socket.vb	Used for communication between the Tool project and the Body project.
Time.vb	Performs the time out judgement.
Event.vb	Receives an event that notifies the update of an internal file created by the Body project.
File.vb	Keeps data of an internal file created by the Body project.
Message.vb	Defines messages displayed on a message box or a dialog box.

Table 4-3 Body Project Items

Item name	Description
Main.vb	This item is activated by Body.vb of the Control project. Obtains the parameter values defined in the Tool project, and activates Body.vb.
Body.vb	Performs Write and Read in System.vb. Imports the Control project.
System.vb	Selects subprograms used for measurement control. Imports the Control and Instrument projects. Also imports modParameter (Parameter.vb) in the Control project.
File.vb	Keeps data of an internal file created by the Body project.
Message.vb	Defines messages displayed on a message box or a dialog box.

Table 4-4 **Instrument Project Items**

Item name	Description
Inst.vb	Defines the common functions such as configuration confirmation, error detection, initialization, self-test, and so on, in functions or subprograms.
InstSpa.vb	Defines the functions for the source monitor unit in functions or subprograms.
InstCmu.vb	Defines the functions for the LCR meter in functions or subprograms.
InstMat.vb	Defines the functions for the switching matrix in functions or subprograms.
Inst415x.vb	Defines the functions only for the 4155C/4156C in functions or subprograms.
InstE527x.vb	Defines the functions only for the E5270B/E5270A/E5272A/E5273A in functions or subprograms.
Inst4284.vb	Defines the functions only for the 4284A in functions or subprograms.
InstB220x.vb	Defines the functions only for the B2200A/B2201A in functions or subprograms.
InstE525x.vb	Defines the functions only for the E5250A in functions or subprograms.
IoGpib.vb	Defines the GPIB common commands in functions or subprograms.
IoSpa.vb	Defines the GPIB commands for the source monitor unit in functions or subprograms.
IoCmu.vb	Defines the GPIB commands for the LCR meter in functions or subprograms.
IoMat.vb	Defines the GPIB commands for the switching matrix in functions or subprograms.
Io415x.vb	Defines the GPIB commands only for the 4155C/4156C in functions or subprograms.
IoE527x.vb	Defines the GPIB commands only for the E5270B/E5270A/E5272A/E5273A in functions or subprograms.
Io4284.vb	Defines the GPIB commands only for the 4284A in functions or subprograms.
IoB220x.vb	Defines the GPIB commands only for the B2200A/B2201A in functions or subprograms.
IoE525x.vb	Defines the GPIB commands only for the E5250A in functions or subprograms.
Message.vb	Defines messages displayed on a message box or a dialog box.

To Change Measurement Conditions

The following procedure provides how to change the measurement condition and the instrument setup. See Table 4-5 for the measurement condition setup parameters.

1. Make backup of all files in <installed folder>`\src`.
   For example, copy them to <installed folder>`\backup\src`.

   Then, <installed folder> is the folder where this program has been installed.
   For example,

   `C:\Program Files\Agilent\iPACE Verification Tool A.01.00`

2. Change the name of the following files. Add `.org` after `.dll`.

   Folder: <installed folder>`\bin`

   File: `Agilent.IpaceVerificationControl.dll`

   File: `Agilent.IpaceVerificationInstrument.dll`

3. Open the following file on Microsoft Visual Basic .Net software.

   Folder: <installed folder>`\src\iPACE Verification Tool`

   File: `Parameter.vb`

4. Change the value of the parameters defined in the file as you want.

   For the variables (measurement condition setup parameters), see Table 4-5.

5. Build the following projects in this order.

   a. Instrument project

   b. Control project

   c. Body project

   d. Tool project

6. Copy the following files to <installed folder>`\bin`.

   Folder: <installed folder>`\src\iPACE Verification Body\bin`

   File: `Agilent.IpaceVerificationControl.dll`

   File: `Agilent.IpaceVerificationInstrument.dll`

Table 4-5 Measurement Condition Setup Parameters

Variable name	Description	Initial setting
Connection check		
VERIFY_CHECK_VS_FORCE	Voltage source output value (V)	10.0
VERIFY_CHECK_VS_COMPLIANCE	Voltage source compliance value (A)	0.001
VERIFY_CHECK_IS_FORCE	Voltage measurement unit output value (A)	0.0
VERIFY_CHECK_IS_COMPLIANCE	Voltage measurement unit compliance value (V)	20.0
Noise offset measurement		
VERIFY_NOISE_INTEG_VALUE	Integration time (number of power line cycles)	50
VERIFY_NOISE_VS_FORCE	Voltage source output value (V)	0.0
VERIFY_NOISE_VS_COMPLIANCE	Voltage source compliance value (A)	0.001
VERIFY_NOISE_VS_NUMBER	Number of measurement points	50
VERIFY_NOISE_HOLD_TIME	Hold time (1.0 = 1 s)	10.0
Settling time/leakage current measurement		
VERIFY_SETTLE_INTEG_VALUE	Integration time (number of power line cycles)	2
VERIFY_SETTLE_VS_FORCE	Voltage source output value (V)	10.0
VERIFY_SETTLE_VS_COMPLIANCE	Voltage source compliance value (A)	0.001
VERIFY_SETTLE_IM_TIME	Total measurement time (repetition time, 10000.0 = 1 s)	1000000.0
VERIFY_SETTLE_HOLD_TIME	Hold time (1.0 = 1 s)	0.0
VERIFY_LEAK_VS_NUMBER	Number of measurement data used to calculate the ILeak value	10

5 Measurement Techniques

This chapter explains the following measurement techniques.

- “Measurement Environments”
- “Kelvin Connections”
- “Low Current Measurements”
- “Low Resistance Measurements”
- “Capacitance Measurements”

Measurement Environments

It is important to prevent the device under test (DUT) from light, noise, vibration, and temperature change to perform measurement, especially sensitive measurement such as low current measurement and low resistance measurement. Before starting measurement:

Light and Noise

To prevent the DUT from light and noise, attach the light shielding panel (E3120-00211) to the probe card interface (Agilent B2220A).

Temperature and Humidity

The measurement accuracy is specified at the following temperature and humidity.

Temperature: 23 °C ± 5 °C (73 °F ± 9 °F)

Humidity: ≤ 60% RH

Use air conditioner to keep the temperature constant. Then, prevent the instruments from direct air flow. The air flow can cool down the instruments. And it will cause the measurement error.

The following additional conditions should be satisfied for measuring low-current and low-voltage.

Temperature change: Within ± 1 °C after the calibration

Temperature change period: ≥ 10 minutes

Humidity: ≤ 50%

Floor Vibration

The following vibration conditions should be satisfied for measuring low-current and low-voltage. Keep away vibrator such as air pump and motor.

Floor vibration: ≤ 1 mG

Floor vibration transmission frequency: ≥ 10 Hz

Also, prevent the instruments and measurement cables from vibration. To do so, stabilize the instrument rack or table that the instruments are placed, and stabilize the measurement cables by using tape.

Air Cleanliness

The Agilent 41000 must be located in an area where the air purity meets or exceeds class 100,000 standards. Also, to ensure trouble-free disk and disk drive operation, system controller peripherals should be located in an environment of similar air purity.

The following air cleanliness condition should be satisfied for measuring low-current and low-voltage.

Air cleanliness: < class 10,000

Kelvin Connections

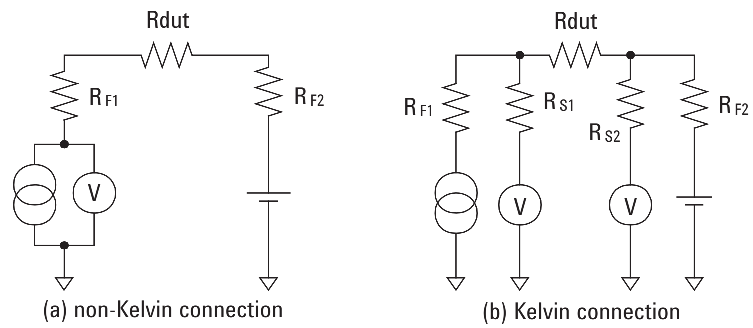
This section describes the Kelvin connections effective for the high current measurement or the low resistance measurement. The Kelvin connection is available for the source monitor unit (SMU) installed in the Agilent 4156C and E5270B.

- "About Kelvin Connections"
- "To Make Kelvin Connections"
- "To Control Switching Matrix"
- "To Connect Ground Unit"

About Kelvin Connections

When you measure a low resistance, high current flows through the DUT. This high current increases the measurement error caused by the residual resistance of cables. To cancel the effect of this resistance, you can use *Kelvin connections* (4-wire) which mean that the force and sense lines are extended separately to the DUT. The next figure shows the equivalent circuits for Kelvin and non-Kelvin connections.

- For the non-Kelvin connection, the voltmeter measures the voltage drop of resistances R_{F1}, R_{dut}, and R_{F2}.
- For the Kelvin connection, the voltmeter measures the voltage drop of resistance R_{dut} only. The impedance of the voltmeter is very high, so the voltage drop of resistances R_{S1} and R_{S2} can be ignored.



The Kelvin connection is effective even when forcing voltage. The voltage drop due to the residual resistance of the force line wiring is fed back to the voltage source via a comparator in the sense line. The input impedance of comparator is high, and current flow into the sense line is very low. So output error is not significant if the sense line wiring has a residual resistance of 10 Ω or less. Therefore, the specified voltage appears at the sense point (point where sense line contacts force line).

To Make Kelvin Connections

The instruments should be connected as shown in Figure 5-1 to make Kelvin connections. Table 5-1 lists the connection cables required to make the Kelvin connection of the source monitor unit (SMU).

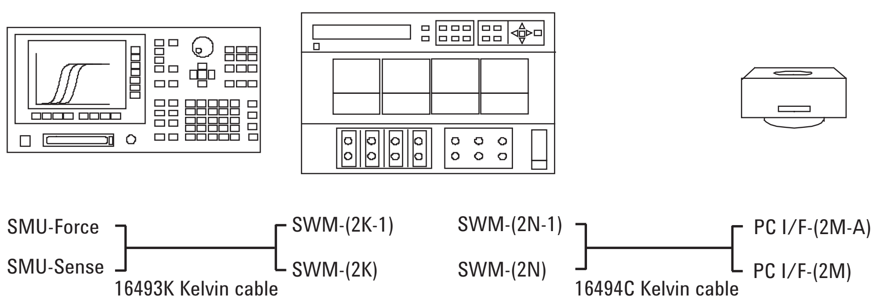
Connect the 16493K Kelvin cable between the SMU and the switching matrix (SWM) input. And connect the 16494C Kelvin cable between the SWM output and the probe card interface (PC I/F) input. The Kelvin connection can be supported over the PC I/F output. To make the sense points, see “Force-sense connections” on page 5-6.

Table 5-1 **Required Cables for SMU Connection**

From	Cable	To
SMU	16493K Kelvin triaxial cable	SWM Input [1]
SWM Output	16494C Kelvin triaxial cable	PC I/F Input [2]

1. Agilent B2200A/B2201A switching matrix (SWM) input pairs 1-2, 3-4, 5-6, or 7-8.
2. Agilent B2220A probe card interface (PC I/F) input pairs 1-2, 3-4, 5-6, ... , or 47-48 for 48 pin configuration, and 2-4, 6-8, 10-12, ... , or 46-48 for 24 pin configuration.

Figure 5-1 **Making Kelvin Connections**



In Figure 5-1, K, N, M, and A are integer, and have the following meaning.

- K: 1 to 4. Used to specify the SWM input port.
- N: 1 to 6×(number of modules installed in the mainframe from slot 1 sequentially).
- M: 1 to 24 for the 48 pin PC I/F or the even number from 2 to 24 for the 24 pin PC I/F.
- A: 1 for the 48 pin PC I/F or 2 for the 24 pin PC I/F.

NOTE

Kelvin input-output paths

The Agilent B2220A probe card interface (PC I/F) uses two input-output paths to make one Kelvin connection. Maximum 12 Kelvin paths are available for the 24 pin PC I/F, 24 Kelvin paths are available for the 48 pin PC I/F.

Force-sense connections

Kelvin output sense and force appear on the adjacent output pins of the Agilent B2220A probe card interface. For example, if a Kelvin path is connected to the inputs 1-2, it is extended to the output 1-2.

When the measurement is performed, the force and sense must be connected together. There is the following ways to make the force-sense connections. Select the way suitable for your measurement environment, and make it.

- On the probe card

  Design the probe card so that a probe needle is connected to both two adjacent contacts on the probe card. See Figure 5-2. The guard terminals should be opened on the probe card or should be connected to the guard terminal of the guarded probe needle.

- On the wafer

  Design the pattern so that a device terminal is connected to both two adjacent contact pads. See Figure 5-3. The pads should be contacted by the adjacent probe needles on the probe card, and the needles should be connected to the adjacent contacts on the probe card.

  The guard terminals should be opened on the probe card or should be connected to the guard terminal of the guarded probe needle.

Figure 5-2 Making Sense Points on Probe Card

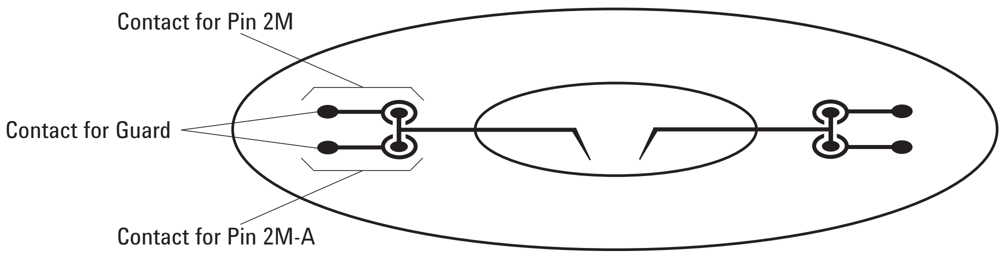
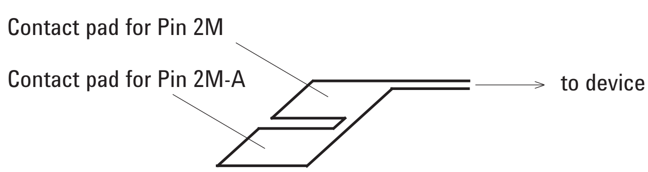


Figure 5-3 Making Sense Points on Wafer



NOTE

Differences from the Agilent 4070 series

For the Agilent 4070 series, one matrix output provides the both force and sense pins. So the maximum 48 Kelvin output ports can be made.

You can use the probe cards designed for the Agilent 4070. However, for the Kelvin connection, the sense points (force-sense connections) must be made on the wafer as shown in Figure 5-3.

To Control Switching Matrix

The Agilent B2200 switching matrix provides the couple mode function. When the couple mode is ON, the matrix switches will be controlled to connect the specified couple input port to the specified couple output port. The couple input ports have to be set to the input ports used for the Kelvin connection.

To set couple input ports

There is two ways to set the couple input ports. First way is to set the couple ports automatically by using the couple port detection capability. And the second way is to set the couple ports manually.

- Setting the couple ports automatically

  Enter the :ROUT:COUP:PORT:DET command. The input ports connected to the Kelvin cable will be detected automatically, and will be assigned as the couple input ports.

- Setting the couple ports manually

  Enter the :ROUT:COUP:PORT *card_number*, '*ports*' command to specify the couple ports. For example, the following command sets two couple ports (input port pairs 1-2 and 3-4) for the all switch module installed in the Agilent B2200.

  ```
  :ROUT:COUP:PORT ALL,'1,3'
  ```

To control Kelvin connection path

After the couple input ports are defined, set the couple mode ON by using the :ROUT:COUP ON command. After that, the :ROUT:CLOS command will control the switches to connect the specified couple input port to the specified couple output port, and the :ROUT:OPEN command will control the switches to disconnect the specified couple input port from the specified couple output port.

The following example connects the input ports 1 and 2 (couple input port) to the output ports 11 and 12 respectively.

```
:ROUT:COUP:PORT ALL,'1,3'
:ROUT:COUP ON
:ROUT:CLOS (@00111)
```

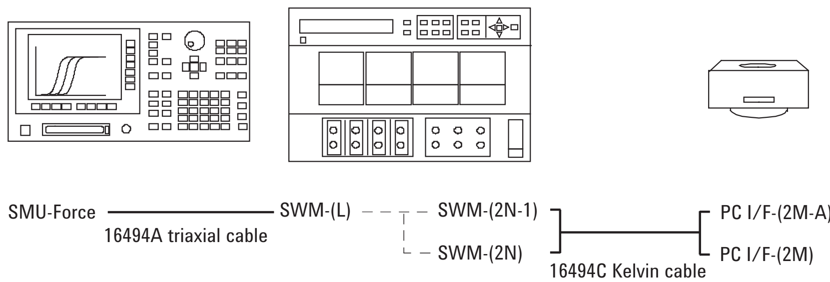
To connect non-couple input ports to couple output ports

When you control the Agilent B2200 switching matrix to connect the non-couple input port to the couple output port that the Kelvin cable is connected to, control the switches to connect the input port to both lines of the Kelvin cable. They should be the same potential when the measurement is performed.

The following example connects the input port 1 to the output ports 11 and 12.

```
:ROUT:CONN:RULE ALL,FREE
:ROUT:CLOS (@00111,00112)
```

Figure 5-4 Connecting Non-couple Input Ports to Couple Output Ports



In Figure 5-4, L, N, M, and A are integer, and have the following meaning.

- L: 1 to 8. Used to specify the SWM input port.
- N: 1 to 6×(number of modules installed in the mainframe from slot 1 sequentially).
- M: 1 to 24 for the 48 pin PC I/F or the even number from 2 to 24 for the 24 pin PC I/F.
- A: 1 for the 48 pin PC I/F or 2 for the 24 pin PC I/F.

And SMU, SWM, and PC I/F indicate the following instrument.

- SMU: Source Monitor Unit
- SWM: Switching Matrix
- PC I/F: Probe Card Interface

To Connect Ground Unit

To use the ground unit (GNDU) of the Agilent 41501B or E5270B, connect the GNDU output to the probe card interface (PC I/F) input, not the switching matrix input. See Figure 5-5. Table 5-2 lists the connection cables required to connect the GNDU.

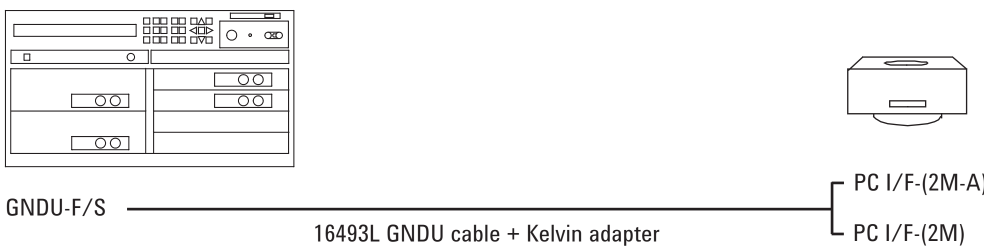
Connect the adapter to the PC I/F input, then connect the GNDU cable between the GNDU and the adapter. The Kelvin connection can be supported over the PC I/F output. To make the sense points, see “Force-sense connections” on page 5-6.

Table 5-2 **Required Cables for GNDU Connection**

From	Cable	To
GNDU	16493L GNDU cable	PC I/F Input [1]
	E5250-60044 Triax-Dual Triax adapter	

1. Agilent B2220A PC I/F input pairs 1-2, 3-4, 5-6, ... , or 47-48 for 48 pin configuration, and 2-4, 6-8, 10-12, ... , or 46-48 for 24 pin configuration.

Figure 5-5 **Connecting GNDU**



In Figure 5-5, M, and A are integer, and have the following meaning.

- M: 1 to 24 for the 48 pin PC I/F or the even number from 2 to 24 for the 24 pin PC I/F.
- A: 1 for the 48 pin PC I/F or 2 for the 24 pin PC I/F.

To make force-sense connection at PC I/F input

To keep the Kelvin connection up to the Agilent B2220A probe card interface (PC I/F) input, not output, see Table 5-3 instead of Table 5-2.

Connect the adapter to the PC I/F input, then connect the GNDU cable between the GNDU and the adapter. The path over the PC I/F input will be the non-Kelvin connection.

Table 5-3 **Required Cables for GNDU Connection (non-Kelvin over PC I/F input)**

From	Cable	To
GNDU	16493L GNDU cable	PC I/F Input
	N1254A-107 Triax(m)-Triax(f) adapter [1]	

1. This adapter connects the center conductor (sense line) and the middle conductor (force line).

To pass GNDU output through SWM

If you have to pass the GNDU output through the Agilent B2200 switching matrix (SWM), use the connection cables listed in Table 5-4.

Connect the GNDU Kelvin cable between the GNDU and the SWM input. And connect the Kelvin cable between the SWM output and the PC I/F input. The Kelvin connection can be supported over the PC I/F output. To make the sense points, see “Force-sense connections” on page 5-6.

Table 5-4 **Required Cables for GNDU Connection (through Agilent B2200)**

From	Cable	To
GNDU	16493N-001 GNDU Kelvin cable for B2200	SWM Input [1]
SWM Output	16494C Kelvin triaxial cable	PC I/F Input [2]

1. Agilent B2200A/B2201A SWM input pairs 1-2, 3-4, 5-6, or 7-8.
2. Agilent B2220A PC I/F input pairs 1-2, 3-4, 5-6, ... , or 47-48 for 48 pin configuration, and 2-4, 6-8, 10-12, ... , or 46-48 for 24 pin configuration.

CAUTION Do not apply high current over the allowable current of the Agilent B2200. The high current may damage the switch module.

Low Current Measurements

This section describes the measurement techniques effective for the low current measurement.

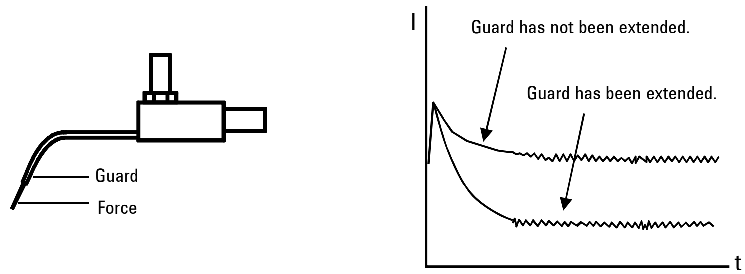
- “Guard Technique”
- “Hold Time”
- “Offset Current Subtraction”

Guard Technique

The guard technique was developed to reduce the leakage current that occurs to the measurement path. It is important to extend the guard pattern as close as possible to the front edge of the probe needle to maximize the effect of the guard. This also reduces the induced noise.

Extending guard pattern will reduce the leakage current as shown in Figure 5-6.

Figure 5-6 Guard Technique



CAUTION Never connect the guard line/pattern to anything. Making connection will damage the unit.

WARNING **Do not touch the guard terminal/pattern with bare hands because you may be shocked by high voltage. The potential is equal to the force level.**

Hold Time

Dielectric absorption is considerable for the low current measurement. It may be unexpected current caused by rapid voltage changes. To measure low current properly, it is important to wait until when this transitional current settles down. So, the low current measurement should be performed with the reasonable hold time setting. To find the reasonable hold time, perform the dielectric absorption current measurement as shown below.

1. Make open state at the end of the measurement path for the all output ports.

   The measurement path should include the probe card, manipulator, or something to contact pad/terminal of device under test (DUT).

2. Connect the current measurement path to a source monitor unit (SMU). Connect unused paths to the ground unit (GNDU) or other SMU.

3. Set the dielectric absorption current measurement condition; integration time, measurement range, output voltage, compliance, and so on.

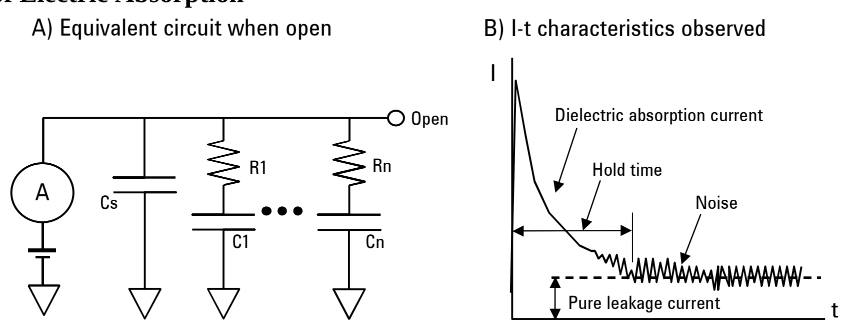
   - The integration time should be enough long (e.g. 16 power line cycles). And the value must be the same as the value set for the actual measurement.
   - The measurement range, output voltage, and compliance value must be the value (e.g. 10 pA, 10 V, 10 mA) used for the actual DUT measurement.
   - All unused source outputs must be 0 V.

4. Enable time stamp function.

5. Apply voltage and reset time stamp. And then, perform current measurement and record data (current and time stamp data). And repeat the current measurement until the time stamp value is over 100 sec, for example.

6. Find the reasonable hold time from the measurement result. Or, plot the measurement data on the current-time graph, and find the reasonable hold time.

Figure 5-7 **Effect of Electric Absorption**



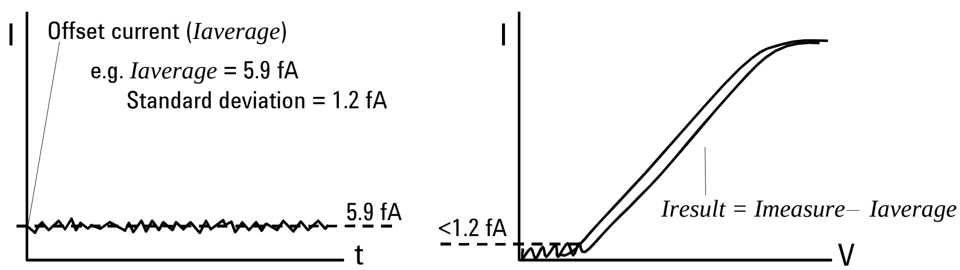
Offset Current Subtraction

Offset current of the measurement path is considerable for the low current measurement. It is important to subtract the offset current (*Iaverage*) from the measurement data (*Imeasure*) to approximate the real data (*Iresult*). This section introduces the following two ways.

- "To subtract the open state offset current"
- "To subtract the contact state offset current"

The offset current can be subtracted as shown in Figure 5-8.

Figure 5-8 **Offset Current Subtraction**



To subtract the open state offset current

In this way, the offset current is defined as the current measured when the end of measurement path is opened. The offset current can be subtracted as shown below.

Summary

- Open state offset current measurement
- Low current measurement of device under test (DUT)
- Offset current subtraction

Procedure

1. Make open state at the end of the measurement path for the all output ports.

   The measurement path should include the probe card, manipulator, or something to contact pad/terminal of device under test (DUT).

2. Connect the current measurement port to a source monitor unit (SMU).
3. Connect unused output ports to the ground unit (GNDU) or other SMU.
4. Set the offset current measurement condition; integration time, measurement range, output voltage, compliance, and so on.

   - The integration time should be enough long (e.g. 16 power line cycles).
   - The measurement range and compliance value must be the value (e.g. 10 pA, 10 mA) used for the actual DUT measurement.
   - All source outputs must be 0 V.

5. Perform offset current measurement (*Ioffset*) about 50 times, for example. And calculate the averaged value (*Iaverage*).
6. Connect the DUT.
7. Set the low current measurement condition as you want.

   Use the SMU used for the offset current measurement.

   Do not change the setting of the integration time, measurement range, and compliance.

8. Perform current measurement (*Imeasure*).
9. Subtract the offset current from the measurement data by the following formula.

   $Iresult = Imeasure - Iaverage$

   Disconnect the DUT after all measurements are completed.

To subtract the contact state offset current

In this way, the offset current is defined as the current measured when a device is connected and it is in the off state. This will be acceptable for active devices such as MOSFET and bipolar transistor. The offset current can be subtracted as shown below.

Summary

- Contact state offset current measurement
- Low current measurement of device under test (DUT)
- Offset current subtraction

Procedure

1. Make open state at the end of the measurement path for the all output ports.

   The measurement path should include the probe card, manipulator, or something to contact pad/terminal of DUT.

2. Connect the current measurement port to a source monitor unit (SMU).
3. Connect unused output ports to the ground unit (GNDU) or other SMU.
4. Set the offset current measurement condition; integration time, measurement range, output voltage, compliance, and so on.
   - The integration time should be enough long (e.g. 16 power line cycles).
   - The measurement range and compliance value must be the value (e.g. 10 pA, 10 mA) used for the actual DUT measurement.
   - The gate or base bias must be set to the value that keeps the DUT being off.
   - All other source outputs must be 0 V.
5. Connect DUT.
6. Perform offset current measurement (*Ioffset*) about 50 times, for example. And calculate the averaged value (*Iaverage*).
7. Set the low current measurement condition as you want.

   Use the SMU used for the offset current measurement.

   Do not change the setting of the integration time, measurement range, and compliance.

8. Perform current measurement (*Imeasure*).
9. Subtract the offset current from the measurement data by the following formula.

   $Iresult = Imeasure - Iaverage$

   Disconnect the DUT after all measurements are completed.

Low Resistance Measurements

For the low resistance measurement, the differential voltage measurement is effective. The impedance of the voltmeter is enough higher than the residual resistance. So the voltage drop by the residual resistance can be ignored. The low resistance measurement can be performed as shown below.

Summary

- Voltage/current measurement
- Output current change
- Voltage/current measurement
- Resistance calculation

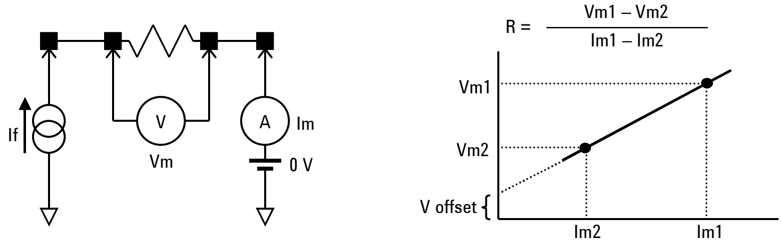
Procedure

1. Connect the device under test (DUT).
2. Connect measurement units as shown in Figure 5-9. Two source monitor units (SMU) and one voltage measurement unit (VMU) are used.
3. Set the measurement condition; integration time, output current, output voltage, compliance, and so on.
    - Integration time 1 or 2 power line cycles is ok for the voltage measurement.
    - Voltage source output value must be 0 V.
    - Current source output value should be decided as described in "To Select the Output Current Value".
4. Perform voltage measurement in the differential mode (*Vm1*).
5. Perform current measurement (*Im1*).
6. Change the current source output value.
7. Perform voltage measurement in the differential mode (*Vm2*).
8. Perform current measurement (*Im2*).
9. Calculate the resistance by the following formula.

   $R = (Vm1 - Vm2) / (Im1 - Im2))$.

   Disconnect the DUT after all measurements are completed.

Figure 5-9 **Low Resistance Measurement**



To Select the Output Current Value

The current source output value is a key factor to perform resistance measurement accurately. The optimum value can be find as shown below.

Summary

- Performs the voltage/current measurement for a sample with current output log sweep
- Plots the resistance, measured voltage, measured current vs. output current curves
- Plots the resistance vs. measured voltage plot curve
- Plots the resistance vs. measured current plot curve
- Decides the current output value for the spot resistance measurement

Procedure

1. Connect a sample of the device under test (DUT). And perform current output log sweep (e.g. Iforce=1 μA to 100 mA). Then measure voltage (Vmeas) and current (Imeas).
2. Calculate resistance (Rcalc). And plot the Vmeas, Imeas, Rcalc vs. Iforce characteristics on the log-log graph as shown in Figure 5-10.
3. Plot the Rcalc vs. Imeas, Vmeas characteristics on the linear-log graph as shown in Figure 5-11.
4. Decide the current source output value for the resistance spot measurement.

   For example of Figure 5-11, the resistance value is stable in the range over 2 mA. The variation is about 1 % of the resistance value (about 35.55 mΩ). So, an output current value should be selected from this range. And the other one should be about 1/10 of the selected current, or less.

Figure 5-10 **Vmeas, Imeas, Rcalc vs. Iforce Plot Example**

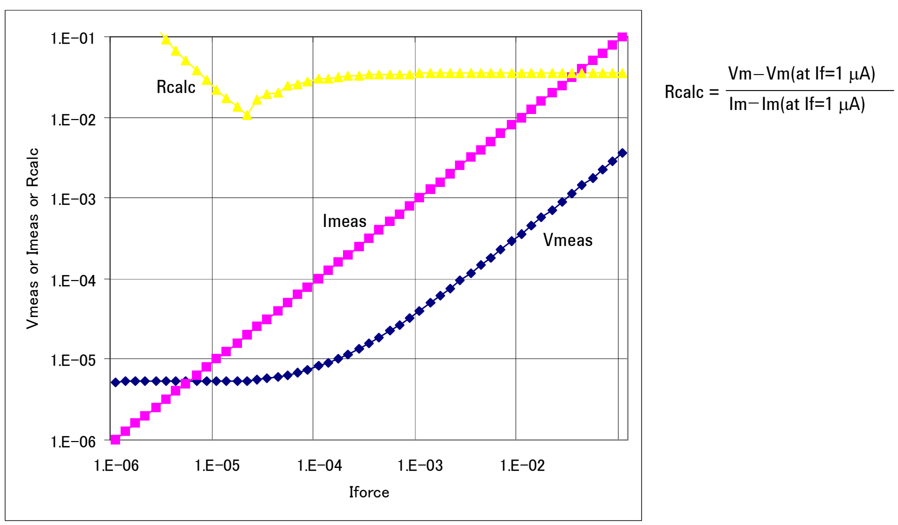
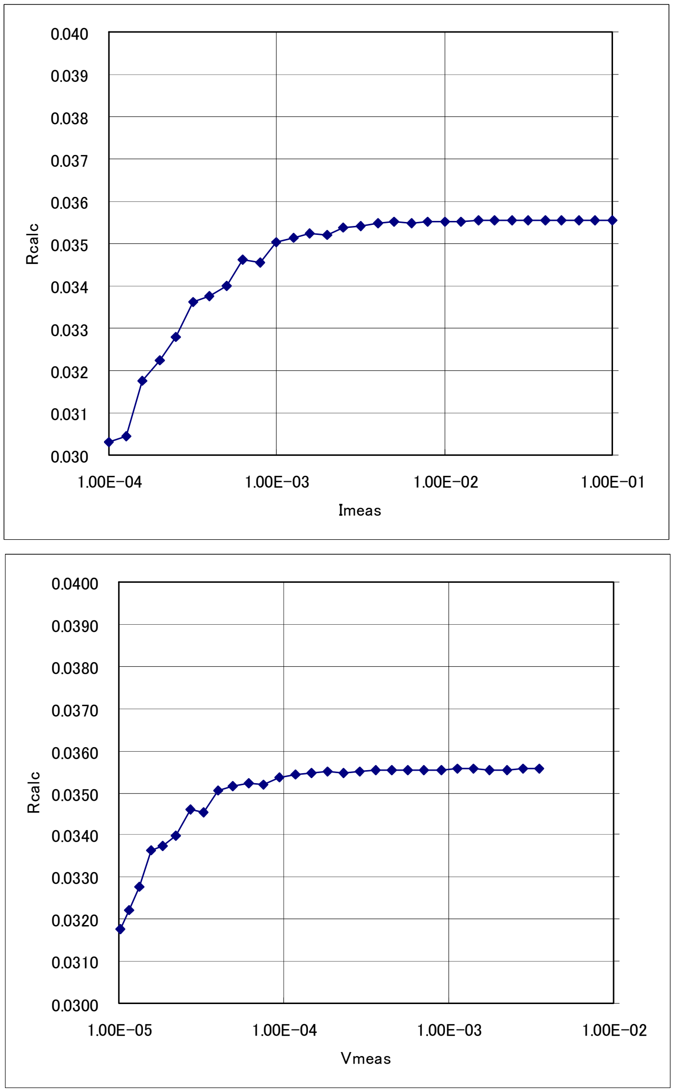


Figure 5-11 **Rcalc vs. Imeas, Vmeas Plot Example**



Capacitance Measurements

NOTE Information described in this section is effective for the Agilent 41000 Model 200/300/400.

When the capacitance/conductance measurement is performed, LCR meter measures the capacitance/conductance of the path including a device under test (DUT), matrix switches, extension cables and so on. So, the data measured by the LCR meter is far from the DUT's capacitance/conductance.

The Agilent B2200 VXI*plug&play* driver provides the functions used to compensate the capacitance/conductance measured by the Agilent 4284A LCR meter in the measurement environments described in "Required Conditions" on page 5-20.

This section explains how to use the capacitance compensation function.

- "Capacitance Compensation Function"
- "Required Conditions"
- "To Create Compensation Data File"
- "To Perform Measurement and Compensation"
- "agb220xa_compenC"
- "agb220xa_selectCompenFile"

Capacitance Compensation Function

Driver functions used for the capacitance compensation are listed below.

- agb220xa_selectCompenFile function
- agb220xa_compenC function

NOTE Corrected data by the function is not guaranteed. But typical data (supplemental data) is as follows.

Capacitance measurement accuracy (typical): ±1 % ±0.5 pF

This typical data is for the following measurement conditions:

Measurement frequency: 1 kHz to 1 MHz

Measurement range: Maximum 1000 pF

Measurement terminal: At the end of the Agilent 16494A/B/C cable connected to the switch module output terminals.

The typical data does not apply to anything extended from the 16494A/B/C cable. The conditions described in "Required Conditions" on page 5-20 must be satisfied.

Required Conditions

The following conditions must be satisfied to use the capacitance compensation function. For the instrument connections, see Figure 5-12.

- Setting of the 4284A
  - Option required: 4284A-006
  - Range of the measurement frequency: 1 kHz to 1 MHz
  - Measurement function: Cp-G
  - Connection to Agilent B2200

    Use the Agilent 16494F CMU cable or the Agilent 16048D/E test leads to connect between the Agilent 4284A and the Agilent B2200 inputs.

    If the 16048D/E is used, the BNC-T adapters (2 ea., Agilent part number 1250-2405 for each) are required to connect between the Hc and Hp terminals and between the Lc and Lp terminals.
  - Calibration

    Perform the 4284A open calibration at the end of the measurement paths in front of the B2200 inputs. If you also perform the short calibration (optional), prepare the BNC through adapter (Agilent part number 1250-0080, 1 ea.).
  - Total cable length of both Hc-Hp side and Lc-Lp side must be the same.
- Agilent B2200 input ports

  AUX Input 13 (CMH, for 4284A Hc-Hp) and 14 (CML, for 4284A Lc-Lp)
- Connection from the Agilent B2200 outputs to the connector plate or the Agilent B2220A probe card interface

  Use the Agilent 16494A triaxial cable or Agilent 16494B/C Kelvin triaxial cable.
- Ahead of the connector plate

  Recommended cable: Agilent part number 8121-1191 Triaxial cable

  You can also use another type of triaxial cable, coaxial cable, or combination of these.

  To approximate the capacitance/conductance of the DUT, you need to obtain the appropriate compensation coefficients for your measurement environment, and create your compensation data file. See Figure 5-12.

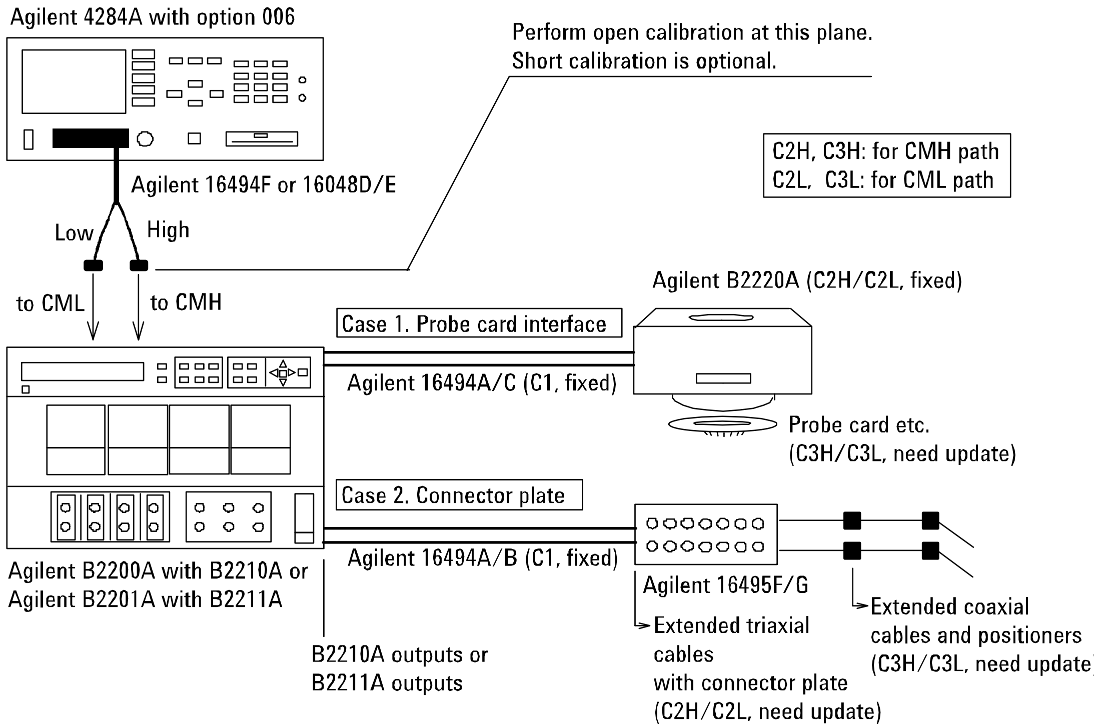
In Figure 5-12, C2H, C2L, C3H, C3L are the compensation coefficients defined in the compensation data file. where, CxH is for the path connected to the Agilent 4284A Hc-Hp terminal, and CxL is for the path connected to the Agilent 4284A Lc-Lp terminal.

When the Agilent B2220A probe card interface is used, obtain the coefficients for C3x, and create your compensation data file. In this case, probe card will be used for the C3x path.

When the connector plate is used, obtain the coefficients for C2x and C3x, and create your compensation data file. In this case, triaxial cable with connector plate will be used for the C2x path. And coaxial cable with positioner will be used for the C3x path.

For obtaining the compensation coefficients and creating the compensation data file, see "To Create Compensation Data File" on page 5-22.

Figure 5-12 Extension Cables and Compensation Coefficients



To Create Compensation Data File

This section explains how to create the compensation data file.

1. Select one of the compensation data files (template, 20 files) installed when the Agilent B2200 VXI*plug&play* driver is installed.

   To select the most appropriate template for your measurement environment, see Table 5-5 that lists the file name and the measurement environment where the template targets. Each template is a text file that contains the information as shown below.

```
#
# Compensation data file for B2210A/Probecard I/F/3m triax cable
#
#
# MB         Mother Board
# MH         Matrix Path High
# ML         Matrix Path Low
# C1         Agilent Triax Cable
# C2H        Probe card I/F or User Triax cable High
# C2L        Probe card I/F or User Triax cable Low
# C3H        Probe card or User Coax cable High
# C3L        Probe card or User Coax cable Low
#
format version 1.0
B2210A
PCIF
#
#           R[Ohm]            L[H]              C[F]
#-----------------------------------------------------------
MB          0.000000e+00      5.250000e-08      2.940000e-11
MH          2.430000e+00      6.310000e-07      1.930000e-10
ML          2.490000e+00      5.970000e-07      1.920000e-10
C1          6.300000e-01      1.250000e-06      1.600000e-10
C2H         2.988000e-01      5.090000e-07      7.000000e-11
C2L         2.988000e-01      5.090000e-07      7.000000e-11
C3H         0.000000e+00      8.000000e-08      1.500000e-13
C3L         0.000000e+00      8.000000e-08      1.500000e-13
```

   The 15th line specifies the used switch module, B2210A or B2211A.

   The 16th line specifies the DUT interface, PCIF or CABLE. PCIF indicates that the Agilent B2220A probe card interface is used. CABLE indicates that the connector plate is used.

   The lines C2H to C3L should be modified for each measurement environment. See Table 5-5 and Table 5-6. Do not modify the other lines.

Table 5-5 Template Compensation Data Files

File name[1]	Measurement environment that template targets			
	Switch module	Cable[2]	DUT interface[3]	Coefficients to be modified
<path>\B2210A\pcif\triax\3m.data	B2210A	16494A-002	B2220A	C3H and C3L
<path>\B2210A\pcif\triax\4m.data		16494A-005		
<path>\B2210A\pcif\kelvin\3m.data		16494C-002		
<path>\B2210A\pcif\kelvin\4m.data		16494C-005		
<path>\B2210A\cable\triax\1_5m.data		16494A-001	16495F/G	C2H, C2L, C3H, and C3L
<path>\B2210A\cable\triax\3m.data		16494A-002		
<path>\B2210A\cable\triax\4m.data		16494A-005		
<path>\B2210A\cable\kelvin\1_5m.data		16494B-001		
<path>\B2210A\cable\kelvin\3m.data		16494B-002		
<path>\B2210A\cable\kelvin\4m.data		16494C-005		
<path>\B2211A\pcif\triax\3m.data	B2211A	16494A-002	B2220A	C3H and C3L
<path>\B2211A\pcif\triax\4m.data		16494A-005		
<path>\B2211A\pcif\kelvin\3m.data		16494C-002		
<path>\B2211A\pcif\kelvin\4m.data		16494C-005		
<path>\B2211A\cable\triax\1_5m.data		16494A-001	16495F/G	C2H, C2L, C3H, and C3L
<path>\B2211A\cable\triax\3m.data		16494A-002		
<path>\B2211A\cable\triax\4m.data		16494A-005		
<path>\B2211A\cable\kelvin\1_5m.data		16494B-001		
<path>\B2211A\cable\kelvin\3m.data		16494B-002		
<path>\B2211A\cable\kelvin\4m.data		16494C-005		

1. <path>: driver_install_folder\AGB220XA\ccdata (e.g. C:\temp\AGB220XA\ccdata)
2. Model number of the cable connected between the switch module and the DUT interface.
3. Agilent B2220A probe card interface or Agilent 16495F/G connector plate.

Table 5-6 Compensation Coefficients and Modifications

Compensation coefficients	Modifications of data file
C2H C2L	For the Agilent B2220A probe card interface, do not modify the lines. For the connector plate, change the R, L, C values in the lines. The value must be changed to the R, L, C values of the C2x path (triaxial cable with connector plate) shown in Figure 5-12.
C3H C3L	Change the R, L, C values in the lines. The value must be changed to the R, L, C values of the C3x path. For the Agilent B2220A probe card interface, probe card will be used for the C3x path. For the connector plate, coaxial cable with positioner will be used for the C3x path.

2. Measure the R, L, C values of the C2x or C3x path by using the Agilent 4284A. See “To obtain compensation coefficients” on page 5-25.

   After the measurements, calculate the per meter value of the R, L, C, and record them into the following table.

Compensation coefficients	Explanation		
	R (Ω)	L (H)	C (F)
C2H			
C2L			
C3H			
C3L			

3. Open the template file selected at step 1 by using a text editor. Exchange the R, L, C values of C2x/C3x with the values recorded at step 2. And save the file as your compensation data file (e.g. C:\temp\my_env_1.txt).

   Do not change any other lines. Also do not change the value for the coefficients that should not be modified.

To obtain compensation coefficients

Obtain the compensation coefficients as shown below.

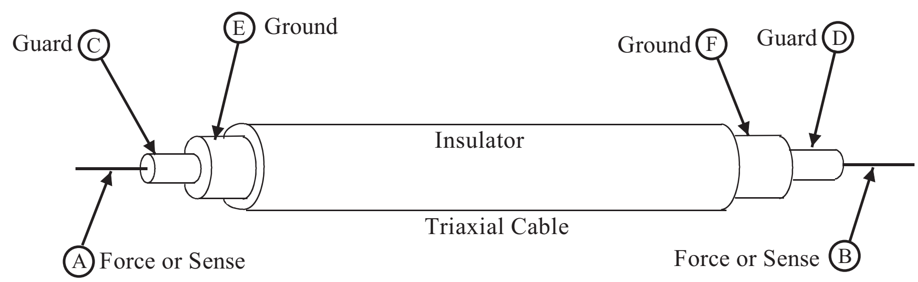
1. Select the measurement frequency (Fmeas) used for the capacitance measurement of a device under test (DUT), and set it to the Agilent 4284A. The coefficients must be measured at the same frequency.
2. Perform the Agilent 4284A open calibration at the measurement terminal. Optionally, perform short calibration if you want.
3. See Table 5-7 and Figure 5-13, and set the Agilent 4284A.
4. Connect the path/cable corresponding to C3H shown in Figure 5-12 to the Agilent 4284A. Then measure and record the R, L, and C values.
5. Connect the path/cable corresponding to C3L to the Agilent 4284A. Then measure and record the R, L, and C values.
6. If you use the connector plate, perform the following procedure.
   a. Connect the path/cable corresponding to C2H to the Agilent 4284A. Then measure and record the R, L, and C values.
   b. Connect the path/cable corresponding to C2L to the Agilent 4284A. Then measure and record the R, L, and C values.

Table 5-7 R, L, C Measurement Conditions

Parameter	Frequency	Function	Terminals
R	1 kHz to 1 MHz [1]	–	A and B
L		SERIES	see note [2]
C		PARALLEL	A and C

1. Select 1 point. Do not change while measurements of all coefficients.
2. For triaxial cable, connect B to F directly, and measure L between A and E. For coaxial cable, connect B to D directly, and measure L between A and C. Ignore E and F.

Figure 5-13 Measurement Terminals of C2H/C2L/C3H/C3L Path



To Perform Measurement and Compensation

Perform the capacitance measurement and compensation as shown below.

1. Set the Agilent 4284A measurement condition. Then the frequency must be the value (Fmeas) used when the compensation coefficients are measured.
2. Before contacting the device under test (DUT), perform the Cp-G measurement in the open condition at the end of the measurement path including positioner or probe card, and record the measurement data (`C1` and `G1`). See Table 5-8.
3. Perform the compensation by using the capacitance compensation function, and record the result data (`C1r` and `G1r`).

   See Table 5-9 for the example to use the capacitance compensation function. This example uses Microsoft Visual C++.
4. Contact the DUT, perform the Cp-G measurement, and record the measurement data (`C2` and `G2`).
5. Perform the compensation and record the result data (`C2r` and `G2r`).
6. Perform the following calculation and record it as the capacitance value.

   `C = C2r - C1r`

Table 5-8 Recording Measurement/Compensation Data

step	Measurement/Compensation Data	
	C (F)	G (S)
2 (measured)	C1 =	G1 =
3 (compensated)	C1r =	G1r =
4 (measured)	C2 =	G2 =
5 (compensated)	C2r =	G2r =
6 (calculated)	C =	

Table 5-9 Capacitance Compensation Program Example

```
#include   "stdafx.h"
#include   <stdio.h>
#include   <stdlib.h>
#include   <visa.h>
#include   "agb220xa.h"

ViStatus main()
{
 ViStatus    ret;
 ViSession   vi;
 ViChar      err_msg[256];
 ret = agb220xa_init("GPIB0::22::INSTR", VI_TRUE, VI_TRUE, &vi);
 if ( ( ret < VI_SUCCESS ) || ( vi == VI_NULL ) ) {
    printf("Initialization failure.\n Status code: %d.\n", ret);
    if ( vi != VI_NULL ) {
       agb220xa_error_message(vi, ret, err_msg);
       printf("Error: %ld\n %s\n", ret, err_msg);
      }
    exit (ret);
   }                                                                   //20
 ret = agb220xa_reset(vi);

 ViChar f_com[] = "C:/temp/my_env_1.txt";                              //23
 ret = agb220xa_selectCompenFile(vi, f_com);

 ViReal64 freq = 1e+06;                   // measurement frequency: 1 (MHz)
 ViReal64 data_c = 100e-12;               // C measured by 4284A: 100 (pF)
 ViReal64 data_g = 500e-06;               // G measured by 4284A: 500 (uS)
 ViReal64 res_c;
 ViReal64 res_g;
 ret = agb220xa_compenC(vi, freq, data_c, data_g, &res_c, &res_g);        //31

 printf("C = %3.6f pF\n", res_c * 1e+12);                              //33
 printf("G = %3.6f uS\n", res_g * 1e+06);

 ret = agb220xa_close(vi);
}
```

Line	Description
1 to 20	The above example is for the B2200 of the GPIB address 22 on the interface GPIB0. “GPIB0” is the VISA name. Confirm your GPIB settings, and set them properly.
23 to 24	The lines specify the compensation data file. The file name must specify your compensation data file.
26 to 31	Compensates the data measured by the Agilent 4284A. In this example, the measurement frequency is 1 MHz, the capacitance data is 100 pF, and the conductance data is 0.5 mS. Change freq, data_c, data_g values for your measurement results.
33 to 34	Displays the compensation result data on the console window. Record the values as C1r and G1r, or C2r and G2r.

agb220xa_compenC

This function compensates capacitance/conductance data measured by the Agilent 4284A LCR meter, and returns compensation results. Before this function is executed, a compensation data file must be specified by using the agb220xa_selectCompenFile function. The file must contain the appropriate compensation coefficients for your measurement environment. For obtaining the compensation coefficients for your environment and creating the compensation data file, see “To Create Compensation Data File” on page 5-22.

Syntax

agb220xa_compenC(ViSession vi, ViReal64 frequency, ViReal64 raw_c, ViReal64 raw_g, ViPReal64 compen_c, ViPReal64 compen_g);

Parameters

vi	Instrument handle returned from agb220xa_init( ).
frequency	Measurement frequency (in Hz). 1E3 (1 kHz) to 1E6 (1 MHz).
raw_c	Capacitance (in F) measured by the 4284A.
raw_g	Conductance (in S) measured by the 4284A.
compen_c	Capacitance compensation result (in F). Returned value.
compen_g	Conductance compensation result (in S). Returned value.

agb220xa_selectCompenFile

This function specifies the compensation data file used by the agb220xa_compenC function. The file must contain the appropriate compensation coefficients for your measurement environment.

For obtaining the compensation coefficients for your environment and creating the compensation data file, see “To Create Compensation Data File” on page 5-22.

Syntax

ViStatus _VI_FUNC agb220xa_selectCompenFile(ViSession vi, ViString file_name);

Parameters

vi	Instrument handle returned from agb220xa_init( ).
file_name	Compensation data file name. Use absolute path. If the value is NULL string, the default data is used.

6 Probe Card Interface

This chapter provides the following information of the Agilent B2220A Probe Card Interface.

- “Product Overview”
- “Outside View and Dimensions”
- “Specifications”
- “Accessories”
- “Options”

NOTE The Agilent B2220A probe card interface is a system component of the Agilent 41000 Model 300 and 400. The probe card interface is not furnished with the option NIF.

Product Overview

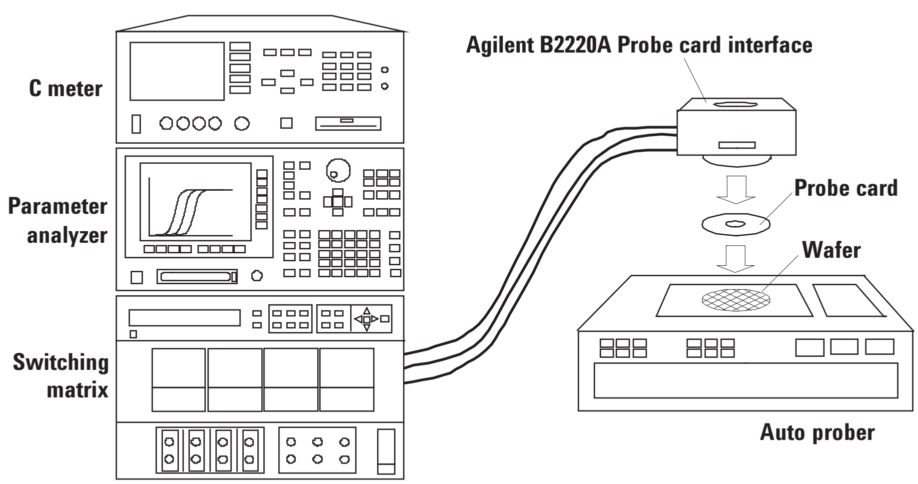
Agilent B2220A probe card interface is designed for testing semiconductor devices on the wafer placed on a semi-auto prober or a full-auto prober. The Agilent B2220A functions as the interface between a probe card and semiconductor parametric measurement instruments such as the Agilent 4155C/4156C Semiconductor Parameter Analyzer, Agilent B2200 Switching Matrix, and so on.

Product image and option configuration are shown in Figure 6-1 and Table 6-1. The Agilent B2220A provides 24 or 48 input/output paths.

Table 6-1 **Product Configurations**

Option Item	Description
B2220A-024	24 inputs/outputs configuration Inputs: 24 triaxial connectors. Outputs: 24 pairs of contact pins. Input/output labels: Even numbers from 2 to 48.
B2220A-048	48 inputs/outputs configuration Inputs: 48 triaxial connectors. Outputs: 48 pairs of contact pins. Input/output labels: Integer numbers from 1 to 48.

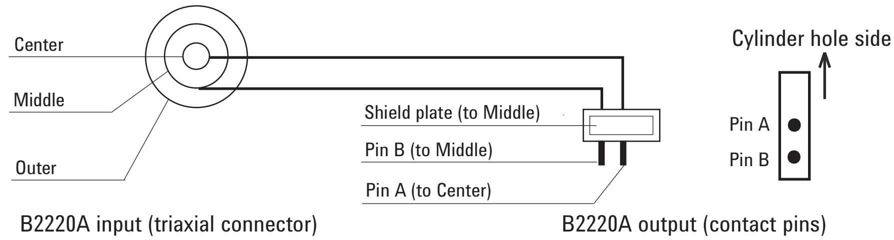
Figure 6-1 **Product Image**



The interconnections of the probe card interface are quite simple. The inputs 1 through 48 are connected to the outputs 1 through 48 respectively. Then, the triaxial connector's center and middle conductors are connected to the pins A and B of the contact assembly as shown in Figure 6-2. And the outer conductor is connected to common. In addition, the middle conductor is also connected to the shield plate of the contact assembly.

For the source monitor unit (SMU) connections, the force (or sense) terminal will be connected to the center conductor and the signal appears on the pin A (cylinder hole side). And the guard terminal will be connected to the middle conductor and the signal appears on the pin B and the shield plate. The force and sense lines should be used to make a Kelvin connection path.

Figure 6-2 **Input-Output Internal Connections**



CAUTION SMU guard signal

Never connect the guard line/pattern to anything. Doing so will damage the unit.

NOTE Kelvin connections

To make a Kelvin connection, use two input/output paths. For example, connect a Kelvin connection path to the input pair 11-12. Then the output pair 11-12 can work for a Kelvin path.

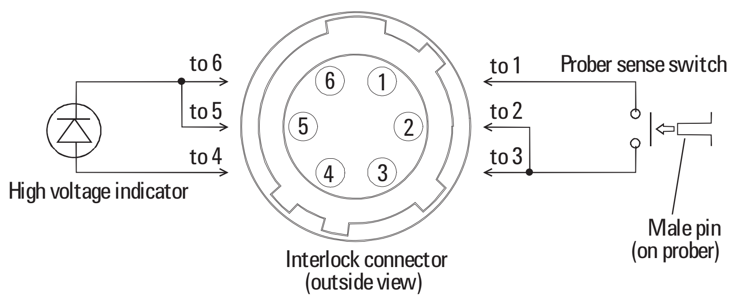
Interlock Circuit

The Agilent B2220A provides the interlock circuit to support the interlock function of the instrument such as the Agilent 4155/4156/E5270. The interlock circuit has been made by connecting the high voltage indicator, prober sense switch, and interlock connector internally. See Figure 6-3. The connector type is same as the interlock connector of the Agilent 4155/4156/E5270.

If you connect the interlock cable between the B2220A's interlock connector and the instrument's interlock connector, the instrument can force voltage up to its maximum output voltage when the prober sense switch is closed (make position), or limits the output voltage when the prober sense switch is opened (break position). The prober sense switch is normally opened. It will be closed during the male pin on the prober presses the prober sense switch.

The high voltage indicator turns on during the instrument forces voltage more than the value limited by the interlock function. For the instrument's interlock function and limit value, see manual of the instrument.

Figure 6-3 Interlock Circuit and Prober Male Pin



WARNING **Potentially hazardous voltages may be presented at the output contact assemblies when the high voltage indicator is lit. Do not touch the contact assemblies.**

Outside View and Dimensions

This section provides the outside drawings of the Agilent B2220A. The drawings are for the 24 inputs/outputs configuration. However, you will be able to imagine the 48 inputs/outputs configuration easily. Only the different point is the number of inputs/outputs.

- Top View (Figure 6-4) when Agilent B2220A is mounted on auto prober
- Handle Side View (Figure 6-5)
- Input Connector Side View (Figure 6-6)
- Bottom View (Figure 6-7) when Agilent B2220A is mounted on auto prober

Figure 6-4 **Top View**

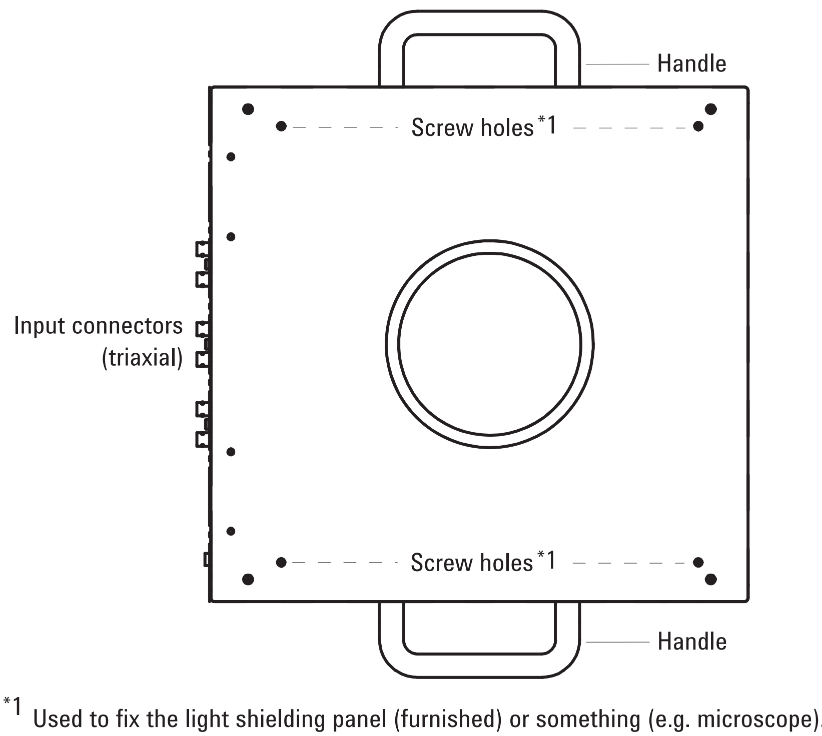
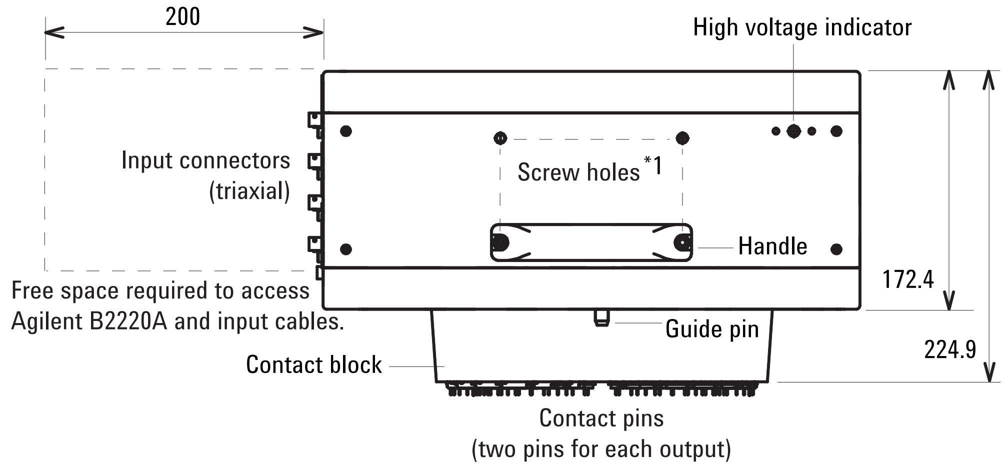


Figure 6-5 **Handle Side View and Dimensions (in mm)**



*1 Used to fix something (e.g. hinge) used to mount the B2220A on the prober.

Figure 6-6 **Input Connector Side View**

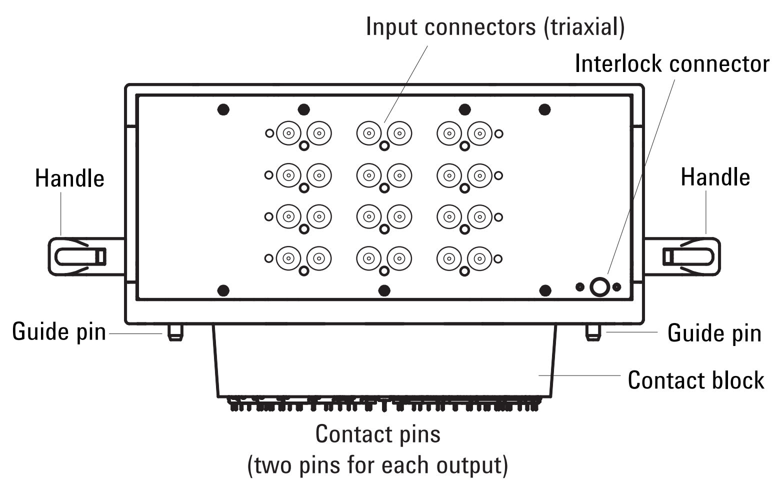
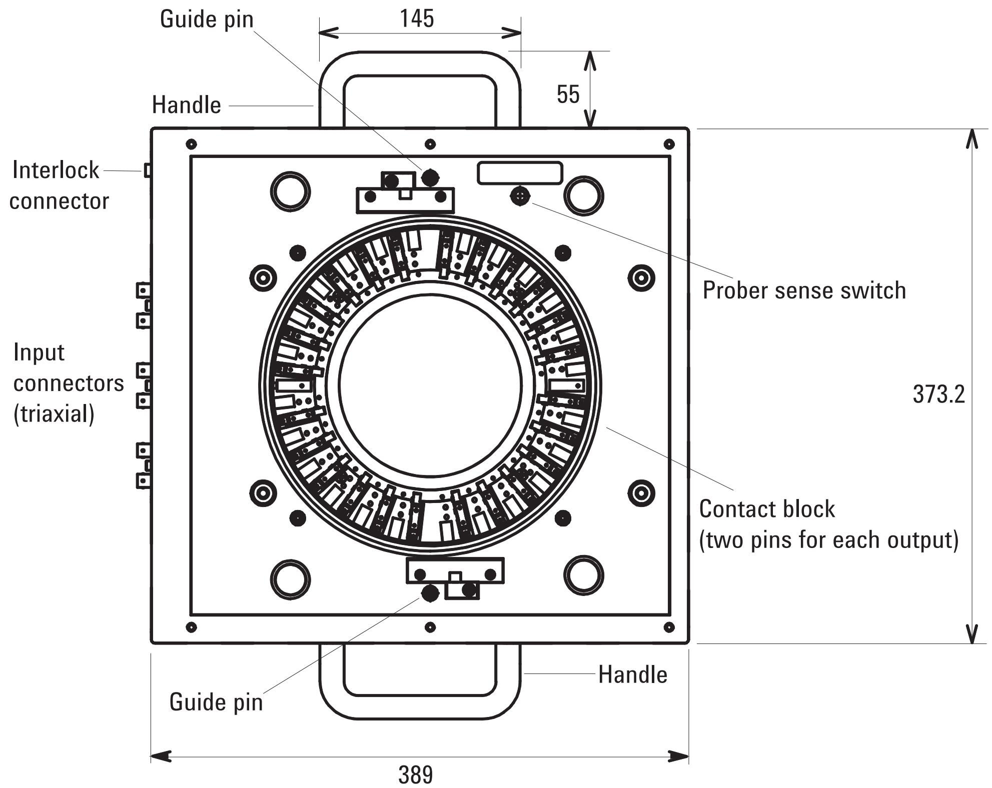


Figure 6-7 **Bottom View and Dimensions (in mm)**



Total 24 or 48 contact assemblies are installed in the contact block. The number of assemblies depends on the option (B2220A-024 or B2220A-048). Each assembly has two contact pins.

Specifications

This section lists complete specifications and supplemental information of the Agilent B2220A. The specifications are the performance standards or limits against which the B2220A is tested. When the B2220A is shipped from the factory, it meets the specifications. The supplemental information are not specifications but are typical characteristics included as additional information for the operator. The "supplemental information" and "typical" entries, in the following specifications are not warranted, but provide useful information about the functions and performance of the instruments.

Input/Output

Agilent B2220A has the following inputs and outputs:

- B2220A-024
  - 24 inputs: triaxial connector (force/guard/common or sense/guard/common)
  - 24 outputs: contact pin (force/guard or sense/guard)
- B2220A-048
  - 48 inputs: triaxial connector (force/guard/common or sense/guard/common)
  - 48 outputs: contact pin (force/guard or sense/guard)

General Specifications

- Operating temperature: 5 °C to 35 °C (non-condensing)
- Operating humidity: 5 % to 70 % Relative Humidity (non-condensing)
- Storage temperature: -20 °C to 60 °C (< 80 % RH, non-condensing)
- Weight: approximately 15 kg (body only)
- Dimensions (W × H × D, in mm):

  389 × 172.4 × 373.2 (without connectors, handles, guide pins, contact block)

  389 × 224.9 × 373.2 (without connectors, handles, guide pins, contact pins)
- Regulatory Compliance:

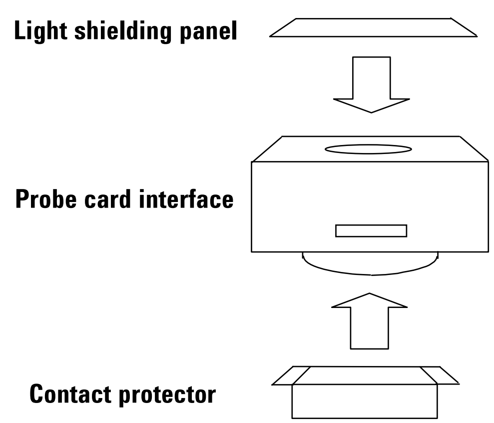
  Safety: IEC 61010

Accessories

The Agilent B2220A contains the accessories listed in Table 6-2. Table 6-3 lists the accessories available for the Agilent B2220A.

Table 6-2 **Furnished Accessories**

Description	Agilent Part Number	Qty.
Light Shielding Panel	E3120-00211	1
Contact Protector (for storage and shipping)	E3144-60012	1
User’s Guide (this document)	B2220-90002	1
Spare Pin (for maintenance)	0360-2066	12



When moving or storing the Agilent B2220A, restore the contact protector to prevent the contact pins from damage.

If a contact pin is damaged, replace it with a spare pin.

Table 6-3 Available Accessories

Model Number	Description
E3140A	Test fixture adapter [1]
E3141A	Universal test fixture for package device test
E3142A	Performance check fixture for low current • E3144-60001 Card fixture • E3190-60042 Open fixture
E3143A	Connection check fixture set for PCIF • E3141A Universal test fixture (E3141-60005) • E3143-60001 Connection check fixture

1. The E3140A is necessary to use the E3141A, E3142A, or E3143A.

Options

The Agilent B2220A has the following options.

Table 6-4 Options

Option Item	Description
B2220A-024	24 inputs/outputs configuration Inputs: 24 triaxial connectors. Outputs: 24 pairs of contact pins. Input/output labels: Even numbers from 2 to 48.
B2220A-048	48 inputs/outputs configuration Inputs: 48 triaxial connectors. Outputs: 48 pairs of contact pins. Input/output labels: Integer numbers from 1 to 48.

7 Service

This chapter consists of the following sections:

- “Troubleshooting”
- “PDU and EMO”
- “Replaceable Parts”
- “Replacement Procedure”
- “Measurement Cable Connections”
- “System Rack and Instruments”

CAUTION

If the Agilent B2200 must be shipped

If you need to ship the Agilent B2200 for servicing or any reasons, use the packing kit furnished with the Agilent B2200.

The Agilent B2200 may have a performance degrade if it is transported or stored in high temperature or high humidity environment. Please make sure to use the moisture-proof and dehumidifying packing kit when shipping or storing the Agilent B2200.

Troubleshooting

This section gives troubleshooting and repair information for the Agilent 41000, and contains the following sections:

- “Safety Considerations”
- “Checking Power Distribution Unit (PDU)”
- “Troubleshooting”

A troubleshooting overview for the Agilent 41000 is shown below.

1. If the Agilent 41000 loses power:

   Check the operation of the power distribution unit (PDU) and the emergency off (EMO) panel.

   See “Checking Power Distribution Unit (PDU)” on page 7-4.

2. If you have trouble with the Agilent 41000 system:

   Check the Agilent 41000 system by using the Agilent iPACE Verification Tool.

   See “Using Agilent iPACE Verification Tool” on page 3-1.

After troubleshooting, repair the Agilent 41000 by replacing the defective part of the system. For the replacement procedures, see “Replacement Procedure” on page 7-18.

NOTE Several troubleshooting procedures described in this chapter require access to several components/assemblies in the Agilent 41000 system cabinet. For the location of components and assemblies, see “Replaceable Parts” on page 7-11.

Safety Considerations

WARNING, CAUTION, and NOTE must be observed to ensure the safety of the service personnel or to prevent damage of the system and any system component (instrument).

WARNING **Several procedures described in this chapter are performed with power applied. Service personnel must be aware of the hazards involved, and perform the procedures carefully and safely to prevent electric shock hazard.**

When troubleshooting can be performed without power applied, turn the power off. After repairs are completed, make sure all safety features are intact and all necessary parts are connected to their protective grounds.

WARNING **To ensure your safety, use the lockout mechanism of the PDU if you leave the Agilent 41000 while troubleshooting the power supply. Set the PDU main switch to off. This prevents the Agilent 41000 from being accidentally turned on.**

For the turning on and off procedure, see “Turning the PDU On and Off” on page 2-24.

Checking Power Distribution Unit (PDU)

If the Agilent 41000 loses power, check the operation of the power distribution unit (PDU) and the emergency off (EMO) panel.

Before Starting

Before starting “Troubleshooting” on page 7-5, perform the following steps:

1. Turn the site power line off.
2. Disconnect the main power cable from the site power line.
3. Turn the site power line on.
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.

Troubleshooting

Troubleshoot the PDU as shown below.

1. Confirm that the site power line is turned off.
2. Disconnect power cable of PDU from site power line.
3. Confirm that the following items are connected properly. If you find any incorrect connection, correct it.
    - a cable from the EMO panel to the PDU
    - cables between the PDU and the instrument power outlets
    - short bar (on the PDU rear panel)
4. Turn on the site power line.
5. Set the following:

    Main switch On position

    EMO button Normal (extended) position

    Instruments breaker Off (lower) position

    Controller breaker Off (lower) position
6. Check the PDU and the EMO panel. See Table 7-1.

Table 7-1 Checking PDU and EMO Panel

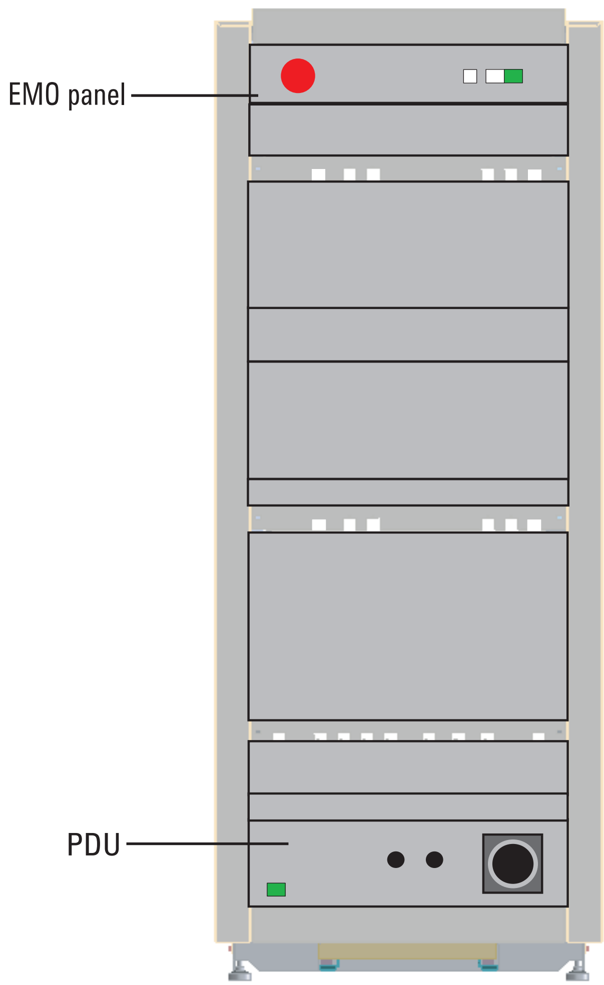
Step	Check item	Action required
1	Set the main switch and the breakers on the PDU to on. Can you set all the breakers to on?	If yes: Go to step 2. If no: Replace the PDU.
2	Turn on the system switch on the PDU and check the line voltage of the controller power outlets on the PDU. Does the proper voltage (depends on the option) appear?	If yes: Go to step 3. If no: Replace the PDU.
3	Check the LINE indicator on the EMO panel. Is the LINE indicator lit?	If yes: Go to step 4. If no: Replace the EMO panel.
4	Press the ON button on the EMO panel. Check the line voltage of the instrument power outlets in the system cabinet. Does the proper voltage (depends on the option) appear?	If yes: End. If no: Go to step 5.
5	Is the green LED in the ON button lit?	If yes: End. If no: Replace the EMO panel.

PDU and EMO

This section explains the following system cabinet components:

- "Power Distribution Unit (PDU)"
- "Emergency off (EMO) Panel"

Figure 7-1 **Agilent 41000 System Cabinet**



Power Distribution Unit (PDU)

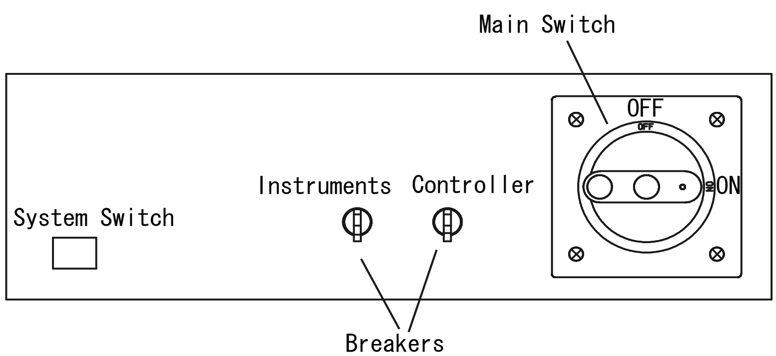
The power distribution unit (PDU) receives AC power from a power switchboard at the installation site and distributes that AC power to the following components in the system cabinet:

- Controller power outlets
- Instrument power outlets
- EMO panel

The PDU is located in the bottom of the cabinet. For the PDU components, see "System Cabinet" on page 1-9.

Figure 7-3 and Figure 7-4 are the overall PDU block diagrams.

Figure 7-2 Power Distribution Unit



The PDU type depends on the power line option and system cabinet serial number prefix as shown in Table 7-2.

Table 7-2 PDU Type

C1232A/C1233A Option Number	Line Voltage and Rated Current
C1230A-PW1	100 to 120 Vac, 20 A max
C1230A-PW2	200 to 240 Vac, 10 A max
C1230A-PW3	100 Vac, 15 A max

Figure 7-3 **PDU Block Diagram for 100 V**

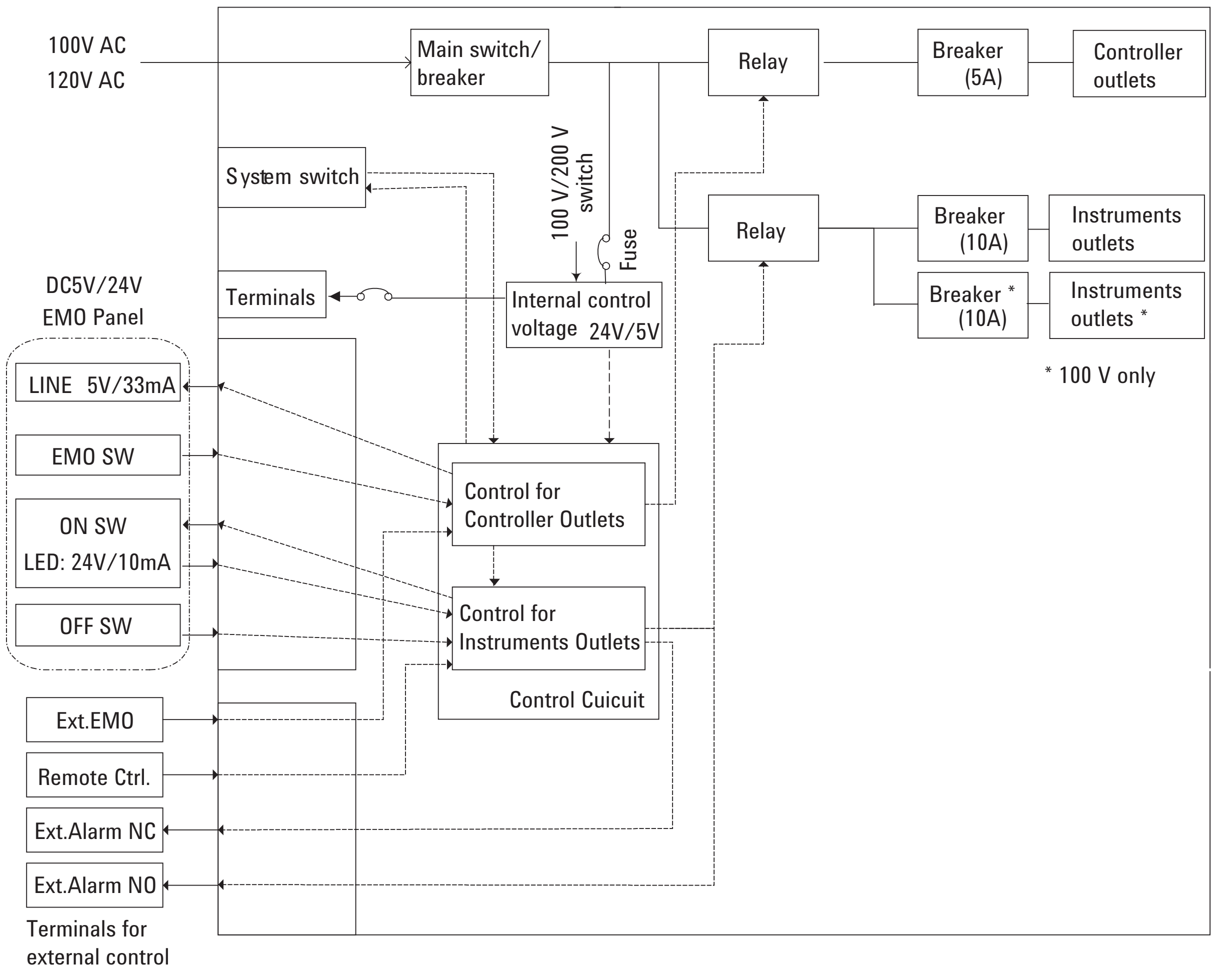
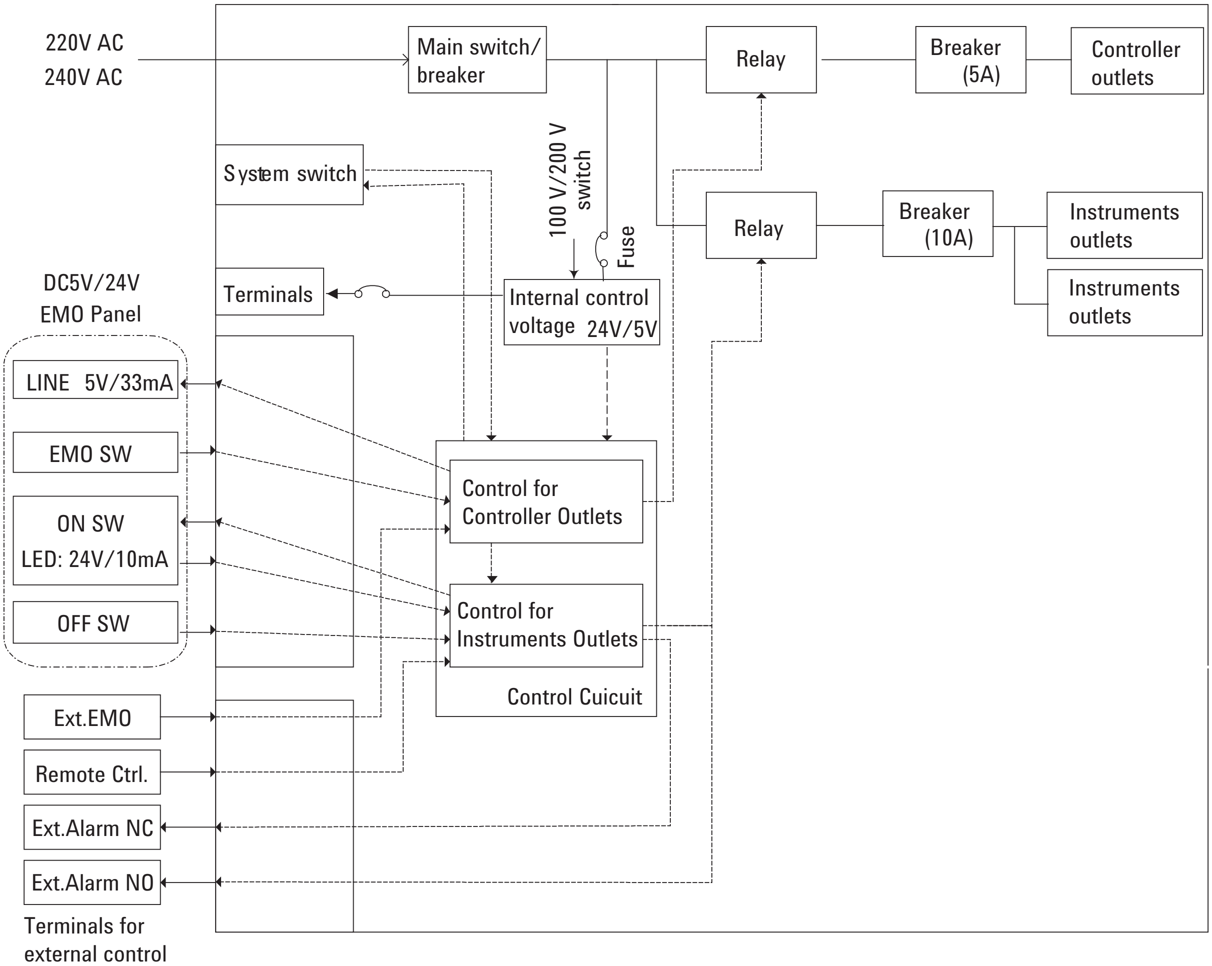


Figure 7-4 **PDU Block Diagram for 200 V**



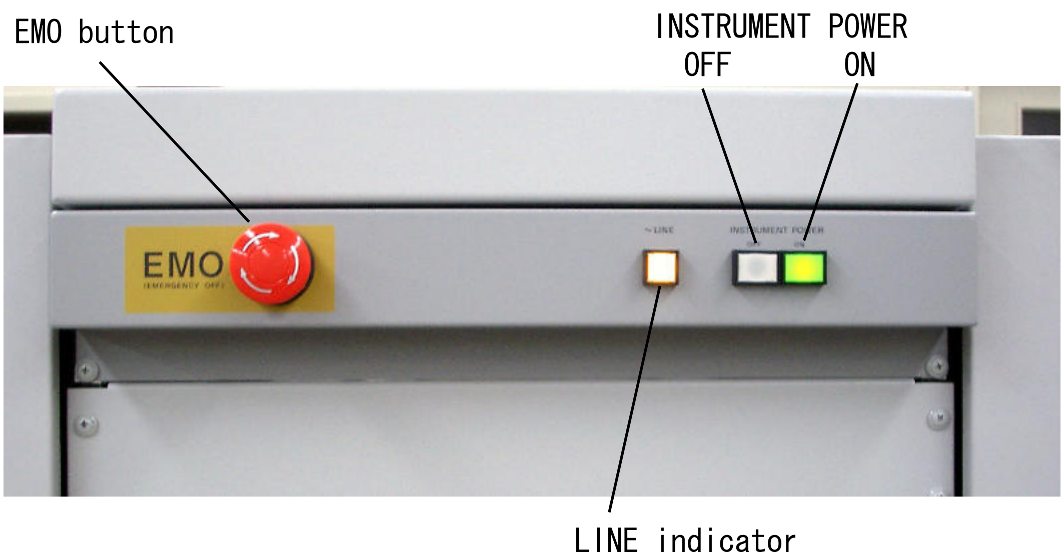
Emergency off (EMO) Panel

The emergency off (EMO) panel is located at the top front of the Agilent 41000 system cabinet. The panel has an EMO button (large red button), LINE indicator, and INSTRUMENT POWER ON and OFF buttons.

The EMO button is used to immediately shut down the Agilent 41000 power in an emergency. When the EMO button is pressed, all equipment connected to the Instruments outlets and the Controller outlets are shut off.

For the EMO components, see "System Cabinet" on page 1-9.

Figure 7-5 **EMO Panel**



Replaceable Parts

This section gives information for the Agilent 41000 replaceable parts, and contains the following sections:

- “System Cabinet”
- “Cables and Accessories”
- “Probe Card Interface”
- “Accessories for Performance Check”

System Cabinet

Table 7-3 through Table 7-6 list the replaceable parts of the system cabinet, and Figure 7-6 through Figure 7-9 show the locations of the replaceable parts.

- Table 7-3, “System Cabinet”
- Table 7-4, “Flanges of Instruments”
- Table 7-5, “Front Side (around Cables)”
- Table 7-6, “Rear Side”

Figure 7-6 **System Cabinet**

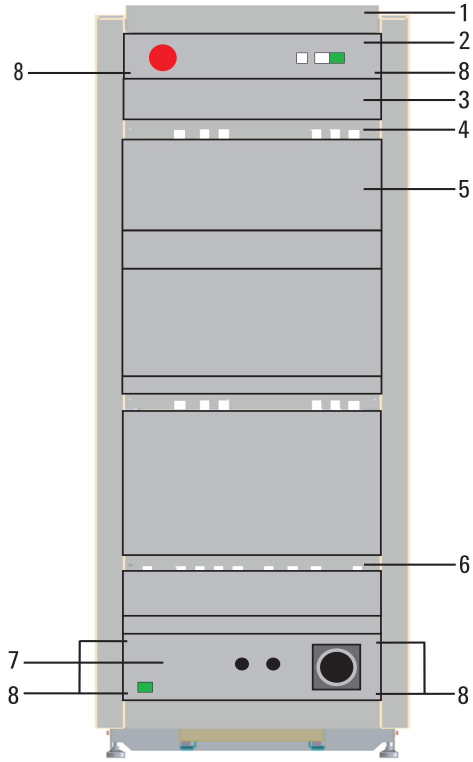


Table 7-3 **System Cabinet**

Reference Designation	Part Number	Quantity	Description
1	C1230-04002	1	Top panel
2	E3160-60176	1	EMO panel assembly [1], 2U
3	E3160-00252	3	Panel, blank, 2U
4	C1230-00211	2	Panel, cable through, 1U
5	E3160-00254	1	Panel, blank, 4U
6	C1230-00201	1	Panel, cable through, 1U
7	C1230-61401	1	PDU 100-120V 20 A -Spare Part
	C1230-61402	1	PDU 200-240V NEMA -Spare Part
	C1230-61403	1	PDU 200-240V IEC -Spare Part
	C1230-61404	1	PDU 100V 15A -Spare Part
8	0570-1577	6	Dress Screw, 10-32, L=0.625 inch (15.875 mm)

1. For the EMO/PDU less option, the 2U/4U blank panels are attached instead of the EMO/PDU respectively.

Figure 7-7 **Flanges of Instruments**

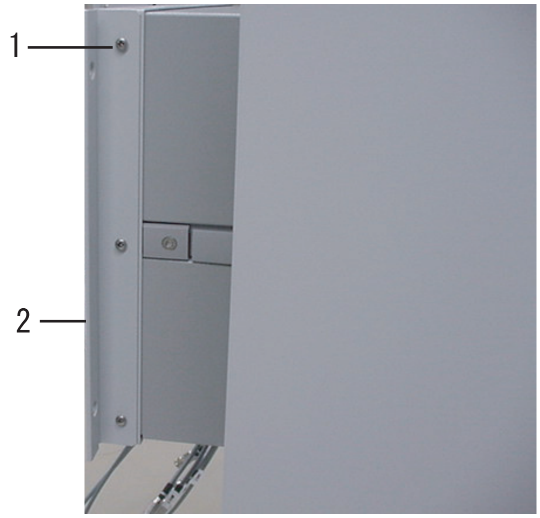


Table 7-4 **Flanges of Instruments**

Reference Designation	Part Number	Quantity	Description
1	0515-1718	-[1]	Screw M4
2	5063-9216	1	Flange for 4155, 4156, and 5270B
	C1230-01201	2	Flange for B2200A
	C1230-01204	1	Right side of flange for Power Distribution Unit (PDU)
	C1230-01205	1	Left side of flange for Power Distribution Unit (PDU)

1. Quantity depends on the instrument.

Figure 7-8 **Front Side (around Cables)**

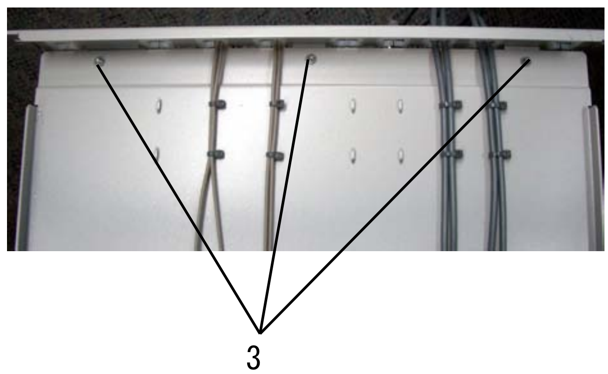


Table 7-5 **Front Side (around Cables)**

Reference Designation	Part Number	Quantity	Description
1	0570-1577	2	Dress Screw, 10-32, L=0.625 inch (15.875 mm)
2	C1230-00201	1	Panel, cable through
3	0515-1012	3	Screw M4

Figure 7-9 **Rear Side**

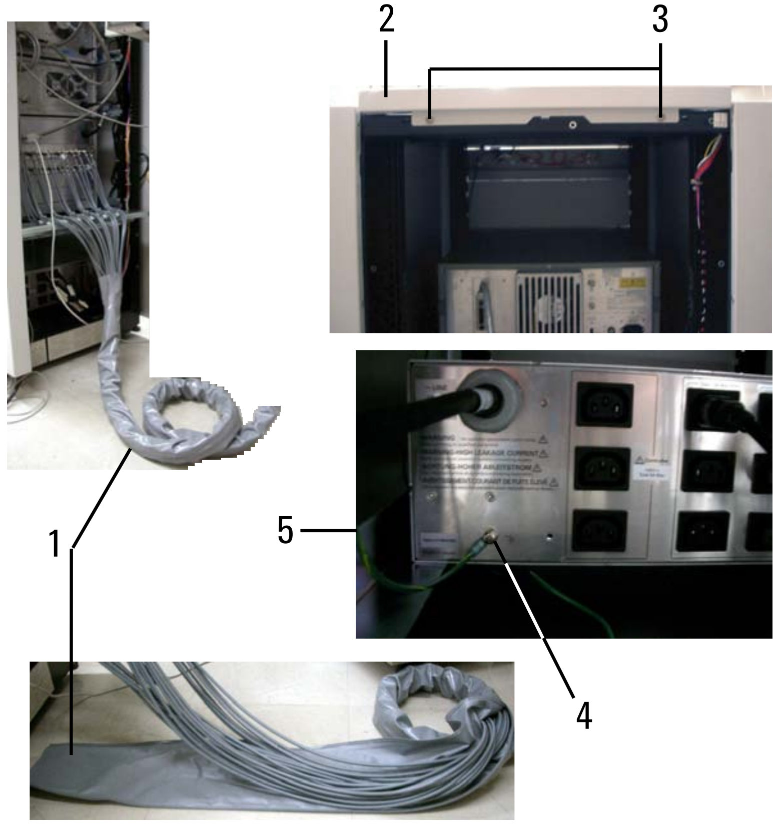


Table 7-6 **Rear Side**

Reference Designation	Part Number	Quantity	Description
1	1400-3280	4	Zipper tube 2 m (for the 3 m cables)
	1400-3280	6	Zipper tube 3 m (for the 4 m cables)
2	C1230-04002	1	Top panel
3	2680-0278C	2	Torx screw, 10-32
4	0515-0386	1	Torx M5 L=10mm with washer
5	0535-0081	1	Nut (HEX NUT M5 with a Washer)
	2190-0687	1	Washer, T-B 5.0, 5,3-MM-ID, 10-MM-OD

Cables and Accessories

Table 7-7 lists the furnished cables and accessories of the Agilent 41000.

Table 7-7 Cables and Accessories

Model Number/ Part Number	Quantity[1]	Description
16494F-001	1	CMU cable 2 m for 4284A
1250-2405	3	BNC-T (m-f-f) type adapter for 4284A
16493B-002	4	BNC cable 3 m for VSU, VMU and PGU of 4155C/4156C/41501B
16494A-001	1 to 8	Triaxial cable 1.5 m for E5270B
16494A-002	1 to 4	Triaxial cable 3 m for 4156C
16493K-001	1 to 4	Kelvin triaxial cable 1.5 m for E5270B
16493K-002	1 to 4	Kelvin triaxial cable 3 m for 4156C
1250-1708	-[2]	Open cap for triaxial connectors
16493J-002	1	Interlock cable 3 m for B2220A PC I/F
16493J-003	1	Interlock cable 5 m for B2220A PC I/F
16493L-002	1	GNDU cable 3 m
16493L-003	1	GNDU cable 5 m
16494A-002	-	Triaxial cable 3 m for B2220A PC I/F
16494A-005	-	Triaxial cable 4 m for B2220A PC I/F
16494C-002	-	Kelvin triaxial cable 3 m for B2220A PC I/F
16494C-005	-	Kelvin triaxial cable 4 m for B2220A PC I/F
8120-1625	-	Power cable, universal
10833A	-	GPIB cable, 1 m

1. Accessories and quantity depend on the option configuration. Contents of your system may be different from this table.
2. 1 to 4 for 4156C, 1 to 8 for E5270B.

Probe Card Interface

Table 7-8 lists the replaceable parts of the Agilent B2220A probe card interface.

Table 7-8 Probe Card Interface Contact Pin

Part Number	Description
0360-2066	Contact pin

Accessories for Performance Check

Table 7-9 through Table 7-11 list the replaceable parts of the accessories required for the performance check.

- Table 7-9, “Agilent E3140A Test Fixture Adapter”
- Table 7-10, “Agilent E3142A Performance Check Fixture for Low Current”
- Table 7-11, “Agilent E3143A Connection Check Fixture Set for Probe Card Interface”

Table 7-9 Agilent E3140A Test Fixture Adapter

Model Number	Quantity	Description
Agilent E3140A	1	Test Fixture Adapter

Table 7-10 Agilent E3142A Performance Check Fixture for Low Current

Part Number	Quantity	Description
E3144-60001	1	Card Fixture
E3190-60042	1	PV Open Fixture

Table 7-11 Agilent E3143A Connection Check Fixture Set for Probe Card Interface

Part Number	Quantity	Description
E3141-60005	1	Universal Test Fixture
E3143-60001	1	Connection Check Fixture

Replacement Procedure

This section explains how to remove the system components of the Agilent 41000 and how to replace the measurement cables.

- "Safety Considerations"
- "Required Tools"
- "To Remove Top Panel"
- "To Remove Top Cover"
- "To Remove Instruments"
- "To Remove EMO Panel"
- "To Remove PDU"
- "To Remove Measurement Cables"
- "To Replace Probe Card Interface Cables"
- "To Replace Contact Pins"

CAUTION

If the Agilent B2200 must be shipped

If you need to ship the Agilent B2200 for servicing or any reasons, use the packing kit furnished with the Agilent B2200.

The Agilent B2200 may have a performance degrade if it is transported or stored in high temperature or high humidity environment. Please make sure to use the moisture-proof and dehumidifying packing kit when shipping or storing the Agilent B2200.

Safety Considerations

Before servicing is started, turn off the Agilent 41000. For the procedure, see “Turning the PDU On and Off” on page 2-24.

WARNING **Turn *OFF* the power distribution unit (PDU) before starting service. Do not turn on the PDU while accessing internal components of the cabinet or until the replacement parts are reinstalled. Dangerous voltage may be applied to several terminals.**

WARNING **To ensure the safety during service, set the PDU main switch to the OFF position.**

WARNING **Be aware of the hazards involved while replacing procedure.**

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 **Remove or reinstall the system component carefully with an assistant and a lifter to prevent from injury.**

The 4155C/4156C/41501B/4284A should be removed or reinstalled by two persons.

The E5270B/B2200A/B2201A should be removed or reinstalled by two persons using a lifter.

The PDU can be removed or reinstalled by one person.

Required Tools

The following tools are required for replacement procedure.

- Pozidrive screwdriver (PZ1)
- Torx screwdriver (T25)
- Plus screwdriver (H2)
- Nut driver (H8)
- Mini-screwdriver
- Nipper
- Slip-joint pliers
- Rubber gloves
- Cable ties
- Hand-held multimeter
- Tool Zip Lock Sealing (Agilent part number 8710-1576)
- *Agilent 41000 Administration Guide* (this book)

NOTE If the Agilent 41000 has been used in a clean room, take special precautions to preserve the air purity in the clean room. Clean the tools, test equipment, replacement parts, and so on by using the air shower to enter the clean room.

To Remove Top Panel

1. Remove Torx screws that fix the top panel at the rear side of the system cabinet (see Figure 7-10 and Figure 7-11). Then use the Torx screwdriver (T25).
2. Slide the top panel to the rear side.
3. Remove the top panel.

Figure 7-10 System Cabinet Panels and Cover

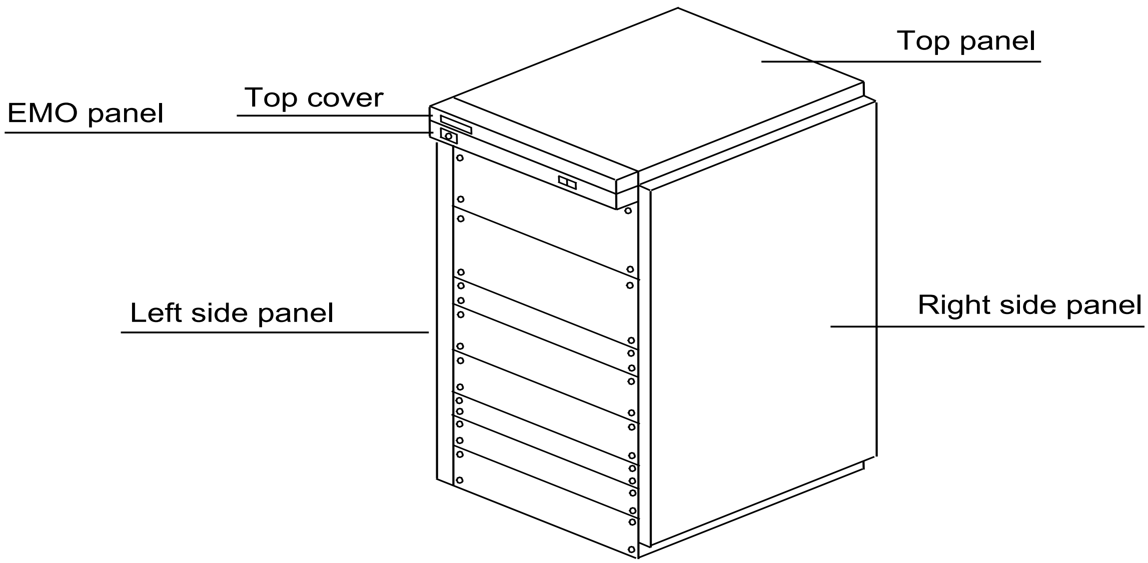
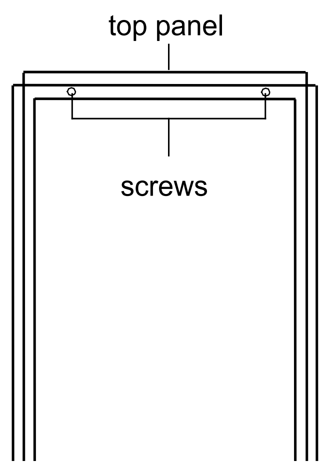


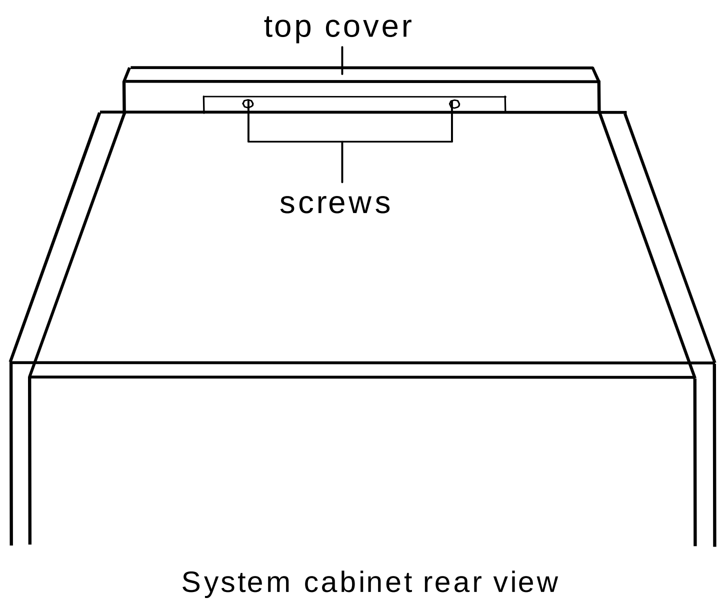
Figure 7-11 System Cabinet Rear View



To Remove Top Cover

1. Remove the top panel. Then see “To Remove Top Panel” on page 7-21.
2. Remove Torx screws at the rear side of the top cover. Then use the Torx screwdriver (T25).
3. Lift up the top cover and remove it.

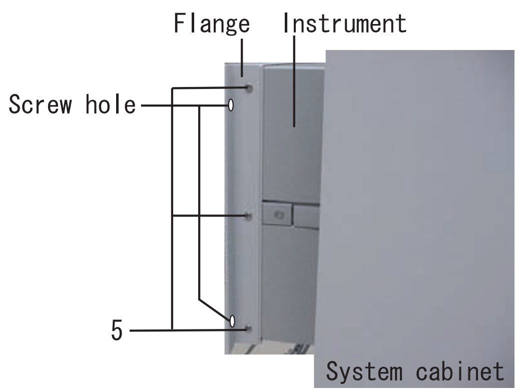
Figure 7-12 **Removing Top Cover**



To Remove Instruments

1. Remove the power cable and the GPIB cable from the instrument at the rear side.
2. Remove the test leads or cable assemblies from the instrument at the front side.
3. Remove dress screws that fix the instrument with flanges to the system cabinet. Then use a plus screwdriver (H2).
4. Slide the instrument to the front side a little, as shown in Figure 7-13.
5. Remove screws that fix the flange to the instrument, and remove the flanges at the both left side and right side. Then use the plus screwdriver (H2).
6. Slide the instrument to the front side, and remove the instrument from the system cabinet.

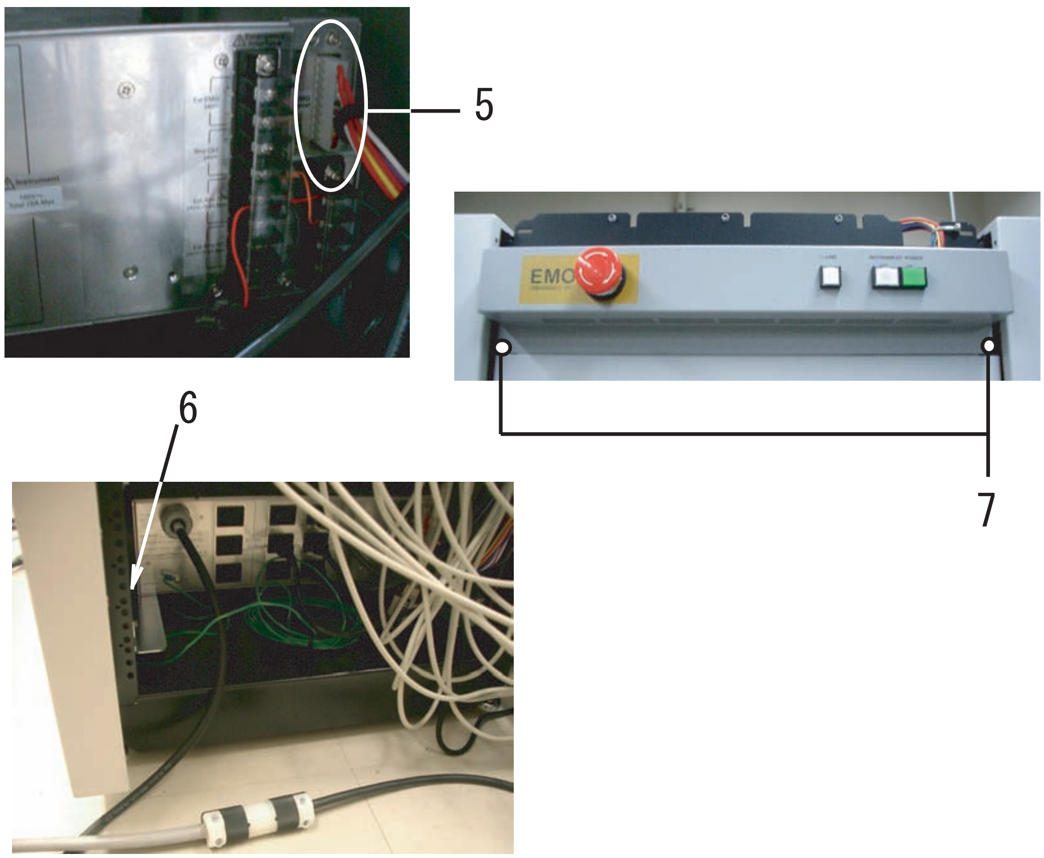
Figure 7-13 **Removing Instrument**



To Remove EMO Panel

1. Set the main switch on the power distribution unit (PDU) to the OFF position.
2. Disconnect the PDU system power cable from the power outlet of the installation site.
3. Remove the top panel. Then see “To Remove Top Panel” on page 7-21.
4. Remove the top cover. Then see “To Remove Top Cover” on page 7-22.
5. Disconnect the EMO cable from the rear side of the PDU.
6. Remove the nut that fastens the EMO ground wire to the system cabinet. Then use a nut driver (H8).
7. Remove screws at the bottom of the EMO panel. Then use a plus screwdriver (H2).
8. Remove the EMO panel.

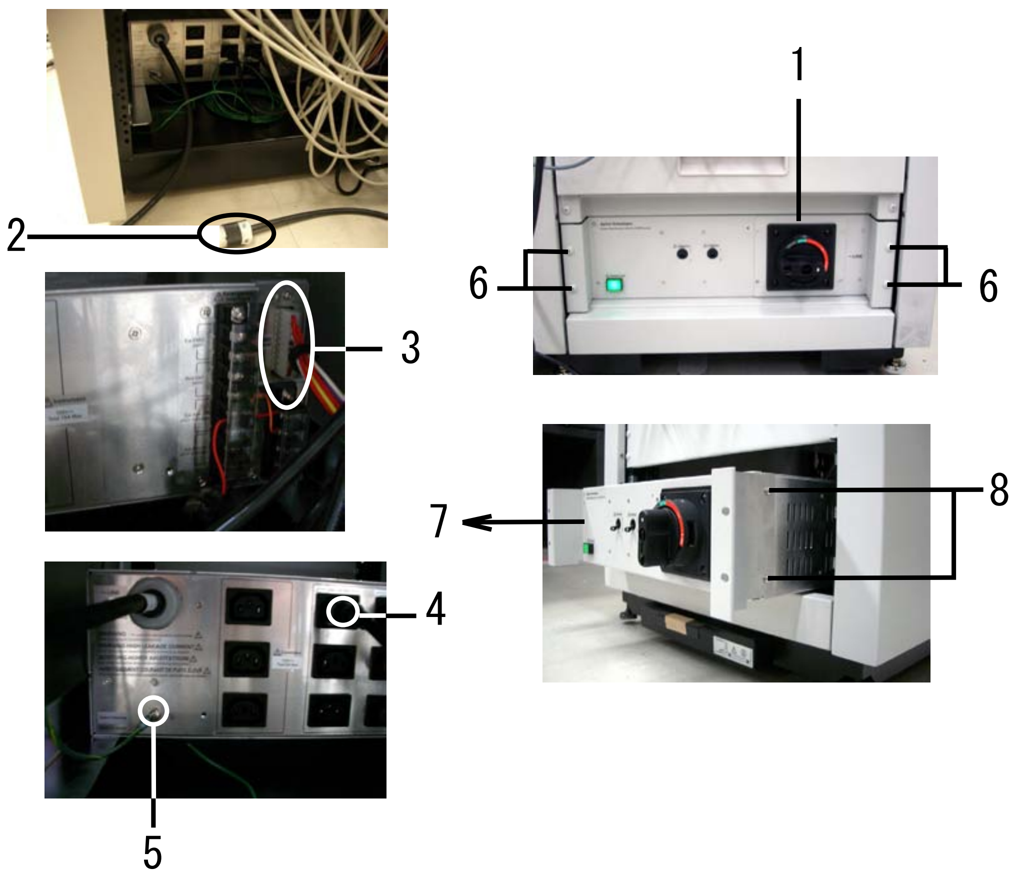
Figure 7-14 **Removing EMO Panel**



To Remove PDU

1. Set the main switch on the power distribution unit (PDU) to the OFF position.
2. Disconnect the PDU system power cable from the power outlet of the installation site.
3. Disconnect the EMO cable from the rear side of the PDU.
4. Remove the power cables of instruments from the rear side of the PDU.
5. Remove screw that fastens the ground wire to the PDU. Then use a plus screwdriver (H2).
6. Remove dress screws that fix the PDU with flanges to the system cabinet. Then use a plus screwdriver (H2).
7. Slide the PDU to the front side a little.
8. Remove screws that fix the flange to the PDU, and remove the flanges at the both left side and right side. Then use the plus screwdriver (H2).
9. Slide the PDU to the front side, and remove the PDU from the system cabinet.

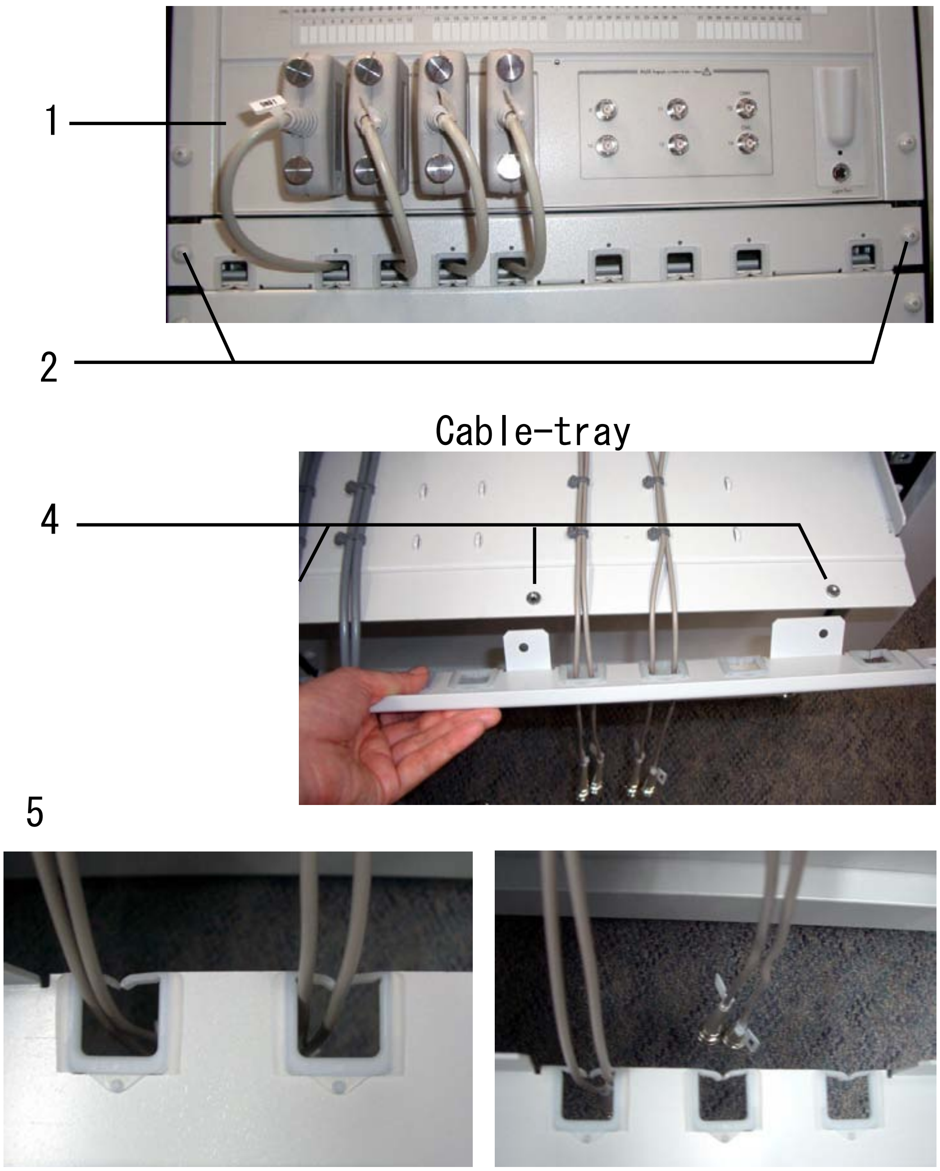
Figure 7-15 **Removing PDU**



To Remove Measurement Cables

1. Disconnect the measurement cables from instruments.
2. Remove screws that fix the cable-through-panel to the system cabinet. Then use a plus screwdriver (H2).
3. Slide the cable-through-panel to the front side a little.
4. Remove screws that fix the cable-through-panel to the cable-tray. Then use a pozidrive screwdriver (PZ1), and remove the cable-through-panel.
5. Remove cables from the cable-through-panel.

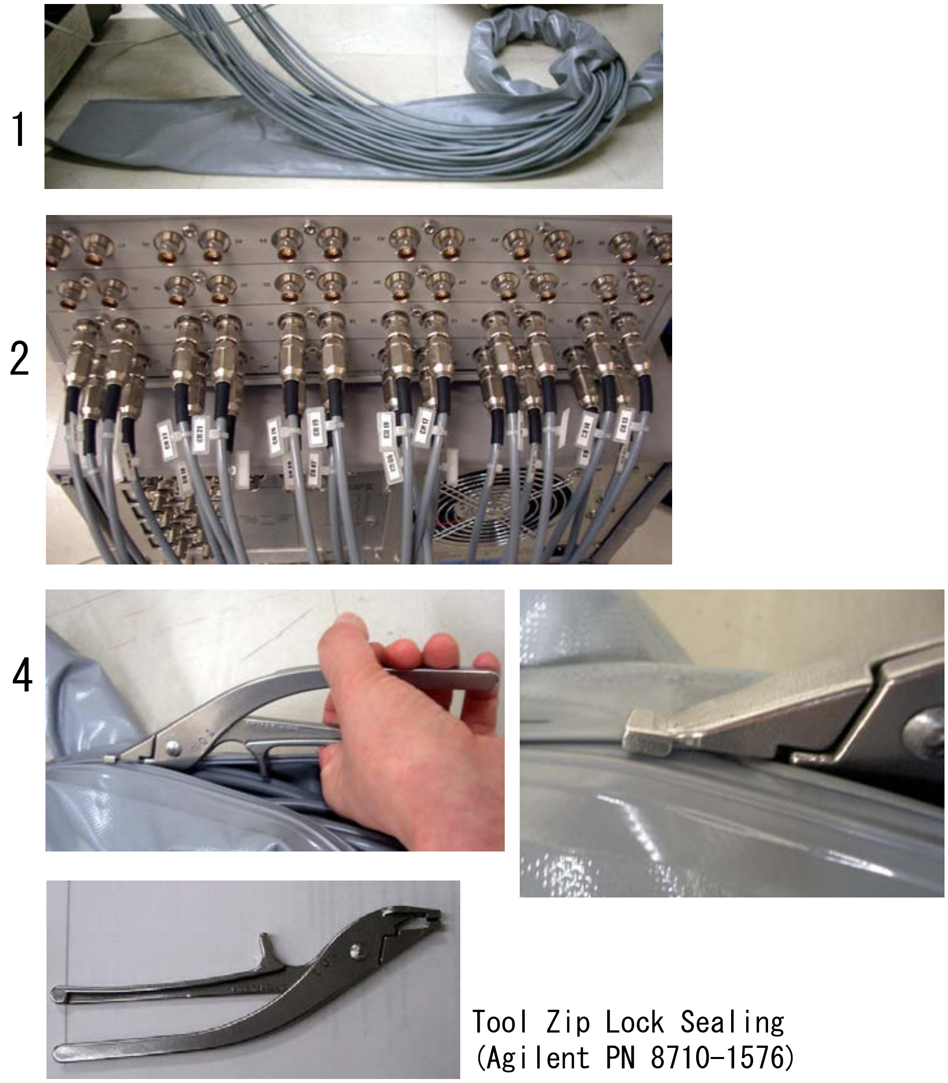
Figure 7-16 **Removing Measurement Cables**



To Replace Probe Card Interface Cables

1. Open the zipper tube.
2. Disconnect and remove the defective cables.
3. Connect and reinstall the new cables instead of the defective cables.
4. Wrap the all measurement cables by using the zipper tube, and close it completely. Then use the Tool Zip Lock Sealing (Agilent part number 8710-1576).

Figure 7-17 **Replacing Probe Card Interface Cables**



To Replace Contact Pins

Agilent B2220A probe card interface fixes the contact pins on its contact assemblies by using rings. To replace the defective pins, perform the following procedure. You will need a mini-screwdriver and a slip-joint pliers. Also use rubber gloves if possible to prevent the contact pin from dirty.

NOTE

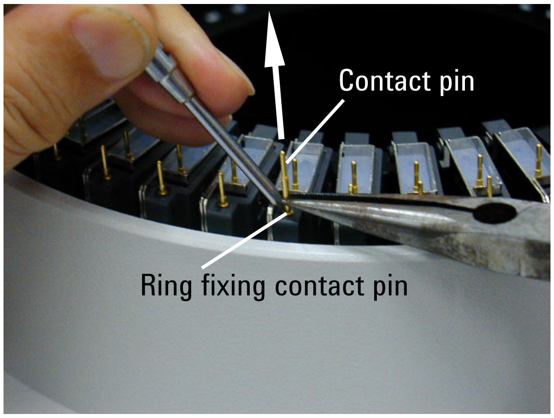
Contact Pins

The contact pin consists of the narrow part (pin) and the thick part (tube), and the pin can be inserted into the tube. A spring in the tube works to keep pushing the pin out.

1. Hold the ring that fixes the defective pin. Then use a mini-screwdriver.
2. Clip the thick part of the defective pin, and remove it from the ring. Then use a slip-joint pliers.
3. Clip the thick part of the new pin by using the slip-joint pliers.
4. Embed the new pin in the ring. Then do not insert the pin more than necessary. The thick part must not be fully inserted into the ring.

   Clean the contact pins if necessary.

Figure 7-18 **Removing Contact Pins**



NOTE

To Clean Contact Pins

To clean contact pins and probe card contacts, prepare alcohol and a dryer. Then clean them as shown below.

1. Spray alcohol to pins or contacts.
2. Dry them enough and carefully using the dryer.

Do *not* wipe with a cloth. It may expand dirty area.

Measurement Cable Connections

The measurement cables are connected between the Agilent B2200 switch mainframe and the instruments as shown in the following tables. For the Agilent E5270B, see “Agilent E5270B Modules and Cables” on page 7-32.

- Table 7-12, “Agilent 4155C Cable Connections”
- Table 7-13, “Agilent 4284A Cable Connections”
- Table 7-14, “Agilent 4156C Connections without HPSMU”
- Table 7-15, “Agilent 4156C Connections with HPSMU”

For the connections between the Agilent B2200 output to the Agilent B2220A probe card interface, see “Model 300/400: To Connect Measurement Cables” on page 2-19. Also see “To Connect GNDU Cable” on page 2-22 for the GNDU connection.

Table 7-12 **Agilent 4155C Cable Connections**

Instrument terminal	Cable	B2201A Input
4155C SMU1	Agilent 16494A triaxial cable	1
4155C SMU2	Agilent 16494A triaxial cable	2
4155C SMU3	Agilent 16494A triaxial cable	3
4155C SMU4	Agilent 16494A triaxial cable	4
4155C VSU1 [1]	Agilent 16493B coaxial cable	9
4155C VSU2 [1]	Agilent 16493B coaxial cable	10
4155C VMU1	Agilent 16493B coaxial cable	11
4155C VMU2	Agilent 16493B coaxial cable	12
4155C Interlock	Agilent 16493J Interlock cable	to B2220A interlock
41501B HPSMU	Agilent 16494A triaxial cable	5
	Agilent 16493K Kelvin triaxial cable [2]	7 and 8
41501B MPSMU1	Agilent 16494A triaxial cable	5
41501B MPSMU2	Agilent 16494A triaxial cable	6
41501B PGU1	Agilent 16493B coaxial cable	9
41501B PGU2	Agilent 16493B coaxial cable	10

1. VSU is not connected if the PGU option is installed.
2. with Kelvin option.

Table 7-13 **Agilent 4284A Cable Connections**

Instrument terminal	Cable	B2200 Input
4284A high (CMH)	Agilent 16494F test leads	13 CMH
4284A low (CML)		14 CML

Table 7-14 **Agilent 4156C Connections without HPSMU**

Instrument terminal [1]	Cable	B2200 Input
4156C SMU1	Agilent 16494A triaxial cable	1
	Agilent 16493K Kelvin triaxial cable [2]	1 and 2
4156C SMU2	Agilent 16494A triaxial cable	2 or 3
	Agilent 16493K Kelvin triaxial cable [3]	3 and 4
4156C SMU3	Agilent 16494A triaxial cable	3 or 4 or 5
	Agilent 16493K Kelvin triaxial cable [4]	5 and 6
4156C SMU4	Agilent 16494A triaxial cable	4 or 5 or 6 or 7
	Agilent 16493K Kelvin triaxial cable [5]	7 and 8
4156C VSU1 [6]	Agilent 16493B coaxial cable	9
4156C VSU2 [6]	Agilent 16493B coaxial cable	10
4156C VMU1	Agilent 16493B coaxial cable	11
4156C VMU2	Agilent 16493B coaxial cable	12
4156C Interlock	Agilent 16493J Interlock cable	to B2220A interlock
41501B MPSMU1	Agilent 16494A triaxial cable	5, 6, 7, 8, or open
41501B MPSMU2	Agilent 16494A triaxial cable	6, 7, 8, or open
41501B PGU1	Agilent 16493B coaxial cable	9
41501B PGU2	Agilent 16493B coaxial cable	10

1. For the non-Kelvin connection, connect the Force terminal and open the Sense terminal.
2. with 1 or more Kelvin options.
3. with 2 or more Kelvin options.
4. with 3 or 4 Kelvin options.
5. with 4 Kelvin options.
6. VSU is not connected if the PGU option is installed.

Table 7-15 **Agilent 4156C Connections with HPSMU**

Instrument terminal [1]	Cable	B2200 Input
4156C SMU1	Agilent 16494A triaxial cable	1
	Agilent 16493K Kelvin triaxial cable [2]	1 and 2
4156C SMU2	Agilent 16494A triaxial cable	2 or 3
	Agilent 16493K Kelvin triaxial cable [3]	3 and 4
4156C SMU3	Agilent 16494A triaxial cable	3 or 4 or 5
	Agilent 16493K Kelvin triaxial cable [4]	5 and 6
4156C SMU4	Agilent 16494A triaxial cable	4 or 5 or 6 or open
4156C VSU1 [5]	Agilent 16493B coaxial cable	9
4156C VSU2 [5]	Agilent 16493B coaxial cable	10
4156C VMU1	Agilent 16493B coaxial cable	11
4156C VMU2	Agilent 16493B coaxial cable	12
4156C Interlock	Agilent 16493J Interlock cable	to B2220A interlock
41501B HPSMU	Agilent 16494A triaxial cable	5
	Agilent 16493K Kelvin triaxial cable [6]	7 and 8
41501B PGU1	Agilent 16493B coaxial cable	9
41501B PGU2	Agilent 16493B coaxial cable	10

1. For the non-Kelvin connection, connect the Force terminal and open the Sense terminal.
2. with 2 or more Kelvin options.
3. with 3 or 4 Kelvin options.
4. with 4 Kelvin options.
5. VSU is not connected if the PGU option is installed.
6. with 1 or more Kelvin options.

NOTE

To make Sense terminal open

Connect the triaxial open connector (Agilent part number 1250-1708) to the Sense terminal.

Agilent E5270B Modules and Cables

The source monitor unit (SMU) modules are installed in the Agilent E5270B mainframe by following the next rule.

1. Modules are installed in the mainframe from the slot 1 sequentially.
2. The HRSMUs are installed in the mainframe before the MPSMUs are installed.
3. The MPSMUs are installed in the mainframe before the HPSMUs are installed.
4. The HPSMU occupies two slots. So it is never installed in the slots 4-5.

Without the Kelvin option, the measurement cables should be connected as shown in Table 7-16. And this rule is effective for the non-Kelvin ports even if a Kelvin option is installed.

With the Kelvin options, the Agilent 16493K Kelvin triaxial cables and the Agilent 16494A triaxial cables will be connected as shown below. The maximum of four Kelvin cables can be connected.

1. The first Kelvin cable is connected between the SMU installed in the largest numbered slot and the Agilent B2200 input port 7-8.
2. The second Kelvin cable is connected between the SMU installed in the next large numbered slot and the Agilent B2200 input port 5-6.
3. The third Kelvin cable is connected between the SMU installed in the next large numbered slot and the Agilent B2200 input port 3-4.
4. The fourth Kelvin cable is connected between the SMU installed in the next large numbered slot and the Agilent B2200 input port 1-2.
5. For the non-Kelvin ports, the triaxial cable is connected between the Force terminal of the SMU installed in the smallest numbered slot and the Agilent B2200's smallest numbered input port. And this is repeated for the all SMU input ports.

Table 7-16 Agilent E5270B Cable Connections, non-Kelvin

SMU number/ terminal	Cable	B2200 Input
E5270B SMU1 Force	Agilent 16494A triaxial cable	1
E5270B SMU2 Force	Agilent 16494A triaxial cable	2
E5270B SMU3 Force	Agilent 16494A triaxial cable	3
E5270B SMU4 Force	Agilent 16494A triaxial cable	4
E5270B SMU5 Force	Agilent 16494A triaxial cable	5
E5270B SMU6 Force	Agilent 16494A triaxial cable	6
E5270B SMU7 Force	Agilent 16494A triaxial cable	7
E5270B SMU8 Force	Agilent 16494A triaxial cable	8
E5270B Interlock	Agilent 16493J Interlock cable, 5 m	to B2220A interlock

System Rack and Instruments

The system components (instruments) will be installed in the system rack as shown in Table 7-17 when the Agilent 41000 is shipped from the factory.

Table 7-17 Instrument Locations on System Rack

Unit	with 4155C/4156C	with E5270B
1 (top)	EMO panel	EMO panel
2		
3	Panel, blank	Panel, blank
4		
5	Panel, cable through	Panel, cable through
6	Agilent 4284A	Agilent 4284A
7		
8		
9		
10	Agilent 4155C or 4156C Panel, blank for C1232A-NAN or C1233A-NAN.	Panel, blank
11		
12		Agilent E5270B
13		
14		
15	Agilent 41501B Panel, blank for C1232A-NAN or C1233A-NAN.	
16		
17		Panel, blank
18		Panel, cable through
19	Agilent B2200A or B2201A	Agilent B2200A or B2201A Panel, blank for Model 100.
20		
21		
22		
23		
24		
25		
26	Panel, cable through	Panel, cable through
27	Panel, blank	Panel, blank
28		
29	Panel, blank	Panel, blank
30	PDU	PDU
31		
32 (bottom)		